MOTOROLA
Semiconductors

master selection guide

JEDEC
PRO-ELECTRON

master selection guide

MOTOROLA
Semiconductors

SELECTING THE BEST SEMICONDUCTOR

Selecting the best semiconductor for a given application can pose a significant challenge. To simplify the task in selecting a "best" transistor, diode or other device for new designs, this book's selection tables include all popular Motorola semiconductor devices and applications. These guides permit a quick comparison of the preferred devices, and a pre-selection of semiconductors that are most suitable.

The selection tables are arranged to highlight the prime selection criteria in easy-to-use order. Since the important characteristics depend on the type of device, the selection tables take different forms. In silicon rectifiers, for example, peak reverse voltage, and average forward current are the basic criteria, and the devices are listed in order of these ratings. For other devices, such as transistors, other important characteristics or suggested applications are specified in their particular section.

The selection tables include only basic specifications. For complete information contact your nearest Motorola sales office or franchised distributor.

Printed in Switzerland

INDEX

INTEGRATED CIRCUITS

DISCRETE SEMICONDUCTORS

MOS
INTEGRATED CIRCUITS

MOS INTEGRATED CIRCUITS

Motorola's MOS Lines range from standard SSI to MSI and LSI functions. Most devices are available in two temperature/voltage ranges, and in both plastic and ceramic packages. Over 200 different devices are offered.

The two major MOS lines include complementary MOS (McMOS) and NMOS Circuits.

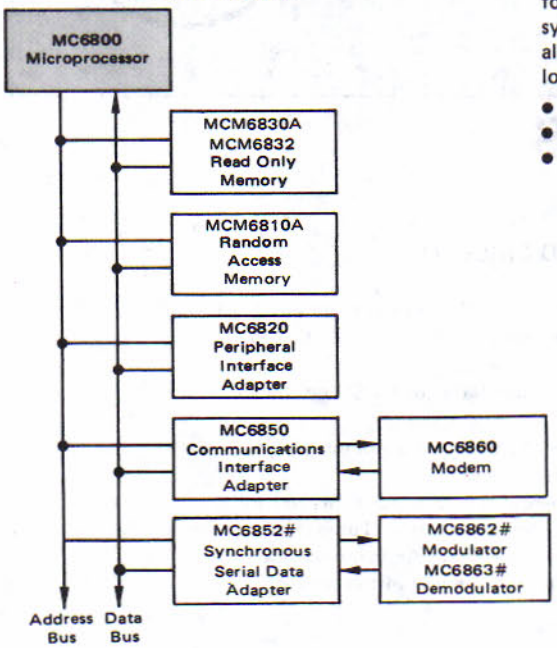
The McMOS family is available in a wide variety of basic and complex logic functions at medium speeds and very low power dissipation.

The NMOS products include the M6800 microcomputer components and an array of memory devices. RAMs, ROMs, Character generators, and unique microcomputer parts, such as Peripheral Interface Adapter (PIA), Asynchronous Communications Interface Adapter (ACIA), and MODEM are part of this series.

TABLE OF CONTENTS

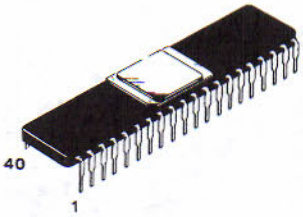
SEE POPULAR PRO-ELECTRON DEVICES TYPES SECTION 8

M6800 MICROCOMPUTER FAMILY BLOCK DIAGRAM

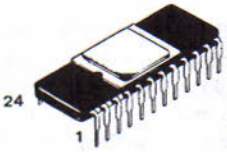


The M6800 family of parts has been designed to set the standard for microcomputer system architecture. The family provides total-system building functions, yet is designed with the flexibility to allow growth. Programmable logic is designed to replace hardwired logic and costly custom microcomputer functions.

- Minimum System Approach
- Powerful Instructions
- Comprehensive Support:
  - Systems Development Tools
  - Software
  - Documentation
  - Applications Aid



CERAMIC PACKAGE
CASE 699



CERAMIC PACKAGE
CASE 684

FUNCTIONS AND CHARACTERISTICS

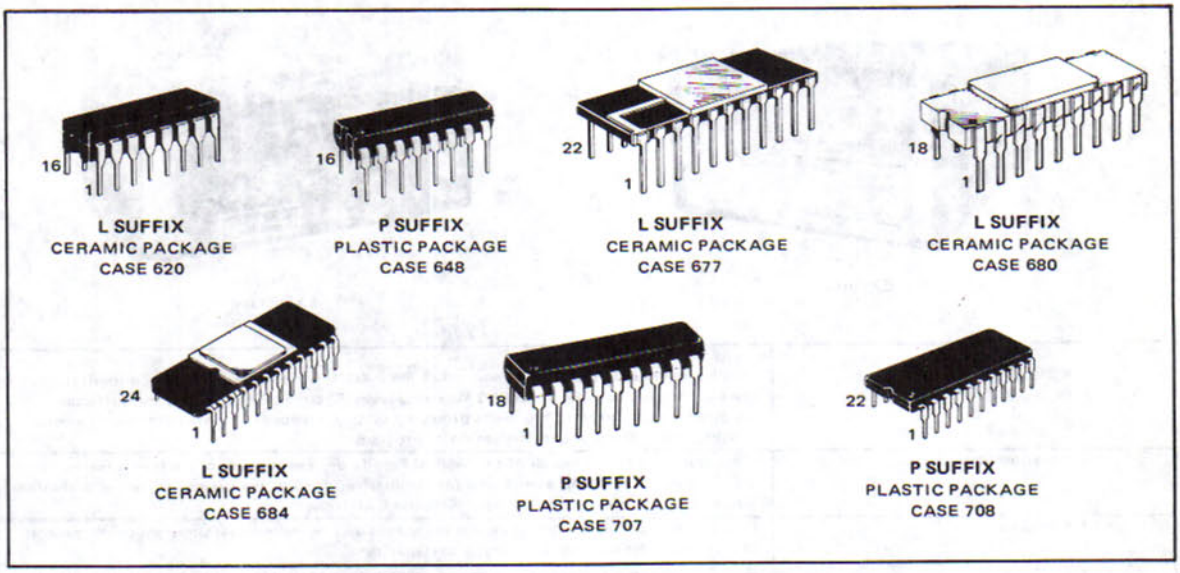
Function	Type	Case	Comments
Microprocessor	MC6800L	699	Monolithic 8-bit MPU forming the central control function for the M6800 family. Bi-directional data bus, 8-bit parallel processing, 16-bit address bus capable of addressing 65K bytes of memory, 72 instructions. DMA and multiple processor capability.
Peripheral Interface Adapter	MC6820L	699	Interfaces MPU to peripherals through two 8-bit bi-directional peripheral data buses and four control lines. Programmed by the MPU during system initialization.
Asynchronous Communications Interface Adapter	MC6850L	684	Provides the data formatting and control to interface serial asynchronous data communications information to bus organized systems. Programmable control register provides variable word lengths, clock division ratios, transmit control, receive control, and interrupt control.
Synchronous Serial Data Adapter#	MC6852L#	684	Provides a bi-directional interface for simultaneously transmitting and receiving standard synchronous communications characters. Programmable control for variable word lengths, synchronization, and interrupt.
Digital Modem	MC6860L	684	Provides necessary modulation, demodulation and supervisory control to implement serial data communications link, over voice-grade channel, utilizing FSK at bit rates to 600 bps.
2400 bps Digital Modulator #	MC6862L #	684	Provides necessary modulation and control to implement serial data communications link, over voice-grade channel, utilizing DPSK at bit rates of 1200 or 2400 bps.
2400 bps Digital Demodulator#	MC6863L#	684	Provides necessary demodulation and control to implement serial data communications link, over voice-grade channel, utilizing DPSK at bit rates of 1200 or 2400 bps.

#To be announced.

THE M6800 MICROCOMPUTER FAMILY (continued)

Device No.	No. of Bits	Description	Organization	Access Time (ns max)	Power Supplies (V)	No. of Pins	Case
RANDOM ACCESS MEMORIES (Silicon Gate NMOS)							
MCM6810A	1024	Static	128 x 8	500	+5	24	684
MCM68111A#	1024	Static, Common I/O and Output Disable	256 x 4	450	+5	18	680, 707
MCM68112A#	1024	Static, Common I/O	256 x 4	450	+5	16	620, 648
MCM6815A#	4096	Dynamic	4096 x 1	300	+12, +5, −5	22	677, 708
MCM6815A2#	4096	Dynamic	4096 x 1	200	+12, +5, −5	22	677, 708
READ ONLY MEMORIES (Silicon Gate NMOS unless otherwise noted)							
MCM6830A*	8192	Mask-Programmable	1024 x 8	500	+5	24	684
MCM68317*#	16384	Mask-Programmable	2048 x 8	500	+5	24	684
MCM6832*†	16384	Mask-Programmable	2048 x 8	550	+12, +5, −5	24	684
MCM68708#	8192	Alterable	1024 x 8	500	+12, +5, −5	24	TBA

*Mask-programmable ROMs are manufactured according to a bit-pattern supplied by the customer. A special device number (SCMxxxx) is assigned to each individual pattern.
#To be announced
† Metal Gate NMOS



M6800 SYSTEM SUPPORT

Numerous semiconductor devices are available to enhance the capabilities of the M6800 Family of integrated circuits. Among these, the following should be given special attention (characteristics are given in the indicated section of this Master Selection Guide):

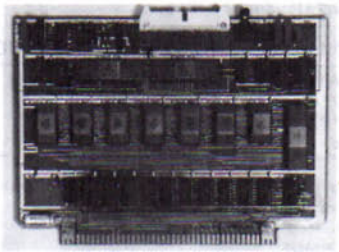
NMOS Random Access Memories NMOS Read Only Memories	Various sizes and types of MOS memories are available to supplement those in the M6800 Family.
MEGALOGIC LSI	These computer-oriented products are a natural complement for MPU- based systems.
Linear Interface Circuits	A broad spectrum of interface circuits will be of particular interest to microcomputer system designers.
McMOS Integrated Circuits	Many of the newer McMOS devices are specialized functions which fit specific needs of microcomputer systems.
MPU Clock Buffer (Multiple Transistor)	The MPQ6842 provides the requirements of the clock buffer for $\phi 1$ and $\phi 2$ inputs of the MPU

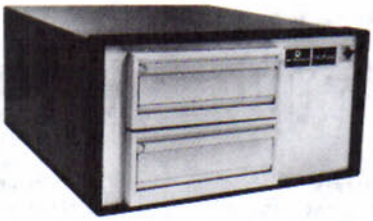
In addition to the categories listed, Two-Phase Clocks (MC6870A, MC6870B, and MC6871A) are available from Motorola Inc., Component Products Department, 2553 North Edgington, Franklin Park, Illinois 60131.

M6800 SUPPORT HARDWARE

EXORciser

Evaluation Module





EXORdisk

EXORtape

EXORciser	Ability to emulate a user's system makes the EXORciser an efficient and economical means for development of M6800 Microprocessor Systems. The optional modules can be arranged to represent the user's proposed system, optional Resident Software permits editing, assembling, and modification of programs.
Evaluation Module	This complete board has all of the M6800 Family devices for ease of parts evaluation. It can be used to run simple programs for familiarization with the system as well as evaluation prior to actual system development with the EXORciser.
EXORdisk	The EXORdisk (Motorola's floppy disk) speeds up microcomputer program development; it is many times faster than teletype or paper tape.
EXORtape	The EXORtape (Motorola's high-speed paper tape reader) provides high-speed reading of paper tape for efficient program loading, editing, and assembling.

M6800 SUPPORT SOFTWARE

Compatible software is available in a variety of forms:

Resident Software	Used with the EXORciser or Evaluation Module, this package consists of the Editor — for editing operations on lines or character strings — and the Assembler — which uses a two-pass operation to produce listing and object tape.
Commercial Timesharing	M6800 software is available on several commercial timesharing services. As circumstances indicate, others will be added.
Host Computer Software	Two software packages are available for host computers: 1. Standard package, normally supplied by vendors; 2. Full capability package, pre-tailored to customer.

RANDOM ACCESS MEMORIES

MOS

Random Access Memories are useful wherever temporary storage is required. They find application in large mainframe memory systems, minicomputers, and conventional digital control circuits.

RAMs which are specifically intended for use with the M6800 Microcomputer Family are shown in another table.

Device No.	No. of Bits	Description	Organization	Access Time (ns max)	Power Supplies (V)	No. of Pins	Case
SILICON GATE NMOS							
MCM2102*	1024	Static	1024 x 1	1000	+5	16	620, 648
MCM2102-1*	1024	Static, High Speed	1024 x 1	500	+5	16	620, 648
MCM2102-2*	1024	Static	1024 x 1	650	+5	16	620, 648
MCM2102A*	1024	Static, Very High Speed	1024 x 1	350	+5	16	620, 648
MCM2102A2*	1024	Static, Very High Speed	1024 x 1	250	+5	16	620, 648
MCM2102A4*	1024	Static, Very High Speed	1024 x 1	450	+5	16	620, 648
MCM2111A*	1024	Static, Common I/O and Output Disable	256 x 4	350	+5	18	680, 707
MCM2111A2*	1024	Static, Common I/O and Output Disable	256 x 4	250	+5	18	680, 707
MCM2111A4*	1024	Static, Common I/O and Output Disable	256 x 4	450	+5	18	680, 707
MCM2112A*	1024	Static, Common I/O	256 x 4	350	+5	16	620, 648
MCM2112A2*	1024	Static, Common I/O	256 x 4	250	+5	16	620, 648
MCM2112A4*	1024	Static, Common I/O	256 x 4	450	+5	16	620, 648
MCM6604	4096	Dynamic	4096 x 1	350	+12, +5, −5	16	690, 648
MCM6604-2	4096	Dynamic	4096 x 1	250	+12, +5, −5	16	690, 648
MCM6604-4	4096	Dynamic	4096 x 1	300	+12, +5, −5	16	690, 648
MCM6605A	4096	Dynamic	4096 x 1	300	+12, +5, −5	22	677, 708
MCM6605A1	4096	Dynamic	4096 x 1	150	+12, +5, −5	22	677, 708
MCM6605A2	4096	Dynamic	4096 x 1	200	+12, +5, −5	22	677, 708
MCM6616*	16384	Dynamic	16384 x 1	350	+12, +5, −5	16	TBA
METAL GATE CMOS							
MCM14505A	64	Static, −55 to +125°C	64 x 1	550#	+3 to +18	14	632
MCM14505C	64	Static, −40 to +85°C	64 x 1	650#	+4.5 to +16	14	632, 646
MCM14537A	256	Static, −55 to +125°C	256 x 1	4000#	+3 to +18	16	690
MCM14537C	256	Static, −40 to +85°C	256 x 1	6000#	+4.5 to +16	16	690
MCM14552A	256	Static, −55 to +125°C	64 x 4	3000#	+3 to +18	24	684
MCM14552C	256	Static, −40 to +85°C	64 x 4	6000#	+4.5 to +16	24	684, 709

*To be announced #Measured with V_{DD} = +5 V, T_A = 25°C

L SUFFIX
CERAMIC PACKAGE
CASE 620

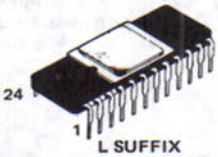
L SUFFIX
CERAMIC PACKAGE
CASE 632

P SUFFIX
PLASTIC PACKAGE
CASE 646

P SUFFIX
PLASTIC PACKAGE
CASE 648

L SUFFIX
CERAMIC PACKAGE
CASE 677

L SUFFIX
CERAMIC PACKAGE
CASE 680



L SUFFIX
CERAMIC PACKAGE
CASE 684

L SUFFIX
CERAMIC PACKAGE
CASE 690

P SUFFIX
PLASTIC PACKAGE
CASE 707

P SUFFIX
PLASTIC PACKAGE
CASE 708

P SUFFIX
PLASTIC PACKAGE
CASE 709

READ ONLY MEMORIES

MOS

Motorola's Read Only Memories include both pre-programmed memories and mask-programmable memories for custom applications.

The character generators are useful in CRT displays as well as in digital printers. Together with the code converters, which facilitate interface circuitry when going from one character standard to another, they provide a wide choice of devices for data display systems. ROMs are also available to provide the rhythm patterns for electronic organs.

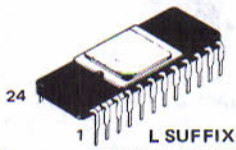
ROMs which are specifically intended for use with the M6800 Microcomputer Family are shown in another table.

Device No.	No. of Bits	Description	Organization	Access Time (ns max)	Power Supplies (V)	No. of Pins	Case
METAL GATE NMOS							
MCM6550*	7168	Mask-Programmable, Static, Rhythm	16 Patterns of 24 or 32 Beats	t_{cyc} = 1 ms	+15, +5, −3	40	699, 711
MCM6560*	8192	Mask-Programmable, Addressable	1024 x 8 or 2048 x 4	350	+12, +5, −3	24	684, 709
Pre-Programmed Standard Memories:							
MCM6561		Binary Code Converter	1024 x 8				
MCM6562		Binary Code Converter	1024 x 8				
MCM6570*	8192	Mask-Programmable 9 x 7 Character Generator, Horizontal Scan, Shift Capability	128c x (9 x 7)	500	+12, +5, −3	24	684, 709
Pre-Programmed Standard Memories:							
MCM6571		ASCII Characters and Greek, Shifted					
MCM6571A		ASCII Characters and Greek, Shifted					
MCM6572		ASCII and Greek, Not Shifted					
MCM6573		Japanese Characters, Not Shifted					
MCM6574		Math Symbols and Pictures, Shifted					
MCM6575		Alphanumeric Control Characters, Shifted					
MCM6576		British Standard Characters, Shifted					
MCM6577		German Standard Characters, Shifted					
MCM6578		French Standard Characters, Shifted					
MCM6579		General European Standard Characters, Shifted					
MCM6580*	8192	Mask-Programmable 7 x 9 Character Generator, Vertical Scan, Shift Capability	128c x (7 x 9)	400	+12, +5, −3	24	684, 709
Pre-Programmed Standard Memories:							
MCM6581		ASCII Characters and Greek, Shifted					
MCM6583		Japanese Characters, Not Shifted					
MCM6590*	16384	Mask-Programmable, Static	2048 x 8	800	+12, +5, −3	24	684
Pre-Programmed Standard Memory:							
MCM6591		Universal Code Converter					
METAL GATE CMOS							
MCM14524A*	1024	Mask-Programmable, −55 to +125°C	256 x 4	2650#	+3 to +18	16	620
MCM14524C*	1024	Mask-Programmable, −40 to +85°C	256 x 4	3975#	+4.5 to +16	16	620, 648

*Mask-programmable ROMs are manufactured according to a bit-pattern supplied by the customer. A special device number (SCMxxxx) is assigned to each individual pattern. #Measured with V_{DD} = +5 V, T_A = 25°C

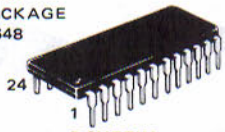
L SUFFIX
RAMIC PACKAGE
CASE 620

P SUFFIX
PLASTIC PACKAGE
CASE 648



L SUFFIX
CERAMIC PACKAGE
CASE 684

L SUFFIX
CERAMIC PACKAGE
CASE 699



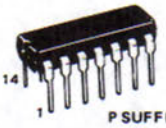
P SUFFIX
PLASTIC PACKAGE
CASE 709

P SUFFIX
PLASTIC PACKAGE
CASE 711

MC14000 and MC14500 Series Complementary MOS

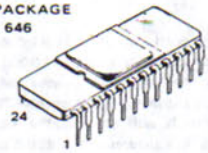
L SUFFIX
CERAMIC PACKAGE
CASE 620

L SUFFIX
CERAMIC PACKAGE
CASE 632

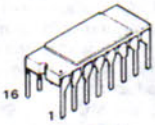


P SUFFIX
PLASTIC PACKAGE
CASE 646

P SUFFIX
PLASTIC PACKAGE
CASE 648



L SUFFIX
CERAMIC PACKAGE
CASE 684



L SUFFIX
CERAMIC PACKAGE
CASE 690

P SUFFIX
PLASTIC PACKAGE
CASE 709

The McMOS series of monolithic integrated logic circuits is designed to provide the system design engineer with a medium-speed integrated circuit family which approaches the ideal in performance. The low power dissipation and flexible power supply requirements of this family of devices greatly simplify power supply design, and the high noise immunity and large fanout capability reduce parts count and simplify printed circuit board layout.

All devices may also be obtained in chip form for the manufacturer of hybrid microcircuits.

FEATURES

- Quiescent Power Dissipation = 10 nW/pkg typical for Gates
- High Noise Immunity = 45% of V_{DD} typical
- Single or Multiple Supply Operation – Positive or Negative
- Fan-out – > 50
- Output Logic Excursion Independent of Fan-out
- Diode Protection on All Inputs

V_{DD} = 3.0 Vdc to 18 Vdc, T_A = -55°C to +125°C for AL Suffix
V_{DD} = 3.0 Vdc to 16 Vdc, T_A = -40°C to +85°C for CL/CP Suffix

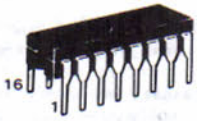
Function	Type	Case
Dual 3-Input NOR Gate plus Inverter	MC14000	632,646
Quad 2-Input NOR Gate	MC14001	632,646
Dual 4-Input NOR Gate	MC14002	632,646
18-Bit Static Shift Register	MC14006	632,646
Dual Complementary Pair Plus Inverter	MC14007	632,646
4-Bit Full Adder	MC14008	620,648
Quad 2-Input NAND Gate	MC14011	632,646
Dual 4-Input NAND Gate	MC14012	632,646
Dual Type D Flip-Flop	MC14013	632,646
8-Bit Static Shift Register	MC14014	620,648
Dual 4-Bit Static Shift Register	MC14015	620,648
Quad Analog Switch/Quad Multiplexer	MC14016	632,646
Decade Counter/Divider	MC14017	620,648
14-Bit Binary Counter	MC14020	620,648
8-Bit Static Shift Register	MC14021	620,648
Octal Counter/Divider	MC14022	620,648
Triple 3-Input NAND Gate	MC14023	632,646
Seven-Stage Ripple Counter	MC14024	632,646
Triple 3-Input NOR Gate	MC14025	632,646
Dual J-K Flip-Flop	MC14027	620,648
BCD-To-Decimal Decoder/ Binary-To-Octal Decoder	MC14028	620,648
Triple Serial Adder (Positive Logic)	MC14032	620,648
8-Bit Universal Bus Register	MC14034	684,709
4-Bit Parallel-In/Parallel-Out Shift Register	MC14035	620,648
Triple Serial Adder (Negative Logic)	MC14038	620,648
12-Bit Binary Counter	MC14040	620,648
Quad Latch	MC14042	620,648
Phase-Locked Loop	MC14046	620,648
Hex Inverter/Buffer	MC14049	620,648
Hex Buffer	MC14050	620,648
Quad 2-Input OR Gate	MC14071	632,646
Quad D-Type Register	MC14076	620,648
Quad 2-Input AND Gate	MC14081	632,646

Function	Type	Case
Triple Gate (Dual 4-Input NAND Gate and 2-Input NOR/OR Gate or 8-Input AND/NAND Gate)	MC14501	620,648
Strobed Hex Inverter/Buffer	MC14502	620,648
64-Bit Static Random Access Memory	MCM14505	632,646
Dual Expandable AND-OR-INVERT Gate	MC14506	620,648
Quad Exclusive OR Gate	MC14507	632,646
Dual 4-Bit Latch	MC14508	684,709
BCD Up/Down Counter	MC14510	620,648
BCD-To-Seven Segment Latch/Decoder/Driver	MC14511	620,648
8-Channel Data Selector	MC14512	620,648
4-Bit Latch/4 to 16 Line Decoder (High)	MC14514	684,709
4-Bit Latch/4 to 16 Line Decoder (Low)	MC14515	684,709
Binary Up/Down Counter	MC14516	620,648
Dual 64-Bit Static Shift Register	MC14517	620,648
Dual BCD Up Counter	MC14518	620,648
4-Bit AND/OR Selector (Quad 2-Channel Data Selector or Quad Exclusive NOR Gate)	MC14519	620,648
Dual Binary Up Counter	MC14520	620,648
24-State Frequency Divider	MC14521	620,648
Programmable Divide-By-N-4-Bit Counter (BCD)	MC14522	620,648
1024-Bit Read Only Memory	MCM14524	620,648
Programmable Divide-By-N-4-Bit Counter (Binary)	MC14526	620,648
BCD Rate Multiplier	MC14527	620,648
Dual Retriggerable/Resettable Monostable Multivibrator	MC14528	620,648
Dual 4-Channel Analog Data Selector	MC14529	620,648
Dual 5-Input Majority Logic Gate	MC14530	620,648
12-Bit Parity Tree	MC14531	620,648
8-Bit Priority Encoder	MC14532	620,648
Real Time 5-Decade Counter	MC14534	684,709
Programmable Timer	MC14536	620,648
256-Bit Static Random Access Memory	MCM14537	690
Dual 4-Channel Data Selector/Multiplexer	MC14539	620,648
Programmable Oscillator/Timer	MC14541	632,646
BCD-to-Seven Segment Latch/Decoder/Driver	MC14543	620,648
Successive Approximation Register	MC14549	620,649
256-Bit Static Random Access Memory	MCM14552	684,709
Three-Digit BCD Counter	MC14553	620,648
2 x 2-Bit Parallel Binary Multiplier	MC14554	620,648
Dual Binary to 1 of 4 Decoder/Demultiplexer	MC14555	620,648
Dual Binary to 1 of 4 Decoder/Demultiplexer (Inverting)	MC14556	620,648
1-to-64 Bit Variable Length Shift Register	MC14557	620,648
BCD-to-Seven Segment Decoder	MC14558	620,648
Successive Approximation Register	MC14559	620,648
NBCD Adder	MC14560	620,648
9's Complementer	MC14561	632,646
128-Bit Static Shift Register	MC14562	632,646
Industrial Time Base Generator	MC14566	620,648
Hex Gate (Quad Inverter Plus 2-Input NOR Gate plus 2-Input NAND Gate)	MC14572	620,648
4 x 4 Multiport Register	MC14580	684,709
4-Bit Arithmetic Logic Unit	MC14581	684,709
Look-Ahead Carry Block	MC14582	620,648
Dual Schmitt Trigger	MC14583	620,648
4-Bit Magnitude Comparator	MC14585	620,648

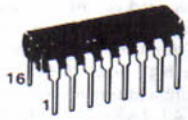
MC14400 Series Complementary MOS

The MC14400 Series contains devices whose designs and specifications are tailored towards specific subsystem applications. The MC14400 Series devices are manufactured with the same low power metal gate complementary MOS processing techniques as the MC14000 and MC14500 Series standard product family devices, and as such will exhibit the same inherent characteristics of the technology such as low power dissipation and high noise immunity. The specifications of these subsystem devices are, however, designed to maximize their efficiency in the applications for which they were intended and may not necessarily meet the more universal specifications required of and guaranteed by our standard MC14000 and MC14500 CMOS product family.

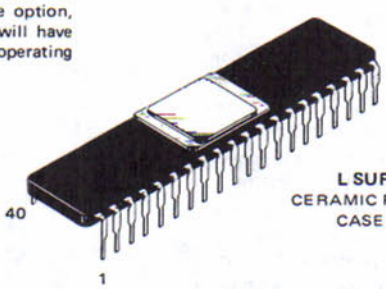
To differentiate the new specification policy, the MC14400 Series will have a new set of suffixes. Some devices will have only a package option, either plastic ("P" suffix) or ceramic ("L" suffix). Other devices will have options available for power supply range ("V" or "F" suffix) and operating temperature range ("E" suffix).



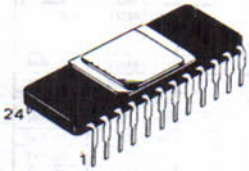
L SUFFIX
CERAMIC PACKAGE
CASE 620



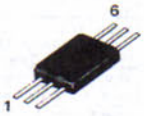
P SUFFIX
PLASTIC PACKAGE
CASE 648



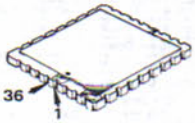
L SUFFIX
CERAMIC PACKAGE
CASE 699



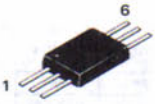
L SUFFIX
CERAMIC PACKAGE
CASE 684



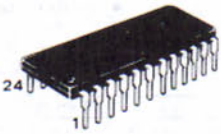
L SUFFIX
CERAMIC PACKAGE
CASE 688



Z SUFFIX
LEADLESS CERAMIC PACKAGE
CASE 703



P SUFFIX
PLASTIC PACKAGE
CASE 704



P SUFFIX
PLASTIC PACKAGE
CASE 709

FUNCTIONS AND CHARACTERISTICS

Function	Type	V_{DD} Range Vdc	Temperature °C	Case
2-of-8 Tone Encoder	MC14410L,P	4.4 to 6.0	-40 to +85	620, 648
Bit Rate Generator	MC14411L,P	5.0	-40 to +85	684, 709
Universal Low Speed (0-600 bps) Modem	MC14412FL	4.75 to 15	-40 to +85	690
	MC14412VL	4.75 to 6.0	-40 to +85	690
Quad Precision Timer/Driver	MC14415EFL	3.0 to 18	-55 to +125	620
	MC14415FL,FP	3.0 to 16	-40 to +85	620, 648
	MC14415EVL	3.0 to 6.0	-55 to +125	620
	MC14415VL,VP	3.0 to 6.0	-40 to +85	620, 648
2-of-8 Keypad-to-Binary Encoder	MC14419L,P	3.0 to 6.0	-40 to +85	620, 648
3½ Digit A/D Logic Subsystem	MC14435EFL	3.0 to 18	-55 to +125	620
	MC14435FL,FP	3.0 to 16	-40 to +85	620, 648
	MC14435EVL	3.0 to 6.0	-55 to +125	620
	MC14435VL,VP	3.0 to 6.0	-40 to +85	620, 648
L. C. D. Watch/Clock Circuit	MC14440L,Z MCC14440	1.4 to 1.65	-10 to +60	699, 703 Chip
Oscillator/2^{16} Divider/Buffer	MC14450L,P MCC14450	1.3 to 3.0	0 to +50	688, 704 Chip
Oscillator/2^{11} to 2^{19} Divider/Buffered Duty Cycle Control	MC14451L,P MCC14451	1.3 to 3.0	-10 to +60	620,648 Chip
Hex Contact Bounce Eliminator	MC14490EFL	3.0 to 18	-55 to +125	620
	MC14490FL,FP	3.0 to 16	-40 to +85	620, 648
	MC14490EVL	3.0 to 6.0	-55 to +125	620
	MC14490VL,VP	3.0 to 6.0	-40 to +85	620, 648

BIPOLAR DIGITAL INTEGRATED CIRCUITS

BIPOLAR DIGITAL INTEGRATED CIRCUITS

Motorola's Bipolar Integrated Circuits include elements of several logic families – MECL, MHTL, MDTL, MRTL and MTTL – from SSI to large scale functions.

Of particular interest is the MECL 10,000 high-speed logic family. This series features significantly lower power dissipation when compared to standard MECL devices. Technological advances have permitted new levels of circuit complexity. One such example is the MCM10149, 1024-Bit PROM.

While not family related, Phase-Locked Loop (PLL) and Megalogic encompass several design approaches to bipolar circuits.

Motorola offers the designer a choice of specifically designed integrated circuits for performing phase-locked loop functions, such as, phase detection, frequency division, filtering, and voltage-controlled signal generation.

Megalogic provides several design approaches to bipolar LSI. Motorola has developed LSI arrays of 160 and 400 gate complexities with typical speeds of 25 ns per gate. These gate arrays keep costly layout and engineering manpower to a minimum.

Motorola's extensive experience in high-reliability military and space programs has resulted in quality assurance for integrated circuits and participation in the MIL-M-385 10 Program. The dielectrically Isolated MDTL family and the Beam-Lead MTTL family are also used in highly reliable systems.

SEE POPULAR PRO-ELECTRON DEVICES TYPES SECTION 8

MECL 10,000 SERIES
INTEGRATED CIRCUITS

MECL

MC10,100/10,200 Series (-30 to +85°C)
MC10,500/10,600 Series (-55 to +125°C)

MECL 10,000 has an excellent speed-power product, has relatively slow rise and fall times, and transmission-line drive capability. The combination of versatile logic functions and the 2.0 ns propagation delay make MECL 10,000 a versatile family for data handling and processing systems.

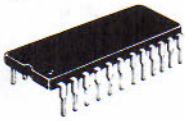
Circuit design with MECL 10,000 is unusually convenient. The differential amplifier input and emitter-follower output permit high fanout, the wired-OR option, and complementary outputs. MECL III is directly compatible with MECL 10,000, and can be used to extend the speed capability of the MECL 10,000 series.


L SUFFIX
CERAMIC PACKAGE
CASE 623

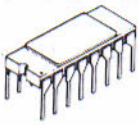

P SUFFIX
PLASTIC PACKAGE
CASE 648


F SUFFIX
CERAMIC PACKAGE
CASE 650


F SUFFIX
CERAMIC PACKAGE
CASE 652


P SUFFIX
PLASTIC PACKAGE
CASE 649


L SUFFIX
CERAMIC PACKAGE
CASE 620


AL SUFFIX
CERAMIC PACKAGE
CASE 690

FUNCTIONS AND CHARACTERISTICS (V_{CC} = 0, V_{EE} = -5.2 V, T_A = 25°C)

Function	Type① -30 to +85°C	Type① -55 to +125°C	Propagation Delay ns typ	Power Dissipation mW typ/pkg*	Case
Quad 2-Input NOR Gate With Strobe	MC10100	–	2.0	100	620
Quad OR/NOR Gate	MC10101	MC10501	2.0	100	620,648,650
Quad 2-Input NOR Gate	MC10102	MC10502	2.0	100	620,648,650
Quad 2-Input OR Gate	MC10103	–	2.0	100	620
Quad 2-Input AND Gate	MC10104	MC10504	2.7	140	620,648,650
Triple 2-3-2-Input OR/NOR Gate	MC10105	MC10505	2.0	90	620,648,650
Triple 4-3-3-Input NOR Gate	MC10106	MC10506	2.0	90	620,648,650
Triple 2-Input Exclusive OR/Exclusive NOR	MC10107	MC10507	2.5	110	620,648,650
Dual 4-5-Input OR/NOR Gate	MC10109	MC10509	2.0	60	620,648,650
Dual 3-Input 3-Output OR Gate	MC10110	–	2.4	160	620,648
Dual 3-Input 3-Output NOR Gate	MC10111	–	2.4	160	620,648
Quad Exclusive OR Gate	MC10113	–	2.5	175	620,648
Triple Line Receiver	MC10114	MC10514	2.4	145	620,648,650
Quad Line Receiver	MC10115	MC10515	2.0	110	620,648,650
Triple Line Receiver	MC10116	MC10516	2.0	85	620,648,650
Dual 2-Wide 2-3-Input OR-AND/OR-AND-INVERT Gate	MC10117	MC10517	2.3	100	620,648,650
Dual 2-Wide 3-Input OR-AND Gate	MC10118	MC10518	2.3	100	620,648,650
4-Wide 4-3-3-3-Input OR-AND Gate	MC10119	MC10519	2.3	100	620,648,650
4-Wide OR-AND/OR-AND-INVERT Gate	MC10121	MC10521	2.3	100	620,648,650
Triple 4-3-3-Input Bus Driver	MC10123	–	3.0	310	620
Quad MTTL to MECL Translator	MC10124	MC10524	3.5	380	620,648,650
Quad MECL to MTTL Translator	MC10125	MC10525	4.5	380	620,648,650
Bus Driver	MC10128	–	12.0	700	620
Quad Bus Receiver	MC10129	–	10.0	750	620
Dual Latch	MC10130	MC10530	2.5	155	620,648,650
Dual Type D Master-Slave Flip-Flop	MC10131	MC10531	f = 160 MHz	235	620,648,650
Dual Multiplexer With Latch and Common Reset	MC10132	–	3.0	225	620,648
Quad Latch	MC10133	MC10533	4.0	310	620,648,650
Multiplexer with Latch	MC10134	–	3.0	225	620,648
Dual J-K Master-Slave Flip-Flop	MC10135	MC10535	f = 140 MHz	280	620,648,650
Universal Hexadecimal Counter	MC10136	MC10536	f = 150 MHz	625	620,648,650

(continued)

① L suffix denotes Dual In-Line Ceramic Package, P suffix denotes Dual In-Line Plastic Package, F suffix denotes flat package (i.e., MC10100L = Ceramic Dual In-Line Package, MC10100P = Plastic Dual In-Line Package and MC10500F = Ceramic Flat Package.)
*External Load Power not included.

FUNCTIONS AND CHARACTERISTICS (continued)

Function	Type ①		Propagation Delay ns typ	Power Dissipation mW typ/pkg*	Case
	-30 to +85°C	-55 to +125°C			
Universal Decade Counter	MC10137	MC10537	f = 150 MHz	625	620,648,650
Bi-Quinary Counter	MC10138	–	f = 150 MHz	370	620,648
64-Bit Random Access Memory (90 Ω)	MCM10140	–	t_{Access} = 15 (max)	420	620,690
Four-Bit Universal Shift Register	MC10141	MC10541	f = 200 MHz	425	620,648,650
64-Bit Random Access Memory (50 Ω)	MCM10142	–	t_{Access} = 10 (max)	420	620
8 x 2 Multiport Register File (RAM)	MCM10143	–	t_{Access} = 10	610	623
256-Bit Random Access Memory	MCM10144	–	t_{Access} = 30 (max)	420	620,690
64-Bit Register File (RAM)	MCM10145	–	t_{Access} = 10	625	620
128-Bit Random Access Memory	MCM10147	–	t_{Access} = 12 (max)	420	620
64-Bit Random Access Memory (50 Ω)	MCM10148	–	t_{Access} = 15 (max)	420	620
1024-Bit Programmable Read-Only Memory	MCM10149	–	t_{Access} = 25 (max)	–	690
Quad Latch	MC10153	–	4.0	310	620
Quad 2-Input Multiplexer (Non-Inverting)	MC10158	–	2.5	197	620
Quad 2-Input Multiplexer (Inverting)	MC10159	–	2.5	218	620
12-Bit Parity Generator-Checker	MC10160	MC10560	5.0	320	620,648,650
Binary to 1-8 Decoder (Low)	MC10161	MC10561	4.0	315	620,648,650
Binary to 1-8 Decoder (High)	MC10162	MC10562	4.0	315	620,648,650
Error Detection-Correction Circuit	MC10163	–	5.0	520	620
8-Line Multiplexer	MC10164	MC10564	3.0	310	620,648,650
8-Input Priority Encoder	MC10165	–	7.0	545	620,648
5-Bit Magnitude Comparator	MC10166	–	6.0	440	620
Quad Latch	MC10168	–	3.0	310	620
9 + 2 Bit Parity Generator-Checker	MC10170	–	4.0	300	620
Dual Binary to 1-4 Decoder (Low)	MC10171	MC10571	4.0	325	620,648,650
Dual Binary to 1-4 Decoder (High)	MC10172	MC10572	4.0	325	620,648,650
Quad 2-Input Multiplexer/Latch	MC10173	–	2.5	275	620,648
Dual 4 to 1 Multiplexer	MC10174	MC10574	3.5	305	620,648,650
Quint Latch	MC10175	MC10575	2.5	400	620,648
Hex "D" Master-Slave Flip-Flop	MC10176	MC10576	f = 150 MHz	460	620,648,650
Triple MECL to NMOS Translator	MC10177	–	–	1.0 W	620
Binary Counter	MC10178	–	f = 150 MHz	370	620,648
Look-Ahead Carry Block	MC10179	MC10579	3.0 (Cn,P) 4.0 (G)	300	620,648,650
Dual High Speed Adder/Subtractor	MC10180	MC10580	4.5	360	620,648,650
4-Bit Arithmetic Logic Unit/Function Generator	MC10181	MC10581	See Logic Diag.	600	623,649,652
2-Bit Arithmetic Logic Unit/Function Generator	MC10182	–	See Logic Diag.	575	620
4 x 2 Multiplier	MC10183	–	50	760	623
Hex "D" Master Slave Flip-Flop/with Reset	MC10186	–	f = 150 MHz	460	620
Quad MST to MECL 10,000 Translator	MC10190	–	2.5	215	620
Hex MECL 10,000 to MST Translator	MC10191	–	2.2	145	620
Error Detection-Correction Circuit	MC10193	–	7.5	520	620
Dual Simultaneous Bus Transceiver	MC10194	–	2.5	405	620
Hex Inverter/Buffer	MC10195	–	2.0	200	620
Hex "AND" Gate	MC10197	–	2.8	200	620
High-Speed Dual 3-Input 3-Output OR Gate	MC10210	–	1.5	160	620,648
High-Speed Dual 3-Input 3-Output NOR Gate	MC10211	–	1.5	160	620,648
High-Speed Dual 3-Input 3-Output OR/NOR Gate	MC10212	–	1.5	160	620
High-Speed Triple Line Receiver	MC10216	MC10616	1.8	100	620,648,650
High-Speed Dual Type D Master-Slave Flip-Flop	MC10231	MC10631	f = 225 MHz	270	620,648,650
High Speed 2 x 1 Bit Array Multiplier Block	MC10287	–	–	400	620

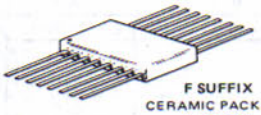
① L suffix denotes Dual In-Line Ceramic Package, P suffix denotes Dual In-Line Plastic Package, F suffix denotes flat package (i.e., MC10100L = Ceramic Dual In-Line Package, MC10100P = Plastic Dual In-Line Package and MC10500F = Ceramic Flat Package.)

*Load Power not included

MC1600 Series (-30°C to +85°C)

The requirement for digital systems with ever higher performance has increased the need for high-speed integrated circuits. The industry has recognized that the only economical way to obtain high operating system speed is through the use of emitter-coupled logic. Motorola offers a state-of-the-art, emitter-coupled logic family with subnanosecond propagation delays — MECL III.

MECL III circuit design is similar to that used in the popular MECL 10,000 family. In the MECL III line, as well as MECL 10,000, advanced processing techniques are employed and the capability for driving low-impedance terminated lines is provided. MECL III is recommended for new designs.

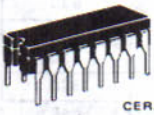


F SUFFIX
CERAMIC PACKAGE
CASE 650

GENERAL FEATURES

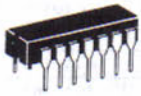
- Gate Switching Speeds of 1.0 ns typical
- Capability of Driving Terminated Lines with Impedance as Low as 50 Ohms
- Flip-Flop Toggle Rate Greater Than 500 MHz
- Operation with Unused Inputs Left Open
- Compatibility with MECL 10,000 Series
- Counting Speeds to above 1 GHz

P SUFFIX
PLASTIC PACKAGE
CASE 646

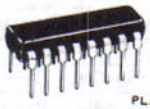


L SUFFIX
CERAMIC PACKAGE
CASE 620

F SUFFIX
CERAMIC PACKAGE
CASE 607



L SUFFIX
CERAMIC PACKAGE
CASE 632



P SUFFIX
PLASTIC PACKAGE
CASE 648

FUNCTIONS AND CHARACTERISTICS (V_{CC} = 0, V_{EE} = -5.2 V, T_A = 25°C unless otherwise noted.)

Function	Type ① -30° to +85°C	Loading Factor # Each Output	Propagation Delay 50-ohm Load ns typ	Power Dissipation (No Load) mW typ/pkg	Case
High Bandwidth Quad 2-Input OR/NOR Gate	MC1601	–	0.75	600	650
High Bandwidth Triple 2-2-3 Input OR/NOR Gate	MC1602	–	0.75	460	650
High Bandwidth 4-5-Input OR/NOR Gate	MC1603	–	0.75	320	650
High Bandwidth Triple Line Receiver	MC1604	–	0.75	460	650
Dual Type D Master-Slave Flip-Flop	MC1605	–	500 MHz typ	525	650
Voltage Controlled Oscillator	MC1648	–	*225 MHz typ	150	607,632,646
Dual A/D Comparator	MC1650	70	3.5	275	620,650
Dual A/D Comparator	MC1651	70	3.0	275	620,650
Binary Counter	MC1654	70	*325 MHz typ	750 ///	620
Voltage-Controlled Multivibrator	MC1658	70	*150 MHz typ	125	620,648,650
Dual 4-Input OR/NOR Gate	MC1660	70	1.1	120	620,650
Quad 2-Input NOR Gate	MC1662	70	1.1	240	620,650
Quad 2-Input OR Gate	MC1664	70	1.1	240	620,650
Dual Clocked R-S Flip-Flop	MC1666	70	1.8	220	620,650
Dual Clocked Latch	MC1668	70	1.8	220	620,650
Master-Slave Type D Flip-Flop	MC1670	70	*350 MHz typ	220	620,650
Triple 2-Input Exclusive OR Gate	MC1672	70	1.3	220	620,650
Triple 2-Input Exclusive NOR Gate	MC1674	70	1.3	220	620,650
Bi-Quinary Counter	MC1678	70	*350 MHz typ	750 ///	620
Dual 4-5-Input OR/NOR Gate	MC1688	70	0.8	125	650
UHF Prescaler Type D Flip-Flop	MC1690	70	*500 MHz min	200	620,650
Quad Line Receiver	MC1692	70	1.1	220	620,650
4-Bit Shift Register	MC1694	70	*325 MHz typ	750 ///	620
1 GHz Divide-By-Ten Counter	MC1696	–	*1 GHz min	650	650
Divide-By-Four Gigahertz Counter	MC1699	–	*1.2 GHz typ	650	650

① L suffix denotes Dual In-Line Ceramic Package, F suffix denotes Ceramic Flat Package, P suffix denotes Dual In-Line Plastic Package. (i.e., MC1600L = Ceramic Dual In-Line Package, MC1600F = Ceramic Flat Package, MC1600P = Plastic Dual In-Line Package).

/// Requires Heat Sink — IERC-LIC-214A2WCB or equivalent.

*Toggle Frequency

#DC Loading Factors are based on:

1. Full load output current, I_L = -25 mAdc max
2. Maximum input current, I_{in} = 350 μAdc

MEGALOGIC LSI

MEGALOGIC is a bipolar LSI family of low-cost products directed to the computer, industrial, and consumer markets, for both MPU and non-MPU applications. The family will include technologies such as TRL and I^2L, plus others that may be applicable. Design techniques will encompass the production-proven gate array technique plus other design approaches to provide the flexibility required for cost-effective, standard bipolar LSI functions.

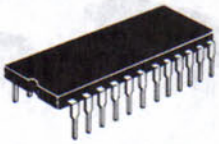
Designers can now implement highly complex systems with only a few basic off-the-shelf LSI components. Benefits include lower system costs, off-the-shelf availability, improved reliability, lower system power drain, fewer parts to assemble and inspect, and more compact system architecture.

BIPOLAR LSI GATE ARRAYS

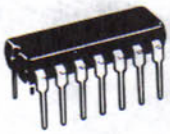
Megalogic encompasses several design approaches to Bipolar LSI. One approach is the basic gate array. The basic arrays with the addition of custom metalization, can be connected quickly and economically into high-density functions of equivalent complexity.

Characteristic	XC160	XC400
Number of Gates	160	400
Number of Bonding Pads	48	74
Fan-In	3	3
Fan-Out (Internal)	5	5
Propagation Delay	25 ns	25 ns
Power Dissipation (Chip)	480 mW	1200 mW
Logic "0" Level*	0.5 V	0.5 V
Logic "1" Level*	2.4 V	2.4 V
Die Size (Mils)	74 x 103	123 x 125

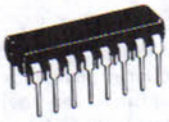
*External, at specified load.



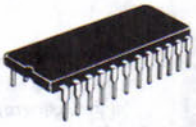
L SUFFIX
CERAMIC PACKAGE
CASE 623



P SUFFIX
PLASTIC PACKAGE
CASE 646



P SUFFIX
PLASTIC PACKAGE
CASE 648



P SUFFIX
PLASTIC PACKAGE
CASE 649

STANDARD PRODUCT LINE

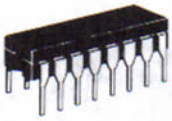
The following standard Bipolar LSI parts have been defined, and are available.

Device	Function	Case	Applications
MC8500	CRCC Generator	649	Magnetic tape drive controllers using NRZI recording; 7 or 9 channels.
MC8501	Error Pattern Register	648	
MC8502	LRCC/Data Register	649	
MC8503	Universal Polynomial Generator (16-Bit)	646	Cassette, floppy disc, data communications
MC8504	Universal Presettable Polynomial Generator (4-Bit, Cascadable)	648	High-speed disc controllers, digital filtering
MC8505	MOS Dynamic Memory Refresh Logic Circuit	648	Add-on memory, memory applications
MC8506	Polynomial Generator (16-Bit)	648	Floppy disc, SDLC terminals
MC8520	Deskew/Queue Register	623	Magnetic tape drive controllers, phase encoded
MC8521*	Data Recovery	TBA	
MC8522*	2-of-8 Tone Decoder (Low Frequency)	TBA	Digital communications, touch tone receivers, telephone networks, mobile radio systems.
MC8523*	2-of-8 Tone Decoder (High Frequency)	TBA	
MC8524*	2-of-8 Tone Decoder Timing and Control	TBA	

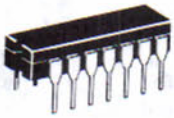
*To be announced.

LOGIC PRODUCTS
for
PHASE-LOCKED LOOP APPLICATIONS

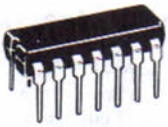
F SUFFIX
CERAMIC PACKAGE
CASE 607



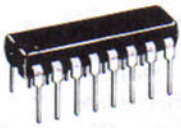
L SUFFIX
CERAMIC PACKAGE
CASE 620



L SUFFIX
CERAMIC PACKAGE
CASE 632



P SUFFIX
PLASTIC PACKAGE
CASE 646



P SUFFIX
PLASTIC PACKAGE
CASE 648

Motorola offers the designer a choice of specially designed integrated circuits for performing phase-locked loop functions: phase detection, frequency division, filtering, and voltage-controlled signal generation. In addition, the choice of circuits permits the designer to select TTL circuits where speed is not critical (<25 MHz), or ECL circuits where high speed is required. The MC12000 series circuits will operate at either +5.0 V or -5.2 V, and translators are included where needed so that all functions are compatible.

FUNCTIONS AND CHARACTERISTICS

Function	Type				Family	Frequency MHz typ	Power Dissipation mW typ/pkg
	-55 to +125°C	Case	0 to +75°C	Case			
Emitter-Coupled Oscillator	–	–	MC1648	607,632,646	MECL	225	150
Voltage-Controlled Multivibrator	–	–	MC1658	620,648	MECL	150	125
Dual Voltage-Controlled Multivibrator	MC4324	607,632	MC4024	607,632,646	MTTL	30	150
Phase-Frequency Detector	MC4344	607,632	MC4044	607,632,646	MTTL	8.0	85
Digital Mixer/Translator	–	–	MC12000	632	MECL	250	470
Two-Modulus Prescaler	–	–	MC12012	620	MECL	200	500
Two-Modulus Prescaler	MC12513	620	MC12013	620,648	MECL	600	–
Counter Control Logic	–	–	MC12014	620	MTTL	25	25
Offset Control	MC12520	632	MC12020	632,646	MECL	–	–
Offset Programmer	MC12521	620	MC12021	620,648	MECL	–	–
Phase-Frequency Detector	MC12540	632	MC12040	632,648	MECL	70	425
Crystal Oscillator	MC12560	620	MC12060	620,648	MTTL	0.1 to 2.0	175
Crystal Oscillator	MC12561	620	MC12061	620,648	MTTL	2.0 to 20	210
Programmable Modulo-N Decade Counter (÷0 thru 9)	MC4316 (MC54416)	620	MC4016 (MC74416)	620,648	MTTL	8.0	250
Programmable Modulo-N Counter (÷0, 1 and ÷0 thru 4)	MC4317 (MC54417)	620	MC4017 (MC74417)	620,648	MTTL	8.0	250
Programmable Modulo-N Hexadecimal Counter (÷0 thru 15)	MC4318 (MC54418)	620	MC4018 (MC74418)	620,648	MTTL	8.0	250
Programmable Modulo-N Counter (÷0 thru 3 and ÷0 thru 3)	MC4319 (MC54419)	620	MC4019 (MC74419)	620,648	MTTL	8.0	250

INTEGRATED CIRCUITS

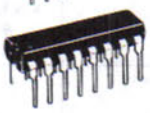
MHTL

***MC660 Series (-30 to +75°C)**

Motorola's MHTL integrated circuits are especially designed to meet the requirements of industrial applications because of the outstanding noise immunity. MHTL circuits provide error-free operation in high noise environments far beyond the tolerance of other integrated circuit families. Multifunction packages and broad operating temperature range further tailor this device family to the industrial designer's requirements.

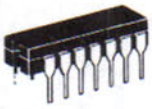
*MHTL cermaic dual in-line devices are available with specification over the -55°C to +125°C temperature range and/or with hi-rel processing on special order. See your Motorola representative for pricing.

P SUFFIX
PLASTIC PACKAGE
CASE 646

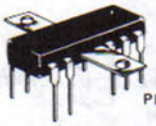


P SUFFIX
PLASTIC PACKAGE
CASE 648

L SUFFIX
CERAMIC PACKAGE
CASE 620



L SUFFIX
CERAMIC PACKAGE
CASE 632



P SUFFIX
PLASTIC PACKAGE
CASE 675

PC SUFFIX
PLASTIC PACKAGE
CASE 676

FUNCTIONS AND CHARACTERISTICS (V_{CC} = 15 V ± 1.0 Vdc, T_A = 25°C)

Function	Type ① -30 to +75°C	Loading Factor Each Output	Propagation Delay ns typ	Power Dissipation mW typ/pkg	Case
Expandable Dual 4-Input NAND Gate (active pullup)	MC660	10	110	88/26 ②	632,646
Expandable Dual 4-Input NAND Gate (passive pullup)	MC661	10	125	88/26 ②	632,646
Expandable Dual 4-Input Line Driver (NAND)	MC662	30	140	180/26 ②	632,646
Dual J-K Flip-Flop	MC663	9	3.0 MHz ③	200	632,646
Master-Slave R-S Flip-Flop	MC664	8	3.0 MHz ③	160	632,646
Triple Level Translator	MC665	MDTL = 8 MTTL III = 5.5 MRTL = 5	40	83 (MDTL) 104 (MRTL)	632,646
Triple Level Translator	MC666	10	75	105	632,646
Dual Monostable Multivibrator	MC667	10	140	240	632,646
Quad 2-Input NAND Gate (passive pullup)	MC668	10	125	176/52 ②	632,646
Dual 4-Input Expander	MC669	–	–	–	632,646
Triple 3-Input NAND Gate (passive pullup)	MC670	10	125	132/39 ②	632,646
Triple 3-Input NAND Gate (active pullup)	MC671	10	110	132/39 ②	632,646
Quad 2-Input NAND Gate (active pullup)	MC672	10	110	176/52 ②	632,646
Dual 2-Input AND-OR-INVERT Gate (active pullup)	MC673	10	110	160/50 ②	632,646
Dual 2-Input AND-OR-INVERT Gate (passive pullup)	MC674	10	125	160/50 ②	632,646
Dual Pulse Stretcher	MC675	10	150 (pins 1,6) 110 (pins 5,6)	180	632,646
BCD-To-Decimal Decoder-Driver	MC676	–	–	380	620,648
Hex Inverter With Strobe (active pullup)	MC677	10	110	246/96 ②	620,648
Hex Inverter With Strobe (without output resistors)	MC678	10	125	192/96 ②	620,648
Dual Lamp/Line Driver	MC679,8	125	0.5 µs typ	250/30 ②	632,646
Hex Inverter (active pullup)	MC680	10	110	246/96 ②	632,646
Hex Inverter (open collector)	MC681	10	125	192/96 ②	632,646
Quad Latch	MC682	10	250	375	620,648
Quad 2-Input Exclusive OR Gate	MC683	10	–	380	632,646
Decade Counter	MC684	10	0.5 MHz ③	480	620,648
Binary Counter	MC685	10	0.5 MHz ③	480	620,648
4-Bit Shift Register	MC686	10	0.5 MHz ③	480	620,648
Dual J-K Flip-Flop	MC688	10	2.5 MHz ③	375	620,648
Hex Inverter (high voltage)	MC689	10	150	173/55 ②	632,646
Hex Inverter (active pullup)	MC690	10	150	173/55 ②	632,646
Hex Inverter/Interface Element	MC691	10	300 (t-+) 150 (t+-)	500/150 ②	632,646
Dual Interface Element, Line Driver/Receiver	MC696	10 @ 10 V V_{CC} 15 @ 25 V V_{CC}	750	225/60 ②	620,648
Dual Power AND Gate	MC699	10	650 (pins 1,6) 350 (pins 1,3)	650/350 ②	675,676 ④

① L suffix denotes Dual In-Line Ceramic Package, P denotes Dual In-Line Plastic Package (i.e., MC660L = Dual In-Line Ceramic, MC660P = Dual In-Line Plastic Package)

② Inputs High/Input Low ③ f_{Tog} ④ Case 676 available on special order only.

INTEGRATED CIRCUITS

MDTL

MC830 Series (0 to +75°C)
MC930 Series (-55 to +125°)

MAXIMUM RATINGS

Rating	Value	Unit
Supply Voltage –		Vdc
Operating	4.5 to 5.5	
Continuous	8.0	
Pulsed, < 1 second	12	
Output Current (Into Outputs with Outputs Low)		mAdc
Buffers, Power Gates – Continuous	100	
Pulsed, < 30 ms	300	
All other types – Continuous	30	
Pulsed, < 30 ms	90	
Input Forward Current –		mAdc
Continuous	-10	
Pulsed, < 30 ms	-30	
or		
Negative Voltage at Input –		Vdc
Continuous	-0.5	
Pulsed, < 30 ms	-1.5	
Input Reverse Current	1.0	mAdc
or		
Positive Voltage at Diode Input	5.5	Vdc
Operating Temperature Range		°C
MC930 Series	-55 to +125	
MC830 Series	0 to +75	
Storage Temperature Range		°C
Metal Can, Ceramic Package	-65 to +150	
Plastic Package	-55 to +125	
Maximum Junction Temperature		°C
MC930 Series	175	
MC830 Series	150	

MDTL integrated circuits provide an excellent balance of speed, power dissipation, and noise immunity for general purpose digital applications. The line includes many multifunction types. Additional logic power is provided by the "wired OR" capability of the basic MDTL gate.

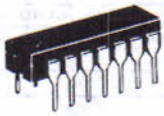
G SUFFIX
METAL PACKAGE
CASE 603-02
TO-100

P SUFFIX
PLASTIC PACKAGE
CASE 646

F SUFFIX
CERAMIC PACKAGE
CASE 607

P SUFFIX
PLASTIC PACKAGE
CASE 648

L SUFFIX
CERAMIC PACKAGE
CASE 620



L SUFFIX
CERAMIC PACKAGE
CASE 632
TO-116

FUNCTIONS AND CHARACTERISTICS (V_{CC} = 5.0 Vdc, T_A = 25°C)

Function	Type ① 0 to +75°C	Case	Type ① -55 to +125°C	Case	Loading Factor Each Output	Propagation Delay ns typ	Power Dissipation mW typ/pkg
Expandable Dual 4-Input NAND Gate	MC830	607,632,646	MC930	607,632	8	30	22
Expandable Dual 3-2 Input NAND Gate	MC830	603	MC930	603	8	30	22
Clocked Flip-Flop	MC831	603,607,632,646	MC931	603,607,632	7	40	55
Expandable Dual 4-Input Buffer	MC832	607,632,646	MC932	607,632	25	35	85
Expandable Dual 3-2 Input Buffer	MC832	603	MC932	603	25	35	85
Dual 4-Input Expander	MC833	607,632,646	MC933	607,632	–	–	–
Dual 4-3 Input Expander	MC833	603	MC933	603	–	–	–
Hex Inverter	MC834	607,632,646	MC934	607,632	8	30	66
Hex Inverter (without output resistors)	MC835	607,632,646	MC935	607,632	8	30	42
Hex Inverter	MC836	607,632,646	MC936	607,632	8	30	66
Hex Inverter	MC837	607,632,646	MC937	607,632	7	25	90
Decade Counter	MC838	607,632,646	MC938	607,632	8	30 MHz ③	150
Divide-by-Sixteen Counter	MC839	607,632,646	MC939	607,632	8	30 MHz ③	150
Hex Inverter (without input diodes)	MC840	607,632,646	MC940	607,632	8	30	66
Hex Inverter (without output resistors and input diodes)	MC841	607,632,646	MC941	607,632	8	30	42
4-Input AND Driver with NOR Strobe	MC843	603	MC943	603	250 mA	80	50
Expandable Dual 4-Input Power Gate	MC844	607,632,646	MC944	607,632	27	30	65
Expandable Dual 3-2 Input Power Gate	MC844	603	MC944	603	27	30	65
Clocked Flip-Flop	MC845	603,607,632,646	MC945	603,607,632	12/10 ②	40	60
Quad 2-Input NAND Gate	MC846	607,632,646	MC946	607,632	8	30	44
Quad Inverter	MC846	603	MC946	603	8	30	44
Quad 2-Input Gate Expander	MC847	607,632,646	MC947	607,632	–	–	–
Clocked Flip-Flop	MC848	603,607,632,646	MC948	603,607,632	11/9 ②	40	70
Quad 2-Input NAND Gate (2 k pullup resistor)	MC849	607,632,646	MC949	607,632	7	25	66
Quad Inverter (2 k pullup resistor)	MC849	603	MC949	603	7	25	60

(continued)

① F suffix denotes Ceramic Flat Package, G suffix denotes Metal Can, L suffix denotes Dual In-Line Ceramic Package, P suffix denotes Dual In-Line Plastic Package. (i.e., MC830G = Metal Can, MC830F = Flat Package, MC830L = Dual In-Line Ceramic Package.

② Fan-out for MC830 series type/Fan-out for MC930 series type.

③ Maximum counting frequency.

FUNCTIONS AND CHARACTERISTICS (V_{CC} = 5.0 Vdc, T_A = 25°C) (continued)

Function	Type ① 0 to +75°C	Case	Type ① -55 to +125°C	Case	Loading Factor Each Output	Propagation Delay ns typ	Power Dissipation mW typ/pkg
Pulse Triggered Binary	MC850	603,607,632,646	MC950	603,607,632	10/8 ②	15	50
Monostable Multivibrator	MC851	603,607,632,646	MC951	603,607,632	10	40	30
Dual J-K Flip-Flop (common clock and C_D, separate S_D)	MC852	607,632,646	MC952	607,632	12/10 ②	40	120
Dual J-K Flip-Flop (separate clock and S_D, no C_D)	MC853	607,632,646	MC953	607,632	12/10 ②	40	120
Dual J-K Flip-Flop (common clock and C_D, separate S_D, 2 k pullup resistor)	MC855	607,632,646	MC955	607,632	11/9 ②	40	140
Dual J-K Flip-Flop (separate clock and S_D, no C_D, 2 k pullup resistor)	MC856	607,632,646	MC956	607,632	11/9 ②	40	140
Quad 2-Input Buffer	MC857	607,632,646	MC957	607,632	25	35	170
Quad 2-Input NAND Power Gate	MC858	607,632,646	MC958	607,632	27	30	130
Expandable Dual 4-Input NAND Gate (2 k pullup resistor)	MC861	607,632,646	MC961	607,632	7	25	33
Expandable Dual 3-2 Input NAND Gate (2 k pullup resistor)	MC861	603	MC961	603	7	25	33
Triple 3-Input NAND Gate	MC862	607,646	MC962	607,632	8	30	33
Dual 2-Input NAND Gate plus Inverter	MC862	603	MC962	603	8	30	30
Triple 3-Input NAND Gate (2 k pullup resistor)	MC863	607,646	MC963	607,632	7	25	50
Dual 2-Input NAND Gate plus Inverter (2 k pullup resistor)	MC863	603	MC963	603	7	25	45
Dual 6-Input NAND Gate	MC1800	607,632,646	MC1900	607,632	8	30	22
Dual 5-Input NAND Gate (2 k pullup resistor)	MC1801	607,632,646	MC1901	607,632	7	25	33
Expandable 8-Input NAND Gate	MC1802	607,632,646	MC1902	607,632	8	30	11
Expandable 8-Input NAND Gate (2 k pullup resistor)	MC1803	607,632,646	MC1903	607,632	7	25	16.5
10-Input NAND Gate	MC1804	607,632,646	MC1904	607,632	8	30	11
10-Input NAND Gate (2 k pullup resistor)	MC1805	607,632,646	MC1905	607,632	7	25	16.5
Quad 2-Input AND Gate	MC1806	607,632,646	MC1906	607,632	8	35	72
Quad 2-Input AND Gate (2 k pullup resistor)	MC1807	607,632,646	MC1907	607,632	7	30	85
Quad 2-Input OR Gate	MC1808	607,632,646	MC1908	607,632	8	35	97
Quad 2-Input OR Gate (2 k pullup resistor)	MC1809	607,632,646	MC1909	607,632	7	30	115
Quad 2-Input NOR Gate	MC1810	607,632,646	MC1910	607,632	8	30	60
Quad 2-Input NOR Gate (2 k pullup resistor)	MC1811	607,632,646	MC1911	607,632	7	25	72
Quad 2-Input Exclusive OR Gate	MC1812	607,632,646	MC1912	607,632	8	40	120
Quad Latch	MC1813	620,648	MC1913	620	7	35	220
Quad Latch	MC1814	607,632,646	MC1914	607,632	7	35	220
Parallel Gated Clocked Flip-Flop	MC1815	607,632,646	MC1915	607,632	12/10 ②	40	65
Parallel Gated Clocked Flip-Flop	MC1816	607,632,646	MC1916	607,632	11/9 ②	40	75
Quad 2-Input NAND Gate (without output resistor)	MC1818	607,632,646	MC1918	607,632	8	30	32
High Voltage Hex Inverter	MC1820	632,646	–	–	7	40	42

① F suffix denotes Ceramic Flat Package, G suffix denotes Metal Can, L suffix denotes Dual In-Line Ceramic Package, P suffix denotes Dual In-Line Plastic Package. (i.e., MC830G = Metal Can, MC830F = Flat Package, MC830L = Dual In-Line Ceramic Package.

② Fan-out for MC830 series type/Fan-out for MC930 series type.

③ Maximum counting frequency.

MRTL

MEDIUM POWER INTEGRATED CIRCUITS

MRTL

MC700 series (+15 to +55°C)
MC800 series (0 to +75 and 0 to +100°C)
MC900 series (-55 to +125°C)

Medium-power MRTL integrated circuits provide a broad line of low-cost, multi-function, digital circuits. Typical gate speed is 12 ns, with power dissipation averages of 19 mW (input high) and 5.0 mW (inputs low) per logic node. Devices from the MC700 Series have loading factors normalized for compatibility with the low-power mW MRTL devices for ease in mixing the two power levels in a system.

G SUFFIX
METAL PACKAGE
CASE 601

G SUFFIX
METAL PACKAGE
CASE 603-02
TO-100

P SUFFIX
PLASTIC PACKAGE
CASE 646

F SUFFIX
CERAMIC PACKAGE
CASE 606
TO-91

F SUFFIX
CERAMIC PACKAGE
CASE 607

P SUFFIX
PLASTIC PACKAGE
CASE 648

FUNCTIONS AND CHARACTERISTICS

(V_{CC} = 3.0 V ± 10% for MC900 Series and MC800F, G Series; 3.6 V ± 10% for MC800P Series and MC700 Series, T_A = 25°C)

Function	Type ① MC700 Series +15 to +55°C	Case	Type ① MC800 Series 0 to +75°C	Case	Type ① MC800 Series 0 to +100°C	Case	Type ① MC900 Series -55 to +125°C	Case	Loading Factor Each Output: With mW MRTL	Loading Factor Each Output: With MRTL	tp ns typ	Power Dissipation mW typ/pkg: MC700 and MC800P Series	Power Dissipation mW typ/pkg: MC800F,G and MC900 Series
Buffer	MC700	601,606			MC800	601,606	MC900	601,606	80	25	20	25/50 ②	16/45 ②
Counter Adapter	MC701	601			MC801	601	MC901	601	16	5	22	80	55
R-S Flip-Flop	MC702	601			MC802	601	MC902	601	13	4	14	32	22
3-Input NOR Gate	MC703	601,606			MC803	601,606	MC903	601,606	16	5	12	28/7.5 ②	19/5.0 ②
Half Adder	MC704	601,606			MC804	601,606	MC904	601,606	16	5	14	65	45
Half-Shift Register	MC705	601,606			MC805	601,606	MC905	601,606	13	4	22	75	53
Half-Shift Register (w/o inverter)	MC706	601,606			MC806	601,606	MC906	601,606	13	4	22	52	36
4-Input NOR Gate	MC707	601,606			MC807	601,606	MC907	601,606	16	5	12	30/7.5 ②	19/5.0 ②
Dual 2-Input NOR Gate	MC714	601,606			MC814	601,606	MC914	601,606	16	5	12	50/15 ②	38/10 ②
Dual 3-Input NOR Gate	MC715	603,606,646	MC815	646	MC815	603,606	MC915	603,606	16	5	12	55/15 ②	38/10 ②
J-K Flip-Flop			MC816	646	MC816	601,606	MC916	601,606	–	3	30	91/79 ③	62/54 ③
J-K Flip-Flop	MC723	601,606,646							10	–	30	91/79 ③	–
Quad 2-Input NOR Gate	MC724,A	607,646	MC824,A	646	MC824	607	MC924	607	16	5	12	100/30 ②	76/20 ②
Dual 4-Input NOR Gate	MC725	607,646	MC825	646	MC825	607	MC925	607	16	5	12	60/15 ②	38/10 ②
J-K Flip-Flop	MC726	603,606,646	MC826	646	MC826	603,606	MC926	603,606	16	5	35	100/86 ③	130/65 ③
Quad Inverter	MC727	603,606			MC827	603,606	MC927	603,606	16	5	12	87/30 ②	76/20 ②
5-Input NOR Gate	MC729	601,606			MC829	603,606	MC929	601,606	16	5	12	33/7.5 ②	19/5.0 ②
Quad Exclusive OR Gate	MC771	607,646	MC871	646	MC871	607	MC971	607	16	5	12	28	72
J-K Flip-Flop	MC774	601			MC874	601	MC974	601	16	5	35	100/86 ③	130/65 ③
Dual Half-Adder	MC775	607,646	MC875	646	MC875	607	MC975	607	16	5	20	120	90
Binary Up Counter	MC777	646	MC877	646					10	3	–	180	–
1 J-K Flip-Flop, 1 Expander, 2 Buffers	MC779	646	MC879	646					–	–	–	141/124 ④	–
Decade Up Counter	MC780	646	MC880	646					10	3	–	250	–
Dual Half-Shift Register	MC783	607,646	MC883	646	MC883	607	MC983	607	13	4	22	140	110
Dual Half-Shift Register (w/inverter)	MC784	607,646	MC884	646	MC884	607	MC984	607	13	4	22	100	75
Quad 2-Input Expander	MC785,A	607,646	MC885,A	646	MC885	607	MC985	607	–	–	12	20/– ②	17/– ②
Dual 4-Input Expander	MC786	607,646	MC886	646	MC886	607	MC986	607	–	–	12	20/– ②	17/– ②
1 J-K Flip-Flop, 1 Inverter, 2 Buffers	MC787	646	MC887	646					–	–	–	138/132 ④	–
Dual 3-Input Buffer, non-inverting	MC788	607,646	MC888	646	MC888	607	MC988	607	80	25	24	145/56 ②	128/42 ②
Hex Inverter	MC789,A	607,646	MC889,A	646	MC889	607	MC989	607	16	5	12	130/15 ②	76/20 ②
Dual J-K Flip-Flop	MC790	607,646	MC890	646	MC890	607	MC990	607	10	3	35	182/158 ③	124/108 ③
Dual J-K Flip-Flop	MC791	607,646	MC891	646	MC891	607	MC991	607	16	5	40	190/160 ③	155/130 ③
Triple 3-Input NOR Gate	MC792	607,646	MC892	646	MC892	607	MC992	607	16	5	12	82/24 ②	57/15 ②
Serial-Parallel Shift Register	MC794	646	MC894	646					16	5	55	225	–
Dual Full Adder	MC796	607,646	MC896	646	MC896	607	MC996	607	16	5	60	225	190
Dual Full Subtractor	MC797	607,646	MC897	646	MC897	607	MC997	607	16	5	60	225	190
Dual Buffer	MC799	603,606,646	MC899	646	MC899	603,606	MC999	603,606	80	25	15	50/90 ②	32/90 ②
Dual 4-Channel Data Selector	MC9701	648	MC9801	648					16	5	25	100	–
Dual J-K Flip-Flop	MC9702	646	MC9802	646					10	3	35	182/158 ③	–
4-Bit Parallel Full Adder	MC9704	648	MC9804	648					6	2	125	265	–
Dual 4-Channel Data Distributor	MC9707	648	MC9807	648					16	5	25	150	–
Quad Schmitt Trigger	MC9709	646	MC9809	646					16	5	30	95	–
Quad 2-Input AND Gate	MC9713	646	MC9813	646					16	5	28	100	–
Quad 2-Input NAND Gate	MC9714	646	MC9814	646					16	5	14 ⑤	145	–
Quad 2-Input OR Gate	MC9715	646	MC9815	646					16	5	14 ⑤	28/100 ②	–
Hex Expander	MC9719,A	646	MC9819,A	646					–	–	12	13/– ②	–

"A" suffix devices have insured capability to drive at least one MTTL load or two MDTL loads.

① G Suffix denotes Metal Can, F suffix denotes Flat Package, P suffix denotes Plastic Package.

② Inputs High/Inputs Low

③ Only Clock Inputs High/Inputs Low

④ Only Clock Input high on flip-flop, other element Inputs High/Inputs Low

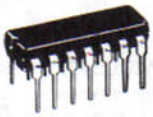
⑤ Operating Frequency (MHz)

MC708 series (+15 to +55°C)
MC808 series (0 to +75°C)
MC908 series (–55 to +125°C)

Low-power mW MRTL integrated circuits are designed for use where minimal system power consumption is desired. Typical gate speed is 27 ns, with typical power dissipation of 6.5 mW (input high) and 0.5 mW (inputs low) per logic node. Devices from the MC708 Series can be mixed with devices from the medium-power MC700 Series which has loading factors normalized for compatibility.

G SUFFIX
METAL PACKAGE
CASE 601

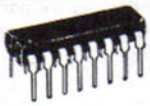
G SUFFIX
METAL PACKAGE
CASE 603
TO-100



P SUFFIX
PLASTIC PACKAGE
CASE 646

F SUFFIX
CERAMIC PACKAGE
CASE 606
TO-91

F SUFFIX
CERAMIC PACKAGE
CASE 607



P SUFFIX
PLASTIC PACKAGE
CASE 648

FUNCTIONS AND CHARACTERISTICS

(V_{CC} = 3.0 V ± 10% for MC908 Series, 3.6 V ± 10% for MC808 Series and MC708 Series; T_A = 25°C)

Function	Type ① MC708 Series +15 to +55°C	Type ① MC808 Series 0 to +75°C	Case	Type ① MC908 Series -55 to +125°C	Case	Loading Factor Each Output All Series	t_p ns typ	Power Dissipation mW typ/pkg MC708 Series & MC808 Series	Power Dissipation mW typ/pkg MC908 Series
Half Adder	MC708	MC808	601,606	MC908	601,606	4	60	19/12.5 ②	14/8.5 ②
2-Input Buffer	MC709	MC809	601,606	MC909	601,606	30	57	7.0/23 ②	5.5/16 ②
Dual 2-Input NOR Gate	MC710	MC810	601,606	MC910	601,606	4	27	10/2.5 ②	8.0/1.0 ②
4-Input OR/NOR Gate	MC711	MC811	601,606	MC911	601,606	4	60	8.0/5.5 ②	6.0/3.5 ②
Half Adder	MC712	MC812	601,606	MC912	601,606	4	66	15.5/10.5 ②	11.5/5.5 ②
Type D Flip-Flop	MC713	MC813	601,606	MC913	601,606	3	75	24/17.5 ③	17.5/13 ③
Quad 2-Input NOR Gate	MC717	MC817	607,646	MC917	607	4	27	20/5.0 ②	16/2.5 ②
Dual 3-Input NOR Gate	MC718	MC818	603,606,646	MC918	603,606	4	27	12/2.5 ②	9.5/1.0 ②
Dual 4-Input NOR Gate	MC719	MC819	607,646	MC919	607	4	27	13/2.5 ②	11/1.0 ②
J-K Flip-Flop	MC720	MC820	601,606	MC920	601,606	2	50	20.5/14.5 ④	15.5/10 ④
Dual 2-Input Gate Expander	MC721	MC821	601,606	MC921	601,606	–	27	3.0/– ②	3.0/– ②
J-K Flip-Flop	MC722	MC822	603,606,646	MC922	603,606	4	70	24/20 ④	17.5/13 ④
5-Input NOR Gate	MC728	MC828	601,606	MC928	601,606	4	27	7.5/1.0 ②	6.5/0.5 ②
Dual Exclusive OR/NOR Gate	MC764	MC864	646	–	–	4	–	25	–
Quad Latch	MC767,A	MC867,A	648	–	–	9	50	110	–
BCD-To-Decimal Decoder	MC770	MC870	648	–	–	7	36	100/– ②	–
Dual J-K Flip-Flop	MC776	MC876	607,646	MC976	607	2	50	41/29 ④	31/20 ④
Dual Type D Flip-Flop	MC778	MC878	607,646	MC978	607	3	60	48/35 ③	35/26 ③
Dual Buffer	MC781	MC881	601	MC981	601	30	57	14/46 ②	11/32 ②
J-K Flip-Flop	MC782	MC882	601	MC982	601	2	80	23/21 ④	15/13 ④
Triple 3-Input NOR Gate	MC793	MC893	607,646	MC993	607	4	27	18/3.5 ②	14/2.0 ②
Dual 2-Input Buffer	MC798	MC898	607,646	MC998	607	30	57	14/46 ②	11/32 ②
Hex Inverter	MC9718	MC9818	646	–	–	4	27	7.0/3.0 ②	–
Hex Expander	MC9720	MC9820	646	–	–	–	12	30/– ②	–
Quad 2-Input Expander	MC9721	MC9821	646			–	27	20/– ②	
Dual J-K Flip-Flop	MC9722	MC9822	646	–	–	4	75	24/– ④	–
Quad 2-Input AND Gate	MC9723	MC9823	646	–	–	4	50	12 ⑤	–
Quad 2-Input NAND Gate	MC9724	MC9824	646	–	–	4	50	20/5.0 ②	–
Quad 2-Input OR Gate	MC9725	MC9825	646	–	–	4	50	–/7.0 ②	–

"A" suffix devices have insured capability to drive at least one MTTL load or two MDTL loads.

① G suffix denotes Metal Can, F suffix denotes Flat Package, P suffix denotes Plastic Package.

② Inputs High/Inputs Low unless otherwise noted.

③ Direct Set and Direct Clear Low, All other Inputs High/All Inputs Low.

④ Only Clock Input High/All Inputs Low.

⑤ One Input High/One Input Low.

BEAM LEAD INTEGRATED CIRCUITS

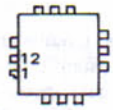
MTTL

MCBC5400 Series (-55 to +125°C)

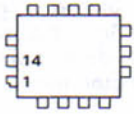
BEAM LEAD

MCBC5400 series integrated circuits comprise a family of transistor-transistor logic designed for general purpose digital applications. The family has a medium operating speed (15-30 MHz clock rate), good external noise immunity, high fan out, and the capability of driving capacitive loads of up to 600 pF.

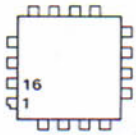
This series is produced using beam lead sealed junction technology. These devices are particularly useful in highly reliable systems using hybrid beam lead assembly techniques.



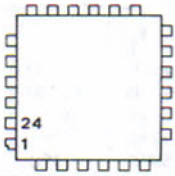
BEAM LEAD CHIP
(12 Lead)
(Geometry Side Down)



BEAM LEAD CHIP
(14 Lead)
(Geometry Side Down)



BEAM LEAD CHIP
(16 Lead)
(Geometry Side Down)



BEAM LEAD CHIP
(24 Lead)
(Geometry Side Down)

MAXIMUM RATINGS

Rating	Value	Unit
Power Supply Voltage	7.0	Vdc
Input Voltage	5.5	Vdc
Operating Temperature Range	-55 to +125	°C
Storage Temperature Range	-65 to +150	°C

FUNCTIONS AND CHARACTERISTICS (V_{CC} = 5.0 V, T_A = 25°C)

Function	Type Chip -55°C to +125°C	Loading Factor Each Output	Propagation Delay ns typ	Power Dissipation mW typ/pkg	Number of Beams
Quad 2-Input NAND Gate	MCBC5400	10	10	40	14
Quad 2-Input NAND Gate (Open Collector Output)	MCBC5401	10	35	40	14
Quad 2-Input NOR Gate	MCBC5402	10	10	48	16
Hex Inverter	MCBC5404	10	13	60	16
Hex Inverter (Open Collector)	MCBC5405	10	35	60	16
Triple 3-Input NAND Gate	MCBC5410	10	10	30	14
Dual 4-Input NAND Gate	MCBC5420	10	10	20	12
8-Input NAND Gate	MCBC5430	10	10	10	12
Dual 4-Input NAND Buffer	MCBC5440	30	13	50	14
Expandable Dual 2-Wide 2-Input AND-OR-INVERT Gate	MCBC5450	10	13	28	14
Dual 2-Wide 2-Input AND-OR-INVERT Gate	MCBC5451	10	13	28	14
Expandable 4-Wide 2-Input AND-OR-Invert Gate	MCBC5453 MCBC5454	10	13	22	14
4-Wide 2-Input AND-OR-Invert Gate	MCBC5454	10	13	22	14
Dual 4-Input Expander for AND-OR-INVERT Gate	MCBC5460	–	5.0	8.0	14
J-K Flip-Flop	MCBC5472	10	30	40	16
Dual J-K Flip-Flop	MCBC5473	10	30	80	24
Dual Type D Flip-Flop	MCBC5479	10	16	84	24

MTTL

Dielectrically Isolated INTEGRATED CIRCUITS

MTTL

MCE54H00 Series, MCE5400 Series (-55 to +125°C)
MCE74H00 Series, MCE7400 Series (0 to +70°C)

The Dielectrically Isolated Integrated Circuit (DIIC) MTTL family is designed specifically for use in military and space applications that require a high degree of reliability under severe radiation environments and post irradiation operation. The MTTL DIIC family utilizes nichrome resistors, post metalization passivation, monometallic interconnections, and very small high frequency transistor structures to enhance the radiation resistant qualities of this line.

F SUFFIX
CERAMIC PACKAGE
CASE 607

FUNCTIONS AND CHARACTERISTICS (V_{CC} = 5.0 V, T_A = 25°C)

Function	MCE54H00/74H00 Series Type		Loading Factor Each Output	Propagation Delay ns typ	Power Dissipation m/W typ/pkg
	-55 to +125°C	0 to +70°C			
Quad 2-Input NAND Gate	MCE54H00	MCE74H00	10	6.0	80
Quad 2-Input NAND Gate (Open Collector Output)	MCE54H01	MCE74H01	10	8.0	80
Hex Inverter	MCE54H04	MCE74H04	10	6.0	120
Triple 3-Input NAND Gate	MCE54H10	MCE74H10	10	6.0	60
Dual 4-Input NAND Gate	MCE54H20	MCE74H20	10	6.0	40
11-Input NAND Gate	MCE54H31	MCE74H31	10	9.0	20
Dual 4-Input NAND Power Gate	MCE54H40	MCE74H40	30	6.0	80
Dual 2-Wide 2-Input AND-OR-INVERT Gate	MCE54H51	MCE74H51	10	6.0	58
4-Wide 2-Input AND-OR-INVERT Gate	MCE54H54A	MCE74H54A	10	6.0	40
Dual 2-Wide 2-3-Input AND-OR-INVERT Gate	MCE54H56	MCE74H56	10	6.0	58
4-Wide 3-3-2-3-Input AND-OR-INVERT Gate	MCE54H57	MCE74H57	10	6.0	40
Dual Type D Flip-Flop	MCE54H79	MCE74H79	10	16	140
Binary To One-Of-Eight Line Decoder	MCE54H146	MCE74H146	10	–	130
	MCE5400/7400 Series Type				
	-55 to +125°C	0 to +70°C			
Dual J-K Flip-Flop	MCE54103	MCE74103	10	8.0	100

NETWORKS

Dielectrically Isolated INTEGRATED CIRCUITS

NETWORKS

MCE7000 SERIES (0° to +100°C)

The MCE7000 series uses a dielectric isolation instead of the usual junction isolation to combat the effects of gamma radiation. Each component is isolated by a high resistance (10^{10} ohms) layer of SiO_2. Dielectric isolation also lowers inter-component capacitance and improves efficiency.

F SUFFIX
CERAMIC PACKAGE
CASE 606
TO-91

F SUFFIX
CERAMIC PACKAGE
CASE 607

Function	Type	Power Dissipation mW typ/pkg	Case
Seven-Diode Array	MCE7003	–	607
Diode-Resistor Network	MCE7005	20*	606
Sixteen-Diode Array	MCE7006	–	606
Twelve-Resistor Network	MCE7007	97	607

*100 Ω resistor.

Dielectrically Isolated INTEGRATED CIRCUITS

MDTL

MCE930 Series (−55 to +125°)

The Dielectrically Isolated MDTL family is intended for use in military and space applications that require a high degree of reliability under severe radiation environments. In addition to dielectric isolation, this family of devices utilizes nichrome resistors throughout. A post-metalization passivation process further enhances the radiation resistance qualities of the family and very small high frequency transistor structures are used throughout.

Dielectrically Isolated MDTL has the same electrical specifications as the MC930 family and may be used interchangeably with it. This eliminates the need for redesigning existing equipment to gain radiation-resistance and allows the design engineer to utilize a familiar logic type for new systems.

MAXIMUM RATINGS

Rating	Value	Unit
Supply Voltage – Continuous Pulsed, < 1 second	8.0 12	Vdc
Output Current (into outputs) – Buffers, Power Gates – Continuous Pulsed, < 30 ms All other types	 150 300 30	mAdc
Input Forward Current	-10	mAdc
Input Reverse Current – Buffers, Power Gates All other types	 5.0 1.0	mAdc
Operating Temperature Range – MCE930 Series	 -55 to +125	°C
Storage Temperature Range	-65 to +150	°C

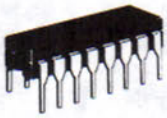
F SUFFIX
CERAMIC PACKAGE
CASE 607
TO-86

FUNCTIONS AND CHARACTERISTICS (V_{CC} = 5.0 Vdc, T_A = 25°C)

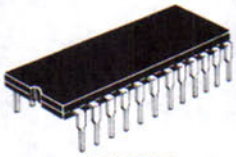
Function	Type Case 607 -55 to +125°C	Loading Factor Each Output	Power Dissipation mW typ/pkg
Expandable Dual 4-Input NAND Gate	MCE930	8.0	22
Expandable Dual 4-Input Buffer	MCE932	25	85
Dual 4-Input Expander	MCE933	–	–
Hex Inverter	MCE936	8	66
Expandable Dual 4-Input NAND Power Gate	MCE944	27	65
Clocked Flip-Flop	MCE945	10	60
Quad 2-Input NAND Gate	MCE946	8	44
Clocked Flip-Flop	MCE948	9.0	70
Triple 3-Input NAND Gate	MCE962	8.0	33

SPECIAL BIPOLAR LOGIC PRODUCTS for *CUSTOM* APPLICATIONS

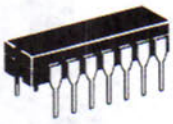
F SUFFIX
CERAMIC PACKAGE
CASE 607



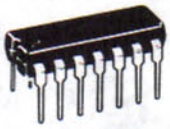
L SUFFIX
CERAMIC PACKAGE
CASE 620



L SUFFIX
CERAMIC PACKAGE
CASE 623

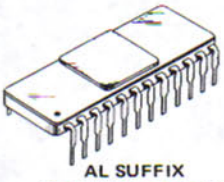


L SUFFIX
CERAMIC PACKAGE
CASE 632

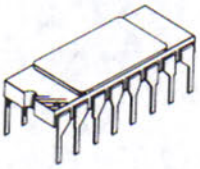


P SUFFIX
PLASTIC PACKAGE
CASE 646

P SUFFIX
PLASTIC PACKAGE
CASE 648



AL SUFFIX
CERAMIC PACKAGE
CASE 684



AL SUFFIX
CERAMIC PACKAGE
CASE 690

(Additional mask-programmable memories are in the MOS device listing.)

Function	Type	Temperature	Case	Comments
128-Bit Read Only Memory (Formerly XC170,171)	MCM4000L,P	0 to +75°C	620,648	Bipolar read only memory organized as 16 eight-bit words. Compatible with MDTL and all MTTL lines. Open collectors or 2.0 kilohm pullup resistors at buffered output bit lines. Truth table and output option specified by user.
	MCM4300L	-55 to +125°C	620	
256-Bit Read Only Memory	MCM4002L,P	0 to +75°C	620,648	Bipolar read only memory organized as 32 eight-bit words. Compatible with MDTL and all MTTL lines. Open collectors or 2.0 kilohm pullup resistors at buffered output bit lines. Truth table and output option specified by user.
	MCM4302L	-55 to +125°C	620	
512-Bit Read Only Memory	MCM4003AL,L	0 to +75°C	684,623	Bipolar read only memory organized as 64 eight-bit words. Compatible with MDTL and all MTTL lines. Open collectors or 2.0 kilohm pullup resistors at buffered output bit lines. Truth table and output option specified by user.
	MCM4303AL,L	-55 to +125°C	684,623	
1024-Bit Read Only Memory*	MCM4004AL,L	0 to +70°C	690,620	Bipolar read only memory organized as 256 four-bit words. Input loading of -0.25 mA maximum. Typical address time of 50 ns, typical chip select time of 25 ns. Open collectors or 2.0 kilohm pullup resistors at output bit lines. Truth table and output option specified by user.
	MCM4304AL,L	-55 to +125°C	690,620	
512-Bit Programmable Read Only Memory	MCM5003AL,L	0 to +70°C	684,623	Bipolar programmable read only memory organized as 64 eight-bit words. Field programmable by "blowing" appropriate nichrome resistors to break metalization links. Ninth bit available for circuit testing. Open collector outputs.
	MCM5303AL,L	-55 to +125°C	684,623	
512-Bit Programmable Read Only Memory	MCM5004AL,L	0 to +70°C	684,623	Same as MCM5003AL except 2.0 kilohm pullup resistors on the collector outputs.
	MCM5304AL,L	-55 to +125°C	684,623	
25 Gate Array	XC177	-55 to +125°C	607,632	Twenty-five gates with two custom layers of metalization required to complete the circuit and obtain the desired function. Compatible with MDTL and all MTTL lines.
		0 to +75°C	646,632, 646,648	

*Standard options of the MCM4004 are available as MCM4067 and MCM4068 Binary-to-BCD Number Converters and MCM4069 and MCM4070 Hollerith-to-ASCII Converters.

LINEAR
INTEGRATED CIRCUITS

LINEAR INTEGRATED CIRCUITS

Linear products include circuits used in consumer, industrial and interface applications. These products are available in a variety of package styles and in chip form.

Consumer devices designed principally for entertainment use, i.e., television, audio, radio, automotive, and organ applications.

Industrial products fill important roles in process control, instrumentation, and signal processing functions.

Interface components span the gap between analog information and digital processing. This category is highlighted at Motorola by the number of new monolithic D/A and A/D converters.

TABLE OF CONTENTS

Chips listed are stock chips. For availability of chips for other products, contact your Motorola sales representative.

SEE POPULAR PRO-ELECTRON DEVICES TYPES SECTION 8

INTERFACE CIRCUITS

Interface is the generic term applied to a wide variety of circuit functions which do not conveniently fit into either the Linear (analog) or Digital realms. Often these devices possess both Linear and Digital circuitry and performance parameters. The following pages include applications for Linear Interface Integrated Circuits.

MEMORY INTERFACE

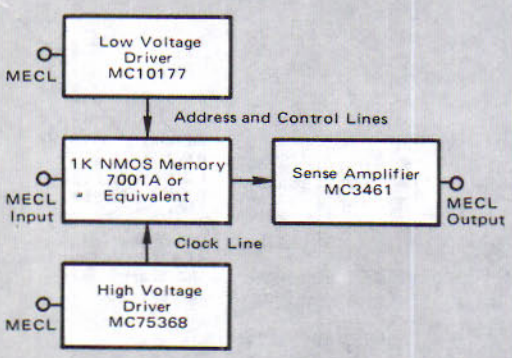
Both NMOS and magnetic memory systems require interface functions.

NMOS Memory

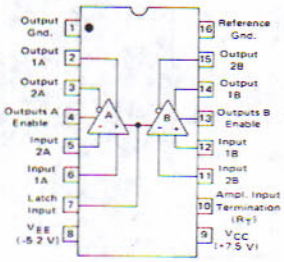
Probably nowhere else has semiconductor technology achieved greater complexities and higher circuit densities in practical, real-world products than in today's advanced NMOS memories. These devices permit greater memory capacity per unit volume and lower costs per bit than imaginable only a few years ago.

However, these memory ICs do not function alone. As an approximate rule of thumb, for each three memory packages in a typical system, one package of support interface circuitry is required. Some memory ICs require only low-voltage ADDRESS and CONTROL line drivers and higher-voltage CLOCK drivers. Other types require a sense amplifier in addition to the drivers.

1K NMOS MEMORIES For MECL Systems. . .
7001A



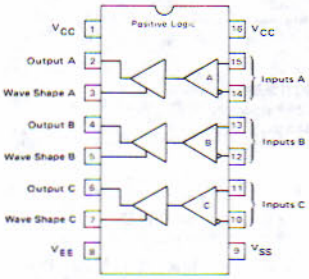
Due to its inherent speed, many of the 7001A 1K NMOS RAMs will be configured into MECL systems.



MC3461
0 to 70°C
L Suffix — Case 620

Dual 7001 to MECL 10,000 Sense Amplifier with latches. No external components required.

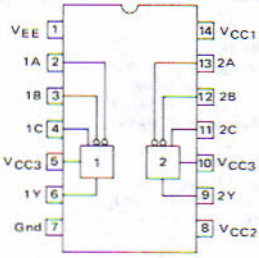
I_{IH} μA Max	t_{PD} (Amplifier) ns Max	t_{PD} (Enable) ns Max
±200	10	5.0



MC10177
−30 to 85°C
L Suffix — Case 620

Triple MECL input Address Line Driver for 1K or 4K RAMs.

V_{OH} @ I_{OH} = −15 mA Volts Min	V_{OL} @ I_{OL} = 1.0 mA Volts Max	$t_{DLH/DHL}$ @ C_L = 350 pF ns Typ
4.0	0.5	6.0



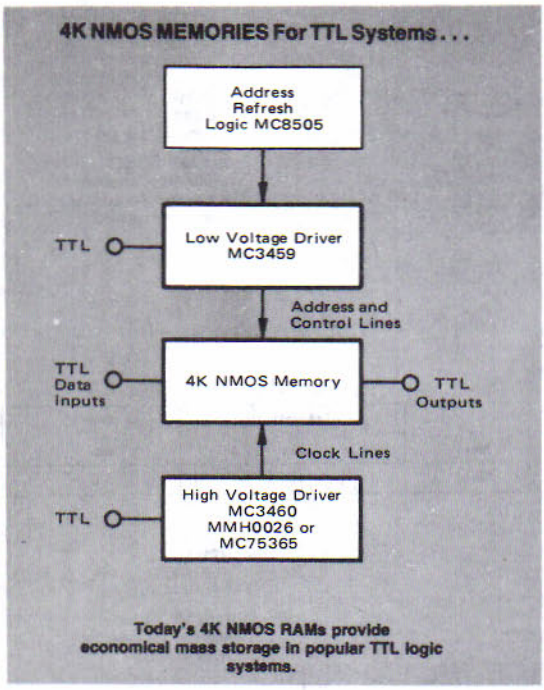
MC75368 **MC75358**
0 to 70°C
L Suffix — Case 632
P Suffix — Case 646

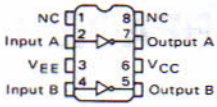
CHIP Enable driver with MECL compatible inputs.

Maximum Supply Voltage = 18V

Maximum Supply Voltage = 22 V

V_{OH} @ I_{OH} = −100 μA Volts Min	V_{OL} @ I_{OL} = 10 mA Volts Max	t_{DLH} @ C_L = 390 pF ns Max
V_{CC} − 3.0	0.2	24





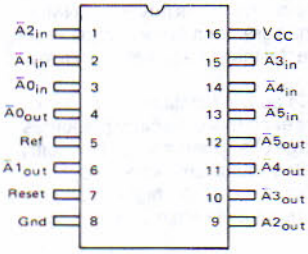
MMH0026
−55 to 125°C
G Suffix — Case 601
L Suffix — Case 632

MMH0026C
0 to 85°C
L Suffix — Case 632
G Suffix — Case 601
P1 Suffix —Case 626

Pin Connections for P1 Package

Drivers for extremely heavy capacitive loading (to 1000 pF).

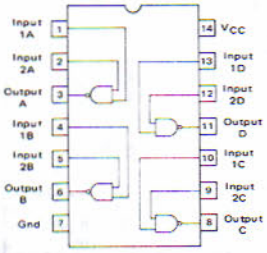
V_{OL} @ $V_I - V_{EE}$ = 0.4 V Volts Min	V_{OL} @ $V_I - V_{EE}$ = 2.5 V Volts Max	t_{PHL} @ C_L = 1000 pF ns Max
V_{CC} − 1.0	V_{EE} + 0.5 V	12



MC8505
0 to 70°C
L Suffix — Case 620
P Suffix — Case 648

LSI Refresh logic circuit for 4K dynamic RAMs

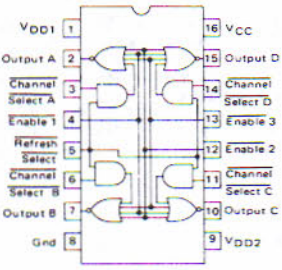
V_{OH} @ I_O = −300 μA Volts Min	V_{OL} @ I_O = 3.2 mA Volts Max	t_{PD} (ADDRESS) ns Max	t_{PD} (REFRESH) ns Max
2.4	0.5	80	145



MC3459
0 to 70°C
L Suffix — Case 632
P Suffix — Case 646

Low Voltage (+5 V) Address Line Driver on popular 1K and 4K NMOS RAMs

V_{OH} @ I_{OH} = −2.0 mA Volts Min	V_{OL} @ I_{OL} = 80 mA Volts Max	t_{PLH} @ C_L = 360 pF ns Max
2.4	0.7	26

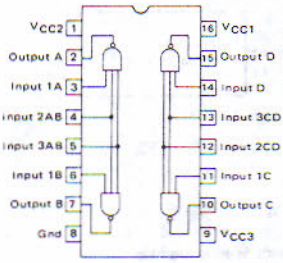


MC3460
Higher voltage (+12 V) CHIP Enable Driver incorporates REFRESH function for 4K RAMs.

MC3466
CHIP Enable Driver specifically guaranteed for 7001 1K RAMs.

0 to 70°C
L Suffix — Case 620
P Suffix — Case 648

V_{OH} @ I_{OH} = −2.0 mA Volts Min	V_{OL} @ I_{OL} = 40 mA Volts Max	t_{DLH} @ C_L = 480 pF ns Max
V_{DD} − 1.0	0.55	23



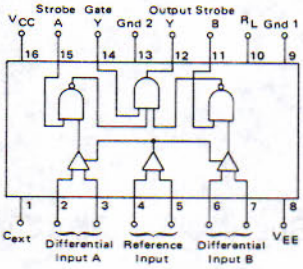
MC75365
0 to 70°C
L Suffix — Case 620
P Suffix — Rase 648

CHIP Enable driver for either 4K or 1K RAMs. Differs from MC3460 by not providing REFRESH Input.

V_{OH} @ I_{OH} = −100 μA Volts Min	V_{OL} @ I_{OL} = 10 mA Volts Max	t_{DLH} @ C_L = 200 pF ns Max
V_{CC} − 0.3	0.3	20

Magnetic Memory

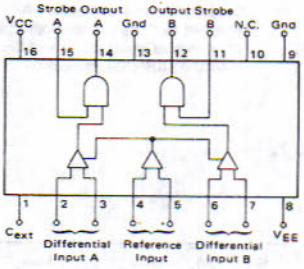
Sense Amplifiers



MC5522
MC5523
−55 to 125°C
L Suffix — Case 620

MC7522
MC7523
0 to 70°C
L Suffix — Case 620

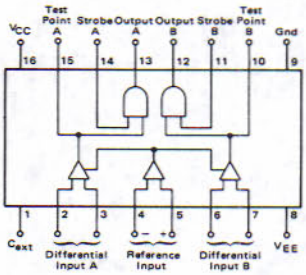
Dual channel with open-collector output, high sink current capability



MC5524
MC5525
−55 to 125°C
L Suffix — Case 620

MC7524
MC7525
0 to 70°C

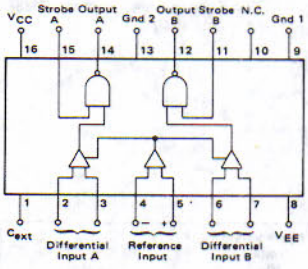
Dual with Independent Strobing
L Suffix — Case 620
P Suffix — Case 648



MC5528
MC5529
−55 to 125°C
L Suffix — Case 620

MC7528
MC7529
0 to 70°C
L Suffix — Case 620
P Suffix — Case 648

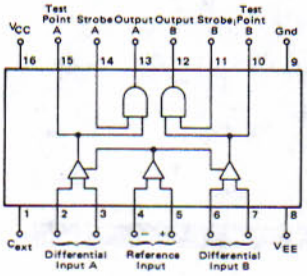
Same as MC7524, 25 except amplifier test points included



MC5534
MC5535
−55 to 125°C
L Suffix — Case 620

MC7534
MC7535
0 to 70°C
L Suffix — Case 620
P Suffix — Case 648

Same as MC7524, 25 except NAND outputs

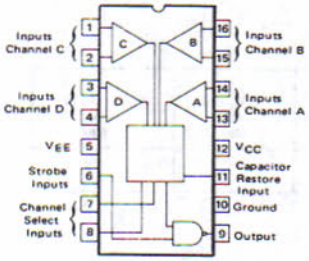


MC5538
MC5539
−55 to 125°C
L Suffix — Case 620

MC7538
MC7539
0 to 70°C
L Suffix — Case 620
P Suffix — Case 648

Same as MC7528, 29 except NAND outputs

	MC5522 MC5524 MC5528 MC5534 MC5538	MC5523 MC5525 MC5529 MC5535 MC5539	MC7522 MC7524 MC7528 MC7534 MC7538	MC7523 MC7525 MC7529 MC7535 MC7539
V_{TH} @ V_{REF} = 15 mV =	10 to 20 mV	8 to 22 mV	11 to 19 mV	8 to 22 mV
V_{TH} @ V_{REF} = 40 mV	35 to 45 mV	33 to 47 mV	36 to 44 mV	33 to 47 mV
Max I_{IB} =	100 μA	100 μA	75 μA	75 μA
Max t_{PLH} @ C_L = 15 pF =	40 ns	40 ns	40 ns	40 ns



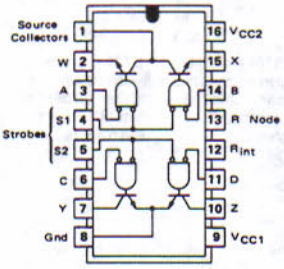
MC1544
−55 to 125°C
L Suffix — Case 620
F Suffix — Case 650

MC1444
0 to 70°C
L Suffix — Case 620

AC-coupled, decoded input channel selection, wired-OR output strobe capability, +5.0 V, −6.0 V power supply.

Device Number	V_{TH} mV	V_{OH} @ I_{OH} = −400 μA Volts Min	V_{OL} @ I_{OL} = 10 mA Volts Max	t_{PD} ns Max
MC1544	0.5 to 1.5	2.4	0.5	25
MC1444	0.3 to 2.3	2.4	0.5	25

Core Driver



MC55325
−55 to 125°C
L Suffix — Case 620
F Suffix — Case 650

MC75325
0 to 70°C
L Suffix — Case 620
P Suffix — Case 648

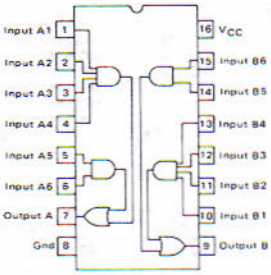
Dual Memory Driver with logic inputs, 24-Volt output capability.

Device Number	V_{sat} @ I_{sink} or I_{source} = 600 mA Volts Max	I_{off} @ V_{CC2} = 24 V μA Max	t_{PLH} (Source) ns Max	t_{PLH} (Sink) ns Max
MC55325	0.70	150	50	45
MC75325	0.75	200	50	45

BUS INTERFACE

Several popular bus formats have been established to allow compatibility of equipment regardless of manufacturer.

Computer Bus



MC8T13

MC8T13 is a dual open emitter driver. Specified for general TTL systems.

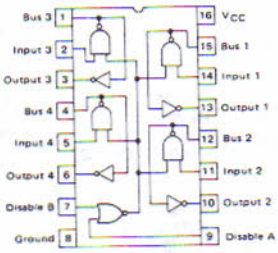
MC8T23

0 to 75°C
L Suffix — Case 620
P Suffix — Case 648

MC8T23 is a dual open emitter driver. Specified to meet IBM System requirements.

Device Number	V_{OH} @ I_{OH} = −75 mA @ I_{OH} = −59.3 mA* Volts Max	I_{CS} @ V_O = 0 mA Max	t_{PLH} @ C_L = 15 pF ns Max
MC8T13	2.4	−30	20
MC8T23	3.11*	−30	20

Minicomputer Bus

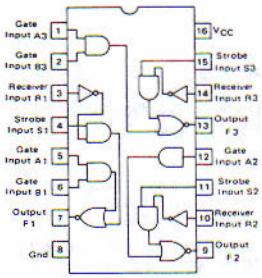


MC3438

0 to 70°C
L Suffix — Case 620
P Suffix — Case 648

Quad Transceivers with hysteresis-equipped receivers and open-collector driver outputs which permit wire-OR connection (DM8838 equivalent).

Receiver Hysteresis Volts Min	$V_{I(BUS)}$ @ I_{BUS} = 50 mA Volts Max	I_{BUS} @ $V_{I(BUS)}$ = 4.0 V μA Max	$t_{PLH(D)}$ @ C_L = 15 pF ns Max	$t_{PLH(R)}$ @ C_L = 15 pF ns Max
0.25	0.7	100	25	30



MC8T14

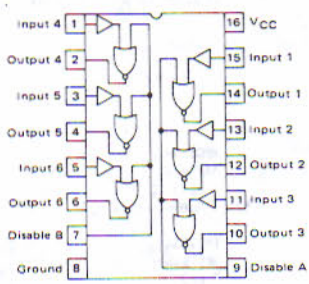
MC8T14 is a triple-hysteresis-equipped receiver. Specified for general TTL Systems.

MC8T24

0 to 70°C
L Suffix — Case 620
P Suffix — Case 648

MCT24 is a triple hysteresis-equipped receiver specified to meet IBM System requirements.

Device Number	$V_{H(R)}$ Volts Min	$I_{IH(R)}$ @ $V_{IH(R)}$ = 3.8 V @ $V_{IH(R)}$ = 3.11 V* mA Max	$t_{PLH(R)}$ @ C_L = 15 pF ns Max
MC8T14	0.3	0.17	30
MC8T24	0.2	0.17*	30



MC3437

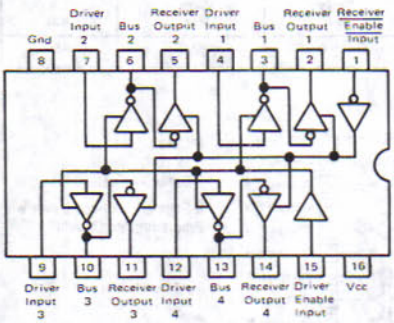
0 to 70°C
L Suffix — Case 620
P Suffix — Case 648

Hex Receivers with Hysteresis for improved noise immunity (DM8837 equivalent)

$I_{I(R)}$ @ $V_{I(R)}$ = 4.0 V μA Max	Hysteresis Volts Min	$t_{PLH(R)}$ @ C_L = 15 pF ns Max
50	0.5	30

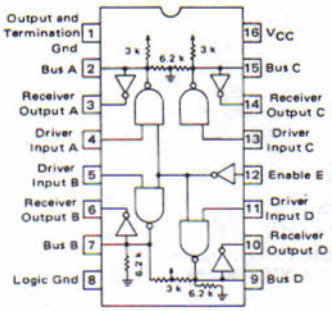
Microprocessor Bus

The revolutionary "Computer on a Chip" is another bus organized system. The requirements on the microprocessor bus are especially stringent. Generally, microprocessors (MPUs) are fabricated utilizing MOS technology with its attendant high circuit density characteristics. However, MOS structures become unduly large when it is necessary to conduct large amounts of current. Therefore it is necessary that each of the elements attached to the MPU bus require minimal load current. Most MPU systems can tolerate a total loading equal to only about one conventional TTL load.

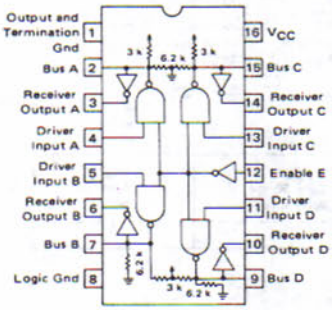


MC8T26/MC6880
0 to +75°C
L Suffix — Case 620
P Suffix — Case 648
Quad three-state bus transceiver

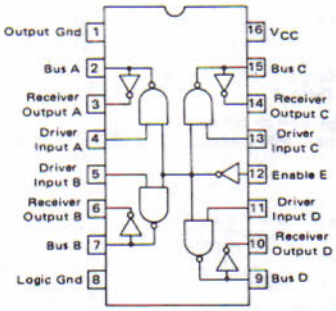
I_{IH} and I_{IL} Input Current (Either Logic State) μA	I_{OHL} Output Disabled Leakage Current — High Logic State Max μA	t_{PLH}, t_{PHL} Propagation Delay Time — High to Low or Low to High ns Max
200	100	17



MC3440
0 to 70°C
P Suffix — Case 648
Quad Transistors with 3 Drivers Sharing a Common Enable Input
R1 = 3.0 k (to V_{CC})
R2 = 6.2 k (to Gnd)



MC3441
0 to 70°C
P Suffix —Case 648
Quad Transceivers with all four drivers controlled by a Common-Enable Input
R1 = 3.0 k (to V_{CC})
R2 = 6.2 k (to Gnd)



MC3443
0 to 70°C
P Suffix — Case 648
Quad Transistors without termination resistors. Functional equivalent to 75138

Instrumentation Bus

Steps toward standardization of the instrumentation interface bus have been made by the International Electrotechnical Commission (IEC) and the IEEE with Standard 488-1975. Acceptance of these standards will permit interconnection of many types of measurement apparatus, manufactured by numerous firms, into complex systems simply by plugging in connecting cables.

Device Number	Receiver Input Hysteresis mV Min	Drive Output Voltage @ I_{OL} = 48 mA; Volts Max	Bus Divider Voltage Volts	t_{PHL} (Driver or Receiver) ns Max
MC3440	400	0.4	2.6 to 3.75	30
MC3441	400	0.4	2.6 to 3.75	30
MC3443	400	0.4	—	25(D) 22(R)

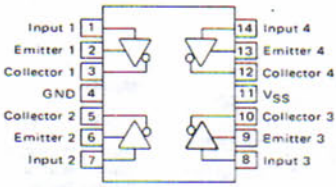
INSTRUMENTATION INTERFACE

Digital techniques are rapidly invading instrumentation systems.

Numeric Display Interface

MC75491
0 to 70°C
L Suffix — Case 632
P Suffix — Case 646

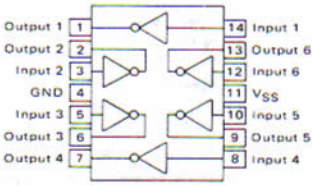
Quad LED Segment Driver for common-cathode displays. MOS compatible inputs.



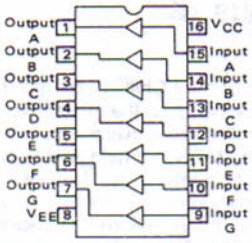
I_i @ V_i = 10 V mA Max	V_{CE} @ I_{CE} = 50 mA Volts Max	V_{SS} Volts Max
3.3	1.2	10

MC75492
0 to 70°C
L Suffix — Case 632
P Suffix — Case 646

Hex LED Digit Driver for common-cathode displays. MOS compatible inputs.



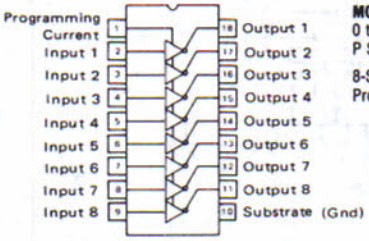
I_i @ V_i = 10 V mA Max	V_{OL} @ I_{OL} = 250 mA Volts Max	V_{SS} Volts Max
3.3	1.2	10



MC3490
0 to 70°C
P Suffix — Case 648

7-Digit Anode Driver with High Logic Level Input Required for Activation

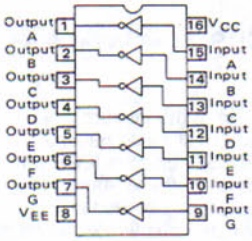
Breakdown Voltage Volts Min	Input Voltage (OFF-State) Volts Min	Input Voltage (ON-State) Volts Max	Input Current μA Max
48	−5.0	−2.0	450



MC3491
0 to 70°C
P Suffix — Case 701

8-Segment Cathode Driver with Programmable Current

Breakdown Voltage Volts Min	Current Deviation (All 8 Outputs) % Max	Output Current Compliance Voltage Volts Range
80	10	5.0 to 50

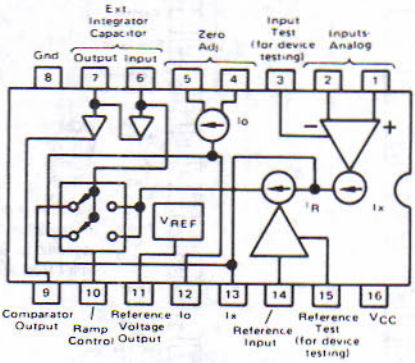


MC3494
0 to 70°C
P Suffix — Case 648

7-Digit Anode Driver with Low Logic Level Input Required for Activation

Breakdown Voltage Volts Min	Input Voltage (OFF-State) Volts Max	Input Voltage (ON-State) Volts Min	Input Current μA Max
48	−2.0	−5.0	−350

A/D-D/A Conversion

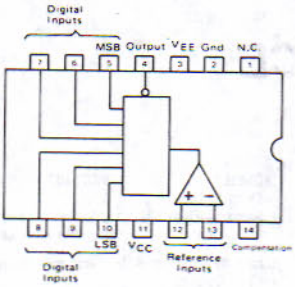


MC1505
−55 to 135°C
L Suffix — Case 620

MC1405
0 to 70°C
L Suffix — Case 620

A dual ramp subsystem which can provide accuracies to 4½ BCD digits or 13 binary bits. May be used with McMOS or MTTL logic systems. Mates with MC14435 for complete 3½ BCD Converter function.

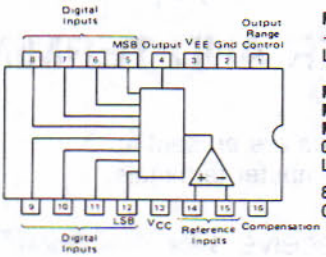
Linearity Error % Max	Voltage Reference Volts	Temperature Coefficient of Reference %/°C	I_{CC} @ V_{CC} = 5.0 V mA Max
±0.05	1.15 to 1.35	0.005	12



MC1506
−55 to 125°C
L Suffix — Case 632

MC1406
0 to 70°C
L Suffix — Case 632

6-Bit Multiplying Digital-to-Analog Converters



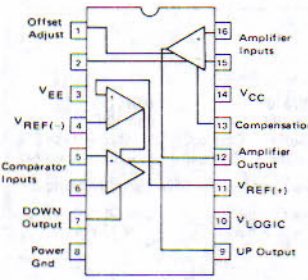
MC1508L8
−55 to 125°C
L Suffix — Case 620

MC1408L8
MC1408L7
MC1408L6
0 to 70°C
L Suffix — Case 620

8-Bit Multiplying Digital-to-Analog Converters

Accuracy % Min	t_{PHL}, t_{PLH} ns Max	Output Current @ V_{EE} = −5.0 V mA Range	P_D @ V_{EE} = −5.0 V mW Max
±0.78	50	0 to 2.1	1.2

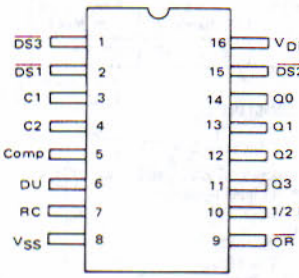
Device Number	Accuracy % Min	Output Current @ V_{REF} = 2.0 V mA Range	P_D @ V_{EE} = −5.0 V mW Max
MC1508L8	±0.19	1.9 to 2.1	170
MC1408L8	±0.19	1.9 to 2.1	170
MC1408L7	±0.39	1.9 to 2.1	170
MC1408L6	±0.78	1.9 to 2.1	170



MC1507
−55 to 125°C
L Suffix — Case 620

MC1407
0 to 70°C
L Suffix — Case 620

MC1507/MC1407 — Tracking or Successive Approximation A/D Subsystem consisting of a high slew rate operational amplifier and an adjustable dual threshold comparator.



MC14435
−55 to 125°C
MC14435EFL — L-Suffix Case 620
MC14435EVL — L-Suffix Case 620

−40 to 85°C
MC14435FL — L-Suffix Case 620
MC14435FP — P-Suffix Case 648
MC14435VL — L-Suffix Case 620
MC14435VP — P-Suffix Case 648

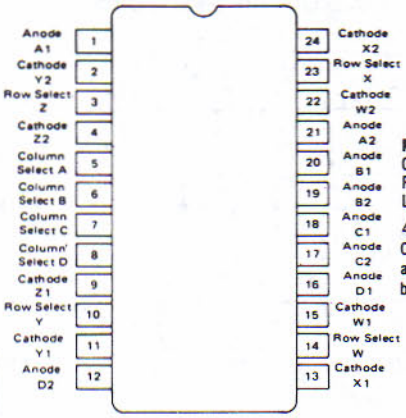
3½ Digit BCD Subsystem for Mating with the MC1505

Device Number	V_{IO} Amplifier mV Max	I_{IB} Amplifier μA Max	Comparator V_{TH} @ V_{REF} = 40 mV mV Range	Comparator V_{IB} mV Range	Comparator I_{sink} mA Min
MC1507	2.0	1.5	±36 to ±44	−150 to +320	3.2
MC1407	6.0	2.5	±30 to ±50	−150 to +320	3.2

$P_{Quiescent}$ @ V_{DD} = 5.0 V mW Max	I_{OL} @ V_{DD} = 5.0 V (Digit Selects) mA Min	I_{OL} @ V_{DD} = 5.0 V (BCD Outputs) mA Min	I_{OL} @ V_{DD} = 5.0 V (All Outputs) mA Min
1.75	1.6	1.6	−0.2

COMMUNICATION INTERFACE

Low-cost solid-state crosspoint switches offer important advantages in modern telephone exchanges.



MC3416
0 to 70°C
P Suffix — Case 649
L Suffix — Case 623

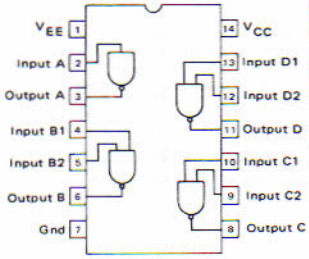
4 x 4 two-wire monolithic Crosspoint Switch for PABX applications. Select inputs are both CMOS and TTL compatible.

r_{off} @ V_{AK} = 10 V MΩ Min	r_{on} @ I_{AK} = 20 mA Ohms Max	BV_{AK} BV_{KA} Volts Min	V_{AK} @ I_{AK} = 20 mA Volts Max
100	10	25	1.1

COMPUTER AND TERMINAL INTERFACE

Important interfaces are present in computers and computer terminals.

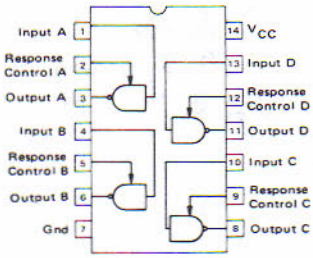
Drivers and Receivers



MC1488
0 to 70°C
L Suffix — Case 632

Quad RS-232C Driver with Output Current Limiting

V_{OH} @ V_{CC}/V_{EE} = ±9.0 V Volts Min	V_{OL} @ V_{CC}/V_{EE} = ±9.0 V Volts Max	I_{OS} mA Range	t_{PHL} @ C_L = 15 pF ns Max
6.0	−6.0	±6.0 to 12	175



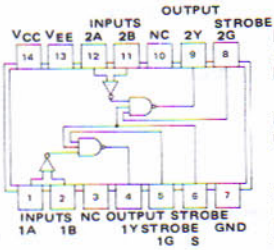
MC1489
0 to 70°C
L Suffix — Case 632

Quad RS-232C Receiver with 0.25 V of Input Hysteresis

MC1489A
0 to 70°C
L Suffix — Case 632

Quad RS-232C Receiver with 1.1 V of Input Hysteresis

Device Number	Input V_{IHL} Volts Range	Input V_{ILH} Volts Range	t_{PHL} @ R_L = 390Ω ns Max
MC1489	1.0 to 1.5	0.75 to 1.25	50
MC1489A	1.75 to 2.25	0.75 to 1.25	50



MC55107
−55 to 125°C
L Suffix — Case 632

MC75107
0 to 70°C
L Suffix — Case 632
P Suffix — Case 646

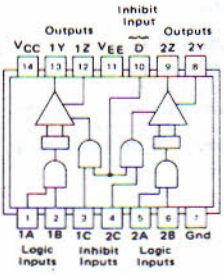
Dual Differential Input Receivers with Active Pull-up TTL Outputs

MC55108
−55 to 125°C
L Suffix — Case 632

MC75108
0 to 70°C
L Suffix — Case 632
P Suffix — Case 646

Dual Differential Input Receivers with Open-Collector Outputs

Input V_{TH} mV Max	I_{IH} @ V_{ID} = 0.5 V μA Max	I_{IL} @ V_{ID} = −2.0 V μA Max	t_{PLH} ns Max
±25	75	−10	25



MC75109
0 to 70°C
L Suffix — Case 632
P Suffix — Case 646

MC75110
0 to 70°C
L Suffix — Case 632
P Suffix — Case 646

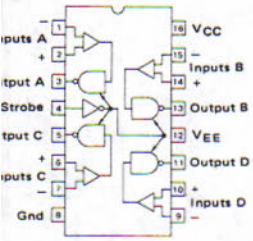
Dual Current-Mode Drivers with Inhibit Inputs

Sink Current ≈ 6.0 mA

Sink Current ≈ 12 mA

Device Number	I_{ON} (ON) mA Max	I_C (OFF) μA Max	t_{PHL} ns Max
MC75109	3.5	100	15
MC75110	6.5	100	15

DRIVERS AND RECEIVERS (continued)



MC3450
0 to 70°C
L Suffix — Case 620
P Suffix — Case 648

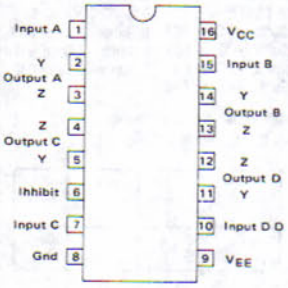
MC3452
0 to 70°C
L Suffix — Case 620
P Suffix — Case 648

Quad Differential-Input Receivers

Common Three-State Enable

Open Collector Outputs

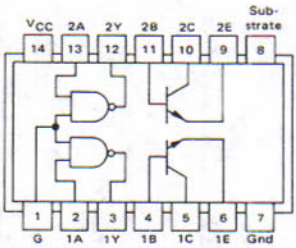
Input V_{TH} mV Max	I_{IH} @ V_{ID} = 0.5 V μA Max	I_{IL} @ V_{IL} = −2.0 V μA Max	t_{PLH} ns Max
±25	75	−10	25



MC3453
0 to 70°C
L Suffix — Case 620
P Suffix — Case 648

Quad Current-Mode Driver with Common Inhibit Input. Current Sink is Approximately 12 mA

Input V_{TH} mV Max	I_{IH} @ V_{ID} = 0.5 V μA Max	I_{IL} @ V_{IL} = −2.0 V μA Max	t_{PLH} ns Max
±25	75	−10	25



Positive Logic: Y = $\overline{AG}$ (gate only)
C = AG (gate and transistor)

MC75450
0 to 70°C
L Suffix — Case 632
P Suffix — Case 646

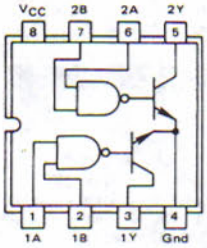
Dual Peripheral Positive AND Driver, plus two non-committed NPN output transistors.

GATE

V_{OH} @ I_{OH} = −400 μA Volts Max	V_{OL} @ I_{OL} = 16 mA Volts Max	t_{PLH} @ C_L = 15 pF ns Max
2.4	0.4	14

TRANSISTOR

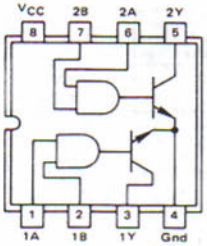
BV_{CEO} Volts Min	BV_{EBO} Volts Min	h_{FE} @ V_{CE} = 3.0 V, I_C = 300 mA Min
35	5.0	30



Positive Logic: Y = AB

MC75451
MC75461
0 to 70°C
P Suffix — Case 626
U Suffix — Case 693

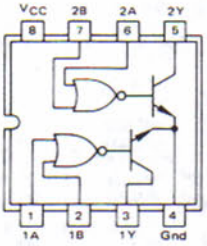
Dual Peripheral Positive AND Driver with Logic Gate Outputs Internally Connected to NPN output transistors.
V_O (max) = 30 V — MC75451
= 35 V — MC75461



Positive Logic: Y = $\overline{AB}$

MC75452
MC75462
0 to 70°C
P Suffix — Case 626
U Suffix — Case 693

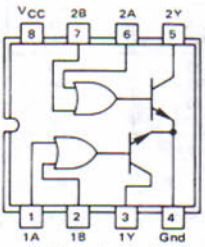
Dual Positive NAND driver with Logic Gate Outputs Internally Connected to NPN Output Transistors.
V_O(max) = 30 V — MC75452
= 35 V — MC75462



Positive Logic: Y = A + B

MC75453
MC75463
0 to 70°C
P Suffix — Case 626
U Suffix — Case 693

Dual Positive OR Driver With Logic Gate Outputs Internally Connected to NPN Output Transistors.
V_O (max) = 30 V — MC75453
= 35 V — MC75463



Positive Logic: Y = $\overline{A + B}$

MC75454
MC75464
0 to 70°C
P Suffix — Case 626
U Suffix — Case 693

Dual Positive NOR Driver with Logic Gate Output Internally Connected to NPN Output Transistors
V_O (max) = 30 V — MC75454
= 35 V MC75464

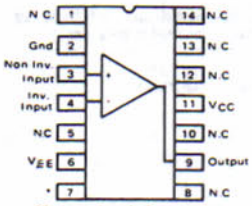
MC75451, MC75452, MC75453, MC75454

I_{OH} @ V_{OH} = 30 V μA Max	V_{OL} @ I_{OL} = 300 mA Volts Max	I_{IH} @ V_{IH} = 2.4 V μA Max	I_{IL} @ V_{IL} = 0.4 V mA Max
100	0.7	40	−1.6

MC75461, MC75462, MC75463, MC75464

I_{OH} @ V_{OH} = 35 V μA Max	V_{OH} (After Switching) @ V_{CC} = 35 V, I_O = 300 mA mV Max
100	−10

Comparators



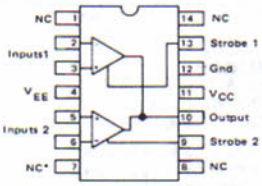
*Connected to pin 6 via the substrate on some plastic units.

MC1710C
0 to 70°C
G Suffix — Case 601
F Suffix — Case 606
L Suffix — Case 632
P Suffix — Case 646

MC1710
−55 to 125°C
G Suffix — Case 601
F Suffix — Case 606
L Suffix — Case 632

Single Comparators

Device Number	V_{IO} mV Max	I_{IB} μA Max	A_{VOL} V/V Min
MC1710C	5.0	25	1000
MC1710	2.0	20	1250



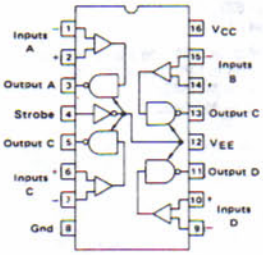
*Connected to pin 4 via the substrate on some plastic units.

MC1711C
0 to 70°C
G Suffix — Case 603
F Suffix — Case 606
L Suffix — Case 632
P Suffix — Case 646

MC1711
0 to 70°C
G Suffix — Case 603
F Suffix — Case 606
L Suffix — Case 632

Dual Comparators with Strobes, Wire-ORed Outputs

Device Number	V_{IO} mV Max	I_{IB} μA Max	A_{VOL} V/V Min
MC1711C	5.0	100	700
MC1711	3.5	75	700



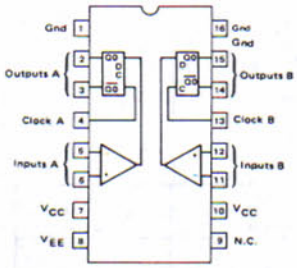
MC3430
MC3431
0 to 70°C
L Suffix — Case 620
P Suffix — Case 648

Quad High-Speed Comparators with Three-State Enable Common to all Four Devices

MC3432
MC3433
0 to 70°C
L Suffix — Case 620
P Suffix — Case 648

Quad Comparators with Open Collector Outputs, Common Strobe Input

Device Number	V_{IS} mV Max	I_{IB} μA Max	t_{PHL} ns Max
MC3430	±6.0	20	45
MC3431	±10	20	45
MC3432	±6.0	20	50
MC3433	±10	20	50

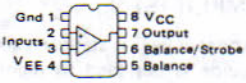


MC1650
MC1651
−30 to 85°C
L Suffix — Case 620
F Suffix — Case 650

Ultra-High Speed Dual Comparators with Latches

Device Number	V_{TH} mV Min	Common-Mode Range Volts Min	t_{PD} (Differential Inputs) ns Max	t_{PD} (Clock) ns Max
MC1650	±20	−2.5 to 3.0	5.0	4.7
MC1651	±20	−3.0 to 2.5	5.0	4.7

COMPARATORS (continued)



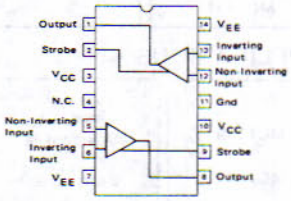
MLM111
−55 to 125°C
G Suffix — Case 601
F Suffix — Case 606
L Suffix — Case 632

MLM211
−25 to 85°C
G Suffix — Case 601
F Suffix — Case 606
L Suffix — Case 632

MLM311
0 to 70°C
G Suffix — Case 601
F Suffix — Case 606
L Suffix — Case 632
P1 Suffix — Case 626

High-Gain, High Input Impedance Comparators. May be used with single power supply. Strobe and balance inputs provided.

Device Number	V_{IO} mV Max	I_{IB} nA Max	V_{OL} @ I_{OL} = 50 mA Volts Max
MLM111	3.0	100	1.5
MLM211	3.0	100	1.5
MLM311	7.5	250	1.5

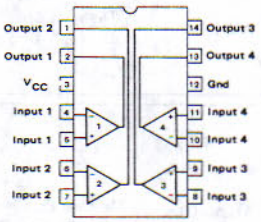


MC1514
−55 to 125°C
F Suffix — Case 607
L Suffix — Case 632

MC1414
0 to 70°C
F Suffix — Case 607
L Suffix — Case 632
P Suffix — Case 646

Dual Comparators with Strobes

Device Number	V_{IO} mV Max	I_{IB} μA Max	A_{VOL} V/V Min
MC1514	2.0	20	1250
MC1414	5.0	25	1000



MLM139
MLM139A
−55 to 125°C
L Suffix — Case 632

MC3302
MLM239
MLM239A
−40 to 85°C
L Suffix — Case 632
P Suffix — Case 646

MLM339
MLM339A
0 to 70°C
L Suffix — Case 632
P Suffix — Case 646

Quad Single Supply Voltage Comparators

Device Number	V_{IO} @ 25°C mV Max	I_{IB} @ 25°C nA Max	I_{sink} @ V_{OL} = 500 mV mA Min	V_{OL} @ I_{OL} = 2.0 mA* @ I_{OL} = 4.0 mA mV Max
MC3302	20	1000	—	400*
MLM139	5.0	100	6.0	500
MLM139A	2.0	100	6.0	500
MLM239	5.0	250	6.0	500
MLM239A	2.0	250	6.0	500
MLM339	5.0	250	6.0	500
MLM339A	2.0	250	6.0	500

OPERATIONAL AMPLIFIERS

Motorola offers a broad line of operational amplifiers to meet a wide range of usages. From low-cost, industry standard types to high precision circuits the span encompasses a large range of performance capabilities.

These linear integrated circuits are available as single, dual, and quad monolithic devices in a variety of package styles as well as standard and beam-lead chips. The following guide is designed to highlight those Motorola operational amplifiers which are recommended for new designs due to their excellent performance, lower relative cost and ready availability.

NON COMPENSATED — Gain and Frequency-Response characteristics may be optimized for specific applications through the selective addition of external compensating capacitors and resistors.

AN INDUSTRY STANDARD — MC1709

This design was among the first high-performance types on the market and still is one of the most popular. Its long history has made it among the most widely sourced unit in the industry, and the most universally available amplifier. In the largest selection of packages, at the lowest cost.

Available Variations:

Prime Device — T_A = -55 to +125°C	MC1709
Relaxed Spec. T_A = 0 to +70°C	MC1709C
Military Processed Devices Available	MC1709A
Beam Lead —	MCB1709
Duals —	
Prime Device —	MC1537
Relaxed Spec. —	MC1437

Chips:

Standard —	MCC1709 MCC1709C
Beam Lead —	MCBC1709
Flip-Chip —	MCCF1709 MCCF1709C

FOR HIGHER PERFORMANCE GENERAL-PURPOSE APPLICATIONS

MC1748

Improved version of MC1709, available at a slightly higher price. Has greater gain and slew rate, better input and output impedances and somewhat lower power dissipation.

Available Variations:

Prime Device — T_A = -55 to +125°C	MC1748
Relaxed Spec. — T_A = 0 to +75°C	MC1748C

Chips:

Standard —	MCC1748 MCC1748C
Beam Lead —	MCBC1748

MC1539

High slew rate amplifier. Also offers substantial improvement in offset current and voltage, and in frequency response. Recommended for high-performance applications at low cost.

Available Variations:

Prime Device — T_A = -55 to +125°C	MC1539
Relaxed Spec. — T_A = 0 to +75°C	MC1439

Chips:

Standard —	MCC1539 MCC1439

FOR SPECIAL APPLICATIONS

MC1520 — Differential Output

Wide-Band Amplifier, recommended primarily for those applications where differential output is an essential circuit requirement.

Available Variations:

Prime Device — T_A = -55 to +125°C	MC1520
Relaxed Spec. — T_A = 0 to +75°C	MC1420

MLM101A — Low Bias Current

High-performance amplifier, featuring exceptionally low input bias and offset currents. Limited temperature version (MLM301A) is particularly attractive as general-purpose amplifier due to low cost.

Available Variations:

Prime Device — T_A = -55 to +125°C	MLM101A
Intermediate Spec. — T_A = -25 to +85°C	MLM201A
Relaxed Spec. — T_A = 0 to +75°C	MLM301A
Military Qualification or Process Devices Available	MLM101A

ELECTRICAL SPECIFICATIONS — (Prime Devices)

Device Type	I_{IB} µA Max	V_{IO} mV Max	I_{IO} nA Max	A_{vol} V/V Min	f_c MHz Typ	BW_p kHz Typ	SR V/µs Typ	Case
MC1709	0.5	5.0	200	25 k	0.5	4.0	0.25	601, 606, 632, 693
MC1748	0.5	5.0	200	50 k	1.0	10	0.8	601, 606
MC1539	0.5	3.0	60	50 k	2.0	50	4.2	601, 632, 693
MC1520	2.0	10	100	1 k	10	150	5.0	602A, 606
MLM101A	0.075	2.0	10	50 k	1.0	10	0.5	601, 693

COMPENSATED — Internal frequency compensation adjusts roll-off to provide stable operation regardless of amount of feedback employed.

FOR GENERAL-PURPOSE APPLICATIONS

MC1741 — An Industry Standard

High-performance amplifier whose wide availability and low-cost (relaxed specification MC1741C) have made it a popular device for general-purpose amplifier applications.

Available Variations:

Prime Device — MC1741
T_A = -55 to +125°C
Relaxed Spec. — MC1741C
T_A = 0 to +75°C
Military Qualification or Process Devices Available — MC1741
Duals —
Prime Device — MC1747, MC1558
Intermediate Spec. — MC1458
Relaxed Spec. — MC1747C, MC1458C

Chips:
Standard — MCC1741, MCC1741C
Beam Lead — MCBC1741
Flip-Chip — MCCF1741, MCCF1741C, MCCF1558, MCCF1458

MC1741S — High Slew Rate

Performance similar to MC1741 except with slew rate and power bandwidth to 20 times higher. Low cost "C" version is ideal for applications where restricted temperature range is suitable.

Available Variations:

Prime Device — MC1741S
T_A = -55 to +125°C
Relaxed Spec. — MC1741SC
T_A = 0 to +75°C

MLM107 — Low Input Current

Designed for applications such as sample-and-hold circuits and long interval integrators, where improved input characteristics are needed.

Available Variations:

Prime Device — MLM107
T_A = -55 to +125°C
Intermediate Spec. — MLM207
T_A = -25 to +85°C
Relaxed Spec. — MLM307
T_A = 0 to +70°C

MC1556 — High Input Impedance

High performance amplifier featuring extremely high input impedance, high gain and a general upgrading of all other characteristics that make this device particularly suited for the most demanding overall amplifier needs.

Available Variations:

Prime Device — MC1556
T_A = -55 to +125°C
Relaxed Spec. — MC1456, MC1456C
T_A = 0 to +70°C

MC1776 — Micropower Programmable

Programmable, by means of external resistor, to optimize current, voltage and noise characteristics. Operates over ±1.2 to ±18 Volt power supply range, with microwatt power dissipation at the lower supply voltages.

Available Variations:

Prime Device — MC1776
T_A = -55 to +125°C
Relaxed Spec. — MC1776C
T_A = 0 to +70°C
Low Cost Version — MC3476
T_A = 0 to +70°C

SPECIAL FEATURES AMPLIFIERS

MLM110 — Unity Gain Follower

For voltage follower purposes in highly critical instrumentation applications.

Available Variations:

Prime Device — MLM110
T_A = -55 to +125°C
Intermediate Spec. — MLM210
T_A = -25 to +85°C
Relaxed Spec. — MLM310
T_A = 0 to +70°C

MC1536 — High Output Voltage

High gain amplifier with maximum supply voltage to ±40 volts, for extremely wide output voltage swing.

Available Variations:

Prime Device — MC1536
T_A = -55 to +125°C
Relaxed Spec. — MC1436, MC1436C
T_A = 0 to +75°C

Chips:
Standard — MCC1536, MCC1436

MC1538 — Power Booster

Designed as high current gain amplifiers, with unity voltage gain. Can deliver load currents to ±300 mA, for driving low impedance loads.

Available Variations:

Prime Device — MC1538
T_A = -55 to +125°C
Relaxed Spec. — MC1438
T_A = 0 to +75°C

ELECTRICAL SPECIFICATIONS — (Prime Devices)

Device Type	I_{IB} μA Max	V_{IO} mV Max	I_{IO} nA Max	A_{vol} V/V Min	f_c MHz Typ	BW_p kHz Typ	SR V/μs Typ	Case
MC1741	0.5	5.0	200	50 k	1.0	10	0.8	601, 606, 632, 693
MC1741S	0.5	5.0	200	50 k	1.0	200	15	601, 693
MLM107	0.075	2.0	10	50 k	1.0	10	0.5	601
MC1556	0.015	4.0	2.0	100 k	1.0	40	2.5	601, 632, 693
MC1776	0.0075	5.0	3.0	200 k	0.2	1.5	0.1	601
MLM110	0.003	4.0	—	Unity	20	300	30	601, 693
MC1536	0.02	5.0	3.0	100 k	1.0	23	2.0	601, 693
MC1538	200	—	—	900	—	1500	75	614

MULTIPLE OPERATIONAL AMPLIFIERS

Dual and Quad operational amplifiers for space and cost savings in applications requiring more than one amplifier.

DUAL OPERATIONAL AMPLIFIERS

MC1537 – NON COMPENSATED

Dual equivalent of the highly popular MC1709.

Available Variations:

Prime Device – MC1537
T_A = -55 to +125°C
Relaxed Spec. – MC1437
T_A = 0 to +75°C

MC1558, MC1747 – COMPENSATED

Dual equivalents of the highly popular MC1741. The two devices and their "variations" differ principally in pin configurations.

Available Variations:

Prime Device – MC1558
T_A = -55 to +125°C
Relaxed Spec. – MC1458
T_A = 0 to +75°C MC1458C

Chips:

Standard – MCC1558
MCC1458
Flip-Chip – MCCF1558
MCCF1458

Available Variations:

Prime Device – MC1747
T_A = -55 to +125°C
Relaxed Spec. – MC1747C
T_A = 0 to +75°C
Military Qualification
or Process Devices Available – MC1747

ELECTRICAL SPECIFICATIONS – (Prime Devices)

Device Type	I_{IB} μA Max	V_{IO} mV Max	I_{IO} nA Max	A_{vol} V/V Min	f_c MHz Typ	BW_p kHz Typ	SR V/μs Typ	Case
MC1537	0.5	5.0	200	25 k	1.0	3.0	0.25	632
MC1558	0.5	5.0	200	50 k	1.1	14	0.8	601, 632, 693
MC1747	0.5	5.0	200	50 k	1.0	10	0.5	601, 603, 607, 646

QUAD OPERATIONAL AMPLIFIERS

MC3503

High performance, compensated quad operational amplifier with specifications similar to MC1741, but with lower power requirements. Operates with single or split power supplies.

Available Variations:

Prime Device – MC3503
T_A = -55 to +125°C
Relaxed Spec. – MC3403
T_A = 0 to +70°C

MC3401

Low cost amplifier with four independent circuits ideal for active filters, multi-channel amplifiers and similar applications.

T_A = 0 to +75°C

MC3301

Similar to MC3401, except with much greater temperature range suitable for wide under hood temperature variations in automotive applications.

T_A = -40 to +85°C

ELECTRICAL SPECIFICATIONS

Device Type	I_{IB} μA Max	V_{IO} mV Max	I_{IO} nA Max	A_{vol} V/V Min	f_c MHz Typ	BW_p kHz Typ	SR V/μs Typ	Case
MC3301	0.3	–	–	1 k	4.0	20	0.6	646
MC3401	0.3	–	–	1 k	5.0	20	0.6	646
MC3403	0.5	8.0	200	20 k	1.0	9.0	0.6	632, 646
MC3503	0.5	5.0	200	50 k	1.0	9.0	0.6	632

OTHER OPERATIONAL AMPLIFIERS

The following operational amplifier types are also manufactured by Motorola. These device types are recommended for exact replacement only.

MC1430 MC1431 MC1433 MC1435	MC1530 MC1531 MC1533 MC1535	MC1712 MC1712C

INTEGRATED CIRCUITS

HIGH FREQUENCY AMPLIFIERS

LINEAR

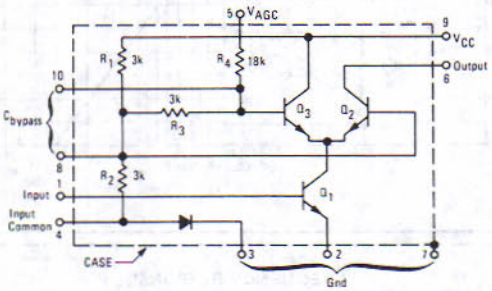
A variety of high-frequency circuits with features ranging from low-cost simplicity to multi-function versatility marks Motorola's line of integrated RF/IF amplifiers. Devices described here are intended for industrial and communications applications. For devices especially dedicated to consumer products, i.e., TV and entertainment radio, see Consumer Applications Selector Guide.

AGC AMPLIFIERS

MC1550 – Low Cost Building Block

Single-stage cascade connected amplifier with delayed AGC characteristics, for operation at frequencies to 100 MHz. Has typical power gain of 25 dB @ 60 MHz. See Application Notes AN-215A, AN-247A and AN-299 for design details.

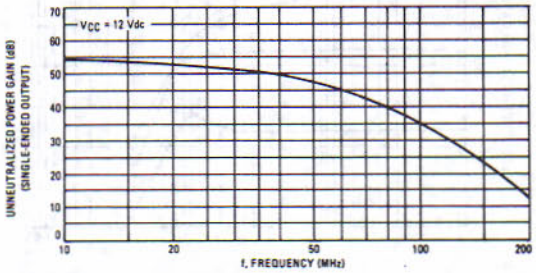
CIRCUIT SCHEMATIC



MC1590 – Wide-Band General Purpose

Has differential inputs and outputs with unneutralized power gain as high as 35 dB typical at 100 MHz in tuned amplifier service. Effective AGC voltage range from 5 to 7 volts for a 30 dB gain reduction. See Application Note AN-513 for design details.

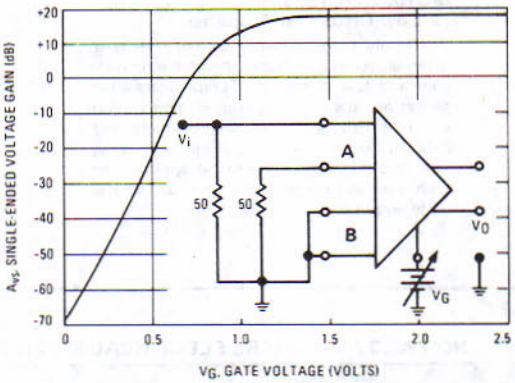
UNNEUTRALIZED POWER GAIN versus FREQUENCY (Tuned Amplifier)



MC1545/MC1445 – Gated 2-Channel Input

Differential input and output amplifier with gated 2-channel input for a wide variety of switching purposes. Typical 75 MHz bandwidth makes it suitable for high-frequency applications such as video switching, FSK circuits, multiplexers, etc.. Gating circuit is useful for AGC control. See Application Notes AN-475 and AN-491 for design details.

GATE CHARACTERISTICS



AGC AMPLIFIERS ELECTRICAL SPECIFICATIONS

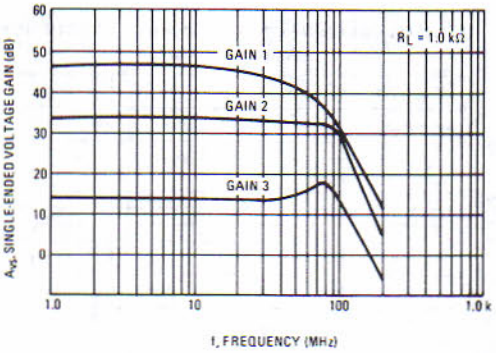
Operating Temperature Range		A_V	Bandwidth	V_{CC}/V_{EE}		
-55 to +125°C	0 to +75°C	dB	MHz	Vdc	Case	Special Features
MC1550	–	22 Min	22	+6/-	602B,606	Low-Cost
MC1590	–	44 Typ @ 4 Typ @	10 100	+12/-	601	Characterized as Video Amplifier and as High Frequency Tuned Amplifier
MC1545	MC1445	19 Typ @	75	+5/-5	602A,607,632	Gate Controlled 2-Channel Input

NON-AGC AMPLIFIERS

MC1733/MC1733C – Utility Amplifier

Differential input and output amplifier provides three fixed gain options with bandwidth to 120 MHz. External resistor permits any gain setting from 10 to 400 V/V. Extremely fast rise time (2.5 ns typ) and propagation delay time (3.6 ns typ) makes this unit particularly useful as pulse amplifier in tape, drum, or disc memory read applications.

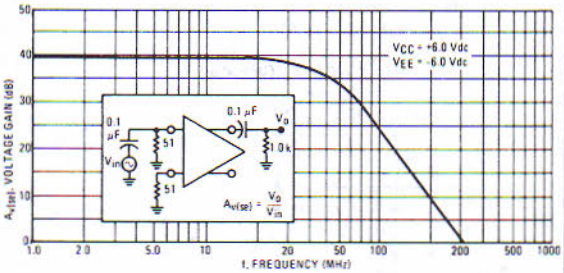
GAIN versus FREQUENCY



MC1510/MC1410 – General-Purpose Amplifier

Differential amplifier with flat response to 40 MHz. Provides excellent performance and simple design for most video and communications purposes.

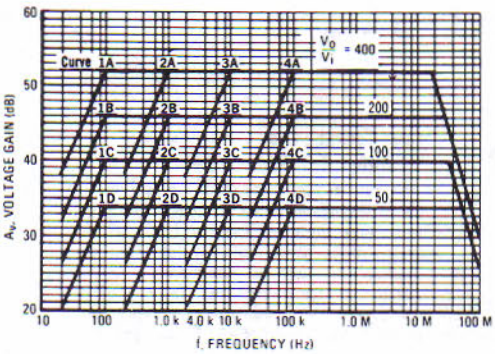
VOLTAGE GAIN versus FREQUENCY



MC1552/MC1553 – Low Distortion Amplifier

Extremely high performance amplifier with internal series feedback for stable voltage gain and low distortion. Temperature compensation stabilizes operating point. Has selectable gain option and well characterized data that permits accurate response shaping (see graph). Useful for critical applications such as wideband linear amplifiers or fast-rise pulse amplifiers.

FREQUENCY RESPONSE

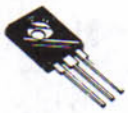


NON AGC AMPLIFIERS ELECTRICAL SPECIFICATIONS

Operating Temperature Range		A_V	Bandwidth	V_{CC}/V_{EE}	Case	Special Features
-55 to +125°C	0 to +75°C	dB	MHz	Vdc		
MC1733	MC1733C	52 @ 40 20	40 90 120	+6/-6	603,632	3-Fixed Gain Options. Fast Rise Time and Propagation
MC1510	MC1410	40	40	+6/-6	601	
MC1553	–	46 @ 52	35 15	+6/-6	602B	High and Low Gain Versions of precision amplifier with distortion as low as 0.2% at 200 kHz.
MC1552	–	34 @ 40 @	40 35	+6/-6	602B	

FIXED OUTPUT VOLTAGE REGULATORS

Low cost, dedicated, monolithic circuits for positive and/or negative regulation requirements from 100 mA to 1.5 A. Most are available in plastic and metal packages. Consult the data sheets for more detailed specifications.



CASE 199-04
(P Suffix)

CASE 11
(K Suffix)

POSITIVE 1.5 A – MC7800 Series

Family Characteristics:
0 to +125°C Junction Temperature
I_O – 1.5 A (Max)
V_O – ±5% of nominal voltage for all line and load condition limits

Nominal V_O	V_I (dc) Min	Max	Device Type
*5 V	7 V	35 V	MC7805C
6 V	8 V	35 V	MC7806C
8 V	10.5 V	35 V	MC7808C
12 V	14.5 V	35 V	MC7812C
15 V	17.5 V	35 V	MC7815C
18 V	21 V	35 V	MC7818C
24 V	27 V	40 V	MC7824C

*Also available as the:
MLM109 (-55 to +150°C)
MLM209 (-25 to +125°C)
MLM309 (0 to +125°C)

CASE 199-04
(P Suffix)

CASE 79-02
TO-39
(G Suffix)

POSITIVE, 500 mA – MC78M00 Series

Family Characteristics:
0 to +125°C Junction Temperature
I_O – 500 mA (Max)
V_O – ±5% of nominal voltage for all line and load condition limits.

Nominal V_O	V_I (dc) Min	Max	Device Type
5 V	7 V	35 V	MC78M05C
6 V	8 V	35 V	MC78M06C
8 V	10.5 V	35 V	MC78M08C
12 V	14.5 V	35 V	MC78M12C
15 V	17.5 V	35 V	MC78M15C
18 V	21 V	35 V	MC78M18C
24 V	27 V	40 V	MC78M24C

CASE 199-04
(P Suffix)

CASE 11
(K Suffix)

NEGATIVE, 1.5 A – MC7900 Series

Family Characteristics:
0 to +125°C Junction Temperature
I_O – 1.5 A (Max)
V_O – ±5% of nominal voltage for all line and load condition limits.

Nominal V_O	V_I (dc) Min	Max	Device Type
2 V	7.2 V	35 V	MC7902C
5 V	7 V	35 V	MC7905C
5.2 V	7 V	35 V	MC7905.2C
6 V	8 V	35 V	MC7906C
8 V	10.5 V	35 V	MC7908C
12 V	14.5 V	35 V	MC7912C
15 V	17.5 V	35 V	MC7915C
18 V	21 V	35 V	MC7918C
24 V	27 V	40 V	MC7924C

POSITIVE, 750 mA – MC7700 Series

Family Characteristics:
0 to +125°C Junction Temperature
I_O – 750 mA (Max)
V_O – ±5% of nominal voltage for all line and load condition limits.

Nominal V_O	V_I (dc) Min	Max	Device Type
5 V	7 V	35 V	MC7705C
6 V	8 V	35 V	MC7706C
8 V	10.5 V	35 V	MC7708C
12 V	14.5 V	35 V	MC7712C
15 V	17.5 V	35 V	MC7715C
18 V	21 V	35 V	MC7718C
20 V	23 V	40 V	MC7720C
24 V	27 V	40 V	MC7724C

CASE 199-04
(P Suffix)

CASE 79-02
TO-39
(G Suffix)

POSITIVE, 100 mA – MC78L00 Series

Family Characteristics:
0 to +125°C Junction Temperature
I_O – 100 mA (Max)
V_O – ±10% of nominal voltage for all line and load condition limits.

Nominal V_O	V_I (dc) Min	Max	Device Type
5 V	7 V	30 V	MC78L05C
8.1 V	10.5 V	30 V	MC78L08C
12 V	10.5 V	35 V	MC78L12C
15 V	17.5 V	35 V	MC78L15C
18 V	21 V	35 V	MC78L18C
24 V	27 V	40 V	MC78L24C

CASE 29-02
TO-92
(P Suffix)

CASE 79-02
TO-39
(G Suffix)

NEGATIVE, 100 mA – MC79L00 Series

Family Characteristics:
0 to +125°C Junction Temperature
I_O – 100 mA (Max)
V_O – ±10% of nominal voltage for all line and load condition limits.

Nominal V_O	V_I (dc) Min	Max	Device Type
3 V	5 V	30 V	MC79L03C
5 V	7 V	30 V	MC79L05C
12 V	14.5 V	35 V	MC79L12C
15 V	17.5 V	35 V	MC79L15C
18 V	21 V	35 V	MC79L18C
24 V	27 V	40 V	MC79L24C

CASE 29-02
TO-92
(P Suffix)

CASE 79-02
TO-39
(G Suffix)

DUAL (±15 V Output) 100 mA REGULATOR

The MC1568 features an output balance of ±1% maximum (±2% for MC1468), current limit control and provisions for remote sensing. The ceramic package (L Suffix) has a balance control pin for critical balance requirements. The preset V_O of ±15 V can be varied from ±8 to ±20 V at the sacrifice of performance over temperature.

	MC1568	MC1468
Temp. Range	-55 to +125	0 to 75
I_O (Max)	100 mA	100 mA
V_O	±15 V, ±2.5%	±15 V, ±6%
V_I (Min/Max)	±17.2/±30	±17.5/±30
Reg_{line} $\%V_O/V_I$ (Max)	0.006	0.01
Reg_{load} ($\%/V_O$ Max)	0.07	0.07

CASE 603
(G Suffix)

CASE 614
(R Suffix)

CASE 632
(L Suffix)

VARIABLE OUTPUT VOLTAGE REGULATORS

When an adjustable or tailored voltage is required, the following regulators should be used. Voltage is set by varying the value of an external resistor or resistors. More complete data on individual devices can be found on the data sheets.

CASE 614 500 mA
(R Suffix)

CASE 602A 200 mA
(G Suffix)

POSITIVE, 500 mA – 2.5 to 37 V

The MC1569 is a high performance regulator designed for either stand-alone operation or with a current boost transistor. It has an electrical complement, the MC1563 for dual supply applications requiring positive and negative outputs. Ripple rejection is typically 0.002%/V. An electronic shutdown control and remote sensing are also provided.

Operating Temperature (Junction)	-55 to +125°C
I_O Max	500 mA
V_O Range	2.5 to 37 V
V_I (Min/Max)	8.5 to 40 V
Reg_{line} Max	0.015%/V_O
Reg_{load} Max	0.05%

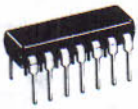
Variations:

The MC1469 is a relaxed specification lower cost version of the MC1569 and operates over a 0 to +70°C Junction Temperature Range.

MC1569/MC1469 also available as non-encapsulated chip, use MCC prefix.

MC1561 is the same as the MC1569 but has a much higher transient response. It is also available as the MC1560 which has a reduced V_O range and slightly relaxed specifications. The MC1461 and MC1460 are also available for 0 to +70°C operation.

CASE 603
(G Suffix)



CASE 646
(P Suffix)

CASE 632
(L Suffix)

POSITIVE, 150 mA – 2 to 37 V

The MC1723 is a very popular, lower current regulator for either stand-alone use or in conjunction with a current boost transistor. Three package variations are available: Metal (G Suffix), dual-in-line ceramic (L Suffix), or Plastic (P Suffix).

Operating Temperature (Ambient)	-55 to +125°C
I_O Max	150 mA
V_O Range	2 to 37 V
V_I (Min/Max)	9.5 to 40 V
Reg_{line} Max	0.2% V_O
Reg_{load} Max	0.15% V_O

Variations:

The MC1723C is a lower cost relaxed specification of the MC1723 for operation over the temperature range of 0 to +75°C (ambient).

The MC1723/MC1723C also available as nonencapsulated chip, use MCC prefix. MC-1723 also available as nonencapsulated beam-lead device; use MCBC prefix, use MCB prefix for device in ceramic flat package.

MC1723 – High reliability processed versions offered.

POSITIVE, 20 mA – 4.5 to 40 V

The MLM105 is also available for low current applications. Line regulation is 0.01%/V and load regulation (no load to full load) 1 mV. Operating temperature is -55 to +125°C ambient.

The MLM205 relaxed specification:
-25 to +85°C
The MLM305 relaxed specification:
0 to +70°C

NEGATIVE, 500 mA – 3.6 to 37 V

The MC1563 is an electrical complement to the MC1569 for construction of positive and negative output regulator systems. In the power package (R Suffix), the case is ground for both types allowing direct mounting on a common heat sink.

Variations:

The MC1463 is a relaxed specification lower cost version of the MC1563 and operates over a 0 to +70°C Junction Temperature Range.

MC1563/MC1463 also available as non-encapsulated chip, use MCC prefix.

Operating Temperature (Junction)	-55 to +125°C
I_O Max	500 mA
V_O Range	3.6 to 37 V
V_I (Min/Max)	8.5 to 40 V
Reg_{line}	0.015%/V_O Max
Reg_{load}	0.05% Max

NEGATIVE, 20 mA – 0.015 to 40 V

The MLM104 is also available for low current applications. Line regulation is 0.01%/V and load regulation (no load to full load) 1 mV. Operating Temperature is -55 to +125°C (ambient).

The MLM204 relaxed specification:
-25 to +85°C
The MLM304 relaxed specification:
0 to +70°C

LABORATORY SUPPLY, VOLTAGE AND CURRENT REGULATOR

The MC1566 is a floating regulator designed for use with an external series pass NPN transistor. The voltage and current capabilities are limited only by the characteristics of the series element. Some of the more important features include:

- Automatic cross-over between voltage and current regulation
- Adjustable to zero volts or current
- Short circuit protection
- Remote Sensing

Operating Temperature (Ambient)	-55 to +125°C
Reg_{line} & Reg_{load}	0.01% + 1 mV
$Reg_{current}$	0.1% + 1 mA

Variations:
The MC1466 is a lower cost relaxed specification version of the MC1566 for operation from 0 to +75°C (ambient)

CASE 603
(G Suffix)

CASE 602A
(G Suffix)

CASE 614 500 mA
(R Suffix)

CASE 603
(G Suffix)

CASE 632
Suffix L

SPECIAL-PURPOSE CIRCUITS

The linear-integrated-circuits listed in this section were developed by Motorola for the system design engineer to fill special-purpose requirements as indicated by the subheadings. Temperature ranges and package availability are also tailored to provide versatility.

MULTIPLIERS

Function	Linearity Error typ	Input Voltage Range Vdc min	Case	Type -55 to +125°C	Type 0 to +70°C
A four-quadrant multiplier designed to operate with ±15-volt supplies; has internal level-shift circuitry and voltage regulator.	±0.3%	±10	620	MC1594	–
	±0.5%	±10	620	–	MC1494
Applications include multiply, divide, square root, mean square, phase detector, frequency doubler, balanced modulator/demodulator, electronic gain control.	X Input = 0.5% Y Input = 1.0%	±10	632	MC1595*	–
	X Input = 1.0% Y Input = 2.0%	±10	632	–	MC1495*

*Also available as a nonencapsulated chip. use MCC prefix.

BALANCED MODULATOR/DEMODULATOR

Function	Carrier Suppression dB @ f typ	MHz	Common-Mode Rejection dB typ	Case	Type -55 to +125°C	Type 0 to +75°C
Balanced modulator/demodulator designed for use where the output voltage is a product of an input voltage (signal) and a switching function (carrier).	65	0.5	85	602A, 632	MC1596	
	50	10		602A, 632, 646		MC1496

LOW-FREQUENCY CIRCUITS

Function	Output Power W typ	Voltage Gain – typ V/V typ	Total Harmonic Distortion % typ	Case	Type -55 to +125°C	Type 0 to +70°C
A power amplifier device capable of single or split supply operation.	1.0	10, 18, 36	0.4	602B	MC1554	MC1454

TIMING CIRCUITS

Function	Supply Voltage V_{CC} Vdc – max	Initial Timing Error V_{CC} = 5 & 15 V, C = 0.1 μF %-typ	V_{OL} V_{CC} = 15 V I_{sink} = 50 mA Vdc – max	V_{OH} V_{CC} = 15 V I_{source} = 100 mA Vdc – min	Case	Type -55 to +125°C	Type 0 to +75°C
Wide range adjustable timers	16	1.0	0.75	12.75	601, 626, 693	–	MC1455
	18	0.5	0.5	13	601, 693	MC1555	–
Dual Adjustable Timers	16	2.25	0.75	12.75	632, 646	–	MC3456
	18	1.5	0.5	13	632	MC3556	–

. . .reflecting Motorola's continuing commitment to semiconductor products necessary for consumer system designs. The tabulation contains data for a large number of components designed principally for entertainment product applications. It is arranged to simplify first-order of linear integrated circuit device lineups to satisfy primary functions for Television, Audio, Radio, Automotive and Organ applications.

TELEVISION CIRCUITS

SOUND

Function	Features	Case	Type
Sound IF, Detector, Limiter, Audio Preamplifier	80 μV, 3 dB Limiting Sensitivity, 3.5 V(RMS) Output, Sufficient for Single Transistor Output Stage	646,647	MC1351
Sound IF Detector	Interchangeable with ULN2111A	646,647	MC1357
Sound IF Detector, DC Volume Control, Preamplifier	Excellent AMR, Interchangeable with CA3065	646,647	MC1358

VIDEO

1st and 2nd Video IF Amplifier	IF Gain @ 45 MHz – 60 dB typ AGC Range – 70 dB min	626	MC1349
	IF Gain @ 45 MHz – 46 dB typ, AGC Range – 60 dB min	626	MC1350
1st and 2nd Video IF, AGC Keyer and Amplifier	IF Gain @ 45 MHz – 53 dB typ, AGC Range – 65 dB min, "Forward AGC" Provided for Tuner	646,647	MC1352
	Same as MC1352, with Opposite AGC for Tuner	646,647	MC1353
3rd IF and Video Detector	Low-Level Detection, Low Harmonic Generation, Reduced Circuit Cost and Complexity, Reduced Shielding	626	MC1330
3rd IF, Video Detector, Sound IF Detector, and Sync Separator	Low-Level Detection, Separate Sound Detector, Differential Inputs	646	MC1331
AGC Keyer, AGC Amplifier, Noise Gate, Sync Separator	High-Quality Noise Gate, One IF AGC Output and Two Tuner AGC Outputs, Adjustable AGC Delay	646	MC1344
Automatic Fine Tuning	High Gain AFT System, Interchangeable with CA3064	646 686	MC1364

CHROMA

Chroma IF Amplifier and Subcarrier System	Includes Complete Chroma IF, AGC, dc Gain and Tint Controls, Injection Locked Oscillator, Low Peripheral Parts Count	646	MC1398
Chroma Subcarrier System	Interchangeable with CA3070, APC Chroma Reference System	648	MC1370
Chroma IF Amplifier	Interchangeable with CA3071, Automatic and Manual Gain Control	646	MC1371
Dual Chroma Demodulators	Industry Standard Demodulator, Low Differential Output dc Drift	603 646, 647	MC1328
	Same as MC1328 with short-circuit protected outputs, and improved dc tracking and temperature coefficients on outputs.	646	MC1329
	Similar to MC1328 but with Luminance and Blanking Inputs, Internal Matrix Provides RGB Outputs	646,647	MC1326
	Same as MC1326 with short-circuit protected outputs, and improved dc tracking and temperature coefficients on outputs.	646	MC1324
	Dual Doubly Balanced Demodulator with RGB Output Matrix and PAL Switch	646,647	MC1327
Triple Chroma Demodulator	Triple Doubly Balanced Demodulator with Adjustable Output Matrix, Contains Three Independent Demodulators.	648	MC1323

DEFLECTION

Horizontal Processor	Includes Phase-Detector, Oscillator and Predriver; Linear Balanced Phase Detector; Adjustable dc Loop Gain	626	MC1391
Horizontal Processor	Same as MC1391 except designed to accept negative sawtooth sync pulse.	626	MC1394
Color Processing Circuit	Includes chroma IF amplifier with ACC, color killer, linear dc chroma control, phase locked loop subcarrier regenerator with dc hue control.	648	XC1399

AUDIO CIRCUITS

PREAMPLIFIERS

Function	V_{CC} Vdc – max	A_{vol} dB min	THD % typ	z_o Ohms typ	Case	Type
Dual Preamplifier	±15	80	0.1	100	632	MC1303

DRIVERS

Function	V_{CC} Vdc – max	Drive Current mA	A_{vol} dB	Case	Type
Class B Audio Drivers	60	–	90 typ	646	XC1387
	25	50 max	–	646	MC1385

POWER AMPLIFIERS

Function	P_O Watts	V_{CC} Vdc max	e_{in} @ rated P_O mV – max	P_D mA – max	R_L Ohms	Case	Type
Audio Power Amplifiers	0.5	12	3.0	4.0	8.0	626	MC1306
	0.25	12	3.0	3.5	16	626	MC3360P

RADIO CIRCUITS

IF AMPLIFIERS

Function	Gain @ 10.7 MHz dB – typ	3 dB Limiting @ 10.7 MHz mV (RMS) typ (μV(RMS)*	AMR dB – typ min*	Recovered Audio Output Δf = 75 kHz mV(RMS)	Power Supply Volts – max	Case	Type
IF Amplifier	58	0.175	60	690	18	626	MC1350
Limiting FM-IF Amplifier	–	0.600	45	480	18	646,647	MC1355
Limiting IF Ampl/Quadrature Detector	53	0.4	–	–	16	646,647	MC1357
IF Amplifier	42	60	50	500	18	626	MC3310P
IF Amplifier, Limiter, Detector, Audio Preamplifier	21				16	646	MC1375
IF Amplifier Quad Detector, AF pre-Amplifier, AFC, AGC, Muting and Tuning Meter Circuits	–	18*	60*	300	16	648	XC1389
Limiting IF Ampl/Quadrature Detector with Built-In Regulator	← Similar to MC1357 →					646,647	MC1356

DECODERS

Function	Channel Separation dB – typ	THD % – typ	Stereo – Indicator Lamp Driver mA – max	Features	Case	Type
FM Multiplex Stereo Decoders	45	0.5	40	Audio Muting	646	MC1304
	45	0.5	40	Audio Muting	646	MC1305
	40	0.5	40	–	646	MC1307
	40	0.3	75	Coilless Operation	646	MC1310
	40	0.5	100	Coilless Operation, Emitter Follower Outputs, and Unity Gain	648	MC1311•
Four-Channel SQ* Decoders	45	0.1	–	V_{CC} = 20 Vdc nom	646	MC1312
Four Channel SQ* Gain and Balance Control	–	–	–	Master Volume Control and LF/RF, LB/RB, E/B Balance Control	646	MC1314
Four Channel SQ* Logic Circuit	–	–	–	Interface with MC1314 and MC1312 to increase F/B Separation and Supply Gain and Balance Control to MC1314.	646	MC1315

*Trademark of Columbia Broadcasting System, Inc.

SPECIAL FUNCTIONS

Function	Toggle Frequency kHz Typ	Power Supply Volts Max	Case	Type
Emitter-Coupled Astable Multivibrator	100	10	626	MC3380

• To be introduced

AUTOMOTIVE CIRCUITS

OPERATIONAL AMPLIFIER

Function	V_{CC} Range Vdc	A_{vol} V/mV – typ	I_{IB} μA – max	Unity Gain Bandwidth MHz – typ	R_{in} MΩ typ	Case	Type
Quad Operational Amplifier	4.0 to 28	2.0	0.3	4.0	1.0	646	MC3301

COMPARATOR

Function	V_{CC} Range Vdc	V_{IDR} Vdc	I_{IB} μA-max	Output Leakage Current μA-max	Sink Current	Case	Type
Quad Comparator	2.0 to 28	$\pm V_{CC}$	0.5	1.0	6.0	646	MC3302
Quad Comparator (Single/Dual Supply)	2.0 to 36	36	100 250 250 100 250 250	0.1	6.0	646/ 632	MLM139 MLM239 MLM339 MLM139A MLM239A MLM339A

ORGAN CIRCUITS

FREQUENCY DIVIDERS

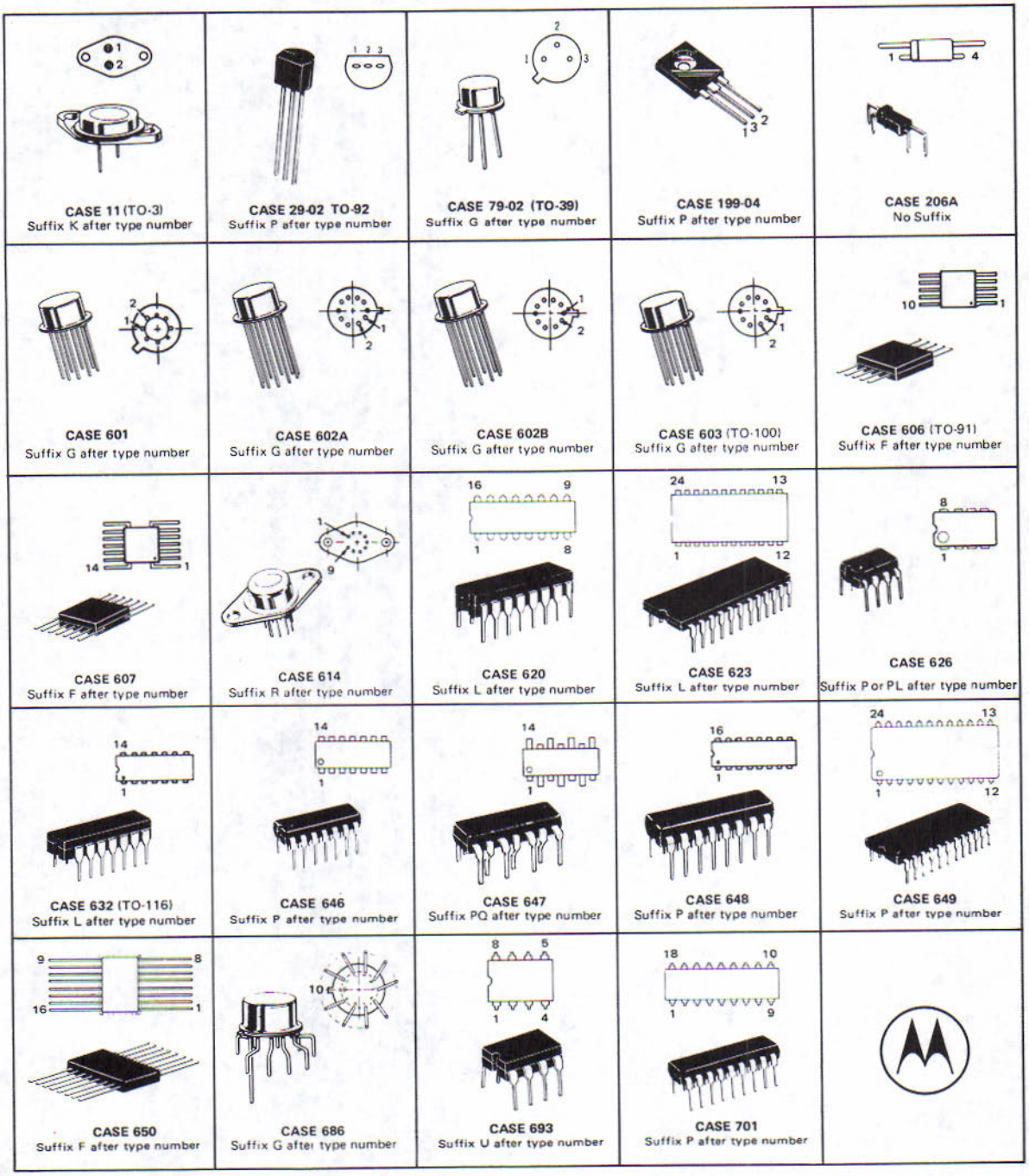
Function	V_{CC} Range Vdc	f_{Tog} MHz – typ	V_{OH} Vdc – min	Case	Type
7-Stage Divider	6.0 to 16	3.0	15.5	646	XC1302 ●

ATTENUATOR

Function	V_{CC} Range Vdc	THD % – typ	A_V dB – typ	Attenuation Range dB – typ	Case	Type
Electronic Attenuator	9.0 to 18	0.6	13	90	626	MC3340P

● To be announced.

LINEAR IC PACKAGES



SILICON POWER TRANSISTORS

This Selector Guide is to help the designer choose the best silicon power transistor for his new equipment and find suitable replacements for devices used in older designs. It is a comprehensive listing of the industry's most complete line of PNP and NPN silicon power transistors, and the devices are rated at currents between 100 mA and 60 amperes, and at voltages up to 1500 volts.

Motorola has the production capability and flexibility to supply devices especially tailored to specific application needs. Where suitable power transistors cannot be selected from this guide, contact your nearest Motorola sales representative or distributor.

TABLE OF CONTENTS

SEE POPULAR PRO-ELECTRON DEVICES TYPES SECTION 8

The following index reflects the devices characterized in this section. To locate the exact page number, see Catalog Index(Page 7-1).

INDEX

General-Purpose Silicon Power Transistors

From over 1400 power device types available from Motorola, the following represent over 200 "best value", selected devices for new designs. These devices are rated primarily on performance, price and availability. It is recommended that these standard device types be given first consideration for new design.

The device types are listed in increasing order of I_C continuous and V_{CEO} ratings. Other basic data is provided to enable the designer to have a wider field of choice — be it polarity, parameter, case style, process type, or complementary device types. Contact your nearest Motorola sales office for assistance in additional device selection and complete technical data.

Device and Polarity NPN	PNP	V_{CEO} Volts Max	h_{FE} Min/Max	@ I_C Amp	$V_{CE(sat)}$ Volts Max	@ I_C Amp	f_T MHz Min	P_D Watts Max	Case
0.3 Amp									
MJE3440		250	40/160	0.02	0.5	0.05	15	15	77
MJE3439		350	40/160	0.02	0.5	0.05	15	15	77
0.5 Amp									
2N5655		250	30/250	0.1	1.0	0.1	10	20	77
MJE5655		250	30/250	0.1	1.0	0.1	10	30	199
2N5656		300	30/250	0.1	1.0	0.1	10	20	77
MJE5656		300	30/250	0.1	1.0	0.1	10	30	199
MJE340K		300	30/240	0.05				30	199
	MJE350	300	30/240	0.05				20	77
MJE340		300	30/240	0.05				20.8	77
MJE5657		350	30/250	0.1	1.0	0.1	10	30	199
2N5657		350	30/250	0.1	1.0	0.1	10	20	77
1.0 Amp									
MJE29	MJE30	40	40/-	0.2	0.7	1.0	3.0	30	77
MJE29A	MJE30A	60	40/-	0.2	0.7	1.0	3.0	30	77
MJE29B	MJE30B	80	40/-	0.2	0.7	1.0	3.0	30	77
MJE29C	MJE30C	100	40/-	0.2	0.7	1.0	3.0	30	77
	MJ5415	200	30/150	0.05	2.5	0.05	15	10	79
2N3738	2N6424	225	40/200	0.1	2.5	0.25	10	20	80
2N3440		250	40/160	0.02	0.5	0.05	15	5.0	79
	MJ5416	300	30/120	0.05	2.5	0.05	15	10	79
2N3739	2N6425	300	40/200	0.1	2.5	0.25	10	20	80
2N3439		350	40/160	0.02	0.5	0.05	15	5.0	31
1.5 Amp									
MJE47		250	30/250	0.3	1.0	1.0	5.0	50	199
MJE2160		300	30/240	0.5	3.5	0.5		50	199
MJE48		300	30/250	0.3	1.0	1.0	5.0	50	199
MJE49		350	30/250	0.3	1.0	1.0	5.0	50	199
2.0 Amp									
2N6408	2N6406	60	50/250	0.1	2.0	2.0	50	12.5	77
2N6409	2N6407	80	50/250	0.1	2.0	2.0	50	12.5	77
2N3583	2N6420	175	40/200	0.5	5.0	1.0	10	35	80
2N3584	2N6421	250	8/80	1.0	0.75	1.0	10	35	80
2N3585	2N6422	300	8/80	1.0	0.75	1.0	10	35	80
2N4240	2N6423	300	10/100	0.75	1.0	0.75	15	35	80

PREFERRED SILICON POWER TRANSISTORS (continued)

Device and Polarity NPN	PNP	V_{CEO} Volts Max	h_{FE} Min/Max	@ I_C Amp	$V_{CE(sat)}$ Volts Max	@ I_C Amp	f_T MHz Min	P_D Watts Max	Case
0.3 Amp									
MJ205		750	2/-	2.5	5.0	2.5	7.5	10	11
BU205		750	2/-	2.5	5.0	2.5	7.5	10	11
3.0 Amp									
MJE520		30	25/-	1.0				25	77
MJE31	MJE32	40	25/-	1.0	1.2	3.0	3.0	40	77
2N4921	2N4918	40	20/100	0.5	0.6	1.0	3.0	30	77
	2N3867	40	40/200	1.5	0.75	1.5	60	6.0	31
	2N3868	60	30/150	1.5	0.75	1.5	60	6.0	31
2N4922	2N4919	60	20/100	0.5	0.6	1.0	3.0	30	77
	MJ2253	60	20/100	0.25	0.3	0.5	3.0	25	80
MJE31A	MJE32A	60	25/-	1.0	1.2	3.0	3.0	40	77
MJE31B	MJE32B	80	25/-	1.0	1.2	3.0	3.0	40	77
	MJ2254	80	20/100	0.25	0.3	0.5	3.0	25	80
2N6416	2N6418	90	40/250	0.2	3.0	3.0	40	15	77
2N4923	2N4920	80	20/100	0.5	0.6	1.0	3.0	30	77
2N6417	2N6419	100	40/250	0.2	3.0	3.0	40	15	77
MJE31C	MJE32C	100	25/-	1.0	1.2	3.0	3.0	40	77
3.5 Amp									
2N3902		400	30/90	1.0	0.8	1.0	2.8	100	11
4.0 Amp									
2N6410	2N6411	25	45/180	2.0	0.8	2.0	50	15	77
2N6412	2N6414	40	40/250	0.2	2.5	4.0	50	15	77
2N5190	2N5193	40	25/100	1.5	0.6	1.5	2.0	40	77
MJE5190	MJE5193	40	25/100	1.5	0.6	1.5	2.0	60	199
2N6037	2N6034	40	750/15k	2.0	2.0	2.0	25	40	77
MJE3300	MJE3310	40	1000/-	1.0	1.5	1.5	20	15	77
2N3054A	2N6049	55	25/100	0.5	1.0	0.5	3.0	75	80
2N6413	2N6415	60	40/250	0.2	2.5	4.0	50	15	77
2N5191	2N5194	60	25/100	1.5	0.6	1.5	2.0	40	77
MJE5191	MJE5194	60	25/100	1.5	0.6	1.5	2.0	60	199
	2N3740	60	30/100	0.25	0.6	1.0	4.0	25	80
2N6294	2N6296	60	750/18k	2.0	2.0	2.0	4.0	50	80
2N6038	2N6035	60	750/15k	2.0	2.0	2.0	25	40	77
MJE3301	MJE3311	60	1000/-	1.0	1.5	1.5	20	15	77
MJE800	MJE700	60	750/-	1.5	2.5	1.5		40	77
MJE3302	MJE3312	80	1000/-	1.0	1.5	1.5	20	15	77
2N5192	2N5195	80	20/80	1.5	0.6	1.5	2.0	40	77
MJE5192	MJE5195	80	20/80	1.5	0.6	1.5	2.0	60	199
	2N3741	80	30/100	0.25	0.6	1.0	4.0	25	80
2N6295	2N6297	80	750/18k	2.0	2.0	2.0	4.0	50	80
2N6039	2N6036	80	750/15k	2.0	2.0	2.0	25	40	77

REFERRED SILICON POWER TRANSISTORS (continued)

Device and Polarity NPN	PNP	V_{CEO} Volts Max	h_{FE} Min/Max	@ I_C Amp	$V_{CE(sat)}$ Volts Max	@ I_C Amp	f_T MHz Min	P_D Watts Max	Case
5.0 Amp									
MJE200	MJE210	25	45/180	2.0	0.75	2.0	65	15	77
2N4231A	2N6312	40	25/100	1.5	0.7	1.5	4.0	75	80
MJE5977	MJE5974	40	20/120	2.5	0.6	2.5	2.0	75	199
2N4232A	2N6313	60	25/100	1.5	0.7	1.5	4.0	75	80
MJE5978	MJE5975	60	20/120	2.5	0.6	2.5	2.0	75	199
2N4233A	2N6314	60	20/120	1.5	0.7	1.5	4.0	75	199
MJE1100	MJE1090	60	750/-	3.0	2.5	3.0		70	90
MJE5979	MJE5976	80	20/120	2.5	0.6	2.5	2.0	75	199
2N6233		225	25/125	1.0	1.0	1.0	20	50	80
2N6497		250	10/75	2.5	1.5	2.5	5.0	80	199
MJE51		250	5.0/-	5.0	2.0	5.0	2.5	80	199
2N6234		275	25/125	1.0	0.5	1.0	20	50	80
2N6542		300	7/35	3.0	1.0	3.0	6.0	100	11
2N6498		300	10/75	2.5	1.5	2.5	5.0	80	199
MJE52		300	5.0/-	5.0	2.0	5.0	2.5	80	199
2N6235		325	25/125	1.0	0.5	1.0	20	50	80
2N6499		350	10/75	2.5	1.5	2.5	5.0	80	199
MJE53		350	5.0/-	5.0	2.0	5.0	2.5	80	199
MJ425		400	30/90	1.0	0.8	1.0	2.5	100	11
2N6543		400	7/35	3.0	1.0	3.0	6.0	100	11
BU108		750			5.0	4.5	7.5	56	11
MJ804		800	2.2/-	3.5			1.5	100	11
6.0 Amp									
MJE41	MJE42	40	30/-	0.3	1.5	6.0	2.0	65	199
MJE41A	MJE42A	60	30/-	0.3	1.5	6.0	2.0	65	199
MJE41B	MJE42B	80	30/-	0.3	1.5	6.0	2.0	65	199
MJE41C	MJE42C	100	30/-	0.3	1.5	6.0	2.0	65	199
2N5758	2N6226	100	25/100	3.0	1.0	3.0	1.0	150	11
2N5759	2N6227	120	20/80	3.0	1.0	3.0	1.0	150	11
2N5760	2N6228	140	15/60	3.0	1.0	3.0	1.0	150	11
MJ3760		550			5.0	6.0	7.5	80	11
8.0 Amp									
MJE5983	MJE5980	40	20/120	4.0	0.6	4.0	2.0	90	199
MJE5984	MJE5981	60	20/120	4.0	0.6	4.0	2.0	90	199
2N6300	2N6298	60	750/18k	4.0	2.0	4.0	4.0	75	80
2N6055	2N6053	60	750/18k	4.0	2.0	4.0	4.0	100	11
2N6043	2N6040	60	1k/20k	4.0	2.0	4.0	4.0	75	199
MJ1000	MJ900	60	1k/-	3.0	2.0	3.0		90	11
MJE5985	MJE5982	80	20/120	4.0	0.6	4.0	2.0	90	199
2N6301	2N6299	80	750/18k	4.0	2.0	4.0	4.0	75	80
2N6056	2N6054	80	750/18k	4.0	2.0	4.0	4.0	100	11
2N6044	2N6041	80	1k/20k	4.0	2.0	4.0	4.0	75	199
2N6045	2N6042	100	1k/20k	3.0	2.0	4.0	4.0	75	199
2N6306		250	15/75	3.0	0.8	3.0	5.0	125	11
2N6307		300	15/75	3.0	1.0	3.0	5.0	125	11
MJ7160		300	25/100	3.0	1.0	3.0	30	140	11
2N6544		300	7/35	5.0	1.5	5.0	6.0	125	11
2N6308		350	12/60	3.0	5.0	1.5	3.0	125	11
MJ7161		400	25/100	3.0	1.0	3.0	30	140	11
2N6545		400	7/35	5.0	1.5	5.0	6.0	125	11
MJ3761		550			5.0	8.0	7.5	80	11

PREFERRED SILICON POWER TRANSISTORS (continued)

Device and Polarity NPN	PNP	V_{CEO} Volts Max	h_{FE} Min/Max	@ I_C Amp	$V_{CE(sat)}$ Volts Max	@ I_C Amp	f_T MHz Min	P_D Watts Max	Case
10 Amp									
2N5304		40	30/120	2.0	0.4	2.0	100	25	9
MJE33	MJE34	40	40/-	1.0	1.0	3.0	2.0	80	199
2N6383		40	1k/20k	5.0	2.0	5.0	20	100	11
2N6384		60	1k/20k	5.0	2.0	5.0	20	100	11
MJE3055	MJE2955	60	20/70	4.0	1.1	4.0	2.0	90	90
MJE3055K	MJE2955K	60	20/70	4.0	1.1	4.0	2.0	90	199
2N5877	2N5875	60	20/100	4.0	1.0	5.0	4.0	150	11
2N3715	2N3791	60	50/150	1.0	0.8	5.0	4.0	150	11
MJE33A	MJE34A	60	40/-	1.0	1.0	3.0	2.0	80	199
2N5878	2N5876	80	20/100	4.0	1.0	5.0	4.0	150	11
2N6385		80	1k/20k	5.0	2.0	5.0	20	100	11
2N3716	2N3792	80	50/150	1.0	0.8	5.0	4.0	150	11
MJE33B	MJE34B	80	40/-	1.0	1.0	3.0	2.0	80	199
MJE33C	MJE34C	100	40/-	1.0	1.0	3.0	2.0	80	199
2N5632	2N6229	100	25/100	5.0	1.0	7.5	1.0	150	11
2N5633	2N6230	120	20/80	5.0	1.0	7.5	1.0	150	11
2N5634	2N6231	140	15/60	5.0	1.0	7.5	1.0	150	11
MJ413		325	20/80	0.5	0.8	0.5	2.5	125	11
MJ423		325	30/90	1.0	0.8	1.0	2.5	125	11
12 Amp									
2N6569		40	15/200	4.0	1.5	4.0	1.5	100	11
2N5989	2N5986	40	20/120	6.0	0.7	6.0	2.0	100	90
2N5990	2N5987	60	20/120	6.0	0.7	6.0	2.0	100	90
2N6057	2N6050	60	750/18k	6.0	2.0	6.0	4.0	150	11
2N5991	2N5988	80	20/120	6.0	0.7	6.0	2.0	100	90
2N6058	2N6051	80	750/18k	6.0	2.0	6.0	4.0	150	11
2N6059	2N6052	100	750/18k	6.0	2.0	6.0	4.0	150	11
15 Amp									
2N3055		60	20/70	4.0	1.1	4.0	2.5	115	11
	MJ2955	60	20/70	4.0	1.1	4.0	4.0	150	11
2N5881	2N5879	60	20/100	6.0	1.0	7.0	4.0	160	11
2N6576		60	500/5k	10	4.0	15		120	11
2N5882	2N5880	80	20/100	6.0	1.0	7.0	4.0	160	11
2N6577		90	500/5k	10	4.0	15		120	11
2N6578		120	500/5k	10	4.0	15		120	11
2N6249		200	10/50	10	1.5	10	2.5	175	11
2N6250		275	8.0/50	10	1.5	10	2.5	175	11
MJ7260		300	25/100	5.0	1.0	5.0	30	175	11
2N6546		300	6/35	10	1.5	10	6.0	175	11
2N6251		350	6.0/50	10	1.5	10	2.5	175	11
MJ7261		400	25/100	5.0	1.0	5.0	30	175	11
2N6547		400	6/35	10	1.5	10	6.0	175	11
16 Amp									
2N5629	2N6029	100	25/100	8.0	1.0	10	1.0	200	11
2N5630	2N6030	120	20/80	8.0	1.0	10	1.0	200	11
2N5631	2N6031	140	15/60	8.0	1.0	10	1.0	200	11
20 Amp									
2N6282	2N6285	60	750/18k	10	2.0	10	4.0	160	11
2N5303	2N5745	80	15/60	10	1.0	10	2.0	200	12
2N6283	2N6286	80	750/18k	10	2.0	10	4.0	160	11
2N6284	2N6287	100	750/18k	10	2.0	10	4.0	160	11

Device and Polarity NPN	PNP	V_{CEO} Volts Max	h_{FE} Min/Max	@ I_C Amp	$V_{CE(sat)}$ Volts Max	@ I_C Amp	f_T MHz Min	P_D Watts Max	Case
25 Amp									
2N5885	2N5883	60	20/100	10	1.0	15	4.0	200	11
	2N6436	80	20/80	10	1.0	10	40	200	11
2N5886	2N5884	80	20/100	10	1.0	15	4.0	200	11
	2N6437	100	20/80	10	1.0	10	40	200	11
2N6338		100	30/120	10	1.0	10	40	200	11
	2N6438	120	20/80	10	1.0	10	40	200	11
2N6339		120	30/120	10	1.0	10	40	200	11
2N6340		140	30/120	10	1.0	10	40	200	11
2N6341		150	30/120	10	1.0	10	40	200	11
30 Amp									
2N5301	2N4398	40	15/60	15	3.0	0.75	10	200	12
2N5302	2N4399	60	15/60	15	2.0	0.75	10	200	12
MJ802	MJ4502	90	25/100	7.5	0.8	7.5	2.0	200	12
50 Amp									
2N5685	2N5683	60	15/60	25	1.0	25	2.0	300	197
2N5686	2N5684	80	15/60	25	1.0	25	2.0	300	197
	2N6377	80	30/120	20	1.2	20	30	250	197
	2N6378	100	30/120	20	1.2	20	30	250	197
2N6274		100	30/120	20	1.0	20	30	250	197
	2N6379	120	30/120	20	1.2	20	30	250	197
2N6275		120	30/120	20	1.0	20	30	250	197
2N6276		140	30/120	20	1.0	20	30	250	197
2N6277		150	30/120	20	1.0	20	30	250	197

Power SWITCHMODE Transistors

The Designers data sheets for switchmode silicon power devices provide detailed information for operating conditions as well as safety limits. Voltage, current, switching, temperature and secondary breakdown requirements are specified in detail.

The 2N6542 thru 2N6547 transistors are designed for high-voltage, high-speed, power switching in inductive circuits where fall time is critical. They are particularly suited for 115 and 220 volt line operated switch-mode applications such as:

- Switching Regulators
- PWM Inverters and Motor Controls
- Solenoid and Relay Drivers
- Deflection Circuits

Specification Features —

High Temperature Performance Specified for:
Reversed Biased SOA with Inductive Loads
Switching Times with Inductive Loads
Saturation Voltages
Leakage Currents

The device types are listed in increasing order of I_C continuous and V_{CEV} rating.

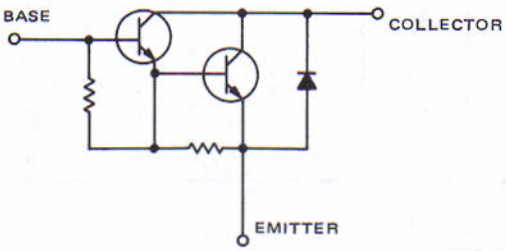
Device	I_C Amp Max	V_{CEV} Volts Max	$V_{CEX(sus)}$ @ 100°C Volts Min	$V_{CE(sat)}$ @ 100°C Volt Max	@ I_C Amp	t_f @ 100°C ns Max	@ I_C Amp
NPN							
2N6542	5.0	650	350	2.0	3.0	800	3.0
2N6543	5.0	850	450	2.0	3.0	800	3.0
2N6544	8.0	650	350	2.5	5.0	900	5.0
2N6545	8.0	850	450	2.5	5.0	900	5.0
2N6546	15	650	350	2.5	10	1500	10
2N6547	15	850	450	2.5	10	1500	10

Power Darlington Transistors

Monolithic power Darlington devices have found wide design usage in a variety of different applications. This power technology promises an even brighter future in advancing the state of the art — high voltage and very high current devices are on the horizon and will soon become a viable alternative to Thyristor devices on the designer's specification list. Darlington devices are not only a very high gain alternative; other significant advantages include:

- integrated circuit compatability
- high input impedance
- high current gain
- reduced component count
- space savings

The following devices are listed in increasing order of I_C continuous and V_{CEO} rating.



Device and Polarity NPN	PNP	I_C Amp Max	V_{CEO} Volts Max	h_{FE} Min/Max	@ I_C Amp	$V_{CE(sat)}$ Volts Max	@ I_C Amp	f_T MHz Min	P_D Watts Max	Case
2N6037	2N6034	4.0	40	750/15k	2.0	2.0	2.0	25	40	77
2N6294	2N6296	4.0	60	750/18k	2.0	2.0	2.0	4.0	50	80
2N6038	2N6035	4.0	60	750/15k	2.0	2.0	2.0	25	40	77
MJE800	MJE700	4.0	60	750/-	1.5	2.5	1.5		40	77
2N6295	2N6297	4.0	80	750/18k	2.0	2.0	2.0	4.0	50	80
2N6039	2N6036	4.0	80	750/15k	2.0	2.0	2.0	25	40	77
MJE3300	MJE3310	4.0	40	1k/-	1.0	1.5	1.5	20	15	77
MJE3301	MJE3311	4.0	60	1k/-	1.0	1.5	1.5	20	15	77
MJE3302	MJE3312	4.0	80	1k/-	1.0	1.5	1.5	20	15	77
MJE1100	MJE1090	5.0	60	750/-	3.0	2.5	3.0	1.0	70	90
MJ1000	MJ900	8.0	60	1k/-	3.0	2.0	3.0		90	11
2N6300	2N6298	8.0	60	750/18k	4.0	2.0	4.0	4.0	75	80
2N6055	2N6053	8.0	60	750/18k	4.0	2.0	4.0	4.0	100	11
2N6043	2N6040	8.0	60	1k/20k	4.0	2.0	4.0	4.0	75	199
2N6301	2N6299	8.0	80	750/18k	4.0	2.0	4.0	4.0	75	80
2N6056	2N6054	8.0	80	750/18k	4.0	2.0	4.0	4.0	100	11
2N6044	2N6041	8.0	80	1k/20k	4.0	2.0	4.0	4.0	75	199
2N6045	2N6042	8.0	100	1k/20k	3.0	2.0	4.0	4.0	75	199
2N6057	2N6050	12	60	750/18k	6.0	2.0	6.0	4.0	150	11
2N6058	2N6051	12	80	750/18k	6.0	2.0	6.0	4.0	150	11
2N6059	2N6052	12	100	750/18k	6.0	2.0	6.0	4.0	150	11
2N6576		15	60	500/5k	10	2.8	10	4.0	120	11
2N6577		15	90	500/5k	10	2.8	10	4.0	120	11
2N6578		15	120	500/5k	10	2.8	10	4.0	120	11
2N6282	2N6285	20	60	750/18k	10	2.0	10	4.0	160	11
2N6283	2N6286	20	80	750/18k	10	2.0	10	4.0	160	11
2N6284	2N6287	20	100	750/18k	10	2.0	10	4.0	160	11

High Voltage Transistors

The high-voltage devices are intended for industrial, commerical and military equipment. Typical applications include high-voltage differential and operational amplifiers, high-voltage inverters, low and medium current switching and series regulators. The devices are listed in decreasing order of V_{CEO} and I_C continuous.

Device and Polarity NPN	PNP	I_C Amp Max	h_{FE} Min/Max	@ I_C Amp	$V_{CE(sat)}$ Volts Max	@ I_C Amp	f_T MHz Min	P_D Watts Max	Case
800 Volts									
MJ804		5.0	2.2/-	3.5			1.5	100	11
750 Volts									
BU108		5.0			5.0	4.5	7.5	56	11
BU208		5.0			5.0	4.5	7.5	56	11
MJ205		2.5	2/-	2.5	5.0	2.5	7.5	10	11
BU205		2.5	2/-	2.5	5.0	2.5	7.5	10	11
550 Volts									
MJ3760		8.0			5.0	8.0	7.5	80	11
MJ3761		6.0			5.0	8.0	7.5	80	11
400 Volts									
MJ7261		15	25/100	5.0	1.0	5.0	30	175	11
2N6547		15	6/35	10	1.5	10	6.0	175	11
MJ7161		8.0	25/100	3.0	1.0	3.0	30	140	11
2N6545		8.0	7/35	5.0	1.5	5.0	6.0	125	11
2N6543		5.0	7/35	3.0	1.0	3.0	6.0	100	11
MJ425		5.0	30/90	1.0	0.8	1.0	2.5	100	11
2N3902		3.5	30/90	1.0	0.8	1.0	2.8	100	11
350 Volts									
2N6251		15	6.0/50	10	1.5	10	2.5	175	11
2N6308		8.0	12/60	3.0	5.0	1.5	3.0	125	11
2N6499		5.0	10/75	2.5	1.5	2.5	5.0	80	199
MJE53		5.0	30/-	0.3	2.0	5.0	2.5	80	199
MJE49		1.5	30/250	0.3	1.0	1.0	5.0	50	199
2N3439		1.0	40/160	0.02	0.5	0.05	15	5.0	79
MJE5657		0.5	30/250	0.1	1.0	0.1	10	30	199
2N5657		0.5	30/250	0.1	1.0	0.1	10	20	77
MJE3439		0.3	40/160	0.02	0.5	0.05	15	15	77
325 Volts									
MJ423		10	30/90	1.0	0.8	1.0	2.5	125	11
MJ413		10	20/80	0.5	0.8	0.5	2.5	125	11
2N6235		5.0	25/125	1.0	0.5	1.0	20	50	80
300 Volts									
MJ7260		15	25/100	5.0	1.0	5.0	30	175	11
2N6546		15	6/35	10	1.5	10	6.0	175	11
2N6307		8.0	15/75	3.0	1.0	3.0	5.0	125	11
MJ7160		8.0	25/100	3.0	1.0	3.0	30	140	11
2N6544		8.0	7/35	5.0	1.5	5.0	6.0	125	11
MJE52		5.0	30/-	0.3	2.0	5.0	2.5	80	199
2N6542		5.0	7/35	3.0	1.0	3.0	6.0	100	11
2N6498		5.0	10/75	2.5	1.5	2.5	5.0	80	199
2N3585	2N6422	2.0	8/80	1.0	0.75	1.0	10	35	80
2N4240	2N6423	2.0	10/100	0.75	1.0	0.75	15	35	80
MJE48		1.5	30/250	0.3	1.0	1.0	5.0	50	199
MJE2160		1.5	30/240	0.5	3.5	0.5		50	199
2N3739	2N6425	1.0	40/200	0.1	2.5	0.25	10	20	80
	MJ5416	1.0	30/120	0.05	2.5	0.05	15	10	79
2N5656		0.5	30/250	0.1	1.0	0.1	10	20	77
MJE5656		0.5	30/250	0.1	1.0	0.1	10	30	199
MJE340K		0.5	30/240	0.05				30	199
MJE340	MJE350	0.5	30/240	0.05				20	77

HIGH VOLTAGE TRANSISTORS (continued)

Device and Polarity NPN	PNP	I_C Amp Max	h_{FE} Min/Max	@ I_C Amp	$V_{CE(sat)}$ Volts Max	@ I_C Amp	f_T MHz Min	P_D Watts Max	Case
275 Volts									
2N6250		15	8.0/50	10	1.5	10	2.5	175	11
2N6234		5.0	25/125	1.0	0.5	1.0	20	50	80
250 Volts									
2N6306		8.0	15/75	3.0	0.8	3.0	5.0	125	11
2N6497		5.0	10/75	2.5	1.5	2.5	5.0	80	199
MJE51		5.0	30/-	0.3	2.0	5.0	2.5	80	199
2N3584	2N6421	2.0	8.0/80	1.0	0.75	1.0	10	35	80
MJE47		1.5	30/250	0.3	1.0	1.0	5.0	50	199
2N3440		1.0	40/160	0.02	0.5	0.05	15	5.0	79
2N5655		0.5	30/250	0.1	1.0	0.1	10	20	77
MJE5655		0.5	30/250	0.1	1.0	0.1	10	30	199
MJE3440		0.3	40/160	0.02	0.5	0.05	15	15	77
225 Volts									
2N6233		5.0	25/125	1.0	1.0	1.0	20	50	80
2N3738	2N6424	1.0	40/200	0.1	2.5	0.25	10	20	80
200 Volts									
2N6249		15	10/50	10	1.5	10	2.5	175	11
	MJ5415	1.0	30/150	0.05	2.5	0.05	15	10	79

High Power Voltage Regulators

The MPC1000 and MPC900 are complete solid state hybrid regulators in a metal hermetic package. Specifications and performance of the MPC1000 positive voltage regulator and the MPC900 negative voltage regulator are nearly identical.

For systems requiring both a positive and a negative power supply, these devices are excellent for use as complementary regulators and offer the advantage of operation with a common ground. The devices are designed to deliver load current to 10 Adc. Output current capability can be increased further through use of one or more external pass transistors. They are specified for operation over the junction temperature range (−55 to +175°C).

Device and Polarity NPN	PNP	V_O Volts Min	V_O Volts Max	I_L A Max	$V_{in1} - V_O$ Volts Min	$V_{in1} - V_O$ Volts Max	V_{in} Volts Min	V_{in} Volts Max	I_{IB} mA Max	Reg_{in} % V_O/V_{in} Max	Reg_L % V_O Max	P_D Watts Max	Case
MPC1000		2.0	35	10	3.0	60	9.5	40	5.0	0.5	0.6	100	662-01
	MPC900	−4.0	−30	10	2.5	30	−9.0	35	20	0.5	0.6	100	662-01

High Frequency Transistors

The following high-frequency devices are intended for a wide variety of power amplifier and high-speed saturated switching applications. With minimum gain-bandwidth products (f_T) up to 100 MHz, these devices provide useful gain at high frequencies. The device types are listed in order of decreasing f_T and increasing I_C continuous.

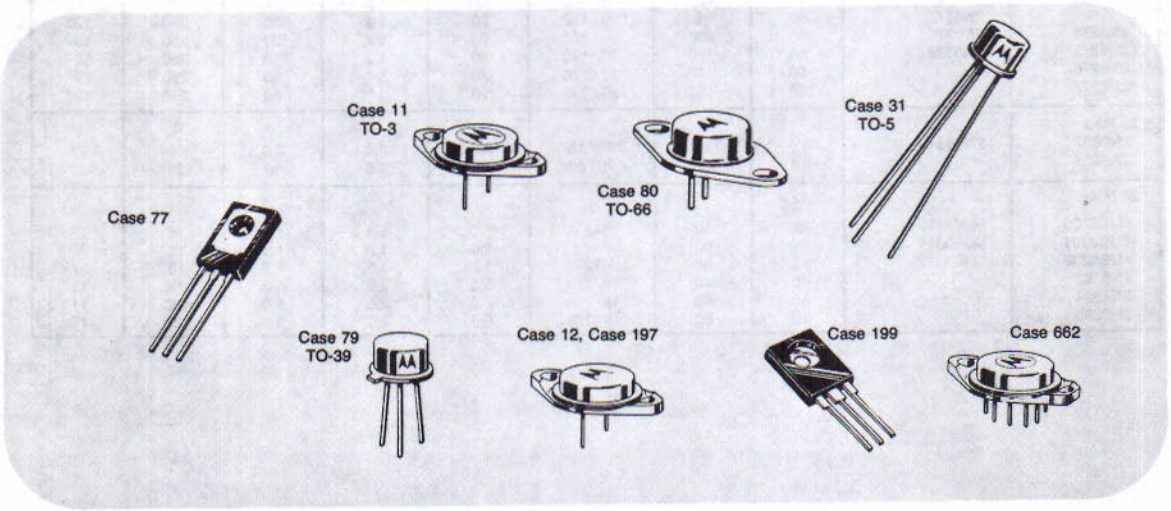
Device and Polarity NPN	PNP	I_C Amp Max	V_{CEO} Volts Max	h_{FE} Min/Max	@ I_C Amp	$V_{CE(sat)}$ Volts Max	@ I_C Amp	P_D Watts Max	Case
100 MHz									
2N5304		10	40	30/120	2.0	0.4	2.0	25	9
60 MHz									
	2N3867	3.0	40	40/200	1.5	0.75	1.5	6.0	31
	2N3868	3.0	60	30/150	1.5	0.75	1.5	6.0	31
50 MHz									
2N6408	2N6406	2.0	60	50/250	0.1	1.4	1.5	12.5	77
2N6409	2N6407	2.0	80	50/250	0.1	1.4	1.5	12.5	77
2N6410	2N6411	4.0	25	45/180	2.0	0.8	2.0	15	77
2N6412	2N6414	4.0	40	40/250	0.2	0.6	1.0	15	77
2N6413	2N6415	4.0	60	40/250	0.2	0.6	1.0	15	77
40 MHz									
2N6416	2N6418	3.0	80	40/250	0.2	1.0	1.0	15	77
2N6417	2N6419	3.0	100	40/250	0.2	1.0	1.0	15	77
	2N6436	25	80	20/80	10	1.0	10	200	11
	2N6437	25	100	20/80	10	1.0	10	200	11
2N6338		25	100	30/120	10	1.0	10	200	11
	2N6438	25	120	20/80	10	1.0	10	200	11
2N6339		25	120	30/120	10	1.0	10	200	11
2N6340		25	140	30/120	10	1.0	10	200	11
2N6341		25	150	30/120	10	1.0	10	200	11
30 MHz									
MJ7161		8.0	400	25/100	3.0	1.0	3.0	140	11
MJ7160		8.0	300	25/100	3.0	1.0	3.0	140	11
MJ7260		15	300	25/100	5.0	1.0	5.0	175	11
MJ7261		15	400	25/100	5.0	1.0	5.0	175	11
	2N6377	50	80	30/120	20	1.2	20	250	197
2N6274	2N6378	50	100	30/120	20	1.2	30	250	197
2N6275	2N6379	50	120	30/120	20	1.2	30	250	197
2N6276		50	140	30/120	20	3.0	50	250	197
2N6277		50	150	30/120	20	3.0	50	250	197
25 MHz									
2N6037	2N6034	4.0	40	750/15k	2.0	2.0	2.0	40	77
2N6495		10	80	10/60	10	1.5	10	70	80
20 MHz									
MJE3300	MJE3310	4.0	40	1k/-	1.0	1.5	1.5	15	77
MJE3301	MJE3311	4.0	60	1k/-	1.0	1.5	1.5	15	77
MJE3302	MJE3312	4.0	80	1k/-	1.0	1.5	1.5	15	77
2N6383		10	40	1k/20k	5.0	2.0	5.0	100	11
2N6384		10	60	1k/20k	5.0	2.0	5.0	100	11
2N6385		10	80	1k/20k	5.0	2.0	5.0	100	11

Motorola Replacements for Popular TIP Series

Type Number	Motorola Nearest Equivalent	Polarity	I_C Amp Max	V_{CEO} Volts Max	Case
TIP29	MJE29	NPN	1.0	40	77R
TIP29A	MJE29A	NPN	1.0	60	77R
TIP29B	MJE29B	NPN	1.0	80	77R
TIP29C	MJE29C	NPN	1.0	100	77R
TIP30	MJE30	PNP	1.0	40	77R
TIP30A	MJE30A	PNP	1.0	60	77R
TIP30B	MJE30B	PNP	1.0	80	77R
TIP30C	MJE30C	PNP	1.0	100	77R
TIP31	MJE31	NPN	3.0	40	77R
TIP31A	MJE31A	NPN	3.0	60	77R
TIP31B	MJE31B	NPN	3.0	80	77R
TIP31C	MJE31C	NPN	3.0	100	77R
TIP32	MJE32	PNP	3.0	40	77R
TIP32A	MJE32A	PNP	3.0	60	77R
TIP32B	MJE32B	PNP	3.0	80	77R
TIP32C	MJE32C	PNP	3.0	100	77R
TIP33	MJE33	NPN	10	40	199
TIP33A	MJE33A	NPN	10	60	199
TIP33B	MJE33B	NPN	10	80	199
TIP33C	MJE33C	NPN	10	100	199
TIP34	MJE34	PNP	10	40	199
TIP34A	MJE34A	PNP	10	60	199
TIP34B	MJE34B	PNP	10	80	199
TIP34C	MJE34C	PNP	10	100	199
TIP41	MJE41	NPN	6.0	40	199
TIP41A	MJE41A	NPN	6.0	60	199
TIP41B	MJE41B	NPN	6.0	80	199
TIP41C	MJE41C	NPN	6.0	100	199
TIP42	MJE42	PNP	6.0	40	199
TIP42A	MJE42A	PNP	6.0	60	199
TIP42B	MJE42B	PNP	6.0	80	199
TIP42C	MJE42C	PNP	6.0	100	199
TIP47	MJE47	NPN	1.5	250	77
TIP48	MJE48	NPN	1.5	300	77
TIP49	MJE49	NPN	1.5	350	77
TIP51	MJE51	NPN	5.0	250	199
TIP52	MJE52	NPN	5.0	300	199
TIP53	MJE53	NPN	5.0	350	199

R Suffix indicates reverse pin outs.

SILICON POWER DEVICE PACKAGES



SMALL-SIGNAL METAL TRANSISTORS

Silicon Small-Signal Transistors

500 AND GROWING! That phrase aptly describes the number of different classifications in Motorola's line of small-signal transistors. And with this many device type numbers covering the small-signal transistor spectrum, it is apparent that the actual differences between some devices becomes quite small. Even when the line is divided into its two natural categories — plastic for lowest cost, and metal for hermeticity — the sheer number of devices in each category makes selection by spec-for-spec comparison a significant task. This selector guide, therefore, ignores the large bulk of general-purpose, small-signal type numbers and concentrates on those transistors that have emerged as the best values in various applications categories.

Since the devices highlighted here are the most popular in each category, it follows that they are among the most widely available, at the lowest cost. They are particularly well-suited for new designs where a continuous, off-the-shelf supply of product is required.

The reader is reminded, however, that semiconductors are manufactured by "batch" processes, and that each "batch" may yield devices with widely varying parameters. This creates device "families". While the various specifications limits assigned to "family members" have been selected on the basis of demonstrated industry need, modern testing methods have made the selection of devices with special characteristics simple and inexpensive. Where the specified characteristics of the "preferred" devices listed in the following selector guides do not meet a particular design requirement, the designer is requested to contact his nearest Motorola sales representative for price quotations on special devices to fit his needs.

TABLE OF CONTENTS

The following index reflects the devices characterized in this section. To locate the exact page number, see Catalog Index(Page 7-1).

INDEX

Switching Transistors

The transistors listed below detail Motorola's Silicon Transistors. Prime devices are shown in Bold Face Type. Devices are listed in order of decreasing turn-on time (t_{on}).

Package	Family	Device Type	t_{on} ns Max	& t_{off} ns Max	@ I_C mA	BV_{CEO} Volts Min	I_C mA Max	h_{FE} Min	@ I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C mA	& I_B mA	f_T MHz Min	@ I_C mA
NPN														
TO-18	5	2N2845	40	40	150	30	—	30	150	0.4	150	15	250	50
		2N2540	40	40	150	30	—	100	150	0.45	150	15	250	20
		2N2539	40	40	150	30	—	50	150	0.45	150	15	250	20
TO-5	22	**2N3507S**	45	90	1500	50	3000	30	1500	1.0	1500	150	60	100
		2N3506S	45	90	1500	40	3000	40	1500	1.0	1500	150	60	100
TO-52	27	**2N3444S**	50	70	500	50	—	20	500	0.6	500	50	175	50
		2N3253S	50	70	500	40	—	25	500	0.6	500	50	175	50
		2N3252S	45	70	500	30	—	30	500	0.5	500	50	200	50
TO-39		**2N3725**	35	60	500	50	2000	35	500	0.52	500	50	300	50
		2N3724	35	60	500	30	2000	35	500	0.42	500	50	300	50
		2N3735	48	60	1000	75	1500	20	1000	0.5	500	50	250	50
		2N3734	48	60	1000	50	1500	30	1000	0.5	500	50	250	50
		MM5189	40	70	—	40	2000	20	1000	1.0	1000	100	350 (typ)	50
		2N5859	35	60	1000	40	2000	15	1000	0.4	500	50	250	50
		MM3734	35	60	1000	30	1500	25	1000	0.5	500	50	200	50
		MM5262	30	60	1000	50	2000	25	1000	0.8	1000	100	350 (typ)	50
		2N5861	25	60	500	50	2000	25	500	0.5	500	50	200	50
TO-18		2N4014	35	60	500	50	1000	35	500	0.52	500	50	300	50
		2N4013	35	60	500	30	1000	35	500	0.42	500	50	300	50
TO-18	73	2N3011	15	20	30	12	200	25	30	0.25	30	3.0	400	20
		2N3227	12	18	100	20	500	30	100	0.25	10	1.0	500	10
		2N2369	12	18	100	15	500	20	100	0.25	10	1.0	500	10
		2N2369A	12	18	10	15	200	40	10	0.2	10	1.0	500	10
		2N2368	12	15	10	15	—	20	10	0.25	10	1.0	400	10
TO-46		2N2319	60	50	20	15	200	40	20	0.35	20	1.0	300	10
		2N2206	40	75	10	12	200	40	10	220	10	1.0	200	10
		2N3508	12	18	10	20	500	40	10	0.25	10	1.0	500	10
		2N3509	12	18	10	20	500	100	10	0.25	10	1.0	500	10
TO-46	81	2N3647	20	25	150	10	500	25	150	0.4	150	15	350	15
		2N3648	16	18	150	15	500	30	150	0.4	150	15	450	15
TO-46	99	2N3737	48	60	1000	50	1500	20	1000	0.5	500	50	250	50
		2N3736	48	60	1000	30	1500	30	1000	0.5	500	50	250	50
		MM3737	45	65	1000	50	1500	20	1000	0.5	500	50	200	50
		MM3736	45	65	1000	30	1500	30	1000	0.5	500	50	200	50

Switching Transistors (Continued)

Package	Family	Device Type	t_{on} ns Max	& t_{off} ns Max	@ I_C mA	BV_{CEO} Volts Min	I_C mA Max	h_{FE} Min	@ I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C mA	& I_B mA	f_T MHz Min	@ I_C mA
PNP														
TO-18	44	2N3249	90	100	10	12	—	100	10	0.125	10	1.0	300	20
		2N869A	50	80	30	18	200	40	30	0.2	30	3.0	400	10
		2N2894	60	90	30	12	200	40	30	0.2	30	3.0	400	30
		2N3012	60	75	30	12	200	30	30	0.2	30	3.0	400	30
TO-18	45	2N3546	40	30	50	12	—	25	50	0.25	50	5.0	700	10
TO-39	50	2N4890S	100	270	150	40	500	50	150	1.4	150	15	100	50
		MM4036	75	175	150	65	1000	40	150	0.65	150	15	60	50
		MM4037	75	175	150	40	1000	50	150	1.4	150	15	60	50
		2N4405	40	210	500	80	1000	25	500	0.5	500	50	200	50
		2N4404	40	210	500	80	1000	15	500	0.5	500	50	200	50
TO-39	56	MM4031	100	240 (typ)	500	80	1000	25	500	0.5	500	50	100	50
		MM4033	100	240 (typ)	500	80	1000	70	500	0.5	500	50	150	50
		MM4032	100	240 (typ)	500	60	1000	70	500	0.5	500	50	150	50
		MM4030	100	240 (typ)	500	60	1000	25	500	0.5	500	50	100	50
		2N4407	75	225	1000	80	2000	15	1000	0.7	1000	100	150	50
		2N4406	75	225	1000	80	2000	10	1000	0.7	1000	100	150	50
		MM4007	—	—	—	100	1000	50	150	0.1 (typ)	150	15	50	50
		MM4006	—	—	—	80	1000	50	150	0.1 (typ)	150	15	50	50
		MM4005	—	—	—	60	1000	50	150	0.1 (typ)	150	15	50	50
TO-39	60	**2N3763S**	43	115	1000	60	1500	20	1000	0.9	1000	100	150	50
		2N3762S	43	115	1000	40	1500	30	1000	0.9	1000	100	180	50
TO-39	337	2N3245S	55	165	500	50	1000	30	500	0.6	500	50	150	50
		2N3244S	50	185	500	40	1000	50	500	0.5	500	50	175	50
		2N3468S	40	90	500	50	1000	25	500	0.6	500	50	150	50
		2N3467S	40	90	500	40	100	40	500	0.5	500	50	175	50
		MM3726	35	60	1000	50	1500	15	1000	1.2	1000	100	200	50
TO-18	345	2N4209	15	20	10	15	200	50	10	0.18	10	1.0	850	10
		2N4208	15	20	10	12	200	30	10	0.15	10	1.0	700	10
		MM4258	15	20	10	12	80	30	10	0.15	10	1.0	700	10
		MM4257	15	15	10	6.0	80	30	10	0.15	10	1.0	500	10
TO-39	454	2N3636S	400	600	50	175	1000	50	50	0.5	50	5.0	150	30
		2N3635S	400	600	50	140	1000	100	50	0.5	50	5.0	200	30
		2N3634S	400	600	50	140	1000	50	50	0.5	50	5.0	150	30
		2N4929S	—	—	—	150	500	25	10	0.5	10	1.0	100	20
		MM4001	—	—	—	150	500	20	10	0.6	10	1.0	—	—

High-Gain Low-Noise Transistors

The transistors are characterized for high-gain and low-noise applications. Devices are listed in decreasing order of NF.

Package	Family	Device Type	NF Wideband Typ* Max dB	BV_{CEO} Volts Min	I_C mA Max	h_{FE} Min	h_{FE} Max	@ I_C µA mA*	f_T MHz Min	@ I_C mA
NPN										
TO-18	18	2N2483	8.0*	60	50	40	120	10	12	0.05
		2N2484	8.0*	60	50	100	500	10	15	0.05
		2N929	4.0	45	30	40	120	10	30	0.5
		2N930A	3.0	45	30	100	300	10	45	0.5
		2N930	3.0	45	30	100	300	10	30	0.5
NPN DARLINGTON										
TO-18	914	MM6427	—	40	300	5000	—	10*	125	100
PNP										
TO-18	55	2N3798	3.5	60	50	150	450	500	30	0.5
		2N3799	2.5	60	50	300	900	500	30	0.5

High-Voltage Amplifiers

The following table lists Motorola standard devices that have high Collector-Emitter Breakdown Voltage. Prime devices are shown in Bold Face Type. Devices are listed in decreasing order of BV_{CEO}.

Package	Family	Device Type	BV_{CEO} Volts Min	I_C mA Max	h_{FE} Min	@ I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C mA	& I_B mA	f_T MHz Min	@ I_C mA
NPN											
TO-39	6	MM3009	180	400	40	10	—	—	—	50	20
		MM3008	120	400	40	10	—	—	—	50	20
TO-39	26R	MM2259	175	300	35	10	0.4	25	2.5	150	20
		2N3501S	150	300	100	150	0.4	150	15	150	20
		2N3500S	150	300	40	150	0.4	150	15	150	20
		2N3114S	150	200	30	30	1.0	50	5.0	40	30
		2N3712S	150	200	30	30	2.0	50	5.0	40	30
		MM3001	150	200	20	10	—	—	—	150	10
		MM2258	120	500	50	10	0.4	25	2.5	150	20
		2N3499S	100	500	100	150	0.6	300	30	150	20
		2N3498S	100	500	40	150	0.6	300	30	150	20
		2N4924S	100	200	40	150	0.4	50	5.0	100	20
		2N657S	100	—	30	200	4.0	200	40	—	—
		2N1990S	—	1000	20	30	0.5	2.0	0.2	—	—
TO-39	88	MM3007	100	2500	50	250	0.35	150	15	50	50
		MM3006	80	2500	50	200	0.35	150	15	50	50
		MM3005	60	2500	50	150	0.35	150	15	50	50
TO-39	210R	2N5058S	300	150	35	30	1.0	30	3.0	30	10
		2N3742S	300	50	20	30	1.0	30	3.0	30	10
		2N5059S	250	150	30	30	1.0	30	3.0	30	10
		2N4927	250	50	20	30	2.0	30	3.0	30	10
		MM3003	250	50	20	10	—	—	—	150	10
		2N4926	200	50	20	30	2.0	30	3.0	30	10
		MM3002	200	50	20	10	—	—	—	150	10

High-Voltage Amplifiers (Continued)

Package	Family	Device Type	BV_{CEO} Volts Min	I_C mA Max	h_{FE} Min	@ I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C mA	& I_B mA	f_T MHz Min	@ I_C mA
PNP											
TO-39	46	**2N3495S**	120	100	40	10	0.35	10	1.0	150	20
		2N4928S	100	100	25	10	0.5	10	1.0	100	20
		MM4000	100	100	20	10	0.6	10	1.0	—	—
		2N3494S	80	100	40	10	0.3	10	1.0	200	20
TO-18	47	2N3497	120	100	40	10	0.35	10	1.0	150	20
		2N3496	80	100	40	10	0.3	10	1.0	200	20
TO-39	49	MM4010	100	500	75	10	0.2 (typ)	10	1.0	150 (typ)	20
		MM5007	100	2000	50	250	0.5	150	15	30	50
		MM4009	80	500	75	10	0.2 (typ)	10	1.0	150 (typ)	20
		MM5006	80	2000	50	200	0.5	150	15	30	50
		MM5005	60	2000	50	150	0.5	150	15	30	50
TO-39	50	2N4405	80	1000	100	150	0.2	150	15	200	50
		2N4404	80	1000	40	150	0.2	150	15	200	50
		MM4036	65	1000	20	150	0.65	150	15	60	50
		MM4037	40	1000	50	150	1.4	150	15	60	50
		2N4890S	40	500	50	150	1.4	150	15	100	50
TO-39	452R	**2N3743S**	300	50	25	30	8.0	30	3.0	30	10
		2N4931S	250	500	20	20	5.0	10	1.0	20	20
		MM4003	250	500	20	10	5.0	10	1.0	—	—
		2N4930S	200	500	20	20	5.0	10	1.0	20	20
		MM4002	200	500	20	10	5.0	10	1.0	—	—
TO-39	454R	**2N3637S**	175	1000	100	50	0.5	50	5.0	200	30
		2N3636S	175	1000	50	50	0.5	50	5.0	150	30
		2N4929S	150	500	25	10	0.5	10	1.0	100	20
		MM4001	150	500	20	10	0.6	10	1.0	—	—
		2N3635S	140	1000	100	50	0.5	50	5.0	200	30
		2N3634S	140	1000	50	50	0.5	50	5.0	150	30

High-Frequency Amplifiers/ Oscillators

The transistors shown are designed for use as both oscillators and amplifiers at UHF and VHF frequencies. Devices are listed in decreasing order of BV_{CEO}.

Package	Family	Device Type	BV_{CEO} Volts Min	h_{FE} Min	@ I_C mA	G_{pe} dB Min	NF dB Max	@ f MHz	f_T MHz Min	@ I_C mA	C_{ob} pF Max
NPN											
TO-72	72	2N917	15	20	3.0	9.0	6.0	60	500	4.0	1.7
		2N918	15	20	3.0	15	6.0	60	600	4.0	1.7
TO-38	75	2N3544	25	25	10	—	—	—	600	10	2.5
		MM1941	20	25	10	7.0	—	—	600	10	2.5
PNP											
TO-18	63	2N3307	35	40	2.0	17	4.5	200	300	2.0	1.3
		2N3308	25	25	2.0	17	6.0	200	300	2.0	1.6
TO-72	65	2N4261	15	30	10	—	—	—	1600	10	2.5
		2N4260	15	30	10	—	—	—	2000	10	2.5

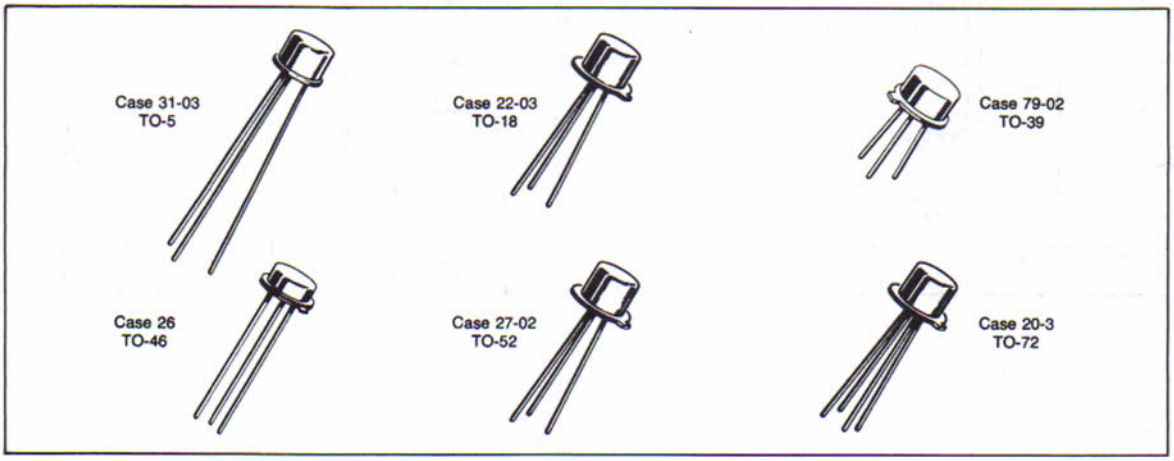
General-Purpose Amplifiers

These transistors are designed for high speed switching circuits, dc to VHF amplifier applications and complementary circuitry. Prime devices are shown in Bold Face Type. Devices are listed in decreasing order of BV_{CEO}.

Package	Family	Device Type	BV_{CEO} Volts Min	f_T MHz Min	@ I_C mA	I_C mA Max	h_{FE} Min	h_{FE} Max	@ I_C mA
NPN									
TO-39	2R	2N2959S	60	250	20	600	100	300	150
		2N2951S	60	200	10	250	20	150	10
		2N1711S	80	70	50	—	100	300	150
		2N1613S	50	60	50	500	40	120	150
		2N2219AS	40	300	20	800	100	300	150
		2N2218AS	40	250	20	800	40	120	150
		2N697S	40	50	50	—	40	120	150
		2N2789S	35	250	20	800	100	300	150
		2N3299S	30	250	50	500	40	120	150
		2N3300S	30	250	50	500	100	300	150
		2N2218S	30	250	20	800	40	120	150
		2N2219S	30	250	20	800	100	300	150
TO-46	2S	**2N5582**	40	300	20	800	100	300	150
		2N5581	40	250	20	800	40	120	150
		2N4450	30	250	50	500	100	300	150
TO-18	3	2N956	50	70	50	—	40	120	150
		2N843	45	40	10	800	45	150	10
		2N2222A	40	300	20	800	100	300	150
		2N2221A	40	250	20	800	40	120	150
		2N718	40	50	50	—	40	120	150
		2N717	40	40	50	500	20	60	150
		2N3301	30	250	50	500	40	120	150
		2N3302	30	250	50	500	100	300	150
		2N2221	30	250	20	800	40	120	150
		2N2222	30	250	20	800	100	300	150
TO-39	14R	**2N3019S**	80	100	50	1000	100	300	150
		2N3020S	80	80	50	1000	40	120	150
		2N699	80	50	50	—	40	120	150
		2N1893S	80	50	50	500	40	120	150
		2N2102S	65	60	50	1000	40	120	150
		2N3053AS	60	100	50	700	50	250	150
		2N1890S	60	60	50	500	100	300	150
		2N656S	60	—	—	—	30	90	200
		MM3053	50	100	50	1000	40	300	150
		2N2193AS	50	50	50	1000	40	120	150
		2N2270S	45	100	50	1000	50	200	150
		2N3110S	40	600	10	1000	40	120	150
		2N3053S	40	100	50	700	50	250	150
		2N2297S	35	60	50	1000	40	120	150
TO-18	23	2N915	50	250	10	—	50	200	10
		2N3946	40	300	10	200	50	150	10
		2N3947	40	300	10	200	100	300	10
		2N916	25	300	10	—	50	200	10
TO-52	221	MM3904	40	300	10	200	100	300	10
		MM3903	40	250	10	200	50	150	10

General - Purpose Amplifiers (Continued)

Package	Family	Device Type	BV_{CEO} Volts Min	f_T MHz Min	@ I_C mA	I_C mA Max	h_{FE} Min	Max	@ I_C mA
PNP									
TO-18	35	**2N3251A**	60	300	10	200	100	300	10
		2N3250A	60	250	10	200	50	150	10
		2N3251	40	300	10	200	100	300	10
		2N3250	40	250	10	200	50	150	10
TO-46	48	2N3485A	60	200	50	600	40	120	150
		2N3486A	60	200	50	600	100	300	150
		2N3673	50	200	50	600	75	225	150
		2N3486	40	200	50	600	100	300	150
TO-18	333	**2N2906A**	60	200	50	600	40	120	150
		2N2907A	60	200	50	600	100	300	150
		2N3073	60	130	50	500	30	130	50
		2N3135	50	200	50	600	40	120	150
		2N2906	40	200	50	600	40	120	150
		2N2907	40	200	50	600	100	300	150
TO-39		**2N2904AS**	60	200	50	600	40	120	150
		2N2905AS	60	200	50	600	100	300	150
		MM4008	60	325 (typ)	20	500	75	—	10
		2N3133S	50	200	50	600	40	120	150
		2N2904S	40	200	50	600	40	120	150
		2N2905S	40	200	50	600	100	300	150
		2N1132AS	40	60	50	600	30	90	150
		2N1131AS	40	50	50	600	30	90	150
		2N2800S	35	120	50	800	30	90	150
		2N1132S	35	60	50	600	30	90	150
		2N1131S	35	50	50	600	30	90	150
		2N1991S	20	40	50	600	15	60	150
TO-52	271	MM3906	40	250	10	200	100	300	10
		MM3905	40	200	10	200	50	150	10



SMALL-SIGNAL
PLASTIC-ENCAPSULATED TRANSISTORS

Plastic-Encapsulated Small-Signal Transistors for Industrial and Consumer applications

The Small-Signal Plastic Transistors represent Motorola's broadest product line. From RF/VHF/UHF amplifiers, mixers, oscillators and switches to general-purpose amplifiers and switches, all are available as standard product or custom specials. Specialty devices for the industrial, computer or consumer market as well as specialty packages – Duowatt and Uniwatt – are all available for unique high technology applications. The following list demonstrates the many applications possible with plastic transistors. If specific applications are not listed, consult your factory representative for assistance.

TABLE OF CONTENTS

The following index reflects the devices characterized in this section. To locate the exact page number, see Catalog Index(Page 7-1).

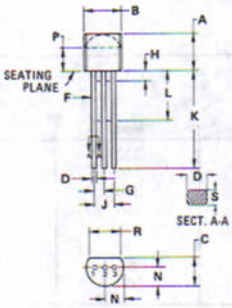
INDEX

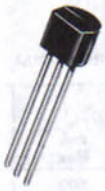
This Selector Guide is designed to help you select the right silicon plastic transistor for your applications. A wide range of device types in three basic package configurations are listed in this Selector Guide.

The TO-92 — is the most popular, high-volume plastic package and will meet most of your high-performance, low-cost requirements.

The Uniwatt/Duowatt Package — is designed for applications requiring greater power dissipation than available with the TO-92 package.

MOTOROLA PLASTIC PACKAGE OUTLINES

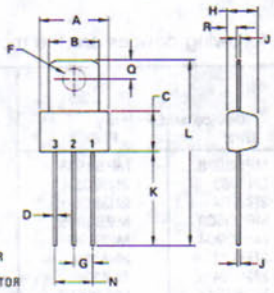




Case 29-02
TO-92

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	4.32	5.33	0.170	0.210
B	4.44	5.21	0.175	0.205
C	3.18	4.19	0.125	0.165
D	0.41	0.56	0.016	0.022
F	0.41	0.48	0.016	0.019
G	1.14	1.40	0.045	0.055
H	–	2.54	–	0.100
J	2.41	2.67	0.095	0.105
K	12.70	–	0.500	–
L	6.35	–	0.250	–
N	2.03	2.92	0.080	0.115
P	2.92	–	0.115	–
R	3.43	–	0.135	–
S	0.36	0.41	0.014	0.016

All JEDEC dimensions and notes apply.

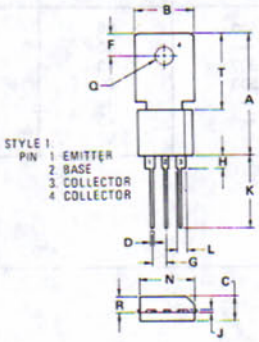


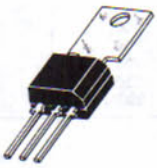
Uniwatt

Case 152-02

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	9.14	9.53	0.360	0.375
B	6.60	7.24	0.260	0.285
C	5.41	5.66	0.213	0.223
D	0.38	0.53	0.015	0.021
F	3.18	3.33	0.125	0.131
G	2.54 BSC		0.100 BSC	
H	3.94	4.19	0.155	0.165
J	0.36	0.41	0.014	0.016
K	12.07	12.70	0.475	0.500
L	25.02	25.53	0.985	1.005
N	5.08 BSC		0.200 BSC	
Q	2.39	2.69	0.094	0.106
R	1.14	1.40	0.045	0.055

NOTE:
1. LEADS WITHIN 0.15 mm (0.006) TOTAL OF TRUE POSITION AT CASE, AT MAXIMUM MATERIAL CONDITION.





Duowatt

Case 306-02

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	21.84	22.35	0.860	0.880
B	9.91	10.41	0.390	0.410
C	4.19	4.44	0.165	0.175
D	0.61	0.71	0.024	0.028
F	3.68	3.94	0.145	0.155
G	2.41	2.67	0.095	0.105
H	1.70	1.96	0.067	0.077
J	0.48	0.66	0.019	0.026
K	12.70	–	0.500	–
L	1.78	2.03	0.070	0.080
N	9.91	10.16	0.390	0.400
Q	3.56	3.81	0.140	0.150
R	2.41	2.67	0.095	0.105
T	13.21	13.97	0.520	0.550

General Purpose Amplifiers and Switches —TO-92 Package

Silicon transistors designed for use in complementary amplifier circuits. The transistors are listed in order of decreasing breakdown voltage (BV_{CEO}).

The following devices are the most popular consumer amplifier transistors:

Device and Polarity NPN	Device and Polarity PNP	BV_{CEO} Volts Min	f_T @ I_C = 10 mA MHz Min Typ*	I_C mA Max	h_{FE} Min	h_{FE} Max	@ I_C mA
MPS8098	MPS8598	60	200	500	100	300	10
2N3903	2N3905	40	270*	200	50	150	10
2N3904	2N3906	40	250	200	100	300	10
MPS3903	MPS3905	40	150	200	50	150	10
MPS3904	MPS3906	40	200	200	100	300	10
2N4123	2N4125	30	250	200	50	150	2.0
2N4124	2N4126	25	300	200	120	360	2.0
MPS6515	MPS6519	25	100	—	250	500	2.0

The following devices are the most popular consumer low-noise transistors:

Device and Polarity NPN	Device and Polarity PNP	BV_{CEO} Volts Min	f_T @ I_C = 500 μA MHz Min	I_C mA Max	h_{FE} Min	h_{FE} Max	@ I_C μA	NF dB Typ
MPS-A18		45	100	200	500	1500	10	4.0
2N5088	2N5086	30	40	50	150	500	100	3.0
2N5089	2N5087	25	40	50	250	800	100	2.0

The following are the most popular industrial high-voltage and high current transistors:

Device and Polarity NPN	Device and Polarity PNP	BV_{CEO} Volts Min	f_T MHz Typ* Min	@ I_C mA	I_C mA Max	h_{FE} @ I_C = 10 mA Min	h_{FE} @ I_C = 10 mA Max
2N5551	2N5401	160	100	10	600	80	250
2N5550	2N5400	140	100	10	—	40	180
MPS-A06	MPS-A56	80	100	100	500	50	—
MPS-A05	MPS-A55	60	100	100	500	50	—
2N4400	2N4402	40	200	20	—	40	—
2N4401	2N4403	40	250	20	—	40	—
MPS6531	MPS6534	40	390*	50	—	60	120

RF/UHF/VHF Amplifiers and CATV Transistors

The transistors listed below are the high performance, high frequency standard transistors available in the TO-92 plastic package. The transistors are listed in order of decreasing breakdown voltage (BV_{CEO}).

Device Type	BV_{CEO} Volts Min	h_{FE} Min	@ I_C mA	G_{pe} G_{pb}* dB Typ# Min	NF dB Typ* Max	@ f MHz	V_{AGC} I_{AGC}# Typ* Min	@ Gain Reduction dB	f_T MHz Min	@ I_C mA.	C_{cb} C_{ce}* pF Max
NPN											
MPS-H04	80	30	1.5	—	2.0	1.0	—	—	80	1.5	1.6
MPS-H05	80	30	1.5	—	2.0	1.0	—	—	80	1.5	1.6
MPS-H34	45	15	20	—	—	—	—	—	500	15	0.32
MPS-H37	40	25	5.0	—	—	—	—	—	300	5.0	100
MPS-H07	30	20	3.0	18*	3.2	100	5.0*	30	400	3.0	0.3*
MPS-H08	30	20	3.0	14*	3.5	200	5.0*	30	500	3.0	0.3*
MPS-H20	30	25	4.0	—	—	—	—	—	400	4.0	0.65
MPS-H24	30	30	8.0	—	—	—	—	—	400	8.0	0.36
MPS-H32	30	27	4.0	22.5	3.3*	45	5.5#	30	300	4.0	0.22
MPS-H10	25	60	4.0	—	—	—	—	—	650	4.0	0.7
MPS-H11	25	60	4.0	—	—	—	—	—	650	4.0	0.7
MPS-H19	25	45	4.0	—	—	—	—	—	300	4.0	0.65
MPS-H02	20	20	4.0	20	3.3	200	4.0	30	375	4.0	0.5
MPS-H30	20	20	4.0	22.5	6.0	45	4.4	30	300	4.0	0.65
MPS-H31	20	20	4.0	22.5	6.0	45	5.2	30	300	4.0	0.65
MPS-H17	15	25	5.0	24#	6.0	200	—	—	800	5.0	0.9
PNP											
MPS-H54	80	30	1.5	—	2.0	1.0	—	—	80	1.5	1.6
MPS-H55	80	30	1.5	—	2.0	1.0	—	—	80	1.5	1.6
MPS-H83	30	20	2.5	10*	6.5	850	4.5*	30	600	2.5	0.3*
MPS-H85	30	20	2.5	14*	6.5	200	—	—	350	2.5	0.2*
MPS6543	25	25	4.0	—	—	—	—	—	750	4.0	—
MPS6546	25	20	2.0	—	—	—	—	—	600	2.0	0.45*
MPS6547	25	20	2.0	20	—	100	—	—	600	2.0	0.35*
MPS6568	20	20	4.0	20	3.3	200	4.0	30	375	4.0	0.5
MPS6569	20	20	4.0	20	6.0	45	4.4	30	300	4.0	0.5
MPS6570	20	20	4.0	20	6.0	4.5	5.2	30	300	4.0	0.5
MPS6507	20	25	2.0	—	—	—	—	—	700	10	—
MPS6511	20	25	10	30	—	4.5	—	—	—	—	—
MPS6541	20	25	4.0	—	—	—	—	—	—	—	—

High-Speed Saturated Switching Transistors

The transistors listed in this table are specially optimized for high-speed saturated switches. They are heavily gold doped and processed to provide very short switching times and low output capacitance (below 6 pF). The transistors are listed in order of decreasing turn-on time (t_{on}).

Device Type	t_{on} ns Max	& t_{off} ns Max	@ I_C mA	BV_{CEO} Volts Oin	h_{FE} Min	@ I_C mA	$V_{CE(sat)}$ Volts @ I_C & I_B Max	mA	mA	f_T MHz Min	@ I_C mA
NPN											
MPS706,A	40	75	10	15	20	10	0.6	10	1.0	200	10
2N4264	25	35	10	15	40	10	0.22	10	1.0	300	10
2N4265	25	35	10	12	100	10	0.22	10	1.0	300	10
MPS835	20	35	10	—	20	10	0.3	10	1.0	300	10
MPS3646	18	28	300	15	30	30	0.2	30	3.0	350	30
MPS834	16	30	10	—	25	10	0.25	10	1.0	350	10
MPS2369	12	18	10	15	40	10	0.25	10	1.0	500	10
PNP											
MPS3640	25	35	50	12	30	10	0.2	10	1.0	500	10
MPS3639	25	25	50	6.0	30	10	0.16	10	1.0	—	

General-Purpose Transistors

These general-purpose transistors are designed for small-signal amplification from dc to low radio frequencies. They are also useful as oscillators and general-purpose switches. The transistors are listed in order of decreasing breakdown voltage (BV_{CEO}).

Device and Polarity NPN	PNP	BV_{CEO} Volts Min	f_T MHz Min	@ I_C mA	I_C mA Max	h_{FE} Min	Max	@ I_C mA
MPS8099	MPS8599	80	150	10	200	100	300	1.0
MPS-A06	MPS-A56	80	100	10	500	50	—	100
MPS8098	MPS8598	60	150	10	200	100	300	1.0
MPS-A05	MPS-A55	60	100	10	500	50	—	100
2N3904	2N3906	40	300	10	200	100	300	10
2N4401	2N4403	40	250	20	600	100	300	150
2N3903	2N3905	40	250	10	200	50	150	10
2N4400	2N4402	40	200	20	600	50	150	150
MPS-A20	MPS-A70	40	125	5.0	100	40	400	5000
MPS6531	MPS6534	40	—	50	600	100	300	150
MPS2222	MPS2907	30	250	20	600	100	300	150
2N4123	2N4125	30	250	10	200	50	150	2.0
MPS3704	MPS3702	30	100	50	600	100	300	50
2N4124	2N4126	25	300	10	300	120	360	2.0
MPS-D06	MPS-D56	25	100	10	50	50	—	10
MPS-D05	MPD-D55	25	100	50	500	80	—	100
2N5225	2N5226	25	50	20	200	30	600	50
MPS6514	MPS6518	25	200	10	200	50	300	10
2N5220	2N5221	15	100	20	500	30	600	50

Low-Noise Amplifier Transistors

The small-signal transistors listed in this table are characterized for low-noise amplification at low frequencies. The transistors are listed in decreasing order of noise figure (NF).

Device Type	NF dB Typ	@ f kHz* Hz	BV_{CEO} Volts Min	h_{FE} Min	@ I_C mA	f_T MHz Min	@ I_C mA
NPN							
2N4123	6.0	Audio	30	50	2.0	250	10
2N3903	6.0	Audio	40	50	10	250	10
2N4124	5.0	Audio	25	120	2.0	300	10
2N3904	5.0	Audio	40	100	10	300	10
MPS6565	4.0	Audio	45	40	10	—	—
MPS6566	4.0	Audio	45	100	10	—	—
2N5209	3.0	Audio	50	150	10	30	500
2N5088	3.0	Audio	30	100	300	50	500
MPS6520	3.0	Audio	25	200	2.0	390	2.0
MPS6521	3.0	Audio	25	300	2.0	390	2.0
2N5210	2.0	Audio	5.0	250	10	30	500
MPS8097	2.0	100	40	250	0.1	200	10
2N5089	2.0	Audio	25	400	10	50	500
MPS-A18	1.5	Audio	45	500	10	100	1.0
MPS-A09	1.4	1.0*	50	100	0.1	30	0.5
MPS6571	1.2	100	20	250	100	50	500
PNP							
2N4125	5.0	Audio	30	50	2.0	200	10
2N3905	5.0	Audio	40	50	10	200	10
2N3906	4.0	Audio	40	100	10	250	10
2N4126	4.0	Audio	25	120	2.0	250	10
2N5086	3.0	Audio	50	100	150	40	500
MPS6522	3.0	Audio	25	200	2.0	340	2.0
MPS6523	3.0	Audio	25	300	2.0	340	2.0
2N5087	2.0	Audio	50	250	10	40	500

Audio = 10 Hz to 15.7 kHz.

High-Voltage Transistors

These high-voltage transistors are designed for driving neon bulbs and Nixie® indicator tubes, for direct line operation, and for other applications requiring high-voltage capability at relatively low collector current. These devices are listed in order of decreasing breakdown voltage (BV_{CEO}).

Device Type	BV_{CEO} Volts Min	I_C Amp Max	h_{FE} Min	@ I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C mA	& I_B mA	f_T MHz Min	@ I_C mA
NPN									
2N6517	350	0.5	40	30	0.30	10	1.0	40	10
2N6516	300	0.5	45	30	0.30	10	1.0	40	10
MPS-A42	300	0.5	40	10	0.5	20	2.0	50	10
2N6515	250	0.5	50	30	0.30	10	1.0	40	10
MPS-A43	200	0.5	40	10	0.4	20	2.0	50	10
MPS-D01	200	0.1	20	30	—	—	—	40	10
2N5551	160	0.6	80	10	0.15	10	1.0	100	10
2N5550	140	0.6	60	10	0.15	10	1.0	100	10
MPSD-02	140	0.05	20	30	—	—	—	40	10
MPS-D03	100	0.05	50	10	0.2	10	1.0	60	10
MPS-L01	100	0.05	20	30	—	—	—	40	10
PNP									
2N6520	350	0.5	30	30	0.30	10	1.0	40	10
2N6519	300	0.5	45	30	0.30	10	1.0	40	10
MPS-A92	300	0.5	40	10	0.8	20	2.0	50	10
2N6518	250	0.5	50	30	0.30	10	1.0	40	10
MPS-A93	200	0.5	40	10	0.7	20	2.0	50	10
MPS-D51	200	0.1	20	30	—	—	—	40	10
2N5401	150	0.6	60	10	0.2	10	1.0	100	10
MPS-D52	140	0.05	20	30	—		—	40	10
2N5400	120	0.6	40	10	0.2	10	1.0	100	10
MPS-D53	100	0.05	20	30	—	—	—	40	10
MPS-L51	100	0.6	40	50	0.25	10	1.0	60	10

® Registered Trademark of Burroughs Corporation.

Medium-Power (Uniwatt and Duowatt) Transistors

For applications requiring higher power dissipation than that of the standard Unibloc package, Motorola has developed the Uniwatt and Duowatt packages. These plastic packages are slightly larger than the TO-92 case. Without a heat sink the Uniwatt package can dissipate 1 Watt @ $T_A = 25^oC$; the Duowatt can dissipate 2 Watts @ $T_A = 25^oC$.

The transistors are listed in order of increasing collector current (I_C).

Uniwatt Transistors (P_D = 1.0 Watt @ T_A = 25° C)

Device Type	I_C Adc Max	BV_{CEO} Volts Min	h_{FE} Min	@ I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C mA	& I_B mA	f_T MHz Min	@ I_C mA
NPN									
MPS-U10	0.5	300	40	10	0.75	30	30	60	10
MPS-U02	0.8	40	50	150	0.4	150	15	15	20
MPS-U03	1.0	120	40	10	0.5	200	20	100	50
MPS-U04	1.0	180	40	10	0.5	200	20	100	50
MPS-U01	2.0	30	60	100	0.5	1000	100	50	50
MPS-U01A	2.0	40	60	100	0.5	1000	100	50	50
MPS-U45	2.0	40	15 k	500	1.5	1.0	2.0	100	200
MPS-U05	2.0	60	60	250	0.4	200	10	50	200
MPS-U06	2.0	80	60	250	0.4	250	10	50	200
MPS-U07	2.0	180	30	250	0.4	250	10	50	200
PNP									
MPS-U60	0.5	300	30	10	0.75	20	2.0	60	10
MPS-U52	0.8	40	50	150	0.4	150	15	150	20
MPS-U51	2.0	30	60	100	0.7	1.0	0.1	50	50
MPS-U51A	2.0	40	60	100	0.7	1.0	0.1	50	50
MPS-U95	2.0	40	15 k	500	1.5	1000	2.0	500	200
MPS-U55	2.0	60	50	250	0.5	250	10	50	200
MPS-U56	2.0	80	50	250	0.5	250	10	50	200
MPS-U57	2.0	100	30	250	0.5	250	10	50	200

Duowatt Transistors (P_D = 2.0 Watt @ T_A = 25°C)

Device Type	I_C Adc Max	BV_{CEO} Volts Min	h_{FE} Min	@ I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C mA	& I_B mA	f_T MHz Min	@ I_C mA
NPN									
2N6557	0.5	250	40	30	0.6	30	3.0	45	10
2N6558	0.5	300	40	30	0.6	30	3.0	45	10
2N5669	0.5	350	40	30	0.6	30	3.0	45	10
2N6551	1.0	60	80	50	0.5	250	10	75	100
2N6552	1.0	80	80	50	0.5	250	10	75	100
2N6553	1.0	100	80	50	0.5	250	10	75	100
2N6548	2.0	40	25 k	200	1.5	1.0	2.0	75	100
2N6549	2.0	40	15 k	200	1.5	1.0	2.0	75	100
PNP									
2N6554	1.0	60	80	50	0.5	250	10	75	100
2N6555	1.0	80	80	50	0.5	250	10	75	100
2N6556	1.0	100	80	50	0.5	250	10	75	100

FIELD-EFFECT TRANSISTORS

Motorola offers a line of field-effect transistors that encompasses the latest technology and covers the full range of FET applications. Included is a wide variety of junction FETs and MOSFETs, with N- or P-channel polarity with both single and dual gates. These FETs include devices developed for operation across the frequency range from dc to UHF in switching and amplifying applications. Package options from low cost plastic to metal TO-72 packages are available.

The selector guides on the following pages are designed to emphasize those FET families and device types that, by virtue of widespread industry use, ease of manufacture and, consequently, low relative cost, merit first consideration for new equipment design.

TABLE OF CONTENTS

The following index reflects the devices characterized in this section. To locate the exact page number, see Catalog Index (Page 7-1).

INDEX

THE TO-18 AND TO-72 – are designed for applications requiring hermeticity as well as greater power dissipation than available with the TO-92 package.

THE MICRO-H CASE 262 – four leaded plastic stripline package.

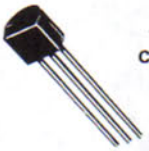
THE TO-92 – is the most popular, high-volume plastic package and will meet most of your high-performance, low-cost requirements.

TO-72 CASE 20

TO-18 CASE 22

THE TO-76 is the EIA standard part for matched dual transistors.

TO-76 CASE 642



TO-92 CASE 29

General-Purpose Devices

Using the same transistor for both switching and amplifier applications can reduce inventories and increase purchase quantities to take advantage of quantity price reductions. Transistors listed here represent good, all-around amplifiers in the audio frequency range, and provide satisfactory medium-speed switching capabilities. MOSFETs listed are characterized primarily as switches but can be used as satisfactory general-purpose amplifiers.

JFETs – N-CHANNEL

Package	Family	Preferred Types	Features	Y_{fs} mmhos Min/Max	I_{DSS} mA Min/Max	$V_{(BR)GSS}$ $V_{(BR)DSS}$* Volts Min	$V_{GS(off)}$ $V_{GS(TH)}$* Volts Min/Max	NF dB nV/√Hz*
TO-92	131	**Standard Family Limits**		0.5/6.5	0.5/24	to -50	-0.2/-8.0	to 2.5
		2N5457	Good overall performance. Low Cost.	1.0/5.0	1.0/5.0	-25	-0.5/-6.0	–
		2N5458		1.5/5.5	2.0/9.0	-25	-1.0/-7.0	–
		2N5459		2.0/6.0	4.0/16	-25	-2.0/-8.0	–
TO-72		2N4220	Somewhat improved specifications;slightly higher cost.	1.0/4.0	0.5/3.0	-30	-/-4.0	2.5
		2N4221		2.0/5.0	2.0/6.0	-30	-/-6.0	2.5
		2N4222		2.5/6.0	5.0/15	-30	-/-8.0	2.5
	130	2N3823		3.5/6.5	4.0/20	-30	-/-8.0	2.5
		2N3824		–	–	-50	–	–

JFETs – P-CHANNEL

TO-92	125	**Standard Family Limits**		0.8/8.0	0.3/30	to 60	-0.2/9.0	115*
		2N5460	Good performance, low cost.	1.0/4.0	1.0/5.0	40	0.75/6.0	115*
		2N5461		1.5/5.0	2.0/9.0	40	1.0/7.5	115*
		2N5462		2.0/6.0	4.0/16	40	1.8/9.0	115*

MOSFET – N-CHANNEL (Enhancement)

TO-72	122	**Standard Family Limits**		1.0/-	10/-	25*	0.5/5.0*	–
		2N4351	Relatively low-cost, complement to 2N4352	1.0/-	10/-	25*	0.5/5.0*	–

MOSFET – P-CHANNEL (Enhancement)

TO-72	123	**Standard Family Limits**		1.0/4.0	-1.0/-10	to -50*	-1.0/-5.0*	–
		2N4352	Relatively low-cost, complement to 2N4351	1.0/-	-10/-	-25*	-1.0/-5.0*	–

General-Purpose Amplifiers

The following transistors are designed for amplification in the audio-frequency range. The devices characterized represent the best values and should receive primary consideration. Other family members are also indicated, together with any specific features they may have..

J FET – N-CHANNEL

Package	Family	Preferred Types	Features	Y_{fs} mmhos Min/Max	I_{DSS} mA Min/Max	$V_{(BR)GSS}$ $V_{(BR)DSS}$* V Min	$V_{GS(off)}$ V Min/Max	NF dB nV/√Hz*
TO-92	131	**Standard Family Limits**		0.5/6.5	0.5/24	to -50	-0.2/-0.8	to 75*
		2N5457	Lowest Cost Family.	1.0/5.0	1.0/5.0	-25	-0.5/-6.0	–
		2N5458	General-purpose application.	1.5/5.5	2.0/9.0	-25	-1.0/-7.0	–
		2N5459		2.0/6.0	4.0/16	-25	-2.0/-8.0	–
TO-72		2N4220A	Similar to above series, but	1.0/4.0	0.5/3.0	-30	-/-4.0	2.5
		2N4221A	with specified NF and	2.0/5.0	2.0/6.0	-30	-/-6.0	2.5
		2N4222A	slightly improved specifica-	2.5/6.0	5.0/15	-30	-/-8.0	2.5
			tions. Somewhat higher cost.					
		2N5556	Very low noise.	1.5/6.5	0.5/2.5	-30	-0.2/-4.0	20*
		2N5557		1.5/6.5	2.0/5.0	-30	-0.8/-5.0	20*
		2N5558		1.5/6.5	4.0/10	-30	-1.5/-6.0	20*
TO-92	124	**Standard Family Limits**		-1.0/2.0	0.05/9.0	to -50	-0.2/-12	75*
		2N5716	For low-power applications,	0.2/1.0	0.05/0.25	-40	-0.2/-3.0	75*
		2N5717	as in battery operated equip-	0.4/1.6	0.2/1.0	-40	-0.5/5.0	75*
		2N5718	ment. Good performance at	0.5/2.0	0.8/4.0	-40	-1.0/-8.0	75*
			low cost.					75*
TO-18		2N3367	Similar to above series, but	0.1/1.0	0.5/0.25	-40	-/-2.5	75*
		2N3366	higher cost due to metal	0.25/1.0	0.2/1.0	-40	-/-7.0	75*
		2N3365	package.	0.4/2.0	0.8/4.0	-40	-/-12	75*

Other Family Members

(All comparisons are referenced to similarly packaged preferred device types in the tables above.)

TO-18	124	MFE2093, 4, 5 – Higher $V_{(BR)GSS}$, higher cost.
TO-72	131	2N3822, 3 – Higher $V_{(BR)GSS}$, higher cost.
		2N5358, 59, 60, 61, 62, 63, 64 – Tighter specifications, higher cost.
TO-92	131	MPF109, MPF111 – Lowest Cost. Loose specifications.

JFET – P-CHANNEL

TO-92	125	**Standard Family Limits**		0.8/8.0	0.3/30	to 60	0.2/9.0	to 3.0
		2N5460	Good performance, Low cost.	1.0/4.0	1.0/5.0	40	0.75/6.0	2.5
		2N5461		1.5/5.0	2.0/9.0	40	1.0/7.5	2.5
		2N5462		2.0/6.0	4.0/16	40	1.8/9.0	2.5
TO-72		2N3330	Tighter specifications, metal package, higher cost.	1.5/3.0	2.0/6.0	20	-/6.0	3.0
TO-92	127	**Standard Family Limits**		0.06/0.7	0.02/2.0	45	0.5/9.0	110*
		2N5797	For low-power applications,	0.06/0.225	0.02/0.1	40	0.5/4.0	115*
		2N5798	as in battery-operated equip-	0.1/0.4	0.08/0.4	40	0.8/6.0	115*
		2N5799	ment. Good performance at	0.16/0.5	0.25/1.0	40	1.2/8.0	115*
		2N5800	low cost.	0.25/0.7	0.7/2.0	40	2.0/9.0	115*
TO-72		2N5474	Similar to above series,	0.16/0.4	0.2/0.5	40	1.2/7.0	115*
		2N5475	higher cost due to metal	0.2/0.5	0.4/1.0	40	1.5/8.0	115*
		2N5476	package.	0.26/0.65	0.8/2.0	40	2.0/9.0	115*

Other Family Members

(All comparisons are referenced to similarly packaged preferred device types in tables above.)

TO-72	127	2N5471, 72, 73 – Lower Y_{fs}, lower I_{DSS}, higher cost.
	125	2N3909,A 2N5265, 66, 67, 68, 69, 70 – MFE4007, 08, 09, 10, 11, 12 – Very tight specifications. Higher cost.
TO-92	125	2N5463, 64, 65 – Higher $V_{(BR)GSS}$. Higher cost. 2N4342, MPF161 – Low cost. 2N4360 – Lowest cost. Very loose specifications.

General-Purpose Amplifiers (Continued)

Package	Family	Preferred Types	Features	Y_{fs} mmhos Min/Max	I_{DSS} mA Min/Max	$V_{(BR)GSS}$ $V_{(BR)DSS}$* V Min	$V_{GS(off)}$ V Min/Max	NF dB nV/√Hz*
MOSFET – N-CHANNEL (Depletion-Enhancement) – **TABLE II** (continued)								
TO-18	110	**Standard Family Limits**		0.7/4.0	0.5/15	to 25*	$V_{GS(TH)}$ -/-8.0	to 3.8
		MFE824	Especially suited for smoke detector applications.	1.0/-	1.0/15	20*	-/-6.0	–
TO-72		MFE3001	I_{GSS} = ±1.0 pAdc Max	0.7/3.5	0.5/6.0	20*	-/-8.0	–
		2N3796		0.9/1.8	0.5/3.0	25	-/-4.0	3.8 Typ
		2N3797		1.5/3.0	2.0/6.0	20	-/-7.0	3.8 Typ
MOSFET – P-CHANNEL (Enhancement)								
TO-18	123A	MFE823	Especially suited for smoke detector applications. I_{GSS} = ±1.0 pAdc Max	1.0/-	-/-20	-25*	-2.0/-6.0	–

Choppers and Switches

FETs have no offset voltages and low "on" resistance. As a result they are especially well suited for chopper/switch applications. The following characterized devices represent the best values and should receive primary consideration.

JFETs – N CHANNEL

Package	Family	Preferred Types	Features	$r_{ds(on)}$ Ohms Max	$I_{D(off)}$ I_{DSS}* nA Max	C_{rss} pF Max	$V_{(BR)GSS}$ $V_{(BR)DSS}$* V Min	$V_{GS(off)}$ $V_{GS(TH)}$* V Min/Max
TO-92	140	**Standard Family Limits**		25 to 100	0.25 to 1	3.5 to 8.0	to -40	-0.5/-10
		2N5638	Good Performance, low-cost.	30	1.0	4.0	-30	–
		2N5639		60	1.0	4.0	-30	–
		2N5640		100	1.0	4.0	-30	–
TO-18		2N4856	Somewhat improved specifi-	25	0.25	8.0	-40	-4.0/-10
		2N4857	cations. Metal Package.	40	0.25	8.0	-40	-2.0/-6.0
		2N4858	Higher cost.	60	0.25	8.0	-40	-0.8/-4.0
Other Family Members								
TO-92	140	MPF4391,2,3 – Similar to 2N5638 Series, slightly higher cost.						
TO-18		2N4091, 2, 3 – Slower than 2N4856 Series, slightly lower cost. 2N4391, 2, 3 – Slightly improved performance, but higher cost. 2N4859, 60, 61 – Same as 2N4856, 57, 58 except for -30 V $V_{(BR)GSS}$ 2N4856A, 57A, 58A, 59A, 60A, 61A – Tighter C_{rss} than non-A version. 2N3970, 71, 72 – MFE2004, 5, 6.						
Other Family Members								
TO-72	136	MFE2010, 1, 2 – Lower $r_{ds(on)}$, significantly higher cost.						

JFETs – P-CHANNEL

TO-92	128	**Standard Family Limits**		100 to 250	10	5.0	30	1.0/12
		MPF970	Good Performance, low cost.	100	10	5.0	30	5.0/12
		MPF971		250	10	5.0	30	1.0/7.0
TO-72	129	**Standard Family Limits**		150 to 300	1.2	3.5 to 5.0	25	1.0/9.5
		2N3993	Higher cost than above	150	1.2	4.5	25	4.0/9.5
		2N3994	plastic series.	300	1.2	5.0	25	1.0/5.5
		2N3994A		300	1.2	3.5	25	1.0/5.5

MOSFET – N-CHANNEL (Enhancement)

TO-72	122	**Standard Family Limits**		100 to 300	10*	1.3	25*	0.5/5.0*
		2N4351	Relatively low cost. Complementary with 2N4352 P-Channel device.	300	10*	1.3	25*	1.0/5.0*
	114	MFE3002	Somewhat higher cost.	100	10*	1.0	15*	-/3.0*
Other Family Members								
TO-72	122	3N169, 170, 171 – Tighter $V_{GS(TH)}$, higher cost.						

MOSFET – P-CHANNEL (Enhancement)

TO-72	**Standard Family Limits**			200 to 600	0.25 to 10*	to 1.3	to -50*	-1.0/-5.0*
	123	2N4352	Relatively Low cost	600	-10*	1.3	25*	-1.0/-5.0*
	115	MFE3003	Slightly Higher cost	200	-10*	1.0	15*	-/-4.0*
Other Family Members								
TO-72	123	3N155, 55A, 56, 56A, 57, 57A, 58, 58A – Tighter parameter limits, higher costs.						

RF Amplifiers

Devices listed here are characterized for operation at frequencies as high as 900 MHz. Both amplifier and mixer devices are included. In general, amplifier transistors have a small-signal power gain (G_{ps}) specification and a noise figure, while mixer devices are characterized by a conversion gain (G_c) specification and may or may not have an assigned noise figure.

A comparison of specifications indicates that MOSFETs, in general, have a considerably lower reverse transfer capacitance (C_{rss}) than JFETs. This makes them suitable for operation over wide frequency ranges, as required for many TV applications. Moreover, all MOSFETs listed are dual-gate devices that often simplify circuit designs. The JFET lines are often preferred for communications circuits where only narrow bandwidths are required.

JFET – N-CHANNEL

Package	Family	Preferred Types	Features	Test Frequency MHz	G_{ps} G_c* dB Min/Max	Y_{fs} mmhos Min/Max	C_{rss} pF Min/Max	NF dB Max	$V_{(BR)DSS}$ $V_{(BR)GSS}$* V Min
TO-92	130	**Standard Family Limits**		to 200	10/20	2.0/7.5	-/3.0	4.0	to 25
		MPF102	Very low cost. Limited specifications.	100	–	2.0/7.5	-/3.0	–	25*
	146	**Standard Family Limits**		to 400	10/30	3.0/8.0	1.0/3.0	–	to 30
		2N5484	Moderate cost. Low noise figure.	100	16/25	3.0/6.0	-/3.0	3.0	25*
		MPF256	Slightly higher cost. Improved performance.	400	12/-	6.0/-	1.2 Typ	4.0	25*
		2N5485	Somewhat higher cost.	400	10/20	3.5/7.0	-/1.0	4.0	25*
		2N5486		400	10/20	4.0/8.0	-/1.0	4.0	25*
TO-72		2N4416	Best value in metal	400	10/-	4.5/7.5	-/0.8	4.0	30*
		2N4416A	As above, but higher breakdown voltage and tighter $V_{GS(off)}$						
		Other Family Members (All comparisons are referenced to similarly packaged preferred device types in the table above.)							
TO-92	130	2N5668, 69, 70 – Somewhat improved specifications. Higher cost. MPF108, MPF112 – Lowest cost. Very limited specifications.							
TO-72		2N4223, 24; 2N3823							
	146	MFE2000, 1							
	120	3N124, 25, 26 – This family is tetrode connected, and is tested at 100 MHz. Has higher breakdown voltage (50 V) and higher cost than other metal packaged devices.							

MOSFET – N-CHANNEL

		AMPLIFIERS							
TO-72	875	**Standard Family Limits**		to 500	10/28	8.0/20	-/-0.05	6.0	to 25
		MFE130	VHF amplifiers listed in order of increasing test frequency. Cost variations are relatively small.	105	17/-	8.0/20	-/0.05	5.0	25
		MFE131		200	17/-	8.0/20	-/0.05	5.0	25
		3N209		500	10/20	10/20	-/0.05	6.0	25
	890	**Standard Family Limits**		to 900	10/-	8.0/20	-/0.025	8.0	25
		MFE590	VHF/UHF amplifiers characterized to 900 MHz. Moderate cost.	900	10.5/-	8.0/20	-/0.025	8.0	25
		MFE591		900	10.5/-	10/20	-/0.02	6.0	25
		MIXERS							
TO-72		**Standard Family Limits**		to 500	10/28	8.0/20	-/0.05	6.0	to 25
	875	MFE132	Good performance.	200	12/-*	8.0/20	-/0.05	–	25
	880	3N223	Improved specifications. Moderately higher cost.	200	21/28*	17/40	-/0.05	–	25
		Other Family Members							
262	875	MPF130 – Amplifier MPF131 – Amplifier 3N210 – Amplifier MPF132 – Mixer							
	880	3N224 – Mixer							
TO-72	112	MFE3004, 5 – Amplifier 3N128 – Amplifier							
	816	3N140 – Amplifier/Mixer							

MULTIPLE DEVICES

SMALL-SIGNAL MULTIPLE TRANSISTORS AND DARLINGTON TRANSISTORS

The trend in electronic system design is toward the use of integrated circuits — to reduce component cost, assembly cost, and equipment cost. But ICs still aren't all things to all people, and for those circuit designs where ICs are not available, there is a noticeable swing towards the use of multiple devices.*

Motorola is reacting to this expanding market requirement by making available a very large selection of Quad, Dual and Darlington transistors for off-the-shelf delivery. The chips used in the Quad and Dual transistors are those that have emerged as the most popular ones for discrete transistor applications. But even beyond that, Motorola offers its entire vast repertoire of discrete small-signal transistors for multiple-device packaging. For special applications where the devices listed may not quite fit the design requirements, special configurations can be supplied with quick turnaround time and low premiums.

**Multiple devices, as described here, encompass two or more transistor chips in a single package. Included in this definition are the Darlington transistors which consist of two interconnected devices functioning as a single-stage amplifier.*

TABLE OF CONTENTS

The following index reflects the devices characterized in this section. To locate the exact page number, see Catalog Index(Page 7-1).

INDEX

QUAD TRANSISTORS

DUAL TRANSISTORS

DARLINGTON TRANSISTORS

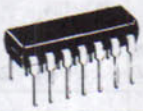
QUAD TRANSISTORS

GENERAL-PURPOSE AMPLIFIER AND SWITCHING TRANSISTORS

The multiple transistors included in this category have been implemented with discrete transistor chips that have proved to be the most popular for high all around performance at low cost. The line is characterized by a relatively high-current gain over an extremely wide range of dc collector current, a high-frequency response and medium-speed switching capability.

CASE 607-04
(Ceramic Flat Package)
MQ Devices

CASE 632
TO-116
(Ceramic Package)
MHQ Devices



CASE 646
(Plastic Package)
MPQ Devices

	NPN TYPES				PNP TYPES			
Prime Devices	MPQ2222 MHQ2222 MQ2219A *(Basic Device Design – 2N2222)*			MPQ3904 *(Basic Device Design 2N3904)*	MPQ2907 MHQ2907 MQ2905A *(Basic Device Design – 2N2907)*			MPQ3906 *(Basic Device Design 2N3906)*
Design Parameters BV_{CEO} Specified h_{FE} Range f_T (Typ) t_{on} (Typ) t_{off} (Typ)	To 60 Vdc 100 μA to 500 mA 300 MHz @ 20 mA 25 ns 250 ns @ 150 mA			To 40 Vdc 100 μA to 100 mA 300 MHz @ 10 mA 40 ns 136 ns @ 10 mA	To 60 Vdc 100 μA to 500 mA 350 MHz @ 50 mA 30 ns 100 ns @ 150 mA			To 40 Vdc 100 μA to 100 mA 350 MHz @ 10 mA 43 ns 155 ns @ 10 mA
Derivatives From Prime Devices (In decreasing order of price)	Ceramic Package	Plastic Package	Ceramic Flat Package	–	Ceramic Package	Plastic Package	Ceramic Flat Package	–
	MHQ2221	MPQ2221 MPQ1000	*MQ2218.A* *MQ2219* MQ1120 MQ1129		MHQ2906	MPQ2906 MPQ1500	*MQ2904* MQ7001 MQ982 MQ3251 (1) MQ7007 (1) (1) See 2N3250 data sheet for basic design parameters.	

Complementary Pairs (2 Pairs Per Package)	Ceramic Package	Plastic Package	Ceramic Flat Package	Description
	MHQ6002 MHQ6001	MPQ6002 MPQ6001	MQ6002 MQ6001	Two Chips from Basic Device Design 2N2222 and 2N2907. Devices differ principally in h_{FE}.
		MPQ6502 MPQ6501		Same as above, but with a different pin arrangement.
		MPQ6700		Two Chips from Basic Device Design 2N3904 and 2N3906.

Numbers in italic type denote data sheet that shows design curves.

LOW-NOISE; HIGH-GAIN AMPLIFIER TRANSISTORS

NPN TYPES			PNP TYPES			
MQ2484 MPQ2484 MHQ2484 *(Basic Device Design – 2N2484)*			MQ3799A (Matched) MPQ3799 MHQ3799 *(Basic Device Design – 2N3799)*			Prime Devices
To 60 Vdc 100 μA to 10 mA 90 MHz @ 500 μA 2.0 dB @ 10 μA			To 60 Vdc 10 μA to 10 mA 140 MHz @ 1.0 mA 1.5 dB @ 100 μA			Design Parameters BV_{CEO} Specified h_{FE} Range f_T (Typ) NF (Typ)
Ceramic Package	Plastic Package	Ceramic Flat Package	Ceramic Package	Plastic Package	Ceramic Flat Package	Derivatives From Prime Devices (In decreasing order of price)
MHQ2483	MPQ2483	MQ930	MHQ3798	MPQ3798	MQ3799 *MQ3798* MQ7003	
Ceramic Package	Plastic Package	Ceramic Flat Package	Description			Complementary Pairs
MHQ6100,A	MPQ6100,A MPQ6600,A	MQ6100 MQ7021	Two Chips from Basic Device Design 2N2484 and 2N3799. The A version has higher gain.			

HIGH-CURRENT SWITCHING AND CORE DRIVER TRANSISTORS

NPN TYPES				PNP TYPES			
MPQ3725A *(Basic Device Design – 2N3725)*	MHQ4014 *(Basic Device Design – 2N4014)*	MPQ3303 *(Basic Device Design – 2N3303)*		MPQ3762 2N5146 *(Basic Device Design – 2N3762)*			Prime Devices
To 50 Vdc 100 mA to 500 mA 300 MHz @ 50 mA 20 ns 50 ns @ 500 mA	To 45 Vdc 10 mA to 1.0 A 300 MHz @ 50 mA 20 ns 50 ns @ 500 mA	To 12 Vdc 100 mA to 1.0 A 500 MHz @ 100 mA 12 ns 20 ns @ 1.0 A		To 40 Vdc 100 mA to 1.0 A 200 MHz @ 50 mA 30 ns 75 ns @ 500 mA			Design Parameters BV_{CEO} Specified h_{FE} Range f_T (Typ) t_{on} (Typ) t_{off} (Typ)
Plastic Package	Ceramic Package	Ceramic Flat Package	–	Ceramic Package	Plastic Package	Ceramic Flat Package	Derivatives From Prime Devices (In decreasing order of price)
MPQ3725 MPQ4004 MPQ4003 MPQ1050	MHQ4013 MHQ4002A MHQ4001A	MQ3725 2N6501		MHQ3467	MPQ3467	MQ3467 MQ3762	

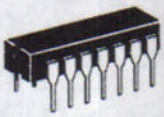
Numbers in italic type denote data sheet that shows design curves.

LOW-CURRENT SWITCHING TRANSISTORS

	NPN TYPES	PNP TYPES
Prime Devices	MPQ2369 MQ2369 MHQ2369 *(Basic Device Design – 2N2369)*	MPQ3546 MHQ3546 *(Basic Device Design – 2N3546)*
Design Parameters BV_{CEO} Specified h_{FE} Range f_T (Typ) t_{on} (Typ) t_{off} (Typ)	To 15 Vdc 10 mA to 100 mA 650 MHz @ 10 mA 9.0 ns 15 ns @ 10 mA	To 12 Vdc 10 mA to 100 mA 850 MHz @ 10 mA 15 ns 25 ns @ 50 mA
Derivative From Prime Devices	Flat Package MQ7004	–

CASE 607-04
(Ceramic Flat Package)
MQ Devices

CASE 632
TO-116
(Ceramic Package)
MHQ Devices



CASE 646
(Plastic Package)
MPQ Devices

RF AMPLIFIERS AND OSCILLATORS, HIGH-VOLTAGE (HV) DRIVERS, AND J-FET-BIPOLAR QUAD TRANSISTORS

	RF NPN TYPES	HV NPN TYPES	HV PNP TYPES
Prime Devices	MPQ918 MQ918 MHQ918 *(Basic Device Design – 2N918)*	MPQ7043 *(Basic Device Design – 2N6515)*	MPQ7093 *(Basic Device Design – 2N6518)*
Design Parameters BV_{CEO} Specified h_{FE} Range f_T (Typ) NF (Typ)	To 15 Vdc 100 μA to 10 mA 850 MHz @ 4.0 mA 4.0 dB @ 1.0 mA	To 400 Vdc** 1.0 mA to 30 mA 70 MHz @ 10 mA	To 400 Vdc** 1.0 mA to 30 mA 70 MHz @ 10 mA
Derivatives From Prime Devices (In decreasing order of price)	Ceramic Flat Package	Plastic Package	Plastic Package
	MQ7005	MPQ7042 MPQ7041	MPQ7092 MPQ7091
Complementary Pairs (2 Pairs Per Package)	–	Plastic Package	Description
	–	MPQ7051 MPQ7052 MPQ7053	Two Chips from Basic Device Design 2N6515 and 2N6518. Devices differ principally in BV_{CEO}.
NPN-Bipolar, N-Channel, J-FET Quad Transistor Combination	–	MPQ2001	Two Chips from Basic Device Design 2N2222 & 2N5358 (J-FET) lines. BV_{GSS} to 25 Vdc, I_{DSS} from 2.0 mA-16 mA

**Supplied as Specials.

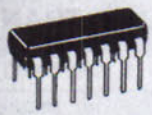
Numbers in italic type denote data sheet that shows design curves.

MPU CLOCK BUFFER

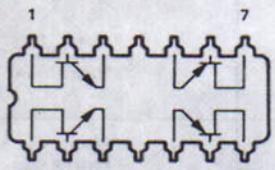
MPQ6842

Quad dual in-line silicon annular complementary pair transistors.

The MPQ6842 is designed to provide the switching speed and saturation voltages necessary to design the clock circuit to meet the MPU clock requirements.



CASE 646
Plastic



CONNECTION DIAGRAM

Design Parameters	Limits
BV_{CEO}	To 40 Vdc
Specified h_{FE} Range	100 μA to 100 mA
f_T (Typ)	300 MHz @ 10 mA
t_{on} (Typ)	45 ns @ 10 mA
t_{off} (Typ)	150 ns @ 10 mA

DUAL TRANSISTORS

LOW-NOISE, HIGH-GAIN AMPLIFIER TRANSISTORS

CASE
610A-03
(Ceramic Package)

CASE
654-07
(Metal Package)

	NPN TYPE		PNP TYPE	
Prime Devices	2N2920 *(Basic Device Design – 2N2484)*		2N3811A *(Basic Device Design – 2N3799)*	
Design Parameters BV_{CEO} Specified h_{FE} Range f_T (Typ) NF (Typ) h_{FE} Matching Avail.	To 60 Vdc 10 μA to 10 mA 90 MHz @ 500 μA 2.0 dB @ 10 μA		To 60 Vdc 1.0 μA to 10 mA 140 MHz @ 1.0 mA 1.5 dB @ 100 μA	
	Metal Package	Ceramic Package	Metal Package	Ceramic Package
Derivatives From Prime Devices (In decreasing order of price)	2N2543,A 2N2639 thru 2N2644 2N2722 2N2903,A 2N2913 thru 2N2919 MD7002,A,B MD8001 MD8003	2N3043 thru 2N3048	2N3806 thru 2N3811 MD7003,A,B	2N3812 thru 2N3817A MD7003F,AF
Complementary Pairs (Basic Device Design 2N2484 and 2N3799)	Metal Package		Ceramic Package	
	MD6100 MD7021		MD6100F MD7021F	
Matched Pairs (Monolithic Devices)	Metal Package		Description	
	2N6441 thru 2N6448		Devices differ principally in gain and matching characteristics.	

Numbers in italic type denote data sheet that shows design curves.

GENERAL-PURPOSE AMPLIFIER AND SWITCHING AMPLIFIERS

The multiple transistors included in this category have been implemented with discrete transistor chips that have proved to be the most popular for high all around performance at low cost. The line is characterized by a relatively high-current gain over an extremely wide range of dc collector current, a high-frequency response and medium-speed switching capability.

CASE
610A-03
(Ceramic Package)

CASE
654-07
(Metal Package)

NPN TYPE			PNP TYPE		
MD2219A,AF *(Basic Device Design – 2N2222)*			MD2905A,AF *(Basic Device Design – 2N2907)*		Prime Devices
To 60 Vdc 10 μA to 500 mA 300 MHz @ 20 mA 40 ns 110 ns @ 150 mA			To 60 Vdc 100 μA to 500 mA 350 MHz @ 50 mA 30 ns 100 ns @ 150 mA		Design Parameters BV_{CEO} Specified h_{FE} Range f_T (Typ) t_{on} (Typ) t_{off} (Typ) h_{FE} Matching Avail.
Metal Package		Ceramic Package	Metal Package	Ceramic Package	
2N2060,A 2N2223,A 2N2480,A 2N2652,A 2N2720 2N2721 2N5793 2N5794	*MD2218,A* *MD2219* MD3409 MD3410 MD1120 MD1121 MD1122 MD1129 MD7000	*MD2218F,AF* *MD2219F* MD1120F MD1129F	2N4015 2N4016 2N5795 2N5796 *MD2904,A* *MD2905* MD7001 MD982	*MD2904F,AF* *MD2905F* MD7001F MD982F	Derivatives From Prime Devices (In decreasing order of price)
Metal Package			Ceramic Flat Package		Complemenatry Pairs (Basic Device Design 2N2222 and 2N2907)
2N4854 2N4855 MD985	MD6001 MD6002 MD6003		2N3838 MD985F MD6001F MD6002F MD6003F		

Numbers in italic type denote data sheet that shows design curves.

RF AMPLIFIERS AND OSCILLATORS

CASE 610A-03 (Ceramic Package)

CASE 654-07 (Metal Package)

CASE 654-01 (Metal Package)

	NPN TYPE		PNP TYPE	
Prime Devices	MD918A MD918AF *(Basic Device Design – 2N918)*		MD5000A *(Basic Device Design – 2N3307)*	
Design Parameters BV_{CEO} Specified h_{FE} Range f_T (Typ) NF (Typ) Gpe h_{FE} Matching Avail.	To 15 Vdc 100 μA to 10 mA 850 MHz @ 4.0 mA 4.0 dB @ 1.0 mA 15 dB @ 4.0 mA		To 15 Vdc 100 μA to 10 mA 900 MHz @ 4.0 mA 3.0 dB @ 1.0 mA 18 dB @ 4.0 mA	
Derivatives From Prime Devices (In decreasing order of price)	Metal Package	Ceramic Package	Metal Package	–
	MD918,B MD1131 MD1132 MD7005	*MD918F,BF* MD1131F MD1132F MD7005F	MD5000 MD5000B	

NEW INTRODUCTIONS

MD4260 MD4261	PNP silicon transistors designed for use as wideband or high-frequency differential amplifiers and dual RF amplifiers.
MD6900	NPN/PNP silicon transistor designed for use as complementary wideband RF amplifiers.

TO BE INTRODUCED

MD5500,F	450 MHz NPN Amplifier

Numbers in italic type denote data sheet that shows design curves.

HIGH-CURRENT SWITCHING AND CORE DRIVER TRANSISTORS

NPN TYPE		PNP TYPE		
MD3725,F *(Basic Device Design – 2N3725)*		MD3762,F *(Basic Device Design – 2N3762)*		Prime Devices
To 45 Vdc 10 mA to 1.0 A 300 MHz @ 50 mA 20 ns 25 ns @ 500 mA		To 40 Vdc 100 mA to 1.0 A 200 MHz @ 50 mA 30 ns 75 ns @ 500 mA		Design Parameters BV_{CEO} Specified h_{FE} Range f_T (Typ) t_{on} (Typ) t_{off} (Typ) h_{FE} Matching Avail.
Metal Package	**Ceramic Package**	**Metal Package**	**Ceramic Package**	Derivatives From Prime Devices
2N6502	2N6503	*MD3467*	MD3467F	

LOW-CURRENT SWITCHING TRANSISTORS

NPN TYPE		PNP TYPE		
MD2369A,AF *(Basic Device Design – 2N2369)*		MD3251A,AF *(Basic Device Design – 2N3250)*		Prime Devices
To 15 Vdc 10 mA to 100 mA 650 MHz @ 10 mA 15 ns 15 ns @ 10 mA		To 40 Vdc 10 μA to 50 mA 300 MHz @ 10 mA 50 ns 200 ns @ 10 mA		Design Parameters BV_{CEO} Specified h_{FE} Range f_T (Typ) t_{on} (Typ) t_{off} (Typ) h_{FE} Matching Avail.
Metal Package	**Ceramic Package**	**Metal Package**	**Ceramic Package**	
2N3425 MD708,A,B *MD2369,B* MD7004	MD708,AF,BF,F MD2369F,BF MD7004F	2N4937 2N4938 2N4939 *MD3250,A* *MD3251,A* MD1123 MD1130 MD7007,A,B MD984	2N4940 2N4941 2N4942 *MD3250F,AF* *MD3251F,AF* MD1130F MD7007F,BF	Derivatives From Prime Devices (In decreasing order of price)
Metal Package		**Ceramic Package**		Complementary Pairs (Basic Device Design 2N2369 and 2N3250)
MD986		MD986F		

Numbers in italic type denote data sheet that shows design curves.

DARLINGTON TRANSISTORS

POWER AND SMALL-SIGNAL DARLINGTON AMPLIFIER TRANSISTORS

Darlington amplifiers are cascade transistors used in applications requiring very high-current gain and input impedance. The plastic transistors have monolithic construction and the metal package transistors are two chip construction. The transistors are listed in order of increasing breakdown voltage (BV_{CEO}).

BV_{CES}* $V_{CEO(sus)}$# BV_{CEO} Volts Min	I_C mA* Amp Max	h_{FE} @ I_C Min	Max	mA* Amp	$V_{CE(sat)}$@ I_C Volts Max	mA* Amp	P_D Watts	f_T MHz Min	NF dB Typ	Device Type NPN	PNP
20*	500*	20,000	–	10*	1.0	10*	0.625	0.035	–	*MPS-A12*	–
25*	300*	1000	–	10*	1.0	0.1	0.625	100	–	*MPS-D04*	MPS-D54
30*	500*	5000	–	10*	1.5	0.1	0.625	125	2.0	*MPS-A13*	–
30*	500*	10,000	–	10*	1.5	0.1	0.625	125	2.0	*MPS-A14*	–
30*	300*	50,000	–	10*	1.5	0.1	0.625	100	2.0	–	*MPS-A65*
30*	300*	75,000	–	10*	1.5	0.1	0.625	100	2.0	–	*MPS-A66*
40	200*	1200	–	10*	1.0	15*	0.5	10	–	2N2785	–
40	300*	5000	–	10*	1.5	0.1	0.375	–	–	*MM6427*	–
40	500*	5000	–	10*	1.5	0.1	0.75	–	–	*MPQ6426*	–
40	1.0	10,000	25,000	150*	–	–	–	175	6.0	–	*2N6521*
40	500*	10,000	200,000	10*	1.2	50*	0.625	–	3.0	*2N6427*	–
40	1.0	20,000	50,000	150*	–	–	–	175	6.0	–	*2N6522*
40	500*	20,000	200,000	10*	1.2	50*	0.625	–	3.0	*2N6426*	–
40	4.0	750	15,000	2.0	2.0	2.0	1.5	–	–	*2N6037*	*2N6034*
60#	500*	1600	8,000	10*	–	–	0.5	–	6.0	2N998	–
60	40*	2000	10,000	10*	1.0	10*	0.5	100	10	2N2723	–
60	4.0	750	–	1.5	2.5	1.5	40	–	–	MJE 800	MJE 700
60	4.0	750	15,000	2.0	2.0	2.0	1.5	25	–	*2N6038*	*2N6035*
60	4.0	750	18,000	2.0	2.0	2.0	50	4.0	–	2N6294	2N6296
80	4.0	750	–	1.5	2.5	1.5	40	–	–	MJE 802	MJE 702
80	4.0	750	15,000	2.0	2.0	2.0	1.5	2.5	–	*2N6039*	*2N6036*
80	4.0	750	18,000	2.0	2.0	2.0	50	4.0	–	*2N6295*	*2N6297*

 Case 20 TO-72	 Case 22-03 TO-18	 Case 29-02 TO-92	 Case 34A	 Case 77-03	 Case 646
2N998 2N2723 2N2785	MM6427	2N6426 2N6427 MPS-A12 MPS-A13 MPS-A14 MPS-A65 MPS-A66 MPS-D04 MPS-D54	2N6521 2N6522	2N6034 2N6035 2N6036 2N6037 2N6038 2N6039 2N6294 2N6295 2N6296 2N6297 MJE 700 MJE 702 MJE 800 MJE 802	MPQ6426 MPQ6427

Numbers in italic type denote data sheet that shows design curves.

MICRO-T TRANSISTORS and DIODES

Micro-T devices combine high performance with extremely small physical size. The type numbers listed below are available from stock, but all other Motorola small-signal transistors may be obtained in Micro-T packages on special order.

TABLE OF CONTENTS

The following index reflects the devices characterized in this section. To locate the exact page number, see Catalog Index(Page 7-1).

INDEX

RF AMPLIFIER/HIGH SPEED SWITCHING TRANSISTORS

Standard metal packaged RF devices, in Micro-T packages are designed for applications where limited space is critical. This package is particularly attractive from a pre-testing and cost point of view as the RF parameters can be 100% tested for high performance. For complete design data, consult the prime device data sheet. For other RF devices not listed, contact your nearest Motorola sales representative or distributor. Ceramic packages with a cold sealing process will also be available in quantity orders in the future.

Case 28

	NPN Types			PNP Types	
Prime Devices	**MMT2857**	**MMT8015**	**MMT3960**	**MMT918**	**MMT4261**
Design Parameters					
BV_{CEO}	To 20 V	To 15 V	To 15 V	To 15 V	To 20 V
Operating h_{FE} Range	1.0 to 20 mA	1.0 to 10 mA	1.0 to 30 mA	3.0 mA	10 mA
f_T (Typ)	1400 MHz @ 5.0 mA	2000 MHz @ 6.0 mA	1600 MHz @ 10 mA	600 MHz @ 4.0 mA	1000 MHz @ 10 mA
NF (Typ)	4.0 dB @ 1.5 mA	3.5 dB @ 1.0 mA	–	6.0 dB @ 1.0 mA	–
G_{pe} (Typ)	15 dB @ 450 MHz	7.0 dB @ 1.0 GHz	–	15 dB @ 200 MHz	–
t_{on} (Typ)	–	–	3.0 ns @ 10 mA	–	–

MMT4049 PNP RF Amplifier – to be introduced.

GENERAL-PURPOSE AND SWITCHING TRANSISTORS

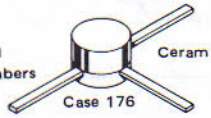
For general-purpose applications and for designs requiring fast switching, the Micro-T packaged transistors are available in either economy plastic or hermetically sealed ceramic. Complete designer data sheets are available for prime devices; equivalent data sheets may be obtained when the same die is used in other 2N – standard devices. For devices not listed, contact your nearest Motorola representative or distributor.

MMT
Type Numbers

Plastic

Case 28

MMCM
Type Numbers



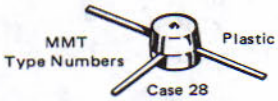
Ceramic

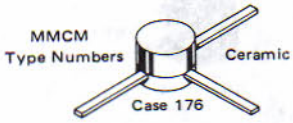
Case 176

	NPN Types		PNP Types	
Prime Devices	**MMT2222 MMCM2222**	**MMT3904 MMCM3904**	**MMT2907 MMCM2907**	**MMT3906 MMCM3906**
Design Parameters				
BV_{CEO}	To 60 V	To 40 V	To 60 V	To 40 V
Operating h_{FE} Range	100 μA to 500 mA	100 μA to 100 mA	100 μA to 500 mA	100 μA to 100 mA
f_T (Typ)	300 MHz @ 20 mA	300 MHz @ 10 mA	350 MHz @ 50 mA	350 MHz @ 10 mA
t_{on} (Typ)	25 ns @ 150 mA	40 ns @ 10 mA	30 ns @ 150 mA	45 ns @ 10 mA
t_{off} (Typ)	250 ns	140 ns	100 ns	160 ns
	Ceramic Package	Plastic Package		Plastic Package
Derivatives from Prime Devices	MMCM2221	MMT3903 MMT76 Ceramic Package MMCM3903		MMT3905 MMT75 Ceramic Package MMCM3905

LOW NOISE/HIGH GAIN AMPLIFIER TRANSISTORS

Two types of specialty transistors complement Motorola's micro-transistor amplifier selection. The combination of high-gain and low-noise have made these standards popular for many years. The Micro-T package coupled with performance permits space premium designs to become a reality. Other high voltage and Darlington transistors are also available as specials.

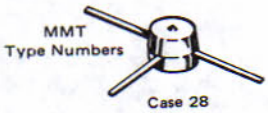


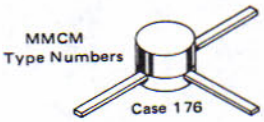


	NPN Types		PNP Types	
Prime Devices	**MMT2484 MMCM2484**		**MMT3799 MMCM3799**	
Design Parameters BV_{CEO} Operating h_{FE} Range f_T (Typ) NF (Typ)	To 60 V 100 μA to 10 mA 90 MHz @ 500 μA 2.0 dB @ 10 μA		To 60 V 10 μA to 10 mA 140 MHz @ 1.0 mA 1.5 dB @ 100 μA	
Derivatives from Prime Devices	Ceramic Package MMCM930	Plastic Package MMT930 MMT70	Ceramic Package MMCM3798	Plastic Package MMT3798 MMT71

LOW CURRENT SWITCHING TRANSISTORS

To complement the Micro-T amplifiers, these high speed switching transistors can be used in circuits where space limitations are critical. For design data, consult prime device data sheet or the 2N JEDEC equivalent. For devices not listed, consult your nearest Motorola sales representative or distributor.





	NPN Types		PNP Types
Prime Devices	**MMT2369 MMCM2369**	**MMT3014**	**MMT3546**
Design Parameters BV_{CEO} Operating h_{FE} Range f_T (Typ) t_{on} (Typ) t_{off} (Typ)	To 15 V 10 mA to 100 mA 650 MHz @ 10 mA 2.0 ns 15 ns @ 10 mA	To 20 V 10 mA to 100 mA 400 MHz @ 30 mA 12 ns 13 ns @ 300 mA	To 12 V 10 mA to 100 mA 850 MHz @ 10 mA 15 ns 25 ns @ 50 mA
Derivatives from Prime Devices		Plastic Package MMT72	

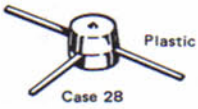
SWITCHING DIODES

The Micro-T product line includes single and double diodes for voltage doubling or bias control functions. Zener diodes are also available as specials. For lead times and availability, contact your nearest distributor or Motorola's sales representative.

	Single	Common Cathode	Common Anode	Series
Prime Devices	**MMD6050**	**MMD6100**	**MMD6150**	**MMD7000**
Design Paremeters				
V_{BR}	To 100 V	To 100 V	To 100 V	To 100 V
I_R (Typ)	10 mA	10 mA	10 mA	10 mA
V_F (Typ)	0.6 V @ 1.0 mA	0.6 V @ 1.0 mA	0.6 V @1.0 mA	0.6 V @ 1.0 mA
t_{rr} (Typ)	10 ns	20 ns	20 ns	20 ns
Derivatives from Prime Devices	MMD70			MMD7001

MICRO-T FIELD-EFFECT TRANSISTORS

Technologies other than bipolar transistors are available in the Micro-T package. One example is the popular J-FET. Also available are other J-FET and MOSFET devices requiring up to four leads and having a chip size less than 25 mils per side. For lead time and availability, contact your nearest Motorola sales representative.



	N-Channel J-FET
Prime Device	**MMT3823**
Design Parameters	
BV_{GSS}	To 35 V
I_{DSS} (surge)	5.0 mA to 20 mA
C_{iss} (Typ)	4.0 pF
NF (Typ)	2.0 dB @ 100 MHz, R_S = 1000 Ohms

Note: Other FETs are available as specials. Standard FET devices to be introduced.

RF TRANSISTORS

and MODULES

This selection guide contains the preferred registered and non-registered RF parts available. From more than 500 total individual available devices, Motorola has selected 17 transistor/module chains from 1.5 to 600 W (PEP) output. All devices are designed, tested and optimized for frequency ranges from 2 to 900 MHz. These devices are designed for your advanced RF engineering concepts.

TABLE OF CONTENTS

The following index reflects the devices characterized in this section. To locate the exact page number, see Catalog Index(Page 7-1).

INDEX

High Frequency, Low Voltage Amplifier Transistors/ Modules

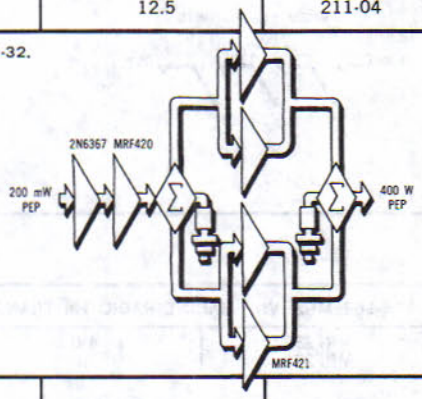
The transistors listed in this table are specified for operation in RF Power amplifiers and are listed by specific application at a given test frequency. Arrangement within each application group is in the order of increasing output power. Modulation type is given in each application heading.

Device Type	P_{out} Output Power Watts	G_{PE} Power Gain dB Min	V_{CC} Supply Voltage Volts	Package
2-30 MHz, SSB TRANSISTORS				
2N6367	9.0 PEP	14	12.5	211-07
MRF432*	12.5 PEP	20	12.5	211-07
MRF433*	12.5 PEP	20	12.5	211-07
MRF406	20 PEP	12	12.5	211-07
MRF425	30 PEP	12	12.5	145A-08
2N6368	40 PEP	10	12.5	211-10
MRF420	75 PEP	10	12.5	211-10
MRF421	100 PEP	10	12.5	211-04

*PNP/NPN Complements for Complementary Symmetry Driver, See EB-32.
For Matched Pairs Order MK433.

Chain 1 — 12.5 V, 2-30 MHz

Off-road vehicles/Oil tankers/Fishing fleets

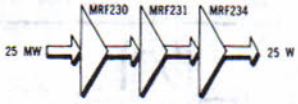


14-30 MHz, CB/AMATEUR TRANSISTORS				
MRF8004	3.5	10	12.5	TO-39
MRF449	30	10	13.6	211-07
MRF449A	30	10	13.6	145A-07
MRF450	50	11	13.6	211-07
MRF450A	50	11	13.6	145A-07
MRF453	60	11	13.6	211-10
MRF453A	60	11	13.6	145A-04
MRF454	80	11	13.6	211-10
MRF454A	80	11	13.6	145-04
27-50 MHz, LOW-BAND FM TRANSISTORS				
MRF402	1.0	10	12.5	TO-39
2N5847	8.0	10	12.5	145A-07
2N5848	20	8.0	12.5	145A-07
2N5849	40	7.5	12.5	145A-08

Device Type	P_{out} Output Power Watts	G_{pe} Power Gain dB Min	V_{CC} Supply Voltage Volts	Package
40-100 MHz, MIDBAND FM TRANSISTORS				
MRF230	1.5	10	12.5	TO-39
MRF231	3.5	10	12.5	145A-07
MRF232	7.5	9.0	12.5	145A-07
MRF233	15	9.5	12.5	145A-07
MRF234	25	10	12.5	145A-07
MRF235	50	8.0	12.5	145A-07

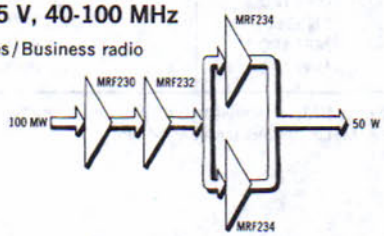
Chain 2 — 12.5 V, 40-100 MHz

European taxis/Off-shore oil rigs



Chain 3 — 12.5 V, 40-100 MHz

European buses/Business radio



156-162 MHz, VHF MARINE RADIO FM TRANSISTORS				
MRF237**	4.0	12	12.5	TO-39
MRF238	30	9.0	12.5	145A-07

**Grounded emitter TO-39 package. See EB-29

Chain 4 — 13.6 V, 160 MHz

Marine radio/Pleasure craft/Fishing boats/2 meter "ham band"

130-175 MHz, HIGH BAND/VHF FM TRANSISTORS				
MRF604	1.0	10	12.5	TO-46
2N4427	1.0	10	12	TO-39
MRF607	1.75	12.5	12.5	TO-39
2N6255	3.0	7.8	12.5	TO-39
2N5589	3.0	8.2	13.6	144B-06
MRF237**	4.0	12	12.5	TO-39
2N6080	4.0	12	12.5	145A-07
2N5590	10	5.2	13.6	145A-07
MRF212	10	9.0	12.5	145A-07

**Grounded emitter TO-39 package. See EB-29

RF TRANSISTORS AND MODULES (continued)

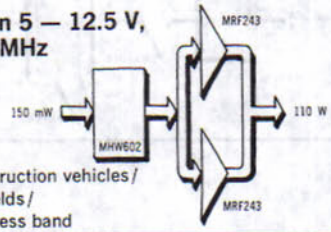
Device Type	P_{out} Output Power Watts	G_{PE} Power Gain dB Min	V_{CC} Supply Voltage Volts	Package
130-175 MHz, HIGH BAND/VHF FM TRANSISTORS				
2N6081	15	6.3	12.5	145A-07
MRF221	15	6.3	12.5	211-07
MRF215*	20	8.2	12.5	278-06
2N5591	25	4.4	13.6	145A-07
2N6082	25	6.2	12.5	145A-07
MRF222	25	6.2	12.5	211-07
2N6083	30	5.7	12.5	145A-07
MRF223	30	5.7	12.5	211-07
2N6084	40	4.5	12.5	145A-07
MRF224	40	4.5	12.5	211-07
MRF216*	40	6.7	12.5	278-06
MRF243*	60	7.0	12.5	278-06
MRF244*	70	6.6	12.5	278-06
MRF245*	80	6.4	12.5	278-06

*Controlled "Q" transistor. See EB-19

146-175 MHz, HIGH BAND/VHF FM MODULES				
MHW601	13	21	12.5	297-01
MHW602	20	21	12.5	297-01

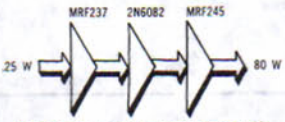
See EB-23 for applications information

Chain 5 — 12.5 V, 175 MHz



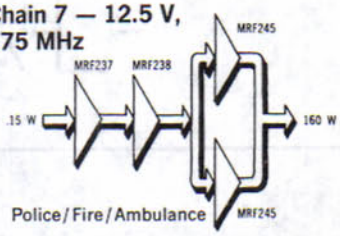
Construction vehicles/
Oil fields/
Business band

Chain 6 — 12.5 V, 175 MHz



Business band/Truck dispatch

Chain 7 — 12.5 V, 175 MHz



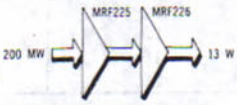
Police/Fire/Ambulance

220 MHz, CITIZENS BAND FM TRANSISTORS				
MRF207	1.0	8.2	12.5	TO-39
MRF225	1.5	9.0	12.5	TO-39
MRF227*	3.0	13.5	12.5	TO-39
MRF208	10	10	12.5	145A-07
MRF226	13	9.0	12.5	145A-07
MRF209	25	4.4	12.5	145A-07

*Grounded emitter TO-39 package. See EB-29

Chain 8 — 12.5 V, 225 MHz

1¼ meter "ham band"/225 MHz class E/Communicator class



407-512 MHz, UHF FM TRANSISTORS				
2N6256	0.5	10	12.5	249.05
MRF626	0.5	10	12.5	305-01
MRF627	0.5	10	12.5	305A-01
MRF628	0.5	10	12.5	249-05
MRF515	0.75	8.0	12.5	TO-39
2N3948	1.0	6.0	13.6	TO-39
2N5644	1.0	7.0	12.5	145A-07
MRF629**	2.0	8.0	12.5	TO-39
2N5944	2.0	9.0	12.5	244-04
2N5945	4.0	8.0	12.5	244-04
2N5946	10	6.0	12.5	244-04
MRF618*	15	6.0	12.5	278-06
MRF644*	25	6.2	12.5	278-06
MRF646*	40	4.9	12.5	278-06

*Controlled "Q" transistor. See EB-19.
**Grounded emitter TO-39 package.

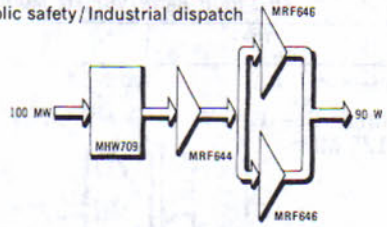
AMPLIFIER MODULES

MODULE	P_{out} Output Power Watts	f MHz	G_{PE} Power Gain dB Min	V_{DC} Supply Voltage	Package
407-512 MHz, UHF FM MODULES					
MHW401-1	1.5	400-440	15	7.5	301-01
MHW401-2	1.5	440-470	15	7.5	301-01
MHW401-3	1.5	470-512	15	7.5	301-01
MHW709-1	7.5	400-440	18.8	12.5	700-01
MHW709-2	7.5	440-470	18.8	12.5	700-01
MHW709-3	7.5	470-512	18.8	12.5	700-01
MHW710-1	13	400-440	19.4	12.5	700-01
MHW710-2	13	440-470	19.4	12.5	700-01
MHW710-3	13	470-512	19.4	12.5	700-01

See EB-8 for applications information

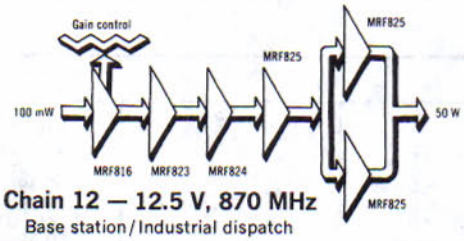
Chain 9 — 12.5 V, 512 MHz
Agricultural communications / Base stations / Repeaters

Chain 10 — 12.5 V, 470 MHz
Public safety / Industrial dispatch

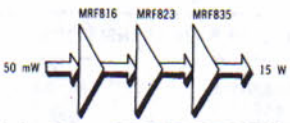


Device Type	P_{out} Output Power Watts	G_{PE} Power Gain dB Min	V_{CC} Supply Voltage Volts	Package
806-947 MHz, UHF FM TRANSISTORS				
MRF816	0.75	10	12.5	249-05
MRF817	2.5	6.2	13.6	244-04
MRF823*	5.0	8.0	12.5	278-05
MRF818	8.0	5.05	13.6	244-04
MRF824*	12	4.8	12.5	278-05
MRF835**	15	7 (G_{PB})	12.5	278-05
MRF825*	25	4.5	12.5	278-05

*Controlled "Q" transistor. See EB-19 **Gold metallization, controlled "Q" transistor. See EB-26, EB-19



Chain 12 — 12.5 V, 870 MHz
Base station / Industrial dispatch



Chain 11 — 12.5 V, 850 MHz
Cellular radio telephone

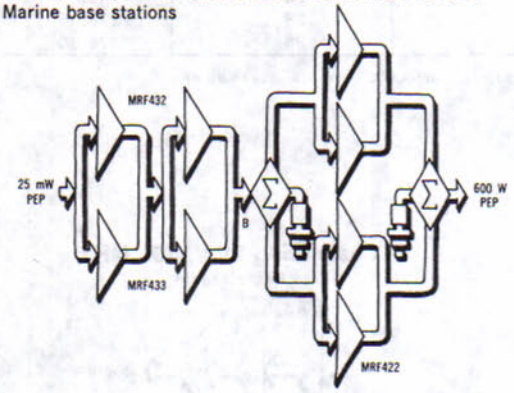
High Frequency, High Voltage, Power Amplifier Transistors

The transistors listed in this table are specified for operation in RF Power amplifiers and are listed by specific application at a given test frequency. Arrangement within each application group is in the order of increasing output power. Modulation type is given in each application heading.

Device Type	P_{out} Output Power Watts	G_{PE} Power Gain dB Min	V_{CC} Supply Voltage Volts	Package
2-30 MHz, SSB TRANSISTORS				
2N6370	10 PEP	12	28	211-07
MRF432	12.5 PEP	20	12.5	211-07
MRF433	12.5 PEP	20	12.5	211-07
2N5070	25 PEP	13	28	TO-60
MRF401	25 PEP	13	28	145A-07
MRF427	25 PEP	12	50	145A-08
2N5941	40 PEP	13	28	211-07
2N5942	80 PEP	10	28	211-04
MRF422	150 PEP	10	28	211-04
MRF428	150 PEP	13	50	307-01

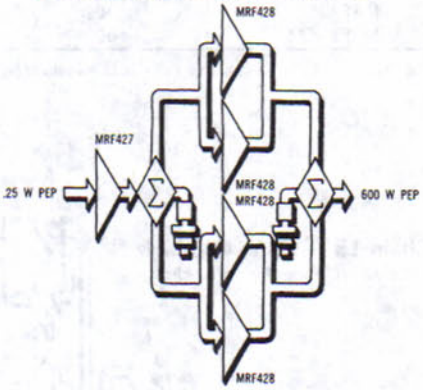
Chain 13 — 28 V, 2-30 MHz

Merchant ships/Land-base stations/Government vehicles/Marine base stations



Chain 14 — 50 V, 2-30 MHz

Commercial ships/Military base stations

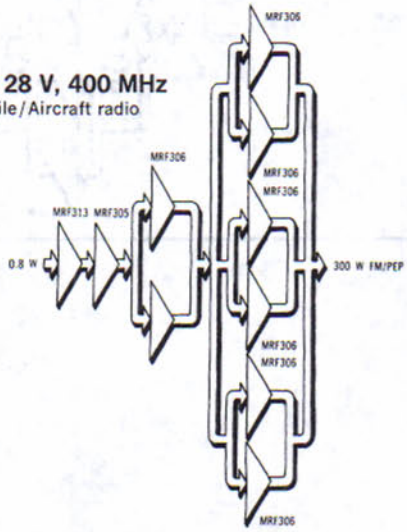


RF TRANSISTORS AND MODULES (continued)

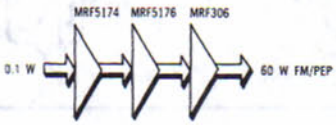
Device Type	P_{out} Output Power Watts	G_{PE} Power Gain dB Min	V_{CC} Supply Voltage Volts	Package
106-175 MHz, VHF AM TRANSISTORS				
2N3866	1.0	10	28	TO-39
2N3553	2.5	10	28	TO-39
2N5641	7.0	8.4	28	144B-04
2N5642	20	8.2	28	145A-07
2N5643	40	7.6	28	145A-07
2N6166	100	6.0	28	211-10
225-400 MHz, UHF AM TRANSISTORS				
MRF509	1.0	10	28	207A-01
2N3866	1.0	10	28	TO-39
MRF313	1.0	16 (Typ)	28	305-01
MRF313A	1.0	16 (Typ)	28	305A-01
MRF5174	2.0	12	28	244-04
2N5635	2.5	6.2	28	144B-04
MRF5175	5.0	11	28	244-04
2N5636	7.5	5.7	28	144B-04
MRF304*	10	9.0	28	278-06
MRF5176	15	10	28	244-04
2N5637	20	4.6	28	145A-07
MRF5177	30	6.0	28	215-01
MRF5177A	30	6.0	28	145A-07
MRF305*	30	8.0	28	278-06
MRF306**	60	8.0	28	278-06

*Controlled "Q" transistor. See EB-19 **Gold metallization, double matched controlled "Q" transistor. See EB-26, EB-19

Chain 15 — 28 V, 400 MHz
Fixed/Mobile/Aircraft radio



Chain 16 — 28 V, 400 MHz
Aircraft radio



Power Varactor Multipliers

Motorola's line of step-recovery multipliers represents a selection of frequency doublers and triplers. Output capabilities range from 15 watts at 450 MHz to 2 watts at 6 GHz. The table is arranged in order of decreasing output frequency.

Device Type	f_{out} GHz	P_{out} Min Watts	f_{in} GHz	P_{in} Watts	Package
1N5155A	6.0	2.0	2.0	5.0	46
1N5155	6.0	2.0	2.0	5.0	46
MV1809C1	2.0	14.5	1.0	25	47
1N5153	2.0	6.0	1.0	12	47
1N5153A	2.0	7.2	1.0	12	47
1N5150A	1.0	25	0.5	37	47
MV1807J1	1.0	25	0.5	37	44
1N5150	1.0	24	0.5	37	47
1N5149	1.0	11	0.5	20	47
1N4388	1.0	11	0.5	20	44
MV1805C	0.75	26	0.25	40	47
MV1805J	0.75	26	0.25	40	44
1N4387	0.45	15	0.15	30	44

UHF and Microwave Oscillators

The transistors listed below are for UHF and microwave oscillator applications as initial signal sources or as output stages of limited range transmitters. Devices are listed in order of increasing test frequency.

Device Type	Test Conditions f MHz	Test Conditions V_{CC} Volts	P_{out} mW Typ* Min	f_T MHz Typ* Min	Package
2N3866	400	15	1000	500	TO-39
2N5179	500	10	20	900	TO-72
2N2857	500	10	30	1000	TO-72
2N3839	500	6.0	30	1000	TO-72
MM8009	1680	20	200	1000	TO-39
2N5108	1680	20	300	1200	TO-39
MRF905	1680	20	500*	2200*	TO-46

Low-Noise Transistors

The low-noise devices listed are produced with carefully controlled r_b' and f_T to optimize device noise performance. Devices listed in the matrix are classified according to noise figure performance versus frequency.

NF	FREQUENCY MHz						Polarity
dB	60	100	200	450	1000	2000	
1.5	2N5829 2N5031	2N5829 2N5031	 MRF904				PNP NPN
2.0	2N4957 2N5032	2N4957 2N5032	2N5829 2N5031	 MRF904	 MRF901		PNP NPN
2.5	2N4958 2N5032	2N4958 2N5032	2N4957 2N5032	2N5829 2N5031	 MRF901		PNP NPN
3.0	2N4959 2N2857	2N4959 2N2857	2N4958 2N5032	2N4957 2N5032	2N5829 MRF901	 MRF901	PNP NPN
3.5	2N4959 2N5179	2N4959 2N5179	2N4959 2N2857	2N4958 2N5032	2N4957 2N5031		PNP NPN
4.0	2N4959 2N5179	2N4959 2N5179	2N4959 2N5179	2N4959 2N2857	2N4958 2N5031		PNP NPN
4.5	2N4959 2N5179	2N4959 2N5179	2N4959 2N5179	2N4959 2N2857	2N4959 2N5032		PNP NPN

General-Purpose Amplifier Transistors

The behavior of f_T as a function of I_C is critical in most Class A amplifier applications. The devices listed in the matrix form below are classified according to f_T versus I_C.

f_T GHz	COLLECTOR CURRENT mA							Polarity
Min	2.0	5.0	10	20	50	100	200	
5.0				MRF911	MRF691			NPN
4.5				MM4049 MRF901				PNP NPN
4.0			MM4049 MRF901	MM4049 MRF901	MRF961			PNP NPN
3.5		MM4049 MRF901	MM4049 MRF901	MM4049 MRF901	MRF961			PNP NPN
2.5	MRF901	MRF901	2N5835	2N5835	2N5836			PNP NPN
2.0		2N5031	2N5841	2N5841	2N5836	2N5837	2N5837	PNP NPN
1.5	2N5031	2N4957 2N3960	2N6304	2N6304	2N5583 2N5943	2N5583 2N5109	2N5837	PNP NPN
1.2	2N4957	2N4959 2N2857	2N6305	2N6305	2N5583 2N5943	2N5583 2N5109	2N5583	PNP NPN
1.0	2N5179	2N5179	2N2857	2N5583 2N5943	2N5160 MM8001	2N5160 2N5108	2N5583	PNP NPN
0.8	MRF502	MRF502	MRF502	2N5160 2N3866	2N5160 2N3866	2N5160 2N4428	2N5583	PNP NPN
0.6	MRF501	MRF501	MRF501	2N3866	2N4073	MM4019 2N3553	MM4019 2N3553	PNP NPN
0.5				MRF532* MRF531**	MRF532* MRF531**			PNP NPN

*BV_{CEO} = 80 Vdc **BV_{CEO} = 100 Vdc

CATV, MATV, and Class A Linear Transistors

The devices listed below are excellent for Class A linear CATV/MATV applications. The new MRF511 is gaining wide industry acceptance. The devices are listed according to increasing Current-Gain (f_T). More information concerning the device for your specific linear design needs can be obtained through your local Motorola Sales Office or Motorola distributor.

Device Type	Nominal Test Conditions V_{CE}/I_C Volts/mA	f_T MHz Min Typ*	Noise Figure Max or Typ* / Freq. MHz	Distortion Specifications 2nd Order IMD	3rd Order IMD	12 ch. Cross-Mod.	Output Level dbMV	Package
MRF501	6/2-5	600	4.5*/200					TO72
MRF502	6/2-5	800	4.0*/200					TO72
2N5179	6/1.5-2	900	4.5/200					TO72
BFY90	5/2	1000	5.0/500					TO72
2N6305	5/2-10	1200	5.5/450					TO72
BFX89	—	1200	6.5/500					TO72
2N5109	15/10-50	1200	3.0*/200					TO39
2N5943	15/30-50	1200	6.8*/200	−50		−42	+50	TO39
2N6304	5/2-10	1400	4.5/450					TO72
MRF511	20/50-80	1500	7.3*/200	−50	−65	−57	+50	144D-04
MRF517	15/25-60	2200	7.5/300	−60	−72	−57	+45	TO39
MRF519	20/50-80	2200	8.0/300	−50	−68	−57	+50	TO39(1)
BFR90	10/14	5000*	2.4*/500					302
BFR91	5/35	5000*	1.9*/500					302
BFR96	10/50	5000*	3.3*/500					302

(1) Grounded Emitter TO39 (Case 79-05)

Hybrid Amplifier Modules

The Hybrid Modules listed are specified for amplifier applications in CATV distribution equipment but are applicable wherever broadband (HF/VHF) low distortion, low-noise amplification is required. These devices can also be used for Broadband Medium Power (0.5 W) Driver Amplifiers.

CATV HYBRID MODULES

Device Type	Gain 40-300 MHz Min/Typ	Maximum Distortion Specifications				Noise Figure
		Output Level Note 1 dBmV	2nd Order Test Note 2 dB / Frequency MHz	3rd Order Test Note 2 dB / Frequency MHz	Cross-Modulation dB / No. of Channels	@ 300 MHz dB
MHW559	15.5/16	+50	−64/chs (2+13) @ ch R	−70/chs (4+5+A) @ ch R	−54/21	8.5
MHW562	15.5/16	+50	−69/chs (2+13) @ ch R	−78/chs (4+5+A) @ ch R	−57/21	10
MHW570	16/16.7	+50	−64/chs (2+13) @ ch R	−76/crs (4+5+A) @ ch R	−54/30	7.5
MHW572	16/16.7	+50	−70/chs (2+13) @ ch R	−79/chs (4+5+A) @ ch R	−57/30	9.0
MHW580	33/34	+48	−65/chs (3+M) @ ch W	−72/chs (U+V+W) @ ch W	−57/35	7.0

Notes:
1. 1.0 Millivolt Referenced to 75 Ohms.
2. Channel Frequency
   ch 2 = 55 MHz, ch 3 = 61 MHz, ch 4 = 67 MHz, ch 5 = 77 MHz, ch A = 121 MHz,
   ch 13 = 211 MHz, ch M = 325 MHz, ch R = 265 MHz, ch U = 283 MHz,
   ch V = 289 MHz, ch W = 295 MHz.

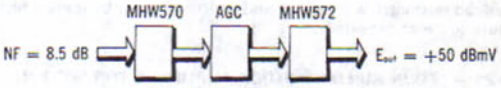
Chain 17 — CATV

GAIN ~ 30 dB (40-300 MHz)

Line extender amplifier

Chain 18 — CATV

GAIN ~ 32 dB (40-300 MHz)



Trunkline amplifier

ENGINEERING BULLETIN ABSTRACTS

EB-8 — "HOW TO APPLY THE MHW709 AND MHW710 UMF POWER MODULES"

Discusses gain control, decoupling, source and load impedance, load mismatch and other operating conditions important to the effective use of the MHW709/710 series modules.

EB-9 — "BUILD THESE CLASS E CITIZENS BAND AMPLIFIERS"

Sufficient information is provided to build an amplifier/low pass filter using the MRF207/208 chain and providing 10 W at 225 MHz at the filter output. Use of the MRF225/226 chain in this circuit will provide 13 W.

EB-17 — "SIMPLE VHF BROADBAND DESIGN USES CQ TRANSISTOR LINEUP"

The fixed-tuned amplifier for the 132-175 MHz band described provides 40 W at 12.5 V from a 1.0 W input using the MRF216/MRF221 transistor chain.

EB-18 — "CQ MODULAR TECHNIQUES MAKE 45 WATT UHF AMPLIFIER PRACTICAL"

Provides construction information for a practical 45 W, 12.5 V UHF amplifier which uses a power module/transistor lineup. Lineups for outputs of 25 W and 35 W are also specified.

EB-19 — "CONTROLLED-Q RF TECHNOLOGY — WHAT IT MEANS, HOW IT'S DONE"

How high frequency energy is efficiently transferred from a signal source to the control element in Motorola's Controlled-Q transistors is explained.

EB-23 — "HOW TO APPLY THE MHW601/602 VHF POWER MODULES"

Discusses operation and testing considerations that should be followed to use the MHW601/602 VHF power modules to the best advantage. Gain control, decoupling, source and load impedances and load mismatch are treated and instructions for building a test fixture are also provided.

EB-25 — "FOUR BUILDING BLOCK AMPLIFIERS FOR 900 MHz COMMUNICATIONS"

Describes the use of a family of four 50 ohm amplifiers for the 900 MHz band to build amplifier chains with up to 50 W output from as little as 50 mW input.

EB-26 — "A METALLIZATION SYSTEM FOR UHF AND MICROWAVE POWER TRANSISTORS"

The metallization system described overcomes the limitations of aluminum under high current density conditions. Justification of the choice of metals for the system is provided in the discussion.

EB-27 — "GET 300 WATTS PEP LINEAR ACROSS 2 TO 30 MHz FROM THIS PUSH-PULL AMPLIFIER"

Provides information sufficient to build a push-pull linear amplifier with 300 watts of PEP or CW output power across the 2 to 30 MHz band. MRF422, a new high power transistor developed for single sideband applications, is used in the design.

EB-29 — "THE COMMON EMITTER TO-39 AND ITS ADVANTAGES"

Motorola's small signal package innovation — the common emitter TO-39 — offers designers significant improvements in gain and thermal performance. EB-29 explains how.

EB-31 — "PERFORMANCE OF THE MHW560 SERIES OF CATV AMPLIFIER MODULES IN 50 OHM SYSTEMS"

The high gain, wideband linear characteristics of the MHW560 series of CATV amplifier modules suit them for use as low-level drivers in communications applications. EB-31 provides typical 50 ohm data and describes the test circuit with which the characterizations were derived.

EB-32 — "A COMPLEMENTARY SYMMETRY AMPLIFIER FOR 2 TO 30 MHz WITH SSB DRIVER APPLICATIONS"

The complementary symmetry amplifier discussed combines push-pull design with single ended impedance matching and high gain from Motorola's MRF432/433 transistors to provide up to 25 W PEP for 2 to 30 MHz SSB driver applications. Adequate information for constructing the circuit is included.

EB-37 — "AMPLIFIER GAINS 10 dB OVER NINE OCTAVES"

Discusses an amplifier, based on the MRF901 transistor, which exhibits a nominal gain of 10 dB over nine octaves of bandwidth. Sufficient information to build the amplifier is provided.

EB-38 — "MEASURING THE INTERMODULATION DISTORTION OF LINEAR AMPLIFIERS"

The two standard methods of measuring the intermodulation distortion of linear amplifiers and three systems for generating the required two-tone test signal are discussed.

EB-46 — "A SINGLE-DEVICE, 80-WATT, 50-OHM VHF AMPLIFIER"

EB-46 describes the design and construction of an amplifier using a single, MRF245, internally-matched transistor and providing 80 Watts with 9.5 gain across the 143 to 156 MHz band from just 8 W drive. Modifications of the basic amplifier for operation across wider bands are also discussed.

EB-53 — "TWO VHF HIGHBAND GAIN BLOCKS FORM 20 dB, 30-WATT AMPLIFIER CHAIN"

EB-53 describes an amplifier chain designed for use in a communications radio for the VHF marine band that can be adapted to both amateur and low-cost commercial usage. Built from MRF237, a 4 Watt common-emitter TO-39 transistor and MRD238, a 3030 Watt device, the amplifier chain provides 20 dB of gain over any 10 MHz portion of the VHH Marine/Amateur/Commercial band.

APPLICATION NOTE ABSTRACTS

AN-555 — "MOUNTING STRIPLINE-OPPOSED-EMITTER (SOE) TRANSISTORS"

The basic construction of the Stripline-Opposed-Emitter package used for many RF power transistors is described. Methods of mounting and heat-sinking both stud and flange type packages are described.

AN-593 — "BROADBAND LINEAR POWER AMPLIFIERS USING PUSH-PULL TRANSISTORS"

Two solid-state linear power amplifiers are discussed. One provides 160 watts while operating from a 28 volt supply and the other provides 80 watts from a 12.5 volt supply.

AN-595 — "25 WATT AND 10 WATT VHF MARINE BAND TRANSMITTERS"

Design, performance and construction information are provided for two power amplifiers suitable for VHF marine band (156-162 MHz) applications. Rated power output levels are 25 watts and 10 watts.

AN-704 — "BROADBAND NETWORK DESIGN FOR UHF AMPLIFIERS"

A practical method to synthesize breadboard matching networks for UHF power amplifier using only a set of filter design tables and a standard Smith chart is developed.

AN-721 — "IMPEDANCE MATCHING NETWORKS APPLIED TO RF POWER TRANSISTORS"

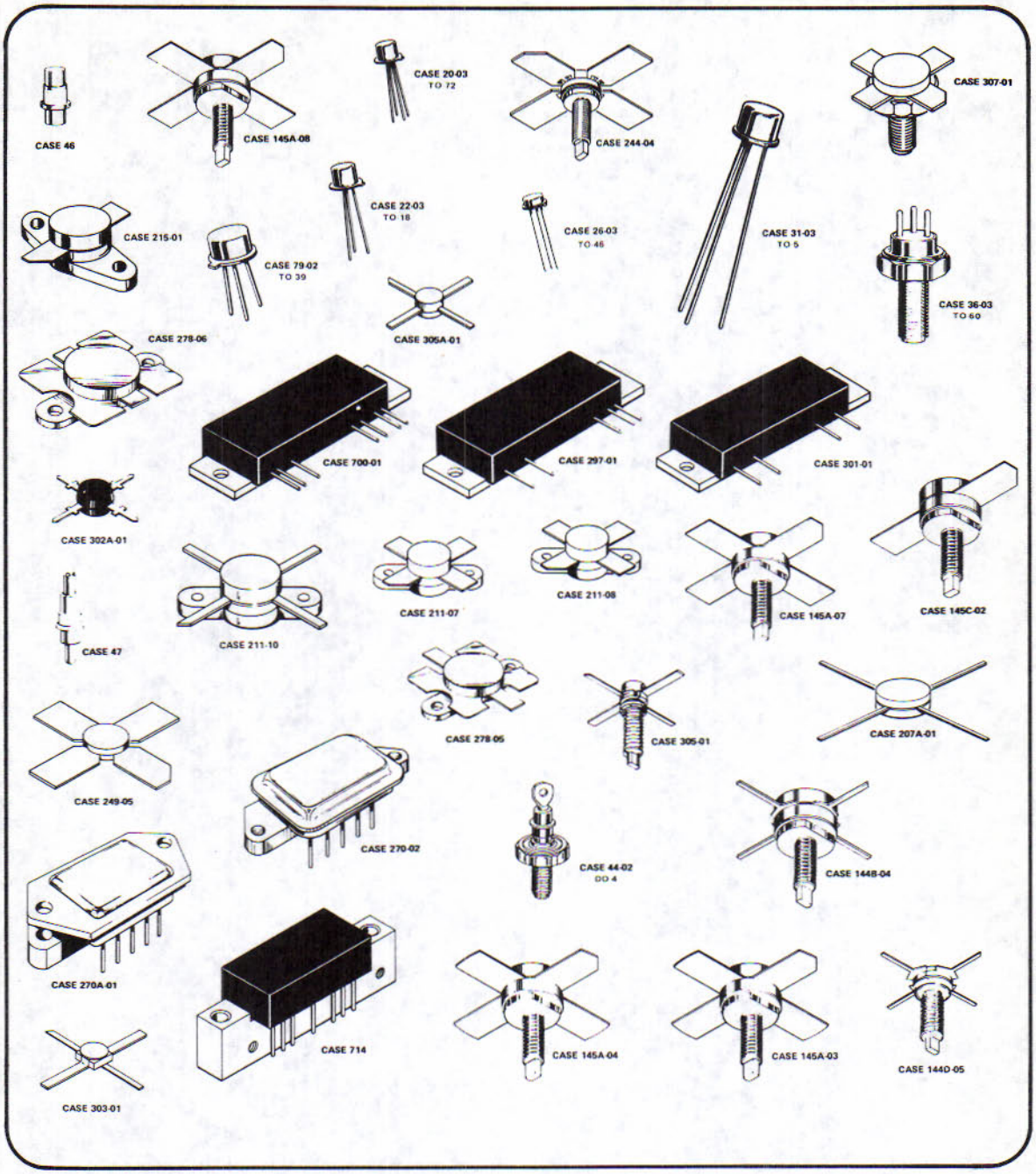
This note covers the basics of interstage and output impedance matching of RF power transistors. Graphical and numerical methods of solution are clearly described, along with sample problems. Photos, schematics and charts are generously provided throughout.

AN-728 — "13 WATT MICROSTRIP AMPLIFIER FOR 220-225 MHz OPERATION"

Design, performance and construction information are provided for a 12.5 volt, FM transmitter power amplifier and low pass filter. MRF225 and MRF226 RF power transistors are utilized in the two-stage amplifier to achieve 13 watts of power output to the filter from approximately 125 mW of drive at 225 MHz. Economical dipped-mica capacitors, microstrip lines and eyelet construction have been employed.

AN-749 — "BROADBAND TRANSFORMERS AND POWER COMBINING TECHNIQUES FOR RF"

This Application Note discusses broadband transformers for RF power applications. Practical examples are given with performance data and power combining techniques are discussed in detail.



PACKAGE INFORMATION

Silicon High Frequency products are available in a variety of packages for many applications. Information on devices in non-standard packaging may be obtained through your local Motorola Sales Office or Motorola distributor.

TUNING DIODES

. . . and Other VHF/UHF Devices

The age of electronic tuning and frequency control is here! Mechanical tuning systems are being outdated by the following advantages of electronic tuning systems:

- Mechanical linkage and contacts are eliminated.
- Channel or station changes can easily be made by push button, continuous tuning, signal search or sweep methods.
- Faster response time
- Remote tuning is simplified
- Tuning components are much smaller than mechanical components
- The designer is released from the mechanical and size restrictions dictated by mechanical tuning methods

Three parameters are of prime consideration in choosing the proper tuning diode.

C_T – Nominal capacitance – Measure of the capacitance at one specified voltage

C_R – Capacitance ratio – Ratio of the capacitance at two separate voltages usually at the operating ends of the CV curve. Measure of the magnitude of capacitance change as the reverse voltage is varied across the operating range.

Q – Figure of Merit – The same figure of merit that is widely used for capacitance and coils and is an indicator of how "good" a capacitor the tuning diode is.

These parameters are highlighted in the following selector guide and organized by package style to permit selection of the required specifications and package.

TABLE OF CONTENTS

The following index reflects the devices characterized in this section. To locate the exact page number, see Catalog Index (Page 7-1).

INDEX

EPICAP TUNING DIODES

LINE HIGHLIGHTS	• LOW CAPACITANCE • MICROWAVE OPERATION • MICROWAVE PACKAGE • HIGH Q	• HIGH Q • CAPACITANCE TOLERANCE 10% and 5.0%	• HIGH Q GUARANTEED @ 4.0 V • CONTROLLED TR	• THE PREMIUM GLASS LINE • VERY HIGH Q • GUARANTEED HIGH TR • CAPACITANCE TOLERANCE 10%,5.0% and 2.0%
MAXIMUM WORKING VOLTAGE		60 VOLTS		
	 Case 45	 Case 51 DO-7	 Case 51 DO-7	 Case 51 DO-7

C_T NOMINAL CAPACITANCE pF ±10% @ V_R = 4.0 V = 3.0 V* f = 1.0 MHz	Cap Ratio 4-60 V Min	Q @4.0 V 100 MHz Min	Device Type	Cap Ratio 4-60 V Min	Q @4.0 V 50 MHz Min	(1) Device Type	Cap Ratio 4-60 V Min	Q @4.0 V 50 MHz Min	Device Type	Cap Ratio 2-30 V Min	Q @4.0 V 50 MHz Min	(2) Device Type
1.0	2.1	350	MV1858D									
2.2	2.5	350	MC1860D									
3.3	2.6	300	MC1862D									
4.7	2.6	300	MV1863D									
6.8	2.7	300	MV1864D	2.7	350	1N5139,A(3)				2.7	600	1N5461A
8.2	2.7	300	MV1865D							2.8	600	1N5462A
10	2.8	250	MV1866D	2.8	300	1N5140,A	3.0	500	MV1866	2.8	550	1N5463A
10												
10												
12	2.8	200	MV1868D	2.8	300	1N5141,A	3.0	500	MV1868	2.8	550	1N5464A
15	2.8	200	MV1870D	2.8	250	1N5142,A	3.0	400	MV1870	2.8	550	1N5465A
18				2.8	250	1N5143,A	3.0	400	MV1871	2.9	500	1N5466A
20										2.9	500	1N5467A
22				3.2	200	1N5144,A	3.2	400	MV1872	2.9	500	1N5468A
22												
27				3.2	200	1N5145,A	3.2	300	MV1874	2.9	500	1N5469A
33				3.2	200	1N5146,A	3.2	300	MV1876	2.9	500	1N5470A
39				3.2	200	1N5147,A	3.2	300	MV1877	2.9	450	1N5471A
47				3.2	200	1N5148,A	3.2	300	MV1878	2.9	400	1N5472A
56										2.9	300	1N5473A
68										2.9	250	1N5474A
82										2.9	225	1N5475A
100										2.9	200	1N5476A
120												
150												
180												
200												
220												
250												
270												
330												

(1) Add Suffix "A" for ±5.0% C_T tolerance
(2) Substitute "B" Suffix for ±5.0% C_T, "C" Suffix for 2.0% C_T
(3) A versions of 1N5139 – 1N5148 series have tighter capacitance min/max windows.

• HIGH Q • CAPACITANCE TOLERANCE 10%,5.0% and 2.0% • CONTROLLED			• PLASTIC PACKAGE • LOW-COST, HIGH VOLUME			• GENERAL PURPOSE			• LOW INDUCTANCE • MINI-L PACKAGE			
30 VOLTS												
												
Case 51 DO-7			Case 182			Case 51 DO-7			Case 226			
Cap. Ratio 2-30 V Min	Q @ 4.0 V 50 MHz Min	Device Type	Cap Ratio 2-30 V Min	Q @ 4.0 V 50 MHz Min	Device Type	Cap Ratio 4-25 V Min	Q @ 4.0 V 50 MHz Min	Device Type	Cap Ratio 3-25 V Min	Q @ 3.0 V 50 MHz Min	Device Type	C_T NOMINAL CAPACITANCE pF ±10% @ V_R = 4.0 V = 3.0 V* f = 1.0 MHz
												1.0
												2.2
												3.3
												4.7
2.5	450	1N5441A	2.5	450	MV2101							6.8
2.5	450	1N5442A	2.5	450	MV2102							8.2
2.6	400	1N5443A	2.5	400	MV2103				4.5	150	MV3140*	10
									4.0	150	MV3141*	10
									3.5	50	MV3142*	10
2.6	400	1N5444A	2.5	400	MV2104							12
2.6	400	1N5445A	2.5	400	MV2105	1.8	30	MV830				15
2.6	350	1N5446A	2.5	350	MV2106	1.8	25	MV831				18
2.6	350	1N5447A										20
2.6	350	1N5448A	2.5	350	MV2107	1.8	25	MV832	4.5	300	MV3102*	22
									4.0	200	MV3103*	22
2.6	350	1N5449A	2.5	300	MV2108	1.8	25	MV833				27
2.6	350	1N5450A	2.5	200	MV2109	1.9	20	MV834				33
2.6	300	1N5451A	2.5	150	MV2110	1.9	20	MV835				39
2.6	250	1N5452A	2.5	150	MV2111	1.9	15	MV836				47
2.6	200	1N5453A	2.6	150	MV2112	1.9	15	MV837				56
2.7	175	1N5454A	2.6	150	MV2113	2.0	15	MV838				68
2.7	175	1N5455A	2.6	100	MV2114	2.0	10	MV839				82
2.7	175	1N5456A	2.6	100	MV2115	2.0	10	MV840				100

* Hyper Abrupt

EPICAP TUNING DIODES (continued)

LINE HIGHLIGHTS

- HIGH Q
- IDEAL FOR RF AND MICROWAVE APPLICATIONS
- CONTROLLED AND UNIFORM TUNING RATIO
- CAPACITANCE TOLERANCE 10%
- MICRO-MINIATURE PACKAGE

MAXIMUM WORKING VOLTAGE — **30 VOLTS**

Case 226

Case 166-02

C_T NOMINAL CAPACITANCE pF ±10% @ V_R = 4.0 V = 2.0 V‡ = 1.0 V● f = 1.0 MHz	Case 226 Cap Ratio 2-30 V Min	Case 226 Q @ 4.0 V 100 MHz Min	Case 226 Device Type	Case 166-02 Cap Ratio 2-30 V Min	Case 166-02 Q @ 4.0 V 100 MHz Min	Case 166-02 Device Type
1.0				2.0	325	MVI-2097
2.2				2.0	325	MVI-2908
3.3				2.2	300	MVI-2909
4.7				2.4	300	MVI-2100
6.8	2.7	225	MV3501	2.7	275	MVI-2101
8.2	2.8	225	MV3502	2.8	275	MVI-2102
10	2.8	200	MV3503	2.8	275	MVI-2103
12	2.8	200	MV3504	2.8	275	MVI-2104
15	2.9	200	MV3505	2.9	275	MVI-2105
18	2.9	175	MV3506	2.9	250	MVI-2106
20						
22	2.9	175	MV3507	2.9	200	MVI-2107
27				2.7	200	MVI-2108
33				2.7	200	MVI-2109
39						
47						
56						
68						
82						
100						
120						
150						
180						
200						
220						
250						
270						
330						
550						

* Motorola has capability to supply a variety of families in the Micro-I. If the device desired is not listed — please contact your nearest distributor or Motorola Sales Representative.

• GENERAL PURPOSE			• HIGH CAPACITANCE • GENERAL PURPOSE			• HYPER ABRUPT • GLASS DIODES				
20 VOLTS						12 VOLTS				
 Case 51 DO-7			 Case 146 DO-14			 Case 51 DO-7				
Cap Ratio 2-20 V Min	Q @ 4.0 V 50 MHz Min	Device Type	Cap Ratio 2-20 V Min	Q @ 4.0 V 20 MHz Min	Device Type	Cap Ratio 2-10 V #1-10 V Min	Q @ 2.0 V 1.0 MHz Min	Device Type		
									1.0	C_T NOMINAL CAPACITANCE pF ±10% @ V_R = 4.0 V = 2.0 V‡ = 1.0 V f = 1.0 MHz
									2.2	
									3.3	
									4.7	
2.0	300	MV1620							6.8	
2.0	300	MV1622							8.2	
2.0	300	MV1624							10	
2.0	300	MV1626							12	
2.0	250	MV1628							15	
2.0	250	MV1630							18	
2.0	250	MV1632							20	
2.0	250	MV1634							22	
2.0	200	MV1636							27	
2.0	200	MV1638							33	
2.0	200	MV1640							39	
2.0	200	MV1642							47	
2.0	150	MV1644							56	
2.0	150	MV1646							68	
2.0	150	MV1648							82	
2.0	150	MV1650							100	
			2.6	250	MV1652	10	200	MV1404‡	120	
			2.6	250	MV1654	10	200	MV1403‡	150	
			2.6	200	MV1656				180	
			2.6	200	MV1658				200	
			2.6	150	MV1660				220	
			2.3	150	MV1662(3)	10	200	MV1405‡	250	
			2.3	100	MV1664(3)				270	
			2.3	100	MV1666(3)				330	
						14	200	#MV1401‡	550	●

FM Radio and TV Hyper-Abrupt Tuning Diodes

. . . designed for use in VHF and UHF tuners and FM radio, providing solid-state reliability in replacement of mechanical tuning methods.

LINE HIGHLIGHTS	• HIGH Q • GUARANTEED CAPACITANCE RANGE			• LOW INDUCTANCE • MINI-L PACKAGE			• GUARANTEED MINIMUM Q • LOW INDUCTANCE • MINI-L PACKAGE			• HIGH Q • CONTROLLED TR • LOW INDUCTANCE • MINI-L PACKAGE			• HIGH Q • CONTROLLED T • LOW INDUCTAN • MINI-L PACKAG		
	MAXIMUM WORKING VOLTAGE 32 VOLTS			30 VOLTS											
	 Case 29-02 TO-92			 Case 226											
	Cap Ratio 3-30 V Min	Q @ 3.0 V 100 MHz Min	Device Type	Cap Ratio 3-25 V Min	Q @ 3.0 V 100 MHz Min	Device Type	Cap Ratio 3-25 V Min	Q @ 3.0 V 100 MHz Min	Device Type	Cap Ratio 3-25 V Min	Q @ 3.0 V 50 MHz Min	Device Type	Cap Ratio 3-25 V Min	Q @ 3.0 V 50 MHz Min	
C_T NOMINAL CAPACITANCE pF ±10% V_R = 3.0 Vdc f = 1.0 MHz	2.2*			4.5	225	BB105B									
	2.3*			4.0	150	BB105G									
	2.6*			4.0	225	BB105A									
	10						4.5	150	MV3140						
	10						4.0	150	MV3141						
	10						3.5	50	MV3142						
	22									4.5	300	MV3102			
	22									4.0	200	MV3103			
	29												5.0	280	M
	29												5.0	200	M
	36	2.5	100	MV104G											
	40	2.5	100	MV104											

*V_R = 25 V for C_T

AM Tuning Diodes

. . . designed for electronic tuning of AM radios, receivers, and general AM frequency control.

LINE HIGHLIGHTS		• HIGH CAPACITANCE RATIO • GUARANTEED DIODE CAPACITANCE			• HIGH CAPACITANCE RATIO • GUARANTEED DIODE CAPACITANCE		
		MAXIMUM WORKING VOLTAGE			28 VOLTS		
		 CASE 29-02 TO-92			 CASE 206-02		
		Cap Ratio 1-25 V Min	Q @ 1.0 V 1.0 MHz Min	Device Type	Cap Ratio 1-25 V Min	Q @ 1.0 V 1.0 MHz Min	Device Type
C_T NOMINAL CAPACITANCE pF ±10% V_R = 1.0 V f = 1.0 MHz	330	15	150	MVAM-2 (Dual AM Diode)			
	450				15	150	MVAM-1 (Triple AM Diode)

Hot-Carrier Diodes

Hot-Carrier diodes are ideal for VHF and UHF mixer and detector applications as well as many higher microwave frequency applications. They provide stable electrical characteristics by eliminating the point-contact diode presently used in many applications. Motorola has the capability of supplying these devices in a variety of packages.

$V_{(BR)R}$ I_R = 10 A Volts Min	C_T V_R = 0 V, f = 1.0 MHz (1) V_R = 15 V, f = 1.0 MHz (2) V_R = 20 V, f = 1.0 MHz (3) pF Max	V_F I_F = 10 mA Volts Max	I_R V_R = 3.0 V (4) V_R = 15 V (5) V_R = 25 V (6) V_R = 35 V (7) μA Max	NF dB Max	Device Type	Case
4.0	1.0 (1)	0.6	0.25 (4)	7.0	MBD101	182-02
4.0	1.0 (1)	0.6	0.25 (4)	7.0	MBD102	226
4.0	1.0 (1)	0.6	0.25 (4)	7.0	MBD103	45-01
20	1.5 (2)	0.6	200 (5)		MBD201	182-03
30	1.5 (2)	0.6	200 (6)		MBD301	182-03
50	1.0 (3)	1.2	200 (6)		MBD501	182-02
50	1.0 (3)	1.2	200 (6)		MBD502	226
70	1.0 (3)	1.2	200 (7)		MBD701	182-02
70	1.0 (3)	1.2	200 (7)		MBD702	226
4.0	1.0 (1)	0.6	0.25 (4)	7.0	MBI-101	166-02

CASE 45

CASE 166-02

CASE 182

CASE 226

Pin Switching Diodes

. . . designed for VHF band switching and general purpose switching.

CASE 166-02

CASE 226

$V_{(BR)R}$ I_R = 10 μAdc Volts Min	R_S I_F = 10 mAdc Ohms Min	C_T V_R = 20 V f = 1.0 MHz f = 100 MHz* pF Max	L_S f_V = 250 MHz nH Typ	C_C f = 1.0 MHz pF Typ	Device Type	Case
35	0.7	1.0	3.0	0.15	MPI-3401	166-02
35	0.7	1.0	3.0	0.1	MPN3401	226
35	0.6	2.0	3.0	0.1	MPN3402	226
25	10	0.45*	3.0	0.1	MPN3411	226
25	15	0.45*	3.0	0.1	MPN3412	226

ZENER DIODES

Voltage Regulator and Reference Devices

In every language under the sun, the name most commonly associated with solid-state regulator and reference devices is Motorola. A pioneer in Zener diodes development, Motorola has consistently led the industry in parameter improvements, packaging proliferation and specifications innovation. Today, Motorola serves the industry with an incomparable line of zener and avalanche regulator diodes, temperature compensated reference devices, and a host of integrated circuits designed to provide the exact degree of regulation required, at the point in the circuit or system where it can be used most conveniently at the lowest cost.

TABLE OF CONTENTS

The following index reflects the devices characterized in this section. To locate the exact page number, see Catalog Index (Page 7-1).

INDEX

INDEX (continued)

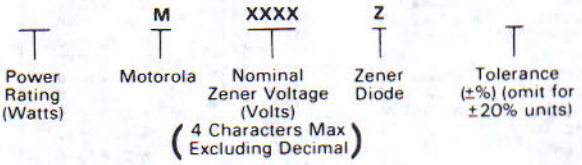
DEVICE OPTIONS

Motorola manufactures a complete line of zener diodes. In cases where a non-standard set of specifications is required, the appropriate device can be selected and ordered from the following device options.

NON-STANDARD ZENER DIODES SPECIAL VOLTAGE AND TOLERANCE RATINGS

JEDEC "IN" type numbers denote a specific Zener voltage, power rating, and tolerance. For example, JEDEC type 1N4728 is a standard 1 watt diode, rated at 3.3 volts ± 10%. A suffix "A" on this type number indicates a ± 5% voltage tolerance.

Special Motorola devices, with a choice of voltages and tolerances, are also available. The following diagram explains the Motorola coding system:



For example, the code for a special 10 watt Zener diode with a voltage of 41 volts and a tolerance of ± 1% would be: 10M41Z1.

Following is a list of other standard Motorola symbols for special Zener device orders (X's indicate nominal Zener voltage):

BASIC MOTOROLA TYPE	DEVICE DESCRIPTION
¼MXXXAZ5	250 mW Alloy Glass, ±5%
¼MXXXZ5	250 mW Glass, ±5%
4MXXXAZ5	400 mW Alloy Glass, ±5%
4MXXXZ10	400 mW Glass, ±10%
.5MXXXZS10	500 mW Surmetic, ±10%
1MXXXZ5	1 Watt Flangeless, ±5%
1MXXXAZ10	1 Watt Alloy Flangless, ±10%
1MXXXZ10	1 Watt Flangeless, ±10%
1MXXXZS5	1 Watt Surmetic, ±5%
1.5MXXXZ	1 5 Watt, ±20%
5MXXXZS5	5 Watt Surmetic, ±5%
10MXXXAZ5	10 Watt Alloy Stud, ±5%
10MXXXZ10	10 Watt Stud, ±10%
50MXXXAZ10	50 Watt Alloy TO-3, ±10%
50MXXXASZ5	50 Watt Alloy Stud, ±5%
50MXXXZ	50 Watt TO-3, ±20%
50MXXXSZ5	50 Watt Stud, ±5%

For reverse polarities (10 W and 50 W), insert "R" before tolerance, i.e., 50M110SZR5.

1N5518 thru 1N5546 — This series may be ordered in ±2% and ±1% tolerance by adding the following suffix:

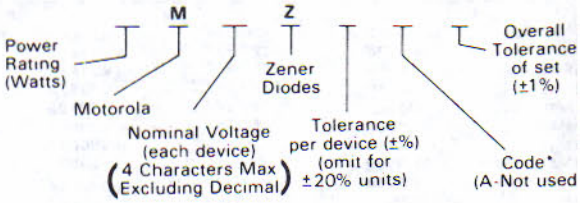
C = ±2% D = ±1%

For example the 1N5518D would be the same as the 1N5518B except V_Z = 3.3 ±1%.

ZENER TYPES BETWEEN NOMINAL VOLTAGES MATCHED SETS OF ZENER DIODES

Zener diodes can also be obtained in sets consisting of two or more matched devices. The method for specifying such matched sets is similar to the one described for specifying units with a special voltage and/or tolerance except that two extra suffixes are added to the code number described above.

These units are marked with code letters to identify the matched sets and in addition, each unit in a set is marked with the same serial number which is different for each set being ordered.

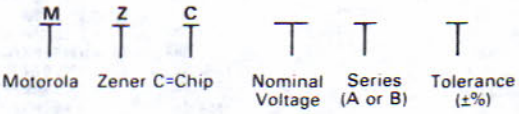


*Code:
- B — Two devices in series
- C — Three devices in series
- D — Four devices in series
- E — Five devices in series
- F — Six devices in series
- G — Seven devices in series
- H — Eight devices in series
- P — Two devices in parallel (not recommended)
- X — Two devices, one standard polarity, the other reverse polarity. (10 and 50 watts only)

i.e., 10M51Z5B1 is for two 10 watt zeners, each of 51 volts, ±5% matched to a total voltage of 102 volts ±1%.

ZENER CHIPS (MZC)

1. The nomenclature for Zener Chips is as follows:

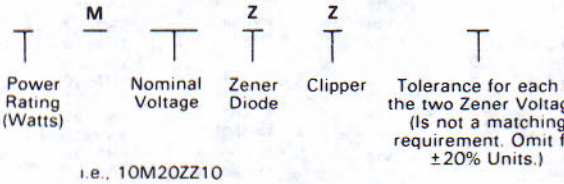


BASIC TYPE MOTOROLA NOMENCLATURE	DEVICE DESCRIPTION
MZCXXAX	Zener Chip—"A" Series, High Level
MZCXXBX	Zener Chip—"B" Series, Low Level

2. Chips are sold in increments of ten (10) only.
3. The pricing formula for between nominal voltages and tight tolerance zeners shall apply.
4. Chips are **not** sold as matched sets or clippers.
5. A "-1" suffix will cause all chips ordered to be supplied in Deka-Pak

ZENER CLIPPERS

Special clipper diodes with opposing Zener junctions built into the device are available by using the following nomenclature:



i.e., 10M20ZZ10

This nomenclature is applicable to all packages and power ratings as restricted in the above paragraphs.

ORDERING INFORMATION

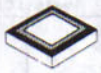
Order using the above nomenclature or else specify the device type, nominal voltage and tolerance required.

ZENER and AVALANCHE REGULATOR DIODES

The devices depicted in the accompanying matrix represent a basic profile of the largest inventoried zener-diode line in the industry. Check the following features for application to your specific requirements.

Wide selection of package materials and styles:

- Plastic (surmetic), for lowest cost
- Glass for highest reliability
- Metal for highest power
- Unencapsulated (chips), for hybrid circuit applications

Nominal Zener Voltage (Note 6)	CHIPS (25 Mils Square) Cathode = Bottom Surface		250 MILLIWATT (400 mW Package) Cathode = Polarity Mark	400 MILLIWATT Cathode = Polarity Mark		500 MILLIWATT Cathode = Polarity Mark		
	 MZC	Actual Size	 Glass Case 51 (DO-7)	 Glass Case 299 DO-35	 Glass Case 51 DO-7	 Surmetic Case 182 (TO-92)	 Surmetic 20 Case 51 (DO-7)	 Glass Case 299-01 (DO-35)
1.8		MZC1.8B10	MZ4614					
2.0		MCZ2.0B10	MZ4615					
2.2		MCZ2.2B10	MZ4616					
2.4	MZC2.4A10	MCZ2.4B10	MZ4617	1N4370		1N5837A	1N5221	1N5985
2.7	MZC2.7A10	MCZ2.7B10	MZ4618	1N4371		1N5839A	1N5223	1N5986
3.0	MZC3.0A10	MCZ3.0B10	MZ4619	1N4372		1N5841A	1N5225	1N5987
3.3	MZC3.3A10	MCZ3.3B10	MZ4620	1N746	1N5518	1N5842A	1N5226	1N5988
3.6	MZC3.6A10	MCZ3.6B10	MZ4621	1N747	1N5519	1N5843A	1N5227	1N5989
3.9	MZC3.9A10	MCZ3.9B10	MZ4622	1N748	1N5520	1N5844A	1N5228	1N5990
4.3	MZC4.3A10	MCZ4.3B10	MZ4623	1N749	1N5521	1N5845A	1N5229	1N5991
4.7	MZC4.7A10	MCZ4.7B10	MZ4624	1N750	1N5522	1N5846A	1N5230	1N5992
5.1	MZC5.1A10	MCZ5.1B10	MZ4625	1N751	1N5523	1N5847A	1N5231	1N5993
5.6	MZC5.6A10	MCZ5.6B10	MZ4626	1N752	1N5524	1N5848A	1N5232	1N5994
6.2	MZC6.2A10	MCZ6.2B10	MZ4627	1N753	1N5525	1N5850A	1N5234	1N5995
6.8	MZC6.8A10	MCZ6.8B10	1N4099	1N754 1N957	1N5526	1N5851A	1N5235	1N5996
7.5	MZC7.5A10	MCZ7.5B10	1N4100	1N755 1N958	1N5527	1N5852A	1N5236	1N5997
8.2	MZC8.2A10	MCZ8.2B10	1N4101	1N756 1N959	1N5528	1N5853A	1N5237	1N5998
9.1	MZC9.1A10	MCZ9.1B10	1N4103	1N757 1N960	1N5529	1N5855A	1N5239	1N5999
10	MZC10A10	MCZ10B10	1N4104	1N758 1N961	1N5530	1N5856A	1N5240	1N6000
11	MZC11A10	MCZ11B10	1N4105	1N962	1N5531	1N5857A	1N5241	1N6001
12	MZC12A10	MCZ12B10	1N4106	1N759 1N963	1N5532	1N5858A	1N5242	1N6002
13	MZC13A10	MCZ13B10	1N4107	1N964	1N5533	1N5859A	1N5243	1N6003
15	MZC15A10	MCZ15B10	1N4109	1N965	1N5535	1N5861A	1N5245	1N6004
16	MZC16A10	MCZ16B10	1N4110	1N966	1N5536	1N5862A	1N5246	1N6005
18	MZC18A10	MCZ18B10	1N4112	1N967	1N5538	1N5864A	1N5248	1N6006
20	MZC20A10	MCZ20B10	1N4114	1N968	1N5540	1N5866A	1N5250	1N6007
22	MZC22A10	MCZ22B10	1N4115	1N969	1N5541	1N5867A	1N5251	1N6008
24	MZC24A10	MCZ24B10	1N4116	1N970	1N5542	1N5868A	1N5252	1N6009
27	MZC27A10	MCZ27B10	1N4118	1N971		1N5870A	1N5254	1N6010
30	MZC30A10	MCZ30B10	1N4120	1N972	1N5545	1N5872A	1N5256	1N6011
33	MZC33A10	MCZ33B10	1N4121	1N973	1N5546	1N5873A	1N5257	1N6012
36	MZC36A10	MCZ36B10	1N4122	1N974		1N5874A	1N5258	1N6013
39	MZC39A10	MCZ39B10	1N4123	1N975		1N5875A	1N5259	1N6014
43	MZC43A10	MCZ43B10	1N4124	1N976		1N5876A	1N5260	1N6015
47	MZC47A10	MCZ47B10	1N4125	1N977		1N5877A	1N5261	1N6016
51	MZC51A10	MCZ51B10	1N4126	1N978		1N5878A	1N5262	1N6017
56	MZC56A10	MCZ56B10	1N4127	1N979		1N5879A	1N5263	1N6018
62	MZC62A10	MCZ62B10	1N4129	1N980		1N5881A	1N5265	1N6019
68	MZC68A10	MCZ68B10	1N4130	1N981		1N5882A	1N5266	1N6020
75	MZC75A10	MCZ75B10	1N4131	1N982		1N5883A	1N5267	1N6021
82	MZC82A10	MCZ82B10	1N4132	1N983		1N5884A	1N5268	1N6022
91	MZC91A10	MCZ91B10	1N4134	1N984		1N5886A	1N5270	1N6023
100	MZC100A10	MCZ100B10	1N4135	1N985		1N5887A	1N5271	1N6024
110	MZC110A10	MCZ110B10		1N986		1N5888A	1N5272	1N6025
120	MZC120A10	MCZ120B10		1N987		1N5889A	1N5273	1N6026
130	MZC130A10	MCZ130B10		1N988		1N5890A	1N5274	1N6027
140	MZC140A10	MCZ140B10		1N989		1N5891A	1N5275	
150	MZC150A10	MCZ150B10		1N990		1N5892A	1N5276	1N6028
160	MZC160A10	MCZ160B10		1N991		1N5893A	1N5277	1N6029
170	MZC170A10	MCZ170B10		1N992		1N5894A	1N5278	
180	MZC180A10	MCZ180B10				1N5895A	1N5279	1N6030
200	MZC200A10	MCZ200B10				1N5897A	1N5281	1N6031

Chips:
A denotes I_{ZT} in mA range
B denotes I_{ZT} in 250 μA
JAN/JANTX available ±5% only

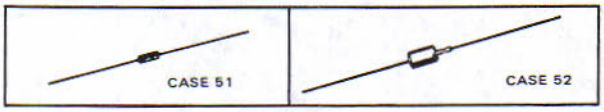
ZENER AND AVALANCHE REGULATOR DIODES (continued)

- Power ratings from 1.4 to 50 Watts
- Breakover tolerances from 1.8 to 200 V in approximately 10% steps
- Available tolerances from 20% (low cost) to as tight as 1% (critical applications) with off-the-shelf-delivery
- Special selection of electrical characteristics available at low cost due to high-volume lines (check your Motorola sales representative for special quotations)
- JAN/JANTX (V) availability

Nominal Zener Voltage	1 WATT Cathode Polarity Mark	1 WATT Cathode to Case	1 WATT Cathode Polarity Mark	5 WATT Cathode Polarity Mark	10 WATT Cathode to Case = 1N3993 Series Anode to Case = 1N2970 Series	50 WATT Anode to Case	
							
	Surmetic 30 Case 59 (DO-41)	Metal Case 52 (DO-13)	Glass Case 59 (DO-41)	Surmetic 40 Case 17	Metal Case 56 (DO-4)	Metal Case 54 (TO-3)	Metal Case 58 (DO-5)
1.8							
2.0							
2.2							
2.4							
2.7							
3.0							
3.3	1N4728	1N3821	1N5913	1N5333			
3.6	1N4729	1N3822	1N5914	1N5334			
3.9	1N4730	1N3823	1N5915	1N5335	1N3993&R	1N4557&R	1N4549&R
4.3	1N4731	1N3824	1N5916	1N5336	1N3994&R	1N4558&R	1N4550&R
4.7	1N4732	1N3825	1N5917	1N5337	1N3995&R	1N4559&R	1N4551&R
5.1	1N4733	1N3826	1N5918	1N5338	1N3996&R	1N4560&R	1N4552&R
5.6	1N4734	1N3827	1N5919	1N5339	1N3997&R	1N4561&R	1N4553&R
6.2	1N4735	1N3828	1N5920	1N5341	1N3998&R	1N4562&R	1N4554&R
6.8	1N4736	1N3829	1N5921	1N5342	1N3999&R	1N4563&R	1N4555&R
		1N3016			1N2970&R	1N2804&R	1N3305&R
7.5	1N4737	1N3830	1N5922	1N5343	1N4000&R	1N4564&R	1N4556&R
		1N3017			1N2971&R	1N2805&R	1N3306&R
8.2	1N4738	1N3018	1N5923	1N5344	1N2972&R	1N2806&R	1N3307&R
9.1	1N4739	1N3019	1N5924	1N5346	1N2973&R	1N2807&R	1N3308&R
10	1N4740	1N3020	1N5925	1N5347	1N2974&R	1N2808&R	1N3309&R
11	1N4741	1N3021	1N5926	1N5348	1N2975&R	1N2809&R	1N3310&R
12	1N4742	1N3022	1N5927	1N5349	1N2976&R	1N2810&R	1N3311&R
13	1N4743	1N3023	1N5928	1N5350	1N2977&R	1N2811&R	1N3312&R
15	1N4744	1N3024	1N5929	1N5352	1N2979&R	1N2813&R	1N3314&R
16	1N4745	1N3025	1N5930	1N5353	1N2980&R	1N2814&R	1N3315&R
18	1N4746	1N3026	1N5931	1N5355	1N2982&R	1N2816&R	1N3317&R
20	1N4747	1N3027	1N5932	1N5357	1N2984&R	1N2818&R	1N3319&R
22	1N4748	1N3028	1N5933	1N5358	1N2985&R	1N2819&R	1N3320&R
24	1N4749	1N3029	1N5934	1N5359	1N2986&R	1N2820&R	1N3321&R
27	1N4750	1N3030	1N5935	1N5361	1N2988&R	1N2822&R	1N3322&R
30	1N4751	1N3031	1N5936	1N5363	1N2989&R	1N2823&R	1N3324&R
33	1N4752	1N3032	1N5937	1N5364	1N2990&R	1N2824&R	1N3325&R
36	1N4753	1N3033	1N5938	1N5365	1N2991&R	1N2825&R	1N3326&R
39	1N4754	1N3034	1N5939	1N5366	1N2992&R	1N2826&R	1N3327&R
43	1N4755	1N3035	1N5940	1N5367	1N2993&R	1N2827&R	1N3328&R
47	1N4756	1N3036	1N5941	1N5368	1N2996&R	1N2829&R	1N3330&R
51	1N4757	1N3037	1N5942	1N5369	1N2997&R	1N2831&R	1N3332&R
56	1N4758	1N3038	1N5943	1N5370	1N2999&R	1N2832&R	1N3334&R
62	1N4759	1N3039	1N5944	1N5372	1N3000&R	1N2833&R	1N3335&R
68	1N4760	1N3040	1N5945	1N5373	1N3001&R	1N2834&R	1N3336&R
75	1N4761	1N3041	1N5946	1N5374	1N3002&R	1N2835&R	1N3337&R
82	1N4762	1N3042	1N5947	1N5375	1N3003&R	1N2836&R	1N3338&R
91	1N4763	1N3043	1N5948	1N5377	1N3004&R	1N2837&R	1N3339&R
100	1N4764	1N3044	1N5949	1N5378	1N3005&R	1N2838&R	1N3340&R
110	1M110ZS10	1N3045	1N5950	1N5379	1N3007&R	1N2840&R	1N3342&R
120	1M120ZS10	1N3046	1N5951	1N5380	1N3008&R	1N2841&R	1N3343&R
130	1M130ZS10	1N3047	1N5952	1N5381	1N3009&R	1N2842&R	1N3343&R
150	1M140ZS10	1N3048	1N5953	1N5383	1N3011&R	1N2843&R	1N3346&R
160	1M160ZS10	1N3049	1N5954	1N5384	1N3012&R	1N2844&R	1N3347&R
180	1M180ZS10	1N3050	1N5955	1N5386	1N3014&R	1N2845&R	1N3349&R
200	1M200ZS10	1N3051	1N5956	1N5388	1N3015&R	1N2846&R	1N3350&R

R, RA, & RB = Reverse Polarity Types Available

ZENER REFERENCE DEVICES



For applications where output voltage must remain within narrow limits during changes in input voltage, load resistance and temperature. Motorola guarantees all Reference Devices to fall within the specified maximum voltage variations, ΔV_Z, at the specifically indicated test temperatures and test current (JEDEC Standard #5). Temperature Coefficient is also specified but should be considered as a reference only – not a maximum rating.

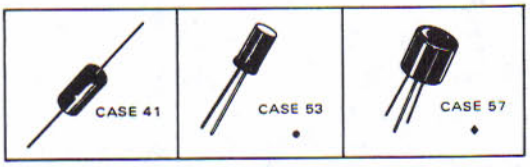
The low voltage devices are hermetically sealed, all-glass structure. Includes JAN; JANTX and radiation hardened device types. These temperature compensated Zener Reference Diodes have low dynamic impedance and silicon-oxide-passivated junctions for long term stability.

			AVERAGE TEMPERATURE COEFFICIENT OVER THE OPERATING RANGE									
			0.01 %/°C		0.005 %/°C		0.002 %/°C		0.001 %/°C		0.0005 %/°C	
V_Z Volts	Test Current mAdc	Test Temp Points	Device Type	V_Z Max Volts	Device Type	V_Z Max Volts	Device Type	V_Z Max Volts	Device Type	V_Z Max Volts	Device Type	V_Z Max Volts
6.2⚠	7.5	A	*1N821, J,TX	0.096	*1N823, J,TX	0.048	*1N825, J,TX	0.019	*1N827, J,TX	0.009	*1N829, J,TX	0.005
6.2⚠	7.5	A	*1N821A	0.096	*1N823A	0.048	*1N825A	0.019	*1N827A	0.009	*1N829A	0.005
6.4	0.5	B	1N4565	0.018	1N4566	0.024	1N4567	0.010	1N4568	0.005	1N4569	0.002
	0.5	A	1N4565A	0.099	1N4566A	0.050	1N4567A	0.020	1N4568A	0.010	1N4569A	0.005
	1.0	B	1N4570	0.048	1N4571	0.024	1N4572	0.010	1N4573	0.005	1N4574	0.002
	1.0	A	1N4570A	0.099	1N4571A	0.050	1N4572A	0.020	1N4573A	0.010	1N4574A	0.005
	2.0	B	1N4575	0.048	1N4576	0.024	1N4577	0.010	1N4578	0.005	1N4579	0.002
	2.0	A	1N4575A	0.099	1N4576A	0.025	1N4577A	0.020	1N4578A	0.010	1N4579A	0.005
	4.0	B	1N4580	0.048	1N4581	0.024	1N4582	0.010	1N4583	0.005	1N4584	0.002
	4.0	A	1N4580A	0.099	1N4581A	0.050	1N4582A	0.020	1N4583A	0.010	1N4584A	0.005
8.4	10	A	*1N3154, J,TX	0.130	*1N3155, J,TX	0.065	*1N3156, J,TX	0.026	*1N3157, J,TX	0.013		
	10	C	*1N3154A	0.072	*1N3155A	0.085	*1N3156A	0.034	*1N3157A	0.017		
8.5	0.5	B	1N4775	0.064	1N4776	0.032	1N4777	0.013	1N4778	0.006	1N4779	0.003
	0.5	A	1N4775A	0.132	1N4776A	0.066	1N4777A	0.026	1N4778A	0.013	1N4779A	0.007
	1.0	B	1N4780	0.064	1N4781	0.032	1N4782	0.013	1N4783	0.006	1N4784	0.003
	1.0	A	1N4780A	0.132	1N4781A	0.066	1N4782A	0.026	1N4783A	0.013	1N4784A	0.007
9.0	7.5	B	*1N935	0.067	*1N936	0.033	*1N937	0.013	*1N938	0.006	*1N939	0.003
	7.5	A	*1N935A	0.139	*1N936A	0.069	*1N937A	0.027	*1N938A	0.013	*1N939A	0.007
	7.5	C	*1N935B, J,TX	0.184	*1N936B	0.092	*1N937B, J,TX	0.037	*1N938B, J,TX	0.018	*1N939B, J,TX	0.009
9.4 ±0.4 (Suffix "A" +0.2 V)	10	D			1N2163,A	0.033			1N2166,A	0.007	1N2169,A	0.004
		E			1N2164,A	0.086			1N2167,A	0.017	1N2170,A	0.009
		F			1N2165,A	0.110			1N2168,A	0.023	1N2171,A	0.012
11.7	7.5	B	*1N941	0.088	*1N942	0.044	*1N943	0.018	*1N944	0.009	*1N945	0.004
	7.5	A	*1N941A	0.081	*1N942A	0.090	*1N943A	0.036	*1N944A	0.018	*1N945A	0.009
	7.5	C	*1N941,B, J,TX	0.239	*1N942B	0.120	*1N943B, J,TX	0.047	*1N944B J,TX	0.024	*1N945B, J,TX	0.012
12.8	0.5	G	1N4896	0.086	1N4897	0.048	1N4898	0.019	1N4899	0.010		
	0.5	A	1N4896A	0.198	1N4897A	0.099	1N4898A	0.040	1N4899A	0.020		
	1.0	G	1N4900	0.096	1N4901	0.048	1N4902	0.019	1N4903	0.010		
	1.0	A	1N4900A	0.198	1N4901A	0.099	1N4902A	0.040	1N4903A	0.020		
	2.0	G	1N4904	0.096	1N4905	0.048	1N4906	0.019	1N4907	0.010		
	2.0	A	1N4904A	0.198	1N4905A	0.099	1N4906A	0.040	1N4907A	0.020		
	4.0	G	1N4908	0.096	1N4909	0.048	1N4910	0.019	1N4911	0.010		
	4.0	A	1N4908A	0.198	1N4909A	0.099	1N4910A	0.040	1N4911A	0.020		
	7.5	G	1N4912	0.096	1N4913	0.048	1N4914	0.019	1N4915	0.010		
	7.5	A	1N4912A	0.198	1N4913A	0.099	1N4914A	0.040	1N4915A	0.020		
1.9	0.5	G	1N4916	0.144	1N4917	0.072	1N4918	0.029				
	0.5	A	1N4916A	0.298	1N4917A	0.149	1N4918A	0.060				
	1.0	G	1N4919	0.144	1N4920	0.072	1N4921	0.029				
	1.0	A	1N4919A	0.298	1N4920A	0.149	1N4921A	0.060				
	2.0	G	1N4922	0.144	1N4923	0.072	1N4924	0.029				
	2.0	A	1N4922A	0.298	1N4923A	0.149	1N4924A	0.060				
	4.0	G	1N4925	0.144	1N4926	0.072	1N4927	0.029	1N4928	0.014		
	4.0	A	1N4925A	0.298	1N4926A	0.149	1N4927A	0.060	1N4928A	0.030		
	7.5	G	1N4929	0.144	1N4930	0.072	1N4931	0.029	1N4932	0.014		
	7.5	A	1N4929A	0.298	1N4930A	0.149	1N4931A	0.060	1N4932A	0.030		

Test Temperature Points	
A	-55, 0, +25, +175, +100
B	0, +25, +75
C	-55, 0, +25, +75, +100, +150
D	0, +25, +70
E	-55, 0, +125, +75, +125
F	-55, 0, +75, +125, +185
G	+25, +75, +100

⚠ Non-suffix – Z_{ZT} = 15, "A" Suffix – Z_{ZT} = 10
*Radiation Resistant Devices Available; to order, specify MZ821, A or B in lieu of "1N" prefix. Not applicable to J or TX devices.

SPECIAL DEVICES (continued)



High-Voltage Devices consist of hermetically sealed discrete glass-packaged devices, properly interconnected to yield higher voltages and encapsulated in a transfer-molded plastic package. Includes JAN devices. All devices encapsulated in Case 41, exceptions shown.

CASE 41 – EXCEPT AS NOTED

Reference Voltage V_Z Volts	Test Current I_{ZT} mA	Max Voltage Change V_Z (Volts) @ Test Temperatures -55 to +25°C	+25 to 100°C	Average Temp. Coeff. %°C	Device Type
6.2	7.5	0.050 (1) 0.050 (1)		0.01 0.01	1N429 (2) 1N1735
8.4	10	0.014 (1) 0.007		0.002 0.001	♦1N1530 ♦1N1530A (2)
12.4	7.5	0.100 (1) 0.050		0.01 0.005	1N1736 1N1736A
12.4	10	0.050 0.020	0.047 0.010	0.005 0.002	1N4057 1N4057A
14.6		0.058 0.023	0.055 0.022	0.005 0.002	1N4058 1N4058A
16.8		0.067 0.027	0.063 0.025	0.005 0.002	1N4059 1N4059A
18.5		0.074 0.030	0.069 0.028	0.005 0.002	1N4060 1N4060A
18.6	7.5	0.150 (1) 0.075		0.01 0.005	1N1737 1N1737A
21	10	0.084 0.034	0.079 0.032	0.005 0.002	1N4061 1N4061A
23	10	0.092 0.037	0.086 0.035	0.005 0.002	1N4062 1N4062A
24.8	7.5	0.200 (1) 0.100		0.01 0.005	1N1738 1N1738A
27	10	0.108 0.043	0.101 0.041	0.005 0.002	1N4063 1N4063A
30	10	0.120 0.048	0.113 0.045	0.005 0.002	1N4064 1N4064A
31.0	7.5	0.250 (1) 0.125		0.01 0.005	1N1739 1N1739A
33	10	0.132 0.053	0.124 0.050	0.005 0.002	1N4065 1N4065A
37	7.5	0.148 0.059	0.139 0.056	0.005 0.002	1N4066 1N4066A
37.2		0.300 (1) 0.150		0.01 0.005	1N1740 1N1740A
43		0.172 0.069	0.161 0.065	0.005 0.002	1N4067 1N4067A
43.4		0.350 (1) 0.175		0.01 0.005	1N1741A 1N1741A

Reference Voltage V_Z Volts	Test Current I_{ZT} mA	Max Voltage Change V_Z (Volts) @ Test Temperatures -55 to +25°C	+25 to 100°C	Average Temp. Coeff. %°C	Device Type
47	7.5	0.188 0.075	0.176 0.071	0.005 0.002	1N4068 1N4068A
49.6		0.400 1 0.200		0.01 0.005	1N1742 1N1742 A
51		0.204 0.082	0.191 0.077	0.005 0.002	1N4069 1N4069A
56		0.224 0.090	0.210 0.084	0.005 0.002	1N4070 1N4070A
62		0.248 0.099	0.232 0.093	0.005 0.002	1N4071 1N4071A
68	5.0	0.272 0.109	0.255 0.102	0.005 0.002	1N4072 1N4072A
75		0.300 0.120	0.281 0.113	0.005 0.002	1N4073 1N4073A
82		0.328 0.131	0.307 0.123	0.005 0.062	1N4074 1N4074A
87		0.348 0.139	0.326 0.131	0.005 0.002	1N4075 1N4075A
91		0.364 0.146	0.341 0.137	0.005 0.002	1N4076 1N4076A
100		0.400 0.160	0.375 0.150	0.005 0.002	1N4077 1N4077A
105	2.5	0.420 0.168	0.394 0.158	0.005 0.002	1N4078 1N4078A
110		0.440 0.176	0.413 0.165	0.005 0.002	1N4079 1N4079A
120		0.480 0.192	0.450 0.180	0.005 0.002	1N4080 1N4080A
130		0.520 0.208	0.488 0.195	0.005 0.002	1N4081 1N4081A
140		0.560 0.224	0.525 0.210	0.005 0.002	1N4082 1N4082A
150		0.600 0.240	0.563 0.225	0.005 0.002	1N4083 1N4083A
175		0.700 0.280	0.656 0.263	0.005 0.002	1N4084 1N4084A
200		0.800 0.320	0.750 0.300	0.005 0.002	1N4085 1N4085A

(1) These devices are tested at the following temperatures: -55°, +25°, and +100°C.
(2) Available as JAN devices.

SPECIAL DEVICES

Precision Reference Diodes. Designed, manufactured and tested for ultra-high stability of voltage with time and temperature change. Use of special measurement equipment and voltage standards provide calibration directly traceable to the National Bureau of Standards.

CASE 51

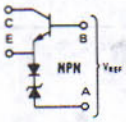
Reference Voltage Volts	Test Current mA	Temperature Stability		CERTIFIED VOLTAGE TIME STABILITY OVER 1000 HOURS OF OPERATION (Parts/Million Change)									
				<5 PPM/1000 HR		<10 PPM/1000 HR		<20 PPM/1000 HR		<40 PPM/1000 HR		<100 PPM/1000 HR	
		ΔV_Z (mV)	OP Temp Range °C	Device Type	Change µV Max	Device Type	Change µV Max	Device Type	Change µV Max	Device Type	Change µV Max	Device Type	Change µV Max
6.2 ± 5%	7.5	2.5	25,75,100	MZ605	30	MZ610	60	MZ620	120	MZ640	240		
8.4 ± 5%	10	3.5	25,75,100	MZ805	45	MZ810	90	MZ820	180	MZ840	360		
6.35 ± 5%	7.5	2.5	25 to 100			1N4895	64	1N4893	127			1N4891*	318
6.35 ± 5%	7.5	5.0	-55 to 100			1N4895A	64	1N4893A	127			1N4891A*	318
6.35 ± 5%	7.5	5.0	25 to 100			1N4894	64	1N4892	127			1N4890*	318
6.35 ± 5%	7.5	10	-55 to 100			1N4894A	64	1N4892A	127			1N4890A*	318
6.2 - 6.5	7.5	3.0	25 to 100									1N3502	636
6.2 - 6.5	7.5	6.0	25 to 100					1N3504	127	1N3503	318	1N3501	636

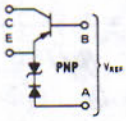
*< 50 PPM time stability on these devices.

Amplifying Regulator Diodes. Designed for use in regulated power supplies as a combination voltage reference element and error voltage amplifier, providing temperature compensation for excellent reference voltage stability. Available with either PNP or NPN transistors by adding either P or N Suffix to part number.

ELECTRICAL CHARACTERISTICS (I_{ZT} = 5.0 mA, V_{CEO} = 30 V)

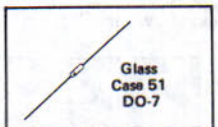
CASE 212-01





V_{REF} Volts	Tolerance ±%	Test Temperature °C	V_{REF} Volts	Device Type
6.8	10	0, +25, +75	0.051 0.025 0.010 0.005	MCA1911 MCA1912 MCA1913 MCA1914
6.8	5.0	-55, 0, +25, -55, +100	0.105 0.052 0.020 0.010	MCA1921 MCA1922 MCA1923 MCA1924
6.8	5.0	-55, 0, +25 +75,+100,+150	0.139 0.069 0.026 0.013	MCA1931 MCA1932 MCA1933 MCA1934
8.6	10	0, +25, +75	0.060 0.030 0.012 0.006	MCA2011 MCA2012 MCA2014 MCA2014
8.6	5.0	-55, 0, +25 +75, +100	0.124 0.062 0.024 0.012	MCA2021 MCA2022 MCA2023 MCA2024
8.6	5.0	-55, 0, +25 +75,+100,+150	0.164 0.082 0.032 0.016	MCA2031 MCA2032 MCA2033 MCA2034
9.5	10	0, +25, +75	0.071 0.035 0.014 0.007	MCA2111 MCA2112 MCA2113 MCA2114
9.5	5.0	-55, 0, +25 -75, +100	0.147 0.073 0.028 0.014	MCA2121 MCA2122 MCA2123 MCA2124
9.5	5.0	-55, 0, +25 +75,-100,+150	0.194 0.097 0.038 0.019	MCA2131 MCA2132 MCA2133 MCA2134
11	10	0, +25, +75	0.082 0.041 0.016 0.008	MCA2211 MCA2212 MCA2213 MCA2214
11	5.0	-55, 0, +25 +75, +100	0.170 0.085 0.034 0.017	MCA2221 MCA2222 MCA2223 MCA2224
11	5.0	-55, 0, +25 +75,+100,+150	0.225 0.112 0.044 0.022	MCA2231 MCA2232 MCA2233 MCA2234

Field-Effect Current Regulator Diodes. High impedance diodes providing a constant current output over a wide range of applied voltages. For applications in instrumentation and protective circuitry.

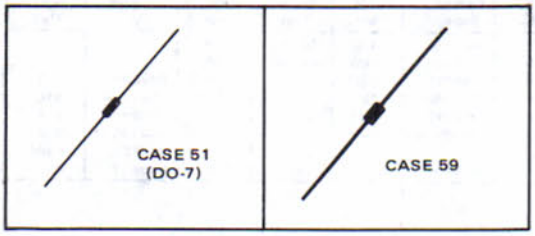


Glass Case 51 DO-7

Reg. Current Ip @V_T = 25 V mA Nom	Device Type	Knee Imp Z_K @V_K = 6.0 V MΩ Max	Limiting Voltage @I_L = 0.8 Ip Volts Max
0.22	1N5283	2.75	1.00
0.24	1N5284	2.35	1.00
0.27	1N5285	1.95	1.00
0.30	1N5286	1.60	1.00
0.33	1N5287	1.35	1.00
0.39	1N5288	1.00	1.05
0.43	1N5289	0.870	1.05
0.47	1N5290	0.750	1.05
0.56	1N5291	0.560	1.10
0.62	1N5292	0.470	1.13
0.68	1N5293	0.400	1.15
0.75	1N5294	0.335	1.20
0.82	1N5295	0.290	1.25
0.91	1N5296	0.240	1.29
1.00	1N5297	0.205	1.35
1.10	1N5298	0.180	1.40
1.20	1N5299	0.155	1.45
1.30	1N5300	0.135	1.50
1.40	1N5301	0.115	1.55
1.50	1N5302	0.105	1.60
1.60	1N5303	0.092	1.65
1.80	1N5304	0.074	1.75
2.00	1N5305	0.061	1.85
2.20	1N5306	0.052	1.95
2.40	1N5307	0.044	2.00
2.70	1N5308	0.035	2.15
3.00	1N5309	0.029	2.25
3.30	1N5310	0.024	3.35
3.60	1N5311	0.020	2.50
3.90	1N5312	0.017	2.60
4.30	1N5313	0.014	2.75
4.70	1N5314	0.012	2.90
0.5±0.3	MCL1300	0.500	1.00
1.0±0.6	MCL1301	0.200	1.50
2.0±0.6	MCL1302	0.100	2.00
3.0±0.6	MCL1303	0.050	2.00
4.0±0.6	MCL1304	0.025	2.50

Low Voltage Regulators

High-conductance silicon diodes designed as stable forward-reference sources for transistor amplifier biasing and similar applications. Available in high reliability glass construction or economic plastic packaging.



ELECTRICAL CHARACTERISTICS

(T_A = 25°C unless otherwise noted).

Forward Reference Voltage Min	Forward Reference Voltage Max	Test Current I_F mA	Leakage Current I_R @ V_R µA	Leakage Current I_R @ V_R Volts	Device Type	Case
0.63	0.71	10	10	5.0	MZ2360	59 Surmetic
1.24	1.38	10	10	5.0	MZ2361	51 Surmetic
1.90	2.10	10	10	5.0	MZ2362	51
0.58	0.70	1.0	0.1	4.0	.4M.64FR10	Glass
1.29	1.43	10	↓	↓	.4M1.36FR5	↓
1.33	1.39	10	↓	↓	.4M1.36FR2	↓
1.94	2.14	10	↓	↓	.4M2.04FR5	↓
2.00	2.08	10	↓	↓	.4M2.04FR2	↓
0.58	0.70	1.0	↓	↓	1N816	↓

Current Limited Temperature Compensated Voltage Reference Diodes

Voltage reference element with inherent temperature compensation and current regulation resulting in excellent reference stability over temperature excursions and wide variations of input voltage.

Specifications in the following table are given for an input of 31 volts. Devices differ specifically in temperature as shown in ΔV_{REF}.

V_{REF} @ V_{in} = 31 Volts Min	V_{REF} @ V_{in} = 31 Volts Max	V_{in} Volts Min	V_{in} Volts Max	I_{in} @ V_{in} = 31 Volts Min	I_{in} @ V_{in} = 31 Volts Max	Input Impedance MΩ Min	Z_{REF} @ I_{in} = 4.0 mA Ohms Max	ΔV_{REF} @V_{in} = 31 Volts -55°C,+25°C,+100°C Volts Max	ΔV_{REF} @V_{in} = 31 Volts -55°C,+25°C,+100°C Device Type	
6.08	6.72	12	75	3.2	4.8	0.2	50	0.010	MCLTC6010	 CASE 181-02
6.08	6.72	12	75	3.2	4.8	0.2	50	0.025	MCLTC6025	
6.08	6.72	12	75	3.2	4.8	0.2	50	0.050	MCLTC6050	
6.08	6.72	12	75	3.2	4.8	0.2	50	0.100	MCLTC6100	

Tuning Diode Regulator

Highly reliable temperature compensated monolithic integrated circuit voltage stabilizer designed for use in television and FM radios that use variable capacitance diode tuners.

V_Z Volts Min/Max	I_Z mA	$\Delta V_Z / \Delta T$ Mv/°C Min/Max	Z_Z Ohms Max	P_D mW	Device Type	
31/35	18	-31/+1.55	25	625	MVS460	 CASE 182-01

Dual Diodes

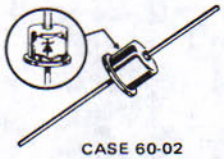
Dual diodes designed for use in low cost biasing, steering and voltage doubler applications including series, common cathode and common anode diodes.

$V_{(BR)}$ @ $I_{(BR)}$ Volts Min	$V_{(BR)}$ @ $I_{(BR)}$ µA	I_R @ V_R µA Max	I_R @ V_R Volts	V_F @ Volts Min/Max	I_F mA	C_{VR} = 0 pF Max	t_{rr} ns Max	Device Type	Description	
100	100	0.1	50	0.67/0.82	10	1.5	4.0	MSD6100	Switching	 CASE 29 (TO-92)
50	100	0.1	40	0.67/0.82	10	2.0	10	MSD6101	Discrimmator	
70	100	0.1	50	0.67/1.0	10	3.0	100	MSD6102	Common Cathode	
70	100	0.1	50	—/1.0	10	8.0	100	MSD6150	Common Cathode	
100	100	0.2	50	0.67/0.82	10	1.5	15	MSD7000	Series	

TRANSIENT SUPPRESSORS

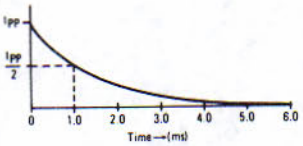
POWER TRANSIENT SUPPRESSORS

Transient suppressors designed for applications requiring protection of voltage sensitive electronic devices in danger of destruction by high energy voltage transients. Select from standard factory available types or design the suppressor to meet specific needs by paralleling cells. For specific options, i.e., non-standard voltages, higher power capacity, and package configurations, consult factory.



CASE 60-02

CASE 119



V_R Operating Voltage		I_R Reverse Current	V_Z Breakdown Voltage @		V_Z Clamping Voltage @		V_F Forward Voltage @			
Nom Vdc	V(RMS)	μA	Min Volts	I_{ZT} mA	Max Volts	I_{pp} Amp	Volts	I_F Amp	Device Type	Case
14	10	50	16	0.4	1.25		1.5	10	MPZ5-16A	119
14	10		16	0.4	1.25				MPZ5-16B	
28	20		32	0.2	1.25				MPZ5-32A	
28	20		32	0.2	1.25				MPZ5-32B	
28	20		32	0.2	1.25				MPZ5-32C	
165	117		180	0.03	1.14				MPZ5-180A	
165	117		180	0.03	1.14				MPZ5-180B	
165	117		180	0.03	1.14				MPZ5-180C	
30.5	21.5	5.0	33	1.0	47.5	32	2.0	100	MZ5555	60-02
40.3	28.5		43.7		63.5	24	2.5		MZ5556	
49	34.5		54		78.5	19	2.8		MZ5557	
175	124		191		265	5.7	3.5		MZ5558	

Power Rectifier/Power Surge Suppressor

. . . designed for applications requiring a low voltage rectifier with reverse avalanche characteristics or for use as a reverse power transient suppressor. Developed to suppress transients in the automotive system, this device operates in the forward mode as a standard rectifier or reverse mode as a power zener diode and will protect expensive mobile transceivers, radios and tape decks from over-voltage conditions.

CASE 296-03

B_V Breakdown Voltage @I_R = 100 mA Volts	I_R Reverse Current @V_R = 20 V Max μA	V_F Instantaneous Forward Voltage @i_F = 79A Volts	$I_{(RMS)}$ Forward Current Max Amp	Device Type
32	50	1.1	94	MR2525,R

Polarity: Standard polarity is cathode to case — MR2525
Reverse polarity is anode to case and is designated by an "R" suffix — MR2525R

RECTIFIERS

From tiny, lead-mounted, low-current rectifiers to powerful multi-cell units with near-thousand-amp capacity; from single-phase, half-wave devices to three-phase circuits; from conventional diode junctions to special-purpose units for specific applications, Motorola's extensive line of rectifiers satisfies every possible requirement for electronic equipment. Moreover, volume production unmatched in the industry offers low-cost selection potential,

TABLE OF CONTENTS

The following index reflects the devices characterized in this section. To locate the exact page number, see Catalog Index(Page 7-1).

INDEX

	1.0	3.0			6.0
Case	59-04 Plastic	60 Metal	70 Metal	267 Plastic	194 Plastic
					
V_{RRM} Volts					
50	1N4001‡	1N4719	1N4997	MR500	MR750
100	1N4002‡	1N4720	1N4998	MR501	MR751
200	1N4003‡	1N4721	1N4999	MR502	MR752
400	1N4004‡	1N4722	1N5000	MR504	MR754
600	1N4005‡	1N4723	1N5001	MR506	MR756
800	1N4006‡	1N4724	1N5002	MR508	
1000	1N4007‡	1N4725	1N5003	MR510	
I_{FSM} (Amps)	30	300	300	100	400
T_A @ Rated I_O (°C)	75	75	75	95	60
T_C @ Rated I_O (°C)					
T_J (Max) (°C)	175	175	175	175	175

‡ Package Size: 0.120" Max Diameter by 0.260" Max. Length

GENERAL PURPOSE RECTIFIERS

Low and Medium Current

Wide variety of low-cost devices to fit any mounting requirements. These lines are also available with anode-to-case connection by adding "R" suffix to the standard part number.

I_O AVERAGE RECTIFIED FORWARD CURRENT (Amperes)										
12	15	20		25			30	35	40	50
245 (DO-4) Metal 	42A (DO-5) Metal 	42A (DO-5) Metal 	283-01 (DO-4) Low-Cost Plastic 	283-01 (DO-4) Low-Cost Plastic 	193-03 Low-Cost Plastic  ▲	43 (DO-21) Pressfit 	43 (DO-21) Metal 	42A (DO-5) Metal 	42A (DO-5) Metal 	43-04 Metal 
MR1120 1N1199,A	1N3208	1N248B 1N1191	MR2000S	MR2500S	MR2500	1N3491	1N3659	1N1183	1N1183A	MR5005
MR1121 1N1200,A	1N3209	1N249B 1N1192	MR2001S	MR2501S	MR2501	1N3492	1N3660	1N1184	1N1184A	MR5010
MR1122 1N1202,A	1N3210	1N250B 1N1194	MR2002A	MR2502S	MR2502	1N3493	1N3661	1N1186	1N1186A	MR5020
MR1124 1N1204,A	1N3212	1N1196 1N1196A	MR2004S	MR2504S	MR2504	1N3495	1N3663	1N1188	1N1188A	MR5040
MR1126 1N1206A	1N3214	1N1198A 1N3214	MR2006S	MR2506S	MR2506	MR328		1N1190	1N1190A	
MR1128 1N3988			MR2008S	MR2508S	MR2508	MR330				
MR1130 1N3990			MR2010S	MR2510S	MR2510	MR331				
300	250	350	400	600	400	30	400	400	800	600
150	150	150	150	150	150	130	100	140	150	150
190	175					175	175	190	190	195

▲ Request Data Sheet for Mounting Information

High-Current Multi-Cell Rectifier Diodes

Multi-Cell construction, with matched cells, for excellent thermal management and highest reliability. Normally available with cathode connected to case. Add "R" suffix to type number for reverse polarity.

	I_O, AVERAGE RECTIFIED FORWARD CURRENT				
	50A	100A		450A	700A
V_{RRM} (Volts)	 Case 100	 Case 167	 Case 189	 Case 128 Case 135	 Case 136
300	MR1205FL	MR1215FL	MR1815SL	MR1245SL,FL	MR1265FL
600	MR1209FL	MR1219SL	MR1819SL	MR1249SL,FL	MR1269FL
I_{FSM} (Amp)	800	2000	2000	8000	1200
T_C @ Rated I_O (°C)	150	135	135	150	150
T_J (Max) (°C)	190	190	190	190	190

RECTIFIER BRIDGES and CIRCUITS

Low-To-Medium Current

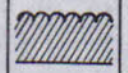
Single-phase rectifier bridges with a wide variety of packaging options. Standard devices are made with general-purpose rectifiers, but similar configurations can be made with special rectifier-cells (i.e., fast recovery cells) on special order.

	I_O, DC OUTPUT CURRENT (Amperes)									
	1.0	1.0	2.0	4.0	8.0		12		30	35
Case	109 (1)	312-01 (1)	312-01	117 (1)	298-01 (2)	117	298-01 (2)	179-01 (1)	179-02 (1)	309
										
V_{RRM} Volts										
50	MDA920A2	MDA100A	MDA200	MDA970-1	MDA800	MDA970-1	MDA1200	MDA980-1	MDA990-1	MDA3500 BYW60
100	MDA920A3	MDA101A	MDA201	MDA970-2	MDA801	MDA970-2	MDA1201	MDA980-2	MDA990-2	MDA3501 BYW61
200	MDA920A4	MDA102A	MDA202	MDA970-3	MDA802	MDA970-3	MDA1202	MDA980-3	MDA990-3	MDA3502 BYW62
400	MDA920A6	MDA104A	MDA204	MDA970-5	MDA804	MDA970-5	MDA1204	MDA980-5	MDA990-5	MDA3504 BYW64
600	MDA920A7	MDA106A	MDA206		MDA806		MDA1206	MDA980-6	MDA990-6	MDA3506 BYW66
800		MDA108A	MDA208							MDA3508 BYW68
1000		MDA110A	MDA210							MDA3510
I_{FSM} Amp	32	45	60	100	300	100	300	300	300	400
T_A @ Rated I_O (°C)	75	55	55	25						
T_C @ Rated I_O (°C)					100	55	100	55	55	55
T_J (Max) (°C)	175	150	175	150	175	150	175	175	175	175

(1) Lead Frame Assembly
(2) Discrete Diode Assembly Utilizing Metal Cased Rectifiers

High-Current Multi-Cell Rectifier Circuits

Multi-cell full-wave rectifier circuits and bridges with up to 650 A current carrying capacity.

	I_O, AVERAGE RECTIFIER FORWARD CURRENT (Forced Convection at 1500 LFM)							
	300 A				600 A		650 A	
Circuit	Single-Phase Full-Wave Center Tap	Single-Phase Full-Wave Bridge	Three-Phase Full-Wave Center Tap	Three-Phase Full-Wave Bridge	Single-Phase Full-Wave Center Tap	Single-Phase Full-Wave Bridge	Three-Phase Full-Wave Center Tap	Three-Phase Full-Wave Bridge
Waveforms								
Case / V_{RRM} (Volts)	154A 	155A 	154 	155 	156A 	157A 	156 	157 
300	MRA133	MRA133B	MRA333	MRA333B	MRA163	MRA163B	MRA363	MRA363B
I_{FSM} (Amps)	3000	3000	2000	2000	6000	6000	5000	5000
I_O Free Convection (Amps)	75	75	75	75	125	125	150	150
T_A @ Rated I_O (1500 FLM or Free Convection (°C)	75	75	75	75	75	75	75	75
T_J(Max) (°C)	150	150	150	150	150	150	150	150

Fast Recovery Rectifiers

. . . available for designs requiring a power rectifier having maximum switching times ranging from 200 ns to 750 ns. These devices are offered in current ranges of 1.0 to 50 amperes and in voltages to 600 volts. Higher voltages are available upon request, but a necessary trade-off against switching speeds results. Reverse polarity (anode to case) obtained by adding an "R" suffix.

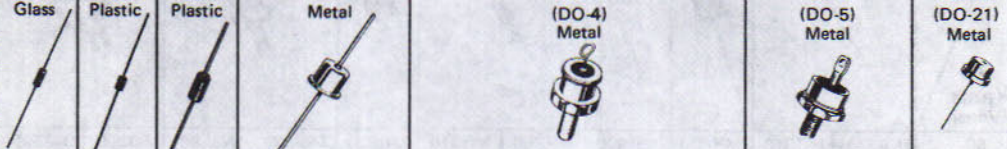
	I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)												
	1.0			3.0			5.0	6.0	12	20	30	40	
Case	59-04 Plastic		60 Metal	70 Metal	267-01 Plastic		194 Plastic	56-02 (DO-4) Metal		257 (DO-5) Metal		42A (DO-5) Metal	
V_{RRM} (Volts)													
50	1N4933‡	MR810	MR830	MR800	MR850	MR910	MR820	1N3879	1N3889	1N3899	1N3909	MR860	MR870
100	1N4934‡	MR811	MR831	MR801	MR851	MR911	MR821	1N3880	1N3890 JAN,JTX	1N3900	1N3910, JAN,JTX	MR861	MR871
200	1N4935‡	MR812	MR832	MR802	MR852	MR912	MR822	1N3881	1N3891 JAN,JTX	1N3901	1N3911, JAN,JTX	MR862	MR872
400	1N4936‡	MR814	MR834	MR804	MR854	MR914	MR824	1N3883	1N3893, JAN,JTX	1N3903	1N3913, JAN,JTX	MR864	MR874
600	1N4937‡	MR816	MR836	MR806	MR856	MR916	MR826	MR1366	MR1376	MR1386	MR1396	MR866	MR876
800		MR817				MR917							
1000		MR818				MR918							
I_{FSM} (Amps)	30	30	100	100	100	100	300	150	200	250	300	350	400
T_A@Rated I_O (°C)	75	75			90*	90*	55*						
T_C@Rated I_O (°C)			100	100				100	100	100	100	100	100
T_J (Max) (°C)	150	150	150	150	175	175	175	150	150	150	150	160	160
t_{rr} (μs)	0.2	0.75	0.2	0.2	0.2	0.75	0.2	0.2	0.2	0.2	0.2	0.2	0.2

*Must be derated for reverse power dissipation. See Data Sheet.
‡Package Size: 0.120" Max Diameter by 0.260" Max Length.

Hot Carrier Rectifiers

. . . Schottky barrier devices, ideal for use in low voltage, high frequency power supplies and as free-wheeling diodes. These units feature very low forward voltages and switching times estimated at less than 10 ns. They are offered in current ranges of 0.5 to 5.0 amperes and in voltages to 30. Reverse polarity (anode to case) is not available.

	I_O, AVERAGE RECTIFIED FORWARD CURRENT (Amperes)											
	0.5	1.0	3.0	3.0	5.0	15		25		40		
Case	51-02 Glass	59-04 Plastic	267 Plastic	60 Metal		245 (DO-4) Metal				257 (DO-5) Metal		430-2 (DO-21) Metal
V_{RRM} (Volts)												
20	MBR020	1N5817	1N5820	MBR320M	1N5823	1N5826	MBR1520	1N5829	MBR2520	1N5832	MBR4020	MBR4020PF
30	MBR030	1N5818	1N5821	MBR330M	1N5824	1N5827	MBR12530	1N5830	MBR2530	1N5833	MBR4030	MBR4030PF
I_{FSM} (Amps)	5.0	100		500	500	500	500	800	800	800	800	800
‡T_C@Rated I_O (°C)						85	80	85	80	75	70	50
T_A = 75°C PC Board Mount	125											
‡T_L@Rated I_O (°C)		90	95	90	80							
T_J(Max) (°C)		125	125	125	125	125	125	125	125	125	125	125
*Max V_F @ I_{FM} = I_O	0.50	0.55	0.50	45 @ 5 A	0.37	0.47	0.55	0.46	0.55	0.55	0.63	0.63



*Values are for the 30 Volt units. The lower votlage parts provide lower limits.
‡Must be derated for reverse power dissipation. See Data Sheet.

High Voltage Diodes and Stacks

. . . low-current, high-voltage diodes and stacks in current ranges of 250 mA to 1.0 ampere and in voltages from 1000 to 5000 volts.

250 mA High Voltage Diodes

Case / V_{RRM} (Volts)	169-02 Plastic 
1000	MR250-1
2000	MR250-2
3000	MR250-3
4000	MR250-4
5000	MR250-5
I_{FSM} (Amps)	15
T_A @ Rated I_O (°C)	75
T_J (Max) (°C)	150

1.0 Ampere Television Damper Diode

Case / V_{RRM} (Volts)	59-04 Plastic 
1000	MR1-1000
1200	MR1-1200
1400	MR1-1400
1600	MR1-1600
I_{FSM} (Amps)	30
T_A @ Rated I_O (°C)	75*
T_J (Max) (°C)	175
t_{rr} (μs)	25

*Must be derated for reverse power dissipation. See Data Sheet.

Low Voltage Rectifiers

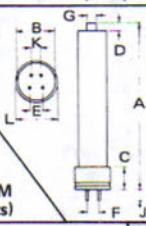
. . . for low voltage applications to suppress reverse power transients.

Avalanche Rectifiers

Case / V_{RRM} (Volts)	269-03 
23	MR2525
23	MR2525R
BV (Volts)	24-32
I_{FSM} (Amps)	600
T_C @ Rated I_O (°C)	150
T_J (Max) (°C)	175

Solid-State Mercury Vapor Tube Replacements

Case 286-03 / V_{RRM} (Volts)



DIM	INCHES MIN	INCHES MAX
A	10.505	10.625
B	2.185	2.225
C	1.405	1.470
D	0.490	0.510
E	0.750 BSC	
F	0.744 BSC	
G	0.559	0.569
J	0.658	0.698
K	0.562 BSC	
L	2.480	2.520

V_{RRM} (Volts)	
30,000	MDA6693
I_O (Amps)	5.0
I_{FSM} (Amps)	400
T_A @ Rated I_O (°C)	75
T_J (Max) (°C)	175
v_F @ i_F = 20 A (Volts) (Pulse Width 10 ms, ≤ 1% Duty Cycle)	38

MDA872A, MDA575A, Mercuty Vapor Tube Replacements Available. Consult Factory.

THYRISTERS

and TRIGGERS

SILICON CONTROLLED RECTIFIERS (SCRs) AND TRIACs
(0.8 to 80 Amperes; 15 to 800 Volts)

Motorola's extensive line of thyristors consists of two generic component categories — SCRs and Triacs. Within each of these categories are two basic packaging divisions, plastic and metal — plastic for lowest cost and metal hermetically sealed packages for applications requiring highest reliability. Combined, these divisions include a large number of individual devices covering a forward-current range from 0.8 to 80 Amperes and a blocking voltage range from 15 to 800 Volts.

But the availability of devices for a wide range of current and voltage requirements doesn't begin to tell the whole story. For within the large selection of different series numbers are device families with characteristics designed for specifically designated applications. Here are some examples of preferred device families for the more high-volume applications, and for special unique purposes.

TABLE OF CONTENTS

The following index reflects the devices characterized in this section. To locate the exact page number, see Catalog Index(Page 7-1).

INDEX

MAC36-4
MAC36-5
MAC36-6
MAC36-7
MAC36-8
MAC36-10
MAC37-1
MAC37-2
MAC37-3
MAC37-4
MAC37-5
MAC37-6
MAC37-7
MAC37-8
MAC37-10
MAC38-1
MAC38-2
MAC38-3
MAC38-4
MAC38-5
MAC38-6
MAC38-7
MAC38-8
MAC38-10
MAC92-1
MAC92-2
MAC92-3
MAC92-4
MAC92-5
MAC92-6
MAC92A-1
MAC92A-2
MAC92A-3
MAC92A-4
MAC92A-5
MAC92A-6
MAC220-2
MAC220-3
MAC220-5
MAC220-7
MAC220-9
MAC221-2
MAC221-3
MAC221-5
MAC221-7
MAC221-9
MAC40688
MAC40689
MAC40690
MAC40795
MAC40796
MAC40797
MAC40798
MAC40799
MAC40800
MAC40801
MAC4688
MAC4689
MAC4690
MAC5441
MAC5442
MAC5443
MAC5444
MAC5445
MAC5446
MAC6400-80
MAC6410-80
MAC6420-80
MBS4991
MBS4992
MCR80-5
MCR80-10
MCR80-20
MCR80-30
MCR80-40
MCR80-50
MCR80-60
MCR80-70
MCR80-80
MCR81-5
MCR81-10
MCR81-20
MCR81-30
MCR81-40
MCR81-50
MCR81-60
MCR81-70
MCR81-80
MCR82-5
MCR82-10
MCR82-20
MCR82-30
MCR82-40
MCR82-50
MCR82-60
MCR82-70
MCR82-80
MCR83-5
MCR83-10
MCR83-20
MCR83-30
MCR83-40
MCR83-50
MCR83-60
MCR83-70
MCR83-80
MCR101
MCR102
MCR103
MCR104
MCR106-1
MCR106-2
MCR106-3
MCR106-4
MCR106-5
MCR106-6
MCR106-7
MCR106-8
MCR106-9
MCR106-10
MCR107-1
MCR107-2
MCR107-3
MCR107-4
MCR107-5
MCR107-6
MCR107-7
MCR107-8
MCR115
MCR120
MCR201
MCR220-5
MCR220-7
MCR220-9
MCR221-5
MCR221-7
MCR221-9
MCR406-1
MCR406-2
MCR406-3
MCR406-4
MCR407-1
MCR407-2
MCR407-3
MCR407-4
MCR649AP-1
MCR649AP-2
MCR649AP-3
MCR649AP-4
MCR649AP-5
MCR649AP-6
MCR649AP-7
MCR649-8
MCR649AP-8
MCR649-9
MCR649AP-9
MCR649-10
MCR649AP-10
MCR729-5
MCR729-6
MCR729-7
MCR729-8
MCR729-9
MCR729-10
MCR846-1
MCR846-2
MCR846-3
MCR846-4
MCR1718-5
MCR1718-6
MCR1718-7
MCR1718-8
MCR1906-1
MCR1906-2
MCR1906-3
MCR1906-4
MCR2305-1
MCR2305-2
MCR2305-3
MCR2305-4
MCR2305-5
MCR2305-6
MCR2305-8
MCR2305-10
MCR2604L-1
MCR2604L-2
MCR2604L-3
MCR2604L-4
MCR2604L-5
MCR2604L-6
MCR2604L-8
MCR2604L-10
MCR3000-1
MCR3000-2
MCR3000-3
MCR3000-4
MCR3000-5
MCR3000-6
MCR3000-7
MCR3000-8
MCR3000-9
MCR3000-10
MCR3818-1
MCR3818-3
MCR3818-5
MCR3818-7
MCR3818-10
MCR3918-1
MCR3918-3
MCR3918-5
MCR3918-7
MCR3918-10
MCR3835-1
MCR3835-2
MCR3835-5
MCR3835-7
MCR3835-8
MCR3835-9
MCR3835-10
MCR3935-1
MCR3935-2
MCR3935-5
MCR3935-7
MCR3935-8
MCR3935-9
MCR3935-10
MPT20
MPT28
MPT32
MPU131
MPU132
MPU133
MPU6027
MPU6028
MU10
MU20
MU2646
MU4891
MU4892
MU4893
MU4894
MUS4987
MUS4988

THYRISTORS in PLASTIC PACKAGES

Excellent reliability and low cost make Motorola plastic-packaged thyristors the preferred devices for high-volume, low and medium current applications. Batch-processed, high-impact plastic provides outstanding mechanical ruggedness while oxide or glass surface passivation protects each die against impurity contamination and moisture penetration for long-term electrical stability.

SCRs

		ON-STATE (RMS) CURRENT								
		0.8 AMP	4.0 AMP					8.0 AMP	12 AMP	16 AMP
										
		Case 29-02 TO-92 Style 10	Case 77-03 Style 2			Case 90-05 Style 1		Case 90-05 Style 1	Case 221-02 TO-220 AB Style 1	
V_{DRM} V_{RRM} Blocking Voltage (DC or peak) Volts	15 V	MCR101	–	–	–	–	–	–	–	–
	25 V	–	–	–	–	–	–	MCR3000-1	–	–
	30 V	MCR102 2N5060	2N6236	MCR106-1	MCR107-1	MCR406-1	MCR407-1	–	–	–
	50 V	–	2N6237	–	–	–	–	2N4441 MCR3000-2	2N6394	2N6400
	60 V	MCR103 2N5061	–	MCR106-2	MCR107-2	MCR406-2	MCR407-2	–	–	–
	100 V	MCR104 2N5062	2N6238	MCR106-3	MCR107-3	MCR406-3	MCR407-3	MCR3000-3	2N6395	2N6401
	150 V	MCR115 2N5063	–	–	–	–	–	–	–	–
	200 V	MCR120 2N5064	2N6239	MCR106-4	MCR107-4	MCR406-4	MCR407-4	2N4442 MCR3000-4	2N6396	2N6402
	300 V	–	–	MCR106-5	MCR107-5	–	–	MCR3000-5	MCR220-5	MCR221-5
	400 V	–	2N6240	MCR106-6	MCR107-6	–	–	2N4443 MCR3000-6	2N6397	2N6403
	500 V	–	–	MCR106-7	MCR107-7	–	–	MCR3000-7	MCR220-7	MCR221-7
	600 V	–	2N6241	MCR106-8	MCR107-8	–	–	2N4444 MCR3000-8	2N6398	2N6404
	700 V	–	–	MCR106-9	–	–	–	MCR3000-9	MCR220-9	MCR221-9
	800 V	–	–	MCR106-10	–	–	–	MCR3000-10	2N6399	2N6405
ELECTRICAL CHARACTERISTICS	I_{TSM} (Amp)	6.0	25	25	25	30	20	80	100	160
	I_{GT} @ 25°C (mA) Max	0.2	0.2	0.2	20	0.2	0.5	30	30	30
	V_{GT} @ 25°C (V) Max	0.8	0.8	1.0	1.5	0.8	1.0	1.5	1.5	1.5
	I_H @ 25°C (mA) Max	5.0	3.0	5.0	20	3.0	5.0	40	40	40

TRIACs

		ON-STATE (RMS) CURRENT								
		0.45 AMP	4.0 AMP			8.0 AMP	10 AMP		12 AMP	
										
		Case 29-02 TO-92 Style 12	Case 77-03 Style 5			Case 221-02 TO-220 AB Style 2	Case 90-05 Style 4		Case 221-02 TO-220 AB Style 2	
V_{DRM} Blocking Voltage (DC or Peak) Volts	25 V	–	2N6068	2N6068A	2N6068B	–	MAC11-1	MAC10-1	–	–
	30 V	MAC92-1 MAC92A-1*	–	–	–	–	–	–	–	–
	50 V	–	2N6069	2N6069A	2N6069B	MAC220-2 MAC221-2	MAC11-2	MAC10-2	–	–
	60 V	MAC92-2 MAC92A-2*	–	–	–	–	–	–	–	–
	100 V	MAC92-3 MAC92A-3*	2N6070	2N6070A	2N6070B	MAC220-3 MAC221-3	MAC11-3	MAC10-3	–	–
	200 V	MAC92-4 MAC92A-4*	2N6071	2N6071A	2N6071B	2N6342 2N6346	2N6154 MAC11-4	2N6151 MAC10-4	2N6342A	2N6346A
	300 V	MAC92-5 MAC92A-5*	2N6072	2N6072A	2N6072B	MAC220-5 MAC221-5	MAC11-5	MAC10-5	–	–
	400 V	MAC92-6 MAC92A-6*	2N6073	2N6073A	2N6073B	2N6343 2N6347	2N6155 MAC11-6	2N6152 MAC10-6	2N6343A	2N6347A
	500 V	–	2N6074	2N6074A	2N6074B	MAC220-7 MAC221-7	MAC11-7	MAC10-7	–	–
	600 V	–	2N6075	2N6075A	2N6075B	2N6344 2N6348	2N6156 MAC11-8	2N6153 MAC10-8	2N6344A	2N6348A
	700 V	–	–	–	–	MAC220-9 MAC221-9	–	–	–	–
	800 V	–	–	–	–	2N6345 2N6349	–	–	2N6345A	2N6349A
ELECTRICAL CHARACTERISTICS	I_{GT} @ 25°C (mA) (Maximum)									
	MT2(+),G(+)	5.0	30	5.0	3.0	50	50	50	50	50
	MT2(+),G(-)	15*	–	5.0	3.0	75#	–	75	–	75
	MT2(-),G(-)	5.0	30	5.0	3.0	50	50	50	50	50
	MT2(-),G(+)	15*	–	10	5.0	75#	–	75	–	75
	V_{GT} @ 25°C (V) (Maximum)		@ -40°C	@ -40°C	@ -40°C					
	MT2(+),G(+)	2.0	2.5	2.5	2.5	2.5	2.0	2.0	2.0	2.0
	MT2(+),G(-)	2.0*	–	2.5	2.5	2.5#	–	2.5	–	2.5
	MT2(-),G(-)	2.0	2.5	2.5	2.5	2.5	2.0	2.0	2.0	2.0
	MT2(-),G(+)	2.0*	–	2.5	2.5	2.5#	–	2.5	–	2.5
I_{TSM} (Amp)		6.0	30	30	30	100	100	100	120	120

*Denotes A Version
#Denotes 2N6346 thru 2N6349 and MAC221 Series only.

SCRs in METAL PACKAGES

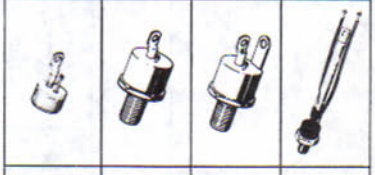
For current handling requirements up to 80 Amperes, with up to 800-Volt blocking potential, Motorola metal packaged SCRs combine highest reliability with the design flexibility offered by a wide variety of package options. Pulse modulator SCRs provide pulse current capacity to 1000 Amperes for radar and similar applications.

		ON-STATE (RMS) CURRENT										
		0.5 AMP	1.6 AMP				8.0 AMP		16 AMP	20 AMP		
												
		Case 22-03 TO-18 Style 6	Case 79-02 TO-39 Style 3				Case 86 Style 1	Case 87L Style 1	Case 263-03 Style 1	Case 310-01 Style 1	Case 263-03 Style 1	Case 311-01 Style 1
V_{DRM} V_{RRM} Blocking Voltage (DC or Peak) Volts	15 V	MCR201	–	–	–	–	–	–	–	–	–	–
	25 V	–	–	2N2322	2N4212	MCR1906-1	2N4167 MCR2305-1	2N4183 MCR2604L-1	2N1842 2N1842A	MCR3818-1	MCR3918-1	–
	30 V	2N2687	–	–	–	–	–	–	–	–	–	–
	50 V	–	2N1595	2N2323	2N4213	MCR1906-2	2N4168 MCR2305-2	2N4184 MCR2604L-2	2N1843 2N1843A	2N5164	2N5168	–
	60 V	2N2688	–	–	–	–	–	–	–	–	–	–
	100 V	2N2689	2N1596	2N2324	2N4214	MCR1906-3	2N4169 MCR2305-3	2N4185 MCR2604L-3	2N1844 2N1844A	MCR3818-3	MCR3918-3	2N6167
	150 V	–	–	2N2325	2N4215	–	–	–	2N1845 2N1845A	–	–	–
	200 V	2N2690	2N1597	2N2326	2N4216	MCR1906-4	2N4170 MCR2305-4	2N4186 MCR2604L-4	2N1846 2N1846A	2N5165	2N5169	2N6168
	250 V	–	–	2N2327	2N4217	–	–	–	2N1847 2N1847A	–	–	–
	300 V	–	2N1598	2N2328	2N4218	–	2N4171 MCR2305-5	2N4187 MCR2604L-5	2N1848 2N1848A	MCR3818-5	MCR3918-5	–
	400 V	–	2N1599	2N2329	2N4219	–	2N4172 MCR2305-6	2N4188 MCR2604L-6	2N1849 2N1849A	2N5166	2N5170	2N6169
	500 V	–	–	–	–	–	2N4173	2N4189	2N1850 2N1850A	MCR3818-7	MCR3918-7	–
	600 V	–	–	–	–	–	2N4174 MCR2305-8	2N4190 MCR2604L-8	–	2N5167	2N5171	2N6170
	700 V	–	–	–	–	–	–	–	–	–	–	–
	800 V	–	–	–	–	–	MCR2305-10	MCR2604L-10	–	MCR3818-10	MCR3918-10	–
ELECTRICAL CHARACTERISTICS	I_{TSM} (Amp)	6.0	15	15	15	15	← 100 →		125	← 240 →		
	I_{GT} @ 25°C (mA) Max	0.2	10	0.2	0.1	1.0	← 30 →		80	← 40 →		
	V_{GT} @ 25°C (V) Max	1.0	3.0	0.8	0.8	1.0	← 1.5 →		2.0	← 1.5 →		
	I_H @ 25°C (mA) Max	2.0	5.0 Typ	2.0	3.0	5.0	← 30 →		–	← 50 →		

HIGH CURRENT SCRs in METAL PACKAGES

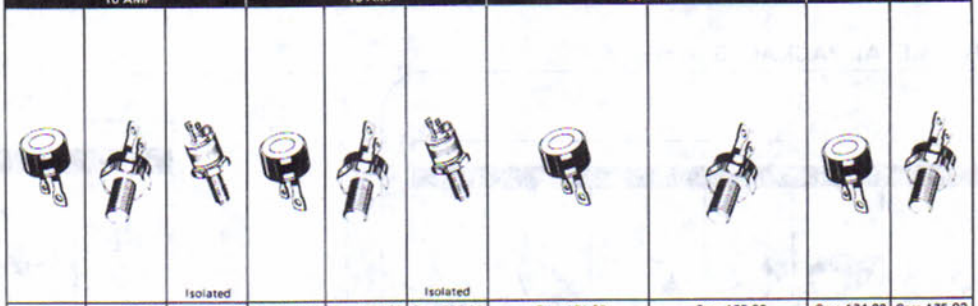
Rs in METAL PACKAGES (continued)

ON-STATE (RMS) CURRENT					
25 AMP			35 AMP		
					
Case 54 Style 2	Case 61 TO-41 Style 1	Case 263-03 Style 1	Case 310-01 Style 1	Case 263-03 Style 1	Case311-01 Style 1
–	–	–	–	–	–
MCR649AP-1	2N2573	2N681	MCR3835-1	MCR3935-1	–
–	–	–	–	–	–
MCR649AP-2	2N2574	2N682	MCR3835-2	MCR3935-2	–
–	–	–	–	–	–
MCR649AP-3	2N2575	2N683	2N3870	2N3896	2N6171
–	–	2N684	–	–	–
MCR649AP-4	2N2576	2N685	2N3871	2N3897	2N6172
–	–	2N686	–	–	–
MCR649AP-5	2N2577	2N687	MCR3835-5	MCR3935-5	–
MCR649AP-6	2N2578	2N688	2N3872	2N3898	2N6173
MCR649AP-7	2N2579	2N689	MCR3835-7	MCR3935-7	–
MCR649AP-8	MCR649-8	2N690	2N3873 MCR3835-8	2N3899 MCR3935-8	2N6174
MCR649AP-9	MCR649-9	2N691	MCR3835-9	MCR3935-9	–
MCR649AP-10	MCR649-10	2N692	MCR3835-10	MCR3935-10	–
260	260	200	← 350 →		
40	40	25	← 40 →		
3.5	3.5	3.0	← 1.6 →		
20 Typ	20 Typ	20 Typ	← 50 →		

		ON-STATE RMS CURRENT 80 AMP			
					
		Case 287-01 Style 1	Case 288-01 Style 1	Case 291-01 Style 1	Case 285-01 Style 1
V_{DRM} V_{RRM} Blocking Voltage (Volts)	25 V	–	–	–	–
	50 V	MCR80-5	MCR81-5	MCR82-5	MCR83-5
	100 V	MCR80-10	MCR81-10	MCR82-10	MCR83-10
	200 V	MCR80-20	MCR81-20	MCR82-20	MCR83-20
	300 V	MCR80-30	MCR81-30	MCR82-30	MCR83-30
	400 V	MCR80-40	MCR81-40	MCR82-40	MCR83-40
	500 V	MCR80-50	MCR81-50	MCR82-50	MCR83-50
	600 V	MCR80-60	MCR81-60	MCR82-60	MCR83-60
	700 V	MCR80-70	MCR81-70	MCR82-70	MCR83-70
	800 V	MCR80-80	MCR81-80	MCR82-80	MCR83-80
ELECTRICAL CHARACTERISTICS	I_{TSM} (Amp)	1000	1000	1000	1000
	I_{GT} @ 25°C (mA) Max	70	70	70	70
	V_{GT} @ 25°C (V) Max	3.0	3.0	3.0	3.0
	I_H @ 25°C (mA) Max	70	70	70	70
	t_{gt} (μs) Typ	70	70	70	70
	dv/dt (V/μs) Typ	100	100	100	100

TRIACs in METAL PACKAGES

Hermetically sealed for highest reliability in control applications to 40 Amperes and voltage to 800 Volts. Wide variety of package options simplifies mechanical design.

		ON-STATE (RMS) CURRENT											
		10 AMP			15 AMP			25 AMP				30 AMP	
													
				Isolated			Isolated						
		Case 174-03 Style 3	Case 175-02 Style 3	Case 235-02 Style 2	Case 174-03 Style 3	Case 175-02 Style 3	Case 235-02 Style 2	Case 174-03 Style 3		Case 175-02 Style 3		Case 174-03 Style 3	Case 175-02 Style 3
V_{DRM} Blocking Voltage (DC or Peak) Volts	25 V	–	–	–	–	–	–	MAC35-1	MAC37-1	MAC36-1	MAC38-1	–	–
	50 V	–	–	–	–	–	–	MAC35-2	MAC37-2	MAC36-2	MAC38-2	–	–
	100 V	–	–	–	–	–	–	MAC35-3	MAC37-3	MAC36-3	MAC38-3	–	–
	200 V	2N5567	2N5569	MAC40799	2N5571	2N5573	2N6145	MAC35-4	MAC37-4	MAC36-4	MAC38-4	2N6157	2N6160
	300 V	–	–	–	–	–	–	MAC35-5	MAC37-5	MAC36-5	MAC38-5	–	–
	400 V	2N5568	2N5570	MAC40800	2N5572	2N5574	2N6146	MAC35-6	MAC37-6	MAC36-6	MAC38-6	2N6158	2N6161
	500 V	–	–	–	–	–	–	MAC35-7	MAC37-7	MAC36-7	MAC38-7	–	–
	600 V	MAC40795	MAC40796	MAC40801	MAC40797	MAC40798	2N6147	MAC35-8	MAC37-8	MAC36-8	MAC38-8	2N6159	2N6162
	800 V	–	–	–	–	–	–	MAC35-10	MAC37-10	MAC36-10	MAC38-10	–	–
ELECTRICAL CHARACTERISTICS	I_{GT}@25°C (mA)												
	Maximum MT2(+),G(+)	25	25	25	50	50	50	75	75	75	75	60	60
	Maximum MT2(+),G(-)	40	40	40	80	80	80	100	–	100	–	70	70
	Maximum MT2(-),G(-)	25	25	25	50	50	50	75	75	75	75	70	70
	Maximum MT2(-),G(+)	40	40	40	80	80	80	100	–	100	–	100	100
	V_{GT}@25°C (V)												
	Maximum MT2(+),G(+)	2.5	2.5	2.5	2.5	2.5	2.5	3.0	3.0	3.0	3.0	2.0	2.0
	Maximum MT2(+),G(-)	2.5	2.5	2.5	2.5	2.5	2.5	3.0	–	3.0	–	2.1	2.1
	Maximum MT2(-),G(-)	2.5	2.5	2.5	2.5	2.5	2.5	3.0	3.0	3.0	3.0	2.1	2.1
	Maximum MT2(-),G(+)	2.5	2.5	2.5	2.5	2.5	2.5	3.0	–	3.0	–	2.5	2.5
	I_{TSM} (Amp)	100	100	100	100	100	100	225	225	225	225	250	250

RIACS IN METAL PACKAGES (continued)

ON-STATE (RMS) CURRENT			
30 AMP	40 AMP		
			
Isolated			Isolated
Case 311-01 Style 1	Case 310-01 Style 1	Case 263-03 Style 1	Case 311-01 Style 1
–	–		
–	–	–	–
–	–	–	–
2N6163	2N5441 MAC5441	2N5444 MAC5444	MAC40688 MAC4688
	–		
2N6164	2N5442 MAC5442	2N5445 MAC5445	MAC40689 MAC4689
	–		
2N6165	2N5443 MAC5443	2N5446 MAC5446	MAC40690 MAC4690
	MAC6400-80	MAC6410-80	MAC6420-80
60	70	70	70
70	70	70	70
70	70	70	70
100	100	100	100
2.0	2.0	2.0	2.0
2.1	2.0	2.0	2.0
2.1	2.0	2.0	2.0
2.5	2.5	2.5	2.5
250	300-2N5441 Ser. 200-MAC Ser.	300-2N5444 S. 200-MAC S.	300-MAC4068 Ser. 200-Rest

PULSE MODULATOR SCRs

These devices are especially designed for pulse modulator applications in radar and similar equipment.

		ON-STATE PULSE CURRENT		
		100 AMP		1000 AMP
				
		Case 63-03 Style 1 TO-64		Case 263-03 Style 1
V_{DRM} V_{RRM} Blocking Voltage (Volts)	25 V	–	MCR846-1	–
	50 V	–	MCR846-2	–
	100 V	–	MCR846-3	–
	200 V	–	MCR846-4	–
	300 V	2N4199 2N4199JAN	MCR729-5	MCR1718-5
	400 V	2N4200 2N4200JAN	MCR729-6	MCR1718-6
	500 V	2N4201 2N4201JAN	MCR729-7	MCR1718-7
	600 V	2N4202 2N4202JAN	MCR729-8	MCR1718-8
	700 V	2N4203 2N4203JAN	MCR729-9	–
	800 V	2N4204 2N4204JAN	MCR729-10	–
ELECTRICAL CHARACTERISTICS	I_{GT} @ 25°C (mA) Max	50	50	50
	V_{GT} @ 25°C (V) Max	1.5	1.5	1.5
	I_H @ 25°C (mA) Min Typ*	3.0	25*	15*
	t_{gt} (μs) Max Typ*	0.4*	0.5* 0.4†	–
	t_{off} (μs) Max Typ*	20	6* 15*†	20*
	dv/dt (V/μs) Max Typ*	250	50	100*

†Applies to MCR729 Series only.

TRIGGER DEVICES


UJT


PUT


SBS


SUS


DIAC


4-LAYER

Trigger devices come under a variety of different classifications, with somewhat differing characteristics –

- Unijunction Transistors
- Unidirectional Switches
- Bidirectional Switches
- Bilateral Triggers
- 4-Layer Diodes

the principal function of all of these is to act as trigger devices for SCR and Triac circuits. Motorola makes them all, and with sufficient breadth of specifications to meet any circuit requirement.

The variety of different trigger devices available complicates device selection. No specific type of trigger has a clear-cut advantage over all others. Hence, trigger selection is often very subjective, based on the designer's experience and familiarity. Nevertheless, some basic comparisons can be drawn that might simplify the job of trigger selection for designers who have not already formed specific preferences.

UNIJUNCTION TRANSISTORS – UJT

Highly stable devices for general-purpose trigger applications and as pulse generators (oscillators) and timing circuits. Useful at frequencies ranging (generally) from 1 Hz to 1 MHz. Available in low-cost plastic package (TO-92) and in hermetically sealed metal package (Case 22A).

UNIJUNCTION TRANSISTORS – (UJT)

Package	Device Type	η Min	η Max	I_P μA Max	I_{EB20} μA Max	I_V mA Min
Plastic Case 29-02 (TO-92) 	MU10	0.50	0.85	5.0	1.0	1.0
	2N4870	0.56	0.75	5.0	1.0	2.0
	2N4871	0.70	0.85	5.0	1.0	4.0
	MU2646	0.56	0.75	5.0	12	4.0
	MU4891	0.55	0.82	5.0	0.01	2.0
	MU4892	0.51	0.69	2.0	↓	↓
	MU4893	0.55	0.82	2.0		
	MU4894	0.74	0.86	1.0		
Metal Case 22A-01 	MU20	0.56	0.85	2.0	0.2	1.0
	2N2646	0.56	0.75	5.0	12	4.0
	2N2647	0.68	0.82	2.0	0.2	8.0
	2N3980	0.68	0.82	2.0	0.01	1.0
	2N4851	0.56	0.75	2.0	0.1	2.0
	2N4852	0.70	0.85	2.0	0.1	4.0
	2N4853	0.70	0.85	0.4	0.05	6.0
	2N4948*	0.55	0.82	2.0	0.01	2.0
	2N4949*	0.74	0.86	1.0	0.01	2.0
	2N5431*	0.72	0.80	0.4	0.01	2.0

*Also available as JAN and JANTX devices

TRIGGER DEVICES (Continued)

PROGRAMMABLE UNIJUNCTION TRANSISTORS – (PUT)

Package	Device Type	I_P R_G = 10 kΩ µA Max	I_P R_G = 1.0 MΩ µA Max	I_{GAO} @40 V nA Max	I_V R_G = 10 kΩ µA Min	I_V R_G = 1.0 MΩ µA Max
Plastic Case 29-02 TO-92 	2N6027	5.0	2.0	10	70	50
	2N6028	1.0	0.15	↓	25	25
	MPU6027	5.0	2.0		70	50
	MPU6028	1.0	0.15		25	25
	MPU131	5.0	2.0	5.0	70	50
	MPU132	2.0	0.3	5.0	50	50
	MPU133	1.0	0.15	5.0	50	25
Metal Case 22-03 TO-18 	2N6116*	5.0	2.0	5.0	70	50
	2N6117*	2.0	0.3	5.0	50	50
	2N6118*	1.0	0.15	5.0	50	25

*Also available as JAN and JANTX devices

PROGRAMMABLE UNIJUNCTION TRANSISTORS – PUT

Similar to UJTs, except that I_V, I_P and intrinsic standoff voltage are programmable (adjustable) by means of external voltage divider. This stabilizes circuit performance for variations in device parameters. General operating frequency range is from 0.01 Hz to 10 kHz, making them suitable for long-duration timer circuits. Two-package availability provides cost option.

Package	Device Type	V_S Volts Nom* Min	V_S Volts Nom* Max	I_S µA Max	I_H mA Max
BILATERAL TRIGGERS – (DIACs)					
Plastic Case 182-02 TO-92 	1N5758/MPT20	20 ± 4.0*		100	
	1N5759	24 ± 4.0*		100	
	1N5760/MPT28	28 ± 4.0*		100	
	1N5761/MPT32	32 ± 4.0*		100	
	1N5762	36 ± 4.0*		100	
	1N5758A	20 ± 2.0*		25	
	1N5759A	24 ± 2.0*		25	
	1N5760A	28 ± 2.0*		25	
	1N5761A	32 ± 2.0*		25	
	1N5762A	36 ± 2.0*		25	
SILICON BIDIRECTIONAL SWITCH – (SBS)					
Plastic Case 29-02 TO-92 	MBS4991	6.0	10	500	1.5
	MBS4992	7.5	9.0	120	0.5
4-LAYER DIODES (I_F = 150 mAdc Max)					
Glass Case 51 DO-7 Glass 	1N5159	9.0	11	50	20
	1N5160	10	12	↓	↓
	1N5779	11	13		
	1N5780	12	14		
	1N5781	13	15		
	1N5782	8.0	10	100	50
	1N5783	9.0	11	↓	↓
	1N5784	10	12		
	1N5785	11	13		
	1N5786	12	14		
	1N5787	13	15		
	1N5788	8.0	10		2.0
	1N5789	9.0	11		↓
	1N5790	10	12		
	1N5791	11	13		
	1N5792	12	14		
	1N5793	13	15		
SILICON UNIDIRECTIONAL SWITCH – (SUS)					
Plastic Case 29-02 TO-92 	MUS4987	6.0	10	500	1.5
	MUS4988	7.5	9.0	150	0.5

BILATERAL TRIGGERS – DIACs

Specifically designed as low-cost bidirectional triggers in line-operated Triac control circuits such as light dimmers, motor controls and temperature controls.

SILICON BIDIRECTIONAL SWITCH – SBS

Applications similar to Diac, but has gate electrode that permits synchronization.

4-LAYER DIODES

Small, axial-lead devices with stable, repeatable characteristics required for critical SCR trigger and pulse generator applications.

SILICON UNIDIRECTIONAL SWITCH – SUS

Similar to 4-Layer Diodes, but has gate electrode that permits synchronization.

OPTOELECTRONICS

Optoelectronic devices are designed for use in computer, industrial and consumer equipment. Motorola's standard line of optoelectronic products include optical couplers, light emitters and light detectors. Compactness, reliability and compatibility with integrated circuits keynote light-emitting diode advantages — as well as perfect spectral matching in infrared (IR) units to silicon detectors. They emit infrared or visible light when forward biased. Motorola offers a variety of red and infrared, fast switching types for flexibility in package, performance and price.

TABLE OF CONTENTS

The following index reflects the devices characterized in this section. To locate the exact page number, see Catalog Index (Page 7-1).

DEVICE INDEX

OPTICAL COUPLERS/ISOLATORS

Couplers are designed to provide isolation protection from high-voltage transients, surge voltage or low level noise that would otherwise damage the input or generate erroneous information. They allow interfacing systems of different logic levels, different grounds, etc., that would otherwise be incompatible. Motorola offers a variety of standard isolation voltages from transients protection of 500 to 5000 Volts minimum.

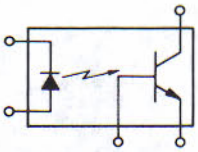
Motorola also offers a wide array of standard devices that have a wide range of specifications (including the first series of DIP transistors and darlington couplers to achieve JEDEC registration: transistors – 4N25 thru 4N28/darlingtons – 4N29 thru 4N33).

CASE 673-04

Actual Size

The Transistor Coupler is probably the most popular form of isolator since it offers moderate speed (approximately 300 kHz), sensitivity and economy. In addition, the collector-base junction can be used as a photo diode to achieve higher speeds. The output in the diode mode is lower, requiring amplification for more usable output levels.

For High Speed, Moderate Efficiency



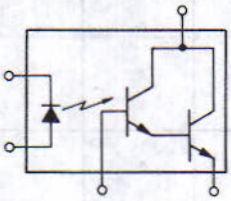
Transistor Output

Device Type	Isolation* Voltage Volts Min	DC Current Transfer Ratio % Min	BV_{CEO} Volts Min	Collector Output Current @I_F = 10 mA Typ mA
4N28	500	10	30	2.0
4N26	1500	20	30	3.5
4N27	1500	10	30	2.0
4N38	1500	20	80	3.5
4N37	1500	100	30	2.0
4N36	2500	100	30	2.0
4N25	2500	20	30	3.5
4N25A**	2500	20	30	3.5
4N38A**	2500	20	80	3.5
4N35	3550	100	30	2.0
MOC1005	5000	20	30	5.0
MOC1006	5000	10	30	3.0

*AC peak voltage – one full sine wave 60 Hz.
**Underwriter Laboratory Recognition

The Darlington Transistor Coupler is used when high transfer ratios and increased output current capability are needed. The speed, approximately 30 kHz, is slower than the transistor type but the transfer ratio can be as much as twenty times as high as the single transistor type.

For High Efficiency, Moderate Speed

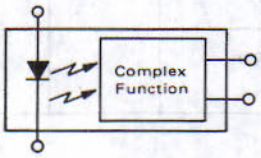


Device Type	Isolation* Voltage Volts Min	DC Current Transfer Ratio % Min	BV_{CEO} Volts Min	Collector Output Current @I_F = 10 mA Typ mA
4N30 (MOC1200)	1500	100		30
4N31	1500	50	30	10
4N33	1500	500	30	60
MOC119	1500	300	30	45
MOC8030	1500	300	80	45
MOC8050	1500	500	80	60
4N29	2500	100	30	30
4N29A**	2500	100	30	30
4N32	2500	500	30	60
4N32A**	2500	500	30	60

*AC peak voltage — one full sine wave 60 Hz.
**Underwriter Laboratory Recognition.

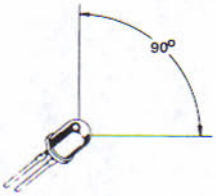
Complex Functions

As the areas of application for couplers grow, more complicated output functions will be required. Higher speeds, lower drive, more current output devices are already beginning to make their appearance on the marketplace. (Motorola now offers a high-speed function and is developing a new TRIAC Driver/Bilateral Swtich function). These new functions will offer the designer even more flexibility and opportunities for creative design.



Device Type	Isolation Voltage Volts Min	Switching Times t_{on} ns Typ	Switching Times t_{off} ns Typ	Off Output Current μA Max
Hi-Speed				
MOC5001	500	300	650	100
MOC5000	1500	250	400	100
Triac Driver/ Bilateral Switch		**LED Trigger Current $I_{F(TH)}$ Typ mA**		**Output Saturation Current $I_{(sat)}$ Typ mA**
MOC3000	5000	5.0		80
MOC3001	5000	5.0		45
MOC3002	5000	5.0		80
MOC3003	5000	5.0		45

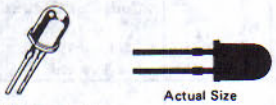
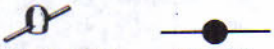
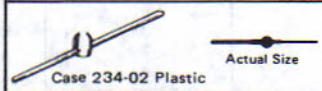
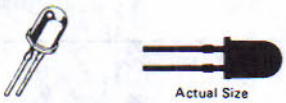
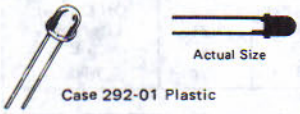
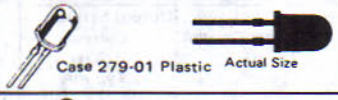
VISIBLE LIGHT-EMITTING DIODES



Motorola visible emitters are available for use in panel and circuit condition indicators, light modulators, and film annotation.

Peak Emission Wavelength = 660 nm (Typ)
Forward Voltage @ 20 mA = 1.6 V (Typ) (Except as noted)

Viewing Angle — Angle at which intensity is 50% of maximum on axis intensity.

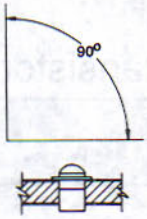
Package	Device Type (Lens Type)	Viewing Angle α	Instantaneous Axial Luminous Intensity Typ mcd	Mounting	
				Panel	Circuit Board
 Actual Size Case 279-01 Plastic	1N5911 (Note 1,2,3) (Formerly MLED750) (Diffusing Green)	90°	0.3 @ 25 mA	×	
	1N5912 (Note 1,2,4) (Formerly MLED850) (Visible Yellow)	90°	0.3 @ 25 mA	×	
 Actual Size Case 171(2) Plastic	MLED600 (Clear Red)	30°	3.0 @ 20 mA	×	×
 Actual Size Case 234-02 Plastic	MLED50 (Clear) MLED55 (Diffusing Red)	70° 100°	1.0 @ 20 mA 0.6 @ 20 mA	× ×	× ×
 Actual Size Case 279-01 Plastic	MLED640 (Milky White)	90°	2.0 @ 20 mA	×	
	MLED655 (Diffusing Red) General Purpose	90°	2.0 @ 20 mA	×	
	MLED660 (Diffusing Red) High Current	90°	1.5 @ 20 mA	×	
 Actual Size Case 292-01 Plastic	MLED440 (Visible Red) MLED445 (Clear)	90° 40°	0.3 @ 20 mA 0.8 @ 20 mA	× ×	
	1N5909 (Formerly MLED455) (Diffusing Red)	75°	1.2 @ 20 mA	×	
 Actual Size Case 279-01 Plastic	1N5910 (Formerly MLED650) (Diffusing Red) Wide Viewing	140°	0.8 @ 20 mA	X	
 Actual Size Case 29-02 Plastic	MLED500 (Diffusing Red)	110°	0.3 @ 20 mA		×

Notes: 1. Indicates JEDEC Registered Data
2. Forward Voltage @ 25 mA = 2.1 mA (Typ)
3. Peak Emission Wavelength = 560 nm (Typ)
4. Peak Emission Wavelength = 575 nm (Typ)

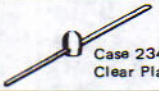
INFRARED-EMITTING DIODES

Infrared (900 nm) gallium arsenide emitters are available from Motorola for use in light modulators, shaft or position encoders, punched card and tape readers, optical switching and logic circuits. They are spectrally matched for use with silicon detectors.

Peak Emission Wavelength = 900 nm (Typ)
Forward Voltage @ 50 mA = 1.2 (Typ)



Emission Angle — Angle at which I_R emission is 50% of maximum intensity.

Package	Device Type	Emission Angle α	Instantaneous Power Output Typ μW	Mounting	
				Panel	Circuit Board
 Actual Size  Case 81A-01 Metal	MLED910	30°	150 @ 50 mA		×
 Actual Size  Case 209-01 Metal	MLED930	30°	650 @ 100 mA	×	
 Actual Size  Case 171 (2) Plastic	MLED900	30°	550 @ 50 mA	×	×
 Actual Size Case 234-02 Clear Plastic	MLED60 MLED90	65° 65°	550 @ 50 mA 350 @ 50 mA	× ×	× ×
 Actual Size  Case 29-02 Plastic	MLED92	110°	650 @ 100 mA	×	×

PHOTODETECTORS

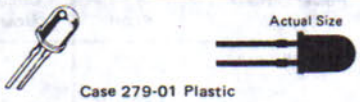
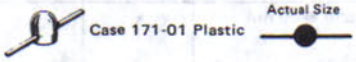
A variety of silicon photodetectors are available for a wide range of light detecting applications. Devices are available in packages offering choices of viewing angle and size in either low cost, economical, plastic cases or rugged, hermetic, metal cans. Advantages over phototubes are high sensitivity, good temperature stability, and proven silicon reliability. Applications include card and tape readers, pattern and character recognition, shaft encoders, position sensors, counters, and others. Maximum sensitivity occurs at approximately 800 nm.

Phototransistors

Phototransistors are used where moderate sensitivity and medium speed (2.0 μs) are required.

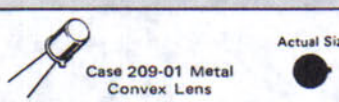
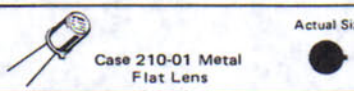
Package	Type Number	Light Current @ H Typ mA	Light Current @ H mW/cm²	BV_{CEO} Volts Min	Dark Current @ V_{CC} nA Max	Dark Current @ V_{CC} Volts
 Actual Size  Case 210-01 Metal	MRD810	4.0	5.0	35	50	20
 Actual Size Case 81A-01 Metal	MRD604 MRD603 MRD602 MRD601	8.5 6.0 3.5 1.5	20 20 20 20	50 50 50 50	25 25 25 25	30 30 30 30
 Actual Size  Case 82-01 Metal	MRD310 MRD300	2.5 7.5	5.0 5.0	50 50	25 25	20 20

Phototransistors (continued)

Package	Type Number	Light Current Typ mA	Light Current @ H mW/cm^2	BV_{CEO} Volts Min	Dark Current nA Max	Dark Current @ V_{CC} Volts
 Case 82-01 Metal (Actual Size)	MRD3054	1.2	5.0	30	100	20
	MRD3056	2.5	5.0	30	100	20
	MRD3055	1.8	5.0	30	100	20
	MRD3051	0.2	5.0	30	100	20
	MRD3050	0.2	5.0	30	100	20
	MRD3052	0.25	5.0	30	100	20
	MRD3053	0.5	5.0	30	100	20
 Case 279-01 Plastic (Actual Size)	MRD120	0.7	1.0	40	100	20
	MRD121	0.25	1.0	40	100	20
 Case 173 Clear Plastic (Actual Size)	MRD150	0.45	5.0	40	100	20
 Case 171-01 Plastic (Actual Size)	MRD450	4.0	5.0	40	100	20

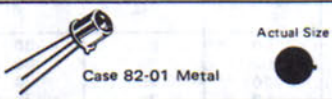
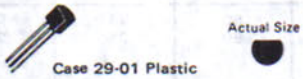
Photodiodes

Photodiodes are used where high speed is required (1.0 ns).

Package	Type Number	Light Current Typ μA	Light Current @ H mW/cm^2	BV_R Volts Min	Dark Current nA Max	Dark Current @ Volts
 Case 209-01 Metal Convex Lens (Actual Size)	MRD500	9.0	5.0	100	2.0	20
 Case 210-01 Metal Flat Lens (Actual Size)	MRD510	2.0	5.0	100	2.0	20

Photodarlingtons

Photodarlingtons are used where maximum sensitivity is required with typical rise and fall times of 50 μs.

Package	Type Number	Light Current Typ mA	Light Current @ H mW/cm^2	BV_{CEO} Volts Min	Dark Current nA Max	Dark Current @ Volts
 Case 82-01 Metal (Actual Size)	MRD360	20	0.5	40	100	10
	MRD370	10	0.5	40	100	10
 Case 29-01 Plastic (Actual Size)	2N5780	8.0	2.0	40	100	12
	2N5779	8.0	2.0	25	100	12
	2N5778	4.0	2.0	40	100	12
	2N5777	4.0	2.0	25	100	12
	MRD14B	2.0	2.0	12	100	12

CHIPS

Motorola has made available to the hybrid circuit manufacturer, in chip form, virtually all of the thousands of discrete and integrated circuit devices in its standard product catalog. For more detailed information on these chips, including testing, visual inspection, packaging, size, geometry, and metallization, contact your nearest Motorola representative or distributor.

DEVICES FOR MILITARY APPLICATIONS

The following tables list devices that appear in QPL-19500 (Qualified Products List) as of 16 September 1975 and are available in the JAN, JANTX, and JANTXV versions as specified. Check with your local Motorola sales office or franchised distributor for current qualification status and availability.

1N. . .Device Numbers
ASSEMBLIES
DIODES
Reference
Zener
Current Regulator
Voltage Regulator
RECTIFIERS

SILICON ZENER DIODES ±5% SERIES

MIL-S-19500/127

1N746A JAN,JTX,JTXV thru 1N759A JAN,JTX,JTXV

MIL-S-19500/117

1N962B JAN,JTX,JTXV thru 1N992B JAN,JTX,JTXV

***MIL-S-19500/114**

1N2804B JAN,JTX thru 1N2811B JAN,JTX
1N2813B JAN,JTX
1N2814B JAN,JTX
1N2816B JAN,JTX
1N2818B JAN,JTX thru 1N2820B JAN,JTX
1N2822B JAN,JTX thru 1N2827B JAN,JTX
1N2829B JAN,JTX
1N2831B JAN,JTX thru 1N2838B JAN,JTX
1N2840B JAN,JTX thru 1N2846 JAN,JTX

***MIL-S-19500/124**

1N2970B JAN,JTX thru 1N2977B JAN,JTX
1N2979B JAN,JTX
1N2980B JAN,JTX
1N2982B JAN,JTX
1N2984B JAN,JTX thru 1N2986B JAN,JTX
1N2988B JAN,JTX thru 1N2993B JAN,JTX
1N2995B JAN,JTX
1N2997B JAN,JTX
1N2999B JAN,JTX thru 1N3005B JAN,JTX
1N3007B JAN,JTX thru 1N3009B JAN,JTX
1N3011B JAN,JTX
1N3012B JAN,JTX
1N3014B JAN,JTX
1N3015B JAN,JTX

MIL-S-19500/115

1N3016B JAN,JTX,JTXV thru 1N3051B JAN,JTX,JTXV

SILICON ZENER DIODES ±5% SERIES (continued)

***MIL-S-19500/358**

1N3305B JAN,JTX thru 1N3312B JAN,JTX
1N3314B JAN,JTX
1N3315B JAN,JTX
1N3317B JAN,JTX
1N3319B JAN,JTX thru 1N3321B JAN,JTX
1N3323B JAN,JTX thru 1N3328B JAN,JTX
1N3330B JAN,JTX
1N3332B JAN,JTX
1N3334B JAN,JTX thru 1N3340B JAN,JTX
1N3342B JAN,JTX thru 1N3344B JAN,JTX
1N3346B JAN,JTX
1N3347B JAN,JTX
1N3349B JAN,JTX
1N3350B JAN,JTX

MIL-S-19500/115

1N3821A JAN,JTX,JTXV thru 1N3828A JAN,JTX,JTXV

****MIL-S-19500/272**

1N3993A JAN,JTX thru 1N4000A JAN,JTX

MIL-S-19500/435

1N4099 JAN,JTX,JTXV thru 1N4135 JAN,JTX,JTXV

MIL-S-19500/127

1N4370A JAN,JTX,JTXV thru 1N4372A JAN,JTX,JTXV

***MIL-S-19500/358**

1N4549B JAN,JTX thru 1N4554B JAN,JTX

MIL-S-19500/435

1N4614 JAN,JTX,JTXV thru 1N4627 JAN,JTX,JTXV

MIL-S-19500/73

1N4557B RB,JAN,JTX thru 1N4562B JAN,JTX

VOLTAGE REGULATORS

MIL-S-19500/437

1N5519B JAN,JANTX thru 1N5545B JAN,JANTX

SEE POPULAR PRO-ELECTRON DEVICES TYPES SECTION 8

CURRENT REGULATORS

MIL-S-19500/463

1N5285 JAN,JTX,JTXV	1N5300 JAN,JTX,JTXV
1N5286 JAN,JTX,JTXV	1N5301 JAN,JTX,JTXV
1N5287 JAN,JTX,JTXV	1N5302 JAN,JTX,JTXV
1N5288 JAN,JTX,JTXV	1N5303 JAN,JTX,JTXV
1N5289 JAN,JTX,JTXV	1N5304 JAN,JTX,JTXV
1N5290 JAN,JTX,JTXV	1N5305 JAN,JTX,JTXV
1N5291 JAN,JTX,JTXV	1N5306 JAN,JTX,JTXV
1N5292 JAN,JTX,JTXV	1N5307 JAN,JTX,JTXV
1N5293 JAN,JTX,JTXV	1N5308 JAN,JTX,JTXV
1N5294 JAN,JTX,JTXV	1N5309 JAN,JTX,JTXV
1N5295 JAN,JTX,JTXV	1N5310 JAN,JTX,JTXV
1N5296 JAN,JTX,JTXV	1N5311 JAN,JTX,JTXV
1N5297 JAN,JTX,JTXV	1N5312 JAN,JTX,JTXV
1N5298 JAN,JTX,JTXV	1N5313 JAN,JTX,JTXV
1N5299 JAN,JTX,JTXV	1N5314 JAN,JTX,JTXV

TC REFERENCE DIODES

MIL-S-19500

1N429 JAN	/299
1N821 JAN,JTX,JTXV	/159
1N823 JAN,JTX,JTXV	/159
1N825 JAN,JTX,JTXV	/159
1N827 JAN,JTX,JTXV	/159
1N829 JAN,JTX,JTXV	/159
1N935B JAN,JTX,JTXV	/156
1N937B JAN,JTX,JTXV	/156
1N938B JAN,JTX,JTXV	/156
1N939B JAN,JTX,JTXV	/156
1N941B JAN,JTX	/157
1N943B JAN,JTX	/157
1N944B JAN,JTX	/157
1N945B JAN,JTX	/157
1N3154 JAN,JTX	/158
1N3155 JAN,JTX	/158
1N3156 JAN,JTX	/158
1N3157 JAN,JTX	/158
1N4565A JAN,JTX,JTXV thru 1N4574A JAN,JTX,JTXV	/452

DIODE ASSEMBLIES

MIL-S-19500

1N1530A JAN	/320
1N1742A JAN	/298

RECTIFIERS

MIL-S-19500/304

1N3890 JAN,JTX,JTXV
1N3890R JAN,JTX,JTXV
1N3891 JAN,JTX,JTXV
1N3891R JAN,JTX,JTXV
1N3893 JAN,JTX,JTXV
1N3893R JAN,JTX,JTXV

MIL-S-19500/308

1N3910R JAN,JTX
1N3911R JAN,JTX
1N3912R JAN,JTX
1N3913R JAN,JTX

2N. . . Device Numbers
TRANSISTORS
Field Effect, High Frequency,
Multiple Device, Power, RF Power,
Switching and Unijunction
THYRISTORS

The following tables list devices that appear in QPL-19500 (Qualified Products List) as of 16 September 1975 and are available in the JAN, JANTX, and JANTXV versions as specified. Check with your local Motorola sales office or franchised distributor for current qualification status and availability.

SWITCHING AND HIGH FREQUENCY TRANSISTORS

	MIL-S-19500
2N499 JAN	/72
2N499A JAN	/72
2N502A JAN	/112
2N502B JAN	/112
2N703 JAN	/153
2N705 JAN	/86
2N706 JAN	/120
2N708 JAN,JTX	/312
2N718A JAN,JTX,JTXV	/181
2N869A JAN,JTX	/283
2N914 JAN,JTX	/373
2N916 JAN	/271
2N929 JAN,JTX	/253
2N930 JAN,JTX	/253
2N962 JAN	/258
2N964 JAN	/258
2N1132 JAN	/177
2N1613 JAN,JTX,JTXV	/181
2N2218 JAN,JTX,JTXV	/251
2N2218A JAN,JTX,JTXV	/251
2N2219 JAN,JTX,JTXV	/251
2N2219A JAN,JTX,JTXV	/251
2N2221 JAN,JTX,JTXV	/255
2N2221A JAN,JTX,JTXV	/255
2N2222 JAN,JTX,JTXV	/255
2N2222A JAN,JTX,JTXV	/255
2N2369A JAN,JTX,JTXV	/317
2N2481 JAN,JTX	/268
2N2857 JAN,JTX,JTXV	/343
2N2905 JAN,JTX,JTXV	/290
2N2905A JAN,JTX,JTXV	/290
2N2906 JAN,JTX,JTXV	/291
2N2906A JAN,JTX,JTXV	/291
2N2907 JAN,JTX,JTXV	/291
2N2907A JAN,JTX,JTXV	/291
2N3013 JAN,JTX	/287
2N3250A JAN,JTX,JTXV	/323
2N3251A JAN,JTX,JTXV	/323
2N3253 JAN	/347
2N3253S JAN	/347
2N3444 JAN	/347
2N3444S JAN	/347
2N3449 JAN	/338
2N3467 JAN,JTX,JTXV	/348
2N3468 JAN,JTX,JTXV	/348
2N3485A JAN,JTX	/392
2N3486A JAN,JTX	/392
2N3498 JAN,JTX,JTXV	/366
2N3499 JAN,JTX,JTXV	/366
2N3500 JAN,JTX,JTXV	/366
2N3501 JAN,JTX,JTXV	/366
2N3506 JAN,JTX,JTXV	/349
2N3507 JAN,JTX,JTXV	/349
2N3634 JAN,JTX,JTXV	/357
2N3635 JAN,JTX,JTXV	/357
2N3636 JAN,JTX,JTXV	/357
2N3637 JAN,JTX,JTXV	/357
2N3743 JAN,JTX,JTXV	/397
2N3762 JAN,JTX,JTXV	/396
2N3763 JAN,JTX,JTXV	/396
2N3764 JAN,JTX,JTXV	/396
2N3765 JAN,JTX,JTXV	/396
2N3959 JAN,JTX	/399
2N3960 JAN,JTX	/399
2N4405 JAN,JTX	/448
2N4449 JAN,JTX,JTXV	/317
2N4453 JAN,JTX	/283
2N4930 JAN,JTX,JTXV	/397
2N4931 JAN,JTX,JTXV	/397
2N5581 JAN,JTX	/423
2N5582 JAN,JTX	/423
2N6365 JAN	/471
2N6365A JAN	/471

POWER TRANSISTORS

	MIL-S-19500
2N3715 JAN,JTX,JTXV	/408
2N3716 JAN,JTX,JTXV	/408
2N3739 JAN,JTX	/402
2N3740 JAN,JTX,JTXV	/441
2N3741 JAN,JTX,JTXV	/441
2N3791 JAN,JTX,JTXV	/379
2N3792 JAN,JTX,JTXV	/379
2N3867 JAN,JTX,JTXV	/350
2N3868 JAN,JTX,JTXV	/350
2N3902 JAN,JTX	/371
2N4399 JAN,JTX,JTXV	/433
2N5302 JAN,JTX	/456
2N5303 JAN,JTX	/456
2N5685 JAN,JTX,JTXV	/464
2N5686 JAN,JTX,JTXV	/464
2N5745 JAN,JTX,JTXV	/433

DEVICES FOR MILITARY APPLICATIONS (continued)

2N. . . DEVICE NUMBERS (continued)

SILICON CONTROLLED RECTIFIERS

MIL-S-19500	
2N4199 JAN	/372
2N4200 JAN	/372
2N4201 JAN	/372
2N4202 JAN	/372
2N4203 JAN	/372
2N4204 JAN	/372

UNIJUNCTION

MIL-S-19500	
2N4948 JAN,JTX	/388
2N4949 JAN,JTX	/388
2N5431 JAN,JTX	/425
2N6116 JAN,JTX	/493
2N6117 JAN,JTX	/493
2N6118 JAN,JTX	/493

MULTIPLE DEVICES

MIL-S-19500	
2N2060 JAN,JTX,JTXV	/270
2N3810 JAN,JTX,JTXV	/336
2N3811 JAN,JTX,JTXV	/336
2N4854 JAN,JTX,JTXV	/421
2N5793,94 JAN,JTX	/495

FIELD-EFFECT TRANSISTORS

MIL-S-19500	
2N3330 JAN,JTX	/378
2N3821 JAN,JTX	/375
2N3822 JAN,JTX	/375
2N3823 JAN,JTX	/375
2N4856,59 JAN,JTX	/385

RF POWER TRANSISTORS

MIL-S-19500	
2N918 JAN,JTX,JTXV	/301
2N1142 JAN	/87
2N1195 JAN	/71
2N2273 JAN	/244
2N3127 JAN	/346
2N3375 JAN,JTX,JTXV	/341
2N3553 JAN,JTX,JTXV	/341
2N3866 JAN,JTX,JTXV	/398
2N3866A JAN,JTX,JTXV	/398

The following tables list devices which are in the process of qualification for listing in QPL-19500 as of 16 September 1975. Check with your local Motorola sales office or franchised distributor for current qualification status and availability.

POWER TRANSISTORS

MIL-S-19500	
2N3439,40 JAN,JTX	/368
2N5664,65 JAN,JTX,JTXV	/455
2N5683,84 JAN,JTX	/466
2N6051,52 JAN,JTX,JTXV	/501
2N6058,59 JAN,JTX,JTXV	/503
2N6306,08 JAN,JTX	/498

MULTIPLE DEVICES

MIL-S-19500	
2N5795,96 JAN,JTX,JTXV	/496

SWITCHING AND HIGH FREQUENCY TRANSISTORS

MIL-S-19500	
2N3019 JAN,JTX	/391
2N3700 JAN,JTX	/391
2N3735,37 JAN,JTX,JTXV	/395
2N4957 JAN,JTX	/426
2N5109 JAN,JTX	/453

FIELD-EFFECT TRANSISTORS

MIL-S-19500	
2N4092 JAN,JTX	/431
2N4093 JAN,JTX	/431
2N4416A JAN,JTX,JTXV	/428
2N4857,58,60,61 JAN,JTX	/385

INTEGRATED CIRCUITS

A typical military part number consists of the JAN prefix, the general specification number, the detail specification number, and a coded part number.

PART NUMBER DESCRIPTION

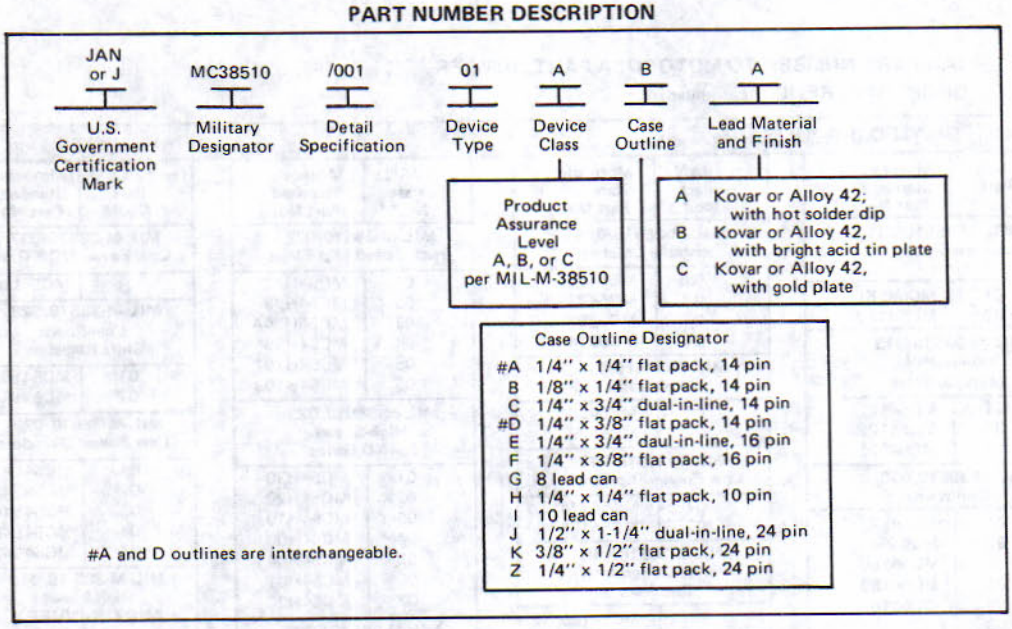


TABLE I – JAN PART NUMBER TO MOTOROLA PART NUMBER CROSS REFERENCE

Contact your local Motorola sales office or franchised distributor for current qualification status and availability.

MTTL INTEGRATED CIRCUITS

JAN Part No.**	Motorola Standard Part No.
MIL-M-38510/001 NAND Gates	
01	MC5430
02	MC5420
03	MC5410
04	MC5400
05	MC5404
06	MC5412
07	MC5401
08	MC5405
09	MC5403
MIL-M-38510/002 Flip-Flops	
01	MC5472
02	MC5473
03	MC54107
04	MC5476
05	MC5474
06	MC5470
07	MC5479

JAN Part No.**	Motorola Standard Part No.
MIL-M-38510/003 NAND Buffers	
01	MC5440
02	MC5437
03	MC5438
MIL-M-38510/004 NOR Gates	
01	MC5402
02	MC5423
03	MC5425
04	MC5427
MIL-M-38510/005 AND-OR-INVERT Gates	
01	MC5450
02	MC5451
03	MC5453
04	MC5454

JAN Part No.**	Motorola Standard Part No.
MIL-M-38510/006 Binary Full Adders	
01	MC15482
02	MC5483
03	MC9304
MIL-M-38510/007 Exclusive OR Gate	
01	MC5486
MIL-M-38510/008 Hex Buffers/Drivers	
01	MC5406
02	MC5416
03	MC5407
04	MC5417
05	MC5426

JAN Part No.**	Motorola Standard Part No.
MIL-M-38510/009 Shift Registers	
01	MC5495
02	MC5496
03	MC54164A
04	MC54165
05	MC54194
06	MC54195
MIL-M-38510/010 Decoders	
01	MC5442
02	MC5443
03	MC5444
04	MC5445
05	MC54145
06	MC5446
07	MC5447
08	MC5448
09	MC5449

**JAN type number must be completed as shown in the Part Number Description.

TABLE I – JAN PART NUMBER TO MOTOROLA PART NUMBER CROSS REFERENCE (continued)

MTTL INTEGRATED CIRCUITS (continued)

JAN Part No.**	Motorola Standard Part No.
MIL-M-38510/011 Arithmetic Logic Unit	
01	MC54181
02	MC54182
MIL-M-38510/012 Monostable Multivibrators	
01	MC54121
02	MC54122
03	MC54123
MIL-M-38510/013 Counters	
01	MC5492
02	MC5493
03	MC54160
04	MC54163
05	MC54162
06	MC54161
07	MC5490
08	MC54192
09	MC54193
MIL-M-38510/014 Data Selectors/ Multiplexers	
01	MC54150
02	MC9312
03	MC54153
04	MC9309
05	MC9322
06	MC54151

JAN Part No.**	Motorola Standard Part No.
MIL-M-38510/015 Bistable Latches	
01	MC5475
02	MC5477
03	MC9308
04	MC9314
MIL-M-38510/016 AND Gates	
01	MC5408
02	MC5409
MIL-M-38510/017 Low-Power Flip-Flops	
01	MC54174
02	MC54175
MIL-M-38510/019 Parity Generators/ Checkers	
01	MC54180
MIL-M-38510/020 Low-Power NAND Gates	
01	MC54L30*
02	MC54L20*
03	MC54L10*
04	MC54L00*
05	MC54L04*
06	MC54L03*
MIL-M-38510/021 Low-Power Flip-Flops	
01	MC54L71*
02	MC54L72*
03	MC54L73*
04	MC54L78*
05	MC54L74*

JAN Part No.**	Motorola Standard Part No.
MIL-M-38510/022 High-Speed Flip-Flops	
01	MC54H72
02	MC54H73
03	MC54H74A
04	MC54H76
05	MC54H101
06	MC54H103
MIL-M-38510/023 High-Speed NAND Gates	
01	MC54H30
02	MC54H20
03	MC54H10
04	MC54H00
05	MC54H04
06	MC54H01
07	MC54H22
MIL-M-38510/024 High-Speed NAND Buffer	
01	MC54H40
MIL-M-38510/025 Counters	
01	MC54L90*
02	MC54L93*
MIL-M-38510/026 Low-Power Exclusive OR Gate	
01	MC54L86*

JAN Part No.**	Motorola Standard Part No.
MIL-M-38510/027 Low-Power NOR Gate	
01	MC54L02*
MIL-M-38510/028 Low-Power Shift Registers	
01	MC54L95*
02	MC54L164*
MIL-M-38510/029 Low-Power Decoders	
01	MC54L42*
02	MC54L43*
03	MC54L44*
04	MC54L46*
05	MC54L47*
MIL-M-385 10/040 High-Speed AND-OR-INVERT Gates	
01	MC54H50
02	MC54H51
03	MC54H53
04	MC54H54
05	MC54H55
MIL-M-38510/041 Low-Power AND-OR-INVERT Gates	
01	MC54L51*
02	MC54L54*
03	MC54L55*
MIL-M-38510/151 Schmitt-Triggers	
01	MC5413
02	MC5414
03	MC54132

MDTL INTEGRATED CIRCUITS

JAN Part No.**	Motorola Standard Part No.
MIL-M-38510/030 NAND Gates	
01	MC930
02	MC935
03	MC936
04	MC946
05	MC962

JAN Part No.**	Motorola Standard Part No.
MIL-M-38510/031 NAND Buffer/Expander	
01	MC932
02	MC944
03	MC957
04	MC958
05	MC933

JAN Part No.**	Motorola Standard Part No.
MIL-M-38510/032 Monostable Multivibrator	
01	MC951

JAN Part No.**	Motorola Standard Part No.
MIL-M-38510/033 Flip-Flops	
01	MC945
02	MC948
03	MC950
04	MC9093**

*Not presently being manufactured or planned for immediate introduction.
**JAN type number must be completed as shown in the Part Number Description.

TABLE I – JAN PART NUMBER TO MOTOROLA PART NUMBER CROSS REFERENCE (continued)

McMOS INTEGRATED CIRCUITS

JAN Part No.**	Motorola Standard Part No.
MIL-M-38510/050 NAND Gates	
01	MC14011A
02	MC14012A
03	MC14023A
MIL-M-38510/051 Flip-Flops	
01	MC14013A
02	MC14027A

JAN Part No.**	Motorola Standard Part No.
MIL-M-38510/052 NOR Gates	
01	MC14000A
02	MC14001A
03	MC14002A
04	MC14025A
MIL-M-38510/053 AND-OR-INVERT Gates	
01	MC14007A
02	MC14019A*
03	MC14030A*
MIL-M-38510/054 4-Bit Full Adder	
01	MC14008A

JAN Part No.**	Motorola Standard Part No.
MIL-M-38510/055 Buffers/Converters	
01	MC1409A
02	MC14010A
03	MC14049A
04	MC14050A
05	MC14041A*
MIL-M-38510/056 Counters/Dividers	
01	MC14017A
02	MC14018A*
03	MC14020A
04	MC14022A
05	MC14024A

JAN Part No.**	Motorola Standard Part No.
MIL-M-38510/057 Static Shif Registers	
01	MC14006A
02	MC14014A*
03	MC14015A
04	MC14021A
05	MC14031A*
MIL-M-38510/058 Quad Analog Switch	
01	MC14016A

MECL 10,000 INTEGRATED CIRCUITS

JAN Part No.**	Motorola Standard Part No.
MIL-M-38510/060# Multiple Gates	
01	MC10501
02	MC10502
03	MC10505
04	MC10506
05	MC10507
06	MC10509
07	MC10504

LINEAR INTEGRATED CIRCUITS

JAN Part No.**	Motorola Standard Part No.
MIL-M-38510/101 Operational Amplifiers	
01	MC1741
02	MC1747
03	MLM101A
04	MLM108A
05	MLH2101A*
06	MLH2108A*
07	MLM118*

JAN Part No.**	Motorola Standard Part No.
MIL-M-38510/102 Voltage Regulator	
01	MC1723
MIL-M-38510/103 Voltage Comparators	
01	MC1710
02	MC1711
03	MLM106*
04	MLM111*

JAN Part No.**	Motorola Standard Part No.
MIL-M-38510/104 Line Drivers and Receivers	
01	MC55107
02	MC55108
03	MC9614*
04	MC9615*
05	MC55113*

JAN Part No.**	Motorola Standard Part No.
MIL-M-38510/106 Voltage Follower Operational Amplifiers	
01	MLM102*
02	MLM110
MIL-M-38510/107 Voltage Regulator	
01	MLM109

MEMORIES

JAN Part No.**	Motorola Standard Part No.
MIL-M-38510/201 Programmable Read Only Memories	
01	MCM5303
02	MCM5304

*Not presently being manufactured or planned for immediate introduction.

**JAN type number must be completed as shown in the Part Number Description.

#A draft of MIL-M-38510/060 has been issued. A series of MIL-M-38510 specifications has been reserved for the complete line of MECL devices including flip-flops, decoders, and arithmetic units.

APPLICATION NOTES

The Application Notes listed have been prepared to acquaint the circuits and systems engineer with the broad line of Motorola Semiconductor Products and their applications.

To obtain copies of these notes, simply list the AN number or numbers and send your request on your company letterhead to: Technical Information Center, Motorola Semiconductor Products Inc., P. O. Box 20912, Phoenix, Arizona 85036.

APPLICATION NOTE NUMBER	TITLE
AN-139A	Understanding Transistor Response Parameters
AN-178A	Epicap Tuning Diode Theory and Applications
AN-182	A Method of Predicting Thermal Stability
AN-189	Solid-State Pulse Width Modulation DC Motor Control
AN-204A	The MC1530, MC1531 Integrated Operational Amplifiers
AN-210	FM Modulation Capabilities of Epicap VV C's
AN-211A	Field-Effect Transistors in Theory and Practice
AN-215A	RF Small-Signal Design Using 2-Port Parameters
AN-219	The Field-Effect Transistor in Digital Applications
AN-220	FET's in Chopper and Analog Switching Circuits
AN-221	4-Layer and Current-Limiter Diodes Reduce Circuit Cost and Complexity
AN-222	The ABCs of Solid-State DC to AC Inverters
AN-238	Transistor Mixer Design Using 2-Port Parameters
AN-240	SCR Power Control Fundamentals
AN-245A	An Integrated Core Memory Sense Amplifier
AN-247A	An Integrated Circuit RF-IF Amplifier
AN-248	The MC1533 Monolithic Operational Amplifier
AN-249	Designing Around the Tuning Diode Inductance
AN-261A	Transistor Logarithmic Conversion Using An Operational Amplifier
AN-267	Matching Network Designs with Computer Solutions
AN-268	Pulse Triggering of Radar Modulator SCR's
AN-270	Nanosecond Pulse Handling Techniques In IC Interconnections
AN-273A	More Value Out of Integrated Operational Amplifier Data Sheets
AN-282A	Systemizing RF Power Amplifier Design
AN-290B	Mounting Procedure for, and Thermal Aspects of, Thermopad Plastic Power Devices
AN-293	Theory and Characteristics of the Unijunction Transistor
AN-294	Unijunction Transistor Timers and Oscillators
AN-295	Suppressing RFI in Thyristor Circuits

SEE POPULAR PRO-ELECTRON DEVICES TYPES SECTION 8

APPLICATION NOTE NUMBER	TITLE
AN-298	Noise Immunity With High Threshold Logic
AN-299	An IC Wideband Video Amplifier With AGC
AN-401	The MC1554 One-Watt Monolithic Integrated Circuit Power Amplifier
AN-403	Single Power Supply Operation of IC Op Amps
AN-404	A Wideband Monolithic Video Amplifier
AN-407	A General Purpose IC Differential Output Operational Amplifier
AN-411	The MC1535 Monolithic Dual Op-Amp
AN-413	Unijunction Trigger Circuits for Gated Thyristors
AN-414	Operation and Application of MHTL IC Flip-Flops
AN-415A	Avoiding Second Breakdown
AN-416	One-Step High Order Frequency Multipliers
AN-417A	IC Crystal Controlled Oscillators
AN-418	High Speed Monostable Multivibrator Design With MECL Integrated Circuits
AN-419	UHF Amplifier Design Using Data Sheet Design Curves
AN-421	Semiconductor Noise Figure Considerations
AN-423	Field-Effect Transistor RF Amplifier Design Techniques
AN-426A	Low-Power Audio Amplifiers Using Complementary Plastic Transistors
AN-436	Conventional and Self-Start Dimming of Incandescent Lights
AN-437B	Design Considerations and Performance of Motorola Temperature-Compensated Zener Reference Diodes
AN-439	MC1539 Op-Amp and its Applications
AN-440	Theory and Characteristics of Phototransistors
AN-442	Designing DC-DC Converters for Capacitor Charging With Batteries
AN-443	Directional and Speed Control for Series, Universal and Shunt Motors
AN-445	Pulse-Width Modulation for DC-Motor Speed Control
AN-447	Fast Charging Systems for Ni-Cd Batteries
AN-455	Using the FET Designer Data Sheet for Worst Case Amplifier Circuit Design

APPLICATION NOTE NUMBER	TITLE
AN-459	A Simple Technique for Extending Op-Amp Power Bandwidth
AN-460	Using Transient Response to Determine Operational Amplifier Stability
AN-461	Transient Suppression With a Power Zener Diode.
AN-462	FET Current Regulators – Circuits and Diodes
AN-464	MTTL Designer's Note – The MC4004/MC4005, A 16-Bit Random Access Memory
AN-465	MTTL Designer's Note – The MC4006/MC4007 Decoders
AN-466	Circuit Applications for the Triac
AN-467	Using Motorola High Threshold Logic
AN-469	Line Operated 15-kHz Inverter
AN-470	Bipolar Chopper Transistors and Circuits
AN-471	Analog-to-Digital Conversion Techniques
AN-472	Mounting and Heat Sinking Uniwatt Plastic Transistors
AN-473	A Monolithic High-Power Series Voltage Regulator
AN-474	The MC1541 – A Gated Dual-Channel Sense Amplifier for Core Memories
AN-475	Using the MC1545 – A Monolithic, Gated-Video Amplifier
AN-478A	Small-Signal RF Design With Dual-Gate MOSFETs
AN-481	A Broadband 4-Watt Aircraft Transmitter
AN-482	Electronic Speed Control of Appliance Motors
AN-483B	20 and 30 Watt Power Amplifiers Using Darlington Output Transistors
AN-484A	Medium-Power Audio Amplifiers
AN-485	High-Power Audio Amplifiers With Short-Circuit Protection
AN-488	High-Speed Addition Using Lookahead Carry Techniques
AN-489	Analysis and Basic Operation of the MC1595
AN-491	Gated Video Amplifier Applications, the MC1545
AN-493	The MC3000/MC3100 Series Transistor-Transistor Logic Flip-Flops
AN-496A	Error Detection and Correction Using Exclusive-OR Gates and Parity Trees
AN-498	Voltage and Current Boost Techniques Using the MC1560-61
AN-499	Shutdown Techniques for the MC1560-61/69 Monolithic Voltage Regulators
AN-500	Development, Analysis, and Basic Operation of the MC1560-61 Monolithic Voltage Regulators
AN-504	The MC1600 Series MECL III Gates
AN-505	The MC4012, A MTTL 4-Bit Shift Register
AN-506	Code Conversion With Semiconductor Read Only Memories
AN-507	A 13-Watt Broadband AM Aircraft Transmitter
AN-508	Applications of Phototransistors in Electro-Optic Systems
AN-509	True RMS Voltage Regulators
AN-511	Low Frequency Applications of Field-Effect Transistors
AN-512	Applications of Fast-Recovery Rectifiers
AN-513	A High Gain Integrated Circuit RF-IF Amplifier With Wide Range AGC

APPLICATION NOTE NUMBER	TITLE
AN-517	Improving the Efficiency of Low-Voltage, High-Current Rectification
AN-518	Constant-Speed Motor Control Using Tachometer Feedback
AN-519	Using MDTL Logic Blocks
AN-521	Using Balanced Emitter Transistors in RF Applications
AN-522	The MC1556 Operational Amplifier and its Applications
AN-524	Converting Relay Control Systems to Digital ICs
AN-526	Theory, Characteristics and Applications of Silicon Unilateral and Bilateral Switches
AN-527	Theory, Characteristics and Applications of the Programmable Unijunction Transistor
AN-529	Regulated Line Operated Inverter Uses High Voltage Power Transistors and Hot-Carrier Rectifiers
AN-530A	The MC7491A Eight-Bit Serial Shift Register and the MC7495 Four-Bit Shift Register
AN-531	MC1596 Balanced Modulator
AN-532A	MTTL and MECL Avionics Digital Fequency Synthesize
AN-533	Semiconductors for Plated-Wire Memories
AN-535	Phase-Locked Loop Design Fundamentals
AN-536	Micro-T Packaged Transistors for High-Speed Logic Systems
AN-540	A Synchronously Gated N-Decade Sweep Oscillator
AN-541	Medium Scale Integration in the Numerical Control Field
AN-543	Integrated Circuit IF Amplifiers for AM/FM and FM Radios
AN-544A	Printed Circuit VHF TV Tuners Using Tuning Diodes
AN-545	Television Video IF Amplifier Using Integrated Circuits
AN-546	Solid-State Linear Power Amplifier Design
AN-547	A High-Speed Dual Differential Comparator, the MC151
AN-548A	Microstrip Design Techniques for UHF Amplifiers
AN-549	A Vertical Deflection Circuit Using Complementary Transistors
AN-550	Programming the MCM5003/5004 Programmable Read Only Memory
AN-551	Tuning Diode Design Techniques
AN-552	The Control Engineer's Guide to IC Applications
AN-553	A New Generation of Integrated Avionic Synthesizers
AN-555	Mounting Stripline-Opposed-Emitter (SOE) Transistors
AN-556	Interconnection Techniques for Motorola's MECL 10,000 Series Emitter Coupled Logic
AN-557	Analog-to-Digital Cyclic Converter
AN-559	Simple RAMP A/D Converter
AN-560	Designing Tuned Lines for UHF TV Tuners
AN-561	How to Use Photosensors and Light Sources
AN-563	Hybrid Gain Modules for Use in CATV Trunk and Line Extender Amplifiers
AN-564	An ADF Frequency Synthesizer Utilizing Phase-Locked Looped Integrated Circuits
AN-565	Using Shift Registers as Pulse Delay Networks
AN-566	High-Speed Binary Multiplication Using the MC10181
AN-567	MECL Positive and Negative Logic
AN-568	A Fuse-Thyristor Coordination Primer

APPLICATION NOTE NUMBER	TITLE
AN-569	Transient Thermal Resistance – General Data and Its Use
AN-571	Isolation Techniques Using Optical Couplers
AN-574	CMOS: A New Logic Type for Control Systems
AN-575A	Variable Speed Control System for Induction Motors
AN-576	The Logical Design of Shift Counters
AN-577	Design Techniques for an 80-Watt, 175 MHz Transmitter for 12.5 Volt Operation
AN-578	UHF Microstrip Amplifiers Utilizing G-10 Epoxy-Glass Laminate
AN-579	Testing MECL 10,000 Integrated Logic Circuits
AN-580	Thermal Runaway in High Power Thyristors
AN-581	An MSI 1500-MHz Frequency Counter Using MECL and MTTL
AN-583	A MECL 10,000 Main-Frame Memory System Employing Dynamic MOS RAMs
AN-584	Programmable Counters Using the MC10136 and MC10137 MECL 10,000 Universal Counters
AN-585	VHF Power Amplifiers Using Paralleled Output Transistors
AN-586	Measure Frequency and Propagation Delay With High-Speed MECL Circuits
AN-587	Analysis and Design of the Op-Amp Current Source
AN-588	A 20 kHz, 1 kW Line Operated Inverter
AN-589	Generate Custom Waveforms Digitally
AN-590	Servo Motor Drive Amplifiers
AN-592	AC Noise Immunity of MECL 10,000 Integrated Circuits
AN-593	Broadband Linear Power Amplifiers Using Push-Pull Transistors
AN-594	A Frequency Synthesizer for Aircraft Automatic Direction Finding Systems
AN-595	25-Watt and 10-Watt VHF Marine Band Transmitters
AN-596	A Class D Citizen's Band Transmitter Using Low-Cost Plastic Transistors
AN-597	Power Control Using the Zero Voltage Switch
AN-598A	Four Terminal, Optically Isolated Zero Crossing AC Relay
AN-599	Mounting Techniques for Metal Packaged Power Semiconductors
AN-700	Simulate MECL System Interconnections With A Computer Program
AN-701	Understanding MECL 10,000 DC and AC Data Sheet Specifications
AN-702	High-Speed Digital-To-Analog and Analog-To-Digital Techniques
AN-703	Designing Digitally-Controlled Power Supplies
AN-704	Broadband Network Design for UHF Amplifiers
AN-705	Pulse Width Modulation for Small DC Motor Control
AN-706	A CRT Display System Using NMOS Memories
AN-707	Noise Immunity Comparison of CMOS Versus Popular Bipolar Logic Families
AN-708	Line Driver and Receiver Considerations
AN-709	MECL 10,000 Arithmetic Elements MC10179, MC10180, MC10181

APPLICATION NOTE NUMBER	TITLE
AN-710	Communication System Transmission Losses
AN-711	The Recovery of Recorded Digital Information in Drum, Disk and Tape Systems
AN-712A	Interface Techniques Between Industrial Logic and Power Devices
AN-713	Binary D/S Converters can Provide BCD-Coded Conversion
AN-714	A Personalized Heart-Rate Monitor With Digital Readout
AN-715	Introduction to CMOS IC's With 3-State Outputs
AN-716	Successive Approximation A/D Conversion
AN-717	Battery Powered 5-MHz Frequency Counter
AN-718A	Industrial Clock/Timer Featuring Back-Up Power Supply Operation
AN-719	A New Approach to Switching Regulators
AN-720	Interfacing With MECL 10,000
AN-721	Impedance Matching Networks Applied to RF Power Transistors
AN-312 (European)	
AN-722	Replacing Sequential Logic With ROMs
AN-724	Operational Aspects of Motorola's Data Terminal
AN-725	A Low-Cost 80 V-1.5 A Color TV Power Supply
AN-726	Bussing With MECL 10,000 Integrated Circuits
AN-727	Television Horizontal APC/AFC Loops: The Last 10 Per-Cent
AN-728	13-Watt Microstrip Amplifier for 220-225 MHz Operation
AN-729	A Medium Cost PLL Varactor Tuning System Utilizing Off-the-Shelf Logic
AN-730	A High-Speed FIFO Memory Using the MECL MC10143 Register File
AN-731	Low-Speed Modem Fundamentals
AN-732	A Non-Volatile Microprocessor Memory Using 4K N-Channel MOS RAMs
AN-733	A ROM-Digital Approach to PWM-Type Speed Control of ac Motors
AN-734	SCR Controller for a Series Field dc Motor
AN-735	Solid-State Gas/Smoke Detector System
AN-736	Lead Forming Tool for Plastic Micro-T Devices
AN-737	Switched Mode Power Supplies – Highlighting a 5-V, 40-A Inverter Design
AN-738	NBCD Sign and Magnitude Adder/Subtracter
AN-739	A Synthetic Spectrum Tunign System for TV
AN-740	The Designing on N-Channel 16 x 16-Bit Memory System for the PDP-11
AN-741	Interface Considerations for Numeric Display Systems
AN-742	A 200 MHz Autoranging MECL-McMOS Frequency Counter
AN-743	Five-Digit Accumulator/Elapsed Time Indicator
AN-744	A Phase-Locked Loop Tuning System for Television
AN-746	A 3½-Digit DVM Using An Integrated Circuit Dual Ramp System
AN-747	Low-Speed Modem System Design Using the MC6860
AN-748	Applications of MC1405/MC14435 in Digital Meters
AN-749	Broadband Transformers and Power Combining Techniques for RF
AN-750	A Self-Regulating Horizontal Scan System

APPLICATION NOTE NUMBER	TITLE
AN-751	A Disassociated Intercarrier Television Video IF Amplifier
AN-752	An 80-Watt Switching Regulator for CATV and Industrial Applications
AN-753	Scanning Logic for RF Scanner-Receivers Using CMOS Integrated Circuits
AN-754	Device Operation and System Implementation of the Asynchronous Communications Interface Adapter (MC6850)
AN-755	Solid-State Relays for AC Power Control
*AN-756	Crystal Switching Methods for MC12060/MC12061 Oscillators
*AN-757	Analog-to-Digital Conversion Techniques With the M68(Microprocessor System

*Available Soon.

ENGINEERING BULLETINS SELECTION GUIDE

The Engineering Bulletins listed below have been prepared to acquaint the systems engineer with the broad line of Semiconductor Products and their applications.

To obtain copies of these bulletins, simply list the EB number or numbers and send your request on your company letterhead to: Technical Information Center, Motorola Semiconductor Products Inc., P. O. Box 20912, Phoenix, Arizona 85036.

ENGINEERING BULLETIN NUMBER	TITLE
EB-1	Sensitive Gate Triacs Form IC Alliance – Operate Loads to 4 A – 600 V
EB-4	We Sense A Change in You, Friend . . .
EB-5	Get the Drift, Men . . .
EB-7	Madam! Your Circuit Scheme Shows Symptoms of Triac Inadequacy
EB-8	How to Apply the MHW709/710 UHF Power Modules
EB-10	Scope's Vertical Amplified by New Circuit
EB-11	Scope Sweep is Quick on the Trigger
EB-12	Clock/Timer Controls Time-Dependent Industrial Systems
EB-13	Switching Regulators Head 'Em Off at the Series Pass
EB-14	Simple Linear Voltage Sweep Uses the MC1555 Timer
EB-15	Power Darlington Design Tips
EB-17	Simple VHF Broadband Design Uses CQ Transistor Lineup
EB-18	CQ, Modular Techniques Make 45 Watt UHF Amplifier Practical
EB-19	Controlled-Q RF Technology – What It Means, How it's Done
EB-20	Multiplier/Op-Amp Circuit Detects True RMS
EB-21	DAC Key to Inexpensive 2 2/3 Digit Voltmeter
EB-22	Economical 225 MHz Receiver Front End Employs FETs
EB-23	How to Apply the MHW601/602 VHF Power Modules
EB-24	Input Buffer Circuits for the MC1505 Dual Ramp A-to-D Converter Subsystem
EB-25	Four Building Block Amplifiers for 900 MHz Communications
EB-26	A Metallization System for UHF and Microwave Power Transistors
EB-27	Get 300 Watts PEP Linear Across 2 to 30 MHz From This Push-Pull Amplifier
EB-28	Low-Cost, Easy-to-Build Exciter/Multiplier for 225 MHz FM Transmitters
EB-29	The Common Emitter TO-39 and its Advantages
EB-30	Sensitive Gate SCRs – Don't Forget the Gate Cathode Resistor
EB-31	Performance of the MHW560 Series of CATV Amplifier Modules in 50 Ohm Systems
EB-32	A Complementary Symmetry Amplifier for 2 to 30 MHz SSB Driver Applications
EB-33	Solid-State Gas/Smoke Detector Systems
EB-34	A Low-Cost 18.75 MHz Oscillator-Buffer for FM Transmitters
EB-35	Autopolarity Circuits for the MC1405 Dual-Slope A/D Converter System
EB-36	4 1/2 Digit DVM System Using the MC1505 Dual-Slope Converter
EB-37	Amplifier Gains 10 dB Over Nine Octaves
EB-38	Measuring the Intermodulation Distortion of Linear Amplifiers
EB-39	80-Watt CATV Switching Regulator Useful in Industrial Amplifiers
EB-40	Three CMOS BCD-to-Seven Segment Decoders
EB-41	The LED Circular Timepiece
EB-42	Motorola Field-Effect Liquid Crystal Displays – A Light Look
EB-43	A 9 1/2 Digit Gas Discharge Display System With Leading Zero Suppression
EB-44	An Isolated, Picket-Fence Firing Circuit for High Current SCRs
EB-46	A Single-Device, 80-Watt, 50-Ohm VHF Amplifier
EB-47	Event Counter and Storage Latches for High Frequency High Resolution Counters
EB-48	A Time Base and Control Logic Subsystem for High Frequencies, High Resolution Counters
EB-49	Application Performance of the MC6860 Modem
EB-50	Build This Simple, Battery-Powered 3 1/2 Digit DVM From Standard Parts
EB-51	Successive Approximation BCD A/D Converter
EB-52	Control Your Switching Regulator With the MC3380 Astable Multivibrator
EB-53	Two VHF Highband Gain Blocks Form 20 dB, 30-Watt Amplifier Chain
EB-54	A Simple Line Phase-Reversal Detection Circuit
EB-55	Battery-Powered 3 1/2 Digit Multimeter
EB-56	A Cordless, CMOS Liquid Crystal Display Clock
EB-57	An Economical FM Transmitter Voice Processor from a Single IC
EB-58	Analog Data Acquisition Network for Digital Processing Using the MC1405-MC14435 A/D System

CATALOG INDEX

CATALOG INDEX

A complete index of type numbers in alphanumerical order for instant device identification. Many of the devices are referred by section and page number to more comprehensive tables in this book. Device types that are not referenced are, nevertheless, manufactured and inventoried by Motorola, but are suggested principally for replacement purposes.

SEE POPULAR PRO-ELECTRON
DEVICES TYPES
SECTION 8

POPULAR PRO-ELECTRON DEVICE TYPES

Index

SMALL SIGNAL PLASTIC TRANSISTORS: TO–92

SMALL SIGNAL PLASTIC TRANSISTORS represent MOTOROLA's broadest product line of any package. The TO–92, from R.F./V.H.F./U.H.F. amplifiers, mixers, oscillators and switches to general purpose amplifiers and switches are all available as standard product or custom specials. Also available are special devices for the Industrial, Computer or Consumer Markets.

Before you finalize your next circuit design, consider MOTOROLA's TO–92 Plastic transistors for every possible socket. The following Cross Reference gives you an alphanumeric list of all pro-electron small signal devices, their suggested replacement and the number of the selection table in which the device is further characterized.

GENERAL PURPOSE AMPLIFIER TRANSISTORS – TO 92. TABLE 1

The general purpose transistors are designed for small signal amplification from d.c. to low radio frequencies. They are also useful as oscillators and general purpose switches.

NPN	PNP	BV_{CEO} Volts	P_DmW	$I_C$max mA cont.	h_{FE} min	h_{FE} max	I_C (mA)	V_{CE} (V)	f_T typ MHz	NF max dB	Pin out
BC182	BC212	50	625	100	120	460	2.0	5.0	200	10	CBE
BC182A	BC212A	50	625	100	120	220	2.0	5.0	200	10	"
BC182B	BC212B	50	625	100	180	460	2.0	5.0	200	10	"
BC237	BC307	45	625	100	120	460	2.0	5.0	200	10	"
BC237A	BC307A	45	625	100	120	220	2.0	5.0	200	10	"
BC237B	BC307B	45	625	100	180	460	2.0	5.0	200	10	"
BC237C	BC307C	45	625	100	380	800	2.0	5.0	200	10	"
BC238	BC308	25	625	100	120	800	2.0	5.0	200	10	"
BC238A	BC308A	25	625	100	120	220	2.0	5.0	200	10	"
BC238B	BC308B	25	625	100	180	460	2.0	5.0	200	10	"
BC238C	BC308C	25	625	100	380	800	2.0	5.0	200	10	"
BC239	BC309	45	625	180	180	800	2.0	5.0	240	4	"
BC239A	BC309A	45	625	100	120	220	2.0	5.0	240	4	"
BC239B	BC309B	45	625	100	180	460	2.0	5.0	240	4	"
BC239C	BC309C	45	625	100	380	800	2.0	5.0	240	4	"
*BC347	*BC350	45	625	100	40	450	2.0	5.0	200	8	EBC
*BC347A	*BC350A	45	625	100	110	220	2.0	5.0	200	8	"
*BC347B	*BC350B	45	625	100	200	450	2.0	5.0	200	8	"
*BC348	*BC351	30	625	100	40	450	2.0	5.0	200	8	"
*BC348A	*BC351A	30	625	100	110	220	2.0	5.0	200	8	"
*BC348B	*BC351B	30	625	100	200	450	2.0	5.0	200	8	"
*BC349	*BC352	20	625	100	40	450	2.0	5.0	240	8	"
*BC349A	*BC352A	20	625	100	110	220	2.0	5.0	240	8	"
*BC349B	*BC352B	20	625	100	200	450	2.0	5.0	240	8	"
BC546	BC556	65	625	100	120	450	2.0	5.0	300	10	CBE
BC546A	BC556A	65	625	100	120	220	2.0	5.0	300	10	"
BC546B	BC556B	65	625	100	180	450	2.0	5.0	300	10	"
BC547	BC557	45	625	100	120	450	2.0	5.0	300	10	"
BC547A	BC557A	45	625	100	120	220	2.0	5.0	300	10	"
BC547B	BC557B	45	625	100	180	450	2.0	5.0	300	10	"
BC547C	BC557C	45	625	100	380	800	2.0	5.0	300	10	"
BC548	BC558	30	625	100	120	800	2.0	5.0	300	10	"
BC548A	BC558A	30	625	100	120	220	2.0	5.0	300	10	"
BC548B	BC558B	30	625	100	180	450	2.0	5.0	300	10	"
BC548C	BC558C	30	625	100	380	800	2.0	5.0	300	10	"

* NOT FOR NEW DESIGN

LOW NOISE AND GOOD H_{FE} LINEARITY. TABLE 2

Theses devices are designed to use on applications where good H_{FE} linearity and low noise caracteristics are required: instrumentation, HIFI preamplifier.

NPN	PNP	BV_{CEO} Volts	PD_{mW} 25°C Amb	H_{FE} 10 uA/5V		H_{FE} 2mA/5V		(1) Vt 120 Hz mV		(2) NF db		FT typ MHz
				min.	typ	min.	max	typ	max	typ	max	
BC239	BC309	45	625	–	–	120	800	9.5	–	2	4	240
BC239A	BC309A	45	625	–	90	120	220	9.5	–	2	4	240
BC239B	BC309B	45	625	–	150	180	460	9.5	–	2	4	240
BC239C	BC309C	45	625	–	270	380	800	9.5	–	2	4	240
BC413	BC415	30	625	100	–	180	800	8	12	0.6	2.5	250
BC413B	BC415B	30	625	100	150	180	460	8	12	0.6	2.5	250
BC413C	BC415C	30	625	100	270	380	800	8	12	0.6	2.5	250
BC414	BC416	45	625	100	–	180	800	8	12	0.6	2.5	250
BC414B	BC416B	45	625	100	150	180	460	8	12	0.6	2.5	250
BC414C	BC416C	45	625	100	270	380	800	8	12	0.6	2.5	250
BC549	BC559	30	625	100	–	180	800	8	12	0.6	2.5	250
BC549B	BC559B	30	625	100	150	180	460	8	12	0.6	2.5	250
BC549C	BC559C	30	625	100	270	380	800	8	12	0.6	2.5	250
BC550	BC560	45	625	100	–	180	800	8	12	0.6	2.5	250
BC550B	BC560B	45	625	100	150	180	460	8	12	0.6	2.5	250
BC550C	BC560C	45	625	100	270	380	800	8	12	0.6	2.5	250
MPSA18		45	625	400	500	500	–	7	–	–	1.5	160

(1) VT: total input noise voltage (see application note on BC 413/BC414 and BC415/BC416 data sheet), at Rs = 2 KΩ, IC = 200 μA, V_{CE} = 5 V

(2) NF: noise figure at RS = 2 KΩ, IC = 200 μA, V_{CE} = 5 V and F = 30 Hz to 15 KHz.

HIGH CURRENT AMPLIFIER TRANSISTORS – TO 92 TABLE 3

Useful in low power audio output stages and medium current switches.

NPN	PNP	BV_{CEO} Volts min	P_D mW T_A=25°C	I_C max m.A. cont.	h_{FE} min	h_{FE} max	I_C (mA)	V_{CE} (V)	f_H typ MHz
BC337	BC327	45	625	800	100	600	100	1	210
BC337-16	BC237-16	45	625	800	100	250	100	1	210
BC337-25	BC327-25	45	625	800	160	400	100	1	210
BC337-40		45	625	800	250	600	100	1	210
BC338	BC328	25	625	800	100	600	100	1	210
BC338-16	BC328-16	25	625	800	100	250	100	1	210
BC338-25	BC328-25	25	625	800	160	400	100	1	210
BC338-40		25	625	800	250	600	100	1	210
BC445	BC446	60	625	200	70	–	10	5	250/200(1)
BC447	BC448	80	625	200	70	–	10	5	250/200(1)
BC449	BC450	100	625	200	70	–	10	5	250/200(1)
BC485	BC486	45	625	1000	60	400	100	2	200/150(1)
BC485L	BC486L	45	625	1000	60	150	100	2	200/150(1)
BC485A	BC486A	45	625	1000	100	250	100	2	200/150(1)
BC485B	BC486B	45	625	1000	160	400	100	2	200/150(1)
BC487	BC488	60	625	1000	60	400	100	2	200/150(1)
BC487L	BC488L	60	625	1000	60	150	100	2	200/150(1)
BC487A	BC488A	60	625	1000	100	250	100	2	200/150(1)
BC487B	BC488B	60	625	1000	160	400	100	2	200/150(1)
BC489	BC490	80	625	1000	60	400	100	2	200/150(1)
BC489L	BC490L	80	625	1000	60	150	100	2	200/150(1)
BC489A	BC490A	80	625	1000	100	250	100	2	200/150(1)
BC489B	BC490B	80	625	1000	160	400	100	2	200/150(1)
MPSA05	MPSA55	60	625	500	50		100	1	150/175(1)
MPSA06	MPSA56	80	625	500	50		100	1	150/175(1)

(1) PNP TYP

MPSA05/06 pinning order EBC
All others CBE

HIGH VOLTAGE AMPLIFIER TRANSISTORS – TO 92 – TABLE 4

NPN	PNP	BV_{CEO} Volts	P_{Dmax} T_A=25°C	I_{Cmax} mA cont.	h_{FE} min	h_{FE} I_C (mA)	h_{FE} V_{CE} (V)	C_{re} P_f typ	f_F I_C (mA)	f_F V_{CE} (V)	f_F typ	Pinning
MPSL01	2N5400	120	625	600	50	10	5	3	10	10	160	EBC
2N5550	–	140	625	600	60	10	5	3	10	10	160	EBC
2N5551	–	160	625	600	80	10	5	3	10	10	200	EBC
	2N5401	150	625	600	60	10	5	4	10	10	150	EBC
BF391	MPSA93	200	625	500	40	10	10	1.6	10	60	70	EBC
BF392	–	250	625	500	40	10	10	1.6	10	60	70	EBC
BF393	–	300	625	500	40	10	10	1.6	10	60	70	EBC

All pinning order EBC

INDUSTRIAL TRANSISTORS TO 92 **TABLE 5**

These devices are special products range in tended for use in applications which required well specified performing devices like high quality amplifiers, differential input, driver stages ....

NPN	PNP	BV_{CEO} VOLTS	P_DmW T_A=25°C	$I_C$max mA cont	h_{FE} min	h_{FE} max	I_C (mA)	V_{CE} (V)	f_T typ MHz	NF typ dB	t_{on} typ ns	t_{off} typ ns
BCX25	BCX26	60	625	200	70	400	10	5	250	2	70	1000/600
BCX27	BCX28	80	625	200	70	400	10	5	250	2	70	1000/600
BCX29	BCX30	100	625	200	70	400	10	5	250	2	70	1000/600
BCX45	BCX46	45	625	1000	50	–	100	2	150	2	30	380
BCX47	BCX48	60	625	1000	50	–	100	2	150	2	30	380
BCX49	BCX50	80	625	1000	50	–	100	2	150	2	30	380
BCX58	BCX78	32	625	200	120	630	2	5	250	2	75	600/350
BCX58-7	BCX78-7	32	625	200	120	220	2	5	250	2	75	600/350
BCX58-8	BCX78-8	32	625	200	180	310	2	5	250	2	75	600/350
BCX58-9	BCX78-9	32	625	200	250	460	2	5	250	2	75	600/350
BCX58-10	BCX78-10	32	625	200	380	630	2	5	250	2	75	600/350
BCX59	BCX79	45	625	200	120	630	2	5	250	2	75	600/350
BCX59-7	BCX79-7	45	625	200	120	220	2	5	250	2	75	600/350
BCX59-8	BCX79-8	45	625	200	180	310	2	5	250	2	75	600/350
BCX59-9	BCX79-9	45	625	200	250	460	2	5	250	2	75	600/350
BCX59-10	BCX79-10	45	625	200	380	630	2	5	250	2	75	600/350
BCX73	BCX75	32	625	800	100	630	100	1	210	2	30	250
BCX73-16	BCX75-16	32	625	800	100	250	100	1	210	2	30	250
BCX73-25	BCX75-25	32	625	800	160	400	100	1	210	2	30	250
BCX73-40	–	32	625	800	250	630	100	1	210	2	30	250
BCX74	BCX76	45	625	800	100	630	100	1	210	2	30	250
BCX74-16	BCX76-16	45	625	800	100	250	100	1	210	2	30	250
BCX74-25	BCX76-25	45	625	800	160	400	100	1	210	2	30	250
BCX74-40	–	45	625	800	250	630	100	1	210	2	30	250

All pinning order CBE

RF TRANSISTORS TO 92 TABLE 6

The RF transistors are designed for small signal amplification from RF to UHF – several are also used as mixer and oscillator in the same range at frequencies type are AGC characterised.

AM/FM/IF NPN	PNP	PIN OUT	BV_{CEO} min	P_D max mW	I_C max mA	h_{FE} min	I_C mA	V_{CE} Volt	f_T min MHz	C_{re} C_{rb} pF	Cob pF	PG typ dB	NF dB	f MHz
BF198 +		CEB	30	625	25	27	4	10	800*	.2*			3.0*	35
BF199		CEB	25	625	100	40	7	10	750*	.28*				
BF254		CEB	20	625	100	65	1	10	260*	.95*			1.7*	1
BF241		CEB	40	625	25	35	1	10	400	.34				
BF254-3		CEB	20	625	100	65	1	10	260*	.95*			1.7*	1
BF254-4		CEB	20	625	100	100	1	10	260*	.95*			1.7*	1
BF255		CEB	20	625	100	35	1	10	200*	.95*			1.7*	1
BF255-2		CEB	20	625	100	35	1	10	200*	.95*			1.7*	1
BF255-3		CEB	20	625	100	65	1	10	200*	.95			1.7*	1
BF368		EBC	15	625	50	35	1	10	250	.95*	1.7		4.0	100
BF369		EBC	20	625	50	70	1	10	400	.95*	1.7		4.0	100
BF371		BEC	30	625	100	40	1	10	500	.23*				
BF373		BEC	45	625	100	40	1	10	720*	.32				
BF394•		BEC	30	625	100	65	1	0	80	.9*			1.7*	1
BF394B•		BEC	30	625	100	100	1	10	80	.9*			1.7*	1
BF395•		BEC	30	625	100	35	1	10	80	.9*			1.7*	1
BF395D•		BEC	30	625	100	35	1	10	80	.9*			1.7*	1
BF395C•		BEC	30	625	100	65	1	10	80	.9*			1.7*	1
MPS918		EBC	15	625	100	20	3.0	10	600		1.7	15	6.0	60
MPSH05		EBC	80	625	100	30	1.5	10	180*	1.6			1.7	1
	MPSH54	EBC	80	625	100	30	1.5	10	185*	1.6			2.0	1
V.H.F.														
BF366		EBC	25	625	25	75	3	10	400	.3		30	3.2	100
BF374		BEC	25	625	100	70			800	.6		20	4.0*	100
BF375		BEC	25	625	100	35			800	.6		20	4.0*	100
BF375C		BEC	25	625	100	70			800	.6		20	4.0*	100
BF375D		BEC	25	625	100	35	1	10	800	.6		20	4.0*	100
	BF706	EBC	25	625	50	20	2	10	700	.4	.6*			
	BF709	EBC	30	625	50	20	2.5	10	350	.3		12	3.5*	200
	BF906	EBC	25	625	50	20	2	10	700	.22*	.6*		2.5*	100
U.H.F.														
	BF739 +	EBC	30	625	50	20	2.5	10	600	.3		10	4.2*	850
	BF740	EBC	20	625	50	20	2	10	600	.4	.6*			
MPSH33 +		EBC	30	625	100	20	2.5	10	950	.3		10	6.5	850

* Typical
+ A.G.C. Characteristic

• NOT FOR NEW DESIGN

MEDIUM POWER (UNIWATT) TRANSISTORS TABLE 7

For applications requiring higher power dissipation than that of the standard TO-92 package MOTOROLA has developed the Uniwatt case. In this plastic-encapsulated package, which is slightly larger than the small signal case, the collector is mounted on a metal tab that extends out of the case. With a satisfactory heat sink Uniwatt transistors can dissipate up to 10 Watts. Without a heat sink power dissipation at an ambient of 25 °C is 1.0 Watt.

NPN	PNP	BV_{CEO} Volts min	P_D @ 25°C W Tamb	Tcase	I_C max Amps	h_{FE} min	max	Amps	V_{CE} Volts	V_{CES} max V	f_T min MHz	COB max Pf	@ I_C Amps
BD505	BD506	20	1.0	10	2	60	–	0.25	2	0.7	50	30	1.0
BD507	BD508	30	1.0	10	2	60	–	0.25	2	0.7	50	30	1.0
BD509	BD510	40	1.0	10	2	60	–	0.25	2	0.7	50	30	1.0
BD515	BD516	45	1.0	10	2	60	350	0.15	2	0.5	50	12	0.5
BD517	BD518	60	1.0	10	2	60	350	0.15	2	0.5	50	12	0.5
BD519	BD520	80	1.0	10	2	60	350	0.15	2	0.5	50	12	0.5
BD525	BD526	60	1.0	10	2	60	–	0.05	2	0.5	50	15	0.25
BD527	BD528	80	1.0	10	2	60	–	0.05	2	0.5	50	15	0.25
BD529	BD530	100	1.0	10	2	60	–	0.05	2	0.5	50	15	0.25
BF380		180	1.0	10	0.5	25	–	0.03	10	0.75	90	–	0.03
BF381		250	1.0	10	0.5	25	–	0.03	10	0.75	90	–	0.03
BF382		300	1.0	10	0.5	25	–	0.03	10	0.75	90	–	0.03
MPSU03		120	1.0	10	1.0	40	–	0.01	10	.5	100	12	.05
MPSU04		180	1.0	10	1.0	40	–	0.01	10	.5	100	12	.05

DUOWATT TRANSISTORS TABLE 8

This is a new family developped by MOTOROLA for high power dissipation in free air applications.As the uniwatt the collector is mounted on a metal tab extend to the care, without a heat sink power dissipation of the duowatt at an ambient of 25 °C is 2.0 Watts.

NPN	PNP	BV_{CEO} Volts min	PD @ 25°C W Tamb	Tcase	I_C max Amps	h_{FE} min	max	Amps	V_{CE} Volts	V_{CES} max	f_T min MHz	I_C @ Amps	COB max Pf	Pinning
BD385	BD386	60	2.0	10	1.0	60	–	0.25	1.0	0.5	75	100	18	ECB
BD387	BD388	80	2.0	10	1.0	60	–	0.25	1.0	0.5	75	100	18	"
BD389	BD390	100	2.0	10	1.0	60	–	0.25	1.0	0.5	75	100	18	"
BD411	BD413	40	2.0	10	2.0	25K	150K	0,2	5.0	–	100	200	7	EBC
BD412	BD414	40	2.0	10	2.0	15K	150K	0.2	5.0	–	100	200	7	
BD415	BD416	60	2.0	10	1.0	60	–	0.25	1.0	0.5	75	100	18	
BD417	BD418	80	2.0	10	1.0	60	–	0.25	1.0	0.5	75	100	18	
BD419	BD420	100	2.0	10	1.0	60	–	0.25	1.0	0.5	75	100	18	
BD421	–	100	2.0	10	2.0	15K	–	0.25	5.0	1.0	100	200	15	
BD422	–	80	2.0	10	2.0	15K	–	0.25	5.0	1.0	100	200	15	
BF460	BD463	250	2.0	10	0.5	40	180	0.03	10	0.6	45	10	3.0	
BF461	BD464	300	2.0	10	0.5	40	180	0.03	10	0.6	45	10	3.0	
BF462	BF465	350	2.0	10	0.5	40	180	0.03	10	0.6	45	10	3.0	
BF466	–	150	2.0	10	1.0	40	–	0.1	10	–	100	50	12	
BF467	–	200	2.0	10	1.0	40	–	0.1	10	–	100	50	12	
BF468	–	250	2.0	10	1.0	40	–	0.1	10	–	100	50	12	
BF666	–	150	2.0	10	1.0	40	–	0.1	10	–	100	50	12	FCB
BF667	–	200	2.0	10	1.0	40	–	0.1	10	–	100	50	12	"
BF668	–	250	2.0	10	1.0	40	–	0.1	10	–	100	50	12	"
BF757	BF760	250	2.0	10	0.5	40	180	0.03	10	0.6	45	10	3.0	"
BF758	BF761	300	2.0	10	0.5	40	180	0.03	10	0.6	45	10	3.0	"
BF759	BF762	350	2.0	10	0.5	40	180	0.03	10	0.6	45	10	3.0	"

MEDIUM CURRENT AMPLIFIERS & SWITCHES (TO-39)

DEVICE TYPE	NPN	PNP	V_{CEO} (VDC)	I_C max (mA)	H_{FE}min. AT	I_C (mA)	V_{CE} (Volts)	V_{CE}(Sat) max Volts	AT I_C (mA)	I_B (mA)	$F_T$min AT	I_C (mA)
BFY50	NPN		35	1000	30	150	6	0.2	150	15	60	50
BFY51	NPN		30	1000	40	150	6	0.35	150	15	50	50
BFY52	NPN		20	1000	60	150	6	0.35	150	15	50	50
BSX45	NPN		40	1000	40	100	1	1.0	1000	100	50	50
BSX46	NPN		60	1000	40	100	1	1.0	1000	100	50	50
BSX47	NPN		80	1000	40	100	1	0.9	500	25	50	50
BFX38		PNP	55	1000	85	100	5	0.15	150	15	100	50
BFX39		PNP	55	1000	40	100	5	0.15	150	15	100	50
BFX40		PNP	75	1000	85	100	5	0.15	150	15	100	50
BFX41		PNP	75	1000	40	100	5	0.15	150	15	100	50

VIDEO OUTPUT (TO-39)

DEVICE TYPE	NPN	V_{CEO} (Volts)	I_C max (mA)	H_{FE} AT (min)	I_C (mA)	V_{CE} (Volts)	V_{CE}(Sat) AT (Volts)	I_C (mA)	I_B (mA)	F_T type AT (MHz)	I_C (mA)	COB max (pF)
BF257	NPN	160	100	25	30	10	1	30	6	110	30	5.5
BF258	NPN	250	100	25	30	10	1	30	6	110	30	5.5
BF259	NPN	300	100	25	30	10	1	30	6	110	30	5.5

AUDIO DRIVERS (TO-39)

DEVICE TYPE	NPN	PNP	V_{CEO} (VDC)	I_C max (mA)	H_{FE} AT	I_C (mA)	V_{CE} (VDC)	V_{CE}(Sat) (VDC)	I_C (mA)	I_B (mp)	$F_T$min AT (MHz)	I_C (mA)
BC140	NPN		40	1000	40	100	1	1	1000	100	50	50
BC141	NPN		60	1000	40	100	1	1	1000	100	50	50
BC160		PNP	40	1000	40	100	1	1	1000	100	50	50
BC161		PNP	60	1000	40	100	1	1	1000	100	50	50

NOTE: Exists IH -6-10-16
HFE Groups

GENERAL PURPOSE SWITCHING & AMPLIFIER TRANSISTORS (TO-18)

DEVICE TYPE	PNP	NPN	V_{CEO} (Volts)	I_C max (mA)	H_{FE} min AT	I_C (mA)	V_{CE} (Volts)	V_{CE} Sat (Volts)	I_C (mA)	I_B (mA)	F_T(MHz) —typ. min	I_C (mA)	COMMENTS
BC177	PNP		45	100	70	2	5.0	0.6	100	5	130	10	EXIST VI.A.B. HFE RANGE
BC178	PNP		30	100	70	2	5.0	0.6	100	5	130	10	
BCY77	PNP		60	100	120	2	5.0	0.8	50	1.25	180 –	10	EXIST VII,VIII.IX.A.B. GROUP
BCY78	PNP		32	200	120	2	5.0	0.8	100	2.5	180 –	10	EXIST HFE GROUP VII.VIII.
BCY79	PNP		45	200	120	2	5.0	0.8	100	2.5	180 –	10	IX.X
BSW21	PNP		25	200	75	2	4.5	0.5	50	3	150	10	
BSW21A	PNP		50	200	75	2	4.5	0.5	50	3	150	10	
BSW22	PNP		25	200	180	2	4.5	0.5	50	3	150	10	
BSW22A	PNP		50	200	180	2	4.5	0.5	50	3	150	10	
BC107		NPN	45	100	110	2	5.0	0.6	100	5.	150	10	EXISTS IN A, B, HFE GROUPS
BC108		NPN	20	100	110	2	5.0	0.6	100	5	150	10	EXISTS A, B, and C, HFE GROUPS
BCY58		NPN	32	200	120	2	5.0	0.7	100	2.5	125 (–)	10	EXISTS VII, VIII, IX, X,
BCY59		NPN	45	200	120	2	5.0	0.7	100	2.5	125	10	HFE GROUPS
BCY65E		NPN	60	200	120	2	5.0	0.7	50	1.25	125 (–)	10	EXISTS VII, VIII, IX, HFE
BSX51		NPN	25	200	75	2	4.5	0.3	50	3	150	10	GROUPS
BSX51A		NPN	50	200	75	2	4.5	0.3	50	3	150	10	
BSX51B		NPN	60	200	75	2	4.5	0.3	50	3	150	10	
BSX52		NPN	25	200	180	2	4.5	0.3	50	3	150	10	
BSX52A		NPN	50	200	180	2	4.5	0.3	50	3	150	10	
BSW52B		NPN	60	200	180	2	4.5	0.3	50	3	150	10	

FAST SPEED SWITCHING TRANSISTORS (TO-18)

Device Type	Polarity	V_{CEO} V_{CER} (–) (V)	I_C max	H_{fe} at	I_C (mA)	V_{CE} (V)	V_{CE} max (V)	I_C (mA)	I_B (mA)	T_{on} (ns)	T_S (ns)	T_{off} (ns)	at I_C (mA)	I_{b1} (mA)	I_{b2} (mA)
BSX90	NPN	12	200	20	10	0.35	1.0	100	10	12	–	40	100	40	20
BSX29	PNP	12	200	30	30	0.5	0.5	100	10	60	18	90	30	3	3

LOW NOISE AMPLIFIER

DEVICE TYP	NPN	PNP	V_{CEO} (VDC)	I_C max (mA)	H_{FE} AT min	I_C (mA)	V_{CE} (Volts)	NF AT (DB) max	V_{CE} (VDC)	I_C (mA)	FT AT (MHz) min	I_C (mA)
BC109	NPN		20	30	220	2	5	4	5	0.2	150	10
BC179		PNP	20	100	120	2	5	4	5	0.2	130	10

POWER PLASTIC TRANSISTORS

GENERAL PURPOSE TRANSISTORS – EPIBASE TECHNOLOGY

NPN	PNP	BV_{CEO} Volts	P_D Watts	I_{Cmax} Amps	h_{fe} min	@ I_C Amps	& V_{CE} Volts	V_{CESat} Volts	@ I_C Amps	f_T MHz	Case
BD165	BD166	45	20.0	1.5	15	0.5	2.0	0.50	0.50	6	77
BD167	BD168	60	20.0	1.5	15	0.5	2.0	0.50	0.50	6	77
BD169	BD170	80	20.0	1.5	15	0.5	2.0	0.50	0.50	6	77
BD233	BD234	45	25.0	2.0	25	1.0	2.0	0.6	1.0	3.0	77
BD235	BD236	60	25.0	2.0	25	1.0	2.0	0.6	1.0	3.0	77
BD237	BD238	80	25.0	2.0	25	1.0	2.0	0.6	1.0	3.0	77
BD175	BD176	45	30.0	3.0	15	1.0	2.0	0.8	1.0	3.0	77
BD177	BD178	60	30.0	3.0	15	1.0	2.0	0.8	1.0	3.0	77
BD179	BD180	80	30.0	3.0	15	1.0	2.0	0.8	1.0	3.0	77
BD433	BD434	22	40	4.0	85	0.5	1.0	0.5	2.0	3.0	77
BD435	BD436	32	40	4.0	85	0.5	1.0	0.5	2.0	3.0	77
BD437	BD438	45	40	4.0	85	0.5	1.0	0.7	3.0	3.0	77
BD439	BD440	60	40	4.0	40	0.5	1.0	0.8	3.0	3.0	77
BD441	BD442	80	40	4.0	40	0.5	1.0	0.8	3.0	3.0	77
BD443		100	30	3.0	40	0.5	2.0	0.7	1.0	0.8	77
BD443A		100	30	3.0	40	0.5	2.0	1.2	0.5	0.8	77
BD561	BD562	40	40	4.0	40	2.0	1.0	0.5	1.0	3.0	77
BD575	BD576	45	30.0	3.0	25	1.0	2.0	0.6	1.0	3.0	199
BD577	BD578	60	30.0	3.0	25	1.0	2.0	0.6	1.0	3.0	199
BD579	BD580	80	30.0	3.0	15	1.0	2.0	0.8	1.0	3.0	199
BD581	BD582	100	30.0	3.0	15	1.0	3.0	0.8	1.0	3.0	199
BD185	BD186	30	40.0	4.0	15	2.0	2.0	1.0	2.0	2.0	77
BD187	BD188	45	40.0	4.0	15	2.0	2.0	1.0	2.0	2.0	77
BD189	BD190	60	40.0	4.0	15	2.0	2.0	1.0	2.0	2.0	77
BD585	BD586	45	40.0	3.0	25	2.0	2.0	0.8	2.0	3.0	199
BD587	BD588	60	40.0	4.0	25	2.0	0.8	0.8	2.0	3.0	199
BD589	BD590	80	40.0	4.0	15	2.0	2.0	0.8	2.0	3.0	199
BD591	BD592	100	40.0	4.0	15	2.0	2.0	0.8	2.0	3.0	199
BD195	BD196	30	65.0	6.0	15	3.0	2.0	1.0	3.0	2.0	90
BD197	BD198	45	65.0	6.0	15	3.0	2.0	1.0	3.0	2.0	90
BD199	BD200	60	65.0	6.0	15	3.0	2.0	1.0	3.0	2.0	90
BD595	BD596	45	55.0	8.0	25	3.0	2.0	1.0	3.0	3.0	199
BD597	BD598	60	55.0	8.0	25	3.0	2.0	1.0	3.0	3.0	199
BD599	BD600	80	55.0	8.0	15	3.0	2.0	1.0	3.0	3.0	199
BD601	BD602	100	55.0	8.0	15	3.0	2.0	1.0	3.0	3.0	199
BD205	BD206	45	90.0	10.0	15	4.0	2.0	1.1	4.0	1.5	90
BD207	BD208	60	90.0	10.0	15	4.0	2.0	1.1	4.0	1.5	90
BD605	BD606	45	90.0	10.0	15	4.0	2.0	1.1	4.0	1.5	199
BD607	BD608	60	90.0	10.0	15	4.0	2.0	1.1	4.0	1.5	199
BD609	BD610	90	90.0	10.0	15	4.0	2.0	1.1	4.0	1.5	199

GENERAL PURPOSE DARLINGTONS – EPIBASE TECHNOLOGY

NPN	PNP	BV_{CEO} Volts	P_D Watts	I_{Cmax} Amps	h_{fe} min	@I_C Amps	&V_{CE} Volts	V_{CESat} Volts	@I_C Amps	f_T MHz	Case
BD675	BC676	45	40.0	4.0	750	1.5	3.0	2.5	1.5	1.0	77
BD675A	BD676A	45	40.0	4.0	750	2.0	3.0	2.8	2.0	1.0	77
BD677	BD678	60	40.0	4.0	750	1.5	3.0	2.5	1.5	1.0	77
BD677A	BD678A	60	40.0	4.0	750	2.0	3.0	2.8	2.0	1.0	77
BD679	BD680	80	40.0	4.0	750	1.5	3.0	2.5	1.5	1.0	77
BD679A	BD680A	80	40.0	4.0	750	2.0	3.0	2.8	2.0	1.0	77
BD695	BD696	45	70.0	8.0	750	3.0	3.0	2.5	3.0	1.0	199
BD695A	BD696A	45	70.0	8.0	750	4.0	3.0	2.8	4.0	1.0	199
BD697	BD698	60	70.0	8.0	750	3.0	3.0	2.5	3.0	1.0	199
BD697A	BD698A	60	70.0	8.0	750	4.0	3.0	2.8	4.0	1.0	199
BD699	BD700	80	70.0	8.0	750	3.0	3.0	2.5	3.0	1.0	199
BD699A	BD700A	80	70.0	8.0	750	4.0	3.0	2.8	4.0	1.0	199
BD701	BD702	100	70.0	8.0	750	3.0	3.0	2.5	3.0	1.0	199

HIGH SPEED TRANSISTORS – PLANAR TECHNOLOGY

NPN	PNP	BV_{CEO} Volts	P_D Watts	I_{Cmax} Amps	h_{fe} min	@I_C Amps	&V_{CE} Volts	V_{CESat} Volts	@I_C Amps	f_T MHz	Case
BD361	BD362	20	15	4.0	25	2.0	1	0.8	1.0	40	77
BD361A	BD362A	20	15	4.0	50	2.0	1	0.8	1.0	40	77
BD135	BD136	45	10	1.5	40	0.15	2	0.5	0.5	40	77
BD135-6	BD136-6	45	10	1.5	40	0.15	2	0.5	0.5	40	77
BD135-10	BD136-10	45	10	1.5	63	0.15	2	0.5	0.5	40	77
BD135-16	BD136-16	45	10	1.5	100	0.15	2	0.5	0.5	40	77
BD137	BD137	60	10	1.5	40	0.15	2	0.5	0.5	40	77
BD137-6	BD137-6	60	10	1.5	40	0.15	2	0.5	0.5	40	77
BD137-10	BD137-10	60	10	1.5	63	0.15	2	0.5	0.5	40	77
BD139	BD140	80	10	1.5	40	0.15	2	0.5	0.5	40	77
BD139-6	BD140-6	80	10	1.5	40	0.15	2	0.5	0.5	40	77
BD139-10	BD140-10	80	10	1.5	63	0.15	2	0.5	0.5	40	77
BD785	BD786	45	15	4.0	40	0.2	3	0.6	1.0	40	77
BD787	BD788	60	15	4.0	40	0.2	3	0.6	1.0	40	77
BD789	BD790	80	15	4.0	40	0.2	3	0.5	0.5	40	77
BD791	BD792	100	15	4.0	40	0.2	3	0.5	0.5	40	77

HIGH SPEED DARLINGTONS – PLANAR TECHNOLOGY

NPN	PNP	BV_{CEO} Volts	P_D Watts	I_{Cmax} Amps	h_{fe} min	@I_C Amps	&V_{CE} Volts	V_{CESat} Volts	@I_C Amps	f_T MHz	Case
BD775	BD776	45	15	4	750	2.0	3.0	1.5	2.0	20	77
BD777	BD778	60	15	4	750	2.0	3.0	1.5	2.0	20	77
BD779	BD790	80	15	4	750	2.0	3.0	1.5	2.0	20	77

HIGH VOLTAGE TRANSISTORS – TRIPLE DIFFUSED TECHNOLOGY

NPN	PNP	BV_{CEO} Volts	P_D Watts	I_{Cmax} Amps	h_{fe} min	@I_C Amps	& V_{CE} Volts	V_{CESat} Volts	@I_C Amps	f_T MHz	Case
BD157		250	20.0	0.5	30	0.05	10	0.25*	0.05	10	77
BD158		300	20.0	0.5	30	0.05	10	0.25*	0.05	10	77
BD159		350	20.0	0.5	30	0.05	10	0.25*	0.15	10	77
BD232		300	20.0	1.0	20	0.15	5	1.0	0.15	10	77
BD457		160	12.5	0.1	25	0.03	10	1.0	0.03	40	77
BD458		250	12.5	0.1	25	0.03	10	1.0	0.03	40	77
BD459		300	13.5	0.1	25	0.03	10	1.0	0.03	40	77

POWER METAL TRANSISTORS

GENERAL PURPOSE TRANSISTORS – EPIBASE TECHNOLOGY

NPN	PNP	BV_{CEO} Volts	P_D Watts	I_{Cmax} Amps	h_{fe} min	@I_C Amps	& V_{CE} Volts	V_{CESat} Volts	@I_C Amps	f_T MHz	Case
BD142		40	117	15.0	12.5	4.0	4.0	1.1	4.0	2.0	TO-3
BD311	BD312	60	150	10.0	25.0	5.0	4.0	1.0	5.0	4.0	TO-3
BD313	BD314	80	150	10.0	25.0	4.0	4.0	1.0	5.0	4.0	TO-3
BD315	BD316	80	200	16.0	25.0	8.0	4.0	1.0	8.0	1.0	TO-3
BD317	BD318	100	200	16.0	25.0	5.0	4.0	1.0	8.0	1.0	TO-3
BD364	BD365	50	200	25.0	25.0	7.0	4.0	1.0	10.0	4.0	TO-3
BD366	BD367	60	200	25.0	25.0	7.0	4.0	1.0	10.0	4.0	TO-3
BD368	BD369	80	200	25.0	25.0	7.0	4.0	1.0	10.0	4.0	TO-3
BD342	BD343	40	100	12.0	15.0	3.0	4.0	1.5	4.0	1.5	TO-3
BDX55		45	12	7.0	40.0	2.0	2.0	1.0	5.0	4.0	TO-39
BDX56		60	12	7.0	40.0	2.0	2.0	1.0	5.0	4.0	TO-39
BDX57		80	12	7.0	40.0	2.0	2.0	1.0	5.0	4.0	TO-39

HIGH VOLTAGE TRANSISTORS – TRIPLE DIFFUSED TECHNOLOGY

NPN	PNP	BV_{CEO} Volts	P_D Watts	I_{Cmax} Amps	h_{fe} min	@I_C Amps	& V_{CE} Volts	V_{CESat} Volts	@I_C Amps	f_T MHz	Case
BU126		300	40	6	15.0	1.0	5.0	5.0	4.0	*8.0	TO-3
BU126A		250	40	6	15.0	1.0	5.0	5.0	4.0	*8.0	TO-3
BU205		700	26	3	2.0	2.0	5.0	5.0	2.0	*8.0	TO-3
BU208		700	56	5	2.25	4.5	5.0	5.0	4.5	*7.0	TO-3
BU222		350	100	6	3.0	6.0	2.5	1.5	4.0	*7.5	TO-3
BU222A		425	100	6	3.0	6.0	2.5	1.5	4.0	*7.5	TO-3
BU223		350	125	10	3.3	10.0	2.5	1.5	7.0	*7.5	TO-3
BU223A		425	125	10	3.3	10.0	2.5	1.5	7.0	*7.5	TO-3
BUY29		200	125	8	15.0	3.0	5.0	2.0	3.5	5.0	TO-3
BUY30		250	125	8	15.0	3.0	5.0	2.0	3.5	5.0	TO-3

* Typical

HIGH VOLTAGE DARLINGTONS – TRIPLE DIFFUSED TECHNOLOGY

NPN	PNP	BV_{CEO} Volts	P_D Watts	I_{Cmax} Amps	h_{fe} min	@I_C Amps	& V_{CE} Volts	V_{CESat} Volts	@I_C Amps	f_T MHz	Case
BU322		350	100	7	23	7	2.7	1.7	4.0	7.5	TO-3
BU322A		425	100	7	23	7	2.7	1.7	4.0	7.5	TO-3
BU323		350	125	10	25	10	2.7	1.7	6.0	7.5	TO-3
BU323A		425	125	10	25	10	2.7	1.7	6.0	7.5	TO-3

RF TRANSISTORS

HIGH FREQUENCY TRANSISTORS

NPN	BV_{CEO} min	P_{Dmax} mW	I_C max mA	h_{FE} @ min	I_C mA	& V_{CE} Volts	f_T typ GHz	Ceb max Pf	NF @ dB	f GHz	Package
BFR90	15	180	30	25	14	10	5.0	1.0	2.4	0.5	SOT-2
BFR91	12	180	35	25	30	5	5.0	1.0	1.9	0.5	SOT-2
BFX90	15	200	50	20	25	1	1.8	1.5	5.0	0.5	TO-72
BFX89	15	200	50	20	25	1	1.2	1.7	6.5	0.5	TO-72

ZENER DIODES

ZENER DIODES DO-7

GLASS	DO-35	BZX79B	2.4 – 200V 2%/o tol.	400 mW axial lead
	DO-35	BZX79C	2.4 – 200V 5%/o tol.	400 mW axial lead
PLASTIC	DO- 7	BZY88C	3.3 – 33V 5%/o tol.	10%/o preferred voltage range. 400 mW axial lead
	DO-41	MZD	3.9 – 200 5%/o tol.	1 W axial lead
	DO- 7	MZF	2.7 – 33V 5%/o tol.	10%/o preferred voltage range. 500 mW axial lead

RECTIFIERS

STANDARD RECOVERY RECTIFIERS – CASE 59-04

DEVICES	V_{RRM} (VOLTS)	I_O (AMPS)	I_{FSM} (AMPS)	I_R (μA)	V_F (VOLTS)
BY126	650	1	40	10	1.5
BY127	1250	1	40	10	1.5
BY133	1300	1	50	5	1.3
BY134	600	1	50	5	1.3
BY135	150	1	50	5	1.3
BYX10	1600	0.36	30	1	1.6

CASE OUTLINE
(CASE 59-04)

CASE DIMENSIONS (MM)

SOFT/FAST RECOVERY RECTIFIERS – CASE 59-04

DEVICES	V_{RRM} (VOLTS)	I_O(AMPS)	IFSM (AMPS)	I_R (μA)	V_F (VOLTS)	t_{rr1} (nS)	t_{rr2} (nS)
BA 145	350	0.4	15	2 μA	1.0 V	350 nS	750 nS
BA 148	350	0.4	15	2 μA	1.0 V	450 nS	750 nS
BA 157	400	0.4	15	5 μA	1.3 V	300 nS	
BA 158	600	0.4	15	5 μA	1.3 V	300 nS	
BA 159	1000	0.4	15	5 μA	1.3 V	300 nS	
BY 196	100	1.2	70	10 μA	1.3 V	500 nS	
BY 197	200	1.2	70	10 μA	1.3 V	500 nS	
BY 198	400	1.2	70	10 μA	1.3 V	500 nS	
BY 199	800	1.2	70	10 μA	1.3 V	500 nS	
BY 206	350	0.5	15	2 μA	1.3 V	300 nS	1000 nS
BY 207	600	0.5	15	2 μA	1.3 V	300 nS	1000 nS
BY 210/4	400	1.0	30	10 μA	1.4 V	300 nS	750 nS
BY 210/6	600	1.0	30	10 μA	1.4 V	300 nS	750 nS
BY 210/8	800	1.0	30	10 μA	1.4 V	300 nS	750 nS
BY 330	50	1.0	30	10 μA	1.25 V	500 nS	750 nS
BY 331	100	1.0	40	10 μA	1.25 V	500 nS	750 nS
BY 332	200	1.0	40	10 μA	1.25 V	500 nS	750 nS
BY 333	300	1.0	40	10 μA	1.25 V	500 nS	750 nS
BY 334	400	1.0	40	10 μA	1.25 V	500 nS	750 nS
BY 336	500	1.0	40	10 μA	1.25 V	500 nS	750 nS
BY 337	800	1.0	40	10 μA	1.25 V	500 nS	750 nS
BY 338	1000	1.0	40	10 μA	1.25 V	500 nS	750 nS
BYX 55/350	350	1.2	40	10 μA	1.25 V	350 nS	750 nS
BYX 55/600	600	1.2	40	10 μA	1.25 V	350 nS	750 nS

SOFT/FAST RECOVERY RECTIFIERS – CASE 267-01

DEVICES	V_{RRM}	I_O (AMPS)	I_{FSM} (AMPS)	I_R (μA)	V_F (VOLTS)	T_{rr1} (nS)	T_{rr2} (nS)
BY 296	100	2	70	10	1.3	500	750
BY 297	200	2	70	10	1.3	500	750
BY 298	400	2	70	10	1.3	500	750
BY 299	800	2	70	10	1.3	500	750
MR 910	50	3	100	10	1.25	300	750
MR 911	100	3	100	10	1.25	300	750
MR 912	200	3	100	10	1.25	300	750
MR 913	300	3	100	10	1.25	300	750
MR 914	400	3	100	10	1.25	300	750
MR 916	600	3	100	10	1.25	300	750
MR 917	800	3	100	10	1.25	300	750
MR 918	1000	3	100	10	1.25	300	750

RECTIFIER BRIDGES – SINGLE PHASE FULL-WAVE DEVICES – CASE 309-01

DEVICES	V_{RRM}	I_O (AMPS)	I_{FSM} (AMPS)	I_R (mA)	V_F (VOLTS)
BYW 20	50	15	400	0.5	0.97
BYW 21	100	15	400	0.5	0.97
BYW 22	200	15	400	0.5	0.97
BYW 23	300	15	400	0.5	0.97
BYW 24	400	15	400	0.5	0.97
BYW 26	600	15	400	0.5	0.97
BYW 28	800	15	400	0.5	0.97
BYW 60	50	35	400	0.5	1.07
BYW 61	100	35	400	0.5	1.07
BYW 62	200	35	400	0.5	1.07
BYW 63	300	35	400	0.5	1.07
BYW 64	400	35	400	0.5	1.07
BYW 65	600	35	400	0.5	1.07
BYW 68	800	35	400	0.5	1.07

SPECIAL PURPOSE DIODES

SPECIAL PURPOSE DIODES – CASE 226

	VR	PD mW	IF mA	Brief Spec.	Type Service
BA 382	40	250	–	Rs 0.8Ω @ 4 mA	Pin switching
BB 105	30	250	200	2 – 10 pF Cs/C25	Voltage variable cap
BB 305	35	250	200	2 – 10 pF Cs/C25	Voltage variable cap

LINEAR INTEGRATED CIRCUITS

IF AMPLIFIERS

Type	Description	V_{CC} max	I_{CC} typ	3 dB limiting input signal typ	AM rejection typ	Package
TBA 120 C	FM IF amplifier, limiter, detector and audio preamplifier. Improved DC volume control.	18 V	14 mA	35 μV rms	50 dB	Plastic TO-116 CASE 646
TBA 120 D	FM IF amplifier, limiter, detector. Pin for pin compatible with TBA 120.	18 V	14 mA	35 μV rms	50 dB	Plastic TO-116 CASE 646

COLOR PROCESSORS

Type	Description	V_{CC} max	I_{CC} typ	P_D mW	Package
TBA 396	Luminance and chrominance control system for PAL.	20 V	7 mA	625	Plastic TO-116 CASE 646
TBA 3950	PAL chroma processing system	–	60 mA max	625	Plastic TO-116 CASE 646

STEREO DECODERS

Type	Description	V_{CC}	Channel separation	distortion	Output voltage	Zout	Package
TCA 4500	PLL Stereo decoder. Improved version of MC 1310. Unity or 6 dB gain.	8-18 V	40 dB min	0.1% at 0.5 V rms	1.5 V rms max	200Ω	16 pin Plastic TO-116 CASE 648

TRIAC CONTROL

Type	Description	V_{CC} max	I_{CC} typ	Firing current	Bias current	Output pulse width	Operating temperature	Package
UAA 1004 DP	Zero voltage switch for ON-OFF power control; differential input	20 V	2 mA	80 mA	1μA	100μs	−20° to +75° C	8 pin DIL CASE 626
UAA 1004 CM							−55° to +125° C	8 pin TO-99 CASE 601
UAA 1006 DP	Zero voltage switch for proportional power control; differential input	20 V	3,5 mA	80 mA	0,5μA	programmable	−20° to +75° C	16 pin plastic DIL CASE 648

EUROPEAN MOTOROLA SEMICONDUCTOR SALES OFFICES

Denmark
Motorola A/S
Bredeboej 23
DK-2800 Lyngby
Tel. (01) 88 44 55

France
Motorola Semiconducteurs S.A.
Headquarter
15-17, avenue de Ségur
75007 Paris
Tel. 551 50 61
Sales Office
42, avenue de La Plaine-Fleurie
38240 Meylan (Grenoble)
Tel. (76) 90 61 32

West Germany
Motorola GmbH, Geschäftsbereich Halbleiter
Headquarter
Luisenstrasse 28
6200 Wiesbaden
Tel. (06121) 3 94 91
Sales Office Hannover
Hans-Böckler-Strasse 30
3012 Langenhagen
Tel. (0511) 77 20 37
Sales Office
Fiedlerstrasse 5
8 München 71
Tel. (089) 79 89 38
Sales Office
Virnsbergerstrasse 43
8500 Nürnberg
Tel. (0911) 6 57 61
Sales Office
Stralsunder Strasse 1
7032 Sindelfingen
Tel. (07031) 8 30 74/8 30 75

Holland
Motorola B.V.
Emmalaan 41
Utrecht
Tel. (030) 51 02 07

Italy
Motorola S.p.A.
Headquarter
Via Ciro Menotti 11
20129 Milano
Tel. 738 61 41/2/3
Sales Office
Via Portanova 10
40123 Bologna
Tel. 26 69 05
Sales Office
Via Costantino Maes 68
00162 Roma
Tel. 831 47 46

Norway
Motorola A/B.
Brugt 1
Oslo 1
Tel. (02) 33 18 80

Sweden
Motorola Semiconductor AB.
Virebergsvaegen 19
171 40 Solna
Tel. 82 02 95

Switzerland
Motorola Semiconductor Products S.A.
Alte Landstrasse 101
8702 Zollikon
Tel. (01) 65 56 56

United Kingdom
Motorola Ltd.
Headquarter
York House, Empire Way
Wembley Middlesex
Tel. (01) 902 88 36
Sales Office
10-12, Mount Street, Television House
Manchester M2 5WS, Lancs
Tel. (61) 833 07 31/833 07 34
Sales Office
Colvilles Road, Kelvin Estate
East Kilbride, Scotland
Tel. (3552) 39 101

HEADQUARTERS EUROPEAN OPERATIONS

Switzerland
Motorola Inc.
Semiconductor Products Division
16, chemin de la Voie-Creuse, P.O. Box 8
1211 Genève 20
Tel. (022) 33 56 07

FRANCHISED MOTOROLA SEMICONDUCTOR DISTRIBUTORS

Austria
Elbatex GmbH
Breitenfurterstrasse 318
1235 Wien
Tel. (222) 86 91 58

Belgium
Diode Belgium
Rue Picard 202-204
1020 Bruxelles
Tel. (02) 428 51 05

Denmark
GDS-Henkel ApS
Fyrrevangen 4
4622 Havdrup
Tel. (03) 38 57 16

Eire
GDS (Sales) Limited
36, Pearce Street
Dublin 2
Tel. 78 22 32

Finland
Field Oy
Veneentekijantie 18
00210 Helsinki 21
Tel. (90) 69 22 577

France
Celdis S.A.
53, rue Charles-Frérot
94250 Gentilly
Tel. 581 00 20
Sté F. Feutrier
Rue des Trois-Glorieuses
42270 St-Priest-en-Jarez (St-Etienne)
Tel. (1577) 33 33 89
Ets. Gros S.A.
14, avenue du Général-Leclerc
5400 Nancy
Tel. (1528) 24 24 22/32
Ets. Gros S.A.
13, rue Victor-Hugo
59350 St-André-lez-Lille
Tel. (1620) 55 64 70
S.C.A.I.B. S.A.
31, quai Rambaud
69002 Lyon
Tel. 42 40 92
S.C.A.I.B. S.A.
15-17, avenue de Ségur
75007 Paris
Tel. (01) 555 17 20/555 71 11
S.C.A.I.B. S.A.
14, rue de Brest
35000 Rennes
Tel. (1699) 59 40 91
Sté. Commerciale Toutelectrique
15-17, boulevard Bonrepos
31008 Toulouse
Tel. (1561) 62 47 84

Germany
Celdis GmbH
Orleansplatz 5
8000 München 80
Tel. (089) 45 43 06
Distron oHG
Mecklenburgsche Strasse 24B
1000 Berlin 33
Tel. (030) 82 33 064
EBV Elektronik Vertriebs-GmbH
In der Meineworth 9a
3006 Burgwebel 1/Hannover
Tel. (051) 39 45 70
EBV Elektronik Vertriebs-GmbH
Oststrasse 129
4000 Düsseldorf
Tel. (0211) 8 48 46
EBV Elektronik Vertriebs-GmbH
Myliusstrasse 54
6000 Frankfurt
Tel. (0611) 72 04 16
EBV Elektronik Vertriebs-GmbH
Gabriel-Max-Strasse 72
8000 München 90
Tel. (089) 64 40 55
EBV Elektronik Vertriebs-GmbH
Alexanderstrasse 63
7000 Stuttgart 1
Tel. (0711) 24 74 81/82/83
Jermyn GmbH
Postfach 1146
6277 Camberg
Tel. (06434) 60 05
Jermyn GmbH
Rheinstrasse 7
8000 München 40
Tel. (089) 39 88 01
Mütron Müller & Co KG
Bornstrasse 22
2800 Bremen
Tel. (0421) 31 04 85
RTG, E. Springorum KG
Brennerstrasse 7
4600 Dortmund
Tel. (0231) 57 92 52
RTG, E. Springorum KG
Hamburgerstrasse 134
2000 Hamburg 76
Tel. (040) 29 29 66
RTG, E. Springorum KG
Voltstrasse 35
3000 Hannover-Vahrenwald
Tel. (0511) 66 20 26
RTG, E. Springorum KG
Halleschestrasse 1
6800 Mannheim-Vogelstang
Tel. (0621) 70 88 88
RTG, E. Springorum KG
8000 München 40
Tel. (089) 36 65 00
RTG, E. Springorum KG
Reutlingerstrasse 87
7000 Stuttgart-Degerloch
Tel. (0711) 76 64 28
RTG, E. Springorum KG
Mendelssohn-Bartholdy-Strasse 6
6200 Wiesbaden
Tel. (06121) 52 73 09
SASCO Vertrieb von elektronischen
Bauelementen GmbH
Postfach 3066
4005 Düsseldorf/Meerbusch 3
Tel. (02150) 14 33
SASCO Vertrieb von elektronischen
Bauelementen GmbH
Postfach 890214
3000 Hannover
Tel. (0511) 86 25 86
SASCO Vertrieb von elektronischen
Bauelementen GmbH
Hermann-Oberth-Strasse 16
8011 Putzbrunn b. München
Tel. (089) 46 50 81
SASCO Vertrieb von elektronischen
Bauelementen GmbH
Katharinenstrasse 18
7000 Stuttgart 1
Tel. (0711) 24 45 21
Technoprojekt
Ostring 150
6231 Schwalbach/Ts
Tel. (06196) 8 21 00
Technoprojekt
Heinrich-Ebner-Strasse 13
7000 Stuttgart – Bad Cannstatt
Tel. (0711) 56 17 12

Greece
Macedonian Electronics Ltd.
Pontou 16 - Charibou
Thessaloniki
Tel. 42 60 32

Holland
B.V. Diode
Hollantlaan 22
Utrecht
Tel. (030) 88 42 14

Iran
Milcom LTD, Motorola Building
Niloo Street, Vanak Square
Theran
Tel. 68 12 14/15

Israel
Motorola Israel Ltd.
16, Kremenetzki Street
Tel Aviv
Tel. 36 941/42 – 38 973

Italy
Celdis Italiana S.p.A. (Main Office)
Via Luigi Barzini 20
20125 Milano
Tel. (02) 68 06 81/688 77 49
Celdis Italiana S.p.A.
Via Emilia Ponente 30
40133 Bologna
Tel. (051) 31 08 43
Celdis Italiana S.p.A.
Via Lorenzo il Magnifico 109
00162 Roma
Tel. (06) 42 38 55/427 15 50
Celdis Italiana S.p.A.
Via Montbarcaro 96
10136 Torino
Tel. (11) 35 93 12/36 74 48
Cramer Italia S.p.A.
Via Melchiorre Gioia 74
20125 Milano
Tel. (02) 376 40 39/376 40 95
Cramer Italia S.p.A.
Via Malta 5
40135 Bologna
Tel. (051) 42 28 90
Cramer Italia S.p.A.
Via Cristoforo Colombo 134
00147 Roma
Tel. (06) 513 93 87/90

Norway
Ola Tandberg Elektro S/A
Skedsmogaten 25
Oslo 6
Tel. (02) 19 70 30

Portugal
Equipamentos de Laboratorio LDA
Rua Pedro Nunes 47
Lisbon 1
Tel. 97 02 51

South Africa
Motorola South Africa (Pty) Ltd.
Pretoria Road 639
Bramley 2018
Tel. (002711) 786 11 84

Spain
Hispano Electronica S.A. (Main Office)
Commandante Zorita 8
Madrid 20
Tel. (01) 233 31 00/233 47 00
Hispano Electronica S.A.
Figols, 27-29
Barcelona 14
Tel. 259 05 22/23

Sweden
Interelko AB
Sandsborgsvagen 55
12233 Enskede
Tel. (08) 49 25 05

Switzerland
GDS (Sales) S.A.
3, rue de l'Aubépine
1211 Genève 9
Tel. (022) 21 59 77
GDS (Sales) S.A.
Mühlebachstrasse 54
8008 Zürich
Tel. (01) 47 28 50
Omni Ray AG
Dufourstrasse 56
8008 Zürich
Tel. (01) 34 07 66/47 82 07

Turkey
Altay Kollektif Sirketi
Kizilirmak Sokak 2 Bakanliklar
Ankara
Tel. 25 25 06/07
ERA, Electronic Sanayii Ve Ticaret A.S.
Eski Büyükdere Caddesi 49A, 4 Levent
Istanbul
Tel. 64 65 00/64 65 01

United Kingdom
Celdis Ltd.
37-39 Loverock Road
Reading, Berks, R63, 1ED
Tel. (0734) 58 22 11
Cramer Components Ltd
16, Uxbridge Road
Ealing, London W.5
Tel. (01) 579 30 01
GDS (Sales) Limited
Michaelmas House, Salt Hill, Bath Road
Slough, Bucks
Tel. 753 02 11
Jermyn Distribution
Vestry Estate
Sevenoaks, Kent
Tel. (0732) 5 01 44
Lock Distribution
Division of A.M. Lock & Co. Ltd.
Neville Street
Oldham OL9 6LF, Lancs
Tel. (061) 652 04 31
Semicomps Ltd.
Northfield Industrial Estate, Beresford Avenue
Wembley, Middlesex, HAO, 15D
Tel. (01) 903 31 61

Yugoslavia
Elektrotehna
Karadjardjeva 71
11000 Beograd
Tel. 62 81 55/63 13 55

EUROPEAN SEMICONDUCTOR FACTORIES

United Kingdom
Motorola Semiconductors Ltd.
Colvilles Road, Kelvin Estate
East Kilbride/Glasgow (Scotland)
Tel. (3552) 39 101

France
Motorola Semiconducteurs S.A.
Canto Laouzetto – Le Mirail
31023 Toulouse CEDEX
Tel. (1561) 40 11 88

master selection guide