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Document number	MCW-E3-025
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Product	E3

Title	E3 Modbus RTU Control & Register Mapping
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Summary	This document gives information on Modbus RTU for Optidrive E3
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Optidrive E3 drives support Modbus RTU communications, allowing a network of drives to be controlled and monitored by any Modbus RTU capable PLC or control system. The Optidrive E3 is always a Slave to an external Modbus RTU Master. This document describes the registers and functions available.

### Modbus RTU Protocol Specification

Protocol	Modbus RTU
Error check	CRC
Baud rate	9600bps, 19200bps, 38400bps, 57600bps, 115200bps (default)
Data format	1 start bit, 8 data bits, 1 stop bit, no parity (Fixed)
Physical signal	RS 485 (2-wire) (3 wire with 0V)
User Interface	RJ45

Maximum cable length for a RS485 link is 1200 metres.

A host controller can operate up to 32 Optidrive E3 inverter drives with the use of one line buffer. Further line buffers can increase this number up to a maximum of 63.

### Terminating Resistors

It is recommended that terminating resistors are **not** used on the RS485 networks unless there is a specific reason for using them.

### Broadcast messaging

Optidrive E3 **does not** support broadcast messaging.

## Modbus Telegram Structure

The following Modbus Function Code Commands are supported:

- 03 Read Holding Registers
- 06 Write Single Holding Register
- 16 Write Multiple Registers (V3.02 and greater software)

**NOTE:** Function code 16 Write multiple registers supports registers 1 to 5 only.

The telegram structure is as follows:

Command 03 – Read Holding Registers						
Master Telegram	Length			Slave Response	Length	
Slave address	1	Byte		Slave Address	1	Byte
Function Code (03)	1	Byte		Function Code (03)	1	Byte
1 <sup>st</sup> Register Address	2	Bytes		Data Length	1	Byte
No. of Registers	2	Bytes		1 <sup>st</sup> Register	2	Bytes
CRC Checksum	2	Bytes		2 <sup>nd</sup> Register	2	Bytes
				Etc.		
				CRC Checksum	2	Bytes

Command 06 – Write Single Holding Register						
Master Telegram	Length			Slave Response	Length	
Slave address	1	Byte		Slave Address	1	Byte
Function Code (06)	1	Byte		Function Code (06)	1	Byte
Register Address	2	Bytes		Register Address	2	Bytes
Value	2	Bytes		Register Value	2	Bytes
CRC Checksum	2	Bytes		CRC Checksum	2	Bytes

See example on following page:

### Request

The request message specifies the starting register and quantity of registers to be read.

Example of a request to read 0...1 (register 40001 to 40002) from slave device 1:

Field Name	RTU (hex)
Header	None
Slave Address	01
Function	03
Starting Address Hi	00
Starting Address Lo	00
Quantity of Registers Hi	00
Quantity of Registers Lo	02
Error Check Lo	C4
Error Check Hi	0B
Total Bytes	8

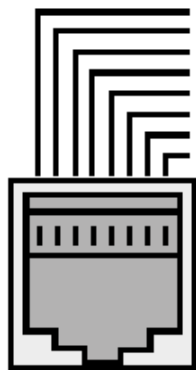
### Response

The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register the first byte contains the high-order bits, and the second contains the low-order bits.

Example of a response to the request:

Field Name	RTU (hex)
Header	None
Slave Address	01
Function	03
Byte Count	04
Data Hi	00
Data Lo	06
Data Hi	00
Data Lo	05
Error Check Lo	DA
Error Check Hi	31
Total Bytes	8

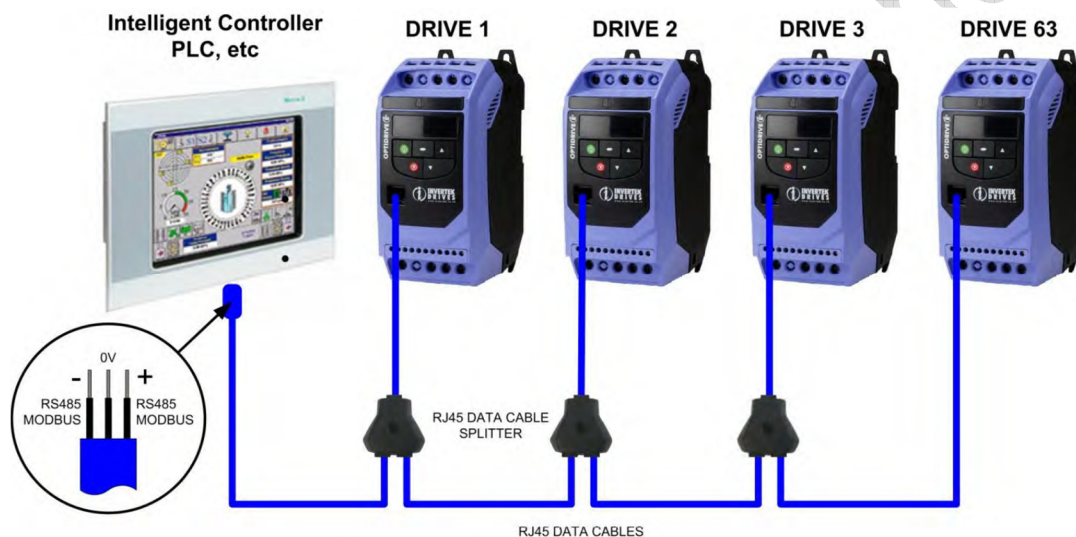
## RJ45 Connection Pin configuration



1	CAN -
2	CAN +
3	0 Volts
4	-RS485 (PC)
5	+RS485 (PC)
6	+24 Volt
7	-RS485 (Modbus RTU)
8	+RS485 (Modbus RTU)

**Warning:** This is not an Ethernet connection.  
Do not connect directly to an Ethernet port.

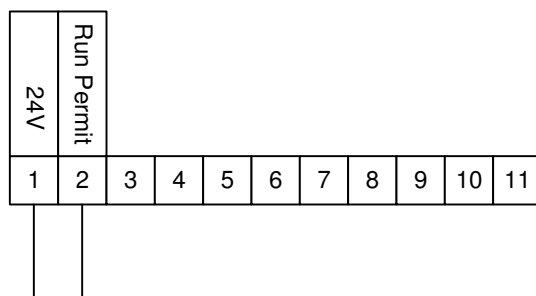
## Typical Modbus RTU Configuration



**NOTE:** The 0V should be connected between the controller and the inverter drives. This stops the common mode voltage going above the communication IC ratings on the inverters communications port inputs.

## Control Terminal Connections

A wire link or switch must be connected between terminals 1 and 2 for the control word to take effect. See **Page 22** onwards for further control terminal information.



## Memory Map

### Control and status registers

**Note :** All registers are Holding Registers

Register Number	Parameter Number	Upper byte	Lower Byte	Format	Min	Max	Command	Type	Scaling
1	-	Control Word		WORD	0	15	03,06,16	R/W	See Below
2	-	Frequency Set-point		S16	-5000	5000	03,06,16	R/W	1dp, e.g. 100 = 10.0Hz
3	-	Reserved		-	-	-	03,06,16	R/W	
4	-	Modbus ramp control time		U16	0	60000	03,06,16	R/W	2dp, e.g. 500 = 5.00s
5	-	High resolution frequency set-point		S16	- 30000	30000	03,06,16	R/W	See below
6	-	Error code	Drive status	WORD	-	-	03	R	See Below
7	-	Output Frequency		S16	0	5000	03	R	1dp, e.g. 100 = 10.0Hz
8	-	Motor Current		U16	0	-	03	R	1dp, e.g. 100 = 10.0A
9	-	Motor Torque		S16	0	2000	03	R	1dp, e.g. 100 = 10.0%
10	-	Motor Power		U16	0	-	03	R	2dp, e.g. 100 = 1.00kW
11	P00-04	Digital Input Status		WORD	0000	1111	03	R	See Below
12	P00-29	Rating ID		U16	-	-	03	R	Internal Value
13	P00-29	Power rating		U16	-	-	03	R	2dp, e.g. 37 = 0.37kW / HP
14	P00-29	Voltage rating		U16	-	-	03	R	See Below
15	P00-28	IO processor software version		U16	-	-	03	R	2dp, e.g. 300 = 3.00
16	P00-28	Motor control processor software version		U16	-	-	03	R	2dp, e.g. 300 = 3.00
17	P00-29	Drive type		U16	-	-	03	R	Internal Value
18	P00-48	Scope Channel 1 Data		S16	-	-	03	R	See Below
19	P00-48	Scope Channel 2 Data		S16	-	-	03	R	See Below
20	P00-01	Analog 1 input result		U16	0	1000	03	R	1dp, e.g. 500 = 50.0%
21	P00-02	Analog 2 input result		U16	0	1000	03	R	1dp, e.g. 500 = 50.0%
22	P00-03	Pre-ramp speed reference value		S16	0	5000	03	R	1dp, e.g. 500 = 50.0Hz
23	P00-08	DC bus voltages		U16	0	1000	03	R	600 = 600 Volts
24	P00-09	Drive power stage temperature		S16	-10	150	03	R	50 = 50°C
25	P00-30	Drive serial number 4		U16	-	-	03	R	See below
26	P00-30	Drive serial number 3		U16	-	-	03	R	
27	P00-30	Drive serial number 2		U16	-	-	03	R	
28	P00-30	Drive serial number 1		U16	-	-	03	R	
29	-	Relay output status		WORD	0	1	03	R	Bit 0 indicates relay status 1 = relay contacts closed
30	-	Reserved		-	-	-	03	R	No function
31	-	Reserved		-	-	-	03	R	No function
32	P00-26	kWh meter		U16	0	9999	03	R	1dp, e.g. 100=10.0kWh
33	P00-26	MWh meter		U16	0		03	R	10=10MWh
34	P00-10	Running time - hours		U16			03	R	1=1 Hour
35	P00-10	Running time – minutes/seconds		U16			03	R	100=100 seconds
36	P00-14	Run time since last disable		U16				R	1=1 Hour
37	P00-14	Run time since last disable – minutes/seconds		U16			03	R	100=100 seconds
38	-	Reserved		-	-	-	03	R	No function
39	P00-20	Internal drive temperature		S16	-10	100	03	R	20=20°C
40	-	Speed reference (Internal format)		U16	0	P-01	03	R	3000=50Hz
41	-	Reserved		-	-	-	03	R	No function
42	-	Digital pot/Keypad reference		U16	0	P-01	03	R	3000=50Hz
43	P00-07	Output voltage		U16	0	-	03	R	100=100VAC RMS
44	-	Parameter access index		U16	1	60	03	R/W	See Below
45	-	Parameter access value		U16	-	-	03	R	See Below

## Format

WORD = WORD Format, functions assigned to individual bits

S16 = Signed 16 Bit Integer

U16 = Unsigned 16 bit Integer

## Control and Status Register Descriptions:

### Read and write registers

#### Register 1: Drive command

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
High Byte								Low Byte							

**Bit 0** : Run/Stop command: Set to 1 to enable the drive. Set to 0 to stop the drive.

**Bit 1** : Fast stop request. Set to 1 to enable drive to stop with 2<sup>nd</sup> deceleration ramp.

**Bit 2** : Reset request. Set to 1 in order to reset the drive if drive is in a trip condition.  
User must clear this bit when drive is under normal condition to prevent un-expected reset.

**NOTE:** Auto-Reset parameter P-30 does not automatically reset the drive when P-12 = 3 or 4.

**Bit 3** : Coast stop request. Set to 1 to issue a coast stop command.

For normal operation, Bit 3 has the highest priority, bit 0 has the lowest priority (bit 3>bit 1>bit 0).

For example if user set command as 0x0009, drive will do a coast stop rather than run. For normal run/start, just set this register to 1.

**Note:** The start/stop (bit 0), fast stop (bit 1) and coast stop (bit 3) only work if P-31= 0, 1, 4 or 5. Otherwise, start/stop function is controlled by drive control terminals. Reset function (bit 2) works all the time as long as drive is operated under Modbus control mode (P-12=3 or 4).

#### Register 2: speed reference setup

This register holds the speed reference value with one decimal place (200 = 20.0Hz). The maximum speed reference value is limited by P-01. Either register 2 or 5 can be used for speed reference control, however only one reference should be used in any control system, otherwise unexpected behaviour can result.

To reverse direction of motor rotation, enter a negative value in register 2 or 5 (-200 = -20.0Hz).

#### Register 4: Acceleration / Deceleration ramp setup

This register specifies the drive acceleration and deceleration ramp time. The same value is applied simultaneously to the acceleration and deceleration ramp times. This register is only active when P-12 = 4. The value has two decimal places, e.g. 500=5.00 seconds.

#### Register 5: High resolution speed reference

This register allows the user to set the speed reference value in the internal format, e.g. 3000 = 50.0Hz. This allows control resolution to 1 RPM with a 2 pole motor. The maximum allowed value is limited by P-01.

Either register 2 or 5 can be used for speed reference control, however only one reference should be used in any control system, otherwise unexpected behaviour can result.

To reverse direction of motor rotation, enter a negative value in register 2 or 5 (-200 = -20.0Hz).

## Read only registers

### Register 6: Drive status and error code

High byte gives drive error code. (Valid when drive tripped, see **Appendix E** for details)

Low byte gives drive status information as follows:

Bit 0: 0 = Drive stopped, 1 = Drive running

Bit 1: 0 = OK; 1 = Drive tripped

Bit 5: 0 = OK; 1 = In standby mode

Bit 6: 0 = Not ready; 1 = Drive ready to run (Not tripped, hardware enabled and no mains loss condition).

### Register 7: Motor speed information

This register gives motor speed information. The data is in Hz and with one decimal place ( e.g. 234 = 23.4Hz)

### Register 8: Motor current

This register gives motor current information. The data is in Amp with one decimal place (e.g. 87 = 8.7A)

### Register 9: Motor torque

This register gives motor torque information. The data is in % with one decimal place (e.g. 100 = 10.0%)

### Register 10: Motor power

This register gives motor power information. The data is in kW with two decimal place (e.g. 100 = 1.00kW)

### Register 11: Digital input status

The value in this register represents the drive terminal digital input status (Digital input 1 to 4). Lowest bit indicates digital input 1 status.

### Register 12: Rating ID

This register gives the following information:

Drive size, drive type, Power units and Power value decimal places

Register value (16 bits HEX format):

X	X	X	X	h	
				Power Units	0 kW
					1 HP
				Drive Type	4 E3
				Power Decimal Places	0 No Decimal Places
					1 One Decimal Place
					2 Two Decimal Places
				Drive Frame Size	1 Frame Size 1
					2 Frame Size 2
					3 Frame Size 3
					4 Frame Size 4

**NOTE :** Power decimal places is used for register 13 (Power rating). For example, if we have value x1x0h in register 12 and value 15 in register 13, this gives the drive power as 1.5KW. If we have value x0x0h in register 12 and same value 15 in register 13, this gives drive power as 15KW. Or if we have x1x1h in register 12 and 5 in register 13, then the drive power rating is 0.5HP. If we have x0x1h in register 12 and 5 in register 13, this gives drive power rating as 5HP.

### Register 13: Power rating

Combined with the value in register 12, this gives the drive power rating information

### Register 14: Voltage level

This register gives the rated input voltage for the drive.

i.e. 230 : 230V 400: 400V 460: 460V

### Register 15: IO processor software version

This register contains the drive software version info. Value includes two decimal places.

(e.g. 300 = version 3.00)

### Register 16: Motor control processor software version

This register contains the drive software version info. Value includes two decimal places.

(e.g. 300 = version 3.00)

### Registers 18 & 19: Scope channel 1 & Scope channel 2 data values

These registers show the scope present data sample value for the first two scope channels. The channel data source selection is carried out through Optitools Studio.



### Registers 25 to 28: Drive serial number

The drive serial number maybe read using these four registers. The serial number has 11 digits, stored as follows:

Register 28		Register 27				Register 26		Register 25		
X	X	X	X	X	X	X	X	X	X	X

#### Example

Register 25     1

Register 26     1

Register 27     8745

Register 28     57

Drive serial no: 5     7     8     7     4     5     0     1     0     0     1

### Indirect parameter access registers

Optidrive E3 allows Read / Write access to all user adjustable parameters using a simple method as detailed below. This is achieved using the following two Modbus registers.

#### Register 44: Drive parameter index

This index value will be used by register 45 to carry out parameter read and write function. The valid range of this parameter is from 1 to 60 (maximum number of drive user adjustable parameters)

#### Register 45: Drive parameter value

When reading this register, value represents the drive parameter value which index is specified by register 44.

When write to this register, value will be written to the drive parameter which index is specified by register 44.

#### Parameter Read Method

In order to read a parameter, firstly write the parameter number to register 44, then read the value from register 45, e.g. to Read the Value of P-01

- Write 1 to Register 44
- Read the Value of Register 45

#### Parameter Write Method

Writing parameter values can be achieved by the same method, however Register 45 is used to write the parameter value after the parameter number has been selected using Register 44, e.g. to Write a Value of 60.0Hz to parameter P1-01

- Write 1 to Register 44
- Register 45 will return the present value of P-01, which can be Read if required
- Referring to the parameter table shown in Appendix A: Parameter Registers and Scaling, apply any scaling necessary
  - In this case, 60.0Hz = 3600
- Write the scaled value to Register 45. P-01 now changes to 60.0Hz, or an exception code may be returned.

## Parameter registers

All user adjustable parameters within the drive are accessible by Modbus, and can be Read or Written to. For further information regarding the parameter functions and specific settings, please refer to the User Guide.

Register	Parameter	Description	Format	Min	Max	Data format
129	01	Max speed limit	U16	0	5*P-09	Internal value (3000 = 50.0Hz)
130	02	Min speed limit	U16	0	P-01	Internal value (3000 = 50.0Hz)
131	03	Accel ramp time	U16	0	60000	2dp, e.g. 300=3.00s
132	04	Decel ramp time	U16	0	60000	2dp, e.g. 300=3.00s
133	05	Stop mode select	U16	0	2	0: Ramp to stop 1: Coast to stop 2: Ramp to stop 3: AC Flux braking
134	06	Energy save	U16	0	1	0: Disabled 1: Enabled
135	07	Motor rated voltage	U16	0	250 500	400=400V
136	08	Motor rated current	U16	0	Drive Rating Dependent	1dp, e.g. 100 = 10.0A
137	09	Motor rated frequency	U16	25	500	Data unit is in Hz
138	10	Motor rated speed	U16	0	30000	Maximum value equals to the sync speed of a typical 2-pole motor
139	11	Boost voltage value	U16	0	Drive dependant	1dp, e.g. 100 = 10.0%
140	12	Control mode	U16	0	6	0: Terminal Control 1: Keypad forward only 2: Keypad forward and reverse 3: Modbus control mode 4: Modbus control with ramp control 5: PID control 6: PID control with analog speed sum 7: CANOpen 8: CANOpen & ramp control 9: Slave mode
141	13	Application mode	U16	0	2	0: Industrial mode 1: Pump mode 2: Fan mode
142	14	Access code	U16	0	9999	No scaling
143	15	Digital input function	U16	0	17	See user guide for function details
144	16	Analog input format	U16	0	7	0: 0...10V 1: b 0...10V 2: 0...20mA 3: t 4...20mA 4: r 4...20mA 5: t 20...4mA 6: r 20...4mA 7: 10...0V
145	17	Effective switching frequency	U16	0	5 (Drive Rating Dependent)	0 = 4KHz 1 = 8KHz 2 = 12KHz 3 = 16KHz 4 = 24KHz 5 = 32KHz
146	18	Relay output function	U16	0	7	See user guide for function details
147	19	Digital output limit	U16	0	1000	100 = 10.0%
148	20	Preset speed 1	U16	-P-01	P-01	Internal value (3000 = 50.0Hz)
149	21	Preset speed 2	U16	-P-01	P-01	Internal value (3000 = 50.0Hz)
150	22	Preset speed 3	U16	-P-01	P-01	Internal value (3000 = 50.0Hz)
151	23	Preset speed 4	U16	-P-01	P-01	Internal value (3000 = 50.0Hz)
152	24	2nd deceleration ramp	U16	0	2500	250 = 2.50s

Register	Parameter	Description	Format	Min	Max	Data format
153	25	Analog output function	U16	0	9	See user guide for function details
154	26	Skip frequency	U16	0	P-01	Internal value (3000 = 50.0Hz)
155	27	Skip freq band	U16	0	P-01	Internal value (3000 = 50.0Hz)
156	28	V/F adjust voltage	U16	0	P-07	100 = 100V
157	29	V/F adjust frequency	U16	0	P-09	50 = 50Hz
158	30	Start mode select	U16	0	6	0: Edgr-r 1: Auto_0 2...6: Auto_1 to Auto_5
159	31	Keypad restart mode	U16	0	7	See user guide for details
160	32	DC injection enable	U16	0	250	250= 25.0s
161	33	Spin start enable	U16	0	2	
162	34	Brake circuit enable	U16	0	4	See user guide for function details
163	35	Analog input scaling	U16	0	20000	1000 = 100%
164 (see next page)	36	Drive address (Low byte)	U16	0	63	Drive comms address
		Baudrate select	U16	1	6	1 = Optibus fixed baudrate 2 = 9K6 3 = 19K2 4 = 38K4 5 = 57K6 6 = 115K2
		Trip time setup	U16	0	8	See user guide for more information
165	37	Access code definition	U16	0	9999	See user guide for more information
166	38	Parameter lock	U16	0	1	0: Unlock 1: Locked
167	39	Analog input offset	U16	-5000	5000	1dp, e.g. 300=30.0%
168	40	Display scaling factor	U16	0	6000	3dp, e.g. 100 = 0.100
169	41	User PI P gain	U16	1	300	1dp, e.g. 10 = 1.0
170	42	User PI I time constant	U16	0	300	1dp, e.g. 10 = 1.0s
171	43	User PI mode select	U16	0	1	See user guide for more information
172	44	User PI reference select	U16	0	1	See user guide for more information
173	45	User PI digital reference	U16	0	1000	1dp, e.g. 100 =10.0%
174	46	User PI feedback select	U16	0	3	See user guide for more information
175	47	2nd an input format	U16	0	6	0: 0...10V 1: 0...20mA 2: t 4...20mA 3: r 4...20mA 4: t 20...4mA 5: r 20...4mA 6: Ptc-th
176	48	Standby Mode timer	U16	0	250	1dp, e.g. 200=20.0s
177	49	PI Control Wake Up Error Level	U16	0	1000	1dp, e.g. 50=5.0%
178	50	User Output Relay Hysteresis	U16	0	1000	1dp, e.g. 50=5.0%
179	51	Motor Control Mode	U16	0	4	0: Simple vector speed control 1: V/f control 2: PM motor vector speed control 3: BLDC motor vector speed control 4: Synchronous reluctance motor speed control
180	52	Motor Autotune	U16	0	1	See user guide for more information
181	53	Vector mode gain	U16	0	2000	1dp, e.g. 500=50.0%
182	54	Maximum current limit	U16	10	1750	1dp, e.g. 1000=100.0%
183	55	Motor stator resistance	U16	0	65535	2dp, e.g. 535=5.35ohms
184	56	Motor stator d-axis inductance	U16	0	65535	1dp, e.g. 35=3.5mH
185	57	Motor stator q-axis inductance	U16	0	65535	1dp, e.g. 35=3.5mH

Register	Parameter	Description	Format	Min	Max	Data format
186	58	DC injection speed	U16	0	P-01	Internal value (3000 = 50.0Hz)
187	59	DC injection current	U16	0	1000	1dp, e.g. 500=50.0%
188	60	Thermal overload retention	U16	0	1	0: Disabled 1: Enabled

## Appendix A: Parameter Registers – Additional Information

### Register 160: DC injection braking

The parameter value is stored as a combined 16 bit word which is constructed as follows:

High Byte								Low Byte							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
<b>DC Injection Mode</b> 0: DC injection on Start 1: DC injection on Stop 2: DC injection on Start & Stop								DC injection duration: 1dp, e.g. 0-250 = 0.0-25.0s							

### Register 164 – Communications Configuration

This Register entry contains multiple data entries as follows :

High Byte								Low Byte							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Trip Configuration				Baud Rate				Drive Address							

#### Address – Low Byte

Drive address 1 (default)

<b>7</b>	<b>6</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
128	64	32	16	8	4	2	1
							1

#### Baud Rate High Byte - 1

Baud Rate 115.2kbps (default)

<b>11</b>	<b>10</b>	<b>9</b>	<b>8</b>
8	4	2	1
2048	1024	512	256
	1	1	

1: No function

2: 9.6

3: 19.2

4: 38.4

5: 57.5

6: 115.2

## Watchdog Timeout High Byte - 2

Watchdog Timeout t 3000 (default)

15	14	13	12
8	4	2	1
32768	16384	8192	4096
	1		

0: 0

1: t 30

2: t 100

3: t 1000

4: t 3000

5: r 30

6: r 100

7: r 1000

8: r 3000

9: t 10000

10: t 30000

11: t 60000

12: r 10000

13: r 30000

14: r 60000

## Register 168: Display scaling

The parameter value is stored as a combined 16 bit word which is constructed as follows:

High Byte								Low Byte							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Display scaling source 0: Motor speed 1: Motor current 2: Analog input 2 signal 3: PI feedback		Display scaling factor: 3dp, e.g. 0-16000 = 0.000-16000													

## Appendix B: Modbus Exception Response Telegrams

Under some circumstances, the drive may reply with an Exception Response (error) in response to a request telegram sent from the network master, for example where the master tries to read a register which does not exist. Exception Responses which can be generated by the drive are listed below:-

### Exception Code 1: Invalid Request

Returned under the following conditions

- Network Master sends an unsupported Modbus command (e.g. Read Coils).
- Run command issued to drive whilst the drive is not set for Modbus Control Mode (e.g. P1-12 <>4).
- Run command issued to drives whilst the drive is not enabled (e.g. Digital Input 1 is open).
- Run command issued to drive whilst the drive is in a tripped condition.

### Exception Code 2: Invalid Modbus register

Returned under the following conditions

- Network Master attempts to read or write a register that does not exist within the drive.

### Exception Code 3: Register Value Out of Range

Returned under the following conditions

- Network Master attempts to write a holding register with a value outside the range of the register

### Exception Code 6: Drive Busy

Returned under the following conditions

- Drive busy due to internal data transfer. The Network Master should re-send the message after a delay

### Appendix C: Dataflow example:

#### Read data from register 6:

Request: [01]	[03]	[00] [05]	[00] [01]	[94] [0B]
(Drive Addr)	(Command)	(Reg start addr)	(No. of Registers)	(Checksum)
Reply: [01]	[03]	[02] [00]	[00]	[B8] [44]
(Drive Addr)	(Command)	(No of data bytes)	(Data)	(Checksum)

**Note:** The actual start address of register 6 is 5. All data in [ ] is in 8bits Hex format.

Write start command to the register 1 (suppose P-12 = 3, P-15 =0 and digital input 1 is closed):

Request: [01]	[06]	[00] [00]	[00] [01]	[48] [0A]
(Drive Addr)	(Command)	(Reg addr)	(Data value)	(Checksum)
Reply: [01]	[06]	[00] [00]	[00] [01]	[48] [0A]
(Drive Addr)	(Command)	(Reg addr)	(Data value)	(Checksum)

**Note:** The actual address of register 1 on the data link is 0. All data in [ ] is in 8bits Hex format.

Reply can be error message depending on drive parameter settings and digital input status.

## Appendix D - Register Changes for E2 Single Phase Output Drives

The Optidrive E3 Single Phase Output drive has some registers that are different to the standard Optidrive E3. For this reason the Registers/Parameters are listed below:

Register	Parameter Number	Description	Format	Min	Max	Command	Type	Scaling
2	-	Frequency set-point	S16	0	5000	03, 06	R/W	1dp, e.g.100=10.0Hz
9	-	Reserved	-	-	-	-	-	-
10	-	Motor power	U16	0	-	03	R	2dp, e.g. 100=1.00kW
40	-	Speed reference (internal format)	U16	0	P-01	03	R	3000=50Hz
134	06	Reserved	-	-	-	-	-	-
139	11	Boost value	U16	0	Drive rating	03, 06	R/W	1dp, e.g. 100=10.0%
141	13	Reserved	-	-	-	-	-	-
148	20	Preset speed 1	U16	0	P-01	03, 06	R/W	Internal value (3000 = 50.0Hz)
149	21	Preset speed 2	U16	0	P-01	03, 06	R/W	Internal value (3000 = 50.0Hz)
150	22	Preset speed 3	U16	0	P-01	v	R/W	Internal value (3000 = 50.0Hz)
151	23	Preset speed 4	U16	0	P-01	03, 06	R/W	Internal value (3000 = 50.0Hz)
160	32	Boost Frequency	U16	0	P-01	03, 06	R/W	50 = 50Hz
161	33	Boost Period Duration	U16	0	150	03, 06	R/W	1dp, e.g. 100 = 10.0 seconds
179	51	Thermal overload retention	U16	0	1	03, 06	R/W	



## Appendix E – Drive fault codes and information

Error codes may be returned in the High Byte of Register 6 as below.

Drive Error Code	Drive Display Fault Code	Description
00	Stop (No fault)	Drive healthy, no fault present
01	OI-b	Brake channel over current
02	OL-br	Brake resistor overload
03	O-I	Over current on drive output
04	I.t-trP	Motor thermal overload
06	O_Volt	Over voltage on DC bus
07	U_Volt	Under voltage on DC bus
08	O-t	Heatsink over temperature (>98°C)
09	U-t	Under temperature (<-10°C)
10	P-dEF	Factory Default parameters have been loaded
11	E-triP	External trip (on digital Input 3)
12	SC-trP	Serial communications loss trip
13	Flt-dc	DC bus ripple too high
14	P-LOSS	Input phase loss trip (3 phase input drives only)
15	hO-I	Hardware over current
16	th-FLt	Faulty thermistor on heatsink
17	dAtA-F	Internal memory fault (IO)
18	4-20 F	Analog input current 4-20mA lost (<2.5mA)
19	DAtA-E	Internal memory fault (DSP)
20	U-dEF	User default parameters have been loaded
21	F-Ptc	Motor PTC thermistor trip
22	FAn-F	Internal cooling fan fault (IP66 only)
23	O-hEAt	Drive internal temperature too high
26	Out-F	Drive output fault
40	AtF-01	Measured motor stator resistance varies
41	AtF-02	Measured motor stator resistance too large
42	AtF-03	Measured motor inductance too low
43	AtF-04	Measured motor inductance too large
44	AtF-05	Measured motor parameters not convergent
50	SC-F01	Modbus comms loss fault
51	SC-F02	CANOpen comms loss trip

### Trip Log – Register 6

The drive trip code and drive status are displayed in this register as follows :-

High Byte								Low Byte							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
Drive trip code								Drive status							

### E3 V3.09 Firmware (Released approx. December 2020)

In V3.09 firmware, a new group of Modbus RTU registers have been added which provides a consecutive group of the most likely status registers used as process data. This allows the group to be read with a single Read Multiple Registers request, speeding up the communications.

#### Modbus RTU Registers

Register No.	Name	Description
2001	New status word	See table below
2002	Motor output speed	Speed in Hz with one decimal place
2003	Motor output current	Current in A with one decimal place
2004	Motor output power	Power in kW with one decimal place
2005	IO status word	See table below for bit definition
2006	Motor output torque	0.0 to +/-200.0%
2007	DC bus voltage	0 to 1000V
2008	Heatsink temperature	Temperature in °C
2009	Analogue input 1	0 to 4096 (12 bit)
2010	Analogue input 2	0 to 4096 (12 bit)
2011	Analogue output	0.0 to 100.0%
2012	PI output	0.0 to 100.0%
2013	Internal temperature	Temperature in °C
2014	Motor output voltage	0 to 500V
2015	IP66 pot input value	0 to 4096 (12 bit)
2016	Trip code	See User Guide for code definition

#### Register 2001 Definition – New Status Word Bit Definition

Bit	Definition	Description
0	Ready	This bit is set if no trip and no mains loss, plus hardware enable
1	Running	This bit is set when the drive is running
2	Tripped	This bit is set when the drive is in a tripped condition
3	Standby	This bit is set when the drive is in standby mode
4	Fire mode	This bit is set when fire mode is active
5	Reserved	Read as 0
6	Speed set point reached (At speed)	This bit is set when the drive is enabled and reaches set speed point
7	Below minimum speed	This bit is set when the drive is enabled and speed is less than P-02
8	Overload	This bit is set when motor current >P-08
9	Mains loss	This bit is set when a mains loss condition occurs
10	Heatsink >85°C	This bit is set when heatsink temperature >85°C
11	Control board >80°C	This bit is set when the control PCB temperature is >80°C
12	Switching frequency reduction	This bit is set when the PWM switching frequency foldback is active
13	Reverse rotation	This bit is set when the motor is in reverse rotation(negative speed)
14	Reserved	Read as 0
15	Live toggle bit	This bit will toggle each time this register is read

**Register 2005 Definition – IO Status Word**

Bit	Definition	Description
0	DI 1 Status	This bit is set when digital input 1 is closed (terminal 2)
1	DI 2 Status	This bit is set when digital input 2 is closed (terminal 3)
2	DI 3 Status	This bit is set when digital input 3 (AI-2) is closed (terminal 4)
3	DI 4 Status	This bit is set when digital input 4 (AI-1) is closed (terminal 6)
4,5	Reserved	Read as 0
6	IP66 switch FWD	This bit is set when the IP66 FWD switch is closed
7	IP66 switch REV	This bit is set when the IP66 REV switch is closed
8	Digital output status	This bit is set when the digital output is active (24V) or analogue output >0 (terminal 8)
9	Relay output status	This bit is set when the user relay is closed (terminals 10 & 11)
10, 11	Reserved	Read as 0
12	Analogue input 1 signal lost (4-20mA)	This bit is set when analogue input 1 signal loss occurs (t4-20) (terminal 6)
13	Analogue input 2 signal lost (4-20mA)	This bit is set when analogue input 2 signal loss occurs (t4-20) (terminal 4)
14	Reserved	Read as 0
15	IP66 pot input >50%	This bit is set when the IP66 integrated pot input value >50%

## Analog and Digital Input Configurations when in MODBUS control mode (P12 = 3 or 4)

By changing the value in P-15 adjusts the functionality of the control terminals as below:

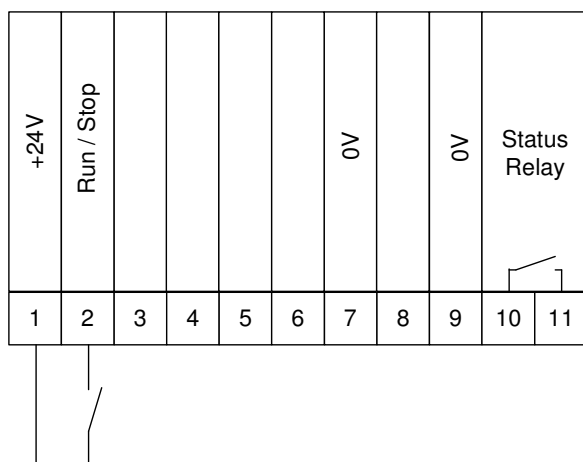
P-15	Digital input 1 (T2)	Digital input 2 (T3)	Digital input 3 (T4)	Analog input (T6)	Comments
0	Open: Stop (disable) Closed: Run (enable)	Fieldbus speed reference			Run and stop commands given via the RS485 link and Digital input 1 must be closed for the drive to run.
1	Open: Stop (disable) Closed: Run (enable)	PI speed reference			Run and stop commands given via the RS485 link and Digital input 1 must be closed for the drive to run.
3	Open: Stop (disable) Closed: Run (enable)	Open : Master speed ref Closed : Preset speed 1	External trip input : Open: Trip, Closed: Run	Analog input reference	Connect external thermistor type PT100 or similar to digital input 3
5	Open: Stop (disable) Closed: Run (enable)	Open : Master speed ref Closed : Preset speed	Open : Preset speed 1 Closed : Preset speed 2	Analog input reference	
	^ Start (P-12 = 3 or 4 Only) ^				
6	Open: Stop (disable) Closed: Run (enable)	Open : Master speed ref Closed : Analog input 1	External trip input : Open: Trip, Closed: Run	Analog input reference	Master Speed Ref - start and stop controlled via RS485. Keypad Speed Ref - drive auto runs if digital input 1 closed, depending on P-31 setting
	^ Start (P-12 = 3 or 4 Only) ^				
7	Open: Stop (disable) Closed: Run (enable)	Open : Master speed ref Closed : keypad speed ref	External trip input : Open: Trip, Closed: Run	Analog input reference	
	^ Start (P-12 = 3 or 4 Only) ^				
14	Open: Stop (disable) Closed: Run (enable)	No action	External trip input : Open: Trip, Closed: Run	Analog input reference	Connect external thermistor type PT100 or similar to digital input 3
15	Open: Stop (disable) Closed: Run (enable)	Open : Preset speed 1 Closed : Master speed ref	Open : Fire mode Closed : OK	Open : Preset speed 4 Closed : Preset speed 2	
16	Open: Stop (disable) Closed: Run (enable)	Open : Preset speed 4 Closed : Master speed ref	Open : Fire mode Closed : OK	Analog input reference	
17	Open: Stop (disable) Closed: Run (enable)	Open : Master speed ref Closed : Preset speed 4	Open : OK Closed : Fire mode	Analog input reference	
18	Open: Stop (disable) Closed: Run (enable)	Open : Analog input 1 Closed : Master speed ref	Open : OK Closed : Fire mode	Analog input reference	

P-15 = 2, 4, 8, 9, 10, 11, 12 & 13 has the same functionality as P-15 = 0

See following pages for further explanation of functionality

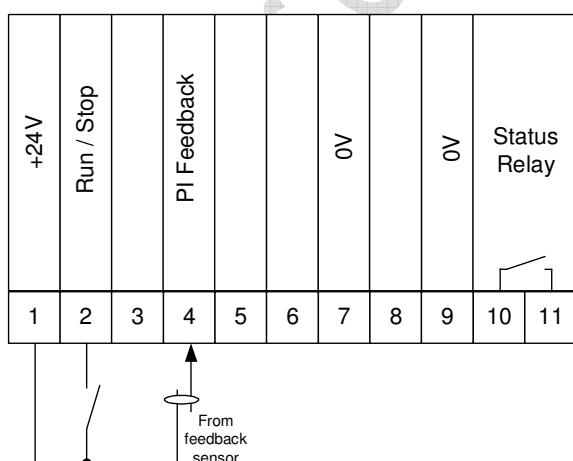
**P-15 = 0**

P-15	Digital input 1 (T2)	Digital input 2 (T3)	Digital input 3 (T4)	Analog input (T6)	Comments
0	Open: Stop (disable) Closed: Run (enable)	No action	No action	No action	Run and stop commands given via the RS485 link. Digital input 1 must be closed for the drive to run.



**P-15 = 1**

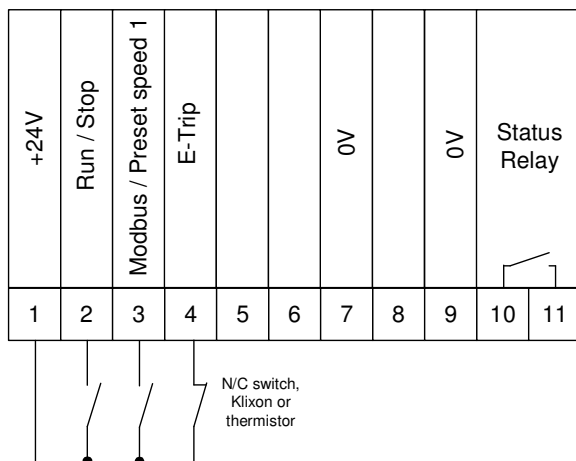
P-15	Digital input 1 (T2)	Digital input 2 (T3)	Digital input 3 (T4)	Analog input (T6)	Comments
0	Open: Stop (disable) Closed: Run (enable)	No action	PI Feedback	No action	Run and stop commands given via the RS485 link. Digital input 1 must be closed for the drive to run.



See MCW-E3-027 for PI set up information

# P-15 = 3

P-15	Digital input 1 (T2)	Digital input 2 (T3)	Digital input 3 (T4)	Analog input (T6)	Comments
0	Open: Stop (disable) Closed: Run (enable)	Open: Modbus Closed: P-20 (Preset 1)	Open: E-Trip Closed: OK	No action	Run and stop commands given via the RS485 link. Digital input 1 must be closed for the drive to run.

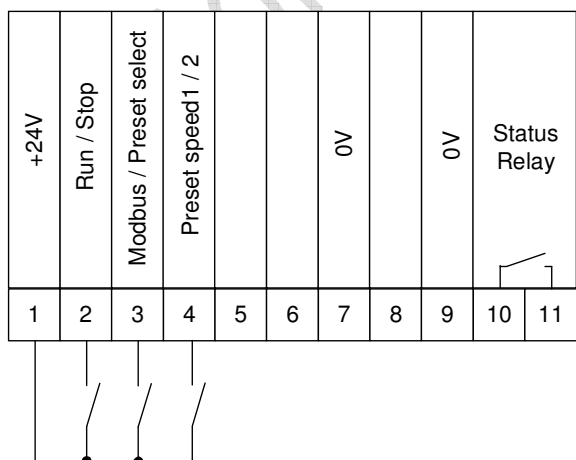


**NOTE:** Preset speed 1 is only selected when the drive is enabled using Modbus control.

**NOTE:** For motor thermistor, set P-47 = Ptc-th

# P-15 = 5

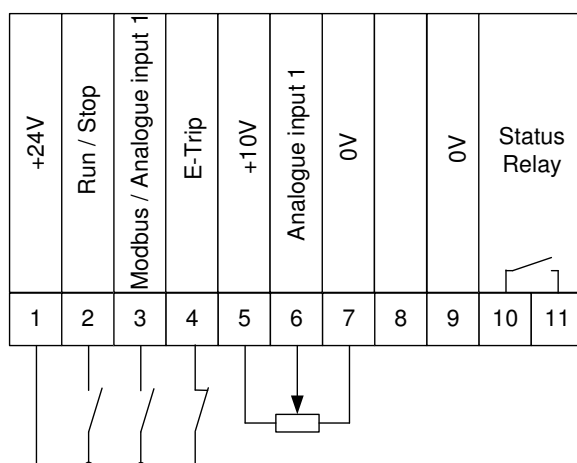
P-15	Digital input 1 (T2)	Digital input 2 (T3)	Digital input 3 (T4)	Analog input (T6)	Comments
0	Open: Stop (disable) Closed: Run (enable)	Open: Modbus Closed: Preset select	Open: P-20 (Preset 1) Closed: P-12 (Preset 2)	No action	Run and stop commands given via the RS485 link. Digital input 1 must be closed for the drive to run.



**NOTE:** Preset select overrides Modbus start/stop control so that when DI 2 is closed, the drive will run (as long as DI 1 is closed)

**P-15 = 6**

P-15	Digital input 1 (T2)	Digital input 2 (T3)	Digital input 3 (T4)	Analog input (T6)	Comments
0	Open: Stop (disable) Closed: Run (enable)	Open: Modbus Closed: Analogue speed reference	Open: E-Trip Closed: OK	Analogue speed reference	Run and stop commands given via the RS485 link. Digital input 1 must be closed for the drive to run.

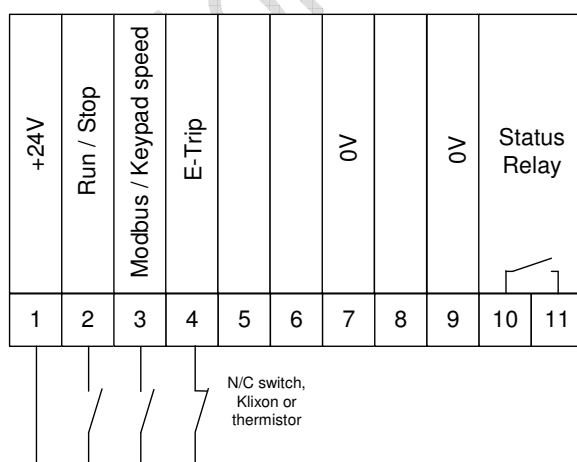


**NOTE:** When Analogue input 1 is selected, it overrides Modbus start/stop control so that when DI 2 is closed, the drive will run (as long as DI 1 is closed)

**NOTE:** For motor thermistor, set P-47 = Ptc-th

**P-15 = 7**

P-15	Digital input 1 (T2)	Digital input 2 (T3)	Digital input 3 (T4)	Analog input (T6)	Comments
0	Open: Stop (disable) Closed: Run (enable)	Open: Modbus Closed: Keypad reference	Open: E-Trip Closed: OK	No action	Run and stop commands given via the RS485 link. Digital input 1 must be closed for the drive to run.

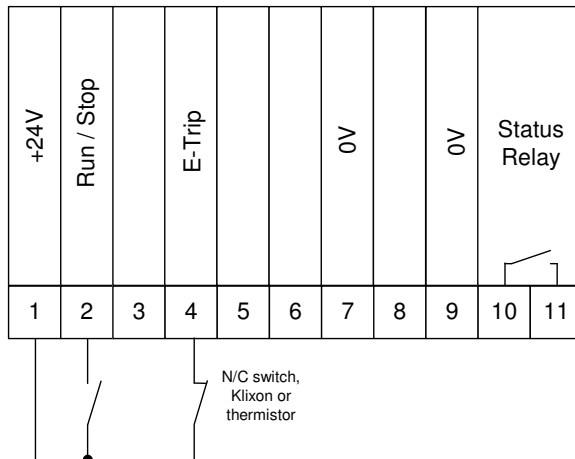


**NOTE:** When Analogue input 1 is selected, it overrides Modbus start/stop control so that when DI 2 is closed, the drive will run (as long as DI 1 is closed)

**NOTE:** For motor thermistor, set P-47 = Ptc-th

**P-15 = 14**

P-15	Digital input 1 (T2)	Digital input 2 (T3)	Digital input 3 (T4)	Analog input (T6)	Comments
0	Open: Stop (disable) Closed: Run (enable)	No action	Open: E-Trip Closed: OK	No action	Run and stop commands given via the RS485 link. Digital input 1 must be closed for the drive to run.



**NOTE:** For motor thermistor, set P-47 = Ptc-th



### V3.09 Firmware

In V3.09 E3 firmware, Modbus registers 2001 to 2016 have been added. These new registers provide a consecutive group of the most likely registers used as process data. This allows the group to be read with a single Read Multiple Registers request speed up the communication.

#### New Modbus RTU Registers

Register Number	Name	Description
2001	New status word	See table below for bit definition
2002	Motor output speed	Speed in Hz with 1 decimal place
2003	Motor output current	Current in Amps with 1 decimal place
2004	Motor output power	Power in kW with 1 decimal place
2005	IO status word	See table below for bit definition
2006	Motor output torque	0.0% to +/-200.0%
2007	DC bus voltage	0 to 1000VDC
2008	Heatsink temperature	Temperature in °C
2009	Analog input 1	0 to 4096 (12 bit)
2010	Analog input 2	0 to 4096 (12 bit)
2011	Analog output	0.0 to 100.0%
2012	PI output	0.0 to 100.0%
2013	Internal temperature	Temperature in °C
2014	Motor output voltage	0 to 500V
2015	IP66 pot input vlaue	0 to 4096 (12 bit)
2016	Trip code	See User Guide for code defintion

#### Register 2001 Definition – New status word bit definition

Bit	Definition	Description
0	Ready	This bit is set if no trip and no mains loss, plus hardware enable
1	Running	This bit is set when drive running
2	Tripped	This bit is set when drive is in a tripped condition
3	Standby	This bit is set when the drive is in Standby mode
4	Fire mode	This bit is set when Fire mode is active
5	Reserved	Read as 0
6	Speed set point reached (At speed)	This bit is set when drive is enabled and reaches speed set point
7	Below minimum speed	This bit is set when drive is enabled and speed <P-02
8	Overload	This bit is set when motor current >P-08
9	Mains loss	This bit is set if a mains loss condition happens
10	Heatsink >85°C	This bit is set if the heatsink temperature >85°C
11	Control board >80°C	This bit is set if the control board temperature >85°C
12	Switching frequency reduction	This bit is set if the switching frequency foldback is active
13	Reverse rotation	This bit I set when the motor is in reverse (negative speed)
14	Reserved	Read as 0
15	Live toggle bit	This bit will toggle each time this register is read

**Register 2005 Definition – IO Status word**

Bit	Definition	Description
0	DI 1 status (terminal 2)	This bit is set when digital input 1 is closed
1	DI 2 status (terminal 3)	This bit is set when digital input 2 is closed
2	DI 3 status (terminal 4)	This bit is set when digital input 3 (AI 2) is closed
3	DI 4 status (terminal 6)	This bit is set when digital input 4 (AI 1) is closed
4	Reserved	Read as 0
5	Reserved	Read as 0
6	IP66 switch FWD	This bit is set when IP66 FWD switch is closed
7	IP66 switch REV	This bit is set when IP66 REV switch is closed
8	Digital output status	This bit is set when digital output is active (24V) or analog output >0
9	Relay output status	This bit is set when user relay is closed
10	Reserved	Read as 0
11	Reserved	Read as 0
12	Analog input 1 signal lost (4-20mA)	This bit is set when analog input1 signal loss happens
13	Analog input 2 signal lost (4-20mA)	This bit is set when analog input2 signal loss happens
14	Reserved	Read as 0
15	IP66 pot input >50%	This bit is set when IP66 integral pot input value >50%