INSTRUCTION MANUAL

THERMOCOUPLE GAUGE CONTROLLER
[MODEL TGC-100C]

Version 2

SERIAL # _____

09.2024

231 B Otto Street - Port Townsend, WA 98368 - (360)385-7707

Safety Warnings:

1. POWER SUPPLY:
The power supply module operates on 120 VAC single phase power. This must be connected to a correctly wired receptacle. If one is not available, one must be installed.

NOTE:
On special request, we manufacture controllers with custom power inputs. Verify the input voltage listed on the nameplate on the supply is the same as is being supplied. DO NOT connect to incorrect voltage. Hazardous conditions and damage will result if this occurs.

2. CABLE ROUTING:
Do not run the cable on the floor. Care is especially important around liquid nitrogen. Mechanical damage or freezing by LN2 may cause failure of the insulation and thus produce equipment failure.

3. Do not exceed the ratings of the process control relay. Equipment failure and damage may result, which may cause hazardous conditions for personnel.

4. Replace any equipment showing damage or misuse.

6. Replace any items that may be damaged or worn.

Preface

Congratulations! You have purchased a precision vacuum positioning device from Thermionics. This unit is capable of many years of use with minimal care and maintenance. This manual is a tool to aid you in obtaining this service.

We at Thermionics encourage your comments and suggestions on this manual.

Product Description

The TGC-100C is a face panel mounted thermocouple gauge controller intended to operate one of three different types of thermocouple tubes offered by Thermionics Laboratory. The suffix added to the model number of the unit designates the tube type that must be used with a respective meter (example-TGC-100C-6343 will operate a TG 6343 tube). Depending on the tube type, the circuitry is factory adjusted to provide the correct heater current and the meter face is calibrated to reflect the pressure in millitorr.

The TGC-100C also provides a degree of system control by the inclusion of relay contacts that close at a preset set point. Besides the relay closure, the set point condition is also indicated on the front panel face by a visible light emitting diode (LED). The set point is adjustable through a potentiometer on the rear panel and can be easily adjusted. Additionally, an amplified thermocouple output is available for strip recorder or computer input.

SPECIFICATIONS:

POWER: 115VAC(60Hz) power
{220VAC(50Hz) available}

PRESSURE: 1-1000 Millitorr (Meter will indicate 1 atmosphere at reduced accuracy)

SIZES: 4" x 5" meter face approximately 4" deep with cable connections

HEATER SUPPLY: Constant current DC current source

PROCESS CONTROL RELAY:
One set of form "C" contacts
maximum contact ratings
1 ampere 30 volts

UNPACKING:
All shipment containers should be visually inspected upon arrival for physical damage. Visual inspection of the product should also be done immediately. Shipping companies often require claims for damage is established upon arrival of goods.

Upon receipt, the controller and the power unit should be inspected for damage occurring during shipping. This controller is a delicate electronic instrument. Any suspect damage must be investigated by a properly qualified technician. We recommend consulting the factory if such investigation is required.

INSTALLATION:

The TGC series controller is manufactured for panel mounting. The following points should be considered when choosing a suitable position.

1. Although low power, adequate ventilation is necessary to provide cooling for the controller.

2. The unit should be mounted so that the operator can observe meter information.

3. The rear panel must be accessible so cables can be connected, and adjustments may be made.

4. The power supply must have the correct power service.

5. The cable path between the controller and the gauge is important. Care is especially important around liquid nitrogen. Freezing due to LN2 boil-off can cause cable damage. Mechanical damage or freezing by LN2 may cause failure of the insulation. Thoroughly insulate LN2 lines when they are near the cable. Do not run the cable on the floor.

Gauge Tube Location/operating conditions

Location of the gauge tube in the vacuum system and the operating conditions may affect the successful operation of the gauge/controller.

Backstreaming oil or other fluids will affect the operation if allowed to collect in the gauge tube. Do not mount the gauge tube as the lowest point on any vacuum assembly.

Ambient temperature and/or temperature fluctuations around the gauge tube can affect the output of the tube. This is usually small but varies with tube type and temperature magnitude. Where possible, choose a tube location which is not expected to see these variations.

Moisture/condensation on the tube body pins can cause corrosion of the pin/socket interface. This can lead to erroneous readings and failure. Select tube locations not subject to high humidity and condensing atmospheres. Use special care if LN2 boiloff is expected near the tube site.

CONNECTIONS:
The connections are made from the back of the meter and must be attached to the appropriate circuits prior to operation.

TC GAUGE TUBE CABLE
Cable exits chassis via rear panel

RECORDER OUTPUT
BNC on rear

PROCESS RELAY
Set pushbutton
Pushbutton on rear

SETPOINT ADJUSTMENT
Shaft on rear

CONNECTIONS
Cable with connector and matching pigtail exits rear
Common: Yellow wire
N.C. Green wire
N.O. Red wire

MAXIMUM CONTACT RATINGS:
1 ampere
30 volts dc
Power input jack
9v DC input from power module

OPERATION:
Once the thermocouple cable has been connected to the tube, the power unit should be plugged into the power jack on the rear of the controller case before plugging the unit into line power.

THEORY OF OPERATION:

The thermocouple vacuum gauge has been a long standing, rugged, and reliable means of pressure measurement in the millitorr vacuum range. It is within this pressure regime that the thermal conductivity of the remaining gas species varies strongly with gas density and is not complicated by other thermal effects. A thermocouple gauge takes advantage of this situation by indirectly measuring the heat lost from a very fine heated wire within the tube to the surrounding gas. The gauge measures this heat loss by measuring the temperature of the heater wire with an additional fine wire thermocouple pair. The greater the number of gas molecules, the greater amount of heat will be transported away from the heater wire and its temperature will change accordingly. At a given temperature, the number of molecules will be proportional to the pressure and by measuring the temperature of the wire, an indirect measure of the pressure is made.

The inaccuracy of thermocouple gauges arises from any process which interferes with this heat loss. Obviously, if the gas surrounding the wire is hotter than the heater wire, no heat will be carried away. However, at ambient temperatures where the tubes are calibrated, the temperature of the heater is high enough (100-200°C) to provide the driving force for heat loss. Ambient temperature variations different from the calibration temperature will cause slight discrepancies because the tube thermocouple is now referenced at a different temperature. Additional operational error may result from the condition of the tube itself. If contamination of the heater occurs, a surface layer may form which does not promote heat loss identical to the original surface and may cause erroneous readings. The use of noble metal wires and chemically passive materials of construction can often minimize this problem.

There are additional effects which ultimately limit the range and accuracy of thermocouple gauge measurements. As one might imagine, there are other ways in which the heater wire may lose heat which are not simply proportional to the gas pressure. These consist of thermal conduction through the wire leads, radiation to the surroundings and convective heat loss at higher pressures. By a judicious choice of operation temperature, radiation losses can be minimized, and the use of tiny wires decreases the effect of thermal conduction through the leads. This decrease in the wire size also improves the time response of the tube and the use of a constant current source in the controller tends to reduce the effects of contact resistances which may vary from tube to tube. However, at very low pressures, there is simply not enough heat carried away by the gas and the temperature of the wire is dictated by the thermal conduction of the leads.

At higher pressures where the gas molecules strike each other before hitting the tube wall, the heat transport begins to depend on the motion of the gas as a convective fluid. These convective effects depend on the geometry and orientation of the tube due to the same processes that cause the rise of heat in a room and tend to limit the upper pressure of the tube and often give erratic meter transients during pump down at higher pressures.

CIRCUIT DESCRIPTION:
The controller consists of a constant current source and a high impedance difference amplifier. The constant current source is composed of U3 and the surrounding circuitry. The current selection is composed of the parallel combination of R17-19 with R19 being the heater adjustment that may be accessed through the rear housing.

R1 provides the input load resistance upon which most thermocouples are calibrated. U1 and the associated circuitry provides a balanced high impedance difference amplifier which provides a gain of 100 for the output of the thermocouple. This amplified signal is used to drive the meter commensurate with changes in the thermal emf output of the thermocouple. R6 is a zero-offset adjustment for the amplifier that is adjusted at the factory and should not be altered except by knowledgeable personnel. The analog output signal is tapped off the output of U1. R8 determines the output impedance of the analog output and prevents external short circuiting of the output from disrupting normal gauge operation.

The set point circuitry is provided by U2 and consists of a voltage source for adjusting the set point (U2B) and a comparator that compares the voltage source output with the amplified thermocouple output. If the thermocouple is less than the voltage source (high pressure), the comparator (U2A) saturates Q1 and K1 is energized and the LED conducts. When the pressure drops in the TC tube, the thermocouple amplified output is high and the comparator turns Q1 off. When the set point switch (SW1) is depressed, the meter and the analog output are connected directly to the output of the voltage source. By adjusting the set point adjustment (R13), the voltage that will be compared to the thermocouple is altered and displayed while SW1 remains depressed. D2 is the reference for the voltage source.

ADJUSTMENTS:

TC HEATER CURRENT:

As received from the factory, the controller is adjusted to provide the correct heater current for the specified tube and no further adjustment should be necessary. If the tube is out of calibration, a degree of compensation for aging or contamination may be affected by simply changing the heater current slightly. This adjustment may be accomplished by turning the appropriate thermocouple current source potentiometer screw. These four adjustment screw areas are accessible through the rear panel. By adjusting the meter reading with the thermocouple tube at a known pressure below 1000 millitorr, the useful life of the tube may be prolonged with a small compromise in accuracy.

PROCESS SET POINT

The TGC-100C comes from the factory with the set point adjusted for 50 millitorr. To change the set point, the meter need not be plugged into a tube. To make the adjustment, simply depress the set point adjustment switch and adjust the set point potentiometer screw. When the switch is depressed, a constant voltage is applied to the circuitry and the front meter will deflect depending on the value of the set point potentiometer. Wherever the meter needle resides after the adjustment, will be the position or pressure at which the set point is tripped. The front panel LED will be on when the system pressure is above the set point and will go off when the pressure is at or below the set point.

MAINTENANCE:

There are no user serviceable components inside the controller.

We recommend the user utilize the factory for service of this controller if such is ever needed. We maintain a supply of components and the testing and calibration facilities. We offer fast and efficient service.

We at Thermionics have a large stake in your new equipment operating up to your expectations. If you experience difficulty with this unit or any other aspect of your endeavor where our experience might be of value, we want to hear from you. We want to be part of your success.

Standard Warranty

Revision A.01 | 2020
Standard and Tailored Products are guaranteed to be free of material and workmanship defects for a period of one (1) year. Custom Projects and electronic components are guaranteed for a period of one (1) year. Expendable component parts are guaranteed for their expected service life. If, for any reason, you are not completely satisfied with our products, let us know. We want to address your concerns.
Our relationship with the user does not end with the delivery of the equipment. We have a large stake in your equipment operating up to your expectations. Our goal is to be part of your success.

Warranty
1.0. THERMIONICS VACUUM PRODUCTS (HEREIN CALLED THERMIONICS) WARRANTS TO THE ORIGINAL PURCHASER:
1.1. Standard catalog products manufactured by Thermionics against defects in workmanship for a period of one (1) year from the date goods are received at the customer's facility.

1.2. Special products and electronic components are covered for one (1) year from the date goods are received at the customer's facility.

2.0. SCOPE

2.1. Liability under this warranty is expressly limited to repair or replacement of defective parts. THERMIONICS, at its sole option, may at any time discharge its warranty as to any of its products by refunding the purchase price and taking back the product(s).

2.2. This warranty applies only to parts manufactured and labor provided by THERMIONICS.

2.3. Valid warranty claims must be received by THERMIONICS within the warranty period and are subject to the terms and conditions hereon.

2.4. All warranty replacement or repair of parts shall be limited to equipment malfunctions, which, at the sole discretion of THERMIONICS, are due or traceable to defects in original materials or workmanship.

2.5. Malfunctions, which in the sole opinion of THERMIONICS, are caused by abnormal wear and tear, lack of maintenance, abuse, operation, maintenance or care inconsistent with the product manual, accident, or neglect of

equipment are expressly not covered by this warranty. It is the responsibility of the user to operate the equipment in a reasonable and prudent manner, consistent with the stated intended use.

2.6. In-warranty repaired, or replaceable parts are warranted only for the remaining portion of the original warranty period, applicable to the parts which have been repaired or replaced, and the total equipment is warranted for the balance of the five (5) year period. After expiration of the applicable warranty period, the buyer shall be charged at THERMIONICS' current prices for parts and labor, plus freight and per diem, when applicable.

2.7. Expendable component parts, including, but not limited to, pump elements, cold cathode gauges, bellows, thermocouple gauges, hot cathode gauges, sublimator filaments, emissive filaments, heater, elastomers, bearings, and gaskets, etc., are guaranteed for their expected service life. If the expendable component parts fail to give reasonable service, as determined solely by THERMIONICS, they will be repaired or replaced at our discretion.

2.8. CONDITIONS

2.9. THERMIONICS expressly disclaims responsibility for any loss or damage caused by the use of its products, when not used in accordance with proper operating and safety procedures in accordance with specifications, or if the equipment is used without the proper recommended maintenance. Reasonable care must be taken by the user to avoid hazards.

3.0. Except as stated herein, THERMIONICS makes no warranty, express or implied, either in fact or by operation of law; and, as stated herein, THERMIONICS shall have no liability under any warranty, express or implied, either in fact or by operation of law.

3.1. THERMIONICS shall have no liability for special or consequential damages of any kind, or from any cause arising out of the sale, installation, or use of any of its products. Statements made by any person, including representatives of THERMIONICS, which are inconsistent or in conflict with the terms of this warranty shall not be binding upon THERMIONICS unless reduced to writing and approved by an authorized officer of THERMIONICS.

3.2. This warranty does not cover normal maintenance requirements, which are the customer's responsibility.

3.3. This warranty does not extend to equipment that (1) someone other than Thermionics approved personnel have disassembled or attempted to repair,

(2) has been modified or altered, or (3) has been contaminated with hazardous material or induced activation.

3.4. PROCEDURES

3.5. If you wish to return equipment for repair, contact the THERMIONICS DIVISION which sold you the product in question. You will be given an RMA Authorization Number and instructions on how and by what means to ship the product to the factory. NO SHIPMENT WILL BE ACCEPTED WITHOUT PRIOR APPROVAL and completed RMA Authorization Form.

3.6. In the first year, goods must be returned, freight prepaid, to the factory and will be returned prepaid, to the customer. After the first year, the customer must pay all freight costs.

Thermionics Laboratory, Inc.
3118 Depot Rd.,
Hayward, CA 94545
E-mail: sales@thermionics.com
www.thermionics.com

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