

# **Firefox Workstation I/O Cover Module Functional Specification**

## **Revision 1.2**

*Michael Nielsen (DECWSE::NIELSEN)*

Workstation Systems Engineering  
Digital Equipment Corporation  
100 Hamilton Avenue  
Palo Alto, CA 94301  
415-853-6679

December 23, 1987

## **RESTRICTED DISTRIBUTION**

Copyright 1986, 1987 by Digital Equipment Corporation

The information in this document is subject to change without notice and should not be construed as a commitment by Digital Equipment Corporation. Digital Equipment Corporation assumes no responsibility for any errors that may occur in this document. This specification does not describe any program or product that is currently available from Digital Equipment Corporation. Nor does Digital Equipment Corporation commit to implement this specification in any product or program. Digital Equipment Corporation makes no commitment that this document accurately describes any product it might ever make.

**Blank Page**

## Table of Contents

### 8. Firefox Workstation I/O Cover Module

8.1. EIA Driver and Receivers .....	1
8.2. Keyboard and Mouse/Tablet Connector .....	1
8.3. Modem Connector .....	2
8.4. Printer/Console Connector .....	3
8.5. Thin/Thick Switch .....	4
8.6. ThickWire Ethernet Transceiver Connector .....	4
8.7. ThinWire Ethernet Transceiver .....	5
8.8. Hexadecimal-Digit Display .....	5
8.9. -10-Volt Switchmode Power Supply .....	5
8.10. Battery .....	5
8.11. Firefox Workstation I/O Module Connector .....	5
8.12. Cover Module Printed Circuit Board .....	6
8.13. Power Requirements .....	6
8.14. Error Diagnosis .....	7

**Blank Page**

**Revision History**

<b>Date</b>	<b>Version</b>	<b>Content/Change</b>
11 Nov 87	1.2	Update references to DC-DC converter Update references to switchmode power supply Change I/O connector pin number assignments Change specification for Ethernet switch Miscellaneous edits
4 Jun 87	1.1	Changed to 5.2 by 8 PCB Remove one hexadecimal digit and LED<7:5> Added MFMD0 to keyboard/mouse connector Enhanced circuit descriptions
25 May 87	1.0	Changed ribbon-cable signal assignments Changed key/mouse-connector signal assignments Miscellaneous edits
27 Apr 87	0.0	Preliminary draft

## 8. Firefox Workstation I/O Cover Module

---

This chapter is the functional specification for the Firefox workstation I/O cover module, which is part of the Firefox workstation I/O cover assembly (H3061). The cover module connects to the Firefox workstation I/O module (L2003) via a 50-conductor ribbon cable and makes the ribbon cable signals externally available as follows:

- Keyboard and mouse/tablet serial lines on a 15-pin D connector
- Modem serial line on a 25-pin D connector
- Printer/console serial line on a 6-pin MMJ connector
- ThickWire Ethernet transceiver line on a 15-pin D connector
- ThinWire Ethernet tap on a BNC connector
- Status outputs on a hexadecimal-digit display

A switch selects either ThickWire or ThinWire Ethernet output.

The cover assembly contains a battery for use by the L2003 during power failures. The keyboard and mouse connector also supplies +5-volt, +12-volt, and -10-volt power for those devices.

The cover assembly consists of a 5.2-inch by 8-inch cover module that contains the connectors, serial line DEC423/EIA-232-D driver/receivers, -10-volt switchmode power supply, and ThinWire Ethernet transceiver plus a battery and a metal cover plate.

### 8.1. EIA Driver and Receivers

The cover module implements the EIA driver, receivers, and transient absorption required for the keyboard, mouse/tablet, modem, and printer/console serial lines. The EIA 5170/5180 driver and receivers are in a DEC423/EIA-232-D compatible configuration, as specified by DEC STD 52-4. Both driver and receivers have ESD/EOS protection circuitry. Receivers are biased and configured to failsafe to a high output in the event of powered-down peripherals, open circuit inputs, or shorted inputs.

The EIA driver has a +/-10-volt supply to minimize power dissipation, which decreases junction temperatures and increases reliability. The +10-volt EIA driver supply is derived from the +12-volt cover module supply through two series 0.975-volt, 1.0 ampere rectifier diodes. The -10-volt EIA driver supply is derived from the +12-volt cover module supply via a switchmode power supply.

To minimize etch length, and thus minimize EMI and maximize the effectiveness of the ESD protection devices, the EIA driver and receivers are positioned adjacent to the serial connectors.

### 8.2. Keyboard and Mouse/Tablet Connector

Table 8-1 lists the signal assignments for the keyboard and mouse/tablet 15-pin, male, filtered, D connector. The manufacturing-mode input and status-display output signals are *not* connected to conductors in the external cable; manufacturing-mode and status-display signals are for use by manufacturing/field service with special loopback connectors.

**Table 8-1: Keyboard and Mouse/Tablet Connector Pin Assignments**

Pin	Source	Signal	Name
1		GND	Keyboard ground
2	L2003	TX0	Keyboard transmitted data
3	KEYBRD	RX0	Keyboard received data
4	L2003	+12V	Keyboard power
5	L2003	+12V	Tablet power
6	MOUSE	RX1	Mouse received data
7	L2003	TX1	Mouse transmitted data
8		GND	Mouse ground
9		GND	Keyboard power return
10		MFMD1	Manufacturing mode input
11	L2003	LED4	MSB of status display output
12		MFMD0	Manufacturing mode input
13	L2003	+5.3V	Mouse power
14	L2003	-10V	Mouse power
15		GND	Mouse power return

The cover module uses a local LM317 regulator to regulate the +12-volt supply down to +5.3 volts for the mouse power. A supply in excess of the nominal +5-volt L2003 supply is required to compensate for IR drops in the external cables and current limit device. The cover module generates the -10-volt supply from a switchmode power supply off its +12-volt input; it supplies +12 volts for the keyboard and tablet from its own +12-volt supply. The nominal +12-volt output is in the range +12.46 volts to +11.59 volts.

The +12-volt keyboard supply is rated for a maximum of 300 milliamperes. The mouse +5.3-volt supply is rated for a maximum of 160 milliamperes, the mouse -10-volt supply is rated for a maximum of 20 milliamperes, and the tablet +12-volt supply is rated for a maximum of 300 milliamperes.

The mouse +5.3-volt supply output has a polymer PTC current limit device that changes from low impedance to high impedance when the current exceeds 0.50 amperes. The mouse -10-volt supply output has a PTC device that trips if the current exceeds 0.50 amperes. The keyboard and tablet +12-volt supply outputs are current-limited by the L2003 if the total +12-volt current exceeds 1.75 amperes.

To ensure worst-case operation of the LK201 keyboard, VSXXX-AA mouse, and VSXXX-AB tablet, the following conditions must be met. The keyboard/mouse external cable power and ground conductors must be a minimum of 20 AWG and a maximum of 15 feet. The external cable must have separate conductors for each of the +12-volt and GND pins on the D connector. The keyboard/mouse external cable signal conductors must be a minimum of 24 AWG and have a minimum insulation thickness of 0.010 inches, a maximum capacitance of 35 picofarads per foot, and a maximum length of 15 feet. The contact resistance of the D connector must be less than 0.030 Ohms. The contact resistance of the MMJ keyboard connector on the remote end of the external cable must be less than 0.125 Ohms. The contact resistance of the DIN mouse/tablet connector on the remote end of the external cable must be less than 0.030 Ohms.

If required for special applications, the keyboard/mouse serial lines can be up to 50 feet in length and still meet worst-case signal margins for up to 9600-baud operation. (Nominal components should operate with cables up to 500 feet in length.) The signal conductors must meet the conditions stated above. The special cable must supply the keyboard and mouse/tablet with power from a power supply at the remote end.

For normal operation, the manufacturing-mode inputs must be unconnected. To activate manufacturing/field-service diagnostic modes, a loopback connector should short the MFMD0 and/or MFMD1 pins to one of the GND pins on the connector. The LED4 output may be used as a status output with  $V_{oh}$  of 2.4 volts at 2 milliamperes and  $V_{ol}$  of 0.5 volts at -10 milliamperes.

### 8.3. Modem Connector

Table 8-2 lists the signal assignments for the modem, 25-pin, male, filtered, D connector.

**Table 8-2: Modem Connector Pin Assignments**

Pin	Source	Signal	CCITT	EIA	Name
1			101	AA	Protective ground
2	L2003	TX2	103	BA	Transmitted data
3	MODEM	RX2	104	BB	Received data
4	L2003	RTS2	105	CA	Request to send
5	MODEM	CTS2	106	CB	Clear to send
6	MODEM	DSR2	107	CC	Data-set ready
7		GND	102	AB	Signal ground
8	MODEM	CD2	109	CF	Carrier detect
9					Unconnected
10					Unconnected
11					Unconnected
12	MODEM	SPDMI2	112	CI	Speed-mode indication
13					Unconnected
14					Unconnected
15					Unconnected
16					Unconnected
17					Unconnected
18	L2003	LLPBK2	141		Local loopback
19					Unconnected
20	L2003	DTR2	108/2	CD	Data terminal ready
21					Unconnected
22	MODEM	RI2	125	CE	Ring indicate
23	L2003	DSRS2	111	CH	Data signaling rate select
24					Unconnected
25	MODEM	TMI2	142		Test-mode indication

For operation up to 9600 baud, the maximum cable length that meets worst-case margins is 50 feet. (Nominal components should operate with cables up to 500 feet in length.) The modem-cable signal conductors must be a minimum of 24 AWG and have a minimum insulation thickness of 0.010 inches and a maximum capacitance of 35 picofarads per foot.

### 8.4. Printer/Console Connector

Table 8-3 lists the signal assignments for the printer/console, six-pin, female, MMJ connector. An EMI filter is located immediately adjacent to the MMJ connector.

**Table 8-3: Printer/Console-Connector Pin Assignments**

Pin	Source	Signal	Name
1	L2003	CO	Control output
2	L2003	TX3	Transmitted data
3	L2003	GND	Transmitted ground
4	PRNTR	GND	Received ground
5	PRNTR	RX3	Received data
6	PRNTR	CI	Control input

In accordance with DEC STD 52-4, the control-output signal is driven to a +5-volt level, and the control input signal is terminated to ground. The control output cannot be modified by software, and the control input is not accessible to software. To avoid inducing surges back onto the termination voltages, the control signals are attached to ESD protection devices.

For operation up to 9600 baud, the maximum cable length that meets worst-case margins is 50 feet. (Nominal components should operate with cables up to 500 feet in length.) The modem-cable signal conductors must be a minimum of 24 AWG and have a minimum insulation thickness of 0.010 inches and a maximum capacitance of 35 picofarads per foot.

### 8.5. Thin/Thick Switch

The Thin/Thick switch selects between the internal ThinWire Ethernet transceiver tap and the external ThickWire Ethernet transceiver connection. The six-pole, double-throw switch connects the six differential Ethernet signals from the L2003 to the ThinWire or ThickWire logic.

The ThickWire D connector and the ThinWire BNC connector are positioned such that it is mechanically impossible to simultaneously use both connections with proper cables.

### 8.6. ThickWire Ethernet Transceiver Connector

Table 8-4 lists the signal assignments for the ThickWire Ethernet transceiver 15-pin, female, D connector. The ThickWire Ethernet connection is compatible with existing Ethernet products and with the *IEEE 802.3 Ethernet Specification*. The control output is terminated to ground and cannot be modified by software. The +12-volt supply is rated for a maximum of 500 milliamperes. The nominal +12-volt output on the D connector is in the range +12.46 volts to +11.59 volts and is current-limited by the L2003 if cover module +12-volt current exceeds 1.75 amperes.

**Table 8-4: ThickWire Ethernet Transceiver Connector Pin Assignments**

Pin	Source	Signal	Name
1		GND	Shield
2	XCVR	COL+	Collision presence
3	L2003	TX+	Transmit
4		GND	Ground
5	XCVR	RX+	Receive
6	XCVR	GND	Power return
7		CTL+	Control output
8		GND	Ground
9	XCVR	COL-	Collision presence
10	L2003	TX-	Transmit
11		GND	Ground
12	XCVR	RX-	Receive
13	L2003	+12V	Power
14		GND	Ground
15		CTL-	Control output

The etch lengths of the differential Ethernet signals are matched to +/- 100 mils between the I/O module connector and the isolation transformer. The traces are similarly matched between the isolation transformer and the Thin/Thick switch, and between the Thin/Thick switch and the ThickWire D connector.

The external transceiver cable must conform to DEC STD 134.

### 8.7. ThinWire Ethernet Transceiver

The cover module implements a ThinWire Ethernet transceiver that can be connected to the ThickWire output from the L2003. The ThinWire transceiver, which is accessible through a BNC connector, which consists of the DP8392 transceiver chip and associated passives, an isolation transformer, and a -9-volt isolated supply. The isolated -9 volts is generated from the cover module +12-volt supply via a DC-to-DC converter that utilizes a pulse-width-modulated, flyback switching-power supply.

The etch lengths of the differential Ethernet signals are matched to +/- 100 mils between the I/O module connector and the isolation transformer. The traces are similarly matched between the isolation transformer and the Thin/Thick switch, and between the Thin/Thick switch and the ThinWire Transceiver chip. The stub length of the Transceiver chip input/output and BNC connector is less than 3 centimeters.

### 8.8. Hexadecimal-Digit Display

The cover module uses a single hexadecimal-digit display with two decimal points for the status output display. The L2003 cable LED<3:0> signals connect to the digit, and the LED<4> signal connects to the left decimal point. The right decimal point is never illuminated. The display blanking control is configured to always display.

### 8.9. -10-Volt Switchmode Power Supply

The cover module implements a -10-volt switchmode power supply to generate the -10-volt supply it requires for the mouse and EIA driver. The power supply is rated for a maximum output current of 250 milliamperes, with an efficiency of 60 percent.

### 8.10. Battery

When the workstation is powered-off, the L2003 uses the cover assembly battery to maintain its time-of-year clock and battery-backed-up RAM. This battery is a three-cell nickel cadmium battery pack that is rated to supply 3.75 volts and has a capacity of 180 milliampere hours. The battery connects to the cover module via a two-pin connector.

### 8.11. Firefox Workstation I/O Module Connector

Table 8-5 lists the signal assignments for the 50-conductor ribbon cable that connects the cover module to the L2003.

**Table 8-6: Firefox Workstation I/O Cover Power Requirements**

Supply	Amperes	Sink
+5V	0.18	Hexadecimal-digit displays
+5V	0.25	EIA receivers
+5.3V	0.16	VSXXX-AA mouse
+12V	0.30	LK201 keyboard
+12V	0.30	VSXXX-AB tablet
+12V	0.50	ThickWire transceiver
+10V	0.10	EIA driver
-10V	0.10	EIA driver
-10V	0.02	VSXXX-AA mouse
+9V	0.18	ThinWire transceiver

#### 8.14. Error Diagnosis

Hardware faults in the cover module can be diagnosed with loopback connectors for the serial lines and by switching between the ThinWire and ThickWire connection for the Ethernet.

For the keyboard/mouse connector, the recommended loopback is jumpers from pin 2 (TX0) to pin 3 (RX0) and from pin 6 (RX1) to pin 7 (TX1). For the modem connector, the recommended loopback is jumpers from pin 2 (TX2) to pin 3 (RX2), from pin 4 (RTS2) to pin 5 (CTS2), from pin 6 (DSR2) to pin 20 (DTR2), from pin 12 (SPDMI2) to pin 23 (DSRS2), and from pin 18 (LLPBK2) to pins 8 (CI2), 22 (RI2), and 25 (TMI2). For the printer/console connector, the recommended loopback is a jumper from pin 2 (TX3) to pin 5 (RX3).

**Table 8-5: L2003 Cover Cable Signal Assignments**

Signal	Pin	Pin	Signal
+12V	50	49	+12V
GND	48	47	GND
TX0	46	45	RX0
CTS2	44	43	GND
RTS2	42	41	DTR2
TX1	40	39	RX1
DSR2	38	37	GND
RI2	36	35	CD2
TX2	34	33	RX2
DSRS2	32	31	GND
SPDMI2	30	29	TMI2
TX3	28	27	RX3
+5V	26	25	+5VBAT
LLPBK2	24	23	GND
-12V	22	21	-12V
MFMD0	20	19	MFMD1
LED0	18	17	LED1
LED2	16	15	LED3
TX+	14	13	TX-
LED4	12	11	SPARE
COL+	10	9	COL-
GND	8	7	GND
RX+	6	5	RX-
GND	4	3	GND
+12V	2	1	+12V

The I/O connector and ribbon cable has -12-volt supply assignments for compatibility with future systems that have a -12-volt power supply output; this will eliminate the need for the switchmode power supply.

The cable is currently specified as a flat, twisted-pair ribbon cable, with a maximum length of 6 inches. The cable has 50 conductors that are specified to be not less than 28 AWG.

### 8.12. Cover Module Printed Circuit Board

The cover module printed circuit board is a 5.2-inch by 8.0-inch fingerless circuit board (ELEN 622-06). It is a four-layer board with two outer signal layers, a split power layer, and a split ground layer, all in 1-ounce copper (ELEN 630-07). The power layer is split between +5 volts, +10 volts, +12 volts, -9 volts, and -10 volts. The ground layer is split between frame ground and the isolated ground for the Ethernet transceiver circuit. The signal etch is 12/13 technology with uncontrolled impedance (GDC DD23AAXXXX).

The nonisolated ground layer functions as a frame ground and is electrically connected to the external connector shells/shields and cover plate. The ground layer connects to the system logic ground through the ribbon cable.

### 8.13. Power Requirements

Table 8-6 summarizes the power requirements for the cover assembly. The worst-case power consumption is 0.43 amperes at +5 volts and 1.26 amperes at +12 volts from the L2003. The cover module itself dissipates a maximum of 9.1 watts.