Motorvision 2 (MV2)

Technical Manual

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1. P&B Motorvision 2 (MV2).

P&B Engineering's MV2 is a highly sophisticated microprocessor based motor protection and control unit, specifically designed to be used as an integral part of any type or manufacture of Motor Control Centre. MV2 provides total control, protection and monitoring of LV and MV motor starters either by direct hard wired inputs and / or via the rear serial port, (RS485 or Profibus connection) with 1ms time stamping of events.

MV2 can be used to control Direct On Line, Star-Delta 2 & 3, Direct On Line Reversing, Air Circuit Breaker, DOL with Heater, Two Speed and Variable Speed Drive motor starters. True RMS current sampling at less than 1msec intervals enables the unit to be used in conjunction with AC Variable Speed Drives or Soft Starters. The MV2 can also be used as an overload device without controlling the starting mechanism.

MV2 monitors the current, voltage and temperature inputs to provide a comprehensive motor protection package. This is combined with all the necessary control and monitoring functions and a high-speed communication facility. The unit is a small, easily installed package supplied at a very competitive cost which makes MV2 the most attractive Motor Protection and Control device available today.

All hard-wired control inputs are connected to the device via optically isolated inputs to enable all starting, stopping and tripping commands to be carried out by the unit. The status of all individual hard-wired contacts is also provided both locally via the liquid crystal display and remotely via any of the communication ports.

All Setting parameters are programmed independently for each unit via the integral keypad and liquid crystal display on the front plate or via any of the communication ports and PC based software package available for the Vision II series of products.

During operation the LCD also gives access to accurate running, statistical and fault data such as; Volts, Phase Amps, Thermal Capacity, Time to Trip, Phase Unbalance, Motor Hours Run and Number of Starts with separate counters for forward/reverse or high/low speed operations.

Tri-Colour Light Emitting Diodes mounted on the front plate give visual indication of the motor status i.e. ON / INHIBIT / OFF and ALARM / FAULTY / HEALTHY conditions.

Flexible high speed control via PLC or DCS systems is obtained through the MV2's communication ports, allowing computer access to full control and monitoring of motor data, including: running data, motor statistical data and control input status.

Note: This manual details the Motorvision 2 (**MV2**), the Advanced Motorvision 2 (**AMV2**), Multi RTD Motorvision 2 (**RTDMV2**) and other variations that include combinations of this hardware. In addition this manual covers the new vertical display format.

1.1. Protective Functions.

Max Start Time Protection
Thermal Overload Protection with adjustable t6x and hot/cold ratio and fixed pre alarm
Undercurrent Protection
Load Increase Protection
Low Set Overcurrent Protection
Overfrequency Protection
Underfrequency Protection
Single Phase Protection
Phase Rotation Protection
Phase Unbalance Protection
Undervoltage Protection
Undervoltage Start Lockout
Earth Fault Protection
PTC or NTC Thermistor or RTD Protection
Excess Number of Starts Protection
Overvoltage Protection
Backspin Protection
Power Factor Protection
Short Circuit Protection
Contactor Fault Protection
Emergency Stop Protection
Serial Timeout Protection
Internal Error Protection
Serial Inhibit Protection
10 External Semi-Customised Protection Settings
2 Channel Trip Circuit Supervision Protection (Optional AMV2)
6/12 multi RTD inputs (Optional RTDMV2)

1.2. Displayed Drive Data.

Phase & Average Amps
Earth Fault Current
Percentage Unbalance
Percentage Motor Load
Voltage (3 Phase, 3VT version only)
Percentage Thermal Capacity
Motor Status
Power k(M/G/T)W
Power Factor
Temperature / Resistance (single channel)
Temperature (multiple channels)
Running Status
Frequency
Time & Date
Hours Run
Hours Run This Start
Reference Start Curve (graphic)
Start Curve (graphic)
Time to Trip
Time to Reset
Last Start Data
Number of Trips
Total Operations, Start A
Total Operations, Start B
k(M/G/T)W Hours
k(M/G/T)VA Hours
k(M/G/T)W Max Demand
k(M/G/T)VA Apparent Power
k(M/G/T)VAr Real Power
Last Peak I
Last Start Source with time and date
Last Stop Source with time and date
Time to Reaccelerate
Time to Clear Inhibit

1.3. Displayed Drive Status.

Running / Starting / Stopped / Inhibit
Forward / Reverse / Two Speed / Star/Delta
Alarm Description, Pre- Trip Values, Alarm History
Trip Description, Pre- Trip Values, Trip History
Auto / Manual Mode
Local / Remote Mode

1.4. Starting Logic.

Direct-on-Line
Reversing Direct-on-Line
2 Speed (separate winding and tapped winding motors)
DOW 2 Speed (as above, also allows speed transition without stopping)
Star/Delta 2
Star/Delta 3 (includes line contactor)
ACB (mechanically latched contactor)
Direct-on-Line Heater (with a facility to inject winding heating supply)
Reversing Direct-on-Line Heater (with a facility to inject winding heating supply)
Variable Speed Drive
Current Based Starting

1.5. Control Functions.

Via Hardwired inputs:
Start, Stop, Reset,

Local/Remote Select, Auto/Manual Select

Via Comms input:
Start, Stop, Reset, Set/Clear Inhibit

Via Keypad:
Start, Stop, Reset,

Local/Remote and Auto/Manual select*

Only if L/R, A/M are not configured as hardwired inputs*

1.6. Control Output Relays.

Output Relay #1, Output Relay #2, Output Relay #3, Output Relay #4

Some of the Output Relays are pre-set depending on the Starter Type chosen. Others can be programmed by the user. They can be programmed as follows: -

Not Used, Follow A, Follow B, Inv A, Inv B, Trip, Trip FS, Alarm, Alarm FS, Healthy, Warning, Serial-Available, Panel-Available, Remote-Available, Health FS, Indicator 1, Indictor 2, Indicator 3, Indicator 4, Indicator 5.

1.7. Control Inputs.

The user can define the function of the twelve optically isolated inputs from the list of 24 below.

1. Not Used
2. Start A
3. Start B
4. Stop
5. E Stop
6. Contactor A
7. Contactor B
8. Test
9. Reset Fault
10. Auto / Manual
11. Local / Remote
12. Speed Switch
13. Authorise
14. External Fault 1
15. External Fault 2
16. External Fault 3
17. External Fault 4
18. External Fault 5.
19. External Fault 6
20. External Fault 7
21. External Fault 8
22. External Fault 9
23. External Fault 10
24. Restart

2. Technical Specification.

Power Supply.

AUXILIARY POWER SUPPLY & LOW VOLTAGE POWER SUPPLY	
AC Nominal	Range 80 – 265V AC / DC Range 24V AC / 24-48V DC (Low Voltage Power Supply Optional Extra)
Frequency	45 - 65 Hz
Maximum Power Consumption	10VA, 15VA Nominal

Measurement.

PHASE CURRENT MEASUREMENT	
Method	True RMS, Sample time <1ms
Range	0.1 to 16x Phase CT Primary Amps
Full Scale	16 x Phase CT Primary Amps Setting
Accuracy	± 3% at Phase CT Primary amps
EARTH PHASE CURRENT MEASUREMENT	
Method	True RMS, Sample time <1ms
Range	0.05 to 2.0x E/F CT Primary Amps
Full Scale	2.0 x E/F CT Primary Amps Setting
Display Accuracy	± 3% of Reading Over Range
Pick Up accuracy	± 3% of setting
VOLTAGE REFERENCE MEASUREMENT Suitable for connection preferably via isolating transformers (VT) or direct connection to max phase to phase system voltage not exceeding the rated voltage.	
Method	True RMS, Sample time <1ms
Rated Insulation Voltage	1000V
Range	100 – 500V AC up to 22kV with external VT
Display Accuracy	± 3%
Power Accuracy	± 5% of Nominal
VT Burden	0.01 VA
THERMISTOR/RTD INPUT.	
Response Time	< 0.5 seconds
Thermistor Range	1 - 30 Kilo-Ohms
Thermistor Accuracy	± 5% of reading or 100 ohms whichever is the greater
RTD Range	0-250°C (0-490°C Multi Channel RTDMV2 only)
RTD Accuracy	not greater than ± 7.7% of reading

Protection Functions.

OVERLOAD ALARM AND TRIP CURVES	
Fault Time Accuracy	± 200mS up to 10 seconds ± 2% of trip time over 10 seconds
Threshold Current Level	Overload Setting ± 2%
CURRENT UNBALANCE ALARM AND TRIP	
Method	Unbalance = 100 x (Imax - Imin) / Ir % Where Imax = max. of 3 phase currents Imin = min. of 3 phase currents Ir = Larger of Imax or Motor FLC
Alarm Threshold Unbalance Level	50% of Unbalance current ± 2%
Alarm Fixed Time Delay Accuracy	1.0 ± 0.5 seconds
Trip Threshold Unbalance Level	Unbalance Current Setting ± 2%
Trip Time Accuracy	± 1 second up to 10 seconds ± 1 second +/- 2% above 10 sec.
TIME DELAYS	
Accuracy	± 0.5 seconds or ± 2% of time
Exceptions	
Earth Fault Trip	+150mS,-0.0@ 1.1 x setting +60mS,-0.0@ 2 x setting +40mS,-0.0@ 5 x setting
Total Run Time	Accuracy ± 2%
Auto Restart delay on Restart Time	± 0.2 seconds

Relay Contacts Ratings.

OUTPUT RELAYS	
Rated Load	10A @ 250 AC 10A @ 30V DC
Maximum Breaking Voltage	250V AC
Max Making Current (max. 4s at duty cycle 10%)	35A
Max Breaking Capacity AC	2500VA

3. Environmental Tests.

CLIMATIC	TEST STANDARD	SEVERITY LEVEL
Temperature Dry Cold Operational	IEC 60068-2-1	-20 deg C ,96 hrs
Temperature Dry Cold Transportation & Storage	IEC 60068-2-1	-40 deg C , 96hrs
Temperature Dry Heat Operational	IEC 60068-2-2	+60 deg C , 96 hrs
Temperature Dry Heat Transportation & Storage	IEC 60068-2-2	+85 deg C , 96 hrs
Damp Heat Steady State	IEC 60068-2-30	95% Non-condensing, Cyclic Test Db
Enclosure	IEC 60529	front IP52 , rear IP00
MECHANICAL		
Vibration	IEC 60255-21-1	Class I
Shock & Bump	IEC 60255-21-2	Class I
Seismic	IEC 60255-21-3	Class I
ELECTRICAL		
Insulation resistance	IEC 60255-5	500 Vdc , 5 secs
Dielectric Test	IEC 60255-5	Series C of table 1 2.5 kV 50Hz , 1 min 1.0 kV open contacts , 1 min
High Voltage Impulse	IEC 60255-5	5 kV peak 1.2/50uS,0.5J 3 pos , 3 neg
Voltage Dips , Short Interruptions & Voltage variations immunity	IEC 60255-11 IEC 61000-4-11	3 dips & 3 interruptions at 10 sec intervals of duration between 10mS and 500mS at zero crossings. Variations 40% &70%
Ripple in dc supply	IEC 60255-11	12% ac ripple
VT input Thermal Withstand		120% Vn , continuous
CT input Thermal Withstand		250xIn half wave,100xIn for 1 second 30 xIn for 10 second , 4 xIn cont.
ELECTROMAGNETIC COMPATIBILITY		
Electrical fast Transient/Burst	IEC 60255-22-4 IEC 61000-4-4	Class IV-4.0kv Power supply Class III -2.0 kV Other inputs 1 min each polarity
Oscillatory Waves 1 Mhz Burst	IEC 60255-22-1	Class III Longitudinal 2.5 kV , 2sec Transverse 1.0 kV , 2 sec
Electrostatic Discharge	IEC 60255-22-2	Class III 8 kV contact 15kV air discharge , 10 discharges at 1 sec intervals
Conducted Disturbance RF fields	IEC 61000-4-6	0.15 to 80 Mhz Severity Level 10Vrms +sweeps 0.05-0.15MHz & 80-100MHz
Radiated e-m field from digital portable telephones	ENV 50204	900 & 1890mhz at 10V/m
Radiated RF e-m field immunity test	IEC 60255-22-3	ClassIII test method A +sweep 500-1000mhz or IEC 1000-4-3 80-1000mhz severity 10V/m 80% modulated 1 kHz
Surge Immunity	IEC 61000-4-5	4kV common mode 2kV differential mode , 1.2/50uS
Power Frequency Magnetic Field	IEC 61000-4-8	1000A/m for 1 sec 100A/m for 1 minute
Pulse Magnetic Field	IEC 61000-4-9	6.4/16uS , 1000A/m
Damped Oscillatory Magnetic Field Immunity	IEC 61000-4-10	0.1 & 1.0 Mhz , 100A/m
Conducted & Radiated RF Interference Emission	EN55022 or EN55011or EN50081-2	Class A interference limits
Power frequency conducted immunity, common mode	IEC 61000-4-16 IEC 60255-22-7	DC to 150kHz sweep test level 4 300V at 16 2/3 & 50/60Hz

4. Analogue Inputs.

4.1. Power Supply Live.

The MV2 requires an AC or DC Voltage to supply the unit. A separate AC/DC voltage is required to supply the digital inputs (Control Supply), this can be taken from the Auxiliary Supply, or a completely isolated supply can be employed.
The MV2 can also be fitted with a Low Voltage Power Supply (PSU) and / or Low Voltage digital inputs.

The MV2 monitors the power supply assumed to be derived from the primary side of the contactor within the starter cubicle or from the MCC busbars to provide an Undervoltage Restart facility. When enabled in the Starter Settings page the MV2 monitors the supply and in the event of a failure will maintain the start signal to the motor for up to 200 milli-seconds. Beyond 200msec the unit will trip the motor and should the power supply be restored to 95% within the programmable Restart Time (2.0 to 200s) the unit will restart the motor after a programmable time delay (1-120s). Should the voltage not be restored within the programmable Restart Time the motor will not be automatically restarted.

There is also a digital input that can be used to enable or block the Undervoltage Restart. If the input is closed then a restart can occur, if open, then the restart is blocked. If no digital input is set to Restart then a restart will always occur in line with the required conditions.

4.2. Voltage Reference.

The MV2 monitors single phase voltage, which can be directly connected for voltages up to 1000V. In order that the MV2 can measure and display the actual voltage, the phase to phase or phase to neutral input must be selected in the settings. A reverse feature has been included to allow incorrect phase connections to be rectified without the need to rewire.
With the use of Voltage Transformer the MV2 can monitor voltages up to 22kV.

For special applications the MV2 can be fitted with 3 phase VT inputs allowing the relay to monitor and base protective functions from a 3 phase aspect. In this case the voltage, power and power factor measurements are shown as referenced to individual phases.

4.3. Current Sensor Inputs.

The current inputs to the MV2 are available as either Conventional Current Transformers or Hall Effect Sensors.

4.3.1. Hall Effect Sensors.

To allow MCC manufacturers to use the smallest size compartments P&B have developed an accurate Hall Effect Current Sensor.

The unit is a compact 3 phase enclosed device. The Current Sensor comes complete with a ribbon cable and connectors to plug directly into the associated MV2-HES dedicated terminal block. See Appendix 2.

The current sensor is available in 3 versions depending upon the calibrated rating for motor full load ratings of 10-25, 25-50 & 50-150 Amperes. To give maximum accuracy the sensors are normally calibrated to the actual drive current or cubicle rating prior to despatch.
Earth fault protection can be achieved via a special internal residual earth fault or as standard, a separate 1A CT input is provided for Core Balance CT connection.

4.3.2. Conventional Current Transformers.

Normally, the MV2 has provision to allow connection of standard 1 amp or 5 amp secondary current transformers. The Earth fault measurement can either be a residual connection from the three phase CT's, a special internal residual earth fault or via a CBCT.

Small Motor Starters can also be directly connected to MV2 to avoid the need of costly small ratio CT's.
A standard 1A unit can connect from 0.5-2A FLC and a 5A unit can connect from 2.5-10A FLC.
A special 2A version allows direct connection of drives from 1A to 4Amp's.

As with both the conventional CT connection or with the HES connection the special internal residual earth fault can be used to offer reliable earth protection to directly connected drives.

4.4. Temperature Input.

Thermistors of either positive or negative temperature coefficients can be directly connected to the MV2 by selecting either PTC or NTC in the default menu. The alarm and tripping range can be adjusted between 1000 Ohms and 30,000 Ohms.

Resistance Temperature Detectors (RTDs) can also be connected to this input, if RTD is selected. The alarm and tripping range can be adjusted between 0° and 250°C.

The RTDMV2 has standard 6 or 12 channels for two or three wire RTD connection. The protection for each channel can be set independently of the others with a range of 0 to 490 degrees Celsius. As with the external fault digital inputs each RTD over temp protection name can be changed to any 11 character text string.

5. MV2 Control Outputs.

5.1. Output Relays.

The MV2 has 4 output relays which can be assigned as follows depending on the type of starter that the motor is connected to.

STARTER TYPE	OUTPUT RELAY			
	RELAY 1	RELAY 2	RELAY 3	RELAY 4
DOL	RUN	Programmable	Programmable	Programmable
S/D 2	STAR	DELTA	Programmable	Programmable
S/D 3	STAR	DELTA	LINE	Programmable
DOLR	FORWARD	REVERSE	Programmable	Programmable
2 Speed	LOW	HIGH	Programmable	Programmable
DOW 2 Speed	LOW	HIGH	Programmable	Programmable
ACB	CLOSE	OPEN	Programmable	Programmable
DOLH	RUN	HEATER	Programmable	Programmable
DOLRH	FORWARD	REVERSE	HEATER	Programmable
VSD	RUN	Programmable	Programmable	Programmable
NO STARTER	TRIP	Programmable	Programmable	Programmable

Where stated the corresponding output relays can be programmed with the following options:-

1. Not Used
2. Follow Contactor A
3. Follow Contactor B
4. Follow Inverse Contactor A
5. Follow Inverse Contactor B
6. Trip
7. Trip Fail Safe
8. Alarm
9. Alarm Fail Safe
10. Healthy
11. Warning
12. Serial Available
13. Panel Available
14. Remote Available
15. Healthy Fail Safe
16. Indicator 1
17. Indicator 2
18. Indicator 3
19. Indicator 4
20. Indicator 5

5.2. Relay Settings.

Follow A.

If an output relay is programmed as ‘Follow A’ its state will mirror the state of output relay 1. When a relay is programmed as ‘Follow A’ a delay may be assigned.

Follow B.

If an output relay is programmed as ‘Follow B’ its state will mirror the state of output relay 2. When a relay is programmed as ‘Follow B’ a delay may be assigned.

Inverse A.

If an output relay is assigned as ‘Inv. A’ its state will always be the inverse of the state of output relay 1.

Inverse B.

If an output relay is assigned as ‘Inv. B’ its state will always be the inverse of the state of output relay 2.

Trip.

If an output relay is assigned as 'Trip' then this relay will change state from the de-energised to the energised relay contact when triggered by any protection function or external device connected to the relay that is configured to trip the motor.

Trip Fail Safe.

If an output relay is assigned as 'Trip FS' (Trip Failsafe) then this relay will change state from energised to the de-energised relay contact when triggered by any protection function or external device connected to the relay that is configured to trip the motor.

Alarm.

If an output relay is assigned as 'Alarm' then this relay will change state from de-energised to the energised relay contact when triggered by any protection function or external device connected to the relay that is configured to alarm.

Alarm Fail Safe.

If an output relay is assigned as 'Alarm FS' then this relay will change state from energised to the de-energised relay contact when triggered by any protection function or external device connected to the relay that is configured to alarm.

Healthy.

If an output relay is assigned as 'Healthy' this relay will be in its de-energised state at all times while the unit reports the motor as being healthy. This relay will be energised when the unit registers either an Alarm or Fault condition or the motor has been inhibited from starting.

Warning.

If an output relay is assigned as 'Warning' then it will change state when any enabled protection function has exceeded its pickup value.
The relay is not latching. When the pickup setting is no longer violated the output relay assigned as 'Warning' will be de-energised. The 'Warning' relay does not wait until the expiry of a trip or alarm timer before being energised. It will energise immediately after an enabled protection feature has its pickup point violated or a digital input registers a fault status.

Serial Available.

If an output relay is assigned as 'Serial Available' this relay will be energised only when the motor is available to be started through the serial port, via a serial command. For details on configuring possible start sources see sections10.5.1.1.1 and 16.

Panel Available.

If an output relay is assigned as "Panel Available" this relay will be energised only when the motor is available to be started from the front panel of the relay. For details on configuring possible start sources see sections 10.5.1.1.1 and 16.

Remote Available.

If an output relay is assigned as 'Remote Available' this relay will be energised only when the motor is available to be started from a remote station via a digital input. For details on configuring possible start sources see sections 10.5.1.1.1 and 16.

Healthy Fail Safe.

If an output relay is assigned as 'Healthy FS' (Healthy Failsafe) this relay will be in its energised state at all times while the unit reports the motor as being healthy. This relay will be de-energised when the unit registers either an Alarm or Fault condition or the motor has been inhibited from starting.

Indicator 1-5.

If an output relay is assigned as any of the 5 available Indicators then this relay will change state from de-energised to the energised relay contact when triggered by any protection function or external device connected to the relay that is configured to indicate on that same indicator channel.
An Indicator relay will only be energised following the expiry of the delay timer (if a delay is assigned) for a protection function or external device that registers its pickup setting or fault status has been violated. When the pickup setting or fault status is no longer violated the output relay assigned to the relevant Indicator will be de-energised. An Indicator is not latched.
Typically these are used for single function signaling or used as output indicators to other drives when forming part of a hardwired permissive control system.

5.3. 4-20mA Output Loop Control.

As an option MV2 has an isolated 4-20mA output control to provide an indication of motor load or power. This feature is set within the calibration set up and as such should be requested at the time of ordering.

An external 24V DC supply is required to power this isolated control loop.

6. MV2 Control Inputs.

The MV2 offers 12 digital inputs to provide full control and indication for the motor starter. The supply to these terminals is derived from a separate Control Supply to the relay. As the digital inputs are completely isolated from the relays internal supply it is possible to have field input signals at a different voltage or phase from the relays' auxiliary power supply.
The condition of all these inputs can be viewed at any time via the Digital Inputs page of the Data Menu which enables complete wire checking without the need to disconnect or even gain access to the rear panel wiring.

The 12 inputs are chosen by the user from the list described in the following sections.

6.1. Start A and Start B Inputs.

When one of these inputs are closed the corresponding output relay is energised as long as the Start Setup Sources has been set accordingly (see sections 10.5.1.1.1 and 16), and provided all other External Faults are in the healthy state. Start A only is used for *DOL*, *DOL Forward*, *Star* or *Low Speed* contactors whilst Start B is used for *DOL Reverse* or *High Speed*. The starter settings menu allows these Start inputs to be either momentary, i.e. from push buttons or maintained, i.e. from PLC outputs not both.

6.2. Stop Input.

If this input is open circuited the motor will be switched off and inhibited from starting as long as the Stop Setup Sources have been set to allow the stop to be active from the *remote* source. (see sections 10.5.1.1.1 and 16).

6.3. Emergency Stop.

This input allows the MV2 to monitor the status and provide indication of the state of any of the external Emergency Stop buttons which are normally directly wired to the contactor closing circuit. Opening of the input causes a trip with an option to alarm depending on the Protection Settings. Emergency Stop is only disabled when used for contactor applications, (short circuit protection is also disabled) when the phase fault current exceeds 9x In.

6.4. Contactor A and B Status.

These status inputs from the contactors allow the MV2 to determine and show via the front plate LED's and LCD display the status of both the A and B contactors, also known as Relays 1 and 2. Cont A is the feedback signal for a Start A command and Cont B is the feedback signal for a Start B command.

Monitoring of these contacts also provides protection against 'Control Open' (when a MV2 START command is not confirmed by these inputs, Cont A and/or Cont B) and 'Welded Contact' (when MV2 STOP command is not confirmed by these inputs). Only when the Contactor Fault protection is enabled do these 'active faults' appear under warranted situations.

6.5. Test Mode.

When in the Test mode the MV2 will disable Undercurrent Protection, Undervoltage, Single Phase and Phase Sequence protection functions, as well as the External Faults if set to Disable in Test.
This allows full functional testing to be performed without the need for voltage or current injection and will allow secondary injection testing to be carried out on all protective functions except for those disabled by the feature.

6.6. Reset Fault.

This input enables the operator to reset MV2 Fault or Alarm conditions. The Input can only perform a reset if the following conditions are met:

1. The Protection Settings for the specific fault or alarm are set to allow remote resets.
2. There is no existing Start command
3. The condition that caused the Fault or Alarm to occur no longer exists.

Providing conditions 2 and 3 are met an operator can override the settings in the Protection Settings by closing the Authorise digital input and pressing the Reset digital input.

6.7. Auto/Manual and Local/Remote Inputs.

These inputs are used to determine the source of both the Start Signal and Stop Signal to the motor. They are configured in the Start Setup Source and the Stop Setup Source. (See sections 10.5.1.1.1 and 16)

6.8. Speed Switch.

Closing of this input reduces the trip time on the cold and hot curves by 50%. A tachometer is generally used on the rotor to determine if the shaft is turning the transducer is fed to this input. This provides a faster trip for stalled motors.

6.9. Authorise.

This function can be programmed as a digital input to allow a physical key switch to override the password and reset all faults. This input can be used to restrict fault and alarm reset, if the Auto and Panel reset options of protective functions are disabled a fault can only be reset from the panel if the authorised input is closed. The use of the "Authorise" function will override the password. All data menus, display scroll and drive control are accessible without requiring the use of the "Authorise" or "Password" functions if these are enabled.

Should a digital input be set to Authorise then the user will be unable to Disable the Password Setting on the relay. To Disable the password the Authorise input must be assigned as another digital input or set to ‘Not Used’.

6.10. External Faults 1-10.

The flexibility of the External Fault inputs gives MV2 an intelligent PLC aspect to protective relaying.
External Faults are voltage based and are assigned to digital inputs to perform a wide variety of roles. Multiple plant interlocking, process shutdown or for use as a gateway onto the serial network for digital signals via the MV2.
External Faults can be configured as independent protective functions and can be configured to any combination of; *Trip*, *Alarm*, *Inhibit* or just to *Stop* the drive. The normal reset types are available; *Auto*, *Panel*, *Serial* and *Remote*. Any combination of 5 indicators can be used to drive output relays configured to the same Indicator function.
The fault status of the input is programmable such that *OFF = Fault* or *ON = Fault* where the input is fed from either a normally closed (NC) or normally open (NO) source.
The trip time (or time to take the configured action) is settable in the range 1 to 60 seconds.

Each External Fault text string (EXTERNAL 1 etc) can be reconfigured to any character and numerical string desired via the keypad (*Unit Settings > Edit Custom Strings*) or via any of the serial ports.

6.11. Restart.

This input will inhibit or permit an Undervoltage Restart to take place. This is to allow the differentiation between power losses that would and would not allow an automated restart of the drive. If the input is closed a restart can occur and if the input is open then the restart will be blocked.

If no digital input is set to Restart then an Undervoltage Restart would always occur, if enabled.
See section 4.1. and section 16.

7. MV2 Serial Ports.

7.1. RS485

The Serial Port supplied with MV2 as standard utilises a half duplex RS485 protocol allowing up to 32 units to be daisy-chained together, or to be multi-drop connected with a single shielded twisted pair cable.
The MV2 in addition to its very comprehensive protection and control features has been equipped with a very powerful data communications system. This extends its boundaries far beyond a motor protection controller into the realms of a complete motor management system. It provides high-speed data acquisition to supervisory computers to form a complete motor management system.

Each MV2 can be connected to an isolated data highway using RS485 communications. Up to 32 units can be connected to each data highway. The host system can interrogate the unit to monitor motor status, running conditions, historical data and fault data as well as control functions such as a start and stop to the motor and reset fault / alarm conditions.

The MV2 is available with P&B network gold (P&B protocol) installed for use with the Xcell Data Concentrator for fully Integrated Protection, Control & Monitoring Systems with full dual redundancy or with a Slave implementation of Modbus RTU protocol for small systems and direct Modbus access to devices where data concentration is not required.

7.2. Profibus

The MV2 can also be fitted with a standard 9-way d-type connector in place of the RS485 connection to provide a Profibus DP interface. See section 13.2.

7.3. RS232

When the Profibus option is chosen the unit is additionally fitted with a front mounted RS232 port to allow relay interface using the P&B Protocol.
This RS232 port is optional to the standard RS485 unit allowing access to historical and running data without disturbing the rear RS485 network. The front mounted serial port also allows disturbance recording traces to be extracted.

Full details of the protocols, device mapping, gsd / gse files and other support documents are available on request.

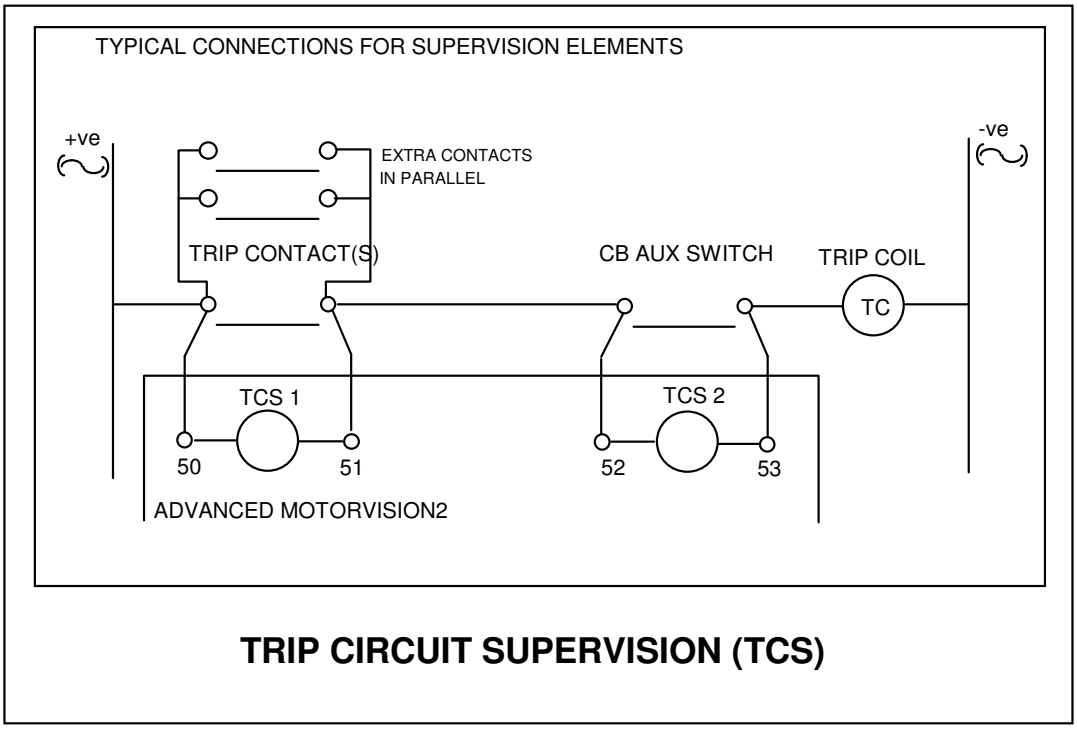
Information on the Xcell Data Concentrator is contained in the P&B Integrated Protection & Control System Integrators Manual, available on request.

8. Trip Circuit Supervision (AMV2 only).

Trip Circuit Supervision is available as an option to the MV2, and when installed the relay is supplied in a larger case and is referred to as the Advanced Motorvision (AMV2).

The trip circuit passes through external components such as fuses, links, relay contacts, auxiliary switch contact and others. Errors in any of these external components could lead to a trip not being called and the breaker remaining closed.
TCS protection is normally applied to breaker controlled Motor Starters.

To protect against these failures the AMV2 has two trip circuit supervision input circuits, one to monitor the trip relay and one to monitor the circuit breaker. Should they both read the same input, i.e. a trip has been called and the breaker is closed, the assigned output relay changes state.



TRIP CIRCUIT SUPERVISION (TCS)

The TCS element consists of two input circuits and two dedicated change-over contact output relays operating in tandem. As the TCS board does not interact with the main relay processor one of the digital outputs provided by the Trip Circuit Supervision should be fed back into the AMV2, as an External Fault input configured to alarm and / or inhibit. The other output can be used to drive an indication lamp for example.

The Trip Circuit Supervision Output Relays are Fail Safe, this means that on power up the relays change state. Therefore in the situation where power is lost to the AMV2 an indication is given through the Trip Circuit.

The output relays will enter an unhealthy state if one or both of the TCS Inputs are closed or if power is lost to the relay. The relays will only go back to a healthy state if both the inputs are open. The voltage supply to the elements can be either AC or DC within the range of the normal Aux. Supply (80-265 V AC/DC).

9. MV2 Faceplate Functions.

The MV2 Faceplate has been designed to provide display and access to all the required information an operator may require.

This is achieved by using 2 tri-colour LED's, a fully graphic LCD display and 4 software driven function keys.

This eliminates the need for additional indication devices on the front of the motor starter panel such as Lamps, Ammeter, Voltmeter, Hours Run Indicator, Operations Counter, etc. which helps reduce the cost of the motor starter panel and gives improved reliability by the reduction of separate components.

AMV2 or RTDMV2 type display with front mounted RS232 port.

The display of the standard MV2 can be found on the front page of this manual.

9.1. LED Status.

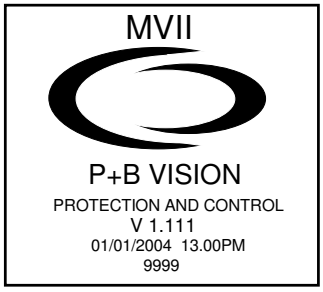
The LED's operate as follows:

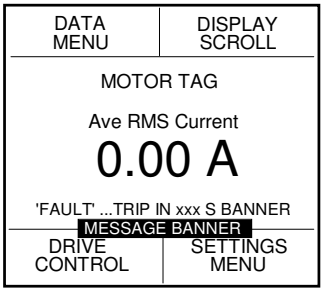
LED Colour	Left LED [Drive Status]	Right LED [Fault Status]
Green	**Off**	**Healthy**
Yellow	**Inhibited**	**Alarm**
Red	**On**	**Fault**

10. Graphical Display.

The MV2's graphical display is fundamental to the philosophy of the Vision IED family of devices. The screen provides access to all dynamic and historical data, protection parameter set points and control set-up.

10.1. Menu Screens.





On power up the MV2 screen appears for a few seconds. The screen shows the software version and the unit serial number, which should be noted in all correspondence with P&B regarding the relay.

After the Introduction screen disappears then the Initial screen appears.

The main portion of the screen shows the main dynamic data of the drive, various message banners can appear under different conditions to alert the operator to the present conditions. These can be time to trip messages, countdown to restart message, countdown to reset or clear inhibit messages and so on. The name of the fault condition causing the trip will also appear along with the timer.

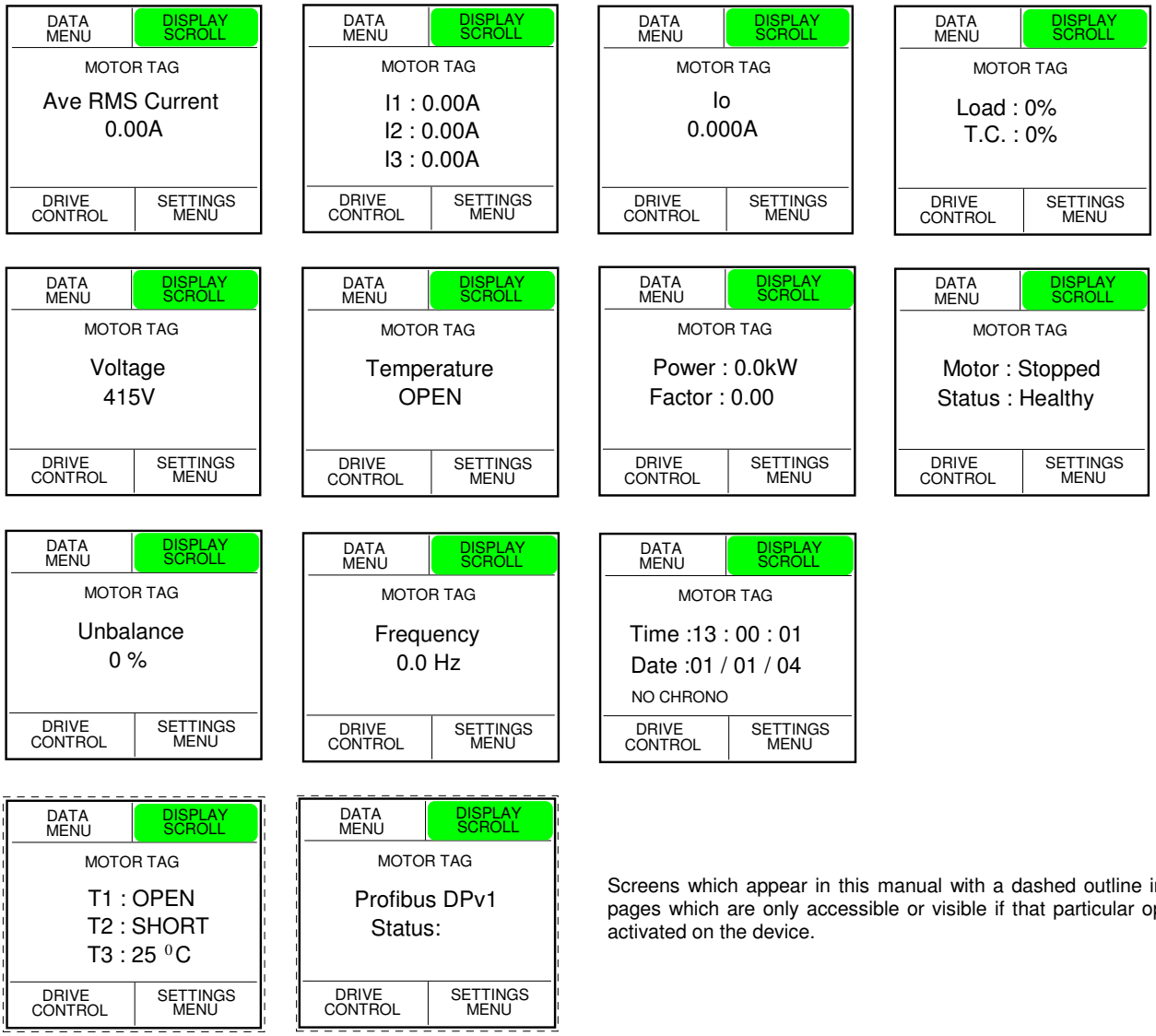
The four menu driven software keys each navigate to four main areas of the menu structure. These are *DISPLAY SCROLL*, *DATA MENU*, DRIVE CONTROL and the *SETTINGS MENU*. Using soft-keys provides a very easy to use environment in order to effectively navigate the entire menu system.

The *DISPLAY SCROLL* button scrolls in a loop displaying various measured values and drive status data. Any one of these pages can be selected as the 'default' page, so that if the unit is left whilst in a sub menu the screen can return to a pre-selected page after a set time-out period.

Average RMS Current(A)	Motor Running Status: (Stopped / Starting / Running / Inhibit)
Separate 3-Phase Currents (A)	and Fault Status: (Healthy / Fault / Alarm)
Earth (ground) Current (A)	Unbalance Current(%)
Motor Load (%) and Thermal Capacity (%)	Frequency (Hz)
Voltage (V)	Time and Date
Temperature (single input)	Temperature (multiple channels)*
Power (k/M/G or TW) and Power Factor	Profibus DP Status**

* RTDMV2 only
** Profibus activated MV2

10.2. Display Scroll.

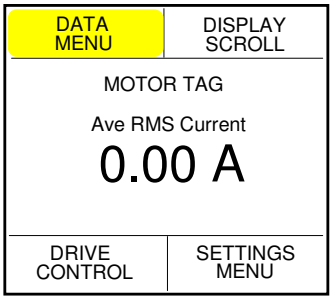


Screens which appear in this manual with a dashed outline indicate pages which are only accessible or visible if that particular option is activated on the device.

Examples of the Display Scroll screens.

10.3. Data Menu.

Upon pressing the DATA MENU button, the menu buttons automatically change function to suit the next tier of menu access.
The main display scroll screen remains with the last selected page before the data menu button was pressed.

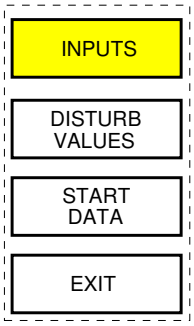


The function buttons now allow access to other data pages as shown left.

The following pages describe in detail each sub page of the Data Menu beginning with the Measured Values.

Exit, whenever pressed restores the screen to the previous page.

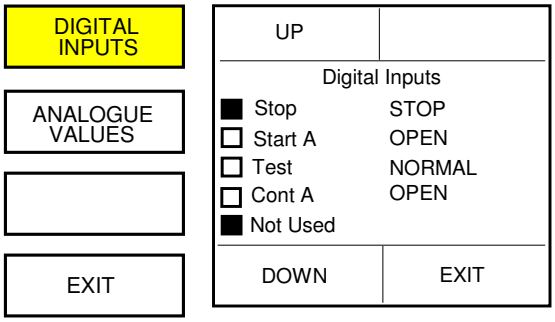
10.3.1.1. Measured Values.



This screen continues to show all the data that is given by the initial screen but there are sub screens accessible to the user by pressing either of the four buttons.

This sub menu page is only visible when the optional Disturbance Recording feature is enabled.

10.3.1.1.1 Inputs> Digital Values.

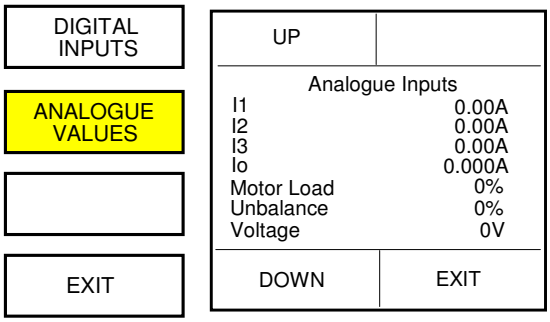


This screen displays the state of the digital inputs to the relay.
The list of data can be scrolled through using the top-left button (UP) and the bottom-left button (DOWN). The status of the 12 digital inputs can be viewed here.

A 'status' box to the left of the digital input gives a representation of the voltage on that terminal.

A filled box represents an active or energised input, a clear box represents a de-energised input.

10.3.1.1.2. Inputs> Analogue Values.



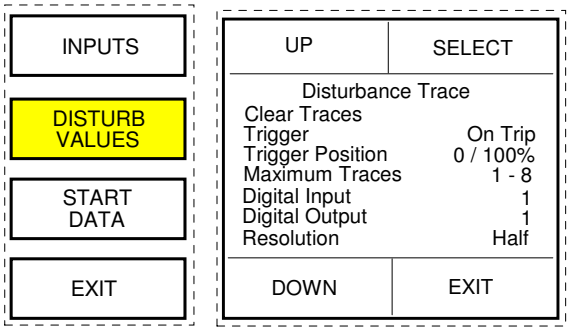
This screen displays the values of the analogue inputs to the relay.

The list of data can be scrolled through using the top-left button (UP) and the bottom-left button (DOWN).

The analogue inputs that can be viewed are as follows:

I1 (A)	VOLTAGE (V)	FREQUENCY (Hz)
I2 (A)	POWER (W)	kVA APPARENT POWER
I3 (A)	POWER FACTOR	KvAr REAL POWER
I0 (A)	THERMAL CAPACITY (%)	EE BLOCK
MOTOR LOAD (%)	RES 1 / TEMPERATURE	
UNBALANCE (%)	DIAG STATUS	

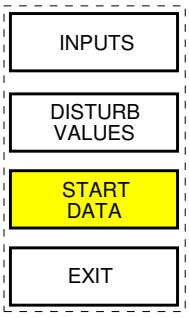
10.3.1.2. Disturb Values.



If Disturbance Recording is enabled, this screen is accessible and allows the viewing and configuring of the disturbance traces.

This facility is explained in further detail in section 20.

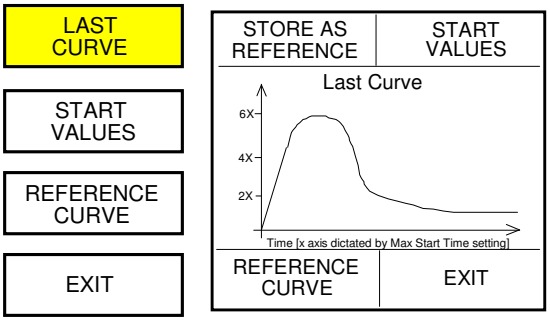
10.3.1.3. Start Data.



Start Data provides access to the recorded information gather during the last successful start of the machine.

The energising Start Curve of the Motor is recorded graphically and can be viewed at any time. This can also be stored permanently as a reference curve. The Starting analogue values are also recorded.

10.3.1.3.1. Last Curve.

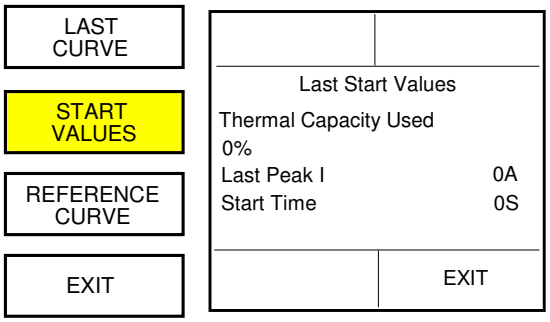


This screen shows the curve of current against time for the last time the motor was started.
The option is given for this curve to be stored as the REFERENCE CURVE by pressing the top-left button.

When the user gives confirmation of the decision, the curve is then stored as the reference curve.

The time axis of the plot is dictated by the trip time (regardless if the function is active or not) of the Maximum start Time protection function.

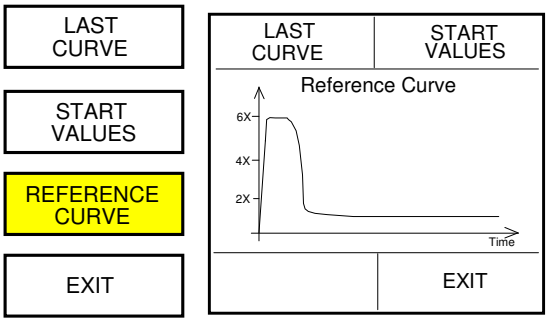
10.3.1.3.2. Start Values.



This screen shows the data that was measured when the motor was last started.
The data that is shown is as follows:

Thermal Capacity Used
Peak Current
Duration of Start

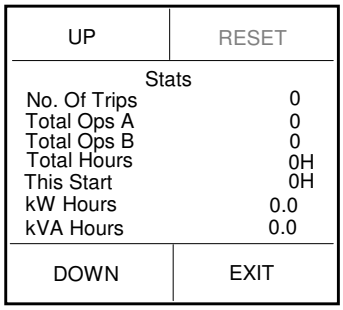
10.3.1.3.3. Reference Curve.



This screen shows the reference curve of the energising current of the machine. The reference curve is a stored previous start.

The reference curve and last start curve can be readily compared. Any differences between the two plots can easily be seen.

10.3.2. Stats.

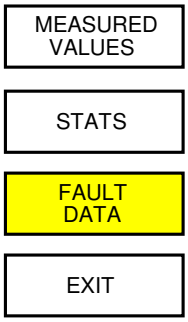


The list of data can be scrolled through using the top-left button (UP) and the bottom-left button (DOWN).

The bottom-right button takes you back to the DATA MENU. The RESET button (top-right) resets the value highlighted to zero. The list of statistical data is as follows:

Number of Trips
Total Ops A (No of Operations of Relay 1)
Total Ops B (No of Operations of Relay 2)
Total Hours
Total Hours This Start
K(M/G/T)W Hours
k(M/G/T)VA Hours
Max Demand
Last Peak I (A)
Last Start (Serial, Panel or Remote Start) or Restart
Last Stop (Serial, Panel or Remote Stop) or Trip
(both the above with time and date stamp)

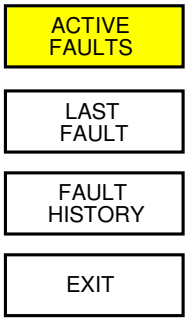
10.3.3. Fault Data.

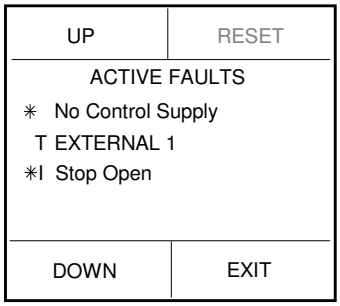


This screen lists the options for the viewing of previous alarms and faults that have occurred as well as faults and alarms that are currently active. There are three further screens that are accessible:

If a fault occurs which results in a TRIP, the unit automatically displays the active faults page.

10.3.3.1. Active Faults.

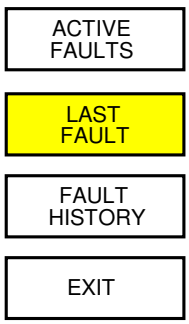




This menu lists the Active Faults of the relay if there are any.
A Reset button will appear if the fault is no longer active and if *PANEL RESET* is *Enabled* in the Protection Function.
The '*' next to the fault means that the fault is still active.

The characters preceding the fault description denote the action taken, a T denoting a TRIP, an A denoting an ALARM and an I denotes an INHIBIT.

10.3.3.2. Last Fault.

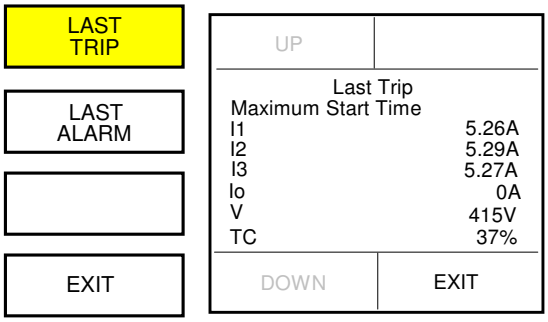


The Last Fault menu allows access to the last recorded TRIP and the last recorded ALARM.

Both Events would also appear with their time and date stamp at the top of the associated fault history pages.

The Analogue data for the last historical event is recorded at the time of Trip or Alarm.

10.3.3.2.1. Last Trip.



This screen shows displays the *LAST TRIP* event and selected analogue values at the time of the trip. The values are as follows-

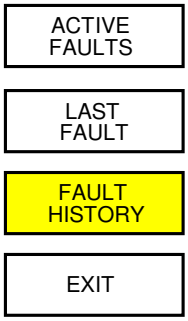
I1 (A)	I0 (A)	Temp/Res
I2 (A)	V (V)	Frequency (Hz)
I3 (A)	TC(%)	Power Factor

If the RTDMV2 is used the values for the multiple RTD channels would also be shown.

10.3.3.2.2. Last Alarm.

This screen displays the same as the *LAST TRIP* screen above except that it shows the *LAST ALARM* event that occurred.

10.3.3.3. Fault History.

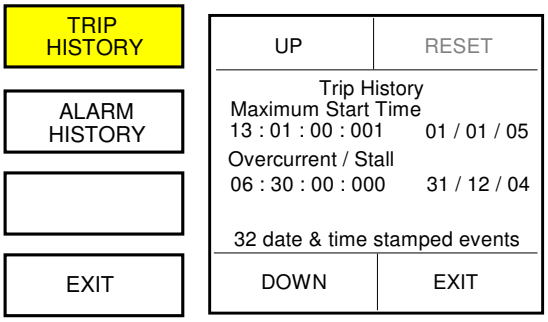


Fault History allows viewing of the last 32 TRIP events and the last 32 ALARM events, each event is time and date stamped to the millisecond.

The two lists operates on a first-in first-out principle meaning any recent events will force the earliest events from the register.

Single events can be deleted providing the password is known.

10.3.3.3.1. Trip History.



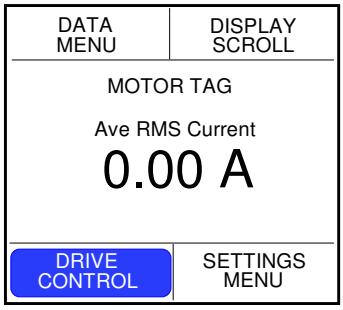
Each occurrence in both the Trip and Alarm histories will be time and date stamped to an accuracy of 1 millisecond.

This can help to identify tripping and alarm trends of the drive and also to aid identification as to the cause of any cascade tripping sequences.

10.3.3.3.2. Alarm History.

This screen displays the same as the *TRIP HISTORY* screen above except that it shows the previous alarm events that have occurred.

10.4. Drive Control.

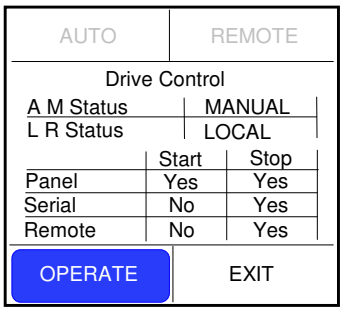


The *DRIVE CONTROL* page allows local or more accurately, *PANEL* control of the Motor.

The drive control page displays the drive availability matrix which shows in a very effective format from which sources the drive can be started and stopped.

Panel refers to any command issued via the face plate buttons.
Serial refers to any command issued via any of the serial ports.
Remote refers to any command issued via the digital inputs.

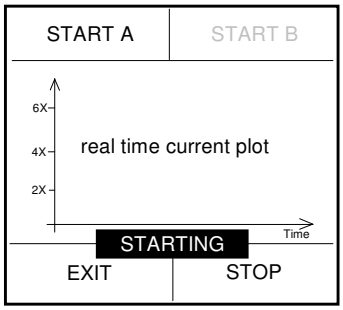
The Auto / Manual status and Local / Remote status of the motor are also shown.
If the motor is in TEST MODE then both the AM and LR status would display *TEST*.



The permissive and inhibit sources displayed here for the motor control are dictated by the set-up made to the Set-Up Start and Stop sources under the Starter Settings. See section 10.5.1.1.1.

Those settings transpose directly into this page producing the YES and NO indications for each source.

If inputs Auto/Manual and/or Local/Remote are not selected as digital inputs then toggle buttons will appear at the top of the screen to allow the user to select their configuration.

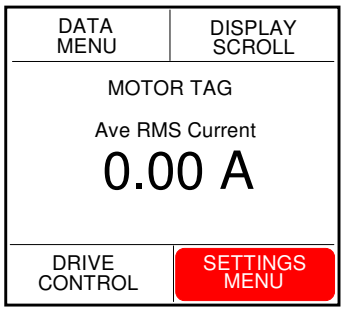


This screen displays the starting curve (current versus time) of the motor. When the motor is started using one of the START buttons the curve is plotted in real time.
Providing the start is successful the curve is then stored as the *last start curve* along with the *last start data.*

If this screen is accessed when the matrix does not allow Panel starts or stops then no start or stop keys available.

Depending upon the chosen Starter type the Start A and Start B buttons will be displayed as LOW and HIGH for two-speed starters, FORWARD and REVERSE for reversing drives. If the starter type only requires single control then Start B will not be used and Start A will be shown as RUN for DOL, VSD or S/D starters and CLOSE for ACB type starters.

10.5. Settings Menu.

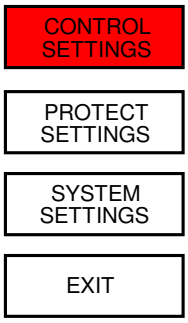


The Settings menu is divided into three main sub menus allowing complete manipulation of the set points associated with the protection and relay set-up.

These are; *CONTROL SETTINGS*, *PROTECT SETTINGS* and *SYSTEM SETTINGS*.
Each of these headings provide sub menu access for the parameter configuration and control set-up.

As the four software driven buttons change function depending upon what page (or equally what type) of data is being changed, this section also details the use of; pop-up boxes, changing values and timers, handling tick box applications and multiple choice settings.

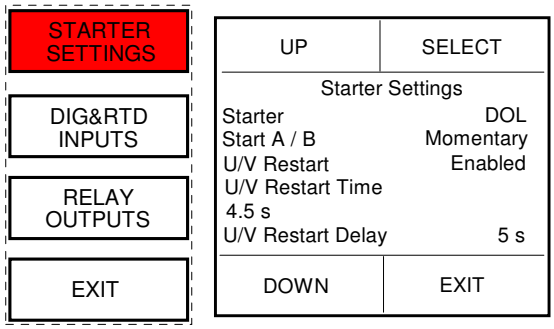
10.5.1. Control Settings.



The *CONTROL SETTINGS* sub menu of the Settings Menu allows manipulation of the necessary functions required to set-up the device for each particular starter application.

The Digital Inputs, Relay Outputs and the Starter Settings functions are all configured under this menu header.

10.5.1.1. Starter Settings.



The Starter Settings are used to determine what type of starter MV2 is attached to and what, if any, specific functions are required in order for the device to operate. A summary of settings is shown in section 12.2.
There are multiple starter types available and each one is explained in detail from section 15

Further STARTER options appear on the screen which can be changed. They are as follows;

TYPE	OPTIONS AVAILABLE								
DOL	START A/B	U/V Restart	U/V Restart Time	U/V Restart Delay	U/V Restart Sense	Start Setup Source	Stop Setup Source		
S/D 2 or S/D 3	START A/B	U/V Restart	U/V Restart Time	U/V Restart Delay	U/V Restart Sense	Start Setup Source	Stop Setup Source	Transition Time	Max Time In Star
DOLR	START A/B	U/V Restart	U/V Restart Time	U/V Restart Delay	U/V Restart Sense	Start Setup Source	Stop Setup Source	Transfer Lock	Transfer Time
2-Speed	START A/B	U/V Restart	U/V Restart Time	U/V Restart Delay	U/V Restart Sense	Start Setup Source	Stop Setup Source	Low to High Transition	High to Low Transition
DOW 2-Speed	START A/B	U/V Restart	U/V Restart Time	U/V Restart Delay	U/V Restart Sense	Start Setup Source	Stop Setup Source	ACB Pulse Time	
ACB	START A/B	U/V Restart	U/V Restart Time	U/V Restart Delay	U/V Restart Sense	Start Setup Source	Stop Setup Source		
DOL (Heat)	START A/B	U/V Restart	U/V Restart Time	U/V Restart Delay	U/V Restart Sense	Start Setup Source	Stop Setup Source		
DOLR (Heat)	START A/B	U/V Restart	U/V Restart Time	U/V Restart Delay	U/V Restart Sense	Start Setup Source	Stop Setup Source	Transfer Lock	Transfer Time
VSD	START A/B	U/V Restart	U/V Restart Time	U/V Restart Delay	U/V Restart Sense	Start Setup Source	Stop Setup Source		
NO STARTER	none								

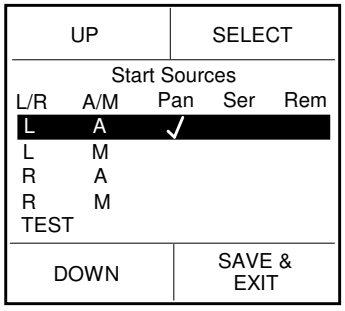
START A/B can be switched between *Momentary* and *Maintained* by pressing the SELECT button when that text line is highlighted using the UP / DOWN buttons.
The Momentary selection then expects Start commands via the Digital Inputs to be fleeting pulse type.
Maintained selection expects Start commands via the Digital Inputs to be maintained.
I.E. If Start A is held closed the drive will start and run until such time that input becomes open the drive then stops.

U/V Restart allows auto re-acceleration to take place if the power or auxiliary supply is lost and restored within the allowable time dictated by the U/V Restart Time setting.
U/V Restart Sense can be switched between *Supply Only* and *Supply or Reference* by pressing the SELECT button.

The U/V Restart feature is explained in further detail in section 16.

Upon selecting Start Setup Source and Stop Setup Source a secondary page appears to allow the source configuration to be made. It is these setting which transpose to the start availability matrix under the *DRIVE CONTROL* menu.

10.5.1.1.1. Start / Stop Source Settings.

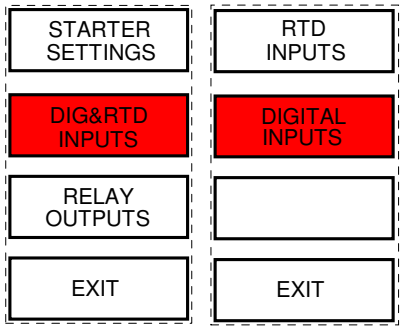


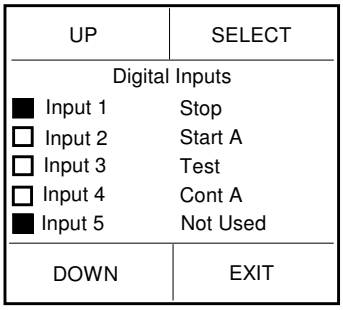
In this screen the user can define from where the motor can be started (Panel, Serial, Remote) depending on the positions of the Local/Remote, Auto/Manual and Test inputs.

By pressing select repeatedly the 'ticks' build similarly to logic. Each 'tick' represents a YES in the drive control page, a blank denotes a NO.

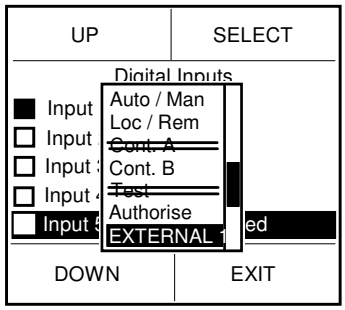
The same procedure is followed for the Stop sources. In the case left, the drive can only be started whilst in LOCAL and AUTO from the relay front panel.

10.5.1.2. Digital Inputs.



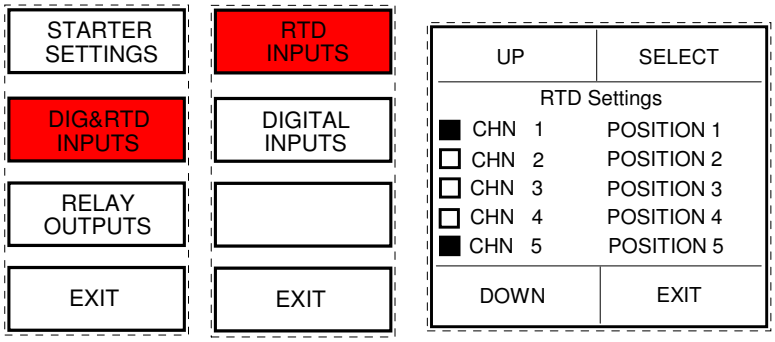


In this screen the 12 digital inputs can be assigned to a function. When an input is selected using the SELECT button an option change pop-up overlays the main screen, the menu buttons will now operate the over-layed pop up menu. As in the DATA MENU the left hand box operates similarly.



If a digital input is already assigned to an input no. then it cannot be set to another input no. it will still appear in the list and will be lined-out.
The digital input functions are described in more detail in section 6.
This pop-up format also applies to Relay Outputs selection or where a list of selectable options is available.
On exit from this screen Input 5 will be set to EXTERNAL 1.

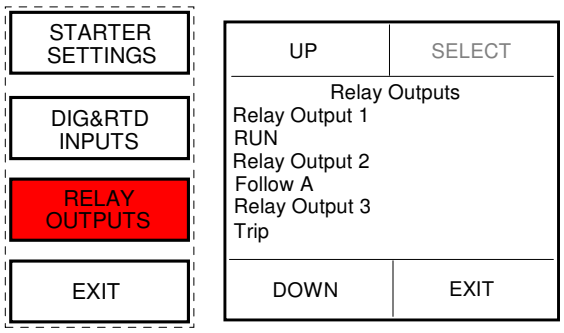
10.5.1.3. RTD Inputs.



The RTD option screen is only available for the RTDMV2 device. If the unit is any other then the digital inputs are directly accessible from the Control Menu.

The order of channels can be selected and changed. Unlike the digital inputs, the left hand box denotes active scanning and update of that input rather than an indication of voltage presence. The Position 1 to 12 text can be changed like the External 1 to 10 inputs using the Edit Custom Strings function in the unit settings.

10.5.1.4. Relay Outputs.



In this menu the output relays can be assigned. A pop-up box overlays the main screen and output relay functions can be chosen, unlike the digital inputs many output relays can be assigned to carry out the same function. They are limited by starter type as shown below.

The list of possible outputs is shown below.

STARTER	RELAY 1	RELAY 2	RELAY 3	RELAY 4
DOL	RUN	Programmable	Programmable	Programmable
S/D 2	STAR	DELTA	Programmable	Programmable
S/D 3	STAR	DELTA	LINE	Programmable
DOLR	FORWARD	REVERSE	Programmable	Programmable
2-Speed & DOW 2-Speed	LOW	HIGH	Programmable	Programmable
ACB	CLOSE	OPEN	Programmable	Programmable
DOLH	RUN	HEATER	Programmable	Programmable
DOLRH	FORWARD	REVERSE	HEATER	Programmable
VSD	RUN	Programmable	Programmable	Programmable
NO STARTER	TRIP	Programmable	Programmable	Programmable

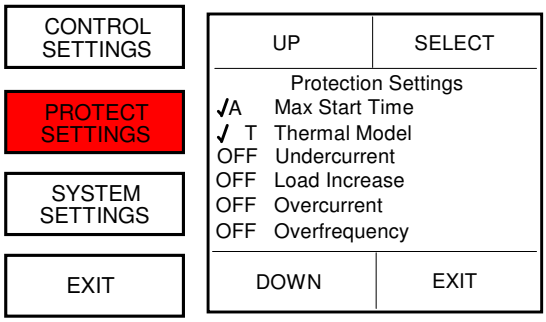
Where Programmable appears in the table above it means that the user can choose what is assigned to that relay from the following list:-

Not Used	Follow A	Follow B	Inv. A	Inv. B	Trip
Trip FS	Alarm	Alarm FS	Healthy	Warning	Serial Available
Panel Available	Remote Available	Healthy FS	Indicator 1	Indicator 2	Indicator 3
Indicator 4	Indicator 5				

If the device has extended I/O there are eight output relays which are user programmable.

The output relay function is explained in detail, see section 5.

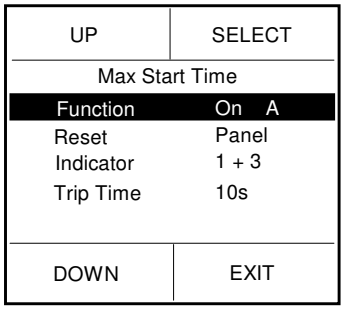
10.5.2. Protection Settings.



On selecting, this page displays all protective function available.
Each function can be selected using the UP and DOWN keys, each function can then be configured.
At a glance the left-hand coloumn shows whether a function is active or not and what configuration or action it is set to.

✓ indicates that the function has been enabled.
A indicates the ALARM is enabled for that function.
T indicates the TRIP is enabled for that function.
OFF means that the function is disabled and not used.

10.5.2.1. Protective Functions.

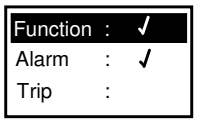


In this example the configuration for the behaviour of Maximum Start Time protection can be controlled.
There are four setting groups:

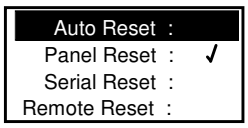
Function	Set ON / OFF, Set ALARM, Set TRIP.
Reset	Auto / Panel / Serial or Remote or combination.
Indicator	Relay output indicators 1, 2, 3, 4 or 5 or combination.
Trip Time	The settable time to action the configured function.

Each option moves a ‘pop-up box’ forward to select the desired operation.

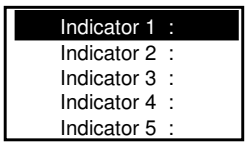
Function



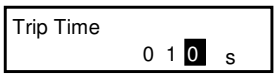
Reset



Indicator

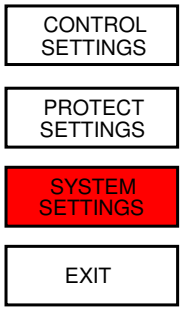


Trip Time



Each protective function has specific settings associated with it. The settable options for each protective function are explained in further detail in sections 12.3 and 17.

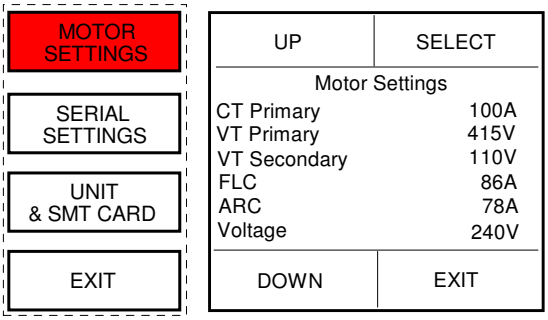
10.5.3. System Settings.



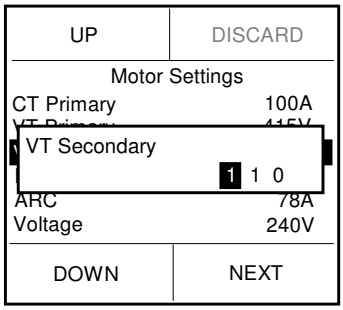
The System Settings menu provide access to a further sub set of menus:

Motor settings, Serial Settings, Unit Settings and if activated Smart Card settings.

10.5.3.1. Motor Settings.



This screen allows the user to change the motor settings of the relay. The list of values to be changed can be scrolled through by pressing the UP and DOWN buttons (top-left and bottom left). A value can be selected to have its value changed by pressing the SELECT button (top-right) when the value is highlighted. This then brings up the VALUE CHANGE SCREEN



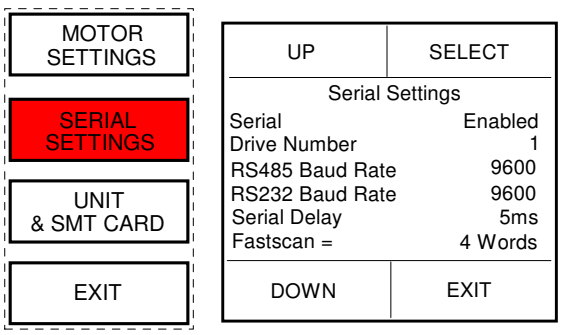
The Value Change pop-up allows you to alter settings in specified steps within the minimum and maximum values of the particular setting range. The pop-up over lays the main screen, the menu buttons operate the pop-up as normal. The Exit button becomes a Next function in this window to skip along to the next character. If an undesired value is inserted incorrectly use the Next button to skip past the last character to the left the Select option button now operates as a Discard to dump the new value without saving – reverting back to the original value on initial selection.

The values to be changed are as follows:

CT Primary (Low and High Speed), VT Primary, VT Secondary, Full Load Current (Low and High Speed), Actual Running Current (Low and High Speed), Voltage, Voltage Ref, EF CT Primary, kW Sample Period,

The Motor Settings are explained detail in sections 12.1 and 14.

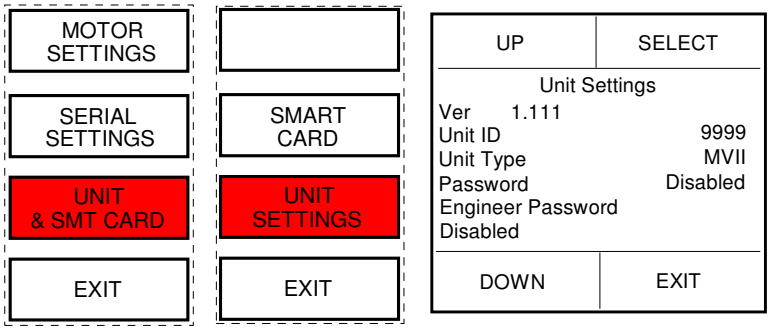
10.5.3.2. Serial Settings.



This screen allows the user to change the communication port aspects of the relay.

Section 13.1 describes in detail the function of each of the available serial settings.

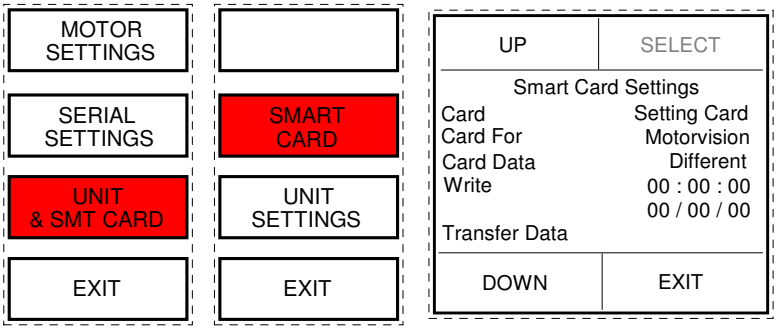
10.5.3.3. Unit Settings.



This screen allows the user to change certain global characteristics of the relay.

Each setting is explained in detail in section 18.

10.5.3.4. Smart Card Settings.



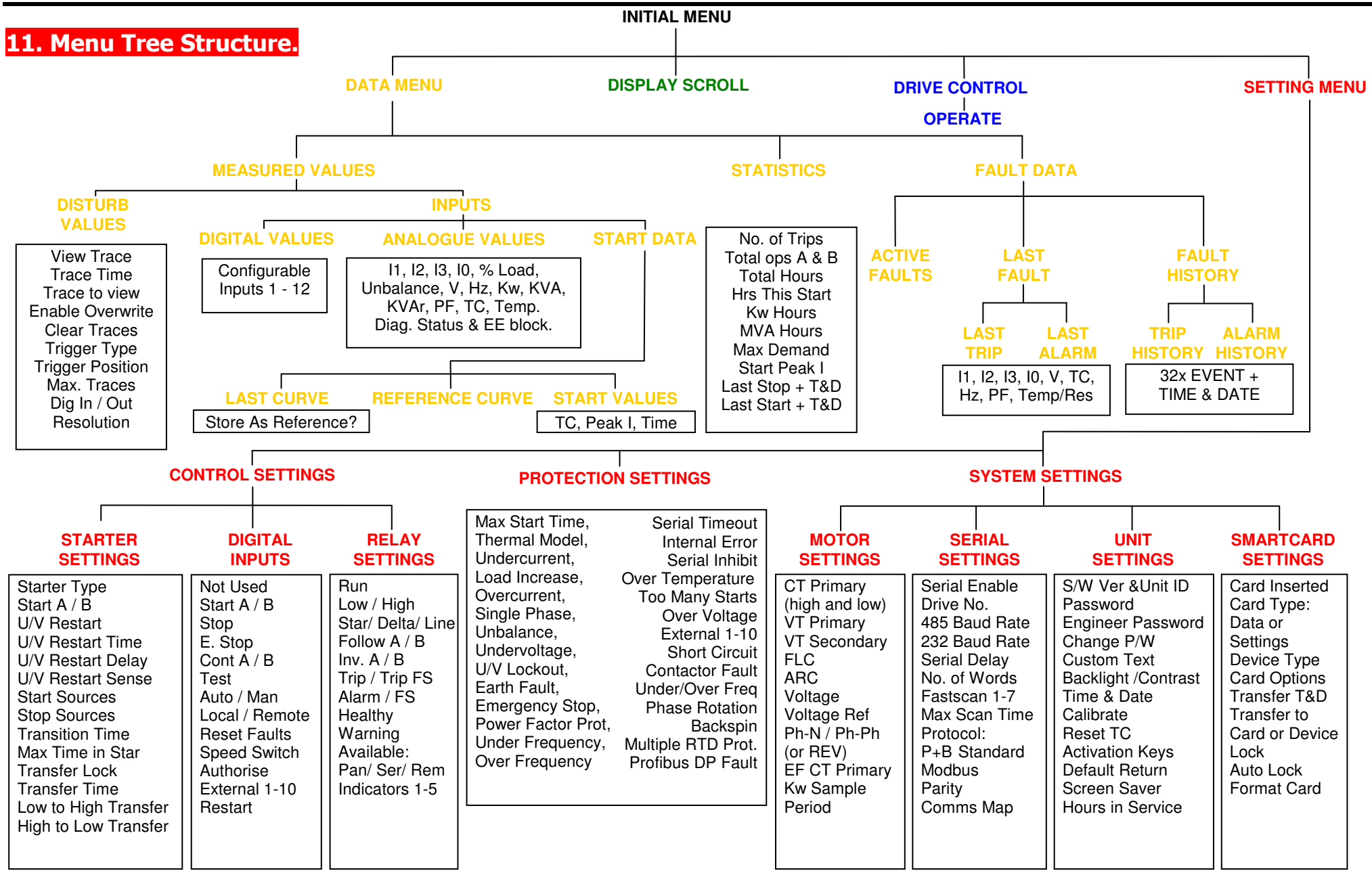
The Smart Card is a removable eeprom memory card which can be supplied with MV2 on request.

An activation code is required to access this menu system in order to allow full manipulation of the card.

The Smart Card can be used for parameter storage and for cloning like drives or it can be formatted as an extended data card which will log and store events.

The Smart Card is explained in detail in section 19.

11. Menu Tree Structure.



12.1. MV2 System Settings Summary.

The following pages show a summary all of the MV2 Setting Pages and give the setting range and default setting. Each setting is then explained in detail.

	Range	Steps	Default
Serial Settings:			
Serial	Enabled / Disabled	1s	Enabled
Drive Number	1-32	1	1
RS485 Baud Rate	9600/19200/38400		9600
RS232 Baud Rate	4800/9600		4ms
Serial Delay	1ms-250ms	1ms	1ms
Fast Scan Words	4 Words / 6 Words / 8 Words		4 Words
Fastscan Analogue 1	0-254	2	0
Fastscan Analogue 2	0-254	2	0
Fastscan Analogue 3	0-254	2	0
Fastscan Analogue 4	0-254	2	0
Fastscan Analogue 5	0-254	2	0
Fastscan Analogue 6	0-254	2	0
Fastscan Analogue 7	0-254	2	0
Max Fast Scan	1-30s	1s	2s
Serial Protocol	Modbus / P&B Standard / P&B Inv		P&B Standard
Parity	Even / Odd / None		Even
Comms Map	Standard / MPC2000		Standard
Motor Settings:			
CT Primary	1-1500A	1A	100A
CT Primary (LOW)	1-1500A	1A	100A
CT Primary (HIGH)	1-1500A	1A	100A
VT Primary	100-22000V	5V	415V
VT Secondary	100-500V	1V	100V
FLC	50-200% of CT Primary	0.01A / 0.1A / 1A	50.0A
Low Speed FLC	50-200% of CT Primary (LOW)	0.01A / 0.1A / 1A	50.0A
High Speed FLC	50-200% of CT Primary (HIGH)	0.01A / 0.1A / 1A	50.0A
ARC	50-100% of FLC	0.01A / 0.1A / 1A	50.0A
Low Speed ARC	50-100% of Low Speed FLC	0.01A / 0.1A / 1A	50.0A
High Speed ARC	50-100% of High Speed FLC	0.01A / 0.1A / 1A	50.0A
Voltage	50-125% of VT Primary	5V	415V
Voltage REF	Ph-N/Ph-Ph/Ph-N(rev)/Ph-Ph(rev)		Ph-N
EF CT Primary	0.1-1500A	0.1A	100A
kW Sample Period	5-60min	1m	5 min
Unit Settings:			
Password	Enabled/Disabled		Disabled
Engineering Password	Enabled/Disabled		Enabled
Change Password	5 Characters		6363
Edit Custom Strings	11 Characters		
Time			
Date			
Time Sync Delay	0-200ms	1ms	0ms
Default Return Time	No Return (Off) 1-5min	1min	1min
4-20mA Gain	0-2048	1	1024
Smart Card Key	6 digits		
Disturbance Key	6 digits		
Scrn Saver	Enabled/Disabled		Disabled
Scrn Saver Time	60-3600s	1s	3600s
Chronovision	Enabled/Disabled		Disabled
Invert LED Colour	Yes/No		Yes

12.2. MV2 Control Setting Summary.

	Range	Steps	Default
Starter Settings:			
Starter	DOL / SD2 / SD3 / DOLR / 2-SPEED / ACB / DOLH / DOLRH / VSD / DOW 2-SPEED		DOL
Start A/B	Momentary / Maintained		Momentary
U/V Restart	Enabled / Disabled		Disabled
U/V Restart Time	2.0 - 200.0s	0.1s	2.0s
U/V Restart Delay	1 - 120s	1s	1s
U/V Restart Sense	Supply / Supply or Reference		Supply
●L -> H Transfer	1 - 250s	1s	0s
●H -> L Transfer	1 - 250s	1s	0s
●Low to High	Enabled / Disabled		Disabled
●High to Low	Enabled / Disabled		Disabled
■Transition Time	0.04 - 2.00	0.01s	0.20s
■Max. Time in Star	1 - 250s	1s	1s
■Stay in Star	NO / YES		NO
▲Transfer Lock	Enabled / Disabled		Disabled
▲Transfer Time	1 - 300s	1s	1s
◆ACB Pulse Time	0 - 200s	1s	0s
●2-Speed starter only			
■Star / Delta starter only			
▲DOL with Reverse			
◆ACB only			
Digital Inputs			
Input 1 - 12	Not Used / Start A / Start B / Stop / E. Stop / Cont. A / Cont. B / Test / Reset Fault / Auto/Man / Loc/Rem / Spd Switch / Authorise / External 1 - 10 / Restart		Not Used
Input 13-24 (Extended I/O version)	as above		
Relay Outputs			
Output 1	RUN / STAR / FORWARD / LOW / CLOSE		RUN
Output 2	DELTA / REVERSE / HIGH / OPEN / HEATER / Not Used / Programmable		Not Used
Output 3	LINE / HEATER / Not Used / Programmable		Not Used
Output 4	Programmable		Not Used
Follow A Delay	0.0 - 60.0	0.1s	0.0s
Follow B Delay	0.0 - 60.0	0.1s	0.0s
Output 5-8 (Extended I/O version)	Programmable		

12.3. MV2 Protection Setting Summary.

● Selectable Option
■ Not Selectable

AMV2 ONLY
RTDMV2 ONLY
MV2, AMV2 & RTDMV2

ANSI No.	Protective Function	Available Action: Trip	Alarm	Inhibit	Stop	Test Option	Available Reset: Auto	Panel	Serial	Remote	Indicators 1-5	Change Name	Variable	Range	Step
48/14	Maximum Start Time	●	●				●	●	●	●	●		Trip Time:	1-250s	1s
26/49	Thermal Model	■	●				●	●	●	●	●		Hot/Cold Ratio: Cool Time Factor: t6x:	20-80% 25-2000% 0.1-120s	1% 5% 0.1s
37	Undercurrent	●	●				●	●	●	●	●		Trip Level: (% of ARC) Trip Time: U/C Reset Delay:	50-95% 1-60s 0-1200s	5% 1s 10s
51	Load Increase	●	●				●	●	●	●	●		Trip Level: (% of ARC) Trip Time:	105-150% 1-60s	5% 1s
50/51	Overcurrent	●	●				●	●	●	●	●		Trip Level: (% of FLC) Trip Time:	150-750% 0.1-10.0s	5% 0.1s
81H	Overfrequency	●	●				●	●	●	●	●		Trip Level: Trip Time:	40-70Hz 1-60s	1Hz 1s
81L	Underfrequency	●	●				●	●	●	●	●		Trip Level: Trip Time:	40-70Hz 1-60s	1Hz 1s
46SP	Single Phase	■	●				●	●	●	●	●		Trip Time: [fixed]	<100ms	
47	Phase Rotation	●	●				●	●	●	●	●		Direction:	ABC/ACB	
46	Unbalance	●	●				●	●	●	●	●		Trip Level: (% of FLC) Trip Time:	10-40% 1-60s	5% 1s
27	Undervoltage	●	●				●	●	●	●	●		Trip Level: (% of Vn) Trip Time:	50-95% 0.1-60s	5% 0.1s
27/86	U/V Lockout		●	■			●	●	●	●	●		Lockout Level: (% of Vn)	50-95%	5%
50/51n	Earth Fault or [Internal Residual E/F]	●	●				●	●	●	●	●		Trip Level: Trip Time:	1[10]-40% 0.1[0.2]-5.0s	0.1% 0.1s
38/49	Over Temperature	●	●				●	●	●	●	●		Resistance Type: RTD Compensation: RTD Trip Level: PTC/NTC Trip: Trip Time:	RTD/PTC/NTC 0-250^0 0-250^0 1000-30Kohm 10-250s	 1^0 1^0 100 1s
66	Too Many Starts			■			■				●		Starts Per Period Start Inhibit Time: Start Period: Start Inhibit Type	1-60 1m-120m 1m-60m IT / RSP / RSP+IT	1 1m 1m
59	Overvoltage	●	●				●	●	●	●	●		Trip Level: (% of Vn) Trip Time:	105-120% 1-60s	5% 1s
86	Backspin			■							■		Backspin Time:	1-300s	1s
55	Power Factor	●	●				●	●	●	●	●		Trip Level: Trip Time:	0.20-0.95 1-60s	0.05 1s
36	External 1 (to 10)	●	●	●	●	●	●	●	●	●	●	●	Fault Polarity: Trip Time:	ON / OFF 0.4-60s	 0.1s
50	Short Circuit	■						●	●	●	●		Trip Level [fixed]: Trip Time: [fixed]	10x In <100ms	
48	Contactor Fault	●	●				●	●	●	●	●		Trip Time:	1-200s	1s
86	Emergency Stop	■	●					●	●	●	●		Trip Time [fixed]:	<100ms	
	Serial Timeout	●	●				●	●	●	●	●		Timeout In:	1-120s	1s
	Internal Error	●	●				●	●	●	●	●				
74	Serial Inhibit			●	●				■		●				
38/49	RTD Over Temp 1 (to 12)	●	●	●			●	●	●	●	●	●	Trip Level: Trip Time:	0-490^0 5-250s	1^0 1s
	Profibus Fault	●	●				●	●	●	●	●		Trip Time:	1-60s	0.1s
74TC	Trip Circuit Supervision*						■								

All functions can be selected to be active or inactive except the Thermal Model protection which is always active.

** Trip Circuit Supervision is a fixed protection arrangement providing two dedicated change-over contacts [AMV2 only]*

Due to the programmable nature of our equipment the following ansi no's are also applicable 3/9/19/34/62/69/68/74/86 and 94.

13.1. Serial Settings.

Serial Enabled / Disabled.
This setting allows the user to enable the MV2 serial communications port. This setting must be set to 'Enable' if communication with the relay through any serial link is required.

Drive Number.
This setting range 1 to 32 (125 Profibus), with a default setting of 1, identifies the MV2 unit to the Xcell unit (or any Master device connected to the Data highway) to which the RS485 or Profibus port is connected. When updating firmware the auto program mode requires the drive number to be 1.

RS485 Baud Rate.
This setting allows the user to configure the appropriate communications baud rate such that the MV2 can communicate effectively on the Data Highway to which it is connected.

RS232 Baud Rate.

This setting allows the user to configure the baud rate for the front mounted RS232 port.

Serial Delay.
The MV2 may be configured to respond to a request for information from the serial port instantly or after a designated delay.

A communications delay may be beneficial to ensure the Master device on the Data Highway receives all information sent back by the MV2 without enduring data collisions on the network.

Fast Scan Words.
A Fast Scan is a system used when operating in conjunction with the XCell Data Concentrator. As the XCell polls relays attached on its network, the fastscan settings allows the user to select important data to be read back faster.

The data on the communications link is broken into Fast Scan Data (or Process Critical Data) and Slow Scan or Full Read Data (Electrical Engineering Data).

The amount of Fast Scan Data to be sent back to the XCell in response to a request is configurable. This setting has the range 4, 6 or 8 Words. A setting of 4 Words will give 3 Fast Scans. The remaining Word is taken up by the Thermal Capacity. A setting of 6 Words will give 5 configurable Fast Scans and a setting of 8 Words will allow 7 configurable Fast Scans.

The configuration of Fast Scan is not necessary unless the MV2 in used in conjunction with the XCell unit.

Fast Scan 1 to 7.
Each FastScan number can be programmed to export important data when requested. This number references an internal address in MV2 and allows configurable data mapping between units. Typical data could be Average Phase Current, Motor Load and so on. A table of the FastScan reference numbers can be found in Appendix 6.

Max Scan Time.
This setting need only be used in order to limit the amount of data traffic on a RS485 network. Dynamic data can change rapidly, this setting allows the MV2 to limit the number of updates it makes to its Fast Scan values.

Protocol.
The RS485 serial communications port may be configured to operate using a slave implementation of Modbus RTU® or P&B Engineering's own protocol "P&B Standard" designed to remove some of the speed issues associated with a function based protocol like Modbus.

Parity.
This setting allows the user to set the parity to match that of the host system on the serial link. The options are "Odd", "Even" and "None". Not required if Profibus.

Comms Map – *Communications Map Type*
This setting is only required if retrofitting an MV2 in place of one of the older MPC2000 units. This setting allows MV2 to replicate the MPC2000 communication map to facilitate easier upgrades without compromising the configuration of the existing host systems.

13.2. PROFIBUS DP (Optional)

PROFIBUS-Interface Pinout

The PROFIBUS can be accessed via a 9-pin connector located at the rear of the MV2, this replaces the 3 wire RS485 connection. If the single channel RTD/PTC/NTC option is also used it may be necessary to use a 'port saver' in addition to the Profibus connector to allow sufficient clearance for the plug and cable arrangements.

The interface has separated potentials and a pin-layout as specified in the DIN 19245.

Pins	Signal
1	n.c.
2	n.c.
3	Data B (RxD/TxD-P)
4	CNTR (Repeater control signal TTL)
5	GND
6	Termination-Power
7	n.c.
8	Data A (RxD/TxD-N)
9	n.c.

9-Way M/F
Port Saver

If three-wire configuration is used, only Pins 3, 8 and 5 are required to be connected.

PROFIBUS Cable

The PROFIBUS standard DIN 19245 Part1 and Part3 permits two types of bus cable (Cable A and Cable B).

PROFIBUS Cable Parameter

Parameter	Cable A PROFIBUS-DP DIN 19245 Part 3 Chap. 6.2	Cable B DIN19245 Part 1 / 4.91 Chap. 3.1.2.3
Type of cable	Two-conductor shielded twisted pair cable	Two-conductor twisted pair cable
Impedance	135 ... 165 □ (3 ... 20 MHz)	100 ... 130 □ (f > 100kHz)
Capacity	< 30 pF/m	< 60 pF/m
Loop resistance	< 110 W/km	-
Diameter	> 0,64 mm > 0,34 mm²	> 0,53 mm > 0,22 mm²

The maximum bus length depends on the type of cable and the baud rate (see table).

Maximum Bus Length

Baud rate KBit/s	9,6	19,2	93,75	187.5	500	1500
Cable A, max. distance in m (without repeater)	1200	1200	1200	1000	400	200
Cable B, max. distance in m (without repeater)	1200	1200	1200	600	200	-

The maximum bus length can be extended until approx. 10 km with repeaters. The max. number of repeaters that can be used in a network depends on the type of the repeater and is between 3 and 10.

Main features of the MV2 Profibus link

- Supports the following baud rates: -

  9.6Kbps, 19.2Kbps, 93.75Kbps, 187.5Kbps, 500Kbps, 1.5Mbps

NOTE: Recognition of data transfer rate is automatic.

- When VPC3+ carries out a DP communication, internally within the relay it automatically sets up all standard DP-SAPs. The following SAPs are supported: SAP53, SAP55, SAP56, SAP57, SAP58, SAP59, SAP60, SAP61, SAP62 and Default SAP (Data exchange).

- One master can communicate with up to 125 Profibus-DP slaves with repeaters.

When using the MV2 with the dedicated PROFIBUS option, the following protocols can be used, P&B Std., MODBUS RTU, P&B Inv. and P&B DP.
When using all but the P&B DP option, the protocol should be implemented in accordance with the protocol specifications.
However, if the P&B DP option is chosen then the communication is handled in the following way.

Data is automatically configured and transmitted by the MV2 to the PROFIBUS master without the need for the PROFIBUS master to send requests to the MV2, as is the case when using any of the other protocol options. The amount of data returned by the MV2 is determined by the number of fastscan words chosen. Only one byte is used for the command outputs to the MV2.

When using the P&B DP protocol option then one of the following should be chosen from the GSD file module list: -

8 Bytes In + 1 Byte Out	(choose this option if fastscan words is set to 4)
12 Bytes In + 1 Byte Out	(choose this option if fastscan words is set to 6)
16 Bytes In + 1 Byte Out	(choose this option if fastscan words is set to 8)

P&B DP Input Structure

First Byte	= MV2 Logic Status
Second Byte	= MV2 Thermal Capacity
Third & Fourth Bytes	= MV2 FS1
Fifth & Sixth Bytes	= MV2 FS2
Seventh & Eighth Bytes	= MV2 FS3

If 6 fast scan words chosen then the additional bytes are included.

Ninth & Tenth Bytes	= MV2 FS4
Eleventh & Twelfth Bytes	= MV2 FS5

If 8 fast scan words chosen then the additional bytes are included.

Thirteenth & Fourteenth Bytes = MV2 FS6
Fifteenth & Sixteenth Bytes = MV2 FS7

P&B DP Output Command Structure

START A = 80 Hex
STARTB = 81 Hex
STOP = 82 Hex
RESET = 84 Hex
SERIAL INHIBIT = C0 Hex
CLEAR INHIBIT = 80 Hex + any other command option START B, STOP or RESET

Care should be taken when using the CLEAR INHIBIT command as it is possible to both clear the inhibit and either START, STOP, or RESET the drive at the same time.

14. Motor Settings.

CT Primary.
This setting allows the user to program the primary current rating of the protection class current transformers on the supply phases. It is assumed that all phase current transformers are of the same rating. There is no need to enter the current transformer secondary rating as the MV2 is pre-programmed depending on whether the relay has been purchased with a 1A, 2A or 5A CT input.

If the Hall Effect Sensor (HES) is used then the CT Primary should be set to the calibrated setting of the Sensor.

If motors are connected using the direct connect technique then the CT Primary should be set as per the rating of the CT Secondary.

On selection of the two-speed starter types the 'CT Primary' setting will offer two settings, 'CT Primary (LOW)' and 'CT Primary (HIGH)'. This allows connection of two independent sets of current transformers to the MV2 to monitor current in the fast and slow supply arms to the motor.

If only one set of current transformers is used then these two values are set to the same 'CT Primary' value. It must be noted that although the Primary values can differ the Secondary values must be the same i.e. 1A, 2A or 5A.


The HES cannot be used in this type of dual-set CT application.

VT Primary.
This setting allows the user to program the primary voltage rating of the voltage transformer (if used).

VT Secondary.
This setting allows the user to program the secondary voltage rating of the voltage transformer (if used).
The VT Primary and Secondary should be set to the same value if directly connecting the voltage input without a step-down transformer.

Full Load Current (FLC).
The FLC is the motors continuous maximum Full Load Current rating as provided in the motor manufacturers data. The settable range is dependant on the 'CT Primary' setting.

The 'FLC' setting enables all protective functions except Undercurrent and Load Increase to be set in terms of a percentage of FLC and enables the MV2 to display the "Motor Load" in terms of a percentage a FLC.

Actual Running Current (ARC).
This setting allows the user to program the motors Actual Running Current when supplying a typical load at normal speed.

This value is typically less than the motor FLC rating and enables the protective functions (Under Current and Load Increased) to be set in terms of a percentage of this value.

Line Voltage.
This should be set to the line voltage of the supply. It is necessary for power calculations and is used for the Under / Overvoltage, Undervoltage Restart and Undervoltage Lockout protection features.

As an example if the voltage input was connected between two phases on a 415V system this setting would be 415V. If however the voltage input was connected between a phase and neutral then this setting should be 240V.

Voltage Ref.
This parameter can be set to Ph-N (Phase to Neutral) or Ph-Ph (Phase to Phase) with a reverse feature to avoid re-wiring for phase correction to match the connection type above.

E/F Primary.
This setting allows the user to program the primary current rating of the protection class current transformer used to measure the earth fault current.

If a residual current transformer connection is used to detect earth fault then the same setting as for CT Primary should be used.

If the Internal Residual Connection is used for earth fault protection then this setting is hidden.

KW Sample Period.
This setting range 5 to 60 min in steps of 1min determines the period over which a measurement is taken to integrate the Kilowatt Hours value.

15. Starting Methods.

The MV2 relay is designed to be used as an intelligent motor starter for LV and MV systems offering comprehensive protection and control features.
A number of starting methods are catered for;

15.1. Direct On Line (DOL)

Direct On Line starting is used for electrically held contactors and allows the motor to be run in one direction only. It applies the full line voltage to the windings immediately upon starting.

DOL Starter expects Start A to be used a hardwired digital input control (momentary or maintained).
Output Relay 1 (RUN) will close to pull in the contactor, Cont A digital input should be used if contactor feedback is required through the digital inputs or contactor fault protection is needed.
Output 1 will release when stopped or tripped.
Typically the inrush current of a 415V motor would be 6x FLC, hence the thermal model protection, t6x. Higher voltage systems generally have lower inrush demands.

15.2. Star / Delta 2 (S/D2)

This starting technique is typically used to reduce the starting currents normally seen when starting a motor by Direct On Line.
By reducing the voltage applied to the motor windings the current is also reduced, as is the starting torque. Care must be taken to ensure the motor can generate enough torque to accelerate on start-up when connected in STAR.

Start A is used as the hardwired or remote start signal and closes Output Relay 1. This output is used to pull in a contactor which connects the motor in a star type connection. Cont A is used for feedback and / or contactor fault protection.
The Star connection provides root 3 of the system voltage to the motor. This has the effect of limiting the inrush current to 2x (as opposed to 6x for normal 415V drives). Once this current increases and falls below 100% of FLC. Output relay 1 opens.
If the current fails to fall below 100% FLC then Output Relay 1 opens after the Max time in star setting.
After the transition time Output Relay 2 closes to pull in a contactor connecting the motor in a delta formation. Cont B is used for feedback and / or contactor fault protection of the delta contactor.
Once the delta inrush current falls below FLC the MV2 will consider the motor as running.
Maximum Start Time protection functions from the time at which the unit transfers to the delta starter.

Output Relay 1 can be held closed for the duration of the Max Time in Star by setting Stay in Star to YES irrespective of the normal current based change-over.

15.3. Star/Delta 3 (S/D3)

For Star / Delta 3 the operation is the same as for the S/D2 type with the exception that Output Relay 3 controls the LINE contactor.
Once a Start A command is received both the Star and Line contacts closes, upon transition the Star opens as normal. The line contact remains closed throughout and only released when the drive is stopped or tripped.

For both S/D2 and S/D3 the Start Time (statistical data) is determined solely by the time taken from the motor starting in Star formation to the transition to the DELTA connection.

15.4. Direct On Line Reversing (DOLR)

With Direct On Line Reversing Output Relay 1 (FORWARD) is used to control the motor in the forward direction and Output Relay 2 (REVERSE) is used to control the motor in the reverse direction. The full line voltage is applied to the motor windings immediately upon starting in either direction.
Start A and Cont A are the start command and feedback for the forward direction. Start B and Cont B are associated with the reverse direction.

15.5. 2-Speed / DOW 2-Speed

In 2-Speed mode Start A controls Output Relay 1 (LOW) and is used to control the motor in the Low speed with Cont A used as feedback confirmation and / or protection.
Start B controls Output Relay 2 (HIGH) and is used to control the motor in the high speed with Cont B used as feedback confirmation and / or protection.
This type of starter is used on 2-Speed motors which typically have 2 sets of windings. Different sets of CT's can be used if the windings are considerably different for one another.

Example. The high speed winding is rated at 90 Amps, therefore 100/1A 5p10 2.5VA CT's are used. If the low speed winding is rated at anything less than 50% of the CT Primary (100A) then a second set of CT's would be required.

In DOW (Direct on Windings) mode the drive can be started in either speed, once in the running mode the motor can be switched to the other speed without stopping.

In normal 2-Speed mode the motor must be stopped before transferring to the other speed.
This transfer between speeds can be partly automated in order to avoid the need to press stop before changing motor speeds.

Example. Low to High = Enabled, Low to High Transfer = 5seconds.
If running in High speed in order switch to low speed the drive must be stopped using a Stop serial command, a Stop digital input or a Stop panel key press. The drive must then receive a Start A command to run in low speed.
In this example the drive can be started in low speed with Start A, if Start B is pressed the drive stops waits 5 seconds then automatically starts in high speed.

If configured to restart the last running speed before power loss would be used to restart the motor.

15.6. Air Circuit Breaker (ACB)

This starter type must be selected when the motor is controlled by a circuit breaker or mechanically held contactor rather than an electrical held contactor regardless if the motor is in actual fact a DOL starter.
Start A drives Output Relay 1 (CLOSE) to close the circuit breaker and start the motor and Output Relay 2 (OPEN) is used to open the circuit breaker and stop the motor.
The operation of the CLOSE and OPEN relays is momentary (pulse type) and has a programmable duration.
A Digital Input can be programmed to provide Circuit Breaker status feedback, Cont A is renamed as ACB Feedback in ACB mode.

15.7. Direct On Line with Heater (DOLH)

This method of starting a motor is for applications where humidity / condensation causes problems in motor windings. Direct on Line with Heater 'DOLH' avoids starting a motor when the windings may be damp by energising Output Relay 2 (HEATER) whilst the motor is stopped. In typically situations this output relay would control a contactor feeding a heater embedded in the windings whilst the motor is stopped to evaporate any condensation which may otherwise have developed in the motor.
This starter type is similar to Direct on Line 'DOL' where Start A is used to drive Output Relay 1 (RUN) to control the motor in one direction only. Output Relay 2 (HEATER) is used to control the Heater embedded in the windings or inject a current in the windings whilst the motor is stopped. Output Relay 2 will automatically energise after 1 hour when the motor is stopped and de-energise when the drive is started.

15.8. Direct On Line Reversing Heater (DOLRH)

This method of starting is the same as that above, but it is used with bi-directional motors. Start A drives Output Relay 1 (FORWARD) to control the motor in the forward direction and Start B drives Output Relay 2 (REVERSE) to control the motor in the reverse direction. Output Relay 3 (HEATER) follows the same function as with DOLH.

15.9. Variable Speed Drive (VSD)

Variable Speed Drives allow precise control of the motor speed by varying the frequency or applied voltage to a motor. By the very nature of variable speed drives the initial large "inrush" current typically seen on Direct On Line started motors can be avoided. For all other starter types (except VSD) the MV2 requires the completion of a successful starting sequence (i.e. the current must exceed 105%FLC and return to or below 100% FLC before the motor is considered as running).
This starter type allows the MV2 to consider the motor as running immediately after a start signal has been issued. Start A drives Output Relay 1 (RUN) to control the motor (which is assumed to be fed from an electrically held contactor).
The VSD starter type should also be selected for other starters which do not exhibit inrush characteristics, such as soft starters.
For all Starter Types except VSD the successful completion of a starting sequence is required before the motor will be considered running and protection features are enabled.
It is recommended the CT's fed into MV2 are primary to the VSD inverter.

15.10. NO STARTER

In no starter mode the MV2 is not in direct control of the motor starter and thus behaves as a pure overload device.
The MV2 **does not** issue the close signal to starter but will, in cases of overload or other active protective functions, issue a trip signal to open the main contactor.

When no starter is selected all of then normal settings associated with the controlling of a motor starter are removed. Therefore the MV2 has no ability to restart, digital inputs Start A and Start B cannot be selected, the start and stop sources are omitted and output relay 1 is forced to operate as a trip output.

Upon accessing the drive control page, the permissive statuses are removed and access is given directly to the start curve page.

The MV2 will determine if the drive is in a running status and indicate via the left hand LED, this is determined by the measured current in the circuit.
As the measured current is the only 'control' signal that the MV2 receives then, if the level of current falls below 10% of FLC then the MV2 will assume the drive has stopped. Care must be taken with systems which may have large changes in load or unload or indeed soft start drives where the inrush current is controlled.

The implementation of this starter type combined with the vertical display makes the MV2 a very attractive retrofit option for replacing electromechanical or early microprocessor protection devices with a newer device which offers better protection for the existing starter.

Refer to our website for details on some of our retrofit solutions.

www.pbeng.co.uk

16. Starter Settings.

Starting Method.
The Starting method or starter type determines how the connected drive is to be controlled. Whether via a single contactor, a two coil operated breaker etc. Each Starter type is explained in full in section 15.

On selection of some starter types other parameter are also required to achieve correct operation. See section 16.1.
For example when Star/Delta 2 is selected, values for the transition time behaviour between star and delta closing is required.

Start A/B.
This setting, ("Momentary" or "Maintained") determines the type of digital input signal used to start and run a motor. A momentary input (such as a push button switch) starts the motor when the button is pushed. The motor will remain running after the push button is released. If the motor is started by a momentary switch select "Momentary" in the Start A/B "pop up option screen".

A maintained input starts the motor when the switch changes state from open to closed. The change of state from closed to open stops the motor. If the motor is started by a maintained signal switch select "Maintained" in the Start A/B "pop up option screen".

The motor can be stopped by using the Stop digital input in either Maintained or Momentary modes.
In some applications there may be two inputs for running motor control, i.e. one for forward direction and another for reverse (or one for slow and another for high speed). In such applications two switches may be wired to the digital inputs for control of relay A and relay B respectively. The Start A/B setting applies to both switches. They cannot be configured independently.

Undervoltage Restart.
This setting activates the undervoltage restart (sometimes referred to as auto re-acceleration) function. A motor must be considered as running prior to voltage or auxiliary supply loss in order for a restart to take effect.

This function restarts the motor after a voltage or auxiliary supply loss. If the voltage or supply loss is less than 200mS the motor will carry on running. If the power to the motor is lost for less than the Restart Time, on voltage restoration, the relay will restart the motor after the Restart Delay has elapsed providing no inhibit exists (e.g. UV lockout protection).
If the power loss is greater than the Restart Time the relay will not restart the motor. Once this is enabled it allows the user to set the Undervoltage Restart Time and the Undervoltage Restart Delay.
If the thermal capacity of the running motor is 50% or more, in some cases the motor will be prevented from restarting after a power loss by an active thermal inhibit as there would be insufficient remaining Thermal Capacity to allow the motor to run up.

In some applications it may be desirable to inhibit a restart of a motor for process reasons even though the conditions exist which would ordinarily result in an automated restart taking place. In this case a digital input can be used to either block or allow this restart. See section 6.11.

Undervoltage Restart Time.
This setting determines the allowable off time (the time a relay can be powered off or without nominal voltage) such that if the power is restored or the voltage returns to normal within this time a restart can occur.
Voltage loss could be result of upstream supplies changing over, an HV motor starting or some other condition which causes downstream connected drives to either trip on undervoltage protection or cause contactors to drop out.

Undervoltage Restart Delay.
Once power has returned the restart delay can be used to help control the sequence of a process restart after an outage. This is a settable time to hold off automated start control after voltage restoration.
This can be used to prevent an entire bus system of motor starters from trying to reaccelerate at the same time.

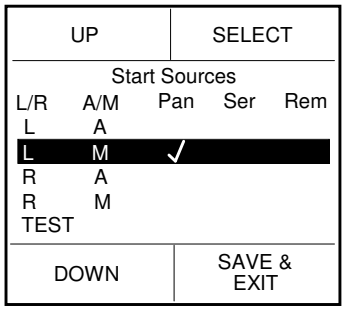
Restart Sense.
This setting, which can be set to 'Supply' or 'Supply or Reference', determines the signal that is examined after a power loss to determine whether an Undervoltage Restart will occur.
If it is set to 'Supply' then after a power loss and when the supply to the relay is active again a restart will occur.
If it is set to 'Supply or Reference' the relay will examine if there is voltage on the Bus-bars that supply the motor. Specifically, if the voltage dips below 65% of the line voltage then a Stop is called, if the voltage is restored to above 65% of the line voltage (within the set Restart Time) then the MV2 will orchestrate the restart. This setting is for the case where the relay is powered off an Auxiliary supply and not from the supplying Bus-bars.

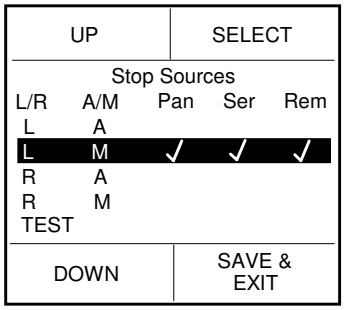
Start and Stop Setup Source.
This setting is used to determine the allowable source control for the Start and Stop signals to the motor.
The Start and Stop signals can come from three different type of input:-

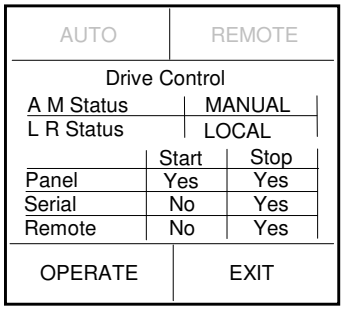
Panel	- the buttons on the front of the relay.
Remote	- from the digital inputs to the relay.
Serial	- through the serial link on the relay.

A matrix is displayed for both the Start and Stop sources and the user can configure which source an allowable start or stop command signal can come from.

The start and stop permissives configured here transpose directly in the availability matrix in the drive control page.







16.1. Additional Starter Settings.

The following settings are only configurable when specific starter types are selected.

- ● **2-Speed Starter (not DOW)**
- ■ **Star / Delta Starters**
- ▲ **DOL with Reverse Starters**
- ◆ **ACB Starter**

● Low to High Transfer.
In order to achieve dual speed control it is necessary to use both Start A and Start B when using hardwired digital inputs.
This setting is the motor stopped time when switching between Low speed to High speed using only the Start A and Start B inputs i.e no issued Stop command.
An explanation is given in section 15.5.

● High to Low Transfer.
As above, for the application of High to Low speed transfer.

● Low to High.
This setting allows the Low to High Transfer time to be used.
If this is set to disabled then speed transfer can only be carried out if the motor is stopped after a Start A command prior to issuing a Start B command

● High to Low.
As above, for the application of High to Low speed transfer.

■ Transition Time.
This setting determines the time period between a change-over from de-energising the Star output to energising the Delta output.

■ Max Time in Star.
This setting, determines the maximum time that the relay can hold the Star output closed.

■ Stay in Star
If the inrush current falls below 100% of FLC the transition to delta would normally take place. If enabled this setting holds the star output closed for the duration of the Max Time in Star setting.

▲ Transfer Lock.
Operates an inhibit period between switching from the forward to reverse direction or vice-versa. An attached load may continue to rotate after the supply power is removed, energising in the reverse direction against this momentum could cause serious mechanical damage to a motor.

▲ Transfer Time.
This is the settable inhibit time when the transfer lock is used.

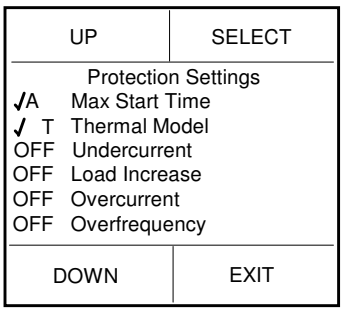
◆ ACB Pulse Time.
The Close and Open output relays are closed only for the set ACB Pulse time.

17. Protection Settings.

Each protection function is configurable independently of the others. The available action, the type of reset, the various threshold levels and trip timers for each and every protection function can be found in section 12.3.
This section describes in detail what each function does and how it operates.

Function.

If a particular protective function is required for use it should be selected and set to Function: Enabled. That function now operates as per its configuration.
On exit the protective list will show to the left hand side of the name a tick if the function is enabled, and A or T, or both if set, which operate an Alarm or a Trip.
If a particular function is not required it can be left disabled and it will display OFF next to the function.



Alarm.

An Alarm is considered as a high level function. If enabled, an A will appear alongside the protection setting description. If the function activates it will be recorded as part of the alarm history and cause MV2 to enter an alarm state; the fault will be displayed in the active faults page and the right hand LED will turn orange.
If an output relay is set as Alarm it will change state with the fault.

Trip.

A Trip is considered as a high level function. If enabled, a T will appear alongside the protection setting description. If the function activates it will be recorded as part of the trip history and cause MV2 to enter a trip state; the fault will be displayed in the active faults page and the unit will automatically display that page, the right hand LED will turn RED.
If an output relay is set as Trip it will change state with the fault.
Even if no output relay is set as Trip the MV2 will stop the drive by releasing the RUN output (or pulsing the OPEN output).

Inhibit.

An Inhibit is considered as a high level function. If enabled and the function activates it will display in the active faults page with a letter I to indicate the function is causing an inhibit. The drive may continue to run but cannot be restarted whilst the inhibit remains.
The left hand LED will turn orange.
The Stop open condition will also cause an inhibit preventing the drive from starting unless; the input is closed or the drive is entered into a state whereby the remote stop source can be ignored.
It is generally good practice to wire the stop signal through the contactor preventing it from closing whilst the stop is open unless the isolator or main power connector is out of service.

Reset.

The configuration of the reset allows that particular function to be cleared or reset to a healthy condition providing the condition that caused the fault, alarm or inhibit has been removed.

If a fault remains active an asterix (*) appears with the T,A or I and fault description in the active faults page.

Auto Reset.

This option, when enabled, automatically resets the Fault when the situation that caused the trip has been removed. If Auto Reset is selected the other reset options are unavailable.

Panel-Reset.

This option, when Enabled, allows a reset of a fault to be carried out from the front panel of the relay. A reset button will be displayed in the active fault page if any fault has been removed and is enabled for a panel reset.

Serial-Reset.

This option, when Enabled, allows a reset of a fault to be carried out through the serial link of the relay.

Remote-Reset.

This option, when Enabled, allows a reset of a fault to be carried out through the digital inputs to the relay. A digital input must be set to Reset Faults and must be closed after the fault condition has been removed in order for the reset to operate.

Indicators.

The indicators can be used for transparent signalling when a protective condition is active. There are five separate indicators to choose from.

The indicators are considered as a low level function meaning no automated response arises from an active condition, i.e the unit does not trip (unless activated to) or indicate via the LEDS.

The Indicators are used to drive output relays and can be used for a specific function output or hardwired interlocking control when driven from the External Fault based protective functions.

The output relay must also be configured as an indicator to operate in this manner.

17.1. Protection Functions.

17.1.1. Maximum Start Time.

When starting a motor a starting sequence must be completed before the MV2 will register the motor as “Running”. For this sequence to be complete the starting current must exceed 105% of the programmed motor full load current (FLC) then fall to or below 100% FLC. The Maximum Start Time protection feature may be configured to allow a maximum time for the motor to complete the starting sequence. If the motor has not been registered as “Running” before the expiry of the programmed timer then the unit may be configured to trip, alarm or indicate as a result. If the VSD starter type is used this function is not required.

Trip Time.

This setting determines the maximum time that the motor is allowed to take to complete it's starting sequence. The starting sequence ends when the current falls to under 100% of FLC at which point the message "Running" appears on the screen.

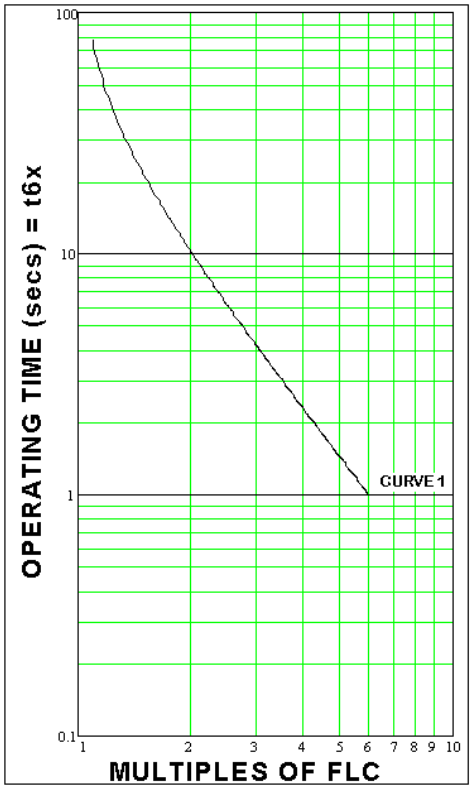
17.1.2. Thermal Model.

The Thermal Model protection is arguably the most fundamental feature in any motor protective relay. This is implemented as a software model of the electromechanical overload operation of the heating element and bimetallic coil which became *the* method of protecting electrical plant.

The Thermal Model protection cannot be switched off, that means even with incorrect settings the relay would try and offer some protection in an overloaded condition.

In order for this protection to operate successfully a motor is assumed to have a “thermal capacity” or TC. In its simplest terms, a motor start from standstill using a DOL method will absorb 6x its full load current (FLC) in order to magnetise and establish a magnetic field. Once the Motor overcomes its initial inertia and begins to rotate, the inrush current decreases until the motor reaches its nominal rotating speed and draws a continuous current, FLC. Once the TC reaches 100% a trip occurs.
From standstill, with a thermal capacity of zero (referred to as the Cold Condition) a motor has 100% of its TC available to start. If the inrush of 6X FLC remained steady (stalled rotor) the time taken to absorb 100% TC and a trip would be equal to the t6x setting. This is called the basic thermal characteristic.

The graph, right, shows multiples of FLC against the operating time. The Thermal model curve remains DT above 6x to allow for fuse discrimination.
I.E. An overload of 7 or 8x would trip in the same time as that for 6x.



Assuming t6x = 1: If a 2x inrush, from cold (0%) occurred the resultant trip time would be 10s.

If the Pre-Alarm setting is Enabled an Alarm is called when the Thermal Capacity reaches 95%. When it reaches 100% a Trip is called. The Pre-Alarm can be disabled, where as the Trip cannot.

When a motor successfully starts and maintains normal a FLC its TC increases to a steady state condition which is determined by the Hot / Cold ratio (H/C). If an overload occurred from this steady state condition the trip time is faster as the motor has already absorbed some thermal capacity up to its steady state (referred to as the Hot Condition). How much it has absorbed is dependant upon the withstand times of the motor or, its H/C ratio.

Hot/Cold Ratio.

The H/C ratio is calculated from the motor manufacturers' data, overload times are quoted both from a stand still (cold) overload and for a running (hot) overload.
The Hot withstand time divided by the Cold withstand time gives us a ratio. This ratio, expressed as a percentage, then equates to a steady state running condition.
i.e.

% Hot / Cold Ratio Setting	**80**	**70**	**60**	**50**	**40**	**30**	**20**
Steady State % Thermal capacity Running At 100% FLC	17	26	35	44	52	61	69
Available % Thermal Capacity For Overloads	83	74	65	56	48	39	31

If we take a ratio of 60%.

After a start and after running at FLC we reach the steady state thermal capacity of 35%, we have 65% TC remaining and available before a trip occurs, if an overload did occur the trip time is determined by the multiple of the overload condition (2x, 3x FLC etc) and the t6x setting.

The overload level for MV2 has a fixed pick-up of 1.05% of FLC, therefore the current must be in excess of this value for the thermal capacity to increase towards 100%.

During the start and run-up of a motor the absorbed TC is generally more than the steady state TC, so it does not follow that with a H/C ratio of 50% and 44% running TC that a second start would be permitted. A second start could only take place once sufficient TC is available. The unit may enter an inhibit mode to prevent a start.

The stats page under the Data menu indicates the TC absorbed during the last start.

Thermal Capacity is retained in non volatile memory to avoid resetting on a power down.

Cool Time Factor.

The time taken for TC to decrease is usually longer than the heating constant as motors generally dissipate absorbed TC by radiation.
The Cool Time Factor should be set according to the ratio of the motor cooling time constant at standstill divided by the heating time constant when running at normal speed. The higher the value of this setting the longer it will take for the thermal capacity to reduce to the level required to enable a restart.

t6x.

This setting defines the basic thermal characteristic, the trip time for a 6x FLC overload condition from 0% absorbed TC.
In real terms, the trip time for a continuous 6x overload from 0% to 100% will equate directly to the t6x setting. (i.e. if t6x is set at 10, the trip time will be 10 seconds)

The formulas below describe how the thermal model operates from cold and hot.

Cold Condition

$$t_c = 32.a.\log_e\left(\frac{p^2}{p^2 - 1.05^2}\right)$$

where;
'p' is the multiple of FLC
'a' is the t6x setting
't_c' is the operating time (in seconds)

Running (Hot) Condition

$$t_C = 32.a.\log_e\left(\frac{p^2 - \left(1 - \frac{H}{C}\right)(I_L)^2}{p^2 - 1.05^2}\right)$$

'I_L' is the steady state prior to overload (If motor is running at FLC I_L = 1)
'H/C' is the hot cold ratio expressed as a decimal i.e. 40% = 0.40

A trip time table for overload level with respect to the H/C condition is given in Appendix 5.

An application example showing how the Thermal Model settings are calculated is available on our website: www.pbeng.co.uk

In 2-speed motor applications two t6x times are to be set, one for low speed and the other for high speed.

17.1.3. Undercurrent.

The MV2 may be configured to trip, alarm and/or indicate as a result of an undercurrent condition, usually the result of loss of load.
Undercurrent protection is disabled during STARTING and in TEST MODE.

Trip Level.

The undercurrent pickup is set as a percentage of the Actual Running Current (ARC) which is the typical loaded current of the motor. The undercurrent pickup should be set higher than the unloaded current the motor may be subject to. If the measured current falls below this threshold level the unit will action after the time delay.

Trip Time.

The trip time is set to determine how long an undercurrent condition can persist before the configured action is taken.

U/C Reset Delay.

When an undercurrent condition occurs the unit can be prevented from resetting until the U/C Reset Delay timer has expired. In some applications, typically well pumps the motor is cooled by the pumped fluid so the motor may be "hot" on tripping. This delay allows for a cooling period before an attempt at restart.

17.1.4. Load Increase.

The MV2 may be configured to trip, alarm and/or indicate as a result of a load (current based measurement) increase condition, often used to indicate process conditions such as stock on a conveyor belt.
Load Increase protection is disabled during STARTING.

Trip Level.
The load increase pickup is set as a percentage of the Actual Running Current (ARC). Depending on the application a load increase may be a frequent occurrence and care must be taken to prevent nuisance tripping.

Trip Time.
The trip time is set to determine how long an increased load condition can persist before the configured action is taken.

17.1.5. Overcurrent.

The MV2 may be configured to trip, alarm and/or indicate as a result of an overcurrent condition, typically caused by a phase or earth fault, mechanical jam or other heavily loaded motor condition.
Overcurrent protection is usually used to ensure faults are cleared more quickly than that provided by the Thermal overload protection.
Overcurrent protection is disabled during STARTING and when in TEST MODE.

Trip Level.
The overcurrent pickup is set as a percentage of the Full Load Current (FLC). If the current rises and remains above the threshold level action is taken after the trip time has elapsed.

Trip Time.
The trip time is set to determine how long an overcurrent condition can persist before the configured action is taken.

17.1.6. Over Frequency.

The MV2 may be configured to trip, alarm and/or indicate as a result of an over frequency condition. Frequency is auto-sensing (50 or 60Hz) and is determined by the Vref input.

Trip Level
If the frequency increases and remains above the set level action is taken after the trip time has elapsed.

Trip Time
The trip time is set to determine how long an over frequency condition can persist before the configured action is taken.

17.1.7. Under Frequency.

Under Frequency protection operates similarly to Over Frequency protection with the exception that measured frequency must fall and remain below the set threshold level for the duration of the trip time before the configured action is taken.

17.1.8. Single Phase.

The MV2 may be configured to trip, alarm and/or indicate as a result of a single phasing condition, i.e. loss of one current phase, and will operate in 100ms.
The function operates at 100% unbalance. If this function is disabled the unbalance protection will not operate at the 100% condition.

17.1.9. Phase Rotation.

The direction of rotation of a motor is determined by the connection of the 3 phase supply. In some applications it may be necessary to prevent the motor accelerating in the opposite direction or with incorrect phase connections.
The MV2 may be configured to trip, alarm and/or indicate as a result of an incorrect phase rotation.
Phase Rotation is only enabled during the STARTING sequence.

Direction.

The configurable phase rotation can be 'ABC' (0^0 120^0 240^0) or 'ACB' (0^0 240^0 120^0) this determines the preference. If the phase relationship is anything other than this the configured action is taken.

17.1.10. Unbalance Current.

Unbalance of a three-phase motor can cause the windings to overheat as the motor continues to rotate and develop the required torque to meet the demand. Unbalance is determined thorough measured current.
The amount of unbalance is calculated using one of the equations detailed below:

i) If the Highest_Phase_I > 80% motor full load current (FLC):

$$\%Unbalance = \frac{(Highest\_Phase\_I - Lowest\_Phase\_I)}{Highest\_Phase\_I} \times 100$$

ii) If the Highest_Phase_I < 80% of FLC:

$$\%Unbalance = \frac{(Highest\_Phase\_I - Lowest\_Phase\_I)}{Motor\_Full\_load\_current} \times 100$$

Trip Level.

If the unbalance increases and remains above the set level action is taken after the trip time has elapsed.

Trip Time.

The trip time is set to determine how long an unbalance condition can persist before the configured action is taken.

17.1.11. Undervoltage.

The MV2 may be configured to trip, alarm and/or indicate as a result of an undervoltage condition. Undervoltage may be due to upstream supplies changing over or HV motor starts creating downstream voltage dips. As such, undervoltage protection should be set with the ability to ride-out some undervoltage conditions to avoid unnecessary tripping. Undervoltage protection is disabled during STARTING and when in TEST MODE.

Trip Level.
The undervoltage pickup is set as a percentage of the Voltage setting. If this decreases and remains below the threshold level action is taken after the trip time has elapsed.

Trip Time.
The trip time is set to determine how long an undervoltage condition can persist before the configured action is taken.

17.1.12. U/V Lockout.

The undervoltage lockout protection can be used as to prevent restarting of a motor after a severe voltage collapse. It can be configured as a second-stage undervoltage feature, the protection will always result in an inhibit with a selectable alarm. It operates instantaneously once the voltage falls below the set level.
U/V Lockout is disabled during STARTING and when in TEST MODE.

This function should be set disabled if U/V restart is enabled as it will inhibit any auto-re-acceleration (auto-restart) from taking place after a voltage dip. Even with auto reset enabled the U/V restart will be inhibited

Trip Level.
The Undervoltage Lockout pickup level is set as a percentage of the Voltage setting and determines the level of voltage below which the motor will be inhibited from starting.

17.1.13. Earth Fault.

The MV2 may be configured to trip, alarm and/or indicate as a result of an EF overcurrent condition. Earth Fault measurement can be achieved in one of three ways.

a) using a core balance transformer (CBCT)
b) using a residual connection from the three phase CT's, or, at request.
c) using an internal residual connection calculated from the measured phases.

Generally it is desired that earth fault protection be instantaneous although in some applications transient earth fault currents may be seen, and requires a small delay to be imposed to prevent nuisance tripping. In most cases the earth fault protection feature should be set to ensure appropriate coordination with other devices.

Depending on the type of system grounding (resistive or solidly earthed) an earth fault current has the potential to be very large. The user must be aware of the maximum earth fault current the system can experience when using the Earth Fault protection feature with a fused contactor. If solidly earthed, the earth fault current may be much higher than the rated current breaking capability of the contactor. An attempt to break a fault current in excess of its rating may cause damage to the equipment. In such applications the user should ensure appropriate coordination between the device and HRC fuses and/or disable the Short Circuit protection feature.

Circuit Breakers are typically rated to break the full fault current, Contactors are not.

Trip Level.

The earth fault pickup is set as a percentage of the EF CT Primary. If the current rises and remains above the threshold level action is taken after the trip time has elapsed.

With a residual connection as in 'a' the EF CT Primary should be set to the same value as the CT Primary.
With a CBCT connection the EF CT Primary should be set to the primary rating of the CT.
In an internal earth fault connection the EF CT Primary settable option is removed and the CT rating is used.

Trip Time.

The trip time is set to determine how long an earth fault condition can persist before the configured action is taken.

17.1.14. Over Temperature. (optional)

The MV2 may be configured to trip, alarm and/or indicate as a result of an over temperature condition, as seen by an external temperature probe. It can provide protection or indication of excessive heating as a result of a lack of ventilation/cooling, negative sequence currents, overvoltage and other conditions which may not be detected by the Thermal Model.
The single temperature input can be provided to allow the connection of several different types of temperature probes including:

- RTD (Resistance Temperature Device – type PT100) displayed in degrees C.
- PTC (Positive Temperature Coefficient Thermistor) displayed as resistance.
- NTC (Negative temperature Coefficient Thermistor) displayed as resistance.

When the Over Temperature function is enabled the device will also indicate as a result of a Short or Open circuited temperature probe

Resistance Type

This setting determines the type connected probe, RTD, PTC or NTC.

RTD Compensation

The setting allows the measured level to be manually offset.

Thermistor Trip Level.

With a PTC the relay will action when the resistance *exceeds* the set level and with a NTC the unit will action if the resistance value changes *below* the set level.

RTD Trip Level.

This setting determines the temperature level at which the configured action should be taken.

Trip Time.

This setting determines the delay between the unit registering and maintaining a threshold pick-up and the resulting configured action.

17.1.15. Too Many Starts.

The MV2 will inhibit and can be configured to indicate as a result of too many starts occurring. It is often desirable to prevent multiple starts of a drive particularly if it is the cause of stability problems on the power system.

No reset type is available. The inhibit will auto-reset after the selected time delay has elapsed. A start can then be made.

Starts per Period.
The number of allowable starts before actively inhibiting further starts from being made.

Start Inhibit Time.
The start inhibit time can be set as a fixed time for the inhibit to be active.

Start Period.
The Start period can be set from 1 minute to 60 minutes.

Start Inhibit Type.
This setting selects the time length for the inhibit, there are three options.

1) Inhibit Time (start inhibit time setting)
2) Remaining SP (the remaining start period)
3) SP + IT (the remaining start period + the fixed Inhibit Time)

Example 1.
A Motor can be started a maximum of 4 times in one hour. We can further say those starts must be evenly spaced throughout the hour.

The *Start Period* should be set to 15mins with a *Starts per Period* of 1. The Start Inhibit Type should be set to Remaining SP.

If the drive starts and runs for 10 minutes and is then stopped, the inhibit will last for 5 minutes.
(Start Period = 15mins) – (run time = 10mins) = (Remaining SP = 5mins)
If the drives starts once and runs for 15mins a second start can be made immediately.

Example 2.
A Motor can be started three successive times within 20mins, if three starts are made the drive should be inhibited for a period of 30 minutes.

The *Start Period* should be set to 20mins with a *Start per Period* of 3. The Start inhibit Type should be set to *Inhibit Time* with a *Start Inhibit Time* setting of 30mins.

If the drive starts and stops three times within 20mins the fourth start can only take place after the 30mins from the last stop.

If the drive starts twice and continues to run as long as the total time for the two starts is in excess of 20mins, the drive can be restarted again immediately.

17.1.16. Overvoltage.

The MV2 may be configured to trip, alarm and/or indicate as a result of an overrvoltage condition.
Overvoltage protection is disabled during STARTING and when in TEST MODE.

Trip Level.
The overvoltage pickup is set as a percentage of the Voltage setting. If this increases and remains above the threshold level action is taken after the trip time has elapsed.

Trip Time.
The trip time is set to determine how long an overvoltage condition can persist before the configured action is taken.

17.1.17. Backspin.

After a motor stop a fixed inhibit will be active for the set period. In certain applications such as well pumping where a motor is pumping against gravity it is often good practice to inhibit a motor starting for a moment prior to a trip or stop. In such applications when the motor is stopped the fluid may rotate the shaft in the opposite direction as it settles.

An Anti Backspin timer can help to prevent undesired mechanical stresses on the machine if a start was made against the downward force.

Backspin Time.
Sets the length of the inhibit time after a stop before a start can be made.

17.1.18. Power Factor.

Power factor is determined from phase 1 current and the voltage reference, if the power factor decreases, tends toward zero, the MV2 can be configured to take suitable action.

Under Power Factor protection is disabled during STARTING.

Trip level.
This setting determines the level at which the power factor must decrease in order to activate the protection.

Trip Time.
Detemines the length of time the threshold can be breached before any action is taken.

17.1.19. External 1 to 10.

The external faults are digital input based, configurable action inputs. Up to 10 are available and bring a flexible PLC approach to the normal protective functionality. Each is independently configurable and can be used to provide permissive interlocking or process commands in addition to the normal Start and Stop functions.
Each External fault can be renamed to an eleven character user defined text string, Unit Settings > Edit Custom Strings.

Function.

The function can be set to any combination of Alarm, Trip, Inhibit or Stop. The function can also be set to Test option which allows the function to be active when in the test mode.

Reset.

Normal reset options apply, Auto or a combination of Panel, Serial and Remote.

Polarity.

This option determines the polarity of the digital input that activates this function. 'OFF=Fault' (typically fed from a NC contact), means that when the digital input is Open the External Fault will action.
'ON=Fault' (typically fed from a NO contact), means that when the digital input is Closed the External Fault will action.

Trip Time.

Determines the time an external input can remain in its fault state before any action is taken.

17.1.20. Short Circuit.

The Short Circuit protection feature provides the user with added protection against attempting to break fault currents in excess of the switchgears rating.

This feature is typically enabled when the motor is being controlled by a circuit breaker rather than a fused contactor arrangement. It provides a fixed instantaneous trip (<100ms) at a fixed phase current setting of 9x In (where In is the phase current transformer primary setting).

When this setting is disabled a trip inhibit is active for currents over 9x In. Above 9x In only the Thermal Model is active and the relay will trip according to the Overload Curve irrespective of other settings. This prevents a contactor from being damaged by attempting to break a fault current in excess of its rating. The intension is to allow the HRC fuse or other fault current rated device to clear the fault.

17.1.21. Contactor Fault.

Contactor Fault protection is determined from the digital input status of Cont A and Cont B inputs to confirm run/close, stop/open and trip commands (ACB Feedback when in ACB starter type).
If the feedback fails to confirm a sent signal via the output relays the configured action for this function will take place.
Regardless whether Start A/B is set to momentary or maintained, feedback signals are always maintained signals.

Trip Time.

Determines the allowable propagation time of a feedback signal before any action is taken.

17.1.22. Emergency Stop.

In many applications an Emergency Stop pushbutton is wired directly in line with the contactor energising coil to stop the motor immediately when pressed. Auxiliary contacts on the Emergency Stop pushbutton may be wired to a digital input to notify the relay that an emergency stop has been triggered. The unit will always issue an instantaneous trip if it receives an E. Stop signal.
A digital input must be assigned as 'E. Stop' in order for this function operate correctly.
The Emergency Stop feature is always fail-safe, meaning it should be continuously closed to denote a healthy signal.

An Emergency Stop trip is only disabled by the Short Circuit protection function when the fault current is in excess of 9xIn.

17.1.23. Serial Timeout.

For a set period of inactivity on the rear communication port the unit can be configured to take some action in the event.
It is worth noting that the MV2 device is slave to any host system, the unit will not send information via the serial port unless it has been requested by a master device.

17.1.24. Internal Error.

The MV2 incorporates an internal software and hardware watchdog feature to monitor the integrity of both on board hardware and software systems. This feature may be configured to indicate as a result of any registered problems. If a problem with the hardware or software is located during the error check routines the MV2 will generate an error code (or diagnostic status) which will be reported at the very bottom of the Analogue Values, Measured Values screen.
In the unlikely event a constant diagnostic status other than '0' is reported please contact P&B Engineering (or your local distributor) providing both the serial number and software version of the relay.

17.1.25. Serial Inhibit.

The serial inhibit protection function inhibits a motor from starting, stop a motor running or can be configured to stop a motor and inhibit further starting as a result of a serial command.
This inhibit will be registered by the MV2 as an active fault condition. This protection feature allows remote stations (control rooms) to inhibit motor starts via the communications port to lockout and prevent local control of the motor.

The Serial Inhibit protection feature may only be disabled by writing to the correct register using the serial port. i.e. The inhibit function may not be disabled via remote switches or from the front panel.
The Serial Inhibit register address may be found in both the Modbus and P&B Network Gold Communications Memory Map Document.

17.1.26. RTD Over Temp Channels 1 to 12. (optional)

The MV2 may be configured to trip, alarm and/or indicate as a result of an over temperature condition, as seen by an external temperature probe. It can provide protection or indication of excessive heating as a result of a lack of ventilation/cooling, negative sequence currents, overvoltage and other conditions which may not be detected by the Thermal Model.

As an additional protective function, which must be requested at ordering, the MV2 can accept up to 12 additional RTD probes. It is then referred to as a Multi RTD Motorvison (RTDMV2).

• RTD (Resistance Temperature Device – type PT100) displayed in degrees C.

RTD Trip Level.
This setting determines the temperature level at which the configured action should be taken.

Trip Time.
This setting determines the delay between the unit registering and maintaining a threshold pick-up and the resulting configured action.

The probes can each be renamed to uniquely identify them with up to 11 characters. Unit Settings, > Edit custom Strings.

17.1.27. Profibus DP Fault. (optional)

For a set period of inactivity or fault with the rear Profibus communication port the unit can be configured to take action in that event.

18. Unit Settings.

Software Version.
Displays the operating software (firmware) loaded on to the unit. This should be noted along with the serial number when corresponding about this equipment

Unit ID. / Unit Type.
Displays the Serial number and device type.

Password.
If the password is set to enabled the default password (6363) may be used to change setting and reset statistical data. If the password has been changed the new password must be used.
If a digital input is set to Authorise, by energising this digital input you can change settings without being prompted for a password.

Engineering Password
If enabled the Engineer Password will allow access using the standard password. Generally if a password is requested a prompt will offer 'AAAAA', changing the second A to a B 'ABAAA' allows access.

The settings may only be modified when the correct password has been entered.

Change Password.
The MV2 default password is '6363'. It is recommended for security purposes this password be changed. The password may be up to 6 characters long and alphanumeric if desired.
If the User Password is lost and the Engineers Password has been disabled the only options are to either Read the information via the serial Link or execute a Configuration Reset on the relay to restore all of the factory defaults.

Edit Custom Strings.

The MV2 provides the user with the ability to assign a unique user definable name to External 1 to 10 functions, the Additional RTD inputs (where fitted) and assign a 'Motor Tag' which appears across each page in the display scroll.

Each name can be up to 11 characters.

LCD Backlight and LCD Contrast.
These functions allow the user to change the display contrast and backlight.

Time and Date.
These functions allow the user to set the date and the time on the relay.

Time Sync Delay. *(Only for use with Chronovision)*
Chronovision is a GPS based device which connects to the RS485 network and synchronises the time and date of each connected unit. This delay prevents immediate updating of the RTC.

Calibration.

Each unit is calibrated prior to dispatch and a signed test report is issued. The user may however access these settings if required and re-calibrate the device if deemed necessary. In addition to the calibration of analogue inputs the Calibration Sub Menu provides some useful diagnostic tools and configuration settings for the 4-20mA output signal.
After entering the password the Calibration Sub Menu will be displayed and allows access to the following settings:

Gain and Offsets for each analogue channel.
Auto Zero Temp

Auto I Cal	4-20mA Output
Auto EF Cal	Soak Setup
Auto V Cal	Digin Diagnostics
Reset Cal Factors	O/P Relay Tests
Run Offset Cal	Noise Check

Reset Thermal Capacity.

The absorbed TC can be forced to zero in order to complete thermal tests or for emergency starting.

Set Default Page / Default Return Time.

Any of the display scroll data pages can be nominated as the default page and returned to after a set period of key press inactivity.
To set the page; select the required page using the display scroll button, then enter the unit setting and select 'set default page'.

4-20mA Gain

The 4-20mA Gain setting should be left at 1024. This was added to allow an offset and correct for theoretical drives sizes.

Software Activation Keys

In order for some functions to operate a unique activation code is required to access hidden menu screens, The Smart Card and Disturbance Recording facility both require unique activation codes to operate.

Screen Saver

To help extend the life of the LCD we can power the display down if the application suits. The screen will power down after the set time from the last key press. The MV2 will still operate and can be remotely controlled via digital inputs or the serial interface.
On any key press or active fault the display will reactivate.

Invert LED Colour

Required to be set to YES when the green-screen LCD version is used.

Hours in Service

The hours in service is a counter which increments whilst the unit is in service or energised, this is used to help determine MTBF figures.

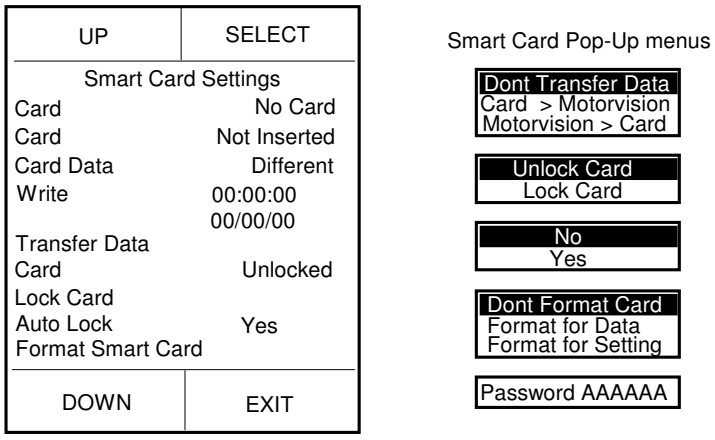
19. Smart Card Settings.

The Smart Card was developed to provide secure parameter storage and ease of data retrieval.
The smart card gives users the ability to transfer drive data between similar devices using the inbuilt card reader/writer, it can be formatted and controlled via the relays' LCD interface or with a PC and dedicated smartcard reader.
Smart Cards are available in two forms, both can be password protected and once formatted for a particular device type they cannot be used in another device type (FV2 for example) without re-formatting.
The two forms are:

Settings Card
- Password protected up to 6 characters (default AAAAA)
- All parameter settings for a single relay can be saved on one card
- Fast transfer time, typically 5 seconds
- One card can be used to clone multiple relays with the same settings
- Data transfer can be controlled without the need of external equipment

Data Card
- Password protected up to 6 characters (default AAAAA)
- Selectable events to record
- 64K of memory available for data logging (150-4500 events)
- Time and date stamping of events to 1ms
- Stored in text file format

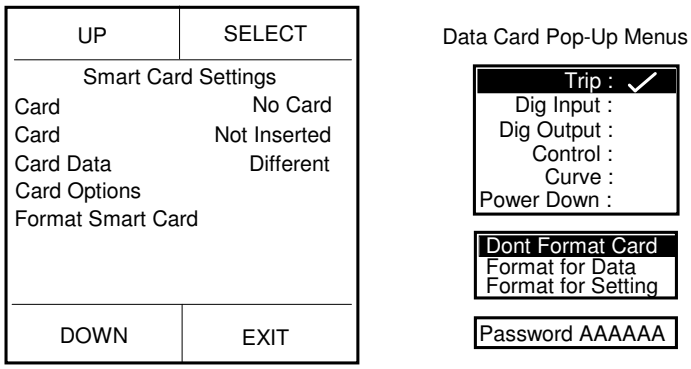
Settings Card:



The Card detail is displayed on the first two lines, the card data indicates whether the parameter settings both on the card and those programmed into the relay concur with each other. Any single setting change causes Compare Fail to be displayed across the screen.
The time and date of the last setting transfer are recorded for that particular card.

The card can be locked against overwriting by means of the password or if set to auto lock the card will be automatically password protected on removal. The password required to unlock and transfer the parameter settings is the password which was set on initial formatting.
Parameters are transferred by selecting Transfer Data.

Data Card:



As with the Settings card the card detail is displayed on the first two lines in the menu. The card options allow the user to set which of the conditions the data card is required to store, single or multiple events can be set.

The format of data storage is as follows;

Trip Data:
Trip Event, Time & Date, All currents and Voltages, all other relevant measured data

Digital Input or Output:
Digital I/O Event, Time & Date, Digital I/O number, Digital I/O name, Final State (Open or Closed)

Control Data:
Control Event (start / close, stop / open or reset), Time & Date, Origin (serial / panel / remote / auto / trip)

Curve:
Time & Date, Start curve data points, FLC setting

Power Down:
Time& Date

The Smart Card reader is supplied as standard on MV2 but in order to use the facility the purchase of a unique Software Activation Key is required for the inbuilt card reader to operate.
Once keyed in the unit must be powered off and on, previously hidden menu screens will now be available.

We recommend that the device is isolated from the process during any smart card use.

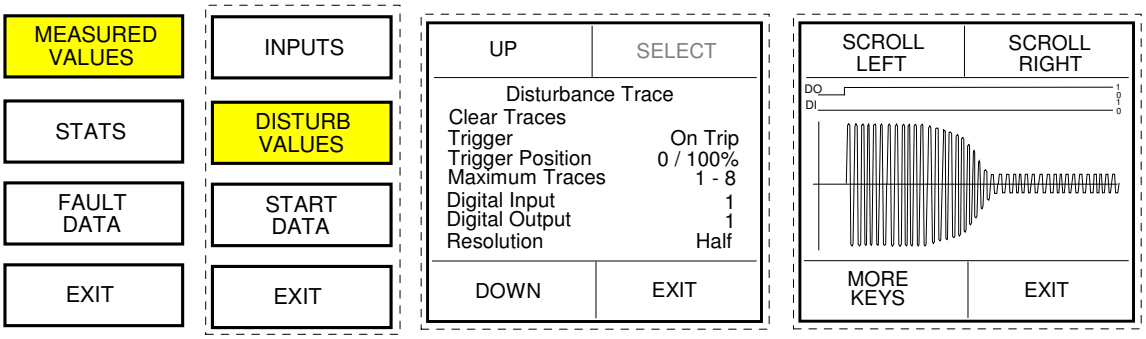
20. Disturbance Recording.

Disturbance and fault recording is a very effective tool for personnel to analyse the performance of the power system and related equipment during and after a major disturbance.
Utilising the graphical display to full effect an onscreen Disturbance Recording facility is now available using a unique software activation key similar to that of the smart card option.

A total of eight seconds recording can be achieved at half resolution with the ability to capture multiple traces, which can be weighted pre and post fault on selectable triggering events.
All the currents and voltages are captured on a single recording (viewable separately) along with a specified digital output and digital input.

The disturbance traces can be extracted via the standard RS485 port or optional front mounted RS232 port in Comtrade format for high resolution analysis.

The four software function buttons allow limited manipulation of the image with the ability to zoom in and out, and scroll left and right allowing the entire oscillograph trace to be viewed without the need for any external equipment.



The More Keys button changes the function of Scroll Left and Scroll Right to Zoom In and Zoom Out.

Disturbance recording options:

View trace

Allows viewing of the selected disturbance via the graphical LCD

Trace Time

Displays the time and date of the selected trace, the trace recordings are identified by their time and date stamp which can be chosen from a pop-up selection.

Trace Input

Selects which of the measured values is be shown when the View trace is selected

Enable Overwrite

Once the maximum traces have been recorded “trace full” will be displayed on screen. If set to overwrite then new recordings will overwrite those previously stored on a fifo basis.

Clear Traces

This clears and permanently deletes all records traces in the buffer memory.

Trigger

Selects the trigger source to begin recording;
On Trip, On Pick-up, On DI Close or On Start.

Trigger Position

Selects the trigger point pre and post fault;
0-100%, 20-80%, 50-50%, 80-20% or 100-0%.

Resolution

The resolution can be set to half (allowing the full eight seconds) or full, which allows a maximum of four seconds recording.

Maximum Traces

Up to eight traces can be recorded. If set to the maximum with full resolution, then each trace length can only be a maximum of 500ms each.

Digital Input No.

Selects which of the 1-24 digital inputs is to be recorded along with the trace.

Digital Output No.

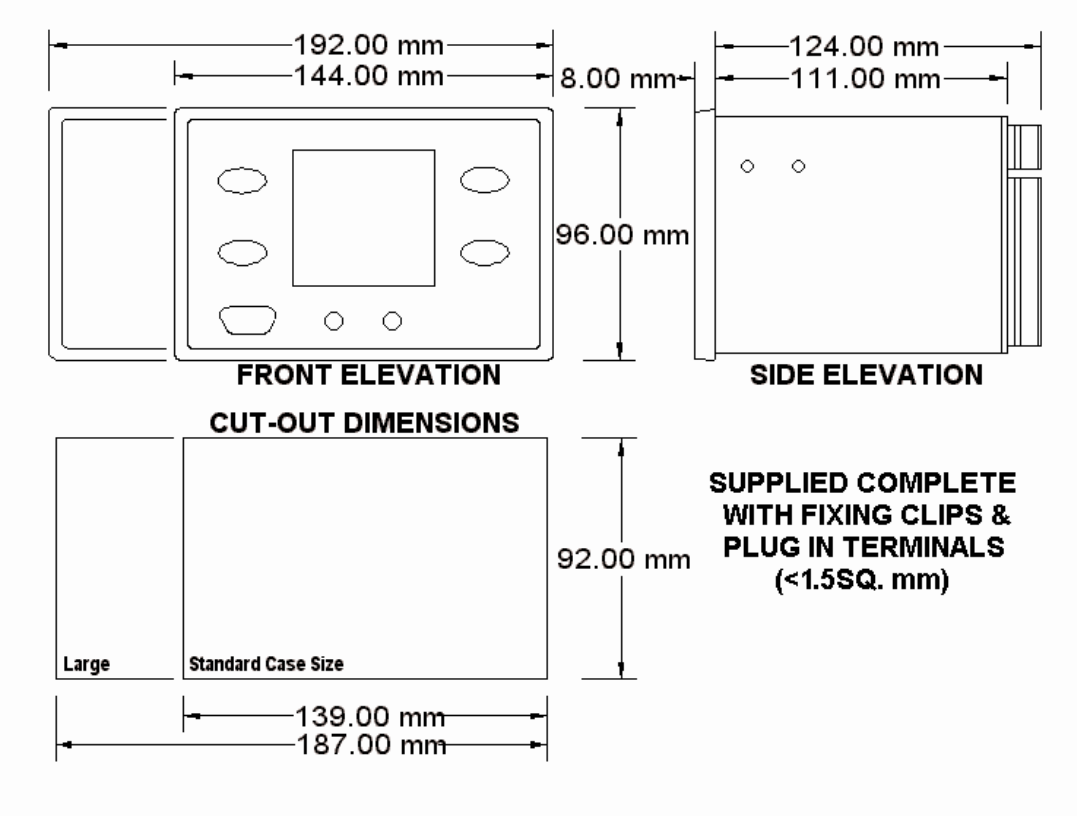
Selects which of the 1-8 output relays is to be recorded along with the trace.

Appendix 1

MV2 Installation.

The MV2 is supplied in a DIN Standard case suitable for flush mounting as detailed below. The control cable should be stranded copper core of 0.5 to 1.5mm^2, CT wiring may be 1.5 to 2.5mm^2 cable.
Wiring torque of plug in connectors should not exceed : 0.5 – 0.6 Nm, M3 Thread
Wiring torque of the CT input connections not exceeding: 0.5 – 0.6 Nm, M3 Thread

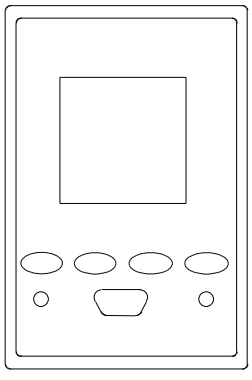
The MV2 has been designed for installation on to open type panels, for use on the flat surface of a type 1 enclosure and for installations where the ambient temperature does not exceed 60^0 C.



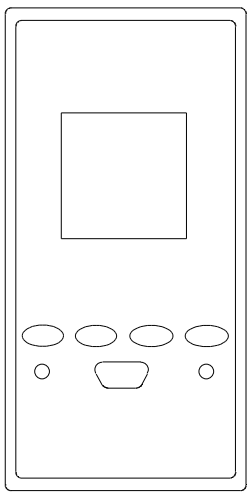
The AMV2 and RTDMV2 are both supplied in the larger case.

Both the Standard and Large cases can be supplied with an optional sash lockable dustproof cover.

Relays can also be requested to be orientated in a vertical format to the same dimensions.



Standard Case Size Vertical

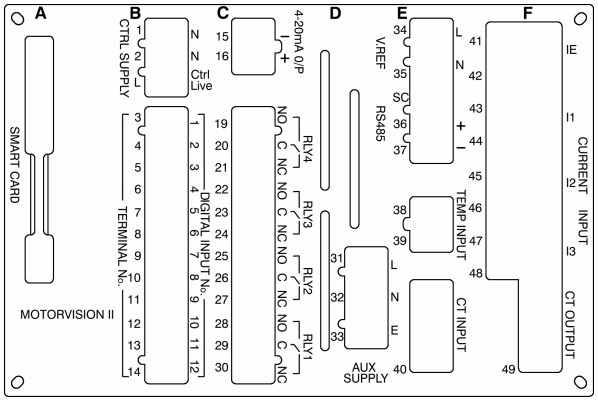


Large Case Size Vertical

Appendix 2

Termination Numbers.

MV2

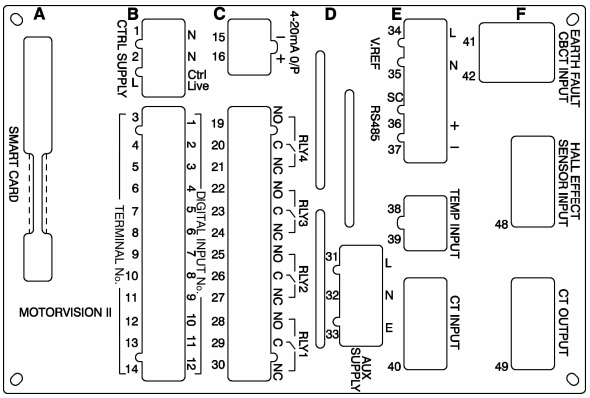


MV2 backplate layout with CT card

A: Smart Card
B: Digital Input Card
C: Relay Card (with 4-20mA O/P control)
D: Power Supply Card
E: Analogue Card (with RTD/Temperature Input option)

F: 1A/2A/5A CT Card

See table over for specific use of terminals.

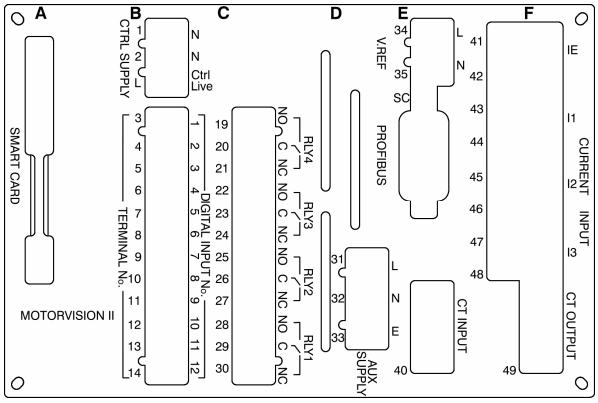


MV2 backplate layout with Hall Effect CT card

A: Smart Card
B: Digital Input Card
C: Relay Card (with 4-20mA O/P control)
D: Power Supply Card
E: Analogue Card (with RTD/Temperature Input option)

F: Hall Effect CT Card

See table over for specific use of terminals.



MV2 backplate layout with Profibus Connector

Smart Card	
CONNECTOR 1	
SMART Card Socket	

Digital Input Card	
CONNECTOR 2 3-WAY AUX. SUPPLY	
PIN NUMBER	SIGNAL.
1	NEUTRAL
2	NEUTRAL
L	CONTROL LIVE

Digital Input Card	
CONNECTOR 3 12-WAY PLANT INPUTS	
PIN NUMBER.	SIGNAL.
3	PROGRAMMABLE INPUT 1
4	PROGRAMMABLE INPUT 2
5	PROGRAMMABLE INPUT 3
6	PROGRAMMABLE INPUT 4
7	PROGRAMMABLE INPUT 5
8	PROGRAMMABLE INPUT 6
9	PROGRAMMABLE INPUT 7
10	PROGRAMMABLE INPUT 8
11	PROGRAMMABLE INPUT 9
12	PROGRAMMABLE INPUT 10
13	PROGRAMMABLE INPUT 11
14	PROGRAMMABLE INPUT 12

Relay Card 4-20mA Option	
CONNECTOR 7 2-WAY 4-20mA Output	
PIN NUMBER	SIGNAL.
15	+ve
16	-ve

Relay Card	
CONNECTOR 8 12-WAY RELAY Output	
PIN NUMBER.	SIGNAL.
19	RELAY 4 NO
20	RELAY 4 C
21	RELAY 4 NC
22	RELAY 3 NO
23	RELAY 3 C
24	RELAY 3 NC
25	RELAY 2 NO
26	RELAY 2 C
27	RELAY 2 NC
28	RELAY 1 NO
29	RELAY 1 C
30	RELAY 1 NC

Power Supply Card	
CONNECTOR 9 3-WAY AUX. SUPPLY INPUT	
PIN NUMBER.	SIGNAL.
31	LIVE
32	NEUTRAL
33	EARTH

Analogue Card	
CONNECTOR 10 2-WAY VOLTAGE REFERENCE	
PIN NUMBER.	SIGNAL.
34	LIVE
35	NEUTRAL

Analogue Card	
CONNECTOR 11 3-WAY RS 485 COMMUNICATION	
PIN NUMBER.	SIGNAL
SC	RS485 Screen
36	RS485 TX+
37	RS485 TX-

Analogue Card RTD/Temperature Input Option	
CONNECTOR 12 2-WAY THERMISTOR/RTD INPUT	
PIN NUMBER.	SIGNAL
38	THERMISTOR/RTD I/P
39	THERMISTOR/RTD I/P

Analogue Card	
CONNECTOR 13 8-WAY CURRENT SENSOR I/P	
PIN NUMBER.	SIGNAL.
40	CURRENT SENSOR

1A / 2A / 5A CT Card	
CONNECTOR 14 8-WAY CT INPUT	
PIN NUMBER.	SIGNAL.
41	I0 S1
42	I0 S2
43	I1 S1
44	I1 S2
45	I2 S1
46	I2 S2
47	I3 S1
48	I3 S2

1A/2A/5A CT Card	
CONNECTOR 15 8-WAY CT SIGNAL	
PIN NUMBER.	SIGNAL.
49	CT SIGNAL

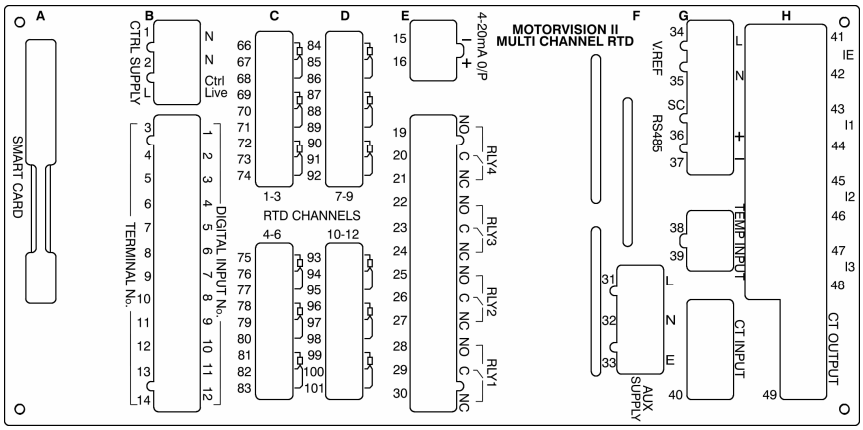
Hall Effect CT Card	
CONNECTOR 16 2-WAY EARTH CT INPUT	
PIN NUMBER.	SIGNAL.
41	I0 S1
42	I0 S2

Hall Effect CT Card	
CONNECTOR 17 8-WAY HALL EFFECT INPUT	
PIN NUMBER.	SIGNAL.
48	SIGNAL

Hall Effect CT Card	
CONNECTOR 18 8-WAY CT SIGNAL	
PIN NUMBER.	SIGNAL.
49	SIGNAL

Termination Numbers.

RTDMV2



MV2 with multiple RTD Inputs backplate layout with CT card
Note: the RS485 can be changed to a profibus connection (not shown)

A: Smart Card
B: Digital Input Card
C: 6 RTD Input Card (Card 1) RTD Channels 1 to 6
D: 6 RTD Input Card (Card 2) RTD Channels 7 to 12
E: Relay Card (with 4-20mA option)
F: Power Supply Card
G: Analogue Card (with RTD/Temperature Input option)
H: 1A/2A/5A CT Card.

See previous table for specific use of terminals (Cards A, B, E, F,G & H)
See below for specific use of terminals (Cards C & D)

6 RTD Input Card (Card 1)	
9-way 1-3 RTD Input connector	
PIN NUMBER	**SIGNAL**
66	RTD 1: RETURN
67	RTD 1: HOT
68	RTD 1: COMPENSATION
69	RTD 2: RETURN
70	RTD 2: HOT
71	RTD 2: COMPENSATION
72	RTD 3: RETURN
73	RTD 3: HOT
74	RTD 3: COMPENSATION

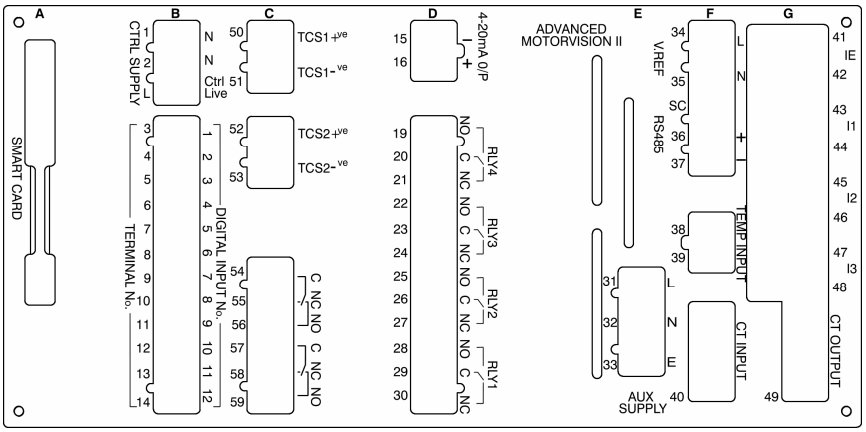
6 RTD Input Card (Card 2)	
9-way 7-9 RTD Input connector	
PIN NUMBER	**SIGNAL**
84	RTD 7: RETURN
85	RTD 7: HOT
86	RTD 7: COMPENSATION
87	RTD 8: RETURN
88	RTD 8: HOT
89	RTD 8: COMPENSATION
90	RTD 9: RETURN
91	RTD 9: HOT
92	RTD 9: COMPENSATION

6 RTD Input Card (Card 1)	
9-way 4-6 RTD Input connector	
PIN NUMBER	**SIGNAL**
75	RTD 4: RETURN
76	RTD 4: HOT
77	RTD 4: COMPENSATION
78	RTD 5: RETURN
79	RTD 5: HOT
80	RTD 5: COMPENSATION
81	RTD 6: RETURN
82	RTD 6: HOT
83	RTD 6: COMPENSATION

6 RTD Input Card (Card 2)	
9-way 10-12 RTD Input connector	
PIN NUMBER	**SIGNAL**
93	RTD 10: RETURN
94	RTD 10: HOT
95	RTD 10: COMPENSATION
96	RTD 11: RETURN
97	RTD 11: HOT
98	RTD 11: COMPENSATION
99	RTD 12: RETURN
100	RTD 12: HOT
101	RTD 12: COMPENSATION

Termination Numbers.

AMV2



AMV2 with Trip Circuit Supervision and CT card
Note: RS485 can be changed to a profibus connector (not shown)

A: Smart Card
B: Digital Input Card
C: Trip Circuit Supervision Card (TCS)
D: Relay Card (with 4-20mA option)
E: Power Supply Card
F: Analogue Card (with RTD/Temperature Input option)
G: 1A/2A/5A CT Card.
See MV2 for specific use of terminals (Cards A, B, D, E, F & G)
See below for specific use of terminals (Cards C)

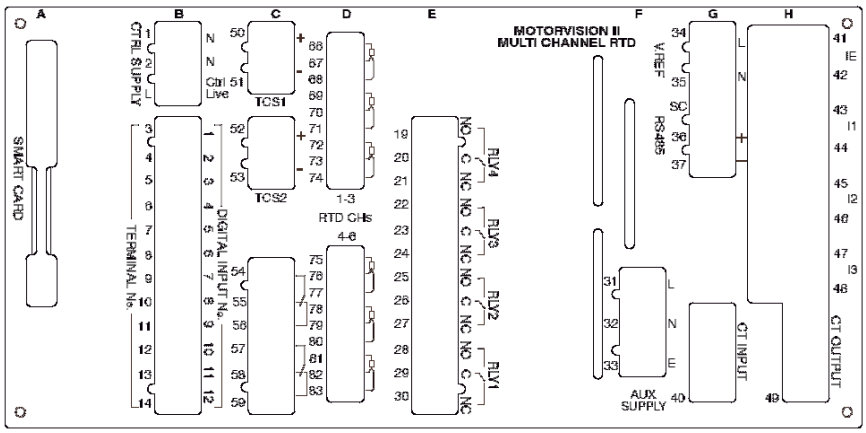
Trip Circuit Supervision Card	
2-way TCS Input 1 connector	
PIN NUMBER	**SIGNAL**
50	TCS 1 +ve
51	TCS 1 -ve

Trip Circuit Supervision Card	
2-way TCS Input 2 connector	
PIN NUMBER	**SIGNAL**
52	TCS 2 +ve
53	TCS 2 -ve

Trip Circuit Supervision Card	
12-Way TCS Output	
PIN NUMBER	**SIGNAL**
54	RELAY 1 C
55	RELAY 1 NC
56	RELAY 1 NO
57	RELAY 2 C
58	RELAY 2 NC
59	RELAY 2 NO

Termination Numbers.

AMV2 with 6 RTD

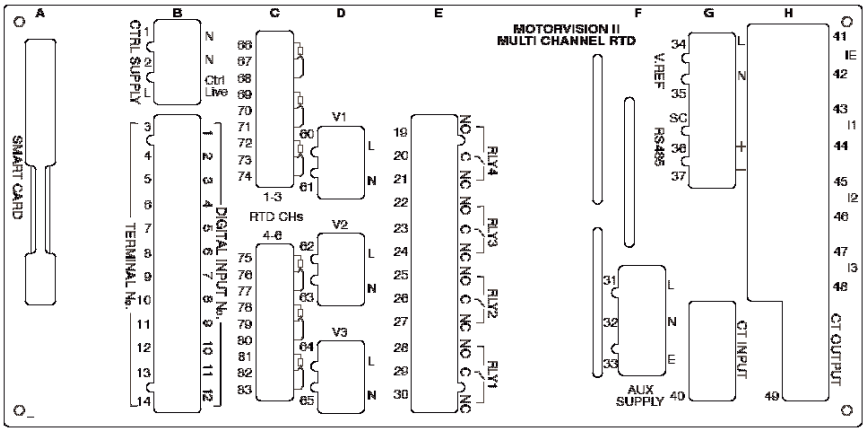


AMV2 with Trip Circuit Supervision, CT card and 6 RTD channels

A: Smart Card
B: Digital Input Card
C: Trip Circuit Supervision Card (TCS)
D: 6 channel RTD Card
E: Relay Card
F: Power Supply Card
G: Analogue Card (with RTD/Temperature Input option)
H: 1A/2A/5A CT Card.
See AMV2 for specific use of terminals (Cards A, B, C, E, F & G)
See RTDMV2 for specific use of terminals (Cards D)

Termination Numbers.

6 RTDMV2 with 3VT



6RTDMV2 with 3 Phase VT and CT card

A: Smart Card
B: Digital Input Card
C: 6 channel RTD Card
D: 3 Phase VT Card
E: Relay Card
F: Power Supply Card
G: Analogue Card (with RTD/Temperature Input option)
H: 1A/2A/5A CT Card.
See MV2 for specific use of terminals (Cards A, B, E, F & G)
See RTDMV2 for specific use of terminals (Cards C)
See below for specific use of terminals (Card D)

Note: The connection of the 3 VT inputs can be made in 1 of two ways;
1 3 wire Delta connection:
phase lives are connected with a false star point made by connecting the 3 neutrals together.
2 4 wire Star Connection:
as above but the neutrals are then connected back to the tx by the fourth wire.

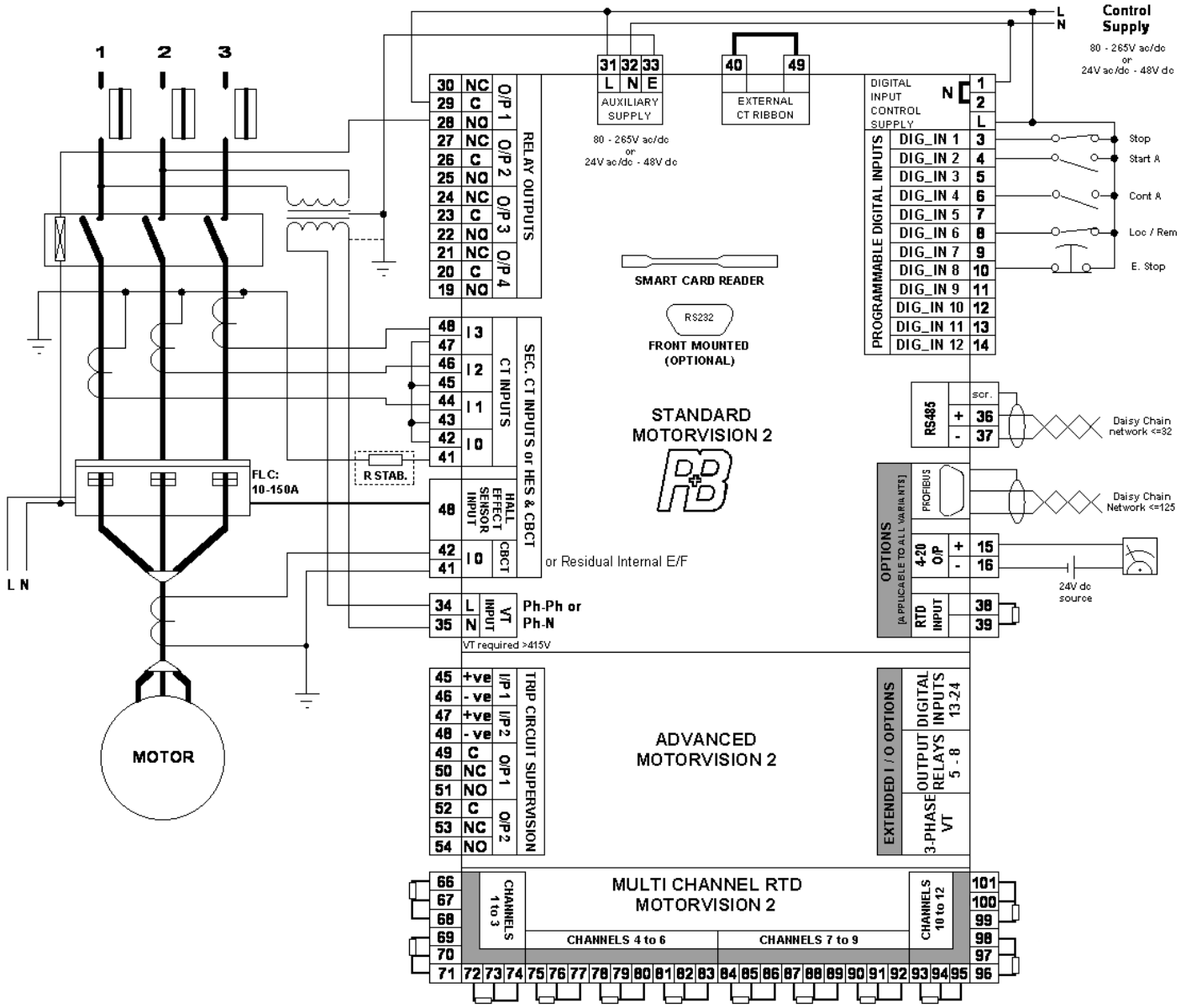
3 Phase VT Card	
2-way VT Input 1 connector	
PIN NUMBER	**SIGNAL**
60	Phase 1 Live
61	Neutral
3 Phase VT Card	
2-way VT Input 2 connector	
PIN NUMBER	**SIGNAL**
62	Phase 2 Live
63	Neutral
3 Phase VT Card	
2-way VT Input 3 connector	
PIN NUMBER	**SIGNAL**
64	Phase 3 Live
65	Neutral

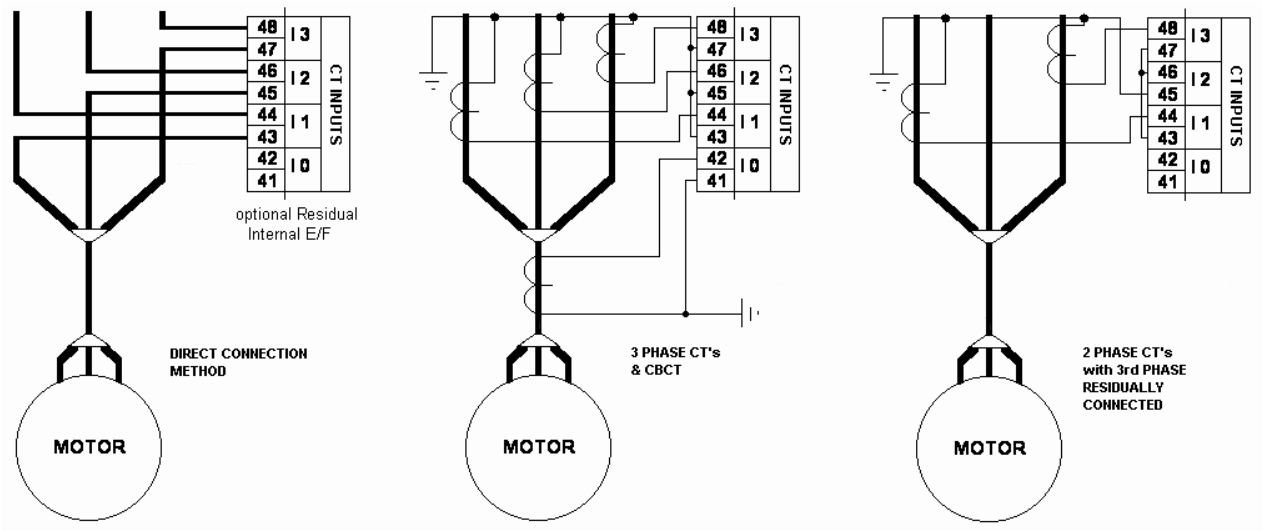
Appendix 3

MV2 Schematic Diagrams.

The following diagram's shows the connection diagram of the MV2 unit in conjunction with the following:

- MV2 with Core Balance and CT's.
- MV2 with Current Sensor (HES) and Core Balance CT.
- MV2 with CT's.
- MV2 with Direct connection.
- MV2 with 2 CT's connected.





Connection of MV2 to the current measuring circuits can be realised in a number of ways:
Conventional Ring-Type Current Transformers of 1A or 5A Secondary rating are common and can be connected directly to the CT inputs of MV2.
Two CT's can be used for phase current measurement with the third phase residually connected through the CT inputs.
Three CT's can be used connected direct to each phase input of MV2, the summation can be connected via the earth CT input to provide earth fault protection.

In the residual earth connection it may be a requirement to addition a stabilising resistor in the earth return leg, this is generally only required when EF protection is set at a low threshold and fast operating time.
The spill current (errors in the CT matching) during the initial energising can cause the drives to trip due to earth fault.

A Hall Effect Sensor can be used for phase current measurement the drive size should be specified on ordering. The HES can be calibrated between 10A to 150Amps. Earth Fault protection can be via a standard 1A CBCT input or the internal calculation.

The Direct connection method is only suitable for drives up to 5kW (3-ph 415V).

The 1A input can accept FLC's from 0.5A to 2Amps.

The 2A input can accept FLC's from 1A to 4Amps.

The 5A input can accept FLC's from 2.5A to 10Amps.

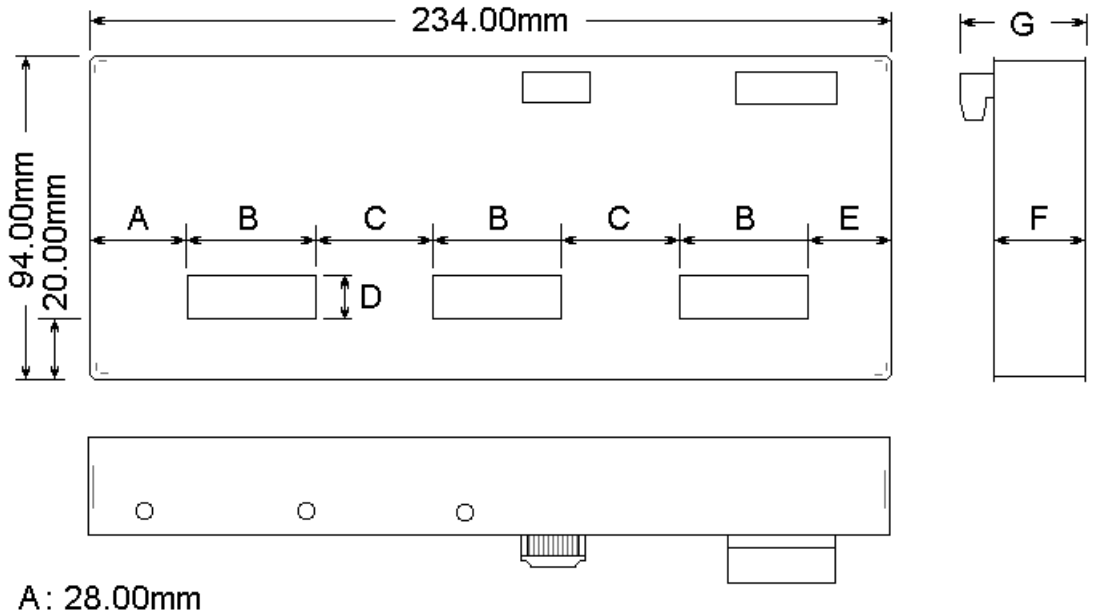
Earth Fault Protection can be via a low ration CBCT with 1A or 5A secondary rating or more practical for high density tier applications, the earth fault can be internally calculated.

In order to use this feature, it must be ordered as an addition to the standard features.

Appendix 4

Hall Effect Current Sensor Installation.

The following drawing details the dimensions and fixing details of the Hall Effect Current Sensor.



A : 28.00mm
B : 32.00mm
C : 38.00mm
D : 10.00mm
E : 34.00mm
F : 36.00mm
G : 48.00mm

Supplied with connectors and 1 metre ribbon cable for connection to MV2

35mm TH Din Rail mounting clamps available on request

Hall Effect Termination Numbers.

Connector 1-4 Way-Supply Voltage.		
Pin Number	**Function**	
	230V Operation	**115V Operation**
1	230V Neutral	115 Neutral
2	Link to Pin 3	Link to Pin 4
3	Link to Pin 2	Link to Pin 1
4	230V Live	115 Live

Appendix 5

Thermal Overload Trip Times.

The table below shows the trip times for Thermal Overload when t6x is set to 1 second.

Multiples Of FLC	Trip Time Cold Condition	Trip Time When H/C=80%	Trip Time When H/C=50%	Trip Time When H/C=20%
1.1	**77.46831**	**71.68687**	**60.40877**	**42.83732**
1.2	46.42665	41.64164	32.77806	20.47689
1.3	33.81144	29.78096	22.58663	13.29105
1.4	26.45371	23.00953	17.02946	9.668931
1.5	21.54703	18.56813	13.50496	7.487293
1.6	18.02511	15.42205	11.07147	6.034917
1.7	15.37403	13.07914	9.295212	5.003074
1.8	13.30997	11.27106	7.946272	4.235556
1.9	11.66149	9.837634	6.890768	3.644744
2	**10.31827**	**8.676889**	**6.04527**	**3.17768**
2.1	9.205826	7.720641	5.355032	2.800485
2.2	8.271929	6.921518	4.782637	2.490488
2.3	7.478859	6.245566	4.301648	2.231962
2.4	6.798677	5.667817	3.892871	2.013661
2.5	6.21025	5.169508	3.542038	1.827342
2.6	5.697305	4.736272	3.238339	1.666828
2.7	5.247117	4.356935	2.973434	1.527405
2.8	4.849597	4.022677	2.740797	1.405415
2.9	4.496648	3.726455	2.53525	1.297983
3	**4.181706**	**3.462575**	**2.352637**	**1.202813**
3.1	3.899395	3.226394	2.189587	1.118058
3.2	3.645273	3.014089	2.043337	1.042213
3.3	3.415644	2.822485	1.911608	0.974041
3.4	3.207406	2.648928	1.792498	0.912516
3.5	3.017942	2.491181	1.684415	0.856783
3.6	2.845028	2.34735	1.586014	0.806122
3.7	2.686764	2.215821	1.496151	0.759922
3.8	2.541521	2.095209	1.413849	0.717665
3.9	2.407889	1.984322	1.338271	0.678907
4	**2.28465**	**1.882129**	**1.268692**	**0.643264**
4.1	2.170741	1.787732	1.204484	0.610407
4.2	2.065233	1.700348	1.1451	0.580047
4.3	1.967312	1.619293	1.090064	0.551934
4.4	1.87626	1.543962	1.038954	0.525849
4.5	1.791444	1.473824	0.991403	0.501597
4.6	1.712303	1.408407	0.947082	0.479009
4.7	1.638336	1.347292	0.905703	0.457935
4.8	1.569099	1.290108	0.867008	0.438239
4.9	1.504193	1.236521	0.830768	0.419803
5	**1.443263**	**1.186234**	**0.796777**	**0.402521**
5.1	1.385988	1.138978	0.76485	0.386297
5.2	1.332079	1.094512	0.734823	0.371045
5.3	1.281275	1.052621	0.706547	0.356689
5.4	1.233342	1.013107	0.679886	0.343159
5.5	1.188065	0.975792	0.65472	0.330392
5.6	1.145251	0.940516	0.630936	0.318332
5.7	1.104724	0.907132	0.608436	0.306926
5.8	1.066322	0.875505	0.587128	0.296128
5.9	1.029899	0.845513	0.566928	0.285896
6	**0.99532**	**0.817046**	**0.54776**	**0.276188**

The curves become definite time for multiples of FLC greater than 6.
I.E.

7	**0.99532**	**0.817046**	**0.54776**	**0.276188**
8	**0.99532**	**0.817046**	**0.54776**	**0.276188**

Appendix 6

Fast Scan Values.

FSV	Parameter
0	Current Phase I1
2	Current Phase I2
4	Current Phase I3
6	Earth Current
8	V1
10	Power Factor
12	Power KW
14	Accumulated Power
16	Reserved
18	Reserved
20	Logic Status
22	Faults
24	Alarms
26	Time To Trip
28	Time To Start
30	Average RMS Current
32	Reserved
34	Motor Load
36	Alarm Fault Number
38.d0	Max Start Time Trip
38.d1	Too Many Starts Trip
38.d2	Control supply off
38.d3	U/C Trip
38.d4	Load Increased Trip
38.d5	Overcurrent/Stall Trip
38.d6	Short Circuit Trip
38.d7	Serial Inhibit
38.d8	Thermal Trip
38.d9	U/V Lockout Inhibit
38.d10	Unbalance Trip
38.d11	Undervoltage Trip
38.d12	Stop Open
38.d13	Overvoltage Trip
38.d14	Single Phasing Trip
38.d15	External Fault 3

FSV	Parameter
40.d0	External Fault 4
40.d1	External Fault 5
40.d2	External Fault 6
40.d3	Temp 1 Trip
40.d4	External Fault 7
40.d5	External Fault 8
40.d6	External Fault 9
40.d7	E/F Trip
40.d8	External Fault 10
40.d9	Internal Failure Trip
40.d10	Reserved
40.d11	Emergency Stop Trip
40.d12	Contactor Fault Trip
40.d13	External Fault 2 Trip
40.d14	External Fault 1 Trip
40.d15	Serial timeout
42	Resistance 1/Temperature
44	Reserved
46	Reserved
48.d7	Prog Digital Input 8
48.d6	Prog Digital Input 7
48.d5	Prog Digital Input 6
48.d4	Prog Digital Input 5
48.d3	Prog Digital Input 4
48.d2	Prog Digital Input 3
48.d1	Prog Digital Input 2
48.d0	Prog Digital Input 1
50.d7	Reserved
50.d6	Reserved
50.d5	Reserved
50.d4	Reserved
50.d3	Prog Digital Input 12
50.d2	Prog Digital Input 11
50.d1	Prog Digital Input 10
50.d0	Prog Digital Input 9

FSV	Parameter
52.d7	Reserved
52.d6	Reserved
52.d5	Reserved
52.d4	Reserved
52.d3	Output Relay 4
52.d2	Output Relay 3
52.d1	Output Relay 2
52.d0	Output Relay 1
54	Current scale factor
56	Reserved
58	Total Run Time
60	Total Operations A
62	Total Operations B
64	Thermal Capacity
66	Trip Fault Number
68	Logic Status
70	Pre Trip I1
72	Pre Trip I2
74	Pre Trip I3
76	Pre Trip I0
78	Pre Trip V
80	Pre Trip TC
82	Pre Trip Temp/Res
84	Last Start Period
86	Last Start Peak I
88 - 120	Reserved
122	Relay Family
124	Relay Type
126	Software Version

Appendix 7

Equipment Disposal.

P&B Engineering are committed to manufacturing practises which does not result in pollution or cause damage to the environment.

As the MV2 contains a non rechargeable battery we would recommend safe disposal of equipment at the end of its life inline with local laws.

Caution, battery may explode if mistreated. Do not recharge, disassemble or dispose of in fire.

If you wish us to dispose of equipment on your behalf we are able to provide such services, however there may well be charges to consider.

Appendix 8

Order Form / Code Structure

PBSI Ltd trading as
P&B ENGINEERING

MOTORVISION2 FAX BACK ORDER FORM

	PART NUMBER										
	QUANTITY	STANDARD UNIT			OPTIONS						
			MV2								
Device Type:											
Standard Motorvision			MV2								
Advanced Motorvision		A									
Multi RTD Motorvision		6 RTD									
or		12 RTD									
CT's:											
4x 1A				1A							
4x 2A				2A							
4x 1A				5A							
Connection to Hall Effect Sensor**				HES							
3x 1A and 1x 5A				1/5A							
3x 2A and 1x 1A				2/1A							
3x 2A and 1x 5A				2/5A							
3x 5A and 1x 1A				5/1A							
Options:											
Single Channel RTD and 4-20mA Control					RTD4-20						
Internal Residual Earth Fault						51N					
Profibus							PB				
Front RS232 port (standard if PB is selected)								232			
Low voltage PSU and Digital Inputs									LV		
Smart Card Software Activation Code*										SC	
Disturbance Recording Software Activation Code											DR

Note:
Hybrid CT's and options beyond the single RTD4-20 are deemed to be special build and are subject to longer delivery times and additional cost.

** Hall Effect Sensor (HES) should be ordered separately.
HES is for three phase measurement only, a single 1A input is provided for CBCT connection or 51N option should be used.

* Smart Cards should be ordered separately.

Standard Motorvision DIN Case 144x96x110mm
Advanced & Multi RTD DIN Case 192x96x110mm

before we can process an order we must be in reciept of an official purchase order along with your company details

Please feel free to contact us if you wish to discuss a specific application.

Due to our continuing efforts to bring you the very best in motor protection and control all information contained within this publication is subject to change without prior notice

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