ZENER VARIDRIVE SOLUTIONS

ZENER 8000

Reference Manual

IM00140F

ZENER TECHNOLOGY AND QUALITY ASSURANCE

Since 1976 Zener Electric has supplied many thousands of drives to industry. These drives have been installed into numerous applications resulting in a wealth of in house experience. The Zener 8000 AC variable speed controller is the culmination of this experience, modern technology and industrial application requirements. The Zener Quality Assurance program ensures that every ZENER 8000 manufactured has proven to operate correctly in the production test bay before dispatch.

SAFETY

Your ZENER 8000 must be applied, installed and operated in a safe manner. It is the responsibility of the user to ensure compliance with all regulations and practices covering the installation and wiring of your ZENER 8000. The instruction manual should be completely read and understood before attempting to connect or operate the ZENER 8000. Only skilled personnel should install this equipment. This equipment contains a number of components that are designated by their various manufacturers as “not for use in life support appliances, devices or systems where malfunction of the components can reasonably be expected to result in personal injury or death”. Customers using or selling Zener products for use in such applications do so at their own risk and agree to indemnify Zener for any damage resulting from improper use or sale.

THE CONTENTS OF THIS MANUAL ARE SUBJECT TO CHANGE WITHOUT NOTICE

Contents

Models Covered

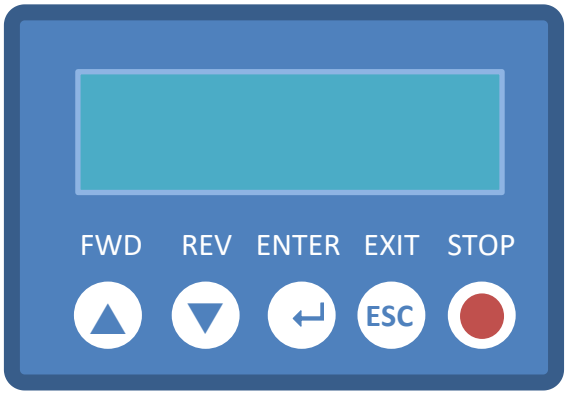
This manual describes the features & operation of firmware versions V5.2.x installed in the following products:

- ZENER8000
  - 240V “L” Series
  - 480V “R” Series
  - 1000V “V” Series
  - Specialty drives
- ECODRIVE8000
  - 240V “L” Series
  - 480V “R” Series

IMPORTANT

Not every feature described in this document is present in every product model. For model specific information, please refer to the specifications, parameter listings and fault message descriptions in individual product manuals.

Console



- 2 line x 16 character display for operation indication and parametric display
- The ▲FWD button
  - In Local mode, starts the motor in the forward direction
  - Increases the speed reference in Local mode
  - Moves to a previous menu or selection
  - Increases a parametric value.
- The ▼ REV button
  - In Local mode starts the motor in reverse (reverse enabled)
  - Decreases the speed reference in Local mode
  - Moves to the next menu or selection
  - Decreases a parametric value.
- The ENTER button enters a menu, accepts a value change or activates an action
- The ESC button exits a mode, menu, selection or value change.
- The STOP button
  - Stops the motor in Local mode
  - Resets a trip condition.

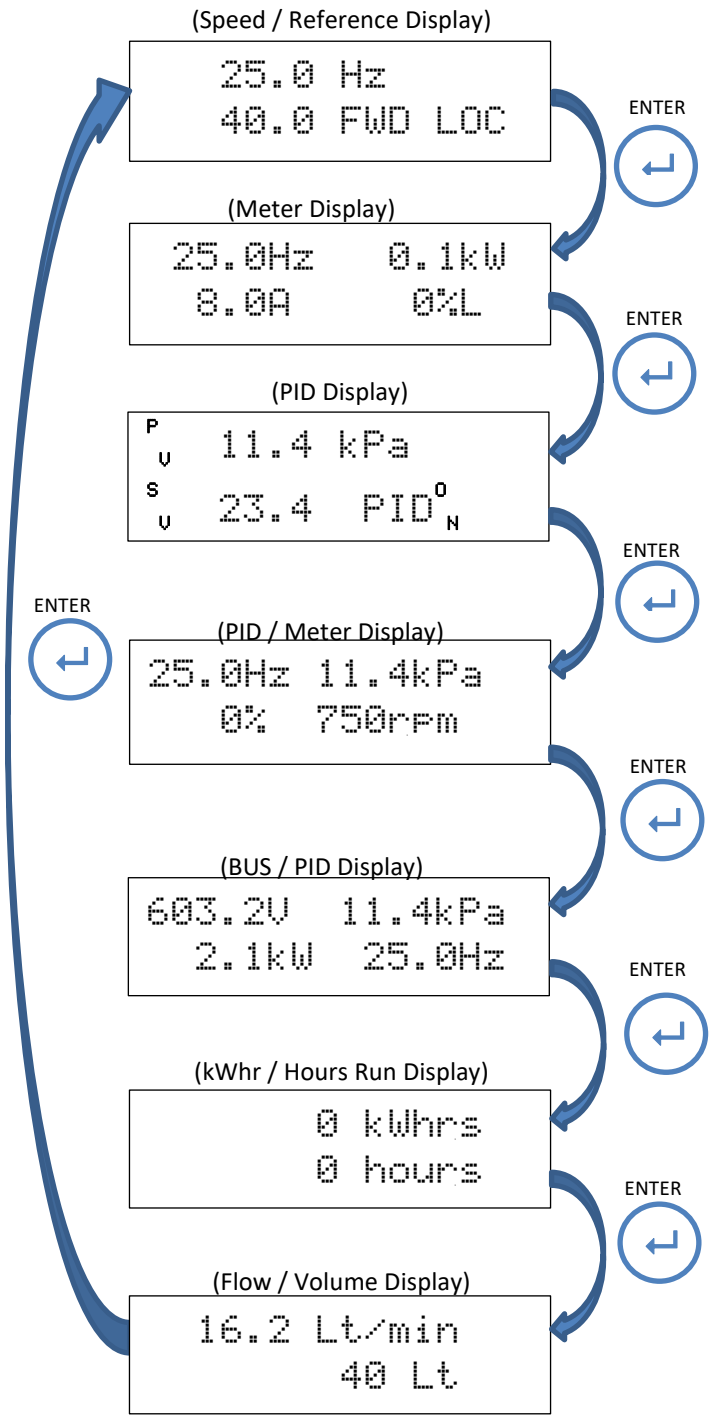
Version Display

When the ZENER 8000 is first powered up, the drive model and version is displayed. After 2 seconds the first operation display is revealed.

This revision of the reference manual describes all features up to V5.2.40.

Operation Displays

The operational displays show the operating state of the ZENER 8000. These displays include:



Speed / Reference Display

The top line displays the operating output frequency and the second line displays the speed reference and the drive status

Meter Display

The top line displays the operating output frequency and power and the second line displays output current and motor load.

PID Display

The top line displays the process variable (PV) with its units and the second line displays set-point variable (SV) expressed with the same units.

PID / Meter Display

The top line displays the operating output frequency and process variable (PV) and the second line displays motor load and motor speed.

BUS / PID Display

The top line displays the DC Bus voltage and process variable (PV) and the second line displays output power and output frequency (ECODRIVE8000 only).

kWhr / Hours Run Display

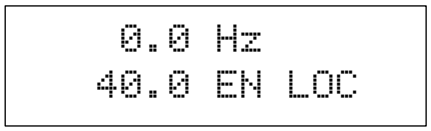
The top line displays the kWhrs consumed by the motor and the second line displays accumulated running time of the motor

Flow /Volume Display

The top line displays the flow rate in the selected units and the bottom line displays the volume delivered since power on or since last cleared (Only displayed with Bore level option fitted)

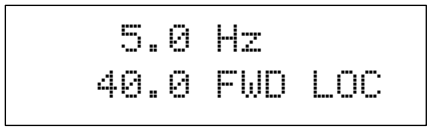
Example: Local Mode Operation

As shipped the ZENER 8000 will function in Local mode when a motor has been connected to it and when powered up.



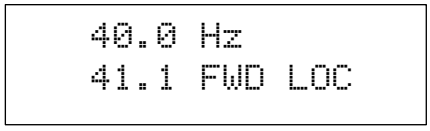
The Speed / Reference display above shows the desired output speed is 40 Hz and the motor shaft is not rotating.

- Press the ▲FWD button and the motor shaft begins to turn. The display shows:

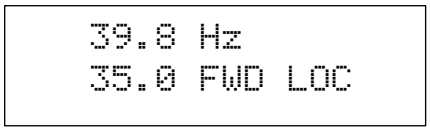


Press the ▼ REV button to starting in reverse (Reverse operation must be enabled).

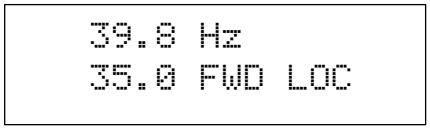
- Press the ▲ FWD button to increase the motor shaft speed.



- Press the ▼ REV button to decrease the motor shaft speed



- Press STOP and the motor shaft will slow down to stand-still.



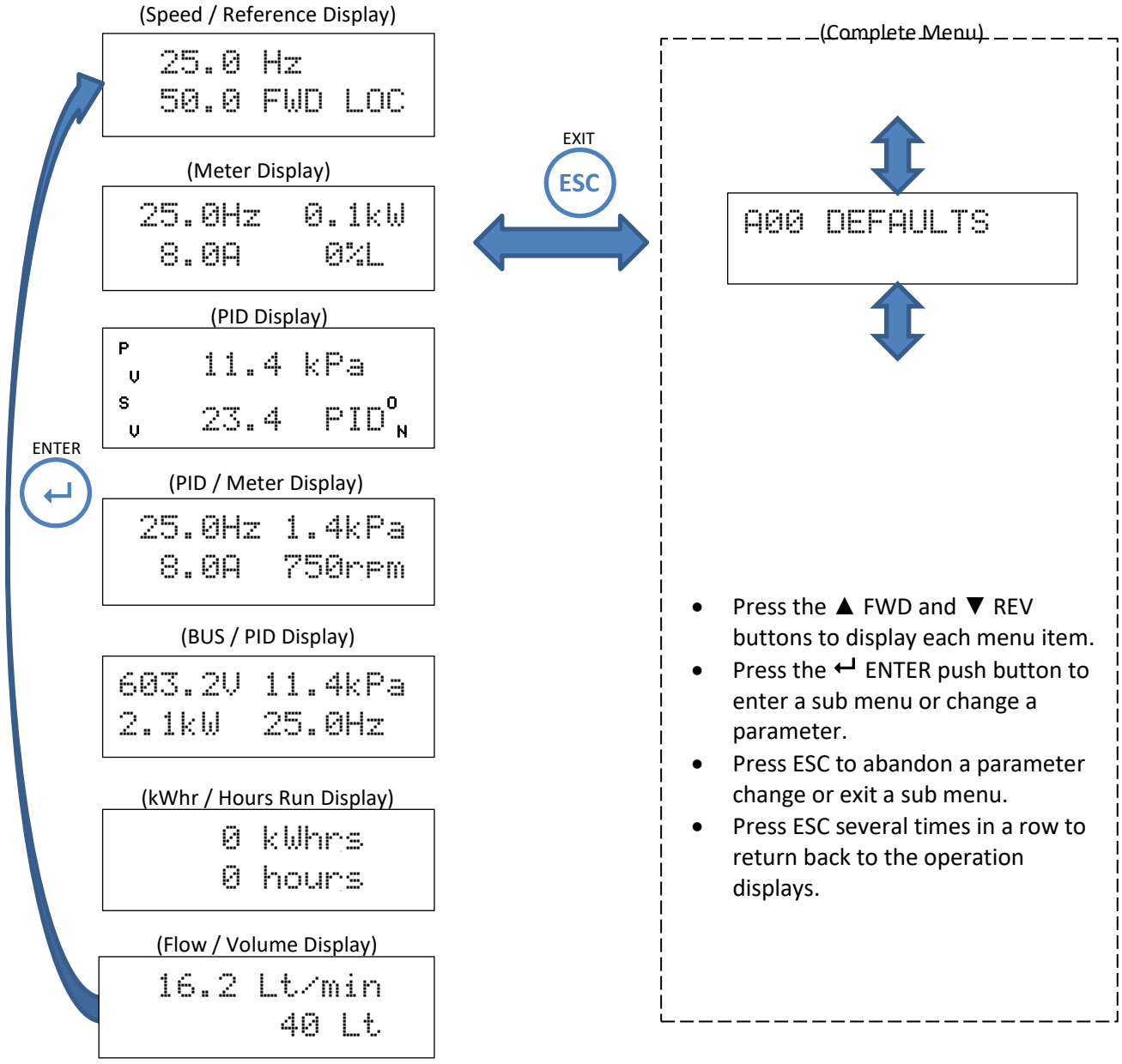
STOP will also reset a trip condition provided the trip has cleared.

IMPORTANT! If the motor shaft rotates in the wrong direction:

- Remove the input power,
- Wait for the ZENER 8000 to discharge
- Swap any two motor phase wires.
- Re-apply input power
- Re-check.

Complete Menu

The broad range of motor-drive solutions requires parametric configuration changes. To gain access to configuration parameters, press ESC to reveal the “Complete Menu”. With factory default parameters installed pressing ESC will reveal the complete menu.



IMPORTANT!

After applying power it is recommended that you at least go through the **B00 MOTOR**, **C00 PERFORMANCE** and **G00 INPUT/OUTPUT** menus to set up the ZENER 8000 before running the motor to prevent any unexpected motor operation. The ZENER 8000 is supplied with a link between the EN terminal and the +5V terminal. This link must always be made for the motor to run.

Applications

An “application” groups parameters together creating a short menu to summarise all the relevant parameters necessary for the task at hand. The ZENER 8000 has several applications on offer ready for service. Each application will have documentation detailing wiring and commissioning.

Standard ZENER8000 Applications

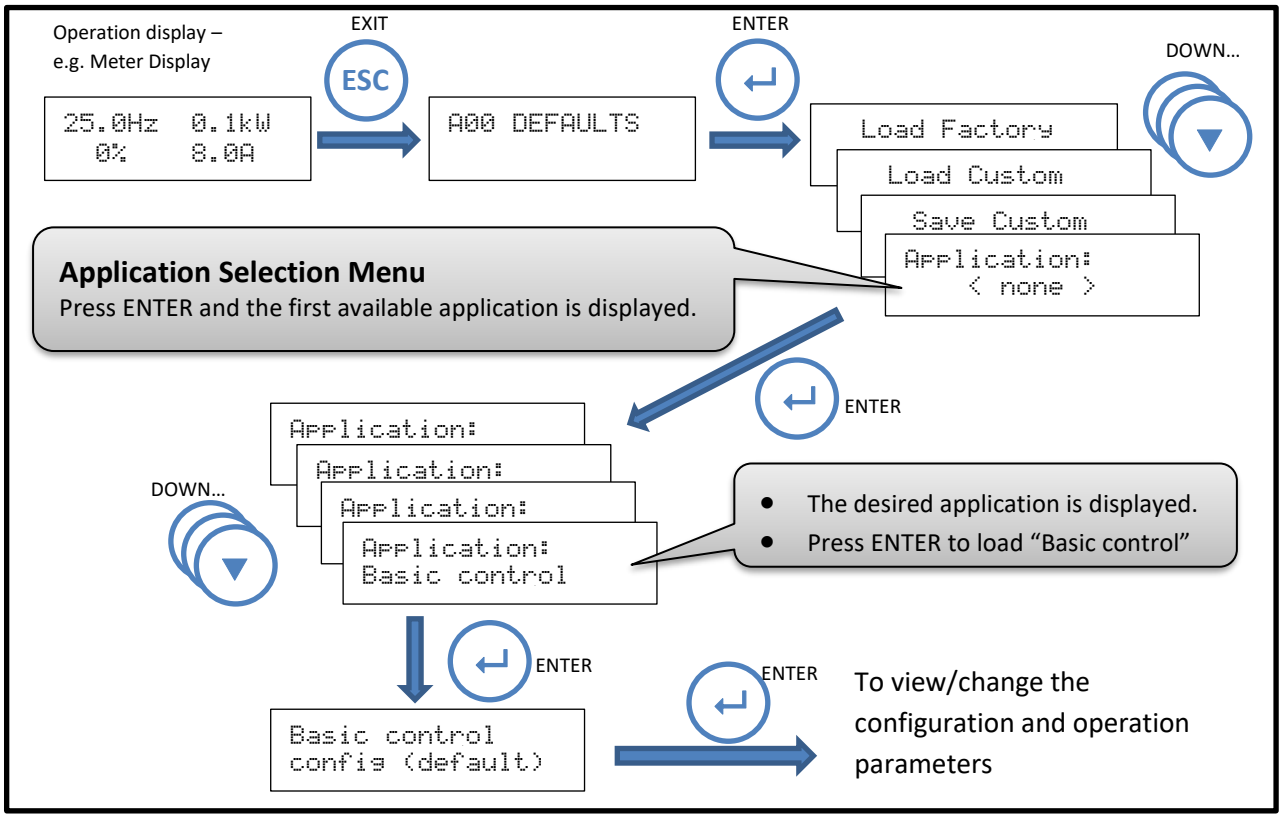
Application	Description	Item number
Basic Control	Standard Industrial terminals, 0 to 10V Remote reference	SW08018
Machine/JOG	Machine Drive, Start/Stop, Jog Forward & Reverse	SW08008
4 Speed Sel	1 of 4 Speed Speed reference selection	SW08017
Pressure Ctl	Water Pumping With Automatic Pressure Control	SW08013
Pump PID 1	PUMP PID 1 Automatic Pressure Control	SW08019
Pump PID 2	PUMP PID 2 Automatic Pressure Control	SW08020
Supply/Spill	Supply Air Fan / Smoke Spill Fan	SW08012
Stairwell Fan	Stairwell Fan, HVAC terminals	SW08010
Air Pressure	Auto Control Stair Pressurisation Fan	SW08011
Cooling Tower	Auto Control Cooling Tower Fan	SW08007
Ret Air Fan	Return Air Fan, HVAC terminals	SW08009

Standard ECODRIVE8000 Applications

Application	Description	Item number
Tank Solar	Solar only Tank Level Control	SW08000
Tank Sol/AC	Solar or AC supply, Tank Level Control	SW08001
PID/Solar	Solar only with Automatic Pressure Control	SW08002
PID/Solar/AC	Solar or AC supply, Automatic Pressure Control	SW08003

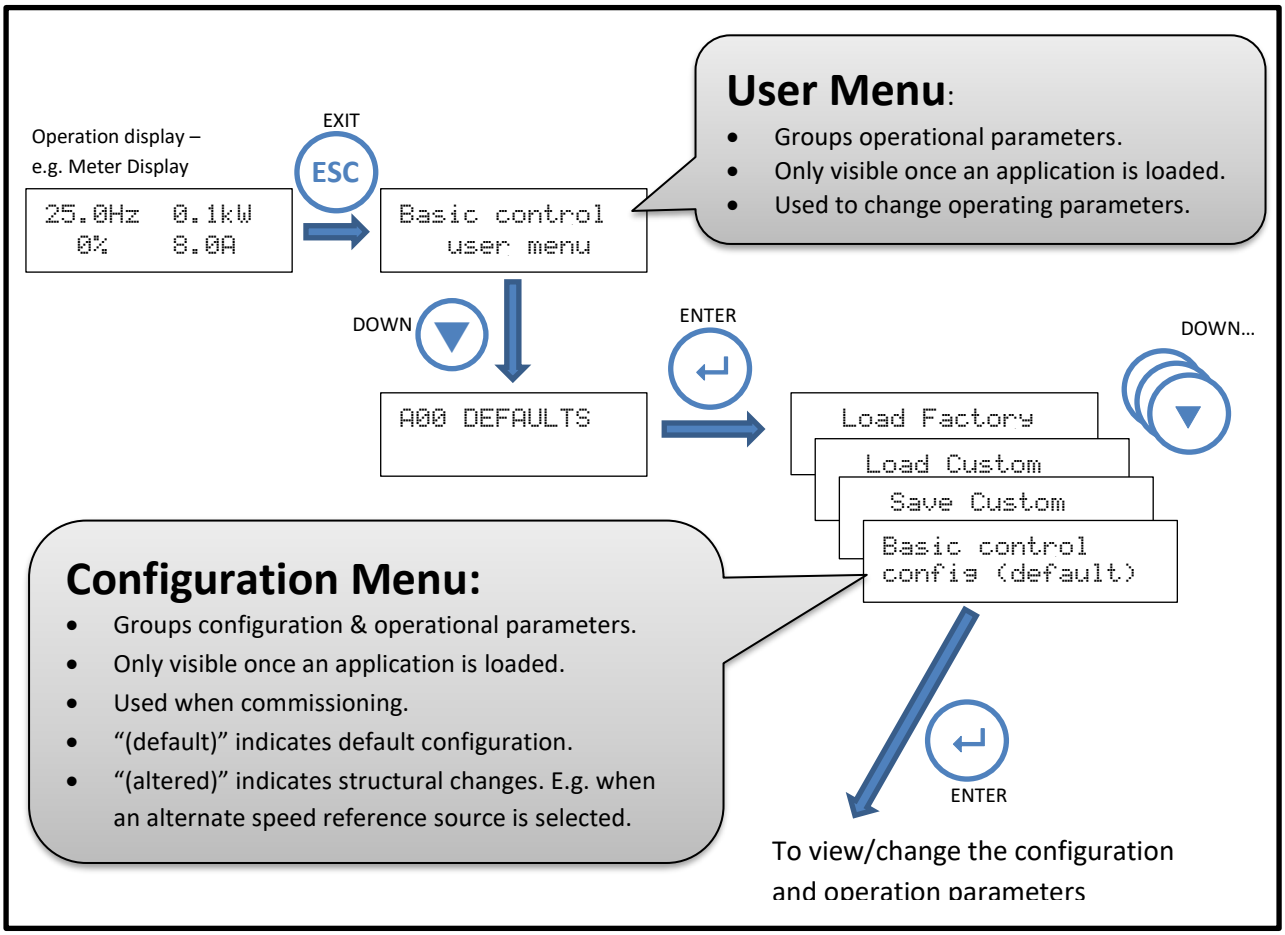
Loading an Application

Follow the diagram below to load an application in this case the “Basic control” application.



Application Menus

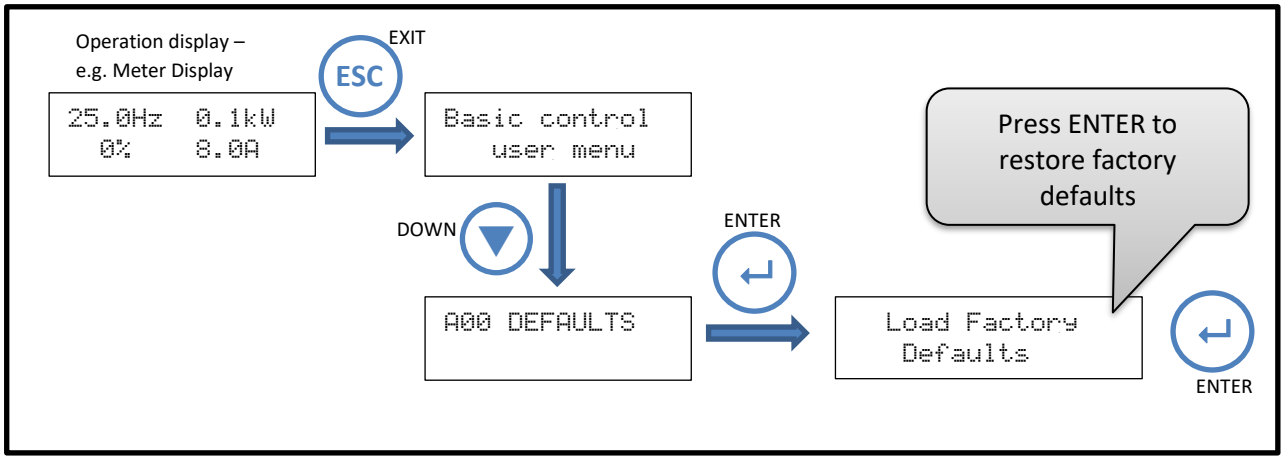
When an application is loaded, two new menus are created: The User menu and the Configuration menu.



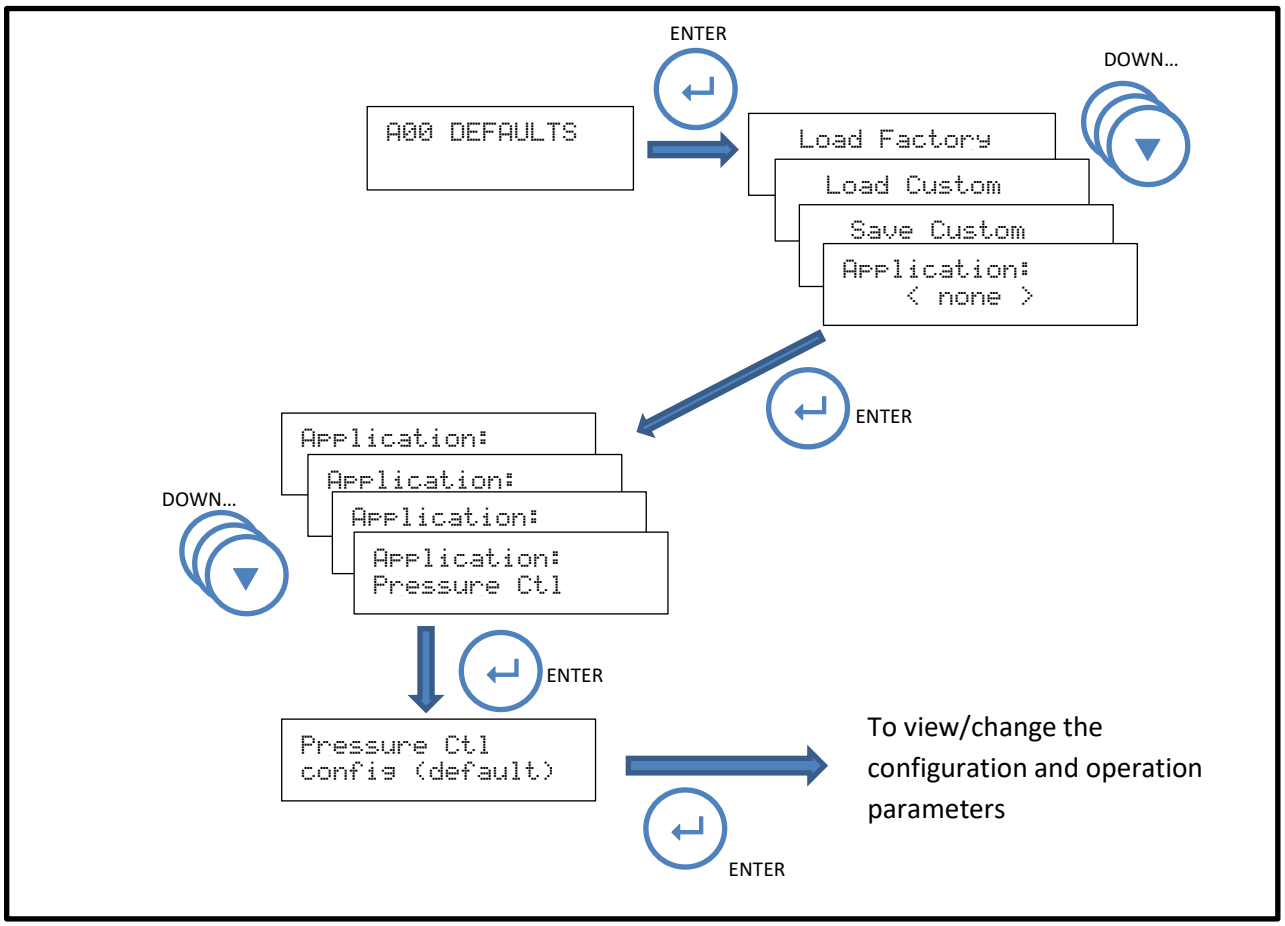
Changing / Re-loading an Application

There are 2 steps necessary to change an application:

1. Restore factory defaults.



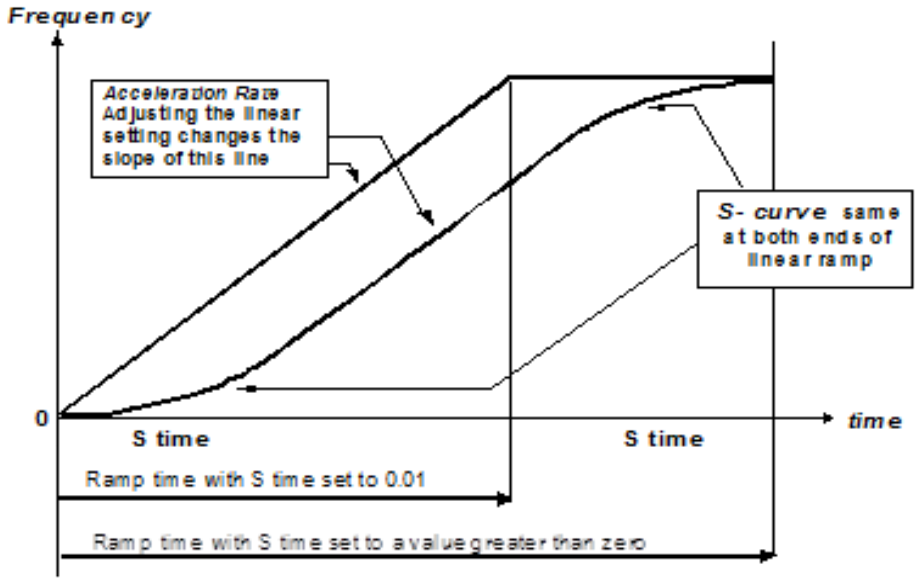
2. Select a new application.



Major Features

Motor Speed Ramp

The ZENER 8000 has a programmable Ramp with adjustable acceleration, deceleration and S-curve rates. Individual settings are provided for the linear and curved portions of the ramp. The motor accelerates at a rate of **B03 MOTOR Hz / C030 ACCEL TIME** and decelerates at a rate of **B03 MOTOR Hz / C031 DECEL TIME**. Each of these rates is applied over the **C032 S TIME** interval to create the S-curve in the diagram above.



Key parameters are:

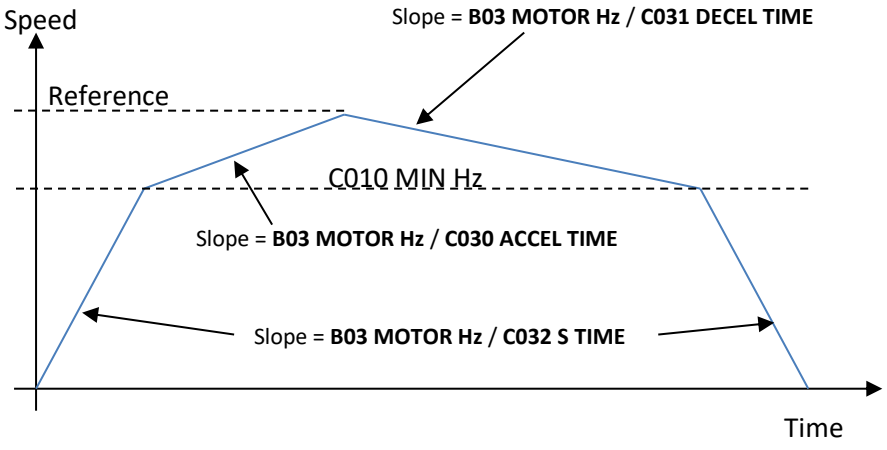
- **B03 MOTOR Hz**
- **C030 ACCEL TIME**
- **C031 DECEL TIME**
- **C032 S TIME**
- **C033 DUAL RAMP**

CAUTION

A separate ramp setting is used during Essential Services Override (ESO) operation. See **C034 ESO RAMP** for details.

Dual Ramps

For applications that use a minimum speed, the ZENER 8000 provides a dual rate acceleration and deceleration. The **C033 DUAL RAMP** option provides this feature. When enabled the rate of acceleration and deceleration in the speed range 0 to **B03 MOTOR Hz** is at a rate of **B03 MOTOR Hz / C032 S TIME**. The diagram below shows the reference as a function of time. Refer to **C033 DUAL RAMP** for details.



Key parameters are:

- **C033 DUAL RAMP**

(function activation)

- **C032 S TIME**
- **C030 ACCEL TIME**
- **C031 DECEL TIME**
- **B03 MOTOR Hz**

Essential Services Override

There are circumstances in some applications for which it is desirable to disable certain of the protective features of the ZENER 8000. These are situations where continued operation has a higher priority than preventing damage to the ZENER 8000 or associated motor. A typical example is a building air conditioning application in which a fan is required to operate as part of a smoke clearance system. Various standards, for example, AS/NZS 1668.1:1998: The use of ventilation and air conditioning in buildings - Fire and smoke control in multi-compartment buildings require that all thermal protection be disabled during operation in a smoke clearance mode and equipment allowed, if necessary, to run to destruction. The ZENER 8000 provides a special mode, Essential Services Override (ESO), to give effect to these requirements.

Operation in ESO requires a control terminal to be configured for the ESO function and that this terminal to be connected to +5V (terminal 1) whenever ESO operation is required. During ESO operation the ZENER 8000 is forced to run and the following protective functions are disabled:

Heat sink over temperature protection
I2t protection
Motor thermistor protection (if fitted)
Supply Fail

In addition, the Auto Restart function is automatically enabled with unlimited auto restarts permitted. In order to allow the ZENER 8000 to be independently optimised for both the usual operating condition and operation in ESO mode, separate parameters are provided for ESO and non ESO operating modes.

WARNING regarding Essential Services Override

The Essential Services Override (ESO) feature provides a “run to destruction” mode of operation for applications that justify this approach. For applications in which this approach is not mandatory, the safety and other implications of the ESO operating mode should be carefully considered in the light of alternative approaches before choosing to use the ESO functionality of the ZENER 8000. It is fundamental to the ESO mode of operation that all protection against overheating of the ZENER 8000 and the associated motor is disabled. This may represent a fire or other hazard. Damage to the ZENER 8000 due to overheating during ESO operation is not covered by warranty. Equipment that has been exposed to ESO operation under conditions that may have been outside the normal boundaries of rated operation should be inspected for damage and internal component degradation prior to being returned to service in a critical application. This inspection and any necessary repairs should be conducted irrespective of whether the ZENER 8000 appears to be working normally or not. Only competent personnel should undertake this work.

CAUTION

Any use of the Essential Services Override feature should be arranged to comply with all local rules and regulations concerning the particular application.

Key ESO configuration parameters are:

- **F030 ESO Ref** (reference selection)
- **F031 ESO Input** (input terminal selection)
- **F032 ESO RAMP**

Remote User Mode Overrides

The ZENER 8000 has customisable user modes of operation. A user mode is given a priority for REMOTE reference choice and optionally; motor start and motor stop governance. Features include:

- 2 user modes: "**USER MODE 1**" and "**USER MODE 2**".
- Selectable speed reference for each mode.
- A prioritised activation input for each mode - "**USER MODE 1**" (highest); "**USER MODE 2**" (lowest).
- A status messages for each mode.
- Each user mode has optional run signal generation.
- Each user mode has optional run latch reset.

Activation of a user mode supplies a reference to the motor control of ZENER 8000. Depending on the mode's configuration the activation input can also supply a run signal. When the mode is deactivated it may reset the run latch also dependant on the mode's configuration.

Key configuration parameters for **USER MODE 1** are:

- **F0120 MODE1 REF** (reference choice)
- **F0121 MODE1 Inpt** (digital input choice)
- **F0122 MODE1 msg** (status message text)
- **F0123 MODE1 cfg**
    - **Reference Only**
    - **Ref & start only** (activates the run latch; requires STOP input)
    - **Ref,start&stop** (input held asserted runs the ZENER 8000/motor; breaks the run latch)
    - **Stop only** (breaks the run latch an clears FWD and REV)

Key configuration parameters for **USER MODE 2** are:

- **F0130 MODE2 REF** (reference choice)
- **F0131 MODE2 Inpt** (digital input choice)
- **F0132 MODE2 msg** (status message text)
- **F0133 MODE2 cfg**
    - **Reference Only**
    - **Ref & start only** (activates the run latch; requires STOP input)
    - **Ref,start&stop** (input held asserted runs the ZENER 8000/motor; breaks the run latch)
    - **Stop only** (breaks the run latch an clears FWD and REV)

Reference Selector

The reference selector permits 1 of 8 references to be selected for desired motor speed. Of the 8 references six are fixed to internal presets. The remaining 2 references, called User References, may be selected from a list of all available references including additional internal presets.

The ZENER 8000 offers 3 methods for reference selection. These methods are:

- Multiplexor Selection Method
- Channel Selection Method
- Input Tally Selection Method.

User References

There are 2 customisable inputs to the reference selector. They are **F061 USER REF 1** and **F062 USER REF 2**. Each of these parameters is itself a single reference selection from the list of available speed reference sources.

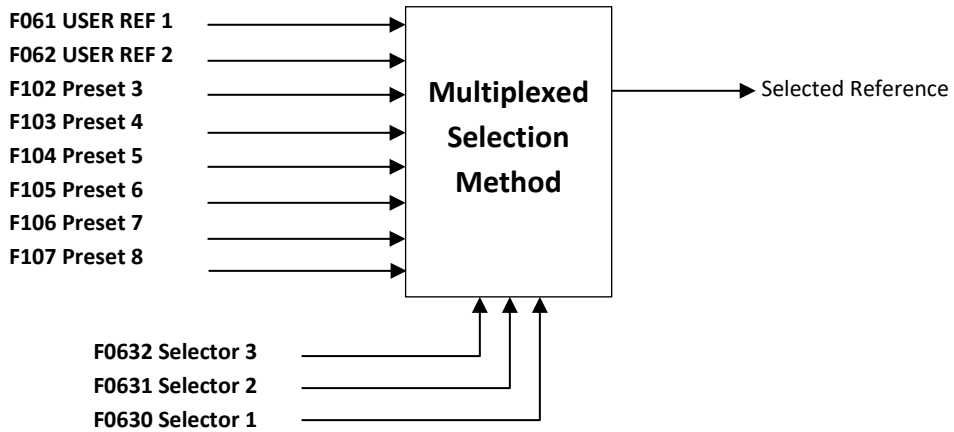
Key configuration parameters are:

- **F060 Method**
- **F061 USER REF 1** and **F062 USER REF 2**
- **F0630 Selector 1** to **F0637 Selector 8** (input terminal selection)
- **F100 Preset 1** to **F107 Preset 8**
- Set **REF SELECT** as a speed reference in REMOTE, LOCAL, ESO, etc.

Multiplexed Selection Method

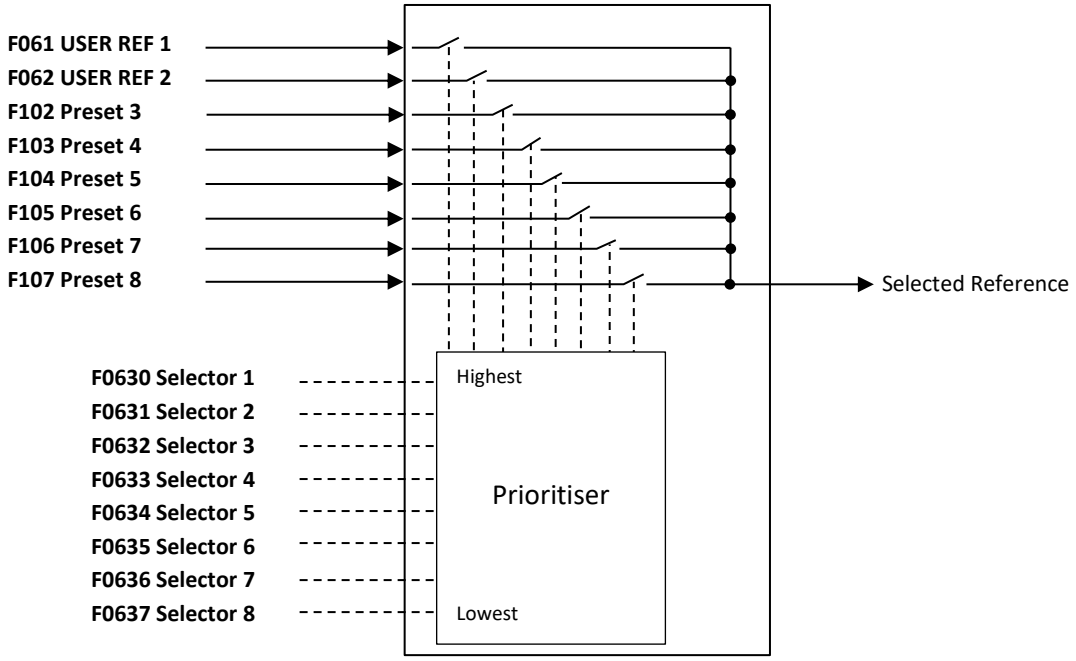
The Multiplexor Selection Method uses three digital inputs to select 1 of 8 reference sources. The High/Low states of the three digital inputs chosen by **F0630 Selector 1**, **F0631 Selector 2** and **F0632 Selector 3** make 8 unique combinations. Each combination is assigned a reference source as given in the table below:

F0632 Selector 3	F0631 Selector 2	F0630 Selector 1	Selected Reference
Low	Low	Low	**F061 USER REF 1**
Low	Low	High	**F062 USER REF 2**
Low	High	Low	**F102 Preset 3**
Low	High	High	**F103 Preset 4**
High	Low	Low	**F104 Preset 5**
High	Low	High	**F105 Preset 6**
High	High	Low	**F106 Preset 7**
High	High	High	**F107 Preset 8**



Multi Speed Selection Method

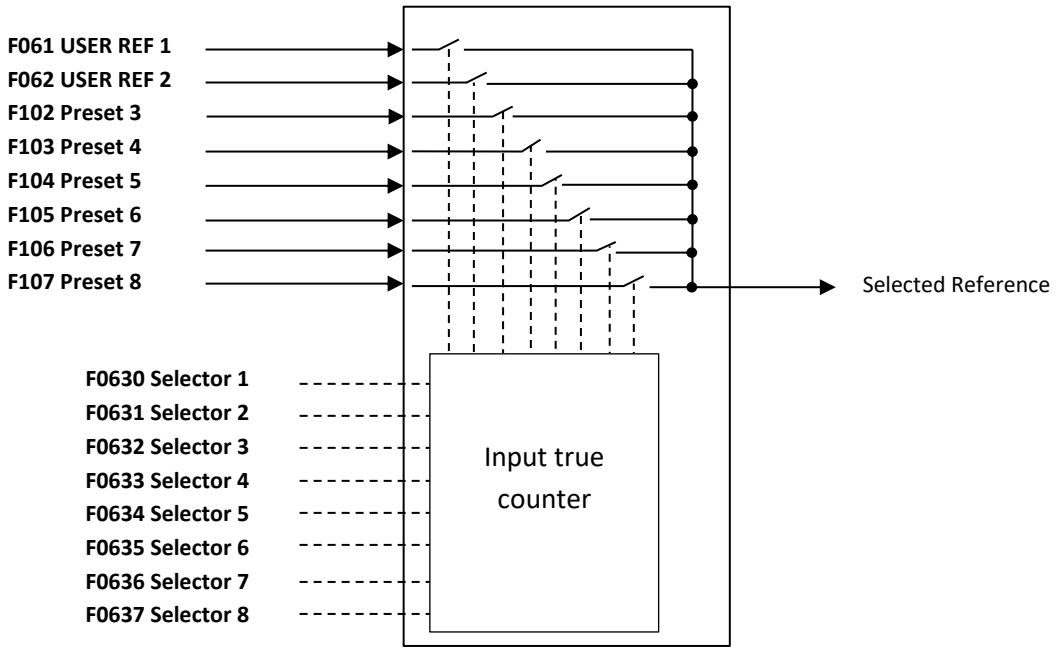
The Multi Speed Selection method uses a single digital input to select a single reference. For example if the digital source for **F0632 Selector 3** evaluates true then **F102 Preset 3** is selected for the output reference. If a second input evaluates true, the reference with the highest priority is selected. If no selector channel evaluates true then the output reference is zero.



Input Tally Selection Method

In this method a count of inputs that evaluate true selects the reference. For example if **F0632 Selector 3**, **F0634 Selector 5**, **F0636 Selector 7** and **F0637 Selector 8** evaluate true then the count will be 4. A count of 4 selects

F103 Preset 4 as the output reference. If the count is zero then the output reference will be zero



Terminal Configurations

The ZENER 8000 provides a flexible method of input configuration is capable of fulfilling control requirements of an ever increasing numbers of motor and drive applications. The ZENER 8000 has a comprehensive set of logical digital inputs to control its behaviour for the application at hand.

Standard Configurations

The ZENER 8000 provides several commonly used input terminal configuration. The **G01 DI config** menu shows the selected configuration. The available choices are:

- Standard Industrial
- HVAC
- Power up/start
- Forward/Reverse
- Machine drive 1
- Machine drive 2
- Machine drive 3
- Custom

The table below lists the configurations and shows which physical terminal drives each internal inverter function.

Internal function / Configuration	I00 FWD& LATCH	I01 REV& LATCH	I02 ~STOP	I03 FWD	I04 REV	IO5 UP	I06 DOWN	I07 RESET	I08 ESO	I09 JOGFWD	I10 JOGREV	I11 REMOTE
Standard Industrial	D3(4)	OFF	D2(3)	OFF	OFF	OFF	OFF	D1(2)	OFF	OFF	OFF	D4(5)
HVAC	D2(3)	OFF	D1(2)	OFF	OFF	OFF	OFF	EN(6)	D3(4)	OFF	OFF	D4(5)
Power up/start	EN(6)	OFF	EN(6)	OFF	OFF	OFF	OFF	EN(6)	OFF	OFF	OFF	EN(6)
Forward/ Reverse	D2(3)	D3(4)	D1(2)	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	D4(5)
Machine drive 1	D2(3)	OFF	D1(2)	OFF	OFF	OFF	OFF	OFF	OFF	D3(4)	OFF	D4(5)
Machine drive 2	OFF	OFF	OFF	D1(2)	D2(3)	OFF	OFF	OFF	OFF	D3(4)	D4(5)	EN(6)
Machine drive 3	D2(3)	OFF	D1(2)	OFF	OFF	D3(4)	D4(5)	OFF	OFF	OFF	OFF	EN(6)
Custom	*User defined. Refer to each function*											

The Custom Terminal Configuration

To create and alter a custom terminal configuration, the **G01 DI config** parameter must be set to **Custom**. When **G01 DI config** is set to **Custom**, each logical function input is un-locked and the current selection can be viewed or altered. The table below lists the logical functions and their behaviours.

Function	Description	Parameters
I00 FWD&LATCH	A momentary contact closure on this input will start the motor in the forward direction. When the input is removed the motor continues to run in the forward direction (latching). It requires: **I02 ~STOP** to be asserted for the motor to run; and de-asserted to break the latch and stop the motor.	None
I01 REV& LATCH	A momentary contact closure on this input will start the motor in the reverse direction. When the input is removed the motor continues to run in the reverse direction (latching). It requires: **I02 ~STOP** to be asserted for the motor to run; and de-asserted to break the latch and stop the motor. **D03 REVERSE** must be **ENABLED** for the motor to run backwards.	None
I02 ~STOP	Assert this input for the motor to run in either direction. If de-asserted, the RUN latch is cleared and the motor will stop running. For use with: **I00 FWD&LATCH** and/or **I01 REV&LATCH**	
I03 FWD	Assert and hold this input to run the motor in the forward direction. When this input is de-asserted the motor will stop running (non-latching) if no other pre-existing run command is asserted. Notes: **I03 FWD** disregards the state of **I02 ~STOP** input and the motor will not stop while asserted.	None
I04 REV	Assert and hold this input to run the motor in the reverse direction. When this input is de-asserted the motor will stop running (non-latching) if no other pre-existing run command is asserted. Notes: **I04 REV** disregards the state of **I02 ~STOP** input and the motor will not stop while asserted. **D03 REVERSE** must be **ENABLED** for the motor to run backwards.	None
IO5 UP	Increases the CONSOLE reference	None
I06 DOWN	Decreases the CONSOLE reference	None
I07 RESET	Will attempt to reset a trip condition	None

Function	Description	Parameters
I08 ESO	While asserted and held the ZENER 8000 will operate in essential services override (ESO). When activated: The motor runs at the selected ESO speed, The following trips are ignored: Supply Fail I^2t Trip All temperature related trips Infinite auto restart of all other trips is enabled The ramp acceleration and deceleration times are set to 10 seconds (default) Auto Restart and Ramp parameters cannot be changed whilst ESO is in operation Reverse operation may occur and is dependent on speed source. Refer to **F03 ESO Config** of the **F00 REFERENCES** menu for ESO speed source selection.	**F030 ESO REF** **F032 ESO RAMP**
I09 JOGFWD	Asserting this input will run the motor forward at the JOGFWD speed. It will also clear the run latch. When the contact is de-asserted the motor will stop	**F040 JOGFWD REF**
I10 JOGREV	Asserting this input will run the motor reverse at the JOGREV speed. It will also clear the run latch. When the contact is de-asserted the motor will stop. It requires: **D03 REVERSE** must be **ENABLED** for the motor to run backwards.	**F050 JOGREV REF**
I11 REMOTE	Asserting this input means that the ZENER 8000 will follow the control inputs on the terminal strip and the motor will run at the speed set by the Remote speed reference. When de-asserted, the ZENER 8000 will be controlled from the console and will run at the speed set by the Local speed reference. This input requires other terminals to stop and start the motor.	**F010 REMOTE REF** **F02 LOCAL REF**

Digital Sources

A digital source is chosen for each function in the table above. The list of digital sources includes:

ON, OFF
EN(6), ~EN(6), /EN(6), EN(6)\ ,
D1(2), ~D1(2), /D1(2), D1(2)\ ,
D2(3), ~D2(3), /D2(3), D2(3)\ ,
D3(4), ~D3(4), /D3(4), D3(4)\ ,
D4(4), ~D4(4), /D4(4), D4(4)\ ,
D1(31)[1], ~D1(31)[1], /D1(31)[1], D1(31) \[1],
D2(33)[1], ~D2(33)[1], /D2(33)[1], D2(33)\[1],
D3(35)[1], ~D3(35)[1], /D3(35)[1], D3(35)\[1],
D4(37)[1], ~D4(37)[1], /D4(37)[1], D4(37)\[1],
D1(51)[2], ~D1(51)[2], /D1(51)[2], D1(51)\[2],
D2(53)[2], ~D2(53)[2], /D2(53)[2], D2(53)\[2],
D3(55)[2], ~D3(55)[2], /D3(55)[2], D3(55)\[2],
D4(57)[2], ~D4(57)[2], /D4(57)[2], D4(57)\[2],
TMR1, ~TMR1, TMR2, ~TMR2, TMR3, ~TMR3
Hi AI(10,11), ~Hi AI(10,11), Lo AI(10,11), ~Lo AI(10,11),
Hi AI(32,34)[1], ~Hi AI(32,34)[1], Lo AI(32,34)[1], ~Lo AI(32,34)[1],
Hi AI(52,54)[2], ~Hi AI(52,54)[2], Lo AI(52,54)[2], ~Lo AI(52,54)[2],
PV-A UNDER, ~PV-A UNDER, PV-A OVER, ~PV-A OVER,
PIPE FILL TMR, ~ PIPE FILL TMR,
UNDER SPEED, ~UNDER SPEED, OVER SPEED, ~OVER SPEED,
UNDER LOAD, ~UNDER LOAD, OVER LOAD, ~OVER LOAD,
PV-B UNDER, ~PV-B UNDER, PV-B OVER, ~PV-B OVER,
CMP1, CMP2, CMP3, CMP4, CMP5,
LOGIC BLOCK 1, LOGIC BLOCK 2
LOGIC BLOCK 3, LOGIC BLOCK 4
UNDER MIN Hz, ~UNDER MIN Hz,
PV-A OutOfReg, ~PV-A OutOfReg,
PV-B OutOfReg, ~PV-B OutOfReg
Supply seq +ve, Supply seq -ve,
No flow
Internal Relay 1, 2, 3, 4
PG RUN signal
RUN, ~RUN, /RUN, RUN\, RUN command
TRIP, PROOF, TRIP ex PF/UV
1Probe&TON[3], 1 Probe&TOFF[3], 2Probe Control[3]
Hi P(76,77)[3], Lo P(76,77)[3], Hi RTD1[3], Lo RTD1[3]
Hi Flow[3], Lo Flow[3], Vol. delivered[3], Time Clock Opt

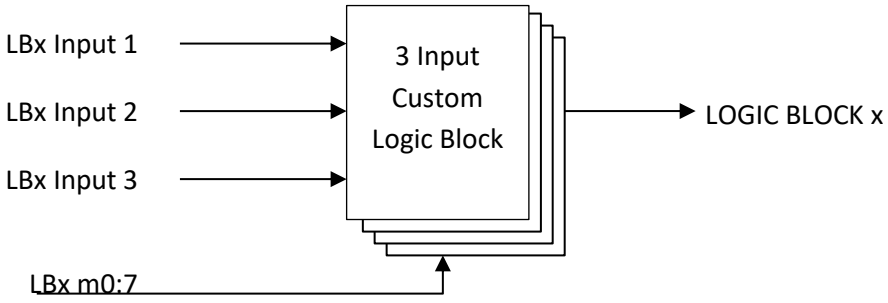
[1] Only visible if extended features card fitted left
[2] Only visible if extended features card fitted right
[3] Only visible if the Bore Level option card is fitted

The choices for physical terminals include:

Selection	Input Truth
D1(2)	Active high level is selected
~D1(2)	Active low level is selected
/D1(2)	Active rising edge is selected
D1(2)	Active falling edge is selected

Logic Blocks

The ZENER 8000 provides four combination logic blocks. Each block combines 3 source selectable digital inputs to produce a single digital output with user specified Boolean logic.



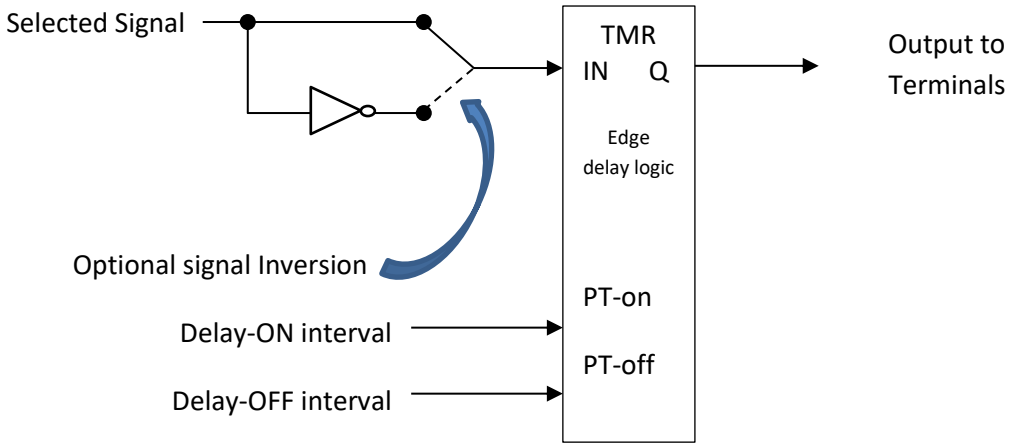
Key configuration parameters are:

I200 LB1 Input 1	**I210 LB2 Input 1**	**I220 LB3 Input 1**	**I230 LB4 Input 1**
I201 LB1 Input 2	**I211 LB2 Input 2**	**I221 LB3 Input 2**	**I231 LB4 Input 2**
I202 LB1 Input 3	**I212 LB2 Input 3**	**I222 LB3 Input 3**	**I232 LB4 Input 3**
I203 LB1 m0:7	**I213 LB2 m0:7**	**I223 LB3 m0:7**	**I233 LB4 m0:7**

Digital Outputs

The ZENER 8000 offers several options for external indication or control of external equipment. Each digital output has the following features:

- A wide selection of driving signals. Refer to “Relay Signal Choice” on page 102 for a complete list.
- Optional activating signal inversion/compliment
- Edge delay timer intervals for sources with fluctuating signals



Key configuration parameters are:

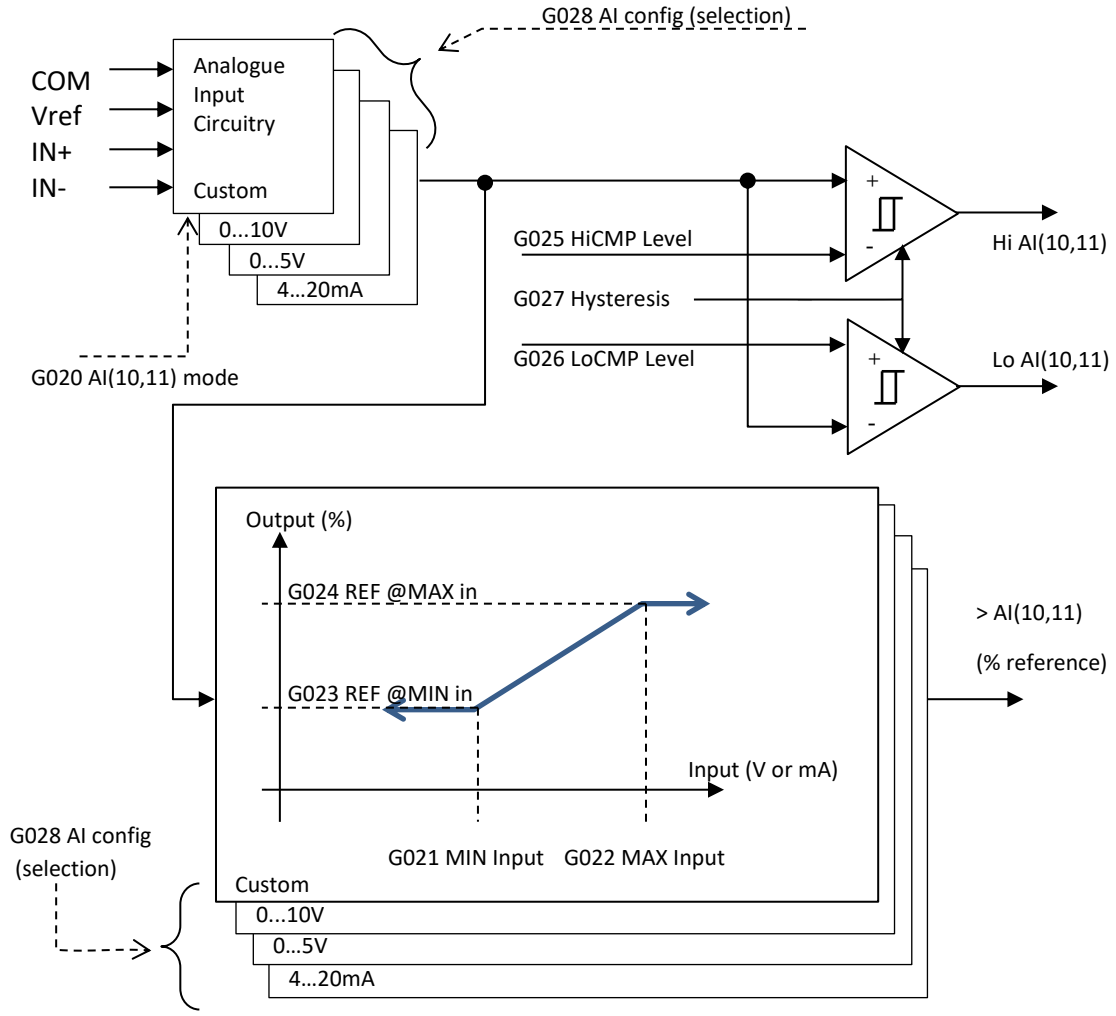
Digital Output	Parameters	Digital Output	Parameters
G03 RL1(15,16)	G030 RL1 Signal G031 RL1 Sense G032 RL1 TON G033 RL1 TOFF	**G04 RL2(15,16)**	G040 RL2 Signal G041 RL2 Sense G042 RL2 TON G043 RL2 TOFF
G08 DO(39,41) [1]	G080 DO Signal G081 DO Sense G082 DO TON G083 DO TOFF	**G12 DO(59,61)** [2]	G120 DO Signal G121 DO Sense G122 DO TON G123 DO TOFF
G17 RL(70,71,72) [3]	G170 RL Signal G171 RL Sense G172 RL TON G173 RL TOFF	**G18 RL(73,74,75)** [3]	G180 RL Signal G181 RL Sense G182 RL TON G183 RL TOFF
G19 RL(80,81,82) [4]	G190 RL Signal G191 RL Sense G192 RL TON G193 RL TOFF	**G20 RL(83,84,85)** [4]	G200 RL Signal G201 RL Sense G202 RL TON G203 RL TOFF
G50 RL(90,91,92) [4]	G500 RL Signal G501 RL Sense G502 RL TON G503 RL TOFF	**G51 RL(93,94,95)** [4]	G510 RL Signal G511 RL Sense G512 RL TON G513 RL TOFF G514 Def wakeup:

[1] Only visible if Extended Features card fitted left
[2] Only visible if Extended Features card fitted right
[3] Only visible if Change-over Relay card fitted left
[4] Only visible if Change-Over Relay card fitted right

Analogue Inputs and Spanning

The ZENER 8000 analogue inputs have been designed with the following features:

- Configurable voltage (V) or current (mA) input configuration.
- Easy to configure spanning and translation.
- High and Low compare logic outputs with adjustable thresholds



Key configuration parameters are:

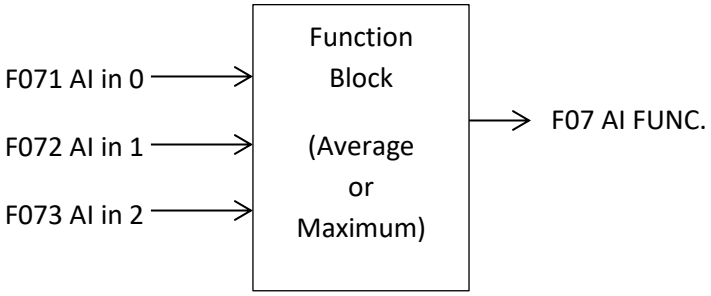
- **G028 AI config**
  - **0…10V**
  - **0…5V**
  - **4...20mA**
  - **Custom**
- **G020 AN IN mode**
- **G021 MIN input** and **G022 MAX input**
- **G023 REF @MIN in** and **G024 REF @MAX in**
- **G025 HiCMP Level** and **G026 LoCMP Level**
- **G027 Hysteresis**

Combining Analogue Inputs

The ZENER 8000 is able to perform arithmetic to combine several analogue inputs into a single reference. Select either “Average” or “Maximum” to combine analogue input readings. The function block offers three inputs to combine:

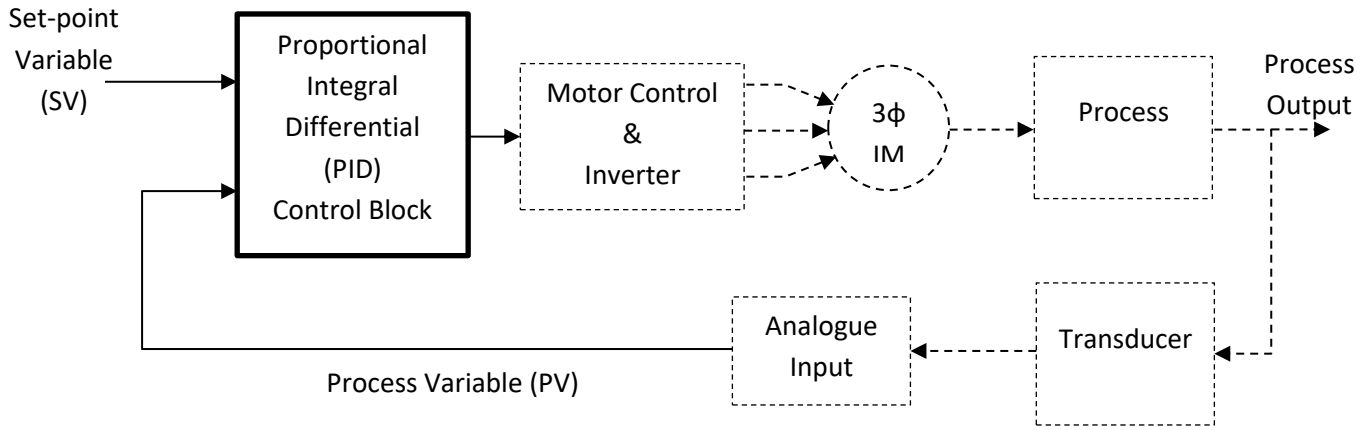
Key configuration parameters are:

- **F070 AI Function**
  - **“Average fxn”** or
  - **“Maximum fxn”**
- **F071 AI in 0 sel**
- **F072 AI in 1 sel**
- **F073 AI in 2 sel**



Proportional Integral Differential (PID) Control

Proportional Integral Differential (PID) Control Block is used to stabilise and/or regulate a process at a desired operating output. PID controllers function by finding the “error” difference between the required set-point variable (SV) and a measured process variable (PV). In regulator mode, the PID controller operates to reduce the error to zero at which point the measured quantity is equal to the required operating point.

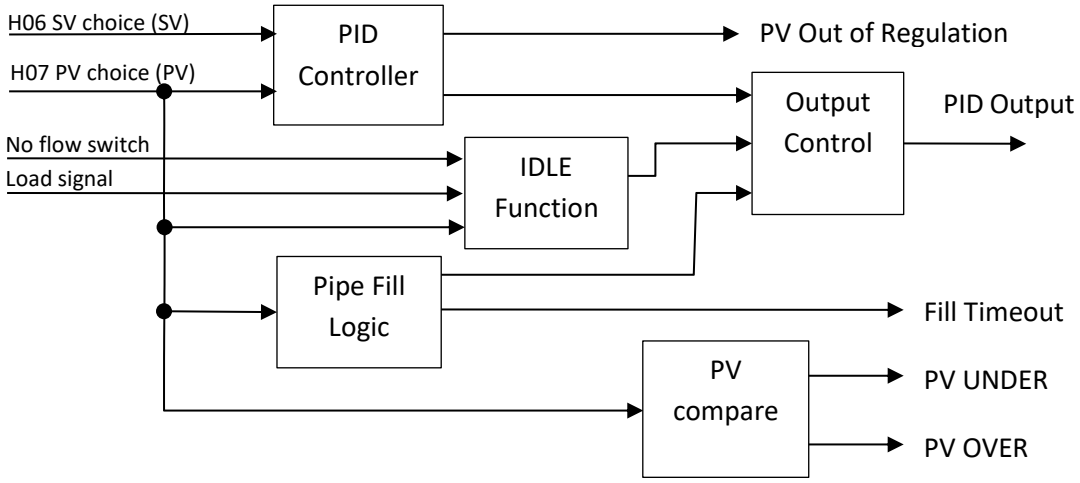


PID features include:

- Three term tuning (PB%, Ti, and Td).
- Output saturation with integrator anti-windup.
- Reference and feedback signal source selections.
- Open loop to closed loop initialisation.
- Process variable spanning and offset available through the selected analogue input.
- Process variable limit alarms with adjustable thresholds.
- Displays incorporating the process variable
- Pumping features:
  - IDLE detection logic
  - Pipe Fill logic for controller and plant initialisation.
  - Multi-pump Cascade control

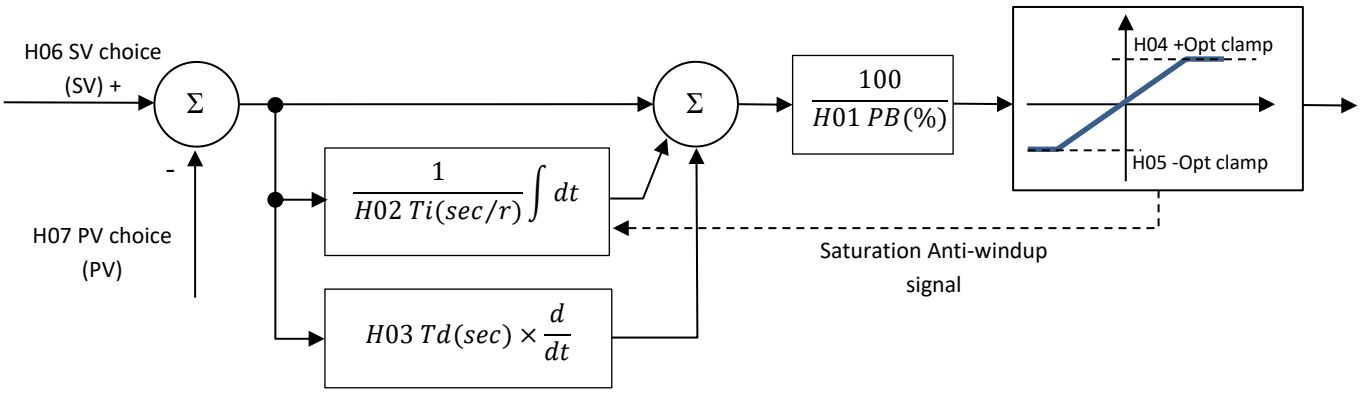
The ZENER 8000 PID-A Control Block

The ZENER 8000 Proportional Integral Differential (PID) Controller is composed of several functional blocks. The diagram below illustrates the structure.



PID Controller

The diagram below shows parameters and structure of the ZENER 8000 PID controller.



Key configuration parameters are:

- **H01 PROP. BAND**
- **H02 Integ. time**
- **H03 Diff time**
- **H04 +Opt clamp**
- **H05 –Opt clamp**
- **H06 SV choice**
- **H07 PV choice**
- **H08 PID Units** (for PID display)
- **H09 PID Scale** (for PID display)

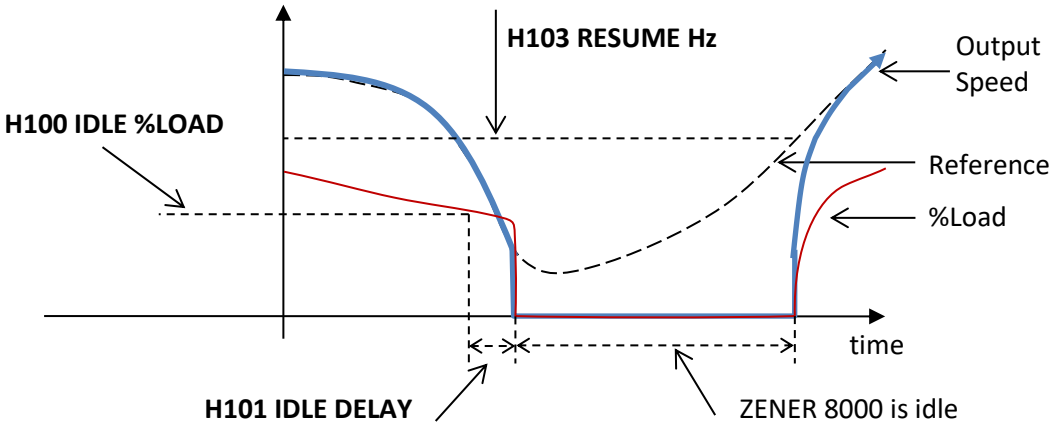
Idle Function

The idle function will stop operation if the %LOAD of ZENER 8000 is lower than **H100 IDLE %LOAD** or the **H107 No Flow Sel** status is true for a time interval specified by **H101 IDLE DELAY**. The conditions for the ZENER 8000 to enter the idle state are:

- ZENER 8000 is enabled (the "EN" terminal connected to "+5V" terminal) & not be tripped.
- Reverse is disabled (D05 Reverse).
- ESO is not active & the jog function is not active.
- No motor stop condition exists: ~STOP wiring in remote mode; STOP button in local mode.
- A run signal is given: FWD & LATCH wiring in remote mode; FWD push button press in local mode.
- %LOAD of ZENER 8000 is lower than **H100 IDLE %LOAD** or the **H107 No Flow Sel** status is true for a time interval specified by **H101 IDLE DELAY** period.

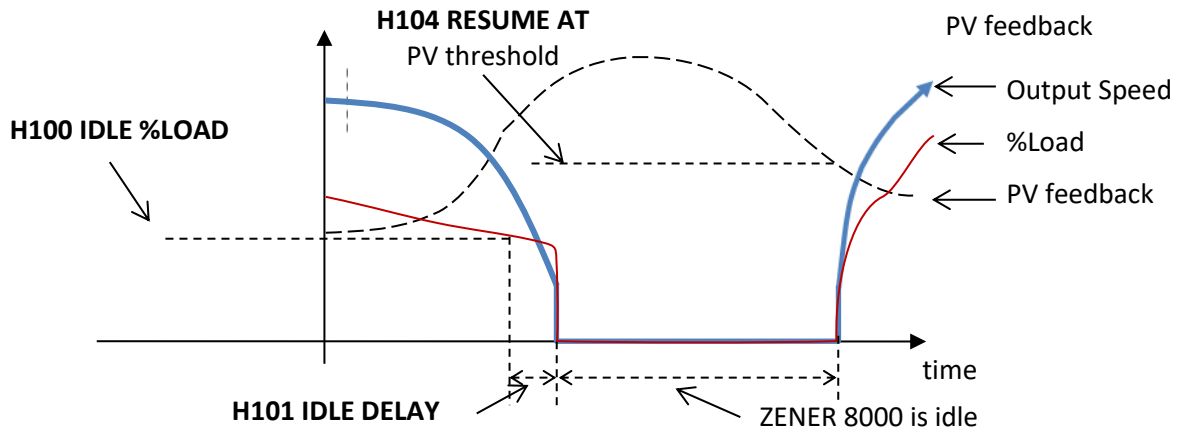
IDLE Function: Resume "by speed ref"

If the parameter **H102 RESUME** is "**by speed ref**", the restart occurs when the active frequency reference exceeds the **H103 RESUME Hz** frequency. The diagram below illustrates the function.



IDLE Function: Resume "by PV threshold"

If **H102 RESUME** is "**by PV threshold**", the restart occurs when the process variable (referred to as PV) falls below the **H104 RESUME AT** threshold". The diagram below illustrates the function.

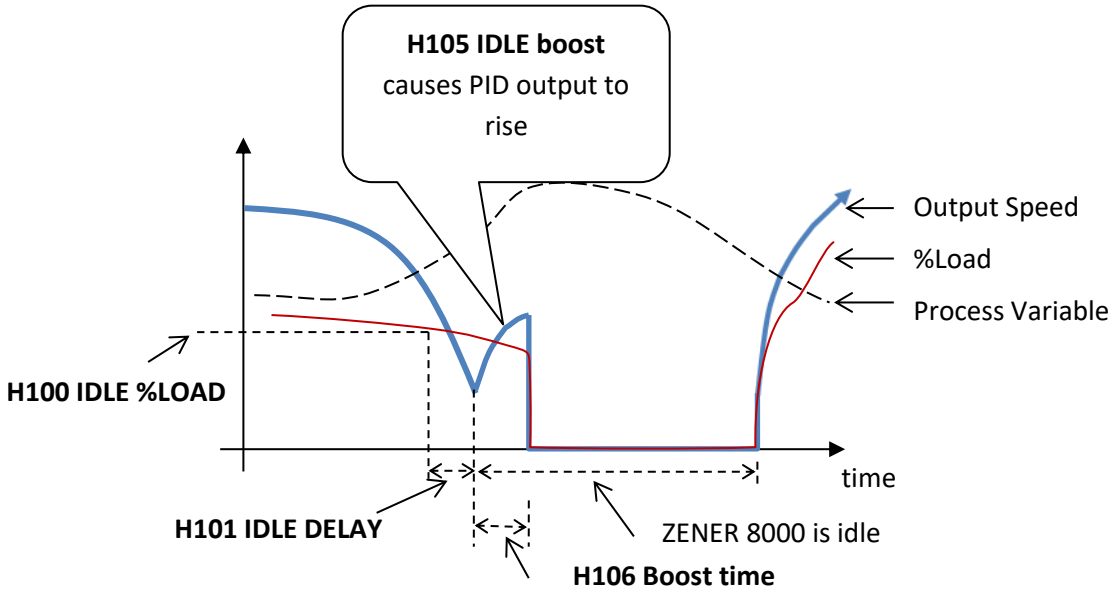


Key configuration parameters are:

- **H100 IDLE %LOAD**
- **H101 IDLE DELAY**
- **H102 RESUME**
- **H103 RESUME Hz**
- **H104 RESUME AT**

IDLE Function: Pre-IDLE Boost

Primarily for pressure control applications, the pre-idle boost creates a reserve of pressure to reduce idle cycling. The pre-idle boost is a pulse expressed as a percentage increase of the set-point with adjustable duration.

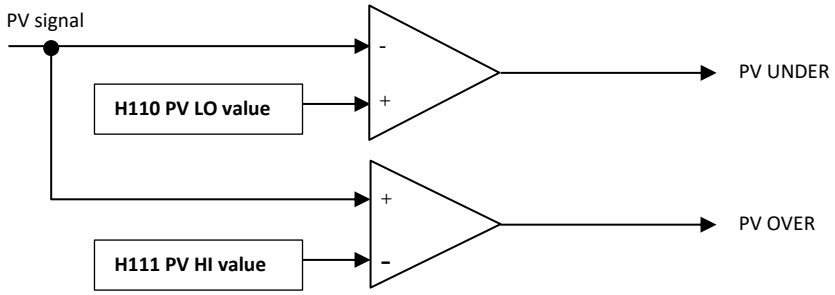


Key configuration parameters are:

- **H105 IDLE boost**
- **H106 Boost time**

Limit Alarms

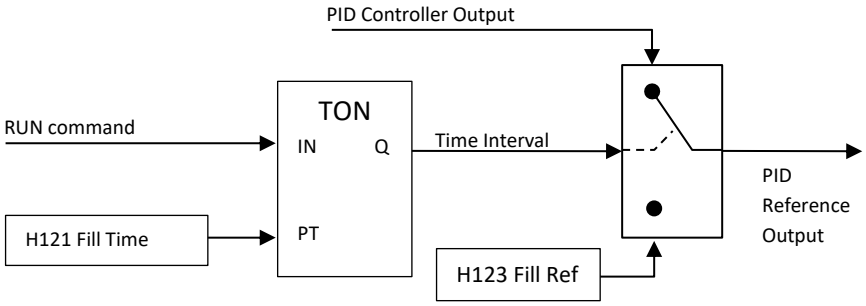
The block diagram below illustrates the structure of the Limit Alarms block:



If the process variable signal is below the **H110 PV LO value**, the PV UNDER signal will be set true. Similarly if the process variable signal is above the **H111 PV HI value**, the PV OVER signal will be set true.

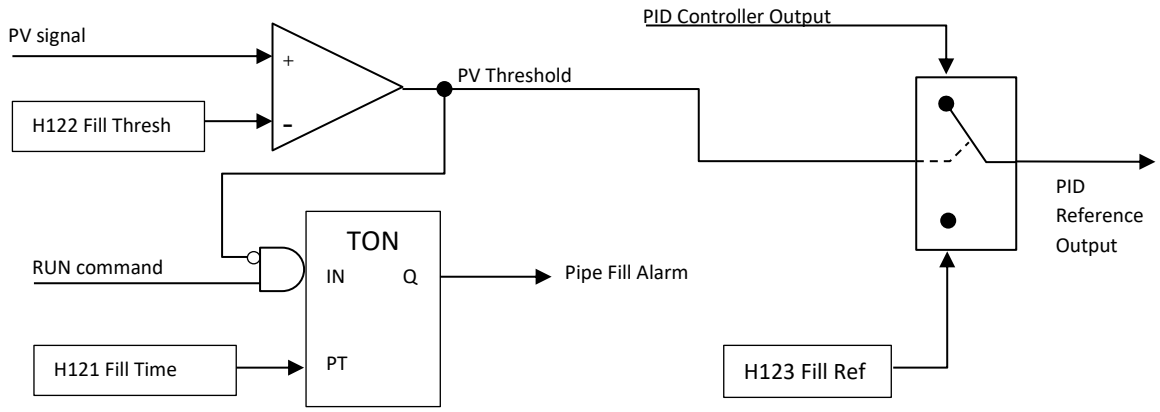
Pipe Fill Logic

The **H120 Fill Mode** selects one of two forms of Pipe Fill Logic: Pipe fill by "Time Interval" or pipe fill by "PV level". The block diagram below illustrates the structure of the pipe fill by "Time Interval":



Timing begins when the RUN command is detected. During the timing the speed reference specified by **H123 Fill Ref** is applied to the motor & pump to fill the pipes. The time period of this filling operation is set by **H121 Fill Time**. When the filling time interval has elapsed, PID closed loop control commences.

Alternatively the pipe fill operation may be determined by process variable threshold. The process variable threshold is defined by the **H122 Fill Thresh**. The block diagram below illustrates the structure of the pipe fill by "PV Threshold":



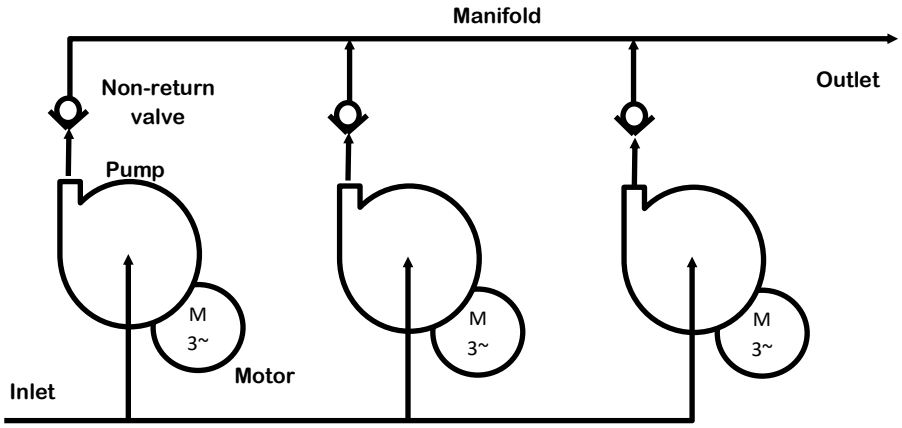
While ever the PV signal is below the **H122 Fill Thresh**, the **H123 Fill Ref** is applied to the motor & pump to fill the pipes. When the PV signal is at or above the **H122 Fill Thresh**, PID closed loop control commences. A pipe fill alarm signal is generated if the PV signal remains below the **H122 Fill Thresh** for a time interval specified by the **H121 Fill Time**.

Key configuration parameters are:

- **H120 Fill mode** ("Off": "Time Interval" or "PV Level")
- **H121 Fill Time** (secs)
- **H122 Fill Thresh** (in PID units)
- **H123 Fill Ref**

Multi-Pump Pressure Control

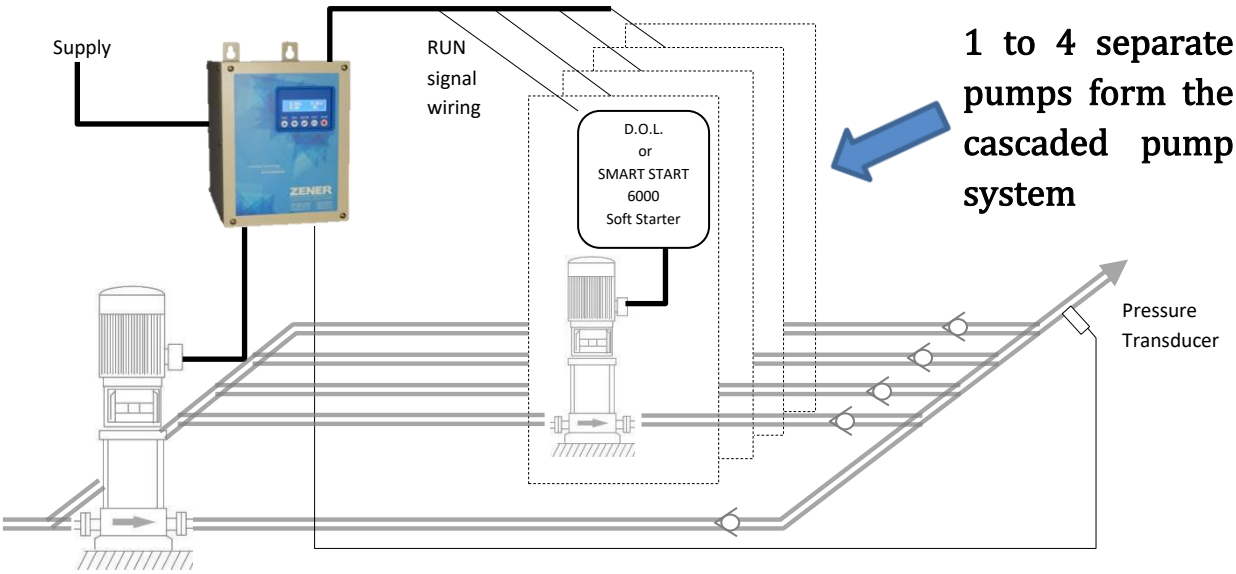
The ZENER8000 has the capability of controlling multiple pumps in conjunction with PID pressure control. The ZENER8000 offers Cascaded Pump Control that assumes each pump's outlet port is plumbed to a common manifold.



Cascade Control

Cascade control is useful in applications that have a wide flow range requirement for a set pressure. A single large pump may be required to achieve maximum flow for a set pressure. However operating a large pump at significantly smaller flows is a region of operation large pumps are not designed for. Instead several smaller pumps are used to cover the extended flow demand and Cascade Pump Control of the ZENER 8000 manages the activation of the cascaded pumps

A single motor and pump driven by ZENER 8000 with an external pressure transducer and up to 4 additional pump / controller sets combine to form a *Cascade Pumping Pressure Regulated Control System*. The ZENER 8000 will maintain a constant pressure with changing water consumption requirements.



It is recommended to use the Cascade Pump application (Zener P/N: SW08023). Application features include:

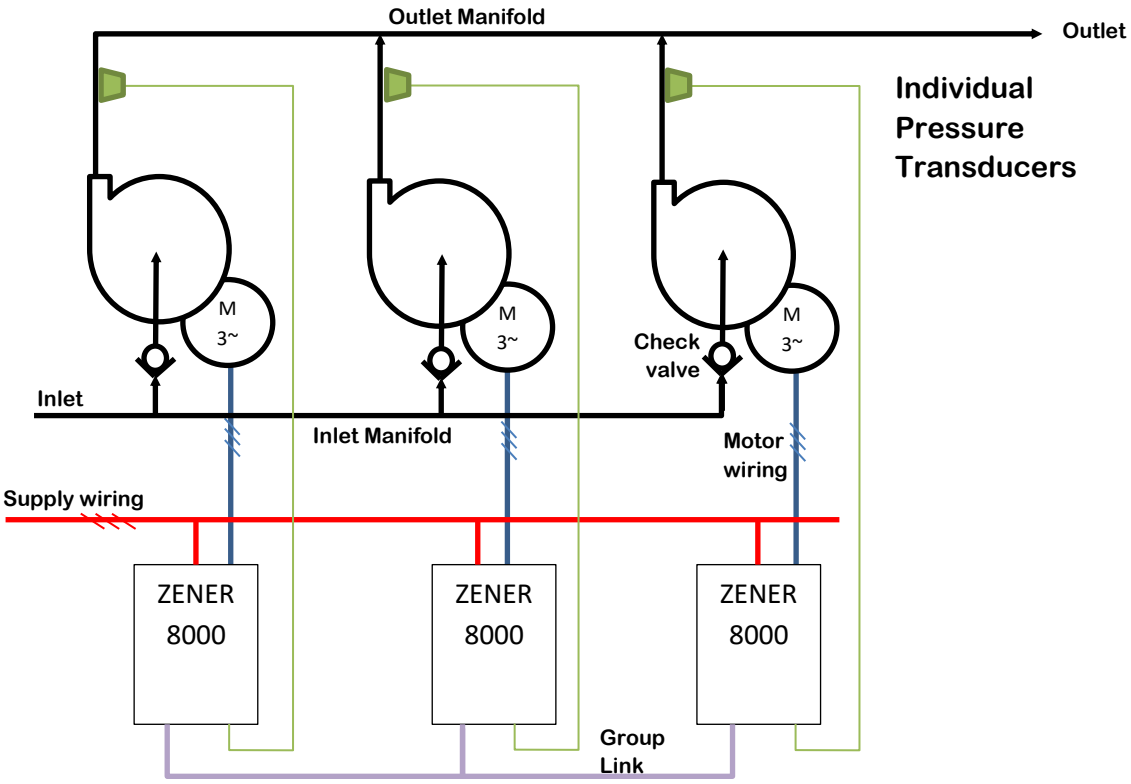
- Pressure regulation: constant pressure through automatic pump speed adjustment.
- Cascade Pump Control:
  - Controls up to 4 supplementary pumps
  - Run signals to supplementary pumps are asserted when flow demand increases.
  - Run signals are de-asserted when flow demand decreases.
- Cascade Pump Rotation
  - “Shares” active service amongst the cascaded pumps.
  - A stopped pump is started and a running pump will be stopped.
  - Promotes even pump ware.
  - User selectable rotation interval
- Cascade Pump Bypass
  - A unique enabling input to the ZENER 8000 signals readiness of a supplementary pump.
  - A bypassed pump (enabling input opened) will not be commanded to start.
  - Enabling input can be interlocked with supplementary pump fault relay.
  - In case of a pump bypass another readied pump is sort to take up the duty.
- Pump Idle Mode
- Cascade System Protection includes:

Loss of transducer signal	No Flow (optional)
High & Low pressure	Low Bore level (optional)

Refer to Cascade Pumps on page Error! Bookmark not defined. for configuration details.

Pump Group

The Pump Group feature employs several smaller drives in a network to serve a pressure regulation requirement whilst satisfying a wide range flow requirement. Each instance of drive/motor/pump is assumed to be identical and operates independently yet cooperatively without a master controller unit. Special logic within each drive takes the information from its neighbours to determine its own operation.



Features

- Multiple identical drive/motor/pump:
  - Load sharing
  - Redundancy operation (even at reduced capability)
  - Promotes equal pump run time
- Reduced wiring and configuration
- Each drive/motor/pump instance works independently.
  - No master
  - No slave
  - No master controller unit required
- Parameter sharing with all group members via Group Link

INFORMATION

For convenient and fast set up, it is recommended to install the “Pump Group” application (p/n SW08025.apf). Refer to “Pump Group Application Guide” (IM00164) for commissioning and operational instructions.

PID SETUP Checklist and Tuning

1. Control Wiring (Assumes factory defaults are loaded)

WARNING! All wiring must be done while the ZENER 8000 is disconnected from the power supply. Refer to the Control Wiring Diagram for details

1.1. Select an analogue input for the process variable (PV) measurement. Choices include: AI(10,11), AI(32,34)[1] or AI(52,54)[2].
1.2. Wire in the transducer that measures the PV to the selected analogue input.
1.3. If required wire in the set point variable (SV) reference signal to a separate analogue input. No wiring required if an internal preset is to hold the desired SV reference.
1.4. If required wire in any metering device to an analogue output. Choices include: AO(36,38)1 above[1] or AO(56,58)[2].
1.5. Ensure the signal levels are compatible with the input/output specifications of each feature. Refer to the PID Control Wiring diagram for details.

2. Preparing for PID Control

2.1. After initial power on alter any ZENER 8000 settings and/or selections.
2.2. Specifically check the desired maximum motor frequency at which the process may be safely driven. Refer to **C02 MAX Hz** to check the maximum Hz setting.
2.3. Configure the selected analogue input that you intend to use for the PV signal (transducer feedback) so that it is the correct type (0…5V, 0…10V or 4…20mA).
2.4. Ensure the chosen analogue input for the PV signal is selected in the **H07 PV choice** menu.
2.5. Ensure the chosen reference for the SV signal is selected in the **H06 SV choice** menu.
2.6. Perform any analogue output adjustments of each analogue output in use.
2.7. Perform any PID parameter adjustments e.g. **H01 PROP. BAND**, **H02 Integ. time**, etc.
2.8. To close the loop the running mode reference (Remote, Local, ESO, JOGFWD or JOGREV) must be set to **> PID Output**.

3. Tuning

CAUTION! The following steps are applicable in most cases. However, running the controller system without defined limits must be done with caution in case excessive speeds result in hazardous conditions or damage

3.1. PV signal verification: Run the drive/motor/process at known set point and check the feedback signal is correct for the operating point.
3.2. If possible, operate the system at the maximum (safe) operating point and verify that the PV signal is now at the expected level.
3.3. Switch off the integrator by setting **H02 Integ. time** to zero.
3.4. Closing the loop: After the loop has been closed observe the PV behaviour. If the system is unstable increase the **H01 PROP. BAND** to stabilize the system. In general, increasing the **H01 PROP. BAND** will stabilize the system. Decreasing **H01 PROP. BAND** will produce a faster response at the expense of system stability.

[1] If optional Extended Features card is fitted in the left hand option slot.
[2] If optional Extended Features card is fitted in the right hand option slot.

3.5. If the system response oscillates momentarily, the system is under damped. An increase of the derivative time **H03 Diff time** can improve damping but an excessive value may increase the systems' response to noise.

3.6. Allow the system to settle. If the PV value does not equal the SV value then the system has a steady state error. To remove steady state error, set the **H02 Integ. time** to the maximum. Decrease the **H02 Integ. time** to remove the steady state error more rapidly.

3.7. Minor adjustments to **H01 PROP. BAND**, **H02 Integ. time** and **H03 Diff time** may be performed to achieve the desired system response. Use the PID Tuning Summary below for general remedies to common problems.

3.8. Change the **H08 PID Units** and **H09 PID Scale** to represent the signal PV and SV signals correctly.

PID Tuning Summary:

Problem	Remedy
In closed loop the PV does not match the desired operating point	Check the analogue input reading matches the transducer output signal; Verify the settings of the selected analogue input for the PV; Check the running mode reference (Remote, Local, ESO, JOGFWD or JOGREV) is set to **> PID Output**.
In closed loop operation the system is unstable	Increase the **H01 PROP. BAND** or decrease **H03 Diff time**.
The system responds too slowly	Decrease the **H01 PROP. BAND** or decrease the **H02 Integ. time**.
The system oscillates momentarily	Increase the **H01 PROP. BAND** or decrease the **H03 Diff time**.
PV does not equal the SV	A steady state error exists and is removed by using the **H02 Integ. time**. Start with a large value and then decrease it until a satisfactory response to a SV change is observed.

PID Application Examples

Step by Step procedures for the following applications are shown in the application sections of this manual

Application: Stair pressurisation fan with internal PID

This setup is for a typical HVAC stair pressurisation fan application that requires air pressure control using an air pressure transducer and PID controller function provided by the ZENER 8000. The ZENER 8000 is configured to run in essential services override (ESO) mode. Prior to commissioning, you will need to know the type of air pressure transducer signal that is to be used (0-10V, 4-20mA).

Application: Cooling tower fan with reverse acting internal PID

This setup is for a typical cooling tower fan application that requires water temperature control using a water temperature transducer and the PID controller function provided by the ZENER 8000. Prior to commissioning, you will need to know the type of air pressure transducer signal that is to be used (0-10V, 4-20mA).

Application: Water pumping with automatic pressure control

This setup is for a typical centrifugal pump application that requires water pressure control using a water pressure transducer and the PID controller function provided by the ZENER 8000. Prior to commissioning, you will need to know the type of pressure transducer signal that is to be used (0-10V, 4-20mA).

Application: Pipe-fill with automatic pressure control

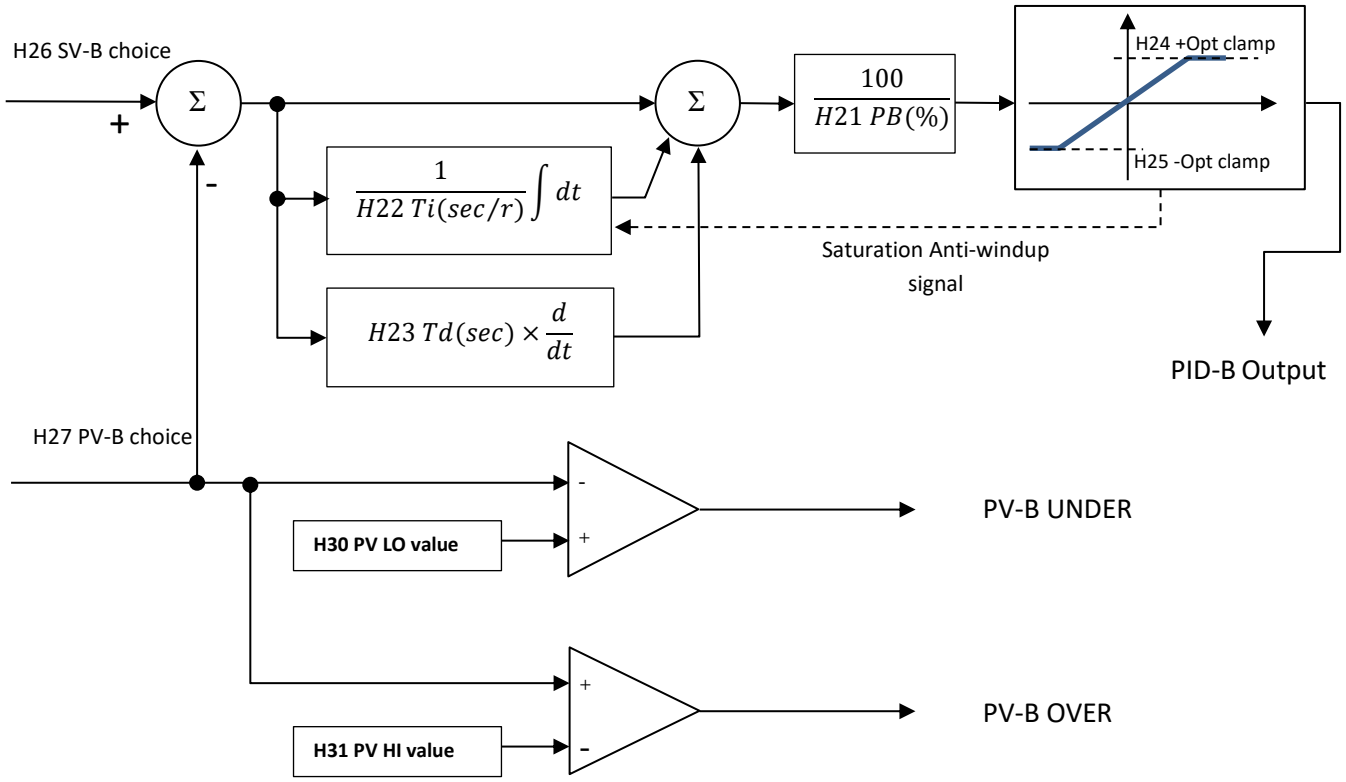
This setup is for a typical centrifugal pump application that requires a long pipe to be filled before water pressure control can take place. Prior to commissioning, you will need to know the type of pressure transducer signal that is to be used (0-10V, 4-20mA).

The ZENER 8000 PID-B Control Block

The ZENER 8000 has a second Proportional Integral Differential (PID) Controller for those applications where a secondary mode or configuration of the plant process requires control. Note the PID-B controller does not replicate the Idle and Pipe fill functions

PID-B Controller

The diagram below shows parameters and structure of the ZENER 8000 PID controller.



Key configuration parameters are:

- **H21 PB (%)**
- **H22 Ti (sec/r)**
- **H23 Td (sec)**
- **H24 +Opt clamp**
- **H25 –Opt clamp**
- **H26 SV-B choice**
- **H27 PV-B choice**
- **H28 PID Units** (for PID display)
- **H29 PID Scale** (for PID display)
- **H30 PV Lo value**
- **H31 PV Hi value**

Solar Supply Operation & Control (ECODRIVE 8000 Models only)

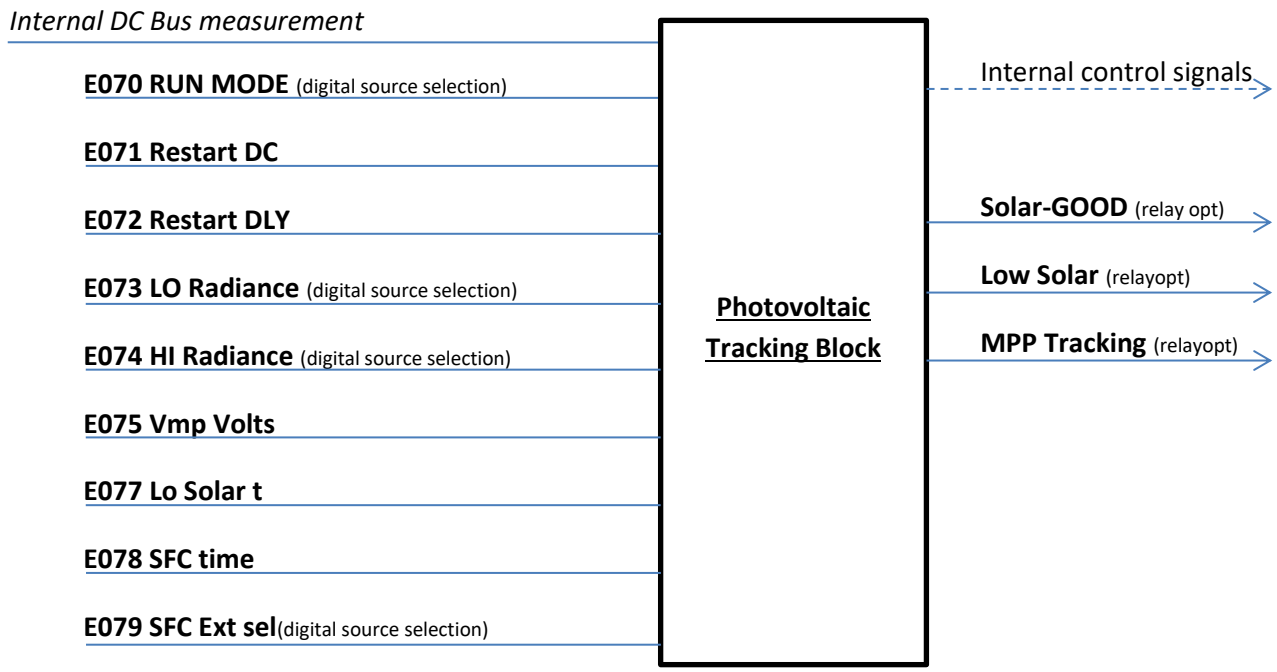
For those applications where the intended power source is a bank of solar - photovoltaic cells, the ECODRIVE 8000 is the drive of choice for motor power supply management. Key to this is the power tracking control feature that monitors supply conditions for motor operation. The maximum power voltage specified by the **E075 Vmp Volts** value activates tracking if the DC voltage of the solar feed falls below this threshold voltage. During periods of low sunshine (low irradiance) the ECODRIVE 8000 can be configured to source power from an AC supply. The ECODRIVE 8000 has features to avoid cycling between solar supply and AC supply. In these applications, conflicting solar supply conditions are trapped and the AC supply is chosen to continue motor operation. This state is called the Solar Function Conflict (SFC) state.

The solar power tracking function activates when the digital source selected by **E070 RUN MODE** evaluates true. The **Solar-GOOD** state is available for relay assignment and is determined true when:

- The **E074 HI Radiance** selection is set to OFF and the internal DC bus measurement greater than the **E071 Restart DC** for **E072 Restart Delay** seconds.
- Or when the digital source selected by **E074 HI Radiance** evaluates true.

The **Low Solar** state is available for relay assignment and is determined true when:

- The ZENER 8000 output frequency less than the **C01 MIN Hz** value and the ZENER 8000 is tracking for a time interval specified by **E077 Lo Solar t** time.
- Or when the digital source selected by **E073 LO Radiance** evaluates true for a time interval specified by **E077 Lo Solar t** time.



Key configuration parameters are:

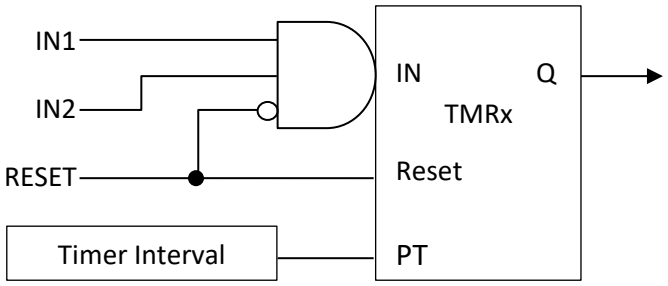
- **C01 MIN Hz**
- **E0701 SOLAR FXN** (DISABLED)
- **E070 RUN MODE** (default OFF)
- **E071 Restart DC**
- **E072 Restart DLY**
- **E073 LO Radiance** (default OFF)
- **E074 HI Radiance** (default OFF)
- **E076 Display var**
- **E075 Vmp Volts**
- **E0751 MPPT step**
- **E0752 MPPT P step**
- **E077 Lo Solar t**
- **E078 SFC time**
- **E079 SFC Ext sel**

Outputs are:

- **Solar-GOOD**
- **Low Solar**
- **MPP Tracking**

General Purpose Timers

The block diagram of a general purpose timer is shown below:



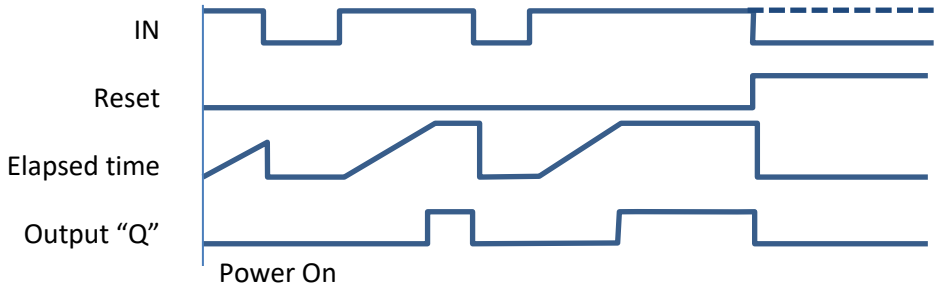
Each timer has 3 timing enable inputs IN1, IN2 and RESET. The choices for IN1, IN2 and RESET are derived from digital inputs including analogue input comparisons and other internal logic. Each timer is configured as for one of the following modes:

- **Delay ON**: The rising input edge is delayed by the interval time. No delay on the falling input edge.
- **Delay ON Init**: Similar to Delay ON mode except the timing phase is skipped at power on if the inputs evaluate true or at any time if reset is true.
- **Delay OFF**: No delay on the rising input edge. The falling input edge is delayed by the interval time.

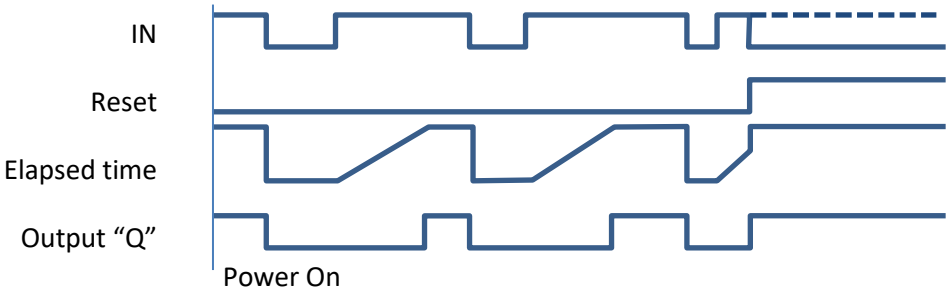
The interval time is set in units of seconds as needed. Refer to the key configuration parameters for details on delay intervals, modes and choices:

Waveforms

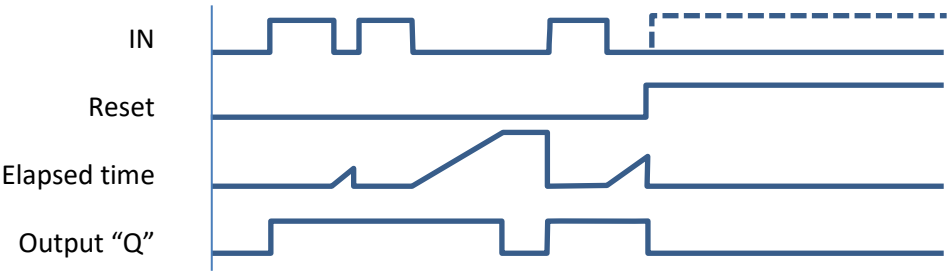
Delay ON: The rising input edge is delayed. No delay on the falling input edge.



Delay ON Init: Initial timing phase skipped if IN evaluates TRUE or Reset is TRUE

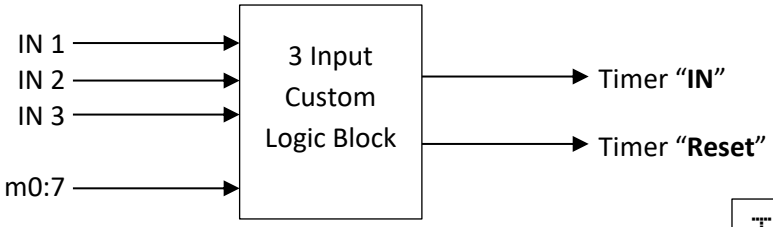


Delay OFF: No delay on the rising input edge. The falling input edge is delayed.

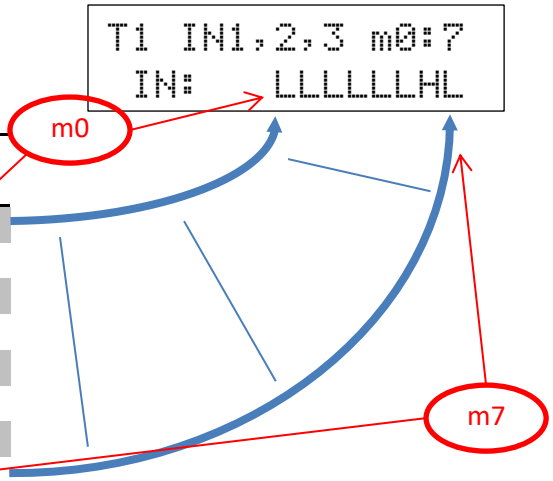


Custom Timer Input Logic

ZENER 8000 offers customisable input logic to control timing. Each timer input block is a 3-input, 2-output truth table one output controls the timing interval logic and the other controls the reset.



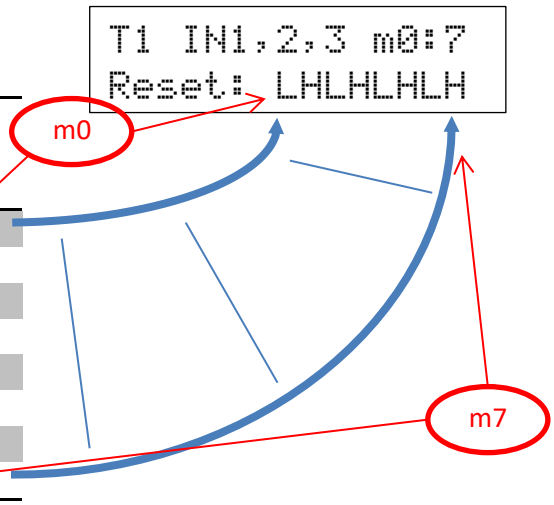
A truth table for the Timer "IN" input is interpreted as follows:



Term	IN 1	IN 2	IN 3	Timer "IN"
m0	LOW	LOW	LOW	LOW
m1	LOW	LOW	HIGH	LOW
m2	LOW	HIGH	LOW	LOW
m3	LOW	HIGH	HIGH	LOW
m4	HIGH	LOW	LOW	LOW
m5	HIGH	LOW	HIGH	LOW
m6	HIGH	HIGH	LOW	HIGH
m7	HIGH	HIGH	HIGH	LOW

The first row is the term **m0**. When **IN 1** is LOW, **IN 2** is LOW and **IN 3** is LOW the "Term" **m0** is selected and in this example **m0** = LOW. The output will be LOW.

A similar truth table for the Timer "**Reset**" input is interpreted as follows:



Term	IN 1	IN 2	IN 3	Timer "Reset"
m0	LOW	LOW	LOW	LOW
m1	LOW	LOW	HIGH	HIGH
m2	LOW	HIGH	LOW	LOW
m3	LOW	HIGH	HIGH	HIGH
m4	HIGH	LOW	LOW	LOW
m5	HIGH	LOW	HIGH	HIGH
m6	HIGH	HIGH	LOW	LOW
m7	HIGH	HIGH	HIGH	HIGH

Key parameters are:

TIMER1:

- **G070 T1 Interval**
- **G071 T1 mode**
- **G0720 T1 Input**
- **G0721 T1 Input 2**
- **G0722 T1 Reset**
- **G0723 T1 Logic**

T1 IN & **Reset** truth tables

TIMER2:

- **G073 T2 Interval**
- **G074 T2 mode**
- **G0750 T2 Input 1**
- **G0751 T2 Input 2**
- **G0752 T2 Reset**
- **G0753 T2 Logic**

T2 IN & **Reset** truth tables

TIMER3:

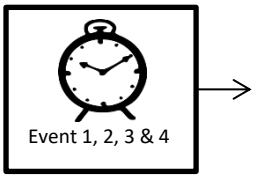
- **G076 T3 Interval**
- **G077 T3 mode**
- **G0780 T3 Input 1**
- **G0781 T3 Input 2**
- **G0782 T3 Reset**
- **G0783 T3 Logic**

T3 IN & **Reset** truth tables

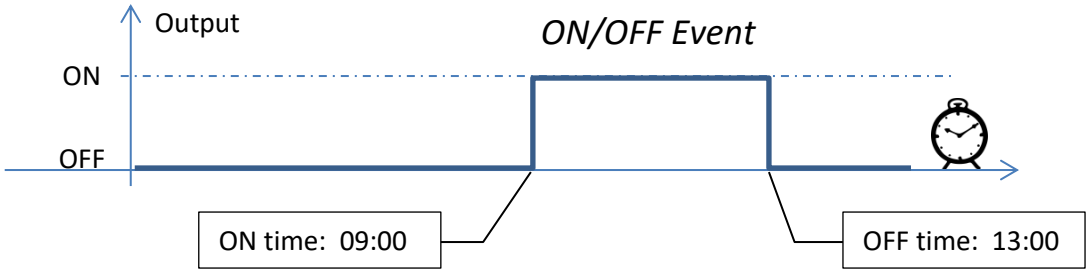
Time Clock Schedule Timer

An activation schedule can be created with the 24 hour schedule timer.
Features include:

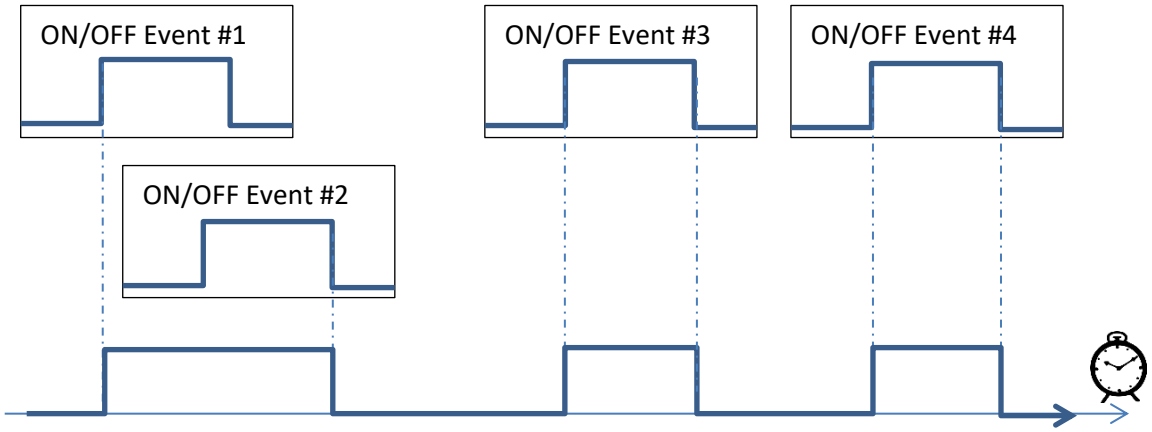
- 4 independent ON/OFF events combined into a single output.
- Each ON/OFF event may be activated on any or all days of the week.
- Overlapping ON/OFF events permitted



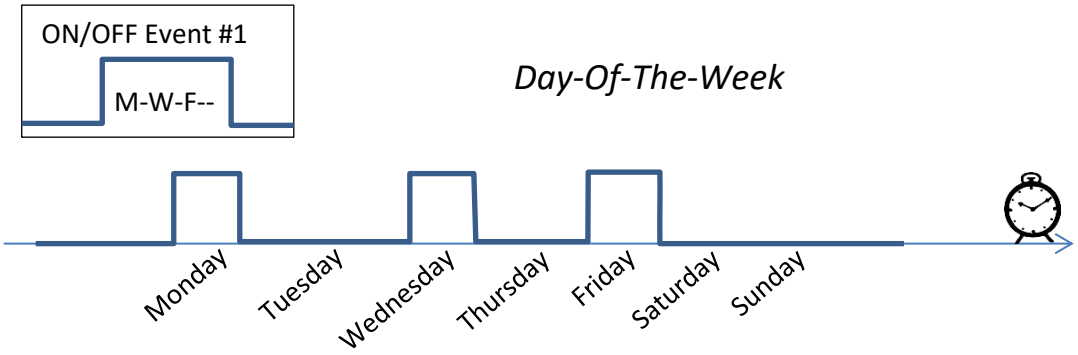
An ON/OFF event has an ON time and an OFF time specified in 24hour format.



ON/OFF events can overlap.



An ON/OFF event is day of the week selectable.



Key parameters are:

- Event 1 parameters: **G5501, G5502, G5503**
- Event 2 parameters: **G5511, G5512, G5513**
- Event 3 parameters: **G5521, G5522, G5523**
- Event 4 parameters: **G5531, G5532, G5533**

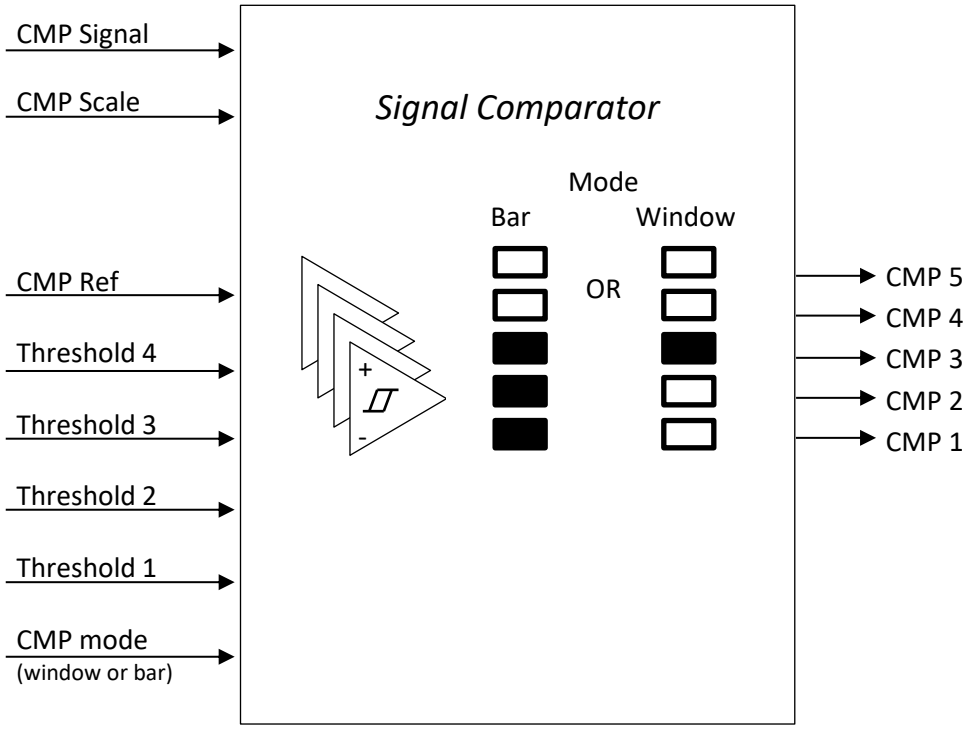
Outputs are:

- **Time clock Opt**

Signal Comparator

The signal comparator feature provides an indication of the level of a signal internal to the ZENER 8000. There are four thresholds that may be scaled to create five levels of indication.

The comparator has five digital outputs that are available as digital sources for inverter command control or for assignment to relay output. The compare outputs may be operated in “bar” mode or “window” mode.



In bar mode, each output is energised and remains energised as the signal rises above each threshold. In window mode each output is energised only when the signal is between thresholds.

Signal Selection – G400 CMP Signal

The signals available to the comparator are:

FREQUENCY(Hz)	% LOAD	F100 Preset 1(%)	Speed Ref (Hz)
SPEED (rpm)	CURRENT (A)	F101 Preset 2(%)	
I^2t Used (A)	POWER (kW or W)	F102 Preset 3(%)	

Signal Scaling – G401 CMP Scale

The **G401 CMP Scale** value is needed to normalise the selected signal to a percentage permitting direct comparison to the compare thresholds.

Compare Threshold Selection – G402 CMP Ref

The **G402 CMP Ref** selection specifies the reference value that scales each threshold. This allows comparison thresholds to be shifted for applications requiring several unique operating points.

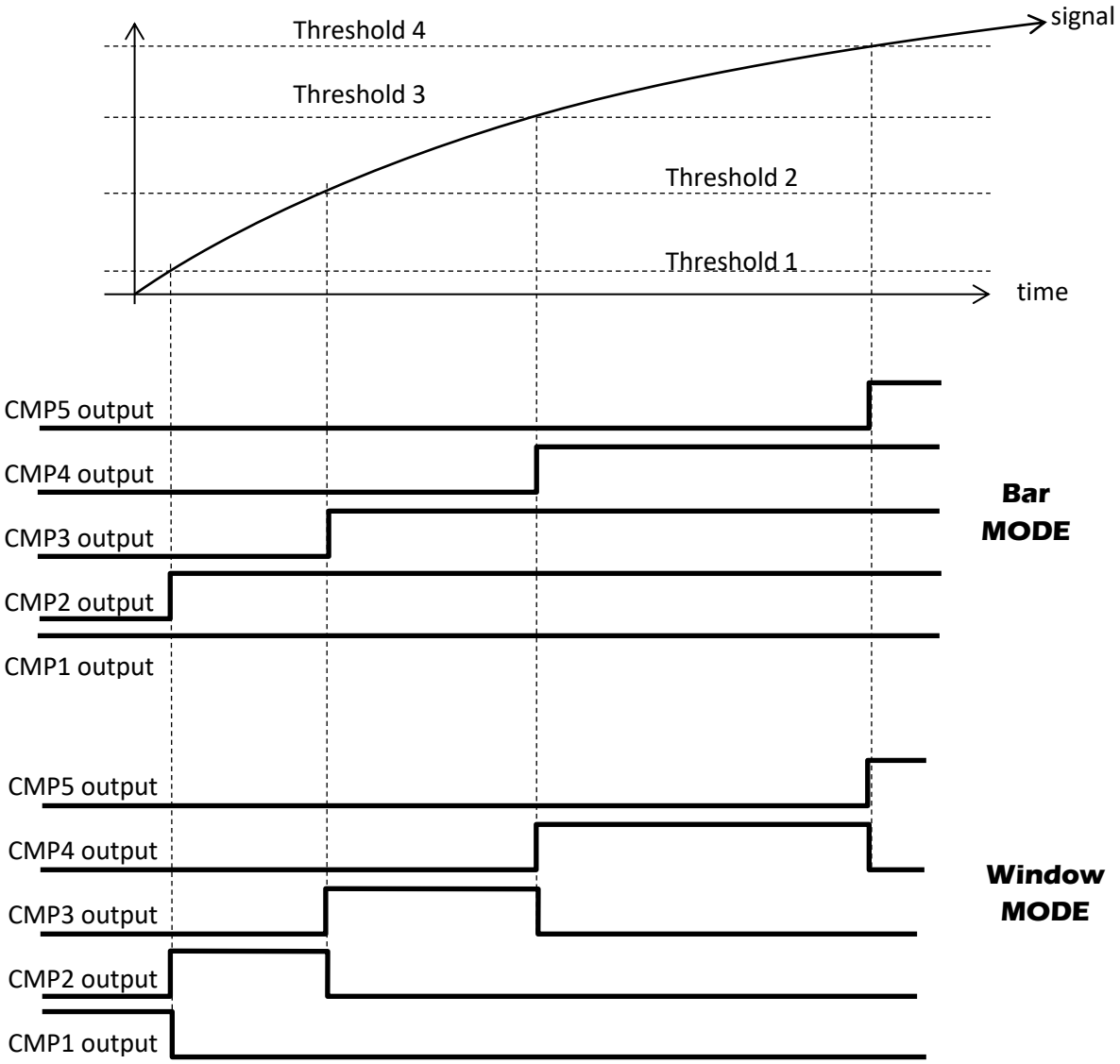
Comparison Thresholds – G403 Threshold 1 … G406 Threshold 4

There are four compare thresholds, **G403 Threshold 1** to **G406 Threshold 4.** Each threshold is scaled by the compare reference (**G402 CMP Ref**) before the actual comparison takes place. When adjusting compare thresholds, the ZENER 8000 will ensure:

- **G406 Threshold 4** is the highest threshold value;
- **G405 Threshold 3** is the 2nd highest threshold value;
- **G404 Threshold 2** is the 2nd lowest threshold value;
- **G403 Threshold 1** is the lowest threshold value;

Output Mode – G407 CMP mode

The two compare output mode behaviours are “Bar” mode and “Window” mode



Key parameters are:

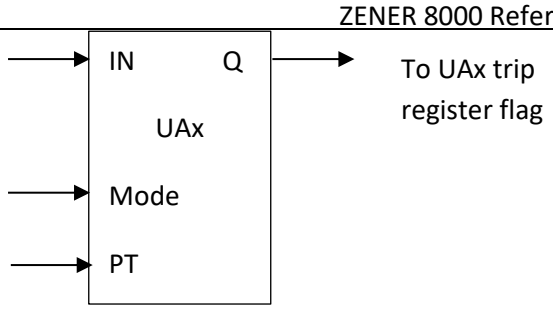
- **G400 CMP Signal**
- **G401 CMP Scale**
- **G402 CMP Ref**
- **G403 Threshold 1 … G406 Threshold 4**
- **G407 CMP mode**

Outputs are:

- **CMP1**
- **CMP2**
- **CMP3**
- **CMP4**
- **CMP5**

User Alarms

The block diagram of a user alarm:



As standard there are 8 user alarms that offer application specific trip conditions to halt drive operation. Each user alarm has an “Alarm mode”, an “Alarm Input”, an “Alarm Delay” and customisable “Alarm text” for display.

Alarm Enable Mode

There are 3 choices for Alarm mode:

ALWAYS: The user alarm is enabled while ever the ZENER 8000 is powered on.
RUN command: The user alarm is enabled when the ZENER 8000 has been commanded to run.
PID closed loop: The user alarm is enabled when the ZENER 8000 is running and the PID controller is operating.

Alarm Input Selection

There are many “Alarm input” to select from. Choices include:

- All digital input terminals available to the ZENER 8000 including their edge and level options
- All analogue input comparison flags internally available to the ZENER 8000 including their logical compliments
- All internal PID status flags and their logical compliments.

Alarm Delay

Each user alarm has a delay on timer. When the user alarm is enabled, the chosen input must be maintained for the configured “Alarm delay” time for the trip event to be generated. The delay time is specified in seconds up to 1200 seconds.

Alarm Text

Each user alarm has customisable “Alarm text” for display. The displayed trip message of each user alarm may be edited to express meaning of the alarm in the context of the application. Each message is composed of fixed user alarm prefix code (e.g. “UA1:” ➔ User Alarm #1) for traceability and an editable field of 12 characters containing custom text.

Key configuration parameters are:

- **G230, G240, G250, G260, G310, G320, G330, G340 Alarm mode**
- **G231, G241, G251, G261, G311, G321, G331, G341 Alarm input**
- **G232, G242, G252, G262, G312, G322, G332, G342 Alarm delay**
- **G233, G243, G253, G263, G313, G323, G333, G343 Alarm text**

User Warnings

Like user alarms, user warnings permit a custom indication of a status condition when viewing an active display. However, the condition does not latch and drive operation is not disturbed. As standard there are 4 user warnings and each user alarm has a: “Warn mode”, “Warn Input” and customisable “Warn text” for display.

Warning Enable Mode

There are 3 choices for the warning mode:

- **ALWAYS**: The user warning is enabled while ever the ZENER 8000 is powered on.
- **RUN command**: The user warning is enabled when the ZENER 8000 has been commanded to run.
- **PID closed loop**: The user warning is enabled when the ZENER 8000 is running and the PID controller is operating.

Warning Input Selection

There are many choices for the “Warn input” selection. Choices include:

- All digital input terminals available to the ZENER 8000 including their edge and level options.
- All analogue input comparison flags internally available to the ZENER 8000 including their logical compliments.
- All internal PID status flags and their logical compliments.

Warning Text

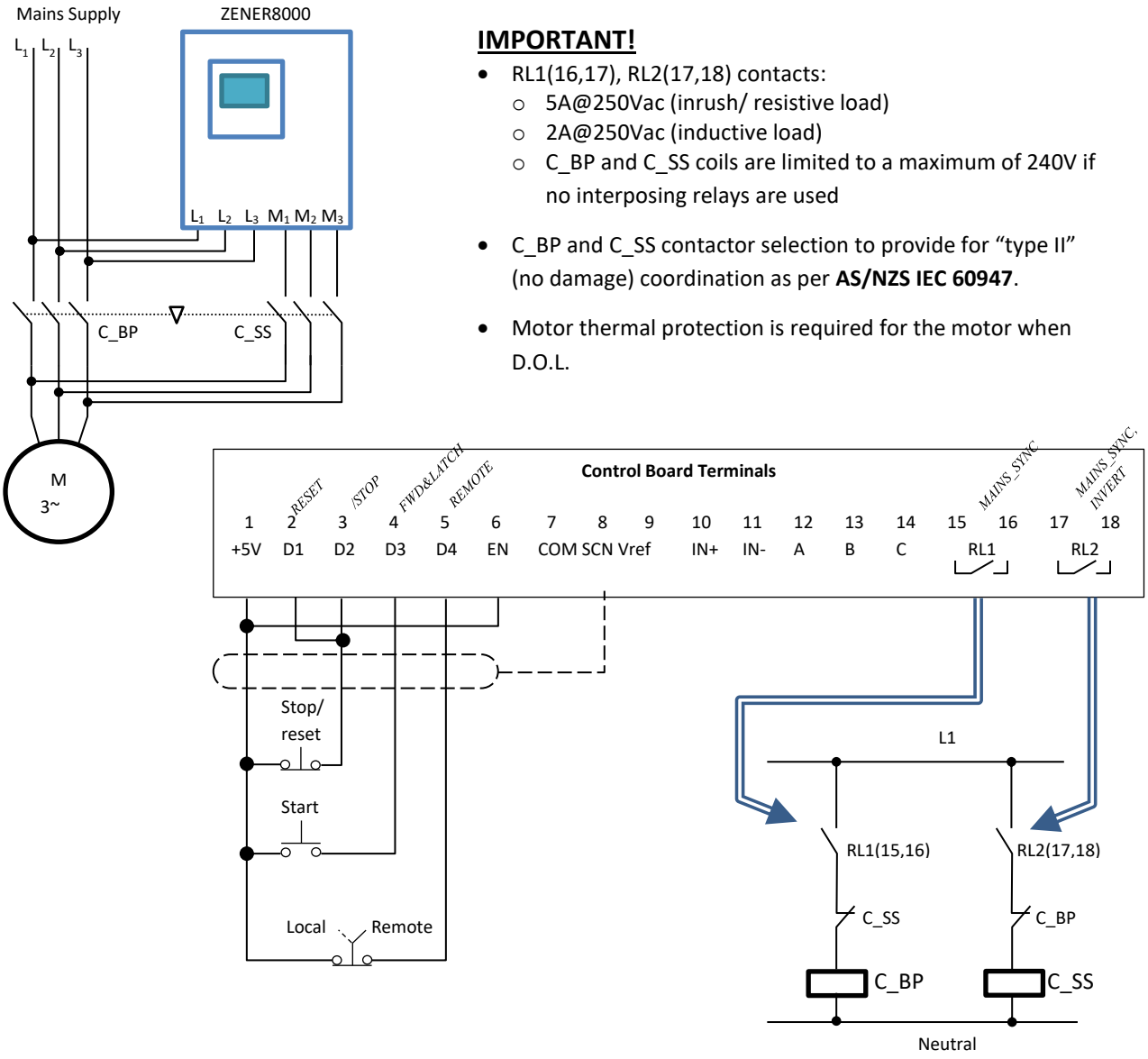
Each user warning has customisable “Warn text” for display. Each message is composed of 8 characters containing custom text.

Key configuration parameters are:

- **G270, G280, G290, G300 Warn mode**
- **G271, G281, G291, G301 Warn input**
- **G272, G282, G292, G302 Warn text**

Mains Synchronisation Feature

The ZENER8000 includes a mains synchronisation feature. This feature significantly reduces motor current inrush compared to D.O.L. levels. When enabled the ZENER8000 can accelerate the motor up to mains supply frequency and phase angle and then operate a bypass contactor to disconnect the motor from the ZENER8000 and connect it directly to the mains. Below is a simplified diagram of crucial wiring:



IMPORTANT!

- RL1(16,17), RL2(17,18) contacts:
  - 5A@250Vac (inrush/ resistive load)
  - 2A@250Vac (inductive load)
  - C_BP and C_SS coils are limited to a maximum of 240V if no interposing relays are used
- C_BP and C_SS contactor selection to provide for "type II" (no damage) coordination as per **AS/NZS IEC 60947**.
- Motor thermal protection is required for the motor when D.O.L.

Key configuration parameters are:

E080 Mains Sync (function activation)

E081 Phase comp (parameter)

Available outputs:

Set **Mains Sync** (as a relay function)

Communications

There are several communication interfaces for the ZENER 8000. As standard there is BACnet MS/TP and MODBUS RTU both of which are EIA/RS-485 based.

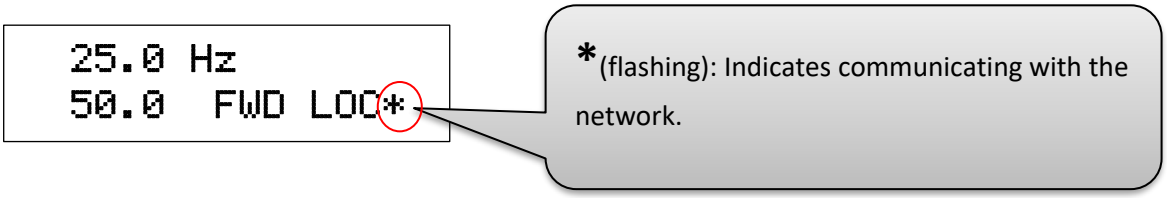
Communication Indicator

The communication indicator gives a visual signal of the operating condition of communications. The indicator is found in the bottom right hand corner of the display. The indications are:

Communication Disabled

No Communication

Communicating



BACnet MS/TP

The ZENER 8000 BACnet interface implements the standard Application Specific Controller (B-ASC) as described in ASHRE Standard 135 2004.

BACnet Services Supported

I-Am
I-Have
Read Property
Write Property

Data Link Layer

The ZENER 8000 implements the BACnet MS/TP Data Link Layer as a master device. The communication port is EIA/RS-485 compliant and is isolated from ground and other circuits.

MAC ID / Device Object Instance

Set via the front panel. Factory defaults are the same across all drives and must be change off-line or prior to connection to the network. By default the MAC ID and Device Object Instance have the same value and can be set independently.

BACnet Set-up and Operation

Setting up the ZENER 8000 for various applications with BACnet communications is similar to conventional wired control using the terminal strip. The interactions between wired control and BACnet features are as follows:

Local mode

Control of the run function (i.e. starting and stopping) is from the console. BACnet commands do not influence the starting and stopping of the ZENER 8000 in local mode. The speed reference used for local operation is determined by the reference source selected by parameter F02 LOCAL REF. See list of speed references for available choices.

Remote mode

Control of the run function (i.e. starting and stopping) is either from the terminal strip or by BACnet depending on the setting of **G166 RUN SIGNALS**. Available choices are **FROM TERMINALS** or **FROM NETWORK**. Setting this parameter to **FROM TERMINALS** allows the terminal strip alone to control the run function. Selecting **FROM NETWORK** allows BACnet alone to control the run function via binary value objects “Run fwd” and “Run rev”

Reset

Reset commands from all sources (terminal strip, internal ZENER 8000 functions and BACnet) are honoured at all times.

Network Speed Reference

If the speed reference for the ZENER 8000 in any given mode is to be determined by the network system, the reference to select is **COMMS_REF**.

Essential services operation (ESO)

ESO mode selection from all sources (wired terminal or BACnet binary object ESO) is honoured at all times.

CAUTION! Loss of communications is a loss of ESO if an ESO terminal is not set up.

Local / remote mode selection

Control of local/remote mode is always from the terminal strip. Operation of the ZENER 8000 may be monitored via BACnet regardless of the local/ remote mode.

BACnet Quick Set-up Guide

Set up all the usual menu items according to the application needs.
Set the various BACnet related menu items BEFORE connecting the network. This will avoid disrupting the BACnet network unnecessarily.
G160 Protocol: Ensure BACnet MS/TP is selected
G161 bits/sec: Select the baud rate to suit the BACnet system.
G163 MAC/Dev ID: This value must be unique for every BACnet device on the BACnet MS/TP network segment that the ZENER 8000 is connected to.
G164 Dev Instance: This is the Device Instance Number of the BACnet interface. This is a number between 0 and 4,194,302. The number of each BACnet interface must be unique across the entire BACnet installation.
G165 Max Masters: This is equal to, or greater than the highest master MAC ID number on the BACnet MS/TP network segment that the ZENER 8000 is connected to. For best BACnet MS/TP performance, this should be set as low as possible.
G166 RUN SIGNALS: This parameter determines if run commands are taken from the ZENER 8000 terminals or from the BACnet interface.
G167 Terminator: If necessary each ZENER 8000 is capable of terminating the EIA-485 network. Setting this parameter to **ENABLED** will terminate the line.
G169 Serial No.: To facilitate traceability of drives at a location the ZENER 8000's serial number may be entered. The serial number uniquely identifies the instance of a ZENER 8000. The serial number is found on the compliance label and this is found on a side of the ZENER 8000's enclosure.

BACnet Status Indicators

Several displays are available in the **S00 SERVICE** menu to check network activity and state. Status indicators include:

Counter	Description
Network messages	Count of valid packets received
Messages in error	Count of receiver hardware errors (framing/overrun/parity) as well packet errors (CRC)
Exception count	Count of access to application objects that are non-existent
Slave Messages	Count of valid data packets received
No response	Count of failures to respond
Overrun count	Count of data item(s) received before the previous item(s) are processed
Buffering errors	Count of occasions where an inbound data packet could not be buffered as no data buffers were available
Recovery count	Count of occasions where buffers were forcibly reclaimed
Reopen count	Count of occasions where the duration of lost communications forced the communications port to re-open

MODBUS RTU & MODBUS/TCP

The **MODBUS RTU** interface is standard with ZENER 8000 and implements MODBUS as described in documents:

- "MODBUS over Serial Line specification and implementation guide V1.02" and
- "MODBUS Application Protocol Specification V1.1b".

Both documents are freely available from www.modbus.org.

The **MODBUS/TCP** interface requires a "ZENER 8000 Ethernet Option" card. The "ZENER 8000 Ethernet Option" card is not standard with the ZENER 8000 and must be installed in a vacant option slot. The ZENER 8000 implements MODBUS/TCP as described in documents:

- "MODBUS Messaging on TCP/IP implementation guide V1.0a" and
- "MODBUS Application Protocol Specification V1.1b".

Both documents are freely available from www.modbus.org.

MODBUS Memory Model

The MODBUS memory model for the ZENER 8000 has separate blocks for Discrete Inputs, Coils, Input registers and holding registers. See the MODBUS appendix for details on addresses and sizes of each block.

Supported MODBUS Function Codes

Function Code 01: Read Coils
Function Code 02: Read Discrete Inputs
Function Code 03: Read Holding Registers
Function Code 04: Read Input Registers
Function Code 05: Write Single Coil
Function Code 06: Write Single Register
Function Code 07: Read Exception Status
Function Code 08: Diagnostics, Sub Codes 0,2,10…18,20
Function Code 15: Write Multiple Coils
Function Code 16: Write Multiple Holding Registers
Function code 43: Read device Identification, Sub Code 14

See the MODBUS appendix for details on function codes and sub codes.

MODBUS Exceptions

Except for broadcast messages, when a master device sends a query to the ZENER 8000 drive it expects a normal response. One of four possible events can occur from the master's query:

If the ZENER 8000 receives the query without a communication error, and can handle the query normally, it returns a normal response.
If the ZENER 8000 does not receive the query due to a communication error, no response is returned.
If the ZENER 8000 receives the query, but detects a communication error (parity or CRC), no response is returned.
If the ZENER 8000 receives the query without a communication error and cannot resolve the intended addressing, it will return an exception response informing the master of the nature of the error. For example if the request is to read a non-existent coil or register.

See the MODBUS appendix for details on function codes and sub codes.

MODBUS Setup and Operation

Setting up the ZENER 8000 for various applications with MODBUS communications is similar to conventional wired control using the terminal strip. The interactions between wired control and MODBUS features are as follows:

Local mode

Control of the run function (i.e. starting and stopping) is from the console. MODBUS commands do not influence the starting and stopping of the ZENER 8000 in local mode. The speed reference used for local operation is determined by the reference source selected by parameter F02 LOCAL REF. See list of speed references for available choices.

Remote mode

Control of the run function (i.e. starting and stopping) is either from the terminal strip or by MODBUS depending on the setting of **G166 RUN SIGNALS**. Available choices are **FROM TERMINALS** or **FROM NETWORK**. Setting this parameter to **FROM TERMINALS** allows the terminal strip alone to control the run function. Selecting **FROM NETWORK** allows the MODBUS network alone to control the run function via binary value objects “Run fwd” and “Run rev”

Reset

Reset commands from all sources (terminal strip, internal ZENER 8000 functions and MODBUS) are honoured at all times.

Network Speed Reference

If the speed reference for the ZENER 8000 in any given mode is to be determined by the network system, the reference to select is **COMMS_REF**.

Essential services operation (ESO)

ESO mode selection from all sources (wired terminal or MODBUS ESO coil) is honoured at all times.

CAUTION! Loss of communications is a loss of ESO if an ESO is terminal not set up.

Local / remote mode selection

Control of local/remote mode is always from the terminal strip. Operation of the ZENER 8000 may be monitored via MODBUS regardless of the local/ remote mode.

MODBUS Quick Set-up Guide

Set the various MODBUS related menu items BEFORE connecting the network. This will avoid disrupting the MODBUS network unnecessarily.

MODBUS RTU

- In **G00 INPUT/OUTPUT ➔ Communication Configuration** menu ensure **MODBUS RTU** is selected.
- **G161 bits/sec**: Select the baud rate to suit the MODBUS system.
- **G162 Parity**: Select the parity to suit the MODBUS system
- **G163 MAC/Dev ID**: This value must be unique for every MODBUS device on the BACnet MS/TP network segment that the ZENER 8000 is connected to.
- **G166 RUN SIGNALS**: This parameter determines if run commands are taken from the ZENER 8000 terminals or from the MODBUS RTU interface.
- **G167 Terminator**: If necessary each ZENER 8000 is capable of terminating the EIA-485 network. Setting this parameter to **ENABLED** will terminate the line.
- **G168 Comms Lost Time**: Check the time interval is greater than the interval between data packet exchanges to your ZENER 8000.
- **G169 Serial No.**: Enter the drives serial number which is found on the compliance label on a side of the ZENER 8000's enclosure. The serial number facilitates the identity and location of the ZENER 8000.
- Connect the ZENER 8000 to the MODBUS network.

MODBUS/TCP

- In **G00 INPUT/OUTPUT ➔ Communication Configuration** menu ensure **MODBUS/TCP** is selected.
- **G1630 IP address**: Check and alter the unique fixed network IP address for the ZENER 8000. Ask your network administrator for an available IP address.
- **G1631 IP mask**: Check and alter the IP mask for the ZENER 8000. Ask your network administrator for an appropriate IP mask.
- **G166 RUN SIGNALS**: This parameter determines if run commands are taken from the ZENER 8000 terminals or from the MODBUS/TCP interface.
- **G168 Comms Lost Time**: Check the time interval is greater than the interval between data packet exchanges to your ZENER 8000.
- **G169 Serial No.**: Enter the drives serial number which is found on the compliance label on a side of the ZENER 8000's enclosure. The serial number facilitates the identity and location of the ZENER 8000.
- Connect the ZENER 8000 to the MODBUS/TCP network.

MODBUS Status Indicators

Several displays are available in the S00 SERVICE menu to check network activity and state. indicators include:

Counter	Description
Network messages	Count of valid packets received
Messages in error	Count of receiver hardware errors (framing/overrun/parity) as well packet errors (CRC)
Exception count	Count of access to application objects that are non-existent
Slave Messages	Count of valid data packets received
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Buffering errors	Count of occasions where an inbound data packet could not be buffered as no data buffers were available
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Reopen count	Count of occasions where the duration of lost communications forced the communications port to re-open

Extended Feature Option Card

The ZENER 8000 may be fitted with 1 or 2 extended features cards. Each card provides additional analogue and digital inputs and outputs. The cards may be fitted in either the left or right option card sockets. The ZENER 8000 will detect the presence of the option cards and commence exchanging I/O data. Additional options will appear in the selection lists and accesses to additional menus are available for extended feature set up.

Extended Feature Digital Inputs

The ZENER 8000 Extended features option card offers 4 digital inputs rated for 5VDC (40mA max). The digital inputs are identified as:

- D1(31), D2(33), D3(35), D4(37) for a card fitted in the left option board slot.
- D1(51), D2(53), D3(55), D4(57) for a card fitted in the right option board slot.

Like the standard digital, inputs each option card input comes with edge and complimentary logic.

Extended Feature Digital Output

The ZENER 8000 Extended features option card offers a digital output rated for 24VDC (400mA max). The digital outputs are identified as:

- DO(39,41) for a card fitted in the left option board slot.
- DO(59,61) for a card fitted in the right option board slot.

Extended Feature Analogue Input

The ZENER 8000 Extended features option card offers an extra analogue input. The analogue inputs are identified as:

- AI(32,34) for a card fitted in the left option board slot.
- AI(52,54) for a card fitted in the right option board slot.

Like the standard analogue input each may be configured for:

- 0 to 5V input.
- 0 to 10V input
- 4 to 20 mA input
- “Custom” input, where all parameters of the translation are available.

Extended feature Loop Supply

The ZENER 8000 Extended features option card offers a loop supply output rated for 24VDC (20mA max). The loop supply is provided to power 4 to 20mA style transducers for process variable control. Apart from wiring there are no configuration parameters.

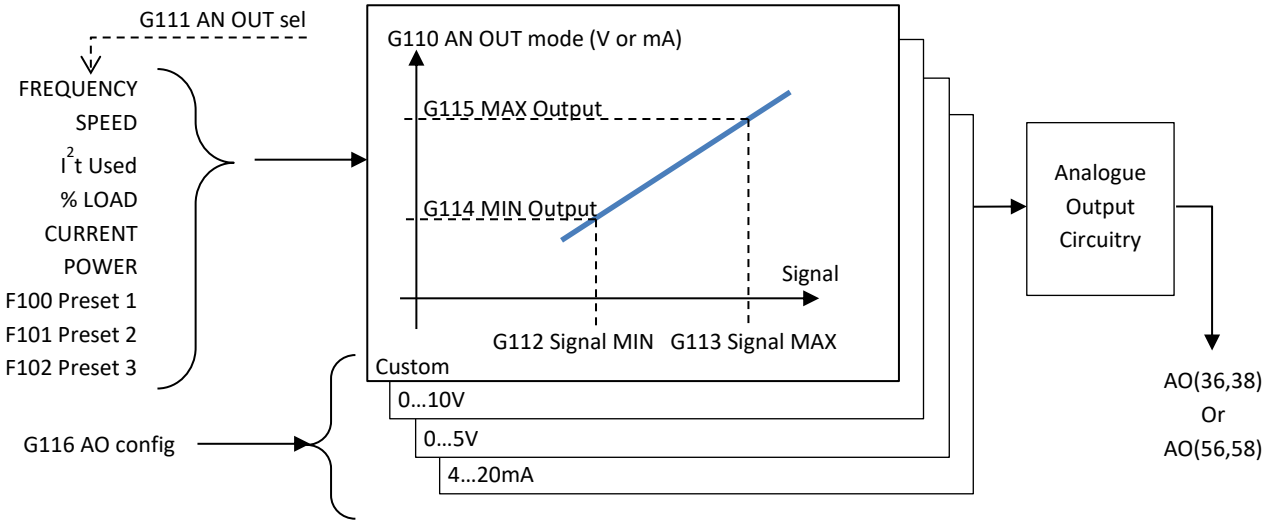
Extended Feature Analogue Output

Each extended feature card for the ZENER 8000 makes available a single analogue output for those applications that require feedback of an internal signal. The analogue output is designed with the following features:

- Configurable voltage (V) or current (mA) input configuration.
- Signal source selection
- Easy to configure spanning and translation.

The analogue outputs are identified as:

- AO(36,38) for a card fitted in the left option board slot.
- AO(56,58) for a card fitted in the right option board slot.



Key configuration parameters are (left-hand-side option connector):

- **G116 AO config**: (0…10V; 0…5V; 4…20mA or Custom)
- **G110 AN OUT mode** (mA or V selection)
- **G114 MIN Output** and **G115 MAX Output**
- **G111 AO source** (signal source selection)
- **G112 Signal MIN** and **G113 Signal MAX**

Refer to G150…G155 for Extended Features AN OUT in the right-hand option connector

Extended feature Thermistor Input

The ZENER 8000 Extended features option card offers a PTC thermistor input for additional thermal motor protection. When enabled a THERMISTOR HOT trip is generated when the measured thermistor resistance is greater than 3000Ω. The thermistor inputs are identified as:

- TH(40,42) for a card fitted in the left option board slot.
- TH(60,62)for a card fitted in the right option board slot.

The configuration parameters are:

- **G09 TH(40,42)** ENABLED/DISABLED (left-hand-side option connector)
- **G13 TH(60,62)** ENABLED/DISABLED (right-hand-side option connector)

The ZENER 8000 will generate a trip and display THERMISTOR SHORT when a low resistance is measured.

Thermistor Option Card

The ZENER 8000 Thermistor option card has a PTC thermistor input for additional thermal motor protection. When enabled a THERMISTOR HOT trip is generated when the measured thermistor resistance is greater than 3000Ω. The thermistor inputs are identified as:

- TH(46,47) for a card fitted in the left option board slot.
- TH(66,67)for a card fitted in the right option board slot.

The configuration parameters are:

- **G21 TH(46,47)** ENABLED/DISABLED (left-hand-side option connector)
- **G22 TH(66,67)** ENABLED/DISABLED (right-hand-side option connector)

The ZENER 8000 will generate a trip and display THERMISTOR SHORT when a low resistance is measured.

Change-Over Relay Option Card

The ZENER 8000 Change-Over Relay Option Card offers 2 change-over style relays with contacts rated for:

- 250VAC, 5A max or
- 30VDC, 5A max

The relays are identified as:

- **RL(70,71,72)** and **RL(73,74,75)** (left-hand-side option connector)
- **RL(80,81,82)** and **RL(83,84,85)** (right-hand-side option connector)

Latching Change-Over Relay Option Card

The latching Change-Over Relay Option Card is primarily to facilitate operation of an ECODRIVE 8000 when powered by a generator on occasions of little or no solar energy availability. The latching Change-Over Relay Option Card offers 2 change-over style relays that operate with minimal power consumption.

The relays are identified as:

- **RL(90,91,92)** and **RL(93,94,95)** with contacts rated for:
  - 125VAC, 0.5A
  - 30VDC, 2A

RL(90,91,92) has a set/ code reset mode associated with it offering a manual reset only capability.

RL(93,94,95) has a battery backed timer associated with it permitting operation when power is removed from the drive.

Ethernet Option Card

The Ethernet Option card is required for MODBUS/TCP communication protocol. The ZENER 8000 checks for the presence of this card in one of its option slots. If present, the ZENER 8000 will enable parameters specifically for MODBUS/TCP

Bore Level Option Card

The Bore Level option card contains several features to facilitate pumping applications. The features include:

- 2x level probe inputs (resistance type)
- 1x flow/ volume input , pulse counting type up to 1000Hz
- 1x 4..20mA (only) analogue input
- 1x LOOP SUPPLY
- 1x Resistance Temperature Detector (RTD, PT100 type) input for motor thermal overload detection

Level Detection WET/DRY Threshold

It is necessary to adjust the WET/DRY threshold to suit the liquid's electrical resistance. Adjustment requires a resistance range selection and the WET/DRY threshold itself.

The **G560 Sense Range** parameter has the following choices:

- **LOW range** For liquids with resistance less than 5kΩ, select "LOW range",
- **MID range** For liquids with resistance between 5kΩ to 50kΩ select "MID range",
- **HIGH range** For liquids with resistance greater than 50kΩ (1MΩ max), select "HIGH range"

The threshold between "WET" and "DRY" is determined by the single threshold setting. The **G561 Threshold** is a percentage of the resistance of the selected range.

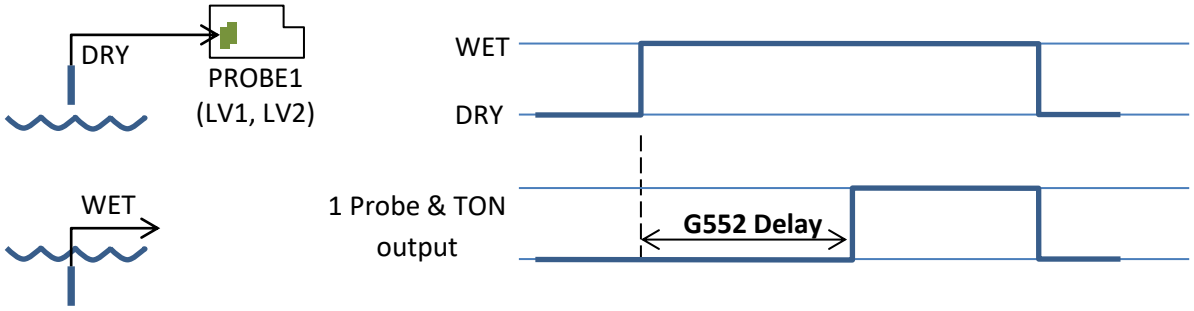
For example:

G560 Sense Range is set to **"MID range"** and
G561 Threshold is set to **50%.**
The effective threshold between WET and DRY is approximately 27.5kΩ.

Level Detection Functions

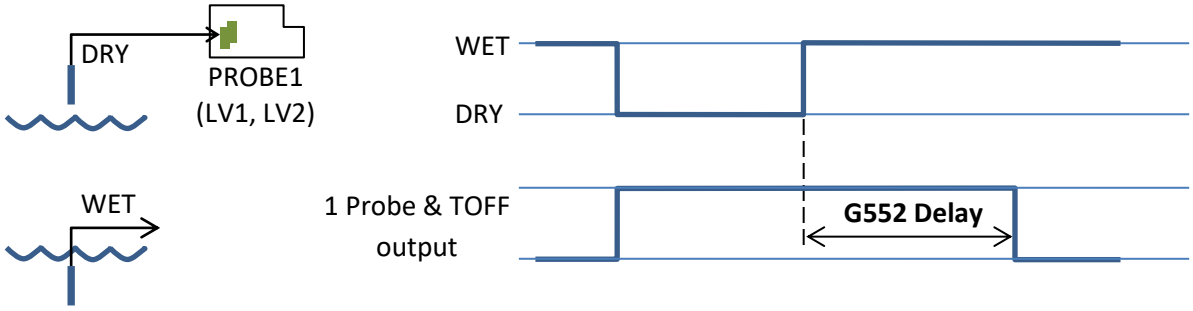
The Bore Level option card supports 1 and 2 detection probe topologies

1 Probe & TON Operation



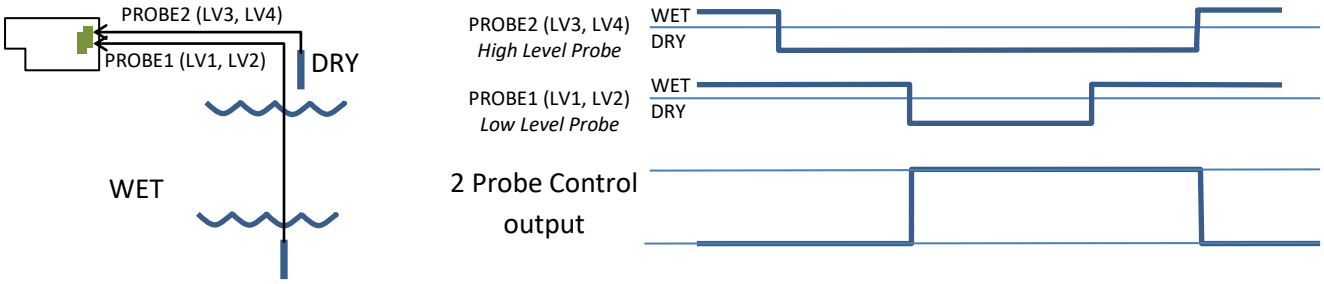
The "1 Probe & TON" output may be used a start pump command when PROBE1 becomes and remains "WET" for the "**G552 Delay**" time interval. The pump is stopped when Probe 1 becomes "DRY".

1 Probe & TOFF Operation



The "1 Probe & TOFF" output may be used a start pump command when PROBE1 is "DRY". The pump is stopped when Probe 1 becomes and remains "WET" for the "**G552 Delay**" time interval.

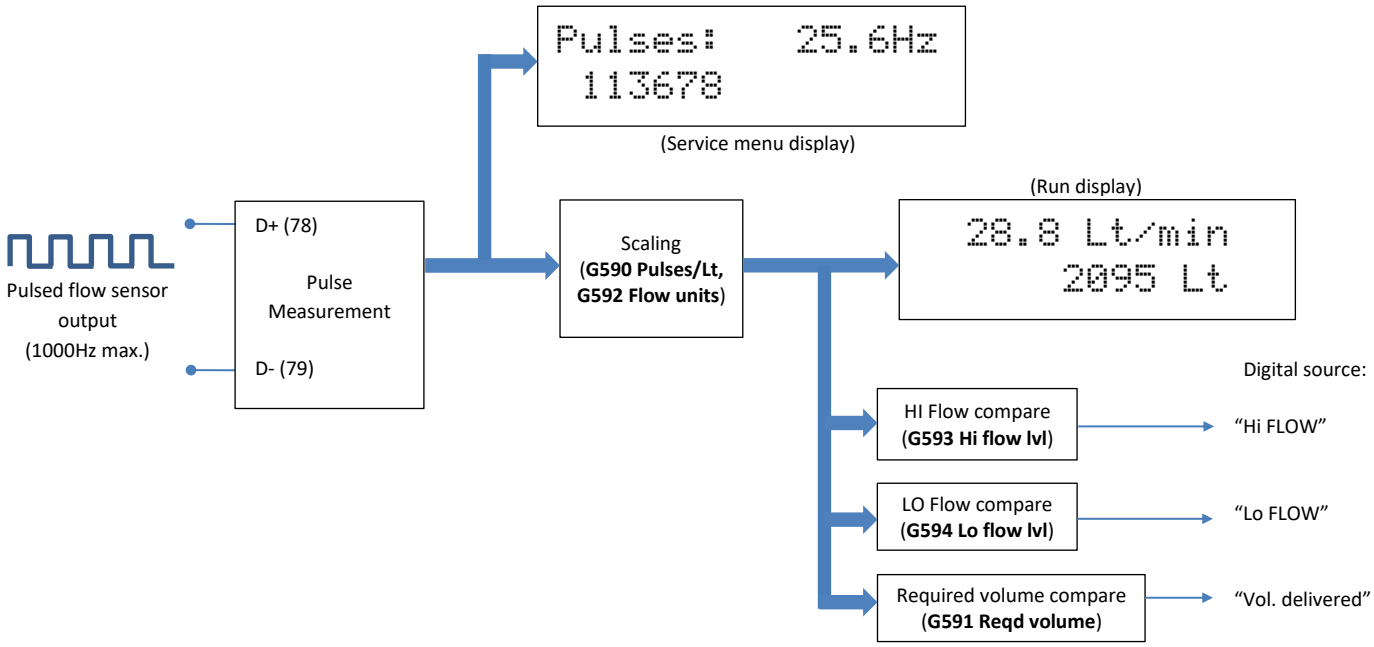
2 Probe Operation



The "2 Probe Control" output may be used as a start pump command when the *Low Level Probe* (PROBE1) is "DRY". The output remains on while ever the *High Level Probe* (PROBE2) is "DRY". The output is switched off when the *High Level Probe* becomes "WET". The output remains off till the *Low Level Probe* becomes "DRY" again.

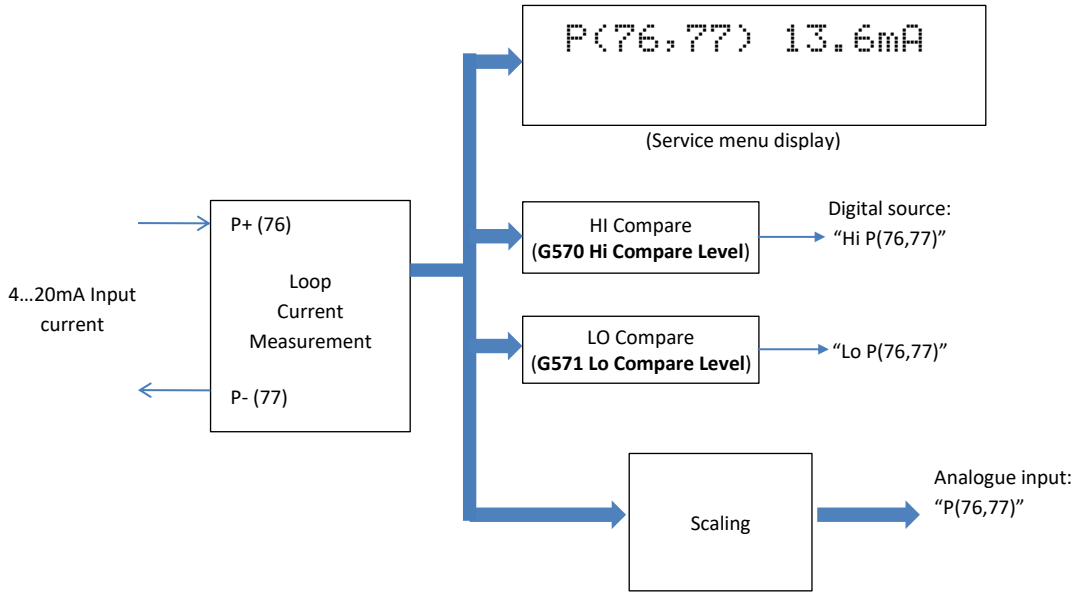
Flow / Volume Input

The Flow/Volume input used in conjunction with a flow sensor with pulsed output indicates flow and volume delivered quantities.



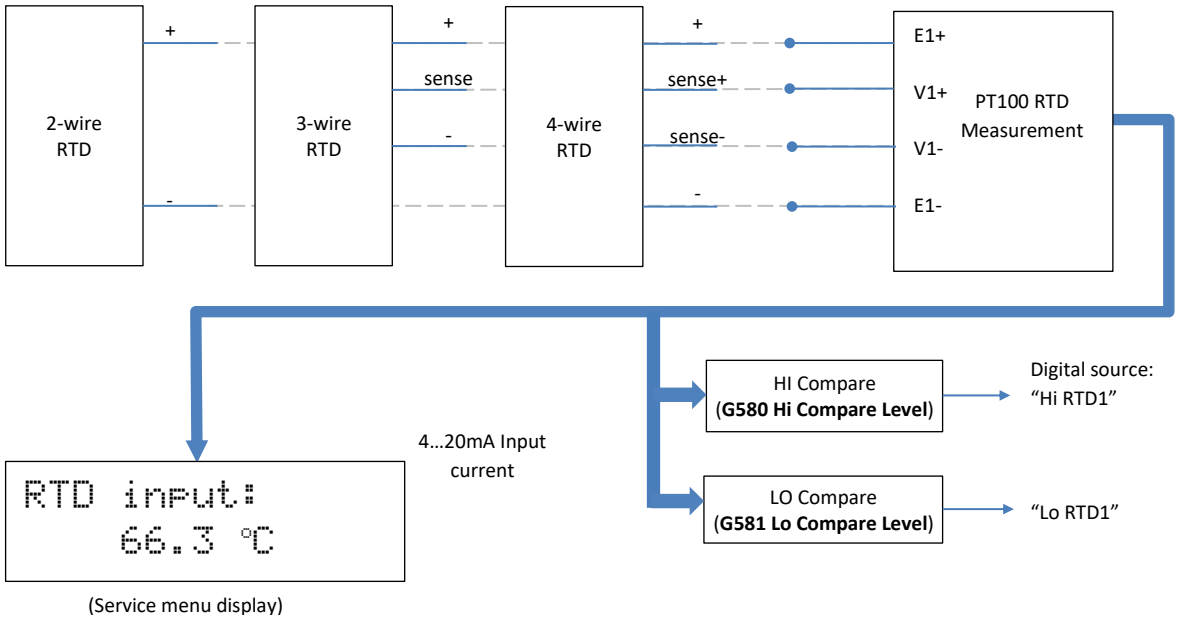
4…20mA Transducer Input

The Bore Level option has a dedicated 4 to 20mA input and loop supply intended for transducer connection. The input has high and low compare outputs available for control and/or monitoring purposes as well.



Resistance Temperature Detector (RTD)

The Bore level option card has a Resistance Temperature Detector (RTD) input intended for 2, 3 or 4 wire PT100 RTDs



Auxiliary Supply Option with External 24V

The Auxiliary Supply option allows the control circuits of the ZENER 8000 to be powered by an external 24V supply without mains power applied.

***IMPORTANT*! When 24V is the only supply source:**

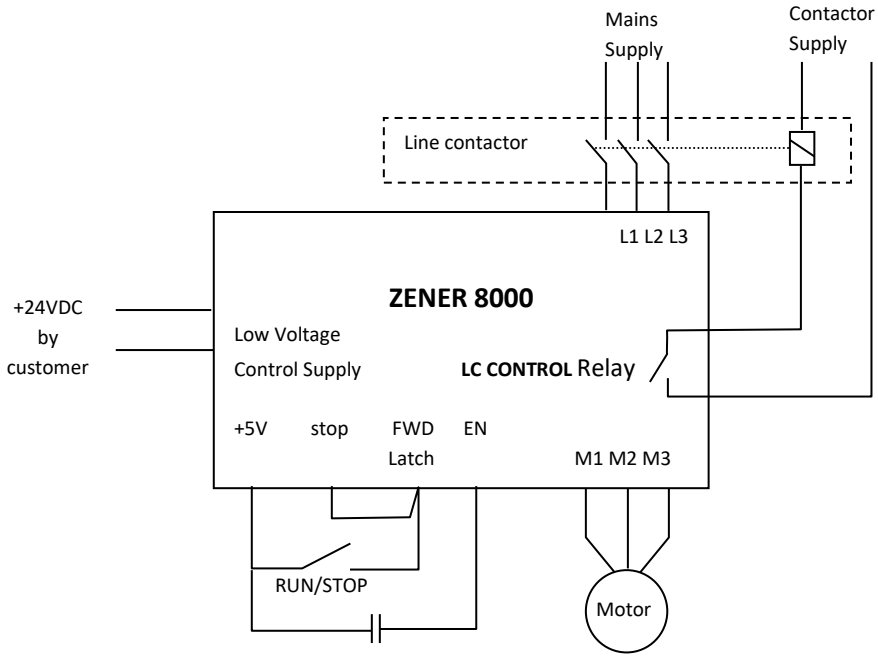
- **Internal signal measurements of volts, amps and temperature is in-accurate.**
- **Internal signals must not be used in any logic evaluations whatsoever.**
- **Only configuration, simple control and communication tasks can be carried out.**

The ZENER8000 offers two modes of operation when an external 24V is the sole power supply. These modes are:

- **Line contactor mode**: A relay of the ZENER 8000 operates a line contactor to apply mains power when a run signal is given to the ZENER 8000.
- **Standby supply mode**: Remains ready for operation and waits for mains power to be applied without registering any faults.

Line Contactor Control

The ZENER 8000 can be powered by a customer supplied external 24V DC supply independent of the mains power supply. In this mode the ZENER 8000 can control an external line contactor to apply mains power to its power circuits. In order to control the external line contactor, one of the ZENER 8000's relays must be configured with the "**LC Control**" function. The diagram below illustrates the wiring.



IMPORTANT! To avoid ZENER 8000 relay contact damage, please ensure the contactor coil ratings do not exceed 2A @ 250Vac.

With 24Vdc applied the ZENER 8000 remains idle until it receives a forward or reverse command. The **LC CONTROL** relay function will then operate the input line contactor charging the ZENER 8000. When charging is complete the motor is run as required. The "**LC CONTROL**" relay will open if:

- The drive experiences a trip,
- The wiring from "+5V" to "EN" of the main terminal strip is opened.
- The motor is run with zero speed for 10 seconds

CAUTION! The line contactor must not be considered a safety isolation device as its operation will apply mains power without notice!

Key configuration parameters are:

- **E06 Aux Pwr mode** set to "**Line contactor**" (function activation)
- Set **LC Control** as a relay function to control the external line contactor

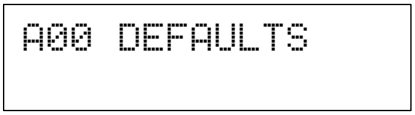
Standby Supply Mode

In standby supply mode the ZENER 8000 simply waits for power to be applied to the drive. Prior to mains power application, faults and other diagnostics are ignored enabling configuration, simple control and communication tasks to operate.

IMPORTANT! When 24V is the only supply source, internal signal measurements of volts, amps and temperature is in-accurate. These erroneous measurements must not be used in any logic evaluations.

The key configuration parameter is:

- **E06 Aux Pwr mode** set to "**Standby supply**" (function activation)



A00 DEFAULTS Menu

This menu provides several choices regarding save and load of parametric defaults. Operations include:

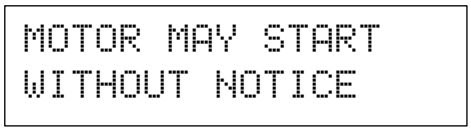
- Loading Factory Defaults
- Loading Custom Defaults
- Saving Custom Defaults
- Loading An Application
- PC Upload/Download Connection

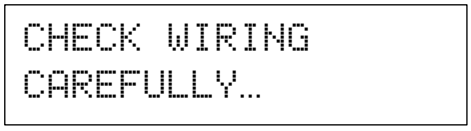
Loading Factory Defaults

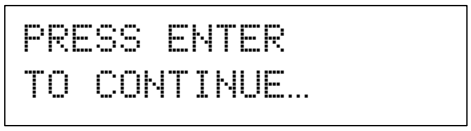
This menu allows the factory default parameters to be reinstalled.

The ZENER 8000 must be in **LOCAL mode and the motor stopped** before loading factory defaults.

Pressing the ↵ button will cause the following message to appear:







The message is intended as a warning and an opportunity to confirm that terminal wiring is suited to the factory default settings, otherwise unexpected drive operation may result.

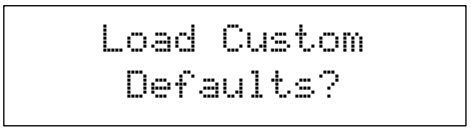
Pressing the ↵ button will cause the following message to appear:

Press ↵ again to load factory defaults as the current set of parameters OR
Press **ESC** to continue with the existing set of parameters

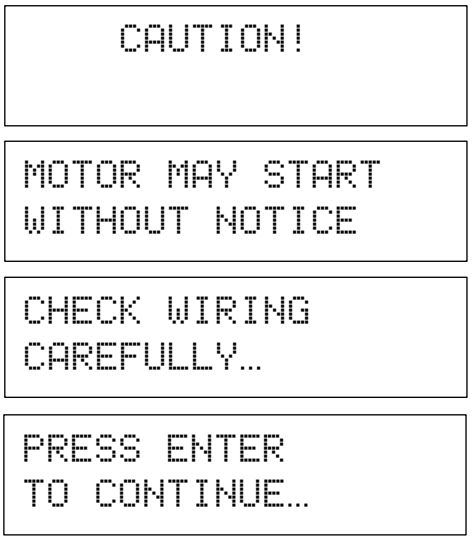
Loading Custom Defaults

Typically when the ZENER 8000 is first commissioned for operation parametric changes are made to suit the application. Once the desired operational configuration is settled, it is recommended that all parameters are stored to Custom defaults. This menu allows custom default parameters to be reinstalled to regain original operating characteristics.

The ZENER 8000 must be in **LOCAL mode and the motor stopped** before loading factory defaults.

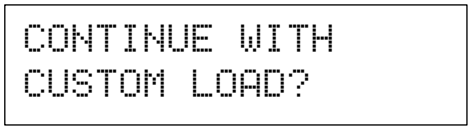


Pressing the ↵ button will cause the following message to appear:



The message is intended as a warning and an opportunity to confirm that terminal wiring is suited to the custom default settings, otherwise unexpected drive operation may result.

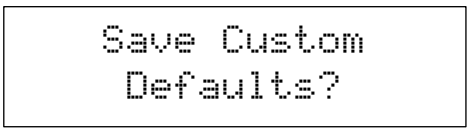
Pressing the ↵ button will cause the following message to appear:



Press ↵ again to load custom defaults as the current set of parameters OR
Press **ESC** to continue with the existing set of parameters

Saving Custom Defaults

It is recommended to save newly configured parameters after a ZENER 8000 is first set up for an application. Called “Custom Defaults”, new and existing parameters form a known configuration that serve as a reference for future changes to the ZENER 8000 and its application. This menu provides a way to save the current set of parameters as the “Custom Defaults”.

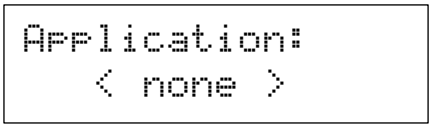


By loading custom defaults the ZENER 8000 may be restored to a known configuration after many parametric changes have been made.

Press ↵ to store the current set of parameters as commissioned defaults OR
Press **ESC** to abandon parameter storage.

Loading an Application

From factory defaults there is no application installed.



Press ↵**(Enter)** to show the 1st application available for selection.
Press ▼only to move through the list

Press ↵**(Enter)** to select the application. This will make the necessary configurations and create the “application menu”.

Upload/Download Connection

The upload / download feature facilitates configuration, diagnostics and update of the ZENER 8000. This feature requires a USB Port Option to be fitted to the ZENER 8000. When the upload/download feature is activated, the ZENER 8000 is represented as an “external disk drive” (i.e. USB Mass Storage Device) to the connected computer.

Once connected exchange of configuration, log data or software update files is possible with the file manager software of the connected computer. Since configuration data etc. may be transferred, the ZENER 8000 must be put off-line to minimise hazardous operation. Details of the connection method are found in the USB Port Option documentation. As a result the ZENER 8000 must:

- Be in LOCAL mode
- And the motor must be stopped before connecting.

Commonly transferred files include:

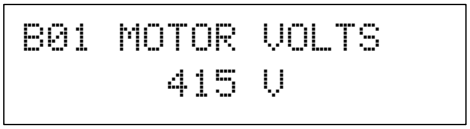
- DSPII.ini This file contains the operating parameters last saved.
- DSPII.cus This file contains parameters saved as “Custom Defaults”.
- TRIP.LOG Contains the last 100 significant faults & events.

CAUTION! Do not alter the contents of these files as unpredictable operation may occur.

B00 MOTOR Menu

This menu allows for the entry of motor nameplate information. Press ▲/ ▼ buttons to view and modify motor volts, motor amps, motor Hz and motor rpm.

B01 MOTOR VOLTS

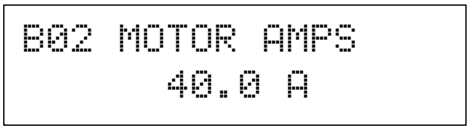


Range: 200...1000V (model dependant)

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The value entered is taken from the motor nameplate and is an important parameter of the motor control algorithm

B02 MOTOR AMPS



Range: 22.5%...171% of the ZENER 8000 current rating (model dependant)

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The value entered is taken from the motor nameplate and is an important parameter of the motor control algorithm. In general the adjustment range is 22.5%...171% of ZENER 8000 rated current. However the actual range of values is model dependant.

B03 MOTOR Hz

Range: 30...200 Hz

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The value entered is taken from the motor nameplate and is an important parameter of the motor control algorithm.

B04 MOTOR RPM

Range: 500...60 x **B03 MOTOR Hz**

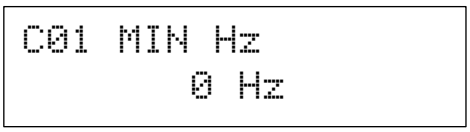
- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The value entered is taken from the motor nameplate and is an important parameter of the motor control algorithm. Note the maximum value is x60 the current **B03 MOTOR Hz** value.

C00 PERFORMANCE Menu

Parameters found within this menu allow motor performance characteristics to be set. Parameters include the minimum and maximum speed of the motor, motor speed ramp times, motor slip compensation and acoustic performance.

C01 MIN Hz



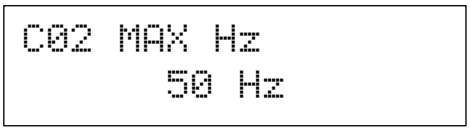
Range: 0…**C02 MAX Hz** - 5Hz

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

This sets the minimum frequency that the ZENER 8000 will run at when given a run signal. The value is entered in Hz. There must be a difference of at least 5Hz between the **C01 MIN Hz** and the **C02 MAX Hz** setting. For example, if **C02 MAX Hz** is set to 45Hz, then the largest allowed value for **C01 MIN Hz** is 40Hz.

It is possible to use the full span of an analogue input to adjust the speed reference from **C01 MIN Hz** through to **C02 MAX Hz**. Refer to the **G02 AN IN Config** menu for details.

C02 MAX Hz

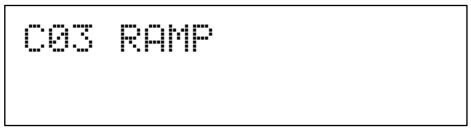


Range: **C01 MIN Hz**+5Hz…200 Hz

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

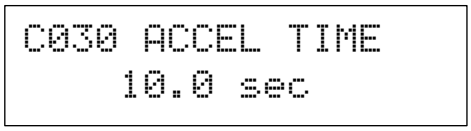
The ZENER 8000 frequency output is limited by **C02 MAX Hz** setting. The output frequency will not exceed this value.

C03 RAMP



The ZENER 8000 has a programmable Ramp with adjustable acceleration, deceleration and S-curve rates. Individual parameters are provided for the linear and curved portions of the ramp. These parameters are found within the **C03 Ramp** menu.

C030 ACCEL TIME

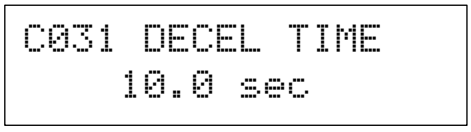


Range: 0.5…600.0 seconds

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The **C030 ACCEL TIME** is the time taken for the motor to go from zero speed up to motor rated speed (assuming minimum **C032 S TIME**). An ZENER 8000 with **B03 MOTOR Hz** set to 50 Hz and **C030 ACCEL TIME** set to 10.0 seconds will take 10 seconds to go from 0 Hz to 50 Hz.

C031 DECEL TIME



Range: 0.5…600.0 seconds

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The **C031 DECEL TIME** is the time taken for the motor to go from motor rated speed down to zero speed (assuming minimum **C032 S TIME**). An ZENER 8000 with **B03 MOTOR Hz** set to 50 Hz and **C031 DECEL TIME** set to 10.0 seconds will take 10 seconds to go from 50 Hz to 0 Hz.

C032 S TIME

```
C032 S TIME
   0.01 sec
```

Range: 0.01…40.00 seconds

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The **C032 S TIME** is the time taken for the motor to reach the limit of acceleration (as set by the rated speed and the **C030 ACCEL TIME** or **C031 DECEL TIME**). Using the **C032 S TIME** ensures smooth speed increases and decreases. A long **C032 S TIME** interval will yield a smoother speed transition, however the **C032 S TIME** will extend the overall ramping time. The ramp time is approximately equal to the **C032 S TIME** plus **C030 ACCEL TIME** or **C031 DECEL TIME**.

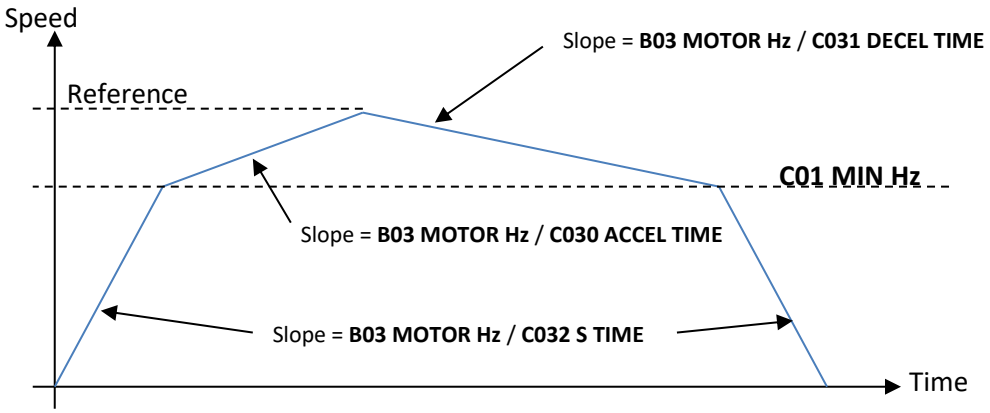
C033 DUAL RAMP

```
C033 DUAL RAMP
>    DISABLED
```

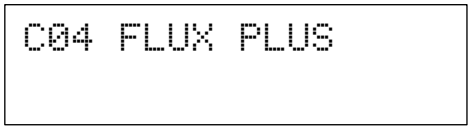
Available Choices: ENABLED
DISABLED

Press ↵ once to begin.
Use the ▲/ ▼ buttons to enable or disable the menu lock.
Press ↵ to confirm the choice.

When this feature is enabled, the C032 S TIME parameter specifies the acceleration and deceleration below the **C01 MIN Hz** setting. Above the **C01 MIN Hz** setting, the acceleration and deceleration times are as per **C030 ACCEL TIME** and **C031 DECEL TIME** respectively. Note that there is no **C032 S TIME** when this feature is enabled. The following graph demonstrates this feature.

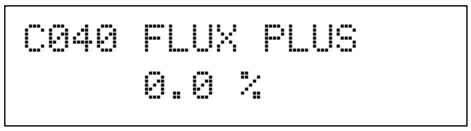


C04 FLUX PLUS



The ZENER 8000 uses a sensorless flux vector control algorithm to control the motor operation. This control algorithm provides independent control of motor flux throughout the speed range and is highly robust against motor parameter changes. It uses the motor nameplate parameters entered in the B00 MOTOR menu as the basis for its calculations to produce the correct flux in the motor. For a motor to produce full torque it must have the correct flux applied to it. This is particularly critical at low speed. Flux Plus adjusts the motor flux estimate to provide additional control where specific adjustments to the motor torque response are required.

C040 FLUX PLUS

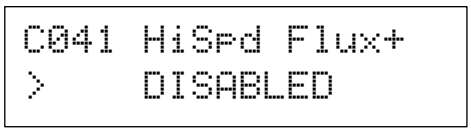


Range: 0 to 150% of adjustment range

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

This feature enables an adjustment in the flux vector algorithm that can increase motor flux to produce more torque for the same motor current. The amount of extra torque produced will vary from motor to motor depending on motor size, efficiency and the operating speed. Increase the value to produce more torque. This should be done in small steps to ensure the drive does not go into Current Limit. If the drive does go into current limit decrease the Flux Plus value slightly. This is the maximum torque that the motor can produce.

C041 HiSpd Flux+

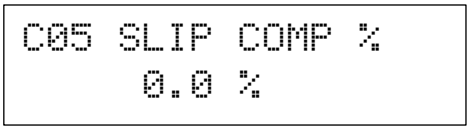


Available Choices: ENABLED
DISABLED

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to enable or disable the high speed flux plus.
- Press ↵ to confirm the choice.

When disabled the flux plus decreases with increasing speed. This allows more efficient operation of the ZENER 8000 on loads that have a high starting torque but do not require any extra torque during normal operation. If your load requires high torque throughout the entire speed range then enable **C041 HiSpd Flux+**.

C05 SLIP COMP %

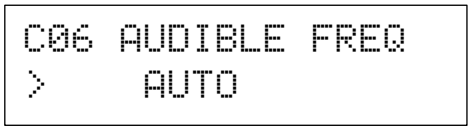


Range: 0 to 150% of slip speed

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

Motor slip is the difference between the shaft speed and the frequency applied to the motor (synchronous speed) and is dependent on load. Slip Comp can provide compensation for this varying slip to produce constant shaft speed under varying loads. The ZENER 8000 estimates the slip of the motor using the parameters entered in the MOTOR parameters menu and the motor load. A value of 100% will make the shaft speed equal the synchronous speed. Flux Plus may be used in conjunction with Slip Comp to provide increase output torque at low speeds.

C06 AUDIBLE FREQ

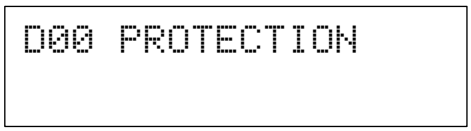


Available Choices:
2kHz
4kHz
8kHz
16kHz
AUTO

- Press ↵ once to begin the selection.
- Use the ▲/ ▼ buttons to select the audible frequency.
- Press ↵ to confirm the choice.

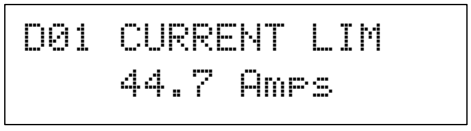
This value sets the maximum frequency that the drive uses in the creation of its PWM output voltage. This frequency is noticeable as an audible sound that the motor makes. Usually higher settings produce less audible noise but increase the switching losses which produce more heat in the drive. For most efficient operation select 2 kHz.

D00 PROTECTION Menu



Motor and system protective feature parameters are found within this menu. Protective features include: current limit, I2t, reverse operation, DC input, single phase input and skip speed.

D01 CURRENT LIM

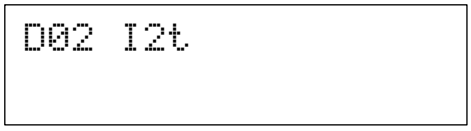


Range: 22...125% of the ZENER 8000 current rating (model dependant)

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

This sets the maximum output current of the ZENER 8000. If excessive load is applied to the motor, the drive will only apply this amount of current to the motor until the overload condition is removed. Current limiting is achieved by reducing the speed of the motor. The Current Limit value cannot be set higher than the maximum output current for the drive.

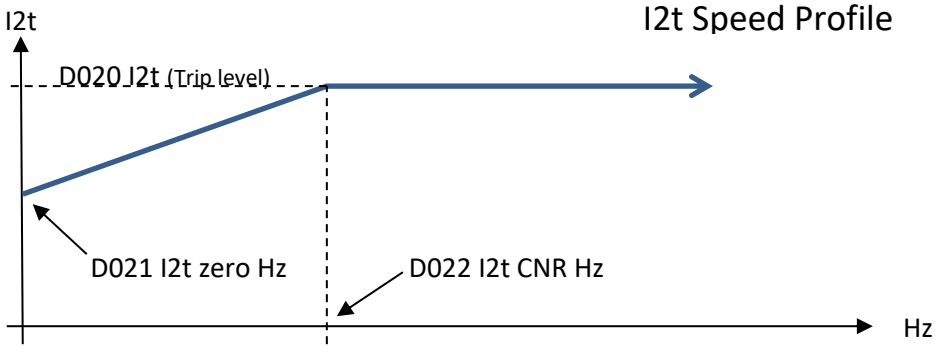
D02 I2t



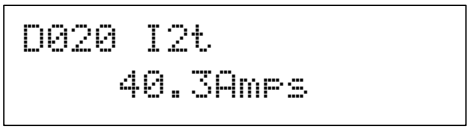
The I2t feature estimates the heating of the motor according to the motor load. When the estimated heating exceeds I2t setting, the drive will trip on I2t. For a motor running at 110% of its I2t current this will take approximately two minutes. The time to trip will shorten the further the motor current exceeds the I2t value.

If power is removed from the drive after an I2t trip, the motor should be allowed to cool down before the inverter is restarted. Motors running highly loaded at low speeds should have external cooling and an external motor thermal sensing device such as microtherms or thermistors for protection.

The I2t feature has the ability to set the trip threshold as a function of output frequency. This allows the I2t to protect motors that have reduced cooling at low speeds because they are not externally cooled. The diagram below is an example of the I2t trip threshold profile.



D020 I2t

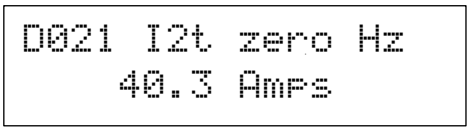


Range: 18...100% of the ZENER 8000 current rating (model dependant)

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

This sets the upper thermal overload limit in amps. An "I2t" trip is generated if the output current is higher than this value for a sufficient amount of time.

D021 I2t zero Hz

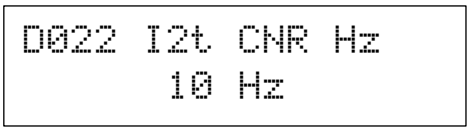


Range: 18...**D020 I2t** value

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

This sets the trip threshold when the speed is zero. This value cannot be set higher than the **D020 I2t** value.

D022 I2t CNR Hz

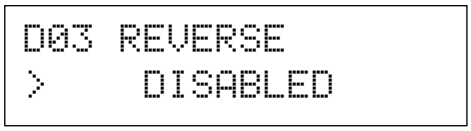


Range: 2...200Hz

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The **D022 I2t cnr Hz** value sets the frequency above which the profile uses the trip threshold as set by **D020 I2t**. Below this frequency the I^2t value is set by the slope on the I^2t profile.

D03 REVERSE

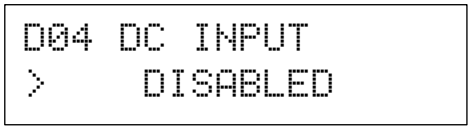


Available Choices: ENABLED
DISABLED

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to enable or disable reverse operation.
- Press ↵ to confirm the choice.

The ZENER 8000 is shipped with its reverse direction disabled to prevent damage to mechanical devices or hazardous equipment operation caused by the motor running backwards.

D04 DC INPUT

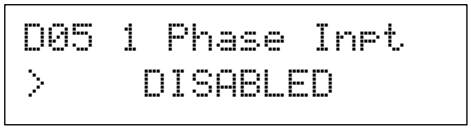


Available Choices: ENABLED
DISABLED

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to enable or disable DC input operation.
- Press ↵ to confirm the choice.

This feature allows the ZENER 8000 to operate from a DC Input supply. The DC Supply voltage should be at least 1.414 times higher than the motor voltage.

D05 1 Phase Inpt



Available Choices: ENABLED
DISABLED

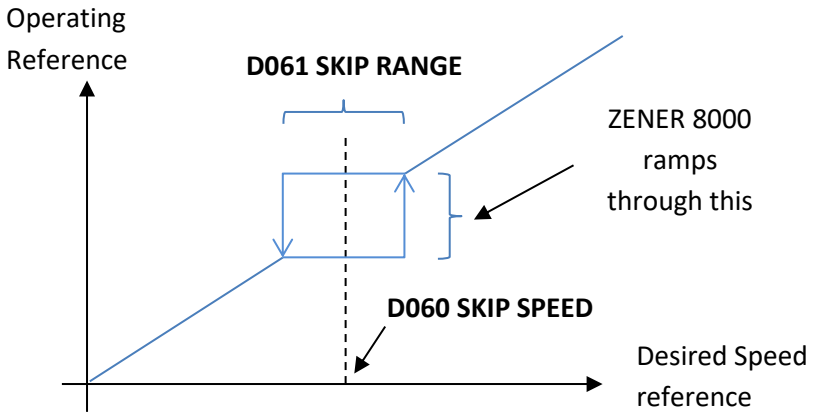
- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to enable or disable DC input operation.
- Press ↵ to confirm the choice.

This feature allows the ZENER 8000 to operate from a single phase electrical supply.

D06 SKIP SPEED

```
D06 SKIP SPEED
```

In some systems, operating a motor within a certain range of speeds can cause system instability, which may lead to hazardous or damaging conditions. The skip speed feature provides the ZENER 8000 a means to avoid operation at these speeds. The ZENER 8000 allows the motor to accelerate or decelerate through the speed range as normal, but will not permit the motor to settle in the troublesome speed range. The diagram below shows how the speed profile is affected by a skip speed.



D060 SKIP SPEED

```
D060 SKIP SPEED
      30 Hz
```

Range: 0...200Hz

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

This sets the centre or main frequency to skip.

D061 SKIP RANGE

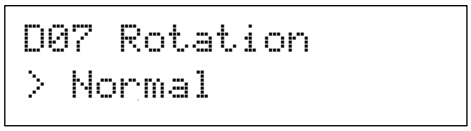
```
D061 SKIP RANGE
      0 Hz
```

Range: 0...200Hz

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

This sets the frequency range either side of the D060 Skip Speed.

D07 Rotation



Available Choices: **Normal**
By Supply Seq.

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to select the rotation preference.
- Press ↵ to confirm the choice.

By default the "**Normal**" output sequence for the forward direction is <M1, M2, M3> regardless of how the input is sequenced. By changing **D07 Rotation** to "**By Supply Seq.**" the motor rotation will be in accordance to the detected sequence of <L1, L2, L3>.

E00 STOP/START Menu

This section sets the motor stopping and starting modes. Features include ramping or coasting to a stop, dynamic breaking, auto-restart, reset by power fail, motor resynchronisation and auxiliary power mode

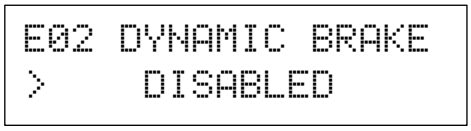
E01 COAST STOP

Available Choices: ENABLED
DISABLED

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to enable or disable coast stop operation.
- Press ↵ to confirm the choice.

Enabling **E01 COAST STOP** instantly removes voltage applied to the motor permitting the motor shaft to coast to zero speed in a time governed by the mechanical load coupled to the shaft. By disabling **E01 COAST STOP**, the motor shaft is stopped in a controlled manner in a time governed by **C03 RAMP** settings.

E02 DYNAMIC BRK



Available Choices: ENABLED
DISABLED

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to enable or disable dynamic brake operation.
- Press ↵ to confirm the choice.

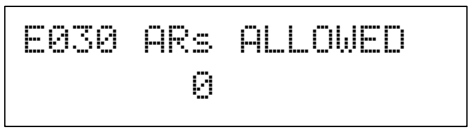
Dynamic Braking provides the means for dissipating the motor regenerative energy into an external resistor. This may be required when the ZENER 8000 experiences regenerative currents from an overhauling load or a high inertia load that is required to decelerate rapidly. Dynamic Braking requires the dynamic braking option to be connected to the ZENER 8000. Please see the dynamic braking instruction manual for resistor sizing and dynamic braking application information.

E03 AUTO RESTART

Auto Restart allows the ZENER 8000 to automatically attempt to restart after a trip occurs. If the ZENER 8000 trips, it will wait 10 seconds then attempt to clear the fault. If it is unsuccessful it will keep trying every ten seconds. It will do this the number of times specified in **E030 ARs ALLOWED**. If the fault is cleared and the drive runs without tripping for the **E031 AR CLR TIME** the number of auto restarts attempted will start counting from one again. If the trip is cleared by any other means the fault count will start from one again.

Note: Alteration to any of the Auto Restart parameters is not permitted while the ZENER 8000 is operating in ESO mode.

E030 ARs ALLOWED

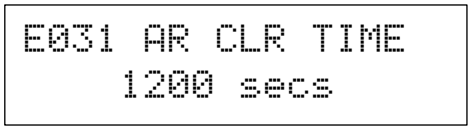


Range: 0...15 attempted restarts

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

This number indicates how many times the ZENER 8000 will attempt to restart after a trip. For the motor to run after the trip is cleared, the drive must be given a valid run command. Select 0 restarts in order to deactivate Auto Restart.

E031 AR CLR TIME



Range: 1...1200 seconds

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

If the ZENER 8000 operates for the **E031 A/R CLR TIME** without any trips, the number of restarts is reset to the value of **E030 A/Rs ALLOWED**. Set the **E031 A/R CLR TIME** to 6 secs for infinite auto restarts

E04 Reset by PF

Available Choices: ENABLED
DISABLED

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to enable or disable reset by power fail operation.
- Press ↵ to confirm the choice.

When enabled trips may be cleared without any extra wiring simply by turning the power off and straight back on again before the drive powers down completely.

E05 Motor Resync

Available Choices: ENABLED
DISABLED

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to enable or disable reset by power fail operation.
- Press ↵ to confirm the choice.

When enabled, the ZENER 8000 will scan for the motor shaft speed. When detected, a smooth transition into operation begins. The motor resynchronisation function avoids current limit braking.

E06 Aux Pwr mode

Available Choices: Disabled
Line Contactor
Standby supply

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to select a mode.
- Press ↵ to confirm the choice.

For this feature to operate correctly, your drive must be fitted with a supplementary 24V supply.

Line Contactor: This function mobilises internal logic to control an external mains supply contactor. The external contactor is driven whenever a motor start is required and so must be used in conjunction with **> LC CONTROL** relay function. See the **Line Contactor Start Control** feature for details.

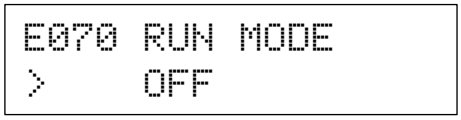
Standby supply: This function mobilises internal logic to operate correctly when the power supply is controlled and applied externally. It is necessary for the 24V option to be fitted and powered to allow the main controller to always remain functional. Permits functions such as communications to operate with no mains supply applied.

E07 Solar Supply Menu (ECODRIVE 8000 only)

The ECODRIVE 8000 provides power tracking control for those applications where the intended power source is a bank of solar - photovoltaic cells. The tracking feature of the ZENER 8000 provides the best operating performance in the presence of fluctuating supply and load conditions.

E0701 Solar Function Enable

E070 RUN MODE Signal Selection

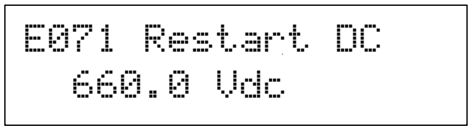


Available Choices: Refer to the “List of Digital Sources” on page 94 for choices

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

If this input evaluates true, the ECODRIVE 8000 will enable logic for a solar supply feed. When active, charging logic is tailored for DC input and power monitoring is used to reduce power consumption during periods of low light and/or fluctuating motor load.

E071 Restart DC Menu

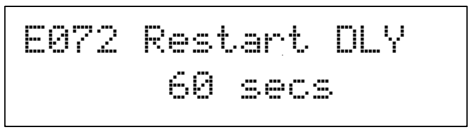


Range: Vmp to Max measureable DC voltage (model dependant)

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

Enter the DC voltage needed to resume output operation.

E072 Restart Delay



Range: 0 to 1200 seconds

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

If the supply capacity has reduced below the minimum, the tracking logic will stop the motor. Before the motor can start again the supply capacity must be restored and operation may recommence after the **E072 Restart DLY** time has elapsed.

E0721 Timer Test

E073 Low Irradiance Signal Selection

E074 High Irradiance Signal Selection

Available Choices: Refer to the "List of Digital Sources" on page 94 for choices

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

The solar supply feature of the ECODRIVE 8000 may be configured to go into an idle condition based on the truth of "Lo Radiance" as a result of a reading of an irradiance sensor. This is typically intended to be sourced from an analogue input compare. If the reading is below a threshold then low radiance is determined true. Alternatively this decision may be sourced from and external controller.

Similarly the level of radiance above which operation may continue is determined from the "Hi Radiance" digital source.

E075 Volts at Maximum Power

Range: 390V (min) to 800V (max) for ECODRIVE 8000R 480V inverters
195V (min) to 400V (max) for ECODRIVE 8000L 240V inverters

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

Enter the nominal voltage at maximum power (Vmp) for supply capacity evaluation. This is the voltage of the solar array's operating point when subjected to the rated current of the motor and load.

The tracking algorithm starts at this value and adjusts operation for the given conditions. An inappropriate Vmp value will track to a limit condition and desired performance may not be achieved.

E0751 MPPT Voltage Reference Step

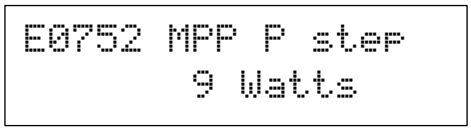
Available Choices:
> No step
> 1 V/sec
> 2 V/sec (default)
:
> 7 V/sec

- Press ↵ once to begin a selection.
- Use the ▲/ ▼ buttons to select a step rate
- Press ↵ to confirm the choice.

This parameter specifies the rate at which the tracking algorithm searches for the actual Vmp. Larger rates will track faster but with notable jitter around the operating point.

E0752 MPPT Power Step Change Threshold

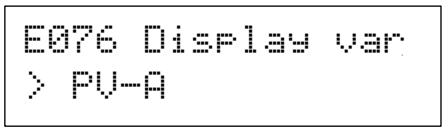
Range: 0 to 10% of measurable power in Watts
(model dependant; kW for large chassis models)



- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

This parameter defines the minimum detectable power change for the tracking algorithm. This parameter discriminates between power changes caused by the tracking algorithm and power changes caused by other influences e.g. measurement noise.

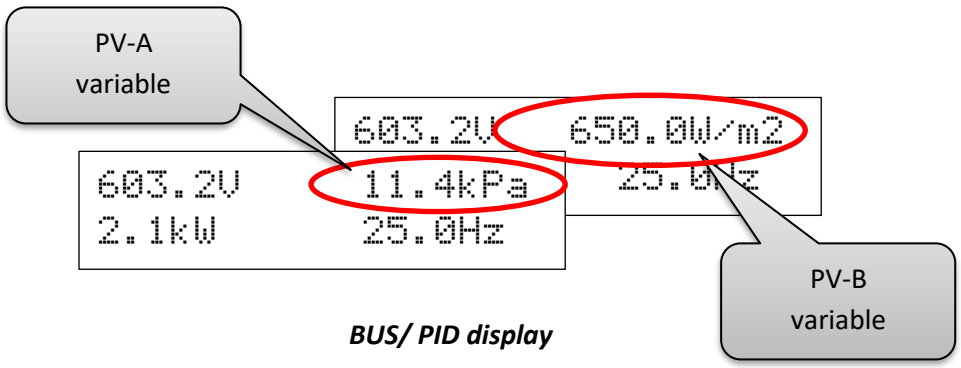
E076 Display Variable



Available Choices: **PV-A**
PV-B
none

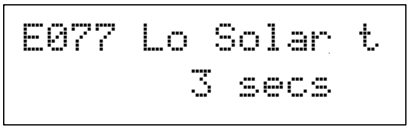
- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

This selection affects the “BUS / PID” display. The BUS / PID display features the process variable and its units in the top right corner of the console display. This selection specifies which process variable to display in the top right corner of the console display.



BUS/ PID display

E077 Lo Solar time



Range: 0 to 60 seconds

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The **E077 Lo Solar t** is a time interval to qualify the low solar conditions. That is if the low solar conditions persist for this time interval, then the **Low Solar** state is detected.

The low solar conditions are:

- The ZENER 8000 output frequency less than the **C01 MIN Hz** value and the ECODRIVE 8000 is tracking,
- Or when the digital source selected by **E073 LO Radiance** evaluates true.
-

E078 SFC time (dual supply only)

Range: 0 to 1024 minutes (~ 17hours)

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The **E078 SFC time** is relevant in dual supply applications only. In these applications, the ECODRIVE 8000 scans for conflicting solar conditions: high irradiance with low DC voltage, for example when the DC breaker is left open. When a conflict is detected, the ECODRIVE 8000 enters “Solar Function Conflict” (SFC) mode.

The ECODRIVE 8000 will remain in SFC mode for an interval specified by the **E078 SFC time**. During the SFC time interval the ECODRIVE 8000 functions with AC power. After the **E078 SFC time** interval has elapsed, the ECODRIVE 8000 will attempt to run again with solar power.

Alternatively, the ECODRIVE 8000 will attempt to use solar power when:

- The conflicting conditions cease to exist. Or
- The Stop push button is pressed – a manual solar restart.

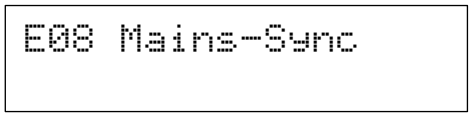
E079 SFC External selection

Available Choices: Refer to the “List of Digital Sources” on page 94 for choices

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

If this input evaluates true, the ECODRIVE 8000 will enter the Solar Function Conflict External state. The ECODRIVE 8000 will remain in SFC External mode for an interval specified by the **E078 SFC time**. During the SFC time interval the ECODRIVE 8000 functions with AC power. After the **E078 SFC time** interval has elapsed, the ECODRIVE 8000 will attempt to run again with solar power.

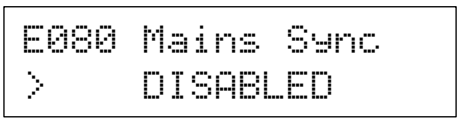
E08 Mains Synchronisation



The ZENER 8000 includes a mains synchronisation feature. When enabled the mains frequency and phase are sensed. If the speed command matches the speed the mains would support, a relay is operated that is used to control external bypassing switch gear. This feature significantly reduces motor current inrush compared to D.O.L. levels.

E080 Mains Synchronisation Enable/Disable

Available Choices: DISABLED (default)
ENABLED

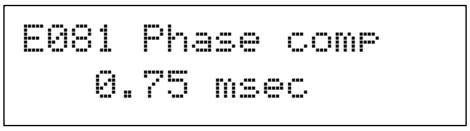


- Press ↵ once to begin selection.
- Use the ▲/ ▼ buttons to select ENABLED or DISABLED.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

Set the mains synchronisation logic ENABLED or DISABLED.

E081 Phase Lag Compensation

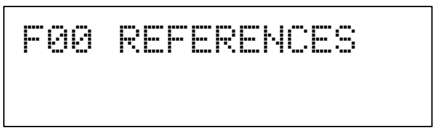
Range: 0 to 2 milliseconds



- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

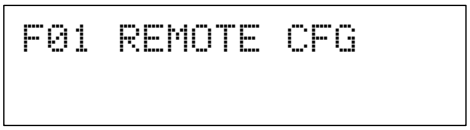
Enter a lag compensation value that accounts for mains sensing delays.

F00 REFERENCES Menu



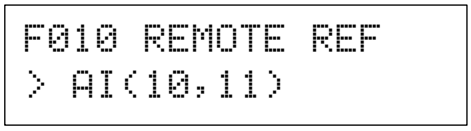
Items found in this menu allow for speed reference choices for the ZENER 8000 operating modes REMOTE, LOCAL, ESO, JOGFWD and JOGREV. Additionally other reference selections and parametric configuration are found within this menu. Some reference choices and parameters are related to connected option cards. If an option card is not fitted, its reference choices will not appear in any lists and its parameters will not be visible.

F01 REMOTE CFG Menu



Items found in this menu permit several options for REMOTE mode speed reference and input selection.

F010 REMOTE Reference



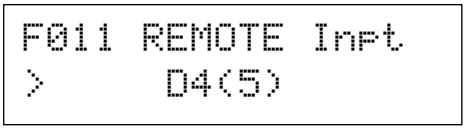
Available Choices:

> AI(10,11)
> CONSOLE
> PID-A Output
> PID-B Output
> AI(32,34) (Extended Features card fitted on the left-hand side)
> AI(52,54) (Extended Features card fitted on the right-hand side)
> COMMS REF
> F100 PRESET1
> F101 PRESET2
> F102 PRESET3
> F103 PRESET4
> F104 PRESET5
> F105 PRESET6
> F106 PRESET7
> F107 PRESET8
> REF SELECT
> ZERO REF
> F07 AI FUNC.

- Press ↵ once to begin a selection.
- Use the ▲/ ▼ buttons to select a reference.
- Press ↵ to confirm the choice.

When the drive is operating in remote mode the ZENER 8000 will take its speed reference from the selected reference source.

F011 REMOTE Input Menu

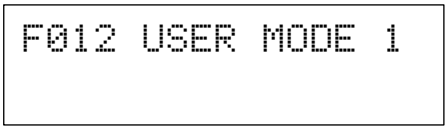


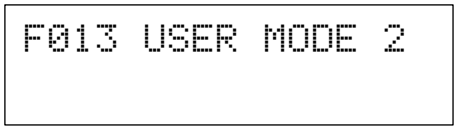
Refer to the "List of Digital Sources" on page 94 for choices

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

Contact closure on this input means that the ZENER 8000 will follow the control inputs on the terminal strip and the motor will run at the speed set by the REMOTE speed reference. When the contact is opened the ZENER 8000 will be controlled from the console and will run at the speed set by the LOCAL speed reference. This input requires other terminals to stop and start the motor.

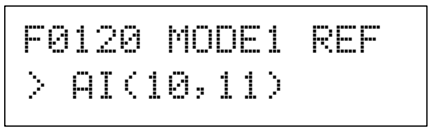
F012 & F013 USER MODES 1 & 2





A user mode is given a priority for REMOTE reference choice and optionally motor start/stop governance. These two menus allow customisation of the each user mode. Customisations include the reference to apply; the activating input signal; the message to display on the console when the mode is activated; and the nature of motor stop and start logic.

Reference Selection

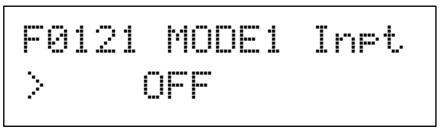


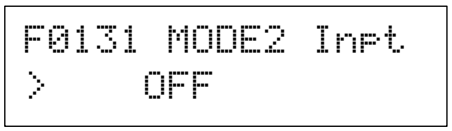
Available choices: Refer to the reference list on page 80 for choices

- Press ↵ once to begin a selection.
- Use the ▲/ ▼ buttons to select a reference.
- Press ↵ to confirm the choice.

This selection specifies the reference that will be asserted when the mode is activated

Input Selection



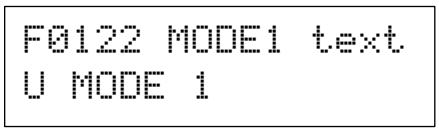


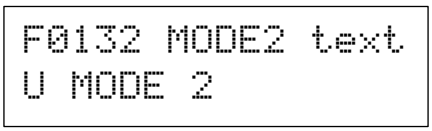
Refer to the "List of Digital Sources" on page 94 for choices

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

This selection specifies the activating signal for the user mode. This input may also start and stop the motor according to the **F0123 MODE1 cfg** and **F0133 MODE2 cfg** for each mode respectively

Status Message Text



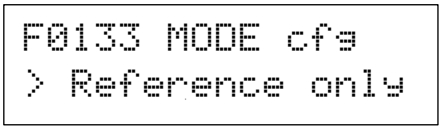


Available characters: 0…9,A…Z, a…z,
punctuation characters,
+, -, *, /, |, #, $, ^, &, !, ~,
{}, [], ()

- Press the ▲ button to move to the timer interval of the selected user alarm.
- Press the ▼ button to move to the enable mode of the selected user alarm.
- Press ↵ and a character to enter begins to flash
- Press ▲ & ▼ to move through the list of available characters
- Press ↵ to select the displayed character;
  the cursor moves to the next character OR the edit completes
- Press the **ESC** button to abandon changes

This parameter specifies the 8 character message to display when the user mode is active.

Operational Configurations



Available Choices: > **Reference only**
> **Ref & Start**
> **Ref,Start&Stop**

- Press ↵ once to begin a selection.
- Use the ▲/ ▼ buttons to select a reference.
- Press ↵ to confirm the choice.

These choices specify the start stop behaviour of the activating input. The start and stop behaviour is as follows:

Reference only: The activating input does not start nor stop the motor operation.

Ref & Start: The momentary activating input also activates the ZENER 8000 run latch and drives the motor to the specified speed reference. A ~STOP input is necessary to stop the operation of the motor.

Ref,Start&Stop: The activating input also activates the ZENER 8000 and drives the motor to the specified speed reference. The activating input must be continually asserted to maintain operation. When the activating input is de-asserted the motor will stop (unless some other lower priority run signal is present). The ZENER 8000 run latch will be reset by the activating input in this configuration.

F02 LOCAL

Available Choices: (See the list for **F010 REMOTE REF**)

- Press ↵ once to begin a selection.
- Use the ▲/ ▼ buttons to select a reference.
- Press ↵ to confirm the choice.

When the drive is operating in local mode the ZENER 8000 will take its speed reference from the selected reference source.

F03 ESO Config Menu

Items found in this menu permit several options for ESO mode operation. Specifically the choice of the ESO speed reference, the ESO input terminal choice and the ESO ramp time setting.

F030 ESO REF Menu

Available Choices: (See the list for **F010 REMOTE REF**)

Press ↵ once to begin a selection.
Use the ▲/ ▼ buttons to select a reference.
Press ↵ to confirm the choice.

When the drive is operating in ESO mode the ZENER 8000 will take its speed reference from the selected reference source.

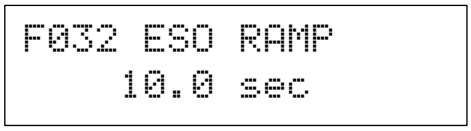
F031 ESO Input Menu

Refer to the “List of Digital Sources” on page 94 for choices

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

While this input is held the ZENER 8000 will operate in Essential Services Override (ESO). Refer to the ESO feature description for details.

F032 ESO RAMP Menu

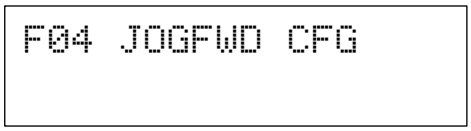


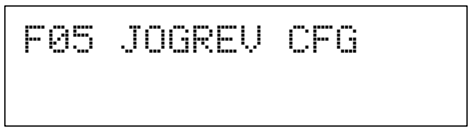
Range: 0.5…600.0 seconds

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

When the drive is operating in ESO mode it will use the **F032 ESO RAMP** setting for acceleration and deceleration instead of the **C030 ACCEL TIME** and **C031 DECEL TIME** settings. The ESO Ramp time is the time taken for the motor to go from zero speed up to motor rated speed (assuming minimum **C032 S TIME**). A ZENER 8000 with the **B03 MOTOR Hz** set to 50 Hz and a **F032 ESO RAMP** set to 10 seconds will take 10 seconds to go from 0Hz to 50Hz.

F04 JOGFWD & F05 JOGREV Configuration Menu





Items found in this menu permit several options for JOGFWD mode operation. Specifically the choice of the JOGFWD speed reference and JOGFWD input terminal choice.

F040 JOGFWD & F05 JOGREV Reference Menu

Available Choices: (See the list for **F010 REMOTE REF**)

- Press ↵ once to begin a selection.
- Use the ▲/ ▼ buttons to select a reference.
- Press ↵ to confirm the choice.

When the drive is operating in jog forward mode the ZENER 8000 will take its speed reference from the selected reference source.

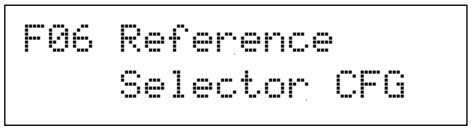
F041 JOGFWD& F05 JOGREV Input Menu

Refer to the “List of Digital Sources” on page 94 for choices

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

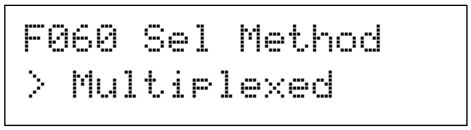
Contact closure on this input will run the motor forward at the JOGFWD speed. It will also clear any latched inputs. When the contact is opened the motor will stop.

F06 Reference Selector Configuration Menu



Items found in this menu permit several options for Reference Selector when used as a speed reference. Note there is no specific mode of operation, instead it determines a reference chosen from a list of 8 speed references. The first 2 references of the list are selectable and the remaining 6 are preset references. Additionally up to 8 controlling inputs are specified to select 1 of 8 speed references.

F060 Sel Method Menu



Available Choices:
> Multiplexed
> Multi Speed
> Tally Method

- Press ↵ once to begin a selection.
- Use the ▲/ ▼ buttons to select a method.
- Press ↵ to confirm the choice.

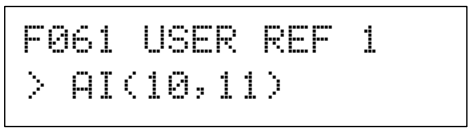
This parameter defines the method for reference selection when the reference selector is used for the speed reference.

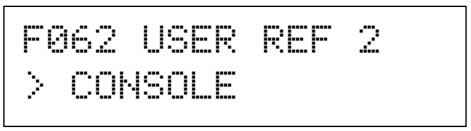
The Multiplexed Method is the traditional selector method based on the combination of three digital inputs.

The Multi Speed Method will select the reference associated with the digital input. If more than one input is detected high, the reference associated with the digital input of highest priority is selected. The highest priority input is **F0630 Selector 1** and the lowest is **F0637 Selector 8**

The tally Method counts the number of active inputs to select the reference. If 6 inputs are found to be active, then Preset 6 will be selected

F061 USER REF 1 and F062 USER REF 2 Menus





Available Choices: (See the list for **F010 REMOTE REF**)

- Press ↵ once to begin a selection.
- Use the ▲/ ▼ buttons to select a reference.
- Press ↵ to confirm the choice.

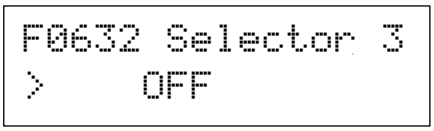
These 2 parameters are the customisable inputs to the reference selector. When the digital inputs **F0630 Selector 1**, **F0631 Selector 2** and **F0632 Selector 3** are all Low, the reference assigned to **F061 USER REF 1** is selected.

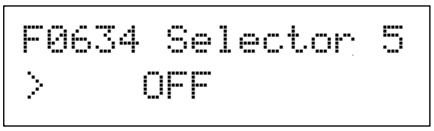
When the digital inputs **F0630 Selector 1** and **F0631 Selector 2** are both Low and **F0632 Selector 3** is High, the reference assigned to **F062 USER REF 2** is selected.

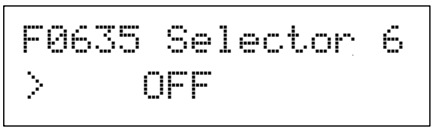
F063 Selector Input Configurations Menus

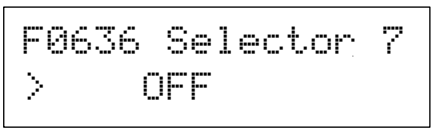
Items found in this menu permit digital input choices that select a reference, to be view and altered

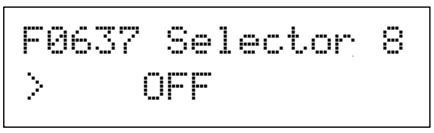
F0630 Selector 1 to F0637 Selector 8 Menus











Refer to the “List of Digital Sources” on page 94 for choices

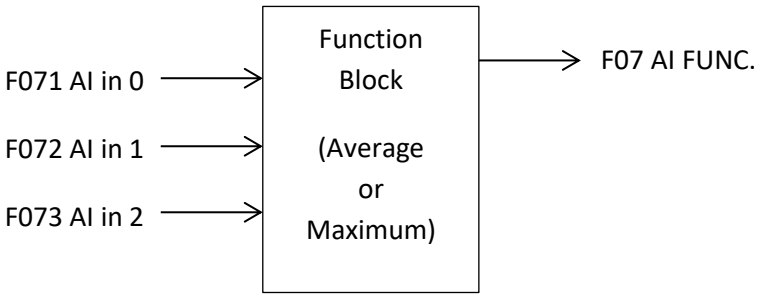
- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

These inputs form a unique combination for the reference selector. See the Reference Selector feature description earlier in this manual for details

F07 Analog Input Function Configuration

```
F07 AI fxn Cfg
```

The ZENER 8000 is able to perform useful arithmetic to combine several analogue inputs into a single reference. Select either “Average” or “Maximum” to combine analogue input readings. The function block offers three inputs to combine. A diagram of the function block is:



Analogue Input Function Selection

```
F070 AI Function
> Average fxn
```

Available Choices: > **Average fxn**
> **Maximum fxn**

- Press ↵ once to begin function selection.
- Use the ▲/ ▼ buttons to select a function.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

Select “Average fxn” and the ZENER 8000 will evaluate the average value of the non-zero inputs only.
Select “Maximum fxn” and the ZENER 8000 will determine the highest reading of the three inputs.

Analogue input Selections

```
F071 AI in 0 sel
> ZERO_REF
```

```
F072 AI in 1 sel
> ZERO_REF
```

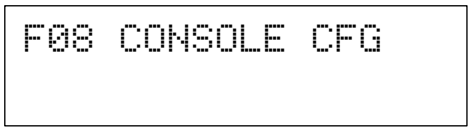
```
F073 AI in 2 sel
> ZERO_REF
```

Available Choices: ZERO_REF,
AI(10,11),
AI(32,34), (Note: Only visible if extended features card fitted left)
AI(52,54) (Note: Only visible if extended features card fitted right)

- Press ↵ once to begin Input selection.
- Use the ▲/ ▼ buttons to view the next choice.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

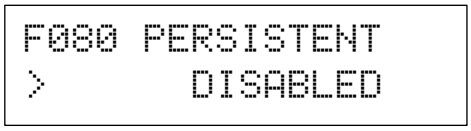
For each input, select from the list of available analogue inputs. Note selecting “ZERO_REF” disables the input and is not included in the average value evaluation.

F08 CONSOLE Configuration



The console reference uses the ▲ and ▼ buttons as well as the **I05 UP** and **I06 DOWN** input functions to modify the reference value. There are two parameters that define the behavior of the console reference.

F080 PERSISTENT Reference



Available Choices: **ENABLED**
DISABLED

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to enable or disable persistent console reference operation.
- Press ↵ to confirm the choice.

When **F080 PERSISTENT** is **ENABLED** the console reference is retained whenever the ZENER 8000 is powered down so that when power is restored, the operating speed reference will be reapplied.

When **F080 PERSISTENT** is **DISABLED** the console reference will be zero each time the ZENER 8000 is powered on.

F081 STOP RESET

Available Choices: **ENABLED**
DISABLED

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to enable or disable stop reset console reference operation.
- Press ↵ to confirm the choice.

When **F081 STOP RESET** is **ENABLED** the console reference value is set to zero whenever the ZENER 8000 is commanded to stop the motor.

When **F081 STOP RESET** is **DISABLED** the console reference value is retained through a stop and start cycle.

F09 COMMS PRESET

Range: -100.0...100.0 % of **C03 MAX Hz**

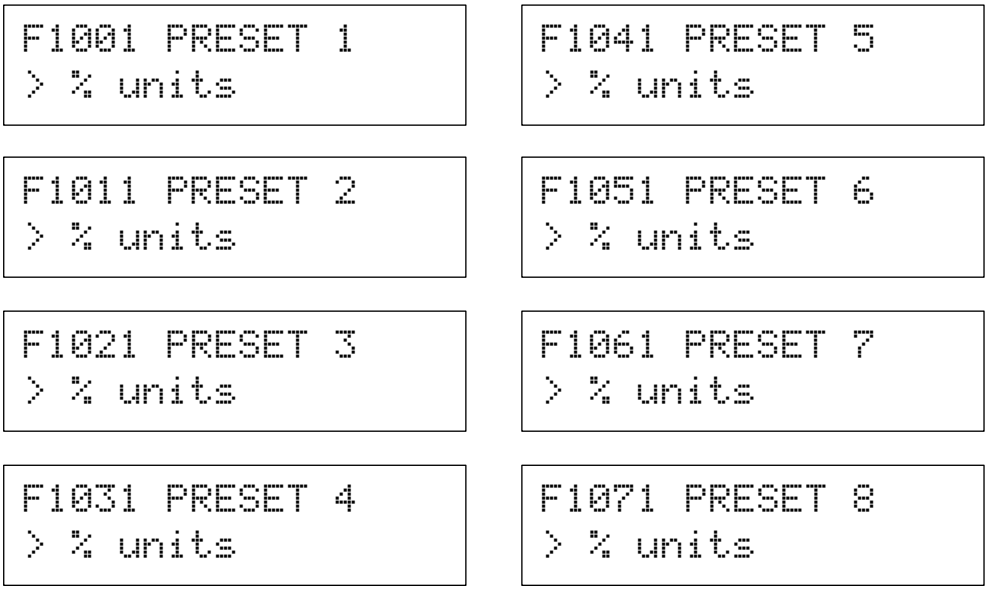
- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The **F09 COMMS PRESET** parameter is the power-on value for the **> COMMS REF** reference. The **> COMMS REF** is the reference by the operating communication network protocol.

F10 PRESETS

There are 8 preset references for the ZENER 8000. Most are used in conjunction with the Reference Selector. Each preset may be expressed in percentage units, PID units or RUN display units. The choice of units and scale is selectable

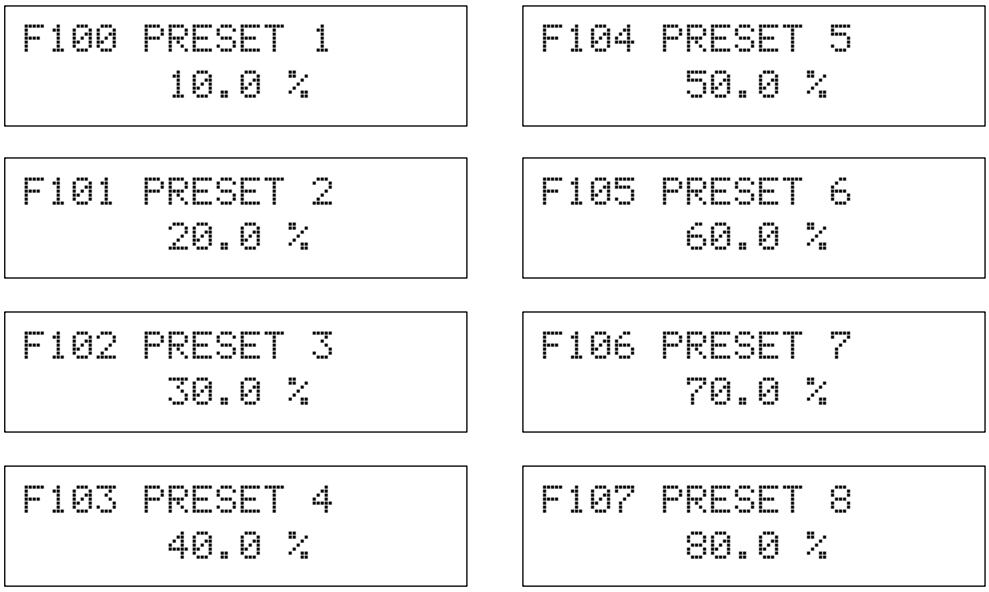
Preset Display Units



Available Choices:
> % units – Preset is scaled as a percentage of **C03 MAX Hz**.
> PID-A units - Preset is scaled according to **H09 PID scale** and **H08 Units**
> PID-B units - Preset is scaled according to **H29 PID scale** and **H28 Units**
> RUN units - Preset is scaled according to **J031 RUN scale** and **J032 Units**

- Press ↵ once to begin unit selection.
- Use the ▲/ ▼ buttons to view the options.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

Preset Speed References



Range: -100.0...100.0 % of **C03 MAX Hz**

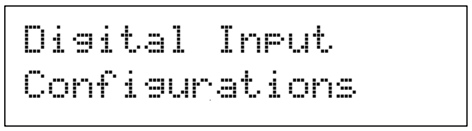
- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

G00 INPUT/OUTPUT Menu

Easily the menu containing the most configuration parameters, the **G00 INPUT/OUTPUT** menu is where all terminal strip configurations are found. All input / output hardware configurations are grouped into one of the following categories:

- Digital Input Configurations
- Relay Output Configurations
- Analogue Input Configurations
- Analogue Output Configurations
- Thermistor Configurations
- Timer Configurations
- Communication Configurations
- User Alarm Configurations

Digital Input Configurations



The ZENER 8000 is operated by a set of digital input functions designed to work with logical signals that originate external to the drive. The extensiveness of this set of functions is testament to variety of applications the ZENER 8000 can operate with. The list of functions includes:

- **I00 FWD&LATCH, I01 REV&LATCH, I02 ~STOP**
- **I03 FWD, I04 REV**
- **I05 UP, I06 DOWN**
- **I07 RESET**
- **I08 ESO**
- **I09 JOGFWD, I10 JOGREV**
- **I11 REMOTE**

Not all functions are necessary for a given application and unused functions may be turned “off”. Functions that are necessary have assigned to them a physical input from the terminal strip. Review “Terminal Configurations” in the “Major Features” section of this document.

The menus within the “Digital Input Configurations” menu provide a way to map a finite set of physical digital inputs to the internal set of input functions. The simplest way to configure digital inputs is to utilise one of the pre-existing configurations from the **G01 DI config** menu. Otherwise a custom configuration can be organised where each function has a physical input terminal assigned to it. In most cases the inputs levels and edges are available for selection. For example digital input **D1** is found at terminal **2** and is identified as **D1(2)**. The choices are:

Selection	Input Truth
D1(2)	Active high level is selected
~D1(2)	Active low level is selected
/D1(2)	Active rising edge is selected
D1(2)	Active falling edge is selected

Selecting Standard Input Configuration

Available Choices:
Standard Industrial
HVAC
Power up/start
Forward/Reverse
Machine drive 1
Machine drive 2
Machine drive 3
Custom

- Press ↵ once to begin configuration selection.
- Use the ▲/ ▼ buttons to view the choices.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

The **G01 DI config** menu permits the selection of all standard and custom configurations. The available choices are:
For each configuration the digital sources are:

	G01 DI config							
Function	Standard Industrial	HVAC	Power up/start	Forward/ Reverse	Machine drive 1	Machine drive 2	Machine drive 3	Custom
I00 FWD&LATCH	D3(4)	D2(3)	EN(6)	D2(3)	D2(3)	OFF	D2(3)	Not specific. Refer to each functional assignment
I01 REV& LATCH	OFF	OFF	OFF	D3(4)	OFF	OFF	OFF	
I02 ~STOP	D2(3)	D1(2)	EN(6)	D1(2)	D1(2)	OFF	D1(2)	
I03 FWD	OFF	OFF	OFF	OFF	OFF	D1(2)	OFF	
I04 REV	OFF	OFF	OFF	OFF	OFF	D2(3)	OFF	
IO5 UP	OFF	OFF	OFF	OFF	OFF	OFF	D3(4)	
I06 DOWN	OFF	OFF	OFF	OFF	OFF	OFF	D4(5)	
I07 RESET	D1(2)	/EN(6)	/EN(6)	OFF	OFF	OFF	OFF	
I08 ESO	OFF	D3(4)	OFF	OFF	OFF	OFF	OFF	
I09 JOGFWD	OFF	OFF	OFF	OFF	D3(4)	D3(4)	OFF	
I10 JOGREV	OFF	OFF	OFF	OFF	OFF	D4(5)	OFF	
I11 REMOTE	D4(5)	D4(5)	EN(6)	D4(5)	D4(5)	EN(6)	EN(6)	

Custom Input Configuration

Each internal function can have its digital source re-assigned if "**Custom**" is chosen for **G01 DI config**.

List of Digital Sources

For each function the available selection choices are:

ON, OFF
EN(6), ~EN(6), /EN(6), EN(6)\
D1(2), ~D1(2), /D1(2), D1(2)\
D2(3), ~D2(3), /D2(3), D2(3)\
D3(4), ~D3(4), /D3(4), D3(4)\
D4(4), ~D4(4), /D4(4), D4(4)\
D1(31)[1], ~D1(31)[1], /D1(31)[1], D1(31) \[1]
D2(33)[1], ~D2(33)[1], /D2(33)[1], D2(33)\[1]
D3(35)[1], ~D3(35)[1], /D3(35)[1], D3(35)\[1]
D4(37)[1], ~D4(37)[1], /D4(37)[1], D4(37)\[1]
D1(51)[2], ~D1(51)[2], /D1(51)[2], D1(51)\[2]
D2(53)[2], ~D2(53)[2], /D2(53)[2], D2(53)\[2]
D3(55)[2], ~D3(55)[2], /D3(55)[2], D3(55)\[2]
D4(57)[2], ~D4(57)[2], /D4(57)[2], D4(57)\[2]
TMR1, ~TMR1, TMR2, ~TMR2
Hi AI(10,11), ~Hi AI(10,11), Lo AI(10,11), ~Lo AI(10,11)
Hi AI(32,34)[1], ~Hi AI(32,34)[1], Lo AI(32,34)[1], ~Lo AI(32,34)[1]
Hi AI(52,54)[2], ~Hi AI(52,54)[2], Lo AI(52,54)[2], ~Lo AI(52,54)[2]
PV-A UNDER, ~PV-A UNDER, PV-A OVER, ~PV-A OVER, PIPE FILL TMR, ~ PIPE FILL TMR
UNDER SPEED, ~UNDER SPEED, OVER SPEED, ~OVER SPEED,
UNDER LOAD, ~UNDER LOAD, OVER LOAD, ~OVER LOAD
PV-B UNDER, ~PV-B UNDER, PV-B OVER, ~PV-B OVER
Solar-good[3], Low Solar[3],
CMP1, CMP2, CMP3, CMP4, CMP5
LOGIC BLOCK 1, LOGIC BLOCK 2, LOGIC BLOCK 3, LOGIC BLOCK 4
UNDER MIN Hz, ~UNDER MIN Hz
PV-A OutOfReg, ~PV-A OutOfReg,
PV-B OutOfReg, ~PV-B OutOfReg,
Supply seq +ve, Supply seq –ve, No flow
Internal Relay 1, 2, 3, 4
PG RUN signal
RUN, ~RUN, /RUN, RUN\, RUN command
TRIP, PROOF, TRIP ex PF/UV,
1Probe&TON[4], 1 Probe&TOFF[4], 2Probe Control[4]
Hi P(76,77)[4], Lo P(76,77)[4], Hi RTD1[4], Lo RTD1[4]
Hi Flow[4], Lo Flow[4], Vol. delivered[4]
Time Clock Opt

[1] Only visible if extended features card fitted left
[2] Only visible if extended features card fitted right
[3] Only available in ECODRIVE 8000 models
[4] Only visible if the Bore level option cards is fitted.

Duplicate Selections

It is possible to select the same input terminal for several input functions. In some cases a single digital input feeding several input functions may not be desirable. When an input terminal is selected for the 2nd (or 3rd, 4th,…) time, the ZENER 8000 presents a warning message and question asking to remove all existing uses for the selected terminal.

For example, the default setup is

```
I07 RESET = D1(2)
I02 ~STOP = D2(3)
I00 FWD & LATCH = D3(4)
I11 REMOTE = D4(5)
```

The operator decides to have "I03 FWD" activated by D4(5). That is:

```
I03 FWD
> D4(5)
```

When the operator presses the ENTER push button to make the selection, the following sequence of messages is displayed:

```
   SELECTED
TERMINAL IN USE.
```

```
   REMOVE ALL
EXISTING USES?
```

```
ENTER=yes ESC=no
        ?
```

If the operator presses **ENTER** for "yes", the outcome will be:

```
I07 RESET = D1(2)
I02 ~STOP = D2(3)
I00 FWD & LATCH = D3(4)
I11 REMOTE = OFF
I03 FWD = D4(5)
```

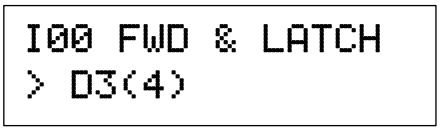
All previous selections of D4(5) are set to OFF

If the operator presses **ESC** for "no", the outcome will be:

```
I07 RESET = D1(2)
I02 ~STOP = D2(3)
I00 FWD & LATCH = D3(4)
I11 REMOTE = D4(5)
I03 FWD = D4(5)
```

Previous selections of D4(5) remain.

I00 FWD & LATCH

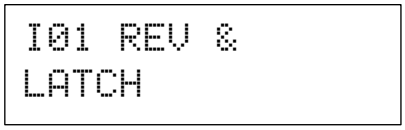


Refer to the “List of Digital Sources” on page 94 for choices

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

A momentary contact closure on this input will start the motor in the forward direction. When the input is removed the motor continues to run in the forward direction (latching). It requires an **I02 ~STOP** function to be assigned in order to break the latch and stop the motor.

I01 REV & LATCH



Refer to the “List of Digital Sources” on page 94 for choices

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

A momentary contact closure on this input will start the motor in the reverse direction. When the input is removed the motor continues to run in the reverse direction (latching). It requires **I02 ~STOP** function to be assigned in order to break the latch and stop the motor. **D03 REVERSE** must be **Enabled** for the motor to run backwards.

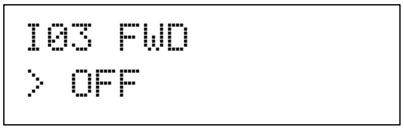
I02 ~STOP

Refer to the “List of Digital Sources” on page 94 for choices

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

This input is required to be held for the motor to run. If it is opened any latched input is cleared and the motor will stop running. This is used with **I00 FWD & LATCH** and **I01 REV & LATCH** to stop the motor. This function is ignored in LOCAL mode.

I03 FWD

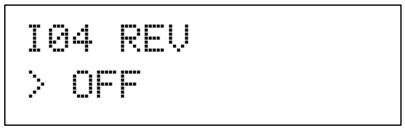


Refer to the "List of Digital Sources" on page 94 for choices

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

While this input is held the motor will run in the forward direction. When the input is removed the motor will stop running (non-latching). The **I03 FWD** function disregards the state of the **I02 ~STOP** input and the drive will not stop while **I03 FWD** input is present and the Enable input is wired to +5V. Both **I03 FWD** & **I04 REV** inputs must be wired to +5 to activate bipolar operation.

I04 REV

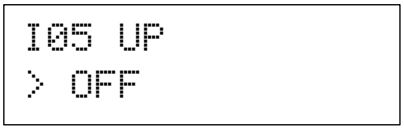


Refer to the "List of Digital Sources" on page 94 for choices

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

The **I04 REV** (non-latching) function disregards the state of the **I02 ~STOP** input and the drive will not stop while **I04 REV** input is held and the Enable input is wired to +5V. Both **I03 FWD** & **I04 REV** inputs must be wired to +5 to activate bipolar operation. **D03 REVERSE** must be **Enabled** for the motor to run backwards.

I05 UP

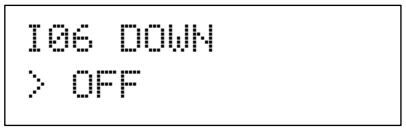


Refer to the "List of Digital Sources" on page 94 for choices

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

When this input is active the CONSOLE reference increases. The CONSOLE reference must be the active reference for this input to have an effect.

I06 DOWN

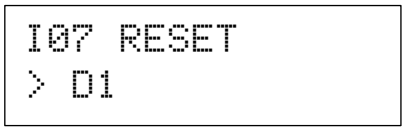


Refer to the “List of Digital Sources” on page 94 for choices

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

When this input is active the CONSOLE reference decreases. The CONSOLE reference must be the active reference for this input to have an effect.

I07 RESET

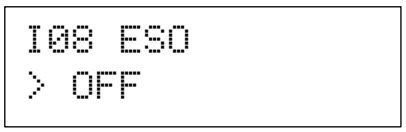


Refer to the “List of Digital Sources” on page 94 for choices

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

When this input is active a reset of one or more trip conditions is attempted.

I08 ESO

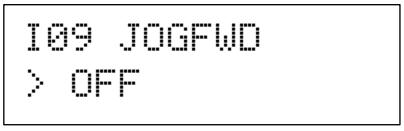


Refer to the “List of Digital Sources” on page 94 for choices

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

While this input is held the ZENER 8000 will operate in Essential Services Override (ESO). Refer to the ESO feature description for details.

I09 JOGFWD

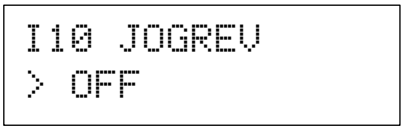


Refer to the “List of Digital Sources” on page 94 for choices

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

Contact closure on this input will run the motor forward at the JOGFWD speed. It will also clear any latched inputs. When the contact is opened the motor will stop.

I10 JOGREV

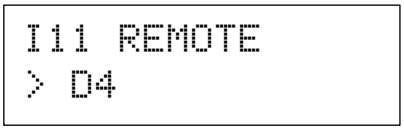


Refer to the “List of Digital Sources” on page 94 for choices

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

Contact closure on this input will run the motor reverse at the JOGREV speed. It will also clear any latched inputs. When the contact is opened the motor will stop. **D03 REVERSE** must be **Enabled** for the motor to run backwards.

I11 REMOTE



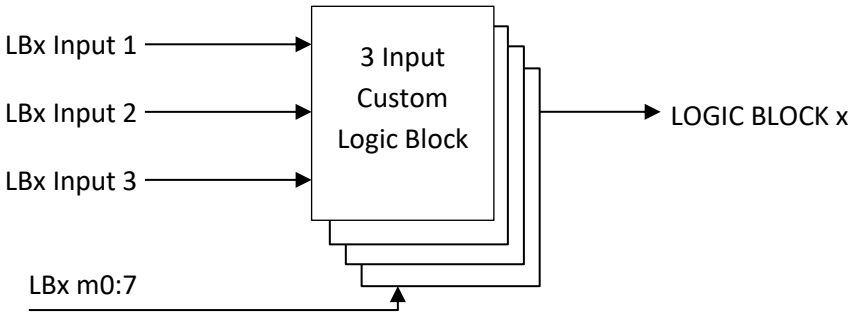
Refer to the “List of Digital Sources” on page 94 for choices

- Press ↵once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

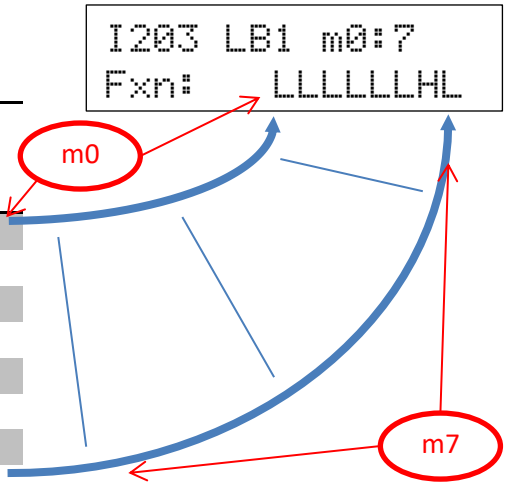
Contact closure on this input means that the ZENER 8000 will follow the control inputs on the terminal strip and the motor will run at the speed set by the Remote speed reference. When the contact is opened the ZENER 8000 will be controlled from the console and will run at the speed set by the Local speed reference. This input requires other terminals to stop and start the motor.

Logic Blocks

The ZENER 8000 provides four logic evaluation blocks for combinational logic. Each block is a 3-input, 1-output truth table.



A truth table is interpreted as follows:



Term	Input Combinations LBx Input 1	LBx Input 2	LBx Input 3	LOGIC BLOCK x
m0	LOW	LOW	LOW	LOW
m1	LOW	LOW	HIGH	LOW
m2	LOW	HIGH	LOW	LOW
m3	LOW	HIGH	HIGH	LOW
m4	HIGH	LOW	LOW	LOW
m5	HIGH	LOW	HIGH	LOW
m6	HIGH	HIGH	LOW	HIGH
m7	HIGH	HIGH	HIGH	LOW

The first row is the term **m0**. When **LBx Input 1** is LOW, **LBx Input 2** is LOW and **LBx Input 3** is LOW the "Term" **m0** is selected and in this example **m0** = LOW. The output will be LOW.

The selections for the inputs are made from the list of available digital sources. Refer to the "List of Digital Sources" on page 94 for choices

Key configuration parameters are:

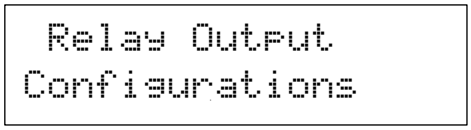
I200 LB1 Input 1	**I210 LB2 Input 1**	**I220 LB3 Input 1**	**I230 LB4 Input 1**
I201 LB1 Input 2	**I211 LB2 Input 2**	**I221 LB3 Input 2**	**I231 LB4 Input 2**
I202 LB1 Input 3	**I212 LB2 Input 3**	**I222 LB3 Input 3**	**I232 LB4 Input 3**
I203 LB1 m0:7	**I213 LB2 m0:7**	**I223 LB3 m0:7**	**I233 LB4 m0:7**

The output of each logic block is available in the digital sources selection list. Refer to the "List of Digital Sources" on page 94 for choices.

The outputs are:

LOGIC BLOCK 1,
LOGIC BLOCK 2,
LOGIC BLOCK 3,
LOGIC BLOCK 4.

Relay Outputs



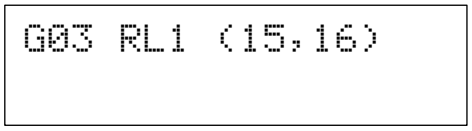
As standard the ZENER 8000 is equipped with 2 relays each with a single normally open contact. These menus allow configuration of the relays. Configuration parameters include: a relay signal function selection, relay signal inversion and delay on and off interval specifications.

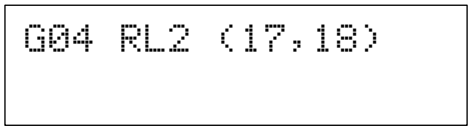
Choosing a Relay

Depending on fitted options the available the list of relays includes:

G03 RL1(15,16) and G04 RL2(17,18)

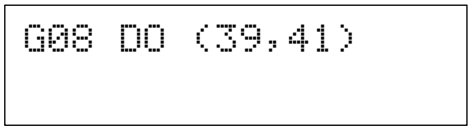
Standard Relay





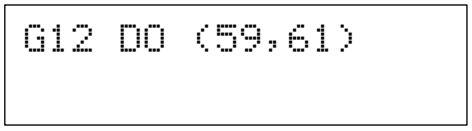
G08 DO(39,41)

Only visible if extended features card fitted left



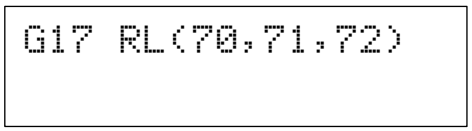
G12 DO(59,61)

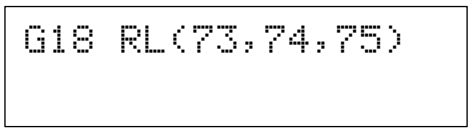
Only visible if extended features card fitted right



G17 RL(70,71,72) and G18 RL(73,74,75)

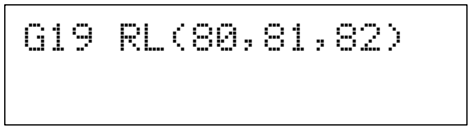
Only visible if change-over relay card fitted left

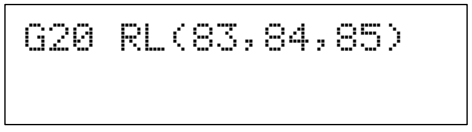




G19 RL(80,81,82)and G20 RL(83,84,85)

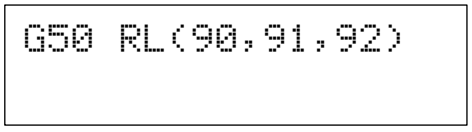
Only visible if change-over relay card fitted right

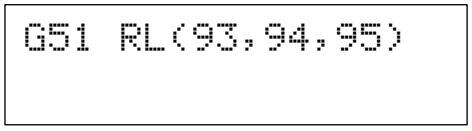




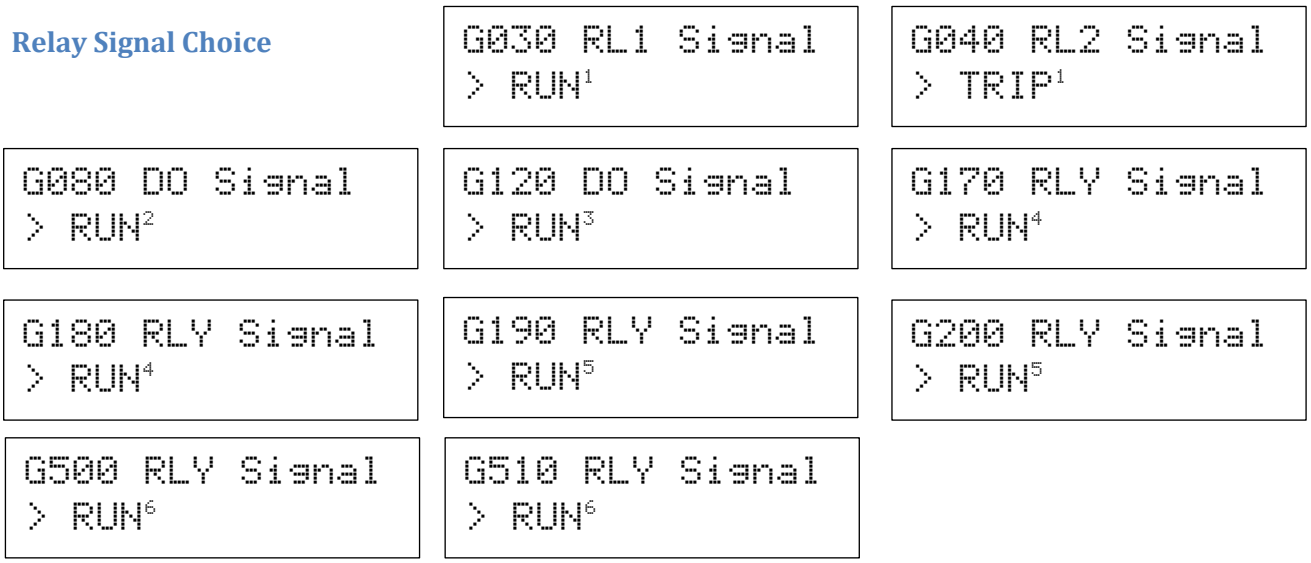
G50 RL(90,91,92) and G51 RL(93,94,95)

Only visible if the latching change-over relay card is fitted (left or right)





Relay Signal Choice



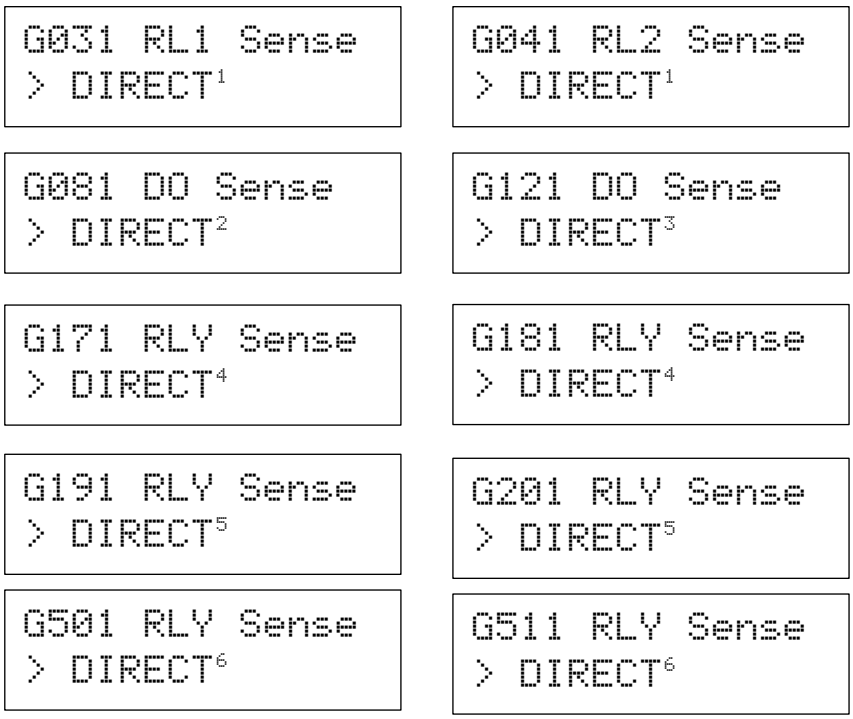
[1] Standard Relay
[2] Only visible if extended features card fitted left
[3] Only visible if extended features card fitted right
[4] Only visible if change over relay card fitted left
[5] Only visible if change over relay card fitted right
[6] Only visible if latching change over relay card fitted (left or right)

Relay Function	Indication when energised
RUN	Running either forward or reverse.
TRIP	A trip has stopped the output of the drive.
ESO	Running in Essential Services Override mode.
PROOF	Enabled and not tripped
ZERO SPD	The motor is at zero speed
AT SPEED	The motor speed is equal to the reference speed
UNDER SPD	The motor speed is below the **G050 UNDER SPEED** threshold
OVER SPD	The motor speed is above the **G051 OVER SPEED** threshold
ON	The relay is energised
OFF	The relay is de-energised
OPT ALARM	The drive output current is more than 12.5% of motor rated current.
A/R FAIL	All specified restarts have been used.
FWD	Motor is running in the forward direction
REV	Motor is running in the reverse direction
ENABLED	ZENER 8000 is enabled
I2t TRIP	I2t thermal motor overload has activated
OVER TEMP	ZENER 8000 is too hot for safe operation
LOAD WARN	Motor load is above the preset characteristic line.
LC Control	Energise a Line Contactor to charge the ZENER 8000 power circuits
Hi AI(10,11)	The reading from the standard analogue input is above the **G025 HiCMP Level**.
Lo AI(10,11)	The reading from the standard analogue input is below the **G026 LoCMP Level**.
Hi AI(32,34)[2]	The analogue input (left extended features card) is above the **G105 HiCMP Level**.
Lo AI(32,34)[2]	The analogue input (left extended features card) is below the **G106 LoCMP Level**.
Hi AI(52,54)[3]	The analogue input (right extended features card) is above the **G145 HiCMP Level**.
Lo AI(52,54)[3]	The analogue input (right extended features card) is below the **G146 LoCMP Level**.
T1 timer Opt	The output of Timer 1
T2 timer Opt	The output of Timer 2
TRIP ex PF/UV	Same as the trip signal above excluding POWER FAIL and DC BUS LOW trip conditions
PV-A UNDER	The reading from the process variable is less than the **H110 PV LO value**

Relay Function	Indication when energised
PV-A OVER	The reading from the process variable greater than the **H111 PV HI value**
PIPE FILL_TMR	The pipe fill timer has timed out
%LOAD UNDER	The % motor load estimate is less than the **G053 %LOAD UNDER** threshold.
%LOAD OVER	The % motor load estimate is greater than the **G054 %LOAD OVER** threshold.
USER ALARM 1, 2, 3, 4	The state of USER ALARM 1, 2, 3, or 4 – a latched fault external to the drive
Internal RLY 1, 2, 3, 4	The state of internal relay 1, 2, 3 or 4 set through EIA485 protocol command
Solar-good	The state of the ECODRIVE 8000 when there is **sufficient** solar energy (ECODRIVE 8000 Models only)
Low Solar	The state of the ECODRIVE 8000 when there is **insufficient** solar energy (ECODRIVE 8000 Models only)
PV-B UNDER	The reading from the process variable is less than the **H30 PV LO value**
PV-B OVER	The reading from the process variable greater than the **H31 PV HI value**
CMP 1, 2, 3, 4, 5	The state of CMP 1, 2, 3, 4 or 5 – derived from the Signal Comparator function
PV-A OutOfReg	PV-A has been beyond the limits set by **H031 OOR Thresh** for an interval set by **H132 OOR time**
PV-B OutOfReg	PV-B has been beyond the limits set by **H321 OOR Thresh** for an interval set by **H322 OOR time**
Supply seq +ve	The ZENER8000 detects UVW mains input phasing when active and WVU input phasing when inactive
No flow	Used in conjunction with pipe fill logic: Set true when the no flow input set by **H107 No Flow Sel** is active
Mains Sync	Mains synchronisation feature: the relay energises when output and input voltages are synchronised
MPP Tracking	An indication the ECODRIVE 8000 is searching for the MPP in the given solar conditions (ECODRIVE 8000 only)
Over Voltage	Primarily for ECODRIVE, the relay energises when the DC bus is too high
Stager 1, 2, 3, 4	The functions energise when the cascade pumping feature determines that another stage should start
USER ALARM 5, 6, 7, 8	The state of USER ALARM 5, 6, 7, or 8 – a latched fault external to the drive
RUN command	The state of the terminal strip run command
LOGIC BLOCK 1, 2, 3, 4	The output state of each of the logic blocks 1..4

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select the output function for relay #1 operation.
- Press ↵ to confirm the choice, **ESC** to abandon the change.

Relay Drive



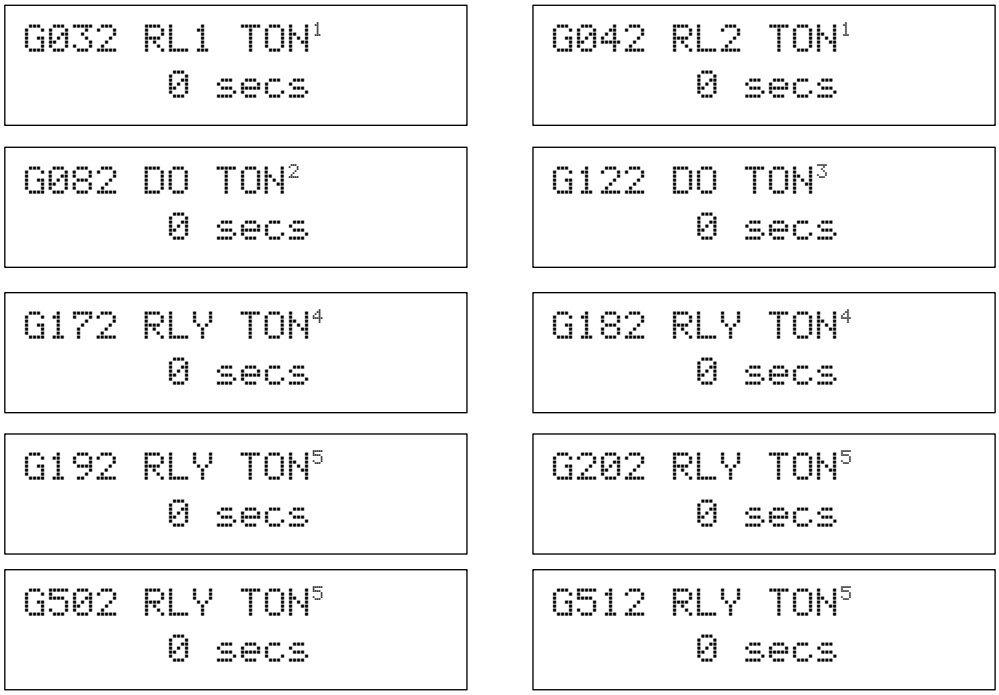
Available Choices: > DIRECT
> INVERT

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select direct or inverted relay operation.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

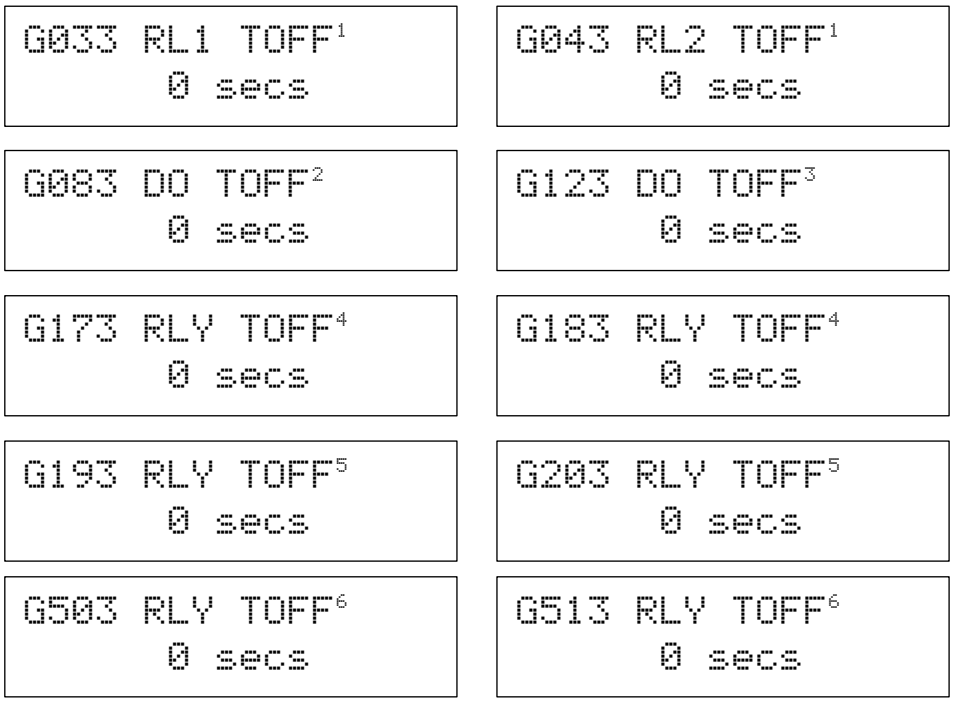
This menu allows relay #1 to be inverse acting for those applications that need inverted contact behaviour.

[1] Standard Relay
[2] Only visible if extended features card fitted left
[3] Only visible if extended features card fitted right
[4] Only visible if change over relay card fitted left
[5] Only visible if change over relay card fitted right
[6] Only visible if latching change over relay card fitted (left or right)

Relay Activate Delays



Relay De-activate Delays



Range: 0...600 seconds

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR press **ESC** to abandon the value change.

These parameters set the relay de-activation delay.

[1] Standard relay.

[2] Only visible if extended features card fitted left.

[3] Only visible if extended features card fitted right.

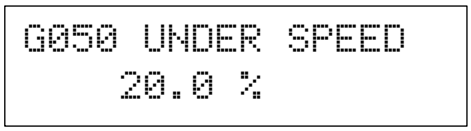
[4] Only visible if change over relay card fitted left.

[5] Only visible if change over relay card fitted right.

[6] Only visible if latching change over relay card fitted (left or right)

G050 UNDER SPEED

This parameter is only viewed when **UNDER SPD** is selected the signal for the relay output



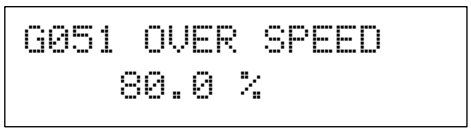
Range: 0.0...100.0 % of (**C03 MAX Hz**)

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The **G050 UNDER SPEED** parameter is a motor frequency compare threshold. When the motor frequency is below this value, the relay will energise. For example the **> UNDER SPEED** relay function has been assigned to relay #2 (**G040 RELAY #2** = **UNDER SPEED**) and **G050 UNDER SPEED** is set to 20%. When the output frequency goes below 20%, relay 2 will energise.

G051 OVER SPEED

This parameter is only viewed when **OVER SPD** is selected the signal for the relay output



Range: 0.0...100.0 % of (**C03 MAX Hz**)

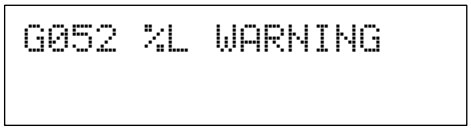
- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The **G051 OVER SPEED** parameter is a motor frequency compare threshold. When the motor frequency is above this value, the relay will energise. For example the **> OVER SPEED** relay function has been assigned to relay #2 (**G040 RELAY #2** = **OVER SPEED**) and **G051 OVER SPEED** is set to 80%. When the output frequency goes above 80%, relay 2 will energise.

G052 %L WARNING

This menu is only viewed when **LOAD WARN** is selected the signal for the relay output

Available Choices: > Low Speed Cal
> High Speed Cal



- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select low or high speed calibration.
- Press ↵ to calibrate. **ESC** to abandon the change.

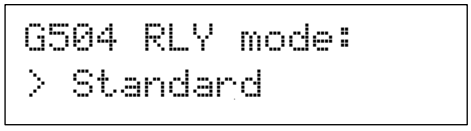
This menu calibrates the %load V speed characteristic curve of fans and pumps. The calibrated characteristic is used as the compare threshold to warn of possible failures in motor and load mechanics. The output of the %load warning feature is available as a relay function. The procedure for calibration is:

1. Run the ZENER 8000 at half of full speed
2. Find the **G052 %L WARNING** menu, press ↵ and select **> Low Speed CAL**
3. Press ↵ again to calibrate at low speed
4. Run the ZENER 8000 at or near full speed
5. Return to the **G052 %L WARNING** menu, press ↵ and select **> High Speed CAL**
6. Press ↵ again to calibrate at high speed
7. Ensure **>% LOAD WARNING** function is assigned to one of the available relays

G504 RLY mode:

This parameter is only viewed when the Latching Change-over Relay option card is fitted in the ECODRIVE 8000

Available Choices: > Standard
> Set/Code reset



- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select the relay mode.
- Press ↵ to accept. **ESC** to abandon the change.

Relay **RL(90,91,92)** may be utilised as a standard set-reset relay where relay activation reflects the state of the selected signal source, specified by **G500 RLY Signal**. Additionally **RL(90,91,92)** has an alternate mode of operation called “Set/Code reset”.

Mode	Operation description
Standard	Standard relay operation, subject to delay settings: • Relay activates when the source signal is true. • Relay de-activates when the source signal is false.

Set/Code reset	Subject to delay settings:
	• Relay activates when the source signal is true.
	• Relay de-activates when the source signal is false **AND** either
	  ○ The reset code is entered correctly on the next menu (DOWN button) OR
	  ○ A hardware contact is closed between terminals DI(96,97)

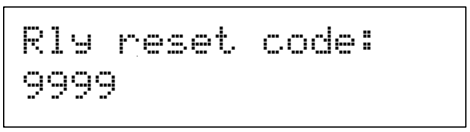
Resetting RL(90,91,92) in Set/Code reset Mode

There are two ways to reset **RL(90,91,92)** when it is configured for "Set/Code reset" mode:

1) By a reset code entered through the console OR
2) By hardware contact closure sensed by **DI(96,97)** located on the Latching Change-over Relay option card

RL(90,91,92) reset by reset code

The code reset entry is found in the **G00 INPUT/OUTPUT ➔ Relay Outputs ➔ G50 RL(90,91,92)** menu and only when **G504 RLY mode** is in "Set/Code reset" mode.



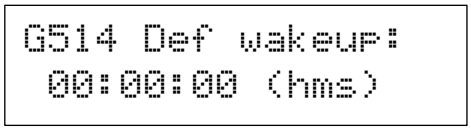
To reset latching relay **RL(90,91,92)**, press ENTER and then enter the code **1580**. You will need to press ENTER after each digit. If the correct code has been entered, pressing ENTER after the last digit will reset RL(90,91,92) provided the relay's source signal is clear.

RL(90,91,92) reset by hardware contact closure

Simply connecting terminals DI(96) and DI(97) together will reset RL(90,91,92) when latched closed (i.e. 90, 91 closed) provided the relay's source signal is clear. This method for reset is only available when **G504 RLY mode** is in "Set/Code reset" mode.

G514 Def wakeup:

This parameter is only viewed when the Latching Change-over Relay option card is fitted in the ECODRIVE 8000 and only applies to relay **RL(93,94,95)**.



Range: 00:00:00…18:12:15 (hms)

- Press ↵ to edit the time
- Press ▲/ ▼ to change the digit.
- Press ↵ to accept the new digit and move to the next
- Press **ESC** to abandon the value change.

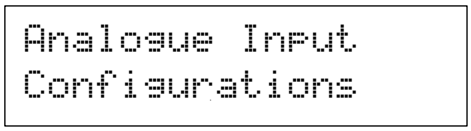
The Latching Change-over Relay option card is intended for those applications where:

- the ECODRIVE 8000 is packaged with a generator supply
- little or no solar energy is present
- motor operation is required
- no operator present to make the system run.

The latching relay **RL(93,94,95)** has a battery back timer associated with it. The **G514 Def wakeup** parameter sets the duration of the timing interval.

Autonomous logic within the ECODRIVE 8000 may determine that no operational requirement persists and the ECODRIVE can instruct external switch gear to remove power from itself. At the moment of power loss timing begins. When the timing interval elapses, RL(93,94,95) operates which can serve to re-power the ECODRIVE for another operating session.

Analogue Input Configurations

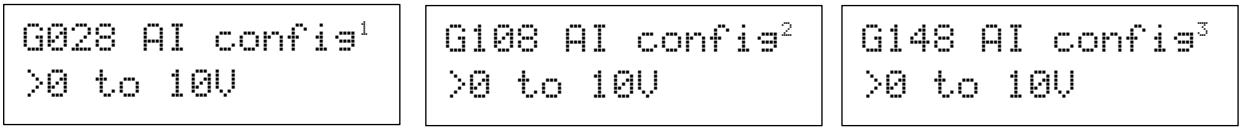


The ZENER 8000 is equipped with a single analogue input as standard and can be configured to receive either: 0 to 5V, 0 to 10V or 0 to 20mA. Additionally the input has a customisable span as well as a high and low compare thresholds. Additional analogue inputs are available when extended features card(s) are fitted.

Choosing an Analogue Input

Depending on fitted options the available the list of analogue inputs includes:

Analogue Input Type



Available Choices:
> 0 to 10V
> 0 to 5V
> 4 to 20mA
> custom

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to view the choices.
- Press ↵ to calibrate. **ESC** to abandon the change.

The ZENER 8000 is equipped with a single analogue input as standard and can be configured to receive either:

- 0 to 5V: 0V ➔0Hz; 5V ➔ C02 MAX Hz
- 0 to 10V: 0V ➔0Hz; 5V ➔ C02 MAX Hz
- 4 to 20mA: 4mA ➔0Hz; 20mA ➔ C02 MAX Hz
- Custom: * Custom input & reference spanning

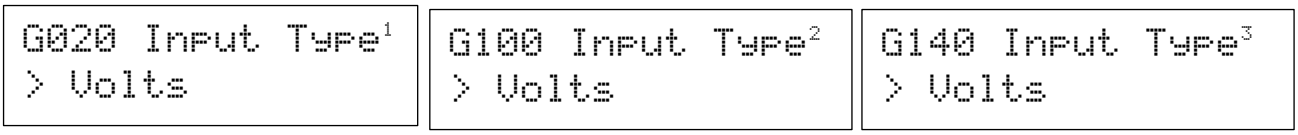
Alternatively the input has a customisable span as well as a high and low compare thresholds. Additional analogue inputs are available when extended features card(s) are fitted.

[1] Standard analogue input.
[2] Only visible if Extended features card fitted left.
[3] Only visible if Extended features card fitted right.
[4] Only visible if the Bore level option is fitted.

Custom Analogue Input Configuration

If the "AI config" setting for an analogue input is set to "**custom**", the analogue input spanning parameters are unlocked and may be adjusted as necessary to complete the input configuration.

Type Selection

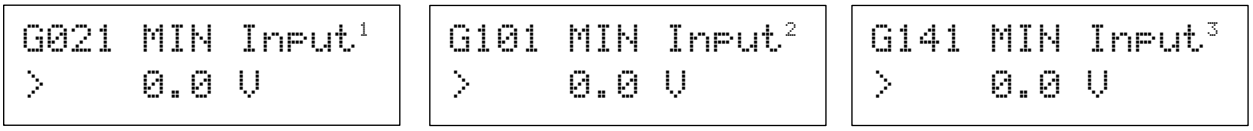


Available Choices: > Volts
> mAmps

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select volts or milliamps input operation.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

The analogue input is configurable for voltage or milliamp input. This selection will configure the input circuitry for either voltage input or current (mA) input without any need to access ZENER 8000 hardware. See the Analogue Inputs and Spanning feature for details.

Minimum Input



Range: 0.0...10.0 V or 0.0 to 20 mA

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

If the analogue input is configured for **> Volts** then the minimum input will be displayed with units of volts (V) otherwise it will be displayed with units of milliamps (mA). In either case the minimum input for spanning is determined by this parameter. See the Analogue Inputs and Spanning feature for details.

[1] Standard analogue input.
[2] Only visible if extended features card fitted left.
[3] Only visible if extended features card fitted right.

Maximum Input

G022 MAX Input[1] > 10.0 V	G102 MAX Input[2] > 10.0 V	G142 MAX Input[3] > 10.0 V

Range: 0.0...10.0 V or 0.0 to 20 mA

Whether the input is configured for 'V' or 'mA' the maximum input for spanning is determined by this parameter.

Reference at Minimum Input

G023 Ref @MIN in[1] 0.0 %	G103 Ref @MIN in[2] 0.0 %	G143 Ref @MIN in[3] 0.0 %

Range: -100.0...100.0 % of **C03 MAX Hz**

Whether the input is configured for 'V' or 'mA' the minimum input for spanning is determined by this parameter.

Reference at Maximum Input

G024 Ref @MAX in[1] 100.0 %	G104 Ref @MAX in[2] 100.0 %	G144 Ref @MAX in[3] 100.0 %

Range: -100.0...100.0 % of **C03 MAX Hz**

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

Regardless of how the analogue input is configured the maximum reference for the maximum input is determined by this parameter.

[1] Standard analogue input.
[2] Only visible if extended features card fitted left.
[3] Only visible if extended features card fitted right.

Analogue Input Compare Thresholds

Input High Compare Threshold

Range: 0.0...10.0 V or 0.0 to 20 mA

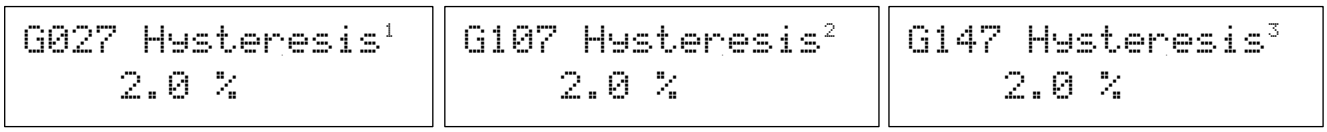
The high level compare parameter determines the compare threshold. When the input rises above this level, the compare output will be true (high).

Input Low Compare Threshold

Range: 0.0...10.0 V or 0.0 to 20 mA

The low level compare parameter determines the compare threshold. When the input falls below this level, the compare output will be true (high).

Analogue Input Compare Hysteresis



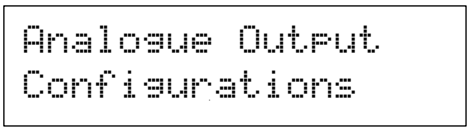
Range: 2.0...100.0% of input scale (V or mA)

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

This parameter specifies the compare hysteresis for each of the comparators of each analogue input. This parameter is used to construct the threshold for the comparator to return to the inactive state. For example: The analogue input is configured for 0 to 10V; a value of 10% creates a 1V margin that the input signal must change by from the set threshold for the compare to change its output.

[1] Standard analogue input
[2] Only visible if Extended Features card fitted left
[3] Only visible if Extended Features card fitted right
[4] Only visible if the Bore Level option card fitted right

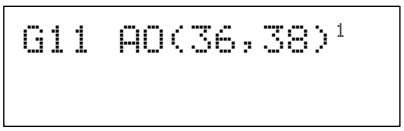
Analogue Output Configurations

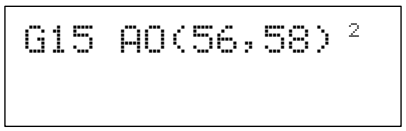


An analogue output is available when the ZENER 8000 is fitted with an extended features card in the left-hand or right-hand option connector. The analogue output can be configured for either: 0 to 5V, 0 to 10V or 0 to 20mA output. Additionally the output has customisable parameters for translation and scaling.

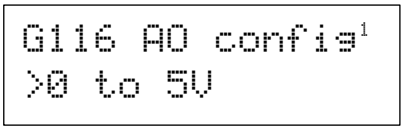
Choosing an Analogue Output

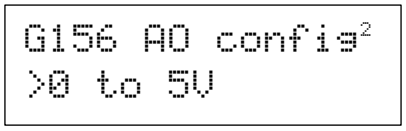
Depending on fitted options the available the list of analogue inputs includes:





Analogue Output Type





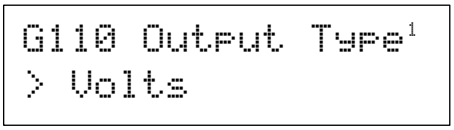
Available Choices:
> 0 to 10V
> 0 to 5V
> 4 to 20mA
> custom

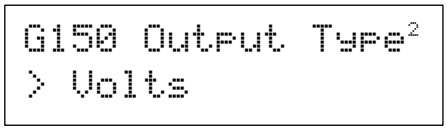
- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select volts or milliamps input operation.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

Custom Analogue Output Configuration

If the analogue output is set to "**custom**", the analogue the analogue output translation parameters may be adjusted as necessary to complete the output configuration.

Type Selection





Available Choices:
> Volts
> mAmps

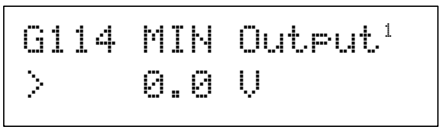
- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select volts or milliamps input operation.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

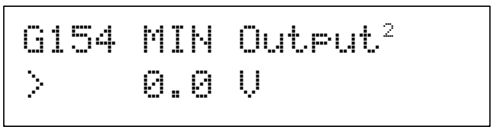
The analogue output is configurable for voltage or milliamp output. This selection will configure the output circuitry for either voltage input or current (mA) output without any need to access ZENER 8000 hardware. See the Extended Feature Analogue Output feature for details.

[1] Only visible if extended features card fitted left

[2] Only visible if extended features card fitted right

Minimum Output



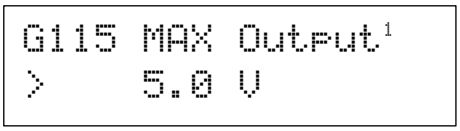


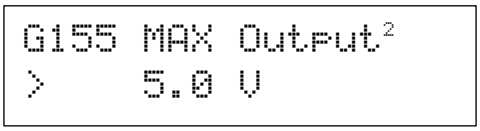
Range: 0.0...10.0 V or 0.0 to 20 mA

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

If the analogue output mode is configured for **> Volts** then the minimum output threshold will be displayed with units of volts (V) otherwise it will be displayed with units of milliamps (mA). In either case the minimum output for spanning is determined by this parameter. See the Analogue Output feature for details.

Maximum Output





Range: 0.0...10.0 V or 0.0 to 20 mA

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

If the analogue output mode is configured for **> Volts** then the minimum output threshold will be displayed with units of volts (V) otherwise it will be displayed with units of milliamps (mA). In either case the maximum input for spanning is determined by this parameter. See the Analogue Output feature for details.

[1] Only visible if extended features card fitted left
[2] Only visible if extended features card fitted right

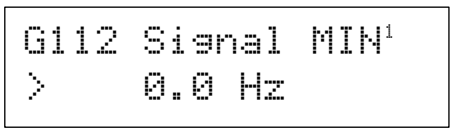
Selecting an Output Source

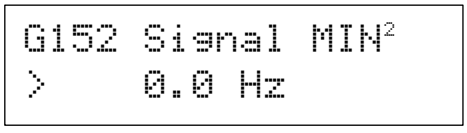
Available choices:

Signal Choices	Description
FREQUENCY	Output frequency, units of Hz
SPEED	Estimated motor speed, units of “rpm”.
I2t	Thermal overload level, units of “Amps”.
% LOAD	Motor loading, units of “%”.
CURRENT	Motor current, units of “Amps”.
POWER	Inverter output power, units of “kW”.
F100 PRESET 1	Preset 1, units of %
F101 PRESET 2	Preset 2, units of %
F102 PRESET 3	Preset 3, units of %
Reference	Output the current speed reference, units of Hz
Pump Flow	Used primarily in pumping applications the output is the flow estimate given the pump details – refer to PID-A→H14

Setting the signal limits

Signal Maximum

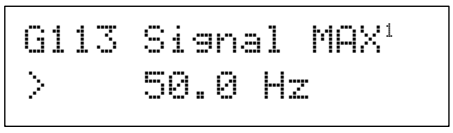


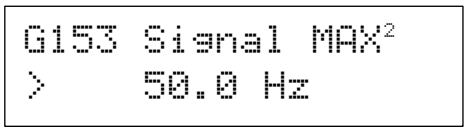


Range: 0.0...1000.0 in the units of the selected signal

This parameter is the minimum signal input used for spanning and has units of the selected signal source. See the Analogue Outputs feature for details.

Signal Maximum





Range: 0.0...1000.0 in the units of the selected signal

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

This parameter is the maximum signal input used for spanning and has units of the selected signal source. See the Analogue Outputs feature for details.

[1] Only visible if extended features card fitted left

[2] Only visible if extended features card fitted right

Level Sensing Configurations

```
Level sensing
Configurations
```

* These menus are only visible if the Bore Level option card is fitted.

G560 Sense Range

```
G560 Sense Range
> MID range
```

Available Choices:

LOW range (up to 5kΩ)
MID range (default; between 5 to 50kΩ)
HIGH range (above 50kΩ)

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to view the next choice.
- Press ↵ to confirm the choice.

In liquid level sensing applications, with a Bore Level Option card fitted, it is necessary to adjust the WET/DRY threshold to suit the liquid's electrical resistance. This parameter sets the liquid's expected resistance range.

G561 WET/DRY Threshold

```
G561 WET/DRY
Threshold  50%
```

Range: 0 to 100% of the **G560 Sens Range** parameter.

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to adjust the threshold.
- Press ↵ to set the threshold

In liquid level sensing applications, with a Bore Level Option card fitted, it is necessary to adjust the WET/DRY threshold to suit the liquid's electrical resistance. This parameter sets the WET/DRY threshold and is expressed as % in the chosen resistance range (**G560 Sens Range** parameter).

For example:

G560 Sense Range is set to **"MID range"** and
G561 Threshold is set to **50%.**
The effective threshold between WET and DRY is approximately 27.5kΩ.

G562 1 Probe Delay Interval

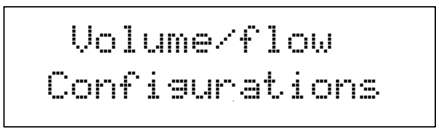
```
G562  1 Probe
delay:     10sec
```

Range: 0 to 300 seconds.

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to adjust the delay interval
- Press ↵ to set the delay interval

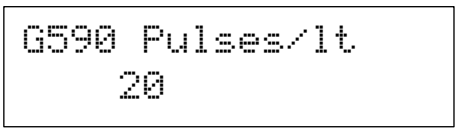
This parameter sets the delay of the "1 Probe & TON" and "1 Probe & TOFF" functions

Volume/flow Configurations



* These menus are only visible if the Bore Level option card is fitted.

G590 Pulses per Litre setting

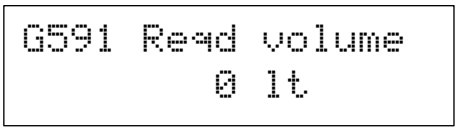


Range: 1 to 1000 pulses per litre

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to view the next choice.
- Press ↵ to confirm the choice.

This is a key parameter for accurate volume metering and flow measurement. The value is necessary for correct volume and flow display and comparisons.

G591Required Volume



Range: 0 to 9999999 Litres.

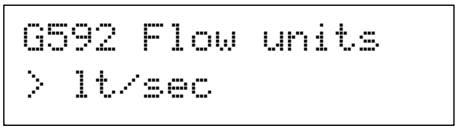
- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to adjust the threshold.
- Press ↵ to set the threshold

This parameter is useful for those applications that require a specific volume delivery. This parameter is essentially a volume threshold. When the volume indication rises above this threshold, the “Vol. delivered” digital source is set true (high). The accumulated volume is reset by answering “yes” to the question “REST VOLUME?” displayed one menu down form this menu.

Resetting the Delivered Volume

- Press ↵ to clear (zero) the accumulated volume
- Press **ESC** to preserve the volume accumulated.

G592 Flow Units Selection

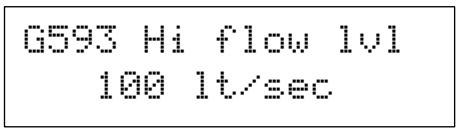


Available Choices: **lt/sec (**default)
lt/min
lt/hr

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to view the next choice.
- Press ↵ to confirm the choice.

Select the desired flow units. The selected units will be used for flow display and comparisons.

G593 Hi flow Threshold

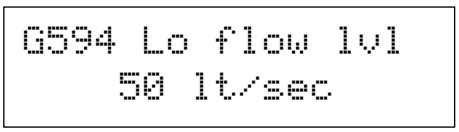


Range: 0...2000 is the units selected by "**G592 Flow units**"

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The digital source "Hi FLOW" is true (high) if the measured flow is greater than this level.

G594 Lo flow Threshold

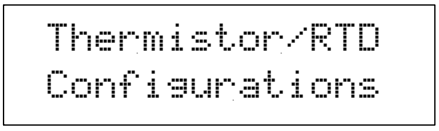


Range: 0...2000 is the units selected by "**G592 Flow units**"

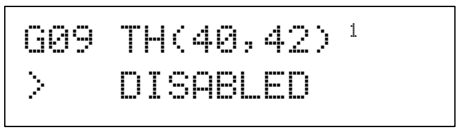
- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The digital source "Lo FLOW" is true (high) if the measured flow is less than this level.

Thermistor/RTD Configurations



Thermistors



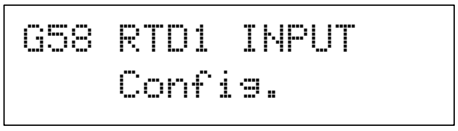
Available Choices: **ENABLED**
DISABLED

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to enable or disable the left thermistor input.
- Press ↵ to confirm the choice.

These parameters enable thermal protection provided by an external thermistor, thermal switch or thermal overload. An OT_THERM trip is generated when the resistance between the **TH+** and **TH-** terminals is greater than approximately 3300 ohms.

[1] Only visible if extended features card fitted left
[2] Only visible if extended features card fitted right
[3] Only visible if thermistor card fitted left
[4] Only visible if thermistor card fitted right

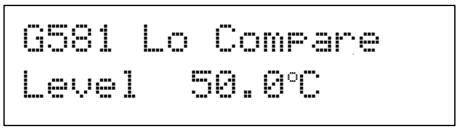
Resistance Temperature Detector (RTD)



* These menus are only visible if the Bore Level option card is fitted.

RTD Compare Thresholds

The digital source “Hi RTD1” is true (high) if the temperature measured by RTD1 is greater than this level.



The digital source “Lo RTD1” is true (high) if the temperature measured by RTD1 is less than this level.

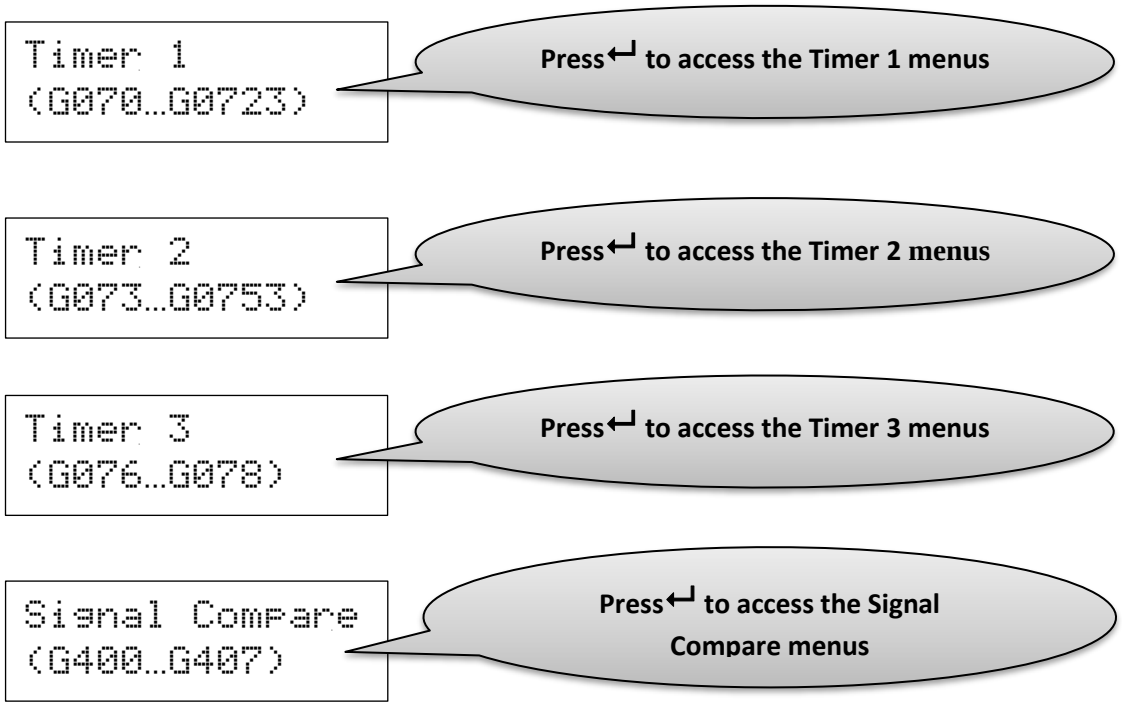
Range: 0.0...200.0 °C

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

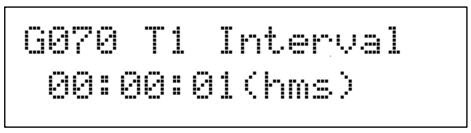
Timer & Compare Configurations

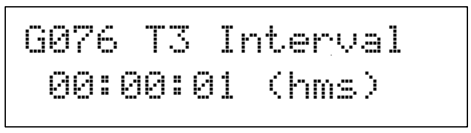
Timer parameters such as timer intervals and timer type are configured within this menu. Refer to the **Digital Input Configurations** menu timer signal source assignments. The output of timers, are available as signal sources as well.

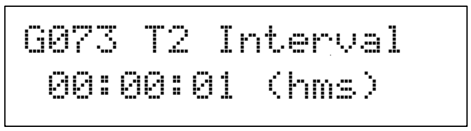
The signal compare function menu is found here as well.



Timer Intervals





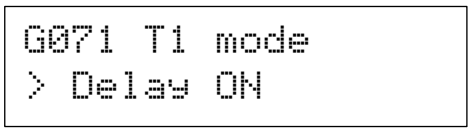


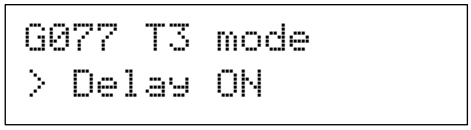
Range: 00:00:00…18:12:15 (hms)

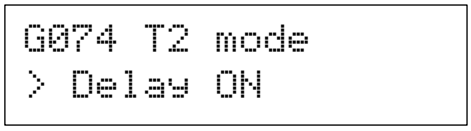
- Press ↵ to edit the time
- Press ▲/ ▼ to change the digit.
- Press ↵ to accept the new digit and move to the next
- Press **ESC** to abandon the value change.

These values set the timing interval for each of the timers. The timing interval begins according to the mode of the timer. See **G071 T1 mode** or **G074 T2 mode** below for details.

Timer Mode







Available Choices: > Delay ON
> Delay ON Init
> Delay OFF

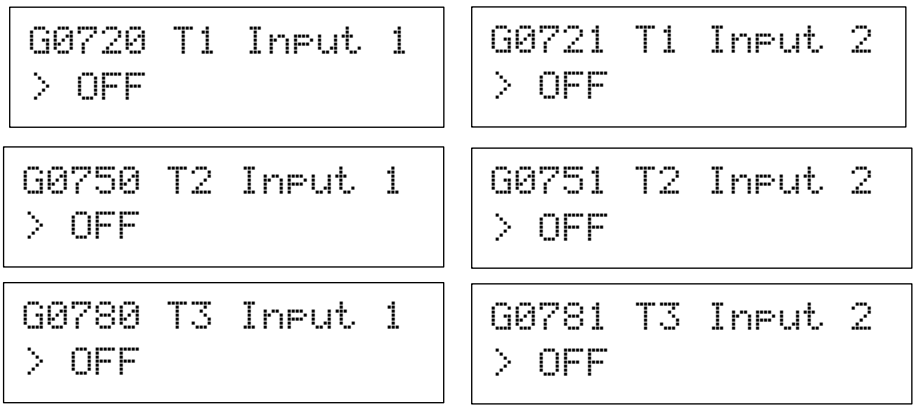
- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

If the timer mode is **> Delay ON**, timing begins when the rising edge of the timer's signal source is detected and continues while ever the signal source is held on. The output of the timer is held off during the timing interval and is held on when timing is complete AND the timer signal source is maintained on.

The timer mode **> Delay ON Init** is identical to **> Delay ON** in all aspects except the elapsed time is initialised to the interval time at power on. This setting skips the timing phase at power on provided the inputs evaluate true and reset is false.

If the timer mode is **> Delay OFF**, timing begins when the falling edge of the timer's signal source is detected and continues while ever the signal source is held off. The output of the timer is held on during the timing interval and is held off when timing is complete AND the timer signal source is maintained off.

Timer Input Selections

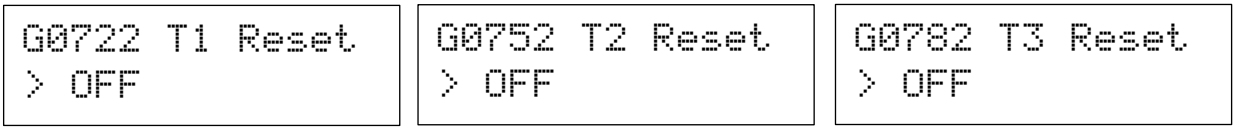


Refer to the "List of Digital Sources" on page 94 for choices

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

Making or breaking contact closure on these input activates (or deactivates) timing.

Timer Reset Selection



Refer to the "List of Digital Sources" on page 94 for choices

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

Breaking contact closure on this input resets the timer output and clears any elapsed time on Timer 1 and Timer 2.
See **G074 T2 mode** for timer behaviour.

Timer Logic Selection

G0723 T1 Logic > Standard	G0753 T2 Logic > Standard	G0783 T3 Logic > Standard

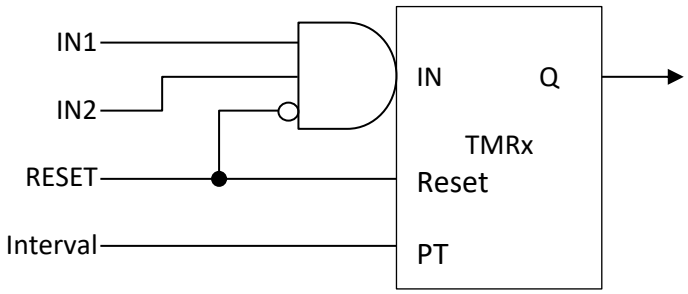
Available Choices: **> Standard**
> Custom

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The timer logic selection makes it possible to customise the timer input logic. Select between Standard logic and Custom logic.

Standard Logic

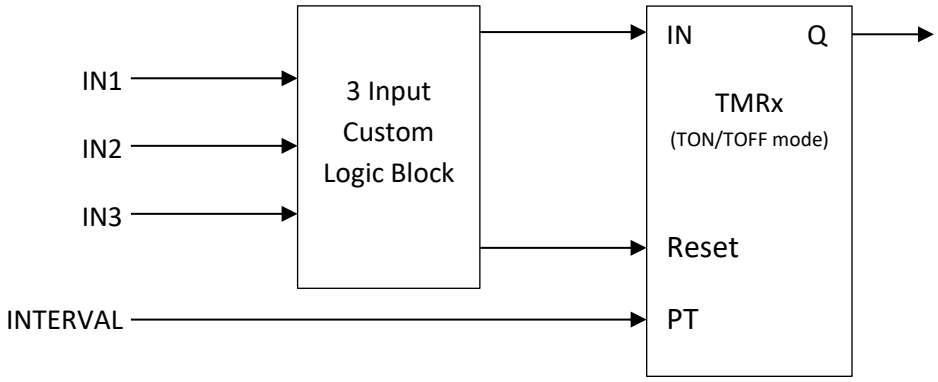
The factory default is standard logic and has 3 timing enable inputs IN1, IN2 and RESET. The RESET clears elapsed time and clears the output regardless of the input.



Refer to the general purpose timer descriptions for details on signal waveforms

Custom Logic

Selecting "Custom" logic makes available truth table specifications for timer "In" and "Reset" control signals in the form of a 3-input / 2-output combination logic block.



After selecting "Custom", press ▼ to reveal the truth tables for each timer input.

```
T1 IN1,2,3 m0:7
IN:   LLLLLLHL
```

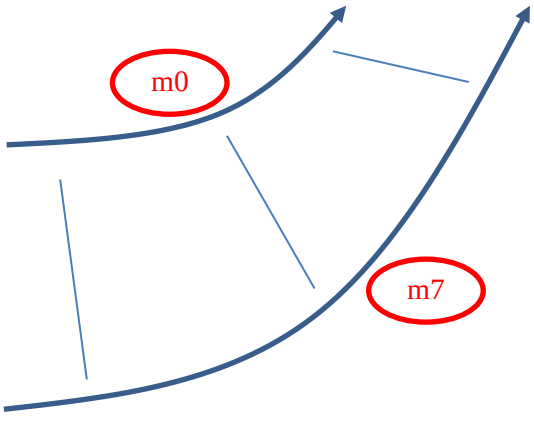
- Similar menus appear for timers 2 and 3

```
T1 IN1,2,3 m0:7
Reset: LHLHLHLH
```

These sample displays show the system default truth tables that is "Standard" logic. A truth table is interpreted as follows:

```
T1 IN1,2,3 m0:7
IN:   LLLLLLHL
```

Term	Input Combinations IN1	IN2	IN3	T1 "IN"
m0	L	L	L	L
m1	L	L	H	L
m2	L	H	L	L
m3	L	H	H	L
m4	H	L	L	L
m5	H	L	H	L
m6	H	H	L	H
m7	H	H	H	L



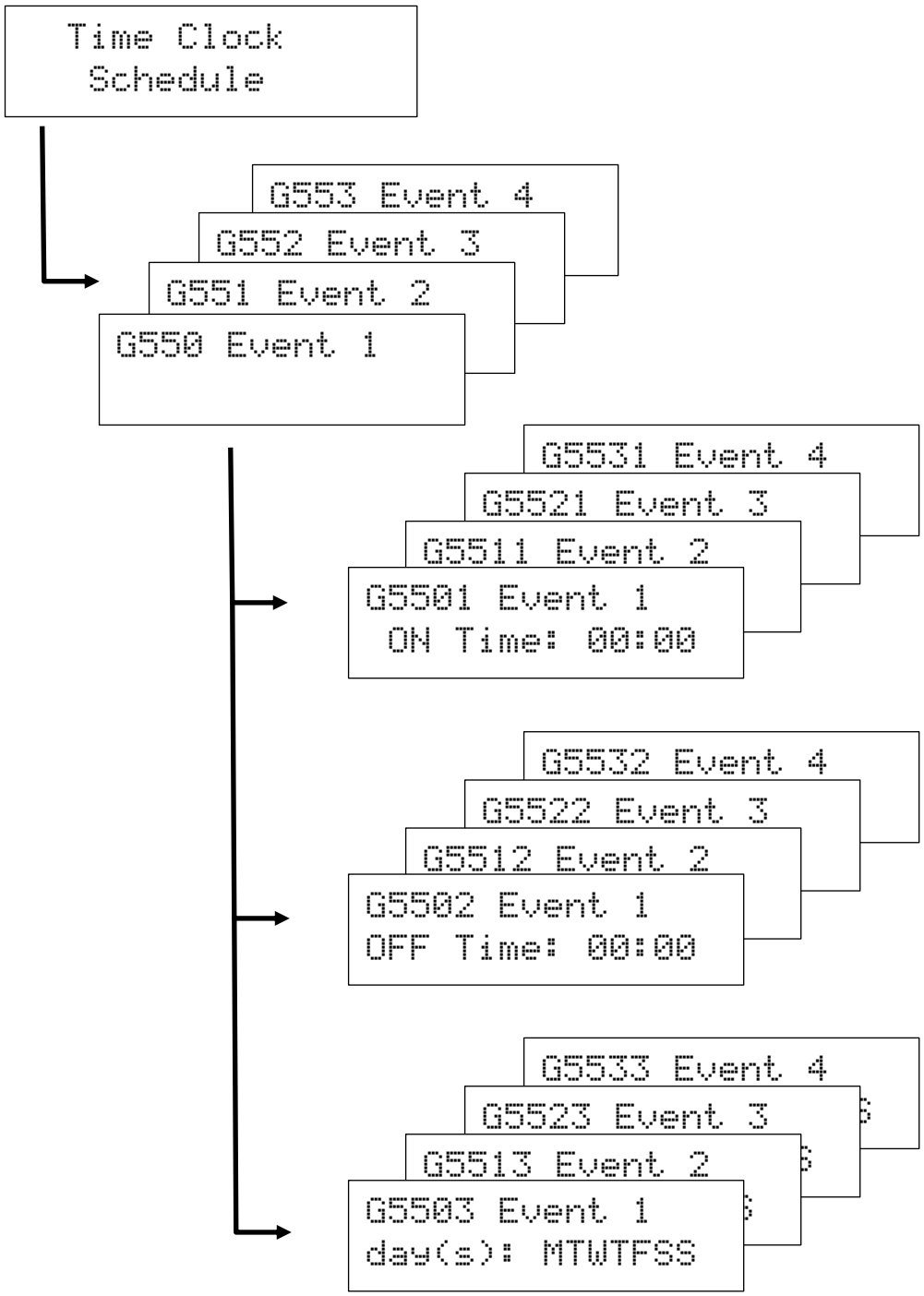
The first row is the term **m0**. When IN1 is low, IN2 is low and IN3 is low the "Term" **m0** is evaluated and sent to the output. In this example it will be low.

In this example timing is enabled when **m6** is high that is when: IN1 is high, IN2 is high and IN3 is low.

Press ↵ to begin adjusting the logic for the "**m0**" input combination.

- Press ▲ or ▼ at the cursor to change the combination output state between H(high) and L(low)
- Press ↵ when done and advance to the next combination output
- Continue until all terms of the truth table are set.

Time Clock Schedule Timer



A signal called the "**Time clock Opt**" is derived from 4 Four independent ON/OFF time specifications. Each ON/OFF specification is called an "event". Each event is fabricated by comparing the ON and OFF times with the ZENER 8000's time of day time keeping facility. Additionally each event can operate on different days of the week. These parameters are described in the pages that follow.

Refer to "Major Features", "Time Clock Schedule Timer" at the beginning of this document for illustrations of its operation.

Schedule ON Time Event

These menus specify a time for the **Time clock Opt** to be set "ON".

The format for the time is "hours: minutes" or "hh:mm".

Range: 00.00...23:59

- Press ↵ to begin the time entry.
- Press ▲/ ▼ to make change the digit.
- Press ↵ to accept the digit and move to the next digit. On the last digit, Pressing ENTER will set the new ON Time
- Press **ESC** to abandon the value change.

Schedule OFF Time Event

These menus specify a time for the **Time clock Opt** to be set "OFF".

The format for the time is "hours: minutes" or "hh:mm".

Range: 00.00...23:59

- Press ↵ to begin the time entry.
- Press ▲/ ▼ to make change the digit.
- Press ↵ to accept the digit and move to the next digit. On the last digit, Pressing ENTER will set the new ON Time
- Press **ESC** to abandon the value change.

Schedule Day of the Week

These menus specify on which day(s) of the week the event is active on.

- Press ↵ to begin the day selection for the event.
- Press ▲/ ▼ to make change the digit.
- Press ↵ to accept the digit and move to the next digit. On the last digit, Pressing ENTER will set the new ON Time
- Press **ESC** to abandon the value change.

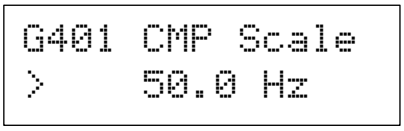
Compare Signal Selection

Available Choices:	> FREQUENCY	> % LOAD
	> SPEED	> CURRENT
	> I2t Used	> POWER

- Press ↵ to change the selection.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

This is the signal of which the comparisons are made.

Compare Signal Scaling

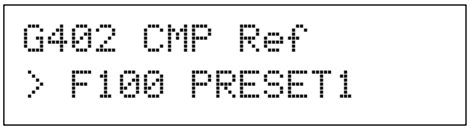


Range: 0.0...100.0% in the units of the selected signal

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

This parameter scales the selected signal and normalises it to a percentage to be used in the comparison.

Compare Reference Selection

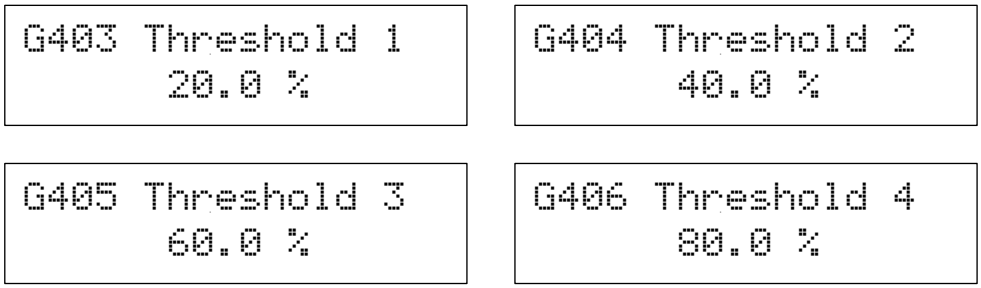


Available Choices:	> COMMS REF	> F104 PRESET5
	> F100 PRESET1	> F105 PRESET6
	> F101 PRESET2	> F106 PRESET7
	> F102 PRESET3	> F107 PRESET8
	> F103 PRESET4	> REF SELECT

- Press ↵ to change the selection.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

This is the reference source that scales the comparators' thresholds. Press ↵ a second time to check the value of the preset.

Compare Thresholds



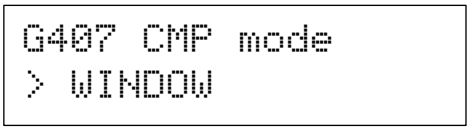
Range: 0.0...100.0 %

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

Each threshold is scaled by the compare reference (**G402 CMP Ref**) before the actual comparison takes place. When adjusting compare thresholds, the ZENER 8000 will ensure:

- **G406 Threshold 4** is the highest threshold value;
- **G405 Threshold 3** is the 2nd highest threshold value;
- **G404 Threshold 2** is the 2nd lowest threshold value;
- **G403 Threshold 1** is the lowest threshold value;

Compare Mode Selection



Available Choices: **> WINDOW**
> BAR

- Press ↵ to change the selection.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

This parameter sets the output behaviour of the comparator function block is the reference source that scales the comparators' thresholds. In BAR mode, each output is energised and remains energised as the signal rises above each threshold. In WINDOW mode each output is energised only when the signal is between thresholds.

Communication Configurations

Several options for communication protocols exist within the ZENER 8000 system. Some protocols may require additional hardware

G160 Protocol

Available choices: none
MODBUS RTU (standard TIA/RS 485 port RS485(12,13,14))
MODBUS/TCP (Only when ZENER 8000 Ethernet Option card)
BACnet MS/TP (standard TIA/RS 485 port RS485(12,13,14))

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select the communications protocol.
- Press ↵ to confirm the choice. Press **ESC** to abandon the change.

This menu selects the communications protocol to use. Once a protocol is chosen, the menu focus shifts to the parameters of the selected protocol.

BACnet MS/TP Configurations

BACnet MS/TP uses the standard TIA/RS 485 port of the ZENER 8000 and has the following parameters:

- G161 bits/sec
- G163 MAC ID
- G164 Dev Instance
- G165 Max Masters
- G166 RUN SIGNALS
- G167 Terminator
- G168 Comms lost time
- G169 Serial No.

Refer to Appendix A for Application Level details

MODBUS RTU Configurations

MODBUS RTU uses the standard TIA/RS 485 port of the ZENER 8000 and has the following parameters:

- G161 bits/sec
- G162 Parity
- G163 Slave ID
- G166 RUN SIGNALS
- G167 Terminator
- G168 Comms lost time
- G169 Serial No.

Refer to Appendix B for Application Level details and register definitions

MODBUS/TCP Configurations

MODBUS/TCP uses a "ZENER 8000 Ethernet Option" card fitted to an available option card slot. The interface has the following parameters:

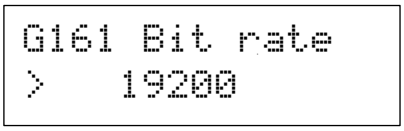
- G1630 IP address
- G1631 IP mask
- G166 RUN SIGNALS
- G168 Comms lost time
- G169 Serial No.

Refer to Appendix B for Application Level details and register definitions

Communication Parameters

Communication parameters will present themselves depending upon the selected protocol

G161 bits/sec (MODBUS RTU and BACnet only)



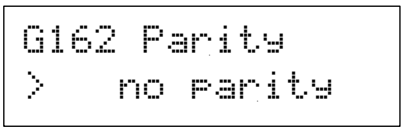
Available choices:

115200 bits/sec	9600 bits/sec
76800 bits/sec	4800 bits/sec
57600 bits/sec	2400 bits/sec
38400 bits/sec	1200 bits/sec
19200 bits/sec	

- Press ↵ once to begin the selection.
- Use the ▲/ ▼ buttons to select the communication bit rate.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

This menu selects the communications bit rate to use for the selected protocol for MODBUS RTU and BACnet MS/TP protocols

G162 Parity (MODBUS RTU and BACnet only)



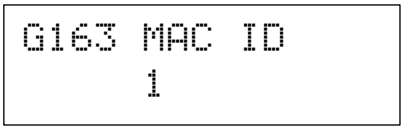
Available choices:

- no parity
- EVEN parity
- ODD parity

- Press ↵ once to begin the selection.
- Use the ▲/ ▼ buttons to select the communication parity.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

The communication parity choice is available for MODBUS RTU only. This menu selects the parity to use for MODBUS RTU. The parity bit is appended to the data bits (positioned after the data bits are transferred).

G163 MAC ID & Slave ID (MODBUS RTU and BACnet only)

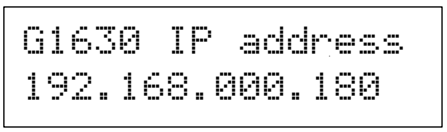


Range: 1...The value of **G165 Max Masters** (BACnet)
1...247 (MODBUS)

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR Press **ESC** to abandon the value change.

Each device on the network requires a unique Identification address code (MAC ID or Slave ID). The ID is used to identify the ZENER 8000 on the communication network. It is necessary change this value from the factory default when the ZENER 8000 is first set up.

G1630 IP address (MODBUS/TCP only)



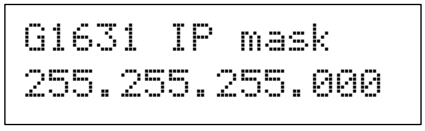
Range: 000.000.000.000 to 255.255.255.255

- Press ↵ to edit each digit.
- Press ▲/ ▼ to change the digit.
- Press ↵ to accept the new digit and move to the next digit OR Press **ESC** to abandon the change.
- After ↵ is pressed on the last digit, the value is verified.

Each device on the TCP network requires a unique and fixed IP address. Ask your network administrator for an available IP address. The IP address is used to identify the ZENER 8000 on the communication network. It is necessary to set this value before the ZENER 8000 is connected to the network.

If the edited IP address is invalid, the original value will be restored. For example “992.168.000.180” is invalid since each number segment must be no larger than 255 and so the attempt to change the IP address fails.

G1631 IP mask (MODBUS/TCP only)



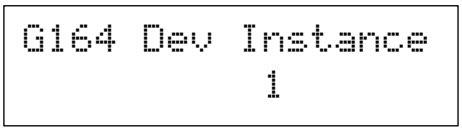
Range: 000.000.000.000 to 255.255.255.255

- Press ↵ to edit each digit.
- Press ▲/ ▼ to change the digit.
- Press ↵ to accept the new digit and move to the next digit OR Press **ESC** to abandon the change.
- After ↵ is pressed on the last digit, the value is verified.

The IP subnet mask (IP mask) facilitates IPv4 subnetworks. Ask your network administrator for a suitable IP subnet mask.

If the edited IP mask is invalid, the original value will be restored. For example “955.255.255.000” is invalid since each number segment must be no larger than 255 and so the attempt to change the IP mask fails.

G164 Dev Instance (BACnet only)



Range: 1...4194302

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

Necessary for BACnet applications only, the device instance uniquely identifies an ZENER 8000 in a complete system across all network segments. It is necessary change this value from the factory default when the ZENER 8000 is first set up.

G165 Max Masters (BACnet only)

Range: 1...127 (BACnet only)

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

Necessary for BACnet applications only, **G165 Max Masters** is a parameter for the BACnet MS/TP connection logic. The value of **G165 Max Master** specifies the highest allowable MAC ID for master devices. This value should be the same as that found in other MS/TP masters on the network segment.

G166 RUN SIGNALS

Available Choices: FROM TERMINALS
FROM NETWORK

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to select the source of run command signals.
- Press ↵ to confirm the choice.

This parameter determines explicitly where the FWD and REV command signals are sourced. Set G166 RUN SIGNALS to FROM TERMINALS when hardwired dedicated switches or push buttons are required to start the ZENER 8000. Set G166 RUN SIGNALS to FROM NETWORK when commands sent through the communication network are required to start the ZENER 8000.

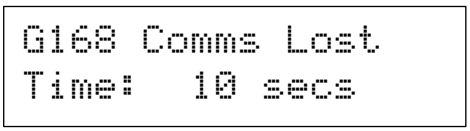
G167 Terminator (MODBUS RTU and BACnet only)

Available Choices: ENABLED
DISABLED

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to enable or disable communication network termination.
- Press ↵ to confirm the choice.

The ZENER 8000 has a “no-touch” communication cable termination capability. Set **G167 Terminator** to **ENABLED** to make the line termination active. Set **G167 Terminator** to **DISABLED** to make the line termination in-active.

G168 Comms Lost Time



Range: 0...600 secs

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The ZENER 8000 will determine a loss of communications if no data exchange takes place for the interval specified by **G168 Comms Lost Time** parameter.

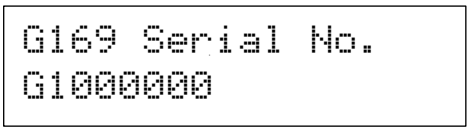
For *MODBUS*, any data packet addressed to the ZENER 8000 and free of transmission errors will reset the timer and the timing interval will begin again.

For *BACnet*, a token pass addressed to the ZENER 8000 and free of transmission errors will reset the timer and the timing interval will begin again.

If **G168 Comms Lost Time** parameter is not zero and the loss of communications timer expires, the power on value for **F09 COMMS PRESET** is reloaded.

If **G168 Comms Lost Time** parameter is zero, the last value written to is preserved even if the loss of communications timer expires. In this case the loss of communications timer interval is fixed at 10 seconds.

G169 Serial Number Entry



Range: S or G first letter
0..9 remaining digits

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

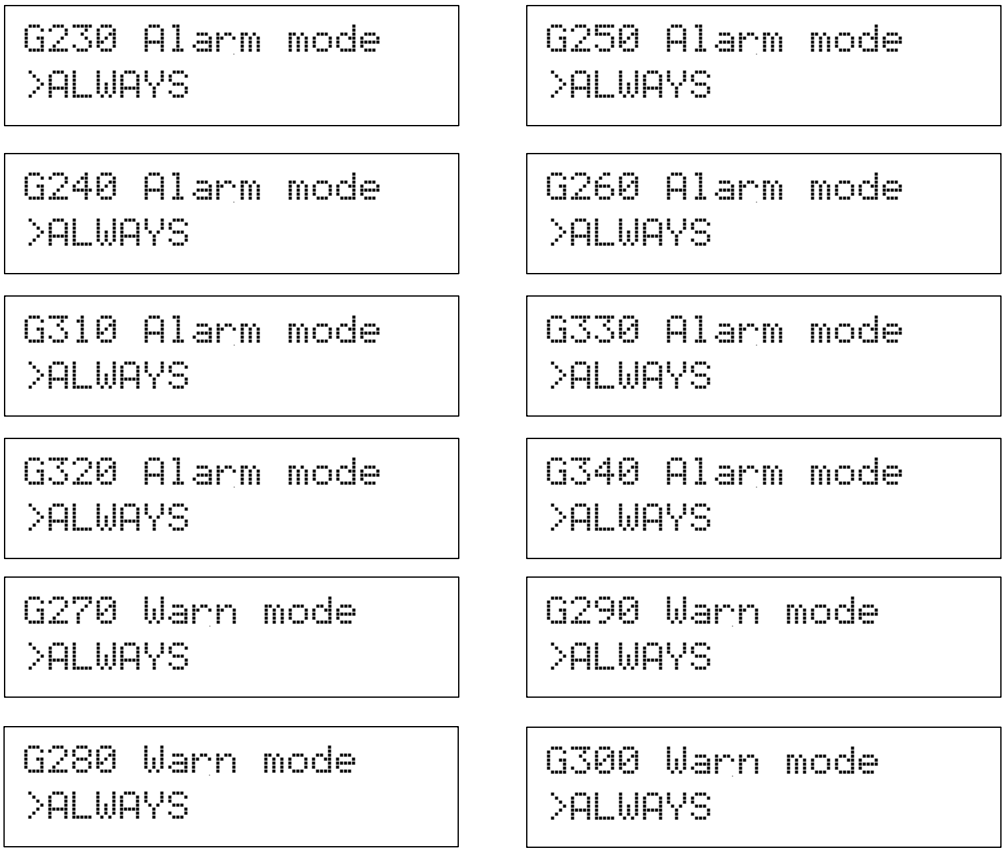
To facilitate traceability of drives at a location the ZENER 8000's serial number may be entered. The serial number uniquely identifies the instance of a ZENER 8000. The serial number is found on the compliance label and this is found on a side of the ZENER 8000's enclosure.

User Warning & Alarm Configurations

Press Enter to access setup for the user alarms. At this level use the ▲/ ▼ buttons to access each of the user alarms.

Select the desired warning / alarm and press ↵ to gain configuration access to the parameters of the intended user alarm.

Mode Selection

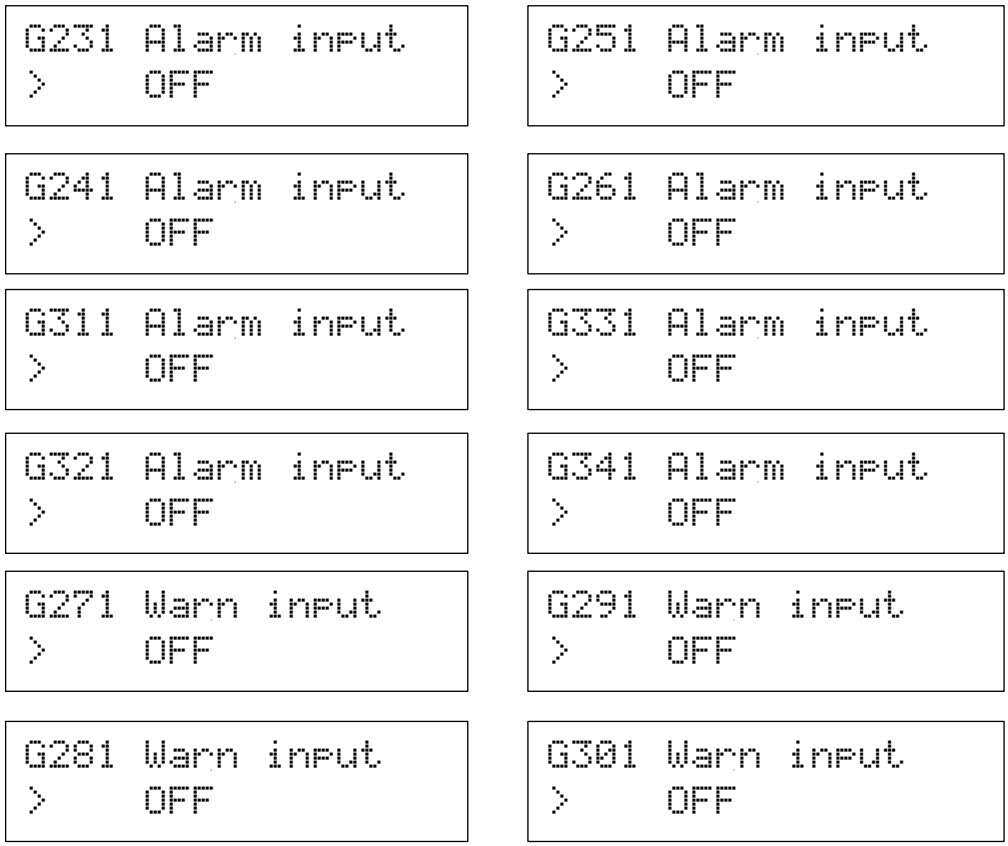


Available Choices: **ALWAYS**
RUN Command
PID closed loop

- Press the ▲ button to move to the trip text parameter of the selected user alarm.
- Press the ▼ button to move to the input choice parameter of the selected user alarm.
- Press ↵ once to begin an enable mode selection.
- Use the ▲/ ▼ buttons to display an enable mode choice.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

Selecting **ALWAYS** enables the user alarm while ever power is applied to the drive.
Selecting **RUN Command** enables the user alarm while ever a command to run is present. E.g. FWD/REV, JOGFWD/JOGREV, etc.
Selecting **PID closed loop** enables the user alarm while ever the PID controller/regulator is operational.

Input Selection

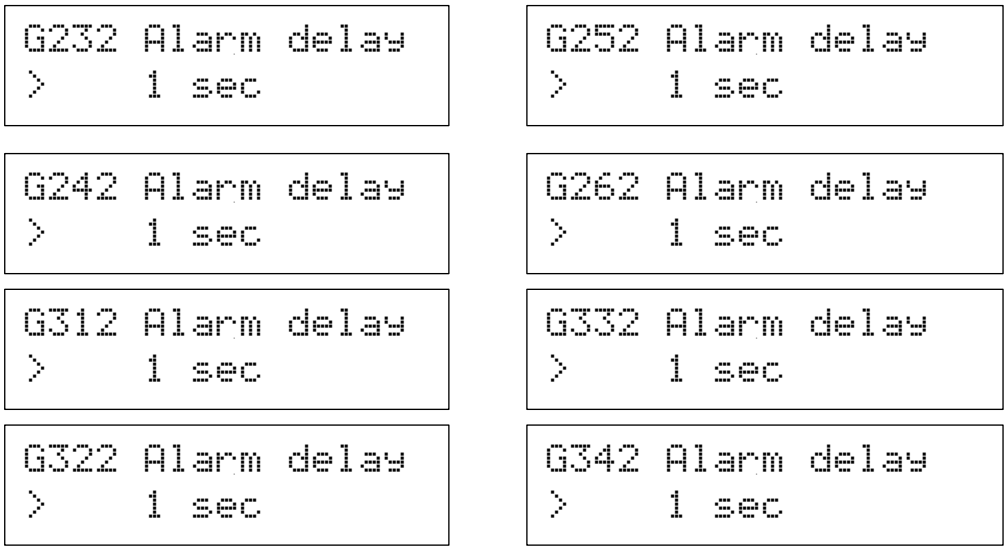


Refer to the “List of Digital Sources” on page 94 for choices

- Press the ▲ button to move to the enable mode of the selected user alarm.
- Press the ▼ button to move to the timer interval of the selected user alarm.
- Press ↵ once to begin an enable mode selection.
- Use the ▲/ ▼ buttons to display an input choice.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

If the logic state of the selected input is TRUE and the particular user alarm is enabled, then the user alarm in question begins timing. If the input is held for the specified timer interval a trip will be generated.

Delay Interval

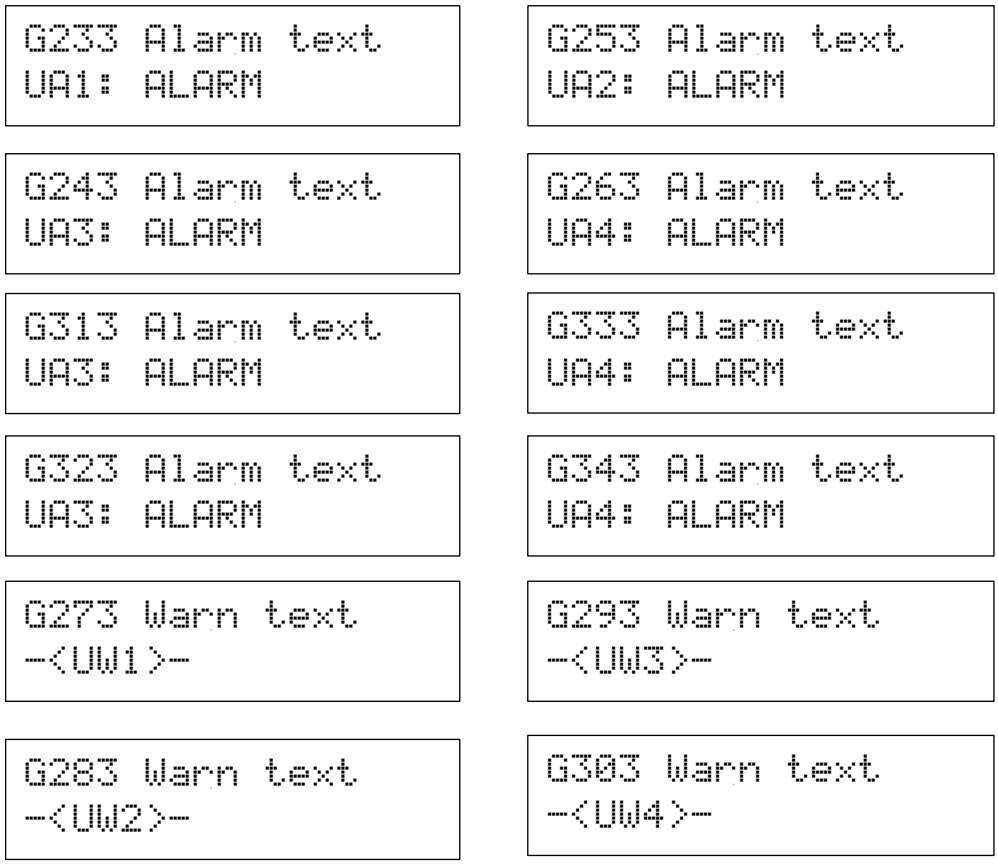


Range: 0...1200 seconds

- Press the ▲ button to move to the enable mode parameter of the selected user alarm.
- Press the ▼ button to move to the trip text parameter of the selected user alarm.
- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

This parameter specifies the timer interval during which the selected input must be maintained TRUE for the enabled user alarm to generate a trip.

Message Text



Available characters: 0…9,A…Z, a…z,
punctuation characters,
+, -, *, /, |, #, $, ^, &, !, ~,
{}, [], ()

- Press the ▲ button to move to the timer interval of the selected user alarm.
- Press the ▼ button to move to the enable mode of the selected user alarm.
- Press ↵ and a character to enter begins to flash
- Press ▲ & ▼ to move through the list of available characters
- Press ↵ to select the displayed character;
  the cursor moves to the next character OR the edit completes
- Press the **ESC** button to abandon changes

This parameter specifies the message to display when the user alarm generates a trip. The first 4 characters are fixed (for traceability) and the remaining 12 characters are editable.

H00 PID Control

This menu is the entry point for the PID controller menus where adjustments can be made. Parameters that may be viewed or adjusted are: the Proportion Band, the integrator gain, the differential gain, the output clamp limit values, the process and set point variable choices and PID scale and units for the PID display.

PID-A & PID-B Controller

The ZENER 8000 has two PID controllers named PID-A and PID-B. PID-A has additional features associated with it (Idle and Pipe-fill functions) and is typically the main controller used. The PID-B Controller is a second instance of the core of the PID-A controller. That is its parameters are a duplication of the PID-A parameters. As a result the descriptions of the core replicated parameters are identical. Descriptions of replicated parameters in this section will appear when necessary

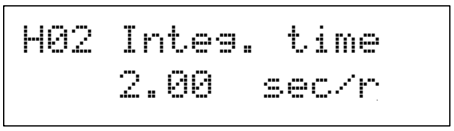
Proportional Band Adjustments

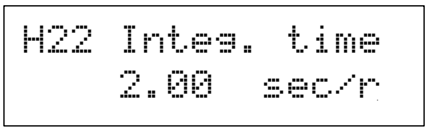
Range: -1000.0...1000.0 %

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The **H01 PROP. BAND** value is the proportion of input required to generate 100% at the output of the PID control (assuming no integrator (I) or differentiator (D) components). For example **H01 PROP. BAND** is 300.0%, the gain is 100/300 = 0.333. That is 3 units of input will generate 1 unit of output. This description applies to **H21 PROP. BAND** as well.

Integral Time Adjustments





Range: 0.0...40.0 sec/r

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

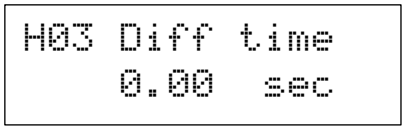
The **H02 Integ. time** value is the time needed by the integrator (I) to “repeat” the value at its input. For example the error signal is 10 units (units not specified); **H02 Integ. time** is set to 2.0 sec/r; the present value of the integrator is 0; after 2 seconds the present value of the integrator is 10 units.

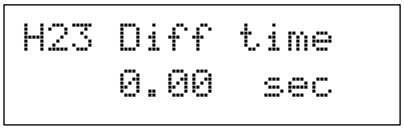
A low **H02 Integ. time** value attempts to regulate the process variable quickly. However if excessively low, over shooting and under shooting will be more prominent.

A high **H02 Integ. time** value diminishes over shooting and under shooting. However regulation takes longer to achieve.

This description applies to **H22 Integ. time** as well.

Differential Time Adjustments





Range: 0.0...5.0 sec/r

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

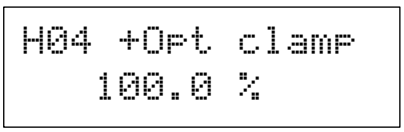
The **H03 Diff time** value determines the estimated component added to the PID output

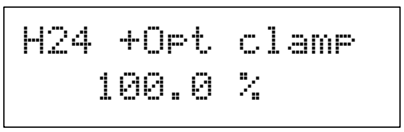
A low **H03 Diff time** contributes a small corrective component and appears to dampen the systems response. If too low, it affects may be unnoticeable.

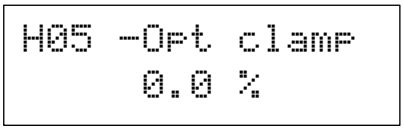
A high **H03 Diff time** value may improve the response to a step input, but may also destabilise the system.

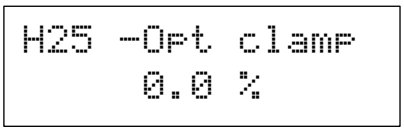
This description applies to **H23 Diff time** as well.

Output Limit Adjustments









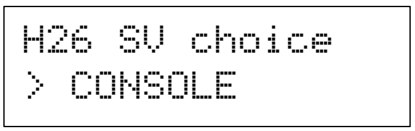
Range: -100.0...100.0 %

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The **H04 +Opt clamp** and **H05 -Opt clamp** values determine the upper and lower limit thresholds for PID output saturation. The PID output will never exceed these values. When the PID output is being clamped the integrator anti-windup activates to prevent the integrator from accumulating error continuously.

This description applies to **H24 +Opt clamp** and **H25 -Opt clamp** as well.

Set point Variable Selections

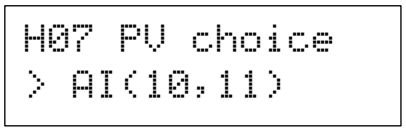


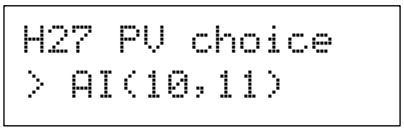
Available Choices: (See the list for **F01 REMOTE**)

- Press ↵ once to begin a selection.
- Use the ▲/ ▼ buttons to select the set point reference.
- Press ↵ to confirm the choice.

The **H06 SV choice** is the reference value the PID controller regulates the process variable to. Invalid reference choices will not appear in the reference list. This description applies to **H26 SV choice** as well.

Process Variable Selections



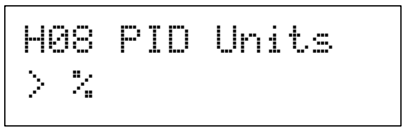


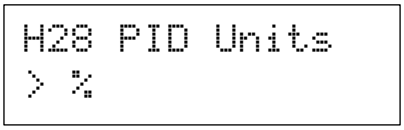
Available Choices:
> AI(10,11)
> AI(32,34) (if left-hand Extended Features card fitted)
> AI(52,54) (if right-hand Extended Features card fitted)
> F07 AI FUNC.

- Press ↵ once to begin a selection.
- Use the ▲/ ▼ buttons to select a reference.
- Press ↵ to confirm the choice.

The **H07 PV choice** is the analogue input on which the process variable is measured. Refer to the menus of the selected analogue input for spanning, offset and limit alarm configurations. This description applies to **H27 PV choice** as well.

Units Display Selections





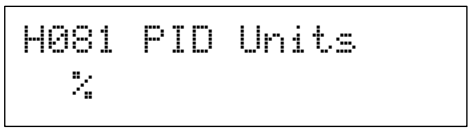
Available Choices:

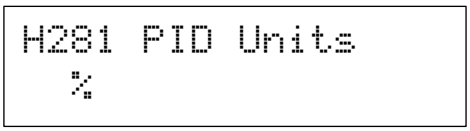
"%"	**"Pa"**
"psi"	**"°C"**
"bar"	**"L/s"**
"kPa"	**custom**

- Press ↵ once to begin a selection.
- Use the ▲/ ▼ buttons to select a reference.
- Press ↵ to confirm the choice.

Select the appropriate PID units for the application. If none of these typically used units suit the application then select custom and enter the appropriate units manually. This description applies to **H28 PID Units** as well.

Entering Custom PID Units



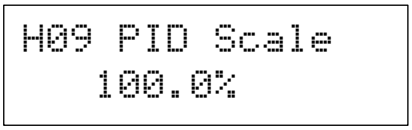


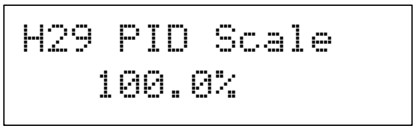
Available characters: 0…9,
A…Z, a…Z,
punctuation characters,
+, -, *, /, |, #, $, ^, &, !, ~,
{}, [], ()

- Press ↵ and the character to enter begins to flash
- Press ▲ & ▼ to move through the list of available characters
- Press ↵ to select the displayed character;
  the cursor moves to the next character OR the edit completes
- Press the **ESC** button to abandon changes

The **H081 PID Units** are custom units displayed on the PID run display. A total of 8 characters may be displayed as units. This description applies to **H28 PID Units** as well.

PID Scale Adjustments





Available Range: 1.0…9999.9

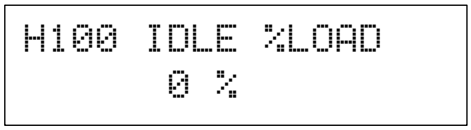
- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The **H09 PID Scale** is used to scale the SV and PV values for the PID run display only and does not affect the PID control loop. The **H08 PID Units** are quoted on the display as well. This description applies to **H29 PID Scale** as well.

IDLE Function (PID-A only)

The parameters contained in this menu control the IDLE function. The IDLE function permits the output to cease in those cases where the driving the motor yields no useful system output. The idle function only works with the PID-A controller.

H100 IDLE %LOAD



Range: **0**…**100%** (Be sure to enter motor details correctly in the **B00 MOTOR** menu)

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

Entry to the idle state is determined by percentage motor load. If the percentage motor load detected by the ZENER 8000 remains below the **H100 IDLE %LOAD** threshold for **H101 IDLE DELAY** seconds, the ZENER 8000 will enter the IDLE state.

H101 IDLE DELAY

Range: 0…120 seconds

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The **H101 IDLE DELAY** time specifies the amount of time to wait before entering the IDLE state.

H102 RESUME

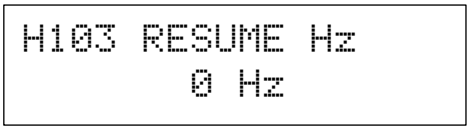
Available Choices: >**by speed ref**
>**by PV threshold**

- Press ↵ once to begin a selection.
- Use the ▲/ ▼ buttons to select a reference.
- Press ↵ to confirm the choice.

When "**by speed ref**" is selected the ZENER 8000 will exit the IDLE state and resume operation when the applied speed reference is greater than the frequency specified by **H103 RESUME Hz**.

When "**by PV threshold**" is selected the ZENER 8000 will exit the IDLE state and resume operation when the process variable is below a threshold specified by **H104 RESUME @PV**.

H103 RESUME Hz



Range: **0**…**C02 MAX Hz** – 5Hz

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The ZENER 8000 will exit the IDLE state and resume operation when the applied speed reference is greater than the frequency specified by **H103 RESUME Hz**.

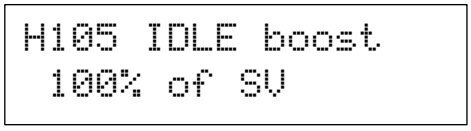
H104 RESUME @PV

Range: **0**…**100%**

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

Only selectable if the choice for "**H102 RESUME**" is: "**>by PV threshold**". With the ZENER 8000 in the idle state, and the process variable is below the set point by this percentage, then the ZENER 8000 will resume operation

H105 IDLE boost

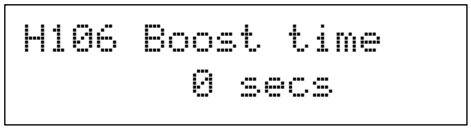


Range: **0**…**50%**

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The **H105 IDLE boost** specifies the increase of set-point to applied before the ZENER 8000 enters the IDLE state

H106 Boost time

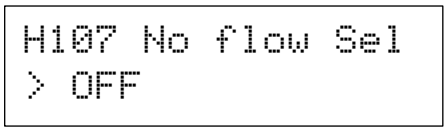


Range: 0…60 seconds

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The **H106 Boost time** specifies the number of seconds to apply the **H105 IDLE boost** set-point increase.

H107 No Flow Selection

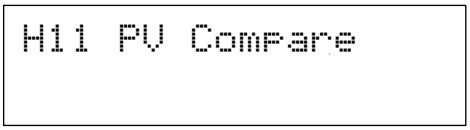


Refer to the “List of Digital Sources” on page 94 for choices

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

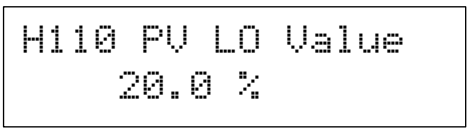
This menu is for those systems where a flow switch is used to shut down pump operation. This menu allows for a digital input to be allocated as the “No Flow Input”. Design your flow switch wiring and then complete its application be selecting the input to which it is wired.

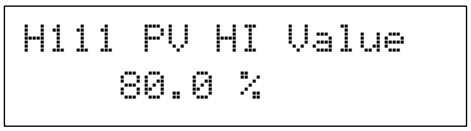
Process Variable Comparisons

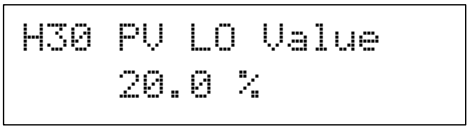


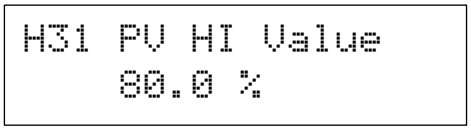
The parameters contained in this menu permit compare threshold adjustment for PV UNDER and PV OVER signals.

Process Variable Compare Thresholds









Range: **0** to **+/- 105%** of **H09 PID Scale**

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The PV low threshold compare value is used to update the PV UNDER signal. The resulting comparison is governed by a fixed hysteresis of 2%**.** Note the value entered will be specified in PID units.

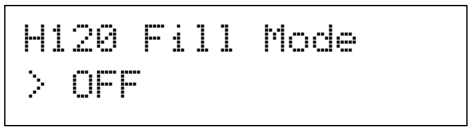
The PV high threshold compare value that is used to update the PV OVER signal. The resulting comparison is governed by a fixed hysteresis of 2%**.** Note the value entered will be specified in PID units.

This description applies to **H30 PV LO Value** and **H31 PV HI Value** as well.

Pipe Fill Function (PID-A only)

The parameters contained in this menu are for the ZENER 8000's "Pipe Fill" feature. These parameters control the behaviour of the pipe fill function.

H120 Fill Mode



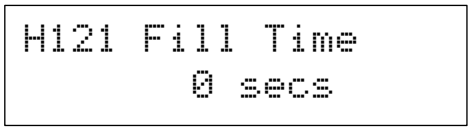
Available Choices: > OFF
> Time Interval
> PV Threshold

- Press ↵ once to begin a selection.
- Use the ▲/ ▼ buttons to select a reference.
- Press ↵ to confirm the choice.

The **H120 Fill Mode** governs the operation of the fill mode feature. When set to "**Time Interval**", the ZENER 8000 drives the pump system to the **H123 Fill Ref** speed for a duration specified by the **H121 Fill Time**.

If the **H120 Fill Mode** is set to "**PV Threshold**", the ZENER 8000 drives the pump system to the **H123 Fill Ref** speed until the PV signal is at or above the **H122 Fill Thresh**. The fill timer may be used to raise an alarm if the filling phase takes longer than the **H121 Fill Time.**

H121 Fill Time



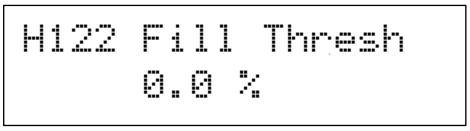
Range: 0…1200 seconds

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

If the **H120 Fill Mode** is set to "**Time Interval**", the **H121 Fill Time** specifies the time interval to operate the ZENER 8000 in the pipe fill mode. During this time the **H123 Fill Ref** is the speed at which the ZENER 8000 drives the pump system.

If the **H120 Fill Mode** is set to "**PV Threshold**", the fill timer may be used to raise an alarm if the filling phase takes longer than the **H121 Fill Time.** During this time the **H123 Fill Ref** is the speed at which the ZENER 8000 drives the pump system.

H122 Fill Thresh

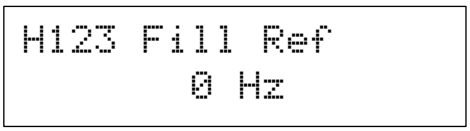


Range: **0**…**H09 PID Scale**

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

If the **H120 Fill Mode** is set to "**PV Threshold**", the **H122 Fill Threshold** represents the value of the process variable at which the ZENER 8000 transitions from pipe-fill mode to PID closed loop control**.** That is when the value is exceeded closed loop operation commences.

H123 Fill Ref



Range: **0**…**C02 MAX Hz** – 5Hz

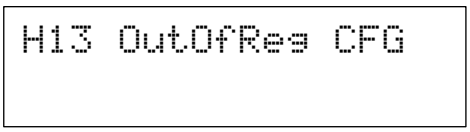
- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

When the ZENER 8000 is in the filling phase, the pump system is driven to the speed set by **H123 Fill Ref.**

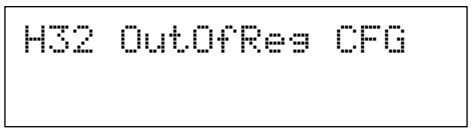
PID Out of Regulation Indication

PID-A and PID-B of the ZENER 8000 are furnished with "Out of Regulation" detection. The difference between set point and feedback is compared to the "Out of Regulation Threshold". Out of regulation is detected if the difference is larger than the Out of Regulation Threshold for the "Out of Regulation Qualification" time interval.

The menu for each PID is:



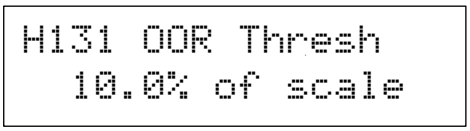
PID-A



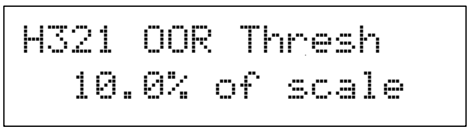
PID-B

Out of Regulation Threshold

The out of regulation threshold specifies how much error between set point and process variable is permitted. The parameter for each PID is:



PID-A



PID-B

Range: **0**…**100%** (of the corresponding PID measurement scale)

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

Out of Regulation Qualification Interval

If the error between set point and process variable remains larger than the out of regulation threshold for the qualification time interval then the Out of Regulation flag is set true and is cleared the instant the error falls below the threshold. The parameter for each PID is:

PID-A

PID-B

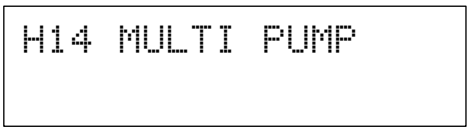
Range: **0**…**1200** seconds

- Press ↵ to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

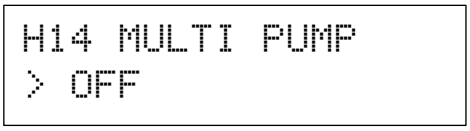
H14 Multi Pump Operation (PID-A only)

Multi-pump pressure control offers pressure regulation for systems that have a wide range flow requirement.

With this menu display in view:



Press ENTER to show the state of the multi pump feature:



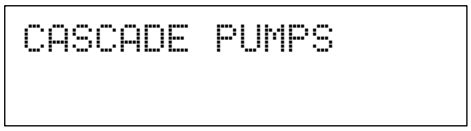
Available Choices: **OFF**,
CASCADE PUMPS,
PUMP GROUP

- Press ENTER (↵) to begin the mode selection.
- Use the ▲/ ▼ buttons to display choices.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

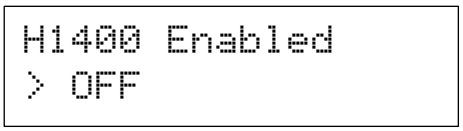
Selection	Description
OFF	Multi pump is disabled
C**ASCADE PUMPS**	Cascade Pump feature controls the operation of up to 4 subordinate pumps from a single dedicated master Zener 8000. • If the flow requirement for a given pressure increases, another parallel pumping stage is activated. • If the flow requirement for a given pressure decreases, one of the active parallel pumping stages will be deactivated. • The drive in which CASCADE PUMPS is selected is the MASTER and must be powered on continually for proper operation. • Refer to page 152 for parametric setup details
PUMP GROUP	The Pump Group feature allows many parallel identical pump/motor/inverter instances to regulate pressure as the flow requirement changes. • If the flow requirement for a given pressure increases, a parallel pump is activated. • If the flow requirement for a given pressure decreases, an active pump is deactivated • There is NO MASTER controller controlling operations. Each Zener 8000 works cooperatively to regulate pressure. • Refer to page 28 for parametric setup details

Cascade Pumps

Press ENTER to access Cascade Pump parameters.



H1400 Cascade Pump Mode



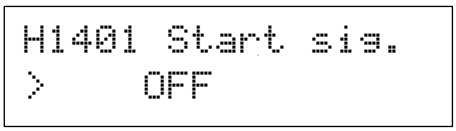
Available Choices: **OFF**, **ALWAYS**, **RUN Command** & **PID closed loop**

- Press ENTER (↵) to begin the mode selection.
- Use the ▲/ ▼ buttons to display mode choices.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

Selection	Description
OFF	Disable the Cascade Pump feature completely.
ALWAYS	Enables the Cascade Pump feature while ever power is applied to the drive.
RUN Command	Enables the Cascade Pump feature while ever a command to run is present. E.g. FWD/REV, JOGFWD/JOGREV, etc.
PID closed loop	Enables the Cascade Pump feature while ever the PID controller/regulator is operational.

H1401 Stage Start Signal choice

Refer to the "List of Digital Sources" on page 94 for choices



- Press ENTER (↵) once to begin the stage start signal selection.
- Use the ▲/ ▼ buttons to display input choices.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

If the Cascade Pump feature is enabled and the logic state of the selected input is TRUE and there is at least one stage in the de-activated state, then another stage (relay) will be activated. Note this is best set to "Over Speed"

H1402 Stage Stop Signal choice

Refer to the "List of Digital Sources" on page 94 for choices

- Press ENTER (↵) once to begin the signal selection.
- Use the ▲/ ▼ buttons to display input choices.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

If the Cascade Pump feature is enabled and the logic state of the selected input is TRUE and there is 2 or more stages active then one of the active stages (relay) will be de-activated. Note this is best set to "Under Speed"

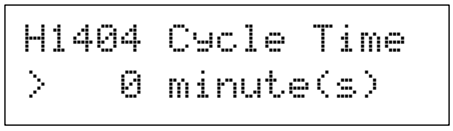
H1403 Lockout Time

Range: 0...1200 seconds

- Press ENTER (↵) to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

Once a stage has been activated OR de-activated, a timing interval begins. During this time, further stage stops and starts are prohibited. This allows the PID controller to settle any pressure transients before further decisions to activate/ de-activate subsequent stages are made.

H1404 Cycle Time



Range: 0...120 minutes

- Press ENTER (↵) to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The cascade feature is able to rotate the duty of operation amongst active stages and so promoting even pump wear. At the end of the timing interval, one of the active stages is stopped and one of the inactive stages is started. The default value is 0 which disables the stage rotation cycle.

H1405...H1408 Stage Enable Input Selection

For each selection, refer to the "List of Digital Sources" on page 94 for choices

- Press ENTER (↵) once to begin the stage enable signal selection.
- Use the ▲/ ▼ buttons to display input choices.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

If a stage's enable input is asserted TRUE, then the stage will activate and de-activate as needed. If the stage's enable input is asserted FALSE, then the stage will be bypassed if required to run and another stage with enabling input asserted TRUE is sort.

Selecting a Relay to control a stage

For the Cascade Pump feature to work, a relay must be dedicated to a stage. Refer to the section Choosing a Relay on page 101

Pump Group

The Pump Group feature employs several smaller instances of drive/motor/pump in a network to serve a pressure regulation requirement whilst satisfying a wide range flow requirement.

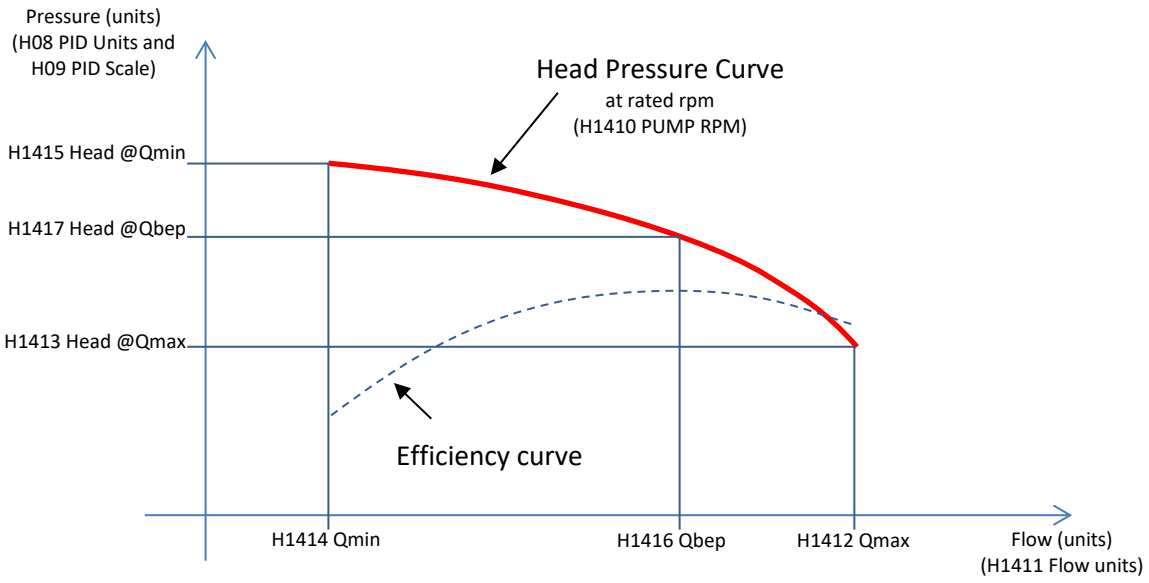
Each instance of drive/motor/pump is assumed to be:

- Identical,
- fed by a common reservoir or manifold,
- connected to the common outlet manifold.

Pump Data

The pump group feature logic requires an estimate of flow. The flow is calculated from shaft speed, the measured head pressure and parameters from the head vs flow curve. The diagram below shows the necessary parameters:

Head Pressure Curve



IMPORTANT For meaningful estimates of pump flow, be sure to select your desired process variable units and scale. Refer to **H08 PID Units** and **H09 PID Scale** for details.

IMPORTANT The pump group feature employs the BACnet protocol. Be sure:

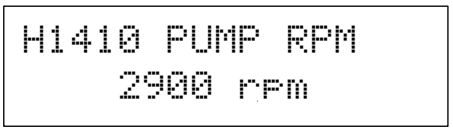
- BACnet MS/TP is the selected protocol. Refer to **G160 Protocol**
- To setup network parameters identically except for:
  - **G163 MAC ID** - unique on the local MS/TP network segment.
  - **G164 Dev Instance** - unique according to the BACnet standard.

INFORMATION

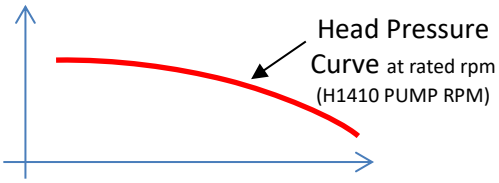
The menus and parameters of this section are documented for completeness. It is recommended to install the "Pump Group" application (p/n SW08025.apf). Refer to "Pump Group Application Guide" (IM00164) for commissioning and operational instructions.

H1410 PUMP RPM

Range: 500…4200 rpm



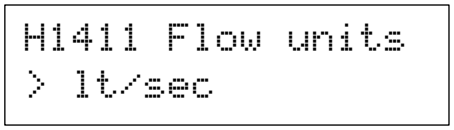
- Press ENTER (↵) to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.



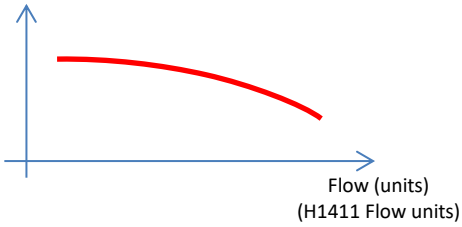
The Head Pressure curve for the pump is defined at a particular shaft (impeller) speed. Enter the rated speed.

H1411 Flow units

Selection: lt/sec (default)
lt/min
lt/hr
m3/sec
m3/min
m3/hr



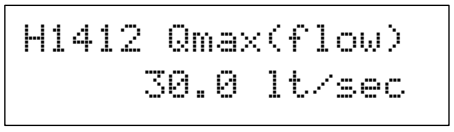
- Press ENTER (↵) to make a selection.
- Press ▲/ ▼ to view the next choice.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the selection



For display purposes please select the preferred flow units.

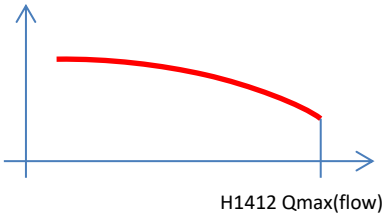
H1412 Qmax(flow)

Range: 0.0…30000.0 in the selected units



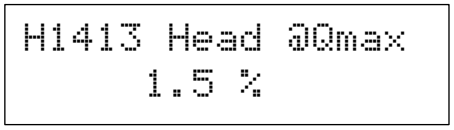
- Press ENTER (↵) to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value
- Press **ESC** to abandon the value change

For estimation purposes please enter the maximum flow value.



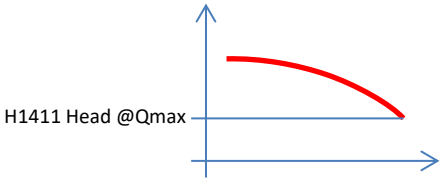
H1413 Head @Qmax

Range: 0.0…30000.0 in the selected units



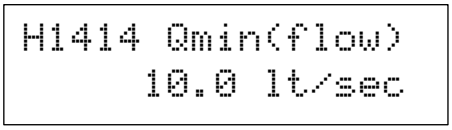
- Press ENTER (↵) to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value
- Press **ESC** to abandon the value change

For estimation purposes please enter the maximum flow value.



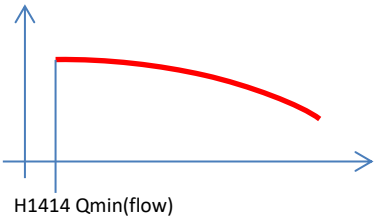
H1414 Qmin(flow)

Range: 0.0…Qmax – 8% in the selected units



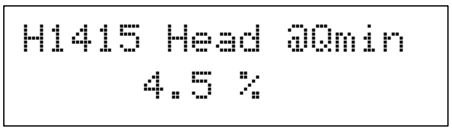
- Press ENTER (↵) to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value
- Press **ESC** to abandon the value change

For estimation purposes please enter the minimum flow value.



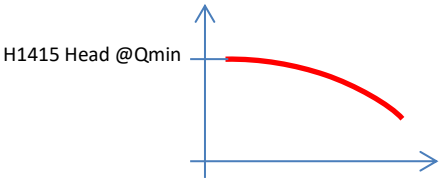
H1415 Head @Qmin

Range: H(Qmax) – 8% … 30000.0 in the selected units



- Press ENTER (↵) to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value
- Press **ESC** to abandon the value change

For estimation purposes please enter the head for Qbep flow value.

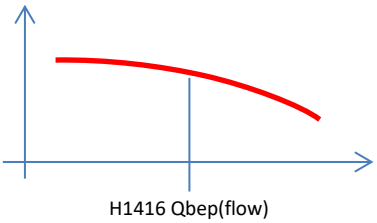


H1416 Qbep(flow)

Range: Qmin…Qmax in the selected units

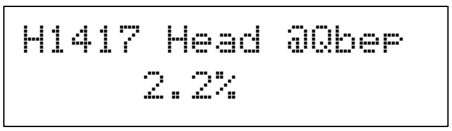
- Press ENTER (↵) to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value
- Press **ESC** to abandon the value change

For estimation purposes please enter the maximum flow value.



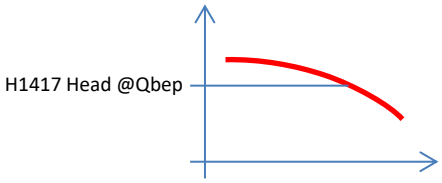
H1417 Head @Qbep

Range: H(Qmin)… H(Qmax) in the selected units



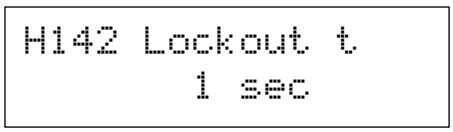
- Press ENTER (↵) to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value
- Press **ESC** to abandon the value change

For estimation purposes please enter the head for Qbep flow value.



H142 Lockout Time

Range: 0...1200 seconds

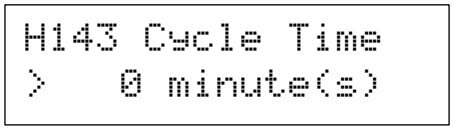


- Press ENTER (↵) to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

Once a drive/motor/pump instance has been activated OR de-activated, a timing interval begins. During this time, stops and starts of other drive/motor/pump instances are prohibited. This allows the PID controller to settle any pressure transients before another drive/motor/pump instance activates/ de-activates.

H143 Cycle Time

Range: 0...120 minutes



- Press ENTER (↵) to edit the value.
- Press ▲/ ▼ to make changes to the value.
- Press ↵ to accept the new value OR
- Press **ESC** to abandon the value change.

The pump group feature is able to rotate the duty of operation amongst active drive/motor/pump instances and so promoting even pump wear. At the end of the timing interval, one of the active instances will stop and one of the inactive instances will start. The default value is 0 which disables the rotation cycle.

J00 CONSOLE

This menu allows the console behaviour to be configured. Items to be configured include: Menu protection lock; Default live display; Run display format, scale and units; Console reference persistent mode and stop reset mode; Remote Override enable / disable.

J01 Menu Lock

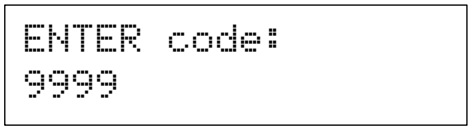
Available Choices: **UNLOCKED**
LOCKED

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to enable or disable the menu lock.
- Press ↵ to confirm the choice.

This feature protects the entire menu mode with a code so that settings and configurations are protected from unauthorised or unintentional changes.

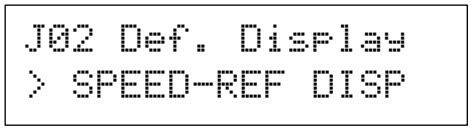
Menu Lock Code Entry

When the J01 MENU LOCK is enabled, each time the menu mode is entered the following message will appear:



The code to access the menus is fixed to “1470”. Press the ↵ button once to begin.
Use the ▲ & ▼ buttons to set each code digit and ↵ to set to the next digit.
After all digits have been entered correctly, the first menu will appear.

J02 Def. Display

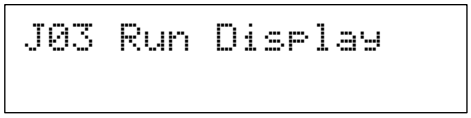


Available Choices: **> SPEED-REF DISP**
> METER DISPLAY
> PID DISPLAY
> PID-METER DISP
> BUS-PID DISP
> kWhrs & Run hrs
> Flow & volume

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to choose a default display.
- Press ↵ to confirm the choice.

The selected display will show when the ZENER 8000 is powered on or when a menu is on show and left unattended for 2 minutes.

J03 Run Display



This menu allows for Run Display configuration. Menus within provide a mechanism to select the run display format, alter the run display scaling and change the displayed units.

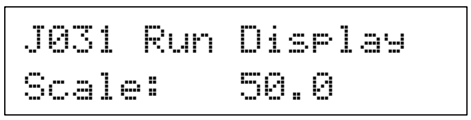
J030 Run Display Format

Available Choices:
> 9999
> 999.9
> 99.99
> 9.999

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to choose a display format.
- Press ↵ to confirm the choice.

The selected format will be used when the run display is on show.

J031 Run Display Scale

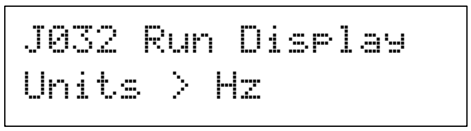


Range: 1.000...9999.9

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to choose a display format.
- Press ↵ to confirm the choice.

The set scale will be used when the run display is on show. The decimal point location is determined by **J030 Display Fmt** setting.

J032 Run Display Units

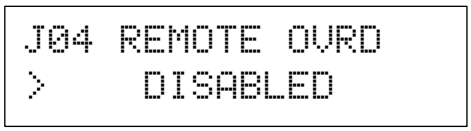


Available characters: _ ! " # $ % & ' ( ) * + , - . / 0…9 : ; < = > ?
@ A…Z [\ ] ^ _ ` a…z { | } ~

- Press ↵ and the character to enter begins to flash
- Press ▲ & ▼ to move through the list of available characters
- Press ↵ to select the displayed character; the cursor moves to the next character OR edit completes
- Press the **ESC** button to abandon changes

The **J032 Run Display Units** are displayed when the run display is on show. A total of 8 characters may be displayed as units.

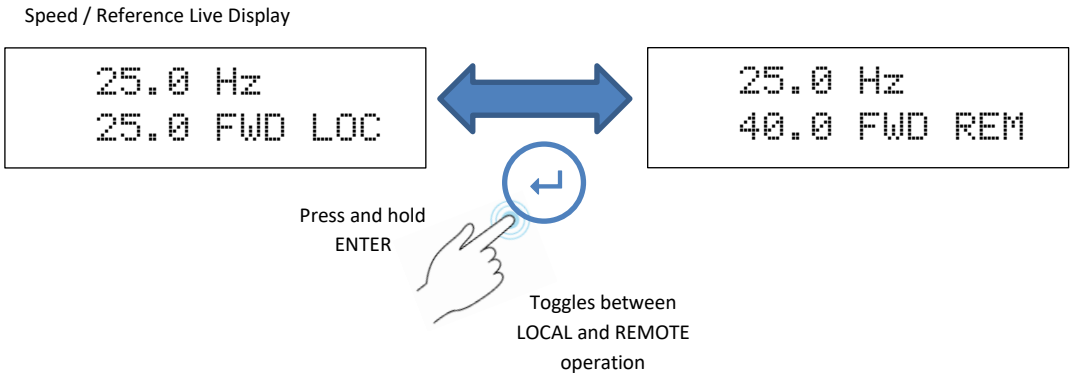
J04 REMOTE OVRD



Available Choices: **ENABLED**
DISABLED
TIMED

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to enable or disable remote override operation.
- Press ↵ to confirm the choice.

If **J04 REMOTE OVRD** is "ENABLED", with the Speed / Reference Live Display in view, press and hold the ↵ push button in for several seconds to toggle LOCAL and REMOTE mode operation. The action behaves as if the **I11 REMOTE** input is energised/de-energised.



If **J04 REMOTE OVRD** is set to "TIMED", the ZENER 8000 is always in REMOTE. Holding the ENTER pushbutton pressed will override REMOTE to LOCAL mode and LOCAL mode will persist for 10 minutes. At the end of the 10 minute interval the operational mode returns to REMOTE mode.

J05 LOCAL RUN ENABLE

Available Choices: Refer to the "List of Digital Sources" on page 94 for choices

- Press ↵ once to begin input selection.
- Use the ▲/ ▼ buttons to select a digital signal source.
- Press ↵ to confirm the choice. **ESC** to abandon the change.

Primarily to facilitate ECODRIVE solar operation, **J05 LOCAL RUN EN** permits running in local subject to external conditions. For example in solar pumping bore applications, running the pump with a dry bore in local may lead to pump damage. In this example the **J05 LOCAL RUN EN** feature implements pump protection logic.

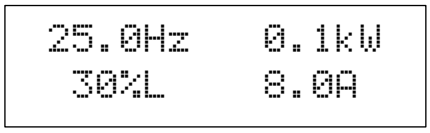
J06 METER Display Variable

Available Choices: **%LOAD**
rpm

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to display either %LOAD or motor rpm on the Meter Display.
- Press ↵ to confirm the choice.

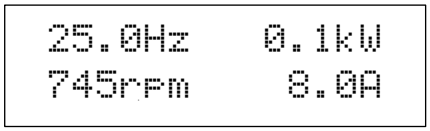
The **J06 METER Display Variable** offers a choice of variable to be displayed in the bottom left corner of the Meter Display. The representation depicts the choice.

Meter Display



J06 METER disp. ← %LOAD

Meter Display

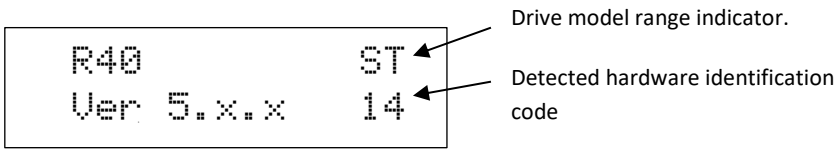


J06 METER disp. ← rpm

S00 SERVICE

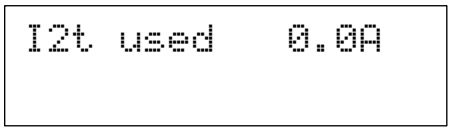
The S00 SERVICE menu is a collection of displays and menus specifically for service and service personnel and so summarised description of each display and menu follows

Version display



This display reveals the software version in operation without having to restart the drive.

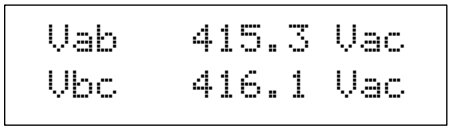
I2t used Display



This display reveals the state of the thermal overload protection feature.

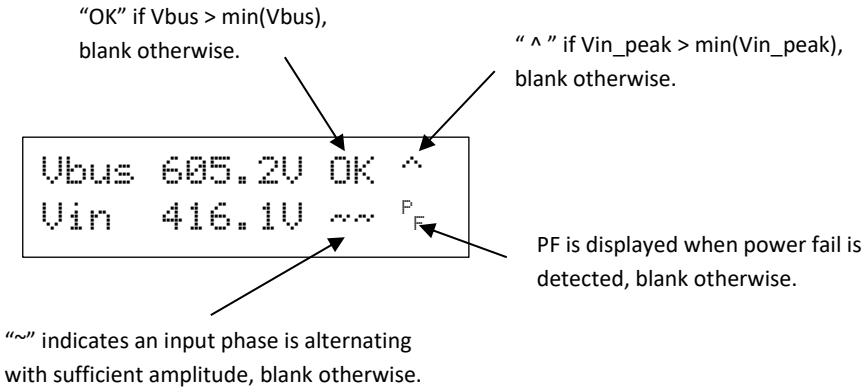
Supply Displays

Mains input display



This display reveals the Vab & Vbc mains input magnitude measurement.

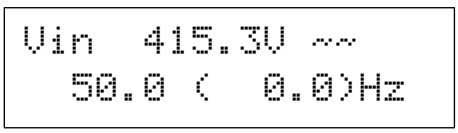
Vbus display



This display reveals the Vbus measurement with: relay pull in condition; bus charge peak condition, mains zero crossing condition and power failure indication.

Supply Voltage & Frequency Display

This display is primarily for synchronising projects. Input voltage and frequency with rotation indication may be viewed together with motor frequency and rotation.



Trigger OV trip?

This display is primarily a test function used in conjunction with the latching change over relay card and ECODRIVE 8000.

```
Trigger OV trip?
Enter=YES ESC=NO
```

Pressing Enter will mimic the event of an overvoltage without actually stressing the power components with high volts.

IMPORTANT Triggering an over voltage fault using this display permits testing of protective lockout switch gear which is strongly recommended during commissioning.

S04 FAN OVERRIDE

```
S04 FAN OVERRIDE
>    DISABLED
```

Available Choices: ENABLED
DISABLED

- Press ↵ once to begin.
- Use the ▲/ ▼ buttons to enable or disable fan override.
- Press ↵ to confirm the choice.

The ZENER 8000 internal cooling fans will be forced ON while ever the **S04 FAN OVERRIDE** parameter is set to ENABLED. When **S04 FAN OVERRIDE** is DISABLED, the fans will operate according to internal temperature measurements.

Temperature Sensors Display

```
Temperature
Sensors
```

This display reveals the temperature measurements of the ZENER 8000.

Timers

```
Timers
```

The displays within indicate the current duration of timing for each timer.

Thermistor Display

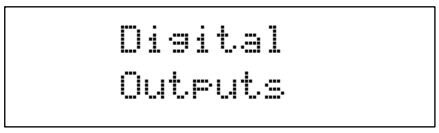
```
Thermistors/RTD
```

These displays show thermistor and RTD input status if the relevant options are fitted.

Digital Inputs Display

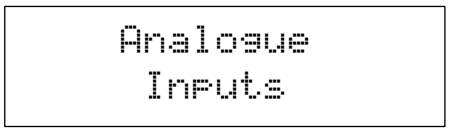
These displays will show the input state of each digital input of the ZENER 8000 system.

Digital Outputs Display



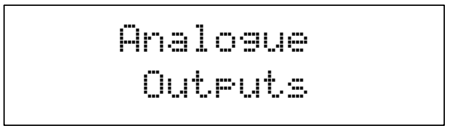
These displays will show the output state of each digital relay output of the ZENER 8000 system.

Analogue Inputs Display



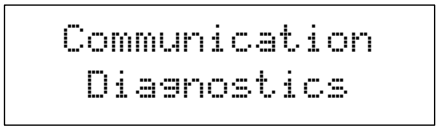
These displays will show the input state of each analogue input of the ZENER 8000 system.

Analogue Outputs Display



These displays will show the output state of each analogue output of the ZENER 8000 system.

Communication Diagnostic Displays

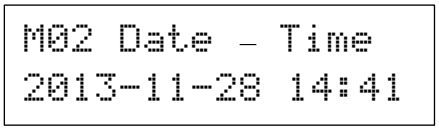


These displays will show diagnostic counters of the currently operating communication protocol.

Advanced

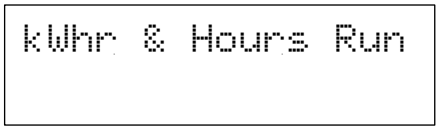
The Advanced menu contains parameters that may yield beneficial improvements to performance. Please seek authorised guidance before making changes in these menus.

M02 Date – Time



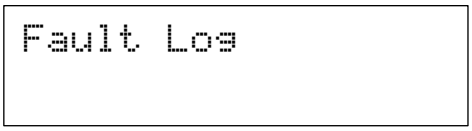
This display reveals the date and time of ZENER 8000 time keeping. The format for the date and time is:
“20yy-mm-dd hh:mm”.

kWhr & Hours Run



This is a menu requires a pass code access to additional menus that manage the kWhrs and Hours Run accumulators

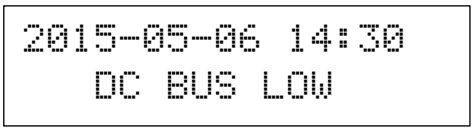
Fault Log



A view of up to 100 faults and trips is permitted through this menu. Also within this menu, the fault log may be cleared and an option to avoid logging power fail and under volts may be decided. Press **Enter** to begin viewing the fault log.

View log

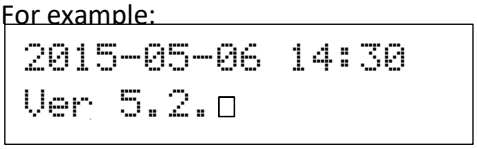
Press Enter at this display to reveal the last recorded fault.



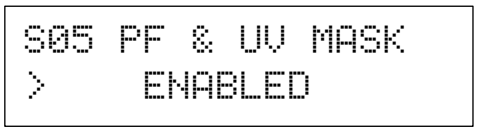
Each press of the **UP** push button will reveal the previous fault. Each press of the **Down** pushbutton will reveal the next most recent fault. If there are no more recent faults the earliest fault is displayed.

Power ON Time-stamp

Each time the ZENER 8000 is powered on, a time-stamp marker with the loaded software version may be written to the fault log (default). For example:



Power Fail & Under Volts

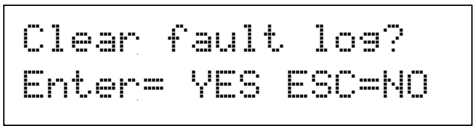


Each time the ZENER 8000 is powered down, a power fail fault is detected and the ZENER 8000 begins to discharge. Several seconds later an under voltage fault will be detected as the internally stored voltage is insufficient for ZENER 8000 operation. If the ZENER 8000 is regularly powered down, the fault log will fill with power fail and under voltage faults. When the **S05 PF & UV MASK** is set to **ENABLED**, power fail and under voltage faults will not be recorded.

Power-On Fault Log Entry

Each time the ZENER 8000 is powered on, a time-stamp marker with the current software version is written to the fault log when **S06 PWR UP ENTRY** is **ENABLED**. The entry will be omitted if set to **DISABLED**.

Clearing the Fault Log



Pressing the **Enter** push button will clear all recorded faults.

Firmware Update?

The menu contained within are intended for service personnel only and so are pass code protected. Please contact your local service agent for further details.

Appendix A: BACnet Protocol – Application Layer Description

Objects and Properties Supported

Property	Object Type			
	Device	Binary Value (BV)	Analog Value (AV)	Accumulator (ACC)
Object Identifier	✓	✓	✓	✓
Object Name	✓	✓	✓	✓
Object Type	✓	✓	✓	✓
Description	*✓	✓	✓	✓
Location	*✓			
System Status	✓			
Vendor Name	✓			
Vendor Identifier	✓			
Model Name	✓			
Firmware Revision	✓			
Application Software Version	✓			
Protocol Version	✓			
Protocol Revision	✓			
Protocol Services Supported	✓			
Protocol Object Types Supported	✓			
Object List	✓			
Max APDU Length Accepted	✓			
Segmentation Supported	✓			
APDU Timeout	✓			
Number APDU Retries	✓			
Max Master	✓			
Maximum Info Frames	✓			
Device Address Binding	✓			
Database Revision	✓			
Present Value		✓	✓	✓
Status Flags		✓	✓	✓
Event State		✓	✓	✓
Out of Service		✓	✓	✓
Units			✓	✓
Reliability		✓	✓	
Priority Array		✓	✓	
Relinquish Default		✓	✓	
Active Text		✓		
Inactive Text		✓		
Max Present Value				✓

* Device Object Description and Location are R/W.

Analog Values

Instance ID	Object Name	Description	Units	Present Value Access
AV0	Cpreset	Speed reference	%	C
AV1	Preset 1	Preset analog value for general Use	%	C
AV2	Accel time	Acceleration time 0 – max speed	seconds	C
AV3	Decel time	Deceleration time max speed – 0	seconds	C
AV4	S time	S characteristic of acceleration and deceleration	seconds	C
AV5	Current limit	Current limit	Amps	C
AV6	AR allowed	Number of auto restarts allowed	-	C
AV7	AR clear time	Running time without trip to clear auto restart counter	secs	C
AV8	Under speed	Set point for under speed alarm	%	C
AV9	Over speed	Set point for over speed alarm	%	C
AV10	Speed	Motor speed	RPM	R
AV11	Speed	Motor speed	%	R
AV12	Frequency	VFD output frequency	Hz	R
AV13	Load	Load torque	%	R
AV14	Current	Motor phase current	Amp	R
AV15	DC Volts	DC bus voltage	Volt	R
AV16	Power	Power to motor	kW	R
AV17	AC Volts	Inverter output voltage	Volt	R
AV18	Temp	Heatsink temperature	Degree C	R
AV19	I2T used	Used thermal capacity of the motor	Amps	R
AV20	Preset 2	Preset analog value for general Use	%	C
AV21	Preset 3	Preset analog value for general Use	%	C
AV22	Irated	Drive rated current	Amps	R
AV23	AI(10,11)	Analogue input reading terminals 10,11	mA/V	R
AV24[1]	AI(32,34)	Analogue input reading terminals 32,34	mA/V	R
AV25[1]	AI(52,54)	Analogue input reading terminals 52,54	mA/V	R
AV26[1]	AO(36,38)	Analogue input reading terminals 36,38	mA/V	R
AV27[1]	AO(56,58)	Analogue input reading terminals 56,58	mA/V	R
AV28[1]	TH(40,42)	Thermistor resistance reading terminals 40,42	kΩ	R
AV29[1]	TH(60,62)	Thermistor resistance reading terminals 60,62	kΩ	R
AV30[1]	TH(46,47)	Thermistor resistance reading terminals 46,47	kΩ	R
AV31[1]	TH(66,67)	Thermistor resistance reading terminals 66,67	kΩ	R

Accumulators

Instance ID	Object Name	Description	Units	Present Value Access
ACC0	kWh	kWh consumed by the motor	kWh	R
ACC1	Hours	Run Number of motor operation hours	hours	R

Present Value Access:
R = Read only
W = Writeable
C= Commandable, priority arrays and relinquish defaults - supported.

Notes:
1 The RELIABILITY property of this variable returns UNRELIABLE_OTHER (7) if the input or output is not physically present i.e. the option is not fitted.

Binary Values

Instance ID	Object Name	Description	Active Text	Inactive Text	Present Value Access
BV0	Run fwd	Run FWD Command	Active	Inactive	C
BV1	Run rev	Run REV Command	Active	Inactive	C
BV2	Reset	Reset Command	RESETTING	Inactive	W
BV3	ESO	ESO Mode	ESO ACTIVE	Inactive	C
BV4	Remote	Remote Status	Remote	Local	R
BV5	Enabled	Enable Status	Enabled	Disabled	R
BV6	Switching	Switching Status	Switching	Output Off	R
BV7	Powered up	Power Up Status	Powered Up	Warming Up	R
BV8	Bus charged	Bus Charged Status	Bus Charged	Charging	R
BV9	Ramping to stop	Ramping Status	Ramping to Stop	Clear	R
BV10	Coasting	Coasting Status	Coasting	Clear	R
BV11	AR failed	Auto Restart Status	AUTO RESTART FAILED	Ready	R
BV12	OPTSC	Output Short Status	OUTPUT SHORT	Clear	R
BV13	Overvoltage	Over Voltage Trip	OVERVOLTAGE	Clear	R
BV14	Overcurrent	Over Current Trip	OVERCURRENT	Clear	R
BV15	DC low	DC Low Trip	DC LOW	Clear	R
BV16	Power fail	Power Fail Trip	POWER FAIL	Clear	R
BV17	Over temp	Over Temp Trip	OVERTEMPERATURE	Clear	R
BV18	I2t trip	I2tTrip	I2t TRIP	Clear	R
BV19	Tripped	Trip Status	TRIPPED	Clear	R
BV20	Vlimit	Voltage Limit	Active	Inactive	R
BV21	Climit	Current Limit	Active	Inactive	R
BV22	Zero speed	At Zero Speed	Zero Speed	Turning	R
BV23	At speed	At Speed Status	At commanded speed	Speed Changing	R
BV24	Run	Run Status	Running	Stopped	R
BV25	iRLY1	Internal Relay 1	ENERGISED	Off	C
BV26	iRLY2	Internal Relay 2	ENERGISED	Off	C
BV27	iRLY3	Internal Relay 3	ENERGISED	Off	C
BV28	iRLY4	Internal Relay 4	ENERGISED	Off	C
BV29	D1(2)	Digital input 1 – terminal 2	Active	Inactive	R
BV30	D2(3)	Digital input 2 – terminal 3	Active	Inactive	R
BV31	D3(4)	Digital input 3 – terminal 4	Active	Inactive	R
BV32	D4(5)	Digital input 4 – terminal 5	Active	Inactive	R
BV33[1]	D1(31)	Digital input 1, Left EF card, terminal 31	Active	Inactive	R
BV34[1]	D2(33)	Digital input 2, Left EF card, terminal 32	Active	Inactive	R
BV35[1]	D3(35)	Digital input 3, Left EF card, terminal 33	Active	Inactive	R
BV36[1]	D4(34)	Digital input 4, Left EF card, terminal 34	Active	Inactive	R
BV37[1]	D1(51)	Digital input 1, Right EF card, terminal 51	Active	Inactive	R
BV38[1]	D2(53)	Digital input 2, Right EF card, terminal 52	Active	Inactive	R
BV39[1]	D3(55)	Digital input 3, Right EF card, terminal 53	Active	Inactive	R
BV40[1]	D4(57)	Digital input 4, Right EF card, terminal 54	Active	Inactive	R
BV41	RL(15,16)	Relay 1, terminals 15,16	ENERGISED	Off	R

Instance ID	Object Name	Description	Active Text	Inactive Text	Present Value Access
BV42	RL(17,18)	Relay 2, terminals 17,18	ENERGISED	Off	R
BV43[1]	DO(39,41)	Digital Output, Left EF card, terminals 39,41	ENERGISED	Off	R
BV44[1]	DO(59,61)	Digital Output, Right EF card, terminals 59,61	ENERGISED	Off	R
BV45[1]	RL1(70,71,72)	Relay 1, Left relay card, Terminals 70,71,72	ENERGISED	Off	R
BV46[1]	RL1(73,74,75)	Relay 2, Left relay card, Terminals 73,74,75	ENERGISED	Off	R
BV47[1]	RL1(80,81,82)	Relay 1, Right relay card, Terminals 80,81,82	ENERGISED	Off	R
BV48[1]	RL1(83,84,85)	Relay 2, Right relay card, Terminals 83,84,85	ENERGISED	Off	R
BV49	User Alarm 1	User Alarm 1 status	Active	Inactive	R
BV50	User Alarm 2	User Alarm 2 status	Active	Inactive	R
BV51	User Alarm 3	User Alarm 3 status	Active	Inactive	R
BV52	User Alarm 4	User Alarm 4 status	Active	Inactive	R
BV53	Commit	Commit parameter changes	Active	Inactive	R

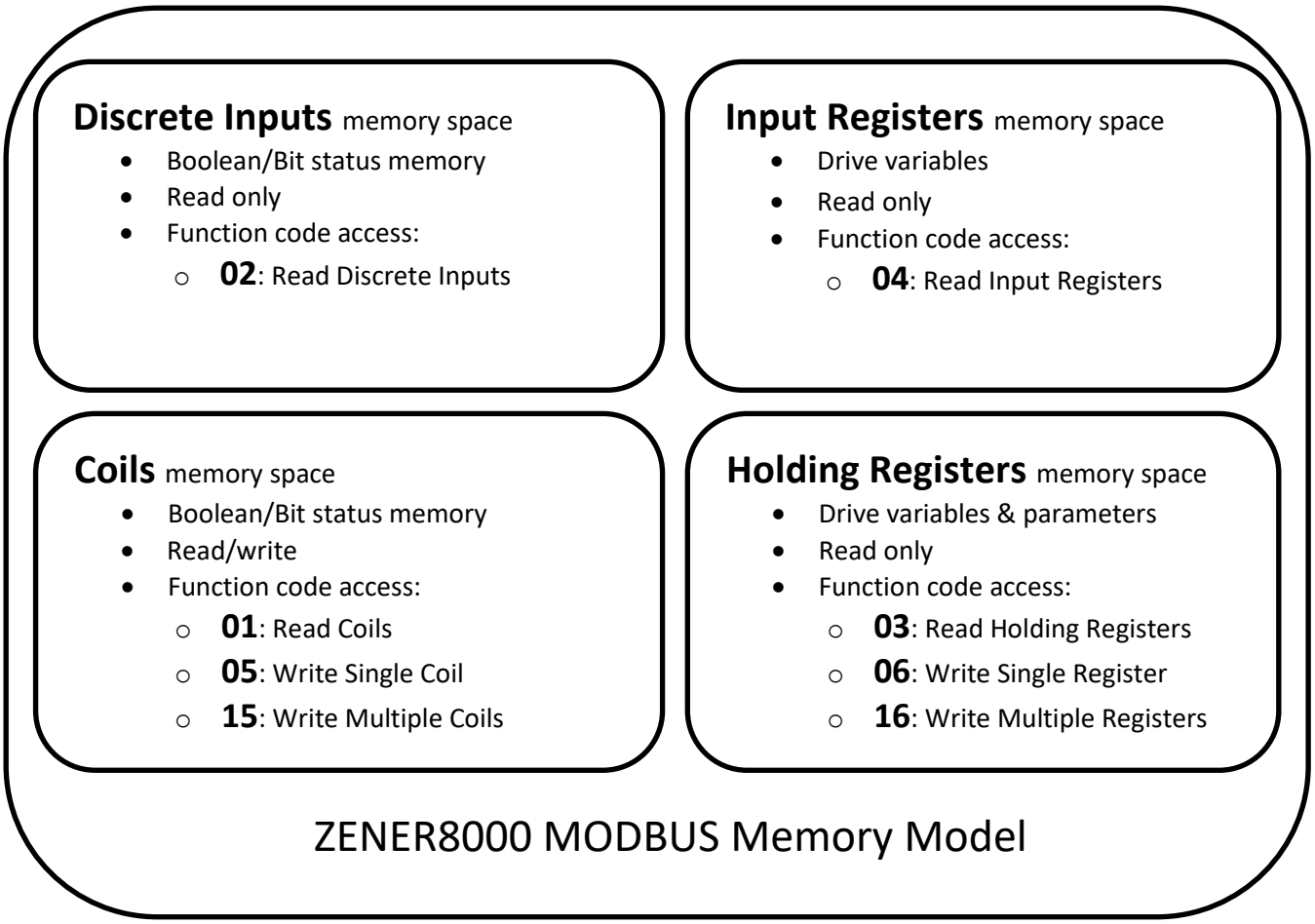
Present Value Access:
R = Read only
W = Writeable
C= Commandable, priority arrays and relinquish defaults - supported

Notes:
1 The RELIABILITY property of this variable returns UNRELIABLE_OTHER (7) if the input or output is not physically present i.e. the option is not fitted.

Appendix B: MODBUS Protocol – Application Layer Description

Memory Model

The MODBUS memory model of the ZENER8000 is composed of 4 non-overlapping memory spaces: Discrete Inputs memory, Coil memory, Input Register memory and Holding Register memory.



Discrete Inputs are the status flags of the ZENER8000 typically indicating an internal condition or state. These are essentially Boolean variables from the ZENER8000 and "input" to the MODBUS network.

Coils are the command flags intended to operate the ZENER8000. These are essentially Boolean command variables from the MODBUS network and "output" to the ZENER8000. Additionally the state of a coil may be read back for indication purposes.

Input Registers are variable of the ZENER8000 typically indicating an internal level or reading. These values of the ZENER8000 are "input" to the MODBUS network.

Holding Registers are the command values intended to operate the ZENER8000. These are command variables from the MODBUS network and "output" to the ZENER8000. Additionally the value of a holding register can be read back for indication purposes.

Discrete Inputs (read only)

Note:

ADU ➔ Application Data Unit

PDU ➔ Protocol Data Unit

MODBUS Address (ADU)	PDU Address	Discrete Input ID	Discrete Input Set	Discrete Input Cleared	Aux supply (24V) only Reliability
10001	0	Remote	Remote mode operation	Local mode operation	✓
10002	1	Enable	ZENER 8000 is enabled	ZENER 8000 is disabled	✓
10003	2	Switching	ZENER 8000 output is ON	ZENER 8000 output is OFF	✓
10004	3	Power Up	ZENER 8000 has been fully powered one time at least	ZENER 8000 is warming up	✓
10005	4	Bus Charged	DC bus is charged	DC bus is charging	✓
10006	5	Ramping	Ramp to stop mode		n/a
10007	6	Coasting	Coast to stop mode		n/a
10008	7	Auto Restart Fail	Failed to auto restart after a trip		✓
10009	8	Output Short	Hardware detected output short circuit		✓
10010	9	Over Voltage	Hardware detected over voltage trip		✓
10011	10	Over Current	Over current trip detected		✓
10012	11	DC Low	Low DC bus voltage trip detected		✓
10013	12	Power Fail	Input power failure trip detected		✓
10014	13	Over Temp	Hardware over temperature trip detected		✓
10015	14	I2t Trip	Over Current trip detected		✓
10016	15	Tripped	One or more trips detected		✓
10017	16	Voltage Limit	Operation at or near max DC bus voltage		n/a
10018	17	Current Limit	Operation at or near max output current.		n/a
10019	18	At-Zero-Speed	Motor is at zero speed		✓
10020	19	At-Speed	Motor is at commanded speed		n/a
10021	20	Run Status	Motor running and not tripped		n/a
10022	21	PID loop status	PID is operating - closed loop		n/a
10023	22	EF_L_fitted	Extended features card fitted – Left slot	EF card not fitted	✓
10024	23	EF_R_fitted	Extended features card fitted – Right slot	EF card not fitted	✓
10025	24	CO_L_fitted	Change Over relay card fitted – Left slot	CO card not fitted	✓
10026	25	CO_R_fitted	Change Over relay card fitted – Right slot	CO card not fitted	✓
10027	26	TH_L_fitted	Thermistor card fitted – Left slot	TH card not fitted	✓
10028	27	TH_R_fitted	Thermistor card fitted – Right slot	TH card not fitted	✓
10029	28	Single_phase	Drive configured for single phase input		✓

MODBUS Address (ADU)	PDU Address	Discrete Input ID	Discrete Input Set	Discrete Input Cleared	Aux supply (24V) only Reliability
10030	29	DC_Input	Drive configured for DC input		✓
10031	30	D1(2)	Input D1(2) is ON		✓
10032	31	D2(3)	Input D2(3) is ON		✓
10033	32	D3(4)	Input D3(4) is ON		✓
10034	33	D4(5)	Input D4(5) is ON		✓
10035	34	D1(31)	EF_L Input D1(31) is ON		✓
10036	35	D2(33)	EF_L Input D2(33) is ON		✓
10037	36	D3(35)	EF_L Input D3(35) is ON		✓
10038	37	D4(37)	EF_L Input D4(37 is ON		✓
10039	38	D1(51)	EF_R Input D1(51) is ON		✓
10040	39	D2(53)	EF_R Input D2(53) is ON		✓
10041	40	D3(55)	EF_R Input D3(55) is ON		✓
10042	41	D4(57)	EF_R Input D4(57) is ON		✓
10043	42	RL(15,16)	Relay RL(15,16) is ON		✓
10044	43	RL(17,18))	Relay RL(17,18) is ON		✓
10045	44	DO(39,41)	EF_L Output DO(39,41) is ON		✓
10046	45	DO(59,61)	EF_R Output DO(59,61) is ON		✓
10047	46	RL(70,71,72)	CO_L Output RL(70,71,72) is ON		✓
10048	47	RL(73,74,75)	CO_L Output RL(73,74,75) is ON		✓
10049	48	RL(80,81,82)	CO_R Output RL(80,81,82) is ON		✓
10050	49	RL(83,84,85)	CO_R Output RL(83,84,85) is ON		✓
10051	50	Fan_status	Cooling fans are commanded ON	Cooling fans are off	n/a
10052	51	Power Limit	Operating at single phase supply power limit		n/a
10053	52	AI(10,11)_mode	mA (current) input mode	Voltage input mode	✓
10054	53	AI(10,11)_gain	Gain = 1 (e.g. 0..10V input)	Gain = 2 (e.g. 0..5V input)	✓
10055	54	AI(32,34)_mode	mA (current) input mode	Voltage input mode	✓
10056	55	AI(32,34)_gain	Gain = 1 (e.g. 0..10V input)	Gain = 2 (e.g. 0..5V input)	✓
10057	56	AI(52,54)_mode	mA (current) input mode	Voltage input mode	✓
10058	57	AI(52,54)_gain	Gain = 1 (e.g. 0..10V input)	Gain = 2 (e.g. 0..5V input)	✓
10059	58	AO(36,38)_mode	mA (current) output mode	Voltage output mode	✓
10060	59	AO(36,38)_gain	Gain = 1 (e.g. 0..5V output)	Gain = 2 (e.g. 0..10V opt)	✓
10061	60	AO(56,58)_mode	mA (current) output mode	Voltage output mode	✓
10062	61	AO(56,58)_gain	Gain = 1 (e.g. 0..5V output)	Gain = 2 (e.g. 0..10V opt)	✓
10063	62	User Alarm 1	User Alarm 1 is flagged		✓

MODBUS Address (ADU)	PDU Address	Discrete Input ID	Discrete Input Set	Discrete Input Cleared	Aux supply (24V) only Reliability
10064	63	User Alarm 2	User Alarm 2 is flagged		✓
10065	64	User Alarm 3	User Alarm 3 is flagged		✓
10066	65	User Alarm 4	User Alarm 4 is flagged		✓
10067	66	User Warning 1	User Warning 1 is flagged		✓
10068	67	User Warning 2	User Warning 2 is flagged		✓
10069	68	User Warning 3	User Warning 3 is flagged		✓
10070	69	User Warning 4	User Warning 4 is flagged		✓

Coils (read)

MODBUS Address (ADU)	PDU Address	Coil ID	Coil Set	Coil Cleared
00001	0	FWD[1]	Motor running in the forward direction	Motor is NOT running in the forward direction
00002	1	REV[1,2]	Motor running in the reverse direction	Motor is NOT running in the reverse direction
00003	2	Reset		Always read as "0"
00004	3	ESO	ZENER 8000 and motor running in ESO mode.	Running under pre-existing conditions
00005	4	Coast2Stop	The motor is not ramping to a stop and the motor and load stops by its own.	The motor is not coasting
00006	5	iRL(1)	Internal relay iRL(1) is ON	Internal relay iRL(1) is off
00007	6	iRL(2)	Internal relay iRL(2) is ON	Internal relay iRL(2) is off
00008	7	iRL(3)	Internal relay iRL(3) is ON	Internal relay iRL(3) is off
00009	8	iRL(4)	Internal relay iRL(4) is ON	Internal relay iRL(4) is off
00010	9	FANovrd	Fan override is active, fans on	Fan override is off

Coils (write)

MODBUS Address (ADU)	PDU Address	Coil ID	Coil Set	Coil Cleared
00001	0	FWD[1]	Start the motor turning or continue in the forward direction.	Ramp or Coast to zero speed.
00002	1	REV[1,2]	Start the motor turning or continue in the reverse direction.	Ramp or Coast to zero speed.
00003	2	Reset	Issue a trip reset	no effect
00004	3	ESO	Start or run the motor under ESO conditions.	Run under pre-existing conditions
00005	4	Coast2Stop	When stopping the motor and load stops by its own.	When stopping the motor is ramped down to zero speed
00006	5	iRL(1)	Internal relay iRL(1) is ON	Internal relay iRL(1) is off
00007	6	iRL(2)	Internal relay iRL(2) is ON	Internal relay iRL(2) is off
00008	7	iRL(3)	Internal relay iRL(3) is ON	Internal relay iRL(3) is off
00009	8	iRL(4)	Internal relay iRL(4) is ON	Internal relay iRL(4) is off
00010	9	FANovrd	Enable the fan override	Disable the fan override

[1] **G166 RUN SIGNALS** must be set to **FROM NETWORK** for this operation.

[2] **D03 REVERSE** must be **ENABLED** for this operation

Input Registers (read only)

Entries in the "Scaling" column convert raw values to decimals in the given units.

MODBUS Address (ADU)	PDU Address	Number of registers	Register ID	Description	Scaling	Units	Aux. Supply (24V) only Reliability
30001	0	2	kWhrs	Accumulated motor kilowatt hours[1]		kWhrs	✓
30003	2	2	Hours Run	Accumulated motor run time[1]		Hours	✓
30005	4	1	Speed RPM	Motor speed in rpm		rpm	✓
30006	5	1	Speed%	Motor speed as a %	÷ 10	%	✓
30007	6	1	Frequency	Output frequency	÷ 10	Hz	✓
30008	7	1	Load	% motor load	÷ 10	%	✓
30009	8	1	Current	Output current	÷ 10	A	✓
30010	9	1	DC volts	DC bus voltage	÷ 10	V	✗
30011	10	1	Power	Output power	÷ 10	kW	✗
30012	11	1	AC volts	Line voltage	÷ 10	V	✗
30013	12	1	Temperature	Power hardware temperature		°K	✗
30014	13	1	I2tused	Thermal capacity	÷ 100	A	✓
30015	14	1	PID ref	PID reference	÷ 10	%	✓
30016	15	1	PID feedback	PID feedback	÷ 10	%	✓
30017	16	1	AI(10,11)	Analogue input reading	÷ 10	mA / V	✓
30018	17	1	AI(32,34)	EF_L analogue input reading	÷ 10	mA / V	✓
30019	18	1	AI(52,54)	EF_R analogue input reading	÷ 10	mA / V	✓
30020	19	1	AO(36,38)	EF_L analogue output	÷ 10	mA / V	✓
30021	20	1	AO56,58)	EF_R analogue output	÷ 10	mA / V	✓
30022	21	1	TH(40,42)	EF_L thermistor reading	÷ 10	kΩ	✓
30023	22	1	TH(60,62)	EF_R thermistor reading	÷ 10	kΩ	✓
30024	23	1	TH(46,47)	TH_L thermistor reading	÷ 10	kΩ	✓
30025	24	1	TH(66,67)	TH_R thermistor reading	÷ 10	kΩ	✓
30026	25	1	VSCALE	Drive voltage scale	÷ 10	V	✓
30027	26	1	ISCALE	Drive current scale	÷ 10	A	✓
30028	27	1	Irms_rated	Drive rated current	÷ 10	A	✓
30029	28	1	Icl_max	Maximum current limit for the drive	÷ 10	A	✓
30030	29	1	Audible_freq	Audible frequency	÷ 204.8	kHz	✓
30031	30	1	f_carrier	Operating carrier frequency	÷ 409.6	kHz	✓
30032	31	1	T1	Temperature channel 1 reading	÷ 65.536	°K	✗
30033	32	1	T2	Temperature channel 2 reading	÷ 65.536	°K	✗
30034	33	1	T3	Temperature channel 3 reading	÷ 65.536	°K	✗
30035	34	1	T4	Temperature channel 4 reading	÷ 65.536	°K	✗
30036	35	1	T5	Temperature channel 5 reading	÷ 65.536	°K	✗
30037	36	1	T6	Temperature channel 6 reading	÷ 65.536	°K	✗
30038	37	1	T7	Temperature channel 7 reading	÷ 65.536	°K	✗
30039	38	1	T8	Temperature channel 8 reading	÷ 65.536	°K	✗
30040	39	1	PIDoutput	PID output reference	÷ 100	%	✓
30041	40	1	Ref_select	Selector output reference	÷ 10	%	✓
30042	41	1	Active_ref	Operating speed reference	÷ 128	Hz	✓
30043	42	1	AIfxn_ref	Analogue input function reference	÷ 100	%	✓
30044	43	1	PID scale	PID scaling factor	÷ 10		✓
30045	44	1	RUN scale	Run display scaling factor	÷ 10		✓

[1] 32 bit value; Little Endian (Least significant 16 bits first)

Holding Registers

Example:

Request packet 0103000A0002E409

Byte	Field	Description
01	Slave Address	Addressing device with MAC ID number "1"
03	Function Code	Read Holding Registers
00	Starting register address (high byte)	• The starting PDU address is "000A" (hex) ➔ "10" (decimal). • Using the Table of Holding Registers below, PDU address 10 is "F101 Preset 2"
0A	Starting register address (low byte)	
00	Count of registers (high byte)	• The count of registers to read is "0002" (hex) ➔ "2" (decimal). • 2 registers beginning with PDU address 10 will be read. • Using the Table of Holding Registers below, "F101 Preset 2" and "F102 Preset 3" will be read.
02	Count of registers (low byte)	
E4	CRC-16 (high byte)	Generated by MODBUS software layer
09	CRC-16 (high byte)	

Response packet 01030400C8012C7B80

Byte	Field	Description
01	Slave Address	Addressing device with MAC ID number "1"
03	Function Code	Read Holding Registers
04	Byte Count	Number of data bytes to follow
00	1st data byte (high byte)	• Combining the high and low byte ➔ "00C8" (hex) • "00C8" (hex) ➔ "200" • From the Table of Holding Registers below "F101 Preset 2" requires divide by 10 • "F101 Preset 2" = "20.0%"
C8	2nd data byte (low byte)	
01	3rd data byte (high byte)	• Combining the high and low byte ➔ "012C" (hex) • "012C" (hex) ➔ "300" • From the Table of Holding Registers below "F102 Preset 3" requires divide by 10 • "F102 Preset 3" = "30.0%"
2C	4th data byte (low byte)	
7B	CRC-16 (high byte)	Generated by ZENER8000
80	CRC-16 (high byte)	

Table of Holding Registers (read).

Entries in the "Scaling" column convert raw values to decimals in the given units.

MODBUS Address (ADU)	PDU Address	Holding Register ID	Description	Scaling	Units
40001	0	**COMMS_REF**	Network supplied speed reference	÷ 10	%
40002	1	**F100 Preset 1**	Preset speed reference 1	÷ 10	%
40003	2	**C030 ACCEL TIME**	Speed ramp acceleration time	÷ 10	sec
40004	3	**C031 DECEL TIME**	Speed ramp deceleration time	÷ 10	sec
40005	4	**C032 S TIME**	Speed ramp S-curve time	÷ 100	sec
40006	5	**D01 CURRENT LIM**	Output current limit specification	÷ 10	A
40007	6	**E030 ARs ALLOWED**	Number of auto re-starts allowed		restarts
40008	7	**E031 AR CLR TIME**	Re-start count reset time interval		sec
40009	8	**G050 UNDER SPEED**	Under speed compare threshold	÷ 10	%
40010	9	**G051 OVER SPEED**	Under speed compare threshold	÷ 10	%
40011	10	**F101 Preset 2**	Preset speed reference 2	÷ 10	%
40012	11	**F102 Preset 3**	Preset speed reference 3	÷ 10	%
40013	12	**C01 MIN Hz**	Minimum output frequency limit FWD or REV		Hz
40014	13	**C02 MAX Hz**	Maximum output frequency limit FWD or REV		Hz
40015– 40044	14-43		*-Reserved, inaccessible-*		
40045	44	**FWD**	Forward (coil 00001) Status		
40046	45	**REV**	Reverse (coil 00002) Status		
40047– 40060	46-59		*-Reserved, inaccessible-*		
40061-40062	60	**Status**	Legacy status registers. Refer to "Legacy Status Definitions" below		
40063– 40082	62-81		*-Reserved, inaccessible-*		
40083	82	**VBUSSCALE**	DC bus voltage scale		V
40084	83	**ISCALE**	Current scale	÷ 10	A
40085	84	**ISCALERMS**	RMS current scale	÷ 10	A
40086	85	**IRMSMAX**	Maximum current scale for edits	÷ 10	A
40087	86	**PWRSCALE**	Power scale	÷ 10	kW
40088-40100	87-99		*-Reserved, inaccessible-*		
40101	100	**Speed**	Output frequency	÷ 128	Hz
40102	101	**%Load**	ZENER 8000 output load	$\times {}^{100}/_{4096}$	%
40103	102	**Current**	ZENER 8000 output current	$\times \frac{[ISCALERMS]}{327680}$	A
40104	103	**DCvolts**	ZENER 8000 DC bus volts	$\times \frac{[VBUSSCALE]}{32768}$	V
40105	104	**Power**	ZENER 8000 output power	$\times \frac{[PWRSCALE]}{327680}$	kW
40106	105	**ACVolts**	ZENER 8000 output voltage magnitude	$\times \frac{[VBUSSCALE]}{50544}$	V
40107	106	**Temp**	ZENER 8000 Heatsink Temperature	$\times {}^{500}/_{32768}$	°K
40108	107	**I²tused**	ZENER 8000 equivalent thermal overload current	$\times \frac{[ISCALERMS]}{327680}$	A
40109-41550	108-1549		*-Reserved, inaccessible-*		

MODBUS Address (ADU)	PDU Address	Holding Register ID	Description	Scaling	Units
41551	1550	**Cpreset**	Communications preset (reference)	÷ 10	%

Legacy Status Definitions

Register	Bit number	Bit ID	Meaning when Set	Meaning when Cleared
40061	0	RUN	The drive is running	The drive is not running
40061	1	SHUTOFF	Output is not permitted	Output is permitted
40061	2	ATSPEED	Drive/motor operating at the reference speed	Drive/motor NOT operating at the reference speed
40061	3	ZEROSPEED	Drive/motor is operating at zero speed	Drive/motor is NOT operating at zero speed
40061	4	CLIMIT	Drive is in current limit	Drive is NOT in current limit
40061	5	VLIMIT	Drive is in voltage limit	Drive is NOT in voltage limit
40061	6	TRIPPED	The drive is tripped	The drive is NOT tripped
40061	7	<reserved>		
40061	8	I2TTRIP	Thermal overload trip	No thermal overload
40061	9	OVERTEMP	Internal over temperature trip	Internal temperature(s) normal
40061	10	SUPPLYFAIL	Supply fault detected	No supply fault
40061	11	PWRFAIL	Power failure detected	Power failure NOT detected
40061	12	DC_LOW	Internal voltage is too low	Internal voltage is above the minimum
40061	13	OVERCURRENT	Current has exceeded the maximum	Over current NOT detected
40061	14	OVERVOLTAGE	Voltage has exceeded the maximum	Over voltage NOT detected
40061	15	OC_EF/HW_ERR	Output short circuit OR Earth fault detected	No Output short circuit NOR Earth fault detected
40062	0	REMOTE	Remote (terminal strip) control	Local (console) control
40062	1	<reserved>		
40062	2	JOGREV	Jog reverse mode	Normal mode
40062	3	<reserved>		
40062	4	<reserved>		
40062	5	REVLATCH	Reverse and latch input asserted	
40062	6	REVERSE	Reverse input asserted	
40062	7	<reserved>		
40062	8	JOGFWD	Jog forward mode	Normal mode
40062	9	<reserved>		
40062	10	<reserved>		
40062	11	FWDLATCH	Forward and latch input asserted	
40062	12	FORWARD	Forward input asserted	
40062	13	STOPBAR	Motor stopping OR stopped	Motor permitted to turn
40062	14	ESO	Essential Services Override mode	Normal mode
40062	15	INITDONE	Initialisation is complete	Initialisation is incomplete

Table of Holding Registers (write)

The “Scaling” instruction of this table will convert a decimal value in the given units to a raw signed 16 bit integer.

MODBUS Address (ADU)	PDU Address	Holding Register ID	Minimum	Maximum	Scaling	Units
40001	0	**COMMS_REF**	-100.0	100.0	x 10	%
40002	1	**F100 Preset 1**	-100.0	100.0	x 10	%
40003	2	**C030 ACCEL TIME**	0.5	600.0	x 10	sec
40004	3	**C031 DECEL TIME**	0.5	600.0	x 10	sec
40005	4	**C032 S TIME**	0.01	40.00	x 100	sec
40006	5	**D01 CURRENT LIM**	22% of model current rating	125% of model current rating	x 10	A
40007	6	**E030 ARs ALLOWED**	0	15		
40008	7	**E031 AR CLR TIME**	0	1200		
40009	8	**G050 UNDER SPEED**	-100.0	100.0	x 10	%
40010	9	**G051 OVER SPEED**	-100.0	100.0	x 10	%
40011	10	**F101 Preset 2**	-100.0	100.0	x 10	%
40012	11	**F102 Preset 3**	-100.0	100.0	x 10	%
40013	12	**C01 MIN Hz**	0	**C02 MAX Hz - 5**		Hz
40014	13	**C02 MAX Hz**	**C01 MIN Hz + 5**	200		Hz
40015– 40044	12-43	*-Reserved, inaccessible-*				
40045	44	**FWD Command**	0 ➔ No command; 1 ➔ FWD Command asserted			
40046	45	**REV Command**	0 ➔ No command; 1 ➔ REV Command asserted			
40047-4048	46-47	*-Reserved, inaccessible-*				
40049	48	**RESET Command**	0 ➔ No command; 1 ➔ RESET Command asserted			
40050-41550	49-1549	*-Reserved, inaccessible-*				
41551	1550	**Cpreset**	-100.0	100.0	x 10	%

Function Codes

Function Code 01: Read Coils
Function Code 02: Read Discrete Inputs
Function Code 03: Read Holding Registers
Function Code 04: Read Input Registers
Function Code 05: Write Single Coil
Function Code 06: Write Single Register
Function Code 07: Read Exception Status
Function Code 08: Diagnostics, Sub Codes 0, 2, 10…18, 20
Function Code 15: Write Multiple Coils
Function Code 16: Write Multiple Holding Registers
Function code 43: Read device Identification, Sub Code 14

The function codes supported are explained in detail in the document entitled "MODBUS Application Protocol Specification V1.1b" available from "www.modbus.org". Implementation options and constraints of the ZENER 8000 are explained in the following sections.

Function Code 01: Read Coils

Request:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	1
Starting address	2 bytes	0 to 9
Quantity of coils	2 bytes	1 to 10

Response:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	1
Byte count	1 byte	1
Coil status	1 byte	ZENER 8000 coils states

Error:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	129 (128+function code, 0x81)
Exception code	1 byte	1, 2 or 3

Function Code 02: Read Discrete Inputs

Request:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	2
Starting address	2 bytes	0 to 69
Quantity of coils	2 bytes	1 to 70

Response:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	2
Byte count	1 byte	1 to 7
Coil status	1 to 3 bytes	ZENER 8000 discrete input states

Error:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	130 (128+function code, 0x82)
Exception code	1 byte	1, 2 or 3

Function Code 03: Read Holding Registers

Request:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	3
Starting address	2 bytes	0 to 11
Quantity of registers	2 bytes	1 to 12

Response:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	3
Byte count	1 byte	2 x (Quantity of registers)
Register value(s)	2 x (Quantity of registers) bytes	ZENER 8000 holding register(s)

Error:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	131 (128+function code, 0x83)
Exception code	1 byte	1, 2 or 3

Function Code 04: Read Input Registers

Request:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	4
Starting address	2 bytes	0 to 44
Quantity of registers	2 bytes	1 to 45

Response:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	4
Byte count	1 byte	2 x (Quantity of registers)
Register value(s)	2 x (Quantity of registers) bytes	ZENER 8000 input register(s)

Error:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	132 (128+function code, 0x84)
Exception code	1 byte	1, 2 or 3

Function Code 05: Write Single Coil

Request:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	5
Output address	2 bytes	0 to 9
Output value	2 bytes	0x0000 or 0xFF00

Response:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	5
Output address	2 bytes	0 to 8
Output value	2 bytes	0x0000 or 0xFF00

Error:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	133 (128+function code, 0x85)
Exception code	1 byte	1, 2 or 3

Function Code 06: Write Single Register

Request:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	6
Register address	2 bytes	0 to 11
Register value	2 bytes	Data for ZENER 8000 holding register

Response:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	6
Register address	2 bytes	0 to 11
Register value	2 bytes	Data for ZENER 8000 holding register

Error:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	134 (128+function code, 0x86)
Exception code	1 byte	1, 2 or 3

Function Code 07: Read Exception Status

Request:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	7

Response:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	7
Output data	1 byte	0 to 255

Function Code 08: Diagnostics, Sub Codes 0, 2, 10…18, 20

Request:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	8
Sub function	2 bytes	0, 0 ⇨ Return query (request) data 0, 2 ⇨ Return diagnostic register 0, 10 ⇨ Clear counters and diagnostic register 0, 11 ⇨ Return network message count 0, 12 ⇨ Return network communication error count 0, 13 ⇨ Return network exception error count 0, 14 ⇨ Return slave message count 0, 15 ⇨ Return slave no response count 0, 16 ⇨ Return slave NAK count 0, 17 ⇨ Return slave busy count 0, 18 ⇨ Return network character overrun count 0, 20 ⇨ Clear overrun counter and flag
Data	2 bytes	Data for ZENER 8000 MODBUS diagnostics

Response:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	8
Sub function	2 bytes	0,2,10…18,20
Data	2 bytes	

Error:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	136 (128+function code, 0x88)
Exception code	1 byte	1 or 3

Message count: The quantity of messages that the ZENER8000 has detected.

Communication error count: The quantity of CRC errors encountered by the ZENER8000.

Exception error count: The quantity of MODBUS exception responses returned by the ZENER8000.

Message count: The quantity of messages the ZENER8000 has processed.

No response count: The quantity of messages the ZENER8000 has not responded to.

NAK count: The quantity of messages the ZENER8000 has returned a Negative Acknowledge (NAK) exception response.

Busy count: The quantity of messages the ZENER8000 has returned a Slave Device Busy exception response.

Character overrun count: The quantity of messages the ZENER8000 could not handle due to a character overrun condition. A character overrun is caused by data characters arriving at the port faster than they can be stored, or by the loss of a character due to a hardware malfunction.

Function Code 15: Write Multiple Coils

Request:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	15
Starting address	2 bytes	0 to 9
Quantity of outputs	2 bytes	1 to 10
Byte count	1 byte	1
Output value	1 byte	

Response:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	15
Starting address	2 bytes	0 to 9
Quantity of outputs	2 bytes	1 to 10

Error:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	143 (128+function code, 0x8F)
Exception code	1 byte	1, 2 or 3

Function Code 16: Write Multiple Holding Registers

Request:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	16
Starting address	2 bytes	0 to 11
Quantity of registers	2 bytes	1 to 12
Byte count	1 byte	2 x (Quantity of registers)
Register values	2 x (Quantity of registers)	

Response:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	16
Starting address	2 bytes	0 to 11
Quantity of registers	2 bytes	1 to 12

Error:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	144 (128+function code, 0x90)
Exception code	1 byte	1, 2 or 3

Function code 43: Read device Identification, Sub Code 14

Request:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	43
MEI[1] type	1 byte	14
Read device ID code	1 byte	1, 3 or 4 (2 = not supported)
Object ID	1 bytes	0 ⇨ Vendor name 1 ⇨ Product code 2 ⇨ Major/minor Revision 128 ⇨ Serial number 129 ⇨ PID units 130 ⇨ RUN display units 131 ⇨ User Alarm 1 text 132 ⇨ User Alarm 2 text 133 ⇨ User Alarm 3 text 134 ⇨ User Alarm 4 text 135 ⇨ User Warning 1 text 136 ⇨ User Warning 2 text 137 ⇨ User Warning 3 text 138 ⇨ User Warning 4 text

Response:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	43
MEI[1] type	1 byte	14
Read device ID code	1 byte	1 ⇨ Request Basic Device ID
Conformity level	1 byte	1 = Basic stream identification 3 = Extend stream identification 129 = Basic stream or individual identification 131 = Extended stream or individual identification
More follows	1 byte	0
Next object Id	1 byte	
Object ID	1 byte	0,1,2,128...138
Object byte count	1 byte	
Object data	"Object byte count" bytes	

[1] MODBUS Encapsulated Interface

Error:		
Field	**Length**	**Data - range**
Station Address	1 byte	1 to 240
Function code	1 byte	171 (128+function code, 0xAB)
Exception code	1 byte	1, 2 or 3

Exceptions

The exception codes supported are explained in detail in the document entitled "MODBUS Application Protocol Specification V1.1b" available from "www.modbus.org". Exception codes supported by the ZENER 8000 are:

Exception code	Name
1	ILLEGAL FUNCTION CODE
2	ILLEGAL DATA ADDRESS
3	ILLEGAL DATA VALUE

Appendix C: Display Messages

The ZENER 8000 displays a variety of messages to indicate its status. These message displays may be divided into two types: Fault messages and Status messages

Fault Messages

The ZENER 8000 will protect itself against a variety of fault conditions. When one or more of these conditions occur, the ZENER 8000 will trip, shut down the motor and display one or more fault messages on the top line of the console display. The messages will be displayed until the fault is cleared and a reset signal is asserted.

NOTE: Some faults are model specific. Please refer to the individual product manual for model specific fault messages.

Fault Message	Description
UA1: ALARM	User defined trip alarm. Refer to **G233 Alarm text** for message customisation.
UA2: ALARM	User defined trip alarm. Refer to **G243 Alarm text** for message customisation.
UA3: ALARM	User defined trip alarm. Refer to **G253 Alarm text** for message customisation.
UA4: ALARM	User defined trip alarm. Refer to **G263 Alarm text** for message customisation.
UA5: ALARM	User defined trip alarm. Refer to **G313 Alarm text** for message customisation.
UA6: ALARM	User defined trip alarm. Refer to **G323 Alarm text** for message customisation.
UA7: ALARM	User defined trip alarm. Refer to **G353 Alarm text** for message customisation.
UA8: ALARM	User defined trip alarm. Refer to **G343 Alarm text** for message customisation.
THERMISTOR HOT	The thermistor wired to the Extended features card indicates the motor is over heated
THERMISTOR SHORT	The thermistor wired to the Extended features card is short circuit
SUPPLY FAIL	There is a problem with the input power supply. One phase is partially missing and motor operation will be impaired
BRAKE SHORT	Either an Over Current or a Ground Fault has been detected on the dynamic brake resistor terminals
EARTH FAULT	An earth leakage fault has been detected
I2t OVERLOAD	An I2t overload trip has occurred
CHARGE FAULT	A rectifier failure has been detected
DC BUS LOW	The DC bus voltage has fallen below its minimum threshold
POWER FAILURE	All phases on the input power supply are either low or missing
OVER CURRENT	The output current has exceeded the ZENER 8000's intermittent output current rating
IMBALANCE OC	Parallel inverter modules are not sharing current equally (paralleled inverter systems only).
RELAY OPEN	The internal bus charge relay has failed to operate correctly
OVER VOLTAGE	The DC bus voltage has exceeded its maximum value
OUTPUT SHORT	An output short circuit has been detected. This is caused by either an Over Current or Ground fault on the motor terminals

Fault Message	Description
Tj OVER TEMP	The ZENER 8000 has determined a power device Junction is too hot
HOT INTERNAL AIR	The internal air temperature has risen beyond the protection rating of the ZENER 8000
Ths OVER TEMP	The internal heat sink temperature has risen beyond the protection rating of the ZENER 8000
Tefct OVER TEMP	The earth fault current transformer temperature has risen beyond the protection rating of the ZENER 8000
T1 OVER TEMP	The temperature of sensor T1 has risen beyond the protection rating of the ZENER 8000
T2 OVER TEMP	The temperature of sensor T2 has risen beyond the protection rating of the ZENER 8000
T3 OVER TEMP	The temperature of sensor T3 has risen beyond the protection rating of the ZENER 8000
T4 OVER TEMP	The temperature of sensor T4 has risen beyond the protection rating of the ZENER 8000
T5 OVER TEMP	The temperature of sensor T5 has risen beyond the protection rating of the ZENER 8000
T6 OVER TEMP	The temperature of sensor T6 has risen beyond the protection rating of the ZENER 8000
T7 OVER TEMP	The temperature of sensor T7 has risen beyond the protection rating of the ZENER 8000
T8 OVER TEMP	The temperature of sensor T8 has risen beyond the protection rating of the ZENER 8000
T SYSTEM FAILURE	Temperature system failure. All temperature channels are reading absolute zero.
MODULE (1)	Parallel inverter trip detected in inverter module No. 1 (paralleled inverter systems only).
MODULE (2)	Parallel inverter trip detected in inverter module No. 2 (paralleled inverter systems only).
MODULE (3)	Parallel inverter trip detected in inverter module No. 3(paralleled inverter systems only).
MODULE (4)	Parallel inverter trip detected in inverter module No. 4 (paralleled inverter systems only).
MODULE (5)	Parallel inverter trip detected in inverter module No. 5 (paralleled inverter systems only).
MODULE (6)	Parallel inverter trip detected in inverter module No. 6 (paralleled inverter systems only).
MODULE (7)	Parallel inverter trip detected in inverter module No. 7 (paralleled inverter systems only).
MODULE (8)	Parallel inverter trip detected in inverter module No. 8 (paralleled inverter systems only).
MODULE (?)	Parallel inverter trip detected in inverter module could not be determined (paralleled inverter systems only).
PV ARRAY FAULT	(ECODRIVE 8000 only) a fault has been detected in the photo voltaic array circuit.
SUPPLY IMBALANCE	The three-phase voltage supply input is out of tolerance.

Status Messages

The prevailing operating conditions are indicated with a status. The status messages include:

Status Message	Description
U MODE 1	Remote user mode 1 message. Refer to **F0122 MODE1 text** for message customisation.
U MODE 2	Remote user mode 2 message. Refer to **F0132 MODE2 text** for message customisation.
-<UW1>-	User defined warning message. Refer to **G272 Warning txt** for message customisation.
-<UW2>-	User defined warning message. Refer to **G282 Warning txt** for message customisation.
-<UW3>-	User defined warning message. Refer to **G292 Warning txt** for message customisation.
-<UW4>-	User defined warning message. Refer to **G302 Warning txt** for message customisation.
V LIMIT	The motor is regenerating or the input voltage is too high
C LIMIT	The motor is drawing its maximum overload current
P LIMIT	The motor's absorbed power exceeds the ZENER 8000 rating when operating from a single phase supply
ESO FWD	The ZENER 8000 is operating in Essential Services Override mode with forward rotation
ESO REV	The ZENER 8000 is operating in Essential Services Override mode with reverse rotation
OFF LINE	The ZENER 8000 has not been given a terminal strip run command in line contactor mode
NO AC	A terminal strip run command is given in line contactor mode; no AC input voltage supply detected.
CHARGING	The ZENER 8000 is waiting for the DC bus capacitors to be fully charged before running the motor
NOT EN	The ZENER 8000 is on but has no enable signal so it is unable to turn a motor
IDLE REM	The ZENER 8000 is idle in remote mode
FWD REM	The ZENER 8000 is running in the forward direction in remote mode
REV REM	The ZENER 8000 is running in the reverse direction in remote mode
EN REM	The ZENER 8000 has an enable signal but no direction is selected in remote mode
IDLE LOC	The ZENER 8000 is idle in local mode
FWD LOC	The ZENER 8000 is running in the forward direction in local mode
REV LOC	The ZENER 8000 is running in the reverse direction in local mode
EN LOC	The ZENER 8000 has an enable signal but no direction is selected in local mode
PID OFF	The PID block is ready to operate but no run command is given
FILLING	The pipe fill function is activated and pipe filling is underway
PID-A $^{O}_{N}$	The PID-A block is operating and the ZENER 8000 is part of a closed loop feedback system
PID-B $^{O}_{N}$	The PID-B block is operating and the ZENER 8000 is part of a closed loop feedback system
BOOSTING	The ZENER 8000 is applying a boost to the process variable before the ZENER 8000 enters the idle mode
Tracking	In solar supply mode the amount of solar energy is insufficient for the required operation (ECODRIVE 8000 Models only)
Solar $^{O}_{N}$	In solar supply mode; solar energy is sufficient for the intended operation (ECODRIVE 8000 Models only)
Lo Solar	In solar supply mode the amount of solar energy is too low for any useful operation and the ECODRIVE 8000 is waiting to restart. Restarts when high solar levels return. (ECODRIVE 8000 Models only)
SFC	In solar supply mode conflicting conditions have been detected: Good irradiance; Low DC (ECODRIVE 8000 Models only)
SFC Ext	An external condition exists that suggests Solar supply conditions are inadequate for satisfactory operation (ECODRIVE 8000 Models only)
PV-A OOR	An external condition exists that prevents PID-A controller from regulating properly
PV-B OOR	An external condition exists that prevents PID-B controller from regulating properly
PBNS	“Power Board Not Supported” – the detected model details cannot be found
MODEL?	The installed model details do not match the detected model.
+MPP SAT	Indicates the tracking algorithm has reached the upper limit. Suggests the MPP voltage is incorrect
-MPP SAT	Indicates the tracking algorithm has reached the lower limit. Suggests the MPP voltage is incorrect
CHK ID	The “Drive ID” is invalid. The ID must be a unique value to identify the drive on the network.
ID USED	The “Drive ID” is not unique. The ID must be a unique value to identify the drive on the network

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