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December 04, 2019

PTCRB Project 79233

MFAST-A-010-2 Rev B Product Certification

Exhibit C4 – DCTU Operational Description

Product Designation:

Manufacturer: Pratt & Whitney Engine Services, Norwood
249 Vanderbilt Avenue
Norwood, MA 02062 USA

Marketing Name: DCTU (Data Collection & Transmission Unit)

HVIN- Part #: MFAST-A-010-2

FCC ID: 2AJ6A-DCTU1	IC_ID: 22451-DCTU1

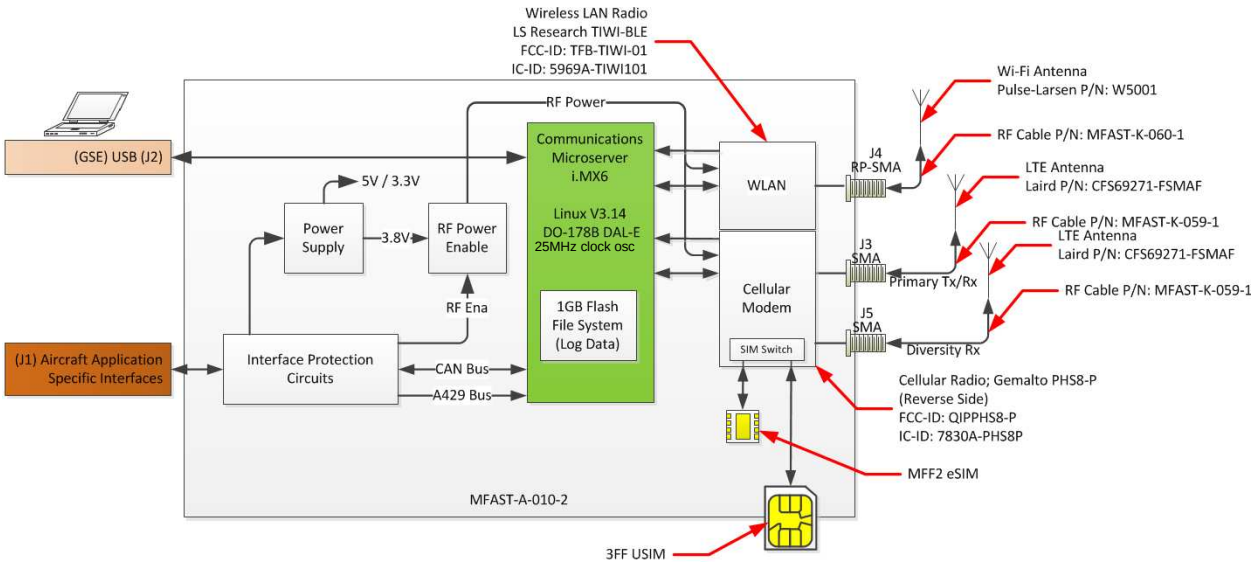
Optional Description Overview:

The DCTU product includes a single microprocessor referred to as the Communications Microserver (CM). This is illustrated in the figure 1 block diagram as shown in green and contains all required memory, serial data bus interfaces and discrete control I/O. The operating system is open source Linux; kernel version 3.1.4 that performs the following functions:

1. Interfaces with flightworthy aircraft systems that supply data for monitoring by MFAST. Systems connected to vary according to specific certified installation but typically include the engine control, aircraft flight display. Collects serial data from aircraft data busses during flight operations from the time the engine is started until it is shut down.
2. Collected data from Step 1 is data reduced based on proprietary algorithms stores the data in local memory and generates further compressed and encrypted log files that will be sent to the ground station.

3. Upon engine shut down, the CM establishes communication with the cellular infrastructure or with a Wi-Fi access point (if one is configured and available).
4. The CM manages cellular connection control through script files that send AT-Commands to the Gemalto PLS62-W radio (FCC-ID: QIPPLS62W, IC-ID: 7830A-PLS62W). Once a PPP connection is made to the cellular provider's APN, a VPN tunnel connection is established between the DCTU and the P&WC ground station for data file transfer.
5. The CM manages Wi-Fi connection control by means of commands to an LS-Research TiWi-BLE Wireless LAN radio (FCC-ID: TFB-TIWI-01, IC-ID: 5969A-TIWI101). Once the TiWi-BLE has established a link to the access point, the same PPP/VPN connection as in the cellular case is established to the P&WC ground station. Wi-Fi, if configured and available has priority for connection over cellular.
6. Once all data has passed to the ground station successfully and there are no other pending interactions between the FAST product and the server, or if the aircraft engines are re-started, the wireless connection is halted and the radios are powered down.
7. The PLS62-W radio has Bluetooth capability included in the module. The Pratt & Whitney Engine Services FAST products do not use this functionality. The function is disabled in the product firmware and there is no antenna connected to the Bluetooth antenna pins of the PLS62-W device.

Figure 1: FAST Product Block Diagram



Operational Conditions and Environment

The product being submitted for PTCRB testing and registration is designed and tested to the following operational conditions and environment:

Size:	2.2”H x 5.5”Wx 7.2”L (55.9mm H X 139.7mm W X182.9mm L)
Weight:	1.8lbs (816.5gm)
Power Supply:	Typical 28vdc 7W
Power Supply Range:	22VDC to 32.2VDC
Operating Temperature:	-67°F to +158°F (-55°C to +70°C) Note: Radios will only transmit within the operating environment of -40 deg C to 85 Deg C when the craft is grounded with the engine off. See item 6 on pg 2 of this document.
Storage Temperature:	-67°F to +250°F (-55°C to +121°C)
Operating Environment:	Aircraft compartments including: Avionics Bay, under floor panels, or other location that will support a secure & protected MFAST box install.
Cellular Radio:	Gemalto: PLS62-W 4G Module FCC-ID: QIPPLS62-W IC-ID : 7830A-PLS62W
Cellular Radio Bands:	FDD-LTE 12 Bands: 700, 800, 850, 900,1700/2100 (AWS), 1800, 1900, 2100, 2600 MHz (Bands 1, 2, 3, 4, 5, 7, 8, 12, 18, 19, 20, 28) UMTS (WCDMA/FDD 7 Bands): 800, 850, 900, 1700/2100 (AWS), 1800, 1900 and 2100 MHz(Bands 1, 2, 4, 5, 8, 9, 19) Quad Band GSM: 850, 900, 1800 and 1900 MHz
Cellular Antenna:	Laird Technologies, P/N:CFS69271-FSMAF or eq, 50Ω, Max Input Pwr: 50W Peak Gain (Frequency Range): 1.5dBi (698-960MHZ), 3dBi (1710-2170MHz), 3.6dBi (2500-2700MHz) Polarization: Linear, VSWR 2.0:1, , Connector: SMA-F, Pattern: Omni, Size LWH-11.2 X 13.8 X .25 cm
WiFi Radio:	LS Research: TiWi-BLE 450-0064 FCC-ID: TFB-TIWI1-01 IC-ID: 5969A-TIWI101
WiFi Antenna:	Laird Technologies, P/N:WRR-2400-RPSMA-B or eq, 50Ω nominal Frequency: 2.4 – 2.5GHz, Gain: 1.5dB@2.45GHz, Size: Length:10.9cm Polarization: Linear, VSWR 2.0:1, , Connector: Rt Angle, RP-SMA, Pattern: Vertical Omni
WiFi Radio Bands	802.11b/g/n,
Subscriber Identity Module:	Supports two SIM devices Internal ‘embedded’ SIM chip is factory installed in all systems (MFF2 type), User SIM is mounted using the existing SIM tray (3FF type) NOTE: User SIM will require a system configuration change to authorize usage.

External Interface

1 External access for User and Maintenance functions:

a. Port J1 is used to provide aircraft 28vdc power to the MFAST product, as well as interface to aircraft sensors and selected signals for data recording during flight.

b. Ports J2 USB laptop communication port used by maintenance personal to evaluate settings and configuration of the MFAST system. This port is not intended for use during routine flight.

c. Ports J3, J4, & J5 are radio antenna ports that support the Cellular and WiFi communication.

d. The External user SIM port (USIM), is located between J2 & J3 on the top of the product. This is available to the user when the system is configured to recognize an external SIM card for cellular communication.

Tune-Up Information

Tuning of the cellular radio is provided by the component's manufacturer; Gemalto, no tuning is required at the product level.

The Wireless LAN is calibrated to lower ETSI power levels for the 2.4GHz band due to the fact that the product is installed on aircraft in worldwide deployment. In production, FAST installs an .ini file provided by LS Research (www.lsr.com) specific to their Ti-Wi-BLE module to calibrate each product as part of P&WC acceptance test process (ATP) prior to product shipment. The calibration procedure is supplied by LSR and operates on our ATP fixture to create the unit specific NVS file that contains the computed calibration parameters generated by the LSR calibration procedure and are used each time the driver is initialized.

The relevant parameters that are used from the .ini file to set the power limits are excerpted here from the file:

```
#------------------------------------------------------------------------------------------------------------------------------------------------------
# SECTION 2.1.1: 2.4G parameters
#------------------------------------------------------------------------------------------------------------------------------------------------------
FEM1_TXBiPReferencePDvoltage_2_4G = 0177 # Unit: 1mV, Format: Unsigned, Source: TI
FEM1_TxBiPReferencePower_2_4G = 80 # Unit: 1/8dB, Format: Signed, Source: TI
FEM1_TxBiPOffsetdB_2_4G = 0C # Unit: 1/8dB, Format: Signed, Source: LSR
FEM1_TxPerRatePowerLimits_2_4G_Normal = 15 1B 18 18 18 18 # Unit: 1/2dB, Format: Signed, Source: LSR
FEM1_TxPerRatePowerLimits_2_4G_Degraded = 12 1B 18 17 17 17 # Unit: 1/2dB, Format: Signed, Source: LSR
FEM1_TxPerRatePowerLimits_2_4G_Extreme = 12 18 14 13 13 13 # Unit: 1/2dB, Format: Signed, Source: LSR
FEM1_DegradedLowToNormalThr_2_4G = 20 # Unit: 1/10 volts, Format: Unsigned, Source: LSR
FEM1_NormalToDegradedHighThr_2_4G = 2D # Unit: 1/10 volts, Format: Unsigned, Source: LSR
FEM1_TxPerChannelPowerLimits_2_4G_11b = 20 22 26 26 26 26 26 26 26 26 26 26 15 27 # Unit: 1/2dB, Format: Signed,
FEM1_TxPerChannelPowerLimits_2_4G_OFDM = 27 27 27 27 27 27 27 27 27 27 27 27 15 2A # Unit: 1/2dB, Format: Signed,
FEM1_TxPDVsRateOffsets_2_4G = 01 02 02 02 02 00 # Unit: 1/8dB, Format: Signed, Source: TI
FEM1_TxIbiasTable_2_4G = 11 11 15 11 15 0F # Unit: Codeword, Format: Unsigned, Source: TI/TQS
FEM1_RxFemInsertionLoss_2_4G = 0E # Unit: 1/8dB, Format: Unsigned, Source: LSR
```