



***GE 8000-Line  
Motor Control Centers***

***Programmable Logic Control PLC***

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# Spectra Series™ and 8000-Line Motor Control Centers

# Programmable Logic Control PLC

## GENERAL

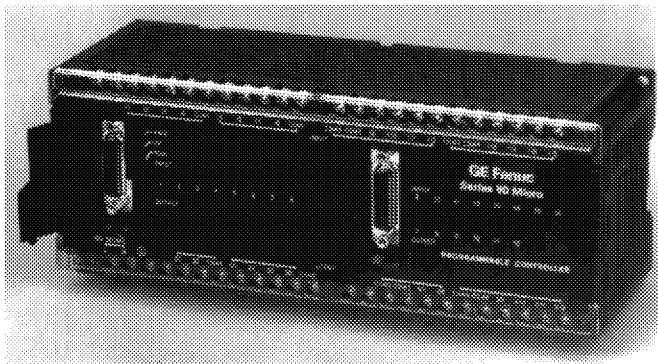
GE Fanuc Automation - Charlottesville, VA, has continually updated/improved its PLC products, which are mounted and wired in the Motor Control Center.

The Series Six PLC was the first in a succession of developments that established GE Fanuc in the marketplace. The Series Six was the first PLC to employ the family concept. Other industry firsts include the Workmaster, the first IBM-based programmer; the Series One, the first modular small PLC; Genius, the first distributed, intelligent I/O system; and the first embedded MAP 3.0 interface in a PLC. GE Fanuc's newest line of PLCs, the Series 90-70 family, is the first PLC with truly open architecture. Thanks to the VME bus back plane, many third party specialty modules are available to enhance the functionality of the Series 90-70.

GE Fanuc was one of the first companies in the United States to attain ESO 9001 registration from UL, CSA and BSI. This means that GE Fanuc has met the most comprehensive quality standard in the design, manufacturing and service of its products. Many of the PLC packages have UL, CSA, and FM recognition.

## MICRO SERIES

8 Input 6 Outputs  
16 Input 12 Outputs  
85-265 VAC



## SERIES 90-30

A versatile unit, the 90-30 is a small PLC with extended capabilities. It is used for MCC lineup sequencing, similar to the Series One PLC. However, with the capability of 512 I/O points, analog I/O, coprocessor modules, and genius communication, it approaches the definition of a larger PLC.

- Inputs AC or DC (common), analog, high speed counter.
- Outputs AC, DC, (Relay, Common, Isolated), analog display (special module). The isolated AC outputs have been tested with Size 1-4 starters for MCC use.
- Special Motion control, high speed counter, third party modules

## SERIES 90-70

The 90-70 system has the most capability in the Series 90 family and is used for system PLCs as well as process lineups of MCC's. It has a wide range of input and output modules as well as extensive communication capabilities. With the GE Fanuc authorized third party VME modules, the Series 90-70 is exceptionally versatile (including imbedded PCs, harddrives, motion control, etc.). The 90-70 is positioned to eventually supercede the Series Six Plus.

## FIELD CONTROL

Modular design gives you more choices. Each field control station consists of a bus interface unit or BIU, an optional field control processor for local logic, up to four field terminal bases, and as many as eight field I/O modules. With field control, you can design a system that meets the precise needs of your application—and upgrade it easily as your application needs change.

## GENIUS I/O SYSTEM

A system of inherently distributed inputs and outputs, which consists of:

- **Genius I/O Blocks** (mounted at the point of control). Input and outputs: AC, DC, isolated, analog, counter. Special Power Management Module
- **Bus Controller** (which serves as the interface between the genius system and the Series Six or Series 90 PLC or other industrial controllers)
- **Hand Held Monitor** (the portable diagnostic and configuration tool) used for trouble-shooting, monitoring, scaling and configuring the I/O Blocks.
- **Genius Bus** which provides communications between the bus controller, hand held monitor, and up to 30 I/O Blocks over a single shielded twisted wire pair.
- **Genius Local Area Network** can communicate between computers, PLCs, and genius blocks up to 7500 ft. using a single twisted pair.

Genius I/O Blocks are mounted, wired, and configured by the factory, and provide superior, built-in diagnostics which detect open circuits, short circuits, overloads, and a variety of other malfunctions which are beyond the power of conventional PLCs to detect.



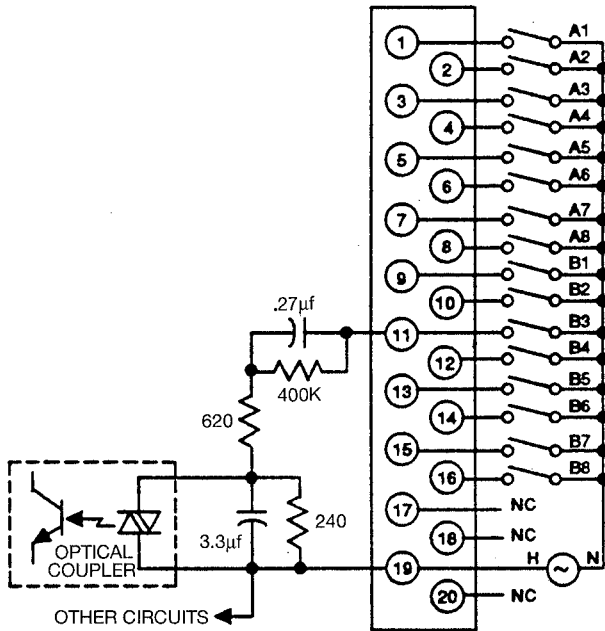
## I/O CIRCUITS

### SAMPLE INPUT CIRCUIT - 120 VOLT AC INPUT MODULE (90-30)

MODULE CIRCUITRY

TERMINALS

FIELD WIRING



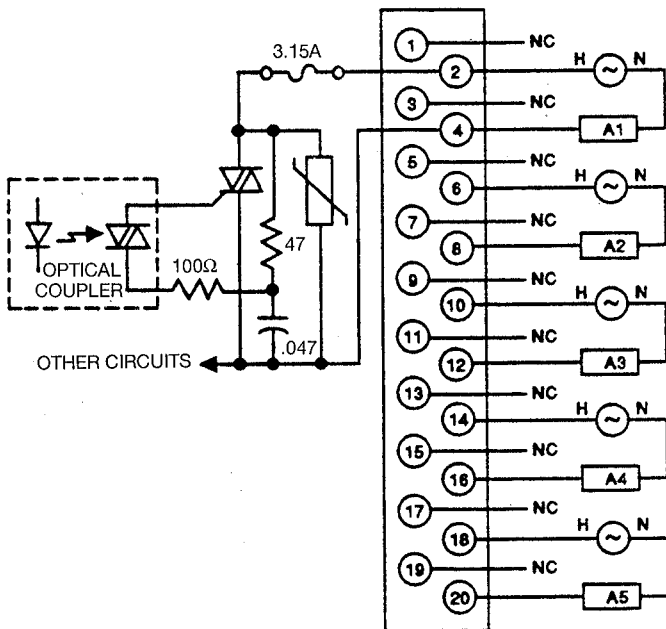
Rated Voltage	120 Volts AC
Inputs per Module	16 (1 group with a single common)
Isolation	1500 volts RMS between field side and logic side
Input Current	14.5 mA (typical) at rated voltage
Input Characteristics:	
Max. On-state	74 volts to 132 volts
Min. Off-state	0 to 20 volts
Min. On-state	6 mA maximum
Max. Off-state	2.2 mA maximum
On response time	30 ms maximum
Off response time	45 ms maximum

### SAMPLE OUTPUT CIRCUIT - 120/240 VOLT ISOLATED AC OUTPUT MODULE (90-30)

MODULE CIRCUITRY

TERMINALS

FIELD WIRING



Rated Voltage	120/240 VAC
Output Voltage Range	85 to 264 VAC
Outputs per Module	5 (each output isolated)
Isolation	1500 volts RMS between field side and logic side
	500 volts RMS between each output
Output Current (Max.)	2 amps per point, 5 amps per module
Output Characteristics:	
Inrush Current	25 amps maximum for one cycle
Min. Load Current	100 mA
Output Voltage Drop	1.5 volts maximum
Output Leakage Current	3 mA maximum at 120 VAC 6 mA maximum at 240 VAC
On response time	1 ms maximum
Off response time	9 ms maximum (1/2 cycle)

## I/O CONFIGURATIONS

Standard I/O for motor control center consists of grouped input cards and isolated output cards (note that the isolated outputs can control all standard motor control center starters).



## SERIES 90™-30 PLC



## MCC SPACE REQUIREMENTS

12-inch per rack plus a 6-inch minimum space for a local CPT and fuses. A 10 slot rack requires a 24-inch wide section for wireway space.

### MODEL 311

The entry level Series 90-30 PLC, Model 311, is available in either a five or ten I/O slot version. With the CPU built into the backplane, the Model 311 provides an "extra" slot for additional I/O or intelligent modules. Model 311 offers 512 words of register memory and 3K of logic memory. This unit provides all the features you want with a small programmable controller.

### MODEL 331

For applications requiring additional I/O the Model 331 can handle your needs. It is expandable to five racks to provide the user with 49 available slots for discrete, analog or intelligent I/O. It offers up to 512 I/O points, 2K words of register memory and 8K words of logic memory.

## SERIES 90-30 GENERAL SPECIFICATIONS

	MODEL 311	MODEL 331
I/O Points (Maximum)	160	512
Logic Memory (Words)	CMOS RAM 3K PROM 3K EEPROM 3K	8K 8K 8K
Execution Speed (1K)	18msec	0.4msec
Internal Functions		
Password Protection	Yes	Yes
Output Coils	512	512
Internal Coils	1024	1024
Timers/Counters	170	>500
Shift Registers	Yes	Yes
Data Registers	512	2048
High Speed Counter 80KHz	Yes	Yes
Analog I/O (12 Bit)	Yes	Yes
Programmable Coprocessor Module	No	Yes
Genius Communications	Yes	Yes
Programming Languages		
Relay Ladder	Yes	Yes
Statement List	Yes	Yes
Advanced Data Operations	Yes	Yes
Devices		
Hand Held Programmer	Yes	Yes
Workmaster or IBM compatible	Yes	Yes
CPU	Built-in	Module
Racks		
5 slot	Yes	Yes
10 slot	Yes	Yes
Operating Environment: 0 to 60° C	5-95% non-condensing humidity	

The Series 90-30 PLC has dimensions similar to the older Series One PLC. It is available in two forms: the model 311 has a basic five slot rack, or a ten slot rack when the I/O requirements exceed the five slot rack capabilities. The model 331 is available with a five or ten slot base rack (CPU plus I/O modules), which then can be expanded to a total of five racks for additional I/O capabilities. With the built-in coprocessor and calendar clock, the Model 331 has faster execution times and can be used with time-of-day programs. The programs are stored in battery-backed CMOS RAM (EPROM chips are available).

The PLC can be programmed from the hand-held programmer, or PC's with LM90 software

### Types of I/O Modules

- IC693MDL390: 120 VAC, 5PT. ISO. OUT.\*
- IC693MDL930: Relay Out. 6PT. ISO.4A
- IC693MDL940: Relay Output, 2A MOD. (16)
- IC693ALG220: Analog Input, E/I, MOD (4)
- IC693ALG390: Analog Output, E MOD. (2)
- IC693PCM300: Prog. Copress. Comm. Mod.
- IC693CMM301: Genius Comm. Mod
- IC693PRG300: Hand Held Programmer

\* Isolated output points have been tested with GE contactors and will energize size 1 through 4 without interposing relays.



## **SERIES 90™-70 PLC**

### **GENERAL**

The Series 90-70 CPU contains an INTEL-base microprocessor and a GE Fanuc-designed Boolean coprocessor for high speed response. It is designed for system level control, and will communicate with other PLCs thru the CCM Protocol, GE net or the Genius LAN. Since it uses the VME standard, many intelligent modules can be added to the rack, thus increasing its versatility. The 90-30 instruction set is a subset of the 90-70s to allow commonality in programming. Built into the CPU is an alarm processor which records and time stamps any faults. This could allow the master program to perform corrective action routines when required.



### **SPECIFICATIONS**

Operating Temperature	0° to 60° C 5% to 95% humidity (non-condensing)
AC Power Required	120/240 VAC (-25%, +10%)
Frequency	47 to 63 Hz
Maximum Load	100 Watts
Battery Type (to retain CMOS memory) load	Lithium 6 month retention under 8-10 year shelf life (no load)
Programmer	Workmaster or IBM PC
Terminal Board	Removable 40 point (1 #14AWG or 2 #16AWG)

### **MCC SPACE REQUIREMENTS**

9 slot rack – 2 S.U., 24 in. W  
5 slot rack – 2 S.U., 20 in. W

No vertical bus behind these PLCs. Interposing TB and smaller wire should be considered due to module density.





# Spectra Series™ and 8000-Line Motor Control Centers

# Programmable Logic Control PLC

## APPLICATION

Series 90-70 PLCs can be coordinated with motor control centers to form a complete, integrated system for material handling, transportation, water treatment, power generation, and many other continuous or batch process applications. From performing simple functions such as start/stop or sequencing operations to comprehensive system monitoring and feed back loops, Series 90-70 control is a powerful addition to MCCs for medium to large applications.

## CPU AND I/O OPTIONS

CPU	731/732	771/772	781/782
User Memory (K words)	16	32,64,128,256	64,128
Discrete I/O Addressing	512	2K	12K
Analog I/O addressing	8K	8K	8K
Boolean Execution	0.4 msec/K	0.4 msec/K	0.4 msec/K
Processor	80186	80186	80386
Floating Point Coprocessor	No/Yes	No/Yes	No/Yes

### Input Modules

- 16 Ckt, 120V AC Isolated Input
- 16 Ckt, 240V AC Isolated Input
- 32 Ckt, 120V AC Input
- 32 Ckt, 24V DC Pos Logic Input
- 32 Ckt, TTL Neg Logic Input
- 32 Ckt, 12V DC +/- Logic Input
- 32 Ckt, 24V DC +/- Logic Input
- 32 Ckt, 48V DC +/- Logic Input
- 8 Ckt, Analog Volt/Curr Input
- 16 Ckt, Analog Current Input Expander
- 16 Ckt, Analog Voltage Input Expander

### Output Modules

- 16 Ckt, 120V AC 2A Output
- 16 Ckt, 120/240V AC Isolated Output\*
- 32 Ckt, 120V AC 0.5A Output
- 16 Ckt, 24/48V DC 2A Pos Logic Output
- 32 Ckt, 24/48V DC 0.5A Pos Logic Output
- 32 Ckt, 12V DC 0.5A Pos Logic Output
- 32 Ckt, 5-48V DC 0.5A Neg Logic Output
- 16 Ckt, Signal Relay 2A Output
- 4 Ckt, Analog Volt/Current Output

### Specialty Modules

- Genius Bus Controller
- Programmable Coprocessor
- Graphics Display Coprocessor
- GENET MAP Carrierband
- GENET MAP Broadband
- MODBUS Interface
- MMS Ethernet

\* Capable of energizing GE size 1 through size 4 starters without interposing relays.



## GE Fanuc Field Control

### GENERAL

With Field Control, GE Fanuc engineers have refined proven technology to create a truly modular system for decentralized I/O and control. Each station of a Field Control network can act as a stand-alone controller, allowing for physical separation of logical control functions and faster processing times. As a result, Field Control is an ideal complement for the Series 90 PLC and Genius I/O a single low-cost solution for a variety of application needs.

### A Local Solution to a Field Logic

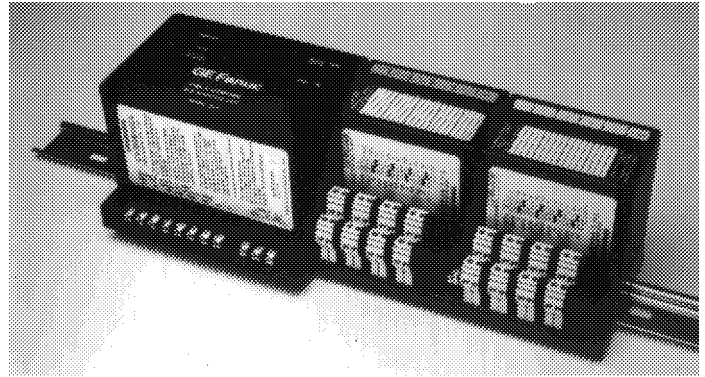
By providing simple logic solving at the local station, Field Control produces sharp increases in a system's raw speed and efficiency. Future versions of Field Control will accommodate additional programming options to build on these advances.

Initially, users will be able to program a Field Control station using standard GE Fanuc Logicmaster™ programming software used on Series 90-30 and Series 90-20 PLCs. In the future, they will be able to choose a programming language of their choice.

With Field Control, GE Fanuc engineers have created a single device that can accept field wiring and condition the signal for input to or output from the control system. There is no need for accessory terminal blocks installed solely to connect field devices with I/O. Designed to be installed and wired like a field terminal block, Field Control can reduce connections by up to one-half.

### The One Choice for Both Local Panel Control and Decentralized I/O

Currently, control specifiers must purchase one I/O platform for local panels and a different platform for decentralized I/O. Field Control is an open platform, equally at home in both applications. Using the Genius bus and other available fieldbuses or communication options, Field Control provides an extremely cost-effective, space-saving option in both local panels and decentralized panel applications.



### Open Architecture Provides the Solution for Diverse Applications

GE Fanuc embraces open architecture for two reasons. It helps our customers make the most of their existing investment in industrial automation. And it enables them to take advantage of new products as they are developed.

To address the diverse needs of all our customers, GE Fanuc will be opening the field processor component to third-party partners to develop additional fieldbus interfaces. In addition, I/O protocol has been published, and we will be encouraging the development of third-party I/Os and accessories.

#### Description

<b>Bus Interface Units:</b>	Genius BIU, 24 VDC Power FIP BIU 24 VDC Power
<b>Field Terminal Bases:</b>	I/O Base, Barrier Style, accommodates 2 modules I/O Base, Box style, accommodates 2 modules High Density Connector Base, accommodates 2 modules Aux. Terminal Block, Qty. 2 Barrier Style Aux. Terminal Block, Qty. 2 Box Style 21" I/O Base Expansion Cable (only 1 per person)

**Field Processors:** Micro Field Processor

<b>Field I/O Modules:</b>	24 VDC Pos./Neg. Input 16 Pt. Grouped 12/24 VDC 0.5A Pos. Output 16 Pt. Grouped Analog Input Current 8 Pt. Grouped Analog Output Current/Voltage 4 Pt. Grouped 48 VDC Pos./Neg. Input 16 Pt. Grouped 120 VAC Input 16 Pt. Grouped 240 VAC Input 16 Pt. Grouped 120 VAC 2A Output 8 Pt. Grouped 12-120VAC Output 16 Pt. Grouped Relay 2A 8 Pt. 6 Form A/2 Form C Isolated 125 VDC Input 16 Pt. Grouped Analog Input Current 16 Pt. Grouped Analog Output Current 8 Pt. Grouped Thermocouple 8 Pt. Isolated RTD 4 Channel Isolated - 3 wire
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## GENIUS® I/O SYSTEM

### General

The Genius I/O, a system of inherently distributed inputs and outputs, is designed to interface to any number of industrial controllers, including GE Fanuc PLCs, and third party CPUs. It can be used as the only I/O on a System or it can be mixed with the present rack-type I/O. Genius represents a complete rethinking of the role of I/O in industrial control. Genius Blocks are UL, CSA, FM and CSA hazardous environment approved. The Genius I/O system was made possible through two key General Electric technological innovations:

**Smart Switch:** A device with the built-in current and voltage sensors required for the extensive diagnostics available with Genius I/O. The smart switch allows detection of faults not only within the programmable controller I/O system, but also faults in the coils and other actuator devices under the control of the programmable controller, as well as the signal path from pushbuttons and other input devices. No other technology provides this level of fault detection.

**Communications Controller:** A token bus local area network controller which allows Genius I/O devices to communicate over a single-shielded twisted wire pair, rather than via bundles of point-to-point wires required in conventional systems.

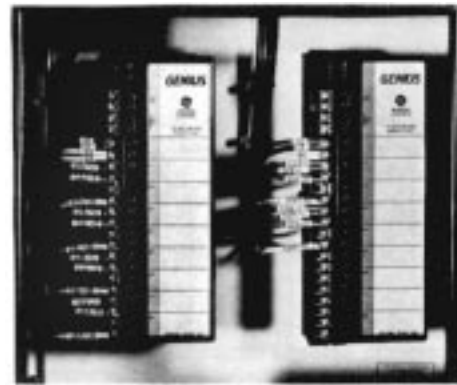
### GENIUS I/O SYSTEM ARCHITECTURE

A simplified block diagram of the Genius I/O System is shown in Figure 2. The PLC, CPU, and I/O rack shown are standard Series 90-70 units. The Genius serial bus connects I/O Blocks with a single shielded twisted pair up to 7500 feet from the Bus Controller.

### Genius I/O Block

A microprocessor-based, configurable, ruggedized solid state device to which field I/O devices are attached. Measuring approximately 9" x 4" x 3", I/O Blocks can be mounted virtually anywhere, such as in a draw-out unit of a motor control center or pushbutton station where it is common to have one input and one output per motor circuit. No separate rack or power supply is required. Field wiring is attached to a terminal assembly which separates from the removable electronics assembly. Thus, field wiring need not be disturbed to service the electronics. Due to the microprocessor and intelligent switching, inputs and outputs may be mixed arbitrarily on blocks. There are no dip switches nor replaceable fuses.

An EEPROM (Electrically Erasable Programmable Read-Only Memory) is located within the terminal assembly. The EEPROM stores all user-selectable options and retains these selections even during POWER OFF conditions. It can be read by the electronics assembly at any time and altered by commands from either the CPU or the Hand Held Monitor. The EEPROM is the only electronic device in the terminal assembly and has a long Mean-Time-Between-Failure (MTBF).



Typical Genius I/O Unit

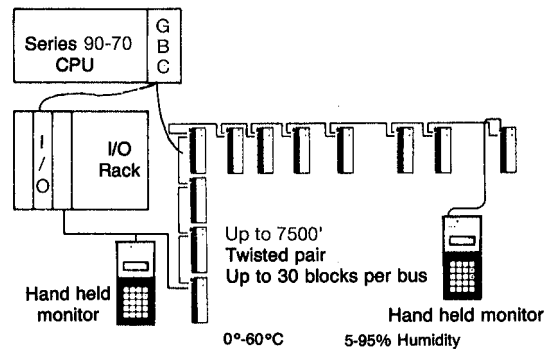


Fig. 2. Genius I/O System Block Diagram

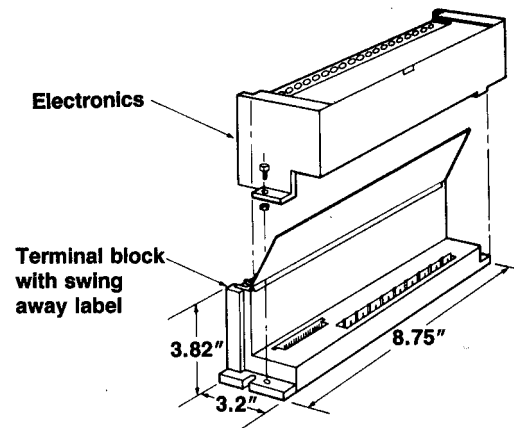


Fig. 3. Genius I/O Block Assembly





## Genius I/O Block (Cont'd)

The electronics assembly contains the power supply, communications chip, microprocessor, smart switches, and other electronic components required to perform Genius I/O functions.

Each I/O Block is keyed to prevent the insertion of a non-matching electronics assembly into a terminal assembly wired for a different power. Once inserted, the electronics assembly automatically reads the content of the EEPROM and initializes itself to match the configuration originally established for the I/O Block in that position. Table 1 lists the types of I/O Blocks currently available, as well as other basic system components.

**Table 1—Genius I/O Components**

Block Function	Nominal Voltage	Working Voltage	No. of Circuits
AC I/O	115 VAC, Grouped combination input and output	93-132 VAC 47-63 Hz	8 (1 x 8) 16 (1 x 16)
AC/DC I/O	115 VAC/125 VDC Isolated combination input and output 4 groups of 2	93-132 VAC 47-63 Hz 105-140 VDC	8 (4 x 2)
DC I/O	24-48 VDC Source combination input and output	18-50 VDC	16 (1 x 16)
DC I/O	24/48 VDC Sink combination input and output	18-50 VDC	16 (1 x 16)
AC Analog	Analog 115 VDC Powered	93-132 VAC 47-63 Hz	4 In/2 Out
DC Analog	Analog 24/48 VDC Powered	18-50 VDC	4 In/2 Out
<b>Other Components</b>			
Metering	Hand Held Monitor	93-132 VAC 47-63 Hz or 185-265 VAC 47-63 Hz With Diagnostics Without Diagnostics	120V-PT 5A-CT
	Bus Controller Bus Controller Power Trac Block	93-132 VAC 105-140 VDC	

## MCC Space Requirements

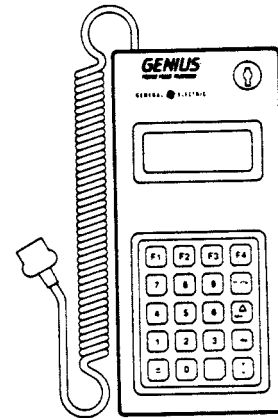
Allow 18-inch height for the first two blocks, plus 12 inches for each additional set of two. This allows room for 120-volt power supply disconnect (or CPT). Maximum of 8 blocks per section, without ventilation.

## Hand Held Monitor (HHM)

A portable diagnostic and configuration tool used for addressing, trouble-shooting, monitoring, scaling and configuring the I/O Blocks. The HHM plugs directly into any block or into the programmable controller, or it can be attached to any location on the twisted pair communications link. It is supplied in a case suitable for you to attach to your belt, or it can be panel mounted using the mounting bezel included with each HHM. It has an alphanumeric LCD display (4 lines x 16 characters) with microprocessor-driven prompts available in English, German, French, or Italian. A key feature of the HHM is its ability to manually perform functions and force discrete and analog I/O, whether or not there is a programmable controller connected to the system. This greatly facilitates system check-out prior to full-scale operation.

The HHM includes:

- An LCD display capable of displaying 16 characters per line on four separate lines.
- Four display-labeled soft keys.
- A decimal keypad, including sign and decimal point keys.
- Four fixed-function keys.



**Fig. 4. Hand Held Monitor**

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# Spectra Series™ and 8000-Line Motor Control Centers

# Programmable Logic Control PLC

## GENIUS® I/O SYSTEM SERIES SIX BUS CONTROLLER

The Bus Controller serves as the interface between the Genius I/O systems and the industrial controller.

Bus Controllers are available for Series 90-70, Series 90-30 (for communications), Series Six PLCs, personal computers, DCSs, Industrial Robots, GE Drive Systems, and others.

### Genius I/O Bus

To connect Genius I/O elements together is a 150 kbit/sec serial token passing bus communications link formed by daisy-chain connection of twisted pair wire. It has high noise immunity (1500 volt common mode) and its operation is not affected by any block attachment, removal or failure. Each data bit is triply encoded for data integrity; error detection is further improved via cyclical redundancy check (CRC). Bus errors are reported automatically.

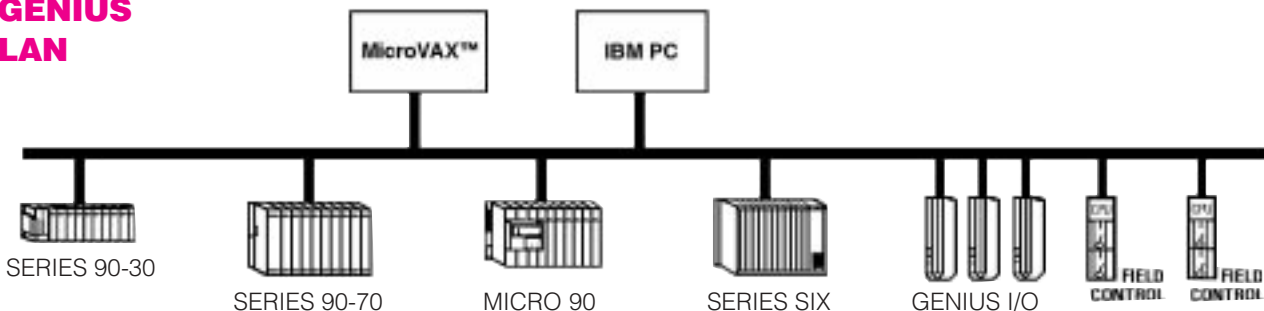
This link requires only one pair and can be Belden type 9302 (or factory approved equivalent) up to 100 feet (30 meters) in total length, or must be Belden type 9182 or Alpha type 9823 (or factory approved equivalent) up to 7500 feet (2258 meters). Belden type 9182 or equivalent is used in motor control center equipment.

### Diagnostics

The Genius I/O system provides advanced diagnostic capability. Error detection for discrete and analog circuits is summarized in Table 2. Such detection includes a variety of block failure modes, bus failures and failures within the Bus Controller. Of greater significance, however, is the diagnostic power for the attached I/O devices. On discrete blocks, the system detects open wires, short circuits, overloads, and a variety of other malfunctions which are beyond the power of conventional programmable controllers to detect. Many faults may be detected before they cause a malfunction in equipment. The Genius I/O can detect the integrity of a control circuit before the circuit must actually be energized by periodic "pulse-testing" under microprocessor control within a Genius I/O Block. Over temperature sensors are also built into each circuit.

On the analog blocks, the Genius I/O can detect an input open wire, mix high-level analog signals on one I/O Block ( $\pm 10$  volts DC,  $\pm 5$  volts DC, 0-10 volts DC, 0-5 volts DC, 1-5 volts DC, or 4-20 mA), establish linear conversions from analog values to engineering units, process high-level and low-level alarms, and detect over-range and underrange analog signals. Analog blocks also allow you to establish different filter delays on inputs: short filter delays (5-10 msec) for fast system response in controlled low-noise environment or longer filter delays (20-1000 msec) to reject electrical noise in harsh environments. All of these faults are automatically reported to the HHM or CPU.

### GENIUS LAN



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**TABLE 2—Genius I/O Diagnostic Features**

Block	Discrete Point	
	Input	Output
-Addition of Block	-Open Wire -Power Loss <sup>①</sup> -Over Temp.	-Failed Switch -Load not present -Overload -Short Circuit -Over Temp. -Power Loss <sup>①</sup>
-Loss of Block (incl. Communications Power, Memory Losses)		
-Address Conflict	Analog I/O	
-Bus Error	-Open Wire <sup>②</sup> -Underrange -Overrange -Hi Alarm -Low Alarm	-Underrange -Overrange
-Bus Controller OK		

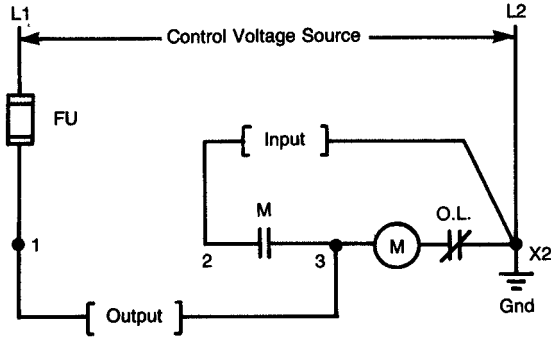
① Isolated only.

② 1-5 volt DC (4-20mA DC) range only.



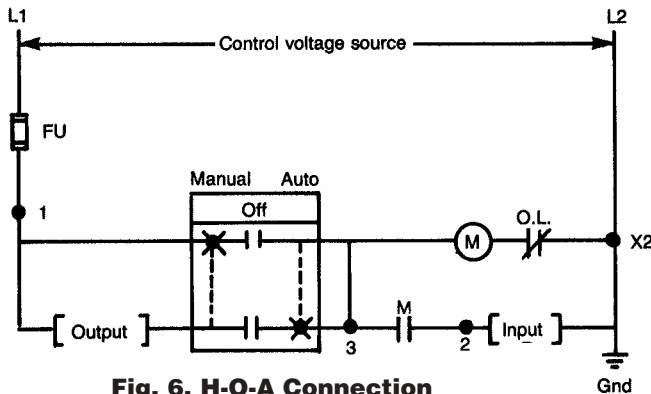
## CONNECTIONS PLC CONTROLLED STARTERS

A combination motor starter will require a minimum of one INPUT and one OUTPUT per starter. As shown in Figure 5, the OUTPUT is connected between the starter coil and the fused, ungrounded leg of the control voltage source (terminals 3, 1). The INPUT connection is made between the starter "Seal contact" and the grounded leg of the control voltage source (Terminals 2, X<sub>2</sub>). The INPUT monitors the status of the seal circuit to independently verify that the starter has closed.



**Fig. 5. INPUT and OUTPUT Connection**

When an H-O-A switch is used with PLC I/O, the configuration will appear as shown in Figure 6. Note: as mentioned previously, the INPUT monitors the status of the starter's seal circuit in the manual mode as well as the PLC (automatic) mode.



**Fig. 6. H-O-A Connection**

## STARTER UNITS WITH INDIVIDUAL CONTROL TRANSFORMERS

For starters having individual control power transformers all OUTPUTS must be isolated type. This requirement is necessary due to the separate voltage sources provided by the individual control transformers. INPUTS may be either isolated or non-isolated types. Where non-isolated INPUTS are used all X<sub>2</sub> terminals must be wired together.

## SURGE SUPPRESSORS

In cases where excessive noise is present on the control line or hard interlocks which will operate often (in series with PLC OUTPUT), surge suppressors are recommended.

## OPTIONAL INPUTS/DIAGNOSTIC

Additional INPUT connections can be made to monitor the specific status of combination starters and feeders to provide further diagnostic information to the process operator and maintenance personnel.

1. The status of the overload relay can be monitored. An electrically-isolated, normally-open auxiliary contact can be ordered with the GE 300-Line overload relay and an additional PLC INPUT can be wired in series with it.
2. A PLC INPUT can be connected between terminals 1 and X<sub>2</sub> to monitor the availability of control power to the starter unit.

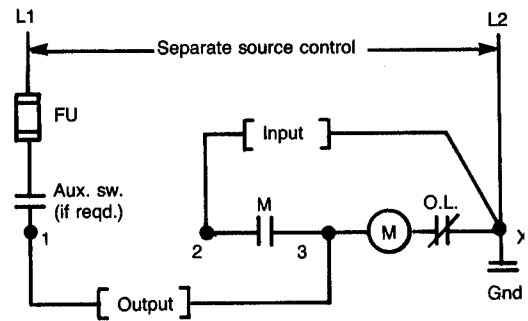
## STARTER UNITS WITH SEPARATE-SOURCE CONTROL VOLTAGE

INPUT and OUTPUT connections are shown below (see Figure 7) for units arranged for separate-source control.

INPUT— A common (non-isolated) INPUT can be used if all X<sub>2</sub> terminals are wired together.

OUTPUT— As required by NEC Article 430-74, if a disconnect auxiliary contact and/or control circuit fuse (FU) is included with each starter, then the OUTPUT must be the isolated type. However, if the auxiliary contact and fuse are omitted, a common OUTPUT module can be used. With common output modules, interposing relays are required with NEMA Size 3 and 4 starters.

**Note:** NEC article 430-74 can be met with GE's standard split-type control terminal boards on all draw-out units, or with GE's pull-apart terminal boards.



**Fig. 7. INPUT and OUTPUT Connections for Separate-Source Control**

## ISOLATED VERSUS NON-ISOLATED OUTPUTS Isolated Outputs

GE's isolated OUTPUTS can be used for direct control of NEMA Size 1 through 4 combination starters without the use of an interposing relay. The contactors of GE's standard NEMA Size 5 and larger starters are operated at line voltage with interposing relays operated from the secondary of the control transformer.

## Non-isolated OUTPUTS

NEMA Size 1-2 starters may be operated directly from common PLC OUTPUT cards. The continuous current rating of GE's non-isolated OUTPUT module requires an interposing relay for NEMA Size 3 and larger starters. Check the module ratings for inrush and continuous values.