TRANSMITTAL SHEET

TO: HOLDERS OF COMPONENT MAINTENANCE MANUAL for Electronic Control Box, ATA 49-63-70, Revision No. 6, May 14/2018 is attached and covers all components held by every operator.

Reason for this revision is the correction of typo in page block “Description and Operation”.

Affected pages are listed on the 'LIST OF EFFECTIVE PAGES' and designated as follows:

R = Revised

Make sure that the content of the manual agrees with the LIST OF EFFECTIVE PAGES.

File the TRANSMITTAL SHEET separately.

PAGE BLOCK	DESCRIPTION OF CHANGE
Title Page	Revised to show this revision.
Record of Revisions	Revised to show this revision.
List of Effective Pages	Revised to show this revision.
Table of Contents	Revised to show this revision.
List of Illustrations	Revised to show this revision.
List of Tables	Revised to show this revision.
Description and Operation	Figure 2 sheet 2: Resolver Input (Sinus) changed from (d5 & h10) to (b5 & h10).

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COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST

Electronic Control Box

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Diehl Aerospace GmbH in Germany

Users are kindly requested to notify DIEHL Aerospace of any discrepancy, omission or error found in this manual.

Make sure that you have the latest revision of this manual. In case you are working with extracts from this manual, make sure that these extracts have the same revision status as the manual.

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RE. NO.	ISSUE DATE	INSERTED	
		DATE	BY
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Retain this record in the front of the manual.

On receipt of revisions, insert revised page in the manual and enter revision number, date and initials.

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INTRODUCTION

TASK 49-63-70-99F-801-A01

1. GENERAL INFORMATION

A. General

(1) This document is written to the ATA Specification iSpec2200 and in ASD-STE100 Simplified Technical English. SI units of measurement are used in this manual, with Imperial units in parentheses.

(2) The manual gives the operation and technical characteristics of the equipment and the instructions for its maintenance.

(3) Only approved persons with the necessary skills must be used for the maintenance procedures described in this manual.

(4) Maintenance Task Oriented Support System (MTOSS) task and subtask identification is used in this manual.

B. Management of Waste Materials

(1) The items described in this CMM are composed of different materials. They can be finished with lacquer and can contain other chemical material like glue etc. The relevant consumable materials are named in this manual as required.

(2) The individual Customer has to obey the individual national laws and regulations when parts/items/consumables have to be discarded.

C. Special Precautions

CAUTION: THE UNIT CONTAINS ELECTROSTATIC DISCHARGE SENSITIVE (ESDS) COMPONENTS. USE APPLICABLE SAFETY PRECAUTIONS WHEN YOU DO MAINTENANCE ON OR NEAR COMPONENTS SENSITIVE TO ELECTROSTATIC DISCHARGE. IF YOU DO NOT DO THIS, YOU CAN CAUSE DAMAGE TO THE UNIT.

CAUTION: THE BOARDS CAN CONTAIN OPERATIONAL SOFTWARE.

Make sure that you obey the precautions.

D. Content of the Manual

This manual contains:

- Technical data for the Line Replaceable Unit (LRU),
- Functional description,
- Maintenance and repair procedures for the LRU,
- An Illustrated Parts List (IPL) with data for the component parts. Parts are identified in all sections of the manual by the IPL Figure and item number.

E. Revision Service

If necessary, this manual will be updated by revisions. Service bulletins may be issued separately. If there is an effect of a Service Bulletin on this manual, the Service Bulletin will be recorded in the Service Bulletin List. The Service Bulletin List will be revised if necessary.

F. Shop Verification

The manufacturer verified the sections. A test of the REPAIR and TESTING AND FAULT ISOLATION procedures was done according to the related sections in this manual.

G. Technical Support

For technical support please refer to the web site of Diehl Aerospace as follows:

http://www.diehl-aerospace.com

NOTE: In case of doubt please contact the Customer Support Center first by e-mail or fax, before you ship a unit for support.

H. How to use the Manual

(1) Make sure that the manual contains the information applicable to your component. Look on the Title Page for the part number.

(2) If you need to identify a part or find a part number, refer to the IPL, which has an introduction to show the procedure.

(3) The instructions in this manual must be used for all the component maintenance. Read all the applicable WARNINGS and CAUTIONS before you do the work on the component.

(4) Make sure that you have the latest revision of this manual. In case you are working with extracts from this manual, make sure that these extracts have the same revision status as the manual.

TASK 49-63-70-94A-801-A00

2. LIST OF ABBREVIATIONS

A/C	Aircraft
ACFT	Aircraft
ACK	Acknowledge
ACMS	Aircraft Centralized Maintenance System
ADC	Analog to Digital Converter
APU	Auxiliary Power Unit
ARINC	Aeronautical Radio, INC.
ATA	Air Transport Association of America
BCD	Binary Coded Decimal
BIT	Built-in Test
BITE	Built-In Test Equipment
BNR	Binary

CAGE	Commercial And Government Entity
CFDIU	Centralized Fault Display Interface Unit
CFDS	Centralized Fault Display System
CJC	Cold Junction Compensation
CM	Connect Module
CMC	Centralized Maintenance Computer
CMD	Command
CMM	Component Maintenance Manual
CMOS	Complementary Metal Oxyde Semiconductor
CPU	Central Processing Unit
CR	Circuit
DAC	Digital to Analog Converter
DAs	DIEHL Aerospace
DC	Direct Current
DAC	Digital to Analog Converter
DMM	Data Memory Module
ECAM	Electronic Centralized Aircraft Monitoring
ECB	Electronic Control Box
ECS	Environmental Control System
EEPROM	Electrically Erasable PROM
EDI	Equipment Designator Index
EGT	Exhaust Gas Temperature
EMI	Electromagnetic Interference
EPROM	Erasable PROM
EFF	Effective / Effectivity
EQ	Equipment
ESD	Electrostatic Sensitive Devices
FSCM	Federal Supply Code for Manufacturers
ESDS	Electrostatic Discharge Sensitive

ESD	Electrostatic Sensitive Devices
FCN	Fault Code Number
FEPROM	Flash Erasable PROM
FREQ	Frequency
GND	Ground
GMT	Greenwich Mean Time
HW	HardWare
I/O	Input/Output
IGV	Inlet Guide Vane
IOT	In Operation Test
INTRO	Introduction
IPL	Illustrated Parts List
LCDT	Load Compressor Discharge Temperature
LCIT	Load Compressor Inlet Temperature
LRU	Line Replaceable Unit
LVDT	Linear Variable Differential Transducer
MC	Micro Controller
MCDU	Multi-Purpose Control and Display Unit
MCU	Modular Concept Unit
MICBAC	Micro-system Bus Access Channel
MTOSS	Maintenance Task Oriented Support System
MUX	Multiplexer
N/A	Not Applicable
NHA	Next Higher Assembly
NI	Numerical Index
NP	Not Procurable
OPT	Optional
OS	Overspeed
PCB	Printed Circuit Board

PN	Part Number
PNR	Part Number
POS	Position
PROM	Programmable ROM
PSU	Power Supply Unit
PUT	Power Up Test
PW	Pulse Width Modulation
R	Revised
RAM	Random Access Memory
REP	Repair
REPLD	Replaced
REPLS	Replaces
RES	Reset
RF	Reference
ROM	Read Only Memory
RTC	Real Time Clock
RTD	Resistor Temperature Device
SB	Service Bulletin
SCV	Surge Control Valve
SET	Self-Test
SRAM	Static RAM
SRD	Software Requirement Document
SSM	Sign/Status Matrix
STO	Storage Including Transportation
SUPSD	Superseded
SUPSDS	Supersedes
SCV	Surge Control Valve
SET	Self-Test
SRAM	Static RAM

SRD	Software Requirement Document
SSM	Sign/Status Matrix
SW	Software
TBD	To Be Defined
TC	Thermocouple
TM	Torque Motor
TPU	Time Processing Unit
TSD	Trouble Shooting Data
TFI	Testing and Fault Isolation
UTC	Universal Time Correlation
VDC	Volts Direct Current
VLV	Valve
ZC	Zone Controller

TASK 49-63-70-94A-802-A00

3. LIST OF SIGNALS AT MAIN CONNECTOR OR TEST CONNECTOR

28DC	28VDC Primary Supply
28SECDC	28VDC Secondary Supply
28V_T	28V Test
ACIDENT1	Aircraft Identifier 1
ACIDENT2	Aircraft Identifier 2
ACRLYCO	AC Relais Command
APUAVCO	APU Available Command
ARCCFDSA	ARINC from CFDS wire A
ARCCFDSB	ARINC from CFDS wire B
ARCECSA	ARINC from ECS wire A
ARCECSB	ARINC from ECS wire B
ARCTXA	ARINC Bus Transmitter line A
ARCTXB	ARINC Bus Transmitter line B
BKSTCNTCO	Backup Start Contactor

DEOILSLCO	De-Oil Solenoid Command
DMMCLKB	DMM Clock B
DMMRXA	DMM Receiver line A
DMMRXB	DMM Receiver line B
DMMSUP	DMM Supply Voltage
DMMTXA	DMM Transmitter line A
DMMTXB	DMM Transmitter line B
DPM	Delta Pressure Signal (Minus)
DPP	Delta Pressure Signal (Plus)
ECSDMDTST	ECS Demand Test
EGT1M	EGT1 Signal (Minus)
EGT1P	EGT1 Signal (Plus)
EMERGSW	Emergency Switch
FCUCOS	Resolver Cosine Signal
FCUGND	Resolver Secondary Ground
FCUPRIA	Resolver Excitation line A
FCUPRIB	Resolver Excitation line B
FCUSIN	Resolver Sine Signal
FLAPCLSSW	Flap Closed Switch Input
FLAPMOVE	Flap Movement Input
FLAPOPNSW	Flap Open Switch Input
FLAPSUP	Flap Switch Supply
FLPCLSCO	Flap Close Command
FLPOPNCO	Flap Open Command
FLTCLG	Filter Clogged Switch Input
FLTSIGCO	Fault Signal Command
FUELTEMPM	Fuel Temperature Input (Minus)
FUELTEMPP	Fuel Temperature Input (Plus)
FUELTMM	Fuel Torque Motor (Minus)

FUELTMP	Fuel Torque Motor (Plus)
IGNITCO	Igniter Command
IGVPOSA	IGV Position Input line A
IGVPOSB	IGV Position Input line B
IGVPRIA	IGV Position Primary Voltage line A
IGVPRIB	IGV Position Primary Voltage line B
IGVTMM	IGV Torque Motor (Minus)
IGVTMP	IGV Torque Motor (Plus)
INAIRSW	In-Air Switch
LCVACSW	Load Control Valve Activate Switch
LCVCLS	Load Control Valve Closed Signal
LCVOPN	Load Control Valve Open Signal
LCVOPNPOS	Load Control Valve Open Position
LCVSOLCO	Load Control Valve Solenoid Command
LFPSW	Low Fuel Pressure Switch Input
LFPVBIT	Low Fuel Pressure Valve Bit
LFPVLV	Low Fuel Pressure Valve Valve
LOPSW	Low Oil Pressure Switch Input
LOQSW	Low Oil Quantity Switch
MESSW	Main Engine Start Switch
OILBIT	Oil Heater BIT
OILTEMLOM	Oil Temperature Low (Minus)
OILTEMLOP	Oil Temperature Low (Plus)
P2M	P2 Signal (Minus)
P2P	P2 Signal (Plus)
POWGND	Power Ground
PRESSM	Pressure Sensor Supply (Minus)
PRESSP	Pressure Sensor Supply (Plus)
PSU_OK	Supply o.k.

PTM	PT Signal (Minus)
PTP	PT Signal (Plus)
RSGND1	RS232 Ground Channel 1
RSGND2	RS232 Ground Channel 2
RSRXD1	RS232 Receive Data Channel 1
RSRXD2	RS232 Receive Data Channel 2
RSTXD1	RS232 Transmit Data Channel 1
RSTXD2	RS232 Transmit Data Channel 2
SCVPOSA	SCV Position Input line A
SCVPOSB	SCV Position Input line B
SCVPRIA	SCV Position Primary Voltage line A
SCVPRIB	SCV Position Primary Voltage line B
SCVSECGND	SCV LVDT Secondary Ground
SCVTMM	SCV Torque Motor (Minus)
SCVTMP	SCV Torque Motor (Plus)
SCVTSTTSW	SCV Test Switch
SIPCO	Start in Progress Command
SP28OP5	Spare Input 28V/OPEN Switch 5
SP28OP6	Spare Input 28V/OPEN Switch 6
SPANI4	Spare Input Analog 4
SPANI5	Spare Input Analog 5
SPANI6	Spare Input Analog 6
SPARCRXA	Spare ARINC Input Wire A
SPARCRXB	Spare ARINC Input Wire B
SPDMMCLKA	Spare DMM Clock Wire A
SPEED1A	Speed Signal 1 line A
SPEED1B	Speed Signal 1 line B
SPEED2A	Speed Signal 2 line A
SPEED2B	Speed Signal 2 line B

SPIOHM	Spare Input Ohm
SPLS2	Spare Low Side Driver 2
SPLS3	Spare Low Side Driver 3
SPLS4	Spare Low Side Driver 4
SPLS5	Spare Low Side Driver 5
SPLS6	Spare Low Side Driver 6
SPLS7	Spare Low Side Driver 7
SPRESETSW	Spare Reset Switch
SPRTD3H	Spare Input RTD 3(+)
SPRTD3L	Spare Input RTD 3(-)
SPTC3H	Spare Thermocouple Input 3(+)
SPTC3L	Spare Thermocouple Input 3(-)
SPTC4H	Spare Thermocouple Input 4(+)
SPTC4L	Spare Thermocouple Input 4(-)
START	Start Switch Input
STCONMON	Start Contactor Monitor Input
STMON	Start Monitor
STOPSW	Stop Switch Input
STRTCONCO	Start Contactor Command
STRTVOLTM	Starter Voltage (Minus)
STRTVOLTP	Starter Voltage (Plus)
STVLV	Starter Valve Switch
T2M	T2 (-)
TESTSUPM	Test Supply (Minus)
TESTSUPP	Test Supply (Plus)
TSO	Technical Standard Order Switch
V5P1_T	5V Test Signal
VARYSPTST	Vary Speed Test

TASK 49-63-70-99F-802-A00

4. EQUIPMENT IDENTIFICATION

A. The configuration of the equipment is shown by the part number stamped on the identification label and modification number with amendment stamped on the modification label. Compare this data with data shown in Table I-1.

B. Special procedures or illustrations necessary for each configuration will be identified by a part number or service bulletin number (Pre SB-, Post SB-). Procedures and illustrations not identified apply to all configurations of the equipment

Part Number	Amendment	Effectivity Code Symbol	Configuration Change Description	Service Bulletin No.
3888394-121202	6A	1A	Software Modification	3888394-49-7602
3888394-121203	8A	1B	Software Modification	3888394-49-7790
3888394-121204	12A	1C	Software Modification	3888394-49-7899
3888394-121205	14A	1D	Software Modification	3888394-49-8107
3888394-221202	7A	1A	Software Modification	3888394-49-7602
3888394-221203	9A	1B	Software Modification	3888394-49-7790
3888394-221204	13A	1C	Software Modification	3888394-49-7899
3888394-221205	15A	1D	Software Modification	3888394-49-8107
3888394-321206	19A	1E	New Standard	n/a

EQUIPMENT IDENTIFICATION LIST
TABLE 1

TASK 49-63-70-99F-803-A00

5. IDENTIFICATION OF UNITS AND ASSEMBLIES

A. Units and assemblies are identified by identification labels which display the following information:

PN : Part Number

SN : Serial Number

MOD : Modification

Name of Manufacturer.

B. Modifications incorporated on each unit or assembly is marked as follows:

- Major changes are identified by a change of the prefix of the partnumber.
- Minor modifications are identified by a change in the letter. Minor modifications do not affect the interchangeability.

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DESCRIPTION AND OPERATION

TASK 49-63-70-870-801-A00

1. GENERAL

The main functions of the ECB are to control and monitor the APU and communicate with other aircraft systems. The ECB is part of the APU system.

The APU system delivers pneumatic power and electrical power to other aircraft systems. The APU consists of a gas turbine which produces shaft power. The shaft power is converted by a load compressor into pneumatic power and by a generator into electrical power.

TASK 49-63-70-870-803-A00

2. DESCRIPTION

A. Mechanical Design

The ECB is a 5 Modular Concept Unit (MCU) Box according to ARINC-600. It contains four boards: PSU board, I/O board, CPU board, and Connect board. One spare board can be mounted onto the PSU board. On the box front there is a handle and the test connector J2 for reading out data or loading software. The main connector J1 is soldered to the Connect board and is mounted to the rear of the box. This assembly consisting of Connect board, main connector J1, and mounting plate is called Connect Module. All external signals are routed from the Connect board via lightning protection on the PSU board to interface circuits either on the PSU itself or on the I/O board. The PSU board and the I/O board filter their respective external interface signals for EMI. The CPU board and the I/O board are assembled to a CPU-I/O Module.

The general arrangement of the ECB is shown in FIGURE 1.

LENGTH	389 mm (15.315 in)
WIDTH	161.2 mm (6.347 in)
HEIGHT	194 mm (7.638 in)
WEIGHT	5.7 kg (12.56 lb) (max)
POWER CONSUMPTION 28 VDC	220 W (max) (worst-case incl. APU loads)
DISSIPATION	20 W (max) at 28 VDC (Stand-alone ECB)

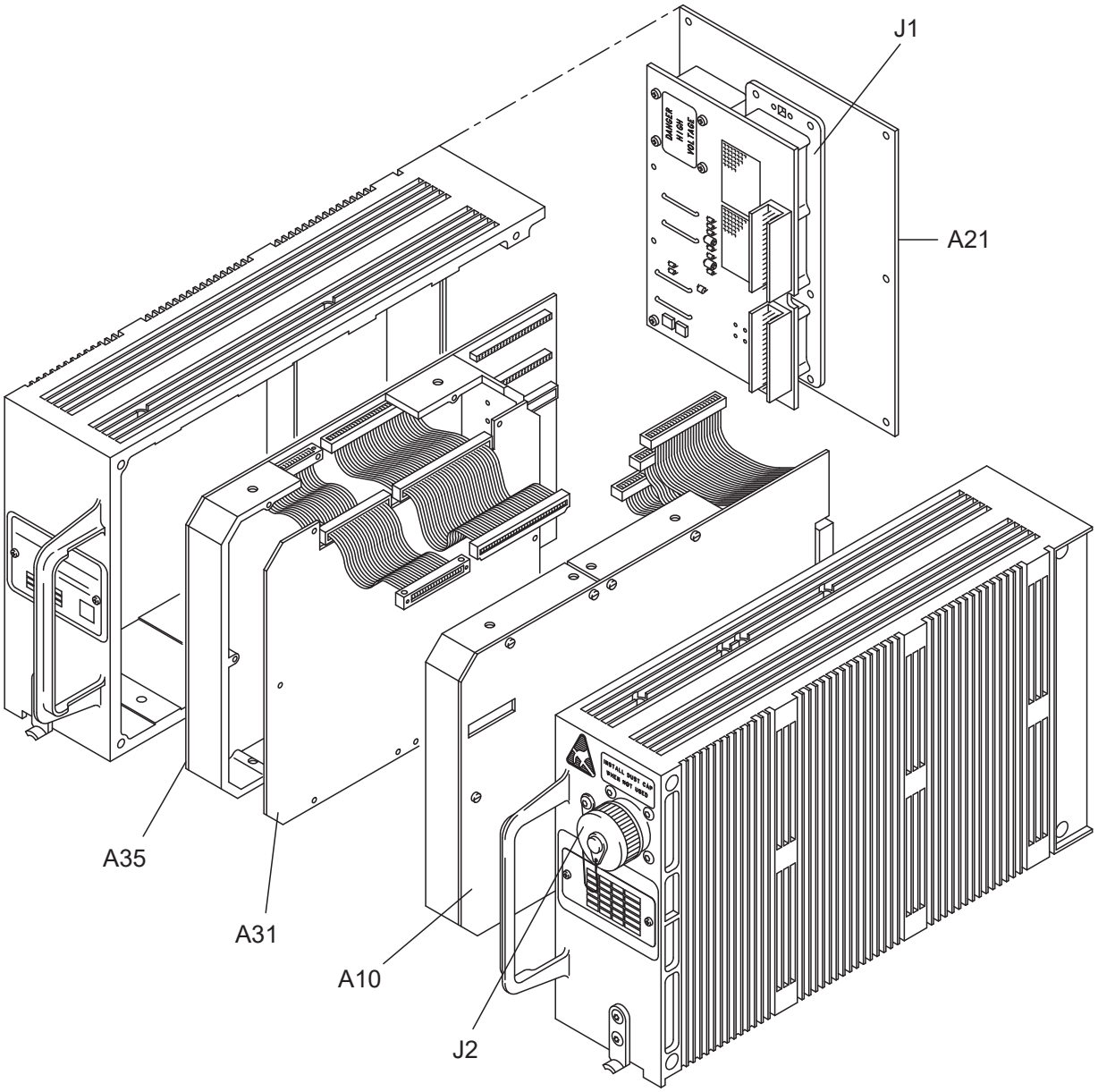
TECHNICAL DATA
TABLE 1

Designator Index	Designation	Type Number
A31	CPU Board	847420231
A35	Input/Output Board	847420235

LIST OF SHOP REPLACEABLE UNITS
TABLE 2 (continued on next page)

Designator Index	Designation	Type Number
A10	Power Supply Unit (PSU)	847420110
A21	Connect Module	8474421

LIST OF SHOP REPLACEABLE UNITS
TABLE 2



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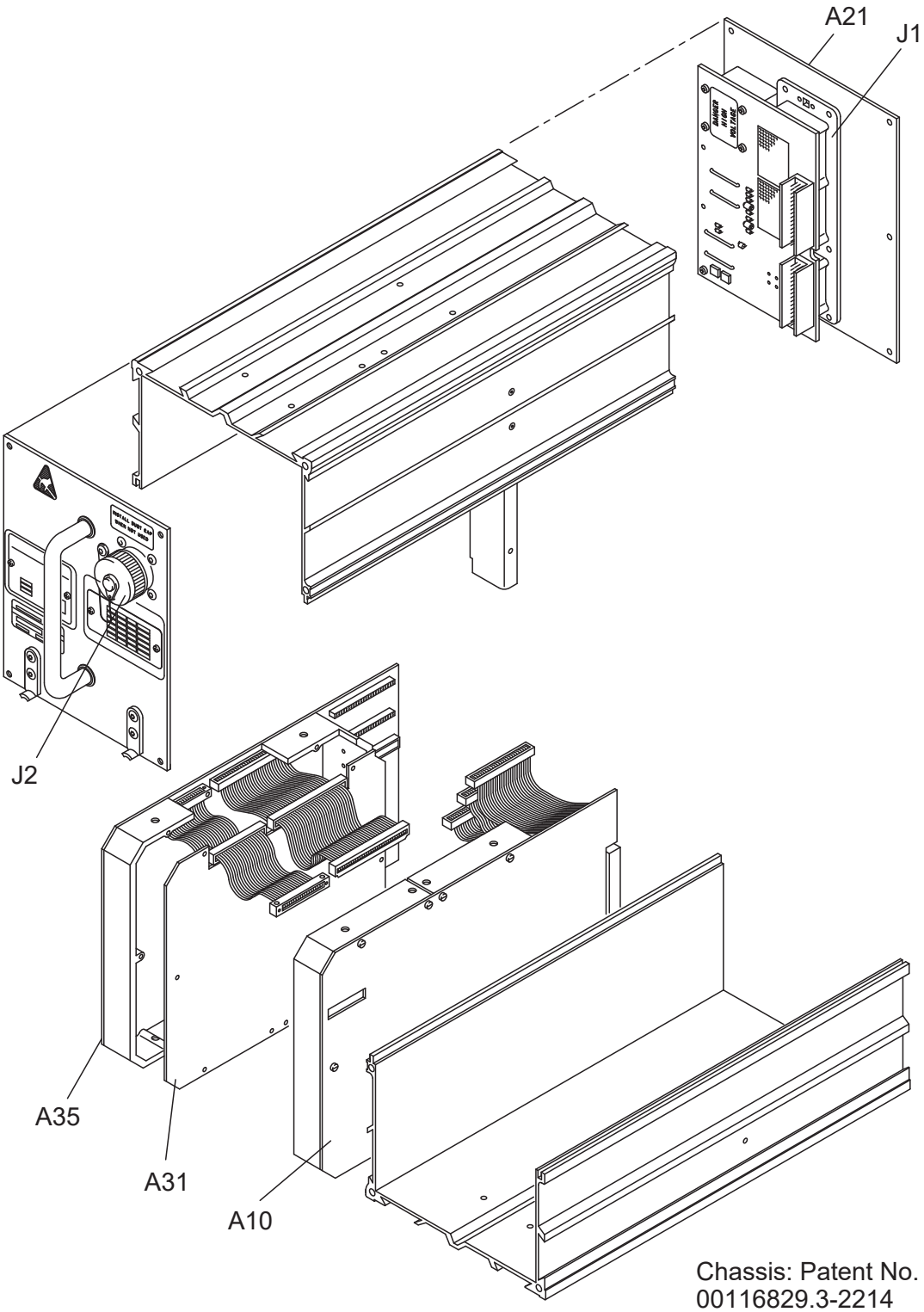
ECB GENERAL ARRANGEMENT
(CAST HOUSING)
FIGURE 1 [SHEET 1 OF 2]



ECB GENERAL ARRANGEMENT
(EXTRUSION HOUSING)
FIGURE 1 [SHEET 2 OF 2]

B. Input/Output Signals

The ECB handles discrete and analog input and output signals from the aircraft and APU. Analog-to-digital converters are used to convert analog input signals to digital words. The outputs to the torque motors are via digital-to-analog converters. Solenoids and indicators are energized via discrete drivers. Frequency signals are acquired via special hardware features of the microcontroller used.

Via ARINC-429 busses the ECB can communicate with other aircraft systems.

The CPU board has serial interfaces (RS 232) for test purposes.

A specific serial interface for data transfer to the engine mounted Data Memory Module is established on the CPU board. All signals via the rear connector J1 are filtered by lightning strike protection and EMI filters.

An overview of all input and output signals is presented in FIGURE 2.

Inputs

Analog from Aircraft

28 VDC Main Power Supply	(j1c-7)
115 VAC Secondary Power Supply	(j1c-8 & j1c-9)
28 VDC Ground	(j1c-3)
Chassis (Case) Ground	(j1c-2)

Discrete from Aircraft

Start Command	(d5)
Stop Command	(a5)
Main Engine Start Command	(e5)
Starter Valve Command	(k12)
Air/Ground	(d11)
Emergency Stop Command	(b4)
Aircraft Identification Signal 1	(a12)
Aircraft Identification Signal 2	(a13)
Load Control Valve Command	(d6)
Start Contactor Monitor Signal	(e3)
Inlet Flap Movement	(g4)
Inlet Flap Open	(g3)
Inlet Flap Close	(g5)
Low Fuel Pressure BIT Enable	(h13)
TSO	(b11)
Oil Heater BITE Enable	(k14)
External ECB Reset	(g14)

Analog from Test Equipment

ECS Demand Test	(j1a-f9)
Vary Speed Test	(j1a-f11)

Discrete from Test Equipment

SCV Test Switch	(b14)
Write enable Flash EPROM	(j2-c)
Test Connector connected	(j2-d)
Test Connector connected	(j1a-e11)

ECB

Outputs

Analog to Aircraft

Inlet Flap Switch Supply	(g2)

Discrete to Aircraft

A/C Relay (f9)	(f9)
Main Start Contactor Command	(j1c-1)
Backup Start Contactor Command	(j1c-6)
Fault Relay Signal	(h5)
APU Available Signal	(j6)
Start in Progress Signal	(h9)
Load Control Valve Open Signal	(h8)
Low Fuel Pressure Valve	(j14)
Inlet Flap Open Command	(j1c-4)
Inlet Flap Close Command	(j1c-5)

Analog to Test Equipment

5 VDC Test Supply	(j1a-d10)
Test Supply Ground	(j1a-d12)
28 VDC	(j2-P)
5 VDC	(j2-T)
Filtered Power Ground	(j2-V)

Discrete to Test Equipment

Keep alive Processor A	(j2-a)
Keep alive Processor B	(j2-b)
PSU O.K.	(j2-R)
FAIL	(j2-S)

NOTE: All pin numbers are for main connector J1 in J1B area unless otherwise stated. Where two pins are noted, the first pin is "+" while the second is "-".

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INPUT/OUTPUT DIAGRAM
FIGURE 2 [SHEET 1 OF 3]

Inputs

Analog from APU

Exhaust Gas Temperature (EGT) 1	(a7 & a6)
Exhaust Gas Temperature (EGT) 2	(a9 & a8)
Thermocouple Input (spare)	(f1 & f2)
Thermocouple Input (spare)	(c1 & d1)
APU Sump Oil Temperature	(j5 & b8)
APU Inlet Temperature (T2)	(h4 & h3)
Fuel Temperature	(c2 & c4)
RTD Input (spare)	(f3 & f4)
Inlet Pressure (P2)	(c8 & c9)
Total Pressure (PT)	(a2 & a3)
Delta Pressure (DP)	(b2 & b3)
IGV LVDT Secondary Input	(e11 & e12)
IGV LVDT Secondary Input (ground)	(c2)
SCV LVDT Secondary Input	(j8 & d10)
SCV LVDT Secondary Input (ground)	(d2)
Resolver Input (Sinus)	(b5 & h10)
Resolver Input (Cosinus)	(b6 & h10)
Speed Monopole 1	(e6 & e7)
Speed Monopole 2	(d3 & d4)
Starter Voltage Monitor	(j10 & j11)
Analog Input (spare)	(g1)
Analog Input (spare)	(g15)
Analog Input (spare)	(j15)

Discrete from APU

Low Oil Pressure Switch	(c5)
Low Fuel Pressure Switch	(b7)
Low Oil Quantity Switch	(h2)
Bleed Valve Position Switch (open)	(d7)
Bleed Valve Position Switch (closed)	(d14)
Oil Filter Clogged Switch	(c11)
Ohm Switch (spare)	(g13)
28 V open Switch (spare)	(b12)
28 V open Switch (spare)	(c12)

ECB

Outputs

Analog to APU

Fuel Torque Motor	(g7 & h11)
IGV Torque Motor	(g8 & g9)
SCV Torque Motor	(g6 & g9)
Pressure Sensor Supply Voltage	(a1 & a4)
IGV LVDT Primary Excitation	(e8 & e9)
SCV LVDT Primary Excitation	(d9 & j7)
Resolver Primary Excitation	(a10 & a11)
Supply Voltage (spare)	(e14)

Discrete to APU

Fuel Solenoid Command	(f6)
De-oil Solenoid Command	(j4)
Load Control Valve Solenoid Cmd	(f10)
Ignition Unit Command	(j1c-10)
Flow Divider Command	(j1c-11)
Low Side Driver (spare)	(k15)
Low Side Driver (spare)	(h7)
Low Side Driver (spare)	(f5)
Low Side Driver (spare)	(h6)
Low Side Driver (spare)	(e15)
Low Side Driver (spare)	(d15)

NOTE: All pin numbers are for main connector J1 in J1B area unless otherwise stated.
Where two pins are noted, the first pin is "+" while the second is "-".

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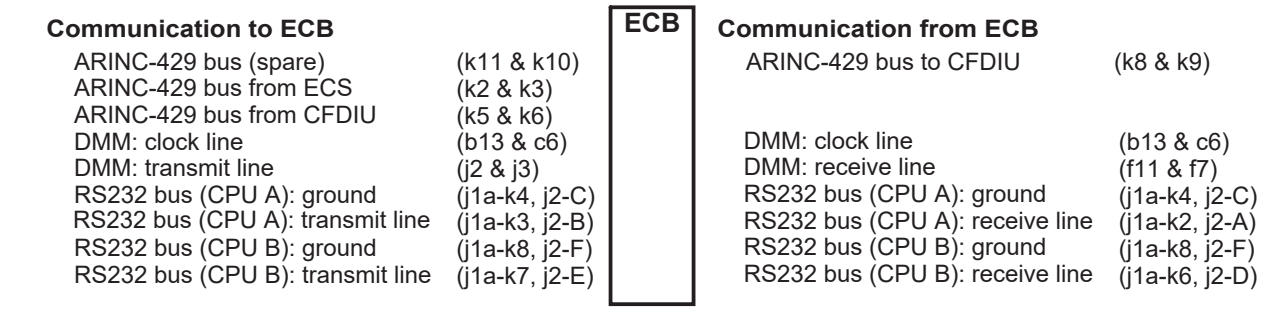
INPUT/OUTPUT DIAGRAM
FIGURE 2 [SHEET 2 OF 3]



NOTE: All pin numbers are for main connector J1 in J1B area unless otherwise stated. Where two pins are noted, the first pin is "+" while the second is "-".

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INPUT/OUTPUT DIAGRAM
FIGURE 2 [SHEET 3 OF 3]

C. Description of the Input Signals

For the description of the input signals, refer to TABLE 3 thru TABLE 6.

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
EGT1P EGT1M	– Temperature range: -101...+2372 °F corresponding to -2.586 ... +52.398 mV – Signal conditioner input voltage – Input resistance ≥100 kΩ – Signal conditioner accuracy: ± 30.3 °F max – Lightning strike protected	Exhaust Gas Temperature 1	I/O board

ANALOG INPUT SIGNALS FROM APU
TABLE 3 (continued on next page)

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
EGT2P EGT2M	– Temperature range: -101...+2372 °F corresponding to -2.586 ... +52.398 mV – Signal conditioner input voltage – Input resistance ≥100 kΩ – Signal conditioner accuracy: ± 30.3 °F max – Lightning strike protected	Exhaust Gas Temperature 2	I/O board
OILTEMLOP OILTEMLOM	- Temperature range: -94...+473 °F corresponding to MIL-T-7990B TABLE 1 - Signal conditioner accuracy: ± 1.59 Ω - Lightning strike protected	Oil Temperature	I/O board
SPEED1A SPEED1B	- Frequency range: 292.11 to 5007.6 Hz corresponding to 7 ... 120 % APU speed - Signal conditioning via the TPU of microcontroller - Signal conditioner accuracy: ± 0.25 % max (F.S.) - Low pass filter at 10 kHz - Lightning strike protected - Amplitude min 0.2 Vpp - Amplitude max 75 Vpp at 5007 Hz	Speed Transducer 1	I/O board

ANALOG INPUT SIGNALS FROM APU
TABLE 3 (continued on next page)

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
SPEED2A SPEED2B	- Frequency range: 292.11 to 5007.6 Hz corresponding to 7 ... 120 % APU speed - Signal conditioning via the TPU of microcontroller - Signal conditioner accuracy: ± 0.25 % max (F.S.) - Lightning strike protected - Amplitude min 0.2 Vpp at 293 Hz - Amplitude max 75 Vpp at 5007 Hz	Speed Transducer 2	I/O board
P2P P2M	- Pressure range: -1.98...20.30 psi corresponding to -4...40.6 mV - Signal conditioner input voltage - Input impedance ≥100 kΩ - Signal conditioner accuracy: ± 0.17 psi max - Lightning strike protected	Ambient Pressure Transducer	I/O board
PTP PTM	- Pressure range: -9.86...98.69 psi corresponding to -12.3...123.3 mV - Signal conditioner input voltage - Input impedance ≥100 kΩ - Signal conditioner accuracy: ± 0.83 psi max - Lightning strike protected	Total Pressure Transducer	I/O board

ANALOG INPUT SIGNALS FROM APU
TABLE 3 (continued on next page)

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
DPP DPM	- Pressure range: -0.725...13.78 psi corresponding to -0.29...5.51 mV - Signal conditioner input voltage - Input impedance ≥100 kΩ - Signal conditioner accuracy: ± 0.22 psi - Lightning strike protected	Delta Pressure Transducer	I/O board
IGVPOSA IGVPOSB IGVSECGND	- DC resistance: 100 ohms ± 10 % - AC impedance: 110 ohms ± 10 % - Stroke distance 1.0 inch - Signal conditioner accuracy: ± 1.1 % - Transformation ratio: Prim: Sec = 5.71: 1 - Lightning strike protected	IGV LVDT Secondary Input	I/O board
SCVPOSA SCVPOSB SCVSECGND	- DC resistance: 100 ohms ± 10 % - AC impedance: 110 ohms ± 10 % - Stroke distance 1.2 inch - Signal conditioner accuracy: ± 2.2 % - Transformation ratio: Prim: Sec = 5.71: 1 - Lightning strike protected	SCV LVDT Secondary Input	I/O board
FUELTEMPP FUELTEMPM	- Temperature range: -94...+473 °F - Signal conditioner accuracy: ± 1.59 Ω - Lightning strike protected	Fuel Temperature	I/O board
T2M T2P	- Temperature range: -94...+473 °F - Signal conditioner accuracy: ± 1.59 Ω - Lightning strike protected	APU-Inlet Temperature	I/O board

ANALOG INPUT SIGNALS FROM APU
TABLE 3 (continued on next page)

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
FCUCOS FCUGND FCUPRIA FCUPRIB FCUSIN	- Resolver signal - Excitation 3500 Hz, 2 Vrms	Fuel Control Unit Position	I/O board

ANALOG INPUT SIGNALS FROM APU
TABLE 3

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
ECSDMDTST	- Signal range: 0... 5 VDC - One wire input - Lightning strike protected	ECS Demand Test. This signal is a test input only available via the J1 connector	I/O board
28DC POWGND	- 6A starting mode - 4A governing mode - Input lower limit: 10 VDC (APU-START) - Input lower limit (APU AVAILABLE): 16 VDC - Input upper limit: 32 VDC - Interrupt limit: 5 sec - Lightning strike protected	28 VDC Power.	PSU

ANALOG INPUT SIGNALS FROM A/C
TABLE 4 (continued on next page)

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
28SECDC	- Lower envelope limit: 16 VDC - Upper envelope limit: 32 VDC - Lightning strike protected	28 VDC Secondary Power. Provides power to the APU system during interruptions on the normal 28 VDC power feedline.	PSU
VARYSPTST	- Signal range: 0... 5 VDC - One wire input - Lightning strike protected	Vary Speed Test. This signal is a test input only available via the J1 connector	I/O board
STRTVOLTP STRTVOLTM	- Signal range: 0...30.3 VDC (via fuse) - Two wire differential input - Supplied by A/C - Signal conditioner accuracy: ± 1.1 % max. (F.S.) - Lightning strike protected	Starter Voltage Monitor	I/O board
CASE	- One wire input - Externally connected to the A/C fuselage - Internally connected to the ECB chassis	Chassis (Case Ground). Lightning strike protection components are connected to this ground	PSU

ANALOG INPUT SIGNALS FROM A/C
TABLE 4

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
LOPSW	- One wire input (series diode) - Supplied by ECB - Nominal current: 2 mA - Wetting current: 34 mA at 28 VDC - Lightning strike protected	Low Oil Pressure Switch. (GND / OPEN LOP = GND)	I/O board
LFPSW	- One wire input (series diode) - Supplied by ECB - Nominal current: 2 mA - Wetting current: 10 mA at 28 VDC - Lightning strike protected	Low Fuel Pressure Switch. (GND / OPEN LFP = GND)	I/O board
LOQSW	- One wire input (series diode) - Supplied by ECB - Nominal current: 2 mA - Wetting current: 10 mA at 28 VDC - Lightning strike protected	Low Oil Quantity Switch 1. (GND / OPEN LOQ = GND)	I/O board
LFPVBIT	- One wire input (series diode) - One wire input - Lightning strike protected	Vary Speed Test. This signal is a test input only available via the J1 connector	I/O board
LCVOPN	- Signal range: 0...30.3 VDC (via fuse) - Two wire differential input - Supplied by A/C - Signal conditioner accuracy: ± 1.1 % max. (F.S.) - Lightning strike protected	Starter Voltage Monitor	I/O board

DISCRETE INPUT SIGNALS FROM APU
TABLE 5 (continued on next page)

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
FLTCLG	- One wire input - Externally connected to the A/C fuselage - Internally connected to the ECB chassis	Chassis (Case Ground). Lightning strike protection components are connected to this ground	I/O board
LCVCLS	- One wire input - Externally connected to the A/C fuselage - Internally connected to the ECB chassis	Chassis (Case Ground). Lightning strike protection components are connected to this ground	I/O board
LFPVLV	- One wire input - Externally connected to the A/C fuselage - Internally connected to the ECB chassis	Chassis (Case Ground). Lightning strike protection components are connected to this ground	I/O board
LCVOPNPOS	- One wire input - Externally connected to the A/C fuselage - Internally connected to the ECB chassis	Chassis (Case Ground). Lightning strike protection components are connected to this ground	I/O board
OILBIT	- One wire input - Externally connected to the A/C fuselage - Internally connected to the ECB chassis	Chassis (Case Ground). Lightning strike protection components are connected to this ground	I/O board

DISCRETE INPUT SIGNALS FROM APU
TABLE 5

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
START	- 28 VDC for 100 msec - One wire input (series diode) - Supplied by A/C - Nominal current: 5.5 mA - Wetting current: 30 mA at 28 VDC - Latched by software means - Lightning strike protected	Start Command (28 V /OPEN START = 28 V)	I/O board
STOPSW	- One wire input (series diode) - Supplied by ECB - Nominal current: 2 mA - Wetting current: 10 mA at 28 VDC - Lightning strike protected	APU Stop (GND /OPEN STOP = GND)	I/O board
MESSW	- One wire input - Supplied by A/C - Nominal current: 5.5 mA - Wetting current: 30 mA at 28 VDC - Lightning strike protected	MES Mode (28 V /OPEN MES = 28 V)	I/O board
INAIRSW	- One wire input (series diode) - Supplied by ECB - Nominal current: 2 mA - Wetting current: 10 mA at 28 VDC - Lightning strike protected	Air / Ground (GND /OPEN GROUND = GND)	I/O board

DISCRETE INPUT SIGNALS FROM A/C
TABLE 6 (continued on next page)

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
EMERGSW	- Ground for 100 msec (series diode) - One wire input - Supplied by ECB - Nominal current: 2 mA - Wetting current: 10 mA at 28 VDC - Lightning strike protected	Emergency Stop (GND /OPEN EMERGENCY = GND)	I/O board
ACIDENT1	- One wire input (series diode) - Supplied by ECB - Nominal current: 2mA - Wetting current: 10 mA at 28 VDC - Lightning strike protected	Aircraft Ident 1 FUNCTION TABLE A/C ID.1 / A/C ID.1 / A/C TYPE GND / GND / A321 OPEN / GND / FAULT GND / OPEN / FAULT OPEN / OPEN / FAULT	I/O board
ACIDENT2	- One wire input (series diode) - Supplied by ECB - Nominal current: 2 mA - Wetting current: 10 mA at 28 VDC - Lightning strike protected	Aircraft Ident 2 FUNCTION TABLE A/C ID.1 / A/C ID.1 / A/C TYPE GND / GND / A321 OPEN / GND / FAULT GND / OPEN / FAULT OPEN / OPEN / FAULT	I/O board
LCVACSW	- One wire input (series diode) - Supplied by ECB - Nominal current: 2 mA - Wetting current: 10 mA at 28 VDC - Lightning strike protected	Load Control Valve Activation (GND / OPEN BLEED AIR = GND)	I/O board

DISCRETE INPUT SIGNALS FROM A/C
TABLE 6 (continued on next page)

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
STCONMON	- Voltage range: 10...28 VDC - Ground or open via 1 kOhm - One wire input - Supplied by A/C (28 VDC) and (GND) - Nominal current: 5.5 mA - Wetting current: 30 mA - Lightning strike protected	Start Contactor Monitor	I/O board
FLAPMOVE	- Voltage >16 VDC (series diode) - One wire input - Supplied by ECB via close or open motor coil - Lightning strike protected	Inlet Flap Movement (>16 V / OPEN MOVING = >16 V)	I/O board
FLAPOPNSW	- One wire input - Supplied by ECB with O/C protection - Nominal current: 5.5 mA - Wetting current: 30 mA at 28 VDC - Lightning strike protected	Inlet Flap Open (>5 V / GND FLAP OPEN = >5 V)	I/O board
FLAPCLSSW	- One wire input - Supplied by ECB with O/C protection - Nominal current: 5.5 mA - Wetting current: 30 mA at 28 VDC - Lightning strike protected	Inlet Flap Closed (28 V / GND FLAP CLOSED = GND)	I/O board

DISCRETE INPUT SIGNALS FROM A/C
TABLE 6 (continued on next page)

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
RESETSW	- One wire input - Supplied by ECB - Nominal current: 2 mA - Wetting current: 10 mA at 28 VDC - Lightning strike protected	External Reset (GND / OPEN RESET = GND)	PSU
TCONN	- One wire input for test purposes only - Not connected in the A/C - No lightning strike protection - Wired thru A-section of main connector J1 and thru test connector J2	Test connector connected (OPEN / GND CONNECTED = GND)	PSU
WENABLE	- One wire input for software download purposes only - Not connected in the A/C - No lightning strike protection - No EMI-filtering - Wired thru test connector J2 only	Write function to FEPROM enabled. (OPEN/GND ENABLED = GND)	PSU

DISCRETE INPUT SIGNALS FROM A/C
TABLE 6

D. Description of the Output Signals

For the description of the output signals, refer to TABLE 7 thru TABLE 10.

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
FUELTMP FUELTMM	- S/C Input voltage range: 0...+2.5 V - Output: 0...300 mA - 12 bit D/A converter resolution - Accuracy: ± 2 % (F.S.) - Torque motor DC resistance: 30 to 40 Ohms - Inductance: 15 to 30 mH - Lightning strike protected	Fuel Control Torque Motor Driver	I/O board
IGVTMP IGVTMM	- S/C Input voltage range: -2.5 V... +2.5 V - Output: -40...+60 mA - 12 bit D/A converter resolution - Accuracy: +/- 2 % (F.S.) - Output current limited to ± 100|mA - Resistance: 20 Ohms ± 10 % - Inductance: 90 mH ± 10 % - Lightning strike protected	IGV Torque Motor Driver	I/O board
SCVTMP SCVTMM	- S/C Input voltage range: -2.5 V... +2.5 V - Output: -40...+60 mA - Accuracy: ± 2 % (F.S.) - 12 bit D/A converter resolution - Output current limited to ± 100 mA - Resistance: 20 Ohms ± 10 % - Inductance: 90 mH ± 10 %	SCV Torque Motor Driver	I/O board

ANALOG OUTPUT SIGNALS TO APU
TABLE 7 (continued on next page)

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
PRESSM PRESSP	- Voltage: ± 5 VDC ± 0.2 V - Max current: 100 mA - Two wire output - Lightning strike protected	Pressure Sensor Supply Voltage	I/O board
IGVPRIA IGVPRIB	- Excitation voltage: 10 Vpp - Frequency: 3000 Hz - DC resistance: 100 Ohms ± 10 % - AC impedance: 825 Ohms ± 15 % - Lightning strike protected	IGV LVDT Primary Excitation	I/O board
SCVPRIA SCVPRIB	- Excitation voltage: 10 Vpp - Frequency: 3000 Hz - DC resistance: 100 Ohms ± 10 % - AC impedance: 825 Ohms ± 15 % - Lightning strike protected	SCV LVDT Primary Excitation	I/O board

ANALOG OUTPUT SIGNALS TO APU
TABLE 7

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
TESTSUPP TESTSUPM	- Voltage: +5 VDC - Connected via a buffer to sensor reference supply with lightning strike protection. Wired thru J1A-section of the ARINC 600 connector.	Test Supply Voltage. This output is for test purposes only	I/O board

ANALOG OUTPUT SIGNALS TO A/C
TABLE 8 (continued on next page)

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
FLAPSUP	- +28 VDC supply for flap open and close switches - Lightning strike protected - Overcurrent protection	+28 VDC Switch Supply Voltage	PSU

ANALOG OUTPUT SIGNALS TO A/C
TABLE 8

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
FLDRSOLCO	- Voltage: 28 VDC - Output current: 2 A max. - Discrete voltage sense - Driver status bit - Overcurrent protection - Lightning strike protected	Flow Divider Solenoid Driver. In case of overcurrent the driver will be switched off by HW means	PSU
DEOILSLCO	- Voltage: 28 VDC - Output current: 1.5 A max. - Driver status bit - Overcurrent protection - Lightning strike protected	De Oil Solenoid Driver. In case of overcurrent the driver will be switched off by HW means	I/O board
LCVSOLCO	- Voltage: 28 VDC - Output current: 1.8 A max. - Discrete voltage sense - Driver status bit - Overcurrent protection - Lightning strike protected	Load Control Valve Solenoid Driver. In case of overcurrent the driver will be switched off by HW means	PSU

DISCRETE OUTPUT SIGNALS TO APU
TABLE 9 (continued on next page)

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
FUELSOLCO	- Voltage: 28 VDC - PWM - Nominal current: 0.7 A - Overcurrent protection - Lightning strike protected	Fuel Solenoid Driver.	PSU
IGNITCO	- Voltage: 28 VDC - Average current: 2 A nominal - Discrete voltage and overcurrent and open sense - Overcurrent set point at 6 A - Lightning strike protected	Ignition Unit Driver. In case of overcurrent the driver will be switched off by HW and SW means	PSU
BKSTCNTCO	- Voltage: 28 VDC - Output current: 1.7 A max. - Driver status bit - Overcurrent protection - Lightning strike protected	Backup Start Contactor Driver. In case of overcurrent the driver will be switched off by HW means	I/O board

DISCRETE OUTPUT SIGNALS TO APU
TABLE 9

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
ACRLYCO	- Output current: 0.4 A max. - Driver status word - Load supplied by A/C (low-side driver) - Overcurrent protection - Lightning strike protected	A/C Relay Driver. In case of overcurrent the driver will be switched off by HW means	I/O board

DISCRETE OUTPUT SIGNALS TO A/C
TABLE 10 (continued on next page)

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
STRTCONCO	- Voltage: 28 VDC - Output current: 1.5 A max. - Driver status bit - Overcurrent protection - Lightning strike protected	Start Contactor Driver. In case of overcurrent the driver will be switched off	I/O board
FLTSIGCO	- Voltage: 28 VDC - Output current: 0.2 A max. - Driver status bit - Overcurrent protection - Lightning strike protected	Fault Relay Driver. In case of overcurrent the driver will be switched off by HW means	I/O board
APUAVCO	- Voltage: 28 VDC - Output current: 0.4 A max. - Driver status bit - Overcurrent protection - Lightning strike protected	APU Available Driver. In case of overcurrent the driver will be switched off by HW means	I/O board
SIPCO	- Voltage: 28 VDC - Output current: 0.4 A max. - Driver status bit - Overcurrent protection - Lightning strike protected	Start In Progress Driver. In case of overcurrent the driver will be switched off by HW means	I/O board
LCVOPNPOS	- Voltage: 28 VDC - Output current: 0.1 A max. - Driver status bit - Overcurrent protection - Lightning strike protected	Low Fuel Pressure Valve Signal. In case of overcurrent the driver will be switched off by HW means	I/O board

DISCRETE OUTPUT SIGNALS TO A/C
TABLE 10 (continued on next page)

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
LFPVLV	- Voltage: 28 VDC - Output current: 0.4 A max. - Driver status bit - Overcurrent protection - Lightning strike protected	Low Fuel Pressure Valve Signal. In case of overcurrent the driver will be switched off by HW means	I/O board
FLPOPNCO	- Voltage: 28 VDC - Output current: 3.5 A max. - Discrete bits for open and short load - Discrete voltage sense - Overcurrent setpoint at 6 A - Lightning strike protected	Inlet Flap Open Command Driver. In case of overcurrent the driver will be switched off by HW and S/W means	PSU
FLPCLSCO	- Voltage: 28 VDC - Output current: 3.5 A max. - Discrete bits for open and short load - Overcurrrent setpoint at 6 A - Lightning strike protected	Inlet Flap Close Command Driver. In case of overcurrent the driver will be switched off by HW and S/W means	PSU

DISCRETE OUTPUT SIGNALS TO A/C
TABLE 10

E. Description of the Digital Bus Interface

For the description of the Digital Bus Interface, refer to TABLE 11.

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
ARCCFDSA ARCCFDSB	- Two wires - 12.5 kHz - Lightning strike protected	ARINC 429 Low Speed Input Bus from CFDIU	CPU

RS232C AND ARINC 429 INTERFACE FROM/TO A/C AND APU
TABLE 11 (continued on next page)

SIGNAL NAME	INPUT SPECIFICATIONS	SIGNAL FUNCTIONS	CONDITIONED ON BOARD
ARCGECSA ARCGECSB	- Two wires - 12.5 kHz - Lightning strike protected	ARINC 429 Low Speed Input from ECS	CPU
ARCTXA ARCTXB	- Two wires - 12.5 kHz - Lightning strike protected	ARINC 429 Low Speed Output Bus to CFDIU, ECAM and ACMS	CPU
RSTXD1 RSRXD1 RSGND1	- Front face mounted connector and rear connector (J1A-section) - Lightning strike protected	RS232C Input/ Output Bus CPU1 board	CPU
RSTXD2 RSRXD2 RSGND2	- Front face mounted connector and rear connector (J1A-section) - Not lightning strike protected - Not used	RS232C Input/ Output Bus CPU2 board	CPU
DMMCLKB DMMTXA DMMTXB DMMRXA DMMRXB	- 5 wire bus - 2 wires to send - 2 wires to receive - 1 wire clock - Lightning strike protected	Input/Output Bus to APU Mounted Data Memory	CPU

RS232C AND ARINC 429 INTERFACE FROM/TO A/C AND APU
TABLE 11

F. Main Functions of the Shop Replaceable Units

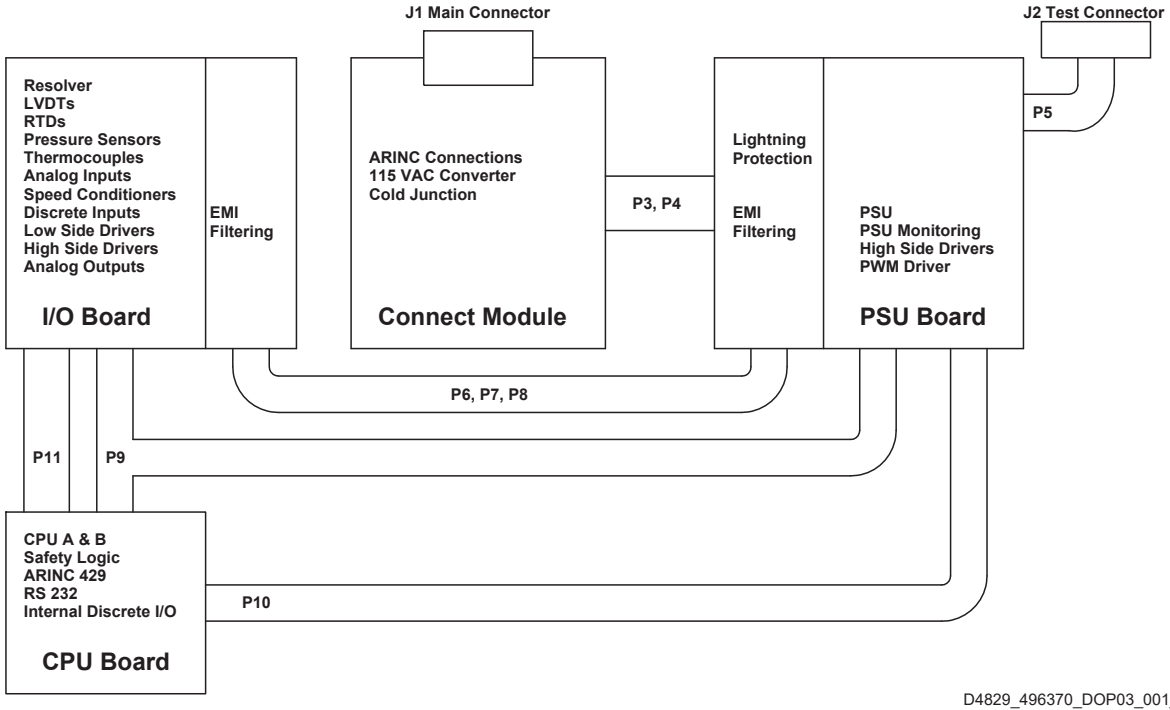
The ECB organization is shown in FIGURE 3. It shows that the CPU board is connected with the I/O board. Internal parallel and serial data busses are used. The data communication between CPU A and CPU B (CPU B is provided for spare purposes but not populated) occurs via a dual port RAM (not populated). Each CPU has a Flash EPROM. All functions are implemented on CPU A.

The Flash EPROMs contain the software program code of the corresponding CPU. The main functions of the software are to control the APU and execute protective and commanded shutdown procedures and built-in test functions. Further, ARINC functions communicate with other aircraft systems via the ARINC-429 busses.

The CPU board provides an RS232 interface for test and maintenance purposes.

The power supply unit supplies the boards with the necessary voltages. At ECB power on all boards are powered.

Lightning strike and EMI filters are established for all input and output signals on the I/O and PSU boards.



ECB ORGANISATION
FIGURE 3

G. Function of the I/O Board

This board contains the functions listed in FIGURE 3.

A block diagram of the I/O Board is given in FIGURE 2001.

NOTE: The ECB can be equipped with two different kinds of I/O boards. The first kind of board only contains analog input/output devices which are connected to a serial bus interface; the second kind of board contains one analog input device and an analog output device which are connected to a parallel bus interface. The actual software recognizes the two different kind of boards.

(1) Resolver:

The resolver circuit for the fuel flow measurement is implemented on the I/ O board. Analog and discrete wrap-arounds are available for Built-In Test purposes.

(2) LVDTs:

The resolver circuit for the fuel flow measurement is implemented on the I/ O board. Analog and discrete wrap-arounds are available for Built-In Test purposes.

(3) RTDs:

Resistor temperature devices (RTDs) produce signals which are related to resistance (ohms). The APU sump oil temperature, the APU inlet temperature, and the fuel temperature are measured using RTDs. One spare input is provided. The signals are converted to digital values via individual converters. The converters are accessed via the serial bus interface. The converters contain the necessary filtering of the various signals.

(4) Pressure Sensors:

Pressure sensors produce signals in mV range. These are converted to digital values via individual converters for each signal. The converters are accessed via the serial bus interface. The converters contain the necessary filtering of the various signals. The pressure signals DP and PT must be acquired via ADC (refer below), if the ECB is equipped with the second kind of I/O board.

(5) Thermocouples:

Thermocouples (TCs) produce signals in mV range. The two devices measuring the exhaust gas temperature use thermocouples. Two spare inputs are provided. The signals are converted to digital values via individual converters. The converters are accessed via the serial bus interface. The converters contain the necessary filtering of the various signals.

(6) Analog Inputs:

The input voltage signals, which are in the range of volts, are converted to digital values via Analog-to-Digital Converters (ADCs). An ADC has an input voltage range of +/- 2.048 V. Various input signals are multiplexed using a single ADC. There are four multiplexers (one is not used) and one ADC with eight channels. The ADC and the multiplexers are connected via serial bus interface.

The second kind of I/O board contains another ADC connected via parallel bus interface. This ADC has an input voltage range of +/- 5.0 V. The ADC is used to acquire total pressure (PT), delta pressure (DP), IGV LVDT secondary input (IGV position), and SCV LVDT secondary input (SCV position).

(7) Speed Conditioners:

The frequency signals are conditioned as depicted in FIGURE 4.

(8) Discrete Inputs:

The discrete input signals can be divided into five groups:

- 28VDC / open
- 28VDC / ground / open
- Ground/open
- 5V / ground / open
- A spare input conditioner for a resistance switch (< 50 Ohm, > 60 Ohm)

A switch is assumed to be "closed", when resistance < 30 Ohms; it is assumed "open", when resistance > 10 kOhms.

There are two spare 28VDC/open switch inputs.

TABLE 12 defines the different discrete inputs.

AIR/GROUND SWITCH	OPEN	IN AIR
	GROUND	ON GROUND
AIRCRAFT IDENTIFIER 1	OPEN	
	GROUND	A321
AIRCRAFT IDENTIFIER 2	OPEN	
	GROUND	A321
APU STOP	OPEN	
	GROUND	STOP
LOAD CONTROL VALVE	OPEN	
	GROUND	ACTIVATE BLEED
LOAD VALVE OPEN	OPEN	
	GROUND	VALVE OPEN
LOAD VALVE CLOSED	OPEN	
	GROUND	VALVE CLOSED
OIL FILTER SWITCH	OPEN	
	GROUND	FILTER CLOGGED
START CONTACTOR MONITOR V	> 5 VDC	VOLTAGE
	GROUND/OPEN	
START CONTACTOR MONITOR G	GROUND	GROUND
	OPEN/> 5 VDC	
TSO	OPEN	
	GROUND	INHIBIT SHUTDOWNS
OIL HEATER BITE ENABLE	OPEN	
	GROUND	ENABLE OIL HEATER BITE
EMERGENCY STOP SWITCH	OPEN	
	GROUND	EMERGENCY

DISCRETE INPUTS
TABLE 12 (continued on next page)

EXTERNAL RESET	OPEN	
	GROUND	RESET
INLET FLAP OPEN	> 5 VDC	OPEN
	GROUND	
INLET FLAP CLOSED	28 VDC	
	GROUND	CLOSED
INLET FLAP MOVEMENT	28 VDC	MOVEMENT
	OPEN	
LOW FUEL PRESSURE	OPEN	
	GROUND	LOW PRESSURE
LOW OIL PRESSURE	OPEN	
	GROUND	LOW PRESSURE
LOW OIL LEVEL	OPEN	
	GROUND	LOW QUANTITY
LOW FUEL PRESS BITE ENABLE	OPEN	
	GROUND	ENABLE LOW FUEL PRESS BITE
MES MODE	28 VDC	MAIN ENGINE START
	OPEN	
START COMMAND	28 VDC	START
	OPEN	
SCV TEST SWITCH	28 VDC	TEST
	OPEN	
STARTER VALVE SWITCH	28 VDC	STARTER VALVE PRESENT
	OPEN	

DISCRETE INPUTS
TABLE 12

(9) Low Side Drivers:

The I/O board contains drivers for the discrete low side output signals to the APU and the aircraft.

The drivers are:

A/C relay driver with overcurrent shutoff and indication at 6 A. No open load detection is provided.

Six spare drivers with overcurrent shutoff and indication at 3 A.

Status signals for BITE purposes are provided for every driver.

(10) High side drivers:

Drivers for the discrete high side output signals to the APU and the aircraft are provided.

The drivers are:

- De-oil solenoid driver with overcurrent shutoff and indication at approx. 15 A.

  This driver also supplies the Data Memory Module (DMM) of the APU.
- Backup start contactor driver with overcurrent shutoff and indication at approx. 15 A.
- Main start contactor driver with overcurrent shutoff and indication at approx. 15 A.
- Load valve position signal driver with overcurrent shutoff and indication at approx. 1 A.
- Fault relay driver with overcurrent shutoff and indication at approx. 1 A.
- Start-in-progress signal driver with overcurrent shutoff and indication at approx. 1 A.
- APU available signal driver with overcurrent shutoff and indication at approx. 1 A.
- Low fuel pressure valve solenoid driver with overcurrent shutoff and indication at approx. 1 A.

An open load is detected when the current is less than 200 mA.

Status signals for BITE purposes are provided for every driver.

(See FIGURE 5).

(11) Analog Outputs:

The torque motor commands from the software control loops for fuel, IGV, and SCV are converted via digital-to-analog converters (DACs). The DAC output voltage range is 0.0 V to 2.5 V. The IGV torque motor output and the SCV torque motor output are embedded in hardware closed loops with the IGV LVDT and the SCV LVDT resp. This is depicted in FIGURE 6 and FIGURE 7 resp.

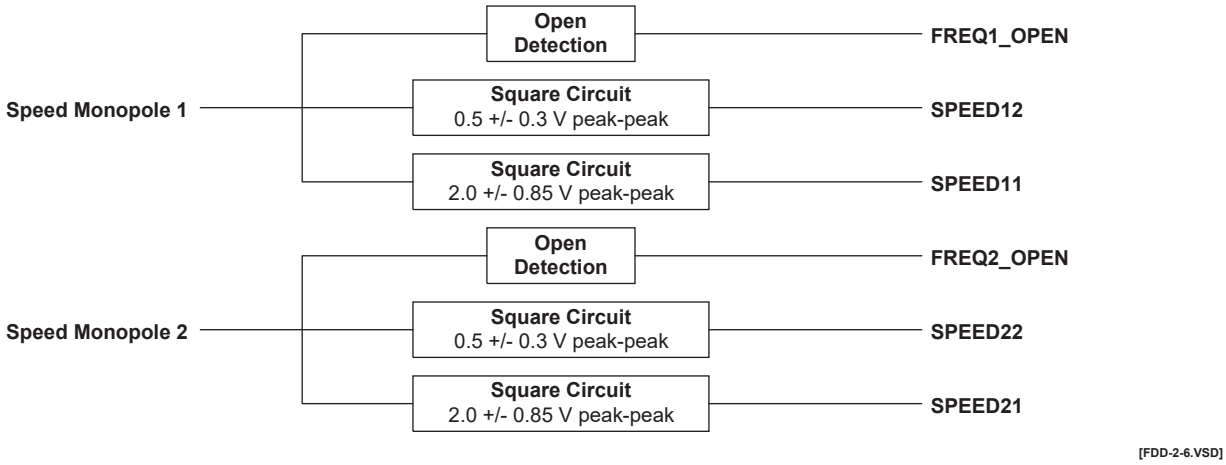
The first kind of I/O board is equipped with a DAC addressed via serial bus interface; the second kind of I/O board is equipped with a DAC addressed via parallel bus interface.

The analog wrap-around signals (voltage and current) provided for BITE purposes are converted via the analog-to-digital converter.

(12) General:

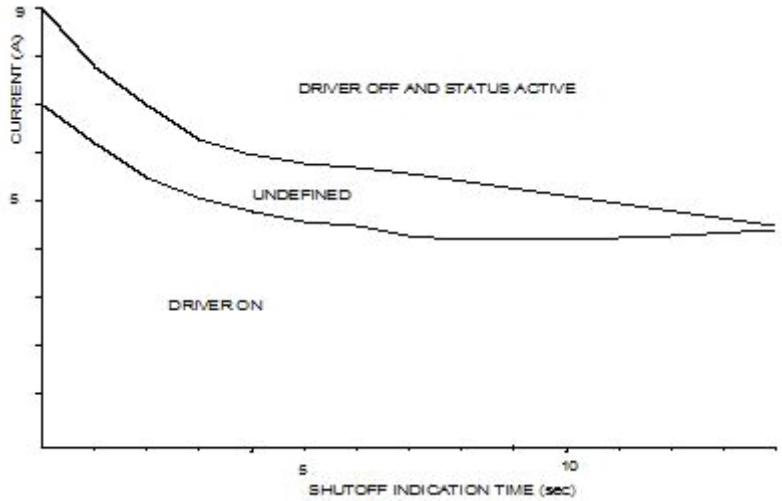
Voltage supplies for the resolver, the LVDTs, the three pressure sensors, and a test supply are provided by the I/O board. The test supply powers the ECS demand and vary speed resistors installed in the APU test cells.

A 256 byte EEPROM contains the I/O board modification status and signal conditioner gains and offsets. The modification status and the gains and offset values are loaded during the first board test after production and are valid for all analog inputs and outputs.



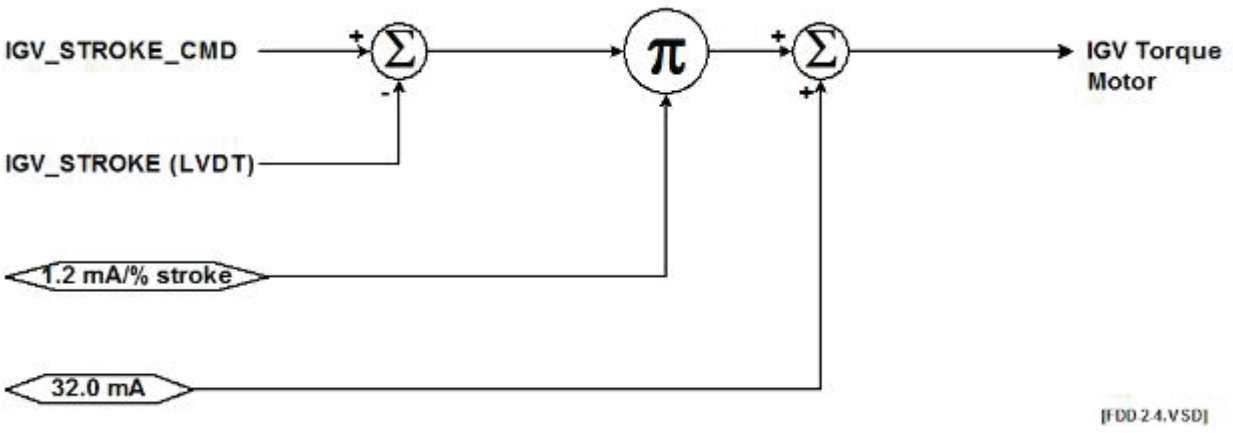
D4829_496370_DOP04_001_R00

FREQUENCY CONDITIONING
FIGURE 4



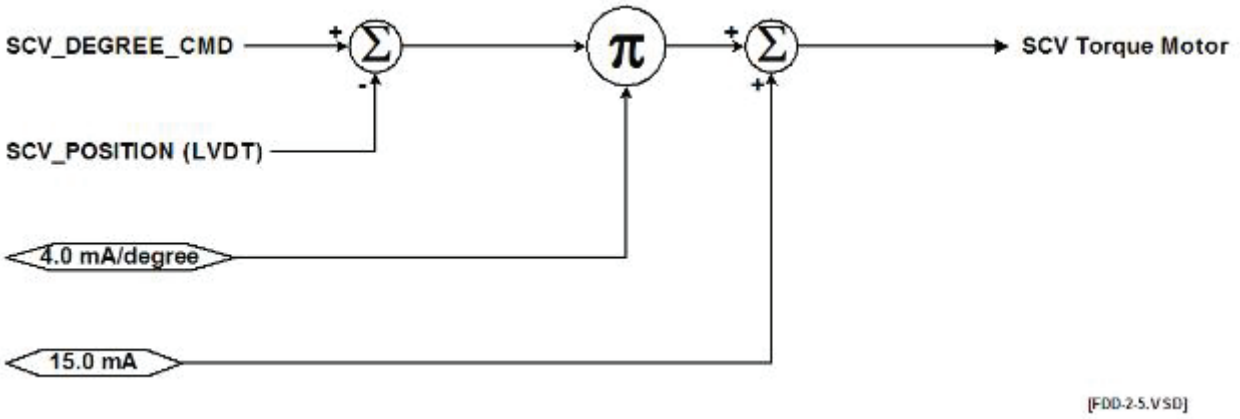
D4829_496370_DOP05_001_R00

DRIVER ENVELOP
FIGURE 5



D4829_496370_DOP06_001_R00

IGV HARDWARE LOOP
FIGURE 6



D4829_496370_DOP07_001_R00

SCV HARDWARE LOOP
FIGURE 7

H. Function of CPU Board

This board contains the functions listed in FIGURE 3.

A block diagram of the CPU board is given in FIGURE 2002.

The core of this board is the Motorola 68332 microcontroller (with a second one for spare purposes which is not populated). The microcontroller operates with 20 MHz. It controls and supervises the APU and checks the hardware of the ECB with software methods according to the operational resident program code stored in the Flash EPROM.

The following memory (types and capacities) is provided (valid for both processors):

- 256k x 8 SRAM
- 1024k x 8 Flash EPROM
- 16k x 8 EEPROM
- 2Kx 8 DUAL PORT RAM (not populated)

The SRAM is used for temporary data storage.The Flash EPROM is loaded with the initialisation program, the Downloader, the MICBAC monitor, and the Operational Functions (Control Software). The address map is provided by TABLE 13. The EEPROM contains failure flags and control parameters. These are listed in TABLE 29.

The EEPROM contains the fault information which is transmitted via ARINC to the Centralized Fault Display Interface Unit (CFDIU) and back-up of the Data Memory Module (DMM).

	Controller_A	Controller_B (not populated)	Chipselect	Waitstates
Flash EPROM	$000000 to $0FFFFF	$000000 to $0FFFFF	CSBOOT	1 WS
EEPROM	$180000 to $183FFF	$180000 to $183FFF	CS8	async.
DPRAM (unused)	$190000 to $1907FF	$190000 to $1907FF	CS7	async.
ARINC	$1A0000 to $1A1FFF		CS4	async.
I/O int.	$1A2000 to $1A23FF	$1A2000 to $1A23FF	CS5	async.
I/O ext.	$1A2400 to $1A27FF		CS5	async.
SRAM	$1C0000 to $1FFFFF	$1C0000 to $1FFFFF	CS9,CS10	0 WS

ADDRESS MAP
TABLE 13

A real time clock (RTC) generates the clock frequency for the CPUs. Via a wait state logic generator the software can influence the wait states. A keep alive circuit shuts down the APU in case of a software or CPU failure. This happens, if the keep alive circuit is not refreshed periodically every 100 msec. The CPU refreshes the keep-alive timer by writing a specific data to a specific address. A hardware failure of the keep-alive circuit causes an APU shutdown for safety reasons.

The speed signals from the speed monopoles are converted by the MC TPU. The wrap-around of the resolver excitation (a frequency signal as well) is also converted via the MC TPU.

(1) ARINC 429:

The CPU board is fitted with three ARINC-429 low speed receivers (one for spare purposes) and one ARINC-429 low speed transmitter. One of the receivers is used to receive signals for further use in the control loops. The other receiver receives data from the aircraft CFDIU (Centralized Fault Display Interface Unit). The transmitter is used to transmit data to CFDIU, Aircraft Condition Monitoring System (ACMS), and Electronic Centralized Aircraft Monitoring System (ECAM).

(2) RS232:

The RS232 serial interface allows communication with test equipment using the MICBAC protocol according to ABD0048 / 13f /. Additionally, performance data for test purposes can be transmitted using the In- Operation Monitor.

(3) Safety Logic:

The safety logic consists of the Overspeed Governor and the Emergency Logic. This is depicted in FIGURE 8. The Overspeed Governor works with an own reference frequency which can be monitored for BITE purposes.

The I/O board generates the signals SPEED12 and SPEED22. The Overspeed Governor compares these signals with a stored overspeed frequency value. If one of the speed signals exceeds the overspeed value of 106 %, (12944 Hz) the fuel solenoid and the flow divider solenoid will be deenergized by hardware thus causing the APU to rolldown.

An overspeed frequency signal OSREF is selected by using the discrete signals OSTEST1 or OSTEST2 in case of a Commanded Shutdown. This will be recognized by the Overspeed Governor and the fuel solenoid and the flow divider solenoid will be de-energized causing the APU to rolldown.

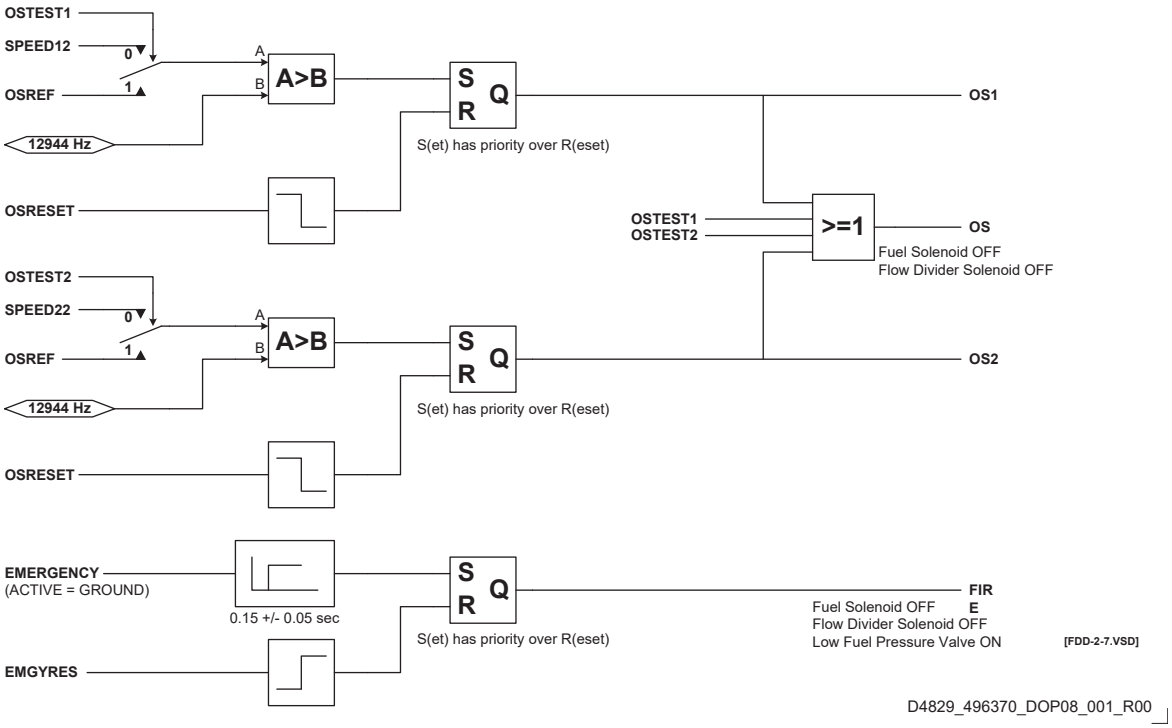
The signal EMERGENCY is conditioned on the I/O board and is used by the Emergency Logic. If EMERGENCY is present for a certain time, the fuel solenoid and flow divider solenoid will be de-energized and the low fuel pressure value will be de-energized by hardware.

(4) Internal Discrete I/O:

Ports are provided for internal discrete I/O (e.g. for communication with the Overspeed Governor).

(5) General:

The hardware modification status of the CPU board and of the PSU board are stored in the EEPROM as well as failures of the CPU-board. CPU failure addresses are in TABLE 29.



SAFETY LOGIC
FIGURE 8

I. Function of the PSU Board

This board contains the functions listed in FIGURE 3.

(1) PSU

A block diagram of the PSU board is given in FIGURE 9.

The power supply unit (PSU) provides all secondary voltages to operate the CPU board and the I/O board (+5 V, 5 V RAM, +8 V, -8 V and +15 V).

During a power interrupt of the main power (28 VDC) the interrupt supply bus (28 VSEC) is activated by means of software. The interrupt supply bus provides 115 VAC which is converted to 28 VSEC on the Connect Module (A21). If 28 VSEC is switched on, 28 VDC power and 28 VSEC secondary power form a hi-win on the PSU itself (see FIGURE 2003).

In case of a main power interrupt, the PSU links itself to the interrupt supply bus for 300 msec only. Additionally, the SRAM is supported with power for at most 200 msec to allow a warmstart capability. Depending on the operating mode, main power interrupts may be survived according to the following table:

Operating Mode	Interrupt Duration being survived
Master Switch OFF; 115 VAC not available	< 2 msec
Master Switch ON; 115 VAC not available	< 2 msec
Master Switch ON; 115 VAC not available and APU on speed	< 200 msec (warm start)
Master Switch OFF; 115 VAC available	< 300 msec
Master Switch ON; 115 VAC available	< 300 msec
Master Switch ON; 115 VAC available and APU on speed	< 550 msec

INTERRUPT DURATIONS
TABLE 14

(2) PSU Monitoring:

Monitoring of primary and secondary voltages are depicted in FIGURE 9.

The signals BATSW , L_INT1, L_INT2, DC1_FAIL, DC2_FAIL, and PSU_OK are monitoring signals. Additionally the analog signal VRMON_T which is the PSU reference voltage may be monitored.

The signal WSTART flags whether a warm start is possible, i.e. the SRAM content is still valid.

The signal DC1_TEST, if stimulated, simulates a main power interrupt, i.e. as long as DC1_TEST is set, 28VDC is cut off. This facility is not used by software.

(3) High Side Drivers:

The PSU board contains drivers for discrete output signals to the APU and the aircraft.

The high side drivers are:

- flow divider solenoid driver
- load control valve solenoid driver
- ignition unit driver
- inlet flap open command driver
- inlet flap close command driver

An open load is detected when the current is less than 200.0 mA, except for the ignition unit driver (100.0 mA, ref. FIGURE 10).

The overcurrent shutoff limit is approx. 6 A (exactly 6 A for the ignition unit driver and flap drivers). The drivers must be de-energized by software in case of overcurrent.

All these circuits include status signals for the Built-In Test (BIT) functions.

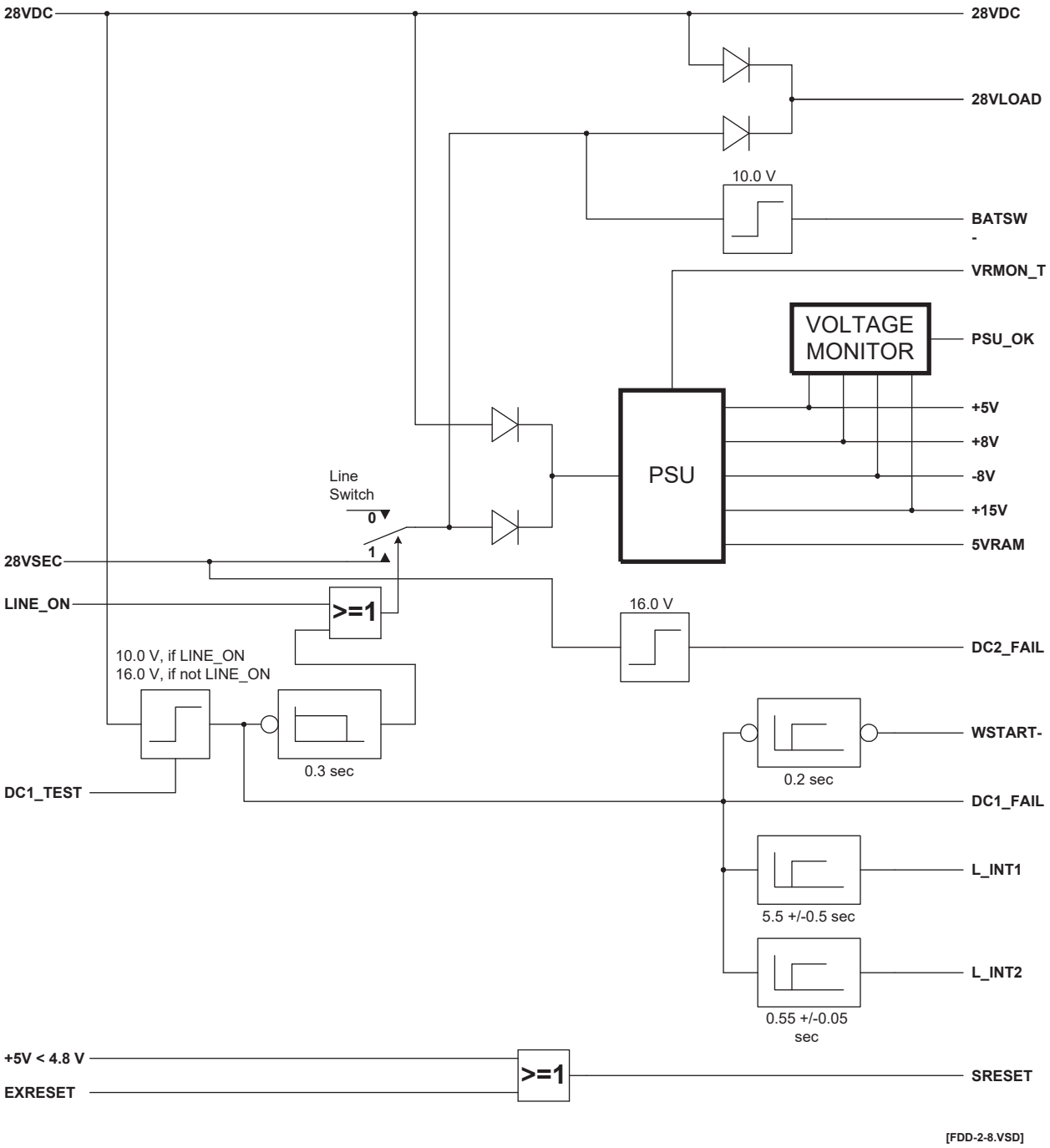
(4) PWM Driver:

The PSU board contains a driver for a pulse width modulated (PWM) signal. This signal drives the fuel solenoid.

All these circuits include status signals for the Built-In Test (BIT) functions.

(5) General:

The PSU powers the inlet flap switches.



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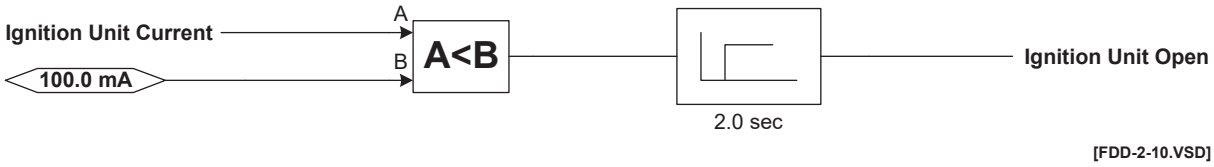
FUNCTION OF THE POWER SUPPLY
FIGURE 9



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IGNITION OPEN DETECTION LOGIC
FIGURE 10

J. Function of Connect Board

This board contains the functions listed in FIGURE 3.

(1) ARINC Connections

The connect board provides the interconnection between ARINC connector and PSU board.

(2) 115 VAC Converter

The interrupt supply signal (115 VAC) is converted to 28 VDC and provided as 28VSEC signal to the PSU.

(3) Cold Junction

A temperature sensor is mounted on the connect board to determines the pin temperatures of ARINC connector so that thermocouple sensor voltages can be corrected by the voltage caused by the dissimilar materials of aircraft wiring and pins. This sensor is termed cold junction.

K. ECB Software Functions

The software functions of the ECB can be divided into three major parts:

- Control Functions: controlling and monitoring of the APU
- Built-in Test Functions: recognition of faults of the APU and/or ECB

- ARINC Functions: communication with other aircraft systems via ARINC-429 bus and data memory module functions

A detailed description of the Built-in Test Functions is provided by para. 4.

(1) Control Functions

The Control Functions can be divided into three subfunctions:

- controlling
- monitoring
- input/output processing (not further detailed)

(a) Controlling Function

The Controlling Function includes the APU control loops, the inlet flap logic, and the load sequencing.

The ECB has three control loops: a fuel control loop, an control loop for the inlet guide vane (IGV) and a surge flow control loop for the surge control value (SVC). The fuel control loop is divided into a start-up control loop, a governor control loop and a fuel adjustment logic. During start-up control the ECB modulates the fuel flow via the fuel torque motor until the APU accelerates to 95 % speed. The APU speed is controlled to follow a prescribed ramp during start, while providing for low engine temperatures. At 95 % speed the governor control loop will be active and modulates the fuel flow to maintain a constant 100 % APU speed, regardless of loading. The fuel adjustment logic measures the actual fuel flow and adjusts the fuel torque motor accordingly. The IGV control loop controls the inlet guide vane position of the APU load compressor. The IGV position command is based on aircraft mode inputs to the ECB while maintaining low APU temperatures. Surge flow control commands the inner surge control valve (SCV) loop (implemented in hardware) to maintain airflow high enough to prevent load compressor surge. The turbine inlet temperature (T4) is used by the fuel control loop and the IGV control loop. T4 is a function of the exhaust gas temperature (T5).

If a protective shutdown (excluding emergency shutdown) occurs in flight, the inlet flap will not be allowed to close until 15 minutes after the APU speed ist below 7%. This allows the hot gas to be evacuated out of the APU prior to closing the inlet flap.

Load sequencing is the logic which commands discrete signals to the aircraft and APU.

(b) Monitoring Function

The monitoring function includes the commanded and protective shutdown procedures.

Commanded shutdown switches the APU engine off by cutting its fuel supply when the master switch is set to the OFF position. This happens after a specific cooldown phase.

The fuel cut off occurs via primary overspeed detection hardware (see FIGURE 2002).

Protective shutdown switches the APU engine off by cutting its fuel supply when a condition occurs which is detrimental to engine or aircraft. Fuel cut off is initiated by software.

(2) ARINC Functions

A low speed ARINC receiver is connected to the Environmental Control System (ECS). ECS demand signal and pack information are received from the ECS. These signals are used by the IGV and SCV control loops.

ARINC Functions store, transmit, and receive data concerning faults in the ECB/APU system for maintenance purposes and transmit data concerning APU system operational performance and identification.

The ARINC functions can be divided into four subfunctions:

- fault management
- ARINC data processing
- memory module function
- ECB statistic calculation

(a) Fault Management

The fault management classifies the faults which are detected by built-in test functions and by the protective shutdown logic and stores the fault code number together with additional data such as date, Greenwich Mean Time (GMT), etc. into the non-volatile fault memory.

There are three different kinds of failure flags defined in the ECB:

- protective shutdown failure flags
- LRU failure flags
- built-in test failure flags

The failure flags are collected in three distinct fault arrays. All failure flags are identified by fault code numbers (FCN).

A protective shutdown fault leads to a shutdown of the engine to prevent damage of APU or aircraft. These faults will be detected in the protective shutdown logic.

LRU faults designate a faulty line replaceable unit (LRU), e. g. a sensor or the ECB itself. They are derived from built-in test results.

The built-in test failure flags for trouble shooting identify the faulty part of a LRU or the kind of LRU failure (e. g. short or open).

The LRU faults are divided into three classes:

1 Class 1 failures

They are indicated to the crew in flight by audio and/or visual means because they have operational consequences.

2 Class 2 failures

They are not automatically indicated to the crew in flight because they have no operational consequences for the current or the next flight(s). But they are indicated to the crew on the ground by the ECAM system after landing because they cannot be left uncorrected until the next scheduled maintenance check.

3 Class 3 failures

They are not indicated to the flight crew because they can be left uncorrected until a scheduled maintenance check.

According to their classes the LRU faults will be stored into distinct zones in the non-volatile fault memory (refer TABLE 17). The fault zones are separated into fault pages containing the fault code number and additional data.

Class 1 and class 2 failures are stored into zone 1. The design of fault page 1 is given in TABLE 18. LRU_FAULT_CODE identifies a specific LRU fault. The flight leg counting shall be done at the transition from flight phase 1 to any flight phase greater than 1, i.e. a new flight begins. The flight leg counter on all faults shall be incremented at this time. Flight leg counting will also be performed for class 3 faults and shutdowns.

GMT, Date, Flight Phase, and Aircraft Identifier are received from CFDIU.

The BIT Fault List contains the current built-in test failure flags. These flags are used for failure isolation in the shop. The list is limited to five. GROUND indicates occurance on ground. The event word stores the status of the system at LRU fault detection (refer TABLE 19).

Zone 6 is used for the storage of protective shutdown faults. Before storage into zone 6 the fault tree logic has to be executed. That means: if a protective shutdown occurs, the ECB will look at the tree for the resp. shutdown. If a current failed LRU matches the LRU in the tree, then the ECB will insert the shutdown fault and the LRU fault into zone 6. If no current failed LRU matches a LRU in the tree, the ECB stores the LRU fault code for the most probable LRU fault into zone 6 and zone 1. The structure of zone 6 is shown in TABLE 20.

Zone 5 contains class 3 faults. The fault page structure is depicted by TABLE 18.

The fault information in the fault zones is transmitted to the Centralized Fault Display Interface Unit (CFDIU) via ARINC.

(b) ARINC Data Processing

ARINC data processing transmits and receives data concerning faults in the APU system and also transmits data concerning APU operational performance and identification.

A low speed ARINC receiver is connected to the Centralized Fault Display Interface Unit (CFDIU). The labels listed below are received on this bus:

• Label 125 :	Greenwich Mean Time (GMT)
• Label 260 :	date
• Labels 301, 302, and 303 :	A/C identifier
• Label 126 :	flight phase
• Label 127 :	A/C configuration
• Label 227 :	BITE command word

ARINC DATA
TABLE 15

For all labels the refresh rate, the parity bit, and the SSM coding are checked. These labels contain information which are used during fault storage into fault memory and for controlling fault transmission.

The BITE command word contains an equipment identifier and the command code. The equipment identifier selects a specific aircraft system or all aircraft systems. The BITE command code is used to determine whether main engines are OFF or ON and to switch the fault transmission to the CFDIU between two modes. These modes are described below.

On the low speed ARINC output bus the CPU transmits data to the Aircraft Condition Monitoring System (ACMS), the Electronic Centralized Aircraft Monitoring System (ECAM), and the Centralized Fault Display System (CFDS).

The ECB continously transmits APU operational data such as speed, temperature signals, pressure signals, etc., and system identification data with various update rates to ECAM and ACMS (ref. to /2/ for the update rates). Additionally, all discrete and analog inputs signals are retransmitted via ARINC. This transmission continues as long as the ECB is powered.

All labels transmitted are listed below:

• label	001:	SCV stroke command	15 sig.bits	0.00366 % res.
• label	002:	SCV degree command	15 sig.bits	0.00366 deg res.
• label	004:	cooldown time (BCD)		

ARINC DATA PROCESSING
TABLE 16 (continued on next page)

• label	037:	discrete word (ref. /2/)		
• label	050:	APU serial number (BCD)		
• label	110:	inlet temperature (T2)	7 sig.bits	1 C res.
• label	112:	inlet pressure (P2)	9 sig.bits	0.004 bar res.
• label	120:	turbine exhaust temp. max. (T5 MAX)	11 sig.bits	1 C res.
• label	121:	turbine inlet temperature (T4)	11 sig.bits	1 C res.
• label	123:	bleed air flow	9 sig.bits	4 g/sec res.
• label	130:	IGV position	12 sig.bits	0.044 deg res.
• label	132:	APU operating hours	14 sig.bits	1 hour res.
• label	133:	APU starts	14 sig.bits	1 cycle res.
• label	134:	SCV position	12 sig.bits	0.044 deg res.
• label	145:	fuel torque motor current command	9 sig.bits	1 mA res.
• label	165:	delta pressure (DP)	9 sig.bits	0.004 bar res.
• label	166	total pressure (PT)	10 sig.bits	0.008 bar res.
• label	175:	exhaust gas temp. (EGT)	11 sig.bits	1 C res.
• label	176:	speed (107 %, if 106 % <= speed < 107 %)	9 sig.bits	0.5 % res.
• label	242:	minimum fuel flow	11 sig.bits	0.25 lb/hr res.
• label	243:	commanded fuel flow	11 sig.bits	0.25 lb/hr res.
• label	244:	measured fuel flow	11 sig.bits	0.25 lb/hr res.
• label	245:	maximum fuel flow	11 sig.bits	0.25 lb/hr res.
• label	247:	sump oil temperature	8 sig.bits	1 C res.
• label	250:	start time	8 sig.bits	1 sec res.
• label	251:	corrected exhaust gas temp. (T5)	11 sig.bits	1 C res.
• label	252:	correct total pressure	10 sig.bits	0.008 bar res.
• label	253:	corrected fuel flow	11 sig.bits	0.25 lb/hr res.
• label	254:	IGV position at main engine start	12 sig.bits	0.044 deg res.
• label	351:	LRU word 1 (ref. /2/)		
• label	352:	LRU word 2 (ref. /2/)		

ARINC DATA PROCESSING
TABLE 16 (continued on next page)

• label	353:	shutdown word (ref. /2/)		
• label	356	fault information		
retransmission				
• label	255:	sump oil temperature. (ref. /2/)	12 sig.bits	0.0625 ohms res.
• label	256:	inlet temperature (ref. /2/)	12 sig.bits	0.0625 ohms res.
• label	257:	SCV LVDT ratio (ref. /2/)	12 sig.bits	0.00013 res.
• label	260:	IGV LVDT ratio (ref. /2/)	12 sig.bits	0.00013 res.
• label	261:	inlet pressure (P2)	8 sig.bits	0.125 mV res.
• label	262:	total pressure (PT)	8 sig.bits	0.125 mV res.
• label	263:	delta pressure (DP)	8 sig.bits	0.125 mV res.
• label	264:	exhaust gas temp. 1 (EGT1)	11 sig.bits	0.031 mV res.
• label	265:	exhaust gas temp. 2 (EGT2)	11 sig.bits	0.031 mV res.
• label	270:	fuel flow position	11 sig.bits	0.0625 deg res.
• label	271:	speed 1	14 sig.bits	1 Hz res.
• label	272:	speed 2	14 sig.bits	1 Hz res.
• label	273:	fuel temperature (ref. /2/)	12 sig.bits	0.0625 ohms res.
• label	274:	discrete retransmission (ref. /2/)		

ARINC DATA PROCESSING
TABLE 16

Fault message transmission to the CFDS via label 356 is performed in clear English and in two modes:

- normal mode (reporting mode)
- menu mode (interactive mode)

The two modes are alternately active. Normal mode transmission starts after power up initialization test is complete.

Via BITE command word, the CFDS switches the ECB to menu mode which transmits a main menu to the CFDS. Then the operator has the choice between nine submenu pages. The layout of the main menu is shown in FIGURE 11. All submenu pages which are transmittable in menu mode on request are listed below.

Submenus transmitted on request:

- LAST LEG REPORT

Identification of class 1 and class 2 faults of the last (or current) flight leg.

- PREVIOUS LEGS REPORT

Indication of class 1 and class 2 faults of the previous 63 flight legs.

- LRU IDENT

Indication of the ECB part, dash, serial number and of the version of the operational software.

- GND SCANNING

Indication of all faults during selection of this menu. Storage of faults in fault memory is inhibited.

- TROUBLE SHOOT DATA

Indicates trouble shooting data of class 1 + 2 faults in current and previous 63 flight legs.

- RETURN

Menu mode left and normal mode restarted.

- CLASS 3 FAULTS

Indication of class 3 faults of last (or current) flight leg and previous 63 flight legs.

- TEST

Starts self-test and indicates faults found during self-test. Storage of faults in fault merory is inhibited.

- SHUTDOWNS

Indication of all APU shutdowns and responsible LRU in current and previous 63 flight legs.

- SERVICE DATA

Indication of APU serial number, operating hours, operating cycles and oil level. A submenu allows display of parameters stored in the DMM.

(3) Memory Module Functions

The Data Memory Module (DMM) related logic in the ECB has four functions (described below):

- Initialisation of DMM and ECB
- APU Statistics
- Health Monitoring
- Update Memory Module

(a) Initialisation of DMM and ECB

The data in the DMM is comprised in the APU data memory structure. The ECB contains a primary and a secondary copy of the APU data structure in a nonvolatile memory. Together with the data, date and GMT of first storage in the ECB is memorized.

(b) APU Statistics

This is a collection of statistics describing how the APU is used, i. e. time, shutdowns occured, T4 in various conditions, etc.

(c) Health Monitoring

Health Monitoring stores changes in the Load Compressor Discharge Pressure (PT), Exhaust Gas Temperature (T5) and Fuel Flow (WFMES) at time intervals of the APU life. This allows the recognition of health trends against time.

(d) Update Data Memory Module

This function updates the APU data structure in the DMM and the copies in the non-volatile memory of the ECB during APU rolldown. It delays Inlet Flap movement.

(4) ECB Statistic Calculation

This function calculates ECB usage hours. It counts the number of power-ons and it measures the maximum and minimum temperature at power-on and power-off and the average temperature.

ZONE 1 & 2	31 entries of LRU fault page: class 1 and class 2 faults
ZONE 3	31 entries of LRU fault page: not used
ZONE 4	1 entry of LRU fault page: not used
ZONE 5	21 entries of LRU fault page: class 3 faults
ZONE 6	31 entries of SDN fault page: shutdowns

FAULT MEMORY STRUCTURE
TABLE 17

Meaning	Size	Coding
LRU CODE	1 16-bit word	hexadecimal
LRU CLASS	1 16-bit word	hexadecimal
FLIGHT LEG	1 16-bit word	hexadecimal
ACFT IDENTIFIER	8 8-bit words	ISO5
DATE	1 32-bit word	BCD

STRUCTURE OF LRU FAULT PAGE
TABLE 18 (continued on next page)

Meaning	Size	Coding
UTC	1 32-bit word	BCD
FLIGHT PHASE	1 16-bit word	hexadecimal
GROUND	1 16-bit word	hexadecimal (AA = false, 55 = true)
FUALT POSITION and SIDE	6 8-bit words	not used
TROUBLE SHOOTING INFO	7 16-bit words	coding in para E.
DUMMY	1 16-bit word	for alignment purposes

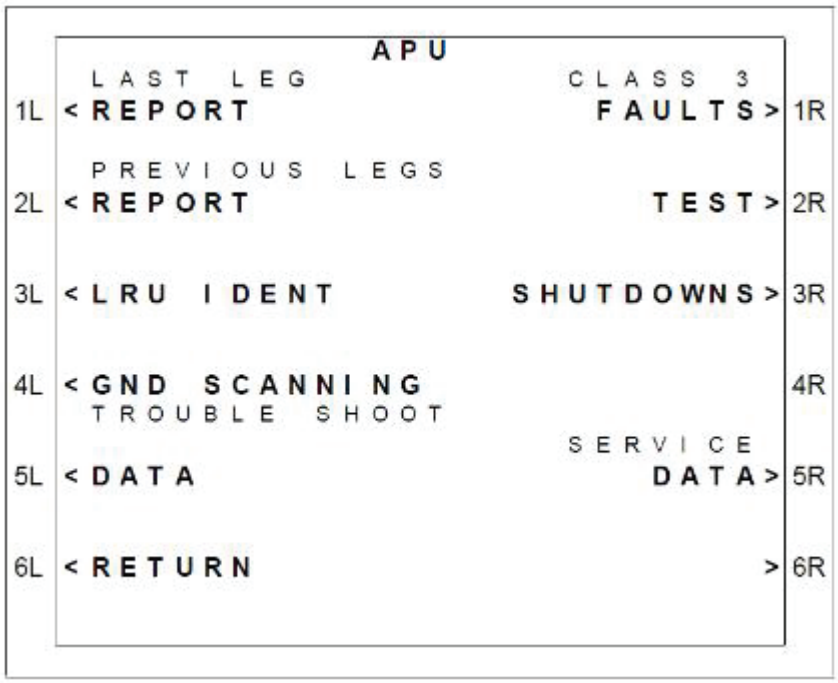
STRUCTURE OF LRU FAULT PAGE
TABLE 18

Bit	Status	Meaning
1 + 2	00	power-up initialization active
	01	power-up test active
	10	self-test active
	11	otherwise
3	T / F	Master Switch ON
4	T / F	Start Switch was pushed
5	T / F	Main Start Contactor engaged
6	T / F	Speed > 7 %
7	T / F	Speed > 95 %
8	T / F	Light off
9	T / F	Load Control Valve activated
10	T / F	MES Mode active
11	T / F	Cooldown Period active
12	T / F	Low Fuel Pressure indicated by Switch
13	T / F	IGV Position > 25.0 deg
14	T / F	SCV Position > 20.0 deg
15	T / F	IGV trim
16	T / F	A/C in air

EVENT WORD DEFINITION
TABLE 19

Bit	Status	Meaning
SDN CODE	1 16-bit word	hexadecimal
INHIBIT	1 16-bit word	hexadecimal (AA = false, 55 = true)
LRU CODE	1 16-bit word	hexadecimal
LRU CLASS	1 16-bit word	hexadecimal
FLIGHT LEG	1 16-bit word	hexadecimal
ACFT IDENTIFIER	8 8-bit words	ISO5
DATE	1 32-bit word	BCD
UTC	1 32-bit word	BCD
FAULT POSITION and SIDE	6 8-bit words	not used
TROUBLE SHOOTING INFO	14 16-bit words	coding in para E.
DUMMY	2 16-bit words	for alignment purposes

STRUCTURE OF SDN FAULT PAGE
TABLE 20



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LAYOUT OF MAIN MENU PAGE
FIGURE 11

TASK 49-63-70-870-802-A00

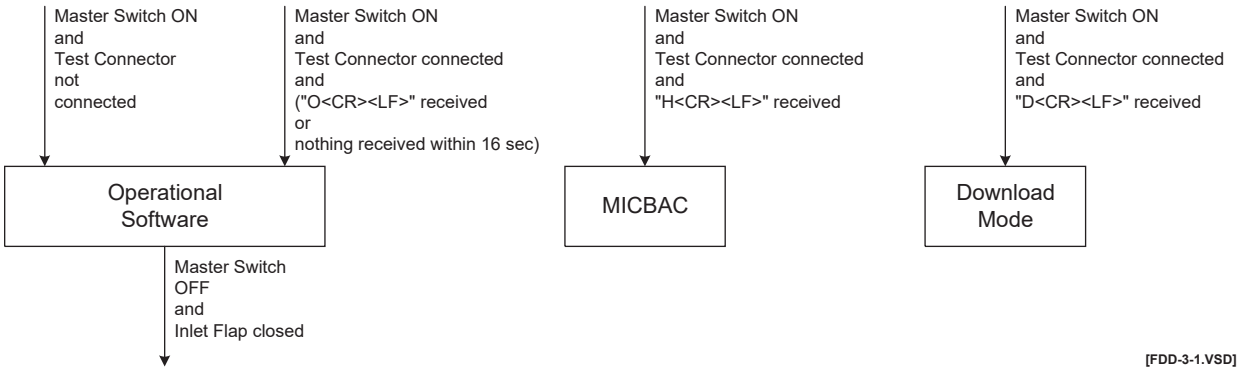
3. OPERATION

FIGURE 12 through FIGURE 14 show the state transition diagrams of the modes of operation of the ECB. Shown is: how events outside the ECB (in the aircraft or APU) affect the modes of the ECB. The modes contain a general description of the operations performed by the ECB.

The ECB is powered when the Master Switch is set to ON position. The ECB is depowered when the Master Switch is set to OFF position, the air intake flap is closed, and the A/C relay has been released by the ECB.

The ECB communicates with other aircraft systems and controls and monitors the APU. While accessing the data memory module (DMM) starting the APU is prohibited.

The ECB has a built-in capability to survive power interrupts less than 200.0 milliseconds while the APU is on speed. If power returns within this time period, the ECB omits the initialization steps and power-up tests to immediately control the APU again.



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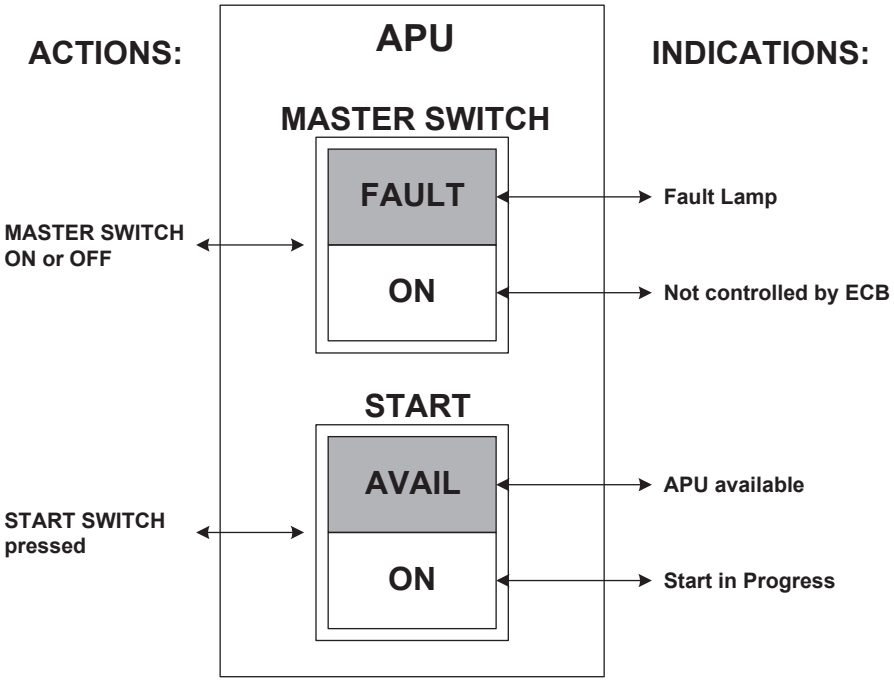
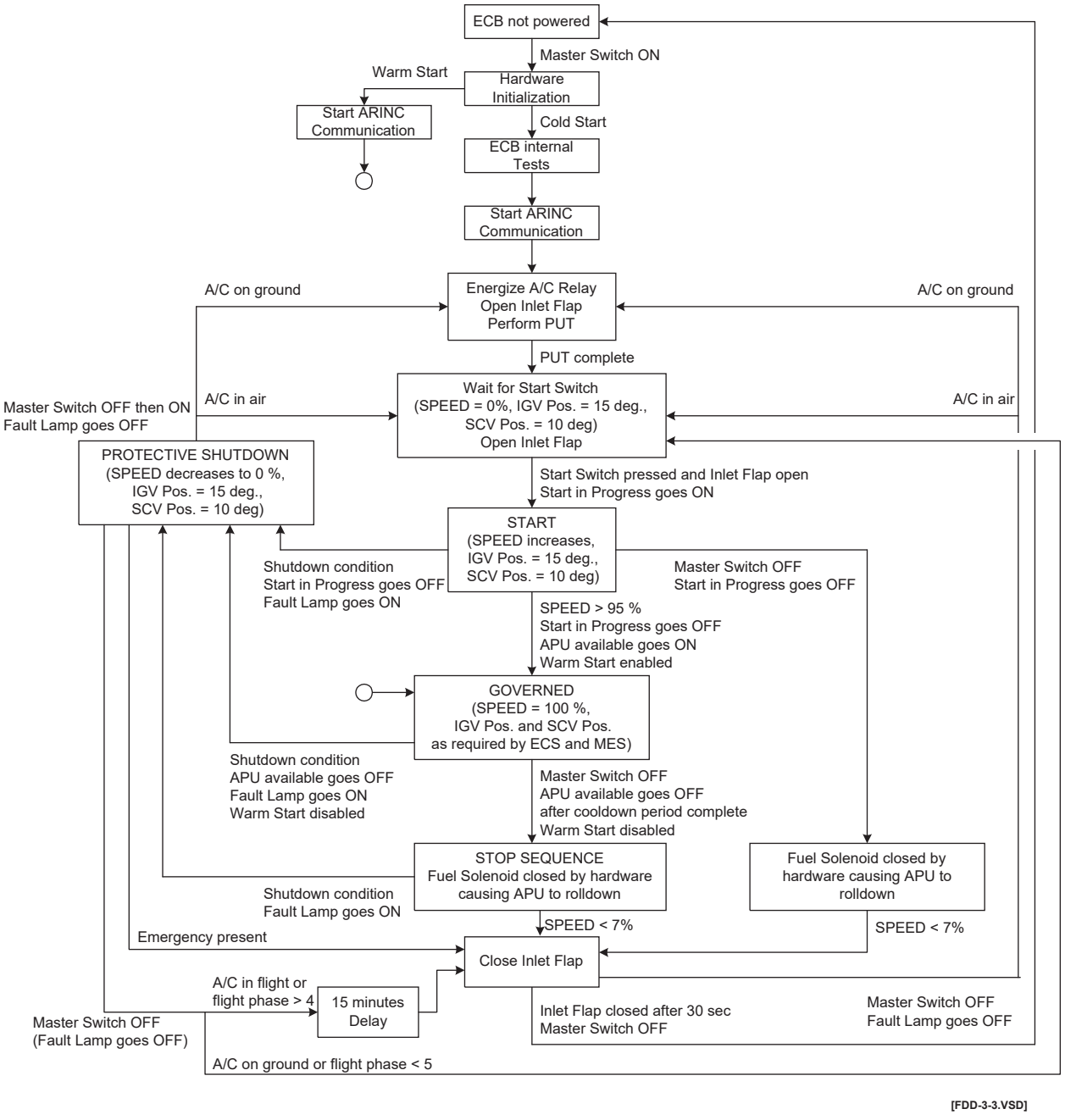
SIMPLE GENERAL SCHEMATIC OF ECB OPERATION
FIGURE 12



APU CONTROL PANEL IN COCKPIT
FIGURE 13

For trouble shooting purposes it is possible to enter MICBAC (ref. ABD0048 / 13f /). This is done by transmitting a 'HELLO'-command immediately after powering the ECB. A software Download Mode is provided. The downloader allows downloading of MICBAC and operational software (control software) and erasing of the MICBAC software. Additionally, the modification states of hardware and software can be displayed.

Entering MICBAC or Download Mode is possible only, if the test connector (J2) is connected.



[FDD-3-3.VSD]

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GENERAL SCHEMATIC OF ECB OPERATION
FIGURE 14

TASK 49-63-70-870-804-A00

4. BUILT-IN TEST

A. Monitoring and Test Philosophy

A major function of the ECB is to automatically test and isolate component malfunctions of the APU system and the ECB itself. This built-in tests are performed in three distinct test modes:

- Power-Up Test (PUT)
- In-Operation Test (IOT)
- Self-test (SET)

The Power-Up Test (PUT) is automatically performed after the ECB is powered. It is repeated (except for the tests performed during hardware initialization) every time the master switch is cycled and the A/C is on ground. The ECB tests its hardware components, monitors the sensor inputs, switch signals for power-up conditions, energizes the actuators and analyses the response signals. Then the ECB decides whether to permit or inhibit an APU start attempt. The ECB may decide to permit APU operation with failed noncritical or redundant sensors by using alternate values and/ or schedules.

During the In-Operation Test (IOT) only those components are evaluated which can only be tested while the APU is running. This is done to devote maximum computer time to the control algorithms.

The ECB continuously monitors APU operating parameters and sensor inputs to detect failure conditions that affect APU operation. In the event of a malfunction or the occurrence of a critical condition of the APU or the aircraft, the ECB will automatically shutdown the engine. If a noncritical sensor fails, the ECB provides alternate values to permit continued safe APU operation.

The Self-test (SET) can only be activated when the APU is not running. This test is intended for verification of removal of failures. It is initiated by a menu mode command. The same tests are performed as during PUT, except the tests being performed during hardware initialization (e.g. memory tests).

B. Fault Isolation Principles

The ECB uses several different fault isolation principles during Built-In Test (BIT). The built-in test can be functionally grouped into nine major parts. These parts are:

- Tests of ECB hardware
- Power supply tests
- Sensor tests
- Switch tests
- Motor tests
- Oil heater tests
- Load tests
- Inlet flap test
- Tests of the ARINC 429 inputs

(1) Tests of ECB Hardware

(a) Memory Tests

There are three different types of memory installed on the ECB. These are:

- Random Access Memory (RAM)
- Flash Erasable Programmable Read Only Memory (Flash EPROM)
- Electrically Erasable Programmable Read Only Memory (EEPROM)

The RAM test is performed by writing the address offset and the complement of the address offset to each location and comparing the stored value with the original value. After these two test cycles the RAM will be cleared. This test is only performed during power-up initialization.

The Flash EPROMs are tested via checksums. This means the software adds the contents of all locations and compares it with the predefined checksum. This test is performed during power-up initialization.

EEPROM tests are plausibility tests of the data stored in the EEPROM.

An error revealed by any memory test must be confirmed by performing the test up to three times.

(b) Configuration Test

The compatibility between the operational software loaded with the actual hardware is checked by this test. If the test fails, the operational software stops execution.

(c) ARINC Loop Back Test

The ARINC loop back test is an ECB internal wrap around test. The loop back is closed before the modulator and demodulator (refer FIGURE 15).

The test is performed by the following steps:

- disable ARINC modulator
- activate loop back mode (test) on ARINC Asic
- setup receiver and transmitter for low speed
- transmit test data via ARINC transmitter TX
- read test data from ARINC receivers
- compare transmitted data with received data set failure flag if data not equal
- enable ARINC modulator
- activate normal mode of ARINC Asic

(d) Watchdog Test

The watchdog circuitry is tested once at power-on to verify its correct function.

(e) Test of Analog to Digital Converter

FIGURE 16 shows the principle of the acquisition of analog signals together with the connections of the various multiplexers and the ADC device.

The correct function of the multiplexers is tested by comparing the voltage reference signals V5RAM and REFAD with predefined limits. A multiplexer is assumed to be failed, if the resp. signal is out of the required range.

(f) Test of Digital to Analog Converter

FIGURE 17 shows the principle wiring diagram of the DAC together with the ADC wiring. of the acquisition of analog signals together with the connections of the various multiplexers and the ADC device.

The DAC is tested by stimulating the signal DACWPR with 1.0 V and reading it back via Multiplexer 2. If the signal read back is not approx 1.0 V, the DAC is assumed to be failed.

(g) Analog Input Conditioner Test

FIGURE 18 shows the principle of the acquisition of those analog signals which are not read via ADC. The ready signal of every device is monitored. A signal conditioner is assumed to be failed, if either the ready signal shows "ready" continuously or the ready signal is not set within five times the update rate of the signal.

(h) Cold Junction Temperature Test

The cold junction temperature is compared with a lower limit (-100.0 °F) and an upper limit (302.0 °F). These limits are far out of the operational range of the ECB. If the cold junction temperature exceeds these limits for 0.5 sec, the cold junction is assumed to be failed.

(i) Pressure Sensor Voltage Test

The pressure sensor supply voltage (PSENREF) is compared with a lower limit (9.8 V) and an upper limit (10.2 V). If the supply voltage exceeds one of those limits for more than 0.4 sec, the supply is assumed to be failed. If the upper limit is exceeded, it is assumed that the source within the ECB is erroneous. If the lower limit is violated, no distinction between ECB and pressure sensors can be made.

Additionally, the current of the pressure sensor supply voltage is measured. If the absolute value of the current drops below 5 mA, it is assumed that the wires to the pressure sensors are broken.

(j) LVDT and Resolver Excitation Test

The ECB provides excitation for LVDTs and resolvers. FIGURE 19 shows the principle wiring of the LVDT excitation. FIGURE 20 showns the priciple wiring for the resolver excitation.

The test for the LVDT excitation reads back the excitation voltage. If the excitation voltage drops below 7.0 VAC, the excitation is assumed to have failed. The test for the resolver excitation reads back the excitation frequency. If the frequency is not in the range from 3000 Hz to 4000 Hz, the excitation is assumed to have failed.

(k) Overspeed Reference Tests

The Overspeed Governor (refer to FIGURE 2002) is supplied with a reference frequence of approximately 3900 Hz. The BITE system checks this frequency to be in the range of 3700 Hz to 4200 Hz. The ECB is assumed to be erroneous, if the reference frequency is not in this range.

The overspeed limit (refer to FIGURE 2002) is adjusted using three discrete signals on the Connect Module. If these signals do not have the coding required by the software, the ECB is assumed to be failed. These signals are checked at power-on and during operation.

(l) Overspeed Governor Tests

The Overspeed Governor (refer to FIGURE 8) is tested at every normal commanded shutdown of the APU. Alternately with every power-on cycle the signals OSTEST1 and OSTEST2 are set. Setting these signals a frequency above the normal overspeed frequency is injected in the overspeed governor. Because of this simulated overspeed condition the hardware is forced to cut off the fuel supply to cause the APU to rolldown. If the circuit fails (i.e. the APU is still on speed after 20 sec), the ECB prohibits any further APU start, even when the power has been removed from the ECB.

(m) Frequency Conditioner Tests

The squaring circuits of the ECB are tested as shown in .FIGURE 21.

(n) Driver Tests

The Fuel Solenoid Driver and the Flow Divider Solenoid Driver will be tested.

The ECB hardware provides discrete voltage wrap-around signals for both drivers. The voltage wrap-arounds signals must be low when the drivers are not energized. If they are high and the drivers are not energized, the drivers are failed.

The fuel solenoid is driven by a pulse width modulated signal. The average current of this signal must not exceed a certain range. The range is tested after the fuel solenoid has been energized at least for 3 seconds.

(2) Power Supply Test

The Power Supply Unit (PSU) (ref. FIGURE 9) is continuously tested.

The signal PSU_OK must always be high. Otherwise correct functioning of the PSU is not guaranteed.

The analog signal VRMON_T must be in the range 1.0 V to 3.0 V. Otherwise the different refernce voltages cannot be generated.

The signals LINE_ON and BATSW- must always have the same polarity, except during the time of 0.3 sec after a main power interrupt.

The signal L_INT2 must go to high at least 0.8 sec after a main power interrupt. This test is only performed during a main power interrupt (DC1_FAIL is high).

(3) Sensor Tests

The ECB tests all pressure sensors, all temperature sensors, the speed monopoles, the fuel flow sensor (resolver), the LVDT sensors and the correct position of the load control valve. The test principle for all sensors is similar. The sensor signals are compared with a lower and an upper limit. The limits are different for Power-Up Test (PUT) and In-Operation Test (IOT).

Open SPEED monoples can be detected. A pull-up is introduced in the monopole circuit and indicates via a discrete, if the monopole is open.

Open thermocouples and pressure sensors can be detected such that the signals fall out of range in case of a broken wire.

The IGV and SCV LVDT primary and secondary sides are tested by monitoring the voltage on the primary sides of the LVDTs to detect an open wire while monitoring via a pull-up circuit the secondary LVDT side for an open wire.

The resolver primary and secondary sides are tested by monitoring the voltage on the primary sides of the resolver to detect an open wire while monitoring via a pull-up circuit the secondary LVDT side for an open wire.

Additionally, the commanded position of the LVDTs and the resolver are compared with the actual positions. The correct position of the load control valve is tested similarly. Temperature and reverse flow tests are provided additionally.

(4) Switch Tests

(a) The switch tests are divided in four different groups (the flap switches are not considered by these tests):

1. switches which a have predefined position when the APU is not running
2. redundant switches which must have the same position
3. switches which signal a system malfunction
4. switches which cannot be tested because both switch positions have a meaning

(b) The following switches belong to the first group:

- load control valve open switch (tested during PUT)
- load control valve closed switch (tested during PUT)
- low oil pressure switch (tested during PUT)
- oil filter switch (tested during IOT and APU not running).

(c) The following switches belong to the second group:

- A/C pin coding 1 and 2 (tested during PUT)

(d) The following switches belong to the third group:

- low oil quantity switch (tested until inlet flap open) indicates low oil level
- low fuel pressure switch (tested during IOT) indicates low fuel pressure
- oil filter switch (tested during IOT and APU on speed) indicates oil filter clogged.

(e) The following switches belong to the fourth group:

- start switch
- stop switch (master switch)
- main engine start (MES) switch
- load control valve activate switch
- emergency switch
- air/ground switch
- TSO
- oil heater BITE enable switch
- low fuel pressure BITE enable switch
- MES starter valve switch
- SCV test switch.

(5) Motor Tests

The motor tests include the fuel torque motor test, the IGV torque motor test, the SCV torque motor test and the starter motor test.

(a) Fuel Torque Motor Test

The fuel torque motor test is performed during power up by energizing the torque motor with a specific command and comparing the wrap around signals with predefined limits. Additionally, the fuel torque motor is tested during IOT when the commanded torque motor current is within specified limits.

During PUT the fuel torque motor is tested by performing the following steps:

- Energize the fuel torque motor with 250 mA
- Wait 100 msec

- Compare the wrap-around signals according to FIGURE 22
- De-energize the fuel torque motor

During IOT the wrap-around signals are evaluated according to FIGURE 23.

(b) IGV Torque Motor Test

The IGV torque motor is tested for broken wire (open) and for short conditions during PUT (and SET) and IOT as shown by FIGURE 24.

(c) SCV Torque Motor Test

The SCV torque motor is tested for broken wire (open) and for short conditions during PUT (and SET) and IOT as shown by FIGURE 25.

(d) Starter Motor Test

- The starter motor test is performed during APU operation. After APU start, the voltage monitor signal is monitored in specific APU modes for failed position.
- The test conditions for the starter motor are shown by FIGURE 26.

(6) Test of Oil Heater

In flight when the APU is not running the APU oil is electrically heated. If the ECB is switched on in flight and the APU temperature is too low, an oil heater failure is indicated. The test is disabled if the time since the ECB was last switched off does not allow enough time to heat the oil. A discrete input flags whether an oil heater is installed. This flag also enables/disables the oil heater test.

(7) Load Tests

The start contactor test are shown by FIGURE 27. They are performed during PUT (and SET) and during IOT.

All other loads are tested for overcurrent (short) conditions and for open conditions (broken wire). If an overcurrent is detected for at most three times, the driver is deenergized. A broken wire conditions does not cause a driver to be deenegized.

(8) Inlet Flap Test

The wiring of the inlet flap actuator is shown by FIGURE 28. According to the figure, four different test groups are defined:

- Test of the flap position switches
- Test of the flap limit switches
- Test of the flap motor
- Overcurrent tests

Each end position of the flap has a position indication switch and a limit switch for the motor. The limit switches are monitored via the movement signal. The flap position is monitored using the signals FLAP_OPEN_SW and FLAP_CLOSE_SW.

The flap position switches are tested as follows:

- If the flap is being commanded to open, the signal FLAP_MOVEMENT has been seen but the flap open position switch does not indicate the flap being open, the flap open position switch is failed.
- If the flap is being commanded to close and the flap position is indicated being open and closed by the position switches, the flap open position switch is failed.
- If the flap is being commanded to close, the signal FLAP_MOVEMENT has been seen but the flap close position switch does not indicate the flap being closed, the flap close position switch is failed.
- If no flap command is energized and the flap position is indicated being open and closed by the position switches, the flap close position switch is failed.

The flap limit switches are tested as follows:

- If the flap is being commanded to open, the signal FLAP_MOVEMENT is active, the flap open position switch does not show open and the flap command wire is sensed open, then the flap open limit switch is failed open.
- If the flap is being commanded to open, the signal FLAP_MOVEMENT is active, and the flap open position switch shows open, then the flap open limit switch is failed short.
- If the flap is being commanded to close, the signal FLAP_MOVEMENT is active, the flap close position switch does not show closed and the flap command wire is sensed open, then the flap close limit switch is failed open.
- If the flap is being commanded to close, the signal FLAP_MOVEMENT is active and the flap close position switch shows closed, then the flap close limit switch is failed short.

The ECB monitors the correct operation of the actuator when opening and closing the inlet flap. The flap is command to move open or closed for always 30 seconds. If the position switches do not indicate the correct position of the flap after 29 seconds of the signal FLAP_MOVEMENT has not been seen within this time period, the actuator is indicated as failed.

Overcurrent conditions are sensed by the ECB on the flap command lines. Because of high inrush currents of the flap motor due to e.g. icing of the inlet flap, overcurrents are only reported by the ECB, if they are detected at least three times consecutively.

(9) Test of ARINC 429 Inputs

All received ARINC labels are checked by the ECB for:

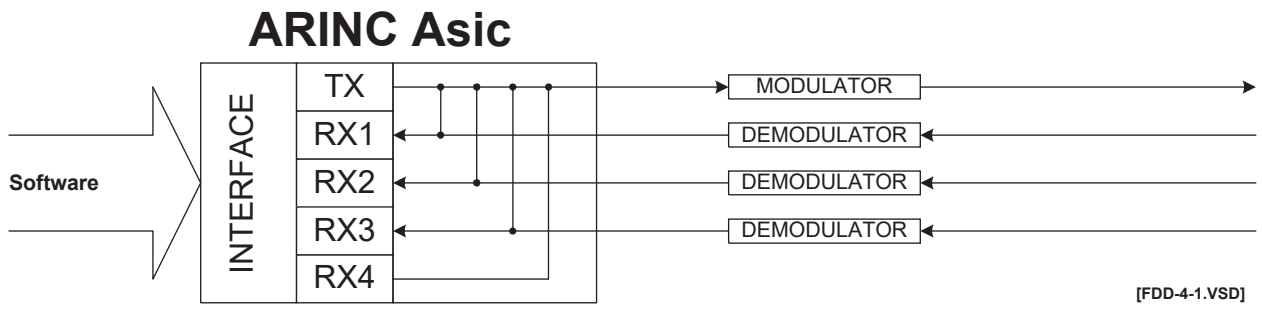
- correct parity (bit 32)
- correct refresh rate
- correct SSM coding

Generally, if the label fails for a short time the last data received is held, if the label is failed for more than 5 times the refresh rate of the label an alternative value is used. When the label is failed for 5 times the label refresh rate plus a consolidation time of 5

seconds when the label is from ECS Zone Controller or 60 seconds when the label is from the CFDIU the sending LRU is indicated as failed.

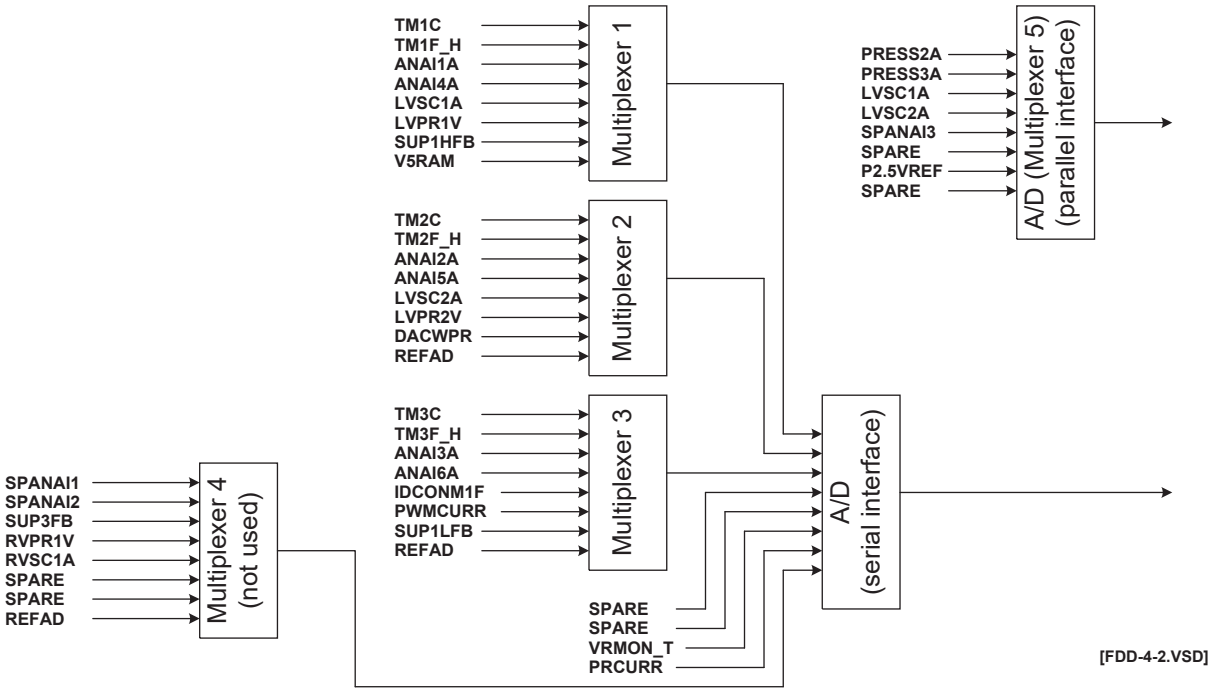
The data part of the labels from the ECS zone controller is monitored for its valid range. In case of a failure, default values will be used in the control loops.

If input labels from the CFDIU fail, then dashes will be used instead of the missed information like CMT, date etc. for fault storage and transmission. An incorrect receival of the BITE command word (label 227) leads to specific actions depending on the mode (normal and menu mode).

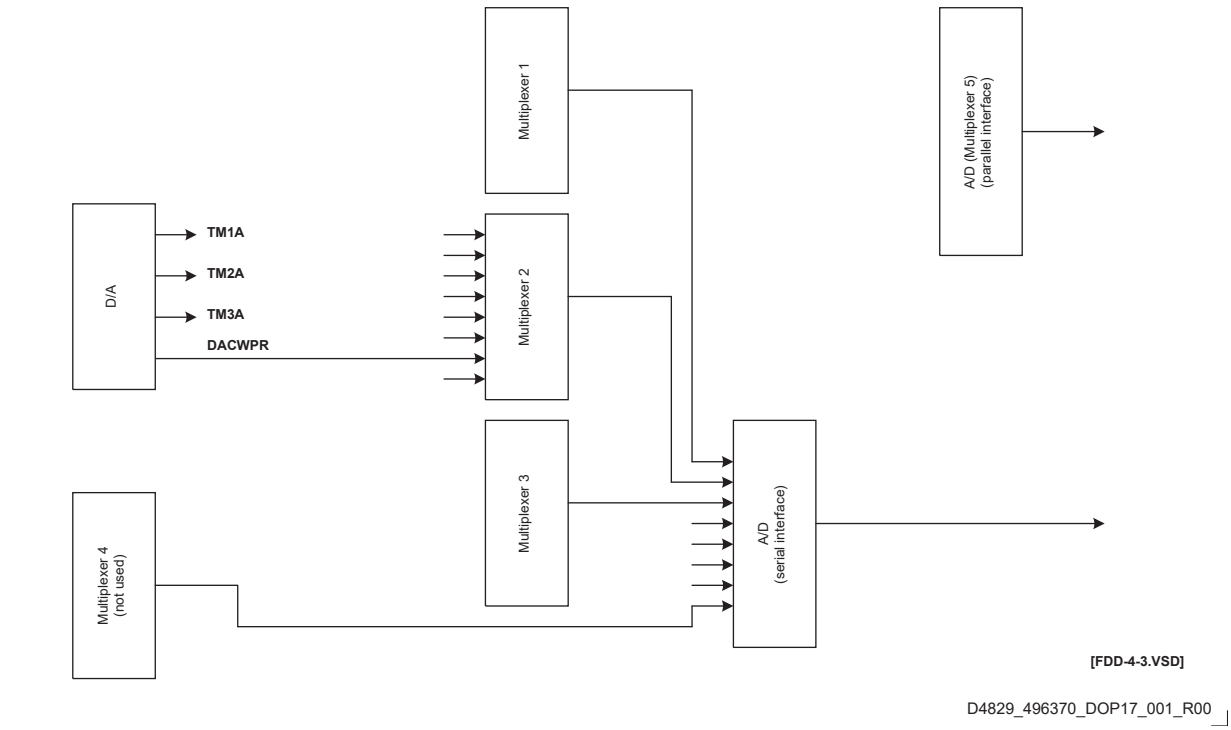


D4829_496370_DOP15_001_R00

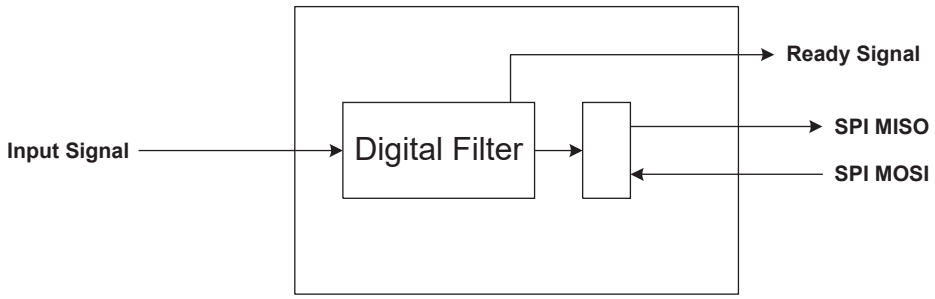
ARINC LOOP BACK TEST
FIGURE 15



WIRING OF MUXS AND ADC
FIGURE 16

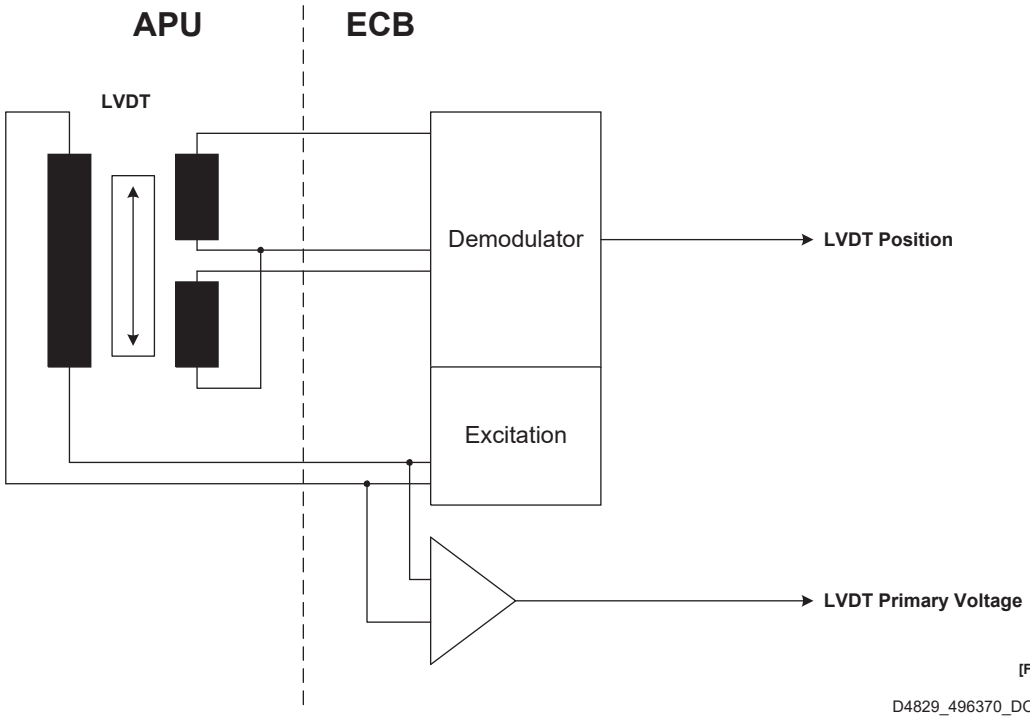


WIRING OF DAC AND ADC
FIGURE 17



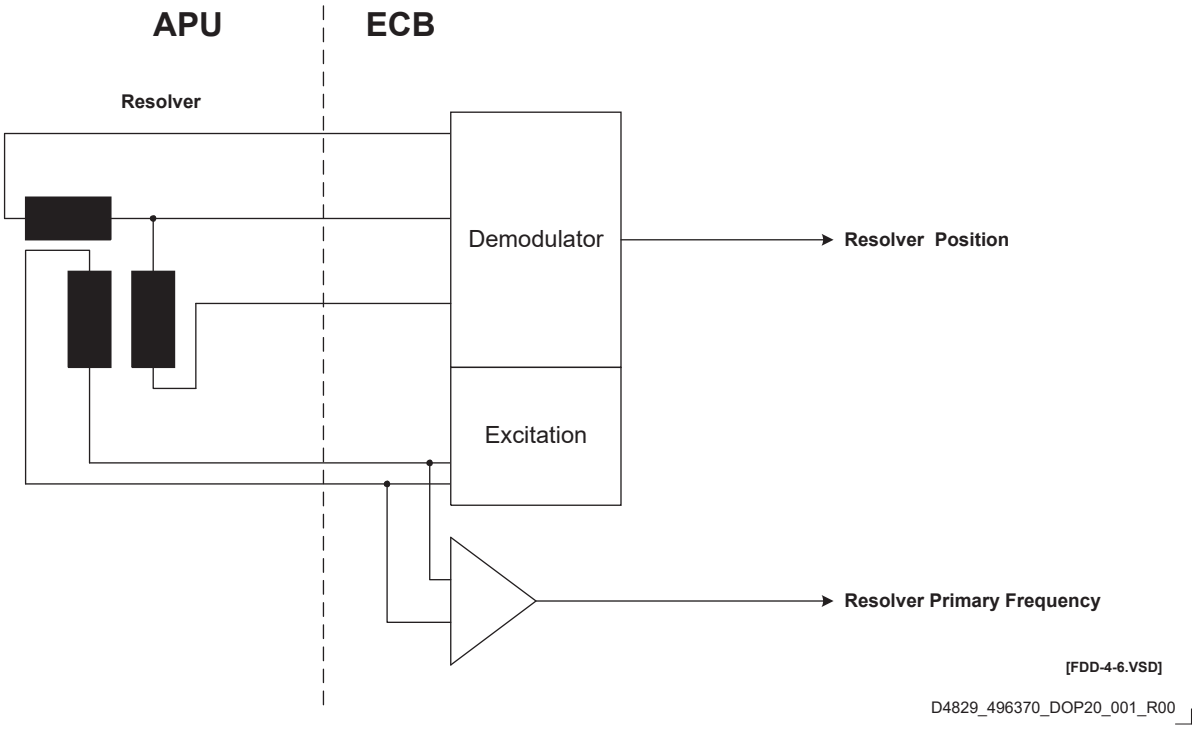
D4829_496370_DOP18_001_R00

WIRING FOR CONDITIONER TESTS
FIGURE 18



D4829_496370_DOP19_001_R00

WIRING FOR LVDT EXCITER TESTS
FIGURE 19



WIRING FOR RESOLVER EXCITATION TEST
FIGURE 20

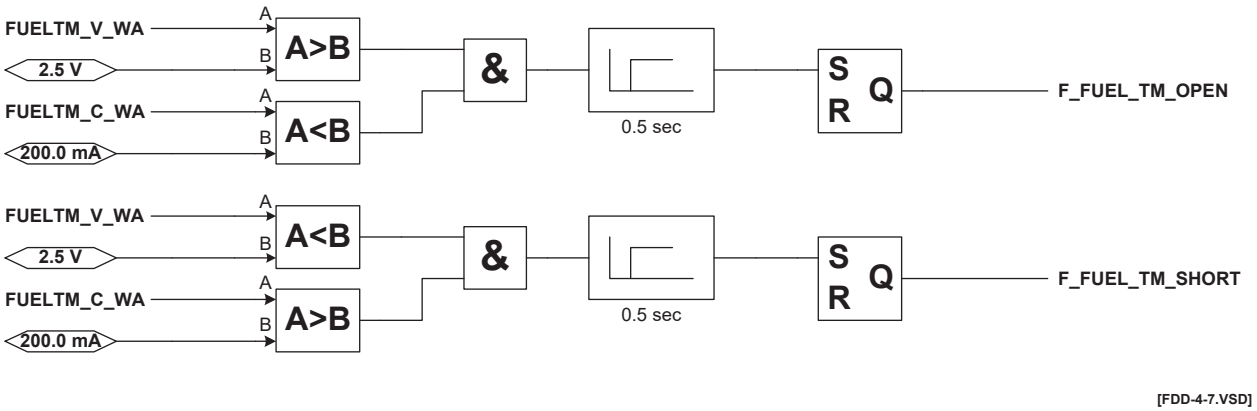
```
if (MAX(SPEED11,SPEED12,SPEED21,SPEED22) > 30 %)
then
  if not LOSS_OF_SPEED1
  then
    if (ABS (SPEED11-SPEED12) > = 3 %)
       and
       (ABS (SPEED11-SPEED21) > = 3 %) for 200 msec
    then
      set F_SQ_CRC1 /* high threshold for speed
      monopole 1 failed*/
      set LOSS_OF_SPEED1
    end if
  end if
  if not (LOSS_OF_SPEED1)
  then
    if (ABS (SPEED12-SPEED11) > = 3 %)
       and
       (ABS (SPEED12-SPEED22) > = 3 %) for 200 msec
    then
      set F_SQ_CRC3 /*low threshold for speed
      monopole 1 failed*/
      set LOSS_OF_SPEED1
    end if
  end if

  if not (LOSS_OF_SPEED2)
  then
    if (ABS (SPEED21-SPEED22) > = 3 %)
       and
       (ABS (SPEED21-SPEED11) > = 3 %) for 200 msec
    then
      set F_SQ_CRC2 /*high threshold for speed
      monopole 2 failed*/
      set LOSS_OF_SPEED2
    end if
  end if

  if not (LOSS_OF_SPEED2)
  then
    if (ABS (SPEED22-SPEED21) > = 3 %)
       and
       (ABS (SPEED22-SPEED12) > = 3 %) for 200 msec
    then
      set F_SQ_CRC4 /*low threshold for speed
      monopole 2 failed*/
      set LOSS_OF_SPEED2
    end if
  end if
end if
```

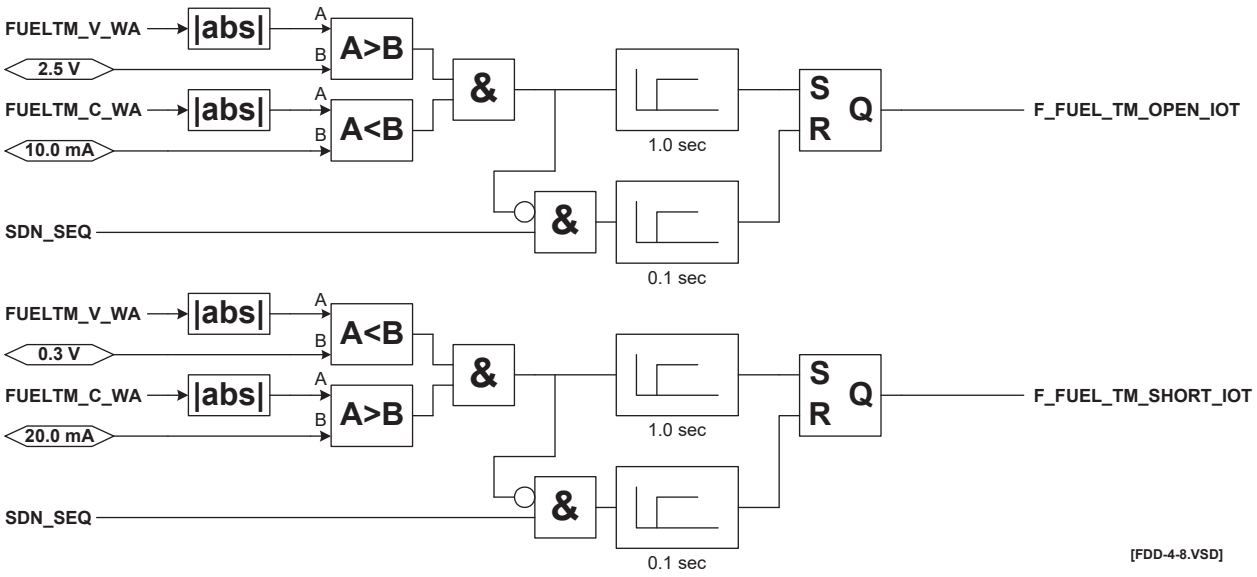
D4829_496370_DOP21_001_R00

FREQUENCY CONDITIONER TESTS
FIGURE 21



D4829_496370_DOP22_001_R00

LOGIC FOR FUEL TORQUE MOTOR TEST DURING PUT
FIGURE 22



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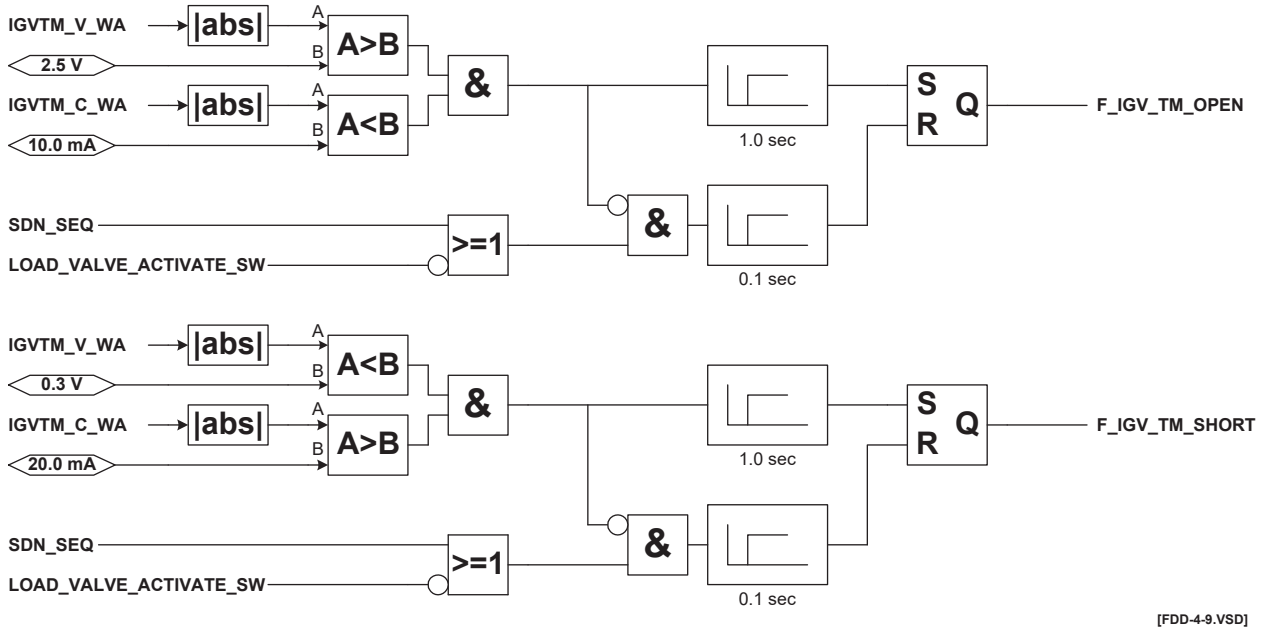
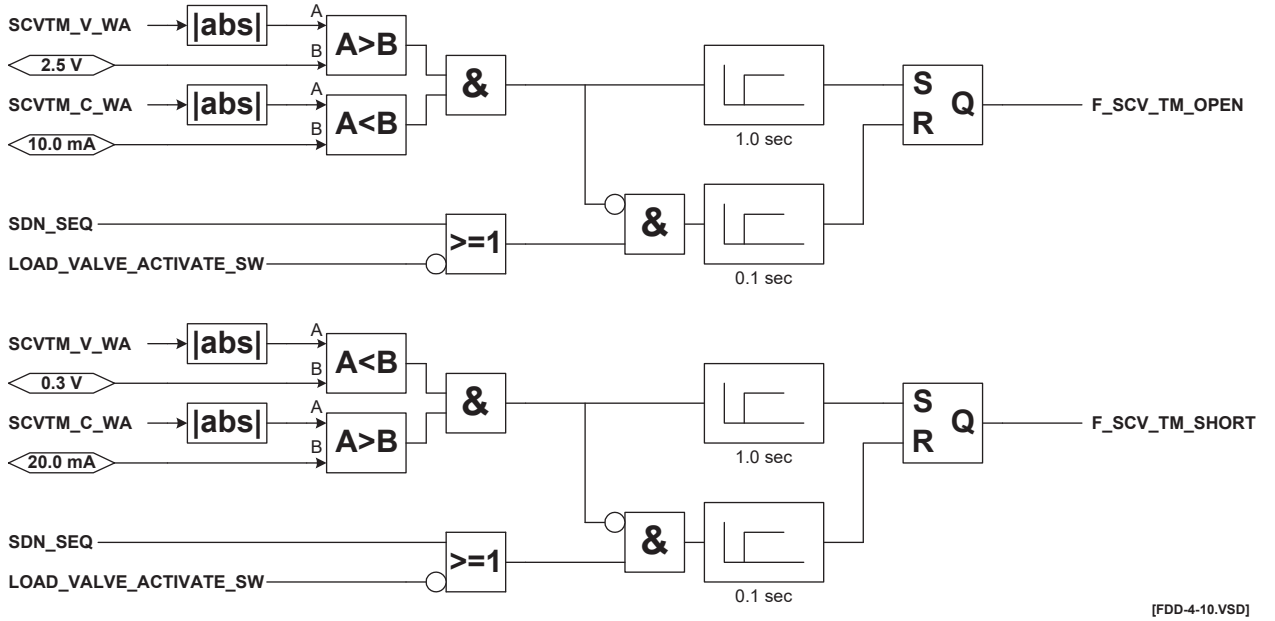
LOGIC FOR FUEL TORQUE MOTOR TEST DURING IOT
FIGURE 23



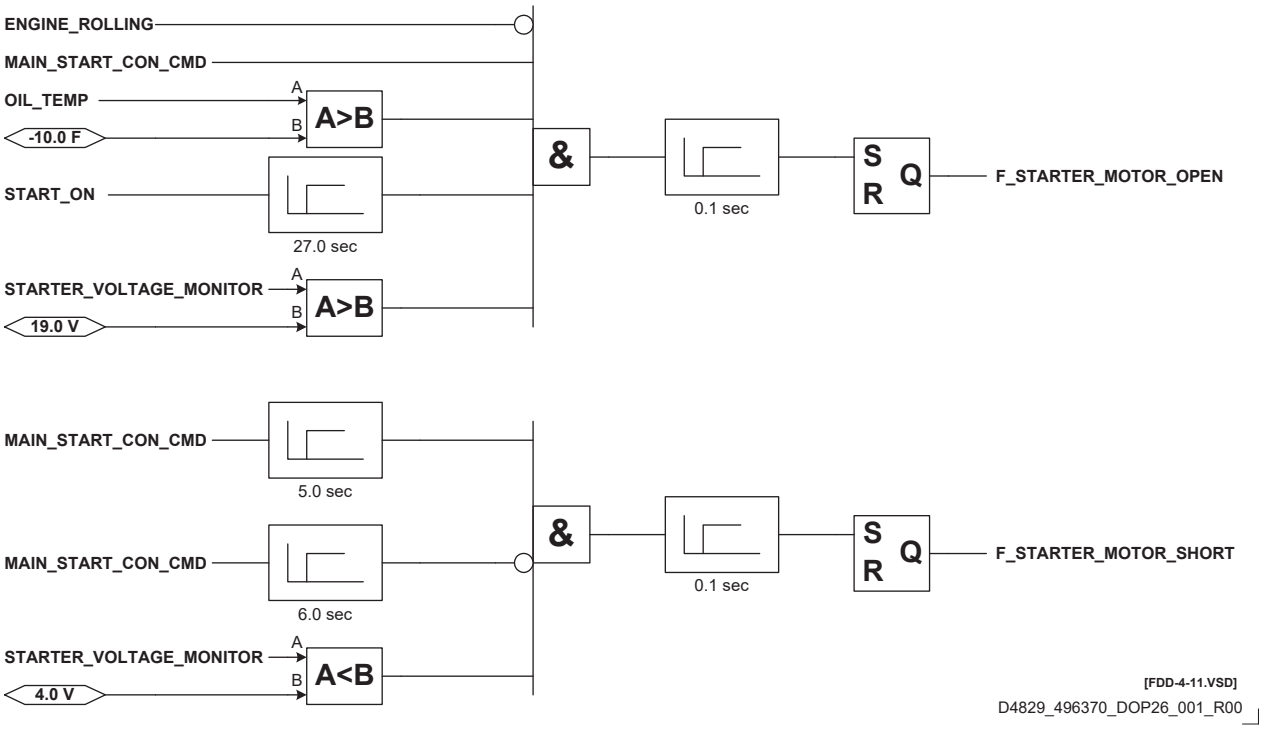
D4829_496370_DOP24_001_R00

LOGIC FOR IGV TORQUE MOTOR TEST
FIGURE 24

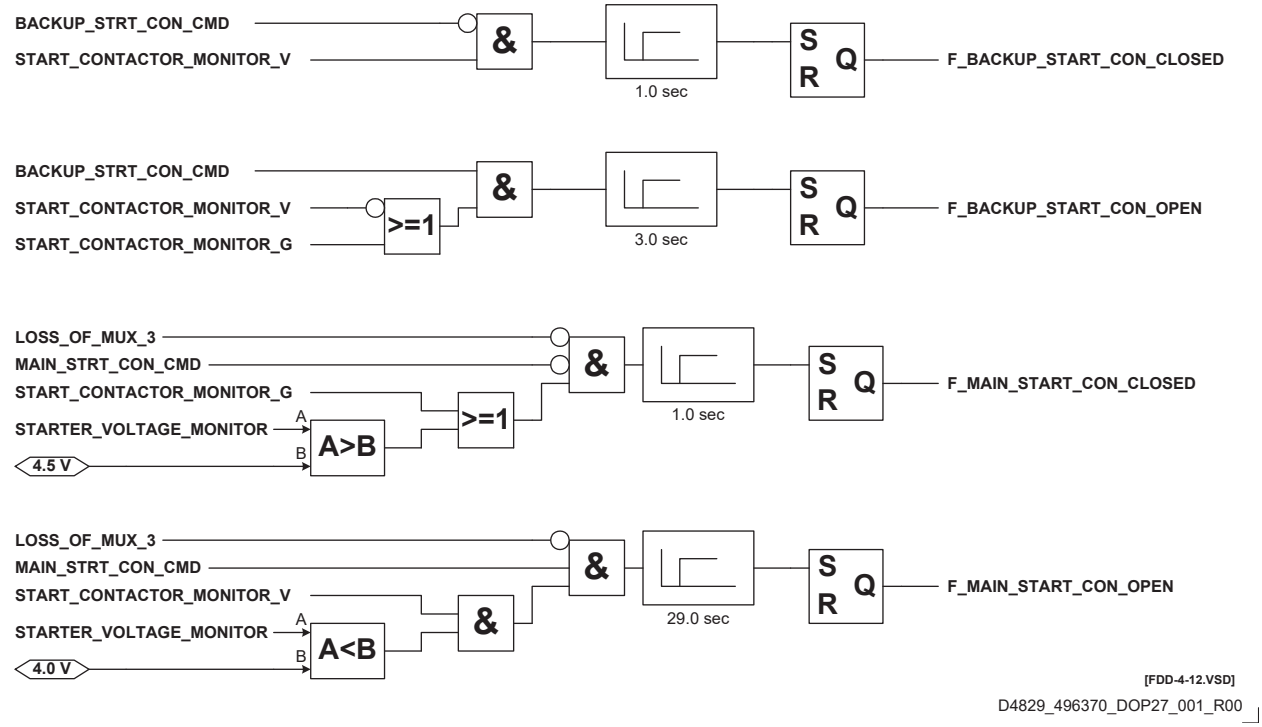


D4829_496370_DOP25_001_R00

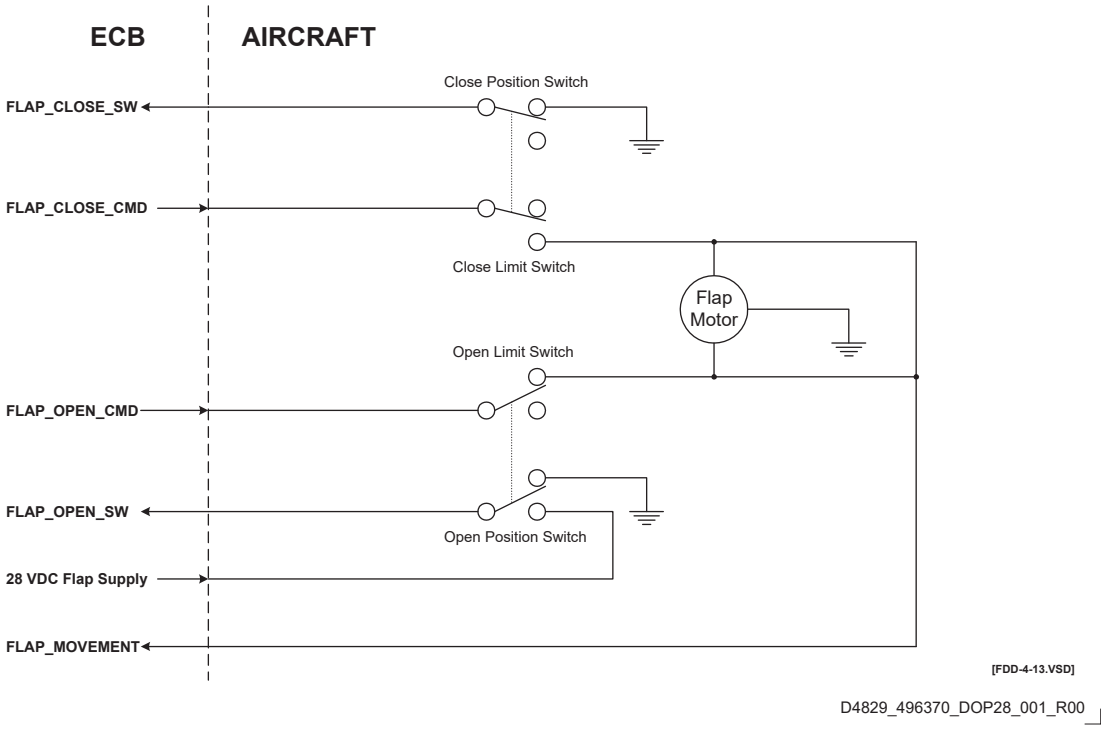
LOGIC FOR SCV TORQUE MOTOR TEST
FIGURE 25



LOGIC FOR STARTER MOTOR TEST
FIGURE 26



LOGIC FOR START CONTACTER TESTS
FIGURE 27



WIRING OF FLAP ACTUATOR
FIGURE 28

C. Built-In Test Coverage

TABLE 21 through TABLE 26 list the line replaceable units (LRUs) of the APU system together with the built-in test which covers the LRU. The built-in test is divided into Power-Up Test (PUT), Selftest (SET) and In-Operation Test (IOT). An 'X' indicates that the specific test is performed.

Item	ECB Hardware Elements	Built-in Test		
		PUT	SET	IOT
1	CPU and Internal Data Bus	covered by item 2		
2	RAM	X		
3	EPROM	X		
4	EEPROM	X	X	X
5	ECB Configuration	X		
6	ARINC Circuits	X		
7	Watchdog (Keep alive) Circuit	X		
8	Analog to Digital Conversion	X	X	X
9	Digital to Analog Conversion	X	X	X

BIT COVERAGE OF ECB HARDWARE ELEMENTS
TABLE 21 (continued on next page)

Item	ECB Hardware Elements	Built-in Test		
		PUT	SET	IOT
10	Analog Input Conditioners	X	X	X
11	Cold Junction Temperature	X	X	X
12	Pressure Sensor Supply	X	X	X
13	LVDT and Resolver Excitation	X	X	X
14	Overspeed Governor (References)	X	X	X
15	Overspeed Governor (Overspeed Protection)			X
16	Frequency Input Conditioners			X
17	Power Supply Unit	X	X	X
18	A/C Relay Driver	covered by resp. load test		
19	Start Contactor Driver (main and backup)	covered by resp. load test		
20	APU Available Driver	covered by resp. load test		
21	Start In Progress Driver	covered by resp. load test		
22	Fault Signal Driver	covered by resp. load test		
23	Load Valve Position Signal Driver	covered by resp. load test		
24	Low Fuel Pressure Valve Driver	covered by resp. load test		
25	De-oil Soelnoid Driver	covered by resp. load test		
26	Ignition Unit Driver	covered by resp. load test		
27	Fuel Solenoid Driver	X	X	X
28	Load Valve Solenoid Driver	covered by resp. load test		
29	Flow Divider Solenoid Driver	X	X	X
30	Flap Open Command Driver	covered by resp. load test		
31	Flap Close Command Driver	covered by resp. load test		
32	Fuel Torque Motor Driver	covered by motor test		
33	IGV Torque Motor Driver	covered by motor test		
34	SCV Torque Motor Driver	covered by motor test		

BIT COVERAGE OF ECB HARDWARE ELEMENTS
TABLE 21

Item	Sensors	Built-in Test		
		PUT	SET	IOT
1	Delta Pressure	X	X	X

BIT COVERAGE OF SENSORS
TABLE 22 (continued on next page)

Item	Sensors	Built-in Test		
		PUT	SET	IOT
2	Inlet (Ambient) Pressure	X	X	X
3	Total Pressure	X	X	X
4	Turbine Exhaust Gas Temperature (T5) (Sensor 1)	X	X	X
5	Turbine Exhaust Gas Temperature (T5) (Sensor 2)	X	X	X
6	Turbine Inlet Temperature (T4)	X	X	X
7	Fuel Temperature	X	X	X
8	APU Sump Oil Temperature	X	X	X
9	Speed Monopole 1	X	X	X
10	Speed Monopole 2	X	X	X
11	Fuel Flow (open wire and position)	X	X	X
12	IGV LVDT Sensor (open wire and position)	X	X	X
13	SCV LVDT Sensor (open wire and position)	X	X	X
14	Load Control Valve Position			X

BIT COVERAGE OF SENSORS
TABLE 22

Item	Switches	Built-in Test		
		PUT	SET	IOT
1	APU Stop (Master Switch)			
2	Air/Ground Switch			
3	Emergency Switch			
4	Aircraft Identification	X	X	
8	Load Control Valve Activation			
9	Low Oil Pressure Switch	X	X	
10	Low Fuel Pressure Switch			
11	Low Oil Quantity Switch			
12	Low Fuel Pressure Valve BITE Enable			
13	Load Control Valve Open Switch	X	X	
14	Load Control Valve Closed Switch	X	X	

BIT COVERAGE OF SWITCHES
TABLE 23 (continued on next page)

Item	Switches	Built-in Test		
		PUT	SET	IOT
15	Oil Heater BITE Enable			
16	TSO			
17	Oil Filter Clogged Switch			X
18	Start Command			
19	MES Mode			
20	SCV Test Switch			
21	MES Starter Valve Switch			
22	Flap Open Switch (position and limit)	X	X	X
23	Flap Closed Switch (position and limit)	X	X	X
24	External Reset			

BIT COVERAGE OF SWITCHES
TABLE 23

Item	Actuators/Indicators	Built-in Test		
		PUT	SET	IOT
1	Fuel Torque Motor	X	X	X
2	IGV Torque Motor	X	X	X
3	SCV Torque Motor	X	X	X
4	Starter Motor	X	X	X
5	A/C Relay	X	X	X
6	Start Contactor (Main and Backup)	X	X	X
7	APU Available	X	X	X
8	Start in Progress	X	X	X
9	Fault Signal	X	X	X
10	Load Control Valve Open Signal	X	X	X
11	Low Fuel Pressure Valve Command	X	X	X
12	De-oil Solenoid	X	X	X
13	Ignition Unit	X	X	X
14	Fuel Solenoid	X	X	X
15	Load Control Valve Solenoid	X	X	X
16	Flow Divider Solenoid	X	X	X

BIT COVERAGE OF ACTUATORS/INDICATORS
TABLE 24 (continued on next page)

Item	Actuators/Indicators	Built-in Test PUT	SET	IOT
17	Flap Open Actuator			X
18	Flap Close Actuator			X

BIT COVERAGE OF ACTUATORS/INDICATORS
TABLE 24

Item	ARINC Transmitters	Built-in Test PUT	SET	IOT
1	Centralized Fault Display System			X
2	ECS Zone Controller			X

BIT COVERAGE OF ARINC TRANSMITTERS IN ACFT
TABLE 25

Item	Miscellaneous	Built-in Test PUT	SET	IOT
1	Oil Level Low			X
2	Oil Pressure Low			X
3	Fuel Pressure Low			X
4	Oil Heater			X
5	ECB Main Power Supply			X
6	Data Memory Module	X		X
7	Oil Filter Clogged			X

BIT COVERAGE OF MISCELLANEOUS LRUS
TABLE 26

D. Trouble Shooting

All MCDU menus which display fault information allow access to trouble shooting data. These data are displayed in simple English.

If more trouble shooting information must be obtained, the fault memory of the ECB can be accessed using the MICBAC monitor. The fault information is stored as shown by TABLE 17 through TABLE 20. The Fault Zones 1&2, 3, 4, and 5 (containing LRU faults) store the trouble shooting information in seven 16-bit words. The Fault Zone 6 (containing shutdowns) stores the trouble shooting information in fourteen 16-bit words. The contents of the trouble shooting words is explained below.

(1) Trouble shooting words for LRU faults (see FIGURE 29).

(2) Trouble shooting words for Shutdowns (see FIGURE 30).

NOTE: The words WRD8 to WR14 are related to the LRU possibly causing the shutdown. All entries in WRD8 to WR14 are stored at the occurrence of the LRU.

(3) LRU Faults

TABLE 27 defines all LRU fault code numbers (identical with BIT fault code numbers) together with the fault class and the fault reason ("x" stands for "L" in case of a LRU fault and for "F" in case fo a BIT fault). If further details are required, refer to the Software Requirement Document.

Coding		Class	Failure Flag	Reason
dec.	hex.			
1	01	1	x_SPEED1_AND_SPEED2	both speed monopoles
2	02	1	x_SPEED1_AND_ECB_SPEED2	speed 1 and squaring circuit 2
3	03	1	x_SPEED2_AND_ECB_SPEED1	speed 2 and squaring circuit 1
4	04	1	x_SQ_CRC_1_AND_SQ_CRC_2	both high threshold circuits
5	05	1	x_SQ_CRC_3_AND_SQ_CRC_4	both low threshold circuits
6	06		not used	
7	07	3	x_SPEED1_OPEN	speed monopole 1 open wire
8	08	3	x_SPEED2_OPEN	speed monopole 2 open wire
9	09	3	x_SPEED1_XCHECK	speed monopole 1 amplitude failure
10	0A	3	x_SPEED2_XCHECK	speed monopole 2 amplitude failure
11	0B	3	x__SQ_CRC_1	squaring circuit speed 1 high threshold
12	0C	3	x__SQ_CRC_2	squaring circuit speed 2 high threshold
13	0D	3	x__SQ_CRC_3	squaring circuit speed 1 low threshold
14	0E	3	x__SQ_CRC_4	squaring circuit speed 2 low threshold
15	0F	1	x_DP_COND	delta pressure conditioner
16	10	1	x_DP_TEST	delta pressure outside range
17	11	1	x_DP_BLEED_LOW	delta pressure < 1.0 psi during bleed
18	12	1	x_DP_RUN_LO	delta pressure < -2.0 psi
19	13	1	x_DP_RUN_HIGH	delta pressure > 28.0 psi
20	14	2	x_P2_COND	ambient pressure conditioner
21	15	2	x_P2_TEST	ambient pressure outside range
22	16	2	x_P2_GROUND	ambient pressure < 8.0 psi on ground
23	17	2	x_P2_LOW	ambient pressure < 1.0 psi

LRU FAULTS
TABLE 27 (continued on next page)

Coding dec.	Coding hex.	Class	Failure Flag	Reason
24	18	2	x_P2_HIGH	ambient pressure > 18.0 psi
25	19	1	x_PT_COND	total pressure conditioner
26	1A	1	x_PT_TEST	total pressure outside range
27	1B	1	x_PT_VS_P2	offset of total pressure >4.0 psi/<-4.0 psi
28	1C	1	x_PT_RUN_LO	total pressure < 1.0 psi
29	1D	1	x_PT_RUN_HIGH	total pressure > 80.0 psi
30	1E	1	x_PSENREF_OPEN	pressure sensor supply open wire
31	1F	1	x_PSENREF_LOW	pressure sensor supply < 9.8 V
32	20	1	x_PSENREF	pressure sensor supply > 10.2 V
33	21		not used	
34	22		not used	
35	23	1	x_EGT1_AND_EGT2	both EGT sensors
36	24	1	x_EGT1_AND_ECB_COND2	EGT sensor 1 and EGT 2 conditioner
37	25	1	x_EGT2_AND_ECB_COND1	EGT sensor 2 and EGT 1 conditioner
38	26	1	x_EGT1_ECB_A_EGT2_ECB	both EGT conditioners
39	27		not used	
40	28	3	x_EGT1_COND	EGT 1 conditioner
41	29		not used	
42	2A	3	x_EGT1_LOW	EGT 1 sensor < -100.0 °F
43	2B	3	x_EGT1_DIFF	EGT 1 < (EGT 2 - 150.0 °F)
44	2C	3	x_EGT2_COND	EGT 2 conditioner
45	2D		not used	
46	2E	3	x_EGT2_LOW	EGT 2 sensor < -100.0 °F
47	2F	3	x_EGT2_DIFF	EGT 2 < (EGT 1 - 150.0 °F)
48	30		not used	
49	31		not used	
50	32	2	x_FUEL_TEMP_COND	fuel temperature conditioner
51	33	2	x_FUEL_TEMP_LOW	fuel temperature < -100.0 °F
52	34	2	x_FUEL_TEMP_HIGH	fuel temperature > 482.0 °F(PUT)
53	35	2	x_OIL_TEMP_COND	APU sump oil temperature conditioner

LRU FAULTS
TABLE 27 (continued on next page)

Coding dec.	Coding hex.	Class	Failure Flag	Reason
54	36	2	x_OIL_TEMP_LOW	APU sump oil temperature < -100.0 °F
55	37	2	x_OIL_TEMP_HIGH	APU sump oil temperature > 482.0 °F
56	38	3	x_T2_COND	inlet temperature conditioner
57	39	3	x_T2_LOW	inlet temperature < -100.0 °F
58	3A	3	x_T2_HIGH	inlet temperature > 482.0 °F
59	3B		not used	
60	3C	3	x_FLAP_OPEN_SW_CLOSED	flap open switch open but flap closed
61	3D	3	x_FLAP_OPEN_SW_OPEN	flap open switch open wire
62	3E	3	x_FLAP_CLOSE_SW_CLOSED	flap close switch closed but flap open
63	3F	3	x_FLAP_CLOSE_SW_OPEN	flap close switch open wire
64	40	2	x_FLAP_CLOSE_CR_OPEN	flap close limit switch open wire
65	41	2	x_FLAP_CLOSE_CR_SHORT	flap close limit switch short circuit
66	42	2	x_FLAP_OPEN_CR_OPEN	flap open limit switch open wire
67	43	2	x_FLAP_OPEN_CR_SHORT	flap open limit switch short circuit
68	44	1	x_FLAP_OPEN_OC	flap open command overcurrent
69	45	2	x_FLAP_CLOSE_OC	flap close command overcurrent
70	46	1	x_FLAP_OPEN	flap did not open
71	47	1	x_FLAP_NOT_OPEN	flap shows closed during APU run
72	48	2	x_FLAP_CLOSE	flap did not close
73	49		not used	
74	4A		not used	
75	4B	2	x_RESOLVER_EXC	resolver excitation incorrect
76	4C	2	x_FUEL_RESOLVER_PRI	resolver primary wire open
77	4D	2	x_FUEL_RESOLVER_SEC	resolver secondary wire open
78	4E	2	x_WF_POSITION	resolver position incorrect
79	4F	1	x_FUELFLOW_VS_CMD	fuel flow disagrees with command
80	50	2	x_IGV_LVDT_EXC	IGV LVDT excitation incorrect
81	51	2	x_IGV_LVDT_PRI	IGV LVDT primary open wire
82	52	2	x_IGV_LVDT_SEC	IGV LVDT secondary open wire
83	53	1	x_IGVPOS_VS_CMD	IGV position disagrees with command
84	54	1	x_SCV_LVDT_EXC	SCV LVDT excitation incorrect

LRU FAULTS
TABLE 27 (continued on next page)

Coding dec.	Coding hex.	Class	Failure Flag	Reason
85	55	1	x_SCV_LVDT_PRI	SCV LVDT primary open wire
86	56	1	x_SCV_LVDT_SEC	SCV LVDT secondary open wire
87	57	1	x_SCVPOS_VS_CMD	SCV position disagrees with command
88	58	2	x_LCV_POSITION	load control valve shows not open
89	59	1	x_REV_FLO_SHUT_OFF	bleed off due to reverse flow
90	5A	1	x_BLEED_OFF_T4	bleed off due to high temperature
91	5B	1	x_BLEED_RV_FLO	bleed off due to reverse flow
92	5C	2	LCV_NOT_CLOSED	load valve position shows not closed
93	5D	2	LCV_SW_MISMATCH	mismatch of load valve open/closed switches
94	5E		not used	
95	5F	3	x_AC_PIN_CODING	A/C pin coding shows different levels
96	60	2	x_LCV_OPN_SW	load control valve open switch
97	61	2	x_LCV_CLS_SW	load control valve closed switch
98	62	2	x_LOP_SW	low oil pressure switch open wire
99	63		not used	
100	64	2	x_LOW_FUEL_PRESSURE	low fuel pressure
101	65	3	x_OIL_FILTER_SW	oil filter switch shows electrical ground
102	66	1	x_OIL_FILTER_CLOGGED	oil filter clogged
103	67		not used	
104	68		not used	
105	69	1	x_FUEL_TM_OPEN	fuel torque motor open wire
106	6A	1	x_FUEL_TM_OPEN_IOT	fuel torque motor open wire
107	6B	1	x_FUEL_TM_SHORT	fuel torque motor short circuit
108	6C	1	x_FUEL_TM_SHORT_IOT	fuel torque motor short circuit
109	6D	1	x_IGV_TM_OPEN	IGV torque motor open wire
110	6E	1	x_IGV_TM_SHORT	IGV torque motor short circuit
111	6F	1	x_SCV_TM_OPEN	SCV torque motor open wire
112	70	1	x_SCV_TM_SHORT	SCV torque motor short circuit
113	71	1	x_STARTER_MOTOR_OPEN	starter motor open wire
114	72	1	x_STARTER_MOTOR_SHORT	starter motor short circuit
115	73	2	x_OIL_HEATER	oil heater failure

LRU FAULTS
TABLE 27 (continued on next page)

Coding dec.	Coding hex.	Class	Failure Flag	Reason
116	74		not used	
117	75		not used	
118	76		not used	
119	77		not used	
120	78	1	x_BACKUP_START_CON_OPEN	backup start contactor open circuit
121	79	3	x_BACKUP_START_CON_CLOSED	backup start contactor circuit closed
122	7A		not used	
123	7B	1	x_MAIN_START_CON_OPEN	main start contactor open circuit
124	7C	3	x_MAIN_START_CON_CLOSED	main start contactor circuit closed
125	7D	1	x_FUEL_SOL	fuel solenoid circuit failure
126	7E	1	x_FLOW_DIV_SOL	flow divider solenoid circuit failure
127	7F	1	x_LCV_SOL	load control valve solenoid circuit failure
128	80	1	x_IGNITION_UNIT_OPEN	ignition unit open circuit
129	81		x_APU_AVAILABLE_OPEN	APU available open circuit
130	82	2	x_APU_AVAILABLE_SHORT	APU available circuit failure
131	83		x_BACKUP_STRT_LOAD_OPEN	backup start contactor load open circuit
132	84		x_BACKUP_STRT_LOAD_SHORT	backup start contactor load circuit failed
133	85	1	x_DEOIL_SOL_OPEN	de-oil solenoid open circuit
134	86	1	x_DEOIL_SOL_SHORT	de-oil solenoid circuit failure
135	87		x_FAULT_RELAY_OPEN	fault relay open circuit
136	88	2	x_FAULT_RELAY_SHORT	fault relay circuit failure
137	89		x_LCV_POS_CR_OPEN	load control valve position open circuit
138	8A	2	x_LCV_POS_CR_SHORT	load control valve position circuit failed
139	8B	2	x_LOW_FUEL_PRESS_RELAY_OPEN	low fuel pressure relais open circuit
140	8C	2	x_LOW_FUEL_PRESS_RELAY_SHORT	low fuel pressure relais circuit failure
141	8D		x_MAIN_STRT_LOAD_OPEN	main start contactor load open circuit
142	8E		x_MAIN_STRT_LOAD_SHORT	main start contactor load circuit failed
143	8F		x_START_IN_PROGRESS_OPEN	start in progress signal open circuit
144	90	2	x_START_IN_PROGRESS_SHORT	start in progress signal circuit failure
145	91		x_AC_RELAY	A/C relay circuit failure

LRU FAULTS
TABLE 27 (continued on next page)

Coding dec.	Coding hex.	Class	Failure Flag	Reason
146	92	1	x_IGNITION_UNIT_SHORT	ignition unit short circuit
147	93	1	x_MUX_5	multiplexer 5 failed
148	94		not used	
149	95		not used	
150	96	3	x_ECS_DEMAND	no ECS demand from Zone Controller
151	97	3	x_PACK_DATA	no pack data from Zone Controller
152	98	3	x_CFDS_UPDATE	no BITE command word from CFDIU
153	99	3	x_FLIGHT_PHASE	no flight phase from CFDIU
154	9A	3	x_AC_CONFIG	no A/C configuration from CFDIU
155	9B	3	x_DATE	no date from CFDIU
156	9C	3	x_UTC	no time from CFDIU
157	9D	3	x_AC_ID_301	no A/C ident part 1 from CFDIU
158	9E	3	x_AC_ID_302	no A/C ident part 2 from CFDIU
159	9F	3	x_AC_ID_303	no A/C ident part 3 from CFDIU
160	A0		not used	
161	A1		not used	
162	A2		not used	
163	A3		not used	
164	A4		not used	
165	A5		not used	
166	A6		not used	
167	A7		not used	
168	A8		not used	
169	A9		not used	
170	AA	1	x_MUX_1	multiplexer 1 failed
171	AB	1	x_MUX_2	multiplexer 2 failed
172	AC	1	x_MUX_3	multiplexer 3 failed
173	AD	1	x_DAC	D/A converter failed
174	AE	3	x_TEMP_COND	cold junction temperature conditioner
175	AF	3	x_TEMP	cold junction
176	B0	1	x_REF	reference for overspeed governor

LRU FAULTS
TABLE 27 (continued on next page)

Coding dec.	Coding hex.	Class	Failure Flag	Reason
177	B1	1	x_OVERSPD_DETECTION	overspeed governor failure
178	B2	1	x_OSID	wrong overspeed identification
179	B3	1	x_PSU	PSU failure
180	B4	1	x_PSU_MON	PSU refernce voltage outside range
181	B5	2	x_SEC_POWER_SW	power supply switch failed
182	B6	2	x_INTERRUPT_COUNT	interrupt counter failed
183	B7	2	x_POWER_BUS	main power supply interrupt
184	B8	2	x_FUEL_SOL_PWM	pulse width modulation failed
185	B9	1	x_FUEL_SOL_DRIVER	fuel solenoid driver failed
186	BA	1	x_FLOW_DIV_SOL_DRIVER	flow divider solenoid driver failed
187	BB		not used	
188	BC		not used	
189	BD		not used	
190	BE		not used	
191	BF		not used	
192	C0		not used	
193	C1		not used	
194	C2		not used	
195	C3		not used	
196	C4		not used	
197	C5		not used	
198	C6		not used	
199	C7		not used	
200	C8		not used	
201	C9	1	x_SD_OVERSPEED	shutdown no LRU fault detected
202	CA	1	x_SD_TRUE_EMERGENCY	shutdown no LRU fault detected
203	CB	1	x_SD_ECB1A	shutdown no LRU fault detected
204	CC	1	x_SD_UNDERSPEED	shutdown no LRU fault detected
205	CD	1	x_SD_OVRTMP_ONSPD	shutdown no LRU fault detected
206	CE	1	x_SD_OVRTMP_START	shutdown no LRU fault detected
207	CF	1	x_SD_SENSOR_FAIL	shutdown no LRU fault detected

LRU FAULTS
TABLE 27 (continued on next page)

Coding dec.	Coding hex.	Class	Failure Flag	Reason
208	D0	1	x_SD_LOP	shutdown no LRU fault detected
209	D1	1	x_SD_NO_FLAME	shutdown no LRU fault detected
210	D2	1	x_SD_FLAP_NOT_OPEN	shutdown no LRU fault detected
211	D3	1	x_SD_HOT	shutdown no LRU fault detected
212	D4	1	x_SD_NO_SPEED	shutdown no LRU fault detected
213	D5	1	x_SD_INLET_OVERHEAT	shutdown no LRU fault detected
214	D6	1	x_SD_LOSS_OF_SPEED	shutdown no LRU fault detected
215	D7	1	x_SD_NO_ACCELERATION	shutdown no LRU fault detected
216	D8	1	x_SD_REVERSE_FLOW	shutdown no LRU fault detected
217	D9	1	x_SD_CLOGGED_OIL_FILTER	shutdown no LRU fault detected
218	DA	1	x_SD_MAIN_POWER_INTERRUPT	shutdown no LRU fault detected
219	DB		not used	
220	DC		not used	
221	DD		not used	
222	DE		not used	
223	DF		not used	
224	E0		not used	
225	E1		not used	
226	E2		not used	
227	E3		not used	
228	E4		not used	
229	E5		not used	
230	E6	1	x_OS	overspeed governor failed
231	E7	3	x_OS_1	overspeed governor channel 1
232	E8	3	x_OS_2	overspeed governor channel 2
233	E9	2	x_ARINC_CPUA	ARINC circuit failed
234	EA	3	x_EEPROM_IO	calibration EEPROM failed
235	EB	3	x_EEPROM_CPUA	EEPROM contents corrupted
236	EC	2	x_FAULT_MEMORY	fault memory corrupted
237	ED	3	x_APU_PRI_DATA	DMM backup corrupted
238	EE	3	x_APU_SEC_DATA	DMM secondary storage corrupted

LRU FAULTS
TABLE 27 (continued on next page)

Coding dec.	Coding hex.	Class	Failure Flag	Reason
239	EF		F_ECB_STATISTICS	ECB statistics data corrupted
240	F0		not used	
241	F1	3	x_DMM_READ	DMM: read failure
242	F2	3	x_DMM_CHECKWORD	DMM: checkword failure
243	F3	3	x_DMM_APU_SN	DMM: invalid APU serial number
244	F4	3	x_DMM_WRITE	DMM: write failure
245	F5	2	x_OIL_LEVEL_LOW	low oil level
246	F6		not used	
247	F7		not used	
248	F8		not used	
249	F9		not used	
250	FA		not used	
251	FB		not used	
252	FC		not used	
253	FD		not used	
254	FE		reserved for software purposes	
255	FF		reserved to identify "no fault"	

LRU FAULTS
TABLE 27

(4) Fault Codes for Shutdowns

TABLE 28 defines the fault codes for shutdowns. If further details are required, refer to the Software Requirement Document.

Code	Meaning
0101	Overspeed Shutdown : detected by hardware
0102	Overspeed Shutdown : detected by software
0201	True Emergency Shutdown : in air or APU running
0301	ECB Shutdown : squaring circuits with low threshold failed
0302	ECB Shutdown : wrong overspeed identification
0303	ECB Shutdown : loss of overspeed protection

FAULT CODES FOR SHUTDOWNS
TABLE 28 (continued on next page)

Code	Meaning
0304	ECB Shutdown : incorrect reference frequency for overspeed governor
0305	ECB Shutdown : erroneous logic of overspeed governor
0306	ECB Shutdown : PSU failure
0307	ECB Shutdown : erroneous reference voltage of PSU
0401	Underspeed Shutdown : speed < 85.0 % for 10.0 sec
0501	Overtemperature Onspeed Shutdown : T4 greater limit while onspeed
0502	Overtemperature Onspeed Shutdown : T5 greater limit for 2.0 sec during speed droop
0601	Overtemperature Start Shutdown : T5 greater limit for 2.0 sec during start
0701	Sensor Failure Shutdown : both EGT sensors failed prior to start or during start
0702	Sensor Failure Shutdown : both EGT sensors failed while onspeed
0703	Sensor Failure Shutdown : low oil pressure switch failed and oil level low indicated
0801	Low Oil Pressure Shutdown : low oil pressure for 20.0 sec while onspeed
0901	No Flame Shutdown : still no flame after 23.0 sec during start
0A01	Flap not Open Shutdown : actuator failure during opening of air intake flap
0A02	Flap not Open Shutdown : flap closed while APU is rotating
0B01	High Oil Temperature Shutdown : APU sump oil temperature > 325.0 °F for 10.0 sec
0C01	No Speed Shutdown : acceleration < 0.3 %/sec for 30.0 sec and speed < 7.0 %
0D01	Inlet Overheat Shutdown : inlet temperature > 350.0 °F for 3.0 sec
0E00	Loss of Speed Shutdown : both speed sensors failed
0F01	No Acceleration Shutdown : acceleration < 0.5 %/sec for 60.0 sec and speed > 7.0 %
0F02	No Acceleration Shutdown : acceleration < 0.3 %/sec for 30.0 sec and speed > 7.0 %
0F03	No Acceleration Shutdown : acceleration < 0.1 %/sec for 15.0 sec and speed > 7.0 %
1001	Reverse Flow Shutdown : reverse flow detected for 6.0 sec
1101	Clogged Oil Filter Shutdown : oil filter clogged and on ground
1201	Main Power Interrupt Shutdown : power interrupt > 0.5 sec and interrupt supply available

FAULT CODES FOR SHUTDOWNS
TABLE 28 (continued on next page)

Code	Meaning
1202	Main Power Interrupt Shutdown : power interrupt > 0.2 sec and no interrupt supply

FAULT CODES FOR SHUTDOWNS
TABLE 28

(5) Fault Codes stored in EEPROM

TABLE 29 defines the fault codes stored in EEPROM locations and the layout of the EEPROM.

Address	Meaning
	Failure Codes
	Coding of boolean values in EEPROM TRUE - 0x0055 FALSE - 0x00AA NMI Failures NO_NMI 0xAA00 no NMI stored NMI_PWRFAIL 0x5501 loss of DC power NMI_WDTHW 0x5502 time out of watchdog NMI_UNKNOWN 0x5503 unknown NMI Exception Codes EXC_NO_ERROR - 0xAA00 EXC_BUS_ERROR - 0x5502 EXC_ADDRESS_ERROR - 0x5503 EXC_ILLEGAL_INSTRUCTION - 0x5504 EXC_ZERO_DIVISION - 0x5505 EXC_CHECK_INSTRUCTION - 0x5506 EXC_TRAP_INSTRUCTION - 0x5507 EXC_PRIVILEGE_VIOLATION - 0x5508 EXC_TRACE_INSTRUCTION - 0x5509 EXC_LINE_1010_EMULATOR - 0x550A EXC_LINE_1111_EMULATOR - 0x550B EXC_HARDWARE_BREAKPOINT - 0x550C

CPU FAILURE CODES AND LAYOUT OF EEPROM
TABLE 29 (continued on next page)

Address	Meaning
	EXC_FMT_ERROR_A_UNINIT_INTERRUPT_1 - 0x550E EXC_FMT_ERROR_A_UNINIT_INTERRUPT_2 - 0x550F EXC_SPURIOUS_INTERRUPT - 0x5518 EXC_IRQ_1 - 0x5519 EXC_IRQ_2 - 0x551A EXC_IRQ_3 - 0x551B EXC_IRQ_4 - 0x551C EXC_IRQ_5 - 0x551D EXC_IRQ_6 - 0x551E EXC_UNEXPECTED_EXCEP_OR_INTERRUPT - 0x55FF
	Task-Overflows NO_TASK_OVERFLOW - 0xAA00 TASK_OVERFLOW_5MS - 0x550A TASK_OVERFLOW_20MS - 0x550B TASK_OVERFLOW_100MS - 0x550C
	Box Info
0x180000	cpu_mod_state
0x180002	psu_mod_state
0x180004	ecb_serial_no[3]
	Power-Up Failures
0x180010	download_ram_fault
0x180012	micbac_ram_fault
0x180014	control_ram_fault
0x180016	download_xsum_fault
0x180018	micbac_xsum_fault
0x18001A	control_xsum_fault
0x18001C	download_ident_fault
0x18001E	micbac_ident_fault
0x180020	control_ident_fault
0x180022	init_ram_fault
0x180024	init_xsum_fault
0x180026	init_nmi_fault

CPU FAILURE CODES AND LAYOUT OF EEPROM
TABLE 29 (continued on next page)

Address	Meaning
0x180028	download_nmi_fault
0x18002A	micbac_nmi_fault
0x18002C	control_nmi_fault
0x18002E	init_exception_fault
0x180030	download_exception_fault
0x180032	micbac_exception_fault
0x180034	control_exception_fault
0x180036	watchdog_fault
0x180038	task_overflow
0x18003A	eeprom_fail_address
	Control Data
0x180040	control_init (value 0x1311 means "initialized")
0x180048	overspd_detection
0x18004A	os_channel
0x18004E	flp_opn_sw
	ARINC Data
0x180060	mem_failed
0x180062	mem_version[2]
0x180066	directory_bank
0x180068	first_page_1[2]
0x18006C	last_page_1[2]
0x180070	first_page_3[2]
0x180074	last_page_3[2]
0x180078	first_page_4[2]
0x18007C	last_page_4[2]
0x180080	first_page_5[2]
0x180084	last_page_5[2]
0x180088	first_page_6[2]
0x18008C	last_page_6[2]
0x180090	lru_ary_newest[2]
0x180094	leg_date
0x180098	main_engines_off_old

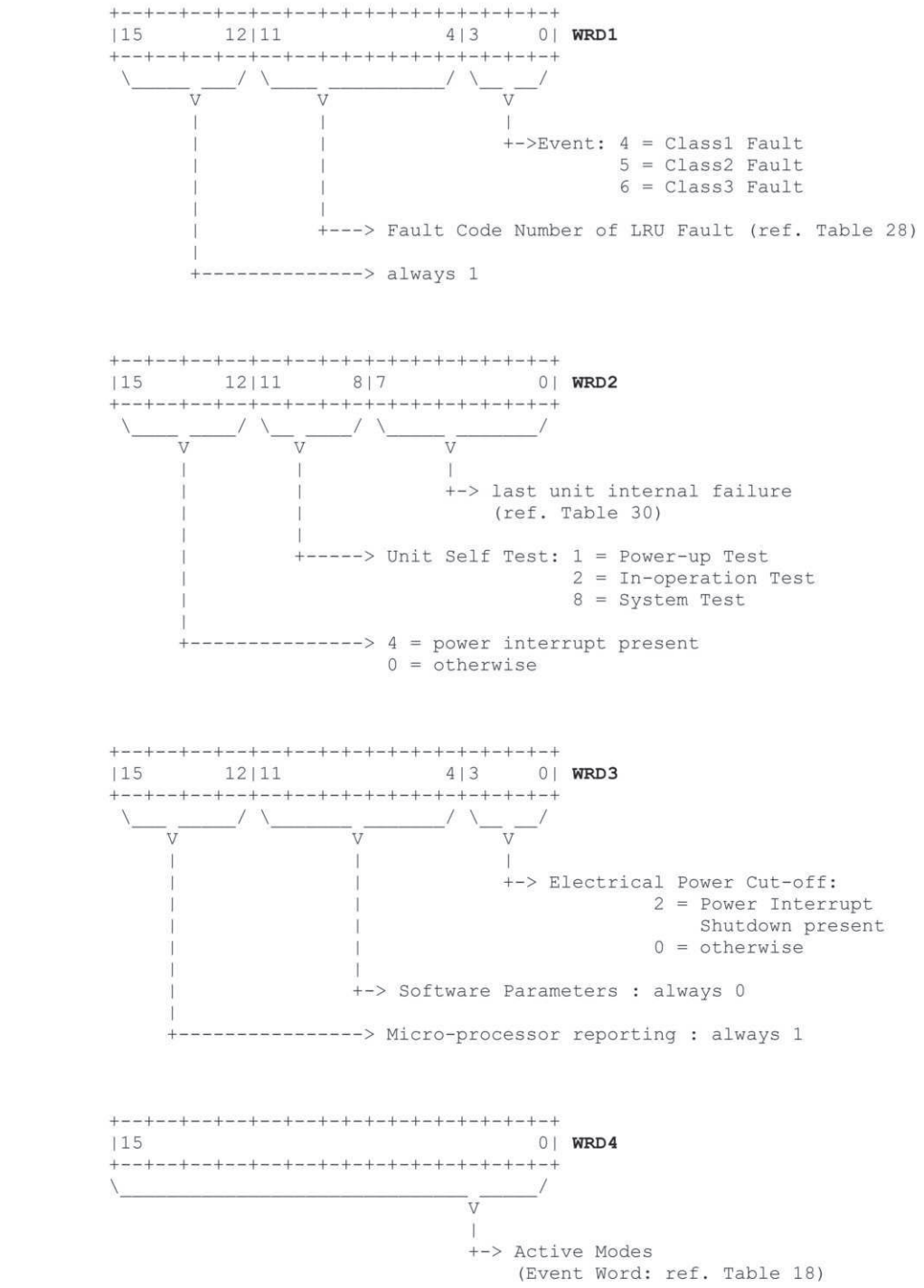
CPU FAILURE CODES AND LAYOUT OF EEPROM
TABLE 29 (continued on next page)

Address	Meaning
0x18009A	flight_old
0x1800FE	fault_memory_failed_reason
	Fault Zones
0x180100	lru_ary[256]
0x180300	fault_zone_1[31]
0x180900	fault_zone_3[31]
0x180F00	fault_zone_4[1]
0x181000	fault_zone_5[21]
0x181400	fault_zone_6[31]
	APU Statistics
0x181C00	dmm_init (value 0x1313 means "initialized")
0x181C02	apu_pri_failed
0x181C04	apu_pri_date
0x181C08	apu_pri_utc
0x181C0C	apu_sec_failed
0x181C0E	apu_sec_date
0x181C12	apu_sec_utc
0x181C18	int_date
0x181C1C	int_utc
0x181C20	loss_of_soak
0x181C22	soak_date
0x181C26	soak_utc
0x181C2A	sd_loss_dcpwr
0x181C40	dmm_read_count
0x181C42	dmm_write_count
0x181C44	dmm_total_read_count
0x181C46	dmm_total_write_count
	ECB Statistics
0x182250	ecb_stat_init (value 0x1311 means "initialized")
0x182252	ecb_stat_failed
0x182254	ecb_on
0x182256	ecb_hour

CPU FAILURE CODES AND LAYOUT OF EEPROM
TABLE 29 (continued on next page)

Address	Meaning
0x18225A	ecb_hour_run
0x18225E	ecb_hour_run_average
0x182262	temp_average
0x182264	temp_max_on
0x182266	temp_min_on
0x182268	temp_max_off
0x18226A	temp_min_off
	APU Statistics
0x182800	pri_apu_data
0x183000	sec_apu_data

CPU FAILURE CODES AND LAYOUT OF EEPROM
TABLE 29



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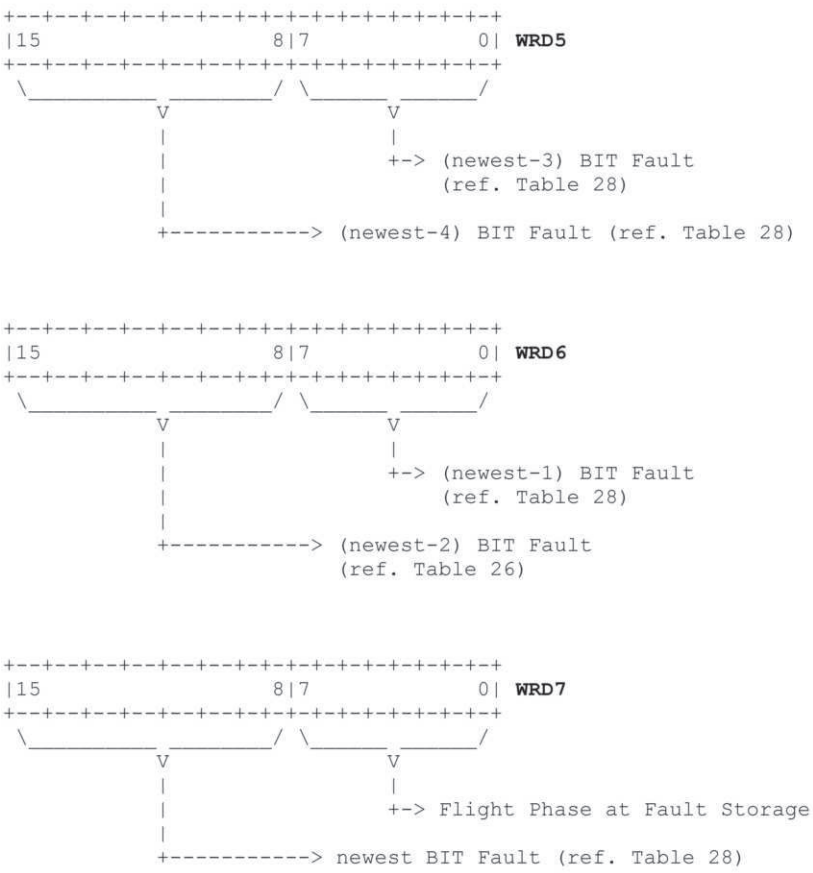
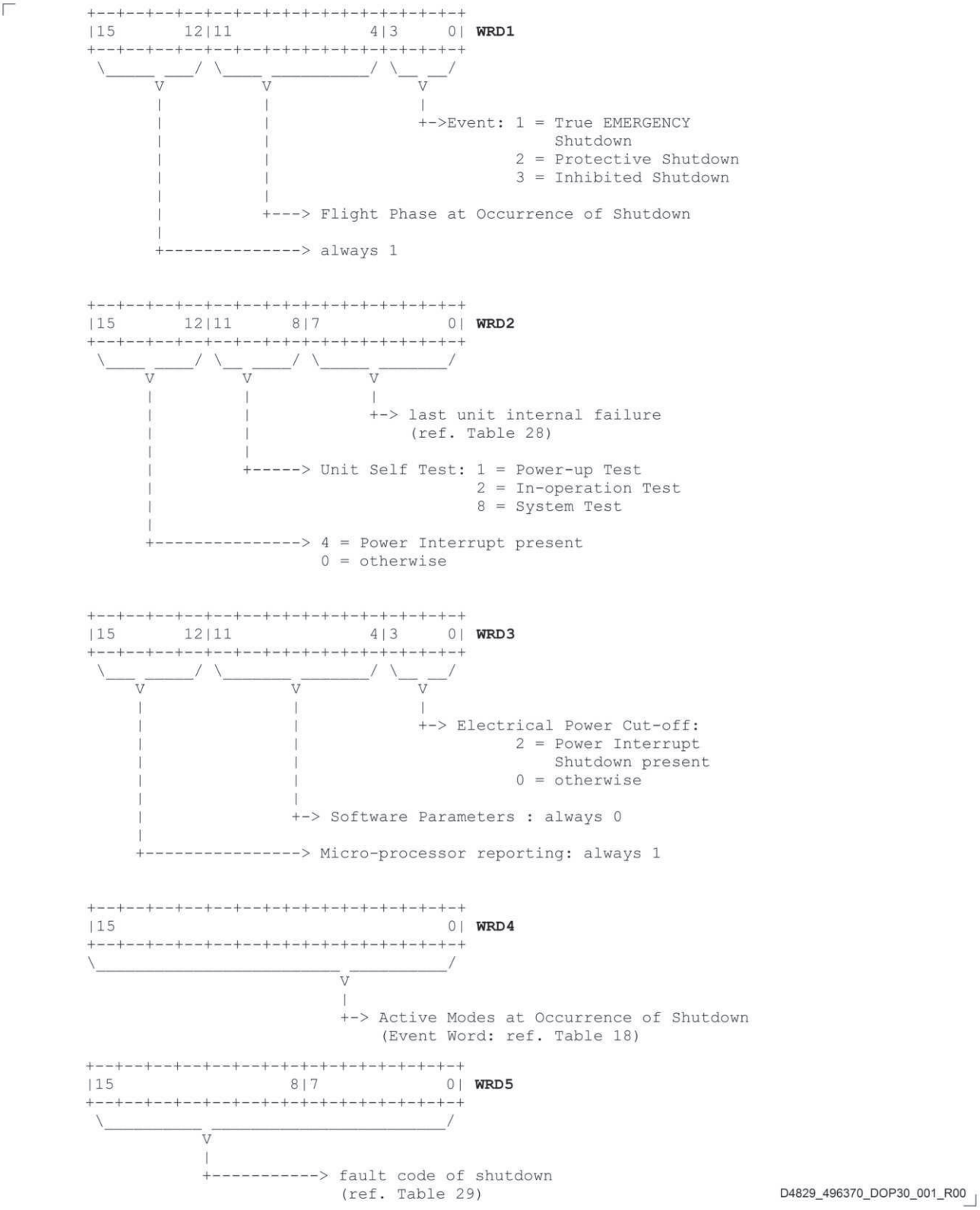
TSD WORD DEFINITION
FIGURE 29 [SHEET 1 OF 2]



D4829_496370_DOP29_002_R00

TSD WORD DEFINITION
FIGURE 29 [SHEET 2 OF 2]



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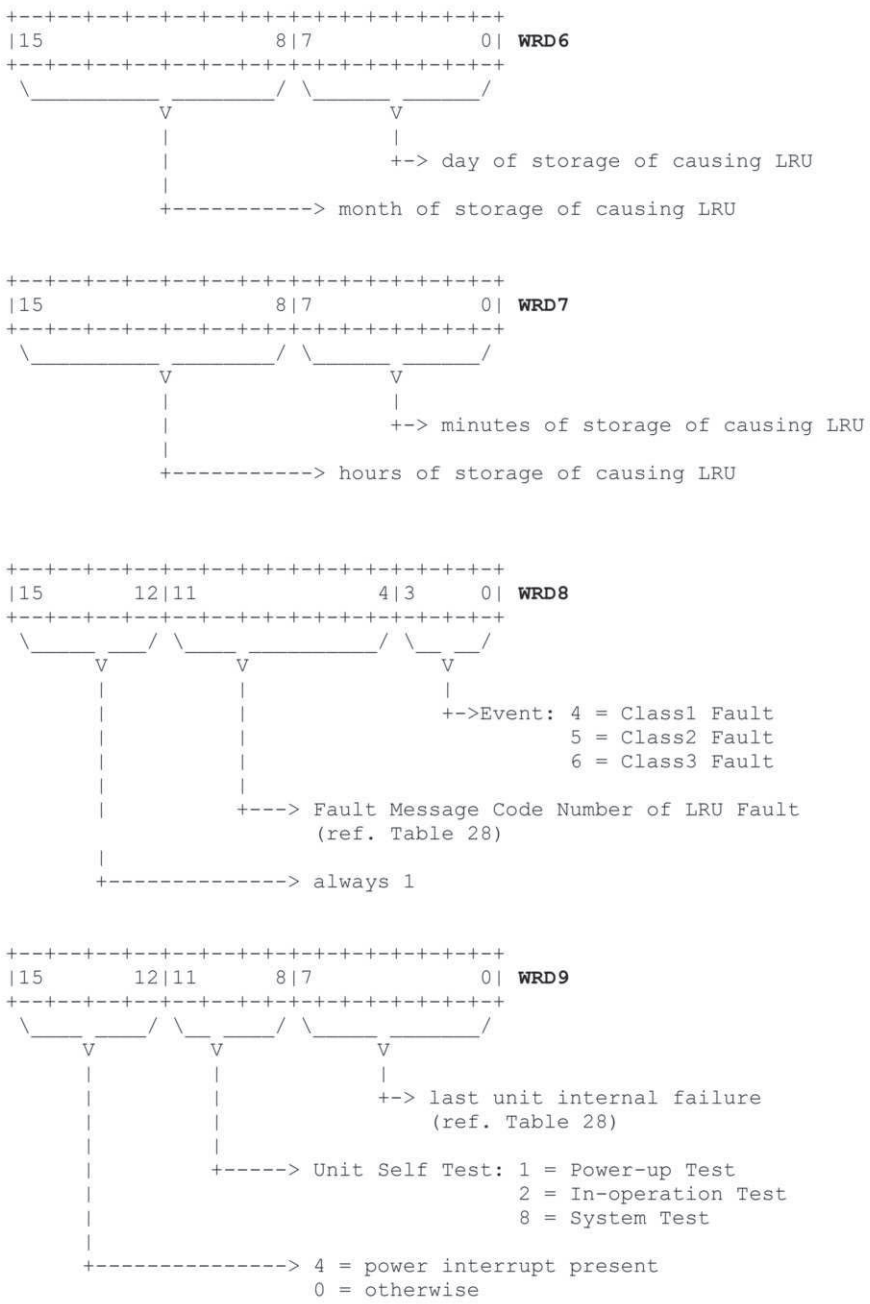
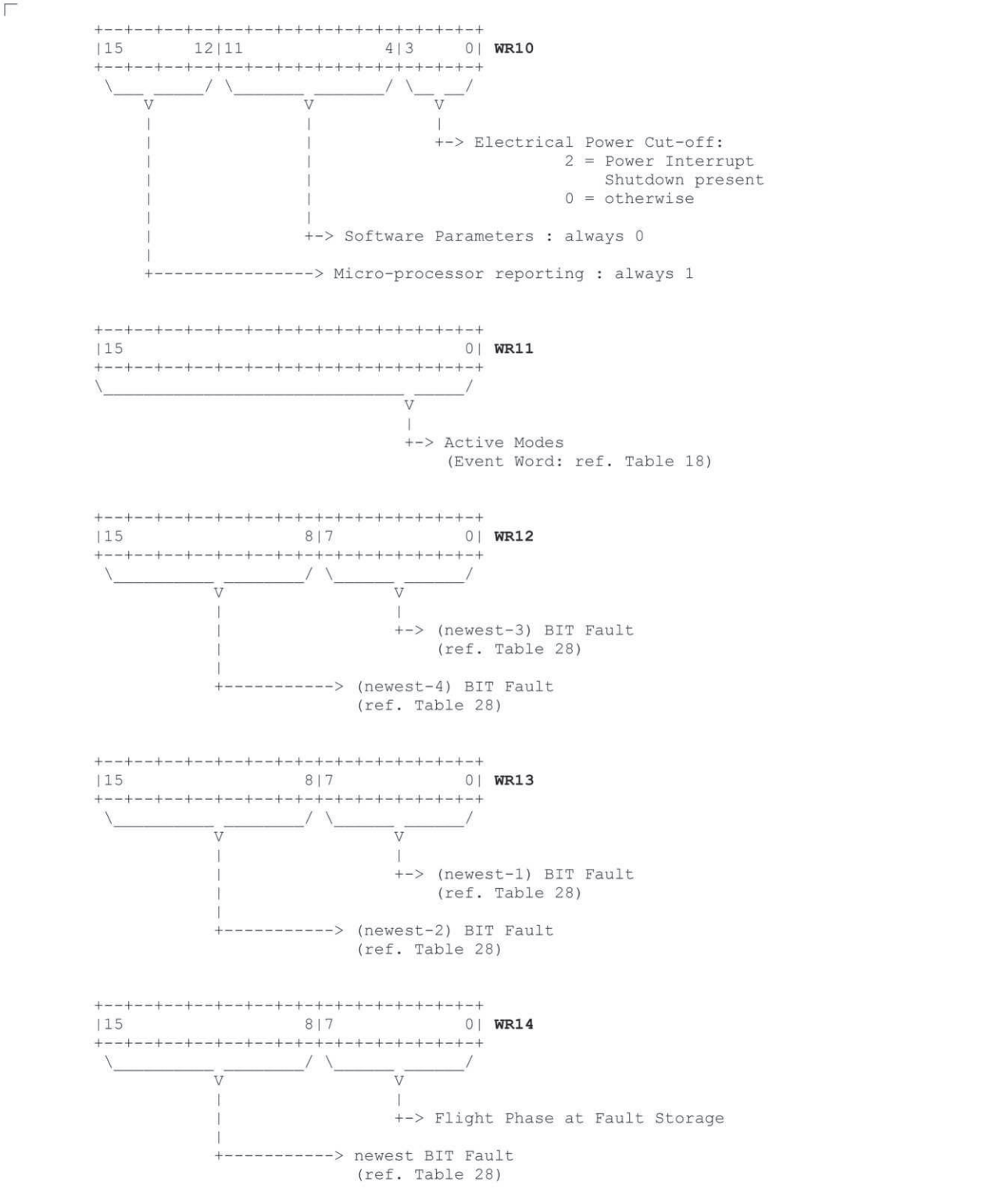
TSD WORD DEFINITION
FIGURE 30 [SHEET 1 OF 3]



D4829_496370_DOP30_002_R00

TSD WORD DEFINITION
FIGURE 30 [SHEET 2 OF 3]



D4829_496370_DOP30_003_R00

TSD WORD DEFINITION
FIGURE 30 [SHEET 3 OF 3]

TASK 49-63-70-870-805-A00

5. SOFTWARE LOADING

A. The software which implements the MICBAC Monitor and the software which implements the control laws and the communication with other aircraft systems can be separately downloaded into the ECB using the RS232 interface provided via the test connector J2. However, to be able to perform the downloading process, a resident downloading software is permanently stored in the ECB. This downloading software can be programmed without removing the Flash EPROMs from the CPU board.

B. Loading of Resident Software

CAUTION: THIS PARA IS FOR INFORMATION ONLY. NORMALLY THE RESIDENT SOFTWARE NEEDS NOT TO BE CHANGED.

The resident software is loaded using the Background Debug Monitor facility of the microcontroller MC68332. This interface is accessible via the connector J12 on the CPU board.

The communication using the Background Debug Monitor is supported by a special software tool running under MS-DOS on a personal computer. The communication link is established by an interface board which connects the connector J12 with the printer interface of the personal computer.

The loading process is performed in the following steps:

- Connect CPU board connector J12 with printer interface of personal computer
- Power personal computer and enter software tool
- Power CPU board
- Start download macro of software tool

The interface board and the software tool and macro may be ordered from DAs. It is not necessary to change the resident software in service, however.

The download macro loads a bootstrap kernel into the SRAM of the microcontroller. This kernel erases the Flash EPROMs completely and then programs the downloading software which is taken from a file. After finishing the programming of the Flash EPROMs the checksums of the downloading software are calculated and verified against the checksums loaded. A resp. message is displayed on the monitor of the personal computer.

C. Loading of Non-Resident Software

The non-resident software (MICBAC Monitor and Control Software) can be loaded via the test connector J2. A special interface program is needed running on a personal computer under MS-DOS. This interface program is supplied together with the loadable images of the MICBAC Monitor and the Control Software.

The resident software (Downloader) can be entered by connecting pin J2-d of the test connector J2 to ground and sending the string ‘D<CR><LF>’ within 16 seconds after powering the ECB. The Downloader answers with "*DOWNLOAD".

The Downloader can only be left by de-powering the ECB.

The Downloader provides the following six commands (implemented as function keys in the interface program):

(1) C<CR><LF> (show configuration)

This command displays the HW and SW configuration of the ECB.

(2) V<CR><LF> (verify Control Software)

This command starts the verification of the Control Software. The EPROM area occupied by the Control Software is compared with the downloadable image stored in a file on the personal computer. The contents of this file are transmitted to the ECB on request. The verification process checks the complete file. It issues a resp. message at the end.

(3) W<CR><LF> (verify MICBAC Monitor)

This command starts the verification of the MICBAC Monitor. The EPROM area occupied by the MICBAC Monitor is compared with the downloadable image stored in a file on the personal computer. The contents of this file are transmitted to the ECB on request. The verification process checks the complete file. It issues a resp. message at the end.

(4) D<CR><LF> (download Control Software)

Prior to issueing this command, pin J2-c of the test connector J2 must be connected to ground. The command starts the downloading of the Control Software. The image of the Control Software stored in a file on the personal computer is send to the ECB on request. The image is only programmed, if the software to be downloaded complies with the hardware of the ECB. If a difference is encountered, the downloading process is aborted and the old software remains valid in the ECB. Otherwise the EPROM area is cleared and then newly programmed with the new image. If a failure is found during the programming or during the checks at the end of the programming, the EPROM area is cleared.

(5) H<CR><LF> (download MICBAC Monitor)

Prior to issueing this command, pin J2-c of the test connector J2 must be connected to ground. The command starts the downloading of the MICBAC Monitor. The image of the MICBAC Monitor stored in a file on the personal computer is send to the ECB on request. The image is only programmed, if the software to be downloaded complies with the hardware of the ECB. If a difference is encountered, the downloading process is aborted and the old software remains valid in the ECB. Otherwise the EPROM area is cleared and then newly programmed with the new image. If a failure is found during the programming or during the checks at the end of the programming, the EPROM area is cleared.

(6) E<CR><LF> (erase MICBAC Monitor)

Prior to issueing this command, pin J2-c of the test connector J2 must be connected to ground. This command erases the memory area occupied by the MICBAC Monitor.

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TASK 49-63-70-700-811-A00

1. GENERAL

NOTE: For Testing and Fault Isolation refer to the Automatic Test Procedure Manual.

A. Manual Identification

PART NUMBER	ATA REF. NO.
3888394-121202	49-63-70
3888394-121203	49-63-70A
3888394-121204	49-63-70B
3888394-121205	49-63-70C
3888394-221202	49-63-70
3888394-221203	49-63-70A
3888394-221204	49-63-70B
3888394-221205	49-63-70C
3888394-321206	49-63-70D

TECHNICAL DATA
TABLE 1001

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TASK 49-63-70-990-822-A00

1. I/O BOARD

A. Schematic Diagram

(1) Revision Reference Sheet

UPDATE No.	DESCRIPTION	PART NUMBER EFFECTIVITY

REVISION REFERENCE SHEET
TABLE 2001

(2) Schematic diagram sheets

Refer to FIGURE 2001

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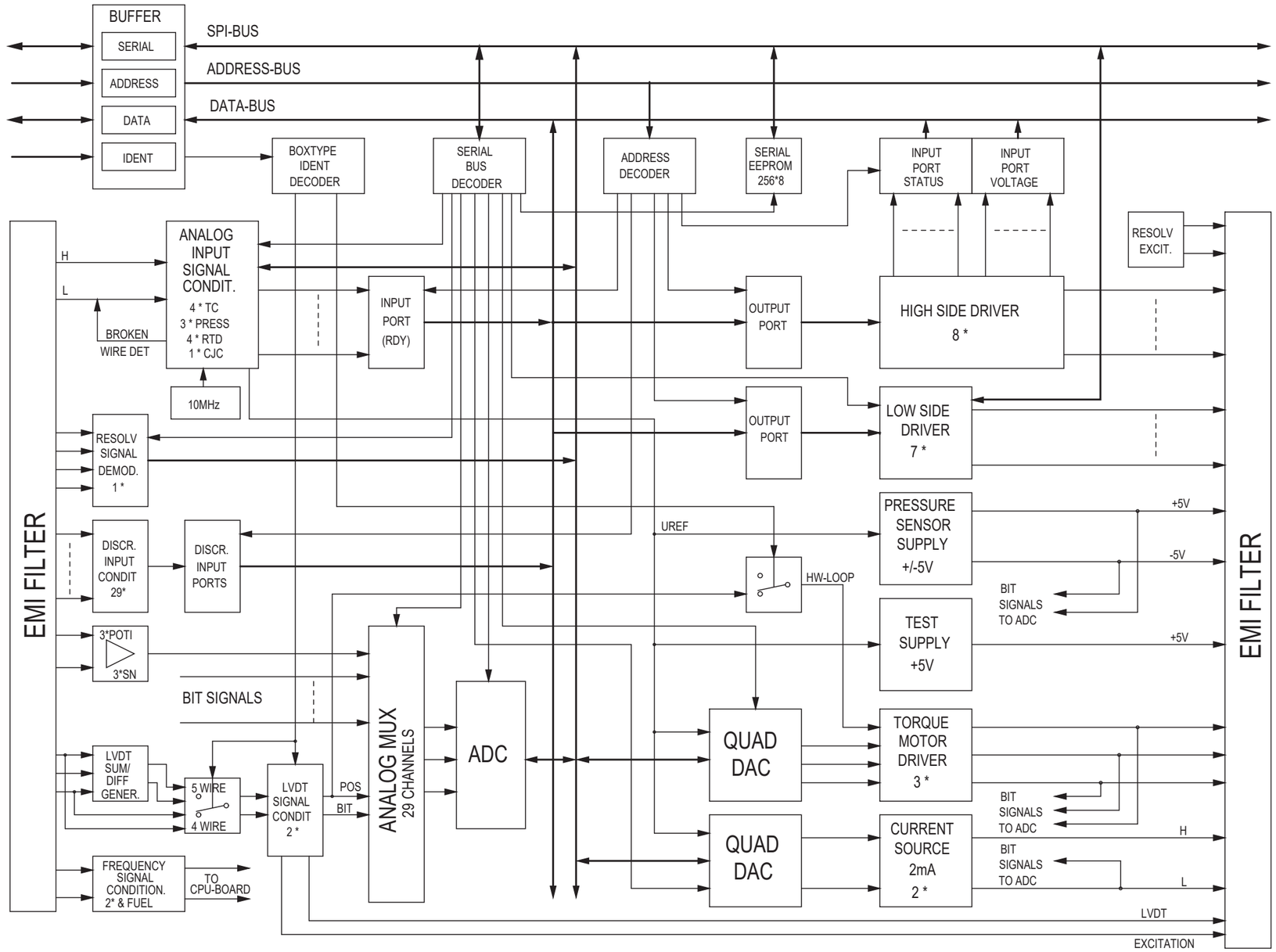

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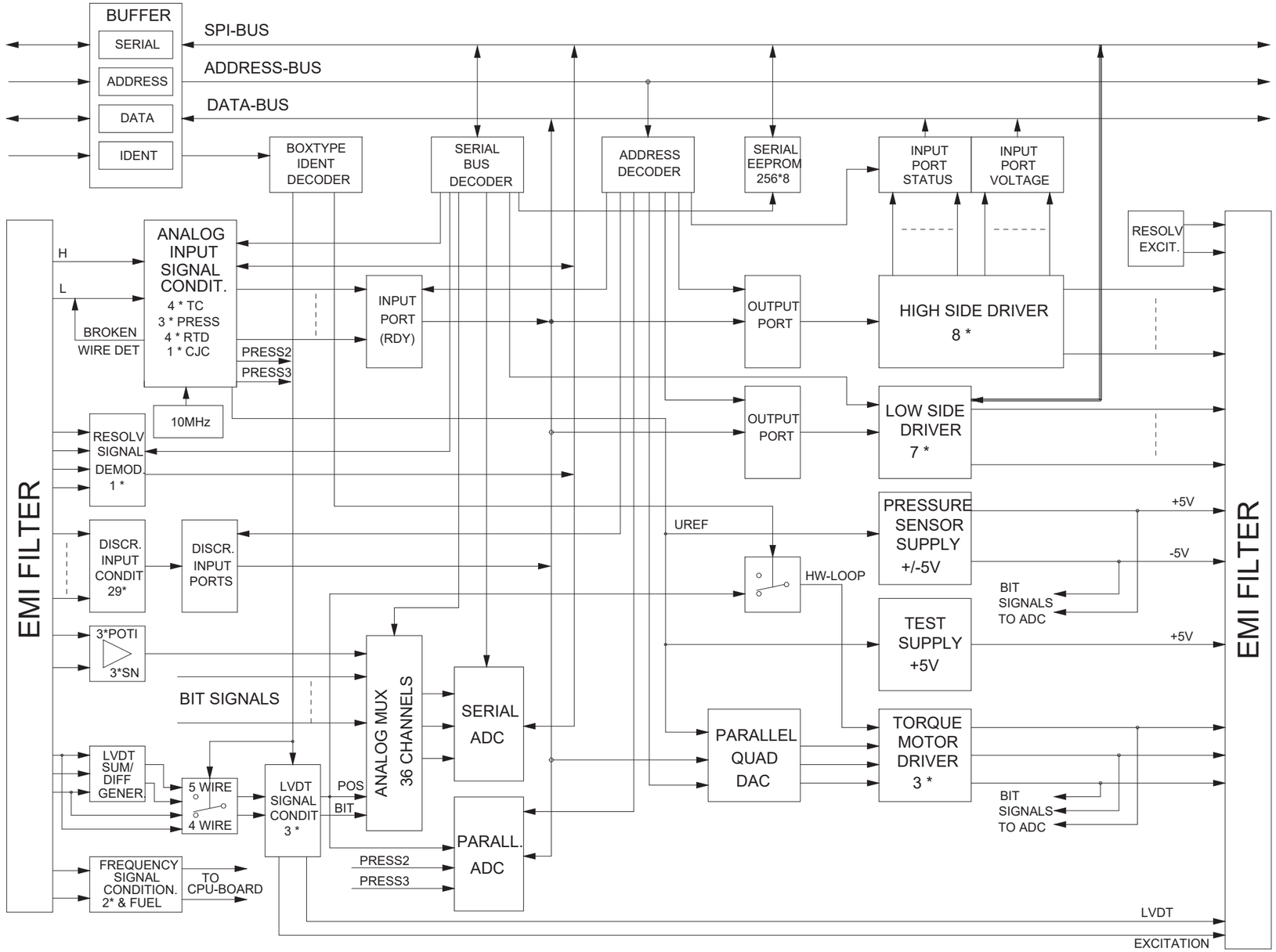
I/O BOARD BLOCK DIAGRAM
PNS 3888394–1212XX
FIGURE 2001 [SHEET 1 OF 2]



D4829_496370_SWD01_002_R00

I/O BOARD BLOCK DIAGRAM
PNS 3888394–2212XX AND PN 3888394–321206
FIGURE 2001 [SHEET 2 OF 2]

TASK 49-63-70-990-821-A00

2. CPU BOARD

A. Schematic Diagram

(1) Revision Reference Sheet

UPDATE No.	DESCRIPTION	PART NUMBER EFFECTIVITY

REVISION REFERENCE SHEET
TABLE 2002

(2) Schematic diagram sheets

Refer to FIGURE 2002

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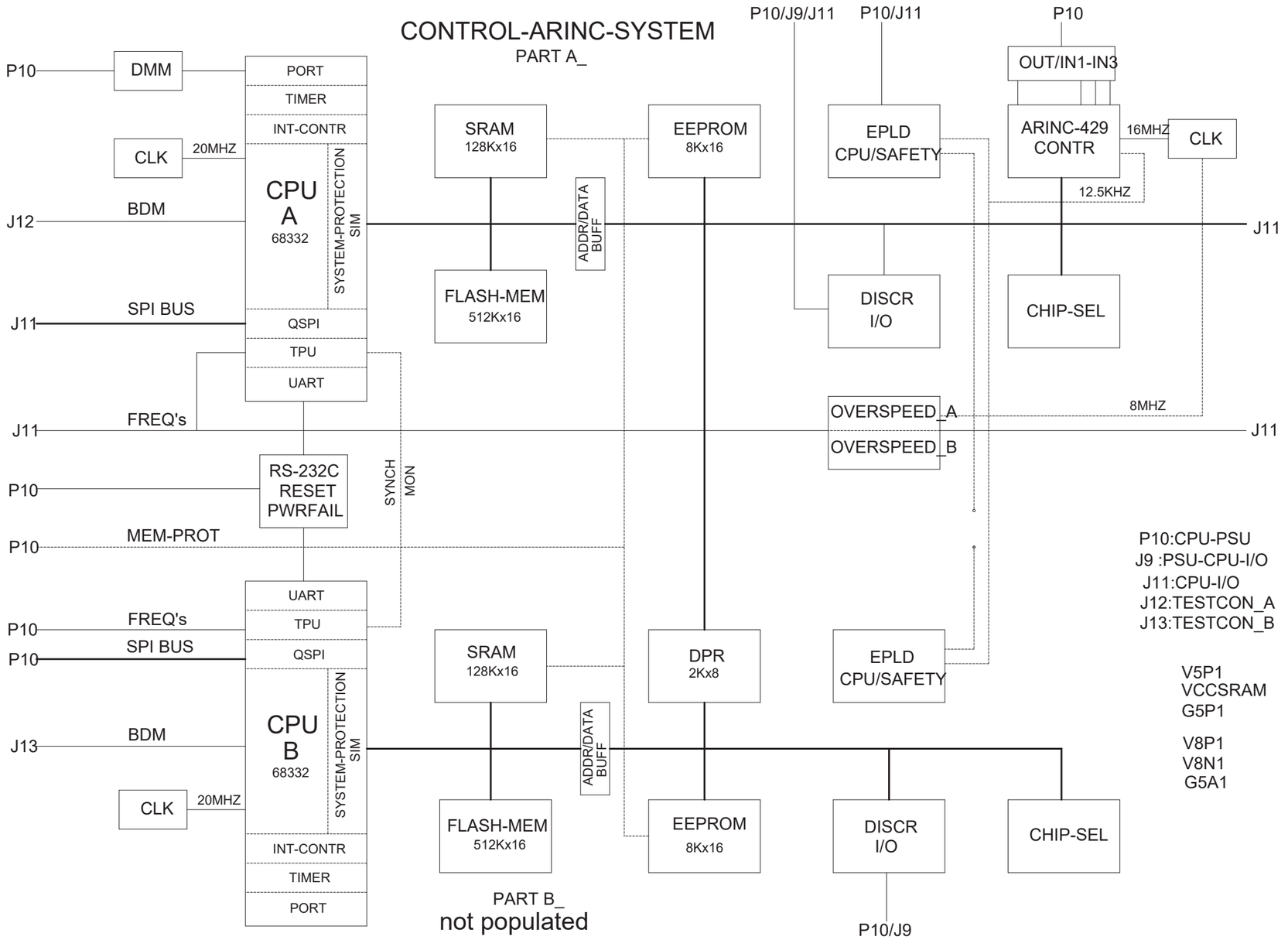

CPU BOARD BLOCK DIAGRAM
FIGURE 2002

TASK 49-63-70-990-823-A00

3. PSU BOARD

A. Schematic Diagram

(1) Revision Reference Sheet

UPDATE No.	DESCRIPTION	PART NUMBER EFFECTIVITY

REVISION REFERENCE SHEET
TABLE 2003

(2) Schematic diagram sheets

Refer to FIGURE 2003

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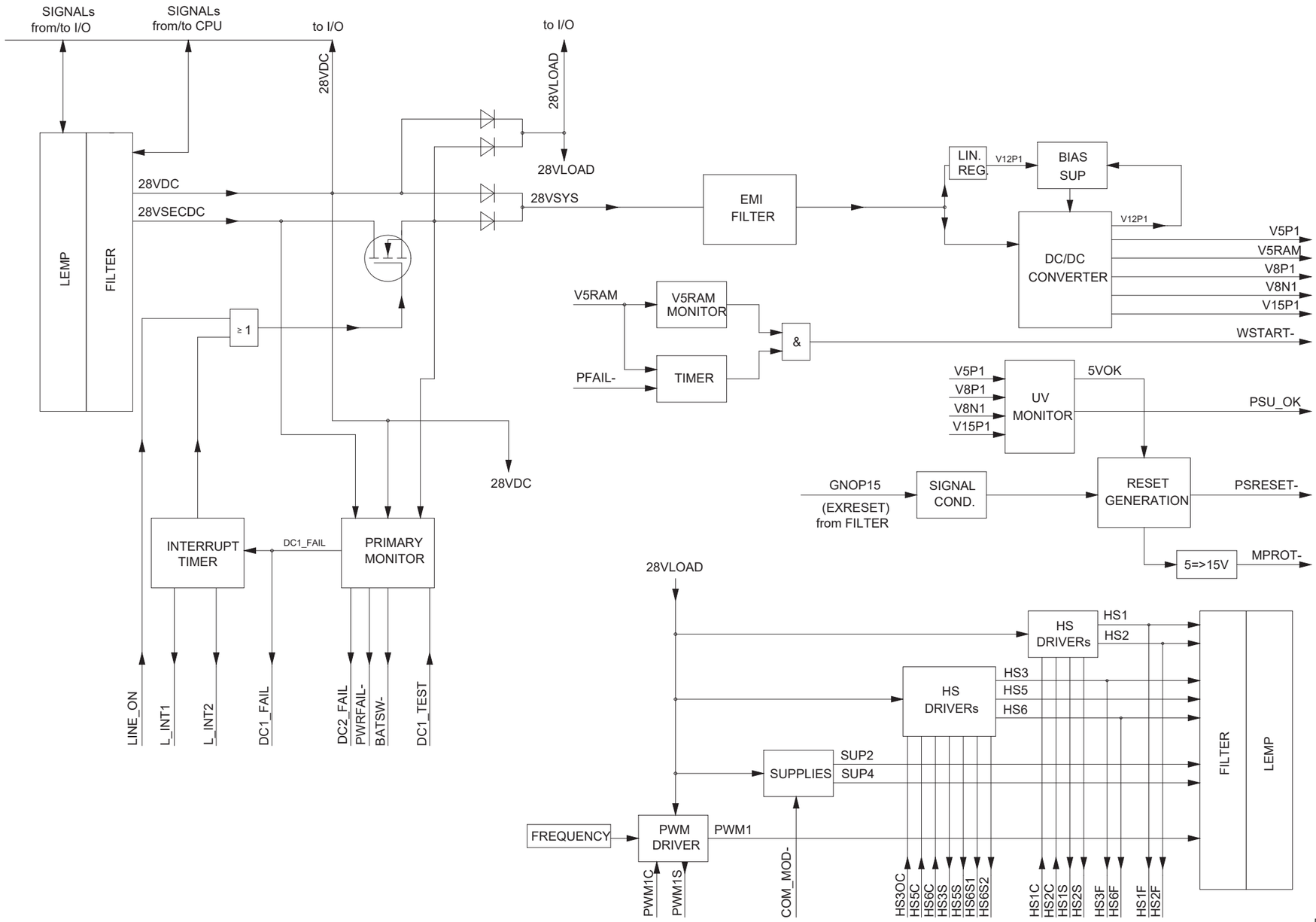

D4829_496370_SWD03_001_R00

PSU BOARD BLOCK DIAGRAM
FIGURE 2003

DISASSEMBLY

TASK 49-63-70-99F-831-A00

1. GENERAL

This section gives information how to disassemble the component.

Do not disassemble the component more than necessary for the repair or the replacement of defective items.

Pageblock "TESTING AND FAULT ISOLATION" informs how to find defective items.

TASK 49-63-70-000-832-A00

2. PROCEDURE

CAUTION: THE UNIT CONTAINS ELECTROSTATIC DISCHARGE SENSITIVE (ESDS) COMPONENTS. USE APPLICABLE SAFETY PRECAUTIONS WHEN YOU DO MAINTENANCE ON OR NEAR COMPONENTS SENSITIVE TO ELECTROSTATIC DISCHARGE. IF YOU DO NOT DO THIS, YOU CAN CAUSE DAMAGE TO THE UNIT.

CAUTION: THE BOARDS CAN CONTAIN OPERATIONAL SOFTWARE.

NOTE: Refer to the pageblock "SPECIAL TOOLS, FIXTURES, EQUIPMENT AND CONSUMABLES" for special tools necessary for disassembly.

EFFECT: 3888394-121202, 3888394-121203, 3888394-121204, 3888394-121205

SUBTASK 49-63-70-000-131-A00

A. DISASSEMBLY PROCEDURE OF ECB (CAST HOUSING)

(1) Removal of the Connect Module

Loosen the six screws (FIGURE 1 - 40) and lift the Connect Module (FIGURE 1 - 45) to remove it correctly from the connectors (J3 and J4, FIGURE 2) and remove the Connect Module from the box.

(2) Removal of the Connector Plate

Loosen the six screws (FIGURE 3 - 75). Adhere the post (FIGURE 3 - 80) with a wrench and loosen the belonging screws (FIGURE 3 - 70). Remove the Connector Plate (FIGURE 3 - 65).

(3) Disassembly of the Core Module (cast housing)

(a) Remove the four screws (FIGURE 2 - 15) from the Core Module (FIGURE 2 - 1) and separate the left chassis (FIGURE 2 - 35) from the right chassis (FIGURE 2 - 105) carefully.

(b) Loosen the safety clamp (FIGURE 2 - 75) and loosen the flat cable connections (FIGURE 2 - 60), (FIGURE 2 - 65) and (FIGURE 2 - 70) from the connectors J6 - J8 (see FIGURE 4).

(c) Loosen the flat cable connection (FIGURE 4 - 35) from the connector J10 of the PSU (see FIGURE 2).

(d) Loosen the safety clamp (FIGURE 2 - 30) and loosen the flat cable connection (FIGURE 4 - 45) from the connector J9 of the PSU (see FIGURE 2).

(4) Removal of the Subsequent Boards

- CPU Board A31 (FIGURE 4 - 20),
- INPUT/OUTPUT Board A35 (FIGURE 4 - 50).

(a) Remove six screws (FIGURE 2 - 25) and remove the CPU-I/O Module (FIGURE 2 - 20) from the left chassis (FIGURE 2 - 35).

(b) Remove eight screws (FIGURE 4 - 25) and washers (FIGURE 4 - 30).

(c) Loosen the flat cable connection (FIGURE 4 - 45) from the connector J9 of the CPU Board (FIGURE 4 - 20).

(d) Loosen the connection (FIGURE 4 - 40) from the connector J11 of the CPU Board (FIGURE 4 - 20) and remove the CPU Board from the INPUT/OUTPUT Board.

(5) Removal of the Power Supply Unit

(a) Loosen the safety clamp (FIGURE 2 - 85) and remove the flat cable connection P5 of the test connector J2 (FIGURE 2 - 80) from connector J5 of the Power Supply Unit (FIGURE 2 - 50).

(b) Remove six screws (FIGURE 2 - 55).

(c) Push the flat cable connection P5 of the test connector J2 (FIGURE 2 - 80) through the wall entrance and remove the Power Supply Unit (FIGURE 2 - 50) from the right chassis (FIGURE 2 - 105).

(6) Removal of the Test Connector J2

Remove the four rivets (FIGURE 2 - 90) by cutting its heads inside the right chassis (FIGURE 2 - 105) and remove the complete test connector (FIGURE 2 - 80).

(7) Removal of the Cap

Remove the rivet (FIGURE 2 - 100) by cutting its head inside the right chassis (FIGURE 2 - 105) and remove the cap (FIGURE 2 - 95).

EFFECT: 3888394-221202, 3888394-221203, 3888394-221204, 3888394-221205, 3888394-321206

SUBTASK 49-63-70-000-132-A00

B. DISASSEMBLY PROCEDURE OF ECB (EXTRUSION HOUSING)

(1) Removal of the Connect Module

Loosen the six screws (FIGURE 1A - 40B) and lift the Connect Module (FIGURE 1A - 45) to remove it correctly from the connectors (J3 and J4, IPL FIGURE 2A) and remove the Connect Module from the box.

(2) Removal of the Connector Plate

Loosen the six screws (FIGURE 3 - 75). Adhere the post (FIGURE 3 - 80) with a wrench and loosen the belonging screws (FIGURE 3 - 70). Remove the Connector Plate (FIGURE 3 - 65).

(3) Disassembly of the Core Module (extrusion housing)

(a) Remove two screws (FIGURE 2A - 20) at the bottom and one screw (FIGURE 2A - 20) at the left hand side of the front plate (FIGURE 2A - 25) of the Core Module (FIGURE 2A - 1).

(b) Remove two screws (FIGURE 2A - 20) from the left hand and right hand side of the extrusion bottom (FIGURE 2A - 90).

(c) Turn the box to the top. Remove two screws (FIGURE 2A - 105) and four screws (FIGURE 2A - 120) from the extrusion bottom (FIGURE 2A - 90). Push back carefully the extrusion bottom from the extrusion top (FIGURE 2A - 80).

(d) Remove three screws (FIGURE 2A - 20) from the front plate (FIGURE 2A - 25) and separate the front plate.

(4) Removal of the Subsequent Boards

- CPU Board A31 (FIGURE 4 - 20),
- INPUT/OUTPUT Board A35 (FIGURE 4 - 50).

(a) Remove two screws (FIGURE 2A - 105) and four screws (FIGURE 2A - 120) and separate the CPU I/O Module (FIGURE 2A - 100) together with the Power Supply Unit (FIGURE 2A - 115) from the extrusion top (FIGURE 2A - 80).

(b) Loosen the safety clamp (FIGURE 2A - 140) and loosen the flat cable connections (FIGURE 2A - 125), (FIGURE 2A - 130) and (FIGURE 2A - 135) from the connectors J6 - J8.

(c) Loosen the flat cable connection (FIGURE 4 - 35) from the connector J10 of the PSU (FIGURE 2A - 115).

(d) Loosen the safety clamp (FIGURE 2A - 110) and loosen the flat cable connection (FIGURE 4 - 45) from the connector J9 of the PSU (FIGURE 2A - 115).

(e) Remove eight screws (FIGURE 4 - 25) and washers (FIGURE 4 - 30).

(f) Loosen the flat cable connection (FIGURE 4 - 45) from the connector J9 of the CPU Board.

(g) Loosen the connection (FIGURE 4 - 40) from the connector J11 of the CPU Board and remove the CPU Board from the INPUT/OUTPUT Board.

(5) Removal of the Power Supply Unit

(a) Remove two screws (FIGURE 2A - 105) and four screws (FIGURE 2A - 120) and separate the CPU I/O Module (FIGURE 2A - 100) together with the Power Supply Unit (FIGURE 2A - 115) from the extrusion top (FIGURE 2A - 80).

(b) Loosen the safety clamp (FIGURE 2A - 140) and loosen the flat cable connections (FIGURE 2A - 125), (FIGURE 2A - 130) and (FIGURE 2A - 135) from the connectors J6 - J8 of the CPU I/O Module (FIGURE 2A - 100).

(c) Loosen the flat cable connection (FIGURE 4 - 35) from the connector J10 of the PSU (see FIGURE 2A).

(d) Loosen the safety clamp (FIGURE 2A - 110) and loosen the flat cable connection (FIGURE 4 - 45) from the connector J9 of the PSU (see FIGURE 2A).

(e) Loosen the safety clamp (FIGURE 2A - 145) and remove the flat cable connection P5 of the test connector J2 (FIGURE 2A - 45) from connector J5 of the Power Supply Unit (FIGURE 2A - 115).

(f) Push the flat cable connection P5 of the test connector J2 (FIGURE 2A - 45) through the wall entrance.

(6) Removal of the Test Connector J2

Remove the four rivets (FIGURE 2A - 50) by cutting its heads inside the front plate (FIGURE 2A - 25) and remove the complete test connector (FIGURE 2A - 45).

(7) Removal of the Cap

Remove the rivet (FIGURE 2A - 60) by cutting its head inside the front plate (FIGURE 2A - 25) and remove the cap (FIGURE 2A - 55).

CLEANING

TASK 49-63-70-100-841-A00

1. GENERAL

NOTE: Refer to pageblock REPAIR.

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CHECK

TASK 49-63-70-210-851-A00

1. GENERAL

NOTE: Refer to pageblock REPAIR.

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REPAIR

TASK 49-63-70-99F-861-A00

1. GENERAL

This section informs how to repair and modify the component.

You must replace the shop replaceable units (SRU) of the Electronic Control Box. For this purpose disassembly and assembly instructions must be done. Repairs which are not described in the sections DISASSEMBLY and ASSEMBLY are detailed hereafter.

You can repair the damaged painted surfaces.

This section informs how to change the applicability of the ECB for engine type Honeywell GTCP331-350 (C).

TASK 49-63-70-94A-861-A00

2. LIST OF MATERIALS

The materials that follow are used in this section.

NOTE: Equivalent alternatives can be used for items in the list.

ITEM	SUPPLIER'S CODE
ADHESIVE (ECCOBOND 286)	D2617
CLEANING AGENT (ISOPROPYL ALCOHOL GRADE A)	C6604
LOCKING COMPOUND (LOCTITE 221)	05972
MASKING TAPE	LOCALLY AVAILABLE
VARNISH (HUMISEAL 1B31)	99109
WIRE MX30-130 ORANGE (JUMPER WIRE PTFE AWG30 OG)	C3033

LIST OF MATERIALS
TABLE 6001

TASK 49-63-70-300-861-A00

3. PROCEDURE

NOTE: Refer to the pageblock SPECIAL TOOLS, FIXTURES, EQUIPMENT AND CONSUMABLES for the consumables which are necessary for repair.

NOTE: You can use a knife or a scalpel to remove ADHESIVE (ECCOBOND 286) which secures items.

NOTE: For detailed repair procedures refer to the Manual "STANDARD PRACTICES", ATA No. 20-00-10.

NOTE: If cleaning CLEANING AGENT (ISOPROPYL ALCOHOL GRADE A) is used, remove all Isopropyl residues by means of an absorbent brush. The brush is to be repeatedly pressed out using an absorbent paper.

SUBTASK 49-63-70-350-161-A00

A. REPLACEMENT OF THE LABELS

(1) Replacement of all adhered Designation Labels, Identification Labels and Warning Labels

(a) Remove the defective label.

(b) Clean the location with CLEANING AGENT (ISOPROPYL ALCOHOL GRADE A).

(c) Remove the protective foil from the new label.

(d) Attach the label in the same location as the removed label.

(2) Replacement of Identification Labels and the Amendment Label attached with screws

EFFECT: 3888394-121202, 3888394-121203, 3888394-121204, 3888394-121205
(a) Remove two screws (FIGURE 1 - 15A) or (FIGURE 1 - 25A)

EFFECT: 3888394-221202, 3888394-221203, 3888394-221204, 3888394-221205, 3888394-321206
(b) Remove two screws (FIGURE 1A - 15A) and (FIGURE 1A - 25A) ore (FIGURE 1A - 15B) and (FIGURE 1A - 16) or (FIGURE 1A - 25B) and (FIGURE 1A - 26).

(c) Remove the defective label.

(d) Put the new identification label in the correct position.

The Identification label must show the following information:

- Partnumber with actual dash-number
- Actual serial number (identical to the serial number of the Core Module)
- Modification Date

The Amendment Label must show the following information:

- Actual Dash-number of the Partnumber
- DAs Modification Status of ECB (EQ), Core Module (HW), Connect Module (CM) and Operational Software (SW)

(e) Apply LOCKING COMPOUND (LOCTITE 221) to the threads of the two screws.

(f) Attach the label with the relevant two screws.

SUBTASK 49-63-70-300-161-A00

B. REPAIR OR MODIFICATION OF THE POLARIZING KEYS

NOTE: Except for modifications no work has to be performed at the polarizing elements.

(1) Modification of the keys in the rear connector.

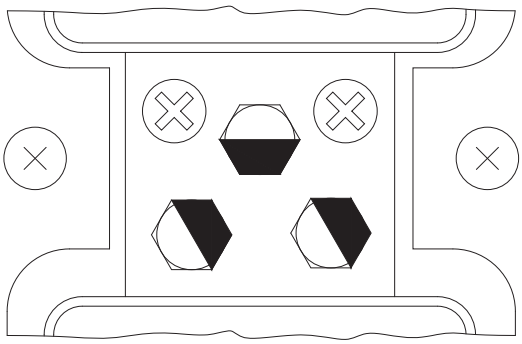
(a) Remove the two screws from the key cover plate (see FIGURE 6001).

(b) Remove the key cover plate.

(c) Replace the keys or do the modification to the keys.

(d) Apply LOCKING COMPOUND (LOCTITE 221) to the threads of the two screws.

(e) Put the key cover plate in the correct position and attach it with the two screws.



D4829_496370_REP01_001_R00

CONFIGURATION OF THE POLARIZING KEYS OF CONNECTOR J1
FIGURE 6001

SUBTASK 49-63-70-380-161-A00

C. REPAIR OF PAINTED SURFACES

(1) Cleaning

Clean the surfaces to be painted with a soft brush or a lint-free cloth soaked in the cleaning agent CLEANING AGENT (ISOPROPYL ALCOHOL GRADE A).

(2) Painting

(a) Use a brush or a spray gun to paint the damaged area.

(b) If necessary, disassemble the parts to be painted. Cover undamaged areas with masking tape when you use a spray gun.

(c) Apply VARNISH (HUMISEAL 1B31) and let it dry.

(d) Remove the masking tape.

SUBTASK 49-63-70-350-162-A00

D. ADDITIONAL CONNECTIONS

(1) Additional Wire Connections on the Connect Module

Refer to table for additional connections made with WIRE MX30-130 ORANGE (JUMPER WIRE PTFE AWG30 OG) and ADHESIVE (ECCOBOND 286).

FROM ITEM	TO ITEM
J1A-B4	J1A-D12
J1A-D10/pin	R11/bottom
R11/top	J1B-K4/pin
J1A-D10/pin	R10/top
R10/bottom	J1B-J2/pin

ADDITIONAL WIRE CONNECTIONS
TABLE 6002

TASK 49-63-70-800-861-A00

4. CHANGE OF THE APPLICABILITY OF THE ECB FOR HONEYWELL APU TYPE GTCP331-350 (C)

A. Remove the Connect Module (FIGURE 1 - 45) or (FIGURE 1A - 45) (see section DISASSEMBLY).

B. Install the Connect Module for Honeywell APU type GTCP331-350 (C) (see section ASSEMBLY).

C. Remove the following labels and attach relevant labels (see paragraph A.):

- Identification Label (FIGURE 1 - 10) and (FIGURE 1A - 10)
- Amendment Label (FIGURE 1 - 20) and (FIGURE 1A - 20)

D. Load the software for the Honeywell APU type GTCP331-350 (C) (refer to CMM 49-63-01 and CMM 49-63-10).

NOTE: Refer to section Description and Operation, paragraph 3.

E. Test the ECB with the applicable ATLAS Test Program (refer to section TESTING AND FAULT ISOLATION).

TASK 49-63-70-800-862-A00

5. SOFTWARE LOADING

The software which implements the MICBAC Monitor and the software which implements the control laws and the communication with other aircraft systems can be separately downloaded

into the ECB using the RS232 interface provided via the test connector J2. However, to be able to perform the downloading process, a resident downloading software is permanently stored in the ECB. This downloading software can be programmed without removing the Flash EPROMs from the CPU board.

The following two chapters describe the software loading process.

A. Loading of Resident Software

CAUTION: THIS PARA IS FOR INFORMATION ONLY. NORMALLY THE RESIDENT SOFTWARE NEEDS NOT TO BE CHANGED.

The resident software is loaded using the Background Debug Monitor facility of the microcontroller MC68332. This interface is accessible via the RS232 connector on the front panel.

The communication using the Background Debug Monitor is supported by a special software tool running under MS-DOS on a personal computer. The communication link is established by an interface cabel which connects the RS232 connector with the personal computer.

The loading process is performed in the following steps:

- Connect the RS232 connector with the personal computer
- Power personal computer and enter software tool
- Power ECB
- Start download macro of software tool

The interface cabel and the software tool and macro may be ordered from DAs. It is not necessary to change the resident software in service, however.

The download macro loads a bootstrap kernel into the SRAM of the microcontroller. This kernel erases the Flash EPROMs completely and then programs the downloading software which is taken from a file. After finishing the programming of the Flash EPROMs the checksums of the downloading software are calculated and verified against the checksums loaded. A resp. message is displayed on the monitor of the personal computer.

B. Loading of Non-Resident Software

The non-resident software (MICBAC Monitor and Control Software) can be loaded via the test connector J2. A special interface program is needed running on a personal computer under MS-DOS. This interface program is supplied together with the loadable images of the MICBAC Monitor and the Control Software.

The resident software (Downloader) can be entered by connecting pin J2-d of the test connector J2 to ground and sending the string ‘D<CR><LF>’ within 16 seconds after powering the ECB. The Downloader answers with "*DOWNLOAD".

The Downloader can only be left by de-powering the ECB.

The Downloader provides the following six commands (implemented as function keys in the interface program):

(1) C<CR><LF> (show configuration)

This command displays the HW and SW configuration of the ECB.

(2) V<CR><LF> (verify Control Software)

This command starts the verification of the Control Software. The EPROM area occupied by the Control Software is compared with the downloadable image stored in a file on the personal computer. The contents of this file are transmitted to the ECB on request. The verification process checks the complete file. It issues a resp. message at the end.

(3) W<CR><LF> (verify MICBAC Monitor)

This command starts the verification of the MICBAC Monitor. The EPROM area occupied by the MICBAC Monitor is compared with the downloadable image stored in a file on the personal computer. The contents of this file are transmitted to the ECB on request. The verification process checks the complete file. It issues a resp. message at the end.

(4) D<CR><LF> (download Control Software)

Prior to issueing this command, pin J2-c of the test connector J2 must be connected to ground. The command starts the downloading of the Control Software. The image of the Control Software stored in a file on the personal computer is send to the ECB on request. The image is only programmed, if the software to be downloaded complies with the hardware of the ECB. If a difference is encountered, the downloading process is aborted and the old software remains valid in the ECB. Otherwise the EPROM area is cleared and then newly programmed with the new image. If a failure is found during the programming or during the checks at the end of the programming, the EPROM area is cleared.

(5) H<CR><LF> (download MICBAC Monitor)

Prior to issueing this command, pin J2-c of the test connector J2 must be connected to ground. The command starts the downloading of the MICBAC Monitor. The image of the MICBAC Monitor stored in a file on the personal computer is send to the ECB on request. The image is only programmed, if the software to be downloaded complies with the hardware of the ECB. If a difference is encountered, the downloading process is aborted and the old software remains valid in the ECB. Otherwise the EPROM area is cleared and then newly programmed with the new image. If a failure is found during the programming or during the checks at the end of the programming, the EPROM area is cleared.

(6) E<CR><LF> (erase MICBAC Monitor)

Prior to issueing this command, pin J2-c of the test connector J2 must be connected to ground. This command erases the memory area occupied by the MICBAC Monitor.

TASK 49-63-70-99F-871-A00

1. GENERAL

This section gives information how to assemble the component.

TASK 49-63-70-94A-871-A00

2. LIST OF MATERIALS

The materials that follow are used in this section.

NOTE: Equivalent alternatives can be used for items in the list.

ITEM	SUPPLIER'S CODE
ADHESIVE (ECCOBOND 286)	D2617
LOCKING COMPOUND (LOCTITE 221)	05972
LUBRICANT SPRAY (PTFE)	C4054

LIST OF MATERIALS
TABLE 7001

TASK 49-63-70-400-871-A00

3. PROCEDURE

CAUTION: THE UNIT CONTAINS ELECTROSTATIC DISCHARGE SENSITIVE (ESDS) COMPONENTS. USE APPLICABLE SAFETY PRECAUTIONS WHEN YOU DO MAINTENANCE ON OR NEAR COMPONENTS SENSITIVE TO ELECTROSTATIC DISCHARGE. IF YOU DO NOT DO THIS, YOU CAN CAUSE DAMAGE TO THE UNIT.

CAUTION: THE BOARDS CAN CONTAIN OPERATIONAL SOFTWARE.

NOTE: Refer to the section "Special Tools, Fixtures, Equipment and Consumables" for special tools necessary for disassembly.

NOTE: You must test the ECB after assembly, refer to the section TESTING AND FAULT ISOLATION.

NOTE: Lock all screws with two spots ADHESIVE (ECCOBOND 286) on the edge of the screw head.

EFFECT: 3888394-121202, 3888394-121203, 3888394-121204, 3888394-121205

SUBTASK 49-63-70-400-171-A00

A. ASSEMBLY PROCEDURE FOR ECB (CAST HOUSING)

(1) Mounting of the Test Connector J2

Put the test connector J2 (FIGURE 2 - 80) into correct position and attach it with four new rivets (FIGURE 2 - 90).

(2) Mounting of the Cap

Put the cap (FIGURE 2 - 95) into correct position and attach its lug with new rivet (FIGURE 2 - 100).

(3) Installation of the Power Supply Unit

(a) Pass the flat cable connection P5 of the test connector J2 (FIGURE 2 - 80) through the wall entrance of the Power Supply Unit (FIGURE 2 - 50) and put it in the correct position into the right chassis (FIGURE 2 - 105).

(b) Attach the Power Supply Unit with six screws (FIGURE 2 - 55), sprayed with LUBRICANT SPRAY (PTFE) and torque to 150 Ncm (13.28 lbf.in.).

(c) Engage the flat cable connection P5 of the test connector J2 (FIGURE 2 - 80) in connector J5 of the Power Supply Unit (FIGURE 2 - 50) and fasten the safety clamp (FIGURE 2 - 85) on connector J5.

(4) Installation of the Subsequent Boards

- CPU Board A31 (FIGURE 4 - 20),
- INPUT/OUTPUT Board A35 (FIGURE 4 - 50).

(a) Engage the flat cable connection (FIGURE 4 - 40) in connector J11 of the CPU Board.

(b) Engage the flat cable connection (FIGURE 4 - 45) in the connector J9 of the CPU Board.

(c) Put the CPU Board in the correct position on the frame of the INPUT/ OUTPUT Board and attach it with eight screws (FIGURE 4 - 25) and eight washers (FIGURE 4 - 30) and torque to 55 Ncm (4.87 lbf.in.). Lock the eight screws with two spots ADHESIVE (ECCOBOND 286) on the edge of the screw head.

(d) Put the CPU-I/O Module (FIGURE 2 - 20) in the correct position in the left chassis (FIGURE 2 - 35) and attach it with six screws (FIGURE 2 - 25), sprayed with LUBRICANT SPRAY (PTFE) and torque to 150 Ncm (13.28 lbf.in.).

(5) Assembly of the Core Module (cast housing)

(a) Engage the flat cable connection (FIGURE 4 - 45) in the connector J9 of the PSU (FIGURE 2 - 50) and fasten the safety clamp (FIGURE 2 - 30).

(b) Engage the flat cable connection (FIGURE 4 - 35) in the connector J10 of the PSU (FIGURE 2 - 50).

(c) Engage the flat cable connections (FIGURE 2 - 60), (FIGURE 2 - 65) and (FIGURE 2 - 70) in the connectors J6 - J8 of the CPU I/IO Module (FIGURE 2 - 20) and fasten the safety clamp (FIGURE 2 - 75) on the flat cable connection (FIGURE 2 - 70).

(d) Bring the left chassis (FIGURE 2 - 35) together with the right chassis (FIGURE 2 - 105) and bolt them together with four screws (FIGURE 2 - 15), sprayed with LUBRICANT SPRAY (PTFE) and torque to 150 Ncm (13.28 lbf.in.). These four screws must always be new parts, due to the self securing inserts.

(6) Installation of the Connector Plate

Put the Connector Plate (FIGURE 3 - 65) in the correct position next to the Connect Module and attach it with six screws (FIGURE 3 - 75) and with five screws (FIGURE 3 - 70). Lock the five screws (FIGURE 3 - 70) only with a spot ADHESIVE (ECCOBOND 286) on the edge of the screw head.

(7) Installation of the Connect Module

CAUTION: MAKE SURE THAT THE FLEX LEADS OF CONNECTORS P6, P7 AND P8 FIGURE 2A DO NOT PREVENT THE ENGAGEMENT OF CONNECTORS P3 AND P4 FIGURE 3.

(a) Put the Connect Module (FIGURE 1 - 45) in the correct position next to the box and engage carefully the Connect Module in the connectors (J3 and J4, FIGURE 2).

(b) Attach the Connect Module with six screws (FIGURE 1 - 40), sprayed with LUBRICANT SPRAY (PTFE) and torque to 100 Ncm (8.85 lbf.in.). These six screws must always be new parts, due to the self securing inserts.

EFFECT: 3888394-221202, 3888394-221203, 3888394-221204, 3888394-221205, 3888394-321206

SUBTASK 49-63-70-400-172-A00

B. ASSEMBLY PROCEDURE FOR ECB (EXTRUSION HOUSING)

(1) Mounting of the Test Connector J2

Put test connector J2 (FIGURE 2A - 45) into correct position and attach it with four new rivets (FIGURE 2A - 50) at the front plate (FIGURE 2A - 25).

(2) Mounting of the Cap

Put the cap (FIGURE 2A - 55) into correct position and attach its lug with new rivet (FIGURE 2A - 60) at the front plate (FIGURE 2A - 25).

(3) Installation of the Power Supply Unit

(a) Pass the flat cable connection P5 of the test connector J2 (FIGURE 2A - 45) through the wall entrance of the Power Supply Unit (FIGURE 2A - 115).

(b) Engage the flat cable connection P5 of the test connector J2 (FIGURE 2A - 45) in connector J5 of the Power Supply Unit (FIGURE 2A - 115) and fasten the safety clamp (FIGURE 2A - 145) on connector J5.

(c) Engage the flat cable connection (FIGURE 4 - 35) in the connector J10 of the Power Supply Unit (FIGURE 2A - 115).

(d) Engage the flat cable connection (FIGURE 4 - 45) in the connector J9 of the Power Supply Unit (FIGURE 2A - 115) and fasten the safety clamp (FIGURE 2A - 110).

(e) Engage the flat cable connections (FIGURE 2A - 125), (FIGURE 2A - 130) and (FIGURE 2A - 135) in the connectors J6 - J8 of the CPU-I/O Module (FIGURE 2A - 100) and fasten the safety clamp (FIGURE 2A - 140) on the flat cable connection (FIGURE 2A - 135).

(f) Attach the CPU-I/O Module (FIGURE 2A - 100) together with the Power Supply Unit (FIGURE 2A - 115) at the extrusion top (FIGURE 2A - 80) with two screws (FIGURE 2A - 105) and four screws (FIGURE 2A - 120) sprayed with LUBRICANT SPRAY (PTFE) and torque to 225 Ncm (19.91 lbf.in.).

(4) Installation of the Subsequent Boards

- CPU Board A31 (FIGURE 4 - 20)
- INPUT/OUTPUT Board A35 (FIGURE 4 - 50).

(a) Engage the flat cable connection (FIGURE 4 - 40) in the connector J11 of the CPU Board (FIGURE 4 - 20).

(b) Engage the flat cable connection (FIGURE 4 - 45) in the connector J9.

(c) Put the CPU Board in the correct position on the frame of the INPUT/ OUTPUT Board and attach it with eight screws (FIGURE 4 - 25) and eight washers (FIGURE 4 - 30) and torque to 55 Ncm (4.87 lbf.in.). Lock the eight screws with two spots ADHESIVE (ECCOBOND 286) on the edge of the screw head.

(d) Engage the flat cable connection (FIGURE 4 - 35) in the connector J10 of the Power Supply Unit (FIGURE 2A - 115).

(e) Engage the flat cable connection (FIGURE 4 - 45) in the connector J9 of the Power Supply Unit (FIGURE 2A - 115) and fasten the safety clamp (FIGURE 2A - 110).

(f) Engage the flat cable connections (FIGURE 2A - 125), (FIGURE 2A - 130) and (FIGURE 2A - 135) in the connectors J6 - J8 of the CPU-I/O Module (FIGURE 2A - 100) and fasten the safety clamp (FIGURE 2A - 140) on the flat cable connection (FIGURE 2A - 135).

(g) Attach the CPU-I/O Module (FIGURE 2A - 100) together with the Power Supply Unit (FIGURE 2A - 115) at the extrusion top (FIGURE 2A - 80) with two screws (FIGURE 2A - 105) and four screws (FIGURE 2A - 120) sprayed with LUBRICANT SPRAY (PTFE) and torque to 225 Ncm (19.91 lbf.in.).

(5) Assembly of the Core Module (extrusion housing)

(a) Attach the front plate (FIGURE 2A - 25) to the extrusion top (FIGURE 2A - 80) with three screws (FIGURE 2A - 20) secured with LOCKING COMPOUND (LOCTITE 221) and torque to 100 Ncm (8.85 lbf.in.).

(b) Push the extrusion bottom (FIGURE 2A - 90) carefully on to the extrusion top (FIGURE 2A - 80).

(c) Attach it with three screws (FIGURE 2A - 20) at the front plate (FIGURE 2A - 25)and with two screws (FIGURE 2A - 20) at the sides of the box, secured with LOCKING COMPOUND (LOCTITE 221) and torque to 95 Ncm (8.41 lbf.in.).

(d) Insert two screws (FIGURE 2A - 105) and four screws (FIGURE 2A - 120) sprayed with LUBRICANT SPRAY (PTFE) and torque to 225 Ncm (19.91 lbf.in.).

(6) Installation of the Connector Plate

Put the Connector Plate (FIGURE 3 - 65) in the correct position next to the Connect Module and attach it with six screws (FIGURE 3 - 75) and with five screws (FIGURE 3 - 70). Lock the five screws (FIGURE 3 - 70) only with a spot ADHESIVE (ECCOBOND 286) on the edge of the screw head.

(7) Installation of the Connect Module

CAUTION: MAKE SURE THAT THE FLEX LEADS OF CONNECTORS P6, P7 AND P8 (FIGURE 2A) DO NOT PREVENT THE ENGAGEMENT OF CONNECTORS P3 AND P4 (FIGURE 3).

(a) Put the Connect Module (FIGURE 1A - 45) in the correct position next to the box and engage carefully the Connect Module in the connectors (J3 and J4, FIGURE 2A).

(b) Attach the Connect Module with six screws (FIGURE 1A - 40B), secured with LOCKING COMPOUND (LOCTITE 221) and torque to 95 Ncm (8.41 lbf.in.).

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FITS AND CLEARANCES

TASK 49-63-70-94C-881-A00

1. FITS AND CLEARANCES

A. Torque Value Table

All the torque values referenced in the different page blocks are listed in the table below.

NOTE: The torque values given are rated values for calibration of the torque wrench in accordance with DIN EN ISO 6789.

DESIGNATION / IPL FIG. ITEM No	TORQUE -M_t-
Screw (FIGURE 1 - 15A)	55 Ncm (4.87 lbf.in.)
Screw (FIGURE 1 - 25A)	55 Ncm (4.87 lbf.in.)
Screw (FIGURE 1 - 40)	100 Ncm (8.85 lbf.in.)
Screw (FIGURE 1A - 15A)	55 Ncm (4.87 lbf.in.)
Screw (FIGURE 1A - 15B)	95 Ncm (8.41 lbf.in.)
Screw (FIGURE 1A - 16)	95 Ncm (8.41 lbf.in.)
Screw (FIGURE 1A - 25A)	55 Ncm (4.87 lbf.in.)
Screw (FIGURE 1A - 25B)	95 Ncm (8.41 lbf.in.)
Screw (FIGURE 1A - 26)	95 Ncm (8.41 lbf.in.)
Screw (FIGURE 1A - 40A)	100 Ncm (8.85 lbf.in.)
Screw (FIGURE 1A - 40B)	95 Ncm (8.41 lbf.in.)
Screw (FIGURE 2 - 15)	150 Ncm (13.28 lbf.in.)
Screw (FIGURE 2 - 25)	150 Ncm (13.28 lbf.in.)
Screw (FIGURE 2 - 55)	150 Ncm (13.28 lbf.in.)
Screw (FIGURE 2A - 20)	95 Ncm (8.41 lbf.in.)
Screw (FIGURE 2A - 105)	225 Ncm (19.91 lbf.in.)
Screw (FIGURE 2A - 120)	225 Ncm (19.91 lbf.in.)
Screw (FIGURE 3 - 170)	55 Ncm (4.87 lbf.in.)
Screw (FIGURE 4 - 25)	55 Ncm (4.87 lbf.in.)

TORQUE VALUES
TABLE 8001

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SPECIAL TOOLS, FIXTURES, EQUIPMENT AND CONSUMABLES

TASK 49-63-70-94A-891-A00

1. LIST OF MATERIALS

The consumables in the list are necessary for the maintenance of the component.

NOTE: Equivalent alternatives can be used for items in the list.

ITEM	SUPPLIER'S CODE	USE		
		REP	ASY	STO
ADHESIVE (ECCOBOND 286)	D2617	X	X	
ATA 300 CATEGORY 2 CONTAINER	LOCALLY AVAILABLE			X
CLEANING AGENT (ISOPROPYL ALCOHOL GRADE A)	C6604	X		
DESICCANT SILICA GEL	LOCALLY AVAILABLE			X
ESD PROTECTION BAG	LOCALLY AVAILABLE			X
LOCKING COMPOUND (LOCTITE 221)	05972	X	X	
LUBRICANT SPRAY (PTFE)	C4054		X	
MASKING TAPE	LOCALLY AVAILABLE	X		
SEALING TAPE	LOCALLY AVAILABLE			X
SELF-SEALING TRANSPARENT TAPE	LOCALLY AVAILABLE			X
VARNISH (HUMISEAL 1B31)	99109	X		
WIRE MX30-130 ORANGE (JUMPER WIRE PTFE AWG30 OG)	C3033	X		

LIST OF MATERIALS
TABLE 9001

TASK 49-63-70-910-891-A00

2. TOOLS, FIXTURES AND EQUIPMENT

A. General

This section contains a list with the special tools required for the maintenance operations described in this Manual, but does not include the conventional tools which operators should have at their disposal.

B. Special Tools and Fixtures

Special tools are required for loosen the flat cable connection. Special flat cable grip tongs can be ordered from Diehl Aerospace GmbH.

C. List of Equipment

No special tester is specified.

NOTE: Items 1, 2, 3 and 5, 6, 7 of Table 901 are always required for testing.

ITEM	PART NUMBER	DESCRIPTION	TES	DIS	REP	ASS	MOD
1	684742950300000	MICBAC Test Software Diehl Aerospace GmbH	X				X
2	084746090995000	Download interface program DL13196A for PN 3888394-121202 DL13197A for PN 3888394-221202 Diehl Aerospace GmbH	X				X
3	084744000061000	Download interface program DL1318A for PN 3888394-121203 DL1319A for PN 3888394-221203 Diehl Aerospace GmbH	X				X
4	084742000060000 P47M-01-2059/001	Download Cable made by DAs Download Cable made by Honeywell	X				X
5	284744000061000	Download interface program DL1319A for PN 3888394-121204 DL1319A for PN 3888394-221204 Diehl Aerospace GmbH	X				X
6	584744000061000	Download interface program DL1319A for PN 3888394-121205 DL1319A for PN 3888394-221205 Diehl Aerospace GmbH	X				X
7	584744000061000	Download interface program DL1319A for PN 3888394-321206 Diehl Aerospace GmbH	X				X

EQUIPMENT
TABLE 9002

STORAGE INCLUDING TRANSPORTATION

TASK 49-63-70-550-951-A00

1. GENERAL

This section gives instructions for ECB preservation, packaging, storing and transport to temperate and tropical climates.

TASK 49-63-70-94A-952-A00

2. LIST OF MATERIALS

The materials that follow are used in this section.

NOTE: Equivalent alternatives can be used for items in the list.

ITEM	SUPPLIER'S CODE
ATA 300 CATEGORY 2 CONTAINER	LOCALLY AVAILABLE
DESICCANT SILICA GEL	LOCALLY AVAILABLE
ESD PROTECTION BAG	LOCALLY AVAILABLE
SEALING TAPE	LOCALLY AVAILABLE
SELF-SEALING TRANSPARENT TAPE	LOCALLY AVAILABLE

LIST OF MATERIALS
TABLE 15001

TASK 49-63-70-94A-951-A00

3. EQUIPMENT AND MATERIALS

No special equipment and materials are required.

TASK 49-63-70-550-952-A00

4. PROCEDURE

SUBTASK 49-63-70-550-251-A00

A. PROCEDURE FOR THE LRU ECB AND PRINTED CIRCUIT BOARDS

(1) Record all details shown on the identification label.

(2) Place the unit or board together with a label showing its code and serial numbers into a ESD protection bag. Further add a bag with a sufficient quantity of desiccant silica gel into this bag depending on the storage time and the air volume in the ESD protection bag. Evacuate the bag by hand as far as possible and seal by high-frequency welding.

NOTE: Sealing must be performed with an over-length of bag materials sufficient for at least three times re-using of the bag.

(3) Place the preformed cushioning into the ATA 300 category 2 container. Place the prepared unit or board into the cushioning and close this by the appropriate cover plate.

(4) Close the container lids and seal its joints with sealing tape.

(5) Apply a unit identification label with following details to three container surfaces:

- unit designation
- manufacturer's name and address
- manufacturer's part number
- quantity
- unit's serial number and unit's code number
- modification state
- packing date (month/year).

(6) Cover these labels with self-sealing transparent tape.

(7) Place the same warning label as applied to the unit of board to three container surfaces and protect the labels with self-sealing transparent tape.

SUBTASK 49-63-70-550-252-A00

B. STORAGE CONDITIONS

Storage environment:

- Ambient temperature: -40 °C (-40 °F) to 54 °C (129 °F)
- Relative humidity: 45% to 75%
- Storage time: not limited.

SUBTASK 49-63-70-540-251-A00

C. UNPACKING

Unpacking during storage is not recommended, unless packing is damaged. Open packing only if the unit is required for use. Cut the ESD protection bag close to the seal, thus allowing re-sealing. Keep container and packing material for further use.

SUBTASK 49-63-70-510-251-A00

D. TRANSPORT

For re-storage and re-shipment it is recommended to use the original container and packing material or a similar packaging and to perform packing in accordance with paragraph "Procedure".

SUBTASK 49-63-70-540-252-A00

E. FUNCTIONAL TEST

After shipment and storage of a time longer than 36 months, before installing the unit in the aircraft, it is recommended to perform a functional test (BITE run or PAT according to section TESTING AND FAULT ISOLATION).

ILLUSTRATED PARTS LIST

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INTRODUCTION

TASK 49-63-70-99F-901-A00

1. GENERAL

A. This ILLUSTRATED PARTS LIST (IPL) is prepared to ATA iSpec 2200. It is divided as follows:

- INTRO: Introduction
- Equipment Designator Index
- Numerical Index (in alphanumeric order)
- List of Vendors
- Detailed Parts List.

B. Function and Use

(1) The IPL contains a list of all the components used in the equipment. Its function is to help the procurement of parts and subassemblies. The parts given in the IPL must be procured by the Part Numbers and from the manufacturers given in the Parts List. If not, the warranty can be cancelled.

NOTE: Before ordering a part directly from its manufacturer, check the Diehl Optional Part Number Catalog (OPNC) ATA No. 20-40-01 for its validity. The OPNC shows other approved optional parts that can also be used instead of this part.

(2) It is possible to identify parts as follows:

(a) From the Manufacturer's Part Number

Find the related Part Number in the Numerical Index (alpha and numerical). The columns to the right give the figure and item number of the part in the Detailed Parts List.

(b) From the Equipment Designator (for electronic components)

Find the equipment designator of the component on the Schematic Diagram. Then refer to the Equipment Designator Index to find:

- The figure and item number of the component in the Detailed Parts List.

NOTE: The Equipment Designator Index has a GEO LOC column which shows the geographical location of the component on the printed circuit board.

(c) If the Part Number or Equipment Designator of the Part are not known:

Look for the figure which shows the part and its item number. Then refer to the Detailed Parts List to find its Part Number.

C. How to use the Detailed Parts List

(1) The Detailed Parts List contains one or more figures which show the main assemblies of the equipment. Details of the parts are given on the opposite and subsequent pages.

(2) The list is divided into these columns:

- 1st column: Figure Item - Figure and Item number
- 2nd column: Part Number - Manufacturer's Part Number
- 3rd column: Airline Stock Number
- 4th column: Nomenclature
- 5th column: Effectivity Code
- 6th column: Units per assy - Quantity for the next higher assembly.

(3) Details of the columns:

(a) Figure and Item Number

The figure number is given on the first line at the top of each page. Each item in the parts list which has a part number also has an item number. If there is a dash in front of an item number, the item is not shown on the figure. A letter before the item number refers to the figure which shows a variant of the related part. A letter after the item number identifies a variant of the part.

(b) Part Number

Each assembly, subassembly and detail part has a manufacturer's Part Number (if it is shown on the figures or not). If the Part Number has more than 15 characters, the data in this column is given for identification only. The full manufacturer's Part Number is given in the NOMENCLATURE column, after the indication "ORDER OVERLGTH MPN...". It is followed by the FSCM (Federal Supply Code for Manufacturer).

(c) Airline Stock Number

This column is for airline use.

(d) Nomenclature

1 The NOMENCLATURE column gives the names of the assemblies and parts. The indication "ATTACHING PARTS" shows the parts which attach an assembly or part. These attaching parts are given directly below the assembly or part they attach. The next line has three asterisks, the first of which is directly below the item which is attached.

2 A Vendor Code is given for all the items which do not have a prime manufacturer's Part Number. This Vendor Code is given at the right of the NOMENCLATURE column. The addresses and codes of Vendors are given in the VENDOR CODE LIST. Optional Part Numbers and Vendors are given in the OPTIONAL PARTS LIST in the IPL. Please note that only the manufacturers who appear in the OPL have been accepted as a result of the equipment qualification test, and should therefore be used.

3 If a part can come from a range of possible parts, the indication "SEL FROM" is given below the part. The indication "ESDS" is given in the NOMENCLATURE column for electronic components which are sensitive to electrostatic discharges.

(e) Usage Code

1 A single upper case (e.g. A,B,C) legend/code is used in the "effectivity" column to show an operator)s current effectivity between parts, and depicts only restricted interchangeability relationships. The term "operator)s current effectivity" refers to the complete effectivity range for all parts, and includes the original item, any or all of its variants and/or their attaching parts. These parts, if affected, are be updated each time a new part (variant) is added, superseded, modified or deleted.

2 Within a figure, a part number identified by a usage code (a single upper case alpha designation) denotes that the coded part must be used with other parts identified with the same alpha designation. Also, coded parts can be used with all other non-coded parts (no alpha designation).

3 The usage code begins with A and continues with B, C, D, ... Z. If required, the succession follows BA, CA, DA ... ZA, CB, DB, EB ... DC, EC, FC, etc., always beginning with the next alpha set which succeeds the last set by one alpha.

4 The usage code identifies affected parts within a single figure only. The same code can appear in other figures, but it is only used for those parts within the figure in which it is listed. Effectivity does not relate to more than one figure. Figure alphas are considered a separate figure.

5 Item numbers with variants that have a common effectivity code or no effectivity code can be intermixed provided that it is not specifically prohibited by special notes in the nomenclature.

(f) Units per Assy

The UNITS PER ASSY column shows the number of parts necessary for the next higher assembly. For some assemblies or parts, the number is replaced by the letters RF (for Reference) and AR (As Required).

D. Interchangeability Statement and Definitions

Interchangeability Terms, Abbreviations, Definitions, and Related T-File Explanation Codes (EC).

Term	Abbreviation	Definition	EC
Alternate	ALT	The part agrees with all functional and structural specifications, but the external dimensions, connection installation, and/or mounting provisions are different. Rework or possible changes can be necessary.	36

INTERCHANGEABILITY TERMS
TABLE 10001 (continued on next page)

Term	Abbreviation	Definition	EC
Optional	OPT	The part is fully interchangeable in form, fit, and function with other item numbers shown.	39
Preferred	PRFD	The part is preferred over the other optional parts shown.	71
Replaced By	REPLD	The part is replaced and is two-way interchangeable with the item number shown (old part number can replace either old or new part number when removed).	02
Replaces	REPLS	The part replaces and is two-way interchangeable with the item number shown (new part number is acceptable replacement for old or new part number).	02
Service Bulletins	SB PRE SB POST SB RWK	Identifies when a Service Bulletin (SB) has an effect on a part. PRE shows the condition of the part before the work in the service bulletin is done; POST shows the condition after the work is done; RWK shows that the part is reworked by the service bulletin.	
Superseded By	SUPSD BY	The part is superseded by and is one-way interchangeable with the item number shown (old part number can be used as replacement only where old part was installed).	01
Supersedes	SUPSDS	The part supersedes and is one-way interchangeable with the item number shown (new part number is acceptable replacement for old or new part number).	01

INTERCHANGEABILITY TERMS
TABLE 10001

E. Abbreviations used in the Detailed Parts List

List of abbreviations

AR	As Required
AMDT	Amendment
DET	Detail
EC	Eplanation Code
EFF	Effectivity
ESDS	Electrostatic Discharge Sensitive
IPL	Illustrated Parts List
NHA	Next Higher Assembly

PCB	Printed Circuit Board
NP	Not Procurable
OPNC	Optional Part Number Catalog
OPT	Optional
ORDER OVERLGTH MP	Order Overlength Manufacturer's Part Number
POST SB	Post Service Bulletin
PRE SB	Pre Service Bulletin
R	Revised
REPLD	Replaced
RF	For Reference
SB	Service Bulletin
SEL FROM	Select From
SUPSD BY	Superseded By
SUPSDS	Supersedes

2. LIST OF VENDORS

For vendor names and addresses refer to the online Business Identification Cross-reference System (BINCS) search engine on: https://cage.dla.mil/Search/ .

NOTE: The data contained in BINCS is government owned information, and as such possibly can not be reused or marketed for commercial use. Searches are for free, however DLA Logistics Information Services reserves the right to restrict access if unreasonable use of the system is made.

MFR	VENDOR ADDRESS
D4829	DIEHL AEROSPACE GMBH ALTE NUSSDORFER STRASSE 23 88662 UEBERLINGEN GERMANY

LIST OF VENDORS
TABLE 10002

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EQUIPMENT DESIGNATOR INDEX

EQUIPMENT DESIGNATOR	GEO. LOC.	FIG.	ITEM
A10		2	50A
A10		2A	115A
A31		4	20A
A31		4	20B
A31-A35		2	20A
A31-A35		2	20B
A31-A35		2A	100A
A31-A35		2A	100B
A31-A35		4	1A
A31-A35		4	1B
A31-A35		4	1C
A31-A35		4	1D
A35		4	50A
A35		4	50B
A35		4	50C
C50		3	95A
C51		3	100A
C52		3	90A
C53		3	105A
C53		3	105B
C54		3	105A
C54		3	105B
C55		3	115A
F1		3	120A
J2-P5		2	80A
J2-P5		2A	45A
J7-P7		2	65A
J7-P7		2A	130A
J8-P8		2	60A
J8-P8		2A	125A
J9-P9		4	45A
L50		3	125A
L50		3	125B
L51		3	125A
L51		3	125B
P10-J10		4	35A
P11		4	40A
P6		2	70A
P6		2A	135A
R1		3	155A
R10		3	160A
R11		3	165A
R2		3	150A
R50		3	145A
R51		3	145A
R60		3	135A
R61		3	135A
R70		3	140A
R71		3	130A
R72		3	130A
R73		3	130A
T50		3	170A
V50		3	190A
V51		3	190A
V52		3	185A
V53		3	185A
V54		3	185A
V55		3	185A
V60		3	200A
V61		3	200A
V70		3	195A

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NUMERICAL INDEX

PART NUMBER	AIRLINE STOCK NUMBER	FIG.	ITEM	TTL REQ
BYV27-200		3	195A	1
B41590A8108T		3	105B	2
B82132A5602M		3	125A	2
LN9499-01-060		2	45A	3
		2	115A	3
LN9499-02-060		2	40A	4
		2	110A	
M39014-02-1320		3	90A	1
M39014-02-1415		3	115A	1
SMBJ7-5CA		3	200A	2
SMCJ15A		3	190A	2
SMSC1R0M01		3	125B	2
SST1-5M		3	110A	4
0000142416		1	35A	1
		1A	35A	1
		2A	35A	1
		4	15A	1
0000142421		3	15A	1
0000164929		3	130A	3
0000164936		3	160A	1
0000165552		3	165A	1
0000171551		3	135A	2
0000171613		3	140A	1
0000171639		3	150A	1
0000171757		3	145A	2
0000181261		3	120A	1
0000194606		3	95A	1
0000197711		3	100A	1
0000535779		3	105A	2
0000543064		4	25A	8
0000543101		1A	15C	2
		1A	26B	1
0000543166		1	15A	2
		1	25A	2
		1A	15A	2
		1A	25A	2

NUMERICAL INDEX

PART NUMBER	AIRLINE STOCK NUMBER	FIG.	ITEM	TTL REQ
0000543782		2A	70A	2
0000602221		2	15A	4
0000603067		3	155A	1
0000603157		2	80A	1
		2A	45A	1
0000603646		2	25A	6
		2	55A	6
		2A	105A	4
		2A	120A	8
0000607497		1A	16A	2
		1A	25B	1
		1A	40B	6
		2A	20A	8
		3	70A	5
		3	75A	6
		3	85A	1
		3	175A	4
0000607498		1	40A	6
		1A	15B	2
		1A	26A	1
		1A	40A	6
0000610105		2A	10A	1
0000610768		2A	30A	1
0000610770		4	10A	1
0000610779		3	25A	1
0000610902		2	10A	2
		3	10A	1
0000617381		2A	40A	1
0000619585		1A	28A	1
0001032045		3	10B	1
0001032051		2A	10B	1
0001032053		3	25B	1
0001032898		4	10B	AR
0001032907		1	30B	AR
		1A	30B	AR
		3	20B	AR

NUMERICAL INDEX

PART NUMBER	AIRLINE STOCK NUMBER	FIG.	ITEM	TTL REQ
0001033351		1	10C	AR
		1A	10C	AR
084641000000010		1	30A	1
		1A	30A	1
		3	20A	1
084641033103000		3	170A	1
084742010100000		2	35A	1
084742010200000		2	105A	1
084744210000002		3	65A	1
084744210000003		3	180A	2
084744210000004		3	80A	1
084744210000009		3	30A	1
084748000000508		1	10B	AR
		1A	10B	AR
1N5550		3	185A	4
184742010100000		2A	15A	1
184742010101000		2A	80A	1
184742010102000		2A	90A	1
184742010103000		2A	25A	1
184742010113000		2A	75A	1
184742011002000		2	70A	1
		2A	135A	1
184742011003000		2	60A	1
		2A	125A	1
184742011004000		2	65A	1
		2A	130A	1
184742023102000		4	35A	1
184742023103000		4	40A	1
184742023502000		4	45A	1
284742000000508		1	10A	1
		1A	10A	1
284742000000509		1	20A	1
		1A	20A	1
284742010103000		2A	25B	1
284742010113000		2A	75B	1
302003016		2A	85A	6

NUMERICAL INDEX

PART NUMBER	AIRLINE STOCK NUMBER	FIG.	ITEM	TTL REQ
		2A	95A	6
3601-1500		2A	65A	1
38828-076		2	95A	1
		2A	55A	4
3888394-000202		1	55A	AR
		1A	60A	AR
3888394-000203		1	55B	AR
		1A	60B	AR
3888394-000204		1	55C	AR
		1A	60C	AR
3888394-000205		1	55D	AR
		1A	60D	AR
3888394-000206		1A	60E	AR
3888394-021000		1	45A	1
		1A	45A	1
		3	1A	RF
3888394-100000		1	50A	1
		2	1A	RF
3888394-121202		1	1A	RF
3888394-121203		1	1B	RF
3888394-121204		1	1C	RF
3888394-121205		1	1D	RF
3888394-200000		1A	50A	1
		1A	50B	1
		2	1B	RF
		2A	1A	RF
3888394-221202		1A	1A	RF
3888394-221203		1A	1B	RF
3888394-221204		1A	1C	RF
3888394-221205		1A	1D	RF
3888394-300000		1A	50C	1
		2A	1B	RF
3888394-321206		1A	1E	RF
407660NRST		4	30A	8
511066720700000		2	85A	1
		2A	145A	1

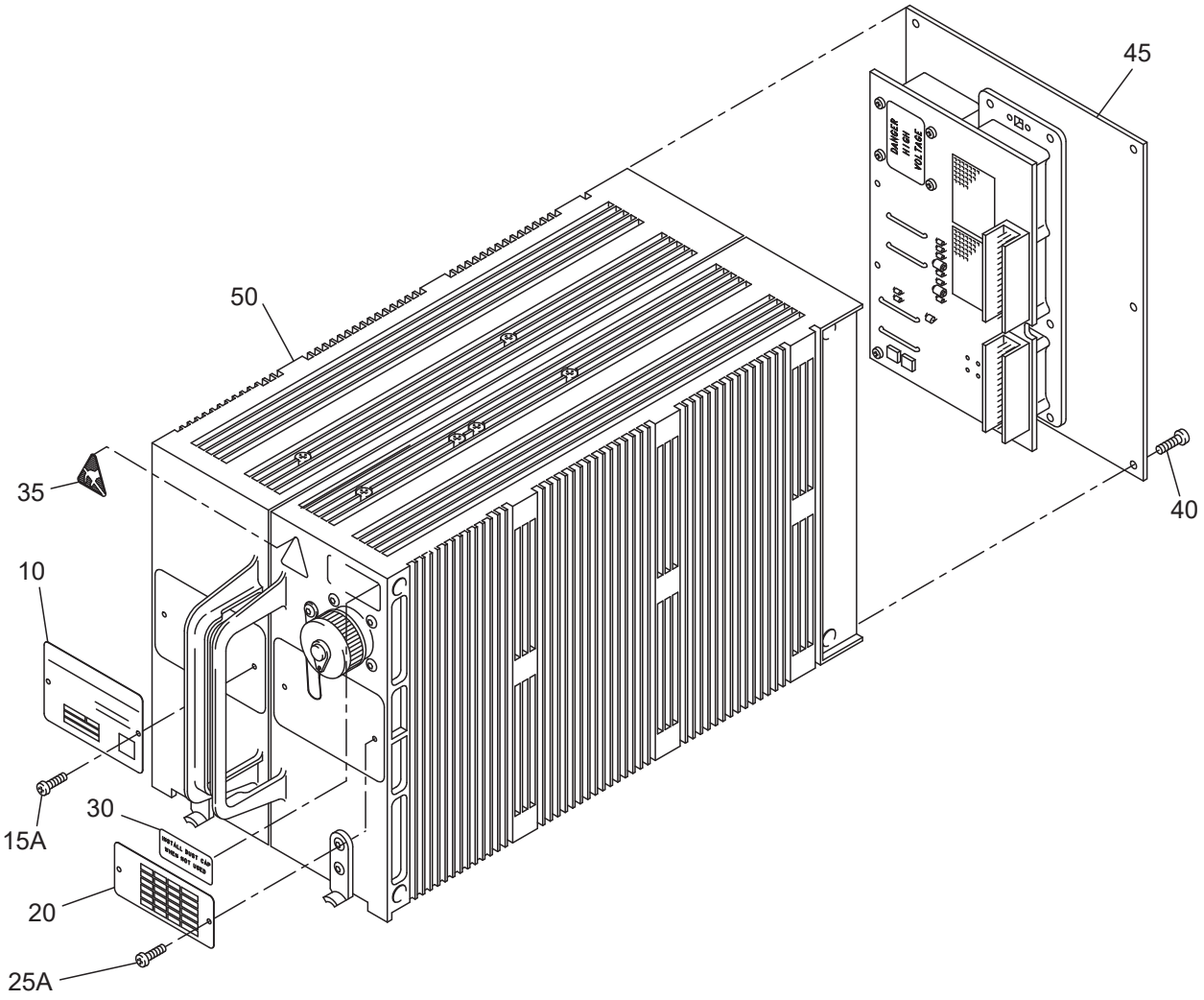
NUMERICAL INDEX

PART NUMBER	AIRLINE STOCK NUMBER	FIG.	ITEM	TTL REQ
511066740700000		2	75A	1
		2A	140A	1
511066750700000		2	30A	1
		2A	110A	1
584742011000000 AMDT A, B, C		2	50A	1
584742011000000 AMDT B		2A	115A	1
584742011000000 AMDT C		2A	115B	1
584742020000000		4	1A	RF
584742020000000 AMDT C		2	20A	1
584742023100000 AMDT A		4	20A	1
584742023500000 AMDT C		4	50A	1
584742950300000		1	60A	AR
620214010		3	40A	4
620234004		3	45A	3
620244005		3	50A	4
620361		3	35A	133
6300146		2	90A	1
		2	100A	1
		2A	50A	4
		2A	60A	1
684742020000000		4	1B	RF
		4	1C	RF
		4	1D	RF
684742020000000 AMDT C		2	20B	1
		2A	100A	1
684742020000000 AMDT D		2A	100B	1
684742023100000 AMDT A		4	20B	1
684742023500000 AMDT D		4	50B	1
684742023500000 AMDT D, E, G, H		4	50C	1
684742023500000 AMDT H		4	50C	1
684742023500000 AMDT D, E, G, H		4	50C	1
684742023500000 AMDT H		4	50C	1
684742950300000		1A	65A	AR
784742950300000		1	60B	AR
8660-146		3	60A	AR
8660-147		3	55A	AR

NUMERICAL INDEX

PART NUMBER	AIRLINE STOCK NUMBER	FIG.	ITEM	TTL REQ
884742950300000		1A	65B	AR

DETAILED PARTS LIST



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ELECTRONIC CONTROL BOX (ECB)
FIGURE 1

FIG. ITEM	PART NUMBER	AIRL. STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UPA
1					
- 1A	3888394-121202		BOX - ELECTRONIC CONTROL ELECTROSTATIC SENSITIVE DEVICE MFD BY D4829 PRE VSB 3888394-49-7790		RF
- 1B	3888394-121203		BOX - ELECTRONIC CONTROL ELECTROSTATIC SENSITIVE DEVICE MFD BY D4829 POST VSB 3888394-49-7790 PRE VSB 3888394-49-7899		RF
- 1C	3888394-121204		BOX - ELECTRONIC CONTROL ELECTROSTATIC SENSITIVE DEVICE MFD BY D4829 POST VSB 3888394-49-7899 PRE VSB 3888394-49-8107		RF
- 1D	3888394-121205		BOX - ELECTRONIC CONTROL ELECTROSTATIC SENSITIVE DEVICE MFD BY D4829 POST VSB 3888394-49-8107		RF
10A	284742000000508		· LABEL - IDENTIFICATION		1
- 10B	084748000000508		· OPTIONAL		AR
- 10C	0001033351		· OPTIONAL	1D	AR
			ATTACHING PARTS		
15A	0000543166		· SCREW ORDER OVERLENGTH PNR IS07045M2-5X4A2-70Z		2
			* * *		
20A	284742000000509		· LABEL - AMENDMENT		1
			ATTACHING PARTS		
25A	0000543166		· SCREW ORDER OVERLENGTH PNR IS07045M2-5X4A2-70Z		2
			* * *		
30A	084641000000010		· LABEL - DESIGNATION		1
- 30B	0001032907		· OPTIONAL		AR
35A	0000142416		· LABEL - WARNING		1
			ATTACHING PARTS		
40A	0000607498		· SCREW - M3X8		6

FIG. ITEM	PART NUMBER	AIRL. STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UPA
1			* * *		
45A	3888394-021000		· MODULE - CONNECT (A318/319/320/321) FOR DET SEE FIGURE 3		1
50A	3888394-100000		· MODULE - CORE FOR DET SEE FIGURE 2		1
- 55A	3888394-000202		· SOFTWARE - CONTROL DOWNLOAD	1A	AR
- 55B	3888394-000203		· SOFTWARE - CONTROL DOWNLOAD	1B	AR
- 55C	3888394-000204		· SOFTWARE - CONTROL DOWNLOAD	1C	AR
- 55D	3888394-000205		· SOFTWARE - CONTROL DOWNLOAD	1D	AR
- 60A	584742950300000		· SOFTWARE - MICBAC DOWNLOAD		AR
- 60B	784742950300000		· SOFTWARE - MICBAC DOWNLOAD		AR

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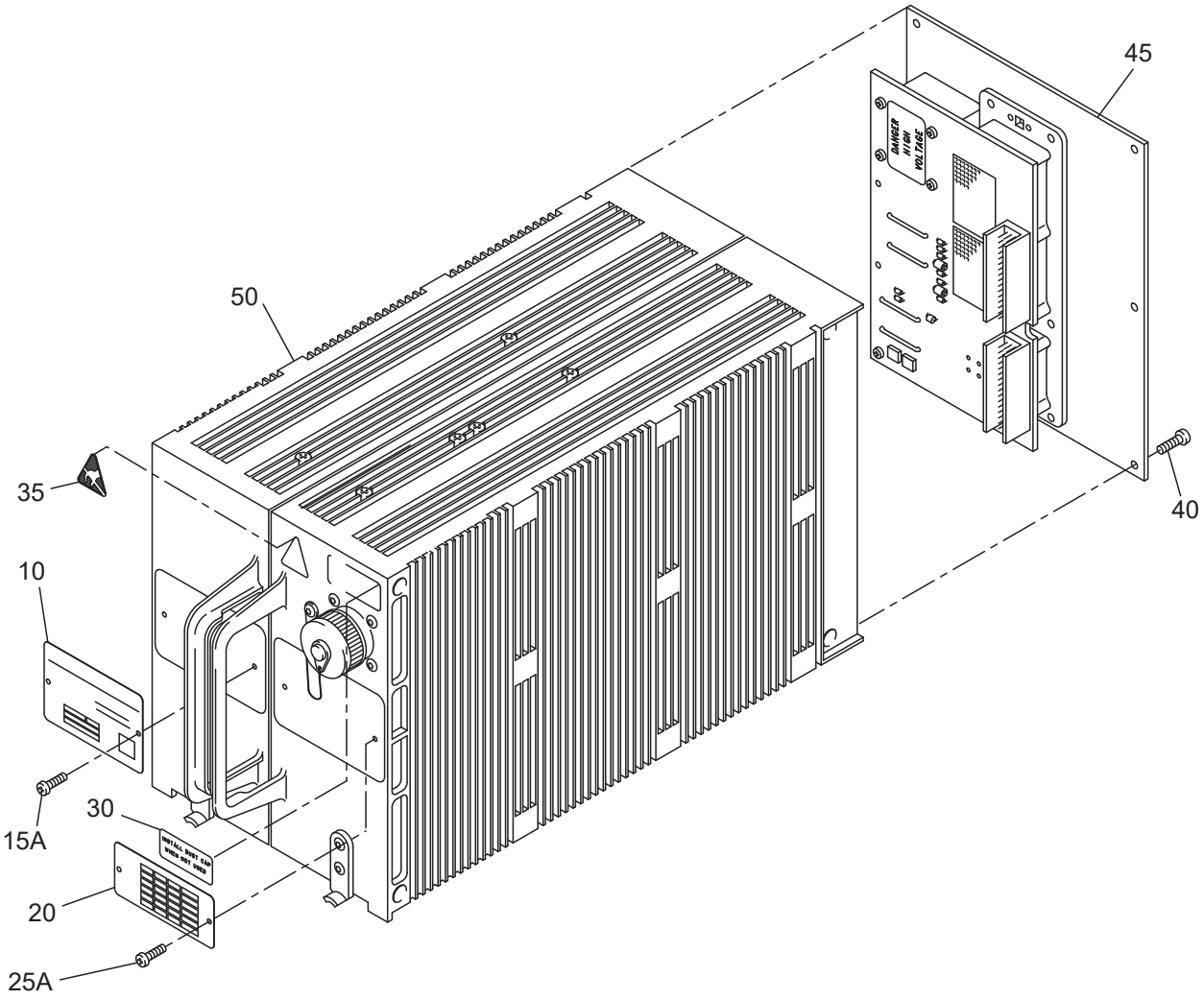

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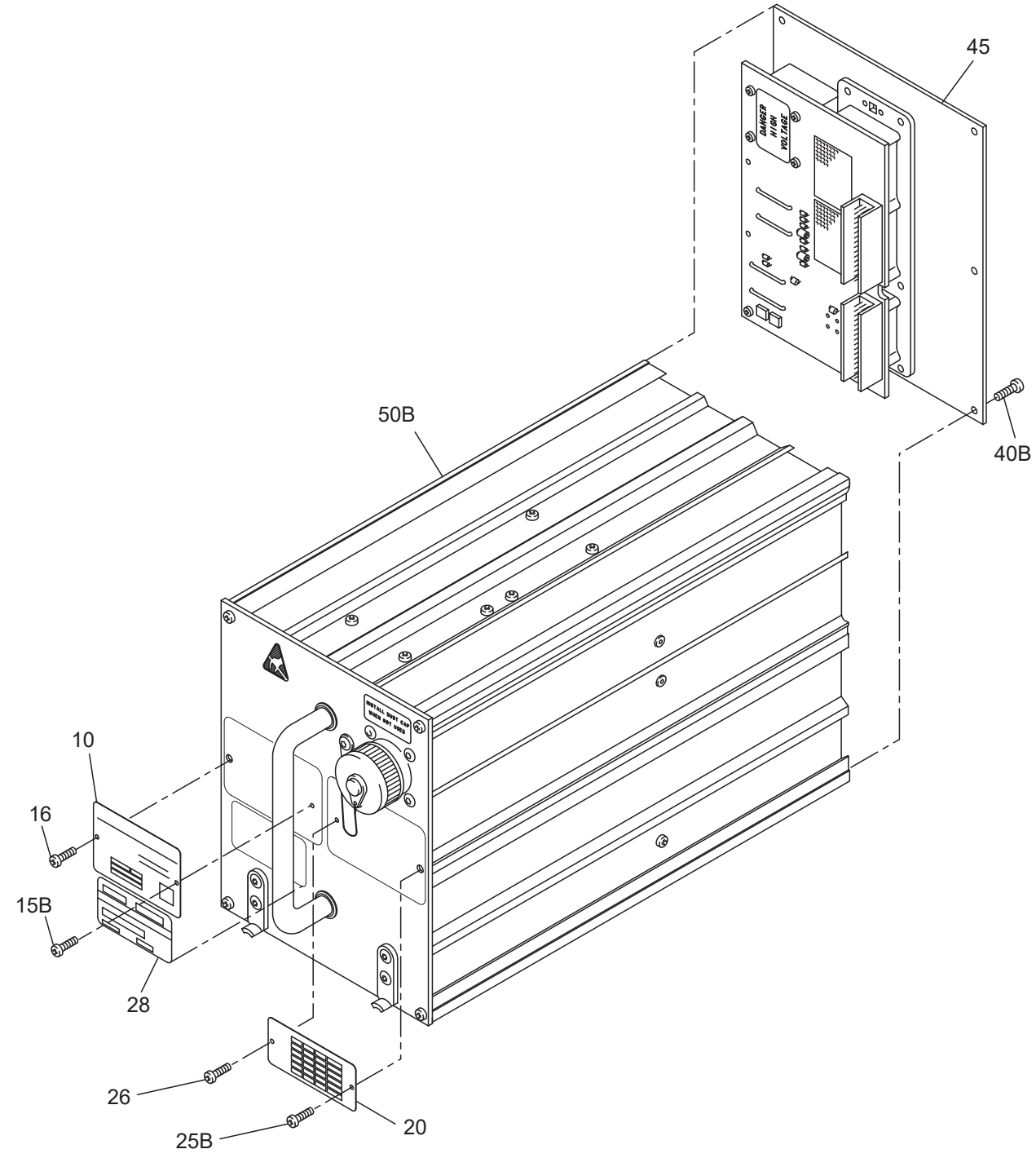
ELECTRONIC CONTROL BOX (ECB)
(CAST HOUSING)
FIGURE 1A [SHEET 1 OF 2]



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ELECTRONIC CONTROL BOX (ECB)
(EXTRUSION HOUSING)
FIGURE 1A [SHEET 2 OF 2]

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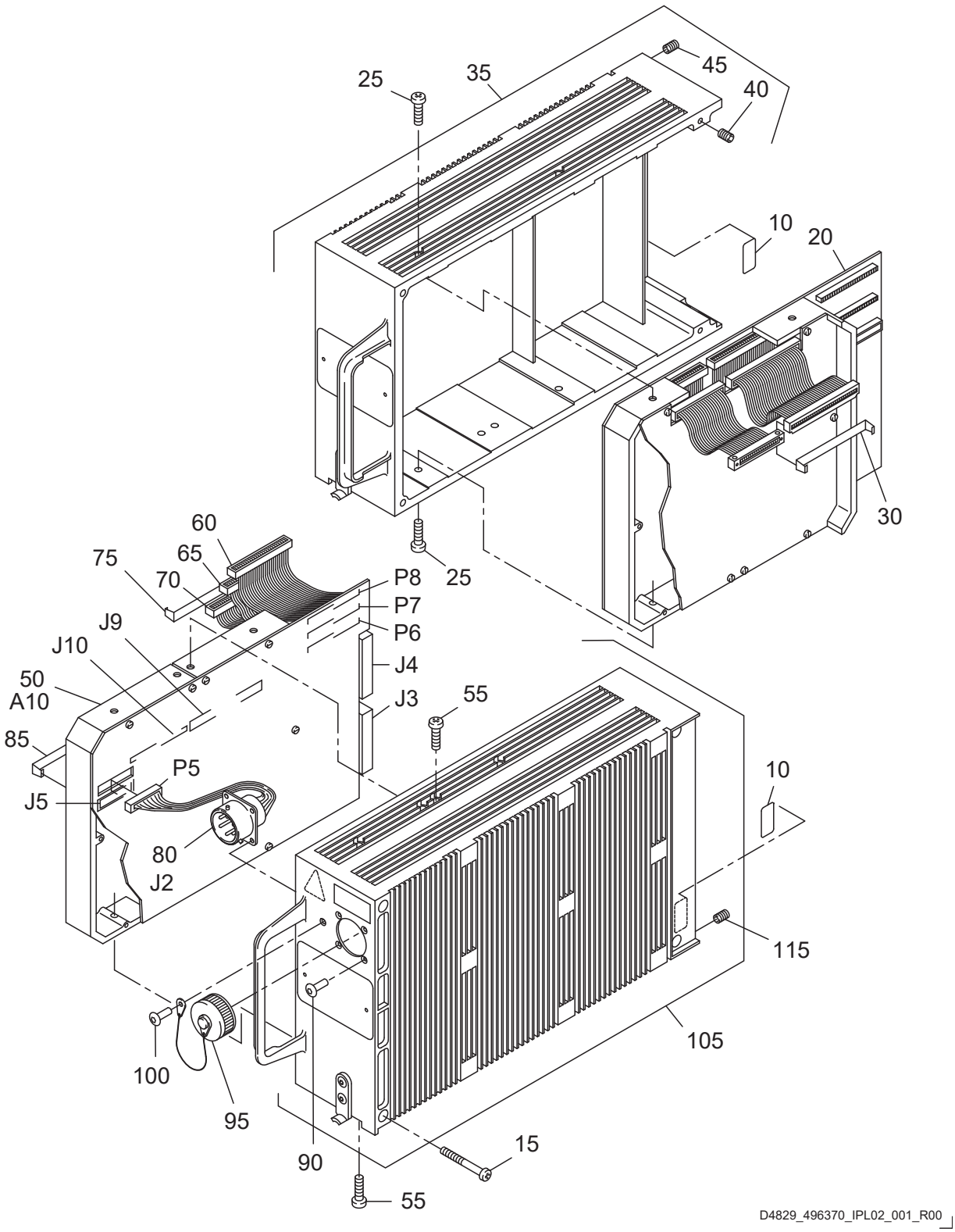
FIG. ITEM	PART NUMBER	AIRL. STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UPA
1A					
- 1A	3888394-221202		BOX - ELECTRONIC CONTROL ELECTROSTATIC SENSITIVE DEVICE MFD BY D4829 PRE VSB 3888394-49-7790		RF
- 1B	3888394-221203		BOX - ELECTRONIC CONTROL ELECTROSTATIC SENSITIVE DEVICE MFD BY D4829 POST VSB 3888394-49-7790 PRE VSB 3888394-49-7899		RF
- 1C	3888394-221204		BOX - ELECTRONIC CONTROL ELECTROSTATIC SENSITIVE DEVICE MFD BY D4829 POST VSB 3888394-49-7899 PRE VSB 3888394-49-8107		RF
- 1D	3888394-221205		BOX - ELECTRONIC CONTROL ELECTROSTATIC SENSITIVE DEVICE MFD BY D4829 POST VSB 3888394-49-8107		RF
- 1E	3888394-321206		BOX - ELECTRONIC CONTROL ELECTROSTATIC SENSITIVE DEVICE MFD BY D4829		RF
10A	284742000000508		· LABEL - IDENTIFICATION	1ABCD	1
- 10B	084748000000508		· OPTIONAL	1ABCD E	AR
- 10C	0001033351		· OPTIONAL	1D	AR
			ATTACHING PARTS		
15A	0000543166		· SCREW ORDER OVERLENGTH PNR IS07045M2-5X4A2-70Z FOR NHA SEE FIG. 2	50A	2
15B	0000607498		· SCREW - M3X8 REPLACED BY ITEM 15C	50B	2
15C	0000543101		· SCREW - M3X6 ORDER OVERLENGTH PNR ISO7045M3X6A2-70Z REPLACES ITEM 15B	50B	2

FIG. ITEM	PART NUMBER	AIRL. STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UPA
1A					
16A	0000607497		· SCREW - M3X10 FOR NHA SEE FIG. 2A	50B	2
			* * *		
20A	284742000000509		· LABEL - AMENDMENT FOR NHA SEE FIG. 2 AND 2A		1
			ATTACHING PARTS		
25A	0000543166		· SCREW ORDER OVERLENGTH PNR IS07045M2-5X4A2-70Z	50A	2
25B	0000607497		· SCREW - M3X10 FOR NHA SEE FIG. 2A	50B	1
26A	0000607498		· SCREW - M3X8 REPLACED BY ITEM 26B	50B	1
26B	0000543101		· SCREW - M3X6 ORDER OVERLENGTH PNR ISO7045M3X6A2-70Z REPLACES ITEM 26A	50B	1
			* * *		
28A	0000619585		· LABEL - BAR CODE DATA RECORD PRINTED ON LABEL PN 0000610105		1
30A	084641000000010		· LABEL - DESIGNATION DATA RECORD PN 0000617381 PRINTED ON LABEL PN 0000610886		1
- 30B	0001032907		· OPTIONAL		AR
35A	0000142416		· LABEL - WARNING		1
			ATTACHING PARTS		
40A	0000607498		· SCREW - M3X8		6
40B	0000607497		· SCREW - M3X10		6
			* * *		
45A	3888394-021000		· MODULE - CONNECT (A318/319/320/321) FOR DET SEE FIGURE 3		1
50A	3888394-200000		· MODULE - CORE CAST HOUSING FOR DET SEE FIGURE 2		1

FIG. ITEM	PART NUMBER	AIRL. STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UPA
1A 50B	3888394-200000		· MODULE - CORE EXTRUSION HOUSING FOR DET SEE FIGURE 2A	1ABCD	1
- 50C	3888394-300000		· MODULE - CORE EXTRUSION HOUSING FOR DET SEE FIGURE 2A	1E	1
- 60A	3888394-000202		· SOFTWARE - CONTROL DOWNLOAD	1A	AR
- 60B	3888394-000203		· SOFTWARE - CONTROL DOWNLOAD	1B	AR
- 60C	3888394-000204		· SOFTWARE - CONTROL DOWNLOAD	1C	AR
- 60D	3888394-000205		· SOFTWARE - CONTROL DOWNLOAD	1D	AR
- 60E	3888394-000206		· SOFTWARE - CONTROL DOWNLOAD	1E	AR
- 65A	684742950300000		· SOFTWARE - MICBAC DOWNLOAD		AR
- 65B	884742950300000		· SOFTWARE - MICBAC DOWNLOAD		AR



CORE MODULE
PN 3888394-100000, 3888394-200000
FIGURE 2

FIG. ITEM	PART NUMBER	AIRL. STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UPA
2					
- 1A	3888394-100000		MODULE - CORE FOR NHA SEE FIGURE 1	A	RF
- 1B	3888394-200000		MODULE - CORE FOR NHA SEE FIGURE 1A	B	RF
10A	0000610902		· LABEL - IDENTIFICATION DATA RECORD PRINTED ON LABEL PN 0000610105		2
			ATTACHING PARTS		
15A	0000602221		· SCREW ORDER OVERLENGTH PNR IS07045M4X30A2-70Z		4
			* * *		
20A	584742020000000		· MODULE - CPU-I/O AMDT C AMENDMENT C FOR DET SEE FIGURE 4	A	1
20B	684742020000000		· MODULE - CPU-I/O AMDT C FOR DET SEE FIGURE 4	B	1
			ATTACHING PARTS		
25A	0000603646		· SCREW ORDER OVERLENGTH PNR IS07045M4X8A2-70Z		6
			* * *		
30A	511066750700000		· CLAMP - SAFETY VD9378 PN 0000543595 BY VD4829		1
35A	084742010100000		· CHASSIS - LEFT		1
40A	LN9499-02-060		· · INSERT - HELICAL COIL		4
45A	LN9499-01-060		· · INSERT - HELICAL COIL		3
50A	584742011000000		· UNIT - POWER SUPPLY AMDT A, B, C		1
			ATTACHING PARTS		
55A	0000603646		· SCREW ORDER OVERLENGTH PNR IS07045M4X8A2-70Z		6
			* * *		
60A	184742011003000		· CONNECTION - FLAT CABLE (PSU-I/O) (10J8-35P8) OPTIONAL PART 0000605293 VD4829		1

FIG. ITEM	PART NUMBER	AIRL. STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UPA
2					
65A	184742011004000		· CONNECTION - FLAT CABLE (PSU-I/O) (10J7-35P7) OPTIONAL PART 0000605292 VD4829		1
70A	184742011002000		· CONNECTION - FLAT CABLE (PSU-I/O) (10P6-35P6) OPTIONAL PART 0000605181 VD4829		1
75A	511066740700000		· CLAMP - SAFETY VD9378 PN 0000543594 BY VD4829		1
80A	0000603157		· CONNECTOR - TEST, ASSEMBLY (J2-10P5)		1
			ATTACHING PARTS		
85A	511066720700000		· CLAMP - SAFETY VD9378 PN 0000543592 BY VD4829		1
90A	6300146		· RIVET - 3X7-AL VD0640 PN 0000604155 BY VD4829		1
			* * *		
95A	38828-076		· CAP VD8311 PN 0000194252 BY VD4829		1
			ATTACHING PARTS		
100A	6300146		· RIVET - 3X7-AL VD0640 PN 0000604155 BY VD4829		1
			* * *		
105A	084742010200000		· CHASSIS - RIGHT VD0640		1
110A	LN9499-02-060		· · DELETED		
115A	LN9499-01-060		· · INSERT - HELICAL COIL		3

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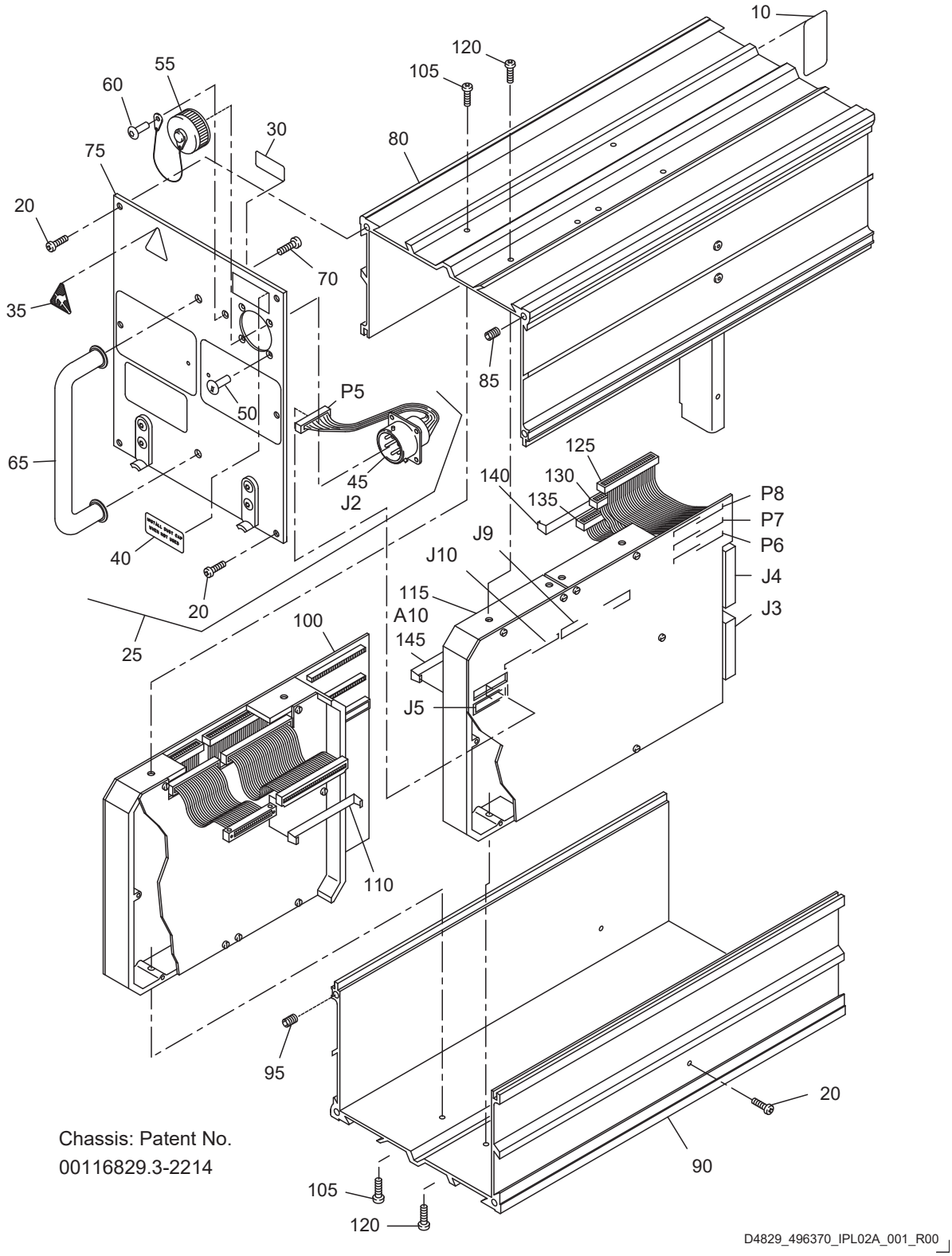
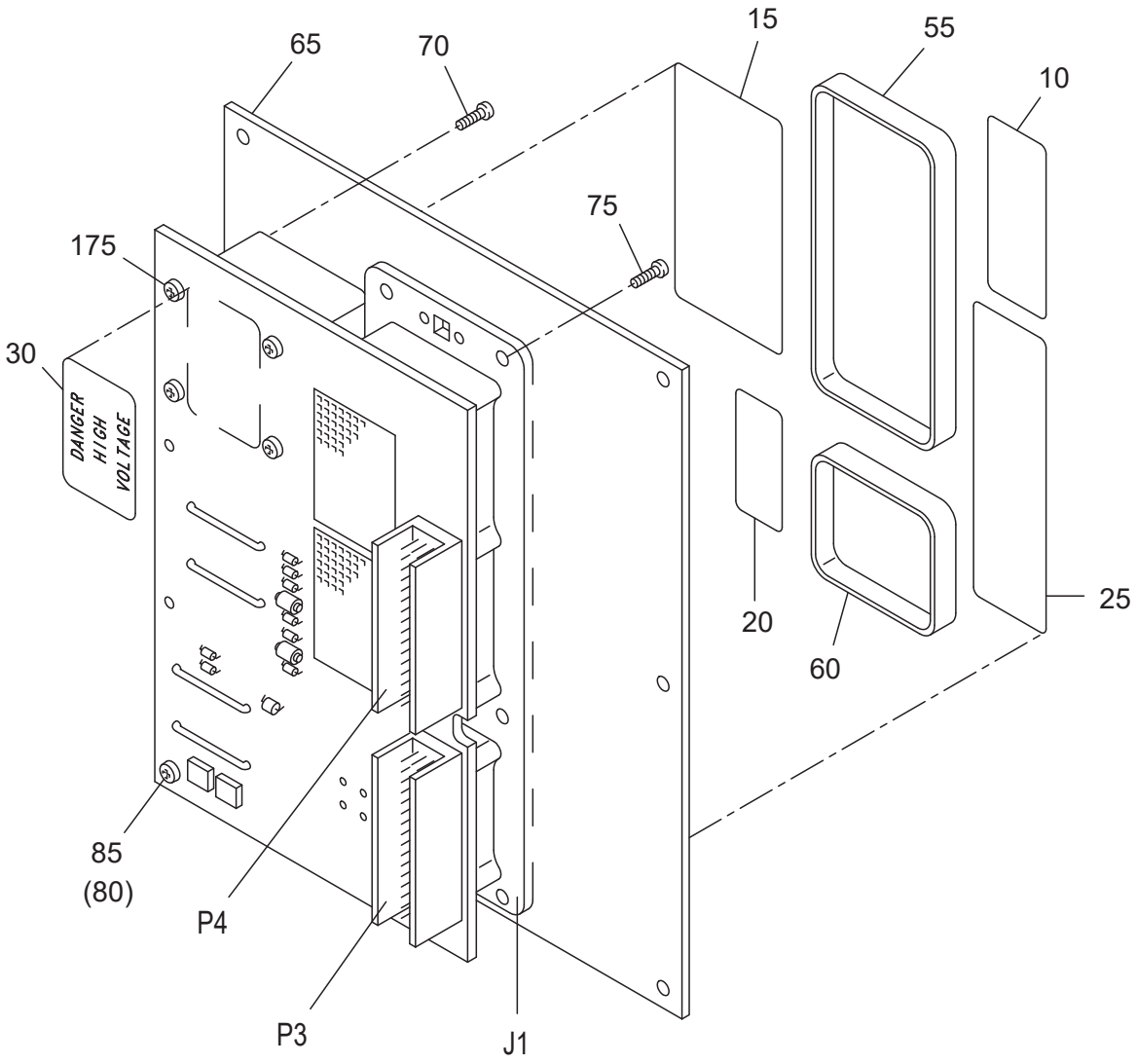


CORE MODULE
PN 3888394-200000, 3888394-300000
FIGURE 2A

FIG. ITEM	PART NUMBER	AIRL. STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UPA
2A					
- 1A	3888394-200000		MODULE - CORE FOR NHA SEE FIGURE 1A		RF
- 1B	3888394-300000		MODULE - CORE FOR NHA SEE FIGURE 1A		RF
10A	0000610105		· LABEL - IDENTIFICATION	1A	1
10B	0001032051		· LABEL - IDENTIFICATION	1B	1
15A	184742010100000		· CHASSIS		1
20A	0000607497		· · SCREW		8
25A	184742010103000		· · PLATE - FRONT ASSEMBLY REPLACED BY ITEM 25B		1
25B	284742010103000		· · PLATE - FRONT ASSEMBLY REPLACES ITEM 25A		1
30A	0000610768		· · · LABEL - IDENTIFICATION DATA RECORD PRINTED ON LABEL 0000610102		1
35A	0000142416		· · · LABEL - WARNING		1
40A	0000617381		· · · LABEL - DESIGNATION DATA RECORD PRINTED ON LABEL 0000610886		1
45A	0000603157		· · · CONNECTOR - TEST, ASSEMBLY (J2-10P5)		1
			ATTACHING PARTS		
50A	6300146		· · · RIVET - 3X7-AL VD0640 PN 0000604155 BY VD4829		4
			* * *		
55A	38828-076		· · · CAP VD8311 PN 0000194252 BY VD4829		4
			ATTACHING PARTS		
60A	6300146		· · · RIVET - 3X7-AL VD0640 PN 0000604155 BY VD4829		1
			* * *		
65A	3601-1500		· · · HANDLE VD1340 PN 0000186261 BY VD4829		1
			ATTACHING PARTS		
70A	0000543782		· · · SCREW ORDER OVERLENGTH PNR IS07045M5X10A2-70Z		2

FIG. ITEM	PART NUMBER	AIRL. STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UPA
2A					
			* * *		
75A	184742010113000		· · · PLATE - FRONT	25A	1
75B	284742010113000		· · · PLATE - FRONT	25B	1
80A	184742010101000		· · EXTRUSION - TOP		1
85A	302003016		· · · INSERT - HELICAL COIL VD0716 PN 0000083152 BY VD4829		6
90A	184742010102000		· · EXTRUSION - BOTTOM		1
95A	302003016		· · · INSERT - HELICAL COIL VD0716 PN 0000083152 BY VD4829		6
100A	684742020000000		· MODULE - CPU-I/O AMDT C FOR DET SEE FIGURE 4	1A	1
- 100B	684742020000000		· MODULE - CPU-I/O AMDT D FOR DET SEE FIGURE 4	1B	1
			ATTACHING PARTS		
105A	0000603646		· SCREW ORDER OVERLENGTH PNR IS07045M4X8A2-70Z		4
			* * *		
110A	511066750700000		· CLAMP - SAFETY VD9378 PN 0000543595 BY VD4829		1
115A	584742011000000		· UNIT - POWER SUPPLY AMDT B	1A	1
- 115B	584742011000000		· UNIT - POWER SUPPLY AMDT C		1
			ATTACHING PARTS		
120A	0000603646		· SCREW ORDER OVERLENGTH PNR IS07045M4X8A2-70Z		8
			* * *		
125A	184742011003000		· CONNECTION - FLAT CABLE (PSU-I/O) (10J8-35P8) OPTIONAL PART 0000605293 VD4829		1
130A	184742011004000		· CONNECTION - FLAT CABLE (PSU-I/O) (10J7-35P7) OPTIONAL PART 0000605292 VD4829		1

FIG. ITEM	PART NUMBER	AIRL. STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UPA
2A					
135A	184742011002000		· CONNECTION - FLAT CABLE (PSU-I/O) (10P6-35P6) OPTIONAL PART 0000605181 VD4829		1
			ATTACHING PARTS		
140A	511066740700000		· CLAMP - SAFETY VD9378 PN 0000543594 BY VD4829		1
145A	511066720700000		· CLAMP - SAFETY VD9378 PN 0000543592 BY VD4829		1
			* * *		



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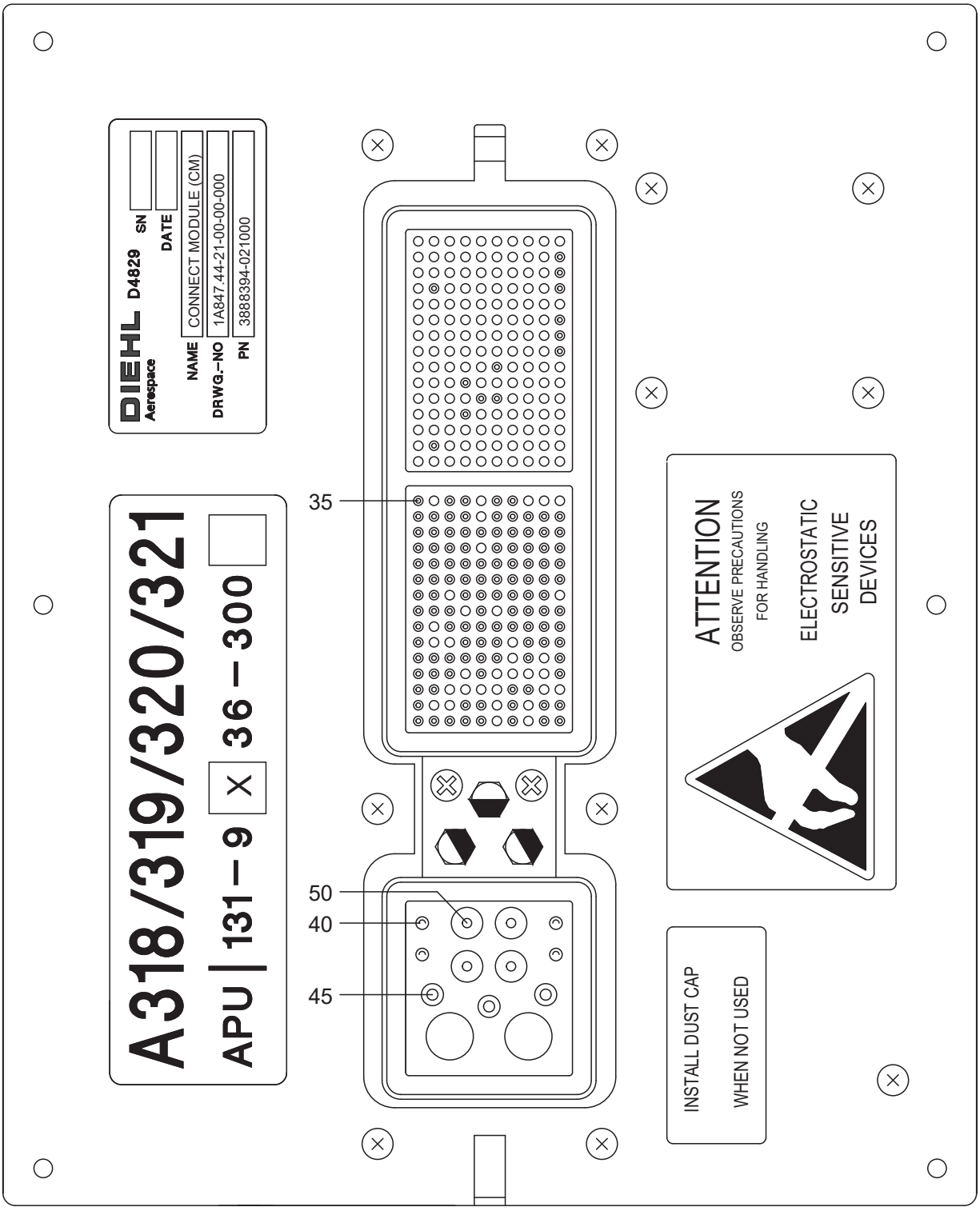
CONNECT MODULE (A318/319/320/321)
FIGURE 3 [SHEET 1 OF 4]



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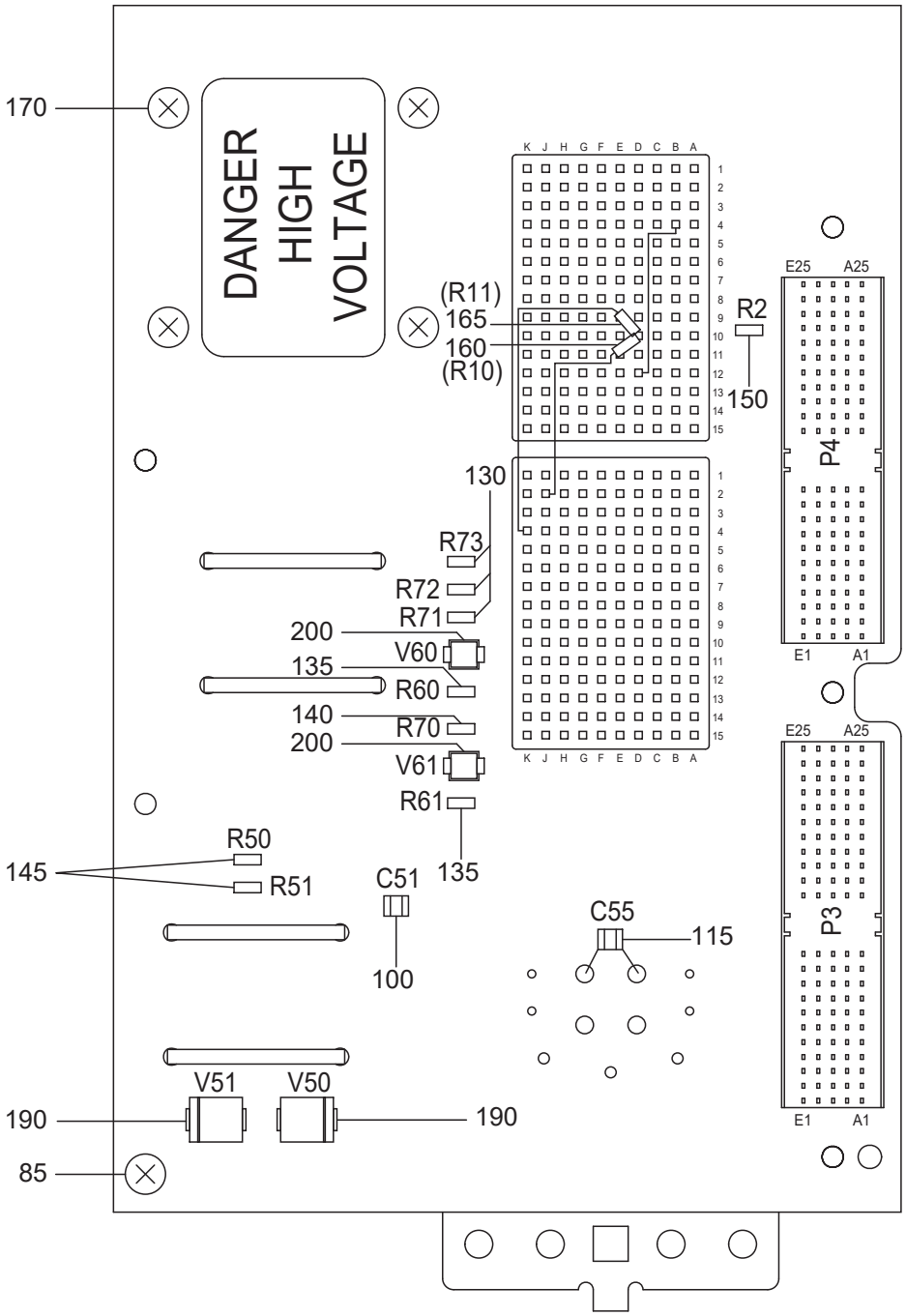
CONNECT MODULE (A318/319/320/321)
FIGURE 3 [SHEET 2 OF 4]



Note: For additional connections refer to section "REPAIR".

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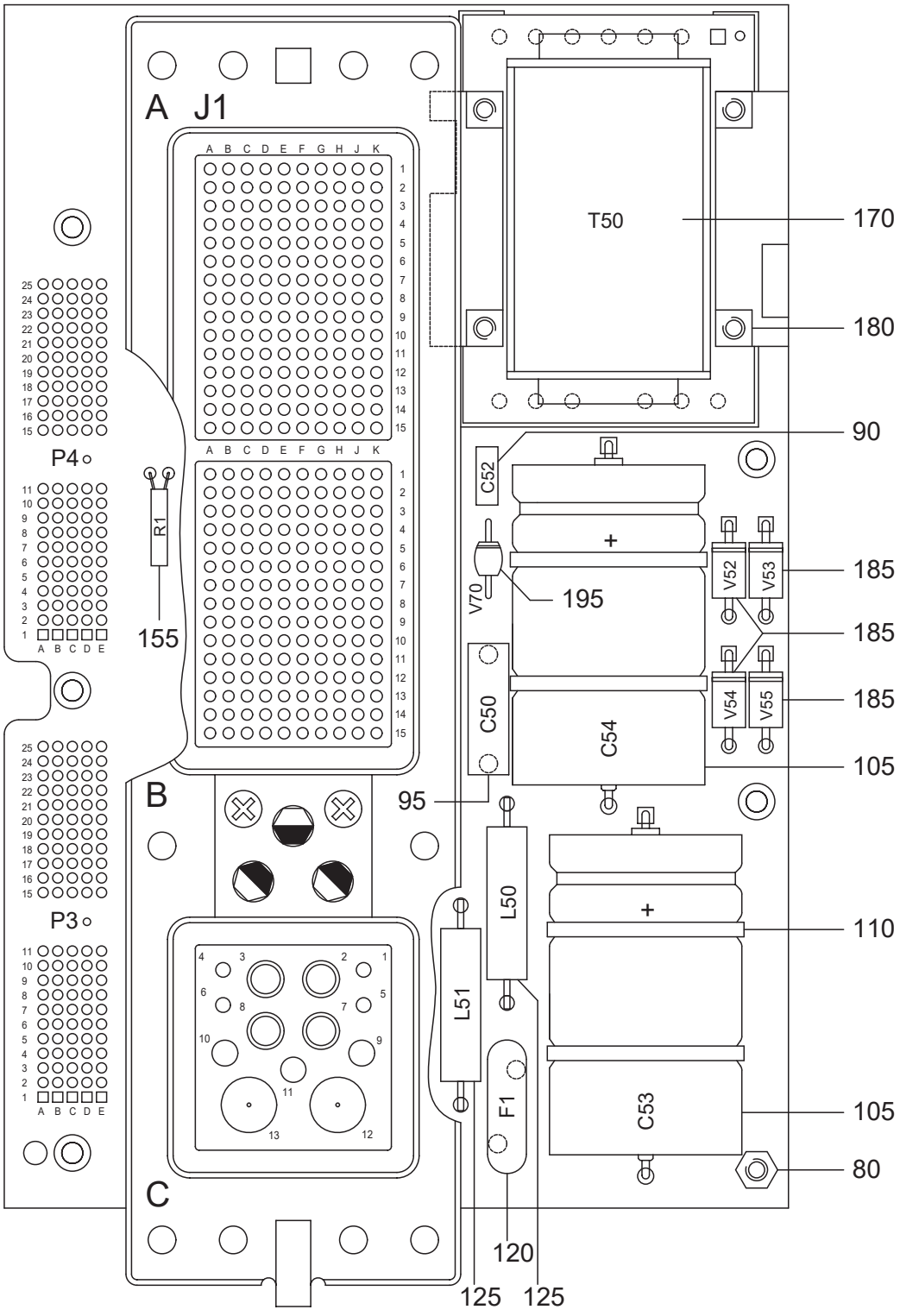
CONNECT MODULE (A318/319/320/321)
FIGURE 3 [SHEET 3 OF 4]



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CONNECT MODULE (A318/319/320/321)
FIGURE 3 [SHEET 4 OF 4]

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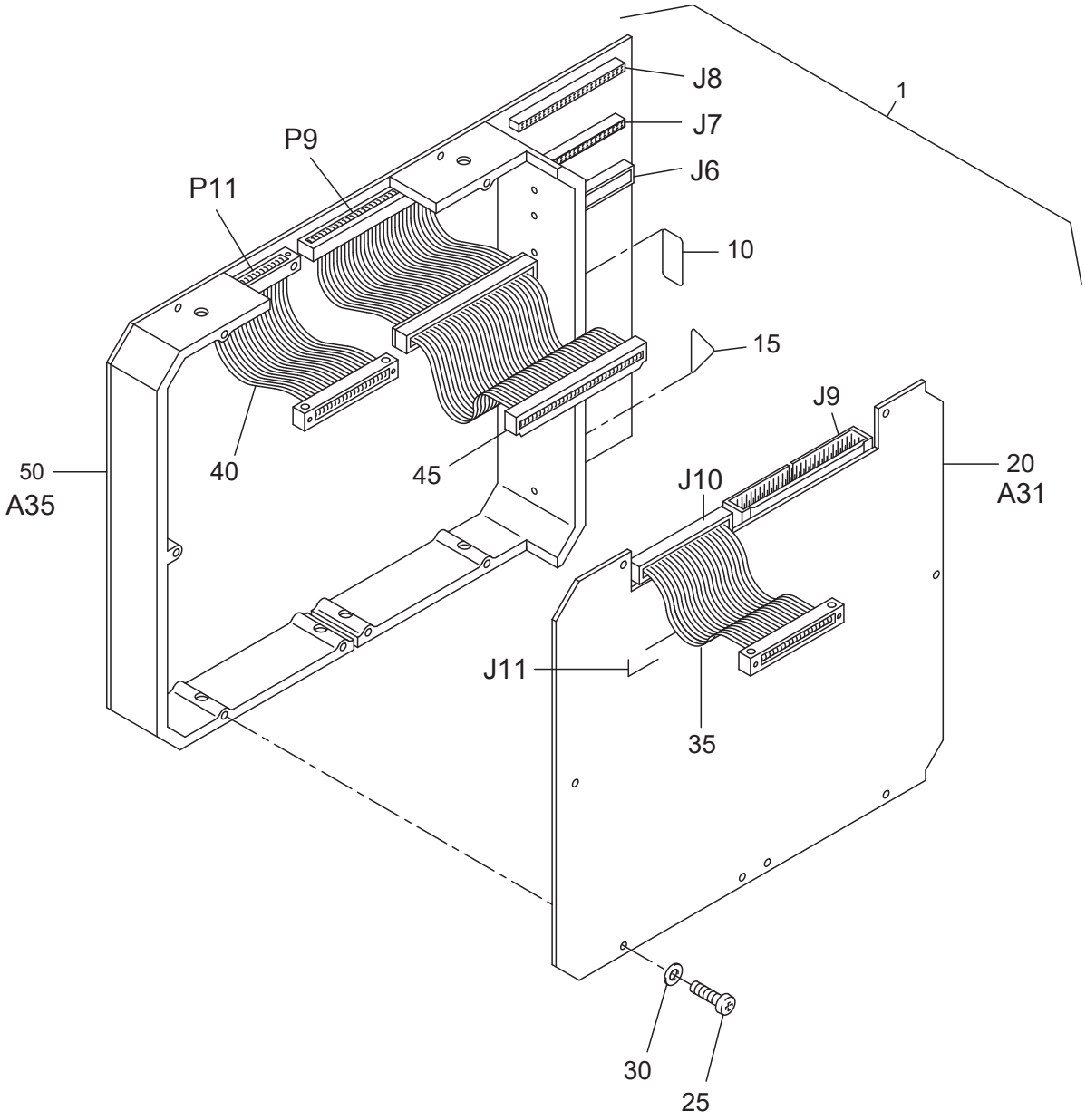
FIG. ITEM	PART NUMBER	AIRL. STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UPA
3					
- 1A	3888394-021000		MODULE - CONNECT (A318/319/320/321) FOR NHA SEE FIGURE 1		RF
10A	0000610902		· LABEL - IDENTIFICATION DATA RECORD PRINTED ON LABEL PN 0000610105 REPLACED BY ITEM 10B		1
- 10B	0001032045		· LABEL - BAR CODE REPLACES ITEM 10A		1
15A	0000142421		· LABEL - WARNING		1
20A	084641000000010		· LABEL - DESIGNATION		1
- 20B	0001032907		· OPTIONAL		AR
25A	0000610779		· LABEL DATA RECORD PRINTED ON LABEL PN 0000610108 REPLACED BY ITEM 25B		1
- 25B	0001032053		· LABEL - APU REPLACES ITEM 25A		1
30A	084744210000009		· LABEL - WARNING		1
35A	620361		· SOCKET - AWG22 VC1213 PN 0000535695 BY VD4829		133
40A	620214010		· PIN - AWG20 VC1213 PN 0000602159 BY VD4829		4
45A	620234004		· PIN - AWG16 VC1213 PN 0000602157 BY VD4829		3
50A	620244005		· PIN - AWG12 VC1213 PN 0000602156 BY VD4829		4
55A	8660-147		· CAP - DUST VF0323 PN 0000137065 BY VD4829		AR
60A	8660-146		· CAP - DUST VF0323 PN 0000137064 BY VD4829		AR
65A	084744210000002		· PLATE - CONNECTOR		1
			ATTACHING PARTS		
70A	0000607497		· SCREW		5
75A	0000607497		· SCREW		6
			* * *		
80A	084744210000004		· POST		1

FIG. ITEM	PART NUMBER	AIRL. STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UPA
3			ATTACHING PARTS		
85A	0000607497		· SCREW		1
			* * *		
90A	M39014-02-1320		· CAPACITOR		1
95A	0000194606		· CAPACITOR VD5243 ORDER OVERLENGTH PNR MKP1841-310-635-10NF630V		1
100A	0000197711		· CAPACITOR VI9003 ORDER OVERLENGTH PNR CECC32101-003E1210R1J33NK200 AE5		1
105A	0000535779		· CAPACITOR - 1000UF 63V VD2540 ORDER OVERLENGTH PNR AHT-DIN2222-119-18102		2
- 105B	B41590A8108T		· OPTIONAL VD1180 PN 0000196641 BY VD4829		2
110A	SST1-5M		· STRIP - CABLE VC0259 PN 0000147601 BY VD4829		4
115A	M39014-02-1415		· CAPACITOR		1
120A	0000181261		· RESISTOR - VARIABLE VD1180 ORDER OVERLENGTH PNR SI0V-S20K175Q69X3230		1
125A	B82132A5602M		· INDUCTOR - 1UH 20PCT VD1180 PN 0000193110 BY VD4829		2
- 125B	SMSC1R0M01		· OPTIONAL VC4620 PN 0000193110 BY VD4829		2
130A	0000164929		· RESISTOR VI9003 ORDER OVERLENGTH PNR CECC40401-001SRC3715C7K5FE5		3
135A	0000171551		· RESISTOR VI9003 ORDER OVERLENGTH PNR CECC40401-001SRC3715C49R9FE 5		2
140A	0000171613		· RESISTOR VI9003 ORDER OVERLENGTH PNR CECC40401-001SRC3715C249RFE 5		1

FIG. ITEM	PART NUMBER	AIRL. STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UPA
3					
145A	0000171757		· RESISTOR VI9003 ORDER OVERLENGTH PNR CECC40401-001SRC3715C24K9FE5		2
150A	0000171639		· RESISTOR VI9003 ORDER OVERLENGTH PNR CECC40401-001SRC3715C499RFE5		1
155A	0000603067		· RESISTOR VD0962 ORDER OVERLENGTH PNR 10252-5-7962132GR2141KLASSE-A		1
160A	0000164936		· RESISTOR VI9003 ORDER OVERLENGTH PNR CECC40401-001SRC3715C20KFE5		1
165A	0000165552		· RESISTOR VI9003 ORDER OVERLENGTH PNR CECC40401-001SRC3715C1K0FE5		1
170A	084641033103000		· TRANSFORMER		1
			ATTACHING PARTS		
175A	0000607497		· SCREW		4
180A	084744210000003		· FASTENER		2
			* * *		
185A	1N5550		· DIODE V24444 PN 0000181141 BY VD4829		4
190A	SMCJ15A		· DIODE - ZENER V14099 PN 0000193010 BY VD4829		2
195A	BYV27-200		· DIODE VD2540 PN 0000198535 BY VD4829		1
200A	SMBJ7-5CA		· DIODE - ZENER V14099 PN 0000602317 BY VD4829		2



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CPU-I/O MODULE
FIGURE 4

FIG. ITEM	PART NUMBER	AIRL. STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UPA
4					
1A	584742020000000		MODULE - CPU-I/O AMENDMENT C FOR NHA SEE FIGURE 2		RF
- 1B	684742020000000		MODULE - CPU-I/O AMENDMENT C FOR NHA SEE FIGURE 2 FOR NHA SEE FIGURE 2A		RF
- 1C	684742020000000		MODULE - CPU-I/O AMENDMENT C FOR NHA SEE FIGURE 2A		RF
- 1D	684742020000000		MODULE - CPU-I/O AMENDMENT D FOR NHA SEE FIGURE 2A		RF
10A	0000610770		· LABEL - IDENTIFICATION DATA RECORD PRINTED ON LABEL PN 0000610103		1
- 10B	0001032898		· OPTIONAL		AR
15A	0000142416		· LABEL - WARNING		1
20A	584742023100000		· BOARD - CPU AMDT A	1ABC	1
- 20B	684742023100000		· BOARD - CPU AMDT A	1D	1
			ATTACHING PARTS		
25A	0000543064		· SCREW ORDER OVERLENGTH PNR IS07045M2-5X6A2-70Z		8
30A	407660NRST		· WASHER VD9532 PN 0000612804 BY VD4829 (S2-5-1-4301)		8
			* * *		
35A	184742023102000		· CONNECTION - FLAT CABLE (CPU-PSU) (31J10-10P10) OPTIONAL PART 0000605294 VD4829		1
40A	184742023103000		· CONNECTION - FLAT CABLE (CPU-I/O) (31P11-35P11) OPTIONAL PART 0000605295 VD4829		1
45A	184742023502000		· CONNECTION - FLAT CABLE (I/O-CPU-PSU) (35P9-31P9-10P9) OPTIONAL PART 0000605296 VD4829		1

FIG. ITEM	PART NUMBER	AIRL. STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UPA
4					
50A	584742023500000		· BOARD - INPUT/OUTPUT AMDT C	1A	1
- 50B	684742023500000		· BOARD - INPUT/OUTPUT AMDT D	1B	1
- 50C	684742023500000		· BOARD - INPUT/OUTPUT AMDT D, E, G, H	1C	1
- 50C	684742023500000		· BOARD - INPUT/OUTPUT AMDT H	1D	1