MOTORTRONICS™
Solid State AC Motor Control

## Innovation in soft starter technology




# VMX-agility™

## USER MANUAL

MAN-AGY-015. Version 01

MOTORTRONICS™
Solid State AC Motor Control

# VMX-agility™ user manual

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# Safety

## Important information

Installers should read and understand the instructions in this guide prior to installing, operating and maintaining the soft starter. The following symbols may appear in this guide or on the soft starter to warn of potential hazards or to draw attention to certain information.

### Dangerous Voltage

Indicates the presence of a hazardous voltage which could result in personal injury or death.

### Warning/Caution

Indicates a potential hazard. Any instructions that follow this symbol should be obeyed to avoid possible damage to the equipment, and personal injury or death.

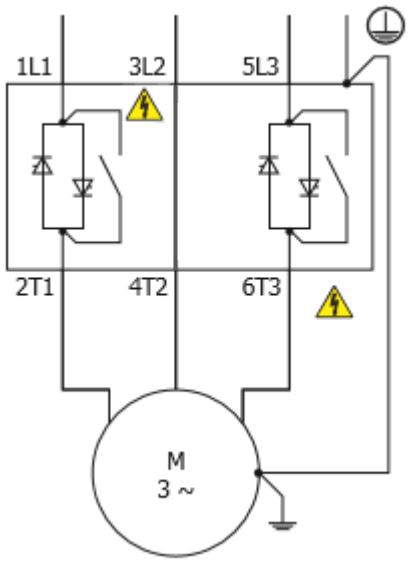
### Protective Earth (Ground)

Indicates a terminal which is intended for connection to an external conductor for protection against electric shock in case of a fault.

## Caution Statements

The examples and diagrams in this manual are included solely for illustrative purposes. The information contained in this manual is subject to change at any time and without prior notice. In no event will responsibility or liability be accepted for direct, indirect or consequential damages resulting from the use or application of this equipment.

| |
|---|
| VMX-agility™ soft starters contain dangerous voltages when connected to the mains supply. Only qualified personnel that have been completely trained and authorised, should carry out installation, operation and maintenance of this equipment. |
| Installation of the soft starter must be made in accordance with existing local and national electrical codes and regulations and have a minimum protection rating. |
| It is the responsibility of the installer to provide suitable grounding and branch circuit protection in accordance with local electrical safety codes. |
| This soft starter contains no serviceable or re-usable parts. |



# Installation

## Mounting

Fix the unit to a flat, vertical surface using the mounting holes (or slots) on its base-plate. The mechanical outline diagrams, shown on Page 8, give the dimensions and mounting hole positions for each model. Ensure that:

- The orientation of the unit has the 'TOP' uppermost (unless horizontally mounted – see page 9).
- The location allows adequate front access.
- The screen can be viewed.

Do not install other equipment that generates significant heat close to the soft starter.

## Requirements for an Enclosure

For a typical industrial environment, an enclosure would provide the following:

- A single location for the unit and its protection/isolation switch-gear
- The safe termination of cabling and/or bus-bars
- Means to effect proper air flow through the enclosure



## Enclosure Ventilation

When fitting VMX-agility™ into a cabinet, ventilation must be provided. The heat dissipated can be approximated with the formula:

### Starting

Watts (VMX-agility™) = start current(A) x start time(s) x number of starts per hour/1800

Running Watts (VMX-agility™) = 0.4 x running amps

Use the following formula to determine the fan requirement. An allowance has been incorporated into the formula so that the figure for Q is the air delivery in the fan suppliers' data.

$$Q = (4 \times W_t / (T_{max} - T_{amb}))$$

Q = volume of air (cubic metres per hour-m3/h)

Wt = Heat produced by the unit and all other heat sources within the enclosure (Watts) $T_{max}$ = Maximum permissible temperature within the enclosure (40°C for a fully rated agility™)

$T_{amb}$ = Temperature of the air entering the enclosure (°C) [to work in CFM, substitute °F for °C. Q is now in CFM]

## Altitude Derate

Altitude above sea level 1000m (3281ft). Above 1000m de rate by 1% of agility™ Ie per 100m (328ft) to a maximum altitude of 2000m (6562ft).

### Ambient Temperature Derate

-20°C (-4°F) to 40°C (104°F). Above 40°C de-rate linearly by 2% of agility™ Ie per °C to a maximum of 60°C (140°F).

# Installation (continued)

## Handling

The VMX-agility soft start range comprises 3 frame sizes, with various weights and dimensions. See pages 8-10 for further information.

Prior to installing the agility unit, the installer should carry-out a risk assessment. If considered appropriate, a suitable handling device should be used.

Do not lift the VMX-agility unit by attachment to the 3-phase terminal connections or busbars.

| WARNING |
| --- |
| **HANDLING AND LIFTING HAZARD**<br>Ensure the area below any equipment is clear of all personnel and property.<br>**Failure to follow this practice may result in death, serious injury, or damage to equipment.** |

## Accessories

The following accessories have been developed and tested for use with the agility range of soft starts:

**VMX-AGY-010** Remote keypad for VMX-AGY-101 to VMX-AGY-305**.** Provides remote functionality for up to 32 soft starter units.

**VMX-AGY-020** 100Vac – 240Vac power supply. Provides mains voltage control power and digital control functionality. **For use with VMX-AGY-101 to VMX-AGY-113 only.**

**VMX-AGY-021** 100Vac – 240Vac power supply. Provides mains voltage control power and digital control functionality. **For use with VMX-AGY-101 to VMX-AGY-305.**

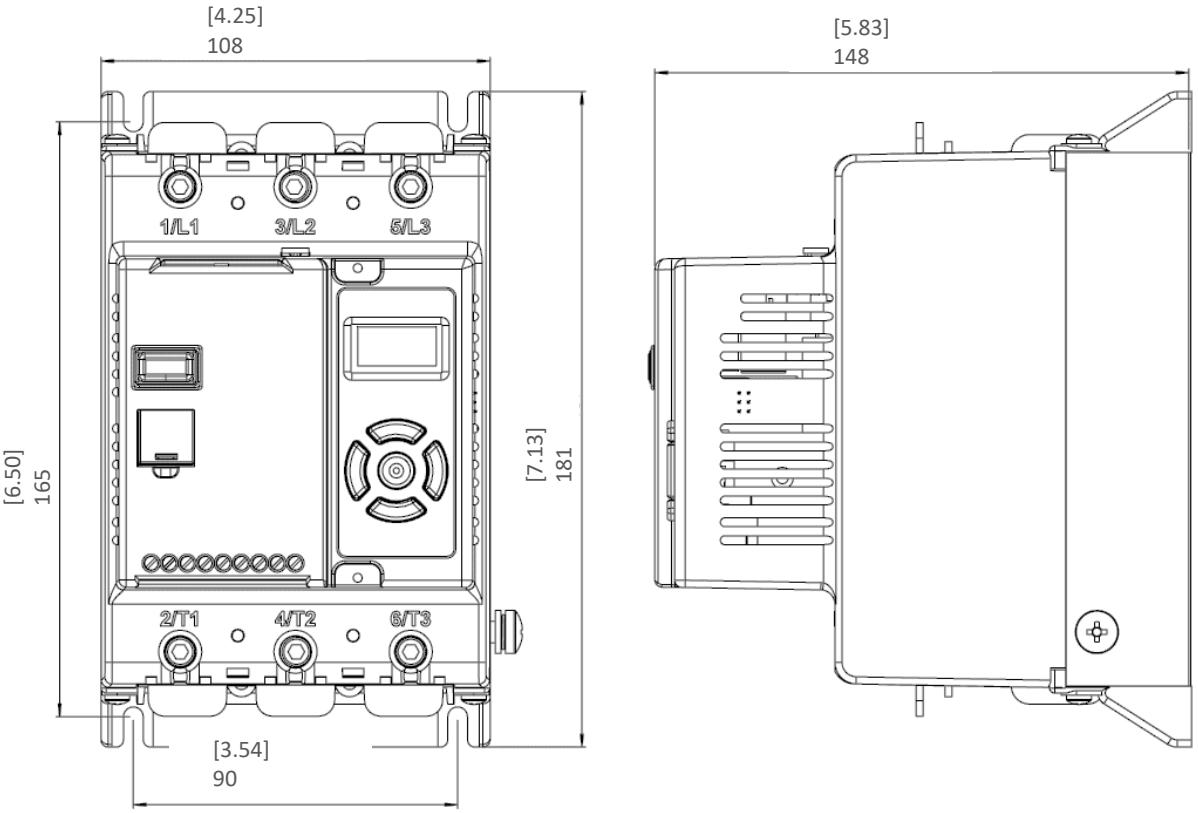
**VMX-AGY-030** Cooling fan accessory for VMX-AGY-101 to VMX-AGY-113 only. Increases the number of starts per hour (see page 19).

**VMX-AGY-031** Cooling fan accessory for VMX-AGY-201 to VMX-AGY-209 only. Increases the number of starts per hour (see page 19).

# Installation (continued)

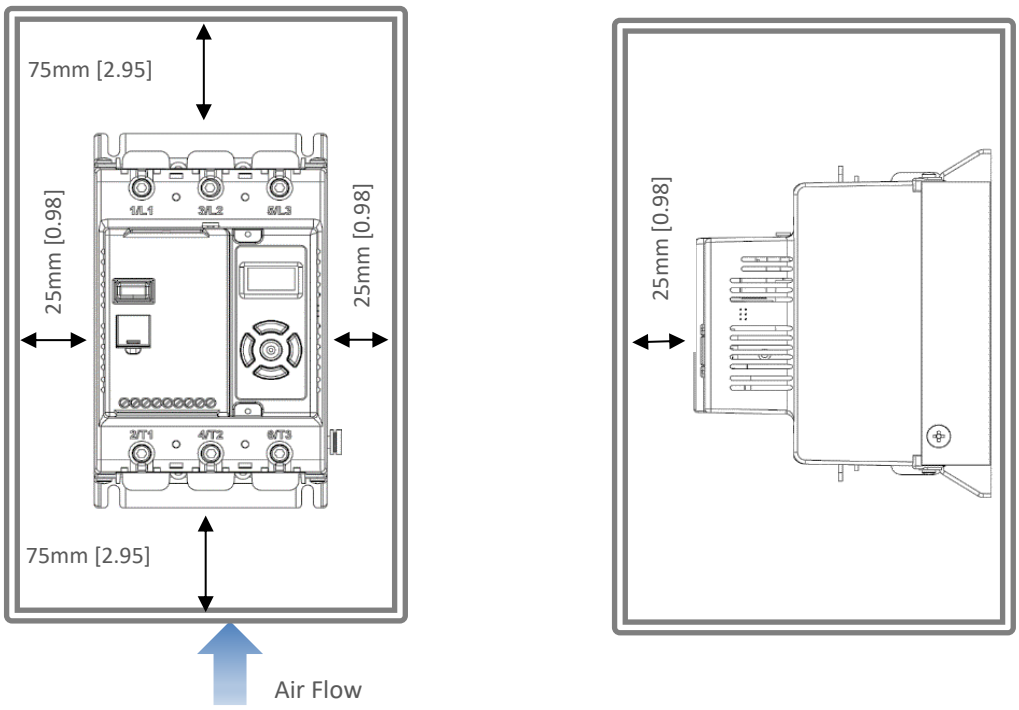
### Dimensions VMX-AGY-101 to VMX-AGY-113

[ ] = inch




Weight 1.97kg (3.75lb)

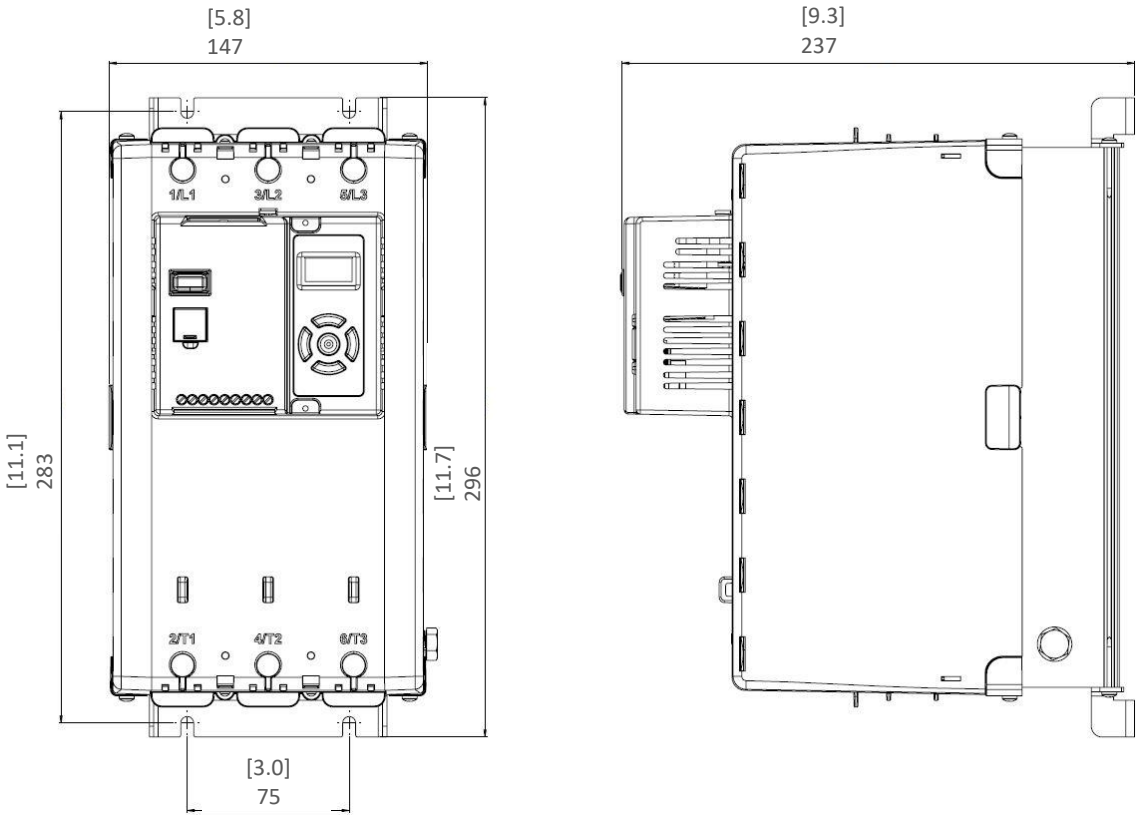
**Fitting**

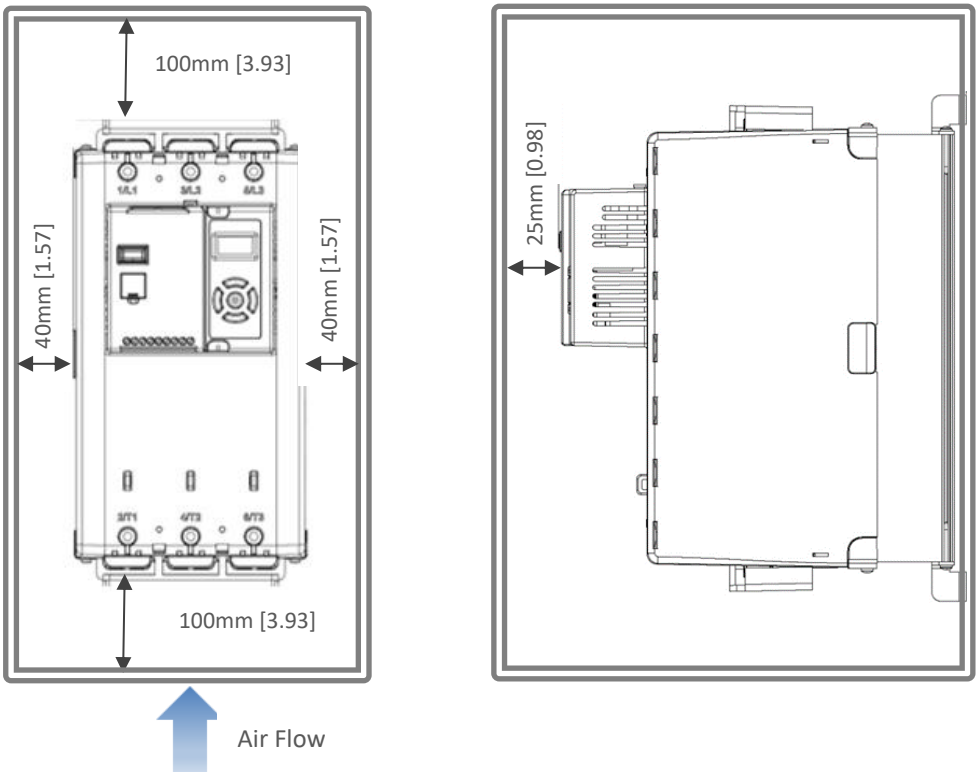


# Installation (continued)

**Dimensions VMX-AGY-201 to VMX-AGY-209**
Weight 6 kg [13.22LB]

[ ] = inch



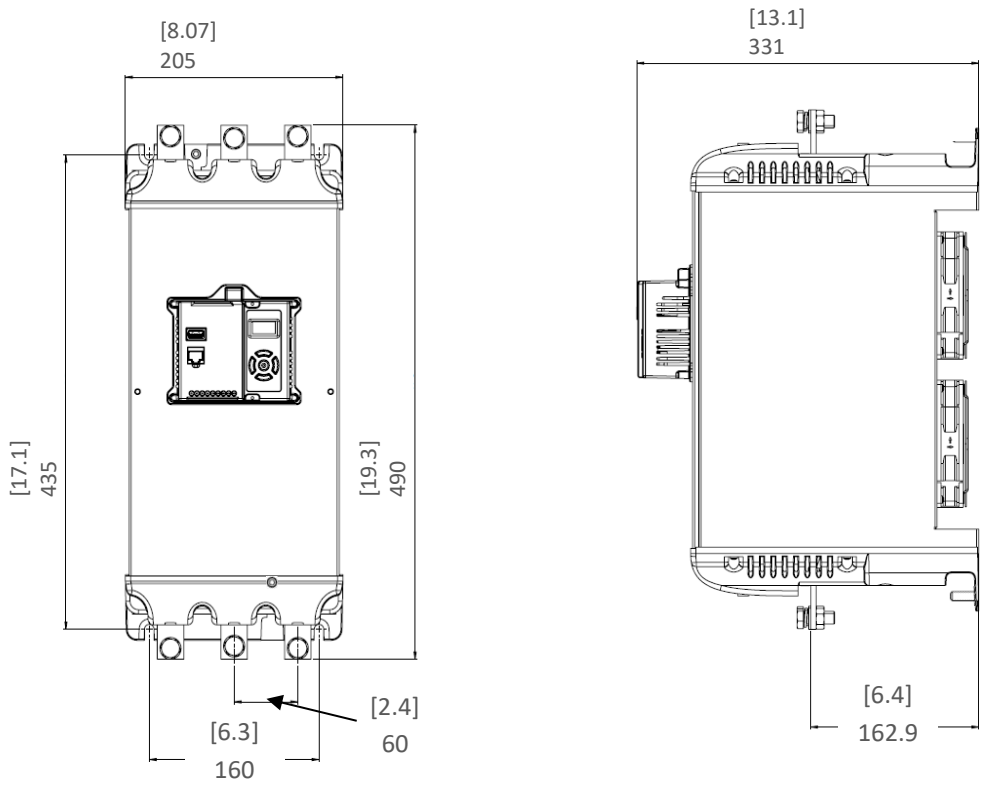



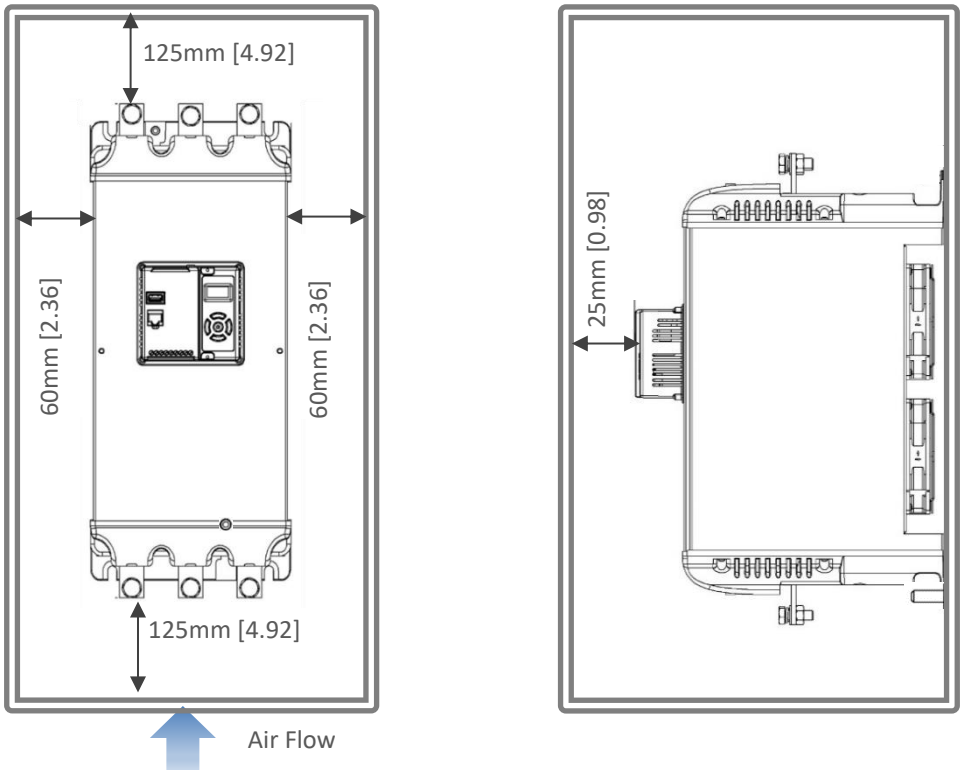
# Installation (continued)

**Dimensions VMX-AGY-301 to VMX-AGY-305**

Weight 15kg [33.10lb]

[ ] = inch



# Installation (continued)

## Environmental Specifications

| Environmental Specifications | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Model (VMX-AGY-)** | **101** | **103** | **105** | **107** | **109** | **111** | **113** |
| Frame Size | 1 | | | | | | |
| Heat output (W) | 9 | 12 | 14 | 16 | 20 | 25 | 30 |
| Weight kg [lb] | 1.97 [4.20] | | | | | | |
| **Model (VMX-AGY-)** | **201** | **203** | **205** | **207** | **209** | | |
| Frame Size | 2 | | | | | | |
| Heat output (W) | 37 | 49 | 61 | 74 | 90 | | |
| Weight kg [lb] | VMX-AGY-201-VMX-AGY-207 6.00 [13.23] VMX-AGY-209 6.30 [13.89] | | | | | | |
| **Model (VMX-AGY-)** | **301** | **303** | **305** | | | | |
| Frame Size | 3 | | | | | | |
| Heat output (W) | 111 | 139 | 166 | | | | |
| Weight kg [lb] | 15.00 [33.10] | | | | | | |
| Ambient Operating Temperature | -20°C [-4°F] to 40°C [104°F] ; above 40°C derate linearly by 2% of VMX-agility Ie per °C to a maximum of 60°C (140°F) | | | | | | |
| Transportation and Storage Temperature | -20°C to 70°C [-4°F to 158°F] continuous | | | | | | |
| Humidity | max 85% non-condensing, not exceeding 50% @ 40°C [104°F] | | | | | | |
| Maximum Altitude | 1,000m [3281ft]; above 1000m derate by 1% of VMX-agility Ie per 100m (328ft) to a maximum altitude of 2,000m (6562ft) | | | | | | |
| Environmental Rating | Main Circuit: IP00 (IP20 with optional finger guards);<br>Control Circuit: IP20; No corrosive gases permitted | | | | | | |

## Horizontal Mounting

The VMX-agility™ unit may be mounted horizontally if required. It will be necessary to apply a deration to the unit power in this instance – see Horizontal Rating Table (Page 16).

# Electrical Installation

## Warnings



### Isolation

Caution: VMX-agility™ uses semiconductor devices in the main circuit and is not designed to provide isolation. For this reason isolation means must be installed in the supply circuit in accordance with the appropriate wiring and safety regulations.



### Electrical Control Supply Requirements

All electrical connections are made to power input and output terminals, control terminals and an earth stud.



### Fuse Protection

The Mains Supply and the Control Supply each require protection. Although all units have electronic overload protection for the Soft Starter, the installer should always fit fuses, for motor protection, between the unit and the Mains Supply, not between the unit and the motor. Semiconductor fuses can be supplied as an option for short-circuit protection of the semiconductors. These fuses must be fitted externally to the VMX-agility™ chassis to comply with certain standards. It is the responsibility of the installer and system designer/specifier to ensure that the required standards or regulations are not affected by so doing.



### Safety

VMX-agility™ soft starters contain hazardous voltages when connected to the electrical power supply. Only qualified personnel who are trained and authorized should carry out installation, operation and maintenance of this equipment. Refer to and carefully follow all of the 'Warnings' section at the beginning of this user manual, as well as other warnings and notes throughout the manual.

### Electrical Supplies

The unit requires a 3-phase balanced Mains Supply to provide the power for the controlled motor, and a 24Vdc for the internal control circuitry. The unit will not operate unless the control supply voltage is within the specified limits.

# Electrical Installation (continued)

| General Specification | | | |
|---|---|---|---|
| **Product Standard** | | EN 60947-4-2: 2012 | |
| **Rated operational voltages** | $U_e$ | 200Vac to 600Vac (See Key to part numbers) | |
| **Rated operational current** | $I_e$ | See Rating Table | |
| **Rating index** | | See Rating Table | |
| **Rated frequencies** | | 50 - 60Hz ± 5Hz | |
| **Rated duty** | | Uninterrupted | |
| **Form designation** | | Form 1, Internally Bypassed | |
| **Method of operation** | | Symmetrically controlled starter | |
| **Method of control** | | Semi-automatic | |
| **Method of connecting** | | Thyristors connected between motor windings and supply | |
| **Number of poles** | | 3 main poles, 2 main poles controlled by semiconductor switching element | |
| **Rated insulation voltage** | $U_i$ | Main circuit | See Key to part numbers |
| | | Control supply circuit | 230Vac r.m.s [1)] |
| **Rated impulse withstand voltage** | $U_{imp}$ | Main circuit | 6 kV |
| | | Control supply circuit | 4 kV [1)] |
| **IP code** | | Main circuit | IP00 (IP20 with finger guards[6)]) |
| | | Supply and Control circuit | IP20 |
| **Overvoltage Category / Pollution degree** | | III / 3 | |
| **Rated conditional short-circuit current and type of co-ordination with associated short circuit protective device (SCPD)** | | Type 1 co-ordination<br><br>See Short Circuit Protection Tables for rated conditional short-circuit current and required current rating and characteristics of the associated SCPD | |

# Electrical Installation (continued)

| General Specification (Continued) | | | | |
|---|---|---|---|---|
| As Standard | Control Supply [2] | Supply input | 0, 24V | Protect with 4A UL listed fuse |
| | | Kind of current, rated frequency | dc | |
| | | Rated voltage $U_s$ | 24Vdc | |
| | | Maximum power consumption | 12VA (VMX-AGY-101 to VMX-AGY-113)<br>48VA (VMX-AGY-201 to VMX-AGY-305) | |
| | Control circuit [2] | Programmable opto-isolated inputs | D1, D2 | |
| | | Common input, marking | COM | |
| | | Kind of current, rated frequency | dc | |
| | | Rated voltage $U_c$ | 24Vdc | |
| With VMX-AGY-020/ VMX-AGY-021 module | Control Supply | Supply input | L, N | |
| | | Kind of current, rated frequency | ac, 50 - 60Hz ± 5Hz | |
| | | Rated voltage $U_s$ | 110V to 230Vac | |
| | | Rated input current | 1A | |
| | Control circuit | Programmable opto-isolated inputs | D1, D2 | |
| | | Common input | COM | |
| | | Kind of current, rated frequency | ac, 50 - 60Hz ± 5Hz | |
| | | Rated voltage $U_c$ | 110V to 230Vac | |
| Auxiliary Circuit [3] | Form A – Single gap make -contact (normally open) | | 13, 14 | |
| | Form B – Single gap break-contact (normally closed) | | 21, 22 | |
| | Utilisation category, voltage rating, current rating | | Resistive load, 250Vac, 2A.<br>Cosø =0.5, 250Vac, 2A [4] | |

Continued over

# Electrical Installation (continued)

| General Specification (continued) | | |
|---|---|---|
| **Electronic overload relay with manual reset and thermal memory** | **Trip Class** | 10 (factory default), 20 or 30 (selectable) |
| | **Current setting** | See Electronic Overload Relay Current Settings |
| | **Rated frequency** | 50 to 60Hz ± 5Hz |
| | **Time-current characteristics** | See Fig.1 for trip curves (Trip time $T_p$ ± 20%) |

[1] With optional VMX-AGY-020 or VMX-AGY-021 power supply module. VMX-AGY-020 TO BE USED WITH VMX-AGY-101 TO VMX-AGY-113 ONLY

[2] Must be supplied by class 2, limited voltage current or protected by a 4A UL 248 listed fuse

[3] Compliant with Annex S of IEC 60947-1:2007 at 24Vdc

[4] Not applicable for UL

[5] The safety functions were not evaluated by UL. Listing is accomplished according to requirements of Standard UL 508 and CSA14-13, general use applications

**[6] For models VMX-AGY-101 to VMX-AGY-209 the main circuit IP20 rating only applies when the finger guards as supplied are fitted**

# Electrical Installation (continued)

**Rating Table – Vertically Mounted**

| $I_e$ | kW [1] | | | FLA | Hp [2] | | | | | Trip Class 10 $I_e$: AC-53a: 3.5-17: F-S [5] | Trip Class 20 $I_e$: AC-53a: 4-19: F-S [5] | Trip Class 30 $I_e$: AC-53a: 4-29: F-S [5] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A [3] | 230V | 400V | 500V [4] | A [3] | 200V | 208V | 220-240V | 440-480V | 550-600V [4] | | | |
| 17 | 4 | 7.5 | 7.5 | 17 | 3 | 5 | 5 | 10 | 15 | - | - | VMX-AGY-101 |
| 17 | 4 | 7.5 | 7.5 | 17 | 3 | 5 | 5 | 10 | 15 | - | VMX-AGY-101 | VMX-AGY-103 |
| 17 | 4 | 7.5 | 7.5 | 17 | 3 | 5 | 5 | 10 | 15 | VMX-AGY-101 | VMX-AGY-103 | VMX-AGY-105 |
| 22 | 5.5 | 11 | 11 | 22 | 5 | 5 | 7.5 | 15 | 20 | VMX-AGY-103 | VMX-AGY-105 | VMX-AGY-107 |
| 29 | 7.5 | 15 | 15 | 27 | 7.5 | 7.5 | 7.5 | 20 | 25 | VMX-AGY-105 | VMX-AGY-107 | VMX-AGY-109 |
| 35 | 7.5 | 18.5 | 22 | 34 | 10 | 10 | 10 | 25 | 30 | VMX-AGY-107 | VMX-AGY-109 | VMX-AGY-111 |
| 41 | 11 | 22 | 22 | 41 | 10 | 10 | 10 | 30 | 40 | VMX-AGY-109 | VMX-AGY-111 | VMX-AGY-113 |
| 55 | 15 | 30 | 37 | 52 | 15 | 15 | 15 | 40 | 50 | VMX-AGY-111 | VMX-AGY-113 | VMX-AGY-201 |
| 66 | 18.5 | 37 | 45 | 65 | 20 | 20 | 20 | 50 | 60 | VMX-AGY-113 | VMX-AGY-201 | VMX-AGY-203 |
| 80 | 22 | 45 | 55 | 77 | 20 | 25 | 25 | 60 | 75 | VMX-AGY-201 | VMX-AGY-203 | VMX-AGY-205 |
| 106 | 30 | 55 | 75 | 100 | 30 | 30 | 30 | 75 | 100 | VMX-AGY-203 | VMX-AGY-205 | VMX-AGY-207 |
| 132 | 37 | 75 | 90 | 125 | 40 | 40 | 40 | 100 | 125 | VMX-AGY-205 | VMX-AGY-207 | VMX-AGY-209 |
| 160 | 45 | 90 | 110 | 156 | 50 | 50 | 60 | 125 | 150 | VMX-AGY-207 | VMX-AGY-209 | VMX-AGY-301 |
| 195 | 55 | 110 | 132 | 192 | 60 | 60 | 60 | 150 | 200 | VMX-AGY-209 | VMX-AGY-301 | VMX-AGY-303 |
| 242 | 75 | 132 | 160 | 242 | 75 | 75 | 75 | 200 | 250 | VMX-AGY-301 | VMX-AGY-303 | VMX-AGY-305 |
| 302 | 90 | 160 | 200 | 302 | 100 | 100 | 100 | 250 | 300 | VMX-AGY-303 | VMX-AGY-305 | - |
| 361 | 110 | 200 | 250 | 361 | 125 | 125 | 150 | 300 | 350 | VMX-AGY-305 | - | - |

**Rating Table – Horizontally Mounted**

| $I_e$ | kW [1] | | | FLA | Hp [2] | | | | | Trip Class 10 $I_e$: AC-53a: 3.5-17: F-S [5] | Trip Class 20 $I_e$: AC-53a: 4-19: F-S [5] | Trip Class 30 $I_e$: AC-53a: 4-29: F-S [5] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A [3] | 230V | 400V | 500V [4] | A [3] | 200V | 208V | 220-240V | 440-480V | 550-600V [4] | | | |
| 17 | 4 | 7.5 | 7.5 | 17 | 3 | 5 | 5 | 10 | 15 | - | VMX-AGY-101 | VMX-AGY-103 |
| 17 | 4 | 7.5 | 7.5 | 17 | 3 | 5 | 5 | 10 | 15 | VMX-AGY-101 | VMX-AGY-103 | VMX-AGY-105 |
| 17 | 4 | 7.5 | 7.5 | 17 | 3 | 5 | 5 | 10 | 15 | VMX-AGY-103 | VMX-AGY-105 | VMX-AGY-107 |
| 22 | 5.5 | 11 | 11 | 22 | 5 | 5 | 7.5 | 15 | 20 | VMX-AGY-105 | VMX-AGY-107 | VMX-AGY-109 |
| 29 | 7.5 | 15 | 15 | 27 | 7.5 | 7.5 | 7.5 | 20 | 25 | VMX-AGY-107 | VMX-AGY-109 | VMX-AGY-111 |
| 35 | 7.5 | 18.5 | 22 | 34 | 10 | 10 | 10 | 25 | 30 | VMX-AGY-109 | VMX-AGY-111 | VMX-AGY-113 |
| 41 | 11 | 22 | 22 | 41 | 10 | 10 | 10 | 30 | 40 | VMX-AGY-111 | VMX-AGY-113 | VMX-AGY-201 |
| 55 | 15 | 30 | 37 | 52 | 15 | 15 | 15 | 40 | 50 | VMX-AGY-113 | VMX-AGY-201 | VMX-AGY-203 |
| 66 | 18.5 | 37 | 45 | 65 | 20 | 20 | 20 | 50 | 60 | VMX-AGY-201 | VMX-AGY-203 | VMX-AGY-205 |
| 80 | 22 | 45 | 55 | 77 | 20 | 25 | 25 | 60 | 75 | VMX-AGY-203 | VMX-AGY-205 | VMX-AGY-207 |
| 106 | 30 | 55 | 75 | 100 | 30 | 30 | 30 | 75 | 100 | VMX-AGY-205 | VMX-AGY-207 | VMX-AGY-209 |
| 132 | 37 | 75 | 90 | 125 | 40 | 40 | 40 | 100 | 125 | VMX-AGY-207 | VMX-AGY-209 | VMX-AGY-301 |
| 160 | 45 | 90 | 110 | 156 | 50 | 50 | 60 | 125 | 150 | VMX-AGY-209 | VMX-AGY-301 | VMX-AGY-303 |
| 195 | 55 | 110 | 132 | 192 | 60 | 60 | 60 | 150 | 200 | VMX-AGY-301 | VMX-AGY-303 | VMX-AGY-305 |
| 242 | 75 | 132 | 160 | 242 | 75 | 75 | 75 | 200 | 250 | VMX-AGY-303 | VMX-AGY-305 | - |
| 302 | 90 | 160 | 200 | 302 | 100 | 100 | 100 | 250 | 300 | VMX-AGY-305 | - | - |

[1] Rated operational powers in kW as per IEC 60072-1 (primary series) corresponding to IEC current rating.

[2] Rated operational powers in hp as per UL508 corresponding to FLA current rating.

[3] The $I_e$ and FLA rating applies for a maximum surrounding air temperature of 40°C. Above 40°C de-rate linearly by 2% of Ie or FLA per °C to a maximum of 60°C.

[4] kW and Hp ratings applicable for VMX-AGY-101-6 to VMX-AGY-305-6 models only.

[5] For VMX-AGY-101 to VMX-AGY-209 models, a higher duty cycle F-S is possible with optional fan fitted as indicated in Fan option table. For VMX-AGY-301 to VMX-AGY-305 models with fans fitted as standard, consult Motortronics UK for higher duties.

# Electrical Installation (continued)

| Short Circuit Protection – VMX-Agility Frame Size 1 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Type designation (VMX-AGY-)** | | | **101-4<br>101-6** | **103-4<br>103-6** | **105-4<br>105-4** | **107-4<br>107-6** | **109-4<br>109-6** | **111-4<br>111-6** | **113-4** | **113-6** |
| **Rated operational current** | $I_e$ | A | 17 | 22 | 29 | 35 | 41 | 55 | 66 | 66 |
| **Rated conditional short circuit current** | $I_q$ | kA | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 10 |
| **Class J time-delay fuse** [#1] | Maximum rating $Z_1$ | A | 30 | 40 | 50 | 60 | 70 | 100 | 125 | 125 |
| **UL Listed inverse-time delay circuit breaker** [#1] | Maximum rating $Z_2$ | A | 60 | 60 | 60 | 60 | 60 | 150 | 150 | 150 |
| **Semiconductor fuse (class aR)** [#2] | Type | | Mersen 6,9 URD 30 _<br>Bussmann 170M30__<br>Bussmann 170M31__<br>Bussmann 170M32__<br>SIBA 20 61___ | | | | Mersen 6,9 URD 31 _<br>Bussmann 170M40__<br>Bussmann 170M41__<br>Bussmann 170M42__<br>SIBA 20 61___ | | | |
| | Fuse rating | A | 160A | 160A | 200A | 200A | 250A | 250A | 250A | 250A |

| Short Circuit Protection – VMX-Agility Frame Size 2 & 3 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Type designation (VMX-AGY-)** | | | **201-4<br>201-6** | **203-4<br>203-6** | **205-4<br>205-4** | **207-4<br>207-6** | **209-4<br>209-6** | **301-4<br>301-6** | **303-4<br>303-6** | **305-4<br>305-6** |
| **Rated operational current** | $I_e$ | A | 80 | 106 | 132 | 160 | 195 | 242 | 302 | 361 |
| **Rated conditional short circuit current** | $I_q$ | kA | 10 | 10 | 10 | 10 | 10 | 18 | 18 | 18 |
| **Class J time-delay fuse** [#1] | Maximum rating $Z_1$ | A | 150 | 200 | 250 | 300 | 400 | 450 | 600 | 600 |
| **UL Listed inverse-time delay circuit breaker** [#1] | Maximum rating $Z_2$ | A | 250 | 300 | 350 | 450 | 500 | 700 | 800 | 800 |
| **Semiconductor fuse (class aR)** [#2] | Type | | Mersen 6,9 URD 31__<br>Bussmann 170M40__<br>Bussmann 170M41__<br>Bussmann 170M42__<br>SIBA 20 61___ | | | | | Mersen 6,9 URD 33__<br>Bussmann 170M60__<br>Bussmann 170M61__<br>Bussmann 170M62__<br>SIBA 20 63__ | | |
| | Fuse rating | A | 400A | 400A | 550A | 550A | 550A | 800A | 900A | 1000A |

# 1. Suitable For Use On A Circuit Capable Of Delivering Not More Than ___$I_q$___ rms Symmetrical Amperes, 600Volts Maximum, When Protected by Class J Time Delay Fuses with a Maximum Rating of ___$Z_1$___ or by a Circuit Breaker with a Maximum Rating of ___$Z_2$___.

# 2. Correctly selected semiconductor fuses can provide additional protection against damage to the VMX-agility unit (this is sometimes referred to as type 2 co-ordination). These semiconductor fuses are recommended to provide this increased protection.

# Electrical Installation (continued)

## Electromagnetic Compatibility

| Electromagnetic Compatibility | | |
|---|---|---|
| **EMC Emission levels** | **EN 55011** | Class A [1] |
| **EMC Immunity levels** | **IEC 61000-4-2** | 8kV/air discharge or 4kV/contact discharge |
| | **IEC 61000-4-3** | 10 V/m |
| | **IEC 61000-4-4** | 2kV/5kHz (main and power ports) |
| | | 1kV/5kHz (signal ports) |
| | **IEC 61000-4-5** | 2kV line-to-ground<br>1kV line-to-line |
| | **IEC 61000-4-6** | 10V |

[1] **NOTICE: This product has been designed for environment A. Use of this product in environment B may cause unwanted electromagnetic disturbances, in which case the user may be required to take adequate mitigation measures**

| Fan Option | |
|---|---|
| **VMX-Agility model** | **Maximum duty cycle F-S with optional fan fitted** |
| VMX-AGY-101 to VMX-AGY-203 | 90-40 (40 cycles per hour) |
| VMX-AGY-205 | 90-30 (30 cycles per hour) |
| VMX-AGY-207 | 90-20 (20 cycles per hour) |
| VMX-AGY-209 | 90-10 (10 cycles per hour) |

VMX-AGY-301 – 305 have permanently fitted fans

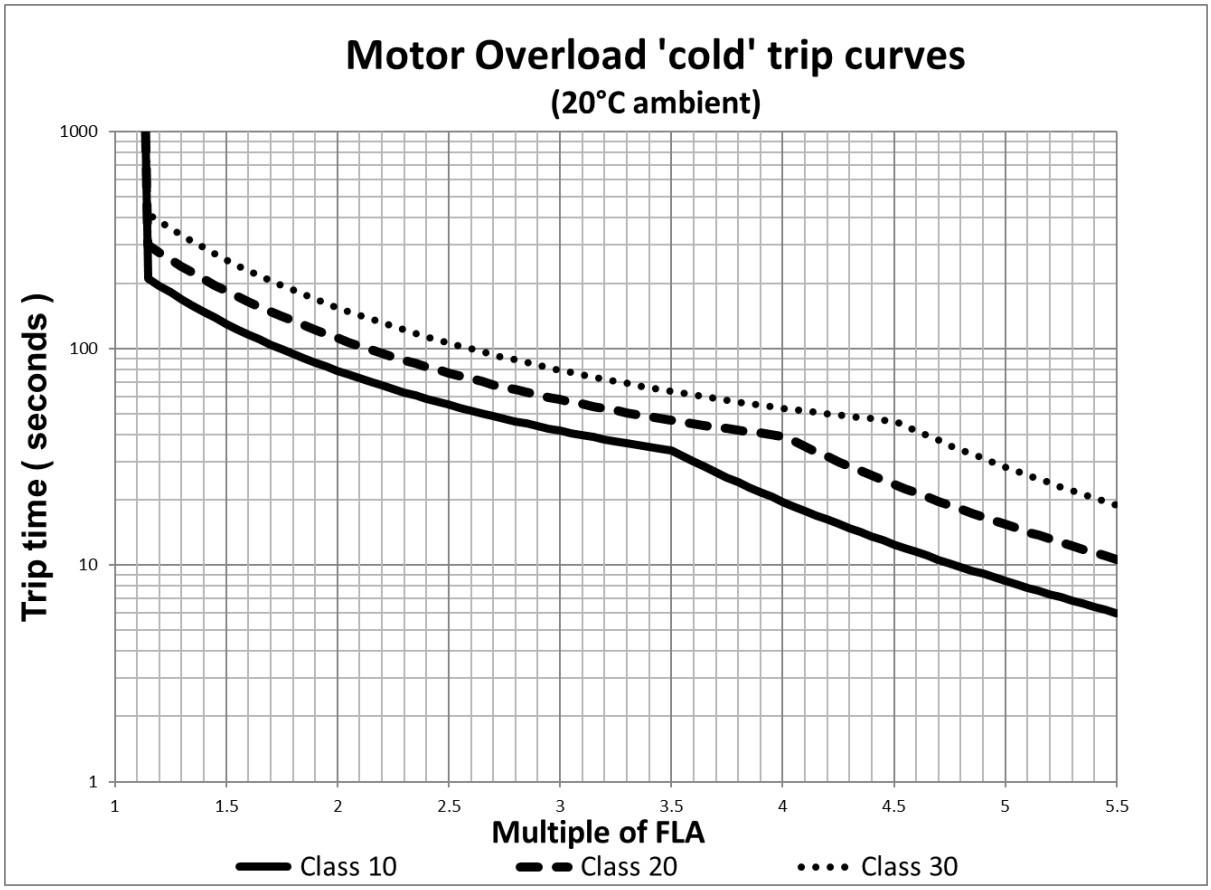
# Electrical Installation (continued)

| Wire Sizes and Torques | | | | | | |
|---|---|---|---|---|---|---|
| **Terminal** | | **Models** | **Wire/Busbar Size** | | **Torque** | |
| | | | **Metric** | **Imperial** | **Nm** | **lb-in** |
| **Main Terminals** | **Terminal** | VMX-AGY-101 to VMX-AGY-113 | 2.5 - 70mm² | 12- 2/0AWG | 9 | 80 |
| **Cu STR 75ºC only** | | VMX-AGY-201 to VMX-AGY-209 | 4 - 185mm² | 12 – 350MCM | 14 | 124 |
| | **M10 bolt** | VMX-AGY-301 to VMX-AGY-305 | 2 x 95mm² | 2 x 4/0AWG | 28 | 248 |
| **Control terminals** | | All models | 0.2–1.5mm² | 24-16AWG | 0.5 | 4.5 |
| **Protective Earth** [1] ⏚ Cu only | **M6 screw** | VMX-AGY-101 | ≥ 4mm² | ≥ 12AWG | 8 | 71 |
| | | VMX-AGY-103 to VMX-AGY-111 | ≥ 6mm² | ≥ 10AWG | | |
| | | VMX-AGY-113 to VMX-AGY-203 | ≥ 10mm² | ≥ 8AWG | | |
| | **M8 screw** | VMX-AGY-205 to VMX-AGY-209 | ≥ 16mm² | ≥ 6AWG | 12 | 106 |
| | **M8 Stud** | VMX-AGY-301 | ≥ 25mm² | ≥ 4AWG | | |
| | | VMX-AGY-303 to VMX-AGY-305 | ≥ 35mm² | ≥ 3AWG | | |
| [1] Protective Earth wire size based on bonding conductor requirements of UL508 Table 6.4 and UL508A Table 15.1. | | | | | | |

# Electrical Installation (continued)

### Motor Overload Protection

VMX-agility™ provides full motor overload protection, configurable through the user interface. Overload trip settings are determined by the Motor Current setting and the Trip Class setting. Trip class choices are Class 10, Class 20, and Class 30. The VMX-agility™ soft starters are protected using full $I^2T$ motor overload with memory. See Appendix 1 for sizing guide.

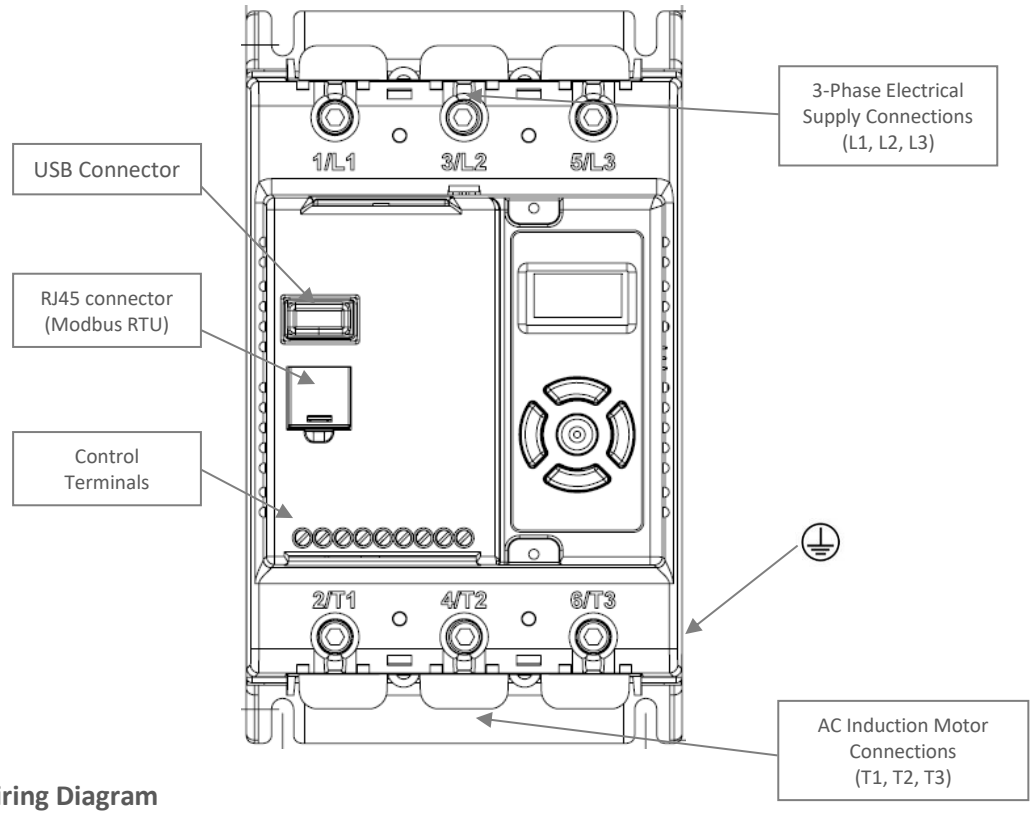



Please note: When the overload has tripped, there is a forced cooling time to allow the overload to recover before the next start.

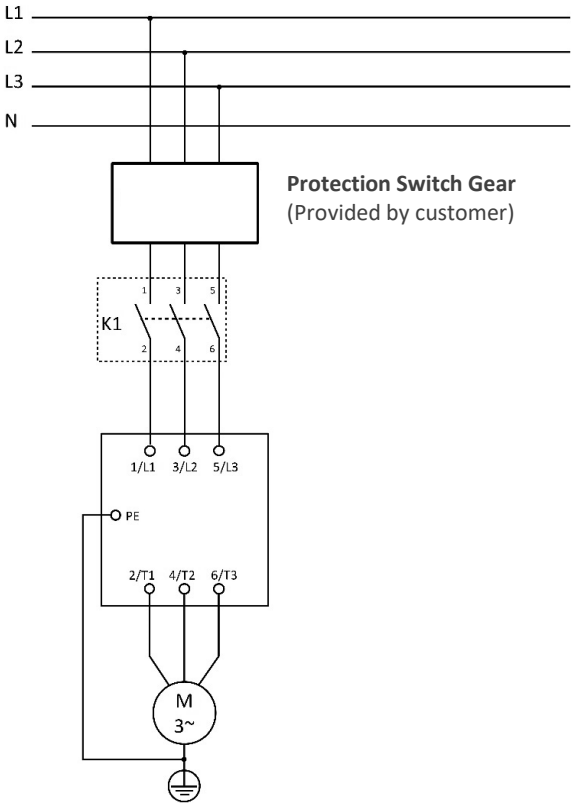
The 'warm' trip times are 50% of the 'cold' trip time.

# Electrical Installation (continued)

## Electrical Connections




## Main Circuit Wiring Diagram

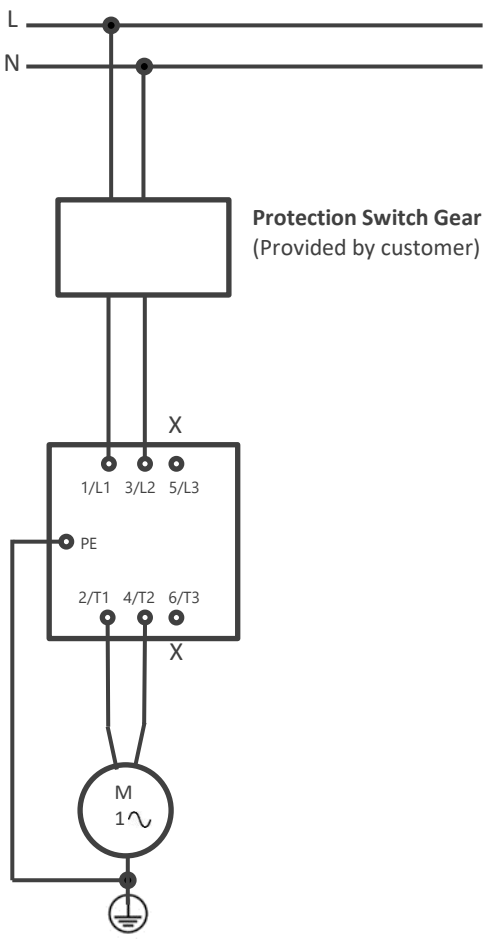


# Electrical Installation (continued)

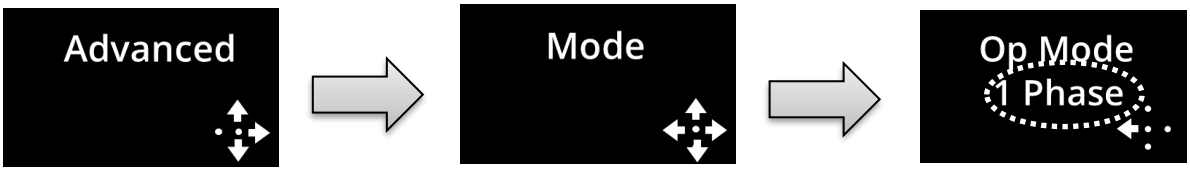
## Single Phase Operation

VMX-agility soft starts may be operated with a single-phase supply and motor. The base rating of the unit is unchanged.

**Electrical Connection**

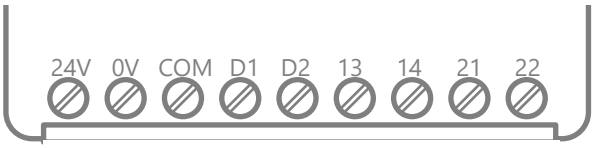



For single phase operation the mode of the soft start must be set correctly in the Advanced menu:



# Electrical Installation (continued)

### Control Terminal Connection




### Control Terminal Functions

| Terminal | Description | Function Selectable | Note |
|---|---|---|---|
| 24Vdc | Control Supply +Us | No | #1 |
| 0V | Control Supply -Us | No | |
| COM | Digital Inputs Common | No | |
| D1 | Digital Input 1 | No | #2 |
| D2 | Digital Input 2 | Yes | #2 |
| 13/14 | Main Contactor Control (Run Relay) | Yes | #3 |
| 21/22 | Fault Relay | Yes | #3 |

#1 24Vdc Specification: See General Specification table (Page 15) for VA rating. Residual ripple < 100mV, spikes/switching peaks < 240mV. Turn On/Off response no overshoot of Vout, Overvoltage voltage protection output voltage must be clamped <30Vdc

#2 The voltage applied to the digital inputs D1 and D2 must not exceed 24Vdc

#3 230Vac, 1A, AC15. 30Vdc, 0.5A resistive

### Digital Input 2 (D2) Selectable Functions

Different functions may be assigned to Digital Input 2 in the I/O menu. Available assignments are:

*Reset*

*Hold Start Ramp*

*Enable*

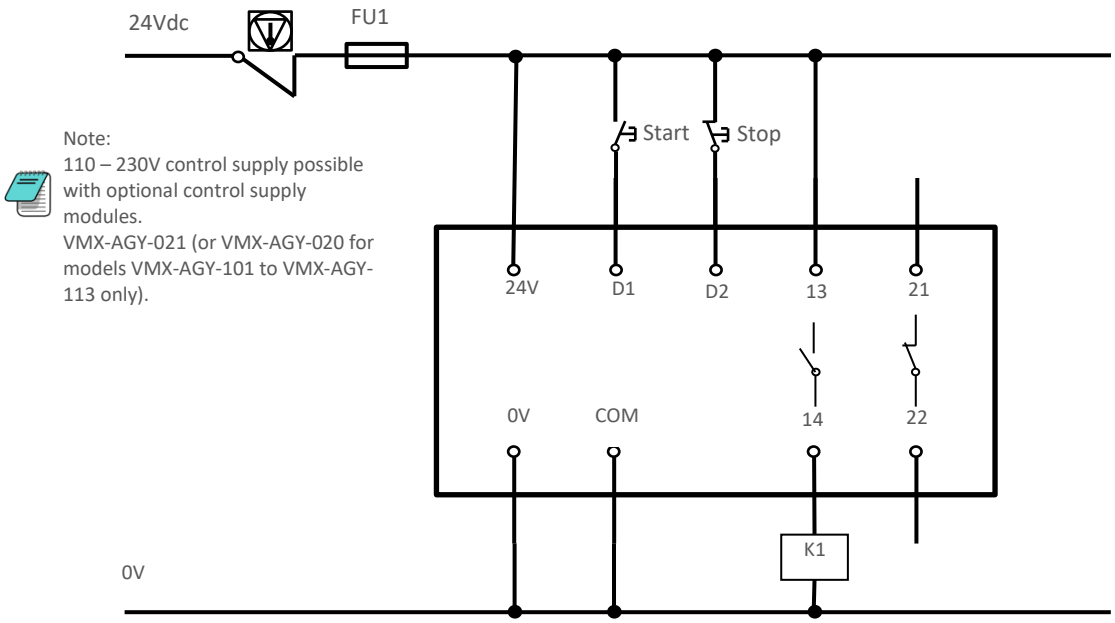
*Fire Mode* ***(In Fire Mode all trips are disabled)***

### Digital Outputs Selectable Functions (13/14 and 21/22)

The output may be mapped to Fault, Top-of-Ramp indication or Auto-Reset Pending or exceeded.

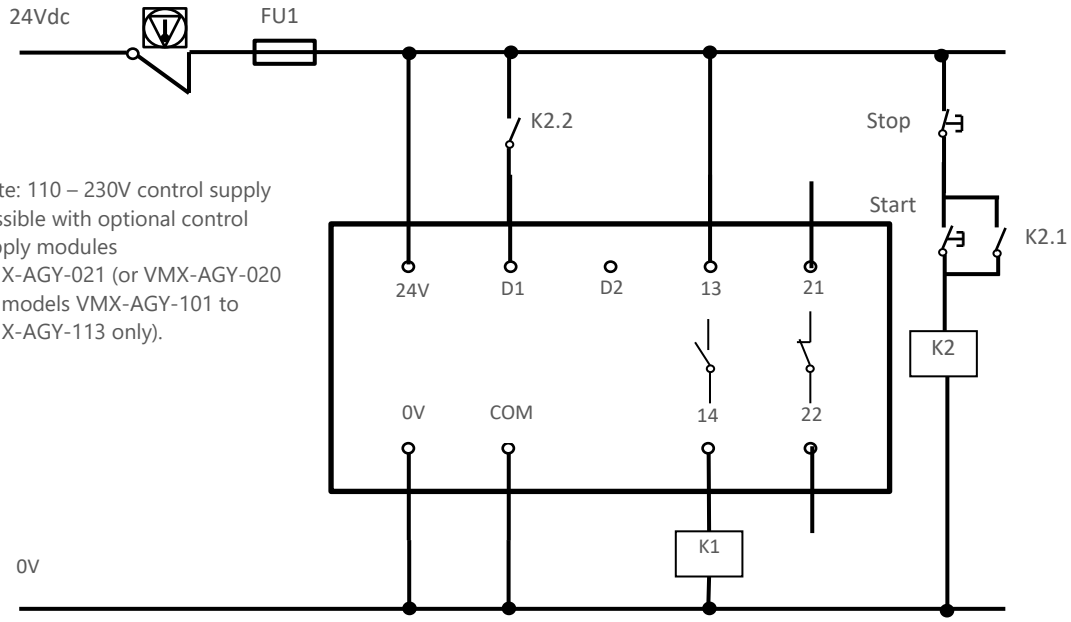
# Electrical Installation (continued)

## 3-Wire Control Circuit Wiring Diagram




Note:
110 – 230V control supply possible with optional control supply modules.
VMX-AGY-021 (or VMX-AGY-020 for models VMX-AGY-101 to VMX-AGY-113 only).

## 2-Wire Control Wiring Diagram




Note: 110 – 230V control supply possible with optional control supply modules
VMX-AGY-021 (or VMX-AGY-020 for models VMX-AGY-101 to VMX-AGY-113 only).

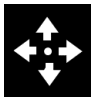
# Configuration and Parameters (continued)

## Display and Controls

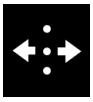



1. Status messages
2. Instantaneous motor current
3. Control scheme: Local, Control terminal, Modbus RTU
4. Keypad guidance wizard: Displays which keys are valid for specific menu items
5. Motor overload level; 0 to 100%
6. Control keypad
7. Status LED (incorporated into centre button) Green/Red

## Keypad Guidance Examples



All keys active



Left & Right keys active



Right, Down & Centre keys active

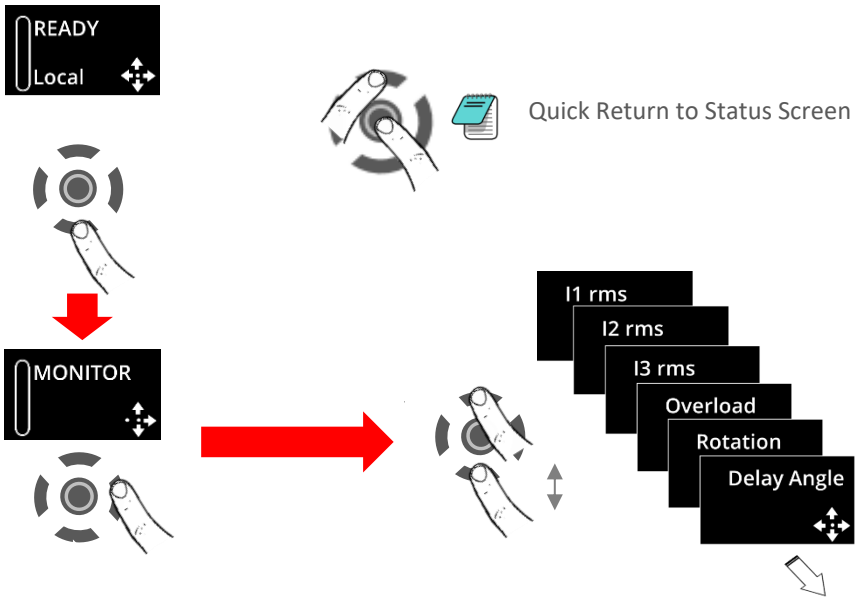
Note: A flashing centre button indicates that a menu item may be selected or saved.

# Configuration and Parameters (continued)

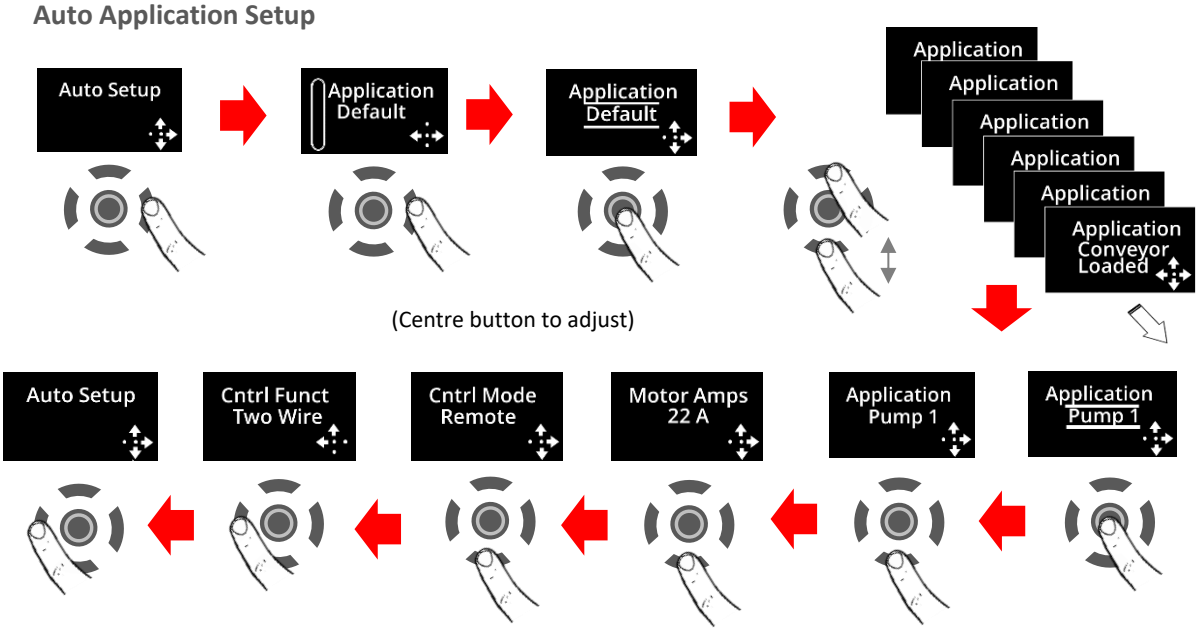
### Operation - Local Motor Start




### Example Navigation Method




### Auto Application Setup



# Configuration and Parameters (continued)

### Auto Setup Procedure (Auto App)

Allows the user to change all of the parameters at once to settings that are typical for general applications. One or more parameters as can be adjusted to fine tune the settings for your specific application.

### Setup by Individual Parameter Settings (Advanced)

Allows the user to change the parameter settings one at a time.

### Auto Application Setup Parameter Settings

| | Initial Volts | Start Time | Stop Time | Trip Class | Current Limit | Current Limit Time |
|---|---|---|---|---|---|---|
| Unit | % | s | s | - | *FLC | s |
| Default | 20% | 10 | 0 | 10 | 3.5 | 30 |
| Heavy | 40% | 10 | 0 | 20 | 4 | 40 |
| Agitator | 30% | 10 | 0 | 10 | 3.5 | 25 |
| Compressor 1 | 40% | 15 | 0 | 20 | 3.5 | 25 |
| Compressor 2 | 35% | 7 | 0 | 10 | 3.5 | 25 |
| Conveyor Loaded | 10% | 10 | 7 | 20 | 5.5 | 30 |
| Conveyor Unloaded | 10% | 10 | 7 | 10 | 3.5 | 30 |
| Crusher | 40% | 10 | 0 | 30 | 3.5 | 60 |
| Fan High Inertia | 40% | 10 | 0 | 30 | 3.5 | 60 |
| Fan Low Inertia | 30% | 15 | 0 | 10 | 3.5 | 30 |
| Grinder | 40% | 10 | 0 | 20 | 3.5 | 40 |
| Mill | 40% | 10 | 0 | 20 | 3.5 | 40 |
| Mixer | 10% | 10 | 0 | 20 | 4 | 25 |
| Moulding M/C | 10% | 10 | 0 | 10 | 4.5 | 25 |
| Press Flywheel | 40% | 10 | 0 | 20 | 3.5 | 40 |
| Pump 1 | 10% | 10 | 60 | 10 | 3.5 | 25 |
| Pump 2 | 10% | 10 | 60 | 20 | 3.5 | 25 |
| PumpJack | 40% | 10 | 0 | 20 | 3.5 | 40 |
| SawBand | 10% | 10 | 0 | 10 | 3.5 | 25 |
| SawCircular | 40% | 10 | 0 | 20 | 3.5 | 40 |
| Screen Vibrating | 40% | 10 | 0 | 20 | 4.5 | 40 |
| Shredder | 40% | 10 | 0 | 30 | 3.5 | 60 |
| Wood Chipper | 40% | 10 | 0 | 30 | 3.5 | 60 |

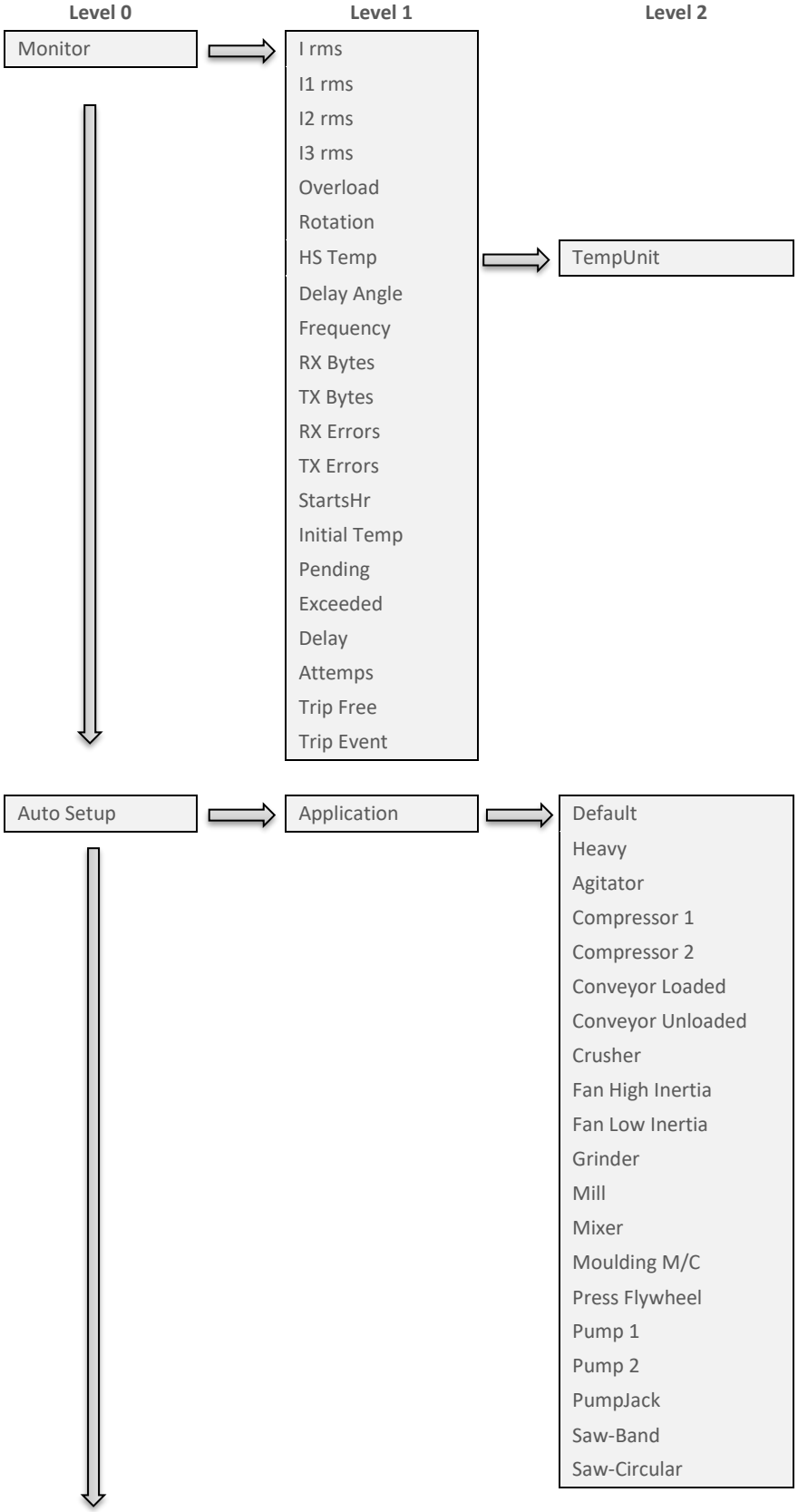
Compressor 1 = Centrifugal, Reciprocating, Rotary Screw

Compressor 2 = Rotary Vane, Scroll

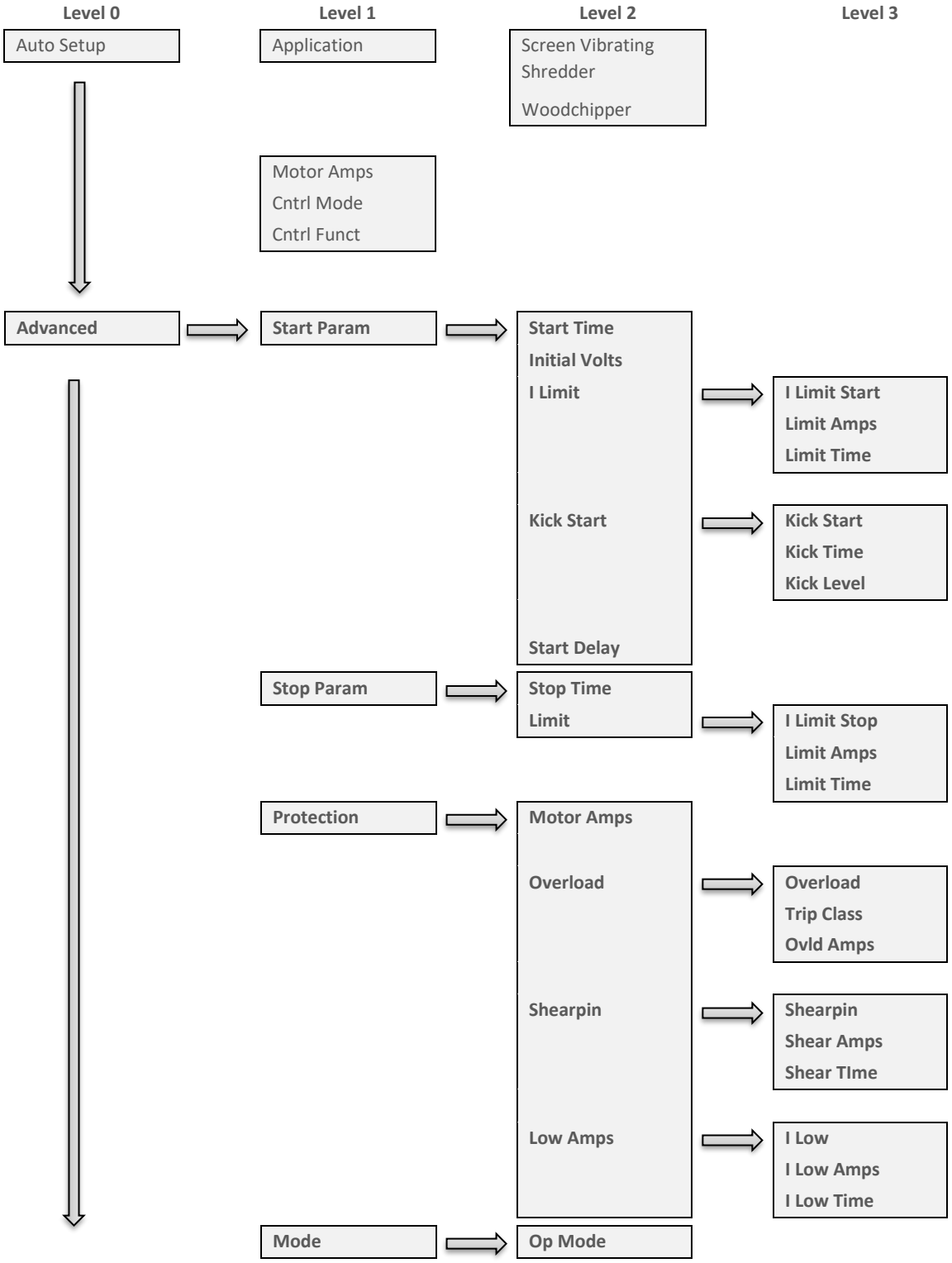
Pump 1 = Submersible: Centrifugal, Rotodynamic

Pump 2 = Positive Displacement: Reciprocating, Rotary

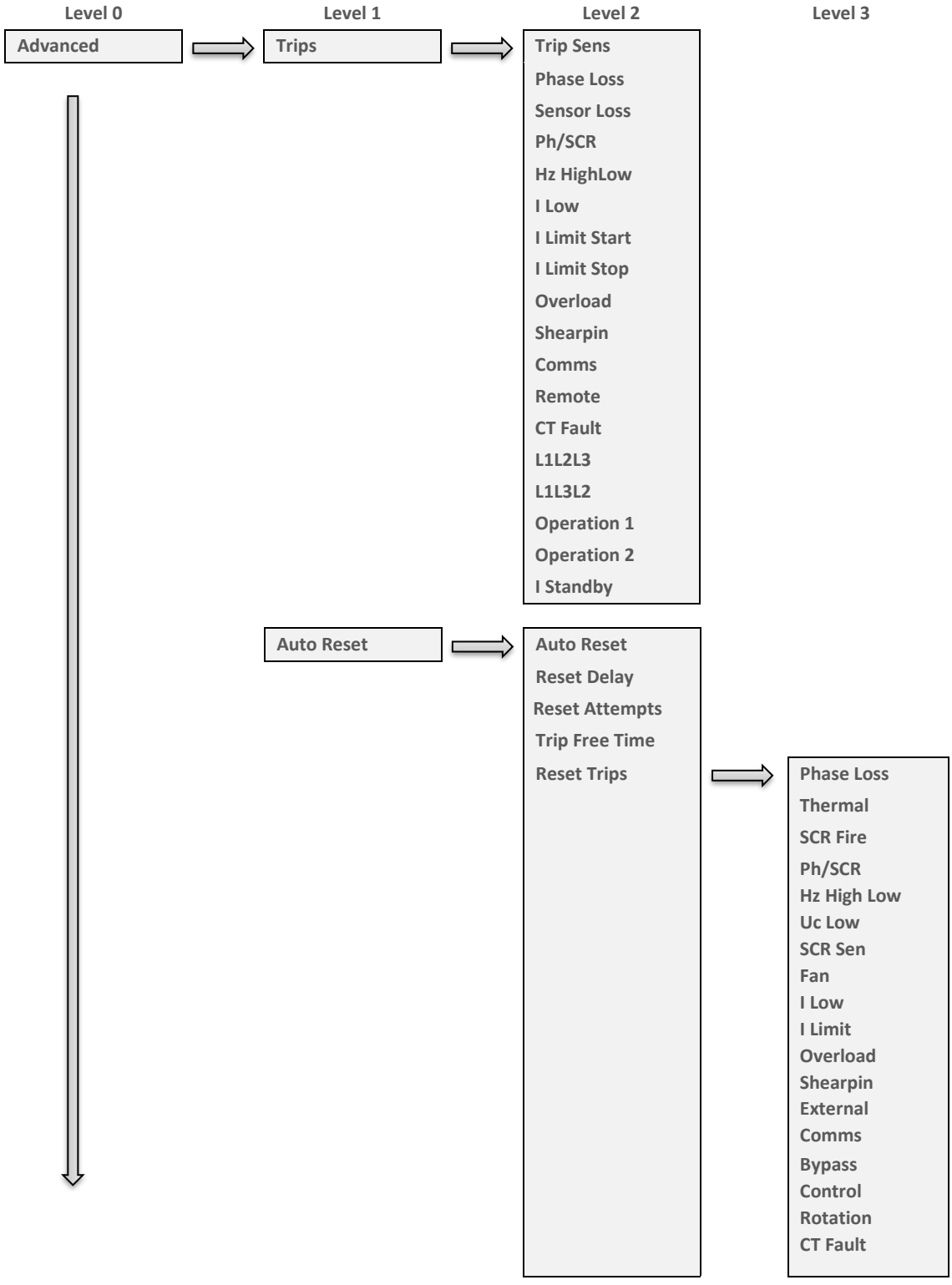
# Menu Structure



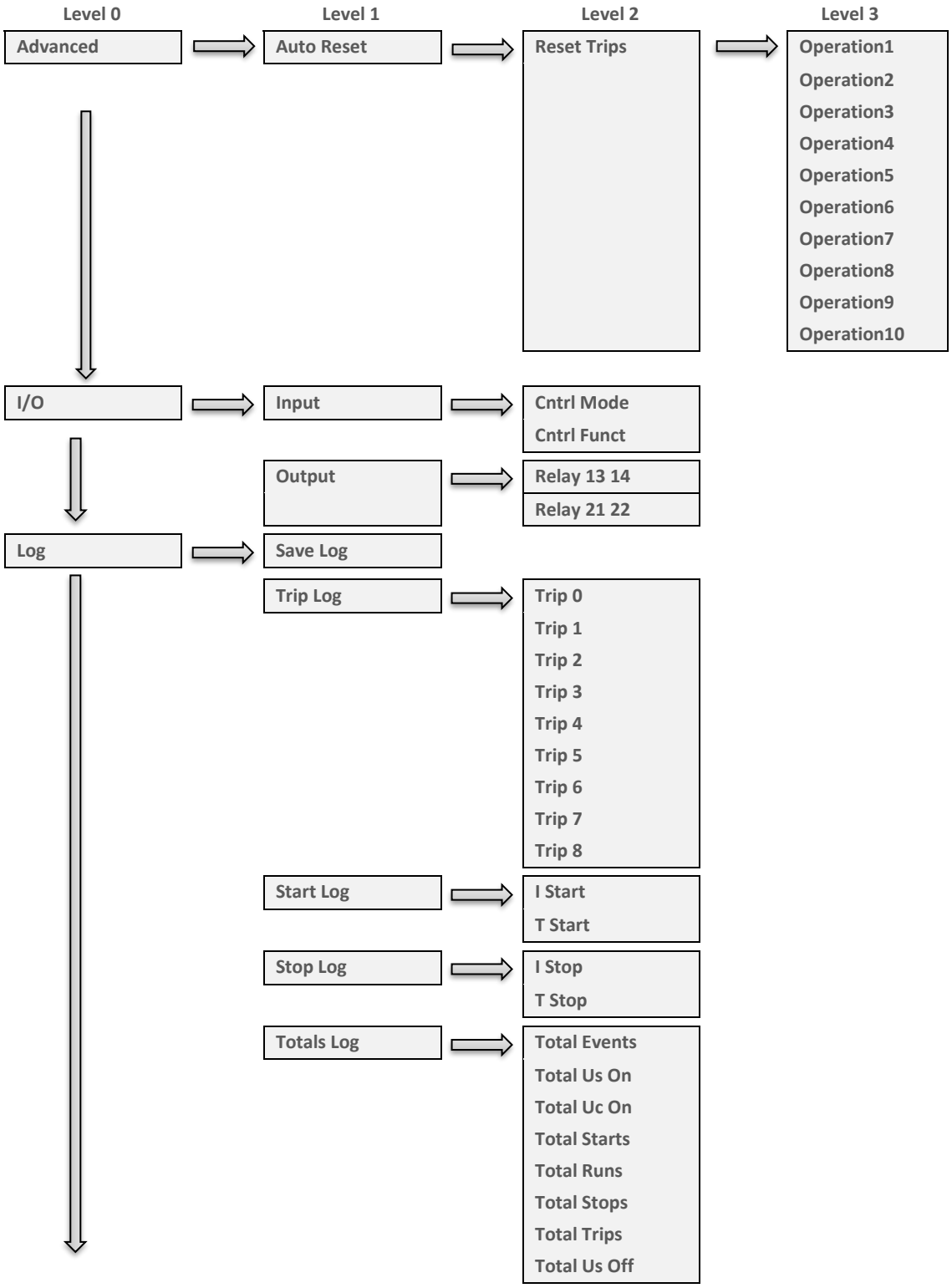
# Menu Structure (continued)



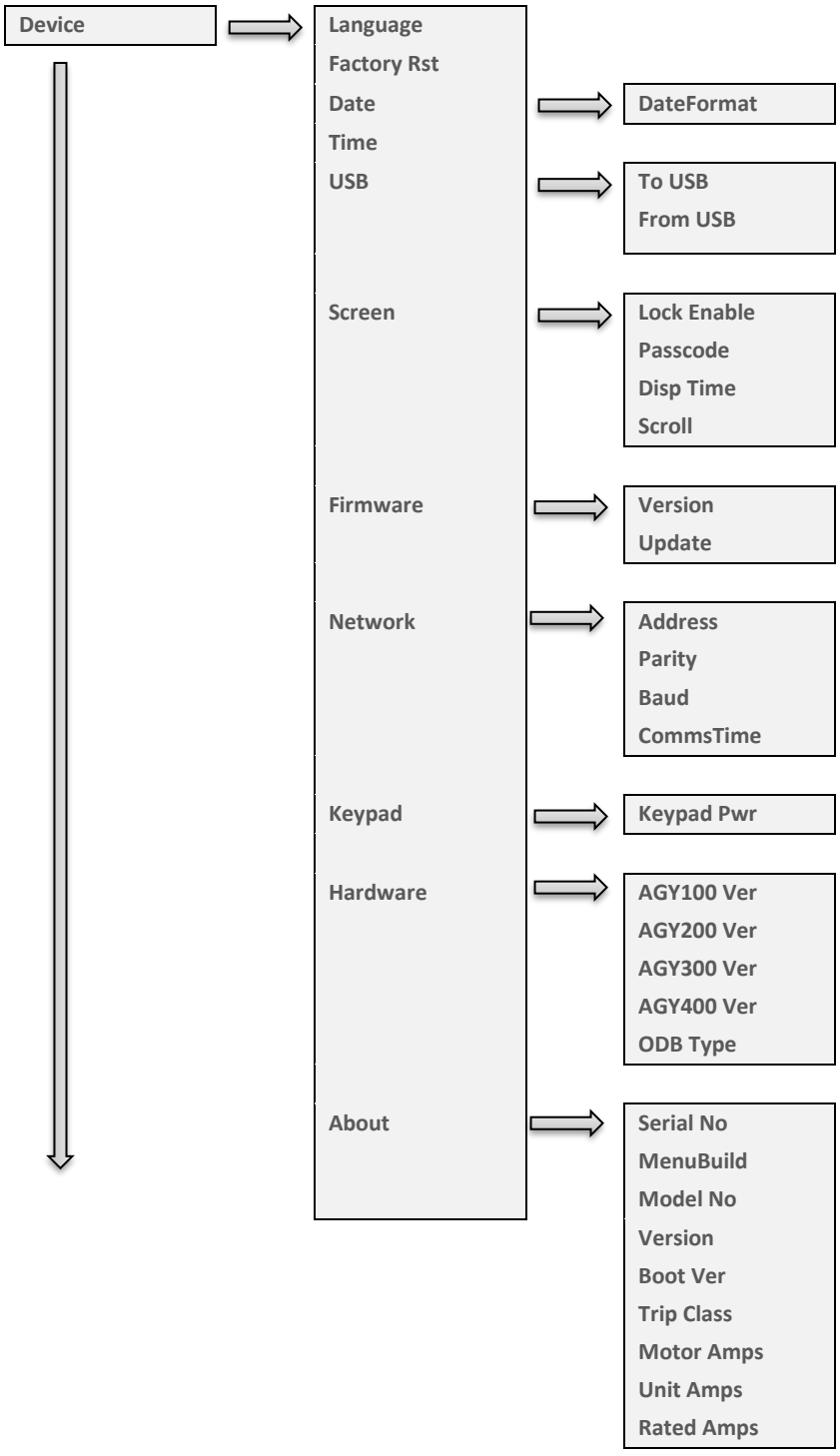
# Menu Structure (continued)



# Menu Structure (continued)



## Menu Structure (continued)



## Function Descriptions

| | |
|---|---|
| Address | Sets the Modbus address number |
| Application | The unit has numerous pre-set applications built in as standard<br>Select the application best suited to the load<br>The selected application will automatically change several parameters and functions<br>Depending on the application loaded the “Trip Class" may also change |
| Baud | Sets the serial communications baud rate<br>The available baud rates are 9600 19200 38400 57600 or 115200 |
| Boot Ver | Software Version for the Bootloader |
| Cntrl Funct | Allows the Digital inputs to be mapped to different functions<br>Cntrl Mode must be set to "Remote"<br>Two Wire: D1 = Start (Reset) / Stop<br>Three Wire: D1 = Start (Reset) D2 = Stop<br>D2 Reset, D2 HoldStart , D2 Enable , D2 FireMode : Programs D2 as shown |
| Cntrl Mode | Selects the method for starting and controlling the motor<br>Local: Control using the button on the keypad<br>Remote: Control using the terminals<br>Modbus: Control via Modbus network |
| Comms | Detects if the communications bus has failed or become inactive<br>To keep the bus active there must be at least one Modbus read or write (any PNU) during the "Comms Time” period (ModbusPNU 147)<br>Trip On: Communication trip enabled<br>Trip Off: External Trip is disabled |
| CommsTime | Communications trip Timeout period<br>To prevent a 'Communications Trip' (if enabled) the bus must be kept active<br>To keep the bus active there must be at least one Modbus read or write (any PNU) during the "Timeout ms” period |
| Cont Delay | Time allowed for external contactors to close<br>Increase if contactors are driven by buffer relays or motor trips on phase loss when start signal applied<br>Decrease if response to start signal needs to be improved |

## Function Descriptions (continued)

| | |
|---|---|
| CT Fault | Detects if the internal current sensors have failed or reading a very low level<br>Trip On: The unit will trip if the internal current sensors fail or the current measured falls to a very low level<br>Trip Off: Will continue to operate even if the sensor has failed. Measurements and overload protection may be effected |
| Date | Enter current date<br>Date format can be set to either dd/mm/yyyy or mm/dd/yyyy. Refer to "Date format" parameter |
| DateFormat | Allows the date format to be changed<br>dd/mm/yy or mm/dd/yy or yy/mm/dd |
| Delay Angle | Internal firing delay angle in Degrees<br>Displayed for diagnostic purposes |
| Disp Time | Time for backlight on display<br>After the period set the back light on the screen will turn off<br>To reactivate touch screen anywhere. To disable set to 0 |
| Factory Rst | Restores the unit to the factory defaults |
| Fan Fault | Detects if the cooling fans have failed<br>Trip On: The unit trips if the cooling fans fitted to the unit fail<br>Trip Off: Will continue to operate and is likely to trip on a thermal trip as the heatsink will not be sufficiently cooled |
| Fire Mode | A special feature that allows the unit to operate with ALL of the trips OFF<br>Set " Cntrl Funct" to "D2 FireMode" , Enabled when D2 is high<br>Although the unit will keep running in this mode it may become damaged<br>In some instances, the damage may inhibit a subsequent starts<br>This is only to be used in an emergency |
| Frequency | The frequency of the 3-phase supply |
| From USB | Allows the user to load parameters stored on a USB flash drive<br>Uploads the parameters from the USB drive to the unit<br>Data is stored in CSV format |
| HS Temp C | The temperature of the internal unit heatsink<br>The unit will trip when the heatsink temperature exceeds 80°C |

## Function Descriptions (continued)

| | |
|---|---|
| HS Temp F | The temperature of the internal unit heatsink<br>The unit will trip when the heatsink temperature exceeds 176°F<br>The optional cooling fans will turn on if this temperature exceeds 104°F |
| I Limit | Selects trip or continue if the current limit has been active for too long<br>Trip On: The unit will trip<br>Trip Off: The start will continue regardless of the motor current level |
| I Low | This can be used to detect if the motor is running lightly loaded<br>Trip On: The unit will trip. This feature is not active during soft start and soft stop<br>Trip Off: The unit will continue to operate regardless of motor current |
| I rms | The RMS motor current<br>Indicates average current of the 3 phases |
| I Start | Displays the peak current during the last start |
| I Stop | Displays the peak current during the last stop |
| I1 rms | The RMS current on phase L1 |
| I2 rms | The RMS current on phase L2 |
| I3 rms | The RMS current on phase L3 |
| Initial Volts | Percentage of the supply voltage applied to motor at the beginning of the soft start<br>Increase to provide more torque If the load fails to break away<br>Decrease if the motor accelerates too quickly |
| Kick Level | Percentage of the supply voltage applied to the motor during the ‘kick' period<br>Increase to provide more torque If the load fails to break away<br>Decrease if the motor accelerates too quickly |
| Kick Start | Applies a short duration torque pulse to dislodge 'sticky' loads<br>On: The torque pulse is applied at start-up when complete the torque drops to the "Initial Volts"<br>Off: The initial starting torque is defined by the "Initial Volts" |

## Function Descriptions (continued)

| | |
|---|---|
| Kick Time | Time that the torque pulse is applied to load<br>Increase to provide more torque If the load fails to break away<br>Decrease if the motor accelerates too quickly |
| Last Trip | |
| Limit Amps | The current in Amps at which the soft Start ramp is held<br>Normally set to 350% of motor FLC<br>Increase if motor fails to accelerate at required rate<br>The "Limit Amps" will affect actual time to start<br>If set too low the motor may not accelerate to full speed |
| Limit Time | The maximum time allowed for the current limit<br>If the current limit is still active at the end of this period, the unit will either 'Trip' or 'continue' |
| MenuBuild | Menu Version |
| Modbus Enable | Enable using Modbus<br>On: The unit is enabled<br>Off: The unit is disabled |
| Modbus Reset | Reset using Modbus<br>On: The initial state required for a reset<br>Off: The final state required for a reset<br>To reset pulse high and then low |
| Modbus Start | Start / Stop using Modbus<br>On: Starts the unit<br>Off: Stops or Soft stops the unit |
| Model No | The device Model number stored at the point of manufacture |
| Motor Amps | This should be set to the Full Load Current shown on the motor plate<br>The overload works with multiples of the set "Motor Amps"<br>Also referred to as Motor FLA |
| MotorState | Indicates the unit operating State |
| Op Mode | |

## Function Descriptions (continued)

| | |
|---|---|
| Overheat | Detects if the internal temperature sensor has malfunctioned<br>Trip On: The unit will trip if the internal temperature sensor malfunctions<br>Trip Off: The unit will continue to operate even if the temperature sensor has malfunctioned<br>Operating with the Trip Off for prolonged periods may result in SCR failure |
| Overload | The unit has an "Overload" function that is an electronic equivalent to a thermal overload<br>Overload displays the overload capacity which is a measure of how close the unit to tripping on "Overload Trip"<br>When "Irms" is greater than the "Overload Amps" the "Overload" increases in accordance with the "Trip Class"<br>When "Current Irms" is less than "Overload Level" the "Overload" decreases exponentially (if greater than 50%)<br>When the "Overload" reaches 100% the unit will trip<br>During situations when "Motor Amps" is equal to "unit Amps" the overload will indicate 50% |
| Overload Trip | The unit has an "Overload" function that is an electronic equivalent to a thermal overload<br>Trip On: The unit will trip when the "Overload" capacity (Modbus PNU 27) exceeds 100%<br>Trip Off: The unit will continue to operate regardless of motor current level |
| Ovld Amps | Determines the level in Amps at which the overload will start<br>Normally set to 115% of the set "Motor Amps"<br>Reduce to speed up trip response |
| Parity | Sets the serial communications parity bit<br>The available parity options are None Even Odd<br>Also, sets the stop bits. No parity uses 2 stop bits. Odd or even parity uses 1 stop bit |
| Patch Addr 1 through 16 | Used to arrange the Modbus Parameters into Groups<br>Refer to MAN-AGY-002-V01 for more details |

## Function Descriptions (continued)

| | |
|---|---|
| Ph/SCR | Detects for various issues when "Starting" or " Stopping"<br>Detects for input phase loss/output phase loss/SCR misfire<br>Trip On: Trips if there is an input phase loss/motor side phase loss/SCR misfire<br>Trip Off: The unit will attempt to run although the operation may be erratic<br>Operating in this mode for prolonged periods may result in SCR failure |
| Phase Loss | Detects for various issues when the start signal is applied<br>Detects for input phase loss/input phase relationship<br>Trip On: Trips if there is an input phase loss/supply out of balance<br>Trip Off: The unit will attempt to run although the operation may be erratic<br>Operating in this mode for prolonged periods may result in SCR failure |
| Rated Amps | Unit Class20/Class30 Current Rating |
| RelayFunct | Allows the n/c relay (21 -22) to be reconfigured<br>Available options are 22 = TOR or 22 = ERR |
| Remote | For safety reasons the unit will trip during some operations if the remote start signal is active<br>Trip On: Trips if the remote start signal is active when the unit is powered up or a reset is applied<br>Trip Off: The unit will not trip and may start unexpectedly if the start signal is accidently left active |
| Rotation | Indicates the phase sequence of the incoming supply<br>RYB = ABC = L1-L2-L3<br>RBY = ACB = L1-L3-L2 |
| Save Log | Download the full log file on to the USB stick<br>The unit logs several parameters during normal and fault conditions<br>Data is stored in CSV format. Please send all downloaded files to Motortronics UK on request |
| Serial No. | The device serial number stored at the point of manufacture |
| Shear Amps | The current in Amps that will cause a "Shear Trip"<br>A trip will occur if the motor current is greater than the "Shear Amps" for the "Shear Time" |

## Function Descriptions (continued)

| | |
|---|---|
| Shear Time | The trip time for the Shearpin trip<br>A trip will occur if the motor current is greater than the "Shear Amps" for the "Shear Time" |
| Shearpin | The Shearpin is an electronic equivalent of a mechanical Shearpin<br>Trip On: The unit will trip. This feature is not active during soft start and soft stop<br>Trip Off: The unit will continue to operate regardless of motor current level |
| Start Time | Time taken to soft start from the "Initial Volts" to the end of the start<br>Normally set between 5 and 30 seconds<br>Actual time to get to full voltage depends on the "Limit Amps"<br>If set too long the motor can be at speed before the end of the time set |
| Stop Time | The time taken to soft stop from full voltage to the end of the stop<br>Normally set between 15 and 30 seconds<br>Actual time to get to the final voltage depends on the "Limit Amps"<br>If set too long the motor may reach zero speed before the end of the time set |
| Store Param | Saves all Read/Write parameters to non-volatile memory<br>Yes: Parameters are permanently written<br>No: Parameters remain changed until next power cycle |
| System | Detects if the Control Board has failed to operate normally<br>Trip On: System Trip enabled<br>Trip Off: System Trip disabled |
| T Start | Displays the time of the last start |
| T Stop | Displays the time of the last stop |
| Tempunit | Selects °C or °F for displayed temperatures<br>°C: All displayed temperatures are °C<br>°F: All displayed temperatures are °F |
| Time | Allows the time to be changed to 'local' time<br>By default, the time is set to GMT |

## Function Descriptions (continued)

| | |
|---|---|
| To USB | Allows the user to save parameters<br>Downloads the parameters from the unit to the USB drive<br>Data is stored in CSV format |
| Total Events | The total number of events that have been recorded in the log file |
| Total Run | The total number of times the unit as successfully got to the "Running" State<br>The Running state is active when the unit is operating at full voltage<br>When operating at full voltage the internal bypass relays are closed |
| Total Starts | The total number of successful starts |
| Total Uc On | The total number of times the unit has been powered up<br>The unit is powered up by applying a voltage to Uc<br>Uc will be 24V or 110V/230V depending on model |
| Total Uc Off | The total number of times the unit has been powered down<br>The unit is powered down by removing the voltage at Uc<br>Uc will be 24V or 110V / 230V depending on model |

## Function Descriptions (continued)

| | |
|---|---|
| Trip 0 | Displays the last Fault trip |
| Trip 1 | Displays the last Fault trip -1 |
| Trip 2 | Displays the last Fault trip -2 |
| Trip 3 | Displays the last Fault trip -3 |
| Trip 4 | Displays the last Fault trip -4 |
| Trip 5 | Displays the last Fault trip -5 |
| Trip 6 | Displays the last Fault trip -6 |
| Trip 7 | Displays the last Fault trip -7 |
| Trip 8 | Displays the last Fault trip -8 |
| Unit Amps | Unit Class10 Current Rating |
| Version | Software Version for the Main control PCB<br>Software version recorded in log file |
| Window 1 though 24 | Used to arrange the Modbus Parameters into Groups |
| Window Code | Used to arrange the Modbus Parameters into Groups |
| Window View | Used to arrange the Modbus Parameters into Groups |

# Trip and Fault Codes

| Trip Code | Trip Name | Description |
|---|---|---|
| 101-199 | Ph Loss | Input phase voltage missing or motor discontinuity at the instant of startup<br>Check all incoming and outgoing connections<br>If a main contactor is being controlled by a digital output check contactor delay is sufficient |
| 201-299 | Thermal | Internal heatsink temperature has exceeded 90°C<br>It is possible the Unit is operating outside specified limits<br>Check enclosure ventilation and airflow around the Unit. If the unit trips immediately the internal temperature sensor could be faulty |
| 301-399 | Ph/SCR | Input phase voltage missing or motor discontinuity or SCR failure<br>Check all incoming and outgoing connections<br>ISOLATE SUPPLY<br>Check by measuring the resistance between L1-T1  L3-T3 (Anything < 10R is assumed short circuit) |
| 601-699 | Uc Low | The internal control supply of the Unit level has fallen to a low level<br>Can be caused by a weak 24VDC control supply<br>Ensure 24VDC supply meets the requirements specified in the Quick Start Guide |
| 1101-1199 | Low Amp | The motor current has been lower than the low trip level for the low trip time<br>This trip is not active during soft start and soft stop and is "off" by default<br>If the low current trip is not required turn "off" in "Trip Settings" |
| 1201-1299 | Limit | The motor has been held in current limit longer than the "Current limit Time"<br>It is likely that the current limit level has been set too low for the application<br>Increase the current limit level or timeout period |
| 1301-1399 | Overload | The "Overload" has exceeded 100%<br>The Unit is attempting to start an application that is outside its capacity or it is starting too often<br>Refer to the overload trip curves to determine whether the Unit has been sized correctly |
| 1401-1499 | Shear | The motor current has been higher than the "Shearpin Trip Level" for the trip time<br>This trip is not active during soft start and soft stop and is "off" by default<br>If Shearpin trip is not required turn "off" in "Trip Settings" |

## Trip and Fault Codes (continued)

| Trip Code | Trip Name | Description |
|---|---|---|
| 1701-1799 | Comms | Communications failure<br>The command or status PNU has not been polled in the time set in the "Timeout" period<br>If the communication trip is disabled the Unit cannot be stopped in the communications fail |
| 1801-1899 | Bypass | One or more of the internal bypass relays has failed to close or open<br>The internal bypass relay has failed or the control supply is to weak<br>Ensure 24Vdc supply meets the requirements specified in the Quick Start Guide |
| 2001-2099 | Remote | The remote start signal is active<br>The remote start signal was active during power up or Reset or Parameter Load<br>Turn off remote or if Remote On trip is not required turn "off" in "Trip Settings" |
| 2101-2199 | Rotation | Checks the input phase rotation<br>The phase rotation is opposite to that required<br>Change phase rotation or if the trip is not required turn "off" in trip settings |
| 2201-2299 | Op1 | Fail Safe operation<br>A process associated with the Control Board has been affected and is unable to recover automatically |
| 2301-2399 | CT Fault | Current sensor failure<br>One or more of the internal sensors used to measure current has failed or is reading a low value<br>Check the connections to the supply and motor as disconnection will result in a zero current reading. Check the plate FLA of the motor being controlled is at least 25% of the "i-motor" rating |
| 11001-11099 | Op2 Pnu | Fail Safe operation<br>A process associated with the Control Board has been affected and is unable to recover automatically |
| 12001-12099 | Op2 Mod | Fail Safe operation<br>A process associated with the Control Board has been affected and is unable to recover automatically |

## Trip and Fault Codes (continued)

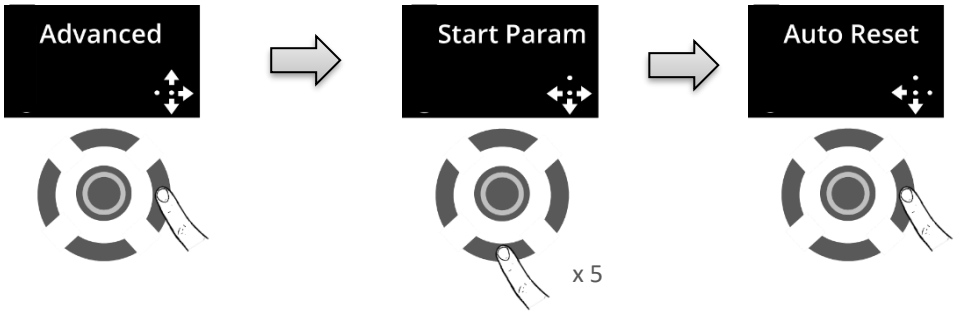
| Trip Code | Trip Name | Description |
|---|---|---|
| 13001-13099 | Op2 Mon | Fail Safe operation<br>A process associated with the Control Board has been affected and is unable to recover automatically |
| 14001-14099 | Op2 Men | Fail Safe operation<br>A process associated with the Control Board has been affected and is unable to recover automatically |
| 15001-15099 | Op2 Keys | Fail Safe operation<br>A process associated with the Control Board has been affected and is unable to recover automatically |
| 16001-16099 | Op2 Motr | Fail Safe operation<br>A process associated with the Control Board has been affected and is unable to recover automatically |
| 17001-17099 | Op2 Log | Fail Safe operation<br>A process associated with the Control Board has been affected and is unable to recover automatically |
| 18001-18099 | Op2 Disk | Fail Safe operation<br>A process associated with the Control Board has been affected and is unable to recover automatically |

# Auto Reset Function

The Auto Reset feature automatically resets a selected number of faults and then attempts a start without user intervention. The time between the resets and the number of reset attempts are both programmable. If the Auto Reset has been successful, the Starter must operate trip free for a set time before the counters are re-initialised. If the number of attempts exceeds the set value, the Auto Reset terminates, and the counters will be re-initialised when a Reset or Stop signal is given by the user.

**WARNING:**
When Auto Reset is enabled, a tripped motor may restart automatically after the Reset Delay time. This may result in equipment damage or personal injury if the function is used in an unsuitable application. Do not use this function without considering applicable local, national, and international standards, regulations, or industry guidelines.

The Auto-Reset function is accessible from the Advanced Menu (see Auto-Reset section of parameter summaries):




From the Auto Reset menu various functions are accessed:




Toggles the Auto Reset On or Off

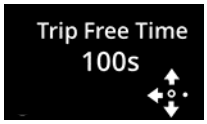



Sets delay between trip and Auto Reset

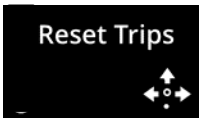



Number of permissible Auto Reset attempts

# Auto Reset Function (continued)




The time the unit must be trip free before the counter is set to zero




Press Right key to assign trips to Auto Reset function




Example of trip assigned to Auto Reset function (Up/Down keys to view and select trips

### Auto Reset Assignable Trips

| | |
|---|---|
| Phase Loss | Comms |
| Thermal | Bypass |
| ScrFire | Control |
| Ph/SCR | Remote |
| HzHighLow | Rotation |
| UcLow | Operation 1 |
| SCRSen | CT Fault |
| Fan | Operation2 |
| Spare900 | Operation3 |
| Spare1000 | Operation4 |
| I Low | Operation5 |
| I Limit | Operation6 |
| Overload | Operation7 |
| Shearpin | Operation8 |
| Spare1500 | Operation9 |
| External | Operation10 |

# Auto Reset Function (continued)

### Auto Reset Function Descriptions

| | |
|---|---|
| AR Attempts | The number of Reset Attempts remaining |
| AR Delay | The amount of time remaining in the Reset Delay counter |
| AR Exceeded | Indicates that the maximum number of reset attempts has been reached<br>Yes: The number of reset attempts has exceeded the value set<br>No: The number of reset attempts has not exceeded the value set<br>To map to digital output refer to PNU154/PNU300 |
| AR Pending | Indicates that the Reset Delay counter is counting down<br>Yes: The Auto Reset Delay is counting down<br>No: The Auto Reset Delay is not counting down<br>To map to digital output refer to PNU154/PNU300 |
| AR Trip Event | The trip that occurred just prior to the auto reset |
| AR Trip Free | The amount of time remaining in the Trip Free Time counter |

## Auto Reset Function (continued)

| | |
|---|---|
| Auto Reset | Enables the Auto Reset Feature<br>Refer to Auto Reset section for more details<br>On: The Auto Reset feature is enabled<br>Off: The Auto Reset feature is disabled and all counters will be re-initialised |
| Bypass | Allows the user to select whether the unit will auto reset if a Bypass Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |
| Comms | Allows the user to select whether the unit will auto reset if a Comms Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |
| Control | Allows the user to select whether the unit will auto reset if a Control Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |
| CT Fault | Allows the user to select whether the unit will auto reset if a CT Fault Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |
| External | Allows the user to select whether the unit will auto reset if a External Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |

## Auto Reset Function (continued)

| | |
|---|---|
| Fan | Allows the user to select whether the unit will auto reset if a Fan Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |
| HzHighLow | Allows the user to select whether the unit will auto reset if a HzHighLow Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |
| I Limit | Allows the user to select whether the unit will auto reset if a I Limit Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |
| Operation 1 | Allows the user to select whether the unit will auto reset if a Operation1 Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |
| Operation10 | Allows the user to select whether the unit will auto reset if a Operation10 Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |
| Operation2 | Allows the user to select whether the unit will auto reset if a Operation2 Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |

## Auto Reset Function (continued)

| | |
|---|---|
| Operation3 | Allows the user to select whether the unit will auto reset if a Operation3 Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |
| Operation4 | Allows the user to select whether the unit will auto reset if a Operation4 Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |
| Operation5 | Allows the user to select whether the unit will auto reset if a Operation5 Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |
| Operation6 | Allows the user to select whether the unit will auto reset if a Operation6 Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |
| Operation7 | Allows the user to select whether the unit will auto reset if a Operation7 Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |
| Operation8 | Allows the user to select whether the unit will auto reset if a Operation8 Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |

## Auto Reset Function (continued)

| | |
|---|---|
| Operation9 | Allows the user to select whether the unit will auto reset if a Operation9 Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |
| Overload | Allows the user to select whether the unit will auto reset if a Overload Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |
| Ph/SCR | Allows the user to select whether the unit will auto reset if a Ph/SCR Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |
| Phase Loss | Allows the user to select whether the unit will auto reset if a Phase Loss Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |
| Relay 13 14 | Allows the n/c relay (13 -14) to be reconfigured<br>Available options are End Of Start or Fault or Run or Pending or Exceeded |
| Remote | Allows the user to select whether the unit will auto reset if a Remote Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |

## Auto Reset Function (continued)

| | |
|---|---|
| Reset Attempts | The number of restart attempts allowed before the Auto Reset terminates. If the Auto Reset has been successful, the counter is reset back to its maximum value when the unit has been running fault free for the Trip Free Time<br>If the Auto Restart has been unsuccessful the counters are re-initialised by applying a reset signal or removing the start signal. If this PNU is set to zero at any point the Auto Reset feature will terminate and the counters will be re-initialised<br>The number of attempts remaining can be viewed in the Monitor menu |
| Reset Delay | The delay between the trip event and the automatic reset, the unit will re-start following the reset if the start signal is active<br>If this is set to zero at any point the Auto Reset feature will terminate and the counters will be re-initialised<br>When the delay is active the Restart Pending parameter is set and the time remaining can be viewed in the monitor menu |
| Rotation | Allows the user to select whether the unit will auto reset if a Rotation Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |
| ScrFire | Allows the user to select whether the unit will auto reset if a ScrFire Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |
| SCRSen | Allows the user to select whether the unit will auto reset if a SCRSen Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |

## Auto Reset Function (continued)

| | |
|---|---|
| Shearpin | Allows the user to select whether the unit will auto reset if a Shearpin Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |
| Thermal | Allows the user to select whether the unit will auto reset if a Thermal Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |
| Trip Free Time | The time the unit must be run trip free before the counters are re-initialised back to zero<br>If this PNU is set to zero at any point the Auto Reset feature will terminate and the counters will be re-initialised<br>The Trip Free Time can be viewed in the Monitor menu |
| UcLow | Allows the user to select whether the unit will auto reset if a UcLow Trip occurs<br>On: The trip will auto reset when the Reset Delay reaches zero<br>Off: The trip will not auto reset |

# Auto Reset Function (continued)

**Two-Wire, Three-Wire and Communications Control**

**(Control Supply maintained)**

The Auto reset operates with two-wire, three-Wire and communications start/stop.

In Two-Wire the motor will not start if the start signal is low, however in 3-wire and communications control the motor may start without a direct start signal (although it is implied as no stop had been given during the reset delay period).

**Control Supply Loss**

When the control supply is removed the microcontroller is unable to make calculations in real time. To overcome this the calculations are made retrospectively when the starter powers up.

**Two Wire:** Following a control supply loss the Start signal must be retained (Fig 2).

**Three Wire:** The state of the start signal is saved when the control supply is removed and if it was set to 'start' the Auto Reset will continue at power up. When operating in this mode the motor may start at power up without a start signal being present (Fig 3).

**Modbus/Communications:** The state of the start signal is saved when the control supply is removed and if it was set to 'start' the Auto Reset will continue at power up. When operating in this mode the motor may start at power up without a start signal being present (Fig 3).

**Auto Restart Termination:** If the time to re-establish the power exceeds the Reset Delay x Reset Attempts the Auto Reset Terminates.

**Overload Trip**

Following an overload trip (1301) the overload % will be at 100% and then cool exponentially to 0% after several minutes. If a re-start is attempted too soon the starter will trip again as the overload % would not have cooled to a sufficient level (Fig 5).

It must be ensured the Reset Delay is long enough to allow the overload to cool. This is also the case for the heatsink over temperature trip.

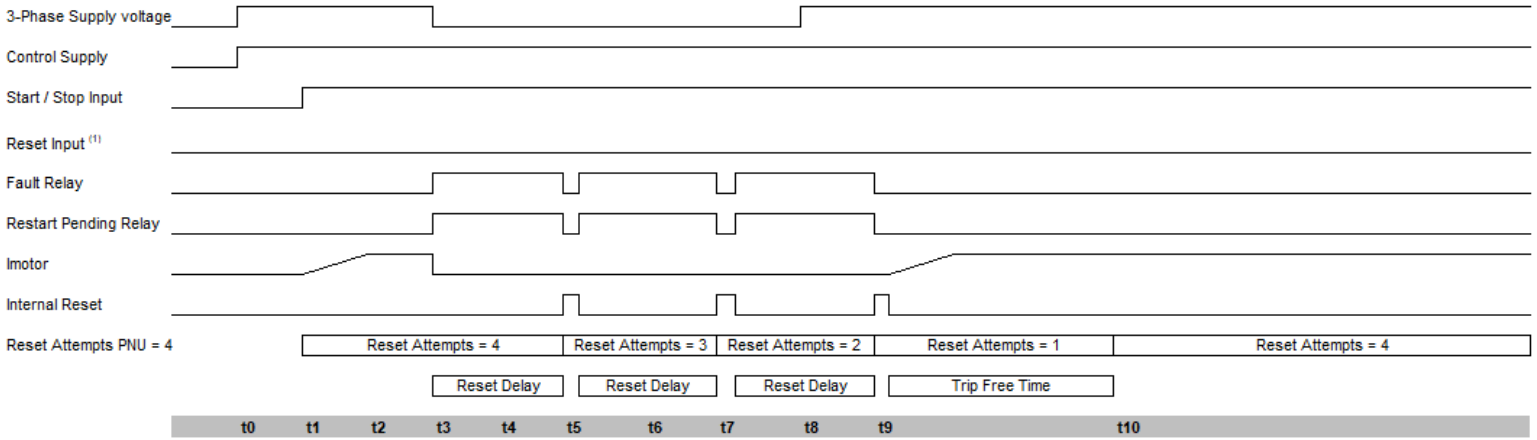
**Remote Start on Trip**

If Auto Reset is turned on some of the Remote Start On trips are disabled and will be ignored.

# Auto Reset Function (continued)

## Fig 1 : Auto Reset - Two Wire -Three Phase Supply Loss

The timing diagrams show the auto reset with a maintained two wire control system
The fault shown is a 3-phase supply loss only, the Control Supply maintained
The 3-Phase power is re-established (after the 2nd attempt ) before the Reset Attempts counter is depleted
This assumes the start signal is maintained, if it is removed the Auto Reset terminates
Once power has been re-established there are no further outages and the counters are reset after the trip free time.




**Sequence of events**

t0 3 phase supply applied
t1 Start signal applied, motor starts
t2 Motor reaches full voltage
t3 3 phase supply removed
t4 Start signal must still be applied
If it has been removed Auto Reset feature re-initialises
t5 Reset delay = 0 Restart Attempt = 3
t6 Rest Signal must be low
If the trip is reset the Auto Reset feature re-initialises
t7 Reset delay = 0 Restart Attempt = 2
t8 3-Phase re-established
t9 Reset delay = 0 Restart Attempt = 1
t10 Trip Free Delay = 0 Restart Attempt = 4

**User Parameters (R/W)**

| PNU | Range | Default |
|---|---|---|
| Auto Reset | Off / On | Off |
| Reset Delay | 0-7200s | 0s |
| Reset Attempts | 0-10 | 0 |
| Reset Trips | All resettable trips | - |
| Trip Free Time | 0-7200s | 600s |

**Monitor Parameters (R/O)**

| PNU | Range |
|---|---|
| Auto Reset Pending | 0-1 |
| Auto Reset Exceeded | 0-1 |
| Auto Reset Delay Remaining | 0-7200s |
| Auto Reset Attempts Remaining | 0-10 |
| Auto Reset Trip Free Time Remaining | 0-7200s |

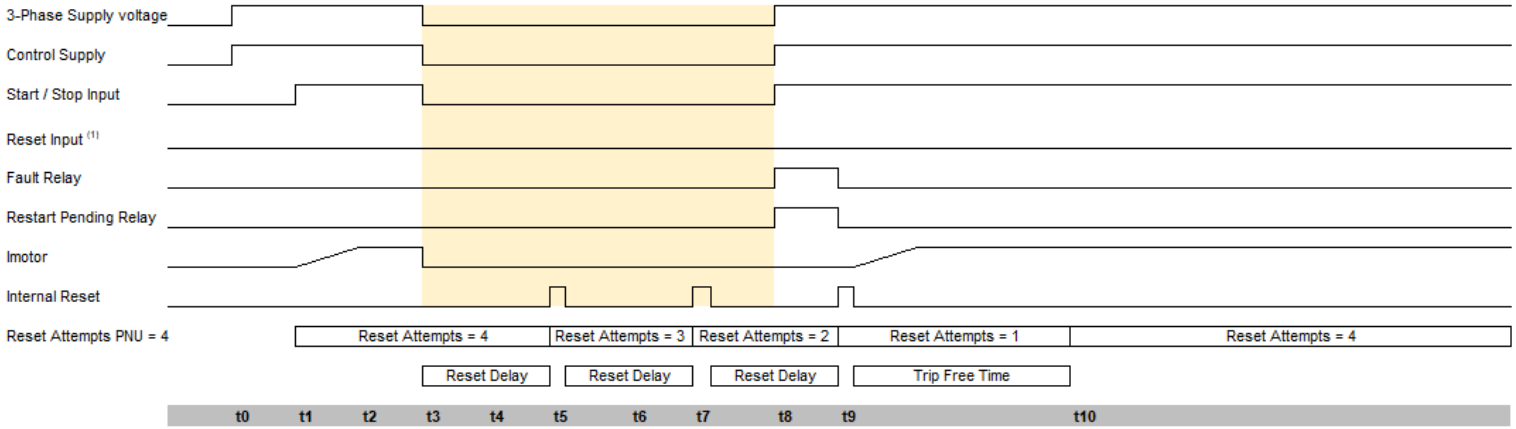
**Notes**

For Two Wire control reset occurs automatically when the start signal changes state from low to high, reset shown is programmable reset input (1)

# Auto Reset Function (continued)

## Fig 2 : Auto Reset - Two Wire - Control Supply Loss

The timing diagrams show the auto reset with a maintained two wire control system
The fault shown is a 3-phase supply loss **and** Control supply loss
The 3-Phase power and control supply are re-established (after the 2nd attempt) before the Reset Attempts counter is depleted
This assumes the start signal is maintained, if it is removed the Auto Reset terminates
Once power has been re-established there are no further outages and the counters are reset after the trip free time.




**Sequence of events**

t0 3 phase supply applied
t1 Start signal applied, motor starts
t2 Motor reaches full voltage
t3 3 phase supply removed
t5 Reset delay = 0 Restart Attempt =3
t7 Reset delay = 0 Restart Attempt = 2
t8 3-Phase re-established
Start signal must still be applied
If it has been removed Auto Reset feature re-initialises
If the trip is reset the Auto Reset feature re-initialises
t9 Reset delay = 0 Restart Attempt = 1
t10 Trip Free Delay = 0 Restart Attempt = 4

**User Parameters (R/W)**

| PNU | Range | Default |
|---|---|---|
| Auto Reset | Off / On | Off |
| Reset Delay | 0-7200s | 0s |
| Reset Attempts | 0-10 | 0 |
| Reset Trips | All resettable trips | - |
| Trip Free Time | 0-7200s | 600s |

**Monitor Parameters (R/O)**

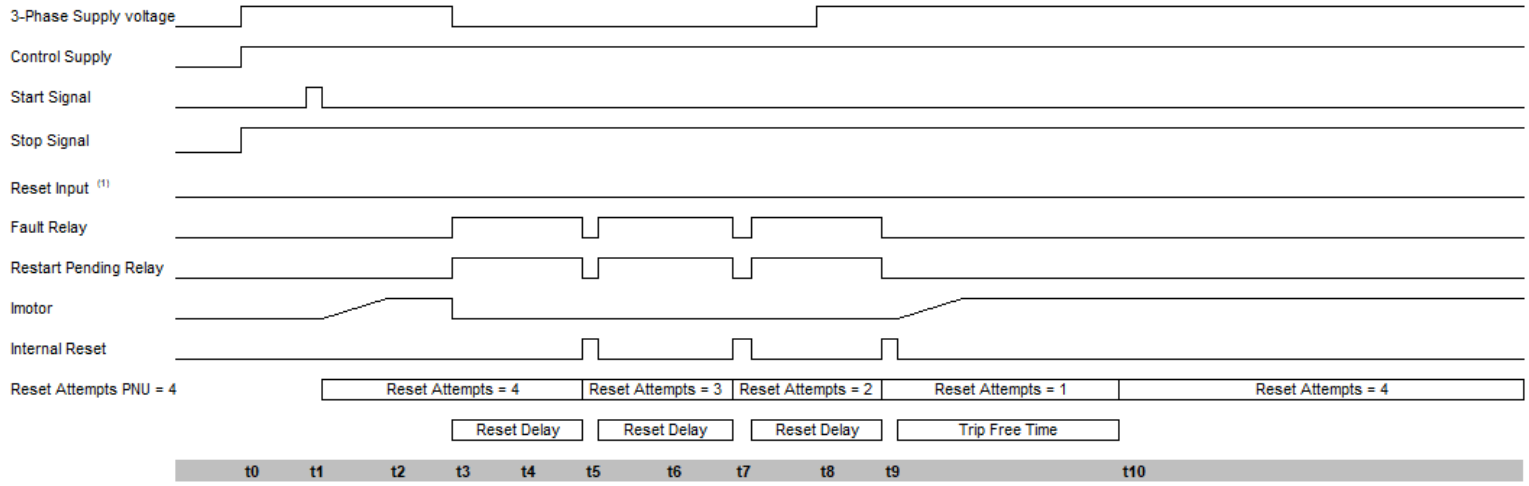
| PNU | Range |
|---|---|
| Auto Reset Pending | 0-1 |
| Auto Reset Exceeded | 0-1 |
| Auto Reset Delay Remaining | 0-7200s |
| Auto Reset Attempts Remaining | 0-10 |
| Auto Reset Trip Free Time Remaining | 0-7200s |

**Notes**
The Starter is powered down between t3 and t8 ( yellow shaded region)
During this time controller is unable to make the calculations in real time
To overcome this the calculations are made retrospectively at time t8
The Start Signal must be maintained, if it is not the Auto Restart will be terminated
For Two Wire control reset occurs automatically when the start signal changes state from low to high, reset shown is programmable reset input (1)
If the time to re-establish the power exceeds (Reset Delay x Reset Attempts) to Auto Reset terminates

# Auto Reset Function (continued)

## Fig 3 : Auto Reset - Three Wire - Three Phase Supply Loss

The timing diagrams show the auto reset with Three wire / Modbus control
The fault shown is a 3-phase supply loss only, the Control Supply maintained
The 3-Phase power is re-established (after the 2nd attempt ) before the Reset Attempts counter is depleted
This assumes the momentary stop signal is not activated, if it is the Auto Reset terminates
Once power has been re-established there are no further outages and the counters are reset after the trip free time.




**Sequence of events**

t0 3 phase supply applied
t1 Start signal applied, motor starts
t2 Motor reaches full voltage
t3 3 phase supply removed
t4 Start signal must still be applied
If it has been removed Auto Reset feature re-initialises
t5 Reset delay = 0 Restart Attempt =3
t6 Rest Signal must be low
If the trip is reset the Auto Reset feature re-initialises
t7 Reset delay = 0 Restart Attempt =2
t8 3-Phase re-established
t9 Reset delay = 0 Restart Attempts =1
t10 Trip Free Delay = 0 Restart Attempts =4

**User Parameters (R/W)**

| PNU | Range | Default |
|---|---|---|
| Auto Reset | Off / On | Off |
| Reset Delay | 0-7200s | 0s |
| Reset Attempts | 0-10 | 0 |
| Reset Trips | All resettable trips | - |
| Trip Free Time | 0-7200s | 600s |

**Monitor Parameters (R/O)**

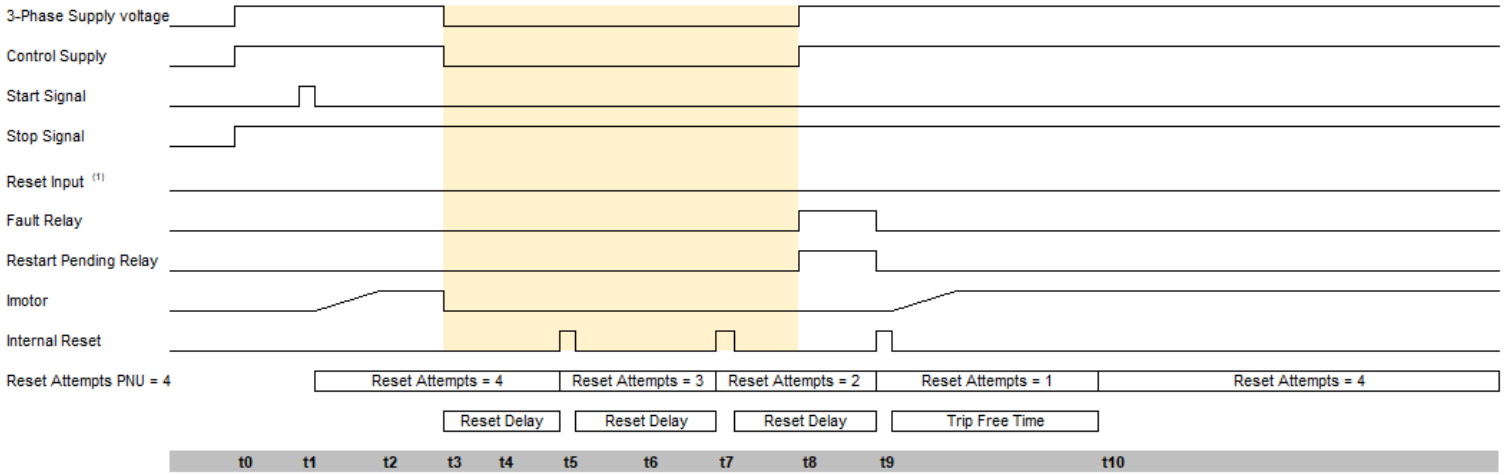
| PNU | Range |
|---|---|
| Auto Reset Pending | 0-1 |
| Auto Reset Exceeded | 0-1 |
| Auto Reset Delay Remaining | 0-7200s |
| Auto Reset Attempts Remaining | 0-10 |
| Auto Reset Trip Free Time Remaining | 0-7200s |

**Notes**
(1) Seperate reset signal not avialble on all products

# Auto Reset Function (continued)

### Fig 4 : Auto Reset - Three Wire - Control Supply Loss

The timing diagrams show the auto reset with Three wire / Modbus control
The fault shown is a 3-phase supply loss **and** Control supply loss
The 3-Phase power and control supply are re-established (after the 2nd attempt) before the Reset Attempts counter is depleted
This assumes the momentary stop signal is not activated, if it is the Auto Reset terminates
Once power has been re-established there are no further outages and the counters are reset after the trip free time.




**Sequence of events**

t0 3 phase supply applied
t1 Start signal applied, motor starts
t2 Motor reaches full voltage
t3 3 phase supply removed
t5 Reset delay = 0 Restart Attempts = 3
t7 Reset delay = 0 Restart Attempts = 2
t8 3-Phase re-established
Start signal must still be applied
If it has been removed Auto Reset feature re-initialises
Rest Signal must be low
If the trip is reset the Auto Reset feature re-initialises
t9 Reset delay = 0 Restart Attempts = 1
t10 Trip Free Delay = 0 Restart Attempts = 4

**User Parameters (R/W)**

| PNU | Range | Default |
|---|---|---|
| Auto Reset | Off / On | Off |
| Reset Delay | 0-7200s | 0s |
| Reset Attempts | 0-10 | 0 |
| Reset Trips | All resettable trips | - |
| Trip Free Time | 0-7200s | 600s |

**Monitor Parameters (R/O)**

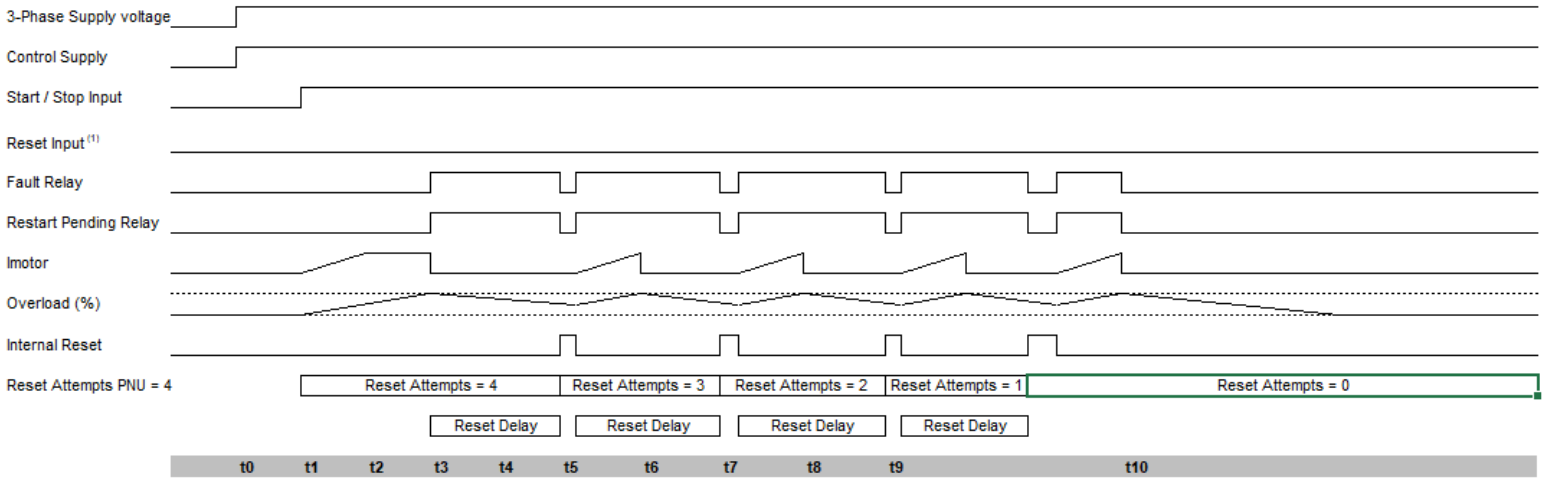
| PNU | Range |
|---|---|
| Auto Reset Pending | 0-1 |
| Auto Reset Exceeded | 0-1 |
| Auto Reset Delay Remaining | 0-7200s |
| Auto Reset Attempts Remaining | 0-10 |
| Auto Reset Trip Free Time Remaining | 0-7200s |

**Notes**
The controller is powered down between t3 and t8 ( yellow shaded region)
During this time controller is unable to make the calculations in real time
To overcome this the calculations are made retrospectively at time t8
Start signal state saved at power down and loaded at power up. **This means it will start without a start signal being present**
If the time to re-establish the power exceeds (Reset Delay x Reset Attempts) to Auto Reset terminates
(1) Seperate reset signal not avialble on all products

# Auto Reset Function (continued)

### Fig 5 : Auto Reset - Two Wire - Overload

The timing diagrams show the auto reset with a maintained two wire control system
The fault shown is an overload trip, the Control Supply maintained
In this instance the Auto Reset clears the trip but the overload (%) will take a certain amount of time to decay
If insufficient time is left before re-starts the overload will trip again repeatably until the Reset Attempts count exceeds it set value.
This must be considered and enough time left to allow the overload to decay to a low level




**Sequence of events**

t0 3 phase supply applied
t1 Start signal applied, motor starts
t2 Motor reaches full voltage
t3 3 phase supply removed
t4 Start signal must still be applied
If it has been removed Auto Reset feature re-initialises
t5 Reset delay = 0 Restart Attempts =3
t6 Rest Signal must be low
If the trip is reset the Auto Reset feature re-initialises
t7 Reset delay = 0 Restart Attempts = 2
t8 3-Phase re-established
t9 Reset delay = 0 Restart Attempts = 1
t10 Trip Free Delay = 0 Restart Attempts = 0

**User Parameters (R/W)**

| PNU | Range | Default |
|---|---|---|
| Auto Reset | Off / On | Off |
| Reset Delay | 0-7200s | 0s |
| Reset Attempts | 0-10 | 0 |
| Reset Trips | All resettable trips | - |
| Trip Free Time | 0-7200s | 600s |

**Monitor Parameters (R/O)**

| PNU | Range |
|---|---|
| Auto Reset Pending | 0-1 |
| Auto Reset Exceeded | 0-1 |
| Auto Reset Delay Remaining | 0-7200s |
| Auto Reset Attempts Remaining | 0-10 |
| Auto Reset Trip Free Time Remaining | 0-7200s |

**Notes**

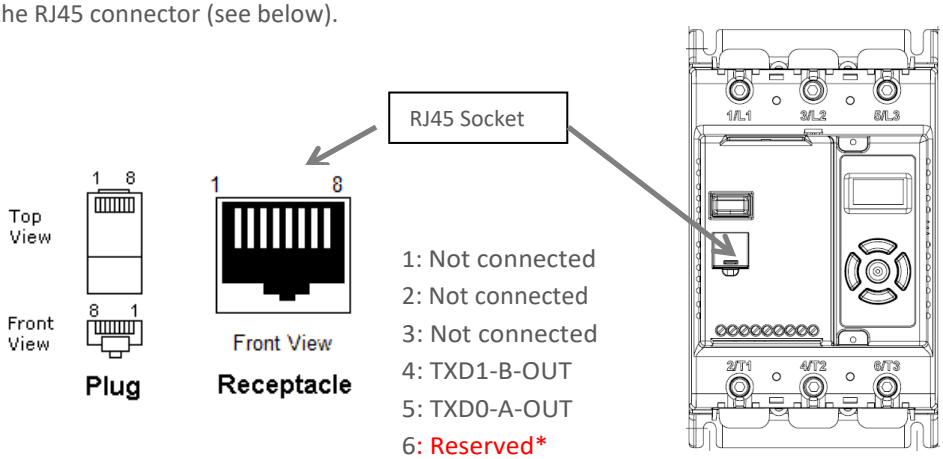
In this instance the starter has failed to Auto Restart in the set number of attempts
The starter will remain in the tripped state until reset
To overcome this the Reset Delay time should be extended to allow the overload to cool
For Two Wire control reset occurs automatically when the start signal changes state from low to high, reset shown is programmable reset input (1)

# Communication

## Modbus RTU Serial Communications

### Modbus RTU Communications Interface

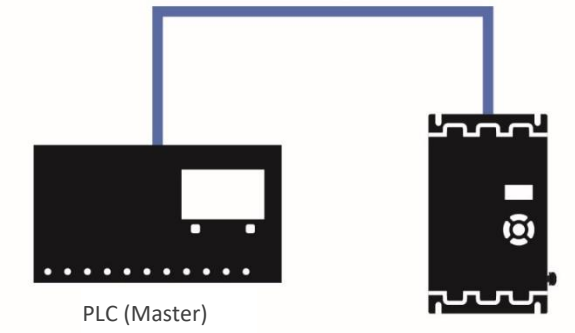
All VMX-agility™ soft starts support Modbus RTU as standard. The RS-485 communications are accessible from the RJ45 connector (see below).



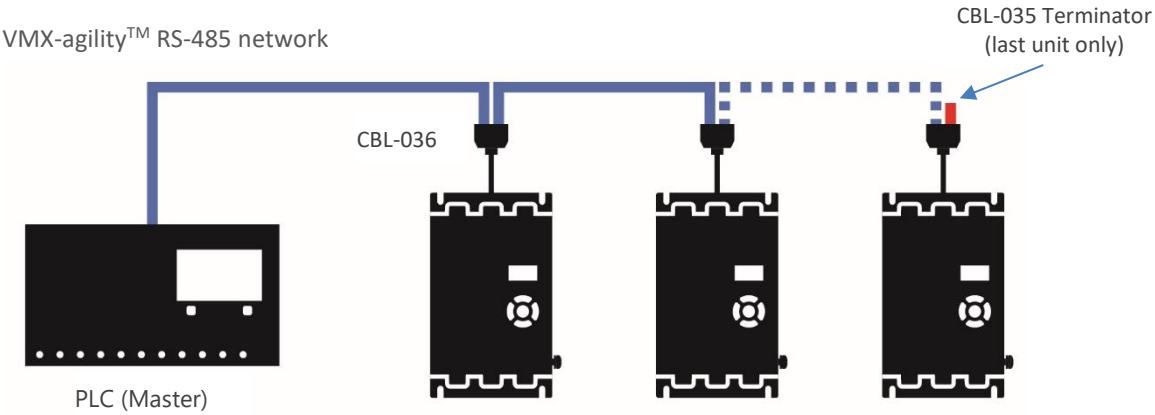

*Warning: To avoid damage to the unit or to the RS-485 master, do NOT connect to these pins!

### Modbus RTU Connections

Single VMX-agility™ RS-485 network




Multiple VMX-agility™ RS-485 network




**The VMX-agility™ units must have: a unique Modbus address on each unit and identical Parity/Baud rate values on each unit**

# Communication (continued)

## Modbus Communications Configuration

The Modbus communication settings may be configured from the Device menu:

Device >> Networks >> Modbus Network Settings >> Address (1 –32)

Device >> Networks >> Modbus Network Settings >> Baud (9600 –115200)

Device >> Networks >> Modbus Network Settings >> Parity (Odd / Even)

(Data bits = 8, Stop bits = 1)

The communication parameters should be set before connecting the Modbus master.

## Transmission Modes

ASCII and RTU transmission modes are defined in the Modbus protocol specification. VMX-agility™ uses *only the RTU mode* for the message transmission.

## Message Structure For RTU Mode

The Modbus RTU structure uses a master-slave system for message exchange. In the case of the VMX-agility™ system, it allows up to 32 slaves, and one master. Every message begins with the master making a request to a slave, which responds to the master in a defined structure. In both messages (request and answer), the used structure is the same:

- Address, Function Code, Data and CRC

***Master (request message):***

| Address (1 byte) | Function (1 byte) | Request Data (n bytes) | CRC (2 bytes) |
|---|---|---|---|

***Slave (response message):***

| Address (1 byte) | Function (1 byte) | Response Data (n bytes) | CRC (2 bytes) |
|---|---|---|---|

## Address

The master initiates the communication by sending a byte with the address of the destination slave. When responding, the slave also initiates the message with its own address. Broadcast to address 0 (zero) is not supported.

## Function Code

This field contains a single byte, where the master specifies the type of service or function requested to the slave (reading, writing, etc.). According to the protocol, each function is used to access a specific type of data.

## Data Field

The format and contents of this field depend on the function used and the transmitted value.

# Communication (continued)

### CRC

The used method is the CRC-16 (Cyclic Redundancy Check). This field is formed by two bytes; where first the least significant byte is transmitted (CRC-), and then the most significant (CRC+). The CRC calculation form is described in the Modbus RTU protocol specification.

### Supported Functions

Modbus RTU specification defines the functions used to access different types of data.

VMX-agility™ parameters are defined as *holding type registers*.

For Modbus RTU/TCP Client devices that use Modicon style addressing, place a 4 as the high digit followed by the Modbus address defined in the parameter mapping table. Note that VMX-agility™ Modbus addressing starts at zero; not 1 as some devices do.

VMX-agility™ 32-bit parameters are High Word/Low Word in Modbus format.

The following services are available:

#### Read Holding Registers

Description: reading register blocks of holding register type (block R/W limited to 8 registers).

- Function code: 03 example

| Modbus Function 03 Transaction Table | | | |
|---|---|---|---|
| *Query* | | *Response* | |
| *Field* | *Hex Byte* | *Field* | *Hex Byte* |
| Slave address | 01 | Slave address | 01 |
| Function | 03 | Function | 03 |
| Start address Hi | 00 | Byte count | 02 |
| Start address Lo | 01 | Data Hi | 01 |
| No of registers Hi | 00 | Data Lo | 2C |
| No of registers Lo | 01 | CRC Lo | B8 |
| CRC Lo | D5 | CRC Hi | 09 |
| CRC Hi | CA | | |

# Communication (continued)

**Write Single Register**

Description: writing in a single register of the holding type.

- Function code: 06 example

| Modbus Function 06 Transaction Table | | | |
|---|---|---|---|
| *Query* | | *Response* | |
| *Field* | *Hex Byte* | *Field* | *Hex Byte* |
| Slave address | 01 | Slave address | 01 |
| Function | 06 | Function | 06 |
| Address Hi | 00 | Address Hi | 02 |
| Address Lo | 0C | Address Lo | 0C |
| Data Hi | 00 | Data Hi | 00 |
| Data Lo | 09 | Data Lo | 09 |
| CRC Lo | 48 | CRC Lo | 88 |
| CRC Hi | 0C | CRC Hi | 77 |

## Write Multiple Registers

Description: writing register blocks of holding register type (block R/W limited to 8 registers).

Function code: 16 example

| Modbus Function 16 Transaction Table | | | |
|---|---|---|---|
| *Query* | | *Response* | |
| *Field* | *Hex Byte* | *Field* | *Hex Byte* |
| Slave address | 01 | Slave address | 01 |
| Function | 10 | Function | 10 |
| Address Hi | 00 | Address Hi | 00 |
| Address Lo | 01 | Address Lo | 01 |
| # Words Hi | 00 | # Words Hi | 00 |
| # Words Lo | 01 | # Words Lo | 01 |
| # Bytes | 02 | CRC Lo | 50 |
| Data Hi | 00 | CRC Hi | 09 |
| Data Lo | 02 | | |
| CRC Lo | 26 | | |
| CRC Hi | 40 | | |

# Modbus RTU Parameters

## Memory Map

VMX-agility™ Modbus communication is based on reading or writing equipment parameters from or to the holding registers. The data addressing is zero offset, such that the parameter Modbus address corresponds to the register number.

| Modbus Address Memory Map | | |
|---|---|---|
| *Parameter Modbus Address* | *Modbus Data Address* | |
| | *Decimal* | *Hex* |
| 0000 | 0 | 0000h |
| 0001 | 1 | 0001h |
| • • • • | • • • • | • • • • |
| 0128 | 128 | 0080h |
| • • • | • • • • | • • • • |

## Message Timing

In the RTU mode there is no specific start or stop byte that marks the beginning or the end of a message. Indication of when a new message begins or when it ends is achieved by the absence of data transmission for a minimum period of 3.5 times the transmission time of a data byte. Thus, in case a message is transmitted after this minimum time has elapsed; the network elements will assume that the first received character represents the beginning of a new message.

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 1 | Cntrl Mode | Selects the method for starting and controlling the motor<br><br>Local: Control using the button on the keypad<br><br>Remote: Control using the terminals<br><br>Modbus: Control via Modbus network | 0=Local, 1=Remote, 2=Modbus. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 2<br>Default: 0 |
| 2 | Initial Volts | Percentage of the supply voltage applied to motor at the beginning of the soft start<br><br>Increase to provide more torque If the load fails to break away<br><br>Decrease if the motor accelerates too quickly | | 1 | R/W | % | Multiplier: 100<br>Divisor: 16384<br>Offset: 0<br>Min: 1638<br>Max: 13107<br>Default: 3277 |
| 4 | Start Time | Time taken to soft start from the "Initial Volts" to the end of the start<br><br>Normally set between 5 and 30 seconds<br><br>Actual time to get to full voltage depends on the "Limit Amps"<br><br>If set too long the motor can be at speed before the end of the time set | | 1 | R/W | s | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 1<br>Max: 30<br>Default: 10 |
| 5 | Stop Time | The time taken to soft stop from full voltage to the end of the stop<br><br>Normally set between 15 and 30 seconds<br><br>Actual time to get to the final voltage depends on the "Limit Amps"<br><br>If set too long the motor may reach zero speed before the end of the time set | | 1 | R/W | s | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 30<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 6 | Start Delay | Time allowed for external contactors to close<br><br>Increase if contactors are driven by buffer relays or motor trips on phase loss when start signal applied<br><br>Decrease if response to start signal needs to be improved | | 1 | R/W | ms | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 100<br>Max: 30000<br>Default: 160 |
| 7 | Serial No | The device serial number stored at the point of manufacture | | 4 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 255<br>Default: 0 |
| 11 | Model No | The device Model number stored at the point of manufacture | | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 101<br>Max: 113<br>Default: 101 |
| 14 | Version | Software Version for the Main control PCB<br><br>Software version recorded in log file | | 2 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |

# Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 16 | Application | The Unit has numerous pre-set applications built in as standard<br>Select the application best suited to the load<br>The selected application will automatically change several parameters and functions<br>Depending on the application loaded the “Trip Class" may also change<br>Refer to the separate 'applications section' for more details | See Table 1 | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 23<br>Default: 0 |
| 17 | Trip Class | The trip class is a numeric value that correlates the trip time with overload level<br>Select Trip class according to application requirements<br>The trip time depends on the selected "Trip Class" the duration of the overload and the level of the over current<br>Refer to the Motor Overload 'cold' trip curves given in the Guide<br>When "Class 20" or "Class30" are selected the Unit current rating (Unit Amps) will be reduced to a lower value (Rated Amps) | 10=Class10,<br>20=Class20,<br>30=Class30. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 10<br>Max: 30<br>Default: 10 |
| 18 | Motor Amps | This should be set to the Full Load Current shown on the motor plate<br><br>The overload works with multiples of the set "Motor Amps"<br><br>Also referred to as Motor FLA | | 2 | R/W | A | Multiplier: 1<br>Divisor: 1000<br>Offset: 0<br>Min: 0.1 x PNU18<br>Max: 1 x PNU20<br>Default: 1 x PNU20 |

# Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 20 | Rated Amps | Unit Class20/Class30 Current Rating | | 2 | R | A | Multiplier: 1<br>Divisor: 1000<br>Offset: 0<br>Min: 17000<br>Max: 66000<br>Default: 17000 |
| 22 | Unit Amps | Unit Class10 Current Rating | | 2 | R | A | Multiplier: 1<br>Divisor: 1000<br>Offset: 0<br>Min: 17000<br>Max: 66000<br>Default: 17000 |
| 24 | MotorState | Indicates the Unit Operating State | See Table 2 | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 25 | I rms | The RMS motor current<br><br>The average of the 3 phases<br><br>This value is used for the current Limit and overload features | | 2 | R | A | Multiplier: 1<br>Divisor: 1000<br>Offset: 0<br>Min: 0<br>Max: 24<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 27 | Overload | The Unit has an "Overload" function that is an electronic equivalent to a thermal overload<br>Overload displays the overload capacity which is a measure of how close the Unit to tripping on "Overload Trip"<br>When "Irms" is greater than the "Overload Amps" the "Overload" increases in accordance with the "Trip Class"<br>When "Current Irms" is less than "Overload Level" the "Overload" decreases exponentially (if greater than 50%)<br>When the "Overload" reaches 100% the Unit will trip<br>During situations when "Motor Amps" is equal to "Unit Amps" the overload will indicate 50% | | 1 | R | % | Multiplier: 10<br>Divisor: 16384<br>Offset: 0<br>Min: 0<br>Max: 16384<br>Default: 0<br>During situations when "Motor Amps" is equal to "Unit Amps" the overload will indicate 50% |
| 30 | Frequency | The frequency of the 3-phase supply | | 1 | R | Hz | Multiplier: 1<br>Divisor: 1000<br>Offset: 0<br>Min: 45000<br>Max: 65000<br>Default: 0 |
| 31 | Factory Rst | Restores the Unit to the factory defaults | 0=Idle,<br>1=Active. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 32 | Store Param | Saves all Read/Write parameters to non-volatile memory<br><br>Yes: Parameters are permanently written<br><br>No: Parameters remain changed until next power cycle | 0=Idle, 1=Active. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 0 |
| 33 | Save Log | Download the full log file on to the USB stick<br><br>The Unit logs several parameters during normal and fault conditions<br><br>Data is stored in CSV format. Please send all downloaded files to Motortronics UK on request | 0=Idle, 1=Active. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 0 |
| 34 | Date | Enter current date<br><br>Date format can be set to either dd/mm/yyyy or mm/dd/yyyy. Refer to "Date format" parameter | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 35 | Time | Allows the time to be changed to 'local' time<br><br>By default the time is set to GMT | | 2 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 37 | Rotation | Indicates the phase sequence of the incoming supply<br><br>RYB = ABC = L1-L2-L3<br><br>RBY = ACB = L1-L3-L2 | 0=------,<br>1=L1L2L3,<br>2=L1L3L2. | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 2<br>Default: 0 |
| 39 | HS Temp C | The temperature of the internal Unit heatsink<br><br>The Unit will trip when the heatsink temperature exceeds 80°C<br><br>The internal cooling fans will turn on if this temperature exceeds 40°C | | 1 | R | C | Multiplier: 1<br>Divisor: 16<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 40 | HS Temp F | The temperature of the internal Unit heatsink<br><br>The Unit will trip when the heatsink temperature exceeds 176°C<br><br>The internal cooling fans will turn on if this temperature exceeds 104°F | | 1 | R | F | Multiplier: 9<br>Divisor: 80<br>Offset: 32<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 41 | I1 rms | The RMS current on phase L1 | | 2 | R | A | Multiplier: 1<br>Divisor: 1000<br>Offset: 0<br>Min: 0<br>Max: 24<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 43 | I2 rms | The RMS current on phase L2 | | 2 | R | A | Multiplier: 1<br>Divisor: 1000<br>Offset: 0<br>Min: 0<br>Max: 24<br>Default: 0 |
| 45 | I3 rms | The RMS current on phase L3 | | 2 | R | A | Multiplier: 1<br>Divisor: 1000<br>Offset: 0<br>Min: 0<br>Max: 24<br>Default: 0 |
| 47 | Delay Angle | Internal firing delay angle in Degrees<br><br>Displayed for diagnostic purposes | | 1 | R | ° | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 180<br>Default: 0 |
| 48 | AGY100 Ver | The hardware version for display PCB | | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 1 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 49 | Phase Loss | Detects for various issues when the start signal is applied<br>Detects for input phase loss/input phase relationship/motor side loss<br>Trip On: Trips if there is an input phase loss/supply out of balance/ motor side loss<br>Trip Off: The Unit will attempt to run although the operation may be erratic<br>Operating with the Trip Off for prolonged periods may result in SCR failure | 0=Trip Off,<br>1=Trip On. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 50 | Overheat | Detects if the internal temperature sensor has malfunctioned<br>Trip On: The Unit will trip if the internal temperature sensor malfunctions<br>Trip Off: The Unit will continue to operate even if the temperature sensor has malfunctioned<br>Operating with the Trip Off for prolonged periods may result in SCR failure | 0=Trip Off,<br>1=Trip On. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 51 | Ph/SCR | Detects for various issues when "Starting" or " Stopping"<br>Detects for input phase loss/output phase loss/SCR misfire<br>Trip On: Trips if there is an input phase loss/motor side phase loss/ SCR misfire<br>Trip Off: The Unit will attempt to run although the operation may be erratic<br>Operating with the Trip Off for prolonged periods may result in SCR failure | 0=Trip Off,<br>1=Trip On. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 58 | I Low | This can be used to detect if the motor is running lightly loaded<br><br>Trip On: The Unit will trip. This feature is not active during soft start and soft stop<br><br>Trip Off: The Unit will continue to operate regardless of motor current | 0=Trip Off, 1=Trip On. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 0 |
| 59 | I Limit Start | Selects trip or continue if the current limit has been active for too long<br><br>Trip On: The Unit will trip<br><br>Trip Off: The start will continue regardless of the motor current level | 0=Trip Off, 1=Trip On. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 60 | Overload | The Unit has an "Overload" function that is an electronic equivalent to a thermal overload<br><br>Trip On: The Unit will trip when the "Overload" capacity (Modbus PNU 27) exceeds 100%<br><br>Trip Off: The Unit will continue to operate regardless of motor current level | 0=Trip Off, 1=Trip On. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 61 | Shearpin | The Shearpin is an electronic equivalent of a mechanical Shearpin<br><br>Trip On: The Unit will trip. This feature is not active during soft start and soft stop<br><br>Trip Off: The Unit will continue to operate regardless of motor current level | 0=Trip Off, 1=Trip On. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 64 | Comms | Detects if the communications bus has failed or become inactive<br><br>To keep the bus active there must be at least one Modbus read or write (any PNU) during the "Comms Time" period (ModbusPNU 147)<br><br>Trip On: Communication trip enabled<br><br>Trip Off: External Trip is disabled | 0=Trip Off, 1=Trip On. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 66 | Remote | For safety reasons the Unit will trip during some operations if the remote start signal is active<br><br>Trip On: Trips if the remote start signal is active when the Unit is powered up or a reset is applied<br><br>Trip Off: The Unit will not trip and may start unexpectedly if the start signal is accidently left active | 0=Trip Off, 1=Trip On. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 67 | CT Fault | Detects if the internal current sensors have failed or reading a very low level<br><br>Trip On: The Unit will trip if the internal current sensors fail or the current measured falls to a very low level<br><br>Trip Off: Will continue to operate even if the sensor has failed. Measurements and overload protection may be affected | 0=Trip Off, 1=Trip On. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 68 | Operation 1 | Detects if the Control Board has failed to operate normally<br><br>Trip On: System Trip enabled<br><br>Trip Off: System Trip disabled | 0=Trip Off, 1=Trip On. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 69 | Limit Amps | The current in Amps at which the soft Start ramp is held<br>Normally set to 350% of motor FLC<br>Increase if motor fails to accelerate at required rate<br>The "Limit Amps" will affect actual time to start<br>If set too low the motor may not accelerate to full speed | | 2 | R/W | A | Multiplier: 1<br>Divisor: 1000<br>Offset: 0<br>Min: 0.5 x PNU18<br>Max: 5 x PNU20<br>Default: 3.5 x PNU20 |
| 71 | Limit Time | The maximum time allowed for the current limit<br>If the current limit is still active at the end of this period the Unit will either 'Trip' or 'continue' | | 1 | R/W | s | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 1<br>Max: 60<br>Default: 30 |
| 72 | Boot Ver | Software Version for the Bootloader | | 2 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 74 | Cntrl Funct | Allows the Digital inputs to be mapped to different functions Cntrl Mode must be set to "Remote"<br>Two Wire: D1 = Start (Reset) / Stop<br>Three Wire: D1 = Start (Reset) D2 = Stop<br>D2 Reset, D2 Hold, D2 Enable, D2 Fire: D1= Start /Stop, D2 programmed as shown | 0=Three Wire,<br>1=Two Wire,<br>2=D2 Reset,<br>3=D2 Hold,<br>4=D2 Enable,<br>5=D2 Fire. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 5<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 75 | Op Mode | Allows the unit to operate with a single phase motor<br><br>3 phase: Set to control a three phase motor<br><br>1 Phase: Set to control a single phase motor | 0=3 phase, 1=1 phase. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 0 |
| 77 | Trip 0 | Displays the last Fault trip | See Table 3 | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 78 | Trip 1 | Displays the last Fault trip -1 | See Table 3 | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 79 | Trip 2 | Displays the last Fault trip -2 | See Table 3 | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 80 | Trip 3 | Displays the last Fault trip -3 | See Table 3 | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 81 | Trip 4 | Displays the last Fault trip -4 | See Table 3 | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 82 | Trip 5 | Displays the last Fault trip -5 | See Table 3 | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 83 | Trip 6 | Displays the last Fault trip -6 | See Table 3 | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 84 | Trip 7 | Displays the last Fault trip -7 | See Table 3 | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 85 | Trip 8 | Displays the last Fault trip -8 | See Table 3 | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 86 | MenuBuild | Menu Version | | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 87 | Kick Level | Percentage of the supply voltage applied to the motor during the 'kick' period<br><br>Increase to provide more torque If the load fails to break away<br><br>Decrease if the motor accelerates too quickly | | 1 | R/W | % | Multiplier: 100<br>Divisor: 16384<br>Offset: 0<br>Min: 3277<br>Max: 13107<br>Default: 9830 |

# Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 88 | Kick Time | Time that the torque pulse is applied to load<br><br>Increase to provide more torque If the load fails to break away<br><br>Decrease if the motor accelerates too quickly | | 1 | R/W | ms | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 100<br>Max: 2000<br>Default: 100 |
| 89 | Kick Start | Applies a short duration torque pulse to dislodge 'sticky' loads<br><br>On: The torque pulse is applied at start-up when complete the torque drops to the "Initial Volts"<br><br>Off: The initial starting torque is defined by the "Initial Volts" | 0=Off,<br>1=On. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 0 |
| 90 | To USB | Allows the user to save parameters<br><br>Downloads the parameters from the Unit to the USB drive<br><br>Data is stored in CSV format | 0=Idle,<br>1=Active. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 0 |
| 91 | From USB | Allows the user to load parameters stored on a USB flash drive<br><br>Uploads the parameters from the USB drive to the Unit<br><br>Data is stored in CSV format | 0=Idle,<br>1=Active. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 94 | I Start | Displays the peak current during the last start | | 1 | R | A | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 528<br>Default: 0 |
| 95 | T Start | Displays the time of the last start | | 1 | R | s | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 90<br>Default: 0 |
| 96 | I Stop | Displays the peak current during the last stop | | 1 | R | A | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 528<br>Default: 0 |
| 97 | T Stop | Displays the time of the last stop | | 1 | R | s | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 90<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 98 | Total Events | The total number of events that have been recorded in the log file | | 2 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 103 | AGY200 Ver | The hardware version for Main PCB | | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 1 |
| 104 | AGY300 Ver | The hardware version for Power PCB | | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 1 |
| 106 | Total Uc On | The total number times the start command has been applied | | 2 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 109 | Operation 2 | Detects if the Control Board has failed to operate normally<br><br>Trip On: System Trip enabled<br><br>Trip Off: System Trip disabled | 0=Trip Off, 1=Trip On. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 110 | Reserved | No user function | | | | | |
| 114 | Shear Amps | The current in Amps that will cause a "Shear Trip"<br><br>A trip will occur if the motor current is greater than the "Shear Amps" for the "Shear Time" | | 2 | R/W | A | Multiplier: 1<br>Divisor: 1000<br>Offset: 0<br>Min: 1 x PNU18<br>Max: 5 x PNU22<br>Default: 3.5 x PNU18 |
| 116 | Shear Time | The trip time for the Shearpin trip<br><br>A trip will occur if the motor current is greater than the "Shear Amps" for the "Shear Time" | | 1 | R/W | s | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 1<br>Max: 10<br>Default: 1 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 119 | Modbus Enable | Enable using Modbus<br><br>On: The unit is enabled<br><br>Off: The unit is disabled | 0=Off,<br>1=On. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 0 |
| 120 | Modbus Start | Start/Stop using Modbus<br><br>On: Starts the Unit<br><br>Off: Stops or Soft stops the Unit | 0=Off,<br>1=On. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 0 |
| 121 | Modbus Reset | Reset using Modbus<br><br>On: The initial state required for a reset<br><br>Off: The final state required for a reset<br><br>To reset pulse high and then low | 0=Off,<br>1=On. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 0 |
| 143 | Fire Mode | A special feature that allows the Unit to operate with ALL of the trips OFF<br>Set "Cntrl Funct" to "D2 Fire Mode”, Enabled when D2 is high<br>Although the unit will keep running in this mode it may become damaged<br>In some instances the damage may inhibit a subsequent starts<br>This is only to be used in an emergency | 0=Off,<br>1=On. | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 145 | TempUnit | Selects °C or °F for displayed temperatures<br><br>°C: All displayed temperatures are °C<br><br>°F: All displayed temperatures are °F | 0=°C, 1=°F. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 0 |
| 146 | Disp Time | Time for backlight on display<br><br>After the period set the back light on the screen will turn off<br><br>To reactivate touch screen anywhere. To disable set to 0 | | 1 | R/W | s | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 7200<br>Default: 60 |
| 147 | CommsTime | Communications trip Timeout period<br><br>To prevent a 'Communications Trip' (If enabled) the bus must be kept active<br><br>To keep the bus active there must be at least one Modbus read or write (any PNU) during the "Timeout ms" period | | 1 | R/W | ms | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 60000<br>Default: 5000 |
| 148 | Address | Sets the Modbus station number | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 1<br>Max: 32<br>Default: 1 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 149 | Parity | Sets the serial communications parity bit<br><br>The available parity options are None Even Odd<br><br>Also sets the stop bits. No parity uses 2 stop bits. Odd or even parity uses 1 stop bit | 0=Odd, 1=Even. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 150 | Baud | Sets the serial communications baud rate<br><br>The available baud rates are 9600, 19200, 38400, 57600 or 115200 | 0=9600 baud,<br>1=19200 baud,<br>2=38400 baud,<br>3=57600 baud,<br>4=115200 baud. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 2<br>Default: 1 |
| 151 | DateFormat | Allows the date format to be changed<br><br>dd/mm/yy or mm/dd/yy or yy/mm/dd | 0=dd/mm/yy,<br>1=mm/dd/yy,<br>2=yy/mm/dd. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 2<br>Default: 1 |
| 153 | AGY400 Ver | Displays the hardware version for the temperature sense PCB | | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 1 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 154 | RelayFunct | Allows the n/c relay (21 -22) to be reconfigured<br><br>Available options are<br><br>22 = TOR or 22 = ER | 0=22 = TOR,<br>1=22 = ERR. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 155 | Reserved | No user function | | | | | |
| 157 | Window View | Used to arrange the Modbus Parameters into Group<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 158 | Window Code | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 159 | Reserved | No user function | | | | | |
| 160 | Patch Addr 1 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 161 | Patch Addr 2 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 162 | Patch Addr 3 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 163 | Patch Addr 4 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 164 | Patch Addr 5 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 165 | Patch Addr 6 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 166 | Patch Addr 7 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 167 | Patch Addr 8 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 168 | Patch Addr 9 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 169 | Patch Addr 10 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 170 | Patch Addr 11 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 171 | Patch Addr 12 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 172 | Patch Addr 13 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 173 | Patch Addr 14 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 174 | Patch Addr 15 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 175 | Patch Addr 16 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 176 | Window 1 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 177 | Window 2 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 178 | Window 3 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 179 | Window 4 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 180 | Window 5 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 181 | Window 6 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 182 | Window 7 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 183 | Window 8 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 184 | Window 9 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 185 | Window 10 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 186 | Window 11 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 187 | Window 12 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 188 | Window 13 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 189 | Window 14 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 190 | Window 15 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 191 | Window 16 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 192 | Window 17 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 193 | Window 18 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 194 | Window 19 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 195 | Window 20 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 196 | Window 21 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 197 | Window 22 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 198 | Window 23 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 199 | Window 24 | Used to arrange the Modbus Parameters into Groups<br><br>Refer to 'Special Modbus parameters' document for more details | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 200 | Total Us On | The total number of times the unit has been powered up<br><br>The unit is powered up by applying a voltage to Uc<br><br>Uc will be 24V or 110V/230V depending on configuration | | 2 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 202 | Total Us Off | The total number of times the unit has been powered down<br><br>The unit is powered down by removing the voltage at Uc<br><br>Uc will be 24V or 110V/230V depending on configuration | | 2 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 204 | Total Runs | The total number of times the unit as successfully got to the "Running" State<br><br>The Running state is active when the unit is operating at full voltage<br><br>When operating at full voltage the internal bypass relays are closed | | 2 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 206 | Total Stops | The total number of successful stops/soft stops | | 2 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 210 | Total Trips | The total number of trips | | 2 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 211 | Reserved | | | | | | Multiplier:<br>Divisor:<br>Offset:<br>Min:<br>Max:<br>Default: |
| 212 | Diagnostic 1 | Used for diagnostic purposes only | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 65535 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 213 | Diagnostic 2 | Used for diagnostic purposes only | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 65535 |
| 214 | Diagnostic 3 | Used for diagnostic purposes only | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 65535 |
| 215 | Diagnostic 4 | Used for diagnostic purposes only | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 65535 |
| 216 | Diagnostic 5 | Used for diagnostic purposes only | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 65535 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 217 | Diagnostic 6 | Used for diagnostic purposes only | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 65535 |
| 218 | Ovld Amps | Determines the level in Amps at which the overload will start<br><br>Normally set to 115% of the set "Motor Amps"<br><br>Reduce to speed up trip response | | 2 | R/W | A | Multiplier: 1<br>Divisor: 1000<br>Offset: 0<br>Min: 1 x PNU18<br>Max: 1.25 x PNU18<br>Default: 1.15 x PNU18 |
| 220 | Language | Selects the display language for the keypad<br><br>Enter the required language from the displayed list | 1=English, 2=Deutsch, 3=Francais, 4=Italiano, 5=Portugues, 6=Espanol. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 1<br>Max: 10<br>Default: 1 |
| 221 | Total Starts | The total number of successful starts | | 2 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 223 | L1L2L3 | Determines if supply phase sequence is incorrect for motor rotation<br><br>On: Trips if the phase sequence is L1-L2-L3<br><br>Off: The Unit will continue to operate normally | 0=Trip Off, 1=Trip On. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 0 |
| 224 | L1L3L2 | Determines if supply phase sequence is incorrect for motor rotation<br><br>On: Trips if the phase sequence is L1-L3-L2<br><br>Off: The Unit will continue to operate normally | 0=Trip Off, 1=Trip On. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 0 |
| 225 | RX Bytes | Diagnostic parameter for Modbus communications<br><br>Indicates transmission bytes are being received | | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 226 | RX Frames | Diagnostic parameter for Modbus communications<br><br>Indicates transmission frames are being received | | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 227 | RX Errors | Diagnostic parameter for Modbus communications<br><br>Indicates whether the data has errors | | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 228 | RX TMO Er | Diagnostic parameter for Modbus communications<br><br>Indicates a timing error | | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 229 | TX Bytes | Diagnostic parameter for Modbus communications<br><br>Indicates transmission bytes are being sent | | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 230 | TX Frames | Diagnostic parameter for Modbus communications<br><br>Indicates transmission frames are being sent | | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 231 | TX Errors | Diagnostic parameter for Modbus communications<br><br>Indicates whether the data has errors | | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 232 | StopCode File | Diagnostic parameter<br><br>For Motortronics UK use only | | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 65535 |
| 233 | StopCode File_1 | Diagnostic parameter<br><br>For Motortronics UK use only | | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 65535 |
| 234 | StopCode Pos | Diagnostic parameter<br><br>For Motortronics UK use only | | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 65535 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 235 | StopCode Pos_1 | Diagnostic parameter<br><br>For Motortronics UK use only | | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 65535 |
| 236 | Limit Amps | The current in Amps at which the soft stop ramp is not allowed to go above<br><br>Normally set to 350% motor FLC. Increase if motor decelerates too rapidly<br><br>The current limit level will affect actual time to stop the motor | | 2 | R/W | A | Multiplier: 1<br>Divisor: 1000<br>Offset: 0<br>Min: 0.5 x PNU18<br>Max: 5 x PNU20<br>Default: 5 x PNU20 |
| 238 | Limit Time | The maximum time allowed for the current limit<br><br>If the current limit is still active at the end of this period the Unit will either trip or continue | | 1 | R/W | s | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 1<br>Max: 60<br>Default: 2 |
| 239 | I Low Amps | The current in Amps that will cause a trip<br><br>A trip will occur if the motor current is less than the "I Low Amps" level for the "I Low Time" | | 2 | R/W | A | Multiplier: 1<br>Divisor: 1000<br>Offset: 0<br>Min: 0.25 x PNU18<br>Max: 1 x PNU18<br>Default: 0.25 x PNU18 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 241 | I Low Time | The trip time for the Low current trip<br><br>A trip will occur if the motor current is less than the "I Low Amps" level for the "I Low Time" | | 1 | R/W | s | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 1<br>Max: 60<br>Default: 30 |
| 242 | I Limit Stop | Selects trip or continue if the current limit has been active for too long<br><br>Trip On: The Unit will trip<br><br>Trip Off: The stop will continue regardless of the motor current level | 0=Trip Off, 1=Trip On. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 0 |
| 243 | Keypad Pwr | Connects the 24V dc supply a pin on the RJ45 connector<br><br>Must be turned "On" if the remote keypad is connected | 0=Off, 1=On. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 0 |
| 244 | Service No. | Diagnostic parameter<br><br>For Motortronics UK use only | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 245 | Scroll | Used to allow the text to scroll on the keypad<br><br>On: If the text is too long for the display it will scroll<br><br>Off: If the text is too long for the display the message will be truncated | 0=Off,<br>1=On. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 246 | Reset Ovld | Factory parameter<br><br>Motortronics UK use only | 0=Off,<br>1=On. | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 0 |
| 247 | StartsHr | When the fan is connected the number of fully rated starts can be increased<br><br>Without the fan connected the number of fully rated starts is 5<br><br>With the fan connected the number of fully rated starts is 40 | | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 248 | Initial Deg C | Displays the temperature of the heatsink at the beginning of the start | | 1 | R | C | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 258 | Auto Reset | Enables the Auto Reset Feature<br><br>Refer to Auto Reset section for more details<br><br>On: The Auto Reset feature is enabled<br><br>Off: The Auto Reset feature is disabled and all counters will be re-initialised | 0=Off,<br>1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 0 |
| 259 | Reset Delay | The delay between the trip event and the automatic reset, the unit will re-start following the reset if the start signal is active<br><br>If this is set to zero at any point the Auto Reset feature will terminate and the counters will be re-initialised<br>When the delay is active the Restart Pending parameter is set and the time remaining can be viewed in the monitor menu | | 1 | R/W | s | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 7200<br>Default: 0 |
| 260 | Reset Attempts | The number of restart attempts allowed before the Auto Reset terminates. If the Auto Reset has been successful, the counter is reset back to its maximum value when the unit has been running fault free for the Trip Free Time<br><br>If the Auto Restart has been unsuccessful the counters are re-initialised by applying a reset signal or removing the start signal. If this PNU is set to zero at any point the Auto Reset feature will terminate and the counters will be re-initialise<br><br>The number of attempts remaining can be viewed in the Monitor menu | | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 10<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 261 | Trip Free Time | The time the unit must be run trip free before the counters are re-initialised back to zero<br><br>If this PNU is set to zero at any point the Auto Reset feature will terminate and the counters will be re-initialised<br><br>The Trip Free Time can be viewed in the Monitor menu | | 1 | R/W | s | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 7200<br>Default: 600 |
| 262 | Phase Loss | Allows the user to select whether the unit will auto reset if a Phase Loss Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off, 1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 263 | Thermal | Allows the user to select whether the unit will auto reset if a Thermal Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off, 1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 264 | ScrFire | Allows the user to select whether the unit will auto reset if a ScrFire Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off, 1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 265 | Ph / SCR | Allows the user to select whether the unit will auto reset if a Ph/SCR Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off, 1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 266 | HzHighLow | Allows the user to select whether the unit will auto reset if a HzHighLow Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off,<br>1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 267 | UcLow | Allows the user to select whether the unit will auto reset if a UcLow Trip occur<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off,<br>1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 268 | SCRSen | Allows the user to select whether the unit will auto reset if a SCRSen Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off,<br>1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 269 | Fan | Allows the user to select whether the unit will auto reset if a Fan Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off,<br>1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 270 | Spare900 | Allows the user to select whether the unit will auto reset if a Spare900 Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off,<br>1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 271 | Spare1000 | Allows the user to select whether the unit will auto reset if a Spare1000 Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off,<br>1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 272 | I Low | Allows the user to select whether the unit will auto reset if a I LOW Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off,<br>1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 273 | I Limit | Allows the user to select whether the unit will auto reset if a I Limit Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off,<br>1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 274 | Overload | Allows the user to select whether the unit will auto reset if a Overload Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off,<br>1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 275 | Shearpin | Allows the user to select whether the unit will auto reset if a Shearpin Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off,<br>1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 276 | Spare1500 | Allows the user to select whether the unit will auto reset if a Spare1500 Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off,<br>1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 277 | External | Allows the user to select whether the unit will auto reset if a External Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off,<br>1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 0 |
| 278 | Comms | Allows the user to select whether the unit will auto reset if a Comms Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off,<br>1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 279 | Bypass | Allows the user to select whether the unit will auto reset if a Bypass Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off,<br>1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 280 | Control | Allows the user to select whether the unit will auto reset if a Control Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off,<br>1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 281 | Remote | Allows the user to select whether the unit will auto reset if a Remote Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off,<br>1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 282 | Rotation | Allows the user to select whether the unit will auto reset if a Rotation Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off,<br>1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 283 | Operation 1 | Allows the user to select whether the unit will auto reset if a Operation1 Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off,<br>1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 284 | CT Fault | Allows the user to select whether the unit will auto reset if a CT Fault Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off,<br>1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 285 | Operation 2 | Allows the user to select whether the unit will auto reset if a Operation2 Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off,<br>1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 286 | Operation 3 | Allows the user to select whether the unit will auto reset if a Operation3 Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off, 1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 287 | Operation 4 | Allows the user to select whether the unit will auto reset if a Operation4 Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off, 1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 288 | Operation 5 | Allows the user to select whether the unit will auto reset if a Operation5 Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off, 1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 289 | Operation 6 | Allows the user to select whether the unit will auto reset if a Operation6 Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off, 1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 290 | Operation 7 | Allows the user to select whether the unit will auto reset if a Operation7 Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off, 1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 291 | Operation 8 | Allows the user to select whether the unit will auto reset if a Operation8 Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off, 1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 292 | Operation 9 | Allows the user to select whether the unit will auto reset if a Operation9 Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off, 1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 293 | Operation 10 | Allows the user to select whether the unit will auto reset if a Operation10 Trip occurs<br><br>On: The trip will auto reset when the Reset Delay reaches zero<br><br>Off: The trip will not auto reset | 0=Off, 1=On | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 1<br>Default: 1 |
| 294 | AR Pending | Indicates that the Reset Delay counter is counting down<br><br>Yes: The Auto Reset Delay is counting down<br><br>No: The Auto Reset Delay is not counting down<br><br>To map to digital output refer to PNU154/PNU300 | | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 295 | AR Exceeded | Indicates that the maximum number of reset attempts has been reached<br><br>Yes: The number of reset attempts has exceeded the value set<br><br>No: The number of reset attempts has not exceeded the value set<br><br>To map to digital output refer to PNU154/PNU300 | | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |

## Modbus RTU Parameters (continued)

| PNU | Name | Description | Options | Words | Type | Units | Detail |
|---|---|---|---|---|---|---|---|
| 296 | AR Delay | The amount of time remaining in the Reset Delay counter | | 1 | R | s | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 297 | AR Attempts | The number of Reset Attempts remaining | | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 298 | AR Trip Free | The amount of time remaining in the Trip Free Time counter | | 1 | R | s | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 299 | AR Trip Event | The trip that occurred just prior to the auto reset | | 1 | R | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 65535<br>Default: 0 |
| 300 | Relay 13 14 | Allows the n/c relay (13 -14) to be reconfigured<br><br>Available options are End Of Start or Fault or Run or Pending or Exceeded | 0=End of start<br>1=Fault<br>2=Run<br>3=Pending<br>4=Exceeded | 1 | R/W | | Multiplier: 1<br>Divisor: 1<br>Offset: 0<br>Min: 0<br>Max: 4<br>Default: 2 |

# Modbus RTU Parameters (continued)

| Table 1 | |
|---|---|
| ***PNU 16 Value*** | ***Auto Application*** |
| 0 | Default |
| 1 | Heavy |
| 2 | Agitator |
| 3 | Compressor 1 |
| 4 | Compressor 2 |
| 5 | Conveyor Loaded |
| 6 | Conveyor Unloaded |
| 7 | Crusher |
| 8 | Fan High Inertia |
| 9 | Fan Low Inertia |
| 10 | Grinder |
| 11 | Mill |
| 12 | Mixer |
| 13 | Moulding M/C |
| 14 | Press Flywheel |
| 15 | Pump 1 |
| 16 | Pump 2 |
| 17 | PumpJack |
| 18 | Saw-Band |
| 19 | Saw-Circular |
| 20 | Screen Vibrating |
| 21 | Shredder |
| 22 | Woodchipper |

| Table 2 | |
|---|---|
| ***PNU 24 Value*** | ***Status*** |
| 20 | Starting |
| 22 | Fire Mode |
| 25 | Limit Start |
| 35 | Limit Stop |
| 40 | Stopping |
| 60 | Running |
| 128 | Ready |
| 140 | Tripped |
| 200 | Disabled |
| 250 | Initialisation |

# Modbus RTU Parameters (continued)

| Table 3 | |
|---|---|
| **PNU 78 thru 85** | **Trip Status** |
| 100 | Ph Loss |
| 200 | Thermal |
| 300 | Ph/SCR |
| 400 | Mot Side |
| 500 | Freq |
| 600 | Uc Low |
| 700 | SCR Sen |
| 800 | Fan |
| 1000 | SCR S/C |
| 1100 | Low Amp |
| 1200 | Limit |
| 1300 | Overload |
| 1400 | Shear |
| 1500 | PTC |
| 1600 | External |
| 1700 | Comms |
| 1800 | Bypass |
| 1900 | FireMode |
| 2000 | Remote |
| 2100 | Rotation |
| 2200 | Op1 |
| 2300 | CT Fault |
| 1100 | Op2 Pnu |
| 1200 | Op2 Mod |
| 13000 | Op2 Mon |
| 14000 | Op2 Men |
| 15000 | Op2 Keys |
| 16000 | Op2 Motr |
| 17000 | Op2 Log |
| 18000 | Op2 Disk |

# Modbus RTU Parameters (continued)

## Special Modbus Registers

List of **special** Modbus registers, descriptions, and usage.

### Window registers section

There is a section of Modbus registers that can be used for special (user programmable) purposes.

| Register Name | Reg ID | Description |
|---|---|---|
| Window View | 157 | Selects what is viewed through the window<br>0 – Patched Registers<br>1 – Log Records |
| Window Code | 158 | Log Record function<br>0 – None<br>1 – Report<br>2 – Rewind<br>3 – Unwind<br>4 – Seek Absolute<br>5 – Seek Relative<br>6 – Next Record<br>16 – Auto Increment |
| Reserved | 159 | For future functionality |
| Patch Address 1 to 16 | 160 to 175 | 16 place holders for the registers that need to be patched |
| Window 1 to 24 | 176 to 199 | Either:<br>If Window View set to 0<br>16 data holders related to the selected addresses in the Patch Address section (in Window 1 to 16 only)<br>Or<br>For Window View set to 1<br>All 24 words to hold the currently select log record |

Currently there are two uses for this group of Modbus registers. (1) Register patching and (2) Log record access.

1) Register patching.

   Register patching is enabled when the Window View register (address 157) is set a to Patched Registers (value 0).

   It allows the user to patch (re-map) a selection of disparate registers into a contiguous register section or window, so that retrieval of the most requested data can be handled in more efficient single block reads by a host controller (PLC). When the address of a register is placed in the Patch section (addresses 160 to 175) then the corresponding 16 bit WORD(s) in the Window section (addresses 176 to 192) will mirror the data and function of those registers.

# Modbus RTU Parameters (continued)

For example, if address 24 (Motor State) is set into register 160 (first Patch Address) then the value report at 176 (first Window address) will be the Motor State from then on.

| Register Name | Register Number | Register Value | | Patch Register | Patch Value | Window Register | Window Value |
|---|---|---|---|---|---|---|---|
| Motor State | 24 | 128 | | 160 | 24 | 176 | 128 |

Consideration needs to be given to registers that produce multiple WORD data. For example, address 22 (Unit Amps) produces a 32 bit or 2 WORD datum. To mirror both of those WORDs into the Window both registers 22 and 23 will need to be assigned (side by side) in to the corresponding Patch Address section.

| Register Name | Register Number | Register Value | | Patch Register | Patch Value | Window Register | Window Value |
|---|---|---|---|---|---|---|---|
| Unit Amps | 22 | 0 | | 160 | 22 | 176 | 0 |
| | | 5500 | | 161 | 23 0r 0 | 177 | 5500 |

It follows that the entire 16 Aliases can be populated with a mixture of the required data, that can then be queried from (or set to, with writable registers) with a 16 word Modbus transaction frame.

| Register Name | Register Number | Register Value | | Patch Register | Patch Value | Window Register | Window Value |
|---|---|---|---|---|---|---|---|
| Serial Number | 7 | 0x0041 | | 160 | 7 | 176 | 0x0041 |
| | | 0x3132 | | 161 | 8 or 0 | 177 | 0x3132 |
| | | 0x3334 | | 162 | 9 or 0 | 178 | 0x3334 |
| | | 0x3536 | | 163 | 10 or 0 | 179 | 0x3536 |
| Motor State | 24 | 128 | | 164 | 24 | 180 | 128 |
| Unit Amps | 22 | 0 | | 165 | 22 | 181 | 0 |
| | | 5500 | | 167 | 23 0r 0 | 182 | 5500 |

# Modbus RTU Parameters (continued)

2) Log record access.

Log record access is enabled when the Window View register (register 157) is set a to Log Records (value 1).

When Log record access is selected these can be accessed by assigning Register address 158 (Window Code) with a one of the function code values described here.

a) Report (address 158 set to value 1)

If Window Code is set to When 1 the Window registers are filled with information about the first and last record in the event log, in the following arrangement.

| Window Register numbers | Description of data copied |
|---|---|
| 176,177 | Index number of first record |
| 178,179,180 | Date and Time when the event was recorded of first record. See date Time format in Appendix |
| 181,182 | Index number of last record |
| 183,184,185 | Date and Time when the last event was recorded. See date Time format. TBD |

b) Rewind (2)

Setting Window Code to 2 will rewind the log record pointer to the first record. Subsequently when the Next Record is requested the data from the first record will be placed into the Window registers.

c) Unwind (3)

Setting Window Code to 3 will set the log record pointer to the last created record. Subsequently when the Next Record is requested the data from the last record will be placed into the Window registers.

d) Seek Absolute (4)

Setting Window Code to 4 along with setting Window 1 and 2 to the required record pointer will prepare the Next Record request to return the record with that record number.

e) Seek Relative (5)

When setting Window Code to 5, the **signed** number set into Window 1 and 2 will added to the current pointer so the Next Record request will return the record whose position is offset by that number.

f) Next Record (6)

Setting Window Code to 6 will cause the log record with the position of the current record pointer to be copied into the Window registers (addresses 176 to 199). These will then contain the following information.

# Modbus RTU Parameters (continued)

| Generic Word PNU Register number | Data Description |
|---|---|
| 176,177 | Record Index number |
| 178,179,180 | Date and Time when the event was recorded. See date Time format. See appendix |
| 181 | Event type. See event type codes. See appendix |
| 181 to 199 | Event data. See event data. See appendix |

g) Auto Increment (16)

If this value can be added (OR'ed) in with Next record (6 + 16 = 22) then each Modbus read of the Window 1 register, with or without a block read of the following 23 registers, will automatically increment the record pointer so that the next read will return information from the next record. This avoids the need to do a Next Record request before each record read. Note that if register Window 1 is read on its own, as one Modbus transaction, the subsequent reads the other higher Window registers will be from the next record. Block reads of all 24 registers is required for this function to successfully.

When an event row is request, after a Next Record function or an Auto Increment, the values recorded for that record are placed in the Window addresses 176 to 199. Specified in the table below.

| Generic Word PNU Register number | Data Description |
|---|---|
| 176,177 | Record Index number |
| 178,179,180 | Date and Time when the event was recorded. See date Time format |
| 181 | Event type. See event type codes |
| 182 to 199 | Event data. See event data |

The Date and Time is recorded in three consecutive registers. This is true for Modbus registers Date, Time, Saved Date, Saved Time and the Time stamps shown in the table below:

| Register Ordinal | Description | Detail Bit Layout of each 16 bit words | |
|---|---|---|---|
| 1 | Date | Bits 0 - 4 | Day (1 – 31) |
| | | Bits 5 - 8 | Month (1 – 12) |
| | | Bits 9 - 15 | Year (00 – 127) -> (2000 - 2127) |
| 2 | Time 1 (Hours, Minutes) | Bits 0 - 5 | Minute (0 – 59) |
| | | Bits 6 - 10 | Hour (0 – 23) |
| | | Bits 11 - 15 | Unused |
| 3 | Time 2 (Milliseconds) | Bits 0 - 9 | Milliseconds (0 – 999) |
| | | Bits 10 - 15 | Seconds (0 – 59) |

# Modbus RTU Parameters (continued)

Event Type Codes represent what kind of event the proceeding data represents.

| Code | Meaning |
|---|---|
| 1 | Initialise (boot up) |
| 10 | Power Off |
| 50 | Start Signal |
| 100 | Motor Run |
| 300 | Motor Dwell |
| 600 | Motor Stop |
| 900 | Motor Tripped |

Depending on the event type code the register addresses 182 to 197 will contain data that is described in the following table.

| | Event Type | | | | | | |
|---|---|---|---|---|---|---|---|
| **Addr** | *Initialise* | *Power Off* | *Start Signal* | *Motor Run* | *Motor Dwell* | *Motor Stop* | *Motor Tripped* |
| *182* | Version | Version | Version | Start Delay | Irms | Irms | Irms |
| *183* | Model No | AGY100 Ver | Model Number | Frequency | I1 rms | I1 rms | StopCodeFile |
| *184* | Unit Amps | AGY200 Ver | Unit Amps | Rot Degrees | I2 rms | I2 rms | StopCodeFile_1 |
| *185* | Rated Amps | AGY300 Ver | Rated Amps | Rotation | I3 rms | I3 rms | StopCodeFile |
| *186* | Motor Amps | AGY400 Ver | Motor Amps | Trip Class | Stop Time | I Stop | StopCodeFile_1 |
| *187* | MenuBuild | ODB Type | MenuBuild | Initial Volts | I Limit Stop | T Stop | StopCodePos |
| *188* | Motor State Save | OverloadSave | Op Mode | Start Time | Limit Amps | Diagnostic 1 | StopCodePos_1 |
| *189* | OverloadSave | Diagnostic 2 | Fire Mode | StartsHr | Limit Time | Diagnostic 2 | I Start |
| *190* | Keypad Pwr | Diagnostic 3 | Trip Class | Limit Amps | I Start | Diagnostic 3 | T Start |
| *191* | Trip Class | Diagnostic 4 | Application | Limit Time | T Start | Diagnostic 4 | I Stop |
| *192* | Application | Diagnostic 5 | Cntrl Mode | Shear Amps | Initial Temp | Diagnostic 5 | T Stop |
| *193* | Language | Diagnostic 6 | Cntrl Funct | Shear TIme | I Low Amps | Diagnostic 6 | CommsTime |
| *194* | I Low | Phase Loss | Relay 21 22 | Ovld Amps | I Low Time | Delay Angle | Delay Angle |
| *195* | Shearpin | Sensor Loss | Reset Attempts | HS Temp | HS Temp | HS Temp | HS Temp |
| *196* | Hz HighLow | Ph/SCR | AR Attempts | Trip Sens | Overload | Overload | Overload |
| *197* | Overload | CT Fault | Kick Start | Overload | Last Warn | Last Warn | Last Trip |

# Modbus RTU Parameters (continued)

**Memory Probes**

Each register WORD is used as two BYTEs. Each byte showing the current amount of available memory for each designation. These are used within the firmware to record and respond to low memory situations in the device operating system. Note that these have a maximum value of 0xff or 255. 0xff could mean a value greater than 0xff, so it works as a soft limit. In normal and stressed operation, it is desirable that these values never reach zero.

| Register Name | Reg ID | Size | Description<br>Free Memory |
|---|---|---|---|
| Main Memory Free | 212 | 2 x BYTE | MSByte – Main Stack<br>LSByte – Main Heap |
| Task 1&2 Free Stack | 213 | 2 x BYTE | MSByte – Task 1 Stack (Monitor)<br>LSByte – Task 2 Stack (IDLE) |
| Task 3&4 Free Stack | 214 | 2 x BYTE | MSByte – Task 3 Stack (Keys)<br>LSByte – Task 4 Stack (Menu) |
| Task 5&6 Free Stack | 215 | 2 x BYTE | MSByte – Task 5 Stack (PNU)<br>LSByte – Task 6 Stack (Modbus) |
| Task 7&8 Free Stack | 216 | 2 x BYTE | MSByte – Task 7 Stack (Disk)<br>LSByte – Task 8 Stack (Log) |
| Task 9&10 Free Stack | 217 | 2 x BYTE | MSByte – Task 9 Stack (Reserved)<br>LSByte – Task 10 Stack (Motor) |

# Modbus RTU Parameters (continued)

### Modbus PNU Alphabetical Cross Reference

(AR = Auto Reset)

| PNU | Name | PNU | Name | PNU | Name | PNU | Name |
|---|---|---|---|---|---|---|---|
| 148 | Address | 216 | Diagnostic 5 | 250 | Irms | 291 | Operation8 |
| 48 | AGY100 Ver | 217 | Diagnostic 6 | 243 | Keypad Pwr | 292 | Operation9 |
| 103 | AGY200 Ver | 146 | Disp Time | 87 | Kick Level | 27 | Overload |
| 104 | AGY300 Ver | 277 | External | 89 | Kick Start | 60 | Overload |
| 153 | AGY400 Ver | 31 | Factory Rst | 88 | Kick Time | 274 | Overload |
| 16 | Application | 269 | Fan | 223 | L1L2L3 | 218 | Ovld Amps |
| 297 | AR Attempts | 143 | Fire Mode | 224 | L1L3L2 | 149 | Parity |
| 296 | AR Delay | 30 | Frequency | 220 | Language | 160 | Patch Addr 1 |
| 295 | AR Exceeded | 91 | From USB | 69 | Limit Amps | 169 | Patch Addr 10 |
| 294 | AR Pending | 39 | HS Temp | 236 | Limit Amps | 170 | Patch Addr 11 |
| 299 | AR Trip Event | 40 | HS Temp | 71 | Limit Time | 171 | Patch Addr 12 |
| 298 | AR Trip Free | 53 | Hz HighLow | 238 | Limit Time | 172 | Patch Addr 13 |
| 258 | Auto Reset | 266 | HzHighLow | 86 | MenuBuild | 173 | Patch Addr 14 |
| 150 | Baud | 273 | I Limit | 119 | Modbus Enable | 174 | Patch Addr 15 |
| 72 | Boot Ver | 59 | I Limit Start | 121 | Modbus Reset | 175 | Patch Addr 16 |
| 279 | Bypass | 242 | I Limit Stop | 120 | Modbus Start | 161 | Patch Addr 2 |
| 74 | Cntrl Funct | 272 | I Low | 11 | Model No | 162 | Patch Addr 3 |
| 1 | Cntrl Mode | 58 | I Low | 18 | Motor Amps | 163 | Patch Addr 4 |
| 278 | Comms | 239 | I Low Amps | 24 | Motor State | 164 | Patch Addr 5 |
| 64 | Comms | 241 | I Low Time | 159 | ODB Type | 165 | Patch Addr 6 |
| 147 | CommsTime | 25 | I rms | 75 | Op Mode | 166 | Patch Addr 7 |
| 280 | Control | 94 | I Start | 68 | Operation 1 | 167 | Patch Addr 8 |
| 67 | CT Fault | 96 | I Stop | 283 | Operation 1 | 168 | Patch Addr 9 |
| 284 | CT Fault | 41 | I1 rms | 109 | Operation 2 | 51 | Ph/SCR |
| 34 | Date | 251 | I1 rms | 293 | Operation10 | 265 | Ph/SCR |
| 151 | DateFormat | 43 | I2 rms | 285 | Operation2 | 49 | Phase Loss |
| 47 | Delay Angle | 252 | I2 rms | 286 | Operation3 | 262 | Phase Loss |
| 212 | Diagnostic 1 | 45 | I3 rms | 287 | Operation4 | 20 | Rated Amps |
| 213 | Diagnostic 2 | 253 | I3 rms | 288 | Operation5 | 300 | Relay 13 14 |
| 214 | Diagnostic 3 | 248 | Initial Temp | 289 | Operation6 | 154 | Relay 21 22 |
| 215 | Diagnostic 4 | 2 | Initial Volts | 290 | Operation7 | 281 | Remote (AR) |

Continued overleaf

# Modbus RTU Parameters (continued)

## Modbus PNU Alphabetical Cross Reference (continued)

| | | | | | |
|---|---|---|---|---|---|
| 66 | Remote | 97 | T Stop | 176 | Window 1 |
| 110 | Rerate Key | 145 | TempUnit | 185 | Window 10 |
| 155 | Rerate USB | 263 | Thermal | 186 | Window 11 |
| 260 | Reset Attempts | 35 | Time | 187 | Window 12 |
| 259 | Reset Delay | 90 | To USB | 188 | Window 13 |
| 37 | Rotation | 98 | Total Events | 189 | Window 14 |
| 282 | Rotation | 204 | Total Runs | 190 | Window 15 |
| 225 | RX Bytes | 221 | Total Starts | 191 | Window 16 |
| 227 | RX Errors | 206 | Total Stops | 192 | Window 17 |
| 226 | RX Frames | 210 | Total Trips | 193 | Window 18 |
| 228 | RX TMO Er | 106 | Total Uc On | 194 | Window 19 |
| 33 | Save Log | 202 | Total Us Off | 177 | Window 2 |
| 264 | ScrFire | 200 | Total Us On | 195 | Window 20 |
| 245 | Scroll | 77 | Trip 0 | 196 | Window 21 |
| 268 | SCRSen | 78 | Trip 1 | 197 | Window 22 |
| 50 | Sensor Loss | 79 | Trip 2 | 198 | Window 23 |
| 7 | Serial No | 80 | Trip 3 | 199 | Window 24 |
| 244 | Service No | 81 | Trip 4 | 178 | Window 3 |
| 114 | Shear Amps | 82 | Trip 5 | 179 | Window 4 |
| 116 | Shear TIme | 83 | Trip 6 | 180 | Window 5 |
| 61 | Shearpin | 84 | Trip 7 | 181 | Window 6 |
| 275 | Shearpin | 85 | Trip 8 | 182 | Window 7 |
| 6 | Start Delay | 17 | Trip Class | 183 | Window 8 |
| 4 | Start Time | 261 | Trip Free Time | 184 | Window 9 |
| 247 | StartsHr | 152 | Trip Sens | 158 | Window Code |
| 5 | Stop Time | 229 | TX Bytes | 157 | Window View |
| 232 | StopCodeFile | 231 | TX Errors | | |
| 233 | StopCodeFile_1 | 230 | TX Frames | | |
| 234 | StopCodePos | 267 | UcLow | | |
| 235 | StopCodePos_1 | 22 | Unit Amps | | |
| 95 | T Start | 14 | Version | | |

# Updating Firmware

## Update Procedure

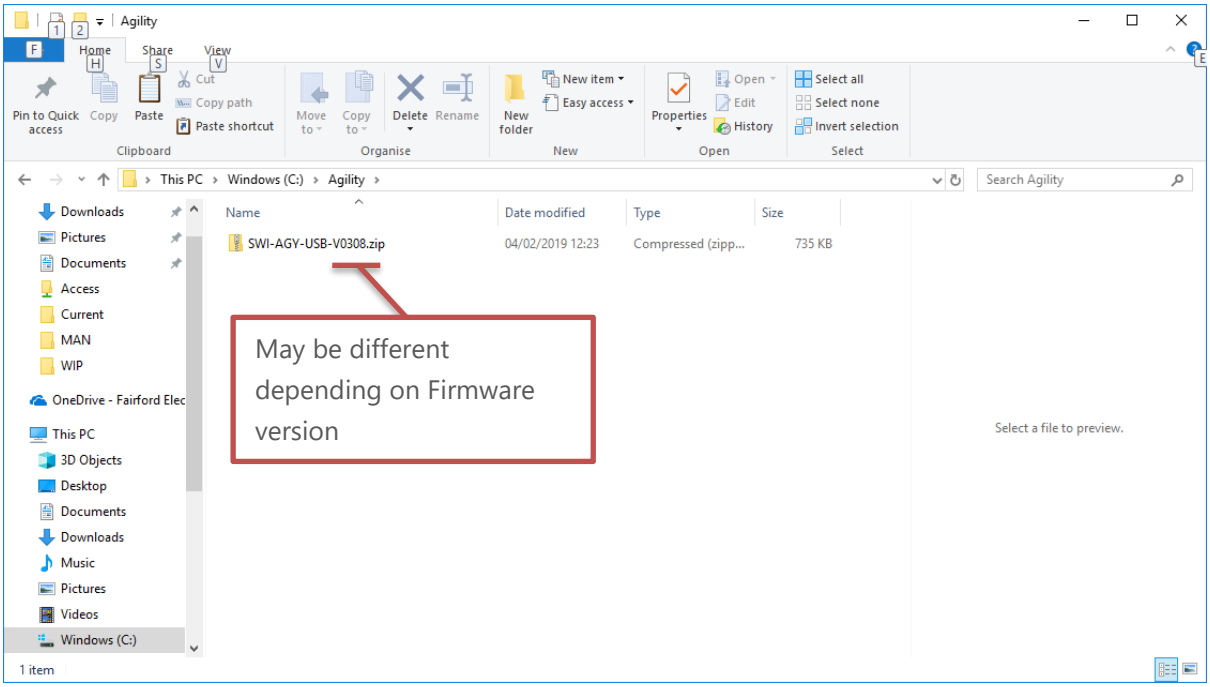
In the event that the VMX-agility™ unit requires a firmware update, this can be achieved on an installed unit without the need for any additional equipment other than a USB memory stick.

## Instruction for Updating

- Obtain a USB flash drive, and ensure that it has been formatted to FAT32.

  Part number USB-KEY is a USB flash drive that has been verified to work with VMX-agility™. Other flash drives may not physically fit, or may not perform correctly. Available to purchase from Motortronics UK Ltd.

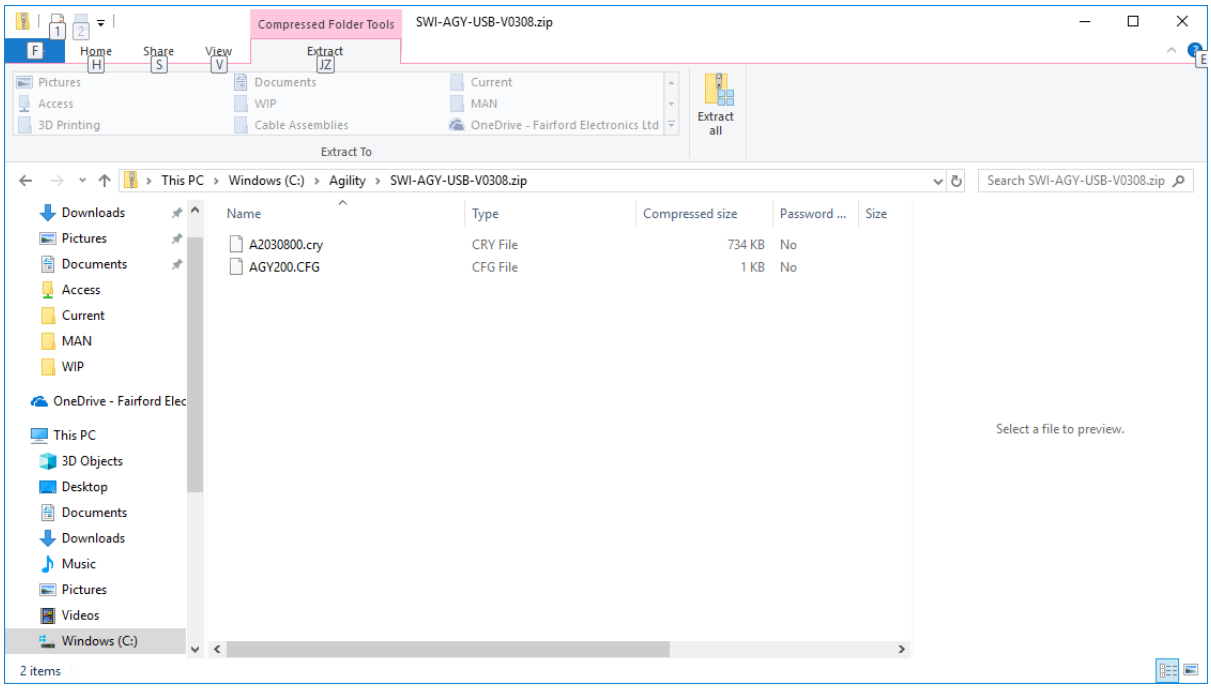
- Download a new firmware zip file from: https://www.motortronics-uk.co.uk/agility/downloads/
- Copy the zip file into a suitable location on your PC that you can extract all of the firmware files



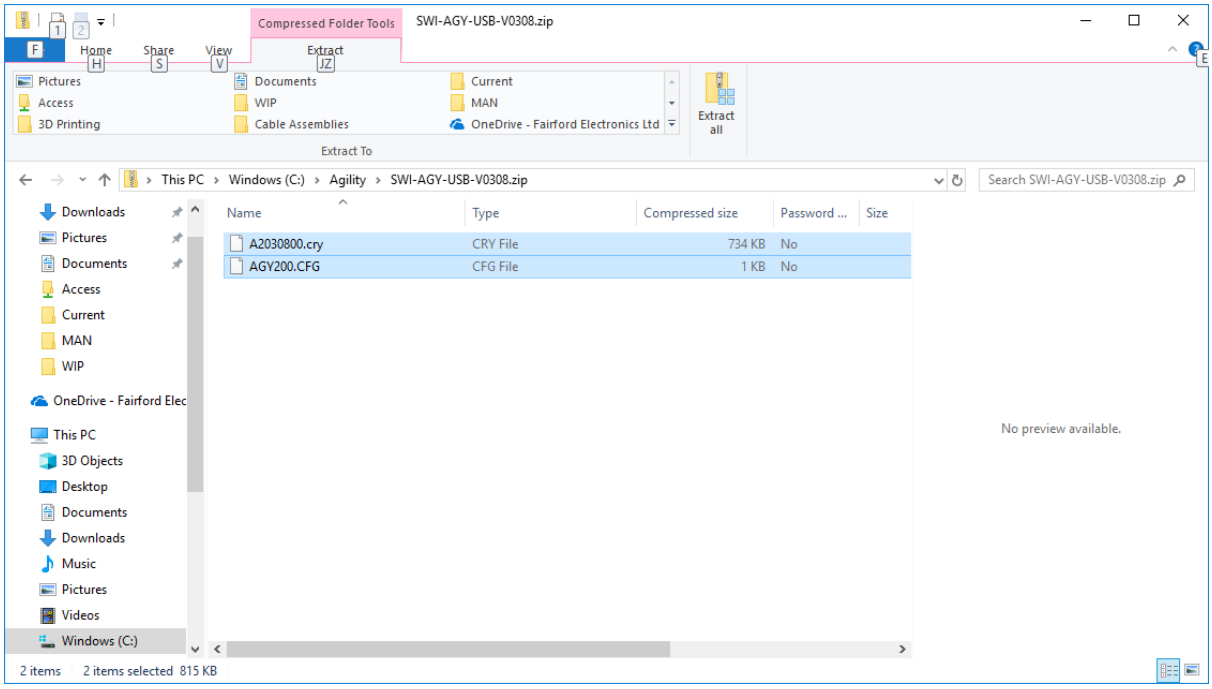

- Right click on the zip file and select extract all. This will create an unzipped directory in the same location with the same name.

Continued over

# Updating Firmware (continued)

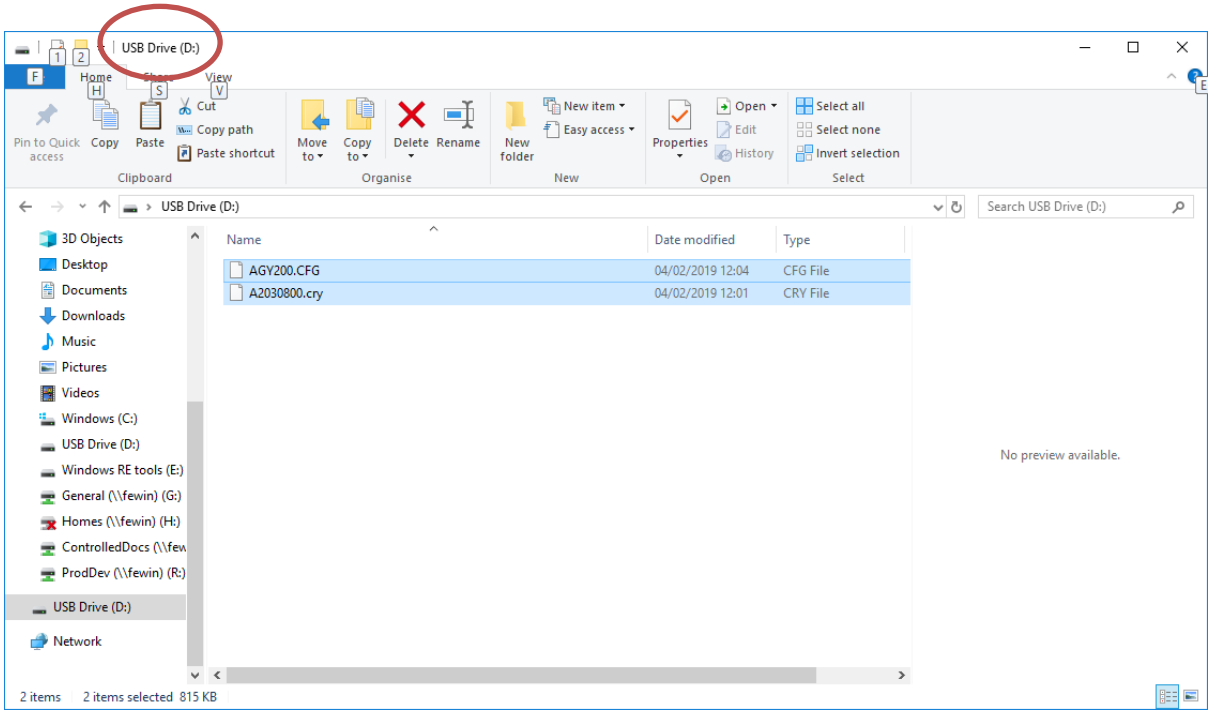



Select all files and copy them to the route directory of the USB flash drive.




Continued over

# Updating Firmware (continued)




Power down the VMX-agility™ unit and insert the USB stick with the upgrade files into the corresponding socket on the front panel.

Power up the VMX-agility™ unit and the upgrade process will start automatically. The update progress will be shown on the display. During this time, do not remove the USB stick and ensure power is not disconnected.

When the upgrade process is completed VMX-agility™ will reboot. The USB stick may now be removed.

# Applications

## Motor Suitability and Associated Considerations

The VMX-agility™ soft-starter is based on the "Motortronics UK System" of microprocessor-based optimising soft-starters which have been used world-wide in critical and non-critical systems. Since 1983, Motortronics UK System soft-starters have successfully operated with almost every type of load and environment from the Antarctic to the Jungle. The design has proven to be both reliable and adaptable, and provides a powerful mechanism with which to control fixed-speed induction motors. However, due to the intrinsic differences between electronic and electro-mechanical starting systems, there are a number of simple rules and observations to follow when using the VMX-agility™ soft-starter. This section introduces guidelines for the user and those incorporating the unit as part of their system design.

**Suitability -** In principle, any induction motor can be started by a soft-starter. Normally, the breakaway torque of the load should be less than the full-load torque of the motor, unless a motor with a high locked rotor torque characteristic is employed. As a quick assessment, any load which has a low or no-load start with a moderate starting time, or which can be started with a star-delta starter, auto transformer or other forms of reduced-voltage starting, can be considered to be a potential application for a soft-starter.

**Induction Motor Characteristics -** Induction motors are required to provide sufficient torque to accelerate the motor and its load from standstill to full speed and to maintain full speed efficiently at all torque levels up to the design full load torque. Most modern induction motors have characteristics that are wholly suitable for use with soft starters, however, the characteristics vary considerably between different manufacturers and design types. It is important that the motor is capable of providing sufficient torque to drive the load at all speeds between standstill and rated speed, to enable the VMX-agilityTM to function properly. It is particularly important that the motor to be soft started does not have a low pull-up or saddle torque otherwise the load may not be accelerated correctly.

The primary function of the soft-starter is to act as a torque-regulating device. It cannot apply a torque greater than that which the motor generates. For this reason, problematic applications for which many different starting methods have been tried but failed, may need analysis of the motor or load performance before a soft-start can be successfully applied.

**Rating -** For most applications, except high inertia loads, the starting demands and the inertia of the rotating masses are small enough to be insignificant. This means that no special consideration needs to be given to the rating of the soft-starter, other than to ensure that it is equal or marginally greater than the rated voltage and current of the controlled motor.

Alternatively, if the number of poles of the motor and the moments of inertia of the load (Jload) and motor rotor (Jmotor) are known, a soft-starter will be suitable if the figures comply with the criteria given in the bottom row of following table:

**Table 8.4.1**

| Number of Poles | 2 | 4 | 6 | 8 |
|---|---|---|---|---|
| Synchronous Speed (rpm) Hz) | 3000 | 1500 | 1000 | 750 |
| (Jload)/(Jmotor) less than | 5 | 15 | 20 | 25 |

# Applications (continued)

### Maximum Motor Cable Length

The length of the cable between the output terminals of the starter and the motor should not normally be greater than 100 metres.

### Power Factor Correction Capacitors

Power factor correction capacitors applied to a single motor MUST always be connected by a separate contactor placed on the SUPPLY side of the VMX-agility™ soft-start. Capacitors should be switched in after top-of-ramp (full line voltage) is reached and switched out of circuit before a stop is initiated.

It is important that any total system PFC scheme that automatically corrects for a range of inductive loads is not operated in such a way as to leave it heavily over compensated since this might introduce oscillations leading to damaging over-voltages.

### Lightly Loaded, Small Motors

Lightly loaded, small-sized (less than 2kW), star connected motors can produce high voltages at the motor terminals when shut down by simply opening the line contactor. As these voltages can damage the soft-starter, it is safer to control the opening of the line contactor with the soft start run relay contacts.

### Motors Fitted with Integral Brakes

Motors that include an integral, electrically operated brake, internally connected to the motor input terminals, can only be soft-started when the brake is re-connected to the supply through its own contactor.

### Older Motors

The action of the fully-controlled soft-starter introduces harmonic currents and voltages to the motor. It is therefore, important to ensure that the motor employs techniques such as rotor skewing in its construction to suppress the effects of harmonic fluxes and avoid rough starting. This is rarely a problem with modern motors because nearly all motors designed in the last 20 years employ these techniques.

### Wound-rotor or Slip-ring Motors

Slip-ring induction motors ALWAYS need some resistance in the rotor circuit to ensure that sufficient rotational torque is generated to overcome any alignment torque, which is present at start-up. The resistance can be safely shorted out in the normal fashion with a contactor controlled by the programmable relay set as ‘top-of-ramp’ contacts.

### Enclosures

Thyristors are not perfect conductors, and the passage of current through them causes heat dissipation in the body of the device, which in turn causes the heatsink temperature to increase. As a rough guide, the heat generated is 1 watt/amp/phase when energy saving, which equates to a dissipation of 30 watts from the heatsink for a line current of 10 amps. Therefore, all cabinets or enclosures that house soft-starters should have adequate ventilation (refer to the Mechanical Installation Procedures, section for more detailed information).

# Applications (continued)

### EU Compliance with the EMC Directive

When considering the use or fitting of any Soft Starter, users and installers in European countries must comply with the EMC Directive 89/336/EEC. The manufacturer of the soft starter has a statutory obligation to provide a guide for compliance with this directive. For VMX-agility™, this guidance is given in the EMC guide which is A3 of this manual. It is essential that users and installers understand and comply with the requirements described in these sections.

### Fuses

Circuit protection fuses should be rated at twice the motor rated current for normal low inertia applications. See also section relating to high inertia loads. Semiconductor fuses are available for the short circuit protection of the thyristors in VMX-agility™. See Electrical Installation section for fuse recommendations.

### Rules for Specific Applications

### High Inertia Loads

High inertia loads such as centrifugal and axial fans, grinders, flywheel presses, etc., may require a larger size of soft-start than the motor. For example, a 75kW starter may be needed for a 55kW motor. This is necessary due to the extra heat produced by the thyristors due to the extended start times and/or higher over-currents. If very high inertia loads are involved, then an analysis of the starting characteristics should be made. This will require accurate data about the motor speed-torque and speed-current characteristics as well as the load characteristics. For further information, consult your supplier. Consideration must also be given to thermal overload and fuse protection systems when extended start times are involved. This must be as for heavy duty starting, as a standard thermal overload will trip under these conditions. A heavy-duty start thermal overload or an electronic overload with dual settings for start and run is recommended. Modern HRC motor fuses will allow for some overload during the start, but the fuse curve, giving time/current data, will give an indication of suitability for the particular application.

### Frequent Starting

High starting frequencies require careful consideration of the soft-start thermal capabilities. In many cases a standard sized VMX-agility™ may be suitable as start times are generally shorter for this type of application. If this is not the case then a larger soft-start may be required (please refer to Motortronics UK for further information).

### Soft-Stopping

Soft-stopping can reduce positive surge pressures in pipelines on shutdown. It is necessary to make sure that the ramp-down time is long enough to remove the energy from the fluid before the firing of the thyristors is stopped, otherwise the surge pressure may still be present. Soft-stopping can also be successfully applied to loads such as conveyer belt systems where sensitive items such as bottles are being transported.

# Applications (continued)

### Reversing Configuration

VMX-agility™ soft-starters used in conjunction with contactor controlled reversing and plug-braked motors show considerable benefits to the user by reducing mechanical and electrical stresses, particularly when utilising the current limited start feature. It is required, with this type of application, to insert a 150 to 350 millisecond delay between the opening of one contactor and the closing of the other, to allow any residual flux in the rotor to die away.

### Replacement of Fluid Couplings

Soft-starters can replace fluid couplings yielding benefits of higher efficiency running and lower costs to the user. If the coupling is used to magnify the available breakaway torque, it may be necessary to replace the fitted motor with another of a larger size or one with a high starting torque characteristic before a soft-start can be employed.

### Two-speed Motor Applications

Two speed motors, whether Dahlander connected or with dual windings, can be soft started at each speed, provided that the start is initiated when the actual motor speed is less than the synchronous speed for the winding selected. This is particularly important when changing from high to low speeds.

### Overhauling Loads

Certain applications can over-speed the motor as part of normal operation. Power flow is then from the motor to the supply. It is important that the optimising is disabled during the over-speed condition and reinserted during normal conditions.

### Application Table

The table on the following page shows many common motor applications that suit the VMX-agility™ soft-starter. It lists typical breakaway torque requirements as a percentage of motor full-load torque (FLT). For the most satisfactory soft-start in a given application, the motor should have a full-voltage locked-rotor-torque (LRT) that is at least twice the breakaway torque (E.g. For a reciprocating compressor the FLT is normally in the region of 50% motor LRT). As a general rule, the higher the motor LRT is above the load breakaway torque, the greater the control over the starting process.

# Applications (continued)

| Applications | | |
|---|---|---|
| Application | Breakaway Torque (%FLT) | Remarks |
| Agitator | 35 | – |
| Air compressor - rotary, unloaded start | 25–35 | – |
| Air compressor - reciprocating, unloaded start | 50–100 | – |
| Air compressor - screw type, unloaded start | 30 | Usually two-pole motor |
| Ball mill | 30–50 | Eccentric load, needs high starting torque motor |
| Carding machine | 100 | Often high inertia |
| Centrifuge | 50–90 | Usually high inertia |
| Centrifugal fan - dampers closed | 10–25 | Usually high inertia |
| Centrifugal fan - dampers open | 10–25 | Usually high inertia, very long ramp times |
| Centrifugal blower - valve closed | 25–35 | – |
| Centrifugal blower - valve open | 30–40 | Can have long ramp time |
| Conveyor - horizontal, unloaded | 10–50 | – |
| Conveyor - horizontal, loaded | 100–150 | – |
| Conveyor - vertical lifting, unloaded | 50–85 | – |
| Conveyor - vertical lifting, loaded | 100–175 | – |
| Conveyor - vertical lowering, unloaded | 10–40 | – |
| Conveyor - vertical lowering, loaded | 10–25 | – |
| Crusher (not rock) - unloaded | 25–75 | Can be high inertia |
| Drilling machine - unloaded | 10 | – |
| Fan, axial-flow propeller | 20–40 | – |
| Feeder - screw | 100–175 | Needs high starting torque motor |
| Feeder - vibrating, motor driven | 100–150 | Needs high starting torque motor |
| Grinder - unloaded | 10–25 | Usually high inertia |
| Hammer mill | 20–125 | Eccentric load, needs high starting torque motor |
| Mills - flour etc. | 30–50 | – |
| Mixer - dry contents | 35–75 | – |
| Mixer - fluid contents | 10–40 | – |
| Mixer - plastic contents | 75–125 | High torque motor offers advantage |
| Mixer - powder contents | 75–125 | High torque motor offers advantage |
| Pelletizers | 50–100 | – |
| Press, flywheel | 50–150 | Needs high starting torque motor |
| Pump - centrifugal | 10–25 | Soft stopping useful |
| Pump - positive displacement, piston type | 100–175 | Needs high starting torque motor |
| Pump - vane type, positive displacement | 100–150 | Needs high starting torque motor |
| Rolling mill | 30–50 | – |
| Saw, band | 10–35 | – |
| Saw, circular | 25–50 | May be high inertia; Plug brake may be useful |
| Screen, vibrating | 30–60 | – |
| Transformers, voltage regulators | Nil | Change firing mode |
| Tumblers | 30–100 | Can be eccentric load, may need high torque motor |

# Applications (continued)

| Applications (continued) | | |
|---|---|---|
| Application | Breakaway Torque (%FLT) | Remarks |
| Rolling mill | 30–50 | – |
| Saw, band | 10–35 | – |
| Saw, circular | 25–50 | May be high inertia; Plug brake may be useful |
| Screen, vibrating | 30–60 | – |
| Transformers, voltage regulators | Nil | Change firing mode |
| Tumblers | 30–100 | Can be eccentric load, may need high torque motor |

### Concepts and principles of fixed-speed induction motor starting and control

Since its invention one hundred years ago, the standard 3-phase induction motor has become one of the most familiar items of industrial equipment ever known. Due to its simplicity of construction, low cost, reliability and relatively high efficiency, it is likely to remain the prime source of mechanical energy for the foreseeable future.

### Introduction

Energy conversion, from the electrical supply to rotating mechanical energy, is a characteristic of all motors. To regulate energy flow, most motor circuits require a mechanism to connect and disconnect them from their electrical power source; electro-mechanical switches, known as 'Contactors', are the standard means of achieving this control. Even today, more than one hundred years after their introduction, contactor-based systems remain the most widely used method of motor control. Nevertheless, there is a definite trend towards more sophisticated electronic systems of control being applied to fixed-speed motor drives. This section will discuss these newest forms of control - namely, electronic, microprocessor-controlled, optimising soft-starters such as VMX-agility™.



Note: Since there is a wealth of detailed literature available in the technical press, it is not proposed to dwell too heavily on the specifics of realising the electronic control system, but rather, to offer an outline of its various capabilities.

### The Induction Motor

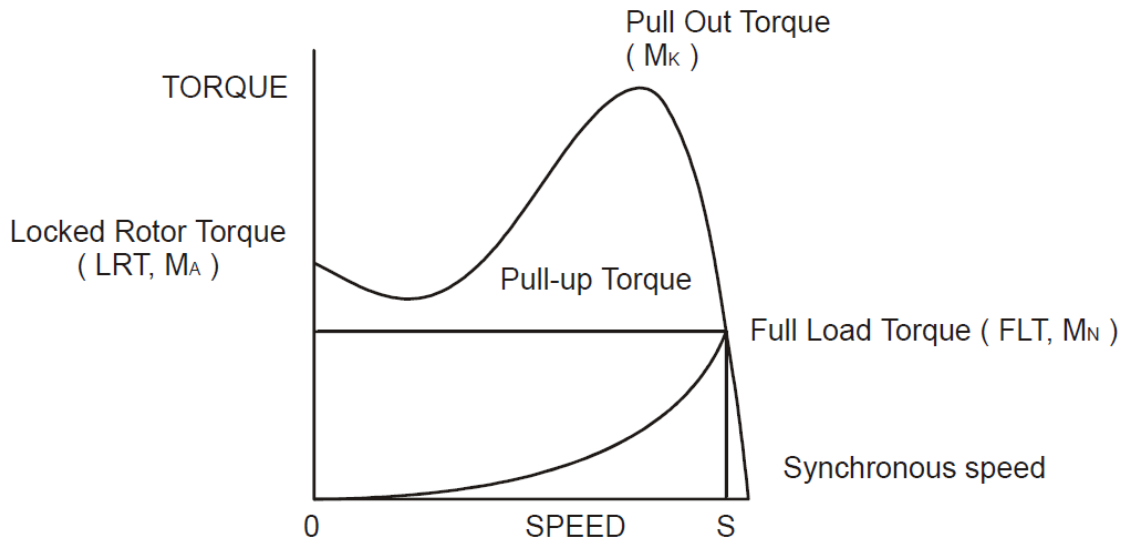
In order to appreciate the benefits of using an electronic controller, it is important to have some understanding of the characteristics and limitations of the induction motor and the electro-mechanical systems currently used to control them. The standard, fixed-speed induction motor fulfils two basic requirements:

- To accelerate itself and its load to full speed (or speeds with multi-speed motors)
- To maintain the load at full speed efficiently and effectively over the full range of loadings

## Applications (continued)

Due to the constraints of materials and design, it can be difficult to achieve both objectives effectively and economically in one machine. So, how does a motor start in the first place? As mentioned earlier, motors convert electrical energy drawn from the power supply into a mechanical form, usually as a shaft rotating at a speed fixed by the frequency of the supply. The power available from the shaft is equal to the torque (moment) multiplied by the shaft speed (rpm). From an initial value at standstill, the torque alters, up or down, as the machine accelerates, reaching a peak at about two thirds full speed, finally to become zero at synchronous speed. This characteristic means that induction motors always run at slightly less than synchronous speed in order to develop power - the 'slip speed' and, hence the term asynchronous. The following graph is of an induction motor torque/speed curve and illustrates this most important characteristic:

**Torque/Speed Curve – Induction Motor**



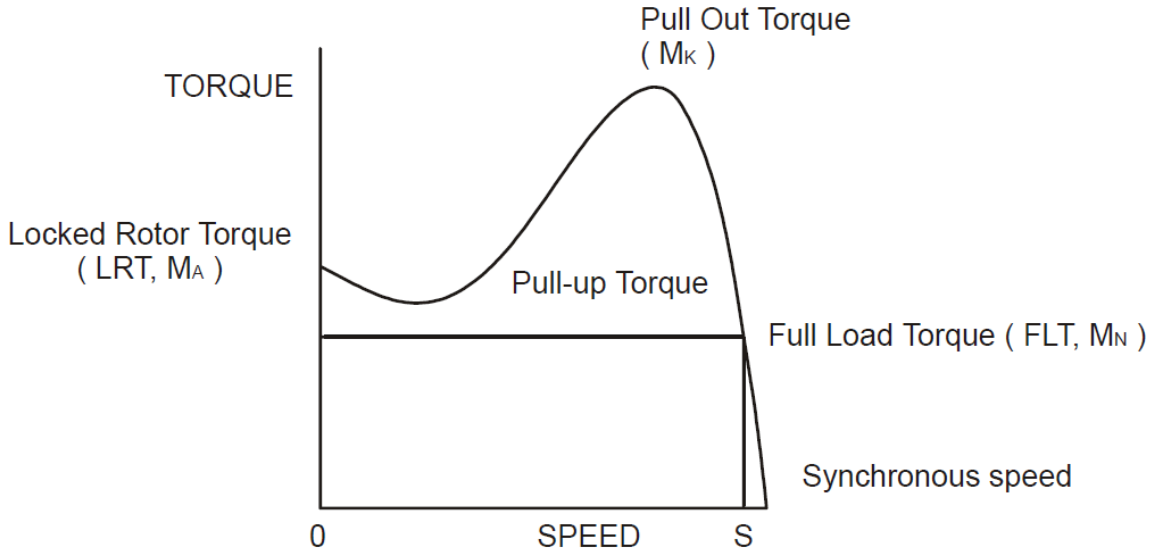

As for each type of motor, so each load coupled to an induction motor has its own speed/torque curve.

# Applications (continued)

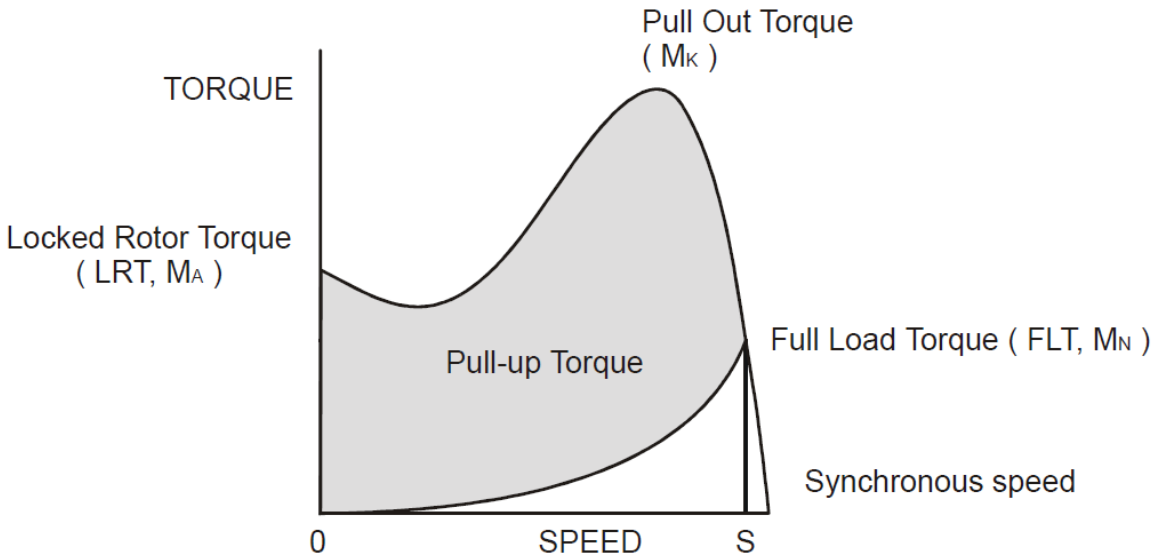
**The Induction Motor (continued)**

The acceleration of a motor-load system is caused by the difference between the developed torque (motor) and the absorbed torque (load), and is shown by the shaded area in the next figure:

**Torque/Speed Curve – Coupled Load**




**Torque/Speed Curve – Accelerating Torque**



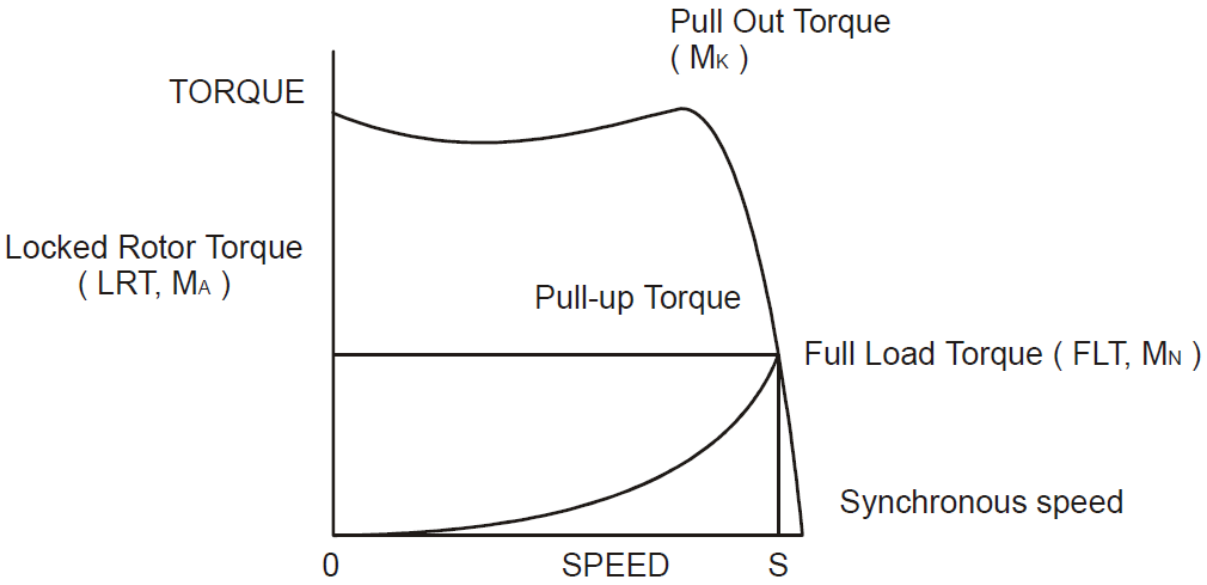

Obviously, the larger the difference, the faster the acceleration and the quicker full speed is reached - and, coincidentally, the greater the stresses experienced by the supply and drive systems during the acceleration process. An “ideal” start would accelerate the load with just sufficient force to reach full speed smoothly in a reasonable time, and with minimum stress to the supply and drive mechanisms.

# Applications (continued)

Broadly speaking, the motor speed/torque characteristic is controlled by the rotor resistance - a motor with high rotor resistance can generate it's peak torque (pull-out torque) at standstill giving the high break-away torque characteristic, which reduces steadily as the speed increases and becoming zero at synchronous speed. At the other end of the scale, a motor with a very low rotor resistance will produce a low starting torque but will generate its peak torque closer to the synchronous speed. Consequently, this type of motor runs at full power with higher operating efficiency and low slip speed. It is possible to combine the twin requirements of high starting torque and efficient full-speed operation within a single motor by techniques such as double-cage or deep bar design, and this, usually, is the motor characteristic chosen for lifting and hoisting applications.

However, most induction motors are designed to have a "standard" characteristic that provides a compromise between starting torque and operating efficiency. To summarise, an induction motor will only start and accelerate when it produces more torque than the connected load absorbs. This is true for all speeds - including standstill and full speed.

**Torque/Speed Curve – High Starting Torque**




### Starting Induction Motors

Starting a de-magnetised induction motor from standstill is a demanding and complex process. At the instant of switching all the energy necessary to magnetise the motor, to provide the acceleration force, and to supply the kinetic energy of the rotor and load, must be present together with the energy to overcome the mechanical and electrical losses. To do so at full supply voltage places considerable stresses on the supply, the motor windings, and the iron cores of the stator and rotor. Excessive acceleration of a rotor when the mechanical load is small can produce torque oscillations in the shaft causing severe wear to transmissions, gears and drives. Excessive acceleration when the load inertia is high such as in centrifugal fans, causes belts to slip in the pulleys, producing rapid wear and early failure.

# Applications (continued)

## Electro-Mechanical Methods Of Starting

Method A: Direct-on-Line

The most simple means of controlling energy flow to an induction motor is to interrupt the power supply by a single, solenoid operated, 3-phase switch, known as a contactor. Very widely applied, the method is known variously as “direct-on-line”, “across-the-line”, “direct” etc., and is the usual form of control where low cost is the first, and most important consideration. As a result, it is most often used on small motor sizes (up to approx. - 22kW), or where the supply is strong enough to withstand the inrush and starting current surges without causing unacceptable voltage drops.

The harsh, damaging effects described earlier are all imposed by direct-on-line starting and, as a control method, it is the most destructive of equipment. Its simplicity and apparent low cost, although attractive at first sight, hide large cost penalties in the shape of increased maintenance, reduced transmission equipment life and higher risk of motor failure, particularly when frequent starting and stopping is needed.

In larger sized motors special strengthening is necessary, at higher cost, before they can be safely used with direct-on-line starting. However, the shortcomings of the direct-on-line starter have been recognised ever since motors have been used and alternative systems have been developed over the years to reduce the damaging effects of this form of control.

Method B: Star-Delta and other Reduced Voltage Starting Systems

Reduced voltage starting makes use of the fact that motor torque is proportional to the square of the terminal voltage; the most familiar type of reduced-voltage starter is the star-delta starter. Consisting of three contactors and a time switch (which can be mechanical, pneumatic, electrical or electronic), the star-delta starter changes the motor winding configuration from an initial star connection to a delta as the motor accelerates. The change-over or transition point is controlled by the time switch and is usually arranged to be approximately at 80% of full speed. The effect of starting in star is to alter the voltage across each stator winding to 58% of normal. This reduces the starting torque to a third of locked rotor torque (LRT) with a consequent reduction in starting currents and acceleration forces.

Although an apparent improvement over the direct system, significant disadvantages still remain. The transfer from star to delta momentarily removes the motor from the supply. During this time the motor is under the mechanical influence of the rotating load and, at the instant of disconnection, current will still flow in the rotor bars due to the time delay necessary for the magnetic flux to die away.

Therefore, there is a residual flux “frozen” on the surface of the rotating rotor, which cuts the stator windings, generating a voltage whose frequency depends on the rotor speed. If the load inertia is small, such as in a pump, or if the friction is high, there could be a significant loss of speed during the time the supply is disconnected.

In this case, when the reconnection to delta is made, a large phase differential can exist between the supply and the rotor fluxes. This can give rise to very large current surges (as much or more than full-voltage locked rotor current), together with massive transient torque oscillations, which can peak at levels in the region of fifteen-times full-load torque. Although the effects described are only present for a very short period of time (about one fifth of a second), they are sources of great stress and damage to the whole drive system, and where frequent starting is necessary, invoke high maintenance costs. The current surges, in the form of a very high level short duration “spikes”, are an increasing problem in these days of computer control systems and other “sensitive” electronic equipment. The voltage disturbance on the supply is very difficult to filter out and can cause severe problems, especially when larger motors are involved.

# Applications (continued)

There are methods of control, for example, the Wauchope starter, which eliminate or reduce the reconnection transients. However, such starters are expensive and have reliability implications; for these reasons they are not widely applied.

The star-delta starter also has disadvantages due to the restricted starting torque available (if you need 40% LRT to break-away, you can only increase the motor size, or revert to direct-on-line). Combined with the severe effects of the re-switching surges, and the additional costs of bringing six conductors from the motor to the starter instead of only three, star-delta only offers an imperfect solution to the problem of starting the induction motor.

Method C: Primary Resistance Starter

It has long been recognised that the transition step in the star-delta system was a source of problems such as welded contactors, sheared drive shafts etc., and for many years a method of stepless control has been available in the form of the primary resistance starter. This type of controller inserts a resistance in one, or more often in each, of the phase connections to the stator at start-up, after which it is progressively reduced and shorted out at the end of the acceleration process. Frequently, the resistances are movable blades that are gradually inserted into an electrolyte liquid. The mechanism is usually large and expensive, both to purchase and to maintain, and considerable heat is created by the passage of current through the electrolyte resistor. This limits the starting frequency (because the electrolyte has to condense back to liquid before a new start can proceed), and these restrictions prevent this starter from being a popular option when selecting a control system. However, it has the distinction of being the smoothest and least stressful method of accelerating an induction motor and its load.

Method D: Other Electro-Mechanical Systems

Other control methods such as auto-transformer starting (popular in North America), primary reactance starting etc., are employed to a greater or lesser extent, to compensate for some of the disadvantages of each type of starter discussed. Nevertheless, the fundamental problems of electro-mechanical starters remain, and it is only in the last decade or two that their dominance has been challenged by the introduction of power semiconductors controlled by electronics.

### The Semiconductor Motor Controller

During the 1950's, much effort was put into the development of a four-layer transistor device which had the power to switch large currents at high voltages when triggered by a very small pulse of current. This device became known as the silicon controlled rectifier (SCR), or in Europe, the 'Thyristor'; it is the basis on which all soft starting systems are built. The characteristic of most interest is the ability of the thyristor to switch rapidly (in about 5 millionths of a second) from "OFF" to "ON" when pulsed, and to remain "ON" until the current through the device falls to zero, - which conveniently, happens at the end of each half-cycle in alternating current supplies.

By controlling the switch-on point of a thyristor relative to the voltage zero crossing in each half wave of an alternating current, it is possible to regulate the energy passing through the device. The closer the turn-on point is to the voltage zero crossing point, the longer the energy is allowed to flow during the half-cycle. Conversely, delaying the turn-on point reduces the time for the energy to flow. Putting two thyristors back-to-back (or anti-parallel) in each of the phase connections to a motor, and by precisely controlling their turn-on points, an electronic soft starter continuously adjusts the passage of energy from the supply so that it is just sufficient for the motor to perform satisfactorily.

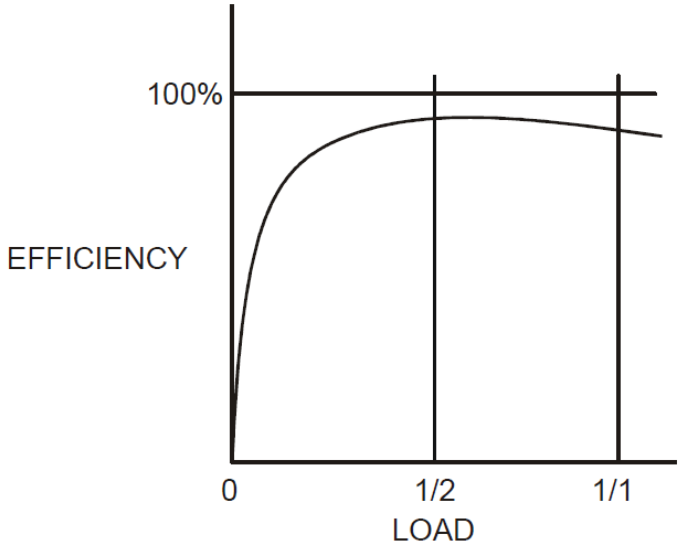
So, for instance, by starting with a large delay to the turn on point in each half cycle, and progressively reducing it over a selected time period, the voltage applied to the motor starts from a relatively low value and increases to full voltage. Due to the motor torque being proportional to the square of the applied voltage, the starting torque follows the same pattern giving the characteristic smooth, stepless start of the soft-starter.

# Applications (continued)

### Running Induction Motors

Once a start has been completed the motor operating efficiency becomes of interest. When working at or near full load, the typical 3-phase induction motor is relatively efficient, readily achieving efficiencies of 85% to 95%. However, as shown below, motor efficiency falls dramatically when the load falls to less than 50% of rated output.

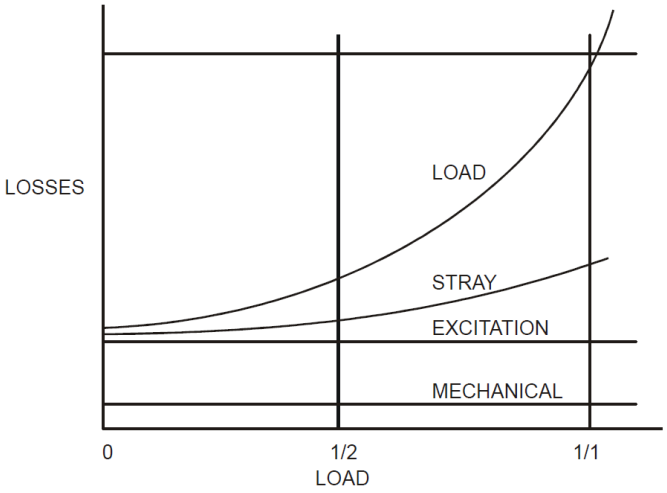
In fact, very few motors actually experience consistent fully rated operation, the vast majority operate at much lower loads due to either over-sizing (a very frequent situation), or natural load variations. For Fan and Pumping applications, the affinity laws will allow the inverter drive to show very considerable energy savings over virtually all other methods of control through varying the speed of the motor in response to changes in load. Where motor speeds cannot be varied, an optimising version of semiconductor motor controller, such as VMX-agility™ will also produce energy savings in lightly loaded motors. Less sophisticated systems of soft-starter remain at full conduction and the motor then behaves as if it were connected directly to the mains supply. However, at light loads and mains voltages, induction motors always have excess magnetic flux, and efficiency loss and power factor degradation result. By detecting the load at any instant, and adjusting the motor terminal voltage accordingly, it is possible to save some of the excitation energy and load loss, and improve motor power factor when the motor is running inefficiently at light loads.




Motor Efficiency/Load Characteristic

# Applications (continued)

All VMX-agility™ soft-starters are microprocessor controlled, and this gives them a number of advantages. Firstly, there are no adjustments to be made for the energy saving function: all calculations necessary to find the best degree of phase-back of the thyristors for any load condition is made by the microprocessor. Secondly, the start always synchronises with the supply voltage and a special structure of turn-on pulses virtually eliminates the inrush currents normally associated with motor start-up; this happens every time. Lastly, there is the absolutely stepless starting process, found only with the primary resistance or reactance electromechanical starters - but without the wasted energy, and with the opportunity to control the maximum current allowed to flow during the starting process. Other features such as soft stopping are included to give considerable control over all modes of induction motor operation.




Motor Efficiency/Loss Characteristic

### Reliability Considerations

An aspect of electronic controllers for induction motors which is of increasing concern is that of reliability. There is little point in installing an expensive item of electronic equipment to save potentially considerable amounts of money if the device is unreliable to the point that vital processes are constantly interrupted.

There are electronic products in the market place which appear to offer soft starting cheaply. They almost always rely on less advantageous technologies such as analogue control, or half-control, where one of the two thyristors in each phase is replaced with a diode. There are systems which only control the energy flow in one phase while the other two are directly connected. Owing to the variable quality and performance of many so-called inverters and soft-starters available to the unsuspecting purchaser, international standards for these products have been developed.

So far, IEC 60947-4-2 - 'AC Semiconductor Motor Controllers and Starters' defines the soft starter in every important respect, including thermal and overload performance as well as electromagnetic compatibility. By ensuring that any motor controller equipment purchased conforms to IEC 60947-4-2, a user should be reasonably safeguarded from shoddy or inadequate products when specifying equipment for future installations. A particular advantage of the use of the optimising soft starter is its impact on the maintenance requirements of associated electro-mechanical equipment. Optimising lowers the surface temperature of the motor by reducing the losses within the motor. This prolongs the motor life - and reduces heating of the surrounding atmosphere in the process. If the atmosphere is subject to air conditioning, reducing the heat input will reduce the air conditioning costs. Reduced starting and running currents reduces cable losses and, contactor

## Applications (continued)

switching operations are carried out under the most advantageous conditions. No current flows on switch-on since all switching is carried out by the thyristors - virtually eliminating the need for contact replacement.

Indeed, there are a growing number of installations where contactors are no longer employed, being replaced by controllable circuit breakers or isolators instead.

In summary, electronic controllers for most fixed-speed applications are opening new ways of increasing the efficient operation of induction motors, as well as offering significant benefits in control. Intending users need to ensure themselves of the quality and performance of any products they expect to fit and this can be reasonably expected if compliance with the appropriate IEC standards is demanded.

# Accessory Installation

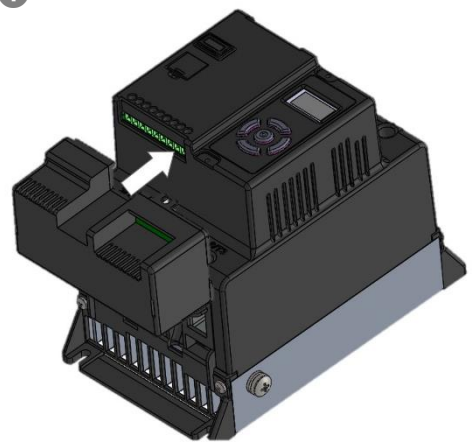
### Power Supply VMX-AGY-020 and VMX-AGY-021

VMX-AGY-020/021 are dedicated mains power supply for the VMX-agility™ soft start. In addition to allowing for mains control voltage operation, the power supply also allows for mains voltage digital control (D1/D2).

**Fitting**

Ensure terminals 24V, 0V, COM, D1 and D2 are fully open before installing power supply as shown below:

❶

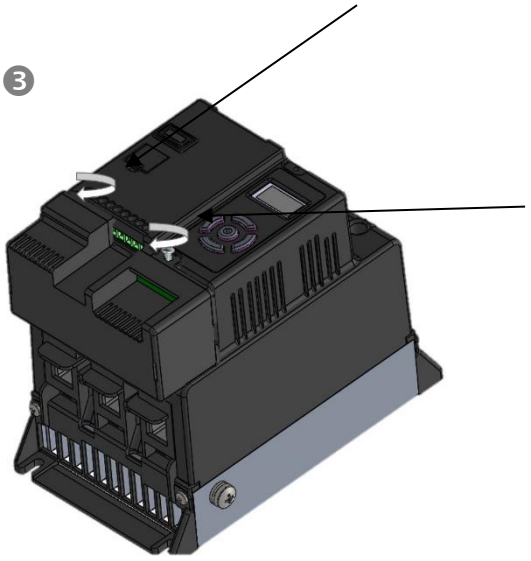


❷



Tighten terminals 24V, 0V, COM, D1 and D2

❸



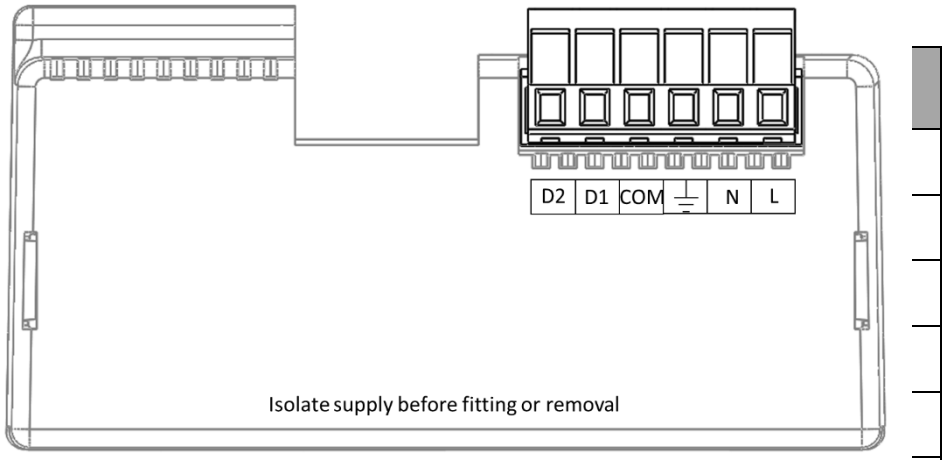
Fit screw and nylon washer (supplied) - DO NOT overtighten (Max 40 cNm)

When the VMX-AGY-020/021 installation is complete, control supply, D1 and D2 are provided on the power supply rather than the VMX-agility™ main unit.

# Accessories (continued)

## Connections

### Control




| | | | |
|---|---|---|---|
| 13/14 | Main Contactor Control (Run Relay) | No | |
| 21/22 | Fault relay | Yes | #2 |

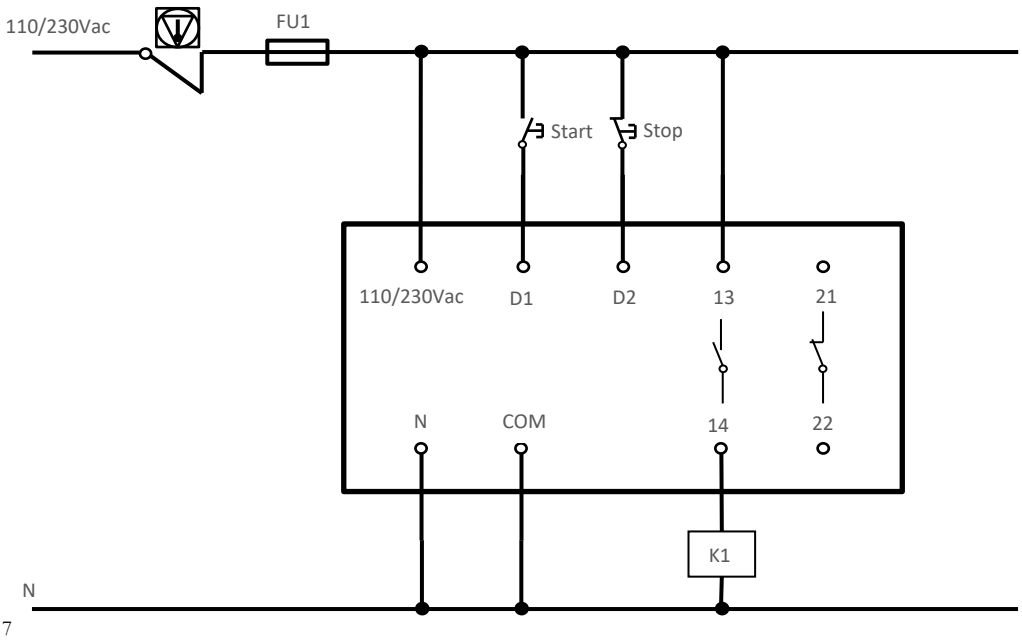
### Functions

#1 The voltage applied to the digital inputs D1 and D2 must be the same as the supply voltage

#2 230Vac, 1A, AC15. 30Vdc, 0.5A resistive

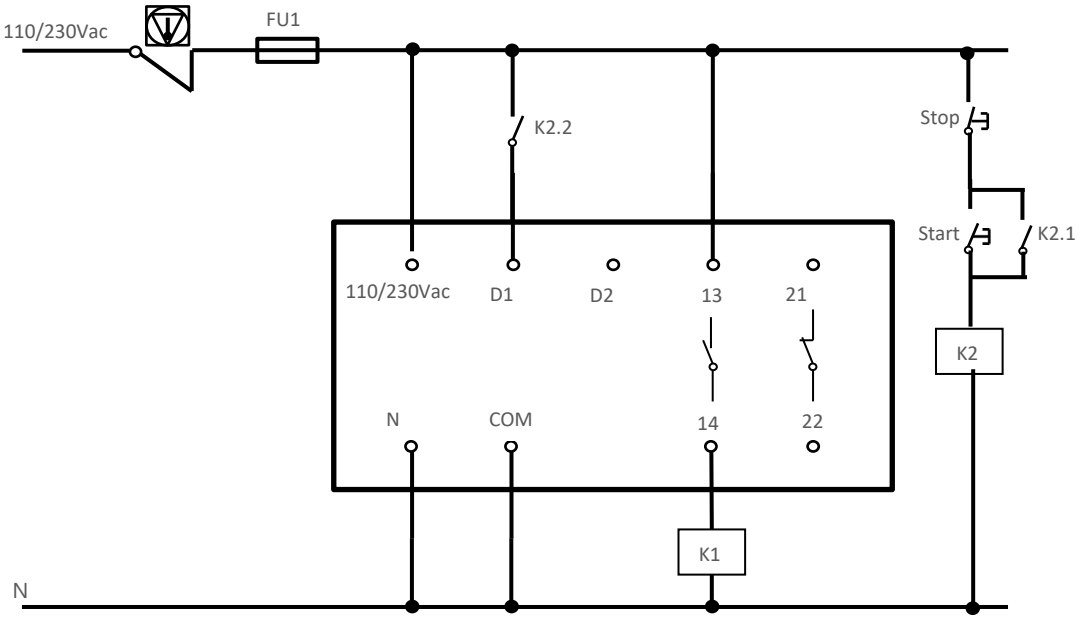
# Accessories (continued)

### 3-Wire Control Using VMX-AGY-020/021




7

### 2-Wire Control Using VMX-AGY-020/021



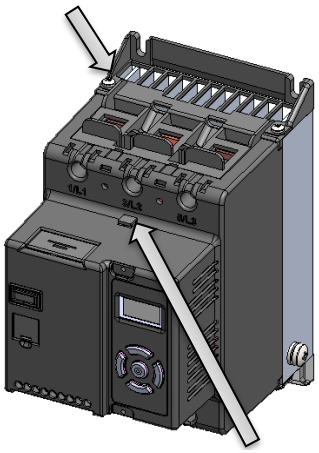
# Accessories (continued)

### Fan (VMX-AGY-030)

VMX-AGY-030 increases the number of starts to 40/hour. The fan operates automatically during a soft start or soft stop and will continue to run if the heatsink temperature is > 45°C. The fan stops when the heatsink temperature has fallen below 40°C.

**Fitting**

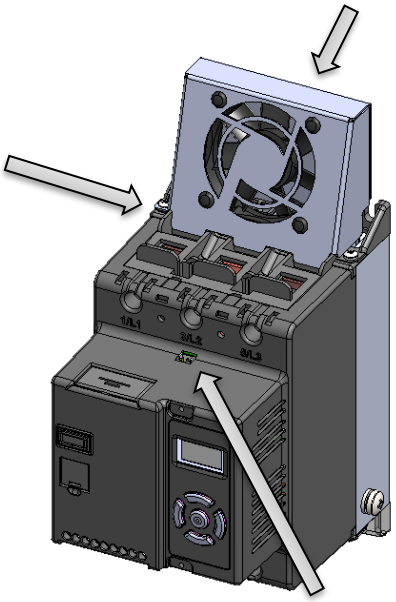
Step 1. Remove screw (x1) and retain



Step 2. Remove blanking plug (x1)

Step 3. Fit fan as shown

Step 4. Replace screw (x1)



Step 5. Fit flying lead from fan into socket

# Accessories (continued)

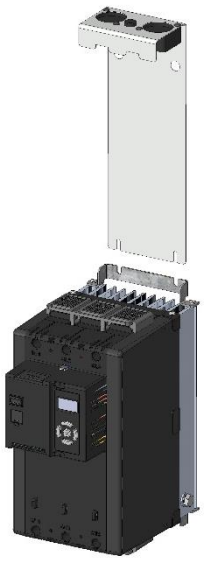
## Fan (VMX-AGY-031)

VMX-AGY-031 is designed for models VMX-AGY-201 to VMX-AGY-209. It increases the number of start/stop cycles per hour (see table below). The fan operates automatically during a soft start or soft stop and will continue to run if the heatsink temperature is > 45°C. The fan stops when the heatsink temperature has fallen below 40°C.

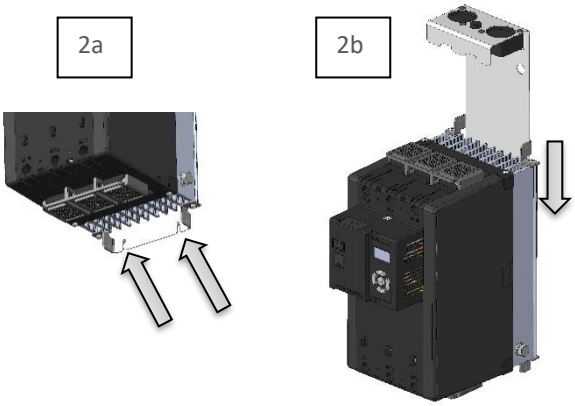
| VMX-Agility model | Maximum duty cycle F-S with optional fan fitted |
|---|---|
| VMX-AGY-203 | 90-40 (40 cycles per hour) |
| VMX-AGY-205 | 90-30 (30 cycles per hour) |
| VMX-AGY-207 | 90-20 (20 cycles per hour) |
| VMX-AGY-209 | 90-10 (10 cycles per hour) |

### Fitting

Step 1. Position the assembly at the top on the VMX-agility unit



Step 2. Loosen the two lower mounting screws (2a) and slide the fan assembly downward between the mounting bracket and the heatsink fins (2b)




Step 3. When the fan assembly is fully home and the lower plate of the assembly has engaged with the lower mounting screws, re-tighten the mounting screws fully



Step 4. Remove the blanking plug and insert the flying lead from the fan assembly into the socket as indicated below



# Accessories (continued)

## Remote Keypad (VMX-AGY-010)



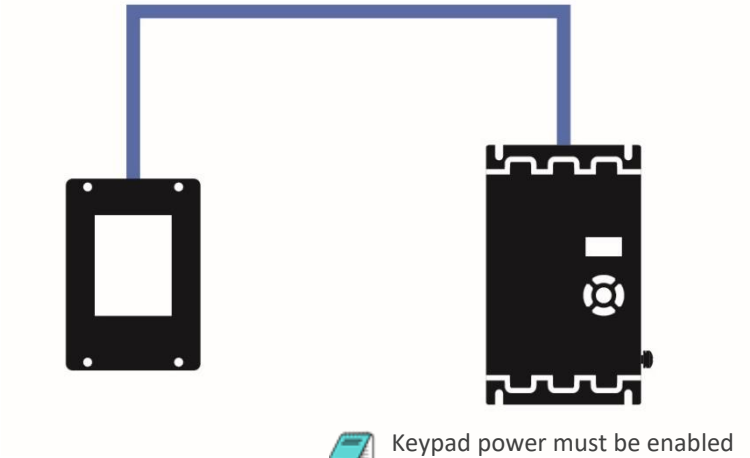

The remote keypad (VMX-AGY-010) can be used to control, monitor and program up to 32 VMX-agility™ soft starters.

The unit is powered from the host VMX-agility™ and requires an Ethernet cable for communication (Modbus RTU).

As the remote keypad acts as the Modbus master, no additional master units must be placed within the network. Failure to observe this may lead to erratic behaviour, network failure and/or equipment damage.

### Network Connection

For a configuration where there is only one VMX-agility™ unit (one-to-one), the remote and main unit can be directly cabled. See diagram below:

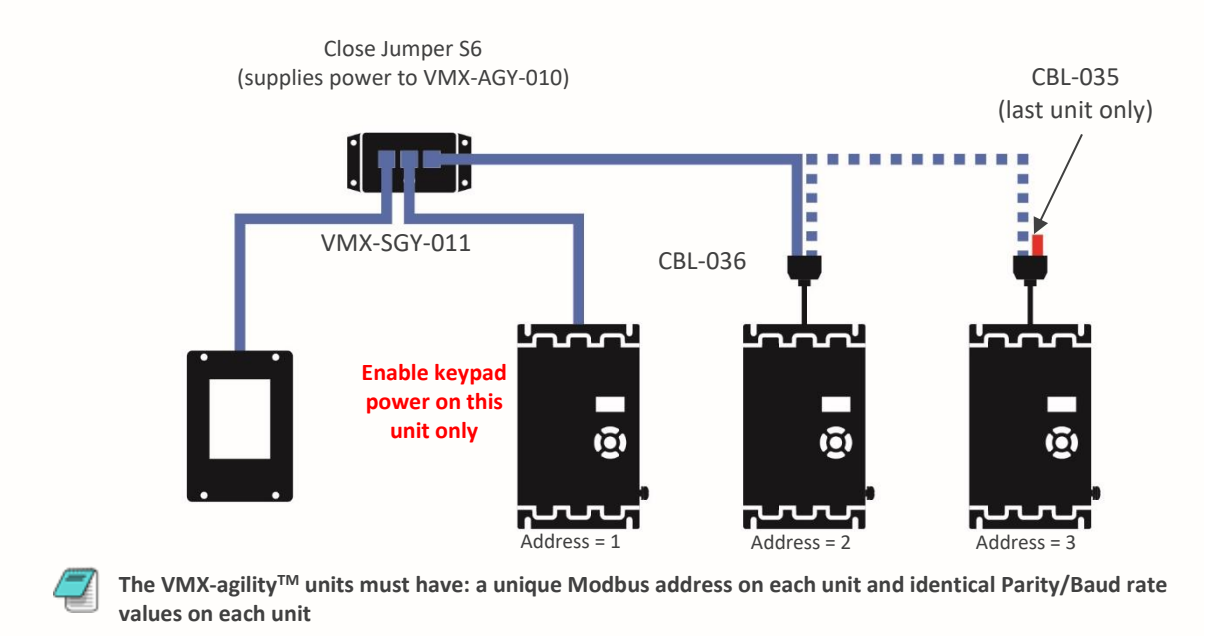


Keypad power must be enabled on the VMX-agility™ starter (see below)

**Enabling Keypad Power:** Scroll to DEVICE menu → KEYPAD menu → KEYPAD PWR = ON

# Keypad Connection and Operation

For multiple base units connected to the keypad, the use of VMX-SGY-011, CBL-036 and CBL-035 (terminator) is highly recommended. See diagram below.




**The VMX-agility™ units must have: a unique Modbus address on each unit and identical Parity/Baud rate values on each unit**

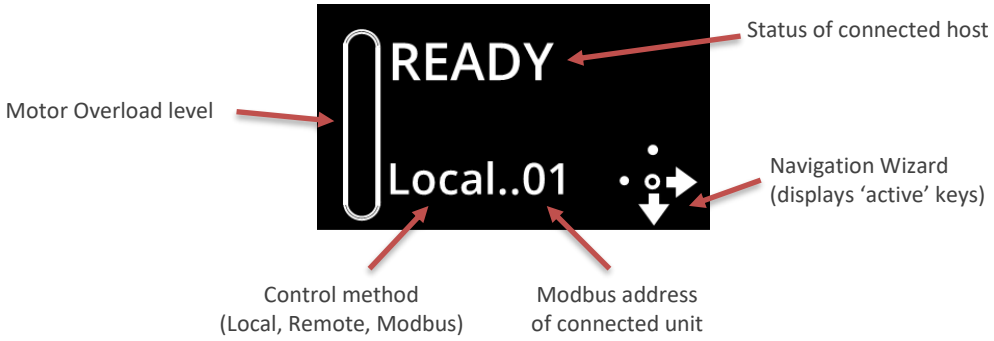
## Operation

Once connected to the VMX-agility™ host unit/s, menu structures and programming are the same as detailed in the VMX-agility™ manuals MAN-AGY-001 and MAN-AGY-002 (both may be downloaded from www.motortronics-uk.co.uk).

However, specific steps must be taken to connect the Remote Keypad to one or more VMX-agility™ host units.

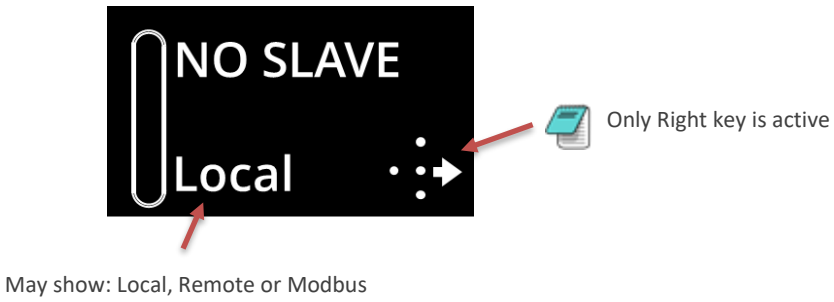
## Initial Power-Up

If the host VMX-agility™ unit/s and the remote keypad have the default Modbus transmission parameters set, and the host unit is powered and has keypad power set to 'on', the keypad will automatically communicate with the host. The following status screen will be seen:

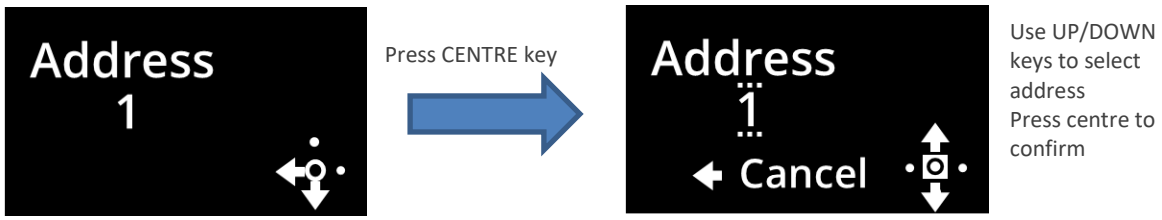


# Keypad Connection and Operation (continued)

If any of the Modbus communication parameters are dissimilar on the host unit or remote keypad, communication will not be established. The keypad will display the following screen:




By pressing the Right key, the user will be taken directly to the Modbus address selection menu:




If the selected Modbus address is valid, the status screen is displayed:




### Selecting Units To Monitor/Configure

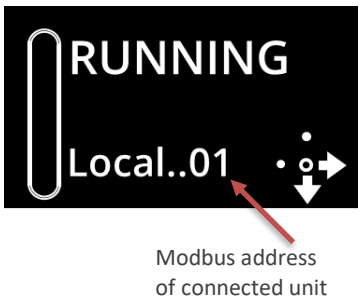
When the Remote Keypad is attached to multiple VMX-agility™ units on the Modbus network, the user can switch between each unit by using the following method.

To simplify this selection process it is recommended that the host VMX-agility™ units are configured with consecutive Modbus addresses

(continued over)

## Keypad Connection and Operation (continued)

Procedure:




1. Press the ‘Right’ key
2. Address selection screen will be shown




3. Press the ‘Centre’ key. Display will change mode




4. Use ‘Up’ or ‘Down’ keys to change address to the desired number (VMX-agility™ address). Press the ‘Centre’ key to confirm
5. Remote display will return to the Status screen and display the new address



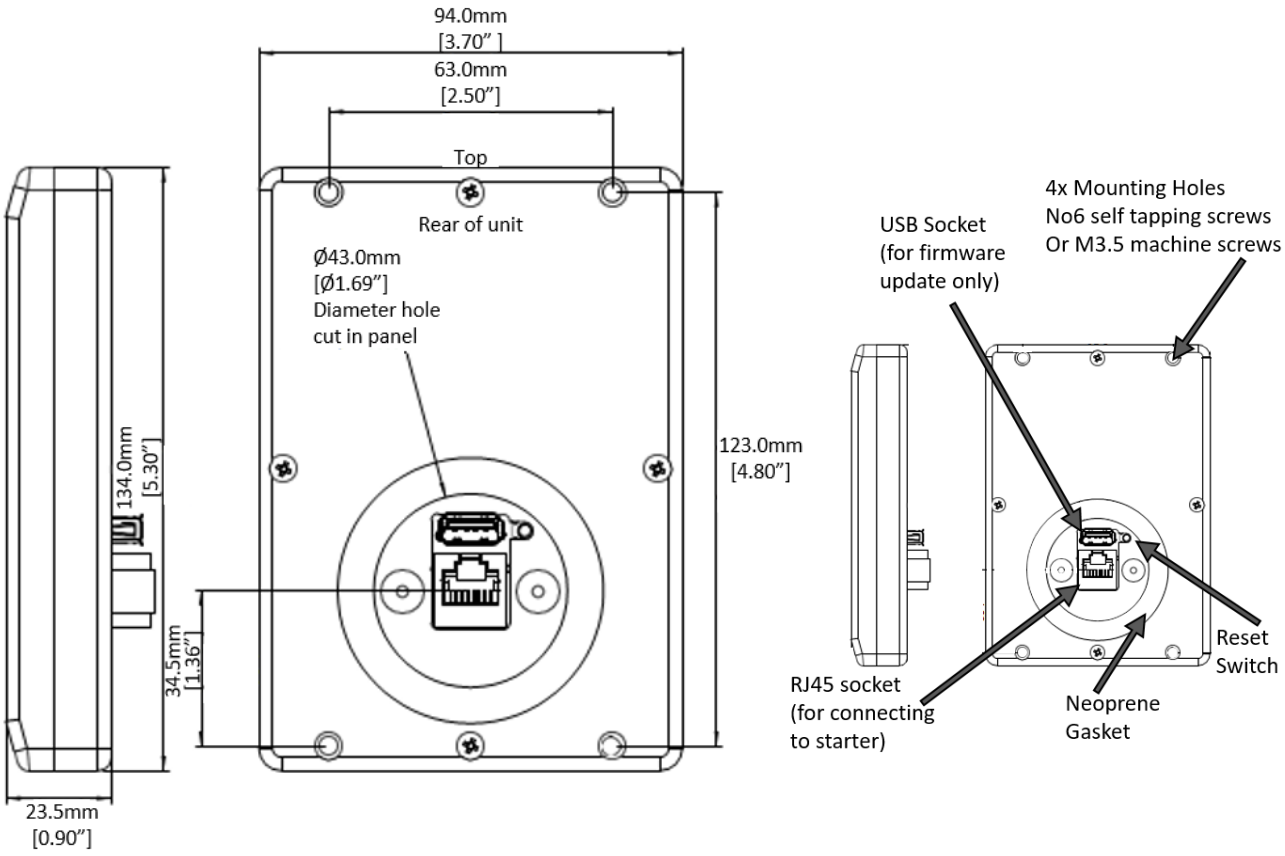
# Keypad Installation

### Mounting

Fix the unit to a flat, vertical surface using the mounting holes in the keypad enclosure.

- The orientation of the unit has the 'TOP' uppermost
- The location allows adequate front access
- The screen can be viewed

Do not install other equipment that generates significant heat close to the keypad.




Note: The host units and Keypad must have the same firmware version.

# Sizing Guide

| agility | | | | |
|---|---|---|---|---|
| | Typical Applications | Standard Duty | Medium Duty | Heavy Duty |
| ***Step 1*** *- Select the application from the list and follow that column down.* | | Agitator | Compressor - Centrifugal | Crusher |
| | | Compressor - Rotary Vane | Compressor - Reciprocating | Shredder |
| | | Compressor -Unloaded | Compressor - Rotary Screw | Wood Chipper |
| | | Conveyor - Unloaded | Ball Mill | Fan - High Inertia or >85A |
| | | Bow Thruster - Zero Pitch | Bow Thruster - Loaded | |
| | | Fan - Low Inertia or <85A | Conveyor - Loaded | |
| | | Feeder - Screw | Grinder | |
| | | Lathe Machines | Hammer Mill | |
| | | Mixer - Unloaded | Mills - flour etc. | |
| | | Moulding Machine | Mixer - Loaded | |
| | | Plastic and Textile Machines | Pelletizers | |
| | | Pump - Submersible | Press, Flywheel | |
| | | - Centrifugal | Positive Displacement Pump | |
| | | Pump - Submersible | - Reciprocating | |
| | | - Rotodynamic | Positive Displacement Pump | |
| | | Saw - Band | - Rotary | |
| | | Transformers | Pump Jack | |
| | | Voltage Regulators | Rolling Mill | *agility is not suitable for very high inertia loads such as centrifuges, loaded crushers or start times >30s.* |
| | | | Roots Blower | |
| | | | Saw - Circular | |
| | | | Screen - Vibrating | |
| | | | Tumblers | |
| ***Step 2*** *- Confirm the rated starting capability of the soft start against the application.* | Trip Class | Trip Class 10 | Trip Class 20 | Trip Class 30 |
| | Rated Starting Capability | 3x Motor Current - 23secs | 4x Motor Current - 19secs | 4x Motor Current - 29secs |
| | | 3.5x Motor Current - 17secs | | |
| | Max Starts per Hour | 5 starts/hour | 5 starts/hour | 5 starts/hour |
| | with Optional Cooling Fan | 40 starts/hour | 40 starts/hour | 40 starts/hour |
| ***Step 3*** *- Consider the operating environment and make the model selection on a higher amp rating.* | Height Above Sea Level | Standard operating height is 1000m, for every 100m increase motor Amps/kW by 1%, up to 2000m. Example: For a 20A motor at 1500m make model selection based on 21A (5% higher) | | |
| | Operating Temperature | Standard operating temperature is 40degC, for every 1degC above, increase motor Amps/kW by 2%, up to 60degC. Example: For a 20A motor at 50degC make model selection based on 24A (20% higher) | | |
| | Increased Starts per Hour | Fit optional fan to increase maximum up to 40 starts per hour. | | |

## Sizing Guide (continued)

| | Motor Rating | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $I_e$ | kW | | | FLA | Hp | | | | | Select Model | Select Model | Select Model |
| | A | 230V | 400V | 500V | A | 200V | 208V | 220-240V | 440-480V | 550-600V | 5 starts/hour @ 40°C | 5 starts/hour @ 40°C | 5 starts/hour @ 40°C |
| *Step 4 - Select your motor Voltage and Horsepower/kW and select model.* | **17** | 4 | 7.5 | 7.5 | **17** | 3 | 5 | 5 | 10 | 15 | **AGY-101** | **AGY-103** | **AGY-105** |
| | **22** | 5.5 | 11 | 11 | **22** | 5 | 5 | 7.5 | 15 | 20 | **AGY-103** | **AGY-105** | **AGY-107** |
| | **29** | 7.5 | 15 | 15 | **27** | 7.5 | 7.5 | 7.5 | 20 | 25 | **AGY-105** | **AGY-107** | **AGY-109** |
| | **35** | 7.5 | 18.5 | 22 | **34** | 10 | 10 | 10 | 25 | 30 | **AGY-107** | **AGY-109** | **AGY-111** |
| | **41** | 11 | 22 | 22 | **41** | 10 | 10 | 10 | 30 | 40 | **AGY-109** | **AGY-111** | **AGY-113** |
| | **55** | 15 | 30 | 37 | **52** | 15 | 15 | 15 | 40 | 50 | **AGY-111** | **AGY-113** | **AGY-201** |
| | **66** | 18.5 | 37 | 45 | **65** | 20 | 20 | 20 | 50 | 60 | **AGY-113** | **AGY-201** | **AGY-203** |
| | **80** | 22 | 45 | 55 | **77** | 20 | 25 | 25 | 60 | 75 | **AGY-201** | **AGY-203** | **AGY-205** |
| | **106** | 30 | 55 | 75 | **100** | 30 | 30 | 30 | 75 | 100 | **AGY-203** | **AGY-205** | **AGY-207** |
| | **132** | 37 | 75 | 90 | **125** | 40 | 40 | 40 | 100 | 125 | **AGY-205** | **AGY-207** | **AGY-209** |
| | **160** | 45 | 90 | 110 | **156** | 50 | 50 | 60 | 125 | 150 | **AGY-207** | **AGY-209** | **AGY-301** |
| | **195** | 55 | 110 | 132 | **192** | 60 | 60 | 60 | 150 | 200 | **AGY-209** | **AGY-301** | **AGY-303** |
| | **242** | 75 | 132 | 160 | **242** | 75 | 75 | 75 | 200 | 250 | **AGY-301** | **AGY-303** | **AGY-305** |
| | **302** | 90 | 160 | 200 | **302** | 100 | 100 | 100 | 250 | 300 | **AGY-303** | **AGY-305** | - |
| | **361** | 110 | 200 | 250 | **361** | 125 | 125 | 150 | 300 | 350 | **AGY-305** | - | - |

### Key to Part Numbers

**VMX-AGY-101-6-XX**

- Option
- Main Supply voltage: 4 – 200Vac to 480Vac, $U_i$ 480Vac, 6 – 200Vac to 600Vac, $U_i$ 600Vac
- Model: See Rating Table
- Series

## Notes

## Notes (continued)

## Notes (continued)

## Notes (continued)

**Electric current, Danger to life!**
Only skilled or instructed persons may carry out the operations.

**Lebensgefahr durch Strom!**
Nur Elektrofachkräfte und elektrotechnisch unterwiesene Personen dürfen die im Folgenden beschriebenen Arbeiten ausführen.

**Tension électrique dangereuse!**
Seules les personnes qualifiées et averties doivent exécuter les travaux ci-après.

**¡Corriente eléctrica! ¡Peligro de muerte!**
El trabajo a continuación descrito debe ser realizado por personas cualificadas y advertidas.

**Tensione elettrica: Pericolo di morte!**
Solo persone abilitate e qualificate possono eseguire le operazioni di seguito riportate.

**触电危险！**
只允许专业人员和受过专业训练的人员进行下列工作。

**Электрический ток! Опасно для жизни!**
Только специалисты или проинструктированные лица могут выполнять следующие операции.

**Levensgevaar door elektrische stroom!**
Uitsluitelijk deskundigen in elektriciteit en elektrotechnisch geinstrueerde personen is het toegestaan, de navolgend beschrevene werkzaamheden uit te voeren.

**Livsfare på grund af elektrisk strøm!**
Kun uddannede el-installatører og personer der e instruerede i elektrotekniske arbejdsopgaver, må udføre de nedenfor anførte arbejder.

**Προσοχή, κίνδυνος ηλεκτροπληξίας!**
Οι εργασίες που αναφέρονται στη συνέχεια θα πρέπει να εκτελούνται μόνο από ηλεκτρολόγους και ηλεκτροτεχνίτες.

**Perigo de vida devido a corrente eléctrica!**
Apenas electricistas e pessoas com formação electrotécnica podem executar os trabalhos que a seguir se descrevem.

**Livsfara genom elektrisk ström!**
Endast utbildade elektriker och personer som undervisats i elektroteknik får utföra de arbeten som beskrivs nedan.

**Hengenvaarallinen jännite!**
Vain pätevät sähköasentajat ja opastusta saaneet henkilöt saavat suorittaa seuraavat työt.

**Nebezpečí úrazu elektrickým proudem!**
Níže uvedené práce smějí provádět pouze osoby s elektrotechnickým vzděláním.

**Eluohtlik! Elektrilöögioht!**
Järgnevalt kirjeldatud töid tohib teostada ainult elektriala spetsialist või elektrotehnilise instrueerimise läbinud personal.

**Életveszély az elektromos áram révén!**
Csak elektromos szakemberek és elektrotechnikában képzett személyek végezhetik el a következőkben leírt munkákat.

**Elektriskā strāva apdraud dzīvību!**
Tālāk aprakstītos darbus drīkst veikt tikai elektrospeciālisti un darbam ar elektrotehniskām iekārtām instruētās personas!

**Porażenie prądem elektrycznym stanowi zagrożenie dla życia!**
Opisane poniżej prace mogą przeprowadzać tylko wykwalifikowani elektrycy oraz osoby odpowiednio poinstruowane w zakresie elektrotechniki.

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**Hengenvaarallinen jännite!**
Vain pätevät sähköasentajat ja opastusta saaneet henkilöt saavat suorittaa seuraavat työt.

**Nebezpečí úrazu elektrickým proudem!**
Níže uvedené práce smějí provádět pouze osoby s elektrotechnickým vzděláním