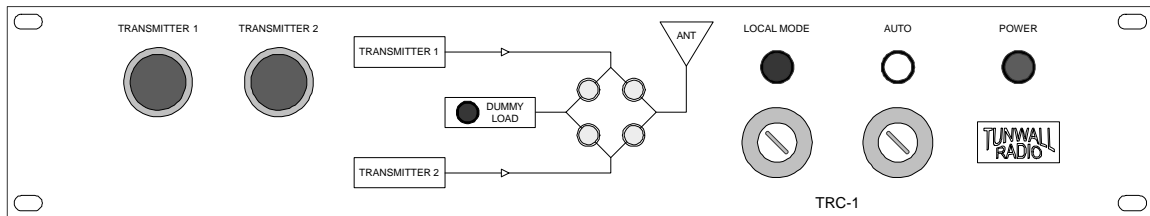


330-995-9642

# INSTALLATION AND SERVICE MANUAL



## TRC-1

## FM SWITCH CONTROLLER

REV 92710



FM switch controller – general .....	2
PLC (programmable logic controller) .....	2
Controller connections .....	3
Remote command inputs .....	3
Remote control status outputs .....	3
Transmitter interlocks .....	3
Dummy load connections .....	4
Switch position tally connections .....	4
Motor control voltage – 50000 series .....	5
Motor control voltage – 60000 series .....	5
Auto transfer connections.....	5
OPERATION .....	6
Front panel status indicators .....	7
Load interlock .....	7
Fuses .....	7
Auto transfer operation .....	7
One-button transmitter 2 change .....	8
Controller schematic diagram .....	9
Interconnection chart for 50000 and 60000 .....	10
Additional coax switches .....	11
Component layout .....	12
50000 coax switch manual .....	7 pages
60000 coax switch manual .....	10 pages



330-995-9642

## **FM SWITCH CONTROLLER**

This is a controller for one coax switch, two transmitters, one antenna, and a dummy load. It is compatible with Dielectric 50000 and 60000, Delta, Andrew, MCI coax switches, or any other switch with 12VDC, 24VDC, or 120VAC position command inputs. The controller can also be used with AM RF contactors, directly if the contactor is 120VAC or with pilot relays for 240VAC. An alternate program is usually loaded into the PLC for use with AM contactors, which can speed up transmitter changes, although this is not required.

The coax switch or RF contactor is connected to a 9-pin AMP socket on the rear panel. All other connections are made to barrier strip terminals. Two and three switch controllers are also available in several configurations.

## **PLC (PROGRAMMABLE LOGIC CONTROLLER)**

This is a PLC-based coaxial switch and transmitter interlock controller, intended for FM transmitter sites. Switch timing and transmitter interlocks are controlled by a NAIS FP0-C14RS programmable logic controller. Programmable logic controllers are not well known to broadcast engineers but have been used in the manufacturing industry for decades.

No knowledge of PLC programming is needed to install and use the FM controller.

The PLC uses EEPROM for program memory. No backup battery is required, so program loss should not be a concern, even if the controller is unplugged for months or years.

The 24 volt power supply illuminates front panel indicators, energizes DC coax switch relays, and provides operating and input common voltage for the PLC.

The DC fuse is 1/2 A. The AC fuse should be about 3A if a Dielectric 50000 coax switch is used. For other coax switches that do not get motor power through the controller, a 1A fuse could be used. The AC fuse is 3A when shipped.

## **CONTROLLER CONNECTIONS**

Schematic drawings and interconnection charts are provided for Dielectric 50000 and 60000, Andrew, Delta, and MCI coax switches. Some variations in non-Dielectric internal wiring turn up occasionally, so if the original documentation for your switch is available, its wiring should be verified. Connections to the coax switch are on the 9-pin AMP socket. All other connections are to terminals 1-20.

## **REMOTE COMMAND INPUTS**

Controller terminals 1-3 are the remote position select connections. Floating relay contacts are best, such as the Burk IP-8, but open collector equipment may be compatible depending on its polarity and operating voltage.

## **REMOTE CONTROL STATUS OUTPUTS**

The remote control status outputs, terminals 4-6, are connected through diodes to the front panel status indicators. The PLC used in the controller was selected because of its low cost (to help keep the controller cost low), and it has a limited number of outputs, so the two status functions are combined. The remote control status outputs are compatible with most remote control systems, Burk for an example. The Burk documentation states that their status inputs can be connected to circuits up to 28 VDC. The only requirement is that one state of the circuit is ground or near ground. The PLC output relays cause terminals 2 and 3 to go near ground when a remote status indication is desired. The series diodes keep the controller's front panel indicators from lighting through the remote control's pull-up resistors. The diode-coupled status output circuit has been used on more than 100 FM controllers so far, with no problems reported.

## **TRANSMITTER INTERLOCKS**

The transmitter interlock terminals 15-18 are to be connected to the interlock or mute terminals of the transmitter(s). Older transmitters that do not have terminals designated for this purpose may have connections for remote plate off. If this circuit requires a continuous closure to keep the plate on, the controller's interlock terminals may be wired in series with the transmitter/remote control circuit.

In older transmitters the interlock or remote plate off circuit may be 120VAC. The PLC relays are rated for 250VAC (at 2A), so it is up to the judgment of the installer whether to connect AC control circuits to the controller. It is generally best to install DC relays in the transmitter.

The interlock logic (normally open/normally closed) can be reversed with internal jumper plugs, as shown on the component layout page.

## DUMMY LOAD CONNECTIONS

The tally terminals of your dummy load should be connected to controller terminals 7 and 8. The PLC has been programmed to operate correctly with a dummy load contact closure when the blower or water is “on”. This allows the transmitter not on-air to be energized, for load testing.

When the load interlock function is not being used, the off-air transmitter is muted. Its filament and blowers should be able to operate.

If you are load testing the off-air transmitter and somebody on- or off-site hits transmitter change, both transmitters will be muted while the switch is moving, so local mode is not required for routine load testing.

If you have a convection load, an external switch should be connected to the load interlock terminals. A switch is usually preferable to a permanent jumper, so that when no one is at the site the off-air transmitter is not allowed to run into the load.

An external load interlock switch might also be desirable with Altronic loads, due to the nature of their tally contact operation – whenever power is applied, their tally contacts close, and will open only if the load overheats. This could allow operator error to turn on an off-air transmitter, and while the load would theoretically not be damaged, the heat from the extra transmitter and the load could cause problems in many transmitter buildings, given some time. Alternatively, you might decide to leave an Altronic load disconnected from power when no one is there.

## SWITCH POSITION TALLY CONNECTIONS

The controller needs to know which position the coax switch is in, to operate the transmitter interlock closures and position change commands. These connections are made to AMP connector pins 1-4. The switch ports you have connected to the transmitters, antenna, and load will affect the way the controller works. The controller will work with any switch port arrangement. The needed logic is selected by the presence or absence of a jumper between controller terminals 9 and 10.

Although there are 4 possible port arrangements (the antenna can be connected to ports 1-4, etc.), there are only two considerations we need to be concerned with: is transmitter 1 connected to the antenna when the switch is in position 1 or position 2?

*Note: Dielectric 50000 switches have a mechanical position indicator. Other switches may have a similar indicator. Any switch manual should provide position/port connection drawings.*

If the answer is position 1, no jumper is needed. If the answer is position 2, the jumper is needed (terminals 9-10). If the jumper/no jumper is wrong, the front panel position indicator pairs will operate backward, and the wrong transmitter interlock will close.

### **MOTOR CONTROL VOLTAGE – DIELECTRIC 50000 SERIES**

The controller is compatible with (50000 series) coax switches that have 12 VDC, 24 VDC or 120 VAC motor control relays. The controller has internal jumper plugs to select control voltage.

Andrew, Delta and MCI coax switches can be used with the controller, using a modified connection chart, provided as needed. Solenoid-type switches might be compatible with the controller but they are generally considered inferior to motorized types, and no consideration for solenoid switches was given to the controller design.

### **MOTOR CONTROL VOLTAGE – 60000 SERIES**

The 60000 switch will operate from DC or 120VAC commands, but the cable wiring is different. Generally, DC control is preferred. The controller has internal jumper plugs to select DC or AC command voltage.

Another control option is possible with 60000 series coax switches – if the control board on the switch is damaged or removed, the FM controller can operate the switch by wiring directly to the 3-terminal motor (the controller must be in 120VAC mode). The 60000 switch motor has one winding for CW, and one for CCW.

### **AUTO TRANSFER CONNECTIONS**

The key switch selected auto transfer will change to transmitter 2 if transmitter 1 fails, and will turn on transmitter 2. To use auto transfer, a transmitter 1 “on” signal must be provided to the controller. This can be done two ways; a floating contact closure (closed = on), or a 5 volt signal capable of about 70mA (5 volts = on). The 5 volt terminals are connected directly to the coil of a small relay, and not grounded. The 5 volt relay coil has a parallel diode for back voltage suppression, so polarity matters – terminal 11 is positive.

The transmitter 1 “on” closure or 5 volt signal can come from the transmitter or any external device such as an RF power detector or suitable modulation monitor. Circuit modifications or additions may be required. Either signal will light the TX 1 PLT ON indicator on the back of the controller. This indicator should be checked before turning the auto mode key switch on.

Auto transfer will turn on transmitter 2 with a momentary relay contact, terminals 19 and 20. This momentary closure comes from a capacitor and relay arrangement. When the transmitter 2 status indicator comes on (in auto mode only), a 1000 mfd capacitor will charge through the coil of K3, energizing the relay for about 1 second. When the transmitter 2 status indicator is off, the capacitor will discharge in about 30 seconds through a 10k resistor. A series diode keeps the transmitter 2 status indicator pair from lighting through the coil of K3, when transmitter 1 is on the antenna. K3 will not do anything unless the auto key switch is on. A separate PLC output for transmitter 2 plate on would be ideal, but does not justify the expense of a larger PLC.

Behavior of the auto transfer function is described further in the operation section.

## **OPERATION**

The two front panel pushbuttons are the local controls for selection of transmitters 1 and 2 to the antenna. If the front panel pushbutton for the transmitter already on-air is pushed, nothing will happen. A switch change command locks out the other for the duration of the switching sequence. The switching sequence is: transmitter interlock connections open, 1 second delay, coax switch operation (as long as it takes up to 30 seconds), at completion of switch movement, interlock delay, 0.2 second (to let the coax switch settle mechanically, and transmitter interlock(s) on.

During the transfer sequence, the status indicator pair for the position being switched to will flash. You may hear the PLC's internal relay operating, which causes the indicator to flash.

The controller has terminals for remote position change commands. These work exactly as the front panel pushbuttons unless the controller is in local. In local, only the front panel pushbuttons are active.

After a switch sequence has been started, if the coax switch doesn't "get there" neither interlock will be completed. This is the primary purpose of the controller, of course. If the switch "hangs" during a transfer the controller will reset after 30 seconds, when the transfer can be attempted again.

If the coax switch does not start to move within 2 seconds after a position change command, and the switch is still in a valid position, the interlock for the correct transmitter will be restored. This is unlikely but might happen if the switch motor AC power connection fails.

If the coaxial switch is moved manually, the transmitter interlocks will open. This protects the switch and transmitter as much as possible under this circumstance, but this should not be done with transmitter(s) on. The coax switch must be moved slightly before its position switch is activated, which means that its

contacts will be moved under power, which is not desirable. If the switch is moved manually, when it “makes” either position, there will be a 0.2 second delay before the interlock(s) is restored.

## **FRONT PANEL SWITCH POSITION STATUS INDICATORS**

The coax switch position status indicator pairs and flow chart graphic indicate the transmitters’ signal path to antenna or load. The switch position number, 1 or 2, that corresponds to main transmitter on-air depend on which ports the transmitters and/or antenna(s) and dummy load have been connected to. The controller is set up for the appropriate switch port arrangement, described in the connections section.

## **LOAD INTERLOCK**

With fan-cooled or water loads, the tally contacts in the load will allow the off-air transmitter to run, through the controller’s load interlock circuit. When the load is on, the front panel dummy load indicator is on, for testing transmitters. With convection loads, an external switch should be connected to the load interlock terminals. If a transmitter change command is given during a load test, the coax switch is protected, because both transmitters will be muted.

## **FUSES**

The front panel DC fuse, 1/2 A, is on the output of the 24V power supply. The AC fuse is in series with the “hot” lead for the entire controller, and the AC power for the coax switch. This fuse should be about 3A with Dielectric 50000 switches. Larger fuses can be used, at your judgment. The controller’s internal power wiring is 18 ga.

## **AUTO TRANSFER**

The optional key switch selected auto transfer will change to transmitter 2 if transmitter 1 fails. To use auto transfer, the controller requires a continuous signal to indicate that transmitter 1 is on – see CONNECTIONS section. Before turning the auto key switch on, the rear panel transmitter 1 indicator should be checked.

When the auto key switch is on, if transmitter 1 fails for 5 seconds, the controller will switch to transmitter 2. If transmitter 1 fails for less than 5 seconds but comes back on, the 5 second timer will reset.

Auto transfer does not start to work until the controller has been on for 5 minutes. If auto transfer is to be used, not connecting the controller to a UPS might be considered. If the main transmitter goes off due to power failure but the controller is still on because of the UPS, the coax switch will be moved to the transmitter 2 position. When power comes back, the station could be off-air unnecessarily because the main transmitter would then be connected to the dummy load.

Worse, it might run into the load, depending on the load interlock wiring situation, and an operator might not know the station is off-air.

Auto transfer may not be appropriate for all stations. Failure of one power line phase might cause a transmitter change you didn't want, if the rack power didn't drop out. If the transmitter's plate on status is used to provide the "on" signal to the controller and the exciter fails, there could be nothing on air (no drive) but the controller would not transfer.

When the auto key switch is on, when the coax switch gets to the transmitter 2 position, a momentary transmitter 2 plate on contact closes. Most tube-type transmitters will come on with a plate on command only (a separate filament command not needed), with warm-up delay of course. The controller does not turn either transmitter off, and will not turn transmitter 1 on when you switch back.

Whenever the auto key switch is on, a change to transmitter 2, whether local, remote, or automatic, will not flash the front panel transmitter 2 status indicator pair during the change. The indicators will light normally when the coax switch is in the transmitter 2 position.

### **ONE-BUTTON TRANSMITTER 2 CHANGE**

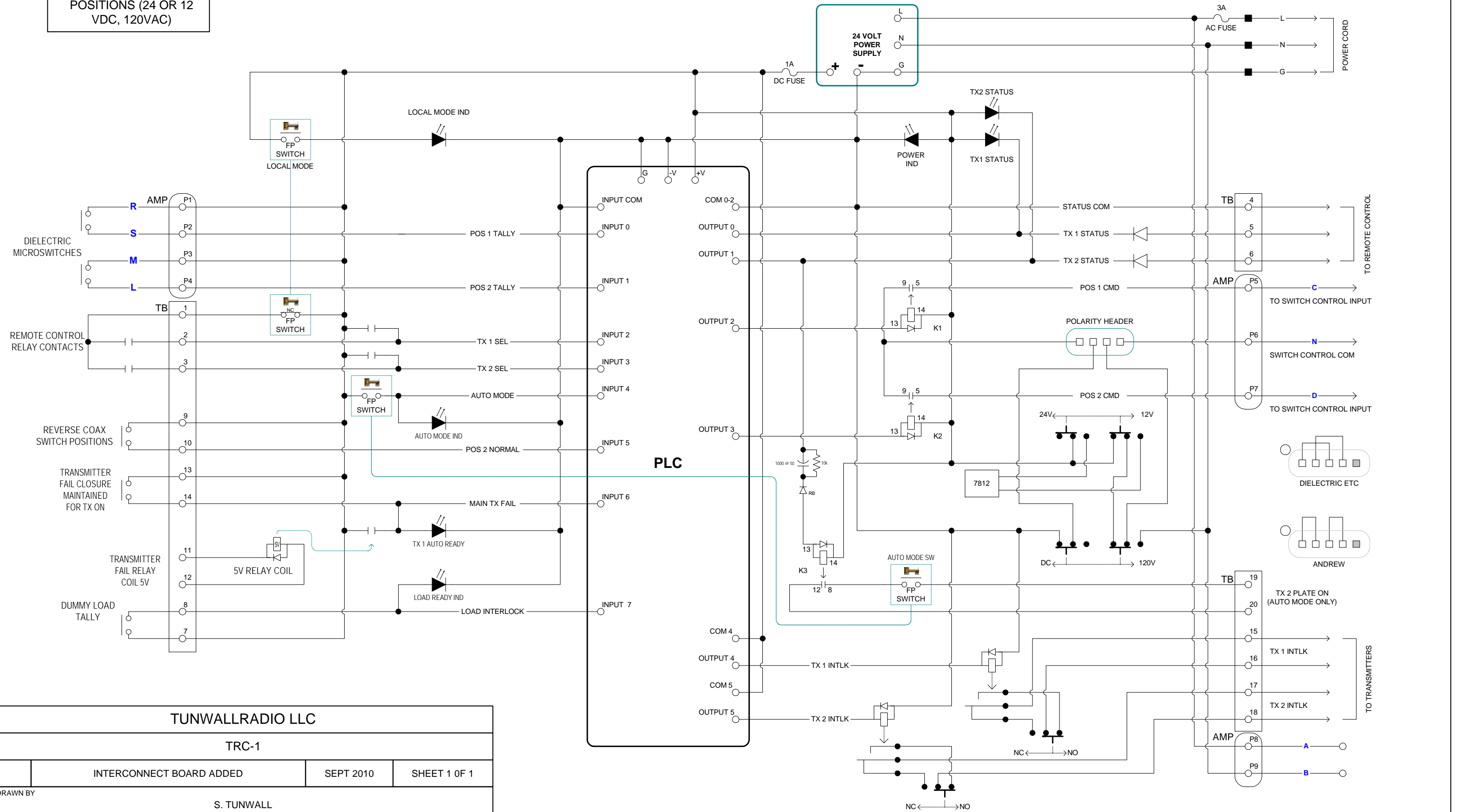
It is possible to use the transmitter 2 auto transfer momentary plate on closure without using the auto transfer, so that an operator can switch to transmitter 2 on-air with one command. A jumper on terminals 13 and 14 will prevent the controller from automatically changing transmitters, and by leaving the auto key switch on, the transmitter 2 plate on closure will operate whenever the coax switch moves to the transmitter 2 position. The front panel position indicators and the remote status output for transmitter 2 will not flash when the auto key switch is on, but the switching sequence is otherwise the same.

Switching back to transmitter 1 on-air will require an external plate on command, but if transmitter 2 is the standby, the automatic change to transmitter 2 may be a benefit if the main transmitter fails.

# TRC-1

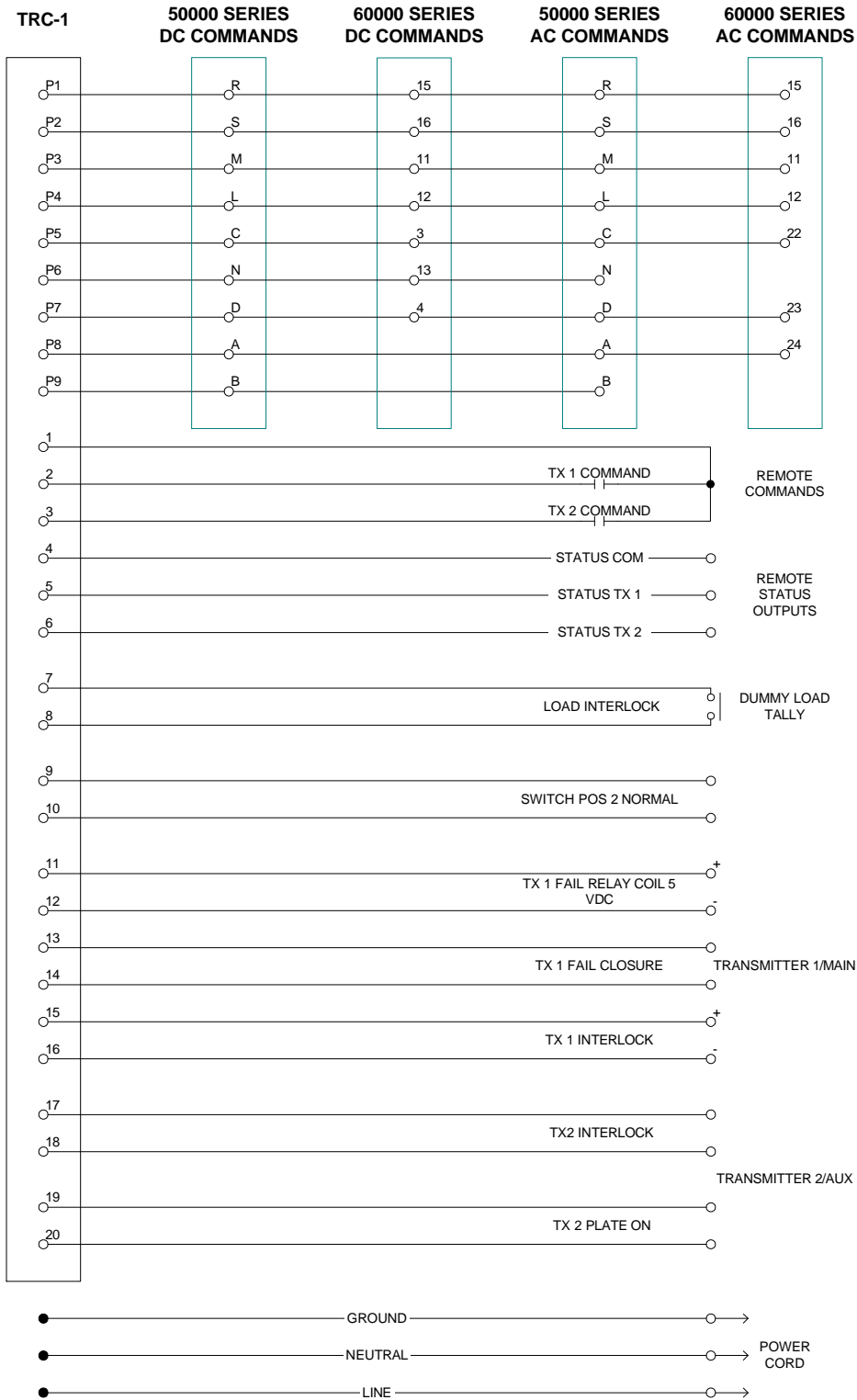
THE INTERNAL VOLTAGE JUMPERS MUST BE IN THE CORRECT POSITIONS (24 OR 12 VDC, 120VAC)

INPUT AND OUTPUT CONNECTIONS (BLUE) ARE TO DIELECTRIC 50000 SWITCH. SEE INTERCONNECTION PAGES FOR 60000 AND OTHERS.



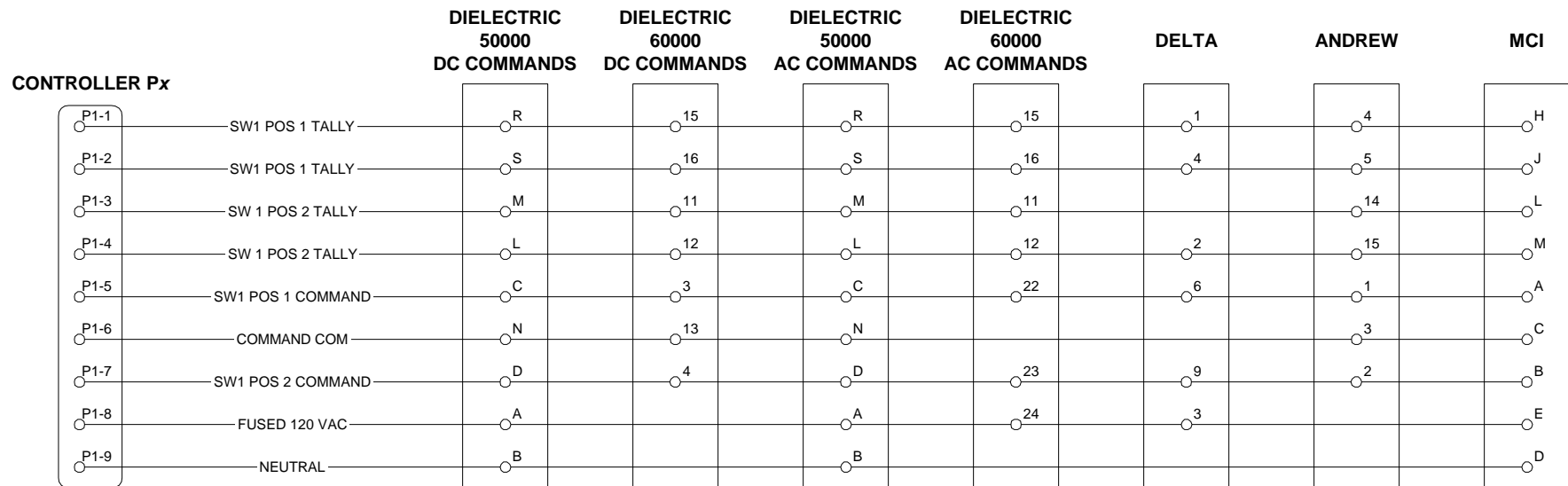
<b>TUNWALLRADIO LLC</b>		
TRC-1		
INTERCONNECT BOARD ADDED	SEPT 2010	SHEET 1 OF 1
DRAWN BY S. TUNWALL		

# SWITCH AND REMOTE CONTROL (SUCH AS BURK) CONNECTIONS 50000 AND 60000 SERIES





## COAX SWITCH CONNECTIONS FOR FM CONTROLLERS



11

ANDREW REQUIRES REVERSE POLARITY HEADER  
 ANDREW 24VDC ONLY  
 DELTA 120VAC ONLY  
 MCI MAY HAVE 5V CONTROL RELAY - CHANGE TO 12V OR 24V  
 TERMINAL NUMBERS FOR DELTA, ANDREW, MCI MAY NOT BE CORRECT FOR EVERY MODEL



