azbil

Specification

Rel. 20

Harmonas-FLeX

# Harmonas-FLeX™ Distributed Controller

## 1. Introduction

The Harmonas-FLeX Distributed controller (FLC) is a compact controller designed to be installed in a local control panel. The functions and features of the FLC are described briefly below.

### ■ Control

- The FLC has the functionality of process controllers like those in Azbil Corporation's DCS series. It can handle both PID and sequence control and is equipped with a rich set of functions.
- The user generates control programs and carries out maintenance in the RTC integrated engineering environment. By means of virtual simulation software that runs on a personal computer, debugging can be done efficiently.
- Control programs can be represented with logic diagrams using function blocks for easy understanding and debugging. Generated programs can be displayed in the form of drawings.

### ■ Installation

- The FLC is compact enough to be installed in a small box (400 × 400 mm). It can be mounted in an existing control cabinet or wall-mounted box.
  Mountable on an existing control cabinet or wall-mounted box.
- Power supply and wiring for field device signals, with a short protection circuit, are built in. Since the FLC can be connected directly to field wiring, installation is complete simply by installing the FLC and connecting the power supply to the field wiring.
- There are up to 368 input/output points (or approximately 256 points with a typical configuration). Various input/output types can be combined to suit the application.
- The FLC was designed to resist environmental factors, and can be operated in a sealed box.

### ■ System Compatibility

- Redundant Ethernet ports are a standard feature.
- Can be connected to a local flat-panel display for graphic operations and data collection and storage. This system can be used as a digital recorder.
- By simple connection of an Ethernet cable, the FLC can be integrated into systems such as the Harmonas-DEO™ automation system. FLC units can be individually installed in local control panels, making incremental networking and systemization possible.

Figure 1. Example of Installation in a Box

Figure 2. Example of local flat-panel display

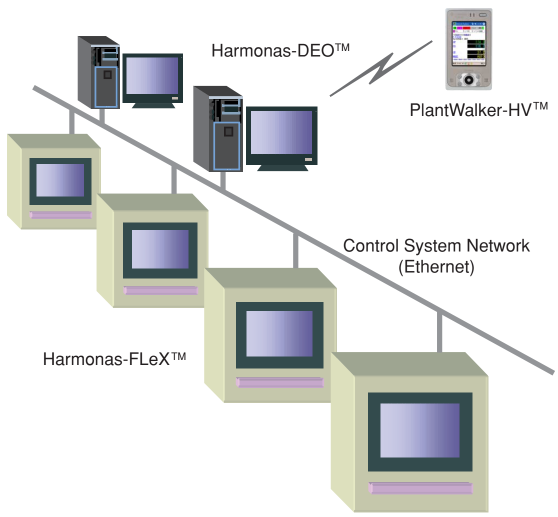



Figure 3. System Architecture

# 2. Functional Overview

The FLC consists of a main unit and up to three expansion units, each unit equipped with 6 I/O card slots. When using an expansion unit, insert an interface card for the expansion unit into an I/O slot in the main unit, and similarly insert a card for interfacing with the main unit into each expansion unit, and then connect the cards with a dedicated cable.* The remaining I/O cards can be selected as needed from among the following types.

- AI (4 to 20 mA/1 to 5V DC) : 8 per/card
- Thermocouple with mV input (-100 to 100 mV) : 4 per/card
- AO (4 to 20 mA) : 8 per/card
- AO (4 to 20 mA) : 4 per/card
- RTD (8 I/O points for air-conditioning, or 4 for free use)
- Pulse input : 8 per/card
- DI : 16 per/card
- DI (relay input) : 16 per/card
- DO (semiconductor output) : 16 per/card
- DO (relay output) : 16 per/card
- Serial communications : 1 port/card
- Local flat-panel display I/F (mounted on the main unit) : 1 port/card

Ethernet is used for the control network and for connection to other systems such as the Harmonas-DEO automation system or an information system. Redundant Ethernet for the control network is a standard feature.

* The interface card in each expansion unit does not use an I/O slot, but instead uses a control card slot, since the I/O expansion units do not require a control card.

## ■ Specifications

**Table 1. Hardware Specifications**

| Item | Specifications |
|---|---|
| CPU | 32-bit |
| Number of I/O points | • Largest configuration when three expansion units are connected<br>- 23 I/O cards max. (if the local flat-panel display is connected, 22 cards max.)<br>- HLAI: 184 pts. (max.), 8 pts./card<br>- Thermocouple mV input: 92 pts. (max.), 4 pts./card<br>- RTD AI for room temperature: 184 pts. (max.), 8 pts./card, fixed range of -20 to 80 °C<br>- RTD Al: 92 pts. (max.), 4 pts./card, free use<br>- AO: 184 pts. (max.), 8 pts./card, max. load resistance 300 Ω<br>- AO: 92 pts. (max.), 4 pts./card, max. load resistance 700 Ω<br>- DI: 368 pts. (max.), 16 pts./card<br>- DO: 368 pts. (max.), 16 pts./card<br>- Pulse input: 184 pts. (max.), 8 pts./card<br>Note: The maximum numbers for I/O points given above assume that the number of available mounting slots is restricted by the connection of three expansion units.<br>Also, in practice there is some restriction on the number of cards from a control functional performance point of view.<br>• Configuration with only the main unit<br>- 6 I/O cards (5 if the local flat-panel display is connected) |
| Weight | Approximately 4 kg |
| Power | 85 to 264V AC, 47 to 63 Hz |
| Grounding | D-type grounding (resistance of 100 Ω or less) |
| Power consumption | Main unit and expansion unit, 150 VA each |
| Instantaneous power interruption | 20 ms (if FLC 3.4V internal power supply is interrupted for a longer period and automatic data backup mode is selected, FLC power supply unit keeps power at least 20 seconds for data saving). |
| Inrush current | 45A max. (at cold start) |

**Table 2. Specifications for Communications**

<table>
<tr><th>Type of Communications</th><th colspan="4">Specifications</th></tr>
<tr><td>Through external network (Harmonas-DEO, etc.)</td><td colspan="4">10 Mbps Ethernet, 400 parameters/second (PPS) max. (total of 400 PPS between controllers)</td></tr>
<tr><td>Between controllers</td><td colspan="4">Using Ethernet, up to 400 PPS (total with external communication)</td></tr>
<tr><td rowspan="6">With PLC</td><td colspan="4">1:1 communication with the PLC through Ethernet. Up to 256 word data elements and up to 1024 bit data elements can be read/written.</td></tr>
<tr><td rowspan="5">Supported model</td><td>Manufacturer</td><td>PLC</td><td>Supported Ethernet module</td></tr>
<tr><td rowspan="3">Mitsubishi Electric Corp.</td><td>MELSEC A series</td><td>AJ71E71-S3, A1SJ71E71-S3</td></tr>
<tr><td>MELSEC QnA series</td><td>AJ71QE71, A1SJ71QE71</td></tr>
<tr><td>MELSEC Q series (Q mode)</td><td>QJ71E71</td></tr>
<tr><td>JTEKT Corporation</td><td>TOYOPUC 3JG</td><td>FL/ET-T-V2</td></tr>
<tr><td>Serial</td><td colspan="4">• 1:1 communication with a serial communication device using RS232 or RS485. (RS485 multidrop is not supported.)<br>• 1 port/card (1 FLC can take up to 4 serial communication cards)<br>• Up to 256 word data elements/card and up to 512 bit data elements/card can be read/written.</td></tr>
<tr><td>I/O</td><td colspan="4">• Dedicated parallel bus<br>(An I/O slot on the main unit is used to interface with the expansion units. No I/O slots are used on the expansion units.)</td></tr>
<tr><td rowspan="3">To flat-panel display</td><td colspan="4">• 1:1 communications with the controller using RS232 or RS485<br>• The EST555Z, EST240Z, Pro-face PFXGP4501TAA and PFXGP4501TAD are available.<br>(An I/O slot on the main unit is used for the interface.)</td></tr>
<tr><td rowspan="2">Transmission distance</td><td>RS232</td><td colspan="2">15 m</td></tr>
<tr><td>RS485</td><td colspan="2">1000 m**</td></tr>
</table>

** This controller should not be installed in an environment strongly affected by noise: near electromagnetic switches or high-voltage facilities, for example. The use of fiber-optic cables (converters) is recommended.

**Table 3. Software Specifications**

| Item | Specifications |
|---|---|
| Control point | 32 Regulatory control points<br>32 Regulatory PV points |
| Control algorithm | 19 types (48 formulas) |
| Control cycle | • Basic cycle is selectable from 0.1, 0.2, 0.5 and 1 second. (CL is fixed at 1 second.)<br>• In part, 0.1 second execution processing is possible (also for CL). |
| Sequence program | • 128 CL (control language) programs (max.)<br>• 6080 MU: 18240–24480 CL statements<br>(The CL memory has no relation to other functions and can be used as dedicated memory.) |
| Logic program | • 64 points<br>• 1024 blocks max., 16 blocks max. for each logic point<br>• 25 algorithms |
| SAMA function block | • 128 points max.<br>• 2048 blocks max.<br>• 91 algorithms<br>(When monitoring from the Harmonas-DEO Supervisory Station and/or local flat-panel display is necessary, values and/or status of block calculations are allocated to numeric variables or flag variables.) |
| Digital composite | 256 points max. |
| Numeric value variable | 8192* + (80 × the number of sequences used) points |
| Flag variable | 8192** + (128 × the number of sequences used) points |
| Timer variable | 32 points |

* 3,000 points are for use by the user, and the rest are reserved for the system.
**3,000 points (including 512 for alarms are for use by the user, and the rest are reserved for the system.

## ■ Environmental conditions

Suitable conditions for FLC installation, use, storage and transport are shown in the following table. Be sure to leave clearance in the specified amount around the main unit. In addition to the following conditions, give due consideration to external magnetic fields, electrostatic discharge, radio interference, and the like.

**Table 4. Environmental Conditions**

| Item | | Standard operating conditions | Normal operating conditions | Restricted operating conditions | Conditions for storage and transport |
|---|---|---|---|---|---|
| Ambient temperature 1 | Range (°C) | 23±2 | 0 to 50 | 0 to 60 | -40 to 70 |
| | Rate of change (°C/h) | ±5 | ±20 | ±20 | — |
| Relative humidity | (%) | 50±10 | 5 to 95<br>(0.020 kg/kg')2 | 5 to 95<br>(0.020 kg/kg') | 5 to 95<br>(0.020 kg/kg') |
| Vibration 3 | Amplitude | 0 | 0.35 mm or less<br>(2 to 9 Hz) | 0.35 mm or less<br>(2 to 9 Hz) | 1.5 mm or less<br>(2 to 9 Hz) |
| | Acceleration | 0 | 1m/s² or less<br>(9 to 150 Hz) | 1m/s² or less<br>(9 to 150 Hz) | 5m/s² or less<br>(9 to 150 Hz) |

Notes:
1. The atmosphere should not contain corrosive gas. Installation in a control panel where the temperature is 45 °C or less is recommended.
2. In humid air, the ratio of kilograms of water vapor to kilograms of dry air.
3. Do not install where there is continuous strong vibration.

Definitions
1) Standard operating conditions: range of operating conditions under which external influences on performance can be ignored.

2) Normal operating conditions: range of operating conditions under which equipment or devices are designed to operate within the specified error rate and range of operating conditions recommended by the manufacturer from all viewpoints such as functions, performance, and reliability.

3) Restricted operating conditions: operating conditions which are outside the normal operating range, and under which the absence of fluctuations in product performance cannot be guaranteed, but under which the equipment can be used without receiving permanent damage; a range of conditions, under which only temporary use is permitted.

4) Transport and storage conditions: range of conditions required for preventing permanent damage during transport, during storage in a warehouse, or while unused. (Equipment requires appropriate protective packing to prevent damage.)

Note 1: Equipment requires appropriate protecting packing to prevent irrecoverable damage.

Note 2: that in some cases, equipment must be adjusted to recover normal performance.

## ■ Input and output specifications

**Table 5. Input and Output Specifications**

| Item | | Specifications |
|---|---|---|
| Analog input | Number of I/O points | 8 per card |
| | Supply voltage and current consumption | 24V DC ± 10%, 70 mA (when the transmitter* power supply is not used) |
| | Input signal | 1 to 5V DC (0 to 100%) |
| | Input range (FS) | 0.726 to 5.276V DC ( -6.9 to 106.9%) |
| | Accuracy | 0.2% F.S. |
| | Effect of ambient temperature change | ±0.02% F.S. /°C |
| | Input type | Differential input for use on different channels (allowable operating voltage ± 3V) |
| | Input impedance | 1 MΩ or higher |
| | Transmitter power supply | 18.6 to 26.4V DC, max. 200 mA (total for 8 points, for all cards) |
| Thermocouple (mV) input | Number of I/O points | 4 per card |
| | Supply voltage and current consumption | 24V DC ± 10%, 50 mA |
| | Input circuit | Isolation per point |
| | Input signal | -100 to 100 mV. For input temperatures, see Table 6 below. |
| | Cold junction compensation accuracy | ±0.5°C (at 25°C) |
| | Conversion standard accuracy | For µV input, ±20 µV. For thermocouple input, see Table 6 below. |
| | Effect of temperature change | For thermocouple input:<br>Based on an FLC ambient temperature of 25°C, for additional accuracy add the result of the following formula to the conversion standard accuracy.<br>*Conversion accuracy =*<br>*Conversion standard accuracy (T2) ±T2 ×(T1 - 25)/15*<br>Where:<br>T1 = FLC ambient temperature (°C)<br>T2 = conversion standard accuracy (= the relevant value in Table 6) |
| | Withstand voltage | 500V AC (between input channels, and between input and field power supply) |
| | Common mode rejection ratio (CMRR) | 120 dB or more (DC to 60 Hz) |
| | Normal mode rejection ratio (NMRR) | 40 dB or more (50 Hz/60 Hz) |
| | Scan cycle | 1 s |
| | Open circuit detection (OTD) | Upscale or downscale, selectable per point |
| | Input impedance | 1 MΩ or more |
| RTD (resistance temperature detector) input: free range | Number of I/O points | 4 per card |
| | Supply voltage and current consumption | 24V DC ± 10%, 50 mA |
| | Input circuit | Isolation per point |
| | Input signal | Pt 100 Ω, variable range |
| | Conversion standard accuracy | ±0.8°C |
| | Effect of temperature change | Based on an FLC ambient temperature of 25°C, for additional accuracy add the result of the following formula to the conversion standard accuracy.<br>*Conversion accuracy =*<br>*Conversion standard accuracy (±0.8 °C) ± 0.8°C ×(T - 25)/15*<br>Where:<br>T = FLC ambient temperature (°C) |
| | Allowable wiring resistance | Max. 20 Ω |
| | Difference in resistance values of wiring | Since this creates temperature measurement error, make the difference as small as possible. |
| | Withstand voltage | 500V AC (between the input and SG) |
| | Common mode rejection ratio (CMRR) | 110 dB or more (DC to 60 Hz) |
| | Normal mode rejection ratio (NMRR) | 40 dB or more (50 Hz/60 Hz) |
| | Scan cycle | 1 s |
| | Input impedance | 1 MΩ or more |
| Temperature input (room temperature, outside air temperature, etc.) | Number of I/O points | 8 |
| | Supply voltage and current consumption | 24 V DC ± 10%, 70 mA |
| | Input signal | PT 100 Ω, -20 to 80°C, fixed range |
| | Accuracy | 1% F.S. (at 25°C ± 2°C) |
| | Isolation | Common isolation with the input power supply and system power supply |
| | Allowable wiring resistance | 5 Ω or less |

* The transmitter power supply is not insulated from the input power supply.
When the transmitter power supply is used, the minus input becomes common and differential input is not possible.
When connecting a two-wire transmitter or 4 to 20 mA input, add a 250 Ω resistor to the external terminal.

## Table 5. Input and Output Specifications (continued)

| Item | | Specifications |
|---|---|---|
| Analog output (8 points/card) | Number of I/O points | 8 per card |
| | Supply voltage and current consumption | 24V DC ± 10%, 140 mA (at 100% output on all points) |
| | Output range | 4 to 20 mA (0 to 100%) |
| | Output scope | 2.9 to 21.1 mA (-6.9% to 106.9%) |
| | Accuracy | 0.35% F.S. |
| | Isolation | Common isolation with the input power supply and system power supply |
| | Maximum load resistance | 300 Ω* |
| Analog output (4 points/card) | Number of I/O points | 4 per card |
| | Supply voltage and current consumption | 24V DC ± 10%, 140 mA (at 100% output on all points) |
| | Output range | 4 to 20 mA (0 to 100%) |
| | Output scope | 2.9 to 21.1 mA (-6.9% to 106.9%) |
| | Accuracy | 0.35% F.S. |
| | Isolation | Isolated from the system power supply |
| | Maximum load resistance | 700 Ω |
| Pulse input | Number of I/O points | 8 per card |
| | Input circuit | Photocoupler input (source/sink is selectable by card) |
| | Common points | 8 |
| | Supply voltage and current consumption | 24V DC ± 10%, 50 mA (when all points are ON) |
| | Input signal | On: 13V or more (12 mA or more)<br>Off: 4V or less (1.2 mA or less) |
| | Input impedance | 1.5 kΩ |
| | Input range | High: 0 to 5 kHz<br>Low: 0 to 20 Hz |
| | Minimum pulse width | High input range: 0 to 5 kHz, ON 0.1 ms, OFF 0.1 ms.<br>Low input range: 0 to 20 Hz, ON 25 ms, OFF 25 ms. |
| | Isolation | Isolated from the system power supply but not isolated from the input power supply |
| Digital input | Number of I/O points | 16 per card |
| | Input circuit | Photocoupler input (source/sink is selectable by card) |
| | Common points | 16 |
| | Supply voltage and current consumption | 24V DC ± 10%, 100 mA (when all points are ON) |
| | Input signal | On: 18V or more (2.4 mA or more)<br>Off: 6V or less (0.8 mA or less) |
| | Input impedance | 6.8 kΩ |
| | Input filter time constant | 10 ms |
| | Isolation | Isolated from the system power supply but not isolated from the input power supply |
| | Input type | Status-type, latch-type (push button), or counter-type, specifiable for each point (by software). |
| | Latch type DI input detection width | 100 ms or more |
| | Countable pulse width | 100 ms or more (200 ms or more for on + off cycle) |
| Digital input (connected to the Omron G7TC) | Number of I/O points | 16 per card |
| | Input circuit | Depends on relays used for the Omron G7TC |
| | Common | |
| | Supply voltage and current consumption | 24V DC ± 10%, 100 mA. Do not feed power to the Omron G7TC from the FLC power supply. Not isolated. |
| | Input signal | Depends on relays used for the Omron G7TC |
| | Input impedance | |
| | Input filter time constant | |
| | Isolation | The I/O card is isolated from the system power supply. For the Omron G7TC, isolation depends on the relays used. |
| | Input type | Status-type, latch-type (push button), or counter-type, specifiable for each point (by software). |
| | Latch-type DI input detector | 100 ms or more |
| | Countable pulse width | 100 ms or more (200 ms or more for on + off cycle) |

Notes:
- If the Omron G7TC-ID16 24V DC type is used, specifications are as follows:
  - — Coil: rated coil current 21 mA, resistance 1150 Ω.
  - — Contacts: rated load 1A (resistive load), 0.5A (inductive load). Electrical life is 10 million operations (10 mA resistive load), 2.5 million operations (10 mA inductive load), 0.05 million operations (1A resistive load), or 0.02 million operations (1A inductive load).

* Generally, the input resistance of a HART protocol-compliant positioner is approximately 600 Ω. To connect an analog output (8-point output type) and HART protocol-compliant positioner, use an isolator or other appropriate device.

### Table 5. Input and Output Specifications (continued)

| Item | | Specifications | |
|---|---|---|---|
| Digital output | Number of I/O points | 16 per card | |
| | Output circuit | Open collector | |
| | Common points | 16 | |
| | Output supply voltage and current consumption | 24V DC ± 10%, 10 mA (when all points are OFF) | |
| | Maximum switching current (load current) | 0.5A (for one point) | |
| | | 2A (for one card) | |
| | Output transistor ON voltage | 1.5V or less (with 0.5A load current) | |
| | Isolation | Isolated from the system power supply but not isolated from the output power supply | |
| | Output type | Latch-type, status-type, or pulse-type output, specifiable for each point (by means of software) | |
| | Pulse-type DO pulse width | 100 ms to 120 s, 100 ms resolution | |
| Digital output (connected to the Omron G7TC) | Number of I/O points | 16 per card | |
| | Output circuit | Depends on the relays used for the Omron G7TC | |
| | Output supply voltage and current consumption | 24V DC ± 10%, 400 mA (powering the Omron G7TC, with 16 relays energized)* | |
| | Contact rating | Depends on the relays used for the Omron G7TC | |
| | Operation time | | |
| | Reset | | |
| | Isolation | The I/O card is isolated from the system power supply. For the Omron G7TC, isolation depends on the relays used. | |
| | Output type, pulse width | Same as open collector input | |
| Serial communications | Number of ports | 1 | |
| | Max. number of cards | 4 per FLC | |
| | Number of communication points | Word data | 256 points/card |
| | | Bit data | 512 points/card |
| | Interface** | RS232 | D-sub 9 pin |
| | | RS485 | 6-pole terminal strip |
| | Transmission rate | 2400, 4800, 9600, 19200 bps | |
| | Circuit configuration | RS232 | 1:1 |
| | | RS485 | 1:1 |

* Limit the number of digital output cards (connected to the Omron G7TC) when power is supplied from the FLC power supply to the Omron G7TC to a maximum of 4 cards/unit.

** RS-232C or RS485 is selected by the DIP switches on the card. The RS-232C and RS485 interfaces cannot be used at the same time by a single card. RS485 multidrop is not supported.

Note: If the Omron G7TC-OC16 24V DC type is used, specifications are as follows:

— Coil: rated coil current 21 mA, resistance 1150 Ω.
— Contacts: rated load 5A (resistive load), 2A (inductive load). Electrical life is 1 million operations (at rated load).

Table 6. Thermocouple Type and Conversion Standard Accuracy

| Thermocouple Type | Input Temperature | Accuracy* |
|---|---|---|
| T | -200 to 0°C | ± (1.0 - 0.005 × input temperature)°C |
| | 0 to 350°C | ± 0.5°C |
| J | -100 to 0°C | ± (1.0 - 0.005 × input temperature)°C |
| | 0 to 1100°C | ± 0.5°C |
| E | -200 to 0°C | ± (1.0 - 0.005 × input temperature)°C |
| | 0 to 900°C | ± 0.5°C |
| K | -200 to 0°C | ± (1.0 - 0.005 × input temperature)°C |
| | 0 to 1300°C | ± 0.5°C |
| R | 0 to 400°C | ± 3.0°C |
| | 400 to 1600°C | ± 2.0°C |
| S | 0 to 300°C | ± 3.0°C |
| | 300 to 1700°C | ± 2.0°C |
| R | 0 to 100°C | ± 3.0°C |
| | 100 to 1770°C | ± 2.0°C |

The above precisions do not include cold junction compensation precision (±0.5˚C).

* These figures for accuracy do not include cold junction compensation accuracy.

## ■ Models

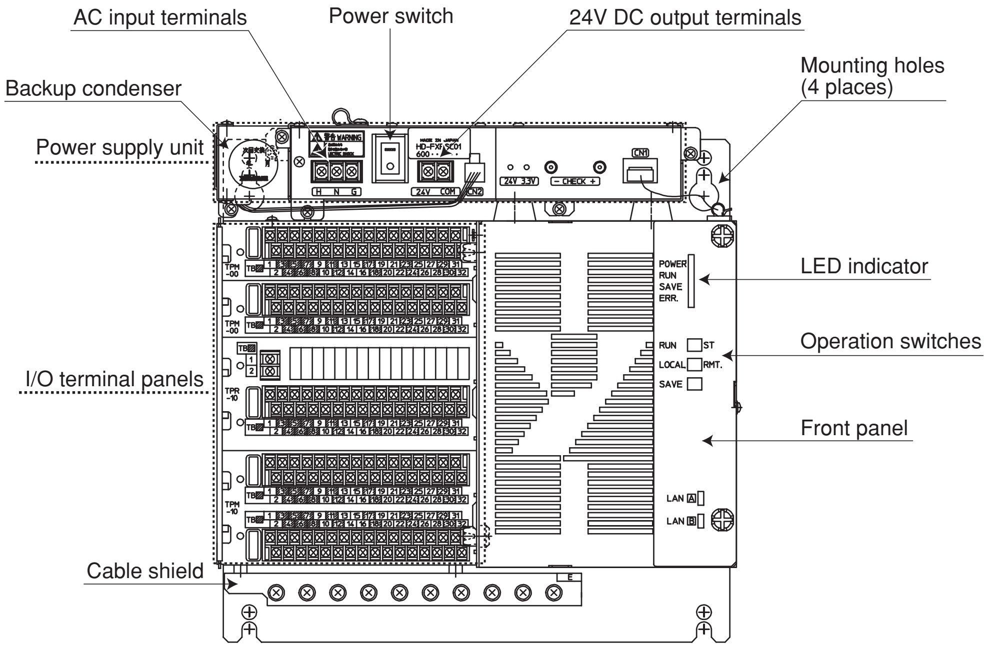
Table 7. List of Models

| Varnish | Model | Description | Remarks |
|---|---|---|---|
| ** | HD-FXFLC24P | Main unit with field power supply | Controller main unit. Select either one. |
| ** | HD-FXFLC24PE | Main unit with field power supply + expansion unit I/F board | |
| | HD-FXSWFLC20 | FLC license | Necessary for each main unit |
| ** | HD-FXFLE20P | Expansion unit with field power supply | Controller expansion unit |
| ** | HD-FXDCBX00 | Expansion unit I/F board (3 ports on the main unit side) | Necessary when connecting an expansion unit to the main unit without an expansion unit I/F |
| | HD-FXEXPNL | Front panel for connecting the expansion unit (a part for the main unit) | |
| | HD-FXCBL01 | Expansion unit connection cable: 1 m | Necessary when using an expansion unit |
| | HD-FXCBL02 | Expansion unit connection cable: 2 m | |
| | HD-FXCBL03 | Expansion unit connection cable: 3 m | |
| ** | HD-FXAIPS10 | Analog input card (with terminals) | Input/output card |
| ** | HD-FXLIPS00 | Thermocouple mV input card (with terminals) | |
| ** | HD-FXRTDPS0 | RTD input card (air conditioning specifications: -20 to 80°C, with terminals) | |
| ** | HD-FXRTDPS1 | RTD input card (free use, with terminals) | |
| ** | HD-FXPIPS00 | Pulse input card (with terminals) | |
| ** | HD-FXAOPS00 | Analog output card (8 I/O points/card with terminals) | |
| ** | HD-FXAOPS10 | Analog output card (4 I/O points/card with terminals) | |
| ** | HD-FXDIPS00 | Digital input card (with terminals) | |
| ** | HD-FXG7IS00 | Digital input card (with terminal panel for connecting to the Omron G7TC) | |
| ** | HD-FXDOPS00 | Digital output card (SS output, with terminals) | |
| ** | HD-FXG7OS00 | Digital output card (with terminal panel for connecting to the Omron G7TC) | |
| ** | HD-FXDYPS00 | Digital output card (with relay terminals) | |
| ** | HD-FXSIPS00ME | Serial communication card (1 port/card, RS232C or RS485) | For communications with a serial communication device |
| | HD-FXG7C10 | G7TC connection cable: 1m | Necessary when using terminal panel for connecting to the Omron G7TC |
| | HD-FXG7C15 | G7TC connection cable: 1.5m | |
| | HD-FXG7C20 | G7TC connection cable: 2m | |
| | HD-FXG7C30 | G7TC connection cable: 3m | |
| | HD-FXG7C50 | G7TC connection cable: 5m | |
| ** | HD-FXESTS00 | Local flat-panel display I/F card | Necessary when connecting to the local flat-panel display |
| | HD-FXSWRTC1E1 | RTC_FLeX, English version for Windows XP, 1 license | |

**For varnish finished products, affix "C" to the end of the model number.

## ■ Component names and functions

The names of each component are given in Figure 4.




Note: Connect the field 24V power supply (2.2A) to the feeder terminal on the specified terminal panel for each I/O module.

**Figure 4. FLC Component Names**

Functions of the LED indicators are as follows:

- POWER: Lit while the power supply of the communication control unit is working normally.
- RUN: Lit while control is being executed.
- SAVE: Lit if the control database is in flash memory. Blinks while saving.
- ERR.: Blinks when an error occurs.

Functions of the operation switches are as follows:

- RUN/STOP: Starts/stops control and puts the system on idle.
- LOCAL/RMT.: Switches to LOCAL control for starting and stopping control with the RUN/STOP switch, and switches to RMT. control when operating through the RTC/local flat-panel display .
- SAVE: To save, move the switch to the left and hold it there until the SAVE LED starts to blink. When the switch is released, it returns to the right.

# 3. Control Functions (Control Points)

Control functions are classified into the following types of control point:

## ■ Regulatory PV Point (RegPV)

Standard I/O processing functions, like industrial unit conversion and alarms, are directly carried out by the above-mentioned I/O monitoring functions. The regulatory PV point performs process variable (PV) calculations and compensation functions. PV processing is accomplished using algorithms such as flow compensation, integration and variable dead time compensation. Detailed configuration possibilities include alarm suppression, signal filtering, and algorithm and calculation formula options. For available algorithms and other supported functions, see Table 8.

**Table 8. Regulatory PV Point Features**

| Available algorithms | Support functions |
|---|---|
| Data acquisition | PV source selection (automatic, manual, substitution) |
| Flow compensation | PV clamping |
| Middle of three | Engineering unit conversion and PV extention range check (sensor failure) |
| High/low/average selector | PV status |
| Summer | PV filtering |
| Totalizer | PV alarming |
| Variable dead time with lead/lag | - Bad PV (sensor failure) |
| General linearization | - PVHI, PVLO |
| Calculator algorithm | - PVHIHI, PVLOLO |
| | - PV rate of change alarm |

## ■ Regulatory Control Point (Reg Ctl)

Regulatory control points are used to carry out the control functions of the FLC. Configuration of the algorithms listed in Table 9 determines the regulatory control point functions. Each algorithm has configurable options, allowing complicated control to be achieved by simple menu selection. Standard functions include initialization and windup protection. Set point lamping (by operator entry of target values and lamp time) is also available.

**Table 9. Regulatory Control Point Features**

| Available algorithms | Support functions |
|---|---|
| PID | Mode/mode attribute |
| PID with feed forward | Red tag |
| PID with external feedback | Initialization |
| Position proportional | Anti-reset windup |
| Ratio control | External mode switching |
| Ramp/soak | Safety shutdown |
| Auto/manual station | Output limit |
| Incremental summing | PV source selection |
| Switch | PV alarming |
| Override selector | - Bad PV (sensor failure) |
| | - PVHI, PVLO |
| | - PVHIHI, PVLOLO |
| | - PV rate of change alarm |

## ■ Digital Composite Point (Dig Comp)

Digital Composite points are multi-input and multi-output points that provide an interface to discrete equipment, like motors, pumps and solenoid valves. Digital Composite points provide interlock processing functions as a standard feature. Dig Comp points can also display interlock states on the screen of a Harmonas-DEO supervisory station. The displayed states have information effective for tracking the cause of the interlock. The local “hand/off/auto” switches generally used for motor driving equipment can also be handled. Figure 5 shows the major parameters related to this type of control point.

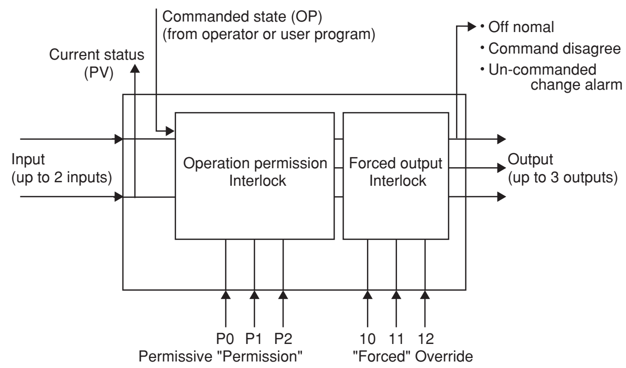



**Figure 5. Structure of Digital Composite Points**

## ■ Logic Point (Logic)

Logic points are used with digital composite points to provide interlock logic functions. A logic point has the processing equivalent of up to two pages of relay ladder logic. A logic point consists of a logic block, flag, numeric value variable, input connection and output connection. There are three possible configurations of logic point inputs, outputs, and logic blocks (see Table 10). In addition to offering logic block functions, logic points can also be used for data transfer. In this role they read data from input connections and transfer it via output connections to the parameters of other defined databases.

**Table 10. Configuration Options for Logic Points**

| Configuration / Type | Input | Output | Logic block |
|---|---|---|---|
| Option 1 | 12 | 4 | 16 |
| Option 2 | 12 | 8 | 8 |
| Option 3 | 12 | 12 | 0 |

Note: Each logic point provides six status flags, six user flags and four numeric value variables.

**Table 11. Logic-Block Algorithms**

| | |
|---|---|
| Logic | AND<br>OR<br>NOT<br>NAND<br>NOR<br>XOR<br>QUALIFIED-OR 2 (2-input majority decision)<br>QUALIFIED-OR 3 (3-input majority decision) |
| Comparison | EQ (= dead band)<br>NE (≠ dead band)<br>GT (> dead band)<br>GE (≥ dead band)<br>LT (≤ dead band)<br>LE (< dead band) |
| Delay | DELAY<br>ON DELAY<br>OFF DELAY |
| Pulse | FIXPLS (fixed length pulse)<br>MAXPLS (maximum time limit pulse)<br>MINPLS (minimum time limit pulse) |
| Watch dog timer | WATCHDOG |
| Flip flop | FLIPFLOP |
| Input error check | CHECKBAD |
| Switch | SWITCH |
| State change detection | CHDETECT |

## ■ Function Block Point (FB)

A function block point offers 91 different types of function blocks (see Table 12) and up to 8191 function blocks can be used in a single point. Function blocks conform to the SAMA (Scientific Apparatus Makers Association) block notation system. The user arranges function blocks in a logic diagram to construct control functions.

**Table 12. Function Block Algorithms**

| | | | | |
|---|---|---|---|---|
| Arithmetic operation (8 types) | ADD (addition) | SUB (subtraction) | MUL (multiplication) | DIV (division) |
| | MOD (modulo) | EXPT (exponent $x^y$) | SUM (4-point addition) | DADD (digital addition) |
| Single number value variable (13 types) | ABS (absolute value) | SQR (square) | SQRT (square root) | LN (logarithm natural) |
| | LOG (customary logarithm) | EXP (exponent $e^x$) | SIN (sine) | COS (cosine) |
| | TAN (tangent) | ATAN (arc tangent) | TRUNC (truncation) | ROUND (rounding) |
| | PSQRT (percent square root) | | | |
| Selection (9 types) | MAX (maximum value) | MIN (minimum value) | AVG (average value) | |
| | HSE (high selector) | LSE (low selector) | MID3 (middle of three) | |
| | SW (switch) | SFT (softening switch) | ALSW (alternate switch) | |
| Detection (12 types) | HLM (high limiter) | LLM (low limiter) | DRL (rate-of-change limiter) | HMS (high monitor) |
| | LMS (low monitor) | DRM (rate-of-change monitor) | DMS (deviation monitor) | NUMCHK (normality check) |
| | BADCHK (badness check) | INFCHK (infinity check) | QLTCHK (change check 1) | CHGCHK (change check 2) |
| Conversion (4 types) | PTE (EU value conversion) | ETP (% conversion) | FUNC (function conversion) | CONV (data type conversion) |
| Logical operation (11 types) | AND (logical product) | OR (logical sum) | NOT (inversion) | NAND (inverted logical product) |
| | NOR (inverted logical sum) | XOR (exclusive logical sum) | QOR2 (2-input majority decision) | SR (set) |
| | RS (reset) | ORIN4 (4-input logical sum) | ANDIN4 (4-input logical product) | |
| Comparison (6 types) | EQ (= dead band) | NE (  dead band) | GT (> dead band) | |
| | GE (  dead band) | LT (< dead band) | LE (  dead band) | |
| Pulse (3 types) | FIXPLS (fixed length pulse) | MAXPLS (max. time limit pulse) | MINPLS (min. time limit pulse) | |
| Timer (5 types) | CYCPLS (timer) | WDT (watchdog timer) | DELAY (delay) | ONDLY (on delay) |
| | OFFDLY (off delay) | | | |
| Counter (4 types) | UCNT (up counter) | DCNT (down counter) | AAV (analog totalizer) | PAV (pulse totalizer) |
| Control operation (8 types) | PID (PID operation) | PRO (proportion) | INT (integration) | DIF (differentiation) |
| | LDLG (lead/lag) | DED (dead time) | TF (filtering time) | DLTPV (speed type PV) |
| Others (8 types) | RMP (ramp) | MAV (moving average) | ANMA (analog memory) | GW (gate way) |
| | SG (single) | FL (flag) | TIMFL (one shot FL) | REDTAG |

## ■ Process Module Data Point (Proc Mod)

Process control often requires flexible control programs that can be used for continuous, batch, or hybrid applications. A process module data point is a user-created program (CL program) written in a special-purpose control language. This language provides powerful sequence control and calculation functions. CL programs can access analog input and output, digital input and output, logic block status, alarm status, failure status, numeric value variables, and flags. Process module data points provide phase, step and statement structures suitable for implementing batch process control functions. They can also activate a sequence for hold, shutdown, or emergency shutdown, making use of the powerful functionality of multilevel error processing.

## ■ Flag Point

Flag points indicate two states, such as on and off, and accept input of Boolean algebra values. Flag points can be changed by operators or user programs. The FLC allows up to 8192 flags, 512 of which support off-normal alarms (a change from steady state generates the alarm).

## ■ Numeric Value Variable Point

Numeric value variable points are variables that save numeric values, which is especially useful for batch (recipe) operations. The FLC has up to 8192 numeric value variable points.

## ■ Timer Point

Timer points are used by both operators and user programs to supervise process events. Timer points are processed once every second. The FLC has 32 available timer points.

# 4. Alarm System Functions

FLC supports a variety of alarm functions. When an alarm occurs, notifications appear at the open supervisory station on various types of screens. Alarms are generally classified as PV alarms or digital alarms.

## ■ PV Alarms

The types of configurable alarm for process variables are listed below. Alarms can be set in both I/O points and control points. In general, if a control point uses an I/O point, the alarm is set in the control point. Otherwise, it is set in the I/O point.

- High
- High high
- Low
- Low low
- Change rate high
- Change rate low
- Significant change

A dead band can be set in all PV alarms mentioned above.

## ■ Digital Alarms

There are three types of digital alarm:

- Off-normal alarm
- Uncommanded change alarm
- Command disagree alarm

Off-normal alarms are activated when the status changes to ON. Both uncommanded change alarms and command disagree alarms are set within digital composite points and detect a disagreement between input and output. A command disagree alarm detects a disagreement between input and output just after an output change, while an uncommanded change alarm detects a disagreement between input and output when no output change has been made. Both alarms can set dead band time.

## ■ Alarm Priority

Alarm priority can be configured for individual alarm types for each point. A choice of seven alarm priorities can be assigned:

- Emergent (emergency)
- Important (high)
- Ordinary (low)
- Journal only
- Only journal printer output (not used when the local flat-panel display is connected)
- Journal recording + printer output (not used when the local flat-panel display is connected)
- None (no action)

## ■ Contact Cutout

The contact cutout function allows a program to temporarily stop an alarm for any point (or all points) having alarm functions. The “CONTCUT” parameter, which is available for points having alarm functions, can be turned on to put points in the alarm stop status.

# 5. Processing Performance

By combining adjustment control loops, logic functions, and sequence and I/O processes, the FLC tailors control functions to fit the needs of specific applications. Configuration needs to take into account restrictions on the maximum number of points per FLC, the processing unit (PU) value, which is a unit of processing capability, and the memory unit (MU) value, which is the permitted memory size for a CL program.

## ■ Maximum Number of Points

Limits on the number of points settable per FLC are as follows.

**Table 13. Maximum Number of Points Per FLC**

| Point type | Maximum number of points |
|---|---|
| Regulatory control | 32 |
| Regulatory PV | 32 |
| Process module | 128 |
| Logic | 64 |
| Digital composite | 256 |
| Function block | 128 |
| Numeric value variable (NN) | 8,192* + 80 × (number of sequences used) |
| Flag variable (FL) | 8,192** + 128 × (number of sequences used) |
| Timer variable (TM) | 32 |
| I/O point | (Number of points per I/O card)×23 |

* 3,000 points are for use by the user, and the rest are reserved for the system.
** 3,000 points (including 512 for alarms) are for use by the user, and the rest are reserved for the system.

## ■ Maximum Number of Blocks

The following restrictions apply to function blocks, which are components of function block points.

**Table 14. Maximum Number of Function Blocks**

| | |
|---|---|
| Per function block point | 2048 blocks |
| Per FLC | 2048 blocks |

## ■ Processing Unit (PU Value)

This unit represents the processing capability of the FLC, based on factors such as the point types and control cycles. The following tables list the maximum PU values per FLC and PU values for various types of points.

**Table 15. Maximum PU Value (Per FLC)**

| Point Type | PU value |
|---|---|
| Total of control points and function blocks and of I/O points | 700 |

**Table 16. PU Values for I/O Points**

| Device | | PU Value | | | |
|---|---|---|---|---|---|
| | | I/O Monitoring Cycle | | | |
| | | 1 s | 0.5 s | 0.2 s | 0.1 s |
| Main unit | 2.0 | -- | | | |
| Expansion unit (per unit) | 4.0 | -- | | | |
| Status input per card (DI) | -- | 0.7 | 1.1 | 2.3 | 4.3 |
| Latch input per card (DI) | -- | 4.0 | 4.0 | 4.0 | 4.0 |
| Integrating input per card (DI) | -- | 4.0 | 4.0 | 4.0 | 4.0 |
| Status output per card (DO) | -- | 0.2 | 0.4 | 1.0 | 2.0 |
| Pulse output per card (DO) | -- | 2.0 | 2.0 | 2.0 | 2.0 |
| Analog input per card (AI) | -- | 1.5 | 2.2 | 4.3 | 7.8 |
| Thermocouple mV input per card | -- | 0.9 | -- | -- | -- |
| RTD input (room temperature) per card | -- | 1.5 | 2.2 | 4.3 | 7.8 |
| RTD input (free range) per card | -- | 0.9 | -- | -- | -- |
| Analog output per card (AO) | -- | 0.3 | 0.6 | 1.5 | 3.0 |
| Pulse input per card (PI) | -- | 1.0 | 1.4 | 2.6 | 4.6 |
| Serial communications per card (SI) | -- | 7.6 | -- | -- | -- |

Note: For AI, the table assumes that two alarms (occurrence or reset) occur once every second in the 4 slots. For DI, it is assumed that one off-normal alarm occurs once every second in the 8 slots.

**Table 17. Control Point and Function Block PU Values**

| Control Point | PU Value (control cycle = 1 s) |
|---|---|
| RegPV | 0.8 |
| RegCtl | 1.1 |
| Logic | 0.7 |
| DigComp | 0.1 |
| ProcMod (short) | 1.0 |
| ProcMod (long) | 2.0 |

| Function Block | 1 s PU Value | Function Block | 1 s PU Value | Function Block | 1 s PU Value |
|---|---|---|---|---|---|
| ADD | 0.024 | LLM | 0.016 | LE | 0.024 |
| SUB | 0.024 | DRL | 0.040 | FIXPLS | 0.024 |
| MUL | 0.024 | HMS | 0.016 | MAXPLS | 0.024 |
| DIV | 0.024 | LMS | 0.016 | MINPLS | 0.024 |
| MOD | 0.020 | DRM | 0.040 | CYCPLS | 0.028 |
| EXPT | 0.024 | DMS | 0.024 | WDT | 0.024 |
| SUM | 0.028 | NUMCHK | 0.016 | DELAY | 0.016 |
| DADD | 0.028 | BADCHK | 0.016 | ONDLY | 0.028 |
| ABS | 0.016 | INFCHK | 0.016 | OFFDLY | 0.028 |
| SQR | 0.016 | QLTCHK | 0.016 | UCNT | 0.020 |
| SQRT | 0.016 | CHGCHK | 0.024 | DCNT | 0.020 |
| LN | 0.024 | PTE | 0.020 | AAV | 0.028 |
| LOG | 0.024 | ETP | 0.020 | PAV | 0.028 |
| EXP | 0.024 | FUNC | 0.028 | PID | 0.076 |
| SIN | 0.024 | CONV | 0.032 | PRO | 0.024 |
| COS | 0.024 | AND | 0.020 | INT | 0.048 |
| TAN | 0.024 | OR | 0.020 | DIF | 0.064 |
| ATAN | 0.024 | NOT | 0.020 | LDLG | 0.040 |
| TRUNC | 0.024 | NAND | 0.020 | DED | 0.036 |
| ROUND | 0.024 | NOR | 0.020 | TF | 0.048 |
| PSQRT | 0.016 | XOR | 0.020 | DLTPV | 0.024 |
| MAX | 0.028 | QOR2 | 0.024 | RMP | 0.032 |
| MIN | 0.028 | SR | 0.020 | MAV | 0.044 |
| AVG | 0.028 | RS | 0.020 | ANMA | 0.028 |
| HSE | 0.024 | ORIN4 | 0.028 | GW | 0.020 |
| LSE | 0.024 | ANDIN4 | 0.028 | SG | 0.016 |
| MID3 | 0.028 | EQ | 0.024 | FL | 0.016 |
| SW | 0.024 | NE | 0.024 | TIMFL | 0.028 |
| SFT | 0.040 | GT | 0.024 | REDTAG | 0.008 |
| ALSW | 0.020 | GE | 0.024 | | |
| HLM | 0.016 | LT | 0.024 | | |

## ■ Memory Unit (MU) Value

The MU value is determined by the total size of the CL programs. It indicates to the user how much FLC memory is available. The MU value tells only the amount of memory used to store the CL programs themselves.

For MU value calculation, a CL program is divided into units of about three statements each. The MU value is then found by the number of units. Each unit is called a CL block, with 1 CL block = 1 MU. The maximum MU value per FLC is 6080.

In contrast to PU values, MU values are not affected by control cycles or the number of I/O points.

## ■ Control Cycles

Control cycles are selectable per FLC from among 1 s, 500 ms, 200 ms and 100 ms (for combinations, see Table 18). Not only the control cycles, but also some of the data points can be processed at high speed (100 ms) by means of the fast scan function.

**Table 18. Combination of Control Cycles**

| SCANRATE Parameter | Point Type | | | |
|---|---|---|---|---|
| | RegcTl, RegPV | Logic, DigComp | PromMod | FB |
| Reg1 Log1 | 1 s | 1 s | 1 s | Selection of the following control cycles per point<br>・1 s<br>・500 ms<br>・200 ms<br>・100 ms |
| Reg1 Log2 | 1 s | 500 ms | 1 s | |
| Reg1 Log5 | 1 s | 200 ms | 1 s | |
| Reg1 Log10 | 1 s | 100 ms | 1 s | |
| Reg2 Log2 | 500 ms | 500 ms | 1 s | |
| Reg2 Log5 | 500 ms | 200 ms | 1 s | |
| Reg2 Log10 | 500 ms | 100 ms | 1 s | |
| Reg5 Log5 | 200 ms | 200 ms | 1 s | |
| Reg5 Log10 | 200 ms | 100 ms | 1 s | |
| Reg10 Log10 | 100 ms | 100 ms | 1 s | |
| Fast scan | 100 ms | 100 ms | 100 ms | |

# 6. Smart Debugging

The smart debug function can check operations of various control functions and I/O processing functions provided by the FLC without using I/O modules.

This function can be carried out for individual FLCs. After the transition to the debug mode, the function neither receives input from I/O modules nor transmits output to I/O modules, except for performing controlling operations within FLC and I/O processing operations.

Users can set any desired values on the FLC as virtual process data, making the debugging of CL programs, etc., easy. Users can also operate and supervise the status of the debug mode on the Harmonas-DEO supervisory station.

# 7. Restart

## 7.1 Warm Restart

The FLC restarts operation based on data from the flash memory on the control card (CTC) at the time of normal restart. It is designed so that, at restart, the necessary startup operations are minimized, while the status of the process is maintained. The control loop sending output to the field is switched to manual mode, and user program sequence can be selected from among automatic start from the beginning, stop at the first step, or stop at the last execution position.

Saving data to flash memory can be done manually with switches on the front panel of the controller or on the local flat-panel display.

## 7.2 Hot Restart

This type of restart is intended for automatic recovery from momentary interruption and resumes control with the database contents immediately before the momentary interruption kept intact. For hot restart to be executed, the automatic data save function must be configured in advance.

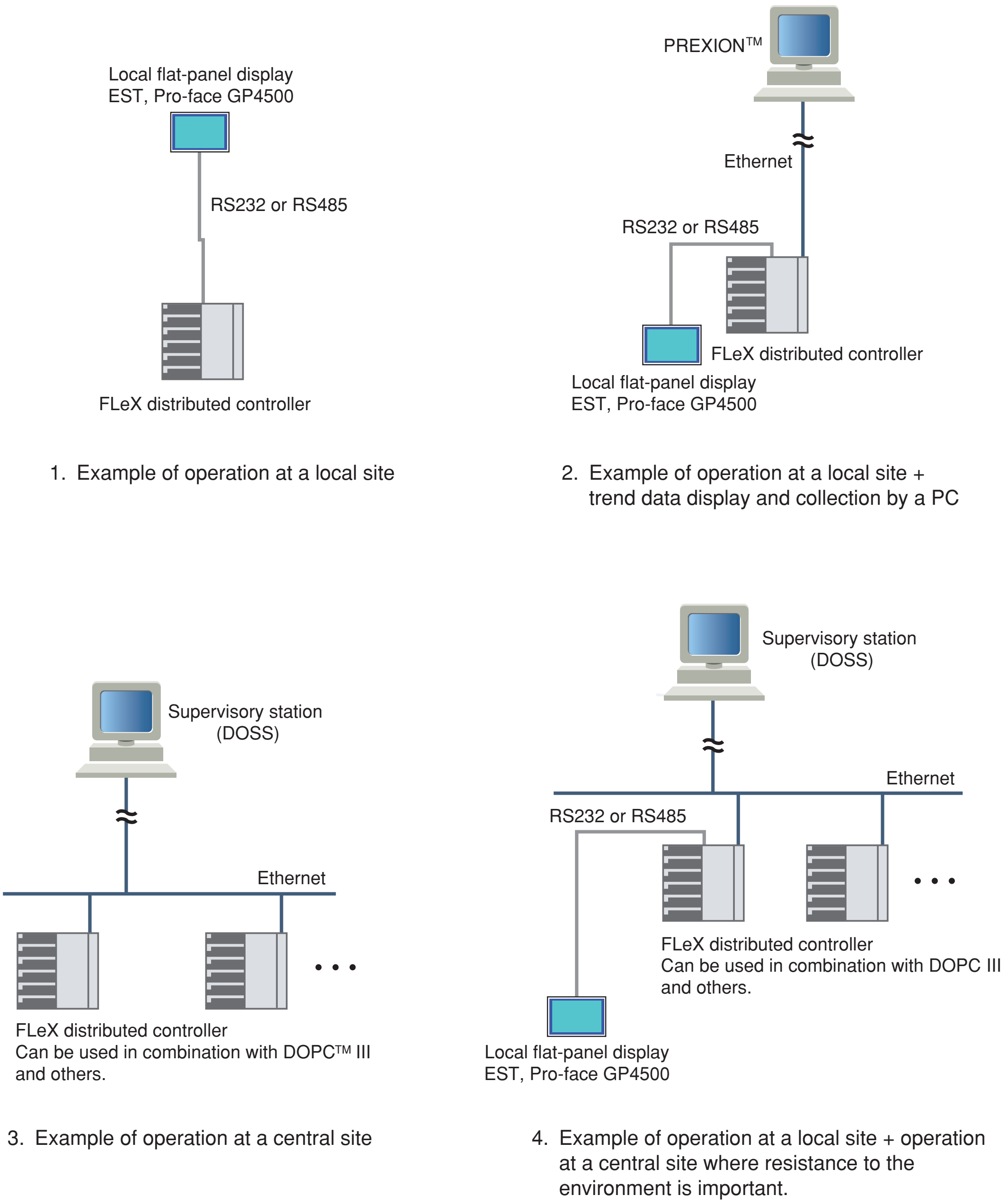



**Figure 6. System Architecture**

# 8. Connection of Expansion Units

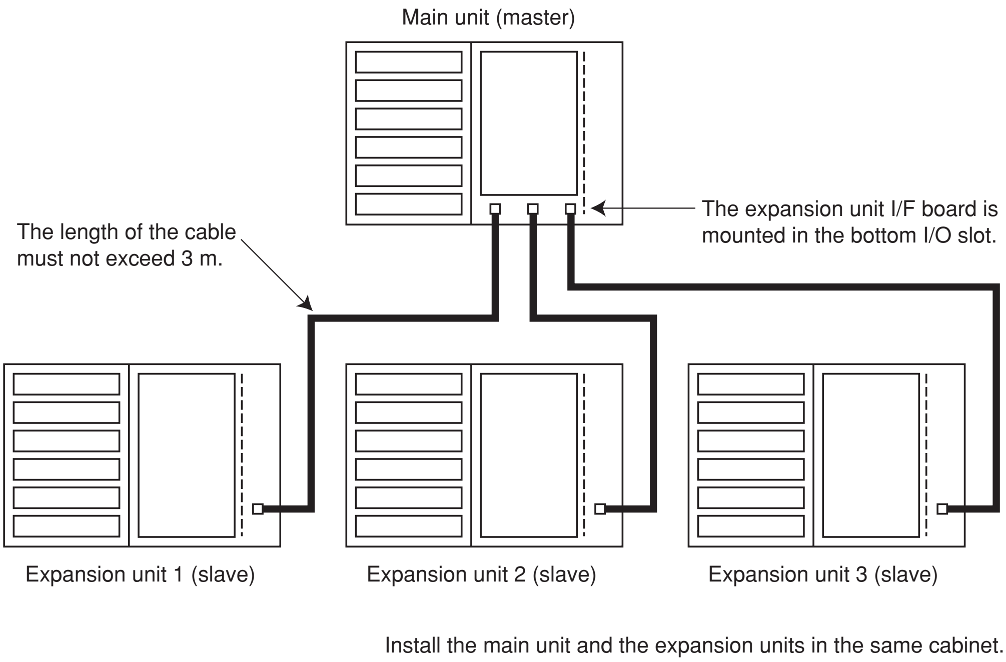



**Figure 7. Diagram for Connection of Expansion Units**

# 9. Dimensions

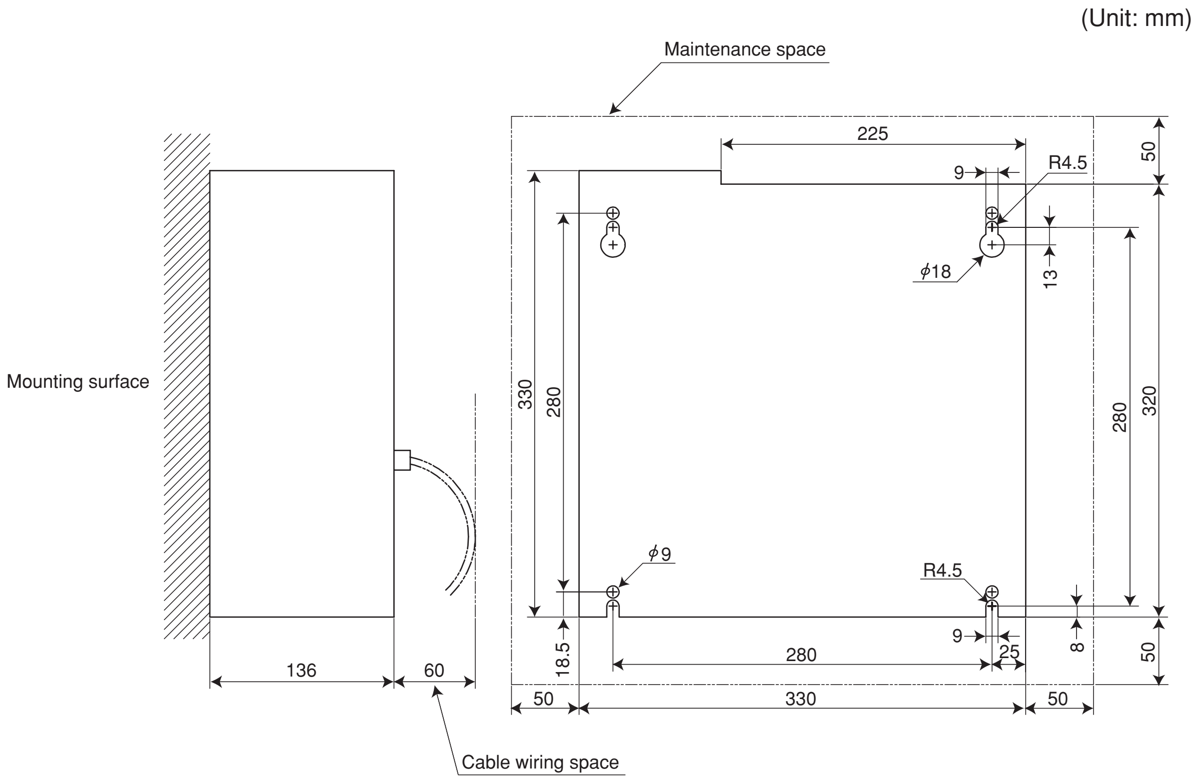



**Figure 8. FLC Outer Dimensions**

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