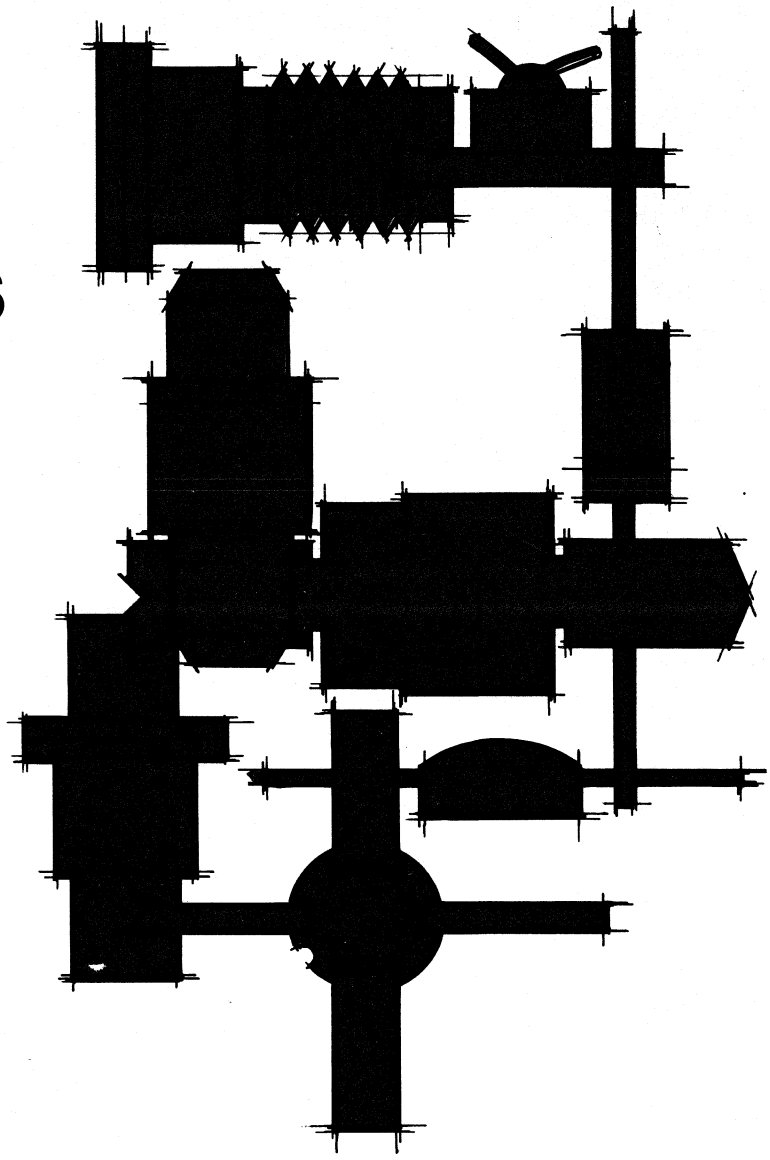
Hewlett Packard Components



Diode and Transistor

Designers Catalog

May 1974

Hewlett-Packard–A Brief Sketch

Hewlett-Packard is one of the world's leading designers and manufacturers of electronic, medical, analytical, and computing instruments and systems, diodes, transistors, and optoelectronic products. From its founding in 1939, the company has conscientiously followed its basic philosophy of offering only products representing significant technological advancements.

To maintain its leadership in instrument and component technology, Hewlett-Packard invests heavily in new product development. Research and development expenditures traditionally average about 10 percent of sales revenue, and 1,500 engineers and scientists are assigned the responsibilities of carrying out the company's various R and D projects. As a result of this effort, about half of the company's current business is represented by products that were not in existence six years ago.

Hewlett-Packard is a well-established, multinational company that has controlled its growth so that expansion is financed generally from income on a pay-as-you-go basis. From its modest beginnings in Palo Alto, California, the company now has ten manufacturing plants in California, two in Colorado, and one each in Massachusetts, New Jersey, and Pennsylvania. Hewlett-Packard overseas manufacturing facilities are located in Scotland, German Federal Republic, France, Japan, Singapore, and Malaysia.

However, for the customer, Hewlett-Packard is no farther away than the nearest telephone. There are 172 HP sales and service offices located in 65 countries around the world.

These field offices are staffed by trained engineers, each of whom has the primary responsibility of providing technical assistance and data to customers. A vast communications network has been established to link each field office with the factories and with corporate offices. No matter what the product or the request, a customer can be accommodated by a single contact with the company.

Hewlett-Packard is guided by a set of written objectives. One of these is "to provide products and services of the greatest possible value to our customers". Through application of advanced technology, efficient manufacturing, and imaginative marketing, it is the customer that the more than 24,000 Hewlett-Packard people strive to serve. Every effort is made to anticipate the customer's needs, to provide the customer with products that will enable more efficient operation, to offer the kind of service and reliability that will merit the customer's highest confidence, and to provide all of this at a reasonable price.

To better serve its many customers' broad spectrum of technological needs, Hewlett-Packard publishes several catalogs. Among these are:

- Electronic Instruments and Systems for Measurement/Computation (General Catalog)
- DC Power Supply Catalog
- Medical Instrumentation Catalog
- Analytical Instruments for Chemistry Catalog
- Coax. and W/G Measurement Accessories Catalog
- Solid State Display and Optoelectronics Catalog

All catalogs are available at no charge from your local HP sales office.

Hewlett-Packard Diodes and Transistors

Over a decade of intensive research, the development of advanced manufacturing techniques and continued expansion has enabled Hewlett-Packard to become a leading supplier of quality, competitively priced RF/Microwave Diodes and Transistors.

In addition to our broad product line, Hewlett-Packard also offers the following services: applications support, special and Q.A. testing and a one year guarantee on all of our products.

Catalog Introduction

This new Diode and Transistor Designer's Catalog contains detailed, up-to-date specifications on our complete product line. It is divided into the following major sections: Transistors, General Purpose Schottky and High Conductance Diodes, Microwave Specified Schottky Diodes, PIN Diodes for Signal Control, Microwave Source Diodes, Devices for Hybrid Integrated Circuits, High Reliability PIN and Schottky Diodes and High Reliability Test Programs.

How To Use This Catalog

For your convenience and easy use of this catalog, we have incorporated three methods for locating components: a Table of Contents that allows you to locate components by their general description, a Numeric Index that lists all components by part number, and a Selection Guide for each product group giving a brief overview of the product line.

How To Order Devices

All of our high quality, competitively priced components may be ordered through any of our Sales and Service Offices listed on page 177 of this catalog.

Hewlett-Packard assumes no responsibility for the use of any circuits described herein and makes no representations or warranties, express or implied, that such circuits are free from patent infringement.

Table of Contents

Numeric Index ii

Microwave Transistors 1
- Selection Guide 2
- General Purpose Transistors 3
- Linear Power Transistors 17
- Low Noise Transistors 23

General Purpose Schottky and High Conductance Diodes 35
- Selection Guide 36
- Schottky Diodes for Fast Switching, RF Mixing and Detecting 37
- High Conductance Diodes for Fast Switching 59

Microwave Specified Schottky Diodes 63
- Selection Guide 64
- Schottky Diodes for Microwave Frequency Conversion 65
- Schottky Diodes for Microwave Signal Detection 77

PIN Diodes for Signal Control 85
- Selection Guide 86
- PIN Diodes for VHF/UHF Switching, Attenuating and Automatic Gain Control 87
- PIN Diodes for Microwave Switching, Attenuating and Limiting 96

Microwave Source Diodes 123
- Selection Guide 124
- IMPATT Diodes for Microwave Oscillators and Amplifiers 125
- Step Recovery Diodes for Comb Generators and Frequency Multipliers 137

Devices for Hybrid Integrated Circuits 141
- Microwave Schottky Diodes 143
- General Purpose Schottky Diodes 143
- Microwave PIN Diodes 143
- VHF/UHF PIN Diodes 143
- Step Recovery Diodes 143

Military Approved PIN and Schottky Diodes 151
- Selection Guide 152
- Schottky Switching Diodes 153
- PIN Switching Diodes 157

High Reliability Test Programs 159
- Selection Guide 160
- Glass Packaged Step Recovery Diodes 161
- Ceramic Packaged Step Recovery Diodes 163
- Ceramic Packaged Microwave Mixer Diodes 165
- PIN RF Resistor Diodes 167
- Ceramic Packaged PIN Diodes. 169
- Hermetic Stripline PIN Diodes 171
- Diode Chips 173

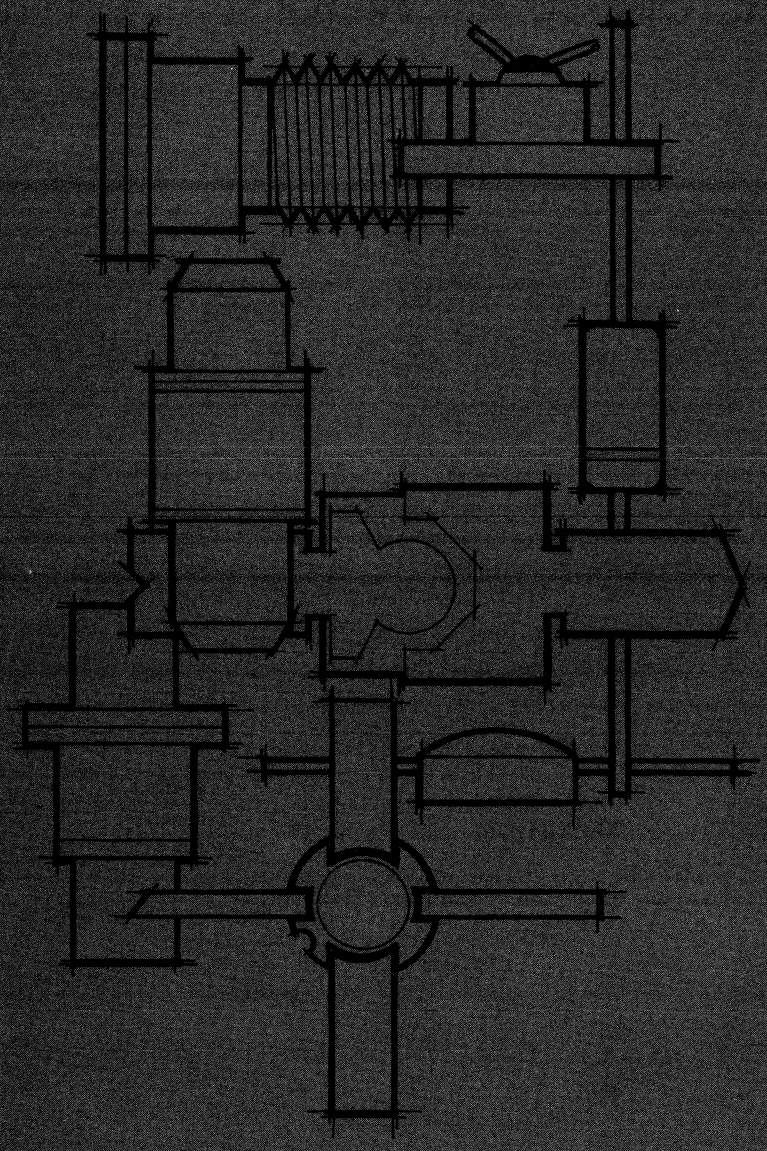
Diode and Transistor Outline Drawings 175

Hewlett-Packard Sales and Service Offices. 177

Application Note Index . . . . . Inside Back Cover

Numeric Index

Commercial Part Number 5082-	Commercial Part Page No.	High Reliability Test Program Page No.
JAN1N5711	153	–
JAN1N5712	155	–
JAN1N5719	157	–
JANTX1N5711	153	–
JANTX1N5712	155	–
JANTX1N5719	157	–
JANTXV1N5711	153	–
JANTXV1N5712	155	–
1N4456	59	–
1N5711	153	–
1N5712	155	–
1N5719	157	–
1N5767	90	–
35820A	3	–
35821B	3	–
35821E	3	–
35822E	3	–
35824A	7	–
35826E	9	–
35827B	13	–
35827E	13	–
35831B Opt. 005	17	–
35831E Opt. 005	17	–
35832B Opt. 005	17	–
35832E Opt. 005	17	–
35850A	19	–
35853B	19	–
35853E	19	–
35854B	19	–
35854E	19	–
35860A	23	–
35861E	23	–
35861E Opt. 100	23	–
35862E	23	–
35862E Opt. 100	23	–
35866E	27	–
35866E Opt. 100	27	–
35867B	31	–
35867E	31	–
0001	143	173
0008	143	173
0009	143	173
0012	143	173
0020	143	173
0023	143	173
0024	143	173
0025	143	173
0029	143	173
0030	143	173
0031	143	173
0034	143	–
0039	143	173
0047	143	–
0049	143	–
0087	143	173
0097	143	173
0112	137	161
0114	137	161
0132	137	163
0151	137	161
0180	137	161
0241	137	163
0243	137	163
0253	137	163
0300	137	163
0303	137	–
0305	143	–
0310	137	163
0316	143	–
0318	143	–
0320	137	163
0335	137	163
0340	143	–
0400	125	–
0401	125	–
0423	129	–
0424	129	–
0425	129	–
0426	129	–
0427	129	–
0431	135	–
0432	135	–
0433	135	–
0434	135	–
0435	135	–
0436	135	–
1001	59	–
1002	59	–
1003	59	–
1004	59	–
1006	59	–
2213	65	–
2214	65	–
2215	65	–
2216	65	–
2217	65	–
2218	65	–
2219	65	–
2220	65	–
2234	73	165
2235	73	165
2276	67	–
2277	67	–
2301	37	–
2302	37	–
2303	37	–
2305	37	–
2306	37	–
2308	37	–
2350	69	–
2351	69	–
2356	37	–
2365	69	–
2370	37	–
2396	37	–
2400	69	–
2401	69	–
2418	69	–
2520	69	–
2521	69	–
2550	69	–
2551	69	–
2565	69	–
2566	69	–
2701	73	165
2702	73	165
2703	73	165
2705	143	–
2706	73	165
2707	73	165
2708	73	165
2709	77,143	–
2710	143	–
2711	73	165
2712	73	165
2713	73	165
2714	73	165
2716	77,143	–
2721	73	165
2722	73	165
2723	73	165
2724	73	165
2750	81	–
2751	81	–
2753	143	–
2754	143	–
2755	81	–
2767	77,143	–
2768	77,143	–
2769	77,143	–
2787	81	–
2800	41	–
2801	143	–
2802	143	–
2804	41	–
2805	41	–
2810	41	–
2811	41	–
2813	41	–
2814	41	–
2815	41	–
2817	47	–
2818	47	–
2819	47	–
2824	47	–
2825	47	–
2826	41	–
2830	51	–
2835	53	–
2837	55,143	–
2844	143	–
2845	143	–
2900	57	–
2912	57	–
2970	57	–
2996	57	–
2997	57	–
3000	143	–
3001	96	–
3002	96	–
3003	99	167
3004	99	167
3005	143	–
3010	143	–
3039	96	–
3040	107	–
3041	107	–
3042	96	–
3043	96	–
3045	143	–
3046	107	–
3071	116	–
3077	92	–
3080	87	167
3081	87	167
3085	143	–
3086	143	–
3101	103	169
3102	103	169
3140	112	171
3141	112	171
3168	94	–
3170	112	171
3188	94	–
3201	103	169
3202	103	169
3258	118,143	–
3259	118,143	–
3301	103	169
3302	103	169
3303	103	169
3304	103	169
3305	120	169
3306	120	169
3309	143	–
3340	107	–

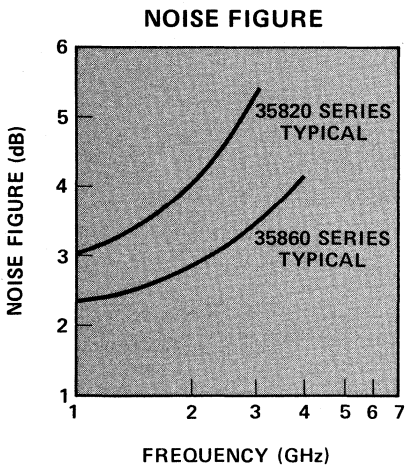


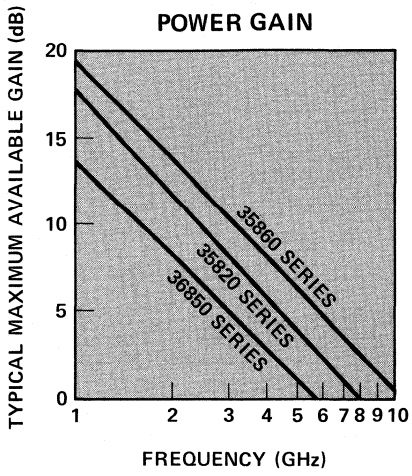
Microwave Transistors

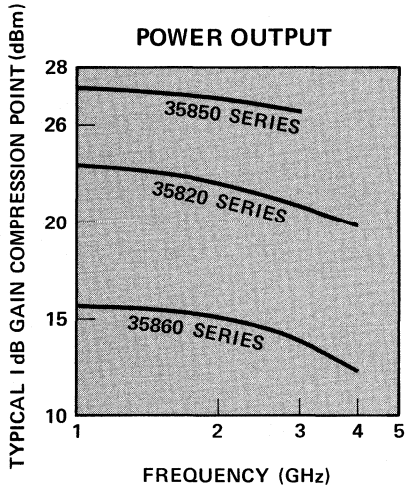
Selection Guide	2
General Purpose Transistors	3
Linear Power Transistors	17
Low Noise Transistors	23

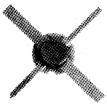
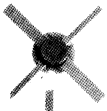
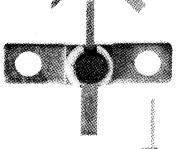
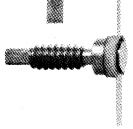
Microwave Transistors

TYPICAL PERFORMANCE CURVES







PACKAGE SELECTION		SERIES SELECTION							
		Low Noise Transistors 35860 Series		General Purpose Transistors 35820 Series		Linear Power Transistors			
						35850 Series		35830 Series	
		Part No.	Page	Part No.	Page	Part No.	Page	Part No.	Page
	CHIPS	35860A (1 Chip)	23	35820A (1 Chip)	3	35850A (1 Chip)	19		
	TO-72			35824A	7				
	HPAC-70	35862E 35862E (Opt. 100)	23	35822E	3				
	HPAC-100	35866E 35866E (Opt. 100)	27	35826E	9				
	HPAC-200	35861E 35861E (Opt. 100)	23	35821B 35821E	3			35831B (Opt. 005) 35831E (Opt. 005)	17
	HPAC-200S							35832B (Opt. 005) 35832E (Opt. 005)	17
	HPAC-200GB					35853B 35853E	19		
	HPAC-200GS					35854B 35854E	19		
	COAX	35867B 35867E	31	35827B 35827E	13				

Note: B suffix indicates common base package configuration, E indicates common emitter.

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COMPONENTS

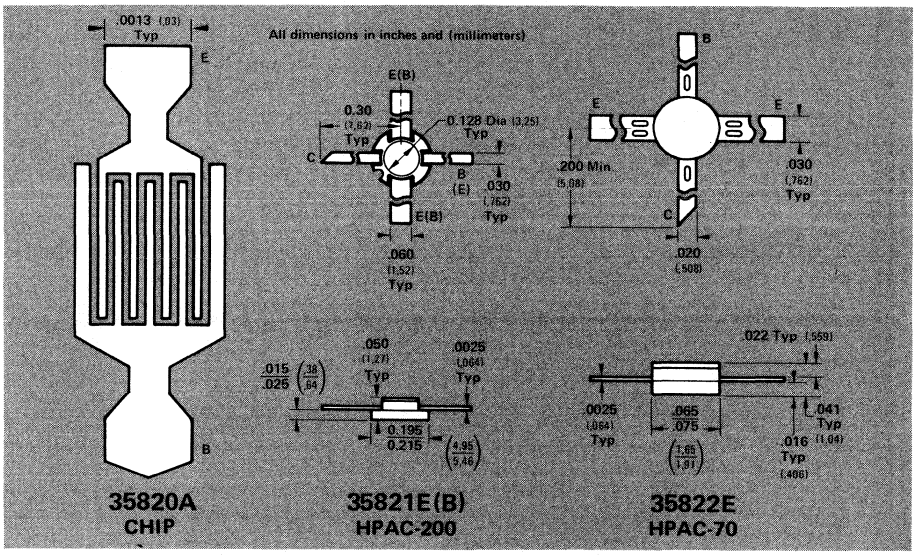
MICROWAVE TRANSISTOR

MODELS

35820A
35821B
35821E
35822E

Features

- USABLE TO 5 GHz
- LOW NOISE FIGURE
  2.3 dB TYPICAL
  AT 1 GHz



35820A CHIP

35821E(B) HPAC-200

35822E HPAC-70

Description

The 35820A, 35821B/E, and 35822E are small signal NPN silicon bipolar transistors. Available both in chip form and in stripline packages, they are usable up to 5 GHz. The 35820A is defined as one unpackaged chip. The 35821B (common base version) and the 35821E (common emitter version) are packaged in the HPAC-200, and the 35822E (common emitter) is packaged in the HPAC-70.

Electrical Specifications $T_A = 25°C$

			35820A, 35821B			35821E, 35822E		
Symbols	Parameters and Test Conditions	Units	Min.	Typ.	Max.	Min.	Typ.	Max.
BV_{CBO}	Collector-Base Breakdown Voltage at $I_C = 100\mu A$	Volts	27	35		27	35	
BV_{CEO}	Collector-Emitter Breakdown Voltage at $I_C = 500\mu A$	Volts	20	25		20	25	
I_{CBO}	Collector Cutoff Current at $V_{CB} = 15V$	μA			10			10.
h_{FE}	Forward Current Transfer Ratio at $V_{CE} = 15V$, $I_C = 15$ mA		15	40	125	15	40	125
$\|S_{21E}\|^2$	Transducer Power Gain at $V_{CE} = 15V$, $I_C = 15$ mA f=1GHz f=2GHz f=4GHz	dB dB dB				 6.0	13.0 7.0 1.0	
G_a(MAX)	Maximum Available Gain at $V_{CE} = 15V$, $I_C = 15$ mA f=1GHz f=2GHz f=4GHz	dB dB dB					18.0 12.0 6.0	
F_{min}	Minimum Noise Figure at $V_{CE} = 10V$, $I_C = 5$ mA f=0.5 GHz f=1GHz f=2GHz	dB dB dB					1.9 2.3 3.8	

Note: All DC tests performed per MIL-STD-750.

Absolute Maximum Ratings

Symbols	Parameters	Limits
V_{CBO}	Collector to Base Voltage*	27V
V_{CEO}	Collector to Emitter Voltage*	20V
V_{EBO}	Emitter to Base Voltage*	1.5V
I_C	DC Collector Current*	35mA
P_T	Total Power Dissipation*	
	35821B/E	700mW
	35822E	375mW
T_J	Junction Temperature	175°C
T_{STG}	Storage Temperature	−65°C to +200°C
θ_{JC}	Thermal Resistance (junction to case)	
	35821B/E	70°C/W
	35822E	400°C/W
T_C	Operating Case Temperature	See Fig. 1
	Lead Temperature (Soldering, 10 seconds each lead)	+250°C

*Case Temperature = 25°C

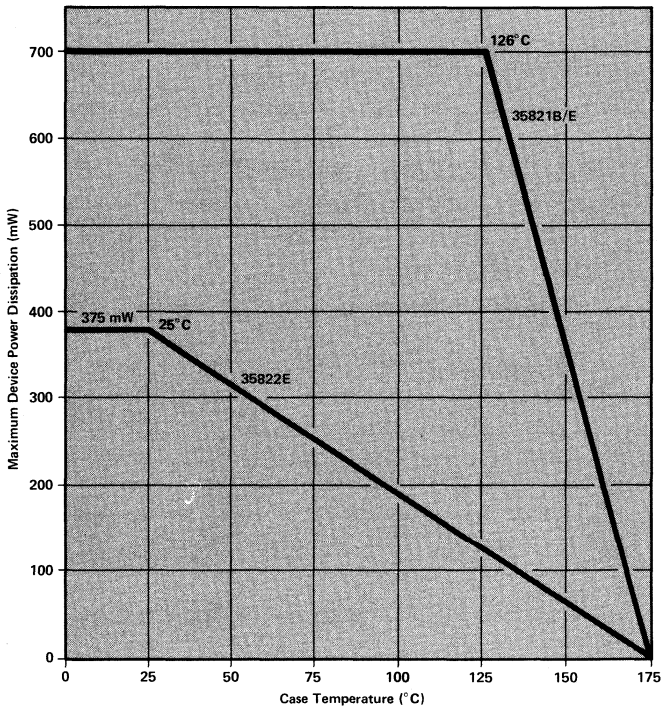


Figure1. Power Derating Curve.

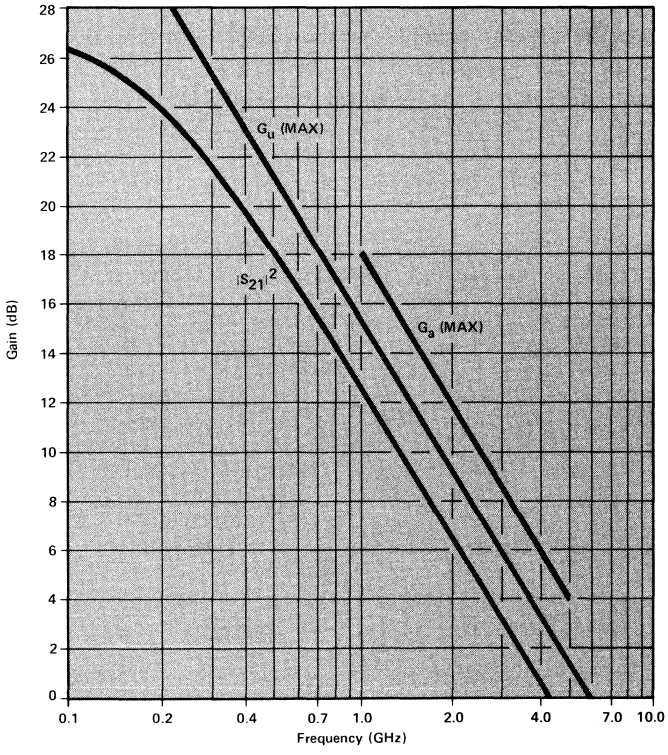


Figure 2. Typical Gain vs. Frequency Data for the 35821E and 35822E for V_{CE} = 15V, I_C = 15 mA.

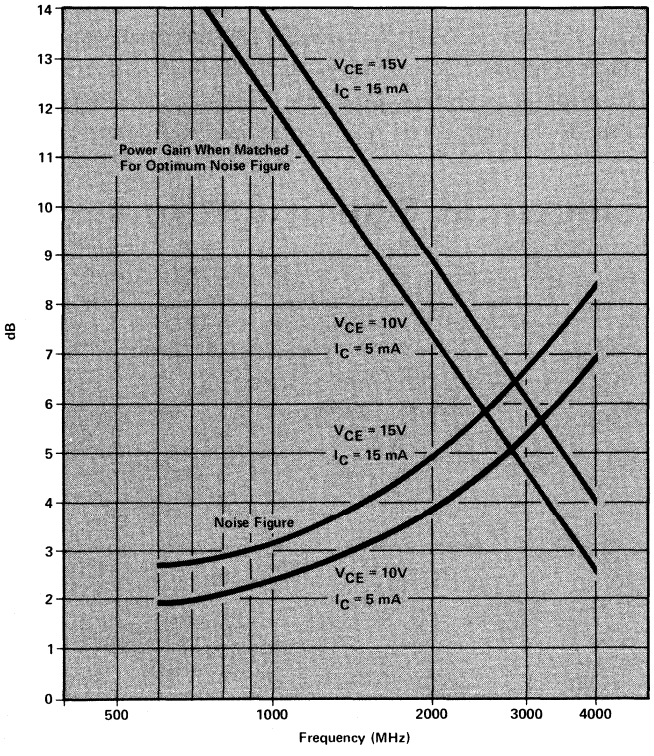


Figure 3. Typical Noise Figure and Associated Power Gain vs. Frequency for Two Different Bias Conditions for the 35821E and 35822E.

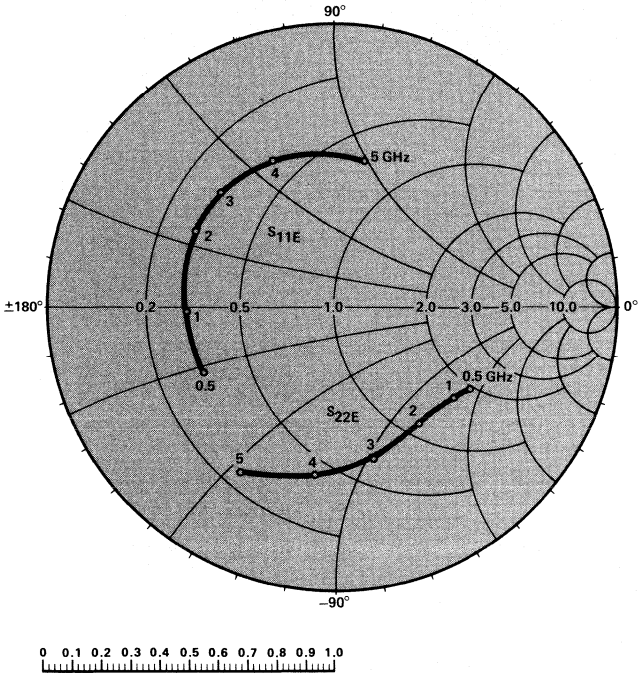


Figure 4. Typical S_{11} and S_{22} vs. Frequency for the 35821E for V_{CE} = 15V, I_C = 15 mA.

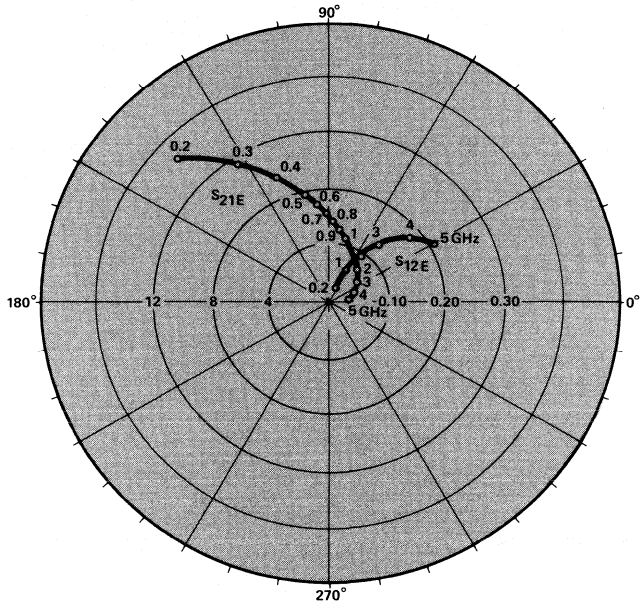


Figure 5. Typical S_{21} and S_{12} vs. Frequency for the 35821E for V_{CE} = 15V, I_C = 15 mA.

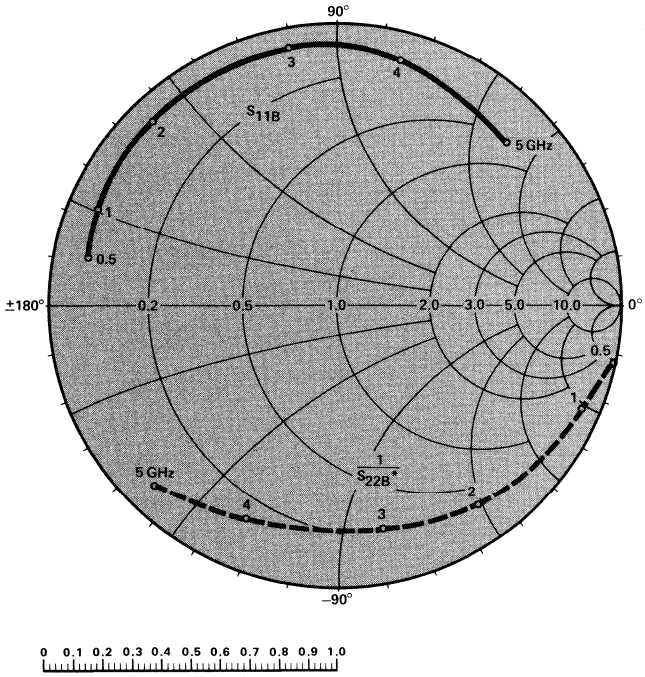


Figure 6. Typical S_{11} and S_{22} vs. Frequency for the 35821B for V_{CB} = 15V, I_C = 15 mA.

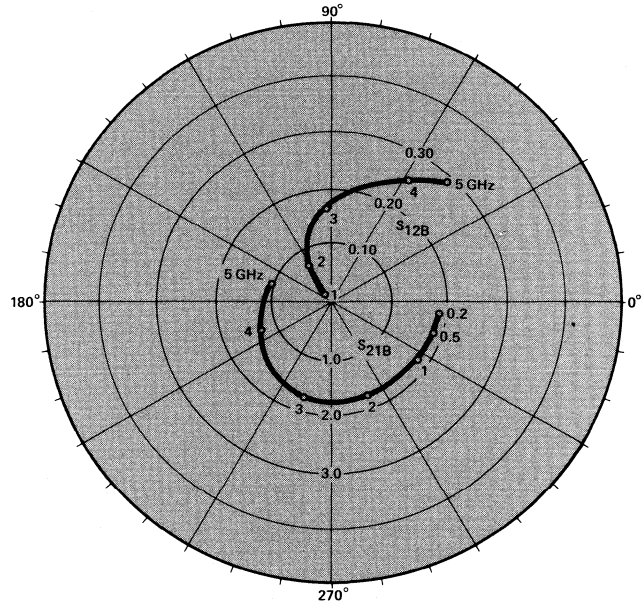


Figure 7. Typical S_{21} and S_{12} vs. Frequency for the 35821B for V_{CB} = 15V, I_C = 15 mA.

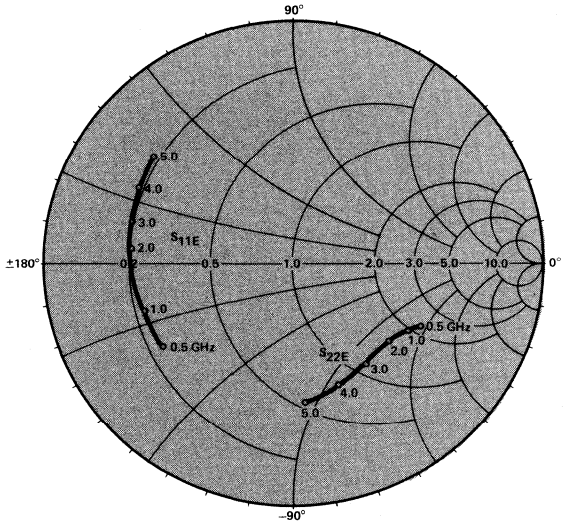


Figure 8. Typical S_{11} and S_{22} vs. Frequency for the 35822E for V_{CE} = 15V, I_C = 15 mA.

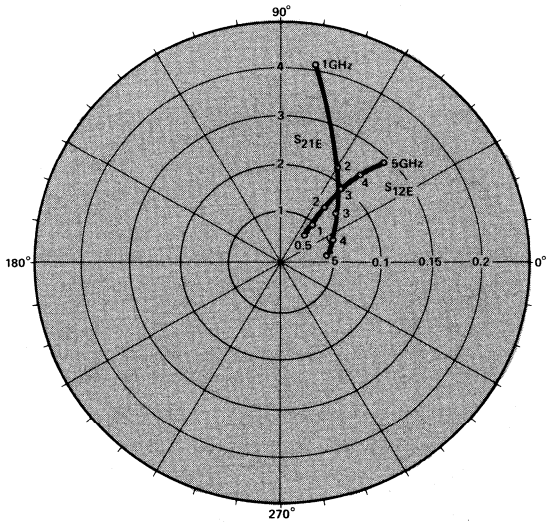


Figure 9. Typical S_{21} and S_{12} vs. Frequency for the 35822E for V_{CE} = 15V, I_C = 15 mA.

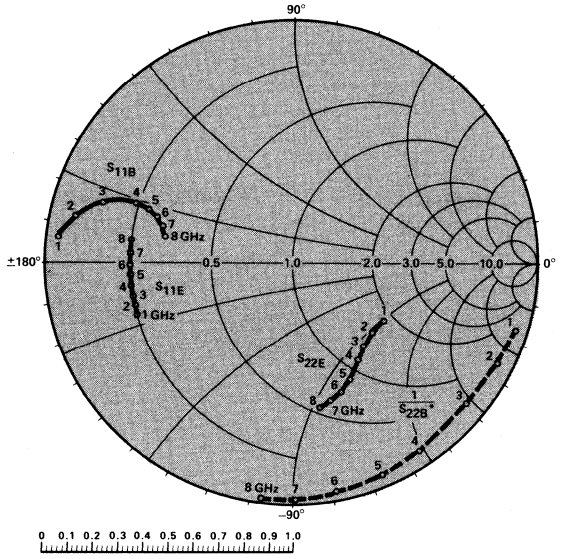


Figure 10. Typical S_{11} and S_{22} vs. Frequency for the 35820A for V_{CB} = 15V, I_c = 15 mA.

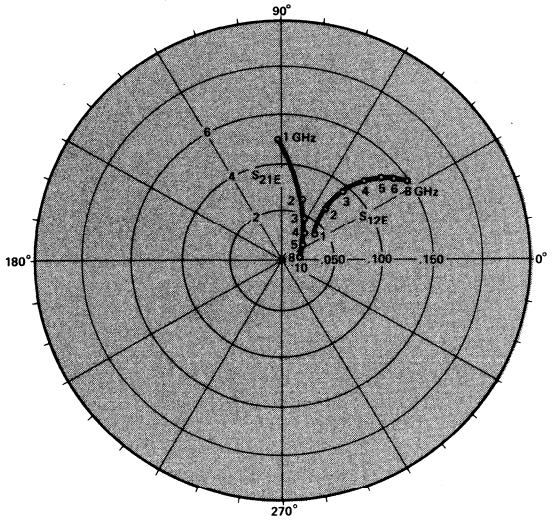


Figure 11. Typical S_{21} and S_{12} vs. Frequency for the 35820A (Common Emitter Configuration) for V_{CB} = 15V, I_C = 15 mA.

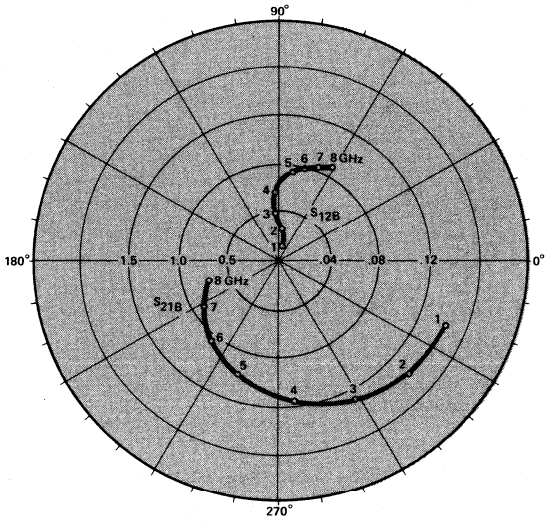


Figure 12. Typical S_{21} and S_{12} vs. Frequency for the 35820A (Common Base Configuration) for V_{CB} = 15V, I_C = 15 mA.

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HIGH FREQUENCY TRANSISTOR

MODEL 35824A

Description

The 35824A, small signal silicon NPN transistor, expands the package flexibility of the HP 21 series transistor. The combination of this high performance but low cost chip in the inexpensive TO-72 Package offers an excellent device in the 100 to 2000 MHz band. It can provide 100 mW linear power out with 12 dB gain at 1 GHz; saturated power out equals 250 mW. The 35824A is an inexpensive and versatile transistor for use in both oscillator or amplifier circuits.

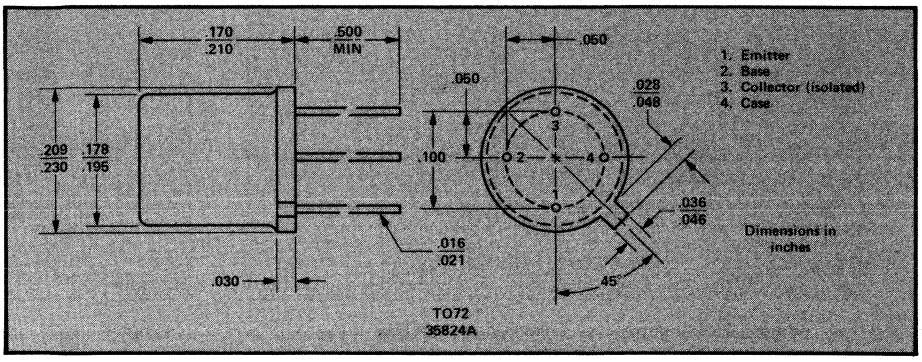


Figure 1. Outline Drawing.

Absolute Maximum Ratings (CASE TEMPERATURE = 25°C)

Symbols	Parameters	Limits
V_{CBO}	Collector to Base Voltage	25 V
V_{CEO}	Collector to Emitter Voltage	20 V
V_{EBO}	Emitter to Base Voltage	3.0 V
I_c	Collector Current	35 mA
T_j	Operating Junction Temperature	175°C
T_{STG}	Storage Temperature	−65°C to +200°C
P_t	Total DC Device Dissipation	400 mW
θ_j	Thermal Resistance (Junction to Ambient)	375°C/W

Outline Drawing Tabulations

Inches	Millimeters	Inches	Millimeters
0.016	0.41	0.100	2.54
0.021	0.53	0.170	4.32
0.028	0.71	0.178	4.52
0.030	0.76	0.195	4.95
0.036	0.91	0.209	5.31
0.046	1.17	0.210	5.33
0.048	1.22	0.230	5.84
0.050	1.27	0.500	12.70

Electrical (CASE TEMPERATURE = 25°C)

Symbols	Parameter and Test Conditions	Units	Min	Typ	Max
BV_{CBO}	Collector-Base breakdown voltage at $I_C = 0.1$ mA, $I_E = 0$	V	25		
I_{EBO}	Emitter Cutoff current at $V_{EB} = 2.0$ V, $I_C = 0$	μA			10
BV_{CEO}	Collector-Emitter breakdown voltage at $I_C = 0.5$ mA, $I_B = 0$	V	20	25	
I_{CBO}	Collector Cutoff current at $V_{CB} = 10$ V, $I_E = 0$	μA			20
h_{fe}	Forward Current transfer ratio at $V_{CE} = 15$ V, $I_B = 0.15$ mA		15	25	125
f_{max}	Frequency at which G_a (max) = 0 dB, $V_{CB} = 15$ V, $I_C = 15$ mA	GHz		4	
f_s	Frequency at which $\|S_{21}\|^2 = 0$ dBm at $V_{CB} = 15$ V, $I_C = 15$ mA	GHz		3	
NF_1 NF_2	Noise Figure (common emitter) at $V_{CB} = 10$ V, $I_C = 5$ mA, $f_1 = 0.5$ GHz, $f_2 = 1$ GHz	dB dB		2.8 3.0	

NOTE: All DC tests performed per MIL-STD-750

Typical Performance Curves

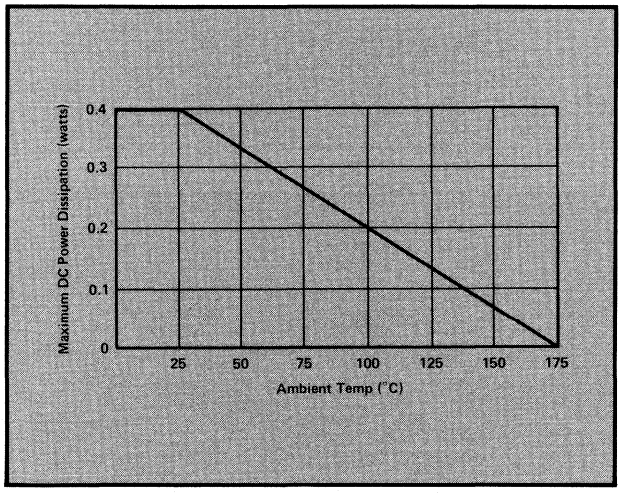


Figure 2. DC Power vs. Temperature Derating Curve.

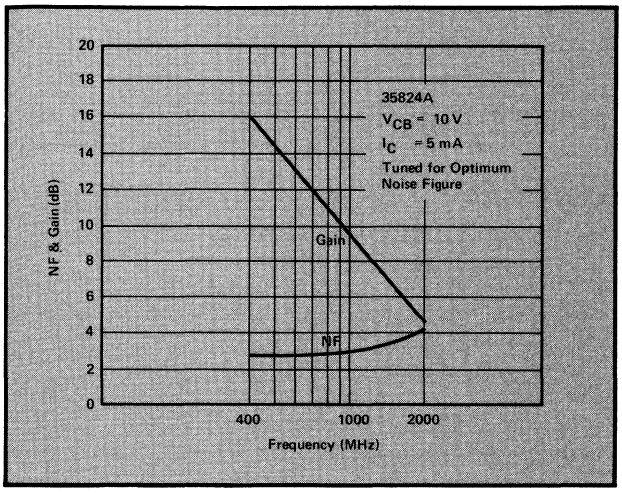


Figure 3. Noise Figure (and Gain) vs. Frequency at Optimum Bias.

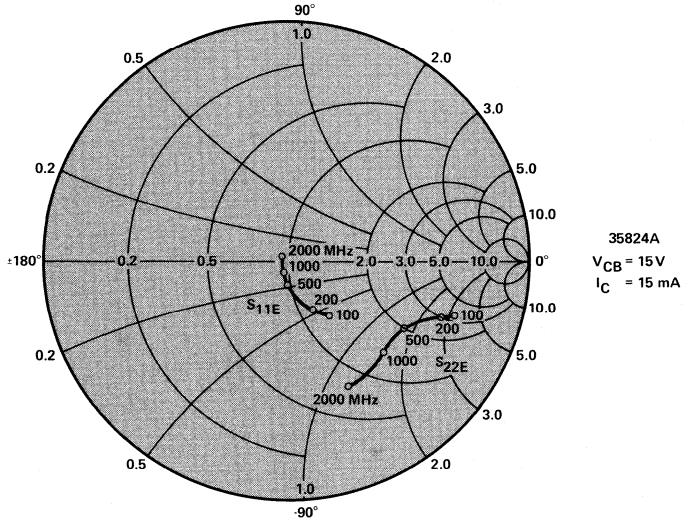


Figure 4. Common Emitter Input and Output Reflection Coefficients.

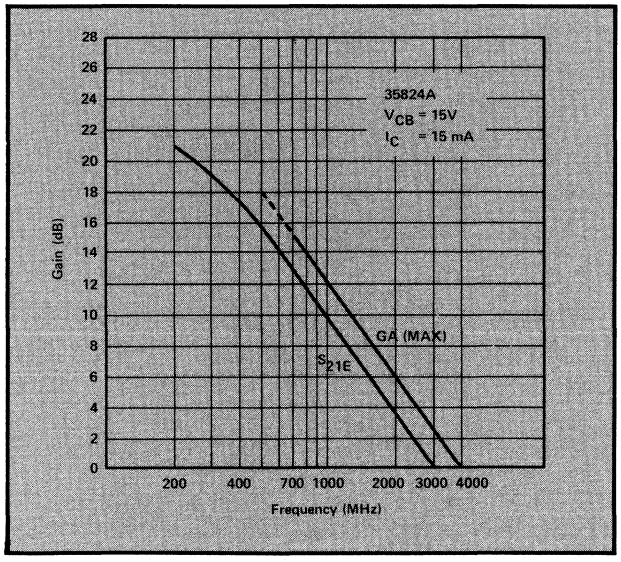


Figure 5. Gain vs. Frequency at Optimum Bias.

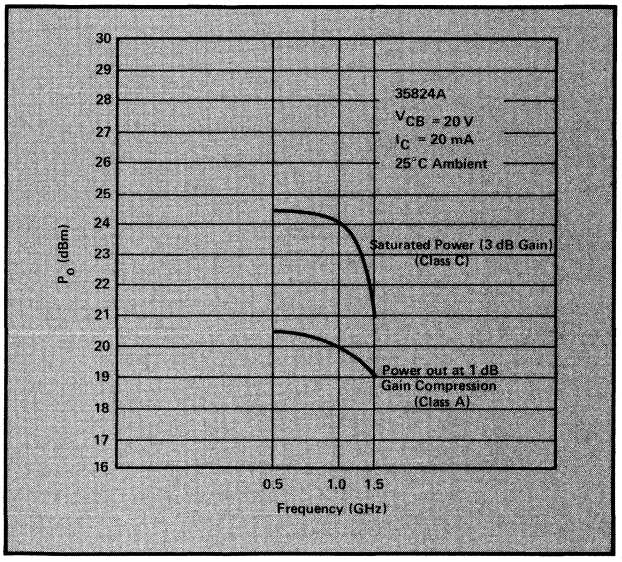


Figure 6. Power Out vs. Frequency at Optimum Bias.

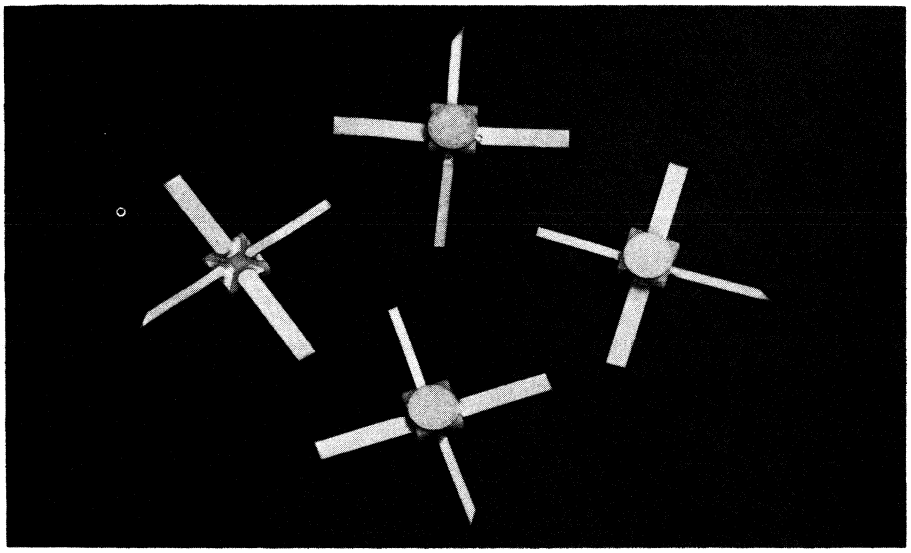
HEWLETT hp PACKARD
COMPONENTS

Microwave Transistor

MODEL
35826E

Features

- USABLE TO 5 GHz
- RUGGED HERMETIC PACKAGE



Description

The HP 35826E is a small signal NPN silicon bipolar transistor. With f_{max} = 8 GHz, the device is usable up to 5 GHz. It is available in the HPAC-100, a rugged metal ceramic hermetic package.

Applications

The HP 35826E is designed for low noise and general purpose amplifier applications. Preconditioning and screening tests are recommended for devices terminating in high reliability applications. The HP 35826E is capable of meeting the appropriate environmental requirements of MIL-S-19500 and the test requirements of MIL-STD-750/883.

Electrical Specifications T_A = 25°C

Symbols	Parameters and Test Conditions		Units	Min.	Typ.	Max.
BV_{CBO}	Collector-Base Breakdown Voltage at I_C = 100 μA		Volts	27	35	
BV_{CEO}	Collector-Emitter Breakdown Voltage at I_C = 500 μA		Volts	20	25	
I_{CBO}	Collector Cutoff Current at V_{CB} = 15 V		μA			10
h_{FE}	Forward Current Transfer Ratio at V_{CE} = 15 V, I_C = 15 mA			15		125
$\|S_{21E}\|^2$	Transducer Power Gain at V_{CE} = 15V, I_C = 15 mA	f = 1GHz	dB		13.0	
		f = 2GHz	dB	6.0	7.0	
		f = 4GHz	dB		1.0	
G_a(MAX)	Maximum Available Gain at V_{CE} = 15 V, I_C = 15 mA	f = 1GHz	dB		18.0	
		f = 2GHz	dB		12.0	
		f = 4GHz	dB		6.0	
F_{min}	Minimum Noise Figure at V_{CE} = 10 V, I_C = 5 mA	f = 0.5GHz	dB		1.9	
		f = 1GHz	dB		2.3	
		f = 2GHz	dB		3.8	

Note: All DC tests performed per MIL-STD-750.

Absolute Maximum Ratings

Case Temperature = 25°C

Symbols	Parameters	Limits
V_{CBO}	Collector to Base Voltage	27V
V_{CEO}	Collector to Emitter Voltage	20V
V_{EBO}	Emitter to Base Voltage	1.5V
I_C	DC Collector Current	35mA
P_T	Total Power Dissipation	700mW
T_J	Junction Temperature	175°C
T_{STG}	Storage Temperature	−65°C to +200°C
θ_{JC}	Thermal Resistance (Junction to Case)	150°C/Watt
—	Hermeticity	$5x10^{-8}$cc/sec of He
T_C	Operating Case Temperature	See Figure 1
—	Lead Temperature (Soldering, 10 seconds each lead)	+250°C

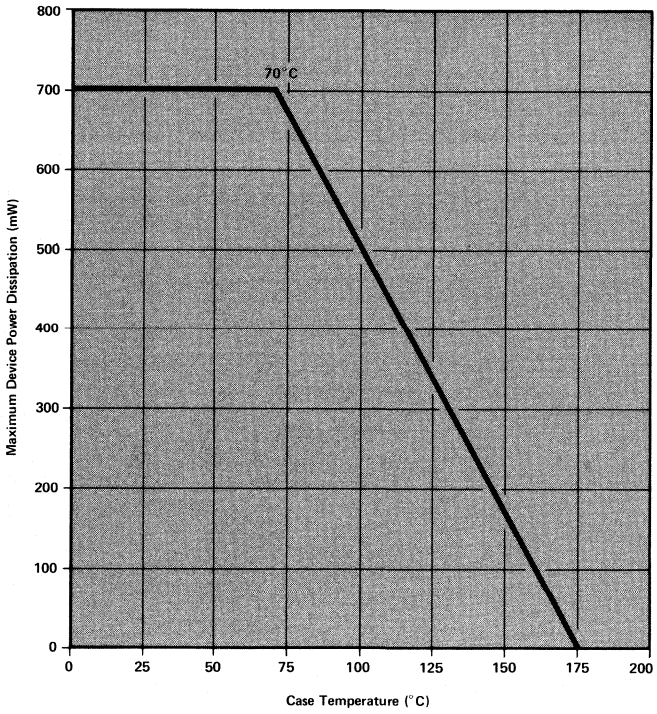


Figure 1. Power Derating Curve.

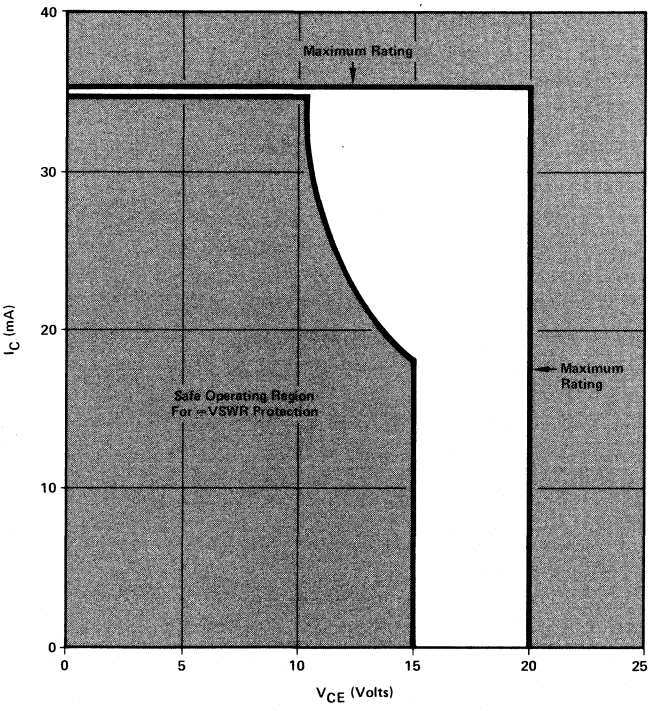


Figure 2. Safe Operating Region for DC Forward Bias. (case temperature, T_C = 25°C)

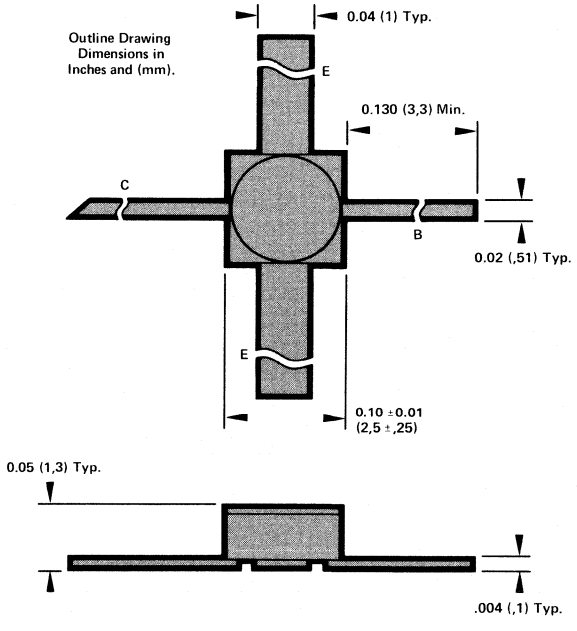


Figure 3. HPAC-100 Package Outline Drawing.

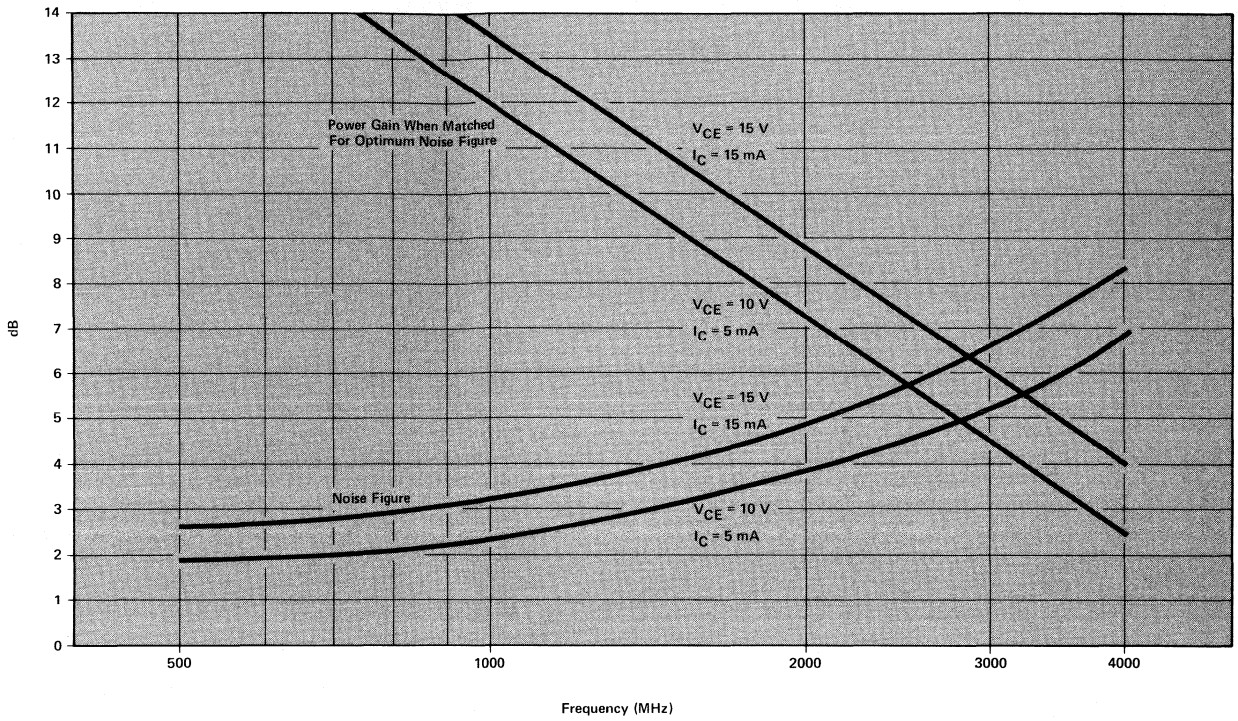


Figure 4. Typical Noise Figure and Associated Power Gain vs. Frequency for Two Different Bias Conditions.

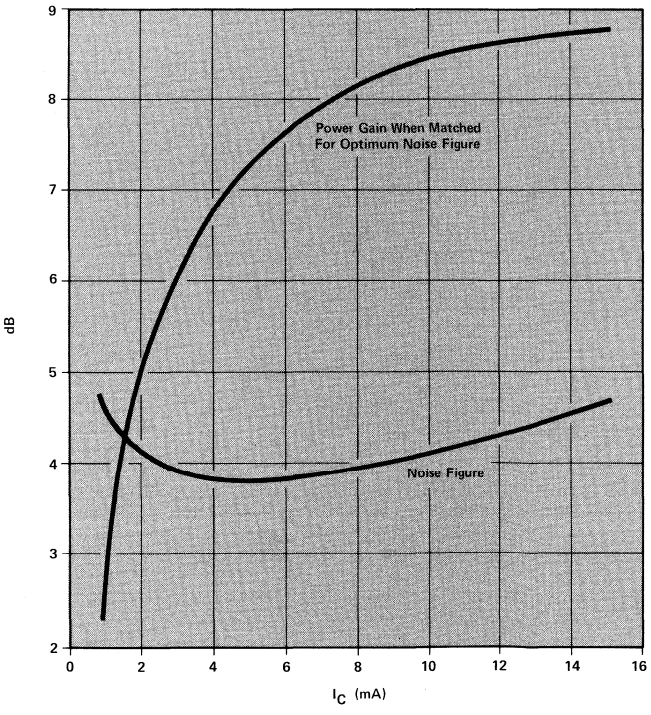


Figure 5. Typical Noise Figure and Associated Power Gain vs. Collector Current at 2 GHz for V_{CE} = 10V.

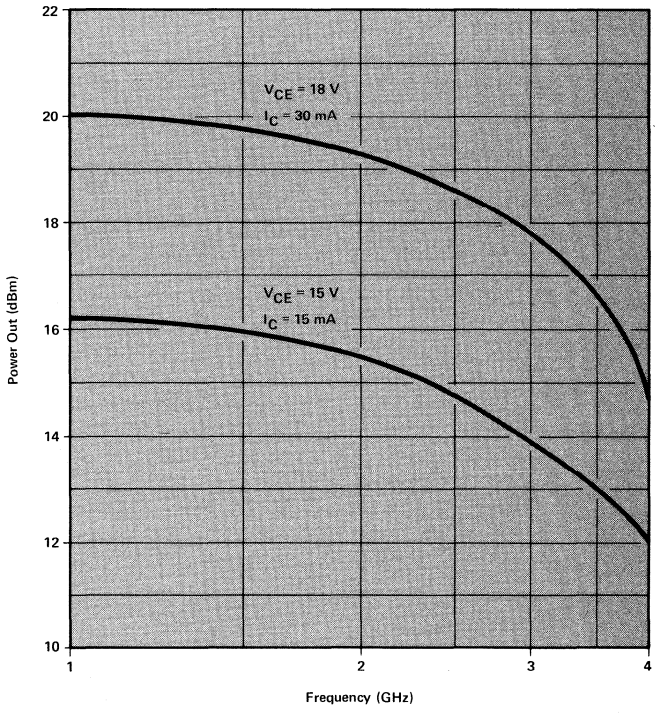


Figure 6. Typical Output Power at the 1 dB Gain Compression Point vs. Frequency for Two Different Bias Conditions.

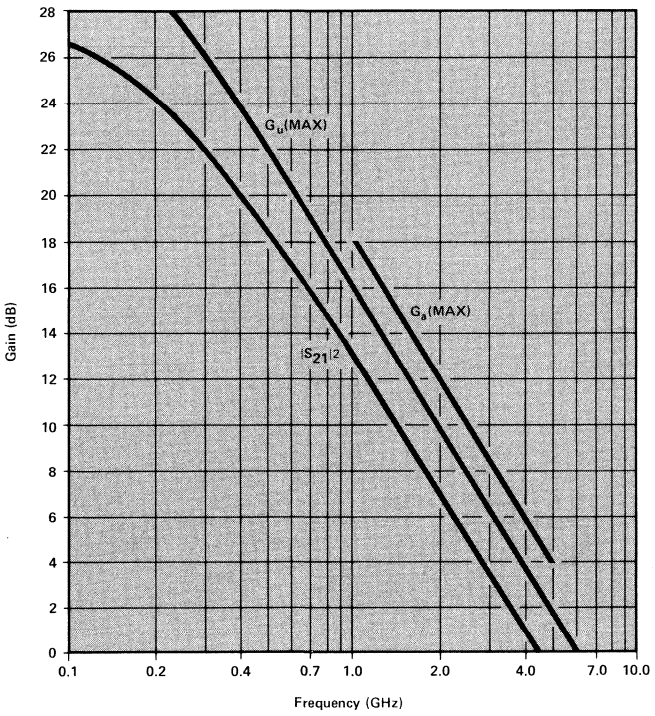


Figure 7. Typical Gain vs. Frequency Data for V_{CE} = 15V, I_C = 15 mA.

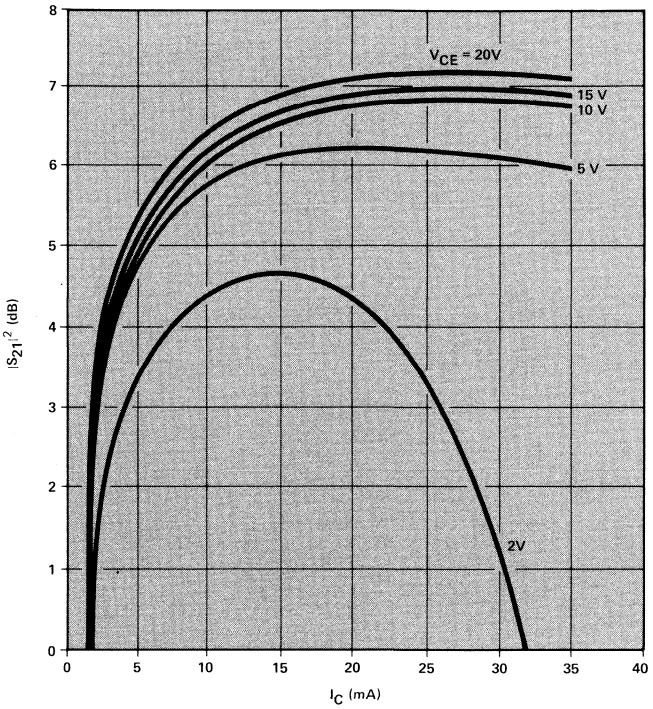


Figure 8. Typical S_{21} vs. Bias Data at 2 GHz.

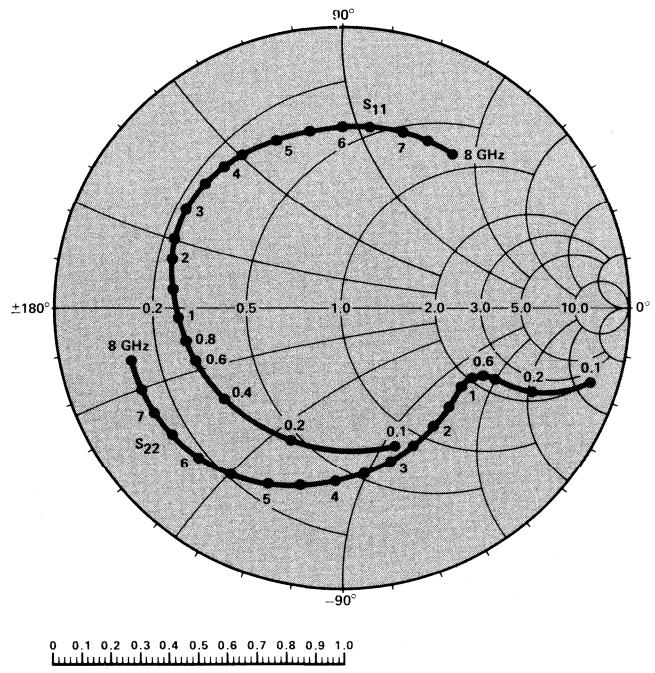


Figure 9. Typical S_{11} and S_{22} vs. Frequency for V_{CE} = 15V, I_C = 15 mA.

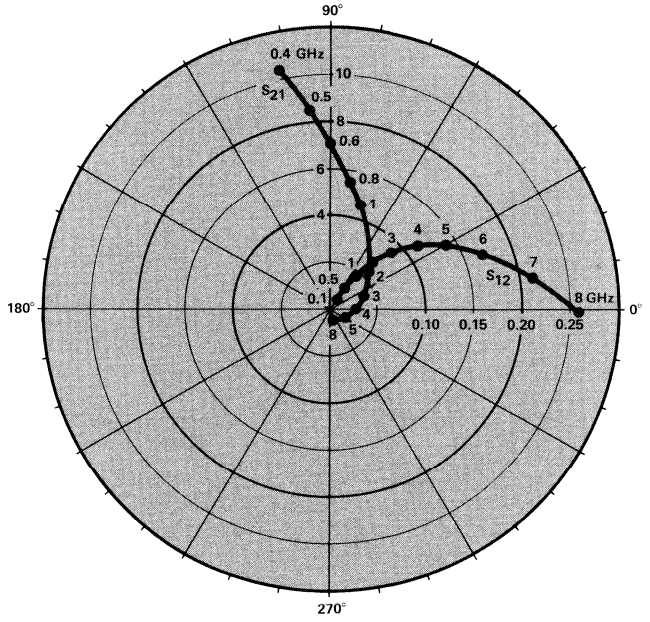


Figure 10. Typical S_{21} and S_{12} vs. Frequency for V_{CE} = 15V, I_C = 15 mA.

Note: Tabulated S-parameter data available on request.

HEWLETT hp PACKARD

COMPONENTS

MICROWAVE TRANSISTOR

models
35827B
35827E



Features

- Coaxial Structure
- Usable to 6 GHz
- Usable as Oscillator or Amplifier

Description

The HP 35827 is a small signal NPN silicon bipolar transistor available in a high performance coaxial package. The 35827B is a common base version (base connected to the ring, emitter connected to the lid) and the 35827E is a common emitter version (emitter connected to the ring, base connected to the lid).

Applications

Intended for use in microwave oscillator and amplifier applications, the package is designed to fit directly into coaxial transmission line structures. With an f_{max} of 8 GHz, the 35827E is usable to 6 GHz. Both the 35827E and the 35827B are capable of 50 mW output power at 4 GHz.

Electrical Specifications (T_A = 25°C)				35827B			35827E		
Symbols	**Parameters and Test Conditions**		**Units**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**
BV_{CBO}	Collector-Base Breakdown Voltage at I_C = 100 μA		Volts	30	35		30	35	
BV_{CEO}	Collector-Emitter Breakdown Voltage at I_C = 500 μA		Volts	20	25		20	25	
I_{CBO}	Collector Cutoff Current at V_{CB} = 15 V		μA			10			10
h_{FE}	Forward Current Transfer Ratio at V_{CE} = 15 V, I_C = 15 mA			15		125	15		125
f_{max}	Frequency at which G_a(max) = 0 dB at V_{CE} = 15 V, I_C = 15 mA		GHz					8.0	
f_s	Frequency at which $\|S_{21}\|^2$ = 0 dB at V_{CE} = 15 V, I_C = 15 mA		GHz				4.0	4.5	
$\|S_{21}\|^2$	Transducer Power Gain at V_{CE} = 15 V, I_C = 15 mA	f = 2 GHz f = 4 GHz	dB dB				6.0 0.0	7.0 1.0	
G_a(max)	Maximum Available Gain at V_{CE} = 15 V, I_C = 15 mA	f = 2 GHz f = 4 GHz f = 6 GHz	dB dB dB					12.0 6.0 3.0	
P_{out}	Saturated Output Power (3 dB Amplifier Gain) at V_{CB} = 20 V, I_C = 35 mA	f = 2 GHz f = 4 GHz	mW mW	30	100 50		25	80 40	

NOTE: All DC tests performed per MIL-STD-750

Absolute Maximum Ratings

(Case Temperature = 25°C)

Symbols	Parameters	Limits
V_{CBO}	Collector to Base Voltage	30 V
V_{CEO}	Collector to Emitter Voltage	20 V
V_{EBO}	Emitter to Base Voltage	1.5 V
I_C	Collector Current	35 mA
P_T	Total Device Dissipation	700 mW
T_J	Junction Temperature	175°C
T_{STG}	Storage Temperature	−65°C to +200°C
—	Thermal Resistance Junction to Collector Post Junction to Ring	 70°C/watt 130°C/watt
—	Hermeticity	5×10^{-8} cc/sec of He
T_C	Operating Case Temperature	See Derating Curve
—	Lead Temperature (Soldering, 10 seconds each lead)	+250°C

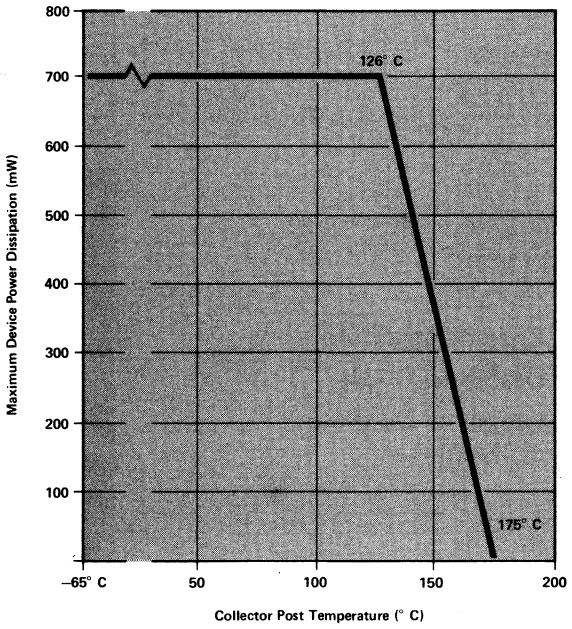


Figure 1. *Power Derating Curve.*

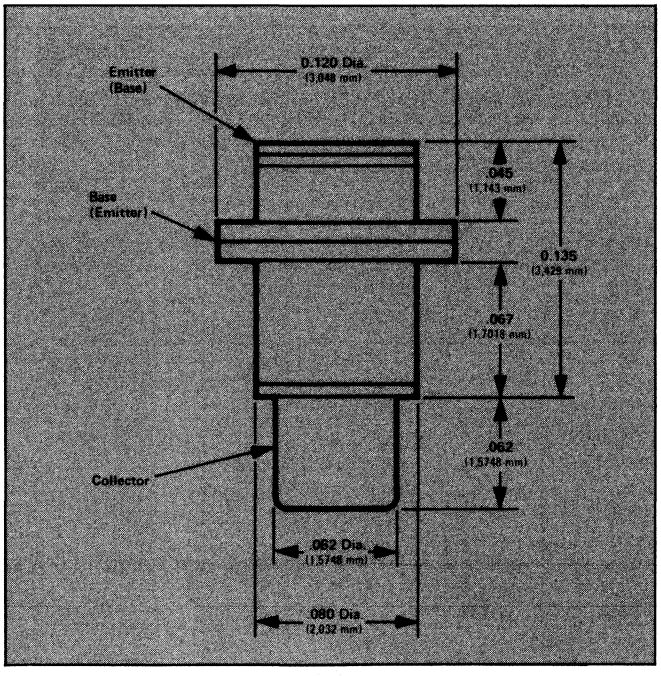


Figure 2. *Package Outline Drawing for 35827B (35827E).*

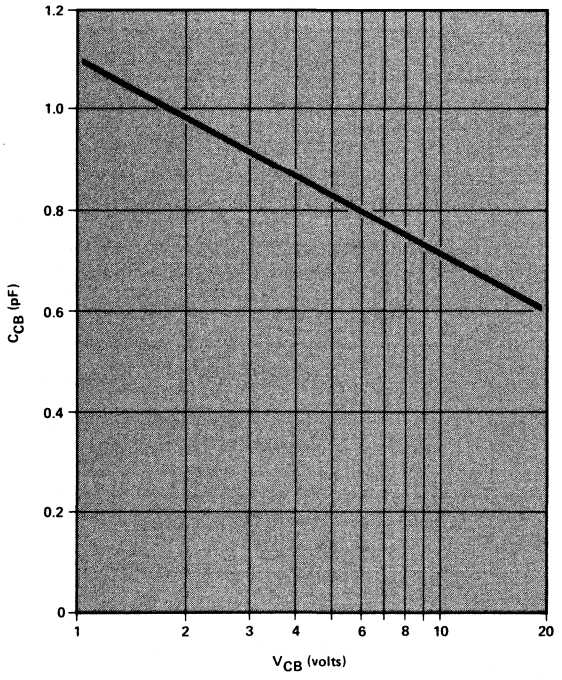


Figure 3. *Typical Collector-Base Capacitance vs. Voltage.*

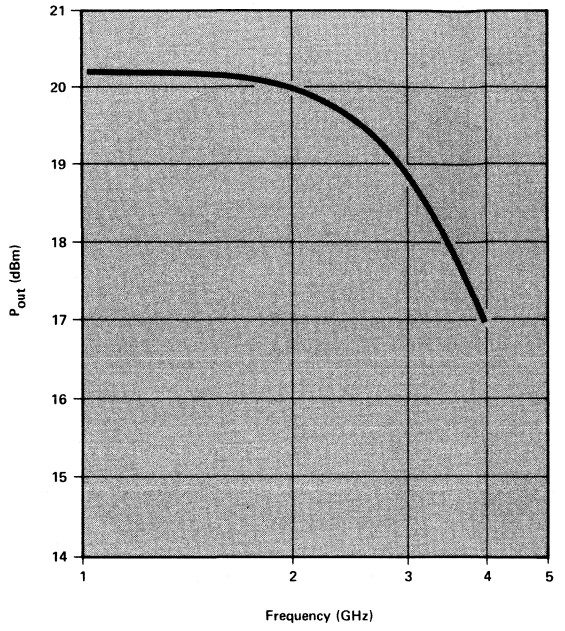


Figure 4. *Typical Saturated Output Power vs. Frequency for $V_{CB} = 20$ V, $I_C = 35$ mA.*

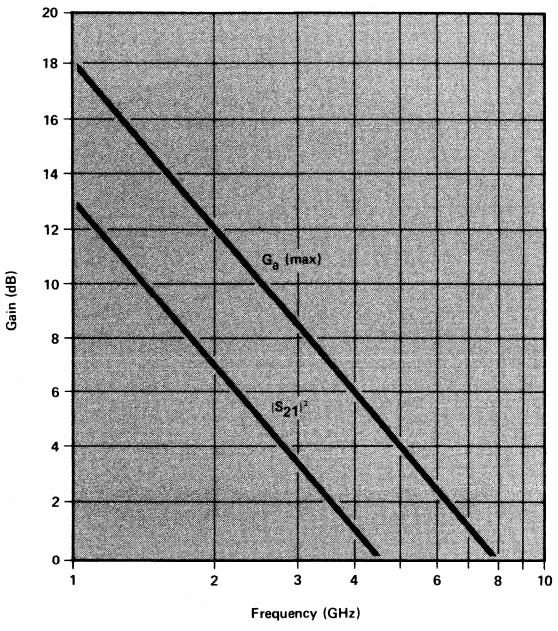


Figure 5. *35827E: Typical Gain vs. Frequency Data for $V_{CE} = 15$ V, $I_C = 15$ mA.*

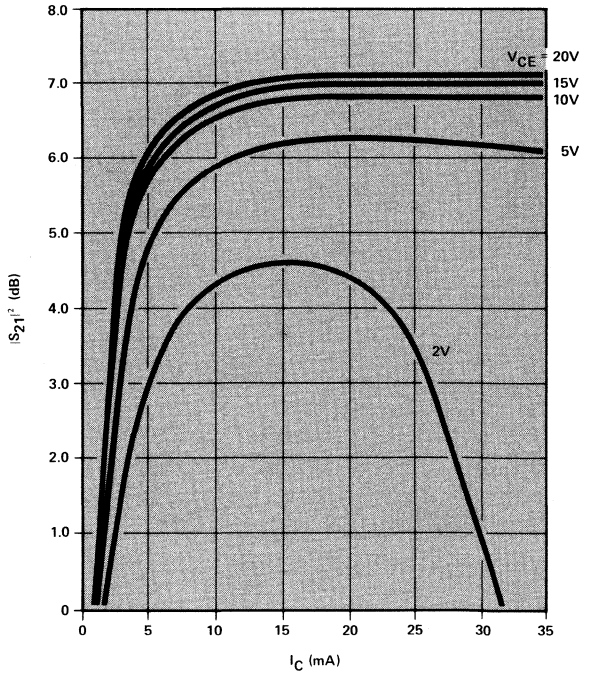


Figure 6. *35827E: Typical S_{21} vs. Bias Data at 2 GHz.*

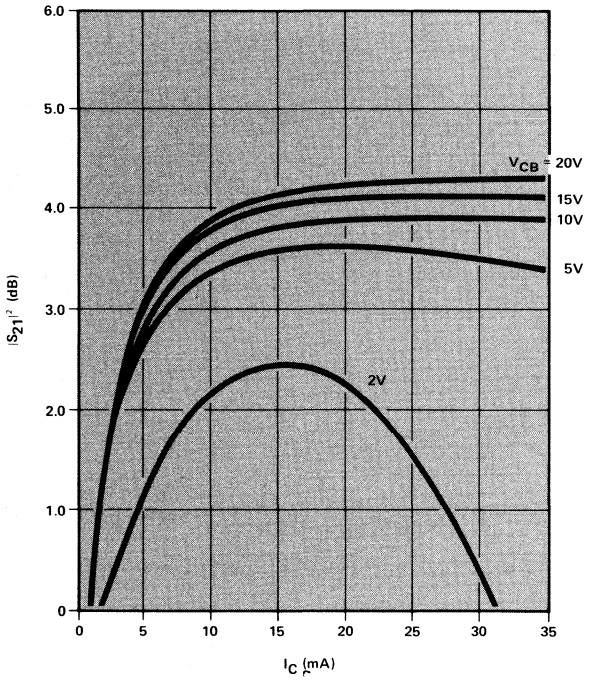


Figure 7. *35827B: Typical S_{21} vs. Bias Data at 2 GHz.*

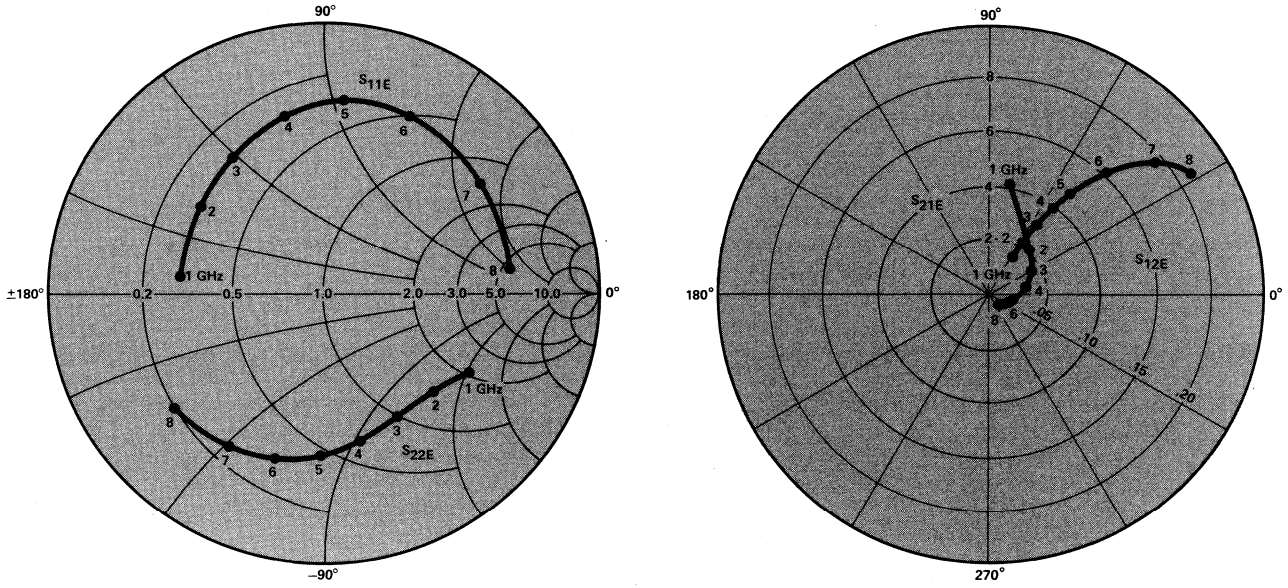


Figure 8. *35827E: Typical S-Parameters vs. Frequency for V_{CE} = 15 V, I_C = 15 mA.*

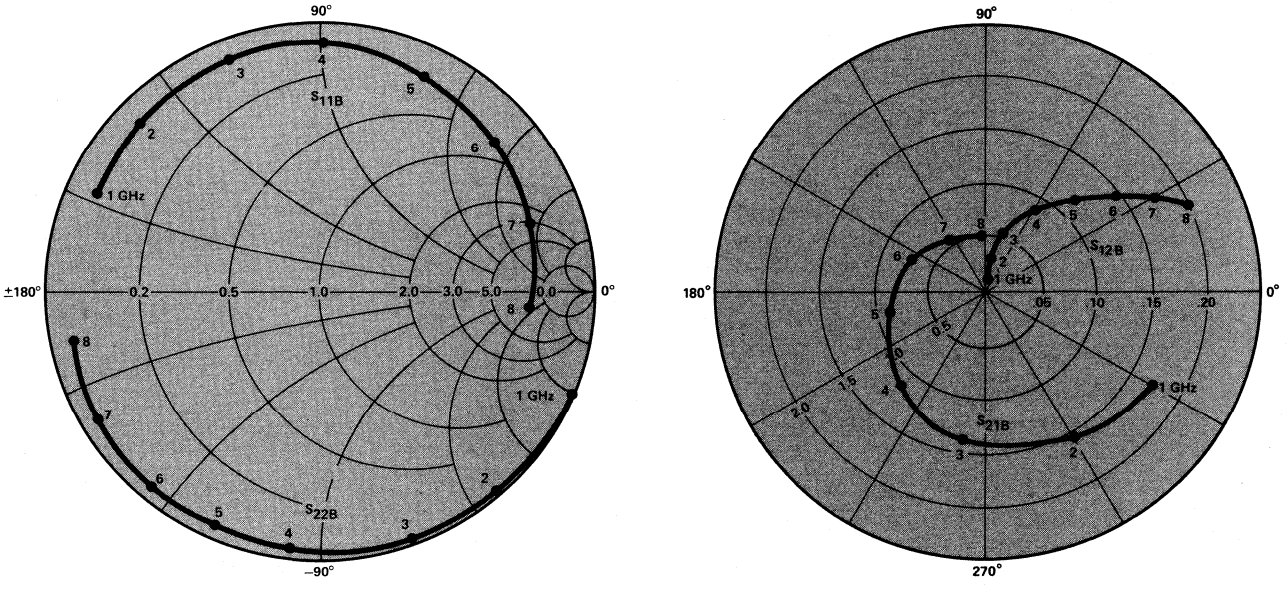


Figure 9. *35827B: Typical S-Parameters vs. Frequency for V_{CB} = 15 V, I_C = 15 mA.*

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COMPONENTS

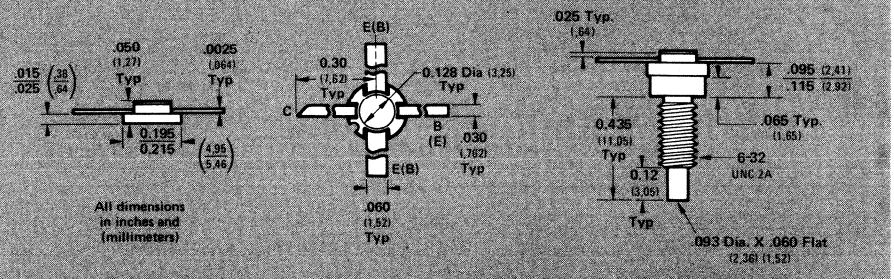
LINEAR POWER MICROWAVE TRANSISTOR

MODELS

35831B Opt. 005
35831E Opt. 005
35832B Opt. 005
35832E Opt. 005

Description

The 35831B/E Option 005 and 35832B/E Option 005 are NPN silicon bipolar microwave transistors. Available in both common base (B) and common emitter (E) configurations, the 35831B Option 005 and the 35831E Option 005 are packaged in the HPAC-200, and the 35832B Option 005 and the 35832E Option 005 are packaged in the HPAC-200S.



HPAC-200
35831B/E Option 005

Top view for both

HPAC-200S
35832B/E Option 005

Electrical Specifications

$T_A = 25°C$

Symbols	Parameters and Test Conditions	Units	35831B Option 005 Min.	35831B Option 005 Typ.	35831B Option 005 Max.	35831E Option 005 Min.	35831E Option 005 Typ.	35831E Option 005 Max.
BV_{CBO}	Collector-Base Breakdown Voltage at $I_C = 100\ \mu A$	Volts	35			35		
BV_{CEO}	Collector-Emitter Breakdown Voltage at $I_C = 500\ \mu A$	Volts	30			30		
I_{CBO}	Collector Cutoff Current at $V_{CB} = 15V$	μA			100			100
h_{FE}	Forward Current Transfer Ratio at $V_{CE} = 15V$, $I_C = 15$ mA		15	40	125	15	40	125
$\|S_{21E}\|^2$	Transducer Power Gain at $V_{CE} = 18V$, $I_C = 60$ mA f = 2 GHz	dB				3.0	4.0	
G_a (MAX)	Maximum Available Gain at $V_{CE} = 18V$, $I_C = 60$ mA f = 1 GHz	dB					14.0	
	f = 2 GHz	dB					8.0	

NOTE: All DC tests performed per MIL-STD-750.

Absolute Maximum Ratings

Symbols	Parameters	Limits
V_{CBO}	Collector to Base Voltage *	35V
V_{CEO}	Collector to Emitter Voltage*	30V
V_{EBO}	Emitter to Base Voltage *	1.5V
I_C	DC Collector Current *	80 mA
P_T	Total Power Dissipation*	1.6W
T_J	Junction Temperature	175°C
	*Case Temperature = 25°C	

Symbols	Parameters	Limits
T_{STG}	Storage Temperature	−40°C to +125°C
θ_{JC}	Thermal Resistance (Junction to Case)	50° C/W
T_C	Operating Case Temperature	See Figure 1
	Lead Temperature (Soldering, 10 seconds each lead)	+250°C

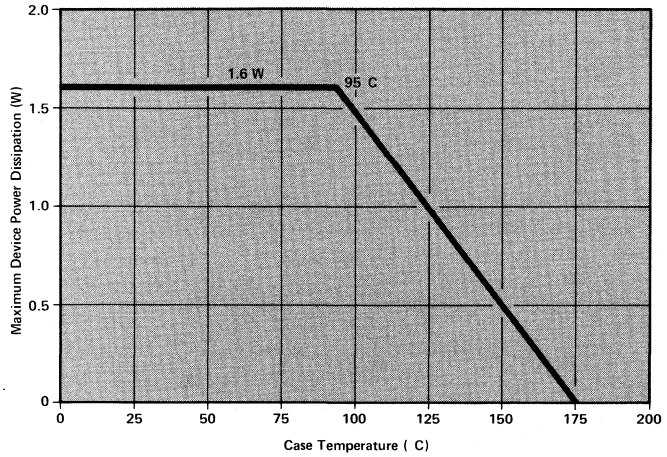


Figure 1. Power Derating Curve.

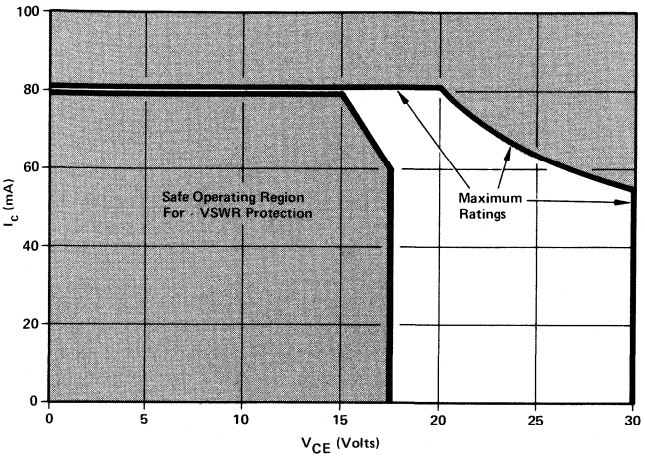


Figure 2. Safe Operating Region for DC Forward Bias. (Case Temperature, T_C = 25°C)

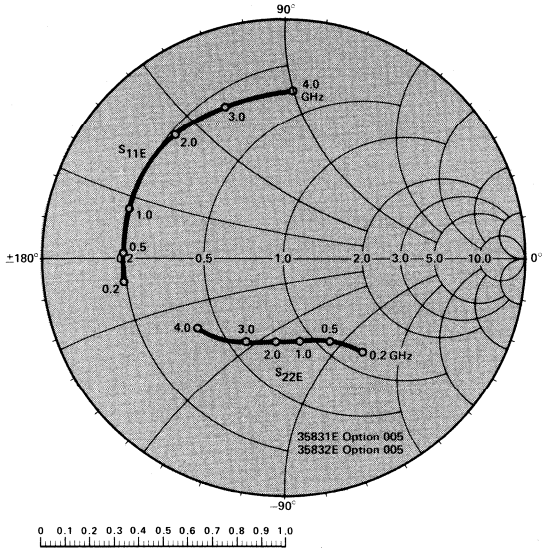


Figure 3. Typical S_{11} and S_{22} vs. Frequency for V_{CE} = 18V, I_C = 60 mA.

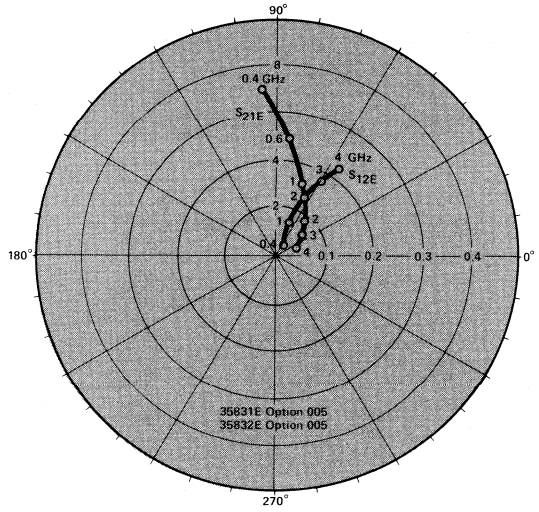


Figure 4. Typical S_{21} and S_{12} vs. Frequency for V_{CE} = 18V, I_C = 60 mA.

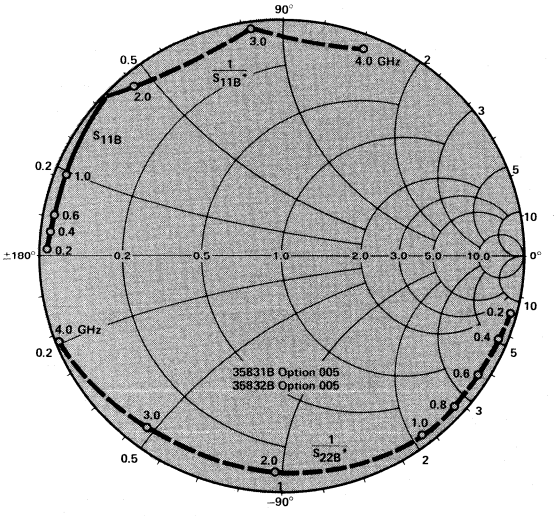


Figure 5. Typical S_{11} and S_{22} vs. Frequency for V_{CB} = 18V, I_C = 60 mA.

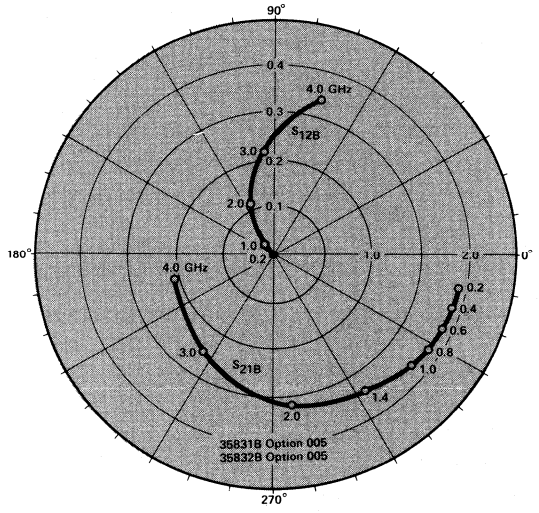


Figure 6. Typical S_{21} and S_{12} vs. Frequency for V_{CB} = 18V, I_C = 60 mA.

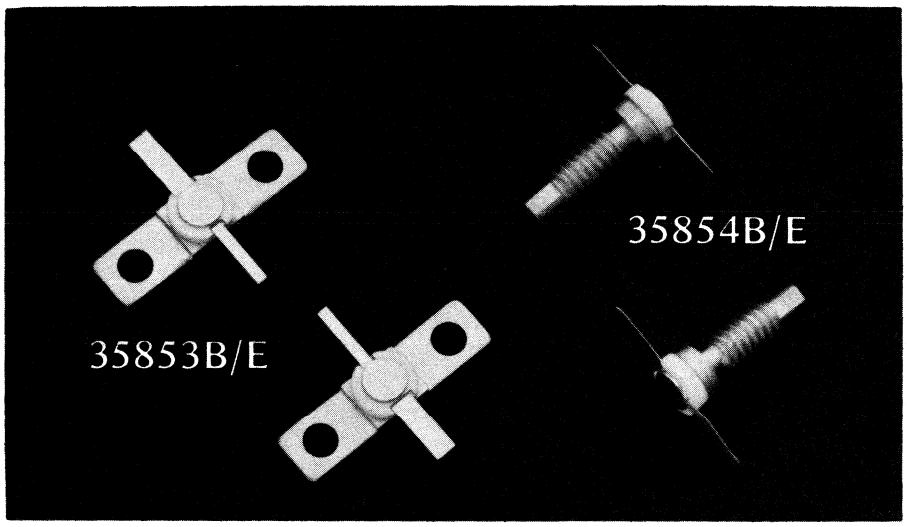
HEWLETT hp PACKARD
COMPONENTS

LINEAR POWER MICROWAVE TRANSISTOR

MODELS
35850A
35853B
35853E
35854B
35854E

Features

- +26 dBm Linear Power at 2GHz
- Rugged Emitter-Ballasted Chip
- Rugged Hermetic Packages



Description

The HP 35850A, 35853B/E, and 35854B/E are NPN silicon bipolar transistors. They are available both as unpackaged chips (the 35850A defines one chip) and in rugged, hermetic metal/ceramic packages in both common emitter (E) and common base (B) configurations. The HPAC-200GB (grounded bar package) is used for the 35853B/E and the HPAC-200GS (grounded stud package) is used for the 35854B/E.

Applications

The common emitter versions of the 35850 series provide linear power up to +26 dBm at 2GHz for broadband amplifiers. The common base versions are ideally suited for Class C saturated power amplifier or oscillator applications. For high reliability requirements these packaged transistors are capable of being screened through the appropriate environmental requirements of MIL-S-19500 and the test requirements of MIL-STD-750/883.

Electrical and Thermal Specifications $T_A = 25°C$

Symbols	Parameters and Test Conditions		Units	35850A,53B,54B			35853E,54E		
				Min.	Typ.	Max.	Min.	Typ.	Max.
BV_{CBO}	Collector-Base Breakdown Voltage at $I_C = 300\mu A$		V	30			30		
BV_{CEO}	Collector-Emitter Breakdown Voltage at $I_C = 2.5mA$		V	25			25		
I_{CBO}	Collector Cutoff Current at $V_{CB} = 15V$		μA			100			100
h_{FE}	Forward Current Transfer Ratio at $V_{CE} = 15V$, $I_C = 100mA$			15	40	125	15	40	125
$\|S_{21E}\|^2$	Transducer Power Gain at $V_{CE} = 15V$, $I_C = 100mA$	f=2GHz	dB					3.3	
$G_a(MAX)$	Maximum Available Gain at $V_{CE} = 15V$, $I_C = 100mA$	f=1GHz	dB					13.0	
		f=2GHz	dB					8.0	
		f=3GHz	dB					5.0	
P_{out}	Power Output at 1 dB Gain Compression Point at $V_{CE} = 15V$, $I_C = 100mA$ (at 2GHz, $\Gamma_S = 0.85 \angle -132°$, $\Gamma_L = 0.53 \angle 129°$)	f=2GHz	dBm					+26	
		f=3GHz	dBm					+25	
P_{out}	Saturated Output Power (3dB Gain) at $V_{CE} = 15V$, $I_C = 100mA$	f=2GHz	dBm					+29	
		f=3GHz	dBm					+27	
θ_{JC}	Thermal Resistance (Junction to Case)		°C/W			50			50

Note: All DC tests performed per MIL-STD-750.

Absolute Maximum Ratings

Symbols	Parameters	Limits
V_{CBO}	Collector to Base Voltage*	30V
V_{CEO}	Collector to Emitter Voltage*	25V
V_{EBO}	Emitter to Base Voltage*	1.5V
I_C	DC Collector Current*	125mA
P_T	Total Power Dissipation*	2.5W
T_J	Junction Temperature	175°C
T_{STG}	Storage Temperature	–65°C to +200°C
T_C	Operating Case Temperature	See Figure 1
—	Lead Temperature (Soldering, 10 seconds each lead)	+250°C

*Case Temperature = 25°C

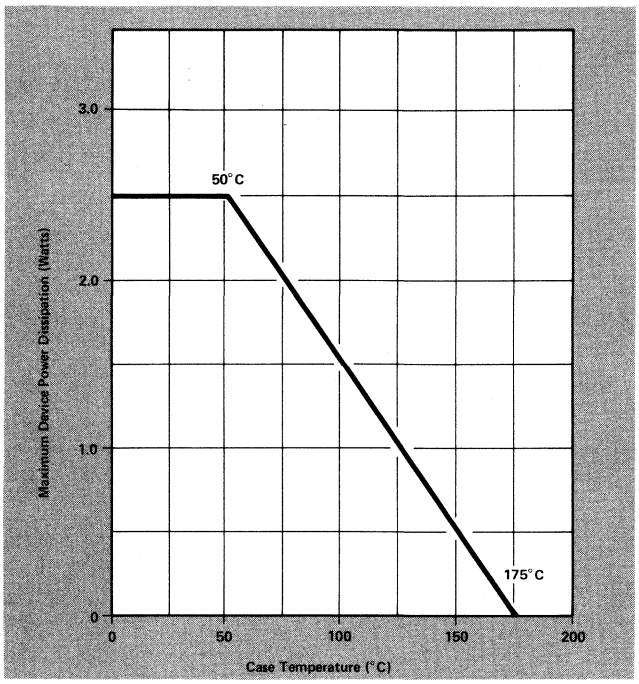


Figure 1. Power Derating Curve.

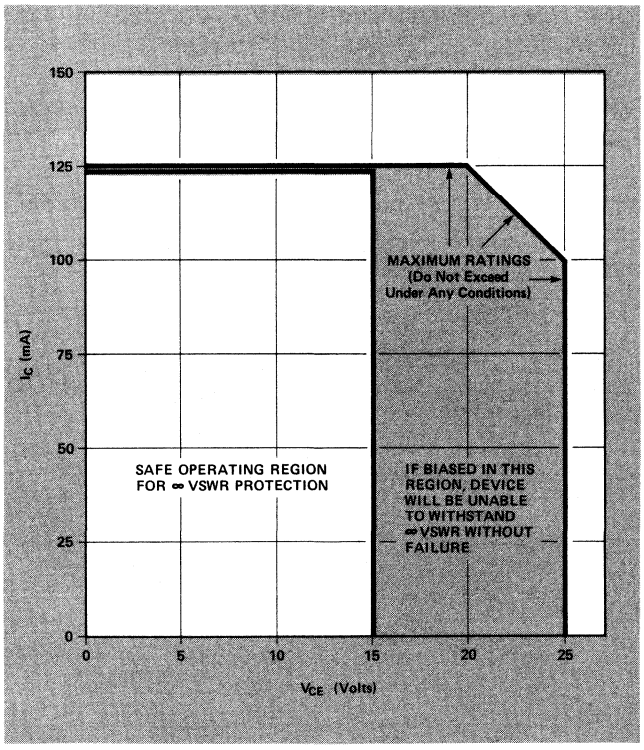


Figure 2. Safe Operating Region for DC Forward Bias. (Case Temperature, T_C = 25°C)

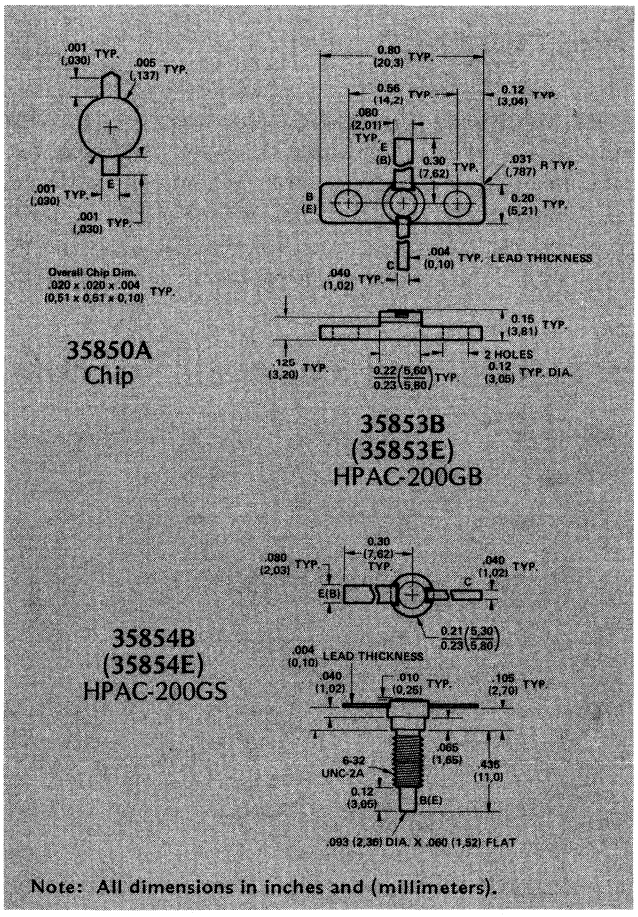


Figure 3. Outline Drawings.

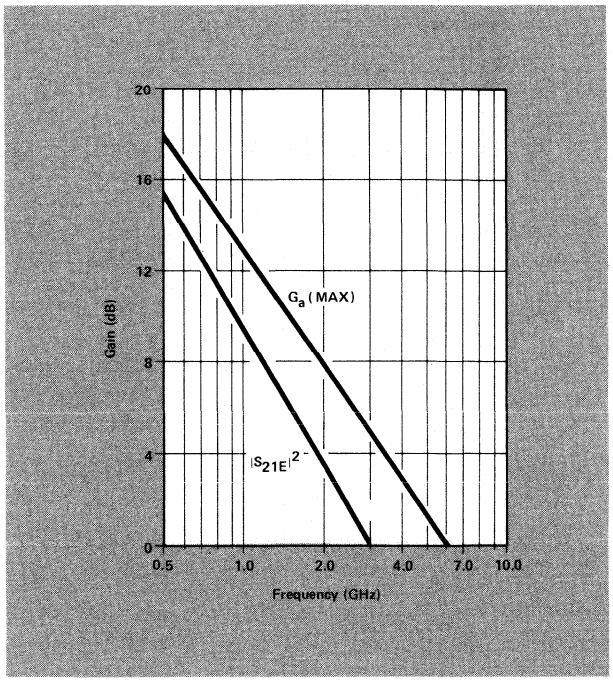


Figure 4. 35853E,54E: Typical Gain vs. Frequency for V_{CE} = 15V, I_C = 100mA.

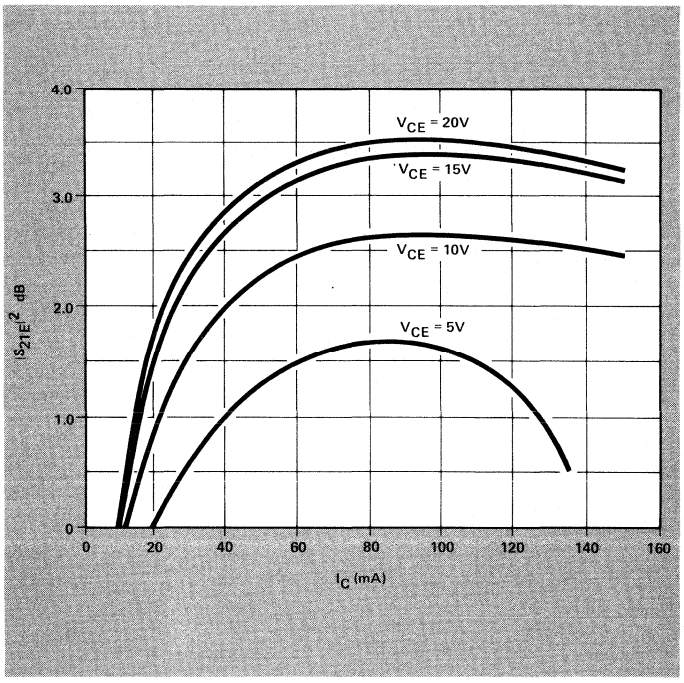


Figure 5. 35853E,54E: Typical S_{21E} vs. Bias at 2GHz.

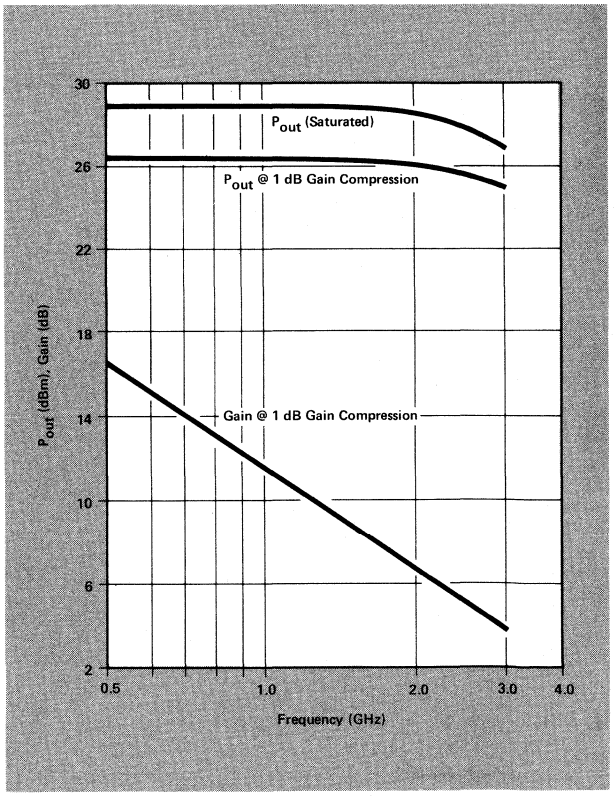


Figure 6. 35853E,54E: Typical Output Power and Gain vs. Frequency for V_{CE} = 15V, I_C = 100mA.

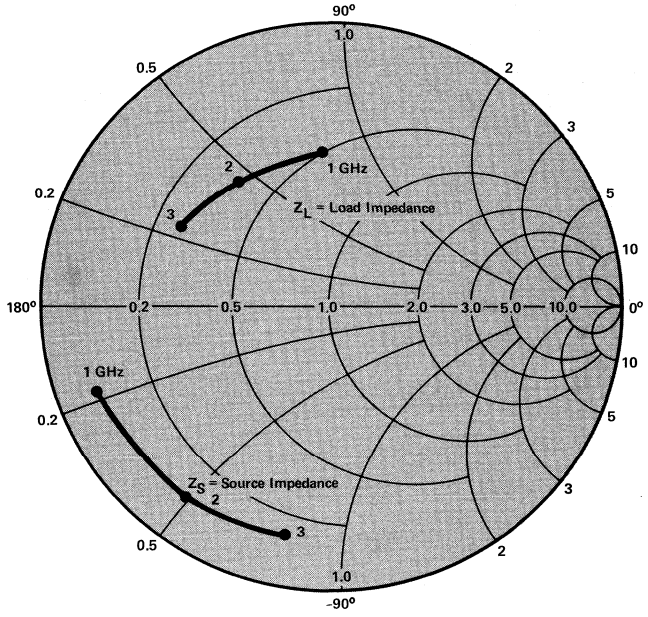


Figure 7. 35853E,54E: Typical Matching Impedances vs. Frequency for P_{in} = 200mW, V_{CE} = 15V, I_C = 100mA.

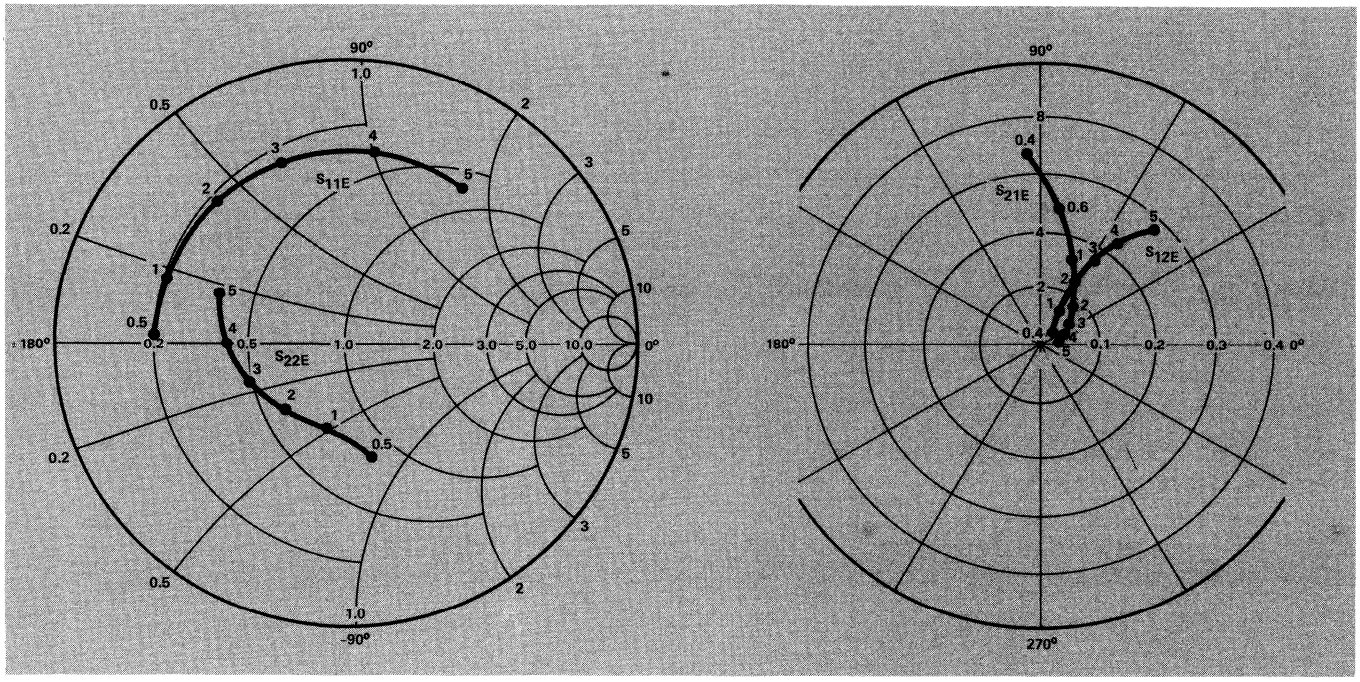


Figure 8. 35853E,54E: Typical S-Parameters vs. Frequency for V_{CE} = 15V, I_C = 100mA.

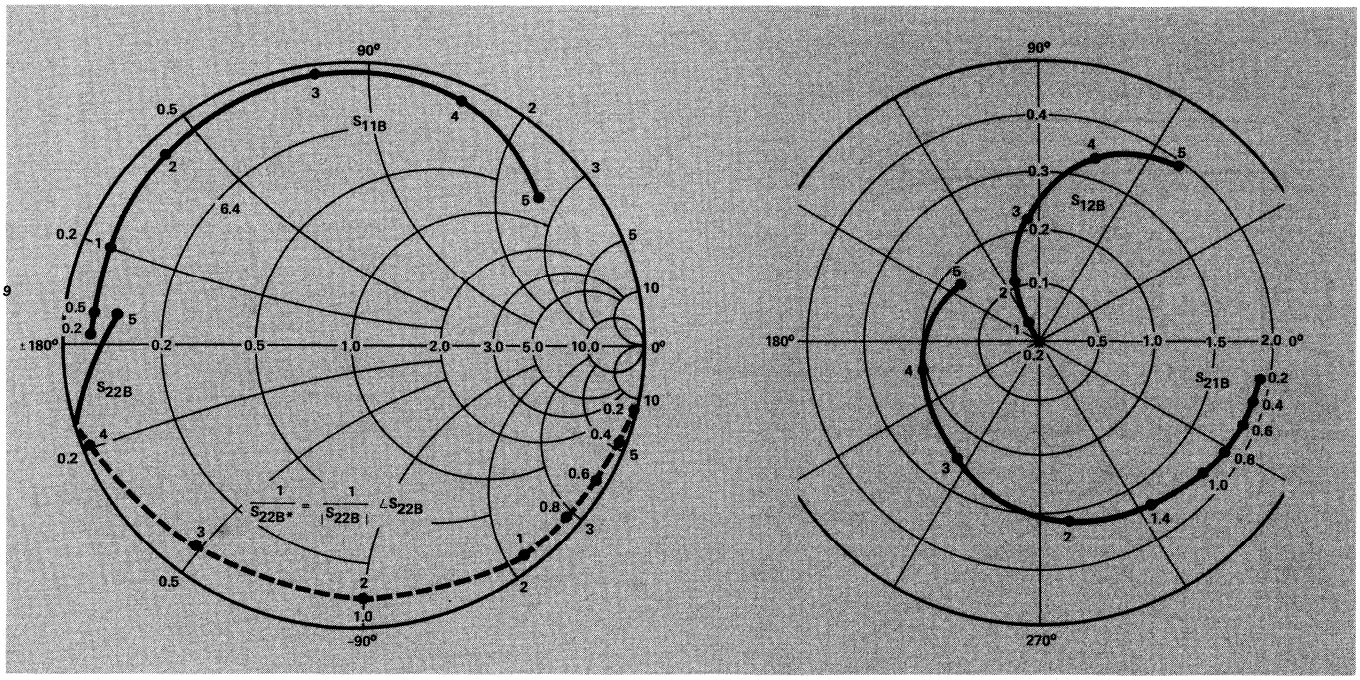


Figure 9. 35853B,54B: Typical S-Parameters vs. Frequency for V_{CB} = 15V, I_C = 100mA.

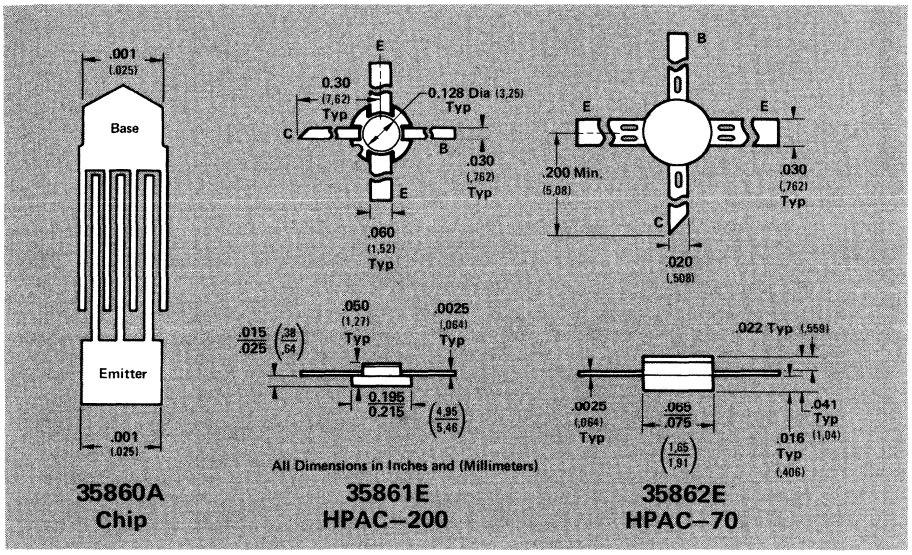
HEWLETT hp PACKARD
COMPONENTS

LOW NOISE MICROWAVE TRANSISTOR

MODELS
35860A
35861E
35861E Opt. 100
35862E
35862E Opt. 100

Features

- LOW NOISE FIGURE
  4.5 dB at 4 GHz Guaranteed Maximum
- HIGH GAIN
  8.0 dB Maximum Available Gain at 4 GHz



35860A Chip | 35861E HPAC–200 | 35862E HPAC–70

Description

The 35860A, 35861E, and 35862E are NPN silicon bipolar microwave transistors. The products are available in both chip form and in stripline packages. The 35860A is one unpackaged transistor chip, the 35861E is packaged in the HPAC-200, and the 35862E is packaged in the HPAC-70. The 35861E and the 35862E also come in Option 100 versions which guarantee noise figures of 3.0 dB at 2 GHz and 4.5 dB at 4 GHz.

Electrical Specifications T_A=25°C

			35860A			35861E 35862E			35861E Opt. 100 35862E Opt. 100		
Symbols	Parameters and Test Conditions	Units	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.
BV_{CBO}	Collector-Base Breakdown Voltage at I_C = 100μA	Volts	20	30		20	30		20	30	
BV_{CEO}	Collector-Emitter Breakdown Voltage at I_C = 500μA	Volts	15	20		15	20		15	20	
I_{CBO}	Collector Cutoff Current at V_{CB} = 10V	μA			1.0			1.0			1.0
h_{FE}	Forward Current Transfer Ratio at V_{CE} = 10V, I_C = 10mA		20	50	200	20	50	200	20	80	200
$\|S_{21}\|^2$	Transducer Power Gain at V_{CE} = 10V, I_C = 10mA f=2GHz	dB				8.0	9.5		8.0	9.5	
F_{min}	Minimum Noise Figure at V_{CE} = 10V, I_C = 5mA										
	f=1GHz	dB					3.1			2.0	
	f=2GHz	dB					3.3			2.5	3.0
	f=4GHz	dB					4.8			4.0	4.5

NOTE: All DC tests performed per MIL-STD-750.

Absolute Maximum Ratings

Symbols	Parameters	Limits
V_{CBO}	Collector to Base Voltage*	20V
V_{CEO}	Collector to Emitter Voltage*	15V
V_{EBO}	Emitter to Base Voltage*	1.5V
I_C	DC Collector Current*	20 mA
P_T	Total Device Dissipation*	300 mW
T_J	Junction Temperature	175°C
T_{STG}	Storage Temperature	−65°C to +200°C
θ_{JC}	Thermal Resistance (Junction to Case)	
	35861E	80°C/W
	35862E	400°C/W
T_C	Operating Case Temperature	See Figure 1
	Lead Temperature (Soldering, 10 seconds each lead)	+250°C

*Case Temperature = 25°C

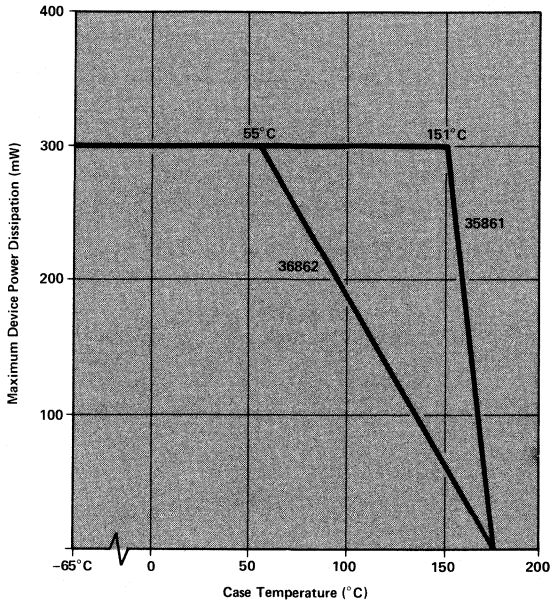


Figure 1. Power Derating Curve.

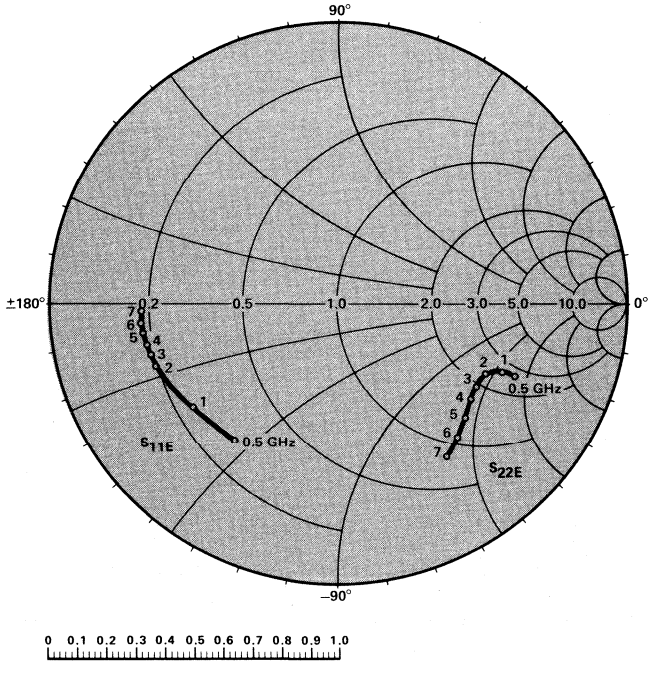


Figure 2. 35860A: Typical S_{11}, S_{22} vs. Frequency Data for V_{CE} = 10V, I_C = 10 mA.

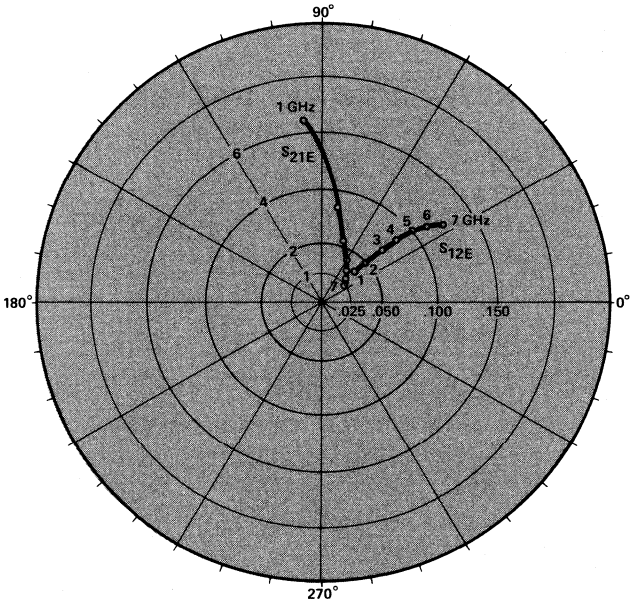


Figure 3. 35860A: Typical S_{21}, S_{12} vs. Frequency Data for V_{CE} = 10V, I_C = 10 mA.

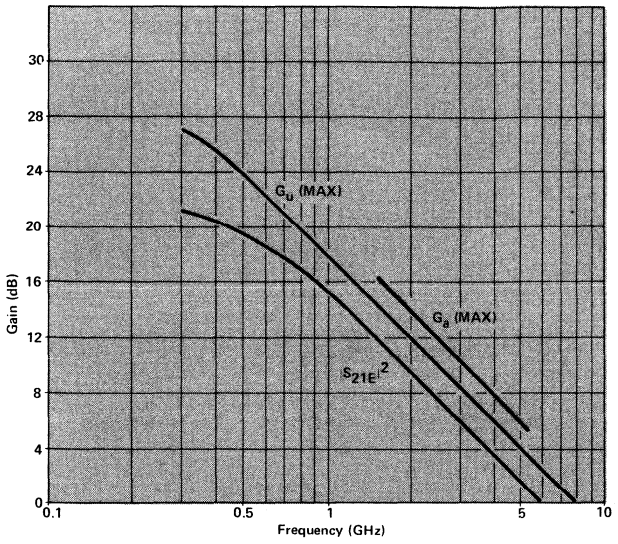


Figure 4. Typical Gain vs. Frequency Data for V_{CE} = 10V, I_C = 10 mA.

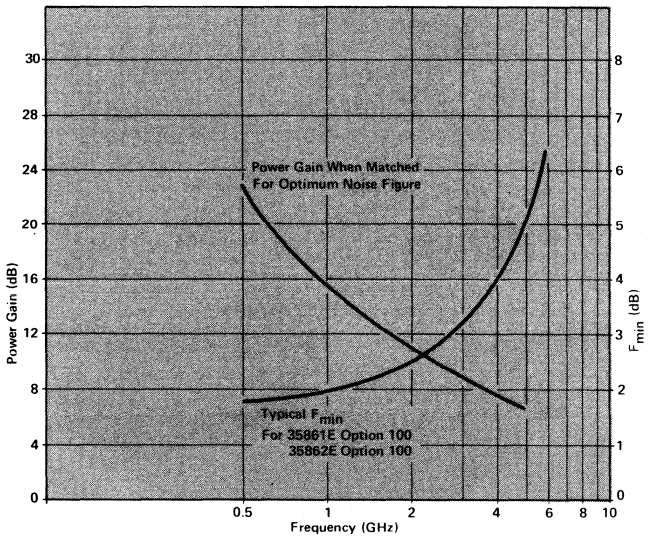


Figure 5. Typical F_{min} and Associated Power Gain vs. Frequency for V_{CE} = 10 V, I_C = 5 mA.

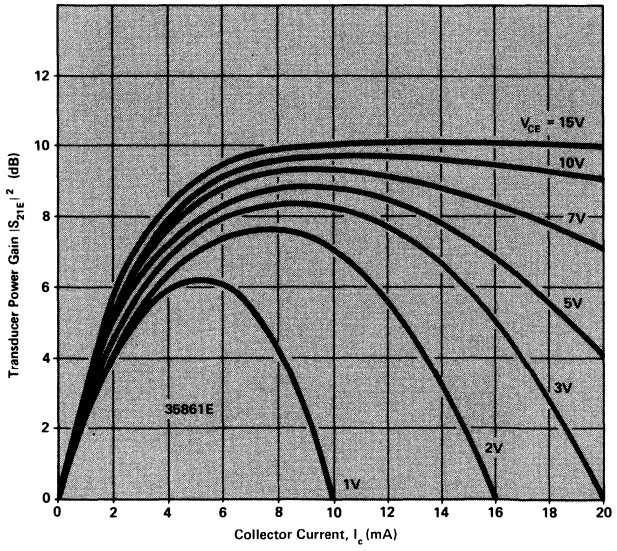


Figure 6. 35861E: Typical S_{21} vs. Bias Data at 2 GHz.

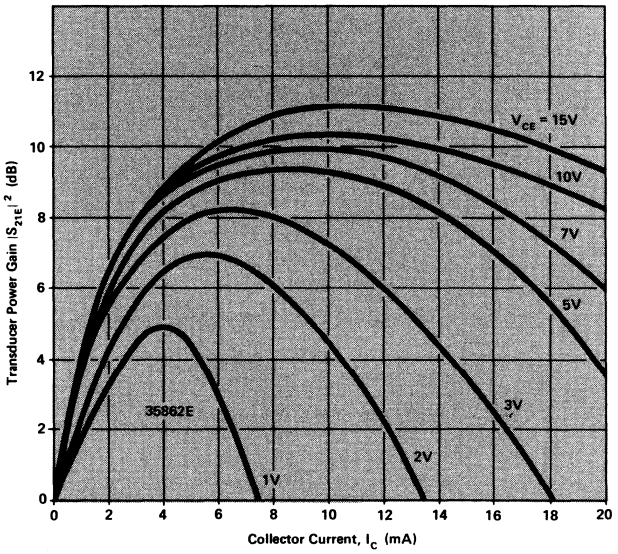


Figure 7. 35862E: Typical S_{21} vs. Bias Data at 2 GHz.

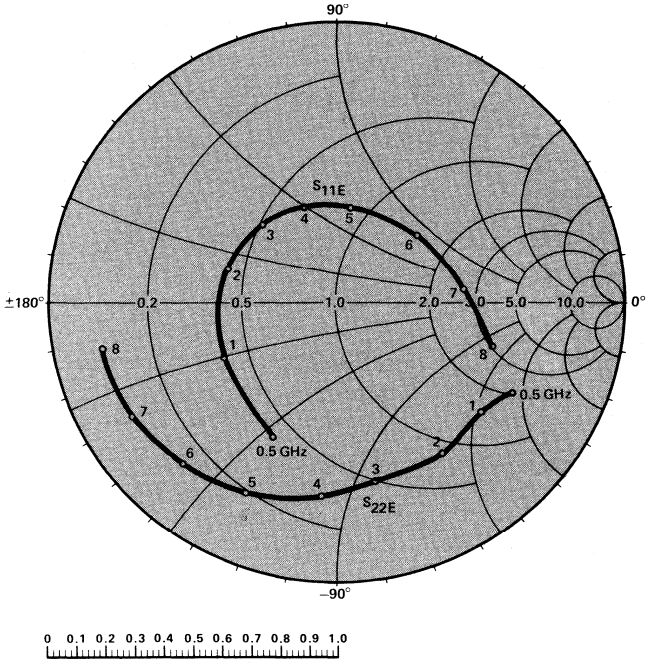


Figure 8. 35861E: Typical S_{11}, S_{22} vs. Frequency Data for V_{CE} = 10V, I_C = 10 mA.

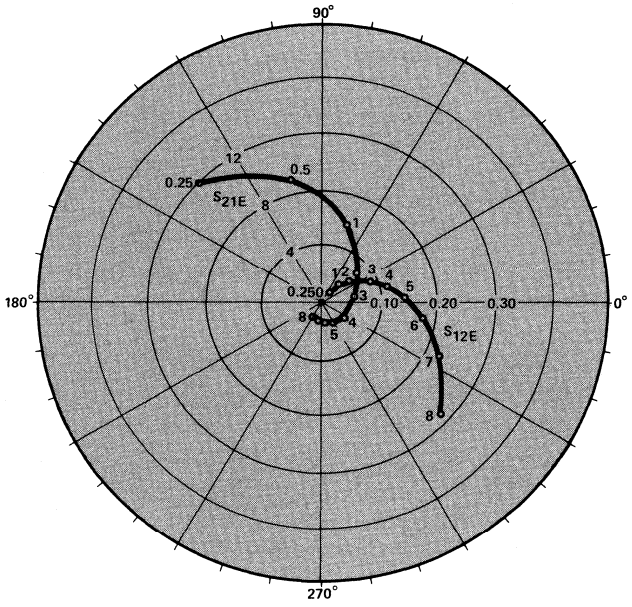


Figure 9. 35861E: Typical S_{21}, S_{12} vs. Frequency Data for V_{CE} = 10V, I_C = 10 mA.

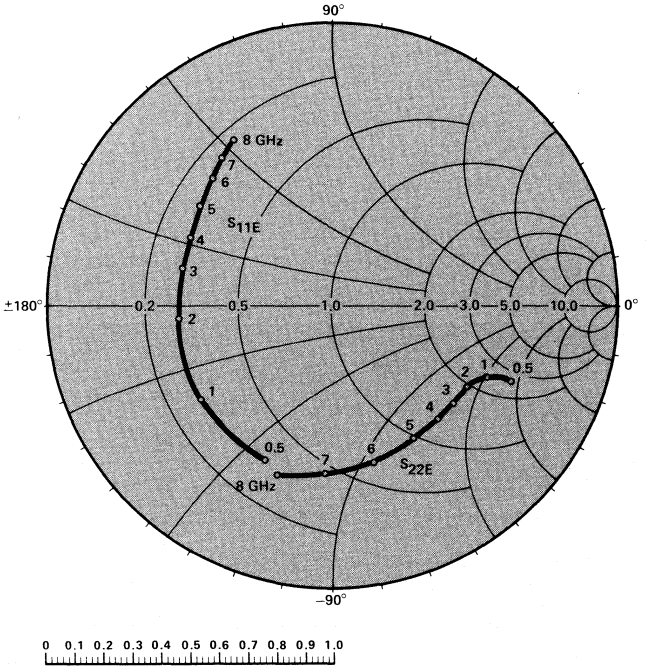


Figure 10. 35862E: Typical S_{11}, S_{22} vs. Frequency Data for V_{CE} = 10V, I_C = 10 mA.

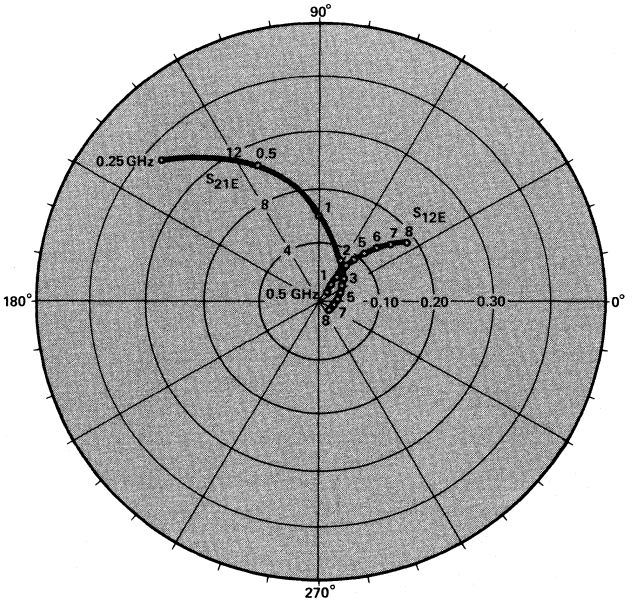


Figure 11. 35862E: Typical S_{21}, S_{12} vs. Frequency Data for V_{CE} = 10V, I_C = 10 mA.

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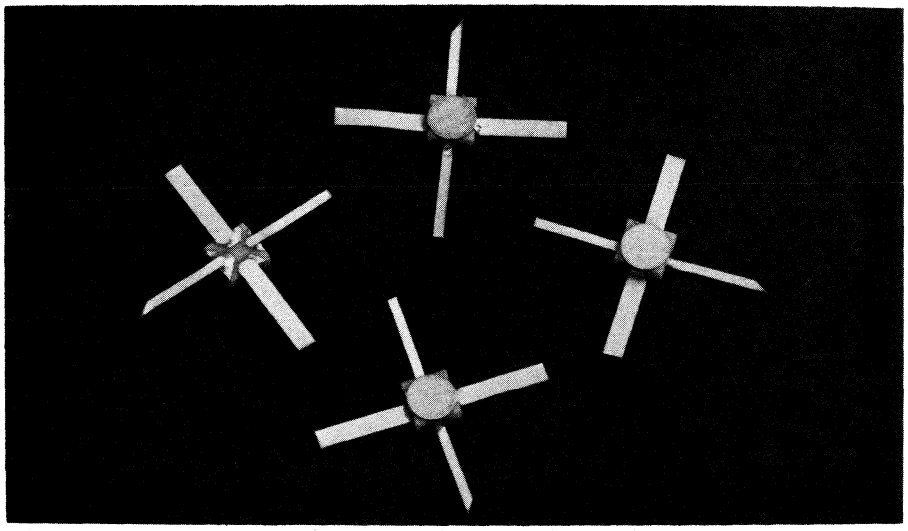
COMPONENTS

LOW NOISE MICROWAVE TRANSISTOR

MODELS
35866E
35866E Opt. 100

Features

- LOW NOISE FIGURE
  4.5 dB at 4 GHz Guaranteed Maximum
- HIGH GAIN
  8.0 dB Maximum Available Gain at 4 GHz
- RUGGED
  Metal/Ceramic Package



Description

The 35866E is a small signal NPN silicon bipolar transistor. The Option 100 version guarantees noise figures of 3.0 dB at 2 GHz and 4.5 dB at 4 GHz. Both the standard 35866E and the 35866E Option 100 feature high linear gain. Typical G_a (MAX) equals 14 dB at 2 GHz and 8.0 dB at 4 GHz. Both products are available in the HPAC-100, a rugged metal/ceramic hermetic package.

Applications

The 35866E is designed for general purpose high gain amplifier applications and the 35866E Option 100 is intended for use in low noise preamplifiers. Preconditioning and screening tests are recommended for devices used in high reliability applications. The 35866E and the 35866E Option 100 are capable of meeting the appropriate environmental requirements of MIL-S-19500 and the test requirements of MIL-STD-750/883.

Electrical and Thermal Specifications $T_A = 25°C$

			35866E			35866E Opt. 100		
Symbols	Parameters and Test Conditions	Units	Min.	Typ.	Max.	Min.	Typ.	Max.
BV_{CBO}	Collector-Base Breakdown Voltage at $I_C = 100\mu A$	Volts	20	30		20	30	
BV_{CEO}	Collector-Emitter Breakdown Voltage at $I_C = 500\mu A$	Volts	15	20		15	20	
I_{CBO}	Collector Cutoff Current at $V_{CB} = 10V$	μA			1.0			1.0
h_{FE}	Forward Current Transfer Ratio at $V_{CE} = 10V$, $I_C = 10mA$		20	50	200	20	80	200
$\|S_{21}\|^2$	Transducer Power Gain at $V_{CE} = 10V$, $I_C = 10mA$ f=2GHz	dB	8.0	9.5		8.0	9.5	
G_a (MAX)	Maximum Available Gain at $V_{CE} = 10V$, $I_C = 10mA$ f=2GHz	dB		14			14	
	f=4GHz	dB		8			8	
F_{min}	Minimum Noise Figure at $V_{CE} = 10V$, $I_C = 5mA$ f=1GHz	dB		3.1			2.0	
	f=2GHz	dB		3.3			2.5	3.0
	f=4GHz	dB		4.8			4.0	4.5
θ_{JC}	Thermal Resistance (Junction to Case)	°C/W			200			200

NOTE: All DC tests performed per MIL-STD-750.

Absolute Maximum Ratings

Symbols	Parameters	Limits
V_{CBO}	Collector to Base Voltage*	20V
V_{CEO}	Collector to Emitter Voltage*	15V
V_{EBO}	Emitter to Base Voltage*	1.5V
I_C	DC Collector Current*	20 mA
P_T	Total Device Dissipation*	300 mW
T_J	Junction Temperature	175°C
T_{STG}	Storage Temperature	−65°C to +200°C
- -	Hermeticity	$5X10^{-8}$ cc/sec of He
T_C	Operating Case Temperature	See Figure 3
- -	Lead Temperature (Soldering, 10 seconds each lead)	+250°C
	*Case Temperature = 25°C	

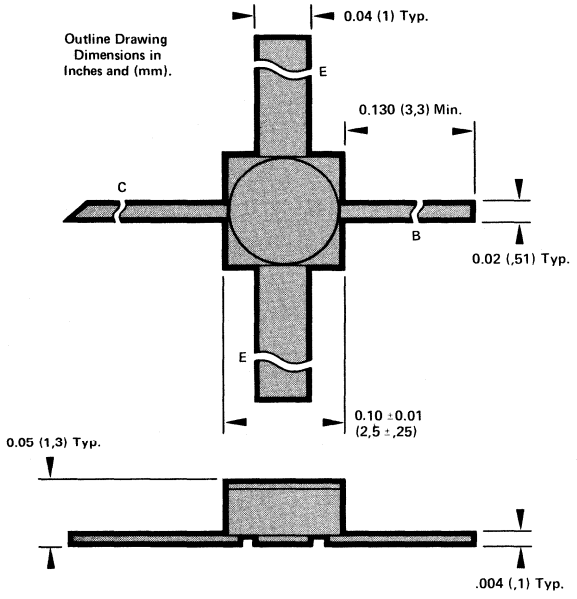


Figure 1. HPAC-100 Package Outline Drawing.

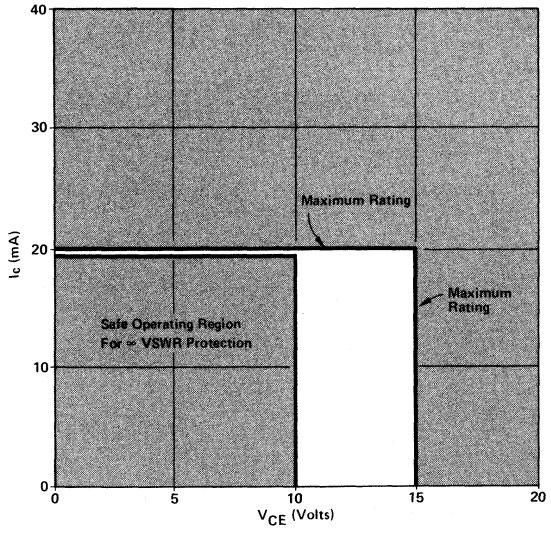


Figure 2. Safe Operating Region for DC Forward Bias. (Case Temperature, T_C = 25° C).

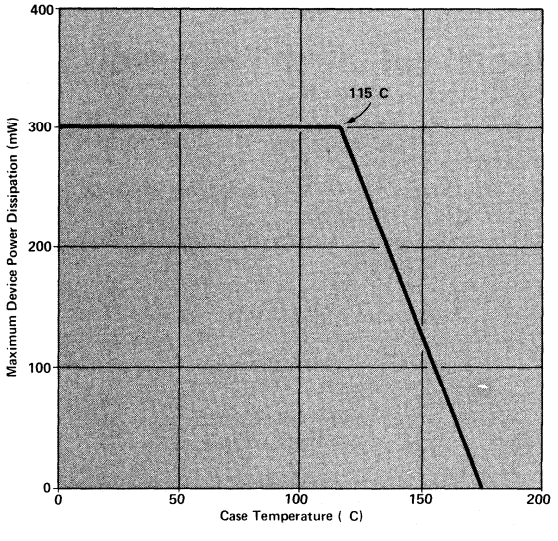


Figure 3. Power Derating Curve.

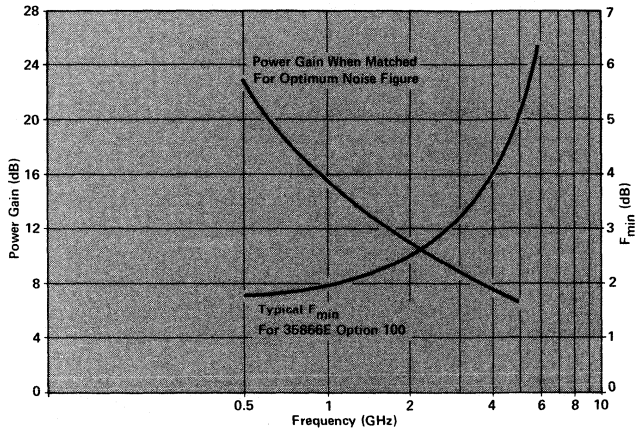


Figure 4. Typical F_{min} and Associated Power Gain vs. Frequency for V_{CE} = 10V, I_C = 5 mA.

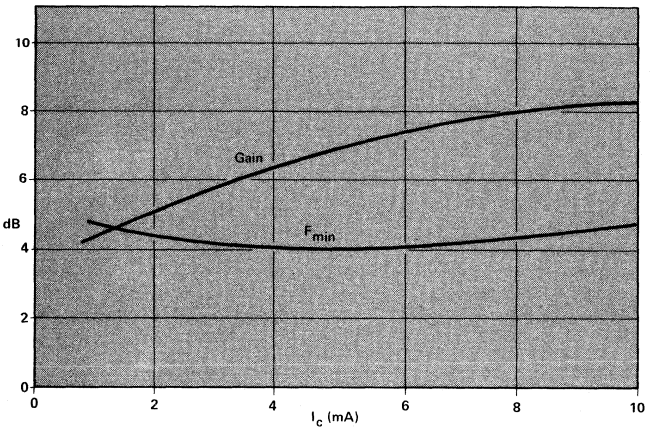


Figure 5. 35866E Option 100: Typical F_{min} and Associated Power Gain vs. I_C at 4 GHz for V_{CE} = 10V.

NOISE FIGURE PARAMETERS

Noise figure as a function of Γ_s (source reflection coefficient) may be expressed as

$$F(\Gamma_s) = F_{min} + 4 R_N \frac{|\Gamma_s - \Gamma_o|^2}{(1-|\Gamma_s|^2)|1+\Gamma_o|^2}$$

where F_{min} = minimum noise figure

R_N = equivalent input noise resistance of the two port

Γ_o = source reflection coefficient required for F_{min}

The above equation may be used to describe a family of circles in the Γ_s plane.

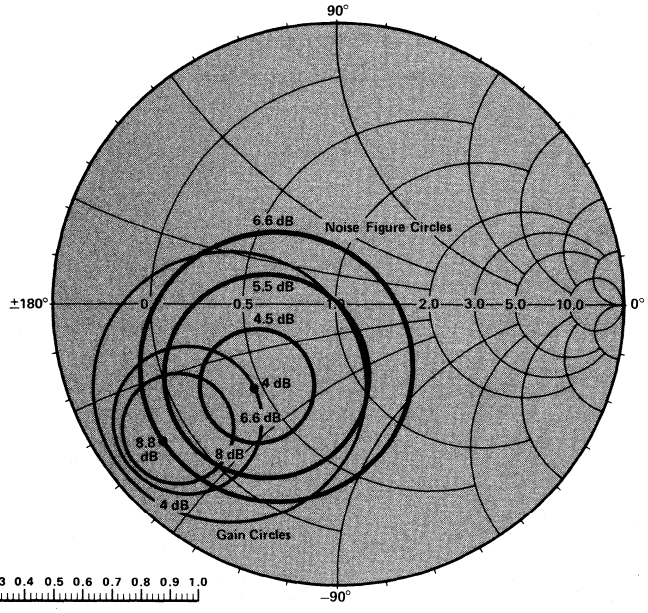


Figure 6. 35866E Option 100: Typical Circles of Constant Gain (Bilateral) and Noise Figure at 4 GHz for V_{CE} = 10V, I_C = 5 mA.

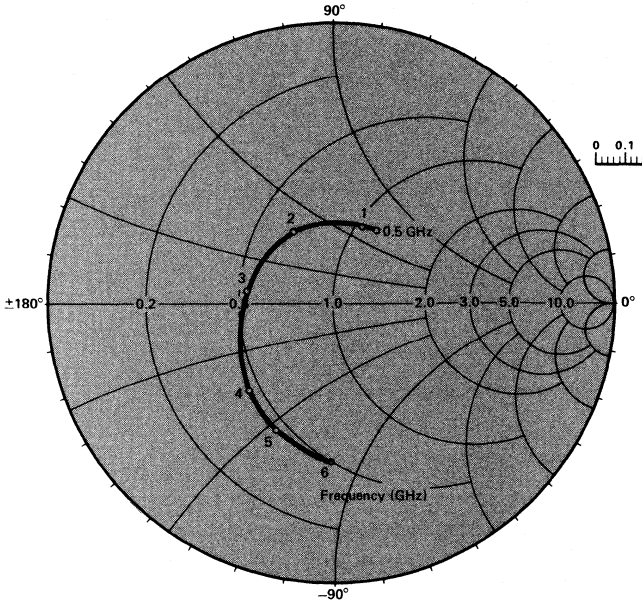


Figure 7. Typical Γ_o vs. Frequency Data for V_{CE} = 10V, I_C = 5 mA.

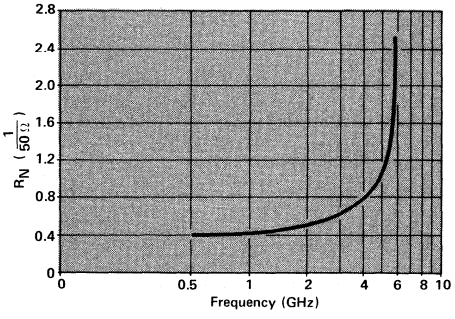


Figure 8. Typical R_N vs. Frequency Data for V_{CE} = 10V, I_C = 5 mA.

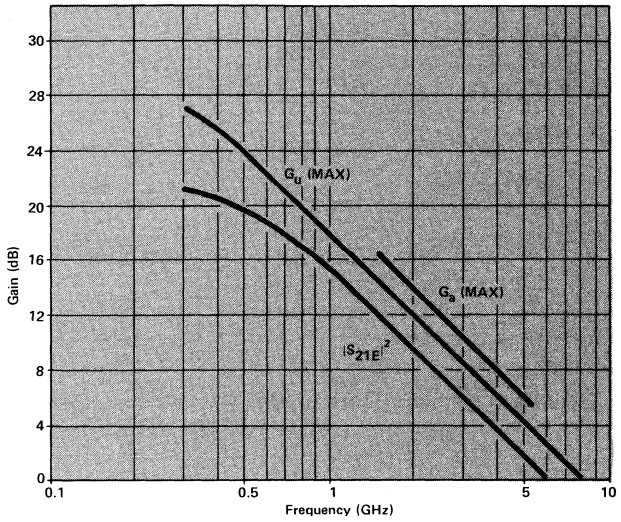


Figure 9. Typical Gain vs. Frequency Data for V_{CE} = 10V, I_C = 10 mA.

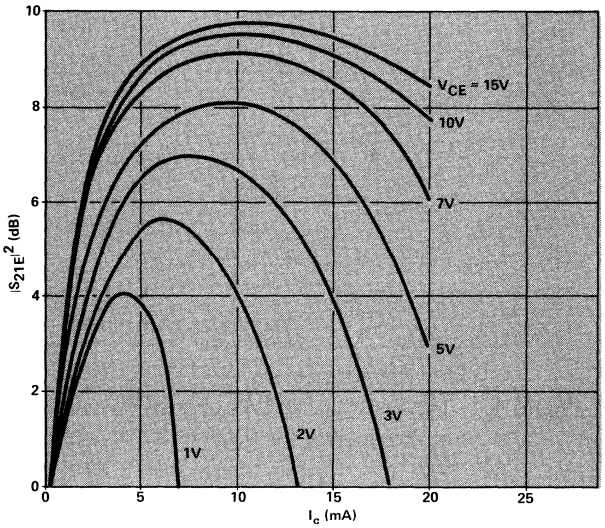


Figure 10. Typical S_{21E} vs. Bias Data at 2 GHz.

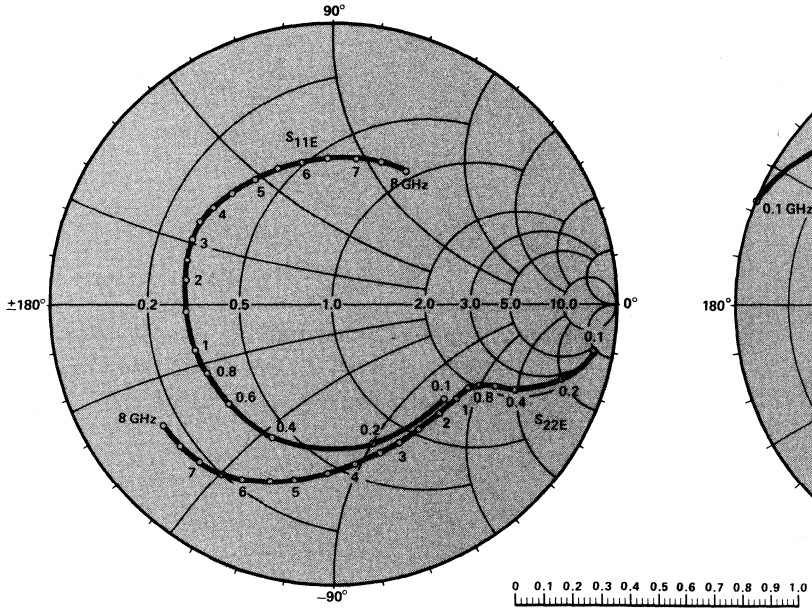


Figure 11. Typical S_{11E}, S_{22E} vs. Frequency Data for V_{CE} = 10V, I_C = 10 mA.

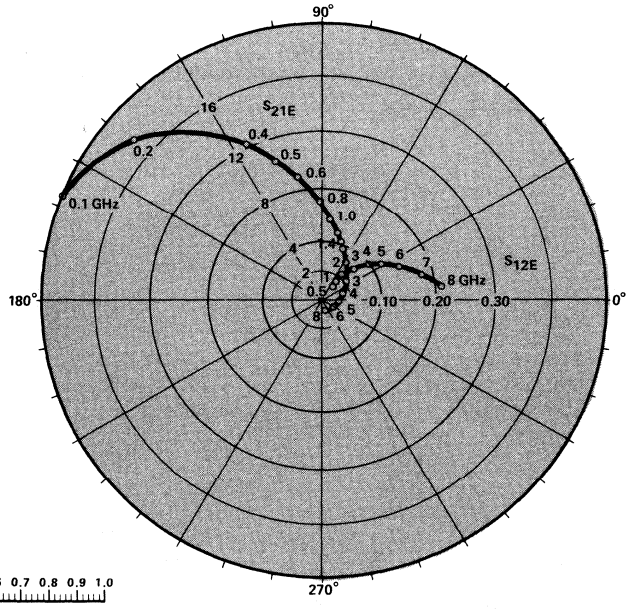


Figure 12. Typical S_{21E}, S_{12E} vs. Frequency Data for V_{CE} = 10V, I_C = 10 mA.

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COMPONENTS

MICROWAVE TRANSISTOR

models
35867B
35867E



Features

- Coaxial Structure
- Usable to 8GHz
- Usable as Oscillator or Amplifier

Description

The HP 35867 is a small signal NPN silicon bipolar transistor available in a high performance coaxial package. The 35867B is a common base version (base connected to the ring, emitter connected to the lid) and the 35867E is a common emitter version (emitter connected to the ring, base connected to the lid).

Applications

Intended for use in microwave oscillator and amplifier applications, the package is designed to fit directly into coaxial transmission line structures. With an f_{max} of 13 GHz, the 35867E is usable to 8 GHz. Both the 35867E and the 35867B are capable of 10 mW output power at 6 GHz.

Electrical Specifications (T_A = 25°C)				35867B			35867E		
Symbols	**Parameters and Test Conditions**		**Units**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**
BV_{CBO}	Collector-Base Breakdown Voltage at I_C = 100 μA		Volts	20	30		20	30	
BV_{CEO}	Collector-Emitter Breakdown Voltage at I_C = 500 μA		Volts	15	20		15	20	
I_{CBO}	Collector Cutoff Current at V_{CB} = 10 V		μA			1.0			1.0
h_{FE}	Forward Current Transfer Ratio at V_{CE} = 10 V, I_C = 10 mA			20	80	150	20	80	150
f_{max}	Frequency at which G_a(max) = 0 dB at V_{CE} = 10 V, I_C = 10 mA		GHz					13.0	
f_t	Frequency at which $\|S_{21}\|^2$ = 0 dB at V_{CE} = 10 V, I_C = 10 mA		GHz					6.2	
$\|S_{21}\|^2$	Transducer Power Gain at V_{CE} = 10 V, I_C = 10 mA	f = 2 GHz f = 4 GHz	dB dB				8.0 2.0	9.8 3.8	
G_a(max)	Maximum Available Gain at V_{CE} = 10 V, I_C = 10 mA	f = 2 GHz f = 4 GHz f = 6 GHz f = 8 GHz	dB dB dB dB					14.2 9.0 6.0 3.7	
P_{out}	Saturated Output Power (3 dB Amplifier Gain) at V_{CB} = 15 V, I_C = 20 mA	f = 4 GHz f = 6 GHz	mW mW		20 10			20 10	

NOTE: All DC tests performed per MIL-STD-750

Absolute Maximum Ratings

(Case Temperature = 25°C)

Symbols	Parameters	Limits
V_{CBO}	Collector to Base Voltage	20 V
V_{CEO}	Collector to Emitter Voltage	15 V
V_{EBO}	Emitter to Base Voltage	1.5 V
I_C	Collector Current	20 mA
P_T	Total Device Dissipation	300 mW
T_j	Junction Temperature	175°C
T_{STG}	Storage Temperature	−65°C to +200°C
—	Thermal Resistance Junction to Collector Post Junction to Ring	80°C/watt 140°C/watt
—	Hermeticity	5×10^{-8} cc/sec of He
T_C	Operating Case Temperature	See Derating Curve
—	Lead Temperature (Soldering, 10 seconds each lead)	+250°C

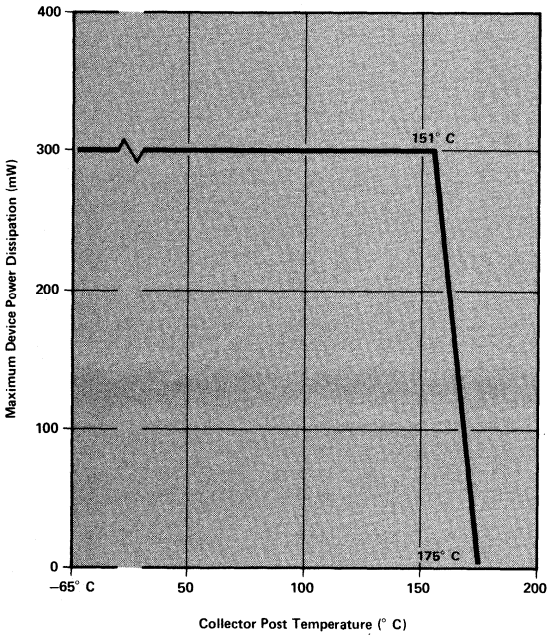


Figure 1. *Power Derating Curve.*

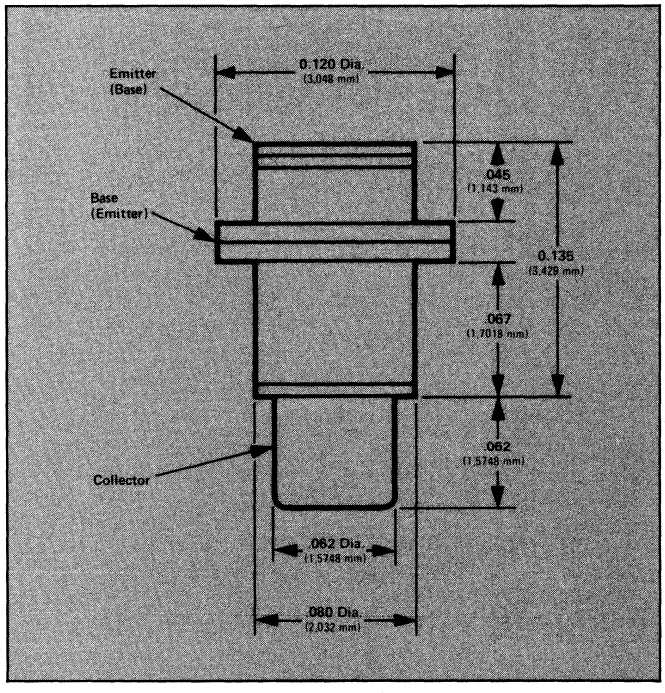


Figure 2. *Package Outline Drawing for 35867B (35867E).*

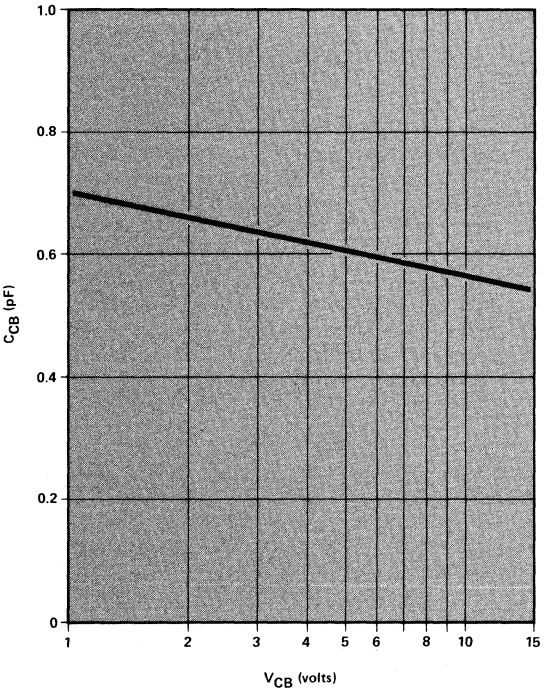


Figure 3. *Typical Collector-Base Capacitance vs. Voltage.*

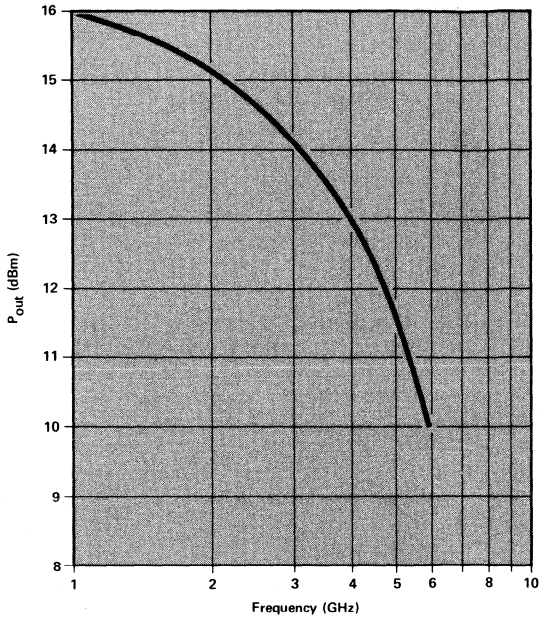


Figure 4. *Typical Saturated Output Power vs. Frequency for $V_{CB} = 15$ V, $I_C = 20$ mA.*

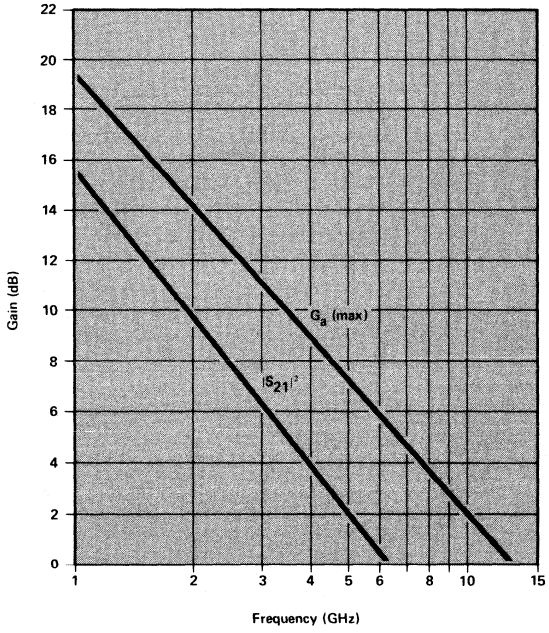


Figure 5. *35867E: Typical Gain vs. Frequency Data for $V_{CE} = 10$ V, $I_C = 10$ mA.*

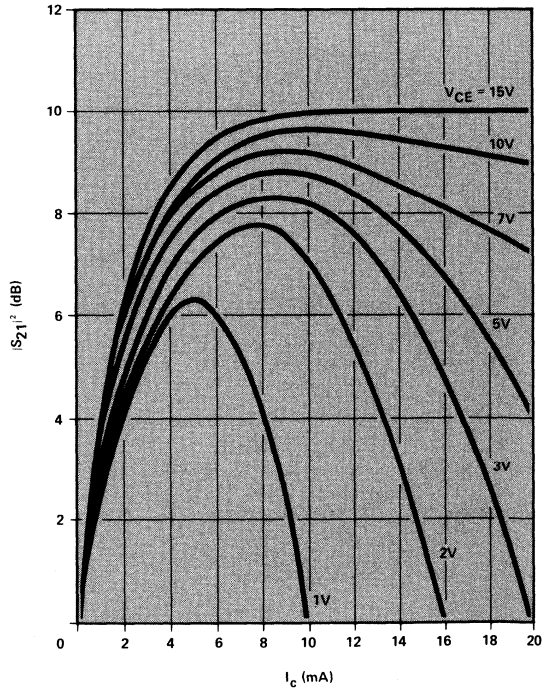


Figure 6. *35867E: Typical S_{21} vs. Bias Data at 2 GHz.*

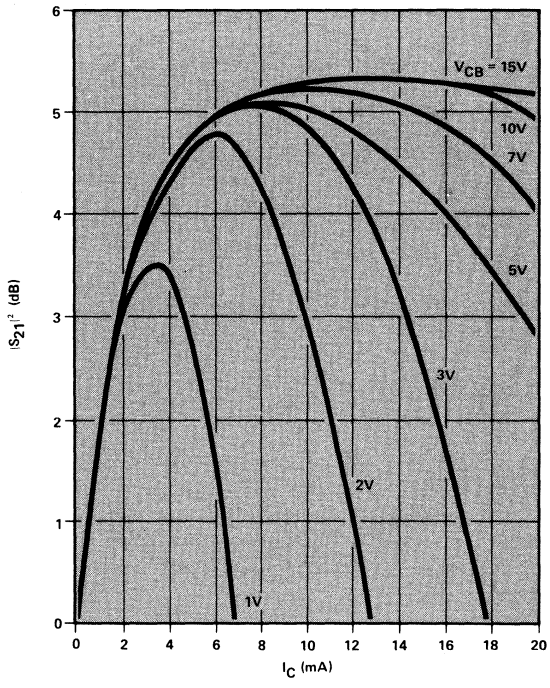


Figure 7. *35867B: Typical S_{21} vs. Bias Data at 2 GHz.*

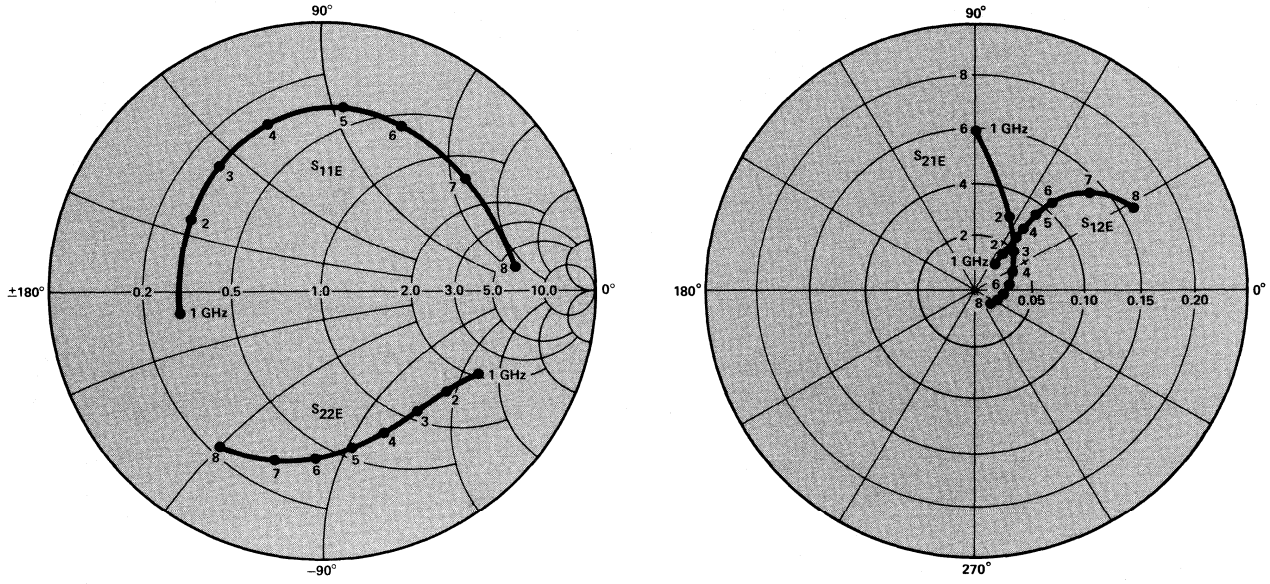


Figure 8. *35867E: Typical S-Parameters vs. Frequency for V_{CE} = 10 V, I_C = 10 mA.*

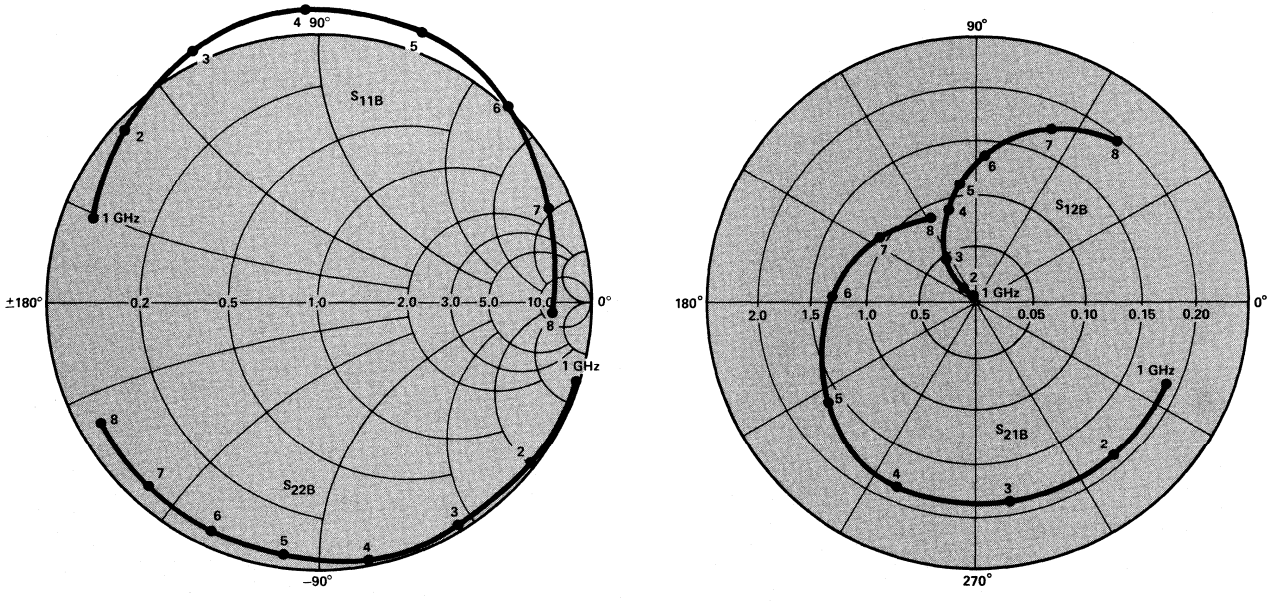
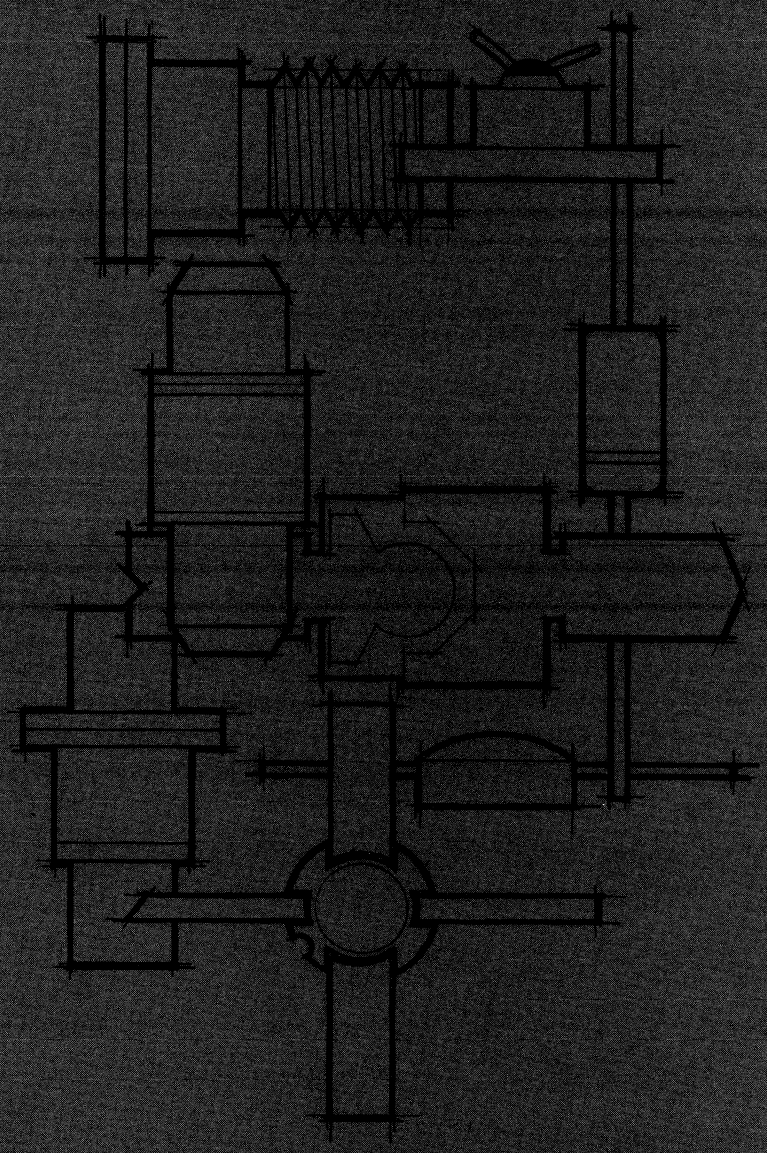


Figure 9. *35867B: Typical S-Parameters vs. Frequency for V_{CB} = 10 V, I_C = 10 mA.*



General Purpose Schottky and High Conductance Diodes

Selection Guide 36

Schottky Diodes for Fast Switching, RF Mixing and Detecting 37

High Conductance Diodes for Fast Switching 59

General Purpose, Switching and RF Specified Schottky Barrier Diodes

Glass Package Style 15



PART NUMBER 5082-	MIN. V_{BR} I_R = 10μA [V]	MAX. C_T (0) f = 1.0MHz [pF]	MAX. V_F I_F = 1.0mA [V]	MIN. I_F V_F = 1.0V [mA]	MAX. I_R		PAGE NO.
					I_R [μA]	V_R [V]	
2835	5 (100μA)	1.0	.32	100 (Typ.)	0.1	1.0	53
2900	10	1.2	.40	20	0.1	5.0	57
2811	15	1.2	.41	20	0.1	8.0	41
2824 [1]	15	1.2 (Typ.)	.41 (Typ.)	35 (Typ.)	0.1	15.0	47
2817 [2]	15	1.2 (Typ.)	.41 (Typ.)	35 (Typ.)	0.1	15.0	47
2303	20	1.2	.40	35	0.5	15.0	37
2810	20	1.2	.41	35	0.1	15.0	41
2302	30	1.0	.40	35	0.3	15.0	37
2301	30	1.0	.40	50	0.3	15.0	37
2305	30	1.0	.40	75	0.3	15.0	37
2800	70	2.0	.41	35	0.2	50.0	41

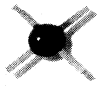
NOTES: 1. RF Specified: Min. TSS = −56dB, Min. α = 6.0mV/mW, R_V = 1.2 −1.5 kΩ.
2. RF Specified: Max. NF = 6dB, Max. VSWR 1.8:1, Z_{IF} = 250-400 Ω.

General Purpose Schottky Barrier Devices for Hybrid Integrated Circuits

STANDARD PART NO. 5082-	CHIP PART NO. 5082-	PAGE NO.	LID PART NO. 5082-	PAGE NO.	MINISTRIP PART NO. 5082-	PAGE NO.	BEAM LEAD PART NO. 5082-	PAGE NO.
2835	0031	143	*		*		N/A	
2811	0097	143	2844	143	2845	143	N/A	
2810	0087	143	*		*		N/A	
2800	0024	143	2802	143	2801	143	2837	55, 143

*Contact your local HP sales office.

Schottky Barrier Double Balanced Mixer Ring Quad



PART NUMBER 5082-	MAX. ΔC_j V_R = 0 [pF]	MAX. V_F I_F = 1mA [V]	MAX. ΔV_F I_F = 5mA [V]	MAX. L_C f = 1GHz P_{LO} = 10mW I_F = 30 MHz [nH]	PACKAGE STYLE	PAGE NO.
2830	.20	.40	20	4.0	E-1	51

High Conductance Diodes

Package Style DO - 7



PART NUMBER 5082-	MIN. V_{BR} I_R = 10μA [V]	MAX. C_T (0) f = 1.0MHz [pF]	MIN. I_F V_F = 1.4V [mA]	MIN. I_F V_F = 1.0V [mA]	MAX. I_R		PAGE NO.
					I_R [mA]	V_R [V]	
1003	25	2.0	300	100	0.2	20.0	59
1004	25	4.0	600	200	0.2	20.0	59
1N4456, 1001	35	1.5	500	150	0.2	30.0	59
1002	35	3.0	800	300	0.2	30.0	59
1N4457, 1006	50	1.1	500	150	0.2	35.0	59

HEWLETT hp PACKARD

SCHOTTKY DIODES

5082-2300 SERIES

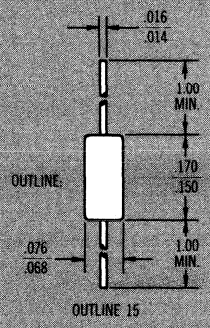


Figure 1a

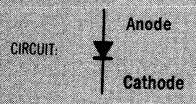


Figure 1b

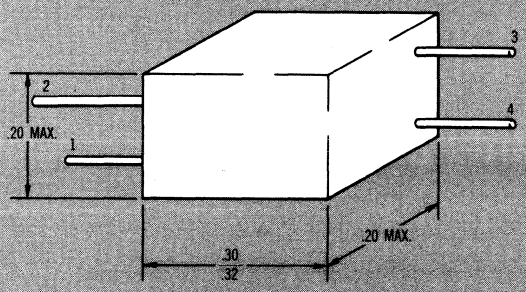


Figure 2

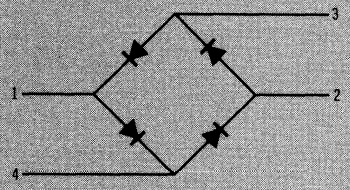


Figure 3

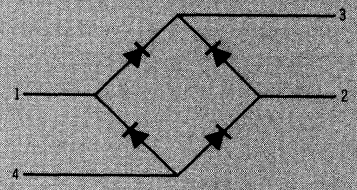


Figure 4

All dimensions in inches

Features

FAST SWITCHING—Picosecond switching speed for use in high speed digital or logic circuits.

LOW 1/F NOISE—Excellent for use in Doppler or narrow band video receivers.

EXCELLENT ENVIRONMENTAL CAPABILITIES—Proven high reliability in major space and military programs.

Description

The HP 5082-2300 series of hot carrier diodes employ a metal-silicon Schottky barrier junction and utilize electrons for majority carrier conduction. The hot carrier diode's performance conforms closely with theory and can be described as closely approximating the ideal diode.

Applications

This series is intended for use in applications requiring the ultimate in performance and reliability. Extensive testing has shown that these devices exhibit the design capability necessary to meet the special reliability requirements of man-rated space systems in addition to the general requirements of MIL-S-19500.

In pulse operations the diode is ideal for clamping, sampling gates, pulse shaping and general purpose usage requiring fractional picosecond switching times.

In the RF area, the hot carrier diode makes an excellent low noise mixer, high sensitivity small signal detector, large signal detector (power monitor) with broad dynamic range, limiter, discriminator and balanced modulator from low frequencies well into the microwave range.

Electrical Specifications at T_A=25°C

Single Diodes

Characteristics	Symbol	HP 2305		HP 2301		HP 2302		HP 2303		Units	Test Conditions
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		
Breakdown Voltage	V_{BR}	30	—	30	—	30	—	20	—	V	$I_R = 10\ \mu A$
Reverse Current	I_R	—	300	—	300	—	300	—	500	nA	$V_R = 15$ V
Forward Current	I_{F_1}	1.0	—	1.0	—	1.0	—	1.0	—	mA	$V_{F_1} = 0.4$ V max. (Note 1)
Forward Current	I_{F_2}	75	—	50	—	35	—	35	—	mA	$V_{F_2} = 1.0$ V max. (Note 1)
Capacitance	C_O	—	1.0	—	1.0	—	1.0	—	1.2	pF	$V_R = 0$ V; f = 1.0 MHz
Effective Minority Carrier Lifetime	τ	—	100	—	100	—	100	—	100	ps	Figure 8

Note 1: The test condition and specification are interchanged to make the tabulation easier to read. The actual test condition is forward current; the actual specification is forward voltage. The forward current is limited to prevent thermal runaway.

Matched Pairs and Quads

HP Type Number	HP 2306	HP 2308	HP 2370	HP 2396	HP 2356
Description	Matched pair of HPA 2301, unencapsulated and unconnected.	Matched pair of HPA 2303, unencapsulated and unconnected.	Matched Quad, unencapsulated and unconnected.	Matched Ring Quad, Epoxy encapsulated.	Matched Bridge Quad, Epoxy encapsulated.
Outline	Fig. 1a	Fig. 1a	Fig. 1a	Fig. 2	Fig. 2
Circuit	Fig. 1b	Fig. 1b	Fig. 1b	Fig. 3	Fig. 4

Characteristics	Symbol	HP 2306		HP 2308		HP 2370		HP 2396		HP 2356		Units	Test Conditions
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		
Breakdown Voltage	V_{BR}	30	—	20	—	20	—	*	—	*	—	V	$I_R = 10\ \mu A$
Reverse Current	I_R	—	300	—	500	—	500	—	*	—	*	nA	$V_R = 15$ V
Forward Current	I_{F_1}	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	mA	$V_{F_1} = 0.4$ V max. (Note 1)
Forward Current	I_{F_2}	50	—	35	—	35	—	35	—	35	—	mA	$V_{F_2} = 1.0$ V max. (Note 1)
Forward Voltage Match**	ΔV_F	—	20	—	20	—	20	—	20	—	20	mV	I_F = 0.75 to 20 mA
Capacitance	C_O	—	1.0	—	1.2	—	1.0	—	*	—	*	pF	$V_R = 0$, f = 1.0 MHz
Capacitance Match**	ΔC_O	—	0.2	—	0.2	—	0.2	—	0.2	—	0.2	pF	$V_R = 0$, f = 1.0 MHz
Effective Minority Carrier Lifetime	τ	—	100	—	100	—	100	—	*	—	*	ps	Figure 8

Note 1: The test condition and specification are interchanged to make the tabulation easier to read. The actual test condition is forward current; the actual specification is forward voltage. The forward current is limited to prevent thermal runaway.

* Breakdown voltage, reverse current, capacitance, and effective minority carrier lifetime cannot be readily verified after assembly and encapsulation because of the shunting effect of the other diodes. The encapsulated quads have the same parameter values as the HP 2370 unencapsulated quad prior to assembly and encapsulation.

** Quads and pairs having additional and/or tighter matching are available upon request. Please contact the local HP field sales office.

Absolute Maximum Ratings

T_{OPR}—Operating Temperature Range.....— 60°C to + 125°C
T_{STG}—Storage Temperature Range.....— 60°C to + 125°C
P_{DISS}—DC Power Dissipation ($T_A = 25°C$).....125 mW
Derate linearly to zero at 125°C
U—Burnout (3 pulses with a 10 ns maximum pulse width; 20% allowable V_{BR} degradation; $T_A = 25°C$).....5 ergs

Package

The HP Outline 15 package has a glass hermetic seal with dumet leads. The leads on the Outline 15 package should be restricted so that the bend starts at least 1/16 inch from the glass body. With this restriction OD-18 package will meet MIL-STD-750, Method 2036, Conditions A and E (4 lbs. tension for 30 minutes). The maximum soldering temperature is 230°C for 5 seconds.

Outline 15 package capacitance and inductance is typically 0.07 pF and 3 nH respectively.

Marking is by digital coding with a cathode band.

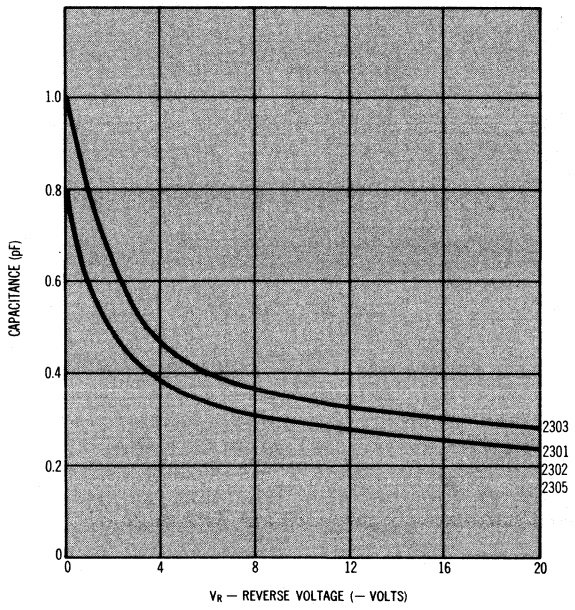


Figure 5. HP 2300 series typical capacitance vs. reverse voltage at $T_A = 25°C$.

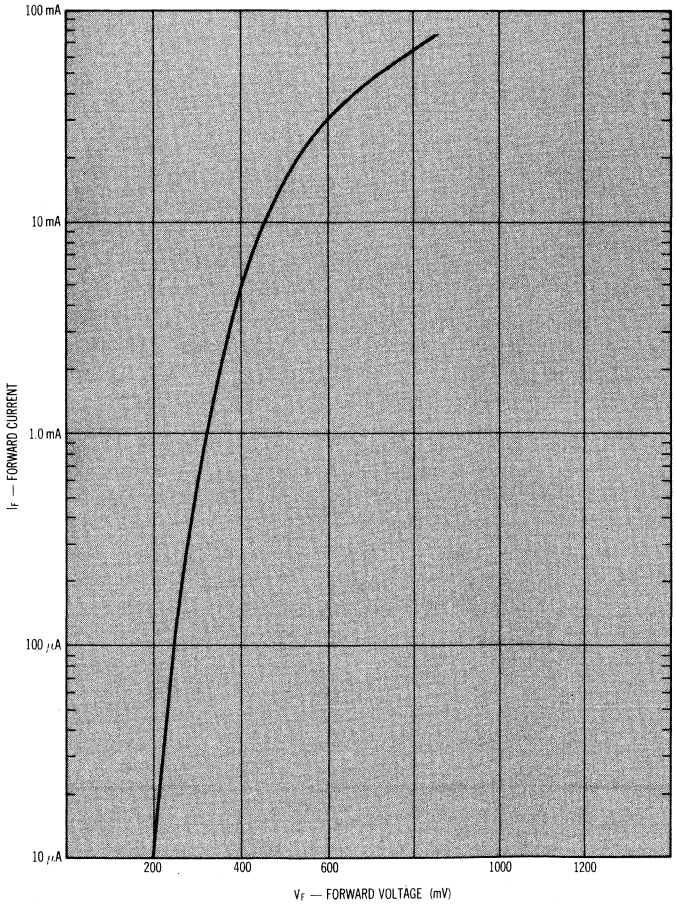


Figure 6. HP 2300 series typical forward current vs. forward voltage at $T_A = 25°C$.

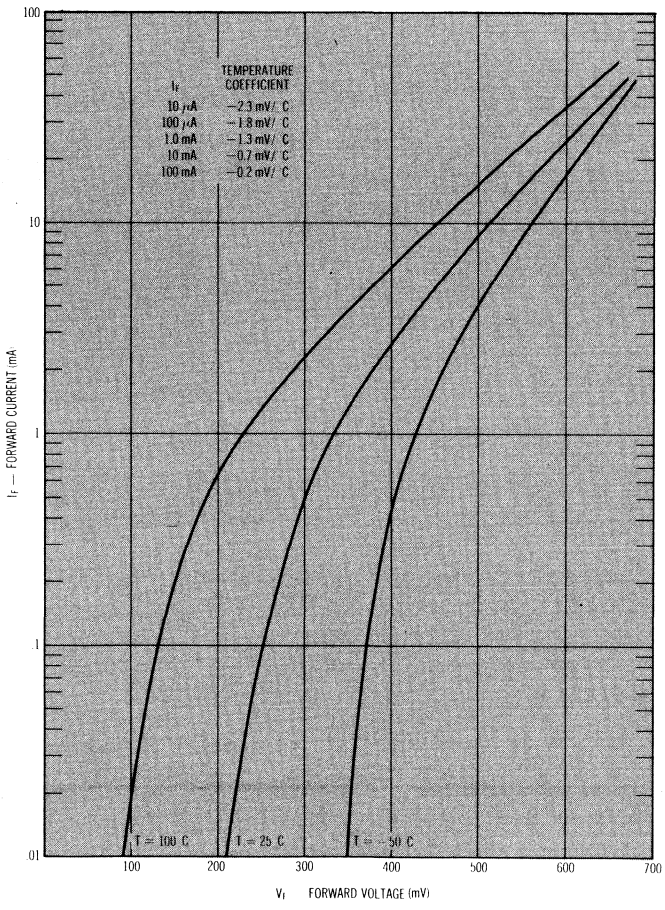


Figure 7. I-V curve showing typical temperature variation for HP 2300 series Hot Carrier Diodes.

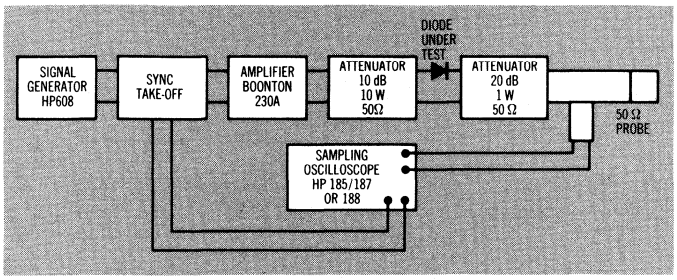


Figure 8a. Test setup.

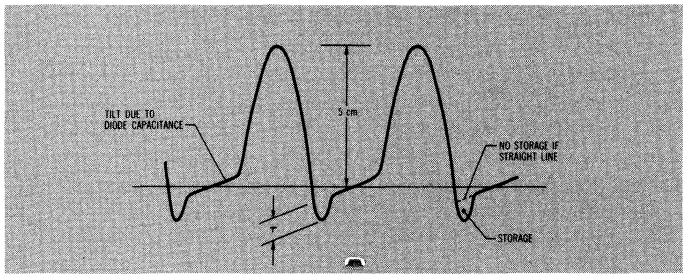


Figure 8b. Resulting oscilloscope display.

Figure 8. Effective minority carrier lifetime measurement.

The signal generator and power amplifier are adjusted to 54 MHz and the output level at 10 V RMS as read on the power amplifier meter. The sampling oscilloscope is adjusted so that the peak deflection corresponding to forward current is 5 cm or 20 mA, where 20 mV/cm = 4.0 mA/cm. Under these conditions, minority carrier lifetime is related to the amplitude designated as "τ" such that 1 cm corresponds to 500 ps. This scale will be linear to about 1.5 cm.

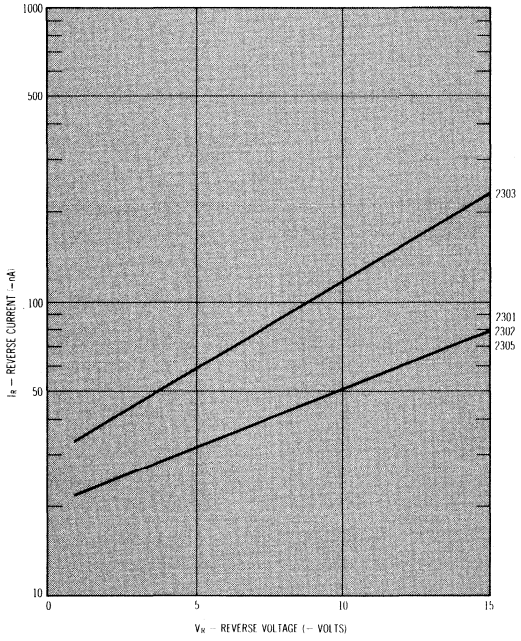


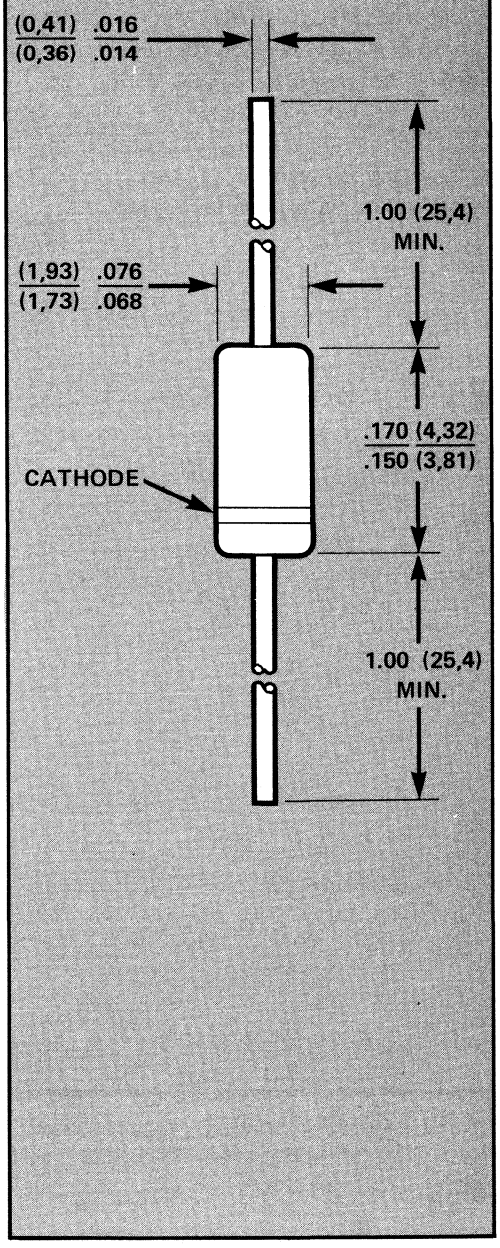
Figure 9. HP 2300 series typical reverse current vs. reverse voltage at $T_A = 25°C$.

HEWLETT hp PACKARD

COMPONENTS

SCHOTTKY BARRIER DIODES

5082-2800 Series



Features

- **LOW COST**
  Attractively priced for all general purpose applications
- **FAST SWITCHING**
  Picosecond switching speed for high speed digital or logic circuits.
- **HIGH BREAKDOWN**
  70 volts breakdown allows high voltages in sampling gates, and wide dynamic range capability as UHF detector.
- **EXCELLENT ENVIRONMENTAL CAPABILITIES**
  200°C operating temperature. 20,000G shock capability and overall ruggedness makes the 2800 family attractive for any military or other high reliability program.

Description

The HP 5082-2800 series is an epitaxial, planar, passivated diode whose construction utilizes a unique combination of both a conventional PN junction and a Schottky barrier. The manufacturing process (Patent No. 3463971), results in a device which has the high breakdown and temperature characteristics of a silicon PN junction and the turn-on voltage and speed of a silicon Schottky barrier, majority carrier device.

Applications

High level detection, switching, or gating; LOG or A-D converting; video detecting, audio detecting, frequency discriminating, sampling or wave shaping are jobs the 2800 family will do better than conventional PN junction diodes. The low turn-on voltage and subnanosecond switching makes it extremely attractive in digital circuits for DTL gates, pulse shaping circuits or other low level applications. Its high PIV allows wide dynamic range for fast high voltage sampling gates.

The 2800's low turn-on voltage gives low offsets. The extremely low stored charge minimizes output offsets caused by the charge flow in the storage capacitor. At UHF, the diodes exhibit 95% rectification efficiencies. Both their low loss and their high PIV allow the diodes to be used in mixer and modulator applications which require wide dynamic ranges.

The combination of these technical features with the low price make these devices the prime consideration for any dc or RF circuit requiring nonlinear elements.

Absolute Maximum Ratings

5082-2800 Series

P_{diss}	Power Dissipation at $T_A = 25°C$	250 mW (Note 1)
	Derate 1.43 mW/°C for $T_A = 25°C$ to 200°C	
T_A	Operating Temp. Range	−65 to +200°C
T_{STG}	Storage Temp. Range	−65 to +200°C

Note 1. As measured using an infinite heat sink.

Mechanical Specifications

The HP Outline 15 package has a glass hermetic seal with dumet leads. The leads on the Outline 15 package should be restricted so that the bend starts at least 1/16 inch (1.6 mm) from the glass body. With this restriction, Outline 15 package will meet MIL-STD-750, Method 2036, Conditions A and E [4 lb (1,8) kg)] tension for 30 minutes. The maximum soldering temperature is 230°C for five seconds.

Outline 15 package inductance and capacitance is typically 2.3 nH and 0.17 pF, respectively.

Marking is by digital coding with a cathode band.

Electrical Specifications at T_A=25°C

Diode Type	Specification	Symbol	Min	Max	Units	Test Conditions
5082-2800 2810 2811	Breakdown Voltage	V_{BR}	70 20 15		Volts	$I_R = 10\ \mu A$
5082-2800 2810 2811	Forward Voltage	V_{F1}		410 410 410	mV	$I_{F1} = 1$ mA
5082-2800 2810 2811	Forward Current	I_{F1}	15 35 20		mA	$V_{F2} = 1$ volt (note 1)
5082-2800 2810 2811	Reverse Leakage Current	I_R		200 100 100	nA	$V_R = 50$ V $V_R = 15$ V $V_R = 8$ V
5082-2800 2810 2811	Capacitance	$C_{T(o)}$		2.0 1.2 1.2	pF	$V_R = 0$ V and f = 1 MHz
5082-2800 2810 2811	Effective Minority Carrier Lifetime	τ		100 100 100	p sec	$I_F = 5$ mA Krakauer Method

Note 1: The test condition and specification are interchanged to make the tabulation easier to read. The actual test condition is forward current; the actual specification is forward voltage. The forward current is limited to prevent thermal runaway.

MATCHED PAIRS AND QUADS

		5082-2804	5082-2805	5082-2813	5082-2814	5082-2815
Specification	**Symbol**	**Matched Pair Unconnected of 5082-2800**	**Matched Quad Unconnected of 5082-2800**	**Matched Bridge Quad Encapsulated of 5082-2811**	**Matched Ring Quad Encapsulated of 5082-2811**	**Matched Quad Unconnected of 5082-2811**
Forward Voltage Match *	ΔV_F	20 mV at $I_F = 0.5\text{-}5$ mA	20 mV at $I_F = 0.5\text{-}5$ mA.	20 mV at $I_F = 1\text{-}10$ mA	20 mV at $I_F = 1\text{-}10$ mA	20 mV at $I_F = 1\text{-}10$ mA
Package Outline		Fig. 1A	Fig. 1A	Fig. 2A	Fig. 3A	Fig. 1A
Circuit		Fig. 1B	Fig. 1B	Fig. 2B	Fig. 3B	Fig. 1B

* Breakdown voltage, reverse current, capacitance, and effective minority carrier lifetime cannot be readily verified after assembly and encapsulated because of the shunting effect of the other diodes. The encapsulated guads have the same parameter values as the HP 5082-2815 unencapsulated quad prior to assembly and encapsulation.

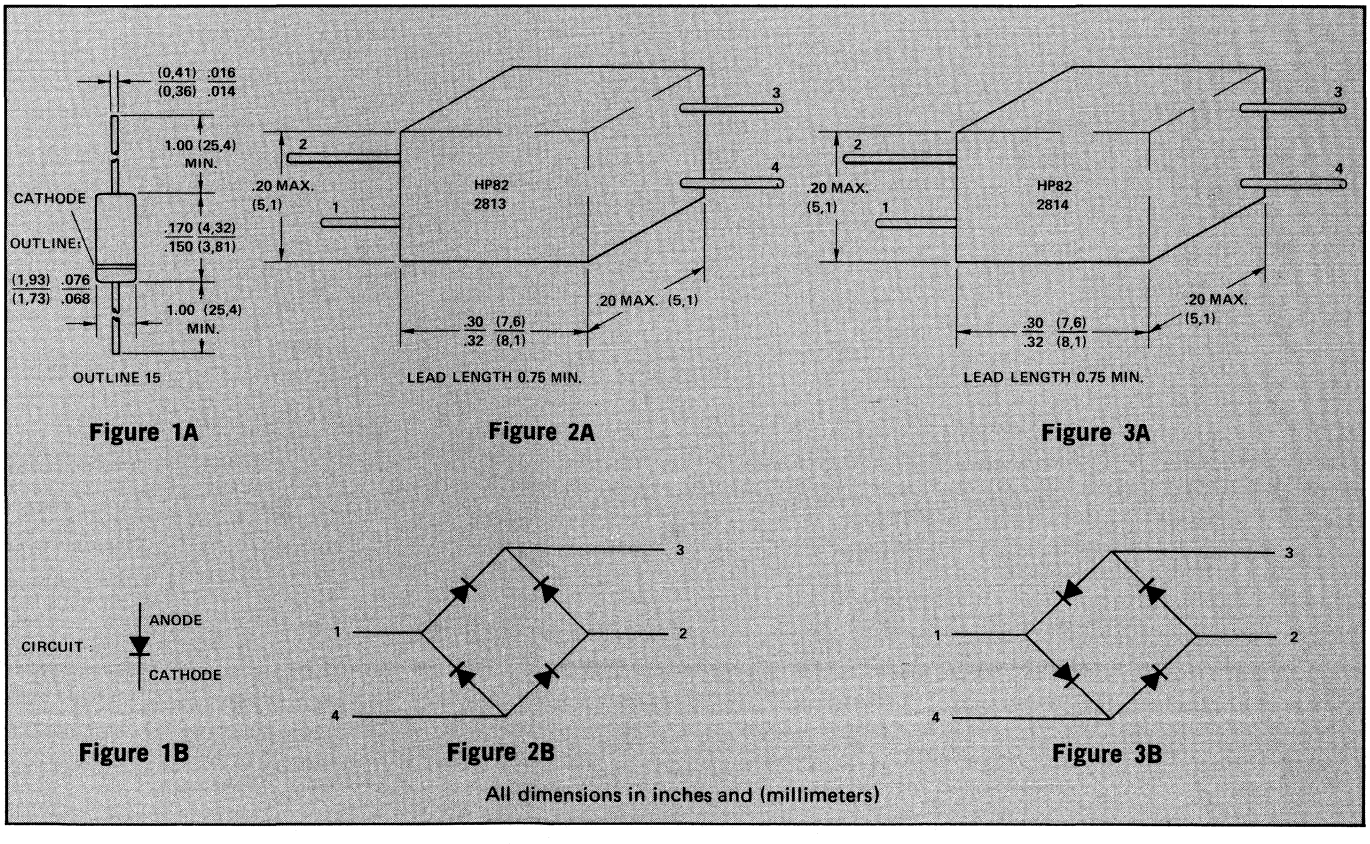


Figure 1A

Figure 2A

Figure 3A

Figure 1B

Figure 2B

Figure 3B

All dimensions in inches and (millimeters)

Environmental Capabilities

	MIL-STD-750 Reference	Conditions
Temperature, Storage	1031	−65°C to +200°C
Temperature, Operating		−65°C to +200°C
Solderability	2026	230°C as applicable
Temperature, Cycling	1051	5 cycles, −65°C to +200°C
Thermal Shock	1056	5 cycles, 0-100°C
Moisture Resistance	1021	10 days, 90-98% RH
Shock	2016	5 blows, X_1, Y_1, Y_2 at 1500 G
Vibration Fatigue	2046	32 hrs, X_1, Y_1, Z_1 at 20 G min.
Vibration Variable Frequency	2056	Four 4-min. cycles, X, Y, Z at 20 G min., 100 to 2000 Hz
Constant Acceleration	2006	X_1, Y_1, Y_2, at 20,000 G
Terminal Strength	2036	See mechanical specifications
Salt Atmosphere	1041	35°C fog for 24 hours

Reliability

The HP 5082-2800 series is suitable for high reliability space applications where maximum performance under the most adverse conditions is required. Maintenance of product reliability during manufacture has resulted in the use of HP diodes in major aerospace and national defense programs.

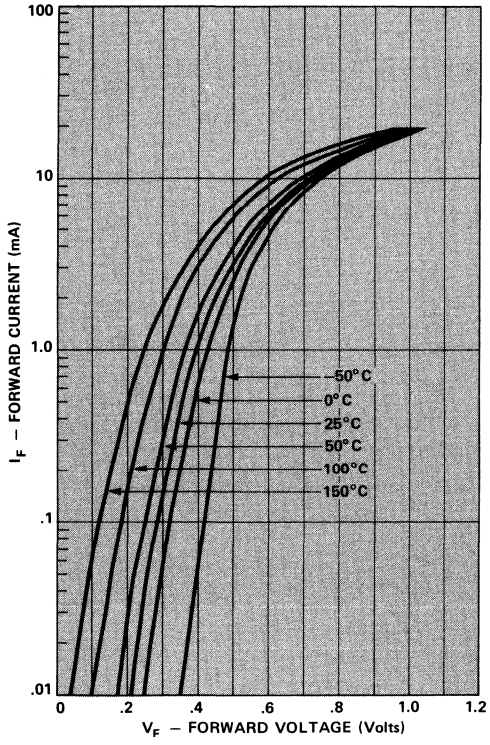


Figure 4. (5082-2800) Typical variation of forward current (I_F) vs. forward voltage (V_F) at various temperatures.

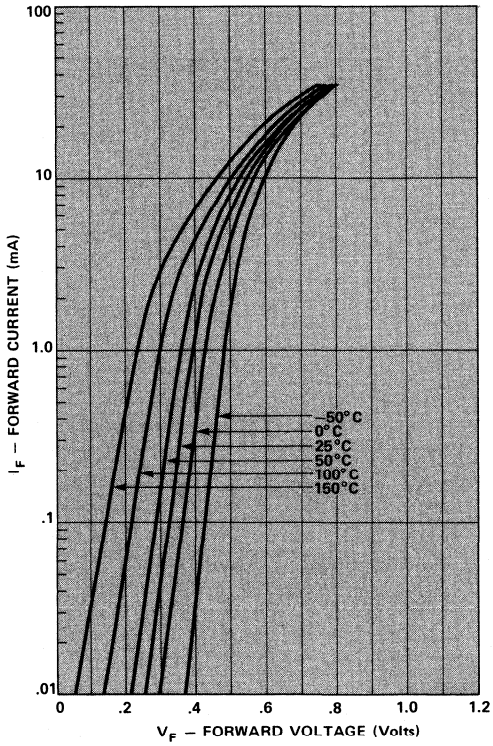


Figure 5. (5082-2810) Typical variation of forward current (I_F) vs. forward voltage (V_F) at various temperatures.

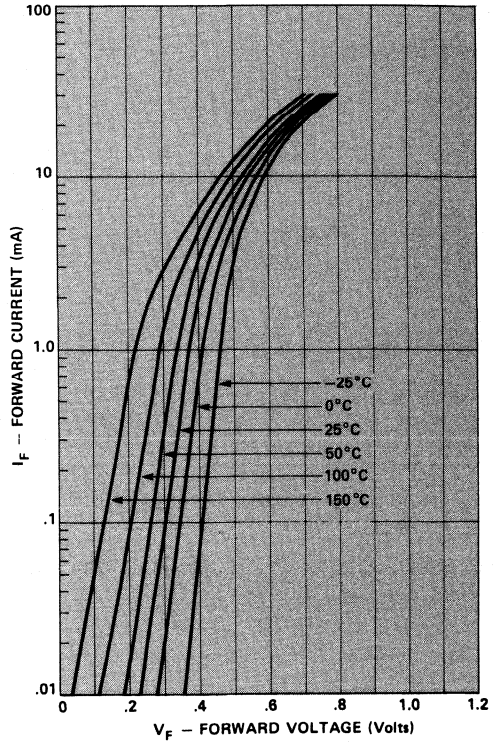


Figure 6. (5082-2811) Typical variation of forward current (I_F) vs. forward voltage (V_F) at various temperatures.

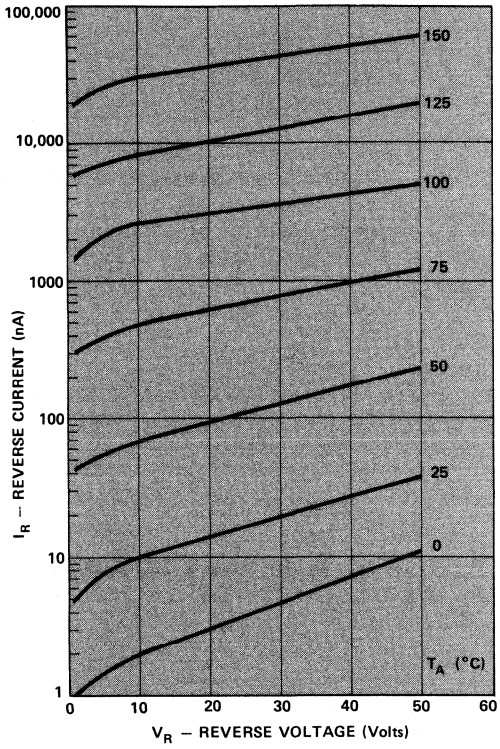


Figure 7. (5082-2800) Typical variation of reverse current (I_R) vs. reverse voltage (V_R) at various temperatures.

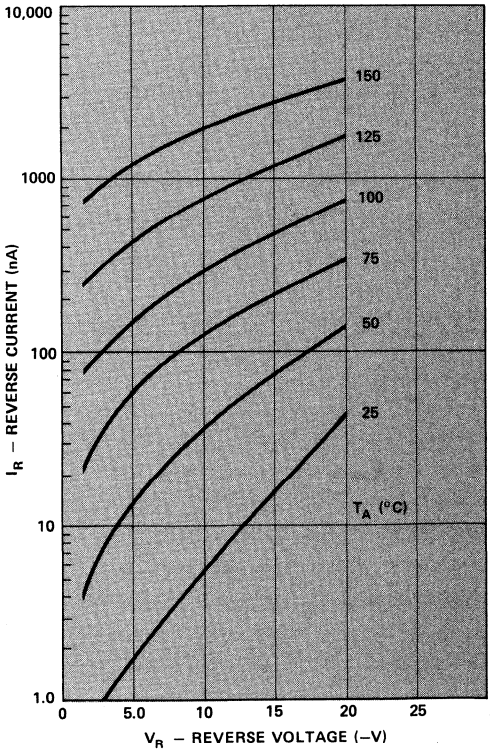


Figure 8. (5082-2810) Typical variation of reverse current (I_R) vs. reverse voltage (V_R) at various temperatures.

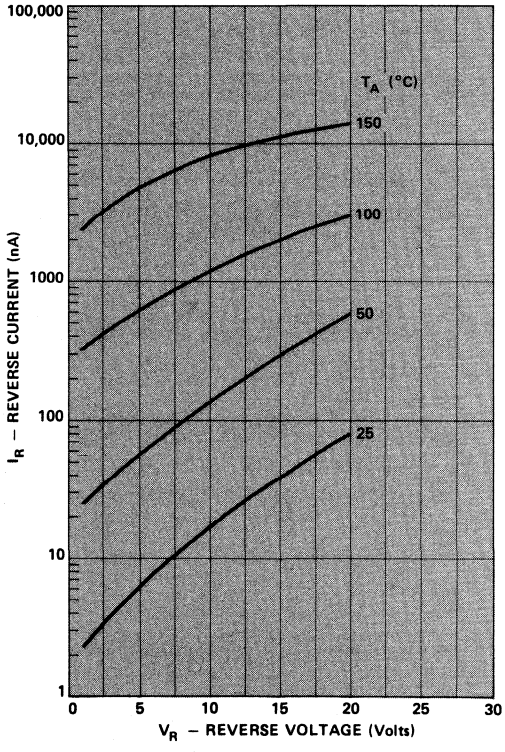


Figure 9. (5082-2811) Typical variation of reverse current (I_R) vs. reverse voltage (V_R) at various temperatures.

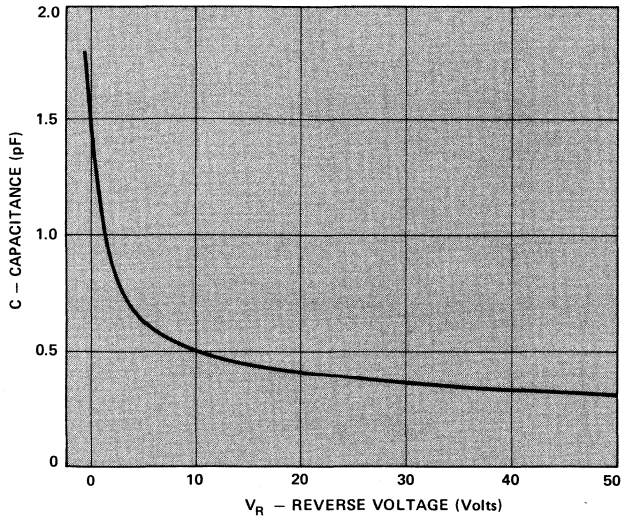


Figure 10. (5082-2800) Typical capacitance (C) vs. reverse voltage (V_R) at T_A = 25°C.

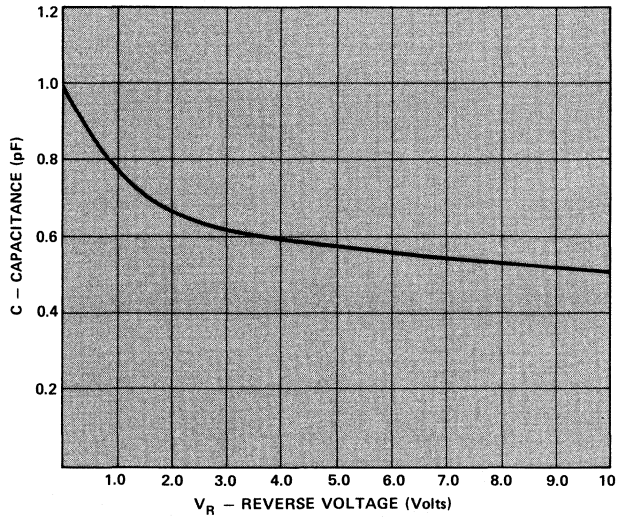


Figure 11. (5082-2810) Typical capacitance (C) vs. reverse voltage (V_R) at T_A = 25°C.

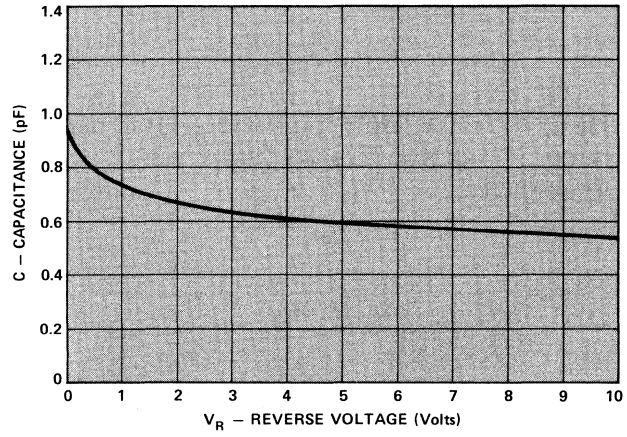


Figure 12. (5082-2811) Typical Capacitance (C) vs. reverse voltage (V_R) at T_A = 25°C.

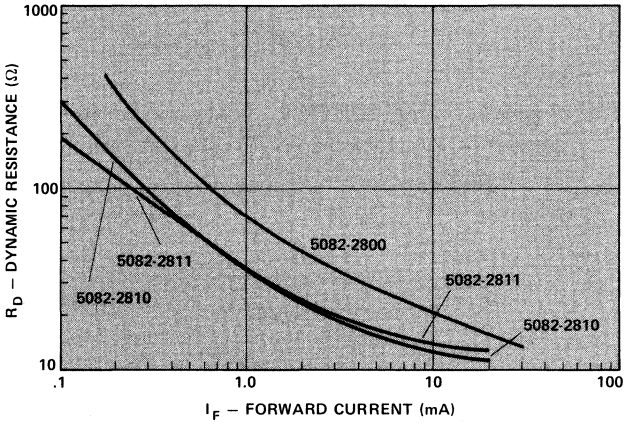


Figure 13. Typical dynamic resistance (R_D) vs. forward current (I_F) at T_A = 25°C.

BATCH MATCHED DIODES FOR VOLUME APPLICATIONS HP 5082-2826

Description

The HP 5082-2826 is a batch matched 5082-2811. All diodes in each batch are within the specified ranges for ΔV_F and ΔC_O, and meet all of the electrical specifications of the 5082-2811.

ELECTRICAL SPECIFICATIONS

BATCH MATCHED SPECIFICATIONS 5082-2826		
Parameter	**Specification**	**Test Conditions**
ΔV_F	±5 mV	I_F = 10 mA
ΔC_o	±0.05 pF	V_R = 0, f = 1 MHz

Applications

This diode is specifically intended for applications such as double balanced mixers, ring modulators, bridges and sampling gates where a close match between two, four or more diodes is necessary to obtain maximum performance. Particularly where volume usage of these diodes is intended, the availability of relatively large quantity batches of closely matched individual diodes can result in substantial simplification and cost reduction in manufacturing.

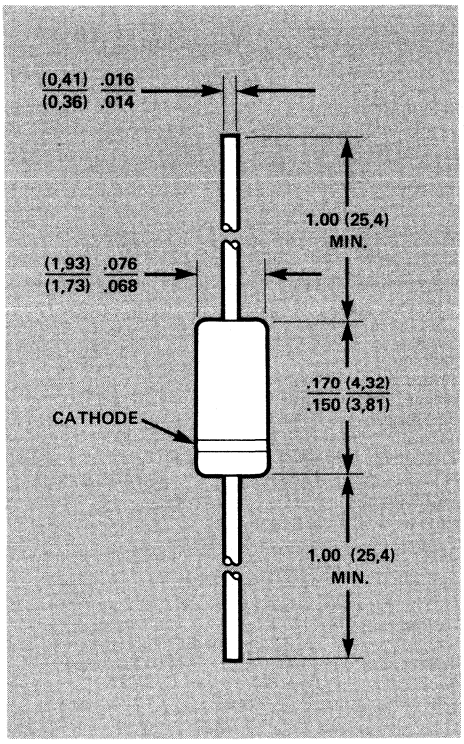
HEWLETT hp PACKARD

COMPONENTS

SCHOTTKY DIODES FOR MIXING AND DETECTING

1-2 GHz

5082-2817
5082-2818
5082-2819
5082-2824
5082-2825



Features

- **High Burnout**
  4.5 Watt burnout capability makes these diodes ideal for shipboard, airborne, or other systems where high power interference signals are present.
- **Low I/f Noise**
  8kHz noise corner frequency for 1mA dc current for Doppler mixing and low video frequency detecting.
- **Low NF for Mixer Applications**
  6dB at 2GHz and below allows this series to be used in sensitive receiver systems.
- **High TSS for Detector Applications**
  –56dBm at 2GHz makes this series a prime choice for those receivers which require high sensitivity in signal reception.
- **Excellent Environmental Capabilities**
  200° C operating temperature. 20,000 G shock capability and overall ruggedness make this family ideal for any military or other high reliability program.

Description

These microwave silicon Schottky diodes are epitaxial, planar, passivated devices of hybrid construction which utilize a unique combination of a conventional pn junction and a Schottky barrier.

This manufacturing process (Patent No. 3463971) results in a diode with greatly increased ruggedness and burnout reliability without sacrificing low noise properties.

Applications

This series is designed for use in video and superheterodyne receivers up to S-Band. They are especially useful in airborne or other severe environmental applications due to their high burnout and 20,000 G shock capabilities. Because of their high sensitivity, they are eminently suited for high performance receivers. This ruggedness and sensitivity is now available for high volume applications.

Absolute Maximum Ratings at T_A=25°C

Pulse Power Dissipation	4.5W (Notes 1,2)
CW-Power Dissipation	1W (Notes 1,3)
Peak Inverse Voltage	15V
Operating Junction Temperature Range	–65°C to +200°C
Storage Temperature Range	–65°C to +200°C

Typical Electrical Characteristics at T_A=25°C

Chip Capacitance, at V_f = 0V	0.8pF
Package Capacitance	0.17pF
Series Resistance	9Ω
Series Inductance	2.3nH (Note 4)

Electrical Specifications at T_A=25°C

5082-2817, 2818, 2819

Parameter	Min.	Typ.	Max.	Unit	Notes
Noise Figure	—	5.8	6.0	dB	5,6
VSWR	—	1.3	1.5	—	6
IF-Impedance	250	330	400	Ω	6

Model Number	Description	Matching Criteria
5082-2817	Single Diode	
5082-2818	Matched Pair	Note 7
5082-2819	Matched Quad	Note 7

5082-2824, 2825

Parameter	Min.	Typ.	Max.	Unit	Notes
Tangential Signal Sensitivity		−58	−56	dBm	8,9
Voltage Sensitivity	6.0	8.5	—	mV/μW	8
Video Output Resistance	1.2	1.35	1.5	kΩ	8

Model Number	Description	Matching Criteria
5082-2824	Single Diode	—
5082-2825	Matched Pair	Note 10

Notes:

1. Derate linearly to zero at 200°C.
2. Power absorbed by the diode.
   Frequency 2GHz
   Pulse Width 1μs
   Duty Cycle .001
   Load Resistance 38kΩ
3. Power absorbed by the diode, applied for one minute.
   Frequency 2.0GHz
   DC-load Resistance <1Ω
   The cathode lead is connected to an infinite heat sink at the plane where it leaves the glass body.
4. Series inductance of a coaxial line section consisting of the diode with short circuited chip as inner conductor and an outer conductor of 0.28 inch diameter. The geometrical length of the coaxial line is determined by the length of the glass-package body.
5. Single sideband receiver noise figure including an IF-amplifier noise figure of 1.5dB (intermediate frequency 30MHz). Noise figure guaranteed at 2GHz and below.
6. Measurement conditions are:
   The diode is inserted into a fix tuned coaxial mount.
   Local Oscillator Frequency 2.0GHz
   Local Oscillator Incident Power 1.0mW
   DC-load Resistance 100Ω
7. Noise Figure Match $\Delta F \leq 0.3$dB
   IF-Impedance Match $\Delta Z_{IF} \leq 25\Omega$
8. The measurement conditions are:
   The diode is inserted into a fix tuned coaxial mount.
   Signal Frequency f_{signal} = 2.0GHz
   DC Bias Current I_{bias} = 20μA
   Video Load Resistance R_L = 38kΩ
9. TSS is defined as incident RF power level which yields a signal to noise power ratio of 8.0dB at the video receiver output.
   Video Bandwidth Δf_{video} = 2.0MHz
   Equivalent Noise Resistance of Video Amplifier R_A = 500Ω
10. Voltage Sensitivity Match $\Delta\gamma \leq 0.5$mV/μW
    Video Resistance Match $\Delta R_v \leq 100\Omega$

Mechanical Specifications

The HP Outline 15 package has a glass hermetic seal with dumet leads. The leads on the Outline 15 package should be restricted so that the bend starts at least 1/16 inch (1,6mm) from the glass body. With this restriction, Outline 15 package will meet MIL-STD-750, Method 2036, Conditions A and E [4 lb (1,8kg)] tension for 30 minutes. The maximum soldering temperature is 230°C for five seconds.

Marking is by digital coding with a cathode band.

Reliability

This series of diodes is suitable for high reliability space applications where maximum performance under the most adverse conditions is required. Maintenance of product reliability during manufacture has resulted in the use of HP diodes in major aerospace and national defense programs.

Environmental Capabilities

	MIL-STD-750 Reference	Conditions
Temperature, Storage	1031	−65°C to +200°C
Temperature, Operating		−65°C to +200°C
Solderability	2026	230°C as applicable
Temperature, Cycling	1051	5 cycles, −65°C to +200°C
Thermal Shock	1056	5 cycles, 0-100°C
Moisture Resistance	1021	10 days, 90-98% RH
Shock	2016	5 blows, X_1, Y_1, Y_2 at 1500G
Vibration Fatigue	2046	32 hours, X_1, Y_1, Z_1, at 20G min.
Vibration Variable Frequency	2056	Four 4-min. cycles, X, Y, Z, at 20G min., 100 to 2000Hz
Constant Acceleration	2006	X_1, Y_1, Y_2, at 20,000G
Terminal Strength	2036	See mechanical specifications
Salt Atmosphere	1041	35°C fog for 24 hours

TYPICAL PERFORMANCE CURVES AT $T_A = 25°C$

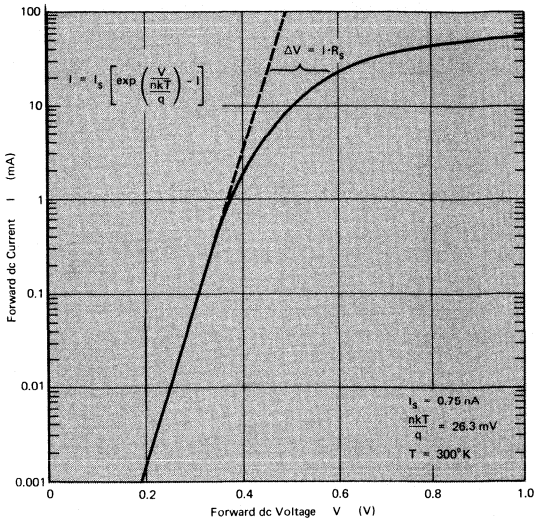


Figure 1. Static forward current versus voltage relationship.

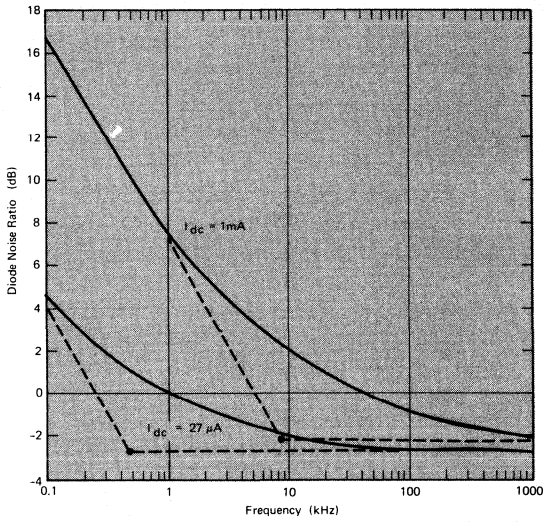


Figure 2. Typical diode noise ratio versus frequency for two dc-current levels.

TYPICAL MIXER PERFORMANCE CURVES AT $T_A = 25°C$

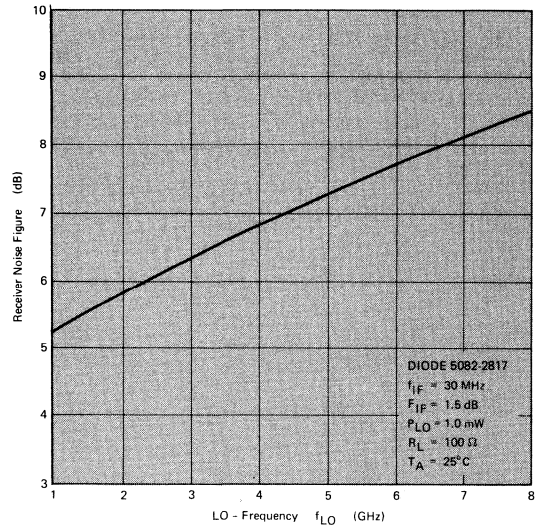


Figure 3. Single sideband receiver noise figure F_r (including an IF-amplifier noise figure of 1.5dB) versus local-oscillator frequency f_{LO}. The mount is tuned for minimum noise figure at each frequency.

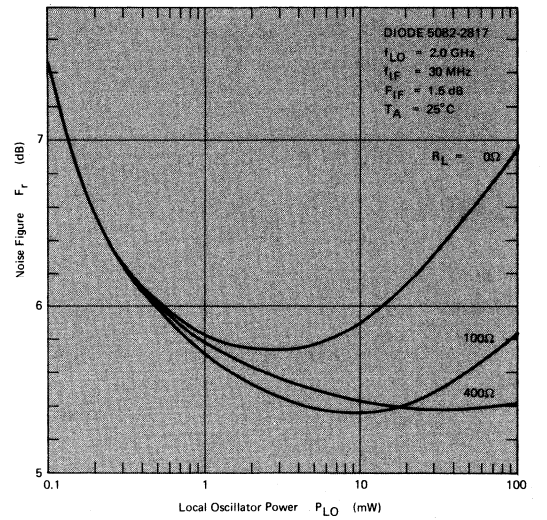


Figure 4. Single sideband receiver noise figure F_r (including an IF-amplifier noise figure of 1.5dB) versus incident LO-power P_{LO} for various dc-load resistances R_L. (The mount is tuned for minimum noise figure at each LO-power level and for each load resistance.)

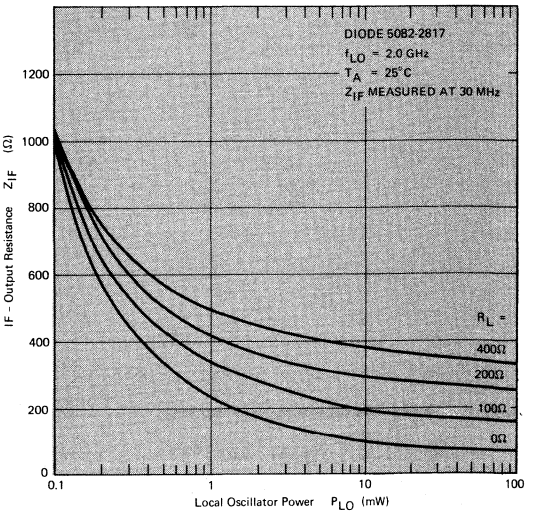


Figure 5. IF-output resistance Z_{IF} versus incident LO-power P_{LO} for various dc-load resistances R_L. (The mount is tuned for minimum noise figure at each LO-power level and for each load resistance.)

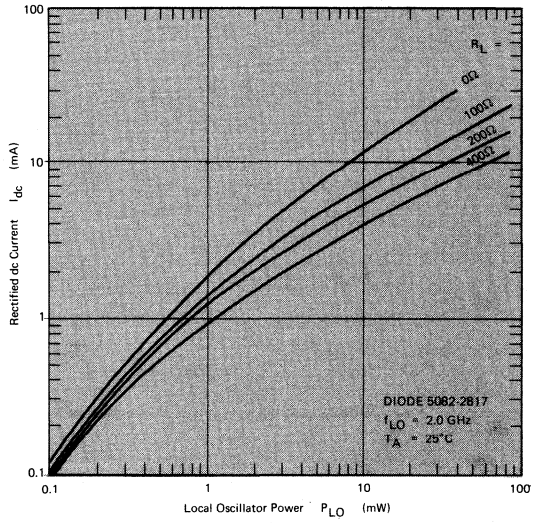


Figure 6. Rectified dc-current I_{DC} versus incident LO-power P_{LO} for various dc-load resistances R_L. (The mount is tuned for minimum noise figure at each LO-power level and for each load resistance.)

TYPICAL DETECTOR PERFORMANCE CURVES AT T_A = 25°C

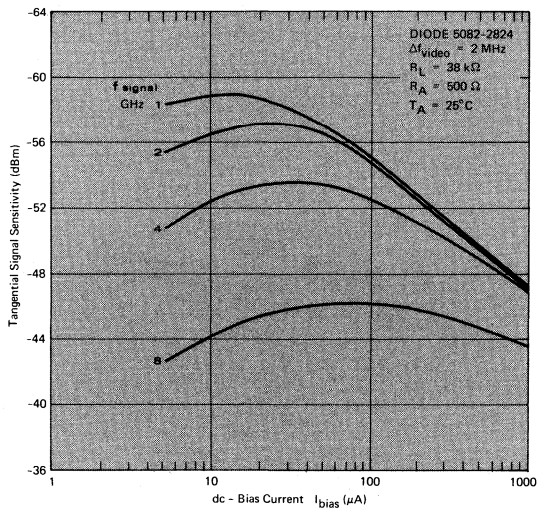


Figure 7. Tangential signal sensitivity versus dc-bias current for various signal frequencies. (At each bias current and frequency the mount was tuned for maximum signal sensitivity.)

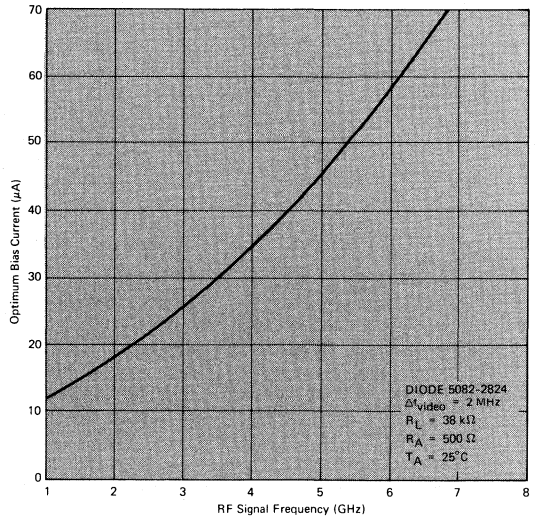


Figure 8. Optimum dc-bias current, which yields maximum signal sensitivity, versus RF-signal frequency.

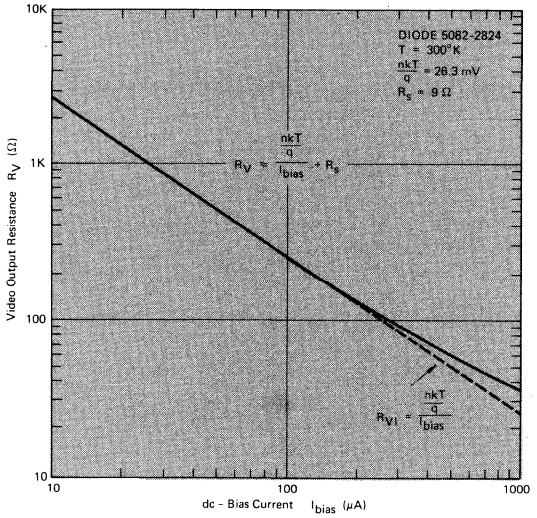


Figure 9. Video output resistance versus dc-bias current.

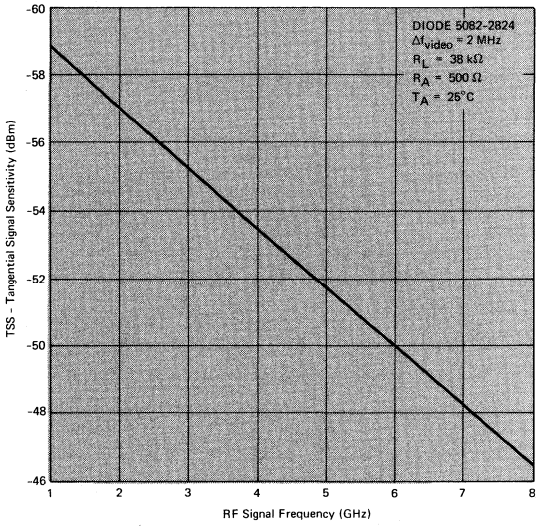


Figure 10. Optimum tangential signal sensitivity versus RF-signal frequency. (At each frequency the bias current was optimized and the mount tuned for maximum signal sensitivity.)

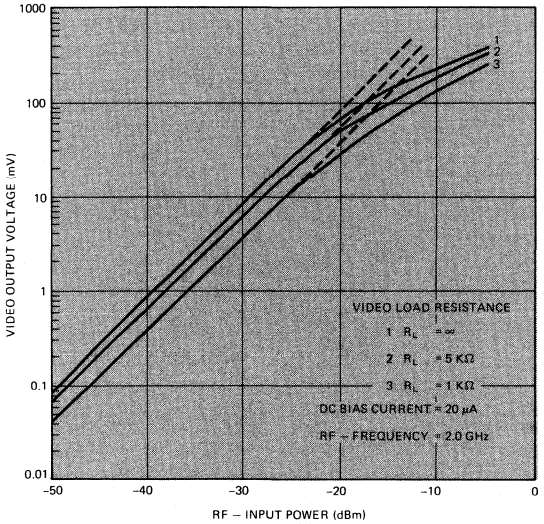


Figure 11. Video output voltage V_O versus incident RF-signal power P_i for various video load resistances R_L.

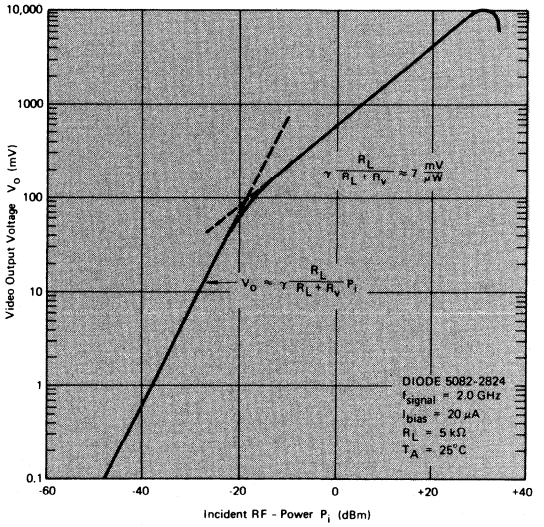


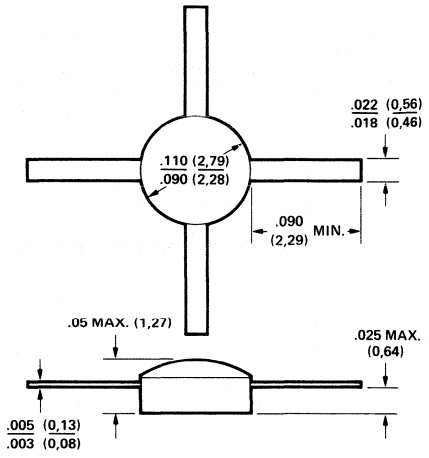
Figure 12. Video output voltage V_O versus incident RF-signal power P_i.

HEWLETT hp PACKARD

COMPONENTS

SCHOTTKY DIODE DOUBLE BALANCED MIXER RING QUAD

5082-2830



OUTLINE E-1

Features

- Wideband Operation to 2GHz
- Tight Match Improves Mixer Balance
- Improved Balance Over Temperature
- Low Conversion Loss
- Low Distortion Products

Description

The 5082-2830 matched diode quad consists of a monolithic array of Schottky barrier diode interconnected in ring configuration.

Close proximity of the active junctions and a common dielectric substrate provide for inherent diode match and temperature tracking characteristics far superior to four individual diodes.

The Schottky barrier diode array is mounted into a four lead stripline package to provide easy mechanical handling and application in MIC's and printed circuits without deterioration of the electrical performance characteristics.

Applications

These devices are for high volume, low cost applications to provide diode circuit functions such as: Double Balanced Mixers, AM Modulator Pulse Modulators, Phase Detectors, and Low Power Limiters requiring wideband operation and/or small size.

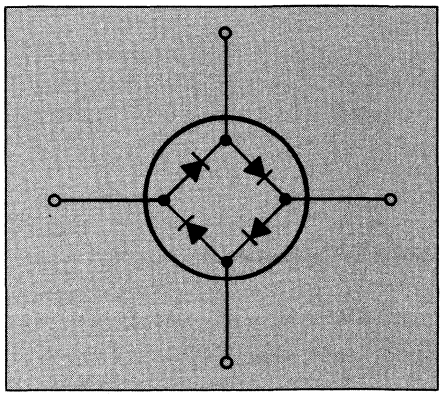


Figure 1. Diode Circuit Configuration.

Absolute Maximum Ratings

T_{OPR} — Operating Temperature Range ..... 65°C to +125°C
T_{STG} — Storage Temperature Range ..... 65°C to +125°C
P_{DISS} — DC Power Dissipation ..... 75 mW (Note 1)
Lead Pull on Any Lead ..... 0.5 lb, 10 sec
Solder Temperature ..... 230°C , 5 sec. max.

Electrical Specifications at T_A=25°C

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Capacitance Balance	ΔC_j	—	—	0.20	pF	V_R = 0V, f = 1 MHz
Forward Voltage	V_F	—	0.40	—	V	I_F= 1 mA
Forward Voltage Balance	ΔV_F	—	—	15	mV	I_F= 5 mA
Conversion Loss	L_C	—	4.0	—	dB	f = 1 GHz L.O. Power = 1 mW IF = 30MHz

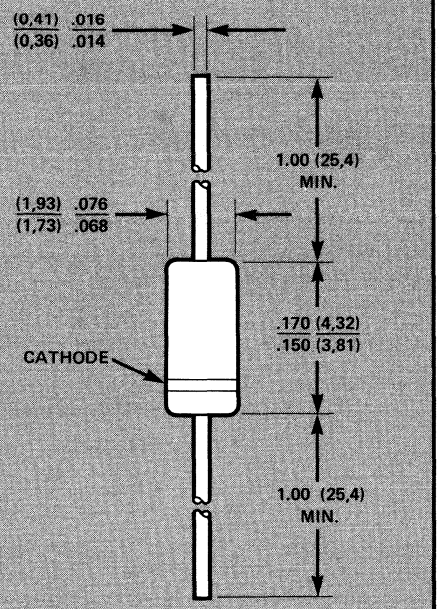
Note 1: Per junction, multiply by four for total device. Derate linearly at 0.75 mW/°C per junction.

HEWLETT hp PACKARD

COMPONENTS

LOW OFFSET SCHOTTKY DIODE

5082-2835



Features

- Low Turn-on Voltage
- Fast Switching
- Planar Passivated
- Low Temperature Coefficient
- Low Price
- Uniform Forward Tracking

Description

The HP 5082-2835 is an epitaxial, planar passivated diode whose construction utilizes a metal-to-silicon junction. This results in extremely low forward voltage drops and ultra high speed switching.

Applications

The low forward voltage drop, combined with fast switching and high temperature capability, makes these devices attractive as replacement for germanium and silicon P/N junction diodes in such applications as low level switching, clamping, sampling, reference circuits, and low noise UHF mixers.

The uniformity of forward characteristics with current over the temperature range also makes these units suitable for circuitry requiring tight matching of characteristics.

Mechanical Specifications

The HP Outline 15 package has a glass hermetic seal with dumet leads. The leads on the Outline 15 package should be restricted so that the bend starts at least 1/16 inch (1,6 mm) from the glass body. With this restriction, Outline 15 package will meet MIL-STD-750, Method 2036, Conditions A and E [4 lb (1,8 kg)] tension for 30 minutes. The maximum soldering temperature is 230°C for five seconds.

Outline 15 package inductance and capacitance is typically 2.0 nH and 0.2 pF, respectively.

Marking is by digital coding with a cathode band.

Absolute Maximum Ratings

Power Dissipation at $T_A = 25°C$ .....150 mW
Operating Temperature Range.....−55°C to +125°C
Storage Temperature Range.....−55°C to +150°C

Electrical Specifications at T_A=25°C

Characteristics	Symbol	Min.	Max.	Units	Test Conditions
Breakdown Voltage	V_{BR}	5		volts	$I_R = 100\ \mu A$
Reverse Current	I_R		100	nA	$V_R = 1$ V
Forward Voltage	V_F		0.34	volts	$I_F = 1$ mA
Forward Voltage	V_F		0.45	volts	$I_F = 10$ mA
Capacitance	C_O		1.0	pF	$V_R = 0$, f = 1 MHz
Effective Minority Carrier Lifetime	τ		100	psec	$I_F = 20$ mA

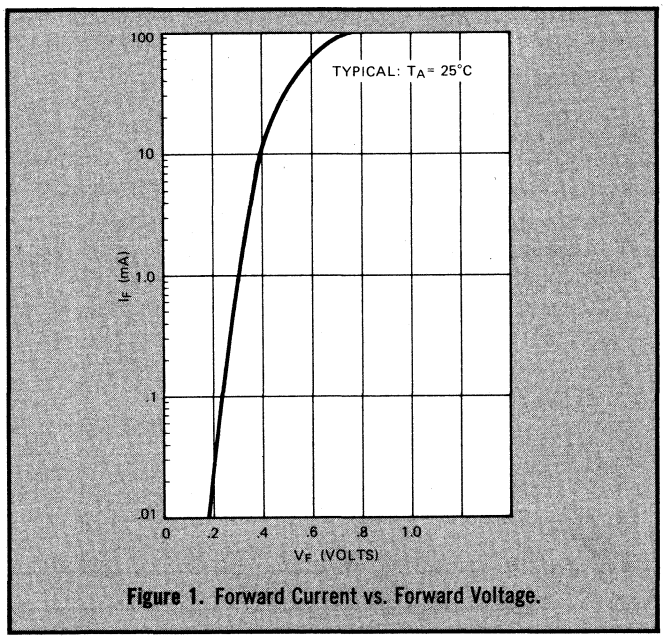


Figure 1. Forward Current vs. Forward Voltage.

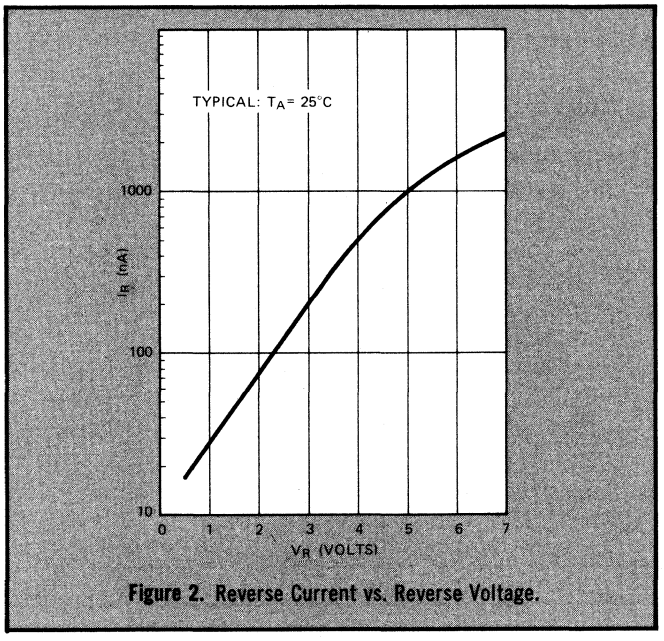


Figure 2. Reverse Current vs. Reverse Voltage.

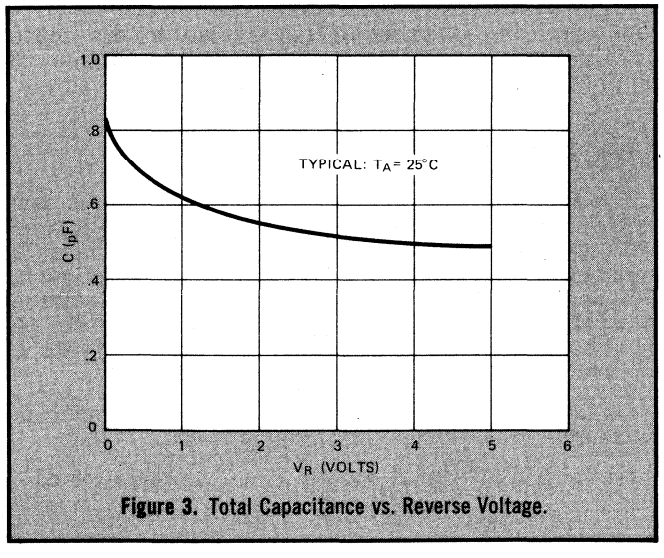


Figure 3. Total Capacitance vs. Reverse Voltage.

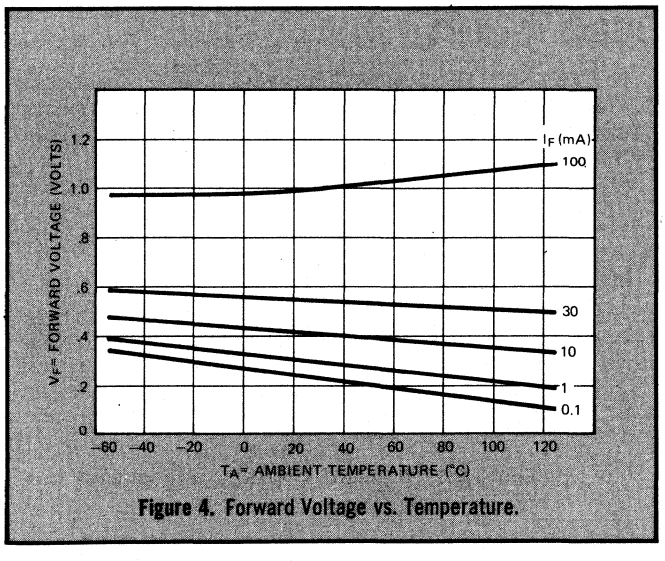
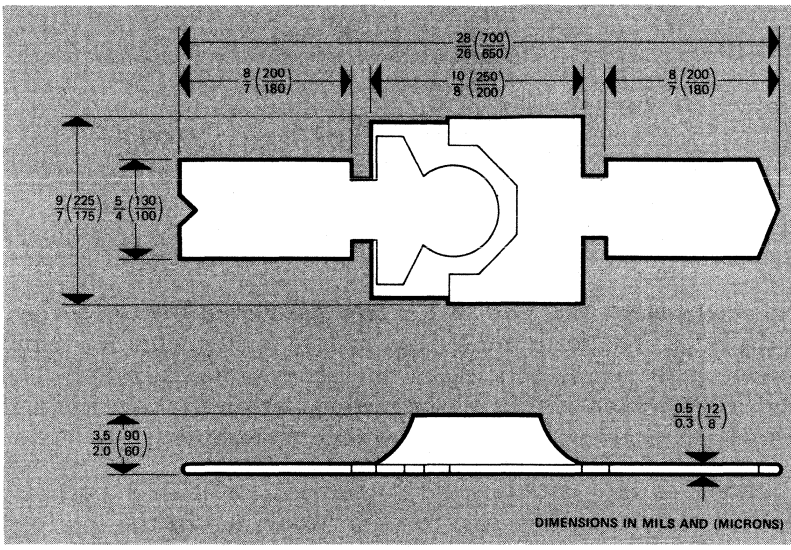


Figure 4. Forward Voltage vs. Temperature.

HEWLETT hp PACKARD

COMPONENTS

BEAM LEAD SCHOTTKY DIODE 5082-2837



Features

- Low Cost
- Fast Switching
- High Breakdown

Description

The HP 5082-2837 is an epitaxial planar passivated Beam Lead Diode whose construction utilizes a unique combination of both a conventional PN junction and a Schottky barrier. This manufacturing process results in a device which has the high breakdown and temperature characteristics of a silicon PN Junction and the turn-on voltage and speed of a silicon Schottky diode majority carrier device.

This device is intended for high volume, low cost applications, and is the beam lead equivalent of the HP 5082-2800 glass packaged diode.

Applications

High level detection, switching, or gating; logarithmic or A-D converting; sampling or wave shaping are jobs the 5082-2837 will do better than conventional PN junction diodes. The low turn-on voltage and subnanosecond switching makes it extremely attractive in digital circuits for DTL gates, pulse shaping circuits or other low level applications. Its high PIV allows wide dynamic range for fast high voltage sampling gates.

The 5082-2837 low turn-on voltage gives low offsets. The extremely low stored charge minimizes output offsets caused by the charge flow in the storage capacitor. At UHF, the diodes exhibit 95% rectification efficiencies. Both their low loss and their high PIV allow the diodes to be used in mixer and modulator applications which require wide dynamic ranges.

The combination of these technical features with the low price make these devices the prime consideration for any hybrid dc or RF circuit requiring nonlinear elements.

Absolute Maximum Ratings at T_A=25°C

Operating Temperature Range	−60°C to +150°C
Storage Temperature Range	−60°C to +150°C
Maximum Lead Pull	2 Gms

Electrical Specifications at T_A=25°C

Specification	Symbol	Min.	Max.	Units	Test Conditions
Breakdown Voltage	V_{BR}	70	—	Volts	I_R = 10μA
Forward Voltage	V_{F1}	—	410	mVdc	I_{F1} = 1mA dc
Forward Voltage	V_{F2}	—	1.0	V_{dc}	I_{F2} = 15mA dc
Reverse Leakage Current	I_R	—	200	nA	V_R = 50V
Capacitance	C_o	—	2.0	pF	V_R = 0V and f= 1MHz
Effective Minority Carrier Lifetime	τ	—	100	pS	I_F = 5mA Krakauer Method

Bonding Recommendations

Beam lead devices are silicon chips with coplanar plated gold tabs that extend parallel to the top surface of the chip approximately 8 mils beyond the edge. The leads are approximately 4 mils wide by ½ mil thick and are mounted by thermocompression or ultrasonic bonding to the substrate metallization. The bonding is accomplished by placing the device face down with the tabs resting flat on the pad area and using heated wedge (and/or substrate), parallel-gap (step-welding), or ultrasonic techniques.

The heated wedge may be continuously heated, as in most standard equipment, or it may be pulse resistance heated where a high current, short duration pulse is used to raise the wedge to the required temperature. In the step-welding operation, current is passed through the substrate metallization and the device lead. Most of the heat is generated at the interface between the two, where the bond is formed.

The major advantage of pulse heating techniques is that a cold ambient may be used, generating only localized heating in the vicinity of the bond itself. The electrodes (or wedge) can be placed on the device lead while the bond area is cold, and maintain a constant force through the heating and cooling cycle.

Ultrasonic bonding is even more recommendable because the diode is not exposed to any elevated temperature at all.

Handling Instructions

The mechanical and electrical performance characteristics of beam lead diodes require careful and considerate handling during inspection, testing, and assembly. The handling techniques described here are necessary so that the diodes will not be mechanically or electrically damaged, particularly where reverse voltages approach the diode breakdown rating.

Visual Inspection

The enclosed beam lead diodes may be viewed through the transparent underside of the shipping tray without its being opened.

Unloading

1. Open the lid, remove the foam pad, and carefully lift off the antistatic fabric liner.
2. A vacuum pickup with a #27 tip is recommended for picking up single beam lead devices. This should be done under 20X magnification for accurate positioning of the tip on the die.
3. Replace the fabric and pad for storage of unused devices.

HEWLETT PACKARD

HOT CARRIER DIODES

5082-2900 SERIES
HCD-3

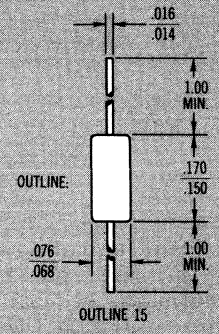


Figure 1a

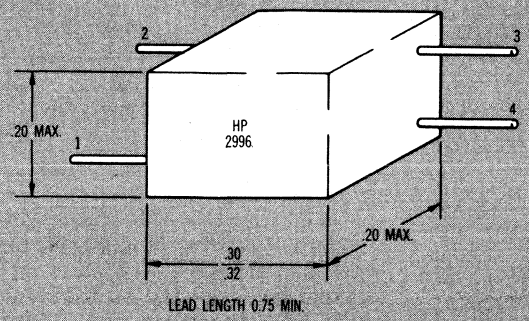


Figure 2a

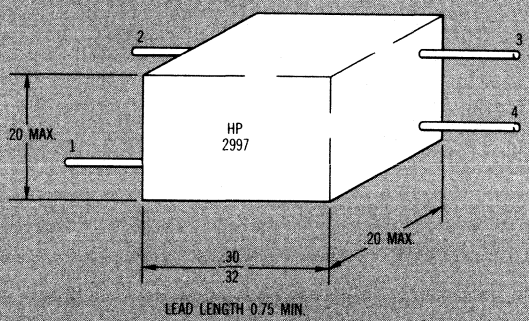


Figure 3a

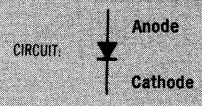


Figure 1b

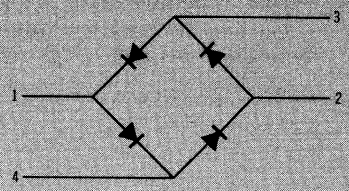


Figure 2b

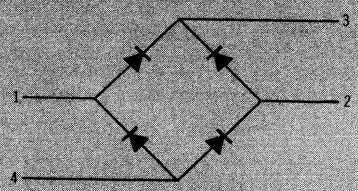


Figure 3b

All dimensions in inches

Low Cost
No-Charge Storage
Pulse Burnout Resistant
Ultrafast Switching
Low 1/f Noise

Description

The HP 5082-2900 series of Hot Carrier Diodes employ a metal-silicon Schottky barrier junction and utilize electrons for majority carrier conduction. The Hot Carrier Diode's performance conforms closely with theory and can be described as closely approximating the ideal diode.

Applications

The HP 5082-2900 series of Hot Carrier Diodes is priced for use in commercial applications.

In pulse operations the diode is ideal for clamping, sampling gates, pulse shaping, and general purpose usage requiring fractional picosecond switching times.

In the RF area the Hot Carrier Diode makes an excellent low noise mixer, high sensitivity, small signal detector, large signal detector (power monitor), limiter, discriminator, and balanced modulator from low frequencies through the UHF range.

The HP 5082-2300 series Hot Carrier Diode—rather than the 5082-2900 series—should be considered for military and space applications requiring high reliability performance.

MATCHED PAIRS AND QUADS

HP Type Number	5082-2900	5082-2912	5082-2970	5082-2996	5082-2997
Description	Single Diode	Matched pair of 5082-2900, unencapsulated and unconnected.	Matched Quad, unencapsulated and unconnected.	Matched Ring Quad, Epoxy encapsulated.	Matched Bridge Quad, Epoxy encapsulated.
Outline	Fig. 1a	Fig. 1a	Fig. 1a	Fig. 2a	Fig. 3a
Circuit	Fig. 1b	Fig. 1b	Fig. 1b	Fig. 2b	Fig. 3b

Characteristics	Symbol	5082-2900		5082-2912		5082-2970		5082-2996		5082-2997		Units	Test Conditions
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		
Breakdown Voltage	V_{BR}	10	—	10	—	10	—	*	—	*	—	V	$I_R = 10\ \mu A$
Reverse Current	I_R	—	100	—	100	—	100	—	*	—	*	nA	$V_R = 5.0$ V
Forward Voltage	V_{F1}	—	0.4	—	0.4	—	0.4	—	0.4	—	0.4	V	$I_{F1} = 1.0$ mA
Forward Voltage	V_{F2}	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	V	$I_{F2} = 20$ mA
Forward Voltage Match	ΔV_F	—	—	—	30	—	30	—	30	—	30	mV	$I_F = 1.0$ to 10 mA
Capacitance	C_O	—	1.2	—	1.2	—	1.2	—	*	—	*	pF	$V_R = 0$ V, f = 1.0 MHz
Effective Minority Carrier Lifetime	τ	—	120	—	120	—	120	—	*	—	*	ps	Krakauer Method

* Breakdown voltage, reverse current, capacitance, and effective minority carrier lifetime cannot be readily verified after assembly and encapsulation because of the shunting effect of the other diodes. The encapsulated quads have the same parameter values as the HP 5082-2970 unencapsulated quad prior to assembly and encapsulation.

Absolute Maximum Ratings

T_{OPR}—Operating Temperature Range.....— 60°C to + 100°C
T_{STG}—Storage Temperature Range.....— 60°C to + 100°C
P_{DISS}—Power Dissipation ($T_A = 25$°C).....50 mW
Derate ⅔ mW/°C for T_A from 25°C to 100°C
U—Burnout (3 pulses with a 10 ns maximum pulse width; 20% allowable V_{BR} degradation; $T_A = 25$°C).....5 ergs

Package

The HP Outline 15 package has a glass hermetic seal with dumet leads. The leads on the Outline 15 package should be restricted so that the bend starts at least 1/16 inch from the glass body. With this restriction OD-15 package will meet MIL-STD-750, Method 2036, Conditions A and E (4 lbs. tension for 30 minutes). The maximum soldering temperature is 230°C for 5 seconds.

Outline 15 package inductance and capacitance are typically 3 nH and .07 pF respectively.

Marking is by digital coding with a cathode band.

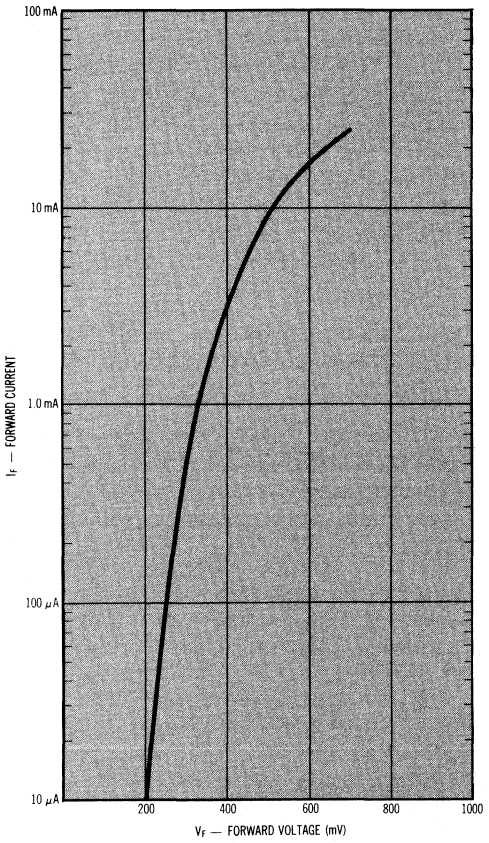


Figure 4. Typical HP 5082-2900 forward current vs. forward voltage characteristics.

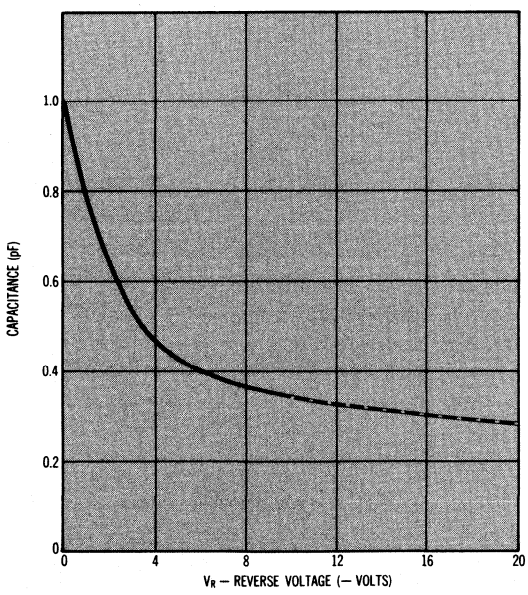


Figure 5. Typical HP 5082-2900 capacitance vs. reverse voltage characteristics at $T_A = 25$°C.

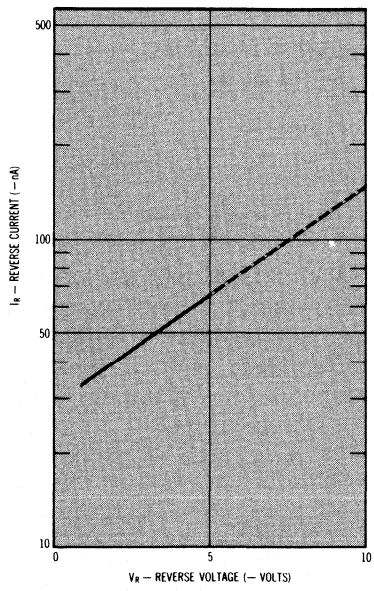
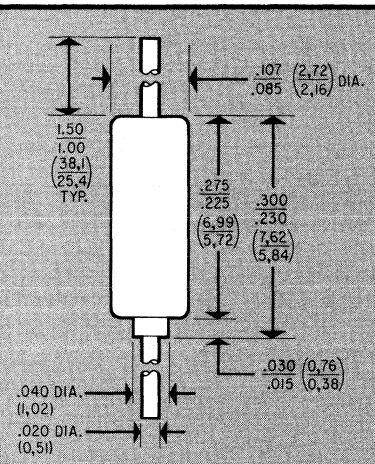


Figure 6. Typical HP 5082-2900 reverse current variation vs. reverse voltage at $T_A = 25$°C.

HEWLETT PACKARD
COMPONENTS

HIGH CONDUCTANCE DIODES

5082-1000 SERIES



Mechanical Data - All dimensions are in inches.
Encapsulation - Glass hermetic seal.
Marking - Either digital coding with cathode band or color band coding from the cathode.
Leads - Dumet.

Features

- **Fast Switching**
- **Low Capacitance**
- **High Current Capability**

Description

The 5082-1000 series of diodes feature planar silicon epitaxial construction to provide high conductance, low capacitance, and nanosecond turn-on and turn-off. Process control of the diode manufacturing enables specification of effective minority carrier lifetime. Turn-on time and voltage overshoot are minimized in these diodes of low conductivity modulation.

Applications

These diodes are ideally suited for applications such as core drivers, pulse generators, input gates or wherever high conductance without loss of speed is required.

Absolute Maximum Ratings at T_A=25°C

WIV - Working Inverse Voltage 1006 ..... 40 Volts
1001/1002 ..... 30 Volts
1003/1004 ..... 20 Volts
i_f (surge) - Forward Current Surge, ... 0.75 Amp
1.0 second duration
i_f (surge) - Forward Current Surge, ... 7.50 Amp
1.0 microsecond duration
P_{DISS} - Power Dissipation (Note 1) 500mW
T_A - Operating Temperature Range ..... −65°C to +175°C
T_{STG} - Storage Temperature Range ..... −65°C to +200°C

Electrical Characteristics at T_A=25°C

Characteristic	Symbol	5082-1001 Min.	5082-1001 Max.	5082-1002 Min.	5082-1002 Max.	5082-1003 Min.	5082-1003 Max.	5082-1004 Min.	5082-1004 Max.	5082-1006 Min.	5082-1006 Max.	Units	Test Conditions
Forward Current	I_F	150	–	300	–	100	–	200	–	150	–	mA	V_F= 1.0V (Note 2)
Forward Current	I_F	500	–	800	–	300	–	600	–	500	–	mA	V_F= 1.4V (Note 2)
Breakdown Voltage	BV_R	35	–	35	–	25	–	25	–	50	–	V	I_R= 10μA
Reverse Current	I_R	–	200	–	200	–	200	–	200	–	200	nA	(Note 3)
Reverse Current (150°C)	I_R	–	200	–	200	–	200	–	200	–	200	μA	(Note 3)
Capacitance	C_o	–	1.5	–	3.0	–	2.0	–	4.0	–	1.1	pF	V_R= 0V, f = 1.0MHz
Reverse Recovery Time	t_{rr}	–	1.5	–	2.0	–	1.5	–	2.0	–	1.5	ns	(Figure 9)
Turn-on Time	t_{on}	–	2.5	–	2.5	–	2.0	–	2.0	–	–	ns	(Figure 10)
Inductance	L	Typically 4.0nH for all devices.											(Note 4)
Rectification Efficiency	RE	Typically 65% for all devices.											(Figure 8)

Notes: 1. Mounted on a printed circuit board in still air.
2. Measured at a repetition rate not to exceed the power dissipation.
3. V_R= 35V for 1006; V_R=30V for 1001, 1002; V_R=20V for 1003, 1004.
4. Measured at the edge of the glass package seal.
5. JEDEC designation 1N4456 applies to 5082-1001.

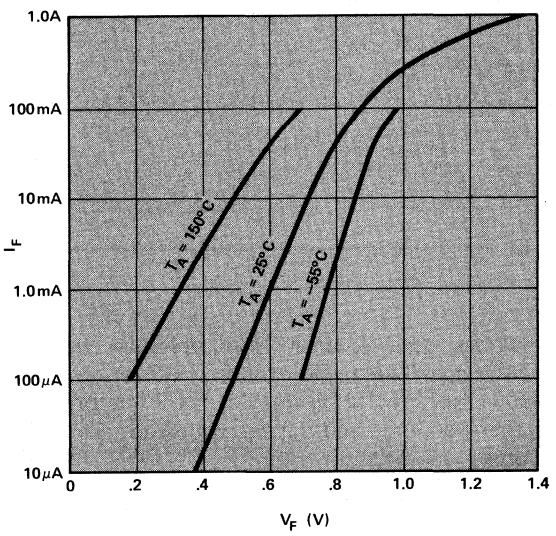


Figure 1. Typical Forward Conduction Characteristics, 5082-1001, 1003, and 1006.

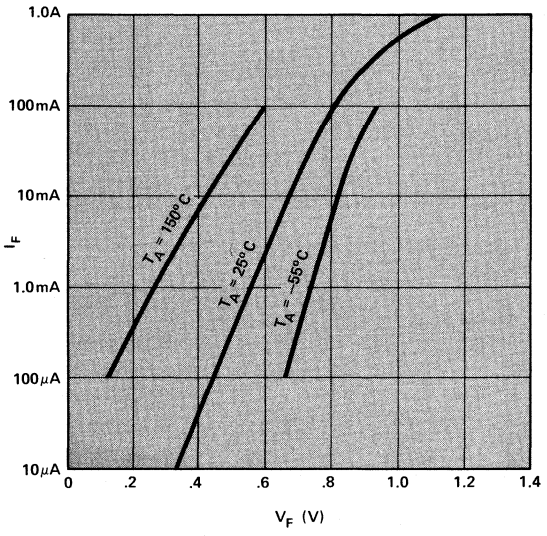


Figure 2. Typical Forward Conduction Characteristics, 5082-1002 and 1004.

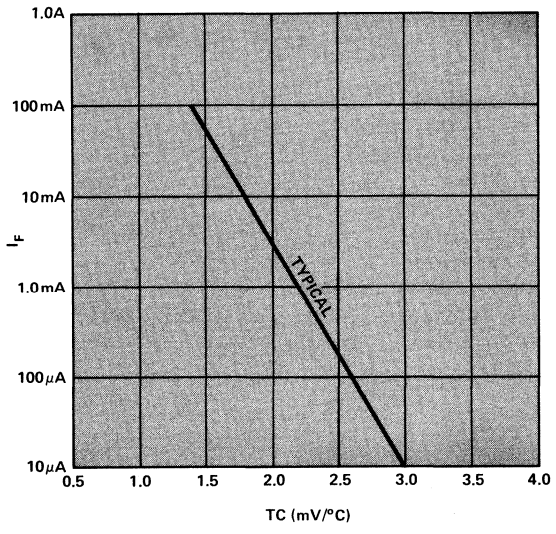


Figure 3. Typical Forward Current Temperature Coefficient for HP High Conductance Diodes.

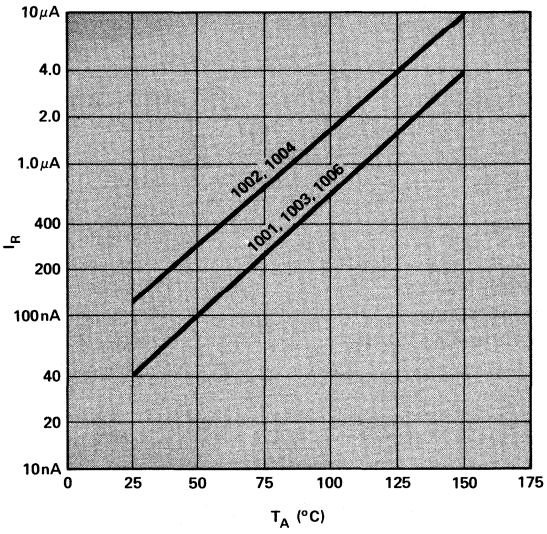


Figure 4. Typical Reverse Current at Specified V_R vs. Increasing Temperature of HP High Conductance Diodes.

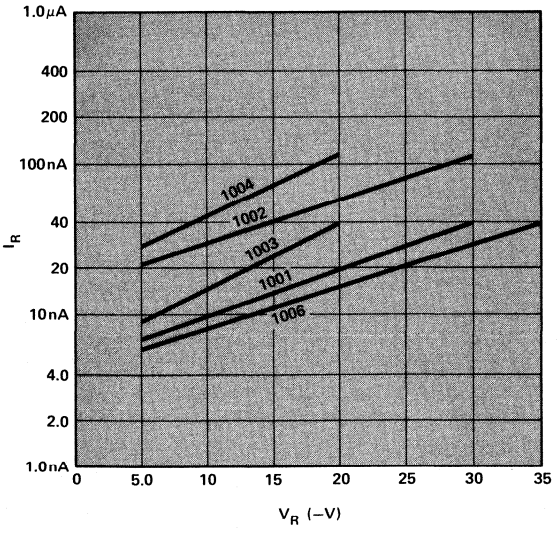


Figure 5. Typical Reverse Current vs. Reverse Voltage for HP High Conductance Diodes

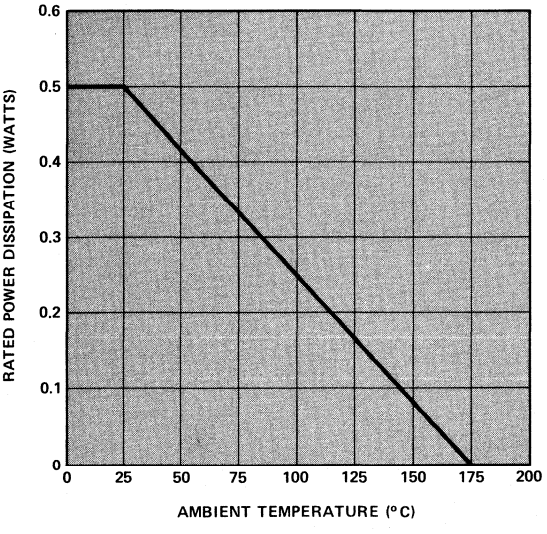


Figure 6. Power Dissipation Derating Characteristics.

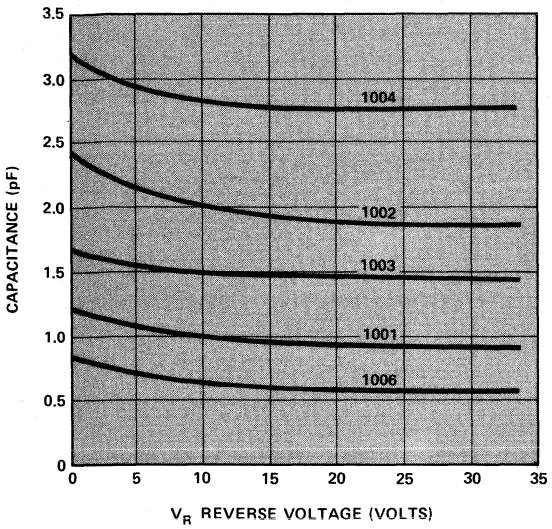


Figure 7. Typical Capacitance vs. Reverse Voltage Characteristics of HP High Conductance Diodes, T_A=25°C.

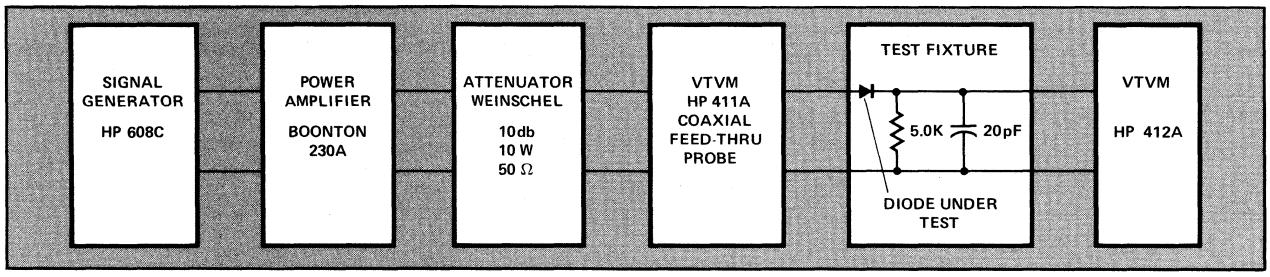


Figure 8. Test Circuit for Measuring the Rectification Efficiency. Signal source is adjusted to 100 MHz and 2 v RMS as read on the 411A. The rectification efficiency is calculated from the DC output voltage by RE = V_{DC}/2.83.

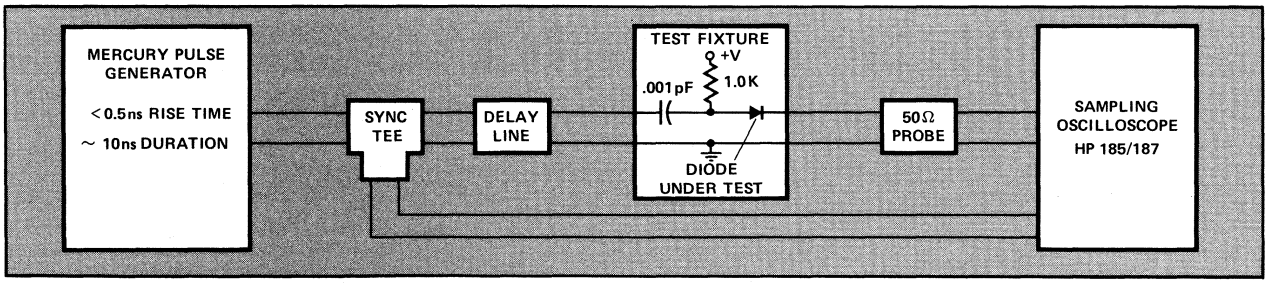


Figure 9. Test Circuit for Measuring Reverse Recovery Time. I_F is set equal to I_R (anywhere from 10 to 400 mA). t_{rr} is measured as the time required to recover to 0.1 I_R as timed from the zero crossover. The observed waveform will be determined more by diode capacitance than by minority carrier storage.

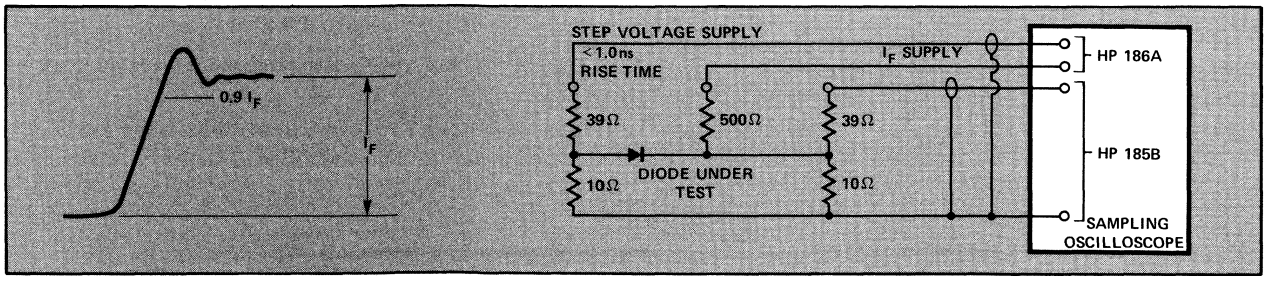
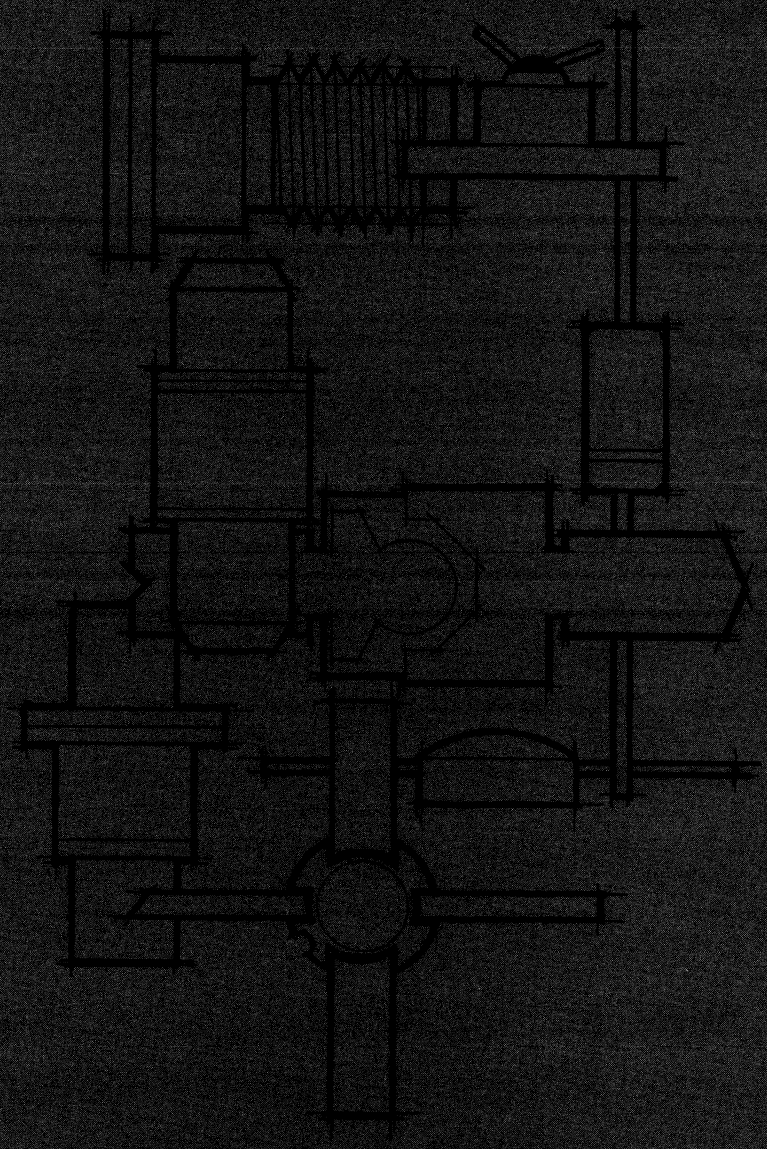


Figure 10 Test Circuit for Measuring Turn-on Time. I_F is adjusted for 10 mA after applying the step voltage. t_{on} is measured as the time required to reach 0.9 I_F from initial application of the step voltage. For high excitation levels the t_{on} value is significantly lower than the value specified, i.e., at 100 mA t_{on} is typically less than 1.0 nsec.



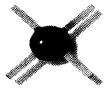
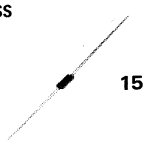
Microwave Specified Schottky Diodes

Selection Guide 64

Schottky Diodes for Microwave Frequency Conversion 65

Schottky Diodes for Microwave Signal Detection 77

Microwave Schottky Diodes

	Mixer Diodes								Detector Diodes	
	TEST FREQUENCY									
	2GHz		3GHz		9.3GHz		16GHz		10GHz	
PACKAGE**	5082-	Page No.	5082-	Page No.	5082-	Page No.	5082-	Page No.	5082-	Page No.
Stripline  E2			2213/2214 2215/2216	65 65	2217/2218 2219/2220	65 65				
 E1			2276* Quad	67	2277* Quad	67				
Glass  15	2400/2401 2365/2418 2350/2351	69 69 69	2565/2566 2550/2551 2520/2521	69 69 69					2755 2787	81 81
Ceramic  49					2711/2712 2713/2714 2234/2235	73 73 73	2721/2722 2723/2724	73 73	2751	81
Ceramic  44					2701/2706 2702/2707 2703/2708	73 73 73			2750	81
Devices for Hybrid Integrated Circuits										
Beam Lead					2768 2709*	77,143 77,143	2767 2769 2716*	77,143 77,143 77,143		
Chip					0023*	143	0029*	143	0009*	143
LID					2705*	143			2754*	143
Ministrip					2710*	143			2753*	143

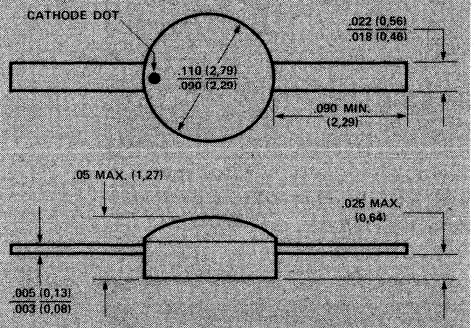
*Standard part is not rf tested. 100% rf tested devices (except chips) can be provided: contact your local HP Sales Office.
**Part numbers are given as single/matched pair, e.g., 2711/2712.

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COMPONENTS

STRIPLINE SCHOTTKY DIODES FOR MIXERS (1–12 GHz)

S–BAND	X–BAND
5082-2213	5082-2217
5082-2214	5082-2218
5082-2215	5082-2219
5082-2216	5082-2220



OUTLINE E-2

Features

- Low and Stable Noise Figure
  - Less than 6dB at 3GHz
  - Less than 6.5dB at 9GHz
- High Burnout Rating
  - 0.8 Watt RF Pulse Power Incident
- Low Cost
  - For Telecommunication Mixers
- High Uniformity
  - VSWR of 1.5:1 Assures Repeatable RF impedance

Description

These HP mixer diodes are silicon Schottky barrier diodes of planar, epitaxial, passivated structure. The processing technique applied produces a diode family with extremely uniform electrical characteristics. Very tight tolerance in junction capacitance and minimized series resistance provide uniform RF impedance from diode to diode.

Applications

The Schottky mixer diodes described in this data sheet are optimized for use in both broad and narrow band stripline mixer assemblies operating in the 1 to 12GHz frequency range where low noise and low cost are important. The excellent uniformity of RF characteristics make the devices field replaceable without circuit adjustments. Typical equipment applications include telecommunication receivers, microwave synthesizers, and ECM/Radar front ends where high burnout power and sensitivity are required.

Mechanical Specifications

The HP E2 plastic-on-ceramic package is designed for MIC, Microstrip, and Stripline use from dc through X-Band. The leads provide a good continuity of transmission line impedance to the diode. The device is capable of meeting the solderability performance requirements of MIL-STD-202, Method 208, with a lead temperature of 230°C for 5 seconds.

Absolute Maximum Ratings

Pulse Power Incident [1] 0.8W
CW Power Dissipation (RF) [2,3] 125mW
DC Forward Current [2] 100mA
Operating Junction Temperature Range . . . . . −60°C to +125°C
Storage Temperature Range . . . . . −60°C to +125°C

Typ. Freq. Range (GHz)	Part No. 5082-	Device Configuration	Test Freq. (GHz)	Noise Figure (dB) [4,5] Typ.	Noise Figure (dB) [4,5] Max.	IF – Impedance [5] Min.	IF – Impedance [5] Max.	Max. VSWR [5]
1–4	2213	Single	3	5.5	6.0	200	400	1.5:1
	2214	Matched Pair		5.5	6.0	200	400	1.5:1
	2215	Single		6.5	7.0	200	400	2.0:1
	2216	Matched Pair		6.5	7.0	200	400	2.0:1
4–12	2217	Single	9.375	6.0	6.5	200	400	1.5:1
	2218	Matched Pair		6.0	6.5	200	400	1.5:1
	2219	Single		7.0	7.5	200	400	2.0:1
	2220	Matched Pair		7.0	7.5	200	400	2.0:1

NOTES:

1. 1μs pulse, Du = .001.
2. Derate linearly to zero at 125°C.
3. Power absorbed by the diode. DC load resistance $< 1\Omega$.
4. Single sideband receiver noise figure including an IF amplifier noise figure of 1.5dB.
5. Measurements are performed on the diode in a fixed mount which has been tuned to an average diode.

   Local oscillator power – 1 mW
   Local oscillator frequency – See diode test frequency.
   DC load resistance – $< 10\Omega$
   Pairs are matched to the following limits:
   Noise figure match, $\Delta NF \leq 0.3$dB
   IF impedance match, $\Delta Z_{IF} \leq 25\Omega$

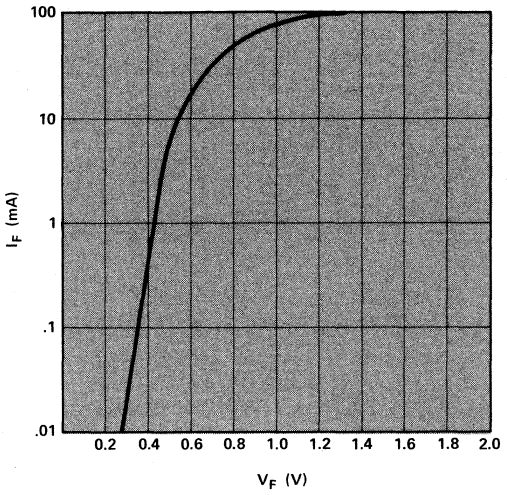


Figure 1. Typical I_F vs. V_F, 5082-2213 through 2220.

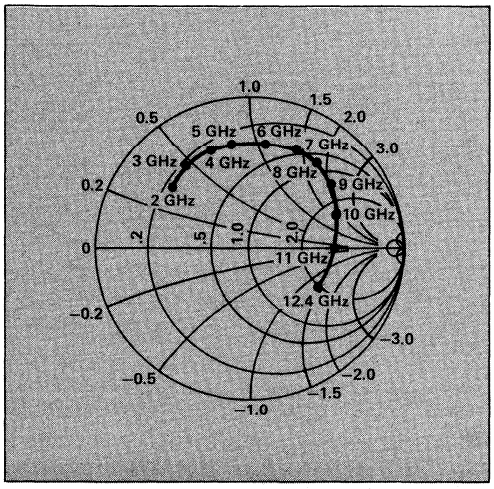


Figure 2. Typical Admittance vs. Frequency, 5082-2213 through 2220. Rectified current = 1.5mA.

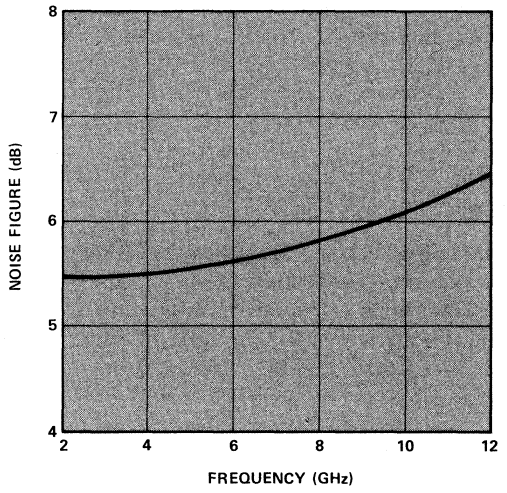


Figure 3. Typical Single Sideband Noise Figure vs. Frequency, 5082-2217.

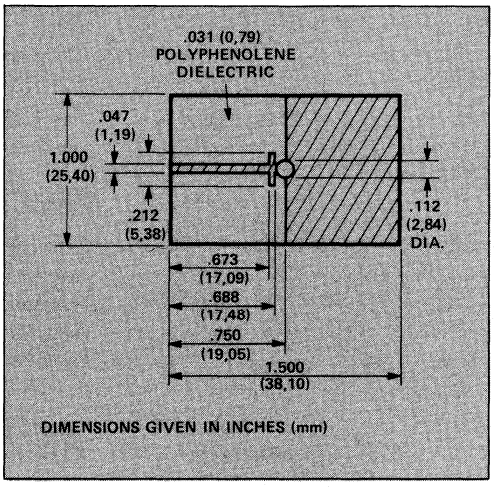


Figure 4. Stripline Mixer Test Fixture for 9.375GHz (bottom section).

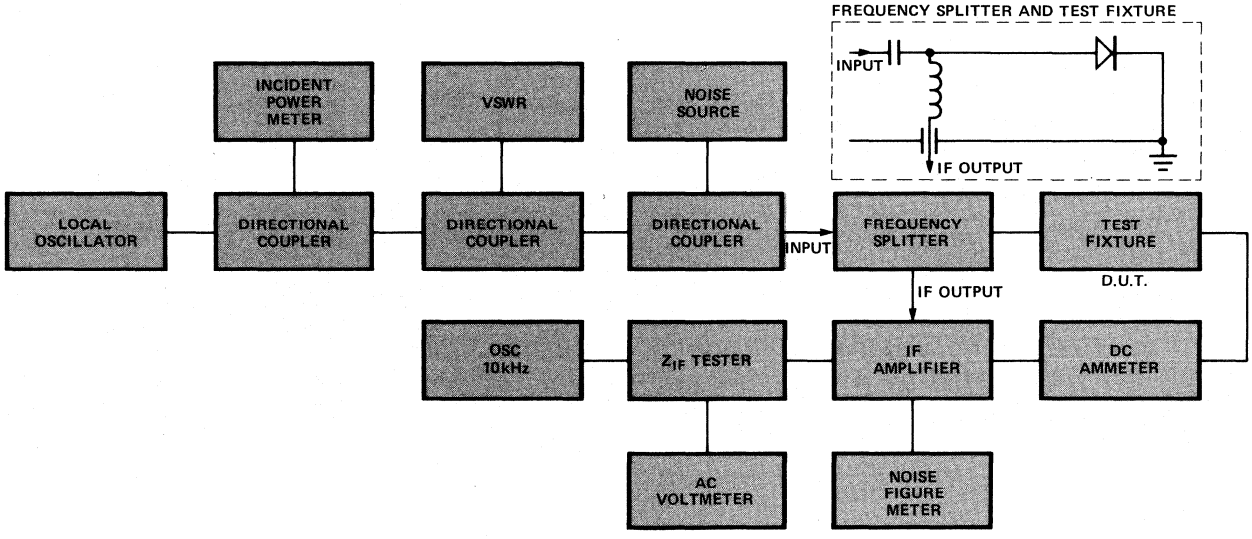


Figure 5. Mixer Test Setup.

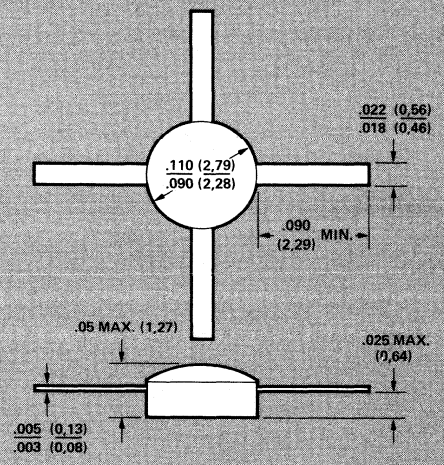
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COMPONENTS

STRIPLINE SCHOTTKY DIODE QUADS FOR DOUBLE BALANCED MIXERS (1-8GHz)

S-BAND 5082-2276

C-BAND 5082-2277



OUTLINE E-1

Features

- WIDEBAND OPERATION
- TIGHT MATCH IMPROVES MIXER BALANCE
- IMPROVED BALANCE OVER TEMPERATURE
- REDUCED NOISE FIGURE IN FREQUENCY CONVERTERS
  Typical < 6.0dB, S-Band, 5082-2276
  Typical < 6.5dB, C-Band, 5082-2277
- LOW INTERMODULATION PRODUCTS
- OPTIMIZED FOR STRIPLINE, MICROSTRIP, AND MIC
  Small size, 100 mil diameter

Description

The 5082-2276 and 5082-2277 matched diode quads consist of a monolithic array of Schottky barrier diodes interconnected in ring configuration.

The four diodes are isolated by a dielectric with good microwave properties and interconnected with microstrip lines of less than 20 mils length each, resulting in an interconnecting inductance of less than 0.5 nH each. Special care has been exercised to minimize the parasitic capacitances.

Close proximity of the active junctions and a common dielectric substrate provide for inherent diode match and temperature tracking characteristics far superior to four individual diodes.

The Schottky diode array is mounted into a four lead microwave stripline package to provide easy mechanical handling and application in MIC's and printed circuits without deterioration of the electrical performance characteristics.

Applications

These devices are intended for use in Hybrid Integrated Circuits, OEM Components, and RF Systems in stripline technology to provide diode circuit functions such as: Double Balanced Mixers, AM Modulators, Pulse Modulators, Phase Detectors, and Low Power Limiters requiring wideband operation and/or small size.

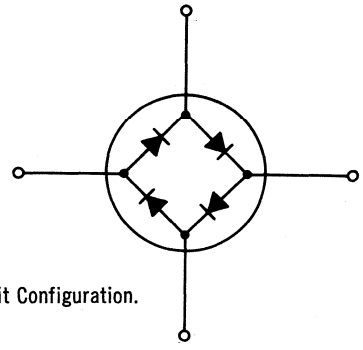


Figure 1.
Diode Circuit Configuration.

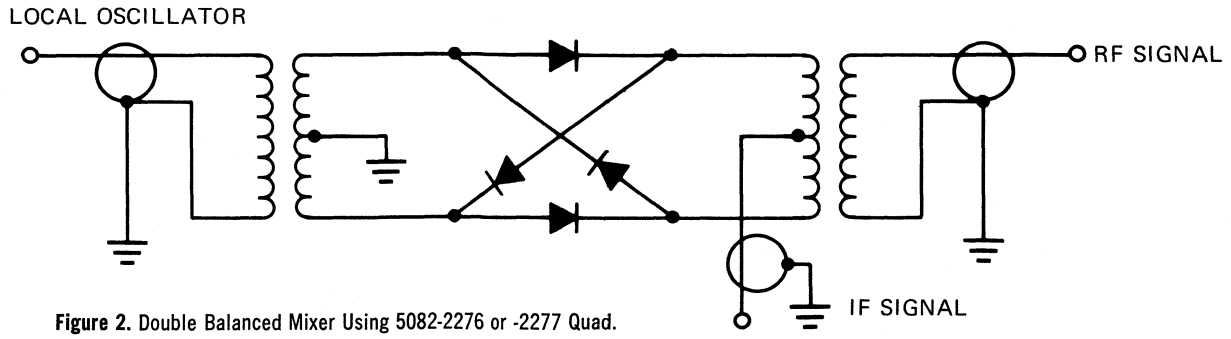


Figure 2. Double Balanced Mixer Using 5082-2276 or -2277 Quad.

Absolute Maximum Ratings

T_{OPR} — Operating Temperature Range . −65°C to +125°C

T_{STG} — Storage Temperature Range . . −65°C to +125°C

P_{DISS} — DC Power Dissipation . . . . . 75mW (Note 1)

Lead Pull on Any Lead . . . . . 0.5 lb., 10 sec

Lead Temperature . . . . . 235°C, 5 sec

Mechanical Specifications

The HP outline E1 epoxy-on-ceramic package is designed for MIC, Microstrip, and Stripline use from dc through X-Band. The leads provide a good continuity of transmission line impedance to the monolithic diode array. The device is capable of meeting the solderability performance requirements of MIL-STD-202, Method 208, with a lead temperature of 230°C for 5 seconds. Package capacitance is approximately .08pF between adjacent leads.

Electrical Specifications at T_A=25°C

Parameter	Symbol	5082-2276 S-Band		5082-2277 C-Band		Units	Test Conditions
		Typ.	Max.	Typ.	Max.		
Capacitance	C_T	–	0.60	–	0.40	pF	(Note 2)
Capacitance Balance	ΔC_T	–	0.10	–	0.10	pF	V_R = 0V, f = 1MHz
Forward Balance	V_F	0.40	–	0.45	–	V	I_F = 1mA
Forward Voltage Balance	ΔV_F	–	20	–	20	mV	I_F = 5mA
Dynamic Resistance	R_D	–	15	–	20	Ω	(Note 3)
SSB Noise Figure	NF	6.0	–	6.5	–	dB	
Effective Minority Carrier Lifetime	τ	–	100	–	100	ps	I_F = 5mA

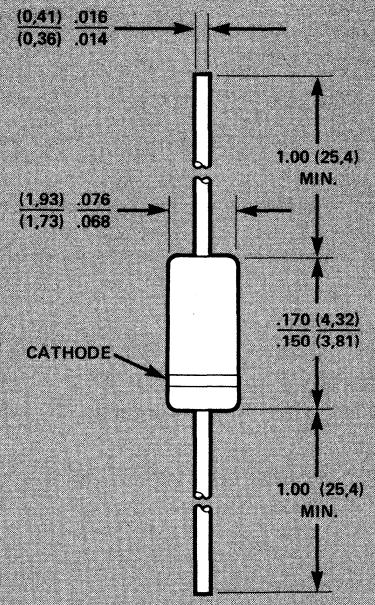
NOTES:

1. Per junction, multiply by four for total device. Derate linearly at 0.75mW/°C per junction.
2. Measured between two diagonal leads at 0V with f = 1MHz.
3. Measured at I_F = 5mA and 200μA ac signal. Includes 5Ω "Barrier Resistance" of Schottky barrier diode junction.

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COMPONENTS

SCHOTTKY DIODES FOR MIXERS AND DETECTORS (to 4 GHz)

5082-2350 5082-2520
5082-2351 5082-2521
5082-2365 5082-2550
5082-2400 5082-2551
5082-2401 5082-2565
5082-2418 5082-2566



Outline 15

Features

- LOW 1/f NOISE – 3dB 1/f noise temperature ratio at 100 Hz
- LOW NOISE FIGURE – 6dB NF available
- EXCELLENT ENVIRONMENTAL CAPABILITIES

Description

Schottky Diodes employ a metal-silicon Schottky barrier junction and utilize electrons for majority carrier conduction. The Schottky diode's performance conforms closely with theory and can be described as closely approximating the ideal diode.

Applications

HP's Schottky Mixer and Detector Diodes are intended for use in applications requiring the ultimate in performance and reliability. Extensive testing has shown that these devices exhibit the design capability necessary to meet the general requirements of MIL-S-19500, in addition to the special reliability requirements of man-rated space systems.

As mixers they offer low and stable noise figure as well as high pulse burnout resistance. Their uniform and repeatable RF characteristics allow the designer a great deal of latitude in specifying his RF circuitry.

The diodes are also intended for use as small signal square law detectors, and in large signal power monitor applications.

The low 1/f noise, high voltage sensitivity, and low noise figure make these devices ideally suited for video detectors, zero IF mixers, and square law detectors as required in doppler radar equipment, broadband ECM-receivers, and measurement equipment.

Mechanical Specifications

The HP Outline 15 package has a glass hermetic seal with Dumet leads. The leads on the Outline 15 package should be restricted so that the bend starts at least 1/16" from the glass body. With this restriction, Outline 15 package will meet MIL-STD-750, Method 2036, Conditions A and E (4 lbs. tension for 30 minutes). The maximum soldering temperature is 230°C for 5 seconds. Outline 15 package inductance and capacitance is typically 3nH and 0.07pF, respectively.

Marking on all packages is by digital coding with a cathode band.

Absolute Maximum Ratings

	Units	5082-2350 Series 5082-2400 Series	5082-2500 Series
Operating Temperature Range	°C	–60 to +125	–60 to +125
Storage Temperature Range	°C	–60 to +125	–60 to +125
CW Power Dissipation at $T_A = 25°C$	mW	200	200
Peak Power Dissipation (1μs pulse, 0.001 Du at $T_A = 25°C$)	W	15	4
Peak Inverse Voltage	V	30	5

Electrical Specifications at $T_A = 25°C$

Test Frequency†	2.0 GHz	3.0 GHz
NF_o = 6.0 dB Single	2400	2565
NF_o = 6.0 dB Pair*	2401	2566
NF_o = 6.5 dB Single	2365**	2550
NF_o = 6.5 dB Pair*	2418**	2551
NF_o = 7.0 dB Single	2350	2520
NF_o = 7.0 dB Pair*	2351	2521
VSWR	1.5	1.5
Z_{IF} (o hms)	150-250	100-250

* Noise Figure Match ΔNF_o 0.3 dB max.
IF Impedance Match ΔZ_{IF} 25 ohms max.

† Test Conditions: The noise figure is measured at the specified test frequency and is a single sideband receiver noise figure using a 30 MHz, 1.5 dB Noise Figure IF amplifier. L.O. power is 1.0 mW.

** VSWR (max) = 1.3:1.

Typical Parameters at $T_A = 25°C$

HP Type	Junction Capacitance C_{jo} (pF)	Series Resistance R_S (Ω)	NF_o Temperature Coefficient +dB/°C
5082-2350, -2400 Series	0.5-0.9	5-8	0.004
-2500 Series	0.3-0.7	3-6	0.004

Reliability

Hewlett-Packard Schottky Diodes are suitable for high reliability space applications where maximum performance stability under the most adverse conditions is required. Maintenance of product reliability during manufacture has resulted in the use of these diodes in major aerospace and national defense programs.

Environmental Characteristics

	MIL-STD-750 Reference	Conditions
Temperature, Storage	1031	See maximum ratings
Temperature, Operating	–	See maximum ratings
Solderability	2026	230°C as applicable
Temperature, Cycling	1051	5 cycles, –65° to +125°C
Thermal Shock	1056	5 cycles, 0-100°C
Moisture Resistance	1021	10 days, 90-98% RH
Shock	2016	5 blows, X_1, Y_1, Y_2, at 1500 G
Vibration Fatigue	2046	32 hrs, X, Y, Z at 20 G min.
Vibration Variable Frequency	2056	4, 4-min. cycles, X, Y, Z, at 20 G min., 100 to 2000 Hz
Constant Acceleration	2006	X_1, Y_1, Y_2 at 20,000 G
Terminal Strength	2036	Package dependent
Salt Atmosphere	1041	35°C fog for 24 hours

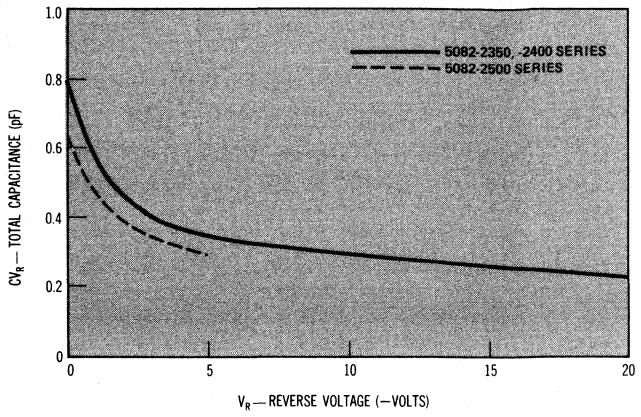


Figure 1. Typical Capacitance vs. Reverse Bias Voltage Characteristics at T_A = 25°C.

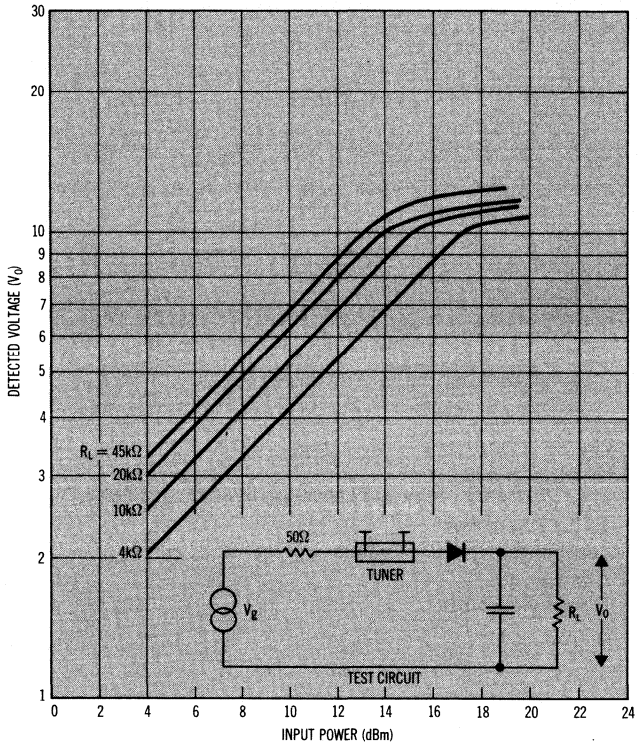


Figure 3. Typical 5082-2350 Large Signal Detector Characteristics at T_A = 25°C, f = 2GHz.

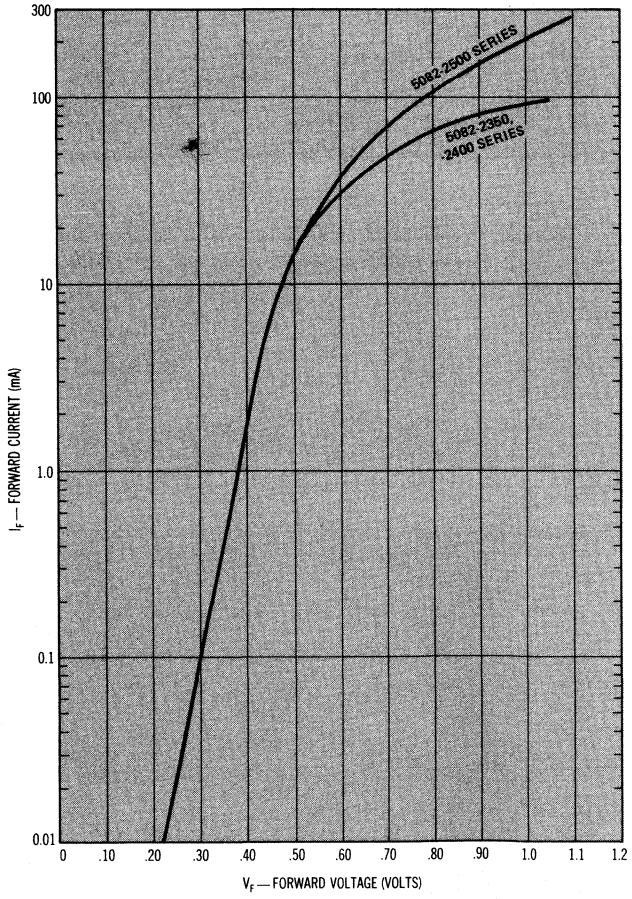


Figure 2. Typical Forward Current vs Forward Voltage Characteristics at T_A = 25°C.

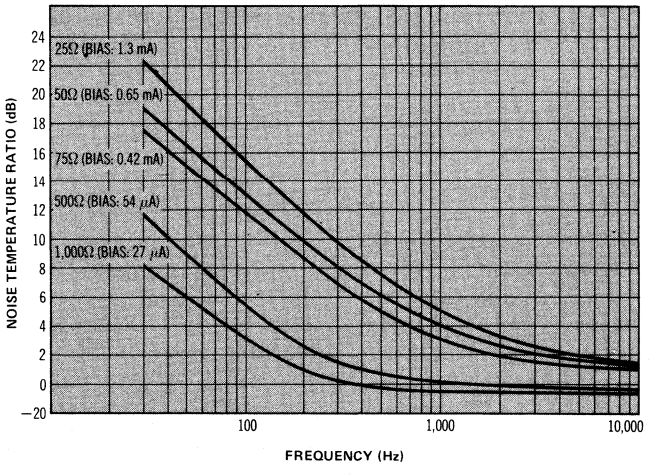


Figure 4. Typical Flicker (1/f) Noise Characteristics at T_A = 25°C.

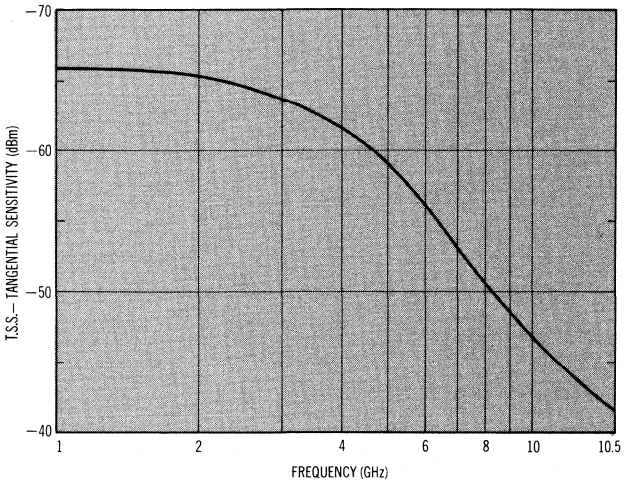


Figure 5. Typical Tangential Sensitivity, 5082-2350.

Test Parameters:

Amplifier Noise Resistance 200Ω
Bandwidth 100kHz
Load Resistance 25kΩ

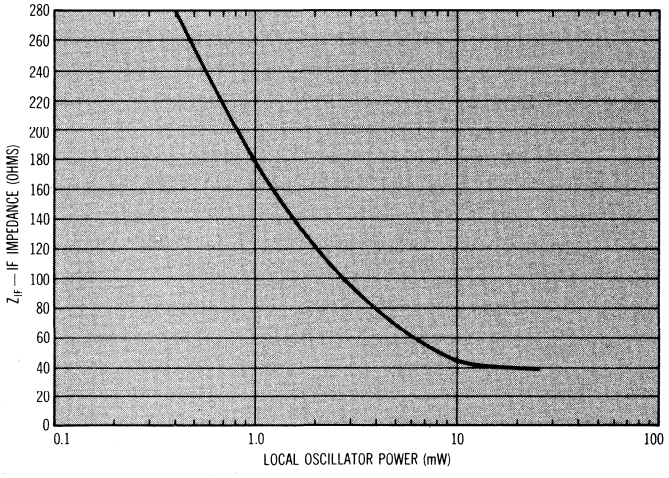


Figure 6. Typical 5082-2350 and -2400 Series IF Impedance vs. Local Oscillator Power with f_{LO} = 2.0GHz and f_{IF} = 30MHz.

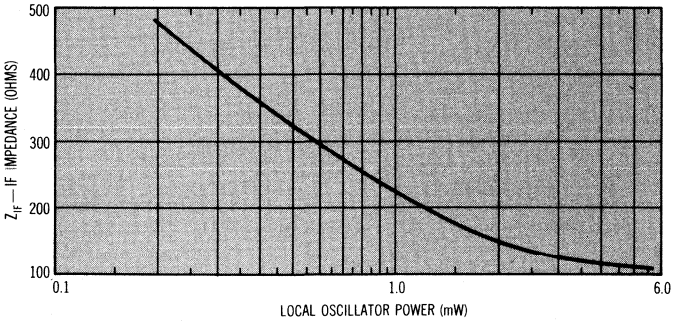


Figure 7. Typical 5082-2500 Series IF Impedance vs. Local Oscillator Power at f_{LO} = 3.0GHz and f_{IF} = 30MHz.

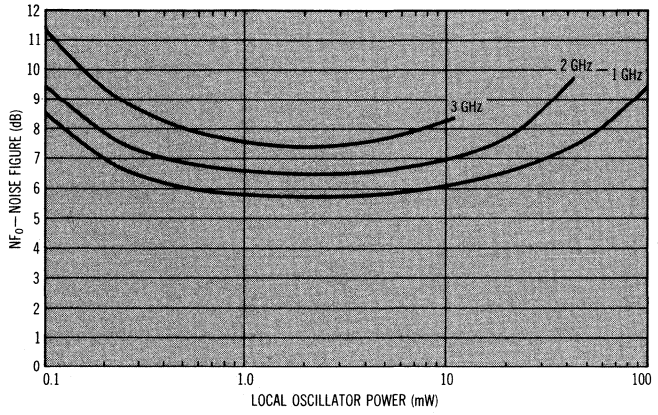


Figure 8. Typical 5082-2350 Noise Figure vs. Local Oscillator Power with f_{IF} = 30MHz and NF_{IF} = 1.5dB.

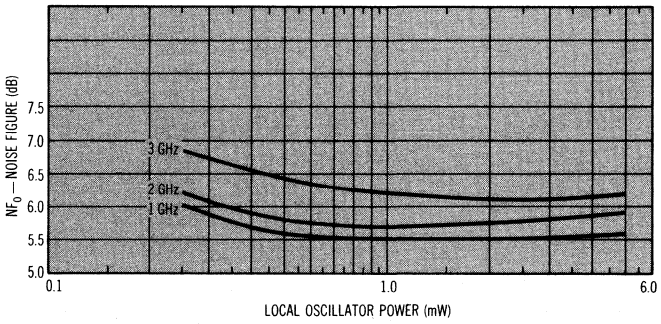


Figure 9. Typical 5082-2550 Noise Figure vs. Local Oscillator Power with f_{IF} = 30MHz and NF_{IF} = 1.5dB.

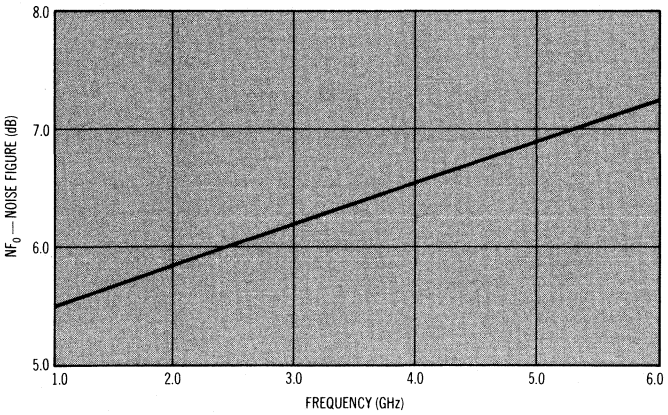


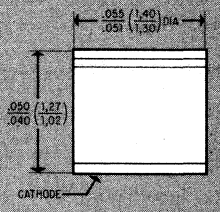
Figure 10. Typical 5082-2550 Noise Figure vs. Frequency with P_{LO} = 1.0mW, f_{IF} = 30MHz, and NF_{IF} = 1.5dB.

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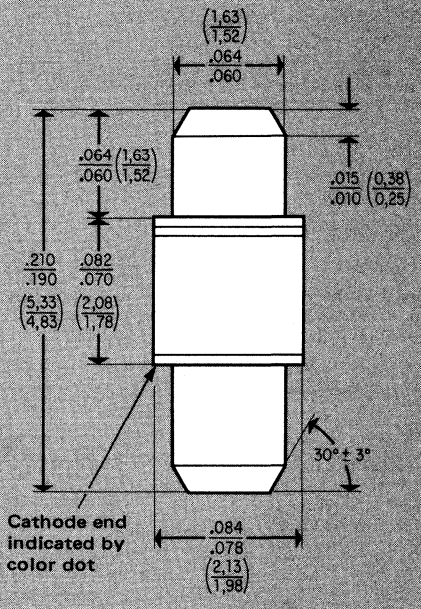
COMPONENTS

SCHOTTKY DIODES FOR MIXERS (1-18 GHz)

5082-2234
5082-2235
5082-2701 thru 2703
5082-2706 thru 2708
5082-2711 thru 2714
5082-2721 thru 2724



Outline 44.



Outline 49.

Dimensions in Inches & Millimeters

Features

- **Low and Stable Noise Figure**
  - **Less than 6.0 dB at 10 GHz**
  - **Less than 6.5 dB at 16 GHz**
- **High Burnout Rating**
  - **1 W RF Pulse Power Dissipation**
- **High Uniformity**
  - **VSWR of 1.5:1 Assures Repeatable RF Impedance**
- **Rugged Design**
  - **Two Hermetically Sealed Package Styles Available**
- **Excellent Environmental Capabilities**

Description

These mixer diodes are silicon Schottky barrier diodes of planar, epitaxial passivated chip design. The processing technique used produces a diode family with extremely uniform electrical characteristics. A very tight tolerance in junction capacitance and a minimized series resistance provide a uniform RF impedance from diode to diode and low and stable noise figure characteristics. In the rugged and hermetically sealed metal ceramic packages, the conventional cat whisker has been replaced by the more reliable thermocompression bond. This construction allows the device to be used in environments requiring reliable performance during high shock and vibration.

Applications

The Schottky diodes described in this data sheet are useful for use in broad and narrow band stripline, coaxial, or waveguide mixer assemblies operating from 1 to 18 GHz and above, where low noise and high reliability are of importance. This excellent uniformity of the Schottky diode RF characteristics allows the design of mixers with predictable performance characteristics and makes the devices field replaceable with no circuit adjustments. Typical equipment applications include telecommunication receivers, ECM/radar front ends, and OEM mixers where sensitivity and high burnout power are required.

Absolute Maximum Ratings

T_{OPR}		— Operating Junction Temperature Range	–60° C to +150° C
T_{STG}		— Storage Temperature Range	–60° C to +150° C
P_{DISS}	(Pulse)	— Pulse Power Dissipation at T_A = 25° C (Notes 1, 2, 3)	1W
P_{DISS}	(CW)	— CW Power Dissipation at T_A = 25° C (Notes 2,3)	200 mW
I_F		— DC Forward Current at T_A = 25° C (Note 3)	100 mA

Electrical Specifications at T_A=25°C

TEST FREQUENCY, GHz	PART NUMBER 5082-	CONFIGURATION	PACKAGE OUTLINE	NOISE FIGURE dB		IF IMPEDANCE Ω		MAXIMUM VSWR
				TYP.	MAX.	MIN.	MAX.	
9.375	2713	SINGLE	49	5.8	6.0	200	400	1.5:1
	2714	MATCHED PAIR						
	2701	SINGLE	44	5.8	6.0	200	400	1.5:1
	2706	MATCHED PAIR						
	2711	SINGLE	49	6.3	6.5	200	400	2.0:1
	2712	MATCHED PAIR						
	2702	SINGLE	44	6.3	6.5	200	400	2.0:1
	2707	MATCHED PAIR						
	2234	SINGLE	49	6.8	7.0	200	400	2.0:1
	2235	MATCHED PAIR						
	2703	SINGLE	44	6.8	7.0	200	400	2.0:1
	2708	MATCHED PAIR						
16.0	2723	SINGLE	49	6.3	6.5	200	400	1.5:1
	2724	MATCHED PAIR						
	2721	SINGLE	49	6.8	7.0	200	400	2.0:1
	2722	MATCHED PAIR						
TEST CONDITIONS	—	—	—	(NOTES 4,5)		(NOTE 7)		(NOTE 4)

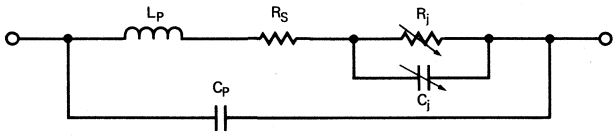


Figure 1. Equivalent Circuit of Packaged Diode.

Typical Equivalent Circuit Parameters at T_A=25°C

PART NUMBER 5082-	PACKAGE OUTLINE	L_P	C_P	R_S	R_j	C_j
2701–2703 2706–2708	44	0.3	0.13	9	300	0.15
2711–2714 2234 2235	49	1.0	0.15	9	300	0.15
2721–2724	49	1.0	0.15	9	300	0.13
UNITS	—	nH	pF	Ω	Ω	pF
TEST CONDITIONS	—	NOTE 6	—	—	—	—

NOTES:

1. 1 μs pulse, Du = .001.
2. Power absorbed by the diode. Frequency range: X- or Ku-Band, DC load resistance <1 Ω. Cathode stud is connected to infinite heat sink.
3. Derate linearly to zero at 150°C.
4. Measurements are performed on the diode in a fixed tuned mount.

Local Oscillator Power . . . . . 1 mW
Local Oscillator Frequency. . . (See Diode Test Frequency)
IF Frequency . . . . . 30 MHz
DC Load Resistance . . . . . <1.0 Ω
For matched pairs, the following additional specifications apply:
Noise Figure Match . . . . . $\Delta NF \leq 0.3$ dB
IF Impedance Match . . . . . $\Delta Z_{IF} \leq 25\,\Omega$

5. Single sideband receiver noise figure including an IF amplifier noise figure of 1.5 dB.
6. Series inductance of a coaxial line consisting of the diode with short circuited chip as inner conductor and an outer conductor of 0.18 inch diameter. The ends of the coaxial line are defined by the ends of the diode (for package outline 44) or by the steps to .083 in. diameter (for package outline 49).
7. Same conditions as Note 4, except IF frequency is 10 KHz.

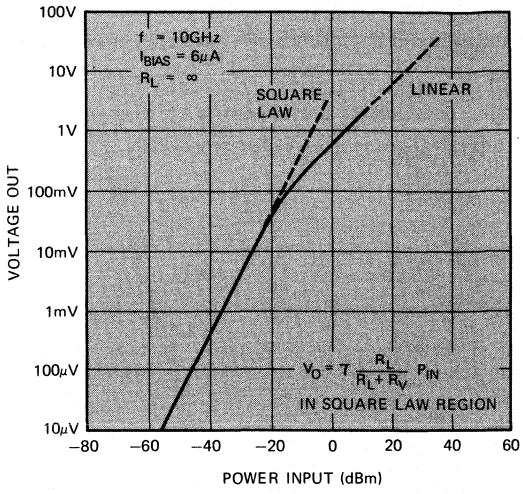


Figure 2. Typical Detected Voltage vs. Input Power. Voltage Sensitivity = 3 mV/μW Typical.

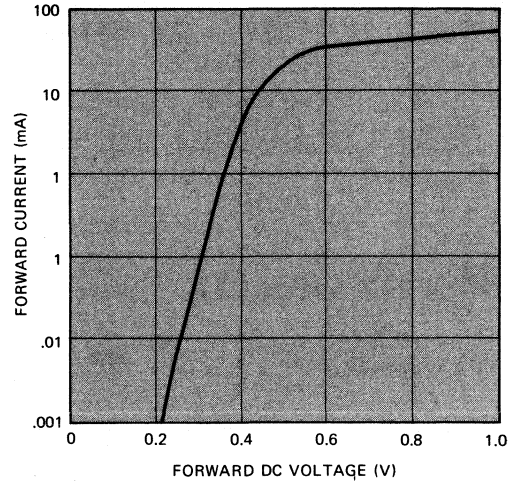


Figure 3. Typical Forward Characteristics.

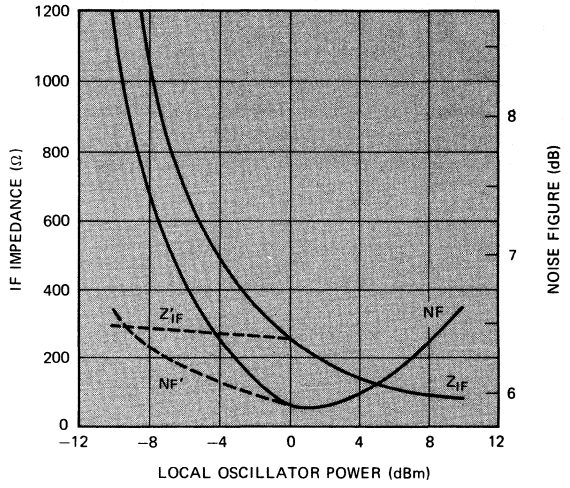


Figure 4. Typical Noise Figure and IF Impedance for 5082-2711 vs. Local Oscillator Power. Note the improved performance at low levels of L.O. power when d.c. bias is superimposed (dashed curves).

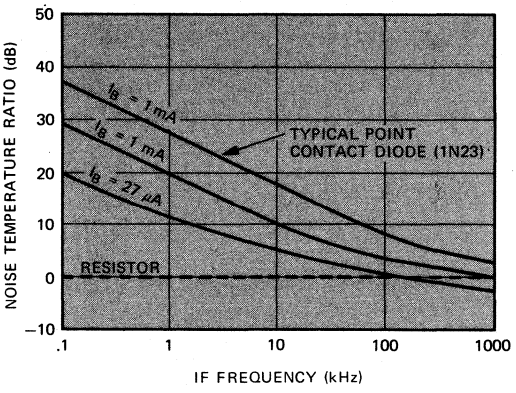


Figure 5. Typical Flicker (1/f) Noise vs. IF Frequency and Bias Current showing Typical Schottky and Point Contact Diodes.

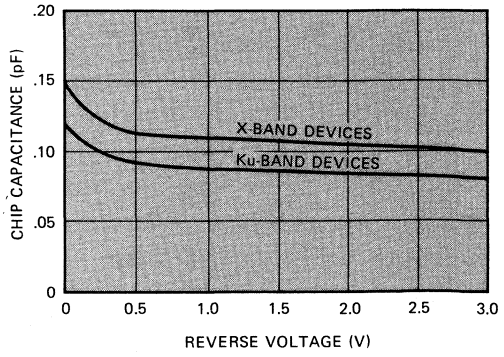


Figure 6. Typical Chip Capacitance vs. Reverse Voltage.

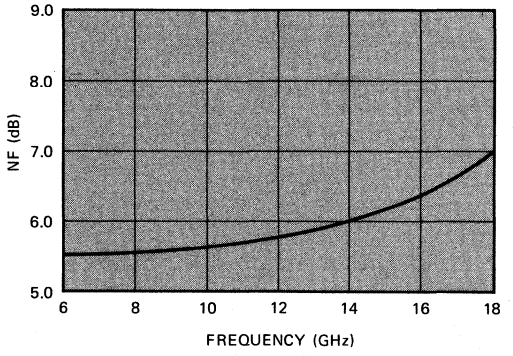


Figure 7. Typical Single Sideband Noise Figure vs. Frequency, 5082-2723. IF = 30 MHz, NF_{IF} = 1.5 dB, P_{LO} = 1 mW.

Mechanical Specifications

The HP outline 44 is a hermetically sealed ceramic package. Both flanges are gold plated kovar. The maximum soldering temperature is 230°C for 5 seconds.

The HP package 49 is a hermetically sealed double stud ceramic package. The anode and cathode stud are gold plated kovar. Stud-stud TIR is 0.010 inch maximum. The maximum soldering temperature is 230°C for 5 seconds.

Environmental Capabilities

The HP packages 44 and 49 have been designed to have the environmental capabilities as outlined in MIL-STD-750 with the following conditions:

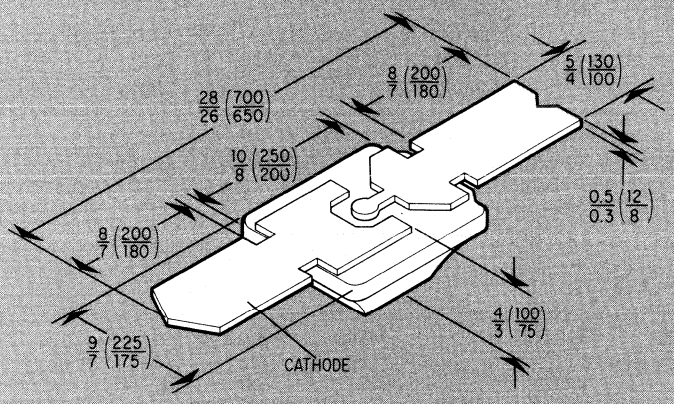
TEST	METHOD	CONDITIONS
Temperature, Storage	1031	See maximum ratings
Temperature, Operating	1026	See maximum ratings
Temperature, Cycling	1051	5 cycles, −65°C to +125°C
Thermal Shock	1056	5 cycles, 0°C to +100°C
Moisture Resistance	1021	10 days, 90-98% RH, −10°C to +65°C
Shock	2016	5 blows, X_1, Y_1, Y_2 at 1500 G
Vibration Fatigue	2046	32 hours each X, Y, Z at 1500 G
Vibration Variable Frequency	2056	Four 4 minute cycles, X, Y, Z at 20 G min 100 - 200 Hz
Constant Acceleration	2006	1 minute each X_1, Y_1, Y_2 at 20,000 G

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COMPONENTS

BEAM LEAD SCHOTTKY DIODES FOR MIXERS AND DETECTORS (1-18 GHz)

X-BAND
5082-2709
5082-2768
Ku-BAND
5082-2716
5082-2769
5082-2767



Dimensions in mils (μM)

Features

- **Planar Surface**
  - **Easier Bonding, Stronger Leads**
- **Passivated**
  - **Stable, Reliable Performance**
- **Low Noise Figure**
  - **6dB Typical at 9GHz**
- **High Uniformity**
  - **Tightly Controlled Process Insures Uniform RF Characteristics**

Description

These beam lead diodes are constructed using a metal-semiconductor Schottky barrier junction. Advanced epitaxial techniques and precise process control insure uniformity and repeatability of this planar passivated microwave semiconductor.

During manufacturing, gold leads are deposited onto a glass passivation layer before the wafer is separated into dice. This provides exceptional lead strength.

Applications

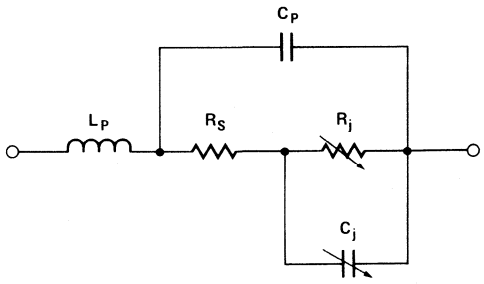
The diode can be mounted in a stripline or microstrip circuit using welding, or thermocompression or ultrasonic bonding.

5082-2709 and -2768 are optimized for mixer applications through X-Band. The -2768 is a -2709 selected for a maximum noise figure of 6.5dB at 9.375GHz.

5082-2716 and -2769 are optimized for mixer applications through Ku-Band. The -2769 is a -2716 selected for maximum noise figure of 7.5dB at 16GHz. The 5082-2716 and -2769 are also recommended for detector applications in X and Ku-Band. The 5082-2767 is selected for a maximum total capacitance of 0.1pF.

See Application Note 940 for further details.

Typical Circuit Parameters



Parameter	Symbol	X-Band 5082-2768, -2709	Ku-Band 5082-2769, -2716	Ku-Band 5082-2767	Units
Junction Resistance	R_j	230	230	230	Ω
Series Resistance	R_s	5	5	6	Ω
Junction Capacitance	C_j	.12	.09	.07	pF
Package Capacitance	C_p	.02	.02	.02	pF
Package Inductance	L_p	.1	.1	.1	nH

Note: 1mW L.O. Power, dc Load Resistance <10Ω on 10 mil Substrate.

Absolute Maximum Ratings

Pulse Power Incident at $T_A = 25°C$ (Note 1) 1W
CW Power Dissipation at $T_A = 25°C$ (Note 2) 300mW
T_{OPR} – Operating Temperature Range . . . . . –60°C to +150°C
T_{STG} – Storage Temperature Range . . . . . –60°C to +150°C
Maximum Pull On Any Lead . . . . . 2 grams
Diode Mounting Temperature . . . . . 220°C for 10 sec. max.

DC Electrical Specifications $T_A = 25°C$

Parameter	Symbol	5082-2709	5082-2768	5082-2716	5082-2769	5082-2767	Units	Test Conditions
Minimum Breakdown Voltage	V_{BR}	3	3	3	3	3	V	$I_R = 10\mu A$
Maximum Forward Voltage	V_F	1	1	1	1	1	V	$I_F = 20mA$
Maximum Total Capacitance	C_T	0.25	0.25	0.15	0.15	0.10	pF	$V_R = 0V$, f = 1MHz

RF Electrical Specifications at $T_A = 25°C$

Parameter	Symbol	5082-2768	5082-2769	Units	Test Conditions
Noise Figure	NF_{SSB}	6.5 max.	7.5 max.	dB	1mW L.O. Power IF = 30MHz, 1.5dB NF

Typical RF Characteristics at $T_A = 25°C$

Parameter	Symbol	Typical Value	Units	Test Conditions
Mixer:				
RF Impedance	Z_{IF}	250-500	Ω	1mW Local Oscillator Power. IF =
Voltage Standing Wave Ratio	VSWR	1.25:1	–	30MHz
Detector:				
Tangential Sensitivity	TSS	–54	dBm	
Detection Sensitivity	γ	6.6	mV/μW	Video Bandwidth = 2MHz
Video Resistance	R_V	1400	Ω	

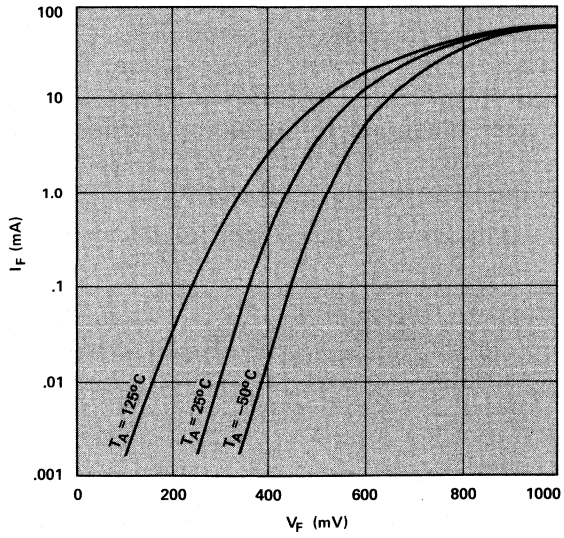


Figure 1. Typical Forward Characteristics, 5082-2709 and -2768.

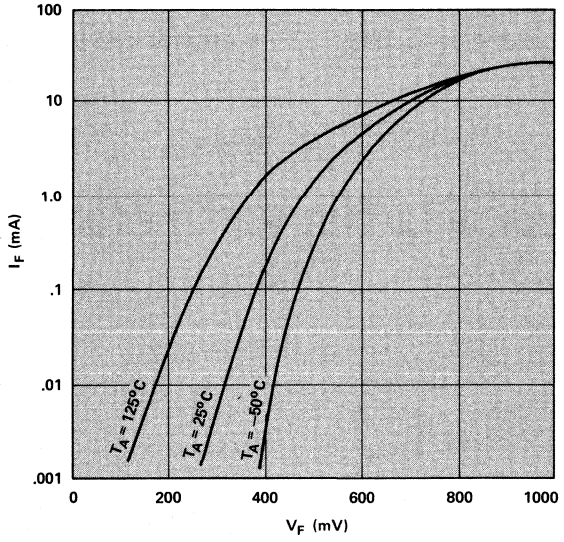


Figure 2. Typical Forward Characteristics, 5082-2716, -2769, and -2767.

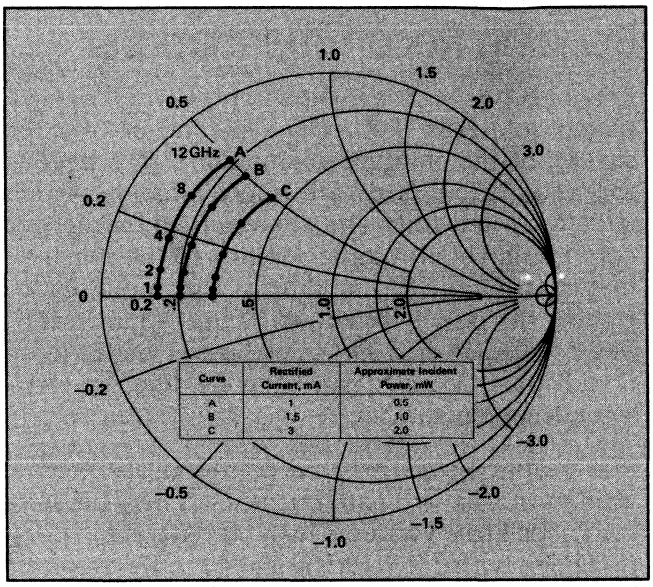


Figure 3. Typical Admittance Characteristics, 5082-2709 and -2768 with self bias.

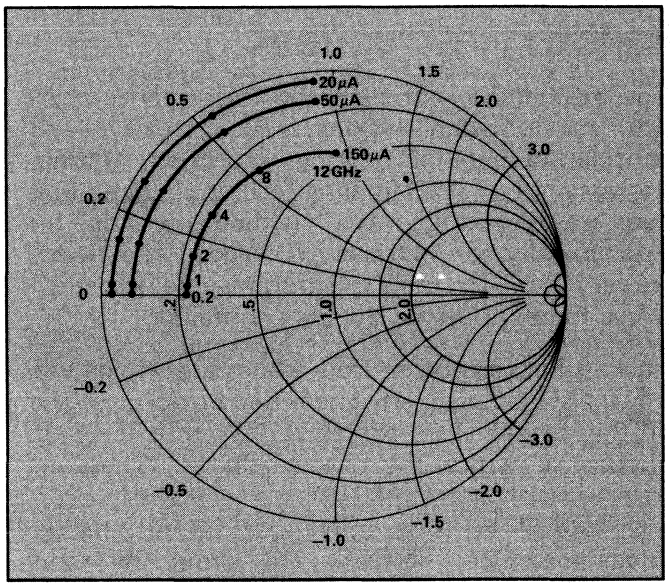


Figure 4. Typical Admittance Characteristics, 5082-2709 and -2768 with external bias.

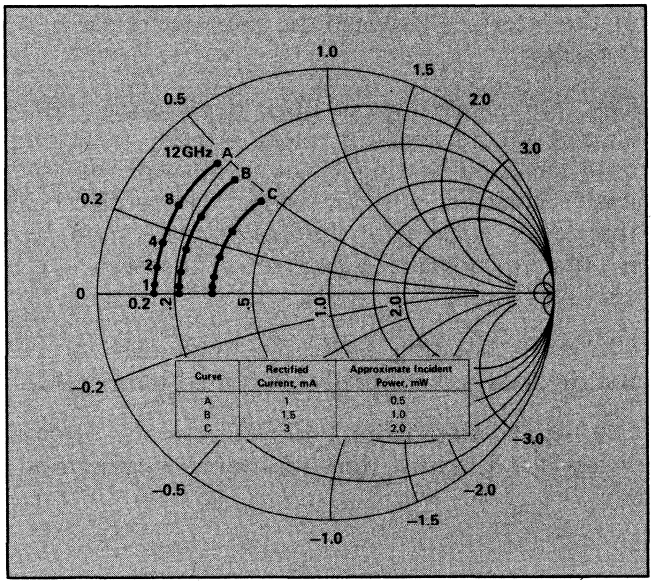


Figure 5. Typical Admittance Characteristics, 5082-2716, and -2769 with self bias.

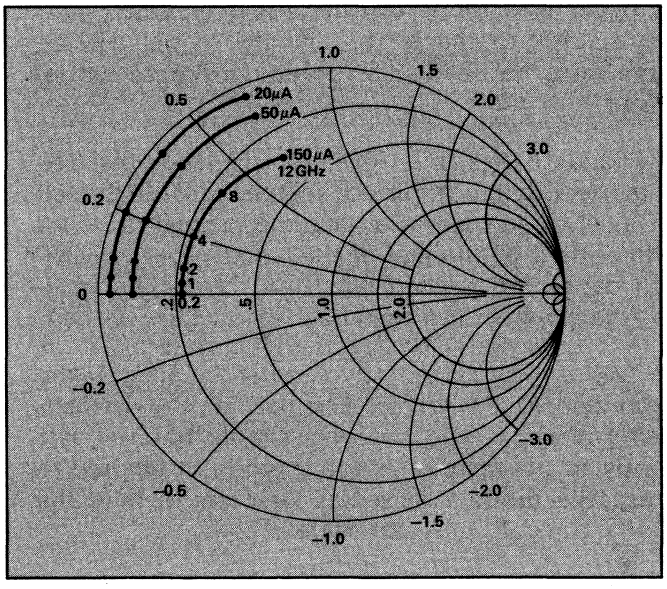


Figure 6. Typical Admittance Characteristics, 5082-2716 and -2769 with external bias.

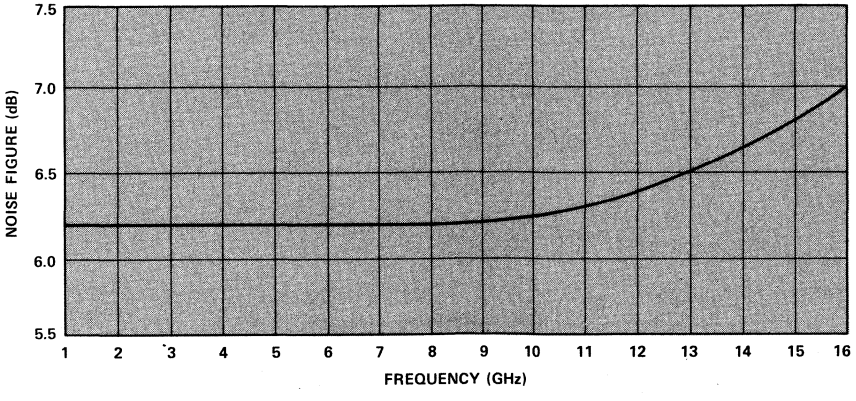


Figure 7. Typical Noise Figure vs. Frequency.

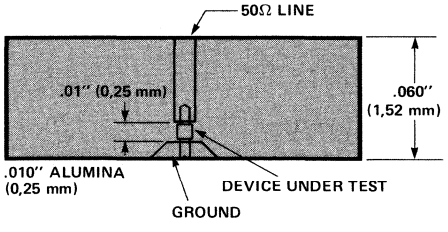


Figure 8. Admittance Test Circuit.

Notes: 1. 1μs pulse, Du=.001. 2. Power absorbed by the diode. DC load resistance <1Ω.

Handling Instructions

The mechanical and electrical performance characteristics of beam lead diodes require careful and considerate handling during inspection, testing, and assembly. The handling techniques described here are necessary so that the diodes will not be mechanically or electrically damaged. The diodes are very small and magnification may be necessary to see them inside the shipping container.

Hewlett-Packard beam lead diodes are shipped in a flat, plastic container. The inside bottom surface of the container is coated with a thin layer of silicone to which the diodes adhere. They are covered with anti-static silk. A vacuum pickup with a #27 tip is recommended for picking up single beam lead devices. This should be done under 20 X magnification for accurate positioning of the tip on the die.

A beam lead diode can be destroyed electrically by a static discharge through the diode. Hence, they must be handled so static discharges cannot occur.

If a vacuum pickup is not used, it is recommended that a wooden toothpick or sharpened Q-tip dipped in alcohol be used as a handling probe. A diode will adhere to the end of the wooden probe without danger of mechanically or electrically damaging the diode. It can then be placed where needed.

If tweezers are used, they must be electrically grounded to the surface upon which the device is being placed. The tweezers should be used as a probe to lift the diodes and should not be used to grasp the diode. If used as tweezers to hold the diode, the gold tabs can be deformed.

Bonding Recommendations

Beam lead devices are silicon chips with coplanar plated gold tabs that extend parallel to the top surface of the chip approximately 8 mils beyond the edge. The leads are approximately 4 mils wide by ½ mil thick and are mounted by thermocompression or ultrasonic bonding to the substrate metallization. The bonding is accomplished by placing the device face down with the tabs resting flat on the pad area and using heated wedge (and/or substrate), parallel-gap (step-welding), or ultrasonic techniques.

The heated wedge may be continuously heated, as in most standard equipment, or it may be pulse resistance heated where a high current, short duration pulse is used to raise the wedge to the required temperature. In the step-welding operation, current is passed through the substrate metallization and the device lead. Most of the heat is generated at the interface between the two, where the bond is formed.

The major advantage of pulse heating techniques is that a cold ambient may be used, generating only localized heating in the vicinity of the bond itself. The electrodes (or wedge) can be placed on the device lead while the bond area is cold, and maintain a constant force through the heating and cooling cycle.

Ultrasonic bonding is also recommended because the diode is not exposed to elevated temperature.

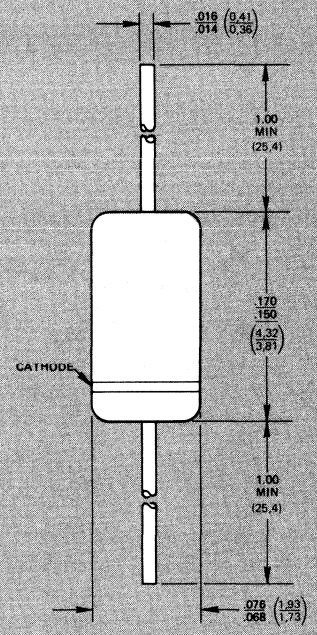
See Application Note 940 "Diodes for Hybrid Integrated Circuits" for additional information.

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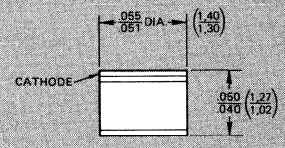
COMPONENTS

SCHOTTKY DIODES FOR DETECTORS

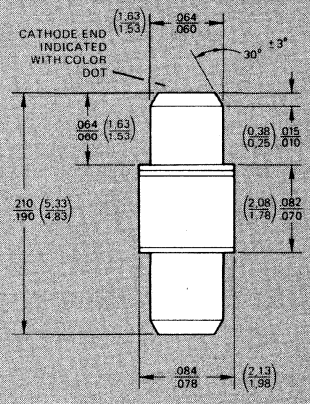
5082-2750
5082-2751
5082-2755
5082-2787



OUTLINE 15



OUTLINE 44



OUTLINE 49

All dimensions in inches and millimeters.

Features

- **Improved Detection Sensitivity**
  - **Typical TSS of −60dBm at 10GHz**
- **Low 1/f Noise for Detectors and Zero IF Mixers**
  - **Typical Noise Temperature Ratio = 4dB at f_m = 1kHz**
- **High Peak Power Handling Capability**
  - **2W RF Peak Pulse Power**
- **Extremely Low Capacitance**
  - **Typical 0.08pF Chip Capacitance**
- **Uniform and Repeatable RF Characteristics**
  - **Advanced Planar Passivated Chip Design**
- **Low Cost for Consumer/Industrial Applications**
  - **RF Sample Tested Version 5082-2787**

Description

The HP 5082-2750 series Schottky Diodes are constructed using a metal silicon Schottky barrier junction with the silicon semiconductor material optimized for extremely low 1/f noise.

The use of P-type semiconductor material provides low 1/f noise with good overall noise figure and high voltage sensitivity. Advanced epitaxial techniques and precise process control ensure uniformity and repeatability.

Applications

The low 1/f noise, high voltage sensitivity, and low noise figure make devices of the 5082-2750 series ideally suited for video detectors, zero IF mixers, and square law detectors as required in doppler radar equipment, broadband ECM-receivers, and measurement equipment.

The low cost RF sample tested version 5082-2787 is optimized for applications in low cost consumer/industrial applications such as intrusion alarms, traffic radar, and proximity sensors. The low capacitance also makes this device suited for high speed logic, multiplexer circuits, RF modulators, and sampling gates. More detailed application information and design considerations for use as video detectors are described in HP Application Note 923, available from your local HP Sales Office.

The low capacitance makes this diode type susceptible to damage by accidental discharge of static electricity pulses from handling equipment. Appropriate grounding of such equipment will protect the units from damage.

Absolute Maximum Ratings

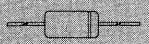
P_{DISS} – DC Power Dissipation (Note 1) 100mW

T_{OPR} – Operating Temperature Range (Note 2) . . . . . –60° to +150°C

T_{STG} – Storage Temperature Range . . . . . –60° to +150°C

P_{MAX} – Maximum Incident RF Peak Pulse Power (Note 3) 2.0W

RF Specifications at T_A=25°C

Package Type		Style	Type Numbers		
 Glass		15	5082-2755		5082-2787
 Double Stud		49	5082-2751		—
 Pill		44	5082-2750		—
Parameter	**Symbol**	**Units**	**Min.**	**Max.**	**Typ.***
Tangential Signal Sensitivity @ 375 kHz Video Bandwidth @ 2 MHz Video Bandwidth (Note 4)	TSS TSS	–dBm –dBm	58.5 55	— —	55 52
Voltage Sensitivity (Note 5)	γ	mV/μW	5.0	—	3.5
Video Resistance (Note 5)	R_V	kΩ	1.2	1.6	1.4

* The 5082-2787 is intended for consumer/industrial applications. V_{BR} is tested for 4 V (min.) @ 10 μA, I_F is 10 mA (min.) @ V_F = 1 V. Tangential sensitivity, γ and R_V are sample tested.

Typical Performance Data at 25°C

Symbol	Parameter	Typical	Units	Conditions
TSS	Tangential Signal Sensitivity	60	–dBm	f_{RF} = 10 GHz R_A = 500 Ω I_B = 20 μA B_V = 0.375 MHz
NF_O	Single Sideband Noise Figure	7.0	dB	P_{LO} = 1.0 mW f_{RF} = 9.375 GHz f_{IF} = 30 MHz NF_{IF} = 1.5 dB
t	Noise Temperature Ratio	5.0 15.0	dB dB	f = 20 kHz f = 1 kHz R_V = 50 Ω both cases
V_{BR}	Breakdown Voltage	5.0	V	I_R = 10 μA

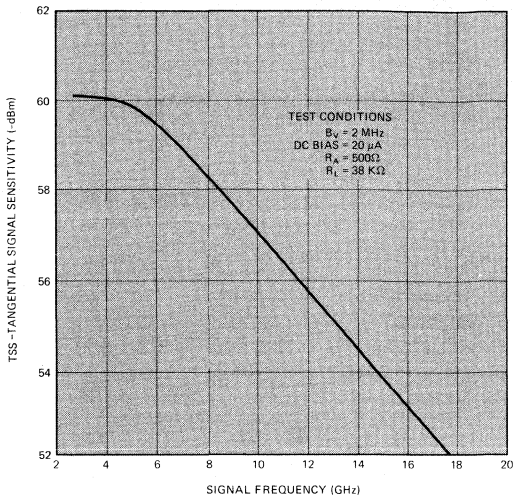


Figure 1. Typical TSS vs. Frequency.

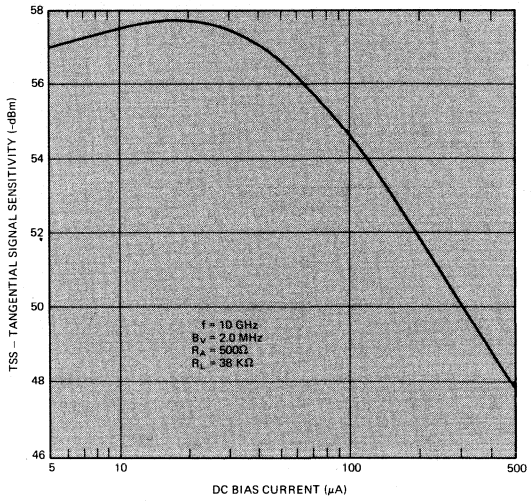


Figure 2. Typical TSS vs. Bias.

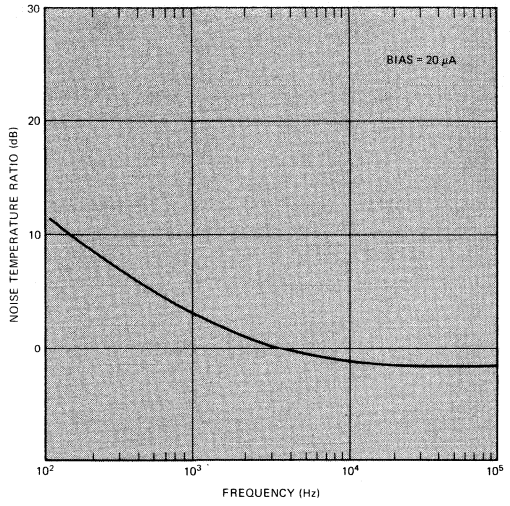


Figure 3. Typical Flicker (1/f) Noise vs. Frequency.

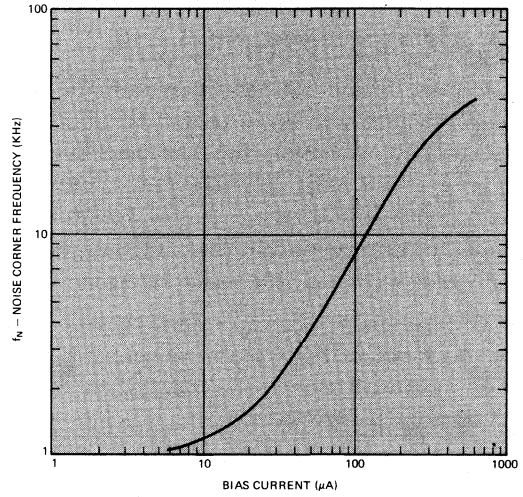


Figure 4. Typical Noise Corner Frequency vs. Bias.

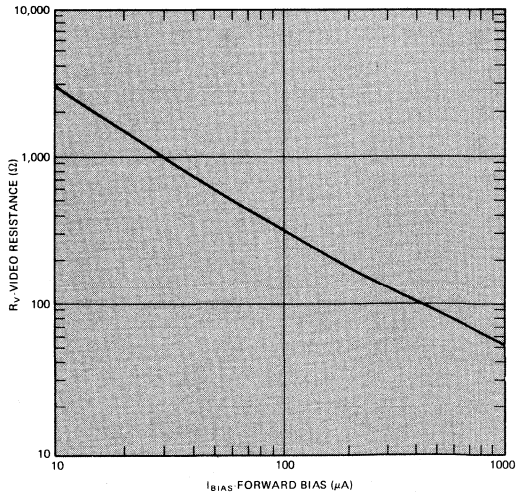


Figure 5. Typical R_V vs. Bias.

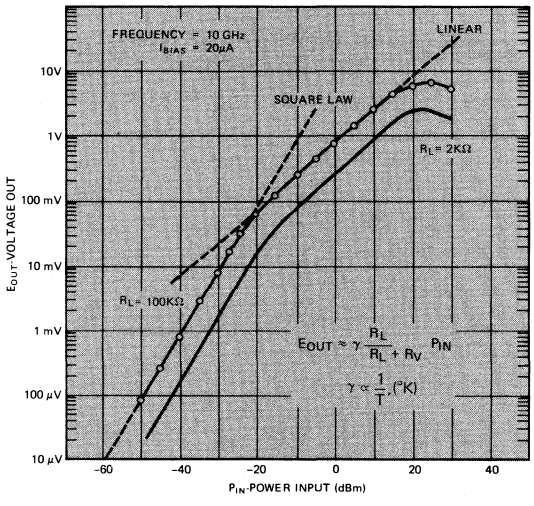


Figure 6. Typical Dynamic Transfer Characteristic.

NOTES:

1. At a case temperature of 25°C.
2. Derates linearly to zero power dissipation at 150°C.
3. Pulse Width = 1 μs. Repetition Rate = 1000 pps. Test Time = 30 sec. Frequency = 1 - 10 GHz.
4. **Test Conditions for TSS:** RF Signal: 10 GHz, DC Bias: 20 μA, Video Amplifier Equivalent Noise Resistance: 500 Ω.
5. **Test Conditions for γ and R_V:** As in Note 4 and at an RF Signal Power level of —40 dBm.

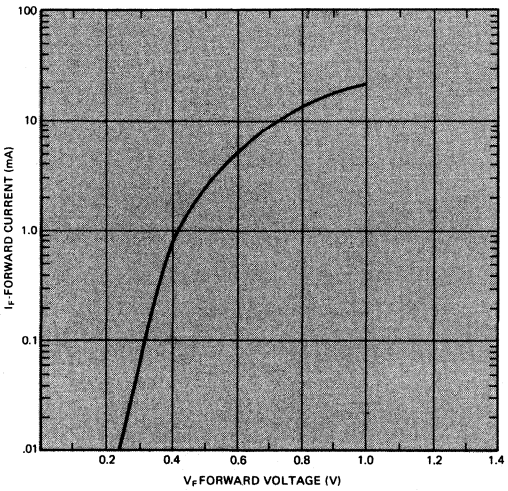
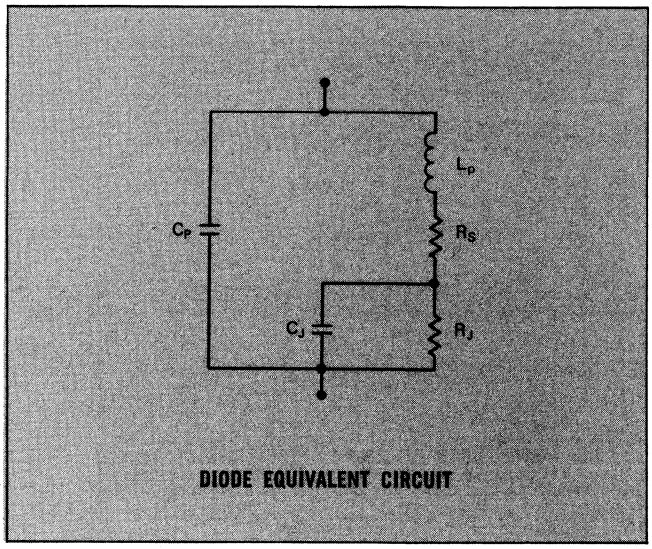


Figure 7. Typical Forward VI Characteristic.

Typical Parameter Values

	Package Outline 15	49	44
C_p—Package Capacitance	0.1 pF	0.15 pF	0.13 pF
L_p—Package Inductance	2 nH	1 nH	0.3 nH
R_s—Series Resistance	25 Ω	25 Ω	25 Ω
R_j—Junction Resistance (Ω)	28/I(mA)	28/I(mA)	28/I(mA)
$C_{j(o)}$—Junction Capacitance (zero bias)	0.08 pF	0.08 pF	0.08 pF



DIODE EQUIVALENT CIRCUIT

Package Characteristics

The HP Outline 15 package has a glass hermetic seal with Dumet leads which should be restricted so that the bend starts at least 1/16" (1,6mm) from the glass body. With this restriction, it will meet MIL-STD-750, Method 2036, Conditions A and E (4 lb. [1,8 kg] tension for 30 minutes). The maximum soldering temperature is 230°C for 5 seconds. Marking is by digital coding with a cathode band.

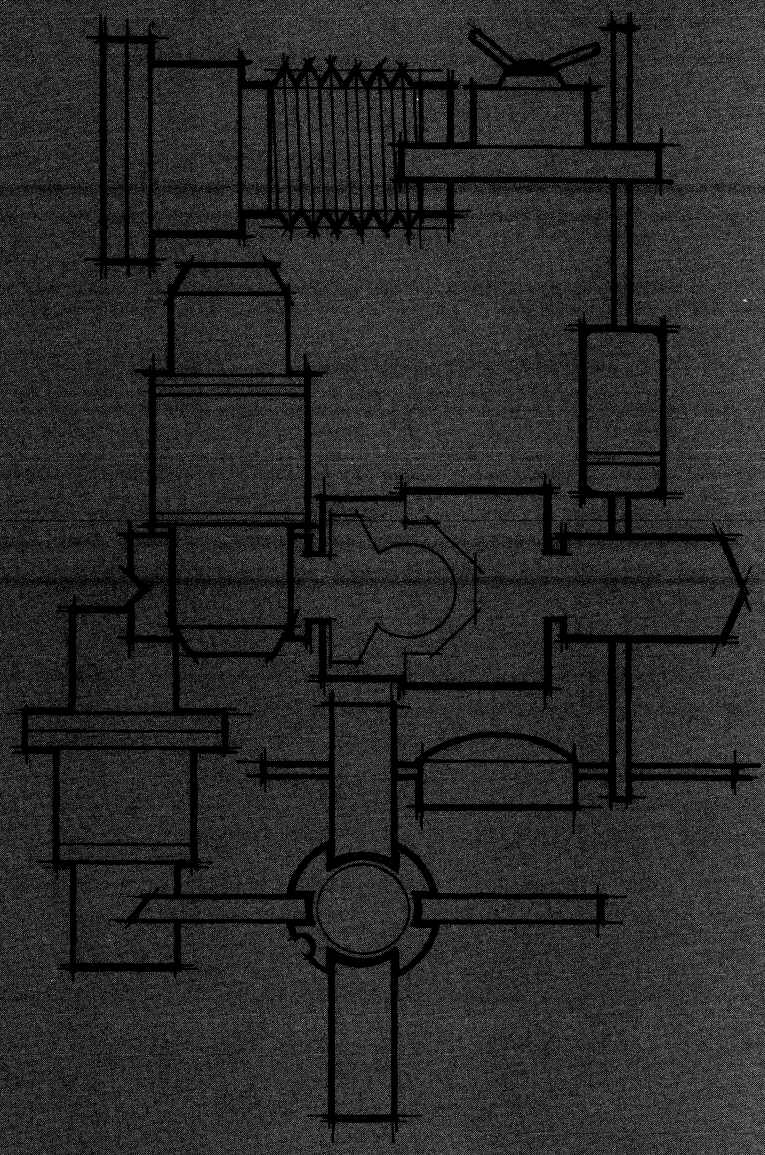
The HP Outline 49 package has a metal-ceramic hermetic seal. The anode and cathode studs are gold-plated Kovar. The maximum soldering temperature is 230°C for 5 seconds. Stud-stud T/R is 0.010" max.

The HP Outline 44 package is a hermetically sealed ceramic package. The anode and cathode are gold-plated Kovar. The maximum soldering temperature is 230°C for 5 seconds.

Environmental Capabilities

The HP Package Outlines 15, 44, and 49 have been designed to have the environmental capabilities outlined in MIL-STD-750 with the following conditions:

PARAMETER	METHOD	CONDITIONS
Temperature, Storage	1031	See Maximum Ratings
Temperature, Operating	—	See Maximum Ratings
Solderability	2026	230°C as applicable
Temperature, Cycling	1051	5 cycles, −65° to +125°C
Thermal Shock	1056	5 cycles, 0° to +100°C
Moisture Resistance	1021	10 days, 90-98% RH
Shock	2016	5 blows, X_1, Y_1, Y_2 @ 1500 G
Vibration Fatigue	2046	32 hrs X, Y, Z, @ 20 G min., 60 Hz
Vibration Variable Frequency	2056	Four 4-min cycles, X, Y, Z, @ 20 G min., 100 to 2000 Hz
Constant Acceleration	2006	X_1, Y_1, Y_2 @ 20,000 G
Terminal Strength	2036	Package Dependent
Salt Atmosphere	1041	35°C fog for 24 hours



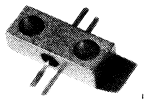
PIN Diodes for Signal Control

Selection Guide 86

PIN Diodes for VHF/UHF Switching, Attenuating and Automatic Gain Control 87

PIN Diodes for Microwave Switching, Attenuating and Limiting 96

PIN Diodes

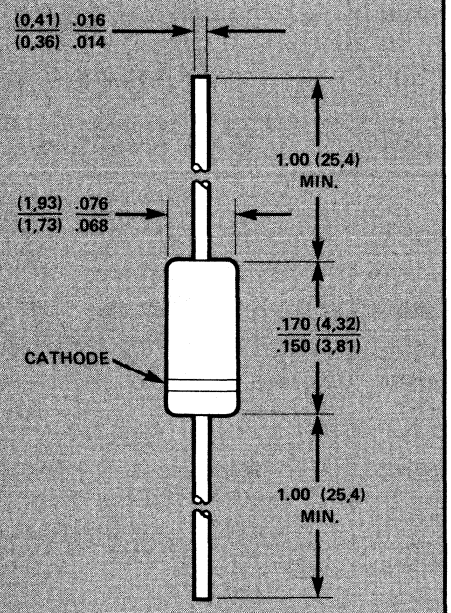
PACKAGE	PART NO. 5082-	PAGE NO.	DESCRIPTION
Glass	3080	87	VHF/UHF Attenuating and AGC
	3081	87	
	1N5767	90	
 15	3077	92	General Purpose VHF/UHF/Microwave
	3001	96	
	3002	96	
	3039	96	
	3003	99	Specified for Controlled Attenuation
	3004	99	
	3042	96	10ns Switching
	3043	96	
	3168	94	VHF/UHF Band Switching
	3188	94	
Ceramic	3201	103	Medium Power – Anode Heat Sink
	3202	103	
 31	3303	103	Medium Power – Cathode Heat Sink
	3304	103	
	3306	120	10ns Switching – Cathode Heat Sink
Ceramic	3101	103	Medium Power – Anode Heat Sink
	3102	103	
 38	3301	103	Medium Power – Cathode Heat Sink
	3302	103	
	3305	120	10ns Switching – Cathode Heat Sink
Stripline  (Hermetic) 60	3141	112	10ns Switching – Cathode Heat Sink
	3170	112	Medium Power – Cathode Heat Sink
	3140	112	Medium Power – Canode Heat Sink
	3041	107	10ns Switching – Cathode Heat Sink
	3304	107	Medium Power – Cathode Heat Sink
 61	3040	107	Medium Power – Anode Heat Sink
	3046	107	High Pulse Power – Anode Heat Sink
	3071	116	Limiter
Devices for Hybrid Integrated Circuits			
Chip	0001	143	10ns Switching – Cathode Back Contact
	0025	143	VHF/UHF Attenuating and AGC – Anode Back Contact
	0039	143	VHF/UHF Attenuating and AGC – Anode Back Contact
	0034	143	VHF/UHF Band Switching – Cathode Back Contact
	0012	143	General Purpose – Anode Back Contact
	0030	143	General Purpose – Cathode Back Contact
	0047	143	General Purpose – Anode Back Contact
	0049	143	General Purpose – Anode Back Contact
LID	3045	143	10ns Switching
	3085	143	VHF/UHF Attenuating and AGC
	3005	143	General Purpose
Ministrip	3010	143	10ns Switching – Cathode Heat Sink
	3086	143	VHF/UHF Attenuating and AGC – Anode Heat Sink
	3000	143	General Purpose – Anode Heat Sink
	3309	143	General Purpose – Cathode Heat Sink
Microstrip Post	3258	118,143	10ns Switching – Cathode Heat Sink
	3259	118,143	General Purpose – Anode Heat Sink

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COMPONENTS

HF/VHF/UHF CURRENT CONTROLLED RESISTOR

5082-3080
5082-3081



Features

- Priced for Industrial/Commercial Communications Equipment
- Low Distortion Products
- Useful Down to 1 MHz
- Specified RF Resistance with Bias
- Low Temperature Coefficient
- Tight Resistance Tracking Between Units
- Hermetically Sealed Glass Package

Description

The low frequency current controlled resistor consists of a specially processed and tested silicon PIN diode. The long minority carrier lifetime assures usefulness at operating frequencies down to 1 MHz with very low distortions. The fabrication process is tightly controlled and units are selected on the basis of similarity of RF resistance variation with bias.

Application

The low frequency current controlled resistor is ideally suited for constant impedance AGC-circuits, leveling circuits and electronically controlled RC and RL circuits operating in the frequency range from 1 MHz to 1 GHz and requiring extremely low signal distortions.

Special care is taken during manufacturing to assure repeatability of the RF resistance from unit to unit, which makes the device ideal for constant impedance attenuators in either pi-, T-, or bridged T-configurations.

The low and high resistance values have been specified to eliminate adjustments in high quantity production.

Mechanical Specifications

The HP Outline 15 package has a glass hermetic seal with leads. The leads on the Outline 15 package should be restricted so that the bend starts at least 1/16 inch (1,6 mm) from the glass body. With this restriction, Outline 15 package will meet MIL-STD-750, Method 2036, Conditions A and E [4 lb (1,8 kg)] tension for 30 minutes. The maximum soldering temperature is 230°C for five seconds.

Marking is by digital coding with a cathode band.

Absolute Maximum Ratings

Power Dissipation (T_A = 25°C) .....250 mW
Operating Temperature Range .....−65°C to +150°C
Storage Temperature Range .....−65°C to +150°C

DC Electrical Specifications at T_A=25°C)

Characteristic	Symbol	5082-3080			5082-3081			Units	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.		
Breakdown Voltage	V_{BR}	100			100			volts	I_R = 10 μA
Total Reverse Bias Capacitance	C_{VR}		0.3	0.4			0.4	pF	V_R = 50 V, f = 1 MHz
Effective Minority Carrier Lifetime	τ		1.3			2.0		μsec	I_F = 50 mA, I_R = 250 mA

RF Electrical Specifications at T_A=25°C

Characteristic	Symbol	5082-3080			5082-3081			Units	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.		
High Resistance Limit	R_H	1000	2500		1500	3000		ohms	I_{DC} = 0.01 mA, f = 100 MHz
Low Resistance Limit	R_L		5	8		6	8	ohms	I_{DC} = 20 mA, f = 100 MHz
Residual Series Resistance	R_s		1.5	2.5		2	3.5	ohms	I_{DC} = 100 mA, f = 100 MHz
2nd Order Distortion*	K_2		−70			−75		dB	Two-channel test on 10 dB, 75-ohm bridged T attenuator with 40 dBmV output on each channel f_1 = 65 MHz f_2 = 100 MHz*
Cross Modulation*	C_m		−62			−75		dB	

* See Figures 3 and 4.

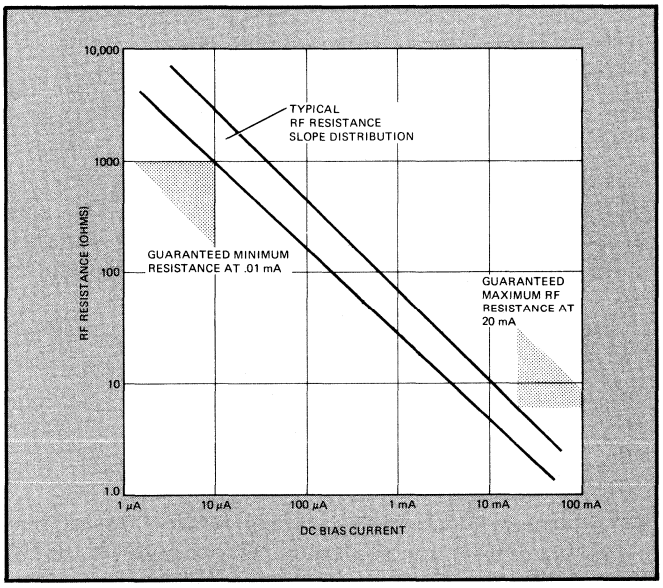


Figure 1. Typical PIN Diode RF Resistance versus DC Bias Current (5082-3080).

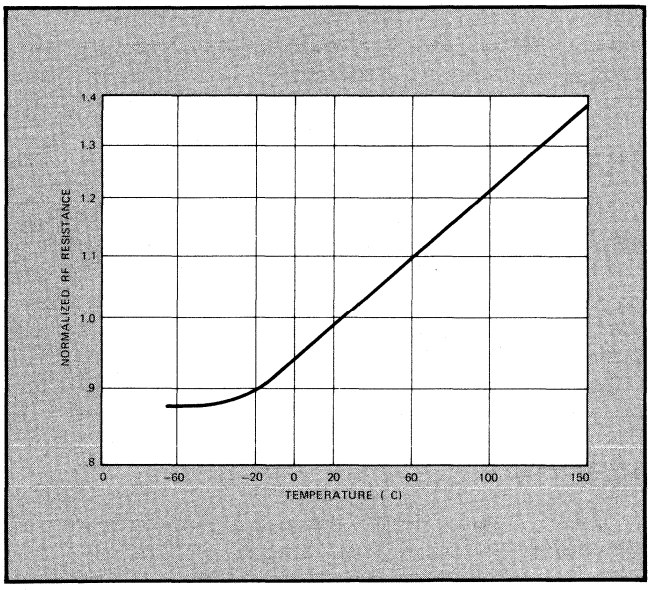


Figure 2. Typical Temperature Sensitivity of RF Resistance.

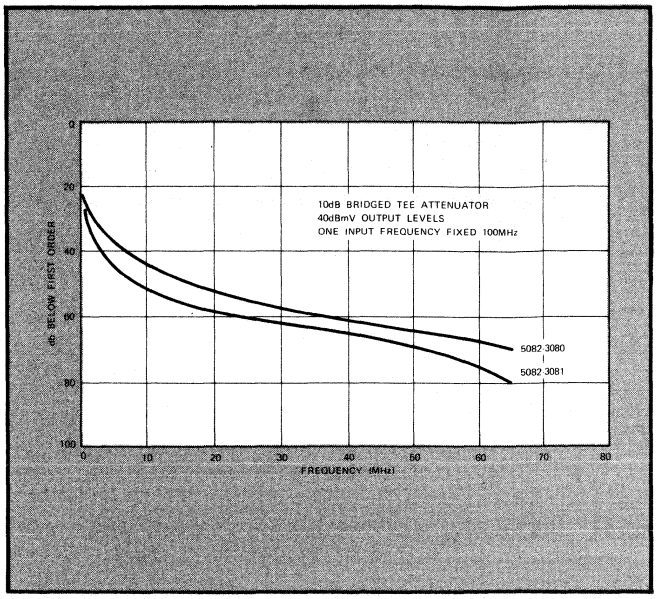


Figure 3. Typical Second Order Intermodulation Distortion.

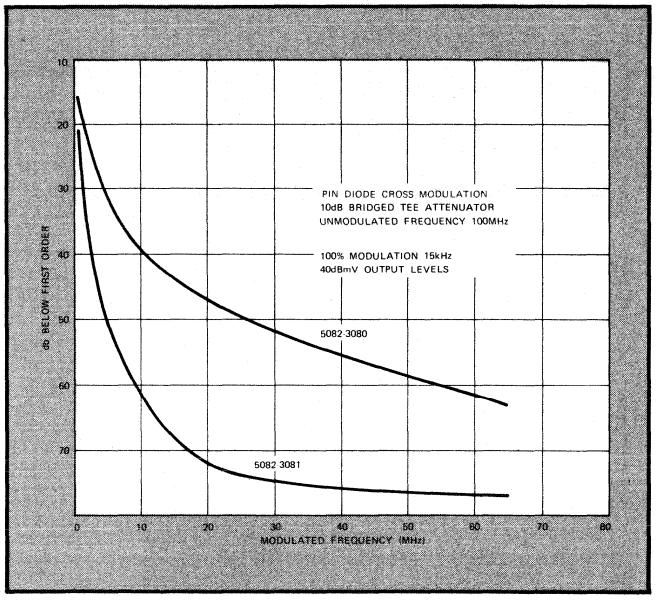


Figure 4. Typical Cross Modulation Distortion.

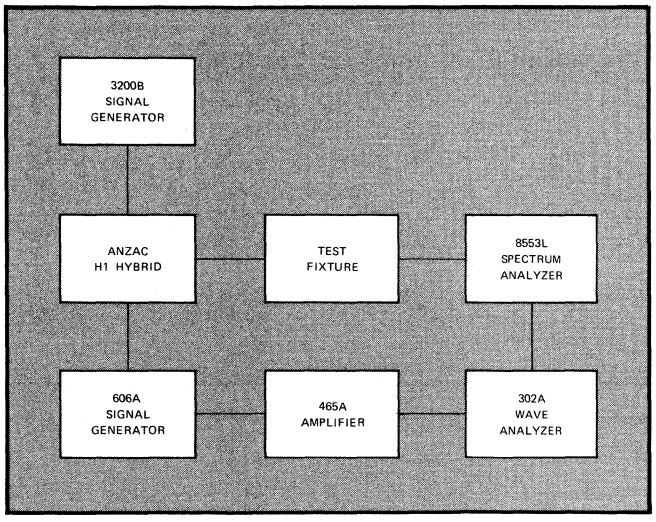


Figure 5. Cross Modulation Test Circuit.

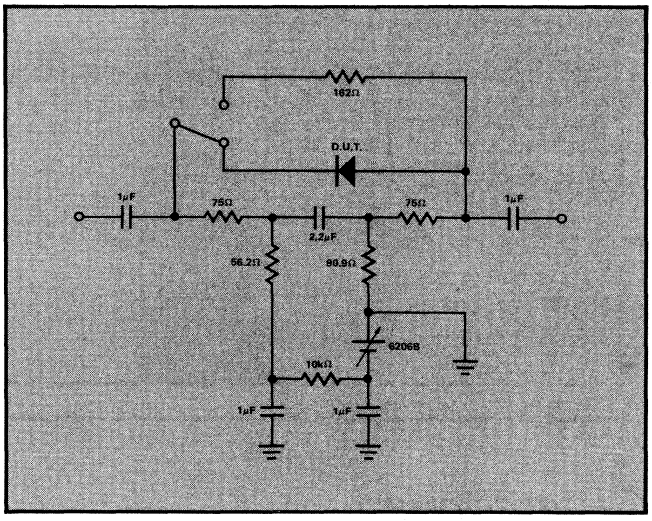


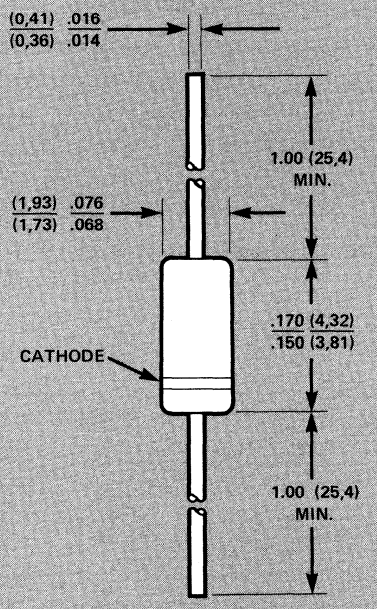
Figure 6. Bridged Tee Attenuator Test Circuit.

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COMPONENTS

HF/VHF/UHF CURRENT CONTROLLED RESISTOR

1N5767



Features

- Useful Down to 1 MHz
- Specified RF Resistance with Bias
- Low Temperature Coefficient
- Tight Resistance Tracking Between Units
- Excellent Environmental Capability

Description

The low frequency current controlled resistor consists of a specially processed and tested silicon PIN diode. The long minority carrier lifetime assures usefulness at operating frequencies down to 1 MHz with very low distortions. The fabrication process is tightly controlled and units are selected on the basis of similarity of RF resistance variation with bias.

Applications

The low frequency current controlled resistor is ideally suited for constant impedance AGC-circuits, leveling circuits and electronically controlled RC and RL circuits operating in the frequency range from 1 MHz to 1 GHz and requiring extremely low signal distortions.

Mechanical Specifications

The HP Outline 15 package has a glass hermetic seal with leads. The leads on the Outline 15 package should be restricted so that the bend starts at least 1/16 inch (1,6 mm) from the glass body. With this restriction, Outline 15 package will meet MIL-STD-750, Method 2036, Conditions A and E [4 lb (1,8 kg)] tension for 30 minutes. The maximum soldering temperature is 230°C for five seconds.

Marking is by digital coding with a cathode band.

Absolute Maximum Ratings

Power Dissipation (T_A = 25°C) ..... 250 mW
Operating Temperature Range..... −65°C to +150°C
Storage Temperature Range ..... −65°C to +150°C

DC Electrical Specifications at T_A=25°C

Characteristic	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Breakdown Voltage	V_{BR}	100			volts	I_R = 10μA
Reverse Current	I_R			1.0	μamp	V_R = 50V
Forward Voltage	V_F			1.0	volts	I_F = 100mA
Total Capacitance	C_{VR}			0.4	pF	V_R = 50V, f = 1MHz
Effective Minority Carrier Lifetime	τ	1.0			μsec	I_F= 50mA, I_R=250mA

RF Electrical Specifications at T_A=25°C

Characteristic	Symbol	Min.	Typ.	Max.	Units	Test Conditions
High Resistance Limit	R_H	1000			ohms	I_{DC} = 0.01mA, f = 100MHz
Low Resistance Limit	R_L			8	ohms	I_{DC} = 20mA, f = 100MHz
Residual Series Resistance	R_s			2.5	ohms	I_{DC} = 100mA, f = 100MHz

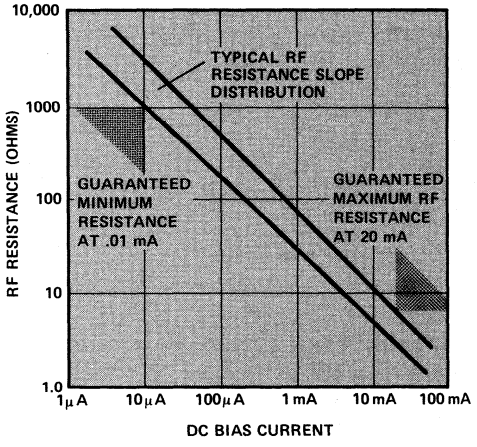


Figure 1. Typical PIN Diode RF Resistance versus DC Bias Current

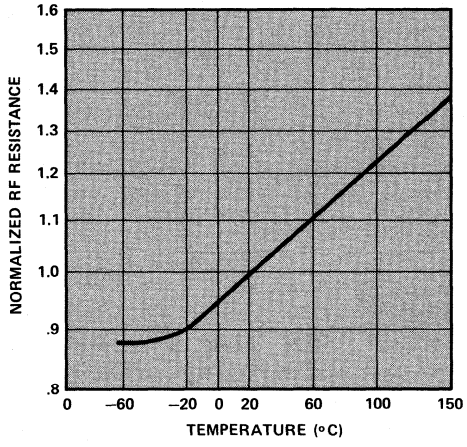


Figure 2. Typical Temperature Sensitivity of RF Resistance

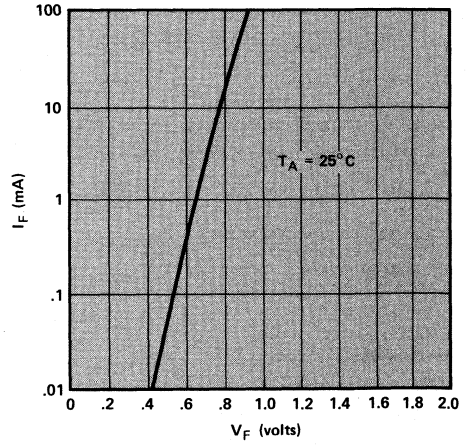


Figure 3. Typical Forward Current versus Forward Voltage

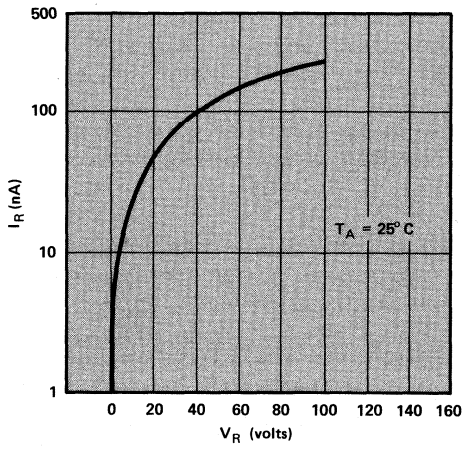


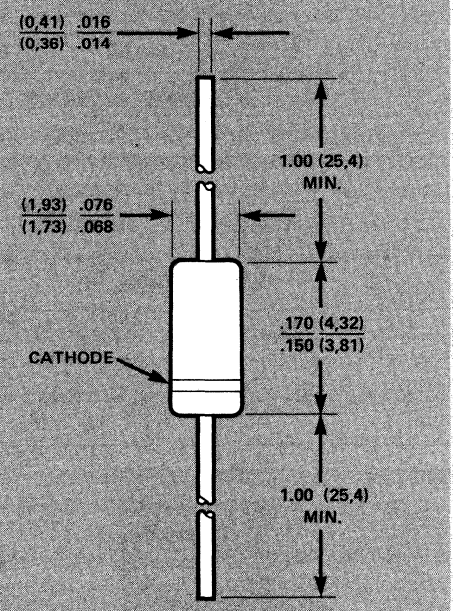
Figure 4. Typical Reverse Current versus Reverse Voltage

HEWLETT hp PACKARD

COMPONENTS

PIN DIODES FOR VHF/UHF SWITCHING AND ATTENUATING

5082-3077



Features

- **LOW COST**
  - FOR HIGH VOLUME APPLICATIONS IN VHF/UHF SWITCHING, ATTENUATING, MODULATING AND AGC CIRCUITS
- **LARGE DYNAMIC RANGE**
  - TYPICAL RESISTANCE SWING 1Ω TO 10,000Ω
- **HIGH SERIES ISOLATION**
  - LESS THAN 0.3pF TOTAL CAPACITANCE

Description

The HP 5082-3077 PIN diode is a low-capacitance planar-passivated silicon device manufactured using modern processing techniques to provide optimum characteristics for RF switching, modulating and automatic gain control applications. The device physics of the PIN junction provides for a varying RF resistance from less than 1 ohm to 10,000 ohms as a function of a varying DC bias current.

Applications

The HP PIN diode described in this data sheet is intended for low power low cost switching applications such as: RF Duplexers, Antenna Switching Matrixes, Digital Phase Shifters, Time Multiplex Filters; or in control applications such as: Variable RF Attenuators, Automatic Gain Control Circuits, RF Modulators Electronically Tuned Filters, Analog Phase Shifters, RF Limiters.

The 5082-3077 is optimized for wide dynamic range, high Q, and low intermodulation products. At a constant bias the RF resistance is relatively insensitive to temperature variations, increasing only 15% for a temperature change from +25°C to +100°C.

More detailed application information is available in Application Note 922 (PIN Diode Applications). Harmonic generation calculation procedures are described in *"Special Information No. 5."* Above publications are available from your local HP Sales Office.

Mechanical Specifications

The HP Outline 15 package has a glass hermetic seal with dumet leads. The leads on the Outline 15 package should be restricted so that the bend starts at least 1/16 inch (1.6 mm) from the glass body. With this restriction, Outline 15 package will meet MIL-STD-750, Method 2036, Conditions A and E (4 lbs [1.8 kg] tension for 30 minutes). The maximum soldering temperature is 230°C for five seconds. Typical package inductance and capacitance are 2.5 nH and .13pF respectively. Marking is by digital coding with a cathode band.

Absolute Maximum Ratings

Power Dissipation (T_A=25°C) ..... 250 mW
Operating Temperature Range ..... -65°C to +150°C
Storage Temperature Range ..... -65°C to +150°C

Electrical Specifications at T_A=25°C

Characteristic	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Breakdown Voltage	V_{BR}	200	—	—	Volts	I_R = 10 μA
Total Reverse Bias Capacitance	C_{VR}	—	—	0.3	pF	V_R = 50V, f = 1 MHz
Residual Series Resistance	R_S	—	—	1.5	Ohms	I_F = 50 mA, f = 100 MHz
Effective Minority Carrier Lifetime	τ	100	—	—	nsec	I_F = 50 mA
Reverse Recovery Time	t_{rr}	—	150	—	nsec	I_F = 20 mA, V_R = 10V 90% Recovery
CW Power Switching Capability	P_A	—	10	—	Watts	50 Ohm System Series Switch. For Shunt Configuration, divide by 4.

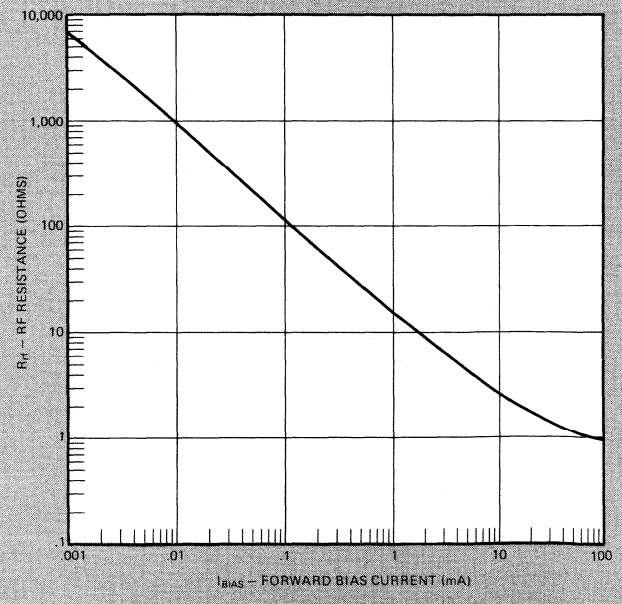


Figure 1.

Typical RF Resistance vs. DC Bias Current

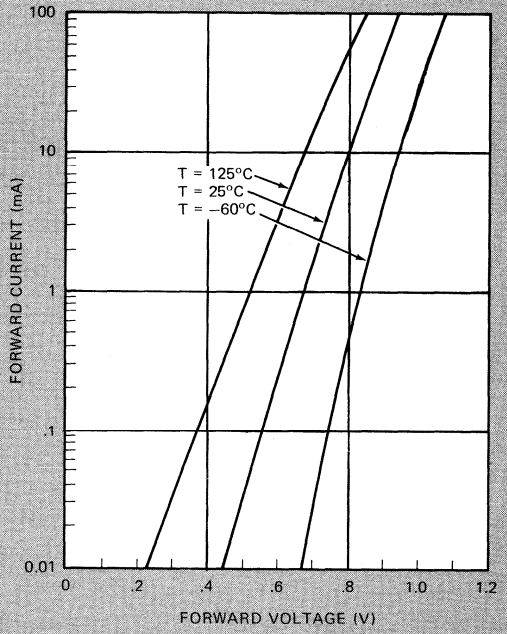


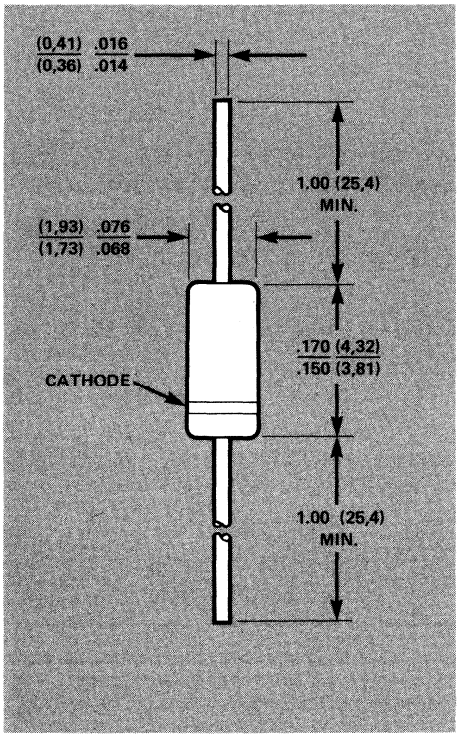
Figure 2.

Typical Forward Conduction Characteristics

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COMPONENTS

VHF/UHF SWITCHING PIN DIODES

5082-3168
5082-3188



Features

- **LOW COST**
  - Priced for large volume VHF/UHF and general purpose switching applications
- **LOW SERIES RESISTANCE**
  - R_S typically .35Ω at 10mA
- **LOW CAPACITANCE**
  - C_{tot} typically .8pF at –20V
- **HERMETIC PACKAGE**
  - Axial lead glass package for mechanical and environmental ruggedness

Description

The HP 5082-3168 and -3188 diodes are passivated, silicon PIN diodes designed for optimal VHF/UHF switching characteristics. These devices switch rapidly between high and low values of RF impedance as a function of DC bias current.

Applications

These PIN diodes are designed for use in VHF/UHF band switching and general purpose RF switching applications that require high performance and mechanical and environmental ruggedness at economical prices.

Mechanical Specifications

For superior mechanical and environmental performance, the 5082-3168 and -3188 are supplied in the HP outline 15 hermetically sealed glass package. If bent leads are required, the bend should occur at least 1/16" (1.6mm) from the glass body. The maximum soldering temperature is 230°C for 5 seconds. Marking is by digital coding with a cathode band.

Absolute Maximum Ratings

Power Dissipation (T_A = 25°C) [Derate linearly to 0 at 125°C] 250mW
Operating Temperature ..... −65°C to +125°C
Storage Temperature ..... −65°C to +150°C
Junction Temperature ..... 125°C Max.

Electrical Specifications at T_A=25°C

Characteristic	Symbol	5082-3168		5082-3188		Units	Conditions
		Min.	Max.	Min.	Max.		
Breakdown Voltage	V_{BR}	35		35		V	I_R = 10μA
Total Capacitance	C_{TOT}		2.0		1.0	pF	V_R = 20V, f = 1MHz
Residual Series Resistance	R_S		.5		.6	Ω	I_F = 10mA, F = 100MHz
Reverse Current	I_R		100		100	nA	V_R = 20V

Typical Package Inductance is 2.5nH
Typical Package Capacitance is .1pF

Environmental Capabilities

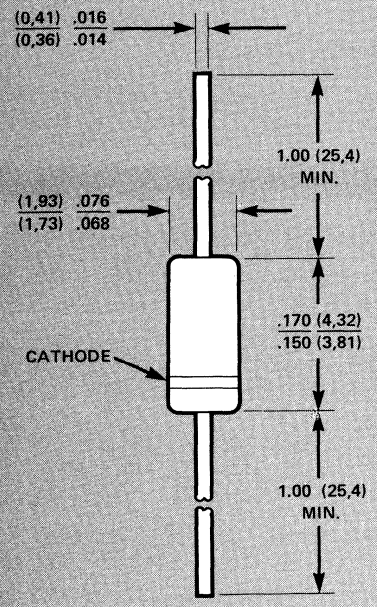
	MIL-STD-750 Reference	Conditions
Storage Temperature	1031	See Absolute Maximum Ratings
Operating Temperature	—	See Absolute Maximum Ratings
Solderability	2026	230°C for 5 seconds
Temperature Cycling	1051	5 cycles, −65°C to +150°C
Thermal Shock	1056	5 cycles, 0°C to +100°C
Moisture Resistance	1021	10 days, 90-98% RH
Shock	2016	5 blows, X_1, Y_1, Y_2 at 1500G
Vibration Fatigue	2046	32 hours, X, Y, Z at 60Hz, 20G min.
Vibration, Variable Frequency		Four 4 min. cycles, X, Y, Z at 20G min., 100 to 2000Hz
Constant Acceleration	2006	X_1, Y_1, Y_2 at 20,000G
Terminal Strength	2036	A, E, 4 lbs. (1.8kg) tension, 30 minutes
Salt Atmosphere	1041	35°C fog for 24 hours
Hermeticity	MIL-STD-202 Method 112A	Fine Leak Test, Condition C, Procedure III A. Gross Leak Test, Non-corrosive Ethylene Glycol, Condition A

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COMPONENTS

PIN DIODES FOR RF SWITCHING AND ATTENUATING

5082-3001
5082-3002
5082-3039
5082-3042
5082-3043



Features

Large Dynamic Range
— Typical Resistance Swing 1 Ohm to 10,000 Ohms

High Series Isolation
— Low Total Capacitance

Low Harmonic Distortion
— Greater than 300 ns Lifetime Available

Fast Switching and Modulating
— Less than 5 ns Reverse Recovery Available (5082-3042)

Description

The HP 5082-3000 series PIN diodes are silicon devices manufactured using modern processing techniques to provide optimum characteristics for RF switching, modulating and automatic gain control applications. Part numbers 5082-3001, -3002, and -3039 are of planar passivated design. The devices 5082-3042 and -3043 are of mesa passivated design. The device physics of the PIN junction provides for a varying RF resistance from less than 1 ohm to 10,000 ohms as a function of a varying DC bias current. In addition to low forward resistance, PIN diodes exhibit low capacitance. For device types 5082-3001, -3002 and -3039 this capacitance is independent of bias.

Applications

The HP PIN diodes described in this data sheet are intended for low power switching applications such as: RF Duplexers, Antenna Switching Matrices, Digital Phase Shifters, Time Multiplex Filters; or in control applications such as: Variable RF Attenuators, Automatic Gain Control Circuits, RF Modulators, Electronically Tuned Filters, Analog Phase Shifters, and RF Limiters.

The devices are useful over the frequency range from approximately 10 MHz to 1 GHz in broadband applications and to much higher frequencies in resonated narrowband switching circuits.

Part numbers 5082-3001, -3002, and -3039 describe devices optimized for wide dynamic range, high Q, and low intermodulation products. At a constant bias the RF resistance is relatively insensitive to temperature variations, increasing only 15% for a temperature change from +25° C to +100° C.

Devices 5082-3042, and -3043 are optimized for fast switching and/or low bias current applications at frequencies above approximately 100 MHz. These devices are also recommended for broadband modulators with modulation frequencies in the MHz range and for active and passive limiters.

More detailed application information is available in Application Note 922 (PIN Diode Applications) and AN 929 (Fast Switching PIN Diodes). Harmonic generation calculation procedures are described in "Special Information No. 5." Above publications are available from your local HP Sales Office.

Absolute Maximum Ratings

T_{OPR}	Operating Temperature Range	-65°C to +150°C
T_{STG}	Storage Temperature Range	-65°C to +150°C
P_{DISS}	DC Power Dissipation at T_C = 25°C	250 mW
PIV	Peak Inverse Voltage	V_{BR}

Electrical Specifications at T_A=25°C

HP PART NUMBER 5082-	MINIMUM BREAKDOWN VOLTAGE V_{BR} (V)	MAXIMUM TOTAL CAPACITANCE C_T (pF)	MAXIMUM SERIES RESIDUAL RESISTANCE R_S (Ω)	MINIMUM EFFECTIVE CARRIER LIFETIME τ (ns)	TYPICAL REVERSE RECOVERY TIME t_{rr} (ns)	TYPICAL CW POWER SWITCHING CAPABILITY P_A (W) Ω
3001	200	0.25	1.0	100	150	12.0
3002	300	0.2	1.0	100	150	12.0
3039	150	0.25	1.25	100	150	10.0
3042	70	0.4*	1.0*	15(TYP)	5 (MAX)	12.0
3043	50	0.4*	1.5*	15(TYP)	10(MAX)	10.0
TEST CONDITIONS	I_R = 10 μA	V_R = 50V f = 1MHz *V_R = 20V	I_F = 100mA f = 100MHz *I_F = 20mA	I_F = 50mA I_R = 250mA	I_F = 20mA V_R = 10V 90% Recovery	50Ω System, Series Switch. For Shunt Configuration, Divide by 4.

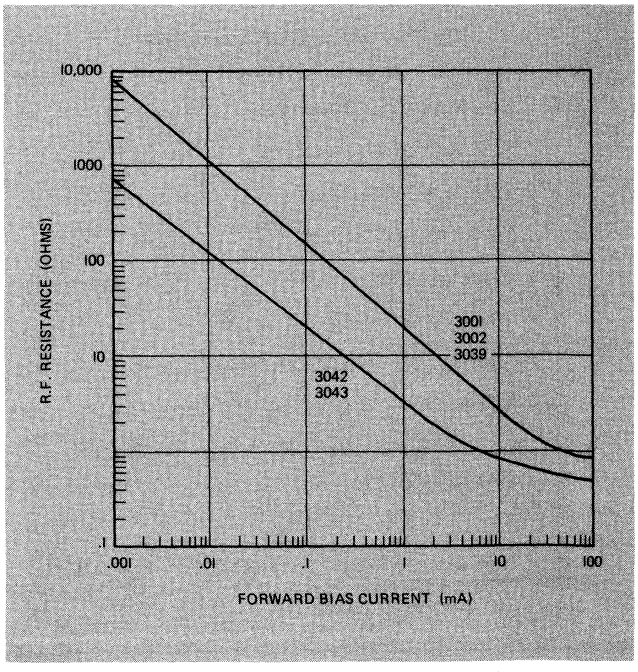


Figure 1. Typical RF Resistance vs Forward Bias Current

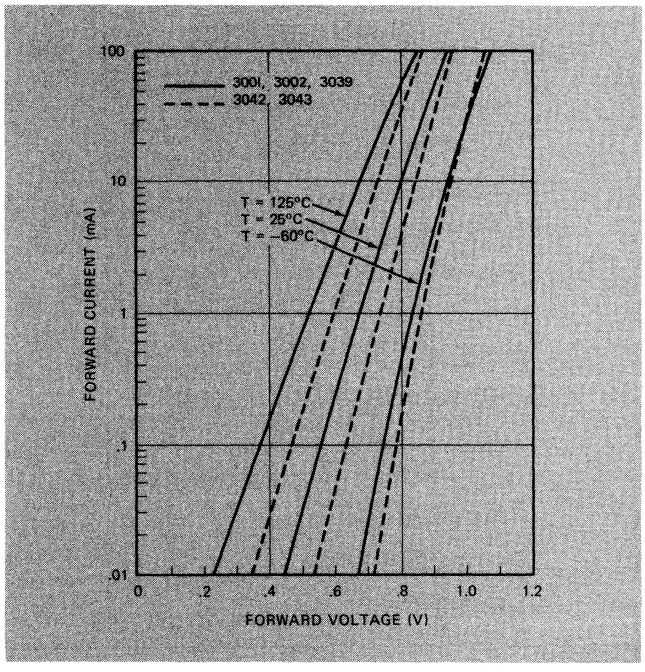


Figure 2. Typical Forward Current vs Forward Voltage

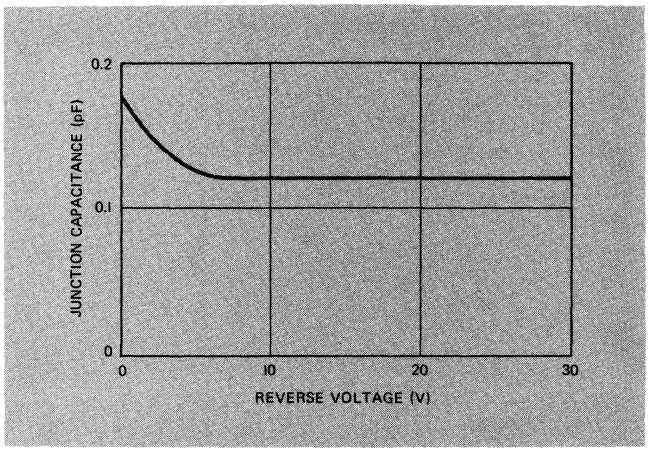


Figure 3. Typical Junction Capacitance vs Reverse Voltage, 5082-3042, 3043

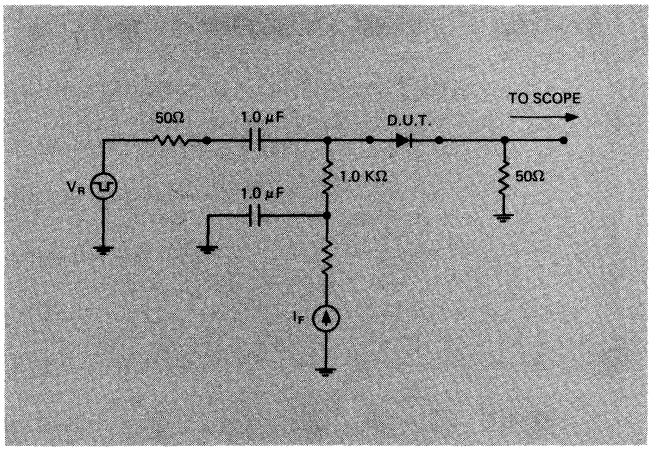


Figure 4. Basic t_{rr} Test Setup

Mechanical Specifications

The HP Outline 15 package has a glass hermetic seal with dumet leads. The leads on the Outline 15 package should be restricted so that the bend starts at least 1/16 inch (1.6 mm) from the glass body. With this restriction, Outline 15 package will meet MIL-STD-750, Method 2036, Conditions A (4 lbs., [1.8 kg.], tension for 30 minutes) and E. The maximum soldering temperature is 230°C for five seconds. Typical package inductance and capacitance are 2.5 nH and 0.13pF, respectively. Marking is by digital coding with a cathode band.

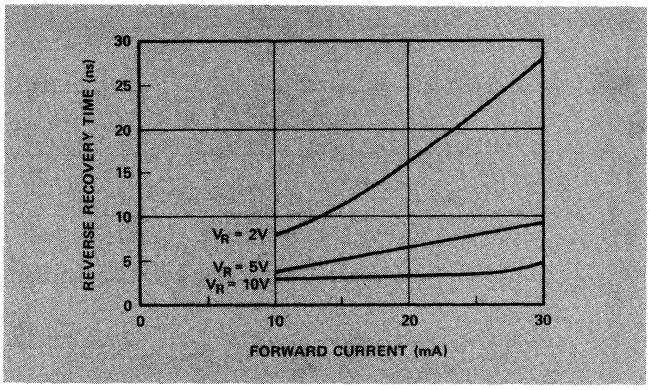


Figure 5. Typical Reverse Recovery Time vs Forward Current for Various Reverse Driving Voltages, 5082-3042, 3043. For further discussion of switching characteristics see 5082-3041 data sheet.

Environmental Capabilities

CHARACTERISTIC	MIL-STD-750 REFERENCE	CONDITIONS
*Temperature, Storage	1031	See Maximum Ratings.
Temperature, Operating	——	See Maximum Ratings.
Solderability	2026	230° C as applicable
Temperature, Cycling	1051	5 cycles, -65 to +150° C
Thermal Shock	1056	5 cycles, 0 to +100° C
Moisture Resistance	1021	10 days, 90—98% RH
Shock	2016	5 blows, X1, Y1, Y2 at 1500 G
Vibration Fatigue	2046	32 hrs. X, Y, Z, at 60 Hz, 20 G minimum.
Vibration Variable Frequency	2056	Four 4-min. cycles, X, Y, Z, at 20 G min., 100 to 2000 Hz
Constant Acceleration	2006	X1, Y1, Y2 at 20,000 G
Terminal Strength	2036	A (4 lbs. [1.8 kg.], tension for 30 min.) and E
Salt Atmosphere	1041	35° C fog for 24 hours

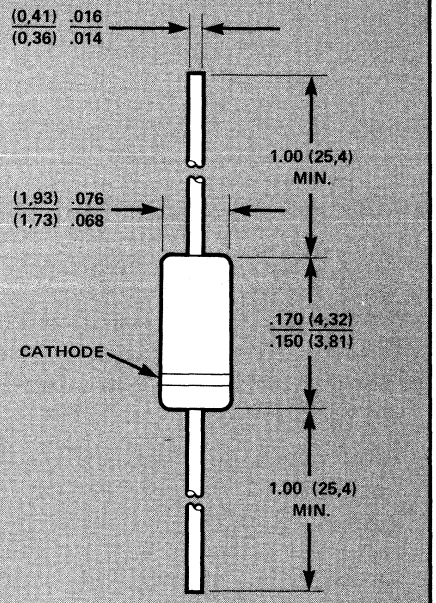
*For prolonged storage at 150° C, an extra heavy plating of gold on the leads is required.

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COMPONENTS

CURRENT CONTROLLER RF RESISTORS

5082-3003
5082-3004



Features

- **Tested for Constant Impedance Attenuator Performance**
  - **Guaranteed RF Resistance Variation versus Bias**
- **Wide Dynamic Attenuation Range**
  - **Typical 1Ω to 10,000Ω Resistance Swing**
- **Low Distortion Products**
  - **100ns Minimum Carrier Lifetime**
- **Low VSWR Over Wide Frequency Range**
  - **Tight Resistance Tracking and Low Capacitance Specified**
- **Low Temperature Coefficient**
  - **Typical <15% Resistance Change Over 25° to 100°C Temperature Range**
- **Low Cost to Use in Printed Circuits**
  - **Economic and Rugged Miniature Glass Package**

Description

The HP 5082-3003/4 current-controlled RF resistors consist of specially processed and tested silicon PIN diodes of planar passivated chip design. The fabrication process is tightly controlled and units are selected on the basis of similarity of RF resistance variation with bias. RF resistance is measured and specified on each unit at 100 MHz and at two bias points. The RF resistance versus bias slope is also specified with tight limits to further assure tracking of individual devices. At frequencies above approximately 10 MHz the devices exhibit high linearity for RF signals and a low, bias independent capacitance.

Long lifetime assures usefulness at operating frequencies down to 10 MHz at small signal levels. Special care is taken to assure high uniformity of device parameters, in addition to guaranteed limits.

Applications

The current-controlled RF resistor (CCR) is a very useful device for realizing current-controlled RF attenuators, RF AGC circuits, constant impedance leveling circuits, electronically controlled RF circuits, variable Q resonating networks and filters, modulating circuits, and as an element in any circuit that requires the use of a dc or low-frequency control of an RF resistance. Further information is available in HP Application Note 922.

The CCR has a resistance characteristic that is accurately described by $R = KI^{-x}$ in the range of 0.01 mA to 1 mA. When displayed on log-log coordinates, as shown in Figure 1, this characteristic plots as a straight line with a slope of $-x$, and at 1 mA $R = K$. The equation constants for the HP 5082-3003 are typically $K = 20$ and $x = 0.88$. For HP 5082-3004, $K = 15$ and $x = 0.88$.

To assure repeatability of the RF resistance characteristic from unit to unit, the high and low resistance values are specified to within ±20%. To assure tight tracking between units, the slope is also specified to be in the range of 0.9 - 0.86. This is particularly useful when several CCR's in an attenuator or modulator attenuator or modulator circuit must track each other closely. For very close tracking, the individual CCR's can be biased with a slight offset with respect to a reference CCR. This is shown in Figure 1.

The characteristic curve of CCR_1 is used as reference. The characteristic curve of CCR_2 is moved over

from A to B by a current offset until they intersect at CCR_1's 0.1 mA position.

$$\text{If } R_1 = K_1 I_1^{-x_1}$$
$$\text{and } R_2 = K_2 I_2^{-x_2}$$

then to shift CCR_2 to any current point on CCR_1, the required current offset is:

$$\left(\frac{K_2}{R}\right)^{\frac{1}{x_2}} - \left(\frac{K_1}{R}\right)^{\frac{1}{x_1}}$$

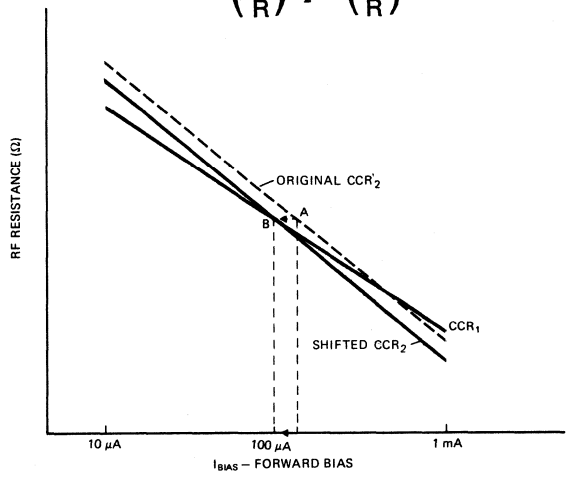
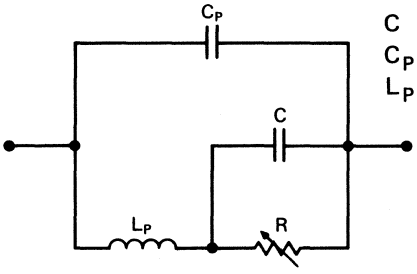


Figure 1. Tracking of Individual CCR's by Bias Current Offset.

DC-control current offset and the two different resistance specifications of the 5082-3003 and -3004 allow the optimization of various constant impedance attenuator configurations for extremely low VSWR versus attenuation.

At RF, the equivalent circuit of the CCR can be represented as shown in Figure 2.



C = 0.06 pF typ.
C_P = 0.11 pF typ.
L_P = 2.5 nH typ.

Figure 2. RF Equivalent Circuit of CCR.

L_P and C_P are the package inductance and capacitance, respectively. The capacitance C is the capacitance of the intrinsic silicon layer of the chip and is typically 0.06 pF. This capacitance does not change with frequency or bias. At constant bias, the RF resistance of the CCR is relatively insensitive to temperature, changing only +15% for a temperature change from 25° to 100°C.

Typical Circuit Operation

Since the PIN diode has an RF resistance characteristic that is a function of dc bias, it can be used as the variable resistance element in a π-type constant impedance attenuator circuit over the wide frequency range of 10 MHz to 1 GHz.

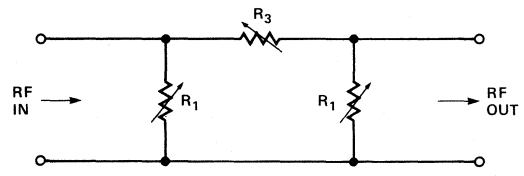


Figure 3. Equivalent RF Circuit of Constant Impedance Diode Attenuator.

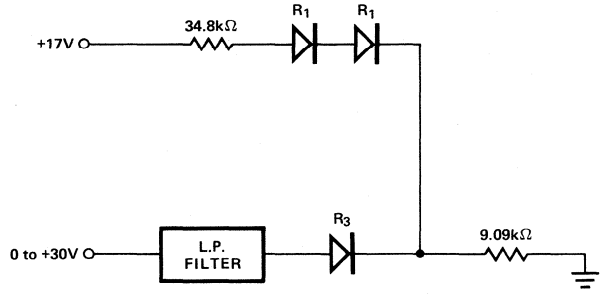


Figure 4. Equivalent DC Bias Circuit for π-Type Attenuator Operation.

A variable bias current which is supplied through a low pass filter directly controls the resistance of R_3. This current also indirectly controls the resistance of R_1 by subtracting from the bias current that is supplied by the 17 V bias source. In this manner it is possible to produce the increasing dc current through the series arm simultaneously with a decreasing current through the shunt arms, as required for constant impedance operation.

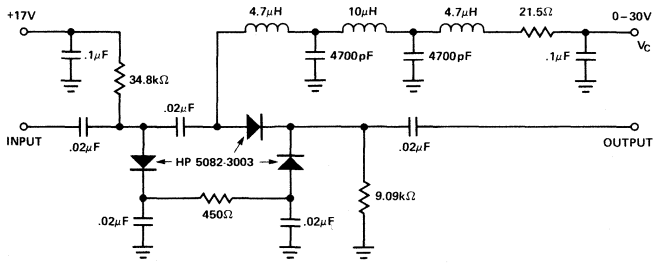


Figure 5. Constant Impedance Attenuator Circuit.

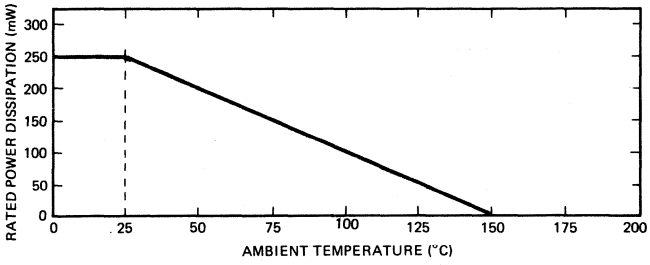


Figure 6. Power Dissipation Derating Characteristics.

Absolute Maximum Ratings

T_{OPR}—Operating Temperature Range .....−65° to +150°C
T_{STG}—Storage Temperature Range .....−65° to +150°C
P_{DISS}—DC Power Dissipation (at T_A = 25°C) .....0.250 watt
Maximum soldering temperature is 235°C for 5 seconds.

RF Electrical Specifications at T_A=25°C

Parameter	Symbol	5082-3003		5082-3004		Units	DC Bias (Test Frequency 100 MHz)
		Max.	Min.	Max.	Min.		
High Resistance Limit	R_H	1380	920	1040	690	ohms	10 μA
Low Resistance Limit	R_L	24	16	18	12	ohms	1.0 mA
Resistance vs. Bias Slope	−x	−0.9	−0.86	−0.9	−0.86	—	10 μA and 1.0 mA
Series Resistance	R_S	1.5	—	1.5	—	ohms	100 mA

DC Electrical Specifications at T_A=25°C

Parameter	Symbol	Max.	Min.	Units	Test Conditions
Breakdown Voltage	V_{BR}	—	100	volts	I_R = 10 μA
Total Capacitance Note 1	C_{VR}	0.3	—	pF	V_R = 50 V f = 1.0 MHz
Effective Minority Carrier Lifetime	τ	—	100	ns	I_F = 50 mA I_R = 250 mA

Note 1. Typical junction capacitance is 0.06 pF.

Environmental Capabilities

Hewlett-Packard PIN diodes are suitable for high reliability space applications where maximum performance stability under the most adverse conditions is required. Maintenance of product reliability during manufacture has resulted in the use of HP diodes in major aerospace and national defense programs.

Test	MIL-STD-750 Reference	Conditions
Temperature, Storage*	1031	See Maximum Ratings
Temperature, Operating	—	See Maximum Ratings
Solderability	2026	230°C as applicable
Temperature, Cycling	1051	5 cycles, −65° to +150°C
Thermal Shock	1056	5 cycles, 0° to +100°C
Moisture Resistance	1021	10 days, 90-98% RH
Shock	2016	5 blows, at 1500 G, X, Y, Z
Vibration Fatigue	2046	32 hrs., X, Y, Z, at 20 G min.
Vibration Variable Frequency	2056	Four 4-min. cycles, X, Y, Z, at 20 G min., 100 to 2000 Hz
Constant Acceleration	2006	20,000 G, X, Y, Z
Terminal Strength	2036	See "Package" section above
Salt Atmosphere	1041	35°C fog for 24 hours

* For prolonged storage at 150°C, an extra heavy plating of gold on the leads is required.

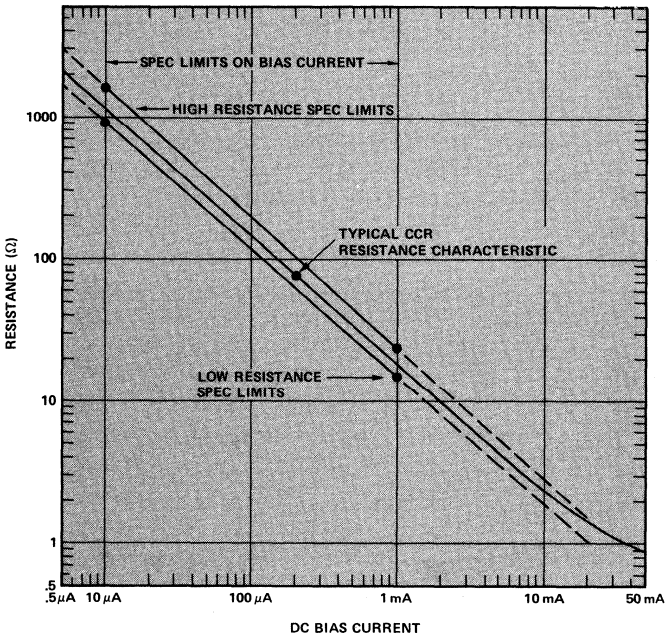


Figure 7. RF Resistance versus Bias Current for 5082-3003.

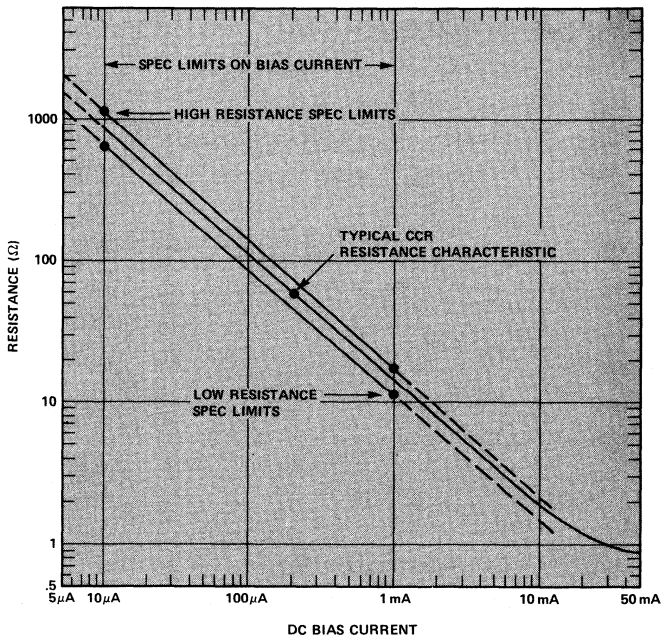


Figure 8. RF Resistance versus Bias Current for 5082-3004.

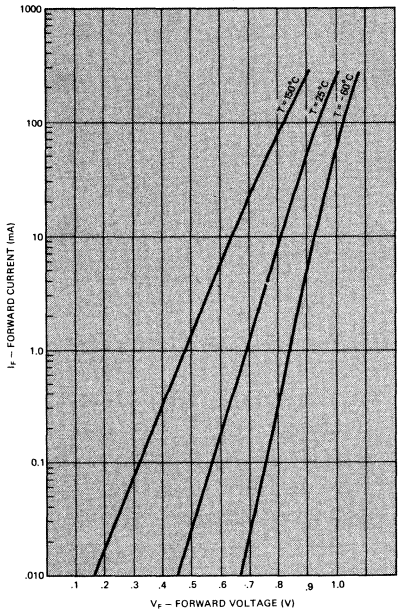


Figure 9. Typical Forward Conduction Characteristics.

Mechanical Specifications

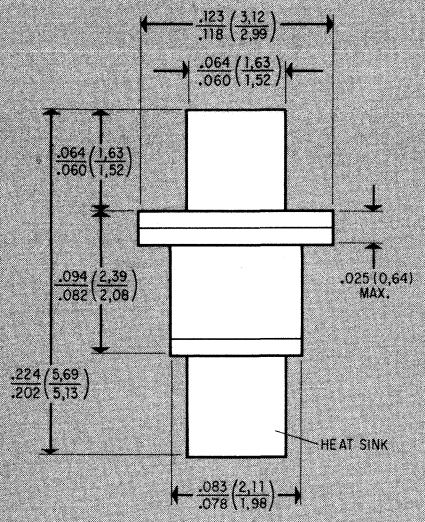
The HP Outline 15 package has a glass hermetic seal with dumet leads. The leads on the Outline 15 package should be restricted so that the bend starts at least 1/16 inch (1,6 mm) from the glass body. With this restriction, Outline 15 package will meet MIL-STD-750, Method 2036, Conditions A and E (4 lb [1,8 kg] tension for 30 minutes). The maximum soldering temperature is 230°C for 5 seconds. Typical package inductance and capacitance is 2.5 nH and 0.13pF, respectively. Marking is by digital coding with a cathode band.

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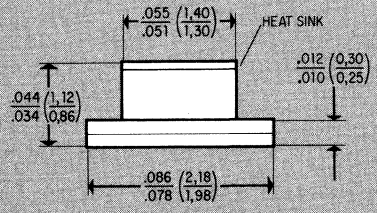
COMPONENTS

PIN DIODES FOR RF POWER SWITCHING/ATTENUATION

5082-3101
5082-3102
5082-3201
5082-3202
5082-3301
5082-3302
5082-3303
5082-3304



HP PACKAGE 31



HP PACKAGE 38

All dimensions in inches and millimeters

Features

- **Both anode and cathode heat sink models available**
  Compatible with NPN or PNP driving circuits
- **High Isolation**
  Greater than 25 dB with typical saturated forward resistance of less than 1 ohm
- **Low Insertion Loss**
- **High Dynamic Signal Control Range**
  10,000:1 RF resistance change
- **Low Harmonic Distortion**
  Specified lifetime greater than 100 ns
- **Low Cost**
  Priced for volume RF control applications

Description

Hewlett-Packard PIN diodes are silicon devices manufactured using modern processing techniques to provide optimum characteristics for RF switching, signal conditioning and control. These devices are of planar passivated design. Both anode and cathode heat sink models are available.

PIN diodes provide a variable RF resistance with DC bias current. The main advantages of a PIN diode over PN switching diodes are the low forward resistance and the low device capacitance.

Applications

HP PIN diodes are intended for use in RF switching, multiplexing, modulating, phase shifting, and attenuating applications at frequencies from approximately 10 MHz to frequencies well into the microwave region. Due to their low parasitic capacitance and inductance, both HP package outline 31 and 38 are well suited for broadband circuits up to 1 GHz and for resonated circuits up to 8 GHz. Broadband designs above 1 GHz are usually more economical using stripline PIN diodes (HP package outline 61) or devices for microstrip circuits (HP package outline 74). Both stripline and microstrip devices are described in other HP data sheets.

Devices of the 5082-3100, 5082-3200, and 5082-3300 series are especially useful where the lowest possible residual series resistance and junction capacitance are required for high on-to-off switching ratios.

At constant bias, the RF resistance is relatively insensitive to temperature, increasing only 15% for a temperature change from +25°C to +100°C.

Additional information on PIN diodes is available in HP Application Notes 922 (Applications of PIN Diodes) and 929 (Fast Switching PIN Diodes). HP Special Information Note #5 discusses PIN diode harmonic generation.

Absolute Maximum Ratings

T_{OPR} – Operating Temperature Range . . . . . –65°C to +150°C
T_{STG} – Storage Temperature Range . . . . . –65°C to +150°C
P_{DISS} – DC Power Dissipation at T_A = 25°C (Derate linearly to zero at 150°C)
HP 5082-3101, -3102, -3301, -3302 . . . . . 1.0W
HP 5082-3201, -3202, -3303, -3304 . . . . . 3.0W
Soldering Temperature . . . . . 230°C for 5 sec.

Electrical Specifications at T_A=25°C

Part Number 5082-	Package Outline	Minimum Breakdown Voltage V_{BR} (V)	Maximum Total Capacitance C_T (pF)	Maximum Residual Series Resistance R_S (Ω)	Minimum Effective Carrier Lifetime τ (ns)	Typical Reverse Recovery Time t_{rr} (ns)	Typical CW Power Handling Capability P_A (W)
3101	38	200	0.32	1.2			40
3102	38	300	0.30	0.8			60
3201	31	200	0.35	1.2			120
3202	31	300	0.32	0.8	100	150	180
3301	38	200	0.40	1.2			40
3302	38	300	0.32	0.8			60
3303	31	200	0.40	1.2			120
3304	31	300	0.32	0.8			180
Test Conditions		I_R=10μA	V_R=50V f =1 MHz	I_F=100mA f =100MHz	I_F=50mA I_R=250mA	I_F=20mA V_R=10V 90% Recovery	Series Switch in 50Ω system. Divide by 4 for Shunt Switch.

Mechanical Specifications

The HP Outline 31 Package has a metal ceramic hermetic seal. The heat sink stud is gold plated copper. The opposite stud is gold plated Kovar. The maximum soldering temperature is 230°C for 5 seconds. Typical package inductance is 1.0 nH and typical package capacitance is 0.2 pF.

The HP Outline 38 Package uses gold plated Kovar for both the anode and cathode contact. The maximum soldering temperature is 230°C for 5 seconds. Typical package inductance is 0.4 nH and typical package capacitance is 0.2 pF.

Environmental Capabilities

Both packages are designed to have the environmental capabilities as outlined in MIL-STD-750 with the following conditions:

		Conditions
Temperature, Storage	1031	See Maximum Ratings
Temperature, Operating	–	See Maximum Ratings
Solderability	2026	230°C as applicable
Temperature, Cycling	1051	5 cycles, –65 to +125°C
Thermal Shock	1056	5 cycles, 0 to +100°C
Moisture Resistance	1021	10 days, 90-98% RH
Shock	2016	5 blows, X_1, Y_1, Y_2 @ 1500 G
Vibration Fatigue	2046	32 hrs. X, Y, Z, @ 1500 G
Vibration Variable Frequency	2056	Four 4-min cycles, X, Y, Z, @ 20 G Min., 100 to 2000 Hz
Constant Acceleration	2006	X_1, Y_1, Y_2 @ 20,000 G
Salt Atmosphere	1041	35°C fog for 24 hours

Device Polarity

Heat Sink	Part Number	Package Outline
Anode	5082-3101, 3102	38
	5082-3201, 3202	31
Cathode	5082-3301, 3302	38
	5082-3303, 3304	31

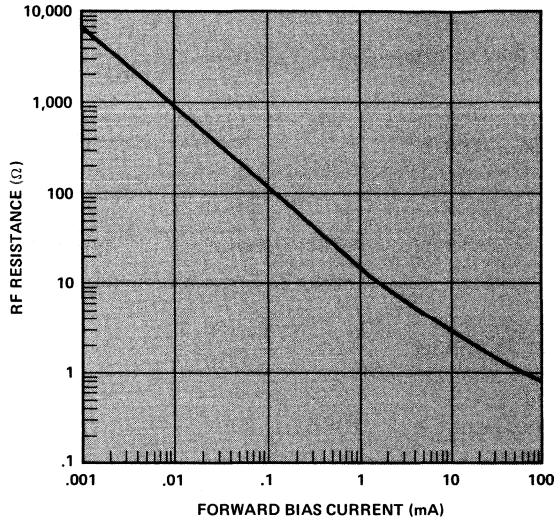


Figure 1. Typical RF Resistance vs. Forward Bias Current

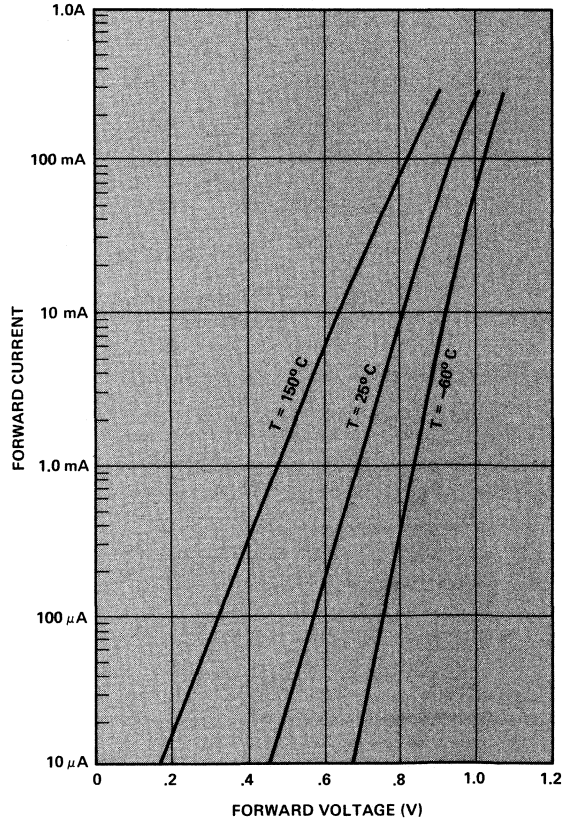


Figure 3. Typical Forward Characteristics

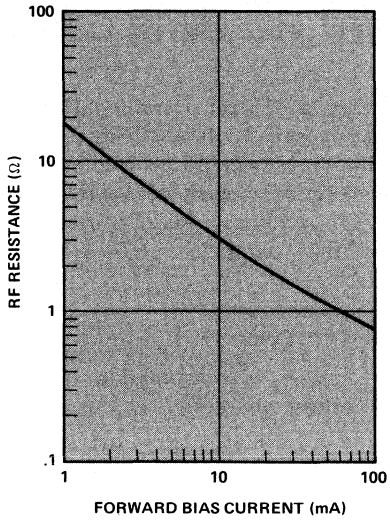


Figure 2. Typical RF Resistance vs. Forward Bias Current

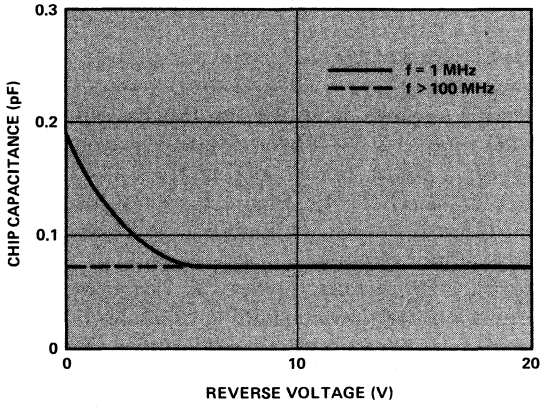


Figure 4. Typical Chip Capacitance vs. Reverse Voltage

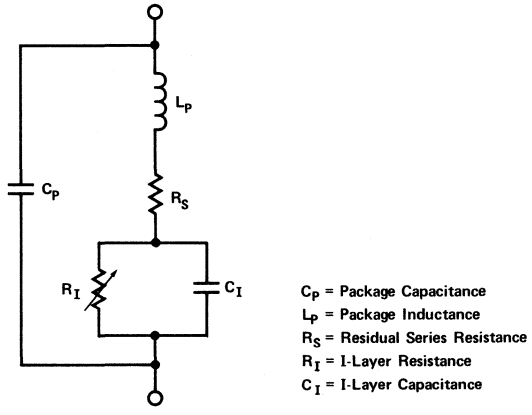


Figure 5. Device Equivalent Circuit.

Typical values for C_P and L_P are given under "Mechanical Specifications". With reverse bias, $R_I \simeq 10k\Omega$. Total capacitance is C_T and is given in "Electrical Specifications". With forward bias C_I is no longer present. R_I decreases with increasing forward bias to approximately zero at 100 mA.

Power Handling Capability

Calculation of Power Handling Capability of PIN Diode Attenuators and Switches: This summary of equations for power handling calculations is intended to provide the tools for a first order analysis of the RF power handling capability of TR switches, phase shifters, or attenuators. It is assumed that parasitic circuit elements are negligible or tuned out.

Summary of Symbols:

P_A — Power in transmission line (maximum available power to load).

P_R — Power dissipated in PIN diode, may be as high as P_{DISS} max specified for the device under consideration.

R — Resistance of PIN diode in "on" or "off" condition, whichever creates higher P_R.

V_{BR} — Breakdown voltage of PIN diode.

A — Attenuation ratio of series or parallel diode inserted into transmission line.

CALCULATION SEQUENCE:

1. Read P_{DISS} max from the absolute maximum ratings.
2. Determine the CW Power Multiplier from Equation (1) for a shunt circuit, or Equation (4) for a series circuit. Alternatively, Figure 8 can be used if diode resistance is known, or Figure 9 can be used if circuit attenuation is known.
3. Multiply P_{DISS} max by the CW Power Multiplier to determine CW power handling capability.
4. Determine the Pulse Power Multiplier, if applicable, from Figure 10.
5. Multiply the CW power handling capability by the Pulse Power Multiplier to determine pulse power handling capability.
6. Check for power handling limit due to V_{BR} by using Equation (3) for shunt circuits and Equation (6) for series circuits.

Shunt Circuit

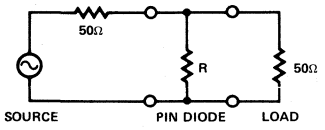


Figure 6. Shunt Attenuator/Switch Circuit

$$\text{Power Multiplier: } \frac{P_A}{P_R} = \frac{(25 + R)^2}{50R} \quad (1)$$

$$\text{Attenuation: } A = 20 \log_{10} \left(1 + \frac{25}{R}\right), \text{dB} \quad (2)$$

$$\text{Breakdown Voltage Limit: } P_A(\text{max}) = \frac{(V_{BR} - V_R)^2}{100}, \text{W} \quad (3)$$

Series Circuit

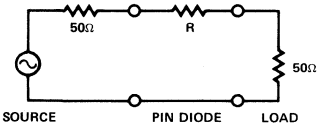


Figure 7. Series Attenuator/Switch Circuit

$$\text{Power Multiplier: } \frac{P_A}{P_R} = \frac{(100 + R)^2}{200R} \quad (4)$$

$$\text{Attenuation: } A = 20 \log_{10} \left(1 + \frac{R}{100}\right), \text{dB} \quad (5)$$

$$\text{Breakdown Voltage Limit: } P_A(\text{max}) = \frac{(V_{BR} - V_R)^2}{400}, \text{W} \quad (6)$$

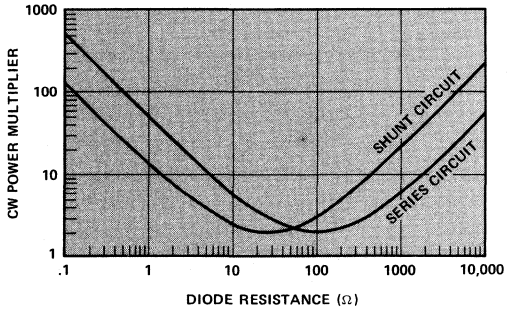


Figure 8. CW Power Multiplier vs. Diode Resistance

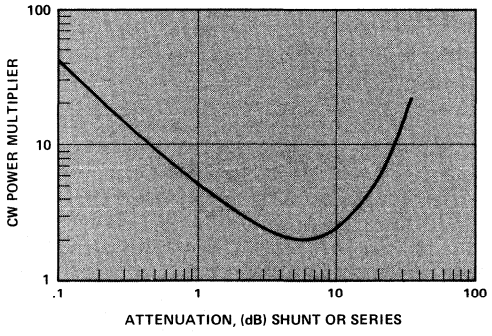


Figure 9. CW Power Multiplier vs. Series or Shunt Attenuation

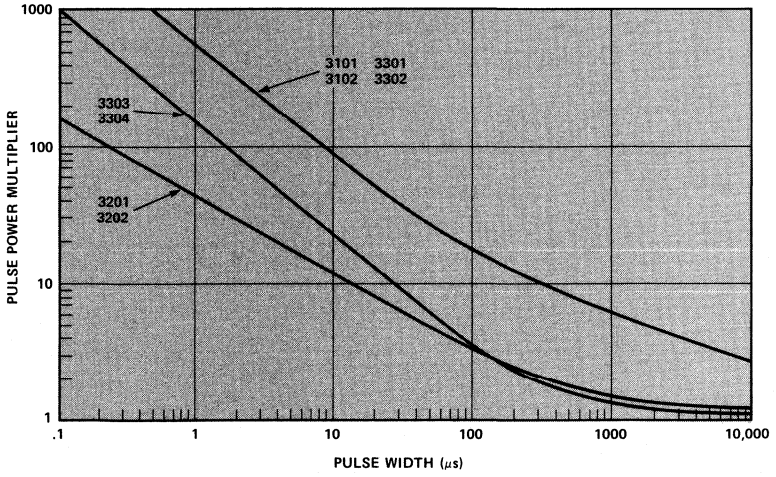


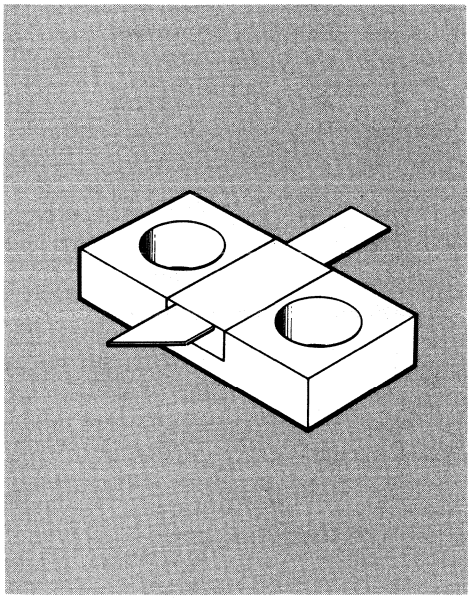
Figure 10. Pulse Power Multiplier vs. Pulse Width

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COMPONENTS

STRIPLINE PIN DIODE SWITCHES/ATTENUATORS 10 MHz - 18 GHz

5082-3040
5082-3041
5082-3046
5082-3340



Features

- **Low Cost to Use**
  - **Designed for Easy Mounting**
- **Broadband Operation**
  - **HF Through X-Band**
- **Low Insertion Loss**
  - **Less Than 0.5 dB to 10 GHz (5082-3040, 3340)**
- **High Isolation**
  - **Greater Than 20 dB to 10 GHz**
- **Fast Switching/Modulating**
  - **5ns Typical (5082-3041)**
- **High Power Handling**
  - **2kW Pulse Power, 45W CW Typical (5082-3046)**
- **Low Drive Current Required**
  - **Less Than 20 mA for 20 dB Isolation (5082-3041)**

Description

Hewlett Packard stripline PIN diode switches/attenuators consist of specially processed silicon PIN diodes in shunt configuration within a 50 ohm "metal plastic bolt channel" (MPBC) stripline package. They are optimized for good continuity of characteristic impedance, which allows a continuous transition when used in 50 ohm stripline or microstrip circuits. When forward biased, the PIN diode will appear as a current variable resistor in shunt with the transmission line, its value being variable between less than 1 ohm at high forward bias to greater than 10,000 ohms at zero or reverse bias.

The MPBC stripline package concept, originally developed by Hewlett Packard in 1967, overcomes the limitations in insertion loss, isolation, and bandwidth that are imposed by the package parasitics of other discrete devices.

The PIN diode chips used in 5082-3040, 5082-3046, and 5082-3340 devices are of oxide passivated planar design; the chip used in the 5082-3041 is of oxide passivated mesa design. Passivation insures maximum stability and reliability.

Applications

HP stripline SPST switches/attenuators are designed for applications in microwave and HF-UHF systems using stripline, or microstrip transmission line techniques.

Typical circuit functions performed consist of switching, duplexing, multiplexing, leveling, modulating, limiting, or gain control functions as required in TR switches, pulse modulators, phase shifters, and amplitude modulators operating in the frequency range from HF through X-Band.

Near ideal transmission characteristics and low intermodulation products from HF through X-Band are provided by the 5082-3040. The 5082-3340 is a reverse polarity device with characteristics similar to the 5082-3040.

The 5082-3046 has been developed for high peak pulse power handling as required in TR switches for distance measurement and TACAN equipment. The long effective minority carrier lifetime provides for low intermodulation products down to 10MHz.

The 5082-3041 is recommended for applications requiring fast switching or high frequency modulation of microwave signals, or where the lowest bias current for maximum attenuation is required. A similar device specified as a Limiter is available as the 5082-3071, described in a separate data sheet.

More information is available in HP Application Notes 922 (Applications of PIN Diodes) and 929 (Fast Switching PIN Diodes). Special Note #5 discusses harmonic generation in PIN diodes.

Absolute Maximum Ratings

PARAMETER	SYMBOL	5082-3040	5082-3041	5082-3046	5082-3340
OPERATING TEMPERATURE RANGE	T_{OPR}	−65°C to +125°C			
STORAGE TEMPERATURE RANGE	T_{STG}	−65°C to +125°C			
POWER DISSIPATION AT T_A=25°C (Note 1)	P_{DISS}	2.5W	1.0W	4.0W	2.5W
PEAK INCIDENT PULSE POWER AT T_A=25°C (Note 2)	P_{IN}	225W	50W	2000W	225W
PEAK INVERSE VOLTAGE	PIV	150V	70V	450V	150V

Electrical Specifications at T_A=25°C

PARAMETER	5082-3040	5082-3041	5082-3046	5082-3340	UNITS	TEST CONDITIONS (Note 3)
MINIMUM ISOLATION	20	20	20	20	dB	I_F = 100mA (except -3041, 20mA)
MAXIMUM INSERTION LOSS	0.5	1.0	1.0	0.5	dB	I_F = 0 P_{IN} = 1mW
MAXIMUM VSWR	1.5	1.5	1.5	1.5	–	I_F = 0 P_{IN} = 1mW
MAXIMUM REVERSE RECOVERY TIME, t_{rr}	–	10	–	–	ns	I_F = 20mA I_R = 200mA Recovery to 90%

Typical Parameters at T_A=25°C

PARAMETER	SYMBOL	5082-3040	5082-3041	5082-3046	5082-3340	UNITS	TEST CONDITIONS
CARRIER LIFETIME	τ	200	15	1000	200	ns	I_F = 50mA I_R = 250mA
CW POWER SWITCHING CAPABILITY	P_A	30	13	50	30	W	–

Typical Equivalent Circuit Parameters at T_A=25°C

PART NUMBER	L_C (pH)	L_P (nH)	R_P (Ω)	R_L (Ω)	R_S (Ω)	C_T (pF)
5082-3040	25	.25	.25	1.5K	1.0	.07
5082-3041	25	.35	.25	2.5K	.9	.12
5082-3340	25	.25	.25	1.5K	.8	.07
5082-3046	25	.25	.25	1.5K	.5	.30

NOTES:

1. Device properly mounted in sufficient heat sink. Derate linearly to zero at 125°C.
2. t_p = 1 μs, f = 10GHz, Du = .001, Z_o = 50Ω
3. Test frequencies: 5082-3040, 10GHz; 5082-3041, 8GHz; 5082-3046, 8GHz; 5082-3340, 10GHz
4. I_F = 100mA except 5082-3041 which is 20mA.

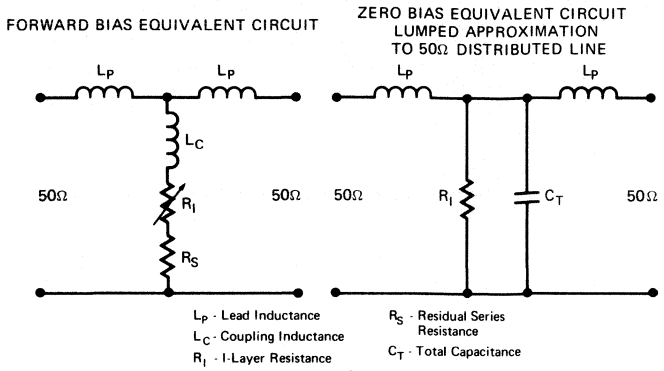


Figure 1. Equivalent Circuit, Forward and Reverse Bias. At the Bias Current Levels Listed in Note 4, $R_I \simeq 0$.

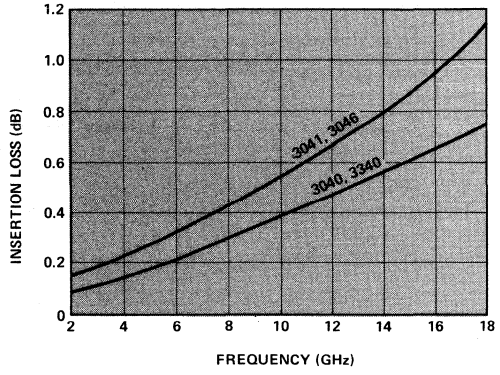


Figure 2. Typical Insertion Loss vs. Frequency

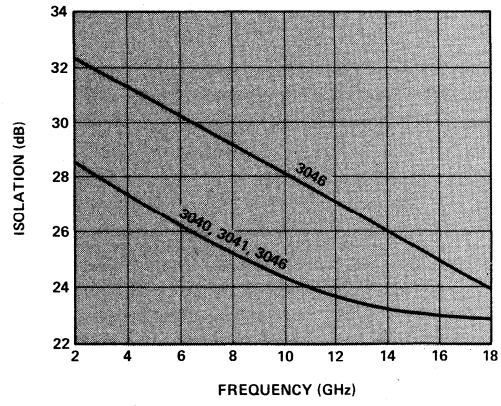


Figure 3. Typical Isolation vs. Frequency.

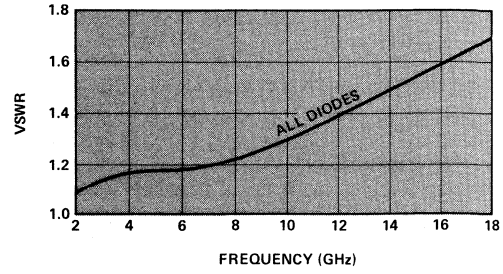


Figure 4. Typical VSWR vs. Frequency

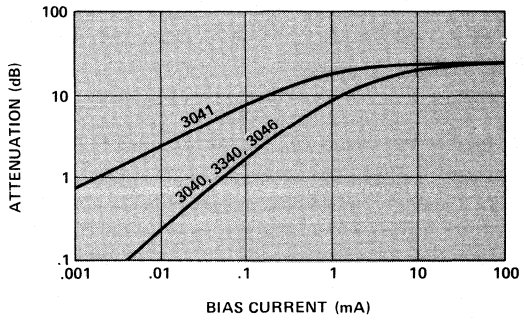


Figure 5. Typical Attenuation Above Zero Bias Insertion Loss vs. Bias Current at f = 8GHz.

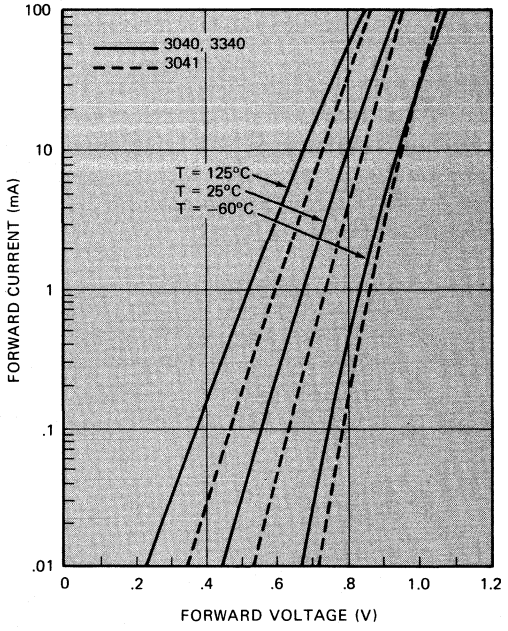


Figure 6. Typical Forward Characteristics for the 5082-3040, 3041, and 3340

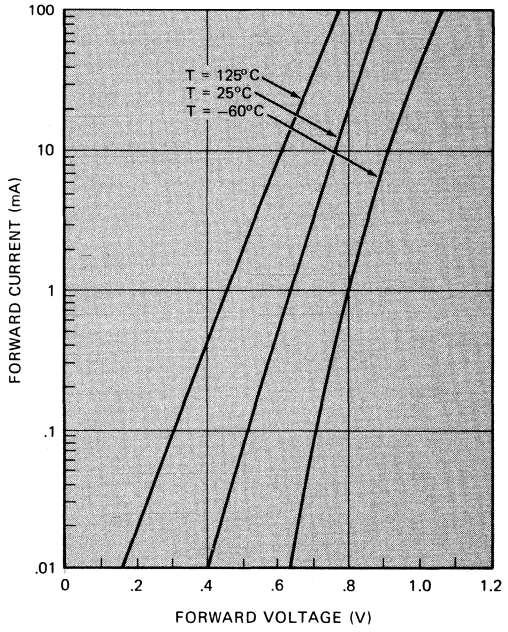


Figure 7. Typical Forward Characteristics for the 5082-3046

Typical Switching Parameters

RF SWITCHING SPEED
HP 5082-3041

The RF switching speed of the HP 5082-3041 may be considered in terms of the change in RF isolation at 2 GHz. This switching speed is dependent upon the forward bias current, reverse bias drive pulse, and characteristics of the pulse source. The RF switching speed for the shunt-mounted stripline diode in a 50 Ω system is considered for two cases: one driving the diode from the forward bias state to the reverse bias state (isolation to insertion loss), second, driving the diode from the reverse bias state to the forward bias state (insertion loss to isolation).

The total time it takes to switch the shunt diode from the isolation state (forward bias) to the insertion loss state (reverse bias) is shown in Figure 8. These curves are for three forward bias conditions with the diode driven in each case with three different reverse voltage pulses (V_{PR}). The total switching time for each case includes the delay time (pulse initiation to 20 dB isolation) and transition time (20 dB isolation to 0.9 dB isolation). Slightly faster switching times may be realized by spiking the leading edge of the pulse or using a lower impedance pulse driver.

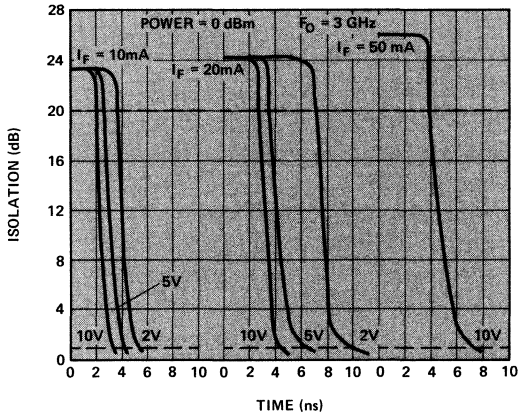


Figure 8. Isolation vs. Time (Turn-on) for HP 5082-3041. Frequency, 2 GHz.

The time it takes to switch the diode from zero or reverse bias to a given isolation is less than the time from isolation to the insertion loss case. For all cases of forward bias generated by the pulse generator (positive pulse), the RF switching time from the insertion loss state to the isolation state was less than 2 nanoseconds. A more detailed treatise on switching speed is published in AN929; Fast Switching PIN Diodes.

REVERSE RECOVERY TIME

Shown below is reverse recovery time, (t_{rr}) vs. forward current, (I_F) for various reverse pulse voltages V_{PR}. The circuit used to measure t_{rr} is shown in Figure 9.

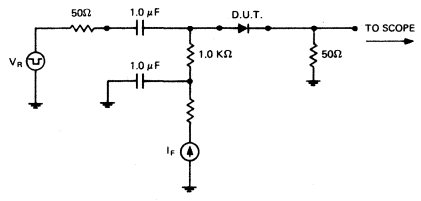


Figure 9. Basic t_{rr} Test Setup

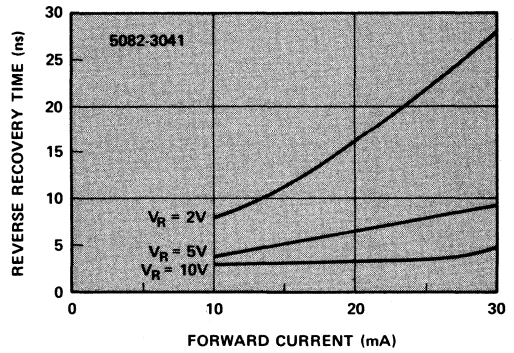


Figure 10. Typical Reverse Recovery Time vs. Forward Current for Various Reverse Driving Voltages, 5082-3041

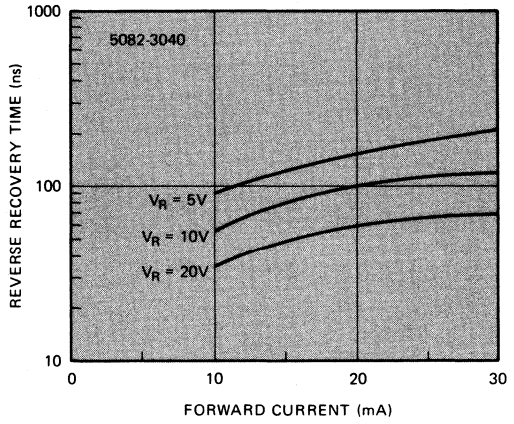


Figure 11. Typical Reverse Recovery Time vs. Forward Current for Various Reverse Driving Voltages, 5082-3040

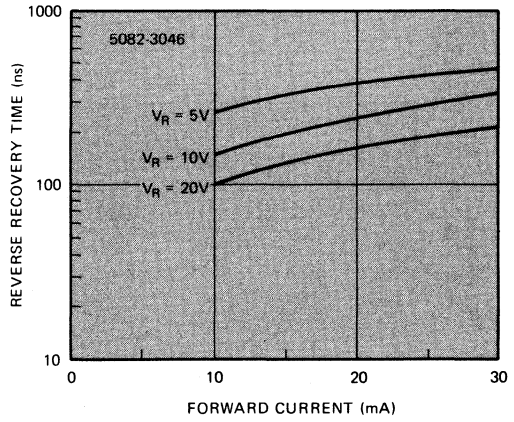


Figure 12. Typical Reverse Recovery Time vs. Forward Current for Various Reverse Driving Voltages, 5082-3046

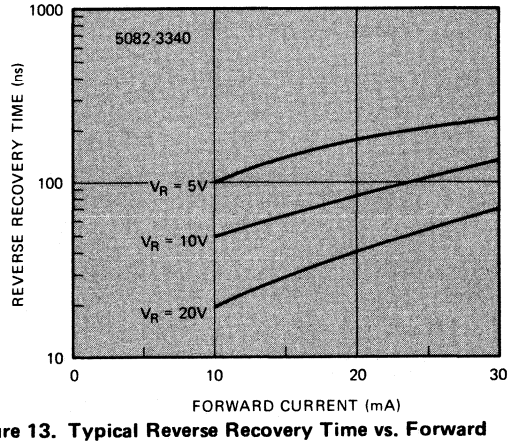


Figure 13. Typical Reverse Recovery Time vs. Forward Current for Various Reverse Driving Voltages, 5082-3340

Mechanical Specifications

The cover channel supplied with each diode should be used in balanced stripline circuits in order to provide good electrical continuity from the upper to the lower ground plane through the package base metal. Higher order modes will be excited if this cover is left off or if poor electrical contact is made to the ground plane.

The package transmission channel is filled with epoxy resin which combines a low expansion coefficient with high chemical stability.

The 5082-3040 and 3046 have anode heatsinks. The 5082-3041 and 3340 have cathode heatsinks.

HEATSINK POLARITY

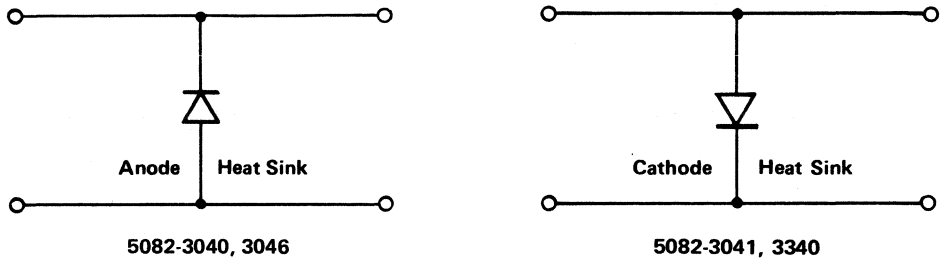


Figure 14. Heat Sink Polarities

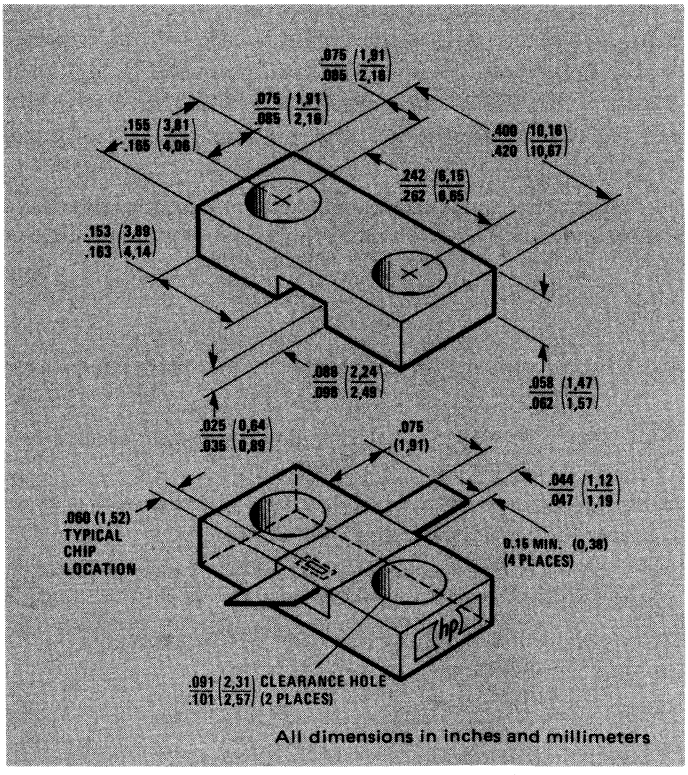


Figure 15. HP Package Outline 61

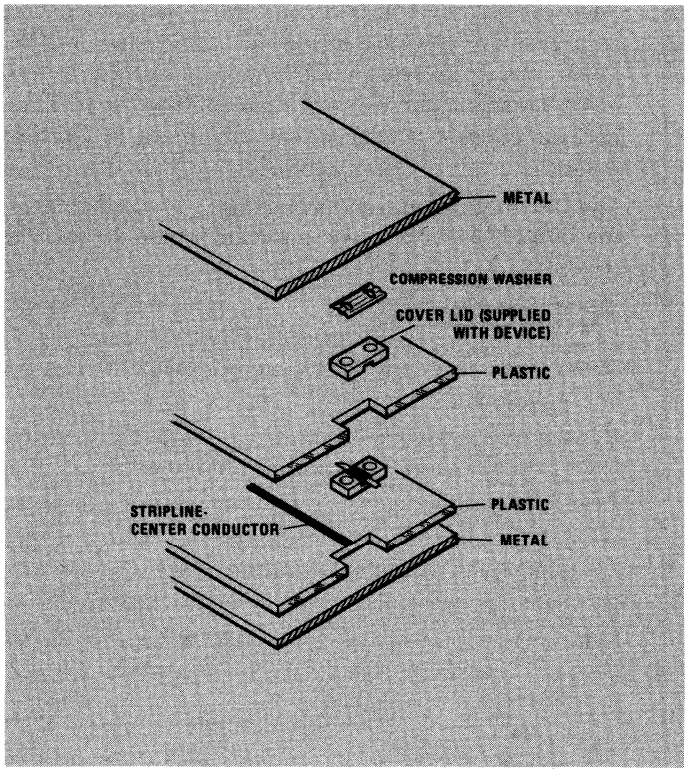


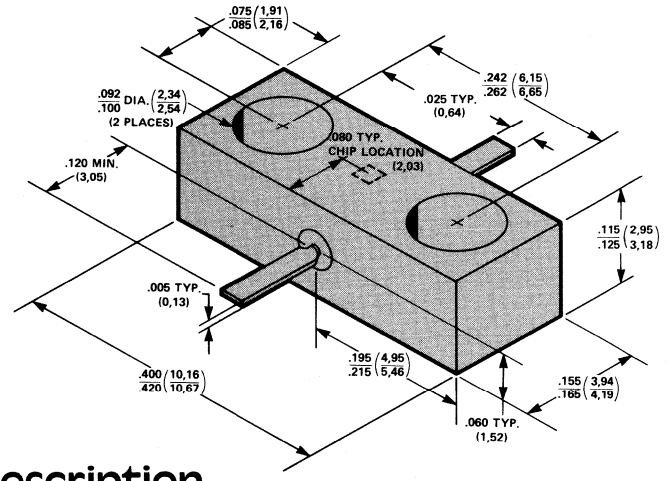
Figure 16. Suggested Balanced Stripline Assembly Technique

HEWLETT hp PACKARD

COMPONENTS

HERMETIC PIN DIODES FOR STRIPLINE/MICROSTRIP SWITCHES/ATTENUATORS 3 MHz - 12 GHz

5082-3140
5082-3141
5082-3170



Features

- **Broadband Operation**
  - **HF Through X-Band**
- **Low Insertion Loss**
  - **Less Than 0.5 dB to 10 GHz (5082-3140, 3170)**
- **High Isolation**
  - **Greater Than 20 dB to 10 GHz (5082-3140, 3170)**
- **Fast Switching/Modulating**
  - **5 ns Typical (5082-3141)**
- **Low Drive Current Required**
  - **Less Than 20 mA for 20 dB Isolation (5082-3141)**

Description

These Hewlett-Packard PIN diode switches/attenuators consist of specially processed silicon PIN diodes in shunt configuration within a 50 ohm hermetic package. They are optimized for good continuity of characteristic impedance, which allows a continuous transition when used in 50 ohm stripline or microstrip circuits. The HP package style 60 is a direct mechanical replacement for HP package style 61 with top cap. For most applications the 5082-3140, 3141, and 3170 are direct electrical replacements (with top cap in place) for the 5082-3040, 3041, and 3340, respectively. Because of a difference in chip location between packages 60 and 61, there will be a difference in the phase relationships between equivalent devices. When forward biased, the PIN diode will appear as a current variable resistor in shunt with the transmission line, its value being variable from less than 1 ohm at high forward bias to greater than 10,000 ohms at zero or reverse bias. The stripline package concept overcomes the limitations in insertion loss, isolation, and bandwidth that are imposed by the package parasitics of other discrete devices.

The PIN diode chips used in the 5082-3140 and 5082-3170 devices are of oxide passivated planar design; the chip used in the 5082-3141 is of oxide passivated mesa design. Passivation and package hermiticity ensures maximum stability and reliability.

Applications

These diodes are designed for applications in microwave and HF-UHF systems using stripline, or microstrip transmission line techniques.

Typical circuit functions consist of switching, duplexing, multiplexing, leveling, modulating, limiting or gain control functions as required in TR switches, pulse modulators, phase shifters, and amplitude modulators.

Near ideal transmission characteristics and low intermodulation products from HF through X-Band are provided by the 5082-3140. The 5082-3170 is a reverse polarity device with characteristics similar to the 5082-3140.

The 5082-3141 is recommended for applications requiring fast switching or high frequency modulation of microwave signals or where the lowest bias current for maximum attenuation is required.

More information is available in HP Application Notes 922 (Applications of PIN Diodes) and 929 (Fast Switching PIN Diodes). Special Information #5 discusses harmonic generation in PIN diodes.

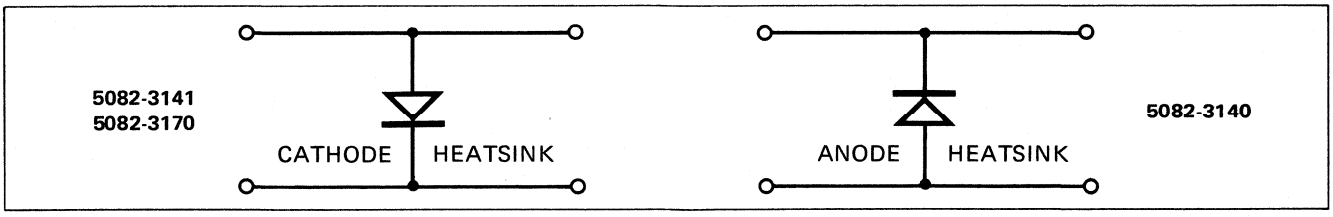


Figure 1. Heat Sink Polarities

Absolute Maximum Ratings

Parameter	Symbol	5082-3141	5082-3170	5082-3140
Operating Temperature Range	T_{OPR}		−65°C to +150°C	
Storage Temperature Range	T_{STG}		−65°C to +150°C	
Power Dissipation at T_A = 25°C (Note 1)	P_{DISS}	1.0W	2.5W	2.5W
Peak Incident Pulse Power at T_A=25°C (Note 2)	P_{IN}	50W	225W	225W
Peak Inverse Voltage	PIV	70V	150V	150V

Electrical Specifications at T_A=25°C

Parameter	5082-3141	5082-3170	5082-3140	Units	Test Conditions
Minimum Isolation	20	20	20	dB	I_F=100mA (except -3141, 20mA) (Note 3)
Maximum Insertion Loss	1.0	0.5	0.5	dB	I_F = 0, P_{IN} = 1mW (Note 3)
Maximum VSWR	1.5	1.5	1.5	–	I_F = 0, P_{IN} = 1mW (Note 3)
Maximum Reverse Recovery Time, t_{rr}	10	–	–	ns	I_F = 20mA, V_R = 10V Recovery to 90%
Heat Sink Polarity	Cathode	Cathode	Anode	–	–

Typical Parameters at T_A=25°C

Parameter	Symbol	5082-3141	5082-3170	5082-3140	Units	Test Conditions
Carrier Lifetime	τ	15	200	200	ns	I_F = 50mA, I_R = 250mA
CW Power Switching Capability	P_A	13	30	30	W	–

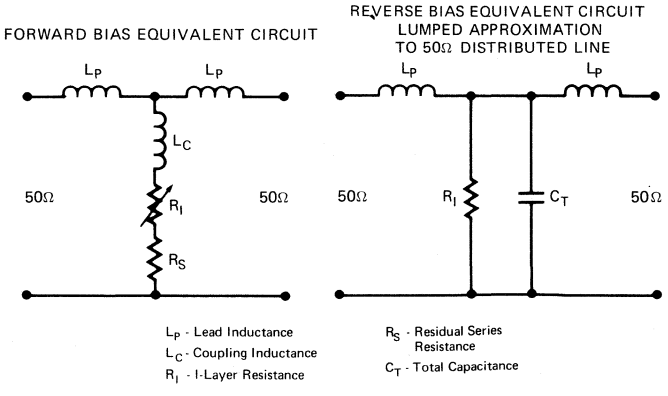


Figure 2. Equivalent Circuit, Forward and Reverse Bias

NOTES:
1. Device properly mounted in sufficient heat sink. Derate linearly to zero at 150°C.
2. t_p = 1μs, f = 10GHz, Du = .001, Z_o = 50Ω.
3. Test frequencies: 5082-3141 8GHz
   5082-3170 10GHz
   5082-3140 10GHz

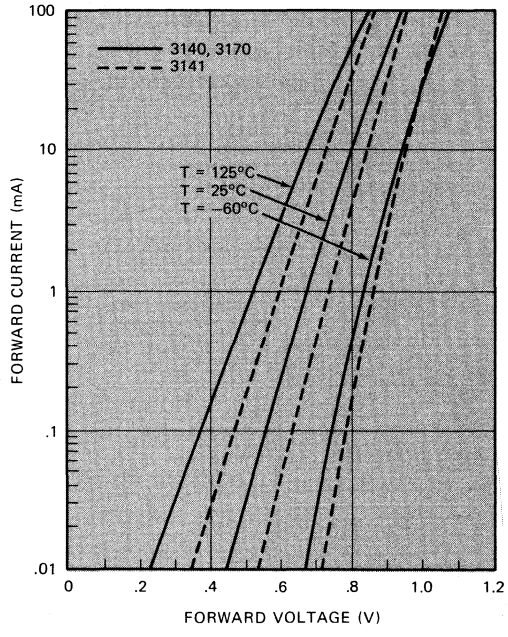


Figure 3. Typical Forward Characteristics for the 5082-3140, 3141, and 3170.

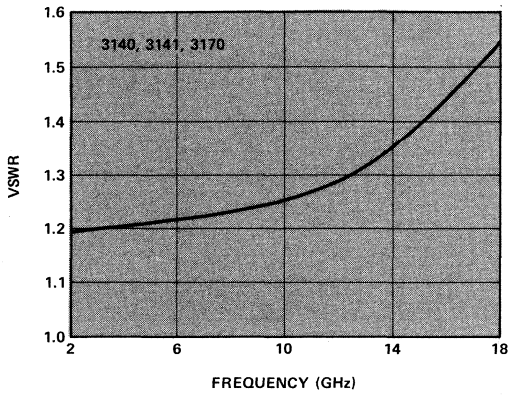


Figure 4. Typical VSWR vs. Frequency

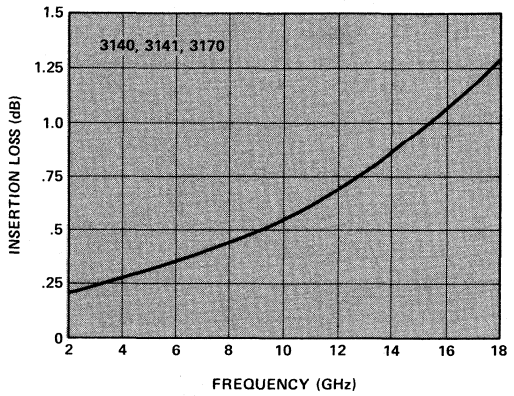


Figure 5. Typical Insertion Loss vs. Frequency

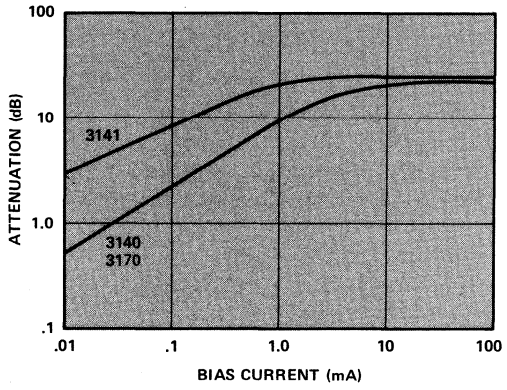


Figure 6. Typical Attenuation vs. Bias Current at f = 8 GHz

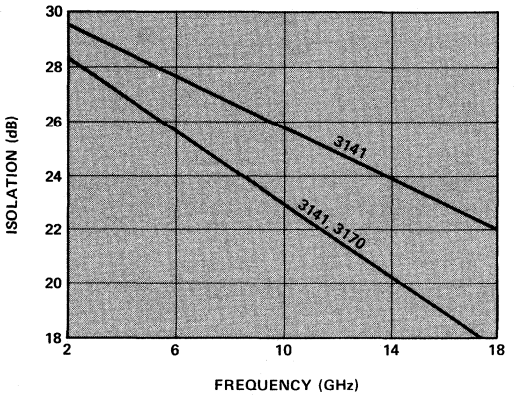


Figure 7. Typical Isolation vs. Frequency

Environmental Capabilities

The HP package style 60 is capable of passing the following environmental tests.

Characteristic	MIL-STD-750 Reference	Conditions
Moisture Resistance	1021	
Temperature, Storage	1031	–65°C to +150°C
Temperature, Operating	–	–65°C to +150°C
Solderability	2026	230°C as applicable
Temperature, Cycling	1051	5 cycles, –65°C to +150°C
Thermal Shock	1056	5 cycles, 0°C to +100°C
Shock	2016	5 blows, X_1, X_2, Y_1, Y_2, Z_1, Z_2 @ 1500 G
Vibration Fatigue	2046	32 hours, X, Y, Z @ 20 G
Vibration Variable Frequency	2056	Four 4-min. cycles, X, Y, Z, @ 20 G Min., 100 to 2000 Hz
Constant Acceleration	2006	20,000 G X_1, X_2, Y_1, Y_2, Z_1, Z_2
Terminal Strength	2036	Tension and Bending Stress
Barometric Pressure	1001	150,000 feet
Salt Atmosphere	1041	
Hermetic Seal	1071	Helium and Gross Leak

Typical Switching Parameters

RF SWITCHING SPEED
HP 5082-3141

The RF switching speed of the HP 5082-3141 may be considered in terms of the change in RF isolation at 2 GHz. This switching speed is dependent upon the forward bias current, reverse bias drive pulse, and characteristics of the pulse source. The RF switching speed for the shunt-mounted stripline diode in a 50 Ω system is considered for two cases: one driving the diode from the forward bias state to the reverse bias state (isolation to insertion loss), second, driving the diode from the reverse bias state to the forward bias state (insertion loss to isolation).

The total time it takes to switch the shunt diode from the isolation state (forward bias) to the insertion loss state (reverse bias) is shown in Figure 8. These curves are for three forward bias conditions with the diode driven in each case with three different reverse voltage pulses (V_{PR}). The total switching time for each case includes the delay time (pulse initiation to 20 dB isolation) and transition time (20 dB isolation to 0.9 dB isolation). Slightly faster switching times may be realized by spiking the leading edge of the pulse or using a lower impedance pulse driver.

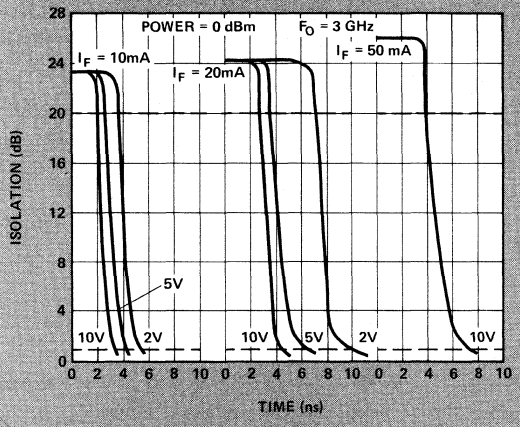


Figure 8. Isolation vs. Time (Turn-on) for HP 5082-3141. Frequency, 2 GHz.

The time it takes to switch the diode from zero or reverse bias to a given isolation is less than the time from isolation to the insertion loss case. For all cases of forward bias generated by the pulse generator (positive pulse), the RF switching time from the insertion loss state to the isolation state was less than 2 nanoseconds. A more detailed treatise on switching speed is published in AN929; Fast Switching PIN Diodes.

REVERSE RECOVERY TIME

Shown below is reverse recovery time, (t_{rr}) vs. forward current, (I_F) for various reverse pulse voltages V_{PR}. The circuit used to measure t_{rr} is shown in Figure 9.

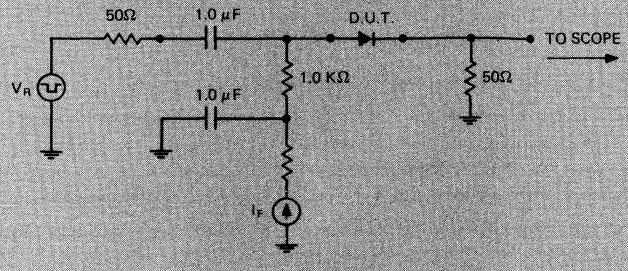


Figure 9. Basic t_{rr} Test Setup

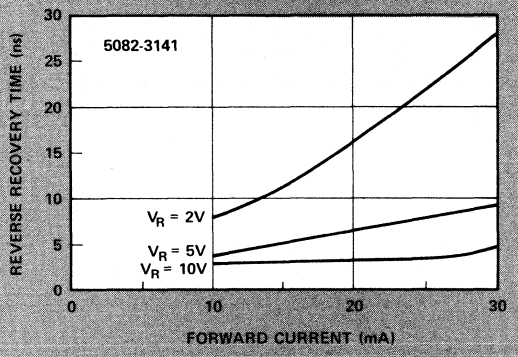


Figure 10. Typical Reverse Recovery Time vs. Forward Current for Various Reverse Driving Voltages, 5082-3141.

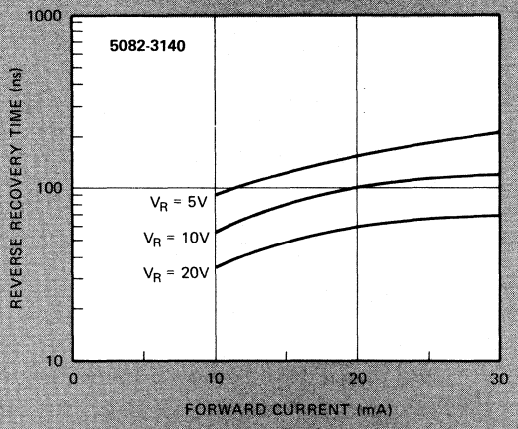


Figure 11. Typical Reverse Recovery Time vs. Forward Current for Various Reverse Driving Voltages, 5082-3140.

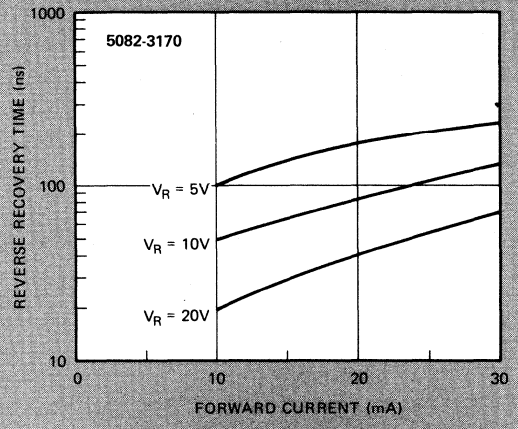


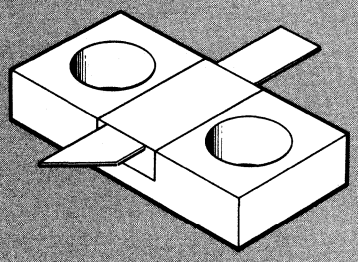
Figure 12. Typical Reverse Recovery Time vs. Forward Current for Various Reverse Driving Voltages, 5082-3170.

HEWLETT hp PACKARD

COMPONENTS

MICROWAVE PASSIVE LIMITER

5082-3071



Features

- High Power Handling Capability
  - 50 W Peak Pulse Power
- Low Cost
  - For Telecommunications, DME, ECM, and Radar Applications
- Low Intermodulation Products
  - Typical .2 W Threshold Assures Wide Dynamic Linear Range
- Broad Bandwidth
  - 500 MHz to 10 GHz
- Low Insertion Loss
  - Less Than 1 dB in X-Band
- Easy to Use
  - Package Compatible with Stripline and Microstrip
- Negligible Spike Leakage

Description

The HP 5082-3071 passive limiter module consists of an oxide passivated PIN chip of mesa construction mounted in the HP "metal plastic bolt channel" (MPBC) package to provide an exceptionally easy to use limiter module for stripline and microstrip circuits. The chip is functionally integrated into a 50 ohm transmission line to provide a broadband, linear, low insertion loss transfer characteristic for small signal levels. Limiter performance is practically independent of temperature over the rated temperature range.

Applications

This limiter module is designed for applications in telecommunication equipment, ECM receivers, distance measuring equipment, radar receivers, telemetry equipment, and transponders operating anywhere in the frequency range from 500 MHz through 10 GHz. The easy to use MPBC package provides miniature size and good continuity of the 50 ohm transmission line, by incorporating the capacitance of the PIN chip into a matched low pass filter. An external dc return is required for self bias operation. This dc return is often present in the existing circuit, i.e. inductively coupled antennas, or it can be provided by a $\lambda/4$ resonance shunt transmission line. Selection of a high characteristic impedance for the shunt transmission line affords broadband operation. Another easy to realize dc return consists of a small diameter wire connected at a right angle to the electric field in a microstrip or stripline circuit.

Mechanical Specifications

The cover channel supplied with each diode should be used in balanced stripline circuits in order to provide good electrical continuity from the upper to the lower ground plane through the package base metal. Higher order modes will be excited if this cover is left off or if poor electrical contact is made to the ground planes.

The package transmission channel is filled with epoxy resin which combines a low expansion coefficient with high chemical stability. The package should be operated in a hermetic enclosure if moisture resistance and salt atmosphere resistance capabilities of the equipment are required.

Absolute Maximum Ratings

T_{OPR}	— Operating Temperature Range	−65°C to +125°C
T_{STG}	— Storage Temperature Range	−65°C to +125°C
P_{DISS}	— Power Dissipation at T_A = 25°C (Note 1)	1 W
P_{IN}	— Peak Incident Pulse Power at T_A = 25°C (Notes 1, 2)	50 W
PIV	— Peak Inverse Voltage	50 V

NOTES:
1. Device properly mounted in heat sink. Derate linearly to zero at 125° C.
2. 50 ohm stripline system, external dc return; f = 9.4 GHz, t_p = 1μs, Du = 0.001, t_{test} = 1 minute.
3. Slightly less at lower frequencies.
4. Slightly less at lower power levels.

Electrical Specifications at T_A=25°C

PARAMETER	MIN.	TYP.	MAX.	UNITS	TEST CONDITION
BREAKDOWN VOLTAGE, V_{BR}	50	70	—	V	I_R = 10μA
VOLTAGE STANDING WAVE RATIO - VSWR	—	1.4:1	2.0:1	—	f = 9.4 GHz P_{IN} = 0dBm
INSERTION LOSS	—	0.8	1.2	dB	f = 9.4 GHz P_{IN} = 0dBm
RF LEAKAGE POWER	—	0.8 (Note 3)	1.0	W	f = 9.4 GHz P_{IN} = 50 W
RECOVERY TIME	—	100 (Note 4)	—	ns	P_{IN} = 50 W

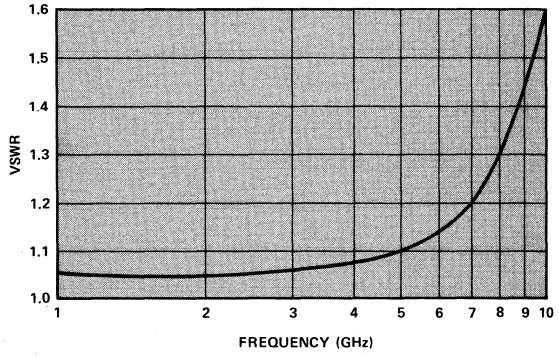


Figure 1. Typical VSWR vs. Frequency.

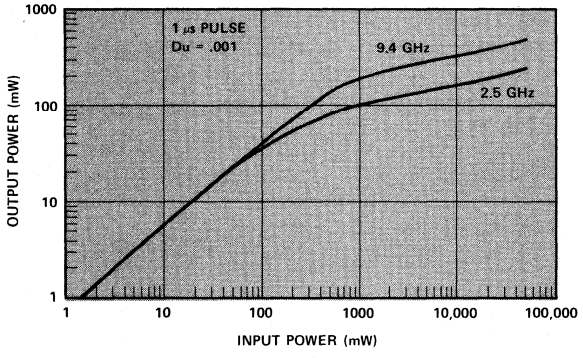


Figure 2. Typical Pulse Limiting Characteristics.

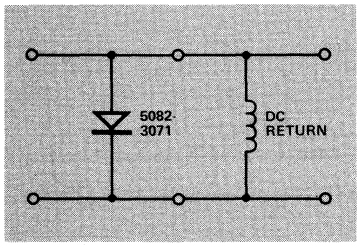


Figure 3. Passive Limiter Circuit. An External DC Return is Required for Self Bias (Passive) Limiter Operation.

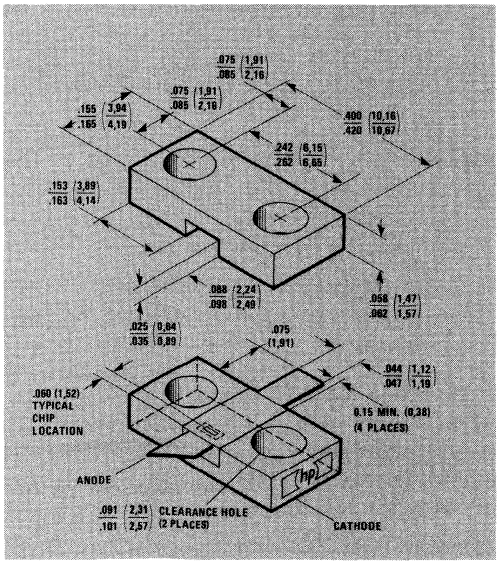


Figure 4. HP Package 61 Outline.

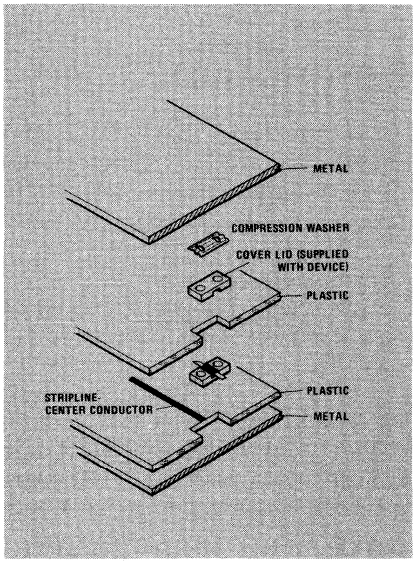


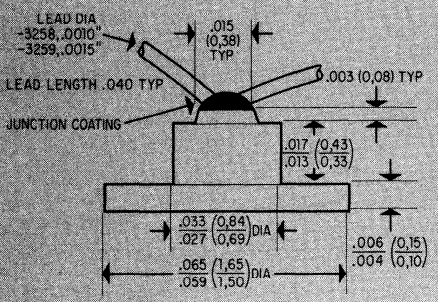
Figure 5. Suggested Stripline Assembly.

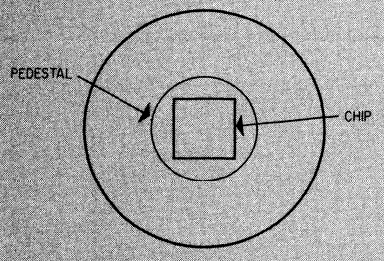
HEWLETT PACKARD

COMPONENTS

MICROSTRIP SWITCHING AND PHASE SHIFTING PIN DIODES

5082-3258
5082-3259





Chip Center is Within .003 (0,08) of Pedestal Center

HP PACKAGE OUTLINE 74

All dimensions in inches and millimeters

Features

- ☐ **Optimized for Microstrip Shunt Switches**
  - **Unique Miniature Pedestal Package**
- ☐ **High Reproduceability of Chip Location**
  - **Chip Center Located within .003 Inch of Center of Pedestal**
- ☐ **Low Cost**
  - **Priced for Volume Applications in Digital Phase Shifters and Microstrip Attenuators**
- ☐ **Low Insertion Loss**
  - **High Dynamic Signal Control Range 10,000:1 RF Resistance Change**
- ☐ **Fast Switching and Modulating**
  - **Typically Less than 5 ns Reverse Recovery Time for 5082-3258**

Description

These Microstrip PIN Diodes consist of a specially processed silicon chip of passivated design mounted on a gold plated copper pedestal. The HP 5082-3258 uses a mesa passivated chip optimized for fast switching or low bias current operation. The HP 5082-3259 uses a planar passivated chip optimized for medium power and high Q-circuits. The polarity of the 5082-3258 is cathode on heat sink. The polarity of the 5082-3259 is anode on heat sink.

After attachment of a gold wire, the chip is covered with a thin layer of silicone junction coating for protection against mechanical damage. The connecting wires are bent upwards for transportation and easy circuit insertion.

Devices with guaranteed resistance values are available on special order.

Applications

The HP 5082-3258 and -3259 Pedestal PIN diodes are intended for phase shifting, attenuating and modulating applications in microstrip circuits processing microwave signals through Ku-band. The units are ideally suited for phased array antenna phase shifters of the loaded line variety due to their small size, tight manufacturing tolerances and low application cost. Other typical applications include single and multi-throw switches, pulse modulators, amplitude modulators and TR-switches.

Mechanical Specifications

The HP package outline 74 consists of a gold plated copper pedestal. The top contact wire exhibits an inductance (L_P) of approximately .5 nH for a typical connecting wire length of approximately 20 mils.

Absolute Maximum Ratings

T_{OPR} — Operating Temperature Range . . . . . −65°C to +150°C

T_{STG} — Storage Temperature Range . . . . . −65°C to +150°C

P_{DISS} — DC Power Dissipation at T_A = 25°C (Derate Linearity to Zero at 150°C)

5082-3258 . . . . . 1.0W

5082-3259 . . . . . 2.5W

Electrical Specifications at T_A=25°C

PARAMETER	SYMBOL	5082-3258	5082-3259	UNITS	TEST CONDITIONS
MINIMUM VOLTAGE BREAKDOWN	V_{BR}	70	150	V	I_R = 10μA

Typical Parameters at T_A=25°C

PARAMETER	SYMBOL	5082-3258	5082-3259	UNITS	TEST CONDITIONS
TOTAL CAPACITANCE	C_T	0.3	0.15	pF	3258 at −20 V 3259 at −50 V
LEAD INDUCTANCE	L_P	0.5	0.5	nH	Connecting Wire Length, .020"
RESIDUAL SERIES RESISTANCE	R_S	0.8	0.9	Ω	3258 at 20 mA 3259 at 100 mA
CARRIER LIFETIME	τ	15	200	ns	I_F = 50 mA I_R = 250 mA
REVERSE RECOVERY TIME	t_{rr}	5	150	ns	I_F = 20 mA V_R = 10V 90% Recovery
CW POWER SWITCHING CAPABILITY	P_A	15	35	W	—
PULSE POWER HANDLING CAPABILITY	P_P	50	225	W	1μs Pulse Du = .001

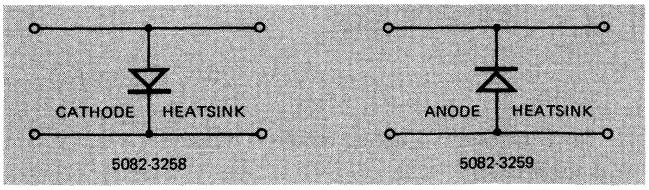


Figure 1. Device Polarity.

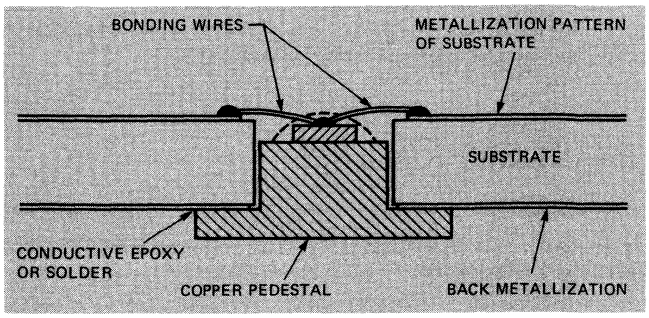


Figure 3. Suggested Microstrip Assembly Technique.

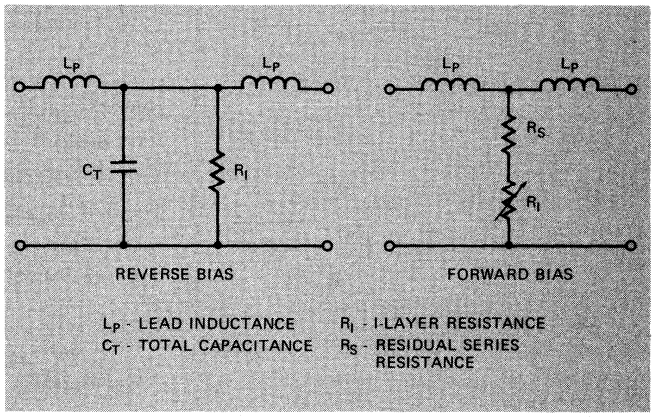


Figure 2. Reverse and Forward Bias Equivalent Circuits. At the Forward Bias Levels Listed under "Typical Parameters, Residual Series Resistance", $R_I \simeq 0$.

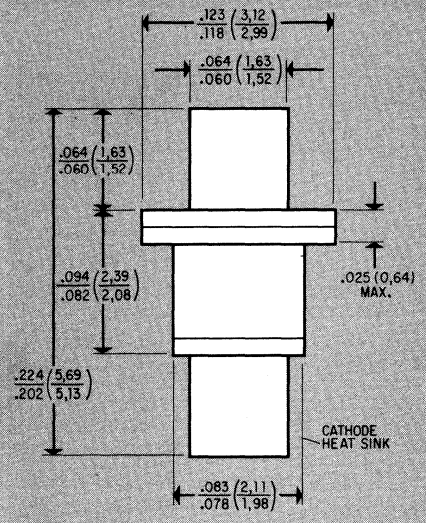
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COMPONENTS

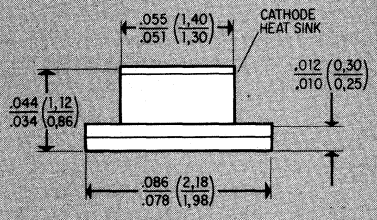
PIN DIODES FOR FAST SWITCHING AND LIMITING

5082-3305

5082-3306



HP PACKAGE 31
(5082-3306)



HP PACKAGE 38
(5082-3305)

Features

- **Nanosecond switching time, typically less than 5 ns.**
- **Low residual series resistance, less than 1Ω**
- **Low drive current required, less than 20 mA for 1Ω R_S**
- **High power limiting capability, 50W peak pulse power**

Description

The HP 5082-3305 and 5082-3306 are oxide passivated silicon PIN diodes of mesa construction. Precisely controlled processing provides an exceptional combination of fast RF switching and low residual series resistance.

The combination of features in this family of HP PIN diodes provides unique benefits in the high isolation to insertion loss ratio afforded by the low residual resistance at low bias currents and the ultra-fast recovery realized through lower stored charge. Where low drive power is desired, these diodes provide excellent performance at much lower bias currents than previously available devices.

Applications

The HP 5082-3305 and -3306 ceramic package PIN diodes are intended for controlling and processing microwave signals up to Ku band. Typical applications include single and multi-throw switches, pulse modulators, amplitude modulators, phase shifters, duplexers, diplexers, TR switches, and limiters.

Mechanical Specifications

The HP Package 31 has a metal ceramic hermetic seal. The cathode stud is gold-plated copper. The anode stud is gold-plated Kovar. The maximum soldering temperature is 230°C for 5 seconds. Typical package inductance is 1.0 nH and typical package capacitance is 0.2 pF.

The HP Package 38 uses gold plated Kovar for both the anode and cathode contact. The maximum soldering temperature is 230°C for 5 seconds. Typical package inductance is 0.4 nH and typical package capacitance is 0.2 pF.

Absolute Maximum Ratings

Operating Temperature Range	−65°C to +150°C
Storage Temperature Range	−65°C to +150°C
DC Power Dissipation at T_A = 25°C	
5082-3305	0.7W
5082-3306	1.25W
(Derate linearly to zero at 150°C)	

Electrical Specifications at T_A=25°C

Characteristic	Symbol	5082-3305		5082-3306		Units	Test Conditions
		Min.	Max.	Min.	Max.		
Series Resistance	R_S	–	1.0	–	1.0	Ω	f = 100MHz, I_F = 20mA
Breakdown Voltage	V_{BR}	70	–	70	–	V	I_R = 10μA
Total Capacitance	C_{VR}	–	0.4	–	0.45	pF	f = 1MHz, V_R = 20V
Reverse Recovery Time	t_{rr}	–	10.0	–	10.0	ns	I_F = 20mA to V_R = 10V, 90% recovery
Package Style	–	–	38	–	31		

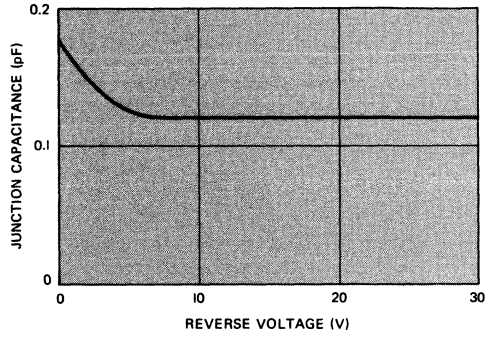


Figure 1. Typical Junction Capacitance vs. Reverse Voltage.

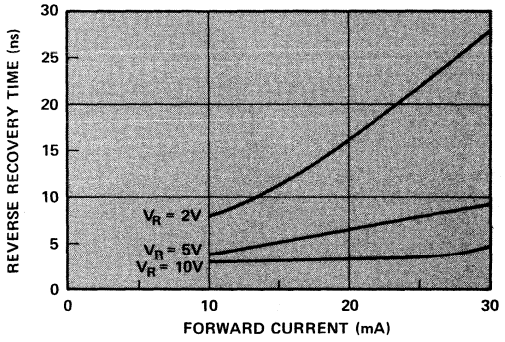


Figure 2. Typical Reverse Recovery Time vs. Forward Current for Various Reverse Driving Voltages. For further discussion of switching characteristics, see 5082-3041 data sheet.

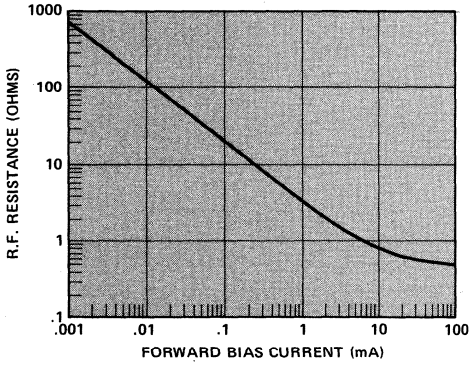


Figure 3. Typical RF Resistance vs. Forward Bias Current.

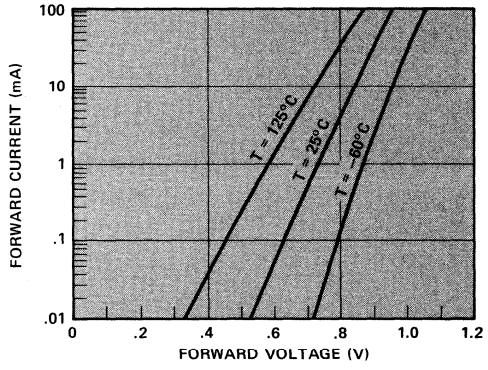
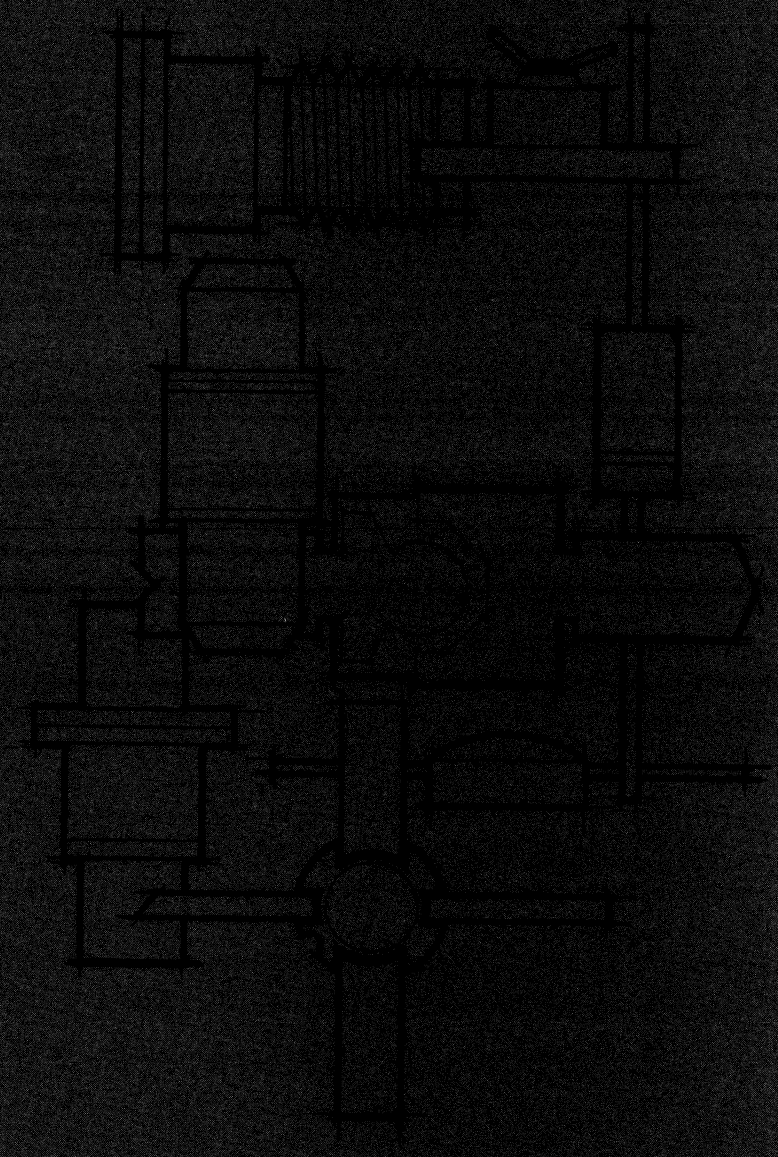


Figure 4. Typical Forward Current vs. Forward Voltage

Environmental Capabilities

Both packages are designed to have the environmental capabilities as outlined in MIL-STD-750 with the following conditions:

CHARACTERISTIC	MIL-STD-750 REFERENCE	CONDITIONS
Temperature, Storage	1031	See Absolute Maximum Ratings
Temperature, Operating	–	See Absolute Maximum Ratings
Solderability	2026	230°C as applicable
Temperature, Cycling	1051	5 cycles, –65 to +150°C
Thermal Shock	1056	5 cycles, 0 to +100°C
Moisture Resistance	1021	10 days, 90-98% RH
Shock	2016	5 blows, X_1, Y_1, Y_2 @ 1500G
Vibration Fatigue	2046	32 hrs. X, Y, Z, @ 20G Min.
Vibration Variable Freq.	2056	Four 4-min cycles, X, Y, Z, @ 20G Min., 100 to 2000Hz
Constant Acceleration	2006	X_1, Y_1, Y_2 @ 20,000G
Salt Atmosphere	1041	35°C fog for 24 hours

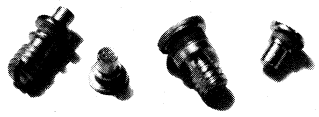


Microwave Source Diodes

Selection Guide 124

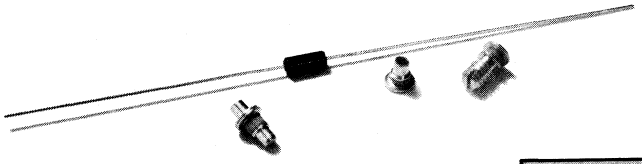
IMPATT Diodes for Microwave Oscillators and Amplifiers 125

Step Recovery Diodes for Comb Generators and Frequency Multipliers 137



IMPATT Diodes

POWER OUT/ FREQUENCY RANGE	PART NUMBER 5082-	PAGE NO.
100mW:		
5 - 9GHz	0431/0434	135
8 - 12GHz	0432/0435	135
10 - 14GHz	0433/0436	135
500mW:		
8 - 10GHz	0400	125
10 - 12GHz	0401	125
1.5 - 1.0W:		
4 - 6.4GHz	0423	129
5.9 - 8.4GHz	0424	129
8 - 10GHz	0425	129
10 - 12GHz	0426	129
10 - 13.5GHz	0427	129



Step Recovery Diodes

FREQUENCY RANGE	PART NUMBER 5082-	PACKAGE	PAGE NO.
VHF/UHF/ L-Band	0180	11	137
	0112	11	137
	0114	11	137
	0151	15	137
S-Band	0241	31	137
	0300*	40	137
	0303*	65	137
C-Band	0132	31	137
	0310*	41	137
X-Band	0243	31	137
	0253	31	137
	0320*	41	137
	0020	Chip	143
	0316	LID	143
	0305	Ministrip	143
Ku-Band	0335*	31	137
	0008	Chip	143
	0318	LID	143
	0340	Ministrip	143

*RF Tested Devices

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COMPONENTS

MEDIUM POWER SILICON IMPATT DIODES (7-14 GHz)

5082-0400
5082-0401



- **High Power Output:**
  (0.5 W minimum in X-band with $\Delta T_j < 175°C$)
- **Low Thermal Resistance:**
  (5082-0400: typically 16°C/W)
  (5082-0401: typically 17°C/W)
- **Low Noise:**
  AM: $(\frac{N}{C})_{DSB} < -135$ dB in 100 Hz BW
  FM: $\Delta f_{RMS} < 10$ Hz in 100 Hz BW
- **Unique fabrication method for low cost and high reliability**
- **High Efficiency: 6.5% typical for 5082-0400**
  6.0% typical for 5082-0401

General Description

IMPATT (IMPact Ionization Avalanche Transit Time) diodes are junction devices operated with reverse bias sufficient to cause avalanche breakdown. In this diode, the combination of avalanche generation and drift of carriers across the diode's active region produces negative resistance at microwave frequencies. Thus, in the appropriate circuit, the device can be the active element of a microwave oscillator.

Device Construction

The HP 5082-0400 and 5082-0401 IMPATT diodes are silicon mesa p-n junction devices fabricated using low temperature double epitaxial techniques. This process assures abrupt junctions and exact control of the thickness of the active portion of the device. Heat sinking of the diode is provided by an integral heat sink which is batch-fabricated for uniformity, economy and intimate thermal contact between the junction and the heat-carrying metal. This process allows high output powers at safe junction temperatures (0.5 W with T_j less than 200°C).

Applications

These devices are intended for use as the active elements in X-band oscillators and amplifiers where power, efficiency, reliability and ease of design are primary requisites. The diode is ideally suited for doppler radars, fuses and ECM systems, as well as other applications where reliability and high performance are critical, as in space landing radars, airborne doppler navigation systems, and point-to-point telecommunication links.

Device theory, noise theory, and circuit design information are available in Application Note 935.

Reliability

The HP IMPATT diodes 5082-0400 and 5082-0401 are designed to meet the requirements of MIL-S-19500 and are suitable for high reliability applications where maximum performance under the most adverse operating conditions is desired.

Absolute Maximum Ratings

Parameter	Symbol	5082-0400/0401
Storage Temperature	T_{STG}	150°C
Junction Operating Temperature (Note 1)	T_J	200°C
Power Dissipation	P_{DISS}	$\frac{200 - T_A}{\theta_T}$

Electrical Specifications at T_A=25°C

Parameter	Symbol	5082-0400			5082-0401			Units	Note
		Min.	Typ.	Max.	Min.	Typ.	Max.		
Frequency Range	f	8		10	10		12.4	GHz	2
CW Output Power	P_O	0.5	0.7		0.5	0.6		W	3
Junction Temperature Rise at P_O = .5W	ΔT_j			175			175	°C	4

Typical Parameters at T_A=25°C

Parameter	Symbol	5082-0400	5082-0401	Units	Test Conditions
Efficiency	η	6.5	6	%	—
Thermal Resistance	θ_T	16	17	°C/W	Note 4
Operating Voltage	V_{OPR}	95	80	V	—
Operating Current	I_{OPR}	115	130	mA	—
Junction Capacitance at V_{BR}	$C_j(V_{BR})$	.52	.57	pF	f = 1MHz, V = V_{BR}–1
Package Capacitance	C_P	0.3	0.3	pF	f = 1MHz
Package Inductance	L_P	0.60	0.60	nH	—
Breakdown Voltage (I_R = .5 mA)	V_{BR}	78	65	V	—

1. Diode burnout occurs for $T_J \simeq 350°C$. Operation at $T_J < 200°C$ thus allows a large margin for safety, ensuring long-term reliable operation and stability of diode parameters.

2. Operation outside the specified range is possible. See Figure 2 for typical performance.

3. Output power is measured in a fixed-tuned mount, shown in Figure 8; the test circuit is shown in Figure 1. The frequency of oscillation varies slightly from diode to diode, due to slight variations in junction capacitance and package inductance. For the 5082-0400, the frequency is approximately 10 GHz; for the 5082-0401, it is approximately 12.4 GHz.

4. The mount for an IMPATT diode must provide an adequate heat flow path away from the diode stud. The junction temperature rise will be:

$$\Delta T_j = \Theta_T (P_{IN} - P_O)$$

Θ_T is measured with the diode mounted in an OFHC copper heatsink using the dc avalanche resistance method (cf HP Application Note 935, Page 6). To determine Θ_{jc}, use $\Theta_{jc} = \Theta_T - 1.5$ (1.5°C/W has been found to be a nominal value for a good heat flow path in the diode mount.)

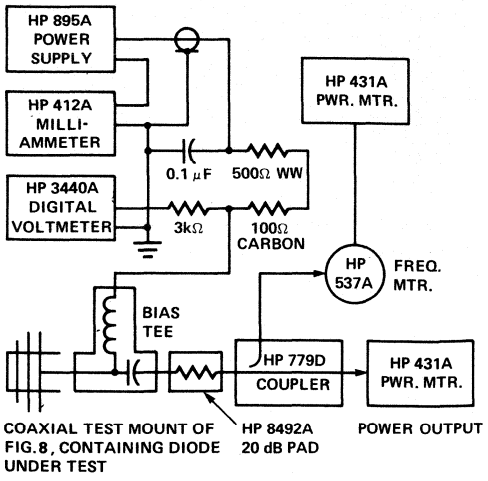


Figure 1. Block Diagram of P_O Test Circuit.

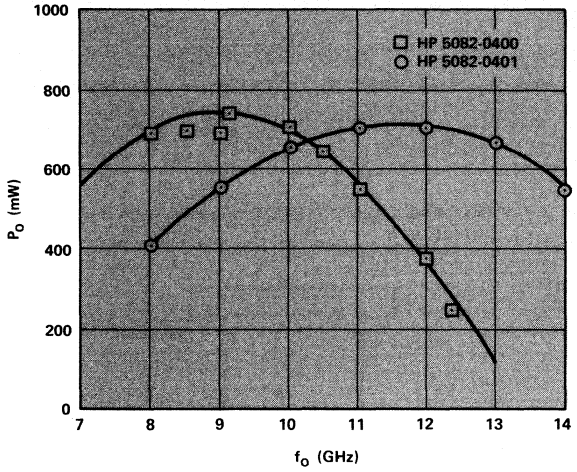


Figure 2. Typical Output Power as a Function of Frequency for HP 5082-0400 and HP 5082-0401.

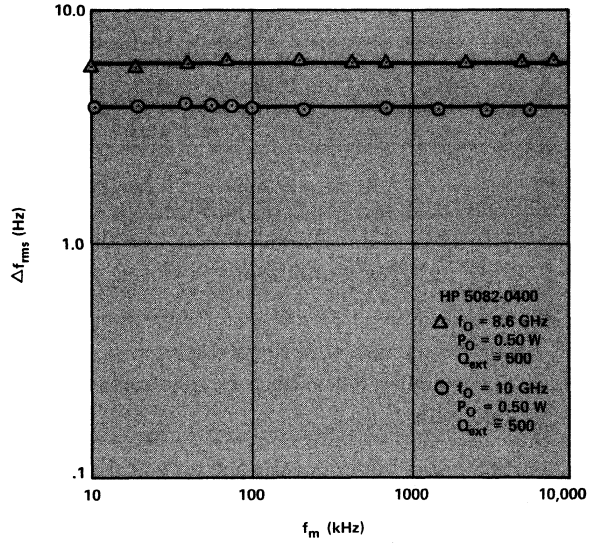


Figure 3. Typical FM Noise for the HP 5082-0400 Diode with a bandwidth = 100 Hz.
Q_{EXT} is determined from injection-locking measurements.

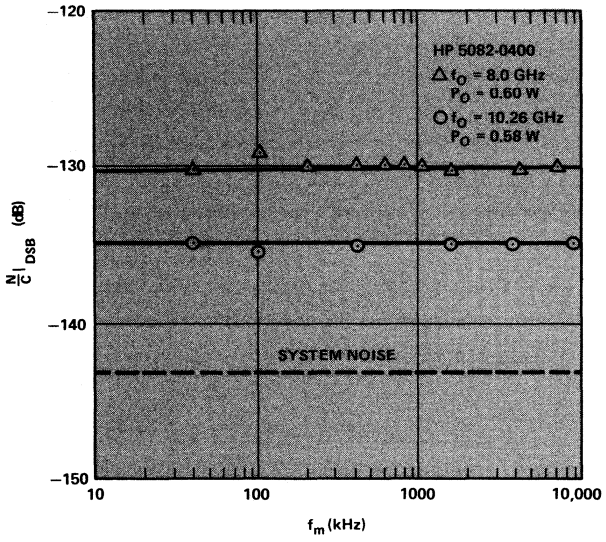


Figure 4. Typical AM Noise for the HP 5082-0400 Diode with a bandwidth = 100 Hz.

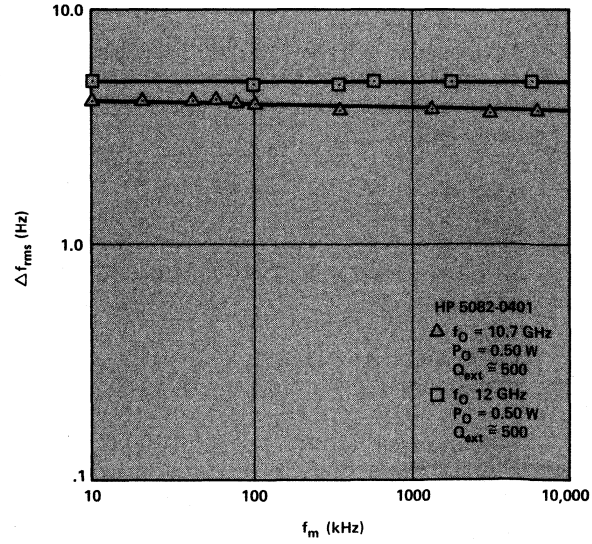


Figure 5. Typical FM Noise for the HP 5082-0401 Diode with a bandwidth = 100 Hz.
Q_{EXT} is determined from injection-locking measurements.

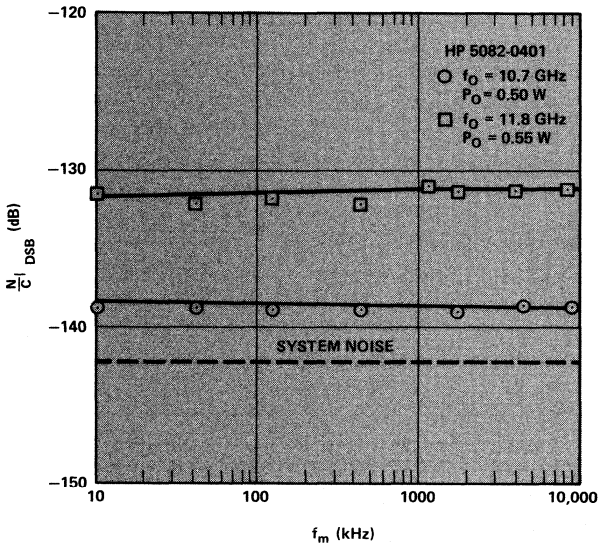


Figure 6. Typical AM Noise for the HP 5082-0401 Diode with a bandwidth = 100 Hz.

Mechanical Specifications

Hewlett-Packard's Impatt Diodes are presently available in the HP Style 41 package. However, a variety of packages are available upon request. Contact your local HP field office for additional information.

The metal-ceramic package is hermetically sealed. The cathode flange is gold-plated Kovar. The anode stud is gold-plated copper. The maximum soldering temperature for a metal-ceramic package is 230°C for five seconds.

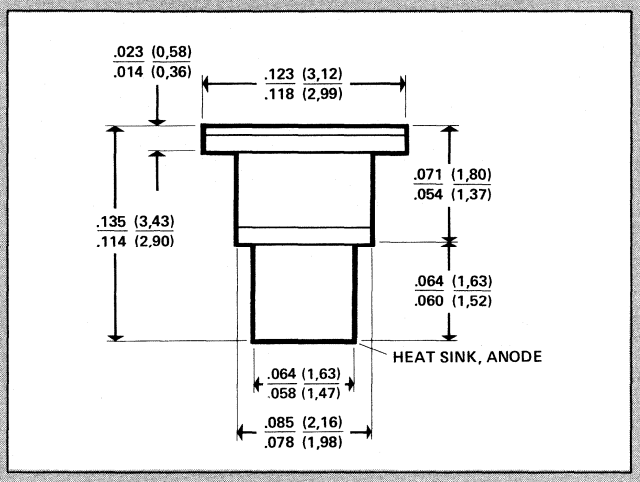


Figure 7. Outline 41.

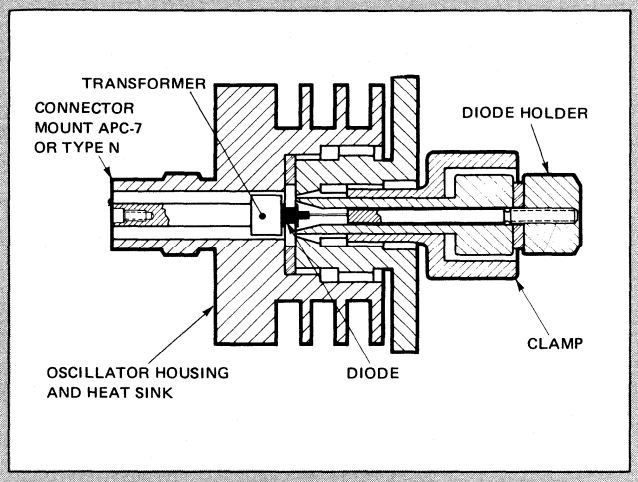


Figure 8. Coaxial Test Mount for Microwave Output Output Power Measurement.

NOTE: Drawings of a variety of coaxial and wave guide test mounts are available through the factory. Please contact your local field office for this information. Also see HP Application Note AN935 "Microwave Power Generation and Amplification Using Impatt Diodes".

Environmental Capabilities

Hewlett Packard IMPATTs are capable of passing the following MIL-STD-750 tests, with conditions as noted.

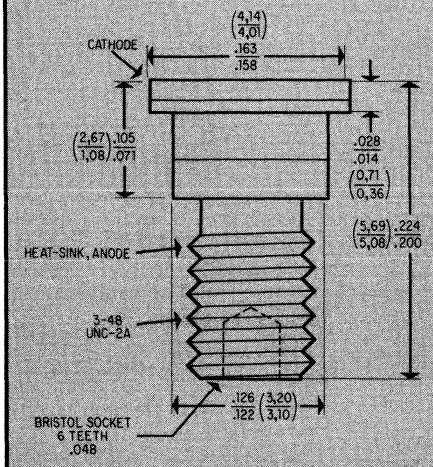
Test	MIL-STD-750 Reference	Test Conditions
Steady State Operating Life	1026.1	1000 hours minimum operating time at reverse power, P_R to raise T_J to maximum rated value
High Temperature Life	1031.1	1000 hours minimum storage time at 150°C
Physical Dimensions	2066	Device profile at 20X
Solderability	2026	Sn 60, Pb 40, solder at 230°C
Temperature Cycling	1051.1 Cond. B	5 cycles from −65°C to +150°C, .5 hrs. at extremes, 5 min. transfer
Thermal Shock	1056.1	5 cycles from 0°C to +100°C, 3 sec. transfer
Moisture Resistance	1021.1	10 days, 90-98% RH, −10°C to +65°C, nonoperating
Shock	2016.1	5 blows each X_1, Y_1, Y_2, 1500 G, 0.5 msec pulse
Vibration Fatigue	2046	32 ± 8 hrs. each X, Y, Z, 96 hr total, 60 Hz, 20 G min.
Vibration Variable Frequency	2056	4, 4 minute cycles each X, Y, Z, at 20 G min., 100 to 2000 Hz
Constant Acceleration	2006	1 minute each X_1, Y_1, Y_2, at 20,000 G
Terminal Strength	2036.1 Cond. E	Stud package – 2 lbs. for 3 sec., 120° apart
Salt Atmosphere	1041.1	35° fog for 24 hours

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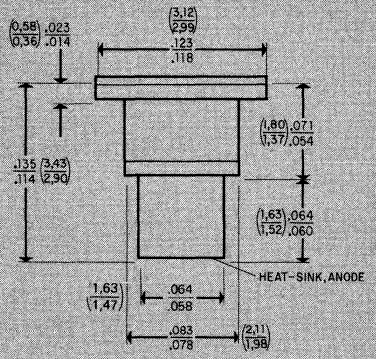
COMPONENTS

HIGH POWER SILICON IMPATT DIODES (4-13.5 GHz)

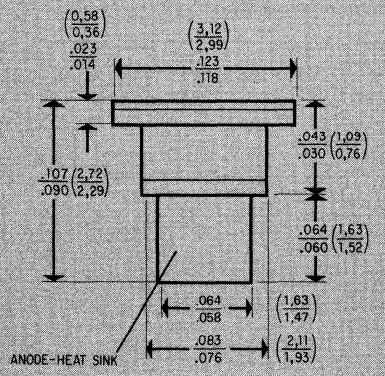
5082-0423
5082-0424
5082-0425
5082-0426
5082-0427



Outline 64



Outline 41



Outline 46

All dimensions in inches and millimeters.

Features

- **High Power Output**
  Typically: 1.5W, 4.0-8.0GHz; 1.25W, 8.0-10.0GHz; 1W, 10.0- 13.5GHz
- **Low Thermal Resistance**
  Safe, low T_j of less than 200°C at rated output power.
- **Unique fabrication method for reliable high power operation**
- **High Efficiency**
  Typically greater than 6.5%
- **Low Noise:**
  AM: Typically −140dB in 100Hz BW, 1kHz from carrier
  FM: Typically less than 4Hz (RMS) in 100 Hz BW, 100 Hz from carrier (Q_{EXT} = 200)

Description

HP 5082-0423 thru 0427 IMPATT (IMPact Ionization Avalanche Transit Time) diodes are junction devices operated with reverse bias sufficient to cause avalanche breakdown. In this diode, the combination of avalanche generation and drift of carriers across the diode's active region produces negative resistance at microwave frequencies. Thus, in the appropriate circuit, the device can be the active element of a microwave oscillator or microwave amplifier.

Applications

Because of their high power output, efficiency and reliability, these devices are ideally suited for use as the active element in oscillators and amplifiers (see Figs. 19 and 20) from C to Ku-Band in point-to-point telecommunications links, telemetry systems, and Doppler landing and navigation systems.

Properly designed IMPATT oscillator circuits can have noise performance comparable to that of reflex klystron or Gunn oscillators in virtually any application. Of particular interest for Doppler radar systems is the fact that IMPATT diodes exhibit no measurable 1/f noise near the carrier.

Noise curves presented in this data sheet are calculated from theory described in HP Application Note 935. It is to be emphasized that noise performance is very much dependent on circuit parameters such as output power and cavity Q.

Device Construction

These IMPATTs are an extension of the integral heatsink technology developed at Hewlett Packard. During manufacture, junction layers are grown epitaxially on the semiconductor wafer, the heatsink is plated on, then the wafer is etched away to form individual diode mesas. The heatsink, which also serves as a substrate, is then cut into separate chips with four diode mesas on each chip. Because of identical processing treatment, the four diodes on each chip are well matched electrically. This fabrication technique also achieves intimate thermal contact between junction and heatsink. Thermal resistance as low as 6°C/W can be achieved.

Absolute Maximum Ratings

T_{STG}	–	Storage Temperature Range	–60°C to +150°C
T_{OPR}	–	Junction Operating Temperature Range	–65°C to +200°C
P_{DISS}	–	Power Dissipation	$\frac{200 - T_A}{\Theta_T}$

Electrical Specifications at T_A=25°C

Parameter	Symbol	5082-0423	5082-0424	5082-0425	5082-0426	5082-0427	Units	Notes
Package style	–	64	64	64	41	46	–	–
Typical operating frequency range	–	4-6.4	5.9-8.4	8-11	10-12	10-13.5	GHz	–
Minimum CW Output power	P_O	1.5	1.5	1.25	1.0	1.0	W	1
Maximum junction temperature rise at minimum rated output power	ΔT_j	175	175	175	175	175	°C	2

Typical Parameters at T_A=25°C

Parameter	Symbol	5082-0423	5082-0424	5082-0425	5082-0426	5082-0427	Units	Test Conditions
Operating voltage	V_{OP}	150	125	100	80	80	V	–
Operating current	I_{OP}	200	220	210	200	200	mA	–
Breakdown voltage	V_{BR}	125	105	78	65	65	V	I_R = 0.5mA
Junction Capacitance at Breakdown	$C_j(V_{BR})$	1.4	1.1	0.9	0.8	0.8	pF	$V_R = V_{BR}-1$ measured at 1MHz
Package Capacitance	C_p	0.5	0.5	0.5	0.3	0.4	pF	Measured at 1MHz
Package Inductance	L_p	0.7	0.7	0.7	0.6	0.3	nH	See Figs. 6-9
Efficiency	η	5.5	6.5	6.0	7.0	7.0	%	$\eta = P_O/P_i$ x 100
Total thermal resistance	Θ_T	5.5	6.5	8.5	10.5	10.5	°C/W	(Note 3)

NOTES

1. Measured in a fixed tuned oscillator at the following approximate frequencies:
   5082-0423 5.5 GHz
   5082-0424 6.6 GHz
   5082-0425 9.0 GHz
   5082-0426 12.0 GHz
   5082-0427 12.0 GHz
   Typical diodes satisfy the minimum specification throughout the operating frequency range. Special models tested at other frequencies are available upon special request.

2. The mount for an IMPATT diode must provide an adequate heat flow path away from the diode stud. The junction temperature rise will be:
   $\Delta T_j = \Theta_T(P_{IN}-P_O)$

3. Θ_T is measured with the diode mounted in an OFHC copper heatsink using the dc avalanche resistance method (cf HP Application Note 935, Page 6). To determine Θ_{jc}, use $\Theta_{jc} = \Theta_T - 1.5$ (1.5° C/W has been found to be a nominal value for a good heat flow path in the diode mount.

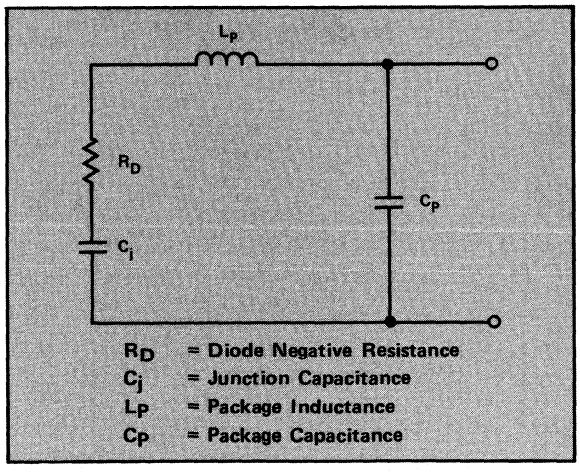


Figure 1. Diode equivalent circuit.

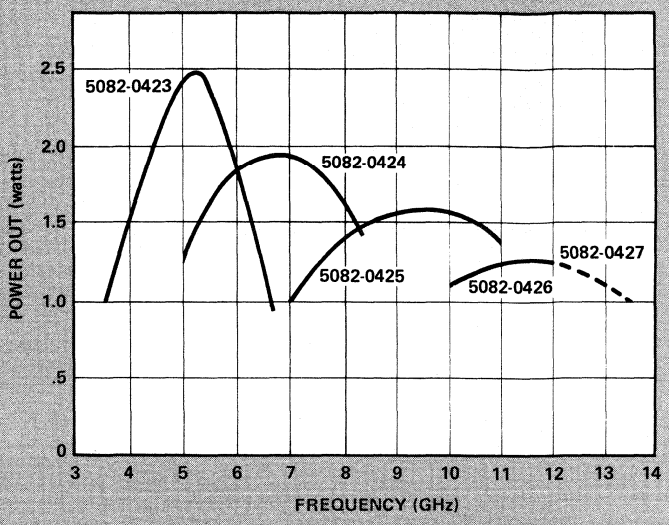


Figure 2. Typical output power vs. frequency at $\Delta T_j = 175^\circ C$. Optimized cavities will give better performance off center frequency.

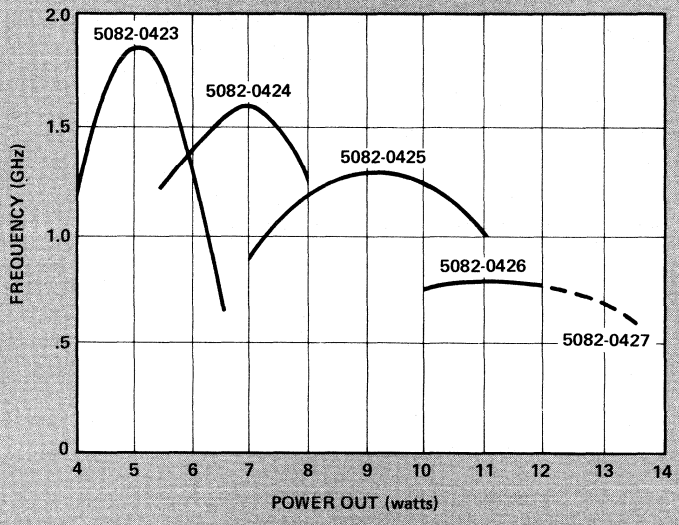


Figure 3. Typical output power vs. frequency at $\Delta T_j = 135^\circ C$. Optimized cavities will give better performance off center frequency.

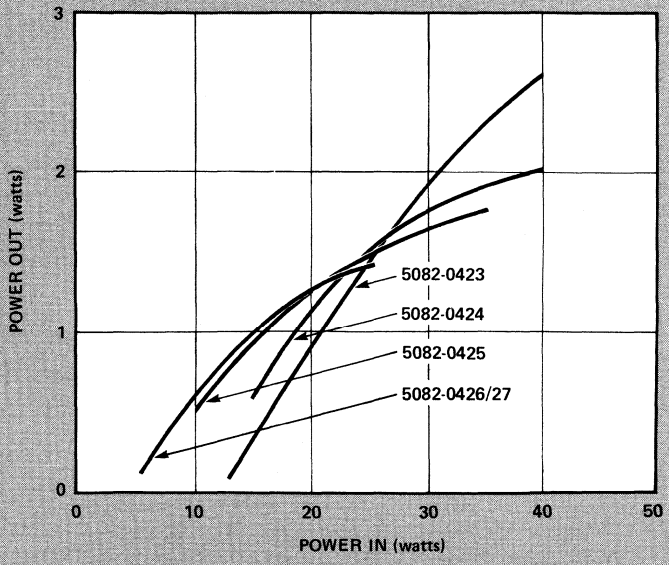


Figure 4. Typical output power vs. input power.

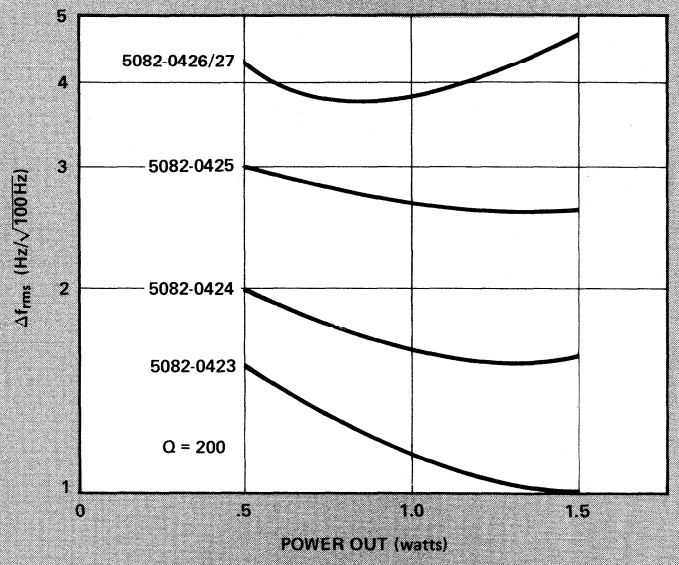


Figure 5. Calculated typical fm noise vs. output power for Q = 200. Δf_{rms} is inversely proportional to Q. For example, if Q = 400, Δf_{rms} is half of these values.

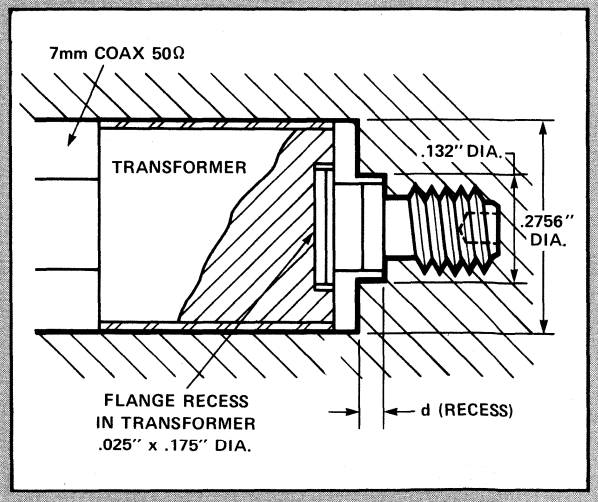


Figure 6. HP Package 64 shown recessed in diode mount.

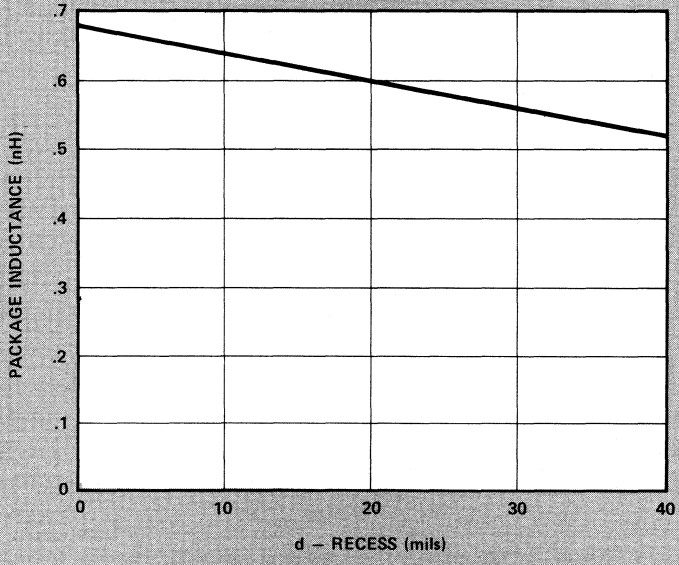


Figure 7. HP Package 64 inductance vs. recess, d.

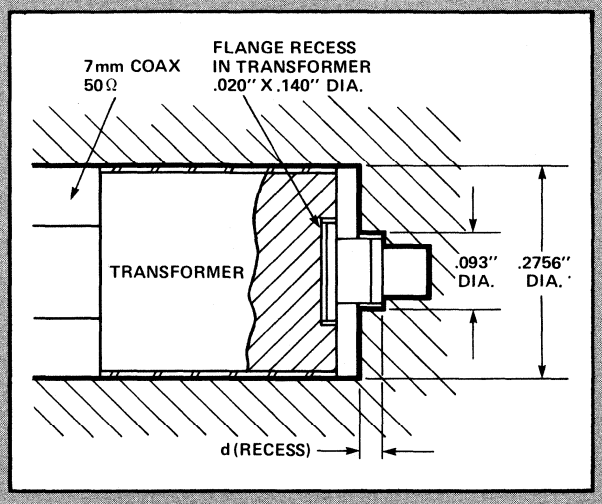


Figure 8. HP Package 41 or 46 shown recessed in diode mount.

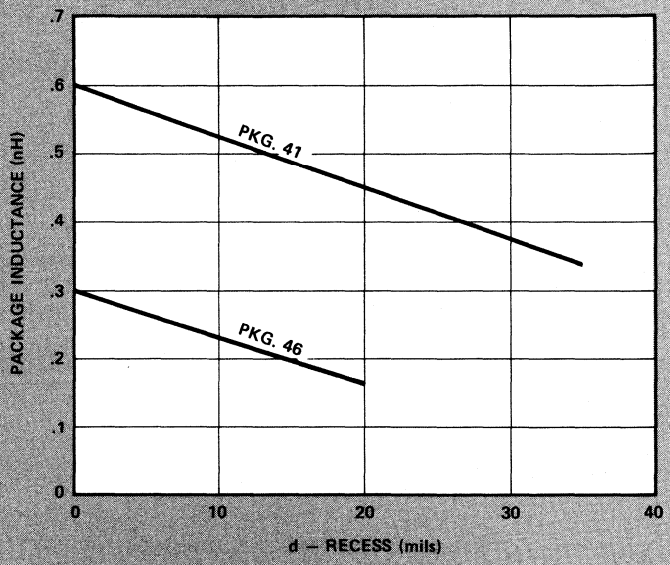


Figure 9. HP Packages 41 and 46 inductance vs. recess, d.

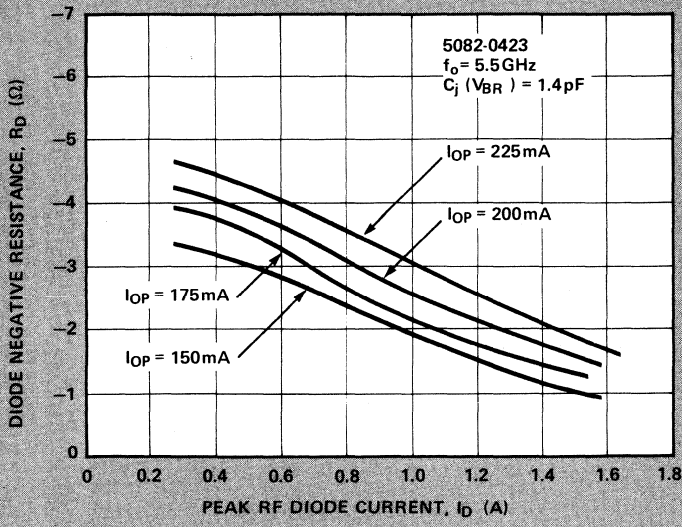


Figure 10. Typical diode negative resistance vs. peak RF diode current with dc operating current as a parameter, 5082-0423.

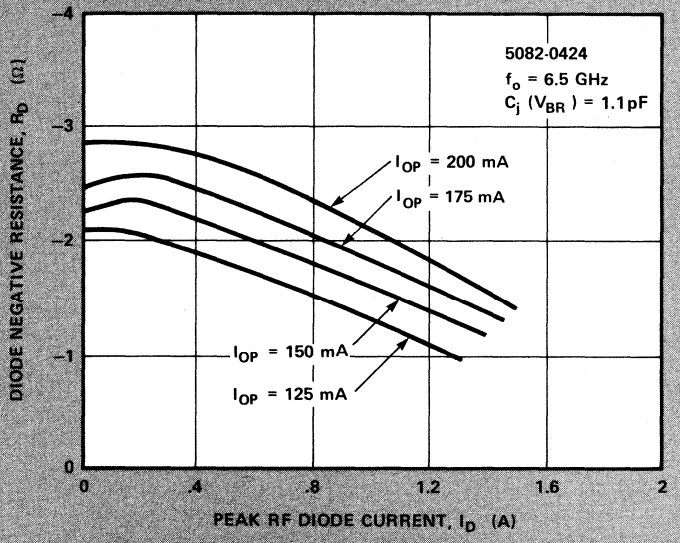


Figure 11. Typical diode negative resistance vs. peak RF diode current with dc operating current as a parameter, 5082-0424.

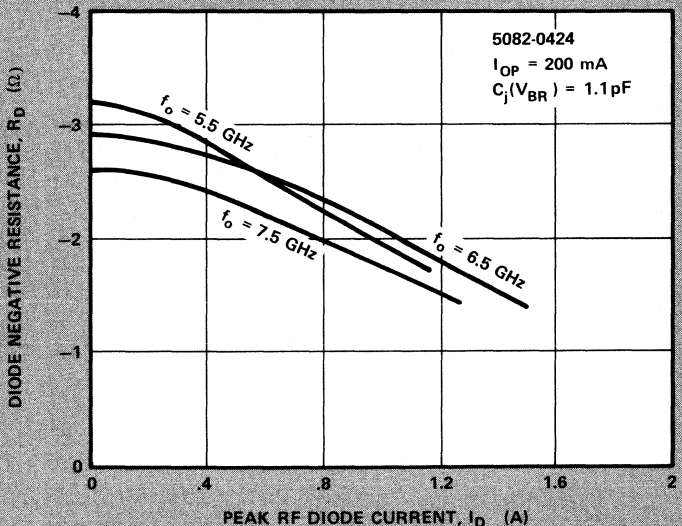


Figure 12. Typical diode negative resistance vs. peak RF diode current with frequency as a parameter, 5082-0424.

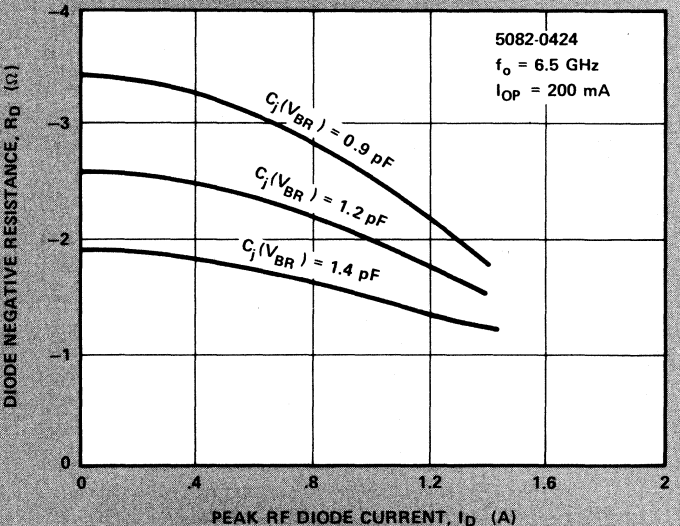


Figure 13. Typical diode negative resistance vs. peak RF diode current with junction capacitance as a parameter, 5082-0424.

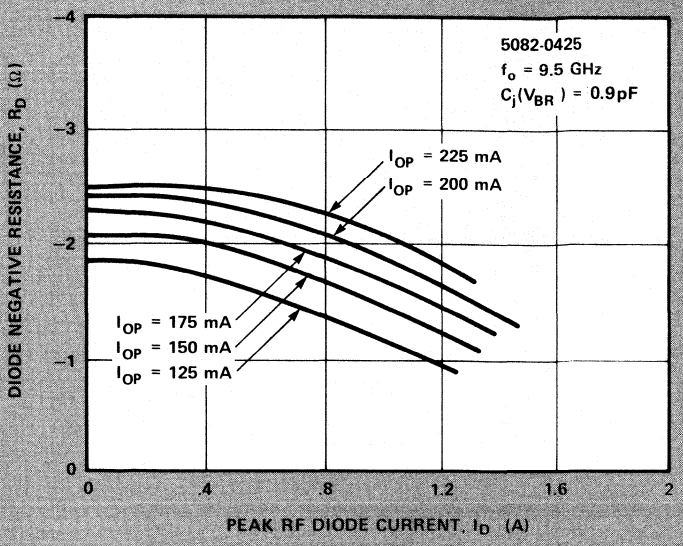


Figure 14. Typical diode negative resistance vs. peak RF diode current with dc operating current as a parameter, 5082-0425.

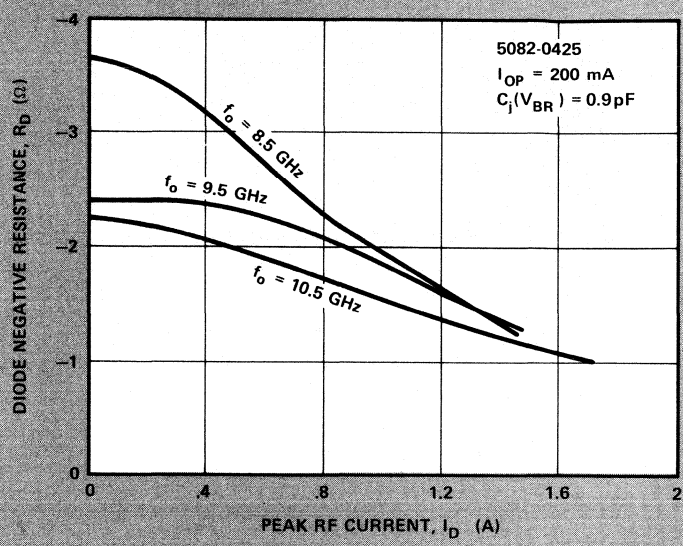


Figure 15. Typical diode negative resistance vs. peak RF diode current with frequency as a parameter, 5082-0425.

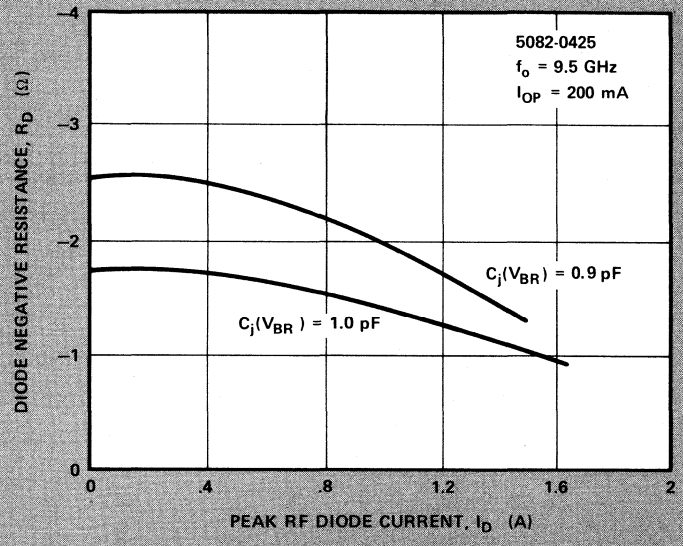


Figure 16. Typical diode negative resistance vs. peak RF diode current with junction capacitance as a parameter, 5082-0425.

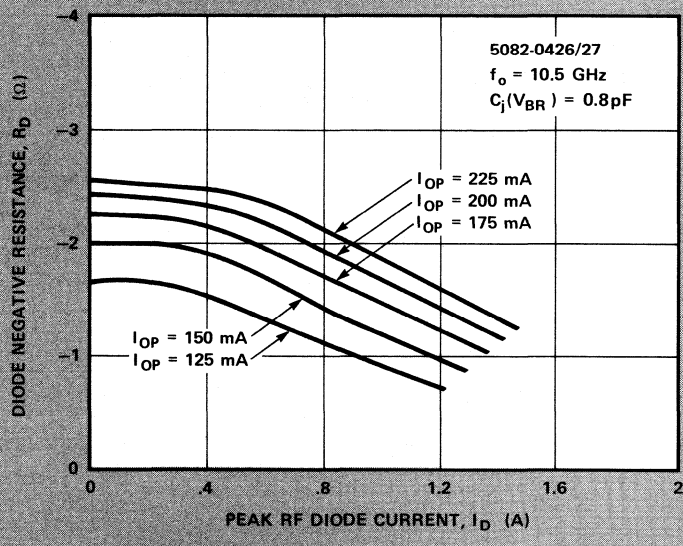


Figure 17. Typical diode negative resistance vs. peak RF diode current with dc operating current as a parameter, 5082-0426/27.

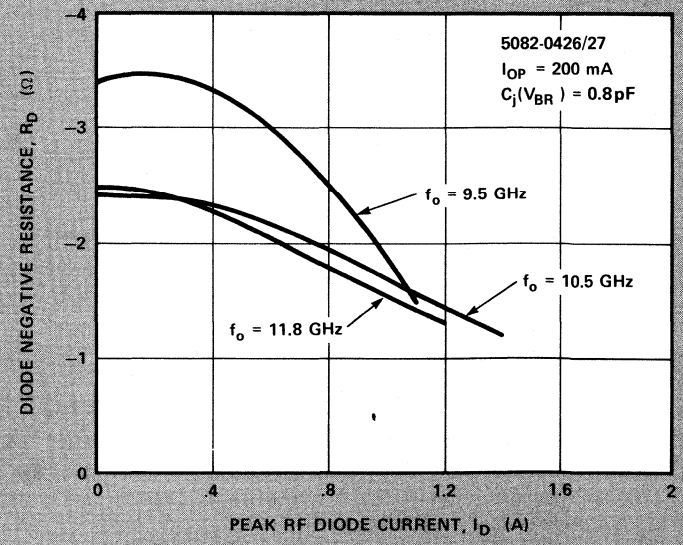


Figure 18. Typical diode negative resistance vs. peak RF diode current with frequency as a parameter, 5082-0426/27.

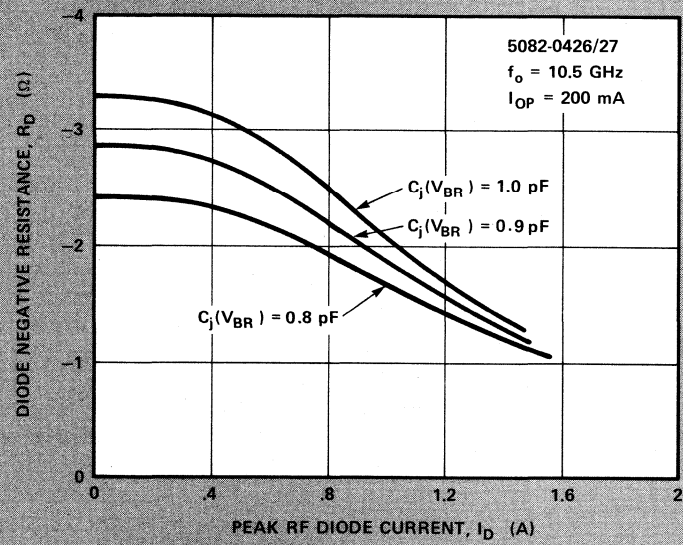


Figure 19. Typical diode negative resistance vs. peak RF diode current with junction capacitance as a parameter, 5082-0426/27.

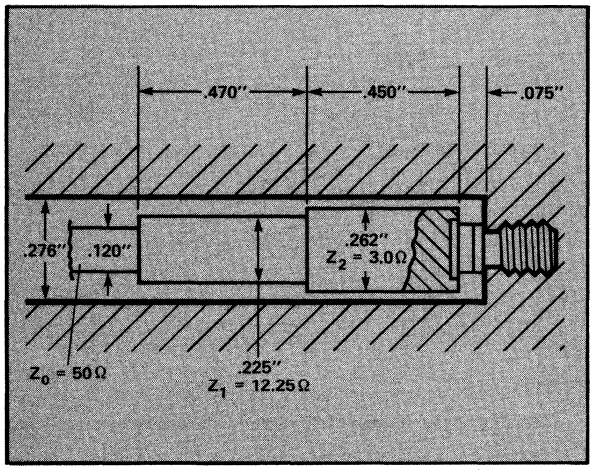


Figure 20. Transformer dimensions for 6.5GHz coaxial amplifier.

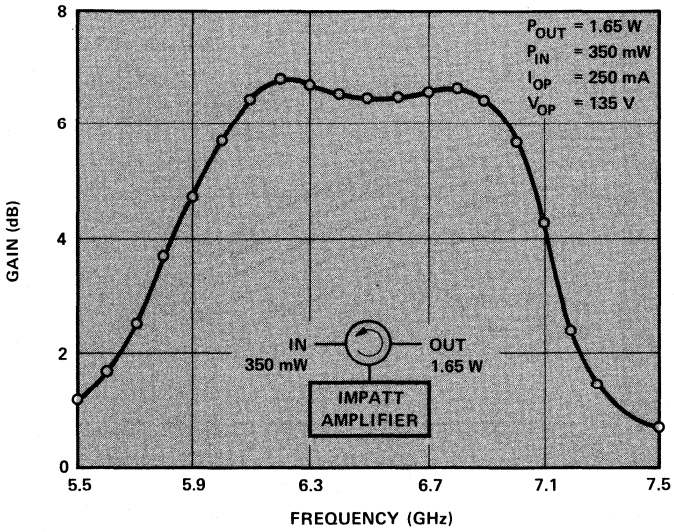


Figure 21. Typical gain vs. frequency for 6.5GHz coaxial reflection amplifier.

Environmental Capabilities

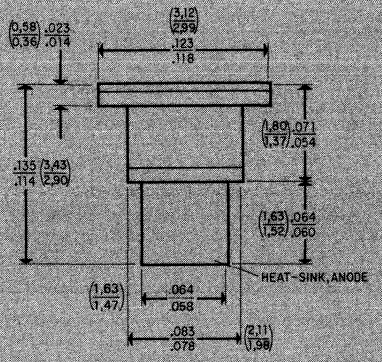
Hewlett Packard IMPATTs are capable of passing the following MIL-STD-750 tests, with conditions as noted.

Test	MIL-STD-750 Reference	Test Conditions
Steady State Operating Life	1026.1	1000 hours minimum operating time at reverse power, P_R to raise T_J to maximum rated value
High Temperature Life	1031.1	1000 hours minimum storage time at 150°C
Physical Dimensions	2066	Device profile at 20X
Solderability	2026	Sn 60, Pb 40, solder at 230°C
Temperature Cycling	1051.1 Cond. B	5 cycles from −65°C to +150°C, .5 hrs. at extremes, 5 min. transfer
Thermal Shock	1056.1	5 cycles from 0°C to +100°C, 3 sec. transfer
Moisture Resistance	1021.1	10 days, 90-98% RH, −10°C to +65°C, nonoperating
Shock	2016.1	5 blows each X_1, Y_1, Y_2, 1500 G, 0.5 msec pulse
Vibration Fatigue	2046	32 ± 8 hrs. each X, Y, Z, 96 hr total, 60 Hz, 20 G min.
Vibration Variable Frequency	2056	4, 4 minute cycles each X, Y, Z, at 20 G min., 100 to 2000 Hz
Constant Acceleration	2006	1 minute each X_1, Y_1, Y_2, at 20,000 G
Terminal Strength	2036.1 Cond. E	Stud package — 2 lbs. for 3 sec., 120° apart
Salt Atmosphere	1041.1	35° fog for 24 hours

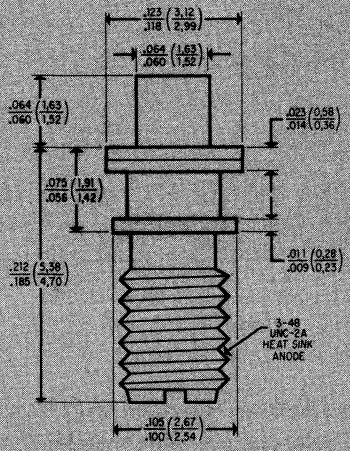
HEWLETT hp PACKARD
COMPONENTS

LOW POWER SILICON IMPATT DIODES (5-14 GHz)

5082-0431
5082-0432
5082-0433
5082-0434
5082-0435
5082-0436



Outline 41



Outline 62

Features

- **Low Cost**
  Achieved by unique batch fabrication process
- **Optimized for Consumer and Industrial Equipment requiring 10-150 mW**
- **High Reliability**
  $T_j < 200°C$ @ 100 mW and $T_A = 75°C$
- **Low Thermal Resistance**
  Typically 30°C/W
- **Low Noise**
  AM: Typ. – 135 dB in 100 Hz BW, 1 kHz from carrier
  FM: Typ. 3 Hz (RMS) in 100 Hz BW, 1 kHz from carrier
  $Q_{EXT} = 2400$

General Description

IMPATT (IMPact Ionization Avalanche Transit Time) diodes are junction devices operated with reverse bias sufficient to cause avalanche breakdown. In this device, the combination of avalanche generation and drift of carriers across the diode's active region produces negative resistance at microwave frequencies. Thus, in the appropriate circuit, the device can be the active element of a microwave oscillator or microwave amplifier.

Applications

Devices of the 5082-0430 series are optimized for consumer and industrial applications requiring a low cost oscillator diode for the frequency range 5-14 GHz. The devices operate in a properly adjusted cavity as a 100 mW oscillator with high efficiency and a high level of inherent device reliability. Typical applications consist of intrusion alarm radars, traffic control radars, fuses, automatic braking systems and low cost telecommunications repeaters. More detailed information is available in HP Application Note 935.

Device Construction

HP 5082-0430 series IMPATT diodes are silicon mesa p-n junction devices fabricated using low temperature, double epitaxial techniques. This process assures abrupt junctions and exact control of the thickness of the active portion of the device. Heat sinking of the diode is provided by an integral heat sink which is batch-fabricated using an HP unique manufacturing process for uniformity, economy, and intimate thermal contact between the junction and the heat-carrying metal.

Absolute Maximum Ratings

Parameter	Symbol	
Storage Temperature	T_{STG}	150°C
Junction Operating Temperature (Note 6)	T_J	200°C
Power Dissipation (Note 7)	P_{DISS}	$\frac{200 - T_A}{\theta_T}$

Electrical Specifications at T_A=25°C

Parameter	Symbol	5082-0431 5082-0434	5082-0432 5082-0435	5082-0433 5082-0436	Units	Notes
Frequency Range	f	5-9	8-12	10-14	GHz	–
Minimum CW Output Power	P_O	100			mW	1
Maximum Thermal Resistance	θ_T	35			°C/W	2

Typical Parameters at T_A=25°C

Parameter	Symbol	5082-0431	5082-0434	5082-0432	5082-0435	5082-0433	5082-0436	Units	Notes
HP Package Style No.	–	41	62	41	62	41	62	–	–
Operating Voltage	V_{OPR}	110		90		75		V	9
Operating Current	I_{OPR}	25		30		35		mA	9
Breakdown Voltage	V_{BR}	103		78		65		V	3
Junction Capacitance at V_{BR}	$C_j(V_{BR})$	0.29		0.20		0.30		pF	4
Typical Efficiency	η	3.5						%	5
Typical Package Capacitance	C_p	.30						pF	4
Typical Package Inductance	L_p	.60						nH	8

Mechanical Specifications

Hewlett-Packard's Impatt Diodes are presently available in the HP Style 41 and 62 packages. However, a variety of packages are available upon request. Contact your local HP field office for additional information. The metal-ceramic package is hermetically sealed. The cathode stud and flange is gold-plated Kovar. The anode stud is gold-plated copper. The maximum soldering temperature for a metal-ceramic package is 235°C for 5 seconds.

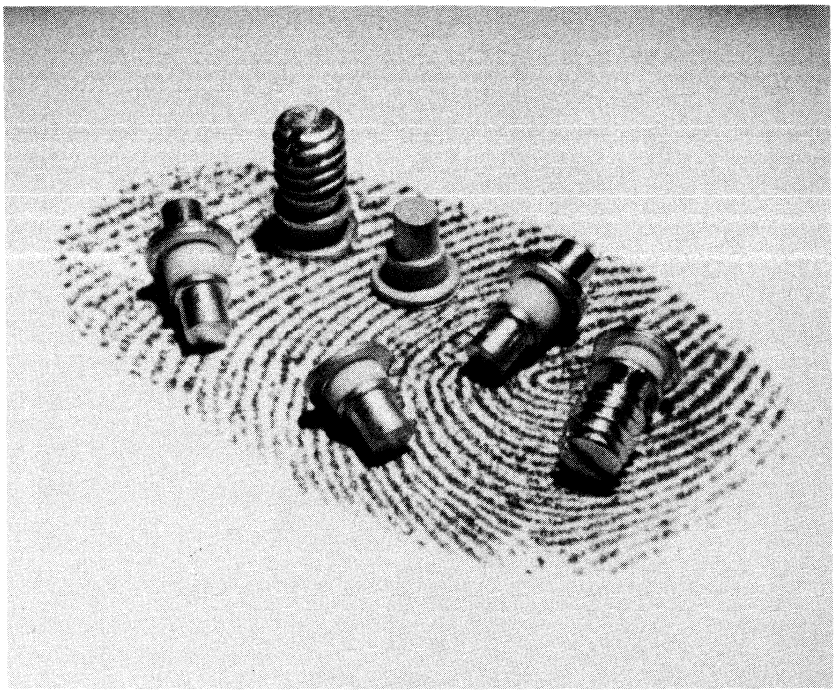
NOTES:

1. Output power is measured in a nominally fixed-tuned mount with Q_{EXT} = 40 and P_{IN} (max) = 3.5 W.
2. Θ_T is measured with the diode mounted in an OFHC copper heatsink using the dc avalanche resistance method (cf HP Application Note 935, Page 6). To determine Θ_{jc}, use $\Theta_{jc} = \Theta_T - 1.5$ (1.5°C/W has been found to be a nominal value for a good heat flow path in the diode mount).
3. I_R = .5 mA.
4. Measured at 1.0 MHz.
5. $\eta = (P_O/P_{IN}) \times 100$
6. Diode burnout occurs for $T_J \simeq 350°C$. Operation at $T_J < 200°C$ thus allows a large margin for safety, ensuring long-term reliable operation and stability of diode parameters.
7. $P_{DISS} = P_{IN} - P_O$.
8. Measured in X-band in 0.276" O.D. coaxial transmission line.
9. IMPATT devices are operated under reverse bias, requiring that the negative terminal of the dc power supply go to the anode (heat sink).

HEWLETT hp PACKARD
COMPONENTS

STEP RECOVERY DIODES for harmonic generation

5082-0100 SERIES
5082-0200 SERIES
5082-0300 SERIES



Features

- ☐ UHF Through Ku Band Diodes
  - — For Low Order and High Order Multipliers
- ☐ Oxide Passivated
  - — For Maximum Stability and Reliability
- ☐ RF Tested
  - — For Guaranteed Performance (5082-0300 Series)
- ☐ Radiation Resistant

Description

HP Step Recovery Diodes are constructed using modern epitaxial techniques. Oxide passivation insures maximum stability and reliability. Devices are available in many package styles, as well as in chip form. For further details on devices for hybrid circuits, see HP brochures "Diode Chips and Carriers for Hybrid Circuits" and AN940.

Applications

These devices are intended for use as low and high order harmonic generators requiring the ultimate in performance and reliability. They excel as doublers as well as high order multipliers, because the fast transition time design allows full usage of the forward stored charge effect in improving nonlinearity and efficiency for frequency multiplication. These step recovery diodes have the basic design capability to meet the general reliability requirements of MIL-S-19500, in addition to the special reliability requirements of man-rated space systems.

Mechanical Specifications

Hewlett-Packard's step recovery diodes are available in a variety of packages. Special package configurations are available upon request. Contact your local HP Field Office for additional information.

Glass package marking is by digital coding with a cathode band.

The glass packages have a hermetic seal with gold-plated dumet leads. The metal ceramic packages are hermetically sealed. The anode studs and flanges are gold-plated Kovar. The cathode studs are gold-plated copper. The maximum soldering temperature for both the glass and metal-ceramic packages is 230°C for 5 seconds.

Absolute Maximum Ratings

T_{OPR} – Operating Temperature Range ..... –65°C to +200°C

T_{STG} – Storage Temperature Range ..... –65°C to +200°C

P_{DISS} – DC Power Dissipation ..... $\frac{200°C - T_{CASE}}{\Theta_{JC}}$

Electrical Specifications for RF tested SRD'S at T_A=25°C

HP Device Number	Package Outline	Output Frequency fo (GHz)	N Order	Output Power Po (W) Min.	Junction Capacitance Cj (pF) Min.	Max.	Breakdown Voltage V_{BR} (V) Min.	Max.	Lifetime τ (ns) Typ.	t_t (ps) at Q_s (pC) Transition Time Max.	Stored Charge Level	Thermal Resistance θ_{jc} (°C/W) Max.
5082-0300	40[4]	2.0	x 10	2.0	3.2	4.7	75	100	200	360 typ.	2400	14
5082-0303	65[4]											
5082-0310	41	6.0	x 10	0.4	1.6	2.7	40	60	75	160	1000	30
5082-0320	41	10.0	x 5	0.23	0.35	1.0	25	40	40	75	300	60
5082-0335	31	16.0	x 8	0.03	0.25	0.5	20	30	15	60	100	75
Test Conditions			Note 1	Note 1	V_R=10V, f=1MHz Note 2		I_R =10μA		Fig. 1	Fig. 2		

Electrical Specifications for DC tested SRD'S at T_A=25°C

HP Device Number	Package Outline	Junction Capacitance C_j (pF) Max.	Breakdown Voltage V_{BR} (Volts) Min.	Lifetime τ (ns) Typ.	t_t (ps) at Q_s (pC) Transition Time Max.	Stored Charge Level	Thermal Resistance θ_{jc} (°C/W) Typ.	Suggested Output Frequency (GHz) Max.
5082-0112	11	1.55	35	50	175	1000	300	1.5
5082-0114	11	3.85	35	125	225	1500	300	
5082-0180	11	4.45	50	100	225	1500	300	
5082-0151	15	0.65	15	20	90	200	600	3.0
5082-0253	31	0.6	25	20	80	200	75	Note 4
5082-0243	31	1.2	35	30	110	600	100	
5082-0132	31	1.5	35	50	175	1000	100	
5082-0241	31	4.6	65	100	275	1500	60	
Test Conditions	Note 1	V_R = 10V, f = 1MHz Note 2	I_R = 10μA	Fig. 1	Fig. 2			

NOTES:

1. Guaranteed multiplier tested results.
   Input Power is:
   5082-0300 15W
   5082-0310 4W
   5082-0320 2W
   5082-0335 .65W
2. Special capacitance selection is available upon request.
3. The suggested maximum output frequency for the Style 31 diodes is determined by the following formula: $f_{omax} \leq \frac{1}{t_t}$
4. Package 65 is an improved version of package 40. It features a Bristol socket rather than a screw-driver slot. A Bristol socket wrench is shipped with each order for 5082-0303.

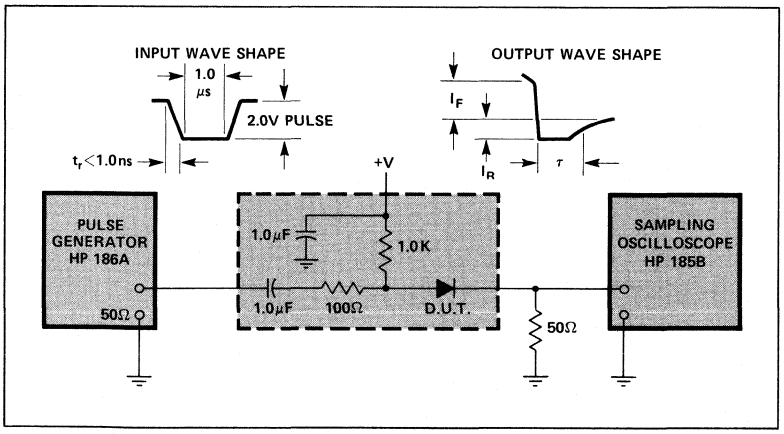


Figure 1. Test circuit for measurement of the effective minority carrier lifetime. The value of the reverse current (I_R) is approximately 6mA and the forward current (I_F) is 1.7 I_R. The lifetime (τ) is measured across the 50% points of the observed wave shape. The input pulse is provided by a pulse generator having a rise time of less than one nanosecond. The output pulse is amplified and observed on a sampling oscilloscope.

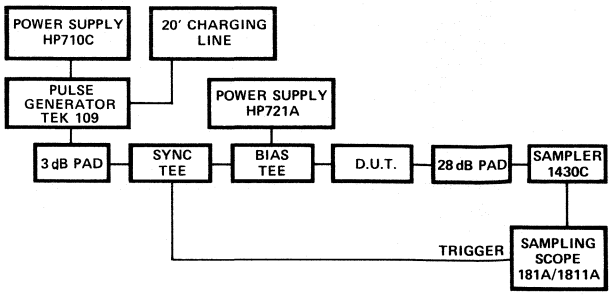


Figure 2. Test circuit for transition time. The pulse generator circuit is adjusted for a 0.5A pulse when testing 5082-0335, -0151, or -0253. A pulse of 1.0A is used for all other diodes. The bias current is adjusted for the specified stored charge level. The transition time is read between the 20% and the 80% points on the oscilloscope.

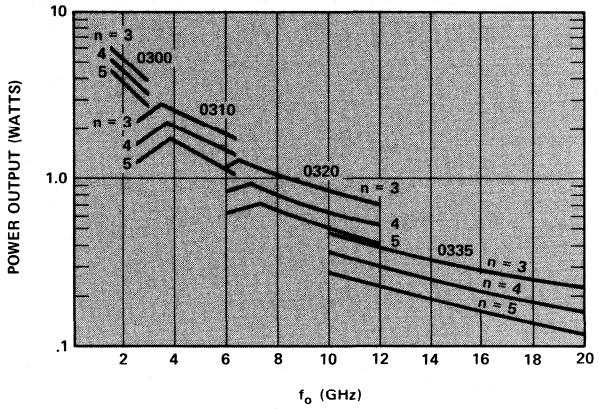


Figure 3. Predicted power output curves for 03XX step recovery diodes in X3, X4, and X5 multiplier applications. These results were obtained using computer organization programs.

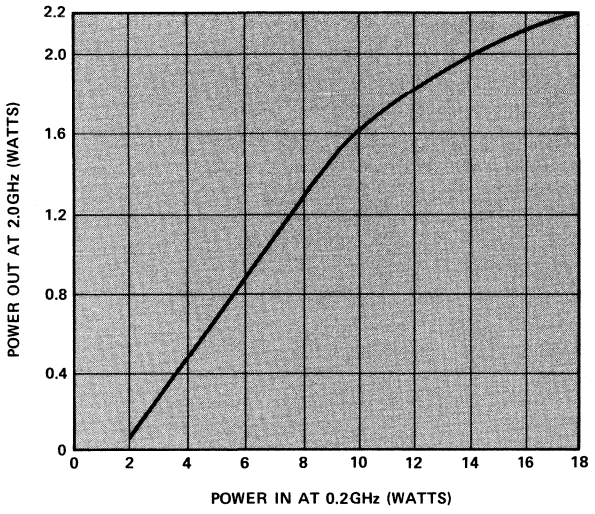


Figure 4. Typical output power vs. input power for HP 5082-0300 in an X10 multiplier at T_A = 25°C.

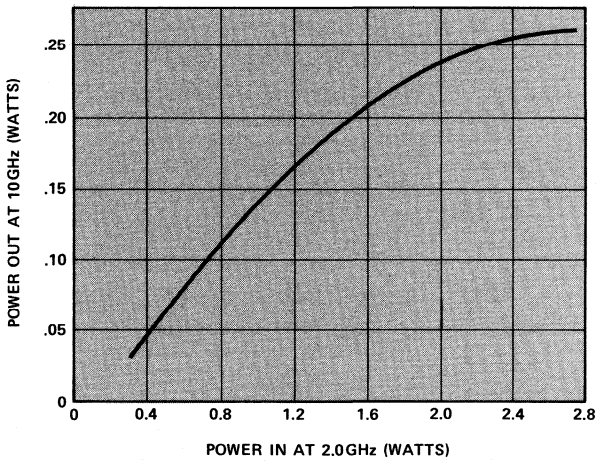


Figure 5. Typical output power vs. input power for HP 5082-0320 in an X5 multiplier at T_A = 25°C.

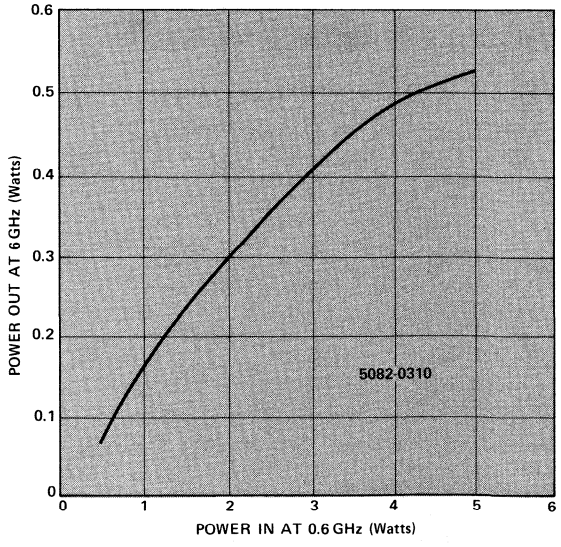


Figure 6. Typical output power vs. input power for HP 5082-0310 in an X10 multiplier at T_A = 25°C.

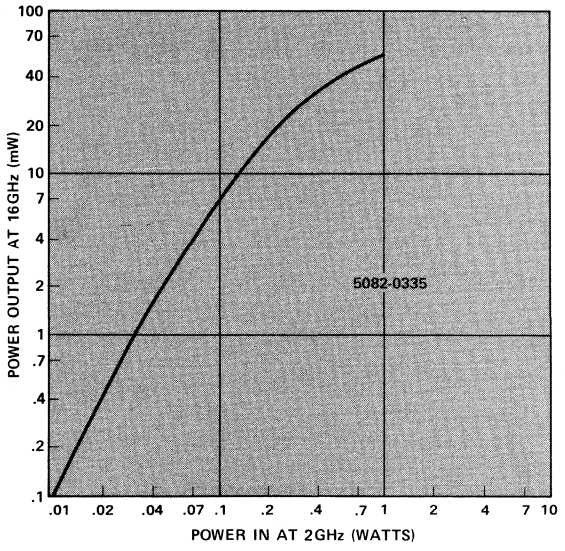
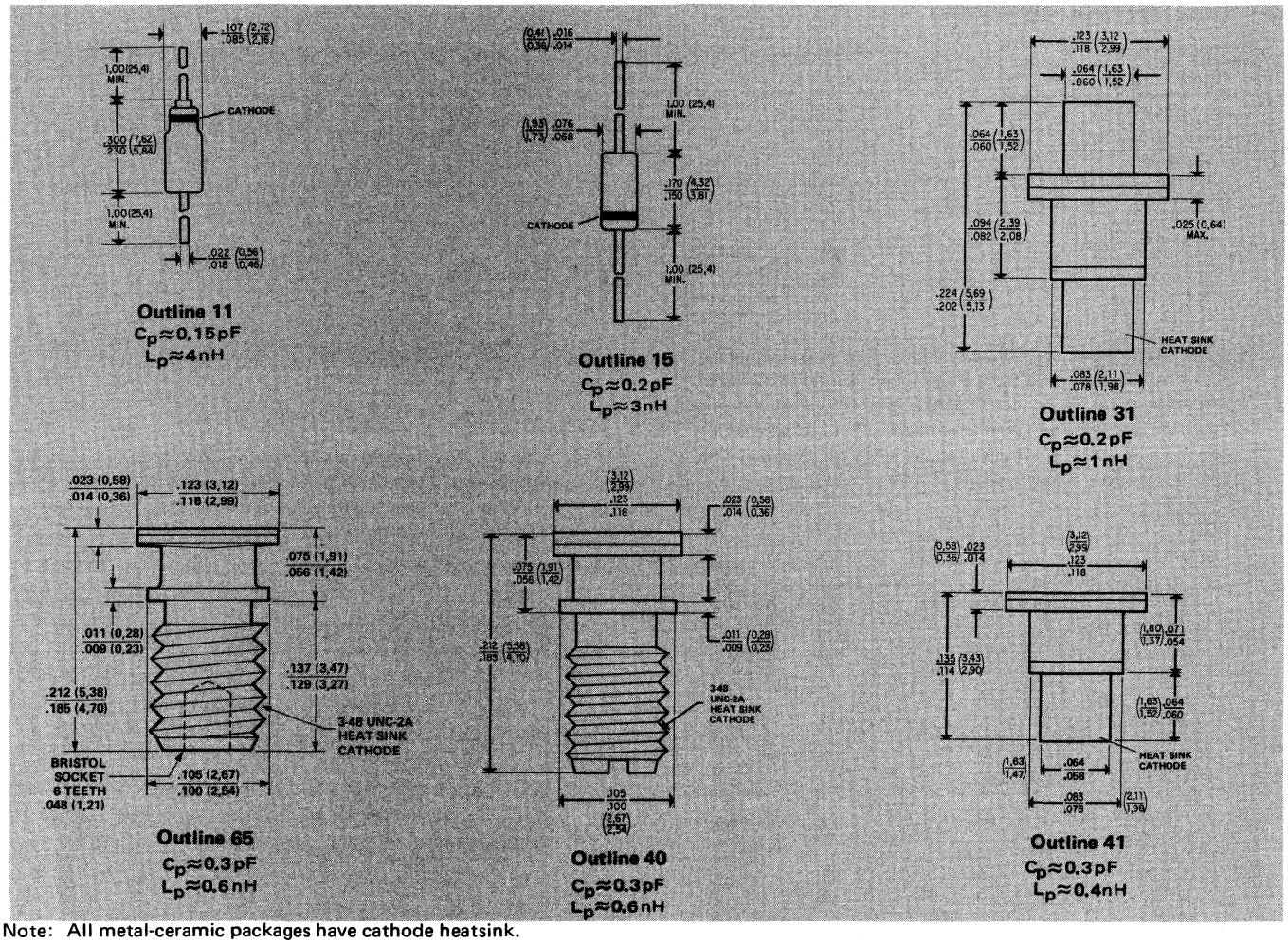


Figure 7. Typical output power vs. input power for HP 5082-0335 in an X8 multiplier at T_A = 25°C.

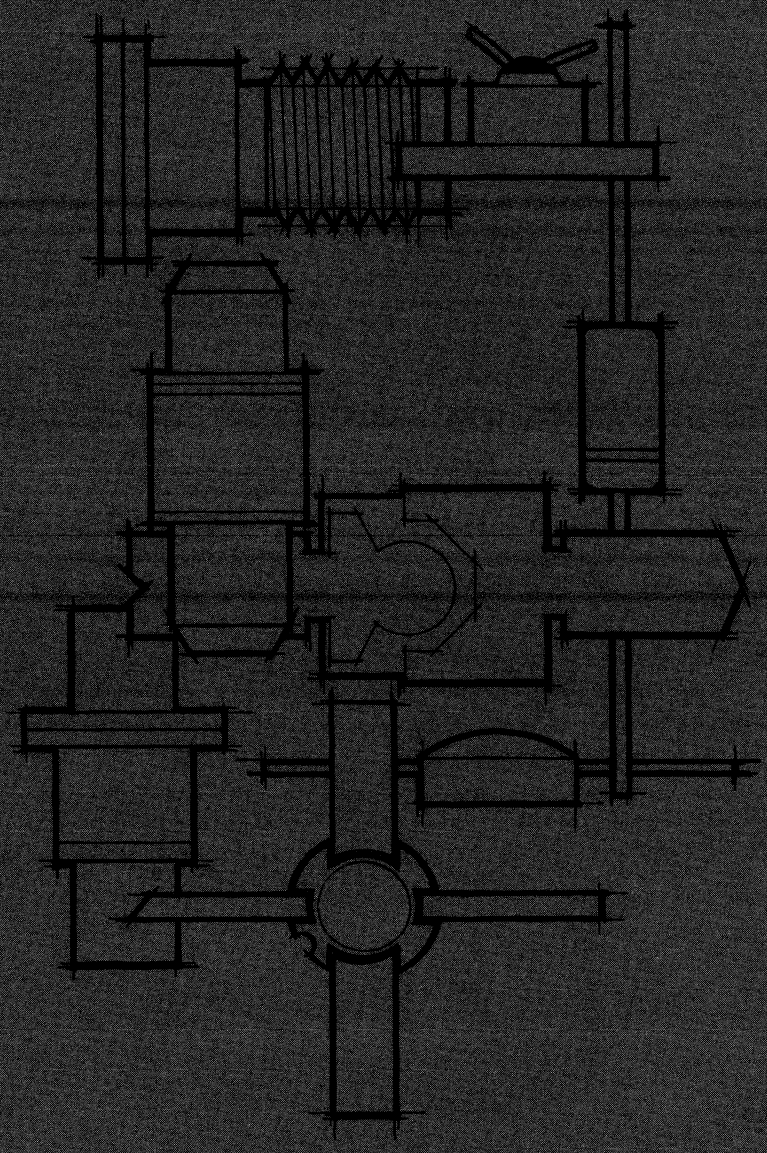


Note: All metal-ceramic packages have cathode heatsink.

Reliability

HP step recovery diodes are suitable for high reliability space applications where maximum performance stability under the most adverse conditions is required. Maintenance of product reliability during manufacture has resulted in the use of HP diodes in major aerospace and national defense programs. With proper prescreening and conditioning, the step recovery diode is capable of meeting the following environmental conditions:

MIL-STD-750		
Test	**Reference**	**Conditions**
Temperature, Storage	1031	See maximum ratings
Temperature, Operating	——	See maximum ratings
Solderability	2026	230°C as applicable
Temperature, Cycling	1051	5 cycles, see individual specification or rating
Thermal Shock	1056	5 cycles, 0-100°C
Moisture Resistance	1021	10 days, 90-98% RH
Shock	2016	5 blows, X, Y, Z at 1500 G
Vibration Fatigue	2046	32 hrs, X, Y, Z at 20 G min.
Vibration Variable Frequency	2056	Four 4-min. cycles, X, Y, Z, at 20 G min., 100 to 2000Hz
Constant Acceleration	2006	X, Y, Z at 20,000 G
Terminal Strength	2036	Package dependent
Salt Atmosphere	1041	35°C fog for 24 hours



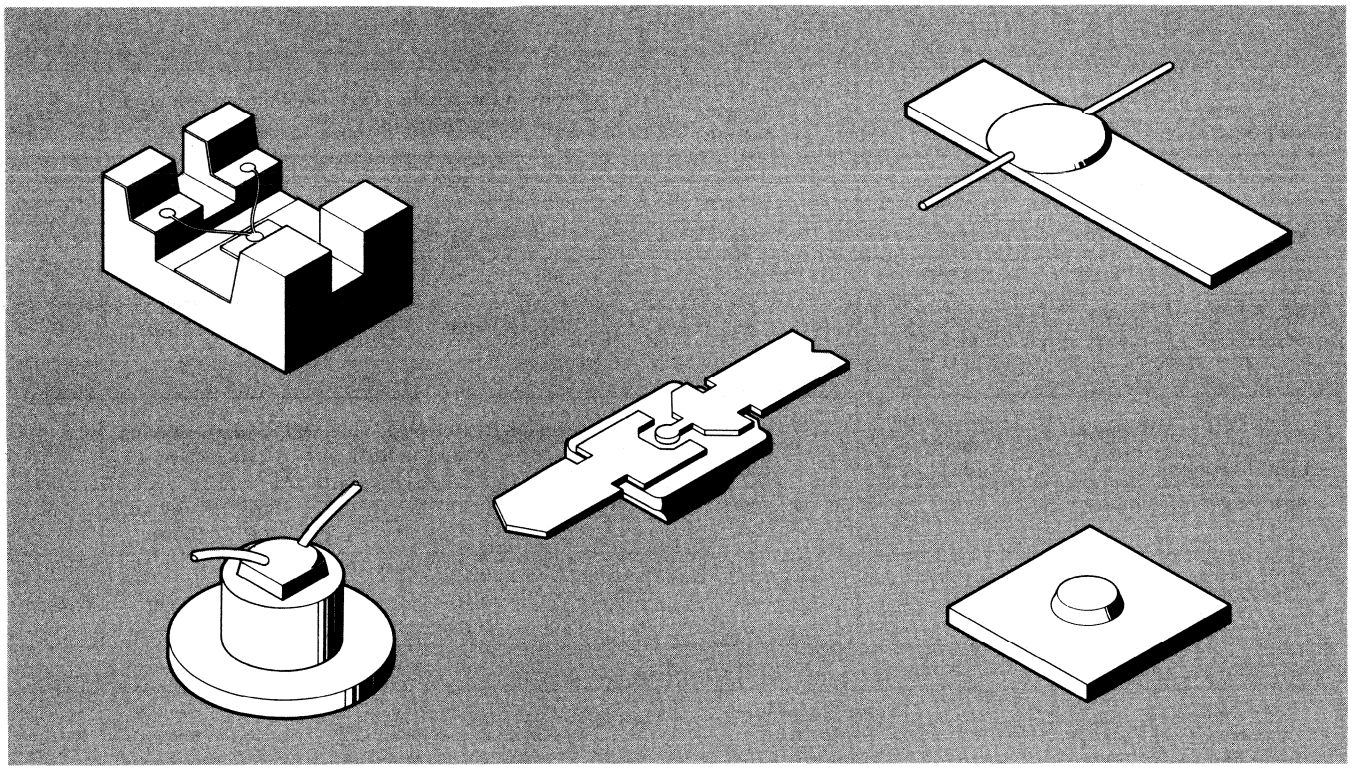
Devices for Hybrid Integrated Circuits

Microwave Schottky Diodes	143
General Purpose Schottky Diodes	143
Microwave PIN Diodes	143
VHF/UHF PIN Diodes	143
Step Recovery Diodes	143

HEWLETT hp PACKARD

COMPONENTS

DIODE CHIPS AND CARRIERS FOR HYBRID CIRCUITS



Devices

SCHOTTKY BARRIER DIODES

RF/Microwave Mixers
RF/Microwave Detectors
Fast Switching
Chip, Beam Lead, LID, Ministrip

PIN DIODES

RF/Microwave Switches
RF/Microwave Attenuators
RF/Microwave AGC
Chip, LID, Ministrip, Microstrip Post

STEP RECOVERY DIODES

Comb Generators
Frequency Multipliers
Pulse Shaping
Chip, LID, Ministrip

Description

Hewlett-Packard offers a complete line of RF, microwave and switching semiconductor diodes in forms especially designed for hybrid integrated circuits.

Diodes included are Schottky barrier switching diodes, Schottky barrier RF and microwave mixer and detector diodes, PIN diodes for RF and microwave switching, attenuating and AGC, and Step Recovery diodes for comb generators and frequency multipliers.

In addition to chips, package forms include the LID (Leadless Inverted Device), Ministrip, Microstrip Post, and Beam Lead.

Although all devices offered are passivated, it is recommended that the end item be hermetically sealed for maximum stability and reliability.

Most dc and RF parameters can be specially tested and guaranteed. Contact your local HP sales office for assistance if special specification is required.

Although not all are listed in this brochure, most Hewlett-Packard diodes are available in chip form. Any available chip can be supplied in any of the carriers listed. Contact your local HP sales office for price and availability of any special device not included in this brochure.

Schottky Diodes for Mixer and Detector Circuits

LOW NOISE FIGURE – NF less than 6.0dB allows superior performance for X-Band mixers
HIGH TANGENTIAL SIGNAL SENSITIVITY – 55dBm permits excellent operation of X-Band detectors
LOW CAPACITANCE – 0.1pF enables operation through Ku-Band

Electrical Specifications at T_A=25°C

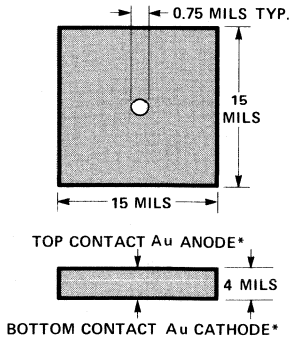
X-Band Mixer (2700 Family)	Package Style	Typical Noise Figure* [dB]	Typical Tangential Sensitivity* [dBm]	Maximum Capacitance (C_o) V_R = 0, f = 1MHz [pF]	Maximum Soldering Conditions	Notes
5082-0023	Chip	6.0	–54	0.18	250°C, 1 min. or 300°C, 15 sec.	1,2
5082-2705	50 (LID)	6.0	–54	0.32	250°C, 5 sec.	1,7,8
5082-2710	71(Mini)	6.0	–54	0.25	250°C, 5 sec.	1,4
5082-2709 5082-2768	Beam Lead	6.0 6.5 max.**	–54	0.25	220°C, 10 sec.	6

Ku-Band Mixer (2700 Family)	Package Style	Typical Noise Figure* [dB]	Typical Tangential Sensitivity* [dBm]	Maximum Capacitance (C_o) V_R = 0V, f = 1.0MHz [pF]	Maximum Soldering Conditions	Notes
5082-0029	Chip	7.0	–54	0.14	250°C, 1 min. or 300°C, 15 sec.	1,2
5082-2716 5082-2767 5082-2769	Beam Lead	7.0 7.0 7.5 max.**	–54	0.15 0.10 0.15	220°C, 10 sec.	6

X-Band Detector (2750 Family)	Package Style	Typical Tangential Sensitivity* [dBm]	Maximum Capacitance (C_o) V_R= 0V, f = 1.0MHz [pF]	Maximum Soldering Conditions	Notes
5082-0009	Chip	–55	0.14	250°C, 1 min. or 300°C, 15 sec.	1,2,5
5082-2754	50(LID)		0.30	250°C, 5 sec.	1,7,8
5082-2753	71(Mini)		0.20	250°C, 5 sec.	1,4,5

*Most RF parameters can be measured and guaranteed for the LID, Ministrip and Beam Lead. Contact your local HP Sales Office.
**100% RF tested device.

5082-0009 CHIP
5082-0023 CHIP
5082-0029 CHIP



All dimensions are nominal

T_A Operating Temperature Range –60°C to +150°C
T_{STG} Storage Temperature Range –60°C to +150°C

*Note: 5082-0009 chip has reverse polarity. Bottom contact, Anode.

Schottky Diodes for Switching Applications

FAST SWITCHING SPEED – 100 psec switching speed allows faster transmission of information
LOW TURN-ON VOLTAGE – As low as 340 mV turn-on enables the use of lower drive voltage
LOW TEMPERATURE COEFFICIENT – Minus 1 mV/°C TC means less change in voltage drop over a wide temperature range
HIGH BREAKDOWN VOLTAGE – Up to 70V V_{BR} allows stand-off of large transients and signals

Electrical Specifications at T_A=25°C

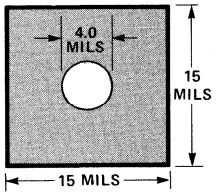
High Voltage Switch (2800 Family)	Package Style	Minimum Breakdown Voltage (V_{BR}) @ 10μA [V]	Maximum Forward Voltage (V_F) @ 15 mA [V]	Maximum Capacitance (C_o) V_R = 0, f = 1.0 MHz [pF]	Maximum Soldering Conditions	Notes
5082-0024	Chip	70	1.0	1.7	300°C, 1 min.	1,2
5082-2802	50 (LID)	70	1.0	2.0	250°C, 5 sec.	1,7,8
5082-2801	72 (Mini)	70	1.0	2.0	250°C, 5 sec.	1,4
5082-2837	Beam Lead	70	1.0	2.0	220°C, 10 sec.	6

General Purpose Switch (2810 Family)	Package Style	Minimum Breakdown Voltage (V_{BR}) @ 10μA [V]	Maximum Forward Voltage (V_F) @ 35 mA [V]	Maximum Capacitance (C_o) V_R = 0, f = 1.0 MHz [pF]	Maximum Soldering Conditions	Notes
5082-0087	Chip	20	1.0	1.0	300°C, 1 min.	1,2

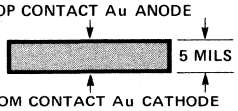
General Purpose Switch (2811 Family)	Package Style	Minimum Breakdown Voltage (V_{BR}) @ 10μA [V]	Maximum Forward Voltage (V_F) @ 20 mA [V]	Maximum Capacitance (C_o) V_R = 0, f = 1.0 MHz [pF]	Maximum Soldering Conditions	Notes
5082-0097	Chip	15	1.0	1.1	300°C, 1 min.	1,2
5082-2844	50 (LID)	15	1.0	1.4	250°C, 5 sec.	1,7,8
5082-2845	72 (Mini)	15	1.0	1.4	250°C, 5 sec.	1,4

Low Voltage Switch (2835 Family)	Package Style	Minimum Breakdown Voltage (V_{BR}) @ 100μA [V]	Maximum Forward Voltage (V_F) @ 1.0 mA [V]	Maximum Capacitance (C_o) V_R = 0, f = 1.0 MHz [pF]	Maximum Soldering Conditions	Notes
5082-0031	Chip	5	0.34	0.8	300°C, 1 min.	1,2

5082-0024 CHIP

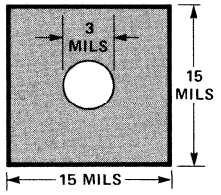


TOP CONTACT Au ANODE

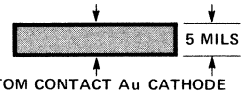


BOTTOM CONTACT Au CATHODE

5082-0087 CHIP
5082-0097 CHIP

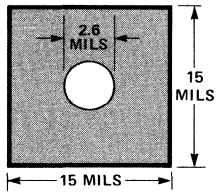


TOP CONTACT Ag ANODE 5082-0097
TOP CONTACT Au ANODE 5082-0087

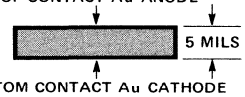


BOTTOM CONTACT Au CATHODE

5082-0031 CHIP



TOP CONTACT Au ANODE



BOTTOM CONTACT Au CATHODE

All dimensions are nominal

T_A Operating Temperature Range –65°C to +200°C
T_{STG} Storage Temperature Range –65°C to +200°C

T_A Operating Temperature Range –65°C to +125°C
T_{STG} Storage Temperature Range –65°C to +150°C

PIN Diodes for RF/Microwave Switching and Attenuating

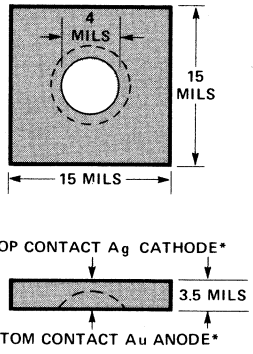
WIDE OPERATING FREQUENCY RANGE – 10MHz through 18GHz
LARGE VARIABLE RF RESISTANCE RANGE – 0.6Ω through 10kΩ
FAST SWITCHING – 5nsec

Electrical Specifications at T_A=25°C

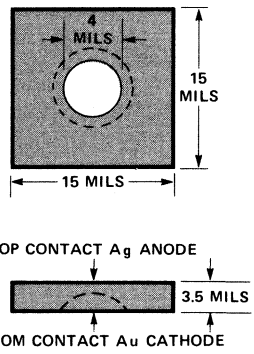
Universal Switch (Cathode Top Contact) (3001 Family)	Package Style	Minimum Breakdown Voltage (V_{BR}) @ 10μA [V]	Typical Series Resistance (R_S)* @100mA 100MHz [Ω]	Typical Capacitance (C_{VR}) V_R=50V f = 1MHz [pF]	Typical Reverse Recovery Time (Trr) I_F=20mA V_R=10V [ns]	Typical Lifetime (τ)* I_F=50mA I_R=250mA [ns]	Maximum Soldering Conditions	Notes
5082-0012	Chip	150	0.8	0.07	150	200	425°C, 1 min.	3,5
5082-0047	Chip	150	0.6	0.09	150	200	425°C, 1 min.	3,5
5082-3005	50(LID)	150	0.8	0.25	150	200	250°C, 5 sec.	7,8
5082-3000	72(Mini)	150	0.8	0.20	150	200	300°C, 5 sec.	4,5
5082-3259	74(Post)	150	0.8	0.15	150	200	250°C, 5 sec.	5

Universal Switch (Anode Top Contact) (3301 Family)	Package Style	Minimum Breakdown Voltage (V_{BR}) @10μA [V]	Typical Series Resistance (R_S)* @100mA 100MHz [Ω]	Typical Capacitance (C_{VR})* V_R=50V f=1MHz [pF]	Typical Reverse Recovery Time (T_{rr}) I_F=20mA V_R=10V [ns]	Typical Lifetime (τ)* I_F = 50mA I_R = 250mA [ns]	Maximum Soldering Conditions	Notes
5082-0030	Chip	150	0.8	0.07	150	200	425°C, 1 min.	3
5082-3309	72(Mini)	150	0.8	0.20	150	200	300°C, 5 sec.	4

5082-0012 CHIP
5082-0047 CHIP



5082-0030 CHIP



*Note - Reverse Polarity

All dimensions are nominal

T_A Operating Temperature Range –60°C to +150°C
T_{STG} Storage Temperature Range –60°C to +150°C

PIN Diodes for RF/Microwave Switching and Attenuating

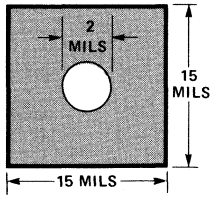
Electrical Specifications at T_A=25°C

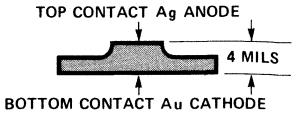
High Speed Switch (3041 Family)	Package Style	Minimum Breakdown Voltage (V_{BR}) @10μA [V]	Typical Series Resistance (R_S)* @ 20mA 100MHz [Ω]	Typical Capacitance (C_{VR})* V_R=20V f=1MHz [pF]	Typical Reverse Recovery Time (T_{rr}) I_F=20mA V_R=10V [ns]	Typical Lifetime (τ)* I_F = 50mA I_R = 250mA [ns]	Maximum Soldering Conditions	Notes
5082-0001	Chip	70	0.8	0.12	5	15	425°C, 1 min.	2
5082-3045	50(LID)	70	0.8	0.30	5	15	250°C, 5 sec.	7,8
5082-3010	72(Mini)	70	0.8	0.25	5	15	300°C, 5 sec.	4
5082-3258	74(Post)	70	0.8	0.30	5	15	250°C, 5 sec.	—

Medium Power Switch (Cathode Top Contact) (3046 Family)	Package Style	Minimum Breakdown Voltage (V_{BR}) @ 10μA [V]	Typical Series Resistance (R_S)* @ 100mA 100MHz [Ω]	Typical Capacitance (C_{VR})* V_R= 50V f = 1MHz [pF]	Typical Reverse Recovery Time (Trr) I_F= 20mA V_R= 10V [ns]	Typical Lifetime (τ)* I_F= 50mA I_R= 250mA [ns]	Maximum Soldering Conditions	Notes
5082-0049	Chip	400	0.6	0.12	200	800	300°C,1 min.	3,5

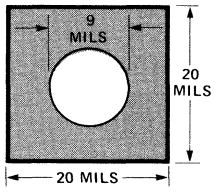
*Typical parameters can be specially measured and guaranteed. Contact your local HP Sales Office.

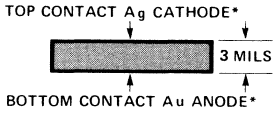
5082-0001 CHIP





5082-0049 CHIP





*Note - Reverse Polarity

All dimensions are nominal

T_A Operating Temperature Range −60°C to +150°C
T_{STG} Storage Temperature Range −60°C to +150°C

PIN Diodes for VHF/UHF Switching and Attenuating

LONG LIFETIME – Useful Down to 1 MHz

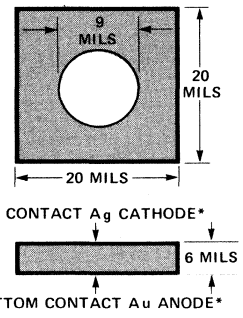
Electrical Specifications at T_A=25°C

AGC and Low Frequency Switch (3080 Family)	Package Style	Minimum Breakdown Voltage (V_{BR}) @ 10μA [V]	Typical Series Resistance (R_S) @ 100 mA 100 MHz [Ω]	Typical Capacitance (C_{VR}) V_R=50 V, f=1 MHz [pF]	Typical Reverse Recovery Time (T_{rr}) I_F=20 mA V_R=10 V [μs]	Typical Lifetime (τ) I_F=50 mA I_R=250 mA [μs]	Maximum Soldering Conditions	Notes
5082-0025	Chip	100	1.5	0.1	8	1.3	300°C, 1 min.	3,5
5082-3085	50 (LID)	100	1.5	0.25	8	1.3	250°C, 5 sec.	7,8
5082-3086	72 (Mini)	100	1.5	0.2	8	1.3	300°C, 5 sec.	4,5

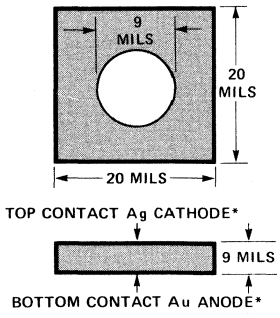
AGC and Low Frequency Switch (3081 Family)	Package Style	Minimum Breakdown Voltage (V_{BR}) @ 10μA [V]	Typical Series Resistance (R_S) @ 100 mA 100 MHz [Ω]	Typical Capacitance (C_{VR}) V_R=50V, f=1 MHz [pF]	Typical Reverse Recovery Time (T_{rr}) I_F=20 mA V_R=10V [μs]	Typical Lifetime (τ) I_F = 50 mA I_R = 250 mA [μs]	Maximum Soldering Conditions	Notes
5082-0039	Chip	100	2.0	0.1	10	2	300°C, 1 min.	3,5

VHF/UHF Switching PIN Diodes (3168/3188)	Package Style	Minimum Breakdown Voltage (V_{BR}) @10μA [V]	Typical Series Resistance (R_S) @100 mA 100 MHz [Ω]	Typical Capacitance (C_{VR}) V_R= 50V f = 1 MHz [pF]	Typical Reverse Recovery Time (Trr) I_F= 20 mA V_R= 10V [ns]	Typical Lifetime (τ) [ns]	Maximum Soldering Conditions	Notes
5082-0034	Chip	35	0.4	0.8	5	2.5	300°C, 1 min.	3

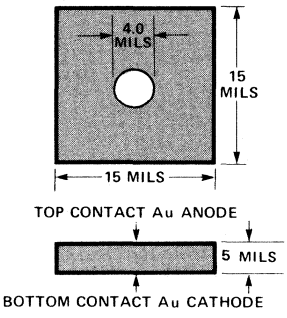
5082-0025 CHIP



5082-0039 CHIP



5082-0034 CHIP



*Note–Reverse Polarity

All dimensions are nominal

T_A Operating Temperature Range –60°C to +150°C
T_{STG} Storage Temperature Range –60°C to +150°C

Step Recovery Diodes for Comb Generators and Frequency Multipliers

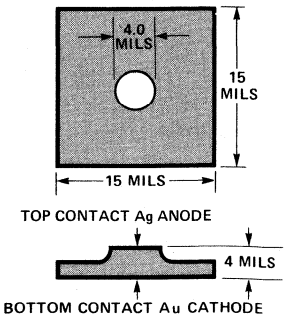
Electrical Specifications at $T_A = 25°C$

Multiplier to 12 GHz (0320 Family)	Package Style	Minimum Breakdown Voltage (V_{BR}) @ 10 μA [V]	Typical Capacitance (C_{VR})* V_R=10V, f=1MHz [pF]	Typical Lifetime (τ) I_F = 10 mA [ns]	Typical Transition Time (T_t) @300 pc [ps]	Maximum Soldering Conditions	Notes
5082-0020	Chip	25	0.5 - 1.0	20	75	300°C, 1 min.	3
5082-0316	50 (LID)	25	0.65 - 1.40	20	75	250°C, 5 sec.	7,8
5082-0305	72 (Mini)	25	0.65 - 1.30	20	75	300°C, 5 sec.	4

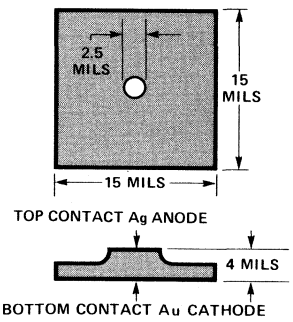
Multiplier to 30 GHz (0335 Family)	Package Style	Minimum Breakdown Voltage (V_{BR}) @10 μA [V]	Typical Capacitance (C_{VR})* V_R=10V, f=1MHz [pF]	Typical Lifetime (τ) I_F = 10 mA [ns]	Typical Transition Time (T_t) @ 100 pc [ps]	Maximum Soldering Conditions	Notes
5082-0008	Chip	20	0.25 - 0.50	10	50	300°C, 1 min.	3
5082-0318	50 (LID)	20	0.4 - 0.70	10	50	250°C, 5 sec.	7,8
5082-0340	72 (Mini)	20	0.4 - 0.60	10	50	300°C, 5 sec.	4

*Capacitance can be specially tested and guaranteed within this typical range. Contact your local HP Sales Office.

5082-0020 CHIP



5082-0008 CHIP



*Note–Reverse Polarity

All dimensions are nominal

T_A Operating Temperature Range –60° C to +150° C
T_{STG} Storage Temperature Range –60° C to +150° C

Notes

1. Handle with grounded tweezers and grounded bonding equipment. These diodes are pulse sensitive and may be damaged by electrostatic charges. Eutectic bonding or die attaching may damage the chip. A preform must be used.
2. Use standard thermocompression bonding techniques. Ultrasonic bonding is not recommended.
3. Either ultrasonic or thermocompression bonding techniques can be employed.
4. Ministrip Handling and Mounting Techniques
   The Ministrips may be mounted by using conductive epoxy such as Hysol K20 or Dupont 5504. Conventional soldering techniques may also be used.

   Direct heating or resistive heating of the substrate using a parallel gap welder are acceptable methods. High temperature solder preforms such as gold-tin (280°C Eutectic) may be used for the Step Recovery and PIN diodes. Low temperature solder preforms such as tin-lead should be used with the Hot Carrier diodes. The composition of the solder preform should be compatible with the techniques and materials used in the substrate and conductive land patterns.

   The leads may be attached by using ultrasonic or thermocompression bonding methods. A parallel gap welder may also be used (Figure 1). Conventional soldering techniques are not recommended for the gold leads.

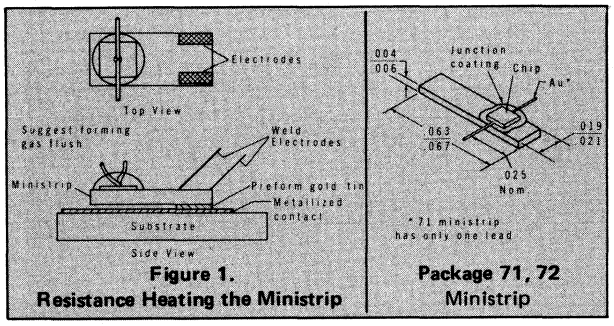


Figure 1. Resistance Heating the Ministrip

Package 71, 72 Ministrip

5. Reverse Polarity - Anode is the bottom contact and the Cathode is the top contact.
6. Handling Beam Lead Diodes
   Hewlett-Packard beam lead diodes require careful handling. The handling techniques described here are necessary so that the diodes will not be mechanically or electrically damaged. The diodes are very small and magnification may be used to see them inside the shipping container.

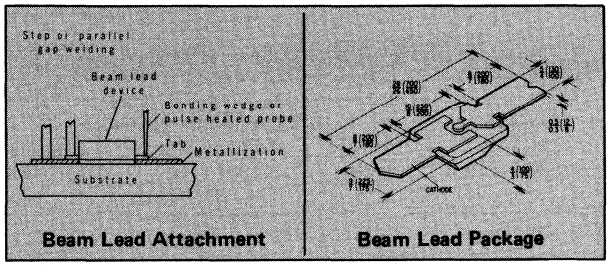
   These beam lead diodes are shipped in a flat, plastic container. The inside bottom surface of the container is coated with a thin layer of silicone to which the diodes adhere. They are covered with anti-static silk. A vacuum pickup with a #27 tip is recommended for picking up single beam lead devices. This should be done under 20 X magnification for accurate positioning of the tip on the die.

   If a vacuum pickup is not used, it is recommended that a wooden toothpick or a plain Q-tip stick be used as a handling probe. The diode will adhere to the end of the wooden probe without danger of mechanically or electrically damaging the diode. It can then be placed where needed.

   Tweezers can also be used but they must be electrically grounded to the surface upon which the device is being placed. The tweezers should be used as a probe to lift the diode, not to grasp the diode. If used to grasp the diode, the gold tabs can be deformed.

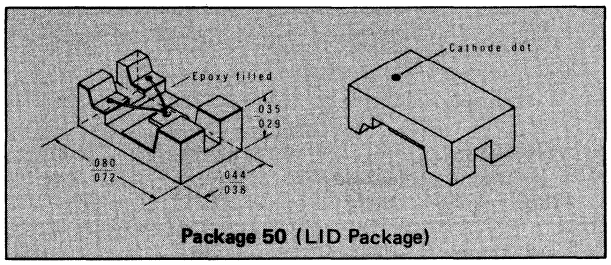
   A beam lead diode can be destroyed electrically by a static discharge through the diode. Hence they must be handled so static discharges cannot occur.

   Parallel gap welding or thermocompression bonding are recommended.



Beam Lead Attachment **Beam Lead Package**

7. Polarity Designation on LIDs.

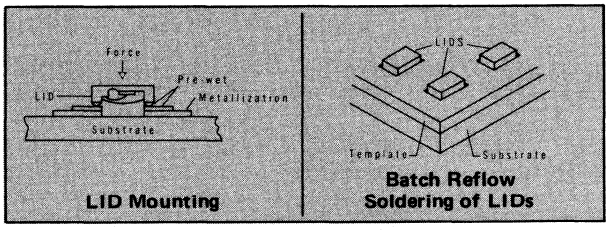


Package 50 (LID Package)

8. Leadless Inverted Device (LID)

   Mounting Recommendations

   The LID may be mounted by individually soldering each device or batch flow soldered as illustrated below:



LID Mounting **Batch Reflow Soldering of LIDs**

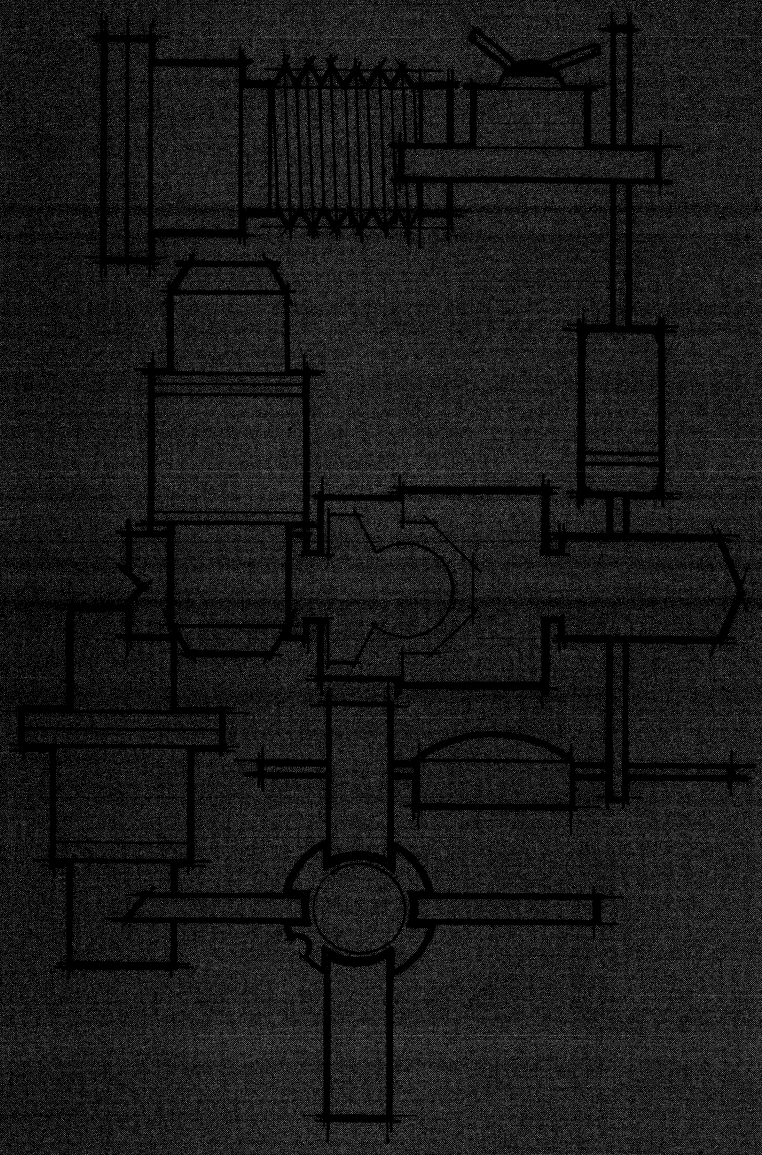
   Prior to soldering it is advisable to tin each device. Scrub the pads of the LID with a Pink Pearl eraser to remove any dirt or other foreign matter. Then rinse the LID in TCE (Trichlorethylene).

   Dip the LID in Alpha 711 Flux using titanium tweezers. With those tweezers, place the unit in a solder bath of 62% Sn, 36% Pb, and 2% Ag, for 30 seconds and remove. Note, the solder bath must be maintained at a temperature of 220°C plus or minus 5°C through the process.

   Dip the LID in the solder bath again for 3 seconds. When removing the LID, hold it 1/8 inch above the solder pot for 5 seconds to obtain thermal equilibrium.

   Wait 10 seconds before rinsing in TCE. Brush off the TCE with an artist's brush.

   Now inspect each LID under a microscope to see if the tin covers over 90% of the contact pad area and if this area appears to have a shiny, bright, continuous homogeneous solder casting. If the LID appearance fails to meet the inspection criteria, repeat the tinning process, starting with the flux dip.



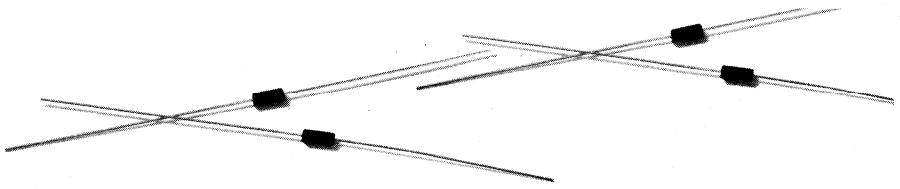
Military Approved PIN and Schottky Diodes

Selection Guide	152
Schottky Switching Diodes	153
PIN Switching Diodes	157

Military Approved PIN and Schottky Diodes

COMMERCIAL PART NO. 5082-	MILITARY APPROVED JAN/JANTX/JANTXV*	PAGE NUMBER
2800	1N5711	153
2810	1N5712	155
3039	1N5719	157

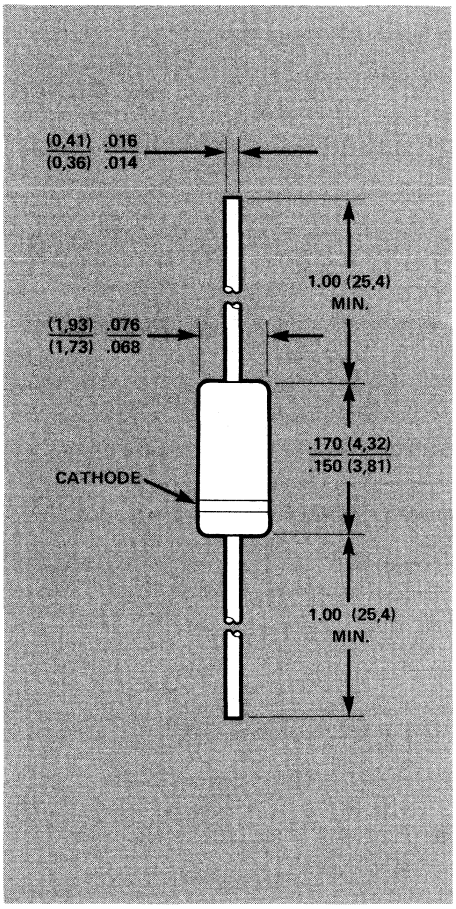
*JANTXV approval does not apply to the 1N5719.



HEWLETT PACKARD
COMPONENTS

SCHOTTKY SWITCHING DIODE
MILITARY APPROVED
MIL-S-19500/444

1N5711
JAN 1N5711
JANTX 1N5711
JANTXV 1N5711



Features

- 70V Breakdown Voltage
- Pico-second Switching Speed
- Low Threshhold Voltage

Description

The 1N5711 is an epitaxial, planar passivated Schottky Barrier Diode designed to have pico-second switching speed. HPA commercial part number HP5082-2800 is equivalent to the 1N5711.

Applications

- High Level Detection
- A/D Converting
- Switching Applications

Absolute Maximum Ratings at T_A=25°C

Reverse Voltage (Working) . . . . . 50V dc (peak)
Power Dissipation** 250mW
Operating Temperature Range . . . . . −65°C to +200°C
Storage Temperature Range . . . . . −65°C to +200°C

**Derate at 1.43mW/°C above T_A = 25°C.

Electrical Specifications at T_A=25°C (Unless Otherwise Specified)

(Per Table I, Group A Testing of MIL-S-19500/444)

Specification	Symbol	Min.	Max.	Units	Test Conditions
Breakdown Voltage	V_{BR}	70	—	V_{dc}	I_R = 10μA
Forward Voltage	V_{F1}	—	.55	V_{dc}	I_{F1} = 1mA
Forward Voltage	V_{F2}	—	1.0	V_{dc}	I_{F2} = 15mA dc
Reverse Leakage Current	I_R	—	200	nA	V_R = 50V
Reverse Leakage Current	I_R	—	200	μA	V_R = 50V, T_A = +150°C
Capacitance	$C_{T(o)}$	—	2.0	pF	V_R = 0V and f = 1MHz
Effective Minority Carrier Lifetime	τ	—	100	pS	I_F = 5mA Krakauer Method [Note 1]

Note 1: Per DESC drawing C-68001

JAN 1N5711: Samples of each lot are subjected to Group A inspection for parameters listed in Table I, and to Group B and Group C tests listed below. All tests are to the conditions and limits specified by MIL-S-19500/444.

JANTX 1N5711: Devices undergo 100% screening tests as listed below to the conditions and limits specified by MIL-S-19500/444. A sample of the JANTX lot is then subjected to Group A, Group B, and Group C tests as for the JAN 1N5711 above.

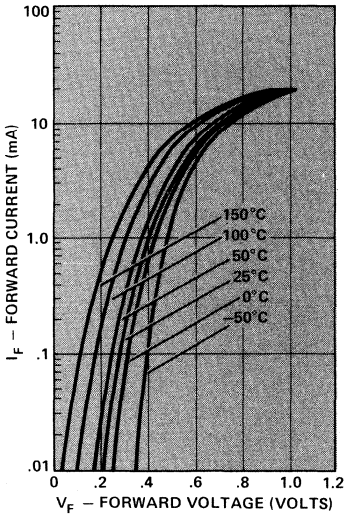
JANTXV 1N5711: Devices are subject to 100% visual inspection in accordance with amendment 4 of MIL-S-19500/444 prior to being subjected to TX screening.

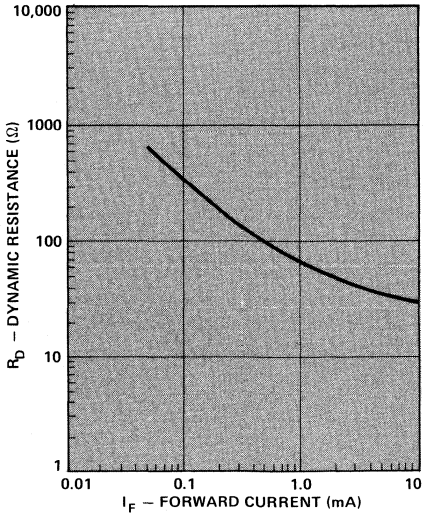
Group B Sample Acceptance Tests	Method MIL-STD-750
Physical Dimensions	2066
Solderability	2026
Temperature Cycling	1051C
Thermal Shock (Strain)	1056A
Terminal Strength: Tension	2036A
Fine Leak Test	1071H
Gross Leak Test	1071E
Moisture Resistance	1021
Mechanical Shock	2016
Vibration, Variable Frequency	2056
Constant Acceleration	2006
Terminal Strength: Lead Fatigue	2036E
Temperature Storage (200°C, 1K hrs.)	1031
Operating Life (I_o = 33mA dc, V_r = 50V [pk] (f = 60, T_A = 25°C, t = 1K hrs.)	1026

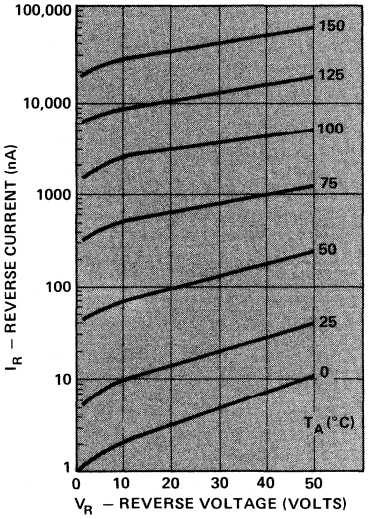
Group C Sample Acceptance Tests	Method MIL-STD-750
Low Temp. Operation (–65°C)	
Forward Voltage	4011
Reverse Current	4016
Salt Atmosphere	1041
Resistance to Solvents	*
Temperature Cycling	1051C
TX Screening (100%)	
High Temp. Storage (200°C, 48 hrs.)	1032
Thermal Shock (Strain)	1056A
Constant Acceleration	2006
Fine Leak	1071H
Gross Leak	1071E
Burn-In (I_o = 33mA dc, V = 50V [pk] (T_A = 25°C, f = 60Hz, t = 96hrs)	
Evaluation of Drift (I_R, V_{BR})	

*MIL-STD-202, Method 215

Typical Characteristic Curves





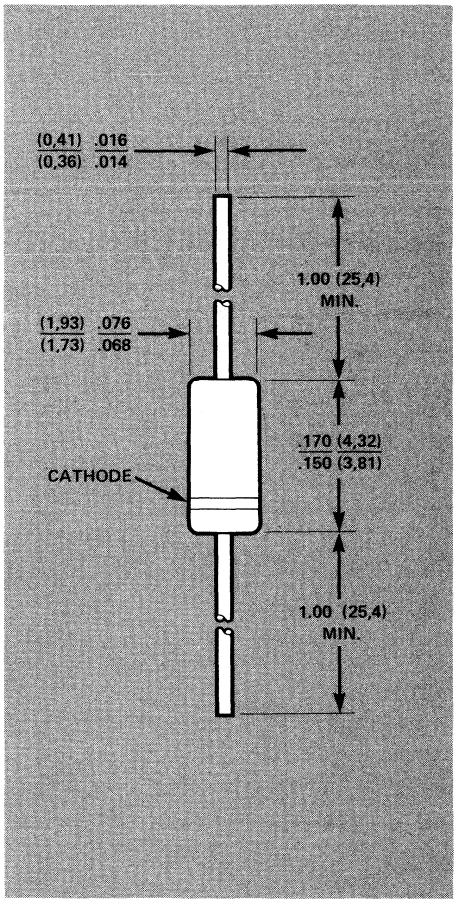


HEWLETT hp PACKARD

COMPONENTS

SCHOTTKY SWITCHING DIODE
MILITARY APPROVED
MIL-S-19500/445

1N5712
JAN 1N5712
JANTX 1N5712
JANTXV 1N5712



Features

- **Pico-second Switching Speed**
- **Low Turn-on Voltage**
- **Low Temperature Coefficient**

Description

The 1N5712 is an epitaxial, planar passivated Schottky Barrier Diode designed to have pico-second switching speed. HPA commercial part number HP5082-2810 is equivalent to the 1N5712.

Applications

- VHF/UHF Mixing
- VHF/UHF Detecting
- A/D Converting
- Switching Applications

Absolute Maximum Ratings at T_A=25°C

Reverse Voltage (Working) . . . . . 16 V dc (peak)
Power Dissipation** . . . . . 250 mW
Operating Temperature Range . . . . . −65°C to +200°C
Storage Temperature Range . . . . . −65°C to +200°C

**Derate at 2.0 mW/°C above T_A = 25°C.

Electrical Specifications at T_A=25°C

(Per Table I, Group A Testing of MIL-S-19500/445)

Specification	Symbol	Min.	Max.	Units	Test Conditions
Breakdown Voltage	V_{BR}	20		V_{dc}	I_R = 10μAdc
Forward Voltage	V_{F1}		.55	V_{dc}	I_{F1} = 1 mAdc
Forward Voltage	V_{F2}		1.0	V_{dc}	I_{F2} = 35 mAdc
Reverse Leakage Current	I_R		150	nAdc	V_R = 16 Vdc
Capacitance	$C_{T(o)}$		1.2	pF	V_R = 0V and f = 1 MHz
Effective Minority Carrier Lifetime	τ		100	pS	I_F = 5 mA Krakauer Method [Note 1]

Note 1: Per DESC drawing C-68001

JAN 1N5712: Samples of each lot are subjected to Group A inspection for parameters listed in Table I, and to Group B and Group C tests listed below. All tests are to the conditions and limits specified by MIL-S-19500/445. A summary of the data gathered in groups A, B, and C lot acceptance testing is supplied with each shipment.

JANTX 1N5712: Devices undergo 100% screening tests as listed below to the conditions and limits specified by MIL-S-19500/445. A sample of the JANTX lot is then subjected to Group A, Group B, and Group C tests as for the JAN 1N5712 above. A summary of the data gathered in groups A, B, and C lot acceptance testing is supplied with each shipment. A summary of drift evaluation is also included.

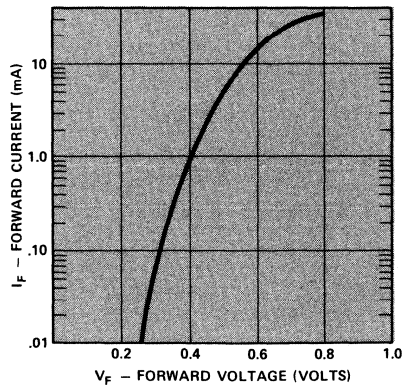
JANTXV 1N5712: Devices are subjected to 100% visual inspection in accordance with amendment 3 of MIL-S-19500/445 prior to being subjected to TX screening.

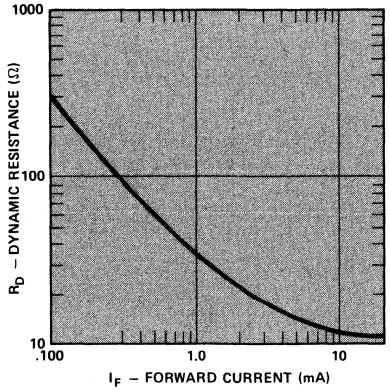
Group B Sample Acceptance Tests	Method MIL-STD-750
Physical Dimensions	2066
Solderability	2026
Temperature Cycling	1051C
Thermal Shock (Strain)	1056A
Terminal Strength: Tension	2036A
Fine Leak Test	1071H
Gross Leak Test	1071E
Moisture Resistance	1021
Mechanical Shock	2016
Vibration, Variable Frequency	2056
Constant Acceleration	2006
Terminal Strength: Lead Fatigue	2036E
Temperature Storage (200°C, 1K hrs.)	1031
Operating Life (I_o = 33mA dc, V_r = 16V [pk] (f = 60, T_A = 25°C, t = 1K hrs.)	1026

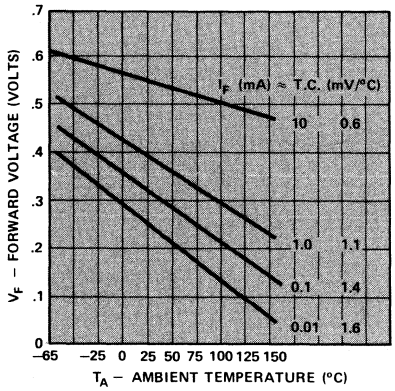
Group C Sample Acceptance Tests	Method MIL-STD-750
Low Temp. Operation (−65°C)	
Forward Voltage	4011
Reverse Breakdown Voltage	4021
Salt Atmosphere	1041
Resistance to Solvents	*
Temperature Cycling	1051C
TX Screening (100%)	
High Temp. Storage (200°C, 48 hrs.)	1032
Thermal Shock (Strain)	1056A
Constant Acceleration	2006
Fine Leak	1071H
Gross Leak	1071E
Burn-In (I_o = 33mA dc, V = 16V [pk] (T_A = 25°C, f = 60Hz, t = 96hrs)	
Evaluation of Drift (I_R, V_F)	

*MIL-STD-202, Method 215

Typical Characteristic Curves





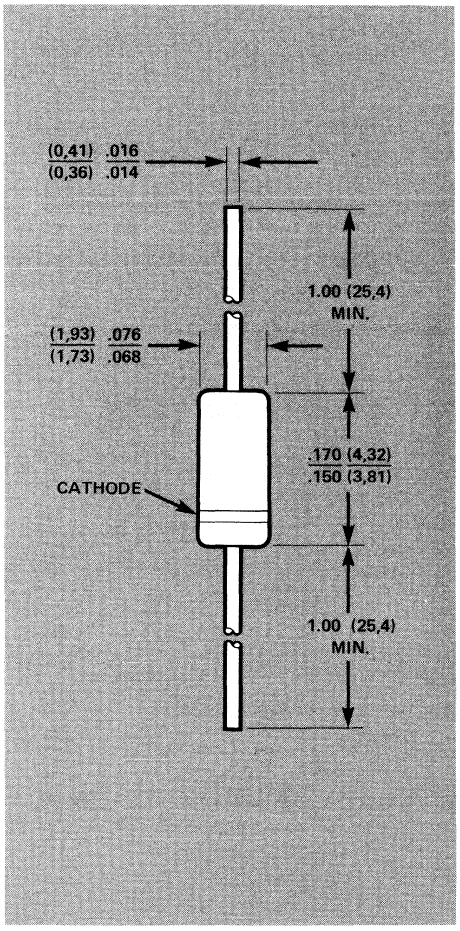


HEWLETT hp PACKARD

COMPONENTS

PIN SWITCHING DIODE MILITARY APPROVED MIL-S-19500/443

1N5719
JAN 1N5719
JAN TX 1N5719



Features

- **Large Dynamic Range**
- **Low Harmonic Distortion**
- **High Series Isolation**

Description

The 1N5719 is a planar passivated silicon PIN diode designed for use in RF switching circuits. The JAN 1N5719 is the military approved equivalent of the HP 5082-3039.

Applications

- Variable RF Attenuators
- Automatic Gain Control Circuits
- RF Modulators
- RF Limiters
- Phase Shifters

Absolute Maximum Ratings

Reverse Voltage (Working) [T_A = 25°C]	100Vdc
Reverse Voltage (non-rep) [T_A = 25°C]	150Vpk
Power Dissipation** [T_A = 25°C]	250mW
Operating Temperature Range	−65°C to +150°C
Storage Temperature Range	−65° C to +150°C

**Derate at 2.0mW/°C above T_A = 25°C.

Electrical Specifications at T_A=25°C

(Per Table I, Group A Testing of MIL-S-19500/443)

Specification	Symbol	Min.	Max.	Units	Test Conditions
Breakdown Voltage	V_{BR}	150		Vdc	I_R = 10μA dc
Forward Voltage	V_F		1.0	Vdc	I_F = 100mA dc
Reverse Current	I_R		250	nAdc	V_R = 100V dc
Reverse Current	I_R		15	μAdc	V_R = 100Vdc, T_A = 150°C
Capacitance	C_{VR}		.30	pF	V_R = 100Vdc, f = 1MHz
Series Resistance	R_S		1.25	Ω	I_F = 100mAdc, f = 100MHz
Effective Carrier Lifetime	τ	100		ns	I_F = 50mA, I_R = 250mA

JAN 1N5719: Samples of each lot are subjected to Group A inspection for parameters listed in Table I, and to Group B and Group C tests listed below. All tests are to the conditions and limits specified by MIL-S-19500/443. A summary of the data gathered in Groups A, B, and C lot acceptance testing is supplied with each shipment.

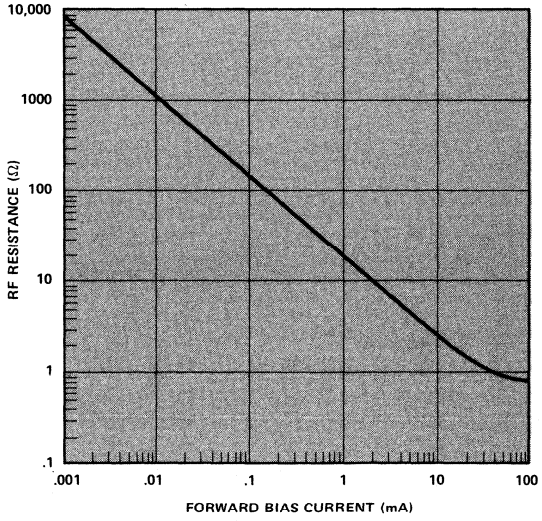
JANTX 1N5719: Devices undergo 100% screening tests as listed below to the conditions and limits specified by MIL-S-19500/443. A sample of the JANTX lot is then subjected to Group A, Group B, and Group C tests as for the JAN 1N5719 above. A summary of the data gathered in Groups A, B, and C lot acceptance testing is supplied with each shipment. A summary of drift evaluation is also included.

Group B Sample Acceptance Tests	Method MIL-STD-750
Physical Dimensions	2066
Solderability	2026
Temperature Cycling	1051F
Thermal Shock (Strain)	1056A
Terminal Strength: Tension	2036A
Hermetic Seal	1071E
Moisture Resistance	1021
Mechanical Shock	2016
Vibration, Variable Frequency	2056
Constant Acceleration	2006
Terminal Strength: Lead Fatigue	2036E
Salt Atmosphere	1041
Temperature Storage (T_A = 150°C, t = 1k hrs.)	1031
Operating Life (I_o = 70mAdc, V_R = 120V [pk], f = 60Hz, T_A = 25°C, t = 1k hrs.)	1026

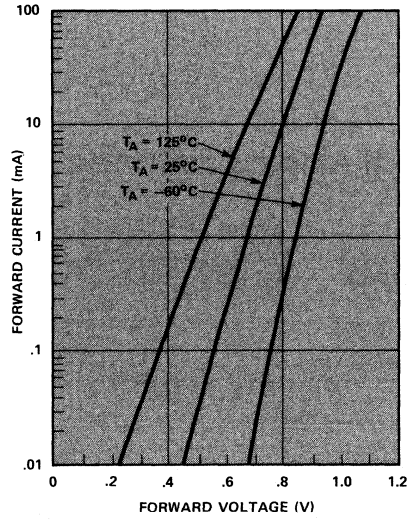
Group C Sample Acceptance Tests	Method MIL-STD-750
Barometric Pressure Reverse Current	1001 4016
Salt Atmosphere	1041
Resistance to Solvents	*
Temperature Cycling	1051F
Low Temperature Operation (–65°C) Forward Voltage Breakdown Voltage	4011 4021
TX Screening (100%)	
High Temp Storage (150°C, 48 hrs.)	1032
Temperature Cycling	1051F
Constant Acceleration	2006
Fine Leak	1071 G or H
Gross Leak	1071E
Burn-in (I_o = 70mAdc, V_R = 120V [pk], T_A = 25°C, f = 60Hz, t = 96 hrs.)	
Evaluation of Drift (I_R, V_F)	

*MIL-STD-202, Method 215

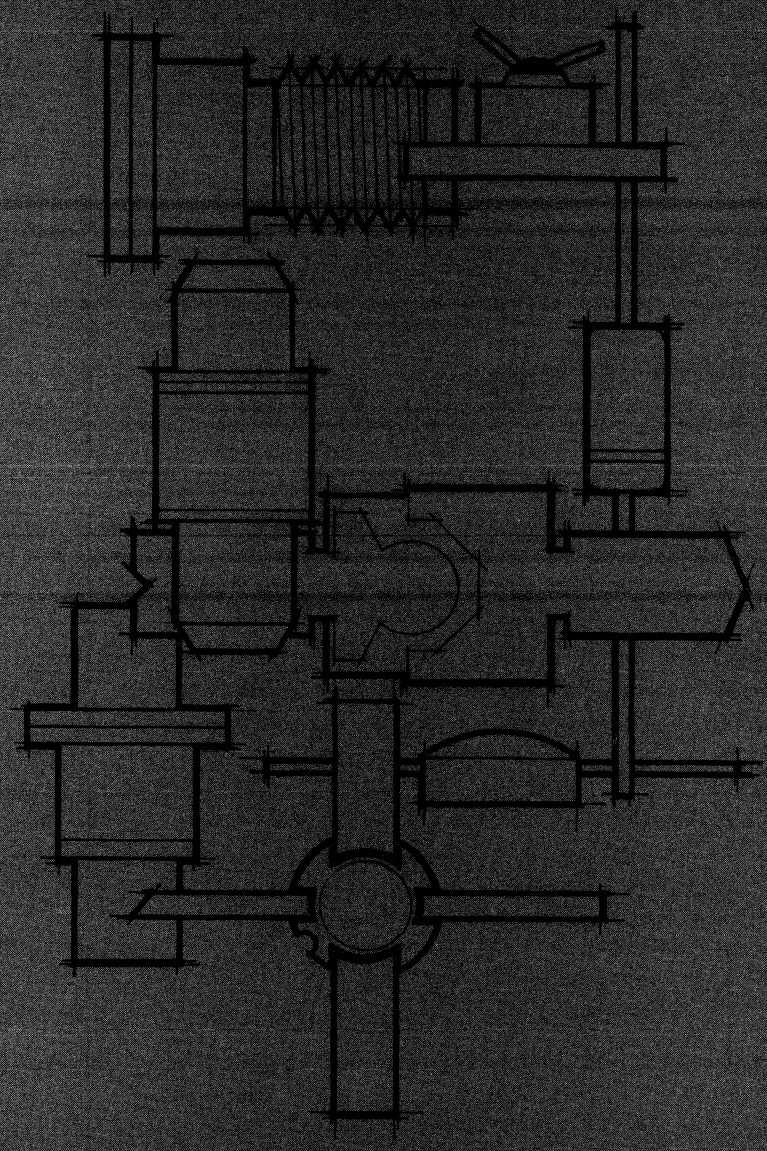
Typical Characteristic Curves



Typical RF Resistance vs. Forward Bias Current



Typical Forward Current Vs. Forward Voltage



High Reliability Test Programs

Selection Guide	160
Glass Packaged Step Recovery Diodes	161
Ceramic Packaged Step Recovery Diodes	163
Ceramic Packaged Microwave Mixer Diodes	165
PIN RF Resistor Diodes	167
Ceramic Packaged PIN Diodes	169
Hermetic Stripline Diodes	171
Diode Chips	173

High Reliability Test Programs [1]

Commercial Part No. 5082- [1]	Commercial Part Page No.	High Reliability Test Program Page No.
GLASS PACKAGED STEP RECOVERY DIODES		
0112	137	161
0114	137	161
0151	137	161
0180	137	161
CERAMIC PACKAGED STEP RECOVERY DIODES		
0132	137	163
0241	137	163
0243	137	163
0253	137	163
0300	137	163
0310	137	163
0320	137	163
0335	137	163
CERAMIC PACKAGED MICROWAVE MIXER DIODES		
2234	73	165
2235	73	165
2701	73	165
2702	73	165
2703	73	165
2706	73	165
2707	73	165
2708	73	165
2711	73	165
2712	73	165
2713	73	165
2714	73	165
2721	73	165
2722	73	165
2723	73	165
2724	73	165

Commercial Part No. 5082- [1]	Commercial Part Page No.	High Reliability Test Program Page No.
PIN RF RESISTOR DIODES		
3003	99	167
3004	99	167
3080	87	167
3081	87	167
CERAMIC PACKAGED PIN DIODES		
3101	103	169
3102	103	169
3201	103	169
3202	103	169
3301	103	169
3302	103	169
3303	103	169
3304	103	169
3305	120	169
3306	120	169
HERMETIC STRIPLINE PIN DIODES		
3140	112	171
3141	112	171
3170	112	171
DIODE CHIPS		
0001	143	173
0008	143	173
0009	143	173
0012	143	173
0020	143	173
0023	143	173
0024	143	173
0025	143	173
0029	143	173
0030	143	173
0031	143	173
0087	143	173
0097	143	173

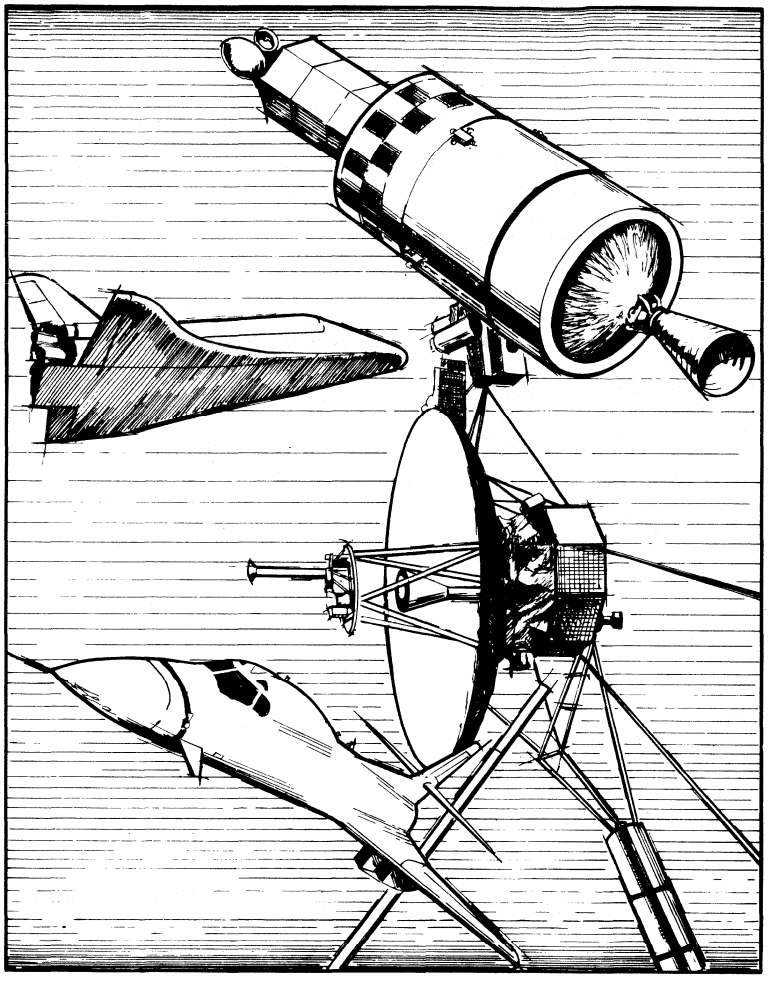
Note 1. All Hewlett-Packard Diodes that have been Hi-Rel tested and are offered as part of one of our High Reliability Test Programs have been assigned a two or three digit prefix, TX- or TXB-, which replaces the commercial part number prefix 5082-.

HEWLETT hp PACKARD

COMPONENTS

HIGH RELIABILITY TEST PROGRAMS FOR GLASS STEP RECOVERY DIODES

TX/TXB-0112
TX/TXB-0114
TX/TXB-0180
TX/TXB-0151



Description

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- The TXB prefix identifies a part which has been preconditioned and screened, and comes from a lot which has been subjected to the Group B tests detailed in Table IV.

TABLE I
Part Number System

Commercial Product	With TX Screening	With TX Screening Plus Group B
5082-XXXX	TX-XXXX	TXB-XXXX

TABLE II
Group A (T_A = 25°C)

Commercial Part Number	Package Outline	C_{VR} (pF) Max.	V_{BR} (Volts) Min.	t_t (ps) at Q_S (pC)	
				Transition Time Max.	Stored Charge Level
5082-0112	11	1.7	35	175	1000
5082-0114	11	4.0	35	225	1500
5082-0180	11	4.6	50	225	1500
5082-0151	15	0.85	15	90	200
Test Conditions	Data Sheet	V_R = 10V, f = 1.0MHz	I_R = 10μA	Data Sheet	
LTPD		5	5	5	

TABLE III. TX Preconditioning and Screening — 100%

Examination or Test	MIL-STD-750 Methods	Conditions
1. Visual and Mechanical Inspection	2072	
2. Electrical Test, C_{VR}, V_{BR}, 100%		
3. High Temperature Storage	1032	168 hrs. @ 200°C
4. Temperature Cycling	1051	−65°C to +200°C
5. Acceleration	2006	20,000 G, Y_1
6. Helium Leak Test	1071	Cond. H
7. Gross Leak Test	1071	Cond. C, Step 1
8. Electrical Test V_F @ I_F = 100mA, I_R @ V_R = 80% V_{BR}		
9. Burn-In, V_r = 80% V_{BR}, T_A = 25°C, f = 60Hz, 168 hrs.	1038	P_{FM}*
10. Electrical Test as in Step 8 and Group A, Table II		
11. Evaluate Drift, ΔI_R, ΔV_F		Max. ΔV_F = ± 100mV, Max. ΔI_R = 50nA or 100% of initial value, whichever is greater.

*Test Power Forward Max. for TX/TXB-0112, -0114, -0180 = 450mW; for TX/TXB-0151 = 225mW

TABLE IV. Group B

Examination or Test	MIL-STD-750		LTPD	Symbol
	Method	Details		
Subgroup 1			15	
Physical Dimensions	2066	See Product Data Sheet		
Subgroup 2			20	
Solderability	2026	Immersion within 0.10" of body		
Subgroup 3			15	
Temperature Cycle (10 cycles)	1051	Test Cond. C		
Thermal Shock	1056	Test Cond. A		
Terminal Strength (Tension)	2036	Test Cond. A, 2.0 lbs., 15 sec.		
Hermetic Seal	1071	Cond. H and Cond. C, Step 1		
End Points:				
Breakdown Voltage*		Per Table II		V_{BR}
Capacitance*		Per Table II		C_{VR}
Subgroup 4			10	
Shock — Non-operating	2016	1500G, t = 0.5ms, 5 blows, X_1, Y_1, Y_2		
Vibration Variable Frequency	2056	Non-operating.		
Constant Acceleration	2006	20,000 Gs, X_1, Y_1, Y_2		
End Points: Same as Subgroup 3				
Subgroup 5			15	
Terminal Strength (Lead Fatigue)	2036	Test Cond. E		
Subgroup 6			λ = 5	
High Temperature Life (non-operating)	1031	T_A = 200°C		
End Points: Per Step 8, Table III				
Drift Criteria: see Step 11, Table III				
Subgroup 7			λ = 5	
Steady State Operating Life	1026	P_{FM} per Table III, V_r = 80% V_{BR}, T_A = 25°C f = 60Hz		
End Points: Same as Subgroup 6				
Drift Criteria: see Step 11, Table III				

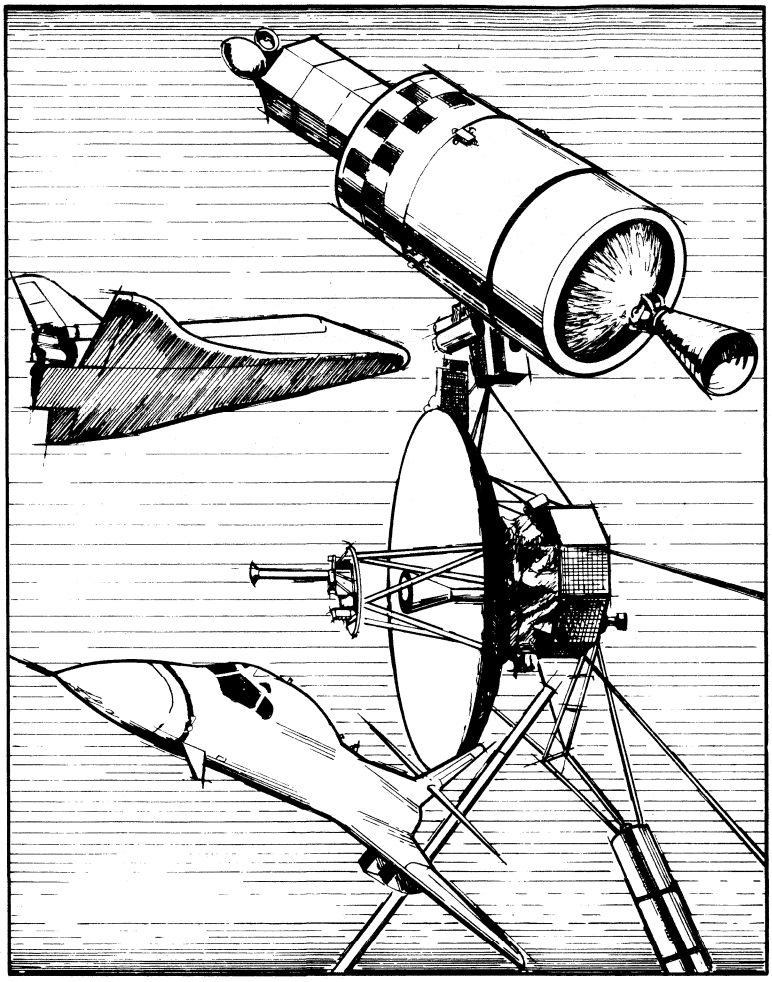
Limits as per Table II.

HEWLETT hp PACKARD

COMPONENTS

HIGH RELIABILITY TEST PROGRAMS FOR CERAMIC STEP RECOVERY DIODES

TX/TXB-0132
TX/TXB-0241
TX/TXB-0243
TX/TXB-0253
TX/TXB-0300 Series



Description

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TABLE I
Part Number System

Commercial Product	With TX Screening	With TX Screening Plus Group B
5082-XXXX	TX-XXXX	TXB-XXXX

TABLE II
Group A (T_A = 25°C)

Commercial HP Device Number	Package Outline	C_{VR} (pF) Min.	C_{VR} (pF) Max.	V_{BR} (Volts) Min.	V_{BR} (Volts) Max.	t_t (pS) @ Q_s (pC) Transition Time Max.	t_t (pS) @ Q_s (pC) Stored Charge Level	P_o (W) @ f_o (GHz) Min.	Lifetest P_{FM} (W)
5082-0300	40	3.5	5.0	75	100	360	2400	2.000 @ 2.0	2.0
5082-0310	41	1.9	3.0	40	60	160	1000	0.400 @ 6.0	2.0
5082-0320	41	0.65	1.3	25	40	75	300	0.225 @ 10.0	2.0
5082-0335	31	0.45	0.70	20	30	60	100	0.030 @ 16.0	0.5
5082-0253	31	–	0.80	25	–	80	200	Not Tested	0.5
5082-0243	31	–	1.4	35	–	110	600	Not Tested	1.4
5082-0132	31	–	1.7	35	–	175	1000	Not Tested	1.4
5082-0241	31	–	4.8	65	–	275	1500	Not Tested	2.0
Test Conditions		V_R = 10V f = 1MHz		I_R = 10μA		Product Data Sheet		Data Sheet	
LTPD		5		5		5		5	

P_{FM} is the maximum forward power value that achieves maximum junction temperature in air.

TABLE III. TX Preconditioning and Screening — 100%

Examination or Test	MIL-STD-750 Methods	Conditions
1. Pre-Cap Visual and Mechanical Inspection	2072	
2. Electrical Test: V_{BR}, C_{VR} per Table II		
3. High Temperature Storage	1032	168 hrs. @ 200°C
4. Temperature Cycling	1051	Cond. C, −65°C to +200°C
5. Acceleration	2006	20,000G, Y_1
6. Helium Leak Test	1071	Cond. H
7. Gross Leak Test	1071	Cond. C, Step 1
8. Electrical Test as in Step 2; and I_R @ V_R = 80% V_{BR}, V_F @ I_F = 40mA		
9. Burn-In, V_R = 80% V_{BR}, T_A = 25°C, f = 60Hz, t = 168 hrs.	1038	P_{FM} per Table II
10. Electrical Test: Group A, Table II; and I_R @ V_R = 80% V_{BR}, V_F @ I_F = 40mA		
11. Calculate Drift, ΔI_R, ΔV_F		Max. ΔV_F = 100mV, Max. ΔI_R = 50nA or 100% of initial value, whichever is greater.

TABLE IV, Group B

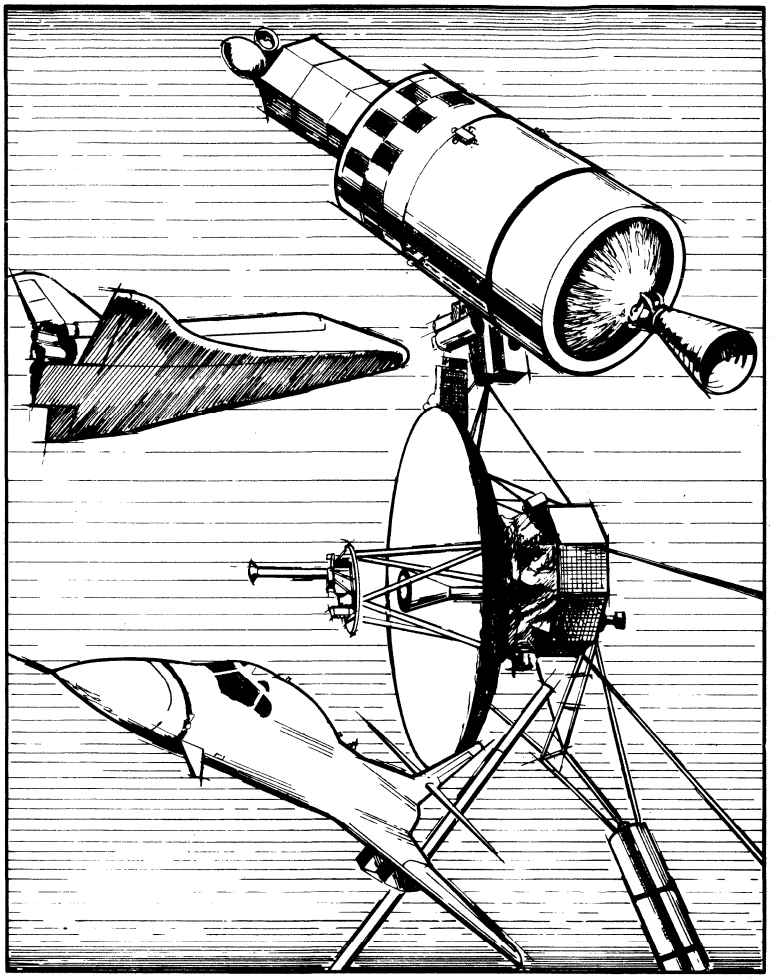
Examination or Test	MIL-STD-750		LTPD	Symbol
	Method	Condition		
Subgroup 1			15	
Physical Dimensions	2066	See Product Data Sheet		
Subgroup 2			10	
Temperature Cycling	1051	Condition F		
Thermal Shock	1056	Condition A		
Hermetic Seal, Fine Leak	1071	Condition H		
Hermetic Seal, Gross Leak	1071	Condition C, Step 1		
End Points:				
Breakdown Voltage*				V_{BR}
Capacitance*				C_{VR}
Subgroup 3			10	
Shock, non-operating	2016	1500G, t = 0.5ms, 5 blows, X_1, Y_1, Y_2		
Vibration, Variable Frequency	2056	Non-operating		
Constant Acceleration	2006	20,000G, X_1, Y_1, Y_2		
End Points:				
Same as Subgroup 2				
Subgroup 4			λ = 5	
High Temperature Life	1031	T_A = 200°C, t = 1000 hrs.		
End Points: Per Step 10, Table III				
Drift Criteria: Per Step 11, Table III				
Subgroup 5			λ = 5	
Steady State Operating Life	1026	V_R = 80% V_{BR}, T_A = 25°C, f = 60Hz, P_{FM} per Table II.		
End Points:				
Same as Subgroup 4				
Drift Criteria: Per Step 12, Table III				

**Limits per Table II.*

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COMPONENTS

HIGH RELIABILITY TEST PROGRAMS FOR CERAMIC MICROWAVE MIXER DIODES

TX/TXB-2234/2235
TX/TXB-2701/2706
TX/TXB-2702/2707
TX/TXB-2703/2708
TX/TXB-2711/2712
TX/TXB-2713/2714
TX/TXB-2721/2722
TX/TXB-2723/2724



Description

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- The TXB prefix identifies a part which has been preconditioned and screened, and comes from a lot which has been subjected to the Group B tests detailed in Table IV.

TABLE I
Part Number System

Commercial Product	With TX Screening	With TX Screening Plus Group B
5082-XXXX	TX-XXXX	TXB-XXXX

TABLE II
Group A (T_A = 25°C)

Frequency Range — GHz	Commercial Part Number	Package Outline	Noise Figure — dB Max.	IF Impedance — Ω Min.	IF Impedance — Ω Max.	VSWR Max.	Matched Pair
6 - 14 (Test Frequency 9.375 GHz)	5082-2713	49	6.0	200	400	1.5:1	5082-2714
	5082-2701	44	6.0	200	400	1.5:1	5082-2706
	5082-2711	49	6.5	200	400	2.0:1	5082-2712
	5082-2702	44	6.5	200	400	2.0:1	5082-2707
	5082-2234	49	7.0	200	400	2.0:1	5082-2235
	5082-2703	44	7.0	200	400	1.5:1	5082-2708
10 - 18 (Test Frequency 16.0 GHz)	5082-2723	49	6.5	200	400	1.5:1	5082-2724
	5082-2721	49	7.0	200	400	2.0:1	5082-2722
Test Conditions			Note 1	Note 2		Note 1	Note 3
LTPD			5	7		5	

NOTES: 1. Measurements are performed on the diode in a fixed tuned mount. Local Oscillator Power = 1 mW, Local Oscillator Frequency = Test Frequency, IF Frequency = 30 MHz, DC Load Resistance = <1.0Ω. 2. Same as Note 1, except IF Frequency = 10 kHz. 3. Noise Figure Match = $\Delta NF \leq 0.3$ dB, IF Impedance Match = $\Delta Z_{IF} \leq 25\Omega$. Matching is done after reliability testing.

TABLE III. TX Preconditioning and Screening — 100%

Examination or Test	MIL-STD-750 Methods	Conditions
1. Radiographic Inspection	2076	
2. Electrical Test, Table II (100%)		
3. High Temperature Storage	1032	t = 168 hrs., T = 150°C
4. Thermal Shock (Temperature Cycling) 10 cycles	1051	−60°C to +125°C
5. Fine Leak Test	1071	Cond. H or G
6. Gross Leak Test	1071	Cond. C, Step 1
7. Constant Acceleration	2006	20,000 Gs, Y1
8. Electrical Test, Same as Step 2; and V_F @ 10mA, C_T @ V_r = 0V, f = 1MHz		
9. Burn-In	1038	Cond. B, t = 168 hrs. T = 25°C, I_F = 10mA
10. Electrical Test, Same as Step 8		
11. Final Visual	2071	
12. Calculate Drift, ΔV_F and ΔC_T		Max. ΔV_F = ±10%, Max. ΔC_T = ±10%

TABLE IV. Group B

Examination or Test	MIL-STD-750		LTPD	Symbol
	Method	Condition		
Subgroup 1			15	
Physical Dimensions	2066	See Product Data Sheet		
Subgroup 2			20	
Solderability	2026			
Subgroup 3			10	
Temperature Cycle (10 cycles)	1051	−60°C to +125°C		
Thermal Shock	1056	Cond. A		
Hermetic Seal, Fine Leak	1071	Cond. H or G		
Hermetic Seal, Gross Leak	1071	Cond. C, Step 1		
Moisture Resistance	1021			
End Points:				
Noise Figure*		Per Table II		NF
IF Impedance*		Per Table II		Z_{IF}
VSWR*		Per Table II		VSWR
Subgroup 4			10	
Shock — Non-operating	2016	1500G, t = 0.5ms, 5 blows, X_1,Y_1,Y_2		
Vibration Variable Frequency	2056	Non-operating		
Constant Acceleration	2006	20,000 Gs, X_1,Y_1,Y_2		
End Points: Same as Subgroup 3				
Subgroup 5			λ = 5	
High Temperature Life	1031	T_A = 150°C, t = 1000 hrs.		
End Points: Per Step 8, Table III				
Drift Criteria same as Step 12, Table III				
Subgroup 6			λ = 5	
Steady State Operating Life	1026	I_F = 10mA, T = 25°C, t = 1000 hrs.		
End Points: Per Step 8, Table III				
Drift Criteria same as Step 12, Table III				

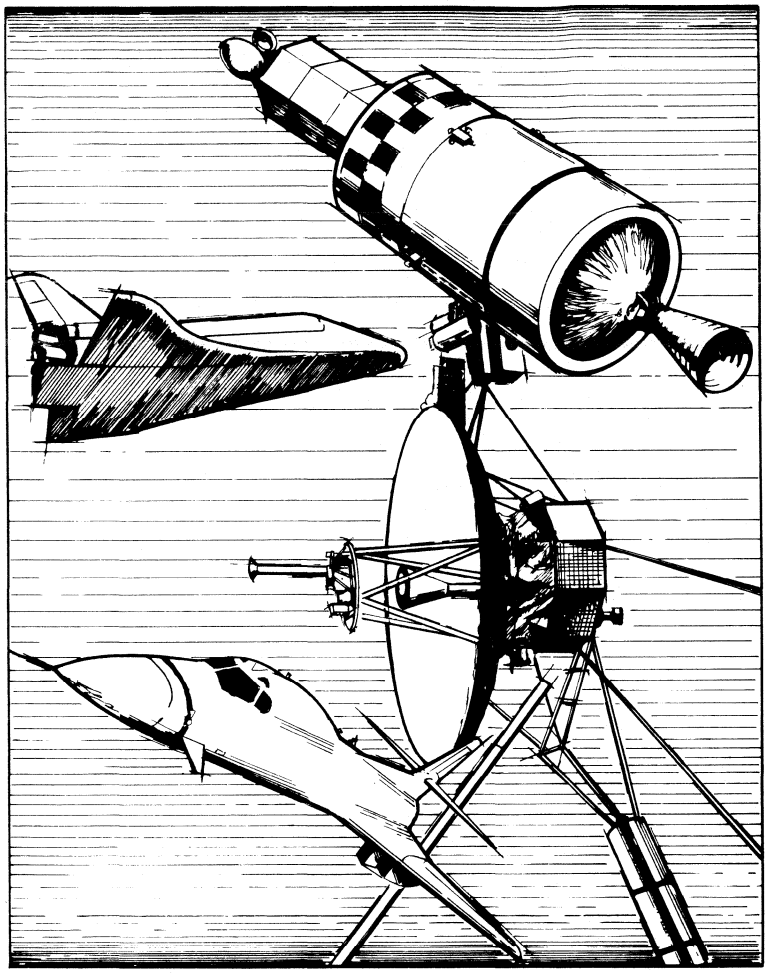
**Limits per Table II.*

HEWLETT hp PACKARD

COMPONENTS

HIGH RELIABILITY TEST PROGRAMS FOR PIN DIODE RF RESISTORS

TX/TXB-3003
TX/TXB-3004
TX/TXB-3080
TX/TXB-3081



Description

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TABLE I
Part Number System

Commercial Product	With TX Screening	With TX Screening Plus Group B
5082-XXXX	TX-XXXX	TXB-XXXX

TABLE II.
Group A (T_A = 25°C)

Parameter	3003	3004	3080	3081	Units	Test Conditions	LTPD
Breakdown Voltage V_{BR} min.	100	100	100	100	V	I_R = 10μA	5
Total Capacitance C_{VR} max.	0.3	0.3	0.4	0.4	pF	V_R = 50V, f = 1.0MHz	5
Effective Minority Carrier Lifetime τ	100 (min.)	100 (min.)	1300 (typ.)	2000 (typ.)	ns	I_F = 50mA I_R = 250mA	10
High Resistance Limit R_H max. R_H min.	1380 920	1040 690	– 1000	– 1500	Ω	I_{DC} = 0.01mA f = 100MHz	10
Low Resistance Limit R_L max. R_L min.	24 16	18 12	8 –	8 –	Ω	I_{DC} = 1.0mA for 3003/4 I_{DC} = 20mA for 3080/81 f = 100MHz	10
Residual Series Resistance R_S max.	1.5	1.5	2.5	3.5	Ω	I_{DC} = 100mA, f = 100MHz	10
Resistance vs. Bias Slope max. min.	–0.9 –0.86	–0.9 –0.86	– –	– –		I_{DC} = 0.01mA and I_{DC} = 1.0mA	10

TABLE III. TX Preconditioning and Screening — 100%

Examination or Test	MIL-STD-750 Methods	Conditions
1. Visual and Mechanical Inspection	2072	
2. Electrical Test, Group A, Table II, 100%		
3. High Temperature Storage	1031	168 Hrs. @ 150°C
4. Temperature Cycling	1051	−65°C to +150°C
5. Acceleration	2006	20,000 G, Y_1
6. Helium Leak Test	1071	Cond. H or G
7. Gross Leak Test	1071	Cond. C, Step 1
8. Electrical Test; Read I_R @ V_R = 50V, V_F @ I_F = 30mA		
9. Burn-In V_R = 80% V_{BR} , T_A = 25°C, f = 60Hz, 168 hrs.	1038	P_{FM} = 200mW*
10. Electrical Test as in Steps 2 and 8.		
11. Evaluate Drift		Max. $\Delta V_F = \pm 10\%$, Max. ΔI_R = 250nA or 100% of initial value, whichever is greater.

*P_{FM} = Test maximum forward power that achieves maximum junction temperature in air.

TABLE IV. Group B

Examination or Test	MIL-STD-750		LTPD	Symbol
	Method	Condition		
Subgroup 1			15	
Physical Dimensions	2066	See Product Data Sheet		
Subgroup 2			20	
Solderability	2026	Immersion within 0.10" of body		
Subgroup 3			10	
Temperature Cycling	1051	Test Condition F		
Thermal Shock	1056	Test Condition A		
Hermetic Seal	1071	Condition H or G, and Condition C, Step 1		
End Points:				
Breakdown Voltage*		Per Table II		V_{BR}
Total Capacitance*		Per Table II		C_{VR}
Subgroup 4			10	
Shock - Non-operating	2016	1500 G, t = 0.5ms, 5 blows in each orientation X_1 , Y_1 , Y_2		
Vibration Variable Frequency	2056	Non-operating		
Constant Acceleration	2006	20,000 G, X_1 , Y_1 , Y_2		
End Points:				
Same as Subgroup 3				
Subgroup 5			10	
Terminal Strength	2036	Test Condition A, 2.0 lbs., 15 sec.		
Terminal Strength	2036	Test Condition E		
Subgroup 6				
High Temperature Life	1031	T_A = 150°C, non-operating	$\lambda = 5$	
End Points:				
Same as Step 8, Table III				
Drift Criteria per Step 11, Table III				
Subgroup 7				
Steady State Operating Life	1026	V_R = 80% V_{BR} , T_A = 25°C, f = 60Hz, P_{FM} = 200mW	$\lambda = 5$	
End Points: Per Subgroup 6				
Drift Criteria: Per Step 11, Tab. II				

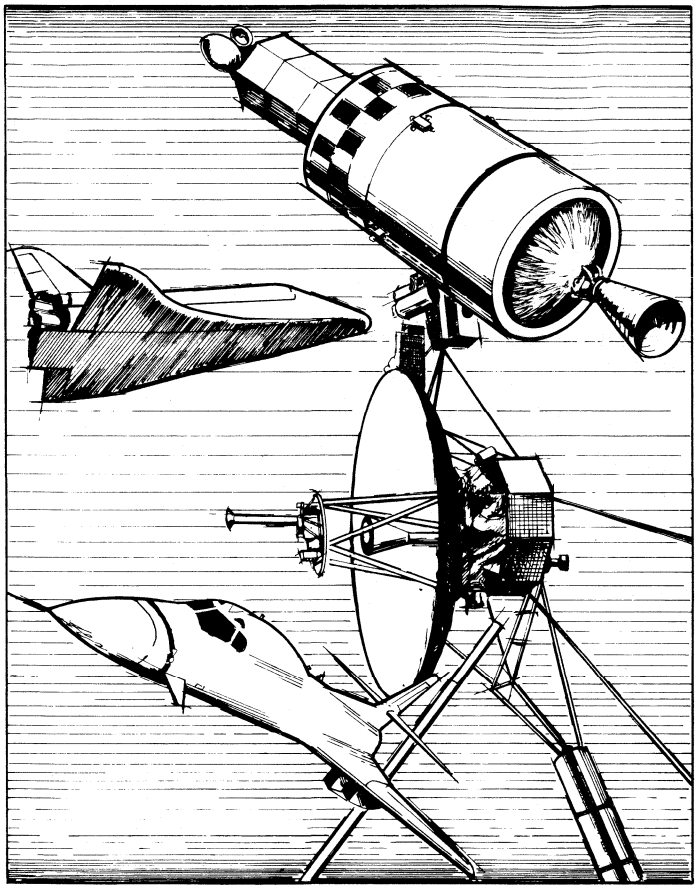
*Limits as per Table II.

HEWLETT hp PACKARD

COMPONENTS

HIGH RELIABILITY TEST PROGRAMS FOR CERAMIC PIN DIODES

TX/TXB-3101
TX/TXB-3102
TX/TXB-3201
TX/TXB-3202
TX/TXB-3301
TX/TXB-3302
TX/TXB-3303
TX/TXB-3304
TX/TXB-3305
TX/TXB-3306



Description

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TABLE I. Part Number System

Commercial Product	With TX Screening	With TX Screening Plus Group B
5082-XXXX	TX-XXXX	TXB-XXXX

TABLE II. Group A (T_A = 25°C)

Commercial Part No.	Package Outline	Breakdown Voltage V_{BR} (V) Min.	Total Capacitance C_T (pF) Max.	Residual Series Resistance R_S (Ω) Max.	Effective Carrier Lifetime τ (ns) Min.
5082-3101	38	200	0.32	1.2	
5082-3102	38	300	0.30	0.8	
5082-3201	31	200	0.35	1.2	
5082-3202	31	300	0.32	0.8	100
5082-3301	38	200	0.40	1.2	
5082-3302	38	300	0.32	0.8	
5082-3303	31	200	0.40	1.2	
5082-3304	31	300	0.32	0.8	
Test Conditions		I_R <10μA [1]	V_R = 50V, f=1MHz	I_F = 100mA, f=100MHz	I_F = 50mA, I_R = 250mA
LTPD		5	5	5	10
Commercial Part No.	**Package Outline**	**Breakdown Voltage V_{BR} (V) Min.**	**Total Capacitance C_T (pF) Max.**	**Residual Series Resistance R_S (Ω) Max.**	**Reverse Recovery Time Trr (ns) Max.**
5082-3305	38	70	0.40	1.0	10
5082-3306	31	70	0.45	1.0	10
Test Conditions		I_R <10μA [1]	V_R = 20V, f=1MHz	I_F = 20mA, f = 100MHz	I_F = 20mA, V_R = 10V, 90% recovery
LTPD		5	5	5	10

Note 1. MIL-STD-750, Method 4021

TABLE III. TX Preconditioning and Screening — 100%

Examination or Test	MIL-STD-750 Methods	Conditions
1. Visual and Mechanical Inspection	2072	
2. Electrical Test, Group A, Table II, 100%		
3. High Temperature Storage	1032	168 Hrs. @ 150°C
4. Temperature Cycling	1051	−65°C to +150°C
5. Acceleration	2006	20,000 G, Y_1
6. Helium Leak Test	1071	Cond. H
7. Gross Leak Test	1071	Cond. C, Step 1
8. Electrical Test as in Step 2; Read I_R @ V_R = 50V, V_F @ I_F = 50mA		
9. Burn-In V_R = 80% V_{BR}, T_A = 25°C, f = 60Hz, 168 Hrs.	1038	P_{FM}*
10. Electrical Test as in Step 8		
11. Calculate Drift ΔI_R, ΔV_F, Limits ΔV_F = ±10%, ΔI_R = 100% or 250nA, whichever is greater.		

*Test Power Forward Maximum for TX/TXB-3101,-3102,-3301,-3302,-3306 = 0.8W; for -3201, -3202, -3303, -3304 = 2.0W; for -3305 =0.5W.

TABLE IV. Group B

Examination or Test	MIL-STD-750		LTPD	Symbol
	Method	Details		
Subgroup 1			15	
Physical Dimensions	2066	See Product Data Sheet		
Subgroup 2			20	
Solderability	2026			
Subgroup 3			10	
Temperature Cycling	1051	Cond. F		
Thermal Shock	1056	Cond. A		
Hermetic Seal, Fine Leak	1071	Cond. H or G		
Hermetic Seal, Gross Leak	1071	Cond. C, Step 1		
End Points:				
Breakdown Voltage*		Per Table II		V_{BR}
Series Resistance*		Per Table II		R_S
Subgroup 4			10	
Shock — Non-operating	2016	1500 G, t = 0.5ms, 5 blows, X_1,Y_1,Y_2		
Vibration Variable Frequency	2056	Non-operating		
Constant Acceleration	2006	20,000 G, X_1,Y_1,Y_2		
End Points: Same as Subgroup 3				
Subgroup 5			λ = 5	
High Temperature Life	1031	T_A = 150°C, t = 1000 Hrs.		
End Points: Per Step 8, Table III				
Drift Criteria: see Step 11, Table III				
Subgroup 6			λ = 5	
Steady State Operating Life	1026	V_R = 80% V_{BR}, T_A = 25°C, f = 60Hz, P_{FM} per Table III.		
End Points: Same as Subgroup 5				
Drift Criteria: see Step 11, Table III				

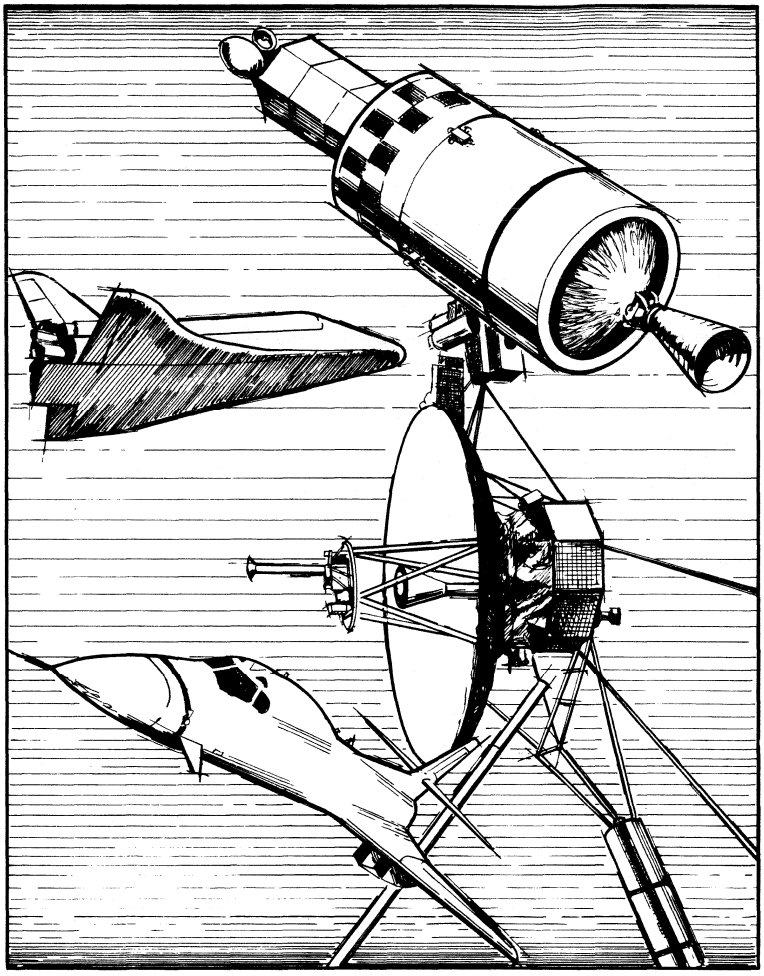
**Limits per Table II.*

HEWLETT hp PACKARD

COMPONENTS

HIGH RELIABILITY TEST PROGRAMS FOR HERMETIC STRIPLINE PIN DIODES

TX/TXB-3140
TX/TXB-3141
TX/TXB-3170



Description

Hewlett Packard provides standard high reliability test programs, patterned after MIL-S-19500, in order to facilitate the use of HP products in military programs.

This sheet, together with the published product data sheet, forms the detail specifications for these products.

HP offers two levels of high reliability testing:

- The TX prefix identifies a part which has been preconditioned and screened per Table III.
- The TXB prefix identifies a part which has been preconditioned and screened, and comes from a lot which has been subjected to the Group B tests detailed in Table IV.

TABLE I
Part Number System

Commercial Product	With TX Screening	With TX Screening Plus Group B
5082-XXXX	TX-XXXX	TXB-XXXX

TABLE II
Group A (T_A = 25°C)

Parameter	3140	3141	3170	Units	*Test Conditions	LTPD
Minimum Isolation (I_{SO})	20	20	20	dB	I_F = 100mA, 3140, 3170, I_F = 20mA, 3141	5
Maximum Insertion Loss (I_L)	0.5	1.0	0.5	dB	I_F = 0, P_{IN} = 1mW	5
Maximum VSWR	1.5	1.5	1.5	–	I_F = 0, P_{IN} = 1mW	5
Maximum Reverse Recovery Time (t_{rr})	–	10	–	ns	I_F = 20mA, V_R = 10V Recovery to 90%	10
Test Power Forward Max. (P_{FM})	2.0	0.8	2.0	W	–	–
Heat Sink Polarity	Anode	Cathode	Cathode	–	–	–

*Test frequencies: 3141 4-8 GHz Swept, 3140 and 3170 10 GHz

TABLE III. TX Preconditioning and Screening — 100%

Examination or Test	MIL-STD-750 Methods	Conditions
1. Visual and Mechanical Inspection	2071	
2. Electrical Test, Group A, Table II, 100%		
3. High Temperature Storage	1032	168 Hours @ 150°C
4. Temperature Cycling	1051	−65°C to +150°C
5. Acceleration	2006	20,000 G, Y_1
6. Helium Leak Test	1071	Condition H or G
7. Gross Leak Test	1071	Condition C; Step 1
8. Electrical Test (Step 2), and V_F @ I_F = 50mA, I_R @ V_R = 50V		
9. Burn-in V_r = 80% PIV, T_A = 25°C, f = 60Hz, 168 Hours	1038	P_{FM} per Table II
10. Electrical Test as in Step 8		
11. Calculate Drift, ΔV_F and ΔI_R		ΔV_F = ±10%, ΔI_R = 250nA or 100% of initial value, whichever is greater

TABLE IV. Group B

Examination or Test	MIL-STD-750		LTPD	Symbol
	Method	Details		
Subgroup 1			15	
Physical Dimensions	2066	See Product Data Sheet		
Subgroup 2			20	
Solderability	2026	Immersion within 0.10" of Body		
Subgroup 3			10	
Temperature Cycling — 10 cycles	1051	Test Condition F		
Thermal Shock	1056	Test Condition A		
Hermetic Seal	1071	Condition H or G, and Condition C, Step 1		
Moisture Resistance	1021			
End Points:				
Isolation*		Per Table II		I_{SO}
Insertion Loss*		Per Table II		I_L
VSWR*	4316	Per Table II		VSWR
Subgroup 4			10	
Shock — Non-operating	2016	1500G, t = 0.5ms, 5 blows in each orientation, X_1, Y_1, Y_2		
Vibration Variable Frequency	2056	Non-operating		
Constant Acceleration	2006	20,000G, X_1, Y_1, Y_2		
End Points: Same as Subgroup 3				
Subgroup 5			10	
Terminal Strength	2036	Test Condition A, 2.0 lbs., 30 minutes		
Subgroup 6			λ = 5	
High Temperature Life (non-operating)	1031	T_A = 150°C		
End Points: Per Step 8, Table III				
Drift Criteria: see Step 11, Table III				
Subgroup 7			λ = 5	
Steady State Operating Life	1026	f = 60Hz, P_{FM} per Table I, V_r = 80% PIV		
End Points: Per Step 8, Table III				
Drift Criteria: see Step 11, Table III				

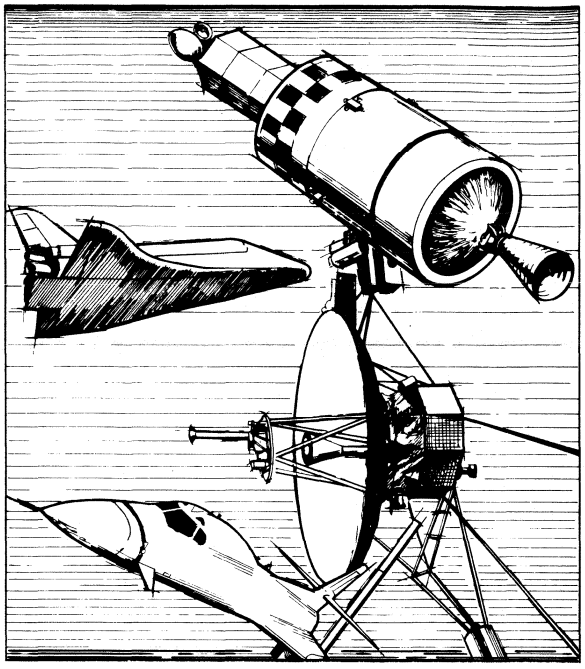
**Limits as per Table II.*

HEWLETT hp PACKARD

COMPONENTS

HIGH RELIABILITY TEST PROGRAMS FOR DIODE CHIPS

SCHOTTKY DIODES PIN DIODES STEP RECOVERY DIODES



Description

Hewlett-Packard provides standard high reliability test programs, patterned after MIL-S-19500, in order to facilitate the use of HP products in military programs. This sheet, together with the published product data sheet, forms the detail specification for these products.

Diode chips must be hermetically sealed into a circuit before they can be considered to be reliable. The reliability testing program for chips is limited by inherent handling and testing difficulties.

HP offers two levels of high reliability testing:

- The TX prefix identifies a part which has been preconditioned and screened per Table III.
- The TXB prefix identifies a TX part from a lot which has been qualified by subjecting a packaged sample to the examinations and tests detailed in Table IV.

TABLE I. Part Number System

Commercial Product	With TX Screening	With TX Screening Plus Group B
5082-XXXX	TX-XXXX	TXB-XXXX

TABLE II. Device Identification (T_A = 25°C)

MICROWAVE SCHOTTKY DIODES

Commercial HP Device Type	Commercial HP Chip Number	Sample Burn-In Conditions
X-Band Mixer (2700 Family)	5082-0023	I_F = 10mA
Ku-Band Mixer (2700 Family)	5082-0029	I_F = 10mA
X-Band Detector (2750 Family)	5082-0009	I_F = 10mA

GENERAL PURPOSE SCHOTTKY DIODES

Commercial HP Device Type	Commercial HP Chip Number	Sample Burn-In Conditions
High Voltage Switch (2800 Family)	5082-0024	P_{FM} = 0.1W
General Purpose Switch (2810 Family)	5082-0087	P_{FM} = 0.1W
General Purpose Switch (2811 Family)	5082-0097	P_{FM} = 0.1W
Low Voltage Switch (2835 Family)	5082-0031	P_{FM} = .05W

Note: P_{FM} is the maximum forward power that achieves maximum junction temperature in air.

PIN DIODES

Commercial HP Device Type	Commercial HP Chip Number	Sample Burn-In Conditions
Universal Switch (3001 Family)	5082-0012	P_{FM} = 0.2W
Universal Switch (3301 Family)	5082-0030	P_{FM} = 0.2W
High Speed Switch (3041 Family)	5082-0001	P_{FM} = 0.2W
Low Frequency Switch (3080 Family)	5082-0025	P_{FM} = 0.2W
Low Frequency Switch (3081 Family)	5082-0039	P_{FM} = 0.2W

STEP RECOVERY DIODES

Commercial HP Device Type	Commercial HP Chip Number	Sample Burn-In Conditions
Multiplier to 12GHz (0320 Family)	5082-0020	P_{FM} = 0.3W
Multiplier to 30GHz (0335 Family)	5082-0008	P_{FM} = 0.3W

TABLE III. TX Preconditioning and Screening — 100%

Examination or Test	MIL-STD-750 Methods	Conditions
1. High Temperature Storage	1032	168 hrs. Max. temperature ratings per product data sheet.
2. Temperature Cycling	1051	Max. temperature ratings per product data sheet.
3. Visual	2072	
4. Electrical Test		Per product data sheet.

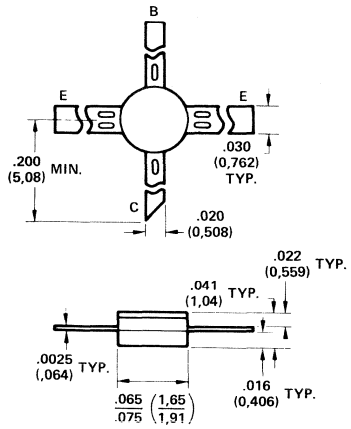
TABLE IV. Packaged Sample Tests — LTPD = 10

Examination or Test	MIL-STD-750	
	Method	Details/Limits
1. Precap Visual	2072	LTPD does not apply
2. High Temperature Storage	1032	48 hrs. @ max. temperature rating
3. Temperature Cycling	1051	Max. temperature ratings per product data sheet.
4. Constant Acceleration	2006	20,000 G, Y_1 axis
5. Electrical Test: V_F @ I_F = 10mA, I_R @ V_R = 50% V_{BR}*		
6. Burn-In		T_A = 25°C, t = 168 hrs., conditions per Table II. "Device Identification"
7. Electrical Test: Same as Step 5, Table III		
8. Evaluate Drift		ΔV_F max. = ±10%, ΔI_R max. = 50nA or 100% of initial value, whichever is greater.

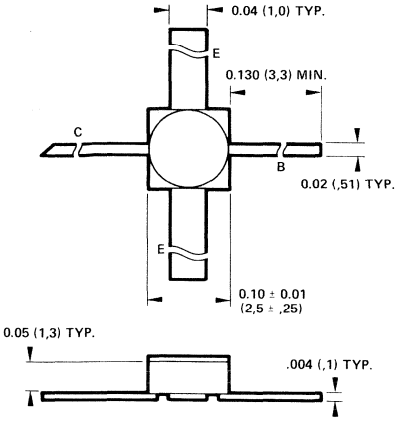
*I_R is not measured for Microwave Schottky Diodes. Repeated measurement with reverse bias is detrimental to these devices.

Diode and Transistor Package Outline Drawings

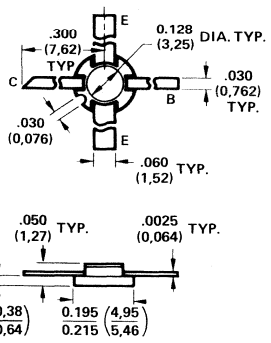
HPAC-70



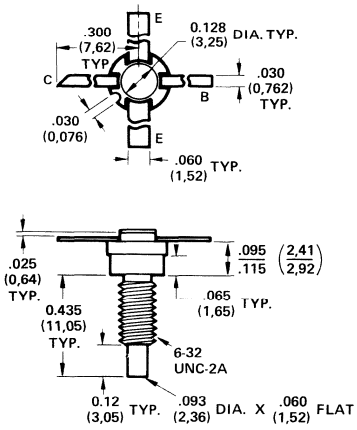
HPAC-100



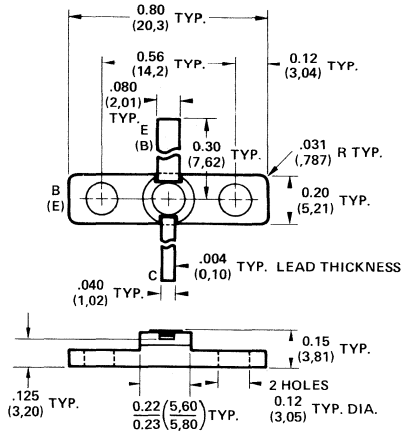
HPAC-200



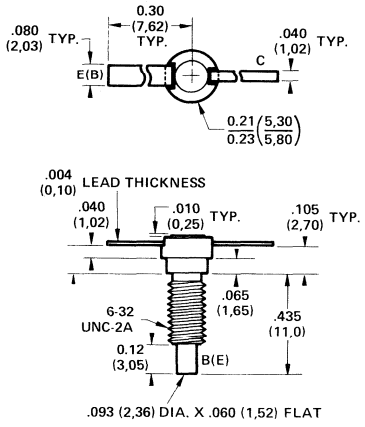
HPAC-200S



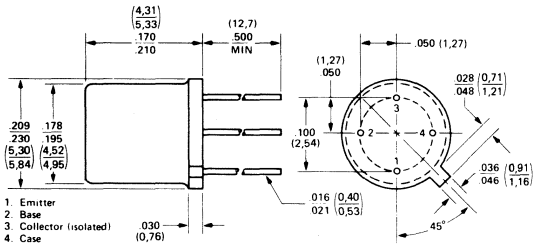
HPAC-200 GB (Grounded Bar)



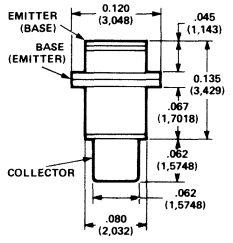
HPAC-200 GS (Grounded Stud)



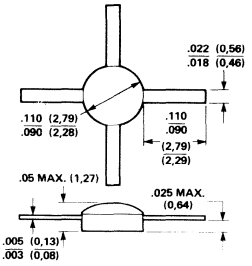
Outline TO-72



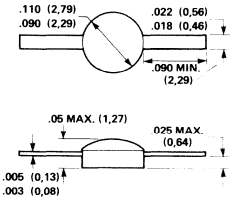
COAX Outline



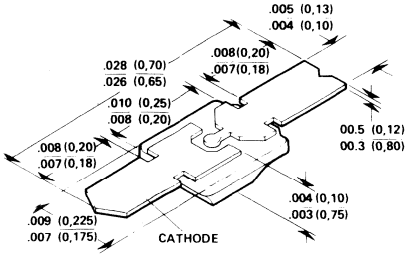
Outline E-1



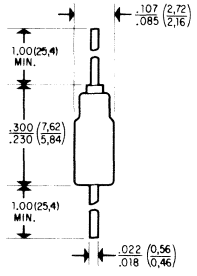
Outline E-2



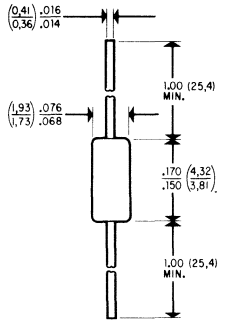
Outline O5



Outline 11



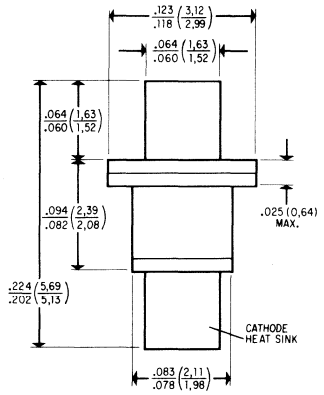
Outline 15,18



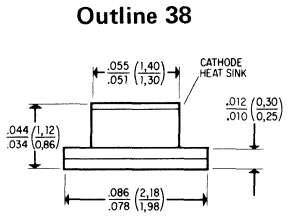
All dimensions in inches and (millimeters).

Diode and Transistor Package Outline Drawings (Cont.)

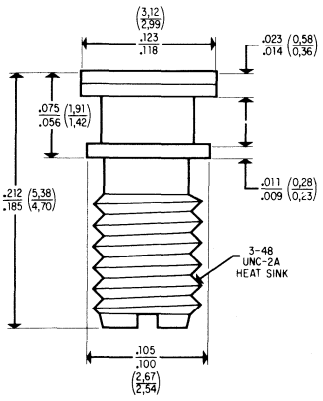
Outline 31



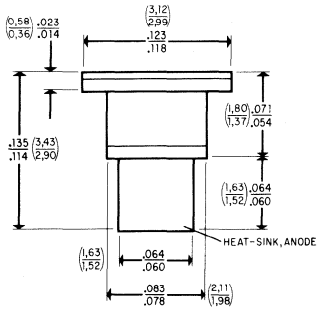
Outline 38



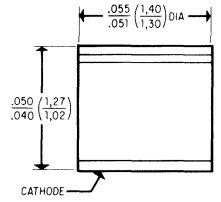
Outline 40



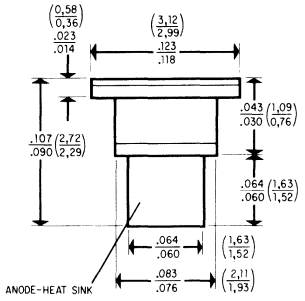
Outline 41



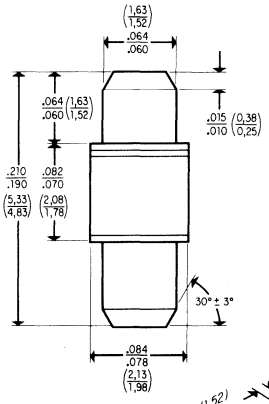
Outline 44



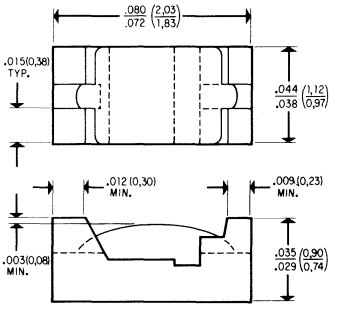
Outline 46



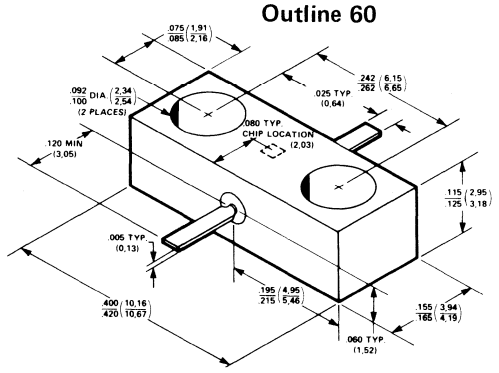
Outline 49



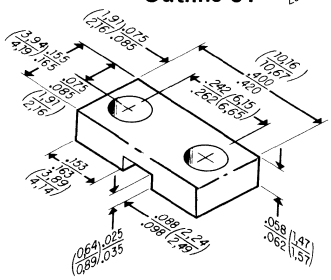
Outline 50

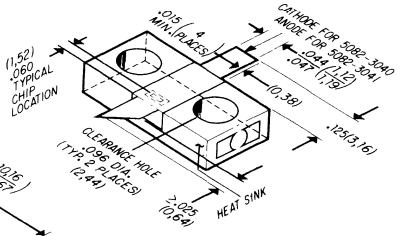


Outline 60

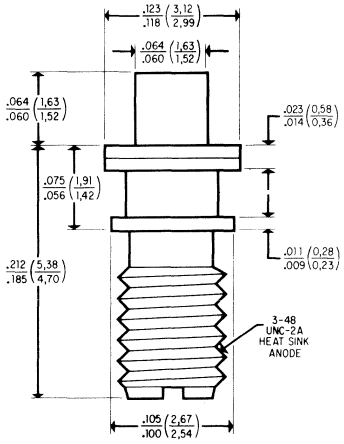


Outline 61

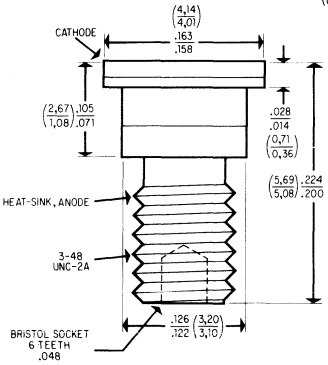




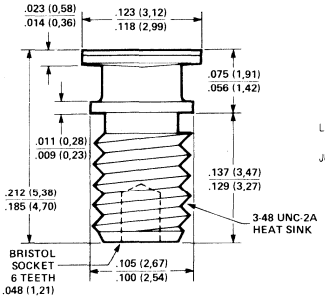
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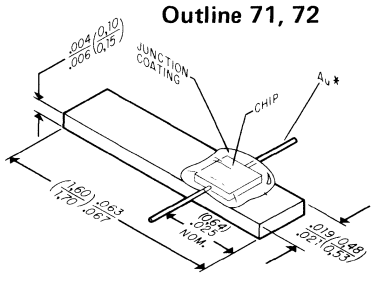
Outline 64



Outline 65

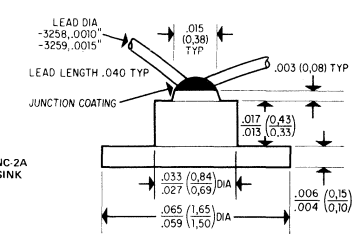


Outline 71, 72



* 71 MINI STRIP HAS ONLY ONE LEAD

Outline 74



Note: All dimensions in inches and (millimeters).

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E 11/73

Application Note Index

Application Note 95

S-Parameters . . . Circuit Analysis and Design

The design and analysis of high-frequency circuits — traditionally a time-consuming "cut-and-try" proposition — can be greatly accelerated by characterizing circuit elements and networks in terms of their scattering parameters. This note is a compilation of several recent articles on s-parameters and their use. Among the subjects treated are: development of the design equations, transistor characterization techniques, determination of stability criteria, and effects of imperfect terminations. Several circuit design examples are described, including the use of computer-aided methods. Techniques for measurement of s-parameters are also described.

Application Note 154

S-Parameter Design

This note is the illustrated script for HP's four-part video tape presentation, "S-Parameter Design Seminar" — a contemporary approach to the design of high frequency solid-state circuits. After reviewing such concepts as s-parameters, the Smith Chart, signal flowgraphs, and stability considerations, the note discusses s-parameter characterization of microwave transistors and the application of constant gain and constant noise figure circles in the design of high-frequency amplifiers.

Application Note 922

Application of PIN Diodes

Discusses how the PIN diode can be applied to a variety of RF control circuits. Such applications as attenuating, leveling, amplitude and pulse modulating, switching, and phase shifting are discussed in detail. Also examines some of the important properties of the PIN diode and how they affect its application.

Application Note 923

Hot Carrier Diode Video Detectors

Describes the characteristics of HP Schottky barrier (hot carrier) diodes intended for use in video detector or video receiver circuits, and discusses some design features of such circuits. Though less sensitive than the heterodyne receiver, the many advantages of the video receiver make it extremely useful. The Schottky diode can be used to advantage in applications such as beacon, missile-guidance, fuse-activating, and countermeasure receivers, and as power leveling and signal monitoring detectors. Among the subjects discussed are the performance characteristics of video detector diodes — tangential sensitivity, video resistance, voltage sensitivity and figure of merit; how these characteristics affect optimum video detector sensitivity; considerations that affect the bandwidth of a video detector; video detector design considerations; considerations that affect dynamic range; and considerations that vary the level at which burnout can occur.

Application Note 928

Ku-Band Step Recovery Multipliers

Discusses use of step-recovery diodes in a times-eight single-state frequency multiplier which, at 16GHz, has a typical maximum output of 75mW. The note also provides design modifications, together with references, for meeting other performance requirements.

Application Note 929

Fast Switching PIN Diodes

Discusses the switching speed of the PIN diodes and the considerations which affect switching capability. For HP's 5082-3041/3042 fast-switching PIN diodes, AN 929 outlines basic drive requirements and comments on a few practical switching circuits. Considerations involved in the design of the filters required for use with the diodes are also discussed. For the 5082-3041, AN 929 provides two curves; 1) typical isolation vs. forward bias and 2) switching time vs. forward bias for peak reverse current as a parameter.

Application Note 935

Microwave Power Generation and Amplification using IMPATT Diodes

Describes the construction and principles of operation of microwave avalanche (IMPATT) diodes. This note presents practical circuit designs and describes how these devices meet the stringent oscillator noise requirements of most military and commercial microwave systems.

Application Note 936

High Performance PIN Attenuator for Low-Cost AGC Applications

PIN diodes offer an economical way of achieving excellent performance in AGC circuits. Significant improvements in crossmodulation and intermodulation distortion performance are obtained, compared to transistors. This note discusses other advantages of PIN diodes, such as low frequency operation, constant impedance levels, and low power consumption.

Application Note 940

Diodes for Hybrid Integrated Circuits

Better reproducibility, lower cost and the smaller size of hybrid integrated circuits mean that they are replacing circuit boards with packaged diodes. This note discusses the different diode package styles for hybrid integrated circuits; chips, beam lead, ministrip, leadless inverted device (LID), and microstrip post. Also presents a technique for designing impedance matching elements.

Application Note 942

Schottky Diodes for High Volume, Low Cost Applications

Discusses switching, sampling, mixing and other applications where the substitution of Schottky diodes will provide significant improvement over PN junction devices.

Application Note 944-1

Microwave Transistor Bias Considerations

A practical discussion of the temperature-dependent variables in a microwave transistor that cause RF performance degradation due to changes in quiescent point. Passive circuit networks that minimize quiescent point drift with temperature are analyzed, and the general equations for dc stability factors are given. Emphasis on practical circuit design is highlighted by typical circuit examples.

Application Note 956-1

The Criterion for the Tangential Sensitivity Measurement

This application note addresses itself to the details of making TSS measurements on detector diodes.

Application Note 956-2

The E-2 Mixer Equivalent Circuit

This note derives the equivalent circuit of the 5082-2217 Schottky barrier mixer diode.



COMPONENTS

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