FX16

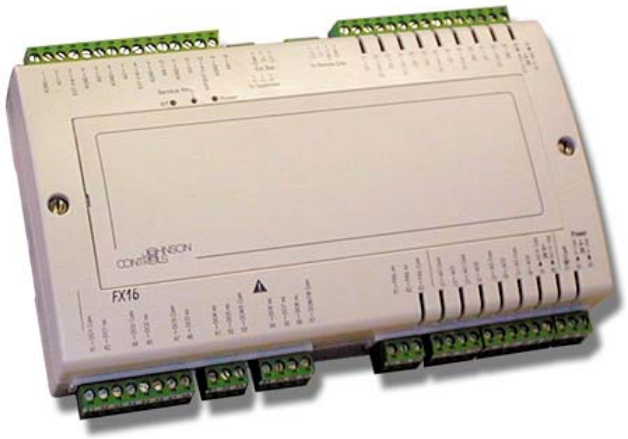
HVAC/R Master Controller

*The FX16 "Master Controller" is a high performance **Multimedia** controller intended for applications such as chillers and rooftops, indoor packaged air conditioning units, Air Handling Units, Close Control Units, etc.*

The FX16 is a protocol independent controller and can adapt to protocols such as LON, Johnson Controls N2Open, TCP-IP.

The controller is freely configurable and can adapt to virtually any applications, thanks to the FX-Tools II configuration package.

The controller allows up to 27 inputs / outputs with the additional possibility to expand its I/O count through the standard XT / XP modules or by using other controllers of the FX family as slave device (Distributed Intelligence Strategy).



FX16 Master Controller

Features and Benefits	
❑ **Distributed Intelligence**	Scalable I/O Expansions
❑ **Trend/Events Logging**	Constant monitoring of the most important data.
❑ **Messaging Services**	Automatic reporting via E-Mail messages and real-time alarm notice via SMS (if GSM modem connected)
❑ **Web Enabled**	Internet Explorer compatible for effortless remote monitoring and commissioning via modem (PPP) connection
❑ **Multilanguage database**	Up to 5 different languages contemporary present in the controller for automatic switch over at the pressure of a button
❑ **Freely programmable via FX TOOLs II**	Adaptable to any application
❑ **Application Upload / Download**	Possibility to upload / Download (ID protected) the application directly to and from the controller, both via PC and programming key
❑ **Real Time Clock**	Real Time Scheduling of Control activities
❑ **LON or N2Open cards (optional)**	Compatible with standard BAS protocols
❑ **RS232 card (optional)**	For modem connection (land line or GSM) and remote monitoring
❑ **Remote User Interface (optional)**	User friendliness on medium size LCD 4 x 20 display

*D*istributed Intelligence

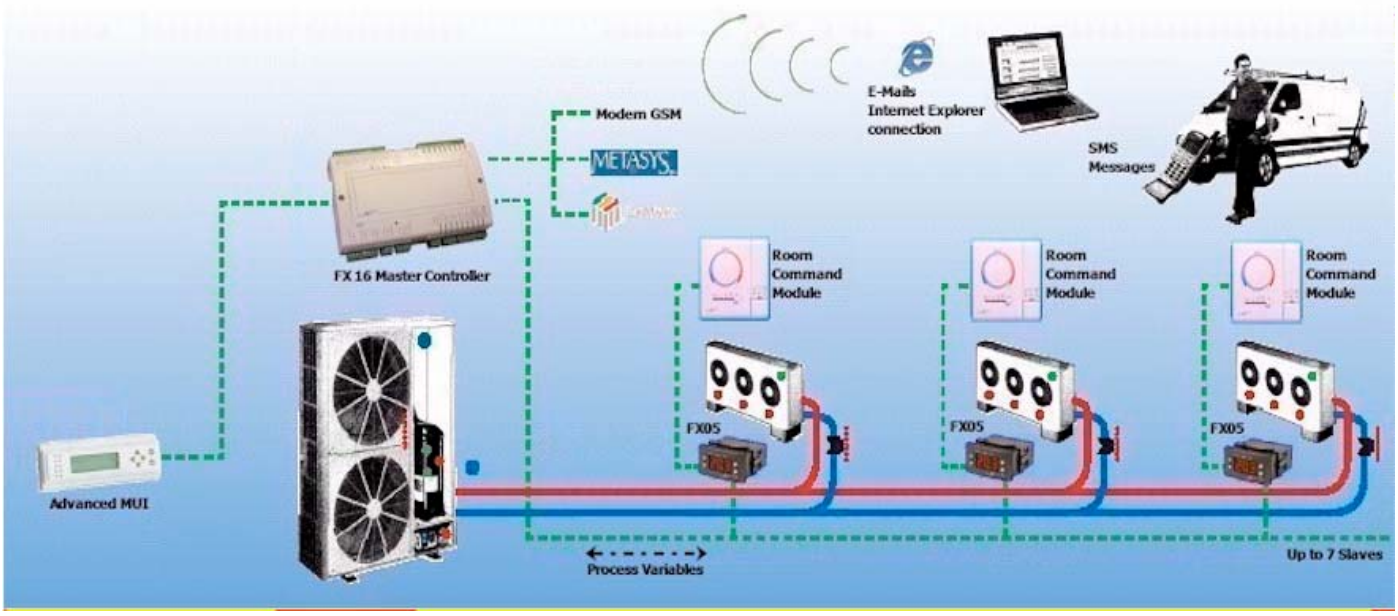
Complex control strategies may now be performed in multiple FX controllers, with the FX16 Master Controller used as the master, without the need for network data exchange routines in a supervisor. Applications include the control of multiple, interdependent air handling units, and large hot water or chilled water generating plants with components distributed in various locations within the building.

This means that up to **8** slave devices, belonging to the FX Platform, can be connected to the FX16 Master Controller extension bus and monitored.

Each slave device works independently and provides its own information to the network through its application profile, the FX16 unit takes care of polling, refreshing or forcing the network variables within the small system in order to synchronise the entire distributed application and to get it work properly.

The distributed applications are directly downloaded into the target FX16 Unit then the relevant parts are subsequently downloaded by the FX16 itself into the connected slaves at the first power up.

The FX used as slaves needs to have the N2Open card installed.



Distributed Application

Scalable I/O Expansions

The input/output capacity of the FX16 Master Controller may be extended by connecting up to four System91 extension modules via the XT-Bus. An extension module comprises an XT-9100 processor / communications module and one or more XP expansion modules. The expansion modules provide input/output capability for the extension modules.

The extension (XT) and expansion (XP) modules may be mounted next to the controller on the same DIN rail, or remotely, up to 1200 m from the controller.

An extension module set is assembled from submodules, providing various combinations of analog and digital (binary) I/O points.

Up to four extension modules and maximum 16 I/Os per each XT (i.e. max 64 I/O on the expansion bus), can be connected to the FX16 “Master controller” via the RS-485 extension bus.

Extension Modules XT/XP

Trend and Event logging

The FX16 Master Controller is also capable to log analogue data and events in the dedicated on-board 1MB flash memory. The trend log function, when predefined conditions are met, logs the referenced value and a time stamp into an internal buffer. The log is done upon either status flags or periodic poll depending on the configuration. The trend-logs memory can be visualised from the connected display and off loaded when close to saturation or periodically by means of the available connections, e.g. via e-mail.

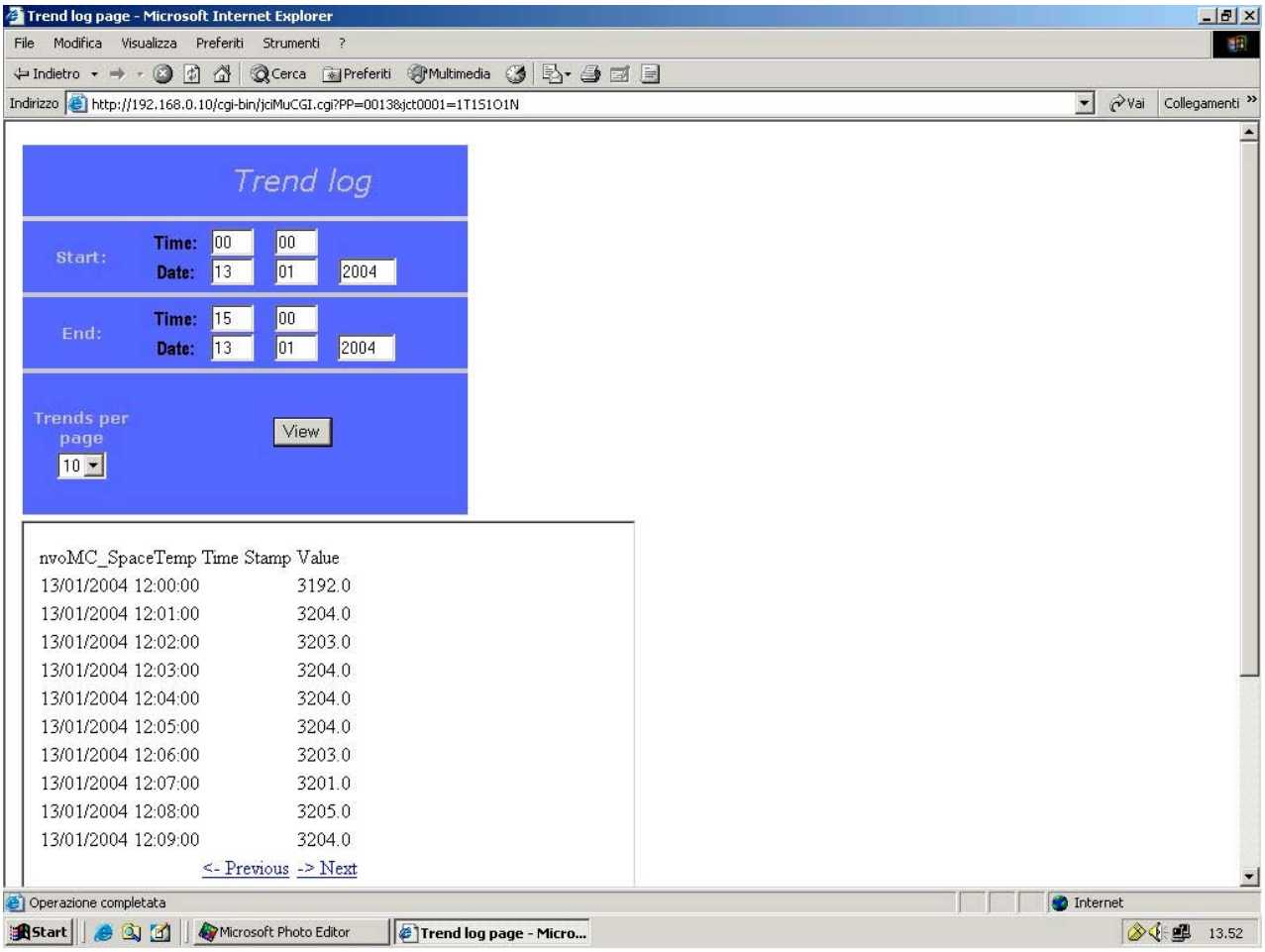
The controller has 1 MB of flash memory dedicated to trend and event logging. The controller will store up to 1000 system events such as power up, communication fail, etc and will allow to log, for example, up to 6 analogue variables, every 15 minutes, for 200 days.

The logged events can be:

- System events
  - Control application error
  - Display application error
  - Bad field configuration
  - Peripheral error
  - Field controller error
  - Outcoming call failed (SMS/FAX/e-mail)
  - Trend area full
  - System power up
  - ...
- Application events
  - Logic states [equal/not equal to…]
  - Analog values [greater, equal, less than ...]
  - Time

The actions that the controller can take at the triggering of an event can be:

- Store the event condition in the memory event buffer;
- Send a pre-defined SMS;
- Send an pre-defined text e-mail;
- Send a FAX with a pre-defined message;
- Print a pre-defined text on the local printer.



Logged Data page web page example

Web Server

The FX16 Master Controller features an embedded web server that allows to the remote user, running Internet Explorer, to dial in and establish a point to point communication with the FX16 and browse alarms, logged data, set configuration parameters, controller variables that are included in the web pages.

This approach enables the day-to-day adjustment and monitoring of the installation to be carried out without the need for installing a proprietary supervisor package.

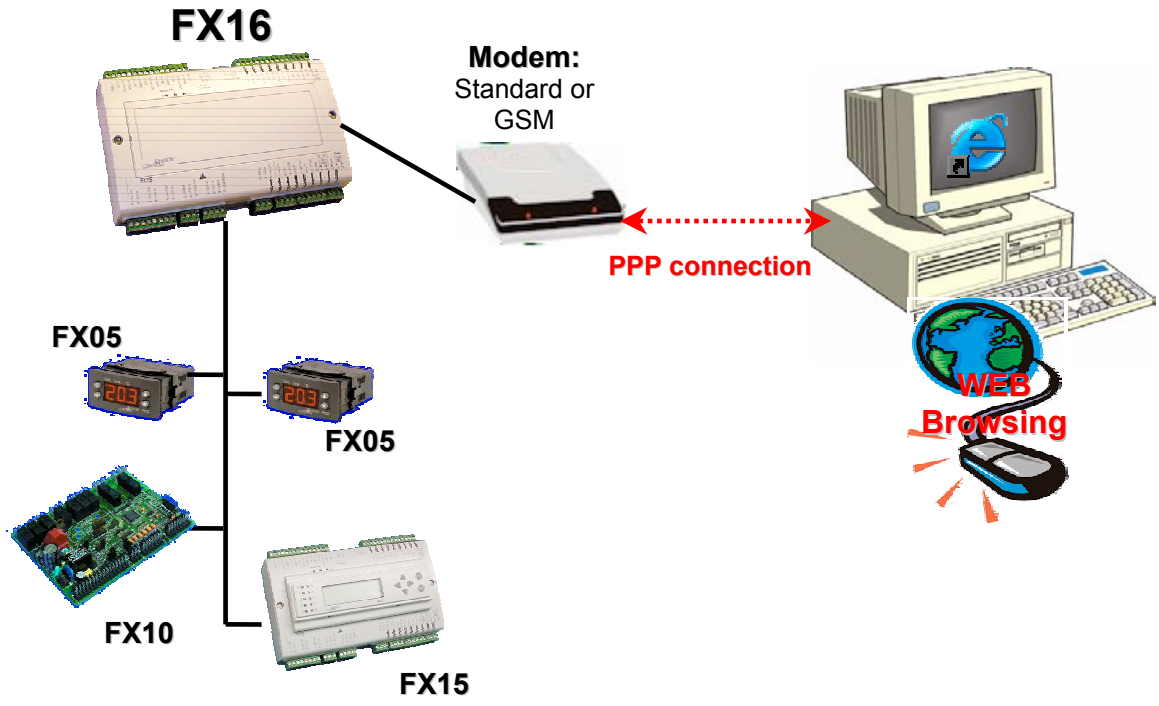
A 2-part log-in procedure to the FX16 prevents unauthorised access and can be used to provide various levels of user control.

The physical connection to the controller is a PPP link that can be local, via RS232, from the PC to the FX16 (up to max 15 mt) or, most important, remote, via modem.

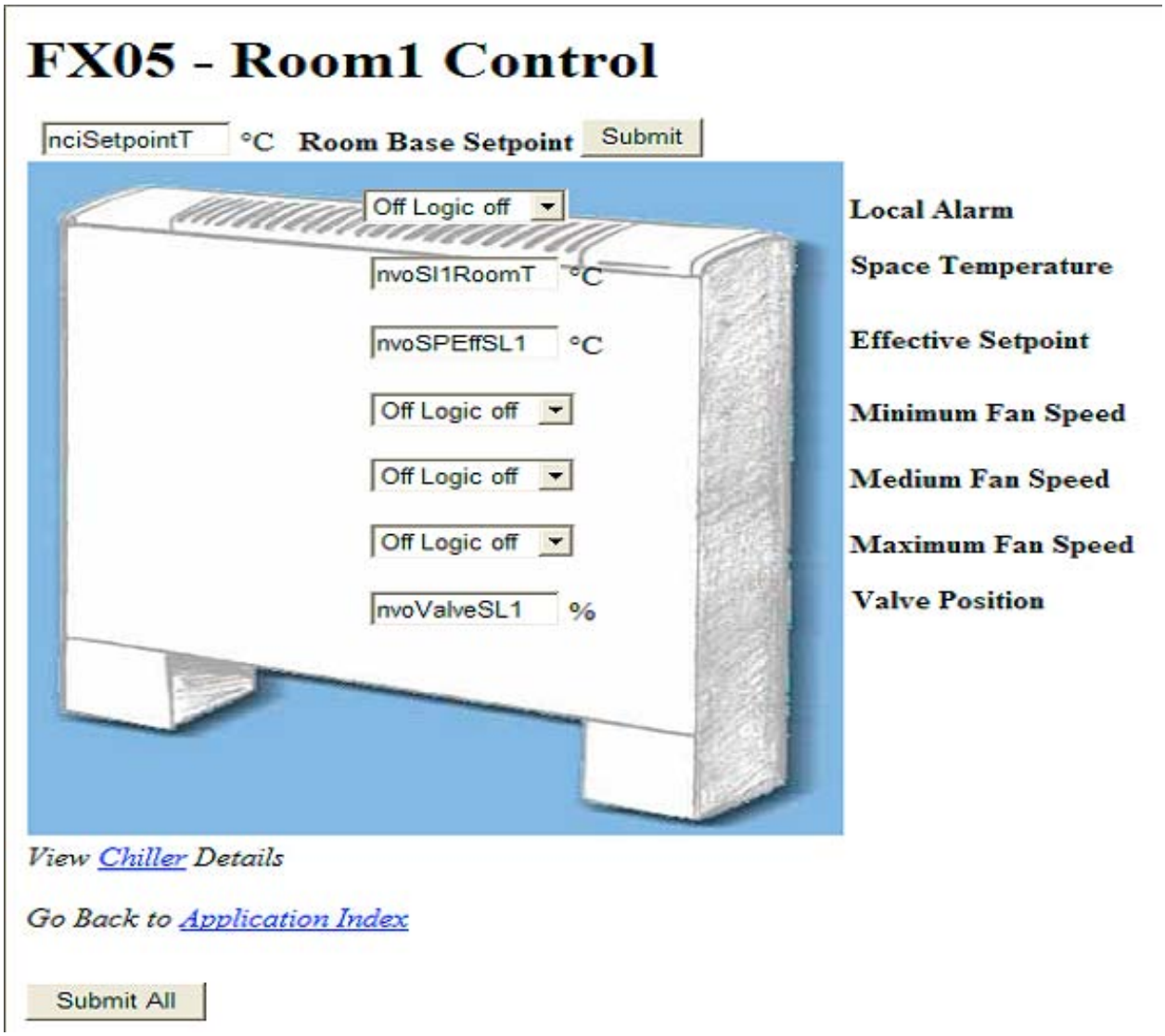
This feature allows users to create an effective and low-cost, remote or local, monitoring control system for information gathered from both the Master Controller and its slave devices.

Thought the web interface the user can:

- Read/modify profile variables
- See current alarms
- Acknowledge active alarms
- Read event log
- See /copy (and past to Excel spreadsheet) trended values
- Enable/disable trends
- Read modify “system parameters” (email address, phone numbers, user names, etc)



Web Browsing process

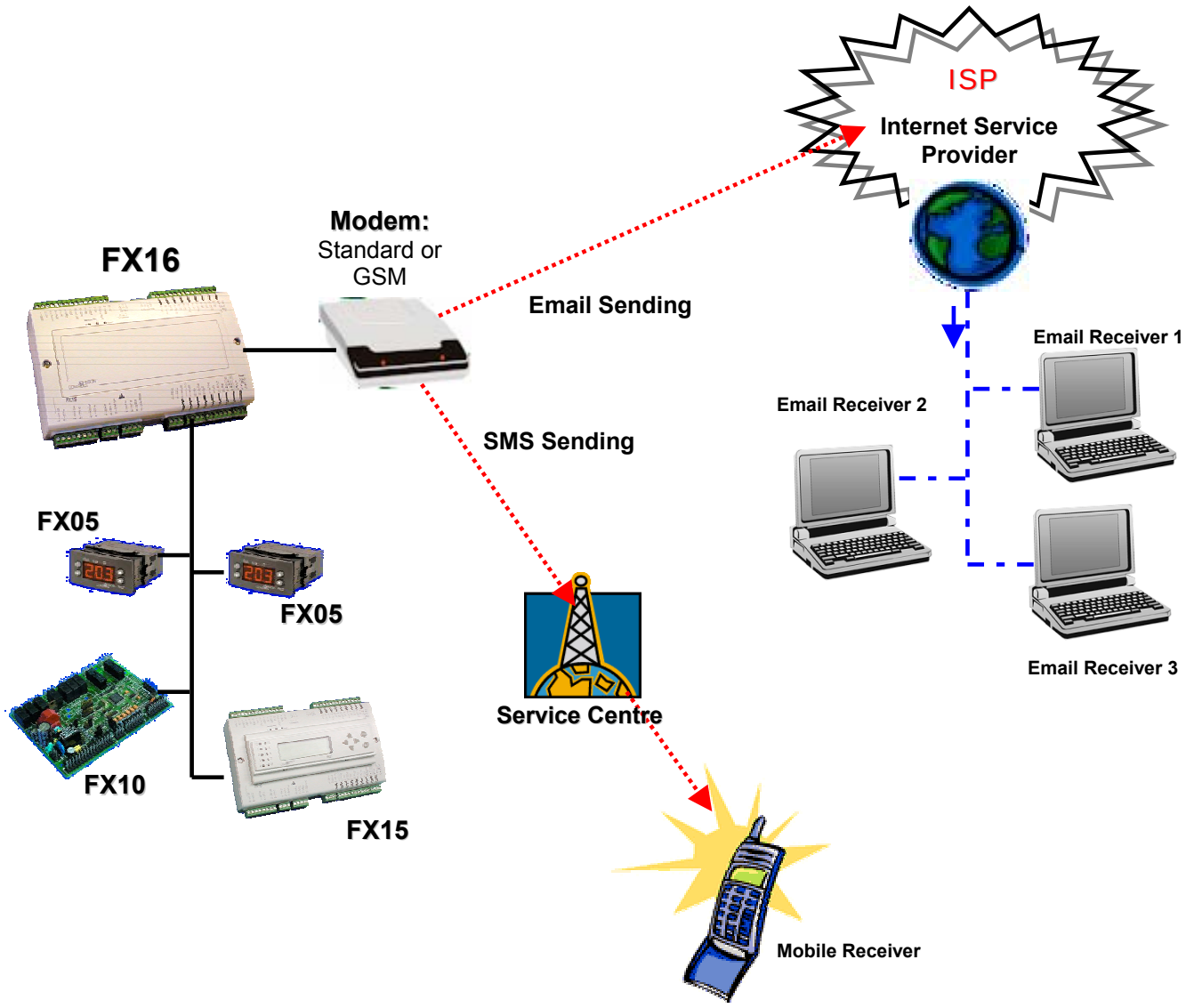


Slave web page example

Messaging Services

The FX16 Master Controller, through a connected modem can be programmed to send e-mails and SMS messages in case triggering conditions, being alarms or logic states, are matched.

E-mails can be programmed to be sent periodically, to off load the controller memory containing the logged trend data and events so allowing to build a remote database.



*M*ulti-language database

The application developed for the FX16 Master Controller can be design with up to 5 different languages that can be then chosen from the end-user, through the display, at run time.

The Display Plug-In allows to develop the main display application in the chosen primary language an export feature will then allow to export all the different strings, name of variables, etc to a file that can be translated. The translation will have to follow certain rules (max string length, etc).
The importing feature of the Display Plug-in will insert the additional language databases into the display application, ready for the download.

*C*ontroller Input/Output

The FX16 Master Controller features 27 I/Os channels with the following characteristics :

- Six high resolution Analogue Inputs (13 bit, A/D Converter);
- Eight opto-isolated Digital Inputs from potential free contacts, each with transition counter;
- Nine Digital Outputs (4 Relays and 5 optionally Relays or Triacs);
- Four opto-isolated Analogue Outputs.

*U*ser Interface (optional)

The FX16 Master Controller has one remote User-Interface. The integrated user-interface is 4x20 LCD backlit display. The remote user-interface is a display unit (that can be chosen within the FX display range) that can be connected to the "Remote Display" plug from which it takes the power supply as well as the serial data.
In order to facilitate its use the FX16 is capable of storing a display database with up to 5 different languages, so the user will be able to select, through a configuration parameter, the displayed language.

For more information please refer to the relative display Product Bulletin and Technical Bulletin.

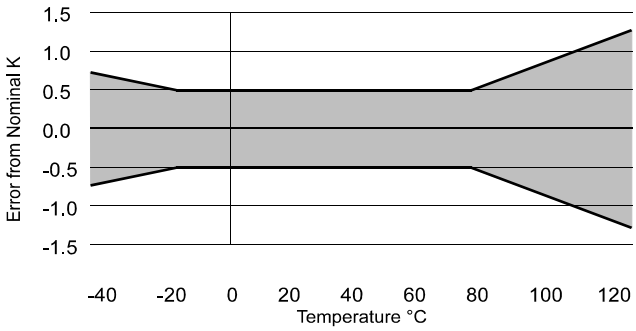
The display models connectable to the FX16 “Master Controller” are:

LP-DIS65P00-0C: Large **U**ser **I**nterface, panel, flush mount or hand held, 4x20 backlit LCD, IP54, extended temperature range: -20° C to +50° C, standard JCI front-plate. The front-plate is fully customisable upon minimum order, see *"LUI display"* product bulletin for more information.

LP-DIS60P10-0C / LP-DIS60P11-0C: Medium **U**ser **I**nterface, 4x20 backlit LCD, IP54, extended temperature range: -20°C to +50°C. Panel mount, non-isolated version, wall mount isolated version.

Sensor Input

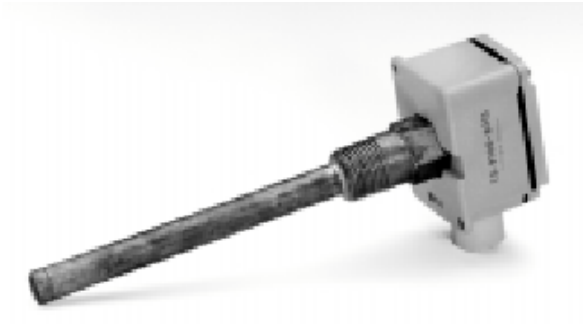
This series of controllers is compatible with Johnson Controls A99 temperature sensor. Its accuracy is within 0.5°C between -15 and 75°C. Its tolerance increases with temperatures outside this range, as shown below:



Its gas tight packaging (IP68) makes it the best sensor for refrigeration applications. For details please refer to A99 documentation.
Further more the AI are compatible with other passive and active sensor typologies.

Sensors and Actuators to complete the system

The FX16 Master Controller and its extension modules are matched to a family of sensors, actuators, control valves, and dampers needed to complete the control of chiller and boiler plants, HVAC processes and other refrigeration and heating applications. Its sensor inputs can accept 0-10V transmitters and passive temperature sensors from the Johnson Controls range, as well as industry standard 4-20mA transmitters. Outputs are available to control both proportional and incremental electric actuators, as well as motor control relays, staged heating and cooling and other electrical equipment such as lighting control relays. Pneumatic actuators may be controlled by the use of an external transducer.

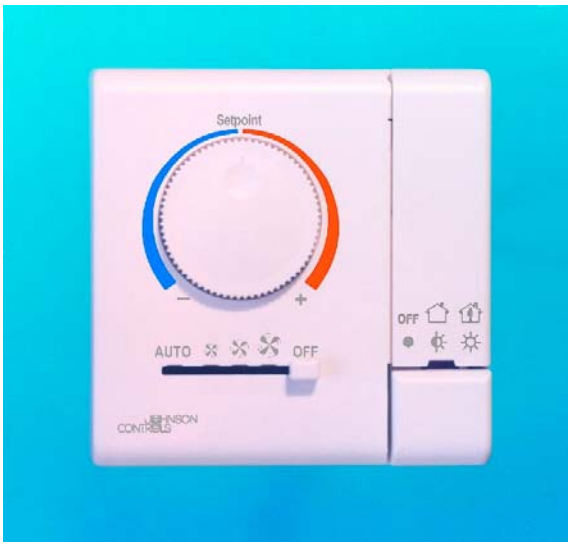


Room Terminal Module

As a point to point room interface the FX16 can be connected the standard analogue terminal module of the series TM-9100 or to the specifically FX designed terminal modules KIT006.

Both the series features: setpoint adjustment, fan speed override knob, occupancy button and LED, room sensor.

The FX16 Master Controller and the terminal module are interfaced via analog / digital signals.



Software and configuration

The FX16 Master Controller provides configurable control algorithm, memory and connectivity services, real time functions and I/O expansion through its customisable, objects and services oriented, architecture.

The device configurations can be created and downloaded into the target controllers via the ***FX-TOOLs II*** suite of software utilities.

The tools available in the package are:

FX-Builder**:** the AppMaker evolution to build the application logic and the display application in a completely graphical environment. This latest version includes in a single Integrated Development Environment (IDE) the plug-ins to edit the whole configurable behaviours and services offered by the FX16 Master Controller device and its distributed intelligence strategy.

FX-Loader**:** to download to the target controller the developed control application and display configuration at the click of a button. N2open and LON protocol supported.

FX-CommPro**:** for the complete control of the network profile of the connected unit. Parameter configuration, machine tuning, default parameters saving for successive configurations are all things possible with the CommPro with the 2 protocol supported: N2Open, LON.

The software package can also be tested and evaluated in demo version. This version allows the complete use and testing of the software package but it will allow to download the developed strategy only to a demo case or to a demo controller.

Real Time Clock

The FX16 on board RTC includes a complete Time-of-Day clock with Hours, Minutes and Seconds control. A calendar function is also available for Day-of-Week and Date-of-Month allowing an yearly Holiday and Alternative days programming. Thanks to this capability the FX16 is able to perform control routines based on Time-of-Day, Day-of-Week or Date-of-Month allowing periodic actions as Trend and Event buffers periodic offload. Moreover it enables all trended data to be time and date stamped. The clock data are battery backed up with an average duration of 2 years.

Security

The FX-TOOLS II and the FX16 Master Controller comes with an embedded security features based on the use of two IDs: the family ID and the customer ID to prevent tampering with the applications and source code protection.

Application Upload / Download

The FX16 is a fully programmable controller and the application can be downloaded to the controller via PC, with the FX-Tools or uploaded / downloaded via programming key.

Communication Interface (Optional)

The FX16 Master Controller has two communication links.
One is called the **Supervisor Link** : N2Open or LON or RS-232 and is used to interface to a supervisory unit.
The other link is called the **Extension Bus** and **Remote Display Bus** and it is used to expand the FX16 Master Controller input/output capability and to connect the FX16 to its user interface.
In particular the RS-232 communication board allows for a modem connection, both GSM or Land-Line standard models can be connected. Moreover a Null Modem connection, directly from PC to the controller allows for point to point communication via TCP.IP protocol.

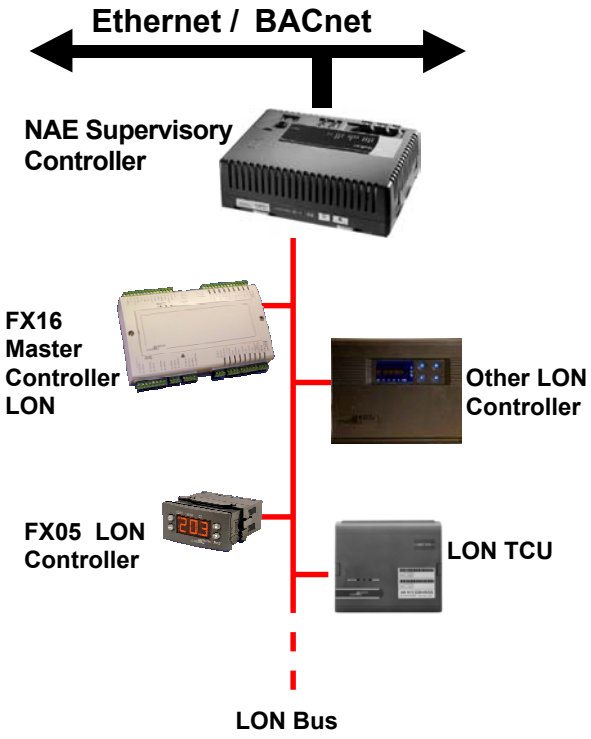
LON Network (Optional)

The FX16 Master Controller can be optionally fitted with a LON communication card, which enables it to pass data from one controller to another and to send event-initiated data to the NAE Network Automation Engine in the Metasys system or to any other, off the shelf, LON supervisory systems.

The NAE must be fitted with a LonWorks (Echelon) driver card.

Thanks to the LON features, the FX16 Master controller have “network” input and output points which can be configured to transmit and receive data over the LonWorks Bus. The transmission of point data is managed by the LonWorks Network and is independent of the supervisory functions of the Metasys Network Control Module.

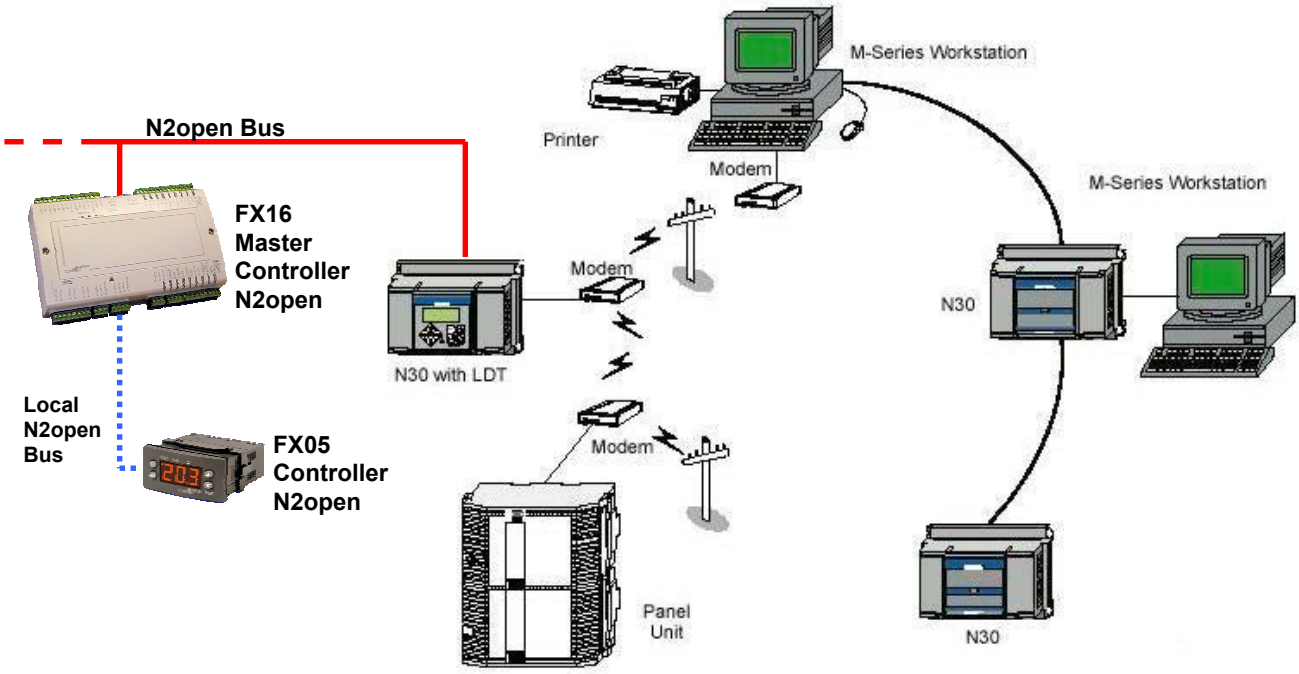
A network of FX16 Master Controller fitted with the LON communication card can be installed to share analog and digital data between controllers on a peer-to-peer basis; a Network Control Module is not required unless the network is to be supervised by a Metasys system.
Further information about compatibility and interoperability with other LonMark devices may be requested from your local Johnson Controls office.



*M*etasys Integration

The FX16 Master Controller is fully programmable and customisable both in terms of control application and network profile.
The **Network Profile** in particular, i.e. the list of variables and parameters available through the network, is not univocally determined but depends on the **Application** loaded to the controller.
For this reason the FX16, as well as all the other controllers of the FX family, are integrated to Metasys as **VND** - N2-Compatible Vendor Device.

The FX-Tools II, that are used to develop the controller strategy, automatically print out a file (.PRN) that contains all the relevant information to integrate the controller load with a specific application to an NAE or N30 supervisory controller.
The PRN file contains a column labelled Point Type and a column labelled point Address.
This information have to be used when specifying Network Point Type and Network Point Address in an NAE or N30.



N30 Multi-site Connection example

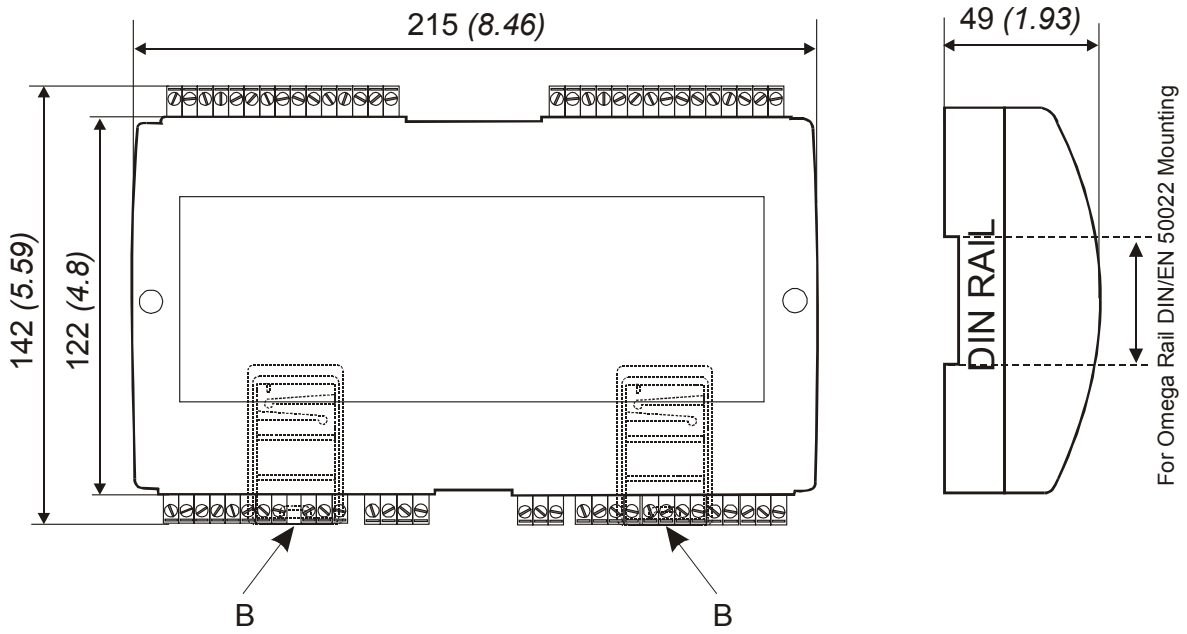
WARNING

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.**

*D*imensions in mm (inch).



FX16-003_09 2003

Installation details of FX16 Master Controller

Ordering Codes

Controllers

Item Code	Description
LP-FX16D00-000C	FX16 “Master Controller”, 9 relays, application-less
LP-FX16D01-000C	FX16 “Master Controller”, 9 relays, application-less, N2Open card pre-assembled
LP-FX16D02-000C	FX16 “Master Controller”, 9 relays, application-less, LON card pre-assembled
LP-FX16D03-000C	FX16 “Master Controller”, 9 relays, application-less, RS-232 card pre-assembled
LP-FX16D10-000C	FX16 “Master Controller”, 4 relays + 5 triacs, application-less
LP-FX16D11-000C	FX16 “Master Controller”, 4 relays + 5 triacs, application-less, N2Open card pre-assembled
LP-FX16D12-000C	FX16 “Master Controller”, 4 relays + 5 triacs, application-less, LON card pre-assembled
LP-FX16D13-000C	FX16 “Master Controller”, 4 relays + 5 triacs, application-less, RS-232 card pre-assembled
LP-FX16DEM-001C	DEMO FX16 “Master Controller”, 9 relays, application-less, N2Open card pre-assembled
LP-FX16DEM-002C	DEMO FX16 “Master Controller”, 9 relays, application-less, LON card pre-assembled
LP-FX16DEM-003C	DEMO FX16 “Master Controller”, 9 relays, application-less, RS-232 card pre-assembled

Accessories

Item Code	Description
LP-NET151-010C	N2Open plug-in communication card
LP-NET162-000C	Advanced LON plug-in communication card. On-field commissioning.
LP-NET162-xxxC	Advanced LON plug-in communication card. Specific application profile.
LP-NET163-000C	RS232 plug-in communication card
LP-KIT007-000C	Link cable for the connection of the FX16 “Master Controller” to the MUI / LUI display - 3 mt.
LP-KIT007-001C	Link cable FX16 “Master Controller” - STD modem - DB9, 1.5mt
LP-KIT007-002C	Link cable FX16 “Master Controller” - GSM modem - DB15, 1.5mt
LP-KIT007-003C	NULL MODEM cable - RS232, 3mt
LP-KIT007-004C	NULL MODEM cable - RS232, 15mt
LP-KIT015-000C	Kit of female screw connectors
LP-KIT015-001C	Kit of female cage clamp connectors.
LP-KIT090-000C	MODEM GSM 900/1800 FastTrack
LP-KIT090-001C	GSM modem plug-in antenna
LP-KIT090-003C	GSM modem magnetic mount antenna - 2,5mt cable
LP-KIT090-004C	GSM modem panel mount antenna - 5mt
LP-KIT090-005C	GSM modem power adpate, 230Vac/12Vdc, wall plug
LP-KIT100-000C	Programming Key
U215LR-9110	Condenser fan speed controller single-phase, 3Amps.

Expansion Boards

Item Code	Description
XT-9100-8304	Extension module DX.
XP-9102-8304	Expansion board: 6AI, 2AO.
XP-9103-8304	Expansion board: 8DO (triacs).
XP-9104-8304	Expansion board: 4DI, 4DO (triacs).
XP-9105-8304	Expansion board: 8DI.
XP-9106-8304	Expansion board: 4DO (relays).

Displays

Item Code	Description
LP-DIS60P10-0C	Advanced Medium User Interface, (4 x20) LCD backlit display, **panel mount** version.
LP-DIS60P11-0C	Advanced Medium User Interface, (4 x20) LCD backlit display, **wall mount** isolated version.

Sensors

Item Code	Description
A99 series	A99 temperature sensors
TS-9104 series **TE-9100-8502**	NTC (K10) temperature sensor -10…+100°C.
HT-9000 series	Humidity sensor (0…5V) 0…100%.
P299 series	Pressure sensor: Ratiometric (0…5V) 10 to 90% of supply voltage, 4-20mA and 0-10V

Demos Cases

Item Code	Description
DEMO-FX16-001	Demo case FX16 “Master Controller” + N2Open communication, 230V.
DEMO-FX16-002	Demo case FX16 “Master Controller” + LON communication, 230V.
DEMO-FX16-003	Demo case FX16 “Master Controller” + RS232 communication, 230V
DEMO-FX16-011	Demo case FX16 “Master Controller” + N2Open communication, 120V.
DEMO-FX16-012	Demo case FX16 “Master Controller” + LON communication, 120V.
DEMO-FX16-013	Demo case FX16 “Master Controller” + RS232 communication, 120V

Technical Specifications

FX16 “Master Controller”

Product	FX16 “Master Controller”
Power Supply Requirements	24 VAC ±15%, 50/60 Hz - Class 2 Power Supply
Power Consumption	15 VA at max load
Internal Fuse	2 A, 250 V
Protection Class	IP 20
Isolation	*Please refer to the Technical Bulletin*
Ambient Operating Conditions	-20°C to +50°C10 to 95% rH (non condensing)
Ambient Storage Conditions	-20°C to +70°C10 to 95% rH (non condensing)
Dimensions (H x W x D)	142 x 215 x 49
Weight (with package)	0,74 Kg
I/O ratings	*(See “Technical Specifications ” on page 20)*
Connection terminals for signals and power supply	Screw terminals for max 1 x 1.5 mm^2 wires or Cage clamp connectors 1 x 1.5 mm^2 wires **To be ordered separately**
LON / N2Open bus connection terminals	Screw terminals, cable size 0.05 to 1.5 mm^2, AWG30 to AWG14 Belden cable, 2-core twisted pair with shield
Connection terminals for extension bus and remote display	Screw terminals, cable size 0.05 to 1.5 mm^2, AWG30 to AWG14
Single cable lengths	
Digital Inputs DI1 - DI8	Max. 100 mt with diameters ≥0.6 mm
Analog Inputs AI1 - AI6	Max. 100 mt with diameters ≥0.6 mm
Triac outputs (when present)	Max. 100 mt where A ≥1.5 mm^2
Analog Outputs AO1 - AO4	Max. 100 mt where A ≥1.5 mm2
Remote Display	Max. 3 mt if display is powered by controller. Max. 1 km if display independently powered
Extension Modules	Max. 1 km
Display and Extensions cable type	Belden 4-core, twisted pair, shielded
CE Compliance	89/336 EEC directive: EN 50081-1 (EN 61000-6-3), EN 50082-1 (EN 61000-6-1) 73/23 EEC directive: EN 60730
UL compliance	UL873

I/O Technical Details

Analog Input (AI)			
Terminal	**Channel**	**Type**	**Remark/Application**
TB1 (1-15)	AI1, AI2, AI3, AI4, AI5, AI6	*See FX16 Technical Bulletin*	Freely software configurable. Application: temperature, humidity, pressure, etc.
3, 8	EXT-VDC	+16 V, 80 mA	To power, directly from the controller, max 4 0-20 / 4-20 mA sensors
13	AVPS / EXT-VDC	AVPS = +5 V, 20 mA EXT-VDC = +16 V, 80 mA	To directly power ratiometric sensors, with AVPS **or** 0-10 V, 0/4 - 20 mA Sensors with EXT-VDC. The selection between AVPS and EXT-VDC is done through jumpers.

List of available sensor input		
Sensor Type	**Linearization Range**	**Accuracy @ 20°C ambient**
Ni1000 JCI	-45°C to 120 °C	+/- 0.5° C
Ni1000 JCI Extended	20 °C to 287 °C	+/- 1.5° C
Ni1000 Siemens	-50,00 °C to 160 °C	+/- 0.5° C
Ni1000 DIN	-60,00 °C to 180 °C	+/- 0.5° C
Pt1000	-50 °C 600 °C	+/- 0.6° C
A99	-50 °C to 110 °C	+/- 0.5° C
NTC 2,2K	-40 °C to 150 °C	+/- 0.5° C
0 to 5 VDC ratiometric	10 to 90% of supply voltage	0.3%
0 to 10 VDC	0 to 10 Volts	0.3%
0 to 20 mA	0 to 20 mA	0.3%

Digital Input (DI)			
Terminal	**Channel**	**Type**	**Remark/Application**
TB2 (21-33)	DI1, DI2, DI3, DI4, DI5, DI6, DI7, DI8	Potential free contacts	Transition counter function: 50 Hz on spurious signals 10 Hz on filtered signals (active for min 10ms) Prescaler function: max division by 100
34, 35	DI V~ Hot DI V~ Com	24 VAC	In order to assure microprocessor insulation a different 24 VAC power supply must be used to power the digital inputs.

Digital Output (DO)			
Terminals	**Channel**	**Type**	**Remark/Application**
TB3	DO1, DO2, DO3	SPST 8(3)A power relays	Max switching power: 2000VA, 240W, 0.5HP, 250VAC UL/CUR rating: 8A 250VAC 8A 30VDC VDE rating: 8A 250VAC Expected electrical life min. operations: 1 x 10^5 operations (360 ops x hour) Dielectric strength: coil-contacts 4000 Vrms
TB4	DO4, DO5	SPST 5(3)A power relays **or** 0,5A / 24 VAC triacs	Max switching power: 1,250VA, 150W Rating (resistive): 10A 125VAC 5A 250VAC 5A 30VDC Expected electrical life (min operations): 10A 125Vac $5x10^4$ 5A 250VAC $5x10^4$ 5A 30VDC 10^5 Dielectric strength: coil-contacts 4000 Vrms for 1 min
TB5	DO6, DO7, DO8	SPST 5(3)A power relays **or** 0,5A / 24 VAC triacs	
TB6	DO9	SPDT NC 8(3)A 250V relay	Same as TB3 relays Fail relay for enhanced security. The relay will return to its NC position not only at power fail but also in case the microprocessor should fail: watch-dog, brown-out, etc.

Analogue Outputs (AO)			
Terminals	**Channel**	**Type**	**Remark/Application**
TB7	AO1, AO2	0 ÷ 10 VDC (max 1.5 mA)	Used to drive motor actuators, power triacs, frequency drives. 16 bit resolution.
TB8	AO3, AO4	0 ÷ 10 VDC (max 1.5 mA)	Used to drive motor actuators, power triacs, frequency drives. 16 bit resolution.
79, 80	AO V~ Hot AO V~ Com	24VAC	In order to assure microprocessor insulation a different 24 VAC power supply must be used to power the analogue outputs.

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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