



Innovative Thinking for Power Control

OZip Single Phase VMI OzCan Device Profile

Functional Specification

FS-0103

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Date and Revision

Nov 2019 Rev A

Part Number

FS-0103

Contact Information

USA

Telephone: 603-546-0090

Email techsupport@oztekc corp.com

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Table 1 - Revision History

Rev	Date	Description of Change	Author
	Jan 2019	Draft 1	Zendzian
	Jul 2019	Draft 2: <ul style="list-style-type: none"> Updated State Enumerations in sec 3.3.2. Added bit 9, Neutral Current Overload to Warning Register, sec 3.3.3. Added bit 27, Neutral Current Overload to Fault Register, sec 3.3.3. 	Zendzian
A	Nov 7, 2019	Initial Release	Zendzian

1. Introduction

This document is intended to provide a detailed functional description of the OZip Single Phase Voltage Mode Inverter (VMI) OzCan device profile. It is meant to convey the details of all messages supported by the OZip VMI device. General OzCan protocol information can be found in Reference document FS-0046.

1.1 Referenced Documents

Ref.	Document	Description
[1]	UM-TBD	OZip Single Phase VMI User's Manual
[2]	FS-0046	OzCAN CAN Communication Protocol Functional Specification
[3]	http://en.wikipedia.org/wiki/Controller-area_network	

1.2 Definitions

AFE	Active Front End
CAN	Controller Area Network
DSP	Digital Signal Processor
EEPROM	Electrically Erasable Programmable Read Only Memory
GTI	Grid Tied Inverter
GUI	Graphical User Interface
HMI	Human Machine Interface
IPM	Intelligent Power Module
PCB	Printed Circuit Board
PCC	Power Control Center
PLL	Phase Locked Loop
POR	Power On Reset
PWM	Pulse Width Modulation
VMI	Voltage mode Inverter

2. CAN Message ID

This section describes the specific OzCAN protocol ID implementation used by the OZip Single Phase VMI.

2.1 Message Priority

The VMI does not utilize the Message Priority bit for receive messages (i.e. it will accept either High or Normal priority messages). All sent messages will be marked as Normal priority.

2.2 Group ID

By default, the VMI's Group ID is set to a value of 5 (standard value for Oztek VMI's). If needed, this can be changed by modifying the appropriate configuration variable.

3. CAN Message Summary

The table below gives a summary of the available CAN messages and their respective IDs for the OZip VMI. Note that the *Default CAN Identifier* column shows the complete 29-bit message header for each message assuming the default VMI Group ID of "5" and Module ID of "1", and a default Host Group ID of "1" and Module ID of "1". The VMI will accept messages from any source, meaning only the Destination Group and Module are required to match.

Table 2 – Summary of VMI CAN Messages

Message Name	Message Type	Message ID	Default CAN ID
On/Off Control	0 - Command	0	0x15081080
AC Voltage Setpoint	0 - Command	2	0x15081082
Fault Reset	0 - Command	6	0x15081086
Configuration Reset	0 - Command	7	0x15081087
Configuration Reload	0 - Command	8	0x15081088
Parameter Read	1 - Parameter	0	0x15091080
Parameter Write	1 - Parameter	1	0x15091081
Parameter Read Response	1 - Parameter	2	0x11095082
Parameter Write Response	1 - Parameter	3	0x11095083
Output Status	2 – Status	0	0x110A5080
System Status	2 – Status	1	0x110A5081
Alarm Status	2 - Status	2	0x110A5082
Illegal CAN Message	2 - Status	3	0x110A5083

3.1 Command Messages

3.1.1 ON/OFF Control

This Command message is sent to turn the inverter ON or OFF. This message contains a one-byte payload of the following format:

Byte 0
ON/OFF [7:0]

- **ON/OFF [7:0]:** This field is used to turn the inverter ON or OFF as follows:
 - **0** – OFF: This turns the VMI OFF
 - **1** – ON: This turns the VMI ON

- **2 to 255** – Not Supported

Values outside of the legal range will be ignored and an “Illegal CAN Message” response will be sent back to the host controller.

3.1.2 AC Voltage Setpoint

This Command message is sent to the VMI to indicate the desired RMS AC output voltage set point. The default voltage following a power-on reset is specified in the configuration memory. The value sent in this command does not change the default voltage stored in the configuration memory, rather it merely provides a dynamic and temporary override from the default value. This message contains a two-byte payload of the following format:

Byte 0	Byte 1
VAC_OUT [7:0]	VAC_OUT [15:8]

- **VAC_OUT [15:0]**: This field specifies the RMS AC voltage set point. This field is specified in units of $0.1 V_{RMS}$. For example, $115 V_{RMS}$ would be entered as 1150 (decimal), or 0x047E (hexadecimal).

3.1.3 Fault Reset

This Command message is used to attempt a reset of any latched fault conditions and to return the VMI to its *IDLE/STANBY* state. This message has no accompanying payload requirements – merely receiving this message is adequate to initiate a fault reset attempt.

3.1.4 Configuration Reset

This Command message is used to reset the complete contents of the VMI’s non-volatile configuration EEPROM back to the original Factory Default values. Note that this command *does not* reload the system configuration; it just resets the contents of the EEPROM. In order for the newly reset values to take effect in the system, the **Configuration Reload** command must be used or the control board power must be cycled off and then on.

This message uses a 2-byte payload to specify a password required to reset the configuration. This password must match the *Configuration Password* stored in the controller’s configuration memory for the Configuration Reset command to be processed. If the incorrect password is specified, the message will be ignored and the “Illegal CAN Message” response will be sent.

The configuration memory may not be reset while the controller is ON. If the user attempts to send this message while the controller is ON the message will be ignored and the “Illegal CAN Message” response will be sent.

Byte 0	Byte 1
PW [7:0]	PW [15:8]

- **PW [15:0]:** Configuration Password - This field specifies the configuration password required to reset the contents of the configuration memory.

CAUTION: Upon execution, all currently stored configuration data will be permanently destroyed and over written with the factory default configuration data.

3.1.5 Configuration Reload

This Command message is used to force a reload of the VMI's system configuration from the non-volatile configuration EEPROM. This configuration command forces a processor reset, causing it to reboot and reload the system configuration. This message has no accompanying payload requirements – merely receiving this message is adequate to initiate a configuration reload. The system configuration may not be reloaded while the controller is ON. If the user attempts to send this message while the controller is ON the message will be ignored and the “Illegal CAN Message” response will be sent.

3.2 Parameter Access Messages

3.2.1 Parameter Read

This message is sent to the inverter to initiate a parameter read request. When received, the inverter will respond with the Parameter Read Response message (see below). This message consists of a 4-byte payload with the following format:

Byte 0	Byte 1	Byte 2	Byte 3
PID [7:0]	PID [15:8]	PW [7:0]	PW [15:8]

- **PID [15:0]:** Parameter ID - This field specifies the ID of the parameter being read.
- **PW [15:0]:** Password - This field specifies the password (if necessary) needed to read the selected parameter. This field is not used if the parameter specified by the PID does not require a password.

3.2.2 Parameter Write

This message is sent to the inverter to initiate a parameter write. When received, the inverter will attempt to write the selected parameter and will then respond with the Parameter Write Response message (see below). This message consists of an 8-byte payload with the following format:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
PID [7:0]	PID [15:8]	WDATA [7:0]	WDATA [15:8]	WDATA [23:16]	WDATA [31:24]	PW [7:0]	PW [15:8]

- **PID [15:0]:** Parameter ID - This field specifies the ID of the parameter being written.
- **WDATA [31:0]:** Parameter Write Data – This field specifies the data to be written to the selected parameter.
- **PW [15:0]:** Password - This field specifies the password (if necessary) needed to write to the selected parameter. This field is not used if the parameter specified by the PID does not require a password.

3.2.3 Parameter Read Response

This message is sent by the inverter in response to a Parameter Read message. This message consists of a 7-byte payload with the following format:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
PID [7:0]	PID [15:8]	RDATA [7:0]	RDATA [15:8]	RDATA [23:16]	RDATA [31:24]	STAT [7:0]

- **PID [15:0]:** Parameter ID - This field specifies the ID of the parameter being read.
- **RDATA [31:0]:** Parameter Read Data – This field returns the read data for the selected parameter. If the read is not successful (as indicated by the STAT field), this field will return all zeros.
- **STAT [7:0]:** Read Status - encoded as follows:
 - **0** – SUCCESS
 - **1** – FAIL, invalid PID
 - **2** – FAIL, parameter not read-able
 - **3** – FAIL, parameter not write-able (*not applicable for reads*)
 - **4** – FAIL, parameter write data out of range (*not applicable for reads*)
 - **5** – FAIL, memory fault (timeout)
 - **6** – FAIL, memory fault (CRC error)
 - **7** – FAIL, password required and incorrect value provided

3.2.4 Parameter Write Response

This message is sent by the inverter in response to a Parameter Write message. This message consists of a 7-byte payload with the following format:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
PID [7:0]	PID [15:8]	WDATA [7:0]	WDATA [15:8]	WDATA [23:16]	WDATA [31:24]	STAT [7:0]

- **PID [15:0]:** Parameter ID - This field specifies the ID of the parameter being written.
- **WDATA [31:0]:** Parameter Write Data – This field returns the write data that was sent by the host.
- **STAT [7:0]:** Write Status - encoded as follows:
 - **0** – SUCCESS
 - **1** – FAIL, invalid PID
 - **2** – FAIL, parameter not read-able (*not applicable for writes*)
 - **3** – FAIL, parameter not write-able
 - **4** – FAIL, parameter write data out of range
 - **5** – FAIL, memory fault (timeout)
 - **6** – FAIL, memory fault (CRC error)
 - **7** – FAIL, password required and incorrect value provided

3.3 Status Messages

Each of the inverter's status messages described below are periodically sent at a regular time interval specified by their respective *CAN Update Rate* configuration parameters. To disable periodic transmissions for a given status message, the corresponding *CAN Update Rate* parameter should be set to 0.

3.3.1 VMI Output Status

This Status message consists of the following 8-byte payload:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
V_OUT [7:0]	V_OUT [15:8]	I_OUT [7:0]	I_OUT [15:8]	F_OUT [7:0]	F_OUT [15:8]	P_OUT [7:0]	P_OUT [15:8]

- **V_OUT [15:0]:** RMS Output Voltage, reported in units of 0.1 V_{rms} .
- **I_OUT [15:0]:** RMS Output Current, reported in units of 0.1 A_{rms} .
- **F_OUT [15:0]:** Output Frequency, reported in units of 0.1 Hz.
- **P_OUT [15:0]:** Calculated Output Power (Real), reported in units of Watts.

3.3.2 VMI System Status

This Status message consists of the following 8-byte payload:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
STATE [7:0]	TEMPA [7:0]	TEMPB [7:0]	TEMP_PCB [7:0]	TEMP_EXT [7:0]	DC_LNK [7:0]	DC_LNK [15:8]	CONT_STAT [7:0]

- **STATE [7:0]:** Enumerated Operating state as follows:

Value	State
0	Initializing
1	Calibrating
2	Wait for DC Input
3	Wait for Charge Command
4	Wait for Valid DC Link
5	Idle
6	On
7	Fault
8	Unknown

- **TEMPA [7:0]:** Measured Phase A IGBT Temperature, reported in units of 1.0 °C.
- **TEMPB [7:0]:** Measured Phase B IGBT Temperature, reported in units of 1.0 °C.
- **TEMP_PCB [7:0]:** Measured PCB Temperature, reported in units of 1.0 °C.
- **TEMP_EXT [7:0]:** Measured External Temperature, reported in units of 1.0 °C.
- **DC_LNK [15:0]:** Measured DC Link Voltage, reported in units of 0.1 V.
- **CONT_STAT [7:0]:** Contactor status, bit-mapped as follows:

Bit	Status
0	DC Input Contactor: 0 = Open, 1 = Closed
1	Pre-charge Contactor: 0 = Open, 1 = Closed
2-7	<i>Reserved for future use</i>

3.3.3 VMI Alarm Status

This Status message is used to convey the present state of the VMI's Warning and Fault bits. This message consists of the following 8-byte payload:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
WARN [7:0]	WARN [15:8]	WARN [23:16]	WARN [31:24]	FAULT [7:0]	FAULT [15:8]	FAULT [23:16]	FAULT [31:24]

- **WARN [31:0]:** Warning bits are active when set to '1', and not present when set to '0'. The warning bits are mapped as follows:

Bit	Warning
0	DC Link Under Voltage
1	DC Link Over Voltage
2	High Temperature - IGBT Phase A
3	High Temperature - IGBT Phase B
4	High Temperature - PCB
5	High Temperature – External Sensor
6	High Output Current
7	5V Supply Out of Tolerance
8	15V Supply Out of Tolerance
9	Neutral Current Overload
10-31	<i>Reserved for future use</i>

- FAULT [31:0]:** Fault bits are active when set to a '1' and not present when set to a '0'. If a fault occurs, the corresponding bit is set to a '1' and remains set until the Fault Reset message is received. When a fault occurs, the Inverter will go to the FAULT state and the Inverter will stop operating. The Inverter will stay in the FAULT state until the Fault Reset message is received. The fault bits are mapped as follows:

Bit	Fault
0	IGBT Desaturation Error, Phase A
1	IGBT Desaturation Error, Phase B
2	IGBT Drive Error, Phase A
3	IGBT Drive Error, Phase B
4	DC Link Over Voltage H/W Error
5	DC Link Over Voltage S/W Error
6	DC Link Under Voltage
7	Output Over Voltage
8	Output Under Voltage
9	$I^2 \cdot T$ Current Overload
10	RMS Current Overload
11	IGBT Over Temperature, Phase A
12	IGBT Over Temperature, Phase B
13	PCB Over Temperature
14	External Over Temperature
15	Hardware Interlock Error
16	DC Contactor Feedback Error
17	DC Link Charge Timeout
18	CAN Communications Timeout
19	Configuration Memory Error
20	Calibration Error

Bit	Fault
21 -26	Reserved - Factory Faults
27	Neutral RMS Over Current
28 -31	<i>Reserved for future use</i>

3.3.4 Illegal CAN Message

This message is returned by the inverter whenever a CAN message has been sent to the inverter using the correct Group ID and Module ID, but that for some reason, the inverter is unable to process. This message consists of the following 5-byte payload:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4
ID [7:0]	ID [15:8]	ID [23:16]	ID [31:24]	ERR [7:0]

- **ID [31:0]:** The CAN message ID of the offending message received by the inverter.
- **ERR [7:0]:** Error code indicating the cause of the error, encoded as follows:
 - **0** – Operation not allowed while the inverter is ON
 - **1** – Write data is not within the legal range
 - **2** – Incorrect message payload length specified
 - **3** – Command not allowed, inverter is configured for H/W control
 - **4** – Password is required and incorrect value was provided

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.

Disclaimer

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.