WJ-861X RECEIVER

APPENDIX F

WJ-861X WIDEBAND IF OUTPUT AMPLIFIER (WBO) OPTIONS

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WARNING

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

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WJ-861X WIDEBAND IF OUTPUT AMPLIFIER (WBO) OPTIONS

F.1 GENERAL DESCRIPTION

The Wideband IF Output Amplifier (WBO) option provides the 21.4 MHz IF signal at the rear panel connector J20. There are two types of WBO options. The output signal of Type 724013-1, associated with the WJ-861X/WBO option, has a constant bandwidth of at least 4.0 MHz, regardless of the selected IF bandwidth. The output signal of Type 724013-2, associated with the WJ-861X/WBO-2 option, has a bandwidth of 6 MHz minimum, regardless of the selected IF bandwidth. The output level for both types is maintained at -30 dBm into a 50Ω load. Internal automatic gain control (AGC) circuitry provides 40 dB of gain control. This enables the WBO level, at J20, to be maintained at -30 dBm ±6 dB with input level changes of up to 40 dB.

F.2 INSTALLATION

The Type 724013-1 or 724013-2 Wideband IF Output Amplifier mounts in the compartment directly below the Signal Monitor compartment, on the underside of the receiver. Four mounting screws secure the module to the receiver deck and three cables provide all electrical connections. Installation of the Type 724013-1 or 724013-2 Wideband IF Output Amplifier is performed as follows:

1. Remove the bottom cover of the receiver exposing the compartment that accepts the Wideband IF Amplifier. This is the compartment directly forward of the receiver Power Distribution circuitry (A1).

2. Disconnect P71 of cable W31 and P69 of cable W30 from connector CP1.

3. Connect P69 of cable W30 to connector J2 of the Wideband IF Output Amplifier module.

4. Connect P71 of cable W31 to connector J1 of the Wideband IF Output Amplifier module.

5. Position the Wideband IF Output Amplifier against the receiver deck and align the four mounting holes on the module with the four threaded studs on the deck. Using 4-40 X 1/4 machine screws and appropriate flat and lock washers, secure each of the four mounting points to the receiver deck.

6. Plug connector A9P1 of the Wideband IF Output Amplifier to J2B, on the RF/IF Motherboard (A3). Position the connector such that pin 1 of A9P1 mates with J2B pin 4 and A9P1 pin 3 mates with J2B pin 6.

7. Re-install the receiver bottom cover.

F.3 OPERATION

The Type 724013-1 or 724013-2 Wideband IF Output Amplifier is operational at all times, when the receiver is powered. No additional operating procedures are required.

F.4 CIRCUIT DESCRIPTION

F.4.1 FUNCTIONAL DESCRIPTION

The input to the Type 724013-1 or 724013-2 Wideband IF Output Amplifier (A9) is taken from the receiver's 2nd Converter (A3A7) prior to band-limiting by the 21.4 MHz IF Amplifier. This 6 MHz wide signal band enters the Wideband IF Amplifier at connector J2. The signal is then amplified by a gain-controlled amplifier (Q1) and a 20 dB fixed-gain amplifier (U1). From the output of the amplification stages, the signal is applied to the output of the subassembly via an RFI filter. This filter passes a frequency spectrum of at least 3.5 MHz, about the 21.4 MHz IF center frequency for the Type 724013-1 board and a frequency spectrum of at least 6 MHz for the Type 724013-2 board.

The output level of the module, at connector J1, is maintained at a level of -30 dBm by an on-board AGC circuit. A sample of the output signal is amplified by a 20 dB amplifier (U2) and applied to the detection circuitry of U3. This AGC circuit provides a dc voltage ranging from +.7 to -6.3 Vdc, controlling the gain of the input amplifier (Q1). The AGC loop permits the output to be maintained at -30 dBm ±6 dB with input level changes of up to 40 dB at the input to the module (J2).

F.4.2 DETAILED CIRCUIT DESCRIPTION

F.4.2.1 Type 724013-1 and 724013-2 Wideband IF Output Amplifier (A9)

The reference designation for this subassembly is A9. Refer to **Figure F-3** for the Type 724013-1 and Type 724013-2 Wideband IF Output Amplifier schematic diagram.

The wideband IF signal, centered about 21.4 MHz enters this subassembly at input connector J2 and is coupled across C1 to gate #1 (pin 3) of transistor Q1. Resistors R7 and R3 form a voltage divider to bias gate #1. Gate #2 (pin 2) of Q1 receives bias from the voltage divider formed by R6, R2 and CR1, with resistor R5 providing a means of injecting the AGC voltage to alter the bias at gate #2 for control of module gain. At low signal levels, the divider formed by R6, R2 and forward biased diode CR1 sets the bias at gate #2 to approximately +4 Vdc, causing Q1 to operate at maximum gain. With increases in signal level, the AGC circuitry applies a negative-going voltage to the anode of CR1, via R5. This voltage varies from 0, when the input signal is at AGC threshold, to -6.3 Vdc, when the signal level is at 40 dB above AGC threshold. When the AGC voltage is sufficiently negative overcoming the forward bias on CR1, CR1 cuts off and is effectively removed from the circuit. The bias at pin 2 of Q1 is then determined by the voltage divider comprised of R6, R2 and R5, connected between the +15 Vdc supply and the output of the AGC circuitry. This arrangement permits the bias on Q1 to be varied between its +4 Vdc maximum gain point to a slightly negative voltage setting the gain of Q1 to minimum, in accordance with the level of the incoming signal. The output of Q1 is developed across the tank circuit comprised of L1, C5 and R10. L1 and C5 center the output response about the 21.4 MHz IF center frequency and R10 lowers the "Q" of the tuned circuit broadening the bandwidth of the tank. Capacitor C21 prevents the flow of dc current through R10.

From the output circuitry of Q1, the signal is applied, via C6, to the input of broadband amplifier U1. This amplifier provides a gain of approximately 20 dB and applies the signal, via R14, to the output of the subassembly and via C22 to the AGC detector circuitry. The operating voltage for U1 is provided at pin 2 of U1 via VR1. VR1 drops the +15 Vdc supply voltage to 6.8 Vdc. Bias at pin 7 is provided by the voltage divider formed by R12 and potentiometer R11, with R11 permitting adjustment of the gain of U1. The output signal at U1 pin 3, is coupled across C9 and developed across output load resistor R13.

The output of U1 is applied to the output connector (J1) via resistor R14 and the bandpass filter comprised of C3 through C10 and inductors L1, L2 and L3. L1, along with capacitors C3, C4 and C5, form a parallel-resonant circuit with a 21.4 MHz center frequency. The input to this circuit is applied at the junction of C3, C4 and C5 matching the input impedance of the tank circuit to the output of U1. The signal is then applied, via the 21.4 MHz series-resonnant circuit comprised of L2 and C6, to a second parallel-resonant tank. In the Type 724013-1, this second parallel-resonant tank consists of L3 and C7 through C10. In the Type 724013-2, this second parallel tank consists of L3 and C8 thru C10. This combination of tank circuits form a bandpass filter which provides a 3.5 MHz (minimum) 3 dB bandwidth about the 21.4 MHz center frequency in the Type 724013-1 and a 6 MHz 3 dB bandwidth about 21.4 MHz with the Type 724013-2. The output is taken from the junction of C8, C9 and C10 providing an output impedance, at J1, of 50Ω.

A sample of the output of U1 is applied to the AGC circuitry of the Wideband IF Output Amplifier controlling the gain of the subassembly. This signal is coupled across C22 and is applied to the amplifier U2. U2 provides 20 dB of amplification, as determined by the voltage divider formed by resistors R15 and R16, and applies its amplified output to the primary of transformer T1. The signal is then coupled across T1 and applied to the detector circuit comprised of CR2, C17 and R20. This circuit strips the 21.4 MHz component from the signal and produces a video signal impressed on a dc level that is representative of the strength of the input signal. Integrated circuit U3A amplifies the detected signal and applies the signal to a peak detector comprised of CR3, C18, R26 and R23. The fast charge and slow discharge time of this detector produces a dc level that is representative of the peak amplitude of the received signal. This dc level is then applied to inverter amplifier U3B producing the gain-control voltage for the subassembly.

The voltage divider formed by R25 and potentiometer R24 sets the point at which the AGC voltage begins controlling the subassembly gain. When the detected voltage at pin 6 of U3B increases above the level at pin 5, the output of U3B begins to produce a negative-going output voltage. This output voltage is then applied to transistor Q1 decreasing the subassembly gain to provide the proper output level. Resistor R21 and regulator VR3 limit the extremes of the AGC voltage to between +.7 and -6.3 Vdc. Under strong signal conditions, VR3 permits the AGC voltage to increase until it reaches its maximum of -6.3 Vdc. At that point VR3 begins conducting to prevent any further AGC voltage increase. Under weak signal conditions, the output of U3B is a positive voltage which is felt at the anode of VR3. VR3 is forward biased at this time and prevents the AGC voltage from increasing to more than 0.7 Vdc.

F.5 ALIGNMENT PROCEDURE

When performing the following alignment procedure, the Wideband IF Output Amplifier mounting screws should be removed permitting access to the adjustments on the underside of the subassembly. The alignment should be performed utilizing the test equipment listed or equivalents.

Equipment	Description	Type
Sweep Generator	0-1200 MHz	Wavetek 2001
Step Attenuator	0-80 dB	TF-10141 (WJ CET)
Detector	50 ohm	HP-423A
Oscilloscope	DC to 35 MHz	Tektronic T935
20 dB amplifier	6 MHz minimum bandwidth	
RF Millivoltmeter		Boonton 92B
	Probe	Boonton 91-12F
	"T" Adapter	Boonton 91-14A
	50 ohm Termination	Boonton 91-15A

F.5.1 **TYPE 724013-1 AND 724013-2 WIDEBAND IF OUTPUT AMPLIFIER ALIGNMENT**

1. Remove the cover from the subassembly and disconnect the jumper from between terminals E3 and E1.
2. Connect the test equipment as illustrated, with the 20 dB amplifier connected at terminal E3.
3. Set the sweep generator to sweep at least 6 MHz about a 21.4 MHz center frequency at an output level of -10 dBm. Activate the 21.4 MHz marker.
4. Set the attenuator for 55 dB of attenuation.
5. Preset R11 to midrange and R24 to its maximum CW position.

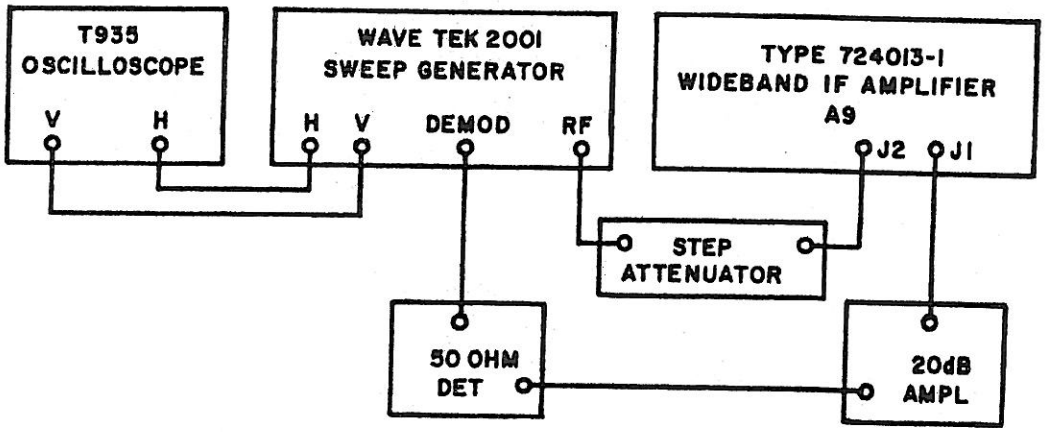

Figure F-1. Wideband IF Output Amplifier Alignment Equipment Connections

6. Adjust the oscilloscope controls to produce a suitable display of the output response, with the 21.4 MHz marker at the center of the display.

7. Adjust C5 centering the wideband response about the 21.4 MHz marker.

8. Disconnect the 20 dB amplifier from E3 and reconnect the jumper between E1 and E3.

9. Temporarily replace the subassembly cover and attach the 20 dB amplifier to output connector J1.

10. Activate the 1 MHz markers on the sweep generator.

11. From the underside of the Type 724013-1 subassembly, adjust L1, L2 and C7 to obtain the following response:

Center Frequency:	21.4 MHz
3 dB Bandwidth:	3.5 MHz, minimum; 5 MHz typical
Ripple:	1 dB or less

From the underside of the Type 724013-2 subassembly, adjust L1, L2 and L3 to obtain the following response:

Center Frequency:	21.4 MHz
3 dB Bandwidth:	6.0 MHz, minimum
Ripple:	1 dB or less

12. Remove the module cover and disconnect the 20 dB amplifier from J1.

13. Set the generator to produce a fixed 21.4 MHz CW output.

14. Connect the RF millivoltmeter and 50Ω load at J1.

15. On Type 724013-1 boards, adjust R11 to produce a -31 dBm indication on the RF millivoltmeter. On Type 724013-2 boards, adjust R11 to produce a -30 dBm (±3 dB) indication on the RF millivoltmeter.

16. Adjust R24 CCW until the indication on the millivoltmeter just begins to decrease. When adjusting R24, the meter indication may rapidly decrease and then spring back. Continue adjusting R24 until no spring back occurs and set R24 to the point where the level just began to decrease.

17. Set the attenuator for -15 dB of attenuation, while observing the RF millivoltmeter indication. The level should not change by more than 6 dB from the level set in step 15. If a change of greater than 6 dB is observed, repeat step 16.

18. Reinstall the subassembly cover and install the subassembly into the receiver.

F.6 PARTS LIST

F.6.1 TYPE 724013-1, WIDEBAND IF OUTPUT AMPLIFIER

REF DESIG PREFIX A9

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
	Revision D				
A1	Wideband IF Output Amplifier	1	270465-1	14632	
C1	Capacitor, Ceramic, Feedthru: 1000 pF, GMV, 500 V	2	54-794-009-102W	33095	
C2	Same as C1				
C3	Capacitor, Mica, Dipped: 300 pF, 2%, 500 V	2	CM05FD301G03	81349	
C4	Capacitor, Ceramic, Standoff: 100 pF, 10%, 500 V	2	54-803-009-101K	33095	
C5	Capacitor, Mica, Dipped: 510 pF, 2%, 500 V	1	DM15-511G	72136	
C6	Capacitor, Ceramic, Tubular: 7.5 pF, ±0.5 pF, 500 V	1	301-000C0H0-759D	72982	
C7	Capacitor, Variable, Air: 0.8-10 pF, 250 V	1	5202	91293	
C8	Capacitor, Mica, Dipped: 430 pF, 2%, 500 V	1	DM15-431G	72136	
C9	Same as C3				
C10	Same as C4				
J1	Connector, Receptacle	1	1012-1511-000	19505	
J2	Connector, Receptacle	1	1004-7511-002	19505	
L1	Coil, Variable	1	558-7107-06	71279	
L2	Coil, Variable	1	558-7107-24	71279	
L3	Coil, Fixed	1	21210-74	14632	
P1	Plug, Assembly	1	370434-4	14632	

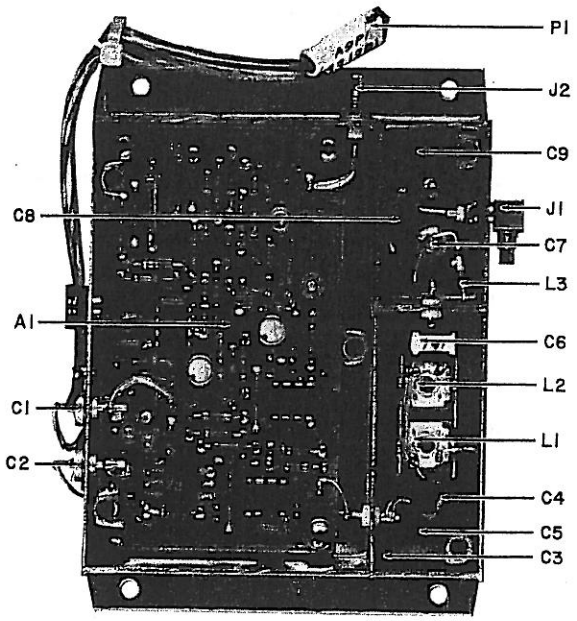

Figure F-2. Type 724013-1, -2 Wideband IF Output Amplifier, (A9), Location of Components

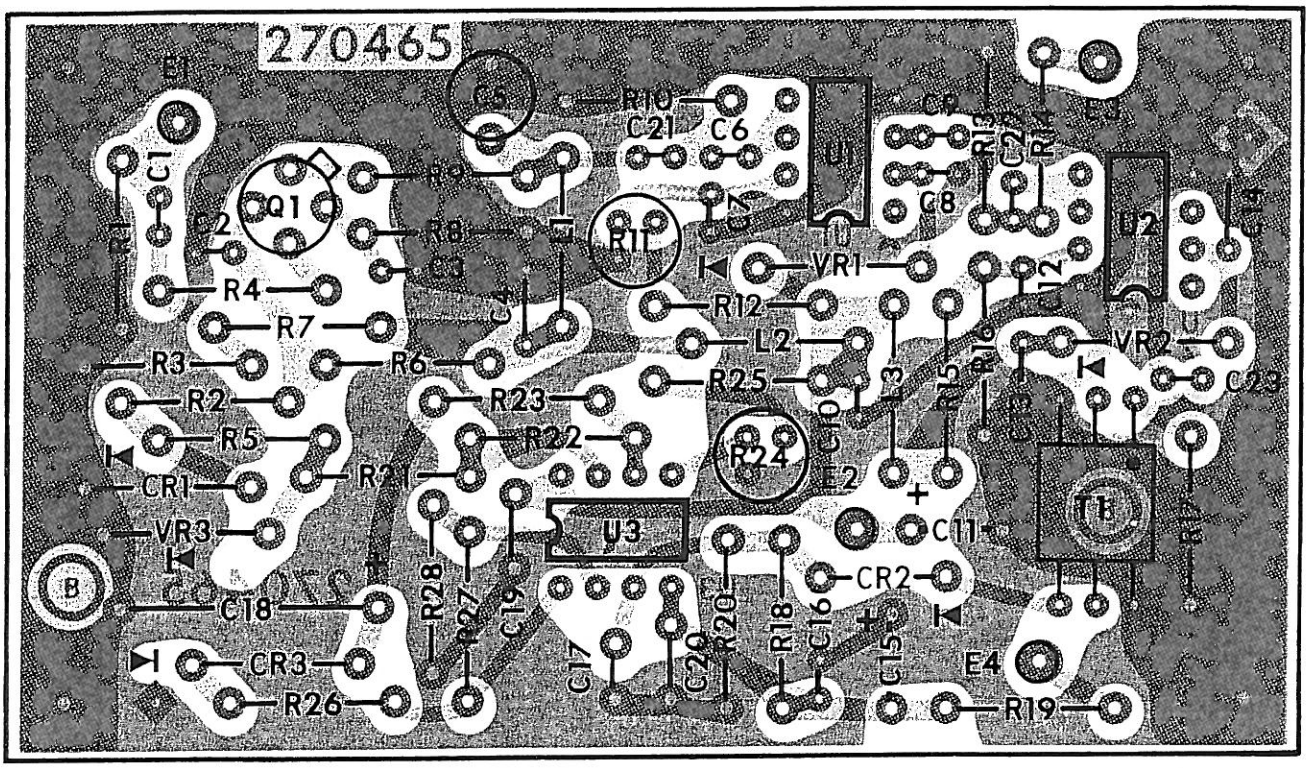

Figure F-3. Part 270465-1 Wideband IF Output Amplifier (A9A1), Location of Components

F.6.1.1 Part 270465-1, Wideband IF Output Amplifier

REF DESIG PREFIX A9A1

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
	Revision E				
C1	Capacitor, Ceramic, Disc: 4700 pF, 20%, 50 V	13	8121-050-651-472M	59660	
C2	Same as C1				
C3	Same as C1				
C4	Capacitor, Ceramic, Disc: 0.1 µF, 20%, 50 V	1	34475-1	14632	
C5	Capacitor, Variable, Ceramic: 5-25 pF, 100 V	1	518-000A5-25	59660	
C6 Thru C10	Same as C1				
C11	Capacitor, Electrolytic, Tantalum: 2.2 µF, 20%, 35 V	2	199D225X0035BE3	56289	
C12	Same as C1				
C13	Same as C1				
C14	Capacitor, Ceramic, Disc: 0.01 µF, 20%, 50 V	1	34453-1	14632	
C15	Same as C11				
C16	Same as C1				
C17	Capacitor, Mica, Dipped: 330 pF, 2%, 100 V	1	CM04FA331G03	81349	
C18	Capacitor, Electrolytic, Tantalum: 22 pF, 10%, 15 V	1	CS13BD226K	81349	
C19	Capacitor, Ceramic, Disc: 0.47 Fp, 20%, 50 V	2	34452-1	14632	
C20	Same as C19				
C21	Same as C1				
C22	Capacitor, Ceramic, Monolithic: 47 pF, ±2%, 100 V	1	150-100-NPO-470G	51642	
C23	Same as C1				
CR1	Diode	2	1N462A	80131	
CR2	Diode	1	5082-2800	28480	
CR3	Same as CR1				
L1	Coil, Fixed: 1.8 pH, 10%	1	1025-26	99800	
L2	Coil, Fixed: 18 pH, 10%	2	1025-50	99800	
L3	Same as L2				
Q1	Transistor	1	MFE211	04713	
R1	Resistor, Fixed, Film: 47Ω, ±5%, 1/4 W	3	CF1/4-47 OHMS/J	09021	
R2	Resistor, Fixed, Film: 33 kΩ, 5%, 1/4 W	1	CF1/4-33K/J	09021	
R3	Resistor, Fixed, Film: 10 kΩ, 5%, 1/4 W	2	CF1/4-10K/J	09021	
R4	Same as R1				
R5	Resistor, Fixed, Film: 4.7 kΩ, 5%, 1/4 W	2	CF1/4-4.7K/J	09021	
R6	Resistor, Fixed, Film: 100 kΩ, 5%, 1/4 W	2	CF1/4-100K/J	09021	
R7	Resistor, Fixed, Film: 68 kΩ, 5%, 1/4 W	1	CF1/4-68K/J	09021	
R8	Resistor, Fixed, Film: 120Ω, 5%, 1/4 W	1	CF1/4-120 OHMS/J	09021	
R9	Resistor, Fixed, Film: 33Ω, 5%, 1/4 W	1	CF1/4-33 OHMS/J	09021	
R10	Resistor, Fixed, Film: 360Ω, 5%, 1/4 W	1	CF1/4-360 OHMS/J	09021	
R11	Resistor, Trimmer, Film: 5 kΩ, 10%, 1/2 W	1	62PR5K	73138	
R12	Resistor, Fixed, Film: 22 kΩ, 5%, 1/4 W	3	CF1/4-22K/J	09021	
R13	Resistor, Fixed, Film: 270Ω, 5%, 1/4 W	1	CF1/4-270 OHMS/J	09021	

REF DESIG PREFIX **A9A1**

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
R14	Same as R1				
R15	Same as R12				
R16	Resistor, Fixed, Film: 3.3 kΩ, 5%, 1/4 W	1	CF1/4-3.3K/J	09021	
R17	Resistor, Fixed, Film: 220 kΩ, 5%, 1/4 W	1	CF1/4-220K/J	09021	
R18	Resistor, Fixed, Film: 150 kΩ, 5%, 1/4 W	1	CF1/4-150K/J	09021	
R19	Resistor, Fixed, Film: 100Ω, 5%, 1/4 W	1	CF1/4-100 OHMS/J	09021	
R20	Same as R5				
R21	Resistor, Fixed, Film: 1 kΩ, 5%, 1/4 W	1	CF1/4-1K/J	09021	
R22	Resistor, Fixed, Film: 620 kΩ, 5%, 1/4 W	1	CF1/4-620K/J	09021	
R23	Same as R6				
R24	Resistor, Trimmer, Film: 100 kΩ, 10%, 1/2 W	1	62PR100K	73138	
R25	Same as R12				
R26	Resistor, Fixed, Film: 2.2 kΩ, 5%, 1/4 W	1	CF1/4-2.2K/J	09021	
R27	Resistor, Fixed, Film: 43 kΩ, 5%, 1/4 W	1	CF1/4-43K/J	09021	
R28	Same as R3				
T1	Transformer	1	T4-1	15542	
U1	Integrated Circuit	2	SL1611C/DP	52648	
U2	Same as U1				
U3	Integrated Circuit	1	MC1458N	18324	
VR1	Voltage Regulator: 8.2 V	2	1N756A	80131	
VR2	Same as VR1				
VR3	Voltage Regulator: 6.3 V	1	1N753A	80131	

F.6.2 TYPE 724013-2, WIDEBAND IF OUTPUT AMPLIFIER

REF DESIG PREFIX A9

REF DESIG	DESCRIPTION	QTY PER ASSY	MANUFACTURER'S PART NO.	MFR. CODE	RECM VENDOR
	Revision A				
A1	Wideband IF Output Amplifier (see **Paragraph F.6.1.1**)	1	270465-1	14632	
C1	Capacitor, Ceramic, Feedthru: 1000 pF, GMV, 500 V	2	54-794-009-102W	33095	
C2	Same as C1				
C3	Capacitor, Mica, Dipped: 100 pF, 2%, 500 V	2	CM05FD101G03	81349	
C4	Capacitor, Ceramic, Standoff: 100 pF, 10%, 500 V	2	54-803-009-101K	33095	
C5	Capacitor, Mica, Dipped: 200 pF, 2%, 500 V	2	CM05FD201G03	81349	
C6	Capacitor, Ceramic, Tubular: 7.5 pF, ±0.5 pF, 500 V	1	301-000C0H0-759D	72982	
C7	Not Used				
C8	Same as C5				
C9	Same as C3				
C10	Same as C4				
E1	Terminal, Fedthru	2	SFU16Y	1DM30	
E2	Same as E1				
J1	Connector, Receptacle	1	1012-1511-000	19505	
J2	Connector, Receptacle	1	1004-7511-002	19505	
L1	Coil, Variable: 0.504-0.616 µH	2	558-7107-10	71279	
L2	Coil, Variable: 7.38-9.02 µH	1	558-7107-24	71279	
L3	Same as L1				
P1	Plug, Assembly	1	370434-4	14632	