MSEL Competition & Development Electronics

Master Relay

User's Manual

www.msel.com | sales@msel.com | +64 9 525 2991

Contents

Description

The Master Relay is a battery isolator that goes much further than just safety in mind. It has been designed with the sole purpose of a motorsport environment. Utilising solid state switching components, the Master Relay has excellent temperature resistance, as well as an aluminium enclosure that is lightweight and robust in even the harshest motorsport environment.

The Master Relay not only has built in engine shutdown functionality in accordance to FIA regulations, it also incorporates alternator load dump protection unavailable on most rival devices. This helps to avoid nasty voltage spikes often seen when disconnecting the battery source whilst the alternator is still charging.

The device can safely shut down the vehicle under a number of different events including: external kill switch press, over current / short circuit, over temperature, and can even be shut down via a remote CAN message. For example, in the event of a severe impact or an overturned.

When connected to a data logger on a CAN bus, the Master Relay provides valuable information about the current, voltage and internal temperature, as well as diagnostic information that makes finding problems a lot easier. As well as transmission to a data logger the Master Relay has a multi-coloured LED that shows a unique colour combination for each of the 10 different states. The driver switch can also be connected with an LED to show when the battery is isolated.

⚠ Safety Precautions

These instructions provide vital information to the safe and desired installation of the Master Relay. Please ensure you are familiar with the entire process before installing this device into your car. Failure to comply with these instructions could damage the Master Relay or other components in the vehicle.

The Master Relay must be completely disconnected before any welding is conducted on the installed vehicle.

The Master Relay should always have the PDM output connected and correctly shutting the engine down. Failure to do so could damage not only the Master Relay but also other computers connected in the vehicle such as ECUs, displays, control units etc.

While all efforts are made to ensure the accuracy of the information in this manual, no responsibility will be taken for the consequences of any omissions in this manual.

MSEL Master Relay *Connection Diagram*

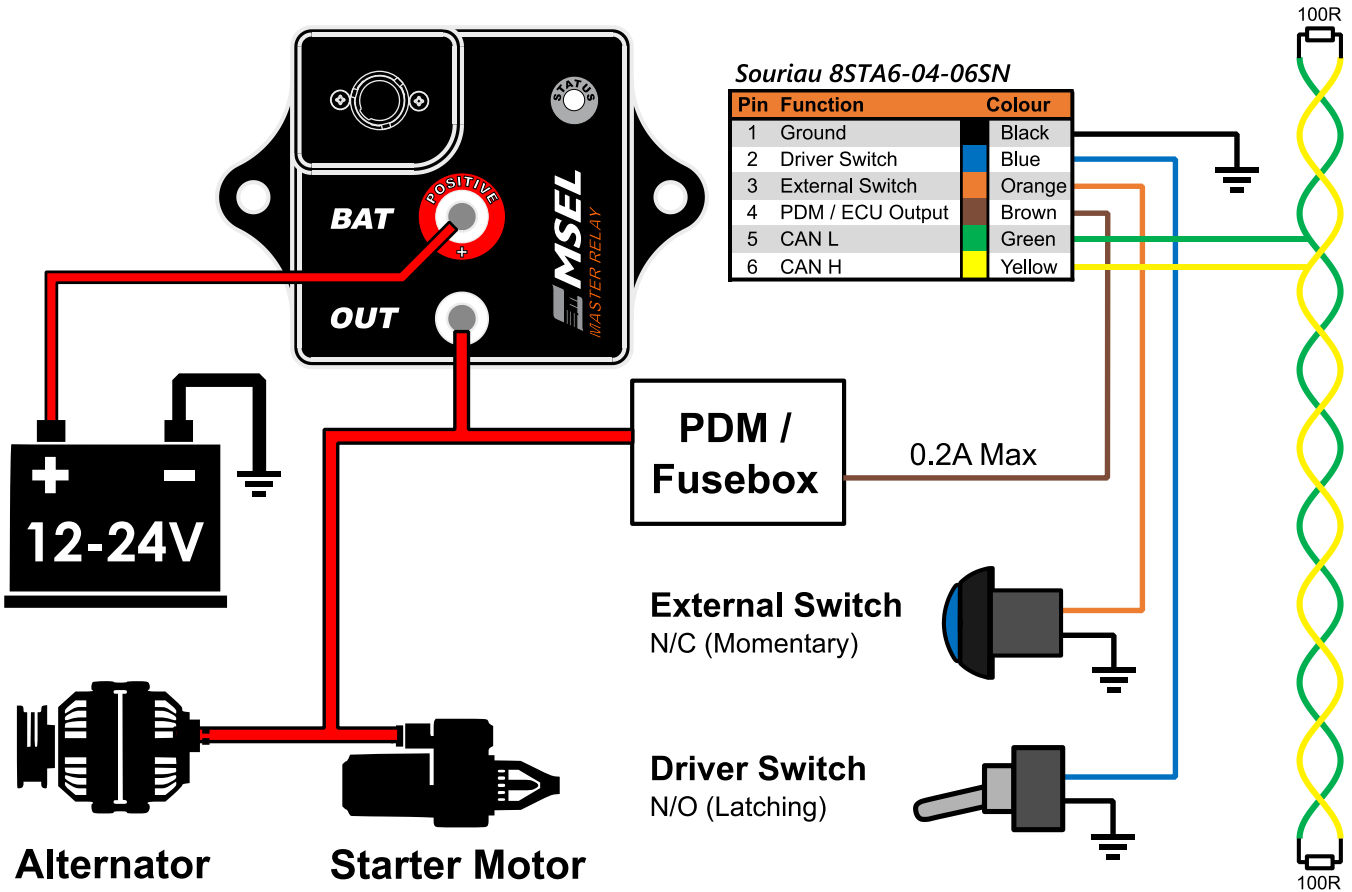


Figure 1: Connection Diagram

Installation

Mounting

The MSEL Master Relay has two tags designed for mounting the device to a flat surface. The spacing between the mounting holes is 84mm (see *Drawing* for details). The location of the Master Relay, as well as the total current load, can have significant effect on the internal temperature of the Master Relay. Where possible try to mount the Master Relay away from significant heat sources.

Electrical Connection

The Master Relay is connected between the positive terminal of the battery and the rest of the vehicles positive power supply. The device should be positioned as close to the battery as possible, keeping the positive lead as short as you can. See the *Connection Diagram* for a typical installation.

ENSURE THAT THE GROUND CONNECTION IS MADE BEFORE CONNECTING THE BATTERY AND VEHICLE TERMINALS.

Power Studs

The battery and output terminals are copper plated M6 studs. Care should be taken to ensure that cables are insulated from the housing and neighbouring studs. It is recommended to use the supplied nut caps with insulated lugs, or for maximum protection, rubber insulating boots can be used on each stud.

Interface Connector

All low current connections are made through a single 6-way Souriau mil-spec connector; keeping things tidy, protected and allowing for quick removal / installation.

The mating connector (Souriau 8STA6-04-06SN) can be purchased individually for custom installs or a breakout harness with DTM connectors is available for generic installs.

Table 1: Interface connector pinout

Pin	Function	Colour
1	Ground	Black
2	Driver Switch	Blue
3	External Switch	Orange
4	PDM / ECU Output	Brown
5	CAN L	Green
6	CAN H	Yellow

Table 1 shows the pinout along with the standard wiring colours supplied with the breakout harness. For those making a custom harness the Souriau connector has #26 terminals and accept 30AWG through to 24AWG wire.

Switch Connection

The Master Relay is controlled by two types of switch, the driver kill switch and the external kill switch.

Driver Kill Switch

The driver kill switch is generally operated from within the vehicle and is the main control for the battery isolation. Generally, just a single driver kill switch is used, however multiple switches can be wired as shown in Multiple Switches, the extra switch could be hidden and used as an additional security measure.

Wiring of the driver kill switch is carried out as shown in the *Connection Diagram*. The switch used should be of a latching type (either toggle or push button). When the switch is in the off position there should be an open circuit between the two terminals. One side of the switch connected to pin 2 of the Master Relay connector, and the other side is connected to ground.

An LED can be added to the circuit as shown in Figure 2. This LED will be on solid when the device is in the normal state, flash when the battery is isolated, and be turned off when the driver switch is off.

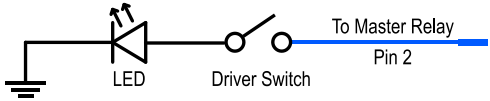


Figure 2: LED indicator wiring

External Kill Switch

The external kill switch allows remote triggering of the Master Relay. It is often mounted on the exterior of the vehicle and indicated by a red lightning bolt on a blue triangle. Multiple external switches can be wired as shown in Multiple Switches. If an external switch is not required, pin 3 of the Master Relay connector should be permanently connected to ground.

Wiring of the external kill switch is carried out as shown in the *Connection Diagram*. The switch used should be of a momentary non-latching type with a normally closed (NC) configuration. When the switch is pressed there should be an open circuit between the two terminals. One side of the switch is connected to pin 3 of the Master Relay connector, and the other side connected to ground.

Multiple Switches

Multiple external kill switches can be connected in series provided that when all switches are in the 'ON' position there is continuity between the input to the Master Relay and ground. When any switch is in the 'OFF' position the connection to ground should be open circuit. See Figure 3 for examples of multiple switch configurations.

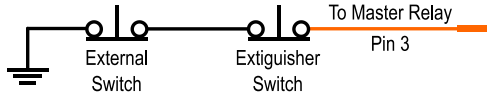


Figure 3: Example multiple external switch configuration

PDM / ECU Connection

Pin 4 of the Master Relay connector provides a logical output for a PDM / ECU allowing engine shutdown functionality in accordance with FIA rules. The drive of this output can be configured in the combinations shown in Table 2 below. The device ships standard with configuration 0 (active high, half bridge). In this configuration when the Master Relay is in an 'On' or 'Normal' state the output is connected to the battery supply, and when 'Off' the output is connected to ground.

Table 2: PDM output drive configurations

Active State	*Output Drive*	*Config.*	*Output 'On'*	*Output 'Off'*
High	**Half Bridge**	0	$V_{battery}$	GND
	Low Side	2	-	GND
	High Side	1	$V_{battery}$	-
Low	**Half Bridge**	4	GND	$V_{battery}$
	Low Side	6	GND	-
	High Side	5	-	$V_{battery}$

In order to change the output drive to one of the other configurations please refer *to* Changing the PDM Output Drive Configuration, or specify your requirements when purchasing.

The PDM / ECU output is short circuit protected and current limited to 200mA. To drive larger loads an external relay is recommended.

CAN Bus Connection

To receive status and channel information from the Master Relay it must be connected to a compatible device on the same CAN bus. Examples of these include a data logger, dash display, or ECU. The Master Relay transmits two messages on a configurable address and is compatible with most CAN capable data loggers on the market. For further information on the format and transmission refer to the *CAN Communications* section.

The Master Relay does not have any internal termination resistors and therefore requires 100R termination resistors at each end of the CAN bus.

Master Relay States

LED Indicator States

The table below shows the corresponding states for each of the possible colour codes displayed on the status LED.

Table 3: LED indicator states

Status	LED Colour
Normal	Green
(CAN Error)	Green Flashing
Over Temperature Warning	Blue Flashing
Over Current Kill	Yellow
Low Voltage Warning	Green/Blue Flashing
High Voltage Warning	Green/Red Flashing
Over Temperature Kill	Blue/Red Flashing
Driver Switch Kill	Red
External Switch Kill	Red Flashing
CAN Trigger Kill	Blue
Power On Reset	Purple

Battery Connected

Normal Operation

The battery is connected to the output and the device is operating normally.

Normal Operation (CAN Error)

The device is operating normally; however, the CAN bus has been unresponsive for more than 2 transmission cycles. CAN communications have been disabled until the CAN bus is back online (this is checked every 5 seconds).

Over Temperature Warning

The device temperature has exceeded the warning temperature (90°C). The device will continue to function normally; however, the temperature is getting close to the device limits. This should be remedied to avoid undesired performance and/or potential damage.

Once the fault is remedied the device will automatically return to normal operation.

Low Voltage Warning

The device voltage has dropped below the lower warning limit (7V). The device will try to continue to function normally, however the voltage is getting close to the device limits. This should be remedied to avoid undesired performance and/or potential damage.

Once the fault is remedied the device will automatically return to normal operation.

High Voltage Warning

The device voltage has exceeded the upper warning limit (28V). The device will try to continue to function normally, however the voltage is getting close to the device limits. This should be remedied to avoid undesired performance and/or potential damage.

Once the fault is remedied the device will automatically return to normal operation.

Battery Isolated

Driver Kill

The driver kill switch has been turned off or the connection has broken. The battery is disconnected and the indicator will be solid red.

The device will remain in this state for 30 seconds before entering a low power state. To return to normal operation a reset is required (see *Resetting the Device*).

External Kill

The external kill switch has been triggered or the connection has broken. The battery is disconnected and the indicator will be flashing red.

To return to normal operation a reset is required (see *Resetting the Device*).

CAN Kill

A CAN message has triggered a shutdown. The battery is disconnected and the indicator will be solid blue. See *CAN Shutdown* for further details on the CAN kill function.

To return to normal operation a reset is required (see *Resetting the Device*).

Over Temperature Kill

The device temperature has exceeded the maximum allowed temperature (110°C). The battery is disconnected and the indicator will be flashing red and blue.

Once the fault is remedied the device will automatically return to normal operation.

Power On Reset

The device has been powered on with the driver & external switches on. The battery remains disconnected and the indicator will be solid purple.

To return to normal operation a reset is required (see *Resetting the Device*).

Over Current Kill

The device temperature has exceeded the maximum allowed current. The battery is disconnected and the indicator will be solid yellow.

Check for any short circuits between the output terminal and the chassis ground. To return to normal operation once the fault is remedied, a reset is required (see *Resetting the Device*).

Resetting the Device

Once the device has been triggered by one of the 5 faults (external kill, driver kill, CAN kill, over-current kill or over-temperature kill) the device will remain in the off state until reset. The LED indicator will show the current fault as outlined in *LED Indicator States*.

Once the fault has been remedied the device can be reset by cycling the driver kill switch off and then back on.

Load Dump Protection

The Master Relay has on board circuitry that will help protect sensitive electronic devices in the event of a shutdown during engine operation. The PDM output will be turned off immediately therefore stopping the engine. However, the battery is not disconnected until the alternator is no longer charging. This avoids the situation where the alternator may still be generating as the battery is disconnected, resulting in voltage spikes as large as 120V that can damage sensitive electronic components.

The Master Relay has a 5 second timeout where by even if for some reason the battery is still being charged it will be disconnected regardless (this can be extended by specifying a longer shutdown delay, see *Shutdown Delay*).

Shutdown Delay

The Master Relay can be programmed to delay switching the battery power off to allow for diagnostic data logging. The shutdown delay is in addition to the load dump protection delay described in *Load Dump Protection*. Therefore, the battery is guaranteed to be connected for the duration of the shutdown delay, except for an over current event where the battery is disconnected immediately to prevent potential damage.

The recommended procedure for this is to use a PDM or ECU to shut down the engine and disable everything except the data logging systems. This allows these devices to receive the shutdown event information and store it before shutting down.

The table below indicates the recommended delay times for different data logging systems:

Table 4: Recommended shutdown delay times

Data Logging Device	Shutdown Delay
All MoTeC products	1.0 seconds

All devices are shipped with no additional shutdown delay, in order to activate this feature please request it at the time of purchase, or program the desired delay as described in Changing the CAN Baud Rate & Shutdown Delay.

Temperature Monitoring

The Master Relay has an on-board temperature sensor for monitoring the internal temperature of the unit. The temperature is transmitted on the CAN bus as well as used internally to isolate the battery in case of excessive temperatures. A warning is displayed on the LED indicator at 90°C (flashing blue) and the device is shut down at 110°C with a blue/red indication on the LED.

The device will automatically attempt to restart when the temperature drops back down below 100°C, or with a device reset (and temperature is below 110°C).

Load Current Monitoring

The Master Relay has internal bi-directional current sensing for the load to / from the battery. This current is transmitted as part of message 1 on the CAN bus (see *CAN Communications*).

The load current is designed as an indication of the total system draw and is accurate to ±10% or 1A (whichever is greatest). It is not intended to be used for detailed, smaller current draw analysis. The Master Relay should be used in conjunction with a PDM for accurate measurement of current for individual devices.

The Master Relay has integrated short-circuit protection and will isolate the battery in the event of a major short circuit on the main output terminal.

Power Saving Mode

After 30 seconds in the Driver Kill mode the Master Relay will enter a power saving mode. In this mode the following functions of the device are turned off to save power.

- CAN transmission is disabled
- The LED indicator is turned off
- Temperature and load monitoring are turned off
- The microcontroller is put into a standby state

The device resumes operation as soon as the driver switch is turned on again.

CAN Communications

The Master Relay comes preprogramed with a baud rate of 1 Mbps. The user can configure the device to a baud rate of 500 Kbps or 250 Kbps as detailed in Changing the CAN Baud Rate & Shutdown Delay, or alternatively request these settings at the time of purchase.

Message Format

The Master Relay transmits status and information on the CAN bus over two addresses. These addresses are defined by the base CAN address (Default: 0x6E4). This can be configured using the process detailed in *Changing the base CAN Identifier*, or alternatively by requesting a particular address at the time of purchase.

Table 5 & Table 6 below show the format of the transmitted channels. Each message is transmitted at a rate of 10Hz, and all multi-byte channels are in Big-Endian format (MSB first).

Table 5: Base address (Default: 0x6E4)

Byte	Channel	Units	Length	Base	Signed	Value	Transmitted
0 1	Voltage Out	V	2	0.01	Unsigned	12.56	1256
2 3	Current Load	A	2	0.1	Signed	54.5	545
4 5	Internal Temperature	°C	2	0.1	Signed	25.2	252
6	Warnings	-	1	1	-		see (2)
7	Status	-	1	1	-		see (1)

Table 6: Base address + 1 (Default: 0x6E5)

Byte	Channel	Units	Length	Base	Signed	Value	Transmitted
0 1	Voltage In	V	2	0.01	Unsigned	12.56	1256
2 3	Serial No.	-	2	1	Unsigned	-	-
4 5	Configuration (3)	-	2	1	Unsigned	-	-
6	Time Since Shutdown	s	1	0.1	Unsigned	15.5	155
7	Shutdown Cause 2 (4) Shutdown Cause (4)	- -	4 MSB 4 LSB	1 1	- -		see (1) see (1)

(1) List of 'Status' enumerations are available in Table 7

(2) 'Warning' bit masks are available in Table 7

(3) 'Configuration' composition is available in Table 8

(4) 'Shutdown Cause 1' is the 2nd to last event, and 'Shutdown Cause 2' is the last event (from serial no. 61061), serial no. prior to 61061 just give last event.

Status and Warning Formats

The status and warning channels transmitted in CAN message 1 contain the current status of the warnings and faults on the device. The status enumerations are listed in Table 7 below.

The warning channel is made up from 8 individual bits, corresponding to the status or switch states. Multiple warnings may be present at any single instance. For example, if both the external switch (0x40) and the driver switch (0x20) are off, the warning channel will be equal to 0x60.

Table 7: Status enumeration & warning channel bit masks

Status	Status Enumeration	Warning Bit Mask
Normal	1	-
Over Temperature Warning	2	0x01
Over Current Warning	3	0x02
Low Voltage Warning	4	0x04
High Voltage Warning	5	0x08
Over Temperature Kill	6	0x10
Driver Switch Kill	7	0x20
External Switch Kill	8	0x40
CAN Trigger Kill	9	0x80
Power On Reset	10	-

Configuration Format

The configuration channel contains information on the current configuration stored in the Master Relay. Table 8 below shows the composition of this channel from the features programmed as detailed in *Device Configuration.*

Table 8: Configuration channel composition

Byte 1								Byte 2							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
CAN Kill Enable		CAN Baud Rate		Output Drive				Shutdown Delay							
0 = Disabled 1 = Enabled 2 = ADR		0 = 1Mbps 1 = 500Kbps 2 = 250Kbps		0 = Active-Hi, Half Bridge 1 = Active-Hi, High Side 2 = Active-Hi, Low Side 4 = Active-Lo, Half Bridge 5 = Active-Lo, High Side 6 = Active-Lo, Low Side				Shutdown Delay (in 0.1 seconds) eg. 10 = 1 second shutdown delay							

CAN Shutdown

The Master Relay has the ability to be shut down remotely via a CAN message. As default this functionality is disabled. Refer to *Setting up CAN Shutdown* for information about how to enable and set up this function, or alternatively request this functionality to be programmed when ordering the device.

When enabled, upon receiving a message with the format shown in Table 9, and on the configured CAN kill address, the Master Relay will shut down the engine and isolate the battery.

Table 9: Example CAN shutdown message for CAN Kill address 0x6E6

Received Address	Byte							
	0	1	2	3	4	5	6	7
0x6E6	0xFF	0x00	0xFF	0x00	0xFF	0x00	0xFF	0x00

This feature can also be programmed to work with a MoTeC Accident Data Recorder (ADR) and trigger after a severe event. To enable this feature set the CAN Kill Enable byte to '2', and the CAN Kill address to the address of the status information transmitted by the ADR (default is 0x449). See *Setting up CAN Shutdown* for further instructions.

Please check previous logged data carefully to ensure that the severe event threshold in the ADR doesn't false trigger on normal impacts such as 'curb strikes'.

Device Configuration

Changing the base CAN Identifier

The default base CAN address is 0x6E4, can be changed using any CAN bus interface device capable of transmitting a message onto the CAN bus. The following procedure changes the CAN identifier on the Master Relay:

1. Configure the CAN interface device to transmit a single message on address 0x789 with the following format:

Table 10: Example CAN ID configuration message

Byte	0	1	2	3	4	5	6	7
Data	0x07	0x89	CAN_ID		CAN_ID		0x07	0x89
Example*	0x07	0x89	0x06	0xE4	0x06	0xE4	0x07	0x89

* shows the correct message format to change the address to 0x6E4

Where 'CAN_ID' is the desired new CAN address in big endian format (MSB first).

Please note that the CAN address must not exceed a length of 11 bits (0x000 to 0x7FF), and must not conflict with any other CAN devices on the network.

2. Press and hold the external kill switch while sending the above message.
3. The Master Relay will send a response message on the base CAN address. See Table 11 for a list of responses.

Table 11: Responses for CAN ID configuration

	0	1	2	3	4	5	6	7
Successful	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00
IDs do not match	0x11	0x11	0x11	0x11	0x11	0x11	0x11	0x11
Frame check error	0x22	0x22	0x22	0x22	0x22	0x22	0x22	0x22
Invalid ID	0x33	0x33	0x33	0x33	0x33	0x33	0x33	0x33

4. After a successful response the Master Relay will be configured to send all CAN information on the new base address.

Changing the CAN Baud Rate & Shutdown Delay

The device comes preconfigured with a default CAN baud rate of 1Mbps, and a shutdown delay of 200ms. These values can be changed using any CAN bus interface device capable of transmitting a message onto the CAN bus. The following procedure is used to change the CAN baud rate and shutdown delay on the Master Relay:

1. Configure the CAN interface device to transmit a single message on address 0x789 with the following format:

Table 12: Example CAN baud rate & shutdown delay configuration message

Byte	0	1	2	3	4	5	6	7
Data	0x04	0x56	BAUD RATE	BAUD RATE	SHUT DELAY	SHUT DELAY	0x04	0x56
Example*	0x04	0x56	0x01	0x01	0x0A	0x0A	0x04	0x56

* shows the correct message format to set the baud rate to 500Kbps and the shutdown delay to 1 second.

Where 'BAUD RATE' is from the table below and 'SHUT DELAY' is the delay in tenths of a second that the power is kept on after a shutdown event (in hex).

Table 13: List of baud rate enumerations

Baud Rate Value	'BAUD RATE'
1Mbps (Default)	0x00
500Kbps	0x01
250Kbps	0x02

2. Press and hold the external kill switch while sending the above message.

3. The Master Relay will send a response message on the base CAN address. See Table 14 for a list of responses.

Table 14: Responses for CAN baud rate & shutdown delay configuration

	0	1	2	3	4	5	6	7
Successful	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00
Values do not match	0x11	0x11	0x11	0x11	0x11	0x11	0x11	0x11
Frame check error	0x22	0x22	0x22	0x22	0x22	0x22	0x22	0x22
Invalid baud rate	0x33	0x33	0x33	0x33	0x33	0x33	0x33	0x33

4. After a successful response the Master Relay will need to be restarted (by removing the power) before the new CAN baud rate is implemented. The shutdown delay is effective immediately.

Changing the PDM Output Drive Configuration

The device comes preconfigured with a default PDM drive output of active high, half-bridge. This configuration can be changed using any CAN bus interface device capable of transmitting a message onto the CAN bus. The following procedure is used to change the PDM output drive on the Master Relay:

1. Configure the CAN interface device to transmit a single message on address 0x789 with the following format:

Table 15: Example PDM output drive configuration message

Byte	0	1	2	3	4	5	6	7
Data	0x0A	0xBC	OUTPUT DRIVE	OUTPUT DRIVE	0x00	0x00	0x0A	0xBC
Example*	0x0A	0xBC	0x06	0x06	0x00	0x00	0x0A	0xBC

* shows the correct message format to set the PDM output drive to active low, low side.

Where 'OUTPUT DRIVE' is selected from the table below:

Table 16: List of output drive enumerations

Active State	Drive	'OUTPUT DRIVE'
High	Half Bridge	0x00
	Low Side	0x02
	High Side	0x01
Low	Half Bridge	0x04
	Low Side	0x06
	High Side	0x05

2. Press and hold the external kill switch while sending the above message.
3. The Master Relay will send a response message on the base CAN address. See Table 17 for a list of responses.

Table 17: Responses for PDM output drive configuration

	0	1	2	3	4	5	6	7
Successful	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00
Values do not match	0x11	0x11	0x11	0x11	0x11	0x11	0x11	0x11
Frame check error	0x22	0x22	0x22	0x22	0x22	0x22	0x22	0x22
Invalid configuration	0x33	0x33	0x33	0x33	0x33	0x33	0x33	0x33

4. After a successful response, the Master Relay will need to be reset before the new PDM output drive is implemented.

Setting up CAN Shutdown

The CAN shutdown function is disabled by default. This configuration can be changed using any CAN bus interface device capable of transmitting a message onto the CAN bus. The following procedure enables / disables the CAN shutdown function of the Master Relay, as well as sets the address for shutdown commands to be received. For more information on how to use the shutdown once enabled, please refer to *Configuration Format*.

1. Configure the CAN interface device to transmit a single message on address 0x789 with the following format:

Table 18: Example CAN shutdown configuration message

Byte	0	1	2	3	4	5	6	7
Data	0x01	0x23	CAN_KILL		CAN_KILL		0x01	0x23
Example*	0x01	0x23	0x16	0xE6	0x16	0xE6	0x01	0x23

* shows the correct message format to enable CAN shutdown on address 0x6E6

Where 'CAN_KILL' is composed as in Table 19 below. The first 4 bits ('EN'), set the CAN shutdown mode, where 0 is disabled, 1 is enabled, and 2 is for a MoTeC ADR. The last 12 bits ('KILL_ID') set the receive CAN address in big endian format (MSB first).

Table 19: Example 'KILL_ID' composition

Byte	0		1	
Mask	0xF0	0x0F	0xF0	0x0F
Data	EN	KILL_ID		
Example*	0x1	0x6	0xE	0x6

* shows the correct byte composition to enable CAN shutdown on address 0x6E6

'EN' must be less than 0x2 to enable the function. Setting 'EN' to any other value will disable the CAN shutdown function.

Please note that the CAN address must not exceed a length of 11 bits (0x000 to 0x7FF), and must not conflict with any other CAN devices on the network.

2. Press and hold the external kill switch while sending the above message

The Master Relay will send a response message on the base CAN address. See Table 20 for a list of responses.

Table 20: Responses for CAN ID configuration

	0	1	2	3	4	5	6	7
Successfully Enabled	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00
IDs do match	0x11	0x11	0x11	0x11	0x11	0x11	0x11	0x11
Frame check error	0x22	0x22	0x22	0x22	0x22	0x22	0x22	0x22
Set to ADR Mode	0x55	0x55	0x55	0x55	0x55	0x55	0x55	0x55
Successfully Disabled	0x66	0x66	0x66	0x66	0x66	0x66	0x66	0x66

3. After a successful response, the Master Relay will need to be restarted (by removing the power) before the CAN shutdown is enabled.

Specifications

Connection

Battery Terminal:	Copper Plated Stud M6
Output Terminal:	Copper Plated Stud M6
Mating Interface Connector:	8STA6-04-06SN Pin 1: Ground Pin 2: Driver Switch Pin 3: External Switch Pin 4: PDM / ECU Output Pin 5: CAN Low Pin 6: CAN High

Power Supply

Operating Voltage:	8 to 30 V
Operating Current:	0.03 A (Normal) 0.02 A (Isolated) 0.001 A (Power saving)

Operating Conditions

Temperature:	-20 to 100 °C
IP Rating:	IP63

PDM / ECU Output

Drive Type:	Configurable, (see *PDM / ECU Connection*)
Output Voltage:	$V_{battery}$
Max Current:	200mA (maintained)

Switched Current

Maintained Current:	200 A
Peak Current:	1000 A

Current Measurement

Sensitivity:	0.5 A (Up to 100A) 5.0 A (Over 100A)
Calibration Error:	±10% or 1 A
Range:	-255 to 600 A

Temperature Measurement

Sensitivity:	0.2 °C
Calibration Error:	± 3°C
Range:	0 to 125°C

CAN Bus

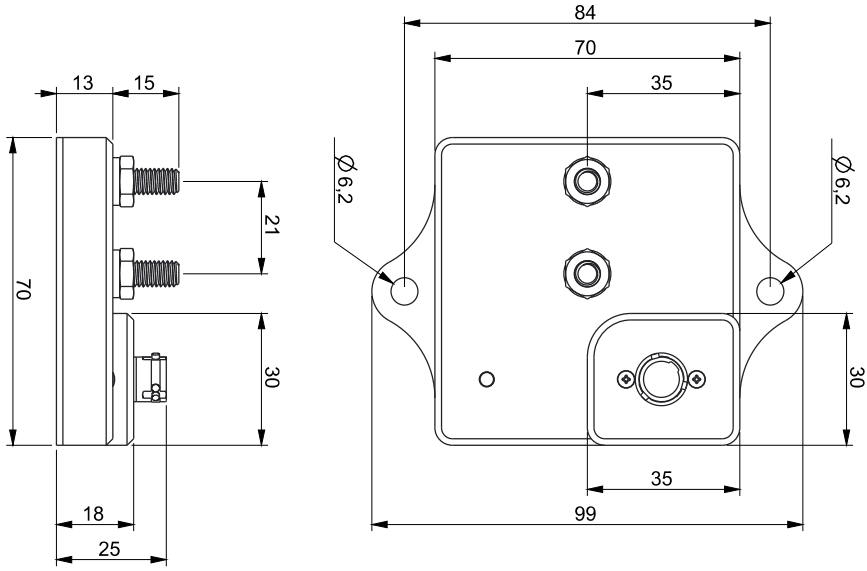
Baud Rate:	Configurable (Default: 1Mbps)
Transmit Addresses:	Configurable (Default: 0x6E4, 0x6E5)
Termination Resistor:	External required

Physical

Mass:	115 g

Drawing

All dimensions are in mm



Revision History

v1.0 – November 2016

Serial No. up to 61060

Initial Release

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v1.1 – October 2017

Serial No. 61061 on

Added '2nd Shutdown Cause' to the CAN messaging. This gives the last two reasons for shutdown, allowing logging the original shutdown event to be seen, even after a 'reset'.

Master Relay User's Manual
Rev 1.1, October 2017

www.msel.com | sales@msel.com | +64 9 525 2991