



Model 560-5183-2
QUAD DIGITAL TO FM FIBER OPTIC TRANSMITTER
MANUAL

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SECTION ONE

1 FUNCTIONAL DESCRIPTION

1.1 PURPOSE OF EQUIPMENT

The TrueTime 560-5183-2 card is configured to provide four fiber optic outputs. The outputs provide a Frequency Modulated optical carrier which transmits a digital copy of the input signal. The card, with four fiber optic connectors, occupies a rear slot.

The signal source for the card is one of the timing signals that is distributed via INPUT 1 through INPUT 8 on the Model 56000 backplane. The card is configured at installation by DIP switches to select the signal that will be the Primary and Secondary input.

The Primary and Secondary inputs are monitored for activity. The activity on both inputs is compared to the Delay switch time-out setting (user settable DIP switch SW3) which operates as a watch dog timer. If activity on either the Primary or the Secondary inputs exceeds the delay switch time-out setting, that input is considered bad. NOTE: An input may be considered bad if the minimum input voltage level is not met.

The 560-5183-2 card can operate without a Fault Monitor CPU card installed in the system. In a system without CPU card, the 560-5183-1 card will automatically switch to the Secondary input source when the following conditions are met:

1. The Secondary input is good (activity time-out not exceeded).
2. The Primary input is bad (activity time-out exceeded).

The card will not switch to the Secondary input source if it has been detected bad. The card will switch back to the Primary input signal source only after the Primary input has been qualified good (good for 1 minute). This feature restores the card to normal operation automatically.

When a Fault Monitor CPU card is installed in the system, the 560-5183-2 card is monitored and can also be controlled by the CPU card. In addition to the 560-5183-2 on-card automatic Primary to Secondary switchover, the CPU card also provides Primary to Secondary input switching when the CPU detects a Primary Status Input fault. The CPU control provides what is called a "Bank Switch," meaning that all cards in the system will switch from the Primary to the Secondary signal source and will stay on the Secondary input until the user commands a switch to Primary via the CPU card. The "Bank Switch" allows timing signal inputs on all cards installed in the system to come from one source. The CPU also has the ability (under user control) to force the use of either the Primary or Secondary inputs.

1.2 FAULT LINE TRANSCEIVER FUNCTION

This is a serial half-duplex signaling operation between the 560-5183-2 card and the Fault Monitor CPU via the active-low FAULT signal line. The Fault Monitor CPU sends control and switching information to the 560-5183-2 assembly serially. The 560-5183-2 assembly provides status information serially to the Fault Monitor CPU.

1.3 PRIMARY/ SECONDARY SIGNAL SELECT FUNCTIONS

If the 560-5183-2 is operating using the Primary input signal and it detects inactivity on this input, the 560-5183-2 card will automatically or, under Fault Monitor CPU control, switch to the Secondary input signal. If the 560-5183-2 card is operating in a system with a Fault Monitor CPU card and the 560-5183-2 card has switched to the Secondary input source, the 560-5183-2 card will NOT switch back to the Primary input unless commanded by the user via the Fault Monitor CPU.

1.4 PHYSICAL SPECIFICATIONS

Dimensions: 0.8" w X 3.94" h X 8.66" d (2 cm X 10 cm X 22 cm)
Weight: Approximately ½ pound (¼ kg)

1.5 ENVIRONMENTAL SPECIFICATIONS

Operating Temp: 0° to +50°C
Storage Temp: -40° to +85°C
Humidity: Up to 95% relative, non-condensing
Cooling Mode: Convection
Altitude: Sea Level to 10,000 ft.

1.6 POWER REQUIREMENTS

Voltage: 18-72 VDC
Power: 3.5 W

1.7 FUNCTIONAL SPECIFICATIONS

1.7.1 INPUT 1 THROUGH 8

Logic Input Level: Low: -5 V < Vin < 1.2 V / High: 1.8 V < Vin < 5.0 V
Impedance: >20k Ohms
Frequency: DC to 100 kpps

1.7.2 FIBER OPTIC OUTPUTS

Quantity: 4
Connector Type: ST
Signal: 820 nm, -14 to -21 dBm into 50/125 micron fiber
Signal: 820 nm, -10 to -18 dBm into 62.5/125 micron fiber

Frequency: 8 MHz Carrier
Modulation: FM (DC to 100 kHz)
Modulation Span: ± 705 kHz for 5 Vpk Input
Signal Delay: < 1 μ s

1.7.3 CARD COMPATIBILITY

Location: Slot 1-17, rear
Compatibility: See Card Compatibility Matrix

SECTION TWO

2 INSTALLATION AND OPERATION

2.1 HOT SWAPPING

All cards, input cables and output cables are hot swappable. It is not necessary to remove chassis power during insertion or removal. Hot swapping and reference-source changes are abrupt, the effects difficult to characterize; however, the system is designed to protect against permanent effects and minimize temporary effects of these events.

Typically, adjacent-card hot swapping has a negligible effect on the Digital output card. The effect of redundant power supply switch-over is also negligible.

2.2 REMOVAL AND INSTALLATION

CAUTION: Individual components on this card are sensitive to static discharge. Use proper static discharge procedures during removal and installation.

Refer to CARD COMPATIBILITY section prior to installing new card. To remove card, loosen the captive retaining hardware at the top and bottom of the assembly, then firmly pull on the handle (or on any connector on rear panel adapter cards) at the bottom of the card. Slide the card free of the frame. Refer to the SETUP section for any required switch settings; or, set them identically to the card being replaced. Reinstall the card in the frame by fitting it into the card guides at the top and bottom of the frame and sliding it in slowly, avoiding contact between bottom side of card and adjacent card front panel, until it mates with the connector. Seat card firmly to avoid contact bounce. Secure the retaining screws at the top and bottom of the card assembly.

2.3 SETUP

The setup of the 560-5183-2 digital output card involves selection of the following DIP switches:

1. Primary input select switch (SW5)
2. Secondary input select switch (SW6)
3. Primary input enable switch (SW1)
4. Secondary input enable switch (SW2)
5. Delay switch (activity time-out) (SW3)

2.3.1 REQUIRED SETTINGS (SW3)

SW3-4 MUST be OFF

2.3.2 PRIMARY INPUT SOURCE SELECT SWITCH (SW5)

Set one SW5 switch to the ON position. The SW5 switch number (1 thru 8) corresponds to INPUT 1 thru INPUT 8 signals that are distributed on the Model 56000 backplane.

2.3.3 SECONDARY INPUT SOURCE SELECT SWITCH (SW6)

Set one SW6 switch to the ON position. The SW6 switch number (1 thru 8) corresponds to INPUT 1 thru INPUT 8 signals that are distributed on the Model 56000 backplane.

2.3.4 PRIMARY INPUT ENABLE SWITCH (SW1)

This switch is readable by the Fault Monitor CPU card which can provide status information to the user. This switch **MUST** be set to a binary representation of the SW5 setting, the Primary input signal switch.

Primary Input	SW1-1	SW1-2	SW1-3	SW1-4
INHIBIT	OFF	OFF	OFF	OFF
INPUT 1	ON	OFF	OFF	OFF
INPUT 2	OFF	ON	OFF	OFF
INPUT 3	ON	ON	OFF	OFF
INPUT 4	OFF	OFF	ON	OFF
INPUT 5	ON	OFF	ON	OFF
INPUT 6	OFF	ON	ON	OFF
INPUT 7	ON	ON	ON	OFF
INPUT 8	OFF	OFF	OFF	ON

This switch is also used to disable the Primary input. If SW1 switches 1 thru 4 are OFF, the card will inhibit operation and fault reporting of the Primary input.

2.3.5 SECONDARY INPUT ENABLE SWITCH (SW2)

This switch is readable by the Fault Monitor CPU card which can provide status information to the user. This switch **MUST** be set to a binary representation of the SW6 setting, the Secondary input signal switch.

Secondary	SW2-1	SW2-2	SW2-3	SW2-4
INHIBIT	OFF	OFF	OFF	OFF
INPUT 1	ON	OFF	OFF	OFF
INPUT 2	OFF	ON	OFF	OFF
INPUT 3	ON	ON	OFF	OFF
INPUT 4	OFF	OFF	ON	OFF
INPUT 5	ON	OFF	ON	OFF
INPUT 6	OFF	ON	ON	OFF
INPUT 7	ON	ON	ON	OFF
INPUT 8	OFF	OFF	OFF	ON

This switch is also used to disable the Secondary input. If SW2 switches 1 thru 4 are OFF, the card will inhibit operation and fault reporting of the Secondary input.

2.3.6 DELAY SWITCH (Activity Time-Out SW3 Switches 1 Thru 3)

SW3 switches 1 thru 3 are used to set the input activity time-out delay. The user should set the delay for a time-out value that is the closest to but longer than the period of the input signal. This will provide fault detection in the shortest amount of time (Primary to Secondary switch-over time is minimized).

Example Setting: If the input signal is 1 kpps (1 millisecond period), the appropriate setting would be SW3-1 ON, SW3-2 OFF, SW3-3 OFF --(2.048 millisecond time-out).

Delay (time-out)	SW3-1	SW3-2	SW3-3
204.8 microseconds	OFF	OFF	OFF
2.048 milliseconds	ON	OFF	OFF
20.48 milliseconds	OFF	ON	OFF
204.8 milliseconds	ON	ON	OFF
2.048 seconds	OFF	OFF	ON
20.48 seconds	ON	OFF	ON
122.88 seconds	OFF	ON	ON
INFINITE	ON	ON	ON

If infinite delay has been selected, Primary and Secondary input fault detection is disabled.

2.4 FAULT STATUS INDICATIONS

This card has no external LED fault indicators.

2.4.1 INIT. FAULT INDICATOR

This is an on-card fault indicator which is not externally visible; although it can be seen by installing the card next to an empty slot. It indicates a failure of the card to initialize properly during power-up. Occasionally, this fault is caused by a temporary condition related to the cycling of power and can be cleared by a power or hot swap cycle. If this is unsuccessful, the card is defective.

2.4.2 DETAILED FAULT STATUS VIA CPU

The Fault Monitor CPU has access to detailed 560-5183-2 card status. This status is available via the Fault Monitor CPU serial port. When it is presented in a 2-byte format, with individual bit definitions as follows:

The Verbose report displays the Fault status. In this context, a reported fault indicates a problem. The Machine report, when used, reports the current status (settings) of the switches and faults in hexadecimal characters. Together, they pinpoint problems and help the technician view the switch settings on the cards without removing them.

2.4.3 VERBOSE REPORTS

The following is an example of a Fault Monitor CPU report in Verbose mode:

```
TrueTime 56000 Site 01
Automatic Reports Enabled
Periodic Reports Disabled
Secondary Inputs Selected REFA No REFB No REFC Off PRI OK SEC OK TER Off

1. Undefined      OK          Undefined      OK
2. Undefined      OK          Undefined      OK
3. 5183-2 XL2 LOCAL OSC FAULT 0207 Undefined OK
4. Undefined      OK          Undefined      OK
```

The above sample tells you that:
Automatic reports are enabled and Periodic reports are disabled.
Primary inputs REF A and REF B are not bussing AUX REF. REF C is off. Primary and Secondary status inputs OK, Tertiary is OFF.

The above readout shows that the Primary input has faulted because of the notice "Secondary Inputs Selected" in this example. If the Primary is OK, it would read "Primary Inputs Selected".

Numbers 1-4 are slots (not all slots are shown in the example). Slots 1,2,and 4 are undefined (empty) and functional (OK).

Slot 3 is read as follows:
5183-2 is the abbreviation of the 560-5183-2 card. The fault reading is 0207.

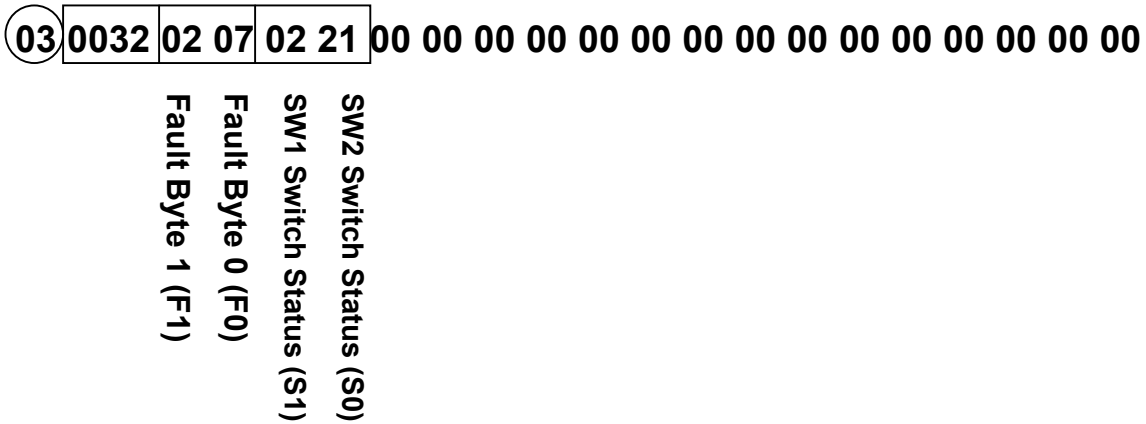
2.4.4 MACHINE REPORTS

The Fault Monitor CPU has another serial output mode called machine report mode. This mode is usually used with a computer program to interrogate the 56000 system status. The machine report mode displays hexadecimal (HEX) characters like the verbose mode report.

The following is an example of a Fault Monitor CPU report in Machine Mode:

```
TrueTime 56000 Site 01
AR1
PR10
P A1 B1 Co P1 S1 To
01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
02 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
03 00 32 02 07 0221 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
04 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
(card slots 05 through 14 HEX not shown)
```

Example from card slot 3 above:



Slot 3 shows that the Fault status is 0207 (F1, F0). The Status report read-out is 0221(S1,S0).

2.4.5 REPORT CONVERSIONS

This section deals with how to read and convert the Fault and Status read-outs using various tables and binary conversions. To decipher a Fault Status report, use Fig. A. For Status reports (S1, S0) use Fig. B.

Fig. A

Spare	Spare	Spare	Spare	Source = Primary	Sec. Input Inactive*	Pri. Input Inactive*	Power Cycled	Undefined	Undefined*	Undefined	Undefined	Output Fault D*	Output Fault C*	Output Fault B*	Output Fault A*
8	4	2	1	8	4	2	1	8	4	2	1	8	4	2	1
2 ³	2 ²	2 ¹	2 ⁰	2 ³	2 ²	2 ¹	2 ⁰	2 ³	2 ²	2 ¹	2 ⁰	2 ³	2 ²	2 ¹	2 ⁰
0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1
Upper Byte High Nibble				Upper Byte Low Nibble				Lower Byte High Nibble				Lower Byte Low Nibble			
0				2				0				7			
Fault Status F1 Report								Fault Status F0 Report							

Key:

Above each 8,4,2,1 is the corresponding fault for that bit. For instance, above the 8 bit in the Upper byte/Low nibble reads Rub. Lockmon, which is the fault .

Shaded area

Informational only. The upper row: Bit value hex weights (8,4,2,1) The Lower row corresponds to the hex weight above. For instance, a readout of 7 equals 111 in binary and 4+2+1 hex weight. Each section of 8,4,2,1 is a nibble of either an Upper or Lower byte and separated for easy recognition. Each nibble = 4 bits and each byte = 8 bits. "02" is the F1 report, "07" the F0 report.

Non-shaded area

This area is used according with the report read-out after a report is converted to binary. The 0207 is an example from a report.

Always read the report from Upper (High) byte to Lower (Low) Byte.

* Latched Fault Bit -- Reset Via Fault Monitor CPU.

Status (S1, S0) Conversion Table

FIG. B

STATUS REG 0	Bit	Bit Value	Switch	
Low	0	1	Pri Input Enable SW1-1	1
Nibble	1	2	Pri Input Enable SW1-2	
Low	2	4	Pri Input Enable SW1-3	
Byte	3	8	Pri Input Enable SW1-4	
High	4	1	Sec Input Enable SW2-1	2
Nibble	5	2	Sec Input Enable SW2-2	
Low	6	4	Sec Input Enable SW2-3	
Byte	7	8	Sec Input Enable SW2-4	
STATUS REG 1				
Low	0	1	Delay SW3-1	2
Nibble	1	2	Delay SW3-2	
High	2	4	Delay SW3-3	
Byte	3	8	Always 0	0
High	4	1	Undefined	
Nibble	5	2	Undefined	
High	6	4	Undefined	
Byte	7	8	Undefined	

Notes: The settings listed under the Switch column are HIGH or ON. For instance, frequency has SW 1-1 and SW 1-2. If SW 1-1 is ON, SW 1-2 is presumed to be OFF (although there is no specific mention of this). For switches, a 1 = ON, 0 = OFF.

BINARY CONVERSION TABLE

Decimal	Displayed in report as	Binary
0	0	0
1	1	1
2	2	10
3	3	11
4	4	100
5	5	101
6	6	110
7	7	111
8	8	1000
9	9	1001
10	A	1010
11	B	1011
12	C	1100
13	D	1101
14	E	1110
15	F	1111

Binary:
 1 = Fault/Switch On
 0 = No Fault/Switch Off

Use the Binary Conversion table to convert a read-out from the monitor to binary. For instance, if the report read-out was 3C15, this would be:

11\1100\1\101 in binary.

USING THE FAULT STATUS REPORT (F0,F1)

The hex weight has been assigned 8, 4, 2, 1. Beneath each number is the corresponding fault. Use Fig. A. The report example read 0207. The 0 is high byte/high nibble, the 2, high byte/low nibble, the 0, low byte/high nibble and 7, low byte/low nibble. Each nibble falls under a section on Fig. A, high to low or left to right.

Look at Fig. A. Below this is a sample read-out. This read-out would appear on the monitor when a Verbose report is requested. In the example, there are no faults in the upper byte/high nibble or in the lower byte/high nibble because both are zero (0). In the upper byte/low nibble, a 2 is reported. Looking directly above this, a 4 bit is easily spotted. The fault is Primary Input Inactive. However, In the lower byte/low nibble a 7 is reported. There is no 7 listed, only a 1, 2, 4, 8. Use the Binary Conversion table to determine the faults.

Seven (7) is converted to 111 in Binary. In Binary, a 1 = fault and 0 = no fault. Read 111 from right (low bit) to left (high bit) using the lower byte/low nibble group. The first three (from low bit to high bit) are 1's, indicating there is a fault with the Output Faults A, B and C.

Note that the hex weight assigned totals to 7 (4+2+1). If the 7 had been a 6, in binary this is 110. Reading from low bit to high bit, the 1's (i.e., faults) fall under hex weight 4 and 2, which equals a hex weight of 6. Of course, glancing at the lower byte/low nibble, you can quickly see (without converting to binary) that under 4 and 2 (i.e., 6) are the Output Fault B and C that are in fault.

Each of the four nibbles is grouped by category for easy visual identification of an offending fault. Each nibble has 15 possible fault combinations. All faults are asserted as a logic 1. The faults are latched on the Oscillator card and must be cleared by the 560-5179-1 Fault Monitor CPU "CL" command.

USING THE STATUS REPORT (S1, S0)

The method used for reading the Fault report is the same when reading the Status report. Refer to Fig. B.

Using the same read-out, 0221, but because the table is different, the 0 is located at the high byte(8) of S1. The rest of the numbers follow upward towards the low byte and ending in Status 0. In this case, the 2 falls in the low byte section of Status 1(Low byte\High nibble). This is a Delay SW3-2 in active mode. The 1 falls in the low byte section of Status 0. Since 1 is not listed, we must convert it to binary, or 1.

1 = Active, 0 = Not active.

Since we have one 1, reading from low byte\low nibble(from top to bottom) in Status 0, the current items are active:

Primary Input Enable SW1-1

QUICK REFERENCE SHEET FOR READING FAULT AND STATUS REPORTS

1. Run a report. This is a portion of a sample Machine report.

```

TrueTime 56000 Site 01
AR1
PR10
P A1 B1 Co P1 S1 To
01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
02 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
03 00 32 02 07 0221 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
04 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
(card slots 05 through 14 HEX not shown)
    
```

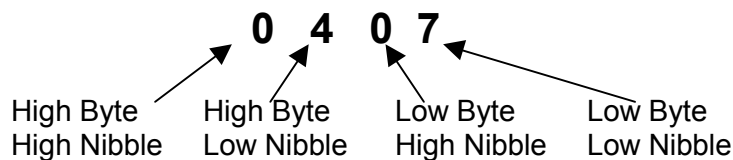
0207 is the Fault Status read-out
0221 is the Status read-out report

02 = Fault Status 1 (F1) report
07 = Fault Status 0 (F0) report
02 = Status 1 (S1) report
21 = Status 0 (S0) report

03 0032 02 07 02 21 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

SW2 Switch Status (S0)
SW1 Switch Status (S1)
Fault Byte 0 (F0)
Fault Byte 1 (F1)

What's in a number?



2. When required, convert Decimal to Binary using the Binary Conversion Table.

BINARY CONVERSION TABLE

Decimal	Displayed in report as	Binary
0	0	0
1	1	1
2	2	10
3	3	11
4	4	100
5	5	101
6	6	110
7	7	111
8	8	1000
9	9	1001
10	A	1010
11	B	1011
12	C	1100
13	D	1101
14	E	1110
15	F	1111

Binary:

1 = Fault/On/Active

0 = No Fault/Off/Not Active

SECTION THREE

3 THEORY OF OPERATION

3.1 GENERAL INFORMATION

This section contains a description of the circuits in the 560-5183-2 Fiber Optic Output card. Use these descriptions in conjunction with the drawings in SECTION FOUR.

3.2 HARDWARE DESCRIPTION

The 560-5183-2 Digital Output card incorporates Primary and Secondary signal input source switches, a DC-to-DC Converter, four output drivers driving 4 LEDs into fiber optic connectors, input fault-detection circuitry and output fault-detection circuitry.

3.3 DETAILED DESCRIPTION

Reference drawing 560-5183.

3.3.1 PRIMARY AND SECONDARY INPUTS

The Primary Input select switch and the Secondary Input select switch each direct the signal on backplane, INPUT 1 thru INPUT 8, to an analog buffer, then to an analog multiplexer. One of the eight switches should be in the ON position. The analog signals from the Primary and Secondary inputs are compared to a voltage level of 0.9 volts via comparators which are used to detect activity. The input level on the Primary and Secondary inputs should be a minimum of 2 Vpp or the Primary and Secondary input activity detection circuitry may indicate a loss of signal. Under normal operation, the analog multiplexer output is either the buffered Primary input signal or the buffered Secondary input signal depending on the state of the analog switch control.

3.3.2 FIBER OPTIC OUTPUTS

The output from analog switch connects via a 0.2 gain stage to a summing junction where it is combined with a reference voltage. The resultant signal is used as the control voltage to a VCO running at a nominal 8 MHz. This results in frequency modulation of the 8 MHz carrier. The output of the VCO is fed to four buffers, each of which drive an LED into a fiber optic connector. Each output buffer has associated fault detector consisting of an AC-coupled charge pump activity-detector.

3.3.3 POWER SUPPLY

The DC-to-DC Converter converts 48 VDC backplane power to local ± 5 VDC power. It is fully-isolated from the backplane power and referenced to signal GND on the Analog output card. Backplane power is supplied via a Polyswitch fuse device, diode

and Pi-section L-C filter. The poly-fuse protects the backplane power bus from internal DC-to-DC shorts. The diode and L-C filter serve a triple purpose. During live-insertion, the high-current inductor minimizes in-rush current to the DC-to-DC being inserted; and, the diode and capacitor serve to hold up the local voltage at the input to each currently-installed DC-to-DC. During steady-state conditions, the L-C filter minimizes switching noise coupled back into the backplane power bus. During live-extraction, the 0.1 uF capacitor absorbs the inductive-kick of the opened circuit, minimizing contact-arcing. The -5 VDC side of the supply is artificially loaded, providing a minimum load to improve output voltage regulation. The power-up reset generator, assures that RESET is active while the +5 VDC supply is between 1 and 4.5 VDC. This guarantees proper configuration of the Xilinx FPGA during hot swapping and power-up.

3.3.4 FPGA

A Field Programmable Gate Array is the interface between the card and the CPU (if installed). The FPGA provides the timing and control signals for the card in both stand-alone and CPU operating modes.

3.3.5 FAULT DETECTION

There are two categories of fault detection: Input signal faults and Output driver faults. Both use a combination of discrete components and Xilinx FPGA logic to perform the detection task.

Input signal faults are described in paragraph 3.3.1 “Primary and Secondary Inputs.” The output driver fault detectors are described in paragraph 3.3.2. The outputs from these are available to the Xilinx FPGA, which passes status to the CPU.

3.3.6 BACKPLANE FAULT OUTPUT

Inside the FPGA, all faults are combined to form a composite fault signal which is used to drive the Fault line to the Fault Monitor CPU. Fault-signal active indicates status-bit true. (Note that FAULT signal is active-low on the backplane.) Refer to manual Section 2.4.4 for detailed information on the fault reporting.

3.3.7 FAULT INDICATION

The INIT. FAULT indicator is driven by the FPGA Initialization-done signal. It activates during initialization, and remains active if initialization does not complete. This is an extremely unusual occurrence.

SECTION FOUR

4 DETAILED DRAWINGS

- 4.1 560-5183 DETAILED DRAWINGS
- 4.2 560-5183-2 BILL OF MATERIALS