Confidentiality Requested

PARTS LIST, TUNE-UP PROCEDURE, FREQ-SENSITIVE, & RF POWER CIRCUITS

Schematic Key	Designator Non/Motorola	Device Type	Circuit Application	Source
Y801	TSX-1A	Crystal Osc.	Reference	Toyocom
Q802	21T11	Dual Diodes	Reference	ROHM
Q801	MMBT3904	NPN	Reference	OnSemiconductor
U501	5185165C03	Digital IC	DFP99	Motorola
U401	5185164C01	Analog IC	AFP 99	Motorola
U301	5185163C03	RF IC	RFP99	Motorola
Q203	MRF9482	MOSFET	PA Final Stage	Motorola
U201	T30C30	RF IC	PA Driver & LNA	TEMIC
Q201	MMBD352	Schottky Diodes	LNA	OnSemiconductor
Q202	4805656W70	NPN	LNA	Toshiba
Q604	MUN5111T1	PNP	DC voltage switch	OnSemiconductor
D601	1SV229	Varactor Diode	VCO	Toshiba
D602*	1SV304	Varactor Diode	VCO	Toshiba
Q601	NE68519	NPN	VCO	NEC
Q602	NE68519	NPN	VCO Buffer	NEC
Q622*	NE68519	NPN	VCO	NEC
U101	MASWSS0021	RF Switch	Antenna Switch	MACOM

- These parts are not actually used during this radio's operation.

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 Source, 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 substitutions.

TUNE UP PROCEDURE, FREQUENCY SENSITIVE AND RF POWER CIRCUITS

The following tune-up procedure is for the factory only. There will be no customer tuning.

There are a total of 4 tuning adjustments. All on-board tuning is performed automatically utilizing software commands. An SCI interface bus is provided for programming. D/A's replace typical manually adjusted potentiometers. All tuning information is stored in the micro-controller's internal EEPROM. For more detailed information regarding the SCI bus and software protocols, refer to section 3.2.

All tuning adjustments should be performed with DC voltage applied to the radio's power terminals. It is preferable to use a DC Power Supply with voltage sense lines available and to use the sense connections at the radio supply input. Nominal battery voltage for the Model Series is 3.8 +/- 0.1 V. All RF signals from test equipment should be terminated at 50 ohms. "Standard RF input signal level" is defined as 1 mV into 50 ohms, or -47 dBm. "Standard test modulation" is defined as a 1 kHz tone @ +/- 1.5 kHz deviation for 12.5 kHz channel spaced radios and +/- 3.0 kHz deviation for 25 kHz channel spaced radios

Critical frequency sensitive and RF power circuits along with their operation in the radio are also described below in sections 10.1 - 10.5.

The radio's codeplug information (i.e., tuning squelch, warping the TCXO, etc.) is protected by checksums, which are corrected when the radio is tuned. In the unlikely event of the tuning data being subsequently corrupted then the radio will not transmit and indicate an error to the user. (The only exception to this is the codeplug area which stores the radio's previous user selected settings, If the checksum of this area is not correct, then the radio automatically uses a pre-defined set of codeplug values).

Table 10.0

UHF							
Channel	**Freqs.**	**Channel**	**Freqs.**	**Channel**	**Freqs.**	**Channel**	**Freqs.**
1	464.5000	15	461.1875	29	462.9125	43	466.2625
2	464.5500	16	461.2125	30	464.4875	44	466.2875
3	467.6250	17	461.2375	31	464.5125	45	466.3125
4	467.8125	18	461.2625	32	464.5375	46	466.3375
5	467.8500	19	461.2875	33	464.5625	47	466.3625
6	467.8750	20	461.3125	34	466.0375	48	467.875
7	467.9000	21	461.3375	35	466.0625	49	467.8375
8	467.9250	22	461.3625	36	466.0875	50	467.8625
9	461.0375	23	462.7625	37	466.1125	51	464.8875
10	461.0625	24	462.7875	38	466.1375	52	467.9125
11	461.0875	25	462.8125	39	466.1625	53	469.4875
12	461.1125	26	462.8375	40	466.1875	54	469.5125
13	461.1375	27	462.8625	41	466.2125	55	469.5375
14	461.6250	28	462.8875	42	466.2375	56	469.5625

10.1 VCO Circuit

The VCO for this product is NOT tuned. The VCO operates "as built", but is tested to make certain that the tuning voltages (VCO_CNTL) necessary to cover the required frequency range of all the radio's frequency channels falls within the given 1.0 to 4.0 Volt spec limit. The VCO operates at 2X the radio's carrier frequency range (which is 461.0375MHz to 469.5625MHz in the case of UHF. Therefore, the VCO operates over the frequency range from 922.075MHz to 939.125MHz for UHF).

The VCO RF signal supplies U301 for both Rx and Tx operation, as well as supplying U501 as part of the radio's Phase Locked Loop. The VCO level into each IC is on the order of -5 to -10 dBm. The VCO signal is divided by 2 internal to U301, so it is now operating on the same frequency as the radio's channel frequency (± some small frequency offset of less than 50 Hz). This divided VCO signal serves as the Local Oscillator (LO) for the Rx path Mixer which is internal to U301, and it also provides the initial carrier frequency of the transmitted signal of the radio.

10.2 Transmitter Circuit

The transmitter for this product produces 1 watt of transmitted RF power. The transmitted power is set by way of factory tuning and testing of the radios. The VCO as described in section 5.1 is where the RF signal originates that eventually will be the transmitted signal for 1 watt out of the radio's antenna. This power tuning adjustment is done on designated frequency bands within the radio's frequency range in order to cover the entire list of possible customer channel frequencies. The radio's specification tuning limits are as follows (conducted measurement):

1W Radio (0.9W < Tuned_Tx_Power < 1.25W)

Continuing from where section 5.1 left off, the divided VCO signal feeds a transmit buffer internal to U301 when the radio is in Tx mode of operation. This buffer amplifies the divided VCO signal (ie the carrier frequency of the radio) to about +3dBm. This signal then feeds the main PA circuitry of the radio starting at U201. U201 contains 2 internal PA driver stages. This IC is biased by the radio's battery. There is also a DC tuning line to U201 (PA_Bias) which is sourced from a DAC (Digital-to-Analog Converter) on U301. The adjustment of this PA_Bias line's DC voltage tunes the gain of the RF signal being amplified by U201, and this signal eventually feeds the PA Final Stage device (Q203). PA_Bias can vary from 0 to 2.5 volts. The value of the RF signal present at Q203 Gate input is about +23 dBm. The Final stage PA device Q203 has the radio battery voltage (SW_BATT) as its DC supply is tuned by the PA_FINAL line for transmit power adjustment. The PA_FINAL supplies a DC tuning voltage to Q203's Gate and it is sourced from a DAC internal to U401. This PA_FINAL varies from 0 to ~ 4.3V DC (it is tuned typically < 2.5V for a 1W radio). The value of PA_FINAL is dependent on the required Tx output power of the radio.(1watt)

The factory PA tuning has default values for both PA_Bias and PA_FINAL tuning. To tune power, the PA_FINAL voltage is adjusted first in an attempt to reach the required target power level. The PA_Bias is purposely set to an initial value that should easily allow for only adjusting the PA_FINAL to reach the required Tx power. In case there is too much or too little Tx power output on a radio such that the PA_FINAL line can not be adjusted down or up in order to achieve the required Tx power, then the PA_Bias is adjusted and the procedure repeats itself.

10.3 Reference Oscillator Adjustment

The reference oscillator is a 16.8 MHz Crystal oscillator. The frequency of the VCO is set by the synthesizer divide ratios. Frequency warping is achieved by offsetting the divide ratio of the synthesizer until the transmit carrier frequency is within +/-50Hz of the nominal Radio frequency. This is checked at a specified temperature in the factory against calibrated equipment.

Temperature compensation of the Radio VCO is also achieved in this way and is based on crystal data supplied with the crystal. This data is loaded at system test.

10.4 Modulation Limiting and Balancing Adjustment

Modulation is achieved through a dual port modulation scheme with one port having a low pass response (LOW PORT) and the other port having a high pass response (HIGH PORT). The low port deviation doesn't require tuning. In the factory the high port deviation is tuned in order to get a flat overall response across the audio frequency band of 300-3000 Hz. A 1kHz audio signal is injected into the microphone socket and the high port deviation is adjusted for best optimum balance and to ensure it is below 2.5 kHz for 12.5 kHz channels and below 5kHz for 25kHz channels.

10.5 Squelch Opening SINAD Adjustment (this is a Rx only procedure)

Squelch level control is provided by a 4-bit attenuation stage located on the AFIC, and is fully programmable via the SCI bus.

1. Apply a standard RF input signal to the radio on the frequency selected according to the tables in section 5.1. Use standard test modulation.
2. Adjust the radio's volume control to obtain rated output power at the speaker jack of the external audio accessory connector. This is the larger of the two input jacks (3.5 mm in diameter). Refer to section 3.3.2 for more information regarding the speaker jack and rated output power.
3. Reduce the RF input signal level to 0 mV, and then slowly increase the RF input signal level until the radio unmutes.
4. Measure the SINAD level.
5. Adjust the squelch control until the SINAD level is within the specified limits.

Spec limit:

Minimum 8 dB SINAD

Nominal 10 dB SINAD

Maximum 12 dB SINAD