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# AD-FCC and AD-FCD Fan Coil Unit Controller

The AD-FCC and AD-FCD Fan Coil Unit Controller are LONWORKS® network compatible devices that provide direct digital control of a fan coil unit with heating and/or cooling coils, an electric heater and a three-speed fan. The controller is designed for field installation or for mounting by original equipment manufacturers (OEMs). The space comfort set point, occupancy mode and fan speed may be adjusted from a room command module. The AD-FCC connects to the TM-21x0 series module and the AD-FCD uses the AD-IRM1005 module with a digital LCD display. A LONWORKS compatible Room Command Module may also be used when the controller is integrated into a LONWORKS network. The controller complies with the LONMARK® interoperability guidelines for sharing data with other network sensors and devices. Operating data can be monitored and controlled from a LONWORKS compatible supervisory system, including the Metasys® NCM Network Control Module and NAE Network Automation Engine that integrate the fan coil unit controller into a facility-wide management network.



**Figure 1: Fan Coil Unit Controller (AD-FCC and AD-FCD are similar)**



**Figure 2: Room Command Modules**

Features and Benefits	
<ul style="list-style-type: none"> <li><input type="checkbox"/> 230 VAC power</li> <li><input type="checkbox"/> Relay outputs at 230VAC 3A for direct fan control</li> <li><input type="checkbox"/> Triac outputs at 230VAC for heating and cooling valve control</li> <li><input type="checkbox"/> Relay output for electric heater control</li> </ul>	<p>Low installed cost for a wide range of fan coil unit applications</p>
<ul style="list-style-type: none"> <li><input type="checkbox"/> Temperature setpoint and fan speed override from attractively styled room command module with option for digital display</li> </ul>	<p>Local control by occupants from easy-to-use wall mounting unit</p>
<ul style="list-style-type: none"> <li><input type="checkbox"/> Multiple modes of operation for various occupancy conditions</li> </ul>	<p>Comfort with economy</p>
<ul style="list-style-type: none"> <li><input type="checkbox"/> Configuration and commissioning using any LonMark compatible LonWorks network or commissioning tool</li> <li><input type="checkbox"/> All configuration parameters in LonMark network profile</li> </ul>	<p>Ease of configuration and commissioning – no special tool required</p>
<ul style="list-style-type: none"> <li><input type="checkbox"/> LONWORKS peer-to-peer communications network</li> <li><input type="checkbox"/> LONMARK Space Comfort Controller Profile</li> </ul>	<p>Interoperability with other LONMARK compliant devices</p>
<ul style="list-style-type: none"> <li><input type="checkbox"/> LONWORKS network connection to Metasys network controller</li> </ul>	<p>Facility-wide control efficiency and cost-effective data sharing</p>
<ul style="list-style-type: none"> <li><input type="checkbox"/> Standalone operation with default parameters</li> <li><input type="checkbox"/> Nonvolatile memory (Flash and E<sup>2</sup>PROM)</li> </ul>	<p>System reliability</p>

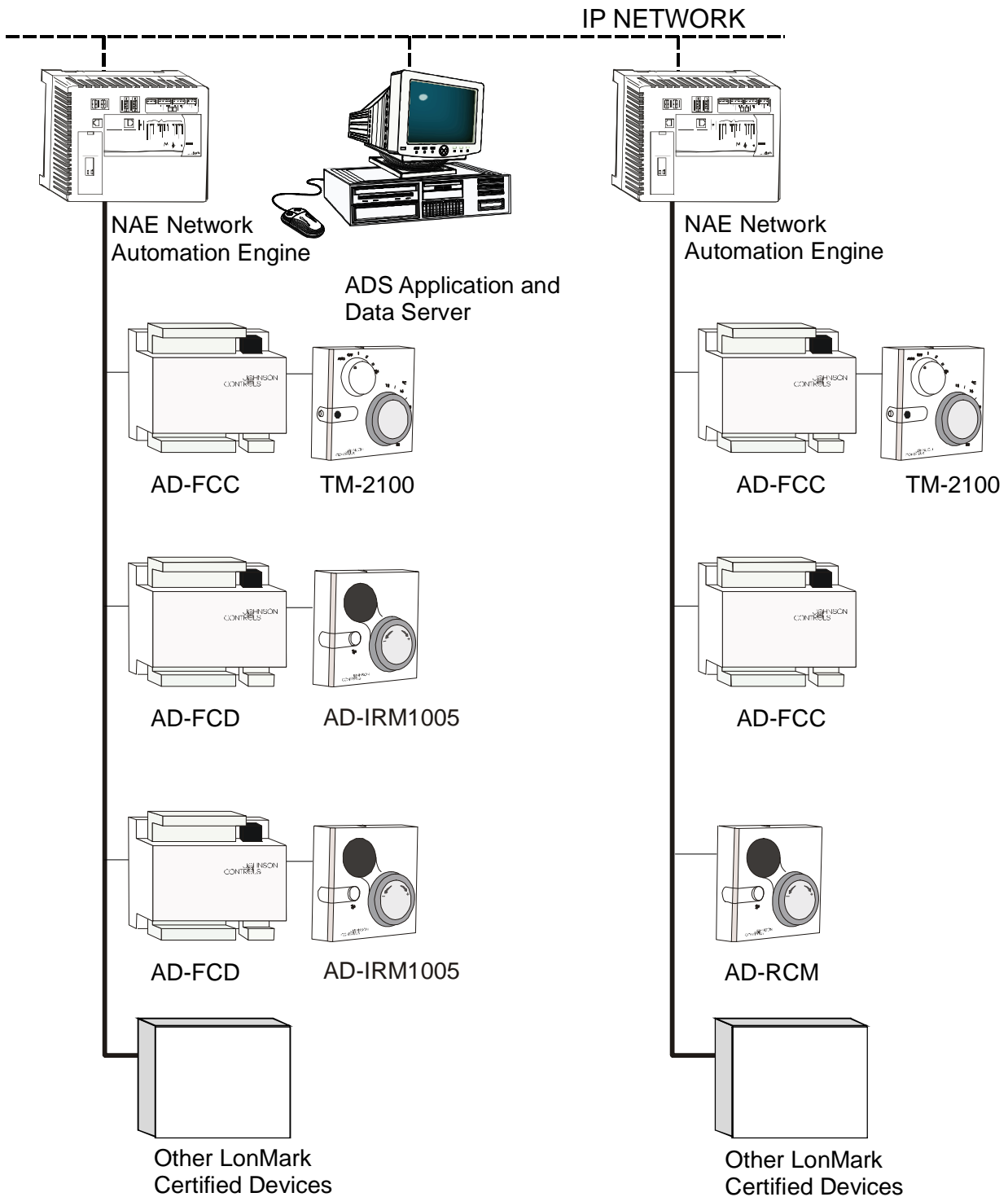


Figure 3: AD-FCC and AD-FCD Fan Coil Unit Controller in the Metasys Network

**O**ccupancy Comfort with Economy

The fan coil unit controller offers three modes of operation - occupied (comfort), standby (temporarily unoccupied) and unoccupied (night and weekends). These occupancy modes can be set from an operator workstation or network controller on a Metasys network, from another device on the LONWORKS network or controlled by the room occupants from a local room command module.

A locally connected room command module provides the occupant with temperature set point and fan speed control, and a button to request the occupied mode for comfort conditions. The AD-FCD controller supports a room module with a display of room temperature, setpoint and fan speed override status. Set point adjustment can be limited within a configurable range to allow occupants to have control over their environment, but not to compromise energy savings.

Alternatively a room command module on the LONWORKS network can be used to give the occupant control over the room temperature, set point, fan speed and occupancy mode.

Whatever local options are chosen, the controller operating mode can also be

scheduled by a Metasys supervisory system or other LONWORKS compatible supervisory system.

A “window open” sensor may be connected to the controller to switch it to the “Energy Hold-off” mode, and an occupancy sensor can be connected to relax the comfort conditions when the space is not occupied, all to avoid energy waste. The controller may also be set to “off” by the supervisory network when the space is not in use.

Where there are multiple fan coil units in a room, the controllers may be configured on the LonWorks network to operate in master/slave mode to control the temperature in the space in unison.

For applications where the cooling coil or pipes are located in the ceiling, a condensation sensor may be connected to switch off cooling if water is condensing on the pipes.

Every controller has a low space temperature detection function as a standard feature that switches on the heating to the maximum value in “Emergency Heat” mode, overriding any other automatic or manual mode of the controller except safety interlocks.

## **F**an Coil Unit Types

The controller may be configured to control fan coil units with a single water coil (2 pipe) or with separate heating and cooling coils (4 pipe). Two pipe fan coil units may be controlled as heating or cooling only, or may be configured to change control from heating to cooling depending on an external change-over signal.

When an electric heater is installed, the heater may be configured as the heat source in a two pipe fan coil unit with a chilled water supply or as supplemental heat in a 2 pipe fan coil unit with a hot water supply or a 4 pipe fan coil unit in heating mode. The AD-FCC and AD-FCD controllers may also be used to control electric heaters with and without a forced air fan.

## **F**an Control Options

The controller may be configured to control a single-speed, two-speed or three-speed fan. Options are also available to keep the fan running continuously at low speed in occupied mode (or in any mode) or to allow the fan to cycle on and off as the space temperature reaches the given setpoint. The fan speed

override command is only active when the space is occupied and when there is no “Energy Hold-off” in order to save energy consumption. If the fan is forced to off, the electric heater control is de-activated and the fan continues to run at low speed for a short time to prevent overheating in the fan coil unit.

# Hardware Inputs and Outputs for FCU Applications

The hardware inputs and outputs have been selected to cover the main requirements for cost-efficient fan coil unit control. The heating and cooling outputs connect to thermally driven valve actuators for low cost modulating control and relays are provided for direct control of the fan and an electric heater if installed.

## Installation Instructions

The AD-FCC or AD-FCD controller is typically mounted in the fan coil unit enclosure or in an electrical cabinet in the space being controlled. The mounting location must be clean and dry, and not subject to extreme heat or cold.

The TM-21x0 series or AD-IRM room module is designed for flush mounting over an electrical outlet box in the wall at a location where the temperature is typical for the controlled space and not subject to radiant heat from a window or air currents from a fan. Refer to Figure 8 for mounting details.

The installation and 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.

For direct mounting, place the controller at the desired position, and mark the location of at least two mounting holes. Drill small guide holes in the mounting surface and fix the controller to the surface using 3 mm diameter self-tapping screws. Refer to Figure 7 for mounting details.

For DIN rail mounting, place the controller on the lower edge of the rail and press the controller firmly against the rail until the spring-loaded clip engages the upper edge of the rail. To remove the controller, lift the controller upwards against the spring of the retaining clip and pull forward from the top.

Before connecting or disconnecting any wires to the controller, ensure that all power supplies have been switched off and that all wires are potential-free to prevent equipment damage and avoid electrical shock.

Local electric codes must be respected for wire size and external protection fuses. No over-current protection is provided within the AD-FCC or AD-FCD controller for the fan control or the 230 VAC triac outputs. Terminations are made on the terminal blocks, at the top and bottom of the controller, which accept up to 1.5mm<sup>2</sup> / 16


Inputs are provided for temperature set point, fan speed override and shutoff from a window contact or condensation sensor. The space temperature sensor may be mounted in the fan coil unit or in the room command module.

AWG wires. Follow the wiring diagrams shown in Figures 4 and 5.

Use a minimum wire size of 0.8 mm / 20 AWG for sensor and TM-21x0 room module connections. For the AD-IRM module a cable is required as shown in Figure 6. Pre-assembled cables and RJ9 connectors are available to order (see *Specifications and Technical Detail*).

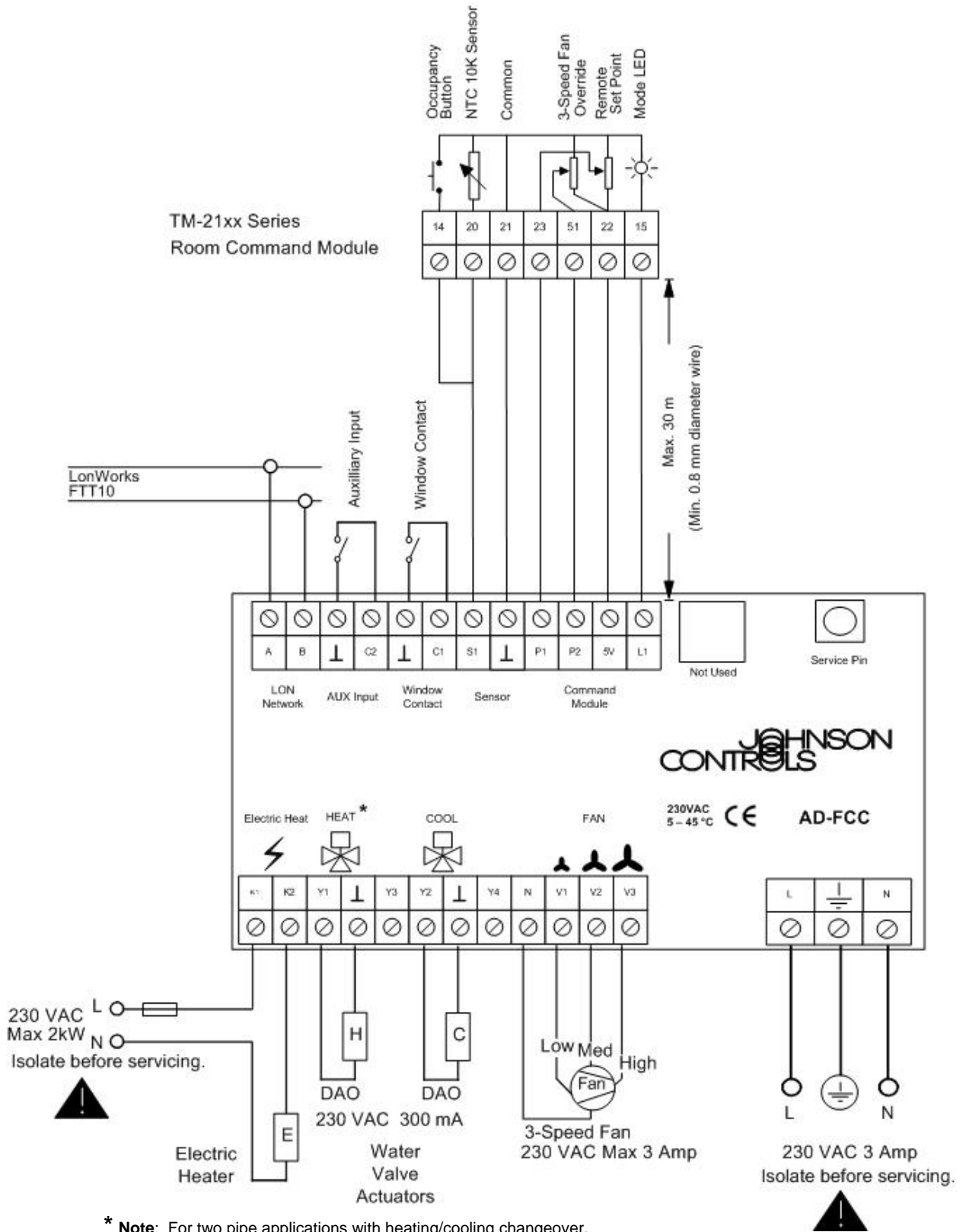
Size other wires according to the current load. If multi-stranded wire is used for 230 VAC connections, a metal sleeve must be crimped onto the exposed metal strands before inserting the wire into the terminal.

Keep all wires and cables as short as possible and tie in position or lay them in cable guides. It is recommended that sensors and actuators are mounted within 15 m of the controller. The IRM cable must not exceed 12m in length. Do not mount the controller or run any cables close to transformers or high frequency generating equipment.

Connect the earth/ground terminal (labeled ) to a clean electrical ground point. This connection provides a discharge path for any high voltage interference that could otherwise damage the controller or the LONWORKS network. Do not connect the LonWorks network cable shield (if installed) to the controller's earth/ground terminal.

The LonWorks network wiring must be installed in accordance with the LonMark Guidelines for the "Free Topology" physical layer of the network. If shielded cable is used, install a 470 kOhm, 1/4 W, ±10% metal-film resistor between the shield and a clean electrical ground point at one accessible location only (normally at the LonWorks network tool location or supervisory station).

Complete and verify all wiring connections before setting the controller into operation.



**Figure 4: AD-FCC Fan Coil Unit Controller Wiring Details**

**CAUTION:** Connections to the AD-FCC controller terminals may carry up to 250 VAC. Isolate live and neutral supply lines (requires use of double-pole isolator switch) before servicing.

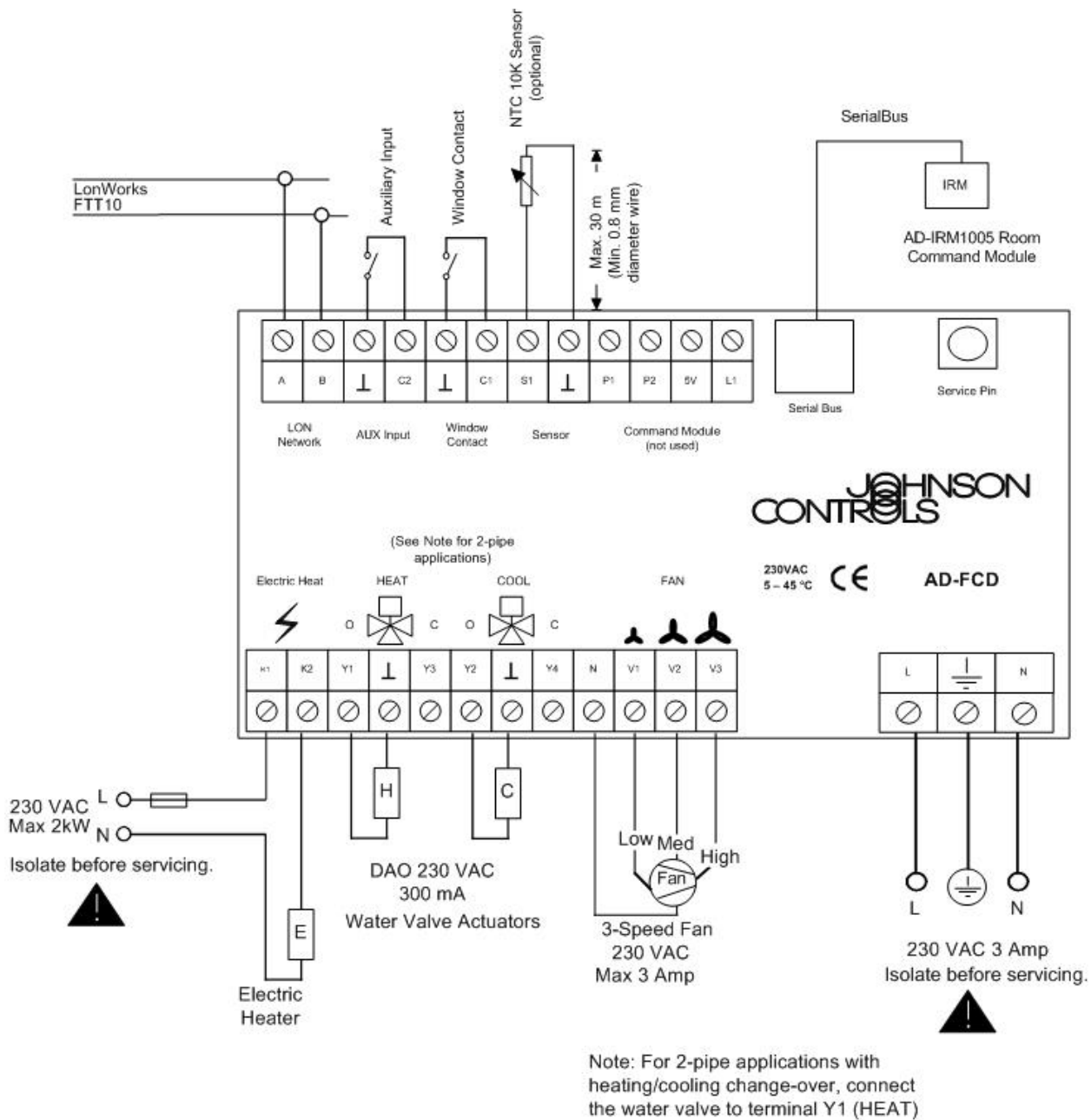


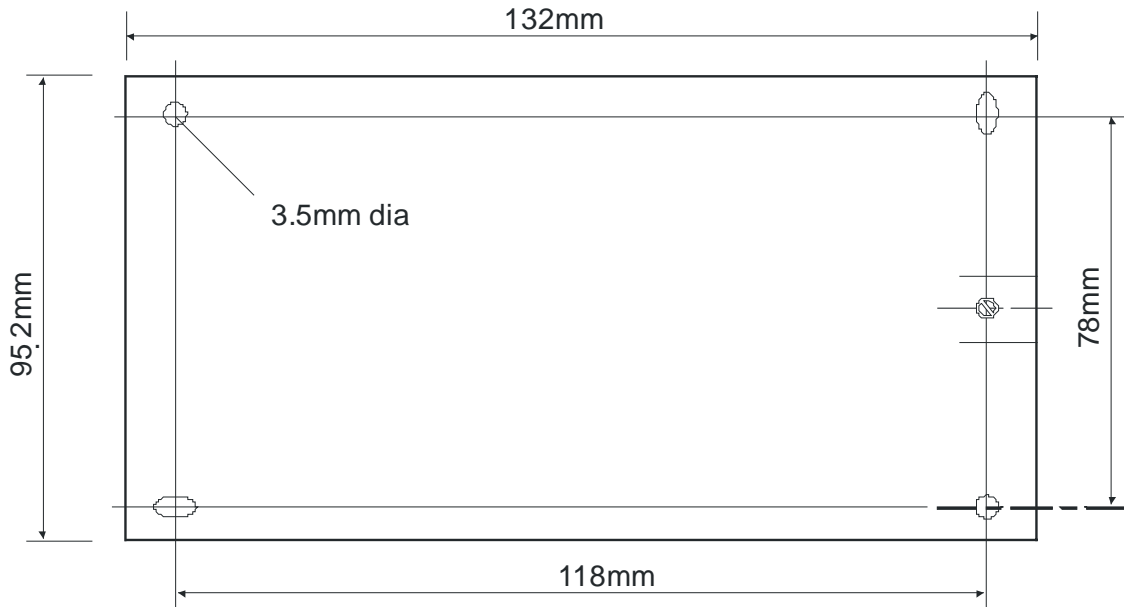
Figure 5: AD-FCD Fan Coil Unit Controller Wiring Details

**CAUTION:** Connections to the AD-FCD controller terminals may carry up to 250 VAC. Isolate live and neutral supply lines (requires use of double-pole isolator switch) before servicing.

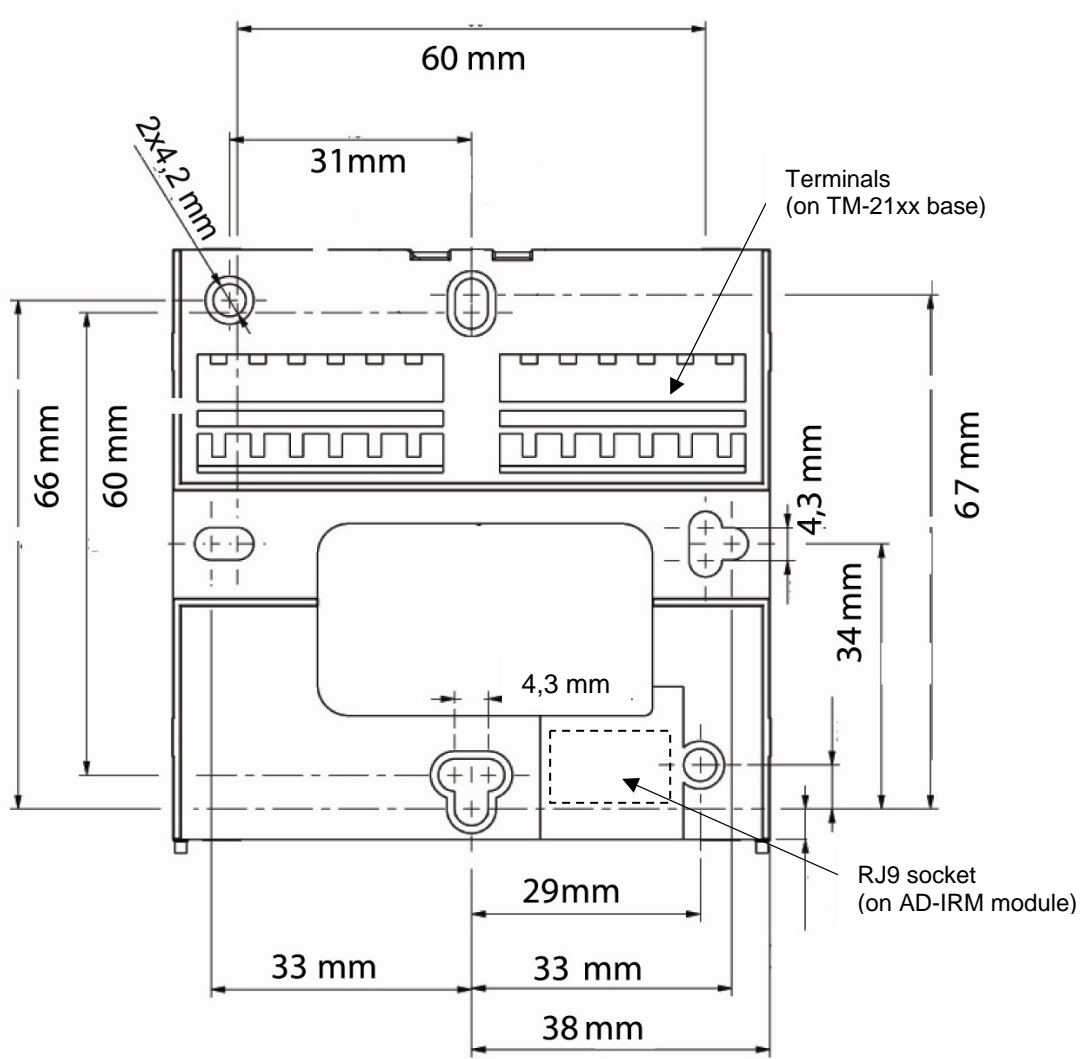


Use **RJ9 – RJ9** to connect serial bus from AD-IRM to AD-FCD  
(AD-IRCBL99S-0 or AD-IRCBL99L-0)

Figure 6: Serial Bus Cable Assembly



**Figure 7: AD-FCC and AD-FCD Fan Coil Unit Controller Mounting Details**



**Figure 8: Room Control Module Mounting Details**

## Convenient Configuration Setup

The application software is pre-loaded and the fan coil unit controller is delivered with factory-set configuration parameters.

All network variables and configuration parameters (or properties) may be accessed using any LonMark compatible network configuration tool. Configuration properties such as occupancy mode set points and control loop tuning constants can be modified, and network variables provide online operating data for the verification of the control sequence.

Once configured, commissioned, and connected to a network, the controller may be monitored from a Metasys operator workstation or other LONWORKS compatible supervisory device.

As the controller is fully LONMARK compliant, it may be connected to any LONWORKS network and configured to communicate with other devices on the network using any LONMARK compatible network configuration tool.

## Network Variables and Configuration Properties

Tables 1, 2 and 3 list the network variables that are available in the controller for monitoring by LonWorks compatible supervisory systems and for binding to other LonMark compliant devices using a LonWorks network configuration tool. The configuration properties are also listed. A limited number of properties may be monitored by a supervisory system as network variables, but all can be read and set by a LonMark network tool with the appropriate communication

capabilities and controller configuration data base information or resource files. For details of system and network configuration procedures, refer to the technical documentation of the system and tools which are to be used.

For further details of the controller configuration options and the factory default values for configuration parameters, refer to the *Configuration Guide – AD-FCC, AD-FCD, AD-IRC*.

## Networking Capabilities

Your facility will benefit even more when the fan coil unit controllers are integrated into a larger Metasys network. The AD-FCC and AD-FCD controller can be connected to a LONWORKS network that is monitored by a Metasys Network Control Module (NCM) or Network Automation Engine (NAE) that can be programmed to provide added energy management and supervisory control capabilities, such as optimal start, trend log, run-time totalization, and more.

The Metasys networking features make information from each controller available throughout the facility. This makes it possible, for example, to reset supply water temperatures based on the load demands of the fan coil unit controllers, and to adjust the room set points based on a common outdoor air temperature for the building or each zone of the building. The Metasys system also makes sensor values, operating status, and any other values in the controller available to operators at Metasys workstations anywhere in your facility.

## Open Communications and Interoperability with LONWORKS

When this controller is installed in a fan coil unit, the LONWORKS communication capability means that the unit and its controller can be integrated into a LONWORKS network in your facility at any time. LONWORKS is an open standard for field communications, and interoperability with other

LONWORKS compatible devices is assured by the LONMARK Interoperability Guidelines. Using the LONWORKS technology in the Metasys system allows you to integrate third party controllers and devices into the facility-wide management system.

**Table 1: Temperature Controller Network Variable Inputs**

Description	SNVT Name	SNVT Type
Space Temperature Input	nviSpaceTemp	SNVT_temp_p
Space Temp. Setpoint (Absolute)	nviSetpoint	SNVT_temp_p
Space Setpoint Offset (for synchronization of multiple controllers)	nviSetptOffset	SNVT_temp_p
Occupancy Mode Command	nviOccManCmd	SNVT_occupancy
Occupancy Input	nviOccSensor	SNVT_occupancy
Application Mode Input	nviApplicMode	SNVT_hvac_mode
Fan Speed Command (auto, off, 1, 2, 3)	nviFanSpeedCmd	SNVT_switch
Energy Hold Off (window open)	nviEnergyHoldOff	SNVT_switch
Heating/Cooling Changeover Command (2 pipe configuration)	nviChangeOver	SNVT_switch
Input for Multiple Window Interlock	nviWindowLoop	SNVT_switch
Enable Power Limit for Electric Heater	nviEconEnable	SNVT_switch

**Table 2: Temperature Controller Network Variable Outputs**

Description	SNVT Name	SNVT Type
Space Temperature	nvoSpaceTemp	SNVT_temp_p
Controller Unit Status (Applic. Mode, Heat Output, Elect. Heater, Cool Output, Fan Status)	nvoUnitStatus	SNVT_hvac_status
Effective Setpoint	nvoEffectSetpt	SNVT_temp_p
Effective Occupancy Mode	*nvoEffectOccup	SNVT_occupancy
Effective Heat/Cool Mode	*nvoHeatCool	SNVT_hvac_mode
Local Setpoint Offset (for synchronization of multiple controllers)	nvoSetptOffset	SNVT_temp_p
Effective Fan Speed Command	nvoFanSpeedCmd	SNVT_switch
Energy Hold-off Status	nvoEnergyHoldOff	SNVT_switch
Window Open Sensor	*nvoWindow	SNVT_switch
Auxiliary Contact (occupancy, heat/cool change-over or condensation sensor by configuration)	*nvoAuxContact	SNVT_switch

\* Transmitted on Heart-beat when Send Heartbeat property value > 0 sec.

SNVT: Standard Network Variable Type

Refer to *LonMark Interoperability Guidelines* for further details.

**Table 3: Temperature Controller Configuration Properties**

<b>Description</b>	<b>SCPT Name</b>	<b>Data Type</b>
Space Temperature Setpoints (configured as network variable)	nciSetpoints	SNVT_temp_setpt
Temporary Occupied Time (for TM / IRM room module occupancy button) (configured as network variable)	nciBypassTime	SNVT_time_min
Proportional Band of Control Loop	nciPropBand	SNVT_temp_p
Integral Action Time of Control Loop	nciIntTime	SNVT_time_sec
Space Temperature Low Limit	nciSpaceLowLimit	SNVT_temp_p
Space Temperature Sensor Offset	nciOffsetTemp	SNVT_temp_p
Setpoint Offset Step Command Value (TM Setpoint Offset Range = +/- value x 8) (IRM Setpoint Offset Range = +/- value)	nciOffsetStep	SNVT_temp_p
Send Heartbeat	nciSndHrtBt	SNVT_time_sec
Fan Coil Unit Type (2 or 4 pipe, electric heater)	nciCfgFcc.FccType	UCPT_CfgFcc
Heat and Cool Valve DAO Cycle Time (sec.)	nciCfgFcc.ValveCycleDur	
Electrical Heater DAO Cycle Time (sec.)	nciCfgFcc.ElecCycleDur	
Fan Control Mode (neutral zone, heat, cool)	nciCfgFcc.FanOp	
Room Module Type (TM with setpoint offset or absolute or IRM)	nciCfgFcc.RoomModuleType	
Space Temp Sensor Select (AD-FCD only) (TM/unit mount sensor or IRM sensor)	nciCfgFcc.SensorSelect	
IRM Display Definition (AD-FCD only) (space temperature/setpoint/fan status)	nciCfgFcc.TempDisplay	
Auxiliary Contact (occupancy, heat/cool change-over or condensation sensor)	nciCfgFcc.AuxContact	
Fan Over-run Time in OFF status (sec.)	nciCfgFcc.FanOffDelay	
Window Contact (not used, NC, NO)	nciCfgFcc.Window	
Fan Speed Levels (speeds 1, 2, 3)	nciCfgFan	UCPT_CfgFan
Back Light Time-out of AD-IRM Display (AD-FCD only) (0 to 60 sec.)	nciIrmBackLight	UCPT_IrmBackLight

SNVT: Standard Network Variable Type SCPT: Standard Configuration Property Type

UCPT: User-defined Configuration Property Type

Note: The LonMark Resource File API must be at Version 2.3 or later. (Update available from LonMark Web site.)

Refer to *LONMARK Interoperability Guidelines* for further details at [www.lonmark.org](http://www.lonmark.org).

# Specifications and Technical Data

## TM-2100 Series Room Command Modules

<b>Product Order Codes</b>	<i>Room Command Modules</i>
	TM-2140-0000 NTC 10k Temperature Sensor only
	TM-2150-0000 Temperature Sensor and Occupancy Button
	TM-2160-0000 Temp. Sensor, Setpoint Dial 12-28°C, Occupancy Button
	TM-2160-0002 Temp. Sensor, Setpoint Dial 12-28°C, Fan Speed, Occ Button
	TM-2160-0005 Temp. Sensor, Setpoint Dial +/-, Occupancy Button
	TM-2160-0007 Temp. Sensor, Setpoint Dial +/-, Fan Speed, Occ Button
	TM-2190-0000 Temp. Sensor and Setpoint Dial 12-28°C
	TM-2190-0005 Temp. Sensor and Setpoint Dial +/-
	<i>For Room Command Modules without temperature sensor refer to TM-1100 Series Product Bulletin (TM-1170-xxxx)</i>
	<i>Temperature Sensor only</i>
	TE-9100-8502 NTC 10k Temperature Sensor – Fan Coil Unit Mounting
<b>Supply Voltage</b>	Powered from AD-FCC Controller
<b>Ambient Operating Conditions</b>	5° to 40°C 10 to 90% RH Noncondensing
<b>Ambient Storage Conditions</b>	-20° to 70°C 10 to 95% RH Noncondensing
<b>Housing</b>	Material: ABS + polycarbonate, UL94VO rated. Protection: IP30 (IEC529)
<b>Mounting</b>	Direct surface mount. Plastic base for surface mount with wiring conduits, recessed wall box and panel mounting kits available to order.
<b>Dimensions (H x W x D)</b>	80 x 80 x 33 mm
<b>Shipping Weight</b>	0.2 kg
<b>Terminations</b>	Screw Terminals for max. 2 x 1.5 mm <sup>2</sup> wires

## AD-IRM1005 Room Command Module

<b>Product Order Code</b>	AD-IRM1005-0 LCD Display, Temperature Sensor, Setpoint Dial, Fan Speed Override and Occupancy Push-buttons
<b>Supply Voltage</b>	Powered from AD-FCD Controller
<b>Ambient Operating Conditions</b>	5° to 40°C 10 to 90% RH Noncondensing
<b>Ambient Storage Conditions</b>	-20° to 70°C 10 to 95% RH Noncondensing
<b>Housing</b>	Material: ABS + polycarbonate, UL94VO rated. Protection: IP30 (IEC529)
<b>Mounting</b>	Direct surface mount. Plastic base for surface mount with wiring conduits, recessed wall box and panel mounting kits available to order.
<b>Dimensions (H x W x D)</b>	80 x 80 x 33 mm
<b>Shipping Weight</b>	0.2 kg
<b>Serial Bus Communication</b>	Proprietary protocol, 4 wire cable 7/0.16mm (26AWG), power and TTL signals. Maximum total bus cable length 12m. Requires 2 x RJ9 type connector (not included) : AMP ref. 0-737628-4 Molex ref. 90075-0027
<b>Standards Compliance</b>	CE Directive 89/336/EEC EN 50081-1/EN61000-6-3, EN 50082-2/EN61000-6-2
<b>Cablings Accessories</b>	AD-IRCBL99S-0 Serial bus cable RJ9 to RJ9 – Length 30cm AD-IRCBL99L-0 Serial bus cable RJ9 to RJ9 – Length 6m AD-IRCKJ09-0 Connectors RJ9 - Pack of 50

# Specifications and Technical Data

## AD-FCC and AD-FCD Fan Coil Unit Controller

Product Order Codes	Fan Coil Unit Controller	Output Configuration
	AD-FCC4245-0	1 x Relay (voltage free) for electric heater (DAO)
	AD-FCD4245-0	2 x Triac (230VAC) for heating/cooling valve (DAO) 3 x Relay (230VAC) for fan control (3 speed) (See below for ratings)
<b>Power Requirements</b>	230 VAC, +10% -15%, at 50/60 Hz, 9 VA (not including external loads of valves and fan motor). Maximum current input 3A (690VA).	
<b>External Fuse</b>	External fuse or circuit breaker recommended (maximum 5A)	
<b>Ambient Operating Conditions</b>	5° to 45°C 5 to 95% RH Noncondensing	
<b>Ambient Storage Conditions</b>	-20° to 70°C 10 to 95% RH Noncondensing	
<b>Housing</b>	Material: Polycarbonate, UL94V0 rated. Protection: IP20 (IEC529)	
<b>Mounting</b>	DIN Rail or 2 Screws (max. 3 mm dia.) within FCU or other closed panel within 3m from valves and fan motor.	
<b>Dimensions (H x W x D)</b>	96 x 132 x 44 mm	
<b>Shipping Weight</b>	0.35 kg	
<b>Terminations</b>	Screw Terminals for max. 2 x 1.5mm <sup>2</sup> wires.	
<b>Physical Inputs</b>	Auxiliary Input and Window Input: Volt-free contact 600 Ohm max. when closed. Space Temperature Sensor: NTC 10k. 5 to 45°C. Accuracy +/- 0.2°C at 20°C (sensor tolerance and wire resistance not included) – Short circuit pulse to request occupancy mode. AD-FCC only: TM Module Inputs: Setpoint and Fan Speed Override – 5VDC power supply and occupancy LED drive from controller. AD-FCD only: Serial bus with RJ9 connectors for AD-IRM1005 Room Module.	
<b>Physical Outputs</b>	Fan Control: 3 relay contacts powered by controller at 230VAC, maximum 3A Heating/Cooling Valve Control: 2 triac outputs powered by controller at 230VAC, maximum 300mA (for thermal actuators with pulse width modulated / duration adjust output control) Electric Heater Control: Relay contact (volt-free) rated for 230VAC 2kW maximum (with pulse width modulated / duration adjust output control)	
<b>LONWORKS Communication</b>	Neuron 3120 and Free Topology Transceiver FTT10a, 78 kbps twisted pair network. (For network cables and layout refer to LonMark Specifications at <a href="http://www.lonmark.org">www.lonmark.org</a> .) Service Pin provided.	
<b>Standards Compliance</b>	CE Directive 89/336/EEC EN61000-6-3, EN61000-6-2 CE Directive 73/23/EEC EN 60950 LVD	
<b>External Interface File</b>	FCC Release 1 Firmware: JCSCCFCC1.XIF - SPID: 80:00:11:55:01:04:04:01 FCD Release 1 Firmware: JCSCCFCD1.XIF - SPID: 80:00:11:55:01:04:04:06	

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, and reserves the right to change or supplement the contents of this publication.

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Headquarters:  
European Distribution Centre:  
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Milwaukee, Wisconsin, USA  
Westendhof 3, D-45143 Essen, Germany  
Essen (Germany) and Lomagna (Italy)  
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