MOTOROLA SOLUTIONS

UHF FM Transceiver

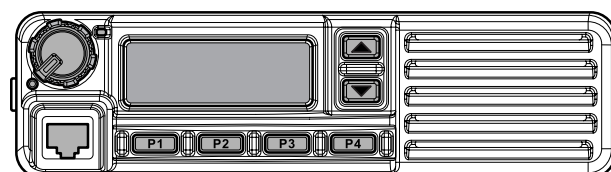# VX-2100 Series
VX-2200 Series
Service Manual
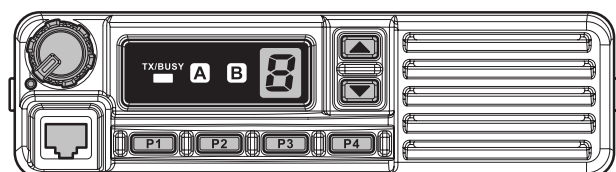
VX-2100 Series | **VX-2200** Series

Introduction

This manual provides the technical information necessary for servicing the **VX-2100/-2200** Series Mobile 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 **VX-2100/-2200** allows a complete alignment of this transceiver to be performed without opening the case of the radio; all adjustments can be performed from the personal computer, using with the Motorola Solutions FIF-12 USB Programming Interface and CE82 Software.

While we believe the information in this manual to be correct, Motorola Solutions 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.

Important Note

This transceiver is assembled using Pb (lead) free solder, based on the RoHS specification.

Only lead-free solder (Alloy Composition: Sn-3.0Ag-0.5Cu) should be used for repairs performed on this apparatus. The solder stated above utilizes the alloy composition required for compliance with the lead-free specification, and any solder with the above alloy composition may be used.

Contents

General

Frequency Ranges:	400 - 470 MHz (Type A)
	450 - 512 MHz (USA, Type D)
	450 - 520 MHz (EXP, Type D)
Number of Groups:	1 group (VX-2100 Series)
	8 groups (VX-2200 Series)
Number of Channels:	8 channels (VX-2100 Series)
	128 channels (VX-2200 Series)
Power Supply Voltage:	13.6 V ± 15%
Channel Spacing:	12.5 / 25 kHz
Current Consumption (Approx.):	TX: 12 A (45 W) or 6 A (25 W),
	RX: 1.5 A,
	Standby: 220 mA
Operating Temperature Range:	−22 °F to +140 °F (−30 °C to +60 °C)
Frequency Stability:	Better than ±2.5 ppm
RF Input-Output Impedance:	50 Ω
Dimension (W x H x D):	6.5″ x 1.8″ x 6.1″ inch (165 x 46 x 155 mm) (W/O knob)
Weight (Approx.):	2.87 lbs (1.3 kg)

Receiver (Measured by TIA/EIA-603-A)

Sensitivity (12 dB SINAD):	0.25 µV
Intermediate Frequency:	1st: 67.65 MHz, 2nd: 450 kHz
Adjacent Channel Selectivity:	73 dB (25 kHz)
	65 dB (12.5 kHz)
Intermodulation:	73 dB (25 kHz)
	70 dB (12.5 kHz)
Spurious & Image Rejection:	80 dB
Audio Output:	Internal: 4 W @18 Ω, 5% THD
	External: 12 W @4 Ω, 5% THD

Transmitter (Measured by TIA/EIA-603-A)

Output Power :	45 / 25 / 10 W (50 W)
	25 / 12.5 / 5 / 1 W (25 W)
Modulation:	16K0F3E,11K0F3E
Maximum Deviation:	±5 kHz (25 kHz)
	±2.5 kHz (12.5 kHz)
Audio Distortion:	< 3 % (@1 kHz)
Conducted Spurious Emission:	70 dB below carrier

Specifications subject to change without notice or obligation.

General

Frequency Ranges:	400 - 470 MHz
Number of Groups:	1 group (VX-2100 Series)
	8 groups (VX-2200 Series)
Number of Channels:	8 channels (VX-2100 Series)
	128 channels (VX-2200 Series)
Power Supply Voltage:	10.8 - 15.6 V DC
Channel Spacing:	12.5 / 20 / 25 kHz
Current Consumption (Approx.):	TX: 6 A
	RX: 1.5 A
	Standby: 220 mA
Operating Temperature Range:	–30 °C to +60 °C
Frequency Stability:	Better than ±2.5 ppm
RF Input-Output Impedance:	50 Ohm
Dimension (W x H x D):	165 x 45 x 155 mm
Weight (Approx.):	1.3 kg

Receiver (Measured by EN300 086)

Sensitivity (20 dB SINAD) (W/N):	–4 dB μV / –2 dB μV
Adjacent Channel Selectivity:	70 dB / 65 dB
Intermodulation:	68 dB
Spurious Response Rejection:	80 dB
Audio Output:	Internal: 4 W @18 Ω, 5% THD
	External: 12 W @4 Ω, 5% THD
Spurious Radiations:	–57 dBm

Transmitter (Measured by EN300 086)

Output Power :	25 / 12.5 / 5 / 1 W
Maximum Deviation:	±5.0 kHz (25 kHz)
	±4.0 kHz (20 kHz)
	±2.5 kHz (12.5 kHz)
FM noise (W/N):	48 / 42 dB
Audio Distortion:	Less than 3 % @ 1 kHz
Spurious Emission:	–36 dBm < 1 GHz / –30 dBm > 1 GHz

Applcable Standards : EN300 086, 113, 219 · EN301 489 · EU directive 2004/104/EC
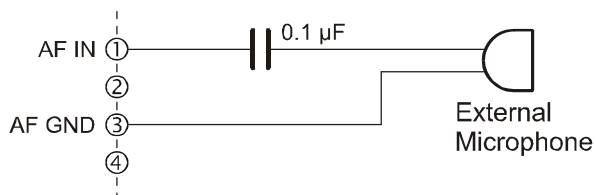*Specifications subject to change without notice or obligation.*
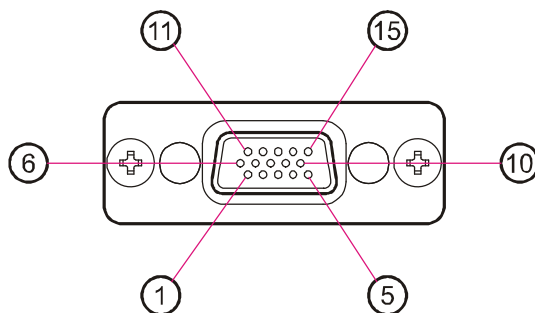
Pin 1: AF IN (ANALOG INPUT)

External Microphone Input. Nominal input level is 6 mV at 600-ohm.

When connect the External Microphone to this port, insert a 0.1 µF coupling capacitor between the microphone and this port; as shown illustlation.

Pin 2: AF OUT (ANALOG OUTPUT)

Low-level receiver output. Peak signal level is 150 mV at 600-ohm.

Pin 3: AF GND

Ground for all logic levels and power supply return.

Pin 4: DC OUT (13.6 V DC OUTPUT)

Switched 13.6V output for supplying power to an accessory.

Pin 5: RSSI (ANALOG OUTPUT)

A DC voltage proportional to the strength of the signal currently being received (Receiver Signal Strength Indicator) is provided on this pin. This low impedance output is gererated by the receiver IF sub-system and bufferd by an internal op-amp. Typical output voltages are 1 V (@No Signal Input) through 2.0 V (@50 dB Signal Input).

Pin 6: EXT PTT

Shorting this port to ground causes the transceiver to be placed in the Transmit mode, while opening the connection to this port returns the transceiver to the Receive mode. Opening voltage is 5 V, closed current approx. 5 mA.

Pin 7: TRX

This port is intended for controlling an external TX/RX switching circuit. This port is open collector output which can sink approx. 100 mA when active. Max. voltage is 16V.

Pin 8: IGN (IGNITION SENSE FEATURE)

The VX-2100/-2200 may be automatically be switched to the STND-BY mode when the vehicle's ignition key is turned on. Maximum current is 20 mA.

Pin 9 - 12: ACC1 - ACC4 (ACCESSORY PORT)

These port features can be programmed via the CE82 programmer. Each port is open collector output which can sink approx. 100 mA when active. Max. output 16V. When the input is selected, it becomes active between 2V and 16V.

Pin 13: ACC5 (ACCESSORY PORT)

The port 5 is available to set only for Output function, and active logic is the opposite side against the Port 1 ~ 4.

Max.output 5V, closed current approx. 1 mA. (CMOS output)
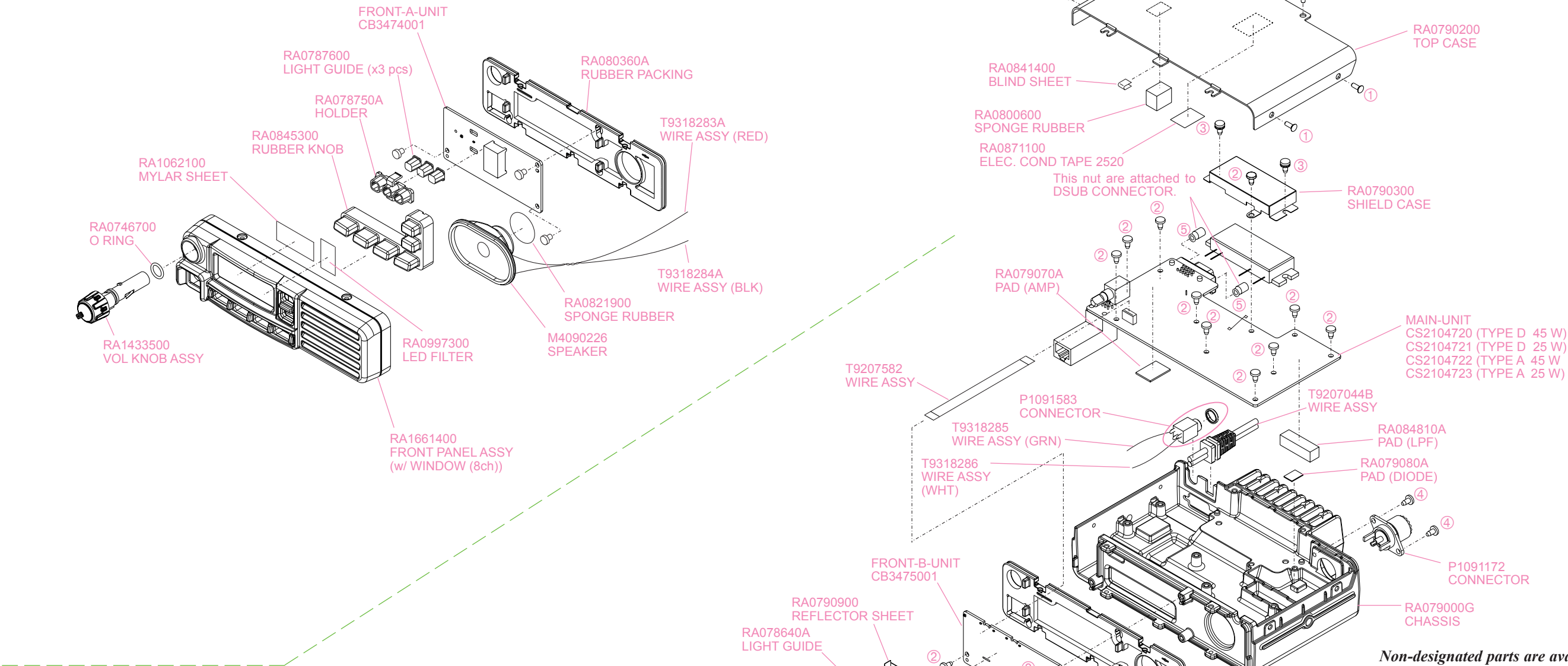
Pin 14: ACC6 (ACCESSORY PORT)

The port 6 is available to set only for Input function, and active logic is the opposite side against the Port 1 ~ 4.
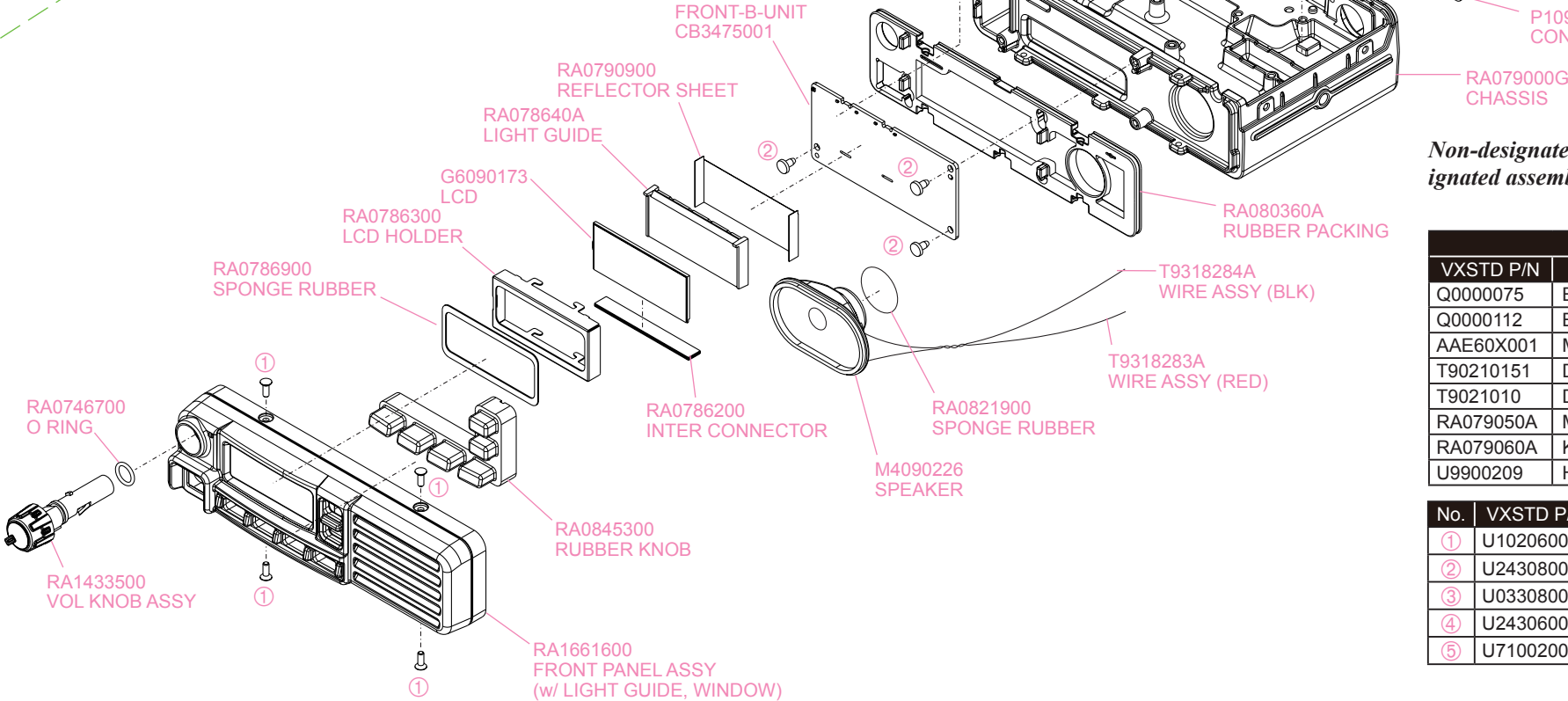
Max.input 5V. (CMOS input)

Pin 15: GND

Chassis ground

VX-2100 FRONT PANEL

FRONT-A-UNIT
CB3474001

RA0787600
LIGHT GUIDE (x3 pcs)

RA078750A
HOLDER

RA0845300
RUBBER KNOB

RA1062100
MYLAR SHEET

RA0746700
O RING

RA1433500
VOL KNOB ASSY

RA080360A
RUBBER PACKING

T9318283A
WIRE ASSY (RED)

T9318284A
WIRE ASSY (BLK)

RA0821900
SPONGE RUBBER

M4090226
SPEAKER

RA0997300
LED FILTER

RA1661400
FRONT PANEL ASSY
(w/ WINDOW (8ch))

RA0841400
BLIND SHEET

RA0800600
SPONGE RUBBER

RA0871100
ELEC. COND TAPE 2520

This nut are attached to
DSUB CONNECTOR.

RA079070A
PAD (AMP)

RA0790200
TOP CASE

RA0790300
SHIELD CASE

MAIN-UNIT
CS2104720 (TYPE D 45 W)
CS2104721 (TYPE D 25 W)
CS2104722 (TYPE A 45 W)
CS2104723 (TYPE A 25 W)

T9207582
WIRE ASSY

P1091583
CONNECTOR

T9318285
WIRE ASSY (GRN)

T9318286
WIRE ASSY
(WHT)

T9207044B
WIRE ASSY

RA084810A
PAD (LPF)

RA079080A
PAD (DIODE)

P1091172
CONNECTOR

RA079000G
CHASSIS

FRONT-B-UNIT
CB3475001

RA0790900
REFLECTOR SHEET

RA078640A
LIGHT GUIDE

G6090173
LCD

RA0786300
LCD HOLDER

RA0786900
SPONGE RUBBER

RA0746700
O RING

RA1433500
VOL KNOB ASSY

RA0786200
INTER CONNECTOR

T9318284A
WIRE ASSY (BLK)

T9318283A
WIRE ASSY (RED)

RA080360A
RUBBER PACKING

RA0821900
SPONGE RUBBER

M4090226
SPEAKER

RA0845300
RUBBER KNOB

RA1661600
FRONT PANEL ASSY
(w/ LIGHT GUIDE, WINDOW)

VX-2200 FRONT PANEL

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

SUPPLIED ACCESSORIES		
VXSTD P/N	DESCRIPTION	QTY.
Q0000075	BLADE FUSE ATC 15A (45 W TYPE)	2
Q0000112	BLADE FUSE ATC 10A (25 W TYPE)	2
AAE60X001	MICROPHONE MH-67A8J (W/ CLIP)	1
T90210151	DC CABLE (45W TYPE)	1
T9021010	DC CABLE (25 W TYPE)	1
RA079050A	MOBILE BRACKET	1
RA079060A	KNOB SCREW (for BRACKET)	2
U9900209	HEX HEAD BOLT HSM5X12B	2

No.	VXSTD P/N	DESCRIPTION	QTY.
①	U10206007	TRUSS HEAD SCREW M2.6X6B	10
②	U24308001	BIND HEAD TAPTITE-B M3X8	13
③	U03308002	SEMS SCREW ASM3X8NI	2
④	U24306002	TAPTITE SCREW M3X6NI	2
⑤	U71002001	SPRING LOCK WASHER SW2.6	2

REF	DESCRIPTION	VALUE	V/W	TOL.	MFR'S DESIG	VXSTD P/N	VERSION	SIDE	LAY ADR
	PCB with Components								
	MAIN UNIT (w/o Q1009 PA Module)					CS2104720	TYPE D 45 W		
						CS2104721	TYPE D 25 W		
						CS2104722	TYPE A 45 W		
						CS2104723	TYPE A 25 W		
	FRONT-A UNIT (VX-2100)					CB3474001			
	FRONT-B UNIT (VX-2200)					CB3475001			
	Mechanical Parts								
	FRONT PANEL ASSY					RAFÎ Î FI €€	VX-2100		
	FRONT PANEL ASSY					RAFÎ Î FÎ €€	VX-2200		
	CHASSIS					RA079000Ö			
	TOP CASE					RA0790200			
	RUBBER PACKING					RA080360A			
	SHIELD CASE					RA0790300			
	RUBBER KNOB					RA0845300			
	VOL KNOB ASSY					RA1433500			
	LIGHT GUIDE					RA0787600	VX-2100		
	HOLDER					RA078750A	VX-2100		
	MYLAR SHEET					RA1062100	VX-2100		
	LED FILTER					RA0997300	VX-2100		
	LCD HOLDER					RA0786300	VX-2200		
	LIGHT GUIDE					RA078640A	VX-2200		
	REFLECTOR SHEET					RA0790900	VX-2200		
	SPONGE RUBBER					RA0786900	VX-2200		
	INTER CONNECTOR					RA0786200	VX-2200		
	Electrical Parts								
	SPEAKER	18-ohm				M4090226			
	CONNECTOR					P1091172	ANTENNA		
	CONNECTOR					P109FÎ Ì HÁ́	EXT SP		
	WIRE ASSY					T9207044B	DC POWER CABLE		
	WIRE ASSY					T9207582	FLAT CABLE		
	MAIN UNIT Electrical Parts								
CD1001	CERAMIC DISC				JTBC450C7	H7901500		B	b5
CF1001	CERAMIC FILTER				LTM450EW-A	H3900574A		A	J4
CF1002	CERAMIC FILTER				LTM450GW-A	H3900573A		A	J4
F 1001	CHIP FUSE	1.25A			FCC16 132ABTP	Q0000109		A	B2
Q 1009	IC				RA60H4452M1	G1094520	TYPE D 45W	A	D1
Q 1009	IC				RA30H4552M1	G1094943	TYPE D 25W	A	D1
Q 1009	IC				RA60H3847M1	G1094949	TYPE A 45W	A	D1
Q 1009	IC				RA30H4047M1-101	G1094555	TYPE A 25 W	A	D1
VR1001	POT.				R9710NS-FB15A7.0-A203-005	J60800325		A	A5
X 1001	XTAL HC-49SMD	11.0592MHz			FYSMD110592	H0103318		A	A4
X 1002 Á	TCXO	16.8MHz			TTS14VSB-A5 16.8MHZ	H9501150		A	G4
XF1001	XTAL FILTER				MFT67P 67.650MHZ	H1102471		A	H4
	FRONT-A UNIT (VX-2100) Electrical Parts								
DS2001	LED				ELS-512SURWA/S530-A3	G2090796		A	D1
	FRONT-B UNIT (VX-2200) Electrical Parts								
DS3001	LCD				TP5434 (AC061)	G6090173		A	C1
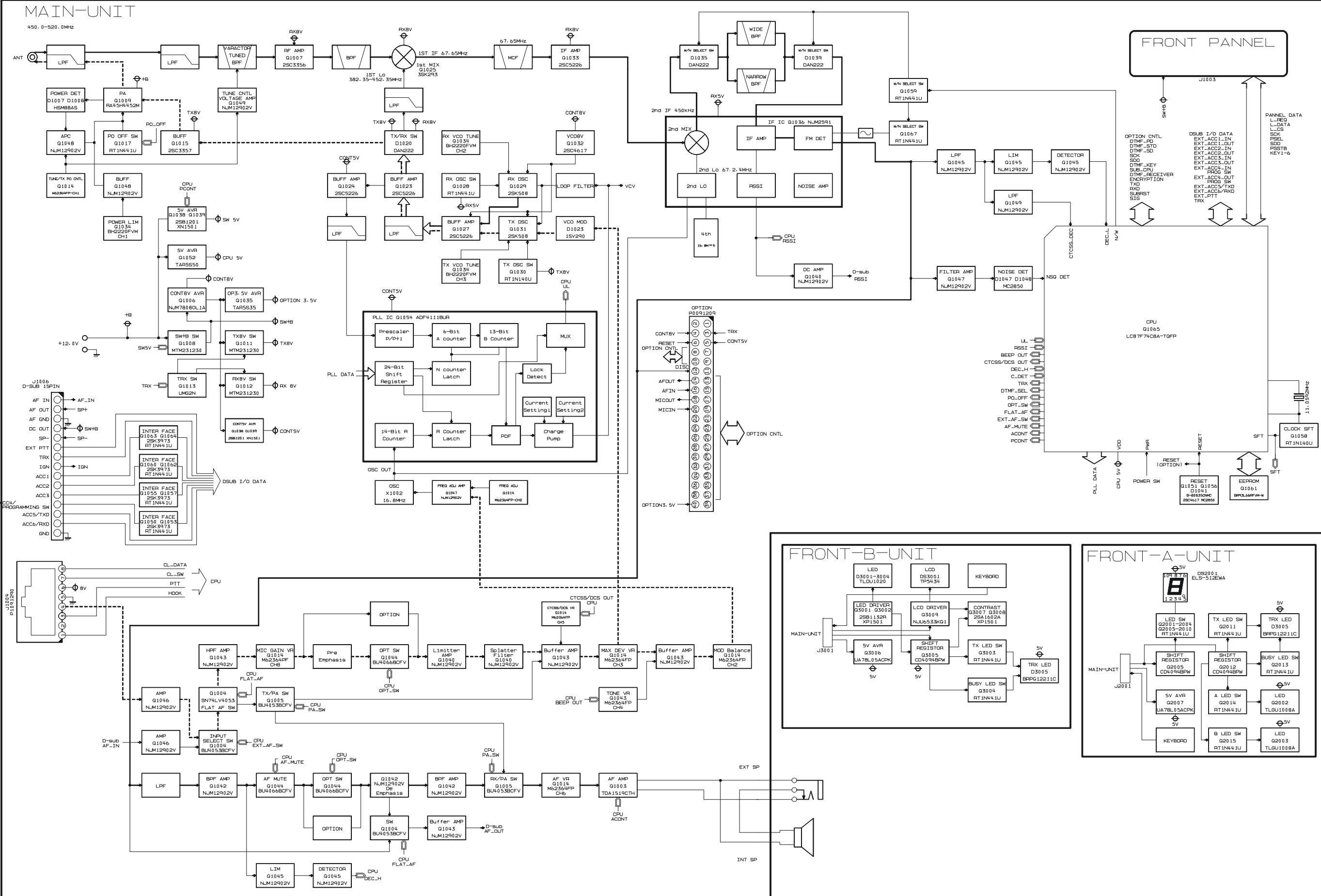
1. Circuit Configuration by Frequency

The receiver is a double-conversion superheterodyne with a first intermediate frequency (IF) of 67.65 MHz and a second IF of 450kHz. The incoming signal from the antenna is mixed with the local signal from the VCO/PLL to produce the first IF of 67.65MHz. This is then mixed with the 67.2 MHz second local oscillator output to produce the 450 kHz second IF. This is detected to give the demodulated signal.The transmit signal frequencyis generated by the PLL VCO and modulated by the signal from the microphone. It is then amplified and sent to the antenna.

2. Receiver System

2-1. Front-end RF amplifier

The incoming RF signal from the antenna is delivered to the RF Unit and passes through the Low-pass filter which removes undesired frequencies by use of varactor diodes, tuned band-pass filter consisting of diodes **D1004** and **D1005** (both **1SV323**), and Coils L1006 and L1009, capacitors C1013, C1016, C1033, C1041 and C1044.

The passed signal is amplified in **Q1007** (**2SC3356**) and moreover cuts an image frequency with the band pass filter consisting of Coils L1011, L1013, L1014, and L1015, capacitors C1103 C1111, C1112, C1116, C1122, C1123, C1127, C1128, C1130, C1039, C1134, and C1141, and comes into the 1st mixer.

2-2. First Mixer

The 1st mixer consists of the **Q1025** (**3SK293**). Buffered output from the VCO is amplified by **Q1024** (**2SC5226**) to provide a purefirst local signal (receiving fequency plus 67.65 MHz) for injection to the first mixer. The output IF signal is entersfrom the mixer to the crystal filter. The IF signal then passesthrough monolithic crystal filters XF1001 (±5.5 kHz BW) to strip away all but the desired signal.

2-3. IF Amplifier

The first IF signal is amplified by **Q1033** (**2SC5226**). The amplifiedfirst IF signal is applied to FM IF subsystem IC **Q1036** (**NJM2591V**) which contains the second mixer second local oscillator limiter amplifier noise amplifier and S-meter amplifier. The signal from the refernce oscillator is tripled by **Q1033** (**2SC5226**), it is mixed with the IF signal and becomes 450 kHz. The second IF then passes through the ceramic filter CF1001 (for wide channels) CF1002 (for narrow channels) to strip away unwanted mixer products which removes amplitude variations in the 450 kHz IF before detection of the speech by the ceramicdiscriminator CD1001.

2-4. Audio amplifier

Detected signal from **Q1036** (**NJM2591V**) is inputted to **Q1042** (**NJM12902V**) and is output through the band pass filter inside **Q1042** (**NJM12902V**). When the optional unit is installed **Q1044** (**BU4066BCFV**) is turned "OFF" and the AF signal from **Q1042** (**NJM12902V**) goes the optional unit. When the optional unit is not installed, **Q1042** (**NJM12902V**) is turned "ON" and the signal goes through **Q1004** (**BU4053BCFV**). The signal then goes through AF mute switch **Q1044** (**BU4066BCFV**) de-emphasis part **Q1042** (**NJM12902V**). amplified with AF power amplifier **Q1003** (**TDA1519CTH**) after passing AF volume **Q1014** (**M62364FP**). The output of **Q1003** (**TDA1519CTH**) drives a speaker (either the internal or external speaker).

2-5. Squelch Circuit

There are 13 levels of squelch setting from 0 to 12. The level 0 means open the squelch. The level 1 means the threshold setting level and level 11 means tight squelch. From 2 to 10 is established in the middle of threshold and tight. The bigger figure is nearer the tight setting. The level 12 becomes setting of carrier squelch.

2-5-1. Noise Squelch

The noise squelch circuit is composed of the band pass filter of **Q1036** (**NJM2591V**) noise amplifier **Q1047** (**NJM12902V**) and noise detector **D1047**, **D1048** (both **MC2850**). When a carrier isn't received, the noise ingredient which goes out of the demodulator **Q1036** (**NJM2591V**) is amplified in **Q1047** (**NJM12902V**) through the band pass filter **Q1036** (**NJM2951V**) is detected to DC voltage with **D1047** and **D1048** (both **MC2850**), and is inputted to 15 pin (the A/D port) of the **Q1065** (CPU: **LC87F5CC8A**). When a carrier is received the DC voltage becomes "LOW" because the noise is compressed. When the detected voltage to CPU is "HIGH," the CPU stops AF output with **Q1044** (**BU4066BCFV**) "OFF" by making pin 80 low. When the detection voltage is low the CPU makes **Q1044** "ON" making pin 80 "H" enabling AF output.

2-5-2. Carrier Squelch

The Pin 14 (A/D port) of **Q1065** (CPU: **LC87F5CC8A**) detects RSSI voltage output from pin 12 of **Q1036** (**NJM2591V**), and controls AF output. The RSSI output voltage changes according to the signal strength of carrier. The stronger signal makes the RSSI voltage higher. The process of the AF signal control is the same as Noise Squelch. The shipping data is adjusted 3dB higher than squelch tight sensitivity.

3. Transmitter System

3-1. Mic Amplifier

There are two micrphone inputs, J1004 (front) and J1006 (D-Sub). Each microphone inputs has it's own amplifier. Which micrphone is selected is controlled by the CPU and in addition, the amplified AF signal is selected with Flat-AF selection switch **Q1043** (**NJM12902V**). Mic Gain is adjusted with Mic gain VR **Q1014** (**M62364PF**) through HPF-AMP **Q1043** (**NJM12902V**), and Pre Enphasis and Mic Mute **Q1044** (**BU4066BCFV**) are passed at FLAT-AF OFF. And, the option use is selected with OPT selection switch **Q1044** (**BU4066BCFV**) by the control from CPU. The selected signal enters maximum deviation adjustment volume **Q1014** (**M62364FP**) after it goes out of Buffer Amp **Q1043** (**NJM12902V**) through limiter and splatter filter of **Q1040** (**NJM12902V**). The adjusted low frequency signal ingredient is amplified by **Q1045** (**NJM12902V**) added modulation terminal of TCXO (X1002) the FM modulation is made by reference oscillator. The high frequency signal ingredient is amplified **Q1043** (**NJM12902V**), and the level is adjusted by volume control **Q1014** (**M62364FP**) to make frequency balance between low frequency. After that, the signal is delievered to the tranmsit carrier by modulator **D1023** (**HVC300A**).

3-2. Drive and Final amplifier

The modulated signal from the VCO **Q1031** (**2SK508**) is buffered by **Q1027** (**2SC5226**) and amplified by **Q1015** (**2SC3357**). The low-level transmit signal is then applied to the Power Module **Q1009** (**RA55H4047M** for version A or **RA45H4452M** for version D) for final amplification up to 45 watts output power or (**S-AU83AL** for version A, **S-AU83AH** for version D, or **RA30H3340M** for version I) for final amplification up to 25 watts output power. The transmit signal then passes through a low-pass filter to suppress harmonic spurious radiation before delivery to the antenna.

3-3. Automatic Transmit Power Control

The output power of Power Module is detected by CM coupler, and is detected by **D1007** and **D1008** (both **HSM88AS**) and is inputted to comparator **Q1048** (**NJM12902V**). The comparetor compares two different voltages and makes output power stable by controlling the bias voltage of the power module. There are 3 levels of output power (Hi, Mid and Lo) which is switched by the voltage of **Q1014-CH1** (**M62364FP**).

4. PLL Frequency Synthesizer

The frequency synthesizer consists of PLL IC **Q1054** (**ADF4111BRU**) VCO, TCXO (X1002) and buffer amplifier. The output frequency from TCXO is 16.8 MHz and the tolerance is ±2.5 ppm (in the temperature range -30 to +60 degrees).

4-1. VCO

While the radio is receiving, the RX oscillator **Q1029** (**2SK508**) in the VCO generates a programmed frequency (receive frequncy plus 67.65 MHz) as 1st local signal. While the radio is transmitting the TX oscillator **Q1031** (**2SK508**) in the VCO generates a frequency (transmit frequncy). The output from oscillator is amplified by buffer amplifier **Q1027** (**2SC5226**) and becomes the output of the VCO. The output from VCO is divided one is amplified by **Q1024** (**2SC5226**) and feed back to pin 6 of the PLL IC **Q1054** (**ADF4111BRU**). The other is amplified in **Q1023** (**2SC5226**) and in case of the reception it is put into the mixer as the 1st local signal through **D1020** (**DAN222**) in transmission it is amplified in **Q1027** (**2SC5226**) and more amplified in **Q1023** (**2SC5226**) through **D1022** (**DAN222**) and it is put the input terminal of the Power Module **Q1009**.

4-2. VCV CNTL

Tuning voltage (VCV) of the VCO expands the lock range of VCO by controlling the of varactor diode voltage and the control voltage from PLL IC **Q1054** (**ADF4111BRU**). Control voltage is added to the varactor diode after converted to D/A converter **Q1014** (**M62364FP**).

4-3. PLL

The PLL IC **Q1054** (**ADF4111BRU**) consists of reference divider, main divider, phase detector, charge pumps and Pulse Swallow Frequency Synthesis. The reference frequency from TCXO is inputted to pin 8 of PLL IC **Q1054** (**ADF4111BRU**) and is divided by reference divider. This IC is decimal point dividing PLL IC **Q1054** (**ADF4111BRU**) and the dividing ratio becomes 1/8 of usual PLL frequency step. Therefore, the output of reference divider is 8 times of frequencies of the channel step. For example when the channel stepping is 5 kHz, the output of reference divider becomes 40 kHz. On the other hand, inputted feed back signal to pin 6 of PLL IC **Q1054** (**ADF4111BRU**) from VCO is divided with the dividing ratio which becomes same frequency as the output of reference divider. These two signals are compared by phase detector, a phase pulse is generated. The phase difference pulse and the pulse from fractional accumulator pass through the charge pumps and LPF. This becomes the DC voltage (VCV) to control the VCO. The oscillation frequency of VCO is locked by the control of this DC voltage. The PLL serial data from CPU **Q1065** (CPU: **LC87F5CC8A**) is sent with three lines of SDO (pin 12), SCK (pin 11) and PSTB (pin 13). The lock condition of PLL is output from the UL (pin 14) terminal and UL becomes "H" at the time of the lock condition and becomes "L" at the time of the unlocked condition. The CPU **Q1065** (CPU: **LC87F5CC8A**) always watches over the UL condition, and when it becomes "L" unlocked condition, the CPU **Q1065** (CPU: **LC87F5CC8A**) prohibits transmitting and receiving.

Introduction

The **VX-2100/-2200** series has been aligned at the factory for the specified performance across the entire frequency range specified. 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 Motorola Solutions 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 Motorola Solutions 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 Motorola Solutions 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, Motorola Solutions 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. 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.

Required Test Equipment

❒ Radio Tester with calibrated output level at 1 GHz
❒ In-line Wattmeter with 5% accuracy at 1 GHz
❒ 50-ohm, 100-W RF Dummy Load
❒ Regulated DC Power Supply (standard 13.6V DC, 15A)
❒ Frequency Counter: ±0.2 ppm accuracy at 1 GHz
❒ AF Signal Generator
❒ AC Voltmeter
❒ DC Voltmeter
❒ UHF Sampling Coupler
❒ IBM® PC/compatible Computer with Microsoft® Windows® 95 or later operating system
❒ Motorola Solutions CE82 Alignment program
❒ Motorola Solutions FIF-12 USB Programming Interface and CT-104A PC Programming Cable

Alignment Preparation & Precautions

A 50-ohm RF Dummy load and in-line 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.

Beacause of the BTL (**B**ridged **T**rans**L**ess) Amplifier circuit used in the VX-2200/-2100, do not connect eather side of the speaker leads to chassis "ground."

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 be the same as that of the transceiver and test equipment, and that this temperature be held constant between 68 °F and 86 °F (20 °C ~ 30 °C). When the transceiver is brought into the shop from hot or cold air, it should be allowed time to come to room temperature before alignment.

Whenever 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.

Note: Signal levels in dB referred to in this procedure are based on 0 dBμ EMF = 1.0 μV.

Test Setup

Setup the test equipment as shown below, and then apply 13.6V DC power to the transceiver.
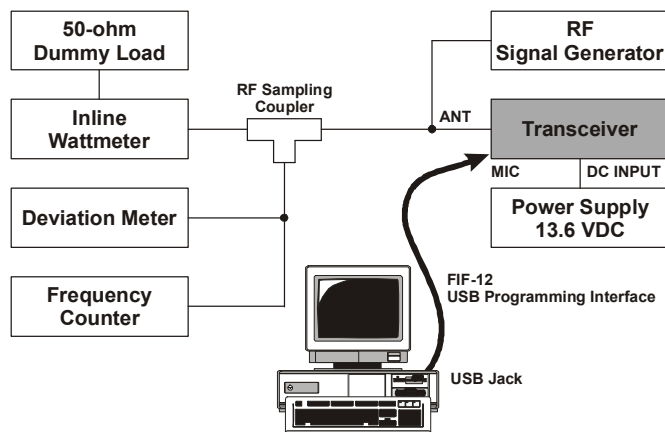
The Alignment Tool Outline

Installation the tool
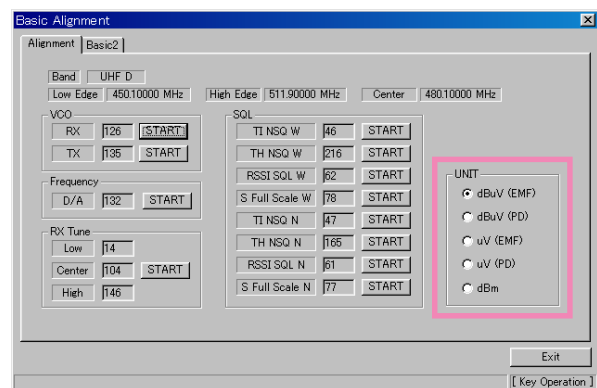
Install the CE82 (Clone Editor) to your PC.
The re-alignment for VX-2200/-2100 series may use the "Alignment" menu of CE82.

Action of the switches

When the transceiver is in alignment mode, the action of PTT and KEY is ignored. All of the action is remote controlled by PC.

Unit

During alignment, the values of dBμV or μV (EMF or PD) can be selected or dBm.

Basic Alignment Mode

The Basic Alignment mode allows you to align the entire radio. The value of each parameter can be changed to the desired position by use of the "←" / "→" and up/down arrow keys, along with direct number input and dragging of the PC mouse.

To enter the Basic Alignment Mode, select "Basic Alignment" in the main "Radio" menu. It will start to "Upload" the written personalized data from the radio. Pressing the "OK" button will then start the Basic Alignment Mode.
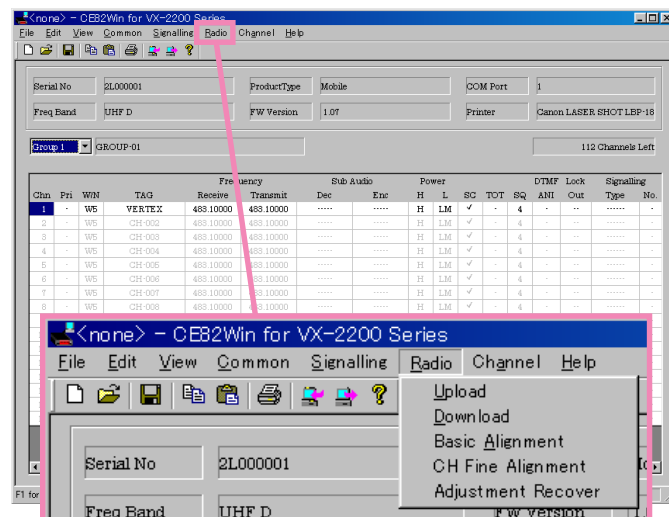
Note: when all items are to be aligned, it is strongly recommended to align them according to following sequence. When the item is selected with TAB key, and the F1 key is pushed, the "Help" file is displayed.
Detailed information for each step may be found in the "Help" file within CE82 (Clone Editor).

1. RX VCO Tune Voltage (RX VCO)
2. TX VCO Tune Voltage (TX VCO)
3. PLL Reference Frequency (Frequency)
4. RX Sensitivity (RX Tune)
5. Squelch (SQL)
6. TX Power
7. Maximum Deviation <Wide> / <Narrow>
8. Sub Audio Deviation <CTCSS> / <DCS>
9. Sequential Tone Deviation

1.   RX VCO Tune Voltage (RX VCO)

This parameter is to align the "Tune Voltage" of RX VCO. This alignment will be done automatically between the radio and PC.

1. Press the "Start" button on the "Basic Alignment" window to open the RX VCO Adjustment window.
2. Press the "Start" button to start the alignment then the "OK" and "Cancel" buttons are inhibited during the alignment.
3. The aligned value will appear and the "OK", "Cancel" buttons come alive when auto-alignment is finished.
4. Press the "OK" button on the window, the value of the alignment for RX VCO will be saved in the radio.
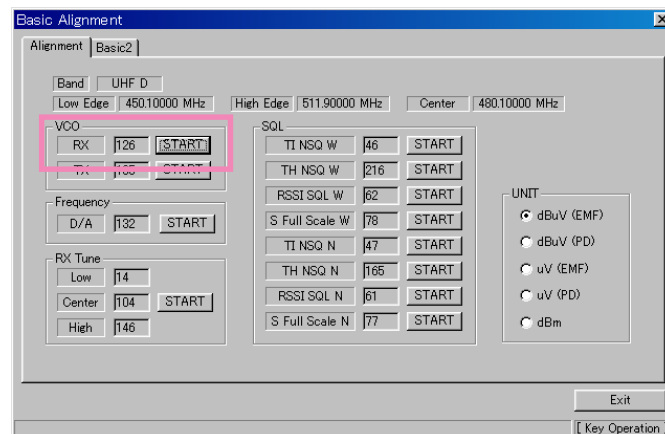
2.   TX VCO Tune Voltage (TX VCO)

This parameter is to align the "Tune Voltage" of TX VCO. This alignment will be done automatically between the radio and PC.

1. Press the "Start" button on the "Basic Alignment" window to open the TX VCO Adjustment window.
2. Press the "Start" button to start the alignment then the "OK" and "Cancel" buttons are inhibited during the alignment.
3. The aligned value will appear and the "OK", "Cancel" buttons come alive when auto-alignment is finished.
4. Press the "OK" button on the window, the value of the alignment for TX VCO will be saved in the radio.
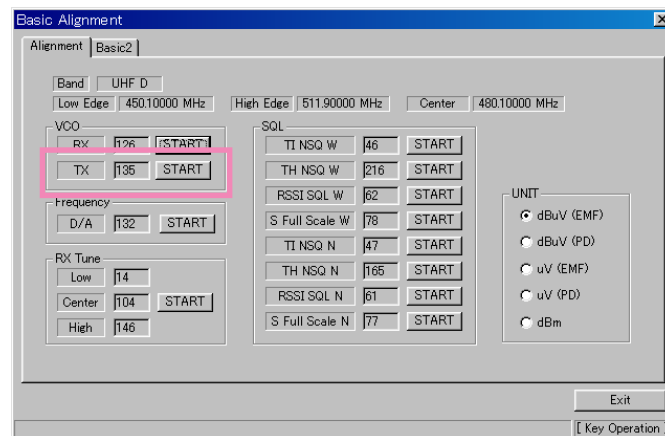
3.   PLL Reference Frequency (Frequency)

This parameter is to align the reference frequency for PLL. The "TX VCO Tune Voltage" alignment must be done before this alignment is going to start.

1. Press the "Start" button to start the alignment then the radio will transmit on the center frequency. It will appear the Frequency Alignment window.
2. Set the value to get desired frequency by left/right arrow key, drag the slide bar by mouse or direct number input.
3. Press the "OK" button on the alignment window to save the re-aligned value, the alignment of the PLL Reference Frequency is accomplished.
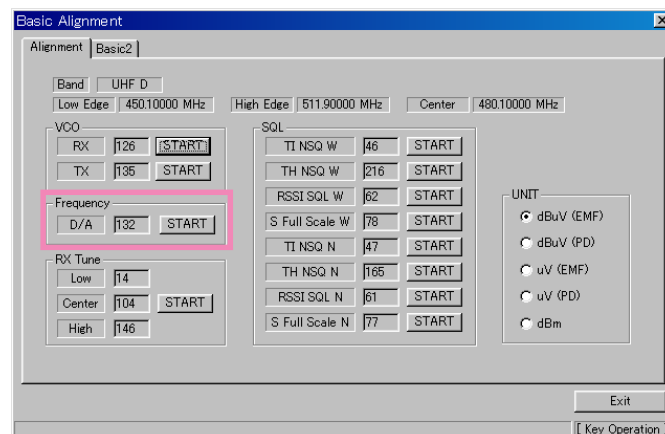
Alignment

4. RX Sensitivity (RX Tune)

This parameter is to align the RX BPF (Band Pass Filter) for Rx sensitivity. It must be done both alignments of the "RX VCO Tune Voltage" and "PLL Reference Frequency" before this alignment is going to start.

1. Press the "Start" button to start the alignment.
2. Set the Signal Generator according to the indication, then press "OK".
3. Repeat the procedure no.2 until the 3point alignment is finished.
4. It will show the result of 3 points alignment and press "OK" then the confirmation window will open.
5. Press "OK" to finish the RX Sensitivity alignment and save the data.
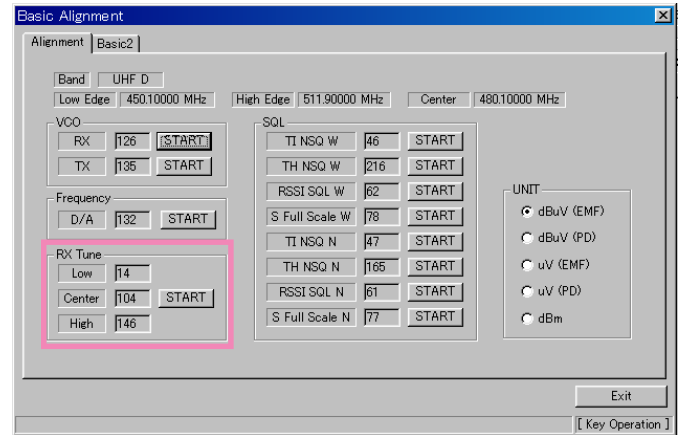
5. Squelch (SQL)

This parameter is to align the SQL (Squelch) Sensitivity. The "RX VCO Tune Voltage", "PLL Reference Frequency" and "RX Sensitivity (RX Tune)" must be done before this alignment is started.

There are several alignments as follows in the Squelch Sensitivity.

Noise SQL Tight <Wide> (TI NSQ W): The Alignment for the Noise SQL Tight level at Wide (5k/4k).
Noise SQL Threshold <Wide> (TH NSQ W): The Alignment for the Noise SQL Threshold level at Wide (5k/4k).
RSSI SQL Level 11 <Wide> (RSSI SQL W): The Alignment for the "level 11" of the RSSI SQL level at Wide (5k/4k).
RSSI SQL Full Scale <Wide> (S Full Scale W): The Alignment for the RSSI Full Scale level at Wide (5k/4k).
Noise SQL Tight <Narrow> (TI NSQ N): The Alignment for the Noise SQL Tight level at Narrow (2.5k).
N*oise SQL Threshold < Narrow > (TH NSQ N)*: The Alignment for the Noise SQL Threshold level at Narrow (2.5k).
RSSI SQL Level 11 < Narrow > (RSSI SQL N): The Alignment for the "level 11" of the RSSI SQL level at Narrow (2.5k).
RSSI SQL Full Scale < Narrow > (S Full Scale N): The Alignment for the RSSI Full Scale levle at Narrow (2.5k).

The procedure for all the alignment is as follows.

1. Press the "Start" button to start the alignment.
2. Set the signal generator according to the level indicated, then press "OK".
3. Press the "OK" button after finish the alignment, then the data will be saved and the alignment is accomplished.
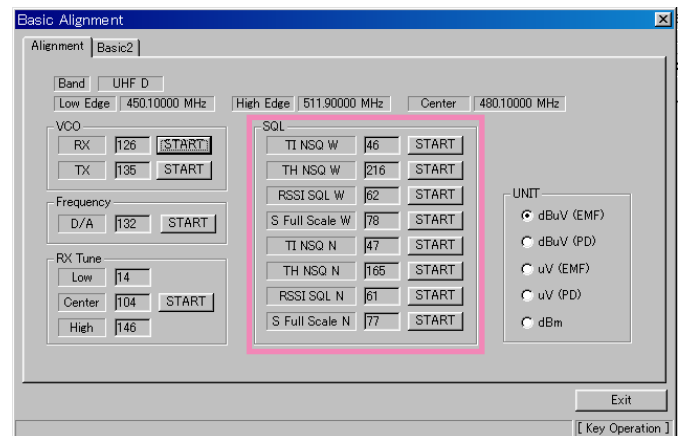
6. TX Power

Open the "Basic2" window, this parameter is to align the Transmit Output (Hi/Low) Power.
The factory default is as followings.

	45 W model	**25 W model**
High	45 W	25 W
Low-High	25 W	12.5 W
Low-Middle	10 W	5 W
E-Low	—	1 W

The procedure for the alignments of the TX Power is followings.

1. Press the "Start" button to start the alignment then the radio will transmit on the center frequency. The TX Power Alignment window will open on the PC.
2. Set the value to get desired output power by left/right arrow key, drag the slide bar by mouse or direct number input.
3. Press the "OK" button on the alignment window to save the re-aligned value, the alignment of the TX POWER is accomplished.
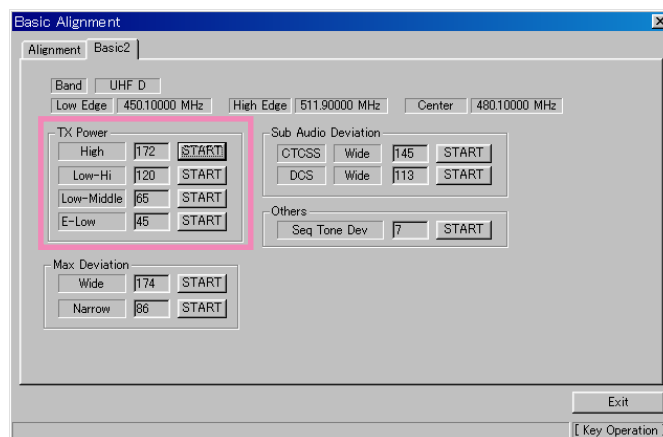
7. Maximum Deviation <Wide> / <Narrow>

This parameter is to align the Maximum Deviation (Wide/Narrow). The "TX VCO Tune Voltage" must be done before this alignment is started.

1. Press the "Start" button to start the alignment.
2. Set the value to get desired deviation (Wide: 4.2kHz, Narrow: 2.1kHz) on the deviation meter by changing the slide bar on your PC.
3. Press the "OK" button after getting the desired Deviation to save the re-aligned value, the alignment of the MAX DEVIATION is accomplished.
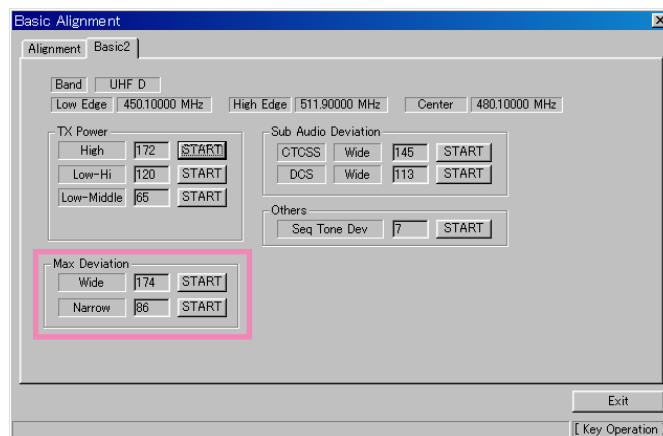
Alignment

8. Sub Audio Deviation \<CTCSS> / \<DCS>

This parameter is to align the Deviation of Sub-Audio (CTCSS/DCS). The "TX VCO Tune Voltage" and "Max Deviation" must be done before this alignment is started.

1. Press the "Start" button to start the alignment.
2. Set the value to get desired deviation (Wide: 0.6kHz) on the deviation meter by changing the slide bar on your PC.
3. Press the "OK" button after getting the desired value to save the re-aligned value, the alignment of the MAX DEVIATION is accomplished.
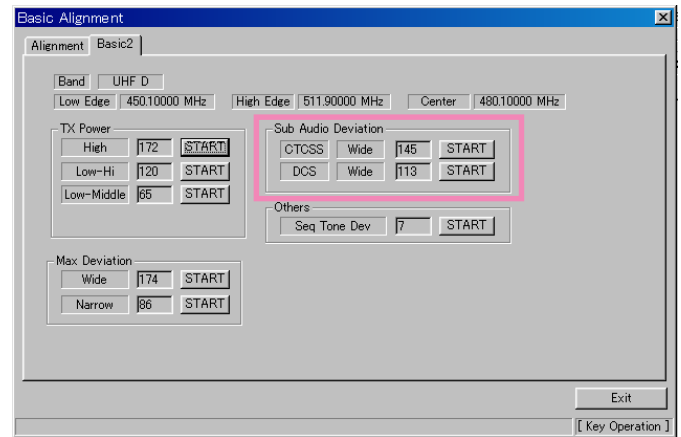
9. Sequential Tone Deviation

This parameter is to align the "Sequential Tone Deviation" (for 2-Tone, 5-Tone and DTMF sequential tones).

1. Press the "Start" button to start the alignment.
2. Set the value to get desired deviation by changing the slide bar on your PC.
3. Press the "OK" button after getting the desired value to save the re-aligned value, the alignment of the SE-QUENTIAL TONE DEVIATION is accomplished.
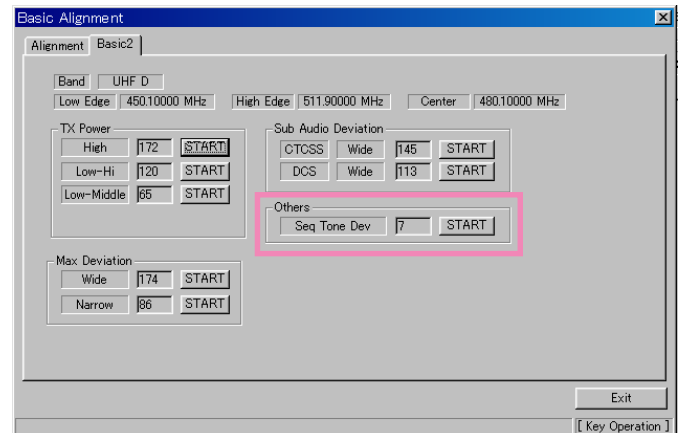
CH (Channel-by-Channel) Fine Alignment Mode

The CH Fine Alignment Mode allows you to align the radio separately for every operating channel. The value of each parameter can be changed to the desired position using the "←" / "→" and up/down arrow keys, direct number input, and by dragging the PC mouse.

To enter the CH Fine Alignment Mode, select "CH Fine Alignment" in the main "Radio" menu. It will start to "Up-load" the written personalized data from the radio. Pressing the "OK" button will then start the CH Fine Alignment Mode.

Note: Detailed information for each step may be found in the "Help" file within CE82 (Clone Editor).
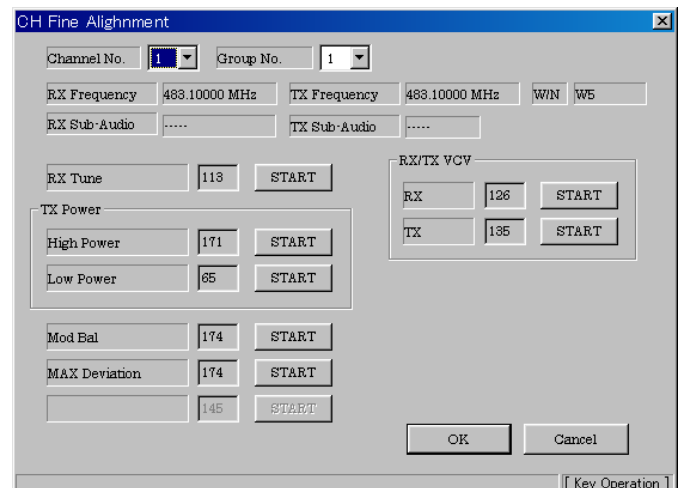
FVP-25/FVP-35/FVP-36

The **FVP-25** is an Encryption/DTMF Pageing Unit which permits secure voice communications with station within your network, while preventing others from listening using normal communications equipment. It allows paging, and enables selective calling using DTMF tone sequences.

The **FVP-35** is an Rolling Code Encryption Unit which permits secure voice communications with station within your network, while preventing others from listening using normal communications equipment.

The **FVP-36** is an Voice Inversion Type Encryption Unit which permits secure voice communications with station within your network, while preventing others from listening using normal communications equipment.

Each optional Unit is easily programmed the configulationsp using a Vertex CE82 programmer with an IBM PC-compatible computer.

1. Disconnect the DC power cable.
2. Referring to Figure 1, remove the 8 screws affixing the Top Cover, then remove the top cover.
3. Referring to Figure 2 & Figure 3, locate the empty connector for the Optional Unit, connect the Optional Unit here.
4. Replace the Top Cover and 8 screws. Installation is now complete.

The VX-2100/-2200 transceiver can not install all Optional Unit at the same time. The VX-2100/-2200 transceiver can install one of FVP-25, FVP-35, and FVP-36.
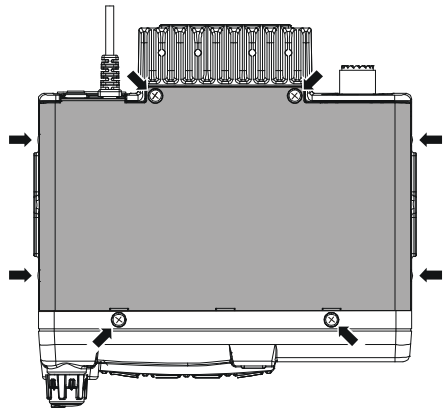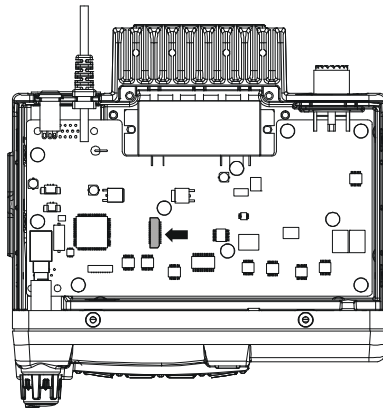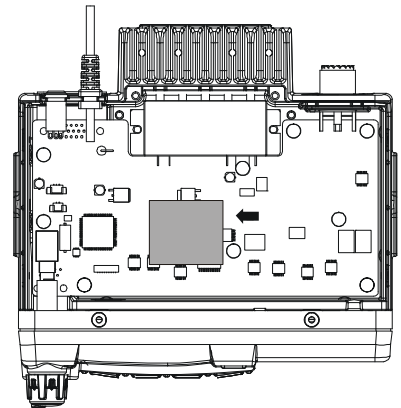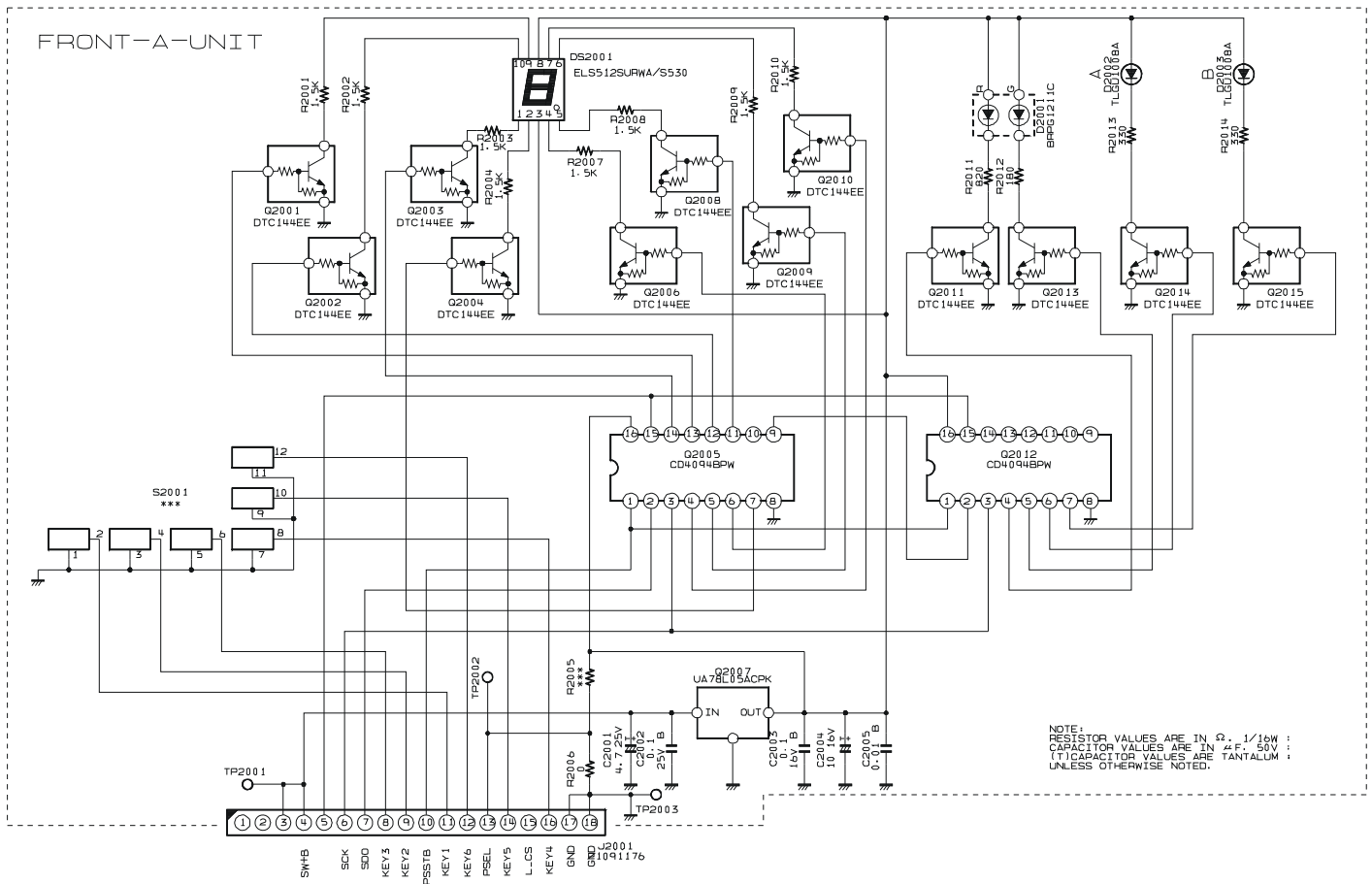

Figure 1

Figure 2

Figure 3

DTMF-UNIT BR005010F

DTMF-UNIT BR005010F

NOTE:
RESISTOR VALUES ARE IN Ω. 1/16W ;
CAPACITOR VALUES ARE IN μF. 50V ;
(T)CAPACITOR VALUES ARE TANTALUM ;
UNLESS OTHERWISE NOTED.

MOTOROLA SOLUTIONS