Alignment (UHF)

Transmitter Output Power

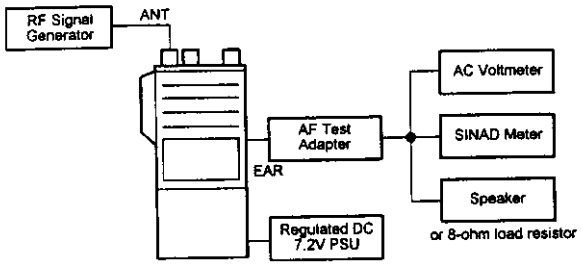
- ❒ Set the transceiver to band center CH 2, and select high power output.
- ❒ Ensure that the supply voltage is precisely 7.2 V, then adjust VR3201 (while the PTT switch is pressed) for 5.0 W on the wattmeter, and confirm that supply current remains below 2.2 A.
- ❒ Press the **A** key on the front panel to select low power output ("**LO**" displayed on the LCD), and adjust VR3202 on the Main Unit for 1.1 W on the wattmeter, and confirm that supply current remains below 1.2 A.

Modulation Level

- ❒ With the transceiver set to band center CH 2, adjust the AF generator for 77 mVrms output at 1 kHz to the MIC jack.
- ❒ Press the PTT switch and adjust VR3204 on the Main Unit for a deviation of ±4.3 kHz (for 25 kHz steps) or ± 2.1 kHz (for 12.5 kHz steps).
- ❒ Reduce the AF generator output to 7.7 mVrms.
- ❒ Press the PTT switch and adjust VR1002 on the Control Unit for a deviation of ± 3.0 kHz (for 25 kHz steps) or ± 1.5 kHz (for 12.5 kHz steps).

Receiver

Set up the test equipment as shown for receiver alignment, and construct the audio test adapter as described in the box above.

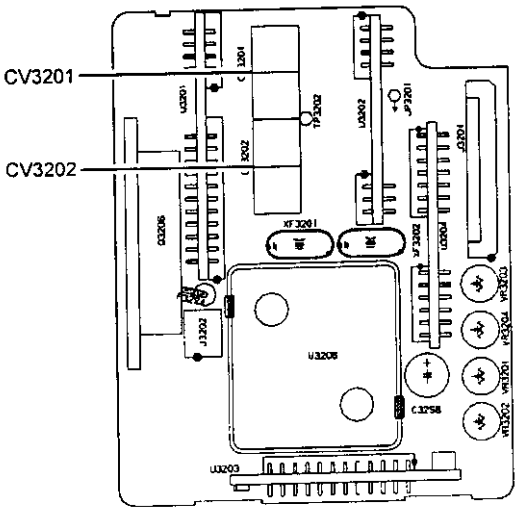


Receiver Alignment Setup

- ❒ With the transceiver set to band center CH 2, and the RF signal generator tuned to the same frequency, set the generator for ± 3.0 kHz deviation with 1 kHz tone modulation, and set the output level for 40 µV at the antenna jack.
- ❒ Adjust CV3201 and CV3202 on the Main Unit for optimum SINAD, reducing the signal generator output level as necessary for proper meter deflection.
- ❒ After the previous step, final signal generator level should be better than –4 dBµ for 12 dB SINAD.

Squelch Threshold

- ❒ Set the transceiver to CH 2, and turn off the RF signal generator output.
- ❒ Turn VR4001 (on the top panel) clockwise until the squelch just closes, and then counter-clockwise very slightly so that it just opens.



UHF Receiver Alignment Points

UHF Transceiver Required Test Equipment

- O IBM PC compatible computer
- O Yaesu VPL-1 Cable, or FRB-2 Service Kit, with CE-21 Channel Programming Diskette
- O Yaesu CN-1 BNC Adapter plug
- O RF Signal Generator with calibrated output level at 1 GHz
- O Deviation Meter (Linear Detector)
- O AC Voltmeter
- O SINAD Meter
- O In-Line wattmeter with 5% accuracy at 1 GHz
- O Regulated DC Power Supply adjustable from 4 to 10 V, 3 A
- O 50-Ω Non-reactive Dummy Load: 10 W at 1 GHz
- O Frequency Counter: ±0.2 ppm accuracy at 1 GHz
- O AF Signal Generator
- O DC Voltmeter: high impedance

Before beginning alignment, connect the transceiver and PC using the VPL-1 Cable or FRB-2 Set as described in the EEPROM Programming chapter, and download the EEPROM data from the transceiver to the computer.

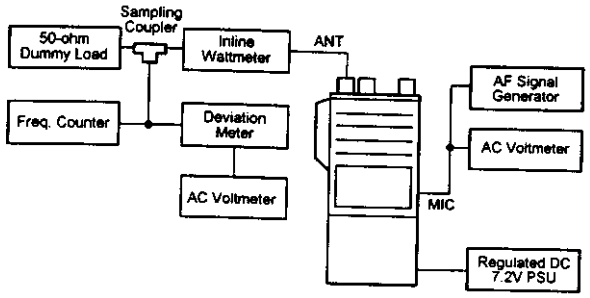
Then store this data in a disk file so that it can be uploaded when alignment is finished.

You should find the corresponding data file on the computer disk for the transceiver version you are aligning, containing channel settings for the high edge, middle and low edge of the transceiver's frequency range in channels 1, 2 and 3, respectively. Up-load this file to the transceiver.

LOW BAND EDGE CH. (1)	BAND CENTER CH. (2)	HIGH BAND EDGE CH. (3)
450.0 MHz	460.0 MHz	470.0 MHz

PLL & Transmitter

Set up the test equipment as shown for transmitter alignment. Adjust the supply voltage to 7.2 V for all steps where not specified otherwise.



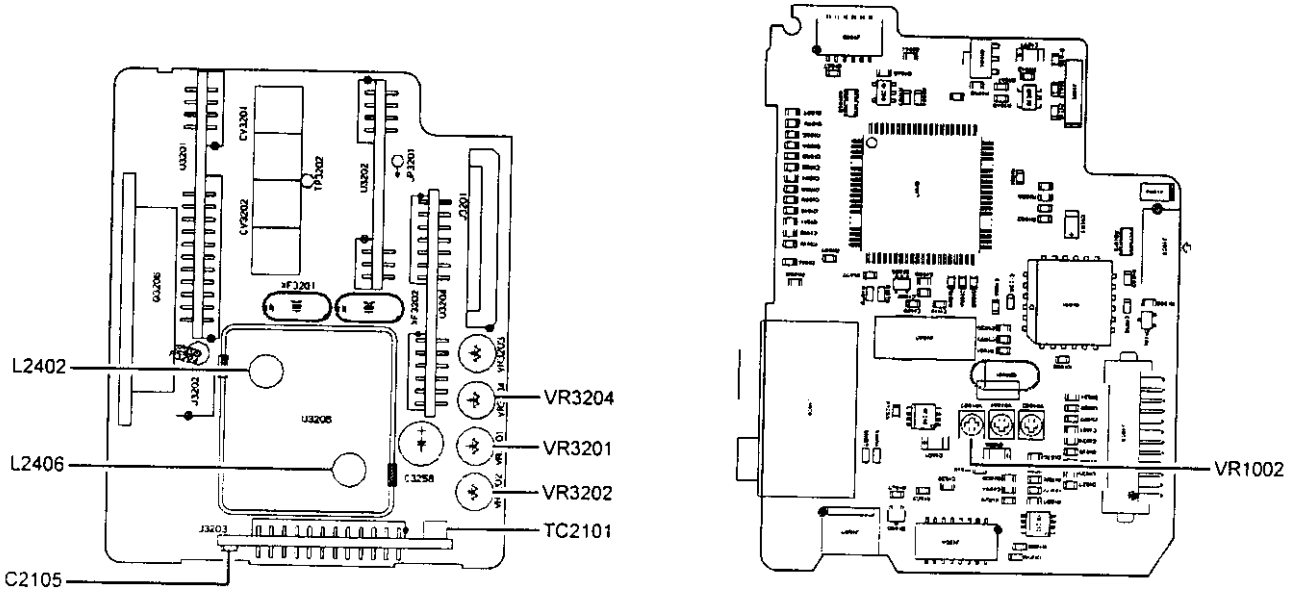
PLL & TX Alignment Setup

PLL VCV (Varactor Control Voltage)

- ❒ Connect the DC voltmeter between C2105 on the PLL Unit and chassis ground.
- ❒ Set the transceiver to CH 3 (high band edge), and adjust L2402 on the VCO Unit for 4.0 V ± 0.1 V on the voltmeter.
- ❒ Transmit on the high band edge, and adjust L2406 for 4.0 V ± 0.1 V on the voltmeter.
- ❒ Set the transceiver to CH 3 (high band edge), and confirm the high-end VCV is more than 1.5 V while transmitting, and also while receiving.

PLL Reference Frequency

- ❒ With CH 2 (band center) selected, key the transmitter and adjust TC2101 on the PLL Unit, if necessary, so the frequency counter displays the band center frequency ±300 Hz (for the version being aligned) when transmitting.



UHF PLL & Transmitter Alignment Points

Circuit Description (UHF)

Refer to the block diagram when reading this description. For finer details, refer to the schematic diagram.

Receiver

In coming signals at the antenna are passed through a low pass filter and T/R switching diode on the ANT SW Unit before delivery to the front-end circuitry on the mother board. Here the signal is band-pass filtered again by a 2-stage resonator, amplified by Q3201 (2SC3356-R24), and then further filtered by a 2-stage band-pass resonator befor application first mixer FET Q3202 (SGM2016M) along with the first local signal from Local Amplifier Q2406 (2SC4226-R24) on the VCO Unit.

The 47.9 MHz product from the first mixer is delivered through 4-pole monolithic crystal filter XF3201 (± 6.0 kHz BW) to strip away all but the desired signal, which is amplified by Q3203 (2SC2620QB) on the Main Unit. FM receiver sub-system IC Q2302 (BA4116FV) on the IF Unit includes local oscillator, mixer, IF limiter amplifier and FM detector circuits. The amplified first IF signal is applied to mixer section, along with the second local signal generated via 48.355 MHz crystal X2301, which produces the 455 kHz 2nd IF when mixed with the 1st IF signal within Q2302. The 2nd IF passes through ceramic filter CF2301 (4.5 kHz BW) or CF2302 (7.5 kHz BW) to strip away unwanted mixer products, and is then applied to the limiter amp in Q2302, which remove amplitude variations in the 455 kHz IF before detection of the speech by Q2302 via quadrature resonator CD2301.

Detected audio is delivered to the CTCSS IC Q1001 (FX165CLH) and then passes through the de-emphasis circuitry consisting of R1033 & C1015, via muting gate Q1011 (2SK160-K6) and volume control to audio power amplifier Q2206 (TDA2822D) and Q2211 (2SC4116GR) on the regulator unit, providing up to 0.5 W to the external speaker jack or 16-Ω loudspeaker.

Squelch Control

The squelch control circuit consists of noise amplifier Q2304 (2SC4116GR) and band-pass filter and squelch trigger within Q2302 on the IF Unit, and control circuitry within microprocessor Q1017 (M38067MC) on the control unit.

When no carrier is received, noise at the output of the detector in Q2302 is amplified by Q2304, and band-pass filtered by the noise amplifier section of Q2302 and then rectified by D2302 to provide a DC control voltage for the squelch switching transistor Q2306 (2SA1586Y). With no carrier, the emitter of Q2306 is high. The signal is buffered by Q1013. This SCAN STOP signal is delivered to the microprocessor on the Control Unit, and microprocessor controlled through Q1003 (FMG5) to the **BUSY** indicator on the top panel, which remains off until a carrier is received. The microprocessor causes audio mute gate Q2207 (DTC144EU) & Q2202 (2SB1132Q) to open the audio power amplifier power source, thus disabling the audio amplifier and silencing the receiver when no signal is being received, and during transmission.

When a carrier appears at the discriminator, noise is removed from the output, causing the emitter of Q2306 to go low, then Q1017 controls the signal high, which in turn causes Q1003 to turn on the **BUSY** indicator. The microprocessor then checks for CTCSS tone information from Q1001, plus Digital Code Squelch information form Q1006 (TA75S393F). If not transmitting and no tone squelch is programmed for the channel, or if the received tone matches that programmed for the channel, the microprocessor switches Q2207 to allow operation of the audio power amplifier.

Transmitter

When the PTT switch is depressed, audio from the microphone is delivered to the Control Unit, where it is high-pass filtered by Q1018 (2SC4116GR), and by one section of microphone audio processing dual opamp IC Q1008 (NJM2904V). After pre-emphasis by C1074 and R1030, another section of Q1008 serves as an IDC (Instantaneous Deviation Control) amplifier to prevent over-deviation from excessive microphone levels, and the two remaining states provide low-pass filtering to suppress out-of-band modulation, and buffering.

Processed audio from the IDC Unit is delivered to VCO Unit where it is applied, along with carefully filtered DC from Q2407 (2SC4116), to varactor diode D2403 (1SV230) to modulate (via the TX Line) VCO FET Q2404 (2SK508-K52, on the VCO Unit), which oscillates at the transmit frequency. VCO output is buffered and amplified by Q2406 on the VCO Amplifier Unit before returning to the Main Unit. Buffered, modulated VCO output is applied via T/R switch D3202 to driver Q3205 (2SC3356), Q3214 (2SC3357), and the transmit signal is delivered to RF Power Module Q3206 (M68732H).

The transmit signal is passed through T/R switching diode D2001 on the APC Unit, and then low-pass filtered by L2003~2005, and C2007, C2011 to suppress spurious harmonics before application to the antenna.

Transmitter output is controlled by Q2001 (2SA1586Y) and Q2002 (FMW1) on the APC Unit. When the TX 5V line (from the regulator Unit) is active, bias voltage and driver collector voltage is applied to the RF Power Module via Q2003 and Q2004 , turning it on. A sample of the final transistor collector current in the RF Power Module is taken via R3224 on the mother board, detected by Q3207 (IMZ2), passed through RF Power potentiometer VR3201 on the main unit back to APC switch Q2001 (2SA1586Y) via one half of Q2002 (FMW1) on the APC Unit. Q2002 passes the Automatic Power Control voltage when enabled by the other (transmit sequencer) half of Q2002. This circuit is also used by the PLL to disable the transmitter when the PLL is unlocked, and by the microprocessor to select low power output.

Circuit Description (UHF)

PLL

The first local signal for the receiver, and the carrier for the transmitter (at the transmitter frequency) are generated by the PLL. This circuit consists two voltage controlled oscillator (VCOs), prescalar, programmable divider, reference oscillator, phase detector, charge pump and low pass filter.

The VCO (on the VCO Unit) consists of Q2401, Q2404 and varactor diodes D2401, D2402 and D2403 (mentioned above). The oscillating frequency is controlled primarily by the level of DC voltage fed from the loop filter (low-pass filter) to the varactor diodes. The VCO output is buffered by Q2406 (2SC4226), and then to prescalar within Q2105 (MB1505) on the PLL Unit, which divides the VCO frequency by 64 or 65, according to a control signal from the prescalar control logic section of PLL IC Q2105.

The divided signal from the prescalar is fed to the programmable divider section of Q2105, where it is further divided down to 10/12.5 kHz according to data from microprocessor Q1017 on the Control Unit. Meanwhile, the reference oscillator section of Q2105 generates the reference frequency with crystal X2101, which signal is divided by Q2105.

The reference and the divided VCO signal are applied together to the phase detector section of Q2105, from which any phase difference between the two signals results in a pulse train from the phase detector. The pulses are applied to the charge pump Q2102 (IMD3) and then through low-pass filter R2101, R2103 ~ R2106, R2122 and C2102, C2104 ~ C2107, to produce a DC voltage at a level corresponding to the difference in phase between the reference and the divided VCO signal. This DC voltage is returned to the varactor diodes on the VCO Unit, locking the frequency of the VCO to the crystal reference oscillator.

In the Tx mode, Tx 5 volts applied to inverter Q2106 pulls analog switch Q2101-1/2 off, removing R2106 and R2122 from the PLL loop.

Also, the transmitter VCO is modulated by the filtered speech audio applied to modulating varactor diode D2403, as previously described. If Digital Coded Squelch is in operation, the DCS signal modulation is applied to the PLL reference, via varactor D2102 & D2103 (HVU350).

Control Unit & Supply Buses

Microprocessor Q1017 (M38067MC) on the control unit contains programming in masked ROM to generate serial data to control the Liquid Crystal Display driver IC Q5001 (LC75821E) on the LCD Unit, and the programmable divider in the PLL according to channel frequency data stored in externally programmable EEPROM. Q1017 also includes programming for channel frequency scanning. DCS encode/decode, CTCSS IC Control, option unit control, selectable channel steps and frequency range.

The microprocessor receives an indication of the condition of the noise squelch from the FM receiver subsystem IC on the IF Unit, by which scanning is activated or deactivated.

Q1017 also controls the power saver function and transmit/receive switching by selecting the supply buses on the regulator unit:Q2209 (DTB123EK), Q2205 (DTA143XK) and Q2210 (DTC144EU) disables the RX 5V bus when the power saver is active.

When the PTT switch is pressed, the impedance change on the microphone line is detected by Q1015 (2SA1586Y) on the control unit, which signals the microprocessor that the transmitter is active. The microprocessor then activates LED indicator D5001 to glow red (TX).

Voltage comparator Q1012 (RH5VL45AA) controls power-up resetting of the microprocessor.

Preliminary

~~HX511U~~ Component Application

Control Unit

Location	Type	Nomenclature	Application
Q1001	Analog IC	FX365CLS	CTCSS Encoder/Decoder
Q1002	EEPROM	BR93LC66RF	Programmable Data Storage
Q1003	Dual Transistor	FMG5	TX/BUSY LED Driver
Q1004	Transistor	DTDG23YP	Pilot Lamp Driver
Q1005	Dual OP-AMP	NJM2904V	LPF
Q1006	Comparator	TA75S393F	Comparator
Q1007	Transistor	DTC144EU	Encoder Switch
Q1008	Dual OP-AMP	NJM2904V	IDCAMP
Q1009	Transistor	DTA143EU	TX 5V Supply
Q1010	Analog Switch	TC4W66FU	Option Switch
Q1011	FET	2SK160-K6	Beep Mute Control
Q1012	Reset IC	RN5VL45AA	CPU Power Reset Control
Q1013	Dual Transistor	FMW1	SQL Switch
Q1014	Analog Switch	TC4W53FU	AF/CLONE Switch
Q1015	Transistor	2SA1586Y	PTT Switch
Q1016	Dual Transistor	FMG2	RESET/ACC Switch
Q1017	MOS LSI/IC	M38063M6	CMOS Microcomputer
Q1018	Transistor	2SC4116GR	IDC HPF
Q1019	Not Used		
Q1020	Dual Transistor	UMG1	Clock Shift Switch
Q1021	Transistor	DTC144EU	MIC Switch
D1001	Dual Diode	DAN202U	Decode Switch
D1002	Dual Diode	DAN202U	SP Control Switch
D1003	Dual Diode	DA227	SP Control Switch
D1004	Dual Diode	DA204U	Static Voltage Protection
D1005	Dual Diode	DAN202U	Reverse Voltage Protection
D1006	Dual Diode	DA204U	Decode Switch

Main Unit

Location	Type	Nomenclature	Application
Q3201	Transistor	2SC3356-R24	Receiver RF AMP
Q3202	MOS FET	SGM2016M	Receiver First Mixer
Q3203	Transistor	2SC2620QB	IF Amplifier
Q3204	Transistor	2SC5005	Transmitter RF Buffer
Q3205	Transistor	2SC3356-R24	Transmitter RF Driver
Q3206	Hybrid RF Module	M68732H	Transmitter RF Power Amplifier
Q3207	Dual Transistor	IMZ2	Transmitter RF Power Control
Q3208	Transistor	DTC144EU	LOW Power Control
Q3209	Dual OP-AMP	M5223FP	IDC LPF
Q3210	Transistor	DTC144EU	APC Control
Q3211	Transistor	RN2305	Separation Control
Q3212	Transistor	DTC144EU	Separation Control
Q3213	Transistor	DTC144EU	Separation Control
Q3214	Transistor	2SC3357	Transmitter RF Driver
Q3215	Transistor	DTC124TU	Transmitter Control
D3201	Not Used		
D3202	Dual Diode	1SS184	Transmit/Receive Low Switch

IF Unit

Location	Type	Nomenclature	Application
Q2301	Transistor	DTA144EE	Separation Control Switch
Q2302	Analog IC	BA4116FV-E2	FM RX 2nd Low, Detector
Q2303	Transistor	DTC144EU	Noise Detector
Q2304	Transistor	2SC4116GR	Separation Control Switch
Q2305	Transistor	DTC144EU	Noise AMP
Q2306	Transistor	2SA1586Y	Separation Control Switch Buffer
D2302	Dual Diode	DA221	Noise Detector
D2303	Diode	MA111	Switch
D2304	Dual Diode	MA142WK	Separation Control Switch
D2305	Dual Diode	MA142WK	Separation Control Switch

PLL Unit

Location	Type	Nomenclature	Application
Q2101	Analog Switch	TC4W66F	PLL TX/RX Switch
Q2102	Dual Transistor	IMD3	Charge Pump
Q2103	Transistor	DTC114TK	Pulse Switch
Q2104	Transistor	DTA144EU	PLL Unlock Switch
Q2105	Analog IC	MB1505PF	PLL REF. OSC, Divider, Phase-Comparator & Prescaler
Q2106	Transistor	DTC144EU	TX Switch
D2101	Diode	MA111	Temperature Control
D2102	Varactor Diode	HVU350	REF Mod Control
D2103	Varactor Diode	HVU350	REF Mod Control
D2104	Dual Diode	DAN202U	OR Circuit

VCO Unit

Location	Type	Nomenclature	Application
Q2401	FET	2SK508	Receiver VCO
Q2402	Transistor	DTC124EU	Receiver VCO Switch
Q2403	Transistor	DTC124EU	Receiver VCO Switch
Q2404	FET	2SK508	Transmitter VCO
Q2405	Transistor	DTC124EU	Transmitter VCO Switch
Q2406	Transistor	2SC4226	Buffer AMP
Q2407	Transistor	2SC4116GR	Ripple Filter
D2401	Varactor Diode	HVU351	VCO Tuning
D2402	Varactor Diode	HVU351	VCO Tuning
D2403	Varactor Diode	1SV230	Modulator
D2404	Dual Diode	DAN202U	Charge up Diode

REG Unit

Location	Type	Nomenclature	Application
Q2201	Transistor	2SA1586Y	DC AMP Supply Receiver AF
Q2202	Transistor	2SB1132Q	DC AMP Supply Receiver AF
Q2203	Voltage Regulator	TK11650UTL	CONT 5V Regulator
Q2204	Transistoir	DTB123EK	CONT 5V Regulator

			pass Transistor
Q2205	Transistor	DTA143XK	RX 5V Supply Gate
Q2206	Audio IC	TDA2822D	Receiver AF Amplifier
Q2207	Transistor	DTC144EU	Current Limit Switch
Q2208	Transistor	DTC144EU	Current Limit Switch
Q2209	Transistor	DTB123EK	TX 5V Supply Gate
Q2210	Transistor	DTC144EU	PTT Inverter for RX 5V supply Gate

APC Unit

Location	Type	Nomenclature	Application
Q2001	Transistor	2SA1298Y	Transmitter Power Control
Q2002	Dual Transistor	FMW1	Transmitter Power Control
Q2003	Transistor	2SA1298Y	Transmitter Voltage Regulator
Q2004	Transistor	2SC4116GR	Transmitter Voltage Regulator
Q2005	Transistor	DTC144EU	Transmitter UL Switch
Q2006	Transistor	DTC144EU	Transmitter UL Switch
D2001	Diode	UM9957F	Antenna Switch
D2002	Diode	RLS135	Antenna Switch
D2003	Diode	RLS135	Antenna Switch
D2004	Zener Diode	RD3.6MB1	Transmitter Power Control

LCD Unit

Location	Type	Nomenclature	Application
Q5001	CMOS LSI	LC75821E	LCD Driver
D5001	Dual LED	LT1EP53A	TX/BUSY Indicator