

All ED 5 Series products



EST 1984

brainboxes



Quick Start Guide

for Brainboxes Ethernet to I/O Industrial Range



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Thank you for purchasing this Brainboxes Ethernet to DIO product.

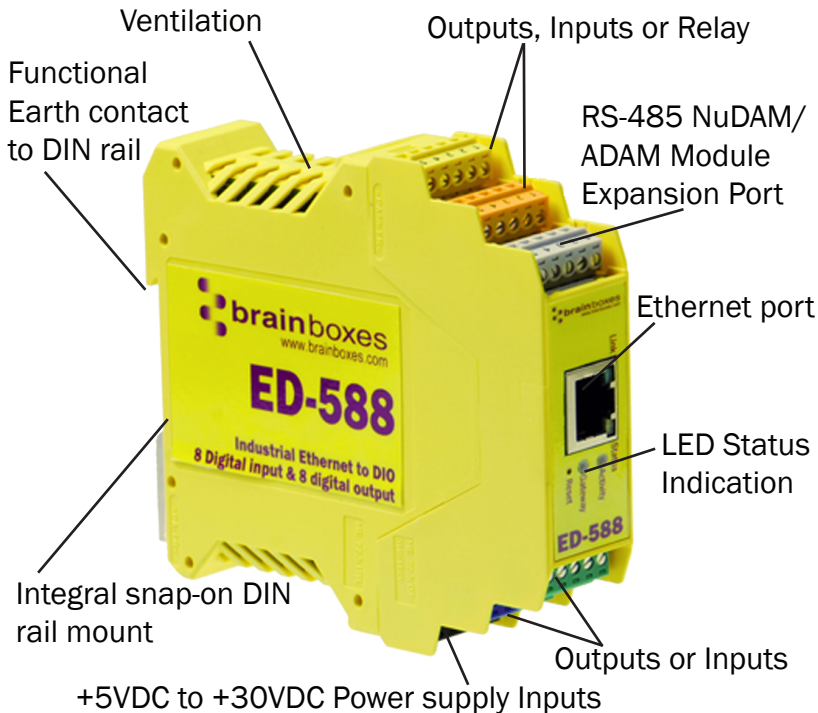


Download the latest software and drivers
<http://www.brainboxes.com/software>

	ED-516	ED-527	ED-538	ED-588	ED-504	ED-549	ED-560	ED-582	ED-593
	DIGITAL					ANALOGUE			
INPUTS	16		8	8	4 I/O + SERIAL	8		4 RTD	8 TC
OUTPUTS		16	4 RELAY	8			4		

For more information, including accreditations, safety, and correct disposal, please refer to the product manual and other resources, which are included in the software CD or available to download from www.brainboxes.com

1. Overview



2. Pin Outs & LEDs

Link LED	Green light on	Network Link Established
	Flashing Green	Network Data RX/TX
Status LED	Green	Device Ready
	Flashing Yellow	Changing Settings
	Flashing between Red & Green	Querying IP
	Flashing Green and Red	User performing Hard Reset
	Flashing between Green & Red/Yellow	IP address diagnostic
	Flashing between Green & Yellow	Initialization diagnostic
Activity LED	Flashing Green	Output set/Input Read
	Flashing Red	Output overload
Expansion LED	Flashing Green	RS-485 data TX/RX
	Flashing Red	RS-485 Comms error

ED-516 : 16 digital inputs

Type of Port	Terminal Block	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
Digital In	Yellow	-V	DIn 0	DIn 1	DIn 2	DIn 3
Digital In	Orange	-V	DIn 4	DIn 5	DIn 6	DIn 7
Expansion	Grey	SIG GND	RS-485 D-	RS-485 D+	RS-485 D+	RS-485 D-
Digital In	Green	-V	DIn 8	DIn 9	DIn 10	DIn 11
Digital In	Blue	-V	DIn 12	DIn 13	DIn 14	DIn 15
Power	Black	-V	+VA	+VB	-V	Func. GND

2. Pin Outs...

ED-527 : 16 digital outputs

Type of Port	Terminal Block	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
Digital Out	Yellow	-V	DOut 0	DOut 1	DOut 2	DOut 3
Digital Out	Orange	-V	DOut 4	DOut 5	DOut 6	DOut 7
Expansion	Grey	SIG GND	RS-485 D-	RS-485 D+	RS-485 D+	RS-485 D-
Digital In	Green	-V	DOut 8	DOut 9	DOut 10	DOut 11
Digital In	Blue	-V	DOut 12	DOut 13	DOut 14	DOut 15
Power	Black	-V	+VA	+VB	-V	Func. GND

ED-538 : 4 relays and 8 digital inputs

Type of Port	Terminal Block	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
Relay Out	Yellow	RL 0 COM	RL 0 N/O	RL 1 COM	RL 1 N/O	-
Relay Out	Orange	RL 2 COM	RL 2 N/O	RL 3 COM	RL 3 N/O	-
Expansion	Grey	SIG GND	RS-485 D-	RS-485 D+	RS-485 D+	RS-485 D-
Digital In	Green	-V	DIn 0	DIn 1	DIn 2	DIn 3
Digital In	Blue	-V	DIn 4	DIn 5	DIn 6	DIn 7
Power	Black	-V	+VA	+VB	-V	Func. GND

2. Pin Outs...

ED-588 : 8 digital outputs and 8 digital inputs

Type of Port	Terminal Block	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
Digital Out	Yellow	-V	DOut 0	DOut 1	DOut 2	DOut 3
Digital Out	Orange	-V	DOut 4	DOut 5	DOut 6	DOut 7
Expansion	Grey	SIG GND	RS-485 D-	RS-485 D+	RS-485 D+	RS-485 D-
Digital In	Green	-V	DIn 0	DIn 1	DIn 2	DIn 3
Digital In	Blue	-V	DIn 4	DIn 5	DIn 6	DIn 7
Power	Black	-V	+VA	+VB	-V	Func. GND

ED-504 : 4 Digital IO & RS232/422/485

Type of Port	Terminal Block	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
RS232	Yellow	SIG GND	CTS	RXD	RTS	TXD
RS422	Yellow	SIG GND	RXD-	RXD+	TXD+	TXD-
RS485	Yellow	SIG GND			DATA+	DATA-
Digital IO	Green	-V	DIO 0	DIO 1	DIO 2	DIO 3
Power	Black	-V	+VA	+VB	-V	Func. GND

2. Pin Outs...

ED-549 : 8 Analogue Inputs

Type of Port	Terminal Block	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
Analogue In	Yellow	AGND	Aln 0-	Aln 0+	Aln 1-	Aln 1+
Analogue In	Orange	AGND	Aln 2-	Aln 2+	Aln 3-	Aln 3+
Expansion	Grey	SIG GND	RS-485 D-	RS-485 D+	RS-485 D+	RS-485 D-
Analogue In	Green	AGND	Aln 4-	Aln 4+	Aln 5-	Aln 5+
Analogue In	Blue	AGND	Aln 6-	Aln 6+	Aln 7-	Aln 7+
Power	Black	-V	+VA	+VB	-V	Func. GND

ED-560 : 4 Analogue Outputs

Type of Port	Terminal Block	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
Analogue Out	Yellow	AGND	VOUT 0	VOUT 1	IOUT 0	IOUT 1
Expansion	Grey	GND	RS-485 D-	RS-485 D+	RS-485 D+	RS-485 D-
Analogue Out	Green	AGND	VOUT 2	VOUT 3	IOUT 2	IOUT 3
Power	Black	-V	+VA	+VB	-V	Func. GND

2. Pin Outs...

ED-582 : 4 RTD Inputs

Type of Port	Terminal Block	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
RTD Input 0	Yellow					
RTD Input 1	Orange					
RTD Input 2	Green					
RTD Input 3	Blue					
Expansion	Grey	SIG GND	RS-485 D-	RS-485 D+	RS-485 D+	RS-485 D-
Power	Black	-V	+VA	+VB	-V	Func. GND

ED-593 : 8 Thermocouple Inputs

Type of Port	Terminal Block	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
TC Input	Yellow	AGND	TC 0-	TC 0+	TC 1-	TC 1+
TC Input	Orange	AGND	TC 2-	TC 2+	TC 3-	TC 3+
Expansion	Grey	GND	RS-485 D-	RS-485 D+	RS-485 D+	RS-485 D-
TC Input	Green	AGND	TC 4-	TC 4+	TC 5-	TC 5+
TC Input	Blue	AGND	TC 6-	TC 6+	TC 7-	TC 7+
Power	Black	-V	+VA	+VB	-V	Func GND

3. Connecting your ED Device

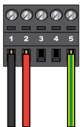
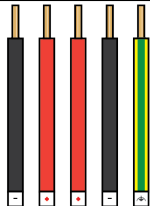
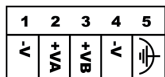
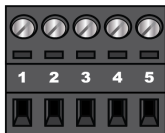
1. Connect a power supply providing a minimum of 1.1 Watts with an output voltage between +5VDC and +30VDC to the removable black terminal block. The optional PW-600 and PW-650 power supplies enable the device to be plugged easily into a standard power socket or powered via USB.

Using one power supply: connect the positive terminal of the power supply to either +VA or +VB pin and the negative to one of the -V pins.

Using two separate power supplies: connect one to +VA and -V and the other to +VB and -V. The higher voltage of the two power supplies is selected by the device and in the event of a failure the other supply automatically takes over to keep the device running.

The status of the power supply inputs can be monitored visually via a browser from the ED devices home page and also programmatically.

2. The LED's will flash when the power is first applied. When the Status LED turns steady green (after 5-60 seconds) the device is ready to use.



4. Network IP Addressing

Connect the ED device to your local network or directly to your PC using a standard straight-through or crossover Ethernet cable.

On connecting to the network, the device automatically checks if it is connected to a DHCP Server. If this is the case, the DHCP server will automatically allocate an IP address to the ED device.

If no DHCP server is detected (E.g. you are using a direct cable connection to the PC) the ED device will default to an IP address of 192.168.127.254 within 60 seconds. Please ensure the PC you're using for configuration can communicate with the 192.168.127.xxx IP range, as sometimes the subnet mask on the PC needs to be altered.

Network IP Address [Web Server/UPnP](#)

Obtain IP Address Automatically (Use DHCP)

Assign Static IP Address (Recommended)

Static IP Address: . . .

Subnet Mask: . . .

Gateway Address: . . .

In windows the ED device can be found by browsing the network (Start > Network) and looking under “other devices”. Double click the device to open its home webpage in a browser.

5. Firewall Exceptions and Port Numbers

When using the ED Devices with a firewall you may need to manually add the exception entries and port numbers to the firewall list.

Below are the default ports numbers and the firewall exceptions.

Function	Default port number
Device web server	TCP port 80
ASCII protocol	TCP port 9500
Modbus protocol	TCP port 502
Serial port	TCP port 9001
Firmware upgrade	UDP ports 67, 68, 69

Default Windows Firewall Exception entries:

- Brainboxes Boost.IO Suite
- Brainboxes Boost.IO Suite (Device Discovery)
(Except Windows XP 32 & 64 bits)
- UPnP Framework (Windows XP 32 & 64 bits)
- Network Discovery (Windows 7 or later)

6. Installing Boost.IO Manager & Configuring

To control your ED device using a Windows PC's COM port you need to install Boost.IO manager:

1. Insert the CD into your PC.
2. Locate the "Setup.exe" program on the CD and double click to launch.
3. Follow the on screen instructions to install Boost.IO software.
4. When installation is complete, an icon labelled Boost.IO Manager on the desktop. Double click this icon to open the application.

Find and install device:

1. Click on "File" > "Find Devices" button in the top left corner of the window.
2. Find your Brainboxes ED device by selecting a device and matching it with the corresponding MAC address available in the left hand panel.
3. Scroll down to the "Tasks" section and click "Install Device" - the COM ports section will then appear in the left panel.

Configure device:

1. In Boost.IO Manager, double click the installed COM Port under the "COM Ports" section in the left panel.
2. Click on the "Port Settings" tab, then on the "Configure Settings" button.
3. This will open the web configuration page from which all the settings of the ED device can be changed.

7. Default Settings

Factory Default Settings

Network Settings	
Network IP Address	DHCP Mode
Web Server Port	80

ASCII Protocol Settings	
Device Address	01
TCP Port	9500
Idle Timeout	0
Data Format	Engineering unit
Checksum	Disabled

Serial Expansion Settings	
Baud Rate	9600
Command Timeout	200ms

Modbus Protocol Settings	
Slave IDs	Respond to IDs 0 and 255 only
Accept All Addresses	Disabled
TCP Port	502
Max connections	8
Idle Timeout	0 (disabled)
Data Format	Engineering unit

8. Protocol Examples: ASCII

ASCII

This COM port can then be used to send and receive ASCII commands using any standard Windows Serial port program e.g. Hyperterminal. A sample terminal program called PuTTY and a comprehensive list of protocol examples can be found on the CD and on our website www.brainboxes.com

Command Format

The command string is made up of several different parts. For example, the command \$aa5vv can be broken down into as many as 6 separate parts.

\$	aa	5	vv	[CS]	(CR)
Delimiter	Address	Command	Parameters	Checksum*	Carriage Return

* Optional parameter for the command.

Response Format

The response received from the device will depend on the ASCII command that has been sent.* Only applicable for certain commands that return data.

!	aa	(Data)	[CS]	(CR)
Delimiter	Address	Data*	Checksum**	Carriage Return

** Optional parameter for the command.

Example Commands - See Manual for full lists

8. Protocol Examples: ASCII

Command	Response	Description	Supported Devices
%aannttcff	!aa	Set device configuration	All Devices
***	No Response	Synchronised sampling	ED-549
#aa	>(Data)	Read analogue input of all channels	ED-549
#aan	>(Data)	Read the analogue input of one channel	ED-549
#aan(Data)	>	Set the output value for one channel	ED-560
\$aa0Ci	!aa	Perform span calibration on a channel	ED-549
\$aa1Ci	!aa	Perform zero calibration on a channel	ED-549
\$aa2	!aannttcff	Read the device configuration	All Devices
#AA0BDD	>	Set Digital Output of Upper 8 Channels	Digital Output Devices
#AA1cDD	>	Set a Single Digital Output of Lower 8 Channels	Digital Output Devices
#AAAcDD	>	Set a Single Digital Output of Lower 8 Channels	Digital Output Devices
#AAN	!AA(Data)	Read Digital Input Counter	Digital Input Devices
\$AA4	!S(Data)	Read Synchronized Data	All Devices
\$AA5	!AAS	Read Reset Status	All Devices
\$AA6	!(Data)	Read Digital I/O Status	All Devices
\$AAC	!AA	Clear Latched Digital Input	Digital Input Devices
\$AACN	!AA	Clear Digital Input Counter	Digital Input Devices

8. Protocol Examples: Modbus

Note that different software uses different ways to express Modbus addresses, so you may need to look up the address in a different style. For full tables of Modbus-addressable controls and inputs, please refer to the manual.

Example 1: Set digital output channel 3 to ON

Request: Write Single Coil (function code=5), logical address=0x0003, data=0xFF00

Response: Function code=5, logical address=0x0003, data=0xFF00

The response just acknowledges that the request was handled without error

Example 2: Read state of all digital inputs

Request: Read Holding Registers (function code=3), logical address=0x0020, quantity=0x0001

Response: Function code=3, no. of bytes=2, data=0x0013

This data value means that inputs 0, 1 and 4 are in a '1' state, and others are in a '0' state

Example 3: Read state of analogue input channels 3, 4 and 5, as 16-bit integer values

Request: Read Holding Registers (function code=3), logical address=0x0003, quantity=0x0003

Response: Function code=3, no. of bytes=6, data=0x4000, 0x2000, 0xE000

The encoding of values to integers is configurable, but this example could mean the inputs are at 50%, 25%, and -25% of the +FSR of the input channels

8. Protocol Examples: Modbus

Example 4: Read state of analogue input channel 1, as a 32-bit floating-point value (each value uses two 16-bit Modbus registers)

Request: Read Holding Registers (function code=3), logical address=0x0012, quantity=0x0002

Response: Function code=3, no. of bytes=4, data=0x064B, 0x3f9E

The 32-bit value is 0x3f9E064B, which is the IEEE 754 encoding of the floating-point value 1.234567

Example 5: Set state of analogue output channels 0 – 3

Request: Write Multiple Registers (function code=16), logical address=0x0000, quantity=4, no. of bytes=8, data=0x0000, 0x1000, 0x2000, 0x3fff

Response: Function code=16, logical address=0x0000, quantity=4

The encoding of analogue values to integers is configurable, but this example could mean the outputs are set to 0%, 25%, 50% and 100% of their FSR. The response just acknowledges that the request was handled without error.

Modbus Address tables: detailed tables for each product available in the device's manual - see the CD or our website

ED-540	Modbus access type	Modbus function	Logical address	16-bit style address	32-bit address
Analogue outputs (as integer)	holding register	1, 6, 16	0x0000 - 3	40001 - 4	NAM00 - 3
Analogue outputs (as float)	holding register	3, 16	0x0020 - 7	40003 - 40	NAM32 - 39
Analogue type/range	holding register	3, 6, 16	0x0060 - 3	40009 - 100	NAM096 - 99
Integer format	holding register	3, 6, 16	0x0080	40129	NAM128
Integer format	coil	1, 5, 15	0x0080	00129	NAM128

ED-549	Modbus access type	Modbus function	Logical address	16-bit style address	32-bit address
Analogue inputs (as integer)	holding register	3	0x0000 - 7	40001 - 8	NAM00 - 7
Analogue inputs (as integer)	input register	4	0x0000 - 7	30001 - 8	N/A
Analogue inputs (as float)	holding register	3	0x0020 - 7	40013 - 40	NAM32 - 39
Analogue inputs (as float)	input register	4	0x0020 - 7	30013 - 40	N/A
Input error flags	Discrete input	2	0x0040 - 7	11025 - 1032	N/A
Input error flags	input register	4	0x0400	31025	N/A
Input error flags	holding register	3	0x0400	41025	NAM1024
Input channel enable	holding register	3, 6, 16	0x0400	40065	NAM064
Input channel enable	coil	1, 5, 15	0x0400 - 7	00065 - 72	NAM64 - 71
Input type/range	holding register	3, 6, 16	0x0600 - 7	40097 - 104	NAM096 - 103
Integer format	holding register	3, 6, 16	0x0080	40129	NAM128
Integer format	coil	1, 5, 15	0x0080	00129	NAM128

9. Input/Output Specification

Digital Inputs	NPN/PNP	Jumper configures all inputs with either pull-up for NPN (contact closes to 0V) type sensors, or pull-down for PNP (close to V+) type sensors
	Logic Level 0:	0V to +1V maximum
	Logic Level 1:	+2.0V to +30V maximum
	Latched Inputs:	Triggered by user programmable positive or negative edges, stays true until acknowledged
	Counter Inputs:	User programmable – counts positive or negative transitions, up to 250Hz count rate 16-bit (65335 count) or 32-bit (4.2 billion count) counters Counter values persist over power-off periods
Digital Outputs	Max output current	0.85A on all outputs simultaneously (ambient temperature $\leq 70^{\circ}\text{C}$, 1m/s airflow) 0.5A on all outputs simultaneously (ambient temperature $70\text{-}80^{\circ}\text{C}$, 1m/s airflow) Outputs can be paralleled for higher current loads
	Max output load Voltage	36V
	ESD Protection	Intelligent short circuit protection up to 36V Over-temperature shutdown ESD Protection to 16kV
Relay Outputs	Relay Type	4 Form A (SPST: Single Pole Single Throw) - Normally Open
	Contact Rating	5 A @ 30 VDC, 5 A @ 250VAC, 5 A @ 110 VAC
	Inductive Load	2 A
	Resistive Load	5 A
	Breakdown Voltage	500 VAC
	Relay On/Off Time	1500 ms (Max)
	Initial Insulation Resistance	1G min @ 500 VDC
	Expected Life	100,000 times (Typical)
	Initial Contact Resistance	30 milli-ohms (Max)
	Pulse Output	0.3 Hz at rated load

9. Input/Output Specification

Analogue Inputs	Voltage input ranges	$\pm 10V, \pm 5V, \pm 2.5V, \pm 1V, \pm 500mV, \pm 250mV, \pm 150mV$ or $\pm 75mV$
	Current input ranges	$\pm 20mA, 0-20mA$ or $4-20mA$
	Measurement rate	12 measurements per second, divided between all enabled inputs
	Measurement accuracy	0.1% of full-scale range at $25^{\circ}C$ 0.3% of full-scale range over -30 to $+80^{\circ}C$
	Input impedance	Voltage Mode: $10M\Omega$
	CMRR	120dB
	NMRR	100dB at 50Hz and 60Hz
Analogue Outputs	Voltage Output Range	0-10V
	Current Output Ranges	0-20mA or 4-20mA
	Current Output Type	Sink (requires external current source)
	Output Resolution	12 Bit
	Watchdog	Sets outputs to predefined values on timeout
	Max Load	Voltage mode: Current $\pm 5mA$ / Current Mode: Voltage 30V
	Dropout Voltage	2.8V (Current Mode)
	Output Accuracy	0.1% of FSR @ $25^{\circ}C$ ($77^{\circ}F$)
	Output Drift	Voltage Mode: Zero drift less than $30\mu V/^{\circ}C$, span drift less than $25ppm/^{\circ}C$ Current Mode: Zero drift less than $0.2\mu A/^{\circ}C$, span drift less than $25ppm/^{\circ}C$
Output Slew Rate	Voltage Mode: 170 kV/s, Current Mode: $4.3A/s$	
Output Settling Time	Voltage Mode: $350\mu s$, Current Mode: $4\mu s$	
Serial Port	Ports	Software Selectable RS232, RS422 Full Duplex, or RS485 Half Duplex
	Conductor Wire	28 to 16 AWG, 0.14mm to 1.5mm Max
	Baud Rate	Any custom Baud rate between 60 - 1,000,000 (1 MegaBaud)
	Data Bits	5,6,7 or 8
	Parity	Odd, Even, None, Mark or Space
	Stop Bits	1, 1.5 or 2
	Flow Control	RTS/CTS, DSR/DTR, XON/XOFF

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