Innovative Thinking for Power Control

OZip AFE/GTI Inverter Modbus Register Profile

Functional Specification

FS-0092

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1. Introduction

This document is intended to provide the register map used to communicate with the OZip AFE/GTI Inverter using the Modbus communication protocol. It provides the Modbus register address for each of the parameter registers supported by the inverter's firmware. Application details for the registers themselves including scaling, bit assignments, etc., can be found in UM-0056 - *OZip AFE/GTI Inverter User's Manual*. Details on the actual Modbus protocol as implemented in the Oztek Modbus Module (OMM) firmware can be found in the complementary specification FS-0053 - *Modbus Communication Module Functional Specification*.

1.1 Referenced Documents

Ref.	Document	Description
[1]	www.modbus.org/specs.php	Modbus specification
[2]	FS-0053	Modbus Communication Module Functional Specification
[3]	UM-0056	OZip AFE/GTI Inverter User's Manual

1.2 Definitions

AFE	Active Front End
CAN	Controller Area Network
DSP	Digital signal processor
EEPROM	Electrically Erasable Programmable Read Only Memory
EMC	Electro-Magnetic Compatibility
EMI	Electro-Magnetic Interference
GND	Ground (low side of input power supply)
GTI	Grid Tied Inverter
GUI	Graphical User Interface
HMI	Human Machine Interface
IPM	Intelligent Power Module
NC	Not Connected
OMM	Oztek Modbus Module
PCB	Printed Circuit Board
PCC	Power Control Center
PID	Parameter Identifier
PLC	Programmable Logic Controller
PLL	Phase Locked Loop
POR	Power On Reset
PWM	Pulse Width Modulation

2. Overview

The OMM is a simplified version of the industry standard Modbus protocol. It provides support for a 2-wire, RS-485 physical layer and the RTU transmission mode. More specifically, it provides access to the inverter's *Command, Instrumentation,* and *Configuration* parameter registers described in UM-0056 – *OZip AFE/GTI Inverter User's Manual*. The tables below show the Modbus register address assignments for each of parameters described in the inverter user's manual.

2.1 Handling 32 bit Values

The Modbus protocol specifies that each addressable register holds a 16-bit quantity. In order to write or read 32-bit quantities, the least significant (LSW) and most significant words (MSW) must be accessed independently. When performing 32-bit register writes, it is required that the LSW be written first, immediately followed by the writing the MSW; the inverter's internal 32-bit register will not be written until the MSW Modbus register is written.

3. Command Registers

Table 1 – Command Registers

Modbus Address		PID	Description
Decimal	Hex		
1	0x0001	0x0000	On/Off Control
2	0x0002	0x0001	Charge Command
3	0x0003	0x0002	Fault Reset
4	0x0004	0x0003	Grid Current, Real
5	0x0005	0x0004	Grid Current, Reactive
6	0x0006	0x0005	Grid Power, Real
7	0x0007	0x0006	Grid Power, Reactive

4. Instrumentation Registers

Table 2 – Instrumentation Registers

Modbus Address		PID	Description
Decimal	Hex		
2048	0x0800	0x4000	Operating State
2049	0x0801	0x4001	Operating Mode
2050	0x0802	0x4002	DC Link Voltage
2051	0x0803	0x4003	DC Input Voltage
2052	0x0804	0x4004	AC Line Voltage, Phase A-to-B
2053	0x0805	0x4005	AC Line Voltage, Phase B-to-C
2054	0x0806	0x4006	AC Line Voltage, Phase C-to-A

Modbus Address		PID	Description
Decimal	Hex		
2055	0x0807	0x4007	AC Current, Phase A
2056	0x0808	0x4008	AC Current, Phase B
2057	0x0809	0x4009	AC Current, Phase C
2058	0x080A	0x400A	AC Line Frequency
2059	0x080B	0x400B	Power Factor
2060	0x080C	0x400C	AC Power, Real
2061	0x080D	0x400D	AC Power, Reactive
2062	0x080E	0x400E	PLL Status
2063	0x080F	0x400F	Contactor Status
2064	0x0810	0x4010	IGBT Temperature, Phase A
2065	0x0811	0x4011	IGBT Temperature, Phase B
2066	0x0812	0x4012	IGBT Temperature, Phase C
2067	0x0813	0x4013	PCB Temperature
2068	0x0814	0x4014	External Temperature
2069	0x0815	0x4015	Warning Status (LSW)
2070	0x0816		Warning Status (MSW)
2071	0x0817	0x4016	Fault Status (LSW)
2072	0x0818		Fault Status (MSW)
2073	0x0819	0x4017	Register Operation Status
2074	0x081A	0x4018	Inverter Software Revision – Major
2075	0x081B	0x4019	Inverter Software Revision – Minor
2076	0x081C	0x401A	Bootloader Revision – Major
2077	0x081D	0x401B	Bootloader Revision – Minor
2078	0x081E	0x401C	HV Sense FPGA Revision – Major
2079	0x081F	0x401D	HV Sense FPGA Revision – Minor

5. Configuration Registers

Table 3 – Configuration Control Parameters

Modbus Address		PID	Description
Decimal	Hex		
4097	0x1001	0x8000	Factory Configuration Revision – Major
4098	0x1002	0x8001	Factory Configuration Revision – Minor
4099	0x1003	0x8002	User Configuration Revision

Table 4 – Modbus Interface Parameters

Modbus Address		PID	Description
Decimal	Hex		
4110	0x100E	0x800D	Modbus Device Address
4111	0x100F	0x800E	Modbus Baud Rate
4112	0x1010	0x800F	Modbus Parity

Table 5 – CAN Interface Parameters

Modbus Address		PID	Description
Decimal	Hex		
4117	0x1015	0x8014	CAN Group ID
4118	0x1016	0x8015	CAN Module ID
4119	0x1017	0x8016	CAN Baud Rate
4120	0x1018	0x8017	CAN Timeout
4125	0x101D	0x801C	CAN Update Rate – DC Link Status
4126	0x101E	0x801D	CAN Update Rate – Grid Voltage Status
4127	0x101F	0x801E	CAN Update Rate – Inverter Current Status
4128	0x1020	0x801F	CAN Update Rate – Grid Status
4129	0x1021	0x8020	CAN Update Rate – System Status
4130	0x1022	0x8021	CAN Update Rate – Alarm Status
4131	0x1023	0x8022	CAN Status Destination Group ID
4132	0x1024	0x8023	CAN Status Destination Module ID
4133	0x1025	0x8024	CAN Automatic Alarm Transmit Enable
4134	0x1026	0x8025	CAN Broadcast Message Receive Enable

Table 6 – Grid Monitor and Protection Parameters

Modbus Address		PID	Description
Decimal	Hex		
4139	0x102B	0x802A	Nominal Grid Voltage
4140	0x102C	0x802B	Nominal Grid Frequency
4145	0x1031	0x8030	Grid Fast Under-Voltage Threshold
4146	0x1032	0x8031	Grid Slow Under-Voltage Threshold
4147	0x1033	0x8032	Grid Fast Over-Voltage Threshold
4148	0x1034	0x8033	Grid Slow Over-Voltage Threshold
4149	0x1035	0x8034	Grid Fast Under-Frequency Delta
4150	0x1036	0x8035	Grid Slow Under-Frequency Delta
4151	0x1037	0x8036	Grid Over-Frequency Delta
4152	0x1038	0x8037	Grid Fast Under-Voltage Clear Time
4153	0x1039	0x8038	Grid Slow Under-Voltage Clear Time
4154	0x103A	0x8039	Grid Fast Over-Voltage Clear Time
4155	0x103B	0x803A	Grid Slow Over-Voltage Clear Time
4156	0x103C	0x803B	Grid Fast Under-Frequency Clear Time
4157	0x103D	0x803C	Grid Slow Under-Frequency Clear Time
4158	0x103E	0x803D	Grid Over-Frequency Clear Time
4159	0x103F	0x803E	Grid Fault Auto-Reconnect Enable
4160	0x1040	0x803F	Grid Reconnect Delay Time

Table 7 – Fault and Warning Parameters

Modbus Address		PID	Description
Decimal	Hex		
4165	0x1045	0x8044	DC Link Over Voltage Fault Threshold
4166	0x1046	0x8045	DC Link Over Voltage Warning Threshold
4167	0x1047	0x8046	DC Link Under Voltage Fault Threshold
4168	0x1048	0x8047	DC Link Under Voltage Warning Threshold
4169	0x1049	0x8048	Grid Over Current Fault Threshold
4170	0x104A	0x8049	Grid Over Current Warning Threshold
4179	0x1053	0x8052	DC Link Over Voltage Warning Recover Delta
4180	0x1054	0x8053	DC Link Under Voltage Warning Recover Delta
4181	0x1055	0x8054	Grid Over Current Warning Recover Delta

Table 8 – Inverter Control Parameters

Modbus Address		PID	Description
Decimal	Hex		
4193	0x1061	0x8060	Control Mode
4194	0x1062	0x8061	Hardware On/Off Pin Enable
4195	0x1063	0x8062	Hardware Interlock Pin Enable
4196	0x1064	0x8063	Hardware Fault Reset Pin Enable
4203	0x106B	0x806A	Inductance – Inverter Side (LSW)
4204	0x106C		Inductance – Inverter Side (MSW)
4205	0x106D	0x806C	Inductance – Grid Side (LSW)
4206	0x106E		Inductance – Grid Side (MSW)

Table 9 – Pre-Charge and Contactor Parameters

Modbus Address		PID	Description
Decimal	Hex		
4225	0x1081	0x8080	DC Link Pre-charge Mode
4226	0x1082	0x8081	DC Link Pre-charge Reference
4227	0x1083	0x8082	DC Link Charge Timeout Threshold
4228	0x1084	0x8083	AC Contactor Action
4229	0x1085	0x8084	DC Contactor Action
4235	0x108B	0x808A	Contactor Monitor Enables

Table 10 – AC Current Control Parameters

Modbus Address		PID	Description
Decimal	Hex		
4325	0x10E5	0x80E4	Rated Current
4326	0x10E6	0x80E5	Real Current Command Minimum
4327	0x10E7	0x80E6	Real Current Command Maximum
4328	0x10E8	0x80E7	Reactive Current Command Minimum
4329	0x10E9	0x80E8	Reactive Current Command Maximum
4337	0x10F1	0x80F0	Reactive Current Offset
4338	0x10F2	0x80F1	Current Command Slew Rate
4339	0x10F3	0x80F2	Current Foldback Mode Select
4340	0x10F4	0x80F3	Current Control Proportional Gain (K_p)
4341	0x10F5	0x80F4	Current Control K_p Scale
4342	0x10F6	0x80F5	Current Control Integral Time Constant (T_i)
4343	0x10F7	0x80F6	Current Control T_i Scale
4344	0x10F8	0x80F7	Zero Sequence Control Enable
4345	0x10F9	0x80F8	Zero Sequence Proportional Gain (K_p)
4346	0x10FA	0x80F9	Zero Sequence K_p Scale
4347	0x10FB	0x80FA	Zero Sequence Integral Time Constant (T_i)
4348	0x10FC	0x80FB	Zero Sequence T_i Scale

Table 11 – Grid Power Control Parameters

Modbus Address		PID	Description
Decimal	Hex		
4367	0x110F	0x810E	Real Power Command Minimum
4368	0x1110	0x810F	Real Power Command Maximum
4369	0x1111	0x8110	Reactive Power Command Minimum
4370	0x1112	0x8111	Reactive Power Command Maximum
4377	0x1119	0x8118	Power Command Slew Rate

Table 12 – DC Voltage Control Parameters

Modbus Address		PID	Description
Decimal	Hex		
4383	0x111F	0x811E	DC Voltage Command
4389	0x1125	0x8124	DC Voltage Command Slew Rate
4390	0x1126	0x8125	DC Voltage Control Proportional Gain (K_p)
4391	0x1127	0x8126	DC Voltage Control K_p Scale
4392	0x1128	0x8127	DC Voltage Control Integral Time Constant (T_i)
4393	0x1129	0x8128	DC Voltage Control T_i Scale
4394	0x112A	0x8129	DC Voltage Droop Control

Table 13 – Instrumentation Parameters

Modbus Address		PID	Description
Decimal	Hex		
4251	0x109B	0x809A	Filter Cutoff – DC Voltage
4252	0x109C	0x809B	Filter Cutoff – Grid Voltage
4253	0x109D	0x809C	Filter Cutoff – AC Current

Table 14 – External Temperature Sensor Parameters

Modbus Address		PID	Description
Decimal	Hex		
4285	0x10BD	0x80BC	External Thermistor Enable
4286	0x10BE	0x80BD	External Thermistor Coefficient A
4287	0x10BF	0x80BE	External Thermistor Coefficient A Scale
4288	0x10C0	0x80BF	External Thermistor Coefficient B
4289	0x10C1	0x80C0	External Thermistor Coefficient B Scale
4290	0x10C2	0x80C1	External Thermistor Coefficient C
4291	0x10C3	0x80C2	External Thermistor Coefficient C Scale
4292	0x10C4	0x80C3	External Temp Fault Threshold
4293	0x10C5	0x80C4	External Temp Warning Threshold
4294	0x10C6	0x80C5	External Temp Warning Recover Delta

Warranty and Product Information

Limited Warranty

What does this warranty cover and how long does it last? This Limited Warranty is provided by Oztek Corp. ("Oztek") and covers defects in workmanship and materials in your OZip Inverter. This Warranty Period lasts for 18 months from the date of purchase at the point of sale to you, the original end user customer, unless otherwise agreed in writing. You will be required to demonstrate proof of purchase to make warranty claims. This Limited Warranty is transferable to subsequent owners but only for the unexpired portion of the Warranty Period. Subsequent owners also require original proof of purchase as described in "What proof of purchase is required?"

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USA
Telephone: 603-546-0090
Email techsupport@oztekcorp.com

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- The dated purchase receipt from the original purchase of the product at point of sale to the end user
- The dated dealer invoice or purchase receipt showing original equipment manufacturer (OEM) status
- The dated invoice or purchase receipt showing the product exchanged under warranty

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Before returning a product directly to Oztek you must obtain a Return Material Authorization (RMA) number and the correct factory "Ship To" address. Products must also be shipped prepaid. Product shipments will be refused and returned at your expense if they are unauthorized, returned without an RMA number clearly marked on the outside of the shipping box, if they are shipped collect, or if they are shipped to the wrong location.
When you contact Oztek to obtain service, please have your instruction manual ready for reference and be prepared to supply:

- The serial number of your product
- Information about the installation and use of the unit
- Information about the failure and/or reason for the return
- A copy of your dated proof of purchase

Return Procedure

Package the unit safely, preferably using the original box and packing materials. Please ensure that your product is shipped fully insured in the original packaging or equivalent. This warranty will not apply where the product is damaged due to improper packaging. Include the following:

- The RMA number supplied by Oztek clearly marked on the outside of the box.
- A return address where the unit can be shipped. Post office boxes are not acceptable.
- A contact telephone number where you can be reached during work hours.
- A brief description of the problem.

Ship the unit prepaid to the address provided by your Oztek customer service representative.

If you are returning a product from outside of the USA or Canada - In addition to the above, you MUST include return freight funds and you are fully responsible for all documents, duties, tariffs, and deposits.

Out of Warranty Service

If the warranty period for your product has expired, if the unit was damaged by misuse or incorrect installation, if other conditions of the warranty have not been met, or if no dated proof of purchase is available, your unit may be serviced or replaced for a flat fee. If a unit cannot be serviced due to damage beyond salvation or because the repair is not economically feasible, a labor fee may still be incurred for the time spent making this determination.

To return your product for out of warranty service, contact Oztek Customer Service for a Return Material Authorization (RMA) number and follow the other steps outlined in "Return Procedure".

Payment options such as credit card or money order will be explained by the Customer Service Representative. In cases where the minimum flat fee does not apply, as with incomplete units or units with excessive damage, an additional fee will be charged. If applicable, you will be contacted by Customer Service once your unit has been received.