AS3-02075N
Revised 06-03
Section 75
00-02-0515

AS3000 Engine/Generator Controller Installation and Operation Manual

Please read the following information before installing. A visual inspection of this product for damage during shipping is recommended before mounting. It is your responsibility to have a qualified person install this unit and make sure it conforms to NEC and local codes.

GENERAL INFORMATION

WARNING

BEFORE BEGINNING INSTALLATION OF THIS MURPHY PRODUCT

- ✔ Disconnect all electrical power to the machine.
- ✔ Make sure the machine cannot operate during installation.
- ✔ Follow all safety warnings of the machine manufacturer.
- ✔ Read and follow all installation instructions.

Description

The AS3000 provides control circuitry for the automatic or manual starting and stopping of a diesel generator, pump or other engine driven equipment. A basic AS3000 system comprises two modules:-

User Interface Module – mounted in the front of a control panel. The module consists of 3 operator control keys, LEDs for status and fault indication, and electrical connectors for front-of-panel equipment.

Panel Interface Module – designed for DIN rail mounting inside the panel. This module contains the main control circuitry and terminals for connection to the engine wiring harness.

The two modules are connected by a single communications lead. The two-part design may be used to reduce wiring between engine cabling and front-of-panel user controls.

WARNING: Do not bundle AC and DC wiring together. They must be separated by 2 inches, ideally, and require separate conduit runs.

Specifications

Power supply:

Continuous voltage range: *8 – 35 VDC*
Brown out voltage: *5 VDC for 2 secs (recovery to 8V).*
Blackout voltage: *0V for 50mS (from 10V, recovery to 5V)*
Overvoltage withstand: *50 VDC for 5 seconds (to SAEJ1810 load dump immunity)*
Reverse voltage withstand: *100 VDC continuous*
Current consumption (standby): *50mA*
Current consumption (max): *500mA (plus output loads)*

DC Inputs

Oil pressure, coolant temp, auxiliary and charger faults: *closed to negative DC (±3V) on fault.*
Remote start positive: *open from positive DC to start.*
Remote start negative: *close to negative DC (±3V) to start.*
Lamp test: *close to negative DC (±3V) to activate.*
DC input protection: *±50 VDC max.*

AC Inputs

Magnetic pickup: *3 – 60 VAC, 200 Hz – 10 kHz.*
Generator AC: *80 - 600 VAC (L-L or L-N), 50/60 Hz.*

Outputs

Fuel: *positive DC (transistor), 5A max.*
Crank, preheat: *positive DC (transistor), 2A max.*
Common alarm, fault lockout: *negative DC (transistor), 300mA max.*
Generator Hz. Meter: *0 - 1mA (= 45 - 65 Hz) into 50 Ohm moving coil meter.*

Physical

Dimensions: *see "System Overview" on page 2.*
Operating temperature: *14 to 149°F (-10 to +65°C).*
Relative humidity: *95% @ 140°F (60 °C).*
Environmental protection: *AS3000 front: IP65, NEMA4. Back of User Interface and Panel interface require weather-proof enclosures for outdoor use.*
Vibration: *ISO 88528 pt.9, & 3 axis 3g.*
Weight: *AS3000 User Interface: approx. 9 oz. (250g). AS300 Panel Interface: approx. 6 oz. (160g).*
Shipping Weight: *1 lb. 4 oz. (554 g.).*
Shipping Dimensions: *7-3/8 x 5 x 3-1/8 inch. (187 x 127 x 79 mm.).*

Anti-static Precautions

The AS3000 features sensitive electronic components that may be damaged by static discharge. It is recommend that anti-static precautions are observed when storing, unpacking and handling the AS3000:

- Store AS3000 modules in the packing provided.
- Use grounded wrist straps and anti-static mats when handling and during installation.
- Handle each module at the edges, using the plastic mouldings. Where possible, avoid physical contact with exposed circuit boards and electrical connectors.

Unpacking

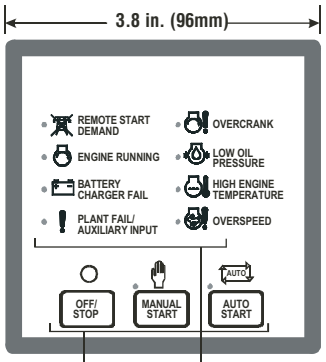
Each AS3000 system includes the following components:

- Panel Interface module (41.05.0002), with 9 circuit board links for setting operating options.
- User Interface (front of panel) module (41.05.0001/black; 41.05.0003/white), complete with fixing clamp and nuts. There are two standard variations:

SYSTEM OVERVIEW

AS3000 front view

International symbol and US English text legends shown

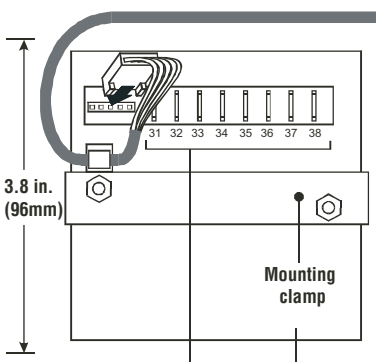


Operator control keys:

- OFF-STOP (reset)
- MANUAL mode (+ amber LED)
- AUTO mode (+ green LED)

Status/fault LED indicators x8
- Remote start/Mains fail
- Engine running
- Charge fault
- Auxiliary / plant fault
- Start fail/overcrank fault
- Low oil pressure fault
- High engine temp fault
- Overspeed fault

AS3000 back view

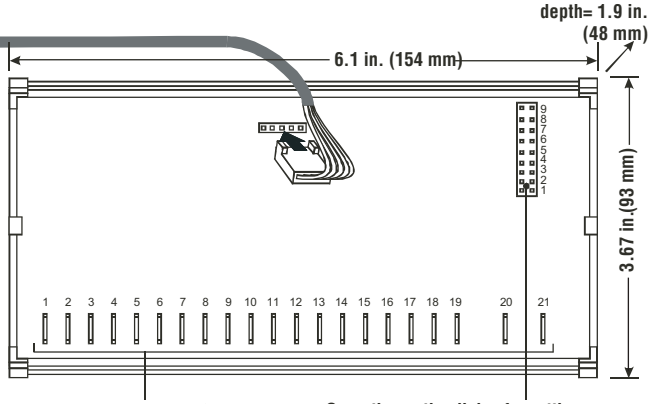


Terminals 31 - 39 (1/4" blades)

depth= 1.1 in. (28 mm)

Communication lead

AS3000 Panel Interface



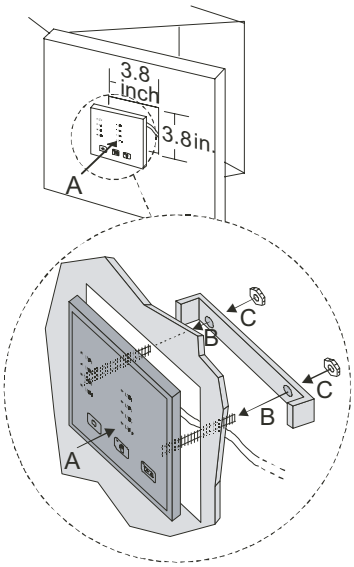
Terminals 1 - 21 (1/4" blades)

Operating option links, for setting:
- crank/rest time (5, 10 or 15 seconds)
- preheat time (0, 5, 10 or 15 seconds)
- crank disconnect speed (40% or 10%)
- engine cool time (0 or 5 minutes)
- number of crank attempts (1, 3 or 6)
- loss of speed (warning or shutdown)

WARNING: Do not bundle AC and DC wiring together. They must be separated by 2 inches, ideally, and require separate conduit runs.

MOUNTING

AS3000 User Interface module

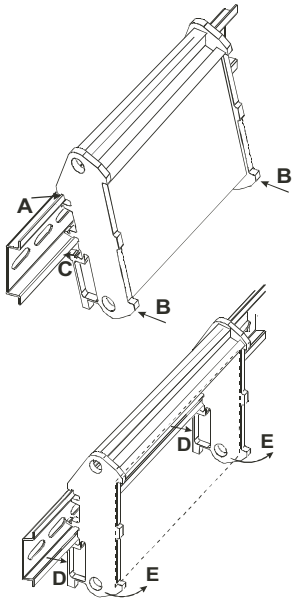


The AS3000 is mounted in the front of a control panel through a 92mm square (DIN standard) cut-out:

- Remove the two fixing nuts and clamp at the module rear.
- From the panel front, insert the unit into the cut-out (A).
- Refit the mounting clamp (B) and nuts (C). Before fully tightening the nuts, ensure that the unit and its integral sealing gasket are squarely located in the cut-out.

The module extends 1.1 in. (28 mm) behind the panel front, but a minimum of 2 inch (51mm) should typically be allowed where (optional) panel wiring is used.

AS3000 Panel Interface module



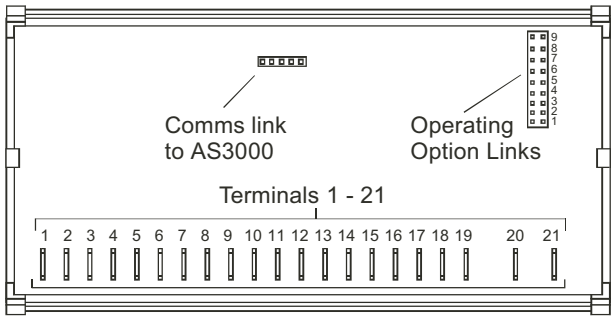
The plastic mouldings on either side of the AS3000 are designed to allow snap- mounting to a control panel DIN rail (e.g. Murphy part number: 40 -05 - 0474 (7 inch [178 mm] DIN rail).

- Locate each moulding on to the top edge of the DIN rail (A).
- Push the edges of the module (B) so that the lower part of the moulding snaps on to the lower edge of the DIN rail (C).
- To release the module, apply pressure (e.g. with fingers or a levered screwdriver) to the flexible section of both mouldings (D), pull the module outwards (E) and off the rail.

FUNCTION SETTINGS

PCB Links

The AS3000 has a number of operating options, set by 9 links on the AS3000 circuit board.



The PCB links must be set correctly before the AS3000 is connected or used.

WARNING: Incorrect settings may cause malfunction or damage to engine and plant.

WARNING: We recommend that anti-static precautions (as detailed above) are observed during the fitting or removal of PCB links.

Add or remove links as shown in the table opposite. Note that standard units are supplied with all links fitted.

Function	Links		Option	Factory Default
✓ = link fitted ✕ = link removed ✕✓ = link may be fitted or removed				
Crank/rest time	1	2		
	✓	✓	10 secs	●
	✕	✓	15 secs	
	✕✓	✕	5 secs	
Preheat time	3	4		
	✓	✓	0 secs (no preheat)	●
	✕	✓	5 secs	
	✓	✕	10 secs	
	✕	✕	15 secs	
Crank disconnect speed	5			
	✓		40% of nominal	●
	✕		10% of nominal	
Engine cool time	6			
	✓		0 minutes	●
	✕		5 minutes	
Number of crank attempts	7	8		
	✓	✓	3 attempts	●
	✕	✓	6 attempts	
	✕✓	✕	1 attempt	
Loss of speed signal response	9			
	✓		shutdown	●
	✕		warning (alarm) only	

ELECTRICAL CONNECTION

DANGER ! HIGH VOLTS

WARNING: DANGER OF INJURY OR DEATH. For certain operating configurations, the AS3000 includes connection of high voltage AC supplies. Before connection, disconnect or handling of the AS3000, ensure that all AC and DC power supplies are turned off and locked out. Connection to or disconnection from live wiring can also cause damage to AS3000 internal components. Do not bundle AC and DC wiring together. They must be separated by 2 inches, ideally, and require separate conduit runs.

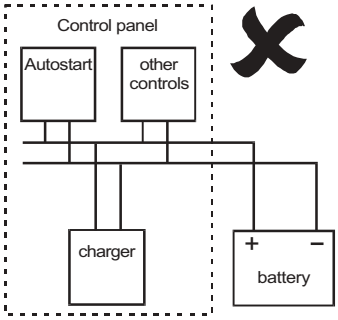
General

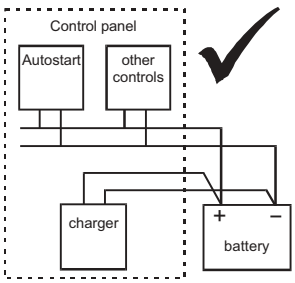
Electrical connection on both AS3000 modules is via 1/4 inch (6.3mm) blade terminals. Murphy makes the following general connection recommendations:

Battery Chargers

Some battery chargers feature significant ripple and switching noise on the DC output. This electrical interference can be imposed on the panel power supply and control lines, with the potential to cause faulty operation of (and in extreme cases damage to) electronic control equipment.

Minimize the effects of charger output noise by using separate wiring 1) between charger output and battery terminals and 2) between battery terminals and panel DC supply rail.



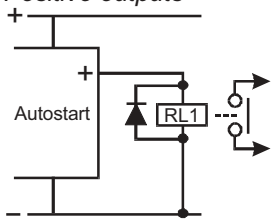


External Slave Relays are a recommended connection on all outputs (as shown right), either to achieve the required load switching capability, or to reduce wear and tear on internal relay contacts.

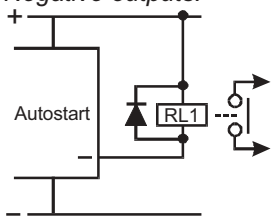
Slave Relays and Solenoid Coils

will naturally emit voltage spikes when de-energising, with the potential to cause mis-operation of, or damage to, electronic equipment. Suppress relay and solenoid coils at source, using the manufacturer's recommended suppression network. DC coiled relays may also be suppressed using a reversed biased flywheel diode as shown right.

Positive outputs



Negative outputs:-



A typical, full wiring diagram for the AS3000 is shown on page 4.

Electrical Connection, AS3000 Panel Interface

WARNING: Do not bundle AC and DC wiring together. They must be separated by 2 inches, ideally, and require separate conduit runs.

Connection is via 6.3mm (1/4") blade terminals on the main circuit board, numbered 1 – 21:

1 Negative DC power supply

2 Positive DC power supply

The power supply for the AS3000. Steady state operating voltage range is 8 – 35 VDC. See specification for high and low voltage withstand thresholds.

3 Preheat Output

4 Crank Output

5 Fuel Output

Connect these (transistor) outputs to engine preheat, starter motor and fuel circuits. Each terminal gives a positive DC output when active.

The fuel output is designed for use with energized to run fuel solenoids, and is rated to 5 Amps. The crank and preheat outputs are each rated to 2 Amps.

Slave relays with suppressed coils (diodes across them), should be wired between each output and battery negative, with the slave relay contacts used to drive fuel/starter solenoids and preheat circuits.

6 Charge Alternator D+ or WL

Pin 6 may be connected to the D+ or WL (warning lamp) terminal of an engine driven charge alternator. The AS3000 provides the necessary current required to excite the alternator, and measures the D+/WL terminal voltage.

Once the engine is running and the fault lockout time has expired, the front facia charge fail LED will light if the D+/WL voltage falls below approx. 9.5 volts.

7 Fault Lockout Output

8 Common Alarm Output

Both these outputs are transistor based, providing a negative DC output when active. The outputs are able to sink up to 300mA max., and are typically used to drive a panel relay (see page 3). The fault lockout output activates after the fault lockout time has expired (15 seconds after an engine start). The common alarm output activates during fault conditions.

9 Remote Start Input (negative)

With the AS3000 in Auto mode, close this input to battery negative to initiate an automatic engine start. Make the input open circuit to return the system to standby mode. See also pin 16 (remote start input positive).

10 Low Oil Pressure (LOP) Input

11 Charge Fail Input

12 High Engine Temperature (HET) Input

13 Auxiliary Fault/Plant Fail Input

14 Overspeed Input

These inputs are used with remote fault switches/contacts to trigger fault conditions. To trigger a fault, each input must be closed to battery negative DC.

While the engine is running, an active Low Oil Pressure, High Engine Temperature or Auxiliary Fault input will cause an immediate engine shutdown. Oil pressure and engine temperature inputs do not operate while the engine is stationary, during engine starting or until the fault lockout timer has expired (15 seconds after engine starting). The Auxiliary fault input may be activated at any time, but acts as 'indication only' while the engine is stationary or cranking.

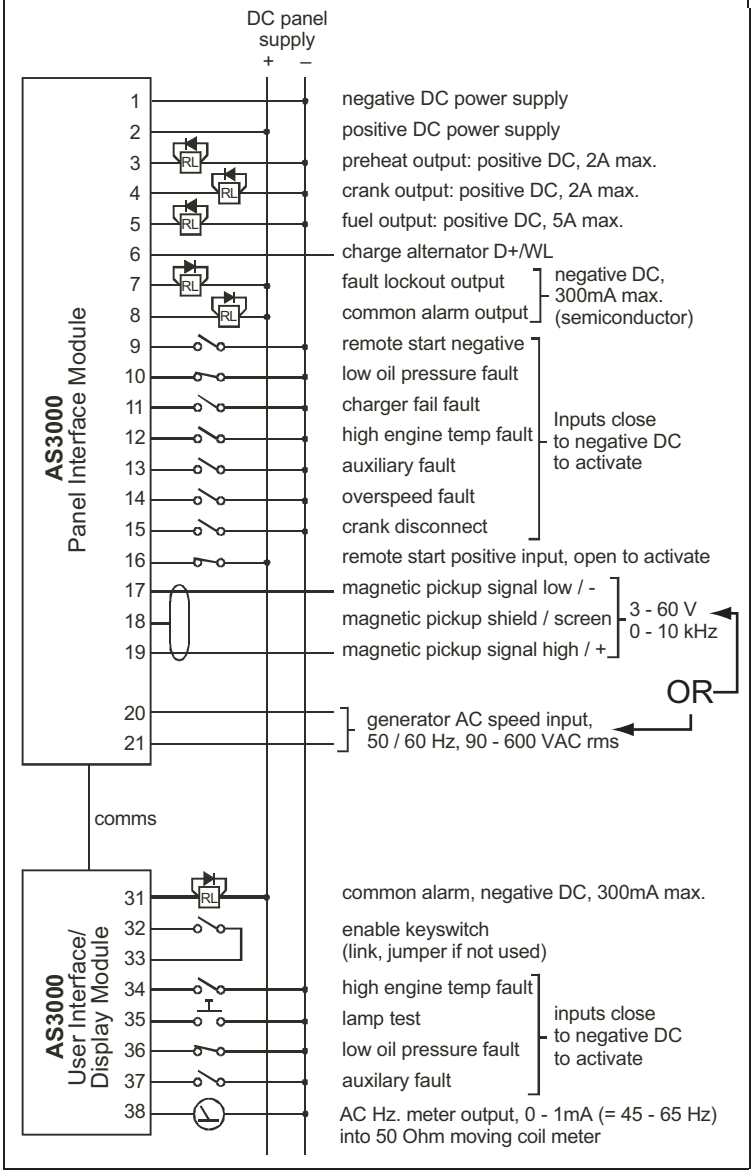
The Overspeed input allows an immediate shutdown to be externally triggered at any point after engine starting. This input is provided in addition to the on-board overspeed measurement and tripping.

The Charger Fail input may be activated at any time, causing the charge fail LED to light. The AS3000 does not shut down the engine or inhibit an engine start.

All the fault conditions above will cause the operation of the common alarm outputs (pins 8 and 31).

Note that some of the above inputs are duplicated on the user interface module, allowing optional, more convenient wiring to front facia mounting equipment (e.g. Murphy SWICHGAGE®). See AS3000 connection (page 5) for full details.

Typical Wiring Diagram



15 Crank Disconnect Input

The AS3000 may be configured to measure engine speed using a magnetic pickup or AC Hz. signal, and to disconnect cranking once the engine is running.

Alternatively, pin 15 may be used to trigger a crank release from an external contact (e.g. a remote speed trip). To disconnect the starter, connect pin 15 to battery negative.

16 Remote Start Input (positive)

With the AS3000 in Auto mode, make this input open circuit to initiate an automatic engine start. To return the system to standby mode, close this input to battery positive DC.

See also pin 9 (remote start input negative).

17 Magnetic Pickup Speed input (negative)
18 Magnetic Pickup Speed Input (screen/shield)
19 Magnetic Pickup Speed Input (positive)

The signal from an engine mounted magnetic pickup may be used to sense engine speed. The pickup negative and positive output terminals should be respectively connected to pins 17 and 19. (Note: the polarity of connection is not usually important if the pickup head is isolated from the pickup body and ground.) The connection between pickup and AS3000 should use a two-core and screen cable. The cable screen should be connected at the AS3000 end only, to pin 18.

If pins 17 – 19 are connected, pins 20 and 21 (generator AC speed sensing) must be left open circuit.

Note that the speed sensing circuit must be calibrated before the AS3000 can be used - see ‘speed calibration’ on page 6.

20 AC Speed Input
21 AC Speed Input

WARNING: HIGH VOLTAGE – DANGER OF INJURY OR DEATH.

- **Ensure that all AC power supplies are turned off before connection, disconnection or handling.**
- **Use fully insulated wiring connectors on these terminals.**

Do not bundle AC and DC wiring together. They must be separated by 2 inches, ideally, and require separate conduit runs.

These terminals allow measurement of engine speed using a generator AC signal (nominal 50 or 60 Hz).

The input may be connected to generator line to neutral or line to line voltage, maximum 600 VAC.

If pins 20 and 21 are connected, pins 17, 18 and 19 (magnetic pickup speed sensing) must be left open circuit.

Before the AS3000 can be used, this circuit must be correctly calibrated - see ‘Speed Calibration’ on page 6.

Electrical Connection, AS3000 User Interface

WARNING: Do not bundle AC and DC wiring together. They must be separated by 2 inches, ideally, and require separate conduit runs.

Connection to the User Interface module is via 8 blade terminals (1/4 “ / 6.3 mm). Some of the terminals duplicate features found on the AS3000 Panel Interface unit, allowing optional, more convenient connection to local, front-of-panel equipment.

31 Common Alarm Output

Connection and operation is identical to AS3000 pin 8.

32 Keyswitch
33 Keyswitch

Use these terminals to restrict AS3000 operation via a Keyswitch or other remote contact. The system will only operate while these pins are connected.

If this feature is not used, connect pins 32 and 33 using the wire link (jumper) supplied.

34 High Engine Temperature Fault Input
36 Low Oil Pressure Fault Input
37 Auxiliary Fault/Plant Fail Input

Operation is identical to AS3000 Panel Interface unit inputs 12, 10 and 13. The fault inputs may be used instead of, or in addition to, the Panel Interface inputs, e.g. where front of panel Murphy SWICH-GAGE® units are used for pressure and temperature monitoring.

35 Lamp Test

Close this input to battery negative to light all the front facia LEDs. This input is typically used with a front of panel, momentary action push button.

38 Analog Speed Output, 0 - 1mA

When engine speed is measured from the generator AC (via pins 20 and 21), pin 38 may be used to drive a suitably scaled ‘generator Hz.’ meter.

The meter must have a 0 – 1mA DC movement, with scale 45 – 65 Hz. For greatest accuracy, use a meter with a 50 Ohm nominal coil impedance.

Connect the meter between pin 38 and battery negative.

Communication Link

Communication between AS3000 User Interface and AS3000 Panel Interface modules is via a short 1.3 meter lead.

Electrical connection is via 5 male pin headers (on each module) and female connector blocks (at each end of the lead).

The AS3000 User Interface is normally supplied with the communication lead pre-connected. If the lead needs to be disconnected, ensure that the lead connector block is correctly orientated during reconnection: the correct orientation is shown on page 2, and on the product label.

Note: incorrect connection will not damage the AS3000, but will result in non-operation.

At the AS3000 Panel Interface end, both lead connector block and male pins are polarised, ensuring correct connection. The correct orientation is again shown on page 2 and on the product labelling.

Communication Link

Before use, the AS3000 must be set up (calibrated) to correctly perform two functions related to engine speed:

a) automatic release of the engine starter motor.

b) automatic shutdown on engine overspeed.

WARNING: Incorrect speed calibration may cause faulty operation of the above functions, wih potential damage to engine and plant.

The AS3000 can measure engine speed through one of two circuits: pins 17, 18 and 19 allow measurement using an (engine mounted) magnetic pickup speed transducer; pins 20 and 21 (on generator applications) allow measurement of the generator AC frequency. Alternatively, the AS3000 can be set so that crank release and/or overspeed trip are initiated by remote contacts (via pins 15 and 14 respectively).

Calibration/setup is typically carried out after connection into the control panel, during engine commissioning. Alternatively, e.g. when an engine is not available, calibration may be performed 'on the bench', by simulating the speed signal (either magnetic pickup or generator AC).

Entering Calibration Mode

- Connect the AS3000 as for normal operation.
  At minimum, this must include:-
  - The DC power supply
  - The enable Keyswitch/link (pins 32 and 33)
  - The magnetic pickup or generator AC circuit (assuming these are to be used)
- Press then release the MANUAL/ key.

If the speed calibration has not been previously set, the AS3000 automatically enters calibration mode, indicated by a flashing amber manual LED - continue setting up from the 'crank disconnected set-up' heading below.

If the speed calibration has already been set, the manual LED lights continuously (normal manual mode operation).

To recalibrate the unit, e.g. for another type of engine, enter calibration mode as follows:

- Press and hold the OFF-STOP/ key
- Press and hold the MANUAL/ key
- Release the OFF-STOP/ key, but continue to hold the MANUAL/ key for around 15 seconds until the green (auto) LED lights.
- Release the MANUAL/ key: the green (auto) LED should go out, leaving the flashing amber manual LED.

Crank Disconnect Set Set-up

When calibration mode is selected (amber Manual LED flashing), automatic crank disconnection is inhibited.

Start the engine as follows:

- Press and hold the MANUAL/ key. If a preheat option has been set, the preheat output will operate for the selected time before engine cranking. Maintain the MANUAL/ key through the preheat time and after the engine cranks.
- Release the MANUAL/ key when the engine fires.
- Allow the engine to run up to normal speed, adjusting the governor control if necessary. If a magnetic pickup or generator AC speed sensing is used, check that the AS3000 ENGINE RUNNING/ LED is flashing.
- Press and release the MANUAL/ key. This sets the crank release speed to 10% or 40% of the running speed (depending on the setting of link 5). Note: If no speed signal is present (if the ENGINE RUNNING/ LED is not flashing) when the MANUAL/ key is pressed, the AS3000 defaults to give a crank release by use of external contact (using pin 15).

Once the crank disconnect speed has been set, the ENGINE RUNNING/ LED lights continuously, and the OVERSPEED/ LED flashes to indicate…

Overspeed Trip Set Set-up

In this set-up phase, both MANUAL/ key and OVERSPEED/ LEDs flash, and the ENGINE RUNNING/ LED is lit continuously. With the engine running at normal speed:

- Press and release the MANUAL/ key. This sets the overspeed trip to give an immediate shutdown at 115% of the measured (nominal) speed, and a 3 second delayed shutdown at 110% nominal. If no speed signal is present when the MANUAL/ key is pressed, the overspeed trip is set to operate using the overspeed input (pin 14).

After the overspeed trip has been set, the AS3000 automatically stops the engine; the engine running and overspeed LEDs will go out, but the manual LED should stay flashing.

To exit set up mode and save the calibration changes, press OFF-STOP. If OFF-STOP/ is pressed at any stage before this, the AS3000 stops the engine and reverts to the settings that were held prior to entering calibration mode.

Operation

User control of the AS3000 and engine is through the three front facia operating mode keys:

OFF-STOP (reset)/ ◯

Press this key to power down the AS3000, stop the engine and reset latching shutdown faults.

AUTO START/ AUTO

Press this key to select Auto mode. A green LED lights continuously when Auto this mode is selected.

In Auto mode, the AS3000 will automatically preheat, start, run and stop the engine in response to the remote start contact(s) - see 'electrical connection' above for pins 9 and 16. The AS3000 User Interface face plate (remote start/mains fail) LED lights to indicate when the engine is 'on demand'.

MANUAL START/

Use this key to give manual mode control over engine starting and running.

If the engine is stationary – i.e. if the AS3000 is in Off-stop or Auto standby modes – use this key to start the engine:

- Press and immediately release the MANUAL/ key.
  The AS3000 adopts manual mode (indicated by the amber LED), turns on the engine fuel, but (provided the key is released immediately) does not crank the engine.
- To (preheat and) crank the engine, press and hold the MANUAL/ key for at least 1 second. If a timed preheat option has been selected, the preheat output will activate.
  At the end of the preheat time, or if preheat has been turned off, the start output will operate. The start and preheat outputs will only operate while the MANUAL/ key is held down and the engine speed is below the precalibrated crank release level. If the key is released, or if the engine speed rises above the automatic crank release level, the AS3000 disconnects the starter (and preheat), but maintains the engine fuel.

If the AS3000 is already running the engine in Auto mode, the MANUAL/ key allows the operator to maintain engine running indefinitely:-

- Press and release the MANUAL/ key; the amber manual mode LED will light. The AS3000 will then ignore the state of the remote start inputs and will run the engine continuously.

To stop the engine, the operator has 2 options:

- Press the OFF-STOP/ key. The AS3000 will stop the engine immediately.
- Press the AUTO/ key. Engine stopping (and restarting) then reverts to the control of the remote start inputs.

Responding to Faults

In Auto and Manual modes, the AS3000 continuously monitors for engine and plant faults.

The operator is typically warned of faults by use of an audible alarm, driven from the AS3000 'common alarm' output (see 'electrical connection' details for pins 8 and 31). Once alerted, the operator can identify fault and system status using the front facia LEDs:

- **REMOTE START** (mains fail) input active
- **ENGINE RUNNING**
- **CHARGE FAIL** fault
- **PLANT FAIL / AUXILIARY INPUT** fault
- **OVERCRANK** (start fail) fault
- **LOW OIL PRESSURE** fault
- **HIGH ENGINE TEMPERATURE** fault
- **OVERSPEED** fault. Flashing LED indicates speed signal failure

Shutdown Faults

Start fail/overcrank, low oil pressure, high engine temperature and overspeed alarms cause an immediate shutdown and/or lockout of the engine. These faults operate on a latching, 'first-out' indicated basis.

Overspeed monitoring begins immediately after crank release, while Low Oil Pressure and High Engine Temperature faults do not operate until the 'fault lock-out' time has expired (15 seconds after crank release).

The Auxiliary fault input may be triggered at any time. After the fault lockout time, the input acts as part of the first-out alarm system, causing an engine shutdown. While the engine is stationary and during starting, an active plant fail input causes 'indication only' on the front facia.

In the event of a shutdown fault, the operator should:

- Make a note of the indicated fault LEDs
- To reset the fault, press the OFF-STOP/ key
- Investigate the cause of fault.

The AS3000 should not be returned to Auto or Manual modes until the cause of shutdown has been found and corrected.

Warning Only Faults

A lit CHARGE FAIL/ LED indicates a battery/DC charging fault. Two inputs allow for the monitoring of an engine driven charge alternator (pin 6) and/or an AC powered battery charger (pin 11). For further operating details, please refer to 'electrical connection' above.

Following a charge fail fault, the AS3000 does not shut down the engine, but does activate its Common Alarm outputs.

The charge fail fault is non-latching: the charge fail LED goes out and the Common Alarm outputs de-activate as soon as the fault clears.

Speed Signal Fault

Once the fault lockout time has expired, and provided magnetic pickup or generator AC speed measurement has been set, the AS3000 will continually check that an engine speed signal is present.

If the speed signal fails when the engine is running, both START FAIL/ and OVERSPEED/ LEDs will flash.

Use link 9 on the AS3000 Panel Interface circuit board to set whether this fault results in a 'shutdown' or 'warning only' response.

Inter-Module Communication Fault

If all LEDs on the AS3000 User Interface flash momentarily once every 2 to 3 seconds, this indicates a communication problem between the AS3000 Panel Interface and AS3000 User Interface modules: check that the interconnecting lead is correctly seated and oriented.

Warranty

A two-year warranty on materials and workmanship is given with this FWMurphy product.
A copy of the warranty may be viewed or printed by going to www.fwmurphy.com/warranty.asp.

FW**Murphy**
P.O. Box 470248
Tulsa, Oklahoma 74147 USA
(918) 317-4100
fax (918) 317-4266
e-mail sales@fwmurphy.com
www.fwmurphy.com

CONTROL SYSTEMS & SERVICES DIVISION
P.O. Box 1819; Rosenberg, Texas 77471; USA
(281) 633-4500 **fax** (281) 633-4588
e-mail sales@fwmurphy.com

MURPHY DE MEXICO, S.A. DE C.V.
Blvd. Antonio Rocha Cordero 300, Fracción del Aguaje
San Luis Potosí, S.L.P.; México 78384
+52-444-8206264 **fax** +52-444-8206336
Villahermosa Office +52-993-3162117
e-mail ventas@murphymex.com.mx
www.murphymex.com.mx

FRANK W. MURPHY, LTD.
Church Rd.; Laverstock, Salisbury SP1 1QZ; U.K.
+44 1722 410055 **fax** +44 1722 410088
e-mail sales@fwmurphy.co.uk
www.fwmurphy.co.uk

MURPHY SWITCH OF CALIFORNIA
41343 12th Street West
Palmdale, California 93551-1442; USA
(661) 272-4700 **fax** (661) 947-7570
e-mail sales@murphyswitch.com
www.murphyswitch.com

MACQUARRIE CORPORATION
1620 Hume Highway
Campbellfield, Vic 3061; Australia
+61 3 9358-5555 **fax** +61 3 9358-5558
e-mail murphy@macquarrie.com.au

In order to consistently bring you the highest quality, full featured products, we reserve the right to change our specifications and designs at any time.

Printed in U.S.A.