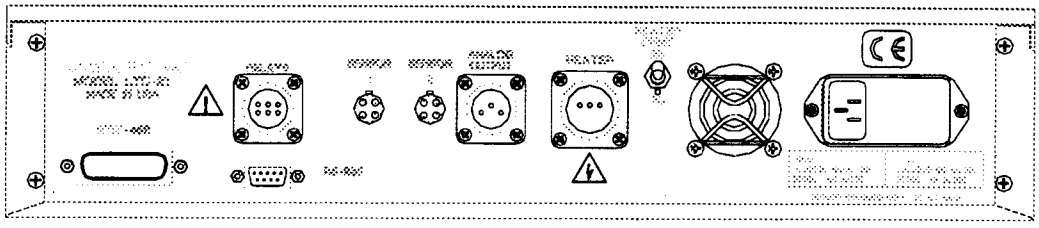


Figure 3 LTC-21 Rear Panel

2.3. Power Requirements

ac power can be provided to the LTC-21 at voltages of 100/120 or 220/240 Volts, 50 or 60Hz. These MUST be selected by the voltage selector which is part of the ac power entry module mounted on the rear panel of the instrument.

To change the power configuration perform the following steps:

a) Disconnect the ac power cord from the instrument.

b) Locate the ac input module on the rear panel. The ac power configuration can be seen in a small window in the fuse drawer.

c) Push on the small locking tab on the fuse drawer and remove the fuse drawer.

d) To change the ac input configuration, remove the switch block from the rear of the fuse drawer. Rotate the switch block until the desired ac input appears in the window of the fuse drawer.

e) Install the fuse drawer into the ac input module and connect the ac power cord.

The LTC-21 will operate properly from either 50 or 60Hz ac power.

WARNING:

Never attempt to operate the LTC-21 at a different input line voltage than is shown on the power input module on the rear panel. Serious injury or equipment damage may result.

2.3.1. Fuse

The instrument fuse is located in the ac power entry module which is mounted on the rear panel of the instrument. This module also contains a spare fuse.

The LTC-21 requires the following fuses depending on the line voltage used:

ac Power	Fuse
100 - 120 V_{ac}	3 Amp normal blow
220- 240 V_{ac}	1.6 Amp time lag

Table 2 ac Fusing

WARNING:

Always replace the fuse with the correct value to prevent shock and fire hazards, as well as damage to the LTC-21.

2.3.2. Grounding And Shielding

The LTC-21 is equipped with a three-conductor power cord that connects the instrument chassis to earth ground.

WARNING:

TO PREVENT SHOCK AND FIRE HAZARDS, ALWAYS CONNECT THE POWER CORD TO A THREE-CONDUCTOR, GROUNDED RECEPTACLE.

Grounding and shielding of sensor and output lines are important considerations when using a low-noise instrument such as the LTC-21. The sensor inputs, the heater output and the analog output are all isolated from earth ground and are connected at one point to circuit ground inside the LTC-21.

2.4. Heater Connection

2.4.1. Heater Wiring

The Heater output is available on the rear panel at the labeled connector.

Connect your heater leads to the mating connector supplied. Care should be taken not to ground either heater lead. If this is not possible, ground the lead connected to pin 2.

WARNING:

WITH PROPER VENTILATION, THE LTC-21 IS DESIGNED TO OPERATE INDEFINITELY WITHOUT DAMAGE TO ITSELF IF ITS HEATER OUTPUT IS SHORT CIRCUITED. HOWEVER, CARE SHOULD BE TAKEN TO AVOID THIS CONDITION SINCE THE 50 WATT OUTPUT COULD DAMAGE OTHER COMPONENTS OR RESULT IN A FIRE HAZARD.

The wire size required in your cryostat depends on the maximum power that will be required. If 50 Watt power will be required, use 24 gauge, or heavier, stranded copper wires. Connect the heater to the positive (+) and negative (-) outputs. The earth ground should only be used for shielding.

Best performance will be achieved if the heater wires are run as twisted pairs which are physically separated from the sensor leads. Heater leads should never be connected to the sensor grounds.

2.4.2. Heater Selection.

The Heater output is driven by a current source with maximum capability of 1 Amp. This output is calibrated for use with a 50Ω heater which also allows the maximum output power of 50 Watts. Although the exact heater resistance is not critical, the use of a nominal 50Ω heater is strongly recommended. The LTC-21 will work with other heater resistances, but the output will no longer be calibrated. If a resistance other than 50Ω is used, the actual power may be calculated from the power indicated on the front panel using the following equation:

$$\text{Actual Power} = \text{Indicated Power} * (\text{Heater Resistance}) / 50$$

The voltage compliance of the current source is limited to about 50 volts. For this reason, full-scale linear operation is only possible under the following conditions:

Range	Maximum Heater Resistance
50 Watt	50Ω
5 Watt	160Ω
0.5 Watt	500Ω
0.05 Watt	1.6KΩ

Table 3 Conditions for Linear Operation of Heater

Use of a heater resistance value less than 50Ω provides linear operation under all conditions, but the output power is always less than indicated. For systems that require heater power substantially less 50 mWatt, it is possible to use a current divider having a 50Ω resistor at room temperature connected in parallel with a higher resistance heater attached to the system.

Some users may want to use a 25Ω heater and therefore a heater voltage switch is provided on the rear panel of the instrument to select between 50Ω and 25Ω heater resistors. When

the 25Ω heater is selected, the power range can be determined by dividing the displayed range by 2. The following ranges are available in the 25Ω mode; 0.025W, 0.25W, 2.5W, 25W.

2.4.3. Analog Output Connection

The Analog output port can be software-configured as either a 1 W (max) output for temperature regulation or as a calibrated analog output for monitoring temperature. The hardware connection is the same in either case.

The ground connection should only be used for shielded leads. The low side of this output may be grounded when using it to monitor temperature, but a differential measurement is usually preferred to avoid adding noise to the measurement. The low side should not be grounded when using the Analog output for temperature regulation. If this can not be avoided, it is essential that the low side be grounded at one point only and that it not be connected in common with the sensors.

The type of wire used to connect to the Analog output is usually not critical. Shielded, twisted, 24 gauge copper wire is commonly used inside the cryostat, but the exact choice depends on thermal requirements and electrical noise in your cryostat.

2.5. Sensor Connection

Sensors can be attached to the two labeled Sensor input connectors on the rear panel. A mating connector (Lemo Inc. FGG.1B.304.CNAD52) with attached shielded cable is supplied for use in attaching your sensor.

The LTC-21 is designed to make accurate readings, even in the presence of large interfering signals, such as power-line pick up. Nevertheless, it is always best to use properly designed input leads to minimize stray pick up. The sensor cable supplied with the LTC-21 has been carefully selected for low-noise operation. It comprises two, twisted pair cables inside a non-current carrying shield. If it is necessary to replace this cable, always use a cable of similar design. Additional or replacement connectors with attached cable are available from NEOCERA Instrument and Systems Group.

Wiring diagrams for various sensor types are shown in Appendix C. For best performance, all sensors should be connected in a four-terminal configuration. Polarity is critical with diode sensors, but generally unimportant with all other types. All four connections should be floating, but if it is necessary to ground any part of the sensor circuit, it must be the low (-) side. The ground connection should only be used for the sensor cable shield. The cable shield should be grounded at the connector. It is generally best NOT to ground the shield at the cryostat.

Optimum wire selection for use inside your cryostat depends on many factors. In all cases, it is best to make a four-wire connection using two sets of shielded, twisted pairs. The shield should <u>not</u> be connected to the low side of the sensor leads. The shield ground should be attached to the sensor connector at the rear panel of the instrument. Special wire is available for sensor connection from a number of sources. In most cases, it is adequate to run two pair

of twisted, 0.005" diameter leads inside your cryostat. Common choices of metal for these leads include phosphor-bronze, brass, and Manganin. Very high resistance leads (greater than 100 ohm per wire) should be avoided if possible. Low resistance (copper) leads work well so long as they do not conduct so much heat into the sensor as to cause erroneous readings.

After the sensor is connected, it is essential that the LTC-21 software be correctly configured for use with the installed sensor type.

2.6. Relay Connection

Each relay contact is rated at 0.5A, $30V_{rms}$ or $60V_{DC}$.

The relay contacts will change state on all relays which are enabled if the temperature exceeds the assigned high or low limits.

2.7. Interface Connection

Connection to the IEEE-488 is via an industry standard IEEE-488 connector to the IEEE-488 connector on the rear panel.

Connection to the RS-232 is via a female DB-9 connector to the RS-232 connector on the rear panel.

2.8. Mounting The LTC-21

Bench Mounting

The LTC-21 is supplied ready for bench use. Plastic feet are supplied on the bottom of the instrument; these should not be removed as they allow for an air gap beneath the instrument which aids in cooling. The front of the instrument may be elevated for better viewing angle using the built-in tilt stand.

Rack Mounting

The LTC-21 may be rack mounted using the optional rack-mount kit available from NEOCERA Instrument and Systems Group. Simply attach the supplied ears to the sides of the LTC-21. The LTC-21 may then be mounted in any standard 19" rack-mount enclosure.

Appendix C
Interface Connector Pinouts

Appendix C: Interface Connector Pinouts

Relays

Relay uses an AMP 8 pin receptacle. The mating plug is an AMP 206434- 1.

Connector face view with pin assignments are shown below.

Relay	Normally Closed	Common	Normally Open
1	pin 8	pin 7	pin 6
2	pin 5	pin 4	pin 3

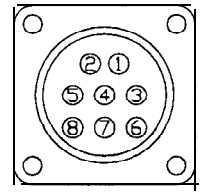


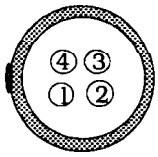
Table 26 Relay Connector Pin-out

Sensors

Sensors use a LEMO 4 connector (FGG.1B.304.CNAD52). When assembling this connector, ensure that the cable shield is firmly connected to the connector metal shell.

Note also that a sensor and cable assembly is available from NEOCERA Instrument and Systems Group.

Connector face view with pin assignments are shown below.



Pin Number	Signal Name	Color Code
1	Sense In+ (V+)	Black
2	Sense in- (V-)	Red
3	CCS Ground (I-)	Green
4	CCS OUT (I+)	White

Table 27 Sensor Connector Pin-out

Color codes shown are for a Belden 8723 type cable. In all cases, a shielded twisted pair cable should be used.

On the instrument end of the sensor cable, the shield connection is made via the connector body.

On the sensor end of the cable, the shield should be connected to a non-current carrying earth ground whenever possible. If no such ground is available, the shield should be left disconnected. Never connect a shield to a current carrying conductor.

While using a Platinum sensor, the polarity of the connection terminals is not important. However, when a Diode type sensor is used, the Anode must be connected to the positive terminal and the Cathode must be connected to the negative terminal.

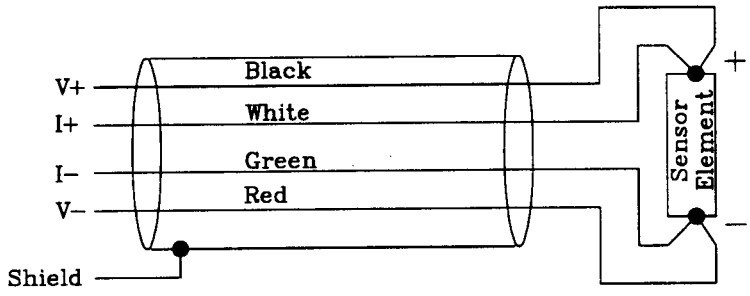


Figure 29 Platinum Sensor Four-wire Connection

Example Diode Sensor Connections

The proper connection for a LakeShore™ DT-470 diode is shown to the right. This connection may be used for the DT-470, DT-471 or DT-450 type diodes.

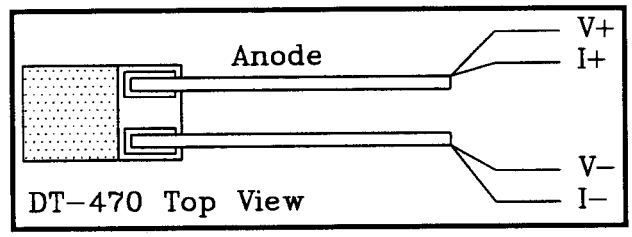


Figure 30 DT-470 Sensor Four-wire Connection

Many of the CryoCal™ Silicon Diodes have four color coded leads. They are connected as follows:

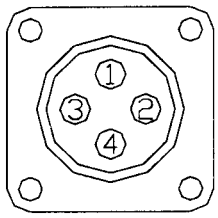
Diode wire color	Name	Cable wire color
White	I+	White
Yellow	V+	Black
Green	V-	Red
Black	I-	Green

Table 28 CryoCal™ Silicon Diodes Wire Color Codes

Analog Output:

The Analog Output uses a AMP 4 pin connector. The mating plug is AMP 206429-1.

Connector face view with pin assignments are shown below.



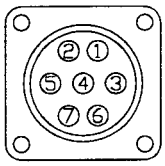
Pin	Signal
1	Output+
2	Output-
3	Chassis GND
4	NC

Table 29 Analog Output Pin-out

Heater:

The Heater Output uses an AMP 9 pin connector. The mating plug is AMP #211400-1.

Connector face view with pin assignments are shown below (pins 3-7 are unused).



Pin Number	Signal Name	Color Code
1	HTR +V	Red
2	HTR GND	Black
3	Chassis GND	Green
4-7	NC	

Table 30 Heater Connector Pin-out