651S-1/1A General Purpose HF Receiver

COLLINS

maintenance

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NOTICE: This section replaces second edition dated 1 July 1972.

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Record of Revisions

RETAIN THIS RECORD IN THE FRONT OF MANUAL.
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REV. NO.	REVISION DATE	INSERTION DATE	BY	REV. NO.	REVISION DATE	INSERTION DATE	BY
1st Ed	1 Jan 72						
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1. GENERAL

The 651S-1/1A General Purpose HF Receiver should be maintained with various levels of repair in mind. The simplest method of repair is card/module replacement. Procedures are included to isolate malfunctions to the card/module level. Overall test procedures are in table 2, and card/module test procedures are in tables 3 through 19. The next level of repair is chassis-mounted piece parts and wiring replacement. These parts include the front/rear panel parts, the power supply parts, the audio power amplifier parts, and the cabling. Also replacement of parts in rf module A6 is not too difficult.

The next level of repair is replacement of parts on all planar cards except the subcards on the four synthesizer cards (A10 through A13). Only technicians trained in repair of planar assemblies and replacement of microminiature packages should attempt this work. The last level of repair is replacement of parts on the synthesizer subcards. Many of the parts on these subcards are epoxied in place, or the whole subcard is epoxied, and replacement is very critical as well as difficult. Only Collins authorized repair facilities should attempt this work.

The intent of this maintenance section is to guide the technician to the probable cause of trouble (whatever level of repair is involved) and to recommend the method of repair.

Note

For ease of tuning the 651S-1/1A receiver and monitoring audio output, the audio output terminals should be terminated in a 600-ohm resistive load and an 8-ohm speaker connected to the SPKR jack for all tests except where noted.

2. TEST EQUIPMENT AND POWER REQUIREMENTS

Test equipment required to maintain the 651S-1/1A is listed in table 1. If the items listed are not available, equivalent test equipment may be used.

The power required to operate the 651S-1/1A during test is 115 or 230 volts ±10 percent, 47 to 63 Hz, 70 watts. An additional 40 watts is required if all the optional cards are installed. A source of 6 to 12 volts dc, 1 A unregulated, is required if the keep-alive function is to be checked.

Table 1. Test Equipment Required.

EQUIPMENT	MANUFACTURER TYPE NUMBER/ PART NUMBER	REQUIRED CHARACTERISTICS
Wave analyzer	HP 302A	Audio frequency, 2-tone analysis.
Signal generator (two required)	HP 606B	250 kHz to 30 MHz.
Two-tone generator	Collins 779-9878-001	Crystal accuracy; tones clear to 70 dB down. Frequencies required are 12.5, 10, 2, 1 MHz, and 450 kHz.
514S-1 Remote Control Unit	Collins 622-0370-102	Required to test TCU card A9.

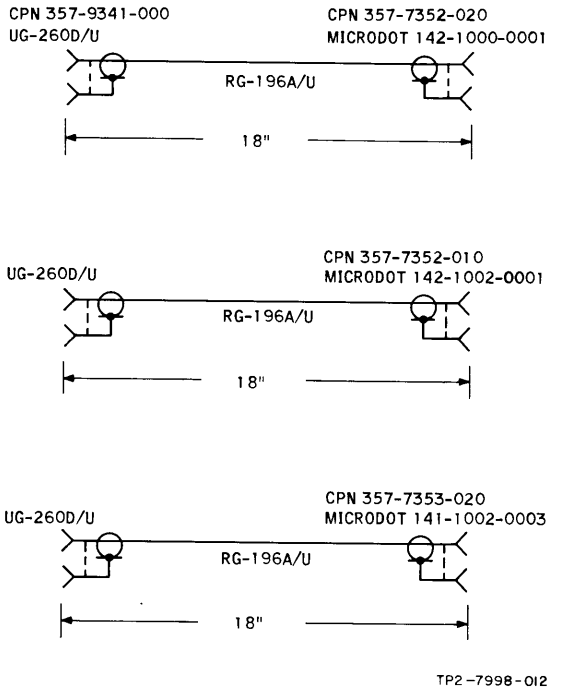
Table 1. Test Equipment Required (Cont).

EQUIPMENT	MANUFACTURER TYPE NUMBER/ PART NUMBER	REQUIRED CHARACTERISTICS
Signal generator	HP 608D	10 to 125 MHz.
Rf voltmeter	Boonton 91DA	0 to 10 Vrms rf, 400 kHz to 30 MHz.
Rf voltmeter adapter	Boonton 91-8B	50 ohms.
Distortion analyzer	HP 331A	0 to 15 Vrms, 0 to 30 percent distortion.
Oscilloscope	Tektronix 454	Measure 50-μs pulses.
Digital voltmeter	Fairchild 7000	Ac and dc measurements.
Variable rf pad	Daven RFB-543-5C	0 to 80 dB, 50 ohms.
Rf pad	Measurements 80-ZH3	6 dB, 50 ohms.
Pulse generator	HP 222A	5-V, 10-kHz, 50-μs pulses.
Frequency counter	HP 5245L	400 kHz to 109.35 MHz.
Frequency counter prescaler	HP 5252A	Increase range of HP 5245L.
FM signal generator	Marconi 1066B	400 kHz to 30 MHz.
Audio oscillator	HP 200CD	0 to 10 kHz, 600 ohms.
Serial digital word generator/ monitor	Collins 7404A-1	Generate/monitor biphase modulated 4800-Hz words.
Power meter	HP 432A	99 MHz, 0.05 to 5 mW.
Power meter thermistor mount	HP 478A	
Loudspeaker		8 ohms, 2 watts min.
Headphones		High impedance.
Dc power supply	Kepco ABC 40-0.5M	Variable 0 to 40 Vdc, 50 milliamperes.
Resistor	CPN 747-5418-000	8.2 ohms, 6.5 watts, 5%, with speaker cable attached.
Resistor	CPN 705-7042-000	75 ohms, 1/2 watt, 1%.
Resistor	CPN 705-3603-340	604 ohms, 1/4 watt, 1%.
Resistor	CPN 745-1352-000	1 kΩ, 1/2 watt, 10%.
Resistor	CPN 705-7068-000	261 ohms, 1/2 watt, 1%.
Resistor	CPN 745-1412-000	27 kΩ, 1/2 watt, 10%.
Resistor	CPN 745-1366-000	2.2 kΩ, 1/2 watt, 10%.
Resistor	CPN 745-1394-000	10 kΩ, 1/2 watt, 10%.
Resistor	CPN 745-1317-000	150 ohms, 1/2 watt, 10%.

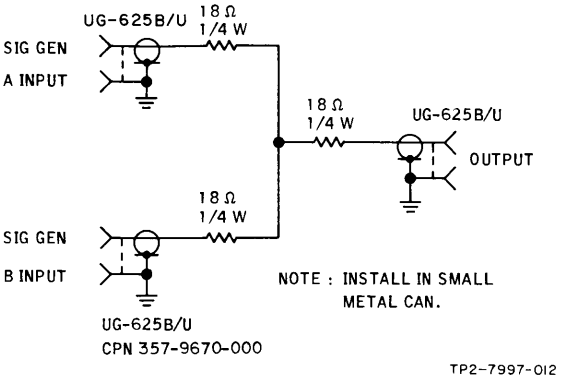
Table 1. Test Equipment Required (Cont).

EQUIPMENT	MANUFACTURER TYPE NUMBER/ PART NUMBER	REQUIRED CHARACTERISTICS
Resistor	CPN 705-3603-320	54.9 ohms, 1/4 watt, 1%.
Resistor	CPN 705-3602-260	549 ohms, 1/4 watt, 1%.
Resistor	CPN 705-6643-000	953 ohms, 1/4 watt, 1%.
Resistor	CPN 705-6536-000	56.2 ohms, 1/4 watt, 1%.
Resistor (four required)	CPN 705-3602-500	1810 ohms, 1/4 watt, 1%.
Resistor	CPN 705-6611-000	205 ohms, 1/4 watt, 1%.
Dc power source (power supply or battery)	Standard dc power supply	+6 to +12 Vdc.
Card extender	CPN 778-2953-001	Extend card A1.
Card extender	CPN 778-2954-001	Extend card A2.
Card extender	CPN 778-2959-001	Extend card A3.
Card extender	CPN 778-2955-001	Extend card A4.
Card extender	CPN 778-2956-001	Extend card A5.
Card extender	CPN 790-2667-001	Extend card A6.
Card extender	CPN 778-2957-001	Extend card A7.
Card extender	CPN 778-2958-001	*Extend card A8.
Card extender	CPN 778-2856-006	**Extend card A9.
Card extender	CPN 778-2856-004	Extend card A10.
Card extender	CPN 778-2856-010	Extend card A11.
Card extender	CPN 778-2856-009	Extend card A12.
Card extender	CPN 778-2856-008	Extend card A13.
Card extender	CPN 606-3397-001	Extend card A14.
Serial digital test adapter cable	Fabricate	Refer to figure 3.
Remote control cable	Fabricate	Refer to figure 11.
Two-tone mixer adapter	Fabricate	Refer to figure 2.
BNC to subminiax adapter cables	Fabricate	Refer to figure 1.
Power meter adapter cable	Fabricate	Refer to figure 4.

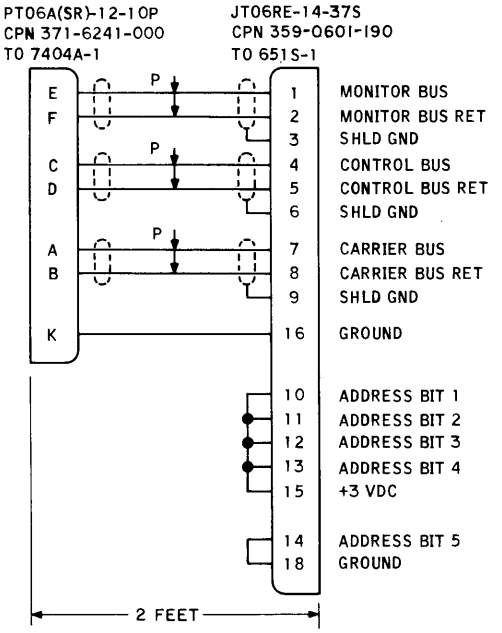
*Card A8 extender extends either the interconnect card or the DCFE card.
**Card A9 extender extends either the DCU card, TCU card, or scan control card.



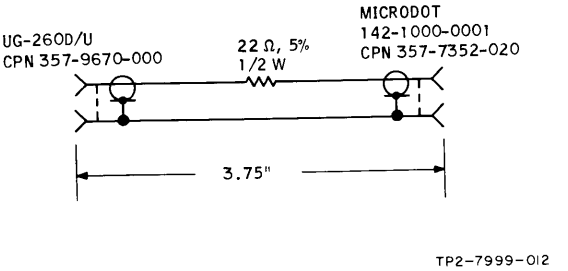
BNC to Subminiax Adapter Cables, Schematic Diagram
Figure 1



Two-Tone Mixer Adapter, Schematic Diagram
Figure 2



Serial Digital Test Adapter Cables, Schematic Diagram
Figure 3



Power Meter Adapter Cable, Schematic Diagram
Figure 4

Table 2. Overall Performance Test Procedures.

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. Controls check	a. Set POWER switch to OFF. Connect the speaker. Be sure all assemblies are completely inserted and that all coax connectors are properly mated.		
	b. Set POWER switch to ON. Set BFO switch to FIXED. Set METER switch to RF. Set AGC switch to FAST. Set CONTROL switch to LOCAL. Set SQUELCH switch to OFF (optional). Set DIAL switch to unlock. Set MODE switch to SSB. Set AF GAIN control to midrange. Set BANDWIDTH switch to 2.7U.		
	c. Select 10.0000 MHz and adjust the RF GAIN control for a 40-dB meter indication.		
	d. Note status of comma in frequency readout.	Lit.	Check voltage to DS105 (+25 Vdc nominal). If voltage is normal, replace lamp.
	e. Rotate RF GAIN control and note meter level and background noise level. Reset for 1 μV on meter.	Affects meter and background noise level.	Check wiring. Replace control. Check METER switch.
	f. Rotate AF GAIN control and note audio level.	Affects audio level.	Check wiring. Replace control.
	g. Set DIAL switch to LOCK. Rotate large tuning knob.	Frequency does not change.	Check wiring to switch. Check switch (replace if necessary). Substitute card A14. If A14 faulty, test, using procedures in table 19.
	h. Set DIAL switch to unlock. Check all tuning controls to see that they can select all digits of frequency.	All controls operate properly.	Check wiring to switches. Substitute card A7. If A7 is faulty, test, using procedures in table 9. Substitute card A14. If faulty, test, using procedures in table 19. Replace faulty control(s).

Table 2. Overall Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
2. AGC action	a. Connect the signal generator to the ANT jack through a 6-dB pad and set it for 1-μV output at 28.0000 MHz.		If this test does not meet standards, test the 651S-1/1A using test 18 of this table.
	b. Set the 651S-1/1A to 27.9990 MHz in SSB, BANDWIDTH to 2.7U, with the AGC switch in the off (center) position and with the RF GAIN control set to maximum cw position.		
	c. Connect a 600-ohm resistor and the distortion analyzer across the AUDIO LINES STD terminals. Set the analyzer to VOLTMETER.		
	d. Connect an rf voltmeter (with 50-ohm probe) to the STD IF output jack.		
	e. Tune the 651S-1/1A for maximum if output on rf voltmeter and check audio output level.	Audio level; NLT 0 dBm.	Perform test 7.
	f. Set AGC to FAST and check audio output level.	NLT -1 dBm.	Test card A4 using table 6.
	g. Check if output level.	40 to 70 mV.	
	h. Set signal generator for 0.1-V output. Check increase of audio level.	NMT 6 dB increase.	Same as step f.
	i. Repeat preceding steps if anything was adjusted because there is interaction between potentiometers.		
	j. Set the AGC switch to SLOW. Set the signal generator for 0.01-V output. Disconnect the signal generator. The audio tone should disappear, the speaker output should be relatively quiet for approximately 1 second, then background noise should be heard. Reconnect generator.	As in procedure.	If AGC is inactive completely, test card A2 using table 4. If slow or fast, repeat this entire test.
	k. Set the AGC switch to FAST. Disconnect the signal generator. The time between audio and background noise should be almost undetectable (approximately 0.1 second). Reconnect generator.	As in procedure.	Same as step j.
	l. Set the AGC switch to off (center). Audio level should increase appreciably.	As in procedure.	Same as step j.

Table 2. Overall Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
3. Mode	a. With equipment connected as in test 2, set the 651S-1/1A and signal generator to 10.0000 MHz.		
	b. On 651S-1/1A, set AGC to ON, MODE to AM, and BANDWIDTH to 16. Set signal generator output level to 10 μV, modulated 30 percent at 400 Hz.		
	c. Check audio out with modulation on, then off.	Audio output with modulation on. No audio output with modulation off.	Perform test 7, then test card A2 using table 4.
	d. Adjust signal generator output to 1-μV and turn modulation off.		
	e. Set 651S-1/1A MODE to SSB. Sweep the signal generator frequency across the 651S-1/1A frequency and note audio output.	Audio output present when signal generator frequency is swept by the 651S-1/1A frequency and not present when the signal generator is 20 kHz or more from the 651S-1/1A frequency.	Same as step c.
	f. Set 651S-1/1A MODE to CW and repeat step e.	Same as step e.	Same as step c.
4. Selectivity (standard filters)	a. Connect a frequency counter to the UNCAL RF jack on the signal generator (to monitor frequency). Leave other equipment connected as in test 3.		
	b. Set 651S-1/1A MODE to SSB, BANDWIDTH to 2.7U, AGC off, and frequency to 1.1100 MHz.		
	c. Set signal generator for 1.1110 MHz at 1000-μV output.		
(Cont)	d. Adjust 651S-1/1A rf gain for a convenient if output level indicated on the rf voltmeter (30 to 100 mV). Slowly sweep the signal generator frequency across the passband of the 651S-1/1A to find the peak if output. Use this as a 0-dB reference.		

Table 2. Overall Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
4. (Cont)	e. Slowly increase signal generator frequency until the if output drops 3 dB from peak response, note signal generator frequency.	Upper freq: NMT 1.1135 MHz.	Test filter card A5 using table 7.
	f. Slowly decrease signal generator frequency below the 651S-1/1A frequency until the if output again drops 3 dB from peak response, note signal generator frequency.	Lower freq: NLT 1.1102 MHz.	Same as step e.
	g. Compute the 3-dB bandwidth by subtracting the lower frequency limit from the upper frequency limit.	3-dB bw: 2.290 to 3.110 kHz.	Same as step e.
	h. Set signal generator to 1.1090 MHz and set the 651S-1/1A BANDWIDTH to 2.7L.		
	i. Repeat steps d through g for the LSB filter.	3-dB BANDWIDTH Upper freq: NMT 1.1098 MHz. Lower freq: NLT 1.1065 MHz. Bw: 2.290 to 3.110 kHz.	Same as step e.
	j. Set 651S-1/1A MODE to AM, BANDWIDTH to 6, AGC on, and frequency to 1.1100 MHz.		
	k. Set signal generator to 1.1100 MHz modulated 30 percent at 400 Hz.		
	l. Repeat steps c through g for the AM, 6-kHz filter, except measure the 6-dB points.	6-dB bw: From 5.100 to 6.900 kHz.	Same as step e.
	m. Set the 651S-1/1A MODE to 3, and repeat steps c through g for the AM, 3-kHz filter.	3-dB bw: From 2.550 to 3.450 kHz.	Same as step e.
5. Selectivity (optional filters) (Cont)	a. If the 500-Hz CW filter is installed in A5A1 or one of the optional A5A2 filter subcards is installed, determine which bandwidths are being used and check their filtering performance.		

Table 2. Overall Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
5. (Cont)	b. Set the 651S-1/1A MODE to CW, BANDWIDTH to the appropriate position, and repeat steps 4.c through 4.g for the appropriate filters installed.	The total 3-dB bandwidth shall be within 50 percent of the nominal bandwidth.	If a failure occurs, test subcard(s) using procedures in table 7.
	BANDWIDTH SWITCH / FILTER / NOMINAL 3-dB BANDWIDTH		
	1st CW position (1, 4, WSRT, or WBTY) / 1 kHz / 1 kHz		
	1.1 kHz (offset +2 kHz) / 1.1 kHz		
	1.1 kHz (offset +2.55 kHz) / 1.1 kHz		
	4 kHz / 4 kHz		
	2nd CW position (.5, 2, or CW) / 500 Hz / 500 Hz		
	2 kHz / 2 kHz		
	3rd CW position (.2, 1, or NSRT) / 200 Hz / 200 Hz		
	370 Hz (offset +2 kHz) / 370 Hz		
	1.1 kHz / 1.1 kHz		
6. Sensitivity	a. Connect signal generator through a 6-dB pad to the ANT jack and set for 5 μV at 281 kHz. Set 651S-1/1A MODE to SSB, AGC off, BANDWIDTH to 2.7U at 280 kHz. Note audio output level (vary frequency slightly to peak audio out).	Audio out more positive than -8 dB. Use as reference only.	Perform test 7, (gain).
	b. Disconnect signal generator and note drop in audio level.	Snr: NLT 10 dB.	Test module A6 using table 8.
	Note Set signal generator 1 kHz higher than the 651S-1/1A for USB and 1-kHz lower for LSB.		
	c. Repeat steps a and b at 500 kHz and 1250 kHz with the signal generator set to 2.5-μV output.	Snr: NLT 10 dB.	Same as step b.
(Cont)	d. Repeat steps a and b at 2.05 MHz, 8.05 MHz, and 28.05 MHz with signal generator set to 0.7-μV output.	Snr: NLT 10 dB.	Same as step b.

Table 2. Overall Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
6. (Cont)	e. Set signal generator to 2.05 MHz, 3.5 μV modulated 30 percent at 400 Hz. Set 651S-1/1A MODE to AM, BANDWIDTH to 6, AGC on, and frequency to 2.05 MHz. Note audio output level. (Vary frequency slightly to peak audio out.)	Reference.	Test card A4 using table 6.
	f. Turn modulation off and note drop in audio output.	Snr: NLT 10 dB.	Same as step b.
7. Gain	a. Set 651S-1/1A MODE to SSB, BANDWIDTH to 2.7U, AGC on, and frequency to 280 kHz. Set signal generator to 281 kHz at 1 μV. (Vary frequency slightly to peak audio out.)		
	b. Measure audio output.	NLT 0 dBm.	Test card A2 using table 4.
	c. Repeat steps a and b at 500 kHz, 1.250 MHz, 2.05 MHz, 8.05 MHz, and 28.05 MHz.	NLT 0 dBm.	Same as step b.
	d. Set 651S-1/1A BANDWIDTH to 2.7L and frequency to 2.05 MHz. Set signal generator to 2.0490 MHz at 1 μV. (Vary frequency slightly to peak audio out.)		
	e. Measure audio output.	NLT 0 dBm.	Same as step b.
(Cont)	f. Set 651S-1/1A MODE to CW and BANDWIDTH to the applicable position. Turn modulation off on signal generator and set to 2.051 MHz at 3 μV. Vary frequency slightly to peak audio output.		

Table 2. Overall Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
7. (Cont)	g. Measure audio output for appropriate filters installed. BANDWIDTH 2.7U 1 or WRST or 4 or WBTY .5 or CW or 2 .2 or NSRT or 1	 NLT -6 dBm NLT -6 dBm NLT -6 dBm NLT -6 dBm	Same as step b.
8. Meter calibration	a. Set signal generator to 28.0000 MHz unmodulated with 0.10 mV output. Set 651S-1/1A to 27.9990 MHz in SSB, BANDWIDTH to 2.7U, and AGC on. Tune the 651S-1/1A as necessary for a 1-kHz beat note.		
	b. Set the METER switch to RF. Set the RF GAIN control to maximum cw. Note meter indication.	80 ±3 dB.	Adjust A4R109.
	c. Set signal generator output to 1 μV. Set the METER switch to LINE. Note audio output.	0 ±1 dBm.	Adjust A2R70.
	d. Set the METER switch to RF. Vary generator output to set meter at 1 μV.	1 μV ±3 dB.	
9. ISB operation (optional)	a. Connect the 600-ohm load resistor and the distortion analyzer to the AUDIO LINES ISB 600-ohm audio output terminals. Connect the rf voltmeter (with 50-ohm probe) to the ISB IF jack.		
	b. Set signal generator to 10.0000-MHz output at 1 μV. Set the 651S-1/1A to 10.0010 MHz in the ISB mode, BANDWIDTH to 2.7U, with AGC set to off (center) position.		
	c. Check the audio level.	+1 dBm.	Adjust A3R92.
	d. Set 651S-1/1A AGC to SLOW. Check audio level.	More positive than -1 dBm.	Adjust A3R57.
	e. Check if output level.	35 to 70 mV.	
	f. Increase signal generator output to 0.1 V. Check that if and audio output levels increase.	NMT 6 dB increase.	Adjust A3R7.
	g. If any adjustments are made, repeat the entire test.		

Table 2. Overall Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
10. FM operation (optional)	a. Connect FM signal generator to ANT jack through 6-dB pad.		
	b. Tune 651S-1/1A and FM generator to 10,000 MHz. Set generator output at 100 μV with 1-kHz deviation.		
	c. Set 651S-1/1A to CW mode, BANDWIDTH to .5, and set METER switch to RF. Peak 651S-1/1A meter indication by tuning the FM generator frequency (stay within 500 Hz of 10 MHz).		
	d. Set 651S-1/1A to FM mode and BANDWIDTH to 6.		
	e. Tune FM generator incremental frequency off frequency to 3 kHz above and below 10 MHz.	Audio does not degrade appreciably.	Test card using procedures in table 6.
	f. Repeat step e but go beyond 3-kHz limits.	Audio degrades after approximately 3-kHz deviation.	Test card using procedures in table 6.
	g. Repeat steps e and f with 651S-1/1A in FM mode, BANDWIDTH to 16, and using incremental frequency limits of ±8 kHz.	Same as steps e and f.	
11. Audio distortion	a. Ensure that the magnetic card cage covers are on. Actuate the 2-tone signal source (12.5 MHz is used in the following steps as a typical test frequency; any frequency between 5 and 15 MHz is satisfactory). Set one for 12.5006 MHz with 50-mV output and the other to 12.5016 MHz with 50-mV output. (Measure the 50-mV output with rf voltmeter and 50-ohm probe.) Connect the two generators through the 2-tone mixer adapter (figure 2) to the ANT jack.		
	b. Connect the wave analyzer across a 600-ohm resistor and connect both to the AUDIO LINES STD 600-ohm terminals.		
	c. Set 651S-1/1A to SSB, BANDWIDTH to 2.7U, at 12.5000 MHz, and AGC on. Record the dB level of the distortion products listed below with respect to F1. Note that the audio output signals are at 600 Hz (F1), and 1600 Hz (F2).		Test card A2 using procedures in table 4.
(Cont)			

Table 2. Overall Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
11. (Cont)	F1 (600 Hz) F2 (1600 Hz) 2F2-F1 (2600 Hz)	0-dB reference. 0 ±1 dB. NLT 40 dB down.	
	d. Turn off the tone at 12.5006 MHz and disconnect the wave analyzer. Connect the distortion analyzer AF INPUT to the AUDIO LINES 600-ohm terminals. Set the distortion analyzer to SET LEVEL and set it for 0-dB reference (at 600 Hz). Set the distortion analyzer to DISTORTION and record total distortion (audio output signal is now 1600 Hz).	NLT 40 dB down.	
	e. (Optional) Repeat steps a, b, and c with 651S-1/1A in ISB mode, BANDWIDTH to 2.7U, at 12.5022 MHz with wave analyzer connected to AUDIO LINES ISB 600-ohm terminals.		Test card A3 using procedures in table 5.
	F1 (600 Hz) F2 (1600 Hz) 2F2-F1 (2600 Hz)	0-dB reference. 0 ±1 dB. NLT 40 dB down.	
12. Power output and distortion	a. Connect one tone of the 2-tone generator to the ANT jack. Connect the 8-ohm resistor (with speaker cable) to the SPKR jack.		
	b. Connect the distortion analyzer METER inputs to the 8-ohm resistor.		
(Cont)	c. Set tone generator for 0.1-V output. Set AF GAIN for 4-V audio. Move audio to AF INPUT terminals of distortion analyzer. Switch distortion analyzer to SET LEVEL. Set for 0 dB. Switch to DISTORTION and measure the total distortion.	NLT 33 dB down from 0-dB reference.	Check Q1, Q2, and U1 and associated components in chassis-mounted audio amplifier circuit. Replace faulty component.

Table 2. Overall Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
12. (Cont)	d. Plug high impedance headphones into front panel headphone jack and note that audio is transferred from speaker jack (audio meter indication at speaker jack disappears) to headphones.	Audio transfers.	Check wiring to J58 (headphone jack). Replace jack if wiring checks out.
13. Vbfo operation	a. Connect one tone of the 2-tone generator to the ANT jack. Set for 1-MHz output at 0.01 V.		
	b. Connect the frequency counter to the 8-ohm resistor (connected to SPKR jack).		
	c. Tune 651S-1/1A to 0.9990 MHz in SSB, BANDWIDTH to 2.7U, BFO to VAR.		
	d. Measure output frequency at each position of the VBFO control starting at extreme counterclockwise position.	Frequency changes in steps of approximately 10 Hz.	Test card A2 using table 4.
	e. Set 651S-1/1A to CW, BANDWIDTH to 2.7U or .5/CW/2 as appropriate and repeat step d. Readings between limits of VBFO control do not have to be linear.	Frequency changes in step of approximately 150 Hz.	Same as step d.
14. Squelch operation (optional)	a. Connect an hf signal generator through a 6-dB pad to the ANT jack. Connect a speaker to the SPKR jack. Set the signal generator to 10.0000 MHz with 3-μV output, unmodulated.		
(Cont)	b. Set 651S-1/1A to 10.0 MHz in AM mode, BANDWIDTH to 6. Set SQUELCH control at maximum ccw position against the switch, but do not operate the switch.	Circuit noise is audible.	

Table 2. Overall Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
14. (Cont)	c. Modulate signal generator with 400 Hz at 15%. Slowly rotate SQUELCH control in cw direction until squelch circuit disables audio output.	SQUELCH control is 10 to 30° from ccw end when audio goes off.	Test card A2 using table 4.
	d. Increase modulation to 90%.	Audio comes on.	
	e. Rotate SQUELCH control to maximum cw position.	Audio stays on.	
	f. Turn SQUELCH control to OFF.	Audio stays on.	
	g. Disconnect signal generator.		
15. Battery keep-alive operation (optional)	a. Connect +6 to +12-Vdc source (power supply or battery) to BATT-6V terminals. Note frequency readout.		
	b. Disconnect power plug from ac source (651S-1/1A POWER switch in OPER). Leave disconnected for 30 seconds.	Red battery light comes on.	Ensure battery voltage is applied to DS101. Check Q501 through Q504 and associated parts.
	c. Reconnect line cord and check frequency readout.	Same frequency as step a.	Check that battery voltage (+5 Vdc) is getting to card A14. If it is, test A14, using table 19.
16. Optional remote control monitor operation (Collins DCU/ DCFE cards installed)	***Caution*** Assure that J30-46 is not jumpered to J31-47 on the 651S-1/1A sideboard.		
	a. Connect 651S-1/1A to primary power. Set POWER switch to OFF. Connect speaker. Connect signal generator through 6-dB pad to ANT jack. Connect frequency counter to UNCAL RF jack on signal generator. Connect 7404A-1 Source Generator/Display Unit LCU SINE WAVE connector to 651S-1/1A REMOTE INPUT connector using special cable (figure 3).		
(Cont)	b. Set signal generator to 10.0000 MHz at 100-μV output modulated 30% at 1 kHz.		

Table 2. Overall Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
16. (Cont)	c. Set 651S-1/1A controls as follows: POWER OFF BFO FIXED METER RF AGC FAST CONTROL LOCAL VBFO MAX CCW RF GAIN MAX CW SQUELCH (optional) OFF MODE FM AF GAIN Midsetting BANDWIDTH 6 d. Set 7404A-1 front panel controls as follows: POWER ON PARITY MODE SENSED RETRANSMIT OFF MODE FDX ADDRESS LENGTH 5 BIT PARITY ENCODE MANUAL e. Set 7404A-1 rear panel controls as follows: Function LCU Sine/logic SINE f. Set 7404A-1 control word switches 0 thru 4 to logic 1 (up) and switch 5 to logic 0 (down) for all tests.		
	g. Set 651S-1/1A POWER switch to ON. Press 7404A-1 CLEAR pushbutton and then set switch 7 up and the remaining switches (6, 8 thru 31) down. Press SEND/READY pushbutton. Note 7404A-1 lamps.	7404A-1 lamp 0 out. 1 thru 4 lit (logic 1); 5 and 6 out (logic 0); 7 lit; 8 out; 9 lit; 10 out; 12, 13, and 14 lit; 15 through 19 out; and disregard 11 and 20 through 31.	Repeat test. Test card A8 or A9 using table 11 or 12.
	h. Press 7404A-1 CLEAR pushbutton and set switch 7 down, 8 up, 9 and 10 down, 11 up, and 12 thru 31 down. Press SEND/READY pushbutton.	Disregard response. This is just to sync the 651S-1.	Same as step g.
(Cont)	i. Set 651S-1/1A to FM, BANDWIDTH to 16. Set BFO switch to VAR. Press 7404A-1 CLEAR button and set 7404A-1 switch 7 up and 8 thru 31 down. Press SEND/READY button.	Lamps 8 thru 11 out, 12 thru 14 lit, 15 thru 23 out, disregard others.	Same as step g.

Table 2. Overall Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
16. (Cont)	j. Set 651S-1/1A to AM, BANDWIDTH to 3, and set VBFO control one stop from extreme ccw. Press 7404A-1 CLEAR button, then press SEND READY button.	Lamps 8 thru 11 out, 12 and 13 lit, 14 and 15 out, 16 lit, 17 thru 22 out, 23 lit, disregard others.	Same as step g.
	k. Set 651S-1/1A to AM, BANDWIDTH to 6, with VBFO control in second stop. Press 7404A-1 CLEAR and SEND/READY buttons.	Lamps 8 thru 11 out, 12 and 13 lit, 14 and 15 out, 16 lit, 17 thru 21 out, 22 lit, 23 out, disregard others.	Same as step g.
	l. Set 651S-1/1A to AM, BANDWIDTH to 16, with VBFO control in third stop. Press 7404A-1 CLEAR and SEND/READY buttons.	Lamps 8 thru 11 out, 12 and 13 lit, 14 and 15 out, 16 lit, 17 thru 21 out, 22 and 23 lit, disregard others.	Same as step g.
	m. Set signal generator to CW. Set 651S-1/1A to 9.9991 MHz in SSB, BANDWIDTH to 2.7U, with VBFO control in fourth stop. Press 7404A-1 CLEAR and SEND/READY buttons.	Lamps 8 thru 11 out, 12 and 13 lit, disregard 14, 15 thru 17 out, 18 lit, 19 and 20 out, 21 lit, 22 and 23 out, 24 lit, 25 and 26 out, 27 lit, 28 thru 30 out, 31 lit.	Same as step g.
	n. Set 651S-1/1A to 10.0009 MHz in SSB, BANDWIDTH to 2.7L, with VBFO control in fifth stop. Press 7404A-1 CLEAR and SEND/READY buttons.	Lamps 8 thru 11 out, 12 and 13 lit, disregard 14, 15 thru 18 out, 19 lit, 20 out, 21 lit, 22 out, 23 lit, 24 thru 27 out, 28 lit, 29 and 30 out, 31 lit.	Same as step g.
	o. Set 651S-1/1A to CW, BANDWIDTH to .2/1, with VBFO control in sixth stop and CONTROL switch in MON. Press 7404A-1 CLEAR and SEND/READY buttons.	Lamps 8 thru 11 out, 12 and 13 lit, disregard 14, 15 lit, 16 out, 17 lit, 18 thru 20 out, 21 and 22 lit, 23 thru 27 out, 28 lit, 29 and 30 out, 31 lit.	Same as step g.
	p. Set 651S-1/1A to CW, BANDWIDTH to .5/2, with VBFO control in seventh stop. Press 7404A-1 CLEAR and SEND/READY buttons.	Lamps 8 thru 11 out, 12 and 13 lit, disregard 14, 15 lit, 16 out, 17 lit, 18 thru 20 out, 21 thru 23 lit, 24 thru 27 out, 28 lit, 29 and 30 out, 31 lit.	Same as step g.
(Cont)			

Table 2. Overall Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
16. (Cont)	q. Set 651S-1/1A to CW, BANDWIDTH to 1/4, with VBFO control in eighth stop. Set 7404A-1 switches 7, 8 and 29 up (others as they were) and press the CLEAR and SEND/READY buttons.	Lamps 8 thru 11 out, 12 and 13 lit, disregard 14, 15 lit, 16 out, 17 lit, 18 and 19 out, 20 lit, 21 thru 27 out, 28 lit, 29 and 30 out, 31 lit.	Same as step g.
	r. Set 651S-1/1A to ISB, BANDWIDTH to 2.7L, with VBFO control in ninth stop. Press 7404A-1 CLEAR and SEND/READY buttons.	Lamps 8 thru 11 out, 12 and 13 lit, disregard 14, 15 lit, 16 and 17 out, 18 lit, 19 out, 20 lit, 21 and 22 out, 23 lit, disregard others.	Same as step g.
	s. Set 651S-1/1A VBFO control to tenth stop. Press 7404A-1 CLEAR and SEND/READY buttons.	Lamps 8 thru 11 out, 12 and 13 lit, disregard 14, 15 lit, 16 and 17 out, 18 lit, 19 out, 20 lit, 21 out, 22 lit, 23 out, disregard others.	Same as step g.
	t. Set 651S-1/1A VBFO control to eleventh stop. Press 7404A-1 CLEAR and SEND/READY buttons.	Lamps 8 thru 11 out, 12 and 13 lit, disregard 14, 15 lit, 16 and 17 out, 18 lit, 19 out, 20 lit, 21 out, 22 and 23 lit, disregard others.	Same as step g.
	u. Set 651S-1/1A VBFO control to twelfth stop (max cw). Press 7404A-1 CLEAR and SEND/READY buttons.	Lamps 8 thru 11 out, 12 and 13 lit, disregard 14, 15 lit, 16 and 17 out, 18 lit, 19 out, 20 and 21 lit, 22 and 23 out, disregard others.	Same as step g.
(Cont)	v. Set 651S-1/1A CONTROL switch to REMOTE. Press 7404A-1 CLEAR and SEND/READY buttons.	Lamps 8 thru 10 out, disregard 11, 12 out, 13 lit, disregard 14, 15 thru 17 out, 18 lit, 19 out, disregard others.	Same as step g.

Table 2. Overall Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
16. (Cont)	w. Set 7404A-1 switches 11, 14, 18, 19, 21, 25, 27, 29, and 30 up; and set the others (between 6 and 31) down. Press SEND/READY button.	651S-1/1A frequency should go to 12.3456 MHz. 7404A-1 lamp 8 lit, 9 and 10 out, 11 lit, 12 and 13 out, 14 lit, 15 thru 17 out, 18 and 19 lit, 20 out, 21 lit, 22 thru 24 out, 25 lit, 26 out, 27 lit, 28 out, 29 and 30 lit, and 31 out.	Same as step g.
	x. Set 7404A-1 switches 6 through 31 down except for 7, 8, and 29. Press SEND/READY pushbuttons.	Lamps 8 thru 12 out, 13 lit, disregard 14, 15 thru 17 out, 18 lit, 19 out, 20 and 21 lit, 22 thru 24 out, 25 lit, 26 out, 27 lit, 28 out, 29 and 30 lit, and 31 out.	Same as step g.
17. Optional remote control, control operation (Cont)	a. Connect FM signal generator through an 80-dB pad plus the 6-dB pad to one-half of T-connector, connect frequency counter to other half of T-connector, and connect T-connector to ANT jack. b. Leave 7404A-1 and speaker connected as in test 16, step a. c. Set FM generator for 10.0000 MHz with 1.0-volt output. Set for nominal deviation to produce audio. d. Set 651S-1/1A controls as follows: POWER — ON BFO — FIXED METER — RF AGC — FAST CONTROL — REMOTE VBFO — Center RF GAIN — Max cw AF GAIN — 1/4 full SQUELCH (optional) — OFF		

Table 2. Overall Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
17. (Cont)	e. Set 7404A-1 front panel controls as follows: POWER ON PARITY MODE SENSED RETRANSMIT OFF MODE FDX ADDRESS LENGTH 5 BIT PARITY ENCODE MANUAL		
	f. Set the 7404A-1 rear panel controls as follows: Function LCU Sine/logic SINE		
	g. Set 7404A-1 control word switches 0 thru 4 to logic 1 (up) and switch 5 to logic 0 (down) for all tests.		
	h. Press 7404A-1 CLEAR pushbuttons and set switch 11 up. Set all others (6 thru 31) down. Press SEND/READY button. Set switch 11 down and set switches 7, 10, 22, 27, and 29 up only. Press SEND/READY button. Set switches 7, 10, 22, 27, and 29 down. Set switches 6, 28, 29, 30, and 31 up only. Press SEND/READY button. Determine that 651S-1/1A is functioning in FM mode at 10 MHz, with a bandwidth of 6 kHz.	Functioning properly.	Repeat test. Test card A8 or A9 using table 11 or 12.
	i. Set 7404A-1 switches 6 thru 31 down, and set switch 11 back up. Press SEND/READY pushbutton. Set switch 11 down and set switches 7, 10, 23, 27, and 29 up only. Press SEND/READY button. Determine that 651S-1/1A is functioning in FM mode at 10 MHz with a bandwidth of 16 kHz.	Functioning properly.	Same as step h.
	j. Connect an hf signal generator through a 6-dB pad to the ANT jack. Set it for 10.0000-MHz output at 100 μV modulated 30% at 1 kHz.		
(Cont)	k. (Perform only if optional filter card that provides 3-kHz bandwidth is installed.) Set 7404A-1 switches 6 thru 31 down, and set switch 11 back up. Press SEND/READY button. Set switch 11 down, and set switches 7, 11,	Functioning properly.	Same as step h.

Table 2. Overall Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
17. (Cont)	22, 26, and 29 up only. Press SEND/READY button. Determine that 651S-1/1A is functioning properly in AM mode at 10 MHz, with a bandwidth of 3 kHz.		
	l. Set 7404A-1 switches 6 thru 31 down. Set switch 11 back up. Press SEND/READY button. Set switches 7, 11, 22, 27, and 29 up only. Press SEND/READY button. Determine that 651S-1/1A is functioning properly in the AM mode at 10 MHz, with a bandwidth of 6 kHz.	Functioning properly.	Same as step h.
	m. Set 7404A-1 switches 6 thru 31 down. Set switch 11 back up. Press SEND/READY button. Set switches 7, 11, 23, 27, and 29 up only. Press SEND/READY button. Determine that 651S-1/1A is functioning properly in the AM mode at 10 MHz, with a bandwidth of 16 kHz.	Functioning properly.	Same as step h.
	n. Turn off signal generator modulation. Set the 7404A-1 switches 6 thru 31 down. Set switches 12, 15, 16, 19, 20, 23, 24, and 27 up. Press SEND/READY button. Set switches 6 thru 31 down. Set switches 7, 12, 14, 20, 27 and 29 up. Press SEND/READY button. Determine that 651S-1/1A is functioning properly in the USB mode at 9.9990 MHz. 1000-Hz tone should be heard.	Functioning properly.	Same as step h.
	o. Set 7404A-1 switches 6 thru 31 down. Set switches 11 and 27 up. Press SEND/READY button. Set 11 and 27 down. Set switches 7, 12, 14, 21, 27, and 29 up. Press SEND/READY button. Determine that 651S-1/1A is functioning properly in LSB at 10.0010 MHz. 1000-Hz tone should be heard.	Functioning properly.	Same as step h.
(Cont)	p. Set 7404A-1 switches 6 thru 31 down. Set switches 12, 15, 16, 19, 20, 23, 24, and 27 up. Press SEND/READY button. Set switches 6 thru 31 down. Set switches 7, 12, 13, 14, 20, 27, and 29 up. Press SEND/READY button. Determine that 651S-1/1A is functioning properly in ISB (upper channel) at 9.9990 MHz. A 1000-Hz tone should be heard.	Functioning properly.	Same as step h.

Table 2. Overall Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
17. (Cont)	q. Connect distortion analyzer to ISB 600-ohm terminals with a 600-ohm resistor in parallel. Set analyzer to voltmeter function. Set 7404A-1 switches 6 thru 31 down. Set switches 11 and 27 up. Press SEND/READY button. Set 11 and 27 down. Set switches 7, 12, 13, 14, 20, 27, and 29 up. Press SEND/READY button. Determine that 651S-1/1A is functioning properly in ISB (low channel) at 10.0010 MHz. Analyzer should indicate +2 to +4-dBm audio level. Disconnect analyzer.	Functioning properly.	Same as step h.
	r. (Perform this step only if optional CW bandwidth filter card A5A2 is installed.) Set 7404A-1 switches 6 thru 31 down. Set switch 11 up. Press SEND/READY button. Set 11 down. Set switches 7, 12, 15, 19, 24, and 29 up. Press SEND/READY button. Determine that 651S-1/1A is in CW at 10.0000 MHz.	A 500-Hz tone should be heard with a noise band as wide as the optional filter bandwidth.	Same as step h.
	s. Set 7404A-1 switches 6 thru 31 down. Set 11 back up. Press SEND/READY button. Set 11 down. Set switches 7, 12, 15, 22, 24, and 29 up. Press SEND/READY button. Determine that 651S-1/1A is in CW at 10.0000 MHz.	A 500-Hz tone should be heard with a noise band 500 Hz wide. Vbfo equivalent to position 4.	Same as step h.
	t. (Perform this step only if step r was performed.) Set 7404A-1 switches 6 thru 31 down. Set switch 11 up. Press SEND/READY button. Set 11 down. Set switches 7, 12, 15, 22, 25, and 29 up. Press SEND/READY button. Determine that 651S-1/1A is in CW at 10.0000 MHz.	A 500-Hz tone should be heard with a noise band as wide as the optional filter bandwidth.	Same as step h.
(Cont)	u. Set 7404A-1 switches 6 thru 31 down. Set switches 12, 15, 16, 19, 20, 23 24, and 27 up. Press SEND/READY button. Set switches 6 thru 31 down. Set switches 7, 12, 14, 18, 20, 27, and 29 up. Press SEND/READY button. Check for slow AGC release time (1 second) by disconnecting the hf signal generator. Reconnect generator.	Audio should disappear, there should be a 1-second quiet spot, and then background noise should be heard.	Same as step h.

Table 2. Overall Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
17. (Cont)	v. Set 7404A-1 switches 6 thru 31 down. Set switches 12, 15, 16, 19, 20, 23, 24, and 27 up. Press SEND/READY button. Set switches 6 thru 31 down. Set switches 7, 12, 14, 20, 27, and 29 up. Press SEND/READY button. Check for fast AGC release time (0.1 second) by disconnecting hf signal generator. Reconnect generator.	Audio should disappear and background noise should be present in 0.1 second.	Same as step h.
	w. Connect distortion analyzer to STD 600-ohm terminals with 600-ohm resistor in parallel. Set to voltmeter function. Set 7404A-1 switches 6 thru 31 down. Set switches 12, 15, 16, 19, 20, 23, 24, and 27 up. Press SEND/READY button. Set switches 6 thru 31 down. Set switches 7, 12, 14, 20, 27, 28, and 29 up. Press SEND/READY button. Check for no AGC action by varying signal generator output level from 0 to 20 μV.	Audio output should rise linearly. If AGC is operating, the audio would flatten out above approximately 1 μV.	Same as step h.
	x. VBFO Check		
	(1) Connect one tone of the 2-tone generator to the ANT jack. Set it to 10.0000 MHz at 1 μV. Connect frequency counter to the 651S-1/1A SPKR jack. Set 7404A-1 switches 6 thru 31 down. Set switches 12, 15, 16, 19, 20, 23, 24, and 27 up. Press SEND/READY button. Set switches 6 thru 31 down. Set switches 7, 12, 16, 20, 27, and 29 up. Press SEND/READY button. Set switches 6 thru 31 down. Set switches 6, 28, 29, 30, and 31 up. Press SEND/READY button. Check audio frequency.	1060 ±6 Hz.	Test DCFE A8 using table 11.
	(2) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 27, 28, 29, 30, and 31 up. Press SEND/READY button. Check audio frequency.	1050 ±5 Hz.	Same as step x.(1).
	(3) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 26, 28, 29, 30, and 31 up. Press SEND/READY button. Check audio frequency.	1040 ±5 Hz.	Same as step x.(1).
	(4) Set 7404A-1 switches 6 thru 31 down. Set switches 6 and 26 thru 31 up. Press SEND/READY button. Check audio frequency.	1030 ±4 Hz.	Same as step x.(1).

Table 2. Overall Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
17. (Cont)	(5) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, and 28 thru 31 up. Press SEND/READY button. Check audio frequency.	1020 ±4 Hz.	Same as step x.(1).
	(6) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, and 27 thru 31 up. Press SEND/READY button. Check audio frequency.	1010 ±3 Hz.	Same as step x.(1).
	(7) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, 26, and 28 thru 31 up. Press SEND/READY button. Check audio frequency.	1000 ±3 Hz.	Same as step x.(1).
	(8) Set 7404A-1 switches 6 thru 31 down. Set switches 6 and 25 thru 31 up. Press SEND/READY button. Check audio frequency.	990 ±3 Hz.	Same as step x.(1).
	(9) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 24, and 28 thru 31 up. Press SEND/READY button. Check audio frequency.	980 ±4 Hz.	Same as step x.(1).
	(10) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 24, and 27 thru 31 up. Press SEND/READY button. Check audio frequency.	970 ±4 Hz.	Same as step x.(1).
	(11) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 24, 26, and 28 thru 31 up. Press SEND/READY button. Check audio frequency.	960 ±5 Hz.	Same as step x.(1).
	(12) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 24, and 26 thru 31 up. Press SEND/READY button. Check audio frequency.	950 ±5 Hz.	Same as step x.(1).
(Cont)	(13) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 24, 25, and 28 thru 31 up. Press SEND/READY button. Check audio frequency.	940 ±6 Hz.	Same as step x.(1).

Table 2. Overall Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
17. (Cont)	y. Perform the following steps only if DCFE card A8 is jumpered for rf gain:		
	(1) Set the signal generator for CW at 10.0000 MHz with 1-μV output. Monitor STD 600-ohm audio output level with distortion analyzer. Set 7404A-1 switches 6 thru 31 down. Set switches 12, 15, 16, 19, 20, 23, 24, and 27 up. Press SEND/READY button. Set switches 6 thru 31 down. Set switches 7, 12, 14, 20, 27, 28, and 29 up. Press SEND/READY button. Set switches 6 thru 31 down. Set switches 6, 25, 26, and 28 thru 31 up. Press SEND/READY button. Note audio output level for reference.	Reference audio level.	
	(2) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, 26, and 28 thru 30 up. Press SEND/READY button. Vary signal generator level to produce audio reference. Record dB relationship to 1 μV.	+6 dB nom.	Test DCFE card A8 using table 11.
	(3) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, 26, 28, 29, and 31 up. Press SEND/READY button. Again produce audio reference. Record dB relationship.	+6 dB nom.	Same as step y.(2).
	(4) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, 26, 28, and 29 up. Press SEND/READY button. Record dB change to produce reference.	+6 dB nom.	Same as step y.(2).
	(5) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, 26, 28, 30, and 31 up. Press SEND/READY button. Record dB change to produce reference.	+6 dB nom.	Same as step y.(2).
	(6) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, 26, 28, and 30 up. Press SEND/READY button. Record dB change to produce reference.	+6 dB nom.	Same as step y.(2).
(Cont)	(7) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, 26, 28, and 31 up. Press SEND/READY button. Record dB change to produce reference.	+6 dB nom.	Same as step y.(2).

Table 2. Overall Performance Test Procedures (Cont).

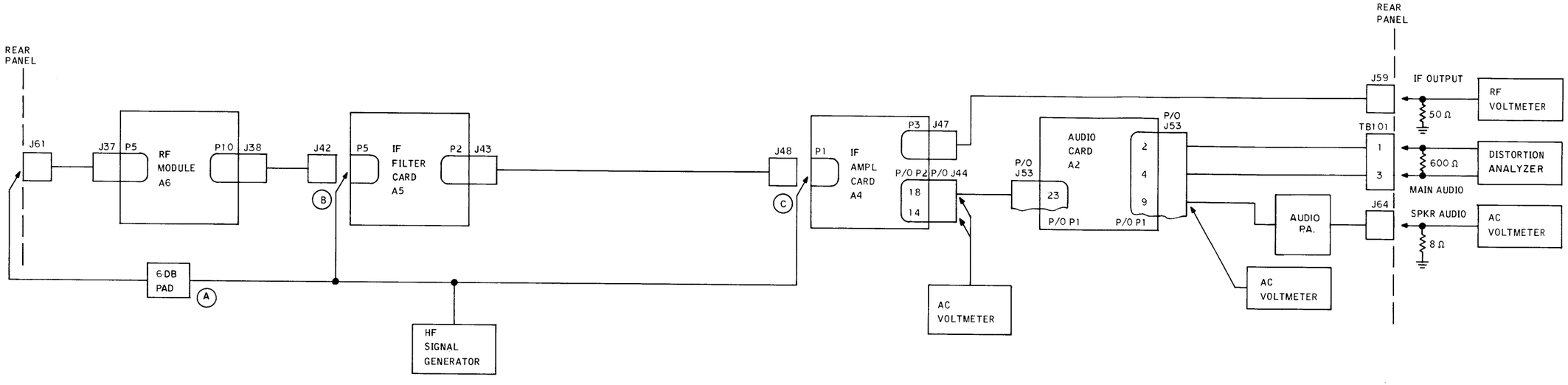
TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
17. (Cont)	(8) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, 26, and 28 up. Press SEND/READY button. Record dB change to produce reference.	+6 dB nom.	Same as step y.(2).
	(9) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, 26, and 29 thru 31 up. Press SEND/READY button. Record dB change to produce reference.	+6 dB nom.	Same as step y.(2).
	(10) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, 26, 29, and 30 up. Press SEND/READY button. Record dB change to produce reference.	+6 dB nom.	Same as step y.(2).
	(11) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, 26, 29, and 31 up. Press SEND/READY button. Record dB change to produce reference.	+6 dB nom.	Same as step y.(2).
	(12) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, 26, and 29 up. Press SEND/READY button. Record dB change to produce reference.	+6 dB nom.	Same as step y.(2).
	(13) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, 26, 30, and 31 up. Press SEND/READY button. Record dB change to produce reference.	+6 dB nom.	Same as step y.(2).
	(14) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, 26, and 30 up. Press SEND/READY button. Record dB change to produce reference.	+6 dB nom.	Same as step y.(2).
	(15) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, 26, and 31 up. Press SEND/READY button. Record dB change to produce reference.	+6 dB nom.	Same as step y.(2).
(Cont)	(16) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, and 26 up. Press SEND/READY button. Record dB change to produce reference.	+6 dB nom.	Same as step y.(2).

Table 2. Overall Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
17. (Cont)	z. Perform the following steps only if DCFE card A8 is jumpered for squelch:		
	(1) Set signal generator to CW at 10.0000 MHz. Connect speaker to 651S-1/1A. Set 7404A-1 switches 6 thru 31 down. Set switches 12, 15, 16, 19, 20, 23, 24, and 27 up. Press SEND/READY button. Set switches 6 thru 31 down. Set switches 7, 12, 14, 17, 20, 27, 28, and 29 up. Set switches 6 thru 31 down. Set switches 6, 25, 26, 28, 29, 30, and 31 up. Press SEND/READY button. Find signal generator output level that just breaks squelch to produce audio.	0 dB ref.	Test card A8. Normal setup for squelch operation is 1-dB increment. This can be varied by the program.
	(2) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, 26, 28, 29, and 30 up. Press SEND/READY button. Record level to break squelch.	+1 dB nom.	Same as step z.(1).
	(3) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, 26, 28, 29, and 31 up. Press SEND/READY button. Record level to break squelch.	+1 dB nom.	Same as step z.(1).
	(4) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, 26, 28, and 29 up. Press SEND/READY button. Record level to break squelch.	+1 dB nom.	Same as step z.(1).
	(5) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, 26, 28, 30, and 31 up. Press SEND/READY button. Record level to break squelch.	+1 dB nom.	Same as step z.(1).
	(6) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, 26, 28, and 30 up. Press SEND/READY button. Record level to break squelch.	+1 dB nom.	Same as step z.(1).
(Cont)	(7) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, 26, 28, and 31 up. Press SEND/READY button. Record level to break squelch.	+1 dB nom.	Same as step z.(1).

Table 2. Overall Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
17. (Cont)	(8) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, 26, and 28 up. Press SEND/READY button. Record level to break squelch.	+1 dB nom.	Same as step z.(1).
	(9) Set 7404A-1 switches 6 thru 31 down. Set switches 6, 25, 26, and 29 thru 31 up. Press SEND/READY button. Record level to break squelch.	+1 dB nom.	Same as step z.(1).
18. Abnormal SSB gain card isolation. (Do not perform this test unless some previous test has failed.)	a. If gain is abnormal, the defective subassembly can be isolated using the following steps. Refer to figure 5 for a block diagram of the procedure.		
	b. Extend card A5. Disconnect extender coaxial connector from A5P5. Connect the hf signal generator to A5P5 using BNC to subminiax adapter cable. Connect the distortion analyzer to the AUDIO LINES STD 600-ohm terminals with a 600-ohm resistor in parallel. Use distortion analyzer METER input.		
	c. Set 651S-1/1A to SSB, BANDWIDTH to 2.7U, at 9.9990 MHz (or 2.7L at 10.0010 MHz), fixed bfo, fast AGC, maximum RF GAIN, maximum AF GAIN.		
	d. Set the signal generator for 5-μV output, at 10.35 MHz. Peak the audio with the signal generator frequency.	Approx 0 dBm.	If abnormal, rf module A6 is good; proceed to next step. If normal, rf module is bad; proceed to table 8.
	e. Check level at STD IF output jack with rf voltmeter (using 50-ohm probe).	Approx 50 mV.	Same as step d.
	f. Connect the 8-ohm load resistor with speaker cable to the SPKR 8 OHM jack. Measure audio voltage with distortion analyzer.	Approx 2.85 V (1 watt).	Same as step d.
	g. Reinstall A5. Extend A4. Disconnect extender coax from A4P1. Connect signal generator to A4P1 and set it for 27-μV output at 450 kHz. Repeat measurements of steps d, e, and f.	Same as steps d, e, and f.	If abnormal, if filter card A5 is good; proceed to next step. If normal, if filter card A5 is bad; test using table 7.
	h. Measure audio level at A4P2-18 with digital voltmeter ac probe.	Approx 12 mVrms.	If abnormal, if ampl card A4 bad; proceed to table 6. If normal, proceed to step i.
	i. Measure audio level at A2P1-9 with digital voltmeter ac probe.	Approx 200 mVrms.	If abnormal, audio card A2 bad; proceed to table 4. If normal, and speaker audio level abnormal, audio power amplifier on chassis is bad; repair.



FOR GAIN CARD/ASSY ISOLATION, THE INJECTIONS TO EQUAL AGC THRESHOLD (1 UV, 10.0000 MHZ) AT POINT (A) ARE:

POINT (B) 5UV AT 10.35 MHZ

POINT (C) 30UV AT 450 KHZ

FOR SENSITIVITY CARD/ASSY ISOLATION, THE INJECTIONS TO EQUAL 0.4 UV AT 10 MHZ AT POINT (A) ARE:

POINT (B) 0.7 UV AT 10.35 MHZ

POINT (C) 0.32 UV AT 450 KHZ

FOR LARGE SIGNAL GAIN CARD/ASSY ISOLATION, THE INJECTIONS TO EQUAL 0.1 V AT 10 MHZ AT POINT (A) ARE:

POINT (B) 1.5 MV AT 10.35 MHZ

POINT (C) 5.8 MV AT 450 KHZ

REFER TO THE TEST PROCEDURE FOR THE OUTPUT LEVELS AT THE POINTS INDICATED.

TP2-8102-014

Card Isolation Tests, Test Setup Block Diagram
Figure 5

Table 8. Power Supply Regulator Card A1, Test Procedures.

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. Output voltage measurements	a. Extend regulator card A1. Connect the 651S-1 to primary power and set the POWER switch to OPER.		
	b. Measure the dc level at the following pins of A1P1:		
	3, 4, 9, 10	+5.0 to +5.2 Vdc.	Select new A1R16. Check +5.1-Vdc regulator circuit. If pins 3 and 4 only are incorrect, check enable circuit from A1P1-38 to relay A1K2.
	5, 6, 13, 14	-14.7 to -15.3 Vdc.	Select new A1R6. Check -15-Vdc regulator circuit. If pins 13 and 14 only are incorrect, check enable circuit from A1P1-38 to relay A1K2.
	23, 24, 29, 30,	+14.7 to +15.3 Vdc.	Select new A1R4. Check +15-Vdc regulator circuit. If pins 23 and 24 only are incorrect, check enable circuit from A1P1-38 to relay A1K1.
	33, 35, 36	+23.0 to +25.0 Vdc.	Check +25-Vdc regulator circuit. Check enable circuit from A1P1-38 to relay A1K1.
2. Performance monitor	a. Measure the dc level at performance monitor output pin A1P1-48.	NMT +0.5 Vdc.	Check gates U4A and U4B and associated circuits.
3. Blanking circuit	a. Rapidly rotate the 100-Hz tuning knob and measure the dc level at the following pins on A1P1:		
	71	NMT +1.0 Vdc while tuning.	Check blanking circuit from A1P1-69 to outputs A1P1-71 and A1P1-73.
	73	NLT +4.5 Vdc while tuning.	
	b. Select any operating frequency and measure the dc level at the following pins on A1P1:		
	71	NLT +1.0 Vdc.	Check blanking circuits from A1P1-69 to outputs A1P1-71 and A1P1-73.
	73	NMT +0.5 Vdc.	

Table 4. Audio Card A2, Test Procedures.

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. Dc voltages	a. Extend audio card A2. Connect the primary power and set the POWER switch to OPER. b. Measure the dc level at the following test points: ON 778-2948-002, -004 / ON 778-2948-003, -005 A2J6 / A2J1-2 A2J1 / A2J1-3	 +11 ±1 Vdc. -5 ±0.5 Vdc.	 A2VR5 or A2R83. A2VR1 or A2R1.
2. Af gain	a. Remove if amplifier card A4. Set MODE switch to SSB. Jumper A2P1 pins 23, 30, and 44. Connect a 27-kΩ resistor to a 2.2-kΩ resistor. Connect the free end of the 27-kΩ resistor to the high side of the audio oscillator output and the free end of the 2.2-kΩ resistor to the low side of the audio oscillator output (grounded). b. Connect a 600-ohm load resistor across the AUDIO LINES STD terminals and ground one side. Connect the meter portion of the distortion analyzer to the same points (make sure the low side of the meter input is the grounded side on the terminals). c. Set the audio oscillator for 17-mV (at the junction of the two resistors) output at 1 kHz. Connect junction to A2P1-23. d. Note the audio output level. e. Set the MODE and BANDWIDTH switches to the positions listed below and measure the audio output at each: MODE / BANDWIDTH FM / 6 FM / 16 AM / If installed, 3 AM / 6 AM / 16 f. Connect a 10-kΩ resistor from A2P1 pin 9 to ground and connect the audio meter across the resistor. (Cont)	 0 dBm. 0 ±1 dBm. -6 ±1 dBm. 0 ±1 dBm. 0 ±1 dBm. -6 ±1 dBm.	 Adjust A2R70. A2Q7, Q8, Q13 and Q14, and associated circuits. A2Q9, Q10, and associated circuits.

Table 4. Audio Card A2, Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
2. (Cont)	g. Measure the audio level in dBm at each of the following modes. MODE — BANDWIDTH SSB — 2.7U CW — If installed, .2	 -10 ±1.5 dBm. -10 ±1.5 dBm.	
3. Performance and af level monitors	a. Return oscillator frequency to 1 kHz. Adjust the oscillator output level for 0 dBm on the audio voltmeter. b. Measure the dc level at audio performance monitor pin A2P1-12. c. Adjust the oscillator output level for -10 dBm on the audio voltmeter and measure the dc level at pin A2P1-12. d. Readjust the oscillator output level for 0 dBm on the audio voltmeter. Set front panel METER switch to LINE. Check indication on front panel meter.	 NMT +0.5 Vdc. NLT +4.0 Vdc. 0 dBm ±1.3 dB.	 Check A2Q16, Q17, Q19, and associated circuits. Check A2Q16, Q17, Q19, and associated circuits. Check A2R91 and wiring to A2P1-6.
4. Distortion	a. With oscillator at 1 kHz, adjust the output level for 0 dBm on the audio voltmeter. b. Connect the distortion portion of the distortion analyzer to the 600-ohm STD AUDIO LINES terminals. Measure and record the total harmonic distortion. c. Adjust oscillator output level for +6 dBm on the audio voltmeter. Measure and record the total harmonic distortion.	 NMT 1.0%. NMT 1.0%.	
5. Squelch (CPN 778-2948-002; -004 only) (Cont)	a. Adjust oscillator at 1 kHz for 0 dBm on audio voltmeter. Ensure SQUELCH switch is in OFF. b. Connect audio voltmeter to the squelch low-channel test point A2J2 and vary the oscillator frequency until the voltmeter reads a maximum. Record frequency and voltage. c. Connect the audio voltmeter to the squelch high-channel test point A2J3 and vary the oscillator frequency for a voltage maximum. Record the frequency and voltage.	 650 ±100 Hz at NLT 750 mV. 2700 ±300 Hz at one half the voltage for the low channel.	 Check low-channel circuits and A2U1A. Check high-channel circuits and A2U1B. Adjust A2R27 for voltage level.

Table 4. Audio Card A2, Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
5. (Cont)	d. Connect the audio voltmeter to the 600-ohm STD AUDIO LINES terminals. Adjust the oscillator for 1 kHz and 0 dBm on the audio voltmeter.		
	e. Set the front panel SQUELCH switch to position 7 (OFF is position 0, position 1 is next step clockwise).		
	f. Increase the oscillator frequency until the audio output suddenly drops. Record the level on the audio voltmeter.	NMT -40 dBm.	Check squelch gate A2Q15. Check A2U2 and circuits to A2Q15.
	g. Decrease frequency slowly until the audio level jumps back to 0 dBm. Increase frequency quickly to beyond the squelching frequency and note the time delay before the audio drops out.	1 to 3 seconds.	Check A2C46, R97.
	h. Set front panel SQUELCH switch to OFF.	Audio output comes back up.	Check squelch control circuits from A2P1-32 to A2Q15.
	i. Rapidly rotate the 100-Hz tuning knob.	Audio output drops out while tuning.	Check audio blanking circuits from A2P1-11 A2Q15.
	j. Disconnect test equipment.		
6. Vbfo	a. Set POWER switch to OFF. Remove the cover from the vbfo subassembly. Terminate A2P2 with a 150-ohm load (resistor). Connect oscilloscope, counter, and rf voltmeter with high-impedance probe to bfo output jack A2P2. ***Note*** Steps b and c apply to -002 and -003 (effectivity up to CI-72353) only.		
	b. Set front panel BFO switch to VAR, MODE switch to CW, and BANDWIDTH to .5. Check waveform.	Clean sinusoid at approximately 450 kHz.	Check filter circuit A2A1T1, -T2, -C42, -C43, and -C44.
	c. Set MODE switch to SSB, BANDWIDTH to 2.7U, and check waveform.	Clean sinusoid at approximately 450 kHz.	Check filter circuit A2A1T1, -T2, -C42, -C43, and -C44.
(Cont)	d. Return MODE switch to CW, BANDWIDTH to desired bandwidth, and set VBFO switch to position 7 (center). Check output frequency.	450.000 ±.010 kHz.	Adjust A2R34.

Table 4. Audio Card A2, Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
6. (Cont)	e. Check output level on rf voltmeter.	300 ±30 mV.	On -002 and -003 (effectivity up to CI-72353) adjust A2A1T1 and A2A1T2 for maximum level on rf voltmeter. If level is still not within specification, select new A2A1R32 (larger A2A1R32 decreases output level). On -004 and -003, -005 (effectivity CI-72373) select new A2A1R32.
	f. Set MODE switch to SSB, BANDWIDTH to 2.7U, and check rf voltmeter indication.	300 ±30 mV.	Same as step e.
	g. Set VBFO switch to 13 (cw). Set MODE switch to CW, and BANDWIDTH to desired bandwidth. Measure output frequency at A2P2.	451 kHz.	Check crystal oscillator circuits. Check mixer A2A1U1 and associated circuits.
	h. Set BFO switch to FIXED and measure output frequency at A2P2.	450,000 kHz.	Check diodes A2A1CR7 and -CR8.
	i. Reinstall cover on the vbfo subassembly. Set BFO switch to VAR and VBFO switch to position 7 (center). Measure output frequency.	450.000 ±.005 kHz.	Adjust A2R34.
	j. Measure output frequencies at the following VBFO switch positions:		
	1 (ccw) 13 (cw)	NMT 449.100 kHz. NLT 450.900 kHz.	Check crystal oscillator circuits and mixer A2A1U1 circuits.
	k. Set MODE switch to SSB, BANDWIDTH to 2.7U, and VBFO switch to position 7 (center). Measure output frequency.	450.000 kHz.	Adjust A2R43.
	l. Set VBFO switch to position 13 (cw). Measure output frequency.	450.047 to 450.063 kHz.	Adjust A2R41.
	m. Repeat step k and l until both frequencies are correct.		
	n. Set VBFO switch to position 1 (ccw). Measure output frequency.	449.937 to 449.943 kHz.	Select new A2C3 (larger A2C3 lowers minimum frequency).
	o. If capacitor A2C3 was changed in step m, repeat steps k through n.		

Table 5. ISB Amplifier Card A3, Test Procedures.

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. If gain adjust	a. Extend ISB amplifier card A3. Connect primary power and set the POWER switch to OPER. Set the RF GAIN control fully clockwise, the MODE switch to ISB, the AGC switch to FAST, the SQUELCH switch to OFF, and the BFO switch to FIXED.		
	b. Disconnect the extender coax from A3P1 and connect the hf signal generator (no 6-dB pad) to A3P1 using a BNC to subminiax adapter cable (figure 1). Set it to 451 kHz at 27 μV.		
	c. Connect the rf voltmeter to the ISB IF output jack, set A3R57 fully clockwise, and peak the output with A3T1. Note the rf voltmeter indication.	50 mV.	Adjust A3R7.
2. ISB audio output	a. Connect a 600-ohm load resistor and the meter portion of the distortion analyzer to the AUDIO LINES ISB 600-ohm terminals.		
	b. Peak the audio indication using A3T2. Note the final level.	0 ±1 dBm.	Adjust A3R92.
	c. Increase the signal generator output level to 10 mV and note the rise in audio output.	4 to 5-dB rise over step b.	Adjust A3R57.
3. AGC operation	a. Set the signal generator output level to 0. Slowly increase the level to 27 μV and monitor the audio. Continue to increase the output up to 10 mV.	Audio level increases rapidly with up to 27 μV in; then the increase slows considerably. Final level at 10 mV is NMT 5 dB above that for 27 μV in.	Repeat steps 1, 2, and 3 until the following requirements are met: AGC threshold, 25 to 30 μV; audio rise, 5 to 6 dB; and if output, 40 to 60 mV.
4. If gain reduction	a. Set the signal generator for 27 μV out. Note the rf voltmeter indication for reference.		
	b. Set the AGC switch to off (center position) and set the RF GAIN control fully counterclockwise.		
	c. Increase the signal input until the reference rf voltmeter indication is reached, and note the increase required.	85 to 95 dB.	

Table 5. ISB Amplifier Card A3, Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
5. Audio distortion	a. Connect the 2-tone generator to the 2-tone adapter (figure 2). Set the tones for 450.6 and 451.6 kHz, each at 2.5 mV (at the adapter output). Connect the adapter to A3P1. b. Connect the wave analyzer to the 600-ohm AUDIO LINES ISB terminals (with 600-ohm load) and measure the distortion products at the following frequencies: F1 (600 Hz) 2F2-F1 (2600 Hz)	 0-dB reference. NLT 40 dB down.	

Table 6. IF Amplifier Card A4, Test Procedures.

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. If gain adjust	a. Extend if amplifier card A4. Connect the 651S-1/1A to primary power and set the POWER switch to OPER. Set the RF GAIN control fully clockwise, the MODE switch to SSB, BANDWIDTH to 2.7U, and the AGC switch to off (center) position.		
	b. Disconnect the extender coax from A4P1 and connect the signal generator (no 6-dB pad) at 451 kHz, 27 μV to A4P1 using a BNC to subminiax adapter cable (figure 1). Connect an rf voltmeter (with 50-ohm probe) to the STD IF output jack.		
	c. Set A4R61 fully clockwise. Adjust A4T1 for maximum output. Note the rf voltmeter indication.	57 mV.	Adjust A4R6.
	d. Set AGC switch to FAST. Note rf voltmeter indication.	50 mV.	Adjust A4R61.
	e. Repeat procedure as necessary so rf voltmeter indication is 57 ±1 mV with no AGC and 50 ±1 mV with AGC.		
2. AGC control	a. Set AGC switch to FAST. Set the signal generator to 27 μV and note the rf voltmeter indication.	0-dB reference.	Check AGC amplifier circuits.
	b. Set the signal generator to 5-mV output and note the rf voltmeter indication increase.	NMT 5-dB rise.	
3. SSB audio output	a. Set the BFO switch to FIXED. Set the signal generator for 27 μV.		
	b. Connect the meter portion of the distortion analyzer to A4P2-18. Note the indication.	15 to 22 mV.	Adjust A4T3 for maximum output.
4. SSB audio distortion	a. Connect the 2-tone generator through the adapter shown in figure 2. Set the tones for 450.6 kHz and 451.6 kHz, each at 2.5 mV (at the adapter output). Connect the adapter to A4P1, connect the wave analyzer to A4P2-18, and measure the following distortion products: F1 (600 Hz) 2F2-F1 (2600 Hz)	 0-dB reference. NLT 40 dB down.	

Table 6. IF Amplifier Card A4, Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
5. AM audio output	a. Connect the signal generator to A4P1 and set it for 450 kHz at 5-mV modulated 30% at 1000 Hz.		
	b. Set 651S-1/1A to AM mode with a bandwidth of 6 kHz. Measure audio output at A4P2-4.	15 to 25 mV.	Check audio amplifier.
6. FM audio output (-001, -003 only)	a. Set the audio oscillator for 1-V output at 1000 Hz. Connect it to the signal generator external modulation input. Set the signal generator for 450 kHz at 5 mV.		
	b. Set the 651S-1/1A to FM mode with a bandwidth of 6 kHz; measure the audio output at A4P2-21.	2 to 6 mV.	Adjust A4L8 for maximum output.
7. Meter output	a. Set the 651S-1/1A METER switch to RF. Disconnect the audio oscillator. Set the signal generator to 450 kHz at 5 mV. Connect a 205-ohm resistor to A4P2-12 and ground, and measure the dc level.	0.15 V.	Adjust A4R109.
8. If gain reduction	a. Set the signal generator to 450 kHz at 27 μV. Connect the rf voltmeter (with 50-ohm probe) to the STD IF output jack. Set the 651S-1/1A RF GAIN control fully clockwise.		
	b. Note the rf voltmeter indication.	0-dB reference.	
	c. Set the RF GAIN control fully counterclockwise and note the increase of signal generator output necessary to produce the 0-dB reference on the rf voltmeter.	85 to 95 dB.	

Table 7. IF Filter Card A5, Test Procedures.

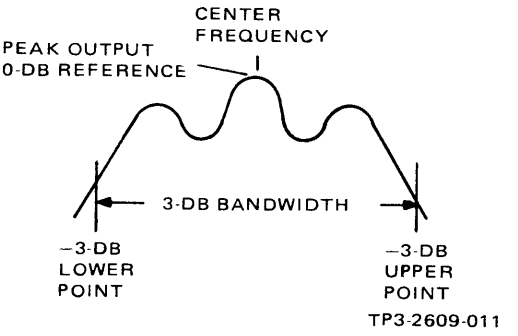
TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. Gain, standard modes	a. Extend if filter card A5. Connect the primary power and set the 651S-1/1A POWER switch to OPER, BFO switch to FIXED, MODE switch to FM, BANDWIDTH switch to 6, at any frequency. Set the RF GAIN control fully clockwise.		
	b. Connect one tone of the 2-tone generator at 9.9 MHz, 0.6 Vrms to A5P4 using a BNC to subminiax adapter cable. Connect an hf signal generator to A5P5 and set it for 10.35 MHz at 3.0-mV output. Connect an rf voltmeter (with 50-ohm probe) to A5P2.		
	c. Vary the signal generator frequency for a maximum indication on the rf voltmeter indication.	14 to 20 mV.	Adjust A5T1 and A5T2 for maximum output.
	d. Repeat step c for the following modes:		Same as step c.
	MODE / BANDWIDTH		
	FM 16	14 to 20 mV.	
	AM 6	20 to 30 mV.	
	AM 16	15 to 25 mV.	
	SSB 2.7U	15 to 23 mV.	
	SSB 2.7L	15 to 23 mV.	
2. Gain, optional modes	a. Repeat the procedures of step 1 for the following optional modes, if applicable:		Same as step 1.c.
	MODE / BANDWIDTH		
	AM 3	20 to 30 mV.	
	CW 1, 4, WSRT, or WBTV	20 to 30 mV.	
	CW .5, 2, or CW	20 to 30 mV.	
	CW .2, 1, or NSRT	20 to 30 mV.	
	b. Connect the rf voltmeter to A5P1 (ISB if output). Set the MODE switch to ISB and vary the signal generator frequency to obtain the maximum rf voltmeter indication. Note the indication.	17 to 24 mV.	Same as step 1.c.
3. Filter responses, AM, USB, and LSB (Cont)	a. Set the 651S-1/1A to SSB mode with BANDWIDTH at 2.7U and frequency at 450 kHz. Set the signal generator to 451 kHz. Vary frequency slightly to peak output. Increase signal to produce 10 mV at A5P2. Note as 0-dB reference.		

Table 7. IF FILTER Card A5, Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
3. (Cont)	b. Decrease signal generator frequency until output decreases 2-dB from reference bandpass point, lower). Note the frequency.	NMT 450.6 kHz.	
	c. Slowly increase the frequency (starting at 451 kHz) to find upper bandpass as in step b.	NLT 453.05 kHz for upper 2-dB point.	
	d. Refer to figure 6 for bandwidth definitions.		
	e. Set the 651S-1/1A to SSB mode, BANDWIDTH to 2.7L, and repeat steps a through d using the 449 kHz as the 0-dB reference.	NMT 446.95 kHz for the lower bandpass 2-dB point, NLT 449.4 kHz for the upper bandpass 2-dB point.	
	f. Set the 651S-1/1A to AM mode with a 6-kHz bandwidth. Set the signal generator to 450 kHz and record the output level as 0-dB reference.		
	g. Find the 6-dB drop points above and below 450 kHz. Note the frequency at each point. Subtract the frequencies and record the result.	5.25 to 6.75 kHz.	
	h. Refer to figure 6 for AM bandwidth definitions.		
4. Filter responses, AM and CW	a. With the same setup as in step 3, set the signal generator to 10.35 MHz with output to produce 12 mV at the rf voltmeter.		
	b. Set the 651S-1/1A to AM mode and BANDWIDTH to 3 (if AM 3 is installed). Also two bandwidths of AM 3 are possible, 3 or 4 kHz. Sweep the signal generator around 10.35 MHz to find the upper and lower 3-dB down points (bandwidth). Refer to figure 6 for bandwidth definitions.	Bandwidth, 2.7 to 3.3 kHz. Bandwidth, 3.8 to 4.2 kHz.	
	c. Set the 651S-1/1A to CW BANDWIDTH to the appropriate position and sweep the signal generator frequency to find the 3-dB bandwidth as in step b for all CW modes installed. Refer to figure 6. Use enough signal to produce 12-mV out.	***Note*** The total 3-dB bandwidth shall be within 50 percent of the nominal bandwidth. For example, the 500-Hz filter shall have a 3-dB bandwidth of 500 Hz ±250 Hz or from 250 to 750 Hz.	Check appropriate filter.
(Cont)			

Table 7. IF Filter Card A5, Test Procedures (Cont).

TEST	PROCEDURE		NORMAL INDICATION	IF INDICATION IS ABNORMAL
4. (Cont)	BANDWIDTH SWITCH	FILTER	NOMINAL 3-dB BANDWIDTH	
	1st CW position (1, 4, WSRT, or WBTY)	1 kHz	1 kHz	
		1.1 kHz (offset +2 kHz)	1.1 kHz	
		1.1 kHz (offset +2.55 kHz)	1.1 kHz	
		4 kHz	4 kHz	
	2nd CW position (.5, 2, or CW)	500 Hz	500 Hz	
		2 kHz	2 kHz	
	3rd CW position (.2, 1, or NSRT)	200 Hz	200 Hz	
		370 Hz (offset +2 kHz)	370 Hz	
		1.1 kHz	1.1 kHz	



IF Filter Card A5, Filter Response
Figure 6

Table 8. RF Module A6, Test Procedures.

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. Passband variations	a. Extend rf module A6 on its module extender. Connect the 651S-1/1A to primary power and set POWER switch to OPER. Set 651S-1/1A MODE switch to SSB, BANDWIDTH switch to 2.7U, AGC switch to off (center) position, and RF GAIN control fully clockwise. Tune the 651S-1/1A to 10.0 MHz. b. Connect the rf voltmeter (with 50-ohm probe) to the IF OUTPUT jack (J59). Connect the signal generator (through a 6-dB pad) to ANT jack (J61); set it for 10.0 MHz at 2 μV and tune for zero beat. c. Set 651S-1/1A MODE switch to AM, BANDWIDTH to 16, and note if output level. d. Tune the 651S-1/1A ±3 kHz and measure the if output variation in dB.	NMT 1 dB.	Perform voltage checks and adjustment procedures, steps 6 through 11.
2. Sensitivity (Cont)	***Note*** The 651S-1/1A 600-ohm audio output (TB101, terminals 1 and 3) must be terminated in a 600-ohm resistive load when performing tests on rf module A6. a. Connect an audio vtvm to the 600-ohm audio output (TB101, terminals 1 and 3) on the 651S-1/1A. b. Set 651S-1/1A MODE to SSB and BANDWIDTH to 2.7U. c. Measure sensitivity (snr) at the following frequencies and input signal levels:		Perform voltage checks adjustment procedures, steps 6 through 11.

FREQ		INPUT SIG LVL	SNR
100 kHz, 300 kHz, 550 kHz	(790-1048-010, -021 only)	2.5 μV 2.5 μV 2.5 μV	NLT 10 dB NLT 10 dB NLT 10 dB
350 kHz	(790-1048-008, -020 only)	2.5 μV	NLT 10 dB
1350 kHz		2.5 μV	NLT 10 dB
2.0 MHz		0.7 μV	NLT 10 dB
3.0 MHz		0.7 μV	NLT 10 dB
4.0 MHz		0.7 μV	NLT 10 dB
6.0 MHz		0.7 μV	NLT 10 dB

Table 8. RF Module A6, Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
2. (Cont)	FREQ / INPUT SIG LVL / SNR 8.0 MHz / 0.7 μV / NLT 10 dB 12 MHz / 0.7 μV / NLT 10 dB 16 MHz / 0.7 μV / NLT 10 dB 24 MHz / 0.7 μV / NLT 10 dB 29.999 MHz / 0.7 μV / NLT 10 dB d. For rf module A6 790-1048-010 or -021, connect equipment as shown in figure 7. **Note** Assure that the jumper on vlf filter FL601 is connected for 50-ohm input (terminals 2 and 3). e. Measure sensitivity at the following frequencies and input signal levels: FREQ / INPUT SIG LVL / SNR 12 kHz / 2.5 μV / NLT 10 dB 50 kHz / 2.5 μV / NLT 10 dB f. Connect the jumper on FL601 for 1000-ohm input (terminals 1 and 3) and connect the 1000-ohm resistor as shown with dashed lines in figure 7. g. Measure sensitivity at 12 kHz with signal generator output level at 6 volts. **Note** Restrap FL601 for 50-ohm input (normal).	Snr: NLT 10 dB.	Perform voltage checks and adjustment procedures, steps 6 through 11.
3. Internal spurious level	a. Connect rf signal generator (through a 6-dB pad) to the ANT jack and an audio vtvm to the 600-ohm audio output on the 651S-1/1A. b. Set signal generator output level to zero, the 651S-1/1A to 20.7005 MHz, MODE to SSB, and BANDWIDTH to 2.7U. c. Note audio output for reference. Detune the 651S-1/1A to 20.6005, set the signal generator to 20.6005 MHz, and increase output level to produce the same audio output as noted for reference. Note signal generator output level.	Signal generator output level NMT 10 μV.	Perform voltage checks and adjustment procedures, steps 6 through 11.

Table 8. RF Module A6, Test Procedures (Cont).

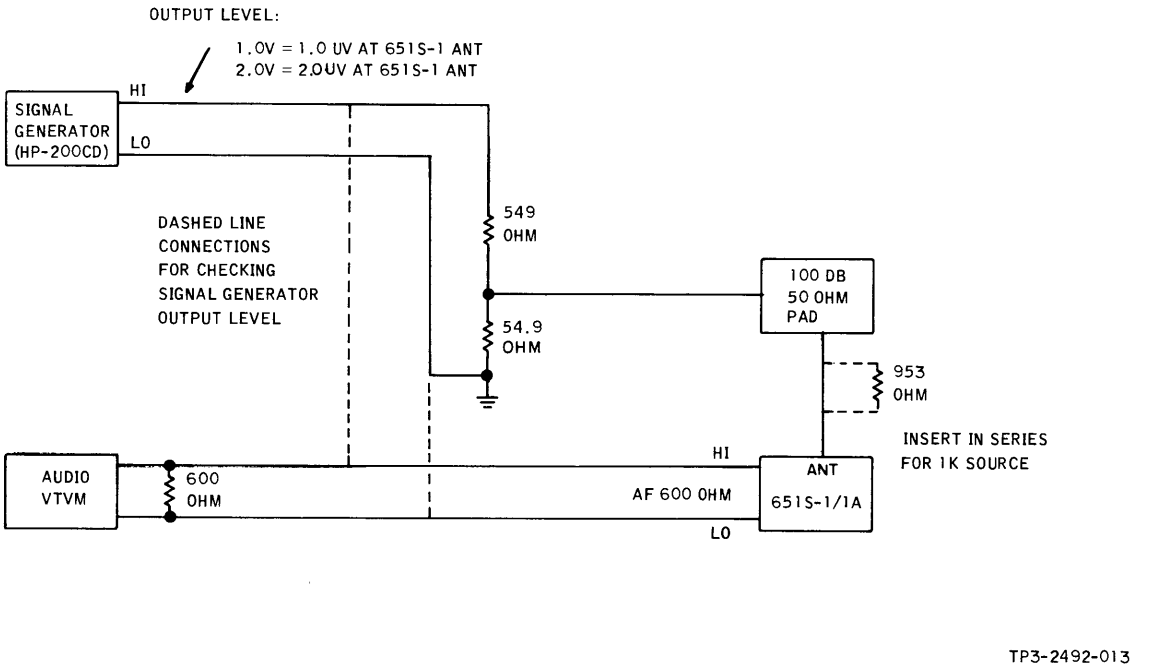
TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
4. Gain	a. Set signal generator for 28.0000 MHz at 1 μV.		
	b. Set 651S-1/1A to 28.0000 MHz. Vary frequency for peak audio out and measure audio output.	790-1048-008, -010: +0.5 to -0.5 dBm. 790-1048-020,-021: +2.5 to +3.5 dBm.	Adjust A6R31 (figure 8).
	c. For rf module A6 790-1048-010, set signal generator to 250 kHz at 1 μV and 651S-1/1A to 250 kHz. Vary frequency to peak audio out and measure audio output.	-2 to +2 dBm.	Perform voltage checks and adjustment procedures, steps 6 through 11.
5. AGC	a. Set the 651S-1/1A and the signal generator to 10.0 MHz. Vary frequency slightly to peak audio, and adjust signal generator output level to produce 0-dBm audio output.		
	b. Connect a variable dc source to the AGC lead (green) on the rf module, (figure 8), and adjust for +2.2 Vdc.		
	c. Readjust signal generator output level for a 0-dBm audio output and note the increase in dB.	45 to 55 dB.	Check AGC diodes A6CR1 through A6CR4.
	d. For rf module A6 790-1048-010 or -021, repeat steps a, b, and c with signal generator and 651S-1/1A set to 250 kHz.	45 to 55 dB.	Check AGC diodes A6CR1 through A6CR4.
6. Injection voltage (figure 8)	***Note*** Tests (adjustments) 6 through 11 not required if 651S-1/1A successfully passed tests 1 through 5.		
	a. Set the 651S-1/1A MODE to SSB, BANDWIDTH to 2.7U, and frequency to 10.0 MHz.		
	Note Do steps b and c for A6 790-1048-008 and -010. Do only step c for A6 790-1048-020 and -021.		
	b. With rf voltmeter (use hi-z probe with a very short ground lead), measure injection voltage at the source lead of U1 (figure 8).	2.25 to 2.50 Vac.	Change test select resistor A6R20.
	c. Measure injection voltage at the source of Q1 or Q2.	1.80 to 2.50 Vac.	Change test select resistor A6R25.

Table 8. RF Module A6, Test Procedures (Cont).

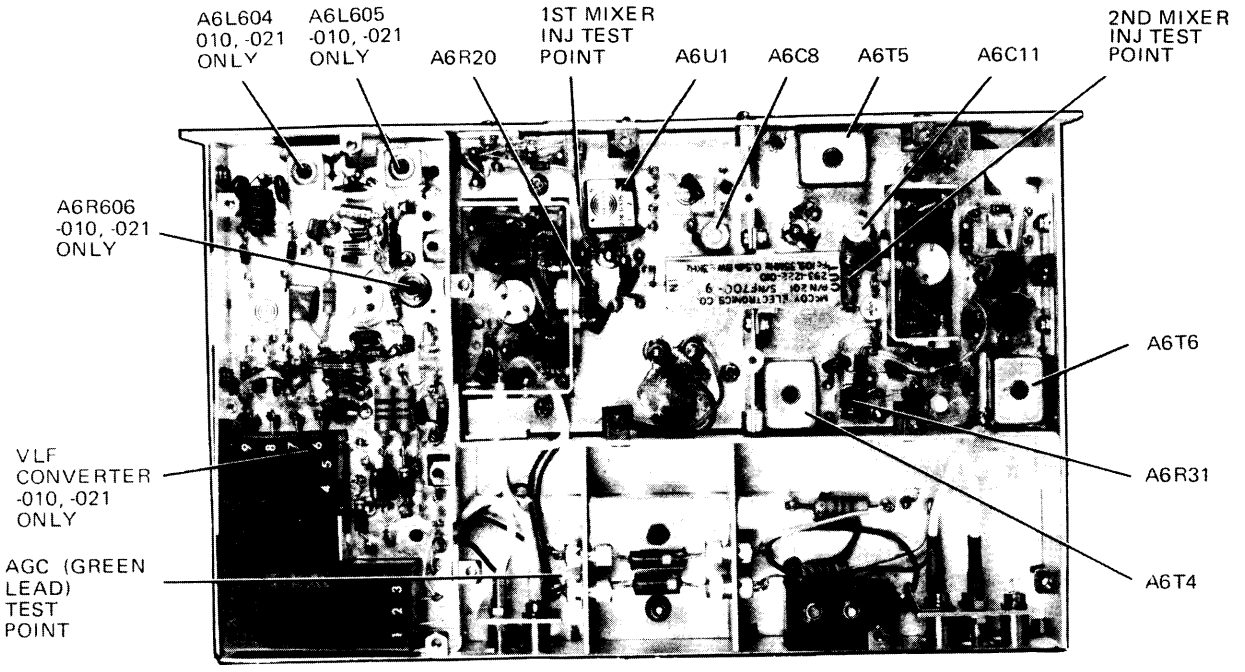
TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
7. Initial adjustments (figure 8)	a. Set A6R31 fully cw. Set 651S-1/1A to 10 MHz and signal generator to 9.9990 MHz at 1 μV. (Vary frequency slightly to peak audio out.)		
	b. Adjust A6C8, A6C11, and A6T4 for maximum audio output.	Peak adjustment possible.	Peak adjustment not possible. Check Q1, Q2, Q3, U1, and associated circuits.
8. 9.45-MHz trap adjustment (figure 8) (All -008 and -010 part numbers and the -020 part number if T6 is installed.)	a. Set 651S-1/1A to 9.1 MHz. Set signal generator output level for 1 μV and frequency to 9.1 MHz. Adjust slightly to peak audio output.		
	b. Set 651S-1/1A to 10 MHz. Increase signal generator output level to 0.1 volt and adjust frequency slightly to peak audio output.		
	c. Adjust A6T6 for a null in the audio output.	Null possible.	Null not possible. Check Q3, T6, and associated components.
	d. Return 651S-1/1A to 9.1 MHz. Set signal generator output level to 1 μV and adjust frequency to peak audio output.		
	e. Adjust A6T4 and A6T5 for maximum audio output.		
	f. Repeat steps b through e until no further improvement is possible.		
	g. Note the audio output with the 651S-1/1A and signal generator at 9.1 MHz. Note signal generator output level in dB.	0-dB reference.	
	h. Set the 651S-1/1A to 10 MHz and increase the signal generator output level until audio output is the same as 0-dB reference in step g. Compute the dB change in the signal generator output level from step g.	dB change in the signal generator output level; NLT 85 dB.	
9. Gain adjustment (figure 8)	a. Set 651S-1/1A to 28.0000 MHz. Set signal generator for 28.0000 MHz at 1 μV. Vary frequency slightly for peak audio output.		
	b. Adjust A6R31 as follows:		
	For 790-1048-008, -010: 0-dBm audio output.	0 dBm	
	For 790-1048-020, -021: +3 dBm audio output.	+3 dBm.	

Table 8. RF Module A6, Test Procedures (Cont).

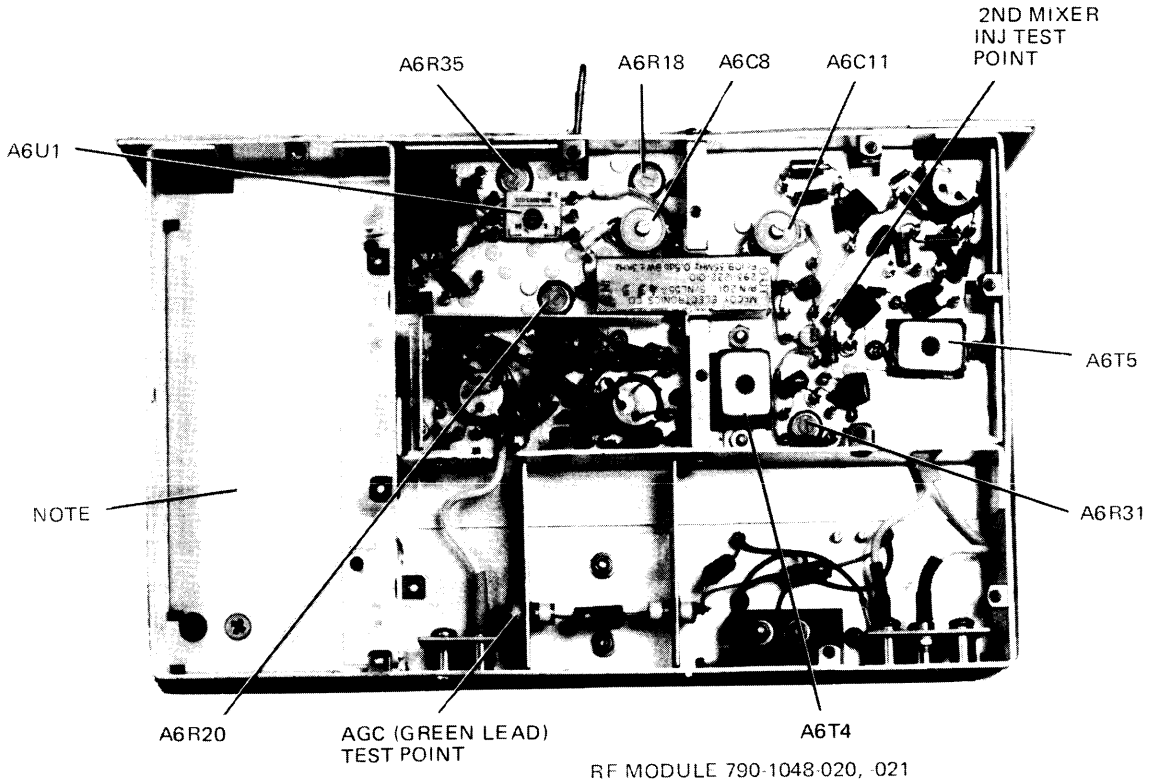
TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
10. Vlf converter adjustment (790-1048-010, -021) (figure 8)	a. Set the 651S-1/1A and signal generator to 250 kHz. Vary frequency slightly to peak audio output. Assure that AGC is off. Adjust the signal generator output level to produce 0-dBm audio output. b. Peak audio output by adjusting A6L604 and A6L605; readjust signal generator output level as necessary to maintain a 0-dBm audio output. c. Set the 651S-1/1A only to 12 kHz. Note audio output noise level. d. Adjust A6R606 for minimum noise output.		
11. First mixer adjustments (790-1048-020, -021) (figure 8)	a. Connect equipment as shown in figure 9. Set 651S-1/1A to 2.0 MHz, and set AGC off. Set signal generator A to 2.026 MHz and signal generator B to 4.027 MHz. b. Adjust A6R18, A6R20, and A6R35 for a minimum in 2nd order distortion level as indicated on the audio output vtvm. c. Set 651S-1/1A to 24.2 MHz, generator A to 8.2 MHz, and generator B to 16.001 MHz. d. Adjust A6R20 for a minimum audio output level. e. Set 651S-1/1A to 7.8 MHz and adjust A6R18 for minimum audio output. f. Set 651S-1/1A to 2.0 MHz, generator A to 2.026 MHz, generator B to 4.027 MHz, and adjust A6R35 for minimum audio output. g. Repeat steps c through f until no further improvement is possible.		
12. Final test	After completion of adjustments, repeat applicable tests (1 through 5).		



RF Module A6 Sensitivity (12-50 kHz), Test Setup
Figure 7



RF MODULE 790-1048-010



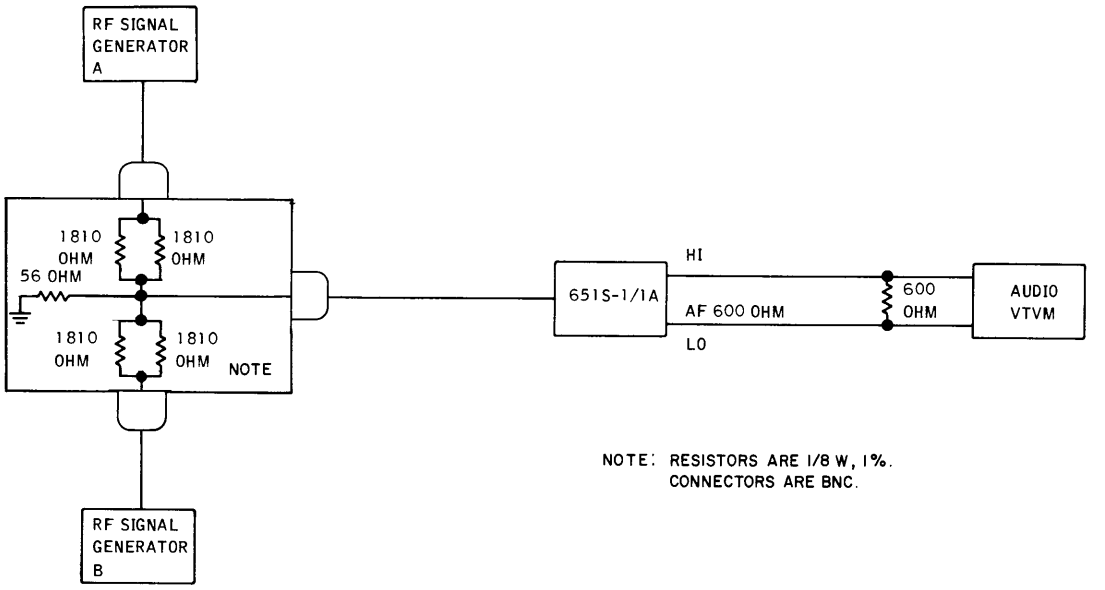
RF MODULE 790-1048-020, -021

NOTE:

REFER TO THE -010 VIEW FOR COMPONENTS LOCATION OF THE VLF CIRCUITS IN THE -021.

TP3-2485-017

RF Module A6, Location of Test Points and Adjustments
Figure 8



RF Module A6 (790-1048-020, -021), Distortion Test Setup
Figure 9

Table 9. Decoder/Driver Card A7, Performance Test Procedures.

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. Band outputs (778-2928-003 only)	a. Extend card A7 on appropriate card extender. Connect 651S-1/1A to primary power. Set POWER switch to OPER. Measure dc levels at the following pins of A7P1 with the 651S-1/1A set to 400 kHz.		
	62	-15 Vdc nom.	Check Q2 and assoc drivers.
	45	-15 Vdc nom.	Check Q4 and assoc drivers.
	64	-15 Vdc nom.	Check Q6 and assoc drivers.
	72	-15 Vdc nom.	Check Q8 and assoc drivers.
	43	-15 Vdc nom.	Check Q9 and assoc drivers.
	60	-15 Vdc nom.	Check Q10 and assoc drivers.
	44	-15 Vdc nom.	Check Q11 and assoc drivers.
	56	-15 Vdc nom.	Check Q12 and assoc drivers.
	84	-15 Vdc nom.	Check Q13 and assoc drivers.
	86	+5 Vdc nom.	Check Q14 and assoc drivers.
	b. Increase frequency in 20-kHz steps to 540 kHz and measure as in step a at each increment.	Same as step a.	Same as step a.
	c. Set 651S-1/1A to 560 kHz and repeat step a.	All pins in step a -15 Vdc, except 84 is +5 Vdc.	Same as step a.
	d. Measure same points with 20-kHz incremental frequency increase up to 1.980 MHz.	Same as step c.	Same as step a.
	e. Set 651S-1/1A to 2 MHz and repeat step a.	All pins in step a -15 Vdc, except 56 is +5 Vdc.	Same as step a.
	f. Measure same points with 20-kHz incremental frequency increase up to 2.980 MHz.	Same as step e.	Same as step a.
	g. Set 651S-1/1A to 3 MHz and repeat step a.	All pins in step a -15 Vdc, except 44 is +5 Vdc.	Same as step a.
	h. Measure same points with 20-kHz incremental frequency increase up to 3.980 MHz.	Same as step g.	Same as step a.
(Cont)	i. Set 651S-1/1A to 4 MHz and repeat step a.	All pins in step a -15 Vdc, except 60 is +5 Vdc.	Same as step a.

Table 9. Decoder/Driver Card A7, Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. (Cont)	j. Measure same points with 20-kHz incremental frequency increase up to 5.980 MHz.	Same as step i.	Same as step a.
	k. Set 651S-1/1A to 6 MHz and repeat step a.	All pins in step a -15 Vdc, except 43 is +5 Vdc.	Same as step a.
	l. Measure same points with 20-kHz incremental frequency increase up to 7.980 MHz.	Same as step k.	Same as step a.
	m. Set 651S-1/1A to 8 MHz and repeat step a.	All pins in step a -15 Vdc, except 72 is +5 Vdc.	Same as step a.
	n. Measure same points with 20-kHz incremental frequency increase up to 11.980 MHz.	Same as step m.	Same as step a.
	o. Set 651S-1/1A to 12 MHz and repeat step a.	All pins in step a -15 Vdc, except 64 is +5 Vdc.	Same as step a.
	p. Measure same points with 20-kHz incremental frequency increase up to 15.980 MHz.	Same as step o.	Same as step a.
	q. Set 651S-1/1A to 16 MHz and repeat step a.	All pins in step a -15 Vdc, except 45 is +5 Vdc.	Same as step a.
	r. Measure same points with 20-kHz incremental frequency increase up to 23.980 MHz.	Same as step q.	Same as step a.
	s. Set 651S-1/1A to 24 MHz and repeat step a.	All pins in step a -15 Vdc, except 62 is +5 Vdc.	Same as step a.
	t. Measure same points with 20-kHz incremental frequency increase up to 29.980 MHz and at 29.9999 MHz.	Same as step s.	Same as step a.
2. Band outputs (608-9087-001 or 608-9121-001)	a. Extend card A7 on appropriate card extender. Connect 651S-1/1A to primary power. Set POWER switch to OPER. Measure dc levels at the following pins of A7P1 with 651S-1/1A set to 260 kHz:		
	56	-15 Vdc nom.	Check Q2 and assoc drivers.
	84	-15 Vdc nom.	Check Q4 and assoc drivers.
(Cont)	86	+5 Vdc nom.	Check Q3 and assoc drivers.

Table 9. Decoder/Driver Card A7, Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
2. (Cont)	b. Increase frequency in 20-kHz steps to 540 kHz and measure dc levels, as in step a, at each increment.	Same as step a.	Same as step a.
	c. Set 651S-1/1A to 560 kHz and repeat the dc level measurements in step a.	Pins 56 and 86 at -15-Vdc. Pin 84 at +5 Vdc.	Same as step a.
	d. Increase frequency in 20-kHz steps to 1.980 MHz and repeat dc level measurements at each increment.	Same as step c.	Same as step a.
	e. Set 651S-1/1A to 2.0 MHz and repeat the dc level measurements in step a.	Pins 84 and 86 at -15 Vdc. Pin 56 at +5 Vdc.	Same as step a.
	f. Increase frequency in 20-kHz steps to 29.980 MHz and repeat the dc level measurements at each increment.	Same as step e.	Same as step a.
3. Bcd output (778-2928-003 or 608-9121-001)	a. Set the 651S-1/1A to 20 MHz. Check dc level at A7P1 pins listed:		
	6	+3.2 Vdc nom.	Check flatpacks U1D and U1E, or U4B and U4C.
	4	0 Vdc nom.	Check flatpacks U1A and U1B or U4A and U4F.
	20	0 Vdc nom.	Check flatpacks U3D and U3E or U4D and U4E.
	18	0 Vdc nom.	Check flatpacks U3A and U3B or U5B and U5C.
	10	0 Vdc nom.	Check flatpacks U2A and U2B or U5A and U5F.
	14	0 Vdc nom.	Check flatpacks U2D and U2E or U5D and U5E.
	32	0 Vdc nom.	Check flatpacks U4D and U4E or U8A and U8F.
	23	0 Vdc nom.	Check flatpacks U4A and U4B or U6A and U6F.
	38	0 Vdc nom.	Check flatpacks U5D and U5E or U6D and U6E.
	25	0 Vdc nom.	Check flatpacks U5A and U5B or U8B and U8C.
	36	0 Vdc nom.	Check flatpacks U10D and U10E or U9B and U9C.
	26	0 Vdc nom.	Check flatpacks U10A and U10B or U9A and U9F.
	30	0 Vdc nom.	Check flatpacks U4C and U5C or U9D and U9E.
	b. Set 651S-1/1A to 10 MHz and repeat step a.	All pins in step a 0 Vdc, except 4 is +3.2 Vdc.	Same as step a.
(Cont)	c. Set 651S-1/1A to 8 MHz and repeat step a.	All pins in step a 0 Vdc, except 20 is +3.2 Vdc.	Same as step a.

Table 9. Decoder/Driver Card A7, Performance Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
3. (Cont)	d. Set 651S-1/1A to 4 MHz and repeat step a.	All pins in step a 0 Vdc, except 18 is +3.2 Vdc.	Same as step a.
	e. Set 651S-1/1A to 2 MHz and repeat step a.	All pins in step a 0 Vdc, except 10 is +3.2 Vdc.	Same as step a.
	f. Set 651S-1/1A to 1 MHz and repeat step a.	All pins in step a 0 Vdc, except 14 is +3.2 Vdc.	Same as step a.
	g. Set 651S-1/1A to 800 kHz and repeat step a.	All pins in step a 0 Vdc, except 32 is +3.2 Vdc.	Same as step a.
	h. Set 651S-1/1A to 400 kHz and repeat step a.	All pins in step a 0 Vdc, except 23 is +3.2 Vdc.	Same as step a.
	i. Set 651S-1/1A to 10.2 MHz and repeat step a.	All pins in step a 0 Vdc, except 4 and 38 are +3.2 Vdc.	Same as step a.
	j. Set 651S-1/1A to 10.1 MHz and repeat step a.	All pins in step a 0 Vdc, except 4 and 25 are +3.2 Vdc.	Same as step a.
	k. Set 651S-1/1A to 10.08 MHz and repeat step a.	All pins in step a 0 Vdc, except 4 and 36 are +3.2 Vdc.	Same as step a.
	l. Set 651S-1/1A to 10.04 MHz and repeat step a.	All pins in step a 0 Vdc, except 4 and 26 are +3.2 Vdc.	Same as step a.
	m. Set 651S-1/1A to 10.02 MHz and repeat step a.	All pins in step a 0 Vdc, except 4 and 30 are +3.2 Vdc.	Same as step a.

Table 10. Interconnect Card A8, Test Procedures.

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. Continuity	a. Remove interconnect card A8 from the 651S-1/1A and check for continuity between the following pins:		
	A8P1-10 to A8P1-12	0 ohm.	Check wiring between pins.
	A8P1-55 to A8P1-56	0 ohm.	
	A8P1-59 to A8P1-21	0 ohm.	
	A8P1-63 to A8P1-64	0 ohm.	
	A8P1-67 to A8P1-68	0 ohm.	
	A8P1-41 to A8P1-23	0 ohm.	
	A8P1-8 to A8P1-13	0 ohm.	

Table 10. Interconnect Card A8, Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. (Cont)	b. Measure the resistance between pins A8P1-15 and A8P1-19.	8200 ohms ±10%.	Check A8R4. Check wiring to pins.
2. Mode enabling outputs	a. Connect interconnect card A8 to a card extender. Connect the 651S-1/1A to primary power and set the POWER switch to OPER.		
	b. Set BFO switch to FIXED. Change mode selector as shown in figure 10 and check the output pins on A8 for the indicated levels.	Refer to figure 10.	Check diodes and wiring associated with the chosen mode.
	c. Set BFO switch to VAR and switch mode selector switch through the mode positions. Check the output pins using figure 10. (The only pins affected by switching the BFO switch from FIXED to VAR are pins 35, 37, and 38.)	Refer to figure 10.	Check diodes, gates, and wiring associated with the chosen mode.

MODE AND BANDWIDTH SELECTORS		OUTPUT FROM CARD A8 PINS A8P1-( )																		
		FIXED BFO															VAR-BFO			
POSITION		1	2	3	4	21	23	25	35	37	38	77	79	81	83	84	85	35	37	38
FM 6				X		X							X							
FM 16				X		X											X			
AM 3		X					X						X							
AM 6				X			X						X							
AM 16				X			X										X			
SSB 2.7U				X				X		X				X						X
SSB 2.7L				X				X		X						X				X
CW A8 -004 only	1		X					X		X			X					X		
	.5				X			X		X			X					X		
	.2				X			X		X		X						X		
CW A8 -006 only	WRST		X					X		X			X					X		
	CW				X			X		X			X					X		
	NRST			X				X		X		X						X		
CW A8 -007 only	WBTY		X					X		X							X	X		
	.5				X			X		X			X					X		
	.2				X			X		X		X						X		
ISB				X						X				X	X					x

Note

An X indicates +5 Vdc at the pin in a given mode; a space indicates 0 Vdc.

Interconnect Card A8, Mode Output
Figure 10

Table 11. DCFE Card A8, Test Procedures.

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. Operating voltages	***Note*** If required, remove the strip between J30-46 and J31-47 on the 651S-1/1A sideboard.		
	a. Using the appropriate card extender, extend DCFE card A8 from the 651S-1/1A. Install DCU card A9 in the 651S-1/1A (J30). Connect the 651S-1/1A to primary power. Set POWER switch to OPER and CONTROL switch to LOCAL. Measure the dc level at the following pins:		
	A8P1-28	+14.3 to +15.7 Vdc.	Check C10.
	A8P1-27	+4.7 to +5.3 Vdc.	Check C1 through C7, and C9.
	A8P1-20	-14.3 to -15.7 Vdc.	Check C11.
	A8P1-11, 72	Less than -10 Vdc. NMT 0.5-ohm resistance.	Check wiring.
	b. Check logic level at A8P1-10 and A8P1-60. Set CONTROL to REMOTE and recheck levels.	LOCAL: A8P1-10 NMT +1.0 Vdc. A8P4-60 +4.7 to +5.3 Vdc. REMOTE: A8P1-10 +4.7 to +5.3 Vdc.	
2. Control word II (mode I info) (Cont)	a. Set 651S-1/1A POWER to OFF. Connect 7404A-1 Source Generator/ Display Unit LCU/SINE WAVE connector to 651S-1/1A REMOTE INPUT connector using special cable (figure 3).		
	b. Set 651S-1/1A controls as follows: BFO — FIXED METER — RF AGC — FAST CONTROL — REMOTE VBFO — CCW RF GAIN — CW AF GAIN — Midrange MODE — FM BANDWIDTH — 6		

Table 11. DCFE Card A8, Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
2. (Cont)	c. Set 7404A-1 front panel controls as follows: POWER ON PARITY MODE SENSED RETRANSMIT OFF MODE FDX ADDRESS LENGTH 5 BIT PARITY ENCODE MANUAL d. Set 7404A-1 rear panel controls as follows: Function LCU Sine/logic SINE e. Set 7404A-1 control word switches 0 through 4 to logic 1 (up) and switch 5 to logic 0 (down) for all tests. f. Set 651S-1A POWER to OPER. g. Press 7404A-1 CLEAR switch; set control word switches 7, 8, 10, 18, 22, 27, 29, and 30 to logic 1 (up). Assure that all other control word switches are at logic 0 (down). Press SEND/READY switch and observe indicators on the 7404A-1 for monitor word II response (refer to table 8 in the description and principles of operation section for content and format).	***Note*** Lamps 0 through 4 will be lit and 5 will be OFF for all tests.	
(Cont)	MONITOR WORD II FUNCTION Dialogic bit 5-bit DCU address DCFE subaddress	LAMP NO / STATUS 0 Lit 1 Lit 2 Lit 3 Lit 4 Lit 5 Off 6 Off 7 Lit	Check 7404A-1. Check address strapping on special cable (figure 3). Check DCU card A9.

FUNCTION / LAMP NO / STATUS
DCFE Address: 6 Off, 7 On

Table 11. DCFE Card A8, Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
2. (Cont)	MONITOR WORD II FUNCTION	LAMP NO / STATUS	
	Parity	8 Lit	Check 7404A-1.
	Pwr interrupt	9 Lit	Check U5, U17, and associated circuits.
	Pwr supply perf	10 Off	Check U17 and U18.
	Synth lock	11 Off	
	Remote	12 Lit	Check Q5, U108, U23, U22, and U21.
	Operate	13 Lit	Check U35, U22, and U21.
	Audio perf	14 Lit	Check U22, U21, and U9.
	Freq storage	15 Off	Continue tests.
	Mode, FM	16 Off	Check CR2, CR23, U19, U25, and U26.
		17 Off	
		18 Off	
		19 Off	
	Vbfo	20 Off	Continue tests.
		21 Off	
		22 Off	
		23 Off	
	Freq	24 through 31 Off	Continue tests.
	h. Set 651S-1/1A MODE to AM. Press 7404A-1 CLEAR switch, set control word switches 10 down and 11 up, and press SEND/READY switch.	LAMP NO / STATUS	
	Mode, AM	16 Lit	Check CR3, U19, U25, and U31.
		17 Off	
		18 Off	
		19 Off	
	i. Set 651S-1/1A MODE to SSB, BANDWIDTH to 2.7U. Press 7404A-1 CLEAR switch; set control word switches 11 and 22 down; set 12, 14, and 20 up; and press SEND/READY switch.	LAMP NO / STATUS	
	Mode, USB; fixed bfo	16 Lit	Check CR5, CR17, U19, U25, U26, U27, and U31.
		17 Lit	
		18 Lit	
(Cont)		19 Off	

Table 11. DCFE Card A8, Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
2. (Cont)	j. Set 651S-1/1A BFO switch to VAR. Press 7404A-1 CLEAR switch, set control word switches 14 down and 15 up, and press SEND/READY switch.		
	Mode, USB; vbfo	LAMP NO — STATUS 16 — Off 17 — Lit 18 — Lit 19 — Off	Check U14 and U23.
	k. Set 651S-1/1A BFO to FIXED and BANDWIDTH to 2.7L. Press 7404A-1 CLEAR switch, set control word switches 20 down and 21 up, and press SEND/READY switch.		
	Mode, LSB; vbfo	LAMP NO — STATUS 16 — Off 17 — Lit 18 — Off 19 — Lit	Check U14.
	l. Set 651S-1/1A BFO to FIXED, MODE to CW, and BANDWIDTH to .5/2. Press 7404A-1 CLEAR switch; set control word switches 15, 21, 27 down and 23, 24 up; and press SEND/READY switch.		
	Mode, CW; fixed bfo	LAMP NO — STATUS 16 — Lit 17 — Lit 18 — Off 19 — Off	Check CR6, CR7, and U31.
	m. Set 651S-1/1A BFO to VAR. Press 7404A-1 CLEAR switch, set control word switches 14 down and 15 up, and press SEND/READY switch.		
(Cont)	Mode, CW; vbfo	LAMP NO — STATUS 16 — Off 17 — Lit 18 — Off 19 — Off	Check CR9 and U14.

Table 11. DCFE Card A8, Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
2. (Cont)	n. Set 651S-1/1A BFO to FIXED and MODE to ISB. Press 7404A-1 CLEAR switch, set control word switches 15 down and 14 up, and press SEND/READY switch.	LAMP NO STATUS	
	Mode, ISB; fixed bfo	16 Lit 17 Lit 18 Lit 19 Lit	Check CR7 and CR43.
	o. Set 651S-1/1A BFO to VAR. Press 7404A-1 CLEAR switch, set control word switches 14 down and 15 up, and press SEND/READY switch.	LAMP NO STATUS	
	Mode, ISB; vbfo	16 Off 17 Lit 18 Lit 19 Lit	Check CR11 and U14.
	p. Assure that the 651S-1/1A VBFO switch is fully ccw. Press 7404A-1 CLEAR switch; then press SEND/READY switch, and observe lamps 20 through 23. Measure dc voltage at P1-68 with dvm.	Lamps 20 through 23 off. P1-63 +3, ±0.2 Vdc.	Check U29 and U30.
	q. Observe lamps 20 through 23 and measure dc voltage at P1-68 for each position (step) cw of the VBFO switch. Press 7404A-1 CLEAR switch; then the SEND/READY switch for proper results in each step.		
	STEP	LAMPS VDC	
	1	20, 21, 22 out; 23 lit +3.8 ±0.2	Check U40, U29, U30, U34, Q4, and associated components.
	2	20, 21, 23 out; 22 lit +4.6 ±0.2	Check Q3 and associated components.
	3	20, 21 out; 22, 23 lit +5.4 ±0.2	Check Q3, Q4, and associated components.
(Cont)	4	20, 22, 23 out; 21 lit +6.2 ±0.2	Check Q2 and associated components.

Table 11. DCFE Card A8, Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
2. (Cont)	STEP	LAMPS VDC	
	5	20, 22 out; 21, 23 lit +7 ±0.2	Check Q2, Q4, and associated components.
	6	20, 23 out; 21, lit +7.7 ±0.2	Check Q2, Q3, and associated components.
	7	20 out; 21, 22 23 lit +8.5 ±0.2	Check Q2, Q3, Q4, and associated components.
	8	21, 22, 23 out; 20 lit +9.2 ±0.2	Check Q1 and associated components.
	9	21, 22 out; 20, 23 lit +10 ±0.2	Check Q1, Q4, and associated components.
	10	21, 23 out; 20, 22 lit +10.7 ±0.2	Check Q1, Q3, and associated components.
	11	21 out; 20, 22 23 lit +11.5 ±0.2	Check Q1, Q3, Q4, and associated components.
	12	22, 23 out; 20 21 lit +12 ±0.2	Check Q1, Q2, and associated components.
3. Control word I (freq info)	a. Set 651S-1/1A MODE to AM, BANDWIDTH to 6, and BFO to FIXED. Press 7404A-1 CLEAR switch, set control word switches 7, 8, 11, 23, 27, and 29 up, and all other control word switches from 6 through 31 shall be down. Press SEND/READY switch.	Lamp 6 off, 7 lit, ignore other lamps.	
	b. Press 7404A-1 CLEAR switch; set control word switches 11, 15, 19, 23, 27, 31 up, and all others 6 through 31 shall be done. Press 7404A-1 SEND/READY switch. Observe frequency readout on 651S-1/1A and lamps 10 through 31 on 7404A-1.	651S-1/1A frequency reads 11.1111 MHz. Lamps 6 and 7 off. Ignore lamps 11, 15, 19, 23 and 27: and 31 shall be lit.	Check logic levels and appropriate pins of U16, U20, U24, U28, U32, U36, U33, and U37.
(Cont)	c. Press 7404A-1 CLEAR switch; set control word switches 10 up, 11 down, 15 down, 14 up, 19 down, 18 up, 23 down, 22 up, 27 down, 26 up, 31 down, 30 up. Press SEND/READY switch.	651S-1/1A frequency reads 22.-2222 MHz. Lamps 10, 14, 18, 22, 26, and 30 lit.	Same as step b.

Table 11. DCFE Card A8, Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
3. (Cont)	d. Press 7404A-1 CLEAR switch. Set control word switches 14, 18, 22, 26, and 30 down and 13, 17, 21, 25, and 29 up. Press SEND/READY switch.	651S-1/1A frequency reads 24.4444 MHz. Lamps 10, 13, 17, 21, 25, and 29 lit.	Same as step b.
	e. Press 7404A-1 CLEAR switch; set control word switches 13, 17, 21, 25, and 29 down and 12, 16, 20, 24, and 28 up. Press SEND/READY switch.	651S-1/1A frequency reads 28.8888 MHz. Lamps 10, 12, 16, 20, 24, and 28 lit.	Same as step b.
4. Control word II (mode II info)	a. Press 7404A-1 CLEAR switch, set control word switch 6 up, and press SEND/READY switch.	Lamp 6 lit, 7 off. 651S-1/1A frequency reads 28.8888 MHz.	Check word III load and gate circuits.
	b. Measure dc voltage at P1-64 and P1-60.	P1-64 +1.8 Vdc. P1-60 less than 0.1 Vdc.	Check U41, Q6, and associated components. Check U39B, and U38. Check Q7, Q8, and K1.
	c. Press 7404A-1 CLEAR switch, set control word switches 28 down and 29 up. Press SEND/READY switch and measure dc voltage at P1-64.	P1-64 +1.9 Vdc.	Same as step b.
	d. Repeat step c, except set control word switches 29 down and 30 up.	P1-64 +2.0 Vdc.	Same as step b.
	e. Repeat step c, except set control word switches 30 down and 31 up.	P1-64 +2.1 Vdc.	Same as step b.
	f. Repeat step c, except set control word switch 28 up.	P1-64 +1.7 Vdc.	Same as step b.
5. Control word IV (monitor request)	a. Press 7404A-1 CLEAR switch, set control word switches 7 up, 28 and 31 down. Press SEND/READY switch.	Lamps 6 and 7 lit. 651S-1/1A frequency reads 28.8888 MHz.	Check monitor gate circuits.
6. AGC	a. Press 7404A-1 CLEAR switch, set control word switches 6 down and 7, 8, 11, 18, 22, 27, 28, and 29 up. Set 651S-1/1A AGC to off (center). Press 7404A-1 SEND/READY switch.		
	b. Measure dc voltage at P1-24 with 651S-1/1A AGC switch in off, FAST, and SLOW position. Place AGC switch to FAST.	P1-24 0 Vdc in all positions.	Check Q9 and U35.
	c. Press 7404A-1 CLEAR switch and set control word switch 28 down.		
	d. Monitor the AGC voltage at P1-24 when the 7404A-1 SEND/READY switch is pressed.	Voltage counts up to +12 ±0.2 Vdc.	Same as step b.

Table 12. DCU Card A9, Test Procedures.

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. Operating voltages, logic levels	a. Connect DCU card to a card extender. Connect 651S-1/1A to primary power and set POWER switch to OPER. Set CONTROL switch to LOCAL. Measure the dc level at the following pins:		
	A9P1-44	+11.3 to +12.1 Vdc.	Check zener A9VR12 and diode A9CR6.
	A9P1-46	-11.3 to -12.1 Vdc.	Check zener A9VR13 and diode A9CR3.
	A9P1-24 (logic 1)	NLT +3.2 Vdc.	
	A9P1-37 (logic 0)	NMT +0.45 Vdc.	
2. Output signals	a. Set POWER switch to OFF. Remove DCFE card A8 and set CONTROL switch to REMOTE. Connect 7404A-1 Source Generator/Display Unit LCU SINE WAVE connector to 651S-1/1A REMOTE INPUT connector using special cable (figure 3). Set 7404A-1 rear-panel controls as follows: Function: LCU Sine/logic: SINE Set 7404A-1 front-panel controls as follows: POWER: ON PARITY MODE: SENSED RETRANSMIT: OFF MODE: FXD ADDRESS LENGTH: 5 BIT PARITY ENCODE: MANUAL		
	b. Set 7404A-1 control word switches 0 thru 4 to logic 1 (up) and switch 5 to logic 0 (down) for all tests.		
	c. Set 7404A-1 control word switches 6 thru 31 to logic 0 (down). Set 651S-1/1A POWER switch to OPER. Press CLEAR button. Set RETRANSMIT switch to CONTINUAL and check the line-to-line voltage at pins A9P1-2, 4. (Measurement is made by adding the signal measured between each line and ground. The signals added should be 180 degrees out of phase.)	1.7 ±0.8 V p-p line to line.	Check monitor output circuit.
(Cont)			

Table 12. DCU Card A9, Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
2. (Cont)	d. Set 7404A-1 RETRANSMIT switch to OFF. Connect the following pins, in turn, to A9P1-21. For each connection, push the 7404A-1 SEND/READY button and check the monitor response lights on the 7404A-1. (Light 0 should be off, 1 thru 4 on, and 5 off for all responses).		On 793-9414-001, if 3 or less of the first four points (A9P1-1, 3, 5, or 11) of test fail, check counter circuit. If all five points fail, check output flatpacks (U403, U303, or U904 and associated circuits). If the test fails at A9P1-17, check control gate circuits (U102B, etc). On 624-5781-001, if test fails at A9P1-11, check counter circuits U23 or U24 and U21. If test fails at A9P1-17, check control gate circuits (U14B, etc).
	A9P1-1 (793-9414-001 only)	7404A-1 lights 8 thru 15 on, 16 thru 23 off, and 24 thru 31 on.	
	A9P1-3 (793-9414-001 only)	Lights 8 thru 15 off and 16 thru 31 on.	
	A9P1-5 (793-9414-001 only)	Lights 6, 7 on; 8, 9 off; 10, 11 on; 12, 13 off, etc.	
	A9P1-11	Lights 6, 7 on; 8 thru 11 off; 12 thru 15 on, etc.	
	A9P1-17	Lights 6 thru 31 off.	
3. Carrier bus, bit clock phase relationship	a. Connect A channel of dual trace oscilloscope to carrier bus input pin A9P1-12. Connect B channel to bit clock pin A9P1-19 and sync scope with B channel input. Ac couple both inputs. Ground both scope probes. Set 7404A-1 RETRANSMIT switch to CONTINUAL.		
	b. Set channel B to 2 V/cm and channel A to 0.1 V/cm. Set sweep for 20 μs/cm and carefully center the horizontal sweep lines. Uncalibrate the scope and adjust the waveform period to exactly 10 cm. Check the phase relationship between the A and B channel waveforms. (Ignore any transient on the carrier bus near the crossover point.)	180.0 ±7.2 degrees out of phase.	Check clock generation circuits on 793-9414-001, U801, U903, U803, and U404A; on 624-5781-001, U62, U64, and U34B.
	c. Connect A channel of scope to sampling clock. On 793-9414-001, connect to flatpack pin A9U401-9. On 624-4781-001, connect to flatpack pin A9U34. Compare the falling edges of the A and B channel signals.	A channel leads B channel by 2.5 ±0.2 cm (50 ±4 μs).	
	d. Set 7404A-1 RETRANSMIT switch to OFF.		

Table 12. DCU Card A9, Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
4. Control data output, control gate, and monitor gate	a. Connect A channel of oscilloscope to control data output pin A9P1-17. Sync scope with TRAN GATE output on 7404A-1. Push CLEAR button on 7404A-1. Set 7404A-1 RETRANSMIT switch to CONTINUAL and check the control gate on the oscilloscope.	Bits 0 thru 5 are logic 0 and bits 6 thru 31 are logic 1.	
	b. Check the monitor gate pin A9P1-13.	Logic 0 from bit 0 to bit 31 of a control word period. Logic 0 from bit 0 to bit 5 and logic 1 from bit 6 to bit 31 of the next control word period. (Control gate and the monitor gate are never both logic 1 during the same period.)	
	c. Change 7404A-1 control word bit switches 1 thru 5 from the standard bit configuration and recheck the control gate (A9P1-17) and the monitor gate (A9P1-13).	Logic 0 in all bit positions.	Check address recognition circuit.
	d. Set 7404A-1 RETRANSMIT switch to OFF. Set 7404A-1 control word bit switches 0 thru 4 to up position and 5 thru 31 down. Connect oscilloscope to control data pin A9P1-23. Push 7404A-1 CLEAR button. Set 7404A-1 RETRANSMIT switch to CONTINUAL and check the control data on the oscilloscope.	Bits 0 thru 4 are logic 1, and 5 thru 31 are logic 0.	
	e. In turn, set each of the 7404A-1 control word bit switches 6 thru 31 to the up position. Check the control data on the oscilloscope for each switch position change.	Bits 0 thru 4 are logic 1 and 5 is 0. When one of switches 6 thru 31 is up, a logic 1 appears in that control word bit position. If a switch is down, that bit position is logic 0.	
	f. Set 7404A-1 RETRANSMIT switch to OFF.		

Table 12. DCU Card A9, Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
5. Monitor data	a. Connect A9P1-21 to A9P1-37. Set 7404A-1 control word bit switches 0 thru 4 to up, 5 down, and 6 thru 31 up. Push 7404A-1 CLEAR button. Set RETRANSMIT switch to CONTINUAL. Check the logic levels represented on the monitor bus output from A9P1-4 (biphase modulated sine wave) with dual trace oscilloscope. Connect the other channel of the scope to carrier bus input A9P1-12. If a cycle of the signal at A9P1-4 is in phase with the signal at A9P1-12, a logic 1 is represented at A9P1-4. If a cycle is 180 degrees out-of-phase, a logic 0 is represented.	Bit 0 is logic 0, 1 thru 4 are 1, and 5 thru 31 are 0. Supervisory interval is all 1's.	
	b. Check the signal level at A9P1-24.	793-9414-001: Greater than 2.8 Vdc.	
	c. Set 7404A-1 RETRANSMIT switch to OFF. Disconnect A9P1-21 from A9P1-37 and connect A9P1-21 to A9P1-24. Push 7404A-1 CLEAR button. Set 7404A-1 RETRANSMIT switch to CONTINUAL and check the monitor bus output A9P1-4 as in step 5.a.	624-5781-001: Greater than 3.2 Vdc. Bit 0 is logic 0, 1 thru 4 are 1, 5 is 0, and 6 thru 31 are 1's. Supervisory interval is all 1's.	
	d. Set 7404A-1 RETRANSMIT switch to OFF. Disconnect A9P1-21 from A9P1-24 and connect A9P1-21 to A9P1-11. Push the 7404A-1 CLEAR button. Set 7404A-1 RETRANSMIT switch to CONTINUAL and check the monitor bus output at A9P1-4.	Bit 0 is logic 0, 1 thru 5 are 1, and 6 thru 31 alternate 1's and 0's.	
	e. Change 7404A-1 control word bit switches 1 thru 5 from the standard bit configuration and recheck monitor bus output at A9P1-4.	No monitor output.	
	f. Set 7404A-1 RETRANSMIT switch to OFF and disconnect A9P1-21 from A9P1-11.		

Table 18. TCU Card A9, Test Procedures.

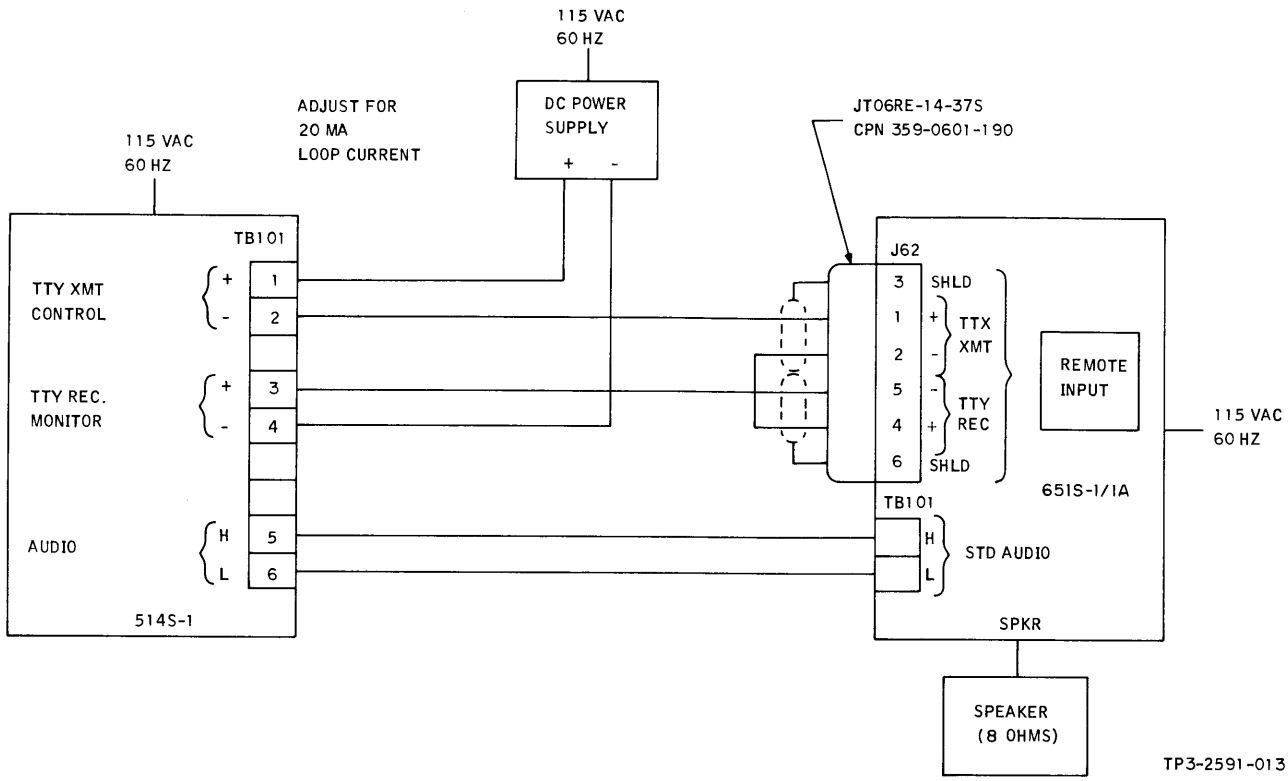
TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. Initial setup	a. Assure that TCU card A9 and 651S-1/1A sideboard are properly strapped (refer to the installation section of this instruction book). Refer to the 514S-1 control instruction book, Collins part number 523-0764187, for strapping information for the 514S-1. b. Using the appropriate extender card, extend the TCU card from the 651S-1/1A. Install DCFE card A8 in the 651S-1/1A. c. Connect the 651S-1/1A, speaker, 514S-1, and dc power supply as shown in figure 11. d. Set the 514S-1 controls as follows: POWER — OPER BFO — FIXED METER — RF AGC — FAST CONTROL — REMOTE VBFO — CCW RF GAIN — CW AF GAIN — Midrange MODE — SSB BANDWIDTH — 2.70 e. Set 651S-1/1A controls as follows: POWER — OPER CONTROL — REMOTE f. Turn on dc power supply and adjust output voltage to produce 20 mA output current. If more than 40 Vdc is required, remove cover from 514S-1 and adjust A9R3 as required.		
2. Voltage and logic levels	***Note*** Refer to figure 12 for location of test points and components. a. Set 514S-1 frequency to 10.0000 MHz. b. With dvm check for +5 Vdc to all microcircuits (refer to note 3 on schematic diagram for pin numbers). c. Check logic level at TPA.	651S-1/1A frequency reads 10.0000 MHz. 4.7 to 5.3 Vdc. Logic 1 (3.2 to 5.3 Vdc).	Continue tests. Check C4 through C8. Check R11.

Table 13. TCU Card A9, Test Procedures (Cont).

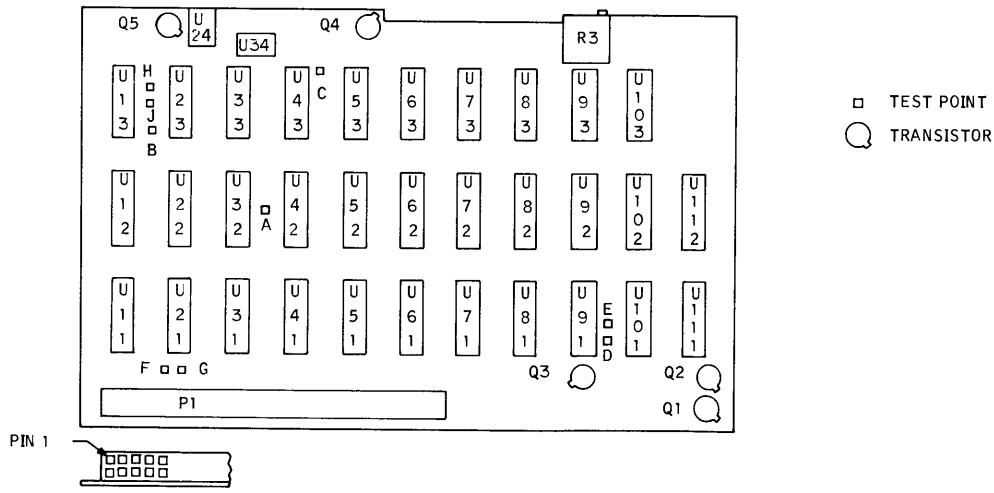
TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
3. Timing circuit	a. With an oscilloscope, measure the period (frequency) of the clock pulse at TPD.	282 to 286 μs (3520 Hz).	Adjust A9R3. If adjustment fails to bring pulse to within limits, check Q1, Q2, Q3, and associated components.
	b. Measure pulse rate (WT2F) at U12A-8.	1750 to 1770 Hz.	Check U12, U103C, and U103D.
4. Fault line	a. The equipment should not go into fault condition during normal testing.	Fault indicator on 514S-1 out at all times.	Check CR7, U34, U24, VR1, Q5, and associated components.
5. Frequency and mode	a. Increase 514S-1 frequency in 1-MHz increments to 29.0000 MHz.	651S-1/1A frequency shall increase in 1-MHz increments and track with the 514S-1 frequency.	Most circuits in TCU card A9 are interacting. Therefore, to locate a malfunction, troubleshoot in sequence the following circuits. (Refer to the schematic diagram and the functional block diagram as required.) (1) DCFE interface circuit; U22, U41, and associated drivers. (2) Subaddress decode circuit, U92A and associated drivers. (3) Down counter circuits; U82, U102B, U72, U92B, and associated drivers. (4) Scan control circuit; U51 and associated drivers. (5) Address control circuit; U31, U32, U42, U33A, U33B, and associated drivers. (6) TTY character receive circuit; U61, U34, U101, U102B, U73A, and associated drivers. (7) Error detection circuit; U24, U13, U22, U12, and associated drivers.
(Cont)	b. Increase 514S-1 frequency in 100-kHz increments to 29.9000 MHz.	651S-1/1A frequency shall increase in 100-kHz increments and	Same as step a.

Table 13. TCU Card A9, Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
5. (Cont)		track with the 514S-1 frequency.	
	c. Increase 514S-1 frequency in 100-Hz increments to 29.9999 MHz.	651S-1/1A frequency shall increase in 100-Hz increments and track with the 514S-1.	Same as step a.
6. Audio and vbfo	a. Set 514S-1 frequency to 9.9999 MHz and set 514S-1 AF GAIN fully ccw, then rotate slowly cw.	Shall have good control of audio level in speaker.	Same as test 5, step a.
	b. Set 514S-1 BFO switch to VAR and slowly rotate VBFO control cw, one position at a time, and note change in audio level in speaker.	Tone shall vary slightly (10 Hz) in each position.	Same as test 5, step a.
7. Rf gain	a. Rotate the 514S-1 RF GAIN control counterclockwise and note rf meters on the 514S-1 and 651S-1/1A.	Meter indication increase. The 651S-1/1A meter tracks the 514S-1 meter. Audio disappears in speaker.	Same as test 5, step a.



TCU Card A9, Test Setup
Figure 11



TCU Card A9, Test-Point and Component Location
Figure 12

Table 14. Scan Control Card A9, Test Procedures.

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. Continuity	Verify continuity between the following pin pairs: P1-15, 47 P1-42, 43 P1-10, 45 P1-2, J1-13 P1-4, J1-15 P1-6, J1-27 P1-8, J1-25 P1-12, J1-29 P1-14, J1-7 P1-16, J1-5 P1-18, J1-3 P1-20, J1-1 P1-24, J1-11 P1-26, J1-9	Continuity	Replace respective wire.
2. Preliminary setup	a. If required, remove jumpers from J30-29 to 31 and J30-32 to 34 on 651S-1/1A chassis sideboard. b. Strap the scan control card for a scan range of 100 kHz and a dwell time of 600 ms (refer to the installation section of this instruction book). c. Extend scan control card A9 using the appropriate extender card. Connect the 651S-1/1A to primary power and set controls as follows: POWER — OPER BFO — FIXED METER — RF AGC — FAST CONTROL — LOCAL SQUELCH — OFF (optional) DIAL — UNLOCK MODE — SSB BANDWIDTH — 2.7U AF GAIN — Midrange d. Select 10.0000 MHz and adjust the RF GAIN control for 1 mV on meter.		
3. Voltage and logic levels	a. Check the dc level at the following points: P1-35 and 36 P1-37 and 38 P1-21 b. Check for logic 1 at J1-33.	 4.7 to 5.3 Vdc. Ground. 0 Vdc. 4.3 to 5.7 Vdc.	 Check C8 through C10. Check wiring from P1-37 and 38 to ground. Check R17.

Table 14. Scan Control Card A9, Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
4. Scan operation	a. Set 651S-1/1A frequency to 10.0000 MHz.		
	Note Use a stopwatch, a standard watch, or clock with second hand to measure scan-up and scan-down time.		
	b. Set 651S-1/1A control switch to REMOTE and make the following checks:		
	(1) Up-scan tracking	Frequency display shall track upward in frequency in 100-Hz increments.	Perform test 5.
	(2) Scan range	100 kHz up from initial frequency of 10.0000 MHz.	Perform test 5.
	(3) Scan-up time	NMT 10 minutes.	Perform test 5.
	(4) Scan-down time	651S-1/1A shall automatically scan down to initial frequency in NMT 5 seconds then automatically repeat up-scan operation.	Perform test 5.
	c. Set 651S-1/1A CONTROL to LOCAL and reset frequency to 10.0000 MHz.	Scanning operation stops.	Perform test 5.
	d. Set 651S-1/1A POWER to OFF. Remove scan control card and strap for a scan range of 60 kHz and a dwell time of 100 ms (refer to the installation section of this instruction book). Reinstall the scan control card on the extender card.		
	e. Set 651S-1/1A POWER to OPER, CONTROL to REMOTE, and make the following checks:		
	(1) Scan range	60 kHz up from initial frequency of 10.0000 MHz.	Perform test 5.
	(2) Scan-up time	NMT 8 minutes.	Perform test 5.
(Cont)	(3) Scan-down time	NMT 5 seconds.	Perform test 5.

Table 14. Scan Control Card A9, Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
4. (Cont)	(4) Automatic action	651S-1/1A shall automatically repeat scanning operation.	Perform test 5.
	(5) Set frequency counter TIME BASE to 10S and measure master clock pulse rate, during scan-up operation, at test point P2-1.	38 to 47 Hz.	Check Q2, A3, and associated circuits.
	(6) Set frequency counter TIME BASE to 1S and measure master clock pulse rate, during scan-down operation, at P2-1.	480 to 580 Hz.	Same as step (5).
	(7) Set frequency counter TIME BASE to 10S and measure the program clock pulse rate, during scan-up operation, at P2-2.	Pulse rate one-half the pulse rate in step (5) ±1 Hz.	Check U11, U12B, U22A, and U22B.
	(8) Set frequency counter TIME BASE to 1S and measure program clock pulse rate, during scan-down operation, at P2-2.	Pulse rate the same as the master clock pulse rate in step (6) ±10 Hz.	Same as step (7).
	(9) Repeat steps c, d, and e (1), (2), (3), (4) with the scan card strapped for dwell times of 200 ms, 300 ms, 400 ms, and 500 ms and various scan ranges from 5 kHz to 100 kHz. ***Note*** Test 5 should be performed only if some part of test 4 fails.	Scan range determined by strapping. Scan-up time NMT 10 minutes at any frequency. Scan-down time NMT 5 seconds at any frequency. Automatic scanning action.	Same as step e(1), (2), (3), and (4).
5. Fault isolation trouble-shooting (Cont)	a. Set 651S-1/1A CONTROL to LOCAL and POWER to OFF. Remove the scan control card and strap for a scan range of 100 kHz and a dwell time of 100 ms. Reinstall scan control card on extender. b. Set 651S-1/1A POWER to OPER, frequency to 10.0000 MHz, and CONTROL to REMOTE. ***Note*** Refer to the illustrated parts list, part 2, of this instruction book for location of components.		

Table 14. Scan Control Card A9, Test Procedures (Cont).

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
5. (Cont)	c. Clock circuits		
	(1) With the 651S-1/1A in up-scan operation, check for an enabling signal (logic 0) on U41A-8.	Logic 0.	Proceed to step d.
	(2) Set frequency counter TIME BASE to 10S for up-scan, 1S for down-scan, and measure master clock pulse rate at P2-1.	Up-scan: 38 to 47 Hz. Down-scan: 480 to 580 Hz.	Check Q2, Q3, U62E, and associated circuits.
	(3) Measure program clock pulse rate at P2-2.	Up-scan: one-half the pulse in step (2) ±1 Hz. Down-scan: same as pulse rate in step (2) ±10 Hz.	Check U11, U12B, U21A, U22A, and U22B.
	(4) Measure scan clock pulse rate at P2-5.	One-half the program clock pulse rate.	Check U41B.
	d. Scan load and direction. With dvm, measure logic level on the following:		
	P2-3	Logic 1.	Check Q1 and associated circuit. Check U52A, U12A, U62A, B, and C.
	P2-6	Up-scan: logic 1. Down-scan: logic 0.	Check U41A.
	P1-34	Up-scan: logic 1. Down-scan: logic 0.	Check U31A, B, and D.
	P2-4 U21C-10	Logic 1 at all time. Logic 0 at all time.	Check flip-flop U21D and C.
	e. Automatic scan circuits. Observe frequency display.	Frequency will track (in 100-Hz increments) up through the scan range, then track down through the scan range to initial frequency, and then automatically repeat operation.	Check U42A and associated RC circuits. Check U31C, U32C and D. Check U51, U61, and U71, and associated circuits.

Table 15. Synthesizer Divider Card A10, Performance Test Procedures.

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. Divider ratio	a. Remove 651S-1/1A dust cover. Extend card A10. Disconnect the extender coaxial connector from A10P1. Connect the hf signal generator through a 6-dB pad to A10P1 using a BNC to subminiax adapter cable. Set if for CW output at 25 MHz at 0.8 V.		Return to Collins authorized repair facility.
	b. Disconnect extender coax from A10P4 and connect A10P4 to the frequency counter.		
	c. Connect the uncalibrated rf output of the hf signal generator to the external time base input on the frequency counter.		
	d. Set the 651S-1/1A POWER switch to OPER and set it to 3.3333 MHz (any mode).		
	e. Record the division ratio indicated on the frequency counter.	717.	
	f. Set the 651S-1/1A to 29.9999 MHz and record the division ratio.	3449.	
	g. Set the 651S-1/1A to 16.6666 MHz and record the division ratio.	2083.	
	h. Reinstall card A10.		

Table 16. Synthesizer Reference Card A11, Performance Test Procedures.

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. Signal levels	a. Remove the 651S-1/1A dust cover and connect to primary power. Extend card A11. Disconnect extender coaxial connector from A11P9. Connect the power meter to A11P9 using the power meter adapter cable (figure 4).		Return to Collins authorized repair facility.
	b. Set the 651S-1/1A POWER switch to OPER, any frequency, and any mode.		
	c. Record the power meter indication.	3.5 to 4.6 mW.	
	d. Disconnect extender coax from A11P8 and connect the power meter to A11P8 using the power meter adapter cable. Record the power meter indication.	0.14 to 0.19 mW.	
	e. Reconnect extender coaxes to A11P8 and A11P9 respectively. Disconnect extender coax from A11P2. Clip a 75-ohm, 1/2-watt resistor from the center conductor of A11P2 to ground. Measure the rf level at A11P2 with an rf voltmeter.	550 to 710 mV.	Select new value of A11R2.
	f. Reconnect coax to A11P2. Disconnect extender coax from A11P1 and clip 1000-Ω, 1/2-watt resistor from A11P1 to ground. Measure the rf level at A11P1.	550 to 710 mV.	Select new value of A11R1.
	g. Ground pin A11P5-4 and measure the rf level at A11P1 again.	NMT 100 mV.	
	h. Unground A11P5-4. Measure the frequency at A11P1.	450.000 kHz.	
	i. Reconnect coax to A11P1.		
2. Loop 1 divider	a. Connect an oscilloscope to the center conductor of A11P6.		
	b. Measure the pulse width of one pulse in the pulse train displayed at 2 V up from zero.	20 to 80 μs.	
	c. Leave the scope connected and disconnect coax from A11P7.	Scope display should drop to 0 ±0.2 Vdc, no pulses.	
	d. Reconnect coax to A11P7. Disconnect coax from A11P6.	Scope display should go to 4.9 ±0.2 Vdc, no pulses.	
	e. Reconnect coax to A11P6.		

Table 16. Synthesizer Reference Card A11, Performance Test Procedures (Cont).

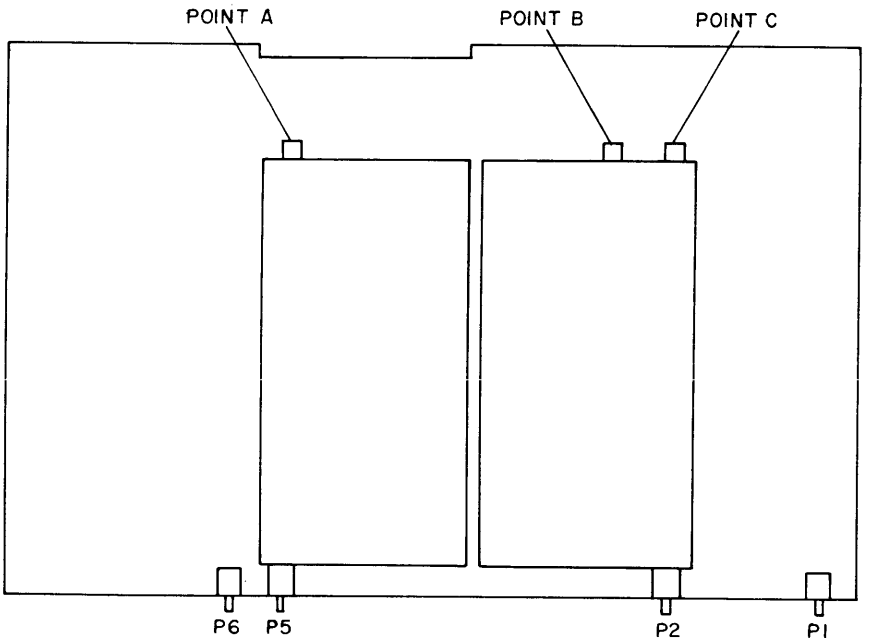
TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
3. Loop 2 divider	a. Monitor A11P3 with the scope. Measure one pulse width.	20 to 80 μs.	
	b. Disconnect coax from A11P3, with scope still on A11P3.	Scope display should go to 0 ±0.2 Vdc, no pulses.	
	c. Reconnect coax to A11P3. Disconnect coax from A11P4.	Scope display should go to 3.5 ±0.6 Vdc, no pulses.	
	d. Reconnect coax to A11P4.		
4. Fault line check	a. Check the dc level at A11P5-2 with digital voltmeter.	0 ±0.2 Vdc.	
	b. Disconnect coax from A11P7. Check dc level at A11P5-2.	+3.7 ±0.7 Vdc.	
	c. Reconnect coax to A11P7. Disconnect coax from A11P4. Check dc level at A11P5-2.	+3.7 ±0.7 Vdc.	
	d. Reconnect coax to A11P4.		
5. Frequency test	a. Disconnect coax from A11P3. Connect frequency counter to A11P3 with BNC to subminiax adapter cable.		
	b. Check frequency at A11P3.	10 kHz ±1 Hz.	
	c. Reconnect coax to A11P3. Disconnect coax from A11P6. Check frequency (as above) at A11P6.	9.9 kHz ±1 Hz.	
	d. Reconnect coax to A11P6. Disconnect coax from A11P2. Check frequency at A11P2.	9.9 MHz ±10 Hz.	
	e. Reconnect coax to A11P2. Disconnect coax from A11P9. Check frequency at A11P9.	99 MHz ±10 Hz.	
	f. Reconnect coax to A11P9. Disconnect coax from A11P8. Check frequency at A11P8.	99 MHz ±10 Hz.	
	g. Reinstall card A11.		

Table 17. Synthesizer Mixer Card A12, Performance Test Procedures.

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. Divider test	a. Remove 651S-1/1A dust cover. Extend card A12. Disconnect extender coax from A12P4. Connect an hf signal generator to A12P4. Set it to 80 MHz with 100-mV output.		Return to Collins authorized repair facility.
	b. Disconnect coax from A12P5 and connect an hf signal generator to A12P5. Set it to 101 MHz with 100-mV output.		
	c. Disconnect coax from A12P7. Connect the frequency counter input to A12P7, and connect the frequency counter external time base to A12TP14.		
	d. Set the 651S-1/1A POWER switch to OPER at 10.0033 MHz.		
	e. Record the frequency counter indication.	1433.	
	f. Set the 651S-1/1A to 10.0066 MHz and record the frequency counter indication.	1466.	
	g. Set the 651S-1/1A to 10.0099 MHz and record the frequency counter indication.	1499.	
2. Mixer	a. Reconnect extender coaxes to A12P4, A12P5, and A12P7. Disconnect coax from A12P2 and connect an hf signal generator to A12P2. Set it for 99 MHz with 100-mV output.		
	b. Disconnect coax from A12P3 and connect an hf signal generator to A12P3. Set it to 59 MHz with 100-mV output.		
	c. Connect a 261-ohm resistor from A12TP14 to ground.		
	d. Measure the rf level at A12TP14.	NLT 0.7 Vrms.	

Table 18. Synthesizer VCO Card A13, Performance Test Procedures.

TEST	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. Regulator	a. Remove dust cover. Set 651S-1/1A POWER switch to OPER, any mode, any frequency.		Return to Collins authorized repair facility.
	b. Check dc levels at points A, B, and C (figure 13).	A = +10.5 ±0.2 Vdc. B = -10.5 ±0.3 Vdc. C = +10.6 ±0.2 Vdc.	
2. Filter driver	a. Extend card A13. Disconnect extender coaxes from A13P1 and A13P6. Connect a pulse generator to both A13P1 and A13P6.		
	b. Disconnect extender coaxes from A13P2 and A13P5. Connect a frequency counter to A13P2.		
	c. Set the pulse generator to 10.000 kHz with 5.0-V pulses. Monitor pulse generator output with oscilloscope. Set pulse width to equal pulse and space timing (50% duty cycle).		
	d. Measure frequency at A13P2.	91 ±4 MHz.	
	e. Measure frequency at A13P5.	105 ±4 MHz.	



VCO Card A13, Test-Point Location
Figure 13

Table 19. Frequency Control Card A14, Test Procedures.

TEST	PROCEDURES	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1. Voltage and logic levels	a. Using the appropriate card extender, extend frequency control card A14 from the 651S-1/1A chassis. Set CONTROL switch to LOCAL.		
	b. On 651S-1/1A receivers that have the keep-alive voltage option, connect a +6-Vdc power source to the battery terminals at rear of receiver.		
	c. Set 651S-1/1A POWER to OPER, MODE to SSB, BANDWIDTH to 2.7U, and frequency to 10.9990 MHz.		
	d. Measure the dc level at the following pins:		
	P1-3 and 4	+26.5 to +29 Vdc.	Check Q1 through Q5 and associated circuits.
	P1-17 and 18	+4.3 to +5.7 Vdc.	Check C24, C26, and C28 through C33.
	P1-19 and 20	+4.3 to +5.7 Vdc.	Check C25, C27, C34 and C35.
	P1-1 and 2	Ground	Check wiring on pins.
	e. Measure the logic level at the following points:		
	P1-57	Logic 1.	Check R3 and R4.
	P1-5	Logic 1.	Check R5 and R7.
2. Remote control mode	a. Set 651S-1/1A frequency to 19.9999 MHz and CONTROL switch to REMOTE.	Frequency display reads 19.9999 MHz. Comma indicator is lit.	Check U36, U35 and U29. Check U31, U32, U38, and U28. Check U40, U41, U30, U39, and U33.
	b. Set 651S-1/1A frequency to 26.6666 MHz.	Frequency display reads 26.6666 MHz. Comma indicator is lit.	Same as step a.
3. Remote to local transfer	a. Set 651S-1/1A CONTROL switch to LOCAL.	Same as step b.	Check 651S-1/1A CONTROL switch.

Table 19. Frequency Control Card A14, Test Procedures (Cont).

TEST	PROCEDURES	NORMAL INDICATION	IF INDICATION IS ABNORMAL
4. Frequency controls	a. Set 651S-1/1A frequency to X2.2222 MHz. Slowly rotate the 1-MHz control clockwise (increase) one increment at a time at least 20 steps and observe frequency.	Frequency increases in 1-MHz steps. Comma indicator lit.	From 2 to 9 MHz, check U5, U25, U18, and U12. From 10 MHz up, check U6, U27, U34, U26, U33, U19, U20, and U7. Check Q8, Q9, and associated circuits.
	b. Slowly rotate the 1-MHz control counterclockwise (decrease) one increment at a time to X1.2222 MHz.	Frequency decreases in 1-MHz steps to X1.2222 MHz.	Same as step a.
	c. Slowly rotate the 100-kHz control clockwise (increase) one increment at a time to 1.9222 MHz.	Frequency increases in 100-kHz steps to 1.9222 MHz.	Check U4, U24, UT1, and U17.
	d. Slowly rotate the 100-kHz control counterclockwise one increment at a time to 1.2222 MHz.	Frequency decreases in 100-kHz steps to 1.2222 MHz.	Same as step c.
	e. Rotate the 1-MHz control counterclockwise (decrease) one increment.	Frequency display shall read XX2222. The 10-MHz and 1-MHz digits and the comma indicator shall be out.	Same as step a.
	f. Set 651S-1/1A frequency to XX1990. Slowly rotate the 100-Hz control (tuning knob) clockwise one increment at a time to XX1999.	The 100-Hz digit increases in 100-Hz steps.	Check U1, U21, U14, and U8.
	g. Continue to rotate the 100-Hz control clockwise, one increment at a time to XX2090.	The 1-kHz digit will increase one 1-kHz step for each ten 100-Hz steps.	Check I2, U22, U15, and U9.
	h. Continue to rotate the 100-Hz control clockwise one increment at a time to XX2900.	The 10-kHz digit will increase one 10-kHz step for each ten 1-kHz steps.	Check U3, U23, U16, and U10.
5. 30-MHz reset	a. Set 651S-1/1A frequency to 29.9999 MHz. Rotate the 100-Hz control (tuning knob) clockwise one increment.	Frequency display reads XX0000, note that the 10-MHz and 1-MHz digits and comma indicator are OUT.	Repeat tests 1 through 4.

Table 19. Frequency Control Card A14, Test Procedures (Cont).

TEST	PROCEDURES	NORMAL INDICATION	IF INDICATION IS ABNORMAL
6. Tuning control slew rate	a. Set 651S-1/1A frequency to 11.1111 MHz. Set 651S-1/1A POWER to OFF then back to OPER.	Frequency display shall read XX0000 when power is turned back on.	
	b. Observe the knob position of the 100-Hz tuning control for reference; then rotate the tuning control clockwise, three complete rotations, at a rate of approximately one rotation per second.	Frequency display shall track as tuning control is rotated.	
	c. Rotate the tuning control three complete rotations counter-clockwise at a rate of approximately one rotation per second and observe the frequency display.	Frequency display shall track as tuning control is rotated. When tuning control is returned to the initial starting point (reference), the frequency display shall read XX0000.	
7. Power loss frequency storage	a. On 651S-1/1A receivers having the keep-alive voltage circuit option, (assure that a +6-Vdc source is connected to the battery terminals at the rear of the receiver) set frequency controls to any frequency between 10.0000 and 29.9999 MHz and note the reading.		
	b. Unplug the primary power cable from the 651S-1/1A for 5 to 6 seconds and then reconnect.	Frequency display shall read the same as in step a.	
8. Dial lock	a. Depress the dial lock switch. Rotate tuning control while observing frequency display.	Frequency reading shall not change.	