DC-TO-DC CONVERTER
+6.6 VOLTS, 30 AMPERES
J87340
OPERATING METHODS

1. GENERAL

1.01 The J87340 dc-to-dc converter provides a nominal 6.6-volt, 30-ampere dc output from a nominal 26-volt dc input for use with the 3A and 4A switch units, ESS 101 PBX.

1.02 This issue does affect the Equipment Test List.

1.03 The J87340 dc-to-dc converter operates within the working limits of 20.5 to 30 volts, 0 to 15 amperes dc at the input to provide a regulated 6.0- to 7.2-volt, 0- to 30-ampere dc output. Overload protection is provided to protect the converter from damage due to an overload or short circuit on the output.

1.04 High output voltage protection is provided by sensing the output voltage and disabling the converter should the output voltage increase to above 7.9 volts dc. The converter will shut down and must be turned off and restarted after a high-voltage condition.

1.05 Low input voltage protection is provided by a low-voltage detector which monitors the input voltage to the control circuit and will shut down the converter should the input voltage decrease to below 18.0 volts dc. The converter will automatically restart when the input voltage is increased to the proper value.

1.06 For parallel operation of J87340 converters, an isolation diode is required to isolate the converter outputs and provide selective high-voltage shutdown protection. If R30 resistor is in parallel with R9 resistor (Z-option), it is necessary to remove the two strap wires connecting the resistors in parallel. With R30 resistor disconnected, the converter output voltage is raised approximately 0.7 volt dc to compensate for the isolation diode in series with the output.

1.07 The abbreviations cw and ccw refer to clockwise and counterclockwise, respectively.

1.08 Routine checks should be made when they will cause the least service reaction.

1.09 The instructions are based on circuit schematic drawing SD-81965-01. For a detailed description of the operation, see the corresponding circuit description.

1.10 The J87340 dc-to-dc converter will function with the following circuit:

SD-1H200-01	No. 101 System Block Diagram and Power Distribution Circuit for 3A Switch Unit

2. LIST OF TEST APPARATUS

CODE OR SPEC NO.	DESCRIPTION
KS-8039	DC Volt-Milliammeter
—	Oscilloscope Tektronix, Model 535A (or equivalent)
—	Current Probe Tektronix, Model P6016 (or equivalent)
—	Resistor, 1000 Ohms, 0.5 Watt
—	Test Prod Wire (approximately 8 inches required)
—	Insulated Alligator Clips, Mueller (or equivalent) (two reqd)

3. OPERATION

Preparing to Start

3.01 When preparing to put the converter in service, check that:

(a) All external connections are made in accordance with the schematic drawing covering the circuits associated with the plant.

(b) The input fuse (NON BUSS, 30-ampere) is removed.

(c) If the converter is to be operated in parallel, verify that an isolation diode is in series with the output and that the Z-option (SD-81965-01) is removed.

Caution: Before attempting any converter operation, check the operating methods for the power plant concerned for any operating precautions that may have to be observed.

Starting

3.02 To place the converter in service, install the input (NON BUSS, 30-ampere) fuse. The converter is regulated for a nominal 6.6-volt dc output and does not require any adjustment.

Stopping

3.03 To remove the converter from service, remove the input (NON BUSS, 30-ampere) fuse.

3.04 ***High-Voltage Shutdown:*** If the converter shuts down due to a high-voltage condition, it may be restarted by momentarily removing the CP1 regulator and control circuit or the input fuse.

4. ROUTINE CHECKS

4.01 ***Voltage Checks:*** Check the output voltage using the KS-8039 volt-milliammeter set to the 15-volt dc range. The voltage should be between 6.0 and 7.2 volts dc.

4.02 Check that the ventilating passages are unobstructed.

5. TROUBLES

5.01 ***Output Voltage Adjustment After Repairs:*** In the event components are replaced on the REGULATOR AND CONTROL CIRCUIT CP1 (ED82369), the output voltage should be checked using the KS-8039 volt-milliammeter to ensure that it is between 6.5 and 6.7 volts. If the output voltage is greater than 6.7 volts or less than 6.5 volts, refer to Table A to determine which shorting straps (A through G) should be cut to bring the output voltage within the limits of 6.5 and 6.7 volts (nominal 6.6 volts). If the output voltage is within these limits, no straps need to be cut.

5.02 ***Trouble Charts:*** Failure of the J87340 converter will most probably be characterized by one of two conditions—operated input fuse and consequent loss of output voltage, or loss of output voltage without the operation of the input fuse. Charts I and II are designed to troubleshoot the converter from the standpoint of either of these two symptoms. For example, if initial inspection discloses an operated input fuse, Chart II should be consulted directly. If there is no output and the input fuse is nonoperated, Chart I should be consulted. Chart III contains steps to be followed should the output voltage stray out of regulation limits. Test points E1 through E8 are provided on the CP1 regulator and control circuit to facilitate troubleshooting.

TABLE A

(A) If the output voltage is less than 6.5 volts, cut straps B and D followed by:

STRAP	TO RAISE THE OUTPUT VOLTAGE
E	0.09 volt
F	0.18 volt
G	0.25 volt
E,G	0.32 volt
F,G	0.38 volt
E,F,G	0.42 volt

(B) If the output voltage is greater than 6.7 volts, cut straps A and C followed by:

STRAP	TO LOWER THE OUTPUT VOLTAGE
E	0.10 volt
F	0.21 volt
G	0.33 volt
E,G	0.44 volt
E,F,G	0.55 volt

CHART I: NO OUTPUT VOLTAGE — INPUT FUSE NOT OPERATED

STEP	POSSIBLE CAUSE	TEST PROCEDURE	RESULTS	
			PROPER INDICATION	REASON FOR INCORRECT INDICATION
1.	Loss of input voltage	(a) Ensure that the input fuse is nonoperated and properly installed. (b) Using the KS-14510 volt-ohm-milliammeter, measure the voltage from terminal A of P1 (+) to terminal C of P1 (—) and across C2 capacitors.	Input battery voltage	Open circuit between battery and converter. Faulty input fuse holder. Faulty P1 connector. Open wiring to C2 capacitors.
2.	Loss of supply voltage to CP1 regulator and control circuit	Using the KS-14510 volt-ohm-milliammeter, measure the voltage from terminal 7 (+) to terminal 2 (—) of the CP1 frame receptacle.	Approximately 22 volts dc	Open wiring from input supply to terminals 7 or 2 of the CP1 frame receptacle. Defective R8 resistor (power circuit). Defective CR17 zener diode.
3.	Input battery voltage too low — operated low input voltage shutdown circuit	Repeat test procedure in Step 2.	19 volts dc minimum	The low input voltage shutdown circuit keeps the converter from operating when the input voltage decreases to less than approximately 19 volts dc.
4.	High-voltage shutdown	(a) Momentarily remove the CP1 circuit pack from its frame receptacle and replace. (b) Using the KS-14510 volt-ohm-milliammeter, measure the voltage across C4 capacitor.	Converter restarts and the meter should indicate 6.0 to 7.2 volts dc.	Failure to restart indicates a problem in the power circuit or control circuit as outlined in Steps 5 through 17.
5.	Open output circuit	(a) Remove the 30-ampere input fuse. (b) Discharge all capacitors in the power circuit. (c) Using the KS-14510 volt-ohm-milliammeter, check for continuity from the positive terminal of C4 capacitors to terminal B of P1. (d) Using the KS-14510 volt-ohm-milliammeter, check for continuity through terminal B of P1.	Zero ohms	Open wiring from C4 capacitors to P1 connector. Faulty P1 connector.
6.	Open gate resistor or gate lead	(a) Ensure that input fuse is removed. (b) Using the KS-14510 volt-ohm-milliammeter, measure the resistance from the CP1 frame receptacle, terminal 8 and CA1 terminal 10. (c) Check for continuity between CP1 frame receptacle, terminal 10 and CA1 terminal 4.	The resistance measured in (b), (c), (d), and (e) should be approximately zero ohms.	Open gate lead(s).

CHART I: NO OUTPUT VOLTAGE — INPUT FUSE NOT OPERATED — (Cont)

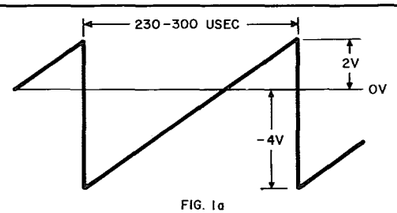
STEP	POSSIBLE CAUSE	TEST PROCEDURE	RESULTS	
			PROPER INDICATION	REASON FOR INCORRECT INDICATION
6.	(Cont)	(d) Check for continuity between CP1 frame receptacle, terminal 10 and CA1 terminal 4. (e) Check for continuity between CP1 frame receptacle, terminal 11 and CA1 terminal 3.		
7.	Open or shorted gate on Q1, Q2, Q3, or Q4 thyristors	(a) Ensure that the input fuse is removed. (b) Remove the CP1 regulator and control circuit. (c) Using the KS-14510 volt-ohm-milliammeter on the RX1 range, check the resistance from CA1 terminal 3 to CA1 terminal 4. (d) Check the resistance from CA1 terminal 9 to CA1 terminal 10.	The resistance readings will vary due to individual thyristor gate characteristics. A reading between 20 and 100 ohms should be obtained.	An indication less than approximately 20 ohms indicates a shorted gate. Infinity ohms indicates an open gate or gate resistor. In either case, replace the CA1 assembly.
8.	Loss of continuity in FS1 power circuit	(a) Using the KS-14510 volt-ohm-milliammeter, check for continuity from the positive terminals of C2 capacitors to CA1 terminal 2. (b) Using the KS-14510 volt-ohm-milliammeter, check for continuity between CA1 terminal 1 and CA1 terminal 8. (c) Using the KS-14510 volt-ohm-milliammeter, check for continuity from CA1 terminal 8 to one terminal of C1 capacitor. Check continuity from other terminal of C1 capacitor to CA1 terminal 5. (d) Using the KS-14510 volt-ohm-milliammeter, check continuity between CA1 terminal 5 and ground.	Zero ohms Zero ohms Zero ohms Zero ohms	Open wiring from C2 capacitor to CA1 terminal 2. Open wiring between CA1 terminals 1 and 8. Open L1 inductor. Open wiring. Open L2 inductor or open wiring to L2 inductor.
9.	Loss of timing ramp	(a) Remove the input fuse. (b) Open CA1 terminal 2. (c) Replace the input fuse. *Note:* CA1 terminal 2 should remain open for all the following control circuit tests in Steps 10 through 17. Replace the leads when testing is completed. (d) Refer to SD-81965-01 for test point location. Connect the oscilloscope ground to	 FIG. 1a *Notes:* (1) To obtain a stable waveform, it	

CHART I: NO OUTPUT VOLTAGE — INPUT FUSE NOT OPERATED — (Cont)

STEP	POSSIBLE CAUSE	TEST PROCEDURE	RESULTS	
			PROPER INDICATION	REASON FOR INCORRECT INDICATION
9.	(Cont)	test point E17. Connect the vertical input of the scope to test point E3.	may be necessary to eliminate the random noise source by connecting a clip lead from test points E18 to E17. (2) Voltages shown are approximate.	If ramp is present and within limits shown, proceed to Step 15 of Chart I. If the ramp is not present or does not conform to the figure, proceed with Step 10.
10.	Faulty zener supplies	(a) Using the KS-14510 volt-ohm-milliammeter, check the voltage from test point E1 (+) to test point E17 (—). (b) Using the KS-14510 volt-ohm-milliammeter, measure the voltage from test point E2 (+) to test point E17 (—).	Approximately 22 volts dc 11.6 to 13.2 volts dc *Note:* Voltages must fall within these limits.	Faulty CR17 zener diode. Faulty CP1 frame receptacle. Open R8 resistor or lead 9 in power circuit. CR18 diode, CR19 diode, or R25 resistor defective.
11.	Defective regulator circuit	(a) Connect the ground of the oscilloscope to test point E17 and the vertical input to test point E4. (b) Remove the lead from terminal 3 of CP1 frame receptacle. (c) With the scope connected as in (a), momentarily connect a 1000-ohm resistor between test point E2 and terminal 3 of CP1 frame receptacle. (d) Replace the lead on terminal 3 of CP1 frame receptacle. (e) Connect the oscilloscope ground to test point E17 and the vertical input to test point E5.	Approximately 12 volts dc DC level shift from approximately 12 volts to zero volts Approximately 6.0 to 7.5 volts dc Approximately 6.0 to 7.5 volts dc	IC1 level detector or CR7 diode defective. If voltage fails to shift from 12 to 0 volts, IC1 level detector defective. R2, R6, R7, R8, R9, or R30 resistor defective. Incorrect strapping of R6, R7, and R8 resistors.
12.	Defective low input voltage shutdown circuit	(a) Using the KS-14510 volt-ohm-milliammeter, measure the voltage from test point E6 (+) to test point E17 (—). (b) Connect the oscilloscope ground to test point E17 and the vertical input to test point E7. (c) Connect the oscilloscope ground to test point E17 and the vertical input to test point E8.	Approximately 6.5 volts dc Approximately 0.1 volt dc Approximately 22 volts dc	R4, R23, or R28 resistor defective; CR15 diode open; or Q7 transistor defective. An indication of approximately 0.7 volt indicates Q7 transistor defective. Q6 transistor shorted collector to emitter or defective high-voltage shutdown circuit as outlined in Step 13.
13.	Defective high-voltage shutdown circuit	(a) Remove the input fuse.	Typical front to back resistance ratio produced by the CR14 diode when ohmmeter leads are reversed	Zero ohms indicates Q4 thyristor, Q6 transistor, or CR14 diode shorted.

CHART I: NO OUTPUT VOLTAGE — INPUT FUSE NOT OPERATED — (Cont)

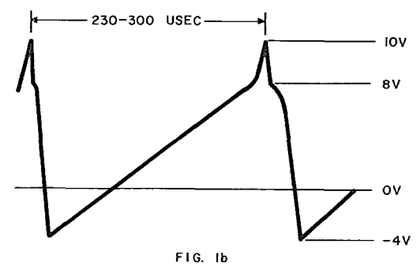
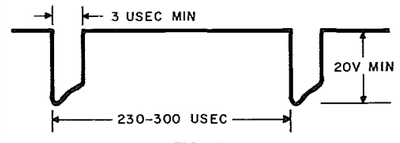
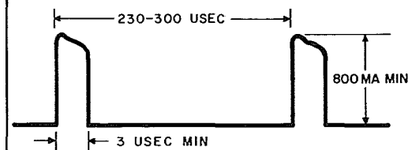
STEP	POSSIBLE CAUSE	TEST PROCEDURE	RESULTS	
			PROPER INDICATION	REASON FOR INCORRECT INDICATION
13.	(Cont)	(b) Using the KS-14510 volt-ohm-milliammeter, measure the resistance from test point E8 to test point E17. (c) Using the KS-14510 volt-ohm-milliammeter, set to the RX1 range, check CR13 zener diode for a typical diode front to back resistance ratio.	Greater resistance in the reverse biased direction than in the forward biased direction	CR13 diode defective.
14.	Defective current limit circuit	(a) Replace the input fuse. (b) Using the KS-14510 volt-ohm-milliammeter, measure the voltage between test point E10 (+) and test point E17 (—).	Approximately 1 volt dc	0.7 xolt dc or less indicates Q9 transistor defective. 22 volts dc indicates Q8 thyristor or CR20 diode defective.
15.	Inoperative astable blocking oscillator	(a) Ensure the input fuse is installed. (b) Connect the oscilloscope ground to test point E17 and the vertical input to test point E12.	 FIG. Ib	INDICATION / DEFECTIVE COMPONENT 0 volts dc — CR10 diode shorted; R7 resistor, C4 capacitor defective. 3 volts dc — CR8 diode shorted. 6 volts dc — Q5 transistor open base to emitter; R12 resistor defective; Q8 thyristor open. Ramp starts from —27 volts — CR8 diode open.
		(c) Relocate the vertical scope input to test point E13.	 FIG. Ic	Q5 transistor defective or T1 pulse transformer open between terminals 3 and 4.
		(d) Using a Tektronix P6016 current probe or equivalent, observe the gate pulse in the lead from terminal 9 of the CP1 frame receptacle.	 FIG. Id	T1 pulse transformer defective (check for open windings or interwinding shorts). Defective CP1 frame receptacle. Open wiring, gate resistor or gate on Q3 or Q4 thyristors in power circuit.

CHART I: NO OUTPUT VOLTAGE — INPUT FUSE NOT OPERATED — (Cont)

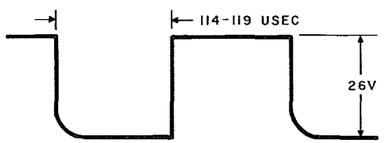
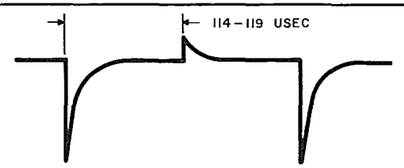
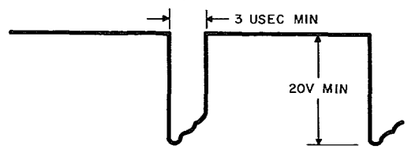
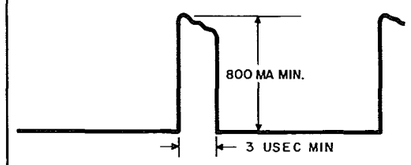
STEP	POSSIBLE CAUSE	TEST PROCEDURE	RESULTS	
			PROPER INDICATION	REASON FOR INCORRECT INDICATION
16.	Inoperative monostable multivibrator	(a) Ensure the input fuse is properly installed. (b) Connect the scope ground to test point E17 and the vertical input to test point E14.	 FIG. Ie	RV2 varistor, RV3 varistor, Q1 transistor, Q2 transistor, or CR3 diode defective.
17.	Defective blocking oscillator	(a) Ensure that the input fuse is in place. (b) Connect the oscilloscope ground to test point E17 and the vertical input to test point E15. (c) Relocate the vertical scope input to test point E16.	 FIG. If  FIG. Ig	C5 capacitor, R18 or R19 resistor defective. Q6 transistor defective or T2 pulse transformer open between terminals 3 and 4. R5 resistor open.
		(d) Using a Tektronix P6016 current probe or equivalent, observe the gate pulse in the lead from terminal 11 of the CP1 frame receptacle.	 FIG. Ih	T2 pulse transformer defective. (Check for open windings or interwinding shorts.) Open contact CP1 frame receptacle.

CHART II: NO OUTPUT VOLTAGE — INPUT FUSE OPERATED

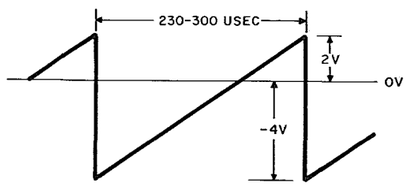
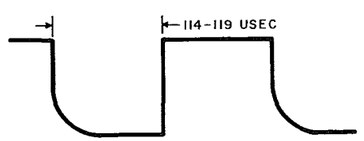
STEP	POSSIBLE CAUSE	TEST PROCEDURE	RESULTS	
			PROPER INDICATION	REASON FOR INCORRECT INDICATION
1.	Faulty wiring between input fuse and P1 terminals A and C or faulty wiring at converter input	(a) Remove the input fuse. (b) Using the KS-14510 volt-ohm-milliammeter, measure the resistance between P1 terminals A and C.	Approximately 1000 ohms	Faulty winding; R6 resistor defective; C2 capacitor defective.
2.	A short in any of the following devices as shown in FS1 of SD-81965-01: Q1, Q2, Q3, or Q4 thyristors	(a) Ensure that the input fuse is removed. (b) Using the volt-ohm-milliammeter, set to the RX1 scale, check for shorted components by measuring the resistance between CA1 terminals 1 and 2 and CA1 terminals 7 and 8.	The resistance measured will vary due to connecting circuitry. Therefore, for an indication other than zero ohms, the device may be assumed operable.	Replace the CA1 assembly if components are defective.
3.	CR1 or CR4 diode defective	With the input fuse removed and P1 disconnected, measure the front to back resistance ratio of CR1 and CR4 with the KS-14510 volt-ohm-milliammeter. This is accomplished by measuring the resistance between terminals 5 and 6 of CA1.	Low resistance in the forward-biased direction; high resistance in the reverse-biased direction.	A high resistance in both directions indicates CR1 open. *Note:* Ohmmeter will initially indicate low resistance due to charging of C4 capacitors.
4.	C1 capacitor or associated wiring shorted	With the input fuse removed, check C1 capacitor and associated wiring for a short circuit.	One side of C1 capacitor should measure a relatively high resistance to ground. The other side of C1 is grounded through L2 inductor and should read zero ohms.	Zero ohms to ground on both terminals of C1 capacitor indicates C1 capacitor, Q3 or Q4 thyristors shorted.
5.	Incorrect astable blocking oscillator timing (CP1)	(a) Ensure that the input fuse is removed. (b) Open terminal 2 of CA1 (FS1). (c) Replace the input fuse. (d) Connect the oscilloscope ground to test point E17 and the vertical input to test point E3.	 FIG. 11 *Note:* Voltages shown are approximate.	R3 resistor or C4 capacitor defective. CR18 or CR19 zener diode defective or out of specified limits. If negative portion of ramp is not at — volts with respect to zero, CR8 zener diode defective.
6.	Incorrect monostable multivibrator timing	With the converter connected as in Step 5, relocate the vertical oscilloscope input to test point E14.	 FIG. 11	C7 capacitor, R15 resistor, Q1 or Q2 transistor defective.

CHART II: NO OUTPUT VOLTAGE — INPUT FUSE OPERATED — (Cont)

STEP	POSSIBLE CAUSE	TEST PROCEDURE	RESULTS	
			PROPER INDICATION	REASON FOR INCORRECT INDICATION
7.	Inoperative current limit circuit	(a) Connect the converter as specified in Step 5. (b) Connect the oscilloscope ground to test point E17 and the vertical input to test point E3. (c) Momentarily short Q9 from collector to emitter.	The ramp as shown in Step 5 will disappear as Q9 transistor is shorted and a dc level of approximately 6.3 volts should be observed.	Q8 or Q9 thyristor defective.
8.	Defective low input voltage shutdown circuit	(a) Connect the converter as outlined in Step 5. (b) Using the KS-14510 volt-ohm-milliammeter, measure the voltage from test point E8 (+) to test point E17 (—). (c) Momentarily short-circuit test points E6 and E17.	DC level shift from approximately 22 volts to zero volts.	Q6 transistor, Q7 transistor, or CR15 diode defective. CR9 diode open.

CHART III: OUTPUT VOLTAGE NOT WITHIN SPECIFIED LIMITS

STEP	POSSIBLE CAUSE	TEST PROCEDURE	RESULTS	
			PROPER INDICATION	REASON FOR INCORRECT INDICATION
1.	Defective reference voltage supply	Using the KS-14510 volt-ohm-milliammeter, measure the voltage from test point E2 (+) to test point E17 (—).	11.6 to 13.2 volts dc	CR18, CR19 zener diodes defective.
2.	Defective reference voltage divider	Using the KS-14510 volt-ohm-milliammeter, measure the voltage from test point E5 (+) to test point E17 (—).	6.65 to 6.75 volts dc (Z-option) 7.37 to 7.45 volts dc	R6, R7, R8, R9, R30, or R2 resistor defective. Incorrect strapping of R6, R7, or R8 resistors. Improper application of Z-option.
3.	High-voltage output caused by defective IC1 level detector *Note:* In order to produce high voltage on the output, a high-voltage condition must be accompanied by a high-voltage shutdown circuit failure.	Connect the oscilloscope ground to test point E17. Connect the vertical input to test point E4.	Random dc level shifts between zero and 12 volts	IC1 defective. Must also be accompanied by defective CR13 or CR9 diode, or Q4 thyristor in high-voltage shutdown circuit.
4.	Overload or short circuit on converter output	(a) Remove the input fuse. (b) Visually inspect the output of the converter for a short circuit. (c) Open terminal 6 on CA1 assembly. (d) Using the KS-14510 volt-ohm-milliammeter, check C4 capacitors for shorts.	Ohmmeter should initially indicate a low resistance and increase to a higher value as C4 charges.	Defective capacitor in C4 capacitor bank.