IDEX CORPORATION

Class 1

ISO 9001 CERTIFIED

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TECHNICAL PRODUCT DATASHEET

Twister™

Electronic Throttle

(Analog version)

P/N 119971

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TECHNICAL DATA SHEET

DATE					10/1/2010
PRODUCT GROUP	THROTTLE CONTROL	P/N	119971	REV	1.20
PRODUCT	Twister Electronic Throttle (Analog version)			BY	AMS

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1. Revision Log

Rev	Date	Changes
1.00	11/16/2009	Initial revision
1.10	9/7/2010	Clarified password entry.
1.20	10/1/2010	Added passwords for “slow” output mode

Product specifications in this manual are subject to change without notice.

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2. Part numbers

2.1. System part numbers

Twister Electronic Throttle (analog) system kit TWIST-A

Kit includes

Twister Electronic Throttle (analog)	QTY-1	119971
Twister main system harness	QTY-1	120430
Knob rotation direction label set	QTY-1	120462

Documentation (available from Class 1's website - www.class1.com)

Twister Electronic Throttle Manual (this manual)	120478
Twister Quick Manual	120319

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3. Overview

3.1. Product description

The Twister Electronic Throttle (p/n 119971) controls engine speed using a variable analog voltage connected to the engine ECM for remote throttle applications. The Twister's analog voltage range is 0.235 volts to 4.448 volts and the minimum (idle) and maximum voltages can be configured between the standard range for specific engine manufacturer requirements (refer to section 4.6).

The Twister utilizes Light Emitting Diodes (LED) to convey status information to the operator. The green **THROTTLE READY** LED is on the left-side of the control knob and the blue **ACTIVE** LED is on the right-side of the control knob.

The Twister has a control knob and an idle button for the operator to control engine speed. The control knob allows manipulation of the engine speed within the configured (and engine allowable) RPM range. The idle button returns the engine speed to the configured idle RPM.

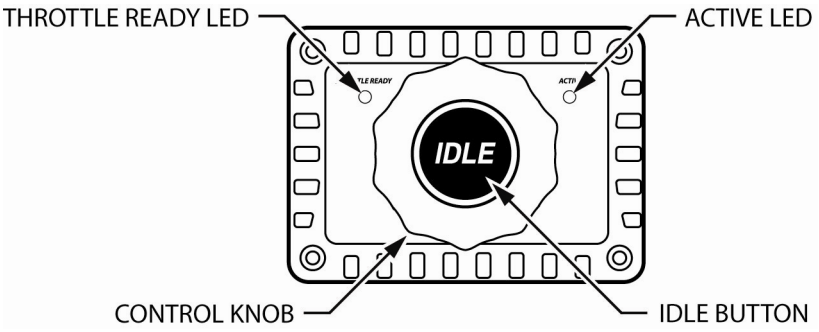

Figure 1. *Twister controls and indicators.*

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3.2. Throttle ready LED indicator

The green **THROTTLE READY** LED indicator shows the status of the Twister interlock input (pin 3) and analog signal diagnostic information.

LED state	Throttle control	Description
ON	**PERMITTED**	**Twister interlock input (pin 3) is active.**
OFF	*NOT PERMITTED*	*Twister interlock input (pin 3) is NOT active.*
FAST FLASH (10 Hz)	*NOT PERMITTED*	*Analog signal error (voltage too low). Verify analog +5 VDC reference and signal line voltage.*
DOUBLE BLINK	*NOT PERMITTED*	*Analog signal error (voltage too high). Verify analog ground reference and signal line voltage.*

Table 1. *Throttle ready LED states.*

3.3. Active LED indicator

The blue **ACTIVE** LED indicator shows the status of the Twister control.

LED state	Throttle control	Description
ON	**ACTIVE**	**The twister is in control of engine RPM.**
OFF	*NOT ACTIVE*	*The Twister is not controlling the engine RPM (engine at idle).*
FLASHING	*AT RPM LIMIT*	*The Twister's control knob is being rotated while the analog output signal voltage is already at the configured limit (minimum or maximum).*

Table 2. *Active LED states.*

3.4. Control knob

The control knob is the operator's interface for RPM control. The control knob is rotated to change the engine speed (RPM). The control knob can be configured to increase engine speed with clockwise or counter-clockwise rotation (section 4.3).

3.5. Idle button

The idle button is the operator's interface to return the engine's speed to its idle RPM. Press and hold the idle button for a **half-second** to ramp the engine speed to idle and release active engine control from the Twister. The Twister ramps the output signal down at a rate of 0.9 volts per second.

4. Configuration

4.1. Entering passwords

The Twister utilizes passwords to modify its operational parameters. All operational parameters are stored in memory and will not be lost when power is disconnected.

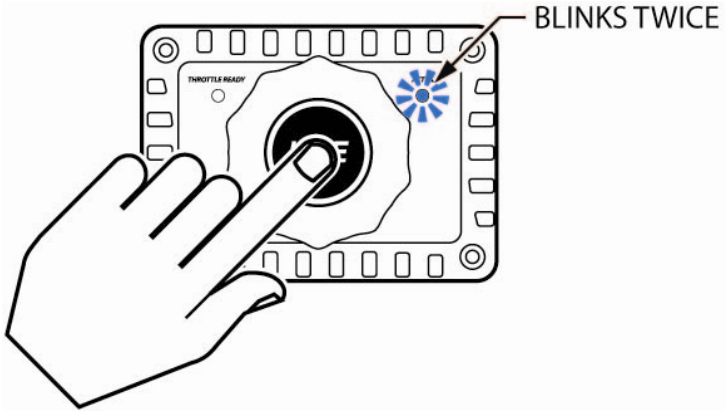

Figure 2. *Password entry mode.*

To enter a password:

- **Press and hold** the IDLE button until the **ACTIVE** LED blinks twice (two seconds). **Continue holding** the IDLE button while entering the password.
- A clockwise ↻ rotation will turn the **ACTIVE** LED ON for a half- second and a counter-clockwise ↺ rotation will turn the **THROTTLE READY** LED ON for a half-second. **Wait for the LED indication to turn OFF before rotating the knob again.**
- A rotation consists of at least one tactile click and a single rotation event is complete when the knob remains stationary for at least half a second.

If an error is made while entering a password, release the IDLE button to clear and then re-attempt the password from the beginning.

Invalid password entry

The **THROTTLE READY** and **ACTIVE** LEDs will quickly flash numerous times to indicate an attempted password is invalid.

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4.2. Interlock polarity

The Twister interlock input (pin 3) must be active before control of the engine speed is possible. The Twister interlock input can be configured for positive (default) or ground input polarity.

4.2.1. Positive polarity (default)

Positive polarity interlock configuration password:

4.2.2. Ground polarity

Ground polarity interlock configuration password:

4.3. Control knob rotation

The control knob can be configured to increase engine RPM with clockwise or counter-clockwise rotation. Included with the Twister is a label set (p/n 120462) which contains a clockwise increase and a counter-clockwise increase label. Affix the label to the Twister which indicates the configured knob rotation direction.

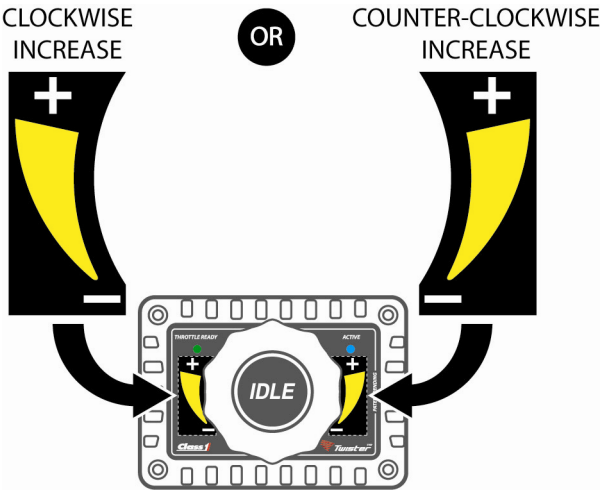

Figure 3. *Rotation direction labels (p/n 120462).*

4.3.1. Clockwise rotation increases RPM (default)

Clockwise knob rotation configuration password:

4.3.2. Counter-clockwise rotation increases RPM

Clockwise knob rotation configuration password:

4.4. Initial deadband clicks

The Twister requires a number tactile clicks of the control knob in the increase direction before it will allow engine control. The default number of tactile clicks is five (5) but can be changed to one (1) or ten (10).

Initial deadband clicks required = 1:

Initial deadband clicks required = 5 (default):

Initial deadband clicks required = 10:

4.5. Load defaults

The Twister's default configurations are:

Knob increase direction:	Clockwise
Interlock polarity:	Positive voltage
Maximum output signal voltage:	3.990 VDC
Idle output signal voltage:	0.235 VDC
Control knob initial dead band:	5 initial tactile clicks

4.6. Engine RPM range configuration

The Twister allows configuration of its idle output signal voltage and maximum output signal voltage which directly affects the engine's RPM range. The defaults are 0.235 volts at idle and 3.990 volts at maximum.
The idle offset voltage level affects the Twister's maximum voltage level. When the idle offset voltage is configured to its lowest level (0.235 volts) the maximum attainable voltage is 3.990 volts. When the idle offset voltage is configured to its maximum level (2.392 volts) the maximum attainable voltage is 4.448 volts. The graph below (Figure 4) shows the relationship between the configured idle offset voltage and its associated maximum voltage level.

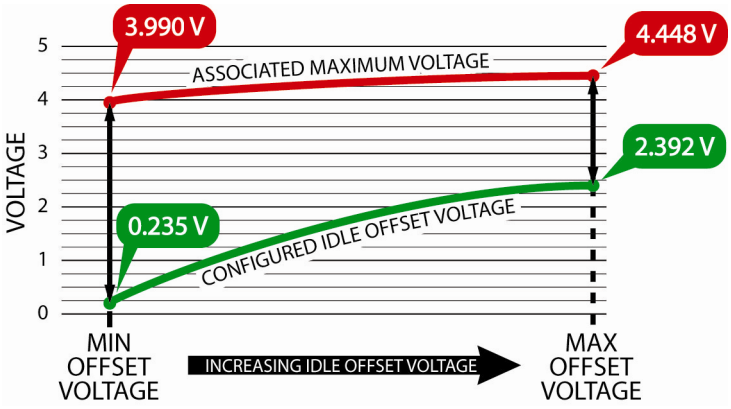

Figure 4. *Idle offset voltage versus maximum voltage.*

4.6.1. Idle RPM configuration

Enter the password:

Release the IDLE button.

The Twister sets its output signal voltage to the lowest point. Use the control knob to increase the output signal voltage until the engine begins to increase its RPM. Use the control knob to find the base limit of control and then press the IDLE button to save the output signal voltage as the idle voltage.

Engine manufacturers will program their ECMs for a curb idle. The Twister cannot force the engine ECM to attain a lower RPM than the manufacturers curb idle.

4.6.2. Maximum RPM configuration

Enter the password:

Release the IDLE button.

The Twister sets its output signal voltage the configured idle voltage. Use the control knob to increase the output signal voltage until the desired maximum RPM is attained. Press the IDLE button to save the output signal voltage as the maximum voltage.

Engine manufacturers will program their ECMs for a maximum safe RPM limit. The Twister cannot force the engine ECM to attain more RPM than the manufacturers limit.

4.7. Output Ramp Rate

The Twister (software version 1.2 and above) can be set for two different output ramp rates. The normal mode, which is the default, increases/decreases the output signal voltage for every click of the control knob. The slow mode increases/decreases the output signal voltage for every two clicks of the control knob, effectively creating a slower response to the user input. In slow mode, the ramp time when returning to IDLE using the IDLE button is also twice as long. The slow mode can be useful in matching the Twister to certain engines if the default ramp speeds are too fast.

Normal Mode (default):

Slow Mode:

5. Operation

5.1. Initialization

The Twister uses a two (2) second initialization cycle. The green throttle ready LED and blue active LED will be ON during the initialization. The Twister will then begin normal operation.

Figure 5. *Twister initialization.*

5.2. Interlocking (enabling the Twister)

The Twister will not allow control of the engine speed until the interlock input (pin 3) has been activated. The interlock input is activated when the proper voltage level is applied. The interlock voltage can be configured for system voltage (default) or system ground (see section 0).

Figure 4 illustrates a typical interlocking scheme with the Twister's interlock configured for system voltage. In this example the OEM makes certain that the park brake and transmission are in the proper modes before allowing system voltage to pass through to the Twister's interlock input (pin 3).

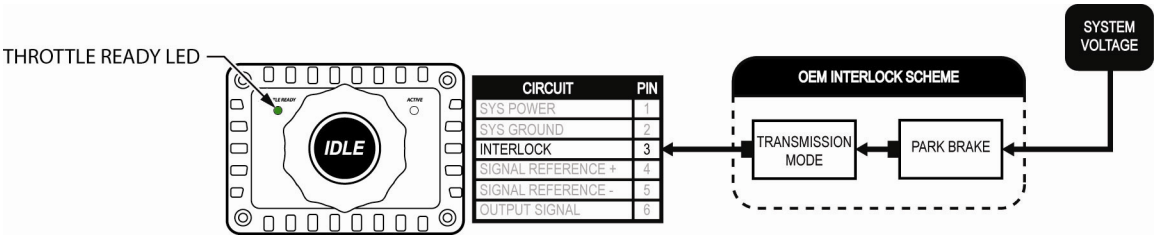

Figure 6. *Twister interlocking example.*

The Twister's green throttle ready LED will be ON when the proper voltage is applied to the interlock input. This indicates that the Twister is ready for operator initiated control via the control knob. *Refer to table Table 1 in section 3.2 for a description of the throttle ready LED status indication.*

The OEM is responsible for creating a safe interlocking scheme to enable the Twister.

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5.3. Controlling engine speed

The Twister allows the operator to control of the engine's speed by rotating the control knob as long as the interlock is active.
The blue ACTIVE LED will be ON once the control knob has been rotated in the increase RPM direction enough clicks to overcome the configured initial deadband (default is 5 clicks).

Each tactile click of the control knob equals a 0.014 volt increase of the analog output signal voltage. With most manufacturers this equals from 5 to 10 RPM per tactile click.

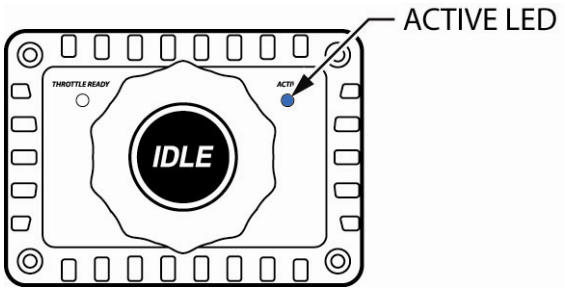

Figure 7. *Active LED.*

The blue **ACTIVE** LED indicator shows the status of the twister control (see Table 2 in section 3.3). The **ACTIVE** LED will blink when the control knob is being rotated while the output signal voltage is already at the configured limit (minimum or maximum voltage).

5.3.1. Control knob initial deadband

The Twister requires a number tactile clicks of the control knob in the increase direction before it will allow engine control. This initial deadband keeps the Twister from inadvertently controlling engine speed caused by accidental bumps, vibration, etc. The default number of tactile clicks is five (5) with each click occurring within a half-second of the last. The blue **ACTIVE** LED activates and throttle control is allowed once the number of tactile clicks has been established.

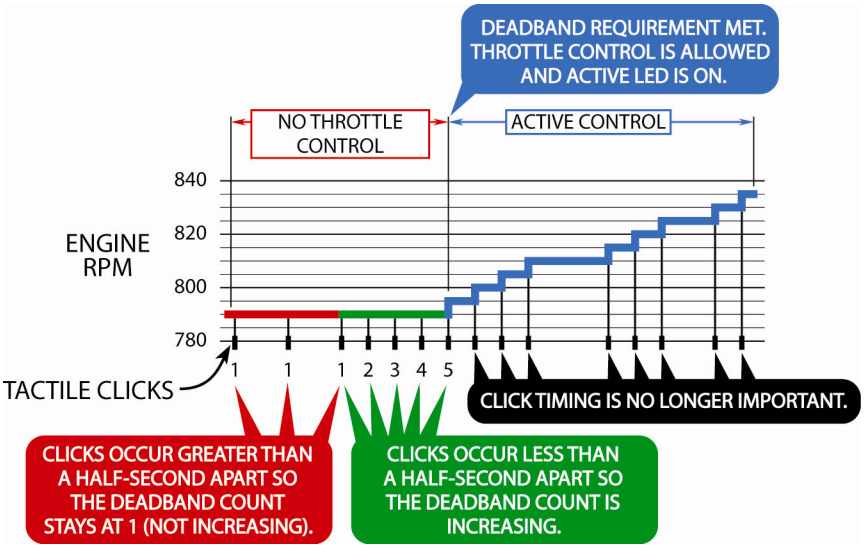

Figure 8. *Initial deadband explanation.*

In the previous graphic (Figure 8) the first three tactile clicks are more than a half-second apart and are not counted for the required number of deadband clicks. The next series of tactile clicks are a half-second (or less) apart and the deadband counter counts each one up to the required number of clicks (5). The Twister then activates the blue **ACTIVE** LED and allows active throttle control. Subsequent tactile clicks change the RPM of the engine and the timing between clicks is not important. The initial deadband requirement will not be required again until the IDLE button has been pressed and the engine RPM has been reduced to curb idle.

5.3.2. Returning the engine speed to idle

Press the idle button for a **half-second** to return the engine speed to idle. The twister will ramp the engine speed from the current RPM down to the configured idle RPM at which time the blue **ACTIVE** LED will turn OFF to indicate that idle has been reached.

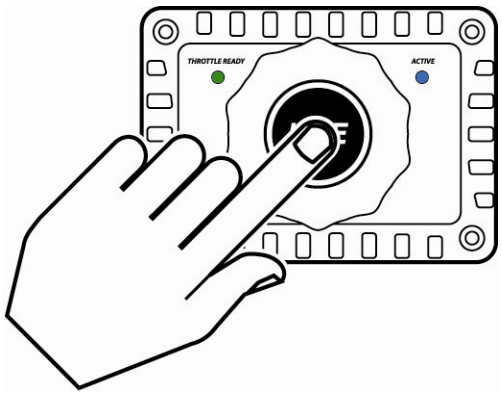

Figure 9. *Pressing the idle button.*

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6. Mounting & installation

6.1. Panel cutout dimensions

Mount the Twister on the operator's panel with four #6 screws and nuts.

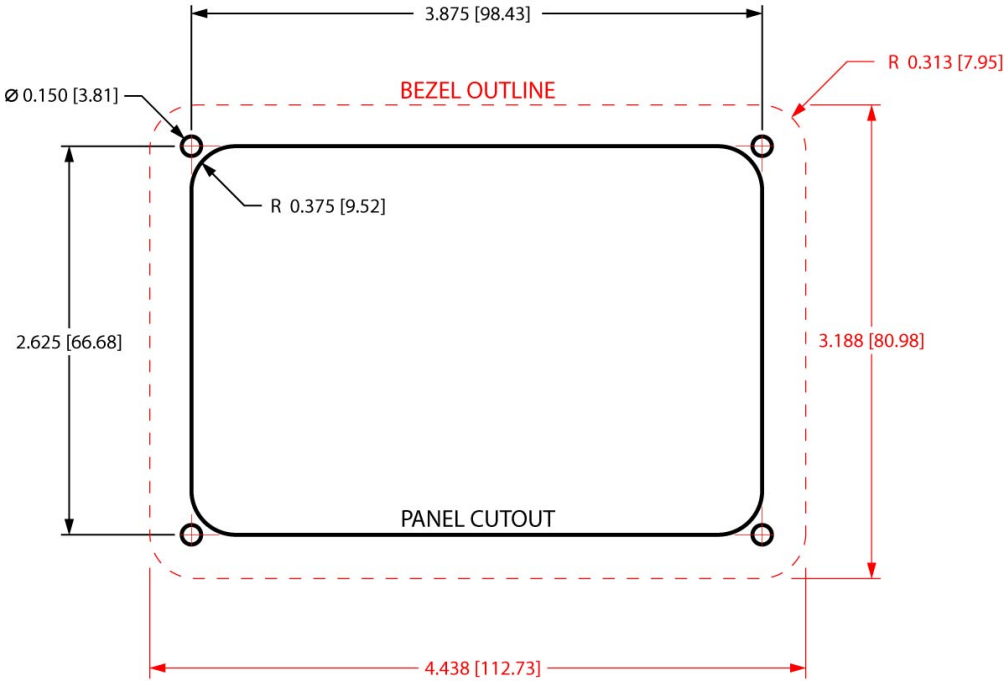

Figure 10. *Installation dimensions in inches [millimeters].*

6.2. Twister side-view dimensions

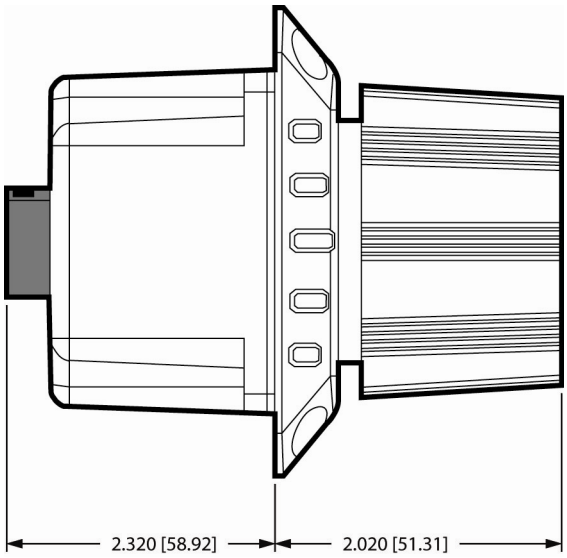

Figure 11. *Side view dimensions in inches [millimeters].*

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6.3. Maintenance

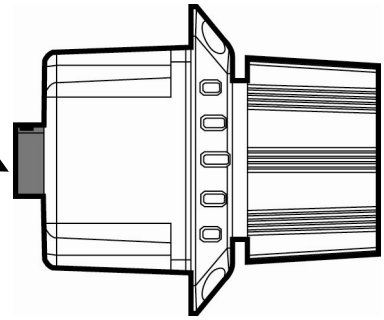
The Twister does not require regular maintenance. The control knob does not require lubrication.

7. Wiring

7.1. Twister connector

The module has one connector and the following definitions apply:

Mating connector: Deutsch DT06-6S GRAY
Mating sockets: Deutsch 0462-201-16141
Gold mating sockets: Deutsch 0462-201-1631
Recommended wire gage: 16-20 AWG
Wedge lock: W6S



PIN	CIRCUIT	DESCRIPTION
1	SYS POWER	(INPUT) – battery voltage (+9VDC...+32VDC)
2	SYS GROUND	(INPUT) – battery ground
3	INTERLOCK	(INPUT) – Positive/Ground polarity (configurable)
4	SIGNAL REF +	(INPUT) – ECM reference voltage, +5 VDC
5	SIGNAL REF -	(INPUT) – ECM reference voltage, ground
6	OUTPUT SIG	(OUTPUT) – ECM remote throttle control voltage

7.2. Twister wiring

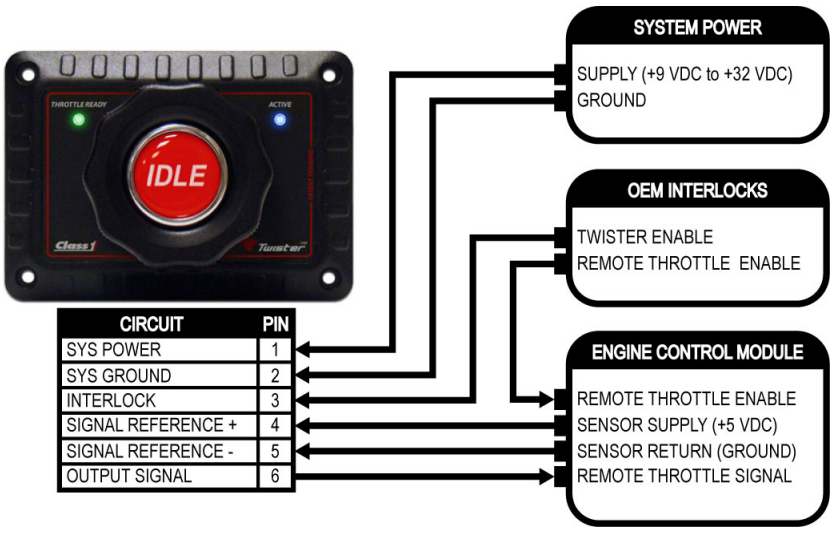


Figure 12. *Twister harness connections.*

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8. Technical Details

Product category	Throttle control (analog)	
Voltage range	+9VDC…+32VDC	
Maximum current draw @13.8VDC @27.6VDC	Logic supply+ input (pin 1 of 6-pin connector) 240 mA 163 mA	
Temperature range	-40ºF…+185ºF (-40ºC…+85ºC)	
Environmental range	IP 67	
LED	2 LEDs (green and blue) to indicate status	
Electrical protection	Internal thermal fuse (750mA on pin 1 of black 6-pin connector) Transient voltage protected to SAE J1113 specification for heavy duty trucks (24V) Load dump voltage protected to SAE J1113 specification for heavy duty trucks (24V)	
Electrical performance	Immunity to Radiated Electromagnetic Fields– Bulk Current Injection (BCI) method, Class C device	SAE J1113-4
	Reverse voltage protection on power leads (pins 1 and 2 of 6-pin connector), Class C device	ISO 16750-2
	Overvoltage due to failing generator, Class A device	ISO 16750-2
	Immunity to conducted transients on power leads, Class C device (24V)	SAE J1113-11
	Immunity to Electrostatic Discharge – powered and unpowered modes	SAE J1113-13
	Immunity to radiated electromagnetic fields, Class C device	SAE J1113-21
	Conducted emission on power leads (level 3 limits)	SAE J1113-41
	Radiated emissions, absorber-lined shielded enclosure (level 2 limits)	SAE J1113-41
	Reset behavior on voltage drop 24V, Class C device	ISO 16750-2
Environmental performance	Thermal shock	SAE J1455 (sec 4.1.3.2)
	Exposure to humidity	MIL-STD-810F (method 507.4)
	Thermal shock due to splash	Class 1 (STD-0001)
	Pressure cleaning	SAE J1455 (sec 4.4)
	Exposure to salt spray atmosphere/fog	SAE J1455 (sec 4.3)
	Exposure to outdoor UV	ISO 4892-2 (method A)
Mechanical performance	Resonance dwell	SAE J1455 (sec 4.9.4.1)
	Random vibration	SAE J1455 (sec 4.9.4.2)
	Mechanical shock	SAE J1455 (sec 4.10.3.4)
Dimensions (W x H x D) in inches [millimeters]	4.438 [112.73] x 3.188 [80.98] x 2.312 [58.74]	
Weight in ounces [grams]	22.8 [646.4]	

9. References

9.1. List of figures

9.2. List of tables

9.3. List of passwords

Passwords are entered by pressing and holding the IDLE button while rotating the control knob (see section 4.1). The "rotate" column in the tables below show the control knob rotation directions with 1's indicating a clockwise ↻ rotation and 0's indicating a counter-clockwise ↺ rotation.

User passwords

Function	Rotate	Hex
Control knob direction – counter-clockwise increases engine speed	10010000	90
Control knob direction – clockwise increases engine speed	**10010001**	**91**
Configure idle RPM	01100101	65
Configure maximum RPM	10010111	97

OEM passwords

Function	Rotate	Hex
Interlock polarity – ground input ACTIVE	111010000000	E80
Interlock polarity – positive input ACTIVE	**111010000001**	**E81**
Control knob initial deadband – 1 tactile click	111000000001	E01
Control knob initial deadband – 5 tactile clicks	**111000000101**	**E05**
Control knob initial deadband – 10 tactile clicks	111000001010	E0A
Load default configurations	111011110000	EF0
Set output ramp rate to SLOW	111010100001	EA1
Set output ramp rate to NORMAL	**111010100000**	**EA0**

Bold text indicates the default configurations.