Application Note   AN-ODP- 38

3GV–M Modbus RTU Register Map

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General

This document details the Modbus RTU memory mapping implemented in Optidrive 3GV-M drives, detailing which addresses are used to read and write data to / from Optidrive pluses in a Modbus RTU network.
Note that Optidrive 3GV does not support Modbus RTU as standard, unless Modbus support is specifically requested when ordering the drive and is referred to as 3GV-M.
It is also possible to upgrade V2.0 drives to support Modbus. Contact Invertek for more details should this be required.

The following parameters should be set correctly when using Modbus :

   P1-12 (set to 4 for Modbus support) **
   P2-26 (communication baud rate)
   P2-27 (drive address)

** For drive software version *V2.20* or later, if P1-12 = 0, 1, 2 or 3, the drive can still be monitored and parameters can be modified via Modbus, but control of the drive is not possible unless P1-12 = 4.

See User Guide for more information on these parameter settings

The Fieldbus Gateways (Profibus, DeviceNet) also use the Modbus interface. In this case, the baud rate must be set to 57kbps. For more information regarding the fieldbus gateway, please contact Invertek Drives Ltd, or visit our web site: www.invertek.co.uk

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Specification

The following table highlights the specification for the Modbus RTU implementation in Optidrive 3GV-M

Protocol	Modbus RTU
Error check	CRC
Baud rate	9600bps, 19200bps, 38400bps, 57600bps, 115200bps (default)
Data format	**1 start bit, 8 data bits, 1 stop bits, no parity.**
Physical signal	RS 485 (2-wire)
User interface	RJ11 (see user guide for more information)

Memory Map

Table 1: Control and status registers

Register	*Upper byte*	*Lower Byte*	*Command*	*Type*
1*	Command		03,06	R/W
2*	Speed reference		03,06	R/W
3*	Torque reference		03,06	R/W
4*	Acc ramp time	Dec ramp time	03,06	R/W
5	Reserved		03	R
6*	Error code	Drive status	03	R
7*	Motor speed		03	R
8*	Motor current		03	R
9*	Motor torque		03	R
10	Motor power		03	R
11	Digital input status		03	R
12**	Rating ID		03	R
13**	Power rating		03	R
14**	Voltage rating		03	R
15**	Software version		03	R

* Registers are available in standard fieldbus gateway configuration
** Registers are only available with drive firmware revision V2.21 or later

Register Description

Read and write register

Register 1: Drive command

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Reserved													2nd	CMD	

Bit1, 0: Drive command setup: 00-stop, 01-start, 10-reset
Bit 2: 2nd deceleration ramp select flag

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 P1-01.

Register 3: torque reference setup

This register holds the torque reference with one decimal place (450 = 45.0%). The data range is from 0 (0%) to 2000 (200.0%)
This torque reference is only active when P4-06=3 and drive is in vector control mode.

Register 4: Acc/Dec ramp setup

This register specifies the drive acceleration and deceleration ramp time.
High byte gives Accel ramp time in second: 25 = 25s, maximum 255.
Low byte gives Dec ramp time in second: 66 = 66s, maximum 255.
Note that if Accel ramp equals to zero, the register value will be ignored.

Read only register

Register 6: Drive status and error code

High byte gives drive error code. (Valid when drive tripped, see appendix for details)
Low byte gives drive status (0: drive stopped, 1: drive running, 2: drive tipped)
Register 7: Motor speed information

This register gives motor speed information. The data is in Hz and with one decimal place (i.e. 234 = 23.4Hz)
Register 8: Motor current

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

Reigster 9: Motor torque

This register gives motor output torque information. It is a percentage value as 100.0% equals to motor rated torque. The data value includes one decimal place.

Register 10: Motor power

This register gives motor power information, the data includes two decimal place. The data unit depends on drive type. (i.e.124 = 1.24 KW/HP)
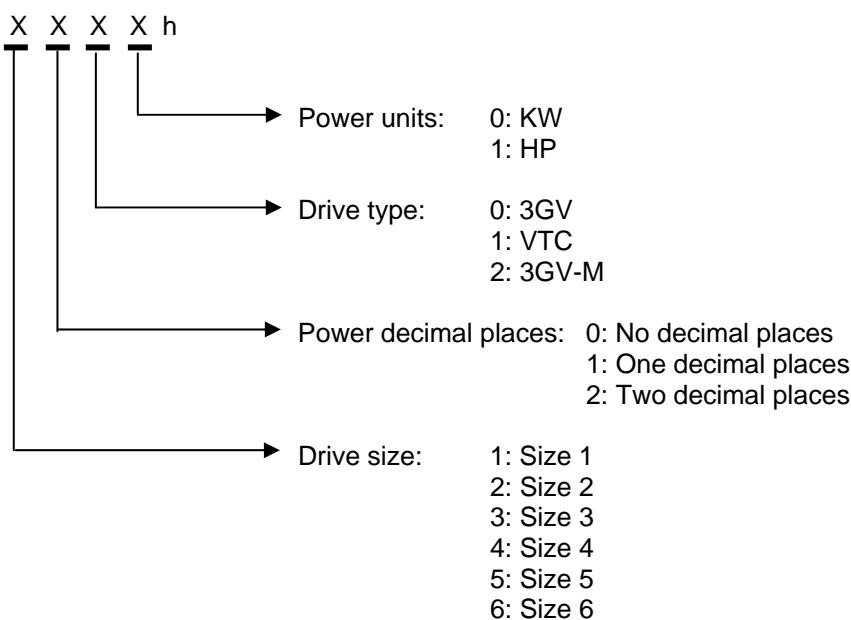
Register 11: Digital input status

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: 0: 3GV
                 1: VTC
                 2: 3GV-M

Power decimal places: 0: No decimal places
                        1: One decimal places
                        2: Two decimal places

Drive size: 1: Size 1
                 2: Size 2
                 3: Size 3
                 4: Size 4
                 5: Size 5
                 6: Size 6

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: Software version

This register contains the drive software version info. Value includes two decimal places.
i.e. 220 means version 2.20

Table 2: Monitor value registers
(Read only register with command 03)

Adr	Description	Data format
21	Bipolar analog input value	One decimal place 156=15.6%
22	2nd analog input value	One decimal place 156=15.6%
23	Speed control reference	156=156%
24*	Digital speed reference	Internal value
25	Motor torque reference	2000=200.0%
26	User PID reference	One decimal place 156=15.6%
27	User PID feedback	One decimal place 156=15.6%
28	User PID error input	One decimal place 156=15.6%
29	User PID P term output	One decimal place 156=15.6%
30	User PID I term output	One decimal place 156=15.6%
31	User PID D term output	One decimal place 156=15.6%
32	User PID Output	One decimal place 156=15.6%
33	Motor output torque	1000 = 100.0%
34	Magnetizing current	One decimal place 156=15.6A
35	Rotor current	One decimal place 156=15.6A
36	Field strength	One decimal place 156=15.6%
37	Stator resistance	Size 1: Two decimal place 156=1.56ohm Other: Three decimal place 156=0.156ohm
38	Stator inductance	Four decimal place 156=0.0156h
39	Rotor resistance	Size 1: Two decimal place 156=1.56ohm Other: Three decimal place 156=0.156ohm
40	DC bus voltage	256 = 256V
41	Drive temperature	23 = 23 ^{0}C
42	Supply voltage L1	230 = 230V
43	Supply voltage L2	230 = 230V
44	Supply voltage L3	230 = 230V
45*	Estimated rotor speed	Internal value
46	Kwh meter	One decimal place 156=15.6Kwh
47	Mwh meter	156=156Mwh

Table 3: Parameter registers
(Support command 03 and 06)

Adr	Description	Data range	Data format
129*	Max speed limit	0 to 7200	Internal value
130*	Min speed limit	0 to 7200	Internal value
131	Accel ramp time	0 to 30000	One decimal place 300=30.0s
132	Decel ramp time	0 to 30000	One decimal place 300=30.0s
133	Stop mode select	0 to 2	0: Ramp to stop 1: Coast to stop 2: Ramp to stop
134	Energy save	0 ,1	0: Disable 1: Enable
135	Motor rated voltage	20 to 250 (Low) 20 to 500 (High)	
136	Motor rated current	Drive dependent	One decimal place 300=30.0A
137	Motor rated frequency	25 to 2000	Data unit in Hz
138*	Motor rated speed	0 to 60000	Data unit in RPM
139	Preset speed 1	-P1-01 to P1-01	Internal value
140	Control mode	0 to 4	0: Terminal 1: Keypad forward only 2: Keypad forward and reverse 3: PID control mode (N/A) 4: Modbus control mode
141	Trip log		Last four trips (See Appendix for details)
142	Access code	0 to 30000	
143	Digital inputs function	0 to 21	See user guide for function details
144*	Preset speed 2	-P1-01 to P1-01	Internal value
145*	Preset speed 3	-P1-01 to P1-01	Internal value
146*	Preset speed 4	-P1-01 to P1-01	Internal value
147*	Preset speed 5	-P1-01 to P1-01	Internal value
148*	Preset speed 6	-P1-01 to P1-01	Internal value
149*	Preset speed 7	-P1-01 to P1-01	Internal value
150*	Preset speed 8	-P1-01 to P1-01	Internal value
151*	Skip frequency 1	-P1-01 to P1-01	Internal value
152*	Skip freq band 1	P1-02 to P1-01	Internal value
153	Analog output function	0 to 10	See user guide for function details
	Digital output ctrl limit (h)	0 to 100	Located in lower byte
154	Digital output ctrl limit (L)	0 to high limit	Located in higher byte
155	Relay output function	0 to 6	See user guide for function details
	Relay control limit (h)	0 to 100	Located in lower byte
156	Relay control limit (L)	0 to high limit	Located in higher byte
157	Relay output mode	0 to 1	0: Normally open 1: Normally closed
158	Zero speed holding time	0 to 60s	600 = 60.0s
159	Start mode select	0 to 6	0: Edgr-r 1: Auto_0 2…6: Auto_1 to Auto_5
160	Reserved	0	Read as zero
161	Keypad restart mode	0 to 3	See user guide for details

Adr	Description	Data range	Data format
162	Enable standby	0 to 60	Data unit in second (s)
163	Display scaling factor	0 to 30000	Three decimal place 300=0.3.00
164	Display scaling source	0 to 1	0: 2nd analog input 1: Drive speed
165	Brake circuit enable	0 to 3	See user guide for function details
166	Effective switching freq.	0 to 4 and it is drive dependent	0 = 4KHz, 1 = 8KHz, 2 = 16KHz 3 = 24KHz, 4 = 32KHz
167	2nd Decel ramp time (s)	0 to 30000	One decimal place 300=30.0s
168	Modbus baudrate	0 to 4	0 = 9600bps 1 = 19200bps 2 = 38400bps 3 = 57600bps 4 = 115200bps
169	Drive comms address	1 to 63	
170	Master/Slave mode	0 to 1	This is for Optibus application only, not for Modbus.
171	Speed scaling factor	0 to 5000	One decimal place 300=30.0%
172	Bipolar an input format	0 to 3	0: 0..24V 1: 0..10V 2: -10..10V 3: -24V ..24V
173	Bipolar an input scaling	0 to 5000	One decimal place 300=30.0%
174	Bipolar an input offset	-5000 to 5000	One decimal place 300=30.0%
175	2nd an input format	0 to 3	0: 0/24V Digital 1: 0..10V 2: 4..20mA 3: 0..20mA
176	2nd an input scaling	0 to 5000	One decimal place 300=30.0%
177	Ditial speed reference scaling control	0 to 3	See user guide for function details
178	Analog output format	0 or 3	0: 0..10V 1: 4..20mA 2: 10..0V 3: 20..4mA
179	Extended access code	0 to 9999	
180	Parameter lock	0 or 1	0: Unlock 1: Locked
181	Drive run time	Read only	Read value as hours
182	Drive power rating	Read only	Power with 2 decimal place
183	Reserved	Read only	Read as zero
184	Reserved	Read only	Read as zero
185	Reserved	Read only	Read as zero
186	Reserved	Read only	Read as zero
187	Reserved	Read only	Read as zero
188	Reserved	Read only	Read as zero
189	Reserved	Read only	Read as zero
190	Reserved	Read only	Read as zero
191	Reserved	Read only	Read as zero
192	Reserved	Read only	Read as zero
193	Reserved	Read only	Read as zero
194	Reserved	Read only	Read as zero

Adr	Description	Data range	Data format
195	Reserved	Read only	Read as zero
196	Reserved	Read only	Read as zero
197	Reserved	Read only	Read as zero
198	Reserved	Read only	Read as zero
199	Control mode	0, 1, 2	0: Vector speed control 1: Vector torque control 2: V/F speed control
200	Motor parameter auto-tune	0 or 1	
201	Speed controller P-gain	0 to 4096	
202	Speed controller integral time constant	0.001 to 0.100s	1 = 0.001s
203	Motor power factor	0.50 to 0.99	78 = 0.78
204	Torque reference select	0 to 3	0: digital preset value 1: Bipolar analog input 2: 2nd analog input 3: Modbus reference
205	Maximum torque limit/Ref	0 to 200%	100= 100%
206	Minimum torque limit	0 to 150.0%	100 = 10.0%
207	V/F characteristic adjustment frequency	0 to P1-09	500 = 50.0Hz
208	V/F characteristic adjustment voltage	0 to P1-07	100 = 100V

* Explanation for internal value:

For some speed related parameters, the drive uses an internal value instead of the actual speed in Hz in order to increase the resolution. For these speed related parameters, the internal value instead of the display value must be used in order to set the parameter correctly.

Speed Internal = Speed in Hz * Factor

When P1-09 <= 100Hz,   Factor = 60.   ie 30.5Hz -> 1830
When P1-09 <= 200Hz,   Factor = 30.   ie 30.5Hz -> 915
When P1-09 >   200Hz,   Factor = 15.   ie 250Hz -> 3750

Table 4: Advanced parameter registers
(Support command 03 and 06)

Adr	Description	Data range	Data format
209	Motor stator resistance	Drive dependent	Size 1: Two decimal place 156=1.56ohm Others: Three decimal place 156=0.156ohm
210	Motor rotor resistance	Drive dependent	Size 1: Two decimal place 156=1.56ohm Others: Three decimal place 156=0.156ohm
211	Motor stator inductance	Drive dependent	Four decimal place 156=0.0156h
212	Motor magnetizing current	Drive dependent	One decimal place 156 = 15.6A
213	Leakage coefficient	0.025 to 0.250	Three decimal place 100 = 0.100
214	Speed filter time constant	0.001s to 0.100s	Three decimal place 100 = 0.100
215	Quick RS measurement	1: Enable 0: Disable	Default value: 1
216	Motor parameter adaptation	1: Enable 0: Disable	Default value: 1
217	Over voltage current control limit	0…100%	
218	Regeneration current control limit	0…200%	
219	Minimum PWM plulse	0..625	Minimum pluse = value * 33.3ns
220	V/F magnetising delay	0…2000ms	
221	Reserved	Read only	Read as zero
222	Thermal fold back control	1: Enable 0: Disable	Default value: 0
223	Auto-restart delay time	1…60s	Default value: 20
224	Relay control speed hyteresis value	0%...25.0%	One decimal place 156 = 15.6%
225	Hoist function boost speed	0%...10.0%	One decimal place 156 = 15.6%
226	Boost speed holding time	0.1s…5.0s	One decimal place 15 = 1.5s
227	Speed dead band zone	0%...20.0%	One decimal place 156 = 15.6%
228	Modbus comms loss time	0: Trip disable 1…60s	
229	Droop control speed	0%...25.0%	One decimal place 156 = 15.6%

Note: Registers in the above table are only available with drive software version 2.21 or later. Please refer to advance user guide for more information of the corresponding parameter in this table.

Appendix

Drive error code information:

0x00	No trip
0x01	Brake circuit over current (short circuit)
0x02	Over current
0x03	External trip
0x04	DC bus over voltage trip
0x05	DC bus under voltage trip
0x06	Over temperature trip
0x07	Under temperature trip
0x08	Spin start fault
0x09	Parameter defaut
0x0A	I*t trip (Over load trip)
0x0B	Phase imbalance trip
0x0C	Brake resister over load
0x0D	Power stage trip
0x0E	Communication link loss trip
0x0F	Phase loss trip
0x10	Thermistor fault
0x11	Auto-tune fault

Dataflow example:

Modbus RTU 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 that the actual start address of register 6 is 5.

--- End ---