

Date: March 14, 2017
To: Tim Sorensen, NTSB
From: Jay Boyle, Williams Int'l
Subject: Repair and NVM Report for FADEC SN CL11AW1879 and CL11AW1890

Disassembly, Inspection and Repair Notes for CL11AW1890 on Engine SN 211156 of Plane 525C-0072

Channel A

General Observation: This board was a little rough around the external connectors. Minor straightening of the connector shells was done to enable to connect to the Engine Maintenance Terminal communication harness (TL-221207) which is needed to be able to retrieve engine data. The other components on the board visually were in pretty good condition.

Note: There was an issue where one of the inner board pins was bent (Pin2-ground) during the disassembly process. When attempting to straighten the pin, it broke off. A replacement pin was soldered in its place.

There was no noticeable visual damage to any of the components except for:

1. Corrosion found on Component R2155 and R2154
 - a. No action taken, the corrosion did not prevent reading of the NVM

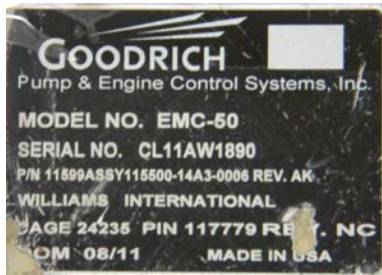
Channel B

General Observation: This board was a rough around the external connectors. Straightening of the connector shells was done to enable to connect the Engine Maintenance Terminal communication harness (TL-221207) which is needed to be able to retrieve engine data. Several internal components had been broken free of the board. The broken components are part of the power supply and would prevent the FADEC from powering up if not repaired. The housing was warped and one of the internal corner fasteners that connect the Circuit Card Assembly to the housing would not engage so it was not installed.

1. Connector J5 EMI fingers bent
 - a. No action taken because this is only necessary for lightning protection which is not needed to read NVM.
2. Connector J5 Pins 33, 32, 31 bent pins
 - a. Straightened
3. Connector J4 Pins 50,49,48 bent pins
 - a. Straightened
4. The large capacitors used for the main power supply were broken loose from the board. In addition, there was a red liquid that had been trapped under the sleeve protecting the capacitor
 - a. C100, C101, C546 and C562 were replaced with substitute parts.
5. The resistor that limits current to the main transformer winding that sets up the power for the board was located in a bag that was taped to the outside of this FADEC. This resistor R437 was examined under the microscope. It had taken quite a large chunk of epoxy and solder mask with it when it came free of the board. The copper traces on the circuit board did not appear to be damaged.
 - a. R437 was soldered back onto the Circuit Card Assembly.
6. FADEC was reassembled without connector gaskets for ease of assembly. Debris in the connector area was cleaned with isopropyl alcohol and brought to the FJXX Programming Station TL-112196.

NVM Fault Data for CL11AW1890 on Engine SN 211156 of Plane SN 525C-0072

FADEC cables from the EMT Communication harness (TL-221207) were connected to CL11AW1890 with a little resistance from the damage to the pins. The FADEC was powered and the Non-Volatile Memory (NVM) data was downloaded using the Williams International Engine Maintenance Terminal WI_EMT (TL-110961) into file 525C-0072_2017-03-09_1419.einfo. This file shows that the FADEC serial number stored in the NVM is CL11AW1894. However, below is the actual label showing that the correct serial number of the FADEC is CL11AW1890. The value that is stored in NVM is an input by the user via the WI_EMT at the time of installing the FADEC. Therefore, the discrepancy with the actual serial number is indicating a user error when entering the serial number into NVM during the installation of this FADEC.



The fault data that was in the history of the Non-Volatile Memory (NVM) was:
AUTO_IGNITION_ACTIVE_AT_SHUTDOWN was recorded 12/18/2016 at 01:14:31 GMT in Channel A and 12/14/2016 at 17:20:57 GMT in Channel B

- This fault can occur during a normal engine shutdown based on the engine control software logic. This is a No Effect fault that does not impact the operation of the engine nor annunciate any lamps in the cockpit. Additionally, this fault does not require any maintenance action.

Note: Because of the damage to the FADECs components and pins the following faults occurred when the FADEC was powered in Williams International's lab on March 9, 2017. They are not part of the history of the FADEC:

Channel A:

TLA_SIGNAL_LOST,
P2_SENSE_LOST,
T2_SENSE_LOST,
ITT_SENSE_LOST,
TLA_SENSE_LOST

Channel B:

TLA_SIGNAL_LOST,
FMV_POSITION_SENSE_LOST,
OPS_BIT_FAILED,
CHANNEL_ID_FAULT,
FADEC_LOCATION_FAULT
TLA_SENSE_LOST

Disassembly, Inspection and Repair Notes for CL11AW1879 on Engine SN 211155 from Plane 525C-0072

General Observations:

1. Observation: Both channels had a few places that had some sediment/dirt on it, but nothing that would prevent power up.
 - a. Action: Dirt was cleaned off and the FADEC was reassembled without the connector gaskets installed for ease of assembly.
 - b. Debris in the connector area was cleaned with isopropyl alcohol and brought to the FJXX Programming Station TL-112196.

NVM Fault Data for CL11AW1879 on Engine SN 211155 from Plane 525C-0072

FADEC cables from the EMT Communication harness (TL-221207) were connected to CL11AW1879 with a noticeable resistance from the damage to the pins. The FADEC was powered and the Non-Volatile Memory (NVM) data was downloaded using the Williams International Engine Maintenance Terminal WI_EMT (TL-110961) into file 525C-0072_2017-03-09_1335.einfo using the Williams International Engine Maintenance Terminal (WI_EMT) using the FJXX Programming Station TL-112196.



The fault data that was in the history of the Non-Volatile Memory (NVM) was:

AUTO_IGNITION_ACTIVE_AT_SHUTDOWN was recorded 12/14/2016 at 23:41:14 GMT in Channel A and 12/14/2016 at 23:41:15 GMT in Channel B

- As identified above on the discussion of the NVM fault data retrieved from CL11AW1890, this fault can occur during a normal engine shutdown based on the engine control software logic. This is a No Effect fault that does not impact the operation of the engine nor annunciate any lamps in the cockpit. Additionally, this fault does not require any maintenance action.

Note: Because of the damage to the FADECs components and pins, the following faults occurred when the FADEC was powered in Williams International's lab on March 9, 2017. They are not part of the history of the FADEC:

Channel A:

TLA_SIGNAL_LOST,
CHANNEL_ID_FAULT,
TLA_SENSE_LOST

Channel B:

TLA_SIGNAL_LOST,
FMV_POSITION_SENSE_LOST,
FSOV_BIT_FAILED,
CHANNEL_ID_FAULT,
P2_SENSE_LOST,
T2_SENSE_LOST,
ITT_SENSE_LOST,
TLA_SENSE_LOST

Trend Data for 525C-0072 during Takeoff

For each takeoff, the FADEC records a trend point that captures critical engine parameters indicative of the engine performance. This trend data is only recorded in the Active Channel of the FADEC. The following data is for 12/29/2016 at 22:32:25 GMT (or 5:32:35 PM EST).

12/29/16 5:32:25 PM (EST)		
Takeoff Trends	CL11AW1879	CL11AW1890
Page / Channel Trends	769 / ChB	766 / ChB
Identifier:	302	302
N1 (RPM):	16028.27	16002.88
N2 (RPM):	35261.38	34830.59
ITT (R):	1870.86	1889.21
TLA (RVDT):	31.46	31.62
P2 (PSIA):	14.1	14.1
T2 (R):	499.54	499.83
MOP (PSIG):	0	81.39
MOT (°C):	0	40.34
Mach:	0.19	0.19
Altitude (Ft):	942	942
Time:	22:32:25	22:32:25
Date:	29/12/2016	29/12/2016
Engine Flight Time (s):	3099459.75	3099593.25
WfMetered (lbs/hr):	1856.25	1903.12

Note that the identifier being 302 indicates that the trend point was recorded in Bleed Level 2, which indicates that engine and wing anti-ice was active at the time that the aircraft became initially airborne.

Trend Data for 525C-0072 during Takeoff

For each takeoff, the FADEC records a trend point that captures critical engine parameters indicative of the engine performance. Trend data is only recorded in the Active Channel of the FADEC. The following data is for 12/30/2016 at 3:56:48 GMT (which is 12/29/2016 at 10:56:48 PM EST)

12/29/2016 at 10:56:48 PM (EST)		
FADEC SN	CL11AW1879	CL11AW1890
Page/ Channel Trends	802 / ChA	786 / ChA
Identifier:	302	302
N1 (RPM):	15892.68	15874.95
N2 (RPM):	34991.86	34571.93
ITT (R):	1847.5	1863.33
TLA (RVDT):	31.73	31.78
P2 (PSIA):	14.19	14.19
T2 (R):	493.81	494.17
MOP (PSIG):	0	80.05
MOT (°C):	0	32.31
Mach:	0.21	0.21
Altitude (Ft):	567	567
Time:	3:56:48	3:56:48
Date:	30/12/2016	30/12/2016
Engine Flight Time (s):	3101211.25	3101337.5
WfMetered (lbs/hr):	1837.5	1893.75

Note that the identifier being 302 indicates that the trend point was recorded in Bleed Level 2, which indicates that engine and wing anti-ice was active at the time that the aircraft became initially airborne.