Innovative Thinking for Power Control

OZip DC/DC Converter
Modbus Register Profile

Functional Specification

FS-0097

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Merrimack NH 03054

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About Oztek

Oztek Corp. is a proven innovator of power and control solutions for the most demanding industrial applications. Oztek products include variable motor drives, grid tie inverters, frequency converters, stand-alone inverters, DC/DC converters, and DSP based control boards for power control applications.

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Exclusion for Documentation

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1. Introduction

This document is intended to provide the register map used to communicate with the OZip DC/DC Converter using the Modbus communication protocol. It provides the Modbus register address for each of the parameter registers supported by the firmware. Application details for the registers themselves including scaling, bit assignments, etc., can be found in UM-0060 - *OZip DC/DC Converter 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-0060	OZip DC/DC Converter 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 DC/DC Converter's *Command, Instrumentation,* and *Configuration* parameter registers described in UM-0060 – *OZip DC/DC Converter User's Manual*. The tables below show the Modbus register address assignments for each of parameters described in the user's manual.

2.1 Handling 32-bit Values

The Modbus protocol specifies that each addressable register holds a 16-bit quantity. 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 converter'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	Voltage Setpoint
3	0x0003	0x0002	Current Setpoint
4	0x0004	0x0003	Control Mode
5	0x0005	0x0004	Fault Reset
6	0x0006	0x0005	Precharge Enable
7	0x0007	0x0006	Aux Relay Enable
8	0x0008	0x0007	Host Heartbeat
9	0x0009	0x0008	Restore Default Configuration
26	0x001A	0x0019	Dynamic Output Impedance

4. Instrumentation Registers

Table 2 – Instrumentation Registers

Modbus Address		PID	Description
Decimal	Hex		
2048	0x0800	0x4000	Operating State
2049	0x0801	0x4001	Control Mode
2050	0x0802	0x4002	Input Voltage – Internal
2051	0x0803	0x4003	Input Voltage – External

Modbus Address		PID	Description
Decimal	Hex		
2052	0x0804	0x4004	Output Voltage
2053	0x0805	0x4005	Inductor Current, Phase A
2054	0x0806	0x4006	Inductor Current, Phase B
2055	0x0807	0x4007	Inductor Current, Phase B
2056	0x0808	0x4008	Inductor Current, Total
2057	0x0809	0x4009	IGBT Temperature A
2058	0x080A	0x400A	IGBT Temperature B
2059	0x080B	0x400B	IGBT Temperature C
2060	0x080C	0x400C	PCB Temp
2061	0x080D	0x400D	Contactor Status
2062	0x080E	0x400E	Warning Status (LSW)
2063	0x080F		Warning Status (MSW)
2064	0x0810	0x400F	Fault Status (LSW)
2065	0x0811		Fault Status (MSW)
2066	0x0812	0x4010	Register Operation Status
2067	0x0813	0x4011	Software Revision – Major
2068	0x0814	0x4012	Software Revision – Minor
2069	0x0815	0x4013	Bootloader Revision – Major
2070	0x0816	0x4014	Bootloader Revision – Minor
2071	0x0817	0x4015	HV Sense FPGA Revision – Major
2072	0x0818	0x4016	HV Sense FPGA Revision – Minor
2073	0x0819	0x4017	DC/DC Heartbeat

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
4122	0x101A	0x8019	CAN Status Destination Group ID
4123	0x101B	0x801A	CAN Status Destination Module ID
4124	0x101C	0x801B	CAN Automatic Alarm Transmit Enable
4125	0x101D	0x801C	CAN Update Rate – Voltage Status
4126	0x101E	0x801D	CAN Update Rate – Current Status
4127	0x101F	0x801E	CAN Update Rate – System Status
4128	0x1020	0x801F	CAN Update Rate – Alarm Status
4129	0x1021	0x8020	CAN Broadcast Message Receive Enable

Table 6 – Fault and Warning Parameters

Modbus Address		PID	Description
Decimal	Hex		
4137	0x1029	0x8028	V_{in} Under-Voltage Fault Threshold
4138	0x102A	0x8029	V_{in} Under-Voltage Warning Threshold
4139	0x102B	0x802A	V_{in} Over-Voltage Fault Threshold
4140	0x102C	0x802B	V_{in} Over-Voltage Warning Threshold
4141	0x102D	0x802C	V_{out} Over-Voltage Fault Threshold
4142	0x102E	0x802D	V_{out} Over-Voltage Warning Threshold
4143	0x102F	0x802E	I_{tot} Over-Current Fault Threshold
4144	0x1030	0x802F	I_{tot} Over-Current Warning Threshold
4145	0x1031	0x8030	I_{phase} Over-Current Fault Threshold
4146	0x1032	0x8031	I_{phase} Over-Current Warning Threshold
4147	0x1033	0x8032	Host Communication Timeout
4148	0x1034	0x8033	Heartbeat Period
4152	0x1037	0x8037	V_{in} Under-Voltage Warning Recover Delta
4153	0x1038	0x8038	V_{in} Over-Voltage Warning Recover Delta
4154	0x1039	0x8039	V_{out} Over-Voltage Warning Recover Delta
4155	0x103A	0x803A	I_{tot} Over-Current Warning Recover Delta
4156	0x103B	0x803B	I_{phase} Over-Current Warning Recover Delta

Table 7 – Control Parameters

Modbus Address		PID	Description
Decimal	Hex		
4172	0x104C	0x804B	Default Control Mode
4173	0x104D	0x804C	Default Voltage Setpoint
4174	0x104E	0x804D	Default Current Setpoint
4175	0x104F	0x804E	Hardware On/Off Pin Enable

Modbus Address		PID	Description
Decimal	Hex		
4176	0x1050	0x804F	Hardware Interlock Pin Enable
4177	0x1051	0x8050	Hardware Fault Reset Pin Enable
4182	0x1056	0x8055	Control Topology
4183	0x1057	0x8056	Pulse Width Modulation Frequency
4192	0x1060	0x805F	Maximum Voltage Command
4193	0x1061	0x8060	Minimum Voltage Command
4194	0x1062	0x8061	Maximum Current Command
4195	0x1063	0x8062	Minimum Current Command

Table 8 – Current Regulator Parameters

Modbus Address		PID	Description
Decimal	Hex		
4202	0x106A	0x8069	Current Control Kp Scale
4203	0x106B	0x806A	Current Control Proportional Gain (Kp)
4204	0x106C	0x806B	Current Control Ti Scale
4205	0x106D	0x806C	Current Control Integral Time Constant (Ti)
4206	0x106E	0x806D	Current Command Slew Rate
4207	0x106F	0x806E	Turn Off Current Slew Rate
4208	0x1070	0x806F	Nominal Output Feedforward Voltage
4209	0x1071	0x8070	Nominal Input Feedforward Voltage

Table 9 – Voltage Regulator Parameters

Modbus Address		PID	Description
Decimal	Hex		
4217	0x1079	0x8078	Voltage Controller Proportional Gain Scale
4218	0x107A	0x8079	Voltage Controller Proportional Gain
4219	0x107B	0x807A	Voltage Controller Integral Time Constant Scale
4220	0x107C	0x807B	Voltage Controller Integral Time Constant
4221	0x107D	0x807C	Voltage Controller Maximum Current
4222	0x107E	0x807D	Voltage Controller Minimum Current
4223	0x107F	0x807E	Voltage Command Slew Rate

Table 10 – Pre-Charge Parameters

Modbus Address		PID	Description
Decimal	Hex		
4227	0x1083	0x8082	Pre-charge Auto Enable
4232	0x1088	0x8087	Pre-charge Enable
4233	0x1089	0x8088	Pre-charge Timeout Threshold
4234	0x108A	0x8089	Contactor Monitor Enables
4235	0x108B	0x808A	Pre-charge Boost Sense Location
4236	0x108C	0x808B	Connect Voltage Delta Threshold

Modbus Address		PID	Description
Decimal	Hex		
4237	0x108D	0x808C	Contactor Close Time
4238	0x108E	0x808D	Contactor Debounce Time
4239	0x108F	0x808E	Aux Contactor Fault Action

Table 11 – Output Impedance Control Parameters

Modbus Address		PID	Description
Decimal	Hex		
4285	0x10BD	0x80BC	Output Impedance Mode
4286	0x10BE	0x80BD	Default Output Impedance

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?"

What will Oztek do? During the Warranty Period Oztek will, at its option, repair the product (if economically feasible) or replace the defective product free of charge, provided that you notify Oztek of the product defect within the Warranty Period, and provided that through inspection Oztek establishes the existence of such a defect and that it is covered by this Limited Warranty.

Oztek will, at its option, use new and/or reconditioned parts in performing warranty repair and building replacement products. Oztek reserves the right to use parts or products of original or improved design in the repair or replacement. If Oztek repairs or replaces a product, its warranty continues for the remaining portion of the original Warranty Period or 90 days from the date of the return shipment to the customer, whichever is greater. All replaced products and all parts removed from repaired products become the property of Oztek.

Oztek covers both parts and labor necessary to repair the product, and return shipment to the customer via an Oztek-selected non-expedited surface freight within the contiguous United States and Canada. Alaska, Hawaii and locations outside of the United States and Canada are excluded. Contact Oztek Customer Service for details on freight policy for return shipments from excluded areas.

How do you get service? If your product requires troubleshooting or warranty service, contact your merchant. If you are unable to contact your merchant, or the merchant is unable to provide service, contact Oztek directly at:

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

Direct returns may be performed according to the Oztek Return Material Authorization Policy described in your product manual.

What proof of purchase is required? In any warranty claim, dated proof of purchase must accompany the product and the product must not have been disassembled or modified without prior written authorization by Oztek. Proof of purchase may be in any one of the following forms:

- 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

What does this warranty not cover? Claims are limited to repair and replacement, or if in Oztek's discretion that is not possible, reimbursement up to the purchase price paid for the product. Oztek will be liable to you only for direct damages suffered by you and only up to a maximum amount equal to the purchase price of the product.

This Limited Warranty does not warrant uninterrupted or error-free operation of the product or cover normal wear and tear of the product or costs related to the removal, installation, or troubleshooting of the customer's electrical systems. This warranty does not apply to and Oztek will not be responsible for any defect in or damage to:

a) The product if it has been misused, neglected, improperly installed, physically damaged or altered, either internally or externally, or damaged from improper use or use in an unsuitable environment
b) The product if it has been subjected to fire, water, generalized corrosion, biological infestations, or input voltage that creates operating conditions beyond the maximum or minimum limits listed in the Oztek product specifications including high input voltage from generators and lightning strikes
c) The product if repairs have been done to it other than by Oztek or its authorized service centers (hereafter "ASCs")
d) The product if it is used as a component part of a product expressly warranted by another manufacturer
e) The product if its original identification (trade-mark, serial number) markings have been defaced, altered, or removed
f) The product if it is located outside of the country where it was purchased
g) Any consequential losses that are attributable to the product losing power whether by product malfunction, installation error or misuse.

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Product

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Return Material Authorization Policy

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.