



# Dual Band FM Transceiver

## FT-7800R

### Technical Supplement

© 2003 VERTEX STANDARD CO., LTD. (EH016M90A)

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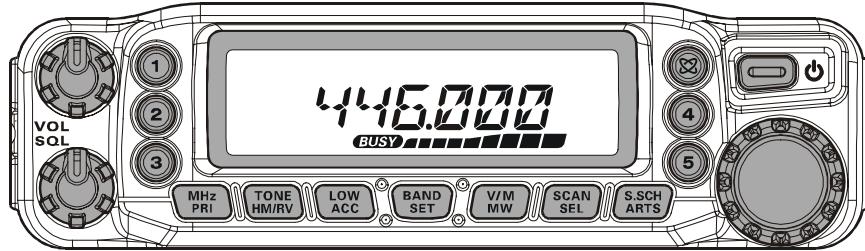
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## Introduction

This manual provides technical information necessary for servicing the FT-7800R Transceiver.

Servicing this equipment requires expertise in handling 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 circuit board in the transceiver. Each side of the board is referred to by the type of the majority of components installed on that side ("leaded" or "chip-only"). In most cases one side has only chip components, and the other has either a mixture of both chip and leaded components (trimmers, coils, electrolytic capacitors, ICs, etc.), or leaded components only.

While we believe the technical information in this manual to be correct, Vertex Standard 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

<b>Frequency Range:</b>	RX: 108.000 - 520.000 MHz, 700.000 - 999.995 MHz (Cellular Blocked)
<b>TX:</b>	144.000 - 148.000 MHz or 144.000 - 146.000 MHz, 430.000 - 450.000 MHz or 430.000 - 440.000 MHz
<b>Channel Steps:</b>	5/10/12.5/15/20/25/50/100 kHz
<b>Modes of Emission:</b>	F3E, F2D, F2A
<b>Antenna Impedance:</b>	50 Ohms, unbalanced (Antenna Duplexer built-in)
<b>Frequency Stability:</b>	±5 ppm @ 14 °F ~ +140 °F (-10 °C ~ +60 °C)
<b>Operating Temperature Range:</b>	-4 °F ~ +140 °F (-20 °C ~ +60 °C)
<b>Supply Voltage:</b>	13.8 VDC (±15 %), negative ground
<b>Current Consumption (Approx.):</b>	RX: 0.5 A (Squelched) TX: 8.5 A
<b>Case Size (W x H x D):</b>	5.5" x 1.6" x 6.6" (140 x 41.5 x 168 mm) (w/o knobs & connectors)
<b>Weight (Approx.):</b>	2.2 lb. (1 kg)

## Transmitter

<b>Output Power:</b>	50/20/10/5 W (144 MHz) 40/20/10/5 W (430 MHz)
<b>Modulation Type:</b>	Variable Reactance
<b>Maximum Deviation:</b>	±5 kHz
<b>Spurious Radiation:</b>	At least -60 dB below
<b>Microphone Impedance:</b>	2 kΩ
<b>DATA Jack Impedance:</b>	10 kΩ

## Receiver

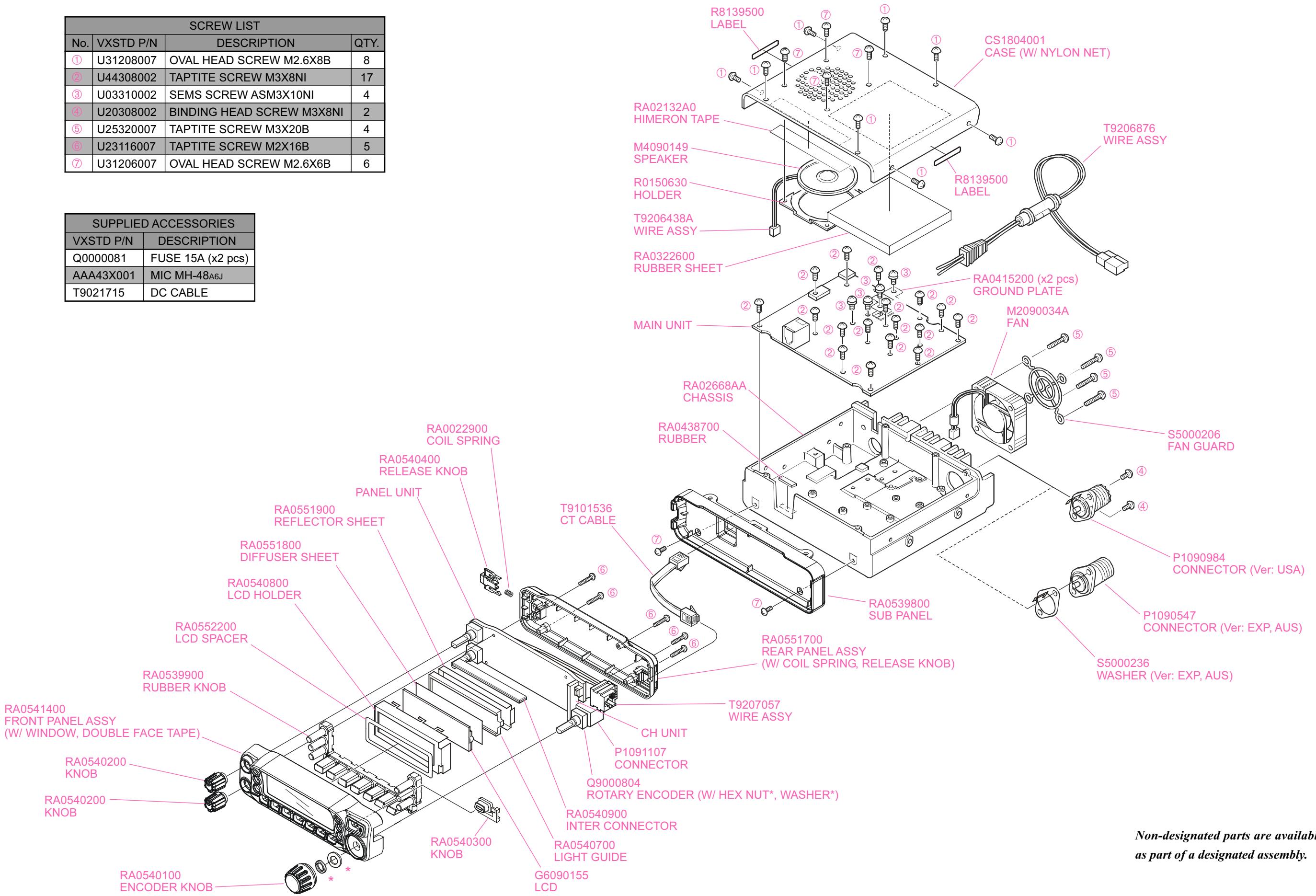
<b>Circuit Type:</b>	Double-conversion superheterodyne
<b>Intermediate Frequencies:</b>	45.05 MHz/450 kHz
<b>Sensitivity:</b>	0.8 µV (TYP) for 10 dB SN (108 - 137 MHz, AM) 0.2 µV for 12 dB SINAD (137 - 150 MHz, FM) 0.25 µV for 12 dB SINAD (150 - 174 MHz, FM) 0.3 µV (TYP) for 12 dB SINAD (174 - 222 MHz, FM) 0.25 µV (TYP) for 12 dB SINAD (222 - 300 MHz, FM) 0.8 µV (TYP) for 10 dB SN (300 - 336 MHz, AM) 0.25 µV for 12 dB SINAD (336 - 420 MHz, FM) 0.2 µV for 12 dB SINAD (420 - 520 MHz, FM) 0.4 µV (TYP) for 12 dB SINAD (800 - 900 MHz, FM) 0.8 µV (TYP) for 12 dB SINAD (900 - 999.99 MHz, FM)
<b>Squelch Sensitivity:</b>	Better than 0.16 µV
<b>Selectivity (-6dB/-60dB):</b>	12 kHz/30 kHz
<b>Maximum AF Output:</b>	2 W @ 8 Ω for 10% THD
<b>AF Output Impedance:</b>	4-16 Ω

Specifications are subject to change without notice, and are guaranteed within the 144 and 430 MHz amateur bands only. Frequency ranges will vary according to transceiver version; check with your dealer.

# Exploded View & Miscellaneous Parts

SCREW LIST			
No.	VXSTD P/N	DESCRIPTION	QTY.
①	U31208007	OVAL HEAD SCREW M2.6X8B	8
②	U44308002	TAPTTIE SCREW M3X8NI	17
③	U03310002	SEMS SCREW ASM3X10NI	4
④	U20308002	BINDING HEAD SCREW M3X8NI	2
⑤	U25320007	TAPTTIE SCREW M3X20B	4
⑥	U23116007	TAPTTIE SCREW M2X16B	5
⑦	U31206007	OVAL HEAD SCREW M2.6X6B	6

SUPPLIED ACCESSORIES	
VXSTD P/N	DESCRIPTION
Q0000081	FUSE 15A (x2 pcs)
AAA43X001	MIC MH-48A6J
T9021715	DC CABLE

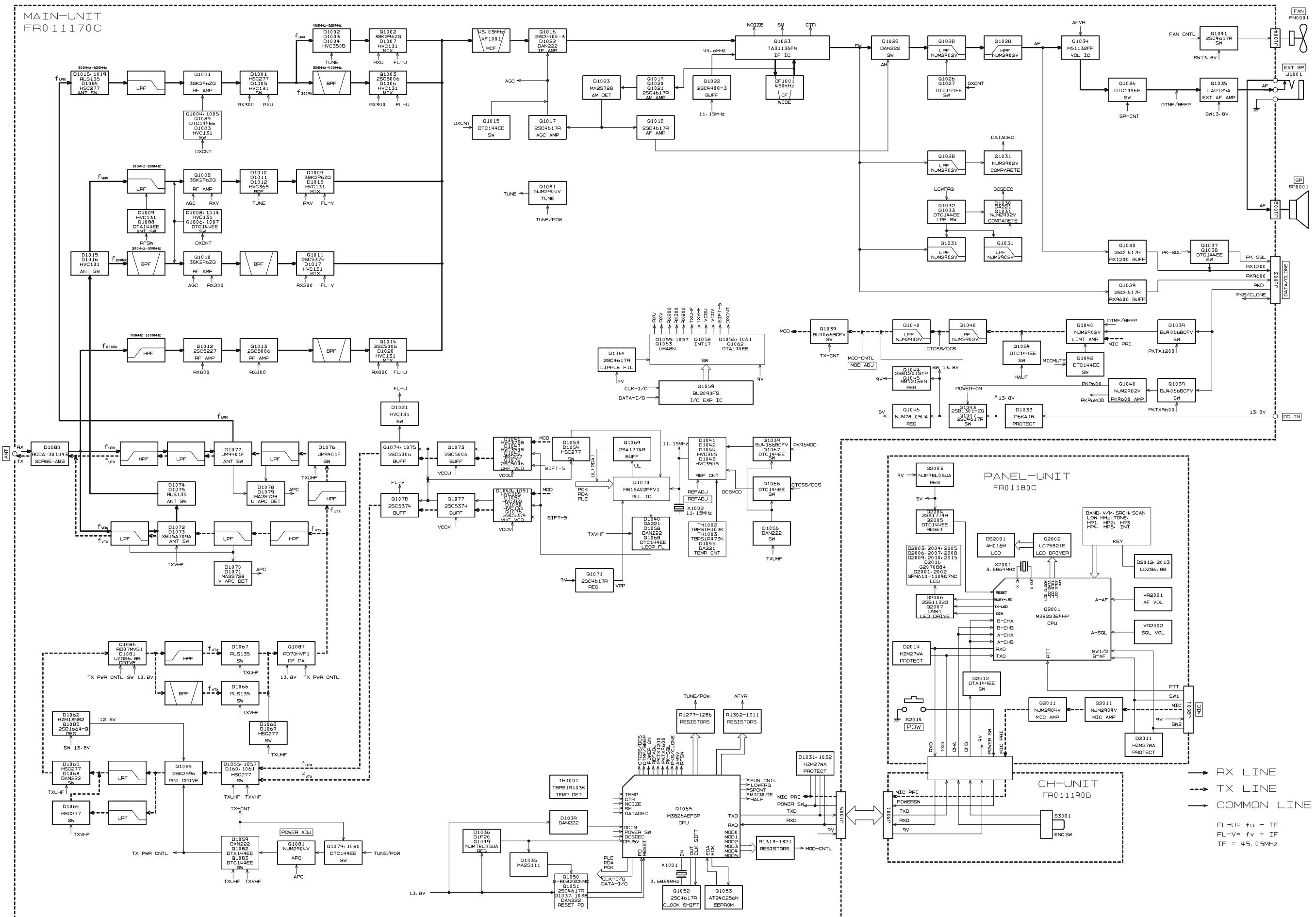


Non-designated parts are available only as part of a designated assembly.

## *Exploded View & Miscellaneous Parts*

*Note*

# Block Diagram



## *Block Diagram*

*Note*

# Circuit Description

## VHF Reception

The incoming VHF signal is passed through a low-pass filter network, antenna switching diodes **D1074 (RLS135)**, **D1075 (RLS135)** and **D1015 (HVC131)**, and another low-pass filter network to the RF amplifier **Q1008 (3SK296ZQ)**. The amplified RF signal is passed through a varactor controlled bandpass filter consisting of L1017, L1018, and **D1010**, **D1011**, and **D1012** (all **HVC365**), then applied to the first mixer **Q1009 (3SK296ZQ)** along with the first local signal from the PLL circuit.

The first local signal is generated between 189.05 MHz and 193.05 MHz, depending on the receiving frequency, by the VHF VCO, which consists of **Q1076 (2SC5374)** and varactor diodes **D1049 (HVC365)**, **D1050 (HVC131)**, **D1051 (HVC365)**, and **D1052 (HVC362)**.

## UHF Reception

The incoming UHF signal is passed through a low-pass filter network, antenna switching diodes **D1077 (UM9401F)** and **D1018 (RLS135)**, **D1019 (RLS135)**, and **D1084 (HSC277)**, and another low-pass filter network to the RF amplifier **Q1001 (3SK296ZQ)**. The amplified RF signal is passed through a varactor-controlled band-pass filter consisting of L1006 and L1007, and **D1002**, **D1003**, and **D1004** (all **HVC350B**), then applied to the first mixer **Q1002 (3SK296ZQ)** along with the first local signal from the PLL circuit.

The first local signal is generated between 384.95 MHz and 404.95 MHz, depending on the receiving frequency, by the UHF VCO, which consists of **Q1072 (2SC5006)** and varactor diodes **D1046 (HVC375B)** and **D1047 (HVC350B)**.

## IF and Audio Circuits

The 45.05 MHz first IF signal is applied to the monolithic crystal filter **XF1001** which strips away unwanted mixer products, and the IF signal is applied to the first IF amplifier **Q1016 (2SC4400)**. The amplified first IF signal is then delivered to the FM IF subsystem IC **Q1023 (TA31136FN)**, which contains the second mixer, limiter amplifier, noise amplifier, and FM detector.

The 44.6 MHz second local signal is derived from 11.15 MHz crystal X1002, the frequency of which is multiplied by four at **Q1022 (2SC4400)**, producing the 450 kHz second IF signal when mixed with the first IF signal within **Q1023 (TA31136FN)**.

The 450 kHz second IF signal is applied to the ceramic filter **CF1001** which strips away all but the desired signal, and then passes through the limiter amplifier within **Q1023 (TA31136FN)** to the ceramic discriminator **CD1001** which removes any amplitude variations in the 450 kHz IF signal before detection of speech.

The detected audio passes through the de-emphasis network, a low-pass filter consisting of **Q1028 (NJM2902V)** and associated circuitry, and a high-pass filter consisting of **Q1028 (NJM2902V)** and associated circuitry. The filtered audio signal is passed through the audio volume control IC **Q1034 (M51132FP)** which adjusts the audio sensitivity to compensate for audio level variations, then delivered to the audio switch **Q1036 (DTC144EE)**.

## Squelch Control

When no carrier received, noise at the output of the detector stage in **Q1023 (TA31136FN)** is amplified and band-pass filtered by the noise amp section of **Q1023 (TA31136FN)**. The resulting DC voltage is applied to pin 2 of main CPU **Q1065 (M3826AEFGP)**, which compares the squelch threshold level to that set by the front panel SQL knob.

While no carrier is received, pin 53 of **Q1065 (M3826AEFGP)** remains "low," to disable audio output from the speaker.

## Transmit Signal Path

The speech signal from the microphone passes through the MIC jack J2001 to AF amplifier **Q2011 (NJM2904V)** on the PANEL unit. The amplified speech signal is subjected to amplitude limiting by **Q1040 (NJM2902V)** on the MAIN unit. The speech signal then passes through low-pass filter network **Q1040 (NJM2902V)** and band switch **Q1039 (BU4066BCFV)** to the VHF VCO or UHF VCO.

## VHF Transmit Signal Path

The adjusted speech signal from **Q1040 (NJM2902V)** is delivered to VHF VCO **Q1076 (2SC5374)** which frequency modulates the transmitting VCO made up of **D1049 (HVC365)**. The modulated transmit signal passes through buffer amplifiers **Q1077** and **Q1078** (both **2SC5374**). The amplified transmit signal is then applied to the Pre-Drive amplifier **Q1084 (2SK2596)** and Driver amplifier **Q1086 (RD07MVS1)**, then finally amplified by Power amplifier **Q1087 (RD70HVF1)** up to 50 Watts. This three-stage power amplifier's gain is controlled by the APC circuit. The 50 Watt RF signal passes through high-pass filter and low-pass filter network, antenna switch **D1072** and **D1073** (both **XB15A709A**), and another low-pass filter network, and then is delivered to the ANT jack.

# Circuit Description

## UHF Transmit Signal Path

The adjusted speech signal from Q1040 (**NJM2902V**) is delivered to UHF VCO Q1072 (**2SC5006**) which frequency modulates the transmitting VCO made up of D1046 (**HVC375B**). The modulated transmit signal passes through buffer amplifiers Q1073, Q1074, and Q1075 (all **2SC5006**). The filtered transmit signal is then applied to the Pre-Drive amplifier Q1084 (**2SK2596**) and Driver amplifier Q1086 (**RD07MVS1**), then finally amplified by Power amplifier Q1087 (**RD70HVF1**) up to 40 Watts. This three-stage power amplifier's gain is controlled by the APC circuit. The 40 Watt RF signal passes through high-pass filter and low-pass filter networks, antenna switch D1077 (**UM9401F**), and another low-pass filter network, and then is delivered to the ANT jack.

## TX APC Circuit

A portion of the power amplifier output is rectified by D1070 and D1071 (UHF: **D1078** and **D1079**, all **MA2S728**), then delivered to APC Q1081 (**NJM2904V**), as a DC voltage which is proportional to the output level of the power amplifier. The APC Q1081 (**NJM2904V**) compares the rectified DC voltage from the power amplifier and the reference voltage from the main CPU Q1065 (**M3826AEFGP**), to produce a control voltage, which regulates supply voltage to the Pre-Drive amplifier Q1084 (**2SK2596**), Drive amplifier Q1086 (**RD07MVS1**) and Power amplifier Q1087 (**RD70HVF1**), so as to maintain stable output power under varying antenna loading conditions.

## PTT Circuit

When the PTT switch is pressed, pin 8 of sub CPU Q2001 (**M38223E**) goes "high", which send the "PTT" command to main CPU Q1065 (**M3826AEFGP**). When the CPU receives the "PTT" command, it engages Q1057 (**UMA8N**) and Q1058 (**IMT17**), which activates the Tx circuit.

## PLL Circuit

A portion of the output from the VCO Q1076 (**2SC5374**) and Q1072 (**2SC5006**), passes through the programmable divider section of the PLL IC Q1070 (**MB15A02PFV1**), which divides the VCO frequency according to the frequency dividing data that is associated with the current frequency input from the main CPU Q1065 (**M3826AEFGP**). It is then sent to the phase comparator. The 11.15 MHz frequency of the reference oscillator circuit derived from X1002 is divided by the reference frequency divider section of Q1070 (**MB15A02PFV1**) into 4250 or 3400 parts to become 5 kHz or 6.25 kHz comparative reference frequencies, which are utilized by the phase comparator. The phase comparator section of Q1070 (**MB15A02PFV1**) compares the phase between the frequency-divided oscillation frequency of the VCO circuit and the comparative frequency and its output is a pulse corresponding to the phase difference. This pulse is integrated by the charge pump and loop filter of Q1070 (**MB15A02PFV1**) into a control voltage (VCV) to control the oscillation frequency of the VCOs.

## Introduction and Precautions

The **FT-7800R** has been carefully aligned at the factory for the specified performance across the 144 MHz and 430 MHz amateur bands. 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 Vertex Standard 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 Vertex Standard 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 Vertex Standard 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, Vertex Standard must reserve the right to change circuits and alignment procedures in the interest of improved performance, without notifying owners.

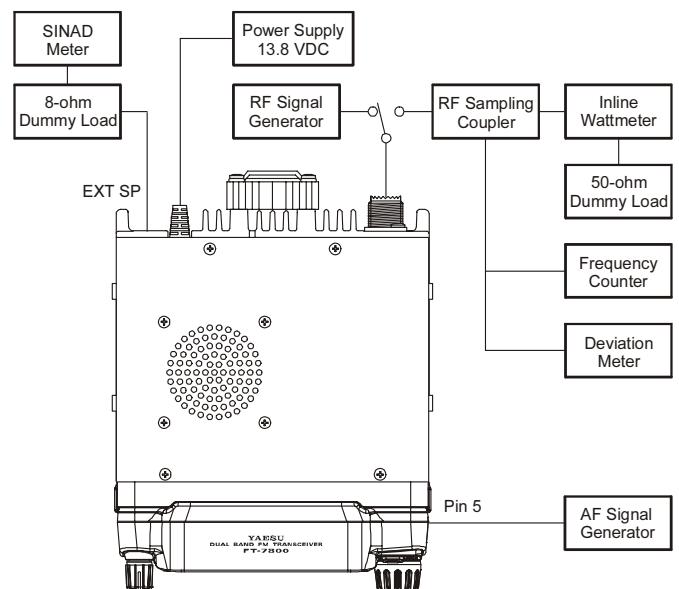
Under no circumstances should any alignment be attempted unless the normal function and operation of the transceiver are clearly understood, the cause of the malfunction has been clearly pinpointed and any faulty components replaced, and the need for realignment determined to be absolutely necessary.

## 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.

- Regulated DC Power Supply: adjustable from 11.5 to 16 VDC, 10 A
- RF Signal Generator with calibrated output level at 500 MHz
- Frequency Counter:  $\pm 0.1$  ppm accuracy at 500 MHz
- AF Signal Generator
- SINAD Meter
- Oscilloscope
- Spectrum Analyzer
- Deviation Meter (linear detector)
- AF Millivoltmeter
- AF Dummy Load: 8-Ohm, 5 W
- DC Voltmeter: high impedance
- Inline Wattmeter with 5% accuracy at 500 MHz
- 50-Ohm non-reactive Dummy Load: 50 watts at 500 MHz
- VHF/UHF Sampling Coupler

Set up the test equipment as shown below, and apply 13.8 VDC power to the transceiver.



# Alignment

## 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 68 °C and 86 °F (20 °C ~ 30 °C). 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.

**Notes:** Signal levels in dB referred to in alignment are based on  $0 \text{ dB}\mu = 0.5 \mu\text{V}$  (closed circuit).

## Entering the Alignment mode

Alignment of the **FT-7800R** is performed using a front-panel software-based procedure. To perform alignment of the transceiver, it must first be placed in the "Alignment Mode," in which the adjustments will be made and then stored into memory.

To enter the Alignment mode:

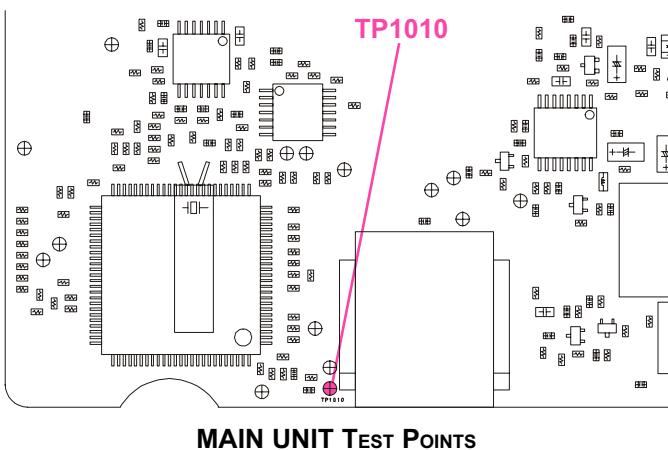
1. Press and hold in the [**MHz(PRI)**] key and the Hyper Memory [**5**] key while turning the radio on. Once the radio is on, release these two keys.
2. Press the front panel keys in the following sequence.  
[MHz(PRI)] → [TONE(HM/RV)] → [LOW(ACC)] →  
[BAND(SET)] → [V/M(MW)] →  
[SCAN(SEL)] → [S.SCH(ARTS)]
3. Press and hold in the [**xx**] key to cause "A-0 REF.xxH" to appear on the display, this signifies that the transceiver is now in the "Alignment mode."

## PLL Reference Frequency

1. Tune the frequency to 435.050 MHz, then set the Transmit Power Level to "LOW."
2. Press the [**BAND(SET)**] key while pressing and holding in the [**xx**] key, if needed, to set the Alignment parameter to "A-0 REF.xxH."
3. Press the **PTT** switch to activate the transmitter, and adjust the **DIAL** knob while pressing and holding the [**xx**] key, if needed, so that the counter frequency reading is 435.050 MHz ( $\pm 100 \text{ Hz}$ ).

## RF Front-end Tuning

1. Connect the DC voltmeter to **TP1010** on the MAIN Unit, then inject a 439.050 MHz signal at a level of +10 dB $\mu$  (with 1 kHz modulation @ $\pm 3.5$  kHz deviation) from the RF Signal Generator.
2. Tune the frequency to 439.050 MHz.
3. Press the [**BAND(SET)**] key while pressing and holding the [**xx**] key to set the Alignment parameter to "A-1 TUN.xxH."
4. Adjust the **DIAL** knob while pressing and holding in the [**xx**] key, if needed, so that the DC voltmeter reaches maximum deflection. The FT-7800R's RF Front-end has a broad bandwidth. Therefore, prior to adjustment you must adjust the **DIAL** knob to set the frequency to the middle of the band, in step 2, so you can set peak in the DC voltmeter's deflection in the center of the RF passband.
5. Tune the frequency to 145.050 MHz.
6. Inject a 145.050 MHz signal at a level of +10 dB $\mu$  (with 1 kHz modulation @ $\pm 3.5$  kHz deviation) from the RF Signal Generator.
7. Adjust the **DIAL** knob while pressing and holding in the [**xx**] key, if needed, so that the DC voltmeter reaches maximum deflection. As in the previous section, be sure to set the **DIAL** knob for the center of the band prior to making this adjustment.



## **TX Power Output**

1. Tune the frequency to 440.050 MHz, then set the Transmit Power Level to "LOW."
2. Press the [**BAND(SET)**] key while pressing and holding in the [ $\otimes$ ] key to set the Alignment parameter to "A-2 PWR.xxH."
3. Press the **PTT** switch to activate the transmitter, and adjust the **DIAL** knob while pressing and holding in the [ $\otimes$ ] key, if needed, so that the wattmeter reading is 5 Watts ( $\pm 0.5$  Watt).
4. Increase the Transmit Power Level to "MID2."
5. Press the **PTT** switch to activate the transmitter, and adjust the **DIAL** knob while pressing and holding in the [ $\otimes$ ] key, if needed, so that the wattmeter reading is 10 Watts ( $\pm 0.5$  Watt).
6. Increase the Transmit Power Level to "MID1."
7. Press the **PTT** switch to activate the transmitter, and adjust the **DIAL** knob while pressing and holding in the [ $\otimes$ ] key, if needed, so that the wattmeter reading is 20 Watts ( $\pm 0.5$  Watt).
8. Increase the Transmit Power Level to "HIGH."
9. Press the **PTT** switch to activate the transmitter, and adjust the **DIAL** knob while pressing and holding in the [ $\otimes$ ] key, if needed, so that the wattmeter reading is 40 Watts ( $\pm 0.5$  Watt).
10. Tune the frequency to 146.050 MHz, then set the Transmit Power Level to "LOW."
11. Press the **PTT** switch to activate the transmitter, and adjust the **DIAL** knob while press and holding the [%] key, as needed, so that the wattmeter reading is 5 Watts ( $\pm 0.5$  Watt).
12. Increase the Transmit Power Level to "MID2."
13. Press the **PTT** switch to activate the transmitter, and adjust the **DIAL** knob while pressing and holding in the [ $\otimes$ ] key, if needed, so that the wattmeter reading is 10 Watts ( $\pm 0.5$  Watt).
14. Increase the Transmit Power Level to "MID1."
15. Press the **PTT** switch to activate the transmitter, and adjust the **DIAL** knob while pressing and holding in the [ $\otimes$ ] key, if needed, so that the wattmeter reading is 20 Watts ( $\pm 0.5$  Watt).
16. Increase the Transmit Power Level to "HIGH."
17. Press the **PTT** switch to activate the transmitter, and adjust the **DIAL** knob while pressing and holding in the [ $\otimes$ ] key, if needed, so that the wattmeter reading is 50 Watts ( $\pm 0.5$  Watt).

## **TX Deviation**

1. Tune the frequency to 440.050 MHz, then set the Transmit Power Level to "LOW."
2. Press the [**BAND(SET)**] key while pressing and holding in the [ $\otimes$ ] key to set the Alignment parameter to "A-3 DEV.xxH."
3. Inject a 1 kHz audio tone at a level of 80 mV (-20 dBm) from the Audio Generator.
4. Press the **PTT** switch to activate the transmitter, and adjust the **DIAL** knob while pressing and holding in the [ $\otimes$ ] key, if needed, so that the deviation meter reading is 4.2 kHz ( $\pm 0.2$  kHz) (EXP Version: 4.5 kHz ( $\pm 0.2$  kHz)).
5. Tune the frequency to 146.050 MHz, then set the Transmit Power Level to "LOW."
6. Press the **PTT** switch to activate the transmitter, and adjust the **DIAL** knob while pressing and holding in the [ $\otimes$ ] key, if needed, so that the deviation meter reading is 4.2 kHz ( $\pm 0.2$  kHz) (EXP Version: 4.5 kHz ( $\pm 0.2$  kHz)).

## **DCS TX Deviation**

1. Tune the frequency to 440.050 MHz, then activate the DCS with a "023" DCS code, and set the Transmit Power Level to "LOW."
2. Press the [**BAND(SET)**] key while pressing and holding in the [ $\otimes$ ] key to set the Alignment parameter to "A-4 DSC.xxH."
3. Press the **PTT** switch to activate the transmitter (with no microphone input), and adjust the **DIAL** knob while pressing and holding in the [ $\otimes$ ] key, if needed, so that the deviation meter reading is between 0.50 kHz and 0.60 kHz.
4. Tune the frequency to 146.050 MHz, then activate the DCS with a "023" DCS code, and set the Transmit Power Level to "LOW."
5. Press the **PTT** switch to activate the transmitter (with no microphone input), and adjust the **DIAL** knob while pressing and holding in the [ $\otimes$ ] key, if needed, so that the deviation meter reading is between 0.50 kHz and 0.60 kHz.

# Alignment

## CTCSS TX Deviation

1. Tune the frequency to 440.050 MHz, then activate the CTCSS Encoder with a "100 Hz" tone, and set the Transmit Power Level to "LOW."
2. Press the [BAND(SET)] key while press and holding the [ $\diamond$ ] key to set the Alignment parameter to "A-5 CTC.xxH."
3. Press the **PTT** switch to activate the transmitter (with no microphone input), and adjust the **DIAL** knob while pressing and holding in the [ $\diamond$ ] key, if needed, so that the deviation meter reading is between 0.65 kHz and 0.75 kHz.
4. Tune the frequency to 146.050 MHz, then activate the CTCSS Encoder with a "100 Hz" tone, and set the Transmit Power Level to "LOW."
5. Press the **PTT** switch to activate the transmitter (with no microphone input), and adjust the **DIAL** knob while pressing and holding in the [ $\diamond$ ] key, if needed, so that the deviation meter reading is between 0.65 kHz and 0.75 kHz.

## Center Meter Sensitivity

1. Tune the frequency to 440.050 MHz.
2. Press the [BAND(SET)] key while press and holding the [ $\diamond$ ] key to set the Alignment parameter to "A-6 CNTL/V."
3. Inject a 1 kHz audio tone at a level of +10 dB $\mu$  from the Audio Generator.
4. Press the [LOW(ACC)] key while press and holding the [ $\diamond$ ] key.

## S-Meter Sensitivity

1. Tune the frequency to 440.050 MHz.
2. Press the [BAND(SET)] key while press and holding the [ $\diamond$ ] key to set the Alignment parameter to "A-7 SM L/V."
3. Inject a 440.050 MHz signal at a level of -5 dB $\mu$  (with 1 kHz modulation @ $\pm 3.5$  kHz deviation) from the RF Signal Generator.
4. Press the [LOW(ACC)] key while pressing and holding in the [ $\diamond$ ] key.
5. Increase the RF Signal Generator output level to +23 dB $\mu$ .
6. Press the [V/M(MW)] key while pressing and holding in the [ $\diamond$ ] key.

7. Tune the frequency to 146.050 MHz.
8. Inject a 146.050 MHz signal at a level of -5 dB $\mu$  (with 1 kHz modulation @ $\pm 3.5$  kHz deviation) from the RF Signal Generator.
9. Press the [LOW(ACC)] key while pressing and holding in the [ $\diamond$ ] key.
10. Increase the RF Signal Generator output level to +23 dB $\mu$ .
11. Press the [V/M(MW)] key while pressing and holding in the [ $\diamond$ ] key.
12. Tune the frequency to 230.050 MHz.
13. Inject a 230.050 MHz signal at a level of -5 dB $\mu$  (with 1 kHz modulation @ $\pm 3.5$  kHz deviation) from the RF Signal Generator.
14. Press the [LOW(ACC)] key while pressing and holding in the [ $\diamond$ ] key.
15. Increase the RF Signal Generator output level to +23 dB $\mu$ .
16. Press the [V/M(MW)] key while pressing and holding in the [ $\diamond$ ] key.
17. Tune the frequency to 850.050 MHz.
18. Inject a 850.050 MHz signal at a level of +3 dB $\mu$  (with 1 kHz modulation @ $\pm 3.5$  kHz deviation) from the RF Signal Generator.
19. Press the [LOW(ACC)] key while pressing and holding in the [ $\diamond$ ] key.
20. Increase the RF Signal Generator output level to +31 dB $\mu$ .
21. Press the [V/M(MW)] key while pressing and holding in the [ $\diamond$ ] key.

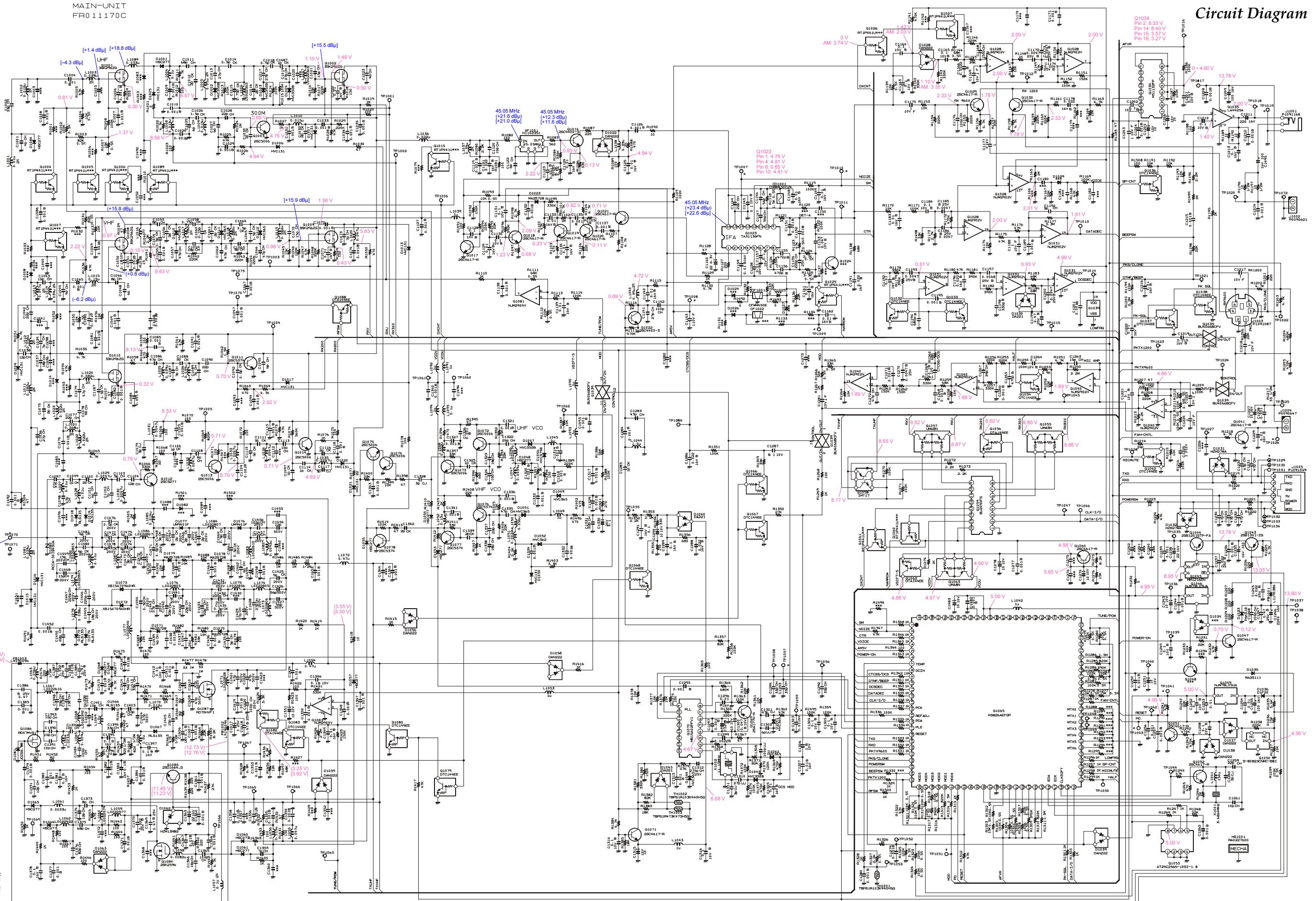
## DC Voltmeter

1. Set the power supply voltage to 13.8 VDC.
2. Press the [BAND(SET)] key while pressing and holding in the [ $\diamond$ ] key to set the Alignment parameter to "A-8 BAT SC."
3. Press the [SCAN(SEL)] key.

To close the Alignment mode, just press and hold in the **PWR** switch for 0.5 seconds (to turn the power off). The next time the transceiver is turned on, normal operation may resume.

# MAIN Unit

## Circuit Diagram

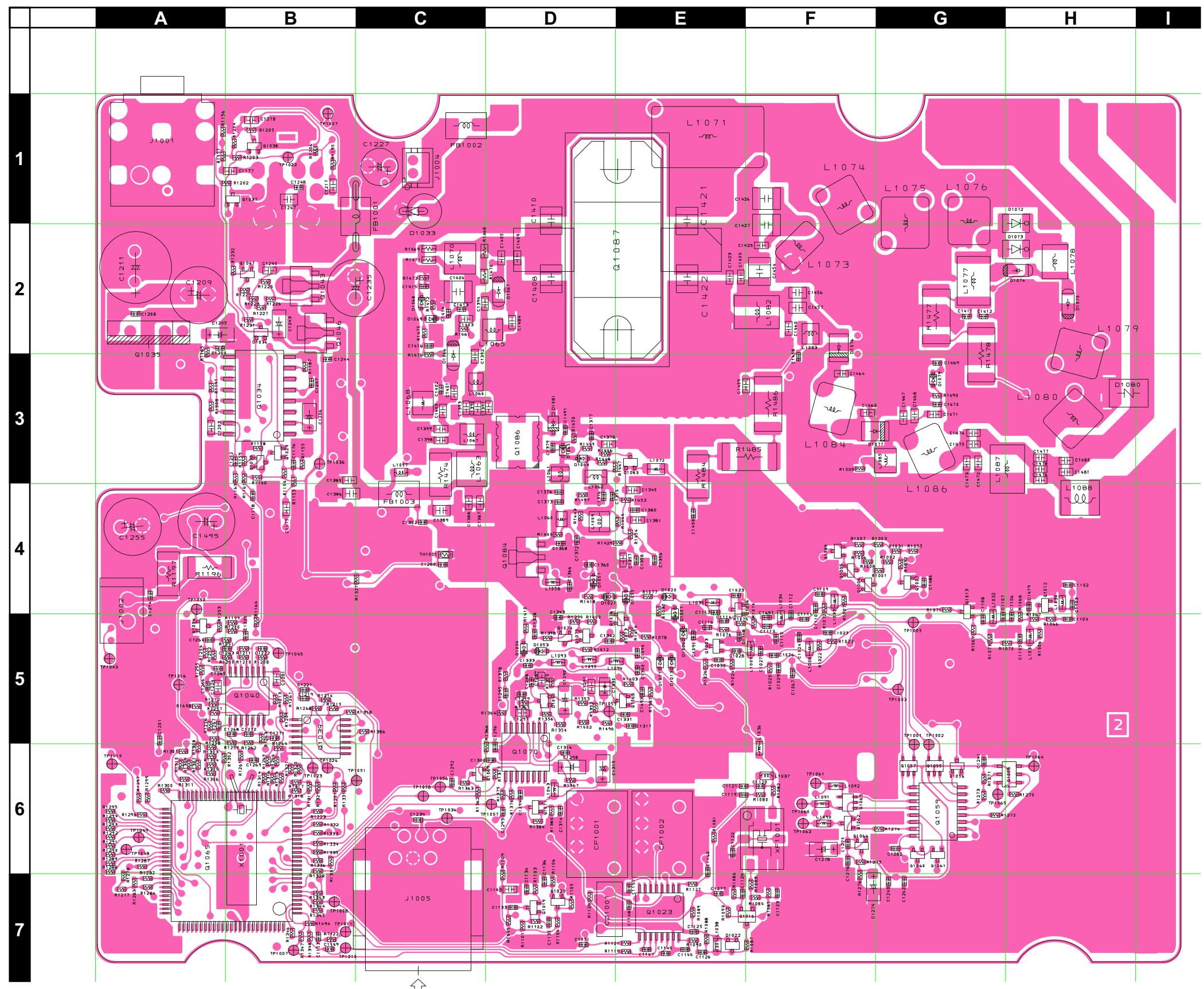


## ***MAIN Unit***

*Note*

# MAIN Unit

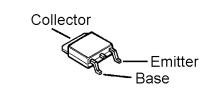
Parts Layout (Side A)



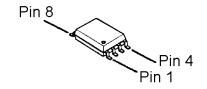
M3826AEFGP (Q1065)	BU2090FS (Q1059)	BU4066BCFV (Q1039)
	M51132FP (Q1034)	NJM2902V (Q1040)
	MB15A022PFV1 (Q1070)	
	RD70HVF1 (Q1087)	
	TA31136FN (Q1023)	
	2SA1774 (FR) (Q1069)	
	2SB1301 (ZQ) (Q1043)	
	LA4425A (Q1035)	
	T17 IMT17 (T17) (Q1058)	
	2SK2596 (BX) (Q1084)	
	2SC4400 (RT4) (Q1016)	
2SC4617 (BR) (Q1019, 1020, 1029, 1030, 1047, 1064, 1071)		
2SC5006 (24) (Q1003, 1013, 1014, 1074, 1075)		
2SC5277 (D2) (Q1012)		
2SC5374 (NA) (Q1078)		
	RD07MVS1 (Q1086)	
	DTC144EE (26) (Q1037, 1038, 1054, 1068)	
	UMA8N (A8) (Q1055, 1057, 1063)	
	DA221 (K) (D1040)	
	DAN222 (N) (D1022, 1063)	

# MAIN Unit

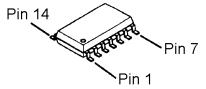
## Parts Layout (Side B)



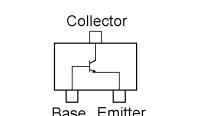
2SB1201S  
(Q1044)



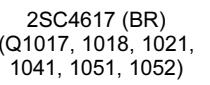
AT24C256  
(Q1053)



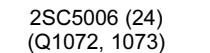
NJM2902V  
(Q1028, 1031)



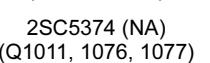
2SC4400 (RT4)  
(Q1022)



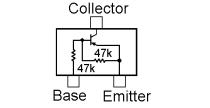
2SC4617 (BR)  
(Q1017, 1018, 1021,  
1041, 1051, 1052)



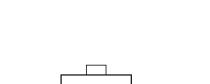
2SC5006 (24)  
(Q1072, 1073)



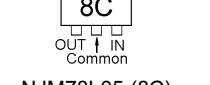
2SC5374 (NA)  
(Q1011, 1076, 1077)



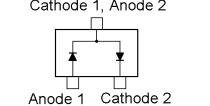
2SC4400 (RT4)  
(Q1022)



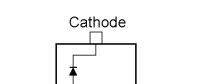
DTA144EE (16)  
(Q1082, 1088)



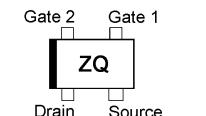
NJM78L05 (8C)  
(Q1049)



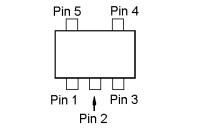
DA221 (K)  
(D1030, 1045)



HZM13NB2 (132)  
(D1062)



3SK296ZQ (ZQ)  
(Q1001, 1002, 1008,  
1009, 1010)



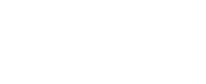
MM1216ENRE (1C)  
(Q1045)



S-80823CNMC  
(Q1050)



DAN222 (N)  
(D1028, 1037, 1038,  
1039, 1056, 1058,  
1059)



HZM27WA (27A)  
(D1031, 1032)

# MAIN Unit

## Parts List

REF	DESCRIPTION	VALUE	V/W	TOL.	MFR'S DESIG	VXSTD P/N	VERS.	LOT	SIDE	LAY ADR	
	PCB with Components					CS1803001 CS1803004 CS1803005 CS1803006 CS1803007 CS1803008 CS1803009 CS1803010 CS1803011 CS1803012 CS1803013 CS1803014 CS1803015 CS1803016	USA EXP EXP EXP EXP EXP EXP EXP EXP EXP EXP EXP EXP AUS AUS	A2U A1 A2 A3 B1 B2 B3 C1 C2 C3 D1 D2 H1 H2			
	P.C.B. W/O COMP.				AH016M000	FR011170C	1-				
C 1001	CHIP CAP.	4pF	50V	CH	GRM36CH040B50PT	K22178291			B	c3	
C 1002	CHIP CAP.	33pF	50V	CH	GRM36CH330J50PT	K22178224			B	c4	
C 1004	CHIP CAP.	0.001uF	50V	B	GRM36B102K50PT	K22178809			B	c4	
C 1006	CHIP CAP.	0.001uF	50V	B	GRM36B102K50PT	K22178809			B	c4	
C 1007	CHIP CAP.	0.001uF	50V	B	GRM36B102K50PT	K22178809			B	c4	
C 1008	CHIP CAP.	0.001uF	50V	B	GRM36B102K50PT	K22178809			B	c4	
C 1009	CHIP CAP.	0.001uF	50V	B	GRM36B102K50PT	K22178809			B	c5	
C 1010	CHIP CAP.	0.001uF	50V	B	GRM36B102K50PT	K22178809			B	c5	
C 1011	CHIP CAP.	68pF	50V	CH	GRM36CH680J50PT	K22178232			B	c4	
C 1012	CHIP CAP.	2pF	50V	CK	GRM36CK020B50PT	K22178289			B	c4	
C 1013	CHIP CAP.	27pF	50V	CH	GRM36CH270J50PT	K22178222			B	c5	
C 1014	CHIP CAP.	0.5pF	50V	CK	GRM36CK0R5B50PT	K22178285			B	c5	
C 1015	CHIP CAP.	0.75pF	50V	CK	GRM36CKR75B50PT	K22178286			B	c5	
C 1016	CHIP CAP.	2pF	50V	CK	GRM36CK020B50PT	K22178289			B	d5	
C 1017	CHIP CAP.	27pF	50V	CH	GRM36CH270J50PT	K22178222			B	d5	
C 1018	CHIP CAP.	0.5pF	50V	CK	GRM36CK0R5B50PT	K22178285			B	d5	
C 1019	CHIP CAP.	27pF	50V	CH	GRM36CH270J50PT	K22178222			B	d5	
C 1021	CHIP CAP.	15pF	50V	CH	GRM36CH150J50PT	K22178216			B	d5	
C 1022	CHIP CAP.	0.01uF	16V	B	GRM36B103K16PT	K22128804			B	d4	
C 1023	CHIP CAP.	4pF	50V	CH	GRM36CH040B50PT	K22178291			A	E4	
C 1024	CHIP CAP.	0.001uF	50V	B	GRM36B102K50PT	K22178809			A	F5	
C 1025	CHIP CAP.	6pF	50V	CH	GRM36CH060B50PT	K22178293			A	F5	
C 1026	CHIP CAP.	1.5pF	50V	CK	GRM36CK1R5B50PT	K22178288			A	F5	
C 1027	CHIP CAP.	6pF	50V	CH	GRM36CH060B50PT	K22178293			A	F5	
C 1028	CHIP CAP.	22pF	50V	CH	GRM36CH220J50PT	K22178220			A	E5	
C 1029	CHIP CAP.	0.001uF	50V	B	GRM36B102K50PT	K22178809			A	F5	
C 1030	CHIP CAP.	1pF	50V	CK	GRM36CK010B50PT	K22178287			A	E5	
C 1031	CHIP CAP.	0.001uF	50V	B	GRM36B102K50PT	K22178809			B	d5	
C 1032	CHIP CAP.	2pF	50V	CK	GRM36CK020B50PT	K22178289			B	d5	
C 1033	CHIP CAP.	0.001uF	50V	B	GRM36B102K50PT	K22178809			B	d5	
C 1034	CHIP CAP.	0.001uF	50V	B	GRM36B102K50PT	K22178809			B	d5	
C 1035	CHIP CAP.	0.001uF	50V	B	GRM36B102K50PT	K22178809			B	d5	
C 1036	CHIP CAP.	27pF	50V	CH	GRM36CH270J50PT	K22178222	AUS		B	b3	
C 1036	CHIP CAP.	27pF	50V	CH	GRM36CH270J50PT	K22178222	EXP		B	b3	
C 1036	CHIP CAP.	27pF	50V	CH	GRM36CH270J50PT	K22178222	USA		B	b3	
C 1037	CHIP CAP.	18pF	50V	CH	GRM36CH180J50PT	K22178218			B	b3	
C 1038	CHIP CAP.	12pF	50V	CH	GRM36CH120J50PT	K22178214	AUS		B	b3	
C 1038	CHIP CAP.	12pF	50V	CH	GRM36CH120J50PT	K22178214	EXP		B	b3	
C 1038	CHIP CAP.	12pF	50V	CH	GRM36CH120J50PT	K22178214	USA		B	b3	
C 1039	CHIP CAP.	7pF	50V	CH	GRM36CH070B50PT	K22178294			B	b3	
C 1042	CHIP CAP.	22pF	50V	CH	GRM36CH220J50PT	K22178220			B	b3	
C 1043	CHIP CAP.	10pF	50V	CH	GRM36CH100B50PT	K22178297	AUS		B	b3	
C 1043	CHIP CAP.	10pF	50V	CH	GRM36CH100B50PT	K22178297	EXP		B	b3	
C 1043	CHIP CAP.	10pF	50V	CH	GRM36CH100B50PT	K22178297	USA		B	b3	
C 1044	CHIP CAP.	4pF	50V	CH	GRM36CH040B50PT	K22178291	AUS		B	b4	
C 1044	CHIP CAP.	4pF	50V	CH	GRM36CH040B50PT	K22178291	EXP		B	b4	
C 1044	CHIP CAP.	4pF	50V	CH	GRM36CH040B50PT	K22178291	USA		B	b4	
C 1045	CHIP CAP.	0.001uF	50V	B	GRM36B102K50PT	K22178809			B	b4	
C 1046	CHIP CAP.	8pF	50V	CH	GRM36CH080B50PT	K22178295	AUS		B	b4	
C 1046	CHIP CAP.	8pF	50V	CH	GRM36CH080B50PT	K22178295	EXP		B	b4	
C 1046	CHIP CAP.	8pF	50V	CH	GRM36CH080B50PT	K22178295	USA		B	b4	
C 1047	CHIP CAP.	0.001uF	50V	B	GRM36B102K50PT	K22178809			B	b3	
C 1048	CHIP CAP.	6pF	50V	CH	GRM36CH060B50PT	K22178293	AUS		B	b4	
C 1048	CHIP CAP.	6pF	50V	CH	GRM36CH060B50PT	K22178293	EXP		B	b4	
C 1048	CHIP CAP.	6pF	50V	CH	GRM36CH060B50PT	K22178293	USA		B	b4	
C 1049	CHIP CAP.	0.001uF	50V	B	GRM36B102K50PT	K22178809			B	b4	
C 1050	CHIP CAP.	0.1uF	10V	B	GRM36B104K10PT	K22108802			B	c4	
C 1051	CHIP CAP.	0.001uF	50V	B	GRM36B102K50PT	K22178809			B	c4	









































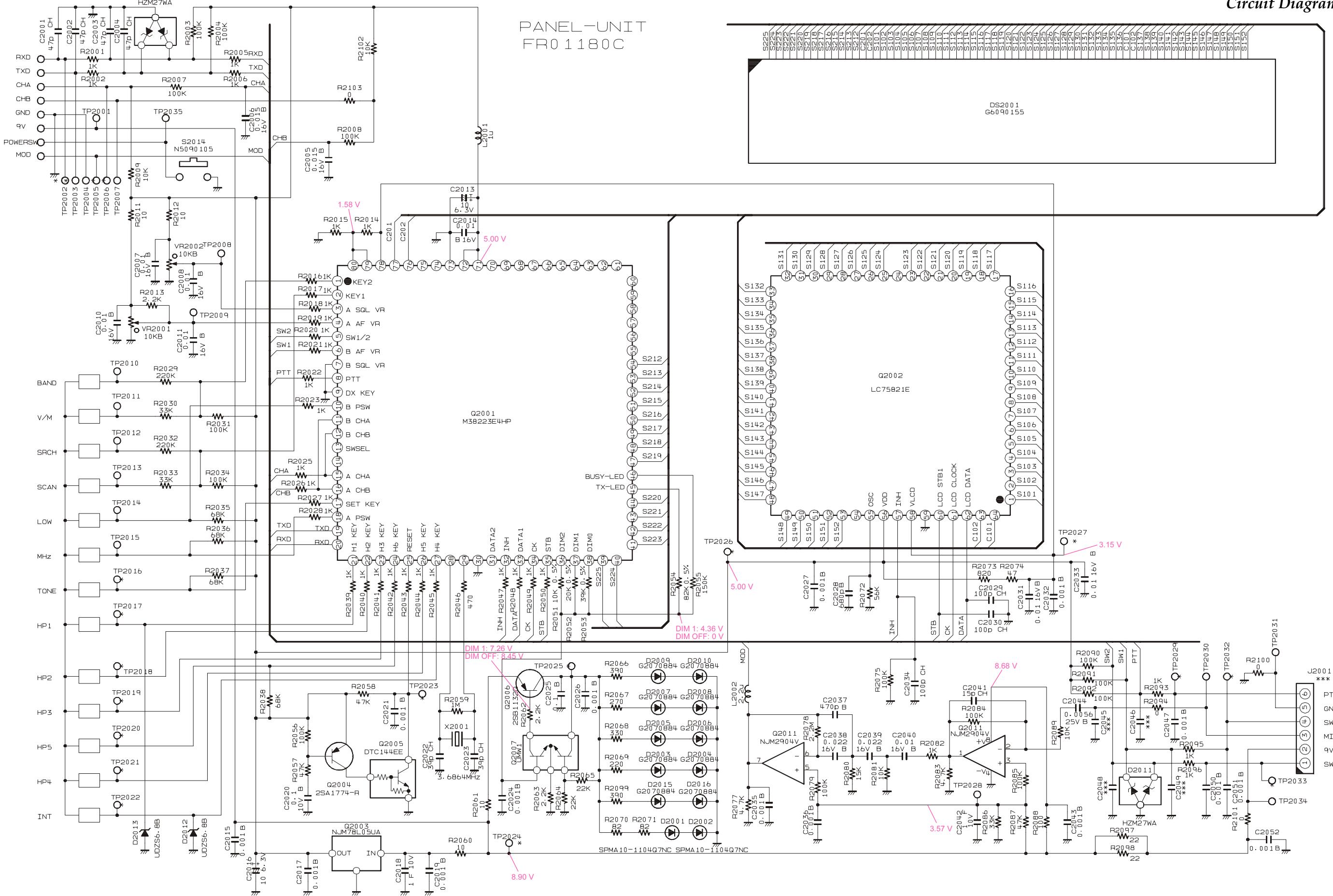
# MAIN Unit

## Parts List

REF	DESCRIPTION	VALUE	V/W	TOL.	MFR'S DESIG	VXSTD P/N	VERS.	LOT	SIDE	LAY ADR
R 1488	CHIP RES.	10k	1/16W	5%	RMC1/16S 103JTH	J24189037	USA	1-	B	c2
R 1489	CHIP RES.	10k	1/16W	5%	RMC1/16S 103JTH	J24189037		1-	B	c2
R 1490	CHIP RES.	10k	1/16W	5%	RMC1/16S 103JTH	J24189037		1-	A	G3
R 1491	CHIP RES.	4.7k	1/16W	5%	RMC1/16S 472JTH	J24189033		1-	B	b2
R 1492	CHIP RES.	0	1/16W	5%	RMC1/16S JPTH	J24189070		1-	B	e7
R 1493	CHIP RES.	0	1/16W	5%	RMC1/16S JPTH	J24189070		1-	B	e6
R 1495	CHIP RES.	100k	1/16W	5%	RMC1/16S 104JTH	J24189049		1-	B	g6
R 1496	CHIP RES.	470	1/16W	5%	RMC1/16S 471JTH	J24189021		1-	A	D5
R 1497	CHIP RES.	68k	1/16W	5%	RMC1/16S 683JTH	J24189047		1-	A	D4
R 1498	CHIP RES.	33k	1/16W	5%	RMC1/16S 333JTH	J24189043		1-	A	A5
R 1499	CHIP RES.	1M	1/16W	5%	RMC1/16S 105JTH	J24189061		1-	B	h3
R 1500	CHIP RES.	1k	1/16W	5%	RMC1/16S 102JTH	J24189025		1-	B	g7
R 1504	CHIP RES.	47	1/16W	5%	RMC1/16S 470JTH	J24189009		1-	B	c3
R 1505	CHIP RES.	1M	1/16W	5%	RMC1/16S 105JTH	J24189061		1-	A	F3
R 1506	CHIP RES.	100	1/16W	5%	RMC1/16S 101JTH	J24189013		1-	A	H5
R 1508	CHIP RES.	100	1/16W	5%	RMC1/16S 101JTH	J24189013		1-	A	A3
R 1509	CHIP RES.	270k	1/16W	5%	RMC1/16S 274JTH	J24189054	AUS	1-	B	h5
R 1509	CHIP RES.	270k	1/16W	5%	RMC1/16S 274JTH	J24189054		1-	B	h5
R 1510	CHIP RES.	82k	1/16W	5%	RMC1/16S 823JTH	J24189048	AUS	1-	B	h5
R 1510	CHIP RES.	82k	1/16W	5%	RMC1/16S 823JTH	J24189048		1-	B	h5
TH1001	THERMISTOR				TBPS1R103K440H5Q	G9090067		1-	A	C4
TH1002	THERMISTOR				TBPS1R103K440H5Q	G9090067		1-	B	f6
TH1003	THERMISTOR				TBPS1R473K475H5Q	G9090068		1-	B	f6
X 1001	XTAL CSA-310	3.6864MHz			3.6864MHZ	H0102988		1-	A	B6
X 1002	XTAL TSS-5032A	11.15MHz			11.15MHZ	H0103268		1-	B	f6
XF1001	XTAL FILTER				MFT45R6 45.05MHZ	H1102351		1-	A	F6
	SHIELD CASE VCO GROUND PLATE					RA0272500 RA0415200		1-		

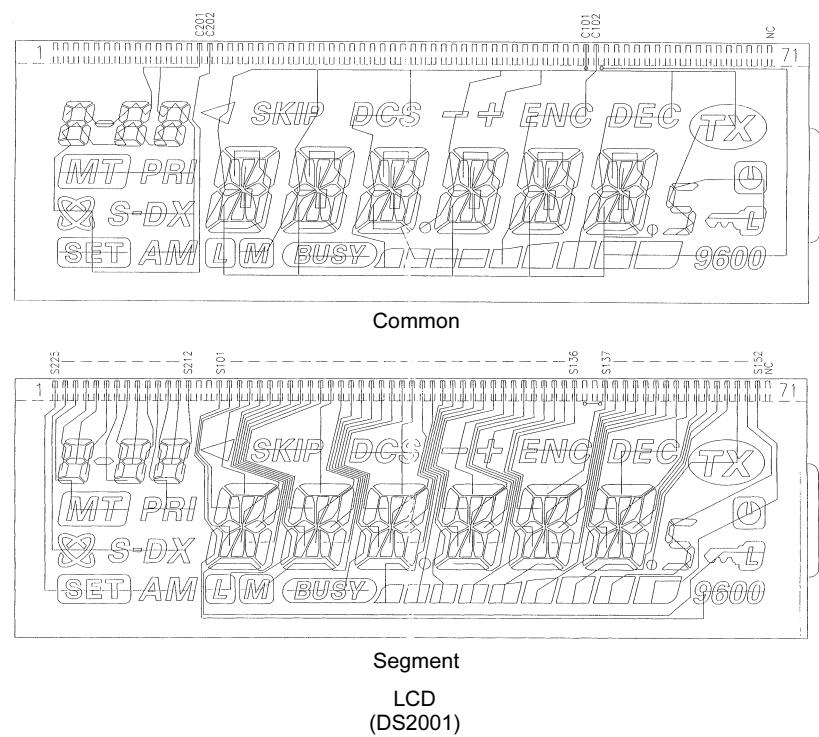
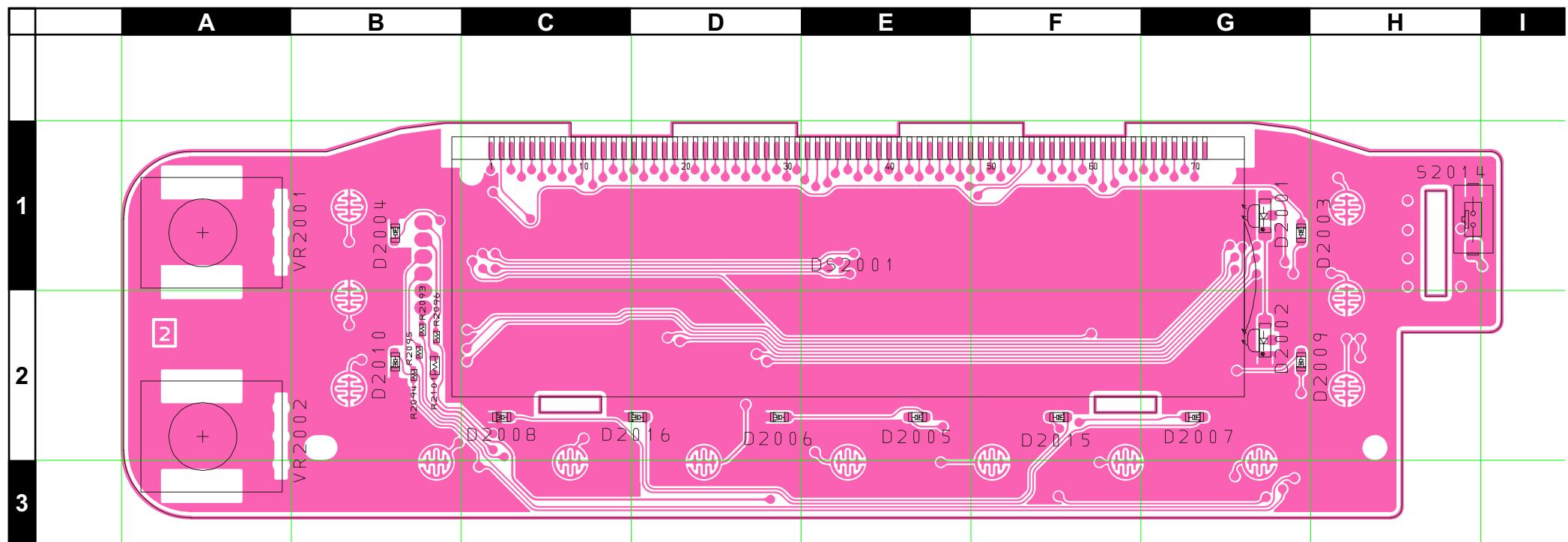
# PANEL Unit

Circuit Diagram

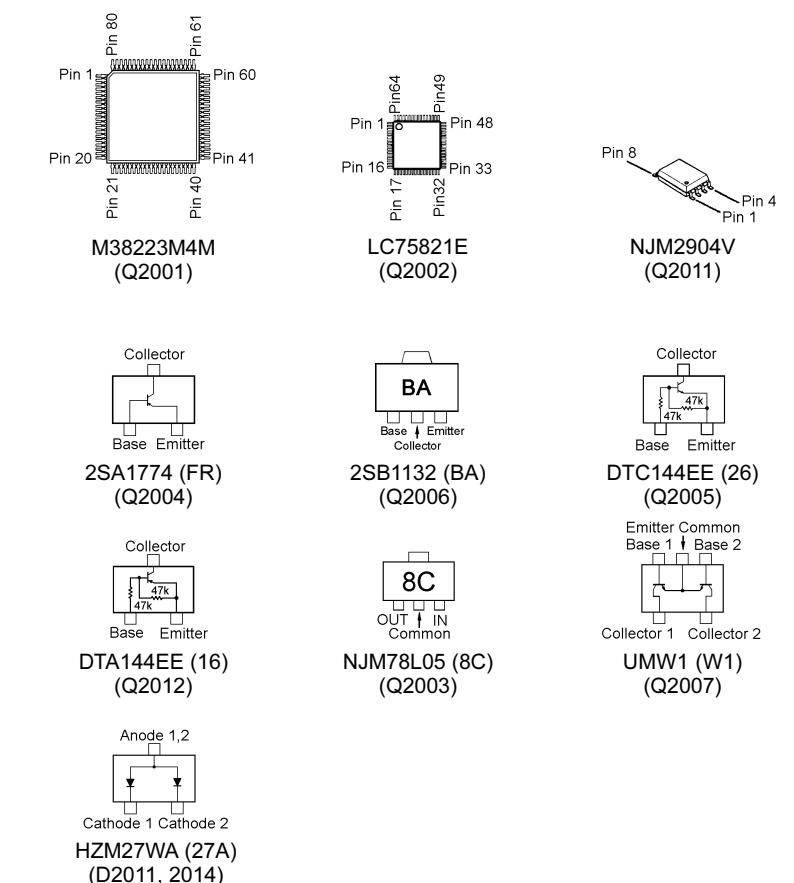
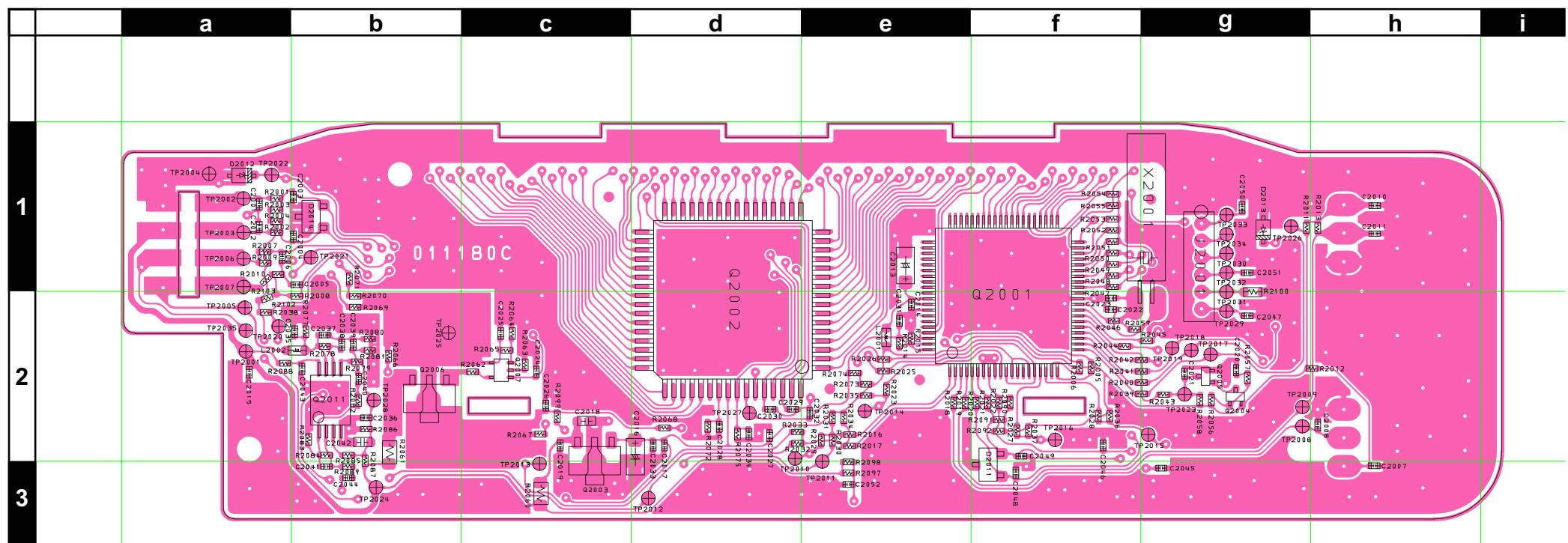


# PANEL Unit

## Parts Layout (Side A)



## Parts Layout (Side B)







**PANEL Unit****Parts List**

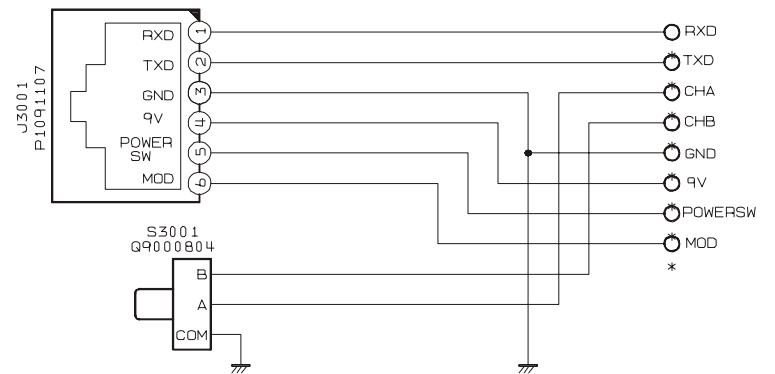
REF	DESCRIPTION	VALUE	V/W	TOL.	MFR'S DESIG	VXSTD P/N	VERS.	LOT	SIDE	LAY ADR
R 2071	CHIP RES.	82	1/16W	5%	RMC1/16S 820JTH	J24189012		1-	B	b1
R 2072	CHIP RES.	56k	1/16W	5%	RMC1/16S 563JTH	J24189046		1-	B	d2
R 2073	CHIP RES.	820	1/16W	5%	RMC1/16S 821JTH	J24189024		1-	B	e2
R 2074	CHIP RES.	47	1/16W	5%	RMC1/16S 470JTH	J24189009		1-	B	e2
R 2075	CHIP RES.	100k	1/16W	5%	RMC1/16S 104JTH	J24189049		1-	B	d2
R 2077	CHIP RES.	4.7k	1/16W	5%	RMC1/16S 472JTH	J24189033		1-	B	b2
R 2078	CHIP RES.	2.2M	1/16W	5%	RMC1/16S 225JTH	J24189065		1-	B	b2
R 2079	CHIP RES.	100k	1/16W	5%	RMC1/16S 104JTH	J24189049		1-	B	b2
R 2080	CHIP RES.	15k	1/16W	5%	RMC1/16S 153JTH	J24189039		1-	B	b2
R 2081	CHIP RES.	10k	1/16W	5%	RMC1/16S 103JTH	J24189037		1-	B	b2
R 2082	CHIP RES.	1k	1/16W	5%	RMC1/16S 102JTH	J24189025		1-	B	b2
R 2083	CHIP RES.	4.7k	1/16W	5%	RMC1/16S 472JTH	J24189033		1-	B	b2
R 2084	CHIP RES.	100k	1/16W	5%	RMC1/16S 104JTH	J24189049	AUS	1-	B	b2
R 2084	CHIP RES.	100k	1/16W	5%	RMC1/16S 104JTH	J24189049	EXP	1-	B	b2
R 2084	CHIP RES.	100k	1/16W	5%	RMC1/16S 104JTH	J24189049	USA	1-	B	b2
R 2085	CHIP RES.	100k	1/16W	5%	RMC1/16S 104JTH	J24189049		1-	B	b2
R 2086	CHIP RES.	33k	1/16W	5%	RMC1/16S 333JTH	J24189043		1-	B	b2
R 2087	CHIP RES.	47k	1/16W	5%	RMC1/16S 473JTH	J24189045		1-	B	b2
R 2088	CHIP RES.	100	1/16W	5%	RMC1/16S 101JTH	J24189013		1-	B	a2
R 2089	CHIP RES.	10k	1/16W	5%	RMC1/16S 103JTH	J24189037		1-	B	b3
R 2090	CHIP RES.	100k	1/16W	5%	RMC1/16S 104JTH	J24189049		1-	B	f2
R 2091	CHIP RES.	100k	1/16W	5%	RMC1/16S 104JTH	J24189049		1-	B	f2
R 2092	CHIP RES.	100k	1/16W	5%	RMC1/16S 104JTH	J24189049		1-	B	f2
R 2093	CHIP RES.	1k	1/16W	5%	RMC1/16S 102JTH	J24189025		1-	A	B2
R 2094	CHIP RES.	0	1/16W	5%	RMC1/16S JPTH	J24189070		1-	A	B2
R 2095	CHIP RES.	1k	1/16W	5%	RMC1/16S 102JTH	J24189025		1-	A	B2
R 2096	CHIP RES.	1k	1/16W	5%	RMC1/16S 102JTH	J24189025		1-	A	B2
R 2097	CHIP RES.	22	1/16W	5%	RMC1/16S 220JTH	J24189005		1-	B	e3
R 2098	CHIP RES.	22	1/16W	5%	RMC1/16S 220JTH	J24189005		1-	B	e2
R 2099	CHIP RES.	390	1/16W	5%	RMC1/16S 391JTH	J24189020		1-	B	c2
R 2100	CHIP RES.	0	1/16W	5%	RMC1/16 000JATP	J24185000		1-	B	g1
R 2101	CHIP RES.	0	1/16W	5%	RMC1/16 000JATP	J24185000		1-	A	B2
R 2102	CHIP RES.	10k	1/16W	5%	RMC1/16S 103JTH	J24189037		1-	B	a2
R 2103	CHIP RES.	0	1/16W	5%	RMC1/16S JPTH	J24189070		1-	B	a1
S 2014	TACT SWITCH				SKQMAL	N5090105		1-	A	H1
VR2001	POT.				RK09D1130C2P 10KB	J60800268		1-	A	A1
VR2002	POT.				RK09D1130C2P 10KB	J60800268		1-	A	A2
X 2001	XTAL CSA-310	3.6864MHz			3.6864MHz	H0102988		1-	B	f2
	LCD HOLDER INTER CONNECTOR LIGHT GUIDE DIFFUSER SHEET REFLECTOR SHEET LCD SPACER				(LCD)	RA0540800 RA0540900 RA0540700 RA0551800 RA0551900 RA0552200		1-		

## *PANEL Unit*

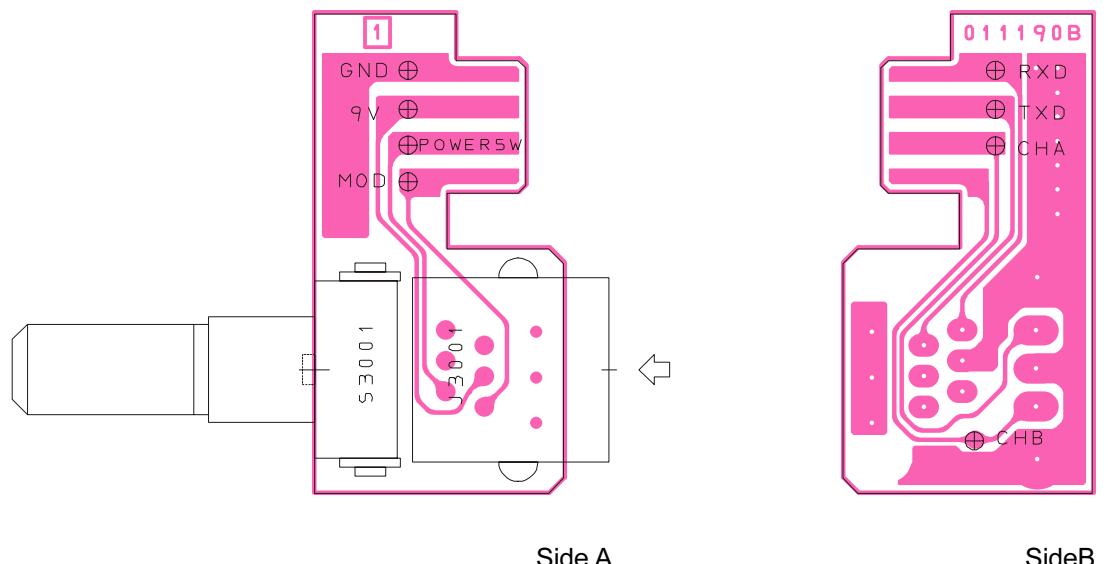
*Note*

# CH Unit

## Circuit Diagram



## Parts Layout



Side A

Side B

## Parts List

REF	DESCRIPTION	VALUE	V/W	TOL.	MFR'S DESIG	VXSTD P/N	VERS.	LOT	SIDE	LAY ADR
	PCB with Components					CB2350001				
	Printed Circuit Board				AH016M000	FR0111900				1-
J 3001	CONNECTOR				NTC-623PCBL6-B	P1091107				
S 3001	ROTARY ENCODER				EC11B15202AA	Q9000804				

## *CH Unit*

*Note*





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