

INSTALLATION, OPERATION AND INSTRUCTION MANUAL

Level-Trac Model LT-210 Control Unit

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Note: This document should be reviewed in its entirety prior to installation of equipment.

1.0 Operating Principle

The Level-Trac LT-210 is a remote level indication system, as described in ASME Section I, PG-60. The system may also be used as an alarm or trip device.

Discrimination between water and steam is based on the significant difference in resistivity between the two states over the saturation range. The sensing element is a probe with an insulated tip inserted in a probe manifold (Figure 1.1.) If a voltage is applied to the probe tip, conduction occurs between the tip and the inside wall of the column, resulting in an indication of water. Probe and manifold dimensions are selected to provide a resistance typically less than 100 K Ω when the probe is immersed in water, as compared to a resistance greater than 5 M Ω when in contact with steam. An electronic discrimination circuit is arranged to sense whether the Probe resistance is less than 100 K Ω representing water or greater than 5 M Ω representing steam.

With probes spaced vertically in a manifold attached to the boiler (Figure 1.1) and with each probe connected to its own sensing and water/steam indication circuit, a vertical display of Green/Red indicators provides a simulation of water level in the steam drum. Spacing between probes is per customer requirements to cover the visible range and alarm or trip points.

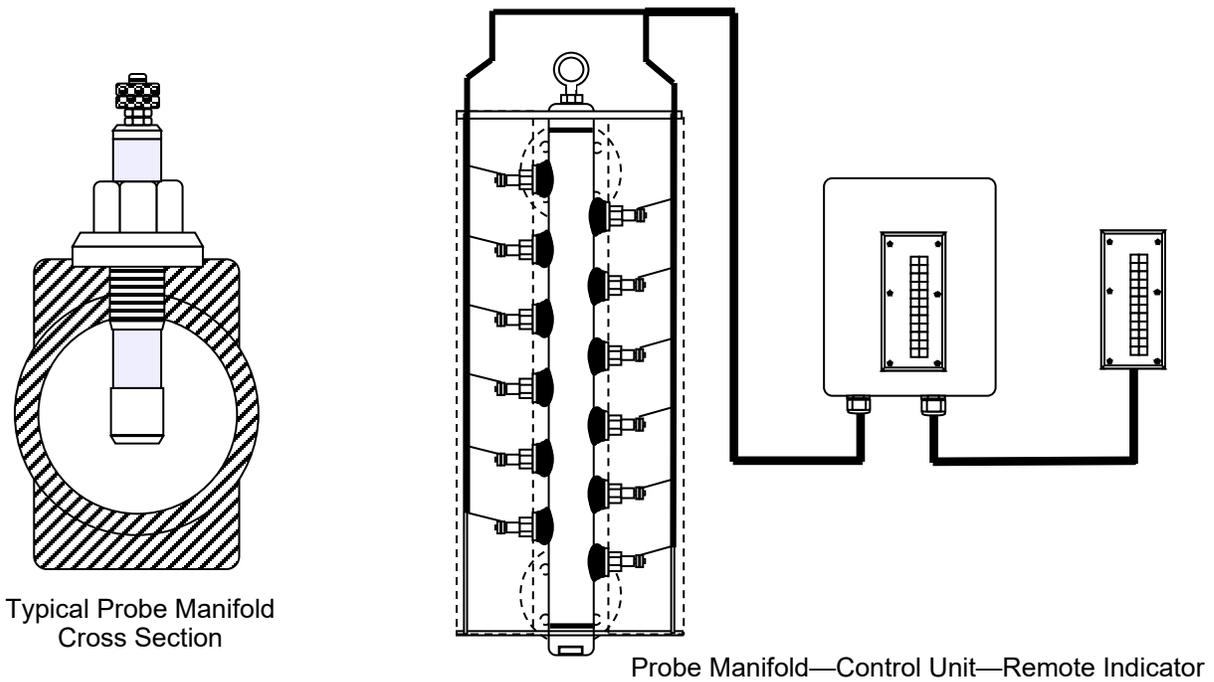


Figure 1.1

2.0 System Configuration

Probes are installed in the probe manifold. A length of high temperature wire connects the probes and the manifold to the control unit. The probe manifold itself serves as a common conductor. The presence of water will complete a circuit between the manifold and the probe tip.

Two printed circuit boards contained in a NEMA 4X (IP65) wall mounted enclosure provide up to 12 discrete water/steam discrimination circuits, LED display, relay alarm/trip outputs, 4-20 mA output, fault detection and terminals for the connection of a remote display Unit.

To avoid galvanic interaction with the probe and variations in sensing voltage due to changing electrolytic potentials, an alternating voltage source is applied to the probe and the sensing circuit responds only to an alternating waveform. Two low frequency oscillators are provided for the source voltage; one drives the odd numbered channels and the other the even numbered channels. The voltage applied to the probe is less than 6 volts, current limited to 50 μ A, and presents no risk to personnel.

2.1 Channel Assignment

Alarm, Trip and Indicator Flash: For the purpose of Alarm and Trip function, channels 1 through 6 are normally wet and channels 7-12 are normally dry. This means that the alarm or trip state is designated to the opposite of the normal wet or normal dry state.

Cable Monitoring: Each probe is independently set as normally wet or dry. Normally wet probes require one conductor and normally dry probes require two.

2.1 Local Indication

Each channel output drives a green LED for water or a red LED for steam, along with a yellow flashing LED for system fault, to a door mounted display.

2.2 Remote Indication

A panel mounted remote indicator (Model LTI-210) is available. This indicator is typically panel mounted in a control room. The standard configuration requires six conductors to provide a serialized signal and power to the red/green LEDs.

2.3 Alarm/Trip and Fault Detection Relays

Five 8A DPDT relays are supplied to provide contacts for alarms, trips or system fault annunciation.

RL1, RL2, RL3 and RL4 are independently selected to operate in energized (failsafe) or de-energized normal state. When operated in the energized state, trip will occur in the event of power loss to the system.

RL1, RL2 RL3 and RL4 are independently set to delay 1 second, 5 seconds, 10 seconds or 15 seconds.

RL5 System Fault, is set to a normally energized state with a delay of 15 seconds; these functions are not adjustable.

2.3.1 Alarm Relays

RL2 and RL3 are intended to be used for Low Water Alarm and High Water Alarm, respectively. These may be set to channels 2 through 12, and will be activated by any single selected channel being out of its normal state.

2.3.2 Trip Relays

RL1 and RL4 are intended to be used for Low Water Trip and High Water Trip respectively. The actions of these relays are dependent on the comparison of multiple channels. This is to ensure that a single channel indication does not initiate a shut-down. The circuitry will compare adjacent probes and initiate action only when there is an agreement that an actionable condition exists.

RL1 may be set to Channels 1, 2, 3 or 4. RL4 may be set to Channels 8, 9, 10, 11 or 12. Appendix 1 illustrates the scenarios that will activate these two relays depending on which channel is selected.

2.4 Sensitivity

The LT-210 may be set to one of three sensitivity ranges:

- >4 mS/cm²
- >2 mS/cm²
- >1 mS/cm²

These values are effectively halved by using a shrouded probe. This increases the surface area of the system common and places the common much closer to the probe sensing element. Sensitivity is rarely an issue, and it is suggested that the mid-range setting be used initially to evaluate system performance in the actual application.

2.5 4-20mA Output

The LT-210 has a self-powered 4-20 mA proportional output that can be set to increase from 4 to 20 mA or decrease from 20 to 4 mA in increments that track the probe's response to changing water level.

2.6 Indicator Flash

The indicator LEDs can be set to flash when channels 2 through 6 are dry, or channels 7 through 12 are wet. This setting is completely local and any remote display must be independently set.

2.7 Test Switches

The LT-210 is supplied with two test switches, that simulate an all Wet or all Dry state. As a default the system will be set so that the Trip Relays (RL1 and RL4) will ignore the test switches, however the Alarm Relays (RL2 and RL3) will be activated depending on how they are set.

2.8 System Fault

The LT-210 System Fault indication is based on an out of sequence logic, i.e. Water over Steam. Since this condition cannot naturally exist, any indication of such will trigger the System Fault yellow flashing LED and the RL5. A failed probe insulator will typically cause the probe to be grounded, regardless of whether it is normally Wet or Dry. Hence, a dry probe with a failed insulator will indicate as Wet. If this occurs with a probe that has a functioning Dry probe below it, the out of sequence logic will declare a System Fault.

Probe cable monitoring is achieved by verifying continuity between two wires to probes that are expected to be normally Dry. A break in continuity between these two wires will simulate a Wet probe, and cause a System Fault. For the single wire connection to the normally Wet probes, an open-circuit connection will indicate Dry, activating the out of sequence Fault Detection circuit.

3.0 Installation and Cabling

3.1 Enclosure

The LT-210 Electronic Unit enclosure is usually located adjacent to the probe manifold. The LT-210 enclosure should be located to provide clear routing of cables, minimum risk of damage from surrounding plant or activities and adequate visibility of the display. The standard enclosure is a Stahlin Diamond Shield, Model DS100806HPL, supplied with mounting foot kit. The instructions for mounting this enclosure are provided as Appendix B of this manual.

3.2 Main Power Supply

Line, Neutral and Earth Ground are connected directly to the Switching Power supply located in the base of the enclosure. The power requirements are: 100 to 240 VAC \pm 10% @ 15VA, 48 - 63 Hz

3.3 Wiring Control Unit-to-Probes

It is recommended that a continuous length of high temperature cable be used to cover the span from the probe manifold to the LT-210 control unit. Quest-Tec Solutions has a custom fabricated cable, available as an option, in 8, 12, 16 and 25 conductor versions. (The specification for 16 conductor cable is attached as Appendix C to this manual.) 20 AWG, nickel plated copper conductors should be used where elevated temperatures are expected. A maximum run of no more than 100 feet is recommended. Two conductors are required for each normally Dry probe, one conductor for each normally Wet probe, and two conductors for system Common.

Figure 3.3 shows the wiring arrangement required when 6 probes are expected to be normally Wet. Note that where one wire is used, the corresponding "A" jump alongside TB1 and TB2 must be made. The Common (Ground) is generally attached to the probe manifold at the 1/4-20 bolt provided on the probe cover support.

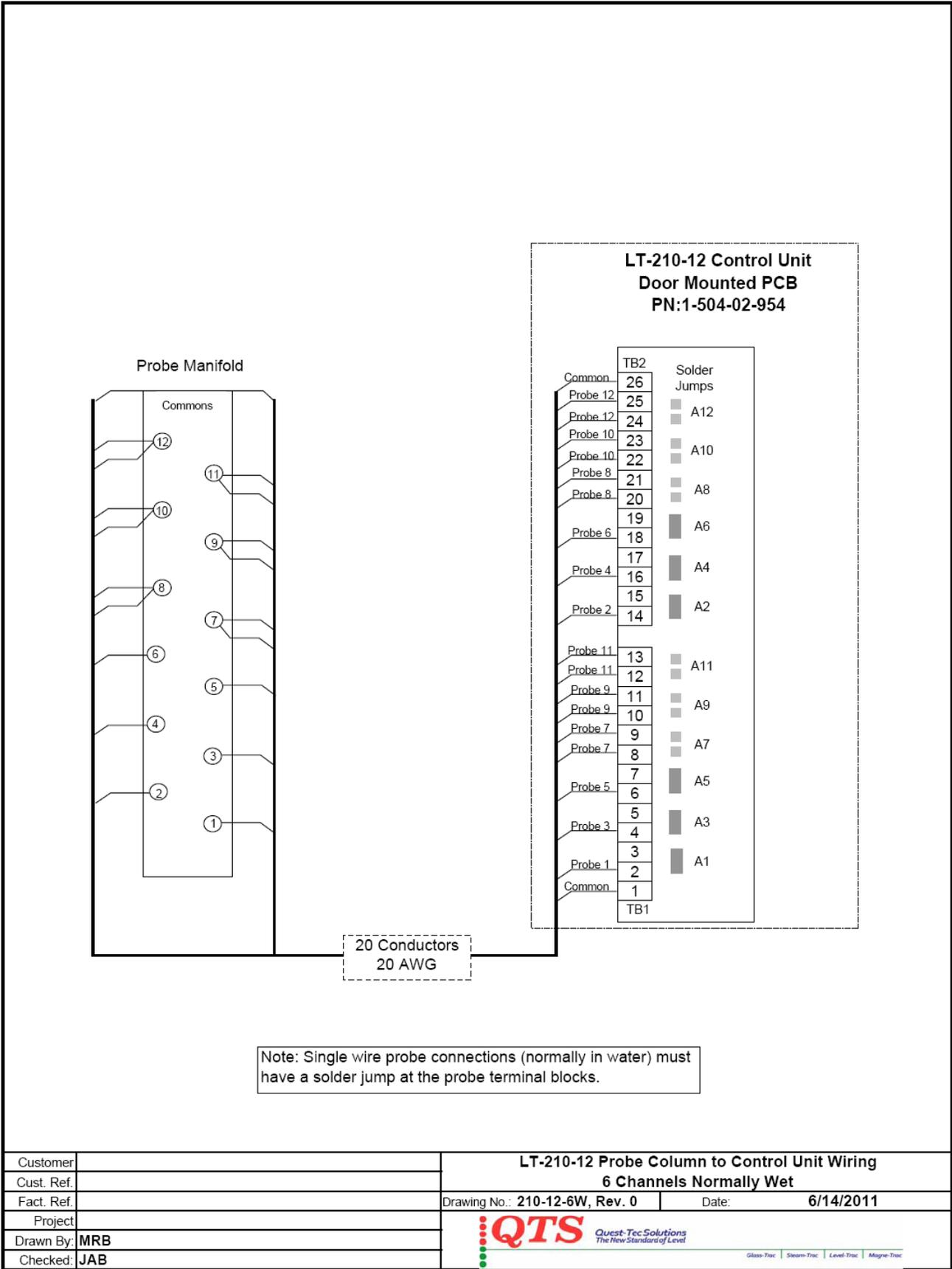


Figure 3.3.1

3.4 Wiring Alarm/Trip Relays and 4-20 mA

Figure 3.4 shows the connection point for relays and 4-20 mA output. Each terminal block is supplied with a Phoenix Series MSTB plug.

There is an LED located at each relay to indicate the current status of the relay. When illuminated, the corresponding relay is energized. The relays are rated 8A at 250 VAC.

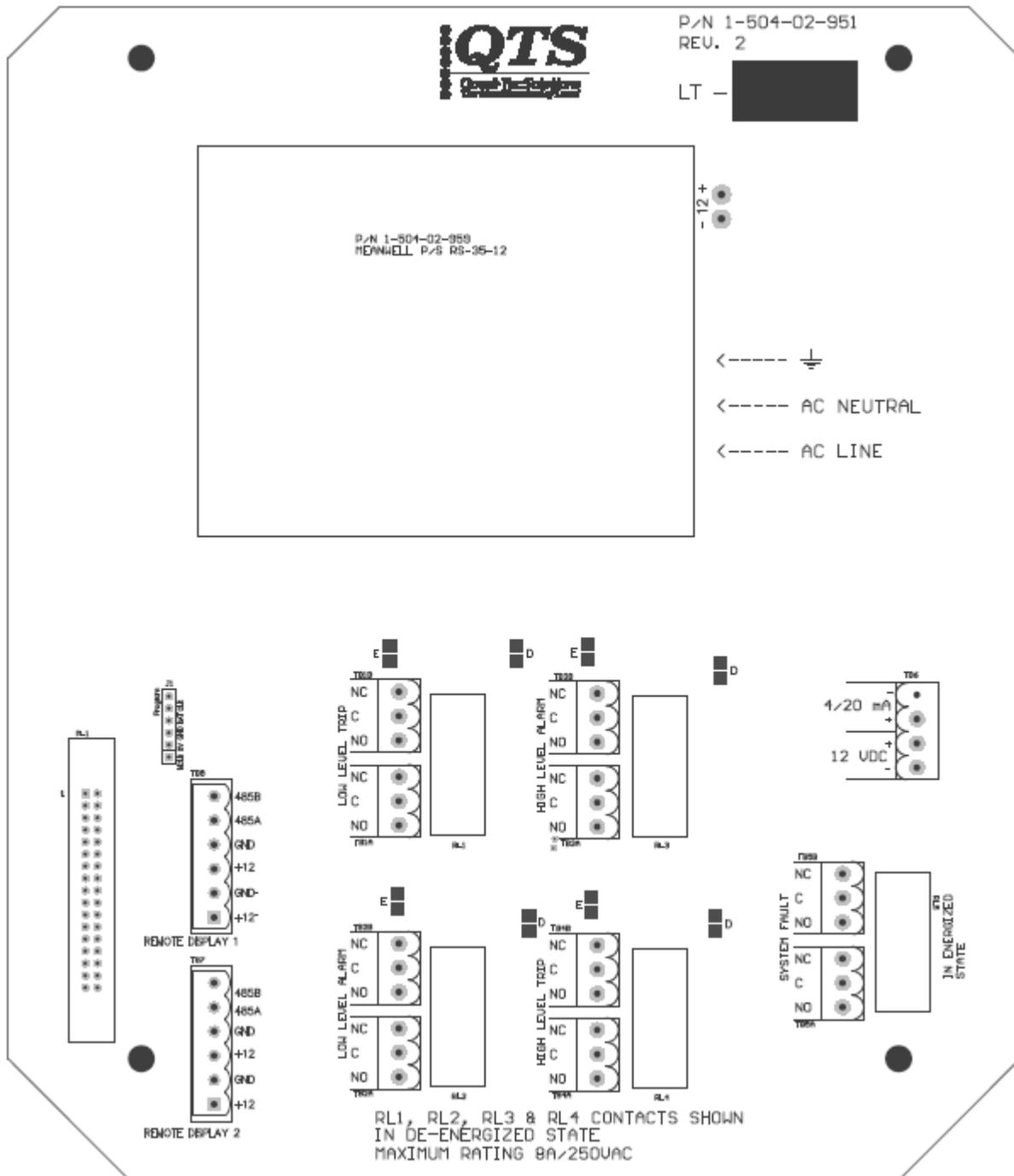


Figure 3.4.1

3.5 Panel Mount Remote Level Indicator

The Model LT-210 Control Unit can power up to two remotely mounted displays. The Model LTI-210 is designed to be mounted on a panel with a cut-out size of 7" H X 2-5/8" W (178 mm H x 67 mm W). See Figure 3.4 for the location of terminal blocks TB7 and TB8.

The LT-210 terminal functions correspond directly with the terminals on the LTI-210. The remote display will operate with a single Ground and +12 VDC, the second pair is redundant. Six conductors are required, with the A and B conductors being a twisted pair. (The other 4 conductors do not have to be twisted pair, but typically cable will only be available in multiples of twisted pairs.) Quest-Tec recommends using 20 AWG, 3 Twisted Pairs, Shielded cable.

4.0 Commissioning

4.1 Prior to initially powering up, verify that the ribbon cable connecting the two PCBs is oriented correctly and fully seated. The red conductor must be towards the "1" marked on the PCB.

4.2 Before installing the wired plugs for the probes, remote indicators, 4-20 mA output and relays, power up the unit, depress and hold the green test switch and check that all green LEDs are illuminated. Release the green test switch, then depress and hold the red test switch and check that all red LEDs are illuminated.

4.3 Turn off the power and install the wired probe plugs. Power up the unit, and observe; if the column is empty all probe channels should have the red LEDs illuminated. Short each probe in turn by touching a wire between the knurled nuts and probe body, checking that the corresponding green LED becomes illuminated.

4.4 Turn off the power and install the wired remote display plugs, if used. To prevent permanent damage to the discriminator PCB, confirm that the wiring to the indicator is correct before powering up. Power up the unit and check correct illumination of LED's by operation of the green and red test buttons.

4.5 Verify that the RL1 thru RL4 relays are receiving power as intended by observing the LED associated with each relay. When an LED is illuminated the associated relay has power and should be energized. If the "E" solder jump is made, the relay LED will be illuminated when in normal state and will turn off when in the alarm or trip state. This is reversed when the "D" solder jump is made (the relay LED is powered by the current that activated the relay. It will verify that the relay has power, but does not verify that the relay has actually closed. Continuity must be checked at the terminals to verify that the relay is performing properly).

When configuring the wiring for relays, note that the PCB labels "NC" and "NO" are based on the relays being in a de-energized (solder jump "D") mode.

5.0 Routine Maintenance

The LT-210 control unit requires no routine maintenance. However, it is recommended to periodically clean the external probe insulators with a small brush to keep free of accumulated dust, and to remove, clean and inspect the probes after one year's service.

5.0 LT-210 Control Unit Specifications

Enclosure:

Wall mounted glass-fiber reinforced polyester, IP65/NEMA4X protection for location in harsh environments.

Dimensions: 11.42" H X 9.79" W X 6.56" D (290 mm H X 249 mm W X 167 mm D)

Mounting Legs: (4) 0.50" X 0.31" (13 mm X 8 mm) Slots on 12.19" H X 6" W Centers (310 mm H X 152 mm W)

Inputs:

Discrimination between water and steam for up to 12 channels numbered in ascending order.

Sensitivity: Discrimination threshold may be selected for a minimum conductivity of 1 mS/cm², 2 mS/cm² or 4 mS/cm². (Use of a shrouded probe insert effectively reduces these values by half.)

Probe Normal State: This is set by solder jumps, making a jump for all probes anticipated to be in the wet state as normal. Probes that are normally wet require a single wire, probes that are normally dry require two wires.

Display:

Two vertical columns having 0.4" (10 mm) square LED's on the front of the enclosure. One row of Green LED's represents water and another row of Red LED's represents steam. Channels 2 - 6 can be selected to flash when in a Dry State. Channels 7-12 can be selected to flash when in a Wet State. A Yellow flashing LED signals a System Fault Condition

Supply Requirements:

100 to 240 VAC ± 10%, 48 - 63 Hz

Utility Consumption:

20 Watts

Temperature Rating:

Operating: -13° F (-25° C) to 158° F (70° C), Storage: -58° F (-50° C) to 212° F (100° C)

Relay Outputs:

Alarms: Two relays are dedicated to the Low Water (RL2) and High Water (RL3) alarms, channels 2 through 12 can be selected for either Relay.

Trips: Two relays are dedicated to the Low Water (RL1) and a High Water (RL4) trip. The relays will activate based on logic that compares adjacent probes. Low Water trip can be set to Channel 1, 2, 3 or 4; High Water trip can be set to Channel 8, 9,10, 11, or 12.

Fault Alarm: One relay (RL5) is dedicated to activate when a Fault is indicated.

Alarm and Trip Relays may be set to a direct (de-energized) or inverse (energized) normal state. The Fault relay is set to an inverse (energized) normal state.

Relay Ratings:

DPDT, Max. Current: 8 Amps @ 250VAC

4-20 mA Signal:

Self Powered, 0-10 VDC, Load Impedance: 500 ohms Max.

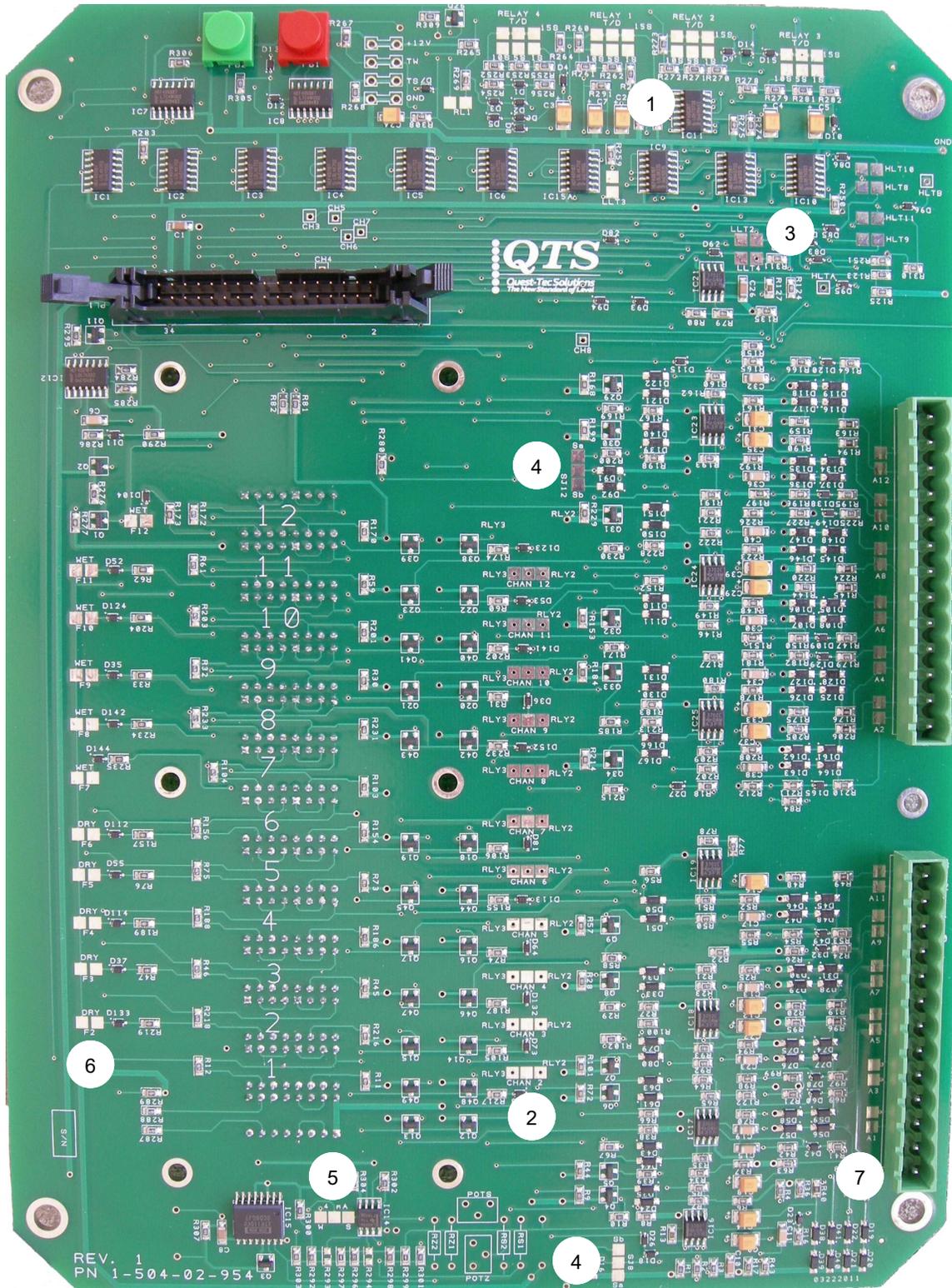
Remote Display:

Two sets of 6 terminals are provided for direct connection to Remote Display Units. The Remote Display Unit option LTI-210 duplicates the display on the front of the main unit and is intended for control room location.

Panel Mounted 7.75" H X 3" W (197 mm H x 76 mm W), Panel cut-out: 7-5/8" H X 2-7/8" W (194 mm H x 73 mm W)

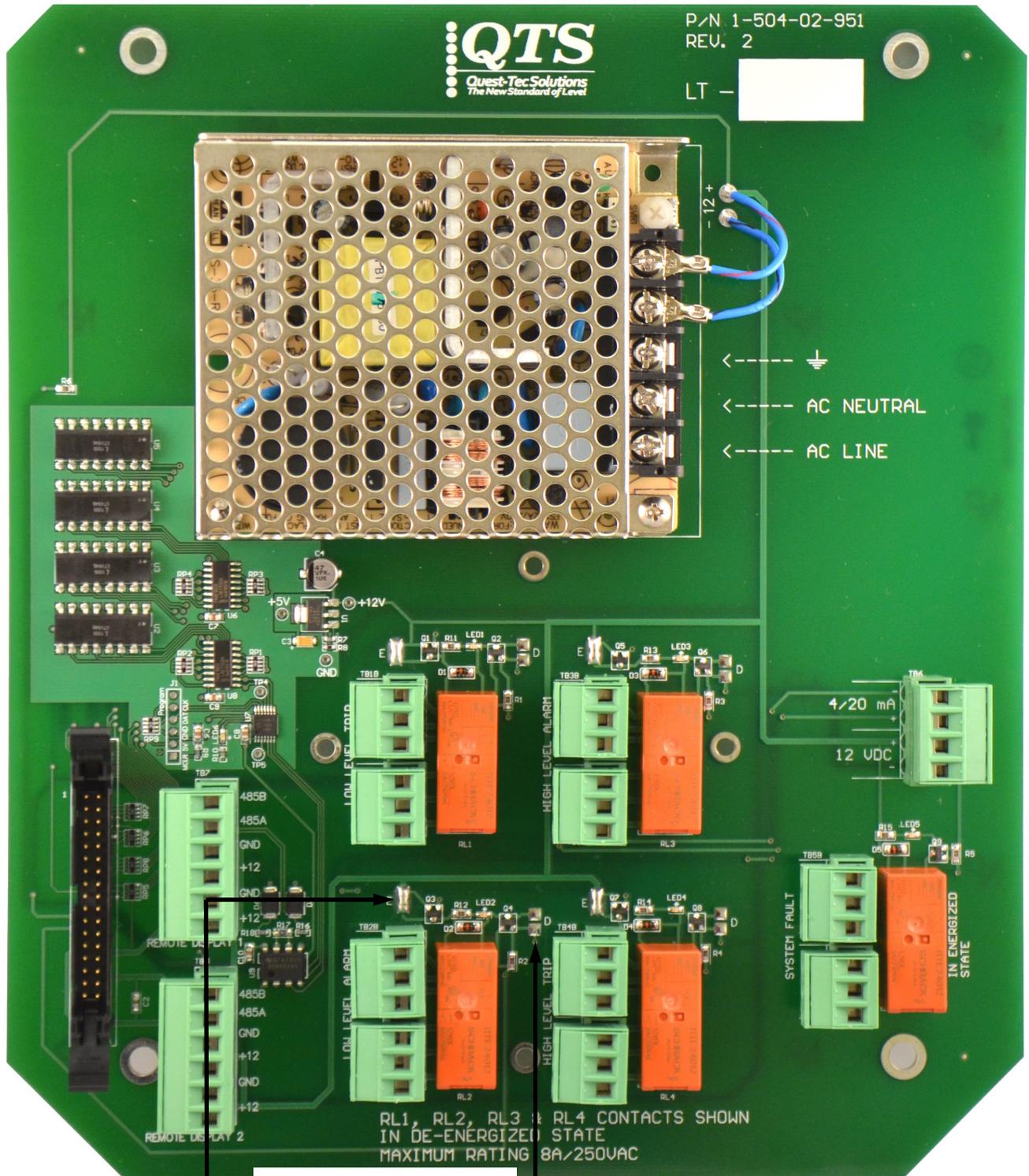
6 Field Programming

6.1 Discriminator PCB



- 1) Time Delay: No Jump = 15 seconds (See Part 2.3)
- 2) Alarm Relays: Assigns RL2 and RL3 (See Part 2.3.1)
- 3) Trip Relays: Assigns trip logic to RL1 and RL4 (See Parts 2.3.2 and Appendix A)
- 4) Sensitivity (2 Places): No Jump $>4\mu S/cm^2$, Sa to Center is $>2\mu S/cm^2$, Sb to Center is $>1\mu S/cm^2$ (See Part 24)
- 5) 4-20 mA: Jump to "S" Sets 4 mA to all Steam, Jump to "W" sets 4 mA to all Water.
- 6) Indicator Flash: The Indicator will flash at any position jumped (See Part 2.6)
- 7) Probe Assignment: Jump "A" to set probe to normally Wet state. (See Part 3.3 and Figure 3.4.1)

6.2 Power Supply/Relays PCB



Normal Relay State
 E = Inverse (Energized)
 D = Direct (De-energized)

Appendix A

LT-210 Low level Trip Logic
Trip on 1

Solder Jump: None

4	Wet	Dry	Wet	Dry	Wet	Dry										
3	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry
2	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry
1	Wet	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry							
RL1													Trip	Trip	Trip	Trip

Trip on 2

Solder Jump: LLT2

4	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
3	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry
2	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry
1	Wet	Wet	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry						
RL1							Trip	Trip					Trip	Trip	Trip	Trip

Trip on 3

Solder Jump: LLT2 & LLT3

4	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
3	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry
2	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry
1	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
RL1				Trip			Trip	Trip					Trip	Trip	Trip	Trip

Trip on 4

Solder Jump: LLT2 & LLT3 & LLT4

5	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
4	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry
3	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry
2	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
1	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Wet
RL1				Trip			Trip	Trip					Trip	Trip	Trip	Trip

Trip on 4 (cont.)

5	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
4	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry
3	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry
2	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Dry							
1	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
RL1				Trip			Trip									

LT-210 High level Trip Logic
Trip on 12

Solder Jump: None

12	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry								
11	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry
10	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry
9	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
RL4	Trip				Trip											

Trip on 11

Solder Jump: HLT11

12	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
11	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry
10	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry
9	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
RL4	Trip	Trip	Trip		Trip		Trip		Trip	Trip			Trip			

Trip on 10

Solder Jump: HLT11 & HLT10

10	Wet	Dry	Wet	Dry												
9	Wet	Wet	Dry	Dry												
8	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry
7	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
RL4	Trip															

Trip on 9

Solder Jump: HLT11, HLT10 & HLT9

10	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
9	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry
8	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry
7	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
RL4	Trip	Trip			Trip				Trip	Trip			Trip			

Trip on 8

Solder Jump: HLT11, HLT10, HLT9 & HLT8

10	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
9	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry	Wet	Wet	Dry	Dry
8	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry
7	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Wet	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
Trip RL4	Trip	Trip	Trip	Trip	Trip		Trip		Trip	Trip			Trip			

Installing and Removing Covers

To remove cover:

- 1) Open the enclosure completely and provide adequate support to keep the cover from being damaged during disassembly.
- 2) Using a hammer and screwdriver, gently tap on the end of the hinge pin nearest the middle of the enclosure (closed end) so that the pin becomes unseated at the other end (approx. 1/4")
- 3) Using pliers, grasp the opposite end (flattened) of the hinge pin and pull completely out. Repeat steps 1 and 2 to remove the second hinge pin.

To install new cover

- 4) Assemble hinge pins to the cover by inserting the round end of the pin into the hinge core in the cover. You may need to use a hammer to gently tap the pin into place. Repeat this for the second pin.
- 5) Align the cover with the base in the open position.
- 6) Using a small hammer, gently tap the hinge pin into the corresponding hole in the base until the end of the pin is fully seated and flush with the cover surface. Repeat this step for the second hinge pin.

Changing out the latches

- 7) Remove existing latch by gently tapping the latch off the dovetail on the side of the enclosure.
- 8) Assemble the new latch by sliding the latch base onto the corresponding dovetail on the enclosure base **UNTIL COMPLETELY SEATED**. Repeat steps 7 & 8 for the other latches.

Adding Mounting Feet

- 9) Place mounting foot on the back side of enclosure so that the countersink hole is directly over the brass insert.
- 10) Using a screw driver and the #10-32 x 7/16" flat head screw, tighten the mounting foot to the enclosure. Torque to approximately 25 in-lbs. Repeat steps 9 and 10 for the remaining mounting feet.

