User Manual for the
HE697FBX100
& HE697FBX105

Fiber Optic Expansion Interface

Fourth Edition
20 November 1998

MAN0215-04

PREFACE

This manual explains how to use the Fiber Optic Expansion Interface Module.

Information in this document is subject to change without notice and does not represent a commitment on the part of Horner APG, LLC.

HP is a trademark of Hewlett Packard.

For user manual updates, contact Horner APG, Technical Support Division, at (317) 916-4274 or visit our website at www.heapg.com.

LIMITED WARRANTY AND LIMITATION OF LIABILITY

Horner APG, LLC. ("HE") warrants to the original purchaser that the Fiber Optic Expansion Interface modules (master and slave); manufactured by HE is free from defects in material and workmanship under normal use and service. The obligation of HE under this warranty shall be limited to the repair or exchange of any part or parts which may prove defective under normal use and service within two (2) years from the date of manufacture or eighteen (18) months from the date of installation by the original purchaser whichever occurs first, such defect to be disclosed to the satisfaction of HE after examination by HE of the allegedly defective part or parts. THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR USE AND OF ALL OTHER OBLIGATIONS OR LIABILITIES AND HE NEITHER ASSUMES, NOR AUTHORIZES ANY OTHER PERSON TO ASSUME FOR HE, ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OF THIS Fiber Optic Expansion Interface. THIS WARRANTY SHALL NOT APPLY TO THIS Fiber Optic Expansion Interface OR ANY PART THEREOF WHICH HAS BEEN SUBJECT TO ACCIDENT, NEGLIGENCE, ALTERATION, ABUSE, OR MISUSE. HE MAKES NO WARRANTY WHATSOEVER IN RESPECT TO ACCESSORIES OR PARTS NOT SUPPLIED BY HE. THE TERM "ORIGINAL PURCHASER", AS USED IN THIS WARRANTY, SHALL BE DEEMED TO MEAN THAT PERSON FOR WHOM THE Fiber Optic Expansion Interface IS ORIGINALLY INSTALLED. THIS WARRANTY SHALL APPLY ONLY WITHIN THE BOUNDARIES OF THE CONTINENTAL UNITED STATES.

In no event, whether as a result of breach of contract, warranty, tort (including negligence) or otherwise, shall HE or its suppliers be liable of any special, consequential, incidental or penal damages including, but not limited to, loss of profit or revenues, loss of use of the products or any associated equipment, damage to associated equipment, cost of capital, cost of substitute products, facilities, services or replacement power, down time costs, or claims of original purchaser's customers for such damages.

To obtain warranty service, return the product to your distributor with a description of the problem, proof of purchase, post paid, insured and in a suitable package.

ABOUT PROGRAMMING EXAMPLES

Any example programs and program segments in this manual or provided on accompanying diskettes are included solely for illustrative purposes. Due to the many variables and requirements associated with any particular installation, Horner APG cannot assume responsibility or liability for actual use based on the examples and diagrams. It is the sole responsibility of the system designer utilizing the Fiber Optic Expansion Interface to appropriately design the end system, to appropriately integrate the Fiber Optic Expansion Interface and to make safety provisions for the end equipment as is usual and customary in industrial applications as defined in any codes or standards which apply.

Note: The programming examples shown in this manual are for illustrative purposes only. Proper machine operation is the sole responsibility of the system integrator.

TABLE OF CONTENTS

PAGE INTENTIONALLY LEFT BLANK

CHAPTER 1: INTRODUCTION

1.1 General

The Fiber Optic Expansion Interface Modules (master and slave) connect a transmitter (HE697BEM713) to two receivers (IC697BEM711) and significantly increase the allowable distance between the units. Without the Fiber Optic Expansion Interface Modules, the maximum distance of the entire system is limited to 15 meters (50 feet). The use of the Fiber Optic Expansion Interface Master (HE693FBX105) and Slave (HE697FBX100) Modules increases the maximum allowable distance by 1.4km. Remote fault detection is also provided by the Fiber Optic Expansion Interface. **The information contained within this user manual covers Product Revision 1.0 and higher.**

Note: The HE697BEM713 is a GE Fanuc Series 90-70 Transmitter (IC697BEM713) that has been modified by Horner.

Figure 1.1 depicts the setup of the HE693FBX105 and HE693FBX100. Also shown are the parts that are supplied with the modules, which are required to meet CE standards and assure proper operation.

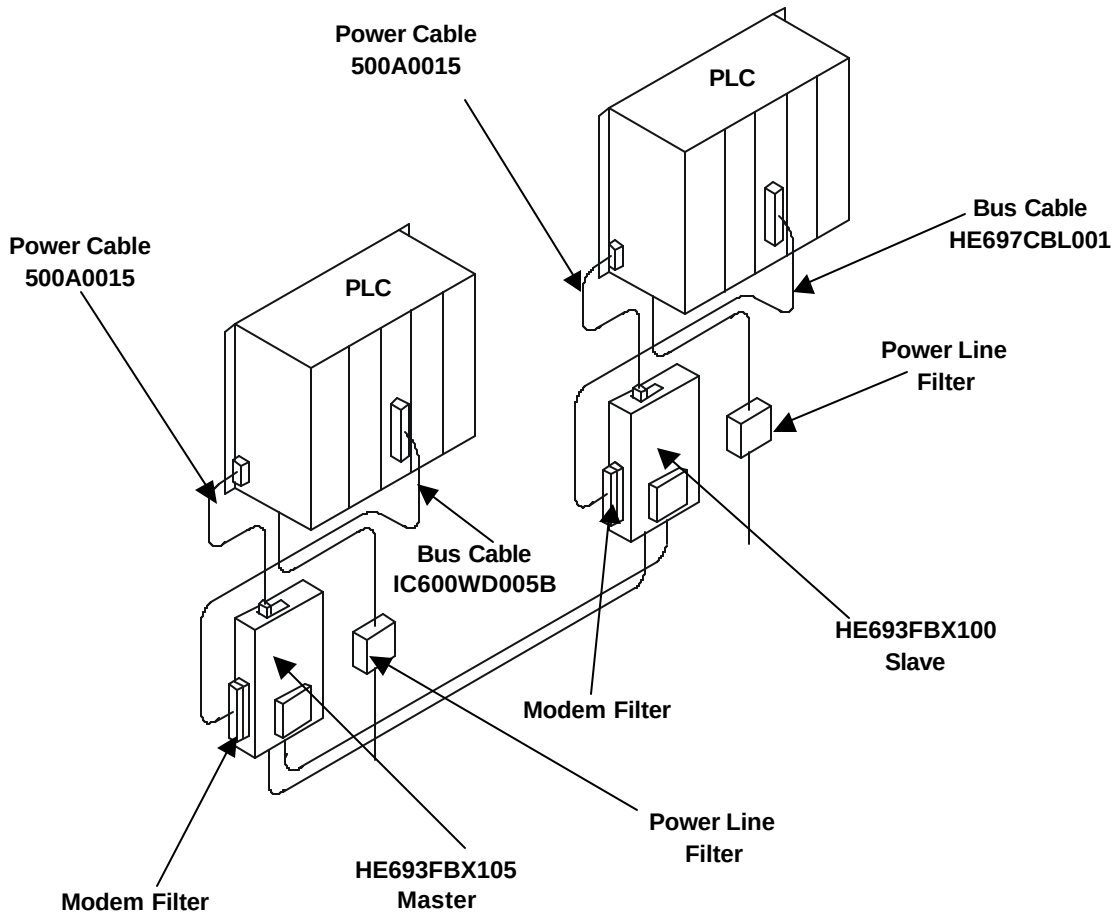

Figure 1.1 – Overall Equipment Setup (including Supplied Parts)

1.2 Specifications

Table 1.1 - Specifications	
Maximum Length of Fiber Optic Cable	Up to 1.4K
Type of Fiber Optic Cable	62.5µm. multi-mode optic fiber
Fiber Optic Driver	HP 1312T, x300 Series (Operates at 1,300nm. wavelength)
Fiber Optic Receiver	HP 2316T, x300 Series (Operates at 1,300nm. wavelength)
Mounting Requirements	184.66mm high x 132.84mm wide x 29.49mm deep
Power Draw	**Master:** Steady State: 1.1A @ 5 VDC **Slave:** Steady State: 950mA @ 5 VDC **Input Voltage:** 4.75 VDC to 5.25 VDC
Transmitter/Receiver Interface (Fiber Optic to TTL Logic)	AMD TAXI IC
Delays	
Maximum Transmit Delay (through HE697FBX105)	500NS.
Maximum Delay of Data (through Cable)	Approximately 5µs. per Km. (through glass)
Maximum Receive Delay (through HE697FBX100)	1µs.
Maximum Total Delay between transmitter and receiver units (using 1.4Km. fiber optic cable)	8.5µs. (round trip)

1.3 Overview of Fiber Optic Expansion Interface Modules (See Figure 1.2)

The Fiber Optic Expansion Interface Master (HE697FBX105) and Slave (HE697FBX100) modules allow for greater distances between Horner Transmitters (HE697BEM713) and Receivers (IC697BEM711). The master has two channels (Ch.1 and Ch.2) allowing communication between a transmitter and up to two receivers. Each slave has only one channel (Ch.1). The following explanation briefly describes how the equipment functions together using fiber optic communications. **For a more detailed explanation, see Chapter 3: Operations.**

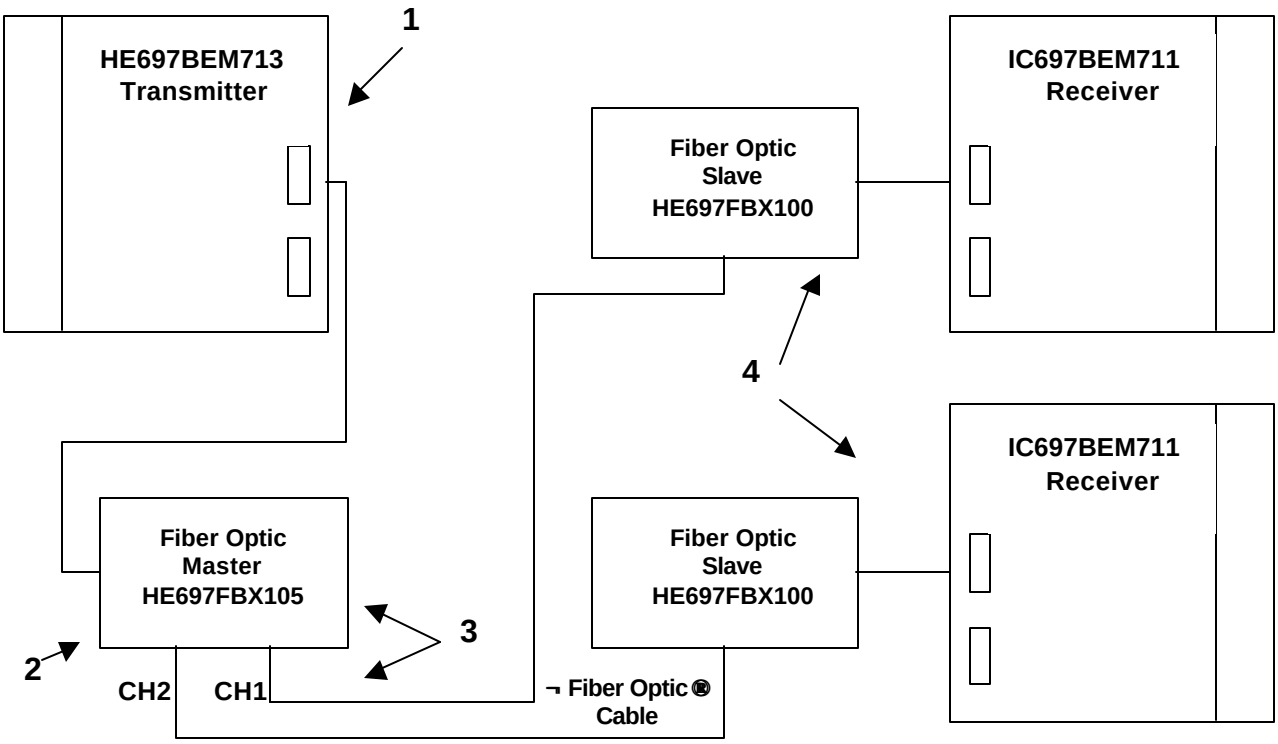

Figure 1.2 - Overview

1. The transmitter sends requests and obtains information from up to two receivers by interfacing with the Fiber Optic Expansion Interface Master (HE697FBX105) and Slave (HE697FBX100) modules. The maximum distance between the master and the slave modules is 1.4Km. The transmitter sends RS-422 signals to the HE697FBX105 over a 37-way cable.

2. The HE697FBX105 converts the RS-422 signals into digital logic, and then, converts the logic into an 8-bit parallel format. The 8-bit parallel format is sequenced and sent to an AMD Taxi Transmitter IC where it is converted into a serial differential signal. The serial differential signal drives the fiber optic drivers to send the data to one or two slave modules over fiber optic cable. In addition, timing sync pulses are regularly sent from the master to keep in synchronization with the slaves.

3. The following delay occurs in the HE697FBX105 master and in the fiber optic cable:

a. A delay occurs within the master module during the conversion processes and lasts 500ns. The delay only occurs when there is an ***initial*** incoming byte. Subsequent bits are not delayed, and thus, the delay is not cumulative.

b. The total maximum delay through the cable is approximately 5µs. per Km (through glass).

Example: 1.4Km. delay = 5µs. x 1.4 = 7µs.

4. The slave module accepts the incoming data and converts the 8-bit parallel format to digital logic. The logic is then converted to RS-422 signals and is sent to the receiver. The slave module has a delay of 1µs. The slave responds to requests from the transmitter by sending the data back to the master module in the reverse of the processes just described.

Note: Figure 1.1 shows only one IC697BEM 711 Receiver connected to each HE697FBX100. However, up to seven IC697BEM711 receivers may be connected off of one HE697FBX100 (multi-drop).

CHAPTER 2: INSTALLATION / CONFIGURATION

2.1 List of Supplied Parts

Several parts are included with each HE697FBX105 and HE697FBX100 Module. **It is important to use the supplied parts with the master and slave modules to meet CE standards and to assure proper operation.** The supplied parts are covered in more detail in Section 2.6.

a. Power Cable with Cable Clamps
b. Power Line Filter
c. Modem Filter

2.2 Mounting Requirements

Figures 2.1 and 2.2 depict the mounting dimensions for HE697FBX105 and HE697FBX100:

Note: Use M4 hardware to mount the HE697FBX105 and HE697FBX100.

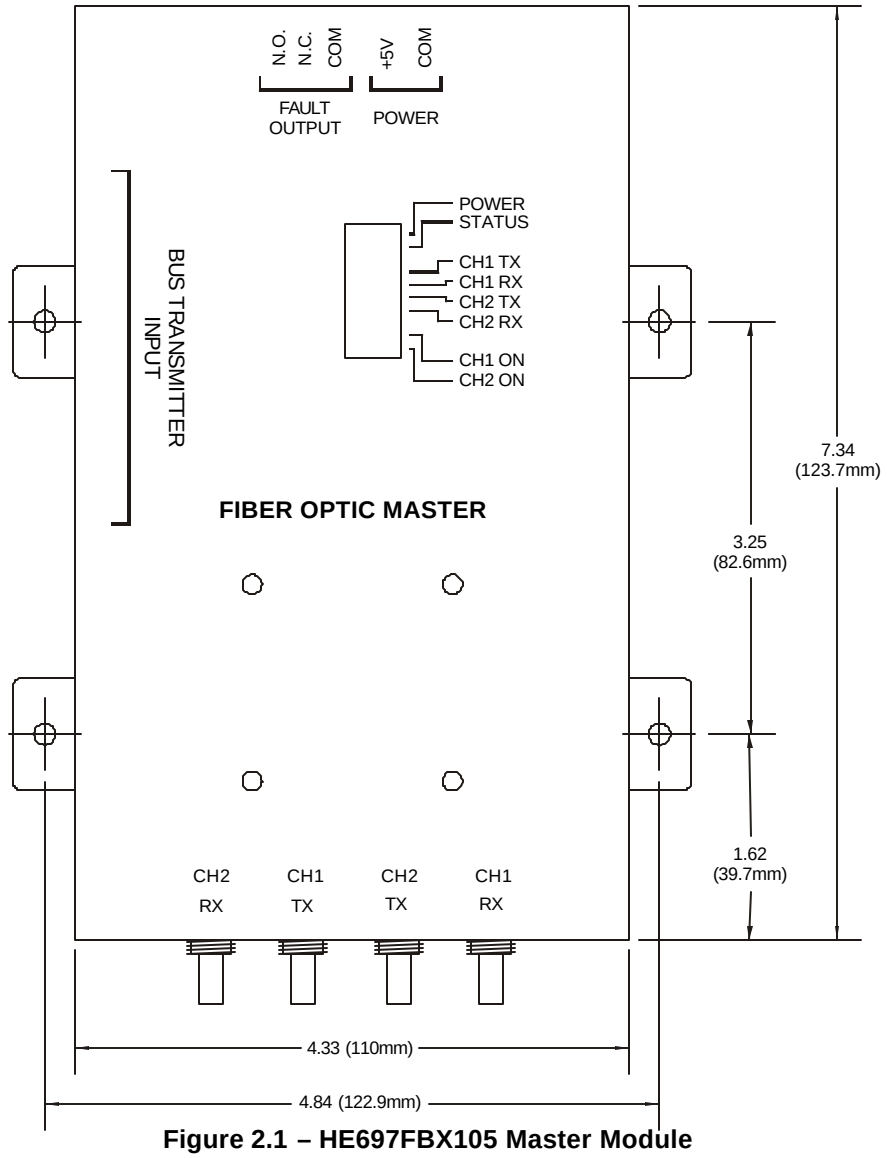

Figure 2.1 – HE697FBX105 Master Module

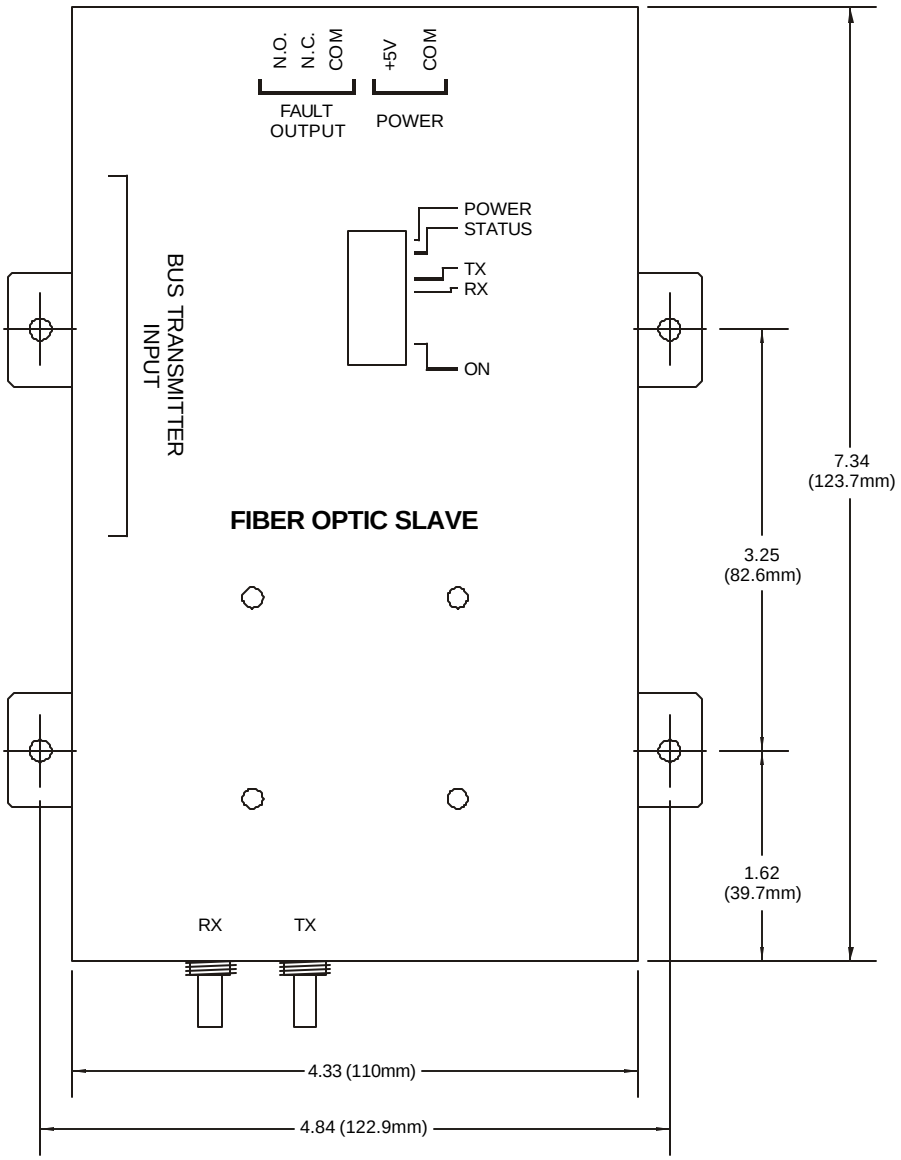

Figure 2.2 – HE697FBX100 Slave Module

2.3 Connectors (See Figures 2.1 and 2.2 for connector locations.)

2.3.1 Power Connector

The power connector is a 2-pin male, removable terminal connector providing +5 VDC and 0 VDC to the board.

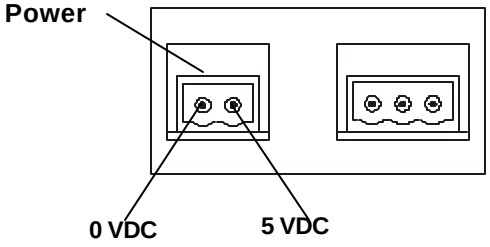

Figure 2.3 – Power Connector

2.3.2 External Fault Connector

The External Fault Connector (Figure 2.4) provides signals to an external circuit to detect faults or errors on the Fiber Optic Expansion Interface. A relay on the PCB closes or opens depending upon the type of circuit used to indicate a fault. Refer to Table 2.1 for external faults.

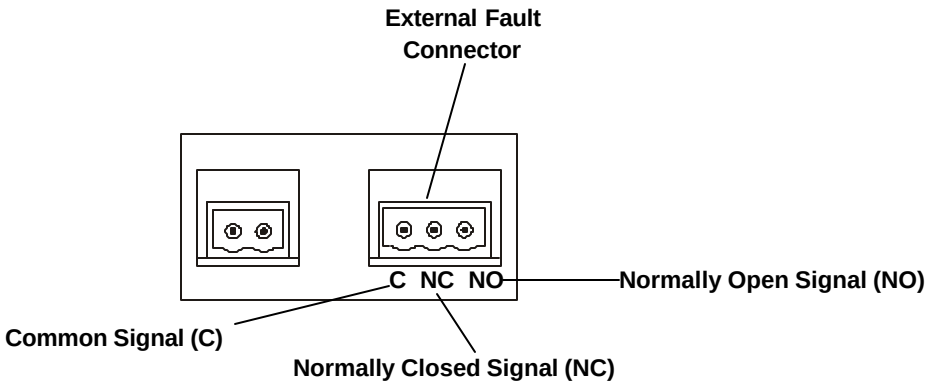

Figure 2.4 – External Fault Connector

Table 2.1 – External Fault Table

State	Normally Closed Signal (NC)	Normally Open Signal (NO)
ON STATE	NC is *opened* during normal operation when power is applied.	NO is *closed* during normal operation when power is applied.
OFF STATE	The circuit is *closed* between NC and C when either: a. No power is applied or b. A fault occurs	The circuit is *opened* between NO and C when either: a. No Power is applied or b. A fault occurs

NOTES:

a. The following types of faults are reported to an external circuit via the External Fault Connector and impact the relay (on the FBX module) as indicated:

1. No power (if the Power LED is not lit). The relay is in the OFF state.
2. FPGA not programmed (if the Power LED is lit, but the Status LED is not lit). The relay is in the OFF state.
3. Channel 1 error (if Power and Status LEDs are lit and Ch.1 LED is lit). The relay alternates continuously between the ON and OFF states.
4. Channel 2 error (if Power and Status LEDs are lit and Ch. 2 LED is lit). The relay alternates continuously between the ON and OFF states.
5. Fan fault – the fan is not working properly. The relay is in the OFF state.

b. LED indications are covered in more detail in Chapter 3. See Table 3.1 (for the master module) and Table 3.2 (for the slave module).

2.3.3 DB37 Connector

The DB37 connector is used to interface the Fiber Optic Expansion Interface Module to the HE697BEM713 transmitter or IC697BEM711 receiver. The Fiber Optic Master unit connects directly to the HE697BEM713 bus transmitter via a 37-way M/F Cable (Part #: IC600WD005B). The Fiber Optic slave connects directly to the IC697BEM711 bus receiver via a 37-way F/F Cable (Part #: HE697CBL001).

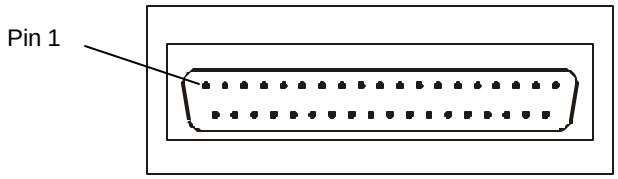

Figure 2.5 - DB37 Connector

Table 2.2 – Pin Connections

Pin No.	Signal Name	Master	Slave	Description	Pin No.	Signal Name	Master	Slave	Description
1	GND	PWR	PWR	Signal Ground	21	STB-	In	Out	Strobe Negative
2	D0+	Bidir	Bidir	Data0 Positive	22	C0+	In	Out	Control0 Positve
3	D0-	Bidir	Bidir	Data0 Negative	23	C0-	In	Out	Control0 Negative
4	D1+	Bidir	Bidir	Data1 Positive	24	DTACK+	Out	In	Data Acknowledge Positive
5	D1-	Bidir	Bidir	Data1 Negative					
6	D2+	Bidir	Bidir	Data2 Positive	25	DTACK-	Out	In	Data Acknowledge Negative
7	D2-	Bidir	Bidir	Data2 Negative					
8	D3+	Bidir	Bidir	Data3 Positive	26	PERROR+	Out	Bidir	Parity Error Positive
9	D3-	Bidir	Bidir	Data3 Negative	27	PERROR-	Out	Bidir	Parity Error Negative
10	D4+	Bidir	Bidir	Data4 Positive	28	C1+	In	Out	Control1 Positive
11	D4-	Bidir	Bidir	Data4 Negative	29	C1-	In	Out	Control1 Negative
12	D5+	Bidir	Bidir	Data5 Positive	30	SYSFAIL+	Bidir	Bidir	SystemFail Positive
13	D5-	Bidir	Bidir	Data5 Negative	31	SYSFAIL-	Bidir	Bidir	SystemFail Negative
14	D6+	Bidir	Bidir	Data6 Positive	32	INT+	Out	In	Interrupt Positive
15	D6-	Bidir	Bidir	Data6 Negative	33	INT-	Out	In	Interrupt Negative
16	D7+	Bidir	Bidir	Data7 Positive	34	NC			unused
17	D7-	Bidir	Bidir	Data7 Negative	35	NC			unused
18	PAR+	Bidir	Bidir	Parity Bit Positive	36	NC			unused
19	PAR-	Bidir	Bidir	Parity Bit Negative	37	GND	SHD		Shield Ground
20	STB+	In	Out	Strobe Positive					

2.4 Fiber Optic Interface Connectors

The master unit, HE697FBX105, has four fiber optic connectors while the slave (HE697FBX100) has only two. Each fiber channel has a pair of fiber connectors. Therefore, the master unit has two fiber channels, and the slave only has one fiber channel.

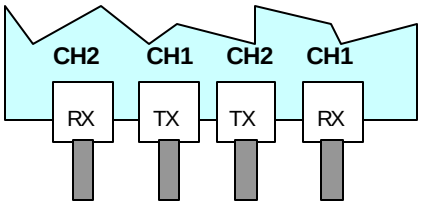

Figure 2.6 – Fiber Optic Connections

2.5 Channel Select Switch

A 2-way dip-switch is used to turn on/off each channel in the master and is located under the cover on the printed circuit board. The switch is not present in the slave unit.

Setting 1 of the switch corresponds to Channel 1, and setting 2 corresponds to Channel 2. To activate a channel, the corresponding switch setting must be moved to the ON position.

To turn off the channel, move the switch setting away from ON position. By default, both switch settings are in the ON position.

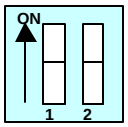

Figure 2.7 – 2-Way Dip-Switch

2.6 Supplied Parts

The following parts are included with each HE697FBX105 and HE697FBX100 Module. **It is important to use the supplied parts with the master and slave modules to meet CE standards and to assure proper operation**

a. Power Cable (9-Pin) 500A0015 (See Figure 2.8.)
b. Power Line Filter
c. Modem Filter

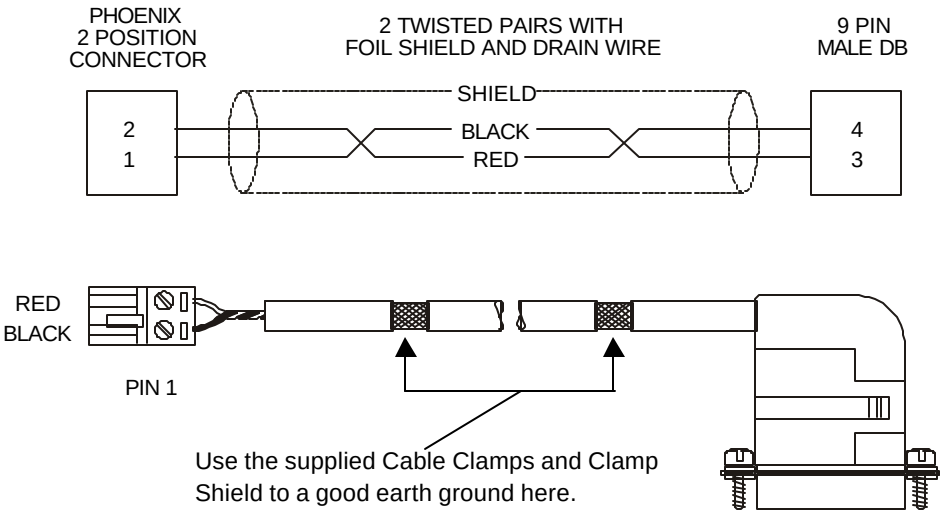

Figure 2.8 – Power Cable (Provided with HE697FBX105 and 100 Modules)

CHAPTER 3: OPERATION

3.1 Fiber Optic Expansion Interface Operation (See Figures 3.1 & 3.2)

3.1.1 General

The Horner Electric Transmitter (HE697BEM713) sends requests and obtains information from up to seven GE Fanuc Series 90-70 Receivers (IC697BEM711) via the Fiber Optic Expansion Interface Master (HE697FBX105) and Slave (HE697FBX100) modules. The following provides a detailed explanation of the operation of the Fiber Optic Expansion Interface Master (HE697FBX105) and the Slave (HE697FBX100) modules.

3.1.2 HE697FBX105 Master Module

1. Horner Electric's Transmitter (HE697BEM713) sends RS-422 signals to DB37 (a 37-pin D-Type sub-miniature connector) in the master module (HE697FBX105). (See Figure 3.1.) The signals are routed to the RS-422 Converter on a bus line and are converted into digital logic.

2. The digital output is routed to a Field Programmable Gate Array (FPGA) and is converted into an 8-bit parallel format. The FPGA sends the 8-bit parallel format at a particular rate to the AMD Taxi Transmitter IC where it is converted into a serial differential signal. The FPGA synchronizes with the AMD Transmitter IC and provides notification to the Taxi TX chip of an incoming byte.

3. The serial differential signal drives the fiber optic drivers to send the data to up to two slave modules over a fiber optic cable. (The master has two channels allowing communication with two slave modules and two receivers, if selected. The slave modules only have one channel each.) The maximum distance between the master and slave modules is 1.4Km.

a. <u>If there is NO incoming signal to the master module (HE697FBX105) from the transmitter (HE697BEM713) :</u>

The master continues to maintain synchronization with the slave module(s) via a timing sync pulse sent by the AMD Taxi Transmitter IC.

b. <u>If there is an incoming signal to the master module (HE697FBX105) from the transmitter (HE697BEM713):</u>

A delay occurs within the master module during the conversion processes lasting 500ns. The delay only occurs when there is an ***initial*** incoming byte. Subsequent bits are <u>not</u> delayed, and thus, the delay is <u>not</u> cumulative.

3.1.3 HE697FBX100 Slave Module

1. The slave module (HE697FBX100) receives the incoming serial differential signal via the fiber optic receiver. (See Figure 3.2.) The data has been delayed due to travel time through the fiber optic cable. The delay is approximately 7μs. [through glass] for 1.4 Km.

2. The serial differential signal is routed to the Taxi Rx1 IC and is converted into an 8-bit parallel format. The 8-bit parallel format is then sent to the FPGA where it is converted into digital logic. The digital logic is sent to the RS-422 Converter and is converted into RS-422 signals. The RS-422 signals exit the slave via the DB37 and are sent to the GE Fanuc Series 90-70 IC697BEM711 Receiver.

a. If there is an incoming signal into the HE697FBX100 from HE697FBX105:

Because of the various conversion processes within the slave module, there is a delay of 1µs.

3. The receiver responds to requests from the transmitter by sending data back to the slave and master modules in the reverse order of the processes described above.

The total maximum delay of data from the HE697BEM713 Transmitter and the IC697BEM711 Receiver via fiber optic cable (1.4 Km.) is 17.µs (round trip delay).

3.1.4 Power

1. A supplied power cable is used to provide +5 VDC power from the PLC. . The interface consists of a 2-pin removable terminal connector and a DB9 Connector of the supplied power cable.

3.1.5 Fault Detection

1. In addition to LED indicators for status and error detection, an external fault circuit is also provided to send an input to a remote location to help notify the user of a fault. The external fault indicator port is a 3-pin removable terminal connector providing signals to allow fault detection.

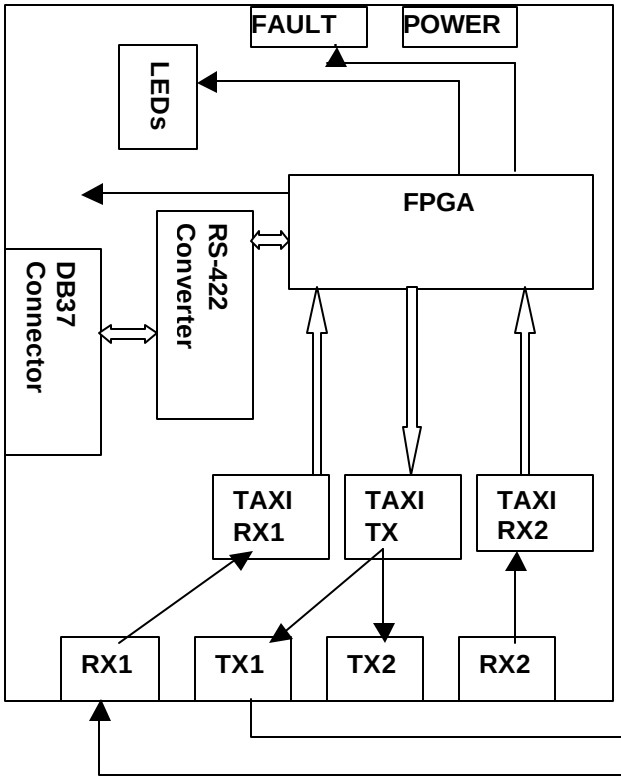

Figure 3.1 – Master (HE697FBX105)

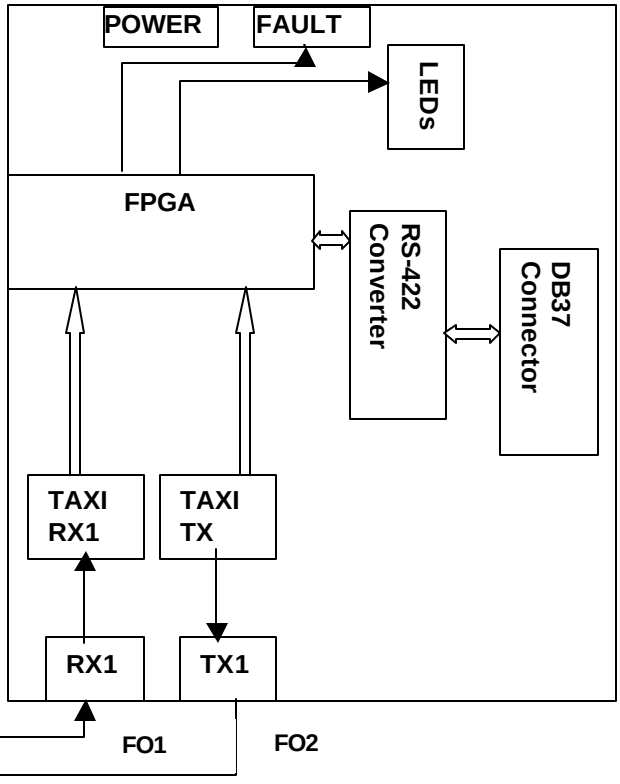

Figure 3.2 – Slave (HE697FBX100)

3.2 Indicators

The following LED indicators provide status and error detection for the HE697FBX100 and the HE697FBX105. Table 3.1 and Table 3.2 provide a description of the indicators.

Table 3.1 – Description of LED Indicators for Master (HE697FBX105)	
Indicator	**Meaning**
POWER	'Power' indicator. Once power is applied, the LED lights.
STATUS	Fault LED. This lights once the FPGA is programmed. It turns off if this is not so or if a TAXI chip receiver has detected an error.
Ch1 TX	Transmitter activity on channel 1. For the slave, only channel 1 exists.
Ch1 RX	Receiver activity on Channel 1.
Ch2 TX	Transmitter activity on channel 2.
Ch2 RX	Receiver activity on channel 2.
Ch1 ON	Status of channel 1. If the channel is activated, the LED lights.
Ch2 ON	Status of channel 2. If the channel is activated, the LED lights.

Table 3.2 – Description of LED Indicators for Slave (HE697FBX100)	
Indicator	**Meaning**
POWER	'Power' indicator. Once power is applied, the LED lights.
STATUS	Fault LED. This lights once the FPGA is programmed. It turns off if this is not so or if a TAXI chip receiver has detected an error.
TX	Transmitter activity on channel 1. For the slave, only channel 1 exists.
RX	Receiver activity on Channel 1.
ON	Status of channel 1.

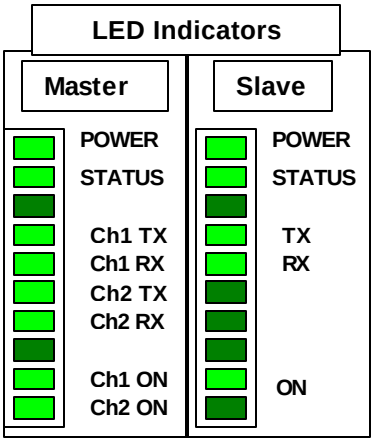

Figure 3.3 – LED Indicators