RADIO FREQUENCY INTERFERENCE (RFI) SUPPRESSION

FOR 28 ELECTRICAL SERVICE ASSEMBLIES AND ASSOCIATED COMPONENTS

TROUBLESHOOTING

CONTENTS PAGE

1. GENERAL

1.01 This section presents an outline for checking some of the difficulties that may be encountered in the operation of the electrical service assembly (ESA) and its associated components. It also outlines a suggested procedure for field repair where adequate facilities are not available.

1.02 Since the ESA encloses and is dependent on other component circuits for its operation, the field troubleshooting and repair for these components are also included in this section. Reference should be made to wiring diagram section for each set and/or the wiring diagram package for circuit tracing and identification of components.

2. TROUBLESHOOTING

ELECTRICAL SERVICE ASSEMBLY

2.01 Troubleshooting for an ESA is required only to repair the power supply or correct wiring in case of loose, broken, or faulty wiring. Wiring can be checked by following the different circuits on the appropriate wiring diagram, point-to-point, and comparing with the actual equipment wiring.

2.02 Before attempting to repair a power supply fault, one should familiarize himself with the power supply card and ESA wiring. Refer to the circuit description in Section 573-613-100TC and the wiring diagrams in section for each set or the wiring diagram package listed in the chart of Section 573-600-100TC.

2.03 If trouble should develop, it may be found by performing the test outlined in the troubleshooting charts of Figures 1 and 2 with a multimeter.

2.04 Colored test point jacks are provided on top of the power supply circuit card to accept standard meter probes.

2.05 When a fault in the power supply is suspected but not obvious, disconnect all power from the ESA. Remove all keyer (LLK), selector magnet driver (SMD), and clutch magnet driver (CMD) circuit cards. Apply 100 to

Step	Action	Probe Position	Normal Response	Abnormal Response and Procedure
1	Check voltage from -7 test jack.	COM -7	Meter reading should be: Min -6.6 volts Max -7.8 volts If normal, proceed to Step 2.	RESPONSE: Meter reading of zero volt. DIFFICULTY: CR5 shorted or R5 open. PROCEDURE: Remove power supply card and repair or replace. Recheck Step 1. RESPONSE: Meter reading of +57 volts to +90 volts. DIFFICULTY: CR5 open. PROCEDURE: Remove power supply card and repair or replace. Recheck Step 1.
2	Check voltage from +7 test jack.	COM +7	Meter reading should be: Min +6.6 volts Max +7.8 volts If normal, proceed to Step 3.	RESPONSE: Meter reading of zero volt. DIFFICULTY: CR6 shorted or R4 open. PROCEDURE: Remove power supply card and repair or replace. Recheck Step 1. RESPONSE: Meter reading of +57 volts to +90 volts. DIFFICULTY: CR6 open. PROCEDURE: Remove power supply card and repair or replace. Recheck Step 1.
3	Check voltage from UNREG. test jack.	COM UNREG.	Meter reading should be: Min +57 volts Max +90 volts If normal, proceed to Step 4.	RESPONSE: Meter reading of zero volt. DIFFICULTY: Loose or blown fuse. PROCEDURE: Remove power supply card and secure or replace fuse. Proceed to Step 5. RESPONSE: Meter reading indicates voltage which is too low. DIFFICULTY: CR1 and/or CR4 open or shorted. C8 defective. T1 and power line filter defective. PROCEDURE: Remove power supply card or defective parts and repair or replace. Recheck Step 1.

Figure 1 - Power Supply Troubleshooting Procedure (0.5 Ampere Card)

Step	Action	Probe Position	Normal Response	Abnormal Response and Procedure
4	Check voltage from +50 test jack.	COM +50	Meter reading should be: Min +47 volts Max +53 volts If normal, end test.	RESPONSE: Meter reading of zero volt. DIFFICULTY: Q1 and/or Q2 open. PROCEDURE: Remove power supply card and repair or replace. Recheck Step 1. RESPONSE: Meter reading of more than zero volt but less than +47 volts. DIFFICULTY: Too many shorting straps across CR8, CR9, CR10, and CR11. PROCEDURE: Remove power supply card and remove straps, as necessary, to increase voltage. Replace card. Recheck Step 1. RESPONSE: Meter reading of +57 volts to +90 volts. DIFFICULTY: Q1 and/or Q2 shorted. PROCEDURE: Remove power supply card and repair or replace. Recheck Step 1.
5	Check voltage from UNREG. test jack.	COM UNREG.	Meter reading should be: Min +57 volts Max +90 volts Return to Step 4.	RESPONSE: Meter reading of zero volt. DIFFICULTY: Repeated fuse blowing. PROCEDURE: Disconnect power and remove power supply card. Make continuity checks between card terminals B and N, N and H, B and H. A zero or near zero reading on the 1-ohm scale of a multimeter indicates a short. Check continuity between Q1 case and its heat sink (Q1 must be electrically isolated from heat sink with mica insulators). If the power supply card checks satisfactorily, check power line filter, T1, and C8 for shorted condition. Repair or replace card. Recheck Step 1. RESPONSE: Meter reading indicates voltage which is too low. DIFFICULTY: CR1 and/or CR4 open or shorted. C8 defective. T1 and power line filter defective. PROCEDURE: Remove power supply card or defective parts and repair or replace. Recheck Step 1.

Figure 1 - Power Supply Troubleshooting Procedure (0.5 Ampere Card) (Continued)

Step	Action	Probe Position	Normal Response	Abnormal Response and Procedure
1	Check voltage from UNREG. test jack.	COM UNREG.	Meter reading should be: Min +57 volts Max +90 volts If normal, proceed to Step 2.	RESPONSE: Meter reading of zero volt. DIFFICULTY: Loose or blown fuse. PROCEDURE: Remove power supply card and secure or replace fuse. Proceed to Step 3. RESPONSE: Meter reading indicates voltage which is too low. DIFFICULTY: CR1 and/or CR2 open or shorted. C5 defective. T1 and power line filter defective. PROCEDURE: Remove power supply card or defective parts and repair or replace. Recheck Step 1.
2	Check voltage from +50 test jack.	COM +50	Meter reading should be: Min +47 volts Max +53 volts If normal, end test.	RESPONSE: Meter reading of zero volt. DIFFICULTY: Q1 and/or Q2 open. PROCEDURE: Remove power supply card and repair or replace. Recheck Step 1. RESPONSE: Meter reading of more zero volt but less than +47 volts. DIFFICULTY: Too many shorting straps across CR4, CR5, CR6, and CR7. PROCEDURE: Remove power supply card and remove straps, as necessary, to increase voltage. Replace card. Recheck Step 1. RESPONSE: Meter reading of +57 to +90 volts. DIFFICULTY: Q1 and/or Q2 shorted. PROCEDURE: Remove power supply card and repair or replace. Recheck Step 1.

Figure 2 - Power Supply Troubleshooting Procedure (1.0 Ampere Card)

Step	Action	Probe Position	Normal Response	Abnormal Response and Procedure
3	Check voltage from UNREG. test jack.	COM UNREG.	Meter reading should be: Min +57 volts Max +90 volts Return to Step 2.	RESPONSE: Meter reading of zero volt. DIFFICULTY: Repeated fuse blowing. PROCEDURE: Disconnect power and remove power supply card. Make continuity checks between card terminals D and S, S and K, D and K. A zero or near zero reading on the 1-ohm scale of a multimeter indicates a short. Check continuity between Q2 case and its heat sink (Q2 must be electrically isolated from heat sink with mica insulators). If the power supply card checks satisfactorily, check power line filter, T1 and C5 for shorted condition. Repair or replace card. Recheck Step 1. RESPONSE: Meter reading indicates voltage which is too low. DIFFICULTY: CR1 and/or CR2 open or shorted. C5 defective. T1 and power line filter defective. PROCEDURE: Remove power supply card or defective parts and repair or replace. Recheck Step 1.

Figure 2 - Power Supply Troubleshooting Procedure (1.0 Ampere Card) (Continued)

130 volt ac power to the ESA and proceed with the troubleshooting procedure as outlined in Figures 1 and 2.

CAUTION: BE EXTREMELY CAREFUL WITH CAPACITORS; THEY MAY BE CHARGED. A SEVERE ELECTRICAL SHOCK MAY BE RECEIVED FROM A CAPACITOR OR LEADS CONNECTED TO THE POWER SUPPLY WHILE IT IS IN OPERATION.

2.06 In following the procedure outlined in the troubleshooting chart, perform Step 1. If a normal response is received, proceed to Step 2. If an abnormal response is received, repair or replace card. After this procedure, return to Step 1. Next, perform Step 2 and so on in the same manner.

2.07 If this troubleshooting fails to reveal the difficulty, check for loose or cold solder connection or a broken or misplaced wire in the ESA. Recheck all wiring as indicated in 1.02.

2.08 Fuse blowing - Continually blowing fuses indicate a shorted component or components. Disconnect power, remove the circuit card assembly and make continuity checks between circuit card connector terminals B and N, N and H, and B and H. A zero or near zero reading on the one ohm scale of a multimeter indicates a short; disregard any other reading. Also, check continuity between the power transistor case and its heat sink; the power transistor must be electrically isolated from the heat sink with mica insulators. If the board assembly checks satisfactorily, examine the power line filter, power transformer, and rectifier

filter capacitor for a shorted condition. (These components are located within the electrical service assembly.)

2.09 Failure to detect the fault using the methods described above normally indicates a loose or cold solder connection, broken or misplaced wire in the service assembly. Check all wiring according to appropriate wiring diagrams.

SELECTOR MAGNET DRIVER

Note: The TP323810 selector magnet driver (SMD) is a circuit card assembly that needs only to be plugged into a properly keyed (polarizing key between pins E and F) 15-pin receptacle which is wired into the electrical service assembly (ESA).

2.10 It is recommended that any damaged TP323810 selector magnet driver (SMD) unit be replaced in the field and maintained in a repair center. The repair center should have equipment capable of simulating normal operating condition.

2.11 It is also recommended that the SMD be radio frequency interference (rfi) suppression tested after servicing and prior to final installation. Failures from this standpoint are not necessarily recognized by monitoring a typical communications operation.

A. Troubleshooting

2.12 The following information may be used as a guide for troubleshooting:

	Symptom	Probable Cause
(a)	Switching levels out of tolerance	(1) Improper adjustment of R3 and/or R15
		(2) Q1 and/or Q5 low gain
		(3) CR5 defective or out of tolerance
(b)	Circuit always marking	(1) Q8 open
		(2) Q1, Q5, Q6, Q7, or Q9 collector-emitter shorted
(c)	Circuit always spacing	(1) Q1, Q5, Q6, Q7, or Q9 collector-emitter open
		(2) Q8 collector-emitter shorted
		(3) CR13 open
(d)	Output current too high	R23 out of tolerance
(e)	Output current too low	R23 out of tolerance
(f)	Transient suppressor network ineffective	(1) CR14 open
		(2) R24 open
		(3) C6 open
(g)	Loss of receiving margin	(1) Q8, Q9 improper gain
		(2) C4, C5, or C6 out of tolerance or defective
		(3) CR14 shorted

B. Adjustments

Note: No mechanical adjustments are required on the TP323810 selector magnet driver. If necessary, the driver may be electrically adjusted as follows.

2.13 Terminate the output of the driver with a 28 selector wired for 60 ma operation (pins A or B and H, J, K, L, or M).

(a) Apply +47 to +53 v dc to the driver (pins C or D to H, J, K, L, or M).

(b) With input 2 (pins E, F) open circuited, short input 1 to common (pins N, P to H, J, K, L, or M).

(c) Adjust R3 until the selector magnet changes state. Note the position of the potentiometer.

(d) Rotate R3 until the selector returns to its initial state.

(e) Set the potentiometer midway between the two positions obtained in (c) and (d).

(f) Secure the adjustment by applying an appropriate cement to the potentiometer adjustment screw.

2.14 Repeat 2.13 (a) through (f), this time adjusting R15 with input 1 (pins N, P) open circuited and input 2 shorted to common (pins E, F to H, J, K, L, or M).

LOW-LEVEL KEYER (TP303142 AND TP323130)

2.15 The keyer is a circuit card assembly that needs only to be plugged into a properly keyed 15-pin receptacle which is wired into an appropriate ESA.

2.16 It is recommended that any damaged keyer card be replaced in the field and maintained in a repair center. The repair center should have equipment capable of simulating normal operating conditions.

2.17 It is also recommended that the keyer and associated filter cards (if any) be radio frequency interference (rfi) suppression tested after servicing and prior to final installation. Failures from this standpoint are not necessarily recognized by monitoring a typical communications operation.

A. Troubleshooting for the TP303142 Keyer

2.18 The following information may be used as a guide for troubleshooting:

	Symptom	Probable Cause
(a)	Circuit always marking	(1) Q1 and/or Q2 shorted
		(2) Excessive signal generator contact resistance
(b)	Circuit always spacing	Q1 and/or Q2 open
(c)	Mark - space bits detectable but will not go positive on mark	Q4 and/or Q6 open
(d)	Mark - space bits detectable but will not go negative on space	Q3 and/or Q5 open

B. Adjustments for the TP303142 Keyer

Note: No mechanical or electrical adjustments are required on the TP303142 low-level keyer or its associated TP321268 filter card. The adjustments given in this part apply to the contact box or signal generator and are for reference only.

2.19 This adjustment is to be made with the contact box installed in the appropriate transmitter or keyboard and may be used in place of the adjustment in 2.21.

(a) Remove the TP325951 nut, TP320043 outer cover, TP325951 nut, TP321273 inner cover, and, without unsoldering the leads to the filter card, remove the TP321268 filter card assembly.

(b) With the contact box bracket mounting screw loosened friction tight, position the box by means of the eccentric, so that the marking and spacing gaps are equal when there is a maximum clearance between the contacts, as determined by engaging the clutch and rotating the main shaft. Tighten the mounting screws and recheck the adjustment.

(c) After completing the adjustment, replace all parts removed in 2.19 (a).

2.20 The following electromechanical adjustment pertains to the signal generator after installation of the TP303142 polar line keyer and associated signal generator assembly. It may be used in place of the adjustment in 2.19 with the signal generator and low-level keyer in place.

2.21 Alternate adjustment procedure:

(a) Using an oscilloscope to view the output of the polar line keyer (transmitter sending repeated Y character), adjust the oscilloscope to trigger at zero volt on the keyer output waveform. Be sure to properly zero the vertical amplifier on the scope before beginning the adjustment.

(b) Adjust the scope sweep rate so as to display one complete mark-space portion of the signal.

(c) Adjust the position of the signal generator until the mark to space transition crosses zero volt at the center of the horizontal

scale. When the signal generator is properly adjusted, the three points at which the waveform passes through zero volt will divide the horizontal axis into two equal segments.

(d) After the adjustment is made, tighten the signal generator bracket screws securely.

C. Troubleshooting for the TP323130 Keyer

2.22 The following information is a guide for troubleshooting:

	Symptom	Probable Cause
(a)	Circuit always marking	Photocell in keyboard or distributor shorted
(b)	Circuit always spacing	Photocell in keyboard or distributor open circuited
(c)	Mark - space bits detectable but will not go positive on mark	Q3 open and/or Q2 shorted
(d)	Mark - space bits detectable but will not go negative on space	Q4 open and/or Q1 shorted

D. Adjustments for the TP323130 Keyer

2.23 Using an oscilloscope to view the output of the polar line keyer (transmitter sending repeated Y character), adjust the oscilloscope to trigger at zero volt on the keyer output waveform. Be sure to properly zero the vertical amplifier on the scope before beginning the adjustment.

(a) Adjust the scope sweep rate so as to display one complete mark-space portion of the signal.

(b) Adjust the 5 megohm trimpot of the keyer until the mark to space transition crosses zero volt at the center of the horizontal scale. When the keyer is properly adjusted, the three points at which the waveform passes through zero volt will divide the horizontal axis into two segments that are within 10 percent of each other. The output voltage peaks will also be within 10 percent of each other.

(c) After the adjustment is made, the adjusting screw may be sealed. This completes the adjustment.

CLUTCH MAGNET DRIVER (TP321991)

Note: The clutch magnet driver (CMD) is a circuit card assembly that needs only to be plugged into a properly keyed 15-pin receptacle which is wired into an appropriate electrical service assembly (ESA).

2.24 It is recommended that any damaged clutch magnet driver (CMD) unit be replaced in the field and maintained in a repair center. The repair center should have equipment capable of simulating normal operating conditions.

2.25 It is also recommended that the CMD be radio frequency interference (rfi) suppression tested after repair and prior to final installation. Failures from this standpoint are not necessarily recognized by monitoring a typical communications operation.

A. Troubleshooting

2.26 The following information may be used as a guide for troubleshooting the TP312991 clutch magnet driver:

	Symptom	Probable Cause
(a)	Switching levels out of tolerance	(1) Improper adjustment of R7
		(2) Q1 low gain
		(3) CR7 defective or out of tolerance
(b)	Circuit always marking	(1) Q3 open
		(2) Q1, Q2, or Q4 collector-emitter shorted
(c)	Circuit always spacing	(1) Q1, Q2, or Q4 open
		(2) Q3 collector-emitter shorted
		(3) CR8 open
(d)	Output current too high	(1) CR2 open
		(2) R17 out of tolerance

Symptom	Probable Cause
(e) Output current too low	(1) R2 improperly adjusted or defective
	(2) R17 out of tolerance
(f) Transient suppressor network ineffective	(1) CR9 open
	(2) R16 open
	(3) C4 open

B. Adjustments

Note: No mechanical adjustments are required on the TP321991 clutch magnet driver. If necessary, the driver may be electrically adjusted as outlined below.

2.27 The following instruments are required for making TP321991 clutch magnet driver (CMD) electrical adjustments (refer to schematic wiring diagram for location of circuit elements):

(a) Milliammeter (to measure 15 ma) with accuracy of ±10 percent.

(b) Plus 6 volts ±20 percent dc source (required power less than 6 milliwatts).

(c) Transmitter distributor with series connected 256M clutch coils.

2.28 Terminate the output of the driver with a transmitter distributor clutch assembly utilizing two 256M coils in series (pins A or B and K, L, or M).

2.29 Place a milliammeter in series (connect positive terminal of meter to test point T4) with the zener regulator diode CR2 (mounted on the heat sink).

2.30 With normal power applied to the circuit (+47 to +53 v dc and -6 v dc), and a +6 volt input to pin N or P, adjust R2 for 15 ma of zener current. Secure the wiper of R2, by applying an appropriate cement, to prevent accidental rotation. Remove the +6 volt input.

2.31 Short the input to common (pins N or P to K, L, or M) and adjust R7 until the clutch magnet changes state. Note the position of the potentiometer.

2.32 Rotate R7 back until the clutch magnet returns to its initial state.

2.33 Set the potentiometer midway between the two positions obtained in 2.31 and 2.32.

2.34 Secure the adjustment by applying an appropriate cement to the potentiometer adjustment screw.

2.35 Remove power and solder the zener diode lead to the cathode pin nearest the component side of the card.