

Chapter 3-3

TM12 Electronic unit fault diagnosis

Introduction

1. If a fault occurs and the procedure given in Chap 3-2 indicates that the electronic unit is unserviceable, the procedure given in Table 1 should be applied to the unit in order to localize the fault to a particular circuit board.
2. No servicing is permitted on individual circuit boards and an unserviceable board must be replaced by a board to the same modification standard.

Note (1) ...

If a circuit board is found to be faulty, and is replaced, the test procedure must be recommenced from test No 1.

Note (2) ...

The signal amplifier and demodulator boards are a matched pair; if either circuit board is found to be unserviceable both boards must be replaced.

Test equipment

3. The following equipment or equivalents where applicable is required:-
 - (1) TM12 Electronic torquemeter test set (Ref No NIV).
 - (2) Multimeter, Model 8 (Ref No F19/6625-99-943-1524 or 5QP/17001).
 - (3) AC valve voltmeter, Type CT 527 (Ref No 10S/17730).
 - (4) Oscilloscope Type CT 414 (Ref No F19/6625-99-943-1632) or Type CT 436 (Ref No 10S/9138618).
 - (5) 28V, 2A dc supply.

Preliminaries

4. Proceed as follows:-

- (1) Connect the electronic unit to the test set using the two leads provided (Chap 3-1, fig 1).
- (2) Connect the 28V dc supply to the test set.
- (3) Ensure that all test set controls and switches are set as follows:-

SW1	OFF
SW2	NORMAL
SW3	OPEN
SW4	COMPRESSOR 1
SW5	OFF
SW6	ZERO
SW7	NORMAL
SW8	INT
RV1	Fully counter-clockwise
RV3	Fully clockwise
RV5	Set to read 0000

TABLE 1
Fault diagnosis procedure

Test No	Procedure	Result	Fault Symptom	Remedy
1	<p>(1) Connect the multimeter, set to indicate 25V dc to the chassis and J303 (+ ve) of the electronic unit, set SW1 to ON.</p> <p>(2) On completion set SW1 to OFF and disconnect the multimeter.</p>	<p>The multimeter must read 18 ± 1 V dc.</p>	<p>If the multimeter does not read as stated either the voltage stabilizer is faulty or there is a fault downstream of the particular circuit.</p> <p>Note ... If the downstream fault is severe the 2A fuse on the test set will have been destroyed.</p>	<p>Remove all circuit boards except voltage stabilizer. If the fault is cleared insert boards one by one until the fault reappears then replace faulty boards.</p>
2	<p>(1) Connect the multimeter, set the 50mA dc range, to test set test points TP15 (+ ve) and TP11 (- ve).</p> <p>(2) Set SW1 to ON and SW2 to REVERSE.</p> <p>(3) Set SW2 to NORMAL.</p> <p>(4) On completion of test set SW1 to OFF.</p>	<p>Multimeter must not read more than 20 micro A maximum.</p>	<p>Any indication on the multimeter above 20 micro A indicates a failure of the reverse polarity protection circuit.</p> <p>Note ... The supply to the test set must not be reversed during this test. The test set circuit is itself protected against reverse polarity voltages and is not subjected to reverse voltage during this test.</p>	<p>Change the voltage stabilizer board.</p>

TABLE 1 (Cont'd)

Test No	Procedure	Result	Fault Symptom	Remedy
3	<p>(1) Remove the test set link from between test points TP7 and TP8.</p> <p>(2) Connect the multimeter, set to the 1A dc range, to TP7 (+ ve) and TP8 (- ve). Set SW1 to ON</p>	<p>330 ± 10 mA</p>	<p>330 ± 10 mA cannot be obtained by adjustment of RV301 on the electronic unit, the unit is faulty</p>	<p>Change the Oscillator amplifier board</p>
4.	<p>(3) Set SW1 to OFF, remove the multimeter and replace test set link between TP7 and TP8.</p> <p>(1) Connect the valve voltmeter, set to the 2.5 V ac range, between TP4 (live) and TP9 (earth) on the test set. Set SW1 to ON.</p> <p>(2) Connect the oscilloscope in parallel with the valve voltmeter.</p>	<p>Meter should read between 0.7 and 1.4V rms waveform undistorted, ie a pure sine wave.</p>	<p>If the meter reading is outside the limits or the waveform is other than a pure sine wave the board is faulty.</p>	<p>Change the crystal oscillator board</p>
5.	<p>(3) Set SW1 to OFF, disconnect the valve voltmeter and oscilloscope.</p> <p>(1) Connect the valve voltmeter, set to the 10V ac range, and the oscilloscope in parallel, between TP5 (live) and TP9 (earth) on the test set.</p> <p>(2) Set SW1 to ON and rotate RV1 on the test set clockwise to obtain a reading of 8V ac.</p>			

TABLE 1 (Cont'd)

Test No	Procedure	Result	Fault Symptom	Remedy
5 (Cont'd)	(3) Transfer voltmeter and oscilloscope connection from TP5 and TP12 on the test set. (4) Set SW1 to OFF	Observe voltmeter and oscilloscope.	If the tests show that the voltage on TP12 and TP5 are not approximately equal or that either waveform is other than a pure sine wave the unit is faulty.	Change the oscillator amplifier board.
6.	(1) Set SW3 to CLOSED and SW1 to ON. (2) Set SW6 to ZERO, and observe meter M1 on the test set. (3) Set SW1 to OFF and SW3 to OPEN.	Meter M1 should read zero	If zero reading is not obtained, adjust RV501 on the electronic unit. If a zero indication still cannot be obtained the unit is faulty	Change the demodulator and signal amplifier boards
7.	(1) Connect the multimeter, set to the 10V dc range, between J302 (+ ve) and J301 (- ve) on the electronic unit, set SW1 to ON and observe the reading. (2) Set SW3 to CLOSED (3) Set SW1 to OFF	The voltage measured at (1) will be seen to kick and settle to between 2.5 and 4V dc.	If the required reading is not obtained adjust RV502 on the electronic unit, if this cannot be done there is possibly one or two faults (1) Faulty demodulator (2) Faulty crystal oscillator.	Replace each circuit board in turn, in the order (1) and (2).

TABLE 1 (Cont'd)

Test No	Procedure	Result	Fault Symptom	Remedy
8.	<p>(1) Connect the multimeter, set to the 10V dc range, between J302 (+ ve) and J301 (- ve).</p> <p>(2) Set SW3 to CLOSED and SW1 to ON.</p> <p>(3) Set SW6 to IDS and back to TDS at the rate of once every two seconds</p> <p>(4) If necessary adjust RV401, on the electronic unit to obtain a constant reading.</p> <p>(5) On completion of the test, set SW1 to OFF and disconnect the multimeter.</p>	<p>Observe that the multimeter reading is the same irrespective of the position of the switch</p>	<p>If the readings are not identical and adjustment of RV401 fails to correct the readings, the unit is faulty</p>	<p>Change the signal amplifier and demodulator boards.</p>
9.	<p>(1) Set SW3 to CLOSED and SW1 to ON.</p> <p>(2) Adjust RV501, on the electronic unit, until meter M1 reads zero.</p> <p>(3) Connect the multimeter, set to the 10V dc range, between J302 (+ ve) and J301 (- ve).</p>			

TABLE 1 (Cont'd)

Test No	Procedure	Result	Fault Symptom	Remedy
9 (Cont'd)	(4) Set SW6 to TDS and back to ZERO at the rate of once every two seconds. (5) Set SW1 to OFF.	There should be no change in the multi-meter reading when the switch is moved from TDS to ZERO. Note ... The meter reading may kick when the switch is moved.	If the readings are not identical and adjustment of RV402 fails to correct the readings the unit is faulty.	Change the signal amplifier and demodulator boards.
10.	(1) Set SW6 to IDS, SW3 to CLOSED and SW1 to ON. (2) Adjust RV502, on the electronic unit until the test set meter M1 indicates 87%. (3) Set SW1 to OFF	87%	If this reading cannot be achieved the unit is faulty.	Change the signal amplifier and demodulator boards.
11.	(1) Set SW6 to TDS, SW3 to CLOSED and SW1 to ON. (2) Adjust RV403, on the electronic unit, until the test set meter M1 indicates 13%. (3) Set SW1 to OFF.	13%	If this reading cannot be achieved the unit is faulty	Change the signal amplifier and demodulator boards.

Note ... Before proceeding to test No 12 the 15-turn precision potentiometer RV5, on the test set must be calibrated as detailed in Chapter 3-1, para 10, sub-para (2) to (5).

TABLE 1 (Cont'd)

Test No	Procedure	Result	Fault Symptom	Remedy
12.	(1) SET SW5 TO ON, SW3 TO CLOSED and SW1 TO ON.			
	(2) Adjust RV5 to 0020	Meter M1 indicates 2%		
	(3) Adjust RV702, on the electronic unit until the servo power trip circuit operates.	Lamp LP1 illuminated when torque is above 2% and LP3 illuminated when torque is below 2%.	If the trip circuit cannot be made to operate by adjustment of RV702 at 2% indicated torque, the unit is faulty.	Change the overtorque warning board.
	(4) Set SW1 to OFF.			
13.	(1) Set SW3 to CLOSED and SW1 to ON.			
	(2) Adjust RV5 to 1040	(a) Meter M1 indicates 104%		
	(3) Adjust RV701, on the electronic unit until the over-torque trip circuit operates.	(b) Demoted by a 2 Hz click or tone as heard in a headset connected between TP16 and TP8 on the test set. (c) The overtorque counter should operate.	(a) If the warning tone or click cannot be heard the unit is faulty. (b) If the counter does not operate the unit is faulty.	(a) Change the over-torque warning board (b) Change the overtorque warning board.
14.	(1) Connect the multimeter, set to the 100V ac range, between TP3 and TP10 on test set.			
	(2) Set SW3 to CLOSED and SW1 to ON.			

TABLE 1 (Cont'd)

Test No	Procedure	Result	Fault Symptom	Remedy
9 (Cont'd)	(4) Set SW6 to TDS and back to ZERO at the rate of once every two seconds. (5) Set SW1 to OFF.	There should be no change in the multi-meter reading when the switch is moved from TDS to ZERO. Note ... The meter reading may kick when the switch is moved.	If the readings are not identical and adjustment of RV402 fails to correct the readings the unit is faulty.	Change the signal amplifier and demodulator boards.
10.	(1) Set SW6 to IDS, SW3 to CLOSED and SW1 to ON. (2) Adjust RV502, on the electronic unit until the test set meter M1 indicates 87%. (3) Set SW1 to OFF	87%	If this reading cannot be achieved the unit is faulty.	Change the signal amplifier and demodulator boards.
11.	(1) Set SW6 to TDS, SW3 to CLOSED and SW1 to ON. (2) Adjust RV403, on the electronic unit, until the test set meter M1 indicates 13%. (3) Set SW1 to OFF.	13%	If this reading cannot be achieved the unit is faulty	Change the signal amplifier and demodulator boards.

Note ... Before proceeding to test No 12 the 15-turn precision potentiometer RV5, on the test set must be calibrated as detailed in Chapter 3-1, para 10, sub-para (2) to (5).

TABLE 1 (Cont'd)

Test No	Procedure	Result	Fault Symptom	Remedy
12.	(1) SET SW5 TO ON, SW3 TO CLOSED and SW1 TO ON.			
	(2) Adjust RV5 to 0020	Meter M1 indicates 2%		
	(3) Adjust RV702, on the electronic unit until the servo power trip circuit operates.	Lamp LPI illuminated when torque is above 2% and LP3 illuminated when torque is below 2%.	If the trip circuit cannot be made to operate by adjustment of RV702 at 2% indicated torque, the unit is faulty.	Change the overtorque warning board.
	(4) Set SW1 to OFF.			
13.	(1) Set SW3 to CLOSED and SW1 to ON.			
	(2) Adjust RV5 to 1040	(a) Meter M1 indicates 104%		
	(3) Adjust RV701, on the electronic unit until the over-torque trip circuit operates.	(b) Demoted by a 2 Hz click or tone as heard in a headset connected between TP16 and TP8 on the test set. (c) The overtorque counter should operate.	(a) If the warning tone or click cannot be heard the unit is faulty. (b) If the counter does not operate the unit is faulty.	(a) Change the over-torque warning board (b) Change the overtorque warning board.
	(4) Set SW1 to OFF.			
14.	(1) Connect the multimeter, set to the 100V ac range, between TP3 and TP10 on test set.			
	(2) Set SW3 to CLOSED and SW1 to ON.			

TABLE 1 (Cont'd)

Test No	Procedure	Result	Fault Symptom	Remedy
14 (Cont'd)	<p>(3) Adjust RV3, on the test set, until a reading of 18V is obtained on the multimeter.</p> <p>(4) Connect a headset between TP9 and TP16, on the test set.</p> <p>(5) Set SW4 to COMPRESSOR 1 and adjust RV601, on the electronic unit, until the engine failure warning tone can be heard in the headset.</p> <p>Note ... The warning tone should cease after approximately 5 sec.</p> <p>(6) Adjust RV3 to give a multimeter reading greater than 18V, then reduce this reading slowly, observing multimeter reading at which the trip circuit operates; this should be 18 ± 1 V ac.</p> <p>(7) If necessary repeat operation (3), (5) and (6).</p> <p>(8) Set SW1 to OFF.</p>	$18 \pm V$ ac	<p>If the trip circuit cannot be made to operate or the multimeter reading is outside the tolerance laid down, the unit is faulty.</p>	<p>Change the engine failure warning board.</p>

TABLE 1 (Cont'd)

Test No	Procedure	Result	Fault Symptom	Remedy
15.	Repeat Test No.14 with SW4 set to COMPRESSOR 2.	As in Test 14	As in Test 14	As in Test 14
16.	Repeat Test 14 with SW4 set to ROTOR 1 and adjusting RV602 on the electronic unit until the trip circuit operates.	As in Test 14	As in Test 14	As in Test 14
17.	Repeat Test 16 with SW4, set to ROTOR 2.	As in Test 14	As in Test 14	As in Test 14
18.	(1) Connect the multimeter, set to the 10V dc range, between J302 (+ve) and J301, on the electronic unit. (2) Set SW7 to 100% and SW1 to ON.	(a) Multimeter should read between 3 and 4V. (b) Meter M1 should read 100% and the engine failure warning tone should be heard in a headset connected between TP16 and TP 8 on the test set. The multimeter reading should not alter by more than $\pm 1.5V$.		
	(3) If necessary adjust RV405, on the electronic unit to obtain 100%.		If the required results are not obtained, the unit is faulty.	Change the signal amplifier and demodulator boards.

TABLE 1 (Cont'd)

Test No	Procedure	Result	Fault Symptom	Remedy
19.	Repeat Test No. 18 with SW7 set to O/T adjust RV404 if necessary.	As in Test 18	As in Test 18	As in Test 18
20.	(1) Set SW7 to O/T, SW3 to CLOSED and SW1 to ON. (2) Listen out on the headset, connected between TP16 and TP8 on the test set to the frequency of the overtorque warning tone. (3) Adjust RV703 on the electronic unit until a frequency modulation of 2 Hz is obtained when timed over a period of 10 seconds. (4) Set SW1 to OFF.	As in Test 18	As in Test 18	As in Test 18
21.	Repeat Tests Nos 12 and 13 and ensure that the volume of the warning tone can be adjusted by RV704 on the electronic unit.	2 Hz	If this cannot be done, the unit is faulty.	Change the overtorque warning board. Change the overtorque warning board.

TABLE 1 (Cont'd)

Test No	Procedure	Result	Fault Symptom	Remedy
22.	(1) Set SW1 to ON (2) Set S101, on the electronic unit to ON. (3) Set S102, on the electronic unit to ON. (4) Set both S101 and S102 to OFF. (5) Set SW1 to OFF.	(a) Lamp LP2, on the test set, illuminated (b) Lamp LP4, on the test set, illuminated	Failure for either lamp to light indicates a faulty switch.	Change the voltage stabilizer board.

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