Ham Tips

from KH6CQ

Number 16

Alignment Procedure for the Motorola Micor UHF RF & IF Board

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The Motorola Micor series base and mobile 2-way radios are some of the most popular used by amateur radio operators. Many of these radios have been converted into the Ham bands where they now serve as FM repeaters, full duplex voice radios, and packet transceivers.

Although most amateur radio operators obtain a copy of the factory instruction manual, many of them find that the specific information they seek is difficult, if not impossible, to find in a timely manner and that, in general, navigating the manual is a daunting task that should be avoided unless absolutely necessary. As a result, many of them compensate by inventing work-arounds for instructions that are hard to find or once found not fully understood. More often than not, this leads to less than optimum performance which then leads to unnecessary modifications and frequent servicing. This seems to be especially true when it comes to understanding and following the instructions for the alignment procedure.

The purpose of this Ham Tip is not to provide a different alignment procedure, but to reformat and present the original information in a way that is more user friendly and useful to the amateur radio operator. I have taken the liberty to include additional content and clarify cryptic instructions while maintaining a conscious effort to retain the integrity and spirit of the original material. The information presented in this Ham Tip was obtained from the factory documentation listed below, discussions with professional 2-way radio technicians, and personal experience.

- SPECTRA TAC Total Area Coverage Voting and Satellite Receivers Instruction Manual 68P81039E45-A
- MICOR Two-Way Mobile Radio Instruction Manual 68P81015E70-H

Tips from the Trenches

If the crystal in a channel element needs to be changed, it is highly recommended that this be done by the crystal manufacturer rather than on the bench. The reason for this is twofold. First, one or more internal components may need to be changed in order for the channel element to operate properly. Second, the temperature compensation adjustment, which is imperative for repeater use and highly recommended for general purpose use, cannot be done on the bench.

If the channel frequency is not being changed by more than 1 MHz, it is usually not necessary to preset the front end tuning screws L111 through L116 prior to alignment.

If the optional preamplifier is available, disconnect and bypass it prior to alignment. After the RF & IF board has been aligned, reconnect the preamp and align it.

Prior to performing an alignment, do these three things:

- ► Verify that 13.8 volts dc and 9.6 volts dc are present on the RF & IF board.
- ► Make sure the RF & IF board is securely seated in a mobile or base station chassis; all mounting screws are tight; and, all shields are in place.
- ► Disable the PL, if present; and, open the squelch.

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MICOR UHF RECEIVER NOMENCLATURE

FREQUENCY RANGE	MODEL NUMBERS			
	RECEIVER	RF & IF BOARD	RF DECK	PREAMP
406 – 420 MHz	TRE1201BA	TLE8031A/B	TLE8021A	TLE8191A
450 – 470 MHz	TRE1203BA	TLE8032A/B	TLE8023A	TLE8192A
470 – 494 MHz	TRE1204BA	TLE8032A/B	TLE8024A	TLE8192A
494 – 512 MHz	TRE1205BA	TLE8033A/B	TLE8025A	TLE8192A

RECEIVER SPECIFICATIONS

CHARACTERISTIC	VALUE
Channel Spacing	25 kHz
Modulation Acceptance	+ / - 7 kHz
Input Impedance	50 ohms
Sensitivity	0.5 uV for 20 dB of quieting (0.25 uV with preamp)
EIA SINAD Sensitivity	0.35 uV (0.175 uV with preamp)
Carrier Squelch Sensitivity	0.25 uV or less at threshold (0.125 uV with preamp)
PL Squelch Sensitivity	0.25 uV or less (0.125 uV with preamp)
DPL Squelch Sensitivity	0.25 uV or less (0.125 uV with preamp)
Intermediate Frequency	11.7 MHz (11.8 MHz for receiver with a shifted IF)
EIA SINAD Selectivity	-90 dB at 25 kHz
EIA SINAD Intermodulation	-85 dB (-80 dB with preamp)
Spurious and Image Rejection	100 dB minimum
Frequency Stability	0.0002% from -30 C to +60 C
Power Supply Requirement	13.8 V dc at 9.6 mA and regulated 9.6 V dc at 100 mA

PREAMPLIFIER SPECIFICATIONS

CHARACTERISTIC	VALUE
Frequency	406 – 450 MHz (TLE8191A) or 450 – 512 MHz (TLE8192A)
Input / Output Impedance	50 ohms
RF Power Gain	10 dB
Squelch Sensitivity	At threshold: 0.125 uV maximum at 6 dB maximum quieting Tight: 0.6 uV at 14 dB minimum quieting
Power Supply Requirement	13.8 V dc at 7.5 mA

METERING

METERING POSITION	MINIMUM READING	DESCRIPTION
1	15 uA	Channel Element
2	15 uA	First Doubler
3	15 uA	Second Doubler
4	0 + / - 2 uA	Discriminator
5	10 uA	IF and Limiter
6		Ground
7		Ground

When using a Portable Test Set, a Station Test Panel, or a SPECTRA TAC Receiver Service Module for metering, switch positions 1 through 5 correspond to metering positions 1 through 5. To measure receiver audio output for the 20 dB quieting test, use switch position 6 on the SPECTRA TAC Receiver Service Module or switch position 11 on either the Portable Test Set or the Station Test Panel. When this test equipment is not available, use a 20 k ohms per volt or higher VOM on the 50 uA full scale range for metering positions 1 through 5.

LOCAL OSCILLATOR CHAIN ALIGNMENT

STEP	ADJUST	METER POSITION	PROCEDURE
1	L101, L102, L103, L104, L105		**Multiplier Coils –** For each coil, turn the core clockwise to the end of its range. Do not use excessive force.
2	L106, L107 L108		**Injection Filter –** Adjust each tuning screw so that the top is about one-eighth of an inch below the receiver shield.
3	L101, L102	1	**Channel Element Output –** Alternately tune L101 and L102 counterclockwise two turns at a time until a peak is obtained.
4	L103, L104	2	**First Doubler –** Tune L103 counterclockwise for a peak. Tune L104 counterclockwise for a dip.
5	L105, L104	3	**Second Doubler –** Tune L105 counterclockwise for a peak. Tune L104 for a peak. Repeak both coils until no further improvement can be obtained.
6	L101	3	Detune L101 until the meter reading falls to 10 uA.
7	L103	3	Tune L103 for a peak but keep the peak below 12 uA by further detuning L101 if necessary.
8	L101, L102	1	Alternately tune L101 and L102 for a peak. Repeat this step until no further improvement can be obtained.
9	L106, L107 L108	3	**Injection Filter –** Tune L106 for a dip. Tune L107 for a peak. Tune L108 for a dip. Do not repeat this step.

DISCRIMINATOR ALIGNMENT*

STEP	ADJUST	METER POSITION	PROCEDURE
1			Insert the injection probe of the RF signal generator into L110 hole on receiver shield. Be careful not to contact the circuit board.
2		5	Set the RF signal generator to 11.7 MHz and adjust the output level so that a full scale meter reading is obtained.
3		4	It should be possible to obtain readings on either side of zero (center) by tuning L109.
4	L109	4	Tune L109 for an exact zero reading. This adjustment is critical.

* Do not attempt to align the discriminator unless the calibration of the RF signal generator is known to be accurate.

FRONT END ALIGNMENT

STEP	ADJUST	METER POSITION	PROCEDURE
1	L111, L112, L113, L114, L115, L116		**RF Preselector and Mixer –** Adjust each tuning screw so that the top is about one-eighth of an inch below the receiver shield.
2			Connect the RF signal generator to the receiver input connector. Set the RF signal generator to the channel frequency and set the output level to 1000 uV.
3	L111, L112, L113, L114, L115, L116	5	Tune L111 through L116 for a peak. If a peak cannot be obtained, adjust L111 through L116 clockwise one turn at a time, while watching for an increase in signal above the noise level. Reduce the output level of the RF signal generator to keep the peak below 50 uA.
4	L110	5	Tune L110 for a peak.
5	L111, L112, L113, L114, L115, L116	5	Tune L111 through L116 for a peak. Reduce the output level of the RF signal generator to keep the peak below 50 uA.
6	L111, L112, L113, L114, L115, L116	5	Turn L111 through L116 in or out as necessary until all screws are level.
7	L111, L112, L113, L114, L115, L116	5	Repeat Step 5.

FRONT END OPTIMIZATION

STEP	ADJUST	METER POSITION	PROCEDURE
1			Connect the RF signal generator to the receiver input connector.
2		5	Set the RF signal generator to the channel frequency and set the output level for a meter reading of about 25 uA.
3		6, 11, or ▼	Increase the volume so that the meter reads half scale.
4	L106, L107, L108	▼	Tune L106, L107, and L108 for best noise quieting (minimum audio output).
5	L111,L112, L113,L114, L115, L116	▼	Tune L111 through L116 for best noise quieting (minimum audio output). Repeat this step until no further improvement can be obtained.

▼ To measure receiver audio output for the 20 dB quieting test, use switch position 6 on the SPECTRA TAC Receiver Service Module or switch position 11 on either the Portable Test Set or the Station Test Panel. When this test equipment is not available, use a VOM and a dummy load. Temporarily replace the speaker with a dummy load (10 ohm 10 watt resistor) and measure the AC voltage across the dummy load with the VOM set for the lowest AC voltage range available.

PREAMPLIFIER ALIGNMENT

STEP	ADJUST	METER POSITION	PROCEDURE
1			Install the optional preamplifier.
2			Connect the RF signal generator to the receiver input connector.
3		5	Set the RF signal generator to the channel frequency and set the output level for a meter reading of about 25 uA.
4	C1, C2	5	Tune C1 and C2 for a peak.
5		6, 11, or ▼	Increase the volume so that the meter reads half scale.
6	C1, C2, L111	6, 11, or ▼	Tune C1, C2, and L111 for best noise quieting (minimum audio output).

▼ See note under Front End Optimization.

CHANNEL ELEMENT NETTING

STEP	ADJUST	METER POSITION	PROCEDURE
1			**Warp Capacitor –** Connect the RF signal generator to the receiver input connector.
2		5	Set the RF signal generator to the channel frequency and set the output level for a meter reading of about 25 uA.
3	Capacitor in the Channel Element	4	Adjust the variable capacitor in the channel element for a zero reading.

Channel Element Information

The UHF RF & IF board can use either a KXN1024A or a KXN1029 channel element. The KXN1024A supports the use of automatic frequency control (AFC), has a crystal tolerance of 5 ppm (0.0005%) and is the channel element most commonly used. The KXN1029 does not support AFC (pin 4 is missing), has a crystal tolerance of 2 ppm (0.0002%) and is known as the optional high accuracy channel element. The crystal formula for a board with a standard IF (11.7 MHz) is:

$$F_{crystal} = (F_{channel} - 11.7) / 24 \text{ MHz}$$

When two RF & IF boards are used in the same cabinet, the IF of the second receiver must be shifted to 11.8 MHz when the difference in channel frequencies between the first receiver and second receiver is a sub-harmonic of 11.7 MHz (5.85 MHz, 3.90 MHz, or 2.925 MHz) plus or minus 25 kHz. The crystal formula for a board with a shifted IF (11.8 MHz) is:

$$F_{crystal} = (F_{channel} - 11.8) / 24 \text{ MHz}$$