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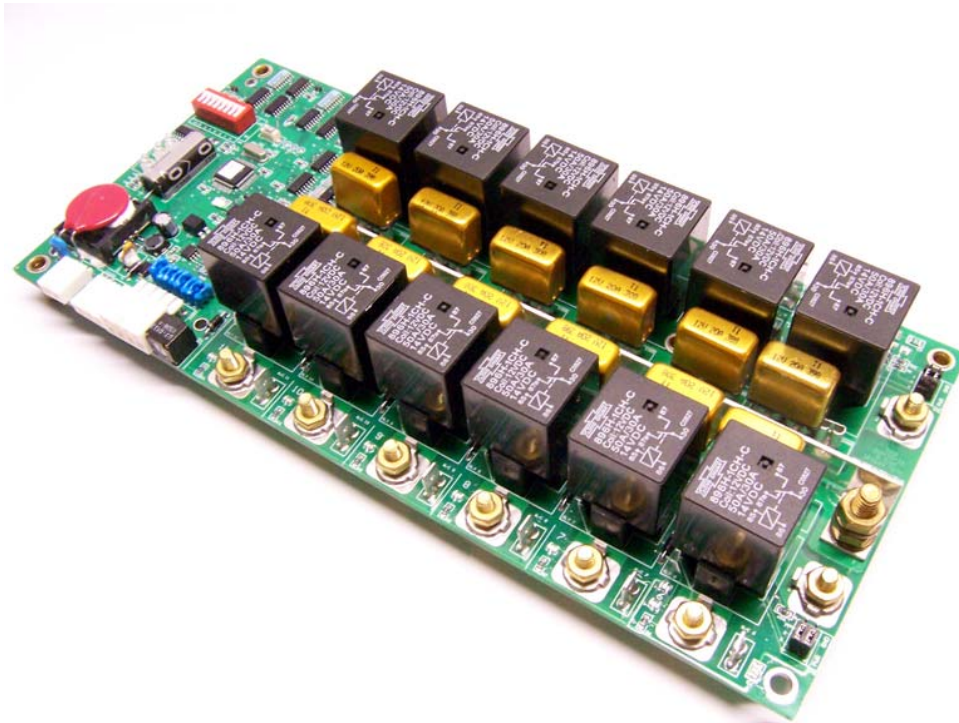
Class 1

ISO 9001 CERTIFIED

607 NW 27th Ave
Ocala, FL 34475
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SUITABLE FOR EXTERNAL DISTRIBUTION

OPERATION MANUAL

ES-Key
12- Relay Board

P/N 103190 and 103338

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	PRODUCT	**12-Relay Board**		BY	**AMS**

1.   Revision Log

Rev	Date	Approved	Changes
1.00	5-12-2009	AGK	Initial requirements
1.10	10-13-2009	MH	Made corrections to section 3.3 regarding input polarity configuration

2. Overview

2.1. Part numbers

103190 - 12-relay outputs (10 positive polarity, 2 selectable polarity), 8 inputs (selectable polarity).

103338 - Identical to the 103190 but includes a metal cover.

2.2. Module description

The ES-Key 12-relay board (p/n 103190, 103338) is designed with the ability to be utilized within an ES-Key electrical system network to control distributed loads in the same manner as other ES-Key output modules.

2.3. ES-Key module type

The ES-Key 12-relay board is designated as a Power Distribution Module (PDM) within the ES-Key network.

2.4. ES-Key module input/output memory space

The ES-Key 12-relay board uses standard ES-Key input/output memory space mapping to control the state of the outputs and report the state of the inputs.

- **Input space** contains the physical input states of the relay board as *reported to* the ES-Key network.
- **Output space** contains the desired output states of the relay board as *commanded by* the ES-Key network.

INPUT MEMORY SPACE	
INPUT	**DESCRIPTION**
0	Physical input 0 is active
1	Physical input 1 is active
2	Physical input 2 is active
3	Physical input 3 is active
4	Physical input 4 is active
5	Physical input 5 is active
6	Physical input 6 is active
7	Physical input 7 is active
8	* Output detected on N/O of relay 0
9	* Output detected on N/O of relay 1
10	* Output detected on N/O of relay 2
11	* Output detected on N/O of relay 3
12	* Output detected on N/O of relay 4
13	* Output detected on N/O of relay 5
14	* Output detected on N/O of relay 6
15	* Output detected on N/O of relay 7
16	* Output detected on N/O of relay 8
17	* Output detected on N/O of relay 9
18	* Output detected on N/O of relay 10
19	* Output detected on N/O of relay 11
20	* Output NOT detected on N/O of relay 0
21	* Output NOT detected on N/O of relay 1
22	* Output NOT detected on N/O of relay 2
23	* Output NOT detected on N/O of relay 3
24	* Output NOT detected on N/O of relay 4
25	* Output NOT detected on N/O of relay 5
26	* Output NOT detected on N/O of relay 6
27	* Output NOT detected on N/O of relay 7
28	* Output NOT detected on N/O of relay 8
29	* Output NOT detected on N/O of relay 9
30	* Output NOT detected on N/O of relay 10
31	* Output NOT detected on N/O of relay 11

OUTPUT MEMORY SPACE	
OUTPUT	**DESCRIPTION**
0	Relay output 0 energize command
1	Relay output 1 energize command
2	Relay output 2 energize command
3	Relay output 3 energize command
4	Relay output 4 energize command
5	Relay output 5 energize command
6	Relay output 6 energize command
7	Relay output 7 energize command
8	Relay output 8 energize command
9	Relay output 9 energize command
10	Relay output 10 energize command
11	Relay output 11 energize command

*Note: these input memory space tags are asserted only if the associated output memory space is active.*

2.5. Relay outputs

The ES-Key 12-relay board has 10 positive polarity relay outputs (1, 2, 3, 4, 5, 7, 8, 9, 10, and 11) and 2 selectable polarity relay outputs (0 and 6).
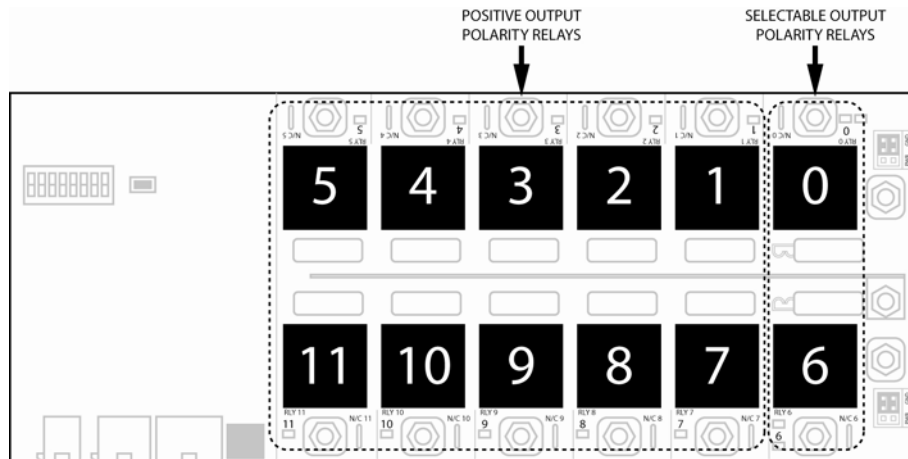
Each relay is capable of supplying 20 Amps continuously has a Normally Open (N/O) *stud* and a Normally Closed (N/C) *terminal* that may be used as required.
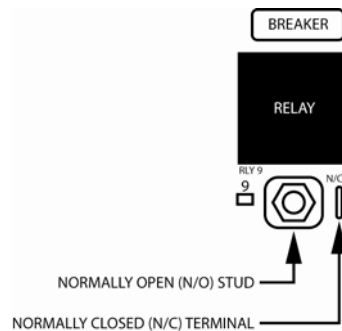
2.5.1. Thermal circuit breakers

Each relay has an associated thermal circuit breaker rated for 20 Amps at 12 Volts. These breakers are thermally controlled with a self-resetting mechanism. A tripped (open) breaker is reset by disconnecting the output load or switching off the supply voltage for a short time (less than 35 seconds).

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2.5.2. Positive polarity output relays

Relays 1, 2, 3, 4, 5, 7, 8, 9, 10, and 11 are positive polarity outputs. The positive voltage applied to the busbar stud is sw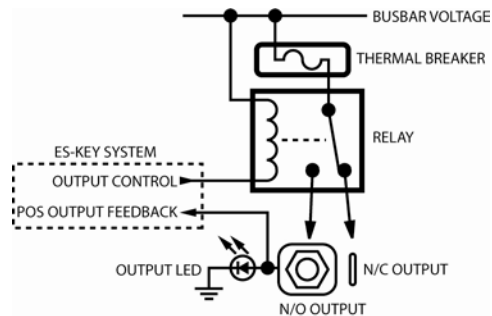itched through the relay's Normally Open (N/O) and Normally Closed (N/C) contacts based upon the output control message from the ES-Key database (ES-Key output memory space 1, 2, 3, 4, 5, 7, 8, 9, 10, and 11). The Normally Open (N/O) stud has a diagnostic LED (green) attached for visual indication of the output status. The output is also routed back to the ES-Key system for use with database diagnostics. This feedback is mapped into the relay module's ES-Key input memory space (see section 2.4).

2.5.3. Selectable polarity output relays

Relays 0 and 6 have selectable output polarity. The position of the relay's thermal breaker dictates which polarity is switched through the relay's Normally Open (N/O) and Normally Closed (N/C) contacts. Control of the relay is based upon the output control message from the ES-Key database (ES-Key output memory space 0 and 6). The Normally Open (N/O) stud has a diagnostic LED (green) attached for visual indication of the output status. The output is also routed back to the ES-Key system for use with database diagnostics. This feedback is mapped into the relay module's ES-Key input memory space (see section 2.4).
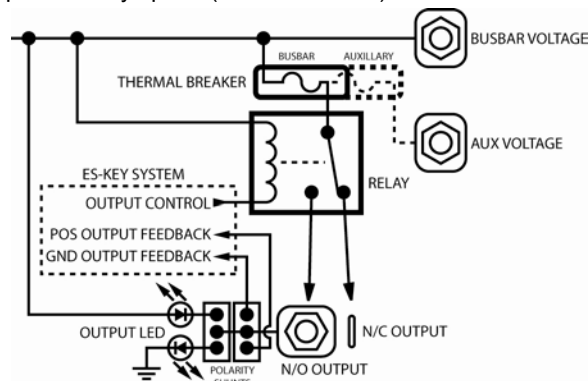
2.5.4. Normally Open (N/O) stud

The Normally Open (N/O) stud is designed for use with a #10 ring terminal. The Normally Open (N/O) stud is ACTIVE when the associated relay is energized by the ES-Key network (section 2.4, output memory space).

For example, when the relay board's output space 2 is ACTIVE then relay 2 is energized and voltage from the busbar stud is routed to the relay's Normally Open (N/O) stud.

2.5.5. Normally Closed (N/C) terminal

The Normally Closed (N/C) terminal is designed for use with a ¼ inch push-on female spade terminal. The Normally Closed (N/C) terminal is ACTIVE when the associated relay is NOT energized by the ES-Key network (section 2.4, output memory space).

For example, when the relay board's output space 2 is NOT ACTIVE then relay 2 is NOT energized and voltage from the busbar stud is routed to the relay's Normally Closed (N/C) terminal.

2.6. Physical inputs

The ES-Key 12-relay board has 8 selectable polarity (ground or power) inputs accessible through the 8-pin input connector (see section 4.1.1).
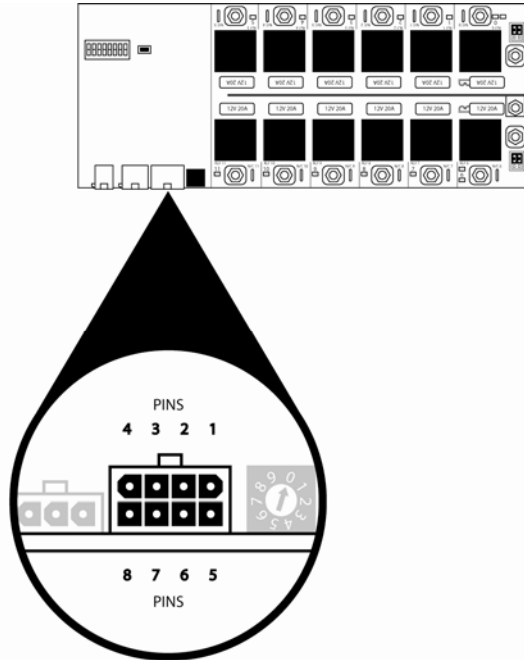
ES-KEY INPUT	PHYSICAL PIN
INPUT 0	PIN 1
INPUT 1	PIN 2
INPUT 2	PIN 3
INPUT 3	PIN 4
INPUT 4	PIN 5
INPUT 5	PIN 6
INPUT 6	PIN 7
INPUT 7	PIN 8

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3. Configuration

### 3.1. Selectable polarity output relay configuration (relays 0 and 6)

The thermal breaker associated with relays 0 and 6 dictate the voltage source for relays 0 and 6 and must be placed correctly to ensure desired voltage polarity and operation.

- **Positive output polarity** comes from the voltage applied to the standard busbar.
- **Ground output polarity** comes from the voltage applied to the relay's auxiliary stud.

Configure the relay to use **positive output polarity** (main busbar stud voltage) by placing the relay's thermal breaker into the two terminals furthest from the edge of the relay board.
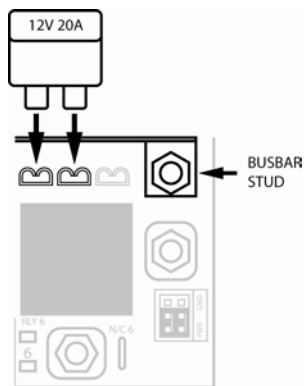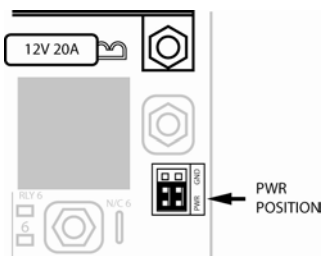
Configure the relay to use **ground output polarity** (auxiliary stud voltage) by placing the relay's thermal breaker into the two terminals closest to the edge of the relay board.
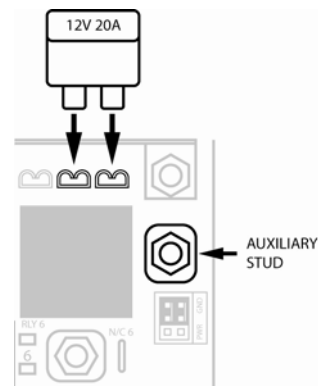
3.1.1. Output Polarity shunt

The output polarity shunt routes the relay's Normally Open (N/O) output voltage to its proper diagnostic LED and notifies the ES-Key feedback system of the configured output circuit polarity

Configure the output polarity shunt for use with **positive output polarity** (main busbar stud voltage) by placing the relay's shorting jumper onto the shunt's **PWR** position.

Configure the output polarity shunt for use with **ground output polarity** (auxiliary stud voltage) by placing the relay's shorting jumper onto the shunt's **GND** position.
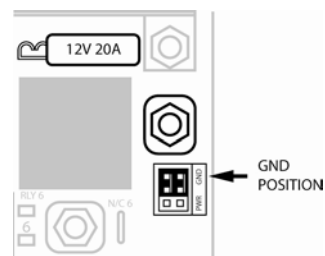
Note: The ES-Key system will report an output fault if the output polarity shunt is configured incorrectly (or not installed) for the output voltage. For example, the ES-Key system will log a fault when the output polarity shunt is set to the GND position but the activated relay is outputting positive voltage. This is also true if the shunt is not installed.

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Make certain that the jumper is placed onto the output polarity shunt correctly.

The shorting element of the jumper must be aligned as shown in the picture for proper operation.

The three shunts located nearest the PWR/GND lettering are used to notify the microprocessor as to the configured output polarity.

The three shunts located away from the PWR/GND lettering are used to route the output voltage to the relay's proper diagnostic LED.
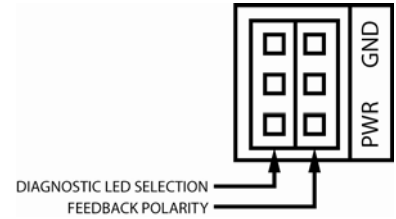
3.2. ES-Key module address configuration

The ES-Key 12-relay board may be configured for an address of 0 through 9 by selecting the desired address value on the board's address switch. Point the arrow of the switch toward the desired address value.

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3.3. Input polarity configuration

The ES-Key 12-relay board has 8 inputs which can be configured for either positive or ground input polarity.
Locate the input *polarity configuration switch* (SW4) and place the switch's individual positions to the polarity desired for each input.
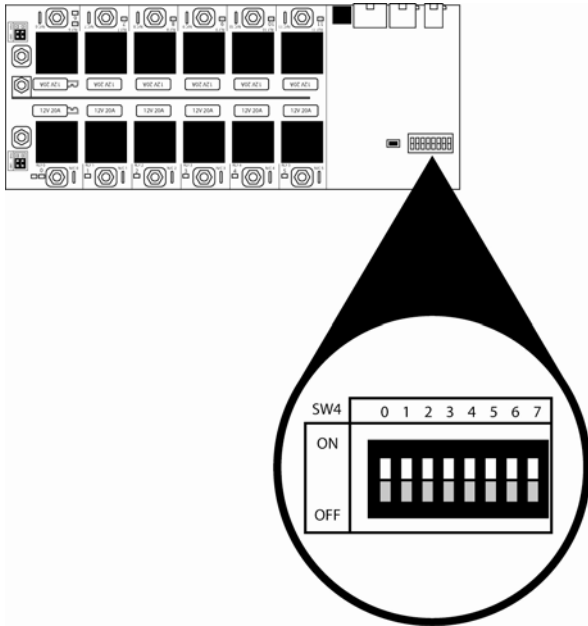
SW4	POSITION	POLARITY
0	ON	INPUT 0 = GROUND
	OFF	INPUT 0 = POSITIVE
1	ON	INPUT 1 = GROUND
	OFF	INPUT 1 = POSITIVE
2	ON	INPUT 2 = GROUND
	OFF	INPUT 2 = POSITIVE
3	ON	INPUT 3 = GROUND
	OFF	INPUT 3 = POSITIVE
4	ON	INPUT 4 = GROUND
	OFF	INPUT 4 = POSITIVE
5	ON	INPUT 5 = GROUND
	OFF	INPUT 5 = POSITIVE
6	ON	INPUT 6 = GROUND
	OFF	INPUT 6 = POSITIVE
7	ON	INPUT 7 = GROUND
	OFF	INPUT 7 = POSITIVE

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4. Wiring and Mounting

4.1. Connector description

The ES-Key 12-relay board has three (3) connectors and the following definitions apply:

4.1.1. Input connector

Mating connector:	Amp 794821-1 (Mini-Universal Mate-N-Lok)	
Mating sockets:	Amp 770988-1	
Connector seal:	Amp 794772-8	
Wire seal:	Amp 794758-1	
Recommended wire gage:	16-20 AWG	
PIN	**CIRCUIT**	**DESCRIPTION**
1	INPUT 0	(INPUT) – polarity selectable (positive, ground)
2	INPUT 1	(INPUT) – polarity selectable (positive, ground)
3	INPUT 2	(INPUT) – polarity selectable (positive, ground)
4	INPUT 3	(INPUT) – polarity selectable (positive, ground)
5	INPUT 4	(INPUT) – polarity selectable (positive, ground)
6	INPUT 5	(INPUT) – polarity selectable (positive, ground)
7	INPUT 6	(INPUT) – polarity selectable (positive, ground)
8	INPUT 7	(INPUT) – polarity selectable (positive, ground)
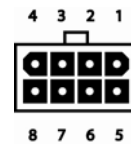
4.1.2. Communication connector

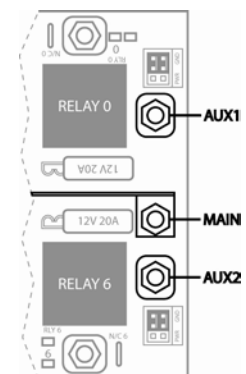| Mating connector:	Amp 172166-1 - Mini-Universal Mate-N-Lok	
Mating sockets:	Amp 770988-1	
Connector seal:	Amp 794772-8	
Recommended wire gage:	16-20 AWG	
PIN	**CIRCUIT**	**DESCRIPTION**
1	CAN HIGH	(DATA) – ES-Key CAN 2.0B, 250Kbits/s
2	CAN SHIELD	(DATA) – ES-Key CAN 2.0B, 250Kbits/s
3	CAN LOW	(DATA) – ES-Key CAN 2.0B, 250Kbits/s

4.1.3. Power connector

Mating connector:	Amp 172165-1 - Mini-Universal Mate-N-Lok	
Mating sockets:	Amp 770988-1	
Connector seal:	Amp 794772-8	
Recommended wire gage:	16-20 AWG	
PIN	**CIRCUIT**	**DESCRIPTION**
1	SUPPLY (+)	(INPUT) – battery voltage (+9VDC...+14VDC)
2	SUPPLY (-)	(INPUT) – battery ground

4.1.4. Relay power input studs

Mating connector:	¼-20 ring terminal	
STUD	**CIRCUIT**	**DESCRIPTION**
MAIN	RELAY POWER	(INPUT) – battery voltage (+9VDC...+14VDC) Provides power for relays

Mating connector:	#10 ring terminal	
STUD	**CIRCUIT**	**DESCRIPTION**
AUX1	RELAY 0 AUX	(INPUT) – battery voltage or ground Provides auxiliary power for relay 0
AUX2	RELAY 6 AUX	(INPUT) – battery voltage or ground Provides auxiliary power for relay 6

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4.2. Mounting detail

The ES-Key 12-relay board has four (4) mounting holes. Dimensions are in inches and [millimeters].

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5.   Diagnostics

5.1.   Diagnostic LEDs

The ES-Key 12-relay board has three (3) diagnostic LEDs (PWR1, PWR2, and STAT). These LEDs can be used to determine various conditions of the relay board.
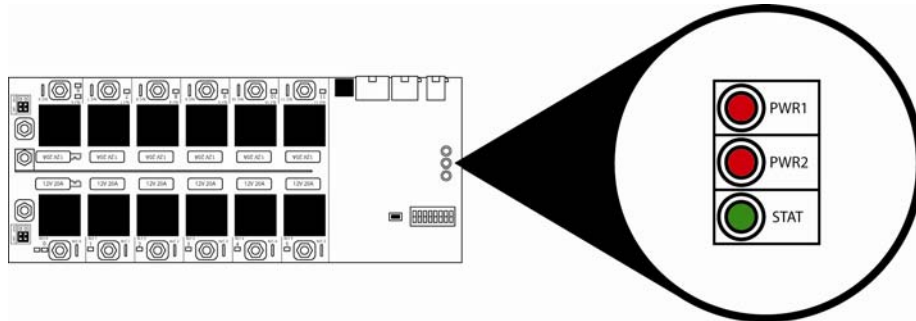
LED	STATE	DESCRIPTION
PWR2 (red)	OFF	No power to the relay board's power connector (see section 4.1.3).
	ON	Power is applied to the relay board's power connector.
PWR1 (red)	OFF	No power applied to the relay board's busbar stud.
	ON	Power is applied to the relay board's busbar stud.
STAT (green)	OFF	No CAN communications connection to the relay board.
	FLASHING (1Hz)	CAN communications okay, but relay board is not recognized or configured in the ES-Key network.
	FLASHING (5Hz)	CAN communications okay, but relay board has an address conflict with another module configured in the ES-Key network.
	FLASHING (10Hz)	Relay board is in self test mode (see section 5.2).
	ON	CAN communications okay, relay board is active.

5.2.   Diagnostic self-test

The ES-Key 12-relay board has diagnostic self-test (test button) which may be used to verify the physical inputs and the relay control functions.

1.   Unplug the CAN connector from the 3-pin communication connector (section 4.1.2).

2.   Apply power to the 2-pin power connector (section 4.1.3).

3.   Unplug the 8-pin input connector (section 4.1.1).

4.   Press and hold the test button (SW5) for the duration of the test. The STAT diagnostic LED will flash quickly (see section 5.1).

5.   Apply the configured polarity to the pins of the input connector. See section 3.3 for the input configuration table and section 4.1.1 for the input connector pin description. A corresponding output relay will activate for each input.

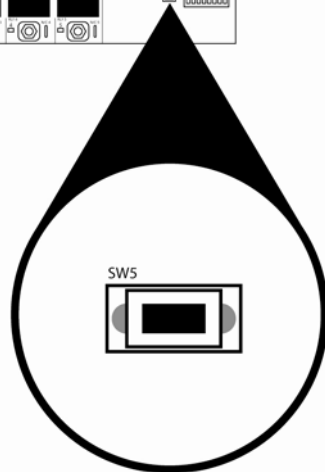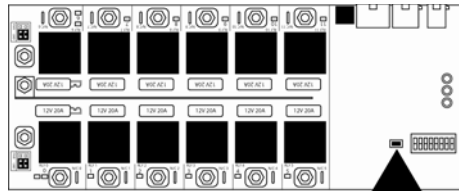|		PAGE	13 of 13
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SW5

INPUT PIN	ACTIVATED RELAY
PIN 1	RELAY 0
PIN 2	RELAY 1
PIN 3	RELAY 2
PIN 4	RELAY 3
PIN 5	RELAY 4
PIN 6	RELAY 5
PIN 7	RELAY 6
PIN 8	RELAYS 7, 8, 9, 10, and 11

6. Technical details

6.1. Technical details

Product category	ES-Key
Voltage range	+9VDC…+14VDC
Power consumption @13.8VDC (25ºC)	65 mA (logic circuitry)
Operational temperature range	-40ºC…+85ºC
CAN specification	SAE J1939 proprietary, 250 Kbits/second
Protection	Internal thermal fuse (logic circuitry) Thermal circuit breakers (relay outputs) Reverse voltage protection (pins 1 and 2 of 2-pin power connector) CAN buses protected to 24V ESD voltage protected to SAE J1113 specification for heavy duty trucks Transient voltage protected to SAE J1113 specification for heavy duty trucks
Dimensions (W x H x D) in inches [mm]	5.000 [127.00] x 11.000 [279.40] x 2.150 [54.61]

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