ZENER VARIDRIVE SOLUTIONS

ZENER 8000 ECODRIVE®

Solar VSD Installation Manual - Supplement

ZENER

VARIDRIVE SOLUTIONS

Support Links:

ECODRIVE Support Page: www.zener.com.au/support-8e.php

ZENER 8000 Reference manual: www.zener.com.au/images/im00140.pdf

Document: IM00140

ZENER 8000 Installation Manual: www.zener.com.au/images/im00124.pdf

Document: IM00124

ECODRIVE Supplement manual: www.zener.com.au/images/im00130.pdf

(This manual) Document: IM00130

ECODRIVE Blocking Diodes: www.zener.com.au/images/im00156.pdf

Document: IM00156

ECODRIVE Solar Connectors: www.zener.com.au/images/im00157.pdf

Document: IM00157

If the above cannot be accessed or found please contact ZENER VARIDRIVE:

Phone: 1300 4 ZENER   (1300 493 637)
Email: sales@zener.net

CONTENTS

Section:

Quick Setup Guides:

This manual is a simplified guide for the ZENER ECODRIVE 8000 firmware revision V5-2-7.

For full details on parameters & programmable functions refer to the ZENER 8000 Reference manual IM00140.

For details on AC Wiring & circuit protection refer to the ZENER 8000 installation manual IM00124.

SAFETY & GENERAL WARNINGS

Read and follow all instructions carefully!!

This chapter contains safety instructions that must be followed when installing, operating and servicing the ZENER ECODRIVE 8000. Non-compliance may result in damage to the ECODRIVE, the motor or other equipment being driven. Non-compliance may also result in physical injury or death to personnel, livestock or wildlife.

Before installing, commissioning or operating this equipment read the safety instructions in the ZENER 8000 installation manual IM00124.

All reference to 'Equipment' within this chapter refers to the ECODRIVE 8000.

Explanation of symbols

WARNING:
Indicates a condition or practice that, if the warning is not strictly observed, could result in damage to the equipment, personal injury or death.

ELECTRICAL WARNING:
This symbol is used to highlight an electrical hazard. Failure to strictly observe the warning could result in electrocution.

General

The information and warnings provided consider normal operation and fault situations in an installation where any fault is promptly repaired (or the equipment isolated from all power sources) so as to avoid the possibility of a second fault occurring that may result in a hazardous situation.

Read all operating & installation instructions before installing, operating or servicing the equipment. This equipment must be applied and installed by a suitably qualified and experienced tradesperson in accordance with its manual, good engineering practice and all local rules and regulations.

There are hazardous voltages inside the ECODRIVE whenever it is connected to an electrical supply and for some time afterwards. Before touching anything inside the ECODRIVE enclosure or other equipment connected to the ECODRIVE terminals, disconnect all sources of electrical power, wait at least 11 minutes for capacitors within the ECODRIVE to discharge to less than 50VDC and then ensure, by measurement, that there is no hazardous AC or DC voltage present at any terminal.

Note: Auxiliary circuits that are wired into the ECODRIVE enclosure may be powered from other external sources. Use a Multimeter which is rated to measure 1000Vdc and 600Vac.

Do not work on the ECODRIVE, Photovoltaic Cells, Aux Power sources or motor or associated cables whenever the ECODRIVE is connected to any power source or Photovoltaic generator, even during times of low intensity or no sunlight. Always switch off or isolate all power sources and never touch the input side of the isolation switch that has high DC voltage.

The ECODRIVE contains high energy circuits that may be hazardous. Do not operate the ECODRIVE with the door open or any part of the enclosure removed.

Do not touch the terminals of the equipment or any associated motor wiring when the equipment is energised, even if motor is stopped. Electric shock may result.

In Auxiliary Power (Dual) Supply applications where the ECODRIVE is supplied from AC power, the photovoltaic conductors must be treated as being live parts.

Do not modify this equipment electrically, mechanically or otherwise. Modification may create safety hazards as well as resulting in non-compliance to required standards or approvals.

Ensure the Photovoltaic array maximum open circuit voltage at the expected minimum temperature does not exceed 800Vdc for an 8Exxx or 400Vdc for an 8ELxxx Type ECODRIVE.

Where the ECODRIVE is a component of another product, it is the responsibility of the purchaser to ensure their final product meets all necessary safety, EMC, regulatory, operational and other requirements for that product. The requirements for the purchaser's final product may be substantially different to the requirements for standalone VSD's or equipment.

Installation:

The wiring & connection of the ECODRIVE, the motor, photovoltaic modules and other associated equipment must be carried out by qualified personnel only and installed in a manner which complies with all appropriate standards and regulations.

Mount the equipment on a vertical, flat, incombustible surface such as metal or masonry. Do not place combustible or flammable material near the equipment. The equipment must be mounted vertical. Failure to observe these precautions may create a fire hazard.

Do not install this equipment in locations where mechanical damage to the enclosure is possible. In particular consider vehicles, vandalism and attack by insects or animals. The equipment may require additional consideration to prevent unauthorised access.

The ECODRIVE must be mounted away from direct sunlight and any source of heat. If installed in another enclosure, adequate ventilation must be provided and the resulting temperature rise in the enclosure allowed for. The ambient temperature of the equipment must be below maximum rated operating temperature.

Attention is drawn to the potential for condensation in vulnerable environments. Additional precautions may be required.

The installation location and environment should provide for safe access and working conditions for service personnel. Do not mount the ECODRIVE in "confined spaces"[1].
Do not drill holes in the enclosure except in the gland plate. Remove the gland plate before drilling cable holes.
Do not allow metal shavings or any other conductive material to enter the enclosure or damage may result.

The ECODRIVE is not a Grid Interactive Inverter and does not have integral earth leakage protection or residual current monitoring functions.

Functional earthing of any of the conductors on the DC side is not permitted. This is a transformer less (non-isolated) system.

[1.] Confined spaces are generally defined in Occupational Health and Safety (OH&S) regulations to mean spaces where special precautions are necessary to ensure a safe breathing atmosphere, or there is limited access for escape/rescue in case of emergency.

The ECODRIVE does not have integral disconnect devices and these must be provided externally for each supply source. The disconnector in the DC supply circuit must be rated to switch the whole photovoltaic array current and rated to switch the array maximum open circuit DC voltage at the expected minimum temperature. A pole in each polarity is required.

In Dual Supply applications where the ECODRIVE is supplied from AC power and DC power from a photovoltaic generator, a disconnect contactor must be fitted in series with the AC input of the ECODRIVE. Control for the disconnect contactor coil must be powered by a transformer powered from 2 phases of the AC Power Supply.

In Dual Supply applications where the ECODRIVE is supplied from AC power and DC power from a photovoltaic generator, a 1600V Blocking Diode must be fitted in series with either the Positive or Negative conductor in every array string. Refer to wiring/application section for more details.

This equipment is intended for use only in fixed wiring applications. It is not intended for use on a flexible supply cable without the use of a connection with an industrial connector according to IEC 60309 and a minimum protective Earthing conductor cross-section of 2.5mm^2 as part of a multi-conductor power cable. Adequate strain relief shall be provided.

Due to high system leakage capacitances, integral EMC filtering and the dynamic system voltage changes, this equipment is not compatible for use with residual current devices for protection against electric shock.

If a residual current device used for the protection against a fire hazard is required, it must be fitted on the AC input of the ECODRIVE when operating from an earth referenced AC supply. A type A or type B device can be used if the AC supply is single phase. The residual current device must be type B when the AC supply is three phase.
A separate residual current device or monitor is required if protection against a fire hazard is required when the ECODRIVE is disconnected from the AC supply and powered from the photovoltaic generator.

Install emergency stop circuitry that removes power from the equipment and does not depend on any feature of the product for proper and safe operation.

Earthing:

It is the installer's responsibility to assure that all earthing connections are properly made and meet all local rules and regulations.

All exposed conductive parts of the ECODDRIVE, motor and solar panels must be earthed to ensure personal safety in all circumstances.

A protective earthing conductor shall be connected at all times when power is supplied to the ECODDRIVE.

Unless local wiring regulations state otherwise, the protective earthing conductor cross-sectional area shall be determined from the following table:

Cross-sectional area of Supply conductors S (mm^2)	Minimum cross-sectional area of corresponding protective earthing conductor Sp (mm^2)
S ≤ 4	4
4 ≤ S ≤ 16	S
16 < S ≤ 35	16
35 < S	S/2
The values in this table are valid only if the protective earthing conductor is made of the same metal as the phase conductors.	

The ECODDRIVE's touch current is greater than 3.5 mA ac. The standard IEC 62109-1 states that, one or more of the following measures shall be applied.

a) Permanently connected wiring, and:

- a cross-section of the protective earthing conductor of at least 10 mm^2 Cu or 16 mm^2 Al, or
- automatic disconnection of the supply in case of discontinuity of the protective earthing conductor; or
- Wiring a second protective earthing conductor of the same cross-sectional area as the original protective earthing conductor to a second protective earthing conductor terminal.

or

b) connection with an industrial connector according to IEC 60309 and a minimum protective earthing conductor cross-section of 2.5 mm^2 as part of a multi-conductor power cable.
Adequate strain relief shall be provided.

Operation

Power should only be applied to the ECODRIVE after:

- all wiring has been checked including earthing.
- all wiring including the solar array has been insulation tested to verify that there are no earth faults present.
- All components of the system have been checked to be suitably rated and connected as per manufacturer's specifications and recommendations.

Ensure you understand how to operate the equipment before attempting to run the motor/pump to test direction. Use the set-up guide provided to setup / commission the equipment or consult Zener for assistance.

If you are require clarification or more information on any of the above please contact Zener.

Phone: 1300 493 637
or
Email: sales@zener.net

GLOSSARY of Terms & Abbreviations

This manual uses the following terms and abbreviations:

Term/*Abbreviation*	Explanation
AUX Power Supply	This refers to a secondary or backup supply that can be connected to the ECODRIVE during times of Low solar intensity or no sunlight.
Blocking Diode	This is a semiconductor device that is connected in each string that allows current to flow in one direction only. It prevents current flow from the ECODRIVE to the PV modules.
ECODRIVE	This is a ZENER product that converts a DC supply (and AUX AC supply) to control a 3phase induction motor dependent upon the power extracted from an array of solar panels. A registered trademark of Zener Electric Pty Ltd.
Grid Interactive Inverter	Is a device that converts direct current (DC) electricity into alternating current (AC) with an ability to synchronize and be fed onto the public utility grid.
kW	*Kilowatts.* A measurement of power, that can refer to electrical or mechanical power.
MPPT	*Maximum Power Point Tracking*. The control or algorithm to extract the maximum available power from the PV array under all conditions.
NOCT	*Normal Operating Cell Temperature*. Measurements are provided by PV manufacturers to provide a more practical/in field ratings. Defined as the temperature reached by open circuited cells in a module under the conditions as listed below: Irradiance on cell surface = 800 W/m^2 Air Temperature = 20°C Wind Velocity = 1 m/s Mounting = open back side.
PID	A type of automatic controller that seeks to drive a measured value (such as pressure) to a preset value by means of a control effort determined by proportional, integral and derivative functions.
Photovoltaic cell / PV	This refers to the device used to convert sunlight directly into electricity by the photovoltaic effect. The output is a DC voltage.
PV Array or Solar Array	This is a network of solar panels connected in a 'series & parallel' arrangement to achieve the required voltage and current (Power)
PV String	This refers to the series connected PV modules. The number of PV modules in a string will determine the system voltage. The strings of equal quantity of modules are then connected in parallel to achieve the current & power required.
STC	*Standard Test Conditions.* Stands for standard test conditions and is the major solar panel output performance testing condition used by most manufacturing and testing bodies. The test conditions are defined as – irradiation: 1000W/m^2, temperature: 25°C, AM:1.5
Vmax.	*Voltage at maximum power*. Voltage measured at output of a Photovoltaic module or array, with a load connected under maximum power conditions.
Voc	*Open circuit voltage*. Voltage from the Photovoltaic module or array without no load connected.

ZENER ECODRIVE® 8000

INTRODUCTION

The ZENER ECODRIVE 8000 is a variable speed drive and as applied to solar power systems is an 'off the grid' system that is also able to import power from the grid. It is designed for the sole purpose to operate a standard 3 phase induction motor.

The ECODRIVE is designed to allow the connection of an Auxiliary AC Power supply in the absence of sufficient sunlight. This could be from the GRID or a generator.

The ECODRIVE provides Maximum Power Point Tracking (MPPT), a control algorithm that achieves the maximum power from the PV array under all conditions. The ECODRIVE also includes Zener's sophisticated motor control algorithm designed to achieve maximum energy efficiency. The ECODRIVE is versatile, offering enormous flexibility for system integrators or OEMs with its internal logic functions, programmable I/O and ability to communicate with other equipment.

Although the ECODRIVE is an ideal pumping solution it can be used on other applications or load types that operate a 3 phase motor.
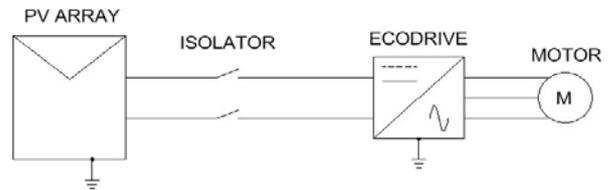
Features & Benefits:

- Operates a standard 3 phase motor
- Maximum Power Point Tracking - MPPT
- Fast start response speed
- Automatic control of Auxiliary power supply
- Input for & monitoring of radiance sensor
- Reduced motor starting currents
- Soft start & stop on pump
- Easy parameter access and adjustment
- DC solar input and AC input
- Range of digital & analogue inputs & outputs

- Robust IP66 Enclosure
- Stainless Steel option Available
- Robust & durable metallic enclosure for protection against mechanical damage and damage from harsh environmental conditions.
- Protection level of IP66
- Plain English display
- High ambient temperature rating available
- Advanced & customised pump protection
- Easily customised systems

Applications & Application Menus:

There are many modes of operation that can be customised depending on your individual requirements. To simplify installation & setup, Zener has selected 2 common modes of operation in which an 'Application Menu' has been developed for each. These are further detailed within this manual.

Application menu Choices are:

1. **Tank Fill Operation**   **'Tank Solar'** for operation on solar only to fill a tank using a float switch to control the pump.
   'Tank Solar AC' for operation on solar to fill a tank using a float switch to control the pump. An auxiliary supply is used to operate the pump when insufficient solar energy.

2. **Pressure Control Operation**   **'Pressure Solar'** for operation on solar only to control a pump to deliver constant pressure.
   'Pressure Solar AC' for operation on solar only to control a pump to deliver constant pressure. An auxiliary supply is used to operate the pump when insufficient solar energy.

The Application Menu aims to simplify the setup & programming process by providing a customised menu with only the parameters required. Other parameters are assessable in other menus. Please contact Zener for assistance with other types of applications and/or the development of a customised Application menu or refer to the ZENER 8000 manual.

STANDARD APPLICATIONS

Application – Tank Fill

The ECODRIVE is configured to pump and fill a tank or vessel when the level is not full and there is sufficient solar energy available. An AC supply can also be used to pump when insufficient solar available.

A single float switch located in the tank closes a contact when the water in the tank falls. When this contact closes and there is sufficient solar energy (ie.'SOLAR GOOD'), the ECODRIVE will start to pump. The ECODRIVE will run at a 'preset' speed or alternate speed reference. When the water level increases and the float switch contact is open for a preset ('qualifying time') time the ECODRIVE will stop the pump. The float needs to be installed below the high water level with an allowance for pumping for the duration of the qualifying time. This approach means the tank is always full, not waiting for a low level switch to turn on the pump when there may be no solar energy available.

If the solar energy is not sufficient to maintain the desired operating speed, the speed is reduced resulting in a lower flow rate. When the solar energy or the speed reaches the minimum level (ie. 'SOLAR LO') for a period of time ('qualifying time') the ECODRIVE will switch off. When there is insufficient voltage from the solar array the ECODRIVE will completely shut down.

When sufficient solar energy returns the ECODRIVE will re-power and can automatically restart the pump.

Diagram 4a: Simple Tank Fill

Bore/Well Level Protection:
An optional bore level protection is also available to prevent dry running the pump. When a low level is detected the ECODRIVE will stop the pump and restart after an adjustable time period.

Irradiance Sensor:
When operating from Solar only, an irradiance sensor is optional. Without the irradiance sensor the ECODRIVE monitors the DC bus voltage and adjusts the motor speed accordingly. When an Auxiliary AC supply is used an irradiance sensor is required.

Auxiliary AC power Supply:
During periods of 'Lo Solar' or no sunlight, the ECODRIVE can provide an output to connect the GRID or generator supply to continue to operate. This may be finely tuned to achieve no interruption during changeover as the solar is always connected.

Configuration / programming:
To guide you through the setup/programming for this application refer to the following pages:

Supply & Motor Wiring	Page 13
Earthing:	Page 18
Control wiring:	Page 19
Preliminary checks:	Page 25
Programming /setup:	Solar only Solar OR AC Aux Supply Page 31

Application – Constant Pressure Control

The ECODRIVE is configured to provide a constant pressure using an integral PID controller. The ECODRIVE monitors the pressure and adjusts the motor/pump speed to achieve the set pressure.

The ECODRIVE will operate the pump at the speed required to achieve constant pressure. If the solar energy is not sufficient to maintain this pressure the system can be configured to operate at a lower pressure or switch off.

When the solar energy or the speed reaches a minimum level (ie. 'SOLAR LO') for a preset time ('qualifying time') the ECODRIVE will switch off. When there is insufficient voltage from the solar array the ECODRIVE will completely shut down.

When there is sufficient solar energy the ECODRIVE will re-power and can be configured to automatically restart the pump.

The ECODRIVE with an option board fitted provides a 24VDC DC loop power supply for a pressure transducer.

Additional protection for bore level, no flow or external over pressure can be included.
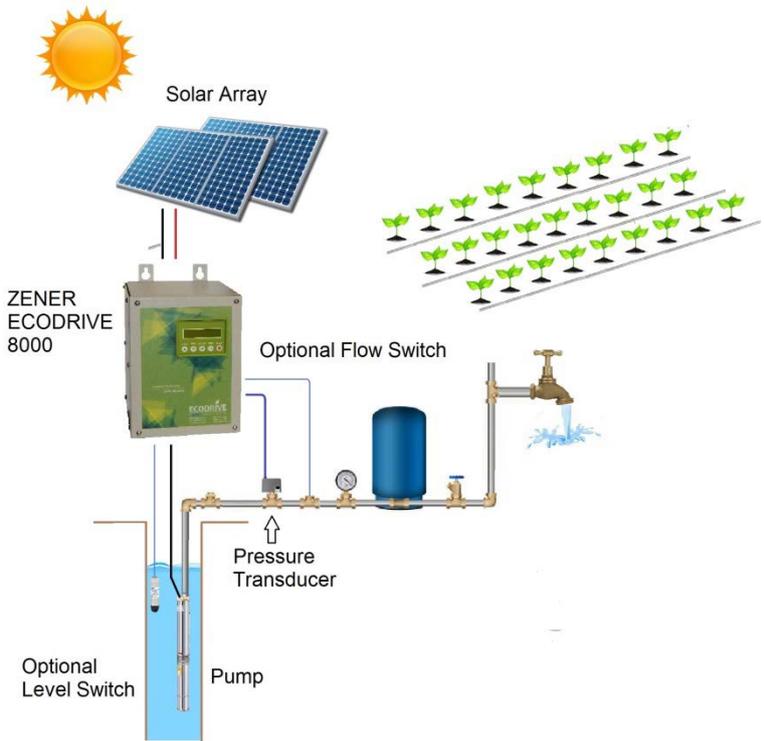
Diagram 4b: Simple Pressure Control

Bore/Well Level Protection:
An optional bore level protection is also available to prevent dry running the pump. When a low level is detected the ECODRIVE will stop the pump and restart after an adjustable time period.

Irradiance Sensor:
When operating from Solar only, an irradiance sensor is optional. Without an irradiance sensor the ECODRIVE monitors the DC bus voltage and adjusts the motor speed accordingly. In a dual supply arrangement and an AC supply is used, an irradiance sensor is required.

Dual Supply / AC Power:
During periods of 'Lo Solar' or no sunlight, the ECODRIVE can provide an output to connect the GRID or generator supply to continue to operate. This may be finely tuned to achieve no interruption during changeover as the solar is always connected.

Configuration / programming:
To guide you through the setup/programming for this application refer to the following pages:

TECHNICAL SPECIFICATION & RATINGS

⚠️ Ensure to select the appropriate controller model to according to the PV modules, motor and load requirements.

⚡ Ensure to number of PV Modules per string do not exceed the ECODRIVE's maximum voltage rating under all conditions.

Electrical Specifications:

The following applies to the 480V model (suitable for 3 Phase motors)

PV DC Input Voltage:	Maximum 800VDC
	(Must ensure that Voc at lowest operating temperature does not exceed this voltage)
Auxiliary AC Input Voltage:	380 - 480Vac 3 Phase or 1 phase [2] (-15%, +10%)
Nominal MPP Voltage:	407-727VDC
Output Voltage:	0-480VAC 3 Phase [3]
Output Frequency:	0-200Hz (maximum speed subject to DC bus voltage & solar energy available)
V/Hz:	Adjustable

For all other voltages contact Zener.

Input / Output Current:

Model	Continuous Output Current (Amps)		Nominal Motor Nameplate Power (kW)[4]	PV DC Input current (A RMS max.)		Auxiliary AC Input Current with DC bus Choke fitted (A RMS max.)
	40°C	50°C	40°C / 50°C	Continuous	Intermittent	
8E001XX	2.0	2.0	0.75 / 0.75	2.4	3.2	1.9
8E003XX	3.6	3.0	1.5 / 1.1	4.4	5.7	5.2
8E005XX	5.0	4.1	2.2 / 1.5	6.1	7.9	6.9
8E007XX	7.2	6.0	3.0 / 2.2	8.7	11.4	9.7
8E011XX	10.8	9.0	5.5 / 4.0	13.1	17.1	13.6
8E016XX	16.0	13.2	7.5 / 5.5	18.1	23.5	17.8
8E023XX	22.5	18.8	11.0 / 7.5	27.3	35.5	27.7
8E030XX	30.1	25.0	15.0 / 11.0	36.6	47.5	35.4
8E040XX	40.3	33.8	22.0 / 15.0	49.0	63.7	44.4
8E057XX	57.0	46.0	30.0 / 22.0	69.2	84.8	64.2
8E082XX	82.0	69.1	45.0 / 37.0	100	125	89.1
8E109XX	109.0	91.3	55.0 / 45.0	132	166	123
8E140XX	140.0	118.9	75.0 / 55.0	170	213	153
8E170XX	170.0	141.3	90.0 / 75.0	207	227	183

Contact Zener for sizes above this for a customised solution, up to 490Amps

Refer to instruction manual IM00124 for more details on ratings, in particular for standard 3phase AC operation and recommended circuit protection.

---

[2] For single phase operation a DC bus choke must be fitted and a derating applied. Contact Zener for assistance.
[3] The output voltage cannot be higher than the AC input voltage or 70% of the DC input.
[4] Always select the ECODRIVE on motor full load current not power.

ZENER ECODRIVE® 8000

Chassis Dimensions:

Model	Chassis ID	IP30	IP66	S/Steel IP66
8E001XX	CHA	-	310h 190w 236d	310h 190w 236d
8E003XX	CHA	-	310h 190w 236d	310h 190w 236d
8E005XX	CHA	-	310h 190w 236d	310h 190w 236d
8E007XX	CHA	-	310h 190w 236d	310h 190w 236d
8E011XX	CHA	-	310h 190w 236d	310h 190w 236d
8E016XX	CHA	-	310h 190w 236d	310h 190w 236d
8E023XX	CHB	459h 234w 243d	459h 234w 243d	459h 234w 243d
8E030XX	CHB	459h 234w 243d	459h 234w 243d	459h 234w 243d
8E040XX	CHB	459h 234w 243d	459h 234w 243d	459h 234w 243d
8E057XX	CHB	459h 234w 243d	459h 234w 243d	459h 234w 243d
8E082XX	CHC	715h 470w 298d	715h 470w 298d	715h 470w 298d
8E109XX	CHC	715h 470w 298d	715h 470w 298d	715h 470w 298d
8E140XX	CHC	715h 470w 298d	715h 470w 298d	-
8E170XX	CHC	715h 470w 298d	(IP54) 715h 470w 298d	-
8E170XX	CHC+	-	(IP66) 715h 670w 298d	-

All dimensions in mm. Contact Zener for larger sizes.

Blocking Diode :

A blocking diode is required whenever an Auxiliary AC Power Supply is used. With standalone solar installations, blocking diodes are optional but recommended with multi-string installations to ensure maximum efficiency where partial shading of the PV modules may occur.

Continuous Current Rating:	14Amps @ 50°C
Maximum panel/String Isc @ STC:	10Amps
Voltage Rating:	1600V
Part Number:	AQ08300
Instruction sheet:	IM00156

Other sizes available on request.

PV Wiring - Mulitple String with Blocking Diode
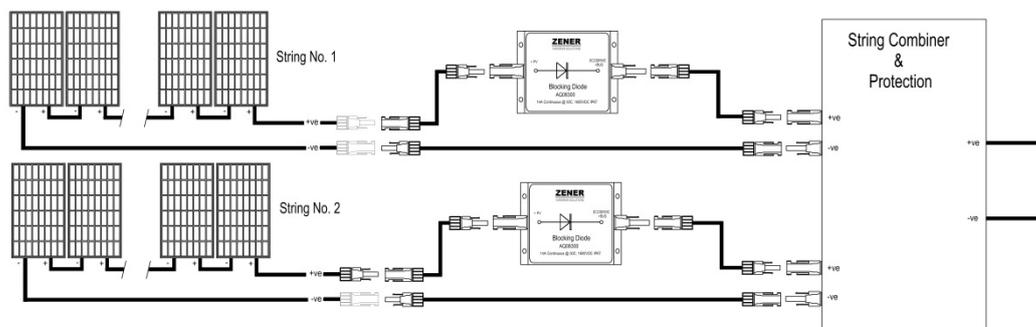
Options :

DC Bus Choke	Fitted within the ECODRIVE's IP30 or IP66 enclosure. A DC bus choke is mandatory for all applications using an Auxiliary AC power Supply.
Additional Extended Features Option Board	AQ/AF08001 (1x Option Board included as standard)
Relay Option Board	AQ/AF08202: 2x Programmable Relays with Changeover contacts.
Irradiance Sensor	AQ/AF08304
Ethernet Modbus TCP Communications	AQ/AF08204
Remote IP66 Console	AQ/F08217 Remote Console /Interface kit - CHA/B
	AQ/F08218 Remote Console /Interface kit - CHC
	AQ/F08219 Remote Console /Interface kit - CHD
Output Filters:	Filters for submersible pumps, long cable runs or no screen cables
AC 'Step up/step down' Blending Transformer:	Contact Zener for selection

THE SOLAR ARRAY & PV SELECTION:

The Solar Array consists of a number of Photovoltaic (PV) modules connected in a series & parallel combination to achieve a certain voltage, current and power. It is important to select these carefully as the PV modules are a major cost of an installation and can be very expensive to rectify. Incorrect selection may result in damage to the equipment or not provide sufficient energy to operate the motor and the load it is driving. An array would normally consist of a number of PV modules in series, known as a 'string'. Strings of PV modules are then connected in parallel to achieve the required current (Amps) to form an 'Array'.
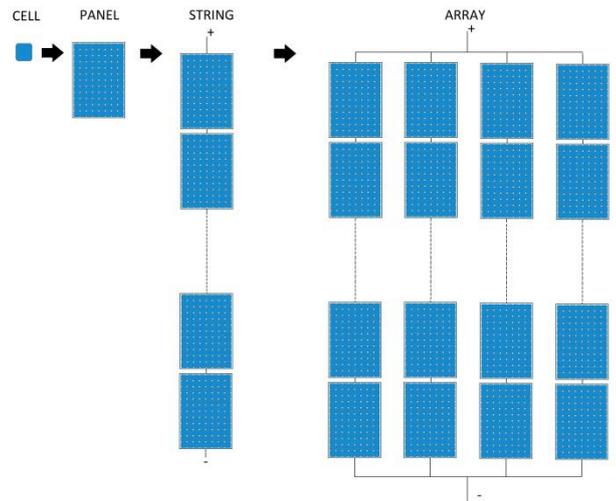
Voltage:

The quantity of series connected PV modules determine the DC voltage of the Solar Array which determines the output motor voltage. This can have a direct impact on the maximum motor speed achievable. If rated speed of the pump is not required then the Vmpp of the system can also be reduced. In this case the power requirement is also reduced.

There are two variables that are critical for system operation:

TOTAL Voc = The sum of the 'Open circuit voltages' of the PV modules connected in series. The total open circuit voltage must be <800Vdc under all possible conditions.

TOTAL Vmpp = The sum of the 'voltage at maximum power' of the PV modules connected in series. This voltage under max load conditions is the voltage level for Maximum power point tracking.
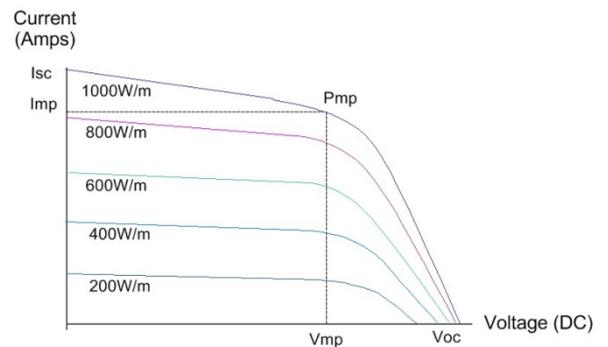
Graph 5a. PV voltage & current at different solar intensity

Current & Power:

The quantity of 'Strings' connected in parallel will impact the current and power available to operate the pump. If the current required to pump is higher than what can be delivered by the solar array, the pump speed will be reduced. Graph 5a illustrates the reduced current & power based on the instantaneous solar intensity.

The incorrect amount of PV modules or an incorrectly installed array may result in the following:
- Pump will not operate at the required speed.
- Pump will not operate at the desired solar intensity (such as filtered sunlight, cloudy periods).
- Pump will not operate for the desired period per day.
- Damage to the equipment.

The PV modules and solar array should be selected by an experienced and accredited person.

The PV modules must be installed by a qualified and experienced person to ensure all equipment is installed to best practice, local codes and regulations.

Unsure about your Solar Array configuration?

For guidance with selecting the correct Solar Array configuration complete the ' ECODRIVE Checklist' available on our website and email to us.

http://zener.com.au/images/solar_ecodrive_checklist.pdf

INSTALLATION & WIRING

REMINDER: This equipment must be installed by qualified electrical personnel with the appropriate accreditations. The equipment operates from 800VDC which requires special consideration when installing and operating. Refer to all warnings located at the front of this manual. This manual should be read in conjunction with the ZENER 8000 instruction manual and all applicable standards and regulations.

PLEASE READ ALL WARNINGS IN SECTION 1 BEFORE PROCEEDING.
Section 1 contains critical safety warnings that relate to the installation of the equipment in particular earthing requirements.

Mounting location

In general the ECODRIVE should be mounted as close to the motor as practical, consistent with other requirements. This is not an absolute requirement, but does provide some advantages.

The ECODRIVE must be mounted to a wall or internal mounting plate of an enclosure. Ensure that the full weight of the ECODRIVE can be supported.

The equipment must be protected from direct sunlight and installed in a location suited to its enclosure type. If installed in an enclosure, adequate ventilation is required and temperature rise within the enclosure considered.

The ECODRIVE must be mounted with clearance around the vents and the enclosure to allow for sufficient airflow for the enclosure to dissipate heat. The following clearances should apply.

CHA Allow 50mm above, below and either side of the enclosure
CHB Allow 75mm above, below and either side of the enclosure
CHC Allow 100 above, below and either side of the enclosure

- Do not drill holes in the enclosure except in the gland plate provided.
- Remove the gland plate before drilling holes.
- Do not allow metal shavings or other conductive material to enter the enclosure or damage may result.
- The location & environment should provide for safe access and working conditions for service personnel. Do not mount the equipment in a 'Confined Space'[5].

For all other auxiliary equipment such as PV modules, transducers, diodes refer to the manufacturer's instructions.

---

[5] Confined spaces are generally defined in occupational health and Safety regulations to mean spaces where special precautions are necessary to ensure a safe breathing atmosphere, or there is limited access for escape/rescue in case of an emergency.

Input Power Wiring – PV Only

This manual should be read in conjunction with the ZENER 8000 instruction manual and all applicable standards and regulations. This equipment and other components that are part of the system must also be installed as per the manufacturer's recommendations and any applicable standards and regulations.

The following is an overview of power wiring for a Solar Only operation:

Blocking Diodes
For PV only systems blocking diodes are optional but can provide benefit to solar only installations with multiple PV strings. See Page 15 for detail.

DC Disconnect switch
The disconnector in the DC supply circuit must be rated to switch the whole photovoltaic array current and rated to switch the array maximum open circuit DC voltage at the expected minimum temperature. A pole in each polarity is required.

PV Protection
Overcurrent protection for the PV array is required in additional to the DC disconnect switch. The circuit protection must be rated and installed to comply with all local codes and regulations.

Over current Protection
Fuse or circuit breaker protection is required if DC input wiring is rated for less than 1.25x array Isc at STC.

Solar Array

Blocking Diode

ECODRIVE

Fuse or c/breaker

Motor / Pump

See Page 17
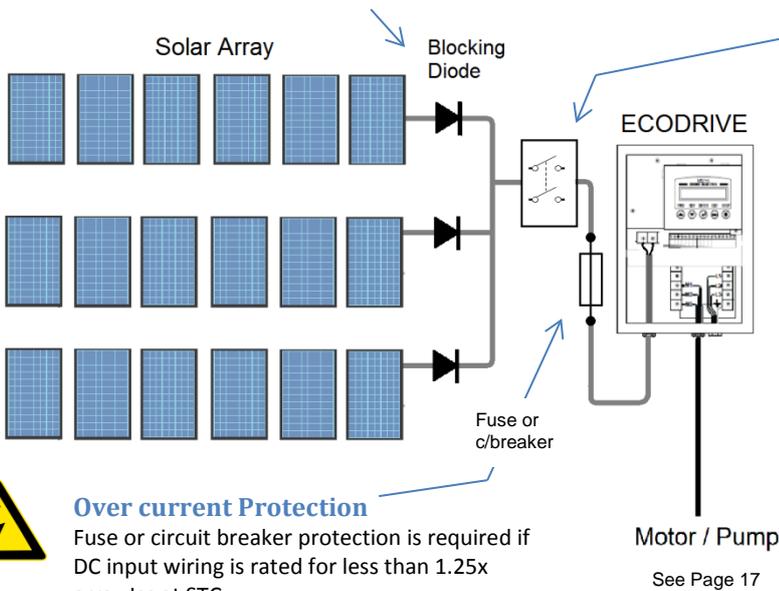
Solar PV Input Wiring

The ECODRIVE has two terminals to connect the DC supply from the Solar Array. These are labelled DC+ and DC-. Always check and measure that wiring is correct and insulation tests satisfactorily completed before connecting to the ECODRIVE. Do not connect additional equipment of any kind (including additional ECODRIVEs) to a solar array that is used to power ECODRIVE. Severe equipment damage may result.

ECODRIVE
DC+ DC-

Earth

PV Circuit Protection, isolation switches, lightning arrestors and other devices.
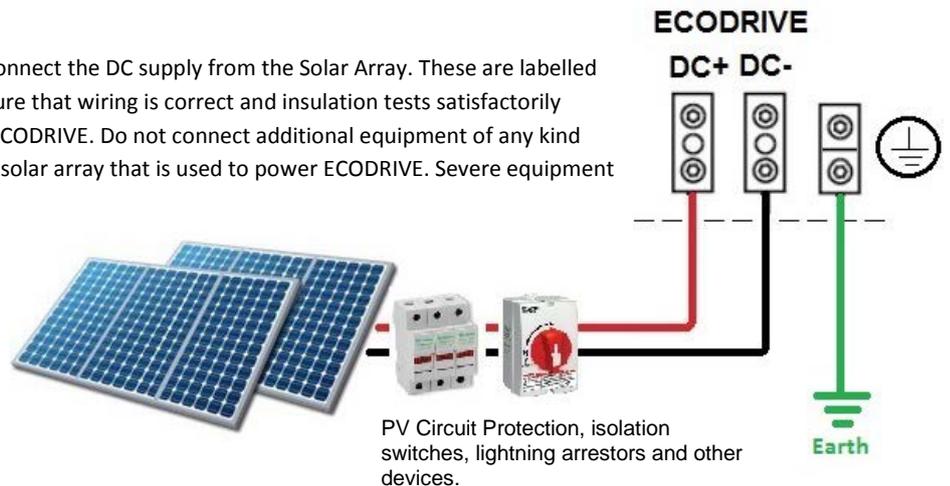
If the ECODRIVE is to operate from an auxiliary AC power supply, blocking diode(s) must be fitted. Refer to page 15 for details. With standalone solar installations, blocking diodes are optional but recommended with multi-string installations to ensure maximum efficiency where partial shading of the PV modules may occur.

Input Power Wiring – PV and AUX AC Supply

The ECODRIVE can also operate from an auxiliary AC power supply such as GRID or generator supply. Refer to page 16 for information on switching the auxiliary AC supply and 'blending'.

A single ECODRIVE should be the only load connected to any particular solar array. Do not connect additional equipment of any kind (including additional ECODRIVEs) to a solar array that is used to power ECODRIVE. Severe equipment damage may result.
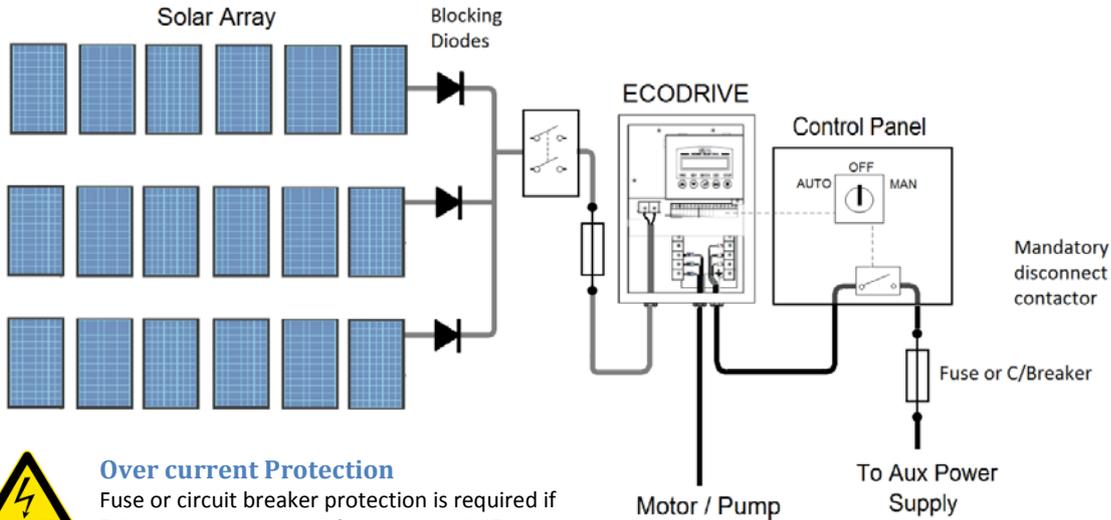
Over current Protection
Fuse or circuit breaker protection is required if DC input wiring is rated for less than 1.25x array Isc at STC.

Isolation from Earth
Both sides (+ & - terminals) of the solar array MUST be isolated from earth for systems using an auxiliary AC supply.

Connect the AC supply to the terminals provided, L1, L2 & L3 as shown below.
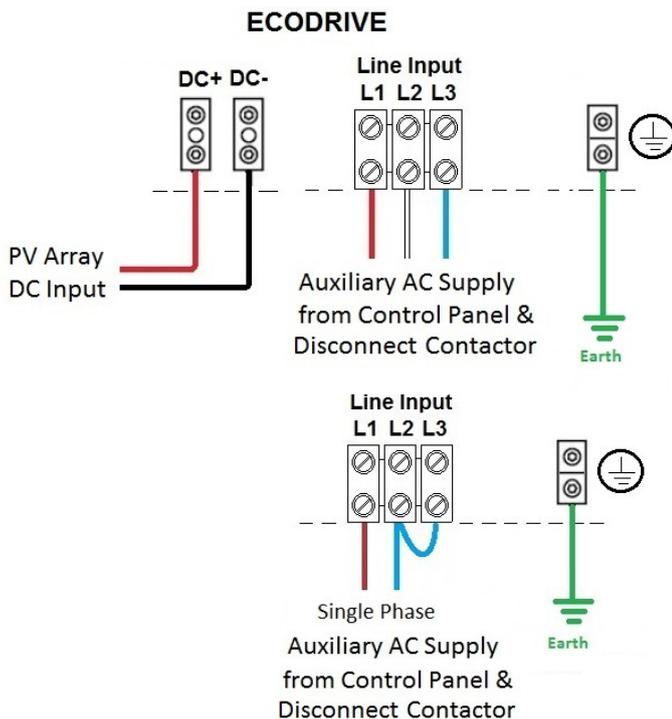
AUX AC Power Control panel
An external control panel with a disconnect contactor is required to disconnect the Auxiliary AC power supply when not required. The AC contactor control circuit must be powered from 2 phases of the Auxiliary AC supply. Additional controls may be required for a generator supply.

DC Disconnect switch
The disconnector in the DC supply circuit must be rated to switch the whole photovoltaic array current and rated to switch the array maximum open circuit DC voltage at the expected minimum temperature. A pole in each polarity is required.

Blocking Diodes Part No. AQ08300
When operating the ECODRIVE with a DC solar supply and an auxiliary AC power supply, blocking diodes must be installed in series with each string. They must be rated 1600VDC and 1.4x Isc at STC..

PV Protection
Over current protection for the PV array is required in addition to the DC disconnect switch. The circuit protection must be rated and installed to comply with all local codes and regulations.

A HYBRID SYSTEM: Switched and/or Blended AC Supply

A 'solar hybrid system' is a power system that combines the solar power from a photovoltaic system with another power generating energy source. The system can be configured to source power from both power sources simultaneously. Extracting maximum power from the array at all times is dependent on how well the 'blending' has been optimised for a particular site.

The ECODRIVE´s internal MPPT controller will automatically control the pump to achieve maximum pump running time from the solar array. When there is insufficient power available from the array to operate at a desired (or minimum) motor shaft power an auxiliary AC supply can be connected to continue pumping at the required power. This can be a seamless transition if correctly configured. With additional controls the Auxiliary AC supply can be from a generator supply, however a seamless transition can be more difficult to achieve.

During the shoulder periods (dusk & dawn) there is an opportunity for 'Blending' to extend pumping time, whilst extracting power from the array. At this point, there may be still a significant amount of solar power available but just not enough to operate at the required power. An 'optimised blended system' ensures that maximum power from the array is used and only supplemented by the Auxiliary AC supply. Without ensuring an 'optimised blended system' the maximum benefit from your solar investment may not be achieved.

When the solar power is sufficient the ECODRIVE will disconnect the Auxiliary AC Supply and operate only from the array. The ECODRIVE monitors the irradiance levels to provide an output to control the Auxiliary AC supply. The irradiance levels that control the Auxiliary AC supply are adjustable.
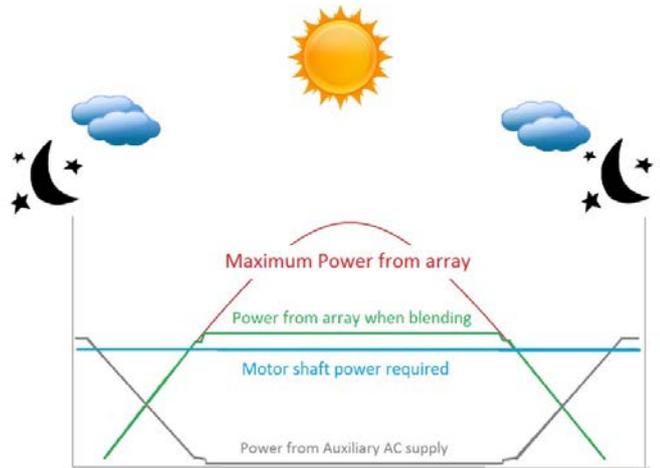
Actual results will vary depending on the size of the array, blending transformer (if required) and power requirements..

Refer to the instruction manual IM00124 for more details on ratings and installation for standard 3 phase AC operation and recommended circuit protection.

A disconnect contactor must be fitted in series with the AC input of the ECODRIVE. Control for the disconnect contactor must be powered by a control transformer powered from 2 phases from the Aux AC power.

A transformer must be used for low voltage control circuit to operate R1. A switch mode power supply must not be used.

A 'step-up or step-down' transformer' on the AC supply may be required to achieve maximum benefit from 'blending'.

CONTACT ZENER FOR SELECTION

Motor Wiring

The Motor wires are terminated into the terminals as shown.

⚠️ Also check that the motor is correctly wired at the motor termination box for the correct voltage.

If an output filter is to be installed refer to page 18.
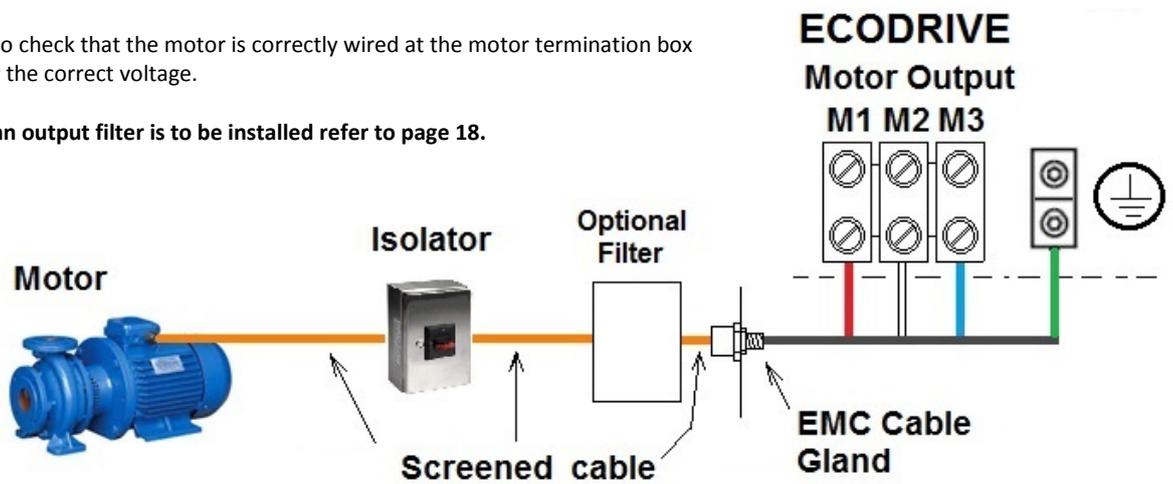
NOTE: See below regarding requirement for installing motor cables.

Installation practices for Electromagnetic Compatibility (EMC) Compliance

The EMC performance of the ECODRIVE is installation dependent. For compliance with EMC standards, the use of a screened power cable between the ECODRIVE and the motor is required. Other suitable or approved arrangements may also be used.

To achieve the required electrical performance at high frequencies, it essential that:

- The screen has a 360 connection to both the ECODRIVE gland plate and the motor terminal box.
- The correct type of gland for the cable is used.
- The protective earth cable is terminated in the usual way that meets local wiring codes.
- The screen is continuous from the ECODRIVE to the motor.
- Any isolation switches installed between the ECODRIVE and Motor are enclosed in a metallic enclosure with the screened properly terminated at both sides.

For more details the ZENER 8000 installation manual for detailed explanation. IM00126
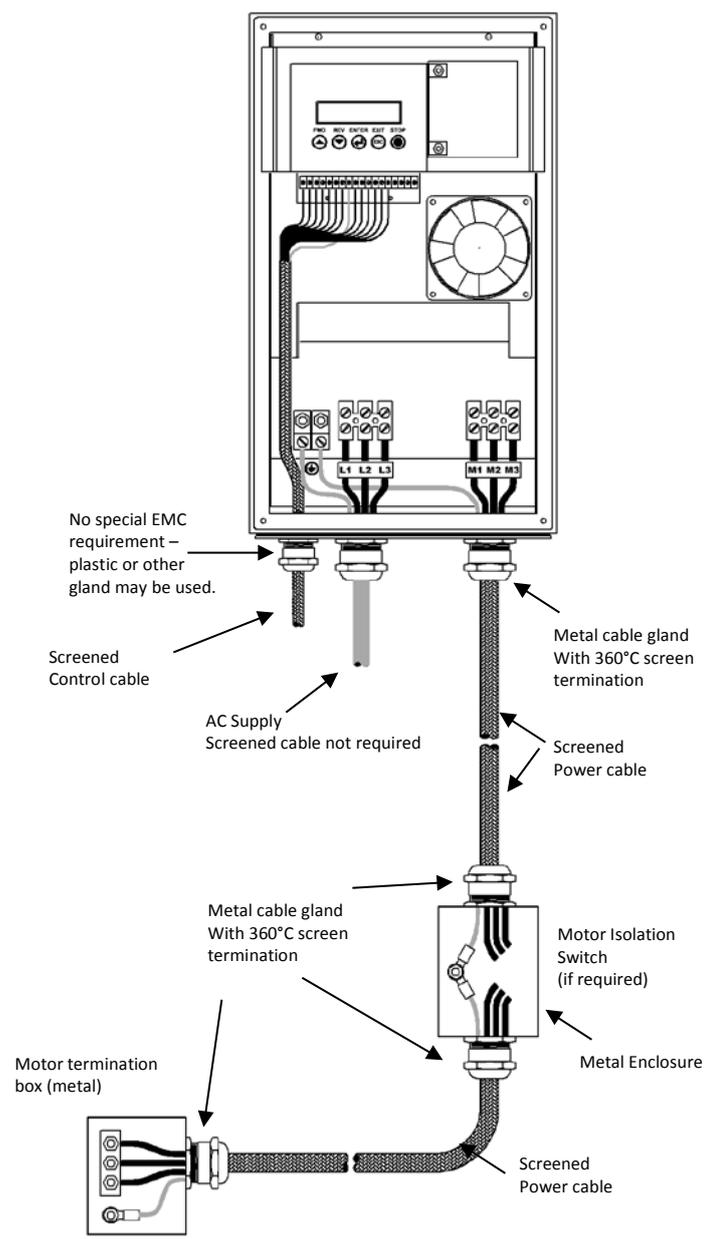
Output Filters

Some pump motors are not 'inverter rated' motors and manufacturers require special output filters to be fitted.

Output filters may also be recommended for installations for the following reasons:
- To eliminate RF interference in sensitive environments
- To eliminate the need for screened motor cables
- Long cable runs
- Poor motor insulation or old motors with poor insulation
- Reduce/eliminate bearing currents

Contact Zener to discuss requirements and the most economical solution.

The ZENER High Performance Output Filter:

The Zener High Performance Output Filter (HPOF) requires connection to the DC bus. The ECODRIVE includes the following terminals for the filter if required.

Chassis Size:	Connection
CHA (8E1 to 8E16)	Use PV input terminals
CHB (8E23 to 8E57)	Use PV input terminals
CHC (8E82 to 8E170)	Use Fused (30A) B+/B- terminals provided
CHD (8E220 to 8E490)	Use Fused (30A) B+/B- terminals provided
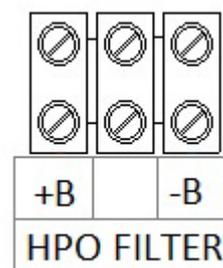
Refer to the High Performance Output Filter Manual for connection & cable size requirements.

IM00151 Installation Manual: *IP66 High Performance High Efficiency Output Filte*r

IM00123 Installation Manual: *IP00 High Performance Output Filter*

Fused terminals provided on CHC & CHD for connection of a ZENER High Performance Output Filter. (30Amp fuse fitted)

Depending on the filter (IP00 or IP66) either the B+ only or both or B+ and B- connection required.

Earthing

READ ALL SAFETY WARNINGS (page 2-5), IN PARTICULAR EARTHING.

It is mandatory to provide protection against electric shock. It is therefore critical that every effort is made to ensure correct & adequate earthing is in place and all electrical hazards are removed. Good earthing also helps EMC performance, prevents possible equipment damage and necessary for effective lightning protection.

Attention should be given to equipment which is painted to ensure earthing continuity is present. Ensure purpose made fittings for bonding of dissimilar metals are used.

Earthing Arrangement:
The ECODRIVE must be earthed using the required conductor size as per local rules and regulation. The earth connection of the ECODRIVE must be solidly connected to the installation 'earth', which is also connected to all exposed conductive parts as required by appropriate standards. In a solar only installation an earth electrode must be installed. This must be installed and checked by a qualified & experienced person.

In some cases PV manufacturers may suggest connecting the Positive of the PV Array to the earth to prevent electrolysis and corrosion. This must not be done with the ECODRIVE operating from an auxiliary AC power supply. Both sides (+ & - terminals) of the solar array MUST be isolated from earth for systems using an auxiliary AC supply.

Lightning Protection

A good earth connection is important for lightning protection. Zener recommends that surge protection devices also be installed at the ECODRIVE on the AC & DC supply inputs and PV array if located in an area where lightning flash density is greater than two flashes per square Km per year.

CONTROL WIRING

Control wiring is provided for the 'application menus' offered with the ECODRIVE. Since all the Digital & analogue I/O is completely programmable alternative wiring is possible. Refer to the ZENER 8000 manual for more detail and alternate wiring.

Solar Tank Fill Control Wiring

The following control wiring is recommended when the application for 'Tank Solar' or 'Tank Solar AC' is selected.

Input D1 (2): Operating mode
Remove link for 'Solar Only' operation. The ECODRIVE will run only when 'SOLAR GOOD' conditions are met. This will prevent operation under low solar conditions. Install link for "Solar & Auxiliary AC operation

Input D2 (3): Tank level Switch:
This operates on having one level switch only installed. When the water level is high the level switch opens and ECODRIVE will stop the pump after the preset 'qualifying' time. This ensures the tank is always full. When the water level falls and the contact closes, the ECODRIVE is ready to restart.

Input D3 (4): Run Input
Close to run when operating in AUTO/'REMOTE Mode'

Input D4 (5): REMOTE/LOCAL Mode Selection
See AUTO/MANUAL below. Close for AUTO (REMOTE MODE). REMOTE = AUTO & LOCAL = MANUAL

Input Opt. D4 (37):
Bore/Well Level Probe/Switch:
Running completely dry can damage the pump. A probe should be installed in the pump well to detect a loss of water and turn off the pump before running dry. When the water level is low the ECODRIVE will stop the pump. When the water level returns and the contact closes, the ECODRIVE will wait for the preset time and then restart.

AN1 (10,11) Irradiance Sensor Input:
An irradiance sensor is _optional_ for solar only but mandatory with an Aux AC power supply.

Suggested Control Wiring:

Power Up Start and always
run whenever Solar Power Available
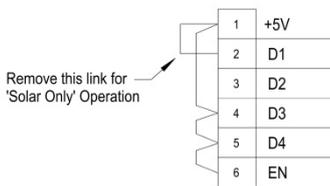
Auto/Manual Switch
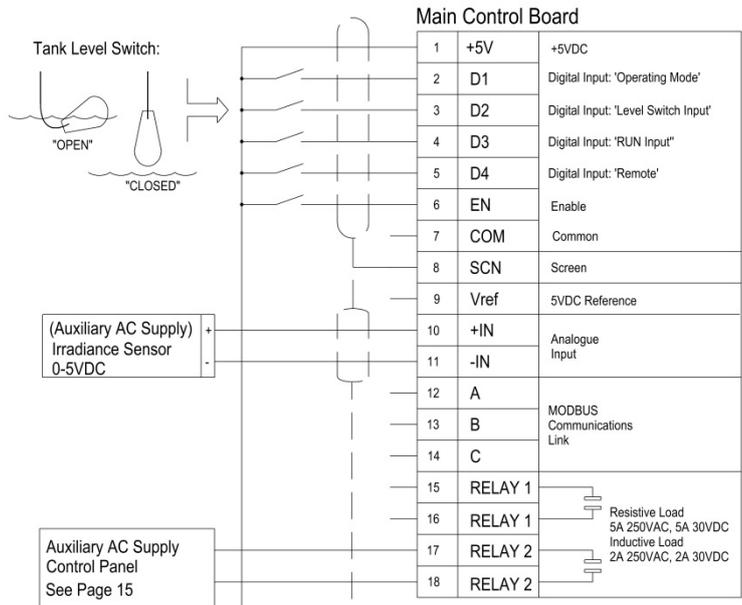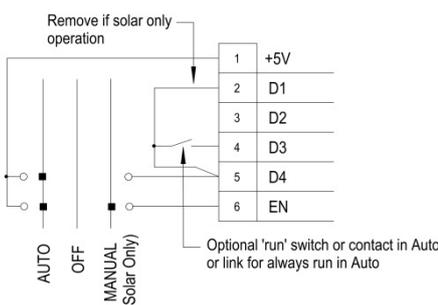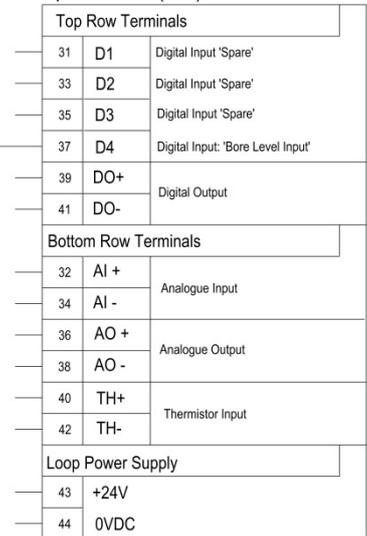
Note:
"Local" Operation: "Local" mode normally provides control from the front console and is active when D4(5) is off / inactive. In local operation the following inputs remain active.
- D1(2) 'Operating mode'
- D2(3) Tank Level Control
- Opt D4(37) Bore level protection

Auto/Manual switch (if fitted or wired externally):
Auto: With this wiring configuration, "Auto" mode will control the load depending on the solar intensity. If required, an additional run switch can be installed for remote start/stop or other remote control. When there is sufficient Solar Power available the ECODRIVE will run on Solar, and automatically switch off or changeover to auxiliary Ac supply when the solar intensity is 'LOW'. When sufficient Solar intensity returns the ECODRIVE will automatically start or switch back to Solar if running with an auxiliary AC supply.

Manual (LOCAL MODE) : "Manual" Mode allows control from the local console and with the wiring shown, configured to operate from solar only.

Solar Pressure Control Wiring:

The following control wiring is recommended when the application for 'Pressure Solar' or 'Pressure solar AC' is selected.

Input D1 (2): Operating mode

Remove link for 'Solar Only' operation. The ECODRIVE will run only when 'SOLAR GOOD' conditions are met. This will prevent operation under low solar conditions. Install link for "Solar & Auxiliary AC operation.

Input D2 (3): Level Switch

Not used – Ensure a link is installed as shown.

Input D3 (4): Run Input

Close to run when operating in AUTO/'REMOTE Mode'.

Input D4 (5): REMOTE/LOCAL Mode Selection

See AUTO/MANUAL below. Close for AUTO (REMOTE MODE). REMOTE = AUTO & LOCAL = MANUAL

AN1 (10,11) Irradiance Sensor Input:

An irradiance sensor is optional for solar only but mandatory with an Aux AC power supply.

Flow Switch (D3)35:

A flow switch can be connected to trigger idle mode. This may be required for installations with multiple set points or a variable set point where the '% Load ' method may not be suitable. Refer to page 46 or explanation on Idle mode.

Input Opt. D4 (37):
Bore/Well Level Probe/Switch:

Running completely dry can damage the pump. A probe should be installed in the pump well to detect a loss of water and turn off the pump before running dry. When the water level is low the ECODRIVE will stop the pump. When the water level returns and the contact closes, the ECODRIVE will wait for the preset time and then restart.

Additional Protection:

Additional protection may be required depending on the application. Protection that is critical to an operation or may result in damage to equipment or material in the process should be engineered to operate independent to the ECODRIVE with adequate fail safe measures considered.

Suggested Control Wiring:

Power Up Start and always run whenever Solar Power Available

Remove this link for 'Solar Only' Operation

Auto/Manual Switch

Remove if solar only operation

Optional 'run' switch or contact in Auto or link for always run in Auto

Main Control Board

1	+5V	+5VDC
2	D1	Digital Input: 'Operating Mode'
3	D2	Digital Input: 'Level Switch'
4	D3	Digital Input: 'RUN Input"
5	D4	Digital Input: 'Remote'
6	EN	Enable
7	COM	Common
8	SCN	Screen
9	Vref	5VDC Reference
10	+IN	Analogue Input
11	-IN	
12	A	MODBUS Communications Link
13	B	
14	C	
15	RELAY 1	Resistive Load 5A 250VAC, 5A 30VDC Inductive Load 2A 250VAC, 2A 30VDC
16	RELAY 1	
17	RELAY 2	
18	RELAY 2	

(Auxiliary AC Supply) Irradiance Sensor 0-5VDC

Auxiliary AC Supply Control Panel See Page 15

Optional flow switch input for idle mode operation, Opens on 'No Flow' **Install Link if not used**

Bore Level Protection 'Opens on Low Water' **Install Link if not used**

Pressure Transducer or other process feedback 4-20mA

Option Board (Left)

Top Row Terminals

31	D1	Digital Input 'Spare'
33	D2	Digital Input 'Spare'
35	D3	Digital Input 'Flow Switch'
37	D4	Digital Input: 'Bore Level Input'
39	DO+	Digital Output
41	DO-	

Bottom Row Terminals

32	AI +	Analogue Input
34	AI -	
36	AO +	Analogue Output
38	AO -	
40	TH+	Thermistor Input
42	TH-	

Loop Power Supply

43	+24V
44	0VDC

Note:

MANUAL ("LOCAL" MODE): this mode normally provides control from the front console and is active when D4(5) is off/inactive. In this mode of operation the following inputs remain active.

- D1(2) 'Operating mode'
- D2(3) Tank Level Control
- Opt D4(37) Bore level protection

Auto/Manual switch (if fitted or wired externally):

Auto: With this wiring configuration, "Auto" mode will control the load depending on the solar intensity. If required, an additional run switch can be installed for remote start/stop or other remote control. When there is sufficient Solar Power available the ECODRIVE will run on Solar, and automatically switch off or changeover to auxiliary AC supply when the solar intensity is 'LOW'. When sufficient solar intensity returns the ECODRIVE will automatically start or switch back to Solar if running with an auxiliary AC supply.

Manual (LOCAL MODE) : "Manual" Mode allows control from the local console and with the wiring shown, configured to operate from solar only.

KEYPAD OPERATION

Programming

The basic keypad function is:

ENTER:　　To ENTER a menu or save a parameter

EXIT:　　To exit or go back without saving

UP:　　To scroll upward through a menu or increase a parameter value

DOWN:　　To scroll downward through a menu or decrease a parameter value

STOP:　　No function

To access menu: Press 'ESC', then 'DOWN' to scroll through menu's

IMPORTANT NOTE: The ECODRIVE will ask you to save changes, ensure you press enter to save otherwise all changes will be lost. Ensure the ECODRIVE has completed the saving process before power is switched off to the unit.

Local Operation

In LOCAL MODE, the basic keypad function is:

ENTER:　　No function for local operation

EXIT:　　No function for local operation

UP:　　To go FORWARD or INCREASE SPEED

DOWN:　　To go REVERSE or DECREASE SPEED

STOP:　　STOPS the pump/motor or resets a 'TRIP' condition

For the local keypad to function, 'REMOTE' must be disabled or switched off using a 'remote' input (default D4, terminal 5). When 'LOCAL' mode is enabled, the speed reference may be configured to a different source other than the keypad.

Remote Operation

When 'REMOTE' mode is active the digital inputs have start/stop control. The speed reference is configured within the menu from various sources. This also includes PID operation.

Refer to the ZENER 8000 instruction manual.

ZENER ECODRIVE® 8000

Multiple Display Readout:

Press ↵ 'ENTER' to step through the various displays.

DC Voltage from Array

Feedback from Irradiance sensor

```
550V        675W/m^2
0.9kW       SOLAR °N
```

On each display, this line flashes between operating status and other messages. See message description below

```
        1425kwhrs
        190hours
```

```
30.0Hz
30.0           EN   REM
```

Display of Actual speed (TOP) and set speed (BOTTOM)

```
30.0Hz        7.2kW
80.0%         14.1A
```

```
Pv   4.7 Bar
Sv   4.7    EN REM
```

When PID is used, this displays the Process Variable (PV) and the Setpoint Variable (SV) in the customised units

```
30.0Hz        80%
14.1A         1100rpm
```

EN	Enabled.
LOC	Local Mode Active.
REM	Remote Mode Active.
SOLAR ON	Operating in Solar Mode.
Lo solar	DC bus or irradiance below lower threshold entered.
TRACKING	Limiting output due to reduced solar power.
AC Pwr	Operating on the aux AC power source.
SFC	Solar Function Conflict. This is a Conflict between PV DC volts & Irradiance sensor feedback.
C LIMIT	Current limit warning. Motor current at the maximum current limit setting.
I2t	Motor Overload trip.
OC	Over Current trip.
<DRY>	Bore/Well is Dry. Will attempt restart after delay.
<FULL>	Pump not running because tank is Full. Level switch indicating tank full.
Lo Pressure	Lo Pressure Trip. Pressure from transducer reading below set point for preset time period.
Hi Pressure	Hi Pressure Trip. Pressure from transducer reading above set point for preset time period.
NO SIGNAL	No Signal from Transducer.
Under Min Hz	Operating Under minimum speed setting for set period of time.
PV Only	Digital input selected for Solar only operation
AC + PV	Digital input selected for Solar and AC operation

See the ZENER 8000 manual for other standard and customised trip messages & warnings.

SOLAR MODE & PARAMETERS

Please read this section to understand the terminology and parameters before proceeding with any programming.

Solar related parameters

This manual supplement includes only the solar related parameters. For all other parameters refer to the ZENER 8000 manual. The setup guide in Appendix A will guide you through the parameters and commissioning process for the different applications.

These parameters will be programmed by loading the 'Application' and accessed if required in the 'Application Menu'

E07 SOLAR SUPPLY:	Menu ID.
E070 RUN MODE:	A logic input to select the solar operation and its internal 'tracking' controller.
E071 RESTART DC:	The DC voltage from the solar panels that is required to attempt a restart of the motor (pump). An Irradiance sensor (if fitted) can also be used to restart if assigned to a control input or function.
E072 RESTART DELAY:	The time that the DC bus voltage from the solar panels must be above the restart DC voltage before a restart commences.
E073 RADIANCE LO	When an irradiance sensor is used, this can be selected as a digital source to trigger a stop (or other purpose).
E074 RADIANCE HI	When an irradiance sensor is used, this can be selected as a digital source to trigger a start (or other purpose).
E075 VMP VOLTS	Array volts at Maximum Power, this is obtained from the PV data sheet x number of series panels in a string. Tracking activates if voltage from the PV's (solar panels) falls below this threshold.
E076 Display Var	This allows the selection of either PV-A (PID such as Pressure) or PV-B(Solar W/m2) variable.
E077 LO SOLAR TIME	When the speed decreases less than the 'C01 MINIMUM SPEED' for this time period, low solar state is active. This is generally used to stop the ECODRIVE or can also be assigned to a relay to switch on an AC Power supply.
E078 SFC time	Relevant for dual or aux supply applications only to detect a conflict. When a conflict is detected the ECODRIVE will run on AC power for the set time period before re-attempting to run with solar power.
E079 SFC Ext Sel	A logic input to force an 'SFC' state from an external or other source.

Solar Function & Modes

The ECODRIVE when operating in Solar Mode will be in one of the following modes or states:

1. **"OFF"**   Solar Operation OFF, Standard VSD operation.

2. **"LO SOLAR"**   The output frequency (speed) is less than 'C01 Minimum speed' due to tracking and 'E077 LO SOLAR TIME' has lapsed.
   OR
   If an irradiance sensor is fitted, by the digital source 'E073 LO Radiance' and 'E077 LO SOLAR TIME' has lapsed.

3. **"SOLAR GOOD"** The DC bus voltage is greater than the 'E07 Restart DC' for the 'E072 Restart delay'.
   OR
   If an irradiance sensor is fitted, by the digital source 'E074 HI Radiance' for the 'E072 RESTART DELAY'.

Solar Only – No Irradiance Sensor

The ECODRIVE monitors the DC voltage. If the voltage from the solar array reduces below the entered "VOLTAGE AT MAXIMUM POWER" the ECODRIVE MPPT tracking adjusts its output accordingly. If the speed decreases less than the 'C01 MINIMUM SPEED' for the 'LO SOLAR QUALIFICATION TIME' period, low solar state is activated, and the pump is stopped.

When sufficient Solar Energy is available and the DC voltage rises to the "RESTART DC VOLTS" for the "RESTART DELAY" the Pump will restart.

Solar & Auxiliary AC Power Management

When an auxiliary AC power supplied is used an irradiance sensor is required.

| 587V | 675W/m^2 |
| 0.9kW | SOLAR ^O_N |

If the measured irradiance is greater than the "SOLAR GOOD THRESHOLD" for the "RESTART DELAY TIME" then the AC power supply contactor is opened and the power for pumping is sourced only from the solar array.

| 550V | 501W/m^2 |
| 0.9kW | TRACKING |

The ECODRIVE monitors the operating conditions for signs of insufficient solar energy conversion. The ECODRIVE will 'track' these conditions and adjust its output to the solar power available.

| 530V | 480W/m^2 |
| 0.9kW | AC Pwr |

If the measured irradiance is less than the "LOW SOLAR THRESHOLD" for the "LOW SOLAR QUALIFICATION TIME" then the AC power supply contactor is closed and the power for pumping is sourced from both the AC power source and the PV array.

| 530V | 480W/m^2 |
| 0.9kW | Lo solar |

| 604V | 480W/m^2 |
| 0.9kW | AC Pwr |

Should there be a conflict between the irradiance sensor feedback and the DC voltage, the ECODRIVE will continue to operate from the AC power supply source. For example: measured irradiance is high but the DC volts are low due to solar array isolator left open.

| 604V | 480W/m^2 |
| 0.9kW | SFC |

If the irradiance sensor feedback is faulty then the ECODRIVE will continue to operate from the AC power supply source.

When a 'LO SOLAR' condition is met but the Auxiliary AC power supply is not present, a 'PF' Alarm is displayed. If sufficient solar is or becomes available the ECODRIVE will restart on Solar Power.

PREPARATION & PRELIMINARY CHECKS

> ⚠️ **CAUTION!**
> Check PV voltage and polarity at the PV side of the Isolation switch at maximum solar intensity. Check all wiring in particular polarity. The PV DC bus voltage must not exceed 800VDC for 8E type or 400VDC for the 8EL type ECODRIVE. If an auxiliary AC power supply is to be used, check all wiring to the ECODRIVE and the functionality of the control panel.

STEP 1:   Prepare to apply power

1. Disable the ECODRIVE, by removing the wire in terminal 6 (ENABLE) or ensure RUN/STOP switch is set to 'STOP' (if fitted).
2. Switch the ECODRIVE to operate in local mode. If AUTO/Manual switch fitted, switch to manual or remove wire from terminal 5 (D4 = REMOTE).
3. Fit all covers and apply power to the ECODRIVE. If there is sufficient solar energy, switch on the PV array to the ECODRIVE, or switch the AC power supply if connected.

STEP 2:   Check pump rotation

Using the local control panel, press FWD and increase the speed to check pump direction. If direction is correct go to step 3. If direction is incorrect, switch off all the supply isolators and ensure all power is removed from the ECODRIVE. Switch 2 wires on the output of the ECODRIVE (not the input) and recheck the direction.

> ⚠️ **CAUTION!**
> Before touching and removing the cover, disconnect all supply sources and wait at least 11minutes for the capacitors to discharge. Before touching anything inside the equipment or anything connected to the terminals inside, check that there are no hazardous voltages present, AC or DC.

"Loading an Application"

STEP 3: Select configuration from applications menu

(This may have already been preconfigured by your ZENER Supplier/Distributor)

The following steps will load the application.

1. As the ECODRIVE powers on, the model and software version is displayed on the console.
2. After the 2 seconds have elapsed a meter display is revealed (assuming no application is loaded).

```
 R40
 Ver 5.2.□
```

3. Press ESC to access the menu.
4. Press ENTER to access the A00 DEFAULT MENU.
5. Press DOWN until 'Application: <NONE>''is displayed and press ENTER.
6. Press DOWN to the desired application: such as "TANK solar" press ENTER to select.
7. Press ESC until asked to SAVE, Press ENTER and wait until completed.
8. **THE ECODRIVE has now been loaded with an application – go to the appropriate setup guide. (See Page 28)**

```
 A00 DEFAULT
```

```
Application:
TANK Solar
```

IMPORTANT NOTE: To change 'Applications' you must restore defaults and then load the desired application.

CHECK / SETUP OF IRRADIANCE SENSOR

The irradiance sensor is used to return to SOLAR operation when it has been switched over to the Auxiliary AC power supply. It can also be used to switch from Solar to an AC power supply. If an irradiance sensor is installed it must be checked otherwise the system will not operate correctly.

Checking Irradiation Sensor Feedback

This should display about 1000w/m2 on a sunny day with panels facing the sun. If incorrect check wiring. If the irradiance sensor was not supplied by ZENER check the settings & scaling.

To modify the irradiance Scale

1. Press **ESC** from any of the active displays to show:

    ```
    Pressure Solar AC
    set up (default)
    ```

2. Press ⏎ to access the application parameter menus.

3. Press 🔽 to scroll down to:

    ```
    Irradiance scale
       1562.5W/m^2
    ```
    .

4. Press ⏎ to edit, then increase or decrease the value using: 🔽 🔼

5. Press ⏎ to save & exit.

(Intentionally Blank)

Application

SETUP GUIDE

Application 1: Tank Fill … Page 31

 1A Tank Solar

 1B Tank Solar AC

Application 2: Pressure Control … Page 36

 2A Pressure Solar

 2B Pressure Solar AC

WARNING:

When programming the ECODRIVE never remove the power when it is going through it 'Saving sequence'. If running on Solar, ensure power will remain on long enough to allow the 'Saving sequence' to finish. Remember to press ENTER to 'save' when exiting the menu.

(Intentionally Blank)

1 TANK FILL (or BASIC PUMPING)

This setup guide is for a 'Tank fill' application assuming the application 'Tank Solar' or 'Tank Solar AC' is selected and all control and sensor wiring is as per wiring detailed in the manual.

Quick Setup Guide

Before proceeding further with this quick setup guide, ensure the following has been checked and/or completed.

1. Read all safety warnings.
2. Check all earthing, power wiring and voltages are correct and within specification and is safe to operate before applying power.
3. Check control wiring is correct and all external wiring and level switches are wired & operate correctly.
4. Check motor direction (in manual or local mode).
5. Load application – refer to page 25 of manual.
6. Check irradiance sensor (if fitted) – refer to page 26 of manual.

This guide will step through the following.

7. Configure the solar application parameters.
8. Determine and enter the minimum speed for the pump.
9. Enter the operating speed.
10. Check system functionality under various conditions.

SETUP for Tank Fill / Basic Pumping

⚠️ **Saving Changes:**
During the commissioning sequence you may be asked to save changes. It is not necessary to save changes each time a parameter is changed. It may be faster to leave this step till last or when all parameters are set appropriately.
Before power is removed <u>always</u> ensure parameters are saved.

The Application Parameters

This section assumes the 'Tank Solar' or 'Tank SolarAC' application is loaded. If the application is not loaded refer to page 25 step 3.

To access Solar parameters:

Press **(ESC)** from any of the active displays to show:

```
TANK Solar AC
set up (default)
```

Press **(↵)** to access the application parameter menus.

Press **(▲)** or **(▼)** to view the Solar/AC Power parameters.

Press **(↵)** to save the parameter and progress to the next.

This symbol 🌞 represents settings required for solar only

This symbol 🌞**AC** represents settings required for solar + Auxiliary AC power supply

Only the menu items applicable will be displayed in the application menu.

Operating Frequency

🌞**AC**
```
Operating Freq
    42.0 Hz
```

The operating speed is the desired pump operating speed and is expressed as output frequency. The speed is generally known at the stage the system is designed and a pump selected or based on the flow rate required.

Voltage at Maximum Power

🌞**AC**
```
Voltage @max Pwr
   500.0 Vdc
```

The voltage output of the solar array at maximum output power is commonly identified as "Vmp" and is typically given in solar device data. The value specified to the ECODRIVE must be the effective Vmp of the entire solar array structure. MPPT tracking activates when the DC voltage falls below this value.

This value is the Vmp of the array.

ie. TOTAL Vmp = 'PV STC Max. Power Point Voltage' x 'number of PV's in a string'

Restart DC

```
Restart DC
550VDC
```

The voltage required for the ECODRIVE to restart the motor/pump in solar only operation. Typically this would be set 20-25VDC higher than array voltage at maximum power. The Minimum Restart DC allowable is the Vmp setting.

Restart Delay

```
Restart Delay
10 Sec
```

The time delay that the 'Restart DC' voltage or 'SOLAR GOOD' condition must be present for the ECODRIVE to restart the motor/ pump. 'SOLAR GOOD' is set by the 'SOLAR GOOD THRESHOLD' . If an irradiance sensor is fitted in solar only operation, this may need to be extended to lengthen the time between starts during sunrise and sunset. This time will reduce the number of occasions the system transitions from solar power to AC power. Alternatively an irradiance sensor can be used.

Irradiance Scale (Irradiance sensor fitted)

```
Irradiance scale
 1562.5W/m^2
```

This should have been checked previously. An irradiance sensor is not mandatory for solar only applications. See page 26 for more details.

Solar Good Threshold (Irradiance sensor fitted)

```
Solar Good W/m^2
  450.0W/m^2
```

The irradiance threshold above which solar power is sourced is determined by the "Solar Good" threshold. This level activates (after restart delay time) solar only operation when an irradiance sensor is used.

Low Solar Threshold (Irradiance sensor fitted)

```
Low Solar W/m^2
  400.0W/m^2
```

The irradiance level which an auxiliary AC and PV power is sourced is determined by the "Low Solar" threshold value. When the irradiance level is below this value, a relay output (relay 2 – LO SOLAR) provided to control the Auxiliary AC power Supply will de-energise. The difference between Solar Good and Low solar is the hysteresis between 'solar' & 'AC' operation. This parameter is not used if an irradiance sensor is not fitted (for Solar only operation).

Low Solar Qualification Time (with/without Irradiance sensor fitted)

```
Low Solar Qtime
     2 secs
```

The conditions to start sourcing AC power must be maintained for a time interval called the "Low Solar Q-time". Low solar Q time is also used in **solar only** operation without an irradiance sensor. When tracking is active and operating below minimum speed for this qualification time, the ECODRIVE will stop the pump. This time must be shorter than the low speed trip time.

Float Switch Qualification Time

```
Float SW Qtime
     3 secs
```

The float switch qualification time is the 'off' delay when the switch changes to open state. The pump will run when contact closes. This delay also reduces the occurrence of momentary switching due to disturbances of the liquid surface. Increasing the time will increase the hysteresis above the full level.

Well/Bore Level Clear Delay

```
DRY Well SW Qtime
     10sec
```

The delay to restart the pump after a bore low signal is received.

ZENER ECODRIVE® 8000

Rated Motor Current

```
Rated Motor Amps
    40.2 A
```

An important parameter is the motor rated current which is used to help estimate the motor load. The rated current is that found on the motor nameplate.

Overload Current

```
Overload Amps
    40.2 Amps
```

The ECODRIVE monitors the motor current and will generate a trip if high current has been flowing for a sufficient amount of time. Generally, the overload current is the same as the rated motor current.

Minimum Output Frequency

```
Min frequency
    0 Hz
```

This section is primarily intended for those applications employing a centrifugal pump. The pump speed to overcome the "head" pressure and create a fluid flow is said to be the minimum speed for the system. Below this speed no fluid flow occurs and prolonged operation below the minimum speed reduces the pumps' service lifetime. To help fin the minimum speed value for the system the ECODRIVE is best to operate in local mode. (generally by removing link to D4 ie.terminal 5)

50Hz = 100% Speed

If the minimum speed is unknown, the following process will determine what the minimum speed should be set to. If the pump/motor manufacturer has specified a minimum speed, ensure your setting is equal or above this speed.

Some pumps such as bore pumps require rapid acceleration to 30Hz (60% Speed) of 1 or 3 seconds depending on the pump manufacturer. A Dual ramp is selected as default with an acceleration & deceleration time of 2 seconds. Further adjustment may be required to suit the application. Refer to Page 44.

Finding the minimum output speed (frequency)

1. Press several times to show the meter display:

```
0.0Hz   0.0kW
0%     EN LOC
```

2. Press and hold the t... ease the output to about 10Hz. Observe the % Load indication.

```
10.0Hz    0.8kW
15%       8.3A
```

% Load Indication

3. The '% Load' will rise as fluid begins to flow. Continue to increase the speed (1 or 2 Hz steps) and observe the '% Load' indication.

4. Release the button when the '% Load' begins to rise significantly.

This frequency (plus 1-2Hz) will be entered as the min frequency.

```
32Hz      5.1kW
43%L      6.7A
```

5. Press STOP to stop the motor.

6. Access the application parameters and find the "Min frequency" menu. Adjust and press ENTER

Low Speed trip

```
Lo Speed Trip time
    20 secs
```

During 'Tracking' only, if the output speed operates below the minimum speed the ECODRIVE will fault. This setting adjusts the trip time. It should be set as short as possible to provide the required protection of the pump/motor but longer than the 'LO SOLAR Q Time'. This is feature is to provide protection for the pump and is the system is correctly configured system it should not result in a 'LOW SPEED' Trip.

When the ECODRIVE is operating in solar mode it may track below minimum speed depending on the available power. This will result in an alarm 'Lo Speed Trip'. It is recommended to configure this under minimum speed protection where operation below a 'minimum speed' for a prolonged period may cause damage to the pump or motor. The 'LO SOLAR Q' time adjusted to 1 second and the 'LO SPEED TRIP' time should be changed to 2-3 seconds. This protection may be modified or removed if required.

Single Phase In

```
Single Phase In
    Disabled
```

If the Auxiliary AC supply is a single phase supply this parameter must be 'enabled'. For a 3 phase supply change to 'Disabled'.

Confirm the operation of all controls and the system functions correctly.

1. With Solar Only: Check that the ECODRIVE operates the pump at the desired speed under full sunlight conditions. The conditions in which solar operation switches on & off, will depend on the PV capacity and the settings. Fine tune as required.

2. With Solar and Auxiliary AC supply: Check that ECODRIVE operates the pump at the desired speed under full sunlight conditions. Check that the Auxiliary AC power supply switches in as required. The conditions where the solar operation cycles will depend on the PV capacity and the settings. Fine tune as required.

3. Check that all level switches provide the correct operation under all conditions.

4. Check that adequate protection is in place and functions correctly.

(Intentionally Blank)

2 SETUP for a pressure Control System

This setup guide is for a 'Pressure Control' application assuming the application 'SOLAR Pressure Control' is selected and all control and sensor wiring is as per wiring detailed in the manual.

Quick Setup Guide

Before proceeding further with this quick setup guide, ensure the following has been checked and/or completed.

1.   Read all safety warnings.
2.   Check all earthing, power wiring and voltages are correct and within specification and is safe to operate before applying power.
3.   Check control wiring is correct and all external wiring and level switches are wired & operate correctly.
4.   Check motor direction (in manual or local mode).
5.   Load application – refer to page 25.
6.   Check irradiance sensor (if fitted) – refer to page 26.

This guide will step through the following.

7.   Configure the 'SOLAR & PRESSURE CONTROL' application parameters.
8.   Determine and enter the minimum speed & Hibernation levels (if required) for the pump.
9.   Enter the Set-point variable speed.
10. Check system functionality under various conditions.

[SETUP for a pressure Control System]

Checking the Transducer Feedback

It is possible to check for the transducer signal by viewing its present value in the service menu. In general, when power is first applied it is reasonable to expect that there is no pressure in the plumbing system. From the meter display:

```
0.0Hz      0.0kW
  0%    EN LOC
```

1. Press **ESC** and the display will show:

```
Pressure Control
set up (default)
```

2. Press ▲ twice to display:

```
S00 SERVICE
```

3. Press ⏎ to display:

```
 R40        ST
 V5.2.□
```

4. Press ▲ several times to display:

```
   Analogue
    Inputs
```

5. Press ⏎ to display:

```
AI(10,11) 0.00V
```

6. Press ▼ once to display:

```
AI(32,34) 4.00mA
```

If the **displayed value is significantly less than 4mA** then there may be a problem with the transducer or its wiring. Review the transducer wiring and check that it is wired in accordance to the manufactures documentation. Press **ESC** several times to return to the meter display.

The Application Parameters

Saving Changes:

During the commissioning sequence you may be asked to save changes. It is not necessary to save changes each time a parameter is changed. It may be faster to leave this step till last or when all parameters are set appropriately.

Before power is removed <u>always</u> ensure parameters are saved.

The Application Parameters

This section assumes the 'Pressure Solar' or 'Pressure SolarAC' application is loaded. If the application is not loaded refer to the ECODRIVE manual supplement.

To access Solar parameters:

Press from any of the active displays to show:

```
Pressure Solar AC
set up (default)
```

Press to access the application parameter menus.

Press or to view the Solar/AC Power parameters.

Press to save the parameter and progress to the next.

This symbol represents settings required for solar only

This symbol represents settings required for solar + Auxiliary AC power supply

Only the menu items applicable will be displayed in the application menu.

Voltage at Maximum Power


```
Voltage @max Pwr
   500.0 Vdc
```

The voltage output of the solar array at maximum output power is commonly identified as "Vmp" and is typically given in solar device data. The value specified to the ECODRIVE must be the effective Vmp of the entire solar array structure. Tracking occurs if the DC voltage falls below this value.

This value is the Vmp of the array.

ie. TOTAL Vmp = 'PV STC Max. Power Point Voltage' x 'number of PV's in a string'

[SETUP for a pressure Control System]

Restart DC

```
Restart DC
550VDC
```

The voltage required for the ECODRIVE to restart the motor/pump in solar only operation. Typically this would be set 20-25VDC higher than array voltage at maximum power. The Minimum Restart DC allowable is the Vmp setting.

Restart Delay

```
Restart Delay
10 Sec
```

The time delay that the 'Restart DC' voltage or 'SOLAR GOOD' condition must be present for the ECODRIVE to restart the motor/ pump. 'SOLAR GOOD' is set by the 'SOLAR GOOD THRESHOLD' . If an irradiance sensor is fitted in solar only operation, this may need to be extended to lengthen the time between starts during sunrise and sunset. This time will reduce the number of occasions the system transitions from solar power to AC power. Alternatively an irradiance sensor can be used.

Irradiance Scale

```
Irradiance scale
  1562.5W/m^2
```

This should have been checked previously. An irradiance sensor is not required for solar only applications. See page 25 for more details.

Solar Good Threshold (Irradiance sensor fitted)

```
Solar Good W/m^2
   450.0W/m^2
```

The irradiance threshold above which solar power is sourced is determined by the "Solar Good" threshold. This level activates (after restart delay time) solar only operation when an irradiance sensor is used.

Low Solar Threshold (Irradiance sensor fitted)

```
Low Solar W/m^2
   400.0W/m^2
```

The irradiance level which an auxiliary AC and PV power is sourced is determined by the "Low Solar" threshold value. When the irradiance level is below this value, a relay output (relay 2 – LO SOLAR) provided to control the Auxiliary AC power Supply will de-energise. The difference between Solar Good and Low solar is the hysteresis between 'solar' & 'AC' operation. This parameter is not used if an irradiance sensor is not fitted (for Solar only operation).

Low Solar Qualification Time (Irradiance sensor fitted and solar only)

```
Low Solar Qtime
    0 secs
```

The e conditions to start sourcing AC power must be maintained for a time interval called the "Low Solar Q-time". Low solar Q time is also used in **solar only** operation without an irradiance sensor. When tracking is active and operating below minimum speed for this qualification time, the ECODRIVE will stop the pump. This time must be shorter than the low speed trip time.

Float Switch Qualification Time (Not required for Pressure Control - link terminal 1 to 3[D2])

```
Float SW Qtime
    3 secs
```

The float switch qualification time is the 'off' delay when the switch changes to open state. The pump will run when contact closes. This delay also reduces the occurrence of momentary switching due to disturbances of the liquid surface.

Well/Bore Level Clear Delay

```
DRY Well SW Qtime
    10sec
```

The delay to restart the pump after a bore low signal is received.

ZENER ECODRIVE® 8000

Rated Motor Current

```
Rated Motor Amps
    40.2 A
```

An important parameter is the motor rated current which is used to help estimate the motor load. The motor load is used to determine if the idle function is to be invoked. The rated current is that found on the motor nameplate.

Overload Current

```
Overload Amps
    40.2 Amps
```

The ECODRIVE monitors the motor current and will generate a trip if high current has been flowing for a sufficient amount of time. Generally, the overload current is the same as the rated motor current.

Minimum Output Frequency

```
Min frequency
    0 Hz
```

This section is primarily intended for those applications employing a centrifugal pump. The pump speed to overcome the "head" pressure and create a fluid flow is said to be the minimum speed for the system. Below this speed no fluid flow occurs and prolonged operation below the minimum speed reduces the pumps' service lifetime. To help fin the minimum speed value for the system the ECODRIVE is best to operate in local mode. (generally by removing link to D4 ie.terminal 5)

50Hz = 100% Speed

If the minimum speed is unknown, the following process will determine what the minimum speed should be set to. If the pump/motor manufacturer has specified a minimum speed, ensure your setting is equal or above this speed.

Some pumps such as bore pumps require rapid acceleration to 30Hz (60% Speed) of 1 or 3 seconds depending on the pump manufacturer. A Dual ramp is selected as default with an acceleration & deceleration time of 2 seconds. Further adjustment may be required to suit the application. Refer to Page 43.

Finding the minimum output speed (frequency)

1. Close all valves & taps downstream and start the ECODRIVE in manual/local operation.

2. Press ⏎ several times to show the PID meter display:

```
0.0Hz      0.0bar
0.0A       0rpm
```

3. Press and hold the ▲ to increase the speed until the pressure indication reaches the pressure set point entered ie. 'Required Pressure'.

```
35Hz      4.9bar
8.3A      1100rpm
```

Pressure Indication

Output frequency

4. Press ⏎ several times to show the meter display:

```
35.0Hz     0.8kW
33%L       8.3A
```

'% Load' Indication

5. Record the frequency and %Load of this condition below:

Output Frequency	
% Load	

[SETUP for a pressure Control System]

6. Press STOP 🔴 to stop the motor.

7. Access the application parameters and find the "Min frequency" menu. Adjust and press ENTER ↩

Low Speed trip

```
Lo Speed Trip time
    20 secs
```

During 'Tracking' only, if the output speed operates below the minimum speed the ECODRIVE will fault. This setting adjusts the trip time. It should be set as short as possible to provide the required protection of the pump/motor but longer than the 'LO SOLAR Q Time'. This is feature is to provide protection for the pump and is the system is correctly configured system it should not result in a 'LOW SPEED' Trip.

⚠️ **When the ECODRIVE is operating in solar mode it may track below minimum speed depending on the available power. This will result in an alarm 'Lo Speed Trip'. It is recommended to configure this under minimum speed protection where operation below a 'minimum speed' for a prolonged period may cause damage to the pump or motor. The 'LO SOLAR Q' time adjusted to 1 second and the 'LO SPEED TRIP' time should be changed to 2-3 seconds. This protection may be modified or removed if required.**

Single Phase In

```
Single Phase In
    Disabled
```

If the Auxiliary AC supply is a single phase supply this parameter must be 'enabled'. For a 3 phase supply change to 'Disabled'.

Transducer Scale

```
Pressure scale
    10.0 bar
```

This is the maximum reading from the pressure transducer. For example a 0-10bar, 4-20mA transducer the entry here is 10bar.

Required Pressure

```
Reqd pressure
    4.9 bar
```

This is the pressure that is to be maintained known as the Set-point Variable or SV. It is possible to have a set-point that is controlled by an external reference, such as a potentiometer, switches or other device. Refer to the ZENER 8000 manual to modify this.

Proportional Band (For Tuning of internal PID/pressure controller, see Page 43)

```
Proportional Band
    100%
```

Decreasing the proportional band value amplifies variations from the desired pressure set point. This causes motor speed changes that reduce the variations. Increasing the proportional band value diminishes variations from set point and motor speed changes are reduced. Refer to the trouble shooting section (Page 43) as a further guide to adjusting this value.

Integration Time (For Tuning of internal PID/pressure controller, see Page 43)

```
Integration Time
    2.00 sec/r
```

Decreasing the integrator time accumulates pressure variations faster. This causes motor speed changes that reduce the variations. Increasing the integrator time accumulates pressure variations slower and motor speed changes are reduced. Refer to the trouble shooting section (page 43) as a further guide to adjusting this value.

⚠️ **Idle Mode** (refer to Page 46 for an explanation on Idle Mode)
The ECODRIVE can be configured to turn the pump off when there is 'no flow' (ie. all valves closed). When a 'no flow' condition is detected (by Flow switch or "Idle threshold - % Load") the ECODRIVE goes into 'IDLE MODE'. When the pressure drops to a preset level (RESUME PUMPING @ % below SV) the pump restarts. **Idle mode can be triggered by either or both, a 'Flow Switch' connected to input D3(terminal 35) or by monitoring the load and setting the 'Idle Threshold' based on % Load.**

Idle Threshold

```
Idle threshold
     35.0 %
```

The % Load recorded at step 5 will initially be used as the idle mode threshold. Add a small margin of 2 or 3% to ensure the idle function will activate. If pump operation develops a load at or below this value, the idle timer begins timing. If the load remains unchanged for the idle interval the ECODRIVE will go to the idle state. **Set to 0% to disable or when an external flow switch is being used to trigger idle mode.**

Time before Idle

```
Time before idle
     5 secs
```

The Idle delay interval controls the amount of time the pump is permitted to operate below the load recorded in step 5. Verify the value is acceptable and alter as required. **This parameter is also used when a flow switch is used.**

Resume Pumping

```
Resume pumping @
  50.0% below SV
```

The ECODRIVE will return to pumping operation when the pressure drops below the "Return from Idle" threshold which is expressed as a % below the required pressure set point value (SV).

WARNING!

High & Low pressure trip is for operational purposes only. Separate independent methods must be employed to prevent economic loss.

Lo Pressure trip

```
Lo pressure trip
     2.5bar
```

The low pressure trip is generated if the pressure has not risen above the threshold value in the set time. The occurrence of this trip suggests a problem with the plumbing, such as a burst pipe. This parameter is the threshold for pressure detection. Verify the value and alter as required. The default trip time is default at 30 seconds. Refer to page 45 to modify the trip time.

Hi Pressure trip

```
Hi pressure trip
     8.0bar
```

The high pressure trip is generated if the pressure rises above the threshold value. The occurrence of this trip suggests a problem with the plumbing like a blocked pipe. This parameter is the threshold for high pressure detection. Verify the value and alter as required. The trip time is default at 0 seconds. Refer to the ZENER 8000 manual to modify this.

Fill Fail Time

```
Fill Fail Time
     60sec
```

The ECODRIVE can be configured to run at a preset speed to fill the pipes to a specified pressure before switching over to PID/pressure control mode. If it fails to reach that pressure within the set 'Fill Fail Time' a trip will occur.

Fill to pressure

```
Fill to Pressure
     2.0bar
```

The pressure in which the fill mode switches over to PID / Pressure control mode.

Filling Speed

```
Filling Speed
     25Hz
```

The preset speed to fill the pipes before operating on PID / pressure control mode.

Operation and Tuning

- Switch to automatic operation or wire in the "REMOTE" or "pressure control" link into D4(5) to enable automatic pressure control as per this partial sketch.
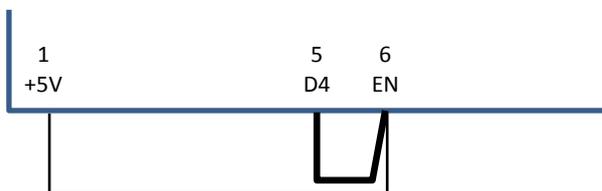
- Ensure the pump is ready to start. Allow the pump to start in pressure control mode. If an auxiliary AC supply is connected, switch to operate from AC supply to perform initial setup of pump control.
- The ECODRIVE should ramp up in speed and the pressure increase. If the pressure does not increase stop the pump and investigate.
- The ECODRIVE will operate the motor and pump to regulate pressure in a stable manner. Ie. the SV should equal the PV without oscillations.
- Where hibernation (Idle) is configured, turn off all valves and check the system turns off.

For some systems the default regulation parameters may not yield the desired performance. Adjust the Proportional Band Value and Integrator Time to alter pressure regulation performance. A troubleshooting guide is also below.

Trouble Shooting

Problem	Remedy
The analogue input reading display found in the service menu reports no feedback -0.00mA	• The transducer may be wired incorrectly or in reverse polarity. • Review the transducer wiring and confirm wires are terminated according to the required terminal polarity.
In closed loop operation the system is unstable	• Set **Prop. band value** to is highest value. • Set **Integrator time** to zero. • Operate the system and observe the performance. • Decrease **Prop. band value** gradually until the instability returns. • Increase **Prop. band value** 1½ times. • For a more detailed stabilisation procedure refer to the section titled "PID Setup Checklist and Tuning" within the "ZENER8000 Instruction Manual" .
PV does not equal the SV	• A steady state error exists and is removed by using the **Integrator time**. • Start with a large value and then decrease it until a satisfactory response to a SV change is observed.
The system responds too slowly	• Decrease the **Prop. band value** except if the system becomes unstable. • Or decrease the **Integrator time**.
The system oscillates momentarily	• Increase the **Prop. band value.**

Confirm the operation of all controls and the system functions correctly.

1. With Solar Only: Check that the ECODRIVE operates the pump at the desired speed under full sunlight conditions. The conditions in which solar operation switches on & off, will depend on the PV capacity and the settings. Fine tune as required.
2. With Solar and Auxiliary AC supply: Check that ECODRIVE operates the pump at the desired speed under full sunlight conditions. Check that the Auxiliary AC power supply switches in as required. The conditions in which the solar operation switches on & off, will depend on the PV capacity and the settings. Fine tune as required.
3. Check that all level switches provide the correct operation under all conditions.
4. Check that adequate protection is in place and functions correctly.

ADDITIONAL SETTINGS

This manual is intended to simplify the setup process for Solar Operation by providing 'application specific' menus. The ECODRIVE has many more features, parameters and functionality which can be accessed in other menus to suit individual requirements. For assistance with other configurations contact Zener or refer to the ZENER 8000 Instruction manual.

Some settings that may be required for pumping & solar applications include:

Dual Ramp:

A dual ramp configuration is available to have different acceleration rates above or below the minimum speed setting. When Dual Ramp is enabled, **C032 S TIME** specifies the acceleration & deceleration rate below the minimum speed. The **C030 ACCEL TIME** and **C031 DECEL TIME** relates to the acceleration & deceleration rate above the minimum speed.
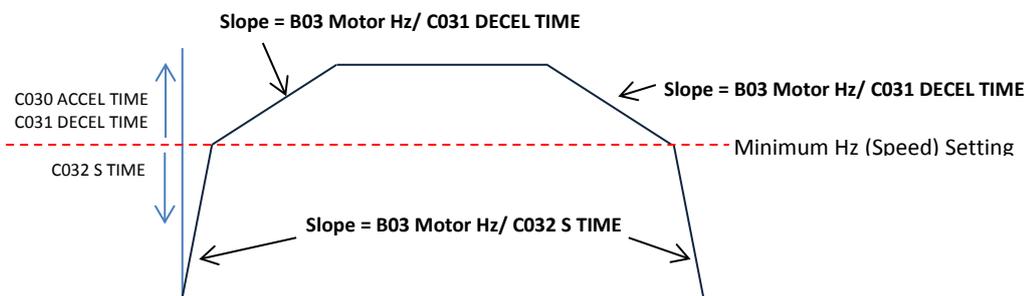
The settings for Dual Ramp can be found in the same menu location as Acceleration Ramp. Follow the procedure below to access & modify the ramp times.

Acceleration Ramp:

Some pumps require a fast acceleration time (1 or 3 seconds to reach 30Hz). It is recommended to consult the pump/motor manufacturer to confirm requirements or contact Zener to discuss.

To change the Acceleration time.
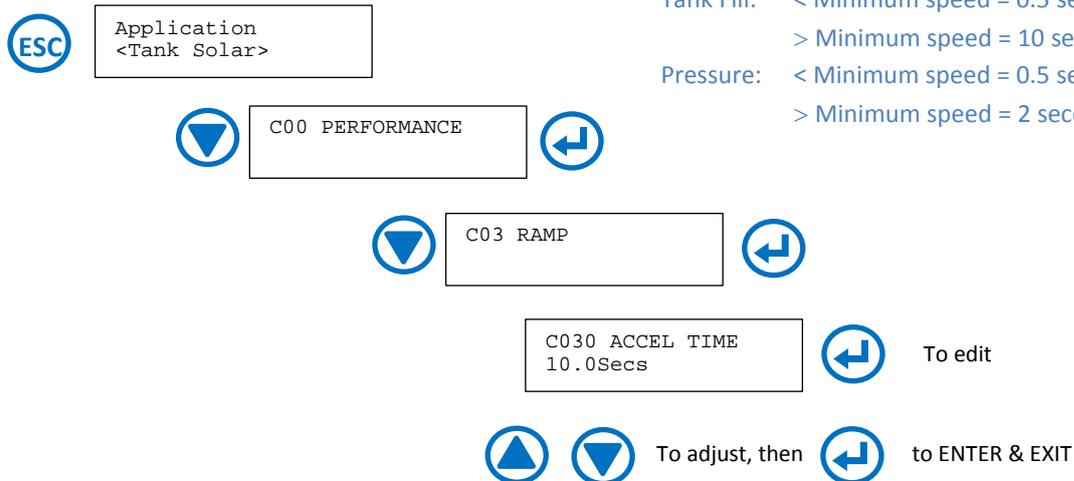
Default Setting:

Tank Fill: < Minimum speed = 0.5 seconds (C032)
            > Minimum speed = 10 seconds (C030)

Pressure: < Minimum speed = 0.5 seconds (C032)
            > Minimum speed = 2 seconds (C030)

Deceleration Ramp:

Some installations may suffer from water hammer problems. By slowly ramping the pump speed through the critical speed region the water hammer can be reduced or eliminated. It is recommended to consult the pump/motor manufacturer to confirm it is suitable to operate with a deceleration or soft stop.

Ensure the ECODRIVE is configured to soft stop via run/stop control signals and the parameter 'Coast to stop' is disabled (Default is disabled).

Default Setting:

Tank Fill: < Minimum speed = 0.5 seconds (C032)

              > Minimum speed = 10 seconds (C031)

Pressure: < Minimum speed = 0.5 seconds (C032)

              > Minimum speed = 2 seconds (C031)

Low Pressure Trip Time:

The Pressure Control 'Application' allows for a low pressure trip. If the trip time needs to be increased follow this procedure.

```
ESC      Application
         <Pressure Solar AC>

         ▼   G00 INPUTS/OUTPUTS        ↵

                ▼   WARNING & ALARM        ↵
                    CONFIGURATIONS

                    ▼   USER ALARM 3        ↵

                        ▼   G252 ALARM DELAY        ↵   To edit
                            10 Seconds

         ▼   ▲   Adjust Value and press   ↵   to ENTER & EXIT
```
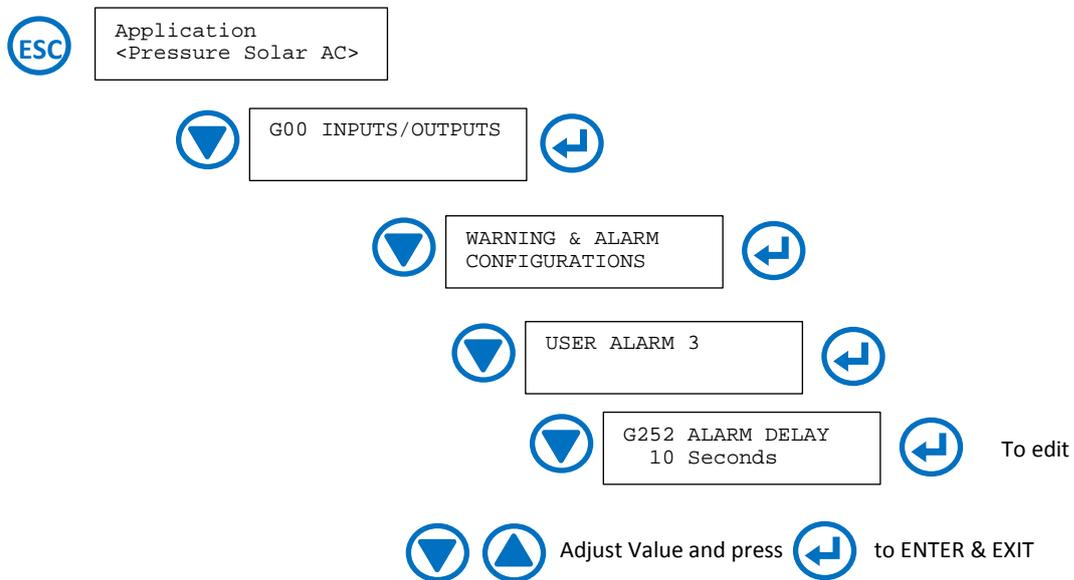
IMPLEMENTING 'IDLE MODE'

What is Idle Mode ?

Idle mode is a feature that automatically switches the pump off when a 'no flow' condition is detected. The pump will then restart based on pressure ('% below SV') [DEFAULT] or PID output ('output frequency').

There are 2 methods in which the 'Idle Mode' can be triggered.

1. **"% LOAD"** [DEFAULT] Monitoring the '% Load' to indicate when the pump load represents a no flow situation. Idle mode is triggered when the load drops to the preset level for the preset time. Depending on the pump performance and operating conditions a flow switch may be required. Eg. Multiple set points.

2. **FLOW SWITCH [**DEFAULT] Connect an external flow switch that triggers 'idle mode' when no flow for the preset 'idle delay'. The switch is connected to digital input on the option board D3(35). The default setting requires a contact that opens on 'no flow'. This input is always active so a link is required when a flow switch is not fitted. A flow switch is the best method to use when operated with a variable or multiple set point. The flow switch provides a more simple setup process as the '% Load' threshold is not used.

3. **OTHER** [CUSTOM] Use an internal logic function or other external device to trigger idle mode.

NOTE: Both the '% Load' and the 'flow switch' methods can be used simultaneously, using the same 'idle delay'.

Idle based on '% Load'

This is detected by a drop in '% Load' for a set period of time. For this to operate it is important to find the '% Load' under a 'No Flow' or 'Dead head' condition. Pumping will resume when the pressure falls below a specified % below the Set point. A flow switch can also be installed to trigger the idle mode.
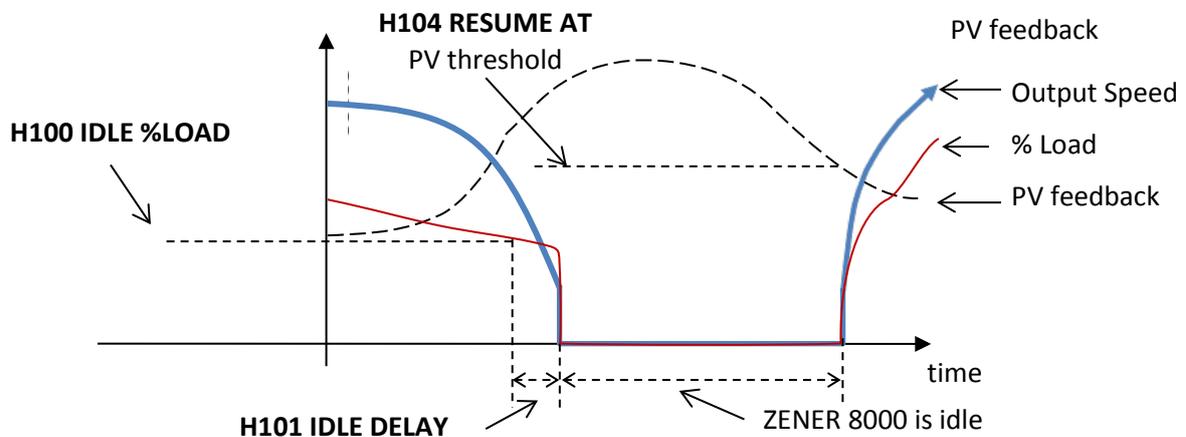
IDLE:

'% Load' decreases with reduced flow to a level for a period of time 'Idle Delay' and then goes into 'Idle Mode' (sleep). Or ; The input from the optional Flow Switch indicating 'No Flow' for the 'Idle Delay'.

WAKE:

When the pressure drops due to returned demand the ZENER 8000 wakes automatically and operates in PID mode.

To ensure correct operation the 'Idle' function must be checked and configured for all possible conditions. For installations where multiple or variable set points the '% load' method may not operate under all conditions and require a flow switch to be installed.

Idle based on Flow Switch Input

This application configures a digital input D3(35) for a flow switch input. The flow switch provides a more simple setup process ('% Load' threshold is not used). When the flow switch provides an 'open contact' (ie.no flow') into D3 (terminal 35) for the 'Idle delay' period the ZENER 8000 will enter idle mode. It can operate in conjunction with the '% Load' method.

NOTE: If there is no switch available or installed a link must be fitted between terminal 1 & 35.
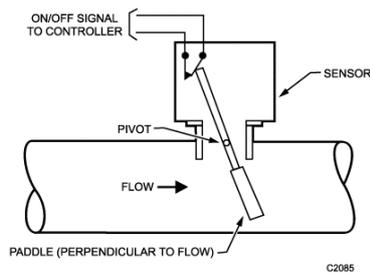
Examples of Flow Switches available from Kelco

Tank Fill via pressure transducer

It is possible to use pressure to switch the pump on and off. This means that wiring of a level switch in the tank back to the ECODRIVE would not be required. A pressure transducer (with 4-20mA signal or similar) at the pump can be directly connected to the ECODRIVE and monitored to control the pump operation. If the pressure feedback provides an accurate indication on the level of water in the tank or when the tank is full, this can be used to switch the ECODRIVE in the same manner as a level switch. The ECODRIVE has a built-in comparator function that allows a 'Hi &/or Lo compare' output to a relay, digital output or other internal function.

The signal from a pressure transducer can be used to change the state of a relay output (relay 1) at a preset level. Alternatively, a high & low pressure level may provide a means to switch the pump ON & OFF.

The ability to use a pressure transducer to provide remote control is dependent on the installation and requires careful consideration.

Contact Zener for assistance to configure the ECODRIVE for your desired operation.

ZENER

VARIDRIVE SOLUTIONS

ZENER AUSTRALIAN DISTRIBUTORS

New South Wales

Sydney
Zener Varidrive Solutions
366 Horsley Road
Milperra   NSW 2214
Phone: 02 9795 3600
Email: sales@zener.net

Regional NSW
Zener Varidrive Solutions
1 William Street
Maryville NSW 2293
Phone: 02 49696788
Email: sales@zener.net

Queensland

Zener Electric Queensland Pty Ltd
Unit 23, 28 Burnside Road
Yatala QLD 4207
Phone: 07 3807 7377
Email: sales@zenerqld.com.au

Western Australia

Power Control Products
Unit 5, 144-146 Bannister Road
Canning Vale WA 6970
Phone: 08 92562133
Email: sales@powercontrol.com.au

South Australia

Rototech Pty Ltd
34-36 Kinkaid Avenue
North Plympton SA 5037
Phone: 1300 553 552
Email: mail@rototech.com.au

Victoria

Rototech Pty Ltd
23 James Street
Clayton South VIC 3169
Phone: 1300 553 552
Email: mail@rototech.com.au

http://www.zener.net