



Class 1

ISO 9001 CERTIFIED

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TECHNICAL PRODUCT DATASHEET



Electronic Throttle (J1939 CAN communication version)

P/N 119970



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1. Revision Log

Rev	Date	Changes
1.00	11/6/2009	Initial revision
1.01	3/16/2010	Updated wedge lock part number to W6S.
1.10	9/7/2010	Added passwords for "CAN transmission control". Clarified password entry.



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 (CAN) system kit TWIST-C

Kit includes

Twister Electronic Throttle (CAN)	QTY-1	119970
Twister main system harness	QTY-1	120431
Knob rotation direction label set	QTY-1	120462

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

Twister Electronic Throttle Manual (this manual)	120477
Twister Quick Manual	120318

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3. Overview

3.1. Product description

The Twister Electronic Throttle (p/n 119970) is an SAE J1939 Controller Area Network (CAN) device that controls engine speed using data communications directly to the engine ECU for remote throttle applications. The Twister supports three CAN message formats: Torque/Speed Control 1 (TSC1) PGN 0 CAN message, Cummins Fire Pump Governor (CFPG), and Scania Body Control message.

Control algorithms are optimized to take advantage of the J1939 CAN data to yield crisp and accurate control of engine.

For engines that may not support the J1939 CAN data link control, an analog output signal version of the Twister Electronic Throttle is available (p/n 119971).

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.

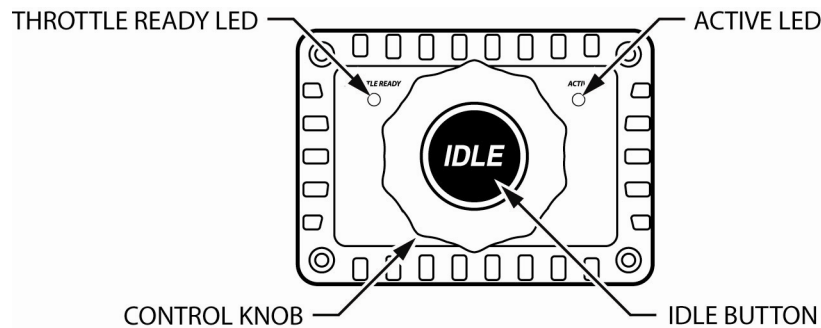


Figure 1. Twister controls and indicators.

THROTTLE READY LED.....	section 3.2
ACTIVE LED.....	section 3.3
Control knob.....	section 3.4
Idle button.....	section 3.5

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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 CAN diagnostic information.

LED state	Throttle control	Description
ON	PERMITTED	Twister interlock input (pin 3) is active.
<i>OFF</i>	<i>NOT PERMITTED</i>	<i>Twister interlock input (pin 3) is NOT active.</i>
<i>SLOW FLASH (1 Hz)</i>	<i>NOT PERMITTED</i>	<i>CAN bus okay, no communication with ECU. Verify CAN bus connection to ECU.</i>
<i>FAST FLASH (10 Hz)</i>	<i>NOT PERMITTED</i>	<i>CAN bus error (passive). Verify terminating resistors are correctly installed on CAN bus.</i>
<i>DOUBLE BLINK</i>	<i>NOT PERMITTED</i>	<i>CAN bus error (active). Evaluate CAN bus wiring for shorts, improper wiring, etc.</i>

Table 1. Throttle ready LED states.

3.3. Active LED indicator

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

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

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 engine speed down at a rate of 333 RPM per second.

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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.

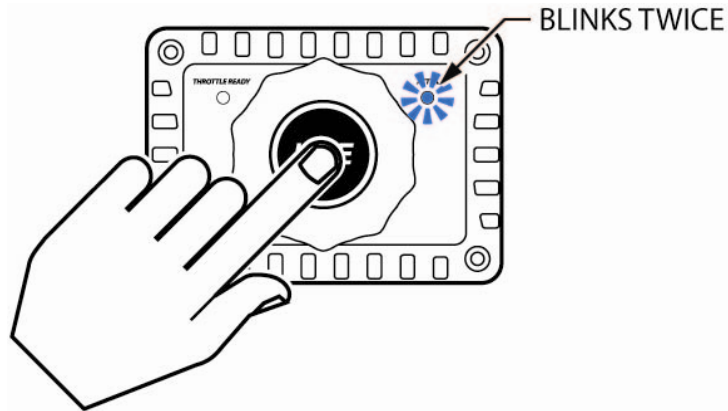


Figure 2. Password entry mode.

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.

4.1.1. **CAN communication method verification**

The Twister's configured communication method can be asserted by pressing and holding the idle button until the active LED blinks twice and turns OFF (takes approximately two seconds). This is the same procedure as entering a password, but do not rotate the knob – release the idle button. The **ACTIVE** LED will blink **once** (TSC1), **twice** (CFPG), or **three times** (Scania) to indicate the configured communication method.

The Twister resumes normal operation after indicating the CAN communication method.

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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.

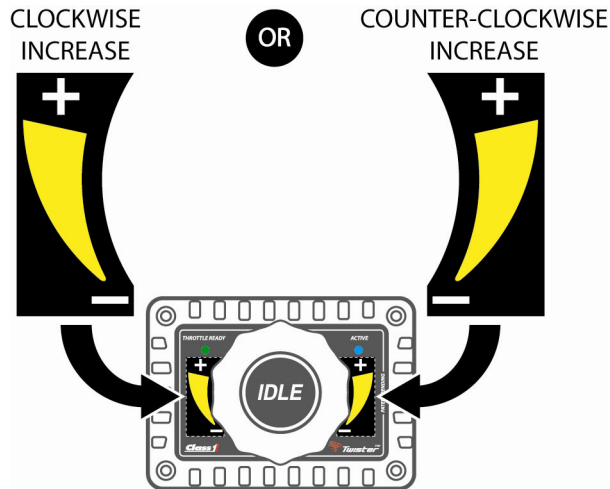


Figure 3. Rotation direction labels (p/n 120462).

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:



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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. Engine RPM range configuration

The Twister allows configuration of its idle RPM and maximum RPM values. The defaults are 750 RPM idle, 2200 RPM maximum.

4.5.1. Idle RPM configuration

Enter the password:



Release the IDLE button.

The idle RPM value is entered by using a password created from the *hundreds* and *tens* digits of the desired idle RPM value. Use the DIGIT/ROTATIONS chart (Table 3) below to select the knob rotations for the two digits of the password. The valid range is 50 (500 RPM) to 95 (950 RPM).

For example, 750 RPM would use the numbers 7 and 5 (750).

The password for 750 RPM is –



Press the IDLE button to clear the RPM password if a mistake has been made.

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4.5.2. Maximum RPM configuration

Enter the password:



Release the IDLE button.

The maximum RPM value is entered by using a password created from the *thousands* and *hundreds* digits of the desired maximum RPM value. Use the DIGIT/ROTATIONS chart (Table 3) below to select the knob rotations for the two digits of the password. The valid range is 15 (1500 RPM) to 45 (4500 RPM).

For example, 2800 RPM would use the numbers 2 and 8 (2800).

The password for 2800 RPM is –



Press the IDLE button to clear the RPM password if a mistake has been made.

DIGIT	ROTATIONS	DIGIT	ROTATIONS
0		5	
1		6	
2		7	
3		8	
4		9	

Table 3. RPM digits entry list.

4.6. Communication method

The Twister must be configured to transmit the J1939 CAN communication data required for the particular engine type. The Twister's default communication data method is via the Torque/Speed Control 1 (TSC1) PGN 0 CAN message, but Cummins Fire Pump Governor (CFPG) or Scania Body Control Message 1 methods may be selected. Changing the communication method automatically resets the CAN transmission rate to the default for the selected communication method (refer to section 4.8.5 for default transmission rates).

The Twister's current communication method can be verified by following the instructions in section 4.1.1.

4.6.1. Engine compatibility

The factory default settings of the Twister make it "out of the box" ready to control any engine that allows J1939 PGN0 (Torque/Speed Control 1) messages from a unique source address. These engines include various Detroit Diesel DDEC engines, Mercedes Benz (MBE) engines, Volvo, and others. The Twister may also be configured for the CFPG method for Cummins engines programmed with the Emergency Vehicle Calibration and the Scania method for Scania engines using their proprietary J1939 Body Control Message 1.

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4.6.2. TSC1 communication method (default)

TSC1 control method configuration password:

**4.6.3. CFPG communication method**

CFPG control method configuration password:

**4.6.4. Scania communication method**

Scania control method configuration password:

**4.7. Load defaults**

The Twister's default configurations are:

Knob increase direction:	Clockwise
Interlock polarity:	Positive voltage
CAN communication method:	TSC1
SPN 3350 (TSC1 control purpose):	P32 (temporary power train control)
SPN 696 (engine requested speed control condition):	3 (stability optimized for PTO driveline)
CAN source address:	3
CAN transmission rate:	100 messages per second
CAN transmission control:	Transmit when interlocked
Maximum RPM:	2200
Idle RPM:	750
RPM dither:	OFF
Control knob initial dead band:	5 initial tactile clicks
Scania control mode:	Normal

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4.8. Advanced Engine Communication Settings

Changes to the following engine configuration settings are not usually required for standard engine compatibilities. These setting should only be changed from the defaults if required by your engine documentation.

4.8.1. Source address (default = 3)

The Twister requires a unique CAN communication source address. The Twister's default source address is 3, but it may be configured to another source address (3 to 254) as may be required by a specific engine manufacturer.

To change the source address, enter the password:



Release the idle button.

Use the control knob to enter the 8-bit binary value of the desired address (see section 9.4). A high bit (1) is a clockwise rotation (CW) and a low bit (0) is a counter-clockwise rotation (CCW). For example, to configure address 7 the knob would be rotated CCW-CCW-CCW-CCW-CCW-CW-CW-CW. Press the IDLE button to clear the value if a mistake has been made. Enter the 8-bit value 255 (CW- CW- CW- CW- CW- CW- CW- CW) to exit this function without saving a new source address.

Once all 8 rotations of the desired address have been completed the Twister will use the THROTTLE READY LED (bit value 0) and ACTIVE LED (bit value 1) to flash-back the 8-bit value.

4.8.2. SPN 3350 (TSC1 control purpose)

The SPN 3350 configuration tells the engine which control mode the Twister is using to generate the TSC1 command. This configuration is applicable only when the communication method is set for TSC1.

Value	Purpose
3	PTO governor (P3)
32	Temporary power train control (P32)

Table 4. SPN 3350 TSC1 control purpose.

SPN 3350 = 3



SPN 3350 = 32 (default)



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4.8.3. SPN 696 (TSC1 speed control characteristic)

The SPN 696 configuration tells the engine the remote throttle characteristics that are desired during speed control. This configuration is applicable only when the communication method is set for TSC1.

Value	Optimization	Description
0	Transient	Provides rapid transition between speed setpoints. RPM overshoot and undershoot may be greater than what is seen with <i>stability optimization</i> .
1	Stability	Minimized RPM overshoot and undershoot. Most appropriate when no driveline is attached.
3	Stability	Minimized RPM overshoot and undershoot. Most appropriate for single driveline applications (e.g. vehicle driveline).
3	Stability	Minimized RPM overshoot and undershoot. Most appropriate for multiple driveline applications (e.g. PTO driveline).

Table 5. SPN 696 speed control characteristic.

SPN 696 = 0



SPN 696 = 1



SPN 696 = 2



SPN 696 = 3 (default)



4.8.4. Engine RPM Dither

Some engines (i.e. Volvo) require constant RPM modification in order to maintain remote engine speed control. When these engines receive a steady RPM from a remote throttle source for too long they reject the remote throttle source's request for active engine control. The Twister accommodates this requirement with a configuration called "dither" which varies the engine speed ± 5 RPM around the desired engine speed when dither has been enabled (ON).

Dither = OFF (default)



Dither = ON



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4.8.5. CAN Transmission Rate

The Twister transmits the engine RPM request message at a rate of 100 messages per second for the TSC1 communication method, 50 messages per second for the GFPG communication method, or 20 messages per second for the Scania communication method. However, the transmission rate for the engine RPM request message may be changed if required by your engine documentation.

Use the table below (Table 6) for the password required for the desired transmission rate. This rate is stored in memory and will not be reset when system power is removed from the Twister.

Messages per second	Time between messages	Password
100 Default for TSC1 communication method	10 mS	
50 Default for GFPG communication method	20 mS	
20 Default for Scania communication method	50 mS	
10	100 mS	
4	250 mS	
2	500 mS	
1.3	750 mS	
1	1000 mS	

Table 6. CAN transmission rate passwords.

4.8.6. CAN transmission control (default = transmit with interlock)

The Twister allows configuration of the CAN message transmission. The default method is to transmit the CAN control message anytime the interlock (pin 3) is active. However, the Twister's CAN transmission control may be set to "no transmit when at idle" if the apparatus has other third party remote engine control devices.

Transmit with interlock (default)



No transmit when at idle



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4.8.7. Scania Body Control Message 1 version (default = 1)

The Twister allows configuration of the Scania BCM1 version (default = 1).

To change the Scania BCM1 version, enter the password:



Release the idle button.

Use the control knob to enter the 8-bit binary value of the desired version (see section 9.4). A high bit (1) is a clockwise rotation (CW) and a low bit (0) is a counter-clockwise rotation (CCW). For example, to configure version 3 the knob would be rotated CCW-CCW-CCW-CCW-CCW-CCW-CW-CW. Press the IDLE button to clear the attempted binary value if a mistake has been made. Enter the 8-bit value 255 (CW- CW- CW- CW- CW- CW- CW- CW) to exit this function without saving a new BCM1 version value.

Once all 8 rotations of the desired version have been completed the Twister will use the THROTTLE READY LED (bit value 0) and ACTIVE LED (bit value 1) to flash-back the 8-bit value.

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4.8.8. Scania Requested Governor Type (default = normal)

The Twister allows configuration of the Scania requested governor type to either normal (default) or stiff.

To change the Scania requested governor type to **NORMAL**, enter the password:



To change the Scania requested governor type to **STIFF**, enter the password:



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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 4. 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 4.2).

Figure 5 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).

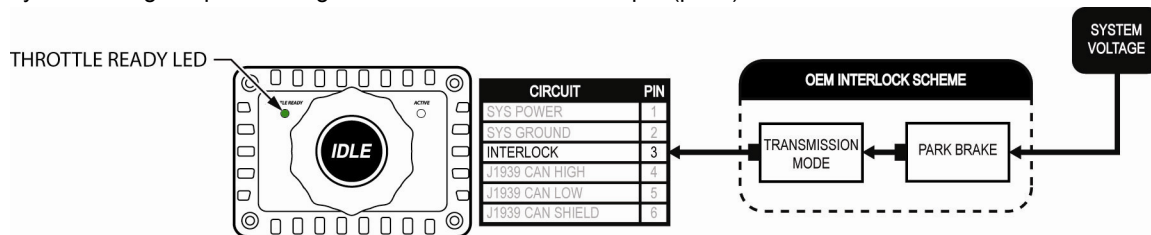


Figure 5. Twister interlocking example.

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 transmitting J1939 engine control commands and 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 (THROTTLE READY LED on steady). The engine's speed will decrease to idle if the interlock is removed.

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 5 RPM.

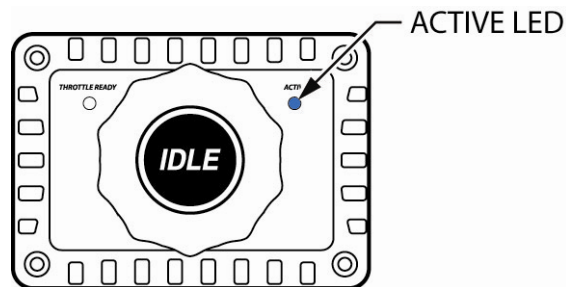


Figure 6. Active LED.

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 engine RPM is already at the configured limit (minimum or maximum RPM).

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.

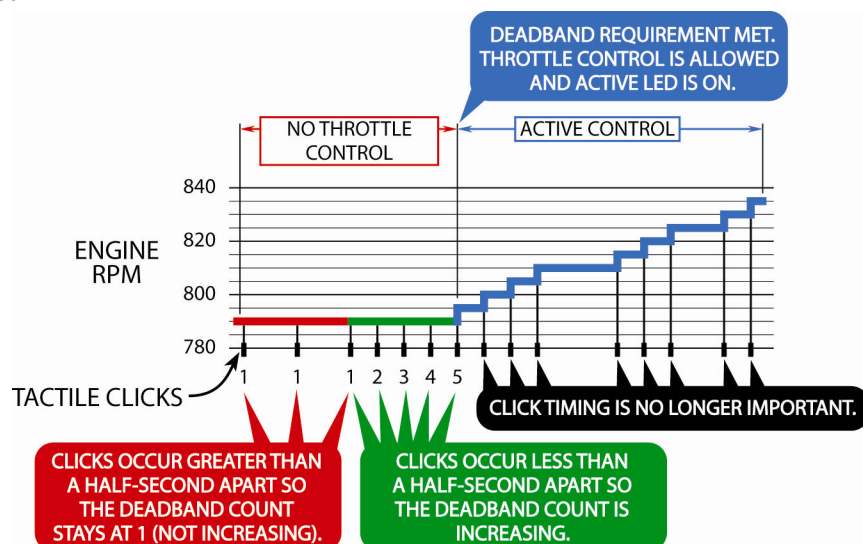


Figure 7. Initial deadband explanation.

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In the previous graphic (Figure 7) 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 and hold 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.

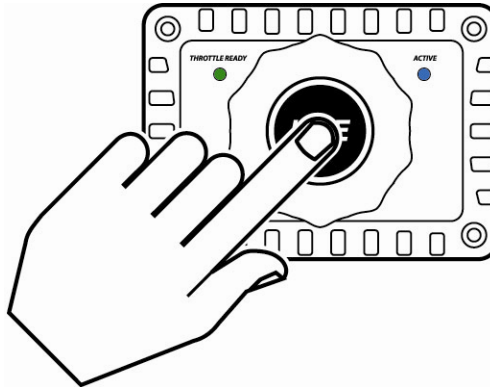


Figure 8. Pressing the idle button.

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6. Mounting, installation, and maintenance

6.1. Panel cutout dimensions

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

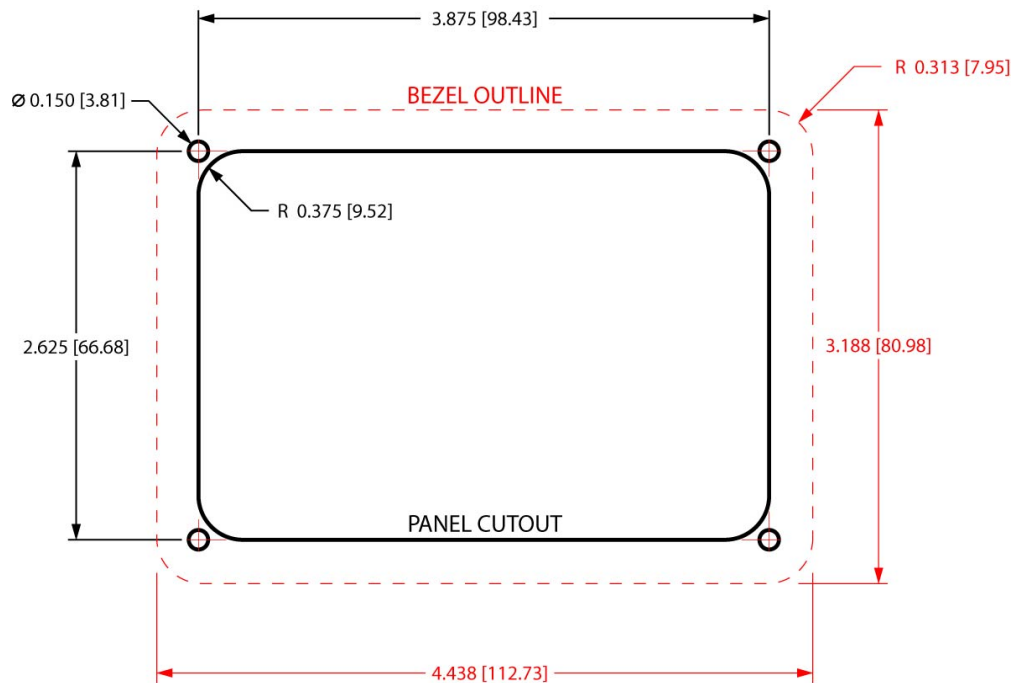


Figure 9. Installation dimensions in inches [millimeters].

6.2. Twister side-view dimensions

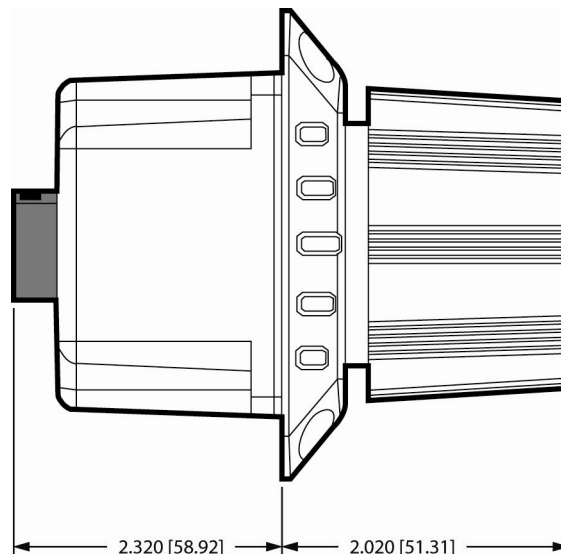


Figure 10. Side view dimensions in inches [millimeters].

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6.3. Maintenance

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

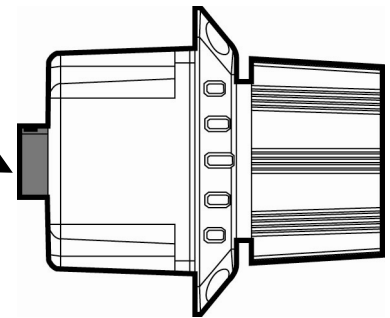
7. Wiring

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	CAN HIGH	(DATA) – SAE J1939 CAN 2.0B, 250Kbits/s *
5	CAN LOW	(DATA) – SAE J1939 CAN 2.0B, 250Kbits/s *
6	CAN SHIELD	(DATA) – SAE J1939 CAN 2.0B, 250Kbits/s *



* Gold sockets recommended for CAN connections.

7.2. Twister wiring

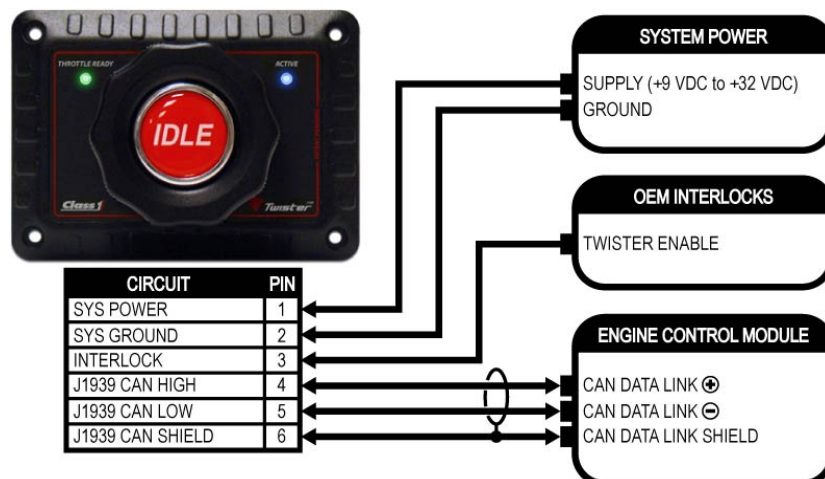


Figure 11. Twister harness connections.

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8. Technical Details

Product category	Throttle control (SAE J1939 CAN)	
Voltage range	+9VDC...+32VDC	
Maximum current draw	Logic supply+ input (pin 1 of 6-pin connector)	
@13.8VDC	240 mA	
@27.6VDC	163 mA	
Temperature range	-40°F...+185°F (-40°C...+85°C)	
Environmental range	IP 67	
CAN specification	SAE J1939, 250 Kbits/second	
LED	2 LEDs (green and blue) to indicate status	
Electrical protection	Internal thermal fuse (750mA on pin 1 of black 6-pin connector)	
	CAN bus protected for heavy duty trucks (24V)	
Electrical performance	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)	
	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)
	Resonance dwell	SAE J1455 (sec 4.9.4.1)
Mechanical performance	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]	

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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
CAN communication method – TSC1	111011000000	EC0
CAN communication method – CFPG	111011000001	EC1
CAN communication method – Scania BCM1	111011000010	EC2
Configure CAN source address (3 to 254)	111000100000	E20
Configure Scania BCM1 address (1 to 254)	111010111111	EBF
Scania control mode – NORMAL	111010110000	E80
Scania control mode – STIFF	111010110001	EB1
TSC1 control purpose – P32 (temporary power train control)	111001001111	E4F
TSC1 control purpose – P3 (PTO governor control)	111001000101	E45
SPN 696 – 0 (transient optimization)	111001000000	E40
SPN 696 – 1 (stabilized optimization, no driveline)	111001000001	E41
SPN 696 – 2 (stabilized optimization, single driveline)	111001000010	E42
SPN 696 – 3 (stabilized optimization, multiple driveline)	111001000011	E43
RPM dither – ON (required for certain engines – i.e. Volvo)	111001000111	E47
RPM dither – OFF	111001000110	E46
CAN communication transmission rate – 100 msgs/second (TSC1)	111000110001	E31
CAN communication transmission rate – 50 msgs/second (CFPG)	111000110010	E32
CAN communication transmission rate – 20 msgs/second (Scania)	111000110011	E33
CAN communication transmission rate – 10 msgs/second	111000110100	E34
CAN communication transmission rate – 4 msgs/second	111000110101	E35
CAN communication transmission rate – 2 msgs/second	111000110110	E36
CAN communication transmission rate – 1.3 msgs/second	111000110111	E37
CAN communication transmission rate – 1 msg/second	111000111000	E38
CAN communication transmission control – transmit with interlock	111011001111	ECF
CAN communication transmission control – no transmit at idle	111011001100	ECC

Bold text indicates the default configurations.

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9.4. Table of binary values

Some of the Twister's configurations (CAN source address, Scania version) require a binary value to be entered using clockwise and counter-clockwise rotations of the control knob. Below is a table of decimal values (0 – 255) with their binary equivalents.

Each binary value consists of eight (8) knob rotations. The “rotate” column to the right of the desired value shows the eight (8) rotation directions with 1's indicating a clockwise  rotation and 0's indicating a counter-clockwise  rotation.

Value	Rotate	Value	Rotate	Value	Rotate	Value	Rotate	Value	Rotate	Value	Rotate
0	00000000	43	00101011	86	01010110	129	10000001	172	10101100	215	11010111
1	00000001	44	00101100	87	01010111	130	10000010	173	10101101	216	11011000
2	00000010	45	00101101	88	01011000	131	10000011	174	10101110	217	11011001
3	00000011	46	00101110	89	01011001	132	10000100	175	10101111	218	11011010
4	00000100	47	00101111	90	01011010	133	10000101	176	10110000	219	11011011
5	00000101	48	00110000	91	01011011	134	10000110	177	10110001	220	11011100
6	00000110	49	00110001	92	01011100	135	10000111	178	10110010	221	11011101
7	00000111	50	00110010	93	01011101	136	10001000	179	10110011	222	11011110
8	00001000	51	00110011	94	01011110	137	10001001	180	10110100	223	11011111
9	00001001	52	00110100	95	01011111	138	10001010	181	10110101	224	11100000
10	00001010	53	00110101	96	01100000	139	10001011	182	10110110	225	11100001
11	00001011	54	00110110	97	01100001	140	10001100	183	10110111	226	11100010
12	00001100	55	00110111	98	01100010	141	10001101	184	10111000	227	11100011
13	00001101	56	00111000	99	01100011	142	10001110	185	10111001	228	11100100
14	00001110	57	00111001	100	01100100	143	10001111	186	10111010	229	11100101
15	00001111	58	00111010	101	01100101	144	10010000	187	10111011	230	11100110
16	00010000	59	00111011	102	01100110	145	10010001	188	10111100	231	11100111
17	00010001	60	00111100	103	01100111	146	10010010	189	10111101	232	11101000
18	00010010	61	00111101	104	01101000	147	10010011	190	10111110	233	11101001
19	00010011	62	00111110	105	01101001	148	10010100	191	10111111	234	11101010
20	00010100	63	00111111	106	01101010	149	10010101	192	11000000	235	11101011
21	00010101	64	01000000	107	01101011	150	10010110	193	11000001	236	11101100
22	00010110	65	01000001	108	01101100	151	10010111	194	11000010	237	11101101
23	00010111	66	01000010	109	01101101	152	10011000	195	11000011	238	11101110
24	00011000	67	01000011	110	01101110	153	10011001	196	11000100	239	11101111
25	00011001	68	01000100	111	01101111	154	10011010	197	11000101	240	11110000
26	00011010	69	01000101	112	01110000	155	10011011	198	11000110	241	11110001
27	00011011	70	01000110	113	01110001	156	10011100	199	11000111	242	11110010
28	00011100	71	01000111	114	01110010	157	10011101	200	11001000	243	11110011
29	00011101	72	01001000	115	01110011	158	10011110	201	11001001	244	11110100
30	00011110	73	01001001	116	01110100	159	10011111	202	11001010	245	11110101
31	00011111	74	01001010	117	01110101	160	10100000	203	11001011	246	11110110
32	00100000	75	01001011	118	01110110	161	10100001	204	11001100	247	11110111
33	00100001	76	01001100	119	01110111	162	10100010	205	11001101	248	11111000
34	00100010	77	01001101	120	01111000	163	10100011	206	11001110	249	11111001
35	00100011	78	01001110	121	01111001	164	10100100	207	11001111	250	11111010
36	00100100	79	01001111	122	01111010	165	10100101	208	11010000	251	11111011
37	00100101	80	01010000	123	01111011	166	10100110	209	11010001	252	11111100
38	00100110	81	01010001	124	01111100	167	10100111	210	11010010	253	11111101
39	00100111	82	01010010	125	01111101	168	10101000	211	11010011	254	11111110
40	00101000	83	01010011	126	01111110	169	10101001	212	11010100	255	11111111
41	00101001	84	01010100	127	01111111	170	10101010	213	11010101		
42	00101010	85	01010101	128	10000000	171	10101011	214	11010110		