



# Optidrive Applications Support Library

<b>Application Note</b>	<b>AN-ODP-2-038</b>
<b>Title</b>	<b>Modbus RTU Control and Register Map</b>
<b>Related Products</b>	<b>Optidrive P2</b>
<b>Level</b> <b>3</b>	1 – Fundamental - No previous experience necessary 2 – Basic – Some Basic drives knowledge recommended 3 – Advanced – Some Basic drives knowledge required 4 – Expert – Good experience in topic of subject matter recommended

## Overview

This document provides an overview of the Modbus RTU memory mapping that is implemented in the Optidrive P2 drives, detailing which addresses are used to read and write data to / from Optidrive P2 in a Modbus RTU network. All data registers within the drive are Holding Registers, and can be accessed by means of the Modbus commands 03 Read Multiple Holding Registers and 06 Write Single Register only.

The Modbus Request PDU specifies the starting register address and the number of registers. In this case, with some Modbus Master Systems, it may be necessary to subtract 1 from the register number (e.g. some systems treat holding register 1 as address 0).

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## MODBUS RTU Protocol Specification

The following table highlights the specification for the Modbus RTU implementation in Optidrive P2

Protocol	Modbus RTU	
Error check	CRC	
Baud rate	9600bps, 19200bps, 38400bps, 57600bps, 115200bps (default)	Adjustable in Parameter P5-03
Data format	1 start bit, 8 data bits, 1 stop bits, no parity. 1 start bit, 8 data bits, 2 stop bits, no parity. 1 start bit, 8 data bits, 1 stop bits, even parity. 1 start bit, 8 data bits, 1 stop bits, odd parity.	Adjustable in Parameter P5-04
Physical signal	RS 485 (2-wire)	

### Modbus Telegram Structure

The following Modbus Commands are supported

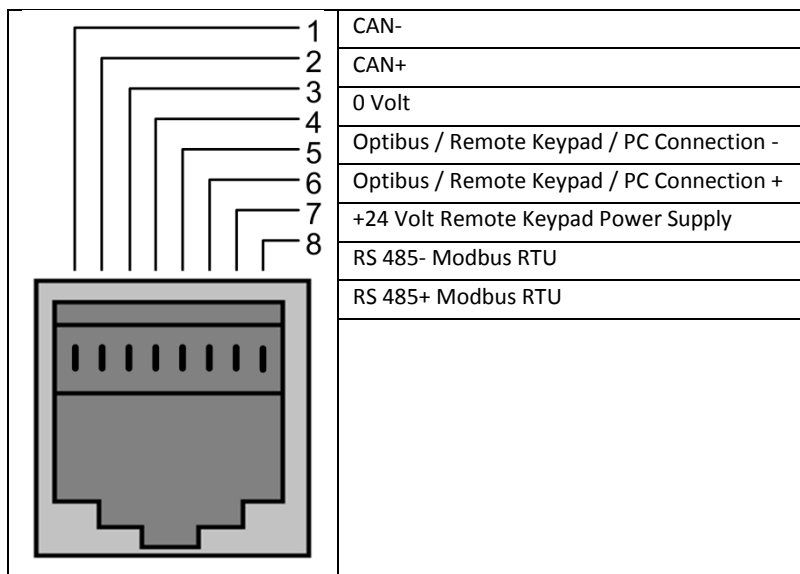
- 03 Read Holding Registers
- 06 Write Single Holding Register

The telegram structure is as follows:-

Command 03 – Read Holding Registers					
Master Telegram			Slave Response		
	Length			Length	
Slave Address	1	Byte	Slave Address	1	Byte
Function Code (03)	1	Byte	Function Code (03)	1	Byte
1st Register Address	2	Bytes	Byte Count	1	Byte
No. Of Registers	2	Bytes	1st Register Value	2	Bytes
CRC Checksum	2	Bytes	2nd Register Value	2	Bytes
			Etc...		
			CRC Checksum	2	Bytes

Command 06 – Write Single Holding Register					
Master Telegram			Slave Response		
	Length			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

### RJ45 Data Connection Pin Configuration:



## Register Map

Table 1: Control and status registers

Register	Function	Command	Type	Format	Format / Scaling	Par.
1	Drive Control Command Word	03, 06	RW	WORD	Bit 0: Run/Stop command: Set to 1 to enable (run) the drive. Set to 0 to disable (stop) the drive. Bit 1: Fast stop request. When set to 1 the drive will decelerate to stop using the 2nd deceleration ramp (P2-25). Bit 2: Reset Fault Request. Set to 1 in order to reset the drive following a trip / fault. (Note: This bit must be reset to zero once the fault is cleared to prevent un-expected reset) Bit 3: Coast stop request. Set to 1 to issue a coast stop command.	-
2	Frequency Setpoint (Reference)	03, 06	RW	S16	500 = 50.0Hz -500 = - 50.0Hz (Reverse)	-
3	Torque Setpoint (Reference)	03, 06	RW	U16	2000 = 200.0%	-
4	Modbus ramp control time	03, 06	RW	U16	3000 = 30.00 Seconds	-
5	Speed reference (IDL format)	03, 06	RW	S16	3000 = 50.0Hz/100Hz/200Hz	-
6	<b>Low Byte : Drive Status</b>	03	RO	WORD	Bit 0: Drive Running Bit 1: Drive Tripped Bit 2: Hand mode (HVAC only) Bit 3: Inhibit Bit 4: Service due Bit 5: Standby Bit 6: Drive Ready (Mains power applied + No trip + No Inhibit + HW Enable Applied) Bit 7: Reserved	-
	U8			Error Code : See below		
7	Output Frequency	03	RO	S16	500 = 50.0Hz	-
8	Output Current	03	RO	U16	100 = 10.0 Amps	-
9	Motor Torque	03	RO	U16	1000 = 100.0%	P0-12
10	Output Power	03	RO	U16	1000 = 10.00kW	-
11	Digital Input Status	03	RO	WORD	Bit 0: Digital Input 1 Bit 1: Digital Input 2 Bit 2: Digital Input 3 Bit 3: Digital Input 4 (Analog 1) Bit 4: Digital Input 5 (Analog 2) Bit 5: Digital Input 6 (Extended I/O) Bit 6: Digital Input 7 (Extended I/O) Bit 7: Digital Input 8 (Extended I/O)	P0-03
12	Rating ID	03	RO	WORD	Bit 0 – 3: Power Index (Internal Reference) Bit 4: 0 = kW, 1 = HP Bit 5: Bit 6: 0 = 3 Ph. Input, 1 = 1 Ph. Input Bit 7: Bit 8 – 11: Voltage Rating Index 1=110V, 2=230V, 3=400V, 4=460V, 5=525V, 6=575V Bit 12 – 15: Drive Size (1 – 8)	P0-29
13	Power rating	03	RO	U16	220 = 2.2kW	P0-29
14	Voltage rating	03	RO	U16	110 = 110 – 115V 230 = 200 – 240V 400 = 380 – 480V 460 = 380 – 480V 525 = 480 – 525V 600 = 500 – 600V	P0-29
15	IO Processor Software Version	03	RO	U16	100 = 1.00	P0-28
16	Motor Control Processor Software Version	03	RO	U16	100 = 1.00	P0-28
17	Drive Type	03	RO	WORD		P0-29
18	Scope channel 1	03	RO	U16		-
19	Scope channel 2	03	RO	U16		-
20	Analog Input 1 Signal Level	03	RO	S16	1000 = 100.0%	P0-01
21	Analog Input 2 Signal Level	03	RO	U16	1000 = 100.0%	P0-02
22	Pre Ramp Speed Reference (Hz)	03	RO	S16		P0-04
23	DC bus Voltage	03	RO	U16	600 = 600 Volts	P0-20
24	Drive Heatsink Temperature	03	RO	S16	40 = 40°C	P0-21
25	Drive Serial Number 4	03	RO	U16	Last 3 Digits	P0-30
26	Drive Serial Number 3	03	RO	U16	Digits 4 & 5	P0-30
27	Drive Serial Number 2	03	RO	U16	Digits 6, 7, 8 & 9	P0-30

Register	Function	Command	Type	Format	Format / Scaling	Par.
28	Drive Serial Number 1	03	RO	U16	Digits 10, 11	P0-30
29	Relay Output Status	03	RO	U16		-
30	kWh meter (User)	03	RO	U16	100 = 10.0kWh	P0-26
31	MWh meter (User)	03	RO	U16	100 = 100MWh	P0-27
32	kWh Meter	03	RO	U16		P0-26
33	MWh Meter	03	RO	U16		P0-27
34	Running time – hour	03	RO	U16		P0-31
35	Running time – min/sec	03	RO	U16		P0-31
36	Running time since last enable – hour	03	RO	U16		P0-34
37	Running time since last enable – min/sec	03	RO	U16		P0-34
38	Reserved	-	-	-		-
39	Internal drive temperature	03	RO	S16		P0-72
40	Speed reference value (IDL format)	03	RO	S16		-
41	Torque reference value	03	RO	U16		P0-05
42	Digital pot reference value	03	RO	U16		P0-06
43	P0-80	03	RO	-		P0-80
44	Index for parameter write	06	Write	U16	501 is index for P5-01	-
**45	Value for parameter write	06	Write	S16		-

\*\* Value sent to parameter indexed by register 44 as soon as register 45 is written

## Internal Register Access area

Register	Function	Command	Type	Format	Scaling
51	User register 1	03, 06	RW	S16	
52	User register 2	03, 06	RW	S16	
53	User register 3	03, 06	RW	S16	
54	User register 4	03, 06	RW	S16	
55	User register 5	03, 06	RW	S16	
56	User register 6	03, 06	RW	S16	
57	User register 7	03, 06	RW	S16	
58	User register 8	03, 06	RW	S16	
59	User register 9	03, 06	RW	S16	
60	User register 10	03, 06	RW	S16	
61	User register 11	03, 06	RW	S16	
62	User register 12	03, 06	RW	S16	
63	User register 13	03, 06	RW	S16	
64	User register 14	03, 06	RW	S16	
65	User register 15	03, 06	RW	S16	
66	Analog output 1 user	03, 06	RW	S16	1000 = 100.0%
67	Analog output 2 user	03, 06	RW	S16	1000 = 100.0%
68	Reserved	03, 06	RW	-	
69	Reserved	03, 06	RW	-	
70	Relay output 1 user	03, 06	RW	WORD	
71	Relay output 2 user	03, 06	RW	WORD	
72	Relay output 3 user	03, 06	RW	WORD	
73	Relay output 4 user	03, 06	RW	WORD	
74	Relay output 5 user	03, 06	RW	WORD	
75	User display scaling	03, 06	RW	WORD	
76	User display decimal	03, 06	RW	U16	
77	User speed reference	03, 06	RW	S16	
78	User torque reference	03, 06	RW	U16	
79	User ramp	03, 06	RW	U16	
80	Scope index 1, 2	03, 06	RW	U16	
81	User register 16	03, 06	RW	S16	
82	User register 17	03, 06	RW	S16	
83	User register 18	03, 06	RW	S16	
84	User register 19	03, 06	RW	S16	
85	User register 20	03, 06	RW	S16	
86	User register 21	03, 06	RW	S16	
87	User register 22	03, 06	RW	S16	
88	User register 23	03, 06	RW	S16	
89	User register 24	03, 06	RW	S16	
90	User register 25	03, 06	RW	S16	
91	User register 26	03, 06	RW	S16	
92	User register 27	03, 06	RW	S16	
93	User register 28	03, 06	RW	S16	
94	User register 29	03, 06	RW	S16	
95	User register 30	03, 06	RW	S16	
96	User register 31	03, 06	RW	S16	

## Control Register Descriptions

### Read and write registers

#### **Register 1: Drive Control Command Word**

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 (run) the drive. Set to 0 to disable (stop) the drive.

Bit 1: Fast stop request. When set to 1 the drive will decelerate to stop using the 2<sup>nd</sup> deceleration ramp (P2-25).

Bit 2: Reset Fault Request. Set to 1 in order to reset the drive following a trip / fault.

(Note : This bit must be reset to zero once the fault is cleared to prevent un-expected reset)

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 the control word is set to 0x0009 by the network master, the drive will do a coast stop rather than run. For normal Start / Stop operation, bit 0 should be used.

#### **Register 2: Modbus Speed Reference Set-point**

This register is used to send the speed reference value. The input data is a 16bit signed integer including one decimal place. For example, a value of 500 represents a speed reference of 50.0Hz, 123 represents 12.3Hz. It is also possible to reverse the drive by sending a negative value in this register. For example, -1 (0xFFFF) gives -0.1Hz. -234 (0xFF16) gives -23.4Hz.

The input value range is from -5000 +5000; however the actual drive output frequency will be limited by the minimum and maximum frequencies set in P1-02 and P1-01 respectively.

#### **Register 3 : Modbus Torque Reference Set-point**

This register is used to send the torque reference / limit value when a Modbus torque reference or maximum torque limit is selected using P4-06. The value must always be positive with a range of 0 – 2000 = 0.0 – 200.0% of the motor nominal torque capacity.

#### **Register 4: Modbus Ramp Control Time**

This register specifies the drive acceleration and deceleration ramp time simultaneously. This value will override the values set in parameters P1-03 and P1-04 respectively, providing P5-08 = 1. The input data range is from 0 to 60 000 (0.00s to 600.00s)

## Drive Parameters

All User Adjustable parameters in Groups 1 to 8 can be accessed by Modbus. For further details regarding the parameter functions, please refer to the Optidrive P2 User Guide.

Register Type definitions are defined as follows

WORD Hexadecimal Word

U16 Unsigned 16 Bit Value

S16 Signed 16 Bit Value

### Group 1 : Basic Parameter Set (Level 1)

Parameter Number	Register Number	Description	Range	Scaling	Type
P1-01	101	Max Frequency Limit	0 to 30000	3000 = 50.0Hz	U16
P1-02	102	Min Frequency Limit	0 to 30000 (Limited by P1-01 Setting)	3000 = 50.0Hz	U16
P1-03	103	Acceleration Ramp Time	0 to 6000	300 = 30.0s	U16
P1-04	104	Deceleration Ramp Time	0 to 6000	300 = 30.0s	U16
P1-05	105	Stop mode	0: Ramp to Stop 1: Coast to Stop 2 = Ramp to Stop, Brake Transistor Enabled 3 = Coast to Stop, Brake Transistor Enabled		U16
P1-06	106	Energy optimiser	0: Disable 1: Enable		WORD
P1-07	107	Motor rated voltage	0V, 20V to 250V 0V, 20V to 500V 0V, 20V to 600V	230 = 23 V	U16
P1-08	108	Motor rated current	20% to 100% of drive rated current	1 = 0.1A	U16
P1-09	109	Motor rated frequency	25 to 500Hz	50 = 50Hz	U16
P1-10	110	Motor rated speed	0 to 30 000rpm	1500 = 1500rpm	U16
P1-11	111	V/F Voltage Boost	Auto, 0.1 to 20%	-1 = Auto 0 = Disabled 1 = 0.1%	S16
P1-12	112	Control mode	0: Terminal mode 1: Keypad mode (Unipolar) 2: Keypad mode (Bipolar + direction toggle) 3: User PID mode 4: Fieldbus (Modbus, Profibus etc.) 5: Slave mode		U16
P1-13	113	Digital inputs function select	0: User defined 1...20 see table		U16
P1-14	114	Extended Menu Access code	0 to 30 000		U16

## Group 2 : Extended parameter set (Level 2)

Parameter Number	Register Number	Description	Range	Scaling	Type
P2-01	201	Preset speed 1	0 to 30000 (Limited by P1-01 Setting)	3000 = 50.0Hz	U16
P2-02	202	Preset speed 2	0 to 30000 (Limited by P1-01 Setting)	3000 = 50.0Hz	U16
P2-03	203	Preset speed 3	0 to 30000 (Limited by P1-01 Setting)	3000 = 50.0Hz	U16
P2-04	204	Preset speed 4	0 to 30000 (Limited by P1-01 Setting)	3000 = 50.0Hz	U16
P2-05	205	Preset speed 5	0 to 30000 (Limited by P1-01 Setting)	3000 = 50.0Hz	U16
P2-06	206	Preset speed 6	0 to 30000 (Limited by P1-01 Setting)	3000 = 50.0Hz	U16
P2-07	207	Preset speed 7	0 to 30000 (Limited by P1-01 Setting)	3000 = 50.0Hz	U16
P2-08	208	Preset speed 8	0 to 30000 (Limited by P1-01 Setting)	3000 = 50.0Hz	U16
P2-09	209	Skip frequency centrepoint	0 to 30000 (Limited by P1-01 Setting)	3000 = 50.0Hz	U16
P2-10	210	Skip frequency band	0 to 30000 (Limited by P1-01 Setting)	3000 = 50.0Hz	U16
P2-11	211	Analog output 1 function select	<b>Digital Mode (0V or 24V only)</b> 0: Drive running 1: Drive healthy 2: Motor at target speed 3: Motor Speed > 0 4: Motor Speed > limit 5: Motor Current > limit 6: Motor Torque > limit 7: 2 <sup>nd</sup> Analog input > limit (Limit set by P2-18, P2-19) <b>Analog Mode</b> 8: Speed 9: Current 10: Torque 11: Power		U16
P2-12	212	Analog output 1 format	0 = 0...10V 1 = 10...0V 2 = 0-20mA 3 = 20-0mA 4 = 4-20mA 5 = 20-4mA		U16
P2-13	213	Analog output 2 function select	<b>Digital Mode (0V or 24V only)</b> 0: Drive running 1: Drive healthy 2: Motor at target speed 3: Motor Speed > 0 4: Motor Speed > limit 5: Motor Current > limit 6: Motor Torque > limit 7: 2 <sup>nd</sup> Analog input > limit (Limit set by P2-18, P2-19) <b>Analog Mode</b> 8: Speed 9: Current 10: Torque 11: Power		U16
P2-14	214	Analog output 2 format	0 = 0...10V 1 = 10...0V 2 = 0-20mA 3 = 20-0mA 4 = 4-20mA 5 = 20-4mA		U16
P2-15	215	User relay 1 output function select	0: Drive running 1: Drive healthy 2: Motor at target speed 3: Motor Speed > 0 4: Motor Speed > limit 5: Motor Current > limit 6: Motor Torque > limit 7: 2 <sup>nd</sup> Analog input > limit		U16
P2-16	216	User relay 1 upper limit	P2-17 to 2000	1 = 0.1%	U16
P2-17	217	User relay 1 lower limit	0 to P2-16	1 = 0.1%	U16



Parameter Number	Register Number	Description	Range	Scaling	Type
P2-18	218	User relay 2 output function select	0: Drive running 1: Drive healthy 2: Motor at target speed 3: Motor Speed > 0 4: Motor Speed > limit 5: Motor Current > limit 6: Motor Torque > limit 7: 2 <sup>nd</sup> Analog input > limit		U16
P2-19	219	User relay 2 upper limit	P2-20 to 2000	1 = 0.1%	U16
P2-20	220	User relay 2 lower limit	0 to P2-19	1 = 0.1%	U16
P2-21	221	Display scaling factor	0 to 30000	1 = 0.001	U16
P2-22	222	Display scaling source	0: Motor Speed 1: Motor Current 2: 2 <sup>nd</sup> Analog input		U16
P2-23	223	Zero Speed holding time	0 to 600	1 = 0.1	U16
P2-24	224	Effective switching frequency	0 = 4kHz 1 = 8kHz 2 = 12kHz 3 = 16kHz 4 = 24kHz 5 = 32kHz		U16
P2-25	225	Fast deceleration ramp time	0 to 3000	S2...S3 1 = 0.01s S4...S7 1 = 0.1s	U16
P2-26	226	Spin start enable	0 : Disabled 1 : Enabled	1	WORD
P2-27	227	Standby mode	0 to 25000	1 = 0.01	U16
P2-28	228	Slave speed scaling control	0: Disabled 1: Preset by slave speed scaling 2: P2-33 scaling + analog in1 offset 3: P2-33 scaling + analog in1 scaling		U16
P2-29	229	Slave Speed scaling factor	-5000 to 5000	1 = 0.1	S16
P2-30	230	Analog input 1 format	0 = 0-10V 1 = -10-10V 2 = 0-20mA 3 = t 4-20mA 4 = r 4-20mA 5 = t 20-4mA 6 = r 20-4mA		U16
P2-31	231	Analog input 1 scaling	0 to 5000	1 = 0.1	U16
P2-32	232	Analog input 1 offset	-5000 to 5000	1 = 0.1	S16
P2-33	233	Analog input 2 format	0 = 0-10V 1 = Ptc-th 2 = 0-20mA 3 = t 4-20mA 4 = r 4-20mA 5 = t 20-4mA 6 = r 20-4mA		U16
P2-34	234	Analog input 2 scaling	0 to 5000	1 = 0.1	U16
P2-35	235	Analog input 2 offset	-5000 to 5000	1 = 0.1	S16
P2-36	236	Start mode select	0 = Edge-r 1 = Auto-0 2 = Auto-1 3 = Auto-2 4 = Auto-3 5 = Auto-4 6 = Auto-5		U16
P2-37	237	Keypad restart speed	0: Minimum speed 1: Previous keypad speed 2: Current running Speed 3: Preset Speed 8		U16
P2-38	238	Mains loss stop control	0: Mains loss ride through 1: Coast to Stop 2: Fast ramp to stop		U16
P2-39	239	Parameter Lock	0: Unlocked 1: Locked		WORD
P2-40	240	Extended parameter access code definition	0 ... 9 999		U16

**Group 3 : User PID control (Level 2)**

Parameter Number	Register Number	Description	Range	Scaling	Type
P3-01	301	User PID Proportional Gain	1 to 300	1 = 0.1	U16
P3-02	302	User PID Integral time constant	0 to 300	1 = 0.1	U16
P3-03	303	User PID Differential time constant	0 to 100	1 = 0.01	U16
P3-04	304	User PID operating mode	0: Direct 1: Inverse		WORD
P3-05	305	User PID reference select	0: Digital preset (P3-06) 1: 1 <sup>st</sup> Analog input 2: 2 <sup>nd</sup> Analog input	1 = 1	U16
P3-06	306	User PID digital reference	0 to 1000	1 = 0.1%	U16
P3-07	307	User PID controller output high limit	P3-08 to 1000	1 = 0.1%	U16
P3-08	308	User PID controller output low limit	0 to P3-07	1 = 0.1%	U16
P3-09	309	User PID output control	0: Digital output limits 1: 1 <sup>st</sup> Analog variable upper limit 2: 1 <sup>st</sup> Analog variable lower limit 3: PID output + 1 <sup>st</sup> analog input		U16
P3-10	310	User PID feedback select	0: 2 <sup>nd</sup> Analog input 1: 1 <sup>st</sup> Analog input		WORD
P3-11	311	PID error to enable ramps	0 to 250	1 = 0.1%	U16
P3-12	312	PID feedback value display scaling factor	0 to 50000	0: Disabled 1 = 0.001	U16
P3-13	313	PID feedback wake-up level	0 to 1000	1 = 0.1%	U16

**Group 4 : Motor control parameter set (Level 2)**

Parameter Number	Register Number	Description	Range	Scaling	Type
P4-01	401	Control mode	0 = Speed control (vector) 1 = Torque control (vector) 2 = Speed control (Enhanced V/F) 3 = PM motor speed control (P1-14 = 201) 4 = PM motor torque control (P1-14 = 201) 5 = BLDC motor speed control (P1-14=201)		U16
P4-02	402	Motor parameter Auto-tune	0 = Disable 1 = Enable		WORD
P4-03	403	Vector Speed controller Proportional Gain	1 to 4000	1 = 0.1%	U16
P4-04	404	Vector Speed controller Integral time constant	1 to 1000	1 = 0.001s	U16
P4-05	405	Motor power factor	0.00, 50 to 99	99 = 0.99	U16
P4-06	406	Torque Control reference	0 = Max Torque limit (P4-07) 1 = 1 <sup>st</sup> analog input 2 = 2 <sup>nd</sup> analog input 3 = Fieldbus / communications 4 = Master drive (Master / Slave) 5 = User PID output		U16
P4-07	407	Max motoring torque limit	P4-08 to 2000	2000 = 200.0%	U16
P4-08	408	Minimum torque limit	0 to P4-07	1 = 0.1%	U16
P4-09	409	Generator mode maximum torque limit	0.0 ... 200%	1 = 1%	U16
P4-10	410	V/F characteristic adjustment frequency	0.0...100% of P1-07	1 = 0.1%	U16
P4-11	411	V/F characteristic adjustment voltage	0.0...100% of P1-09	1 = 0.1%	U16

**Group 5 : Fieldbus communications (Level 2)**

Parameter Number	Register Number	Description	Range	Scaling	Type
P5-01	501	Fieldbus drive address	0...63	1 = 1	
P5-02	502	CANbus baudrate	125kbps 250kbps 500kbps 1Mbps	0 = 125kbps 1 = 250kbps	
P5-03	503	Modbus baudrate	9.6kbps, 19.2kbps, 38.4kbps, 57.6kbps, 115 kbps	0 = 9.6kbps 1 = 19.2kbps	
P5-04	504	Modbus data format	N-1 : None Parity 1 stop bit N-2 : None parity 2 stop bits O-1 : Odd parity 1 stop bit E-1 : Even parity 1 stop bit	0 = N-1 1 = N-2	
P5-05	505	Comms loss timeout	0...0.1... 5.0	1 = 0.1s	
P5-06	506	Communications loss action	0: Trip 1: Ramp to Stop then trip 2: Ramp to stop (No trip) 3: Preset speed 8	1 = 1	
P5-07	507	Fieldbus ramp control	0: Disable 1: Enable	1 = 1	
P5-08	508	Anybus module output process data 4	0: Torque (%) 1: Power (x.xx kW) 2: Digital input status 3: 2 <sup>nd</sup> analog input (%) 4. Power stage temperature	1=1	

**Group 6 : Advanced Parameter set (Level 3)**

Par	Register	Description	Range	Scaling	Type
P6-01	601	Firmware Upgrade enable	0: Disabled 1: Enable (IO and DSP) 2: Enable (IO only) 3: Enable (DSP only)		U16
P6-02	602	Auto thermal management	0: Disable 1: Enable		WORD
P6-03	603	Auto-reset delay time	1 to 60		U16
P6-04	604	User relay hysteresis band	0 - 250	1 = 0.1%	U16
P6-05	605	Encoder feedback enable	0: Disabled 1: Enable		WORD
P6-06	606	Encoder PPR	0 to 65535		U16
P6-07	607	Speed error trip level	0 to 500	1 = 0.1%	U16
P6-08	608	Max speed ref frequency	0, 5 to 20		U16
P6-09	609	Speed Droop Control	0 to 250	1 = 0.1%	U16
P6-10	610	Enable PLC operation	0: Disable 1: Enable		WORD
P6-11	611	Speed hold time on enable	0 to 2500	1 = 0.1s	U16
P6-12	612	Speed hold time on disable	0 to 2500	1 = 0.1s	U16
P6-13	613	Hoist mode brake release delay	0 to 50	1 = 0.1s	U16
P6-14	614	Hoist mode brake apply delay	0 to 50	1 = 0.1s	U16
P6-15	615	Torque threshold for hoist brake release	0 to 2000	1 = 0.1%	U16
P6-16	616	Torque threshold timeout	0 to 250	1 = 0.1s	U16
P6-17	617	Max Torque limit timeout	0 to 250	1 = 0.1s	U16
P6-18	618	DC injection braking voltage	0 : Auto 0 to 250	0 = Auto 1 = 0.1%	U16
P6-19	619	Brake resistor value	0, Min value to 200	1 = 1	U16
P6-20	620	Brake resistor power	0 to 20000	1 = 0.01kw	U16
P6-21	621	Brake chopper UT duty cycle	0 to 200	1 = 0.1%	U16
P6-22	622	Reset cooling fan run-time	0: Disable 1: Enable		WORD
P6-23	623	Reset kWh meter	0: Disable 1: Enable		WORD
P6-24	624	Service time interval	0 ... 60 000 h (0 = disabled)	1=1	U16
P6-25	625	Reset service indicator	0: Disable 1: Reset	1=1	WORD
P6-26	626	Analog output 1 scaling	0 to 5000	1 = 0.1	U16
P6-27	627	Analog output 1 offset	-5000 to 5000	1 = 0.1%	S16
P6-28	628	P0-80 display value index	0 to 127		U16
P6-29	629	Save User Parameters as default	0: Disable 1: Enable		WORD
P6-30	630	Level 3 access code	0 to 9999		U16

**Group 7 : Motor Control Parameter set (Level 3)**

Parameter Number	Register Number	Description	Range	Scaling	Type
P7-01	701	Motor Stator resistance	Drive dependent	1 = 0.001ohm	U16
P7-02	702	Motor Rotor resistance	Drive dependent	1 = 0.001ohm	U16
P7-03	703	Motor stator inductance	Drive dependent	1 = 0.0001H	U16
P7-04	704	Motor Magnetising Current	Drive dependent	1 = 0.1A	U16
P7-05	705	Motor Leakage Coefficient	0 to 250	1 = 0.001	U16
P7-06	706	Motor Stator inductance (PM only)	Drive dependent	1 = 0.0001H	U16
P7-07	707	Enhanced generator control	0: Disable 1: Enable		WORD
P7-08	708	Parameter adaptation	0: Disable 1: Enable		WORD
P7-09	709	Over voltage current limit	0.0 to 100% of motor rated current	1 = 0.1%	U16
P7-10	710	Load Inertia Factor	0 to 600	1=1	U16
P7-11	711	Pulse width minimum limit	0 to 500 (Time = value *16.67ns)	1 = 1	U16
P7-12	712	V/F mode magnetising period	0 to 2000		U16
P7-13	713	Vector Speed Controller D-Gain	0 to 4000	1 = 0.1%	U16
P7-14	714	Low frequency torque boost	0 to 1000	1 = 0.1%	U16
P7-15	715	Torque boost frequency limit	0 to 500	1 = 0.1%	U16

**Group 8 : Application Specific Parameters - Level 3**

Parameter Number	Register Number	Description	Range	Scaling	Type
P8-01	801	Accel Ramp 2	0 to 60000	S2...S3 1 = 0.01s S4...S7 1 = 0.1s	U16
P8-02	802	Speed boundary – Accel ramp 1 → 2	0 to 30000 (Limited by P1-01 Setting)	3000 = 50.0Hz	U16
P8-03	803	Accel Ramp 3	0 to 60000	S2...S3 1 = 0.01s S4...S7 1 = 0.1s	U16
P8-04	804	Speed boundary – Accel ramp 2 → 3	0 to 30000 (Limited by P1-01 Setting)	3000 = 50.0Hz	U16
P8-05	805	Accel Ramp 4	0 to 60000	S2...S3 1 = 0.01s S4...S7 1 = 0.1s	U16
P8-06	806	Speed boundary – Accel ramp 3 → 4	0 to 30000 (Limited by P1-01 Setting)	3000 = 50.0Hz	U16
P8-07	807	Decel Ramp 4	0 to 60000	S2...S3 1 = 0.01s S4...S7 1 = 0.1s	U16
P8-08	808	Speed boundary – Accel ramp 4 → 3	0 to 30000 (Limited by P1-01 Setting)	3000 = 50.0Hz	U16
P8-09	809	Decel Ramp 3	0 to 60000	S2...S3 1 = 0.01s S4...S7 1 = 0.1s	U16
P8-10	810	Speed boundary – Accel ramp 3 → 2	0 to 30000 (Limited by P1-01 Setting)	3000 = 50.0Hz	U16
P8-11	811	Decel Ramp 2	0 to 60000	S2...S3 1 = 0.01s S4...S7 1 = 0.1s	U16
P8-12	812	Speed boundary – Accel ramp 2 → 1	0 to 30000 (Limited by P1-01 Setting)	3000 = 50.0Hz	U16
P8-13	813	Ramp select by Preset Speed	0: Disabled 1: Enable		WORD

**Drive error code information in Register 6:**

In the event of a trip, an error code is returned in the High Byte of the drive status word. The fault values correspond to the following table.

Fault Code	No.	Description	Fault Code	No.	Description
no-Flt	00	No Fault	AtF-01	40	Measured motor stator resistance varies between phases.
OI-b	01	Brake channel over current	AtF-02	41	Measured motor stator resistance is too large.
OL-br	02	Brake resistor overload	AtF-03	42	Measured motor inductance is too low.
O-I	03	Instantaneous over current	AtF-04	43	Measured motor inductance is too large.
I.t-trp	04	Motor Thermal Overload (I2t)	AtF-05	44	Measured motor parameters are not convergent
SAFE-1	05	Safety input circuit error (Processor output)	AtF-06	45	Reserved
O-Volt	06	Over voltage on DC bus	AtF-07	46	Reserved
U-Volt	07	Under voltage on DC bus	AtF-08	47	Reserved
O-t	08	Heatsink over temperature	AtF-09	48	Reserved
U-t	09	Under temperature	AtF-10	49	Reserved
P-dEF	10	Factory Default parameters have been loaded	SC-F01	50	Modbus comms loss fault
E-trip	11	External trip	SC-F02	51	CANopen comms loss trip
SC-ObS	12	Optibus comms loss	SC-F03	52	Anybus module comms loss trip
Flt-dc	13	DC bus ripple too high	SC-F04	53	IO card comms loss trip
P-LOSS	14	Input phase loss trip	SC-F05	54	Reserved
h O-I	15	Instantaneous over current on drive output.	SC-F06	55	Reserved
th-Flt	16	Faulty thermistor on heatsink.	SC-F07	56	Reserved
dAtA-F	17	Internal memory fault. (IO)	SC-F08	57	Reserved
4-20 F	18	4-20mA Signal Lost	SC-F09	58	Reserved
dAtA-E	19	Internal memory fault. (DSP)	SC-F10	59	Reserved
U-dEF	20	User Default Parameters Loaded	OF-01	60	Internal link to option module loss
F-Ptc	21	Motor PTC thermistor trip	OF-02	61	Option module in exceptional condition
FAN-F	22	Cooling Fan Fault	OF-03	62	Reserved
O-hEAt	23	Environmental temperature too high	OF-04	63	Reserved
O-torq	24	Maximum torque limit trip / Over torque (HVAC)	OF-05	64	Reserved
U-torq	25	Output torque too low (hoist) / Under torque (HVAC)	OF-06	65	Reserved
Out-F	26	Drive output fault	OF-07	66	Reserved
Err-01	27	Reserved	OF-08	67	Reserved
Err-02	28	Reserved	OF-09	68	Reserved
SAFE-2	29	Safety input circuit error (Buffer output)	OF-10	69	Reserved
Enc-01	30	Encoder comms/data loss	PLC-01	70	Unsupported PLC function block
Enc-02	31	Encoder speed error	PLC-02	71	PLC program over size
Enc-03	32	Incorrect Encoder PPR count set in parameters	PLC-03	72	Divide by 0
Enc-04	33	Encoder Channel A Fault	PLC-04	73	Lower limit larger than higher limit
Enc-05	34	Encoder Channel B Fault	PLC-05	74	Table function block index overflow
Enc-06	35	Encoder Channels A & B Fault	PLC-06	75	Reserved
Enc-07	36	RS485 data channel error (servo)	PLC-07	76	Reserved
Enc-08	37	IO comms loss (servo)	PLC-08	77	Reserved
Enc-09	38	Wrong type encoder (servo)	PLC-09	78	Reserved
Enc-10	39	KTY trip (servo)	PLC-10	79	Reserved

## 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 Coil Status).
- 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. No hardware enable present).
- 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

## 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 register 1 (suppose P1-12 = 4, P1-13 =1 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

Revision History			
Issue	Comments	Author	Date
01	First Release	KB	28/10/11
02	Added parameter group 0 references to table	KB	13/02/12
03	Added Modbus Error Response details. Corrected data flow example	KB	14/02/12
04	Changed to new format Updated status word definition Added Register 44 & 45 definition	KB	29/07/14
05	Additional registers added for V1.30 Firmware	KB	1/10/14
06	Removed reference to E2 drive	KB	6/5/15