ETH8020 - 20 Relays at 16A, 8 Analogue Inputs

Technical Documentation

Overview

The ETH8020 provides 20 volt free contact relay outputs with a current rating of up to 16Amp each and 8 analogue inputs. The module is powered from a 12vdc supply which can be regulated or unregulated. The DC input jack is 2.1mm with positive core polarity, DC supplies are required to supply at least 1A at 12vdc. The relays are SPCO (Single Pole Change Over) types. The normally open, normally closed and common pins are all available on the screw terminals.

The Relays on the ETH8020 can be controlled from the inputs on the ETH484 or another ETH8020. This offers the opportunity to construct a system where an input can control an output anywhere on the earth provided both locations are connected to the network/internet.

Operating Temperature

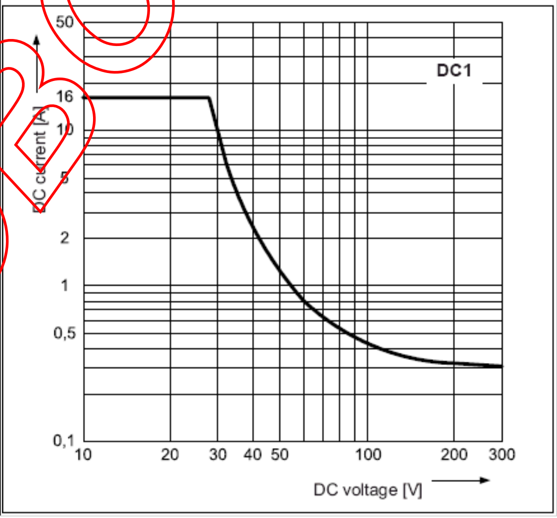
-40C to +70C

LED Indication

The ETH8020 provides a red LED mounted immediately next to each relay to indicate whether it is in a powered state (LED on), there is also two LED's mounted in the Ethernet connector which will flash with Ethernet traffic. Finally there is a green power LED next to the processor.

Relay Power Rating

If the contact load voltage and current of the relay are in the region enclosed by the solid and dotted lines in the figure below, the relay can perform stable switching operation. If the relay is used at a voltage or current exceeding this region, the life of the contacts may be significantly shortened.

load type	Typical applications	Rating	Max DC load capacity
AC1	Non inductive or slightly inductive loads	16A @ 250V AC	
AC15	Control of electromagnetic load (>72VA)	3A @ 120V AC 1.5A @ 240V AC	
AC3	Control of motor	750W	
DC1	Non inductive or slightly inductive loads	16A @ 24V DC	
DC13	Control of electromagnetic loads	0.22A @ 120V DC 0.1A @ 250V DC	

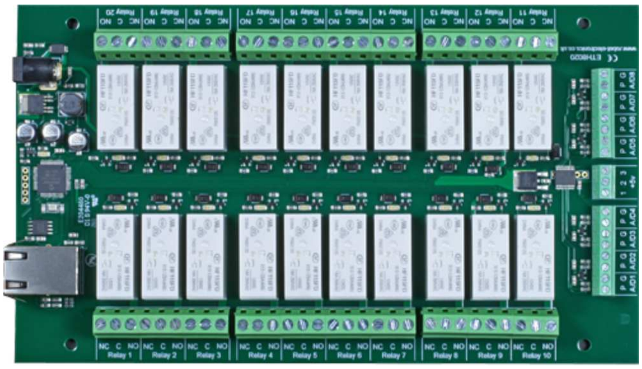
A full datasheet for the relays used on the ETH8020 is here: HF115FD datasheet

Connections

16A Volt Free Contacts, Normally Connected, Common, Normally Open

Analogue inputs

12v dc 2.1mm jack (+ve core)



P = Analogue Input (0-5v)
G = 0v ground

5v dc output

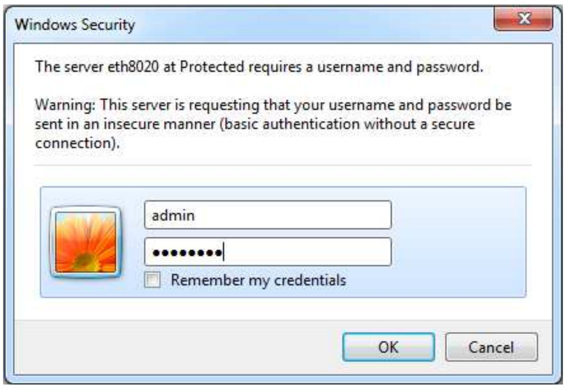
P = Analogue Input (0-5v)
G = 0v ground

RJ45 Ethernet

16A Volt Free Contacts, Normally Connected, Common, Normally Open

First Test

Having plugged in your 12vdc power supply and Ethernet connection, start up your web browser and type **http://ETH8020** into the address bar, please note this only works in windows. You will be prompted for a password as shown below:



Windows Security

The server eth8020 at Protected requires a username and password.

Warning: This server is requesting that your username and password be sent in an insecure manner (basic authentication without a secure connection).

admin

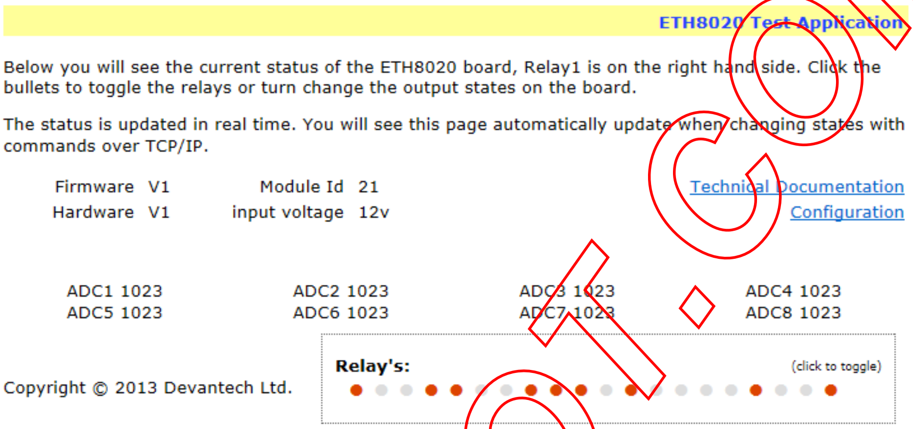
••••••••

☐ Remember my credentials

The default login is:
Username: admin
Password: password

The ability to change these settings is shown in the configuration section

You should now see the following web page:



ETH8020 Test Application

Below you will see the current status of the ETH8020 board, Relay1 is on the right hand side. Click the bullets to toggle the relays or turn change the output states on the board.

The status is updated in real time. You will see this page automatically update when changing states with commands over TCP/IP.

Firmware	V1	Module Id	21
Hardware	V1	input voltage	12v

Technical Documentation
Configuration

ADC1 1023	ADC2 1023	ADC3 1023	ADC4 1023
ADC5 1023	ADC6 1023	ADC7 1023	ADC8 1023

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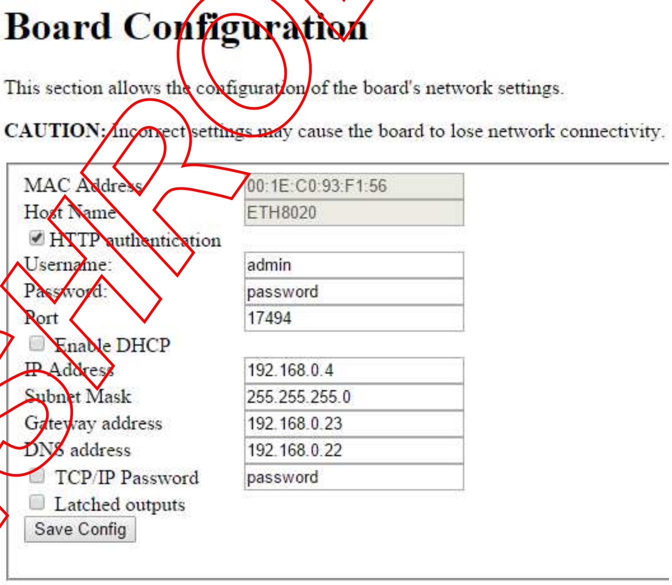
Relay's: (click to toggle)

● ○ ○ ● ● ○ ○ ● ● ● ○ ● ○ ○ ○ ○ ● ○ ○ ●

This web page will allow you to switch the relays on and off by clicking the relay buttons (the red/gray circles). It also contains a link to this technical documentation page.

Configuration
By clicking the configuration link it's possible to configure the ETH8020 IP address and subnet mask together with the ability to set a password for entry to control screens.
All settings are saved to memory so be careful to remember the username and password! Default password settings are shown in the picture below.
Version 2 now offers a latched outputs option, this will automatically save any permanent output changes (not pulsed) and restore them following power loss.



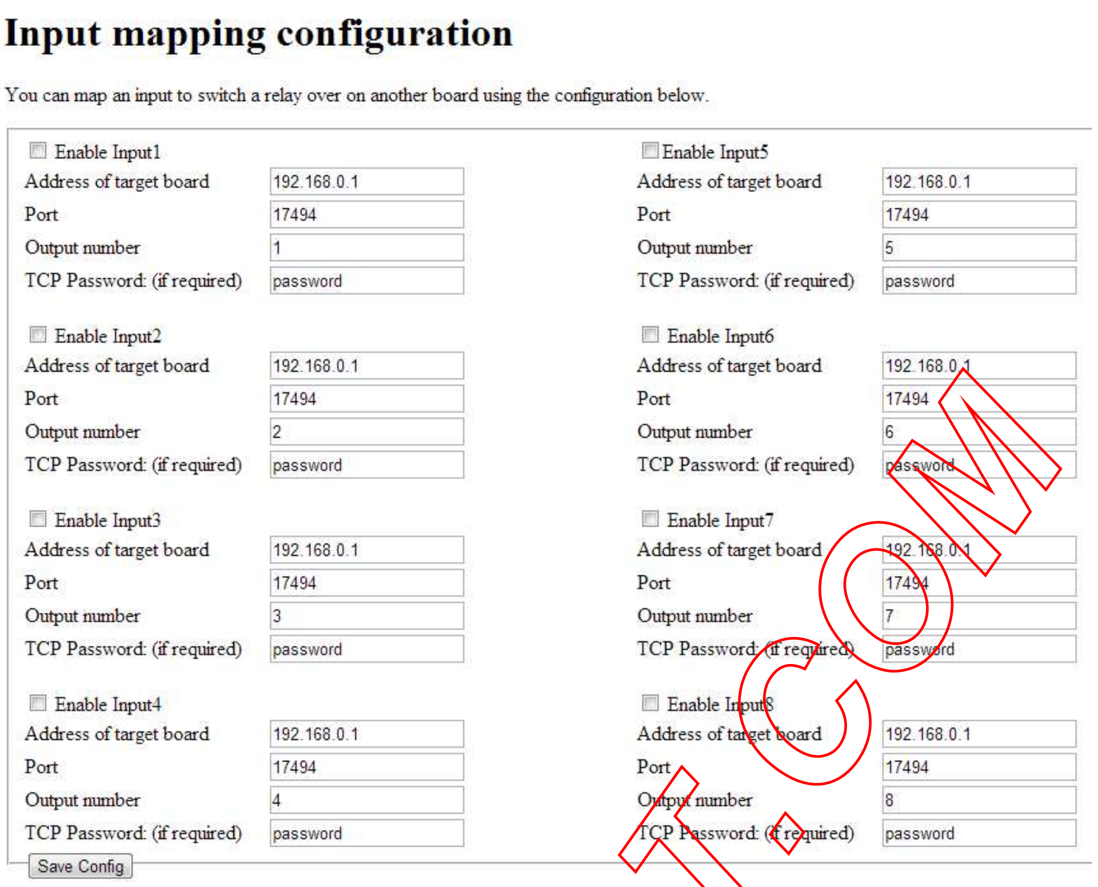
Board Configuration

This section allows the configuration of the board's network settings.

CAUTION: Incorrect settings may cause the board to lose network connectivity.

MAC Address	00:1E:C0:93:F1:56
Host Name	ETH8020
☑ HTTP authentication	
Username:	admin
Password:	password
Port	17494
☐ Enable DHCP	
IP Address	192.168.0.4
Subnet Mask	255.255.255.0
Gateway address	192.168.0.23
DNS address	192.168.0.22
☐ TCP/IP Password	password
☐ Latched outputs	

Mapped inputs
Digital inputs are able to be configured to remotely control outputs on ETH002, ETH008, ETH484 or ETH8020, this offers simple linking and versatile usage. An input in one country can control a output in another, or across a small network.
There are eight independent inputs that can be mapped to eight different relays (on the same or different boards).
The "Address of target board" field accepts an IP address or hostname (which will be converted to an IP address by the DNS server supplied in the board configuration above). If the module is on the local network then you can use the
assigned IP address, if the target is over the internet then you need to supply the gateway in the configuration (internet source IP like your router) and the "Address of target board" is the IP address of the targets internet connection (to point at the router). Accessing the target via a router is dealt with in the section "**Access from the Internet**".



Input mapping configuration

You can map an input to switch a relay over on another board using the configuration below.

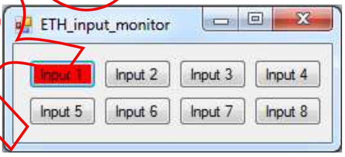
□ Enable Input1		□ Enable Input5	
Address of target board	192.168.0.1	Address of target board	192.168.0.1
Port	17494	Port	17494
Output number	1	Output number	5
TCP Password: (if required)	password	TCP Password: (if required)	password
□ Enable Input2		□ Enable Input6	
Address of target board	192.168.0.1	Address of target board	192.168.0.1
Port	17494	Port	17494
Output number	2	Output number	6
TCP Password: (if required)	password	TCP Password: (if required)	password
□ Enable Input3		□ Enable Input7	
Address of target board	192.168.0.1	Address of target board	192.168.0.1
Port	17494	Port	17494
Output number	3	Output number	7
TCP Password: (if required)	password	TCP Password: (if required)	password
□ Enable Input4		□ Enable Input8	
Address of target board	192.168.0.1	Address of target board	192.168.0.1
Port	17494	Port	17494
Output number	4	Output number	8
TCP Password: (if required)	password	TCP Password: (if required)	password

Mapping inputs to custom devices

Following customer requests for obtaining input states without the need for polling the ETH8020, this can be achieved with the existing input mapping function.
If you would like the inputs to be mapped to a custom device then we have a simple command structure to achieve this, the ETH8020 will send the commands in blue, your device will respond with commands in yellow.
A TCP packet with 0x79 (password entry) in the first byte, then the following bytes will be the password supplied above
To acknowledge a password match, respond with 1, else send 2
Digital active (0x20) or Digital inactive (0x21) followed by the output number
Reply with a 0 for success, else send 1
Note that the complete sequence must be followed, even if the password fails.

Input monitoring example and source code

We have an example of mapping the inputs to a PC, it operates on the default port of 17494, the default password of "password" (although both are easily changed in the source code) and requires the ETH8020 input mapping to be pointed at the host PC IP address. As it's having to constantly listen it's a multi thread program



The input monitor program is available as Visual C# express ready built installation files here, or as Visual C# express project with source files here.
Visual studio express is provided free from Microsoft: http://www.microsoft.com/exPress/download/

Factory Reset

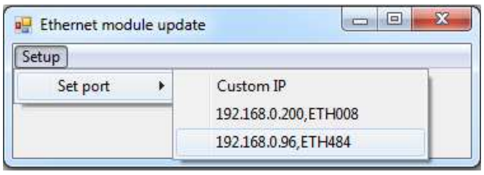
Should it be necessary to reset the ETH8020 to its shipped condition then the end two contacts of the row of 5 holes near the large chip on the side nearest the Ethernet connection must be shorted together at board power up. Keep the pins shorted until the green power LED starts to flash, this will take up to 5 seconds. The green LED will flash as the settings are reset, please wait until the LED finishes flashing and do not remove power during this period.

Firmware Updates

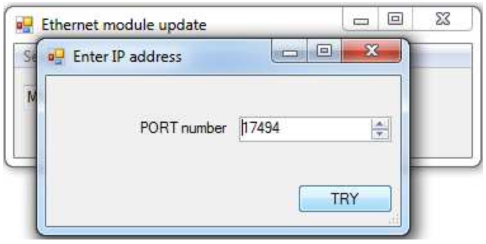
The firmware is fully updateable by re-flashing the board using our custom windows program. The updates currently available are:
V3 - 08/04/2014 - DNS and Gateway removed in http config page as they were not required, new latching function added to config and board name now appears correctly on NBNS (WINS) meaning routers display board name.
V4 - 11/07/2014 - ASCII messages added in tcp, security now on all http pages, http set output commands added
V5 - 13/08/2014 - Fixed ASCII command buffer overruns
V6 - 25/02/2015 - Corrected issue with http password length of 12 characters
V7 - 16/11/2015 - Digital input mapping functionality added, html commands now respond with board relay and input status

Using the Ethernet module update:

First you need to connect to the board, the program will scan the local network and provide any boards in a list that it can see.

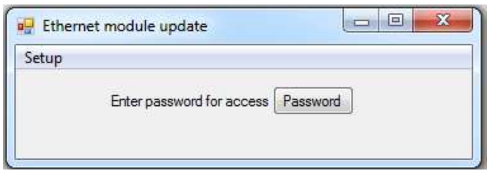


Next you will need to specify what port the board is located on, this will be 17494 unless you have changed it in the settings.

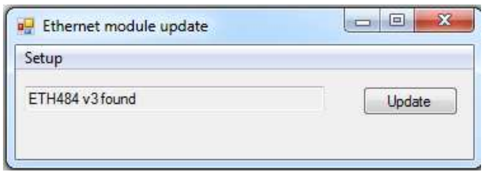


PORT number 17494

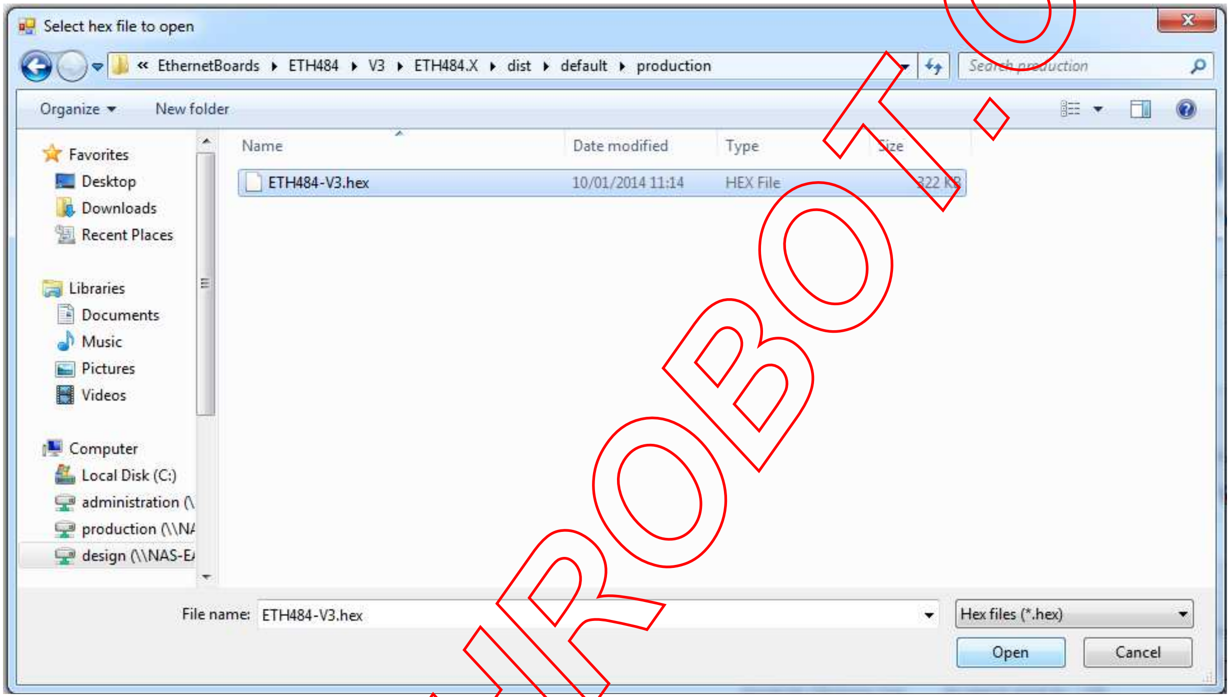
If there is a TCP/IP password the program will require it to be entered by clicking the password button.



Following a successful connection you will now be able to click the update button to select a file



ETH484 v3 found

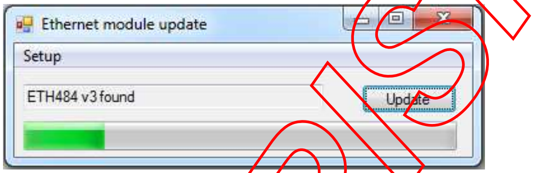


Name	Date modified	Type	Size
ETH484-V3.hex	10/01/2014 11:14	HEX File	322 KB

File name: ETH484-V3.hex

Hex files (*.hex)

Once the file has been opened the programming sequence will now begin, it's fairly short and following it's completion the board will reset (automatically) and the LED will flash quickly while the programming sequence completes. Do not turn the power off in this sequence.



ETH484 v3 found

ETH8020 Command Set

The command set designed to provide consistent expansion and new features, they are sent over TCP/IP on port 17494 (0x4456). This is the default port, it can be changed in the configuration settings.

Five connections are allowed at any one time, these are independently protected but all using the same password as defined in the board configuration.

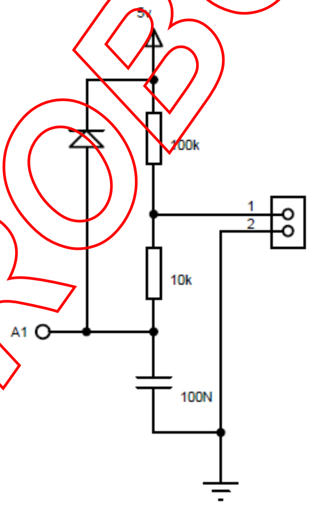
Command		Action
dec	hex	
16	10	Get Module Info - returns 3 bytes. Module Id (21 for ETH8020), Hardware version, Firmware version.
32	20	Digital Active - follow with 1-20 to set relay on, then a time for pulsed output from 1-255 (100ms resolution) or 0 for permanent Board will return 0 for success, 1 for failure
33	21	Digital Inactive - follow with 1-20 to turn relay off, then a time for pulsed output from 1-255 (100ms resolution) or 0 for permanent Board will return 0 for success, 1 for failure
35	23	Digital Set Outputs - follow with 3 bytes, first byte will set relays 1-8, All on = 255 (0xFF), All off = 0, 2nd byte for relays 9-16, 3rd byte for relays 17-20 Board will return 0 for success, 1 for failure

36	24	Digital Get Outputs - returns 3 bytes, the first corresponds with relays 1-8, 2nd byte for relays 9-16, 3rd byte for relays 17-20
37	25	Digital Get Inputs - returns 4 bytes, the first three bytes are always 0, the 4th bytes bits correspond with the 8 digital inputs, a high bit meaning input is active (driven low)
50	32	Get Analogue Voltage - follow with 1-8 for channel and ETH8020 will respond with 2 bytes to form an 16-bit integer (high byte first)
58	3A	ASCII text commands (V4+) - allows a text string to switch outputs, see section below
119	77	Get Serial Number - Returns the unique 6 byte MAC address of the module.
120	78	Get Volts - returns relay supply voltage as byte, 125 being 12.5V DC
121	79	Password Entry - see TCP/IP password
122	7A	Get Unlock Time - see section below
123	7B	Log Out - immediately re-enables TCP/IP password protection

Digital Active/Inactive Commands
These are 3 byte commands:
The first byte is the command, 32 (active means on) or 33 (inactive).
Second byte is the relay number.
Third byte is the on time. Set this to zero for un-timed operation, or 1-255 for a pulse in 100mS intervals (100mS to 25.5 seconds).
For example:
0x20 - turn the relay on command
0x03 - relay 3
0x32 (50) - 5 seconds (50 * 100ms)
Board will return 0 for success, 1 for failure
Note - All bytes in a command must be sent in one TCP/IP packet.

Digital inputs
The 8 analogue inputs are used to create 8 digital inputs. When you request digital inputs a threshold is applied to the 8 analogue inputs. Above 3v will read as low (inactive), below 2v will read as high (active). The region from 2v to 3v is the hysteresis and does not change the previous reading. There are weak pull-up resistors on the inputs which are designed to allow you to directly connect a VFC (Volt Free Contact). This could be from other relay contacts, thermostat contacts, alarm contacts etc. When the contacts are closed the input will read as active. In fact anything that pulls the input pin down to 0v will read as active. Do not think of the inputs in terms of a high or low voltage input. Think of it in terms of Active (or on, something is actively driving the input), or inactive (or off, nothing is driving the input). Command of 0x25 returns 4 bytes. The first 3 bytes are always 0. The 4th byte returned will be encoded with each bit corresponding to whether the input is active or inactive. A high bit means the pin is being pulled low (active) by an external device pulling low. Bit 0 represents AD1 through to bit 7 (AD8). For example 0xED (11101101) would mean inputs AD2 and AD5 were active.

Analogue Inputs
Eight (8) analogue inputs of 0v-5V at 10-bit resolution are provided. The conversion is performed when you send the "Get Analogue Voltage" command 0x32 and the channel number. The resulting 16 bit integer will be transmitted back in two bytes (high byte first), combine these for the result. The 10-bit conversion will be in the lower 10 bits of the 16 bit integer with the upper 6 bits being 0. There is a 5v supply available on the 3-pin terminal block between the analogue inputs .



Representative Analogue Input Schematic.

TCP/IP Password
If this option is enabled in the http configuration page then a password will be required to be entered before relay states can be changed. In the following example the password was set to "apple":

0x79 - 1st byte in frame sent to ETH8020 to indicate password entry
'a' (0x61) - 2nd byte in frame (ASCII hex equivalent in brackets, full table is available at http://www.asciitable.com/)
'p' (0x70) - 3rd byte in frame
'p' (0x70) - 4th byte in frame
'l' (0x6C) - 5th byte in frame
'e' (0x65) - 6th byte in frame

These 6 bytes are then transmitted in the same transaction to the ETH8020 and if the password is correct then 1 will transmitted back, a failure will send 2.
The board will now accept changes from the device that entered the password. If communication becomes idle for more than 30 seconds then the password protection is re-enabled.
There is also a log-out command of 0x7B to enable the protection immediately.

Get Unlock Time
Returns TCP/IP password protection status:
0 - password protection is enabled and password entry is required before changes can be made
1 to 30 - seconds until TCP/IP password protection is re-enabled. All authorised commands set the timer back to 30 seconds (including this one).
255 - TCP/IP password is not enabled.

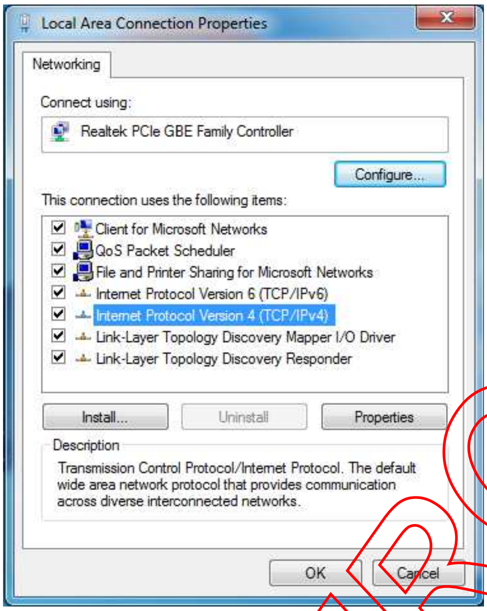
ASCII text commands DOA and DOI (V4+ firmware needed)
Following customer request we have added a feature that allows the outputs to be switched using an ASCII string, devices like a Mobotix camera can now switch relays with simple

strings.
The string for activating output1 for 5 seconds is formatted using comma seperated variables with the following syntax:
":DOA,1,50,password"
To break this down ":" (hex 3A) at the start of the string indicates that there is an ASCII message to follow, "DOA" is digital output active, "1" is the output number, then "50" for 5 seconds (50x100ms) and finally the TCP password (if applicable).
If I wanted to make output 2 inactive for 3 seconds I would use:
":DOI,2,30,password"
To break this down ":" (hex 3A) at the start of the string indicates that there is an ASCII message to follow, "DOI" is digital output inactive, "2" is the output number, then "30" for 3 seconds (30x100ms) and finally the TCP password (if applicable).
Assuming no password is used the previous command would simply be:
":DOI,2,30 "

HTML commands DOAx and DOIx (V4+ firmware needed)
Another customer requested feature, allowing the digital outputs to be switched by the http get function such as used in some voice over ip phones (VOIP). You can use the http get function to write to the io.cgi file with the following syntax:
192.168.0.200/io.cgi?DOA2=10
This would use the default address (192.168.0.200) and make output 2 active for 1 second.
Another example would be to set output 1 inactive for 10 seconds:
192.168.0.200/io.cgi?DOI1=10
You can test these functions by typing them directly into the address bar of most internet browsers. Also be aware that you may need to disable http authentication in the http configuration if your control device does not support it.

IP Addresses & DHCP Servers
The easiest way to use the ETH8020 is to connect it to a network with a DHCP server. In this case the ETH8020 will have its IP address assigned automatically by the DHCP server.

If there is no DHCP server on the network, then a fixed IP address of 192.168.0.200 is used. To control the ETH8020 using this fixed IP address your computer MUST be on the same subnet.
The next step is to set your computers IP address to 192.168.0.x where x is in the range of 1 to 255 but not 200 (the ETH8020 is there!) or any other used IP addresses on the network. The subnet mask dictates what IP addresses the PC can communicate with, we set this to 255.255.255.0 so the PC can talk to any module with an IP address of 192.168.0.x

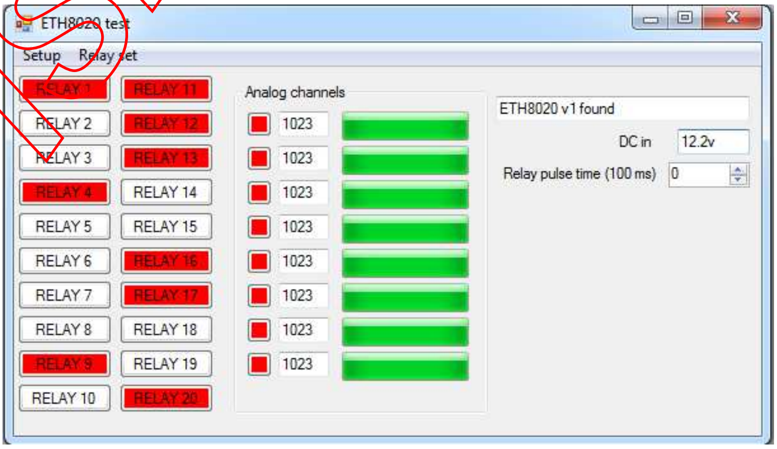

Local Area Connection Properties
Networking
Connect using:
Realtek PCIe GBE Family Controller
Configure...
This connection uses the following items:
☑ Client for Microsoft Networks
☑ QoS Packet Scheduler
☑ File and Printer Sharing for Microsoft Networks
☑ Internet Protocol Version 6 (TCP/IPv6)
☑ Internet Protocol Version 4 (TCP/IPv4)
☑ Link-Layer Topology Discovery Mapper I/O Driver
☑ Link-Layer Topology Discovery Responder
Install... Uninstall Properties
Description

Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.

This image is for a PC running Windows 7.
To get to the TCP/IP properties screen, go to:
Control Panel->Network and Sharing Center->Local Area Connection->Properties.
Select Internet Protocol Version 4(TCP/IPv4) from the scroll box and click Properties.

That gets you to the dialog box shown left.

Test program and example source code
To get the ETH8020 up and running in the minimum amount of time we have put together an example program to demonstrate the functionality of the module. We provide the full source code for this program. You may examine this code to see how it works or use it as a starting point for your own application.



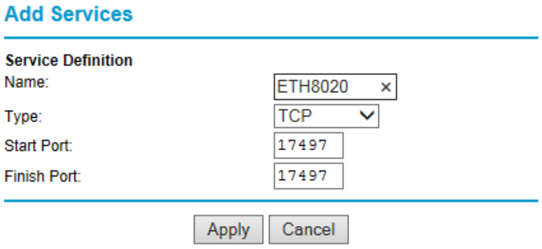
1023
1023
1023
1023
1023
1023
1023
1023

ETH8020 v1 found
DC in 12.2v
Relay pulse time (100 ms) 0

Visual studio express C# examples
The test program is available as Visual C# express ready built installation files here, or as Visual C# express project with source files here.
A Basic example is available here.
Visual studio express is provided free from Microsoft: http://www.microsoft.com/exPress/download/

Access from the Internet
The ETH8020 can be controlled over the internet almost as easily as on your local network. Your network will most likely be connected to the internet with a broadband router. This

will provide NAT (Network Address Translation) and Firewall services. To access the ETH8020 from the internet you will need to open up port 17494 (or whichever port you have your module set to - you can select any port you wish) to allow incoming TCP connections. Be careful not to open up any other ports. There are a wide variety of routers and we cannot give details for all of them. If in doubt ask your system administrator for assistance. The following shows how to open up a port on a Netgear DG834 router.



Add Services

Service Definition

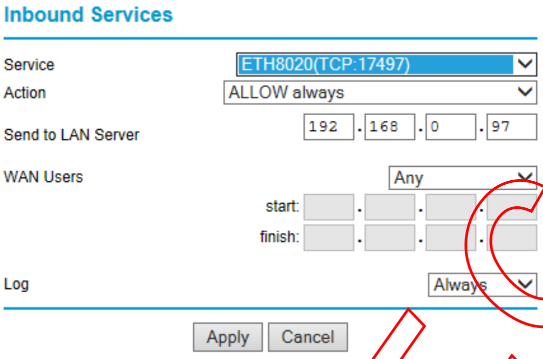
Name: ETH8020

Type: TCP

Start Port: 17497

Finish Port: 17497

After logging on to your routers setup page, the first thing to do is create a new service. Click on the "Services" menu then "Add Custom Service". Enter a name for the service, select TCP and enter the ETH8020's port address for both the start and finish ports. Click "Apply".



Inbound Services

Service: ETH8020(TCP:17497)

Action: ALLOW always

Send to LAN Server: 192 . 168 . 0 . 97

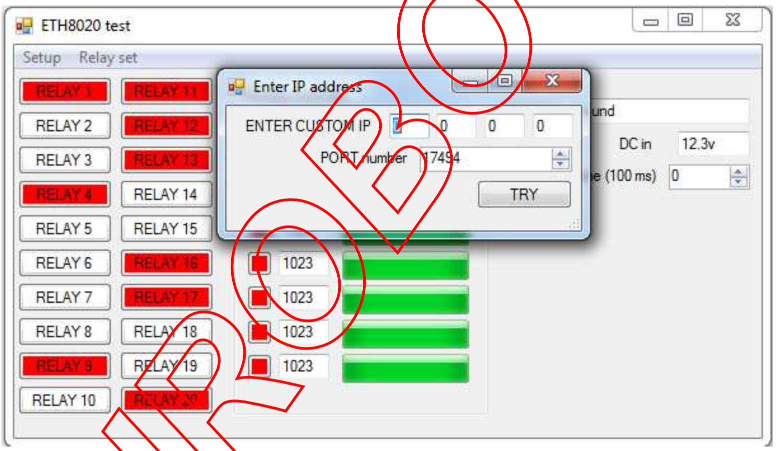
WAN Users: Any

start: . . .

finish: . . .

Log: Always

Now go to the "Firewall Rules" menu and click "Add" in the Inbound services section. Select the ETH8020 service and ALLOW always. The "Send to LAN Server" IP address is the ETH8020's IP address, 192.168.0.97 in the example above but check what it is on your network. Click "Apply" and that's it. The ETH8020 is now accessible over the internet. Before you close the routers setup pages, go to the "Router Status" menu and make a note of its ADSL port IP address. This is the routers internet facing IP address.



ETH8020 test

Enter IP address

ENTER CUSTOM IP 0 0 0 0

PORT number 17494

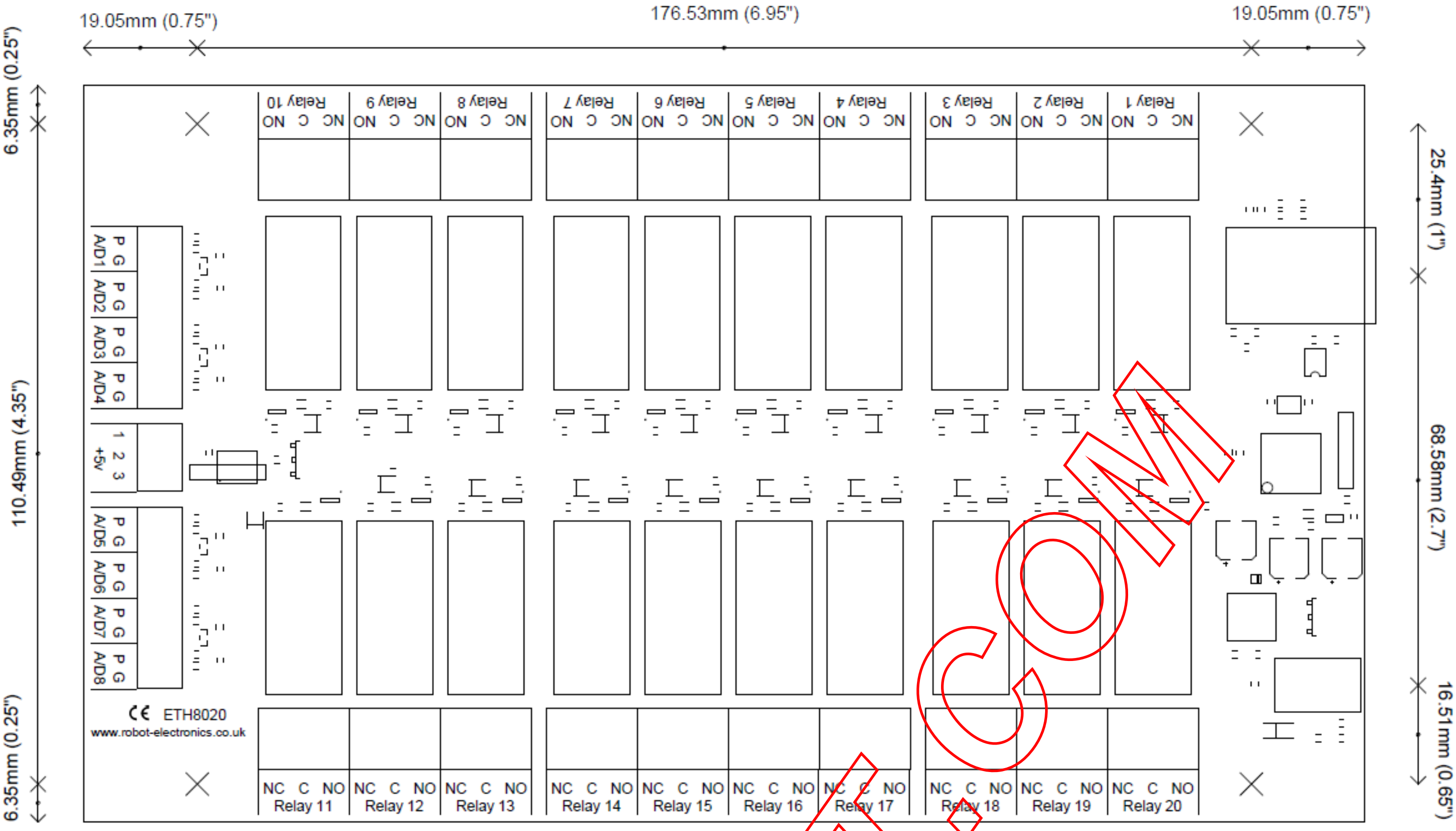
DC in 12.3v

e (100 ms) 0

To test this you will need a computer that has its own internet connection and is NOT connected to the same network as the ETH8020. Download and run the test program above and select Custom IP. In the pop-up box enter your routers internet facing IP address. Click on "Try IP" and it will connect you to the ETH8020 just as if it were on your own network.

Android & iPhone Apps.
We have a free app **IO network** available for Android and iPhone to remotely control your relays, download from Google Play or iTunes. Search for "Devantech" and you will find the app.

Board dimensions


19.05mm (0.75")
176.53mm (6.95")
19.05mm (0.75")
6.35mm (0.25")
110.49mm (4.35")
6.35mm (0.25")
25.4mm (1")
68.58mm (2.7")
16.51mm (0.65")
Relay 10
Relay 9
Relay 8
Relay 7
Relay 6
Relay 5
Relay 4
Relay 3
Relay 2
Relay 1
NO C NC
P G A/D1
P G A/D2
P G A/D3
P G A/D4
1 2 3 +5v
P G A/D5
P G A/D6
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