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SPECIFICATIONS

RADIO TEST SET

MODELS: R-1033A
  RTL-4118A (R-2001 module)
  RTL-4119A (R-2200 module)

Alignment: Metering facilities for alignment of receiver and transmitter through a single metering cable.

Receiver output: Accurate measurements of audio output for receiver quieting or SINAD measurements. Self contained speaker permits audio monitoring.

Meter: 0-50 microamps ±2% full scale accuracy.

AC Voltmeter: Measures audio input to transmitter and audio output of receiver.
  Two ranges: 0 to 0.2 Vac
  0 to 2.0 Vac

Sinad Input: 0.5V to 12V RMS

Frequency Response: ±1db from 200Hz to 5000Hz

Input Impedance: 100K ohms on 2V range
  10K ohms on .2V range

Power Supply: One 9v alkaline battery (60-82728J01), not included.

Storage Temperature: −40°C to +85°C

Operating Temperature: 0°C to +50°C

Size: 7¾” (H) x 12¾” (W) x 6” (D)

Weight: 8 lbs.
INTRODUCTION
The Radio Test Set provides the metering facilities for alignment of receivers and transmitters in the 25-960MHz frequency range.
The R-1033 model has leather-look molded housing ideal for portable use. This model provides ample storage for metering cables and a test microphone in the top cover.
The RTL-4118 model is the radio test set module that may be used in place of the front cover for the R-2001 series Communications System Analyzer.
The RTL-4119 model is the radio test set module that may be used in place of the front cover for the R-2200 series Communications Service Monitor.

DESCRIPTION
The radio test set measures all standard metering points for Motorola radios with metering capabilities. The test set provides metering capabilities for measuring receiver sensitivity either by the 20db quieting method or by the EIA Sinad method.
The unit provides a multiple Push to Talk (PTT) feature allowing the user to key the radio using a momentary switch with or without a 1000Hz modulation tone. Also included is a standard 4 prong microphone socket and a modular type microphone socket.
The unit has a built-in speaker which allows receiver audio monitoring (bridging mode only).
The unit has an interlock feature which eliminates battery drain when the radio metering cable is disconnected. The unit is powered by one 9V alkaline battery (60-82728J01) which is not included in the model.
The unit has been human engineered to provide maximum service efficiency. All switches are grouped for fast review and setting. Meter scales are color coordinated with switch controls to reduce confusion of which scale to read.
The main metering input connector mates with a spring locked connector which is small, lightweight and easy to connect. The spring locking prevents accidental cable disconnect.
ACCESSORY CABLES
The following are available accessory test cables for servicing different radio products.

RTK-4042A Metering cable for MOTRAC, MOTRAN, MOCOM 70, MITREK radios.
RTK-4044A Metering cable for MAXAR radios.
RPX-4028A Adapter, use with RTK-4044A to test certain higher power MAXAR radios.
RTK-4045A Metering cable for MOSTAR and TRAXAR radios.
RTK-4046A Metering cable for MSF5000 fixed stations.
RTK-4047A Metering cable for MICOR fixed stations.

FUNCTION OF CONTROLS, CONNECTORS, AND METER

Meter
The meter is a 50 microamp full scale movement with seven scales.
1. 0-50 microamp for readings in test positions.
2. (−25)-0-(+25) microamps (zero center) for discriminator alignment.
3. 0-1000Vdc for B+ of tube type final amplifiers.
4. 0-20Vdc for Mic dc and receiver A+.
5. 0-(−20) db for 12db SINAD measurements.
6. 0-.2Vac and 0-2Vac scales for measuring 20db quieting.
7. Battery OK range for checking condition of internal battery.

Transmit 1kHz/Transmit Switch
Momentarily keys radio under test with 1kHz modulation/Momentarily keys radio under test with no modulation.

0.2Vac/2Vac Switch
Selects AC voltmeter sensitivity. Scales are set 20db apart to facilitate making 20db quieting receiver measurements.

Rev/Norm Switch
Selects meter polarity.
Ref A/Ref B Switch
Selects meter reference A or reference B for meter select positions 1 thru 5 while servicing certain radios. Meter select position 6 will show the Ref A to Ref B voltage on the 20Vdc scale (polarity is Ref A positive with switches in Norm and in Ref A). Switch also selects M5 (Ref A) and M7 (Ref B) while in meter select position 7 for those radios which require an M5-M7 switch.

SPKR On/Off Switch
Activates radio test set internal speaker; allows receiver audio monitoring. In “On” position, the test set presents a 65 ohm load to the radio under test. In “Off” position, the test set presents no load to the radio under test.

Sinad/Audio Switch
Selects either receiver Sinad meter (blue scale), or Audio voltmeter (red scale). Refer to application sections on Sinad and 20db quieting.

Receiver/Transmitter Switch
Selects metering mode of test set to meter or control either the receiver or the transmitter of the radio under test.

Meter Select Switch (12 position-continuous rotation)
Positions 1 thru 7, meters radio test points as described in particular radio manual.

B+, measures PA B+ voltage on the 1000Vdc scale.

A+, measures A+ to radio on the 20Vdc scale.

Position 10 (Sinad/Audio), while in receiver mode connects receiver audio output to either the Sinad circuit or to the Audio ac meter as determined by the Sinad/Audio switch. While in transmitter mode, position 10 may be used to measure Mic audio input on the Audio ac meter.

Mic, measures microphone dc on 20Vdc scale.

Int Batt, indicates condition of internal battery.
Microphone Input
Two microphone input sockets are provided for functional voice tests. One is a standard 4 prong microphone socket (Motrac type) and the other is a modular type microphone socket (Mostar type).

Test Cable Connector
All connections to the radio under test are made via the 37 pin “D” connector on the front panel. This connector mates with a spring locked connector on the metering cable, which prevents accidental disconnect. The internal battery is connected by an interlock jumper in each cable kit. If the radio test set is not in use for an extended period of time, it is recommended to remove the cable kit or to set the meter select switch in a position where the battery is disconnected.

NOTE
Battery is connected in meter select positions 4, 10 (Sinad/Audio), and Int. Batt.

ALIGNMENT AND CALIBRATION PROCEDURE

NOTE
Before making any adjustment, check the condition of the internal battery. A metering cable must be connected to the radio test set for this test and for all the following procedures.

Meter 4, Zero Center
Set the Receiver/Transmitter switch to Receiver and the Meter Select switch to meter position 4. Adjust R70 (Meter 4 Zero) for zero center meter indication.

Internal 1000 Hz Oscillator Frequency
Connect a frequency counter to pins 1 and 2 (common) of the four pin microphone connector (Motrac type). Set the Receiver/Transmitter switch to Transmitter. Actuate the Transmit 1 kHz/Transmit switch to Transmit 1 kHz and adjust R45 (Oscillator Frequency) for 1000 Hz.
Audio Meter

Connect an audio oscillator to pins 1 and 2 (common) of the four pin microphone connector (Motrac type). Make the following switch settings:

Receiver/Transmitter to Transmitter
Meter Select to Sinad/Audio
Sinad/Audio to Audio
0.2Vac/2.0Vac to 2.0Vac

Adjust the audio oscillator for an output of 1000 Hz at 1.0 volt RMS. Adjust R55 (Audio meter) for a reading of 1.0 volt. Decrease the output of the audio oscillator to 0.1 volt RMS. Set the 0.2Vac/2.0Vac switch to 0.2Vac, the meter should read 0.1Vac.

Sinad Circuit

The Sinad circuit is factory calibrated and normally it should not require any field adjustment. However, should any adjustments be required, follow the alignment procedure carefully.

Adjustment of the notch filters requires a stable frequency source settable within 0.1 Hz. An audio synthesizer, such as the R-1100A, or an audio oscillator and a frequency counter should be used.

Connect the audio source to pins 1 and 2 (common) of the four pin microphone connector (Motrac type). Make the following switch settings:

Receiver/Transmitter to Receiver Meter
Meter Select to Sinad/Audio
Sinad/Audio to Sinad

Adjust the audio source for an output of 996 Hz ± 0.1 Hz at 2.0 volts RMS. Adjust R17 (Notch 1) for minimum meter reading.

Adjust the audio source for an output of 1002 Hz ± 0.1 Hz at 2.0 volts RMS. Adjust R25 (Notch 2) for minimum meter reading. This completes the filter adjustment.

To complete the Sinad circuit adjustment, a 12db Sinad audio signal is required. One method is to use a “known good” radio and an rf signal generator. Using an audio distortion analyzer, such as a Hewlett-Packard 334A, set up a 12db Sinad condition on the radio.

Connect the radio test set to the radio using the appropriate metering cable. The radio test set switches remain as set above.

Remove the rf input to the radio and adjust the squelch to allow the radio to roar. Adjust the radio noise output for approximately 1 volt RMS at the speaker terminals. Adjust R78 (Noise Set) so that the meter indicates in the center of the solid blue region near full scale. Apply the modulated (1000 Hz) rf signal to the
radio, adjust for a 12db Sinad output. Adjust R29 (Sinad) so that the center of the meter-needle flutter reads 12db on the blue scale. Remove the rf input from radio and readjust R78 (Noise Set) for the center of the solid blue region near full scale.

Repeat these last two steps until the meter reads 12db ± 0.5db with the rf signal applied to the radio and the meter reads in the center of the solid blue region near full scale on noise.
APPLICATION NOTE

1. Receiver sensitivity by 20db quieting method.
To measure 20db quieting, the radio test set switches are in the following positions:

- Receiver/Transmitter to Receiver
- .2Vac/2Vac to 2Vac
- Rev/Norm to Norm
- SPKR on/off as desired
- Sinad/Audio to Audio
- Meter Select to position 10 (Sinad/Audio)

With no rf input to the receiver, unsquelch the radio and note the noise voltage reading on the 2Vac scale; adjust for mid scale or higher. Connect an on channel signal with no modulation to the rf input of the receiver and slowly increase the input signal. As the rf input is increased, the noise output of the receiver will decrease. Switch to the .2Vac position and adjust the rf level to give the same meter deflection as there was with no rf signal present. The level of the rf signal in microvolts is the 20db quieting sensitivity of the receiver.

While making the 20db quieting measurement, it will be noted that the meter “flickers”. This is due to the random nature of noise, and so the reading must be interpreted by the operator.
APPLICATION NOTE

2. Receiver sensitivity by Sinad method.

The Sinad circuit is specifically designed for making Sinad measurements on receivers. Special circuit design speeds and simplifies the Sinad measurement by eliminating all distortion meter adjustments.

The notch filter is internally set to the 1000 Hz tone used in Sinad measurements, and an automatic gain control eliminates the need for setting input gain to the meter.

The automatic gain control feature permits the Sinad circuitry to be used as a receiver alignment tool, providing rapid alignment of receivers for optimum performance.

Sinad is an acronym for the ratio of Signal plus Noise and Distortion to Noise and Distortion. Sinad is similar to a 20db quieting measurement but since modulation is present, Sinad is generally considered to give a better figure of merit for receiver sensitivity. The Sinad measurement simulates the reception of voice and 12db Sinad is considered an acceptable threshold for intelligibility.

To measure Sinad, the radio test set switches are in the following positions:

Receiver/Transmitter to Receiver
Rev/Norm to Norm
SPKR on/off as desired
Sinad/Audio to Sinad
Meter Select to position 10 (Sinad/Audio)

In order to make a Sinad measurement, an rf signal generator with the capability of 1000 ± 5 Hz modulation at 3kHz deviation is necessary. Since the Radio Test Set uses a very sharp notch filter to make the Sinad measurement, it may be necessary to adjust the 1000 Hz modulation frequency. To adjust the signal generator 1000 Hz source, apply enough rf signal to a good receiver to insure full quieting (ex. 1000 microvolts). The meter should read well into the blue range at the left edge of the Sinad scale. If not, adjust the 1000 Hz source frequency for a minimum meter indication.

To perform the Sinad measurement, unscotch the receiver and adjust the volume control for full rated audio; meaningful results may be obtained with the volume set to a comfortable listening level.

With no rf input to receiver, the meter should read in the blue range of the right end of the Sinad scale. Slowly increase the rf input to the receiver. The needle should begin to come off the right end of the scale as the rf level is increased. Adjust the rf level for a reading of 12db. The level of the rf signal in microvolts is the 12db Sinad sensitivity of the receiver.

While making the Sinad measurement, it will be noted that the meter “flickers”, this is due to the random nature of noise, and so the reading must be interpreted by the operator.
## APPLICATION NOTE

### 3. Meter point testing

<table>
<thead>
<tr>
<th>TEST SET SWITCHES</th>
<th>RADIO TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Receiver</strong></td>
<td><strong>RTK4043A</strong></td>
</tr>
<tr>
<td>Transmit</td>
<td><strong>RTK4042A</strong></td>
</tr>
</tbody>
</table>

**As required for transmitter or receiver testing.**

| **Transmit 1kHz** | **PTT (1kHz) or PTT (no mod) as desired.** |
| **Transmit**      | **Use for 20dbQ measurement or for Mic audio input.** |
| **0.2Vac**        | **As required, refer to radio manual.** |
| **2.0Vac**        | **Not functional.** |
| **Rev**           | **Selects M5 or M7 while in meter select pos. 7.** |
| **Norm**          | **Not functional.** |

**Ref A (M5)**

- **Not functional.**
- **As required, refer to radio manual.**

**Ref B (M7)**

- **Selects M5 or M7 while in meter select pos. 7.**
- **Not functional.**
- **As required, refer to radio manual.**

| **SPKR**          | **As desired, for receiver audio monitoring.** |
| **On**            | **Not functional.** |
| **Off**           | **Refer to sections on receiver sensitivity measurements.** |

| **Sinad**         | **As required, refer to radio manual.** |
| **Audio**         | **Not functional.** |

| **Meter Select**  | **Not functional.** |

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SHOWN FROM SOLDER SIDE

SOLDER SIDE: BD-DEPS - 35758-C
COMPONENT SIDE: BD-DEPS - 35759-C
OL-DEPS - 35760-C

Note: R56 is not used on issue "O" circuit boards.
NOTE:
1. Unless otherwise indicated: resistor values are in ohms; capacitor values are in microfarads; and inductor values are in millihenries.
2. Integrated circuits on this board are linear devices.
3. IC types and connections for this board are as follows:

<table>
<thead>
<tr>
<th>Reference Designation</th>
<th>Type</th>
<th>VCC</th>
<th>GND</th>
<th>MFGR'S Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>U1, 3</td>
<td>21K71</td>
<td>8</td>
<td>4</td>
<td>Dual Op Amp</td>
</tr>
<tr>
<td>U2, 5</td>
<td>20A80</td>
<td>4</td>
<td>11</td>
<td>Quad op amp</td>
</tr>
<tr>
<td>U4</td>
<td>20A96</td>
<td>7</td>
<td>4</td>
<td>Op Amp</td>
</tr>
</tbody>
</table>

5. Arrows denote clockwise rotation of potentiometers.

6. Denotes radio common.

Denotes front panel connection.