BARIX R6

BARIX R6

DIN-rail mountable relay unit for commercial control, power switching and home automation applications

PRODUCT MANUAL

Version: 01.03
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For Firmware Version 2

BARIX™
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Introduction

The BARIX R6 is a relay extension unit for the Barionet adding 6 relays capable of switching 10 Amps at up to 250 VAC.
Since the standard Modbus/RTU protocol is used, the BARIX R6 can also be employed in other applications as a Modbus controllable relay unit.

The device is configured via the serial interface using standard Modbus read/writes. If the device ID is unknown, a special command is available, which can be sent via broadcast and uses the serial number of the device to send it new configuration info. A “default settings” jumper allows to set the device temporarily to a default configuration.

The protocol supported is Modbus/RTU at 19200 (default) and 9600 Baud, with even (default) or no parity.

For applications needing fast setting of relays on multiple devices, special commands have been added to the standard Modbus functionality.

Hardware

Case

The BARIX R6 relay extension uses a DIN-Rail mountable plastic case which directly snaps onto a standard DIN-Rail.
A mounting bracket is also available as an option.
The snap-on cover can easily be removed using a screwdriver. All screw terminal blocks are conveniently positioned outside of the cover, so the only reason to remove the cover is to access the "default" jumper in case the device configuration is not known.
The RS-485 bus and power connection is available on multiple connectors to facilitate easy daisy-chaining.
8 LED indicators show the status of the outputs as well as power and RS-485 traffic generated by the unit.

Connectors

The load connectors are screw terminal connections which allow the insertion of wires up to AWG14 (2.5mm^2). For every relay, the NO (normally open) and NC (normally closed) contacts are brought out to a terminal. For safety reasons, these terminal blocks are not removable. All load connectors are positioned on the top side of the device.

The RS-485 bus and operating power of the unit can be connected via a 6-pin removable screw terminal block, positioned on the bottom side of the device. Two extension connectors carrying the RS-485 and power connections, one on the left and one on the right side, facilitate easy daisy chaining of multiple devices.

Power supply requirements

The BARIX R6 is equipped with a universal power input and accepts both AC and DC voltage. The AC supply range is12 to 24 Volts and 9 to 30 Volts when powered by a DC power supply. A switching power regulator generates the internally needed operating voltage of 5VDC with high efficiency and consumes with all relays activated maximal 3.5 Watts only.
The R6 is reverse polarity protected.

RS-485

The host interface of the BARIX R6 is an RS-485 interface, which is connectible via extension connectors as well as via screw terminals. Besides "A" and "B" signals for the differential, bidirectional bus signal, a third connection is available, commonly referred to as "reference ground". This signal is internally tied to signal ground via a 100 Ohm series resistor.

Termination resistors are NOT provided on-board.
A termination resistor may be added at each far end of the RS-485 bus, if required.
The BARIX R6, as well as other Barix I/O extension units, feature soft pull-up (B) and pull down (A) of 10kOhm resistors, which force the inactive bus to a relatively high impedance, idle condition. Both A and B line signals are heavily protected against ESD (Electrostatic Discharge).

Supported interface configurations are

19200 baud, 8bit, even parity, 1 stop bit (**default**)
19200 baud, 8bit, no parity, 1 stop bit
9600 baud, 8bit, even parity, 1 stop bit
9600 baud, 8bit, no parity, 1 stop bit

LED Indicators

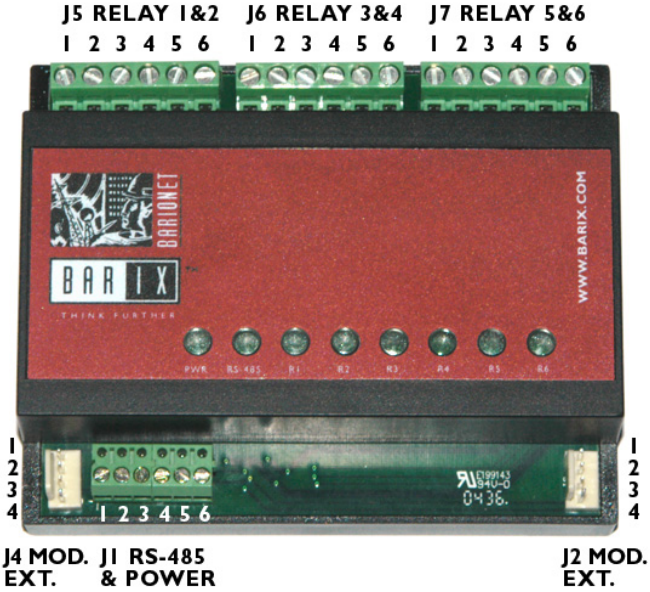
Eight LED indicators on the unit show the following conditions:
LED 1: operating power
LED 2: R6 answers to Modbus messages
LED 3..8: state of the 6 output relays

Configuration Memory

The Barionet R6 contains 256 bytes of configuration memory which can be read and (most of it) written via standard Modbus commands. The EEPROM based memory is persistent over power outages, no batteries are used.

Connectors

Connector Pin out overview



J5,J6,J7 Pin out (Relays)

All relays provide separate NO/NC capability, and can switch up to 10 Amps at max. 250VAC. An indicator LED per relay is activated together with the relay. The "COM" terminal is connected to NC if the relay is inactive, and "NO" when the relay is activated.

Pin	J5	J6	J7
1	NC 1	NC 3	NC 5
2	NO 1	NO 3	NO 5
3	COM 1	COM 3	COM 5
4	NC 2	NC 4	NC 5
5	NO 2	NO 4	NO 5
6	COM 2	COM 4	COM 6

J2, J4 Pin out Extension Connectors

J2 and J4 (Molex, p/n 22-27-2041, 4A max) are provided for easy connection of multiple devices, and are located at the left and right sides. They carry the unregulated supply voltage and RS-485 bus signals.

J4 MOD. EXT.

J2 MOD. EXT.

Pin	Function
1	VCC (+)
2	VSS (-)
3	RS-485 A
4	RS-485 B

J1 Pin out (RS-485 and Power)

J1 can be used to connect the supply voltage and the RS-485 bus to the relay unit. These screw terminals are electrically identical to the expansion connectors J2 and J4. In addition, a "reference ground" and "Signal GND" pin is provided. Reference ground is connected to the Signal ground of the Barionet R6 via a 100 Ohm resistor and can be used for grounding applications. "Signal GND" is the system ground of the R6 – which is NOT identical to the supply "VSS" pin – and is used for measuring purposes only.

D. J1 RS-485 & POWER

Pin	Function
1	Reference GND
2	RS-485 A
3	RS-485 B
4	VCC (+ or ~)
5	VSS (- or ~)
6	Signal GND

Protocol support

General

The BARIX R6 communicates via the well known Modbus/RTU protocol over its RS-485 interface. The unit is also configured via writes to Modbus registers.
In addition to the actual I/O register(s), a 256 byte information area is accessible which contains device type, software version, serial number, the configuration as well as user changeable storage.

Attention:
Writing to registers can take up to 10 milliseconds per address before being confirmed (Modbus acknowledge).

Supported Standard Commands

The following standard Modbus commands are supported by the BARIX R6. All other commands will be answered with an exception code. Due to the limited memory resources of the BARIX R6, the unit cannot receive messages larger than 95bytes and will ignore these (for example, write multiple registers commands).

CMD (hex)	Function
03 (0x03)	read (holding) register
05 (0x05)	write single coil
06 (0x06)	write single register
16 (0x10)	write multiple registers

Special Commands

The BARIX R6 also supports some special, Barix proprietary commands which have been implemented to ease configuration and facilitate the use of the R6 in conjunction with non-Modbus systems. These commands are further described in this manual and are:

CMD (hex)	Function
68 (0x44)	set all outputs on multiple units
69 (0x45)	set configuration using serial number
70 (0x66)	set coil without acknowledge

Exceptions

The BARIX R6 responds to malformed commands or access violations with the defined Modbus exceptions.

Command 68

The command code 68 (hex 44) can be used to set the outputs of a whole group of R6 devices very fast and efficiently. The command is sent via broadcast and can address multiple units, with one byte per device carrying the information for all 6 outputs. All devices addressed by this command will synchronously set their outputs after the command is completely received. No acknowledge is returned.

Command format:

Byte 1 - 0xff (broadcast address)
Byte 2 - 0x44 (command code)
Byte 3 - ah (first address, hi, always 0)
Byte 4 - al (first address, Modbus address of first device)
Byte 5 - ch (count, # bytes, hi, always 0)
Byte 6 - cl (count, #bytes, lo 8 bit)
Byte 7 - nb (number of bytes following (redundant)
Byte 8...8+nb: data bytes for multiple devices
Byte 8+nb+1: crc1 (crc1 according to Modbus spec)
Byte 8+nb+2: crc1 (crc1 according to Modbus spec)

Example: a command with al=5, cl=nb=4, data 01,02,04,08 will set the outputs on the R6 with Modbus address 5 to 01 which means relay one on, all others off, outputs on the R6 with the Modbus address 6 to 02 which means relay two on, all others off, devices with address 7 and 8 accordingly.
All other devices with Modbus addresses 1..4 and 9..255 are not affected by the command.

Command 69

The command code 69 (hex 45) is used to set an R6 device which is connected to the bus and which address is unknown (but serial parameters are correct) or which is forced to default settings with the default jumper.
The command can also be sent multiple times with different serial parameters to find the device.

The serial number of the device, which can be found on a label on the unit (format xxx-yyy), needs to be inserted into this block to address the specific unit. The block is sent out as a Modbus "broadcast".
Bytes 272, 273, 274, 275 of the Modbus register map (configuration memory positions 16..19) will be written with the provided information if the serial number matches.
Command format:

Byte 1	- 0xff	(broadcast address)
Byte 2	- 0x45	(command code)
Byte 3	- s1	(serial number, first part)
Byte 4	- s2	(serial number, second part)
Byte 5	- s1	(serial number, first part, repeated)
Byte 6	- s2	(serial number, second part, repeated)
Byte 7	- c1	(configuration data for register 272)
Byte 8	- c2	(configuration data for register 273)
Byte 9	- c3	(configuration data for register 274)
Byte 10	- c4	(configuration data for register 275)
Byte 11	- crc1	(crc1 according to Modbus spec)
Byte 12	- crc2	(crc2 according to Modbus spec)

Despite the broadcast addressing, the unit will respond with a command acknowledgment (containing bytes 1..6 plus crc) !

Command 70

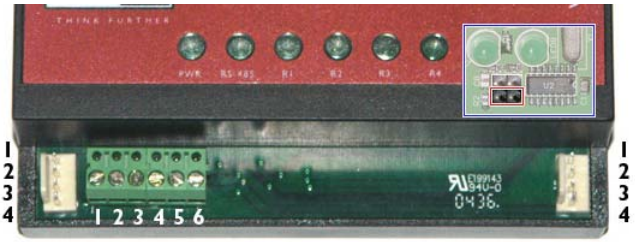
The command code 70 (hex 46) is used to set an R6 output without a return acknowledgment. The command uses the exact syntax of the 05 (set coil) command, but the R6 does not send an answer and is immediately ready to receive the next message. The command should be send addressed to the device address and NOT as a broadcast, otherwise all R6 units on the bus will react to it.

This command has been added to the Barionet R6 to allow slow systems, which are not Modbus native and cannot react fast to serial input (like common home automation systems) to set a series of relays of one or multiple R6 units without the need to observe Modbus message timeouts, answers etc.

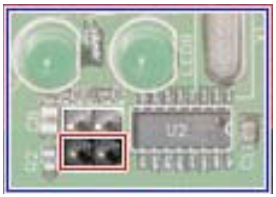
Configuration

Default Parameters

The BARIX R6 is configured via the RS-485 interface using standard Modbus commands.
If the address of the device is not known, it can be temporarily set to default parameters by setting a jumper in the device. No reset is necessary. Within 5 seconds after applying the jumper, the default parameters are assumed. It is NOT necessary to reset or to power cycle the device after removing the jumper ! If no valid Modbus blocks are received by the relay unit for a 5 second time interval, the serial interface is reset and reconfigured with stored parameters.
Use a screw driver to remove the snap-on case top. On one side of the case lift one latch first and gently pull the top then lift the second latch and remove the top completely.



J3 is a 4 pin connector and is located between LED7 and LED8. To set default parameters connect the lower two pins using a standard jumper (not included).

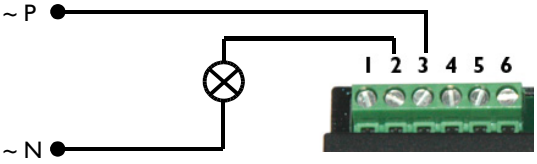


When the jumper is set, the default parameters are:

Serial interface 19200 Baud, even parity, 1 stop bit
Modbus Address 255

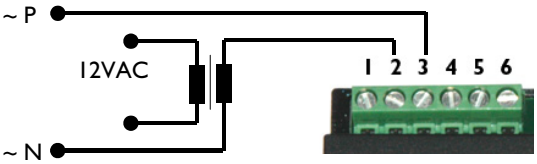
Connecting external loads

The BARIX R6 features 6 relays capable of switching resistive loads (lamps, heater) 10 Amps at up to 250 VAC.

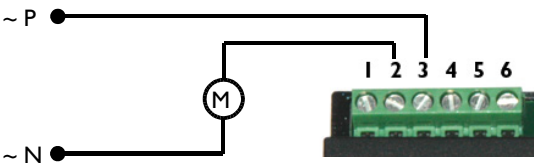


Cautious calculations should be performed when switching inductive loads like motors or transformers as used in low voltage halogen light systems:

A transformer produces a high voltage when switched off causing an arc which is reducing the life span of the relay contacts.



Motors have a high start up current (typical factor of 2 to 5 times the nominal current !) so even a motor with a nominal current draw of 5 Amps could reduce the life time of relay contacts significantly. We advise to check the technical specs of the used motor and to also take in account the added initial current draw caused by the attached mechanics.



Connecting a Barix Barionet controller

The actual Barix Barionet controller features two 3pin expansion connectors which are **NOT** compatible with the 4pin expansion connectors of the BARIX R6. This will be changed in a future hardware revision of the Barix Barionet controller to allow for daisy chaining. This is already supported between BARIX R6 devices and other Barionet extension devices.

RS-485 wiring

However, connecting a Barix Barionet controller is simple as it features the RS-485 signals on J7 which is a detachable screw terminal block:

Pin	485
1	Reference GND
2	Not used
3	Not used
4	RS-485 A
5	RS-485 B
6	Reference GND

- connect Pin 4 (J7) to Pin 2 (J1) of the BARIX R6 (RS-485 A)
- connect Pin 5 (J7) to Pin 3 (J1) of the BARIX R6 (RS-485 B)

RS-485 troubleshooting

When communication problems occur two measures can be taken to improve the RS-485 signal quality.

Reference wire

When using two separate power supplies a third wire should be used to ensure a common voltage level :

- Connect Pin 1 or Pin 6 (J7) to Pin 1 (J1) of the BARIX R6

RS-485 termination

When the two devices need to be connected over a long distance both sides of the cable should be terminated using a 100 Ohm resistor to suppress signal reflections:

- Connect a 100 Ohm resistor between Pin 4 and Pin 5 (J7) directly at the terminals of the Barionet controller
- Connect a 100 Ohm resistor between Pin 2 and Pin 3 (J1) directly at the terminals of the BARIX R6

Modbus Register Map

The BARIX R6 supports all 64k address locations in the Modbus address maps, however, unimplemented locations generate an exception when read or written.

The Modbus address range is divided in multiple address maps, all 65535 registers in size. The Barionet R6 implements the "coils" (64k, 1bit) and the "registers" (64k, 16 bit). There are no functions provided to read back discrete (1bit values) in the shipping software version.

Attention: all Modbus addresses count from 1, while the protocol addresses start at 0. Example: Modbus register 1 is addressed in Modbus/RTU as "0". This documentation uses the Modbus register number – in the protocol the address must be one less !!

Live I/O

The state of the relays can be set/reset using "set coil" and "write register" commands. In addition, the state of the relays can be read back using the "read register" command.

In the "coil/discrete" address map, only positions 1..6 (Modbus/RTU addresses 0..5) are populated in the BARIX R6, which are mapped to relays 1..6. Write access to any other address is prohibited.

In the "register" address map, the relays can be written simultaneously by accessing register 1. Bit 0 is relay 1, bit 1 is relay 2, ... bit 5 is relay 6.

Configuration Data

All configurable parameters are accessible using standard Modbus read/write commands to registers.
The configuration information area is 256 bytes, which are accessible as 256 byte registers (lower 8 bits only), registers 257..512 in the Modbus memory map.
The first 16 bytes of the configuration registers are "one-time" writable only – after setting these registers to a value not equal to 255 (hex 0xff) they cannot be changed any more. All other

registers can be read and written. Within these first 16 bytes, Device type, software version, and serial number are stored. In addition, the installer of the unit can use 8 bytes to write permanent information (like shipping date, system ID where the unit is installed etc). Of the remaining 240 bytes, the first 16 bytes have a special meaning (configuration registers) – all other registers (290..512) can be used by the installer/customer to store information.

ID registers

Device information such as device ID, software version etc can be accessed using standard register read commands. This information is read-only and cannot be overwritten. The information is accessible using standard reads from addresses 257..264.
Register 257: set fixed to "0xB1" (stands for Barionet R6)
Register 258: software version, 2 at the time of printing.
Register 259: first part of the serial number (byte)
Register 260: second part of the serial number (byte)
Register 261..264 are reserved for future use by Barix

Register 265..272 are usable as one-time writable storage by the installer or controlling software.

Configuration registers

Device configuration can be set and read using standard Modbus commands. The R6 will reset its actual communications parameters to these values anytime it does not receive valid host communication for more than 5 seconds and the default jumper is NOT set.

Register 273: Default relay settings in this Register are 00 by default, if Bit 0 is set, Relay 1 will be activated at startup etc..

Register 274: Serial interface mode: only bit 7 and bit 0 are used. Bit 0 selects between 9600 (set) and 19200 (reset) baud. Bit 7 selects between no (set) and even (reset) parity.

Register 275: This register holds the Modbus address of the unit.

Register 276..289: Reserved for future enhancements.

Complete Register Map

Detailed "register" map – again – please note that the protocol address in Modbus/RTU is the register number -1 !!

Register	Function
1	Live I/O (Byte, Relay state in bit 0..5)
2..256	Reserved, not accessible
257	Device type (hex 0xB1)
258	Firmware version
259	Serial number 1st part
260	Serial number 2nd part
261..264	reserved
265..272	One-time writable for installer
273	Default relay setting for startup
274	Serial interface mode
275	Modbus address
276..289	reserved
290..512	Memory for installer/software use
513.... 65536	not accessible

Complete Coils Map

Detailed "coils" map – please note that in the protocol, address in Mobus/RTU is the coil number -1 !!

Coil	Function
1..6	Relay 1..6
7..65536	Reserved, do not access

Technical specifications

CPU	PIC 16F688, 20MHz clock frequency
Relays	6 independent relays (250VAC 10A, 16Amax <1sec) Operate time: 7ms nominal, release time: 3ms nominal. Contact resistance: 50mOhm (measured at 1A 6V) Operating cycles: 10mio typical at no load. Relay type: Massuse ME-11 or equivalent
Load Connectors	3 screw terminal blocks non-removable, with common, NO (normally open) and NC (normally closed) contacts for wires AWG26 - AWG14 / 0.15 – 2.5mm^2
RS-485 / Power Connector	Detachable screw terminal block for wires AWG28 - AWG16 / 0.08 - 1.3 mm^2
Host Interface	RS-485: 9600 and 19200 Baud, 8 bit, even or no parity.
Extension Connectors	2 extension connectors (4 pin) with RS-485 and power terminals, Molex 22-27-2041, 4A max., extension cable (3"/75mm) included (consisting of 2 Crimp Terminal Housings Molex 22-01-2045 and 8 female Crimp Terminals Molex 08-50-0114 of Molex 2759 series)
Power Supply Requirements	12 to 24 VAC / 9 to 30 VDC 3.5 Watt max. (all relays active)
LED Indicators	1 LED for power indication 1 LED for active traffic indication 6 LEDs for relay status indication
Case	High quality plastic, 220 grams, DIN-rail mountable 4.13" x 3.34" x 2.83"/105mm x 85mm x 32mm
Misc.	Internal connector for default settings jumper
Environmental conditions	Temperature:32 to 104° F / 0 to 40° C Humidity: < 70% relative humidity non-condensing
Conformity	FCC A and B, CE A and B Emission EN60730-1:2000 (Class B) Immunity EN60730-1.2000

The newest information about our devices and the latest version of this manual is available via download from our website, www.barix.com.

We explicitly reserve the right to change and improve the product without notice.

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