EGT-AMP USER MANUAL

Table Of Contents

1. GENERAL

EGT-AMP is a universal high-quality K-type thermocouple amplifier with Cold Junction Compensation. It is designed for nominal 12V supply and it's output gives 0-4,994V voltage signal in 0-1000°C (32-2012°F) sensor temperatures. Because of differential output stage EGT-AMP gives accurate readings also in situations where grounding potential errors are present. EGT-AMP is protected from environmental and electrical hazards normally present on automotive environment.

1.1. SPECIFICATION

- **Type of thermocouple: K**
- **Thermocouple connector: Miniature, K-type**
- **Gain: 121 x**
- **Output voltage function: 0°C=0V, 1000°C=4,994V**
  (32°F = 0V, 2012°F=4,994V)
- **Operational supply voltage: 8.5-16Vdc**
- **Polarity protection: -16Vdc continuous, -45V t<20ms**
- **Supply voltage transient: +40V t<20ms**
- **Supply voltage transient, power: 600W max, 10/1000us**
- **Internal fuse protection: 2 x F2A**
- **Operational temperature range: -40 - +85°C (-40 - +185°F)**
- **Cold junction compensation: -30 - +85°C (-22 - +185°F)**
- **Measurement accuracy: ±3°C (±5,5°F)**
- **Cold junction compensation accuracy: ±5°C (±9°F)**
- **Dimensions (W x D x H): 73.5 x 70 x 21.5mm**
- **Ingress protection: IP57 (not applicable to TC-connector)**
- **Weight: 130g**
- **Mating connector, body: TYCO 794805-1**
- **Mating connector, socket: TYCO 1-770988-0**
- **Mating connector, cable seal: TYCO 794758-1**
- **Mating connector, interface seal: TYCO 794772-4**

2. ASSEMBLY

2.1. MECHANICAL ASSEMBLY

Due to high quality parts used in EGT-AMP it can be assembled in many different conditions; wet, dry, cold or hot. Naturally best possible accuracy and reliability can only be achieved in dry, room temperature atmosphere.

Mechanical fixing is easiest to be done via three (3) ready-made vibration dampened fixing points. Maximum fixing screw diameter is 4mm, M4 bolt or 3.9mm thin sheet screws are suitable. Head of the screw must be at least 9mm (11/32") in diameter; otherwise the screw may slide thru rubber grommet. In some cases suitable washers should be used.

Local heat, cold and wind sources should be avoided in the assembly location. Strong sources of heat or cold may deteriorate the operation of the Cold Junction Compensation.

2.2. ELECTRICAL ASSEMBLY

EGT-AMP needs a stable +12V feed for operation, +12V feed (**red** cable) should be free of excessive disturbances. Feed point near starter, alternator of ignition coil is not recommended; high voltage spikes may interfere EGT-AMP operation or in worst case harm it. Grounding is good when ground cable (**black** cable) is short and equipped with a proper grounding connector.

Output of the EGT-AMP is differential and it can adapt to a small ground potential differences (±1,5V) between EGT-AMP and the unit to be controlled. This potential means the voltage measured between black and blue wire. Negative Output- cable should always be connected; not doing so will give falsely readings.

Best possible accuracy can only be achieved when negative Output- cable (**blue** cable) is connected very near the grounding pin of the controlled unit like seen on Picture 1. With this arrangement a voltage drop in controlled unit grounding cable don't have effect on measurement. If controlled unit has a separate signal ground, then negative Output- cable should be connected to that. Especially this is important when controlling ECU's; these have strong ground currents because of injector and ignition control, for example 0.1V voltage drop in ground cable can cause error of 20°C (36°F).

Positive Output+ cable (**yellow** cable) should be connected directly to the positive input of the controlled unit.

EGT-AMP output stage is designed to control high impedance inputs; excessive loading of the output can cause measurement errors or in extreme case can cause permanent failure of the EGT-AMP.

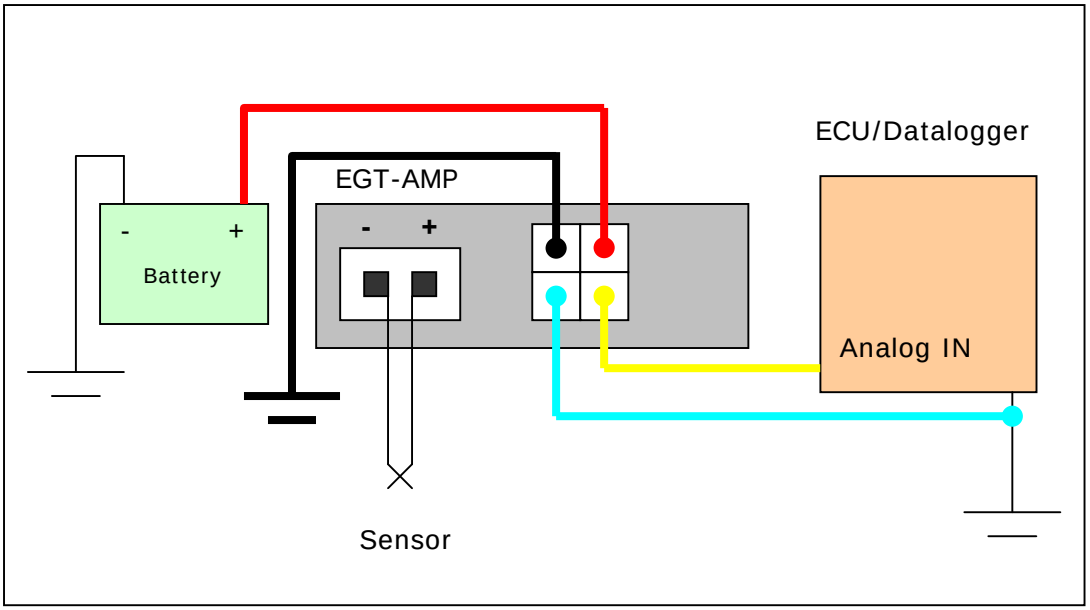
Maximum load of the output of EGT-AMP: 5 kΩ

Direct capacitive loading of the EGT-AMP output is forbidden! Especially small loading capacitances may cause oscillations in the output signal; this causes no harm for the EGT-AMP, but measurement accuracy will be lost. If there is a direct capacitive loading on the input of the controlled unit, then a suitable series resistor should be added between the Output+ of the EGT-AMP and the input of the controlled unit, 4.7kΩ should be ok. Measurement accuracy should be studied case by case after this modification

Never connect Output+ and Output- signals to any high voltage circuits, voltages exceeding -2V - +8V may cause permanent damage to the EGT-AMP!

Pin	Signal	Cable color
1	+12V	Red
2	Ground / -	Black
3	Output +	Yellow
4	Output -	Blue

Table 1 Pinning of the EGT-AMP



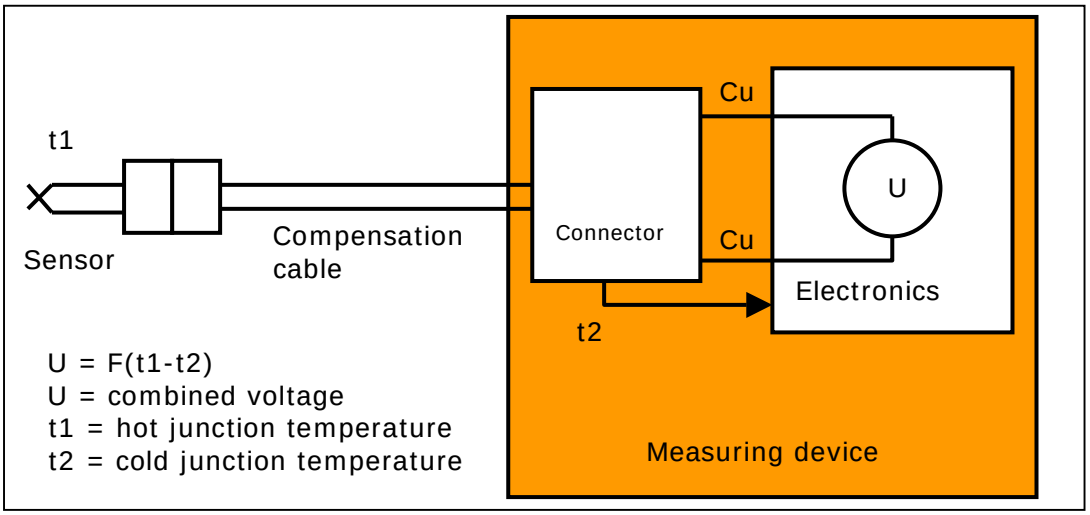
Picture 1 EGT-AMP electrical connection

3. INSTRUCTIONS FOR USE

3.1. THEORY OF THERMOCOUPLE MEASUREMENT

Thermocouple temperature measurement is based on voltage generation over dissimilar metal junction by the temperature. Voltage is dependant on metals used and the temperature of the junction, voltage generation is nearly linear over usable temperature range of the materials used.

Real measurement system always has two measuring points; the actual measuring point called 'hot junction' and the reference junction called 'cold junction'. Measuring device sees the difference of the voltage produced by these two junctions and to get the actual hot point temperature the measuring system needs to know the absolute temperature of the cold junction. Below is a picture of the measuring principle.



Picture 2 Principle of the thermocouple measurement

Temperature °C	Temperature °F	Thermovoltage mV
-50	-58	-1.889
0	32	0.000
100	212	4.096
200	392	8.138
300	572	12.209
400	752	16.397
500	932	20.644
600	1112	24.905
700	1292	29.129
800	1472	33.275
900	1652	37.326
1000	1832	41.276
1100	2012	45.119

Table 2 K-type sensor output voltage (t2 =0°C (32 °F))

3.2. ELECTRICAL OPERATION

EGT-AMP is basically an analog amplifier and it has linear input-to-output voltage conversion. Voltage output of the K-type sensor is non-linear over full operational temperature range; a table type conversion from voltage to temperature is needed for best accuracy. In low-end ECUs etc there are only linear type conversions available, this causes some measurement errors that are not induced by EGT-AMP.

For temperature conversion a following table can be used (Table 3) or in simplified case this can be done by function:

0,000V = 0°C, 4,994V = 1000°C (0,000V = 32°F, 4,994V = 2012°F)

Temperature °C	Temperature °F	Nominal output voltage (V)
-50	-58	-0.229
0	32	0.000
100	212	0.496
200	392	0.985
300	572	1.477
400	752	1.984
500	932	2.498
600	1112	3.014
700	1292	3.525
800	1472	4.026
900	1652	4.516
1000	1832	4.994
1100	2012	5.459

Table 3

NOTE! Due to the technical reason the output voltage of the EGT-AMP is not limited from 0V to 5V and in extreme temperatures (< 0°C (<32°F) or >1000°C (>1832°F)) or in special operational cases (start or sensor failure) the output voltage can be from –2V to +8V. Before connecting EGT-AMP to any system, please make sure the controlled unit can handle this voltage range without problems. Resistor connected between Output+ of the EGT-AMP and the input of the controlled unit can solve this problem in most cases. Measurement accuracy should be studied case by case after this modification. If there are any questions, please ask from the manufacturer of the devices.

4. WARRANTY

EGT-AMP has a full one (1) year warranty from the date of the purchase. Warranty includes component failures and workmanship. Not included are natural wear, usage against specification and Force Majeure -type failures. Warranty does not include failures in other systems connected to EGT-AMP, it is assumed that the end-user of EGT-AMP has skills necessary to assemble and analyse the product so it causes no risk to any other systems even in cases of malfunction and failure. Warranty is valid also in competition use.

5. PROOF OF CALIBRATION

Temperature (°C)	Output Voltage (V)	Nominal Output Voltage (V)	Error mV (5mV=1°C)
-50		-0.229	
0		0.000	
100		0.496	
200		0.985	
300		1.477	
400		1.984	
500		2.498	
600		3.014	
700		3.525	
800		4.026	
900		4.516	
1000		4.994	
1100		5.459	

Table 4 Calibration table

DATE: _____ OPERATOR: _____
Veli-Pekka Vuoristo

List of calibration equipment:
Fluke 714 thermocouple calibrator, serial number: 8660083
Fluke 87 multimeter, serial number: 69470043
Hewlett Packard 6632B power supply, serial number: US37476309

Operational voltage: _____V

Test room temperature: _____°C

Serial number sticker