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Technical Data Sheet

UNIVERSAL SYSTEM MANAGER

Project#: 108138

REV: 1.00 06-03-2003

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DEPARTMENT	ELECTRONICS	PROJECT#	108138	REV	A
PRODUCT	USM (UNIVERSAL SYSTEM MANAGER)			BY	TEB

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1. Revision Log

Rev	Date	Changes
1.00	10-04-03	Initial requirements

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2. USM Module Overview

ES-Key™ module p/n 108138 is a solid-state module that controls and monitors the ES-Key™ network database. The module is referred to as the Universal System Manager (USM). In the ES-Key™ network, the USM is responsible for arbitrating the network variables to each module, monitoring faults and diagnostics and controlling electrical load management functions. The USM has 4 inputs and 3 outputs. The polarity of the inputs is selectable by the end user. The module reports the state of the inputs to the network and will activate the outputs on command from the network.

2.1. 4 Digital Inputs

The USM has 4 digital inputs, each with configurable input polarity. An input is considered to be active under the following conditions:

POLARITY	INPUT REQUIREMENTS
GROUND	INPUT "ON" WHEN V_{INPUT} < 40% $V_{IGNITION}$
POSITIVE	INPUT "ON" WHEN V_{INPUT} > 60% $V_{IGNITION}$

2.2. 3 Solid State Outputs

The module has three solid-state high side ($V_{ignition}$) outputs. The outputs are capable of supplying 0.25 amps to power components such as relays, solenoids or indicators.

2.3. Device Address Selection

There can be only one USM in an ES-Key™ network; there is no address configuration switch.

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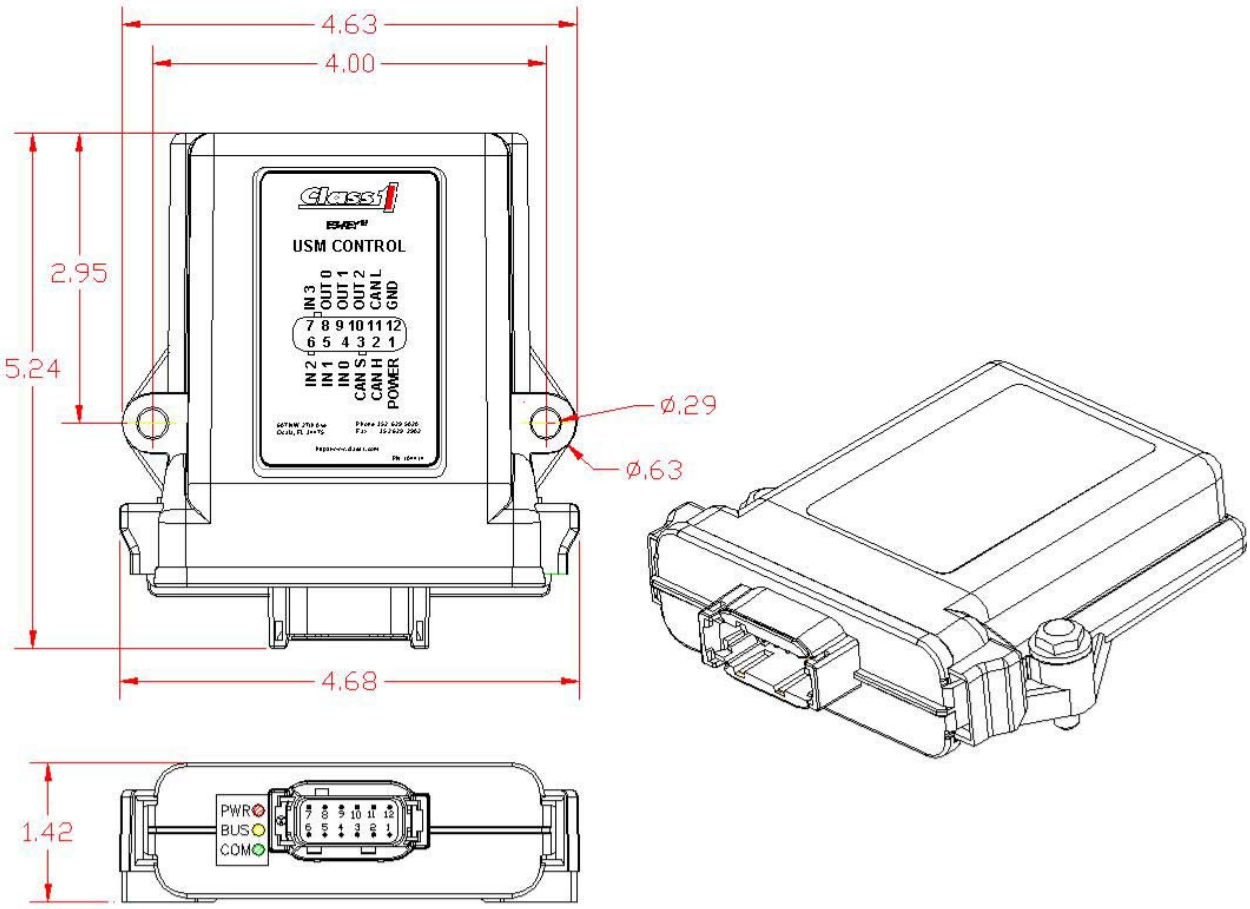
3. MOUNTING AND DIMENSIONS



The module should be mounted so that the connector face and seal are not in direct water spray. Wires must be of correct size to properly seal within the mating Deutsch connector. All unused sockets must be filled with appropriate fill plug. Do not mount the module in an area of excessive heat or vibration.

4. Load Management

4.1. Load Control

4.1.1. Load Sequencing:

Attached loads turn on and off in sequential order to reduce potential instant high current (in-rush) demand on electrical charging system.

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4.1.2. Load Shedding:

Attached loads are turned off to reduce demand on charging system once the battery voltage has dropped below a specified threshold.

4.2. Modes of Operation

Modes of operation are defined by two inputs.

4.2.1. Mode Input:

Allows load to be operated in either one, or both, of two independent modes of operation. The mode of operation is determined by an input in the system.

Examples

a) In the fire service the park brake input can be used to define two modes of operation – Scene mode (when the park brake input is active) and Response mode (when the park input is not active).

b) In the police car application, an input can be configured to define Pursuit mode (when chasing a bad person) or non-pursuit mode.

4.2.2. Stage/Enable Input:

Allows a load to be enabled in the desired mode only when the stage input is active; a load that that is attached to the stage input will otherwise be controlled off.

Examples

a) In the fire service the warning master switch can be used as an input to enable and control the warning lights. This effectively allows an operator to control all warning light functions with a single activation of a switch.

4.3. High Idle Control

4.3.1. High Idle:

Allows interface and activation of the vehicle high idle system.

4.3.2. High Idle Cancel:

Disables high idle system for a short period of time, useful while shifting PTO devices.

4.4. Associating the Mode Inputs

Mode inputs can be associated or “multiplexed” to any input or output in the ES-Key Network. System Memory Module #15 (Utility Module) outputs are utilized for the mode associations. The specific utility module outputs that are associated with load management functions are defined in the following table.

Refer to ES-Key manual for instructions on multiplexing outputs.

Function I/O Description

Function	I/O	Description
High Idle Cancel	Output-0	When this output is activated by the network database, the USM will cancel the high idle request, the request will be cancelled 10 seconds after the output is off.
Load Management Enable	Output-1	When this output is activated by the network database, the USM will enable all load management functions. If this function is OFF, load shedding and high idle functions will be disabled.
Mode Input	Output-2	When this output is activated by the network database, the USM will enable the secondary mode (Mode B) of the load management system. In fire apparatus, this is typically referred as scene mode.
Stage Input	Output-3	When this output is activated by the network database, the USM will enable the stage input of the load management system. In fire apparatus, this is typically referred as the master warning switch.
24 Volt Values	Output-13	When this output is activated by the network database, the USM will use the 24-volt values for the load management system.
Low Voltage	Input-1	SM input-1 will turn on whenever the average system voltage drops to (or below) 11.8 volts (23.6) for more than 10 seconds.
High Idle	Input-2	The high idle input is activated whenever load management is enabled and the average system voltage drops to 12.8 volts (25.6). Once activated, the high idle request input will remain on until the feature is manually cancelled or the voltage recovers above 12.8 volts for more than three minutes.

4.5. Load Sequencing and Operating Mode

Load sequencing is a method by which loads are sequentially turned on and off to prevent an instantaneous high current in-rush in the electrical system. The operating mode feature allows an output to be easily associated with a common application operating condition (defined by the technician).

A typical application may be represented by a vehicle that has multiple high current halogen scene (spot) lamps mounted about the vehicle. When the Scene Light switch is activated, the

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independent lamps can be configured to turn on sequentially, thereby reducing the instantaneous load on the charging system.

There are four discrete sequence positions that can be associated with a specific load: SEQLVL-1, SEQLVL-2 SEQLVL-3 and SEQLVL-4. Sequencing occurs whenever an operating mode changes or when the stage input is activated or deactivated.

The following example demonstrates load sequencing and operating mode.

Example – Load Sequencing and Mode Operation

Stage Input: multiplexed to the Warning Master switch

Mode Input: multiplexed to park brake input

LOAD DESCRIPTION	SEQ LVL	SCENE MODE	RESP MODE	STAGE WARN SW
LD1	1	X		
LD2	2	X		
LD3	3	X		X
LD4	4	X		X
LD5	1		X	X
LD6	2		X	X
LD7	3		X	X
LD8	4		X	X

4.5.1. The vehicle is powered up with the park brake set (Scene Mode):

LD1 – LD2 sequence **on** at 0.5-second interval

4.5.2. The master Warning (stage) switch is turned on:

LD3 – LD4 sequence **on** at 0.5-second interval

4.5.3. The park brake is released and the vehicle responds (Response Mode)

LD5 – LD6 – LD7 – LD8 sequence **on** at 0.5 sec interval

LD4 – LD3 – LD2 – LD1 sequence **off** at 0.5 sec interval

4.5.4. The emergency call is cancelled and the Master Warning (stage) switch is toggled off.

LD8 – LD7 – LD6 – LD5 sequence **off**

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4.6. Load Shedding

Attached loads are turned off to reduce demand on charging system once the battery voltage has dropped below a specified threshold. In certain circumstances, the connected electrical load on a vehicle can exceed the output capacity of the alternator. This can occur for several reasons, including a broken alternator drive belt. In this situation, the battery will discharge and the voltage will drop.

A typical application may be represented by vehicle with large electrical loads and several air conditioning units. If the voltage drops to a predetermined level, the large current loads of the air conditioning system (or other large loads) can be disconnected from the electrical system thereby decreasing the rate of battery discharge. This load management feature can play an important role in enabling the vehicle more time to perform its primary function (for example, fire pump operation).

There are eight levels (or priorities) that can be assigned to any output in the ES-Key system. These levels define the point at which attached loads are disconnected from the system (turned off).

The following definitions apply to Load Management Shedding:

4.6.1. Shed Voltage:

Defines a critical voltage level that requires an attached load to be shed. Each shed level has an associated priority level.

4.6.2. Unshed Voltage:

Defines the voltage level that requires a load to be reconnected to the electrical system. This voltage is any voltage that exceeds the shed voltage level for a particular priority.

4.6.3. Shed Interval:

Defines the time allowed prior to a loads being shed as the voltage drops to or below a shed voltage. This time prevents rapid occurrence of load shedding due to normal voltage transients (starting, low duty electrical motors, etc.) The shed interval is 30 seconds.

4.6.4. Unshed Interval:

Defines the time allowed prior to loads being unshed as the voltage exceeds the shed voltage. The unshed interval is 10 seconds.

4.6.5. Unshed Interval:

Defines the time allowed prior to loads being unshed as the voltage exceeds the shed voltage. The unshed interval is 10 seconds.

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4.6.6. Priority Level/Shed Voltage Point

Priority Level	Shed Voltage 12V system	Shed Voltage 24V system
7	12.7	25.4
6	12.6	25.2
5	12.4	24.8
4	12.2	24.4
3	12.0	24.0
2	11.8	23.6
1	11.4	22.8
0	No Shed	No Shed

4.7. High Idle

The USM will activate an input whenever load management is enabled and the voltage drops to 12.8 volts. This input can be used (multiplexed) to activate an output and interface to the vehicle/engine high idle system. The following definitions apply to the high idle system:

4.7.1. High Idle Voltage:

The high idle input will remain active as long as the voltage remains at or below the high idle voltage point; that point being 12.8 volts for 12 volt systems and 25.6 volts for 24 volt systems. The input will activate 10 seconds after the voltage reaches the high idle voltage point. The high idle input can be cancelled or disable by various inputs in the load management system (load manage enable and high idle cancel).

4.7.2. High Idle Timer:

Defines the minimum time the high idle input will remain active once the input is activated. This period is 3 minutes, and may be interrupted by the high idle cancel, or load management enable input.

4.7.3. High Idle Cancel:

While this output is active, high idle functions will be deactivated. Activating this output will cancel high idle functions. Upon release of this input, high idle may activate again if voltage is low for the required time period. This allows deactivation of the high idle feature for special circumstances; for example, prior to engaging pto devices.

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5. Connector Description

The module has one connector and the following pin definitions apply:

CONNECTOR A

Mating Connector: Deutsch DTM06-12SA Color: GRAY Wedge Lock: WM-12S
Mating Terminals #16-#20 GA. P/N 1062-20-0122; #18-#24 GA. P/N 0462-201-20141
Gold terminals #18-#24GA. P/N 0462-201-2031 recommended for CAN bus

POSITION	CIRCUIT	DESCRIPTION
1	[S+] SUPPLY +	controller supply – vehicle ignition
2	[CH] CAN High	communications
3	[CS] CAN Shield	communications
4	[I±] INPUT 0	discrete input - polarity selectable
5	[I±] INPUT 1	discrete input - polarity selectable
6	[I±] INPUT 2	discrete input - polarity selectable
7	[I±] INPUT 3	discrete input - polarity selectable
8	[O+] OUTPUT 0	discrete output
9	[O+] OUTPUT 1	discrete output
10	[O+] OUTPUT 2	discrete output
11	[CL] CAN Low	communications
12	[S-] SUPPLY -	controller supply – vehicle ground

6. DEVICE NETWORK I/O MEMORY SPACE (I/O ADDRESSES)

The module inputs and outputs are reported to the network via the following I/O assignments. These circuit attachments are made by using the ES-Key™ PRO software.

MODULE INPUTS (REPORTED TO ES-Key™ NETWORK)

INPUT ADDR	DESCRIPTION
INPUT 0	module input 0: active when ON
INPUT 1	module input 1: active when ON
INPUT 2	module input 2: active when ON
INPUT 3	module input 3: active when ON

MODULE OUTPUTS (COMMANDS FROM ES-Key™ NETWORK)

INPUT ADDR	DESCRIPTION
OUTPUT 0	module output 0 command
OUTPUT 1	module output 1 command
OUTPUT 2	module output 2 command

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7. SYSTEM MEMORY SPACE

The ES-Key™ system has a separate module type that is used for storage - these modules are referred to as System Memory Modules, and reside within the USM. System modules are devices that exist in software - they do not have physical connections, however they are mapped into the valid address space of the network. Their purpose is to allow space for interstitial results to be stored by the database designer (refer to ES-Key™ configuration manual), and to access special features and functions of the USM.

These features include special I/O functions such as simple timers and latches, and file merging utilities.

The following system memory addresses are reserved for use by the ES-Key™ system:

- System Memory Module Address 13-15: reserved for special I/O functions
- System Memory Module Address 8-13: reserved for file merge

System Memory Modules 0-7 can be used by the database designer.

8. Special I/O Functions of the USM

The USM utilizes System Memory input variables that can be used by the system developer to turn on or act upon various functions of the USM. As an example, if the low voltage light was to be at the location of PDMx Output, then that output could be activated by attaching the output to System Memory 15 Input 01 (SI:15-01).

8.1. Flasher

MODULE ADDRESS	I/O ADDRESS	FUNCTION	DESCRIPTION
15	INPUT-0	Flasher	SM input-0 toggles at 2 hertz.

8.2. Low Voltage

MODULE ADDRESS	I/O ADDRESS	FUNCTION	DESCRIPTION
15	INPUT-1	Low Voltage	SM input-1 will turn on whenever the average system voltage drops to (or below) 11.8 volts for more than 10 seconds. For a more detailed description of this output, refer to the load management section of the ES-Key™ manual.

8.3. High Idle Request

MODULE ADDRESS	I/O ADDRESS	FUNCTION	DESCRIPTION
15	INPUT-2	High Idle Request	The high idle request input is activated whenever load management is enabled and the average system voltage drops to 12.8 volts. Once activated, the high idle request input will remain on until the feature is manually cancelled or the voltage recovers above

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			12.8 volts for more than three minutes. For a more detailed description of this output, refer to the load management section of the ES-Key™ manual.

8.4. Fault Active

MODULE ADDRESS	I/O ADDRESS	FUNCTION	DESCRIPTION
15	INPUT-3	Fault Active	The fault active variable is "ON" whenever there is any active fault reported by any of the ES-Key™ network devices. Faults are stored in system memory and may be recalled for review at any time.

9. Load Management Functions

The USM utilizes System Memory output variables, which can be programmed by the system developer to control the state of specific inputs to the load manager. For example – to let the USM know that the high idle cancel input is active, the database must attach system memory module 15, output 0 to activate with the input that controls high idle cancel - such as the foot brake input that may be defined as an input within the system.

9.1. High Idle Cancel

MODULE ADDRESS	I/O ADDRESS	FUNCTION	DESCRIPTION
15	OUTPUT-0	High Idle Cancel	When this output is activated by the network database, the USM will cancel the high idle request, the request will be cancelled 10 seconds after the output is off.

9.2. Load Manage Enable

MODULE ADDRESS	I/O ADDRESS	FUNCTION	DESCRIPTION
15	OUTPUT-1	Load Manage Enable	When this output is activated by the network database, the USM will enable all load management functions. For a more detailed description of this output, refer to the load management section of the ES-Key™ manual.

9.3. Mode Input

MODULE ADDRESS	I/O ADDRESS	FUNCTION	DESCRIPTION
15	OUTPUT-2	Mode Input	When this output is activated by the network database, the USM will enable the secondary mode of the load management system. In fire apparatus, this is typically referred as scene/response mode. For a more detailed description of this output, refer to the load management section of the ES-Key™ manual.

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9.4. Stage Switch

MODULE ADDRESS	I/O ADDRESS	FUNCTION	DESCRIPTION
15	OUTPUT-3	Stage Switch	When this output is activated by the network database, the USM will enable the second stage of the load management system. In fire apparatus, this is typically referred as the master warning switch. For a more detailed description of this output, refer to the load management section of the ES-Key™ manual.

9.5. 24 Volt Values

MODULE ADDRESS	I/O ADDRESS	FUNCTION	DESCRIPTION
15	OUTPUT-13	24 Volt Values	When this output is activated by the network database, the USM will use the 24 volt values for the load management system. For a more detailed description of this output, refer to the load management section of the ES-Key™ manual.

10. Special timer functions

Special timer functions use two system memory locations. The developer can activate (or turn on) the function by writing to the system memory output, and the USM will activate a system memory input when the special function triggers. The input can be used within the system database to meet various application specific requirements.

10.1. Latch 1

MODULE ADDRESS	I/O ADDRESS	FUNCTION	DESCRIPTION
15	OUTPUT-4	Bistable Latch #1	When this output is activated by the network database, the USM will toggle the state of System Memory input-4.
15	INPUT-4	Bistable Latch #1	System Memory input will toggle state (if off, will toggle to on, and vice-versa) on each event of System Memory Output-4 being activated by the system database.

10.2. Latch 2

MODULE ADDRESS	I/O ADDRESS	FUNCTION	DESCRIPTION
15	OUTPUT-5	Bistable Latch #2	When this output is activated by the network database, the USM will toggle the state of System Memory input-5.

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15	INPUT-5	Bistable Latch #2	System Memory input will toggle state (if off, will toggle to on, and vice-versa) on each event of System Memory Output-5 being activated by the system database.

10.3. Latch 3

MODULE ADDRESS	I/O ADDRESS	FUNCTION	DESCRIPTION
15	OUTPUT-14	Bistable Latch #3	When this output is activated by the network database, the USM will toggle the state of System Memory input-14.
15	INPUT-14	Bistable Latch #3	System Memory input will toggle state (if off, will toggle to on, and vice-versa) on each event of System Memory Output-14 being activated by the system database.

10.4. Latch 4

MODULE ADDRESS	I/O ADDRESS	FUNCTION	DESCRIPTION
15	OUTPUT-15	Bistable Latch #4	When this output is activated by the network database, the USM will toggle the state of System Memory input-15.
15	INPUT-15	Bistable Latch #4	System Memory input will toggle state (if off, will toggle to on, and vice-versa) on each event of System Memory Output-15 being activated by the system database.

10.5. Latch 5

MODULE ADDRESS	I/O ADDRESS	FUNCTION	DESCRIPTION
15	OUTPUT-16	Bistable Latch #5	When this output is activated by the network database, the USM will toggle the state of System Memory input-16.
15	INPUT-16	Bistable Latch #5	System Memory input will toggle state (if off, will toggle to on, and vice-versa) on each event of System Memory Output-16 being activated by the system database.

10.6. Latch 6

MODULE ADDRESS	I/O ADDRESS	FUNCTION	DESCRIPTION

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15	OUTPUT-17	Bistable Latch #6	When this output is activated by the network database, the USM will toggle the state of System Memory input-17.
15	INPUT-17	Bistable Latch #6	System Memory input will toggle state (if off, will toggle to on, and vice-versa) on each event of System Memory Output-17 being activated by the system database.

10.7. Latch 7

MODULE ADDRESS	I/O ADDRESS	FUNCTION	DESCRIPTION
15	OUTPUT-18	Bistable Latch #7	When this output is activated by the network database, the USM will toggle the state of System Memory input-18.
15	INPUT-18	Bistable Latch #7	System Memory input will toggle state (if off, will toggle to on, and vice-versa) on each event of System Memory Output-18 being activated by the system database.

10.8. Latch 8

MODULE ADDRESS	I/O ADDRESS	FUNCTION	DESCRIPTION
15	OUTPUT-19	Bistable Latch #8	When this output is activated by the network database, the USM will toggle the state of System Memory input-19.
15	INPUT-19	Bistable Latch #8	System Memory input will toggle state (if off, will toggle to on, and vice-versa) on each event of System Memory Output-19 being activated by the system database.

11. TIMERS

11.1. Timer

MODULE ADDRESS	I/O ADDRESS	FUNCTION	DESCRIPTION
15	OUT-X	Timer Run	When System Memory Output-X activated by the network database, the USM will turn on System Memory Input-X three seconds later.
15	INP-X	Timer Expired	System Memory Input-X will activate 3 seconds after System Memory Output-X is activated by the system database. The input will turn off when the associated output is turned off.

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The following table shows the timers and their respective SM activation I/O.

Timer	Delay (secs)	Run	Reset	Expired
1	3	SM15: OUT 06 = ON	SM15: OUT 06 = OFF	SM15: INP 06 = ON
2	5	SM15: OUT 09 = ON	SM15: OUT 09 = OFF	SM15: INP 09 = ON
3	30	SM15: OUT 10 = ON	SM15: OUT 10 = OFF	SM15: INP 10 = ON
4	5	SM15: OUT 11 = ON	SM15: OUT 11 = OFF	SM15: INP 11 = ON
5	3	SM15: OUT 20 = ON	SM15: OUT 20 = OFF	SM15: INP 20 = ON
6	5	SM15: OUT 21 = ON	SM15: OUT 21 = OFF	SM15: INP 21 = ON
7	30	SM15: OUT 22 = ON	SM15: OUT 22 = OFF	SM15: INP 22 = ON
8	600	SM15: OUT 23 = ON	SM15: OUT 23 = OFF	SM15: INP 23 = ON

11.2. One-Shot Timer Pos

MODULE ADDRESS	I/O ADDRESS	FUNCTION	DESCRIPTION
15	OUTPUT-7	One Shot Output Positive Edge Triggered	When this output toggles on (activated by the network database), the USM will turn on System Memory input-7 for one second and will then turn the input off.
15	INPUT-7	One Shot Output Positive Edge Triggered	System Memory input will activate for 1 second when the state of System Memory Output-7 is toggled on.

11.3. One-Shot Timer

MODULE ADDRESS	I/O ADDRESS	FUNCTION	DESCRIPTION
15	OUTPUT-8	One Shot Output Edge Triggered	When this output toggles on or off (activated or deactivated by the network database), the USM will turn on System Memory input-8 for one second and will then turn the input off.
15	INPUT-8	One Shot Output Edge Triggered	System Memory Input will activate for 1 second when the state of System Memory Output-8 is toggled either on or off.

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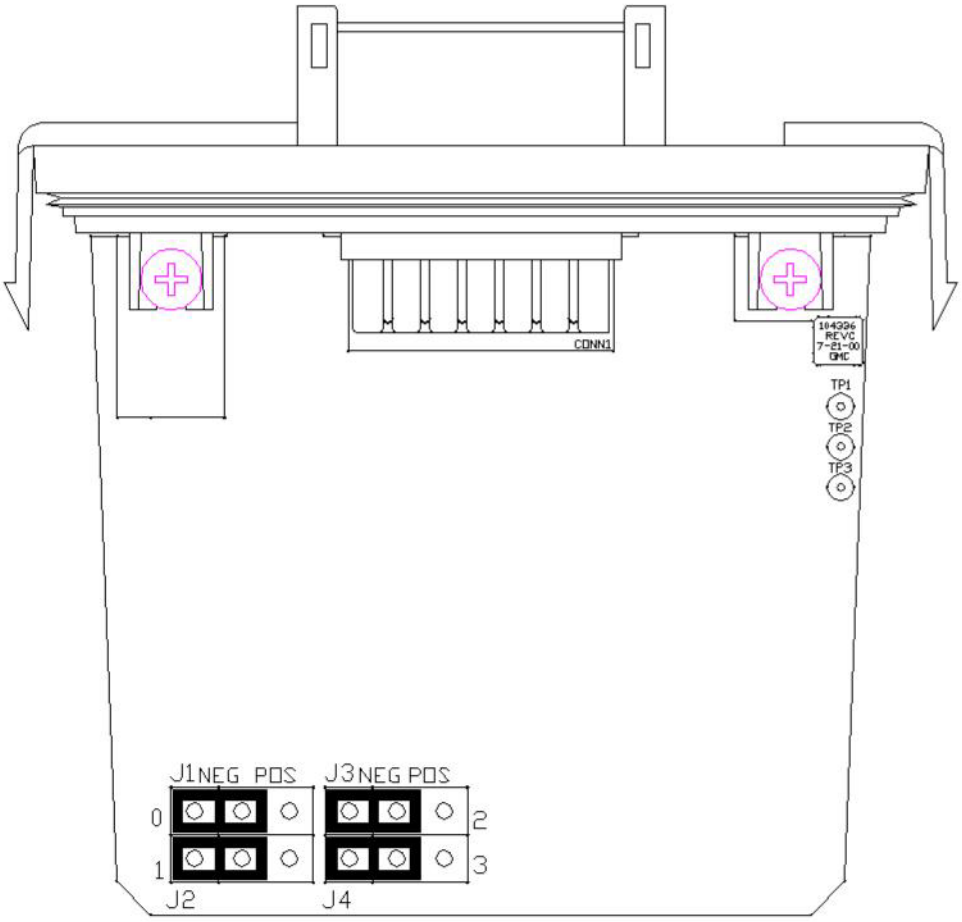
12. Device I/O Configuration

The physical I/O of the module can be configured for both input and output polarity. The configuration switches/jumpers are located on the module circuit card.



SWITCH	POSITION	I/O #	OUTPUT POLARITY CONFIGURATION
J1	GND	INPUT-0	input polarity: ground
	POS		input polarity: positive (ign)
J2	GND	INPUT-1	input polarity: ground
	POS		input polarity: positive (ign)
J3	GND	INPUT-2	input polarity: ground
	POS		input polarity: positive (ign)
J4	GND	INPUT-3	input polarity: ground
	POS		input polarity: positive (ign)

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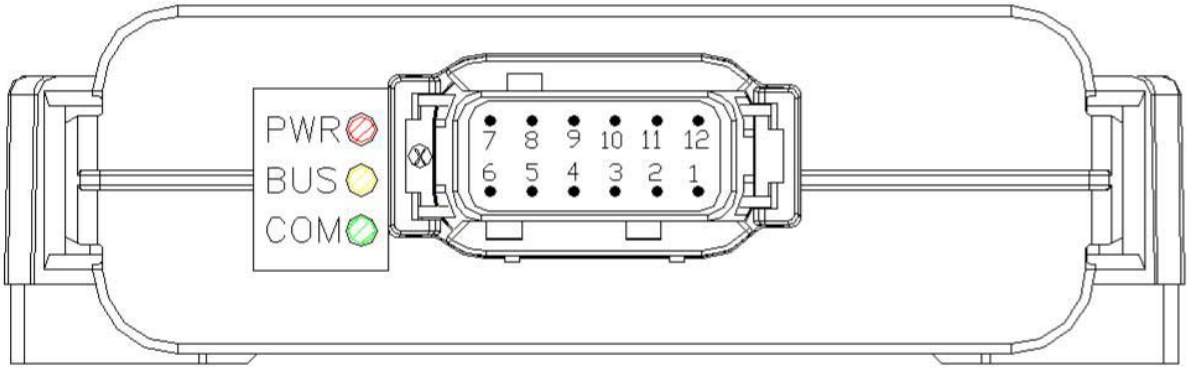
13. DIAGNOSTIC LEDS



The enclosure for each module has 3 diagnostic indicators. These indicators can be used to determine various conditions of the module. The following table describes the various conditions of the indicators.

LED	STATE	DESCRIPTION
PWR (RED)	OFF	indicates no power to the module
PWR (RED)	ON	indicates power to the module
BUS (YEL)	OFF	indicates no power to the output driver bus bar. note that not all modules have a output bus connection - in which case the LED is connected to the internal power of the module.
BUS (YEL)	ON	indicates power to the output driver bus bar; note that not all modules have a output bus connection - in which case the LED is connected to the internal power of the module.
COM (GRN)	OFF	no CAN communications connection to the module
COM (GRN)	FLASH	CAN communications okay, but device not recognized or configured for the network
COM (GRN)	ON	CAN communications okay, module active

14. MODULE OPERATING PARAMETERS

Voltage Supply…… 9.5 - 30 VDC
Temperature…….. -40 - +85 C
Environment…….. IEC Standards IP-65

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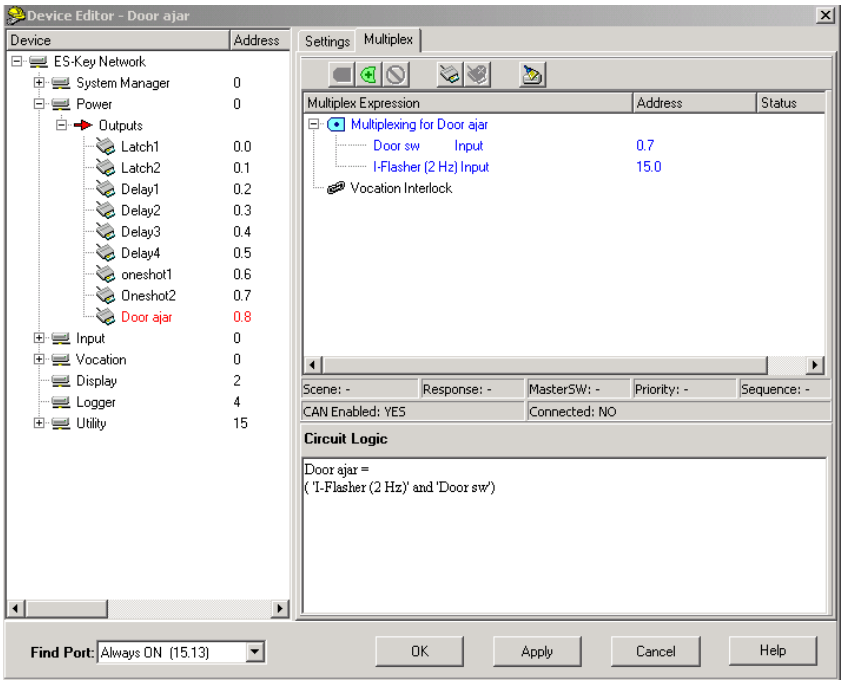
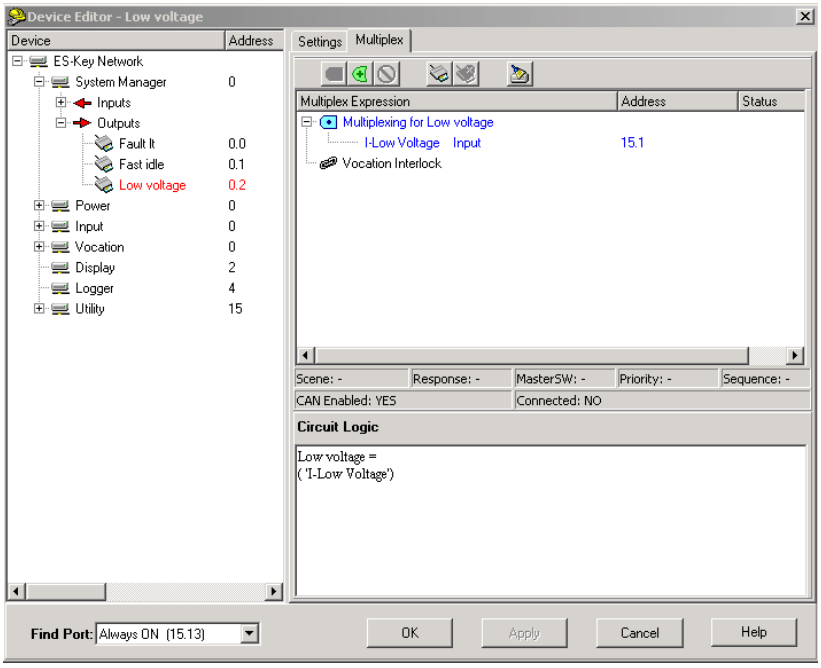
15. LOGIC FLASHER

Flasher can be used to flash any output on the ES-Key Network. See example below:



16. LOGIC LOW VOLTAGE

This enables an output to turn a light or another output on. See example below:



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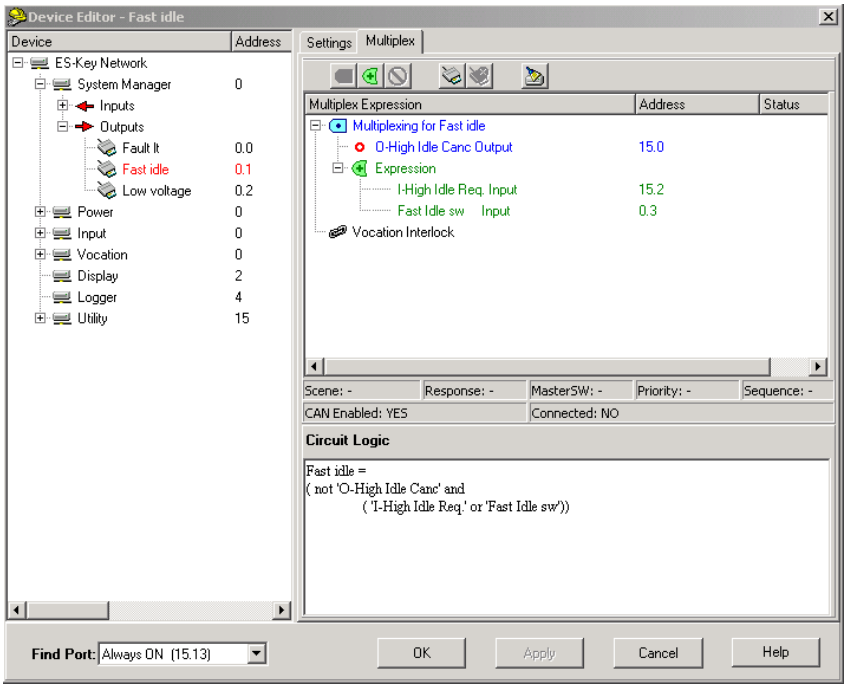
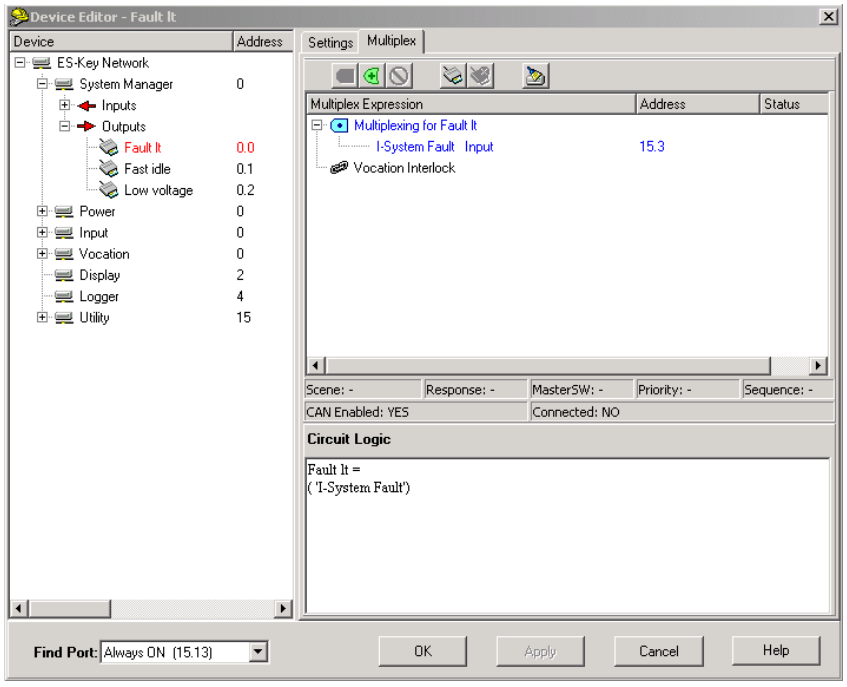
17. LOGIC FAST IDLE

This enables an output when voltage goes below a certain voltage. See example below:



18. LOGIC SYSTEM FAULT

This enables an output when there is an error in the ES-Key Network. See example below:



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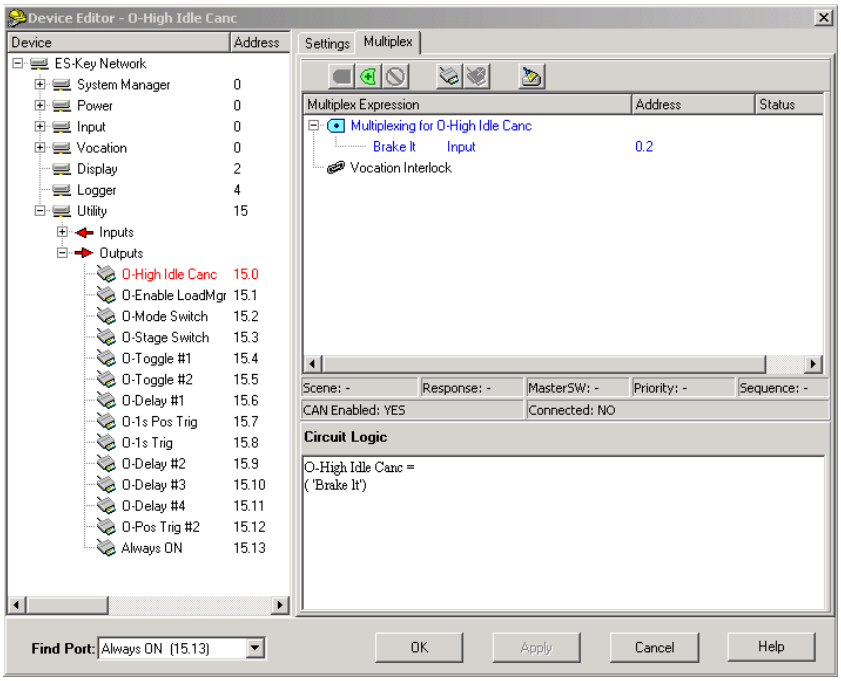
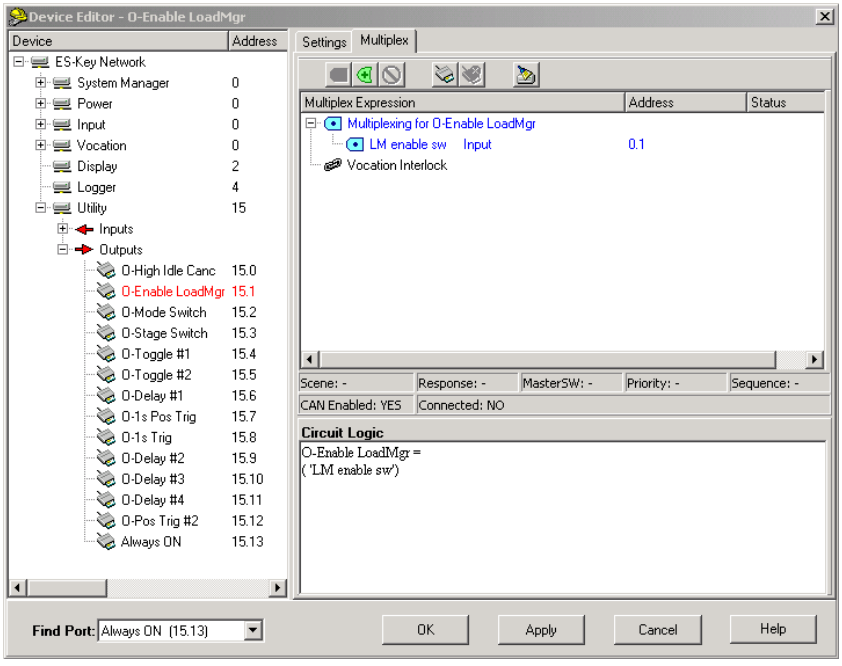
19. LOGIC FAST IDLE CANCEL

This enables an output to disable fast idle for a brief time. See example below:



20. LOGIC LM ENABLE

When this output is active it will enable all load management functions. See example below:



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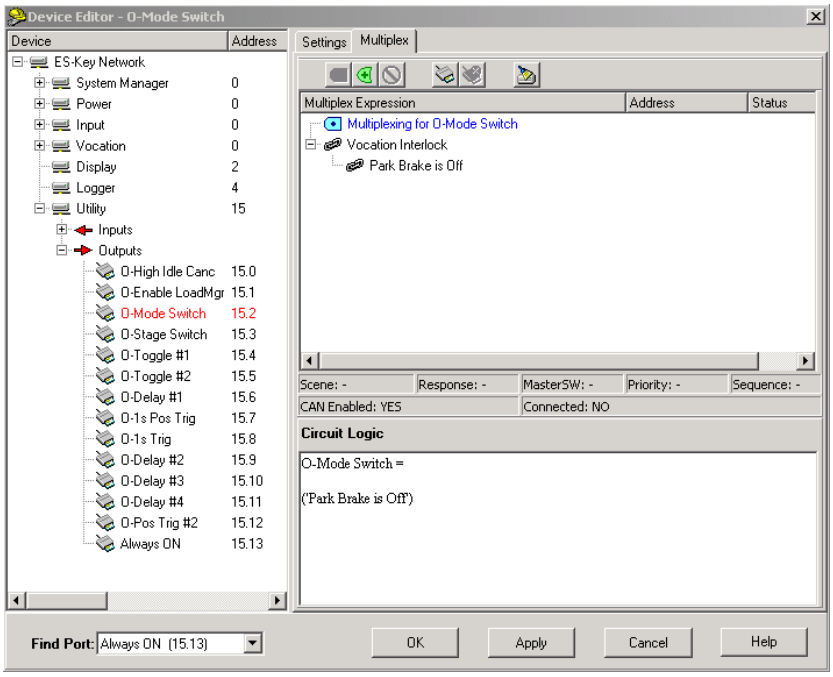
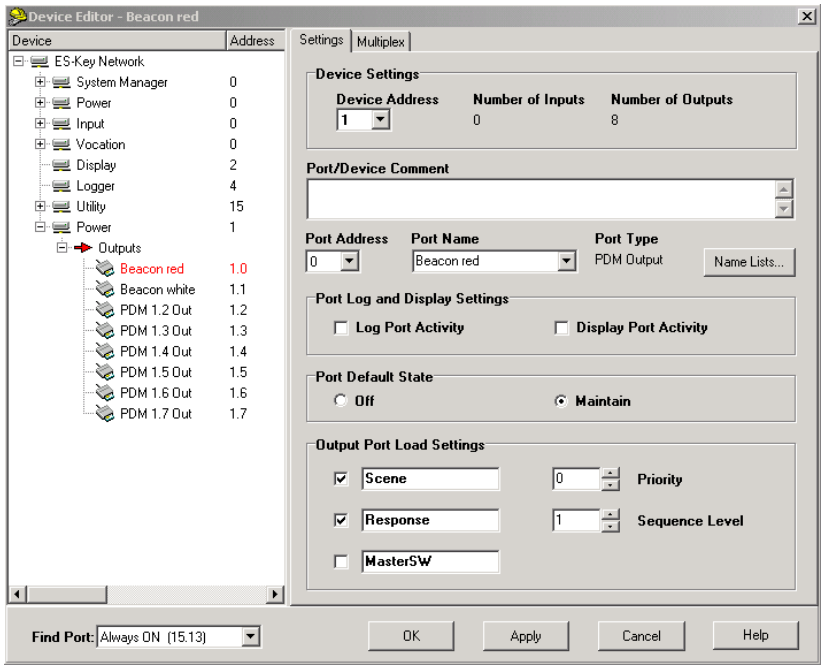
21. LOGIC MODE

This output will turn on certain outputs that are tied to scene or response mode. See example below:





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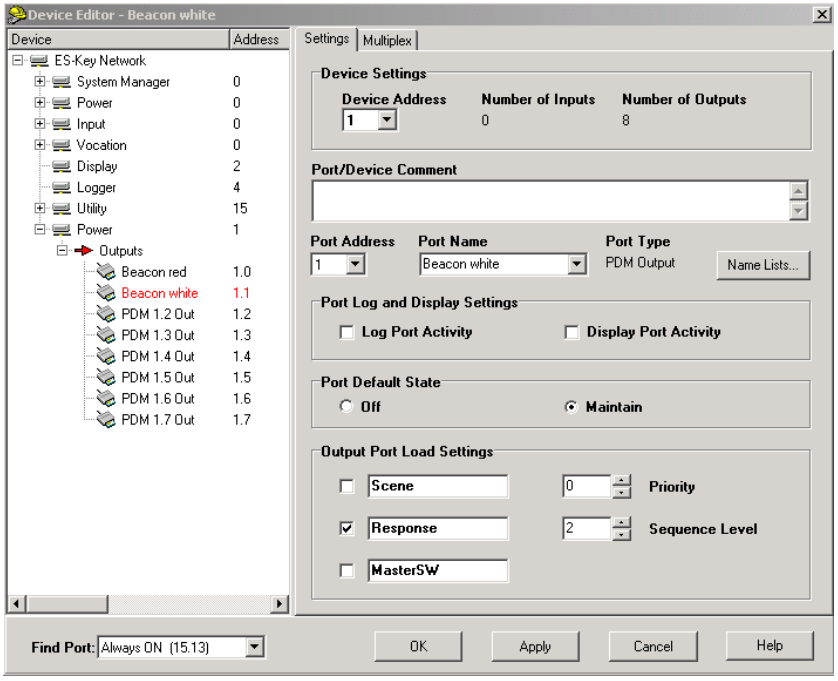
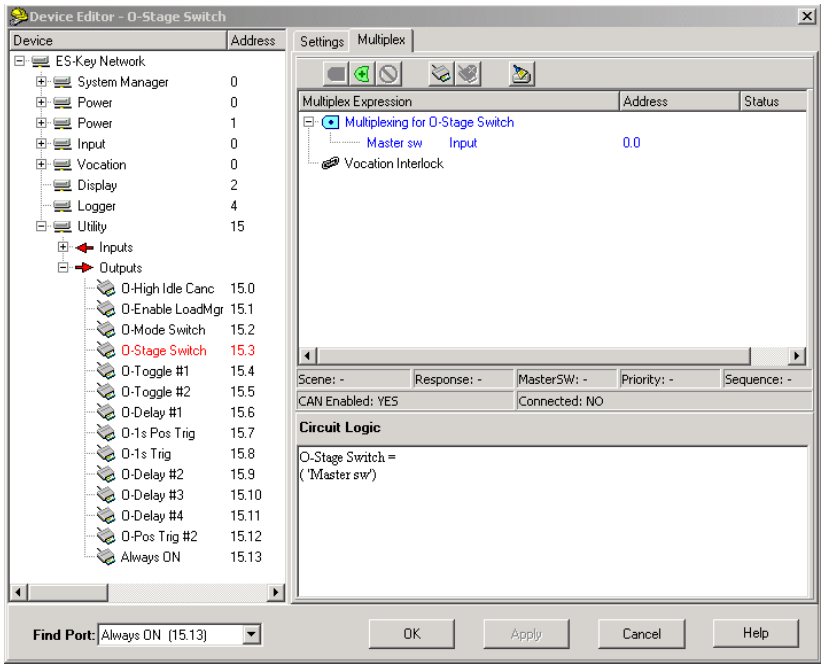


22. LOGIC STAGE

This output will turn on certain outputs that are tied to master sw. See example below:



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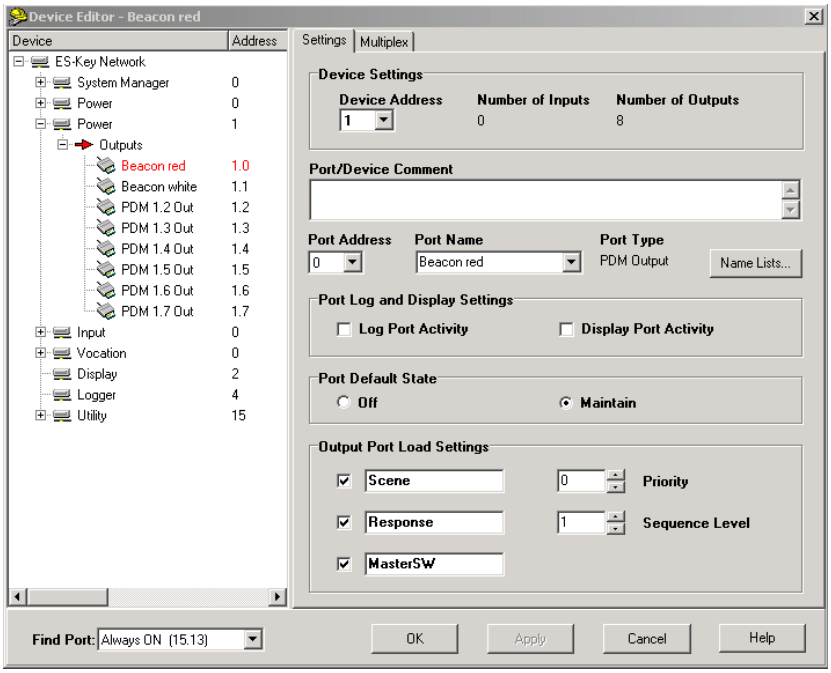
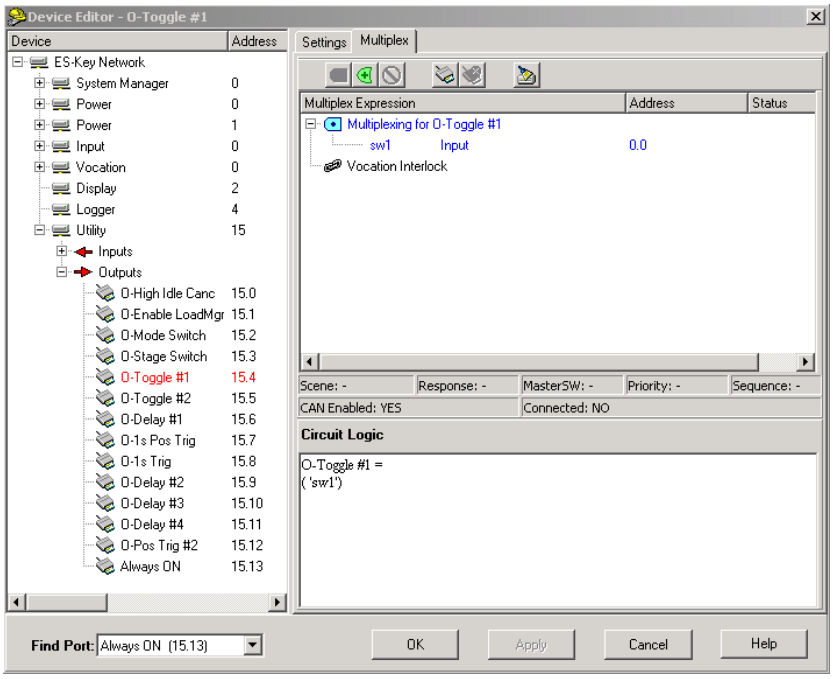


23. LOGIC BI-STABLE

This will allow an output to be toggled from one state to the other. See example below:



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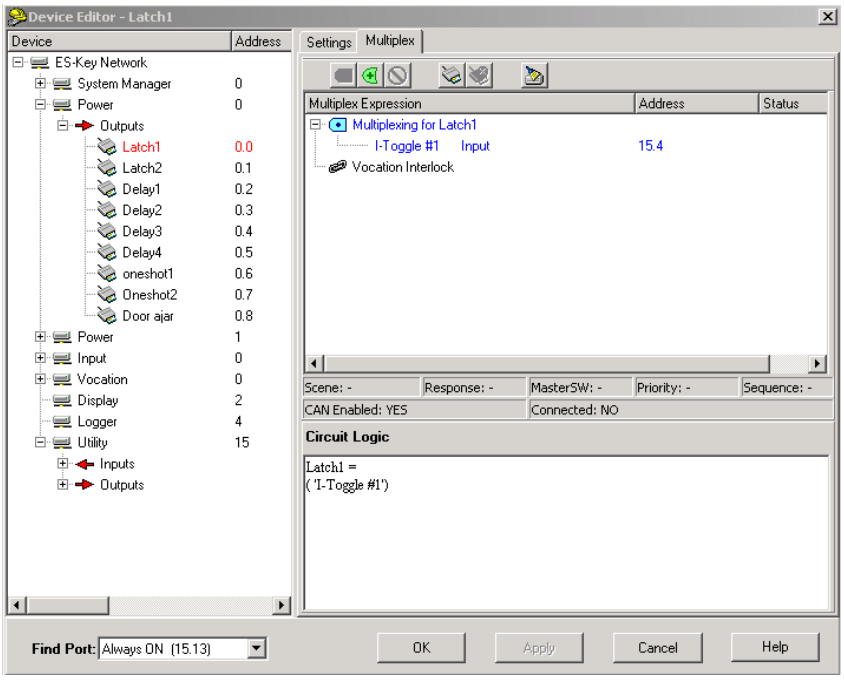
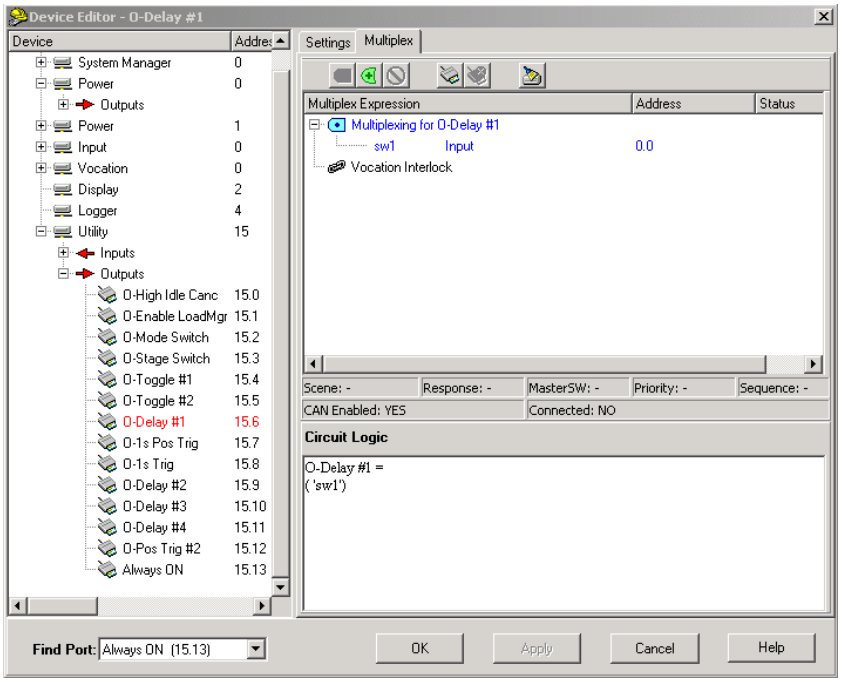


24. LOGIC TIMER

This function will activate a timer for allotted time after the output is turned on. See example below:



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25. LOGIC DELAY

This function will activate for one second and then turn off. See example below: