Open Architecture Control Software

SoftPLC - GE Fanuc 90/30 I/O Driver

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1. INTRODUCTION

The GE Fanuc 90/30 I/O Driver for SoftPLC allows SoftPLC to access up to eight (8) PCIF host I/O interface adapters (**cat. no. IC693PIF300**) , each of which can control up to four (4) GE 90/30 remote or expansion racks, each of which can take up to ten (10) I/O modules. Any mixture of 90/30 I/O modules is possible.

The driver consists of 3 files, namely GE9030.TLM, GECONFIG.EXE, and GE.LST. GE9030.TLM is the runtime component, GECONFIG.EXE is a utility for displaying I/O information and generating an I/O report, and GE.LST is the master configuration file..

GE9030.TLM accesses 90/30 I/O through one or more PCIF cards for the PC/AT/ISA Bus. This card is manufactured by Horner Electric at Indianapolis. The GE9030.TLM supports up to eight cards.

The GE9030.TLM can co-exist with other I/O drivers concurrently.

2. INSTALLATION

GE9030.TLM, GECONFIG.EXE, and GE.LST are installed under the \SPLCZ\IODVR directory when you install SoftPLC. Separate installation is not needed for this driver.

GE9030.TLM is made known to SoftPLC by a line entry in the MODULE.LST file. This file lists all the SoftPLC I/O Drivers in the same way that DOS CONFIG.SYS file lists DOS device drivers. Each I/O driver entry in MODULE.LST has to start with the keyword "DRIVER". The file MODULE.LST may be created with a text editor to be placed in the \SPLCZ directory or wherever SoftPLC resides.

Put the following line in the MODULE.LST file to be able to interface GE 90/30 I/O with SoftPLC:

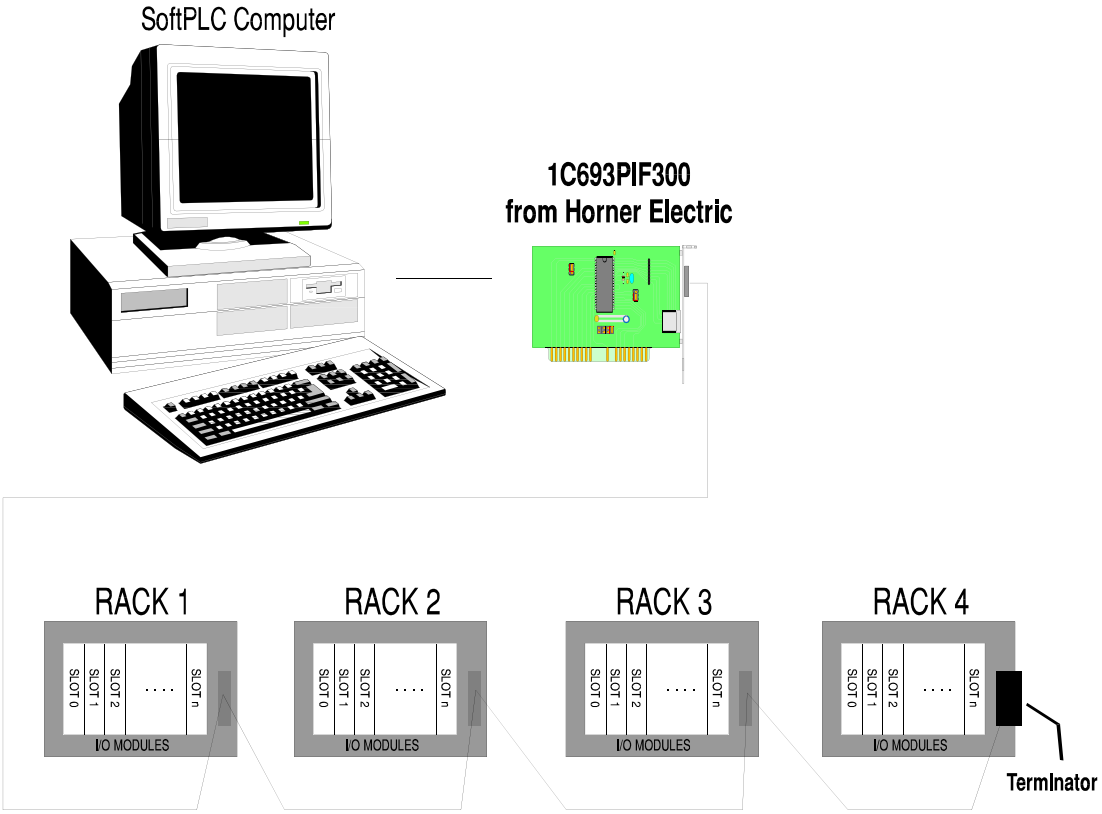
```
DRIVER=C:\SPLCZ\IODVR\GE9030.TLM CFGFILE=C:\SPLCZ\IODVR\GE.LST
```

GE9030.TLM has a mandatory command line argument called CFGFILE. This is used to specify where the master configuration file is for all PCIF cards. The CFGFILE may have any name and reside in any directory.

3. I/O MAPPING

The General Electric 90/30 I/O system starts with at least one PCIF card. Each of these cards can control up to 4 I/O racks, each one of which can contain up to 10 I/O modules. Each module position is called a "slot". The left-most position on a rack is slot 1 and the right-most position is slot 10. Racks are interconnected with 7 twisted pair 24 AWG shielded cable. All racks are also connected in a daisy chain fashion to the PCIF card. Each rack contains RS422 transceivers with 120 Ohm termination resistors. Such a daisy chain originating from a single PCIF card will be called an **I/O network**.

The following diagram shows a single I/O network attached to SoftPLC. Remember that you may have up to 8 of these per SoftPLC system.



SoftPLC's **Input Image** table consists of up to either 64 or 128 16-bit words, depending on whether you have the 1K or 2K kernel. 64 x 16 = 1024 bits, and 128 x 16 = 2048 bits. There is a like table for the **Output Image**. These I/O image tables support **I/O forcing**. These are the only datatable sections which support I/O forcing. I/O forcing is very useful for digital inputs or digital outputs. Forcing is not quite as useful for analog I/O. The GE9030.TLM driver categorizes for you 5 different types of driver data:

```
1.  Digital Outputs     (doWords)
2.  Digital Inputs      (diWords)
3.  Analog Outputs      (aoWords)
4.  Analog Inputs       (aiWords)
5.  Module statuses     (stsWords)
```

You must specify for the driver where you want each of these types of data to reside within SoftPLC's datatables. Each type of data will be a concatenation of like data for all modules associated with a single PCIF card. This is done in the master configuration file, GE.LST, separately for all PCIF cards. In this file you also provide the base host I/O port for each PCIF card. Each PCIF consumes a contiguous range of 8 I/O ports on the host computer. Each PCIF card must be allocated a unique range, given by a unique base host I/O port.

Here is a list of legal host I/O ports. These are always specified in hexadecimal:

```
200, 208, 210, 218, 220, 228, 230,
238, 240, 248, 250, 258, 260, 268,
270, 278, 280, 288, 290, 298, 2A0,
2A8, 2B0, 2B8, 2C0, 2C8, 2D0, 2D8,
2E0, 2E8, 2F0, 2F8, 300, 308, 310,
318, 320, 328, 330, 338, 340, 348,
350, 358, 360, 368, 370, 378, 380,
388, 390, 398, 3A0, 3A8, 3B0, 3B8,
3C0, 3C8, 3D0, 3D8, 3E0, 3E8, 3F0,
```

Each PCIF card has a bank of switches on it that you must set to match the values specified in GE.LST. The switch setting on any PCIF card from the factory is normally 300.

Here is a sample GE.LST file. Any text after a ';' is ignored by the driver.

Notice that as provided, only one card is enabled. Other cards could be enabled by removing the ';' from one of the lines in the [CARDS] section.

```
;This file contains the following section: [CARDS]
;Anything after a semicolon is a comment.
;Add one row to the [CARDS] section for each PCIF card, up to 8
;cards maximum.

;The Port column is the hexadecimal I/O port where the respective card
;is located.

;The next five columns doWords, diWords, aoWords, aiWords, and stsWords
;all take the starting PLC memory address where the respective data
;values are to be found.  If the plc word address is a word corresponding
;to either the I datatable section or the O datatable section, then I/O
;forcing will be possible.  Otherwise the data will be transfered without
;I/O forcing to the given non-I/O image table area.  This latter capability
;can be useful to avoid having analog data consume the valuable
;I/O image table areas, which are the only areas where I/O forcing is
;supported.  I/O forcing is pertinent to digital I/O, and not normally
;pertinent to analog I/O.  Example legal values are: N30:0, I12, O33.
;Note that the I and O datatable sections take octal word addresses, so
;I18 would be illegal because of the '8' digit.


;doWords column: contains the PLC memory address which will source the
; digital output words for this card.  Suggested: O:000

;diWords column: contains the PLC memory address which will receive the
; digital input words for this card.  Suggested: I:000

;aoWords column: contains the PLC memory address which will source the
; analog and/or register output words for this card.  Suggested: N10:0

;aiWords column: contains the PLC memory address which will receive the
; analog and/or register input words for this card.  Suggested: N11:0

;stsWords column: contains the PLC memory address which will receive the
; status words for this card.  Suggested: N12:0

;CfgFile column: gives the name of a file which was generated by the
;GECONFIG.EXE (and may have been subsequently edited by hand) for this
;card and gives detailed module specific configurations
;(for smart modules only).  CfgFile is mandatory, but may be the name
;of an empty file.  Missing smart module cfgs will cause defaults
;to be used for that module.


[CARDS]     ; first is PIFCard 0, second is PIFCard 1, etc.

;Port ;doWords diWords aoWords aiWord, stsWords, Cfgfile
340,  O:000,   I:000,  N10:0,  N11:0,  N12:0,    \SPLCZ\IODVR\GECARD0.CFG

;300, O:010,   I:010,  N10:50, N11:50, N12:50,   \SPLCZ\IODVR\GECARD1.CFG
;300, O:010,   I:010,  N10:50, N11:50, N12:50,   \SPLCZ\IODVR\GECARD2.CFG
;300, O:010,   I:010,  N10:50, N11:50, N12:50,   \SPLCZ\IODVR\GECARD3.CFG
;300, O:010,   I:010,  N10:50, N11:50, N12:50,   \SPLCZ\IODVR\GECARD4.CFG
;300, O:010,   I:010,  N10:50, N11:50, N12:50,   \SPLCZ\IODVR\GECARD5.CFG
;300, O:010,   I:010,  N10:50, N11:50, N12:50,   \SPLCZ\IODVR\GECARD6.CFG
;300, O:010,   I:010,  N10:50, N11:50, N12:50,   \SPLCZ\IODVR\GECARD7.CFG


;EOF
```

You might need to edit this file iteratively in order to get everything situated the way you want it. Start by deciding how many cards you will use and the I/O Ports that they will be using. Here is the step by step procedure to setting up this driver:

1) Edit the “Port” column under the [CARDS] section of the GE.LST file for each of the cards you will use. This file normally resides in \SPLCZ\IODVR.

2) Set the switch settings on each card and install them in the host computer.

3) Attach the I/O racks, using a terminating resistor pack as might be needed on the last rack in each chain

4) Insert the I/O modules and power up the racks.

5) Run the GECONFIG.EXE program from the \SPLCZ\IODVR directory and give it the name of your CFGFILE, which is normally GE.LST: C:>GECONFIG GE.LST

6) Press F3 to display all the communicating I/O modules for each I/O network.

7) Press F4 to generate the GECARD.REP text file, which is a complete definition of how SoftPLC datatable memory will be consumed for each I/O network.

8) Press F5 to generate default configuration file specifications for each smart module. These will be put into text files GECARD0.CFG, GECARD1.CFG, GECARD2,CFG, etc., one for each defined PCIF card.

9) Press F10 to exit GECONFIG.EXE.

10) Look at GECARD.REP and take note of how much datatable memory you will need to allocate for each driver data type, for each I/O network. If you have exceeded the bounds of the Input or Output Image tables, you will have to move that corresponding data type to a different datatable section and give up I/O forcing in turn.

11) Make the final edits to GE.LST, paying attention to the 5 xxWords columns for each I/O network.

If a GE module occupies more than one word in any of the 5 data types, then as many adjacent words in SoftPLC's corresponding datatable as required are consumed. For example, a 64 point digital input module might occupy 4 words in SoftPLC's Input Image table. Similarly, a 4 channel analog output module would occupy 4 output words in the driver’s aoWords area, which might be mapped to a block of SoftPLC's datatable starting at N10:0.

The GE 90/30 I/O Driver for SoftPLC follows these rules when mapping I/O modules to SoftPLC's image tables:

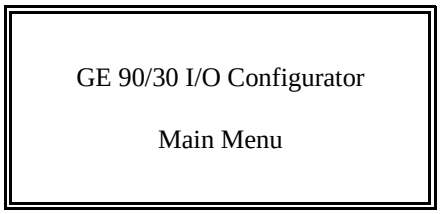
- Each digital point occupies one bit in a 16-bit word, normally.
- Each analog channel occupies one 16-bit word, normally.
- An I/O module is always mapped on 16-bit word boundaries; some I/O modules such as 8 point digital input or output modules use only the lower 8 bits of a 16-bit word. In that case, the upper 8 bits are not used by any other module.

4. CONFIGURATION AND I/O REPORTS

The GE 90/30 driver for SoftPLC comes with a configuration and I/O reporting utility called GECONFIG.EXE. This utility requires one command-line arguments: the name of the CFGFILE, which is normally GE.LST. For example:

```
GECONFIG GE.LST
```

When started, GECONFIG presents the following menu:



F3 - Display I/O Modules
F4 - Generate GECARD.REP file I/O Report
F5 - Generate GECARD<n>.CFG file(s)

F10 - Exit to DOS

Press [F3] to display the attached GE 90/30 I/O modules. Press [F4] to generate text file report on I/O mapping. The report is generated to a disk file called GECARD.REP. This report describes how GE 90/30 I/O modules are mapped to the 5 kinds of driver data types, diWords, doWords, aiWords, aoWords, and stsWords. Press [F5] to generate GECARDx.CFG files for each I/O network. The GECARDx.CFG files may be edited later with a text editor to parameterize smart modules.

Press [F10] to terminate the GECONFIG program.

When you press [F1], the screen should closely resemble the figure below:

SLOT NUMBER	RACK	1	2	3	4
	TYPE	5 Slot Expans	Rack Missing	Rack Missing	Rack Missing
	1	16 Chan Dg In			
	2	8 Chan Dg Out			
	3	4 Chan An In			
	4	2 Chan An Out			
	5				
	6				
	7				
	8				
	9				
	10				

GE IC693PIF300 I/O for PIFCard = 0 Press any key for next PIFCard.

The I/O information may be different based on the number and type of modules you have connected. Press any key to cycle through all PIFCards and go back to the main menu.

5. TLI'S

5.1 GE_PUT_INIT

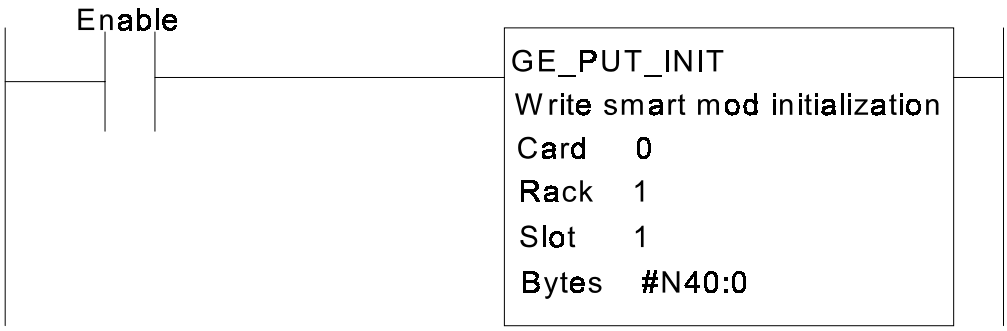
This ladder instruction is used to write an initialization file to a smart I/O module. An initialization file supported here may be up to 160 bytes (80 words) in length maximum. As of this writing, no GE modules used an initialization file longer than 160 bytes. Only some smart modules use initialization files. Consult the GE documentation for each kind of smart module that you wish to use. The initialization file is typically how the module is configured or tuned at runtime. Each module that uses an initialization file will also have a default initialization file that it can respond with to the GE_GET_INIT instruction..

This instruction overwrites the default or previously existing initialization file with a new one. You may use the GE_GET_INIT instruction before using this one to obtain the current initialization file that resides on the module, then modify incrementally the information in the file before writing it back with this instruction.

DEFAULT INITIALIZATION

When SoftPLC loads from disk, the GE9030.TLM will automatically get each smart module's default initialization file from the respective module and turn around and send it back to each smart module, so that all smart modules are programmed and operable in a default mode. (Shortly thereafter your ladder might re-program smart modules with the GE_PUT_INIT ladder instruction.) In order for the startup default initialization process to work properly, it is necessary that all I/O racks and modules be present and powered on at the time SoftPLC loads from disk.

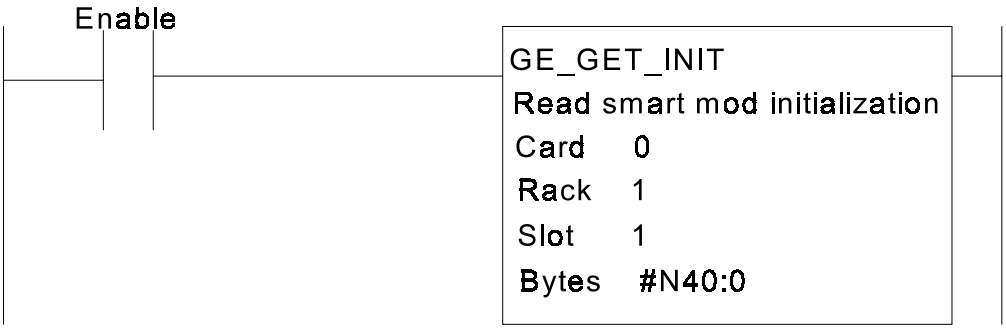
If you are not using the default modes, you will need to use the GE_PUT_INIT instruction. A convenient way to handle this in the program is to put all such rungs in a subroutine, and then call that subroutine on the condition that the "first scan" bit is true. This is bit S1/15 and this bit is automatically set true only on the first program scan after a transition from program to run mode.



The CARD parameter identifies which of the up to 8 PCIF cards the module of interest is attached to. The RACK parameter refers to the I/O rack number. The SLOT paramter gives the slot where the module resides and the BYTES parameter identifies an 80 word block of datatable memory that will source the 160 bytes of initialization file information. Even though some modules use initialization files shorter than 80 words, a full 80 words are reserved by this instruction.

5.2 GE_GET_INIT

This ladder instruction is used to fetch an initialization file from a smart I/O module. The initialization supported here may be up to 160 bytes (80 words) in length. As of this writing, no GE modules used an initialization file longer than 160 bytes. Only some smart modules use initialization files. Consult the GE documentation for each kind of smart module that you wish to use. The initialization file is typically how the module is configured or tuned at runtime. Each module that uses an initialization file will also have a default initialization file that it can respond with. This instruction gets the current initialization file as it exists on the module, and if the GE_PUT_INIT instruction has not been used yet, the obtained initialization file will also be the default initialization file.



The CARD parameter identifies which of the up to 8 PCIF cards the module of interest is attached to. The RACK parameter refers to the I/O rack number. The SLOT paramter gives the slot where the module resides and the BYTES parameter identifies an 80 word block of datatable memory that will receive up to 160 bytes of initialization file information.

If you encounter a module that uses an initialization file larger than 160 bytes, you will need to get a software update from SoftPLC Corporation.

6. OPERATING MODES AND ERROR CODES

The GE 90/30 driver's runtime behavior is determined by SoftPLC's mode of operation:

- When SoftPLC is in PROGRAM, REMOTE PROGRAM or FAULT mode, I/O is not scanned.
- When SoftPLC is in TEST mode, inputs are read from GE 90/30 Input modules and transferred to SoftPLC's datatable. Outputs are disabled.
- When SoftPLC is in RUN or REMOTE RUN mode, inputs are read from GE 90/30 Input modules and transferred to SoftPLC's datatables. Outputs are written from SoftPLC's datatables to GE 90/30 Output modules.

In TEST, RUN and REMOTE RUN modes, any errors detected during I/O scanning are reported in SoftPLC's Status word 15 (S:15). Below is a list of possible error codes that can be found in S:15 in case of a GE 90/30 I/O Error:

ERROR CODE	DESCRIPTION
1	PCIF board was not initialized
2	Internal error; call SoftPLC technical support
3	Parity error
4	Board ID error, or module not present
5	RUN output on the PCIF is disabled

Error code 4 (Board ID error) is the most frequently encountered type. It may be a result of:

- Loss of power to one or more I/O racks
- Disconnected or bad cable
- Adding or removing I/O modules while SoftPLC is in TEST, RUN or REMOTE RUN mode
- A bad I/O module

This word is set only when an error occurs, and it is never cleared should the error go away. You must manually clear it with TOPDOC or with ladder logic. This behavior provides you with a historical record of the error at any time between the last time it was cleared and now.

Additionally, each module is allocated a single status word. The status word is also only set on an error condition. You may set this block of words to zero, and if they stay zero, no errors have occurred. If one of the words turns up non-zero, then an error has occurred while talking to the respective I/O module. The error codes used in each individual stsWord are the same as those given above for S:15.

7. CLEARING ERRORS

If a rack experiences a loss of power, it may be necessary to re-initialize the smart modules with the GE_PUT_INIT instructions to get them to start functioning again, or to perform what is called the **default initialization process**. As discussed in the GE_PUT_INIT section of this document, when SoftPLC loads from disk, the GE9030.TLM will automatically get each smart module's default initialization file and turn around and send it back to each smart module, so that all smart modules are programmed and operable in a default mode. (Shortly thereafter your ladder might re-program smart modules with the GE_PUT_INIT ladder instruction.) In order for the startup default initialization process to work properly, it is necessary that all I/O racks and modules be present and powered on at the time SoftPLC loads from disk.

You may re-trigger the complete default initialization process by doing a SoftPLC mode change from REM_PROG mode to REM_PROG mode. Yes, REM_PROG to REM_PROG. While this is really no mode change at all, it is a signal to GE9030.TLM to perform the default initialization process again. During this mode transition, all outputs are off.

Note that if there was no loss of power, although performing a REM_PROG to REM_PROG transition will cause a default initialization process, any modules that you had previously re-programmed with a GE_PUT_INIT instruction will receive the same modified initialization file sent back to it, as the default is only applicable after a power up condition. The initialization file is memory that is managed by each smart module.

APPENDIX A. SUPPORTED I/O MODULES

The SoftPLC GE 90/30 I/O Driver currently supports the following modules from GE Fanuc:

16	channel	digital	I/O module		
32	channel	digital	output module		
32	channel	digital	input module		
64	channel	digital	output module		
64	channel	digital	input module		
16	channel	digital	input module		
8	channel	digital	I/O module		
32	channel	digital	I/O module		
6	channel	digital	output module		
64	channel	digital	I/O module		
8	channel	digital	input module		
8	channel	digital	output module		
4	channel	analog	input module		
2	channel	analog	output module		
4	channel	analog	output module		

The SoftPLC GE 90/30 I/O Driver currently supports the following modules from Horner Electric:

HE693ASCxxx	ASCII/Basic coprocessor	HE693PIDNET	PID network module - V 1.12 or later
HE693APG128	128 channel [IQ]² remote I/O	HE693THM884	8 channel THM (alarms; J...C)
HE693APG256	256 channel [IQ]² remote I/O	HE693THM406	4 channel THM (no alarms; J...S)
HE693NET485	PID network module	HE693THM446	4 channel THM (alarms; J...S)
HE693STP100	Stepper motor (1 axis; no encoder)	HE693THM806	8 channel THM (no alarms; J...S)
HE693STP110	Stepper motor (1 axis; encoder)	HE693THM886	8 channel THM (alarms; J...S)
HE693STP300	Stepper motor (3 axis; no encoder)	HE693THM447	4 channel THM (clk; alms; J...S)
HE693STP310	Stepper motor (3 axis; encoder)	IC693BEM310	32 %I, 32 %Q SDS CANBUS remote I/O
HE693RTD600	6 channel RTD (no alarms; lo res)	HE693DRVNET	Variable freq. drive network module
HE693RTD601	6 channel RTD (no alarms; hi res)	HE693STG884	8 channel strain gauge (variable res)
HE693RTD660	6 channel RTD (alarms; lo res)	HE693THM407	4 channel THM (clk; J...S)
HE693RTD661	6 channel RTD (alarms; hi res)	HE693THM166	16 channel THM (alarms; J...S)
HE693THM400	4 channel THM (no alarms; J, K, T)	HE693STP101	Stepper motor (1 axis; no enc; isol)
HE693THM401	4 channel THM (no alarms; R)	HE693STP111	Stepper motor (1 axis; enc; isol)
HE693THM440	4 channel THM (alarms; J, K, T)	HE693STP301	Stepper motor (3 axis; no enc; isol)
HE693THM441	4 channel THM (alarms; R)	HE693STP311	Stepper motor (3 axis; enc; isol)
HE693THM800	8 channel THM (no alarms; J, K, T)	HE693STP311	Stepper motor (3 axis; enc; isol)
HE693THM801	8 channel THM (no alarms; R)	HE693DAC410	4 channel isolated DAC (voltage)
HE693THM880	8 channel THM (alarms; J, K, T)	HE693DAC420	4 channel isolated DAC (current)
HE693THM881	8 channel THM (alarms; R)	HE693ADC405	4 channel isolated ADC (voltage)
HE693ADC400	4 channel strain gauge (lo res)	HE693ADC410	4 channel isolated ADC (voltage)
HE693ADC401	4 channel strain gauge (hi res)	HE693ADC415	4 channel isolated ADC (current)
HE693ADC800	8 channel strain gauge (lo res)	HE693ADC420	4 channel isolated ADC (current)
HE693ADC801	8 channel strain gauge (hi res)	IC693ALG392	8 channel analog output