

SYNTHESIZER-DETECTOR SD-31 & RX-31

SECTION 2 INSTALLATION AND OPERATION

2.1 UNPACKING

The SD-31 is ready to operate, with battery installed, as it comes from the box. Inspect the unit for shipping damage after unpacking. Open the cover and see that the correct cables are included in the cover. If the RX-31 has been supplied, only the AC power cord for charging should be there in addition to the RX-31 cable. If the RX-31 has not been ordered, a special cable for connecting the SD-31 to an FIM-21 or FIM-41 Field Strength Meter (five pin plug at one end, phone plug at other end) should be there in addition to the power cord.

Save the packing box and material, if it is not badly damaged, in case it is ever necessary to return the unit to the factory.

2.2 FRONT PANEL CONTROLS AND INDICATORS, SD-31

OUTPUTS:

VAR Output and Control - Control varies output level at VAR connector up to 100 mV for low-level applications.

LO Z - High-level Output for Z_L less than 180 ohms.

HI Z - High-level Output for Z_L greater than 180 ohms.

Meter and METER Switch: Switch selects functions to be indicated by the meter.

CHARGE: Lamp lights when battery is charging.

117 VAC Connector: For connection of AC power for battery charging.

3/16 A Fuseholder: Contains battery charger fuse.

AM Switch Selects internal(INT) or external(EXT) amplitude modulation of RF output.

EXT MOD Control: Adjusts modulation depth for external modulation.

MOD IN/OUT JACK: External modulation input/internal modulation output, controlled by AM switch.

DET GAIN CONTROL Adjusts gain (sensitivity) of coherent detector.

FREQ. 100.0-1999.5 kHz Switch: Sets the output frequency within the indicated range with each digit independently adjusted.

ΔF Control: Varies the output frequency slightly above and below the nominal value.

POWER ON Switch and Indicator Applies power to the unit, lighting the lamp.

RCVR Connector For connection to the RX-31, FIM-21, or other receiver

2.3 FRONT PANEL CONTROLS AND INDICATORS, RX-31

RF INPUT Connector: For connection of the input to the bridge DETECTOR Terminal.

GAIN CONTROL: Adjusts receiver gain.

FREQ MHz Switch: Selects RF filter frequency range.

TUNING Control: Tunes RF filter.

OVERLOAD Indicator: Lamp lights when the receiver signal level approaches the highest useful value.

AUDIO Output: Phone jack on extension cable provides audio signal proportional to RF input.

SYNTHESIZER-DETECTOR SD-31 & RX-31

SECTION 2 INSTALLATION AND OPERATION

2.4 ADDITIONAL ITEMS REQUIRED

The only additional items required for operation of the SD-31 with an impedance bridge are the two coaxial cables needed to connect the SD-31 output to the bridge GENERATOR terminal and the receiver input to the bridge DETECTOR terminal. The impedance and length of these cables is not critical, but it is recommended that they be double-shielded (such as RG-55/U cable) and that they be no more than 10 feet long. Adapters to General Radio 874 Connectors may be needed at the bridge, GR type 874-QBJA (BNC jack).

2.5 OPERATING INSTRUCTIONS

2.5.1 Charging the Battery

Check battery condition by switching the POWER switch to ON and the METER switch to BATT. A fully charged battery should produce an indication of approximately 7.8 (with no AC power to charger). If the indication is below 7.2, the battery should be recharged at the first opportunity. If the indication drops much below 7.0, the SD-31 will not operate properly.

To recharge, remove the furnished line cord from the SD-31 cover and use it to connect the 117 VAC connector on the SD-31 to a 117 VAC power source. The CHARGE lamp lights whenever AC power is applied, indicating that the charger is functioning. The meter indication should rise steadily to a maximum value of 9.0, indicating that the battery is charging. Eight hours of charging with POWER off is sufficient when the battery reading is at the BATT MIN point (7.0) before charging. Do not charge the battery for more than 18 hours continuously unless the battery has accidentally been discharged to a very low voltage (deep discharge); in such cases refer to Paragraph 4.2.1.

A simple way to judge when charging is nearly complete is to feel the temperature of the left hand edge of the front panel (or the side of the case) between the fuseholder and the bottom edge of the panel. This area should feel warmer than the rest of the case during charging because of heat generated in the charger. When a temperature difference can no longer be felt with the hand, charging is nearly complete.

The POWER switch is normally off while charging except when reading the meter. The battery may be also charged while the SD-31 is operating, although it charges more slowly. Since the AC power connection creates an RF current path to the SD-31 that could cause erroneous impedance measurements, however, check for equal impedance measurements with and without the AC cord connected before proceeding.

If the SD-31 is left unused for long periods of time, recharge the battery at least every 6 months to compensate for normal self-discharge.

If the CHARGE lamp does not light when the power cord is connected, and the BATT reading does not rise, check for (1) the presence of AC voltage at the outlet in use, and (2) the presence of a good fuse in the SD-31 fuseholder.

The SD-31 can operate on the charger only, without the battery, if required.

SYNTHESIZER-DETECTOR SD-31 & RX-31

SECTION 2 INSTALLATION AND OPERATION

2.5.2 Setting Up for Impedance Measurements

Place the SD-31 and receiver, if possible, where the operator of the associated impedance bridge can operate the controls of both units. If this is not possible, a second person can operate the SD-31 controls, with the units so placed that the bridge operator can see the SD-31 meter well enough to detect a null.

Note that the cover of the SD-31, containing the receiver, may be detached from the case at the hinge for convenience in setting up. To do this, squeeze the knurled pins together and raise them into the retaining notches in the hinge.

If an FIM-21 or FIM-41 is used as the receiver in the detection system, it must likewise be within sight and reach of the bridge operator or his helper.

Do not place the receiver close to radiating elements, such as large coils, in the network being measured.

2.5.3 Connections for Impedance Measurements

2.5.3.1.1 SD-31 Output to Bridge Input

Connect the bridge input terminal to the LO Z or HI Z outputs of the SD-31, depending on the driving voltage desired and the bridge input impedance. For input impedances less than 180 ohms, use the LO Z output to obtain the highest driving voltage; for higher impedances the HI Z output produces a higher voltage. If the bridge input impedance is not known and the highest driving voltage is desired, proceed as follows: (1) Set METER switch to OUTPUT, FREQ to desired frequency, and POWER to ON; (2) observe the drop in the OUTPUT reading when the bridge input is connected to the HI Z output. If the voltage drop is more than 40 percent, use the LO Z output; otherwise use the HI Z output.

Of the commonly used bridges in the AM broadcast frequency range, the General Radio 1606 (GEN input) requires the LO Z output, while the GR-916A and the 916AL can use the HI Z output. With the Delta OIB-1, use the LO Z output; a fully coaxial connection to the OIB-I input is desirable to reduce radiation. Note that the GR bridges can be used "reversed", with generator output to the DETECTOR terminal and receiver input to the GENERATOR terminal, for higher signal-to-interference ratio. In this mode, all GR bridges can use the HI Z output.

2.5.3.2 Receiver to Bridge Output

If the RX-31 Receiver is used, connect the bridge output (normally the DETECTOR terminal, or, for "reversed" operation, the GENERATOR terminal) to the receiver RF INPUT. Connect the RX-31 cable (5 pin connector) to the RCVR jack on the SD-31 front panel.

If an FIM-21 or FIM-41 is the receiver, connect the bridge output to the EXT RF INPUT jack on the FIM. Use the special cable supplied with the SD-31 to connect between the RCVR jack of the SD-31 and the RECORDER jack of the FIM.

SYNTHESIZER-DETECTOR SD-31 & RX-31

SECTION 2 INSTALLATION AND OPERATION

2.5.3.3 Headphones to Receiver Audio Output

If the RX-31 is the receiver, remove the extension phone jack from its clip in the SD-31 cover and plug into this jack. The jack may be extended three feet on its cable.

If an FIM-21 or FIM-41 is used, plug headphones into the PHONES jack on the FIM.

Although the instructions in this Section mention only the meter as the null indicator, the audio signal heard using headphones can be a very useful null indicator. When using the RX-31, the audio provides a usable indication even when the meter is strongly overloaded, which the meter cannot do. When using an FIM or other receiver, an audio tone can be obtained by externally modulating the SD-31 in accordance with Paragraph 2.6.

2.5.4 Impedance Measurement Procedure

After making all connections, proceed as follows:

(a) Set SD-31 controls:

METER: NULL FAST
AM: INT
DET GAIN: Centered (pointer up)
 Δ F: Centered (pointer up)
FREQ: Adjust each digit switch to display desired frequency
POWER: ON

(b) Set RX-31 controls:

FREQ MHz: Set to correct range
GAIN: Max. Counter clockwise (CCW)

(c) Set FIM-21 or FIM-41 (if used) controls:

RF INPUT: EXT
FULL SCALE: IV
MHz (FIM-41): to desired band
RCVR: to desired frequency
FUNCTION: FI

(d) If the SD-31 is operating properly, the following indications should be obtained:

METER Switch Position	Meter Indication
OUTPUT	4.0-5.0
LOCK	7.0-9.0 (Approximately equal to BATT indication)
BATT	7.0-9.0
NULL	2.0-3.0
POWER indicator lamp:	On
OVERLOAD lamp (RX-31):	Off

SYNTHESIZER-DETECTOR

SD-31 & RX-31

SECTION 2

INSTALLATION AND OPERATION

- (e) RX-31 - Advance the RX-31 GAIN control clockwise (CW) until the meter indication is near full scale. Then adjust the TUNING control for the highest possible reading, adjusting the GAIN control CCW as required to

keep the indication on scale. Keep OVERLOAD lamp off; when the receiver is much overloaded, an increase in signal may result in a lower meter indication.

FIM-21 or FIM-41 - Turn the FULL SCALE switch CCW until a meter indication is obtained. Then adjust the RCVR tuning control for the highest possible indication, using the FULL SCALE and GAIN controls to keep the indications on scale.

- (f) RX-31 - Null the bridge by adjusting its resistance and reactance controls for the lowest possible meter reading, advancing the receiver GAIN control as required to obtain an up- scale deflection.

NOTE

The meter null indication never goes below approximately 2.0. In the absence of strong interference, the GAIN control may be fully CW when the final null is obtained. If at any time the meter goes off scale or the OVERLOAD lamp glows steadily, turn the GAIN control CCW to bring the meter on scale and turn off the lamp. If a sharper null is desired, advance the SD-31 DET GAIN control CW for more sensitivity.

FIM-21 or FIM-41 - Proceed as in (f) RX-31 except that the FULL SCALE control is turned CCW and the GAIN turned CW to increase sensitivity when approaching null. Do not allow the FIM meter indication to exceed 3.5 during this process.

- (g) If a strong interfering broadcast signal is present, the meter indication will be unsteady and the null less distinct. The signal may be strong enough to cause the RX-31 OVER- LOAD lamp to light. In this case (1) reduce the receiver gain enough that the OVER- LOAD lamp only flickers rather than glows steadily; (2) switch the METER switch to NULL SLOW to reduce the meter fluctuation (bridge controls must then be moved slowly because of the slow meter response); and (3) turn the DET GAIN control max. CW for more sensitivity. A very helpful procedure, if the nature of the measurement allows it, is to avoid measuring exactly on the carrier frequency of an interfering signal. For the RX-31 a 500 Hz shift away from the interference frequency is usually enough to keep the interfering carrier out of the receiver passband. If an FIM is the receiver the problem is more difficult, as a shift of at least 5 kHz is required.

SYNTHESIZER-DETECTOR

SD-31 & RX-31

SECTION 2

INSTALLATION AND OPERATION

2.5.5 Zero-Beating the SD-31 with the Transmitter

The SD-31 output frequency can be adjusted to be exactly equal to another frequency, such as that of the transmitter, within the range of the AF control. To do this, feed signals to the receiver input, using a T-connector, from both the SD-31 and the transmitter (from a short wire antenna) simultaneously. A combination of input levels and gain adjustments can then be found that gives an upscale NULL FAST meter indication, with a beat between the two signals indicated by the movement of the meter pointer. The beat frequency should go through zero as the AF control is adjusted, very close to the AF control mid-position if the transmitter frequency is correct. Two more zero-beats may be observed on either side of the mid-position, caused by the transmitter signal beating with the upper and lower sidebands of the SD-31 internal modulation.

2.6 EXTERNAL MODULATION AND CW OPERATION

To use the SD-31 as a continuous sine wave generator, or to modulate it externally, switch the AM switch to EXT. The internal modulation source is then off, and the only modulation is that applied at the MOD IN/OUT jack. The external modulation circuits are designed for voice modulation with reasonable linearity, and can be driven directly by most microphones. To adjust the external modulation level proceed as follows:

- (a) Connect the RF load to the SD-31 output. Set the frequency to the desired value and make any adjustments required to the load (the modulation level varies with RF loading).
- (b) Set the METER switch to OUTPUT. With no modulation the meter should be near full scale. Connect the modulation source at the MOD IN/OUT jack.
- (c) Adjust the EXT MOD control, with modulation applied, so that the OUTPUT indication drops to approximately half its no-modulation value on modulation peaks. This corresponds to 100 percent modulation. For continuous sine-wave modulation, the modulation percentage is given approximately by the formula $200(1-(E/E_0))$ where E and E_0 are the OUTPUT readings with and without modulation.

2.6 STORAGE

The SD-31 should not be kept at temperatures above normal room temperature any longer than necessary, because of the effect on the battery. High temperature increases the battery's rate of self-discharge, and reduces its calendar lifetime. If the unit is to be stored for a long period of time, a cool location is therefore highly desirable. Recharge the battery at least once every six months.