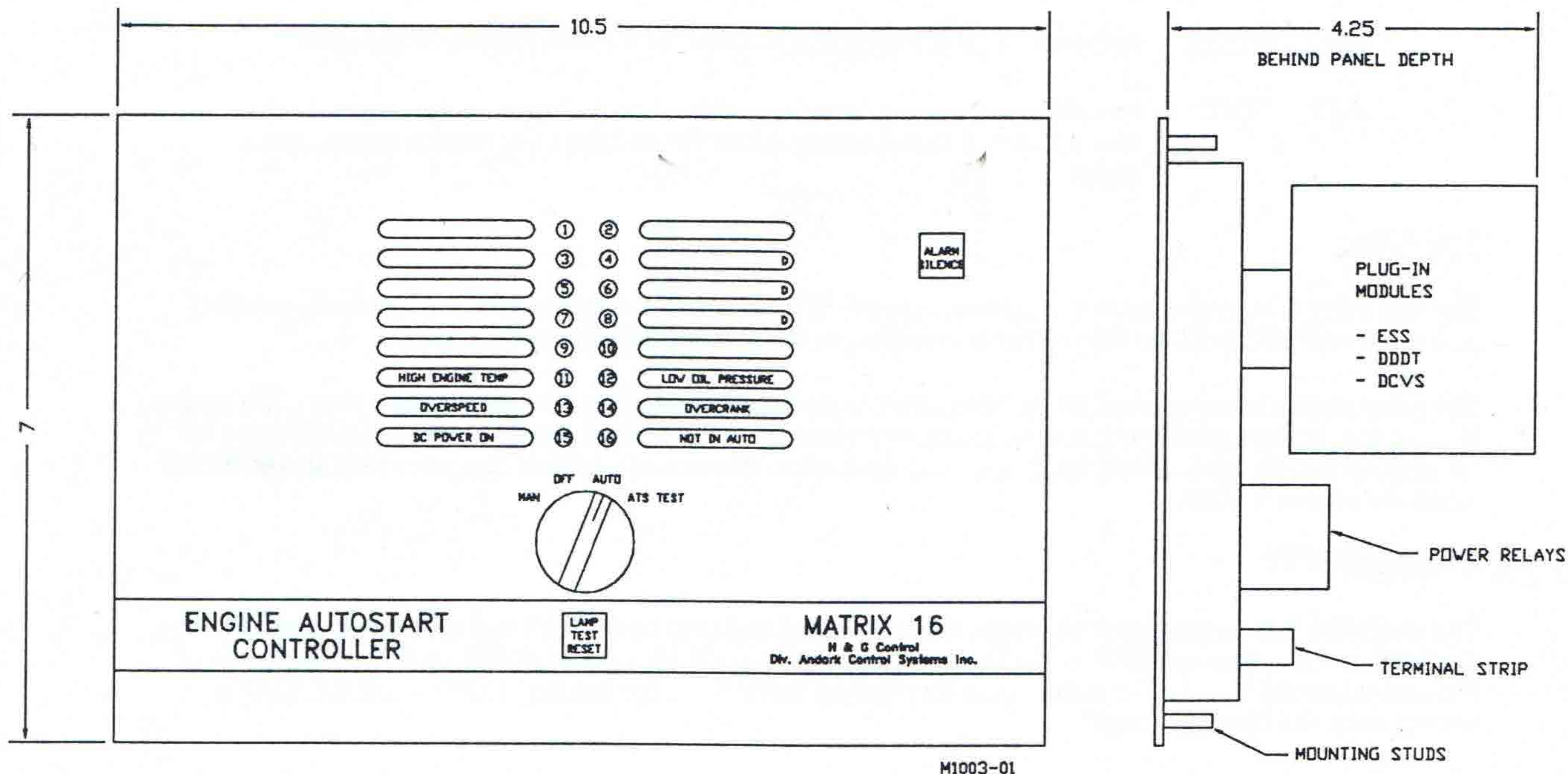


MATRIX 16 ENGINE CONTROLLER INSTALLATION AND OPERATING INSTRUCTIONS



GENERAL DESCRIPTION

The Matrix 16 Engine Controller is designed for unattended automatic starting and stopping of an internal combustion engine in a NEMA 1 operating environment.

The Matrix 16 combines the best of solid state and relay based logic devices giving optimum reliability and is available for 12 or 24 volt DC operation. Indicator lights are long life, low power LED's and comprise two status indicators, a green "power on" light and a flashing amber switch "not in auto" light, plus up to 14 fault indicator lights. A "lamp test" button is provided to test the operation of these lights.

PROTECTION

The Matrix 16, is protected buy a Reverse Power Relay in case the battery terminals are accidentally reversed. If such an event occurs, the whole controller remains "dead", including all power relays so that no damage will result downstream. In addition, the internal circuitry is protected by a 2 amp AGC fuse preventing circuit board damage in case output terminals such as air box solenoid driver (terminal 18), and fault annunciator outputs (terminal 41-55) are short circuited. Crank output terminal #32, and fuel output terminals #30 and #31, and battery auxiliary terminal #26 are NOT short circuit protected, therefore, the supply to the controller should be protected by a 15 amp maximum fuse.

The assembled board is fully covered with conformal coating to protect against humid and corrosive environments.

Switch Operators

The Matrix 16 contains a 4 position switch labeled MAN., OFF, AUTO and ATS TEST.

- Off Position: This is not a true off, but in this position, prevents engine starting, resets any fault indicators and deactivates the fault inputs. In this position, the Battery Voltage Sensor (DCVS) and the Speed Sensor (ESS) are still active.
- Manual Position: starts engine immediately (unless push button option is being used) and activates all fault inputs.
- Auto Position: Activates all fault inputs and is ready for Remote Engine Start Signal.
- ATS - TEST: Functions same as in "auto" but also sends an "open circuit" signal to the transfer switch to test initiate a transfer and thus, the remote engine start signal.

Fuel Relay

The fuel relay is activated by the engine start signal. It is activated in either manual or automatic position and stays activated until the start signal is canceled, or the engine shuts down on a fault.

The relay output is on terminal 30 for "energized to run", and terminal 31 for "energized to stop". The output is at battery voltage level and is not short circuit protected, so the current should be limited to 15 amps by an external supply fuse. Terminal 31 may also be used to disconnect a battery charger which should be off when the engine is running.

Cranking (MCT)

The controller has an integral multi-crank timer on board and may be set for 1 to 6 tries but is normally set for 3 unless otherwise specified (1 for MOE). The number is set by a solder bridge on the exposed side of the printed circuit board. The setting may be changed in the field, but it is best to leave it at the factory setting since the board is coated.

The crank period and the rest period are independently adjusted by a potentiometer on the rear of the Matrix 16 for 5 to 45 seconds.

Cranking stops immediately when the crank disconnect signal is received and the MCT stops timing.

If the engine has a false start, the MCT will go through a rest period to allow the engine to stop rotating before starting the next try sequence. If the engine starts and runs past the "low oil pressure" inhibit period, crank lock-out occurs. Failure of the speed signal after this point will cause the engine to shut down and light up the overcrank indicator.

FAULT INDICATOR

The Matrix 16 has four fixed fault indicators and input/output user selectable fault indicators which can be programmed for a shutdown, or an alarm only condition. All fault inputs are latching and have to be cleared by:

- a) pressing the lamp test/reset button for an alarm only fault, or
- b) switching to the off position for a shutdown fault.

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Fuel Relay

The fuel relay is activated by the engine start signal. It is activated in either manual or automatic position and stays activated until the start signal is canceled, or the engine shuts down on a fault.

The relay output is on terminal #30 for "energized to run" and terminal 31 for "energized to stop". The output is at battery voltage level and is not short circuit protected, so the current should be limited to 15 amps by an external supply fuse. Terminal 31 may also be used to disconnect a battery charger which should be off when the engine is running.

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The fault inputs can be programmed for a positive signal fault input or a negative ground signal input and should be set at the factory for safety reasons. The inputs are designed for normally open switches (i.e. open when engine is running).

The four fixed fault indicators are all set for engine shutdown and are:

a) OVERCRANK (Engine fail to start)

This fault is internally activated after the prescribed number of crank times have been completed. If it initiates the shutdown conditions, i.e. - fuel cut-off, remote alarm.

b) LOW OIL PRESSURE (Terminal 12)

This fault input is activated by a switch which is normally closed until oil pressure builds up, therefore, the input is inhibited during engine start and is adjustable from 5 to 45 seconds. The delay period commences with the crank disconnect signal.

c) HIGH ENGINE TEMPERATURE (Terminal 11) (Delayed on startup)

This fault input is activated by a switch which is normally closed until oil pressure builds up, therefore, the input is inhibited during engine start and is adjustable from 5 to 45 seconds. The delay period commences with the crank disconnect signal.

d) OVERSPEED

This fault can be triggered internally by the plug in Electronic Speed Switch, or externally, by the normally open (N.O.) contact into terminal 13. It may also be triggered by both the switch and the contact. When the fault is activated, a battery positive signal is output to terminal 18 to drive an Air Box damper solenoid relay.

Certain fault inputs have special significance as follows:

Terminal #10 - Low Battery Voltage and Terminal #9 - High Battery Voltage.

In addition to being regular inputs, the inputs tie into the internal outputs of the plug in battery voltage sensor - DCVS - 1 for low battery voltage only, or DCVS-2 for low and high battery voltage alarm.

Terminal #8 -

This input is inhibited during engine start in a similar way to #12 (low oil pressure) and may be used for such inputs as "Low oil pressure pre-warning", "Low Generator Voltage", "Low Generator Frequency", "Phase Imbalance". If this inhibit is not required, then jumper J8 should be bridged.

Terminal #6 and #4

These input terminals are also available as inhibited during Start-UP, but if this is required, it should be specified to the factory when ordering.

SPEED SENSING

Signals for crank disconnect and overspeed can be generated internally with the plug in Electronic Speed Sensor (ESS-2) or externally via terminal #13 (overspeed) and terminal #16 (crank disconnect)

When using the plug-in ESS-2, the signal is input into terminal 14&15, and may be derived from a transformer on a magnetic pick-up (Set the ESS-2 range appropriately). Since this signal is capacitively coupled and not tied to ground, it may be paralleled with other devices.

If it is desired that external speed sensing is to be used, then a normally closed speed switch should be connected between terminal #16 and battery negative (switch opens for crank disconnect). The external crank disconnect switch and the ESS-2 should NOT be used together because of possible conflict.

It is recommended that a crank disconnect backup switch also be used, i.e. oil pressure switch or A.C. generated signal.

An external overspeed switch is connected to Terminal #13 and may be positive or negative fault, depending on the configuration of the other inputs. It is okay to use both the ESS-2 and an external overspeed input at the same time.

Terminal #17 gives access to the normally open contact on the ESS-2 low switch (crank disconnect). The terminal has no control function within the controller, but is useful for turning off such things as the Air Box damper solenoid.

BATTERY VOLTAGE SENSING

An 11 pin socket is provided for a plug in voltage sensing relay, DCVD-1 for low battery volts or DCVS-2 for low and high battery voltage indication. The outputs for this sensor activate indicator #10 for Low Battery Voltage, and indicator #9 for High Battery Voltage. Consequently these inputs should both be used for other fault indications and should be configured as "alarm only". In addition, these indicators are designed to be active even when the selection switch is in the "off" position and this are non-latching and will self reset when the fault has been corrected.

REMOTE ENGINE START

AUTO-POSITION

The controller allows the engine to be started by closing a remote switch (i.e. in a transfer switch). For this to be active, the selector switch must be in the Auto position and can be used in either of two ways:

- a) Instant Start - when the remote switch grounds terminal #34 to battery negative, the engine will immediately start to crank and will run until the switch is opened (about 20mA flows through the switch).
- b) Delays Start/Stop - for this feature, a dual timer DDDT is required to be plugged into the board. The timer has adjustments for delaying start (for 1 - 30 seconds), and for delaying stop (cool-down for 1-30 minutes). The timer is accessed through terminal #33 which, when grounded by the remote switch, starts the "on" delay after which the engine will start. When the remote switch opens, the cool down period starts. If during the "on" delay, the remote switch opens, nothing will happen. If the switch closes during cool down, then the whole cool down period starts after the next time the switch opens.

MANUAL POSITION

Generally, the engine will start as soon as the selection switch is moved to the "Manual" Position. However, some specifications require that there be "push to start" and "push to stop" buttons for the manual position. This feature should be installed at the factory and specified when placing the order. It comprises of a latching relay arranged in a set/reset configuration and is accessed through terminal #35 as shown on drawing W2018-01. When the terminal 35 is made battery negative, it sets the relay and starts the engine. When it is made positive, it de-latches the relay and stops the engine. The resistor R1 prevents a dead short when both buttons are pressed once.

REMOTE OUTPUTS

Common Alarms:

The Matrix 16 has two common alarm relays outputs, one for "alarm only" faults (outputting on terminals 23, 24 and 25) and one for "shutdown only" faults (outputting 27 and 28). These terminals are dry form 'C' contacts rated 120V, 5A. The "alarm only" relay is normally energized and de-energized on fault. This allows a signal to be sent if there is total battery power loss, however, for clarity, the contacts on drawing W2018-01 are shown in the "normal" energized position. In most applications, only one common alarm contact is required for all faults, therefore, by default and unless specifically ordered, the shutdown alarm relay contacts will transfer for BOTH alarm and shutdown faults. This feature can be decoupled in the field by cutting a jumper trace on the rear of the controller board labeled J1. Note that the common points of these relays are adjacent to terminal #26 which is connected to battery positive input terminal, making jumping easy.

Individual Remote Alarms:

The Matrix 16 has the capability of providing outputs for each individual fault. These outputs are at battery positive level and appear on an auxiliary terminal strip (terminals #41-55) installed for this purpose. This, this option must be specified when ordering.

There are 15 outputs in all, one each for the 14 faults and one for the switch "not in auto" position. The outputs are designed to drive a light or a relay and limited to 500mA. They are short circuit protected by the fuse on the controller.

"NOT-IN-AUTO"

In addition to the switch "Not in Auto" indicator light on the controller, this indication can be accessed in two ways.

- a) Through common alarm output.

Unless otherwise specified, the controller, as shipped, will give a remote signal (through terminals 23 and 25, and/or 27 and 28) when the switch is in the "OFF" position only. This can be disengaged by cutting jumper labeled J2. Conversely, the remote alarm can be made to signal when the switch is in the "manual", off, or "ATS Test" positions by bridging jumper labeled J3.

- b) Terminal 21 and 22

These terminals access a section of the selector switch contacts and are open circuit when the switch is in the "Auto" position and closed in the other positions. The contacts are rated 1A, 120V. If necessary, these contacts can be inverted to be closed in the "Auto" position and open in other positions.

BUZZER

When ordered as an option, a buzzer can be built into the controller and will give an audible warning whenever an alarm fault or shutdown fault is activated. The buzzer is of piezoelectric type and comes with a silence push-button.

If a louder alarm is required, the on-board buzzer may be replaced with a terminal block to drive and external piezoelectric buzzer or relay. The silence push-button remains active.