KSM72G 'Enhanced' Key Start Module

Genset Controls - Timers/Monitors/Trips - Battery Charging - Spares & Accessories - Custom Products

- Ultra compact - 72mmsq DIN standard case … only 90mm deep
- 6 to 30Vdc single range supply … no drop-out on cranking
- Selectable – Alternator or MPU speed sensing
- Selectable - LOP and HET inputs for open or close to –Ve on fault
- Auxiliary Input and Common Alarm output
- Many Innovative features

Combining the convenience of manual operation with engine protection, these 'short' 72mmsq DIN standard Keystart Modules can be easily mounted into almost any control panel or switchbox for use with a wide range of engine driven equipment. Five 'High Intensity' Red LED's indicate system status: Auxiliary Shutdown, Low Oil Pressure, Cooling Fault, Overspeed and Charge Fail.

O (OFF) Turn the key to this position to stop the engine and reset all Shutdowns.
Always ensure that the engine is stationary before restarting.
The Key is only removable in this position.

I (RUN) Turn the key from **OFF** to **RUN** to power the unit and energise the fuel solenoid. Wait approx. 1 sec before cranking the engine. Note: if the key remains in the RUN position for 18sec's or more without cranking the engine, the Hold-Off timer will elapse and the module will shutdown on 'Low Oil Pressure'. To re-start the engine from a shutdown (alarm) condition, the key must first be turned to the 'OFF' position for at least 1 second (see above).

II (START) Hold the Key in this position to crank the engine. Release the Key to the 'Run' position as soon as the engine 'fires'. Alternatively, if the engine fails to start after approx. 10 sec's cranking, return the key to the 'OFF' position, wait approx. 10 sec's and try again. If the engine fails to start after three attempts, turn the key to the 'Off' position and consult the engine manufactures Handbook.

Assuming that the engine 'fires', the Keyswitch is returned to the RUN position, disengaging the Starter, the engine runs up to normal speed and the protection hold-off timer is running. The tachometer circuitry continually monitors for Overspeed and the Auxiliary channel is active. When the hold-off timer has elapsed (18 sec from releasing the key to the Run position), the Low Oil Pressure (LOP) and Cooling fault (HET) circuits are enabled. In the event of a shutdown, the appropriate fault Led is lit, the Fuel relay is locked out activating the 'Alarm' output and the LOP & HET channels disabled (first-up interlock).

Note: During engine cranking the protection **hold-off timer** is held at reset. Whenever the key is returned to the 'Run' position the hold-off timer is activated. Thus, with a multi-attempt start, when the Key is returned to the 'Run' position and the protection hold-off times out, it is assumed that the engine is running and the LOP and HET channels are enabled.

Note: This module incorporates a step-up switch-mode power supply to guarantee correct operation while experiencing **voltage 'dips' during cranking** - *without the need for internal batteries.*

Exciting the Charging Alternator: When the fuel solenoid is energised but the engine is stationary or cranking the WL terminal will be at a potential close to Battery negative (Charge Fail led lit). 'Excitation' current (from Fuel+ via a diode and an 82 ohm power resistor) is applied to the WL terminal. As the engine runs up to speed, the potential at the WL terminal should rise to a level close to Battery positive, reducing the excitation current to zero and extinguishing the Charge Failure LED. The excitation supply is switched off at the end of the hold-off time (typically 18 sec from crank-cut).

Charge Failure warning is provided by continuously monitoring the 'WL' terminal on the Charging Alternator while the fuel control relay is energised. If the engine is stationary (or cranking) or the Charging Alternator has failed, the potential at the WL terminal will fall towards zero and the Charge Failure LED will light.

Overspeed Protection is achieved by monitoring the frequency from either the AC voltage of the main Alternator or a Magnetic Pick-Up sensing flywheel teeth. The tachometer circuitry produces an analogue voltage proportional to engine speed. This voltage is fed to the Meter Output and the Overspeed trip comparator which is internally fixed at 2.50V. The system is calibrated by adjusting a single 'Speed CAL' potentiometer so that the meter (Mtr) output terminals will read 2.50V at the required overspeed trip setting (i.e. 1650rpm, 57Hz, 68Hz, etc).

Open-circuit protection (Magnetic Pick-Up ONLY) is enabled by switch-2 on the rear of the module (see page 3). Thus, if either terminals 14 or 15 are open-circuit the unit will shutdown on 'Overspeed' whether or not the engine is running.

Dedicated fault Channels are provided for Low Oil Pressure (LOP) and High Engine Temperature (HET). The Input phasing for each can be selected using Switches 3 & 4 on the rear of the module.

Auxiliary Channel " **!** " allows an extra shutdown input (i.e. Low Fuel) to be connected. Alternatively, one or more EXM72G 'Expansion Modules' can add up to four shutdown channels each (see below).

BUILD OPTIONS

KSM72G - H	an 'LCD' **Hours Counter** is fitted behind a windowed front label. It is powered in the 'Run' (or start) mode. An 'hour glass' indicator flashes every 6th second to indicate that counting is in progress (only while the fuel solenoid is energised). Data retention is in excess of 20 years.
KSM72G - - N	No internal Keyswitch. This is particularly useful where a keyswitch is already fitted or a 'Weather-Proof' keyswitch is required.
KSM72G - - - S	Front Label with 'Symbols'

COMPLIMENTARY MODULES

EXM72G	**Five Channel EXPANSION MODULE** with 'slide in' front label. Same physical size and similar terminal layout as the KSM72G with rear mounted Programming Switches and 'Hold-Off Time' potentiometer. Up to 4 channels can be used for shutdowns or up to 3 channel for indication only. Please request DA02EXM72G-1 for further information or visit our web site: www.capricorn-controls.com

ACCESSORIES

MPU070T	Single Coil Magnetic Pick-Up 70mm thread length x 5/8UNF
MPU070T-16	Single Coil Magnetic Pick-Up 70mm thread length x M16
MPU150T	Single Coil Magnetic Pick-Up 150mm thread length x 5/8UNF
MPU070AD	Dual Coil Magnetic Pick-Up 70mm thread length x 5/8UNF with 3M mating cable
RPM72	72mmsq RPM Meter (0 – 1ma movement, scaled 0 – 2000RPM or as requested). Integral calibration potentiometer. Connect to KSM72G terminals 12 & 13.

SEE LATEST PRICE LIST FOR OUR FULL RANGE OF ACCESSORIES

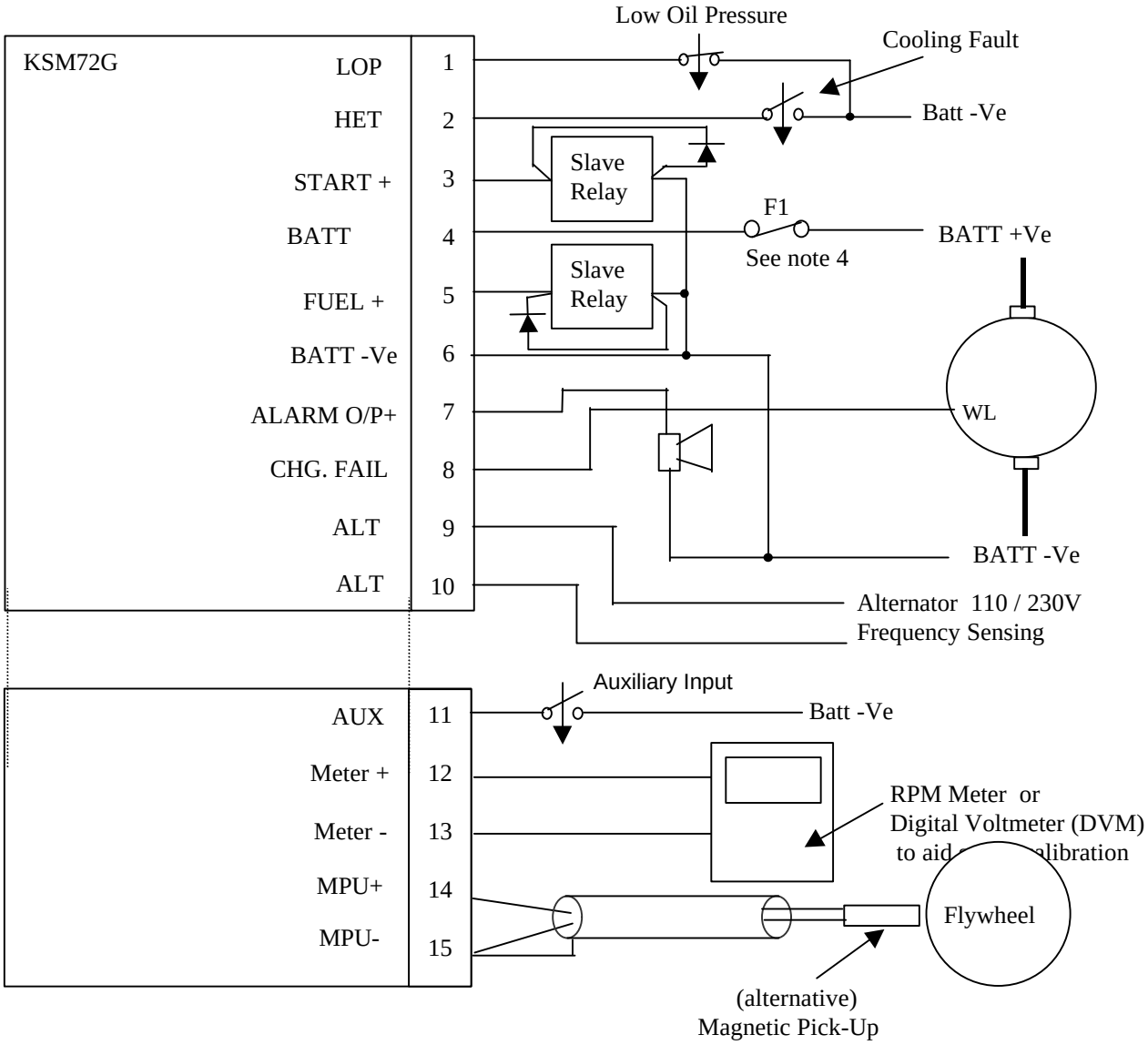
TERMINAL CONNECTIONS

Terminal	Description	Type	Connect To ------
1 LOP	Low Oil Pressure	-Ve Input	Low Oil Pressure switch
2 HET	High Engine Temperature	-Ve Input	High Engine Temp / Coolant Level Switch
3 START+	Max. Load 16 Amps (resistive) ♦	+Ve Output	Solenoid or Solenoid Relay
4 BATT +Ve	Supply +Ve		Battery positive
5 FUEL+	Max. Load 16 Amps (resistive) ♦	+Ve Output	Solenoid or Solenoid Relay
6 BATT -Ve	Common DC -Ve supply		Battery negative
7 ALARM O/P+	Max. Load 16 Amps (resistive) ♦	+Ve Output	External Sounder / Alarm circuit
8 CHG FAIL	Charge Failure (see text)	Input / Output	Charging Alternator (WL)
9 A.C.	Frequency Sense	AC	Main Alternator 30 – 280VAC
10 A.C.	Frequency Sense	AC	
11 AUX	Input	-Ve Input	Auxiliary sensor or Expansion Module
12 Mtr + Calibration)		Signal	+Ve Output Digital Voltmeter (for
13 Mtr -	Signal ground	- Ve Output	Digital Voltmeter (for Calibration)
14 MPU +	Signal	Signal Input	Magnetic Pick-Up
15 MPU -	Signal ground	Signal Input	Magnetic Pick-Up & Cable Screen

NOTE : ♦ 'Max. Load 16 Amps (resistive)' -- de-rate to 14% continuous current for Inductive Loads (Maximum of 16A inrush and 2.2A continuous for a Relay or Solenoid load)

Alarm O/P +Ve (from the N/C contact on the internal Fuel Control relay). Whenever the engine is shutdown on a fault condition the Fuel Control relay de-energises, stopping the engine and providing a +Ve ALARM output at term.7. This output is designed to drive a small sounder or a slave relay. When initially switching from OFF to RUN, the Alarm Output is active while the fuel control relay energises (approx. 20mSec).

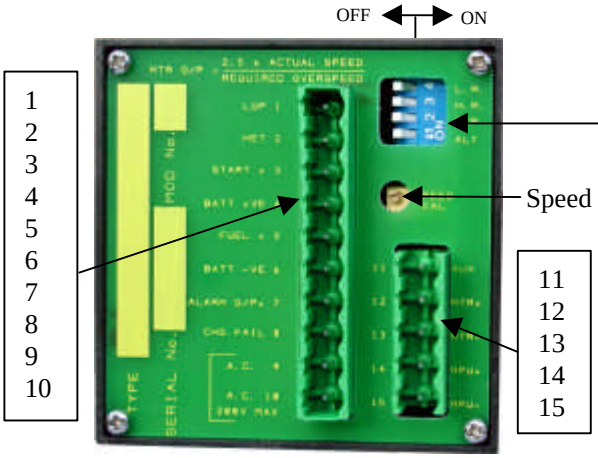
Typical Connections



NOTES

1. Oil Press. & Cooling Fault inputs are shown as ‘close to ground’ on fault.
2. Both Alternator and Magnetic Pick-Up speed sensing shown above. Only one to be connected in reality.
3. Fuse F1 = 5A Anti-surge if Slave Relay on Fuel Solenoid, else 10A Anti-surge.
4. FUEL+ output = 16A resistive, from N/O contact of the internal Fuel Control Relay
5. START+ output = 16A resistive, direct from Keyswitch contacts.
6. ALARM+ output = 16A resistive, from N/C contact of the internal Fuel Control Relay.
7. For Slave Relays see ‘Spares & Accessories’ section of our latest ‘Price List’.
8. All Slave Relays should have ‘flywheel’ suppression diodes fitted, to comply with EMC regulations ()

Programming Switches



Note: Connectors have been removed for clarity

SWITCHES			
4	LR	Off On	LOP Close to –Ve on fault LOP Open from –Ve on fault
3	HR	Off On	HET Close to –Ve on fault HET Open from –Ve on fault
2	OCP	Off On	Disable Enable (MPU only)
1	ALT	Off On	MPU sensing ALT sensing

LR = LOP Reversed
HR = HET Reversed
OCP = Open Circuit Protection
ALT = Alternator
MPU = Magnetic Pick-Up

SPEED CALIBRATION

Overspeed Protection is achieved by monitoring the frequency from either the AC voltage of the main Alternator or a Magnetic Pick-Up sensing flywheel teeth. The tachometer circuitry produces an analogue voltage proportional to engine speed. This voltage is fed to the Meter Output and the overspeed trip comparator which is internally referenced to 2.50V. Therefore, the system is calibrated by adjusting the multi-turn 'Speed CAL' potentiometer so that the meter (Mtr) output terminals will read 2.50V at the required overspeed trip setting (i.e. 1650rpm, 57Hz, 68Hz, etc).

In order to calibrate the KSM72G a method of measuring the actual engine speed will be required. Ideally this will be an accurate RPM indicator (separate to anything connected to the meter output of this module). However, a standard frequency meter connected to the main Alternator could be used.

On a running engine

Use an insulated 'pot adjuster' or miniature insulated screwdriver to carefully set the DIP Switches and adjust the 'Speed CAL' potentiometer.

- Turn the keyswitch to 'O' (Off) . Connect DC Voltmeter to terminals 12 (+) & 13 (-)
- Turn the 'Speed CAL' potentiometer approx. 10 turns anti-clockwise

- Check that Switch-1 & -2 (at rear of module) are set correctly (see page 3)
- Start the Engine and run at approx. normal speed, **note the actual speed**
- Calculate the required Voltmeter reading (Vm = 2.5 x Actual Speed / Required Overspeed).
- Example: Vm = 2.5 x (1580 rpm / 1650 rpm) = 2.4V
- Adjust 'CAL' potentiometer (clockwise) until Voltmeter reads the calculated Vm setting (i.e 2.4V)
- If possible, increase engine speed noting Vm reading until engine shuts down on overspeed.

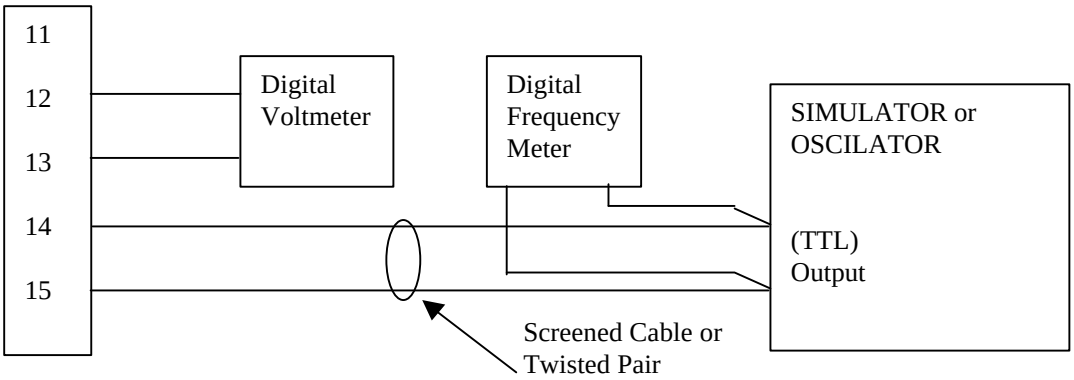
Bench Testing

Use an insulated 'pot adjuster' or miniature insulated screwdriver to carefully set the DIP Switches and adjust the 'Speed CAL' potentiometer.

- Turn the keyswitch to 'O' (Off) . Connect DC Voltmeter to terminals 12 (+) & 13 (-)
- Turn the 'Speed CAL' potentiometer approx. 10 turns anti-clockwise
- Connect a 12V Battery or suitable power supply to terminals 4 (+) and 6 (-)

(a) Magnetic Pick-Up (MPU) speed sensing

- Set Switch-1 & -2 'OFF' (at rear of module)
- Connect a suitable Oscillator & Frequency meter to terminals 14 & 15 (see below)
- Calculate MPU frequency f = (no. of teeth) x Normal Speed in RPM / 60
- (example: for 146 teeth at 1500 rpm f = 3650 Hz)
- Set the Oscilator frequency = %Overspeed x MPU frequency
- (example: 114%/100 x 3650Hz = 4161Hz)
- Required voltmeter reading Vm = 2.5
- Turn the Keyswitch to the 'I' (RUN) position
- Slowly, adjust 'CAL' potentiometer clockwise until the module 'just' trips on Overspeed.
- Before use, set Switch – 2 'ON', to enable the MPU open-circuit protection.



If possible, use a Magnetic Pick-Up 'Simulator' (available from Capricorn Controls) or a general-purpose oscillator with a (5V) 'TTL Output'. This will ensure that the DC Offset level does not change with frequency or amplitude levels. If the DC Offset exceeds +1.2V the KSM72G will not recognise the frequency.

(b) Alternator Frequency Sensing

- Set Switch-1 'ON' and Switch-2 'OFF' (at rear of module).
- **Make no connection to terminals 14 & 15.**
- Connect (50Hz or 60Hz) AC mains supply & Frequency meter to terminals 9 & 10
- Calculate the required Voltmeter reading (Vm = 2.5 x Actual Freq' / Required Overspeed Freq').
- (Example: for 114% Overspeed on a 50Hz generator when the actual frequency is 51Hz, the calculation is as follows: Vm = 2.5 x (51Hz / 57Hz) = 2.24V)
- Turn the Keyswitch to the 'I' (RUN) position
- Adjust 'CAL' potentiometer (clockwise) until Voltmeter reads the calculated Vm setting (i.e. 2.24V)
- Before use – check that Switch-1 is 'ON' and Switch-2 is 'OFF'

FAULT FINDING ----- KSM72G BASED SYSTEMS

Always check the 'obvious' first i.e. :

- System correctly wired
- KSM72G suitably calibrated
- DIP switches correctly selected
- All connections use suitably rated cables to comply with all appropriate regulations.
- All terminal screw connections tight.
- Battery(s) charged, in good condition, clean & tight connections and of the correct voltage
- The Module MUST be fitted in a control panel with adequate protection from adverse Temperature, Moisture & Vibration

WARNING - Incorrect wiring might permanently damage the module i.e. -

1/ Loss of battery negative (term.6).
2/ Connecting any positive DC outputs (i.e. Starter, Fuel, Alarm+, etc.) directly to a negative supply.
3/ Connecting any DC terminals to an AC supply.

- **Unit Dead – DC On led not lit, set will not start**
  Check for battery supply on term.4(B+) and term.6(B-) of the KSM72GM using a DC voltmeter
- **False tripping of Overspeed**
  (a) Module requires calibration or MPU connected and 'ALT' range selected
  (b) Open-circuit MPU input or ALT selected with Open Circuit Protection 'Enabled'
  (c) Engine speed 'overshoots' on run-up.
  (d) Speed sensor cabling must be screened pair, correctly terminated and routed away from power switching cables
- **Low oil pressure shutdown**
  (b) Faulty oil pressure switch, incorrect type or trip setting
  (c) Check user selectable 'Input phasing' (Dipswitch-4 = 'ON' for open from –Ve on fault)
- **Cooling Fault (High engine temp.) shutdown**
  (b) Faulty temperature switch, incorrect type or trip setting
  (c) Check user selectable 'Input phasing' (Dipswitch-3 = 'ON' for open from –Ve on fault)
- **Charging Alternator fails to excite**
  (a) Charge Fail (term.8) not connected to the WL. connection on the charging alternator.
  (b) Charging Alternator fault.

MOUNTING

The module must be fitted into a suitable control panel that provides adequate protection from the extremes of : Temperature, Humidity & Vibration. If this control panel is set-mounted then suitable 'Anti-Vibration' mounts **MUST** be used

SPECIAL BUILDS

KSM72GM - / X0? These 'X' numbers, indicate non-standard product, which have been manufactured to suit specific customer's requirements. They do not appear in any catalogues and may only be available to the original customer. When re-ordering, please quote the full part number together with the 'Serial Number' of the original unit(s).

CUSTOMISED PRODUCTS

If you have a specific requirement that is not listed above; please contact our Sales Desk for a quotation. We can normally customise a standard product within a matter of days in order to provide a prototype (if not, production) unit.

SPECIFICATION

Supply 12 / 24V Single range supply, operating from 6V to 30VDC
Drop out : < 4 V Absolute maximum input = 40V
Burden = 70mA at 12V

Overspeed Sensing
Alternator Frequency Sensing = 40 – 100Hz : 30 – 280Vrms (absolute max)
Magnetic Pick-Up Speed sensing = 1KHz – 7KHz : 2 – 85Vp-p with transient protection
Hold-Off Timer: Fixed 18 sec, held reset while key in position 'II' (cranking)

Meter Output
Single 'Speed CAL' potentiometer sets Voltage proportional to Frequency (engine speed)
Overspeed 'Trip' internally set to 2.50V

Fault Inputs

Low Oil Pressure	Close / open from Batt.-Ve on fault (user selectable)
Cooling Fault	Close / open from Batt.-Ve on fault (user selectable)
Auxiliary	Close to Batt – Ve on fault

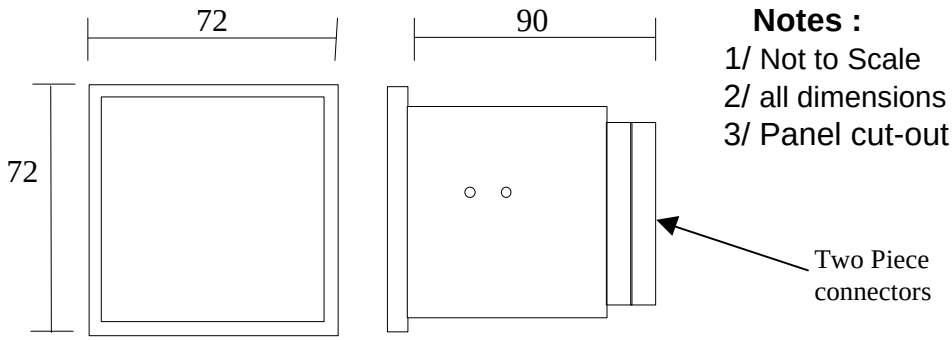
Outputs

FUEL output	16A resistive. (De-rate to 14% (2.2A) continuous for Inductive Load)
START output	16A resistive. (De-rate to 14% (2.2A continuous) for Inductive Load)
ALARM output	16A resistive. (De-rate to 14% (2.2A continuous) for Inductive Load)

General Ambient temperature -10^{0}C to +55^{0}C Operating,
-25^{0}C to +70^{0}C Storage

Construction
Through panel fitting**,** 72mm sq. DIN standard case. Reversed screen-printed "LEXAN" (or similar) front panel. Printed Circuit Boards varnished as standard.

Dimensions



Notes :
1/ Not to Scale
2/ all dimensions in mm
3/ Panel cut-out 68 x 68 mm

For a spare or replacement, please quote the 'Serial Number' of the original unit.

CAPRICORN CONTROLS LIMITED
Electronic Engineers. Est 1988
Specialist Controls for Engine Applications
Thorpe Close, Banbury, OX16 4SW. England
E-mail: sales@capricorn-controls.com Web: www.capricorn-controls.com

Keystart, Remote Start, Start-on-Demand, Mains Failure, Mutual Standby & Multi-set Controllers. Annunciators and Lamp Modules. Voltage, Current, Frequency, Speed, and Temperature Monitors. Timers. Transport Refrigeration Spares. Batteries, Battery Chargers and Power Supplies. Spares and Accessories. Customised Products and Bespoke Designs.