FX05 Controller

The FX05 is a high performance controller specifically designed for single compressor chillers and heat pumps. It includes all the functions usually provided by additional devices such as timers, end-of-defrost thermostats, etc.
Now they all are in a single device and this implies very easy wiring and limited cost of installation.

Moreover the controller is fully programmable, thanks to the FX Tools software, and can virtually adapt to any application, provided the right number of inputs and outputs is available.

Optionally the FX05 can be fitted with a serial communication card to be compatible with the LON and N2Open BAS systems.

A Real Time Clock card is also available for energy saving and better management of the application.

FX05 Controller

Features and Benefits	
❑ **LON and N2Open plug-in comm. cards (option)**	Compatible with standard BAS protocols
❑ **Real Time Clock (option)**	Real Time Scheduling of Control activities
❑ **Freely programmable**	Adaptable to any application
❑ **A99, PT1000 or NTC analog inputs**	Wide range of sensor input available
❑ **Optional input converting modules**	For the added possibility to use active sensors
❑ **Several digital output configurations**	For added flexibility
❑ **Built-in LED User Interface**	User friendliness

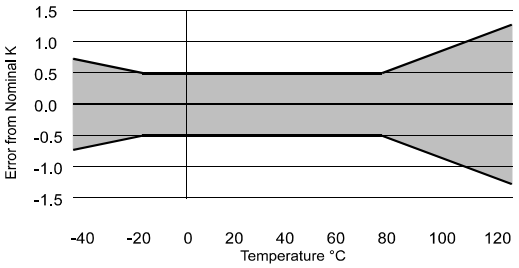
General features

Input/Output

- 4 analogue inputs (AI)
- 5 digital inputs (DI)
- 6 digital outputs (DO)
- 1 analogue output 0…10Vdc (AO)

Sensor Input

This series of controllers uses Johnson Controls A99 temperature sensor. Its accuracy is within 0.5°C between -15 and 75°C. Its tolerance increases with temperatures outside this range, as shown below.



Its gas tight packaging (IP68) makes it the best sensor for refrigeration applications. For details please refer to A99 documentation. Additionally the analog inputs can also be factory configured as PT1000 or NTC (K10) for increased flexibility.

Built-in User Interface

Easy to use display:

- 3x7 segments red LEDs
- 3 Status LEDs
- 4 Keys
- Easy to navigate Menu

And, according to the loaded application:

- Display of status information
- Display and modification of Set-points
- Display of configuration parameters
- Display of active alarms

Communication Interface (option)

The FX05 can be integrated in supervisory systems thanks to plug-in communication cards. Several cards are available depending on the supported protocol: LON or N2Open.

Real Time Clock (option)

This Plug-in card allows introducing functions based on a weekly time schedule.

Software and Software and configuration

The FX05 is fully programmable with the Johnson Controls FX-Tools configuration software.

The configuration is object oriented and free from any programming language. Several object libraries are available to quickly develop and/or customise an application.
The software will be available under a license fee and will allow the full configuration of the control strategy and display application. The software package can also be tested and evaluated in demo version.
The demo version is a full functioning version, i.e. it allows the complete use and testing of the full software package but it will only allow downloading the developed strategy to a demo case or to a demo controller (see ordering codes).

WARNING

Shock Hazard

When servicing make sure that:

- **The electrical supply to the controller is switched off to avoid possible damage to the equipment, personal injury or shock.**
- **You do not touch or attempt to connect or disconnect wires**

I/O Details

Controller Model		Type	Remark/Application
Analog Input (AI)			
FX05P00	AI1 ÷ AI4	**PT1000** Range: -40 to 100°C Accuracy: ±0.3°C @ 20°C ambient (sensor error not included)	Application: temperature.
FX05P01	AI1, AI2, AI3, AI4	**A99** Range: -40 to 100°C Accuracy: ±0.3°C @ 20°C ambient (sensor error not included)	Application: temperature. Humidity, pressure, etc. through Input Converter
FX05P02 / P03	AI1, AI2, AI3	**A99** Range: -40 to 100°C Accuracy: ±0.3°C @ 20°C ambient (sensor error not included)	Application: temperature. Humidity, pressure, etc. through Input Converter
	AI4	**NTC** K10 Range: 0 to 100°C Accuracy: ±0.5°C @ 20°C ambient	For the Fan Speed control signal coming from the Room Command Module
Digital Input (DI)			
FX05P01 / P02 / P03	DI1, DI2, DI3, DI4, DI5	Voltage free contacts	
Digital Output (DO)			
FX05P00 / 01	DO1	SPST 5A, 250 VAC power relay	Double insulated from the other relay group. Application: alarm output, etc
	DO2 ÷ DO6	SPST 5A, 250 VAC power relay	Any combination of loads must not exceed 15A in total (the "commons" pins are internally connected). Max. 5A on C2/3 Max. 5A on C4/5 Max. 5A on C6
FX05P02 / P03	DO1, DO2,	0,5A / 24 VAC triacs	3-point valves, thermal actuators, etc
	DO3 ÷ DO6	SPST 5A, 250 VAC power relay	On the **P02 model** the DO3 ÷ DO5 relays are physically interlocked, i.e. one cannot be energised if the other two aren't off. Application: 3-speed fan motors. The DO6 relay is free. On the **P03 model** all relays are freely usable. Max. 5A on C3, C4, C5 and C6 Any combination of loads must not exceed 15A in total
Analogue Outputs (AO)			
FX05P00 / P01 / P02 / P03	AO1	0…10 VDC	Application: drive motor actuators, power triacs, frequency drives, etc.

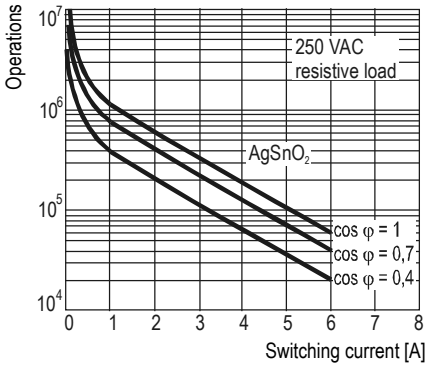
Relay Characteristics

Model: SCHRACK V23092-A1012-A302
DO2 ÷ DO6 on FX05P00 / P01
DO3 ÷ DO6 on FX05P02 / P03

Contact data	
Configuration	**1 N/O contact**
Rated current	6A
Rated voltage / max. breaking voltage AC	250 VAC / 440 VAC
Maximum breaking capacity AC	1500 VA

Contact Ratings		
Type	**Load**	**Operations**
A302	5 A, 250 VAC resistive	1x10 5
A302	2 A, 250 VAC, cosφ0.4	2x10 5
A302	1 A, 24 VDC, L / R=48 ms	2x10 5

Electrical endurance

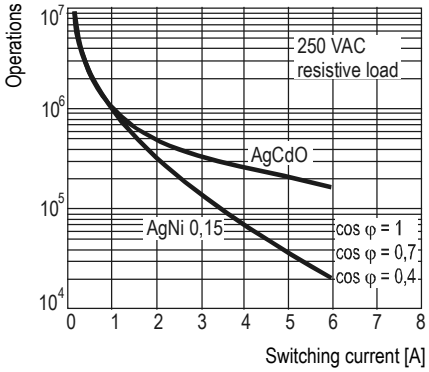


Model: SCHRACK RE030012
DO1 on FX05P00 / 01

Contact data	
Configuration	**1 N/O contact**
Rated current	6A
Rated voltage / max. breaking voltage AC	250 VAC / 440 VAC
Maximum breaking capacity AC	1500 VA
Contact material	AgCdO

Contact Ratings		
Type	**Load**	**Operations**
RE 030	2 A, 400 VAC, AC 11	2x10 5 VDE 0660
RE 030	2 A, 250 VAC, AC 11	4x10 5 VDE 0660
RE 030	0.33 A, 250 VAC, AC 11	5x10 6 VDE 0660
RE 030	1/8hp, 120 VAC	3x10 4 UL 508
RE 030	1/4hp, 240 VAC	3x10 4 UL 508
RE 030	B 300	UL 508
RE 030	6 A, 30 VDC, resistive	5x10 5
RE 030	0.3 A, 50 VDC, L/R=40 ms	3x10 6
RE 030	6 (3) A, 250 VAC	1x10 5 VDE 0631

Electrical endurance



Accessories

Different accessories are available for the FX05.

Item Code	Description
LP-RTC05-000C	Real Time Clock plug-in card
LP-NET051-000C	N2Open communication card
LP-NET052-000C	LON communication card on-field commissioning
LP-NET052-850C	LON communication card 850/851 applications profile
LP-NET052-852C	LON communication card 852/853 applications profile
LP-KIT001-000C	Input Converter module: active input (4-20 mA) to A99
LP-KIT002-000C	Input Converter module: active input (ratiometric) to A99
LP-KIT004-000C	Input Converter module: active input (0-10 V) to A99
LP-KIT005-000C	Pre-crimped set of cables and female connectors for number 5 FX05 controllers
LP-KIT006-000C	Room Command Module for FX05 (triac + relay version) with +/- 3K setpoint dial, fan speed slide, occupancy button, A99 room sensor.
LP-KIT006-001C	Room Command Module for FX05 with 12-28°C setpoint dial and A99 room sensor.
LP-KIT006-002C	Room Command Module for FX05 with 12-28°C setpoint dial, A99 room sensor and occupancy button.
DEMO-FX05-001	Demo case for FX05 with LON communication card pre-assembled, 230V
DEMO-FX05-010	Demo case for FX05 with N2Open communication card pre-assembled, 120V
DEMO-FX05-011	Demo case for FX05 with LON communication card pre-assembled, 120V
LP-FX05DEM-000C	FX05, all relay version, DEMO ID
LP-FX05DEM-001C	FX05, relay + triac version, DEMO ID
U215LR-9110	Condenser fan speed controller single-phase, 3Amps

Sensors

Item Code	Description
A99 series	Recalibrated PTC temperature sensor -40…+100°C

WARNING

Shock Hazard

When servicing make sure that:

- **The electrical supply to the controller is switched off to avoid possible damage to the equipment, personal injury or shock.**
- **You do not touch or attempt to connect or disconnect wires when electric power is on.**

Ordering data

LP-FX05P □□-□□□ **C**

Software application

- **000** Application – less model (Object List 000)
- **001** Application – less model (Object List 001)
- **850** Air/water chiller
- **851** Air/water chiller/HP
- **852** Water/water chiller
- **853** Water/water chiller/HP

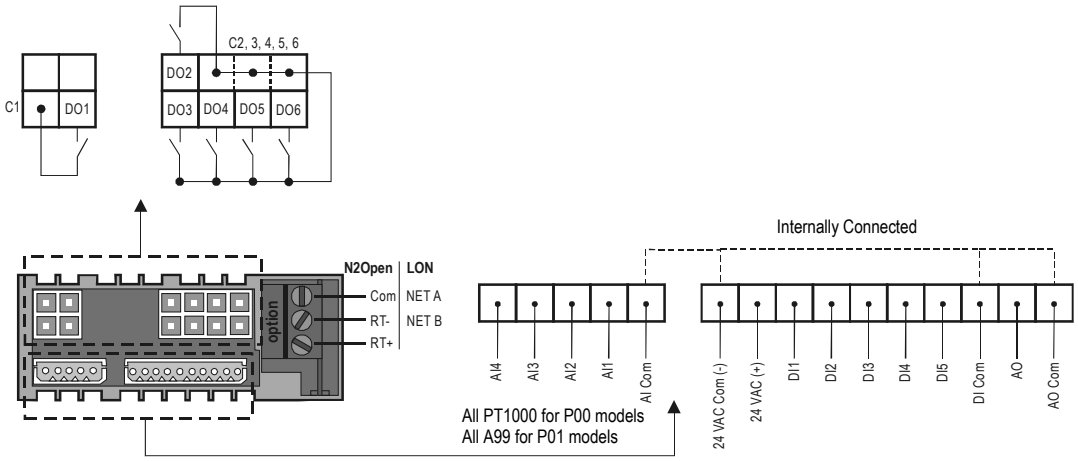
Hardware type

- **00** Standard model, 6 relay outputs, all PT1000 inputs
- **01** Standard model, 6 relay outputs, all A99 inputs
- **02** 2 triacs, 3 interlocked relays + 1 free relay, 3 A99 + 1 NTC inputs
- **03** 2 triacs, 4 free relays, 3 A99 + 1 NTC inputs

General Wiring Diagram

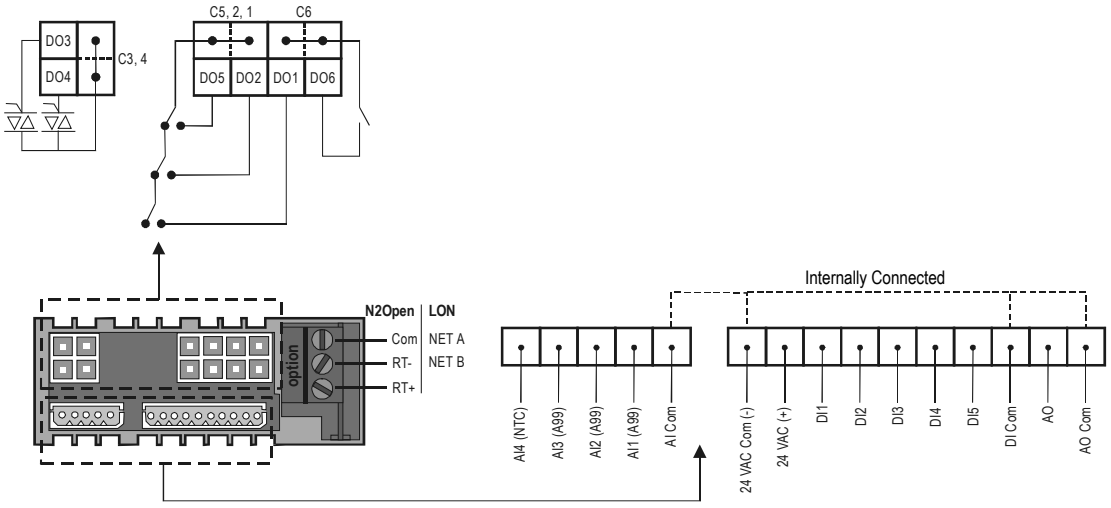
In accordance to EN 60730 the FX05 is an incorporated electronic controller of type 1B action.

LP-FX05P00-xxx and LP-FX05P01-xxx models



FX05-001_10 2002

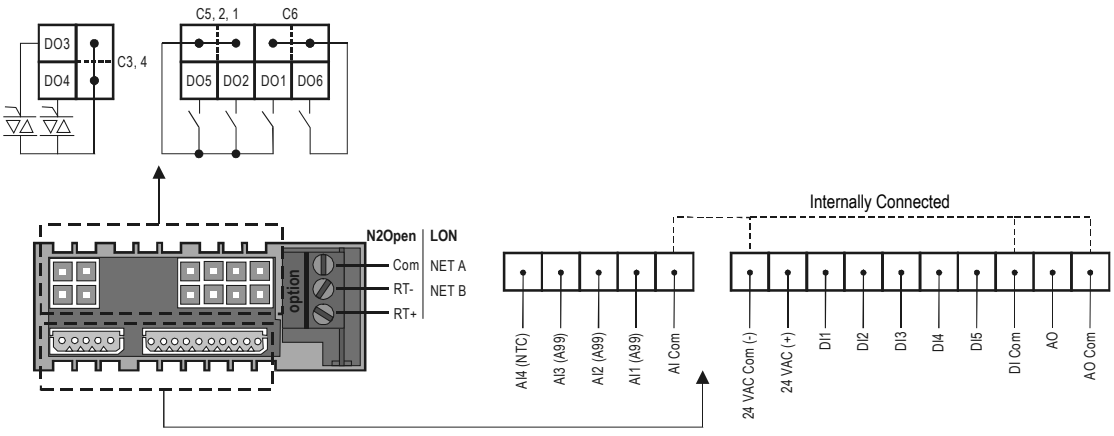
LP-FX05P02-xxx



FX05-002_10 2002

AI: Analog Input; **AO**: Analog Output; **DI**: Digital Input; **DO**: Digital Output

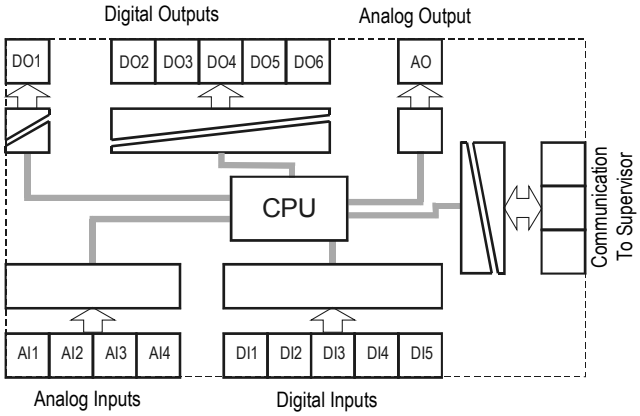
LP-FX05P03-xxx



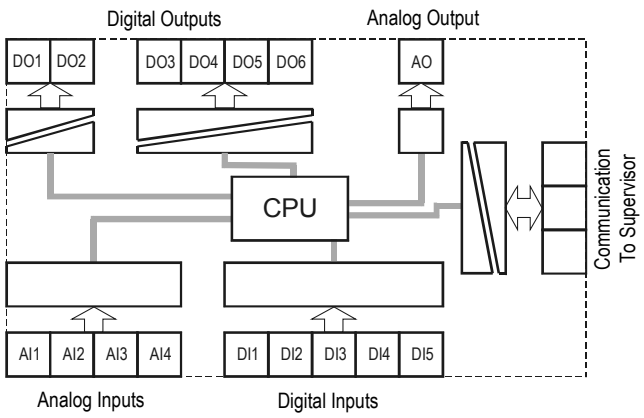
FX05-003_10 2002

Insulation Diagram

In relation to the CPU the insulation of the several I/Os is represented in the diagrams below:



P00 / P01 models



P02 / P03 models

N2Open Serial Card

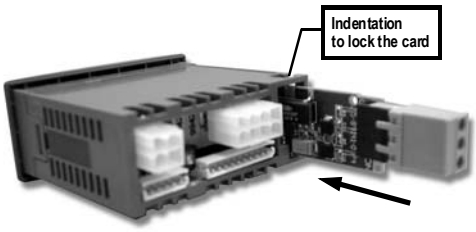


Figure 1: Card Insertion

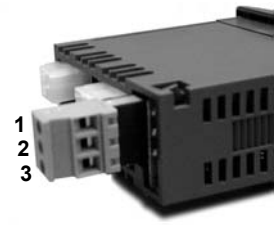


Figure 2: Wiring

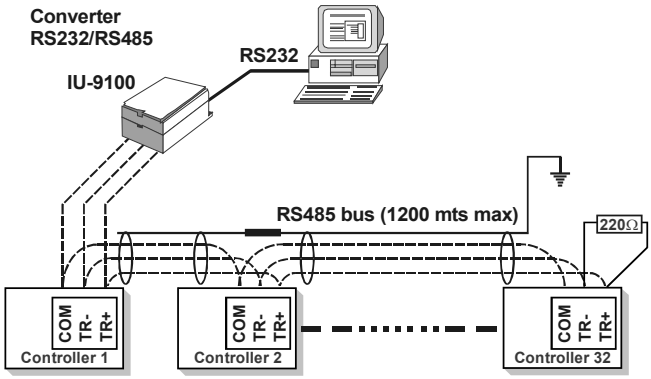


Figure 3: Network Layout

The N2Open serial card is a plug-in, optional card, that allows the controllers of the FX05 line to be connected in a N2Open serial network through the RS485 standard.

Card Insertion

Remove the plastic part on the back of the controller and insert the card until it is fully in and securely locked by the small indentation present on the top of the plastic box **(Figure 1)**.

Wiring

The connection to the network is made by means of the 3 pins on the plug-in connector **(Figure 2)**.
The meaning of each pin is as follows:

Pin	RS485
1	COM
2	RT-
3	RT+

The network cable must be laid along a low voltage cable path. It must be placed at least at 30 cm from cables carrying high voltages or currents (>230V or >30A). If strong interference fields are expected, the cable must be located at the greatest distance possible from the source. The communication line must be laid out on the multi-drop line principle, i.e. from one controller to the next until the last controller has been connected. The line must be terminated at both ends with a 220 Ohm resistor between RT+ and RT- **(Figure 3)**.

RS485 line: maximum length without repeater: 1200 mts, AWG26 twisted pair with shield.

RS232C line: maximum length: 10 mts.

Devices: maximum of 32 per 1200 mts bus segment.

LON Serial Card

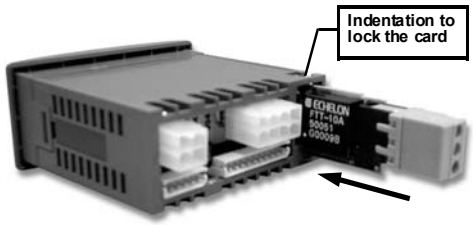
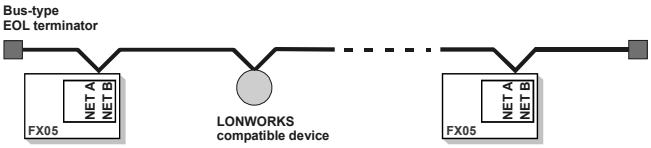
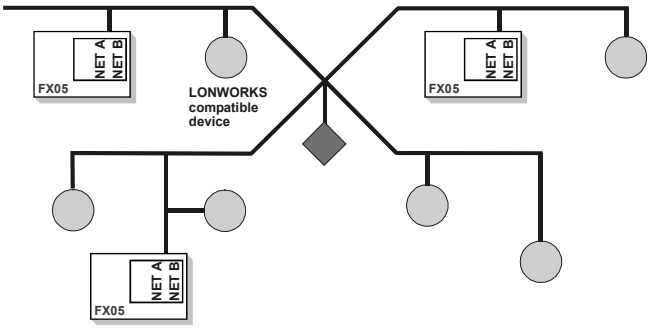


Figure 1: Insertion Card

Figure 2: Wiring



Daisy-chained bus topology layout



Free topology layout

The LON Serial Card is a plug-in, optional card, that allows the controllers of the FX05 / MR40 line to be connected in a LON network.

Card Insertion (Figure 1)

Remove the plastic part on the back of the controller and insert the card until it is fully in and securely locked by the small indentation present on the top of the plastic box.

Wiring (Figure 2)

The connection to the network is made by means of the 3 pins on the plug-in connector. The meaning of each pin is as follows:

Pin	Twisted pair
1	NET A
2	NET B
3	COM

The network cable must be laid along a low voltage cable path. It must be placed at least at 30 cm from cables carrying high voltages or currents (>230V or >30A). If strong interference fields are expected, the cable must be located at the greatest distance possible from the source. The TP/FT-10 network is designed to support free topology wiring, and will accommodate bus, star, loop or any combination of these topologies. FTT-10A transceivers can be located at any point along the network wiring.

LON network: Doubly-Terminated Bus Topology
Free topology (single terminator required).

Nodes: 64 (if repeaters are not used), FTT-10 nodes only.

Cable type	Length with FTT-10 devices	
	Bus topology	**Free topology**
Belden 85102	2700 m	500 m
Belden 8471	2700 m	500 m
Level IV 22 AWG	1400 m	400 m

Power link topology supported.

4 - 20 mA to A99 Input Converter Module

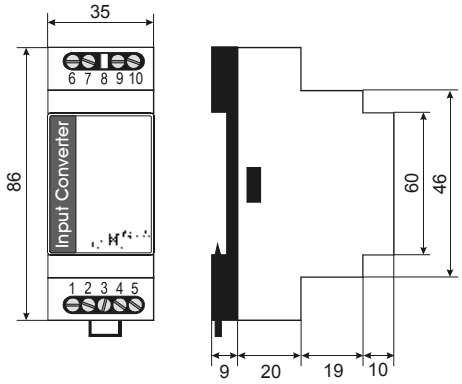


Figure 1: Dimensions

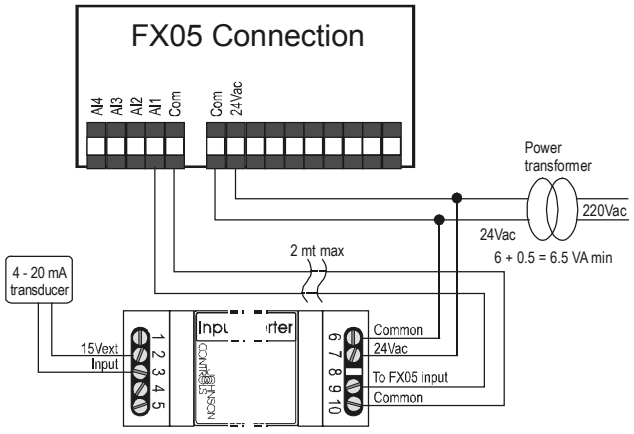


Figure 2: Wiring

The Input Converter Module allows to connect an active 4 - 20 mA signal to an A99 resistive input of the FX controllers.

Wiring (Figure 2)

The connection between an FX05 and a Input Converter Module is shown in figure 2. Make sure to respect polarities in connecting the

24 Vac power supply. The Input Converter Module can be connected indifferently to any analog input of the FX controllers, the software has to be configured accordingly.

For the right connection please follow the table below:

PIN	Meaning
1	Not connected
2	+15 VDC (±0.75V) sensor power supply
3	Signal input (max allowed level 30 mA)
4	Not connected
5	Not connected
6	24 VAC Common
7	24 VAC power supply
9	To FX05 A99 input (max 2 mt)
10	To FX05 A99 Common (max 2 mt)

The same transformer should be used to power both controller and converter. In any case make sure to respect power supply polarities.

Ratiometric to A99 Input Converter

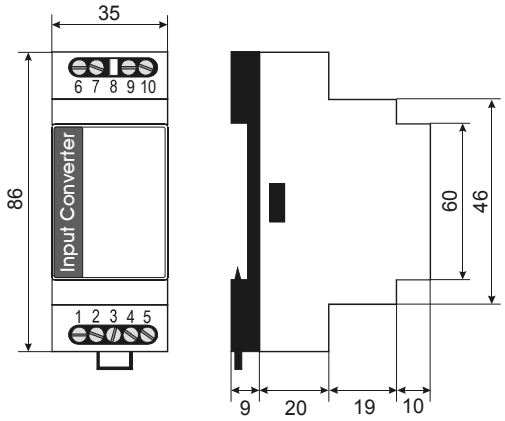


Figure 1: Dimensions

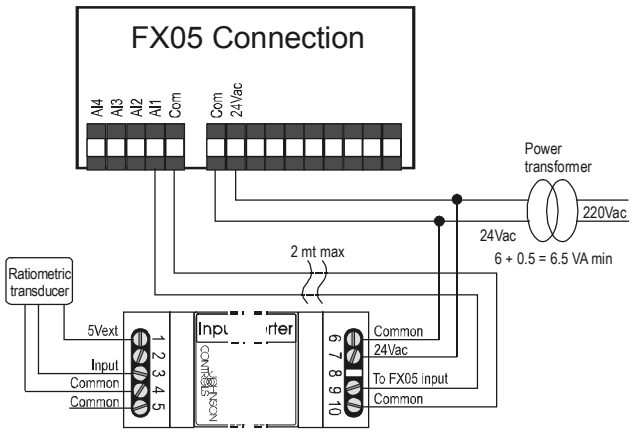


Figure 2: Wiring

The Input Converter Module allows to connect a ratiometric signal to an A99 resistive input of the FX controllers.

Wiring (Figure 2)

The connection between an FX05 and an Input Converter Module is shown in figure 2. Make sure to respect polarities in connecting the 24 VAC power supply. The Input Converter Module can be connected indifferently to any analog input of the FX controllers, the software has to be configured accordingly.
For the right connection please follow the table below:

PIN	Meaning
1	+5 VDC (± 0.5 V; 25 mA max) sensor power supply
2	Not connected
3	Signal input
4	Signal Common
5	Signal Common
6	24 VAC Common
7	24 VAC power supply
9	To FX A99 input (max 2 mt)
10	To FX A99 Common (max 2 mt)

The same transformer should be used to power both controller and converter. In any case make sure to respect power supply polarities.

0 - 10V to A99 Input Converter Module

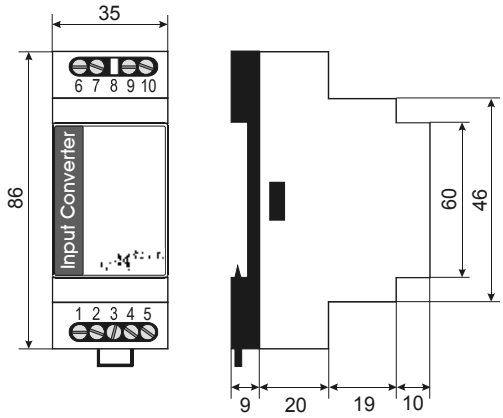


Figure 1: Dimensions

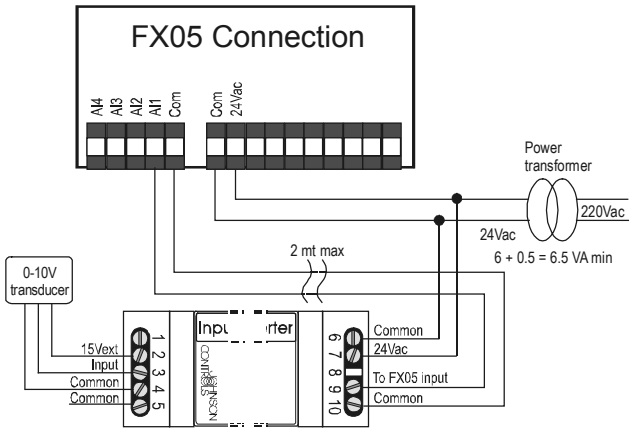


Figure 3: Wiring

The Input Converter Module allows to connect an active 0 - 10V signal to an A99 resistive input of the FX controllers.

Wiring (Figure 2)

The connection between an FX05 and a Input Converter Module is shown in figure 2. Make sure to respect polarities in connecting the 24 Vac power supply. The Input Converter Module can be connected indifferently to any analog input of the FX controllers, the software has to be configured accordingly.

For the right connection please follow the table below:

PIN	Meaning
1	Not connected
2	+15 VDC (± 0.75V, 25 mA max) sensor supply
3	Signal input
4	Signal Common
5	Signal Common
6	24 VAC Common
7	24 VAC power supply
9	To FX A99 input (max 2 mt)
10	To FX A99 Common (max 2 mt)

The same transformer should be used to power both controller and converter. In any case make sure to respect power supply polarities.

LP-KIT006-xxx - Room Command Module Connection

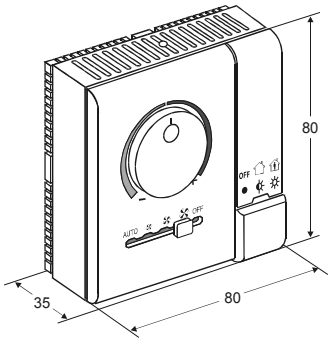


Figure 1: Dimensions *(mm)*

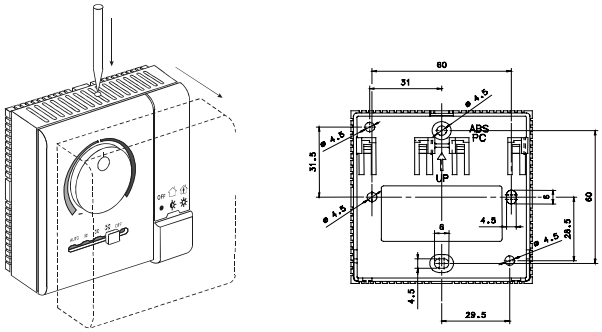


Figure 2: Mounting

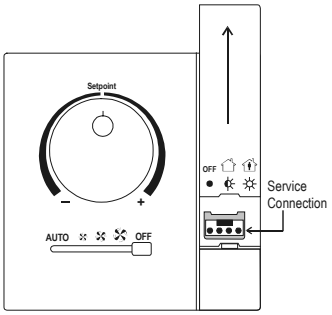


Figure 3: Connection to the serial interface

The LP-KIT006-xxx series of Room Command Modules are designed for use with the FX05 Controllers. The setpoint dial enables the room occupant to adjust the working sepoint of the controller within the range of 12 to 28 °C or -3 to +3 K, according to the model number.
The occupancy button enables the occupant to change the mode of operation of the controller from “COMFORT” to “STANDBY”.
The current operating mode is shown by an LED indicator. For Fan Coil Unit controllers, a Room Command Module with a three-speed fan override adjuster is available.

Occupancy push button with LED indicator

	LED on	Comfort (Occupied) mode	
	LED blinking	Stand-by (Economy) mode	
	LED off	Off	

Override for fan speed control

AUTO	Automatic
OFF	OFF
	Low fan speed
	Medium fan speed
	High fan speed

Mounting (Figure 2)

The LP-KIT006-xxx Series Room Command Module is designed for wall mounting in the room to be controlled. It should be located where the occupant can easily read and adjust the set point dial or fan speed override adjust. If the module has an A99 temperature sensor, it should be placed where the temperature is representative of the general room conditions. Cold or warm air draughts, radiant heat and direct sunlight should be avoided. The installation of electrical wiring must conform to local codes and should be carried out by authorized personnel only. Users should ensure that all Johnson Controls products are used safely and without risk to health or property. Remove the base of the module from the cover by inserting a pointed tool (a special tool, Ordering Code TM-9100-8900, is available from Johnson Controls) into the small hole at the center top of the cover. While pressing down gently, prise the base away from the cover. As the two parts separate, remove the tool and continue to pull the cover away from the base until the cover is free. Mount the base on the wall to cover the electrical output and secure with at least two screws.

Wiring (Figure 3, 4, 5, 6)

Before connecting or disconnecting any wires, ensure that all power supplies have been switched off and all wires are potential-free to prevent equipment damage and avoid electrical shock. Terminations are made on the terminal blocks in the base of the module, which accept up to 1.5 mm^2 (AWG 16) wires. Follow the wiring diagrams shown in figures 4, 5 and 6. All wiring to the module is at extra low (safe) voltage and must be separated from power line voltage wiring. Do not run wiring close to transformers or high frequency generating equipment. Complete and verify all wiring connections before applying power to the controller to which the module is connected. The serial connection through the service connector pins under the lateral cover (Figure 3) is available if the optional serial card (N2Open or LON) is inserted in the FX05 and properly connected to the TM pins 10, 11, 12.

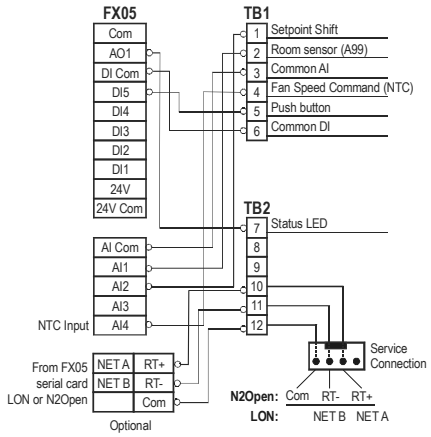


Figure 4: Wiring for KIT006-000

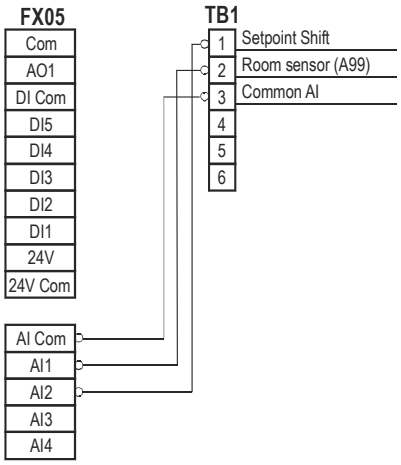


Figure 5: Wiring for KIT006-001

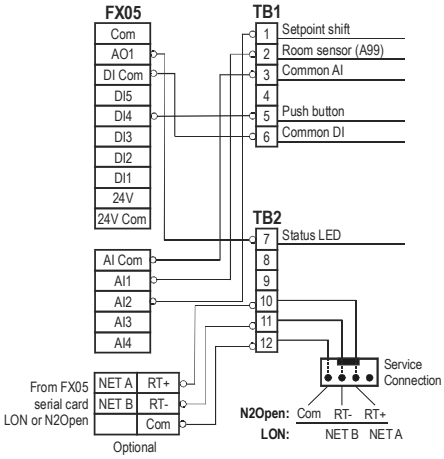


Figure 6: Wiring for KIT006-002

Software Details

The FX05 controller is a fully programmable controller of the FX family. The tools that allows programming, testing and downloading the FX controllers are the FX-Tools.

The FX05 comes application-less or with a standard JCI application already pre-loaded.

The application building philosophy is based on the object structure: basic blocks of basic functions that inter-connected among them build the application.

The object list available in a controller is specified by the code extension after the dash.

Example:

LP-FX05P01-**000**C
(it's an FX05 with the 000 object list)

For the development of an application, maximum 120 instances of the objects available in the chosen list, can be used.

The devices to be used in the AppMaker to program the controllers are:

Device	Models	Object List
FX05P00	LP-FX05P00-xxx	000FX05BL
FX05P01	LP-FX05P01-xxx	000FX05BL
FX05P02	LP-FX05P02-xxx	001FX05BL
FX05P03	LP-FX05P03-xxx	001FX05BL

Object Lists

000FX05BL – General purpose list
Each object performs a basic function

Inputs: Analog Input, Digital Input

Outputs: Analog Output, On/Off Output, Hermetic Compressor

Control/Alarm Functions

- On/Off Controller
- PI
- Manual Reset Binary Alarm
- Analog Alarm

Numeric/Logic Functions

- Calculator
- Integrator
- Selector
- Span
- Timer
- And
- Or
- PLC
- Enumeration Override

Unit Conversion

- Convert
- Enumeration to logic
- HVAC_Generator_Status
- Switch to logic
- UNVT_logic to SNVT_state

Specials

- System Resources
- Time Scheduler
- General Setpoint
- Time Counter

Max number of **executabl**e objects: **120**

001FX05BL – Comfort application object list
Each object performs a basic function

Inputs

- Analog Input
- Digital Input

Outputs

- Analog Output
- On/Off Output
- Hermetic Compressor

Control/Alarm Functions

- On/Off Controller
- PI
- Manual Reset Binary Alarm
- Analog Alarm

Numeric/Logic Functions

- Calculator
- Integrator
- Selector
- Span
- Timer
- And
- Or
- PLC
- Enumeration Override

Unit Conversion

- Convert
- Enumeration to logic
- HVAC_Generator_Status
- Switch to logic
- UNVT_logic to SNVT_state

Specials

- System Resources
- Time Scheduler
- General Setpoint
- Time Counter

Max number of **executable** objects: **120**

Application Coding

Standard JCI applications are build by Johnson Controls application engineers. Standard applications come pre-loaded in the controller or in a library CD and downloaded in the field.

The application code, as for example the compressor chiller / HP one, **851FX0501-000BL**, contains in itself all the information to select the target controller:

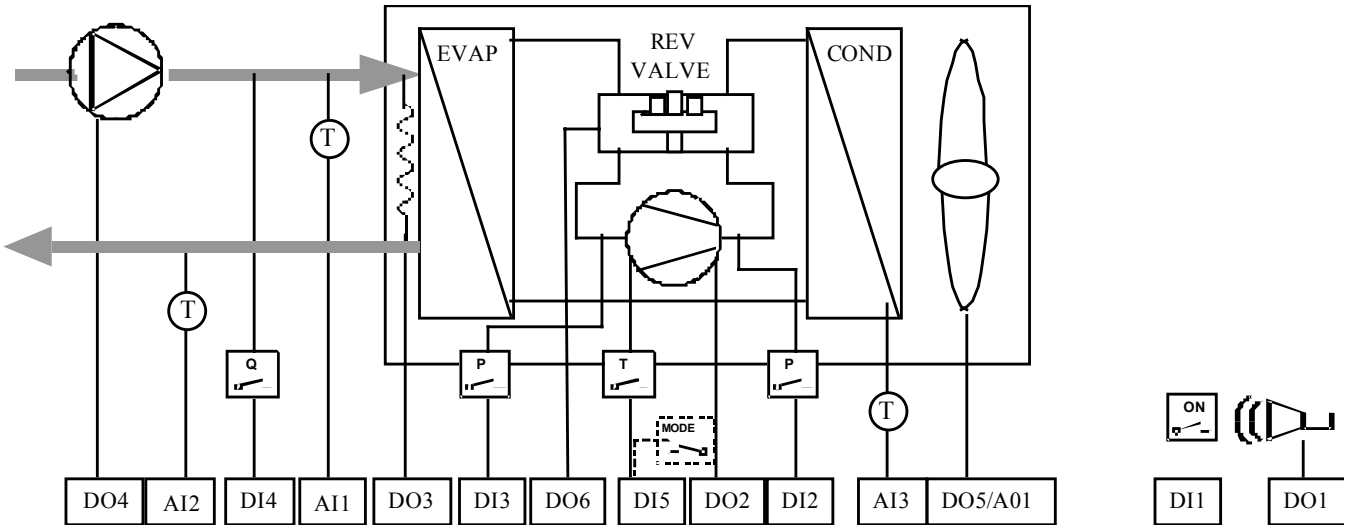
- **851:** application code number;
- **FX05:** target controller family;
- **01:** minimum hardware configuration required, see ordering codes;
- **000:** target object list
- **B:** FX05 standard version
- **L:** built-in display supported.

If the application is pre-loaded, the controller code will take the extension that specify the application itself.

Example:

LP-F05P01-**851**C is an FX05 with the **851**FX0501-000BL application pre-loaded.

Application example 851

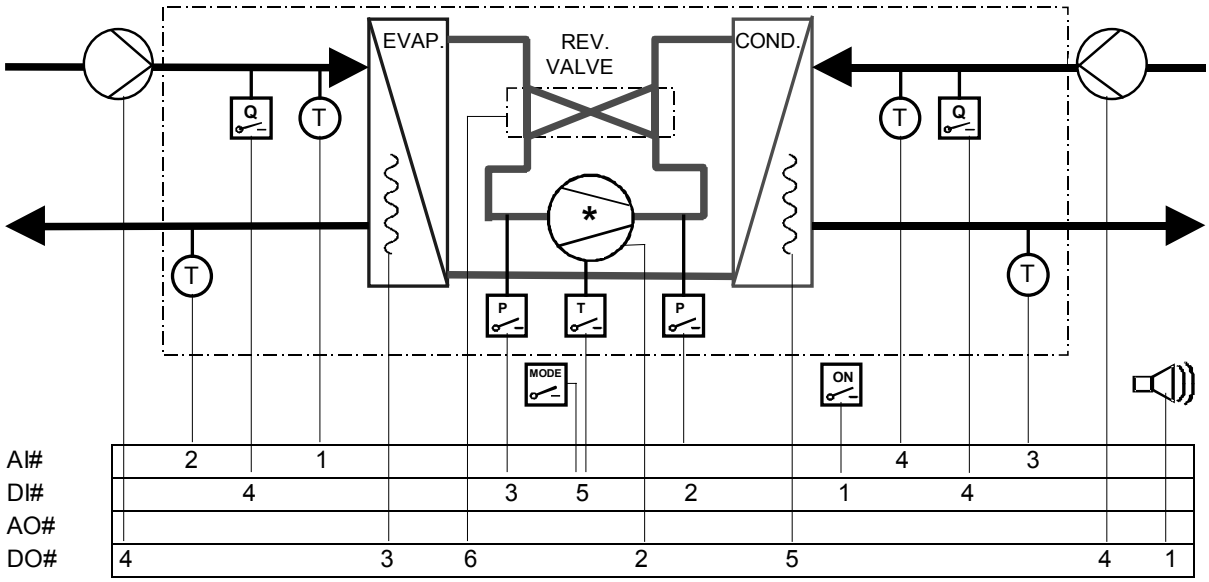


851 - Air/Water Chiller/HP Application

Input /Output

ANALOG INPUT		DIGITAL INPUT		DIGITAL OUTPUT		ANALOG OUTPUT	
AI1	Entering water temperature	**DI1**	Remote ON/OFF	**DO1**	Alarm	**AO1**	Condenser fan speed control
AI2	Leaving water temperature	**DI2**	High Pressure Switch	**DO2**	Compressor		
AI3	Condenser temperature	**DI3**	Low Pressure Switch	**DO3**	Evaporator Heater		
		DI4	Flow Switch	**DO4**	Pump		
		DI5	Motor Protection or Heat/Cool selection	**DO5**	Condenser ON/OFF fan		
				DO6	Reverse Valve		

Application example 853

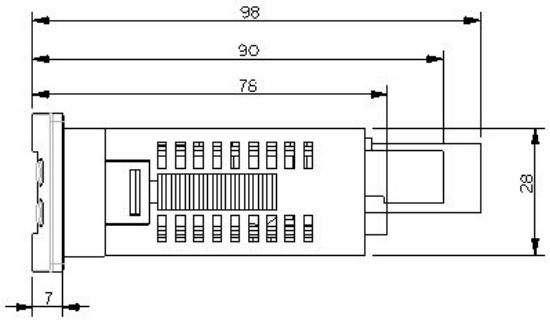


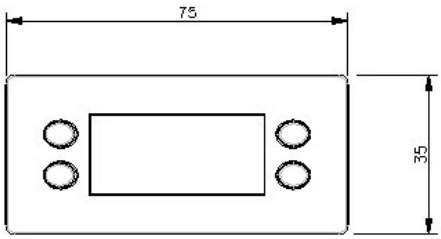
853 - Water /Water Chiller/HP Application

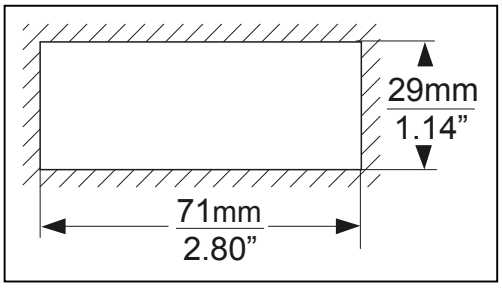
Input/Output

ANALOG INPUT		DIGITAL INPUT		DIGITAL OUTPUT	
AI1	Evaporator Inlet water temperature	**DI1**	Remote ON/OFF	**DO1**	Alarm
AI2	Evaporator outlet water temperature	**DI2**	High Pressure Switch	**DO2**	Compressor
AI3	Condenser outlet water temperature	**DI3**	Low Pressure Switch	**DO3**	Evaporator Heater
AI4	Condenser inlet water temperature	**DI4**	Flow Switch	**DO4**	Pumps
		DI5	Motor Protection or Heat/Cool selection	**DO5**	Condenser Heater
				DO6	Reverse Valve

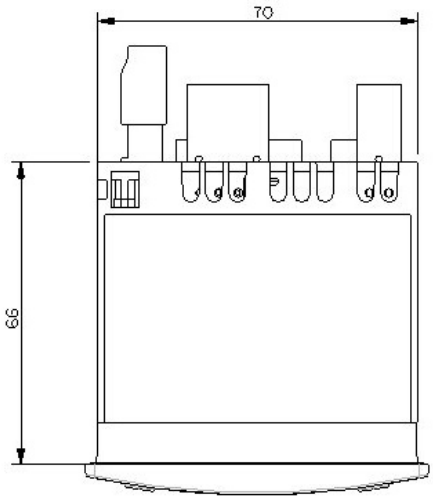
Dimensions *(in mm)*







Panel cut-out



Technical Specifications

Product	FX05 Controller	
Power Requirements	24 VAC/DC ±15%, 50/60Hz	
Power Consumption	6 VA	
Protection Class	Front plate IP54 Rear IP 20	
Insulation	Class II	
Ambient Operating Conditions	-20°C to 50°C 10 to 95 % RH (non condensing)	
Ambient Storage Conditions	-30° to +80°C 10 to 95 % RH (non condensing)	
Control Accuracy	± 0,3°C (sensor not included)	
Display Resolution	± 0.1°C, between –9.9 to +99.9	
I/O ratings	**Digital inputs**	Voltage free contacts, 3k3 pull-up resistors, not isolated
	Analog inputs	A99 JCI temperature sensor
	Analog Outputs	0…10 VDC, 5mA, not isolated
	Digital Outputs *	See values and characteristics at page 3 and 4 of the Product Bulletin
Connections	**Molex®** connectors Relay outputs, Mini-Fit family: Series 5569 94V-2 mates with 5557 dual row receptacle terminals series 5556 cables AWG18 Low voltage I/Os: Series 5268-NA mates with 5264-N terminal housing terminals series 5263 cables AWG22	
Dimensions (H x W x D)	35 x 75 x 90 mm	
CE Compliance	73/23 EEC directive: EN 60730 89/336 EEC directive: EN 50081-1, EN 50082-2	

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products.

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