PARTS LIST / TUNE UP INFORMATION

This exhibit contains a list of the semiconductor devices used in the transceiver and the test equipment and tuning procedures for maintaining the transceiver.

EXHIBIT 10A Function of RF Semiconductors and Other Active Devices

EXHIBIT 10B List of Recommended Test Equipment for Servicing

EXHIBIT 10C Tune Up Information

EXHIBIT 10

Function of RF Semiconductors & Other Active Devices

Applicant: Motorola, Inc. **Equipment Type**: ABZ99FT3038

REF NUMBER	PART NUMBER	CIRCUIT APPLICATION	OPERATING FREQUENCY	INDUSTRY EQUIVALENT
CR1	48-80154K03	CLIPPER	150-174 MHz	MMBD353
CR2	48-80142L01	RF SWITCH	150-174 MHz	MMBV3401
CR51	48-80154K03	CLIPPER	45.15 MHz	MMBD353
CR201	48-02245J22	RF OSC FREQ CONTROL	16.8 MHz	1T363
CR211	48-13833C07	RECTIFIER	1.05 MHz	MMBD7000
CR212	48-13833C07	RECTIFIER	1.05 MHz	MMBD7000
CR241	48-62824C03	RX VCO FREQ CONTROL	104.85-128.85 MHz	1SV232
CR251	48-62824C03	TX VCO FREQ CONTROL	150-174 MHz	1SV232
CR252	48-62824C03	TX VCO MODULATION	150-174 MHz	1SV232
CR401	48-05129M76	DC SWITCH	DC	MMBD914
CR402	48-13833C07	ESD PROTECTION	DC	MMBD7000
CR403	48-80939T01	SWITCH	5 KHZ	1N15711
CR404	48-13833C07	ESD PROTECTION	DC	MMBD7000
CR406	48-83553T02	REV POLARITY PROTECTION	DC	MUR420
CR408	48-05129M76	DC SWITCH	DC	MMBD914
CR451	48-05129M76	DC SWITCH	DC	MMBD914
CR651	48-13833C07	ESD PROTECTION	AUDIO	MMBD7000
CR652	48-13833C07	ESD PROTECTION	AUDIO	MMBD7000
CR653	48-13833C07	ESD PROTECTION	AUDIO	MMBD7000
CR2650	48-02482J02	ANTENNA PIN SWITCH	150-174 kHz	MA4P1250
CR2651	48-02482J02	ANTENNA PIN SWITCH	150-174 kHz	MA4P1250
CR2670	48-80236E07	TRANSIENT SUPPRESSOR	DC	MR2535L
CR2480	48-82290T02	FOREWARD PWR DETECTOR	150-174 MHZ	HSMS-2802
CR2481	48-82290T02	FOREWARD PWR DETECTOR	150-174 MHZ	HSMS-2802
Q1	48-13827A07	RF AMPLIFIER	150-174 MHz	MMBR941
Q2	48-13824A17	RF AMP BIAS CONTROL	DC	MMBT3906
Q51	48-13827A07	I-F AMPLIFIER	45.15 MHz	MMBR941
Q52	48-13827A07	SECOND LOCAL OSCILLATOR	44.965 MHz	MMBR941
Q53	48-80947V01	DC SWITCH	DC	DTC144W
Q54	48-80947V01	DC SWITCH	DC	DTC144W
Q271	48-13827A07	RX VCO BUFFER	194.85-218.85 MHz	MMBR941
Q281	48-13827A07	TX VCO BUFFER	150-174 MHz	MMBR941
Q401	48-80214G02	DC AMPLIFIER	DC	MMBT3904
Q402	48-80947V01	DC SWITCH	DC	DTC144W
Q412	48-13824A17	DC SWITCH	DC	MMBT3906

REF NUMBER	PART NUMBER	CIRCUIT APPLICATION	OPERATING FREQUENCY	INDUSTRY EQUIVALENT
Q413	48-80214G02	DC SWITCH	DC	MMBT3904
Q414	48-80141L03	DC SWITCH	DC	M41L03
Q451	48-02245J25	POWER CONTROL PASS DEVICE	DC	2SB1142S
Q452	48-80214G02	POWER CONTROL DRIVER	DC	MMBT3904
Q453	48-80214G02	CURRENT AMPLIFIER	DC	MMBT3904
Q501	48-80947V01	DC SWITCH	DC	DTC144W
Q551	48-80947V01	DC SWITCH	DC	DTC144W
Q552	48-80944U01	DC SWITCH	DC	DTC144K
Q651	48-80947V01	DC SWITCH	DC	DTC144W
Q901	48-80947V01	DC SWITCH	DC	DTC144W
Q902	48-80214L03	DC SWITCH	DC	BCW68G
Q903	48-80947V01	DC SWITCH	DC	DTC144W
Q904	48-80947V01	DC SWITCH	DC	DTC144W
Q905	48-80947V01	DC SWITCH	DC	DTC144W
Q906	48-80947V01	DC SWITCH	DC	DTC144W
Q907	48-80947V01	DC SWITCH	DC	DTC144W
Q908	48-80947V01	DC SWITCH	DC	DTC144W
Q909	48-80947V01	DC SWITCH	DC	DTC144W
Q910	48-80947V01	DC SWITCH	DC	DTC144W
Q911	48-80947V01	DC SWITCH	DC	DTC144W
Q1101	48-80947V01	DC SWITCH	DC	DTC144W
Q1102	48-80947V01	DC SWITCH	DC	DTC144W
Q1103	48-80947V01	DC SWITCH	DC	DTC144W
Q1104	48-80947V01	DC SWITCH	DC	DTC144W
Q1105	48-80947V01	DC SWITCH	DC	DTC144W
Q1106	48-80947V01	DC SWITCH	DC	DTC144W
Q1107	48-80947V01	DC SWITCH	DC	DTC144W
Q1108	48-80947V01	DC SWITCH	DC	DTC144W
Q2410	48-02245J24	RF BUFFER STAGE	150-174 MHz	BFG35
Q2420	48-02245J28	DRIVER	150-174 MHz	BFQ43A
Q2430	48-80225C18	RF PA FINAL AMPLIFIER	150-174 MHz	MRF2628
U1	51-80505D05	DOUBLE BALANCED MIXER	45.15-174 MHz	05D05
U2	48-09939C04	DC SWITCH	DC	UMC3TL
U51	51-80605E02	RECEIVER SYSTEM	44.85 MHz/455 kHz	CUSTOM
U52	51-05663U35	RF SWITCH	455 kHz	4066B
U53	51-05663U35	RF SWITCH	455 kHz	4066B
U201	51-05457W72	SYNTHESIZER	1.05-174 MHz	CUSTOM
U251	51-05414S84	VCO/BUFFER	194.85-174 MHZ	CUSTOM

REF NUMBER	PART NUMBER	CIRCUIT APPLICATION	OPERATING FREQUENCY	INDUSTRY EQUIVALENT

U401	51-99011D01	MICROCONTROLLER	DC	MC68HC11KA4
U402	51-80604E01	RX AUDIO FILTER	2.1 MHz	CUSTOM U451
U404	51-80633C01	5V REGULATOR	DC	TK11950
U405	51-05469E65	5V REGULATOR	DC	LP2951C
U406	51-13816D03	8V REGULATOR	DC	MC7808
U451	05-80932W01	TX POWER CONTROL	DC	LM2904
U501	51-09699X01	AUDIO POWER AMPLIFIER	AUDIO	TDA1519C
U551	51-02198J28	AUDIO/DATA AMPLIFIER	AUDIO	LM2902D
U552	51-62852A09	AUDIO LIMITER	AUDIO	LMC7101
U553	51-84704M60	AUDIO SWITCH	AUDIO	4053B
U554	51-05663U35	AUDIO SWITCH	AUDIO	4066B
U555	51-13811A35	AUDIO COMPANDER	AUDIO	MC33111
U651	51-05461G61	AUDIO CONTROL LOGIC	DC	TC7S00F
U652	48-09939C04	DC SWITCH	DC	UMC3TL
VR401	48-80140L06	VOLTAGE REGULATOR	DC	MMBZ5231
VR402	48-80948V01	ESD PROTECTION	DC	MMBZ5254
VR409	48-80948V01	ESD PROTECTION	DC	MMBZ5254
VR410	48-80140L15	ESD PROTECTION	DC	MMBZ5240
VR411	48-80948V01	ESD PROTECTION	DC	MMBZ5254
VR412	48-80948V01	ESD PROTECTION	DC	MMBZ5254
VR551	48-80140L15	ESD PROTECTION	DC	MMBZ5240
VR552	48-80140L15	ESD PROTECTION	DC	MMBZ5240
VR553	48-80140L15	ESD PROTECTION	DC	MMBZ5240
VR901	48-80948V01	ESD PROTECTION	DC	MMBZ5254
VR902	48-80948V01	ESD PROTECTION	DC	MMBZ5254
VR903	48-80948V01	ESD PROTECTION	DC	MMBZ5254
VR904	48-80948V01	ESD PROTECTION	DC	MMBZ5254
VR905	48-80948V01	ESD PROTECTION	DC	MMBZ5254
VR906	48-80948V01	ESD PROTECTION	DC	MMBZ5254
VR907	48-80948V01	ESD PROTECTION	DC	MMBZ5254
VR908	48-80948V01	ESD PROTECTION	DC	MMBZ5254
VR909	48-80948V01	ESD PROTECTION	DC	MMBZ5254

COMMENTS: The Motorola designators are special code numbers for active devices used in Motorola radios. These devices are either identical or derived from the device family listed under Industry Equivalent, by the manufacturer or are proprietary to Motorola. Service people do not have access to any cross-references or given any information on proprietary devices and are prevented from making unauthorized substitution.

Applicant: Motorola, Inc. **Equipment Type**: ABZ99FT3038

List of Recommended Test Equipment for Servicing

Instrument	Recommended Type	Application
RF Signal Generator*	HP 8656B or equivalent	Receiver Measurements
Modulation Analyzer*	HP 8901B or equivalent	Frequency and Deviation Measurements
Audio Analyzer*	HP 8903A or equivalent	Receiver Measurements
Power Meter*	HP 438A or equivalent	Transmitter Power Output
Power Sensor*	HP 8482A or equivalent	Transmitter Power Output
DC Power Supply	0-15 volts at 10 amps	
Attenuator Pad*	50 ohms, 50 Watts, 30 dB	Transmitter Measurements
DC Ammeter	30 mA to 20 Amps	Current Drain Measure-ments
Computer	IBM PC, PC/XT or PC/AT	Radio Alignment
Radio Interface Box	01-80353A74	Computer Connection to Radio
Cable	01-80357A44 or A64	From RIB to Computer
Cable	01-80353A75	From RIB to Radio
Software	HVN-9054	Radio Alignment

* These items can be replaced by a Motorola 2000 Series Communications System Analyzer.

Applicant: Motorola, Inc. **Equipment Type**: ABZ99FT3038

Tune Up Information

This exhibit contains the tuning procedures in the same general format as will appear in the service manual.

All transmitter adjustments are performed by electronic means. The transmitter contains no electromechanical components for the purpose of transmitter tuning or adjustment.

The tuning elements that are used for transmitter adjustment are:

Location	Type of Element	Function
U801	Microcomputer	Monitors output of Power Limiting circuit. Supplies data to Attenuators, Fractional-N Synthesizer, Temperature Compensated Crystal Oscillator, and Digital to Analog Converter for Transmitter Modulation, Frequency and Power Adjustment
U201	Programmable Attenuator	VCO Modulation Sensitivity
U201	Programmable Attenuator	Reference Modulation Sensitivity
U651	Programmable Attenuator	Deviation Adjustment
U202	Temperature Compensated Crystal Oscillator	Transmitter Frequency Adjustment
U452	Digital to Analog Converter	Transmitter Power Adjustment

The value of a particular tuning element is determined by data sent to that tuning element by microcomputer U801. This data is generated by the microcomputer based on tuning information that is stored in the microcomputer's EEPROM (Electrically Erasable Programmable Read Only Memory).

Tuning information is stored in the EEPROM during factory adjustment or by qualified field service facilities, using the attached procedure and recommended test equipment.

TUNING PROCEDURE

The tuning procedure assumes that an integrated piece of test equipment is being used. This test equipment is usually referred to as a Communications Systems Analyzer (CSA) and combines the functions of many separate pieces of test equipment. The Radio Service Software (RSS) allows a Service Technician to electronically adjust or calibrate the radio without opening the radio housing to gain access to manual controls (potentiometers, variable capacitors, etc.).

Adjustments versus Calibration

The term "Adjustment" is the ability, through the RSS, to adjust the coarse output power, the maximum deviation and the frequency of the reference oscillator of the transmitter. Adjustments are performed at a single frequency that is normally at the center of the operating range.

The term "Calibration" is the ability, through the RSS, to adjust the RF output power and the maximum system deviation of the transmitter on eight frequency points that span the entire bandwidth of the radio.

When the radio is calibrated at the factory, it will perform within specification on any customer frequency within the frequency band. Therefore, any further adjustment or calibration should not be necessary in the field. The only exception is the alignment of the reference oscillator. Due to the aging characteristics of quartz crystals, the frequency of the oscillator may change over time. This requires that the frequency of the reference oscillator must be periodically readjusted.

Periodic adjustment is not necessary for the output power and the maximum deviation of the transmitter. These operational characteristics of the transmitter do not change over time. It is not recommended to use the adjustment windows for output power and deviation unless absolutely necessary. If an output power adjustment greater than 10 percent is encountered, then the test equipment, cables and antenna loads should be verified as not being defective. If the maximum deviation adjustment is greater than 10 percent, the test equipment should be checked. If the radio is operating beyond these limits, it is recommended that the calibration be performed instead of adjustment.

The procedures for Adjustment and Calibration are explained in the next paragraphs.

A. Test Setup and Initial Reading of Radio Data

1. Connect the radio to an IBM® PC or compatible computer using the Radio Interface Box (RIB) and the appropriate cables.
2. Connect the “RF In/Out” of the CSA to the antenna connector of the radio.
3. Connect the CSA “Mod Out” port to the audio input connector of the breakout box in the cable from the RIB to the radio
4. Turn on power to all equipment.
5. Set the radio to the lowest customer frequency via the front panel “Up/Down” channel pushbuttons of the radio.
6. Start the Radio Service Software (RSS) for the radio.
7. Select **Service** from the menu bar.
8. Click on “Read Radio for Service”.
9. After the radio is read, again select **Service** from the menu bar. The adjustments and calibrations for the radio are shown in Figure 7.1.

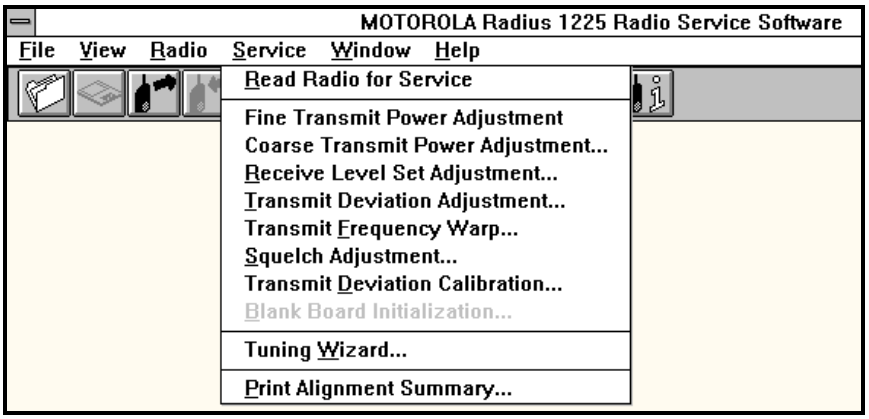

Figure 7.1 – Adjustments and Calibrations

B. Transmitter Deviation Adjustment

The Transmit Deviation Adjustment allows adjustment of the maximum deviation. This adjustment affects all of the frequencies within the operating bandwidth of the radio.

1. Select “Transmit Deviation Adjustment” from the Service dropdown menu. The service adjustment window is shown in Figure 7.2.

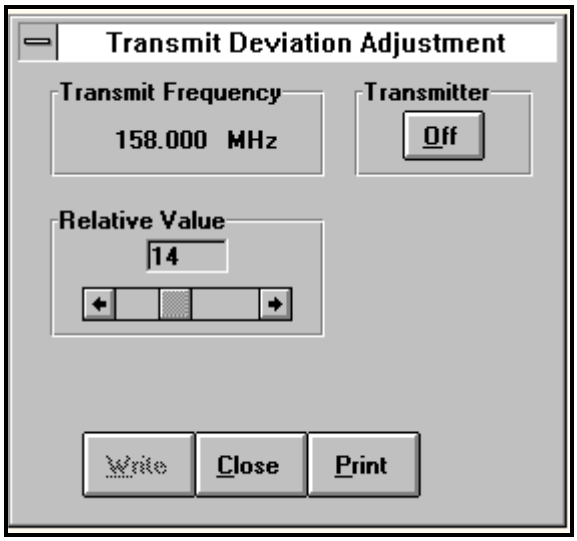

Figure 7.2 – Transmit Deviation Adjustment

2. Adjust the output level of the “Mod Out” of the CSA to 800-mV rms.
3. Key the transmitter by clicking the “Transmitter” button; the button will change to display “On” when the transmitter turns on.
4. Measure the maximum deviation of the transmitter with the CSA.
5. Unkey the transmitter by clicking the Transmitter button; the button will change to display “Off” when the transmitter turns off.
6. Use the right Relative Value arrow button to increase the maximum deviation. Use the left Relative Value arrow button to decrease the maximum deviation.
7. Perform steps 3 to 6 until the correct deviation is obtained. If the radio cannot be adjusted for rated deviation and the Relative Value is at a maximum or a minimum value, refer to the service manual for the radio for repair procedures.
8. Click the Write button to save the new value to the radio.
9. Click the Close button to exit the Transmitter Deviation Adjustment.

C. Transmit Deviation Calibration

The Transmit Deviation calibration window allows adjustment of the maximum deviation at eight (8) frequency points across the operating bandwidth of the radio. The window displays the frequency to which the transmitter has been programmed by the RSS and a relative scale for the value of the maximum deviation at each frequency.

1. Select “Transmit Deviation Calibration” from the Service dropdown menu. The service adjustment window is shown in Figure 7.3.

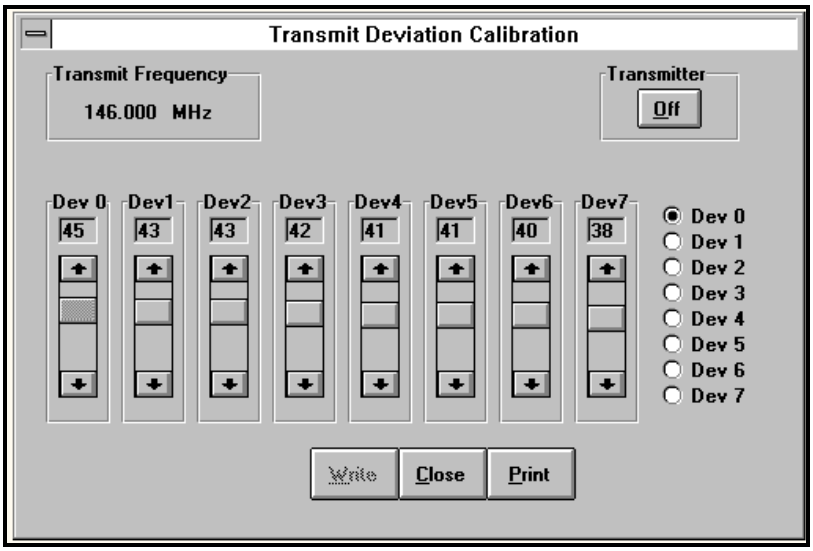

Figure 7.3 – Transmit Deviation Calibration

2. For full calibration, start with “Dev 0”.
3. Adjust the output level of the “Mod Out” of the CSA to 800-mV rms.
4. Key the transmitter by clicking the Transmitter button; the button will change to display “On” when the transmitter turns on.
5. Measure the maximum deviation of the transmitter with the CSA.
6. Unkey the transmitter by clicking the Transmitter button; the button will change to display “Off” when the transmitter turns off.
7. Use the up arrow button to increase the maximum deviation. Use the down arrow button to decrease the maximum deviation.
8. Perform steps 4 to 7 until the correct deviation is obtained. If the radio cannot be adjusted for rated deviation and the value displayed in the “Dev” window is at the maximum or the minimum, refer to the service manual for the radio for repair procedures.
9. After the correct maximum deviation is attained for the first tuning point, “Dev 0”, click on the “Dev 1” selector.
10. Perform steps 4 to 8 for each tuning point (“Dev 0” through “Dev 7).
11. Click the Write button to save the new values to the radio.
12. Click the Close button to exit the Transmit Deviation Calibration.

D. Transmit Frequency Adjustment (Warp)

The Transmit Frequency Warp window allows adjustment of the frequency of the 16.8 MHz reference oscillator (TXCO). The window displays a relative scale of the alignment range available and the current position of the alignment inside that range.

1. Select “Transmit Frequency Warp” from the Service dropdown menu. The service adjustment window is shown in Figure 7.4.

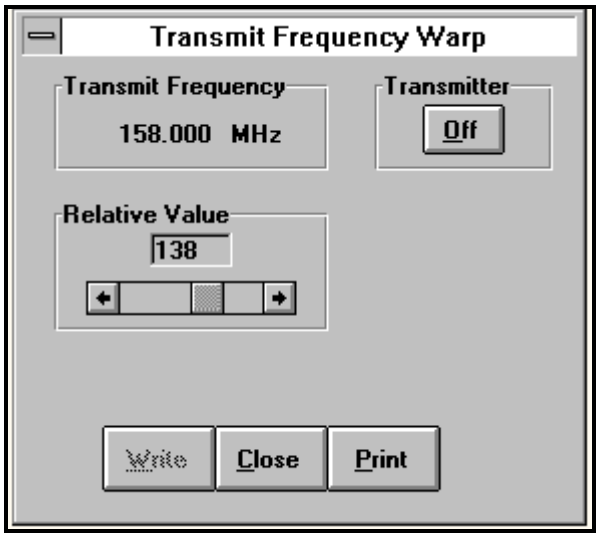

Figure 7.4 – Transmit Frequency Warp

2. Key the transmitter by clicking the "Transmitter" button; the button will change to display "On" when the transmitter turns on.
3. Measure the frequency of the transmitter with the CSA.
4. Unkey the transmitter by clicking the Transmitter button; the button will change to display "Off" when the transmitter turns off.
5. Use the right Relative Value arrow button to increase the frequency. Use the left Relative Value arrow button to decrease the frequency.
6. Perform steps 3 to 6 until the frequency is obtained. If the radio cannot be adjusted to the correct frequency and the Relative Value is at a maximum or a minimum value, refer to the service manual for the radio for repair procedures.
7. Click the Write button to save the new value to the radio.
8. Click the Close button to exit the Transmitter Deviation Adjustment.

E. Coarse Transmit Power Adjustment

The Coarse Transmitter Power Adjustment window allows electronic adjustment of the RF output power of the transmitter. The window displays a relative scale of the range available and the current position of the alignment within that range. The RF output power can be adjusted to two different values, Low Power and High Power. Each channel of operation may be assigned either the Low or the High value. Use the following procedure to adjust the coarse power settings.

1. Select "Coarse Transmit Power Adjustment" from the Service dropdown menu. The service adjustment window is shown in Figure 7.5.

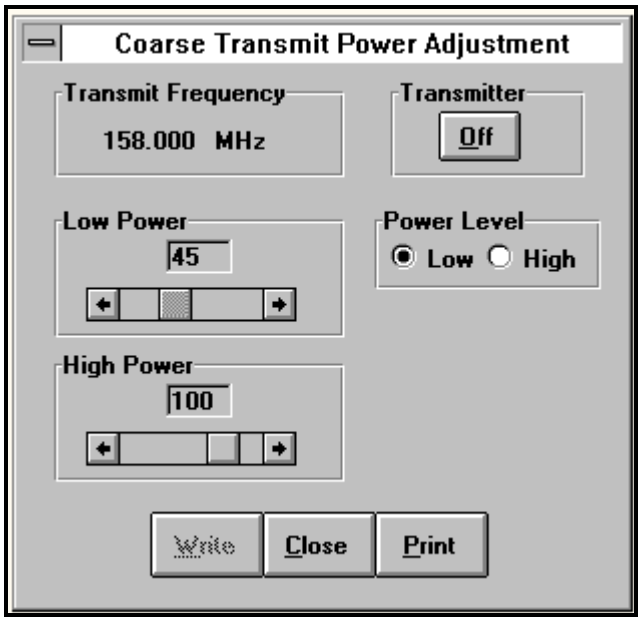

Figure 7.5 – Coarse Transmit Power Adjustment

2. Key the transmitter by clicking the "Transmitter" button; the button will change to display "On" when the transmitter turns on.
3. Measure the RF output power of the transmitter with the CSA.
4. Unkey the transmitter by clicking the Transmitter button; the button will change to display "Off" when the transmitter turns off.
5. Use the right Relative Value arrow button to increase the RF output power. Use the left Relative Value arrow button to decrease the RF output power.
6. Perform steps 3 to 6 until the desired RF output power is obtained for the Low Power setting. If the radio cannot be adjusted to the desired RF output power and the relative value is at a maximum or a minimum, refer to the service manual for the radio for repair procedures.
7. When the desired Low Power setting is obtained, click on the High selector button under Power Level.
8. Repeat steps 2 to 6 until the desired RF output power is obtained.
9. Click the Write button to save the new values to the radio.
10. Click the Close button to exit the Coarse Transmitter Power Adjustment.

F. Fine Transmit Power Calibration

The Fine Transmitter Power Calibration window allows adjusting the RF output power of the transmitter across the operating bandwidth of the radio. The window displays the relative value within the allowable range for each of eight tuning points. Calibration is done for both the Low Power and the High Power settings. Use the following procedure to calibrate the fine power settings.

1. Select "Fine Transmit Power Adjustment" from the Service dropdown menu. The service adjustment window is shown in Figure 7.6.

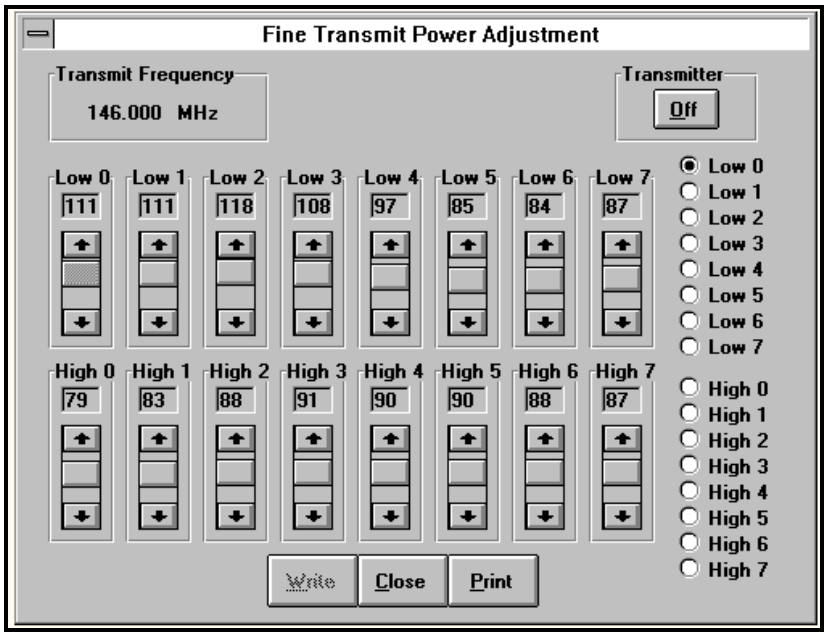

Figure 7.6 – Fine Transmitter Power Calibration

2. For full calibration, start with “Low 0”.
3. Key the transmitter by clicking the Transmitter button; the button will change to display “On” when the transmitter turns on.
4. Measure the RF output power of the transmitter with the CSA.
5. Unkey the transmitter by clicking the Transmitter button; the button will change to display “Off” when the transmitter turns off.
6. Use the up arrow button to increase the RF output power. Use the down arrow button to decrease the RF output power.
7. Perform steps 4 to 7 until the desired RF output power is obtained. If the radio cannot be adjusted for the desired RF output power and the value displayed in the “Low” window is at the maximum or the minimum, refer to the service manual for the radio for repair procedures.
8. After the correct RF output power is attained for the first tuning point, “Low 0”, click on the “Low 1” selector.
9. Perform steps 3 to 7 for each tuning point (“Low 0” through “Low 7).
10. After the Low Power calibration has been completed, click on the “High 0” selector button.
11. Repeat steps 3 to 9 for each of the High Power tuning points (“High 0” through “High 7).
12. Click the Write button to save the new values to the radio.
13. Click the Close button to exit the Fine Transmit Power Calibration.