FutureNow FN485-4x0-10V
Installation Manual

Four Channel Intelligent DIN Rail Mountable Analog Output Unit with Local Inputs Controllable via RS485 Commands

OVERVIEW

The FN485-4x0-10V can be used for dimming fluorescent or LED lighting systems -using an appropriate ballast/driver with 0-10V or 1-10V input- via RS485 bus commands or via local inputs in homes, offices, showrooms, shops, restaurants, hotels, theaters, clubs, etc.

The command set and working principle of the FN485-4x0-10V is exactly the same as of the FN485-3x1kDH dimmer.

Besides, it can be used for control any other devices with 0-10V inputs. Examples are industrial amplifiers and HVAC applications.

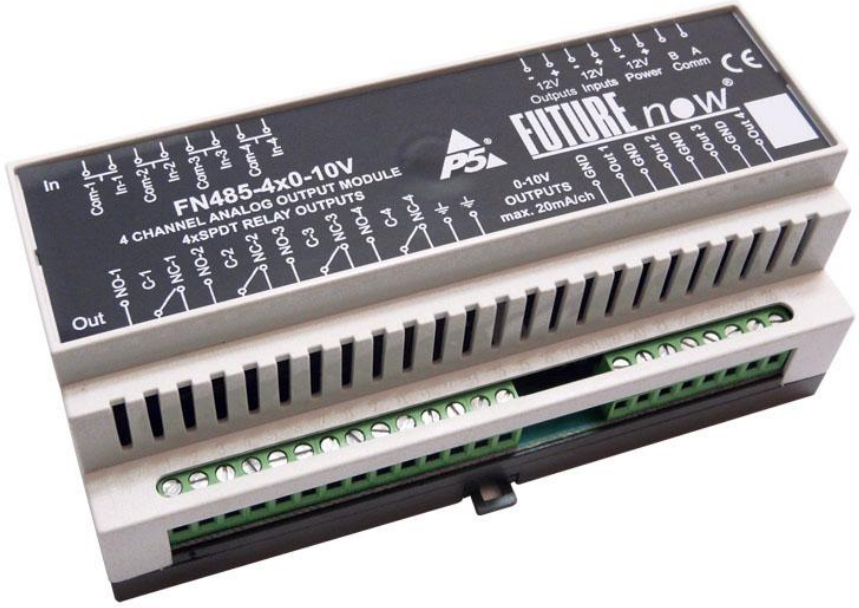

Figure 1. The FN485-4x0-10V analog output module

In addition to the four 0-10V outputs the module has four heavy duty relay outputs to cut off power from the loads at zero dim level.

In addition to the outputs, the FN485-4x0-10V analog output module also provides local inputs which give the customer the ability of using the electrical system even before a central controller is installed, offering several benefits such as stand-alone operation and improved reliability of the overall system since the operation of the relays do not rely on a controller which is usually a single point of failure.

Due to the local inputs the installation of a control system can be carried out in two steps: After installing several FN485-4x0-10V modules and other FutureNow-made FN485 devices (relay modules, dimmers, motor controllers, etc. available through P5's distributors) you can easily have a basic working system. Later, more advanced functions and intelligence can be added by connecting and programming a main controller.

The above features make the module different from most analog output modules available on the market.

Main features

- Control via RS485 or local inputs
- 4 optically isolated, analog, 0-10V outputs for dimming 4 circuits
- 4 heavy duty relays to cut power off from the loads at zero dim level
- 4 optically isolated multi-purpose inputs
- Standard DIN rail mount
- Outputs can be directly operated via local inputs without a controller
- 100 dim levels
- Dim level memory - Modules can remember their last dim level. When next powered on, lights will return to the last remembered value
- Soft start/stop with adjustable ramp rate
- Dim with adjustable ramp rate
- Bus command support for setting dim levels to discrete values
- Stored dim level can be set from a command without turning the output on
- 100+ bus commands for setting dim levels (discrete or relative), scene presets and recall, input modes of operation, timer values of day, delayed commands, etc.
- 26 groups that also can be used as lighting scene presets with independent dim levels for each output
- Monostable mode with adjustable timing
- Flash mode

OUTPUTS

The module has 4 analog 0-10V outputs which can be used to drive devices controllable with 0-10V signal voltage. In addition to the analog outputs, the FN485-4x0-10V provides 4 potential free heavy duty SPDT relay outputs, in order to switch power off from the load when the dim level of the corresponding channel becomes zero.

WARNING! Do not connect LEDs directly to the 0-10V outputs!

INSTALLATION

WARNING! Since the modules are directly connected to the mains, the installation should only be performed by a qualified electrician!

Turn off power (main circuit breaker) before installation!

Terminal connections

The terminal connectors of the FN485-4x0-10V analog output module as depicted in Figure 2. are described in Table 1.

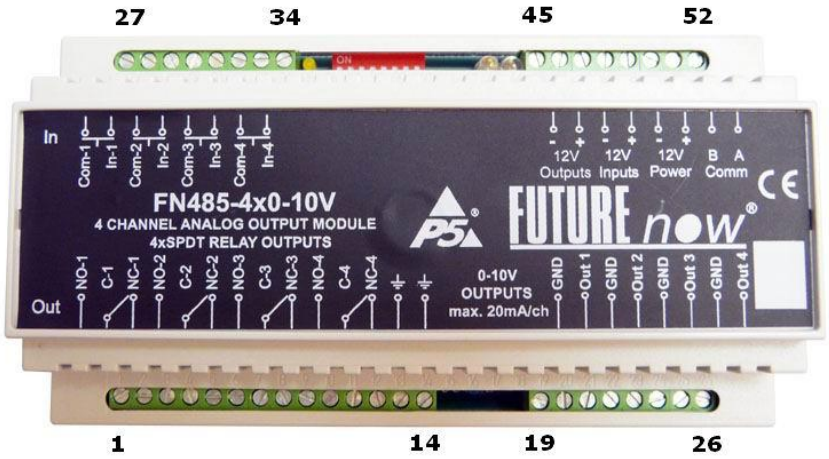

Figure 2. Front view of the FN485-4x0-10V with terminal connectors

No.	Description	No.	Description
1.	Output 1 N.O.	27.	Inputs Common
2.	Output 1 C.	28.	Input 1
3.	Outout 1 N.C.	29.	Inputs Common
4.	Output 2 N.O.	30.	Input 2
5.	Output 2 C.	31.	Inputs Common
6.	Output 2 N.C.	32.	Input 3
7.	Output 3 N.O.	33.	Inputs Common
8.	Output 3. C.	34.	Input 4
9.	Output 3 N.C.		
10.	Output 4 N.O.		
11.	Output 4 C.		
12.	Output 4 N.C.		
13.	Earth Ground		
14.	Earth Ground		
19.	Analog Outputs GND	45.	Power for Analog Outputs GND
20.	Analog Output 1	46.	Power for Analog Outputs +12V-+16V
21.	Analog Outputs GND	47.	Power for Inputs GND
22.	Analog Output 2	48.	Power for Inputs +12V
23.	Analog Outputs GND	49.	Power for Main Circuitry GND
24.	Analog Output 2	50.	Power for Main Circuitry +12V
25.	Analog Outputs GND	51.	RS-485 bus CommB (-)
26.	Analog Output 4	52.	RS-485 bus CommA (+)

Table 1. FN485-4x0-10V terminal connectors

Board layout

The board layout of the FN485-4x0-10V is shown in Figure 3.

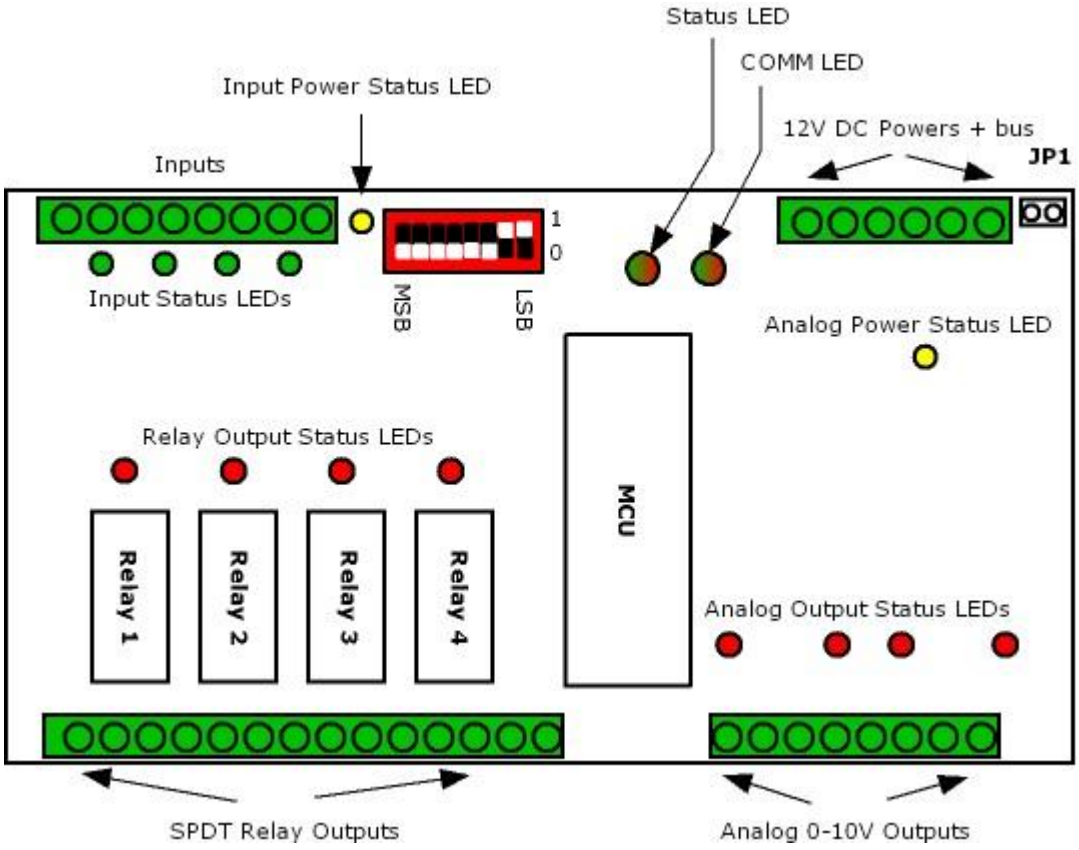

Figure 3. The board layout of the FN485-4x0-10V

Recommended wire types

- Bus cable: Twisted pair, shielding recommended in noisy or industrial environment, with GNDs (Terminal 49) of all units connected together. The commonly available CAT5 patch cable is a widely used option.
- Analog outputs: Two wire shielded cable taking the voltage drop into account.
- Output relays**:** According to the loads attached to the outputs (current and voltage).
- Inputs: A pair of low or high voltage cables.

Power requirements

Calculating power requirement

If multiple FN modules are to be powered by the same power source, the total required power must be calculated as the sum of the maximum power consumption of each of the modules. For example if three FN485-4x0-10V modules and two FN485-8x16A modules are powered from the same PSU, the PSU must be able to supply the required current of 3x300mA + 2x500mA = 1.9 Amps. If a single PSU cannot power the total required modules, multiple PSUs can be used by splitting the modules into separate groups. Each PSU can then power a single group. However, when using multiple PSUs in this manner, the GNDs of the modules (terminal 49) must be connected together to cancel out any voltage differences that could damage the bus drivers.

If you use the same PSU for powering modules located at different locations, please make sure to calculate the needed power requirements with the voltage drop on the wire length in mind. Use low gauge wiring to minimize or eliminate the voltage drop. Alternatively, use separate PSUs at each location, but remember that the GND (Terminal 49) on each module must be connected together.

Powering the local inputs

Note that the galvanic isolation of the inputs is only effective separate power supply is used for powering the inputs. The FN485-4x0-10V has separate power input terminals (47 and 48) for this purpose. If you choose not to use the extra protection the isolated inputs offer, you can use the same power to supply both the main circuitry and the inputs. In that case, simply connect terminal 47 to terminal 49 and terminal 48 to terminal 50.

Powering the analog outputs

The analog outputs are also galvanically isolated from the rest of the circuitry. In order to utilize this, connect a separate 12V DC power supply across terminals 45 and 46. If you choose not to use the extra protection the isolated outputs offer, you can use the same power to supply both the main circuitry and the outputs. In that case, simply connect terminal 45 to terminal 49 and terminal 46 to terminal 50.

Bus Connections

You must use twisted cable pair for the RS-485 bus. The maximum length of the bus cable is 1000m.

It is recommended to run an additional wire connecting the GNDs of all units together to eliminate possible voltage differences on units that are supplied by separate power supply units.

Use shielded cable in noisy or industrial environment.

The units must be daisy chained on the bus. Avoid star and tree topologies.

Up to 32 FutureNow modules can be connected on a bus using the standard communication driver chip. A lower impedance driver chip is available upon request which allows for using up to 127 FN modules on one bus.

Installation steps

Step 1. Making the connections
Make connections as illustrated in the diagram of Figure 4. Don't apply power yet. Each module also has a wiring diagram on the front that can be used when connecting them at installation sites.

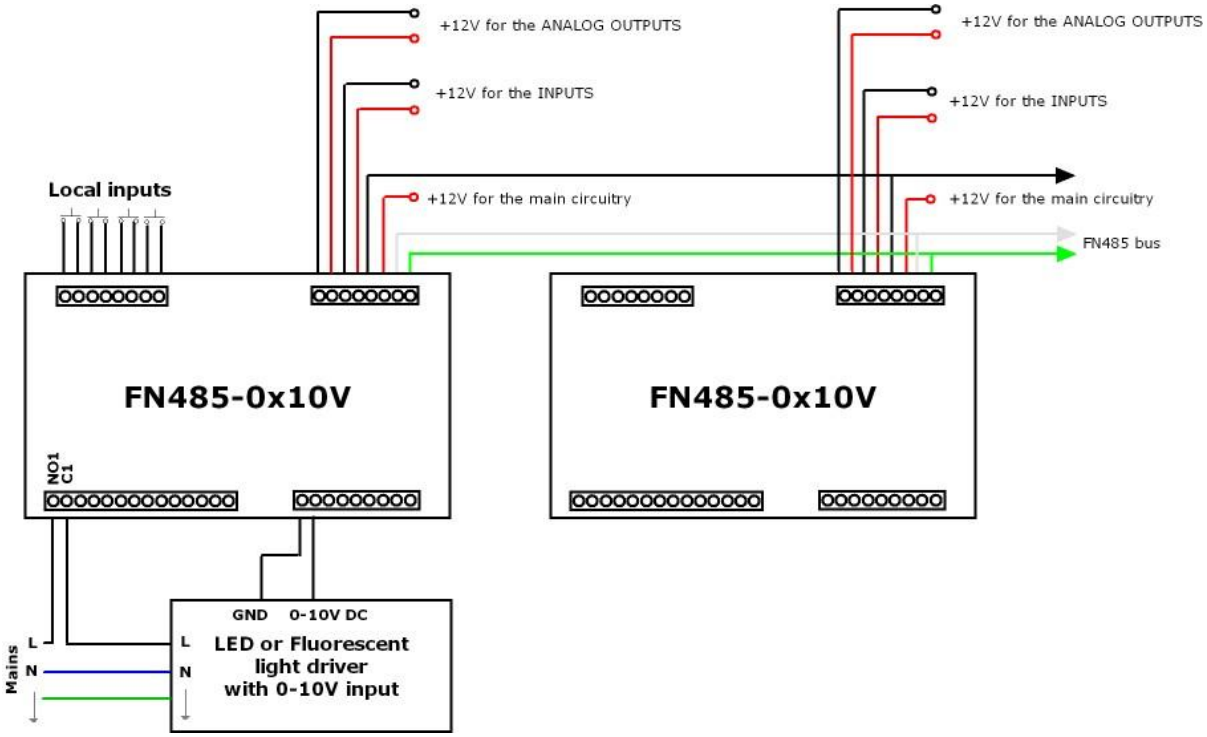

Figure 4. Connection Diagram

The diagram shows two FN485-4x0-10V modules daisy chained on the bus. Separate power sources are used to power the modules main circuitry. Because individual power sources are used, the GNDs of the different power supplies must be connected together to cancel out possible voltage differences.

Step 2. Removing the bus terminator jumpers
Remove the bus terminator jumpers from all units except the first and the last ones on the daisy chain.

Step 3. Assigning an address to the module
Each daisy chained unit is identified by the unique address set by the DIP switches. The address range is 1-127. Switches #2 through #8 are used for setting the 7-bit long address. Switch #8 represents the least significant bit. A bit is set (1) when the corresponding switch is in the ON position and cleared (0) when the switch is in the OFF position.

Set a valid, non-zero unique address for each of the modules using the DIP switches. It should be noted that in case there's no valid address set, the operation of the module is disabled even from the local inputs!

Note that all units must have a unique address! Be sure not to have two or more units set to the same address!

The address of a module (including the FN Gateway) is independent of its physical location on the bus and of the module's type. Modules do not need to be addressed in the order they are connected to the bus.

Do not use address 0 because it is reserved for broadcast commands.

Switch #1 selects the communication protocol. It must be left in the OFF position.

Figure 5. illustrates a DIP switch with an address set to 3.

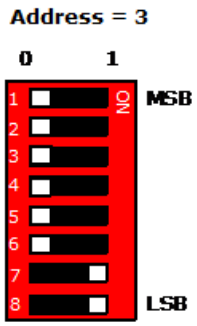

Figure 5. The address of a module set to 3 using DIP switches

Step 4. Applying power to the module
Apply power to the module (12V DC across terminals 49-50) and the analog outputs (12V-16V DC across terminals 45-46.) In case the local inputs are used you must also power the

inputs with 12V DC across terminals 47-48. Check the status LEDs to see if the power is sensed by the module.

Step 5. Testing to see if the outputs can be toggled and dimmed via the inputs
Check if the outputs can be toggled (short button press) and dimmed (button held) via the inputs (only works if input power is connected across terminals 47-48, see 4.)

Check if the relay of the corresponding channel deactivates when the output is dimmed to zero level. The status LEDs will assist you in tracking the status of the outputs and see if the inputs work correctly.

Step 6. Testing the bus communication
Test the bus communication by driving the bus from a controller or a PC hooked up to the bus through the FN485 Gateway or an RS-232(USB)/RS485 convertor and running the FN Commander utility. COMM LED will help you troubleshoot communications problems.

Status LEDs

In order to make installation and debugging easier, communication and channel status are displayed via LEDs.

STATUS LED – Indicates modules status

Color	Status
Solid Green	Normal operation
Solid Red for 1 second after power up	The control of outputs is disabled for that time.
Flashing red	The unit address is set to 0 (not allowed)
Off	The module is writing to non-volatile memory (i.e. when executing commands like defining input modes, group assignments, etc.)
Solid yellow for 0.2 seconds	When receiving a command addressed to all outputs of the module.
Solid yellow for 1 second	When receiving a command addressed to all modules on the bus.

COMM LED – Indicates bus communication

Color	Status
Solid green*	The module is receiving a valid command from the bus

Solid red*	The module is sending a response
Solid red	No valid commands have been received for the last 10 seconds

*If the "reply to commands" option is enabled (factory default), the LED will flash yellow indicating that both a valid command has been received and that the module is replying to the command.

Analog output status LEDs
Each output has a dedicated status LED that illuminates solid red when the corresponding output is on. The dim level of the LED indicates the dim level of the corresponding output.

Relay output status LEDs
Each output has a dedicated status LED that illuminates solid red when the corresponding output is on.

Input status LEDs
Each input has a dedicated status LED that illuminates solid green when the corresponding input is activated.

Input power LED
When on, indicates that the input power is present.

Analog power LED
When on, indicates that the analog power is present.

Local Inputs

For each output, there is a local input to allow for manual operations. If you do not wish to use local inputs, this section may be skipped.

Connect dry contacts (pushbuttons, momentary switches, relay contacts, etc.) or open collector transistor outputs across the appropriate input terminals and the input common terminal. Low voltage for the inputs is supplied by the FN485-4x0-10V.

WARNING! Avoid supplying voltage on these terminals!

All input ports are galvanically isolated to protect the unit against unwanted effects of ground loops, overvoltages or misconnections.

To assure an additional level of safe and reliable operation, the inputs are also software protected against the effects of noise spikes that usually occur when heavy inductive loads

(motors, fans, etc.) are switched nearby. In most systems lacking this level of protection, these spikes may result in unwanted operation.

Note that the galvanic isolation is only effective when an independent power supply is used for powering the inputs. The FN485-4x0-10V has separate power input terminals for this purpose. When you choose not to use this extra protection you can use the same power to supply both the main circuitry and the inputs. In that case simply connect terminal 47 to terminal 49 and terminal 48 to terminal 50.

Three-way switches can be implemented by simply connecting multiple momentary switches parallel.

Operation via local inputs

Inputs are activated when the appropriate input terminal is shorted to the input common terminal.

Throughout this section it is assumed that momentary switches are connected to the local inputs.

In order to power the circuitry for the local inputs, an input power of 8-16V must be applied across terminals 47 and 48. In case local inputs are not needed, this power connection is not necessary.

There are six different input modes. Setting the input mode is possible via bus commands.
The inputs are factory defaulted to ”toggle mode, dimming enabled” mode. The input modes work as follows:

1. Toggle mode, dimming enabled (input mode 5)
Short button press: Toggles the corresponding output

Each press of the button shorter than 0.5 second toggles the corresponding output. If the output was on, it will turn off, if it was off, it will ramp to the last used dim level.
The ramp rate is adjustable with a default of 5 seconds, meaning it takes 5 seconds for the light to ramp from 0% to 100%. Ramping to lower dim levels takes a proportionally shorter time.

Long button press: Sets the desired dim level

Holding the button longer than 0.5 seconds causes the corresponding output to ramp up or down until the button is released. The direction of ramping toggles with each long button press. If it was ramped up last time it will ramp down and vice versa. However, if the

current level is 0%, it will always ramp up and conversely ramp down when the level is currently 100%. The ramp rate is adjustable with a default of 5 seconds, meaning it takes 5 seconds to ramp from 0% to 100%. Each smaller change takes a proportionally shorter time.

WARNING! *Some light bulbs don't illuminate at very low dim levels. So if you adjust a dim level close to zero and then you turn the light off, that dim level will be stored. When turned on the next time, the light will go to that very low dim level and it might seem that it doesn't work because the light will not light. If that is the case, dim up the light first by holding the button.*

2. Independent inputs (input mode 0)
Inputs can be disconnected from their corresponding outputs, in which case they will have no effect on them. Please note that the status of inputs can still be queried via the bus. This can be useful for example, if the input will be interpreted by software exclusively.

3. Input follow mode (input mode 2)
The status of outputs will follow the state of the corresponding inputs, as in case of a regular maintained switch. (The output will be on while the pushbutton is pressed and off while it is released)

4. Monostable mode (input modes 3 and 4)
The outputs can be programmed to switch on (or off for input mode 4) for an adjustable amount of time when the corresponding input is triggered (useful for staircase lighting for example).

5. Toggle mode dimming disabled (input mode 1)
The output will toggle upon each short button press of the corresponding input, but the dim level will not change when holding the button.

Operation via RS-485 bus commands

To achieve the best possible integration with most home and commercial applications, modules can execute a wide range of instructions and queries.
The most widely used commands are on, off, toggle, set dim level, set all outputs as a binary value (on/off), delayed on/off with adjustable delay, monostable on/off with adjustable timing, group definition, group on/off, scene definition, scene activation, and input mode selection.

All settings and states can be retrieved by query commands. The timer values, input modes, and group and scene settings are stored in non-volatile memory and will not be affected by a power outage.

Basically, any third party controller that can implement the FN485-4x0-10V's simple communication protocol can control the FutureNow FN485-4x0-10V. The following controllers and remotes are the most widely used:

- AMX
- Comfort II.
- Control4
- Crestron
- Cue
- HomeVision
- Philips pronto remotes

There have been software modules/plug-ins written for all of the above controllers and are available upon request.

Besides these special-purpose controllers, there are many applications using embedded industrial PC boards and PCs running both Linux and Windows.

The description of the communication protocol, a utility software for testing/reviewing the commands (FNCommander485), and a bus tester application are available upon request.

The timer values, input modes, and group and scene settings are stored in non-volatile memory and will not be affected by a power outage.

Checking the status of inputs and outputs via bus commands

Since RS485 is a master-slave bus architecture, the changes of inputs and outputs will not be reported automatically on the bus. The bus participants cannot send unsolicited messages, they can only reply when asked by the master. The actual status of the inputs and whether they have changed since the last query can be retrieved via query commands from the controller(master on the bus). The actual status of outputs can also be queried.
The controller must send a query every time it needs the status of outputs or inputs. So, if user feedback is needed on the input/output statuses, the units must be polled constantly. However, if the local inputs are not used, the output statuses need not be queried, since the outputs cannot get out-of-sync with the controller.
On the other hand, if you want to trigger events by the change of an input, the inputs must be polled quite frequently to get the event fired within an acceptable time.

It is worth mentioning that frequent polling requires heavy resources from the controller. Since the status of inputs and outputs usually change relatively rarely compared to the frequency of polling, most of the queries are sent unnecessarily.

In order to save the controller from the burden of polling, there is a separate FN Gateway (poller) module available which can be connected between the controller and the bus. This poller will only send a message to the controller when something has changed on the bus that it is polling. See FN Gateway documentation [FutureNow FN Gateway Introduction].

Technical specifications

Power requirement
Main circuitry**:** 8-13.8V DC, max. 300mA@12V
Inputs: 8-16V DC, max. 60 mA@12V
Power for analog outputs: 12V-16V 80mA

Relay Outputs
Type: 8 x SPDT NO, NC dry contacts
Load**:** max. 10A@230VAC or 30V DC for resistive (cosfi=1) loads and
max. 8A@230V AC or 30V DC for inductive (cos(fi)=0.4) loads
max. voltage 230V AC or 125V DC

Analog Outputs
Type: 0-10V DC
Max. load: 20mA

Inputs
Power: 8-16V DC
Current: Approx. 15 mA@12V per closed inputs
Type: 4 x galvanically isolated, noise protected common GND digital inputs for dry contacts or open collector transistor outputs
Functions: Assigned to the corresponding output (Toggle Only, Toggle+Dim, Follow, Monostable On, Monostable Off) or independent

Bus communication
Max. Bus Length: 1000m
Max. No. of modules on a bus: 32 (127 with special comm. chip)
Type: RS485 half duplex
Baud rate: 9600 Baud
Parity: None
Bits: 8
Stop bits: 1

Terminals
Type: Screw terminals for max. 2.5 mm^2 wires

Other parameters
Operating temperature: 0 °C – 70 °C (32-158 °F)

Dimensions: W x H x D = 157 mm x 86 mm x 57 mm (9 DIN module width)
Weight: 0.30 kg
Color: Light grey with black cover plate

Standards
EN 61000-6-1:2007
EN 61000-6-3:2007
EN 60669-2-1
RoHS

Test methods
EN55022:2007/A2:2007
EN 61000-4-3:2006/A1:2007
EN 61000-4-6:2008
EN 61000-4-2:2009

REFERENCES

FutureNow FN485-8x16A Installation Manual
FutureNow FN485-3x1kDH Installation Manual
FutureNow FN485-4xSH Installation Manual
FutureNow FN Gateway Introduction

CONTACT DETAILS

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