YAESU

FT-1500M

VHF FM Transceiver
Technical Supplement

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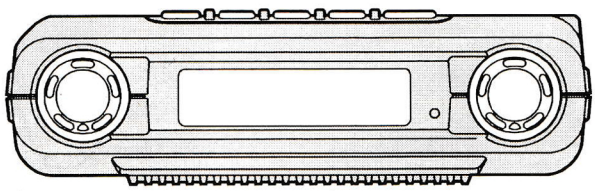

Introduction

This manual provides the technical information necessary for servicing the FT-1500M 144 MHz Band FM Transceiver.

Servicing this equipment requires expertise in handing surface-mount chip components. Attempts by non-qualified persons to service this equipment may result in permanent damage not covered by the warranty, and may be illegal in some countries.

Two PCB layout diagrams are provided for each double-sided board in this transceiver. Each side of the board is referred to by the type of the majority of components installed on that side ("Side A" or "Side B"). In most cases one side has only chip components (surface-mount devices), and the other has either a mixture of both chip and leaded components (trimmers, coils, electrolytic capacitors, ICs, etc.), or leaded components only.

As described in the pages to follow, the advanced microprocessor design of the FT-1500M allows a complete alignment of this transceiver to be performed without opening the case of the radio; all adjustments can be performed from the front panel, using the "Alignment Mode" menu.

While we believe the information in this manual to be correct, Yaesu Musen assumes no liability for damage that may occur as a result of typographical or other errors that may be present. Your cooperation in pointing out any inconsistencies in the technical information would be appreciated.

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Specifications

GENERAL

Frequency Range:	TX: 144 - 146 or 144 - 148 MHz
	RX: 144 - 146 or 137 - 174 MHz
Channel steps:	5, 10, 12.5, 15, 20, 25, 50 & 100 kHz
Frequency Stability:	Better than ±10 ppm (–20° to +60°C)
Standard repeater shift:	±600 kHz
Mode of Emission:	F2, F3
Antenna Impedance:	50 Ω, unbalanced
Supply voltage:	13.8 VDC (±10%), negative ground
Current consumption (typical):	RX: less than 0.7A (max. signal)
	less than 0.3A (squelched)
	TX: 8 A (50W)/6 A (25W)/3A (10W)/2A (5W)
Operating Temperature Range:	–20° to +60°C (–4° to +140° F)
Case size (WHD):	127 x 35 x 126 mm (5 x 1.4 x 5 inch)
	(w/o knobs & connectors)
Weight (approx.):	1 kg (2.2 lb.)

TRANSMITTER

Output Power:	50 W/25W/10W/5W
Modulation Type:	Variable Reactance
Maximum deviation:	±5 kHz/±2.5 kHz
Spurious Radiation:	better than –60 dB
Microphone Impedance:	2-kΩ

RECEIVER

Circuit type:	Double-conversion superheterodyne
Intermediate Frequencies:	21.7 MHz & 450 kHz
Sensitivity (for 12dB SINAD):	better than 0.2 µV
Selectivity (–6/–60dB):	12 kHz/28 kHz
IF Rejection:	better than 70 dB
Image Rejection:	better than 70 dB
Maximum AF Output:	3.5 W @4 Ω for 10% THD

Specifications subject to change without notice or obligation.

Specifications guaranteed only within the amateur band.

Frequency range and repeater shift may vary according to local requirements and regulations

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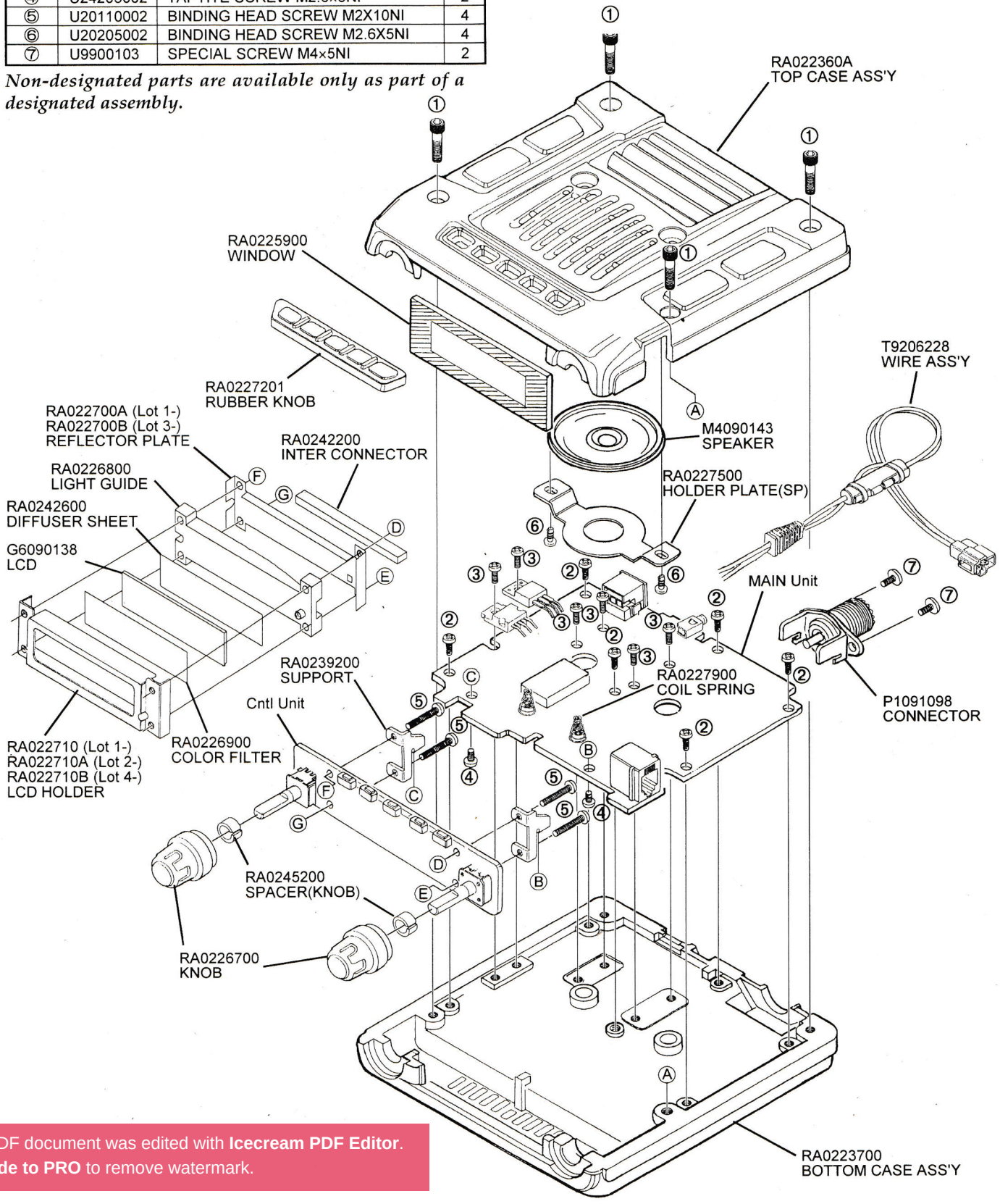
Exploded View & Miscellaneous Parts

REF.	YAESU P/N	Description	Qty.
①	U9900107	HEXA SOCKET HEAD BOLT SM4×20B	4
②	U24308002 U24306002	TAPTITE SCREW M3×8NI (Lot -3) TAPTITE SCREW M3×6NI (Lot 4-)	6
③	U02312002 U02310002	SEMS SCREW SM3×12NI (Lot -3) SEMS SCREW SM3×10NI (Lot 4-)	6
④	U24205002	TAPTITE SCREW M2.6×5NI	2
⑤	U20110002	BINDING HEAD SCREW M2X10NI	4
⑥	U20205002	BINDING HEAD SCREW M2.6X5NI	4
⑦	U9900103	SPECIAL SCREW M4×5NI	2

Non-designated parts are available only as part of a designated assembly.



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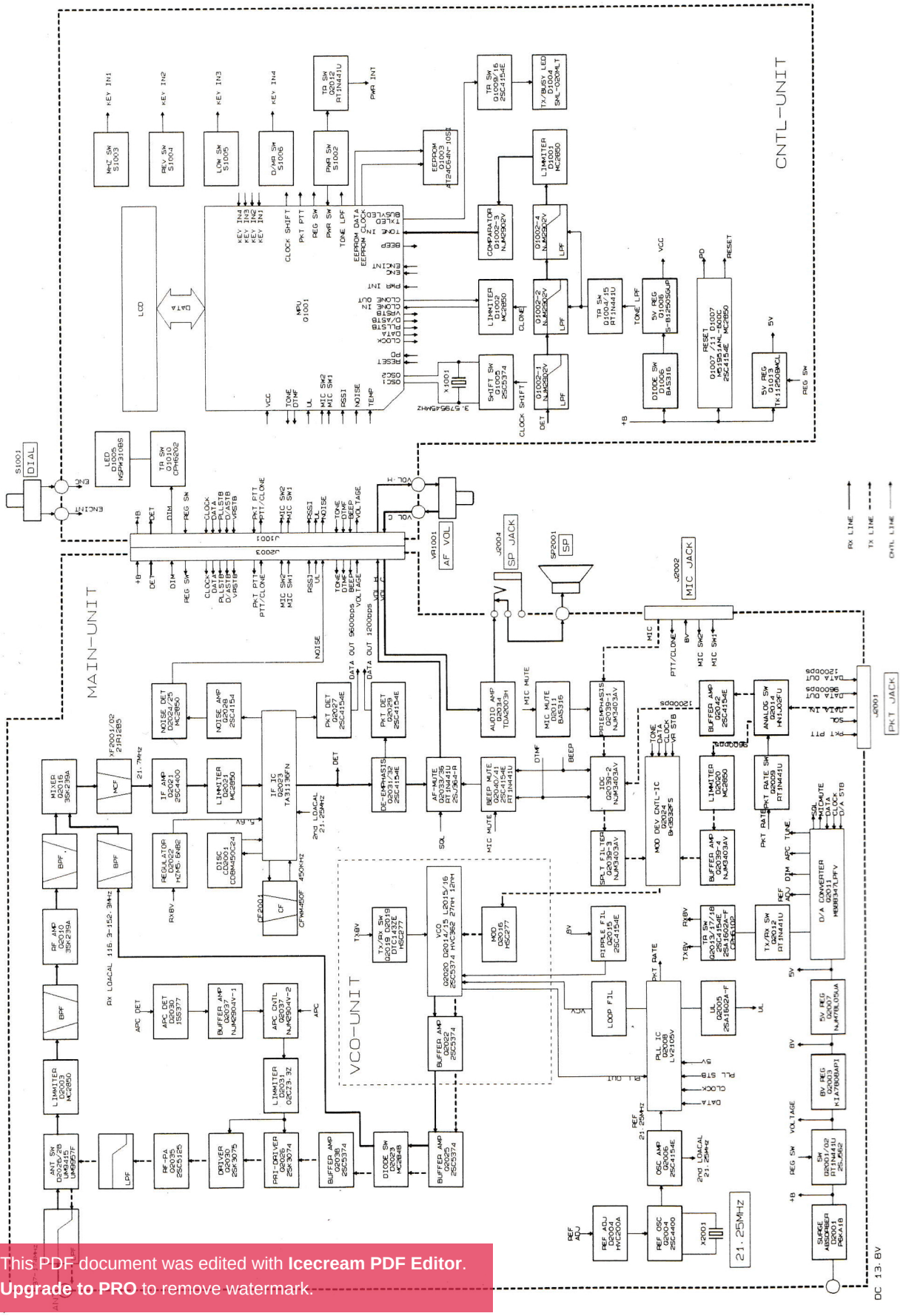
Block Diagram



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Introduction

The FT-1500M has been carefully aligned at the factory for the specified performance across the amateur band. Realignment should therefore not be necessary except in the event of a component failure. All component replacement and service should be performed only by an authorized Yaesu representative, or the warranty policy may be voided.

The following procedures cover the sometimes critical and tedious adjustments that are not normally required once the transceiver has left the factory. However, if damage occurs and some parts are replaced, realignment may be required. If a sudden problem occurs during normal operation, it is likely due to component failure; realignment should not be done until after the faulty component has been replaced.

We recommend that servicing be performed only by authorized Yaesu service technicians who are experienced with the circuitry and fully equipped for repair and alignment. Therefore, if a fault is suspected, contact the dealer from whom the transceiver was purchased for instructions regarding repair. Authorized Yaesu service technicians realign all circuits and make complete performance checks to ensure compliance with factory specifications after replacing any faulty components. Those who do undertake any of the following alignments are cautioned to proceed at their own risk. Problems caused by unauthorized attempts at realignment are not covered by the warranty policy. Also, Yaesu must reserve the right to change circuits and alignment procedures in the interest of improved performance, without notifying owners. Under no circumstances should any alignment be attempted unless the normal function and operation of the transceiver are clearly understood, the cause of the malfunction has been clearly pinpointed and any faulty components replaced, and the need for realignment determined to be absolutely necessary.

Required Test Equipment

The following test equipment (and thorough familiarity with its correct use) is necessary for complete realignment. Correction of problems caused by misalignment resulting from use of improper test equipment is not covered under the warranty policy. While most steps do not require all of the equipment listed, the interactions of some adjustments may require that more complex adjustments be performed afterwards. Do not attempt to perform only a single step unless it is clearly isolated electrically from all other steps. Have all test equipment ready before beginning, and follow all of the steps in a section in the order presented.

- ❍ RF Signal Generator with calibrated output level at 200 MHz
- ❍ Deviation Meter (linear detector)
- ❍ AC Voltmeter
- ❍ SINAD Meter
- ❍ Inline Wattmeter with 5% accuracy at 200 MHz
- ❍ Regulated DC Power Supply: adjustable from 9 to 16.5 VDC, 15A
- ❍ 50-Ohm Non-reactive Dummy Load: 100 W at 200 MHz
- ❍ Frequency Counter: ±0.1 ppm accuracy at 200 MHz
- ❍ AF Signal Generator
- ❍ DC Voltmeter: high impedance
- ❍ VHF Sampling Coupler
- ❍ AF Dummy Load: 4-Ohms, 5W

Alignment Preparation & Precautions

A dummy load and inline wattmeter must be connected to the main antenna jack in all procedures that call for transmission, except where specified otherwise. Correct alignment is not possible with an antenna. After completing one step, read the following step to determine whether the same test equipment will be required. If not, remove the test equipment (except dummy load and wattmeter, if connected) before proceeding.

Correct alignment requires that the ambient temperature in the repair shop be the same as that of the transceiver and test equipment, and that this temperature be held constant between 20° and 30°C (68° ~ 86°F). When the transceiver is brought into the shop from hot or cold air it should be allowed some time for thermal equalization with the environment before alignment. If possible, alignments should be made with oscillator shields and circuit boards firmly affixed in place. Also, the test equipment must be thoroughly warmed up before beginning.

Enabling the "Alignment Mode" of the FT-1500M

Complete alignment of the FT-1500M can be accomplished without opening the case of the transceiver, as all alignment steps may be performed, using the front panel controls and switches, via the FT-1500M's special "Alignment Mode." The "Alignment Mode involves the use of a special Alignment Menu, which allows adjustment of all internal adjustment parameters.

Before beginning alignment, turn the transceiver off. Press and hold in the **[LOW]**, and **[D/MR]** keys, and hold them in while you turn the radio on again. The transceiver now will be in the "Alignment Mode."

Note: Signal levels in dB referred to in this procedure are based on 0 dBμ = 0.5 μV (closed circuit).

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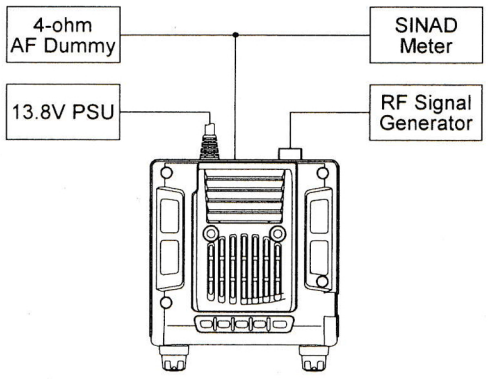
Alignment

PLL & Transmitter

Set up the test equipment as shown for transmitter alignment.

Maintain the supply voltage at 13.8V DC for all steps.



TX Alignment Setup

TX Frequency Setting

During alignment, four different alignment frequencies will be utilized. So as to allow the transceiver to be peaked for maximum performance in the most-often-used frequency segments preferred by the operator, use this step to set up these alignment points. The examples below assume that the transceiver is to be used in a 4-MHz-wide band (144-148 MHz).

Note: It is not possible to guarantee 50 Watts of power output outside the frequency range 144-148 MHz.

- ❒ Rotate the Main Dial knob to change the display to "TX DEF."
- ❒ Press the **[MHz]** key, then rotate the Main Dial knob to change the "**T1**" frequency to the desired lower limit. (for example, set to 144.000 MHz).
- ❒ Press ***and hold*** the **[LOW]** key, then rotate the Main Dial knob to change the "**T2**" frequency which is at least 100 kHz higher than the lower limit. (for example, set to 145.500 MHz).
- ❒ Press ***and hold*** the **[LOW]** key, then rotate the Main Dial knob to change the "**T3**" frequency which is at least 100 kHz below the upper limit. (for example, set to 146.500 MHz).
- ❒ Press ***and hold*** the **[LOW]** key, then rotate the Main Dial knob to change the "**T4**" frequency to the desired upper limit. (for example, set to 148.000 MHz).
- ❒ Press the **[MHz]** key to exit to the "Alignment Mode" (selection screen).

PLL Reference Frequency

- ❒ Connect the wattmeter, dummy load and frequency counter to the antenna jack.
- ❒ Rotate the Main Dial knob to change the display to "TX FRQ."
- ❒ Press the **[MHz]** key.
- ❒ Key the transmitter, and adjust Main Dial knob, if necessary, so the counter frequency is within 100 Hz of the "**T2**" frequency.
- ❒ Press the **[MHz]** key to exit to the "Alignment Mode."

Transmitter Output

(T1 Frequency)

- ❒ Rotate the Main Dial knob to change the display to "TX PWR."
- ❒ Press the **[MHz]** key. You will now align the "L1" (Low Power 1) setting.
- ❒ Key the transmitter, and rotate the Main Dial knob so as to achieve 5 W (±0.5 W) on the wattmeter.
- ❒ Press the **[LOW]** key. You will now align the "L2" (Low Power 2) setting.
- ❒ Key the transmitter, and rotate the Main Dial knob so as to achieve 10 W (±1.0 W) on the wattmeter.
- ❒ Press the **[LOW]** key. You will now align the "L3" (Low Power 3) setting.
- ❒ Key the transmitter, and rotate the Main Dial knob so as to achieve 25 W (±2.0 W) on the wattmeter.
- ❒ Press the **[LOW]** key. You will now align the "HI" (High Power) setting.
- ❒ Key the transmitter, and rotate the Main Dial knob so as to achieve 50 W (±3.0 W) on the wattmeter.

(T2 Frequency)

- ❒ Press ***and hold*** the **[LOW]** key. You will now align the "L1" (Low Power 1) setting.
- ❒ Key the transmitter, and rotate the Main Dial knob so as to achieve 5 W (±0.5 W) on the wattmeter.
- ❒ Press the **[LOW]** key. You will now align the "L2" (Low Power 2) setting.
- ❒ Key the transmitter, and rotate the Main Dial knob so as to achieve 10 W (±1.0 W) on the wattmeter.
- ❒ Press the **[LOW]** key. You will now align the "L3" (Low Power 3) setting.
- ❒ Key the transmitter, and rotate the Main Dial knob so as to achieve 25 W (±2.0 W) on the wattmeter.
- ❒ Press the **[LOW]** key. You will now align the "HI" (High Power) setting.
- ❒ Key the transmitter, and rotate the Main Dial knob so as to achieve 50 W (±3.0 W) on the wattmeter.

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(T3 Frequency)

- ❒ Press ***and hold*** the **[LOW]** key. You will now align the "L1" (Low Power 1) setting.
- ❒ Key the transmitter, and rotate the Main Dial knob so as to achieve 5 W (±0.5 W) on the wattmeter.
- ❒ Press the **[LOW]** key. You will now align the "L2" (Low Power 2) setting.
- ❒ Key the transmitter, and rotate the Main Dial knob so as to achieve 10 W (±1.0 W) on the wattmeter.
- ❒ Press the **[LOW]** key. You will now align the "L3" (Low Power 3) setting.
- ❒ Key the transmitter, and rotate the Main Dial knob so as to achieve 25 W (±2.0 W) on the wattmeter.
- ❒ Press the **[LOW]** key. You will now align the "HI" (High Power) setting.
- ❒ Key the transmitter, and rotate the Main Dial knob so as to achieve 50 W (±3.0 W) on the wattmeter.

(T4 Frequency)

- ❒ Press ***and hold*** the **[LOW]** key. You will now align the "L1" (Low Power 1) setting.
- ❒ Key the transmitter, and rotate the Main Dial knob so as to achieve 5 W (±0.5 W) on the wattmeter.
- ❒ Press the **[LOW]** key. You will now align the "L2" (Low Power 2) setting.
- ❒ Key the transmitter, and rotate the Main Dial knob so as to achieve 10 W (±1.0 W) on the wattmeter.
- ❒ Press the **[LOW]** key. You will now align the "L3" (Low Power 3) setting.
- ❒ Key the transmitter, and rotate the Main Dial knob so as to achieve 15 (25?) W (±2.0 W) on the wattmeter.
- ❒ Press the **[LOW]** key. You will now align the "HI" (High Power) setting.
- ❒ Key the transmitter, and rotate the Main Dial knob so as to achieve 20 (50) W (±3.0 W) on the wattmeter.
- ❒ Press the **[MHz]** key to exit to the "Alignment Mode."

Transmitter Deviation

The alignment procedures for Voice Deviation and CTCSS Deviation are performed individually, for best precision in alignment.

- ❒ Connect the AF generator to the MIC jack, and inject a 50 mV signal at 1 kHz frequency to pin 5 (Mic input) and pin 4 (Ground) of the MIC jack.
- ❒ Rotate the Main Dial knob to change the display to "MAXDEV."
- ❒ Press the **[MHz]** key. You will now set the Deviation at the "**T1**" frequency.
- ❒ Key the transmitter, and rotate the Main Dial knob to achieve ±4.2 kHz deviation on the deviation meter (within 0.1 kHz).
- ❒ Press ***and hold*** the **[LOW]** key. You will now set the Deviation at the "**T2**" frequency.
- ❒ Key the transmitter, and rotate the Main Dial knob to achieve ±4.2 kHz deviation on the deviation meter (within 0.1 kHz).
- ❒ Press ***and hold*** the **[LOW]** key. You will now set the Deviation at the "**T3**" frequency.
- ❒ Key the transmitter, and rotate the Main Dial knob to achieve ±4.2 kHz deviation on the deviation meter (within 0.1 kHz).
- ❒ Press ***and hold*** the **[LOW]** key. You will now set the Deviation at the "**T4**" frequency.
- ❒ Key the transmitter, and rotate the Main Dial knob to achieve ±4.2 kHz deviation on the deviation meter (within 0.1 kHz).
- ❒ Press the **[MHz]** key to exit to the "Alignment Mode."

For alignment of the CTCSS Deviation, four different CTCSS Tone frequencies are use on each transmitter test frequency. This ensures highly-consistent Tone Deviation settings.

(67 Hz Tone Alignment, "T1" Frequency)

- ❒ Rotate the Main Dial knob to change the display to "TONDEV."
- ❒ Press the **[MHz]** key, and reduce the AF generator injection to zero. Key the transmitter, and rotate Main Dial knob to achieve ±0.6 kHz deviation on the deviation meter (within 0.1 kHz).

(100 Hz Tone Alignment, "T1" Frequency)

- ❒ Press the **[LOW]** key.
- ❒ Key the transmitter, and rotate Main Dial knob to achieve ±0.6 kHz deviation on the deviation meter (within 0.1 kHz).

(151.4 Hz Tone Alignment, "T1" Frequency)

- ❒ Press the **[LOW]** key.
- ❒ Key the transmitter, and rotate Main Dial knob to achieve ±0.6 kHz deviation on the deviation meter (within 0.1 kHz).

(250.3 Hz Tone Alignment, "T1" Frequency)

- ❒ Press the **[LOW]** key.
- ❒ Key the transmitter, and rotate Main Dial knob to achieve ±0.6 kHz deviation on the deviation meter (within 0.1 kHz).

(67 Hz Tone Alignment, "T2" Frequency)

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Alignment

❒ Press *and hold* the [**LOW**] key.
❒ Key the transmitter, and rotate Main Dial knob to achieve ±0.6 kHz deviation on the deviation meter (within 0.1 kHz).

(100 Hz Tone Alignment, "T2" Frequency)
❒ Press the [**LOW**] key.
❒ Key the transmitter, and rotate Main Dial knob to achieve ±0.6 kHz deviation on the deviation meter (within 0.1 kHz).

(151.4 Hz Tone Alignment, "T2" Frequency)
❒ Press the [**LOW**] key.
❒ Key the transmitter, and rotate Main Dial knob to achieve ±0.6 kHz deviation on the deviation meter (within 0.1 kHz).

(250.3 Hz Tone Alignment, "T2" Frequency)
❒ Press the [**LOW**] key.
❒ Key the transmitter, and rotate Main Dial knob to achieve ±0.6 kHz deviation on the deviation meter (within 0.1 kHz).

(67 Hz Tone Alignment, "T3" Frequency)
❒ Press *and hold* the [**LOW**] key.
❒ Key the transmitter, and rotate Main Dial knob to achieve ±0.6 kHz deviation on the deviation meter (within 0.1 kHz).

(100 Hz Tone Alignment, "T3" Frequency)
❒ Press the [**LOW**] key.
❒ Key the transmitter, and rotate Main Dial knob to achieve ±0.6 kHz deviation on the deviation meter (within 0.1 kHz).

(151.4 Hz Tone Alignment, "T3" Frequency)
❒ Press the [**LOW**] key.
❒ Key the transmitter, and rotate Main Dial knob to achieve ±0.6 kHz deviation on the deviation meter (within 0.1 kHz).

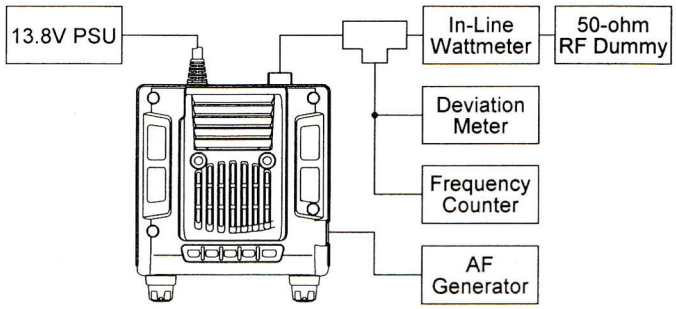
(250.3 Hz Tone Alignment, "T3" Frequency)
❒ Press the [**LOW**] key.
❒ Key the transmitter, and rotate Main Dial knob to achieve ±0.6 kHz deviation on the deviation meter (within 0.1 kHz).

(67 Hz Tone Alignment, "T4" Frequency)
❒ Press *and hold* the [**LOW**] key.
❒ Key the transmitter, and rotate Main Dial knob to achieve ±0.6 kHz deviation on the deviation meter (within 0.1 kHz).

(100 Hz Tone Alignment, "T4" Frequency)
❒ Press the [**LOW**] key.
❒ Key the transmitter, and rotate Main Dial knob to achieve ±0.6 kHz deviation on the deviation meter (within 0.1 kHz).

(151.4 Hz Tone Alignment, "T4" Frequency)
❒ Press the [**LOW**] key.
❒ Key the transmitter, and rotate Main Dial knob to achieve ±0.6 kHz deviation on the deviation meter (within 0.1 kHz).

(250.3 Hz Tone Alignment, "T4" Frequency)
❒ Press the [**LOW**] key.
❒ Key the transmitter, and rotate Main Dial knob to achieve ±0.6 kHz deviation on the deviation meter



RX Alignment Setup

(within 0.1 kHz).
❒ Press the [**MHz**] key to exit to the "Alignment Mode."

Receiver

Set up the test equipment as shown below for receiver alignment.

RX Frequency Setting

The alignment frequency points for the receiver may be set to different frequencies from those utilized for transmitter alignment. This allows the FT-1500M to be aligned optimally for a 144-148 MHz transmit range, with a receive range of 140-165 MHz, if desired. If the full 137-174 MHz capability of the FT-1500M is desired, just used the default values ion the procedure below.

❒ Rotate the Main Dial knob to change the display to "RX DEF."
❒ Press the [**MHz**] key, then rotate the Main Dial knob to change the "**R1**" frequency. The default frequency is 137.100 MHz.

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- ❒ Press *and hold* the [**LOW**] key, then rotate the Main Dial knob to change the "**R2**" frequency. The default frequency is 146.100 MHz.
- ❒ Press *and hold* the [**LOW**] key, then rotate the Main Dial knob to change the "**R3**" frequency. The default frequency is 160.100 MHz.
- ❒ Press *and hold* the [**LOW**] key, then rotate the Main Dial knob to change the "**R4**" frequency. The default frequency is 173.900 MHz.
- ❒ Press the [**MHz**] key to exit to the "Alignment Mode."

Interstage Transformers

- ❒ Connect the RF signal generator to the antenna jack.

(R1 Frequency)

- ❒ Tune the RF signal generator to the "**R1**" frequency. Inject an RF signal with ±3.5 kHz deviation of a 1 kHz tone.
- ❒ Rotate the Main Dial knob to change the display to "RX TUN."
- ❒ Press the [**MHz**] key, then rotate the Main Dial knob for optimum SINAD, reducing the signal generator output level as necessary for proper meter deflection (ultimately, the input signal level should not exceed –7.5 dBµ for 12 dB SINAD).

(R2 Frequency)

- ❒ Tune the RF signal generator to the "**R2**" frequency. Inject an RF signal with ±3.5 kHz deviation of a 1 kHz tone.
- ❒ Press *and hold* the [**LOW**] key, then rotate the Main Dial knob for optimum SINAD, reducing the signal generator output level as necessary for proper meter deflection (ultimately, the input signal level should not exceed –7.5 dBµ for 12 dB SINAD).

(R3 Frequency)

- ❒ Tune the RF signal generator to the "**R3**" frequency. Inject an RF signal with ±3.5 kHz deviation of a 1 kHz tone.
- ❒ Press *and hold* the [**LOW**] key, then rotate the Main Dial knob for optimum SINAD, reducing the signal generator output level as necessary for proper meter deflection (ultimately, the input signal level should not exceed –7.5 dBµ for 12 dB SINAD).

(R4 Frequency)

- ❒ Tune the RF signal generator to the "**R4**" frequency. Inject an RF signal with ±3.5 kHz deviation of a 1 kHz tone.
- ❒ Press *and hold* the [**LOW**] key, then rotate the Main Dial knob for optimum SINAD, reducing the signal generator output level as necessary for proper meter deflection (ultimately, the input signal level should not exceed –7.5 dBµ for 12 dB SINAD).
- ❒ Press the [**MHz**] key to exit to the "Alignment Mode."

Squelch

- ❒ Tune the RF signal generator to the "**R2**" frequency, and inject a –13.0 dBµ RF signal (no modulation) to the antenna jack.
- ❒ Rotate the Main Dial knob to change the display to "SQL."
- ❒ Press the [**MHz**] key, then press the [LOW] key.
- ❒ Press *and hold* the [**LOW**] key, then press the [**LOW**] key.
- ❒ Leave the RF signal generator at the "**R2**" frequency, and inject a –4.0 dBµ RF signal (no modulation) to the antenna jack.
- ❒ Press the [**LOW**] key, then press *and hold* the [**LOW**] key.
- ❒ Press the [**LOW**] key.
- ❒ Press the [**MHz**] key to exit to the "Alignment Mode."

S-Meter Calibration

(S-1 Level Calibration)

- ❒ Tune the RF signal generator to the "**R2**" frequency, and inject a –7.0 dBµ RF signal (no modulation) to the antenna jack.
- ❒ Rotate the Main Dial knob to change the display to "S MTR."
- ❒ Press the [**MHz**] key, then press *and hold* [LOW] key.
- ❒ Press the [**LOW**] key.

(Full-Scale Calibration)

- ❒ Tune the RF signal generator to the "**R2**" frequency, and inject a +20 dBµ RF signal (no modulation) to the antenna jack.
- ❒ Press the [**LOW**] key, then press *and hold* the [LOW] key.
- ❒ Press the [**LOW**] key.
- ❒ Press the [**MHz**] key to exit to the "Alignment Mode."

Exiting the Alignment Mode

- ❒ Press the [**REV**] key to exit to normal operation.

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J2001			
1	0V (0V)	5	0V (0V)
3	5.0V (0V)	6	4.8V (0V)
4	0V (0V)		

J2002			
1	5.0V (5.0V)	5	0V (0V)
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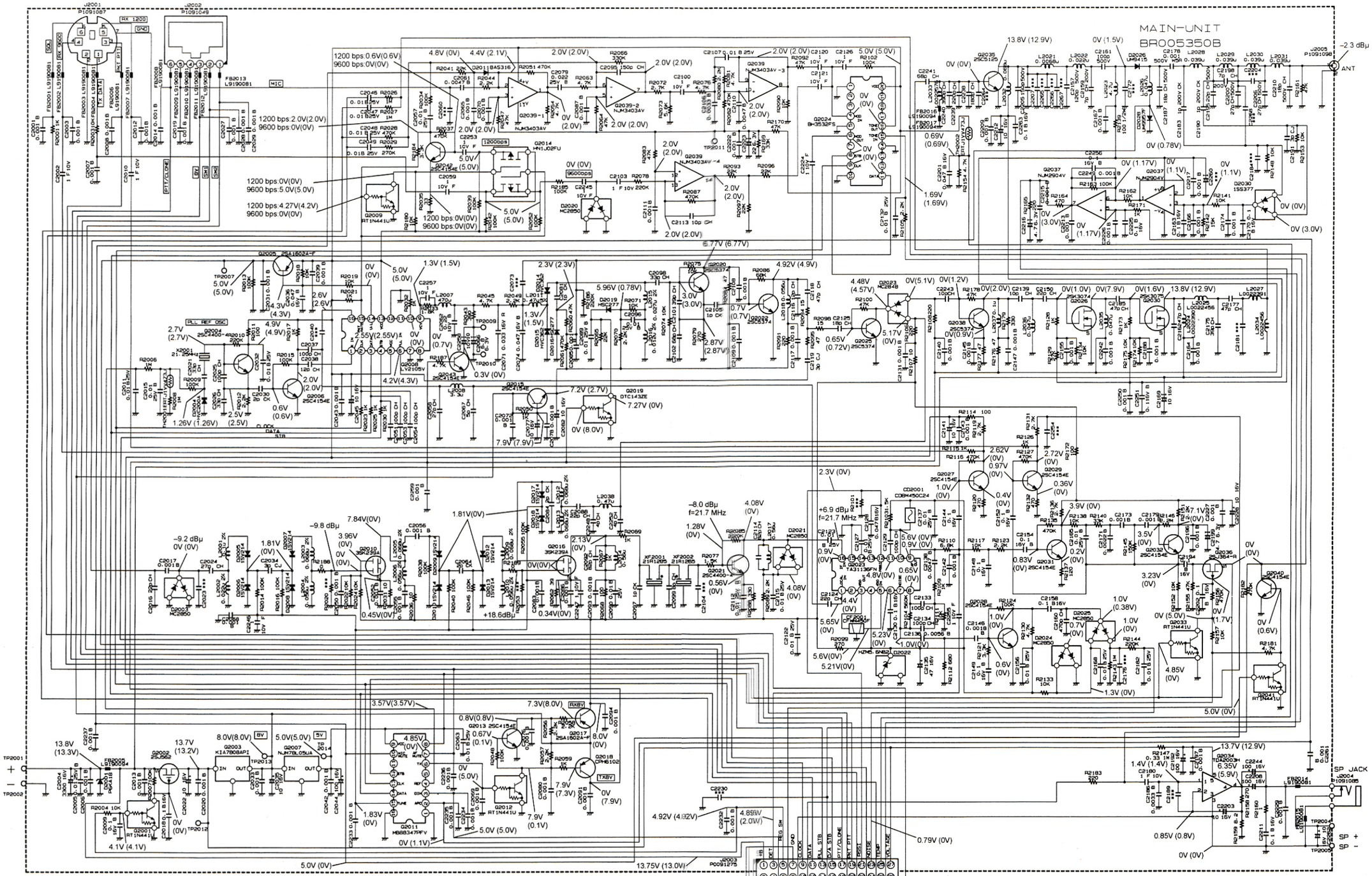
3	8.0V (8.0V)		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PTT CLONE
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1200 bps:0.6V(0.6V)
9600 bps:0V(0V)
1200 bps:2.0V(2.0V)
9600 bps:0V(0V)
1200 bps:0V(0V)
9600 bps:5.0V(5.0V)
1200 bps:4.27V(4.2V)
9600 bps:0V(0V)
1200 bps:0V(0V)
9600 bps:0V(0V)
PLL REF OSC
X2001
21-25444
Q2004 2SA1602A-F
Q2005 2SA1602A-F
Q2006 2SC4154E
Q2007 2SC4154E
Q2008 LV2105V
Q2009 RT1N441U
Q2010 2SC4154E
Q2011 MB88347PFV
Q2012 RT1N441U
Q2013 2SC4154E
Q2014 HN1J02FU
Q2015 2SC4154E
Q2016 3SK239A
Q2017 2SA1602A-F
Q2018 CPH6102
Q2019 DTC143ZE
Q2020 2SC5374
Q2021 2SC4400-T
Q2022 2SC4154E
Q2023 TA31136FN
Q2024 BH3532FS
Q2025 2SC4154E
Q2026 2SK3074
Q2027 2SC4154E
Q2028 2SC5374
Q2029 2SC4154E
Q2030 2SK3075
Q2031 2SC4154E
Q2032 2SC4154E
Q2033 RT1N441U
Q2034 TDA2003H
Q2035 2SC5125
Q2036 2SC5364-R
Q2037 NJM2904V
Q2038 2SC5374
Q2039 NJM4403AV
Q2039-1 NJM4403AV
Q2039-2 NJM4403AV
Q2039-3 NJM4403AV
Q2039-4 NJM4403AV
Q2040 2SC4154E
D2001 MC2850
D2002 MC2850
D2003 MC2850
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D2007 MC2850
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D2013 MC2850
D2014 MC2850
D2015 MC2850
D2016 MC2850
D2017 MC2850
D2018 MC2850
D2019 HSC277
D2020 MC2850
D2021 MC2848
D2022 HZM5.6NB2
D2023 MC2850
D2024 MC2850
D2025 MC2850
D2026 UM9415
D2027 1SS377
D2028 1SS133
D2029 RT1N441U
D2030 1SS377
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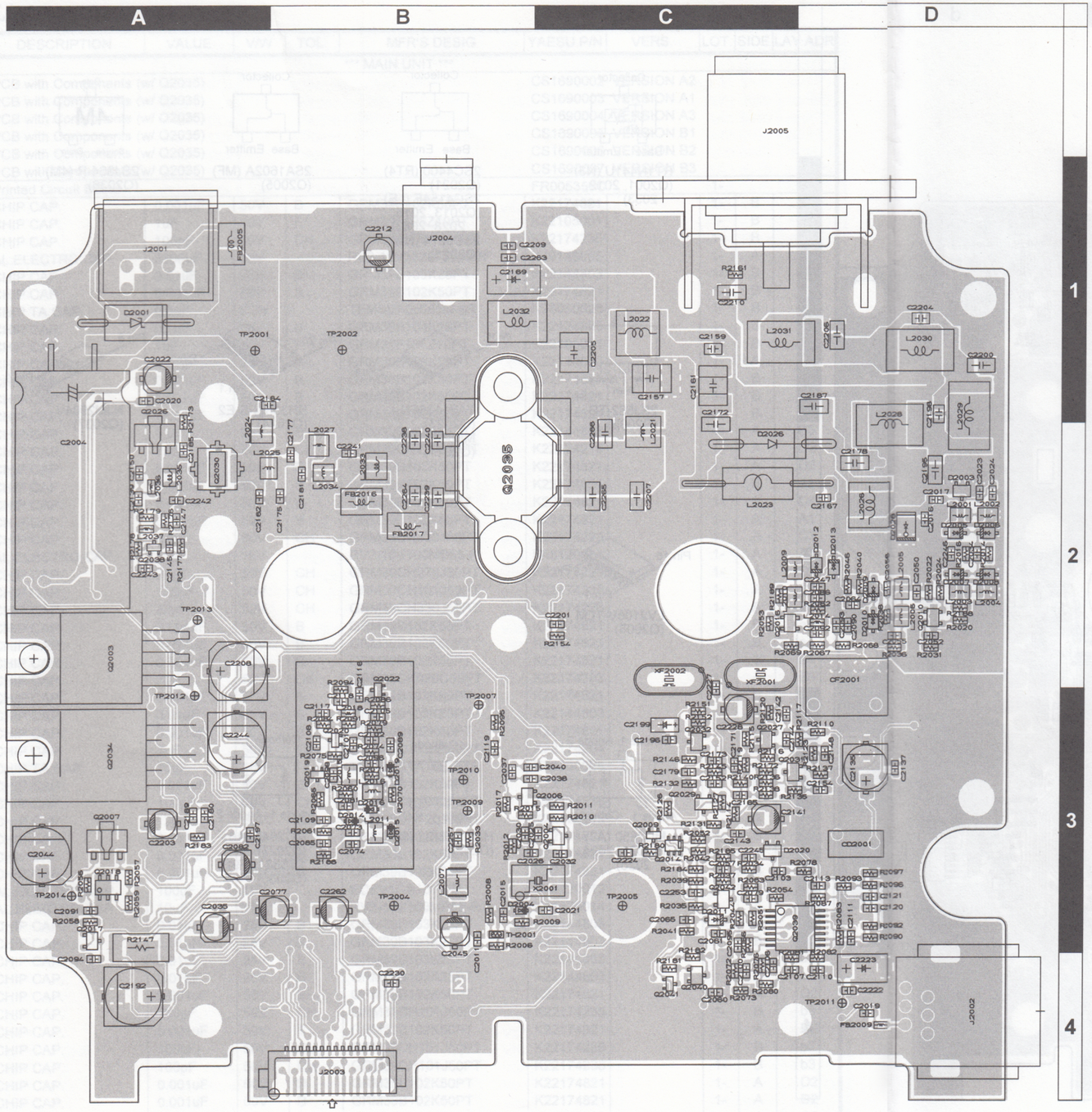

Collector
47k
47k
Base Emitter
RT1N441U (N3)
(Q2009, 2041)

Collector
Base Emitter
2SC4400 (RT4)
(Q2004)
2SC4154E (LE)
(Q2006, 2027, 2029, 2031, 2032, 2040, 2042)
2SC5374 (NA)
(Q2020, 2022, 2038)

Collector
Base Emitter
2SA1602A (MF)
(Q2017)

8C
OUT IN
Common
NJM78L05UA (8C)
(Q2007)

Drain1 Gate2 Source2
Source1 Gate1 Drain2
HN1J02FU (KS)
(Q2014)

Collector
Collector Emitter
Collector Base
Collector
CPH6102 (AB)
(Q2018)

Collector
47k
4.7k
Base Emitter
DTC143ZE (E23)
(Q2019)

WA
Gate Drain
Source
2SK3074 (WA)
(Q2026)

Source
Gate Drain
Source
2SK3075
(Q2030)

Pin 8
Pin 4
Pin 1
NJM3403AV
(Q2039)

Pin 1
Pin 5
TDA2003H
(Q2034)

Output
Common
Input
KIA7808API
(Q2003)

Collector
Emitter Emitter
Base
2SC5125
(Q2035)

Gate 2 Gate1
Drain Source
3SK239AXRTL
(Q2010, 2016)

Cathode 1, Anode 2
Anode 1 Cathode 2
MC2850 (A7)
(D2003, 2020)

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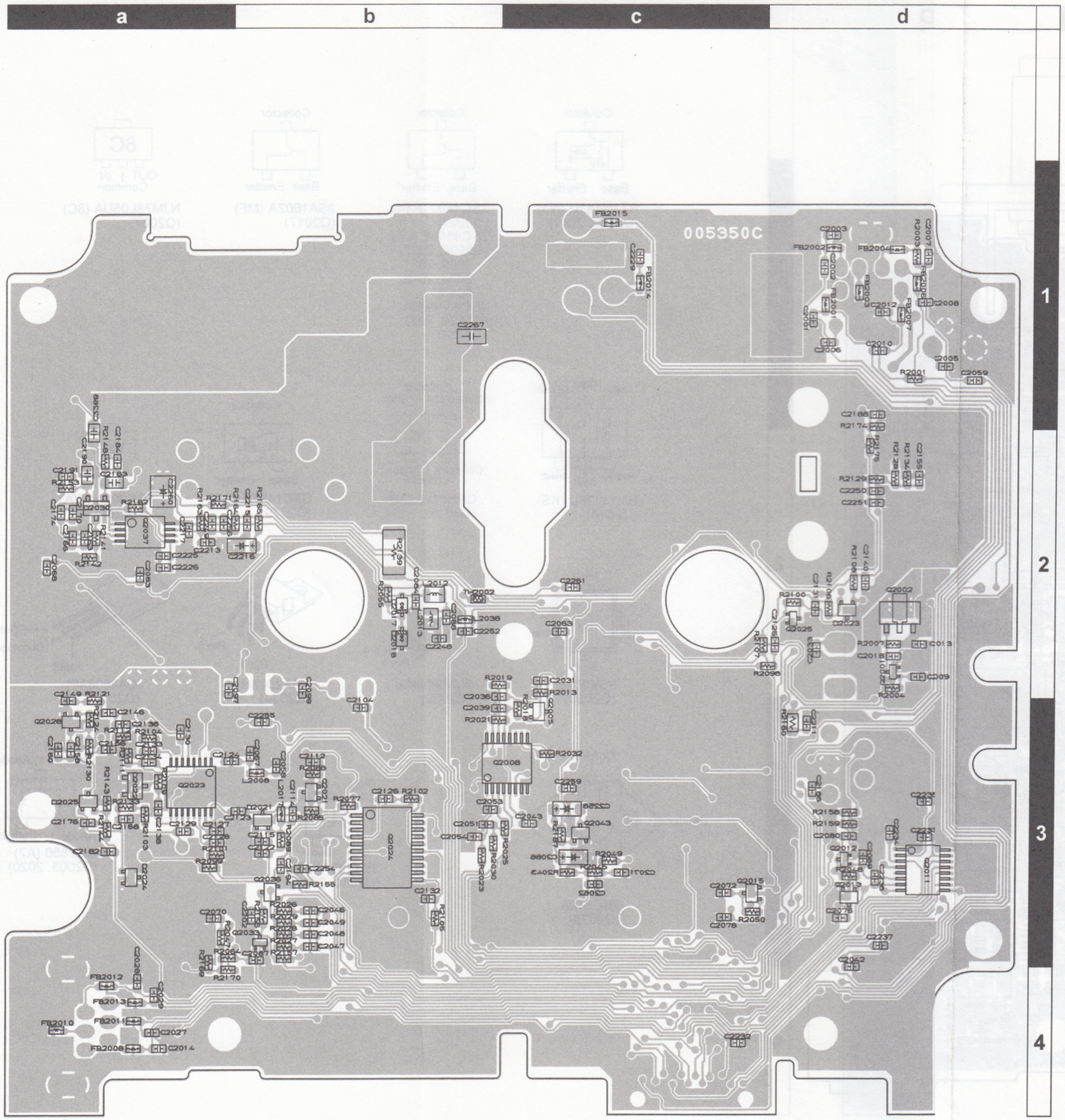
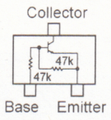
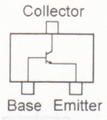
MAIN Unit

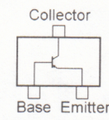




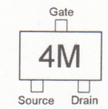
RT1N441U (N3)
(Q2001, 2012, 2033)



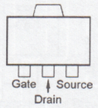
2SC4400 (RT4)
(Q2021)
2SC4154E (LE)
(Q2013, 2015, 2028, 2043)
2SC5374 (NA)
(Q2025)



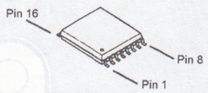
2SA1602A (MF)
(Q2005)



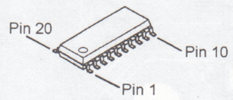
2SJ364-R (4M)
(Q2036)



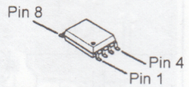
2SJ562-TD
(Q2002)



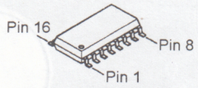
TA31136FN
(Q2023)
MB88347PFV
(Q2011)



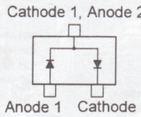
BH3532FS-E2
(Q2024)



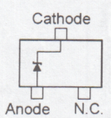
NJM2904V
(Q2037)



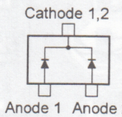
LV2105V-TLM
(Q2008)



MC2850 (A7)
(D2021, 2024, 2025)



HZM5.6NB2 (562)
(D2022)



MC2848 (A6)
(D2023)
1SS321 (F9)
(D2030)

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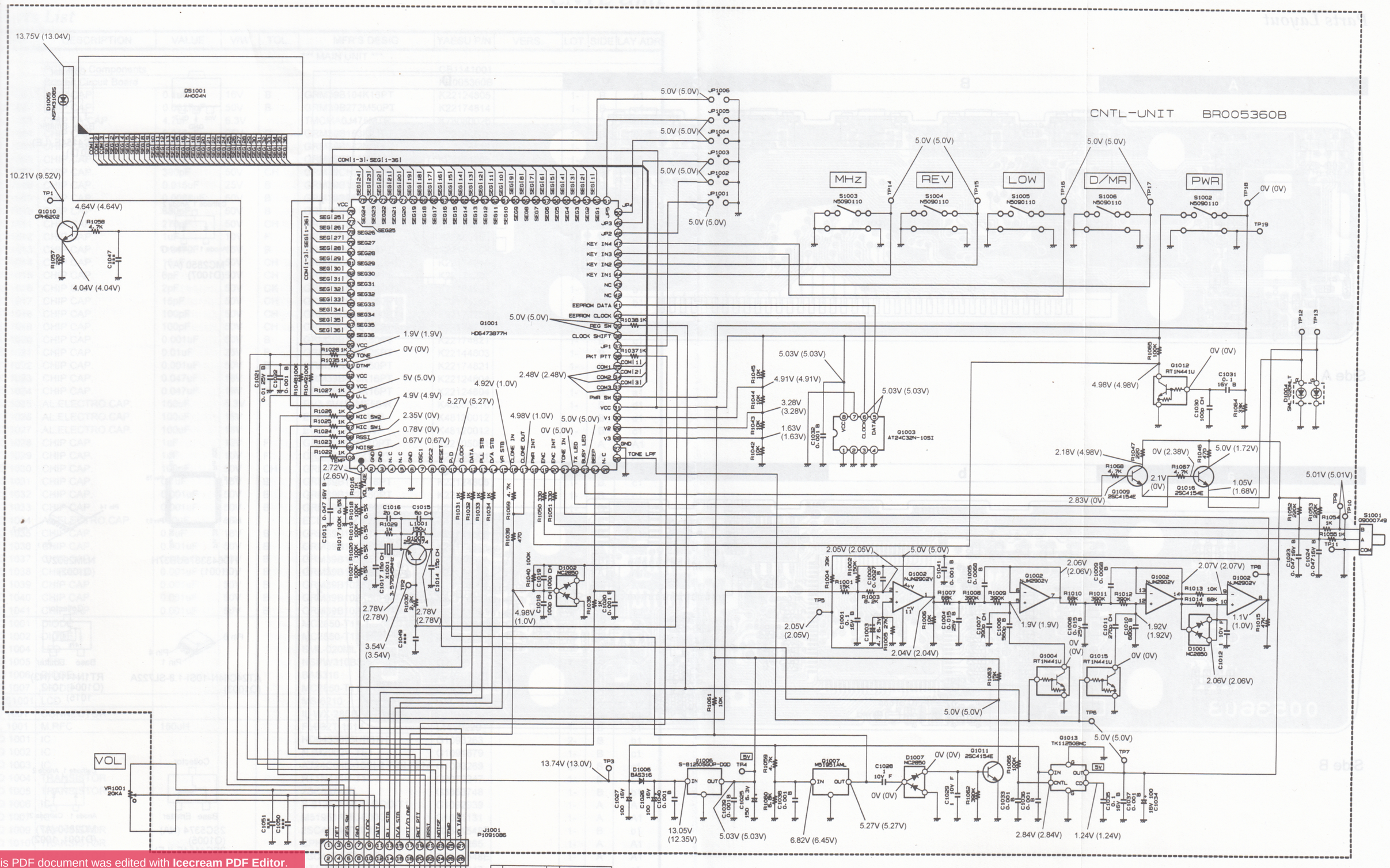

4	5.0V (5.0V)	21	2.35V (0V)
17	5.0V (1.0V)	22	5.0V (0V)
18	5.0V (5.0V)	23	0.79V (0V)
19	5.0V (0V)	27	13.7V (13.2V)
20	5.0V (5.0V)		

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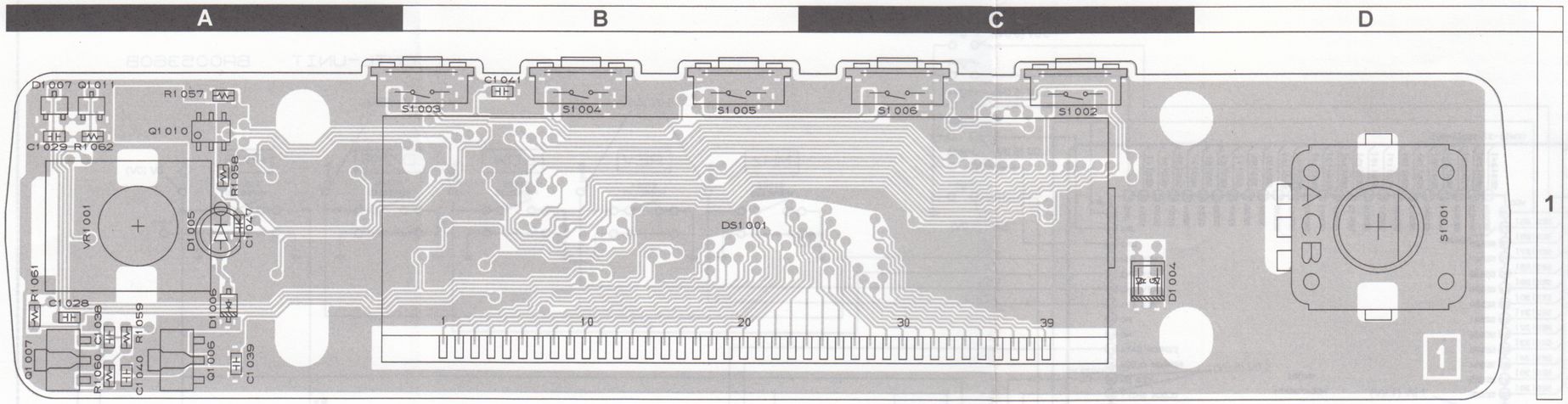
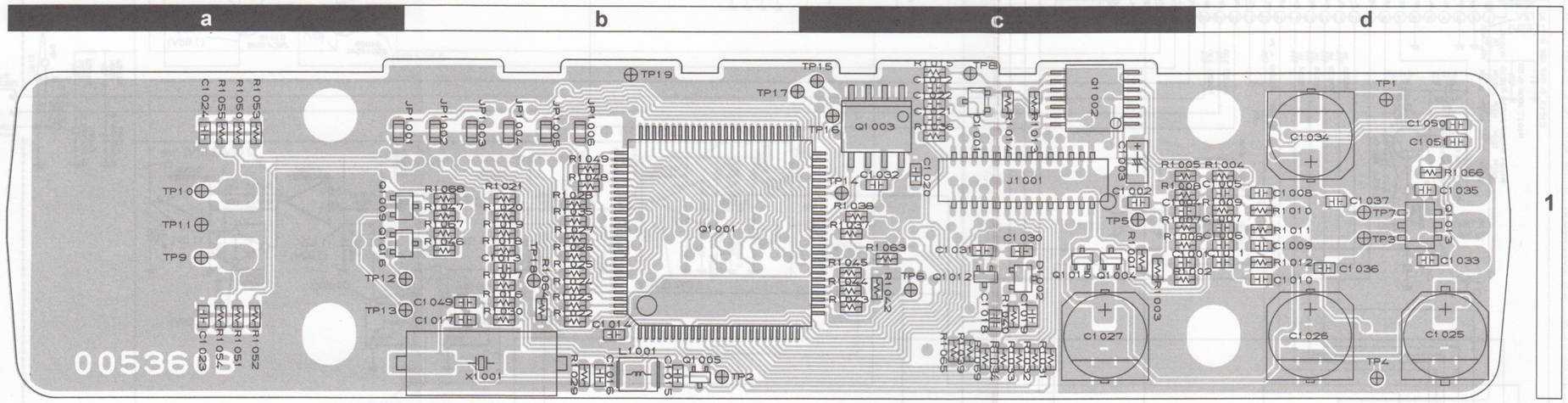
CNTL Unit

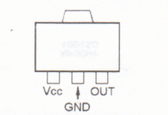
Parts Layout



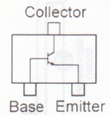
Side A



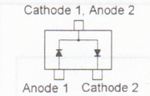
Side B



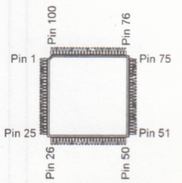
M51951AML-600C (51)
(Q1007)



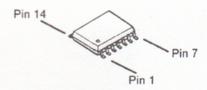
2SC4154E (LE)
(Q1011)



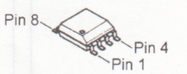
MC2850 (A7)
(D1007)



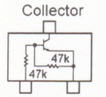
HD6433875UB37H
(Q1001)



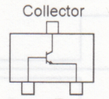
NJM2902V
(Q1002)



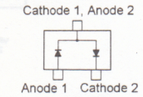
AT24C64N-10SI-1.8-SL722A
(Q1003)



RT1N441U (N3)
(Q1004, 1012, 1015)



2SC5374 (NA)
(Q1005)
2SC4154E (LE)
(Q1009, 1016)



MC2850 (A7)
(D1001, 1002)

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