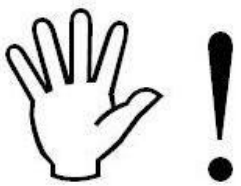
Instruction Manual

PERFORMANCE ELECTRONICS

P/N 30-0500 & 30-0534
X-Series Plus Wideband UEGO AFR Gauge w/ OBD CAN Integration



STOP! - READ THIS BEFORE INSTALL OR USE!

WARNING:
THIS INSTALLATION MAY REQUIRE WELDING OR INTEGRATION INTO A VEHICLE'S ELECTRICAL SYSTEM. DAMAGE TO SENSITIVE ELECTRONICS, FIRE, OR EXPLOSION MAY OCCUR IF PROPER PRECAUTION IS NOT TAKEN. IF THERE IS ANY DOUBT, **DO NOT** ATTEMPT THE INSTALLATION AND CONSULT A PROFESSIONAL.
NOTE: IT IS THE RESPONSIBILITY OF THE ENGINE TUNER TO ULTIMATELY CONFIRM THE CALIBRATION USE FOR ANY PARTICULAR ENGINE IS SAFE FOR ITS INTENDED USE. AEM HOLDS NO RESPONSIBILITY FOR ANY ENGINE DAMAGE THAT RESULTS FROM THE MISUSE OF THIS PRODUCT.

The 52mm (2-1/16") AEM X-Series Plus Universal Exhaust Gas Oxygen (UEGO) Gauge features a four digit central readout and sweeping 24-color-coded LED display, providing immediate reference to the engine air fuel ratio (or Lambda) in real-time. The AEM gauge is ideal for all vehicles including carbureted applications and engine dynamometers. An optional OBD-II output can be used in conjunction with CAN based OBD-II ports found in 2008 and newer vehicles to replace or supplement stock O2 sensors with the fast AEM/FAE sensor for more accurate mixture control. A 0-5V analog output is included and can be used with data loggers or aftermarket ECUs. In addition, an AEMnet (CAN bus) and serial data stream are also available for logging or display.

The X-Series Digital Wideband technology is US Patent #9,575,030.

Features

- X-Digital Technology with improved sensor tuning
- Fast response, 20ms typical
- Smart sensor warmup with condensation removal
- Smart power management with auto wake options
- Exhaust back pressure compensation
- Supports AEM/FAE Sensor
- Supports Bosch LSU4.9 Sensor
- Supports free air or resistor trim calibration modes
- Supports vehicle/system voltages up to 16V
- Configurable 3 or 4 digit precision display mode
- Lambda, AFR, O2 % display modes with reversible faceplate
- 8.0:1 to 20.0:1 AFR / 0.55 to 2.00 Lambda
- 2-1/16" / 52mm outer diameter mounting
- Locking connectors
- AEMnet (CAN bus) Output
- 0-5V Analog Output with 0v reference (10-bit, 500hz)
- OBD-II CAN Output; compatible with 2008 or newer vehicles
  - Daisy-chain up to eight (8) 30-0534 gauges
- Serial RS-232 Output

30-05XX Kit Contents

PN	Description
10-05xx	INST,X-SERIESUEGOGAUGE
35-0500	GAUGEASSY,X-SERIESAFRGAUGE
-	REDINSULATEDBUTTCONNECTORS(4)
35-4005	WELD-IN BUNG,02SENSOR 1214MILD STEEL
35-8618	NUT,KNURLED,M4x0.7(2)
35-8614	BRACKET,X-SERIESGAUGE
35-3430	PWR/IO CABLE,X-SERIESGAUGE **(30-0500 ONLY)**
35-3459	PWR/IO CABLE,X-SERIESGAUGEOBDII **(30-0534 ONLY)**
35-3427	SENSORCABLE,X-SERIESGAUGE
35-8617	RUBBERBAND,X-SERIESGAUGE
35-2404	SENSOR,WIDEBANDUEGOAEM/FAE

OPTIONAL ACCESSORIES	
30-2404	AEM/FAE WIDEBAND REPLACEMENT SENSOR
30-2004	AEM 4.9LSU REPLACENT SENSOR
30-2355-200	NOWELDUEGOCLAMPKIT,1.75" to2.00"
30-2355-250	NOWELDUEGOCLAMPKIT,2.25" to2.50"
30-2355-300	NOWELDUEGOCLAMPKIT,2.75" to3.00"
30-2355-350	NOWELDUEGOCLAMPKIT,3.25" to3.50"
30-4008	WELD-INFINNEDBUNG,O2LONG,STAINLESSSTEEL
35-4001	BUNGPLUG,02SENSOR

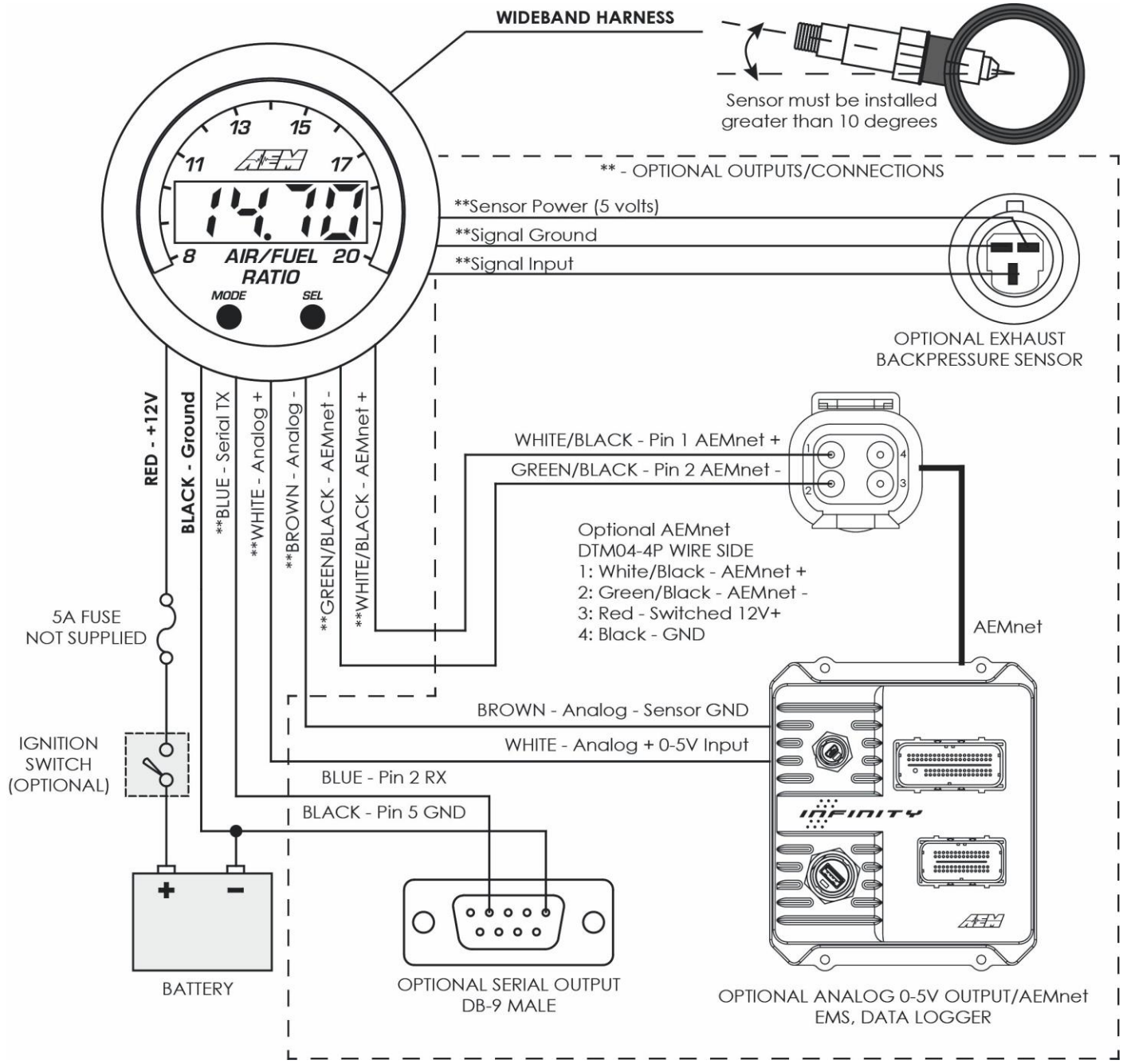
AEM Performance Electronics, 2205 126th Street Unit A, Hawthorne, CA90250 - Phone: (310) 484-2322
http://www.aemelectronics.com

What is a UEGO Wideband Sensor

A Universal Exhaust Gas Oxygen (UEGO) oxygen sensor, also known as a wideband or Lambda sensor, measures the proportion of oxygen (O2) in the exhaust of a running engine. An air to fuel ratio (AFR) or Lambda value can be calculated from this measurement. Typically, when calibrating or "tuning" the fuel delivery system of an engine, a specific AFR can be targeted to achieve maximum power, economy, or emissions. The output from a UEGO sensor controller can be used to adjust a carburetor or fuel injection system to reach this target.

UEGO sensors are one of the more sophisticated sensors found in today's vehicles. The sensing element is made of a zirconium dioxide ceramic with a thin platinum coating and has an integrated heating element. An electronic controller, such as is contained in AEM's X-Series UEGO Gauge or Inline Controller, is **required** to use a UEGO oxygen sensor. The controller connects to the sensor via multiple wires (up to 6) carrying sensitive voltages and electrical currents to process and calculate an AFR value. This value may be read directly from a gauge face or data-log as recorded by an ECU or logger via several methods as discussed elsewhere in this manual.

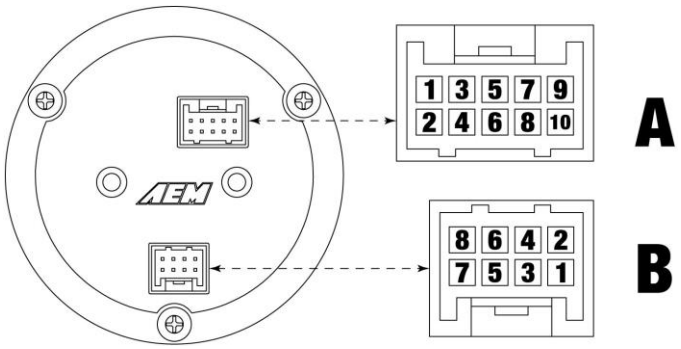
Wiring Installation Diagram



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Gauge Connections

The X-Series UEGO gauge is supplied with a Power/IO wiring harness (**A**) and a UEGO sensor harness (**B**); the harnesses are connected to the gauge as shown below. The UEGO sensor harness simply needs to be routed to the UEGO sensor whereas the Power/IO harness will require further integration into the vehicle. The minimum Power/IO connections required to operate the gauge are switched 12V (5A fuse) and ground. Please reference the provided diagrams and information for further details.



Connector A - Power / IO

Pin	Color	Description
1	RED	Switched 12V Power (5A Fuse)
2	BLACK	Power Ground
3	GREEN/BLACK	AEMnet- / CANL (Optional)
4	WHITE/BLACK	AEMnet+ / CANH (Optional)
5	BLUE	Serial / RS-232 Output (Optional)
6	-	+5V EBP Sensor Power (Optional)
7	-	EBP Sensor Signal Input (Optional)
8	-	EBP Sensor Ground (Optional)
9	WHITE	0-5V Analog Output Positive+
10	BROWN	0-5V Analog Output Negative-

Important Notes on Wiring

- Route harnesses carefully to avoid chafing or undue strain.
- Secure wiring to vehicle with wire ties paying special attention to the sensor harness routing beneath the vehicle and/or in the engine compartment.
- Take care when routing sensor harness near hot exhaust components.
- Apply strain reliefs and wire coverings as necessary.
- Use a 5A inline fuse on the switched 12V power supply line (Pin 1 - Power/IO).
- Avoid cutting or extending the sensor harness.
- Use appropriate gauge wire (20 AWG or thicker) when extending wires, especially Pins 1(Switched 12V) or 2(Ground) of the Power/IO harness.
- Ensure all connections are secure and insulated from shorts to adjacent wires and the vehicle structure. Utilize proper crimping and solder/heat shrink techniques.
- Replacement pins are JST P/N SPUD-001T-P0.5 terminals for 22-26 AWG wire

Connector B - AEM/FAE UEGO Sensor

Pin	Color	Description
1	GREEN	Trim Resistor
2	WHITE	Heater Negative-
3	ORANGE	COM
4	-	Not Used
5	RED	Pump Current
6	BLACK	Sense
7	-	Not Used
8	BROWN	Heater Positive+

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Important Notes on Wideband Sensors

The sensor contains an integrated heating element and will become hot enough to produce burns when powered, even without the presence of exhaust gas. Sensors can remain hot enough to burn or start a fire for quite some time after removing power -- handle with caution.

UEGO sensors are very sensitive devices that must be handled and installed with care. Listed below are several contaminants and conditions which will shorten the life of the sensor or result in outright failure.

The following may damage or destroy oxygen sensors:

- Leaded (tetraethyl) fuel
- Silicone
- Oil
- Engine coolants
- Particulates, carbon (e.g. excessively rich mixtures)
- Mechanical shock (e.g. dropping a sensor on the ground)
- Thermal shock - allowing the sensor to fully heat without starting the engine causes cold exhaust to cross the hot element.
- Extreme exhaust temperatures (Greater than 930 degC / 1700 degF)
- Unheated sensor in exhaust stream. Sensors that are installed in an exhaust must be connected to a properly functioning controller during engine operation.

AEM/FAE Sensor

The 30-05xx X-Series UEGO gauge is supplied with an AEM/FAE sensor (P/N 30-2404). AEM has spent years collaborating with FAE to develop a motorsport-focused oxygen sensor for maximum performance, specifically designed to minimize response times and improve durability and resistance to race fuels. The AEM/FAE sensor provides industry-leading quick response times, which means improved wideband feedback control. This ultimately leads to a safer, more powerful and accurate tune. The mechanical durability and performance have also been improved, and the sensor structure has been reinforced to better protect against lead contamination. The AEM/FAE sensors have undergone innumerable hours of rigorous internal and field testing on high-abuse test engines running a variety of fuels, including race fuel. The result is a fast responding sensor that can also handle the most extreme motorsport environments.

Interpreting Wideband Sensor Readings

An internal combustion engine runs on air (which contains ~20% oxygen) and fuel. The ratio of air to fuel (AFR) that, when combusted, perfectly consumes 100% of both the oxygen and fuel is called the stoichiometric ratio. This ratio is different for every fuel. Ratios lower than stoichiometric have more fuel and are considered "rich"; ratios higher than stoichiometric have less fuel and are considered "lean."

Fuel	Stoichiometric AFR	Lambda
Unleaded Gasoline	14.65 : 1	1.00
Methanol	6.47 : 1	1.00
Ethanol	9.00 : 1	1.00
Propane	15.67 : 1	1.00
CNG	17.20 : 1	1.00

Lambda is a unitless ratio that is fuel agnostic. In other words, a Lambda reading of 1.0 is stochiometric for any fuel.

AFR = (Stoichiometric AFR * Lambda)

In general, an engine will have three areas of operation: idle/cruise, wide open throttle, and fuel cut off. The exact AFR value that should be expected (or tuned to) for these areas is very specific to the type and configuration of each individual engine. However, while monitoring your AEM X-Series controller, you should see readings similar to the chart below. Fuel cutoff is generally experienced when completely lifting off the throttle, while decelerating in gear, at high RPM.

Operating Region	WOT	IDLE/CRUISE	FUEL CUTOFF
Approximate AFR	10.5 (RICH)	14.7 (STOICH)	20.0 (LEAN)

IMPORTANT NOTE!

Engine tuning should only be performed by experienced individuals as engine damage, or outright failure, can be the result of an improper calibration.

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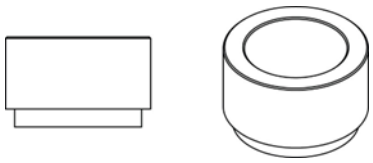
Sensor Placement

The location at which the sensor is installed in the vehicle's exhaust system is critical to its performance and longevity. Please review the following placement guidelines:

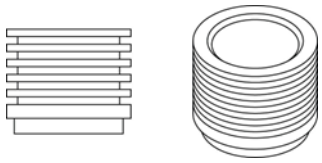
- 18 inches (45cm) downstream of the cylinder head's exhaust port or turbocharger
- Upstream of any catalytic converters or emission control devices
- Downstream of any turbochargers or large contributors to exhaust pressure
- As far as possible from the exhaust exit (tailpipe) to avoid scavenging fresh air in low exhaust flow conditions such as idling
- AEM's X-Series UEGO controller is a very sensitive device and, thus, it is important to have a completely leak-free exhaust

Sensor Bung

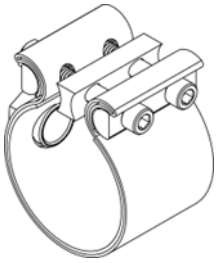
The supplied mild steel sensor bung must be welded into the vehicle's exhaust. An optional stainless steel sensor bung is available for purchase from AEM dealers and may be useful in specific installation scenarios. The taller geometry of this bung helps bring the sensing element further out of the exhaust stream when used in small diameter tubing such as header primaries. In addition, the finned body helps dissipate heat when used in extreme applications. As an alternative to welding, users may purchase a P/N 30-2355-XXX No Weld UEGO Clamp Kit.



P/N 35-4001 Mild Steel Sensor Bung



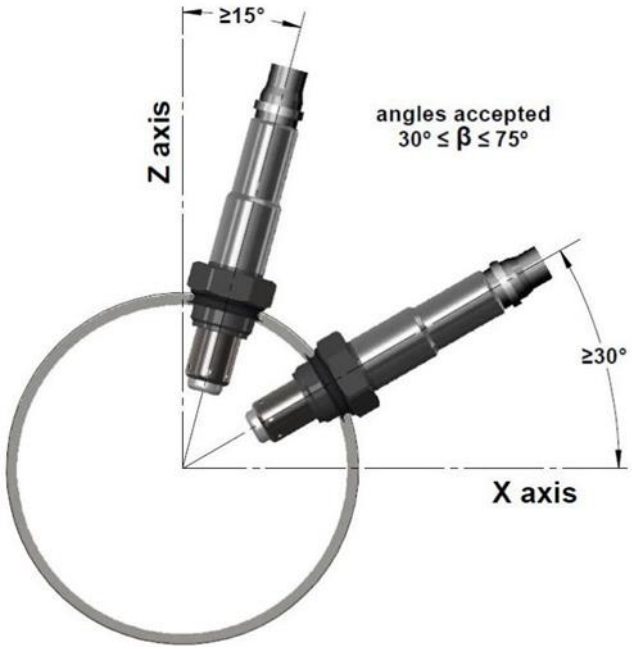
P/N 30-4008 Stainless Steel Tall Sensor Bung w/ Fins



P/N 30-2355-XXX No Weld UEGO Clamp Kit

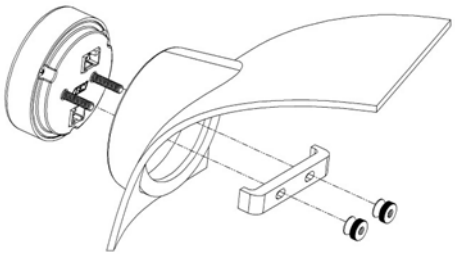
Sensor Installation Angle

The bung should be welded in such a way that the installed sensor orientation is greater than 30 degrees from horizontal and greater than 15 degrees from vertical to allow any condensation to properly drain from the sensor. In addition, it is recommended to avoid a completely vertical sensor orientation to prevent overheating the sensor. Failure to heed these recommendations may result in premature sensor failure.

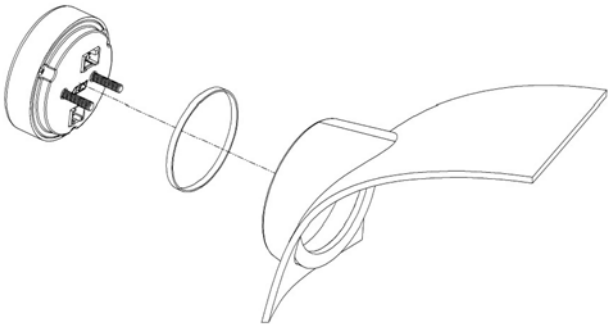


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Gauge Installation



Installation using supplied bracket



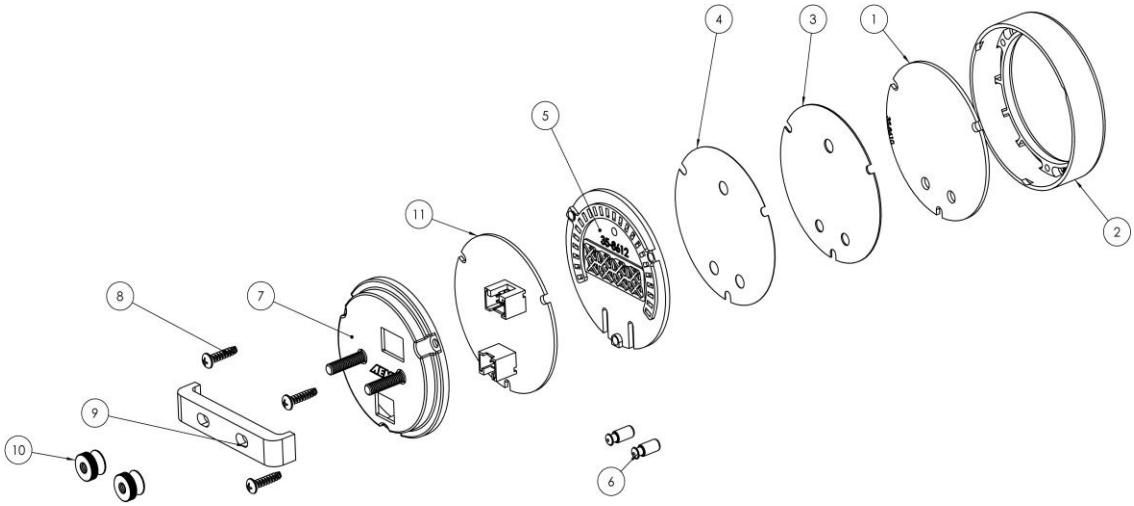
Installation without bracket, using rubber band

A 2-1/6" (52mm) hole is required to mount the X-Series gauge. A bracket and thumbscrews are provided to facilitate installation into a panel or gauge pod. In some cases, the gauge cup may be pushed into a mounting hole causing an interference fit strong enough to retain the gauge; the supplied rubber band may be fit to the gauge to create a tighter fit in mounting holes slightly larger than 52mm. It is, however, recommended that gauges be mounted securely using the supplied bracket to ensure they never become loose and cause a hazard during vehicle operation.

Note: The gauge is not waterproof and should not be installed in a location with exposure to water or snow. Damage caused by water ingress will not be covered under warranty.

Faceplate / Bezel Installation

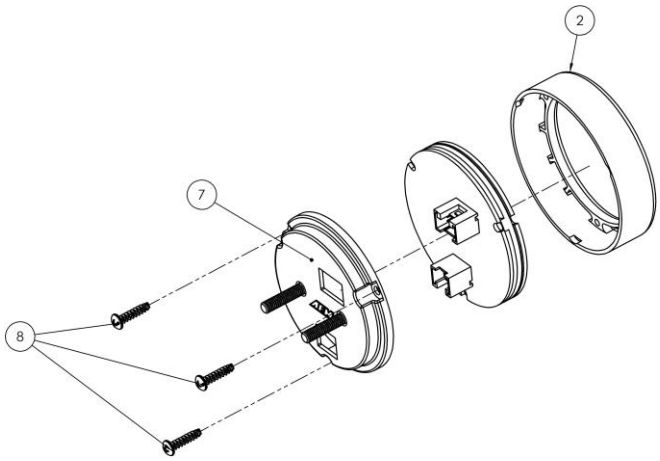
The faceplate may be reversible, displaying alternative units on either side. Reference the Operation section of this manual for details on how to switch the display mode when reversing the faceplate. Disassembly is required to change the faceplate, flip/reverse the faceplate, or change the bezel of the gauge. The following diagram will provide familiarization with the major components of the gauge prior to beginning the procedure.



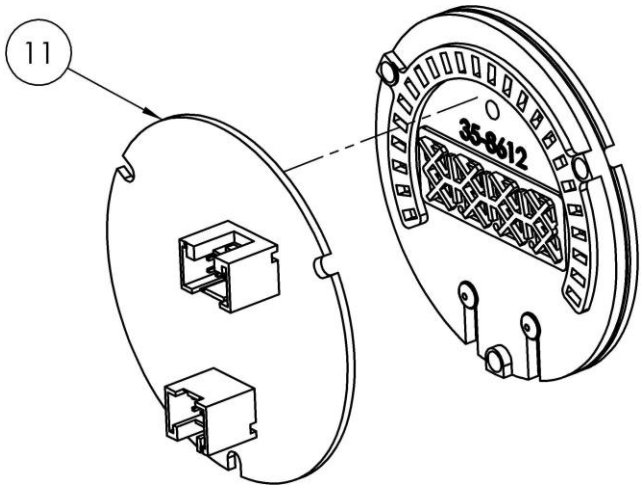
Item	Qty	Description
1	1	Lens
2	1	Bezel
3	1	Faceplate
4	1	Diffuser
5	1	Light Guide
6	2	Button
7	2	Mounting Stud (M4 x 0.7)
8	3	Assembly Screw
9	1	Mounting Bracket
10	2	Brass Thumb Screw (M4 x 0.7)
11	1	Printed Circuit Board (PCB)

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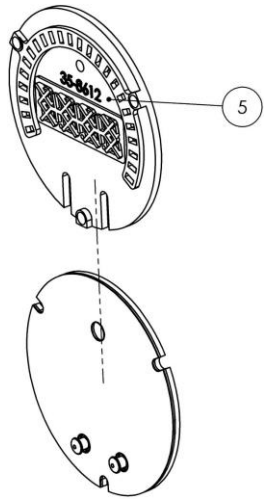
Gauge Disassembly



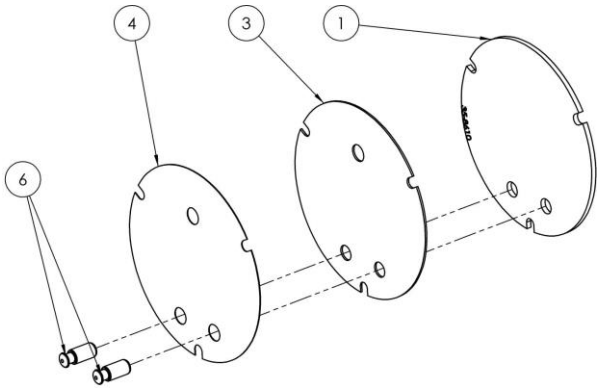
STEP 1 - Remove the three assembly screws (8) using a #1 Phillips head screwdriver. Separate the bezel (2) and cup (7) from the rest of the assembly. If you have purchased the optional accessory kit, the silver bezel may be replaced for the existing bezel at this time



STEP 2 - Separate the PCB (11) from the remaining components



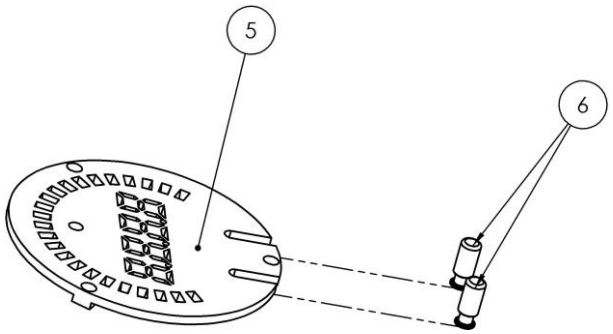
STEP 3 - Slide the light guide (5) upward to remove it, the buttons may fall out at this time - take care not to lose them



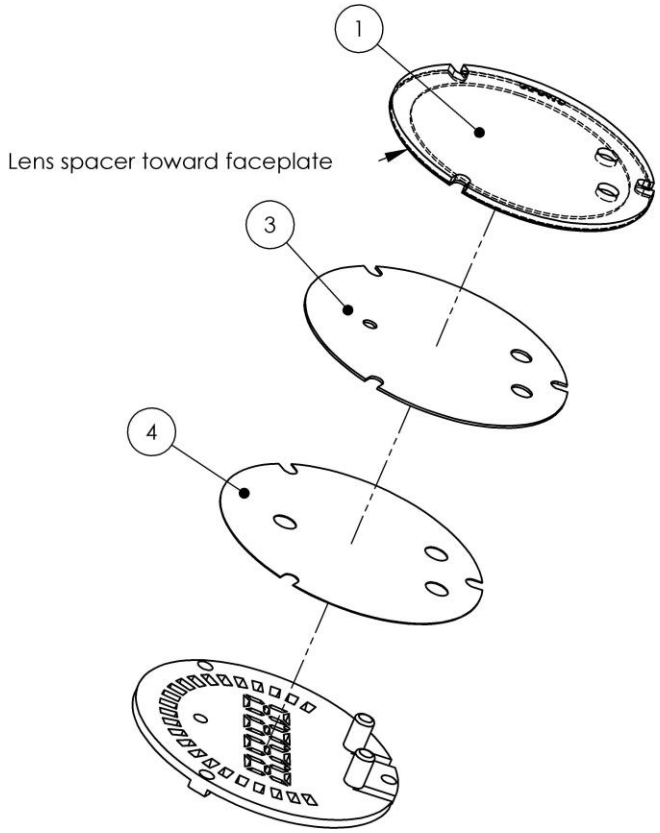
STEP 4 - As you separate the remaining components, diffuser (4), faceplate (3), lens (1), note the order in which they were assembled. The faceplate (3) may now be reversed to display an alternate scaling or replaced for a different color as included in the optional accessory kit

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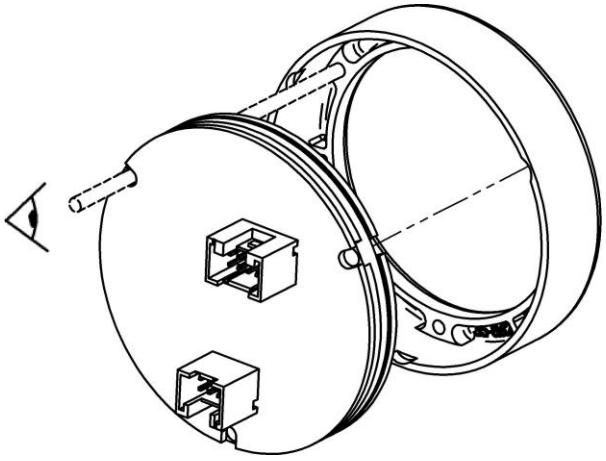
Gauge Assembly



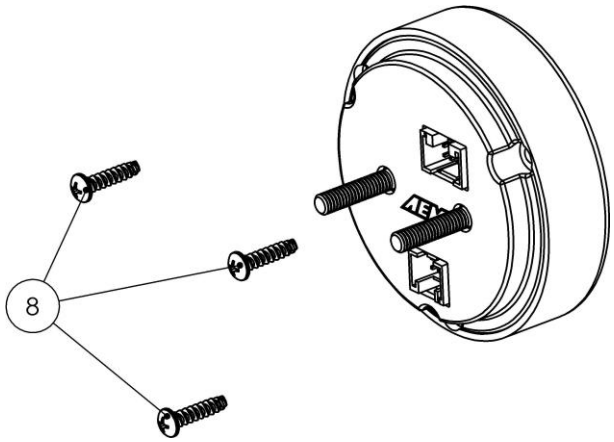
STEP 1 - Place the light guide (5) on a flat surface (black side up) and slide the buttons (6) into the slots



STEP 2 - Stack the diffuser (4), faceplate (3), and lens (1) in order, over the buttons, and on to the light guide



STEP 3 - Reassemble the PCB and display stack with the bezel, making sure screw holes are aligned through the entire assembly



STEP 4 - Reassemble and tighten screws to 2 in-lb (previously assembled bezel) or 3 in-lb (new bezel). **Do not over-tighten!**

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Smart Power Management

The X-Series Plus gauge uses a low power consumption sleep mode with a 30 second sleep timer. This timer is reset and the gauge will wake if any of the following conditions are true:

- Measured battery voltage is greater than 13.4 volts and menu item Pon is set to batt
- If menu item Pon is set to OBDII and an OBDII CAN packet is received (applicable to 2008+ OBDII equipped vehicles only)
- If the MODE button is pressed
- If menu item Pon is set to ON

If the vehicle does not have an alternator charging system or fitted with a battery that has a resting voltage greater than 13.4 volts – connect power input to switched power and set the menu item Pon to ON.

Smart Sensor Warmup

Avoid exposing a fully heated sensor heater element to cold/moist airflow from an engine just after start up. The smart sensor warmup feature includes a new evaporative heating phase combined with an optional HOLD mode that ensures the engine is running before the warmup process initiates. If the SMART feature is enabled, sensor warmup will be prohibited until the system battery voltage exceeds 13.4 volts. If the vehicle does not have an alternator charging system, the feature can be disabled in the menus.

Sensor Auto Detection

The X-Series UEGO gauge can automatically determine whether an AEM/FAE or Bosch LSU4.9 sensor is connected to the UEGO sensor harness.

Calibration

The supplied UEGO sensor is factory calibrated via a trim resistor, integral to the sensor connector, and requires no further calibration. The ability to perform a free air calibration is provided for users that wish to do so. A free air calibration can be used as a sensor ages; however, new sensors should use the resistor calibration for best accuracy.

Resistor Trim Calibration Mode (rCAL)

This is the X-Series UEGO controller's default mode as shipped from the factory. It is the recommended calibration mode and, for most users, no further action or calibration is required.

Free Air Calibration Mode (ACAL)

Refer to the Operation section of this manual for instruction on how to navigate to the menu selection ACAL. The sensor MUST be removed from the exhaust for this procedure. The free air calibration process begins once the ACAL menu option selection is confirmed. The calibration will take approximately ten to fifteen seconds during which the sensor must be placed in a "fresh" air environment, i.e. an area without lingering exhaust or chemical fumes. The process will complete and the gauge will report PASS or FAIL on the display. If the gauge reports FAIL then the sensor detected an abnormally low level of oxygen; this is typically indicative of a sensor being left in the exhaust pipe or in an environment with excess exhaust/chemical fumes.

Exhaust Back Pressure Compensation

Oxygen sensors are sensitive to pressure. An optional exhaust back pressure compensation feature allows for direct pressure measurement and accurate compensation. The feature is optimized for use with the AEM 30-2064 Exhaust Back Pressure Kit. The kit includes a 100 psi pressure sensor and the necessary lines and fitting to safely remote mount the sensor. This feature can be used in applications where exhaust back pressure cannot be avoided.

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Mode Selections



MODE Button SEL(ect) Button

SEnS
MODE
4d 1G SEL 3d 1G Select either 3 digit and 4 digit display mode
MODE
LA SEL O2 SEL AFr Select between Lambda, O2 or AFR display modes
MODE SEL
ACAL SEL ConF SEL Initiate sensor free air calibration feature
MODE
rCAL SEL ConF SEL Select sensor resistor calibration mode
MODE
CAn SEL AnEt SEL obd2 Select between AEMNet and OBDII CAN configurations
MODE
Id SEL Id01 SEL Id 16 Select AEMNet CAN ID
MODE
PId SEL See OBDII Interface section
MODE
ECU SEL See OBDII Interface section
MODE
bitS SEL See OBDII Interface section
MODE
rAtE SEL See OBDII Interface section
MODE
EbPC SEL on SEL oFF Enable or disable exhaust back pressure compensation
MODE
SAFE SEL on SEL oFF Enable or disable smart sensor warmup
MODE
Pon SEL on SEL obd2 SEL bAtt Select smart power management option
SEL See smart power management section

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0-5V Analog Output

WHITE WIRE = Analog Positive +
BROWN WIRE = Analog Negative -

0-5V Analog Output Scaling Formulas		
AFR	=	(2.3750 * Volts) + 7.3125
Lambda	=	(0.1621 * Volts) + 0.4990

The 0-5V analog output is suitable for output to devices such as loggers or ECUs. This differential output requires special care to ensure proper operation. The WHITE signal wire should be connected to the positive of the analog input of the logging device or ECU; the BROWN wire must be connected to the negative of the analog input of the logging device or ECU. If the logging device or ECU does not have a differential analog input (both a dedicated positive and negative terminal for the analog input) then connect the BROWN wire to the shared signal ground. If the device does not have a dedicated signal ground, then as a last course of action, connect it to the power ground of the logging device.

Important Note: If bench testing the analog output outside of a vehicle, a multimeter's positive lead may be connected to the WHITE wire however the BROWN wire must be connected to BOTH the multimeter's negative lead AND power ground going to the X-Series UEGO device. This connection is usually made by the circuitry inside an ECU or data logger.

0-5V Analog Output Scaling Table		
Volts	**Lambda**	**AFR (Gasoline)**
<0.50	SENSOR NOT READY	
0.50	0.58	8.50
0.75	0.62	9.09
1.00	0.66	9.69
1.25	0.70	10.28
1.50	0.74	10.88
1.75	0.78	11.47
2.00	0.82	12.06
2.25	0.86	12.66
2.50	0.90	13.25
2.75	0.94	13.84
3.00	0.99	14.44
3.25	1.03	15.03
3.50	1.07	15.63
3.75	1.11	16.22
4.00	1.15	16.81
4.25	1.19	17.41
4.50	1.23	18.00
>4.50	SENSOR ERROR	

Serial (RS-232) Output

BLUE WIRE = Serial Out

The serial data stream is suitable for output to third party devices such as data loggers, PCs, or reflashed ECUs. The X-Series UEGO serial data stream is designed to match AEM's legacy 30-4100/30-4110 UEGO Digital Gauge for backwards compatibility. The currently selected display mode (Lambda or AFR) will dictate what is output via serial. The format is simply the value followed by a carriage return and line feed, e.g. "14.7\r\n"

baud rate	9600 bps
data bits	8
parity	None
stop bits	1

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OBDII (CAN Bus) Output

The OBD-II output feature simulates an auxiliary ECU when plugged into the vehicle's OBD-II port. As such, the gauge requires its own address that is different than any of the other ECUs that are already on the vehicle's network. The default settings have been chosen such that most users should not have to adjust the following settings; just plug it in and go.

The available settings under the 'obd2' menu are:



This is the unique address the gauge should be set to for scanners to be able to accurately detect O2 readings. The actual hex address used will change depending on the 'bitS' option (below.) The default value is ECU #6 and if using another 30-0534 the second gauge should be set to ECU #7.

ECU #	11-bit	29-bit
1	0x7E1	0x18DA14F1
2	0x7E2	0x18DA18F1
3	0x7E3	0x18DA1CF1
4	0x7E4	0x18DA20F1
5	0x7E5	0x18DA24F1
6 (default)	0x7E6	0x18DA28F1
7	0x7E7	0x18DA2CF1



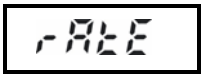
This is the hexadecimal value for the PID that the gauge should emulate. The default value should be listed as O2 #1 and if a second gauge is used then O2 #2 should be selected. If your vehicle is equipped with OEM wideband sensors and the factory powertrain ECU already outputs some of the PIDs in the following table, then you may need to select a different PID. This will highly depend on your vehicle and scanner type. Listed below are the available options.

O2 #	Location	PID
1 (default)	Bank 1 Sensor 1	0x24
2	Bank 1 Sensor 2	0x25
3	Bank 2 Sensor 1	0x26
4	Bank 2 Sensor 2	0x27
5	Bank 3 Sensor 1	0x28
6	Bank 3 Sensor 2	0x29
7	Bank 4 Sensor 1	0x2A
8	Bank 4 Sensor 2	0x2B
EF1	Bank 1 Sensor 1	0x24
EF2	Bank 2 Sensor 2	0x25

'EF1' and 'EF2' should only be selected for use with EFILive Flashscan V2 functionality



This is the size of the CAN bus message identifier used. The available values are 11 and 29 with the default value being 11. Most vehicles will have an 11 bit identifier.



This is the bit rate of the CAN bus. The available values are: 250 and 500 kbps. The default value is 500 kbps and is correct for most vehicles.

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AEMnet (CAN Bus) Output

WHITE WIRE WITH BLACK STRIPE = AEMnet+ / CANH
GREEN WIRE WITH BLACK STRIPE = AEMnet- / CANL

The AEMnet output is suitable for output to AEM devices such as the AQ-1 data logger or Infinity ECU. The following CAN configuration and message definition information is provided below to facilitate interface with third-party devices.

Message ID
If multiple gauges are connected to the same CAN bus, then they must each be configured to have unique message IDs using the gauge's menu system. Depress the MODE button to navigate to the CAN submenu, press the SEL button until the desired ID is displayed then wait 3 seconds to accept setting; dOnE will appear to confirm your selection. The options "ID 1", "ID 2", ..., "ID 16" correspond to the 29-bit identifiers 0x0000180,0x0000181, 0x0000180, ..., 0x000018F.

Bus Termination
All AEMnet/CAN networks must be terminated to have an equivalent of approximately 60 Ohms of resistance. Generally, this means a 120 Ohm resistor connected in parallel to AEMnet+/AEMnet- (or CANH/CANL) at both physical ends of the bus run. The X-Series controller does not have any internal termination and is intended to be connected to a pre-existing, properly terminated network. Please refer to the Bosch CAN2.0B specification for further detail.

30-0500 AEMNet CAN Specifications

bit rate	500kb/sec
format	29-bit ID
transmit rate	100hz
terminating resistor	none
endianness	big / Motorola
Message/Arbitration ID	0x00000180 to 0x0000018F
DLC	8

Byte	Bit	Bitmask	Label	Data Type	Scaling	Offset	Range
0 - 1			Lambda	16 bit unsigned	.0001 Lambda/bit	0	0 to 6.5535 Lambda
2 - 3			Oxygen	16 bit signed	0.001%/bit	0	-32.768% to 32.767%
4			System Volts	8 bit unsigned	0.1 V/bit	0	0 to 25.5 Volts
5			Reserved	---	---	---	---
6	0 (lsb)	0	Reserved	---	---	---	---
	1	2	AEM/FAE Detected	Boolean	0 = false, 1 = true	0	0/1
	2 - 4	4	Reserved	---	---	---	---
	5	32	Free-Air cal in use	Boolean	0 = false, 1 = true	0	0/1
	6	64	Reserved	---	---	---	---
	7 (msb)	128	Lambda Data Valid	Boolean	0 = false, 1 = true	0	0/1
7	0 - 5	0	Reserved	---	---	---	---
	6	64	Sensor Fault	Boolean	0 = false, 1 = true	0	0/1
	7 (msb)	128	Reserved	---	---	---	---

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FAQ / Troubleshooting

What are the minimum wiring connections needed to use the gauge?
12V (RED) and power ground (BLACK) must be supplied to the 10 pin connector. Any unused wires may be secured and fastened away for future use. The 8 pin sensor harness must also be connected between the gauge and sensor.

When should I use free air calibration mode?
The sensor that is supplied is laboratory calibrated using the integral trim resistor; this is the preferred and recommended calibration mode. If you feel your sensor has been extremely contaminated or damaged and requires re-calibration, then it is suggested that you purchase a new sensor. Alternatively, performing a free air calibration may be helpful.

The gauge displays "SEnS", what does this mean?
The gauge is not detecting the O2 sensor. Ensure the 8 pin sensor harness is plugged in and FAE or LSU4.9 sensor is plugged in. If the sensor is not heating up, then the gauge may be damaged, and you should contact AEM Technical Support for further instructions.

The gauge displays "bAtt" when I key-on or crank the engine.
The gauge requires a minimum supply voltage to properly drive the UEGO sensor heater and will display "bAtt" if a low voltage condition is detected. Please ensure the vehicle's battery is in good condition, e.g. >12V engine off, >13.8Vengine running.

I installed my gauge correctly and the display just shows four dashes, "- - - -"
Four dashes mean the sensor is detecting a very lean, high oxygen content higher than 20:1 AFR. This is completely normal behavior in conditions such as engine off, decel fuel cutoff, or when the sensor is outside of an exhaust in openair. It may also be indicative of an exhaust leak upstream of the sensor, or a sensor installed too close to an open air source, especially if this occurs only at idle and light loads.

I performed a free air calibration, but the gauge reported "FAIL"
The sensor must be removed from the exhaust to perform a free air calibration. Remove the sensor from the exhaust to a fresh air environment that is free from exhaust or chemical/solvent fumes.

My engine has two banks; can I wire two sensors into one gauge and switch between them?
No, each sensor must have its own dedicated controller/gauge.

Can I extend the wires in my sensor harness?
Yes, but use of at least 20AWG and proper crimping/soldering techniques is required.

My sensor/gauge seems bad, how can I test it?
The gauge may be powered from a car battery or bench power supply (3A minimum) to perform this test. Once the gauge is powered, it should display "SenS" prior to connecting the sensor. Once the sensor is connected, the gauge should display the sensor type and indicate it is going through the heat up process. If the sensor is in open air, such as on a workbench, the gauge should display full lean as indicated by "----" within ~30 seconds. The gas from an unlit butane lighter can be used to simulate a rich condition when introduced to the sensor. A powered sensor will become hot enough to burn and/or ignite anything flammable -- HANDLE WITH CAUTION. The gauge should visibly see rich then lean as the butane is introduced/removed.

Is the X-Series UEGO controller/sensor compatible with alternative fuels such as E85, methanol, ethanol, CNG, etc?
Yes. The Lambda display mode and faceplate are recommended when using fuels other than gasoline. The AFR display mode uses the gasoline stoichiometric ratio of 14.65 which might be confusing for alternative fuels. Remember that AFR = (Lambda * stoichiometric ratio).

For support, contact AEM Technical Support at 1-800-423-0046 or gentech@aemelectronics.com.

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12 Month Limited Warranty

AEM Performance Electronics warrants to the consumer that all AEM products will be free from defects in material and workmanship for a period of twelve (12) months from date of the original purchase. Products that fail within this 12-month warranty period will be repaired or replaced at AEM's option, when determined by AEM that the product failed due to defects in material or workmanship. This warranty is limited to the repair or replacement of the AEM part. In no event shall this warranty exceed the original purchase price of the AEM part nor shall AEM be responsible for special, incidental or consequential damages or cost incurred due to the failure of this product. Warranty claims to AEM must be transportation prepaid and accompanied with dated proof of purchase. This warranty applies only to the original purchaser of product and is non-transferable. All implied warranties shall be limited in duration to the said 12-month warranty period. Improper use or installation, accident, abuse, unauthorized repairs or alterations voids this warranty. AEM disclaims any liability for consequential damages due to breach of any written or implied warranty on all products manufactured by AEM. Warranty returns will only be accepted by AEM when accompanied by a valid Return Merchandise Authorization (RMA) number. Product must be received by AEM within 30 days of the date the RMA is issued.

Note: The AEM/FAE UEGO oxygen sensor included in this kit carries a 24-month extended warranty.

Please note that before AEM can issue an RMA for any electronic product, it is first necessary for the installer or end user to contact the EMS tech line at 1-800-423-0046 to discuss the problem. Most issues can be resolved over the phone. Under no circumstances should a system be returned or an RMA requested before the above process transpires.

AEM will not be responsible for products that are installed incorrectly, installed in a non-approved application, misused, or tampered with.

Any AEM product can be returned for repair if it is out of the warranty period. There is a minimum charge of $50.00 for inspection and diagnosis of AEM electronic parts. Parts used in the repair of AEM components will be extra. AEM will provide an estimate of repairs and receive written or electronic authorization before repairs are made to the product.

Specifications

Dimensions	diameter (bezel)	2.40 / 61	in / mm
	diameter (cup)	2-1/16 / 52	in / mm
	depth (incl. bezel)	0.825 / 21	in / mm
	depth (cup only)	0.200 / 5	in / mm
Sensor Installation	sensor/bung	M18 x 1.5	thread
	sensor to bung torque	30 / 40.6	ft-lb / N-m
Supply Voltage	min	10	VDC
	max	18	VDC
Supply Current (13.8V)	nominal	1.5	A
	peak	3.0	A
Operating Temperature	min	-4 / -20	degF / degC
	max (16V Supply)	185 / 85	degF / degC
Sensor Temperature	max (sensor element)	1706 / 930	degF / degC
Display Range	min (outer LED)	0.55	Lambda
	max (outer LED)	1.40	Lambda
	min (inner numeric)	0.55	Lambda
	max (inner numeric)	2.00	Lambda
Response Time	typical	20.00	ms
Stoichiometric Constant	-	14.65	gasoline
Analog Output	resolution	10	bit
	update rate	500	hz
CAN 2.0B Output	bit rate	500	kb/sec
	format	29	bit ID
	transmit rate	100	hz
	terminating resistor	none	
	endianness	big / Motorola	
	Message/Arbitration ID	0x00000180-0x0000018F	
	DLC	8	bytes
Serial Output	baud rate	9600	bps
	data bits	8	
	parity	None	
	stop bits	1	

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