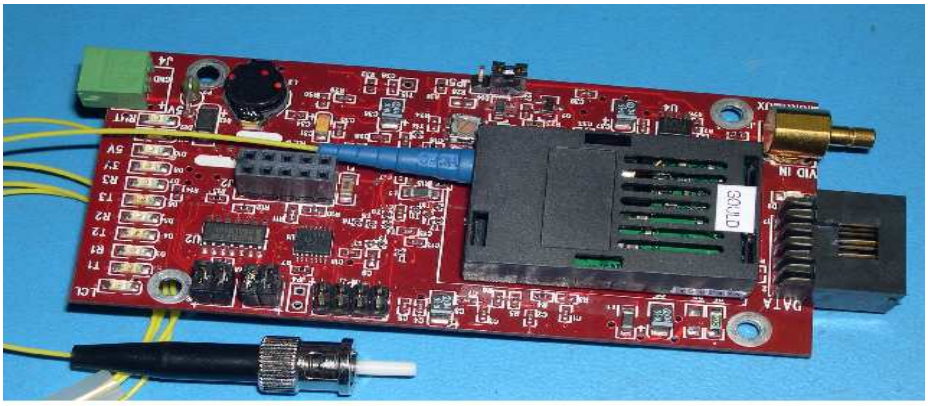
PRIZM™

MicroMux User's Manual

(200790-xxx And 200800-xxx)

And

Troubleshooting Guide



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Rev D.

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1 MicroMux Video Input Board P/N – 200790-xxx and MicroMux Video Output Board P/N – 200800-xxx

The MicroMux Video Input and Output boards are used as a set. The Input Board is used at the system location where the video sources are located while the Output board is located at the system location where the video is to be displayed. These boards are functionally identical with respect to data functions. The only difference between them is a result of the unidirectional nature of the video signal. This board set provides for 1 video channel, 2 RS-232 data channels and 1 RS-422/RS-485 data channel. In addition, the MicroMux Video Input and Output boards provide for the use of a daughtercard for additional data channels.

NOTE: For details on a specific daughtercard, refer to the daughtercards manual. For a current list of available daughtercards, please contact the factory sales personnel.

1.1 MicroMux Manual Revision History

The MicroMux User's Manual and Troubleshooting Guide has gone through the following revisions:

Oct. 2003	Preliminary
Nov. 2003	Rev A
Sep. 2005	Rev B
Jan. 2006	Rev C
Feb. 2009	Rev D Updated contact information to reflect Moog Components Group.

1.2 MicroMux Video Input and Output Board Dash (-) Number Definitions*:*

The MicroMux Video Input and Output boards have a Dash Number appended to the part number. This Dash Number identifies the specific board configurations:

Note:

i. BI-DI refers to an optical module with integral WDM.
ii. The D/B column refers to Daughter Board, an X in the column indicate a Daughter Board is enabled.
iii. WIDE TEMP refers to version with extended temperature range optics
iv. WIDE BANDWIDTH refers to version with wide analog bandwidth (> 8MHz)

MicroMux Input Board 200790-xxx

Dash Number	Board Rev.	Assy. Rev.	Optics Voltage, Wavelength, Notes	Oscillators	D/B Enabled
-001	A	A	5V, 1550nm, PROTOTYPE	33.3, 32.0	X
-002	B	A	5V, 1550nm	33.3, 32.0	X
-003	B	A	5V, 1550nm, Connectors Removed	33.3, 32.0	X
-004	B	A	5V, 1550nm, Dual Fiber	33.3, 32.0	X
-005	B	A	5V, 1310nm, Dual Fiber	33.3, 32.0	X
-006A	B	A	5V, 1550nm, single Fiber, single mode, pressure tolerant	33.3, 32.0	X
-006FC	B	A	5V, 1550nm, single Fiber, single mode, pressure tolerant, FC connector	33.3, 32.0	X
-010A	B	A	5V, 1550nm, single Fiber, multi mode	33.3, 32.0	X
-011A	B	A	5V, 1550nm, single Fiber, multi mode, FC connector	33.3, 32.0	X
-012PC	B	A	5V, 1550nm, single Fiber, multi mode, pressure tolerant	33.3, 32.0	X
-013	B	A	5V, 1550nm, single Fiber, multi mode, no connectors	33.3, 32.0	X
-014	B	A	5V, 1550nm, Dual Fiber, SC connector, unidirectional	33.3, 32.0	X
-015	B	A	5V, 1310nm, Dual Fiber, SC connector, unidirectional	33.3, 32.0	X
-016	B	A	5V, 1550nm, single Fiber, hi speed 485	33.3, 32.0	X
-017A	B	A	5V, 1550nm, single Fiber, for use with disposable spooler	33.3, 32.0	X

MicroMux Output Board 200800-xxx

Dash Number	Board. Rev.	Assy. Rev.	Optics Voltage, Wavelength.	Oscillators	D/B Enabled
-001	A	A	5V, 1550nm, PROTOTYPE	33.3, 32.0	X
-002B	B	A	5V, 1310nm, single fiber, single mode	33.3, 32.0	X
-003	B	A	5V, 1550nm, Connectors Removed	33.3, 32.0	X
-004	B	A	5V, 1310nm, Dual Fiber	33.3., 32.0	X
-005	B	A	5V, 1550nm, Dual Fiber, SC connector	33.3., 32.0	X
-006	B	A	5V, 1310nm, single Fiber, single mode, pressure tolerant	33.3., 32.0	X
-010A	B	A	5V, 1310nm, single Fiber, multimode	33.3., 32.0	X
-011A	B	A	5V, 1550nm, single Fiber, multimode , no connectors	33.3., 32.0	X
-013	B	A	5V, 1310nm, single Fiber, multimode , no connectors	33.3., 32.0	X
-014	B	A	5V, 1310nm, Dual Fiber, receive only	33.3., 32.0	X
-015	B	A	5V, 1310nm, single Fiber, hi speed 485	33.3., 32.0	X
-017	B	A	5V, 1310nm, single Fiber, for use with disposable spooler	33.3., 32.0	X

1.3 MicroMux Video Input and Output Board Operation

The MicroMux Video Input and Output boards include the fiber optic link interface, one channel of video with 10-bit analog-to-digital conversion, two channels of RS-232 data and one channel of RS-485 or RS-422 data. The boards interface to all of the on-board peripheral devices (such as the fiber optic link chips (SERDES), the video analog-to-digital converters (ADCs) and the data interface chips) through a programmable logic device. The boards also provide the interface for a daughtercard connection.

A block diagram of the basic MicroMux Video Input and Output Board I/O is shown on the following page and explained in the subsequent paragraphs.

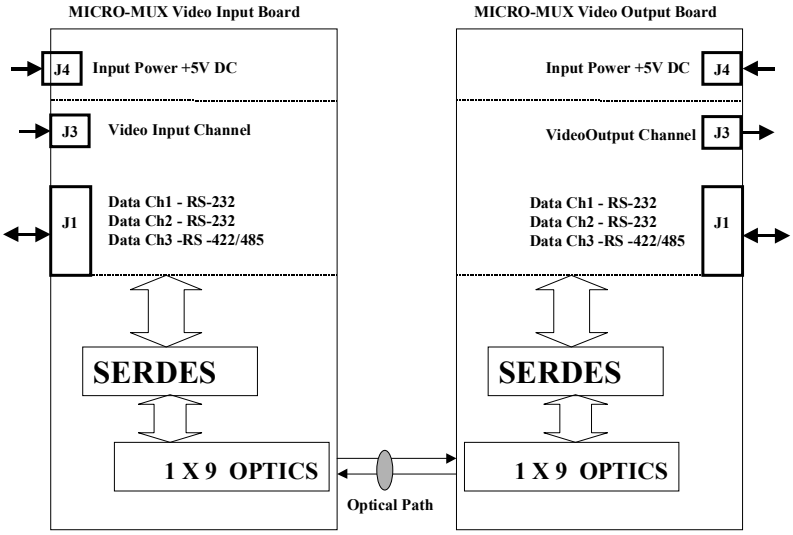
The transmit portion (uplink from vehicle to surface) of the MicroMux Video Input board takes in the video signals from the ADCs, the three onboard serial data signals and the daughtercard data and clock signals and converts them to a single serial optical signal. The signal is transmitted to the MicroMux Video Output board at the other end of the fiber optic link in the control/viewing area. The receive portion of the MicroMux Video Output board accepts the optical signal, recovers the video channel, recovers the three serial data signals and routes them to the appropriate RS-232/RS-485/RS-422 driver chips, and recovers the daughtercard clock and data signals and routes them to the daughtercard connection.

There is no video signal in the optical signal from the MicroMux Video Output board. The transmit portion (downlink from surface to vehicle) of the MicroMux Video Output board takes in the three onboard serial data signals and the daughtercard data and clock signals and converts them to a single serial optical signal. The signal is transmitted to the MicroMux Video Input board at the other end of the fiber optic link in the vehicle. The receive portion of the MicroMux Video Input board accepts the optical signal, recovers the three serial data signals and routes them to the appropriate RS-232/RS-485/RS-422 driver chips, and recovers the daughtercard clock and data signals and routes them to the daughtercard connection.

The MicroMux boards require a +5VDC power source provided through the 2-pin Phoenix connector at J4. The boards have an on-board 5V to 3.3V converter to provide power for the components that use that supply voltage.

MICRO-MUX

Signal and Power Block Diagram



1.3.1 MicroMux Video Input Board Indicator and Controls

LEDS: There are 12 surface mount (SMD) LED indicators on the MicroMux Video Input board to indicate different statuses that are covered by function below.

LED	Indication
D1 (Green)	Labeled RCV LINK 'ON' whenever the onboard SERDES receiver is receiving valid data with no errors. Indicates a good link
D2 (Red)	'ON' when serial transmit data T1 is being sent out of the board
D3 (Green)	'ON' when serial data is being received into the board on channel R1
D4 (Red)	'ON' when serial transmit data T2 is being sent out of the board
D5 (Green)	'ON' when serial data is being received into the board on channel R2
D6 (Red)	'ON' when serial transmit data T3 is being sent out of the board
D7 (Green)	'ON' when serial data is being received into the board on channel R3
D8 (Green)	Labeled '3.3V', located on the mid-right of the board. When 'ON' indicates the on-board 5V to 3.3V converter is operational
D9 (Green)	Labeled VID1 is 'ON' whenever a video or analog signal is present at the channel 1 video input connector J4.
D10 (Green)	Labeled '5V', located on the mid-right of the board. When 'ON' indicates +5V dc is available to the board
D11 (Green)	Located on the left middle of the board, labeled 'FIBER', provides an indication that the transceiver module has detected the presence of an input signal on the fiber link. When 'ON' indicates that this board has a good level of received optical power from the remote unit.
D12 (Green)	Labeled RMT LINK LED 'ON' when the link is established with the remote MicroMux Video Output board and the data stream is synchronized

FUSE: The +5VDC input to the board is protected by a 5A thru-hole fuse, F2.

SWITCHES: There are no switches on the Video Input board.

CONNECTORS: The connectors on the Video Input board are as follows:

J2	Daughterboard Connector				
VDC Supply	1	o	2	VDC Supply (3.3V or 5V) depending on placement of F1 or F3
RXD 4	3	o o	4	TXD4
GND	5	o o	6	GND
RXC	7	o o	8	TXC
RCV LINK	9	o o	10	Future use

J1	Data Connector				
RS-232 TxD1 (out)	1	o	2	RS-232 RxD1 (in)
GND	3	o o	4	GND
RS-232 TxD2 (out)	5	o o	6	RS-232 RxD2 (in)
GND	7	o o	8	GND
RS-422 Tx3+ (out)	9	o o	10	RS-422 Rx3+ (in)/RS-485 RT3+
RS-422 Tx3- (out)	11	o o	12	RS-422 Rx3- (in)/RS-485 RT3-

J3	Video Channel 1 Input SMB connector

J4	+5VDC Power connector

JUMPERS:

There are 5 jumpers on the MicroMux Video Input Board:
(PIN 1 IS DENOTED BY SQUARE PCB PAD AND PIN 2 IS ALONG EDGE OF BOARD)

JP1: RS-485/RS-422 Selection

```
1 o o 2                          1 o o 2
  | |        for RS-485                      for RS-422
3 o o 4                          3 o o 4
```

JP2: RS-485/RS-422 selection

```
1 o o 2                          1 o o 2
  | |        for RS-485                      for RS-422
3 o o 4                          3 o o 4
```

JP3: ISP Programming Header

JP4: 100 Ohm Termination
1 o o 2 Disabled
1 o= =o 2 Enabled

JP5: Video Channel 1 Signal Bias Select
1 o==o o 3 Divider 1 o o==o 3 Video Clamp

1.3.2 MicroMux Video Output Board Indicator and Controls

LEDS: There are 12 surface mount (SMD) LED indicators on the MicroMux Video Input board to indicate different statuses that are covered by function below.

LED	Indication
D1 (Green)	Labeled RCV LINK 'ON' whenever the onboard SERDES receiver is receiving valid data with no errors. indicating a good link
D2 (Red)	'ON' when serial transmit data T1 is being sent out of the board
D3 (Green)	'ON' when serial data is being received into the board on channel R1
D4 (Red)	'ON' when serial transmit data T2 is being sent out of the board
D5 (Green)	'ON' when serial data is being received into the board on channel R2
D6 (Red)	'ON' when serial transmit data T3 is being sent out of the board
D7 (Green)	'ON' when serial data is being received into the board on channel R3
D8 (Green)	Labeled '3.3V', located on the mid-right of the board. When 'ON' indicates the on-board 5V to 3.3V converter is operational
D9 (Green)	Labeled VID1 is 'ON' whenever a video or analog signal is present at the channel 1 video input connector J4.
D10 (Green)	Labeled '5V', located on the mid-right of the board. When 'ON' indicates +5V dc is available to the board
D11 (Green)	Located on the left middle of the board, labeled 'FIBER', provides an indication that the transceiver module has detected the presence of an input signal on the fiber link. When 'ON' indicates that this board has a good level of received optical power from the remote unit.
D12 (Green)	Labeled RMT LINK LED 'ON' when the link is established with the remote MicroMux Video Input board and the data stream is synchronized

SWITCHES: There are no switches on the Video Output board.

CONNECTORS: The connectors on the Video Output board are as follows:

J2	Daughterboard Connector				
VDC Supply	1	o	2	VDC Supply
RXD 4	3	o o	4	TXD4
GND	5	o o	6	GND
RXC	7	o o	8	TXC
RCV LINK	9	o o	10	Future use

J1	Data Connector				
RS-232 TxD1 (out)	1	o	2	RS-232 RxD1 (in)
GND	3	o o	4	GND
RS-232 TxD2 (out)	5	o o	6	RS-232 RxD2 (in)
GND	7	o o	8	GND
RS-422 Tx3+ (out)	9	o o	10	RS-422 Rx3+ (in)/RS-485 RT3+
RS-422 Tx3- (out)	11	o o	12	RS-422 Rx3- (in)/RS-485 RT3-

J3	Video Channel 1 Input SMB connector

J4	+5VDC Power connector

JUMPERS:

There are 5 jumpers on the MicroMux Video Input Board:
(PIN 1 IS DENOTED BY SQUARE PCB PAD AND PIN 2 IS ALONG EDGE OF BOARD)

JP1: RS-485/RS-422 Selection

```
1 o o 2                          1 o o 2
  | |        for RS-485                        for RS-422
3 o o 4                          3 o o 4
```

JP2: RS-485/RS-422 selection

```
1 o o 2                          1 o o 2
  | |        for RS-485                        for RS-422
3 o o 4                          3 o o 4
```

JP3: ISP Programming Header

JP4: 100 Ohm Termination

```
1 o    o 2   Disabled
1 o= =o 2   Enabled
```

JP5: Video Channel 1 Signal Bias Select

1.3.3 MicroMux RS-232/RS-485/RS-422 Data Operation

The MicroMux System provides two independent channels of RS-232 data and one channel of either RS-485 or RS-422 data (jumper selectable). All data channels support at least 115.2 Kbaud, with the RS422 channel capable of up to 2.5Mbps. Refer to the Jumper Configuration section for specific jumper definitions and settings for the Video Input and Video Output boards.

1.3.4 MicroMux RS-232 Data Channel Selection and Operation

The two channels of RS-232 are not optically isolated. There are no baud rate jumpers to select for RS-232 operation. The channels are simply time sampled at 16.5 Megasamples per second (Msps). The maximum RS-232 data rate is governed by the slew rate limiting on the RS-232 driver chips themselves.

1.3.5 MicroMux RS-485/RS-422 Data Channel Selection and Operation

The RS-485/RS-422 channel can have several possible configurations. The configurations are selected by placing jumper shunts on several jumper posts. The RS-485/RS-422 channel does not have optical isolation.

If the channel is selected for RS-485 operation, then the data rate should be selected to agree with the actual rate in use. Six different data rates are selectable: 9.6K, 19.2K, 38.4K, 57.6K, 115.2K and 230.4Kbaud. There is an additional jumper post that, if placed, enables an autobaud mode that supports data rates up the maximum expected data rate (selected from the rates above). Leaving the shunt off selects a fixed data rate (selected above). The receiver line termination should be selected for 100 ohms for most applications.

Note: Refer to the Jumper Configuration section for specific jumper definitions and settings for the Video Input and Video Output boards.

If the channel is configured for RS-422 then the data rate settings are ignored. Any data rate up to and above 2.5 megabaud are supported. The receiver line termination should be selected for 100 ohms for most applications.

NOTE: The default board configuration as shipped from the factory is RS-485, in autobaud mode selected with a maximum of 57.6Kbaud, and with a receiver line termination of 100 ohms enabled.

1.4 MicroMux Video Input and Output Board Specifications:

Optical

Link Data Rate:	up to 1.4 Gbps, 666.6/640 Mbps typically on the uplink/downlink
System Frame Rate:	up to 70 Mega samples/sec (Msps), 33.3/32 Msps typically on the uplink/downlink
Fiber Options:	Singlemode or Multimode
Laser Wavelengths:	1310 and 1550 nanometers
Optical Output Levels:	-5dBm transmitter power output at 1550 nm, typically -5dBm transmitter power output at 1310 nm, typically
Receiver Sensitivity:	-30 dBm receiver sensitivity, typically
Receiver Saturation:	-6 dBm, typically
Optical Budget:	25 dB, typically
Optical Link Lengths:	up to 20 kilometers with singlemode at 450 Mbps up to 4 kilometers with multimode at 450 Mbps

Video

Number of Video Channels:	1
Video Quantizing Level:	10 bits or 1024 levels
Video Sample Rate:	16.5 Msps, typically

Onboard Data Channels

Number of Data Channels:	2 x RS-232, 1 x RS-485/422
RS-232 Data Rates:	At least 115Kbaud
RS-485 Data Rate:	At least 115Kbaud
Selectable:	9.6K,19.2K, 38.4K, 57.6K, 115.2K, 230.4K baud fixed rates or autobaud (default setting on board)
RS-422 Data Rate:	At least 2.5Mbaud

Offboard Data Capability - Daughtercard

Power	+5 or 3.3 VDC supplied via daughtercard connector
Number of Data Channels	Depends on Daughter Board, refer to Daughter Board manual

Misc.

Operating Temperature:	0 degree C to 65 degree C (except high temp version which is -20 deg C to 70 deg C)

1.4.1 MicroMux Video Input and Output Board Dimensions:

Printed circuit board (PCB): 4.01 in x 1.9 in x 0.60 in board-to-board 101.854 mm x 49.26 mm x 15.24 mm

1.4.2 MicroMux Video Input and Output Board Power Requirements

+5 Volts at 1.0 Amps (5.0 Watts), maximum

1.5 MicroMux Video Input and Output Board Adjustment and Troubleshooting

In normal operation the following LED status should be observed:

+5V Power LED – Lit green
+3.3V Power LED – Lit green
FIBER LED – Lit green
RCV LINK LED – Lit green
RMT LINK LED – Lit green
R1/R2/R3 LEDs - Lit green if receiving data into board
T1/T2/T3 LEDs - Lit red if transmitting data out of board
D1 (Daughtercard Power Available) – Lit green
Video LED (D9 on INPUT and Output Board) lit when signal present

1.5.1 Power Section Testing

If both the +5V Power LED +3.3V Power LED are out:

- Check for continuity of fuse F2 with an ohmmeter.
- Replace fuse if blown.

If only the +5V Power LED is out:

- Verify +5V DC is present at the source
  - At J4 if powered off of external power
- If +5V is not available replace the board with a spare.
- If +5V is available check the display LED (D10).

If only the +3.3V Power LED is out:

- Verify +5VDC across C35 (replace board if +5VDC is not available)
- Verify +3.3VDC across C47 on back of board
  - If +3.3V is not available replace the board with a spare.
  - If +3.3V is available check the display LED (D8).

1.5.2 Optical Section Testing

If the FIBER LED, RCV LINK LED and/or RMT LNK LED are off or flickering, one or more of the following conditions is likely:

- The fiber is broken or damaged.
- The optical transceiver module is defective.
- Excessive light loss (low received optical power) is being experienced.
- The MicroMux board (not the optical transceiver module) is malfunctioning.
- There is not enough attenuation in the optical link and the receiver is saturating.

If excessive optical loss is being experienced, the following conditions may be present:

- May have horizontal lines or random white dots on video monitors.
- Check the optical level with an optical power meter and inspect all fiber optic connections including WDMs and sliprings.

To determine if the fiber is broken, a laser module is out, or the board is malfunctioning, first:

- Verify that the optical transceiver is tight in its socket.
- Verify that shunts (jumpers) are placed per system jumper configuration.
- Check all fiber optic connections including WDMs and sliprings to make sure that they are not causing the problem.
- Check that the optical fiber cable is straight at connectors on board for minimum optic loss.

1.5.3 Video Section Testing

If one or more video channels are tearing or have a low video level:

- First, try to adjust the gain on the MicroMux Input board, utilizing trimpot VR1
- Next, try to adjust the gain on MicroMux Output board, utilizing trimpot VR1.

If one or more video channels are out:

- Verify that MicroMux Input board is installed on camera side of link (Usually ROV end) and that MicroMux Output board is installed in the monitor side of the link (usually the surface unit).
- Inspect cameras, cables, connectors, and monitors for damage and repair/replace if necessary.
- Verify that the video level LEDs on the Video Input board is lit to indicate that a video signal is present at the video input connector. Check the video signal at the connector with a monitor or an oscilloscope.
- If a video signal is present at the Video Input board, replace the board with a spare. If this does not fix the problem, replace the Video Output board with a spare.

1.5.4 Data Section Testing

If one or both RS-232 data channels are out or has errors:

- Run RS-232 data into appropriate pins of connector J1 of the channel being tested. The RS-232 data can be input into either the remote vehicle or surface MicroMux board.
- On the other end of the link, short the same pins of connector J1 of the MicroMux RS-232 channel being tested. This will allow the two MicroMux boards to talk to each other in loopback. Both RX and TX LEDs on both boards should be lit and/or flickering in response to the data traffic.
- If the RS-232 data channel is not operating correctly, first check the RS-232. If the wiring appears correct, then first replace the Video Input board with a spare and check the RS-232 channel again. If the problem is still there, return the original Video Input board, replace the Video Output board with a spare and check the RS-232 again.
- If any of the LEDs are not operating correctly check one of the other channels. If the LEDs operate on that channel, replace the MicroMux board with a spare board or use the working channels only.

If the RS-485 data channel is out or has errors:

- Run RS-485 data into appropriate pins of connector J1. The RS-485 data can be input into either the remote vehicle or surface MicroMux board.
- On the other end of the link, attach the other computer used for RS-485 testing to the same pins of connector J1 of the MicroMux RS-485 channel. This will allow the two RS-485 test computers to talk to each other through the MicroMux boards. Both RX and TX LEDs on both boards should be lit and/or flickering in response to the data traffic.
- If the RS-485 data channel is not operating correctly, first check the RS-485 wiring then the jumpers on both MicroMux boards. If the wiring and jumpers appear correct, then replace first the Video Input board with a spare and check the RS-485 again. If the problem is still there, return the original Video Input board, replace the Video Output board with a spare and check the RS-485 again.
- If any of the LEDs are not operating correctly check one of the other channels. If the LEDs operate on that channel, replace the MicroMux board with a spare board or use the working channels only.

If the RS-422 data channel is out or has errors:

- Run RS-422 data into appropriate pins of connector J1. The RS-422 data can be input into either the remote vehicle or surface MicroMux board.
- On the other end of the link, short the TX3+ pin to the RX3+ pin and the TX3- to RX3- pins of connector J1 of the MicroMux RS-422 channel being tested. This will allow the two MicroMux boards to talk to each other in loopback. Both RX and TX LEDs on both boards should be lit and/or flickering in response to the data traffic.
- If the RS-422 data channel is not operating correctly, first check the RS-422 wiring then the jumpers on both MicroMux boards. If the wiring and jumpers appear correct, then replace first the Video Input board with a spare and check the RS-422 again.
- If the problem is still there, return the original Video Input board, replace the Video Output board with a spare and check the RS-422 again. If any of the LEDs are not operating correctly check one of the other channels. If the LEDs operate on that channel, replace the MicroMux board with a spare board.

2 Appendix A: OPTICAL CONSIDERATIONS

2.1 MicroMux Fiber Optics

Both the MicroMux Video Input board and the Video Output board come with the fiber optic transmitter/receiver (an industry standard 1x9 transceiver module) placed in a socket. The Video Input board must be optically linked with a Video Output board for the MicroMux System to function properly.

The fiber optic transceiver module has a duplex SC/PC fiber optic connector. The user's field optical cables can be plugged directly into the transceiver. For single fiber WDM versions, two short SC/PC to ST jumper cables plug into the transceiver and then into the WDM.

NOTE: The MicroMux System does NOT require a full duplex fiber optic connection in place before multiplexed data is sent over the fiber link. If only one direction is operational, then only the information sent in that direction is available. If only single direction video is required and full duplex data is not required then only the uplink fiber needs to be plugged in.

2.1.1 MicroMux System Singlemode Versus Multimode Optical Operation

The Prizm MicroMux System can be configured for use with either singlemode or multimode fiber optic cable in the umbilical and with fiber optic rotary joints (i.e. slip rings). With a singlemode umbilical cable, optical links in excess of 20 kilometers (64,000 feet) can be used with the Prizm MicroMux System.

Note: Some systems are supplied with optics that incorporate the WDM within the 1*9 optical assembly (MRV) – these systems will only work as singlemode fiber systems.

Multimode umbilicals require special attention. Multimode cables typically have optical cores of either 50 or 62.5 micron and are not optimized for use with singlemode lasers, which are designed for a fiber optic cable typically with a 9-micron optical core. The wide core diameter of multimode fiber optic cable allows multiple light paths from the laser instead of the normal single path (or ray) of light found in single mode fiber. The multiple paths lead to differing arrival times for the transmitted laser light and the paths will change as the fiber is moved or bent. The result is a reduction in the effective bandwidth of the optical signal. To operate reliably, multimode link length should be held to a maximum of 4 Kilometers.

NOTE: The Prizm MicroMux System can be configured to operate over a multimode umbilical of up to 4 kilometers.

Singlemode and multimode deck cables should not be mixed. Once the laser light has been coupled into multimode cable, it cannot be coupled back into singlemode cable. The laser light path will still be approximately 9 micron in diameter as it leaves the multimode cable so the chances that the ray will hit the 9-micron fiber core are extremely small. Excessive flexing of the multimode cable will tend to move the laser ray within the cable and the exit of the ray will be anywhere within the optical cross-section of the multimode cable.

2.1.2 MicroMux System Optical Configurations

Several optical configurations can be supported. The most common configurations are single fiber and dual fiber operation.

2.1.2.1 Single Fiber Operation

Single fiber operation is advantageous to maximize the number of spare fibers in an umbilical or slip ring. Single fiber operation is implemented by using two different optical wavelengths to carry the uplink and downlink data on the same fiber. The two wavelengths are filtered and combined by external WDMs to remove any interference between the uplink and downlink signals. The laser transmitters are fabricated with a specific wavelength (i.e. 1310 or 1550 nm) and transmit at these wavelengths. The optical receivers are responsive to a wide range of wavelengths (typically 1000 to 2000 nm). The filtering function of the WDM removes the local transmitter's wavelength (the undesired signal) from the remote transmitter's wavelength (the desired signal). The local transmitter's signal can feed back into the local receiver by the reflection from a poorly terminated fiber optic connector and cause link errors.

Based on the present optics available, there are 3 possible configurations of the MicroMux that will facilitate single fiber operation:

- Single–mode single fiber operation using optics which incorporate an integral WDM
- Single-mode single fiber operation using optics that require a separate external WDM
- Multi-mode Single Fiber operation using optics that require a separate external WDM

2.1.2.2 Dual Fiber Operation

Dual fiber operation uses two separate fibers, one for transmit and the other for receive. The same transmit wavelength is used at both of the Video Input and Output boards. This configuration does not use an external WDM.

A typical optical budget includes cable and connector losses. Notice that the uplink laser output (from the vehicle) is the same as the downlink as this example has 1310 nm laser optics at both ends of the link. No attenuators should be placed in the uplink optical path.

Appendix B. MicroMux SYSTEM INSTALLATION AND CHECKOUT

2.2 General MicroMux System Installation Notes

NOTE: Please read all of this section prior to starting the installation process.

NOTE: The MicroMux System does NOT require a full duplex fiber optic connection in place before multiplexed data is sent over the fiber link. If only one direction is operational, then only the information sent in that direction is available. If only single direction video is required and full duplex data is not required then only the uplink fiber needs to be plugged in.

Test Equipment Required:

1. Video signal generator or video camera
2. Video monitor
3. Serial data test hardware, a computer with appropriate serial data interface cards for RS-232, RS-485, and/or RS-422 and appropriate serial test software, or your actual telemetry control serial link
4. Fiber optic power meter (optional)

2.3 Standalone MicroMux System Installation Checkout Procedure

For this standalone MicroMux System installation checkout procedure, it is assumed that the MicroMux System is composed of a Video Input board mounted in the vehicle and a Video Output board on the surface. +5VDC power is supplied by a separate DC power supply.

1. At the vehicle, mount the MicroMux Video Input board.

2. Wire the DC power leads from the power source (+5VDC only) to a 2-pin Phoenix plug (supplied with the MicroMux board). Use 16-gauge wire (or equivalent) for +5VDC and DC GND connections.

3. Power up the supply (**do not plug the 2-pin Phoenix connector into the Video Input board**) and verify the correct voltage is available at the 2-pin plug. The DC voltage should be in the range of +5.00VDC to +5.50VDC.

*NOTE. If you cannot establish proper voltage **STOP** the installation and refer to the manufacturer's technical documentation provided with the power source.*

4. Once the correct DC power is verified on the 2-pin connector, turn the power supply off, plug the 2-pin connector into the MicroMux Video Input board, turn the power supply back on and verify that the +5V and +3.3V power LEDs light up on the board

5. Now repeat all of the previous steps to install the MicroMux Video Output board at the surface.

6. Connect either a short length of fiber optic test cable or the actual working umbilical cable between the MicroMux Video Input and Video Output boards. Power up the two units and verify that the both of the green FIBER, RCV LINK LED and RMT LED are lit on both the vehicle and surface units.

7. If all 3 LEDs are lit on both boards, skip to the video testing step.

8. If all 3 LEDs are NOT lit, check all fiber connections in the system.

9. Use a video test pattern generator or camera to generate a video signal to test both of the video channels. When the video input source is connected to one of the two channels on a Video Input board, a green LED will light on the corresponding channel on both the Video Input and Video Output boards. Refer to the Video Section Testing under Troubleshooting for more information.

10. Test the data channels on the board. This may be done with an appropriate serial data test generator, a PC with communications software, or even with a square wave signal generator. Refer to the Data Section Testing under Troubleshooting for more information.

NOTE: Ensure that any serial data test signals are appropriate for the data channel type (i.e., if the input channel is an RS-232 interface then up to but not exceeding +/- 12VDC signals can be used).