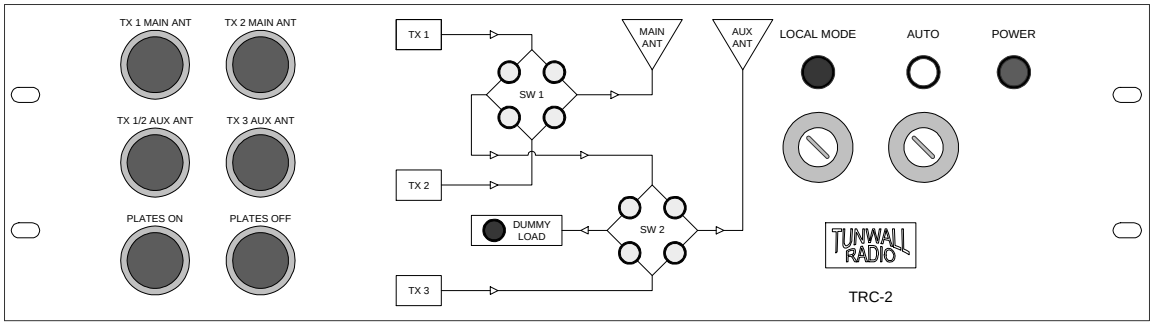
TUNWALL RADIO

330-995-9642




# TRC-2

## INSTALLATION AND SERVICE MANUAL

**Rev. Jan 2008**

## TRC-2 DUAL SWITCH CONTROLLER

This is a controller for two coax switches, three transmitters, two antennas and a dummy load. It was designed for Dielectric 50000 and 60000 series coax switches but will also work with Delta, Andrew, MCI, and others. Coax switches are connected to 9-pin AMP connectors, with cables or plugs provided. All other connections are made to barrier strip terminals.

## PLC (PROGRAMMABLE LOGIC CONTROLLER)

This is a PLC-based controller. All functions are controlled by a NAIS FP0 programmable logic controller and expansion module. Programmable logic controllers are not well known to broadcast engineers but have been widely used in the manufacturing industry for decades. The FP0 is a microprocessor controller, built into a convenient package that includes the power supply, input isocouplers, output relays, status indicators, terminals and connectors, and a programming interface. PLC's are designed and constructed to survive and perform in the environments found in industrial facilities, which typically present several challenges to electronic equipment; heat, dust, vibration, magnetic fields, and power line transients. The FP0 is very reliable in general, and will hold its memory indefinitely with power removed.

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

The PLC and expansion module in this controller have opto-isolated electronic logic inputs, and relay contact outputs. The controller will work with any relay command inputs. Open collector equipment may be used if compatible with positive common wiring.

## CONNECTIONS

### COAX SWITCH CONNECTIONS

Coax switches connect to the 9-pin AMP connectors P1 and P2. Note that 120 VAC is available for the coax switch motors on pins 8 (hot) & 9 (neutral), for switches that are powered by the controller. The pins for the 9-pin AMP connectors are the same as in the larger AMP connectors on Dielectric 60000 coax switches. Many ratcheting crimpers used for audio console installation will work. The pins for the controller side were installed with a Paladin 1645, Newark part #97B3917. A coax switch connection terminal page is provided.

An overall wiring chart is provided for convenience of installation. There is also a coax switch connection terminal page.

### COMMAND POLARITY

The header plug labeled "polarity" on the interconnect board is to reverse DC polarity for Andrew coax switches. Reversed polarity is only required for Andrew switches.



Tunwall Radio 1312 Suffield Oaks Lane Suffield OH 44260 stevetunwall@tunwallradio.com 330-995-9642

## REMOTE CONTROL INPUTS

Controller terminals 1-6 to 1-10 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. Controller terminals 2-1 to 2-3 are remote command inputs for the optional plate on and off functions.

If the controller was ordered for use with master antennas, terminals 2-1 to 2-3 are for external antenna interlocks, and the front panel plate on/off pushbuttons are either not installed or inactive.

## REMOTE CONTROL STATUS OUTPUTS

Controller terminals 1-1 to 1-5 are remote position status outputs. These outputs are connected through diodes to the front panel status indicators. The PLC used in the controller was selected because of its low cost, and it has a limited number of outputs, so the front panel position status indicators and the remote outputs share PLC outputs. This status outputs circuit is compatible with all known remote control systems, Burk as an example. The Burk ARC-16 documentation states that its status inputs can be connected to circuits up to 28 VDC. The only requirement is that one state of the circuit be ground, or near enough to pull the DC close to ground potential. The PLC output relays cause the status output terminals 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

## PLATE ON AND OFF CONNECTIONS

Plate on and off closures are available on TB4, as shown on the interconnections page. These connections are optional, and their use is discussed further in the OPERATION section. The transmitters and coax switches will operate safely if only the transmitter interlock terminals are connected. You may want to connect only some of the plate on and off functions. Some solid state transmitters do not have a true interlock circuit; they will not come back on when the interlock closure is restored. The appropriate plate on closure may be able to correct this.

"Plate" is a traditional term; RF on and off may apply to solid state transmitters. For most tube transmitters, plate on will start the filament delay sequence and eventually turn the transmitter on. For tube transmitters, plate off might best be connected to the filament off circuit.

## TRANSMITTER AND ANTENNA LOGIC

The controller needs to know which position the coax switches are in, to make the transmitter interlocks work correctly. Depending on the layout of the transmission lines, position 1 of either switch might be the reverse of the RF path shown on the controller front panel. The controller can easily reverse the indication and command logic of the coax switches with terminal jumpers on TB2.



Tunwall Radio 1312 Suffield Oaks Lane Suffield OH 44260 stevetunwall@tunwallradio.com 330-995-9642

If both switches are in position 1 when the controller is “normal” (TX1 on main antenna, TX2 on aux antenna), neither jumper is needed. If TX1 is connected to the main antenna when switch 1 is in position 2, reverse switch 1 with a jumper from TB2-8 to TB2-10. If the output of switch 1 is connected to the aux antenna when switch 2 is in position 2, reverse switch 2 with a jumper from TB2-8 to TB2-9. Both switches can be reversed with a 3-spade jumper connecting all 3 terminals.

## MOTOR CONTROL RELAYS

The controller is compatible with coax switches that have 120 VAC, 12 or 24 VDC motor control relays. The 12V – 24V jumper plug on the controller’s internal board switch selects between these two voltages. The DC – 120V jumper plug changes the command output wiring for DC or AC (see diagram). Only the 24VDC setting can be used with Andrew coax switches, and the polarity header must be changed.

Solenoid-type switches might be compatible with the controller but they are generally considered inferior to motorized types, so no consideration for solenoid switches was given to the controller design.

The schematic diagram indicates the Dielectric 50000 switch terminal letters. Connections for other switches are on the coax switch connections page.

## TRANSMITTER INTERLOCK CONNECTIONS

The controller’s interlock terminals are to be connected to the interlock or mute terminals of the transmitter(s). Older transmitters may not have terminals designated for this purpose, but may have connections for remote plate off. If this circuit operates with a continuous closure that holds the plate on, the controller’s interlock terminals may be wired in series with this circuit. The PLC’s transmitter interlock outputs are floating relay contacts.

The controller’s internal board includes jumper plugs to select transmitter 1 and 2 interlock logic. With the jumpers set to NO (normally open), the interlock terminals will work correctly for transmitters that require a closure to run. Most FM transmitters have close-to-run interlock circuits. With either jumper (TX 1 or TX 2) set to NC, the interlock terminals will work correctly for transmitters that require a closure to mute. Most AM and some newer FM transmitters have close-to-kill external interlock circuits. Interlock logic for transmitter 3 can be reversed by a jumper between TB2-6 and TB2-7.

The PLC relay contacts are rated for 250 VAC, 2A. It is up to the engineer’s judgment whether to bring high voltage control circuits out of older transmitters. Since the barrier strip terminals on the controller are somewhat exposed, it might be best to install low voltage relays in transmitters with high voltage controls.

## DUMMY LOAD CONNECTION

The tally terminals of your dummy load should be connected to controller terminals TB2-4 and TB2-5. The PLC has been programmed to operate correctly with a dummy load

contact closure when the blower or water is “on”. This allows an off-air transmitter to be energized, for testing on the load. When the load is off, the transmitter switched to it will be muted. Its filament and blowers should be able to operate, if it has normal external interlock terminals.

If the station’s load is a convection type, a switch for the load interlock terminals should be installed in the rack and labeled “LOAD INTERLOCK”. This way the off-air transmitter will normally not be allowed to run when no one is at the transmitter site, but it is easy to use the switch to allow load testing.

A “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. 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. Or, you might decide to leave an Altronic load disconnected from power when no one is there.

The controller is able to switch positions when the load interlock is active, but the coax switch is still protected from “hot” switching – the transmitters will be muted.

AUTO TRANSFER CONNECTIONS

This is an optional function, selected by a front panel key switch, to transfer to TX 2 if TX 1 fails.

If you are going to use AUTO mode, you may not want to connect the controller to a UPS (not that this is required in any case). Auto mode will not do anything for 5 minutes after power-on, to avoid unwanted transfers due to power interruptions (the auto mode indicator is powered by the key switch, so it comes on immediately). A UPS would keep the 5 minute delay from resetting during power interruptions.

The controller’s PLC “boots up” almost instantly when power comes on, and the controller will not output any commands during power on-off cycles.

Connections for auto transfer are made to TB3. In auto mode, to tell the controller that TX 1 is working, a TX 1 “on” signal must be provided:

> A continuous closure from floating contacts, maintained when the transmitter is running, or
>
> Continuous 5 volts DC when the transmitter is running. These terminals are not connected to ground by the controller

The Transmitter 1 ON closure or 5 volt signal can come from the transmitter, an external RF detector, some VSWR monitors, a modulation monitor, or any other device. The controller does not have an RF detector; the sample available at one station could be hundreds of times the voltage at another station. A detector that could operate reliably at any RF voltage but not be damaged by overvoltage would



Tunwall Radio 1312 Suffield Oaks Lane Suffield OH 44260 stevetunwall@tunwallradio.com 330-995-9642

be too complex and expensive to include as an option that will not be used by all stations.

The 5 volt option energizes a small single pole relay, whose NO contacts are connected in parallel with the controller's transmitter fail closure input. The current draw of the 5 volt relay is 38ma. The 5 volt relay coil has a "protection" diode, so polarity matters, and is indicated on the schematic drawing and interconnection chart. If the Transmitter 1 on closure opens, or if the 5 volt signal drops for more than 5 seconds, the controller will switch to TRANSMITTER 2 MAIN ANT. If the closure or 5 volt signal drops for less than 5 seconds and resumes, the 5 second timer resets.

**OPERATION**

From a single command, the controller operates the transmitter interlocks and switch motors in a timed sequence such that the switches are never moved with RF power applied. The transmitters are "interlocked" or muted, before the switch motors are energized. The PLC in this controller has been programmed to wait 1 second after the interlock terminals open before the coax switches will begin to move.

The 4 large front panel pushbuttons are the local controls for:

TRANSMITTER 1 MAIN ANTENNA
TRANSMITTER 2 MAIN ANTENNA
TRANSMITTER 1/2 AUX ANTENNA
TRANSMITTER 3 AUX ANTENNA

Pushing any button locks out the other 3 for the duration of the switching sequence. The two coax switches cannot be operated simultaneously. 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, 0.2 second interlock delay, and transmitter interlock(s) on.

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

After a switch sequence has been started, if the coax switch "hangs", the transmitter interlock will not be completed. This is the primary purpose of the controller, of course; preventing the coax switches from being moved under power, or having power applied when they are not in position. If a switch hangs during a transfer and is then manually moved to either position, the controller will enable the interlock(s) for the correct transmitter(s) for that combination of switch positions.

This controller is programmed to reset itself after 30 seconds, if a coax switch hangs. After the 30 second time-out, you can try the position change again, or return to the previous position. If the front panel pushbutton for the position a coaxial switch is already in is pushed, nothing will happen.

If a coaxial switch is moved manually, the related transmitter interlocks will open. This doesn't make it safe or a good idea to move a switch manually under power. If a switch is moved manually, when it "makes" either position, there will be a 0.2 second delay before the transmitter interlocks are restored.

## PLATE ON AND OFF

The term "plate" may become obsolete eventually, but most engineers will understand that it is equivalent to RF or power, or whatever terms newer transmitters may use.

No plate on or off connections are necessary. The coax switches will be fully protected if the interlock circuits are the only power controls connected.

The optional on/off connections are available on TB4, as indicated on the interconnections page. All 3 plate off closures come from a single relay, which is momentarily energized for 0.5 second at the start of any transmitter switch cycle, at the instant when interlocks open. Plate on closures are momentarily energized for 0.5 second at the end of a transfer sequence, at the same instant when interlocks are restored.

The controller's PLC has a limited number of outputs, so the plate on closures for TX1 and TX3 come from the same relay. Separate closures would be ideal but a larger PLC for this purpose alone was judged to add more to the cost of the controller than was warranted. The plate on closures are mainly to help with FM transmitters that will not come back on after their interlock circuits have been used to mute RF. This type of "interlock" function seems to be more of an "off" function than an interlock, but some transmitters work this way. The controller's momentary plate on closures may correct the problem. Since the plate on closures are not entirely separate, you may decide to connect only those needed for transmitters that won't come back on after an interlock.

The local plate on pushbutton and its remote control input will operate the TX1 – TX3 on relay, the TX2 on relay, or both, depending on coax switch positions. Because TX1 and TX3 on closures come from a common relay, this may result in an unwanted on closure in some cases.

The local plate on and off pushbuttons will operate the corresponding output closures at any time, for the duration the buttons are pushed.

## EXTERNAL ANTENNA INTERLOCKS

If the controller was ordered for use with master antennas, the remote inputs for plate on and off are instead external antenna interlocks. The front panel pushbuttons for plate on and off are either not installed or inactive. The PLC is programmed differently for external antenna interlocks, so this is not a field modification. Two antenna interlocks are available, for the main and aux antenna. When an external antenna interlock is open, the transmitter(s) connected to the corresponding antenna will be muted.

The plate on and off output closures work normally, but there is no local or remote plate on and off control.

FRONT PANEL POSITION INDICATORS

The small indicators in the front panel flow chart graphic show RF connections between transmitters and loads.

The dummy load indicator is on when the load interlock closure is closed, showing that the transmitter connected to the load is ready to run. The 4 pushbuttons for transmitter changes are illuminated, by parallel connections with the small indicators. Each of the 4 pushbutton indicators correspond to a reciprocal condition in addition to their labels:

| | | |
|---|---|---|
| TRANSMITTER 1 MAIN ANT | = | TRANSMITTER 2 LOAD/AUX ANT |
| TRANSMITTER 2 MAIN ANT | = | TRANSMITTER 1 LOAD/AUX ANT |
| TRANSMITTER 1/2 AUX ANT | = | TRANSMITTER 3 LOAD |
| TRANSMITTER 3 AUX ANT | = | TRANSMITTER 1/2 LOAD |

The additional conditions are shown by the flow chart graphic.

During a transfer sequence, the status indicators for the switch position selected will flash. If a coax switch hangs between positions, the controller will reset itself after 30 seconds, and either position can be selected for a second attempt.

All front panel indicators are solid-state. The PLATE pushbuttons are not illuminated.

REMOTE CONTROL COMMANDS

Terminals for 6 remote control command inputs are provided, that duplicate the functions of the 6 front panel position pushbutton switches, except when the local mode key switch is activated. If the controller was ordered for use with master antennas, plate on and off remote inputs are substituted for external antenna interlocks.

LOCAL MODE KEY SWITCH

The local mode key switch can be used to lock out remote control commands. The front panel pushbuttons work in local mode.

The LOCAL and AUTO switches use the same key, which can be removed from either switch in either position.

AUTO TRANSFER

This is a key switch selected option that is only active in TRANSMITTER 1 MAIN ANT. There is a rear panel indicator, TX 1 PLT ON, that can be used to verify the “ON” signal before turning the AUTO key switch. Auto mode is not active for 5 minutes after power-on, to help avoid unwanted transfers due to power

interruptions (the auto mode indicator is powered by the key switch, so it comes on immediately). Auto mode is also inactive for 1 minute after switching to TRANSMITTER 1 MAIN ANT, to provide time to get it running before another transfer occurs if switching by remote control.

When in TRANSMITTER 1 MAIN ANT, turn the AUTO key switch to the right to engage automatic transfer. The transmitter 1 “on” signal has been connected to the transmitter fail closure terminals, according to the AUTO MODE CONNECTIONS section. If the transmitter 1 “on” signal fails for 5 seconds, the controller will switch to TRANSMITTER 2 MAIN ANT.

FUSES

The 1/2 DC fuse 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 switches. Most coax switch motors are rated 1A, max inrush approximately 3A. Only one coax switch will move at a time, so 3A should be sufficient. Some coax switches are not powered by the controller. Larger fuses can be used, at your judgment, if you have problems. Internal AC wiring is 18ga.



Tunwall Radio 1312 Suffield Oaks Lane  Suffield OH 44260 stevetunwall@tunwallradio.com  330-995-9642

# TRC-2

INPUT AND OUTPUT CONNECTIONS MARKED WITH LETTERS ARE TO DIELECTRIC 50000 SWITCH. OTHER SWITCHES MAY BE USED.

= TB1, TB2 etc

= AMP CONNECTOR

NEUTRAL
GROUND
LINE
3A AC FUSE
POWER CORD

DC POWER SUPPLY
L N G + -
1A DC FUSE
POWER IND

P1-8 B
P1-9 A
P2-8 B
P2-9 A

FRONT PANEL PUSHBUTTONS

TB
1-7 TX1 MAIN ANT SEL
1-8 TX2 MAIN ANT SEL
1-9 TX1/2 AUX ANT SEL
1-10 TX3 AUX ANT SEL
1-6

**FPO BASE**

INPUT 0
INPUT 1
INPUT 2
INPUT 3
INPUT 4
INPUT 5
INPUT 6
INPUT 7
INPUT COM

OUTPUT 0 SW1 POS 1 CMD P1-5 C
OUTPUT 1 SW1 POS 2 CMD P1-6 N P1-7 D
OUTPUT 2 SW2 POS 1 CMD P2-5 C P2-6 N
OUTPUT 3 SW2 POS 2 CMD P2-7 D
COM 0
COM 4
OUTPUT 4
COM 5
OUTPUT 5

**COAX SWITCHES**

P1-1 R SW1 POS1
P1-2 S
P1-3 M SW1 POS2
P1-4 L
P2-1 R SW2 POS1
P2-2 S
P2-3 M SW2 POS2
P2-4 L

COAX SWITCH POSITION INDICATOR CONTACTS

NC NO
K6 INTLK TX1
K7 INTLK TX2
NC NO

TB
3-1
3-2
4-1
4-2
TO TRANSMITTERS

POLARITY
DC 120 V
LOCAL MODE
COAX SWITCH VOLTAGE SELECTOR
7812
24V 12V
DIELECTRIC
ANDREW

FRONT PANEL STATUS INDICATORS

EACH IS X3; A PAIR OF POSITION INDICATORS AND AN ILLUMINATED PUSHBUTTON

**FPO EXP**

TB
2-4 LOAD INTLK
2-5 LOAD INTERLOCK
2-8
2-9 REVERSE SW 2
2-10 REVERSE SW 1
2-6
2-7 TX 3 REVERSE INTLK
3-7 TX1 PLT ON
3-8 TX1 ON
3-9
3-10
2-1
2-2 PLATES ON/ ANTENNA 1
2-3 PLATES OFF/ ANTENNA 2

AUTO MODE
LOAD INTERLOCK
K5

INPUT 20
INPUT 21
INPUT 22
INPUT 23
INPUT 24
INPUT 25
INPUT 26
INPUT 27
INPUT COM

OUTPUT 20 TX 1 MAIN ANT STATUS DS1 1-2
OUTPUT 21 TX 2 MAIN ANT STATUS DS2 1-3
OUTPUT 22 TX 1/2 AUX ANT STATUS DS3 1-4
OUTPUT 23 TX 3 AUX ANT STATUS DS4 1-5
STATUS COM 1-1

TB
TO REMOTE CONTROL

OUTPUT 24 K1
OUTPUT 25 K2
2DK1 2DK2
OUTPUT 26 K3
OUTPUT 27 K4
COM

TX 1 PLATE ON 3-3
TX 1 PLATE ON 3-4
TX 3 PLATE ON 4-9
TX 3 PLATE ON 4-10
TX 2/AUX PLATE ON 4-3
TX 2/AUX PLATE ON 4-4
TX 3 INTERLOCK 4-7
TX 3 INTERLOCK 4-8
TX 1 PLATE OFF 3-5
TX 1 PLATE OFF 3-6
TX 2 PLATE OFF 4-5
TX 2 PLATE OFF 4-6
TX 3 PLATE OFF 4-11
TX 3 PLATE OFF 4-12

OPTIONAL EXTERNAL ANTENNA INTERLOCK CONFIGURATION

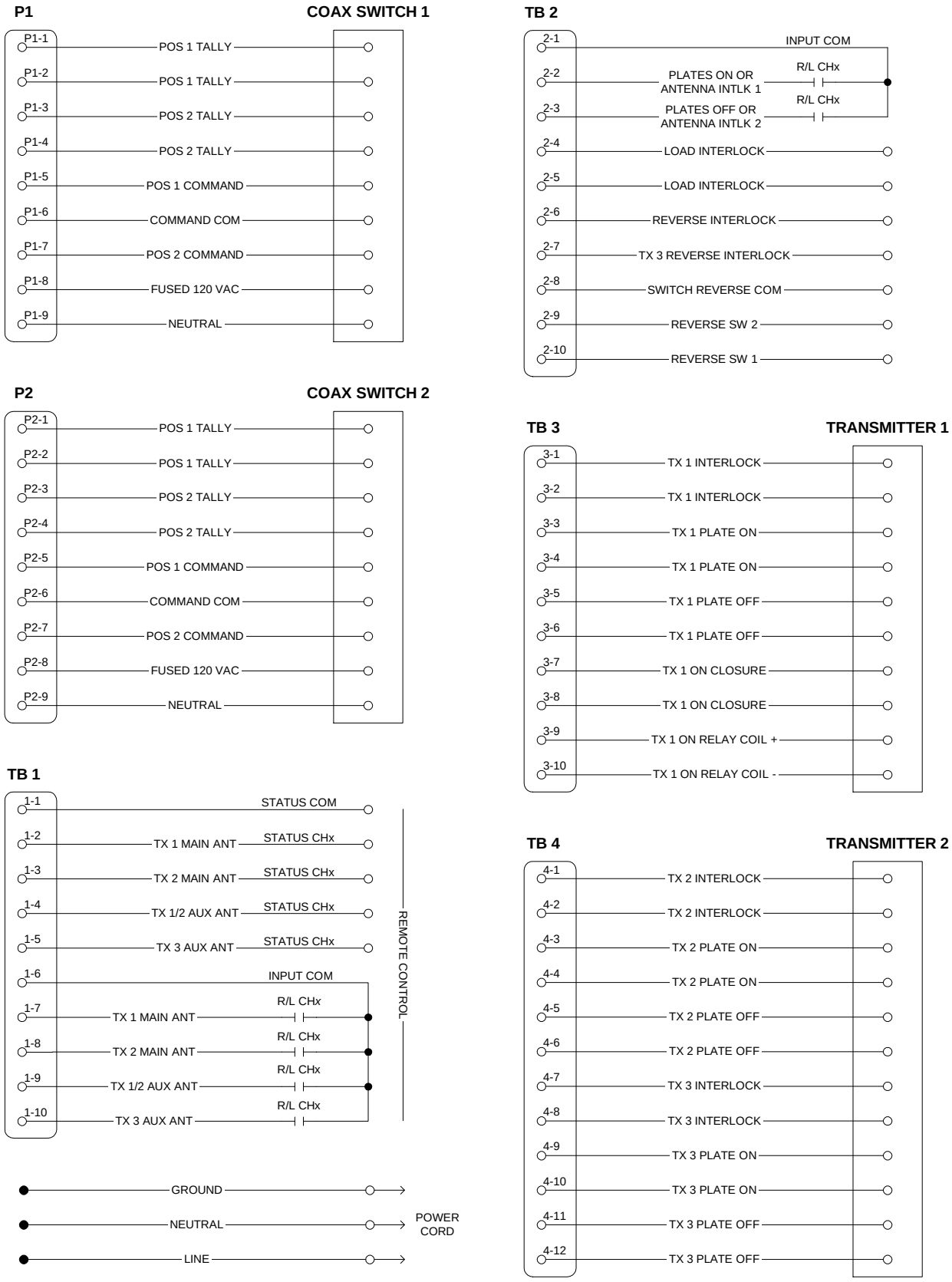
THE FRONT PANEL PUSHBUTTONS ARE CONNECTED AS SHOWN AT RIGHT, AND PLC INPUTS 26 AND 27 BECOME EXTERNAL ANTENNA INTERLOCKS. AN ALTERNATE PLC PROGRAM IS REQUIRED. THIS IS NOT A FIELD MODIFICATION.

ALT PLT ON
ALT PLT OFF

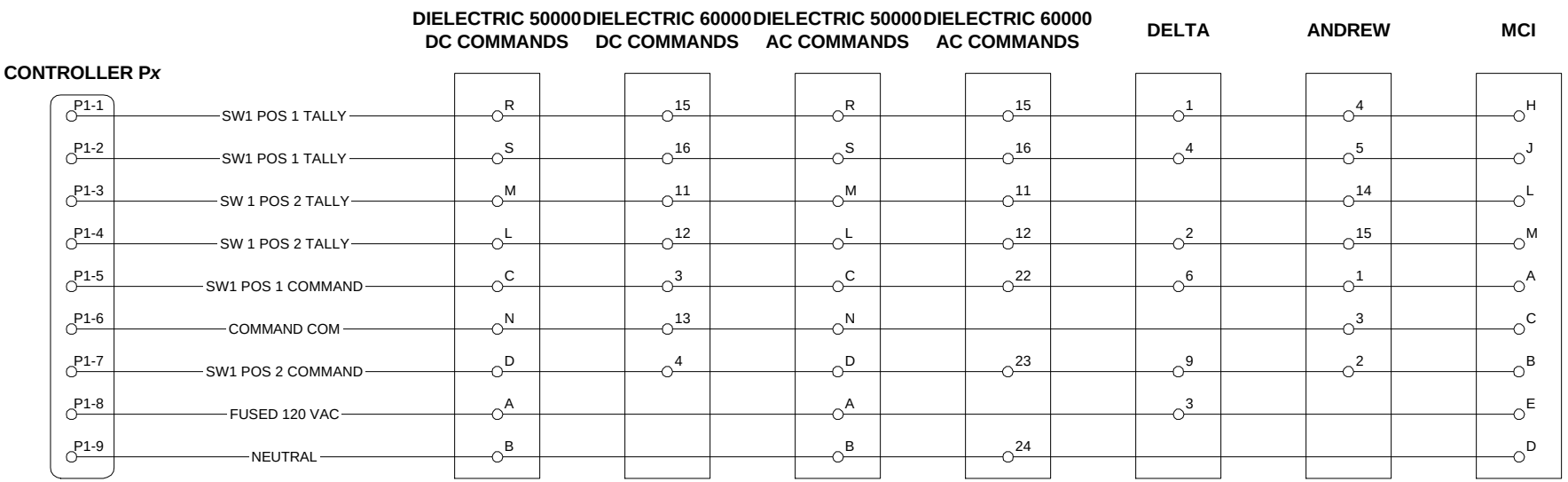
| TUNWALL RADIO LLC | | | |
|---|---|---|---|
| TRC-2 | | | |
| | 2-SWITCH FM CONTROLLER | REV JAN 2008 | SHEET 1 0F 1 |
| DRAWN BY | S. TUNWALL | | |

# TRC-2

## INTERCONNECTION CHART



# COAX SWITCH CONNECTIONS FOR FM CONTROLLERS




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

# TRC-2 LOGIC TABLES

SWITCH POSITION AND TRANSMITTER INTERLOCK LOGIC

--CAN ALSO BE USED AS COMMAND LOGIC TABLES--

SWITCHES ARE ALL WIRED THE SAME; THE CONTROLLER IS SET TO REVERSE COAX SWITCH FUNCTIONS AS NEEDED

RUN = INTERLOCK TERMINALS CLOSED, TRANSMITTER ENABLED

MUTE L = MUTE, BUT TRANSMITTER ENABLED WHEN LOAD IS ON

YELLOW FILL = PLATE ON CLOSURES

NORM

| | SWITCHES | | TX 1 | TX 2 | TX 3 |
|---|---|---|---|---|---|
| TX1 MAIN ANT | SW1 POS1 | SW2 POS1 | RUN | RUN | MUTE L |
| TX2 MAIN ANT | SW1 POS1 | SW2 POS2 | RUN | MUTE L | RUN |
| TX 1/2 AUX ANT | SW1 POS2 | SW2 POS1 | RUN | RUN | MUTE L |
| TX3 AUX ANT | SW1 POS2 | SW2 POS2 | MUTE L | RUN | RUN |

REVERSE SW1

| | SWITCHES | | TX 1 | TX 2 | TX 3 |
|---|---|---|---|---|---|
| TX1 MAIN ANT | SW1 POS2 | SW2 POS1 | RUN | RUN | MUTE L |
| TX2 MAIN ANT | SW1 POS2 | SW2 POS2 | RUN | MUTE L | RUN |
| TX 1/2 AUX ANT | SW1 POS1 | SW2 POS1 | RUN | RUN | MUTE L |
| TX3 AUX ANT | SW1 POS1 | SW2 POS2 | MUTE L | RUN | RUN |

REVERSE SW 2

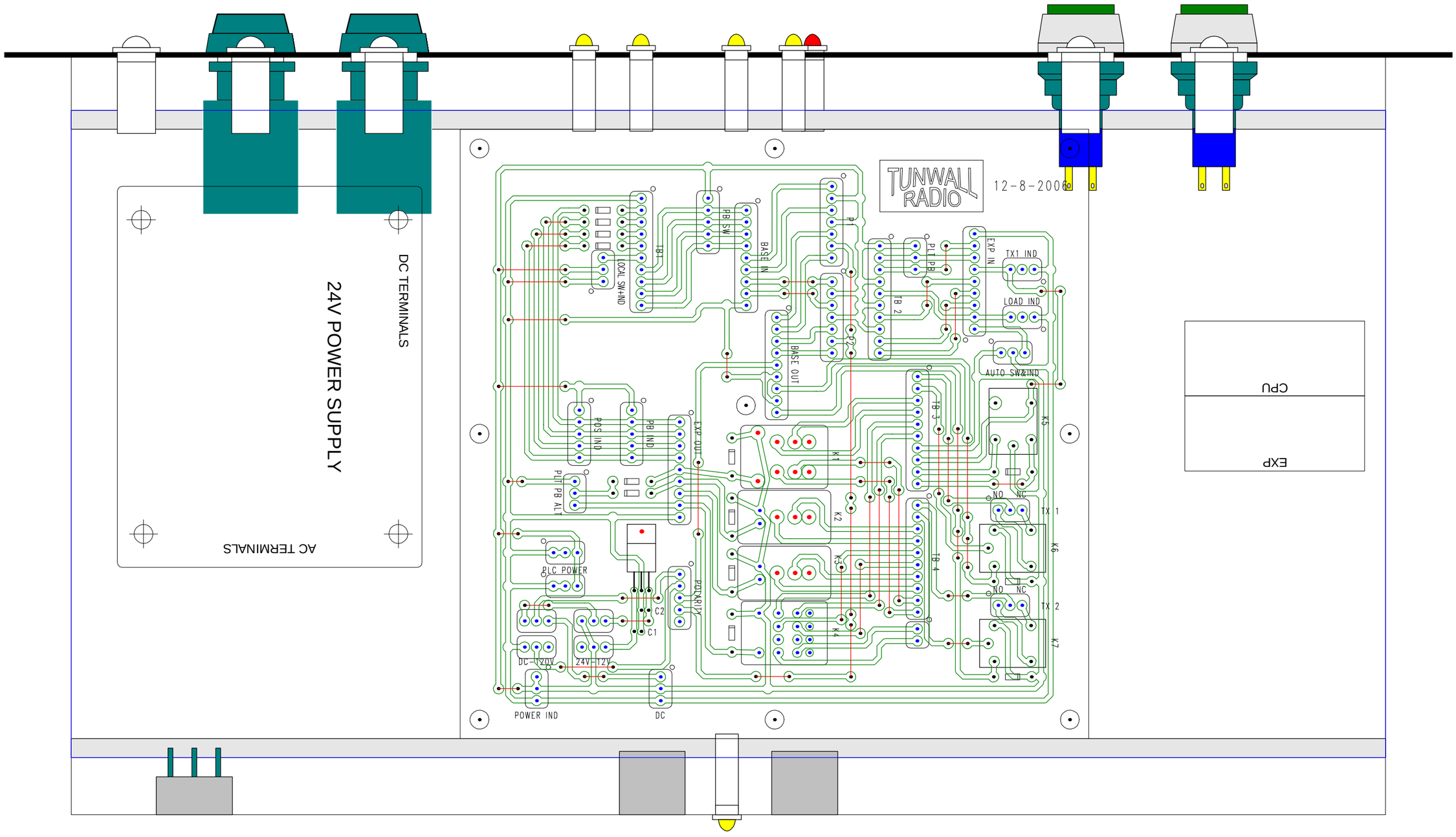
| | SWITCHES | | TX 1 | TX 2 | TX 3 |
|---|---|---|---|---|---|
| TX1 MAIN ANT | SW1 POS1 | SW2 POS2 | RUN | RUN | MUTE L |
| TX2 MAIN ANT | SW1 POS1 | SW2 POS1 | RUN | MUTE L | RUN |
| TX 1/2 AUX ANT | SW1 POS2 | SW2 POS2 | RUN | RUN | MUTE L |
| TX3 AUX ANT | SW1 POS2 | SW2 POS1 | MUTE L | RUN | RUN |

REVERSE SW 1 SW 2

| | SWITCHES | | TX 1 | TX 2 | TX 3 |
|---|---|---|---|---|---|
| TX1 MAIN ANT | SW1 POS2 | SW2 POS2 | RUN | RUN | MUTE L |
| TX2 MAIN ANT | SW1 POS2 | SW2 POS1 | RUN | MUTE L | RUN |
| TX 1/2 AUX ANT | SW1 POS1 | SW2 POS2 | RUN | RUN | MUTE L |
| TX3 AUX ANT | SW1 POS1 | SW2 POS1 | MUTE L | RUN | RUN |

TUNWALL RADIO

# TRC-2
# COMPONENT LAYOUT




TUNWALL
RADIO
RADI