



**OZip AFE/GTI Inverter**  
**OzCan Device Profile**  
Functional Specification  
FS-0091

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## 1. Introduction

This document is intended to provide a detailed functional description of the OZip AFE/GTI Inverter OzCan device profile. It is meant to convey the details of all messages supported by the OZip inverter device. General OzCan protocol information can be found in Reference document FS-0046.

### 1.1 Referenced Documents

Ref.	Document	Description
[1]	UM-0056	OZip AFE/GTI Inverter User's Manual
[2]	FS-0046	OzCAN CAN Communication Protocol Functional Specification
[3]	<a href="http://en.wikipedia.org/wiki/Controller-area_network">http://en.wikipedia.org/wiki/Controller-area_network</a>	

### 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

## 2. CAN Message ID

This section describes the specific OzCAN protocol ID implementation used by the OZip AFE/GTI inverter.

### 2.1 Message Priority

At the present time, the inverter 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 inverter's Group ID is set to a value of 2 (standard value for Oztek AFE'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 inverter. Note that the *Default CAN Identifier* column shows the complete 29-bit message header for each message assuming the default inverter Group ID of "2" and Module ID of "1", and a default Host Group ID of "1" and Module ID of "1". The inverter will accept messages from any source, meaning only the Destination Group and Module are required to match.

**Table 1 – Summary of AFE CAN Messages**

Message Name	Message Type	Message ID	Default CAN Identifier
Parameter Read	1 - Parameter	0	0x12091080
Parameter Write	1 - Parameter	1	0x12091081
Parameter Read Response	1 - Parameter	2	0x11092082
Parameter Write Response	1 - Parameter	3	0x11092083
DC Voltage Status	2 - Status	0	0x110A2080
AC Voltage Status	2 - Status	1	0x110A2081
AC Current Status	2 - Status	2	0x110A2082
Grid Status	2 - Status	3	0x110A2083
System Status	2 - Status	4	0x110A2084
Alarm Status	2 - Status	5	0x110A2085
Illegal CAN Message	2 - Status	6	0x110A2086

### 3.1 Parameter Access Messages

#### 3.1.1 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.

### 3.1.2 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.

### 3.1.3 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

### 3.1.4 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

## 3.2 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.

### 3.2.1 DC Voltage Status

This message consists of the following 4-byte payload:

Byte 0	Byte 1	Byte 2	Byte 3
V_LINK [7:0]	V_LINK [15:0]	V_IN [7:0]	V_IN [15:0]

- **V\_LINK [15:0]**: Measured DC Link voltage, reported in units of 0.1 V.
- **V\_IN [15:0]**: Measured DC Input voltage, reported in units of 0.1 V.

### 3.2.2 AC Voltage Status

This message consists of the following 6-byte payload:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
V_AB [7:0]	V_AB [15:8]	V_BC [7:0]	V_BC [15:8]	V_CA [7:0]	V_CA [15:8]

- **V\_AB [15:0]**: Measured RMS Grid Voltage, Phase A-to-B, reported in units of 0.1 V<sub>rms</sub>.
- **V\_BC [15:0]**: Measured RMS Grid Voltage, Phase B-to-C, reported in units of 0.1 V<sub>rms</sub>.
- **V\_CA [15:0]**: Measured RMS Grid Voltage, Phase C-to-A, reported in units of 0.1 V<sub>rms</sub>.

### 3.2.3 AC Current Status

This message consists of the following 6-byte payload:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
I_A [7:0]	I_A [15:8]	I_B [7:0]	I_B [15:8]	I_C [7:0]	I_C [15:8]

- **I\_A [15:0]**: Measured RMS Inverter Current Phase A, reported in units of 0.1 A<sub>rms</sub>.
- **I\_B [15:0]**: Measured RMS Inverter Current Phase B, reported in units of 0.1 A<sub>rms</sub>.
- **I\_C [15:0]**: Measured RMS Inverter Current Phase C, reported in units of 0.1 A<sub>rms</sub>.

### 3.2.4 Grid Status

This message consists of the following 5-byte payload:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4
FREQ [7:0]	FREQ [15:8]	PLL [7:0]	PF [7:0]	PF [15:8]

- **FREQ [15:0]**: Measured Grid Frequency, reported in units of 0.1 Hz.
- **PLL [7:0]**: PLL status, bit-mapped as follows:

Bit	Status
0	Lock: 0 = not locked, 1 = locked
1-7	<i>Reserved for future use</i>

- **PF [15:0]**: Measured Power Factor at the grid interface, reported in units of 0.1 %.

### 3.2.5 System Status

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
STATE [7:0]	MODE [7:0]	CONT [7:0]	TMP_A [7:0]	TMP_B [7:0]	TMP_C [7:0]	TMP_PCB [7:0]	TMP_EXT [7:0]

- **STATE [7:0]:** Present inverter operating state, enumerated as follows:

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

- **MODE [7:0]:** Present inverter operating mode, enumerated as follows:

Value	Mode
0	DC Voltage Control
1	Grid Current Control
2	Grid Power Control

- **CONT [7:0]:** Contactor status, bit-mapped as follows:

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

- **TMP\_A/B/C [7:0]:** Measured IGBT temperatures, reported in units of 1 °C.
- **TMP\_PCB [7:0]:** Measured controller PCB temperature, reported in units of 1 °C.
- **TMP\_EXT [7:0]:** Measured external temperature, reported in units of 1 °C.

### 3.2.6 Alarm Status

This status message is used to convey the present state of the inverter's warning and fault bits. In addition to being able to periodically transmit this message on a regulator basis, the

controller can also be configured to automatically send this message upon the change of state of any of the bits (checked at 1ms intervals). 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
WARNINGS [7:0]	WARNINGS [15:8]	WARNINGS [23:16]	WARNINGS [31:24]	FAULTS [7:0]	FAULTS [15:8]	FAULTS [23:16]	FAULTS [31:24]

- **WARNINGS [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	High DC Link Voltage
1	Low DC Link Voltage
2	High AC Current, Phase A
3	High AC Current, Phase B
4	High AC Current, Phase C
5	Grid Frequency Out of Tolerance
6	Grid Voltage Out of Tolerance, A-to-B
7	Grid Voltage Out of Tolerance, B-to-C
8	Grid Voltage Out of Tolerance, C-to-A
9	High IGBT Temperature, Phase A
10	High IGBT Temperature, Phase B
11	High IGBT Temperature, Phase C
12	High PCB Temperature
13	High External Temperature
14	PLL Not Locked
15	5V Supply Out of Tolerance
16	15V Supply Out of Tolerance
17	DC Link Under Voltage
18-31	<i>Reserved</i>

- **FAULTS [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 explicitly cleared by the user. When a fault occurs, the inverter will turn OFF immediately and will go to the **Fault** state. The inverter will stay in the **Fault** state until the corresponding fault conditions are cleared. The fault bits are mapped as follows:

Bit	Fault
0	IGBT Desaturation Error, Phase A
1	IGBT Desaturation Error, Phase B
2	IGBT Desaturation Error, Phase C
3	IGBT Drive Error, Phase A
4	IGBT Drive Error, Phase B
5	IGBT Drive Error, Phase C
6	DC Link Over Voltage H/W Error
7	DC Link Over Voltage S/W Error
8	DC Link Under Voltage S/W Error
9	Over Current, Phase A
10	Over Current, Phase B
11	Over Current, Phase C
12	Grid Frequency Fault
13	Grid Voltage Fault, A-to-B
14	Grid Voltage Fault, B-to-C
15	Grid Voltage Fault, C-to-A
16	IGBT Over Temperature, Phase A
17	IGBT Over Temperature, Phase B
18	IGBT Over Temperature, Phase C
19	PCB Over Temperature
20	External Over Temperature
21	Hardware Interlock Error
22	AC Contactor Feedback Error
23	DC Contactor Feedback Error
24	DC Link Charge Timeout
25	PLL Lost Lock
26	CAN Communications Timeout
27	Configuration Memory Error
28	Calibration Error
29	DC Input Measurement Error
30	AC Contactor Interlock Error
31	DC Contactor Interlock Error

### 3.2.7 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](mailto: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

THIS LIMITED WARRANTY IS THE SOLE AND EXCLUSIVE WARRANTY PROVIDED BY OZTEK IN CONNECTION WITH YOUR OZTEK PRODUCT AND IS, WHERE PERMITTED BY LAW, IN LIEU OF ALL OTHER WARRANTIES, CONDITIONS, GUARANTEES, REPRESENTATIONS, OBLIGATIONS AND LIABILITIES, EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE IN CONNECTION WITH THE PRODUCT, HOWEVER ARISING (WHETHER BY CONTRACT, TORT, NEGLIGENCE, PRINCIPLES OF MANUFACTURER'S LIABILITY, OPERATION OF LAW, CONDUCT, STATEMENT OR OTHERWISE), INCLUDING WITHOUT RESTRICTION ANY IMPLIED WARRANTY OR CONDITION OF QUALITY, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE TO THE EXTENT REQUIRED UNDER APPLICABLE LAW TO APPLY TO THE PRODUCT SHALL BE LIMITED IN DURATION TO THE PERIOD STIPULATED UNDER THIS LIMITED WARRANTY. IN NO EVENT WILL OZTEK BE LIABLE FOR: (a) ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING LOST PROFITS, LOST REVENUES, FAILURE TO REALIZE EXPECTED SAVINGS, OR OTHER COMMERCIAL OR ECONOMIC LOSSES OF ANY KIND, EVEN IF OZTEK HAS BEEN ADVISED, OR HAD REASON TO KNOW, OF THE POSSIBILITY OF SUCH DAMAGE, (b) ANY LIABILITY ARISING IN TORT, WHETHER OR NOT ARISING OUT OF OZTEK'S NEGLIGENCE, AND ALL LOSSES OR DAMAGES TO ANY PROPERTY OR FOR ANY PERSONAL INJURY OR ECONOMIC LOSS OR DAMAGE CAUSED BY THE CONNECTION OF A PRODUCT TO ANY OTHER DEVICE OR SYSTEM, AND (c) ANY DAMAGE OR INJURY ARISING FROM OR AS A RESULT OF MISUSE OR ABUSE, OR THE INCORRECT INSTALLATION, INTEGRATION OR OPERATION OF THE PRODUCT. IF YOU ARE A CONSUMER (RATHER THAN A PURCHASER OF THE PRODUCT IN THE COURSE OF A BUSINESS) AND PURCHASED THE PRODUCT IN A MEMBER STATE OF THE EUROPEAN UNION, THIS LIMITED WARRANTY SHALL BE SUBJECT TO YOUR STATUTORY RIGHTS AS A CONSUMER UNDER THE EUROPEAN UNION PRODUCT WARRANTY DIRECTIVE 1999/44/EC AND AS SUCH DIRECTIVE HAS BEEN IMPLEMENTED IN THE EUROPEAN UNION MEMBER STATE WHERE YOU PURCHASED THE PRODUCT. FURTHER, WHILE THIS LIMITED WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, YOU MAY HAVE OTHER RIGHTS WHICH MAY VARY FROM EU MEMBER STATE TO EU MEMBER STATE OR, IF YOU DID NOT PURCHASE THE PRODUCT IN AN EU MEMBER STATE, IN THE COUNTRY YOU PURCHASED THE PRODUCT WHICH MAY VARY FROM COUNTRY TO COUNTRY AND JURISDICTION TO JURISDICTION.

## 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.