# WJ-861X RECEIVER

# APPENDIX L

# WJ-861X BITE OPTION



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## WARNING

This equipment utilizes voltages which are potentially dangerous and may be fatal if contacted. Exercise extreme caution when working with the equipment with any protective cover removed.

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# BITE OPTION

## L.1 GENERAL DESCRIPTION

Built-In Test (BITE) Option performs up to 16 operational receiver tests. Two types of BITE are available: BITE and Extended BITE. Both types of BITE can be performed in one of three different modes: AUTO TEST, SINGLE TEST and SINGLE STEP. Both types of BITE are stand alone test routines; however, the BITE routine is duplicated within the Extended BITE routine. BITE performs 13 test routines without making any external connections. Extended BITE performs all of the same tests as BITE, plus three additional tests. Extended BITE is intended to be used during scheduled maintenance or after BITE has been performed and the operator still suspects the receiver may have a problem. Extended BITE requires the BITE cable (W2) to be attached from the BITE Output (J27) to ANT 2. Extended BITE also requires an IF bandwidth between 100 kHz and 500 kHz to be installed. Each BITE test is indicated by a Test Number (00-15), displayed in the COR LEVEL display window. Within each Test Number are Step Numbers, which are displayed in the MEMORY SELECT window. Step Numbers are used for the different steps performed within a test. Runs indicate the number of times each Step Number is repeated. A multiple run is a Step that is performed more than once. When entering BITE for the first time and BITE is running, the front panel COR LEVEL display indicates the present Test Number selected and the MEMORY SELECT window displays a **P** and the last passed Step Number or an **F** and the failed Step Number.

When the BITE operation is in progress, each receiver bandwidth location is sequentially selected during many of the tests. If a bandwidth location is encountered that does not have a bandwidth card present, error code 814 is displayed in the frequency window on the front panel. This error code remains displayed until the BITE routine accesses a bandwidth location that is occupied, at which time, normal BITE operation will resume. If EXTENDED BITE is activated, the receiver MUST contain an IF bandwidth that is between 100 kHz and 500 kHz. If this requirement is not met, successful completion of EXTENDED BITE operation will not be possible.

BITE is designed to check receiver performance quickly without removing the covers. Tests performed in BITE and Extended BITE include:

| | | |
|---|---|---|
| Power Supply | 1st LO Synthesizer | 2nd LO Synthesizer |
| IF BW Position | FM BW Position | FM Discriminator CF |
| FM Quieting | FM Audio Threshold | AM Quieting |
| AM DEMOD | AM Audio Threshold | AM Audio Path |
| COR Status | FM Discriminator Noise | Audio Squelch |
| | RF Front End S/N Ratio | |

## L.2 INSTALLATION

The Type 794151-X Built-In Test (BITE) Option is a field installable option, using the following components and procedure:

| Part No. | Description | Qty. |
|---|---|---|
| 794151-X | Built-In Test Module | 1 |
| 280263-1 | Cable Assembly (BITE W1) | 1 |
| 280264-1 | Cable Assembly (BITE W2) | 1 |
| 280216-1 | BITE Decal (If necessary) | 1 |

The following procedure describes the steps for installing the BITE Option into the WJ-861XB Receiver:

1. Disconnect line power from the receiver and remove the top protective cover.

2. Remove the round metal cover from the rear panel, located at J27. Bend the cover's tabs inward to remove the tab.

3. Insert J1, of BITE cable W1, through the rear panel opening and secure it to the back panel with the supplied hardware.

4. Connect P1, of BITE cable W1, to J1 of the BITE module. Install the BITE module into the Digital Motherboard (A5) in Option Slot 3. Ensure pin 1 of the BITE module is aligned with pin 1 of the motherboard Option Slot.

5. Reinstall the top protective cover and secure it to the receiver. Reconnect line power to the receiver.

6. Install the BITE decal on the front panel above the AM pushbutton, if necessary.

7. Install the BITE cable W2, between J27 and ANT 2, and terminate ANT 1 when in Extended BITE mode.

**NOTE**

BITE requires the use of Microprocessor Type 796353-X with software version 3.1.0 or greater in order to properly support the BITE testing.

## L.3 MODE SELECTION AND OPERATION

Three different BITE modes (Auto Test, Single Test, and Single Step) are available. Auto Test performs the entire series of BITE tests, from 00-12 for BITE and from 00-15 for Extended BITE. **Auto Test** performs the tests sequentially, without operator assistance. **End** is displayed on the front panel when Auto Test is successfully completed. Auto Test provides an overall receiver check to determine serviceability of the receiver. Auto Test allows an operator to perform a go, no go test of the receiver. Once started, Auto Test continues to the end of the BITE test sequence or until a failure is detected. **Single Test** performs only one Test Number at a time. Single Test permits the operator or maintenance personnel to test one single Test Number. The selected Test Number is visible in the COR LEVEL display window. Initiating Single Test for the displayed Test Number allows the runs (multiple runs) to be performed automatically. Single Test can be used to retest a Test Number after alignment or repair, to verify a particular receiver function. **Single Step** mode requires the operator to select the Test Number and Step Number to be performed. Single Step mode requires extensive operator interactions in order to advance through the run of the certain selected Test Numbers. Single Step allows the Analog-to-Digital value to be displayed for each Step Number, where applicable.

Before performing BITE, make sure that the MASTER/SLAVE operation is not enabled.

When the receiver is in the MASTER/SLAVE operation, the BITE function is inhibited. To operate BITE, the receiver must be in the local manual condition with MASTER/SLAVE operation disabled. To set the receiver up to run BITE, perform the following steps:

1. Turn Receiver "ON"
2. Press the "FUNCTION" key (↑F), then the "REM" key to examine the "Slave" state.
3. See if an "S" is present in the upper right-hand corner of the frequency display (indicating Slave mode).
4. The "Master/Slave" key may be used to toggle Slave activity ON or OFF. Toggle "OFF". ("S" will be extinquished from display.)
5. Press "REM" to return to normal receiver operating mode.

**NOTE**

After Pass or Fail, the "Step" key will move to the next test.

BITE is exited by halting the BITE test in progress via pressing any front panel key, with the exception of the REM key, and then pressing the FUNCTION key.

### L.3.1 AUTO TEST

After enabling the BITE option, via pressing the FUNCTION pushbutton, Auto Test is selected via pressing the AM pushbutton. Pressing the AM key causes 00 to be displayed in the COR LEVEL display window. Auto Test starts with Test Number 00 and continues through each Test Number (13 for BITE or 16 for Extended BITE), until all tests and steps are completed. A successful Auto Test is indicated via **End** displayed in the FREQUENCY display. Auto Test performs each Test Number and every Run without interruption, if tests are successful.

**NOTE**

Test Number 0 is performed almost immediately, thus #00 is displayed on the front panel only briefly.

Auto Test stops when a failure is detected during any step or when a halt command is detected. When a failure is detected, an F is displayed as the left character in the MEMORY SELECT window. The right character displays the Step Number that failed. A halt command is initiated by pressing any front panel key (except REM), which will allow completion of the test in progress before halting Auto Test. Pressing the BITE ("AM") key allows the test in progress to be completed before the Auto Test stops. This allows each test to be performed, providing no failures are detected, and display a P in the MEMORY SELECT display after the last run is completed. If a failure is detected during a multiple run test, the test run is halted on the step where the failure is detected. The front panel MEMORY SELECT displays F and the Step Number that failed. Pressing the BITE (AM) key again allows Auto Test to resume at the same run, of the same Test Number. This allows the run to be completed and provides an overall picture of receiver serviceability before failures are rerun to determine the cause of failure.

After successful completion of Auto Test (in local mode), the front panel displays **End** in the FREQUENCY window.

### L.3.2 SINGLE TEST

Single test (Single Test mode) of course requires more time and attention of the operator than the Automatic Test mode. To operate the Single Test mode, use the following steps:

1. Press BITE (upper-case "AM").
2. Halt operation by pressing any key except the "REM" key.
3. Press the "STEP" key.
4. Continue to press "STEP" for each subsequent step.

**NOTE**

After Pass or Fail, the "Step" key will move to the next test.

Single Test allows the operator to perform only one Test Number at a time. This allows operator selection of the test to be performed. Pressing the STEP key causes the receiver to step through one Test Number once. If the displayed Test Number requires multiple runs, all test runs use the frequency or bandwidth data specified for each run number. The COR LEVEL increment and decrement keys are used to select the desired Test. Pressing either the increment or decrement key changes the displayed Test Number. The displayed Step Number is also changed when the Test Number is changed. The Step Number displayed in the MEMORY SELECT is changed to **-0**. If the MEMORY SELECT displays a **P -** , pressing the STEP key causes the next higher run to be performed. The P- in the MEMORY SELECT indicates the displayed Test Number has been completed successfully without any failures. Pressing the STEP key starts the Single Test at the next higher step. To repeat the displayed Test Number again, press the COR LEVEL increment key and then press the decrement key to display the desired Test Number. Halting a Single Test is accomplished via pressing any front panel key, except REM. Pressing a front panel key halts the BITE program. Pressing the STEP key resumes the Step Number at the next higher step. Likewise, if a failure is detected for a Test Number having more than one Run, pressing the STEP key resumes the testing but at the next higher Run. However, if a failure is detected on the last Run, pressing the STEP key causes a Single Test to be performed on the next higher Test Number.

With Single Test mode halted, pressing the MEMORY SELECT decrement key resets the displayed **F** or **P** to a **-** , allowing the Single Test to be started over again.

### L.3.3 SINGLE STEP

Single Step mode permits the operator to advance manually through the individual steps for the selected Test Number. With BITE enabled and halted, Single Step is selected via pressing the MEMORY SELECT decrement key. Pressing the decrement key causes **-0** to be displayed in the MEMORY SELECT window. Pressing the increment key allows each step to be performed one at a time. Each time the MEMORY SELECT increment key is pressed, the next Step Number of the selected Test Number is performed. This step-by-step procedure allows the operator to determine the status and Analog-to-Digital value (if displayed) for each step. Thus, if a Step Number fails, the operator can walk the receiver through each step to determine which step fails.

Single Step can be used by a technician to determine which module caused a particular failure. As an aid to the technician, applicable Analog-to-Digital data is displayed in the SIGNAL STRENGTH window. If the A/D value has a limit, an **F** or a **P** is displayed in the MEMORY SELECT display to indicate a fail or pass. The A/D value gives an indication of whether the step failed totally or just slightly. This information can be used to indicate whether alignment or repair is necessary.

When the left MEMORY SELECT digit is blanked, the BITE program is in progress. The result of the Step Number (**F** or **P**) is displayed after the test is completed.

During Single Step mode, only the MEMORY SELECT increment and decrement keys can be used to step through the selected Test Number. To return the Single Step mode back to the beginning of the selected Test Number, press the MEMORY SELECT decrement key and then press the increment key. The Single Step is at the beginning of the Test Number again.

### L.3.4 BITE PARAMETER SETTINGS

BITE operation sets the receiver operating parameters as listed in **Table L-1**, for BITE. The standard operating parameters (SOP) are used to establish certain receiver functions for the purpose of the BITE program.

Operating parameters not listed in **Table L-1**, such as tuned frequency, IF bandwidth, gain settings and other parameters are listed in the first step of each Test Number.

**Table L-1. Standard Operating Parameters**

| Function | Setting |
|---|---|
| DET MODE | AM |
| AGC | ON |
| AFC | OFF |
| ANT 2 | ON |
| COR LEVEL | 00 |

During BITE, current operating parameters are retained, in memory, for the Test Number and Step Number being performed, until the next Step Number is started.

## L.4 BITE OPERATION

**NOTE**

Before performing BITE, verify that the receiver MASTER/SLAVE operation is not enabled.

BITE is selected via pressing the FUNCTION key and pressing the BITE (uppercase AM) key. Test Numbers for BITE are from 00-12. Refer to **Table L-2** for the BITE Test Number and the function tested.

**Figure L-1** provides an overall receiver block diagram and the Test Number(s) that passes through each module. Modules with more than one Test Number listed may result in more than one failure indication. Using combinations of Test Numbers, troubleshooting can quickly be localized to one section of the receiver.

**Table L-2. BITE Tests**

| Test # | Function Tested |
|---|---|
| Test #0 | Positive and Negative 15 Volt Power Supply |
| Test #1 | 1st LO Synthesizer Lock Test |
| Test #2 | 2nd LO Synthesizer Lock Test |
| Test #3 | IF Bandwidth Verification Test |
| Test #4 | FM Demodulator Verification Test |
| Test #5 | FM Discriminator Center Frequency Test |
| Test #6 | FM Quieting Test at FM MONITOR Output |
| Test #7 | FM Audio Threshold Test at BITE Card |
| Test #8 | AM Quieting Test at AM DETECTOR Output |
| Test #9 | AM Audio Threshold Test at BITE Card |
| Test #10 | AM DEMODULATOR Test Using BFO and CW Carrier |
| Test #11 | AM Audio Signal Path Test at BITE Card |
| Test #12 | Audio Squelch Test |

## L.5 EXTENDED BITE OPERATION

Extended BITE is selected via holding the FUNCTION key pressed in while turning receiver power on, pressing the FUNCTION key again and then pressing the BITE key. Extended BITE selects BITE Tests 00-12 and three additional tests, 13-15, unique to Extended BITE. **Table L-3** lists all of the Extended BITE tests.

**Table L-3. Extended BITE Tests**

| Test # | Function Tested |
|---|---|
| Test #0 | Positive and Negative 15 Volt Power Supply |
| Test #1 | 1st LO Synthesizer Lock Test |
| Test #2 | 2nd LO Synthesizer Lock Test |
| Test #3 | IF Bandwidth Verification Test |
| Test #4 | FM Demodulator Verification Test |
| Test #5 | FM Discriminator Center Frequency Test |
| Test #6 | FM Quieting Test at FM MONITOR Output |
| Test #7 | FM Audio Threshold at BITE Card |
| Test #8 | AM Quieting Test at AM DETECTOR Output |
| Test #9 | AM Audio Threshold Test at BITE Card |
| Test #10 | AM DEMODULATOR Test Using BFO and CW Carrier |
| Test #11 | AM Audio Signal Path Test at BITE Card |
| Test #12 | Audio Squelch Test |
| Test #13 | COR Status Test |
| Test #14 | FM Discriminator Noise Test |
| Test #15 | RF Front End Signal-to-Noise Ratio Test |

## L.6 BITE TEST DESCRIPTIONS

The following paragraphs describe an overview of each BITE test. The software sequence performed for each Test Number and for each Step Number is also listed. The Step Numbers are listed to help describe the mechanics of the test being performed. The parameter settings are performed via software and are included to provide information on what the test settings are for each step and how the tests are performed.

### L.6.1 TEST #0 POWER SUPPLY TEST

Test #0 checks the positive and negative 15 V power supplies at the BITE module. This test verifies the absolute magnitude of each supply voltage is greater than 14 Vdc.

Step #0 Sets the receiver to the parameters listed in **Table L-1.** Selects IF BW #1 and tunes the receiver to 20 MHz. Reads pin 7 (D5 line) on the BITE module.

A) If the line is HIGH, continues to next step; displays a **P** if in Single Step Mode.

B) If the line is LOW, then halts and displays an **F.**

Step #1 Reads pin 3 (D3 line) on the BITE module.

A) If the line is HIGH, continues to next test number; displays a **P** if in Single Test or Single Step mode.

B) If the line is LOW, then halts and displays an **F.**

### L.6.2 TEST #1 1st LO SYNTHESIZER LOCK TEST

Test #1 checks for proper lock-up of the 1st LO Synthesizer. This test exercises the 1st LO over its entire design range (552-1052 MHz) in 1 MHz steps resulting in 501 runs. A different Run is assigned to each frequency. This test verifies that the synthesizer has achieved phase lock and that the lock time was less than 20 mS.

Step #0 Sets receiver to the standard operating parameters listed in **Table L-1.** Selects IF bandwidth #1 and tunes receiver to XXX.0000 MHz. Waits 20 mS before reading pin 13 (D0 line) of the BITE module.

A) If D0 line is HIGH, continues to next Run. Displays a **P** if in Single Step mode.

B) If D0 line is LOW, then halts and displays an **F.**

### L.6.3 TEST #2 2nd LO SYNTHESIZER TEST

This test checks for proper lock-up of the two phase-lock loops used in the 2nd LO Synthesizer. Test #2 exercises the 2nd LO over its tuning range (529.6001-530.6000 MHz). This test is repeated, tuning from 500.9999 MHz down to 500.0099 MHz in 10 kHz increments. The lock-up is repeated using 100 Hz steps to tune from 500.0099 MHz down to 500.0000 MHz. These multiple-run tests verify that both synthesizers are phase-locked and that the phase lock occurs within 20 mS of receiving a frequency change command.

Step #0 Sets the receiver to the standard operating parameters listed in **Table L-1.** Selects IF bandwidth #1 and tunes the receiver to 500.XXXX MHz. Waits 20 mS after tuning the receiver and then reads pin 15 (D1 line) of the BITE module.

A) If D1 line is HIGH, continues to the next Run, thus selecting and testing the next frequency.

B) Displays a **P** if in Single Step mode. If D1 line is LOW, halts and displays an **F.**

### L.6.4 TEST #3 IF BANDWIDTH VERIFICATION TEST

This test checks the passband and stopband characteristics of the IF filter for the selected IF bandwidth (#1). Test #3 tunes the receiver to several frequencies near 0 MHz to produce a test signal, from the down-converted 1st LO, to measure the filter transmission characteristics. The signal strength circuitry is used to provide level detection for the test. This multiple-run test has one run for each bandwidth and is repeated for each bandwidth.

Step #0 Sets the receiver to the standard operating parameters listed in **Table L-1,** with the exception of selecting Manual Gain (not AGC). Sets the manual gain control to 000, selects IF bandwidth #1 and tunes the receiver to 35 MHz. Waits 2 seconds before reading the value of the Signal Strength line on the Receiver Interface (IN2 of U15). Divides this A/D value by 2 and stores this value in memory.

A) If the A/D value is less than or equal to 30, then continues to the next step. Displays a **P** and the A/D value, if in the Single Step mode.

B) If the A/D value is greater than 30, it halts and displays an **F.** Displays the value if in Single Step mode.

Step #1 Tunes the receiver to 00.0000 MHz and reads the A/D value of the Signal Strength line (IN2 of U15) and divides this A/D value by 2.

A) If the A/D value is greater than or equal to 120, leaves the manual gain control set at 000 and continues to the next Step Number. (Displays a **P** and the value, if in the Single Step mode.)

B) If the A/D value is less than 120, increases the manual gain control until the A/D value is 121 (±1), and continues to next Step Number. (Displays a **P** and the value, if in the Single Step mode.)

C) If the A/D value is less than 120, it halts and displays an **F**. Displays the maximum value obtained, (if in the Single Step mode).

Step #2 Tunes the receiver to a frequency equal to 1/3 of the displayed IF bandwidth (for the selected IF bandwidth number). Reads the signal strength line value (IN2 of U15) and divides this A/D value by 2.

A) If the A/D value is greater than or equal to 60, it continues to the next Step Number. Displays a **P** and the value, (if in the Single Step mode).

B) If the A/D value is less than 60, then halts and displays an F and the A/D value, (if in Single Step mode).

Step #3 Tunes the receiver to a frequency equal to 3/4 of the IF bandwidth (displayed).

A) If the A/D value is less than or equal to the value noted for step #0 plus 5, then continues to next Run Number by selecting the next IF bandwidth number for testing. (Displays a **P** and this value, if in the Single Step mode.)

B) If the A/D value is greater than the value noted in Step #0, it halts and displays an **F**. (Displays the value, if in Single Step mode.)

## L.6.5 TEST #4 FM DEMODULATOR VERIFICATION TEST

This test verifies proper matching of the FM Demodulator module with the selected IF bandwidth module. This is accomplished via measuring the FM discriminator sensitivity and verifying that the sensitivity corresponds to the required sensitivity for the displayed IF bandwidth. The receiver frequency is tuned to a fractional IF bandwidth above 0 MHz. This tuned frequency is used to down convert the 1st LO for use as a calibrated offset signal. This test is a multiple run test repeated for each IF bandwidth.

Step #0 Sets receiver to standard operating parameters listed in **Table L-1**, with the exception of FM detection (not AM), and tunes the receiver to 00.0000 MHz. Selects the first IF bandwidth and tests the dc component value for the FM DET line on the Receiver Interface module (IN2 of U15). Divides this A/D value by 2 and stores this value for later use. Continues to next step. If in Single Step mode, displays the A/D value.

Step #1 Tunes the receiver to 1/5 of the selected IF bandwidth. Reads the dc component value on the FM DET line (IN4 of U15), divides this A/D value by 2, and stores this value. Continue to next step.

Step #2 Subtracts the A/D value noted in Step 0 from the value obtained in Step 1.

A) If the difference is 11 (±4), continues to next Step Number. Displays a **P** and this difference value, if in the Single Step mode.

B) If the difference is not within the value of 11 (±4), halts and displays an **F**. Displays the difference value if in the Single Step mode.

Step #3 Tunes the receiver to 2/5 of the selected IF bandwidth for the selected IF bandwidth. Reads the value of the dc component on the FM DET line (IN4 of U15), and notes this value. If in Single Step mode, displays the A/D value.

Step #4 Subtracts the A/D value noted in step 1 from the value noted in step 3.

A) If this difference is 11 (±4), continues to next Run Number, and selects and tests the next IF bandwidth. If in the Single Step mode, displays a **P** and the difference value.

B) If the difference value is not within 11 (±4), halts and displays an **F**. If in the Single Step mode, displays the difference value.

## L.6.6 TEST #5 FM DISCRIMINATOR CENTER FREQUENCY TEST

This test checks the center tuning of the FM discriminator circuit on the FM Demodulator module. Tuning the receiver to 0 MHz causes the 1st LO to be down converted to 21.4 MHz, for use as a calibrated signal to measure the discriminator offset. This is a multiple-run test and is to be repeated for each IF bandwidth.

Step #0 Sets the receiver to the standard operating parameters listed in **Table L-1**, with the exception of selecting FM detection mode (instead of AM). Tunes the receiver to 00.0000 MHz, selects IF bandwidth #1, and reads the dc component value at the FM DET line (IN4 and U15) on the Receiver Interface module.

A) If the A/D value is 66 (±10), then continues to the next Run Number (selecting and testing the next IF bandwidth). (If in the Single Step mode, displays a **P** and the 2 A/D value.)

B) If the A/D value is not 66 (±10), halts and displays an **F**, also displays the divided A/D value, (if in the Single Step mode).

## L.6.7 TEST #6 FM QUIETING TEST

This test verifies that the ultimate noise quieting in the FM demodulator circuitry is correct. The receiver is tuned to 0 MHz and the down-converted 1st LO is used as a high level unmodulated test signal. This test measures the peak value of the ac component on the demodulated signal coming from the FM detector output. If this ac component exceeds the established limit, the FM demodulator circuitry may be defective or the incidental FM of the LOs may be excessive. This is a multiple run test that is repeated for each IF bandwidth.

Step #0 Sets the receiver to the standard operating parameters listed in **Table L-1**, except selects FM detection mode. Tunes the receiver to 00.0000 MHz and selects IF bandwidth #1. Reads the value of the ac component on the FM DET line (IN7 of U15) and divides this A/D value by 2.

A) If the A/D value is less than or equal to 2, it continues to the next run (selects and tests the next IF bandwidth). (If in the Single Step mode, displays a **P** and the A/D value.)

B) If the value is greater than 2, halts and displays an **F**. (If in Single Step mode, displays the A/D value.)

## L.6.8 TEST #7 FM AUDIO THRESHOLD TEST

This test uses the same procedure as the FM quieting to check for the absence of signal activity on the AUDIO OUTPUT line on the BITE module. This is a multiple-run test and is repeated for each IF bandwidth.

Step #0 Sets the receiver to the standard operating parameters listed in **Table L-1**, with the exception of selecting FM detection mode. Tunes the receiver to 00.0000 MHz and reads pin 9 (the D6 line) on the BITE module.

A) If the line is LOW, then continues to next Run Number (selecting and testing the next IF bandwidth #). (Displays a **P** if in the Single Step mode.)

B) If the line is HIGH, halts and displays an **F**.

## L.6.9 TEST #8 AM QUIETING TEST

This test checks for ultimate AM quieting in the AM detector circuitry. The receiver is tuned to zero frequency and uses the down-converted 1st LO as a high level unmodulated test signal. The test measures the peak value of the ac component of the AM DET circuitry. If this ac component exceeds a certain limit the AM demodulator circuitry may be defective, or the LOs may have excessive amplitude noise, or the IF circuitry may be excessively noisy. The test is run for each available IF BW and therefore is a multiple-run test.

Step #0 Sets the receiver to the standard operating parameters listed in **Table L-1**, tunes the receiver to 00.0000 MHz, and selects IF BW#1. Reads the ac component value on AM DET line at the Receiver Interface module (IN3 of U15) and divides this A/D value by 2.

A) If the A/D value is less than 2, then continues to next Run Number (selecting and testing the next IF BW). (Displays a **P** and the A/D value if in Single Step mode.)

B) If the value is greater than 2, halts and displays an **F**. (Displays the A/D value, if in the Single Step Mode.)

## L.6.10 TEST #9 AM AUDIO THRESHOLD TEST

This test uses the same setup as the previous AM quieting test, but tests for an absence of signal on the AUDIO OUTPUT line at the BITE module. The test verifies that with an unmodulated carrier for the test signal, the peak value of the demodulated AM audio does not exceed a preset threshold on the BITE module. This is a multiple-run type test which is repeated for each available IF BW.

Step #0 Sets receiver to the standard operating parameters listed in **Table L-1** and tunes the receiver to 00.0000 MHz, then reads the D6 line (pin 9) on the BITE module.

A) If the line is LOW, it continues to the next run, selecting and testing the next IF BW. (Displays a **P** and the A/D value if in the Single Step mode.)

B) If this line is HIGH, halts and displays an **F.**

### L.6.11 TEST #10 AM DEMODULATOR TEST

This test checks for proper operation of the AM detector (plus BFO) circuitry by tuning the receiver to 00.0010 MHz, and turning on the BFO. (If the radio has VBFO option installed it must remain set to zero offset frequency.) The BFO mixes with the down-converted 1st LO at the AM DEMOD circuitry, resulting in a waveform exhibiting an amplitude-modulated envelope. This waveform is detected and output as a 1 kHz video signal. This test measures the peak value of the detected waveform on the Receiver Interface module and should be approximately equal to a 50% modulated signal, at or above the rated sensitivity level, when in AGC.

Step #0 Sets receiver to the standard operating parameters listed in **Table L-1**, except BFO is turned on (i.e., selects CW). Tunes the receiver to 00.0010 MHz and selects IF BW#1. Reads the ac value at the AM DET line on the Receiver Interface module (IN3 of U15). Divides this A/D value by 2.

A) If the A/D value is 35 (±25), test continues to next run, selecting and testing the next IF BW. (Displays a **P** and the divided A/D value, if in Single Step mode.)

B) If value is not within limit, halts the test and displays an **F.** (If in the Single Step mode, displays the A/D value.)

### L.6.12 TEST #11 AM AUDIO SIGNAL PATH TEST

This test uses the same set up as the preceding AM DEMOD test, except that it checks for the presence of a signal on the AUDIO OUTPUT line at the BITE card. The test verifies that at the peak value the demodulated AM audio exceeds a preset threshold on the BITE card. The test checks continuity of the AM video signal path starting at the AM detector, through the AM video filter on the FM demodulator module, and then through circuitry on the AUDIO, VIDEO/COR module. The test is a multiple-run type, which is repeated for each available IF BW.

Step #0 Sets the receiver to the standard operating parameters listed in **Table L-1**, except BFO is turned on. Tunes the receiver to 00.0010 MHz, and selects IF BW #1. Reads line D6 (pin 9) on the BITE module.

A) If the line is HIGH, continues to next Run Number. (Displays a **P**, if in the Single Step Mode.)

B) If the line is LOW, halts and displays an **F**.

### L.6.13 TEST #12 AUDIO SQUELCH TEST

This test checks for proper operation of the AUDIO SQUELCH circuit by ensuring the audio threshold operates properly at 40 and - -. With the COR LEVEL set to 40 and - - respectively, the audio threshold is checked at the BITE card.

Step #0 Sets receiver to CW, sets COR LEVEL to 40, and tunes receiver to 00.0010 MHz. Then reads D6 line (pin 9) on BITE card.

A) If the line is HIGH, then continues to next Step Number. (Displays a **P** if in Single Step Mode.)

B) If the line is LOW, then halts and displays an **F**.

Step #1 Sets COR LEVEL to --; then reads D6 line (Pin 9) on BITE Card.

A) If line is LOW, then continues to next run, selecting and testing next IF BW. (Displays a **P**, if in the Single Step Mode.)

B) If the line is HIGH, then halts and displays an **F**.

### L.6.14 TEST #13 COR STATUS TEST

This test checks for proper operation of the COR circuit with and without input signals. With no input signal present (i.e., with comb generator turned off), the COR LEVEL is set to 15 and the COR status must indicate no activity. With an input signal from the LOs, the COR LEVEL is set for 40 and the COR status must indicate activity. This is a multiple-run type test and is repeated for each available IF BW.

Step #0 Sets the receiver to the standard operating parameters listed in **Table L-1**, except sets COR LEVEL to 15, tunes the receiver to 25.0000 MHz, and then reads the COR Status.

A) If COR is not active, then continues to next Step Number. (Displays a **P** if in Single Step Mode.)

B) If COR is active, then halts and displays an **F**.

Step #1 Sets COR LEVEL to 40, tunes the receiver frequency to 00.0010 MHz, and reads the COR Status.

A) If COR is active, then it continues to next Run Number, and selects and tests the next IF BW. (Displays a **P**, if in Single Step Mode.)

B) If COR is not active, it halts and displays an **F**.

## L.6.15 TEST #14 FM DISCRIMINATOR NOISE TEST

This test checks the level of discriminator noise at the output of each FM demodulator module when no input signal is present. This test measures the peak ac component on the FM DET line at the Receiver Interface module. This test requires that no undesired input signals be present; therefore, this test is included in the Extended BITE series tests, requiring the unused antenna input (ANT 1) to be terminated with a 50 ohm load to ensure reliable results. The pass-fail limits for this test are IF bandwidth dependent. This multiple-run test is repeated for each available IF BW#.

Step #0 Sets the receiver to the standard operating parameters listed in **Table L-1**, except selects FM instead of AM, tunes the receiver to 25.0000 MHz and selects ANT 1. Reads the ac value component of FM DET line on the Receiver Interface module (IN7 of U15) and then divides the A/D value by 2.

A) If the A/D value is greater than or equal to the test limit value listed for the selected bandwidth ranges, it continues to next run, and selects and tests the next IF BW. (Displays a **P** and the value, if in Single Step Mode.)

B) If this value is less than the test limit, it halts and displays an **F**. (Displays the A/D value, if in the Single Step Mode.)

| IF Bandwidth Range | Test Limits |
|---|---|
| 3-30 kHz | 8 |
| 40-100 kHz | 18 |
| 200-500 kHz | 8 |
| 1-2 MHz | 1 |
| 4-8 MHz | 0 |

## L.6.16 TEST #15 RF FRONT END SIGNAL-TO-NOISE RATIO TEST

This test checks the RF front end of the receiver for proper operation at three frequencies within each RF preselector band. These frequencies are located at approximately the upper edge, lower edge, and middle of each band. The test compares the LOG IF voltage on the Receiver Interface module, with no signal present, to the voltage with the comb generator turned on at each test frequency. This is a multiple-run type test which is repeated for each required test frequency.

Step #0 Sets the receiver to the standard operating parameters listed in **Table L-1**, except selects Manual Gain Control (MGC). Sets MGC to 255, selects narrowest available IF BW between 100 kHz and 500 kHz, tunes receiver frequency to XXX (see **Table L-4** for required test frequencies), then reads value of LOG IF line on the Receiver Interface module (IN5 pin 3 of U15). Divides this A/D value by 2 and stores it in memory temporarily.

A) If the A/D value is less than or equal to 10, then continues to next Step Number. (Displays a **P** and the A/D value, if in the Single Step Mode.)

B) If the A/D value is greater than 10, then halts and displays an **F**. (Displays the A/D value, if in the Single Step Mode.)

Step #1 Turns on comb generator (no modulation), and again reads LOG IF value. Divides this A/D value by 2 and stores it in memory. Displays divided A/D value, if in the Single Step Mode. Subtracts A/D value obtained in Step # 0 from that obtained in Step # 1.

A) If the difference is greater than 11, then continues to next run, selects next frequency and retests. (Displays a **P** and the divided A/D result, if in the Single Step Mode.)

B) If the difference is less than 11, then halts and displays an **F**. (Displays the divided A/D value if in Single Step Mode.)

**Table L-4. Test Frequencies**

| | | | |
|---|---|---|---|
| 5.0000* | 20.0000 | 120.0000 | 505.0000** |
| 10.0000* | 25.0000 | 150.0000 | 550.0000** |
| 15.0000* | 29.9999 | 185.0000 | 595.0000** |
| | 30.0000 | 190.0000 | 600.0000** |
| | 40.0000 | 240.0000 | 650.0000** |
| | 45.0000 | 290.0000 | 695.0000** |
| | 50.0000 | 330.0000 | 700.0000** |
| | 65.0000 | 380.0000 | 800.0000** |
| | 74.9999 | 385.0000 | 895.0000** |
| | 75.0000 | 440.0000 | 1000.0000** |
| | 100.0000 | 500.0000 | 1100.0000** |
| | 119.9999 | | |

* Only When HFE or LFE Option is Installed

** Only When FE Option is Installed

## L.7 REMOTE OPERATION

Remote operation of the functions of BITE is provided via the Remote Interface connector on the rear panel of the receiver. With the use of a suitable controller, the mnemonics given in **Table L-5** will provide control of the BITE operation. Extended BITE operation is not permitted in remote operation. Refer to **Table L-5** for the BITE mnemonics and descriptions.

**Table L-5. Command Mnemonics and Descriptions for BITE Operation**

| ASCII MNEMONIC | BINARY HEX | DESCRIPTION | RESPONSE |
|---|---|---|---|
| RMT | 81 | Places the receiver in Remote mode of operation. | |
| BIT | A5 | Enables BITE mode, starting BITE, or resuming BITE if in BITE manual mode. | |
| BIT? | A7 | Request current Test number. | BITE Test Number returned. 000 indicates BITE is completed. Any other BITE test number indicates the test number is in progress. Clears Bit 2 of the Status Byte set by the failed test. In binary returns A5xx where xx is Test Number. |
| MOD? | B3 | Queries operating mode. | Returns BIT if enabled and no detected faults. (HEX returns A5.) Returns BIM, if failure detected or if BITE is halted (HEX A6). |
| MAN | 75 | Stops BITE operation. Sending MAN again exits BITE. | |
| CLR | 51 | Exits BITE after last Test Number is completed. | |
| BIC? | AA | Request last A/D value. | Returns last A/D, if applicable. (HEX A8 xx, where xx is last A/D reading. |

Utilizing the preceding remote mnemonics, BITE operation can be controlled and queried to determine the BITE status. While in BITE, the controller is able to interact with the receiver. If a failure is detected during BITE or if BITE is successfully completed, the receiver sets bit two and bit six of the Status Byte. The operator can have the controller perform a serial poll to determine the problem. A set Bit two indicates failure of the BITE test. The Serial poll clears the SRQ. Sending BIT? clears status bit two and the controller is informed of the failed Test Number or bit 000 if BITE has completed its tests. During remote operation, BITE does not cause END to be displayed at the completion of the BITE program.

Pressing any front panel key, except REM, will have no effect during BITE operation.

**NOTE**

When Master/Slave receiver operation is enabled, BITE cannot be enabled.

## L.8 CIRCUIT DESCRIPTION

The option designation for this subassembly is BITE. It installs in Option Slot 3. Refer to **Figure L-3** for the schematic diagram of the Type 794151-1 Built-in Test (BITE) subasssembly.

Power is applied to this subassembly via the circuit board connector. Connector pins 44 and 42 apply -15 Vdc and +15 Vdc respectively to a voltage divider and to a comparator. From this comparator, the voltage levels are applied to another voltage divider. Pins 19 and 20 provide +5 Vdc for the components within this subassembly. Connector pins 11, 9, 7, 5, 3, 17, 15 and 13 are the data bus lines. The address bus lines consist of pins 50 through 60, 43 and 48. Read/Write line (pin 14) is applied to a flip-flop network which is enabled by the OPT* line, connector pin 41. In the read mode, this subassembly reads information from the data bus via the data register U13 and comparator circuit. The write mode enables information to be written onto the data bus via data register U13. The DBE line, connector pin 16 enables the data bus.

Pins 44 and 42, -15 Vdc and +15 Vdc are applied to a voltage divider and to a comparator. These are the first tests of this subassembly. The voltage comparator, U14, must have +2.4 Vdc (pin 6), +2.7 Vdc (pin 11) and +2.5 Vdc (pins 4, 7, 8 and 10) present at these pins to operate properly. Synthesizer tests include the Lock lines, LOCK 1, connector pin 10 and LOCK 2, connector pin 6. These lock lines are applied through networks utilizing D flip-flops and op-amps for monitoring the condition of the Lock lines. Lock line 1 is from the 1st LO Synthesizer, which is responsible for the 1 MHz tuning resolution. Lock line 2 is from the 2nd LO Synthesizer, which is responsible for the 100 Hz tuning resolution. Pin 4 is related to the Audio portion of the BITE test sequence. This signal is applied to an amplifier and to a detector. It is then compared before being applied to the data bus. A 5 MHz internal crystal oscillator is utilized to produce signals in the form of a comb of frequencies to drive the receiver from approximately 5 MHz to 1100 MHz. The output of this oscillator circuit is applied through two NAND gates and an amplifier to a step recovery diode. This diode creates a large comb of RF energy, which is applied to the voltage variable attenuator. Attenuation from 2 dB to 25 dB is obtainable, forming a modulation envelope which is applied to connector J1 and is utilized to apply these signals through the receiver to test receiver parameters.

## L.9 ALIGNMENT PROCEDURE

Alignment of the Type 794151-X Built-In Test subassembly requires a dual trace oscilloscope, such as a Tektronix T935, and a properly calibrated spectrum analyzer, such as an HP-141T, or their equivalent. Utilizing this equipment, proceed as follows:

1. Turn off power, remove the top protective cover and place the Built-In Test module on an extender card. Install the extender card in Option Slot 3.

2. Adjust the spectrum analyzer to place 500 MHz at the center of the display. Connect the BITE cable (W2) with P2 connected to connector J27 and P3 connected to the spectrum analyzer RF input.

3. Enable EXTENDED BITE via holding the FUNCTION pushbutton pressed in, while turning receiver power ON. Using the COR LEVEL increment pushbutton, select Test Number 15. Press the BITE (AM) pushbutton to activate Auto Test. MEMORY SELECT displays an **F 1** indicating Step Number 1 failed.

4. Adjust R34 on the BITE subassembly to produce a -80 dBm signal level at the center of the spectrum analyzer display (500 MHz).

5. Disable BITE by pressing the FUNCTION key.

6. Tune the receiver to 25.000 MHz and select an IF bandwidth between 20 and 250 kHz. A narrow bandwidth is preferred. Connect Channel 1 of the oscilloscope (in the DC coupled mode) to the FM MONITOR (J2) connector on the receiver rear panel.

7. Set the signal generator to 25.000 MHz with an output amplitude 20 dB greater than the rated sensitivity for the IF bandwidth selected.

8. Set the oscilloscope trace to a convenient reference point on the gradicule. Decrease the signal generator frequency by 10 kHz and verify that the trace moves at least one (1) division vertically. If not, adjust the Channel 1 Volts/Div as necessary. Note the position of the trace and retune the signal generator to 25.000 MHz.

9. Connect the external trigger input of the oscilloscope to connector pin A41 of the Microprocessor (A5A3). This point is marked "READY 1" on the schematic.

10. Set up the receiver to step between 24.000 and 25.000 MHz. Adjust the oscilloscope trigger for a stable display of the FM Monitor signal.

11. Connect Channel 2 of the oscilloscope (in the DC coupled mode) to U4 pin 15 on the BITE module. Adjust R16 so the signal on U4 pin 15 goes high when the signal from the FM Monitor output indicates the receiver first local oscillator has settled to within 10 kHz of 25.000 MHz. The settling is within 10 kHz when the trace from the FM Monitor is within the limits established in step 8.

12. Connect the oscilloscope external trigger input to test point TP 10 on the Microprocessor (A5A3). This point is marked "READY 2" on the schematic. Connect Channel 2 of the oscilloscope to U4 pin 8 on the BITE card.

13. Set the receiver to step between 24.9999 and 25.0000 MHz. Adjust R20 until the signal on U4 pin 8 goes high when the signal from the FM Monitor output falls within the 10 kHz limit established in step 8.

14. Disconnect all test equipment connections.

15. Connect channel 1 of the oscilloscope to U14 pin 14. Enable BITE by pressing the FUNCTION (F↑) button and then pressing the BITE (AM) pushbutton. Immediately press the AM pushbutton again. Select Test Number 11 via pressing the COR Increment button. Initiate Single Step Test by pressing the MEMORY SELECT Increment key. Adjust R11 fully clockwise (CW) and observe a 0 Volt level on the oscilloscope. Adjust R11 counterclockwise (CCW) until the trace on the oscilloscope is a constant +5 Volt level. Continue rotating R11 CCW approximately 1/8 of a turn.

16. Select the next run and ensure the oscilloscope indicates +5 Volts. If there is a need to readjust the +5 Volt level, repeat step 15.

17. Remove all test equipment, including the extender card, and reinstall the BITE card into Option Slot 3.

18. Connect cable W2 between BITE Output J27 and ANT 2. Enable BITE by pressing the FUNCTION (F↑) pushbutton and then pressing the BITE (AM) pushbutton.

    Testing continues automatically through 13 different tests. When testing is completed the word End appears in the front panel window. If any failure occurs, investigate the cause to determine whether the failure is related to the receiver or the BITE alignment.

19. Enable Extended BITE by holding the FUNCTION button pressed in while turning receiver power on.

20. Start Extended BITE by pressing the FUNCTION (F↑) pushbutton then pressing the BITE (AM) pushbutton.

    Testing continues automatically through 16 different tests. When testing is completed, End appears in the front panel window. If any failures occur, investigate the cause to determine whether the failure is related to the receiver or the BITE alignment.

## L.10 PARTS LIST

L.10.1 **TYPE 861XB(S1)/BITE BUILT-IN TEST** REF DESIGN PREFIX **OPT 3**

| REF DESIG | DESCRIPTION | QTY PER ASSY | MANUFACTURER'S PART NO. | MFR. CODE | RECM VENDOR |
|---|---|---|---|---|---|
| | Revision A | | | | |
| A1 | Built-In Test P.C. Assembly | 1 | 794151-3 | 14632 | |
| W1 | Cable Assembly | 1 | 280263-1 | 14632 | |
| W1J1 | Connector, Receptacle | 1 | 1-225398-5 | 00779 | |
| W1P1 | Connector, Plug Straight | 1 | 50-024-3875-91 | 98291 | |
| W2 | Cable Assembly | 1 | 280264-1 | 14632 | |
| W2P2 | Connector, Plug Straight | 1 | UG88U | 80058 | |
| W2P3 | Connector, Plug Straight | 1 | UG536BU | 80058 | |

**NOTE**

Refer to **Table A**, page L-27 for type differences

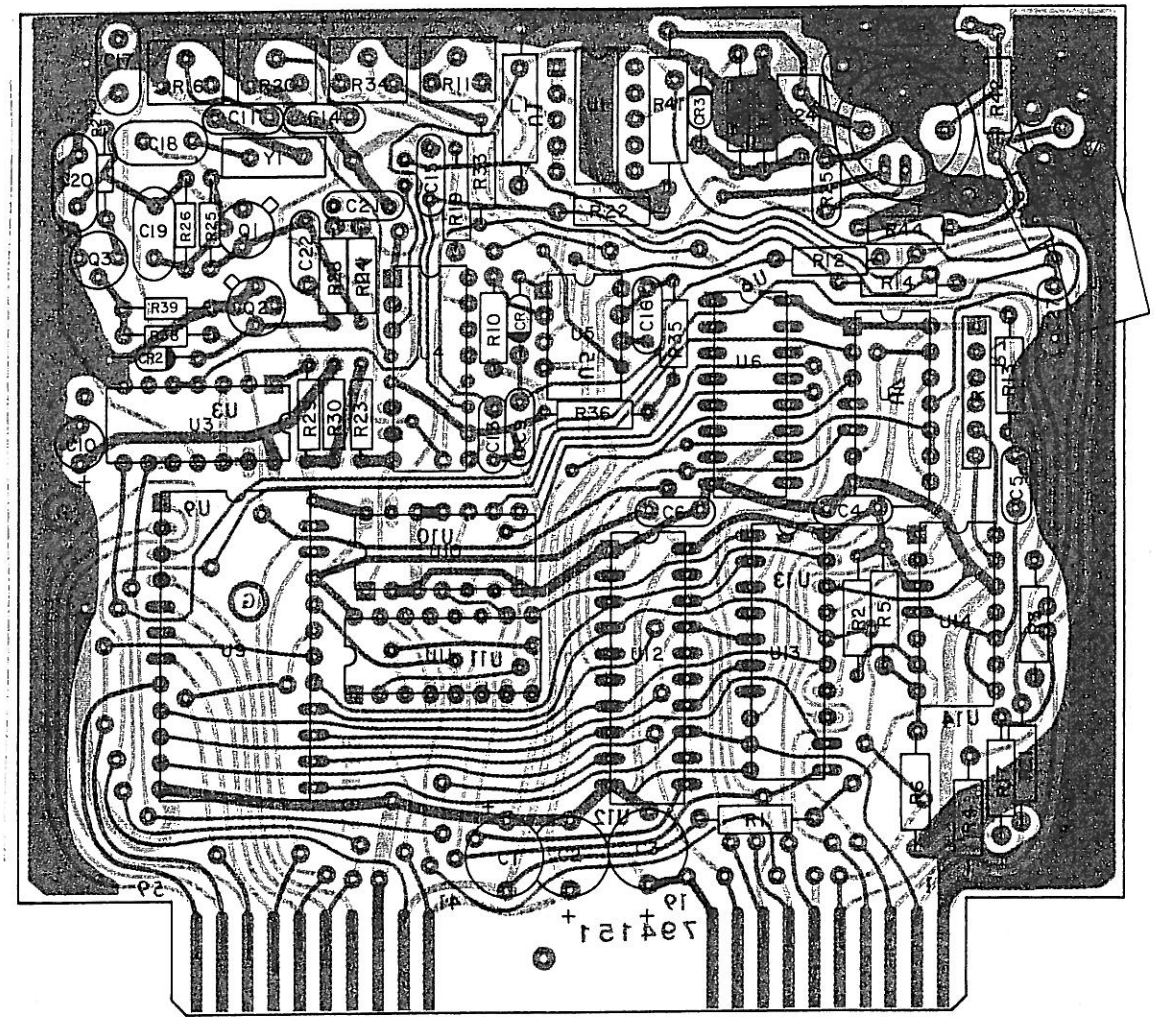

**Figure L-2. Type 794151-X, Built-In Test (BITE) (Option L-BITE), Location of Components**

L.10.1.1 **Type 794151-3 Built-In Test**

REF DESIG PREFIX **OPT 3-A1**

| REF DESIG | DESCRIPTION | QTY PER ASSY | MANUFACTURER'S PART NO. | MFR. CODE | RECM VENDOR |
|---|---|---|---|---|---|
| | Revision A | | | | |
| C1 | Capacitor, Electrolytic, Tantalum: 22 µF, 20%, 35 V | 2 | 196D226X0035PE4 | 56289 | |
| C2 | Same as C1 | | | | |
| C3 | Capacitor, Electrolytic, Tantalum: 47 µF, 20%, 20 V | 1 | 199D476X0020EE4 | 56289 | |
| C4 | Capacitor, Ceramic, Disc: 0.1 µF, 20%, 50 V | 6 | 34475-1 | 14632 | |
| C5 | Capacitor, Ceramic, Disc: .47 µF, 20%, 50 V | 3 | 34452-1 | 14632 | |
| C6 | Same as C4 | | | | |
| C7 | Not Used | | | | |
| C8 | Not Used | | | | |
| C9 | Same as C5 | | | | |
| C10 | Capacitor, Electrolytic, Tantalum: 3.3 µF, 20%, 35 V | 1 | 196D335X0035JE3 | 56289 | |
| C11 | Same as C4 | | | | |
| C12 | Not Used | | | | |
| C13 | Same as C4 | | | | |
| C14 | Same as C4 | | | | |
| C15 | Capacitor, Ceramic, Disc: .01 µF, 20%, 50 V | 1 | 34453-1 | 14632 | |
| C16 | Capacitor, Ceramic, Disc: 3300 pF, 10%, 200 V | 1 | CK06BX332K | 81349 | |
| C17 | Capacitor, Mica, Dipped: 68 pF, 2%, 500 V | 1 | CM05ED680G03 | 81349 | |
| C18 | Capacitor, Mica, Dipped: 39 pF, 2%, 500 V | 1 | CM05FD390G03 | 81349 | |
| C19 | Capacitor, Mica, Dipped: 390 pF, 2%, 500 V | 1 | CM05FD391G03 | 81349 | |
| C20 | Capacitor, Mica, Dipped: 180 pF, 2%, 500 V | 1 | CM05FD181G03 | 81349 | |
| C21 | Same as C5 | | | | |
| C22 | Capacitor, Ceramic, Disc: 5000 pF, 20%, 100 V | 2 | C023B101E502M | 56289 | |
| C23 | Not Used | | | | |
| C24 | Capacitor, Ceramic, Tubular: 7.5 pF, .5 pF, 500 V | 1 | 301-000C0H0-759D | 72982 | |
| C25 | Same as C4 | | | | |
| C26 | Not Used | | | | |
| C27 | Same as C22 | | | | |
| CR1 | Diode | 2 | 1N4446 | 80131 | |
| CR2 | Same as CR1 | | | | |
| CR3 | Diode | 1 | 5082-0153 | 28480 | |
| J1 | Connector, Receptacle | 1 | 1010-7511-001 | 19505 | |
| L1 | Coil, Fixed: 15 µH, 10% | 1 | 1537-40 | 99800 | |
| Q1 | Transistor | 2 | 2N2222A | 80131 | |
| Q2 | Transistor | 1 | 2N3478 | 80131 | |
| Q3 | Same as Q1 | | | | |
| R1 | Resistor, Fixed, Film: 10 kΩ, 1%, 1/10 W | 1 | RN55C1002F | 81349 | |
| R2 | Resistor, Fixed, Film: 1.5 kΩ, 1%, 1/10 W | 2 | RN55C1501F | 81349 | |
| R3 | Resistor, Fixed, Film: 6.81 kΩ, 1%, 1/10 W | 1 | RN55C6811F | 81349 | |
| R4 | Same as R2 | | | | |
| R5 | Resistor, Fixed, Film: 562Ω, 1%, 1/10 W | 2 | RN55C5620F | 81349 | |

REF DESIG PREFIX **OPT 3-A1**

| REF DESIG | DESCRIPTION | QTY PER ASSY | MANUFACTURER'S PART NO. | MFR. CODE | RECM VENDOR |
|---|---|---|---|---|---|
| R6 | Same as R5 | | | | |
| R7 | Resistor, Network: 33 kΩ | 1 | 4306R-101-333 | 80294 | |
| R8 | Not Used | | | | |
| R9 | Not Used | | | | |
| R10 | Resistor, Fixed, Film: 10 kΩ, 5%, 1/4 W | 3 | CF1/4-10K/J | 09021 | |
| R11 | Resistor, Trimmer, Film: 50 kΩ, 10%, 1/2 W | 1 | 62PAR50K | 73138 | |
| R12 | Resistor, Fixed, Film: 10Ω, 5%, 1/4 W | 1 | CF1/4-10 OHMS/J | 09021 | |
| R13 | Resistor, Fixed, Film: 100 kΩ, 5%, 1/4 W | 1 | CF1/4-100K/J | 09021 | |
| R14 | Same as R10 | | | | |
| R15 | Not Used | | | | |
| R16 | Resistor Trimmer, Film: 20 kΩ, 10%, 1/2 W | 2 | 62PAR20K | 73138 | |
| R17 | Resistor, Fixed, Film: 47 kΩ, 5%, 1/4 W | 5 | CF1/4-47K/J | 09021 | |
| R18 | Not Used | | | | |
| R19 | Same as R17 | | | | |
| R20 | Same as R16 | | | | |
| R21 | Same as R17 | | | | |
| R22 | Not Used | | | | |
| R23 | Same as R17 | | | | |
| R24 | Resistor, Fixed, Film: 270Ω, 5%, 1/4 W | 2 | CF1/4-270 OHMS/J | 09021 | |
| R25 | Resistor, Fixed, Film: 68 kΩ, 5%, 1/4 W | 1 | CF1/4-68K/J | 09021 | |
| R26 | Resistor, Fixed, Film: 8.2 kΩ, 5%, 1/4 W | 1 | CF1/4-8.2K/K | 09021 | |
| R27 | Resistor, Fixed, Film: 1.0 kΩ, 5%, 1/4 W | 2 | CF1/4-1.0K/J | 09021 | |
| R28 | Same as R17 | | | | |
| R29 | Same as R24 | | | | |
| R30 | Resistor, Fixed, Film: 33Ω, 5%, 1/4 W | 1 | CF1/4-33 OHMS/J | 09021 | |
| R31 | Not Used | | | | |
| R32 | Resistor, Fixed, Film: 220Ω, 5%, 1/4 W | 1 | CF1/4-220 OHMS/J | 09021 | |
| R33 | Resistor, Fixed, Film: 4.7 kΩ, 5%, 1/4 W | 2 | CF1/4-4.7K/J | 09021 | |
| R34 | Resistor, Trimmer, Film: 1 kΩ, 10%, 1/2 W | 1 | 62PAR1K | 73138 | |
| R35 | Same as R10 | | | | |
| R36 | Same as R33 | | | | |
| R37 | Resistor, Fixed, Film: 47Ω, 5%, 1/4 W | 2 | CF1/4-47 OHMS/J | 09021 | |
| R38 | Resistor, Fixed, Film: 10 kΩ, 5%, 1/8 W | 1 | CF1/8-10K/J | 09021 | |
| R39 | Resistor, Fixed, Film: 4.7 kΩ, 5%, 1/8 W | 1 | CF1/8-47K/J | 09021 | |
| R40 | Same as R27 | | | | |
| R41 | Same as R37 | | | | |
| R42 Thru R44 | Not Used | | | | |
| U1 | Integrated Circuit | 1 | LH0002CN | 27014 | |
| U2 | Attenuator | 1 | G1 | 27956 | |
| U3 | Integrated Circuit | 1 | SN74LS00N | 01295 | |

REF DESIG PREFIX **OPT 3-A1**

| REF DESIG | DESCRIPTION | QTY PER ASSY | MANUFACTURER'S PART NO. | MFR. CODE | RECM VENDOR |
|---|---|---|---|---|---|
| U4 | Integrated Circuit | 1 | LH2311D | 27014 | |
| U5 | Integrated Circuit | 1 | MC1458N | 18324 | |
| U6 | Integrated Circuit | 1 | CD4040BE | 02735 | |
| U7 | Integrated Circuit | 1 | 8674L00 | 14632 | |
| U8 | Not Used | | | | |
| U9 | Not Used | | | | |
| U10 | Integrated Circuit | 1 | MM74C74N | 27014 | |
| U11 | Integrated Circuit | 1 | SN74LS139N | 01295 | |
| U12 | Integrated Circuit | 2 | MM74C374N | 27014 | |
| U13 | Same as U12 | | | | |
| U14 | Integrated Circuit | 1 | LM339N | 27014 | |
| Y1 | Crystal, Quartz: 5.00 MHz | 1 | 91805-35 | 14632 | |