

Interbus-S Module for the GE Fanuc Series 90-30 PLC

**Interbus-S Slave Module
for use with
GE Fanuc Series 90-30 PLC**

**Preliminary User Manual
for HE693IBS100**

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Interbus-S Module for the GE Fanuc Series 90-30 PLC

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SECTION 1: Introduction

The HE693IBS100 module (IBS100) is designed to operate in any module slot of any GE Fanuc Series 90-30 model PLC. When properly configured, this module will allow the PLC to transfer up to 64 words of process data on an Interbus-S remote bus. Some of the module's key features are:

- Dynamic, programmable Interbus-S data width (the PLC ladder program can manipulate this)
- Up to 32 words of Interbus-S process data (32 words in and 32 words out)
- PLC controlled module error generation
- Host error acknowledge is sent to PLC
- Module can be configured to report PLC RUN status to host via I/O and/or module error

1.1 Interbus-S Overview

For more detailed information regarding Interbus-S, obtain *Data Sheet 0005C: Interbus-S Protocol Structure* from Phoenix Contact.

Interbus-S is a serial shift-register-based communication protocol developed by Phoenix Contact. The network consists of a single "host controller" and 1 or more slave nodes. Although primarily used to transfer I/O "process" data, several "intelligent" communication protocols have been implemented. The IBS100 module does not utilize any standard intelligent protocols, only process data is transferred between the IBS100 module and the host controller.

The Interbus-S serial protocol is implemented as remote and local bus types. Each bus type carries the same signals, but at different electrical levels. The IBS100 module supports only the Interbus-S remote bus type (9-pin connectors).

Each module has the ability to generate a "module error". When a module error is generated, the Interbus-S remains active and process data continues to flow. Upon detection of a module error, the host controller can ignore the error or issue an acknowledgment command.

1.2 Module Architecture

The IBS100 Module's core is an Intel 80C196KR 16-bit high-performance embedded microcontroller running at 16 MHz. This device controls communication to the PLC CPU, and supervises the Interbus-S data transfers.

The Interbus-S interface to the microcontroller is accomplished primarily by the Interbus-S μ Processor Interface (μ PI, pronounced "soopee") chip purchased from Phoenix Contact. This device decodes and translates the Interbus-S remote bus signals and provides a synchronized parallel interface to the Interbus-S process data and network status. The physical Interbus-S remote bus interface is electrically isolated (optically and galvanically) from the rest of the module.

The μ PI chip only has provision for up to 4 Interbus-S process data words internally, however expansion signals are provided to allow the presence of external shift registers. The IBS100 module is equipped with a **Field Programmable Gate Array (FPGA)** that provides this expansion. This device allows the IBS100 to

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support up to 32 words of process data. The FPGA also contains logic used by the PLC interface, as well as memory select and wait state control.

1.3 Module Connectors

There are 2 9-pin D connectors on the module, these are the standard Interbus-s remote bus connections. They are clearly labeled IN and OUT.

1.4 Module Indicators (LEDs)

The IBS100 module is equipped with 4 LEDs. These LEDs indicate the following status:

TR: Not used by current firmware, always off.

RC: When ON, the interbus is NOT being reset by the controller, when OFF, interbus is in reset. This LED will normally be ON when the Interbus-S is running.

BA: **Bus Active**

RD: **Remote bus Disabled**, when ON the remote bus is not connected

SECTION 2: Operation

The primary function of the IBS100 module is to transfer Interbus-S process data between the Interbus-S host controller and the PLC. Interbus-S output data is transferred from the host controller to the IBS100 module, and then to the PLC CPU's %AI table where the PLC can read it. The PLC CPU writes to the IBS100 module using the %AQ table, the IBS100 module sends this data to the host controller as Interbus-S input data.

2.1 Data Width Capabilities

The PLC can dynamically, through ladder program control, configure the amount of process data transferred to/from the host controller. However, the amount of data to be transferred between the IBS100 module and the PLC over the PLC backplane (the number of %AI and %AQ registers allocated to the IBS100 module) must be fixed at PLC configuration time. This value will default to 32 words for both %AI and %AQ.

For most applications, this value will not need to be modified. If, however, the IBS100 module is placed in a model 311 rack with several other modules that require %AI and/or %AQ registers, the user may begin to run out of %AI and/or %AQ registers. In this case, the number of registers allocated to the IBS100 module can be reduced to accommodate the amount of Interbus-S data actually transferred over the network.

Additionally, if a significant portion of the %AI and/or %AQ data is not used by the application, a slight performance gain in PLC ladder execution time can be realized by limiting the data transferred to/from the module to the amount that is actually used. The amount of performance gained is dependent on the ladder program and the PLC model.

To optimize system performance, the number of %AI and %AQ registers should be set equal to the number of words to be transferred on the Interbus-S remote bus. If the amount of data transferred on the Interbus-S is to be dynamic, the number of %AI and %AQ registers should be set to the maximum amount of Interbus-S data possible for the given application.

2.2 IBS100 Module Control

The IBS100 module allocates 8 bits of %Q memory (discrete output bits), these bits are defined as follows:

Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
IBS Error	IBS Enable	Interbus-S Data Width					

Bits 1-6: **Interbus-S Data Width** - This field is used to select the desired Interbus-S process data width. For values that are not represented in the table below, the IBS100 module will configure the data with to the next higher legal value. For example if the IBS100 module's %Q bits 1 to 6 are set to 010010B (18 decimal), the module will actually transfer 24 words over the Interbus-S. If bit 6 is set, the module will transfer exactly 32 words, regardless of the state of bits 1 to 5. Note that these bits are read by the module only when a low-to-high transition of bit 7 (described below). Note that the number of Interbus-S input words and the number of Interbus-S output words are always equal.

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Interbus-S Data Width Selection			
%Q6 - %Q1	IBS Data Width	%Q6 - %Q1	IBS Data Width
000000B (0)	1	010000B (16)	16
000001B (1)	1	010001B (17)	24
000010B (2)	2	010010B (18)	24
000011B (3)	3	010011B (19)	24
000100B (4)	4	010100B (20)	24
000101B (5)	5	010101B (21)	24
000110B (6)	6	010110B (22)	24
000111B (7)	7	010111B (23)	24
001000B (8)	8	011000B (24)	24
001001B (9)	9	011001B (25)	32
001010B (10)	10	011010B (26)	32
001011B (11)	12	011011B (27)	32
001100B (12)	12	011100B (28)	32
001101B (13)	14	011101B (29)	32
001110B (14)	14	011110B (30)	32
001111B (15)	16	011111B (31)	32
		1xxxxxB (32-63)	32

Bit 7: **IBS Enable** - When a low-to-high transition is detected, the IBS100 module will configure itself to transfer the Interbus-S process data width specified in bits 1-6. When a high-to-low transition is detected, the IBS100 module will reconfigure itself for either 0 or 1 words of Interbus-S process data, based on the PLC Run Status configuration (see below). Note that if the Interbus-S is running, any transition on this bit will cause an Interbus-S network error and the network host will be required to perform an ID cycle to re-establish communications.

Bit 8: **IBS Error** - The PLC ladder program sets this bit to generate an Interbus-S module error. The IBS100 will latch a module error signal on the low-to-high transition of this bit. See *Module Status Error* below for more details.

2.3 IBS100 Module Status

The IBS100 module occupies 8 bits of %I memory, at present only 3 of these bits are used:

Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
Reserved					MODERR	OUTVALID	BUSACT

Bit 1: **BUSACT** - Interbus-S Bus Active, when set, the host controller is attempting to transfer data on the Interbus-S remote bus. This does not necessarily mean that the data is valid, just that the attempt is being made.

Bit 2: **OUTVALID** - Interbus-S Outputs Valid, when set, this bit indicates that the host controller has, within the last 250 milliseconds, transferred valid output data to the Interbus-S and

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sent an output latch signal. If this bit is ever cleared, it means that a 250 mS period has elapsed since the last “output valid” strobe from the host controller.

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Bit 3: **MODERR** - Module Error, if the PLC ladder program determines that an error condition has occurred that must be reported to the host controller, it can assert the “IBS Error” bit (described on the previous page). The IBS100 module will then latch the module error signal to the host controller. This signal is held in its active state until the host controller sends an acknowledgment message. At that point, the module error signal is cleared until the next low-to-high transition of the IBS Error bit.

In summary, this bit reflects the current state of the module error signal to the host controller; it is *SET* by a low-to-high transition of the IBS Error bit. It is *CLEARED* when the host controller sends an acknowledgment message.

2.3 PLC Run Status

The IBS100 module can be configured to report the PLC run status to the Interbus-S host. This status can be transferred in any of 2 forms. Both options are enabled by default and may be independently disabled.

- 1) The module can be configured to reflect the current PLC run status in the most significant bit of the first process data word. Obviously, if this option is configured, the MSb of the first process data word cannot be used to transfer data from the PLC to the host controller. The remainder of the first process data word is unaffected.
- 2) The module can be configured to generate a module error when a RUN to STOP transition is detected (or if the PLC does not enter RUN mode within 5 seconds following power-up).

Note that if the PLC is configured for “STOP DO I/O” mode, the module will report the PLC run status as always running.

If the PLC powers up in STOP mode (due to a fault or configuration), the Interbus-S data width bits and the IBS Enable bit will not be transferred from the PLC to the IBS100 module (they will be to 0). The IBS100 module will, in this case, initialize itself to transfer either 0 or 1 process data word. The data width configured will depend on whether the PLC run status is transferred in the first process data word (option 1 described above). If the first process data word is used to report PLC run status, the module will configure the process data width to 1 word. If this channel is not used to report PLC run status, the module will configure the data width to 0 words.

The host controller application programmer must ensure that, following the Interbus-S ID cycle, the proper process data width has been configured for the IBS100 module. Assuming that the *proper* process data width for the module is greater than 1 word, the application can assume that the PLC is in stop mode following power-up if the Interbus-S ID cycle indicates that the IBS100 module is configured for 0 or 1 process data words. When the PLC is placed into RUN mode, the IBS100 module will re-initialize to the proper process data width (this will cause a bus fault and require the host controller to perform a new ID cycle).

SECTION 3: Configuration

The PLC must be configured to operate with the IBS100 module prior to operation. This can be done with either a Series 90-30 hand-held programmer (or emulator), or with GE Fanuc LogicMaster 90-30 programming and configuration software.

3.1 Configuring the Module Using the Hand-Held Programmer

1. With the power off, install the IBS100 module into any I/O slot in the 90-30 rack. Turn on the power and enter configuration mode (4).
2. Press the down-arrow key until the rack and slot number of the IBS100 module appear in the HHP display.
3. Press READ/VRFY and then press the ENTER key. The HHP should now display the IBS100 model number and indicate that there are 8 bits of %I memory to be "mapped".
4. Select a starting reference for the 8 %Is, this value must be on a "byte" boundary + 1 (i.e. 9, 17, etc.). Once selected press the ENTER key.
5. The HHP should now display the BS100 model number and indicate that there are 8 bits of %Q memory to be "mapped". Select a starting reference for the 8 %Qs, this value must also be on a "byte" boundary + 1 (i.e. 9, 17, etc.). Once selected press the ENTER key.
6. The HHP should now indicate that there are 32 words of %AI memory to be "mapped". Select a starting reference for the 32 %AIs, then press the ENTER key.
7. The HHP should now indicate that there are 32 words of %AQ memory to be "mapped". Select a starting reference for the 32 %AQs, then press the ENTER key.
8. Press the right (>) arrow key, at this point the HHP will indicate the IBS100 module is configured for 32 AI/AQ words. If a different number of words is desired, numerically enter the desired number of AI/AQ words (1 to 32) and then press the ENTER key.
9. Press the right (>) arrow key again. The "Stop Alarm" parameter will be displayed, and should show the default value of "Er+IO". The valid settings are:

Number	Setting	Meaning
0	None	Module does not report PLC run status
1	Error	Module generates "Module Error" when PLC is in STOP mode
2	I/O	Module reflects PLC run status in MSb of first process data word.
3*	Er+IO	Module performs both Error and I/O functions (default)

10. **VERY IMPORTANT!!!** If you make a change to the number of AI/AQ words, you must delete the IBS100 module configuration and re-enter it for the PLC to map the correct amount of data. To do this, press the DEL key and then press the ENTER key. The HHP display should show the slot

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as EMPTY. At this point, you may re-enter the module configuration starting at step 3 (the number of %AI and %AQ words should now match the value selected in step 8).

11. That's all, the module is ready to run!

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3.2 Configuring the Module Using LogicMaster 90-30

1. Enter LogicMaster configuration, set the PLC to STOP/NO IO mode and ONLINE.
2. Enter I/O configuration mode (F1). Select the slot containing the IBS100 module.
3. Select type "other" module (F8), then select FRGN type (F8).
4. This will bring up a screen with several fields that must be filled in by the user. The first field is module ID and should be set to 3.
5. The I/O configuration should be set as follows:

%I Ref Adr:	User specified (must be on 8-bit boundry+1)
%I Size:	8
%Q Ref Adr:	User specified (must be on 8-bit boundry+1)
%Q Size:	8
%AI Ref Adr:	User specified
%AI Size:	1 to 32 (must match Number of %AI/%AQ Words below)
%AQ Ref Adr:	User specified
%AQ Size:	1 to 32 (must match Number of %AI/%AQ Words below)

6. There are 16 bytes of information on the right side of this screen, each byte can be configured by the user. Only bytes 1, 2 and 3 are used by the IBS100 module. Byte 1 should always contain the value 00000010. Byte 2 should contain one of the following values, based on the desired of %AI / %AQ words (note that bits 6 and 7 are ignored, and that if bit 5 is set, the value is configured at 32):

Number of %AI / %AQ Words			
Byte 2 Value	#AI/AQ Words	Byte 2 Value	#AI/AQ Words
xx000000B (0)	1	xx010000B (16)	16
xx000001B (1)	1	xx010001B (17)	17
xx000010B (2)	2	xx010010B (18)	18
xx000011B (3)	3	xx010011B (19)	19
xx000100B (4)	4	xx010100B (20)	20
xx000101B (5)	5	xx010101B (21)	21
xx000110B (6)	6	xx010110B (22)	22
xx000111B (7)	7	xx010111B (23)	23
xx001000B (8)	8	xx011000B (24)	24
xx001001B (9)	9	xx011001B (25)	25
xx001010B (10)	10	xx011010B (26)	26
xx001011B (11)	11	xx011011B (27)	27
xx001100B (12)	12	xx011100B (28)	28
xx001101B (13)	13	xx011101B (29)	29
xx001110B (14)	14	xx011110B (30)	30
xx001111B (15)	15	xx011111B (31)	31
		xx1xxxxxB (32-63)	32

7. Byte 3 represents the "Stop Alarm" parameter described on the previous page, valid range is 0 to 3.

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8. Download the configuration to the PLC, the module is ready to run!

3.3 Configuration Example

3.3.1 PLC Configuration

Let's assume that the GE Fanuc Series 90-30 I/O is configured as shown below:

Power Supply	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5
	Horner Electric HE693-IBS100 Interbus-S Interface Module	GE Fanuc IC693-BEM320 I/O Link Module	Generic 16-pt Discrete Input Module	Generic 16-pt Discrete Input Module	Generic 5/8-pt Discrete Output Module
%I Required/Used	3/8	64	16	16	0
%Q Required/Used	8/8	64	0	0	8
%AI Required/Used	6/7	0	0	0	0
%AQ Required/Used	7/7	0	0	0	0
%I References	%I97-104	%I1-64	%I65-80	%I81-96	
%Q References	%Q97-104	%Q1-64			%Q65-72
%AI References	%AI1-7				
%AQ References	%AQ1-7				
Interbus-S Process Data References	I/O 1	I/O 2-5	I 6	I 7	O 6

This example illustrates the PLC I/O reference requirements of the IBS100 module. The module only uses 3 bits of %I memory but these bits must be allocated in blocks of 8 bits. In our example, these bits are mapped to %I97, %I98 and %I99. See section 2.3 for a complete functional description of these bits.

The IBS100 module also occupies %Q97 through %Q104. These bits are described in section 2.2

Interbus-S process data is transferred through the IBS100 module to the %AI and %AQ registers allocated to the module. The Interbus-S process data *output* words from the host controller are transferred through the IBS100 module to %AI1-7. In turn, %AQ1-7 are transferred through the IBS100 module to the Interbus-S host controller as process data *input* words.

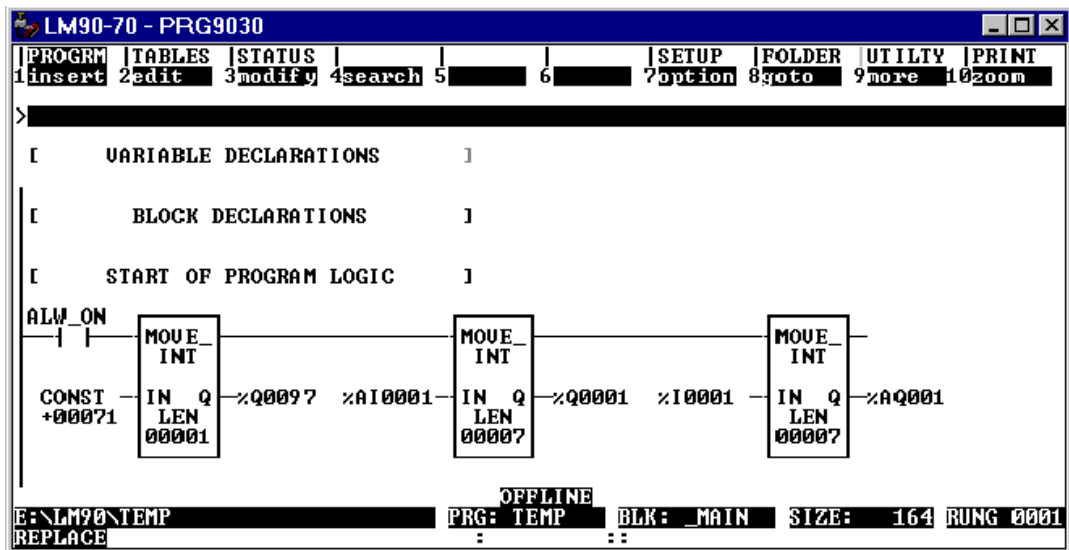
In our example, the first %AI register and the first %AQ register are allocated as a general PLC command/status pair, and are application defined. The remaining %AI and %AQ registers map directly to the %Q and %I bits.

To summarize, the IBS100 module is simply a data “gateway” between the Interbus-S host controller and the PLC's %AI and %AQ data tables. It is up to the PLC program to further manipulate the %AI and %AQ data to do something useful.

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3.3.2 PLC Ladder Programming

In our example, the IBS100's command bits are set to 71 (or 47H). This enables the module for Interbus-S communication and sets it to transfer 7 process data words. The remainder of the rung simply copies the incoming Interbus-S process data (from the %AI registers) to the PLC %Q outputs in the rack (the I/O link outputs in slot 2 and the discrete outputs in slot 5). It also copies the %I PLC input data to the outgoing Interbus-S process data (to the %AQ registers). All of this is accomplished by the following rung of ladder logic:



This is a minimal program and does not attempt to support the Interbus-S module error, or Interbus-S status capabilities of the module.

In this example, the Interbus-S host controller would access the PLC I/O modules at the following process data offset addresses:

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Interbus-S Process Data Reference	IBS100 Reference	PLC I/O Location
Input word 1	%AQ1	PLC Status Word
Input word 2	%AQ2	Slot 2, %I1-16
Input word 3	%AQ3	Slot 2, %I17-32
Input word 4	%AQ4	Slot 2, %I33-48
Input word 5	%AQ5	Slot 2, %I49-64
Input word 6	%AQ6	Slot 3, %I65-80
Input word 7	%AQ7	Slot 4, %I81-96
Output word 1	%AI1	PLC Command Word
Output word 2	%AI2	Slot 2, %Q1-16
Output word 3	%AI3	Slot 2, %Q17-32
Output word 4	%AI4	Slot 2, %Q33-48
Output word 5	%AI5	Slot 2, %Q49-64
Output word 6	%AI6 (low byte)	Slot 5, %Q65-72
Output word 7	%AI7	Not used