



SERVICE MANUAL

VHF MARINE TRANSCEIVER

IC-M31

INTRODUCTION

This service manual describes the latest service information for the **IC-M31** VHF MARINE TRANSCEIVER at the time of publication.

To upgrade quality, all electrical or mechanical parts and internal circuits are subject to change without notice or obligation.

Model	Version	Symbol	AC adapter	TX high power
IC-M31	Europe	[EUR]	BC-147E	5W
	United Kingdom	[UK]	—	
	Germany	[FRG]	BC-147E	1W

DANGER

NEVER connect the transceiver to an AC outlet or to a DC power supply that uses more than 10 V. This will ruin the transceiver.

DO NOT expose the transceiver to rain, snow or any liquids.

DO NOT reverse the polarities of the power supply when connecting the transceiver.

DO NOT apply an RF signal of more than 20 dBm (100mW) to the antenna connector. This could damage the transceiver's front end.

ORDERING PARTS

Be sure to include the following four points when ordering replacement parts:

1. 10-digit order numbers
2. Component part number and name
3. Equipment model name and unit name
4. Quantity required

<**SAMPLE ORDER**>

1110003200 S.IC TA31136FN IC-M31 MAIN UNIT 1 piece
8930060890 2691 keyboard (A) IC-M31 Chassis 5 pieces

Addresses are provided on the inside back cover for your convenience.



REPAIR NOTES

1. Make sure a problem is internal before disassembling the transceiver.
2. **DO NOT** open the transceiver until the transceiver is disconnected from its power source.
3. **DO NOT** force any of the variable components. Turn them slowly and smoothly.
4. **DO NOT** short any circuits or electronic parts. An insulated turning tool **MUST** be used for all adjustments.
5. **DO NOT** keep power ON for a long time when the transceiver is defective.
6. **DO NOT** transmit power into a signal generator or a sweep generator.
7. **ALWAYS** connect a 40 dB to 50 dB attenuator between the transceiver and a deviation meter or spectrum analyzer when using such test equipment.
8. **READ** the instructions of test equipment thoroughly before connecting equipment to the transceiver.

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SECTION 1 SPECIFICATIONS

■ GENERAL

• Frequency coverage	: 156.000–161.450 MHz 156.000–163.425 MHz
• Type of emission	: 16K0G3E
• Antenna impedance	: 50 Ω
• MIC impedance	: 2 k Ω
• Audio impedance	: 8 Ω
• Power supply requirement	: 7.5 V DC (negative ground; supplied battery pack)
• Current drain (approx.)	: Transmit at 5.0 W 1.5 A at 1.0 W 0.7 A at 0.5 W 0.6 A Receive max audio 200 mA
• Frequency stability	: ± 1.5 kHz
• Usable temperature range	: -15°C to $+55^{\circ}\text{C}$
• Dimensions (projections not included)	: 61(W) \times 135(H) \times 41(D) mm
• Weight (approx.)	: 360 g (with ant., BP-224)

■ TRANSMITTER

• RF output power	: 5 W / 1 W 1 W / 0.5 W (FRG version) (with supplied battery pack)
• Modulation system	: Variable reactance frequency modulation
• Maximum frequency deviation	: ± 5.0 kHz
• Spurious emissions	: 250 nW
• Adjacent channel power	: 70 dB
• Transmitter audio distortion	: Less than 10 % at 1 kHz, 60% deviation
• Residual modulation	: 40 dB
• Audio frequency response	: +1 dB to -3 dB of 6 dB octave from 300 Hz to 3000 Hz

■ RECEIVER

• Receive system	: Double conversion superheterodyne system
• Intermediate frequencies	: 1st 21.7 MHz 2nd 450 kHz
• Sensitivity	: 0.79 μV at 12 dB SINAD
• Squelch sensitivity	: 1 μV at threshold
• Adjacent channel selectivity	: 70 dB
• Spurious response rejection	: 70 dB
• Intermodulation rejection ratio	: 68 dB
• Hum and noise	: 40 dB
• Audio output power	: 200 mW at 10% distortion with an 8 Ω load
• Audio frequency response	: +1 dB to -3 dB of -6 dB octave from 300 Hz to 3000 Hz

Specifications are measured in accordance with EN301-178-2.

All stated specifications are subject to change without notice or obligation.

■ VHF MARINE CHANNEL LIST

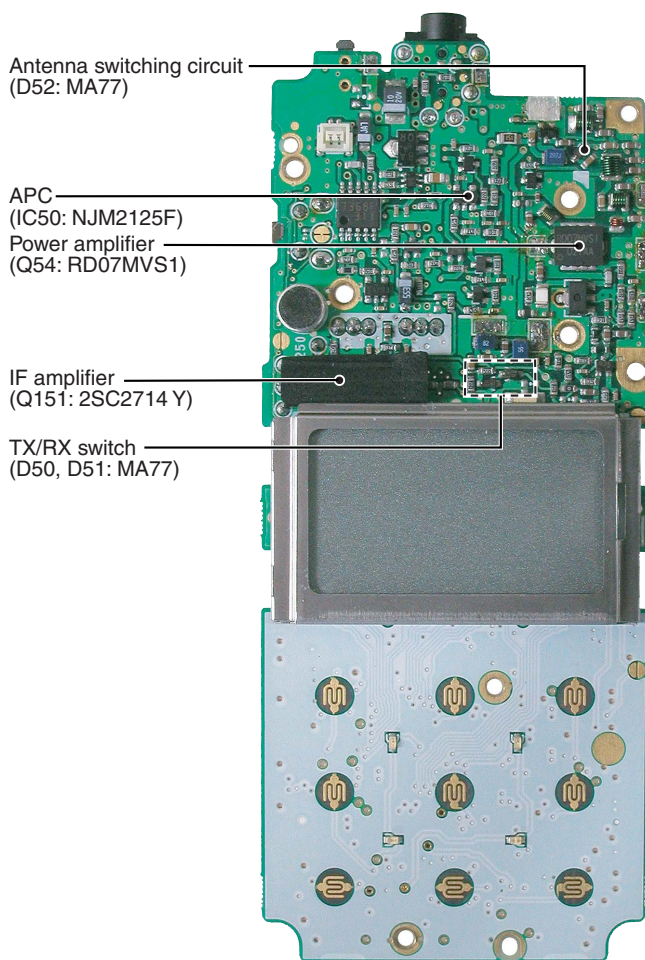
Channel No.		Frequency (MHz)		Channel No.		Frequency (MHz)		Channel No.		Frequency (MHz)	
USA *2	INT	Transmit	Receive	USA *2	INT	Transmit	Receive	USA *2	INT	Transmit	Receive
	01	156.050	160.650		22	157.100	161.700	74	74	156.725	156.725
01A		156.050	156.050	22A		157.100	157.100		75*1	156.775	156.775
	02	156.100	160.700		23	157.150	161.750		76*1	156.825	156.825
	03	156.150	160.750	23A		157.150	157.150	77*1	77	156.875	156.875
03A		156.150	156.150	24	24	157.200	161.800		78	156.925	161.525
	04	156.200	160.800	25	25	157.250	161.850	78A		156.925	156.925
	05	156.250	160.850	26	26	157.300	161.900		79	156.975	161.575
05A		156.250	156.250	27	27	157.350	161.950	79A		156.975	156.975
06	06	156.300	156.300	28	28	157.400	162.000		80	157.025	161.625
	07	156.350	160.950	37A	37A*2	157.850	157.850	80A		157.025	157.025
07A		156.350	156.350		60	156.025	160.625		81	157.075	161.675
08	08	156.400	156.400		61	156.075	160.675	81A		157.075	157.075
09	09	156.450	156.450	61A		156.075	156.075		82	157.125	161.725
10	10	156.500	156.500		62	156.125	160.725	82A		157.125	157.125
11	11	156.550	156.550		63	156.175	160.775		83	157.175	161.775
12	12	156.600	156.600	63A		156.175	156.175	83A		157.175	157.175
13*	13	156.650	156.650		64	156.225	160.825	84	84	157.225	161.825
14	14	156.700	156.700	64A		156.225	156.225	84A		157.225	157.225
15*1	15*1	156.750	156.750		65	156.275	160.875	85	85	157.275	161.875
16	16	156.800	156.800	65A		156.275	156.275	85A		157.275	157.275
17*1	17*1	156.850	156.850		66	156.325	160.925	86	86	157.325	161.925
	18	156.900	161.500	66A		156.325	156.325	86A		157.325	157.325
18A		156.900	156.900	67*	67	156.375	156.375	87	87	157.375	161.975
	19	156.950	161.550	68	68	156.425	156.425	87A		157.375	157.375
19A		156.950	156.950	69	69	156.475	156.475	88	88	157.425	162.025
20	20	157.000	161.600	70	70	Rx only	156.525	88A		157.425	157.425
20A		157.000	157.000	71	71	156.575	156.575				
	21	157.050	161.650	72	72	156.625	156.625				
21A		157.050	157.050	73	73	156.675	156.675				

*1 Low power only, *2 For [UK] version only

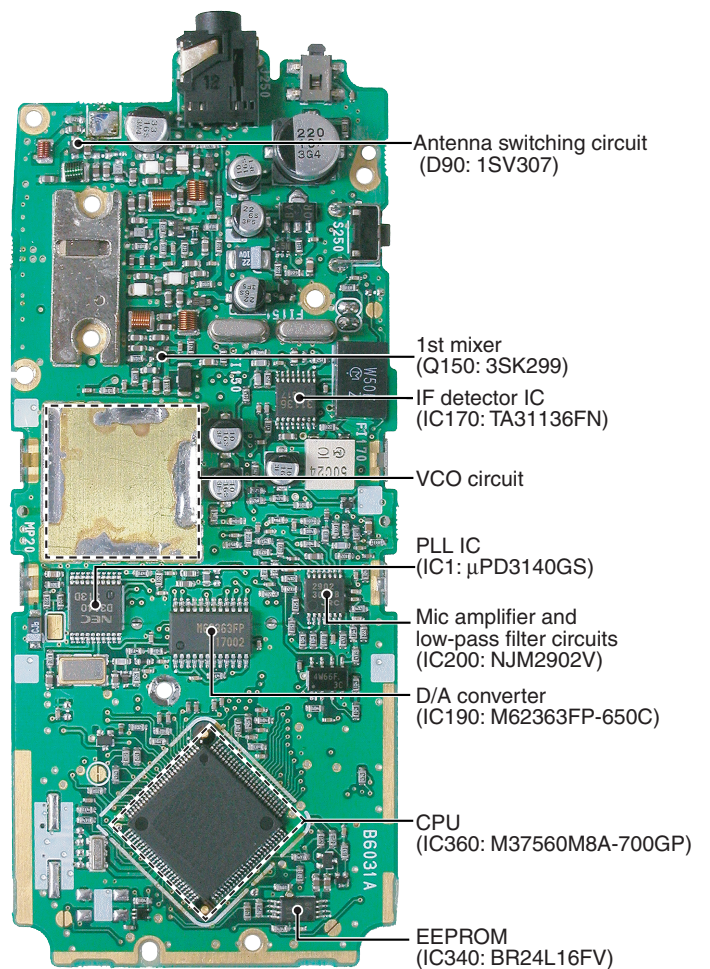
SECTION 2 INSIDE VIEWS

• MAIN UNIT

TOP VIEW

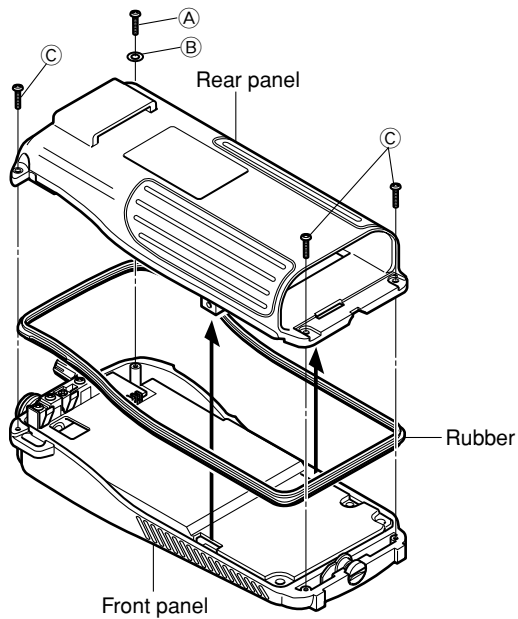


BOTTOM VIEW



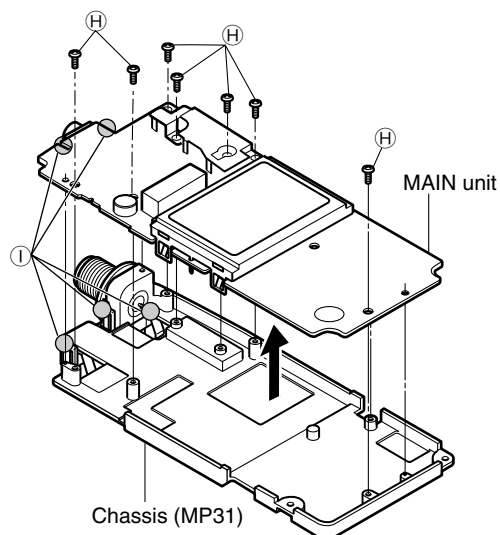
SECTION 3 DISASSEMBLY INSTRUCTIONS

● Removing the Rear panel



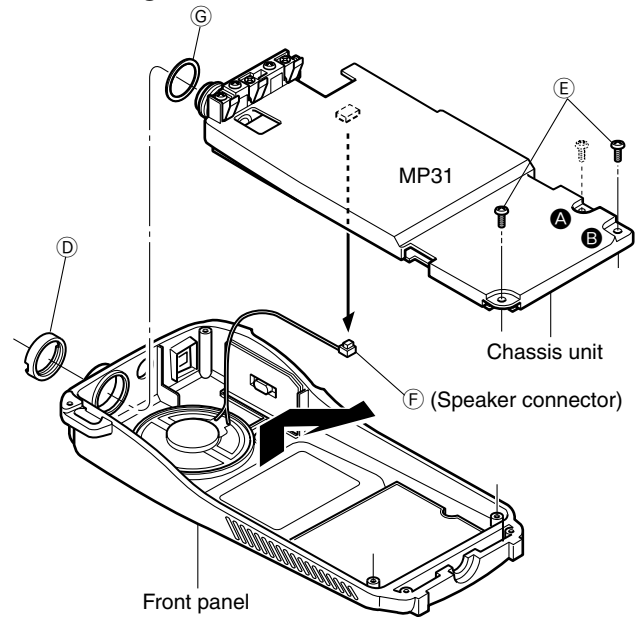
- ① Unscrew 1 screw, **A** (2 × 10 mm), and remove 1 washer, **B**.
- ② Unscrew 3 screws, **C** (2 × 8 mm).
- ③ Remove the rear panel and rubber from the front panel.

● Removing the MAIN unit



- ① Unscrew 7 screws, **H** (2 × 4 mm).
- ② Unsolder 3 points, **I**, and remove earth plate.
- ③ Separate the MAIN unit and the chassis.

● Removing the Chassis unit



- ① Unscrew 1 nut, **D**.
- ② Unscrew 2 screws, **E** (2 × 6 mm).
- ③ Take off the chassis unit in the direction of the arrow.
- ④ Unplug, **F**, to separate the front panel, J251, and the chassis unit.
- ⑤ Remove 1 washer, **G**.

NOTE:

- A** : For IC-M21 only.
- B** : For IC-M31 only.

NOTE: The chassis panel MP31 is a common parts for IC-M21 and IC-M31. Need to screw the MP42 (C) to the **B** location for IC-M31.

SECTION 4 CIRCUIT DESCRIPTION

4-1 RECEIVER CIRCUITS

4-1-1 ANTENNA SWITCHING CIRCUIT (MAIN UNIT)

The antenna switching circuit functions as a low-pass filter while receiving and as resonator circuit while transmitting. The circuit does not allow transmit signals to enter receiver circuits.

Received signals from the antenna connector pass through the low-pass filter (L81, L82, C83–C86, C89) and antenna switching circuit (D52, D90). The filtered signals are then applied to the RF amplifier circuit (Q90).

4-1-2 RF AND 1ST MIXER CIRCUITS (MAIN UNIT)

The 1st mixer circuit converts the received signals to a fixed frequency of the 1st IF signal with a PLL output frequency. By changing the PLL frequency, only the desired frequency will be passed through a pair of crystal filters at the next stage of the 1st mixer.

The signals from the antenna switching circuit are passed through the tunable bandpass filter (D92) and amplified at the RF amplifier (Q90). The amplified signals are passed through another tunable bandpass filter (D130), and then applied to the 1st mixer circuit (Q150).

The filtered signals are mixed at the 1st mixer (Q150) with a 1st LO signal coming from the PLL circuit to produce a 21.7 MHz 1st IF signal. The 1st IF signal is passed through two crystal filters (F150, F151) and is then amplified at the IF amplifier (Q151).

4-1-3 2ND IF AND DEMODULATOR CIRCUITS (MAIN UNIT)

The 2nd mixer circuit converts the 1st IF signal to a 2nd IF signal. A double conversion superheterodyne system (which converts receive signal twice) improves the image rejection and obtain stable receiver gain.

The 1st IF signal is applied to a 2nd mixer section of the FM IF IC (IC170, pin 16). The signal is then mixed with a 2nd LO signal for conversion into a 450 kHz 2nd IF signal.

IC170 contains the 2nd mixer, limiter amplifier, quadrature detector and active filter circuits. A 21.25 MHz 2nd LO signal is produced at the PLL circuit using the reference frequency.

The 2nd IF signal from the 2nd mixer (IC170, pin 3) passes through ceramic filters (F170) to remove unwanted heterodyne frequencies. It is then amplified at the limiter amplifier section (IC170, pin 5) and applied to the quadrature detector section (IC170, pins 10 and 11) to demodulate the 2nd IF signal into AF signals.

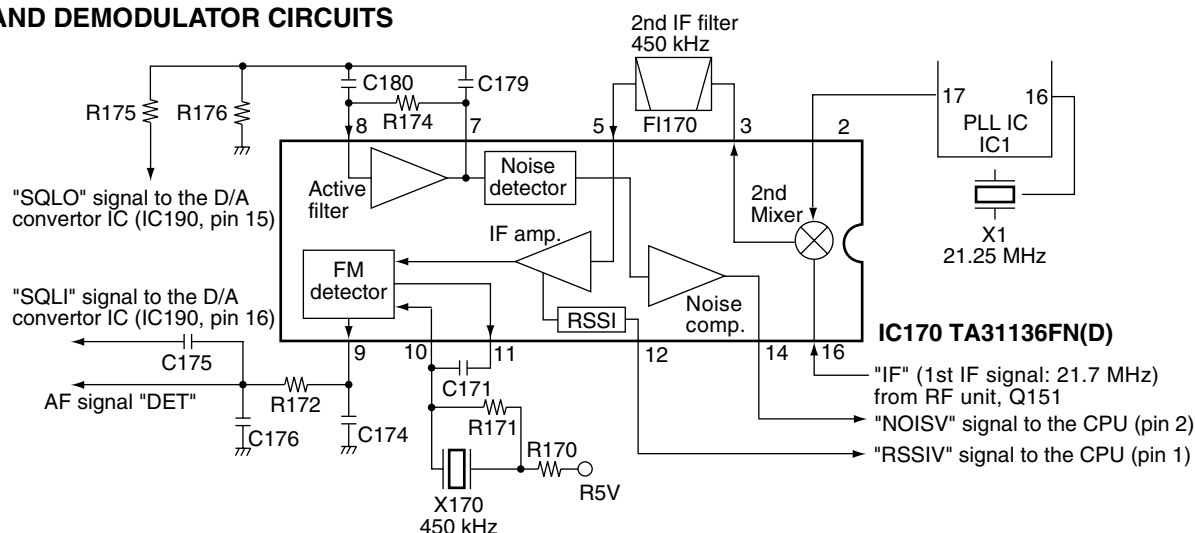
4-1-4 AF CIRCUIT (MAIN UNIT)

AF signals from the FM IF IC (IC170, pin 9) are fed to the analog switch (IC260).

The AF signals (detected signals) are passed through the analog switch (IC260, pins 2 and 1) and are then applied to the active low-pass filter (IC200c, pin 9).

The filtered AF signals are applied to and adjusted audio level at the D/A converter (IC190, pin 24) to adjust amplitude. The level controlled signals are passed through the AF mute switch (Q280) which is controlled by "AFMS" signal from the CPU (IC360, pin 47). The passed signals are applied to the AF power amplifier (IC280, pin 4), and then output to the internal speaker or [EXT SP] jack after being passed through the de-emphasis circuit (R286, C285) to obtain the -6 dB/octave frequency characteristics.

• 2ND IF AND DEMODULATOR CIRCUITS



4-1-5 SQUELCH CIRCUIT (MAIN UNIT)

The noise squelch circuit cuts out AF signals when no RF signals are received. By detecting noise components in the AF signals, the squelch circuit switches the AF mute switch.

A portion of the AF signals divided by C175 from the FM IF IC (IC170, pin 9) are applied to the D/A converter (IC190, pin 16) to adjust amplitude. The signals from the D/A converter (IC190, pin 15) are applied to the active filter section (IC170, pin 8). The active filter section amplifies and filters noise components. The filtered signals are applied to the noise detector section and output from IC170 (pin 14) as the "NOISV" signal.

The "NOISV" signal from IC170 (pin 14) is applied to the CPU (IC360, pin 2). The CPU compares the set squelch level voltage and "NOISV" signal voltage to control the squelch output.

4-2 TRANSMITTER CIRCUITS

4-2-1 MICROPHONE AMPLIFIER CIRCUIT (MAIN UNIT)

The microphone amplifier circuit amplifies audio signals with +6 dB/octave pre-emphasis characteristics from the microphone to a level needed for the modulation circuit.

The AF signals from the microphone are passed through the pre-emphasis circuit (R253, C254) and are then applied to the microphone amplifier (IC200b). The amplified AF signals are applied to analog switch (IC260, pin 5).

The AF signals are amplified again at the limiter-amplifier (IC200a) and then passed through the low-pass filter (IC200d, pins 12 and 13). The filtered audio is applied to the RF unit as the "MOD" signal.

4-2-2 MODULATION CIRCUIT (MAIN UNIT)

The modulation circuit modulates the VCO oscillating signal (RF signal) using the microphone audio signals.

The audio signals "MOD" change the reactance of D20 to modulate an oscillated signal at the VCO circuit (Q21, Q22, D22, D23). The oscillated signal is amplified at the buffer-amplifiers (Q23, Q24).

4-2-3 DRIVE/POWER AMPLIFIER CIRCUITS (MAIN UNIT)

The signal from the VCO circuit passes through the transmit/receive switching circuit (D50, D51) and is applied to the buffer-amplifier (Q50). The amplified signal is amplified by the pre-driver (Q53) and the power amplifier (Q54) to obtain 5 W of RF power (at 7.2 V). The amplified signal passes through the antenna switching circuit (D52), and low-pass filter (L81, L82, C83–C86, C89) and is then applied to the antenna connector.

The bias current of the pre-driver (Q53) and the power amplifier (Q54) is controlled by the APC circuit to stabilize the output power.

4-2-4 APC CIRCUIT (MAIN UNIT)

The APC circuit provides stable output power from the power amplifier even when the input voltage or temperature changes, and, selects HIGH or LOW output power. The APC circuit consists of a power detector and APC control circuits.

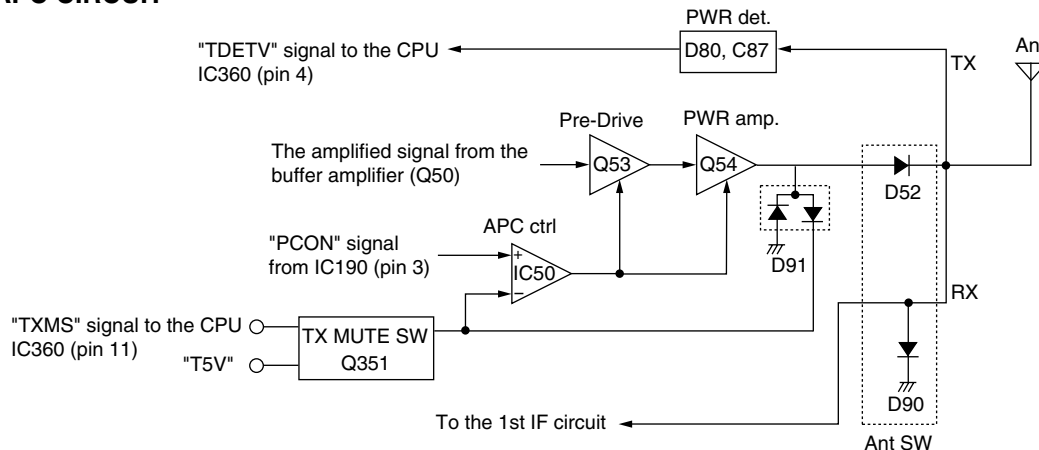
• POWER DETECTOR CIRCUIT (MAIN UNIT)

The power detector circuit (D80, C87) detects the transmit output power level and converts it to DC voltage as the "TDETV" signal. The detected signal is applied to the TX control circuit.

• APC CONTROL CIRCUIT (MAIN UNIT)

The detected signal from the power detector circuit (D91, R280) is applied to the CPU (IC360, pin 4) to control the input voltage of the pre-driver (Q53) and the power amplifier (Q54). When the output power changes, the CPU (IC360) outputs APC control signal to the D/A converter (IC190). And then "PCON" signal from the D/A converter controls the APC controller (IC50) to provide stable output power.

• APC CIRCUIT



4-3 PLL CIRCUIT (MAIN UNIT)

A PLL circuit provides stable oscillation of the transmit frequency and receive 1st LO frequency. The PLL output compares the phase of the divided VCO frequency to the reference frequency. The PLL output frequency is controlled by the divided ratio (N-data) of a programmable divider.

The PLL circuit contains a VCO (Q21, Q22, D22, D23). The oscillated signal is amplified at the buffer-amplifiers (Q23, Q25) and then applied to the PLL IC (IC1, pin 19).

The PLL IC contains the prescalers, programmable counter, programmable divider, phase selector and etc. The entered signal is divided at the prescaler and programmable counter sections by the N-data ratio from the CPU. The divided signal is detected on phase at the phase detector using the reference frequency.

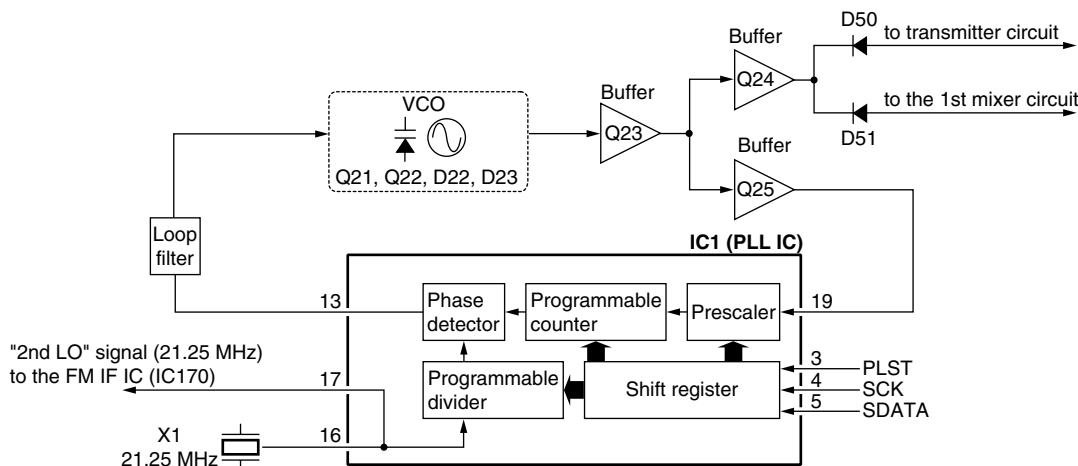
If the oscillated signal drifts, the phase of its frequency changes from the reference frequency, causing a lock voltage changes to compensate for the drift in the oscillated frequency.

A portion of the VCO signal is amplified at buffer-amplifiers (Q23, Q24) and is then applied to the receive 1st mixer (Q150) or transmit driver via the TX/RX switching diode (D50, D51).

4-4 POWER SUPPLY CIRCUITS VOLTAGE LINES

LINE	DESCRIPTION
VCC	The voltage from the attached battery pack.
CPU5V	Common 5 V converted from the VCC line by the CPU5V regulator circuit (IC220). The output voltage is applied to the CPU (IC360), REG5V regulator, etc.
5V	Common 5V converted from the VCC line by the 5V regulator circuit (Q223–Q225). The output voltage is applied to the D/A converter (IC190) and PLL IC (IC1), etc.
R5V	Receive 5V converted from the 5V line by the R5 regulator circuit (Q221). The regulated voltage is applied to the MOD MUTE circuit (Q20, D20, D21) and receiver circuit.
V5V	Common 5V converted from the 5V line by the V5 regulator circuit (Q220). The regulated voltage is applied to the VCO circuit
T5V	Transmit 5V converted from the 5V line by the T5 regulator circuit (Q222). The regulated voltage is applied to the transmitter circuit.

• PLL CIRCUIT



4-5 PORT ALLOCATIONS

4-5-1 CPU (IC360)

Pin number	Port name	Description
1	RSSIV	Input port for the RSSI signal to control S-meter from the FM IF IC (IC170 pin 12).
2	NOISV	Input port for the NOIS signal to control squelch circuit from the FM IF IC (IC170 pin 14).
3	BATTV	Input port for the battery voltage detection.
4	TDETV	Input port for the TX power detection.
5	TEMPV	Input port for transceiver's internal temperature detection.
6	SCK	Outputs serial clock.
7	SDATA	Outputs serial data.
10	LEDS	Outputs key pad and LCD back light control signal. High : While lights ON.
12	BEEP	Outputs beep audio signals.
13	PLST	Outputs strobe signals to the PLL IC (IC1, pin 3).
14	DAST	Outputs strobe signals to the D/A converter IC (IC190, pin 6).
15	5VS	Outputs the M5V regulator control signal.
16	LCDS	Outputs LCD contrast signal.
18	ESCK	Outputs serial clock signal for the EEPROM (IC340, pin 6).
19	CLIN	Input port for the cloning data.
20	CLOUT	Outputs the cloning data.
22	PWSW	Input port for the power switch control signal.
23	UNLK	Input port for the PLL unlock signal. High : PLL is unlocked.
24	ESDA	I/O port for the serial data signals to the EEPROM (IC340, pin 5).
27	TDEC	Outputs the decode monitor signal. High : While muting.
30	PTT	Input port for the [PTT] switch. High : While the [PTT] switch is pushed.
31	WET	Input port for transceiver's internal inundation detection.
39	SCAN	Input port for the [SCN] key. Low : While the [SCN] key is pushed.
40	H/L	Input port for the [H/L] key. Low : While the [H/L] key is pushed.
41	VOL DOWN	Input port for the volume control signal.
42	SQL	Input port for the [SQL] key. Low : While the [SQL] key is pushed.

Pin number	Port name	Description
43	CH/WX	Input port for the [CH/WX] key. Low : While [CH/WX] key is pushed.
44	UP	Input port for the [▲] key. Low : While the [▲] key is pushed.
45	DOWN	Input port for the [▼] key. Low : While the [▼] key is pushed.
46	16	Input port for the [16] key. Low : While the [16] key is pushed.
47	AFMS	Output the speaker mute switch control signal. High : While the AF output is muted.
48	BPFS	Outputs RF bandpass filters control signal. High : While receiving below 159.990 MHz. Low : While receiving above 160.000 MHz.
49	V5VS	Outputs the 5V regulator control signal.
50	T5VS	Outputs the T5V regulator control signal.
51	R5VS	Outputs the R5V regulator control signal.
52	AFVS	Outputs the AF regulator control signal.
53	MICM	Outputs the MIC mute switch control signal.
54	DETM	Outputs the detector mute control signal. Low : While muting.
55	VOL UP	Input port for the volume control signal.

4-5-2 D/A converter IC (IC190)

Pin number	Port name	Description
2	FCON	Outputs the reference frequency adjusting.
3	PCON	Outputs the TX power adjusting signal.
10	MCON	Outputs the transmit modulation adjusting signal.
11	BEPO	Outputs the beep tone level adjusting signal while "AUTO" is selected in set mode.
14	BEPST	Outputs the beep tone level adjusting signal while 1-10 level is selected in set mode.
15	SQLO	Outputs the squelch level adjusting signal.

SECTION 5 ADJUSTMENT PROCEDURES

5-1 PREPARATION

When adjusting IC-M31, the optional CS-M32 CLONING SOFTWARE (Rev. 1.0 or later), OPC-478 CLONING CABLE are required.

EQUIPMENT	GRADE AND RANGE	EQUIPMENT	GRADE AND RANGE
DC power supply	Output voltage : 7.5 V DC Current capacity : 3 A or more	FM deviation meter	Frequency range : 30–300 MHz Measuring range : 0 to ±10 kHz
RF power meter (terminated type)	Measuring range : 0.1–10 W Frequency range : 100–300 MHz Impedance : 50 Ω SWR : Less than 1.2 : 1	Audio generator	Frequency range : 300–3000 Hz Measuring range : 1–500 mV
Frequency counter	Frequency range : 0.1–300 MHz Frequency accuracy : ±1 ppm or better Sensitivity : 100 mV or better	Standard signal generator (SSG)	Frequency range : 100–300 MHz Output level : 0.1 μV–32 mV (–127 to –17 dBm)
Digital multimeter	Input impedance : 10 MΩ/DC or better	Attenuator	Power attenuation : 40 dB or more Capacity : 10 W or more

■ BEFORE ENTERING THE ADJUSTMENT MODE

- Cloning the adjustment frequency 156.800 MHz on the programmable CH.
(No select POC function POC ON on the adjustment frequency.)

■ ENTERING THE ADJUSTMENT MODE

- Push and hold the [H/L] key and [PTT] switch, and then turn power ON.

■ OPERATING IN THE ADJUSTMENT MODE

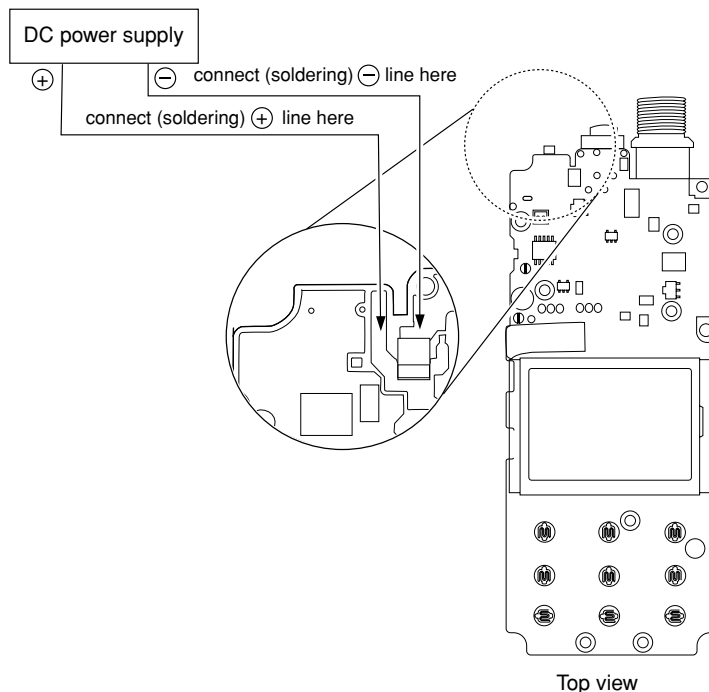
- Change adjustment items: [16] key
- Change adjustment values: [▲] and [▼] keys

■ EXITING THE ADJUSTMENT MODE

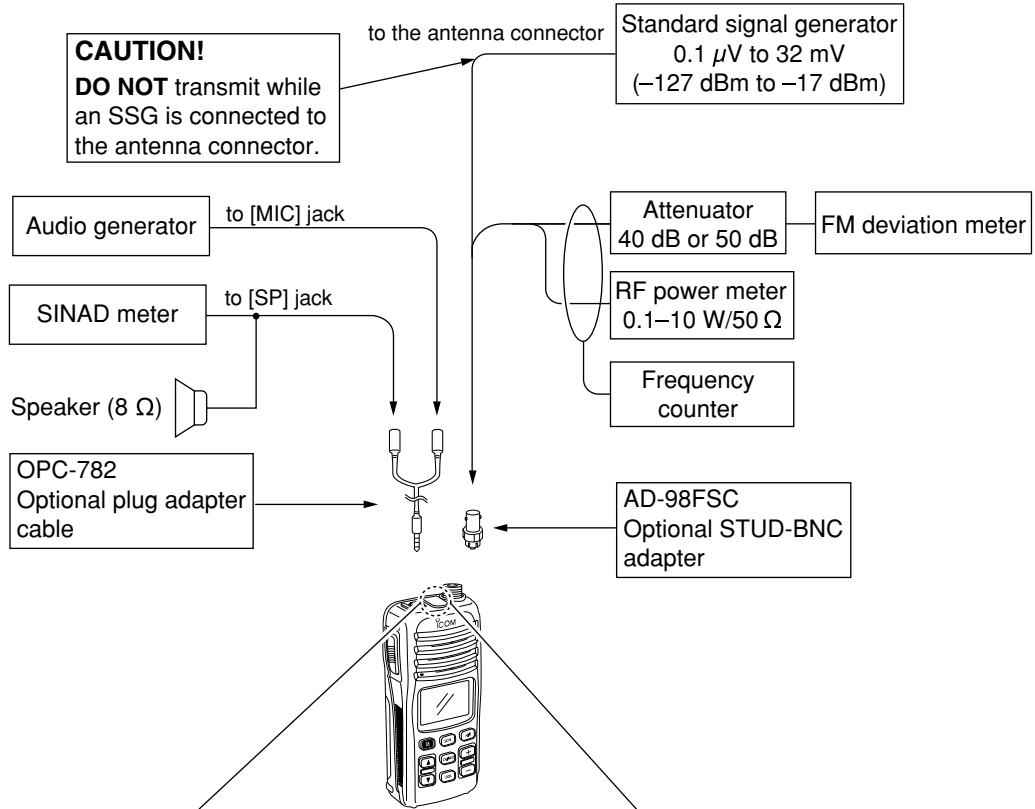
When adjustment is finished, need to do follow operation to cancel the adjustment mode. Otherwise, the transceiver does not work properly.

- Turn power OFF.
- Push and hold the [H/L] key and [PTT] switch, and then turn power ON.

• DC POWER CABLE CONNECTION

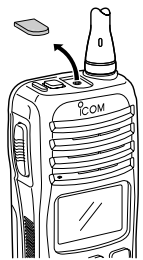


• CONNECTION



DETACHING/ATTACHING THE TOP PANEL

CAUTION!
DO NOT detach the TOP PANEL except for adjustment or cloning to maintain the water resistance capability.



Detach the TOP PANEL with a sharp point such as tweezers for adjustment.
BE CAREFUL cracking the TOP PANEL.



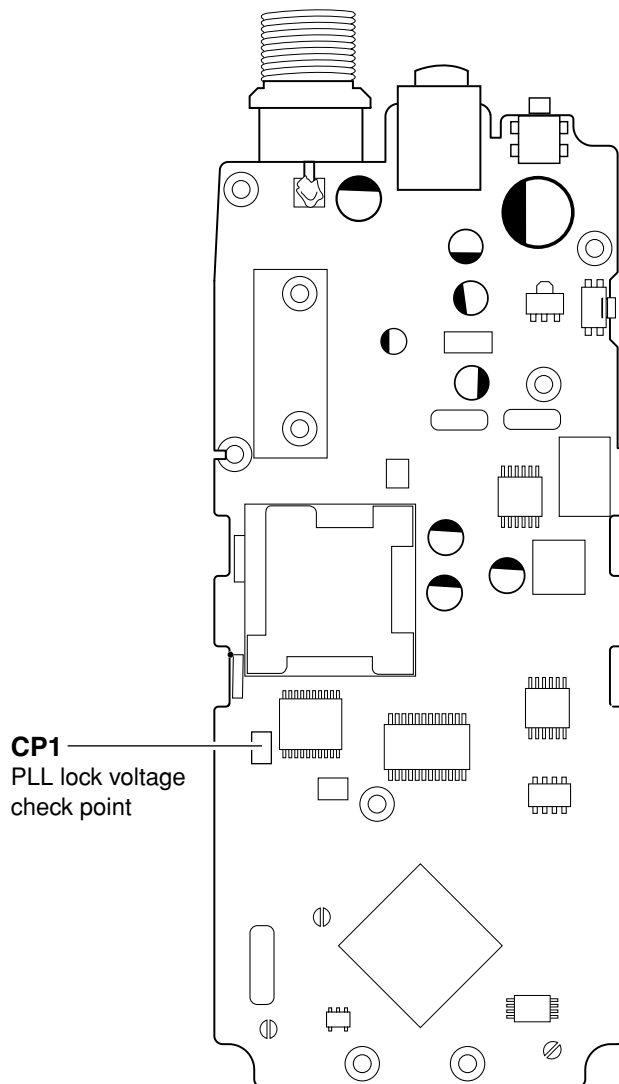
After adjustment, be sure to reattach the TOP PANEL to maintain the water resistance capability.

NOTE: If the tape on the back of the TOP PANEL has lost its adhesion, replacement to a new one is necessary.

5-2 PLL AND RX SENSITIVITY ADJUSTMENTS

ADJUSTMENT	ADJUSTMENT CONDITION	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
LOCK VOLTAGE	1 • Operating freq. : 156.800 MHz • Receiving	MAIN	Connect a digital multi-meter or oscilloscope to the check point CP1.	1.8 V		Verify
	2 • Operating freq. : 156.800 MHz • Output power : Low • Transmitting			1.7 V		
RX SENSITIVITY	1 • Operating freq. : 156.800 MHz • Set an SSG as: Frequency : 156.800 MHz Level : 3.2 μ V* (-97 dBm) Modulation : 1 kHz Deviation : \pm 3.5 kHz • Receiving	Top Panel	Connect an SSG to the antenna connector and a SINAD meter with 8 Ω load to the [SP] jack.	0.56 μ V (-112 dBm)		Verify

*The output level of the standard signal generator (SSG) is indicated as the SSG's open circuit.



5-3 ADJUSTMENT MODE ADJUSTMENTS

Select an operation using [16] key, then set specified value using [▲] / [▼] keys on the front panel of IC-M31.

ADJUSTMENT	ADJUSTMENT CONDITION	MEASUREMENT		VALUE	
		UNIT	LOCATION		
REFERENCE FREQUENCY [Fr]	1 <ul style="list-style-type: none"> Operating freq. : 156.800 MHz Output power : Low Connect an RF power meter or a 50 Ω dummy load to the antenna connector. Transmitting 	Top Panel	Loosely couple the frequency counter to the antenna connector.	156.8000 MHz	
OUTPUT POWER [Po H] (Hi)	1 <ul style="list-style-type: none"> Operating freq. : 156.800 MHz Output power : Hi Transmitting 	Top panel	Connect an RF power meter to the antenna connector.	5.0 W	
	[Po L] (Low)			2 <ul style="list-style-type: none"> Output power : Low Transmitting 	0.8 W
	[Po ML] (Extra-Low)			3 <ul style="list-style-type: none"> Output power : Extra-Low Transmitting 	0.45 W
FM DEVIATION [dE]	1 <ul style="list-style-type: none"> Operating freq. : 156.800 MHz Output power : Low Connect an audio generator to the [MIC] jack and set as: 1 kHz/25 mV Set an FM deviation meter as: HPF : OFF LPF : 20 kHz De-emphasis : OFF Detector : (P-P)/2 Transmitting 	Top panel	Connect an FM deviation meter to the antenna connector through an attenuator.	±4.3 kHz	
SQUELCH LEVEL [nL]	1 <ul style="list-style-type: none"> Operating freq. : 156.800MHz Set an SSG as: Frequency : 156.800 MHz Level : 0.63 μV* (-111 dBm) Modulation : 1 kHz Deviation : ±3.5 kHz Receiving 	Top panel	Connect an SSG to the antenna connector and a SINAD meter with 8 Ω load to the [SP] jack.	More than 12 dB SINAD	
	2 <ul style="list-style-type: none"> Receiving 			<ul style="list-style-type: none"> Push [▼] key to set squelch level to "01" at the sub channel readout. Then, push [▲] key to set squelch level to "00" at the sub channel readout. 	

*The output level of the standard signal generator (SSG) is indicated as the SSG's open circuit. TX power Hi/Low is selectable on all adjustment items.

[MAIN UNIT]

REF NO.	ORDER NO.	DESCRIPTION	M.
C74	4030006860	S.CERAMIC C1608 JB 1H 102K-T	T
C75	4030007050	S.CERAMIC C1608 CH 1H 220J-T	T
C80	4030006860	S.CERAMIC C1608 JB 1H 102K-T	T
C81	4030007040	S.CERAMIC C1608 CH 1H 180J-T	T
C82	4030007040	S.CERAMIC C1608 CH 1H 180J-T	T
C83	4030007050	S.CERAMIC C1608 CH 1H 220J-T	T
C84	4030011530	S.CERAMIC C1608 CH 1H 110J-T	T
C85	4030009650	S.CERAMIC C1608 CH 1H 240J-T	T
C86	4030007000	S.CERAMIC C1608 CH 1H 090D-T	T
C87	4030009500	S.CERAMIC C1608 CH 1H 0R5B-T	T
C88	4030017460	S.CERAMIC ECJ0EB1E102K	T
C89	4030006980	S.CERAMIC C1608 CH 1H 070D-T	B
C90	4030007000	S.CERAMIC C1608 CH 1H 090D-T	B
C91	4030007010	S.CERAMIC C1608 CH 1H 100D-T	B
C92	4030007090	S.CERAMIC C1608 CH 1H 470J-T	B
C93	4030009910	S.CERAMIC C1608 CH 1H 040B-T	B
C94	4030007020	S.CERAMIC C1608 CH 1H 120J-T	B
C95	4030007070	S.CERAMIC C1608 CH 1H 330J-T	B
C96	4030007020	S.CERAMIC C1608 CH 1H 120J-T	B
C97	4030009510	S.CERAMIC C1608 CH 1H 010B-T	B
C98	4030017460	S.CERAMIC ECJ0EB1E102K	B
C99	4030009910	S.CERAMIC C1608 CH 1H 040B-T	B
C100	4030007020	S.CERAMIC C1608 CH 1H 120J-T	B
C101	4030007070	S.CERAMIC C1608 CH 1H 330J-T	B
C102	4030007020	S.CERAMIC C1608 CH 1H 120J-T	B
C103	4030009920	S.CERAMIC C1608 CH 1H 050B-T	B
C104	4030007090	S.CERAMIC C1608 CH 1H 470J-T	B
C105	4030017460	S.CERAMIC ECJ0EB1E102K	B
C106	4030017730	S.CERAMIC ECJ0EB1E471K	B
C107	4030016790	S.CERAMIC ECJ0EB1C103K	B
C108	4030007090	S.CERAMIC C1608 CH 1H 470J-T	B
C109	4030017730	S.CERAMIC ECJ0EB1E471K	B
C110	4030017460	S.CERAMIC ECJ0EB1E102K	B
C115	4030017460	S.CERAMIC ECJ0EB1E102K	B
C120	4030016790	S.CERAMIC ECJ0EB1C103K	B
C121	4030006860	S.CERAMIC C1608 JB 1H 102K-T	T
C122	4030007030	S.CERAMIC C1608 CH 1H 150J-T	T
C123	4030007010	S.CERAMIC C1608 CH 1H 100D-T	T
C130	4030009920	S.CERAMIC C1608 CH 1H 050B-T	B
C131	4030007020	S.CERAMIC C1608 CH 1H 120J-T	B
C132	4030007070	S.CERAMIC C1608 CH 1H 330J-T	B
C133	4030017990	S.CERAMIC MCH185A130JK	B
C134	4030009510	S.CERAMIC C1608 CH 1H 010B-T	B
C135	4030017460	S.CERAMIC ECJ0EB1E102K	B
C136	4030017460	S.CERAMIC ECJ0EB1E102K	B
C137	4030009520	S.CERAMIC C1608 CH 1H 020B-T	B
C138	4030017990	S.CERAMIC MCH185A130JK	B
C139	4030007070	S.CERAMIC C1608 CH 1H 330J-T	B
C140	4030007020	S.CERAMIC C1608 CH 1H 120J-T	B
C141	4030009920	S.CERAMIC C1608 CH 1H 050B-T	B
C142	4030007020	S.CERAMIC C1608 CH 1H 120J-T	B
C143	4030017460	S.CERAMIC ECJ0EB1E102K	B
C150	4030017460	S.CERAMIC ECJ0EB1E102K	B
C151	4030007100	S.CERAMIC C1608 CH 1H 560J-T	B
C152	4030016970	S.CERAMIC ECJ0EB1C223K	B
C153	4030017460	S.CERAMIC ECJ0EB1E102K	B
C154	4030006860	S.CERAMIC C1608 JB 1H 102K-T	B
C155	4030011770	S.CERAMIC C1608 CH 1H 060B-T	T
C156	4030006860	S.CERAMIC C1608 JB 1H 102K-T	T
C157	4030016970	S.CERAMIC ECJ0EB1C223K	T
C158	4030017460	S.CERAMIC ECJ0EB1E102K	T
C159	4030016790	S.CERAMIC ECJ0EB1C103K	T
C160	4030018240	S.CERAMIC ECJ0EB1E562K	T
C170	4030017460	S.CERAMIC ECJ0EB1E102K	B
C171	4030007120	S.CERAMIC C1608 CH 1H 820J-T	B
C174	4030017460	S.CERAMIC ECJ0EB1E102K	B
C175	4030017460	S.CERAMIC ECJ0EB1E102K	B
C176	4030017460	S.CERAMIC ECJ0EB1E102K	B
C177	4030016930	S.CERAMIC ECJ0EB1A104K	B
C178	4030011810	S.CERAMIC C1608 JB 1A 224K-T	B
C179	4030007140	S.CERAMIC C1608 CH 1H 121J-T	B
C180	4030007140	S.CERAMIC C1608 CH 1H 121J-T	B
C181	4030016930	S.CERAMIC ECJ0EB1A104K	B
C191	4030016790	S.CERAMIC ECJ0EB1C103K	B
C192	4510004630	S.ELECTROLYTIC ECEV1CA100SR	B
C193	4030016790	S.CERAMIC ECJ0EB1C103K	B
C194	4030016790	S.CERAMIC ECJ0EB1C103K	B
C200	4030016790	S.CERAMIC ECJ0EB1C103K	B
C202	4030016930	S.CERAMIC ECJ0EB1A104K	B
C205	4030016960	S.CERAMIC ECJ0EB1C183K	B
C206	4030017460	S.CERAMIC ECJ0EB1E102K	B
C207	4030016930	S.CERAMIC ECJ0EB1A104K	B
C220	4510005430	S.ELECTROLYTIC ECEV0JA220SR	B
C221	4030016790	S.CERAMIC ECJ0EB1C103K	T
C222	4030016790	S.CERAMIC ECJ0EB1C103K	T
C223	4030016790	S.CERAMIC ECJ0EB1C103K	T
C224	4510005430	S.ELECTROLYTIC ECEV0JA220SR	B
C225	4030011810	S.CERAMIC C1608 JB 1A 224K-T	B

M.=Mounted side (T: Mounted on the Top side, B: Mounted on the Bottom side)

[MAIN UNIT]

REF NO.	ORDER NO.	DESCRIPTION	M.
C226	4030016790	S.CERAMIC ECJ0EB1C103K	T
C227	4550006710	S.TANTALUM ECST1AX226R	B
C228	4030017460	S.CERAMIC ECJ0EB1E102K	T
C229	4030017460	S.CERAMIC ECJ0EB1E102K	B
C230	4550006820	S.TANTALUM ECST1DX106R	T
C231	4030008680	S.CERAMIC C2012 JF 1C 105Z-T	T
C232	4030016930	S.CERAMIC ECJ0EB1A104K	T
C233	4030016790	S.CERAMIC ECJ0EB1C103K	T
C240	4030017460	S.CERAMIC ECJ0EB1E102K	T
C250	4030016790	S.CERAMIC ECJ0EB1C103K	B
C251	4510004630	S.ELECTROLYTIC ECEV1CA100SR	B
C252	4030017460	S.CERAMIC ECJ0EB1E102K	B
C254	4030016790	S.CERAMIC ECJ0EB1C103K	B
C257	4030016790	S.CERAMIC ECJ0EB1C103K	B
C260	4510004630	S.ELECTROLYTIC ECEV1CA100SR	B
C261	4030016930	S.CERAMIC ECJ0EB1A104K	B
C262	4030016790	S.CERAMIC ECJ0EB1C103K	B
C263	4030016790	S.CERAMIC ECJ0EB1C103K	B
C264	4030017780	S.CERAMIC ECJ0EB1E472K	B
C265	4030007150	S.CERAMIC C1608 CH 1H 151J-T	B
C266	4030017030	S.CERAMIC ECJ0EB1A273K	B
C267	4030011810	S.CERAMIC C1608 JB 1A 224K-T	B
C268	4030016930	S.CERAMIC ECJ0EB1A104K	B
C280	4030017480	S.CERAMIC C1608 JB 1A 474K-T	T
C281	4550006140	S.TANTALUM ECST1EY474R	T
C282	4510004630	S.ELECTROLYTIC ECEV1CA100SR	B
C283	4030016930	S.CERAMIC ECJ0EB1A104K	T
C284	4030017460	S.CERAMIC ECJ0EB1E102K	T
C285	4030016930	S.CERAMIC ECJ0EB1A104K	T
C286	4550006200	S.TANTALUM ECST0JY106R	T
C287	4030007150	S.CERAMIC C1608 CH 1H 151J-T	T
C288	4030016950	S.CERAMIC ECJ0EB1A473K	B
C289	4510005370	S.ELECTROLYTIC ECEV1AA221P	B
C300	4030017770	S.CERAMIC ECJ0EB1E332K	B
C340	4030016790	S.CERAMIC ECJ0EB1C103K	B
C341	4030017030	S.CERAMIC ECJ0EB1A273K	B
C350	4030016790	S.CERAMIC ECJ0EB1C103K	B
C351	4030007090	S.CERAMIC C1608 CH 1H 470J-T	B
C352	4030007090	S.CERAMIC C1608 CH 1H 470J-T	B
C360	4030016790	S.CERAMIC ECJ0EB1C103K	B
C361	4030016950	S.CERAMIC ECJ0EB1A473K	B
C363	4030016950	S.CERAMIC ECJ0EB1A473K	B
C364	4030016950	S.CERAMIC ECJ0EB1A473K	B
C365	4030016950	S.CERAMIC ECJ0EB1A473K	B
C366	4030016950	S.CERAMIC ECJ0EB1A473K	B
C367	4030017040	S.CERAMIC ECJ0EB1A333K	B
C368	4030016950	S.CERAMIC ECJ0EB1A473K	B
C370	4030007040	S.CERAMIC C1608 CH 1H 180J-T	B
C371	4030007050	S.CERAMIC C1608 CH 1H 220J-T	B
C372	4030016930	S.CERAMIC ECJ0EB1A104K	B
C373	4030016930	S.CERAMIC ECJ0EB1A104K	B
C374	4030016930	S.CERAMIC ECJ0EB1A104K	B
C375	4030016930	S.CERAMIC ECJ0EB1A104K	B
C376	4030016930	S.CERAMIC ECJ0EB1A104K	B
C377	4030009490	S.CERAMIC C1608 JB 1H 821K-T	B
C378	4030017780	S.CERAMIC ECJ0EB1E472K	B
C379	4030007100	S.CERAMIC C1608 CH 1H 560J-T	B
C380	4030017460	S.CERAMIC ECJ0EB1E102K	T
C381	4030017460	S.CERAMIC ECJ0EB1E102K	T
C382	4030017460	S.CERAMIC ECJ0EB1E102K	B
J250	6450001910	CONNECTOR HSJ1594-010150	B
J251	6510021900	S.CONNECTOR BM02B-ASRS-TF	T
DS240	5040002660	S.LED FY1101F-TR (LED)	T
DS241	5040002660	S.LED FY1101F-TR (LED)	T
DS242	5040002310	S.LED SML-311YTT86	T
DS243	5040002310	S.LED SML-311YTT86	T
DS244	5040002310	S.LED SML-311YTT86	T
DS245	5040002310	S.LED SML-311YTT86	T
DS246	5030002600	LCD L3-0018TAY-1	T
MC250	7700002480	MICROPHONE SKB-2746 LPC	T
S250	2260001900	SWITCH SW-149 (SKHLLD)	B
S328	2260002710	S.SWITCH SKQLLCE012	B
EP1	0910056712	PCB B 6031B	
EP2	6910014690	S.BEAD MPZ1608S221A-T	T
EP3	6910014690	S.BEAD MPZ1608S221A-T	T
EP360	8930057100	LCD CONTACT SRCN-2497-SP-N-W	T

S.=Surface mount

[CHASSIS UNIT]

REF NO.	ORDER NO.	DESCRIPTION		M.
J31	6910014190	CONNECTOR	2497 ANT CONNECTOR	
SP1	2510001092	SPEAKER	036D0801B <FG>	
W1	8900010960	CABLE	OPC-1129	

M.=Mounted side (T: Mounted on the Top side, B: Mounted on the Bottom side)
S.=Surface mount

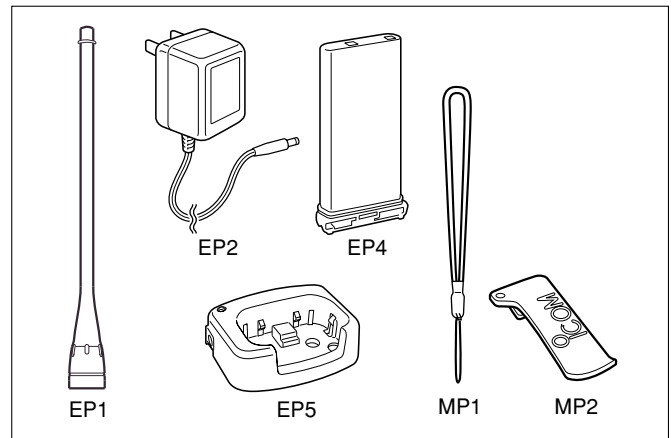
SECTION 7 MECHANICAL PARTS AND DISASSEMBLY

[CHASSIS PARTS]

REF NO.	ORDER NO.	DESCRIPTION	QTY.
J 31	6910014190	2497 ANT connector	1
SP 1	2510001092	Speaker 036D0801B <FG>	1
W 1	8900010960	Cable OPC-1129	1
MP 1	8210020260	2691 front panel assembly	1
MP 2	8310059690	2691 front panel (incl. MP1)	1
MP 4	8930039000	1757 sheet	1
MP 5	8930060890	2691 keyboard (A)	1
MP 6	8930058020	2497 PTT button	1
MP 7	8930056960	2497 PTT holder	1
MP 8	8610011151	Knob 2497 BATT lock-1	1
MP 9	8930056941	2497 lock plate-1 Y609A	1
MP 14	8850001950	Shielding washer (Y)	1
MP 15	8830001250	ANT connector-101 nut	1
MP 16	8210018500	2497 top panel	1
MP 17	8930057260	2497 top sheet	1
MP 21	8210018482	2497 rear panel-2	1
MP 22	8930056950	2497 main seal	1
MP 23	8810010120	Screw PH B0 M2x8 SUS ZK	3
MP 24	8810010150	Screw PH B0 2 x 10 SUS ZK	1
MP 25	8850001880	Shielding washer (W)	1
MP 31	8010019320	2691 chassis	1
MP 32	8930056980	2497 terminal holder	1
MP 33	8810009560	Screw PH BT M2x6 ZK	2
MP 34	8930060770	2691 A-terminal Y678	1
MP 35	8930056900	2497 B-terminal Y607	1
MP 36	8810008640	Screw FH BT No.0 M2x4 NI-ZU	2
MP 37	8930056910	2497 C-terminal Y608	1
MP 38	8810009510	Screw PH BT M2x4 NI-ZU	1
MP 39	8810009510	Screw PH BT M2x4 NI-ZU	7
MP 40	8510015970	2691 grounding plate	1
MP 42	8810009560	Screw PH BT M2x6 ZK	2
MP 43	8510015980	2691 main shield	1
MP 44	8930024961	891terminal rubber (A)-1	3
MP 46	8930060780	2691 PW button	1
MP 47	8930060790	2691 PW holder	1

[ACCESSORIES]

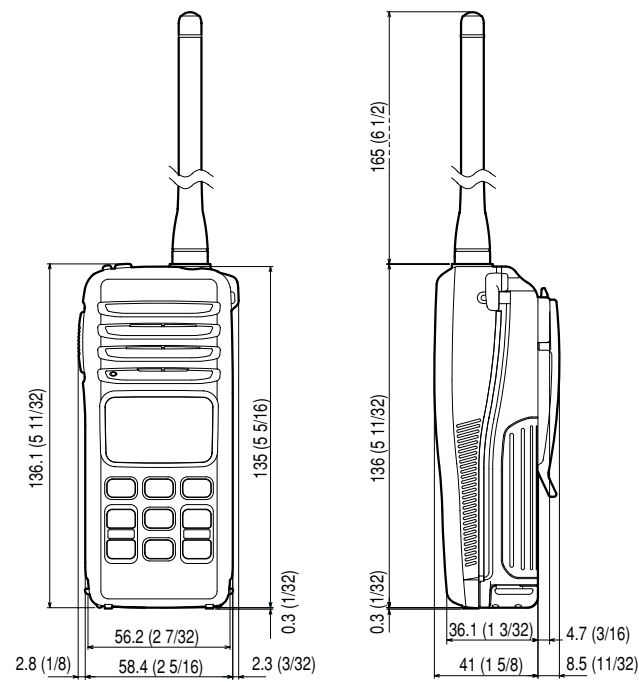
REF NO.	ORDER NO.	DESCRIPTION	QTY.
EP1	3310002321	Antenna FA-SC55V-1	1
EP2	Optional products	Charger BC-147E [EUR], [FRG] only	1
EP4	Optional products	Battery BP-224 ACC (700MAH)	1
EP5	Optional products	Charger BC-150	1
MP1	8010018080	Hand strap HK-009	1
MP2	8930042041	1922 belt crip-1	1
MP3	8210018500	2497 top panel	1
MP4	8930057260	2497 top sheet	1



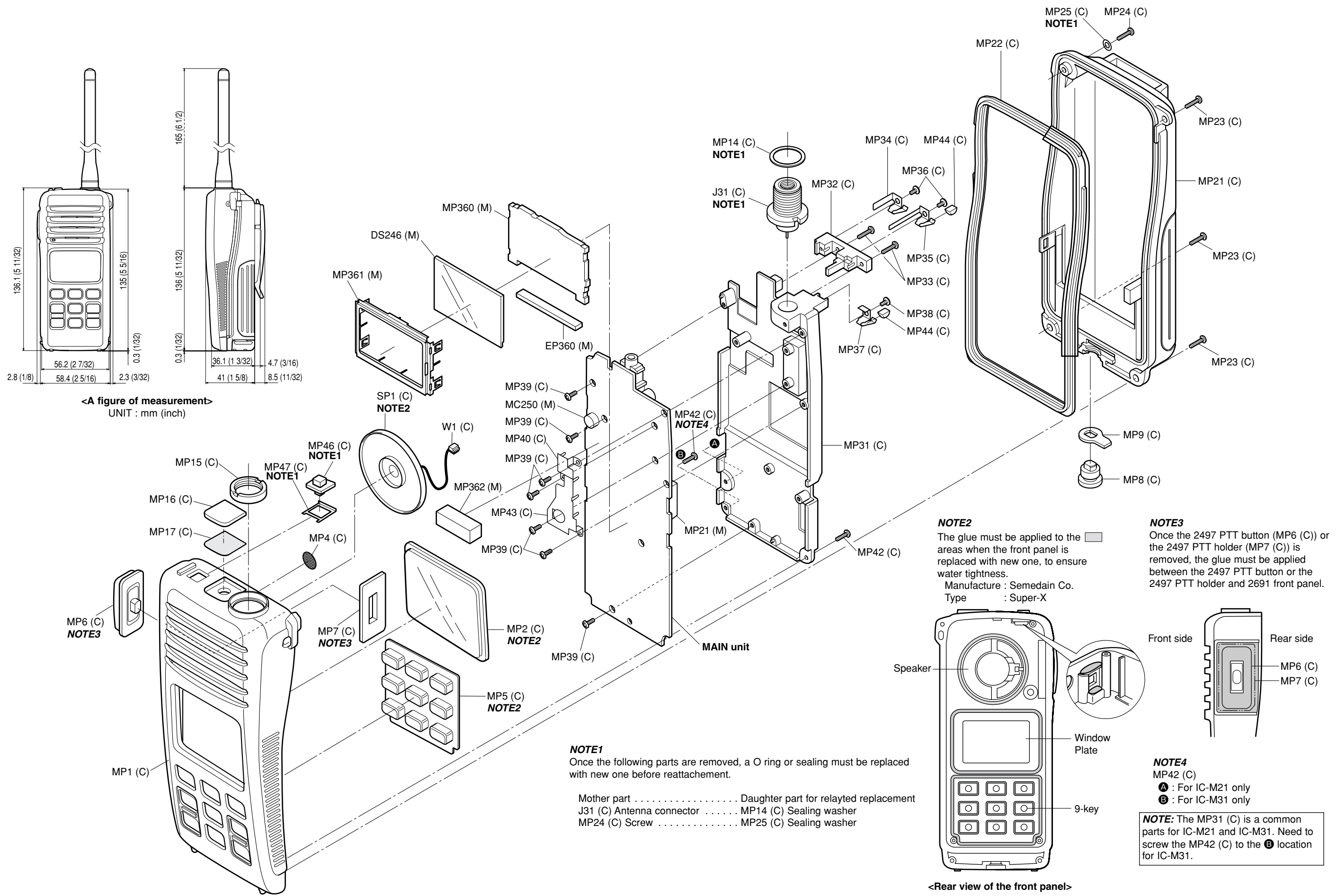
[MAIN UNIT]

REF NO.	ORDER NO.	DESCRIPTION	QTY.
J 250	6450001910	Connector HSJ1594-010150	1
J 251	6510021900	S. connector BM02B-ASRS-TF	1
S 250	2260001900	switch SW-149 (SKHLLD)	1
S 328	2260002710	S. switch SKQLLCE012	1
DS 246	5030002600	LCD L3-0018TAY-1	1
EP 360	8930057100	LCD contact SRCN-2497-SP-N-W	1
MC 250	7700002480	Microphone SKB-2746 LPC	1
MP 20	8510014330	2497 VCO case tip	1
MP 21	8510011101	1922 VCO cover-1 Y340A	1
MP 50	8410002370	2337 PA heatsink (tip) Y539	1
MP 360	8210019970	2691 reflector panel	1
MP 361	8930060800	2691 LCD holder	1
MP 362	8930061580	Sponge (HK)	1

Screw abbreviations B0, BT: Self-tapping, ZK: Black
 NI-ZU: Nickel-zinc, SUS: Stainless
 PH: Pan head, FH: Flat head



<A figure of measurement>
UNIT : mm (inch)



NOTE2
The glue must be applied to the areas when the front panel is replaced with new one, to ensure water tightness.
Manufacture : Semedain Co.
Type : Super-X

NOTE3
Once the 2497 PTT button (MP6 (C)) or the 2497 PTT holder (MP7 (C)) is removed, the glue must be applied between the 2497 PTT button or the 2497 PTT holder and 2691 front panel.

NOTE1
Once the following parts are removed, a O ring or sealing must be replaced with new one before reattachment.

Mother part Daughter part for relayed replacement
J31 (C) Antenna connector MP14 (C) Sealing washer
MP24 (C) Screw MP25 (C) Sealing washer

NOTE4
MP42 (C)
A : For IC-M21 only
B : For IC-M31 only
NOTE: The MP31 (C) is a common parts for IC-M21 and IC-M31. Need to screw the MP42 (C) to the B location for IC-M31.

UNIT abbreviations (C): CHASSIS PARTS, (M): MAIN UNIT

BC-150 CHARGER PARTS LIST
● ELECTRICAL PARTS

[CHARGE UNIT]

REF. NO.	ORDER NO.	DESCRIPTION
R1	7070001130	RESISTOR 120 ERG2SJ
R2	7070001140	RESISTOR 150 ERG2SJ
R3	7010007100	RESISTOR 1K PSD1/4V
J1	6510023070	CONNECTOR HEC2305-01-250
DS1	5040001390	LED TLG124A
EP1	0910054642	PCB B-5787B

● MECHANICAL PARTS

[CHASSIS]

REF. NO.	ORDER NO.	DESCRIPTION	QTY.
MP1	8510014350	2523 Case	1
MP2	8110007680	2523 Cover	1
MP3	8810008660	Screw B0 3 x 8 NI-ZU (BT)	2
MP4	8930047830	Leg cushion (C)	2

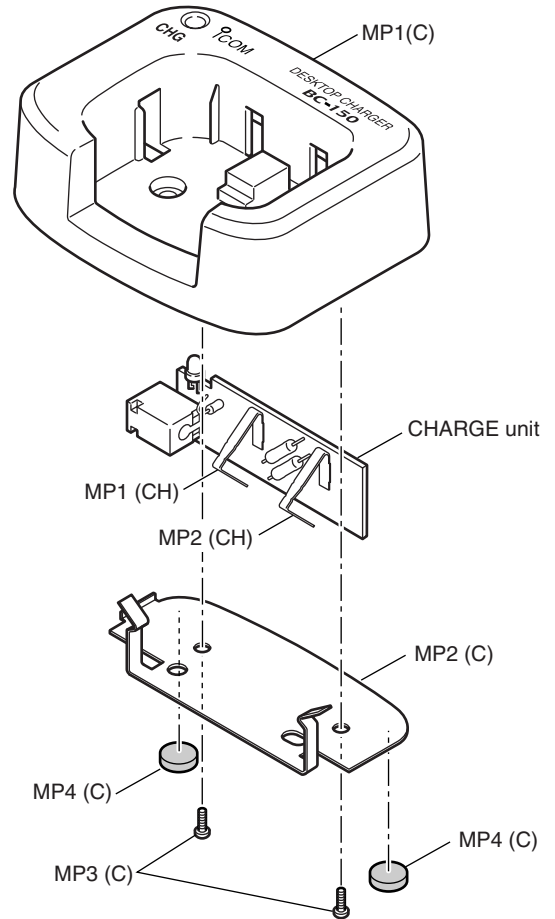
[CHARGE UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	QTY.
MP1	8930057120	2523 Terminal	1
MP2	8930057120	2523 Terminal	1

[ACCESSORIES]

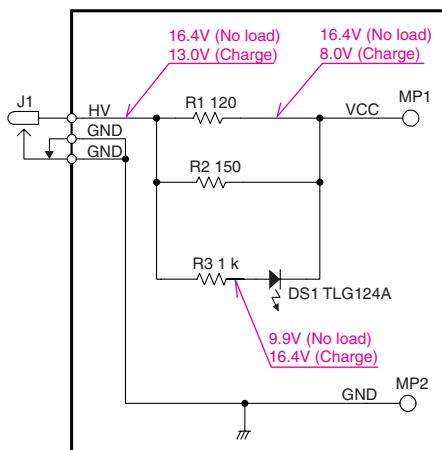
REF. NO.	ORDER NO.	DESCRIPTION	QTY.
MP1	8810001460	Screw A0 3.5 x 20 SUS	2

Screw abbreviations A0, B0, BT: Self-tapping
 NI-ZU: Nickel-zinc
 SUS: Stainless

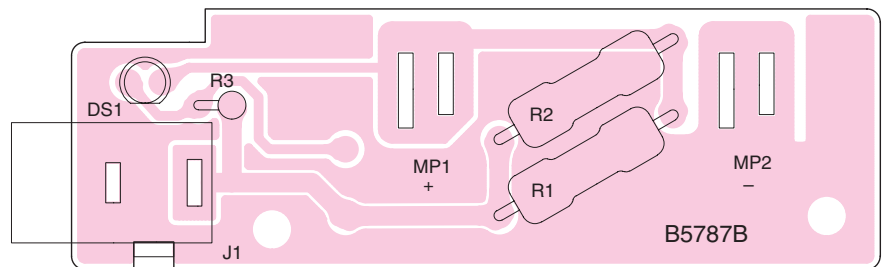


NOTE: (C): CHASSIS (CH): CHARGE UNIT

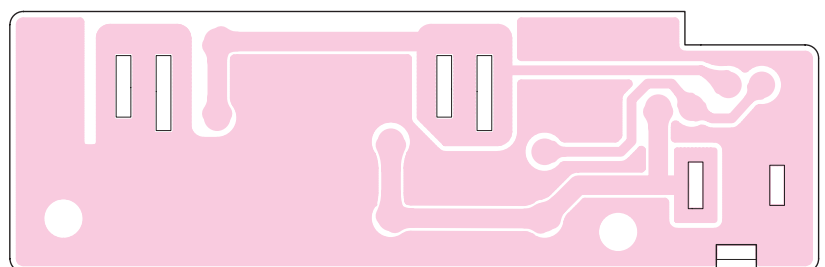
BC-150 VOLTAGE DIAGRAM



BC-150 BOARD LAYOUT
● TOP VIEW

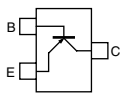
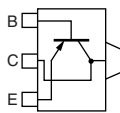
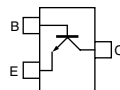
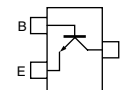
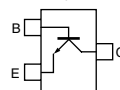
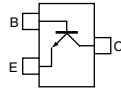
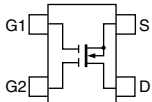
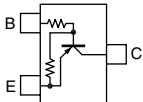
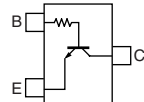
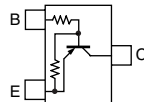
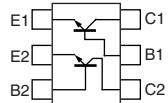
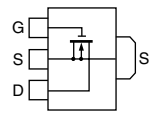
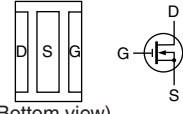


● BOTTOM VIEW

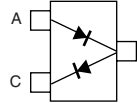
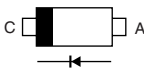
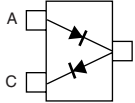
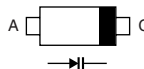
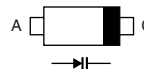
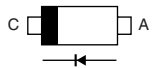

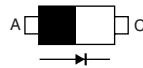
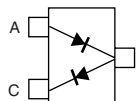


SECTION 8 SEMI-CONDUCTOR INFORMATION

• TRANSISTOR AND FET'S

2SA1588 GR (Symbol: ZG) 	2SB1132 Q (Symbol: BAQ) 	2SC2714 Y (Symbol: QY) 	2SC4213 B (Symbol: AB) 	2SC4215 O (Symbol: QO) 
2SC4226 R25 (Symbol: R25) 	3SK299 U73 (Symbol: U73) 	DTA144 EUA (Symbol: 16) 	DTC144 TU (Symbol: 06) 	UN911 H (Symbol: 6P) 
XP6501 AB (Symbol: 5N) 	RD01MUS1 (Symbol: K2) 	RD07MVS1 (Symbol: RD07MVS1)  (Bottom view)		

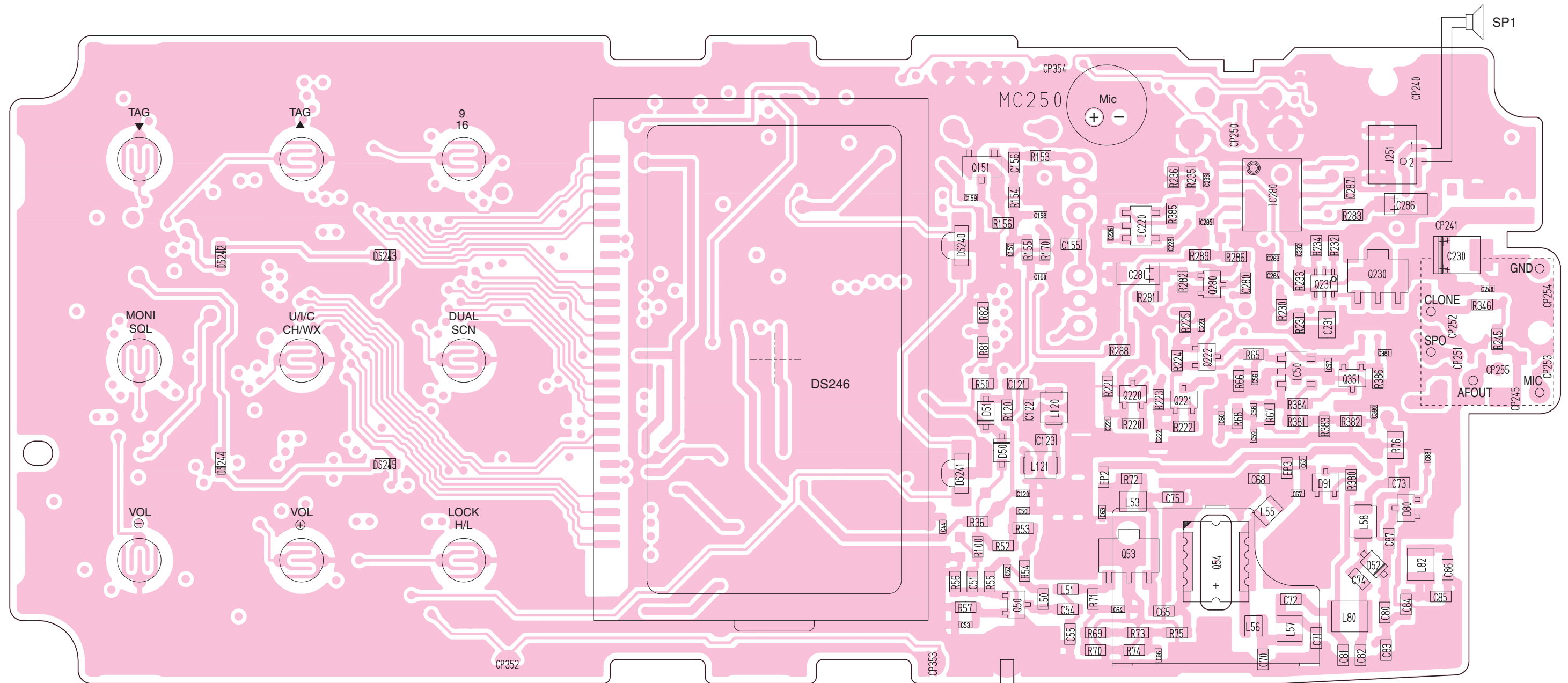
• DIODES

1SS375 (Symbol: FH) 	1SV307 (Symbol: TX) 	DA221 TL (Symbol: K) 	HVC376B TRF (Symbol: B9) 	HVU350 B (Symbol: B0) 
MA2S077 (Symbol: S) 	MA728 (Symbol: 2A) 	MA77 (Symbol: 4B) 	RB706F-40 T106 (Symbol: 3J) 	

SECTION 9 BOARD LAYOUTS

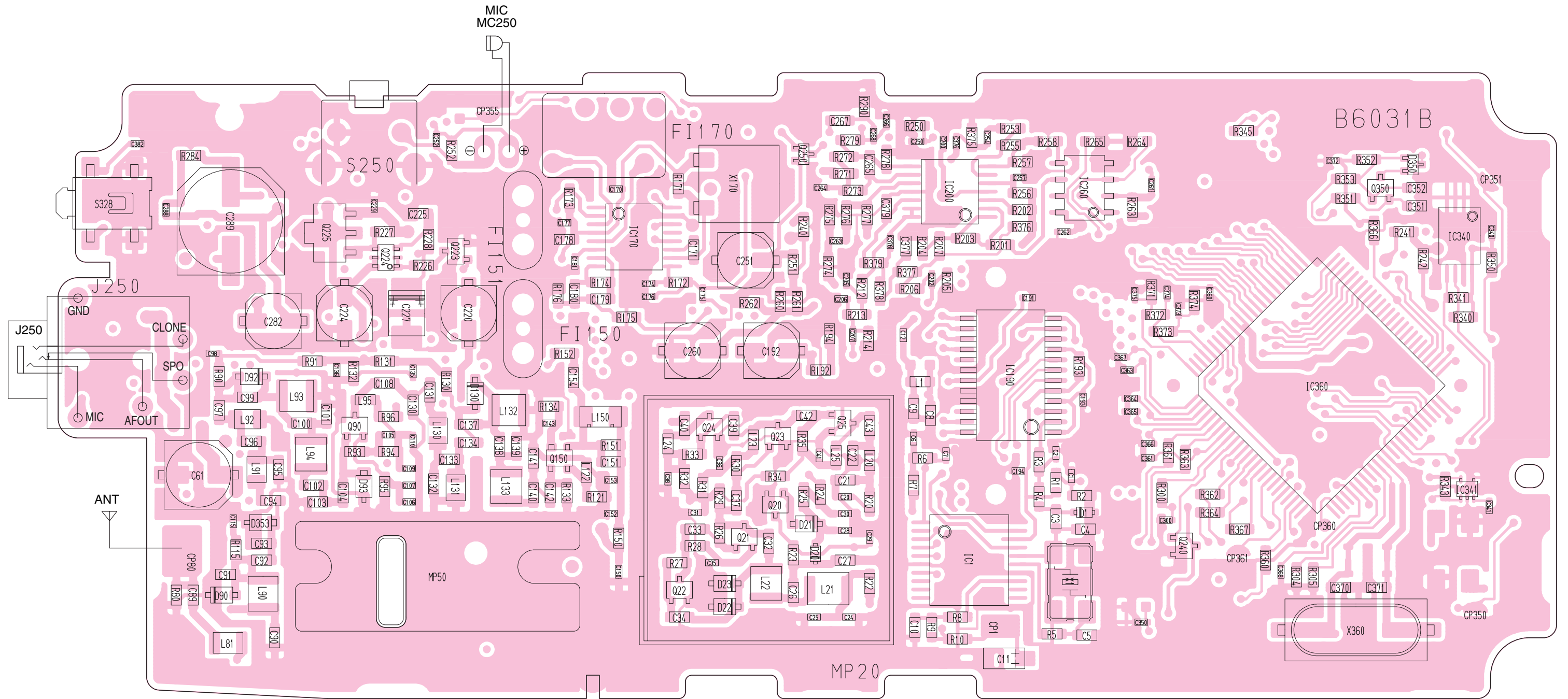
MAIN UNIT
• TOP VIEW

The combination of this page and the next page shows the unit layout in the same configuration as the actual P.C. Board.

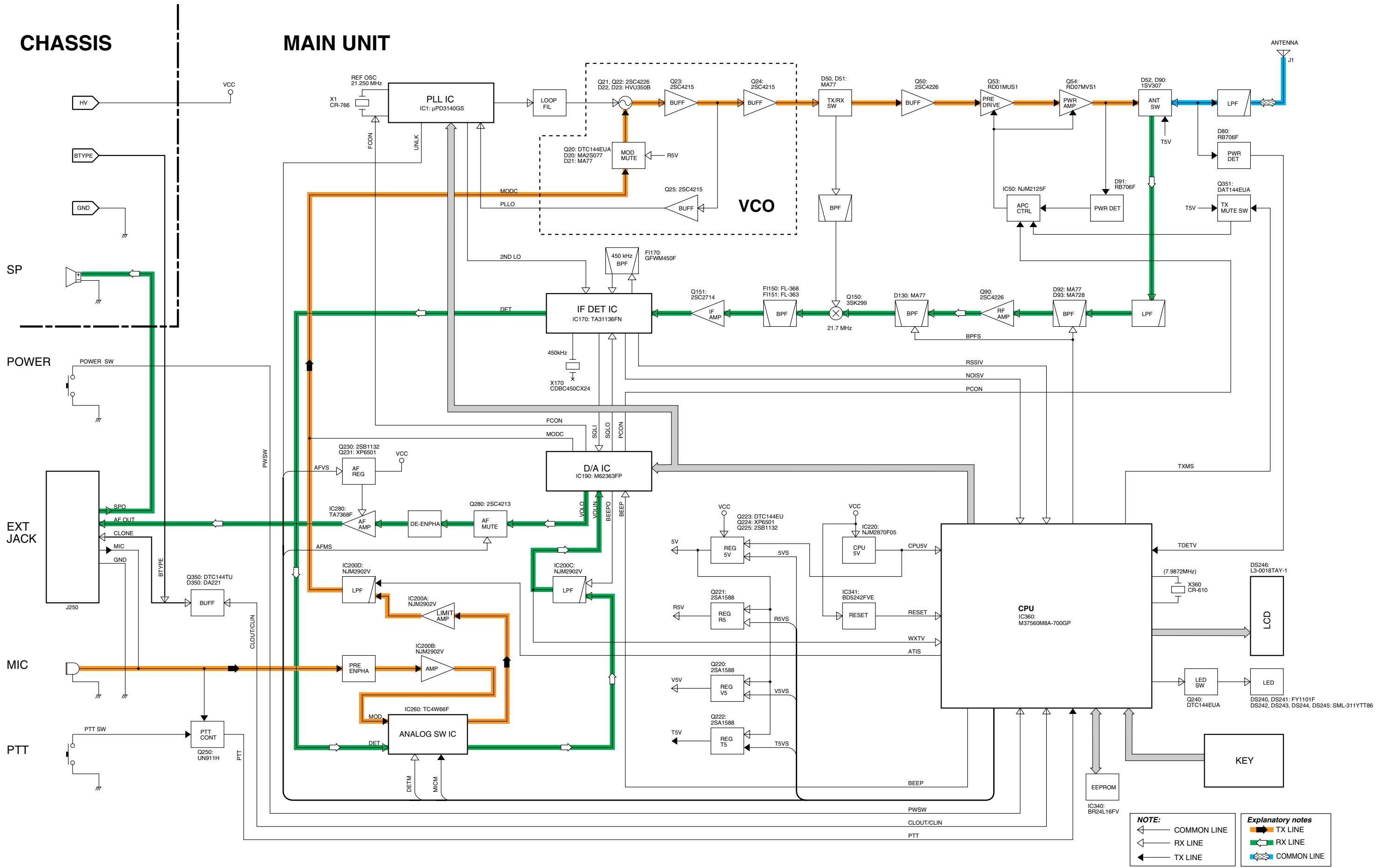


• BOTTOM VIEW

The combination of this page and the previous page shows the unit layout in the same configuration as the actual P.C. Board.



SECTION 10 BLOCK DIAGRAM

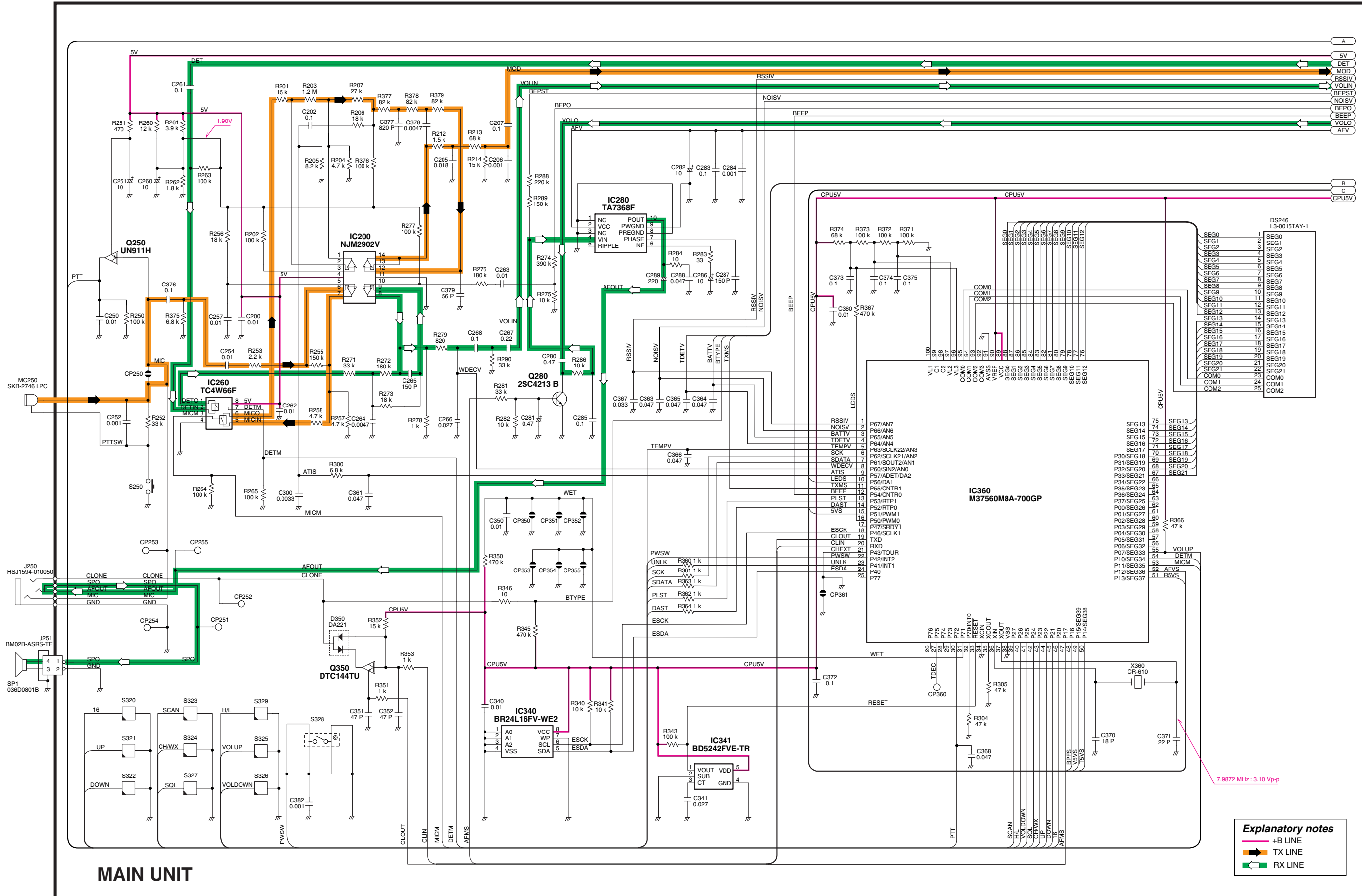


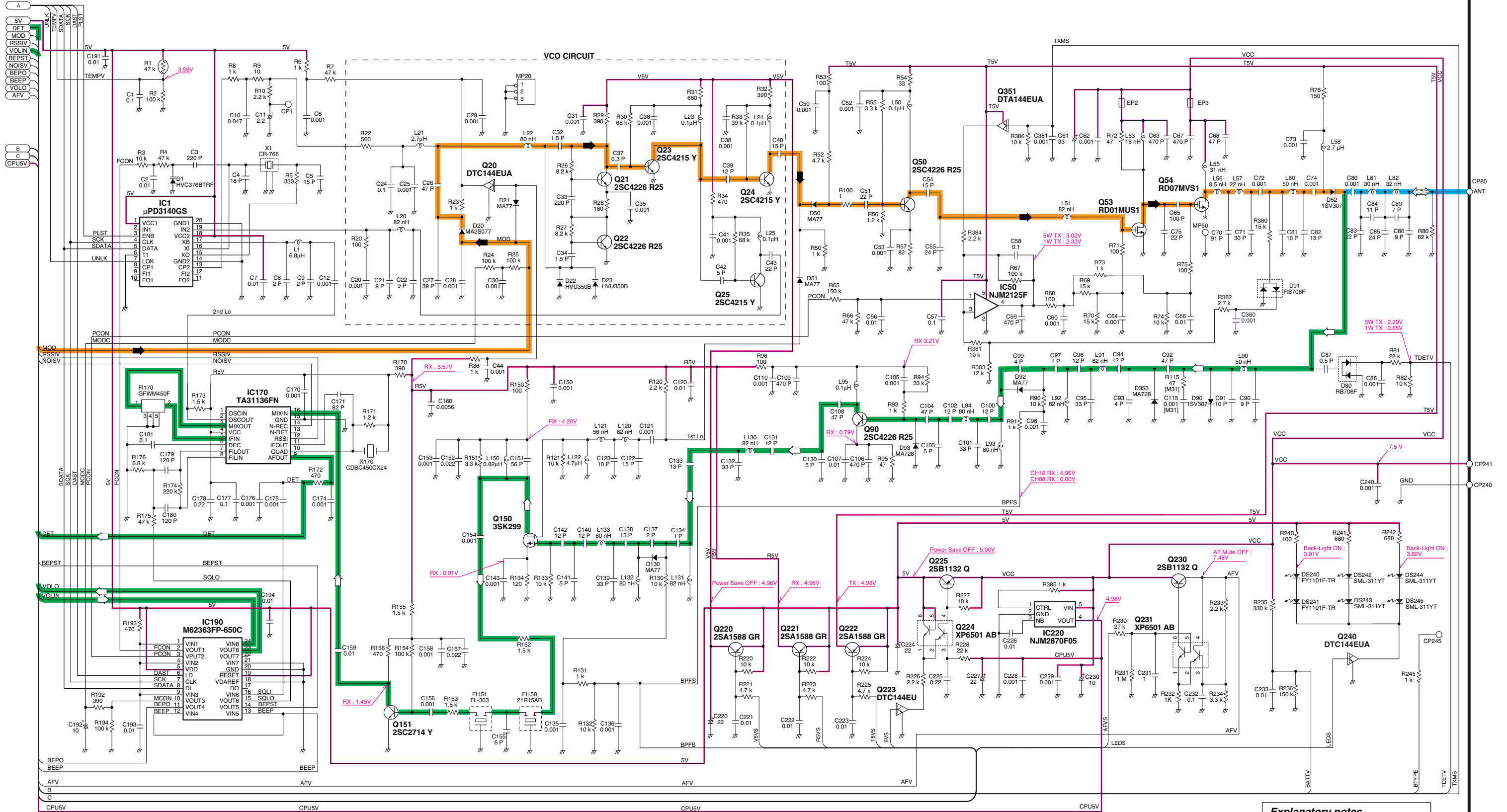
NOTE:
 ◀ COMMON LINE
 ▶ TX LINE
 ◀ RX LINE
 ▶ TX LINE
 ◀ COMMON LINE

Explanatory notes

SECTION 11 VOLTAGE DIAGRAM

MAIN UNIT





Explanatory notes

- +B LINE
- TX LINE
- RX LINE
- COMMON LINE

MAIN UNIT

Icom Inc.

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Fax : +81 (06) 6793 0013

URL : <http://www.icom.co.jp/world/index.html>

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<Corporate Headquarters>
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Phone: +1 (425) 454-8155 Fax: +1 (425) 454-1509
URL : <http://www.icomamerica.com>

<Customer Service>
Phone: +1 (425) 454-7619

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URL : <http://www.icomspain.com>

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URL : <http://www.icom-france.com>

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6F No. 68, Sec. 1 Cheng-Teh Road, Taipei, Taiwan, R.O.C.
Phone: +886 (02) 2559 1899 Fax: +886 (02) 2559 1874
URL : <http://www.asia-icom.com>

Count on us!