Black Box Electronic Wastegate Controller

Black Box by Turbosmart is a dedicated Electronic Wastegate Controller which can be used in cooperation with a range of Factory, Aftermarket and Motorsport ECU's. The Black Box provides protection from the current demands and translation of basic as well as more advanced boost control strategies into a gate position and can be used on single, twin electronic wastegate systems for the ultimate in boost control as well as Antilag Valves.

- Dual Channel, High Current Capable H-Bridge Driver
- Capable of multiple strategies
- PWM as used in standard boost control solenoids.
- CAN BUS Position Target
- Auto-Calibration available via Software
- Over-Temperature Shutdown
- Flow vs. lift calibration for simple setup and accurate boost control.

Power Supply

Operating Voltage	7.0 to 22.0 Volts DC
Operating Current	32mA at 14.0V (Excluding H-Bridge Load)
Polarity Protection	Yes, with Zero Current Draw
Over Current Protection	Yes, as well as Battery Transient
Pin Current Capacity	6 Amps per Pin.

Internal

Processor	64Mhz 16-bit Automotive Processor
Analog Channel Sampling Rate	1000Hz

Inputs

Analog Inputs (AV1-4)	Range	0.0V to 5.0, Resolution 1.22mV 12 Bit
	Input Impedance	100k to Ground
	1st Order LPF	1600Hz
	Analog Sampling Rate	1000Hz
Frequency Inputs Freq In 2 and 4	Range	0.5Hz up to 6500.0Hz, Resolution. 0.1Hz
	Sensor Compatibility	Magnetic and Hall Effect
	Rising Edge Threshold	1.65V
	Falling Edge Threshold	1.0V
Suitable Gauge Wire	22 AWG	

Included in the Box

- Black Box
- 34 Pin Connector
- 34 Pins
- Sticker
- Instruction card

Tools/Parts Req.

Tools	Super seal Connector Crimping Tool
USB	Micro USB to USB 2.0 A
Allen Key	2.5mm Size

Communications

Baud Rate	250k/500k or 1MBaud Auto Detect
Transmit Rate	50Hz/100Hz/200Hz/500/1000 Hz
USB	Yes

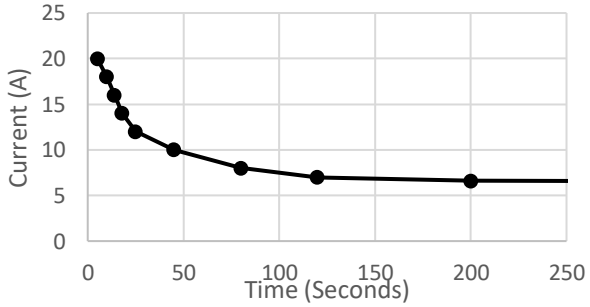
Thermal Data

Operating Temperature Range	-30 to 100°C (-22 to 212°F)

Outputs

Sensor Supply	Output Voltage	5V
	Output Current	250mA Short Circuit to ground protected.
H Bridge	Output Current	6.5A per Channel
	Peak Switched Current	25A Per Channel
	Overtemperature Shutdown	Yes
Suitable Gauge Wire	2x14 AWG	15 Amps
Valve Output Speed	3000%/second	

Current Output vs Time

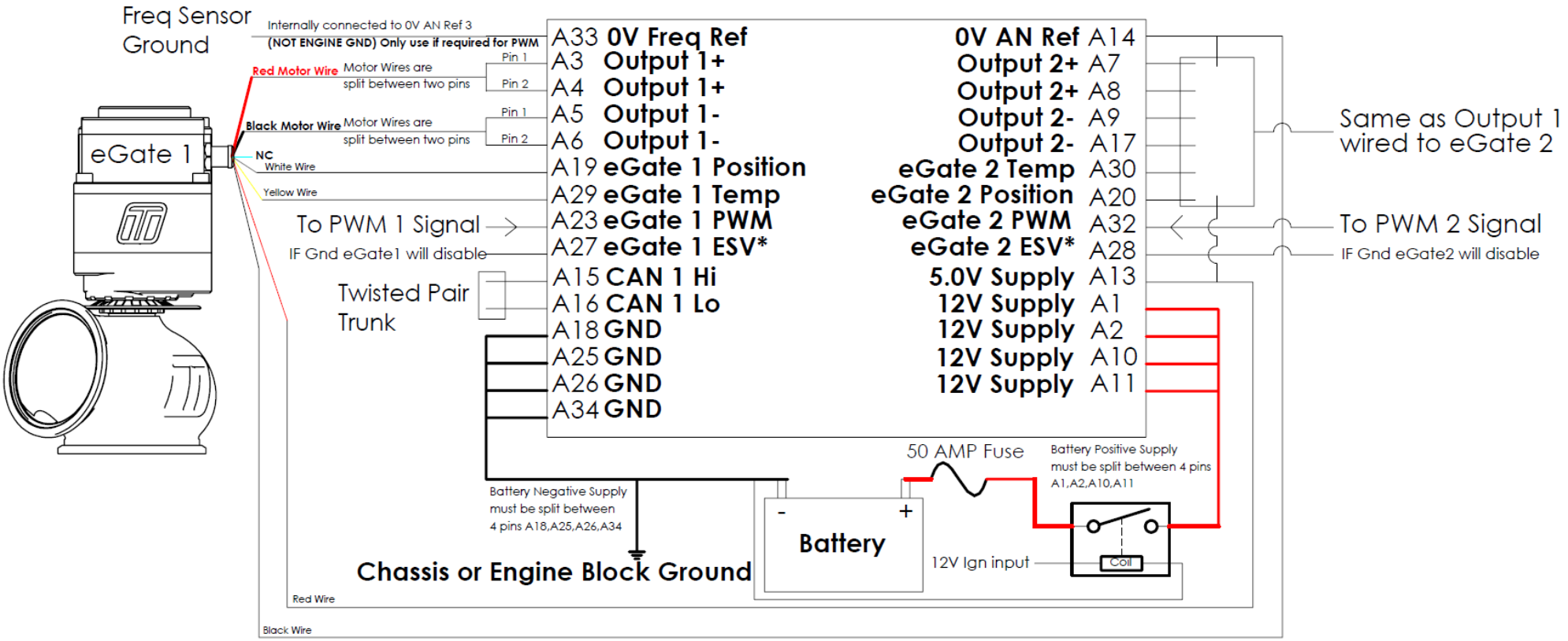


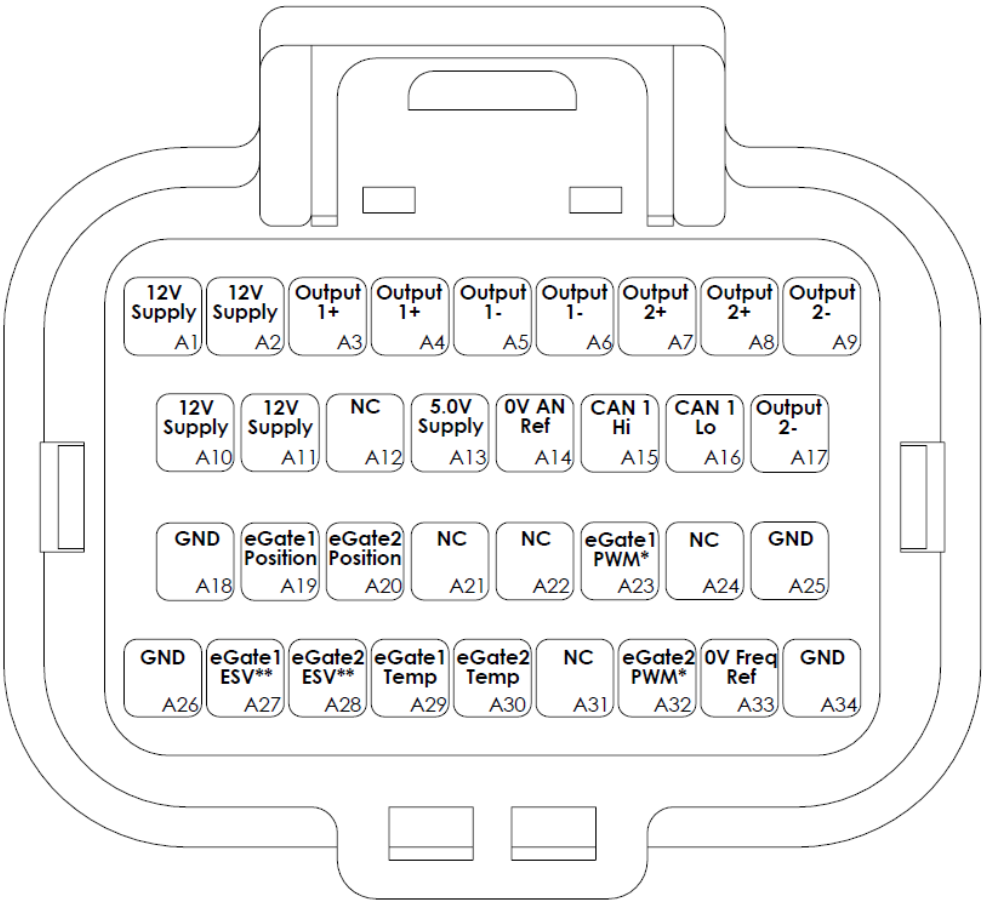
Material Data

Beryllium (Be)	0%
Actuator housing	6061 T6 anodised Al.

Order Data

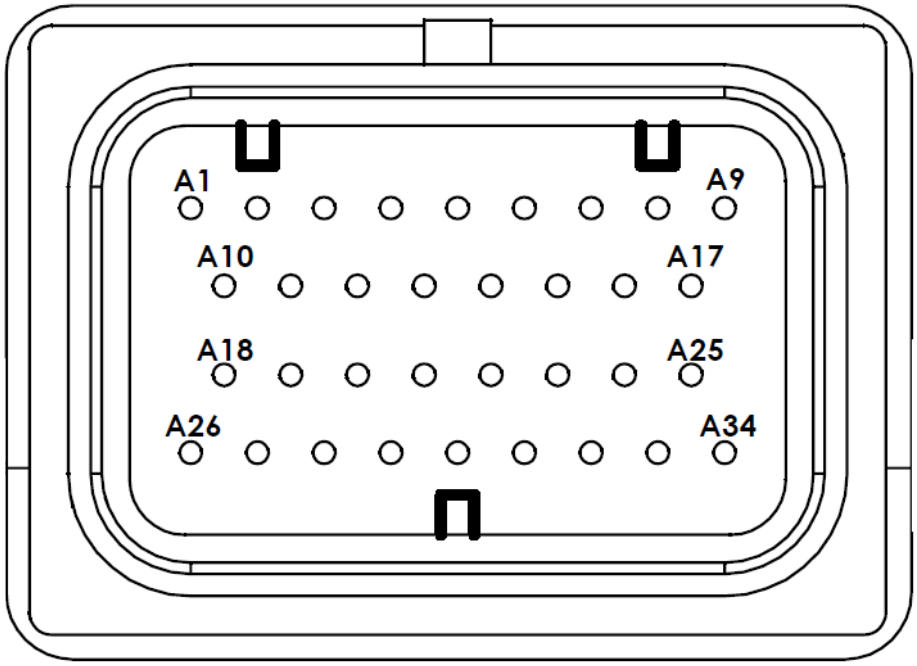
TS-0305-1001	Black Box Electronic Wastegate Controller
TS-0305-3001	Black Box Spare Pin and Connector


Freq Sensor Ground
Internally connected to 0V AN Ref 3
(NOT ENGINE GND) Only use if required for PWM
Red Motor Wire
Motor Wires are split between two pins
Pin 1
Pin 2
Black Motor Wire
Motor Wires are split between two pins
Pin 1
Pin 2
NC
White Wire
Yellow Wire
eGate 1
To PWM 1 Signal
IF Gnd eGate1 will disable
Twisted Pair Trunk
A33 0V Freq Ref
A3 Output 1+
A4 Output 1+
A5 Output 1-
A6 Output 1-
A19 eGate 1 Position
A29 eGate 1 Temp
A23 eGate 1 PWM
A27 eGate 1 ESV*
A15 CAN 1 Hi
A16 CAN 1 Lo
A18 GND
A25 GND
A26 GND
A34 GND
0V AN Ref A14
Output 2+ A7
Output 2+ A8
Output 2- A9
Output 2- A17
eGate 2 Temp A30
eGate 2 Position A20
eGate 2 PWM A32
eGate 2 ESV* A28
5.0V Supply A13
12V Supply A1
12V Supply A2
12V Supply A10
12V Supply A11
Same as Output 1 wired to eGate 2
To PWM 2 Signal
IF Gnd eGate2 will disable
50 AMP Fuse
Battery Positive Supply must be split between 4 pins A1,A2,A10,A11
Battery Negative Supply must be split between 4 pins A18,A25,A26,A34
Battery
-
+
12V Ign input
Coil
Chassis or Engine Block Ground
Red Wire
Black Wire



*PWM input optional
**Enable Switch Voltage - If Grounded coressponding eGate will disable

Backside of Connector



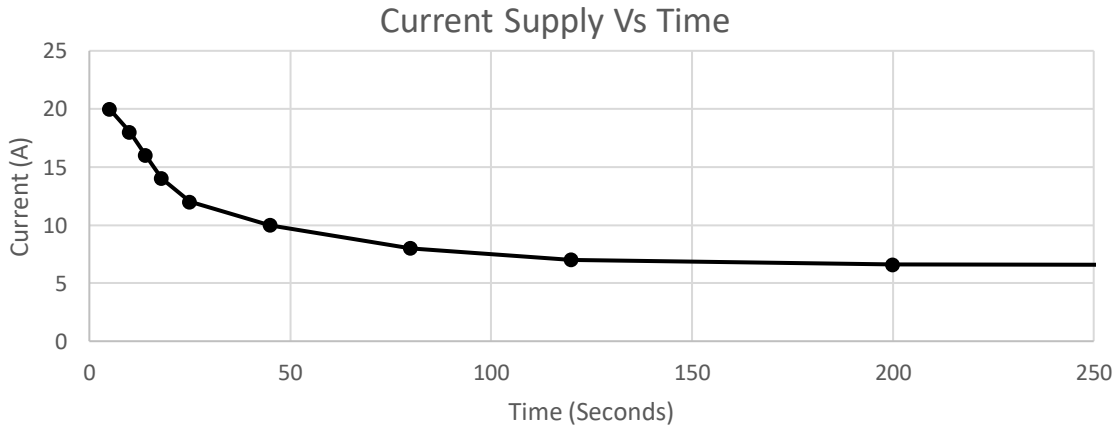
Looking into Black Box Pins

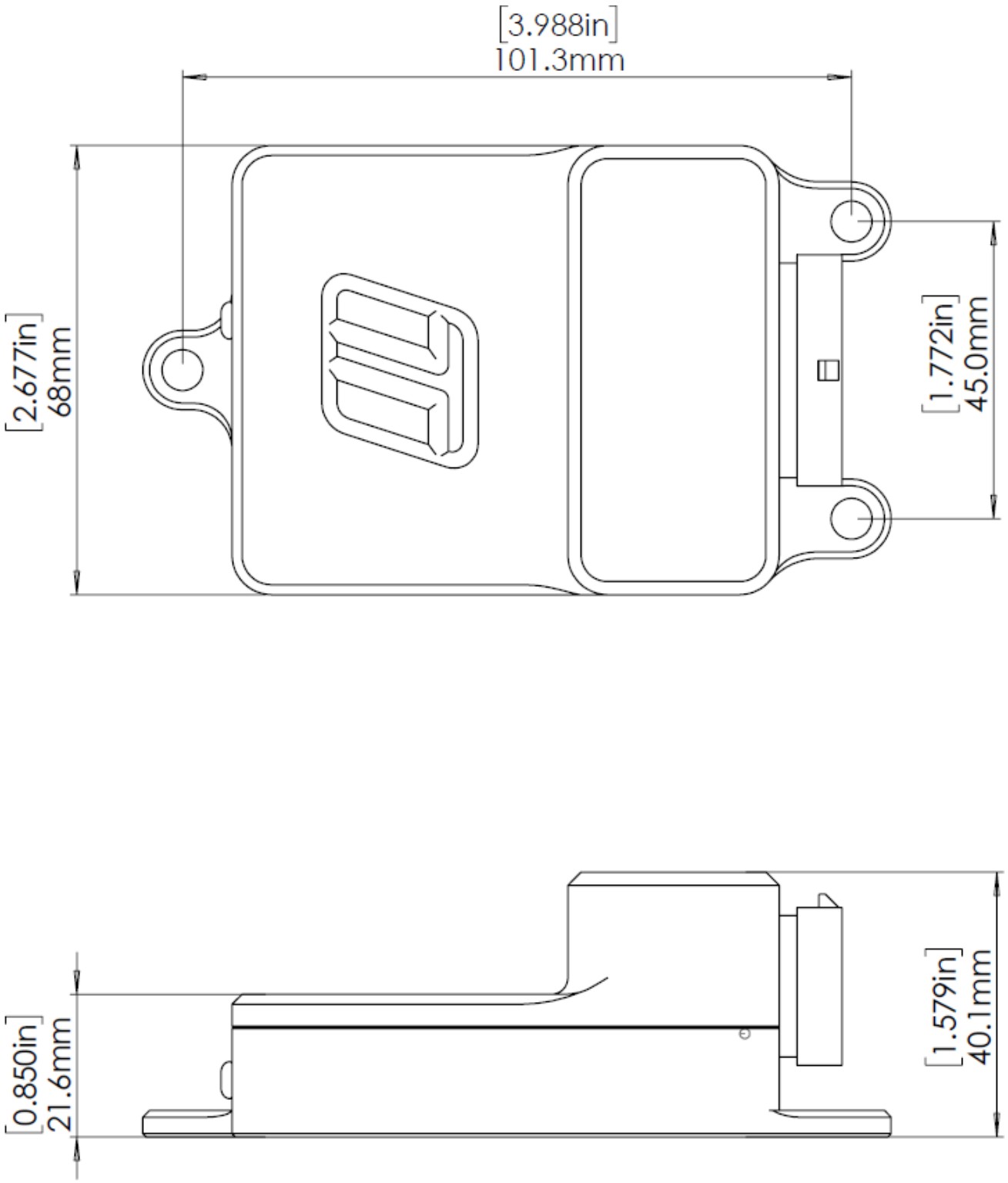
Pin	Channel Name	Description	Wiring from eGates
1	12V Supply	Positive Battery Power Supply 1/4*	
2	12V Supply	Positive Battery Power Supply 2/4*	
3	Output 1+ve	eGate 1 Positive Power Supply 1/2*	eGate 1 Red Larger Gauge Motor Wire
4	Output 1+ve	eGate 1 Positive Power Supply 2/2*	eGate 1 Red Larger Gauge Motor Wire
5	Output 1-ve	eGate 1 Negative Power Supply 1/2*	eGate 1 Black Larger Gauge Motor Wire
6	Output 1-ve	eGate 1 Negative Power Supply 2/2*	eGate 1 Black Larger Gauge Motor Wire
7	Output 2 +ve	eGate 2 Positive Power Supply 1/2*	eGate 2 Red Larger Gauge Motor Wire
8	Output 2+ve	eGate 2 Positive Power Supply 2/2*	eGate 2 Red Larger Gauge Motor Wire
9	Output 2-ve	eGate 2 Negative Power Supply 1/2*	eGate 2 Black Larger Gauge Motor Wire
10	12V Supply	Positive Battery Power Supply 3/4*	
11	12V Supply	Positive Battery Power Supply 4/4*	
12	NC	No Connection	
13	5.0V Supply	5V Sensor Supply	eGate/s Red Wire
14	OV AN Ref**	0V Sensor **(Do NOT connect with Chassis GND)**	eGate/s Black Wire
15	CAN 1 HI	CAN 1 High	
16	CAN 1 LO	CAN 1 Low	
17	Output 2-ve	eGate 2 Negative Power Supply 2/2*	eGate 2 Black Larger Gauge Motor Wire
18	Power Ground	Negative Battery Power Supply	
19	AV1	Analog Voltage 1	eGate 1 White Position Sensor
20	AV2	Analog Voltage 2	eGate 2 White Position Sensor
21	NC	No Connection	
22	NC	No Connection	
23	FREQ IN 1	ECU eGate 1 PWM Input	
24	NC	No Connection	
25	Power Ground	Negative Battery Power Supply	
26	Power Ground	Negative Battery Power Supply	
27	AV5	eGate 1 Enable Switch Voltage	
28	AV6	eGate 2 Enable Switch Voltage	
29	AV7	Analog Voltage 7	eGate 1 Yellow Temperature Sensor
30	AV8	Analog Voltage 8	eGate 2 Yellow Temperature Sensor
31	NC	No Connection	
32	FREQ IN 4	ECU eGate 2 PWM Input	
33	0V FREQ REF**	0V Frequency **(Do NOT connect with Chassis GND)**	
34	Power Ground	Negative Battery Power Supply	

NOTE:

***Each eGate requires 4 power wires. Two Positive and two negative to allow the correct amount of current to flow to the eGate for correct operation. Please see Pinout Current Sharing**

****The Sensor 0V Reference pin(s) are specialised ground outputs for all analog sensors and frequency inputs. Power Ground should not be connected with 0V Reference Pins. They should remain separate. Grounding these sensor grounds to the battery ground will cause issues with calibration and sensor readings due to noise.**




[3.988in]
101.3mm
[2.677in]
68mm
[1.772in]
45.0mm
[0.850in]
21.6mm
[1.579in]
40.1mm

CAN ID Transmitted Information

The black Box Receives and Transmit Certain Data, these addresses are noted below.

Turbosmart Default Transmit Base Address CAN ID 256 (0x100) (Big Endian)

<table>
<tr><th></th><th colspan="2">Data 0 | Data 1</th><th colspan="2">Data 2 | Data 3</th><th colspan="2">Data 4 | Data 5</th><th>Data 6</th><th>Data 7</th></tr>
<tr><td>0x100
TX 100Hz</td><td colspan="2">E-Gate1 Feedback Position 0 - 100.0%
(Multi 0.1 , Offset -100)</td><td colspan="2">E-Gate1 Area Target
(Either received from CAN OR PWM Input)
(Multi 0.1 , Offset 0)</td><td colspan="2">E-Gate1 Motor DC
(Multi 0.1 , Offset -100)</td><td colspan="2">E-Gate1 Position Target (Translated from Area Target received over CAN or PWM input)
(Multi 0.1 , Offset 0)</td></tr>
<tr><td>0x101
TX 100Hz</td><td colspan="2">E-Gate1 P- Gain Result (Multi 0.1 , Offset -100)</td><td colspan="2">E-Gate1 I- Gain Result (Multi 0.1 , Offset -100)</td><td colspan="2">E-Gate1 D- Gain Result (Multi 0.1 , Offset -100)</td><td>Byte 6 = E-Gate1 PID Status
<table><tr><td>0</td><td>OFF</td></tr><tr><td>1</td><td>ON</td></tr><tr><td>2</td><td>Min DC Clamp</td></tr><tr><td>3</td><td>Max DC Clamp</td></tr><tr><td>4</td><td>- Int Clamp</td></tr><tr><td>5</td><td>+ Int Clamp</td></tr><tr><td>6</td><td>Deadband</td></tr></table></td><td>Byte 7 = E-Gate1 System Status
• Note: Over Current Status will require power to be cycled.
<table><tr><td>0</td><td>OFF</td></tr><tr><td>1</td><td>Reserved</td></tr><tr><td>2</td><td>OFF-IC Reset</td></tr><tr><td>3</td><td>OFF-Posn Sensor Err.</td></tr><tr><td>4</td><td>OFF-Enable Sw</td></tr><tr><td>5</td><td>OFF-Over-Temp</td></tr><tr><td>6</td><td>OFF-Auto Stop</td></tr><tr><td>7</td><td>OFF-Parked</td></tr><tr><td>8</td><td>OFF-Over Current</td></tr><tr><td>9</td><td></td></tr><tr><td>10</td><td>Calibrating 0% Posn ..</td></tr><tr><td>11</td><td>Calibrating 100% Posn ..</td></tr><tr><td>12</td><td>Calibrate Complete !!</td></tr><tr><td>13</td><td>eGate Current Calibrating</td></tr><tr><td>14</td><td>eGate Parked</td></tr><tr><td>15</td><td>eGate Prespool</td></tr><tr><td>16</td><td>ON-Temp Sensor Fault</td></tr><tr><td>17</td><td>ON-Target CAN</td></tr><tr><td>18</td><td>ON-Target PWM</td></tr><tr><td>19</td><td>ON-Target USB Override</td></tr><tr><td>20</td><td>ON-Pass-Through %DC</td></tr><tr><td>21</td><td>ON-PreLoad Active</td></tr></table></td></tr>
<tr><td>0x102
TX 100Hz</td><td colspan="2">E-Gate1 Current Draw (A)
(Multi 0.1, Offset 0, signed)</td><td colspan="2">E-Gate1 Temperature (Multi 0.1, Offset -50)</td><td colspan="2">E-Gate1 Position Voltage (Raw V)
(Multi 0.001, Offset 0)</td><td colspan="2">E-Gate1 PWM Input – Duty % (Multi 0.1, Offset 0)</td></tr>
</table>

<table>
<tr><td>0x103
TX 100Hz</td><td>E-Gate2 Feedback Position 0 - 100.0% (Multi 0.1 , Offset -100)</td><td>E-Gate2 Area Target (Either received from CAN OR PWM Input) (Multi 0.1 , Offset 0)</td><td>E-Gate2 Motor DC (Multi 0.1 , Offset -100)</td><td colspan="2">E-Gate2 Position Target (Translated from Area Target received over CAN or PWM input)
(Multi 0.1 , Offset 0)</td></tr>
<tr><td>0x104
TX 100Hz</td><td>E-Gate2 P- Gain Result (Multi 0.1 , Offset -100)</td><td>E-Gate2 I- Gain Result (Multi 0.1 , Offset -100)</td><td>E-Gate2 D- Gain Result (Multi 0.1 , Offset -100)</td><td>Byte 6 = E-Gate2 PID Status
<table><tr><td>0</td><td>OFF</td></tr><tr><td>1</td><td>ON</td></tr><tr><td>2</td><td>Min DC Clamp</td></tr><tr><td>3</td><td>Max DC Clamp</td></tr><tr><td>4</td><td>- Int Clamp</td></tr><tr><td>5</td><td>+ Int Clamp</td></tr><tr><td>6</td><td>Deadband</td></tr></table></td><td>Byte 7 = E-Gate2System Status
<table><tr><td>0</td><td>OFF</td></tr><tr><td>1</td><td>Reserved</td></tr><tr><td>2</td><td>OFF-IC Reset</td></tr><tr><td>3</td><td>OFF-Posn Sensor Err.</td></tr><tr><td>4</td><td>OFF-Enable Sw</td></tr><tr><td>5</td><td>OFF-Over-Temp</td></tr><tr><td>6</td><td>OFF-Auto Stop</td></tr><tr><td>7</td><td>OFF-Parked</td></tr><tr><td>8</td><td>OFF-Over Current</td></tr><tr><td>9</td><td></td></tr><tr><td>10</td><td>Calibrating 0% Posn ..</td></tr><tr><td>11</td><td>Calibrating 100% Posn ..</td></tr><tr><td>12</td><td>Calibrate Complete !!</td></tr><tr><td>13</td><td>eGate Current Calibrating</td></tr><tr><td>14</td><td>eGate Parked</td></tr><tr><td>15</td><td>eGate Prespool</td></tr><tr><td>16</td><td>ON-Temp Sensor Fault</td></tr><tr><td>17</td><td>ON-Target CAN</td></tr><tr><td>18</td><td>ON-Target PWM</td></tr><tr><td>19</td><td>ON-Target USB Override</td></tr><tr><td>20</td><td>ON-Pass-Through %DC</td></tr><tr><td>21</td><td>ON-PreLoad Active</td></tr></table></td></tr>
<tr><td>0x105
TX100Hz</td><td>E-Gate2 Current Draw (A)
(Multi 0.1, Offset 0, signed)</td><td>E-Gate2 Temperature (Multi 0.1, Offset -50)</td><td>E-Gate2 Position Voltage (Raw V) (Multi 0.001, Offset 0)</td><td colspan="2">E-Gate2 PWM Input – Duty % (Multi 0.1, Offset 0)</td></tr>
<tr><td>0x106
TX 20Hz</td><td>Byte 0/1 = E-Gate Main Supply - (Multi 0.001, Offset 0)</td><td>Byte 2/3 = E-Gate 5V supply (Multi 0.001, Offset 0)</td><td>Byte 4/5 = E-Gate Internal Temperature (Multi 0.1, Offset -50)</td><td>Byte 6 = E-Gate 1 Translation Source Bits 0 -3,
<table><tr><td>0</td><td>Unknown</td></tr><tr><td>1</td><td>Poppet Default</td></tr><tr><td>2</td><td>Poppet 1:1 Ratio</td></tr><tr><td>3</td><td>Poppet WG40</td></tr><tr><td>4</td><td>Poppet WG45</td></tr><tr><td>5</td><td>Poppet WG50</td></tr><tr><td>6</td><td>Poppet WG60</td></tr><tr><td>7</td><td>Straight 1:1 Ratio</td></tr><tr><td>8</td><td>Straight</td></tr><tr><td>9</td><td>Bosch</td></tr></table></td><td>Byte 7 =
BIT 0-1: eGate 1 Device Target Source;
<table><tr><td>0</td><td>Unknown</td></tr><tr><td>1</td><td>CAN</td></tr><tr><td>2</td><td>PWM</td></tr></table>
BIT 2-3: eGate 2 Device Target Source;
<table><tr><td>0</td><td>Unknown</td></tr><tr><td>1</td><td>CAN</td></tr><tr><td>2</td><td>PWM</td></tr></table></td></tr>
</table>

10	%DC Pass Through Mode

Source Bits 4 -7,

0	Unknown
1	Poppet Default
2	Poppet 1:1 Ratio
3	Poppet WG40
4	Poppet WG45
5	Poppet WG50
6	Poppet WG60
7	Straight 1:1 Ratio
8	Straight
9	Bosch
10	%DC Pass Through Mode

BIT 4-5: eGate Auto Stop.

0	Unknown
1	OFF
2	ON

Turbosmart Default Receive Base Address CAN ID 272 (0x110) (Big Endian)

<table>
<tr><th></th><th>Byte 0</th><th>Byte 1</th><th>Byte 2</th><th>Byte 3</th><th>Byte 4</th><th>Byte 5</th><th>Byte 6</th><th>Byte 7</th></tr>
<tr><td>0x110
RX 100Hz</td><td colspan="2">Area Target Egate 1: 0 -100.0% (0 – 1000)</td><td colspan="2">Area Target Egate 2: 0 -100.0% (0 – 1000)</td><td>Egate 1 Pass Through %DC (when Egate 1 Translation Type = %DC Pass Through. 0 -100% (0 – 100 CAN)</td><td>Egate 2 Pass Through %DC (when Egate 2 Translation Type = %DC Pass Through. 0 -100% (0 – 100 CAN)</td><td>EGate Pre Load
BIT0 Egate 1 Activate Pre Load*
0 No Change
1 OFF
2 ON
BIT1 Egate2 Activate Pre Load*
0 No Change
1 OFF
2 ON
*(When function has been enabled)</td><td>0=(Unused)</td></tr>
<tr><td>0x111
ONLY send when a setting is changed. DON’T send continuously</td><td>Egate 1 Translation Type(Lower nibble Bits 0-3)
0 Unknown
1 Poppet Default
2 Poppet 1:1 Ratio
3 Poppet WG40
4 Poppet WG45
5 Poppet WG50
6 Poppet WG60
7 Straight 1:1 Ratio
8 Straight
9 Bosch</td><td>BIT0/1= Egate Target Source 1.
0 No Change
1 CAN
2 PWM
BIT2/3 = Egate Target Source 2
0 No Change
1 CAN
2 PWM
BIT4/5 = Egate Auto Stop Control
0 Unknown
1 OFF
2 ON
BIT6/7 = Unused</td><td>OverTemperature Shutdown (1350 = 135.0 DegC Shutdown) 0 = no change</td><td>BIT0/1 = Egate 1 Pre-Load Enable
0 No Change
1 OFF
2 ON
BIT2/3 = Egate 2 Pre-Load Enable
0 No Change
1 OFF
2 ON
BIT4/5 = Egate Auto Stop Control</td><td>BIT0/1: Egate 1 Position Calibration
0 No Change
1 Off
2 ON – Cal Closed Position
3 ON Cal Open Position
BIT2/3: Egate 2 Position Calibration
0 No Change
1 Off
2 ON – Cal Closed Position
3 ON Cal Open Position</td><td>Pre-Load %DC (0dp) . CAN value 65 = -65%</td><td>Pre-Load Max Time (0dp) . CAN value 36 = 36 secs</td><td>Park Enable Target Threshold. CAN Value 12 = Target 1.2%</td></tr>
</table>

	10 | %DC Pass Through* Egate 2 Translation Type (upper nibble bits 4-7) 0 | Unknown 1 | Poppet Default 2 | Poppet 1:1 Ratio 3 | Poppet WG40 4 | Poppet WG45 5 | Poppet WG50 6 | Poppet WG60 7 | Straight 1:1 Ratio 8 | Straight 9 | Bosch 10 | %DC Pass Through* *Raw PWM so NO Closed Loop. The value from the Bytes 4/5 or 6/7 become the %DC and get directly applied to the motor			0 | No Change 1 | OFF 2 | ON BIT6/7: Unused				