Innovative Thinking for Power, Control and Instrumentation

Voltage Mode Inverter (VMI) Modbus Registers

Functional Specification

FS-0054

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1. Introduction

1.1 Purpose

This document is intended to provide the register map used to communicate with the Oztek Voltage Mode Inverter (VMI) control firmware using the Modbus communication protocol. It describes each of the registers along with bit assignments, scaling etc. Details of the actual Modbus protocol implemented in Oztek firmware, the Oztek Modbus Module (OMM), can be found in the complementary specification: FS-0053 – Modbus Protocol Functional Specification.pdf.

1.2 Referenced Documents

Ref.	Document	Description
[1]	http://www.modbus.org/specs.php	Modbus Organization Website
[2]	**FS-0053**	Modbus Protocol Function Specification.pdf

1.3 Definitions

ADU	Application Data Unit
CRC	Cyclic Redundancy Check
DSP	Digital signal processor
EEPROM	Electrically Erasable Programmable Read Only Memory
GUI	Graphical User Interface
LSW	Least Significant Word
MSW	Most Significant Word
OMM	Oztek Modbus Module
PDU	Protocol Data Unit
POR	Power On Reset
RAM	Random Access Memory
RTU	Remote Terminal Unit
USB	Universal Serial Bus

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 the following functions:

- Control
- Configuration
- Instrumentation/Monitoring

2.1 Data Types

Modbus register data is stored internally as either 16-bit or 32-bit quantities and are treated as either signed or unsigned entities. The tables below indicate this information using the following abbreviations for the *Data Type*:

- U16 – Parameter is an unsigned 16-bit entity
- U32 – Parameter is an unsigned 32-bit entity
- S16 – Parameter is a signed 16-bit entity
- S32 – Parameter is a signed 32-bit entity

Parameters that are specified as Boolean are stored as 16-bit entities – a value of all zeros indicates FALSE and any non-zero value indicates TRUE. Unless otherwise specified in the parameter description, the parameters are stored and treated as 16-bit unsigned values.

2.2 Handling 32 bit Values

By protocol, each addressable Modbus 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 written independently, with the LSW being written before the MSW.

2.3 Specifying Fixed-Point Parameters

Some parameters listed in the following sections are specified as 32-bit signed numbers with the units specified as Qxx fixed point numbers, e.g. Q16, Q30. Using these fixed point data formats, the fractional number is scaled by 2^xx power. For example the number 100.375 in Q16 format would be: 100.375 * 2^16 = 0x00646000, where the MSW = 0x0064 (hex) and the LSW = 0x6000 (hex).

2.4 Access Level

The access level for each register is defined as follows:

- **W** (writeable) – the parameter is writable by the user
- **R** (readable) – the parameter is readable by the user
- **P** (password-protected) – the parameter may only be accessed by supplying a password

3. Volatile Registers

3.1 Command Registers

Table 1 Command Register Set

Address		Register Name	Data Type	Units	Factory Default	Min	Max	Access Level
Decimal	Hex							
1	0x0001	On/Off Control	U16	ENUM	0	0	1	R/W
2	0x0002	Fault Reset	U16	ENUM	0	0	1	W
3	0x0003	Output Voltage Setpoint	U16	Vrms	115	10	1000	R/W
4	0x0004	Configuration Password	U16	n/a	0x1111	1	65535	R/W
5	0x0005	Configuration Reset	U16	Bool	n/a	0	1	R/W/P
6	0x0006	Configuration Reload	U16	Bool	n/a	0	1	R/W
7	0x0007	Output Cable Resistance	U16	mOhm	0	0	10000	R/W
8	0x0008	PhA DC Offset Calibration	S16	0.001%	0	-1000	1000	R/W
9	0x0009	PhB DC Offset Calibration	S16	0.001%	0	-1000	1000	R/W
10	0x000A	PhC DC Offset Calibration	S16	0.001%	0	-1000	1000	R/W

3.1.1 On/Off Control

ON/OFF [7:0]: This field is used to turn the converter ON or OFF as follows:

0 – OFF: This turns the converter OFF.
1 – ON: This turns the converter ON.
2 to 255 – Not Supported

3.1.2 Fault Reset

This register is used to reset any latched fault conditions and to return the controller to the STANDBY state.

Fault Reset [7:0]: This field is used to turn the converter ON or OFF as follows:

0 – IDLE: No reset action requested.
1 – RESET: Request to attempt a Fault Reset. Register is auto cleared to 0.
2 to 255 – Not Supported

3.1.3 Output Voltage Setpoint

This Command register is used to adjust the desired RMS output voltage set point, and may be written to while the converter is operating. This commanded set point is stored as the default voltage set point in the non-volatile configuration memory.

3.1.4 Configuration Password

This Command register is used to supply a password for those configuration operations that are password protected. The password is cleared to zero each time an attempt is made to execute a password protected operation.

3.1.5 Configuration Reset

This Command register causes the system to restore its non-volatile configuration memory to the factory default configuration. Successful execution of this command requires the following conditions be met. Note that following a Configuration Reset command a Configuration Reload command is required to load the non-volatile data into the working variables.

- ***The "Configuration Password" register must have been previously loaded with the correct password.***
- ***The system must be in a non-operation state, i.e. the power outputs must be disabled.***

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

3.1.6 Configuration Reload

This Command register causes any modifications to the non-volatile configuration memory to be loaded into the working variables. Successful execution of this command requires the following conditions be met:

- ***The system must be in a non-operation state, i.e. the power outputs must be disabled.***

NOTE: Execution of this command or a Power-On Reset (POR) is required before changes to the configuration space are used for operation.

3.1.7 Output Cable Resistance

This Command register is used to adjust the Output Cable Resistance parameter used by the Voltage Drop Compensation algorithm, and may be written to while the converter is operating. The value sent in this command is stored in the non-volatile configuration memory.

3.1.8 Phase A/B/C DC Offset Calibration

This Command register is used to calibrate out any DC offset in the power stage. The units are in 0.001% PWM duty-cycle. The register should be adjusted while monitoring the transformer primary current with no load attached to the converter. The values sent with these commands are stored in the non-volatile configuration memory.

3.2 Instrumentation Registers

Table 2 Instrumentation Register Set

Address		Register Name	Data Type	Units	Factory Default	Min	Max	Access Level
Decimal	Hex							
2048	0x0800	DC Link Voltage	S16	%	n/a	n/a	n/a	R
2049	0x0801	AC Line Voltage Phase A	S16	%	n/a	n/a	n/a	R
2050	0x0802	AC Line Voltage Phase B	S16	%	n/a	n/a	n/a	R
2051	0x0803	AC Line Voltage Phase C	S16	%	n/a	n/a	n/a	R
2052	0x0804	Output Voltage Phase A	S16	%	n/a	n/a	n/a	R
2053	0x0805	Output Voltage Phase B	S16	%	n/a	n/a	n/a	R
2054	0x0806	Output Voltage Phase C	S16	%	n/a	n/a	n/a	R
2055	0x0807	Output Current Phase A	S16	%	n/a	n/a	n/a	R
2056	0x0808	Output Current Phase B	S16	%	n/a	n/a	n/a	R
2057	0x0809	Output Current Phase C	S16	%	n/a	n/a	n/a	R
2058	0x080A	Output Frequency	S16	%	n/a	n/a	n/a	R
2059	0x080B	Line Frequency	S16	%	n/a	n/a	n/a	R
2060	0x080C	Inverter A Temperature	S16	%	n/a	n/a	n/a	R
2061	0x080D	Inverter B Temperature	S16	%	n/a	n/a	n/a	R
2062	0x080E	Cabinet Temperature	S16	%	n/a	n/a	n/a	R
2063	0x080F	VMI Operating State	U16	ENUM	n/a	n/a	n/a	R
2064	0x0810	Contactor Status	U16	n/a	n/a	n/a	n/a	R
2065	0x0811	Warning Status – Bias Supplies	U16	n/a	n/a	n/a	n/a	R
2066	0x0812	Warning Status – Input	U16	n/a	n/a	n/a	n/a	R
2067	0x0813	Warning Status – Output	U16	n/a	n/a	n/a	n/a	R
2068	0x0814	Fault Status – System	U16	n/a	n/a	n/a	n/a	R
2069	0x0815	Fault Status – Input	U16	n/a	n/a	n/a	n/a	R
2070	0x0816	Fault Status – Output H/W	U16	n/a	n/a	n/a	n/a	R
2071	0x0817	Fault Status – Output S/W	U16	n/a	n/a	n/a	n/a	R
2072	0x0818	Configuration Command Status	U16	ENUM	n/a	n/a	n/a	R
4094	0x0FFE	Software Revision	U16	n/a	n/a	n/a	n/a	R
4095	0x0FFF	FPGA Logic Revision	U16	n/a	n/a	n/a	n/a	R

3.2.1 VMI Operating State

The VMI Operating state is enumerated as follows:

Value	State
0	Initialization
1	Precharge
2	Charge Wait
3	Standby
4	On
5	Fault
6	Calibration

Value	State
8-255	*Unknown: Reserved for future use*

3.2.2 Contactor Status

The Pre-charge and AC Line contactors open/closed status bits are mapped as follows:

Bit	Status
0	AC Line Contactor: 0 = Open, 1 = Closed
1	Pre-Charge Contactor: 0 = Open, 1 = Closed
2-15	*Reserved for future use*

3.2.3 Warning Status

Warning bits are active when set to '1', and not present when set to '0'. The warning bits are mapped into the register as follows.

3.2.3.1 Bias Supply Warnings

Bit	Warning
0	24V Supply Over Tolerance
1	24V Supply Under Tolerance
2	15V Supply Over Tolerance
3	15V Supply Under Tolerance
4	5V Supply Over Tolerance
5	5V Supply Under Tolerance
6	3.3V Supply Over Tolerance
7	3.3V Supply Under Tolerance
8	-15V Supply Over Tolerance
9	-15V Supply Under Tolerance
10 - 15	***Reserved for future use***

3.2.3.2 Input Warnings

Bit	Warning
0	DC Link Low Voltage
1	DC Link High Voltage
2	Line Frequency Low
3	Line Frequency High
4	Line Voltage Phase AB - Low
5	Line Voltage Phase AB - High
6	Line Voltage Phase BC - Low
7	Line Voltage Phase BC - High

Bit	Warning
8	Line Voltage Phase AC - Low
9	Line Voltage Phase AC - High
10 - 15	***Reserved for future use***

3.2.3.3 Output Warnings

Bit	Warning
0	Inverter A High Temperature
1	Inverter B High Temperature
2	Cabinet High Temperature
3	Phase A – Output Current Overload
4	Phase B – Output Current Overload
5	Phase C – Output Current Overload
6 - 15	***Reserved for future use***

3.2.4 Fault Status

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 a "1" is written to the Fault Reset register. When a fault occurs, the controller will go to the FAULT state and the VMI will stop operating. The controller will stay in the FAULT state until the Fault Reset message is received. The fault bits are mapped as follows:

3.2.4.1 System Faults

Bit	Fault
0	Pre-Charge Timeout
1	Pre-Charge Contactor Fault
2	AC Line Contactor Fault
3	Relay Driver Error
4	Configuration Memory Error
5	ADC Calibration Error
6	Reserved – not used
7	Power Module A – S/W Over Temp
8	Power Module B – S/W Over Temp
9	Cabinet – S/W Over Temp
10 - 15	***Reserved for future use***

3.2.4.2 Input Faults

Bit	Fault
0	DC Link Voltage Low
1	DC Link Voltage High
2	Line Frequency Low
3	Line Frequency High
4	Line Voltage Phase AB - Low
5	Line Voltage Phase AB - High
6	Line Voltage Phase BC - Low
7	Line Voltage Phase BC - High
8	Line Voltage Phase AC - Low
9	Line Voltage Phase AC - High
10-15	***Reserved for future use***

3.2.4.3 Output H/W Faults

Bit	Fault
0	Power Module A – H/W Over Temp
1	Power Module A – Phase W - H/W Error
2	Power Module A – Phase V - H/W Error
3	Power Module A – Phase U - H/W Error
4	Power Module B – H/W Over Temp
5	Power Module B – Phase W - H/W Error
6	Power Module B – Phase V - H/W Error
7	Power Module B – Phase U - H/W Error
8-15	***Reserved for future use***

3.2.4.4 Output S/W Faults

Bit	Fault
0	Phase A - Output Current I2T Overload
1	Phase B - Output Current I2T Overload
2	Phase C - Output Current I2T Overload
3	Phase A - Output Current RMS Overload
4	Phase B - Output Current RMS Overload
5	Phase C - Output Current RMS Overload
6	Phase A - Output Voltage High
7	Phase B - Output Voltage High
8	Phase C - Output Voltage High
9	Phase A - Output Voltage Low
10	Phase B - Output Voltage Low

Bit	Fault
11	Phase C - Output Voltage Low
12	Output Frequency high
13	Output Frequency Low
14-15	***Reserved for future use***

3.2.4.5 Configuration Command Status

When a "Reload" or "Reset" configuration command register is written to, the Configuration Command Status register is updated with the execution status of the requested command. The status is enumerated as follows:

Value	State
0	Successful Command Execution
1	Error – System is in a "Powered" state
2	Error – Invalid password for operation
3	Error – Data error
4	Busy – Requested command is executing
5-255	*Unknown: Reserved for future use*

4. Non-Volatile Configuration Registers

Many operating parameters in this application have been made configurable so as to support the various VMI product variants as well as other similar products in the future. As such, the software contains provisions for storing these configuration parameters in an external non-volatile EEPROM device.

Once one or more configuration parameters have been updated by writing to the applicable configuration register, the actual operating configuration variables remain unaffected until one of two events occur: either the user cycles power on the control board or the ***Configuration Reload*** command register (0x0006) is written to. In the second case, the reload is only allowed if the VMI is ***not*** enabled. Attempts to reload the system configuration while the converter is in operation will result in the command being ignored and an error being reported in the ***Configuration Command Status*** register (0x4018).

The ***Configuration Reset*** command register (0x0005) is used to reset the EEPROM back to the original factory default values. The user should take care when using this command as any custom configuration settings will be lost when the entire contents of the configuration memory is overwritten with the specified factory defaults. This command is only allowed if the converter is ***not*** enabled. Attempts to reset the EEPROM data while the converter is in operation will result in the command being ignored and an error being reported in the ***Configuration Command Status*** register (0x4018).

There are multiple scenarios in which the firmware may automatically program the configuration memory at startup with the factory default values. First, when the controller boots following a reset, it attempts to read a predefined read-only header stored in the EEPROM. If the header does not match the expected value, the memory is considered uninitialized and the firmware will automatically write the default factory configuration values into the memory. This would be the case if a control board were just being loaded with the firmware and operated for the first time, in which case the configuration memory wouldn't contain valid data.

The second scenario in which the firmware will automatically update the configuration memory occurs when the firmware has been updated on the control board and its associated configuration memory map is not compatible with the previously programmed version of the firmware. The configuration memory contains two factory revision values; a major and a minor revision. At startup the firmware will read the major revision value and compare it against the default major revision for that particular build of the firmware. If the two do not match, the firmware will automatically reset the configuration memory to the factory defaults. Differences in the minor revision will not cause the memory to be reset. Using this factory configuration revision scheme, the minor revision number is expected to change for minor changes that do not change the layout and format of the data in the configuration memory (i.e. a simple change to a default value for a particular parameter or its legal data range). The major revision number is required to change any time new parameters are added or parameter locations or formats are changed. The user must take care when updating the firmware to understand whether or not the configuration memory will be reset so as not to lose any custom settings previously stored. The present factory revision of the configuration memory is stored in the ***Factory Configuration Revision*** registers (PIDs 0x1001 – 0x1002).

4.1 System Measurement Scaling Parameters

Table 3 Configuration Register Set – Measurement Scale Constants

Address		Register Name	Data Type	Units	Factory Default	Min	Max	Access Level
Decimal	Hex							
4096	0x1000	DC Link Voltage – Full Scale	U16	0.1 V	10000	100	15000	R/W
4097	0x1001	AC Line Voltage – Full Scale	U16	0.1 Vpk	16480	100	20000	R/W
4098	0x1002	AC Line Current – Full Scale	U16	0.1 A	3750	100	10000	R/W
4099	0x1003	AC Line Frequency – Full Scale	U16	0.1 Hz	5000	300	10000	R/W
4100	0x1004	AC Line Current Polarity Select	U16	ENUM	0	0	1	R/W
4101	0x1005	AC Output Voltage – Full Scale	U16	0.1 Vpk	1493	100	15000	R/W
4102	0x1006	AC Output Primary Current – Full Scale	U16	0.1 A	3750	100	10000	R/W
4103	0x1007	AC Output Secondary Current – Full Scale	U16	0.1 A	3750	100	10000	R/W
4104	0x1008	AC Output Secondary Current Polarity Select	U16	ENUM	0	0	1	R/W
4105	0x1009	AC Output Frequency – Full Scale	U16	0.1 Hz	5000	300	10000	R/W
4106	0x100A	Temperature – Full Scale	U16	0.1degC	2000	0	2500	R/W

4.1.1 DC Link Voltage - Full Scale

This parameter defines the full scale value of the DC Link Voltage measured by the signal conditioning circuitry on the control PCB. This full scale value is the actual voltage that would cause a full scale ADC reading (i.e. ADC reading of 0xFFF).

4.1.2 AC Line Voltage - Full Scale

This parameter defines the full scale, peak value of the AC Line Voltage measured by the signal conditioning circuitry on the control PCB. This full scale value is the actual voltage that would cause a full scale ADC reading (i.e. ADC reading of 0xFFF).

4.1.3 AC Line Current - Full Scale

NOTE: This parameter is provisional and does not currently provide any functionality.

This parameter defines the full scale value of the current sensors used to measure the AC Line current. This full scale value is relative to the signal at the DSP's ADC input that would cause a full scale ADC reading (i.e. ADC reading of 0xFFF).

4.1.4 AC Line Frequency - Full Scale

This parameter defines the full scale range of the AC Line frequency to be measured by the software. It is normal to include some margin above the maximum desired measured value.

4.1.5 AC Line Current Polarity Select

NOTE: This parameter is provisional and does not currently provide any functionality.

This parameter provides a means to invert the AC Line Current measurement to correct for different types of sensors and mechanical routing of wires. The polarity select bit is enumerated as follows:

Value	Current Polarity
0	Current from IGBT to AC Line is positive
1	Current from IGBT to AC Line is negative
2-255	*Undefined*

4.1.6 AC Output Voltage - Full Scale

This parameter defines the full scale, peak value of the AC output Voltage measured by the signal conditioning circuitry on the control PCB. This full scale value is the actual voltage that would cause a full scale ADC reading (i.e. ADC reading of 0xFFF).

4.1.7 AC Output Primary Current - Full Scale

This parameter defines the full scale value of the current sensors used to measure the AC output current at the primary side of the output transformer. This full scale value is relative to the signal at the DSP's ADC input that would cause a full scale ADC reading (i.e. ADC reading of 0xFFF).

4.1.8 AC Output Secondary Current - Full Scale

This parameter defines the full scale value of the current sensors used to measure the AC output current, at the output of the transformer as opposed to the output of the switching inverter terminals. This full scale value is relative to the signal at the DSP's ADC input that would cause a full scale ADC reading (i.e. ADC reading of 0xFFF).

4.1.9 AC Output Secondary Current Polarity Select

This parameter provides a means to invert the AC Output Current measurement to correct for different types of sensors and mechanical routing of wires. The polarity select bit is enumerated as follows:

Value	Current Polarity
0	Current from transformer to AC Output is positive
1	Current from transformer to AC Output is negative
2-255	*Undefined*

4.1.10 AC Output Frequency - Full Scale

This parameter defines the full scale range of the AC output frequency to be measured by the software. It is normal to include some margin above the maximum desired measured value.

4.1.11 Temperature - Full Scale

This parameter defines the full scale range of the temperature measurements provided by the software. It is normal to include some margin above the maximum desired measured value.

4.2 Fault and Warning Parameters

Table 4 Configuration Register Set – Fault & Warning Thresholds

Address		Register Name	Data Type	Units	Factory Default	Min	Max	Access Level
Decimal	Hex							
4128	0x1020	DC Link Over Voltage Fault Threshold	U16	0.1 V	7452	0	9000	R/W
4129	0x1021	DC Link Over Voltage Warning Threshold	U16	0.1 V	7128	0	9000	R/W
4130	0x1022	DC Link Over Voltage Recover Threshold	U16	0.1 V	6998	100	9000	R/W
4131	0x1023	DC Link Under Voltage Fault Threshold	U16	0.1 V	5378	100	9000	R/W
4132	0x1024	DC Link Under Voltage Warning Threshold	U16	0.1 V	5702	100	9000	R/W
4133	0x1025	DC Link Under Voltage Recover Threshold	U16	0.1 V	5832	100	9000	R/W
4134	0x1026	AC Line Under Voltage Fault Threshold	U16	0.1 Vrms	3984	100	10000	R/W

Address		Register Name	Data Type	Units	Factory Default	Min	Max	Access Level
Decimal	Hex							
4135	0x1027	AC Line Under Voltage Warning Threshold	U16	0.1 Vrms	4224	100	10000	R/W
4136	0x1028	AC Line Under Voltage Recover Threshold	U16	0.1 Vrms	4320	100	10000	R/W
4137	0x1029	AC Line Over Voltage Fault Threshold	U16	0.1 Vrms	5520	100	10000	R/W
4138	0x102A	AC Line Over Voltage Warning Threshold	U16	0.1 Vrms	5280	100	10000	R/W
4139	0x102B	AC Line Over Voltage Recover Threshold	U16	0.1 Vrms	5184	100	10000	R/W
4140	0x102C	AC Line Low Frequency Fault Threshold	U16	0.1 Hz	550	400	4500	R/W
4141	0x102D	AC Line Low Freq Warning Threshold	U16	0.1 Hz	560	400	4500	R/W
4142	0x102E	AC Line Low Frequency Recover Threshold	U16	0.1 Hz	580	400	4500	R/W
4143	0x102F	AC Line Hi Frequency Fault Threshold	U16	0.1 Hz	650	400	4500	R/W
4144	0x1030	AC Line Hi Frequency Warning Threshold	U16	0.1 Hz	640	400	4500	R/W
4145	0x1031	AC Line Hi Frequency Recover Threshold	U16	0.1 Hz	620	400	4500	R/W
4146	0x1032	Reserved	n/a	n/a	n/a	n/a	n/a	n/a
4147	0x1033	Output Current Overload Warn Threshold	U16	0.1 Arms	2750	0	3500	R/W
4148	0x1034	Output Current Overload Recvr Threshold	U16	0.1 Arms	2500	0	3500	R/W
4149	0x1035	Output Over Voltage Fault Threshold	U16	0.1 Vrms	1500	0	3500	R/W
4150	0x1036	Output Under Voltage Fault Threshold	U16	0.1 Vrms	1000	0	3500	R/W
4151	0x1037	Output Low Frequency Fault Threshold	U16	0.1 Hz	3900	400	4500	R/W
4152	0x1038	Output High Frequency Fault Threshold	U16	0.1 Hz	4100	400	4500	R/W
4153	0x1039	Power Module Temp Fault Threshold	U16	°C	110	50	150	R/W
4154	0x103A	Power Module Temp Warning Threshold	U16	°C	105	50	150	R/W
4155	0x103B	Power Module Temp Recover Threshold	U16	°C	100	50	150	R/W
4156	0x103C	Enclosure Temp Fault Threshold	U16	°C	80	50	150	R/W
4157	0x103D	Enclosure Temp Warning Threshold	U16	°C	60	50	150	R/W
4158	0x103E	Enclosure Temp Recover Threshold	U16	°C	55	50	150	R/W

4.2.1 DC Link Over Voltage Fault Threshold

This parameter defines the DC Link over voltage fault threshold. If the DC Link voltage rises above this value the application will automatically transition to the FAULT state and operation of the inverter will be disabled (and forced OFF).

4.2.2 DC Link Over Voltage Warning Threshold

This parameter defines the DC Link voltage threshold above which the firmware will report a high voltage warning. Once above this warning threshold, the voltage must drop below the corresponding recover threshold before the firmware will clear the high voltage warning.

4.2.3 DC Link Over Voltage Recover Threshold

See warning threshold description above.

4.2.4 DC Link Under Voltage Fault Threshold

This parameter defines the DC Link under voltage fault threshold. If the DC Link voltage falls below this value the application will automatically transition to the FAULT state and operation of the inverter will be disabled (and forced OFF).

4.2.5 DC Link Under Voltage Warning Threshold

This parameter defines the DC Link voltage threshold below which the firmware will report a low voltage warning. Once below this warning threshold, the voltage must rise above the corresponding recover threshold before the firmware will clear the low voltage warning.

4.2.6 DC Link Under Voltage Recover Threshold

See warning threshold description above.

4.2.7 AC Line Under Voltage Fault Threshold

This parameter defines the AC Line under voltage fault threshold. If the voltage drops below this value the converter will automatically transition to the FAULT state and operation of the application will be disabled (and forced OFF).

4.2.8 AC Line Under Voltage Warning Threshold

This parameter defines the AC Line voltage threshold below which the firmware will report a low AC Line voltage warning. Once below this warning threshold, the AC Line voltage must rise above the corresponding recover threshold before the firmware will clear the low AC Line voltage warning.

4.2.9 AC Line Under Voltage Recover Threshold

See warning threshold description above.

4.2.10 AC Line Over Voltage Fault Threshold

This parameter defines the AC Line over voltage fault threshold. If the voltage rises above this value the converter will automatically transition to the FAULT state and operation of the application will be disabled (and forced OFF).

4.2.11 AC Line Over Voltage Warning Threshold

This parameter defines the AC Line voltage threshold above which the firmware will report a high AC Line voltage warning. Once above this warning threshold, the AC Line voltage must fall below the corresponding recover threshold before the firmware will clear the high AC Line voltage warning.

4.2.12 AC Line Over Voltage Recover Threshold

See warning threshold description above.

4.2.13 AC Line Low Frequency Fault Threshold

This parameter defines the AC Line low frequency fault threshold. If the frequency drops below this value the converter will automatically transition to the FAULT state and operation of the application will be disabled (and forced OFF).

4.2.14 AC Line Low Frequency Warning Threshold

This parameter defines the AC Line frequency threshold below which the firmware will report a low frequency warning. Once below this warning threshold, the AC Line frequency must rise above the corresponding recover threshold before the firmware will clear the low frequency warning.

4.2.15 AC Line Low Frequency Recover Threshold

See warning threshold description above.

4.2.16 AC Line High Frequency Fault Threshold

This parameter defines the AC Line high frequency fault threshold. If the frequency rises above this value the converter will automatically transition to the FAULT state and operation of the application will be disabled (and forced OFF).

4.2.17 AC Line High Frequency Warning Threshold

This parameter defines the AC Line frequency threshold above which the firmware will report a high AC Line freqeuncy warning. Once above this warning threshold, the frequency must fall below the corresponding recover threshold before the firmware will clear the high frequency warning.

4.2.18 AC Line High Frequency Recover Threshold

See warning threshold description above.

4.2.19 Output Current Overload Warning Threshold

This parameter defines the output current threshold above which the firmware will report an output current overload warning. Once above this warning threshold, the RMS output current must fall below the corresponding recover threshold before the firmware will clear the overload current warning.

4.2.20 Output Current Overload Recover Threshold

See warning threshold description above.

4.2.21 Output Over Voltage Fault Threshold

This parameter defines the output over voltage fault threshold. If the RMS output voltage rises above this value the converter will automatically transition to the FAULT state and operation of the application will be disabled (and forced OFF).

4.2.22 Output Under Voltage Fault Threshold

This parameter defines the output under voltage fault threshold. If the RMS output voltage falls below this value the converter will automatically transition to the FAULT state and operation of the application will be disabled (and forced OFF).

4.2.23 Output Low Frequency Fault Threshold

This parameter defines the output low frequency fault threshold. If the output frequency falls below this value the converter will automatically transition to the FAULT state and operation of the application will be disabled (and forced OFF).

4.2.24 Output High Frequency Fault Threshold

This parameter defines the output high frequency fault threshold. If the output frequency rises above this value the converter will automatically transition to the FAULT state and operation of the application will be disabled (and forced OFF).

4.2.25 Inverter Temperature Fault Threshold

This parameter defines the Inverter Temperature fault threshold. If the temperature rises above this value the converter will automatically transition to the FAULT state and operation of the application will be disabled (and forced OFF).

4.2.26 Inverter Temperature Warning Threshold

This parameter defines the Inverter temperature threshold above which the firmware will report a high temperature warning. Once above this warning threshold, the temperature must fall below the corresponding recover threshold before the firmware will clear the high temperature warning.

4.2.27 Inverter Temperature Recover Threshold

See warning threshold description above.

4.2.28 Enclosure Temperature Fault Threshold

This parameter defines the Enclosure Temperature fault threshold. If the enclosure temperature rises above this value the converter will automatically transition to the FAULT state and operation of the application will be disabled (and forced OFF).

4.2.29 Enclosure Temperature Warning Threshold

This parameter defines the enclosure temperature threshold above which the firmware will report a high temperature warning. Once above this warning threshold, the enclosure temperature must fall below the corresponding recover threshold before the firmware will clear the high temperature warning.

4.2.30 Enclosure Temperature Recover Threshold

See warning threshold description above.

4.3 Converter Control Parameters

Table 5 Configuration Register Set – Control Parameters

Address		Register Name	Data Type	Units	Factory Default	Min	Max	Access Level
Decimal	Hex							
4176	0x1050	Pulse Width Modulation Freq	U16	1 Hz	8000	1000	20000	R/W
4177	0x1051	PWM Deadband Enable	U16	Bool	True	False	True	R/W
4178	0x1052	PWM Deadband	U16	10 ns	300	25	1000	R/W
4179	0x1053	Control Type	U16	ENUM	1	1	1	R/W
4180	0x1054	Output Frequency Set Point	U16	1Hz	400	10	500	R/W
4181	0x1055	Max Line Drop Compensation	U16	%	5	0	100	R/W

4.3.1 Pulse Width Modulation Frequency

This parameter defines the switching frequency of the power switches within the inverter.

4.3.2 PWM Deadband Enable

This parameter enables software deadband for each inverter half bridge. The deadband is implemented as a turn on delay in the power device on/off command.

4.3.3 PWM Deadband

This parameter defines the duration of the software deadband for each inverter half bridge. The deadband is implemented as a turn on delay in the power device on/off command.

4.3.4 Control Type

This parameter defines the type of control algorithm to be used.

4.3.5 Output Frequency Set Point

This parameter defines the output operating frequency of the converter.

4.3.6 Maximum Line Drop Compensation

This parameter defines the maximum output line drop voltage compensation allowed by the controller. The value is expressed as a percentage of load impedance calculated as Output Voltage (Register 0x1010) divided by Rated Output Current (register 0x1100).

4.4 Temperature Monitor Parameters

Table 6 Configuration Register Set – Temperature Parameters

Address		Register Name	Data Type	Units	Factory Default	Min	Max	Access Level
Decimal	Hex							
4192	0x1060 (LSW)	Inverter Temp Coef C0	S32	Q16	18.515	-10000	10000	R/W
4193	0x1061 (MSW)							
4194	0x1062 (LSW)	Inverter Temp Coef C1	S32	Q16	119.94	-10000	10000	R/W
4195	0x1063 (MSW)							
4196	0x1064 (LSW)	Inverter Temp Coef C2	S32	Q16	-27.232	-10000	10000	R/W
4197	0x1065 (MSW)							
4198	0x1066 (LSW)	Inverter Temp Coef C3	S32	Q16	5.9997	-10000	10000	R/W
4199	0x1067 (MSW)							
4200	0x1068 (LSW)	Enclosure Temp Coef A	S32	Q30	1.032444E-3	-1	1	R/W
4201	0x1069 (MSW)							
4202	0x106A (LSW)	Enclosure Temp Coef B	S32	Q30	2.3856E-4	-1	1	R/W
4203	0x106B (MSW)							
4204	0x106C (LSW)	Enclosure Temp Coef C	S32	Q30	1.5914E-7	-1	1	R/W
4205	0x106D (MSW)							
4206	0x106E (LSW)	Enclosure Therm Bias Resistor	S32	Q16	2000	0	10000	R/W
4207	0x106F (MSW)							
4208	0x1070	Enclosure Temp Monitor Ena	U16	Bool	True	False	True	R/W

4.4.1 Inverter Temp Coefficients (C0 through C3)

The inverter temperature algorithm is designed to interface with a non-linear, Semikron SKiiP based temperature transducer. These parameters define the coefficients used by the polynomial fitting routine within the firmware to convert raw ADC readings to degrees C.

4.4.2 Enclosure Temp Coefficients (A through C)

The enclosure temperature algorithm is designed to interface with a conventional thermistor style temperature transducer. These parameters define the Steinhart-Hart thermistor equation coefficients used by the firmware to convert raw ADC readings to degrees C.

4.4.3 Enclosure Thermistor Bias Resistor

This parameter defines the value of the resistor used to bias the enclosure thermistor, in Ohms.

4.4.4 Enclosure Temp Monitor Enable

This parameter enables the enclosure temperature fault and warning checks. These checks should be disabled if no enclosure temperature sensor is included in the design.

4.5 Voltage Regulator Parameters

Table 7 Configuration Register Set – Voltage Regulator Parameters

Address		Register Name	Data Type	Units	Factory Default	Min	Max	Access Level
Decimal	Hex							
4224	0x1080	Fundamental Controller Gain	U16	1	661	0	65535	R/W
4225	0x1081	Fundamental Controller Phase	U16	1 Deg	30	0	65535	R/W
4226	0x1082	Fundamental Controller Max	S16	0.001	999	0	999	R/W
4227	0x1083	Fundamental Controller Min	S16	0.001	-999	-999	0	R/W
4228	0x1084	3rd Harmonic Controller Gain	U16	1	25	0	65535	R/W
4229	0x1085	3rd Harmonic Controller Phase	U16	1 Deg	140	0	65535	R/W
4230	0x1086	3rd Harmonic Controller Max	S16	0.001	999	0	999	R/W
4231	0x1087	3rd Harmonic Controller Min	S16	0.001	-999	-999	0	R/W
4232	0x1088	5th Harmonic Controller Gain	U16	1	41	0	65535	R/W
4233	0x1089	5th Harmonic Controller Phase	U16	1 Deg	297	0	65535	R/W
4234	0x108A	5th Harmonic Controller Max	S16	0.001	999	0	999	R/W
4235	0x108B	5th Harmonic Controller Min	S16	0.001	-999	-999	0	R/W
4236	0x108C	7th Harmonic Controller Gain	U16	1	165	0	65535	R/W
4237	0x108D	7th Harmonic Controller Phase	U16	1 Deg	50	0	65535	R/W
4238	0x108E	7th Harmonic Controller Max	S16	0.001	999	0	999	R/W
4239	0x108F	7th Harmonic Controller Min	S16	0.001	-999	-999	0	R/W
4240	0x1090	Resonant Controller Max	S16	0.001	999	0	999	R/W
4241	0x1091	Resonant Controller Min	S16	0.001	-999	-999	0	R/W
4242	0x1092	Voltage Command Slew Limit	U16	1 Vrms/s	100	1	65535	R/W
4243	0x1093	Nominal DC Link Voltage	U16	0.1V	6381	1	8500	R/W

4.5.1 Voltage Resonant Controller Gain & Phase Constants

These parameters define the gain and phase constants for the resonant controller used to regulate the output voltage. The resonant controller is comprised of a Fundamental controller as well as 3^{rd}, 5^{th}, and 7^{th} harmonic controllers.

4.5.2 Voltage Resonant Controller Maximum & Minimum Outputs

These parameters define the maximum or minimum output values for the corresponding individual resonant controller terms, i.e. Fundamental, 3^{rd}, 5^{th}, and 7^{th} harmonic controllers, as well as the combined total Resonant controller output.

4.5.3 Voltage Command Slew Limit

This parameter defines the slew rate to use when operating in voltage control mode and the commanded output voltage is changed. This slew rate is used both at initial turn-on when the output voltage is changed from the present value to the programmed set point or when the programmed set point is changed after the converter has already been turned on.

4.5.4 Nominal DC Link Voltage

This parameter defines the nominal operating DC link voltage. It is used to establish the feed-forward voltage correction value for the resonant controller.

4.6 Pre-charge Parameters

Table 8 Configuration Register Set – Precharge Parameters

Address		Register Name	Data Type	Units	Factory Default	Min	Max	Access Level
Decimal	Hex							
4288	0x10C0	DC Link Pre-charge Enable	U16	Bool	True	False	True	R/W
4289	0x10C1	DC Link Pre-charge Timeout	U16	1msec	20000	10	65535	R/W
4290	0x10C2	DC Link Pre-charge Threshold	U16	%	85	0	100	R/W
4291	0x10C3	Contactor Monitor Enables	U16	ENUM	3	0	3	R/W
4292	0x10C4	Contactor Debounce	U16	1 ms	10	1	10000	R/W
4293	0x10C5	Contactor Close Time	U16	1 ms	500	1	10000	R/W

4.6.1 DC Link Pre-charge Enable

This parameter enables the DC Link voltage precharge controller. If the DC Link is being charged or controlled by some other means this parameter should be set to false.

4.6.2 DC Link Pre-charge Timeout

This parameter specifies the maximum amount of time to wait after closing the precharge contactor, before reporting a precharge timeout fault.

4.6.3 DC Link Pre-charge Threshold

This parameter defines the DC Link voltage threshold to charge to. This value is expressed as a percentage of the peak, measured AC Line input voltage.

4.6.4 Contactor Monitor Enables

This parameter is used to determine if contactor feedback monitors are enabled. The enumerated values for this parameter are as follows:

- 0 = No monitoring (i.e. no contactor feedback is provided or checked)
- 1 = Monitor Precharge Contactor only
- 2 = Monitor AC Line Contactor only
- 3 = Monitor Both Contactors

4.6.5 Contactor Debounce

This parameter is used to specify the debounce time for both the main AC Line connect contactor and the precharge contactor. This field is used to delay reporting a change of state in the contactor prior to considering the change valid.

4.6.6 Contactor Close Time

This parameter is used to specify the actuation time for both the main AC Line connect contactor and the precharge contactor. This field should be set to the longest expected delay

from when the contactor is driven open/closed by the software to when the contactor has mechanically changed state (including all expected debounce time).

4.7 Instrumentation Filter Parameters

Table 9 Configuration Register Set – Instrumentation Filter Parameters

Address		Register Name	Data Type	Units	Factory Default	Min	Max	Access Level
Decimal	Hex							
4304	0x10D0	RMS Averaging Time – Output Current	U16	100 us	50	1	65535	R/W
4305	0x10D1	RMS Averaging Time – Output Voltage	U16	100 us	50	1	65535	R/W
4306	0x10D2	RMS Averaging Time – Line Voltage	U16	00 us	5000	1	65535	R/W
4307	0x10D3	LPF Cutoff Freq – DC Link Voltage	U16	1 Hz	2	1	10000	R/W
4308	0x10D4	LPF Cutoff Freq - AC Line Frequency	U16	1 Hz	2	1	10000	R/W
4309	0x10D5	LPF Cutoff Freq - Inverter Temp	U16	1 Hz	2	1	10000	R/W
4310	0x10D6	LPF Cutoff Freq - Enclosure Temp	U16	1 Hz	2	1	10000	R/W
4311	0x10D7	LPF Cutoff Freq - Output Voltage	U16	1 Hz	4	1	10000	R/W
4312	0x10D8	LPF Cutoff Freq - Output Current	U16	1 Hz	4	1	10000	R/W
4313	0x10D4	LPF Cutoff Freq - Output Frequency	U16	1 Hz	2	1	10000	R/W

4.7.1 RMS Averaging Time – Output Current, Voltage & Line Voltage

These parameters define the averaging time used by the iterative RMS algorithm.

4.7.2 Low Pass Cutoff Freq

These parameters define the cutoff frequencies for the first order, digital low pass filters used to filter the corresponding instrumentation data.

4.8 Modbus Configuration Parameters

Table 10 Configuration Register Set – Modbus Parameters

Address		Register Name	Data Type	Units	Factory Default	Min	Max	Access Level
Decimal	Hex							
4336	0x10F0	Modbus Address	U16	1	10	1	257	R/W
4337	0x10F1	Modbus Baud Rate	U16	ENUM	2	0	5	R/W
4338	0x10F2	Modbus Parity	U16	ENUM	0	0	2	R/W

4.8.1 Modbus Address

This parameter defines the device address for Modbus messaging.

4.8.2 Modbus Baud Rate

The serial baud rate values are enumerated as follows:

Value	Baud rate – bit per sec (bps)
0	2400 bps
1	4800 bps

Value	Baud rate – bit per sec (bps)
2	19200 bps
3	38400 bps
4	57600 bps
5	115200 bps
6-255	*Unknown: Reserved for future use*

4.8.3 Modbus Parity

The parity values are enumerated as follows:

Value	Parity
0	None
1	Odd
2	Even
3-255	*Unknown: Reserved for future use*

4.9 Current Overload Protection Parameters

Table 11 Configuration Register Set – Current Overload Protection Parameters

Address		Register Name	Data Type	Units	Factory Default	Min	Max	Access Level
Decimal	Hex							
4352	0x1100	Rated RMS Output Current	U16	Amps	260	1	65535	R/W
4353	0x1101	I2T Overload Fault Enable	U16	Bool	True	False	True	R/W
4354	0x1102	IRMS Overload Fault Enable	U16	Bool	True	False	True	R/W
4355	0x1103	I2T Trip Time	U16	0.1 msec	1000	1	65535	R/W
4356	0x1104 (LSW)	10% RMS Overload Trip Time	U32	msec	720000	1	3600000	R/W
4357	0x1105 (MSW)							
4358	0x1106 (LSW)	20% RMS Overload Trip Time	U32	msec	600000	1	3600000	R/W
4359	0x1107 (MSW)							
4360	0x1108 (LSW)	30% RMS Overload Trip Time	U32	msec	200000	1	3600000	R/W
4361	0x1109 (MSW)							
4362	0x110A (LSW)	40% RMS Overload Trip Time	U32	msec	100000	1	3600000	R/W
4363	0x110B (MSW)							
4364	0x110C (LSW)	50% RMS Overload Trip Time	U32	msec	30000	1	3600000	R/W
4365	0x110D (MSW)							
4366	0x110E(LSW)	60% RMS Overload Trip Time	U32	msec	25000	1	3600000	R/W
4367	0x110F (MSW)							
4368	0x1110 (LSW)	70% RMS Overload Trip Time	U32	msec	20000	1	3600000	R/W
4369	0x1111 (MSW)							
4370	0x1112 (LSW)	80% RMS Overload Trip Time	U32	msec	15000	1	3600000	R/W
4371	0x1113 (MSW)							
4372	0x1114 (LSW)	90% RMS Overload Trip Time	U32	msec	12000	1	3600000	R/W
4373	0x1115 (MSW)							
4374	0x1116 (LSW)	100% RMS Overload Trip Time	U32	msec	10000	1	3600000	R/W
4375	0x1117 (MSW)							

4.9.1 Rated RMS Current

This parameter is the maximum continuous output current rating of the inverter.

4.9.2 I2T Overload Fault Enable

This parameter enables the fast, I-squared Time based output current overload protection feature.

4.9.3 RMS Overload Fault Enable

This parameter enables the RMS based output current overload protection feature.

4.9.4 I2T Trip Time

This parameter defines the time for which the inverter should operate with a 110% overload condition.

4.9.5 10-100% RMS Overload Trip Times

These parameters define the times for which the inverter should operate with 10% to 100% overload conditions.

4.10 Configuration Revision Parameters

Table 12 Configuration Register Set – Configuration Revision Parameters

Address		Register Name	Data Type	Units	Factory Default	Min	Max	Access Level
Decimal	Hex							
4384	0x1120	Factory Config Rev- Major	U16	1	1	0	0xFFFF	R
4385	0x1121	Factory Config Rev- Major	U16	1	0	0	0xFFFF	R
4386	0x1122	Application Config Data Rev	U16	1	0	0	0xFFFF	R/W

4.10.1.1 Factory Configuration Revision – Major

This is a read-only value that represents the major revision of the factory configuration stored in the configuration memory. Major revision changes to the default factory configuration are those that are not compatible with previous configurations, such as when new parameters are added to the memory that are required for proper converter operation, or if existing parameters change locations or formats. At startup the firmware will read this value from the memory and compare it against the factory default for the present build of the firmware. If the two values do not match, the firmware will automatically reset the memory to the factory default values. Updates to the major factory revision value are expected to increment the previous value by 1.

4.10.1.2 Factory Configuration Revision – Minor

This is a read-only value that represents the minor revision of the factory configuration stored in the configuration memory. Minor revisions are those that do not require reloading the memory to the factory default values. This could be a result of a minor value change to the default value for a particular parameter or the addition of a new parameter that is not needed for proper converter operation. Updates to the minor factory revision value are expected to increment the previous value by 1.

4.10.1.3 Application Configuration Data Revision

This value is used to represent the revision of the application-specific configuration data as programmed by the factory. This field is meant to store the revision of any custom configuration settings programmed at the factory for a specific end-user application. The factory default (prior to customization) for this field is zero, indicating that no custom settings have been made to the configuration memory. Application-specific updates to the configuration data are expected to increment this parameter by 1.

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 product. 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.

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USA
Telephone: 603-546-0090
Fax: 603-386-6366
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

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:

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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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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.