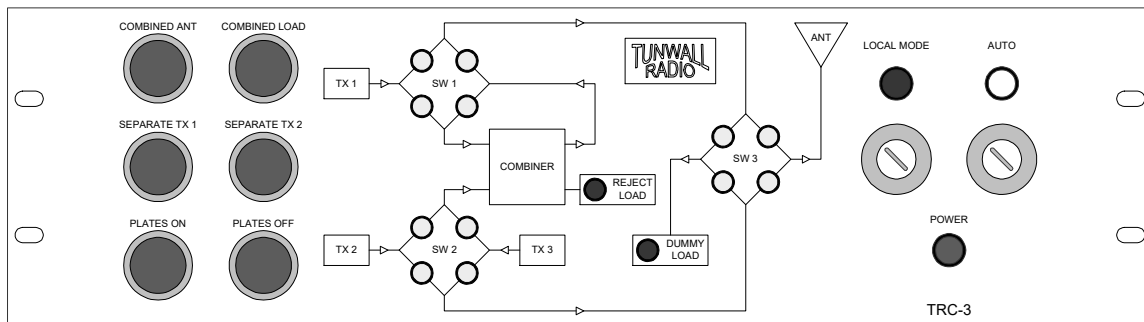


330-995-9642



TRC-3

INSTALLATION AND SERVICE MANUAL

Rev Sept 2007



TRC-3-general -----	2
PLC (programmable logic controller) -----	2
CONNECTIONS -----	3
Coax switch connections -----	3
Remote control connections -----	4
Coax switch reverse jumpers -----	4
Transmitter interlock connections -----	5
Transmitter 2 analog/digital connections -----	5
Dummy load connection -----	6
Plates on/off connections -----	6
Auto transfer connections -----	7
Optional connections -----	7
Reject load interlock connection -----	8
OPERATION -----	8
Antenna system modes -----	9
Illuminated pushbuttons -----	9
Plates on/off -----	9
Auto transfer key switch -----	9
Remote control commands -----	10
Local key switch -----	10
Fuses -----	10
Command polarity -----	10
Controller schematic diagram -----	11
Interconnection chart -----	12
Coax switch wiring charts -----	13
Front panel indicator combinations -----	14
Logic tables -----	15
Component layout -----	16
Dielectric 50000 series switch manual -----	1-7
Dielectric 60000 series switch manual -----	1-10
Appendix A "FM Control system Principles" -----	3 pages

IF THE CONTROLLER WILL NOT ALLOW TRANSMITTERS TO RUN IN COMBINED MODES, CHECK THAT THE REJECT LOAD INTERLOCK (TB6, PINS 1 AND 4) HAS A JUMPER OR IS CONNECTED TO THE LOAD.

IF THE CONTROLLER WON'T MOVE THE COAX SWITCHES, CHECK THAT THE TRANSMITTER OFF TALLIES (TB6, PINS 5 AND 9 TO PIN 1) HAVE JUMPERS OR ARE CONNECTED TO THE TRANSMITTERS.

TRC-3 3-SWITCH FM CONTROLLER

This is a controller for three coaxial switches, two or three transmitters, one antenna, combiner, and a dummy load. It was designed for Dielectric 50000 and 60000 series coax switches but will also work with others. All connections are either made to barrier strip terminals or 9-pin AMP connectors on the back panel.

The controller has no memory of what the coax switch positions were the last time it was on. It will not move coax switches when powered on. If the coax switches are in a valid combination of positions, the controller will enable the appropriate transmitter interlocks. If any coax switches are between positions when the controller is powered on, it will not do anything, but any local or remote command will move all switches to the correct positions.

PLC (PROGRAMMABLE LOGIC CONTROLLER)

This is a PLC-based controller. All functions are controlled by a NAIS FP0-C14RS programmable logic controller, with 3 FP0-C16RS expansion modules. 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 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.

No knowledge of PLC programming is needed to install and use the 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 PLC and expansion unit in this controller have opto-isolated electronic logic inputs, and relay contact outputs. All controller inputs are configured for contact closure equipment (such as a Burk ARC-16 remote control with IP-8 relay panels).

COAX SWITCHES AND CONTROLLERS

If you're not familiar with FM control systems, or coax switches and their control and status signals, Appendix A "FM Transmitter Control Systems General Terms and Principles" may be of interest.

CONNECTIONS

Barrier strip terminals are provided for transmitter and remote control connections. All barrier strip terminals are max 24VDC.

Coax switch connections are made to 9-pin AMP connectors, which use the same pins as Dielectric 60000 switch connectors. The 9-pin connectors can be installed with several types of pin crimpers commonly used in studio console projects. One suitable tool is Paladin 1645, Newark part #97B3917. Pin 8 of the AMP connector is 120VAC "hot" and pin 9 is AC neutral, used for the motors in 50000 switches. 60000 switches get AC power from a separate power cord.

A wiring chart is provided for convenience of installation. If non-Dielectric switches are to be used, connections from representative switch manuals are shown on the coax switch connection chart following the schematic diagram and interconnections pages. Wiring variations in non-Dielectric coax switches, even of the same model number, have been found. Some have internal control relays or not, some have 120V neon indicators or not, and any connections may be different. If the original documentation for your switch is not available, the internal connections should be verified before connection to the controller.

Power for the controller can be connected to a UPS, at the engineer's discretion. The PLC is powered by a switching DC supply that does not usually require protection from transients, or high line voltage – it is designed to operate from up to 250 volts AC. The need for lightning protection is a local decision. The auto transfer function includes a 5 minute power-on delay, to avoid unwanted transfers due to power interruptions. The power-on delay would not work if the controller is powered by a UPS.

COAX SWITCH CONNECTIONS – POSITION TALLY CLOSURES

The controller needs to know what position the coax switches are in. Pins 1-4 of AMP connectors P1 to P3 are for the coax switch tallies. Each coax switch cable is identical, and combinations of switch positions are handled by coax switch reverse jumpers, described in the jumper section below.

COAX SWITCH CONNECTIONS - MOTOR CONTROL RELAYS

The controller is compatible with coax switches that have 120VAC, 12VDC or 24VDC motor control inputs/relays. Position change commands are on pins 5-7 of AMP connectors P1 to P3. With 120VAC motor control relays in a 50000 switch, no connection is needed to pin 6. Two internal jumpers on the interconnection board change the command output wiring between 12VDC, 24VDC and 120VAC.

For 120VAC relays in 50000 switches only – the Dielectric switch schematic does not exactly match the TR controller diagram. The controller reverses AC line and neutral connections, so that neutral is switched through the controller's output terminals instead of line. This way, if the controller's internal voltage select switches are set to 120VAC by mistake, DC relay coils or inputs will not be destroyed. The AC motor in the 50000 switch does not know the difference. 7/8" 50000 switches have DC motors but since they are powered by AC through a transformer and rectifier circuit, this should not matter.

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.

Some Dielectric 50000 switches were shipped with 110VDC relays. These will not work with the controller. In this case you would need to get 12 or 24VDC (or 120VAC) relays, either from Dielectric or from a parts supplier. A (very) few switches may have a 240–120V step-down transformer, which would have to be removed to use the controller.

The schematic diagram page indicates the 50000 switch terminal letters, in blue. The interconnection page shows connections for the 60000 switch. The coax switch connection chart following these two pages shows connections for several other coax switches.

REMOTE COMMAND CONNECTION

Controller terminals TB1-6 to TB1-10 and TB2-1 to TB2-3 are the remote position select and remote plates on/off connections. Floating relay contacts are best, such as the Burk IP-8, but open collector equipment may be used if it is compatible with positive common wiring.

REMOTE STATUS CONNECTION

The remote control status outputs are connected through diodes to the front panel illuminated pushbuttons. Even though there are multiple PLC expansion modules in the controller, there are a limited number of outputs, not enough for separate local and remote status circuits. The diodes keep the front panel illuminated pushbutton indicators from lighting through the remote control's pull-up resistors. This status circuit has been used in hundreds of controllers so far, without any reports of a problem.

The remote control status outputs are compatible with most remote control systems, Burk as an example. The Burk ARC-16 documentation states that the 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 ground. The PLC output relays cause terminals TB1-2 to TB1-5 (TB1-1 common) to go near ground when a remote status indication is on.

The remote status outputs follow the 4 system modes; Combined Antenna, Combined Load, etc., not the switch position indicators in the front panel flow chart.

COAX SWITCH REVERSE JUMPERS

Coaxial switch ports are usually connected to transmitters, antennas, and load according to the physical layout of the equipment and building, rather than arbitrary port number assignments. This can result in different combinations of switch positions for the 4 antenna system modes (Combined Antenna, etc). Rather than wiring switch cables backward when their ports don't match a fixed controller design, the controller can reverse the front panel indicators, transmitter interlock logic, plate on/off logic, and switch position commands by connecting jumpers on the controller back panel.

“Normal” (no reverse jumpers needed) is when all 3 coax switches are in their position 1 when the antenna system is in Combined Antenna mode. If any or all of the coax switches are in their position 2 for Combined Antenna mode, connect a corresponding jumper(s) to the appropriate terminals on TB2 terminals 6-10. Refer to the schematic diagram page on the left side to determine which of these jumpers are needed. TB2-6 and TB2-7 are both +24V common.

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The 4 antenna system modes are:

- Combined Antenna
- Combined Load
- Separate TX 1
- Separate TX 2

Each of these modes mean two things. The 4 front panel indications (illuminated pushbuttons) and remote status closures could be labeled:

- Combined Antenna, TX 3 on Load
- Combined Load, TX 3 on Antenna
- Separate TX 1 on Antenna, TX 2 on Load
- Separate TX 2 on Antenna, TX 1 on Load

...but room on the front panel for labeling is limited. The antenna system mode needed for load testing and TX 3 on antenna can be easily seen with the front panel graphic display.

It doesn't matter if your system has a third transmitter or not. If #3 is added later, the logic and control is programmed into the controller.

The 3 coax switches have 8 position combinations (for any combination of reverse jumpers or none) but only 4 are used or valid. The 4 valid switch position combinations allow all transmitters to get where they need to go, so there are 4 switch combinations that are ignored, as shown on the logic table page. If the switches are manually moved to one of the ignored switch combinations, the controller will not allow any transmitter to run. A valid antenna system mode can be restored with any local or remote command, no matter what positions the switches have been moved to.

TRANSMITTER INTERLOCK CONNECTIONS

The controller's interlock terminals are to be connected to the interlock or mute terminals of the transmitters. Older transmitters may not have terminals designated for this purpose, but may have connections for remote plate off. If such a 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 transmitter interlock outputs are normally close-to-run, but jumpers on TB6 can reverse the interlock logic (to open-to-run) for each transmitter individually.

Transmitter interlock and plate on/off terminal numbers are shown on the Interconnection page, following the schematic diagram.

The PLC relay contacts are rated for 220 VAC. It is up to the engineer's judgment whether to bring high voltage control circuits out of older transmitters. Since the transmitter control connections are barrier strips, low voltage is better if possible.

TRANSMITTER 2 ANALOG / DIGITAL CONTROL CONNECTION

Whenever the system is in Separate TX 2 mode, the analog/digital control relay is energized, and terminals TB5-3 (com) and TB5-1 (analog) will be closed. Analog may mean a composite digital-and-analog transmitter mode. When the system is not in Separate TX 2 mode, the relay is not

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energized, and terminals TB5-3 (com) and TB5-2 (digital) will be closed. Although the TX 2 control board may be intended to operate from momentary closures, most transmitter control circuits will work properly with continuous interface closures, and not be damaged. For a function like analog/digital, it is usually best to use continuous closures, to lock the function to the antenna system's operational mode. If the continuous closures are determined to be a problem, an external conversion to a momentary signal will have to be devised.

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 the transmitter not on-air to be energized, for testing on the load. When the load is off, the transmitter(s) switched to it will be muted. Filament and blowers should be able to operate, with most transmitters.

If the station's load in a convection type, a switch should be installed in the rack and labeled "Load Interlock". This way the off-air transmitter(s) 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 in series with the load tally contacts might be desirable for Altronic fan loads, due to the nature of their tally contact operation. Altronic tally contacts close any time the load is connected to power. Altronic loads turn on their fans when the load heats up, which protects the load resistors, but the unwanted heat that might result from an accidental plate on command to an off-air transmitter might be a problem for some transmitter buildings. As an alternative, some engineers unplug their Altronic loads when finished with load testing.

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.

There is a front panel load ready indicator, in the flow chart graphic.

PLATE ON / OFF CONNECTIONS

"Plate" is traditional; RF on/off or similar is becoming more common. These are floating relay contacts, which should work with any transmitter.

There are no separate filament on/off terminals. For most tube transmitters, a cold plate on is not a problem. If the transmitter's internal control circuits are working correctly, the plate supply will not be turned on until the filament delay runs out.

The plate off terminals might be connected to the filament off terminals of a tube transmitter, if you want the filament and blower to shut down when the transmitter is switched off-air. If the transmitter's internal control circuits are working correctly, the plate will turn off immediately, and the filament time-out will cycle before the blower is turned off. A possible disadvantage to connecting plate off to the filament off circuit is that a transfer from Combined Antenna to a separate mode might cause a filament warm-up delay before getting back on-air.

If all of the plate on and plate off closures are connected to your transmitters, the system may be more automatic than you would like. If you don't plan to use AUTO transfer, you may not want to connect any of the plate control closures. Or, connect just the closures you want. Terminals for plate on/off control are shown on the schematic and interconnection pages.

AUTO TRANSFER CONNECTIONS

This is an optional function, selected by a front panel key switch, to transfer to a separate transmitter if a combined transmitter fails. Details on the auto transfer sequence are explained in the OPERATION section.

Connections related to auto transfer are made to TB3-7 to TB3-10 and TB4-7 to TB4-10. With auto transfer on, to tell the controller that TX 1 and TX 2 are working, a fail signal for each transmitter 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, which is not connected to ground by the controller

The 5 volt option energizes a small single pole relay, whose NO contacts are connected in parallel with the controller's transmitter fail closure inputs. The current draw of the 5 volt relay is 38ma. The 5 volt relay coils have "protection" diodes, so polarity matters, and is indicated on the schematic drawing and interconnection chart. One transmitter (or RF detector, etc.) can provide a closure and the other can use 5 volts, whichever is available. If a transmitter's fail closure opens, or if the 5 volt signal drops, the controller will switch the other to the antenna. If both transmitters' on signals drop at the same time, the controller won't do anything.

The closure or 5 volts can come from the transmitter or any other device such as a Bird Wattcher or suitable modulation monitor.

If you only want one transmitter transfer to be allowed, e.g. only TX 1 can be on the antenna by itself, then jumper the TX 2 fail terminals, so it can never "fail".

TRANSMITTER OFF TALLIES

The controller can be configured so that coax switches will not be moved without "off" closures from transmitters 1 and 2. Most transmitters would require modification or the addition of a relay or equivalent device. If transmitter off tallies are not used, jumper connections are required between TB6-1 (common) and TB6-4 and TB6-5 or the coax switches will not move. There is no off tally connection for transmitter 3.

REMOTE MUTE ALL CONNECTION

TB6-2 (TB6-1 common) is an optional connection for a closure to mute all transmitters at any time.

REMOTE AUTO KILL CONNECTION

Described in more detail in the AUTO transfer operation section. TB6-3 (TB6-1 common) is an optional connection to get out of Separate TX 1 or 2 after a transmitter failure and automatic transfer, by remote control.

REJECT LOAD INTERLOCK CONNECTION

If the reject load has an overheat tally contact that opens on overheat, it can be connected between TB6-1 (common) and TB6-9, to shut down transmitters 1 and 2 in combined modes. The reject load interlock has no effect in separate modes. There is no timeout; transmitter interlocks will close immediately when the reject load interlock is restored. If the reject load interlock is not used, a jumper is required between TB6-1 (common) and TB6-9, or transmitters 1 and 2 will not run in combined modes.

OPERATION

From a single local or remote 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. Other functions include optional automatic transmitter transfer in case of failure, plate on and off control, and transmitter load testing.

ANTENNA SYSTEM MODES

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

- Combined Antenna
- Combined Load
- Separate TX 1
- Separate TX 2

Pushing any of these buttons will lock out the other 3 for the duration of the switching sequence. The switching sequence is: transmitter interlock connections open and plates off; a short delay to let the transmitters' plate supplies discharge; coax switch operation (as long as it takes up to 30 seconds); at completion of switch movement, interlock on delay, 0.2 second (to let the coax switch settle mechanically, in case the coax switch tally signal is slightly ahead of the absolute end of travel); 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. In local, only the front panel pushbuttons are active.

After a switch sequence has been started, if the coax switch “hangs”, the transmitter interlocks will not be closed. This is the primary purpose of the controller, of course; preventing the coax switches from being moved under power. 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) if the combination of switch positions is valid.

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 antenna system mode presently in use is pushed, nothing will happen.

If a coaxial switch is moved manually, the 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, if the switch position combination is valid.

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ILLUMINATED PUSHBUTTONS

The first 4 pushbuttons are illuminated, and show the antenna system mode in use:

- Combined Antenna
- Combined Load
- Separate TX 1
- Separate TX 2

Only one of these indicators will be on at a given time. During a transfer sequence, the status indicator for the selected mode will flash. The remote control status outputs flash along with the illuminated pushbuttons. If a coax switch hangs between positions, the controller will reset after 30 seconds, and none of these 4 indicators will be on. After the reset, the failed mode can be selected again, or any of the others. All front panel indicators are solid-state.

PLATE ON/OFF

If all plate on and off terminals are connected, the control system is fully automatic – for any antenna system command, the transmitter plates will all be turned off, and at the end of the switching sequence, the appropriate transmitters will be turned on. The AUTO key switch has no effect on the plate on/off command outputs.

In local, plate on/off are front panel-only functions, but plates are still all turned off automatically by any change sequence. You can connect the plate on or off commands you want to use, or none at all. The plates on and plates off pushbuttons will turn plates on and off for the transmitters active in any of the antenna system modes; e.g. in Combined Antenna, TX 1 and TX 2 will be turned on and off. If the load is running in combined modes, all 3 transmitters will be turned on. There are remote control terminals for Plates on/off.

AUTO TRANSFER KEY SWITCH

This is a key switch selected option that is only active in Combined Antenna, and it only applies to transmitters 1 and 2. The key switch illuminates the indicator, so although auto transfer is inactive in other antenna system modes, the indicator is on whenever the key switch is in the right position. The AUTO option does not work in local. There are two rear panel indicators, TX 1 and TX 2, that can be verified before turning the AUTO key switch. Auto transfer is not active for 5 minutes after power-on, to help avoid unwanted transfers due to power interruptions.

When in Combined Antenna, turn the AUTO key switch to the right to engage automatic transfer. TX 1 and TX 2 transmitter “on” signals have been connected to the transmitter fail closure terminals, according to the AUTO TRANSFER CONNECTIONS section. If either transmitter’s on signal fails for 5 seconds, the controller will switch to the separate mode for the other transmitter. The sequence is the same as if a front panel transmitter change button was used, except that the separate mode’s front panel pushbutton light and remote control output will keep flashing. If both transmitters fail at the same time, the controller won’t do anything.

The TX 2 analog/digital relay switches to analog whenever Separate TX 2 mode is active, whether it was selected manually or automatically.

Following an auto transfer, none of the local or remote mode change commands will do anything until auto transfer has been reset. Auto transfer can be reset by turning the key switch

off. Auto transfer can also be reset by remote control. Terminals for this are covered in the auto transfer connections section. If auto transfer is reset by remote control, the flashing indicator and corresponding remote control output will stop flashing, and the mode change commands are ready. If a mode other than Combined Antenna is selected next, the auto transfer key switch is ignored.

If, after an auto transfer and remote reset, Combined Antenna is selected, you have 60 seconds after the change, plus the 5 seconds failure time, to get both TX 1 and TX 2 running or the controller will transfer to a separate mode again. The 60 seconds does not start until you switch to Combined Antenna mode.

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 key switch is activated. The front panel pushbuttons operate in local.

LOCAL KEY SWITCH

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

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

FUSES

The front panel DC fuse is on the output of the 24V power supply. 1A should be a good value for this. The AC fuse is in series with the "hot" lead for the entire controller, and the AC power for Dielectric 50000 series coax switches. If no coax switches are powered by the controller, the AC fuse can be about 1A. If 50000 coax switches are used, the AC fuse should be about 3A per switch, since all coax switches will move simultaneously sometimes. Although the AC fuse holder may be labeled 3A, larger or slow-blow fuses can be used at the engineer's judgment. The internal AC wiring is 18ga, good for at least 10A. The 50000 switch specifications state that the motor inrush current is 3.5A, and the running current is 0.5A.

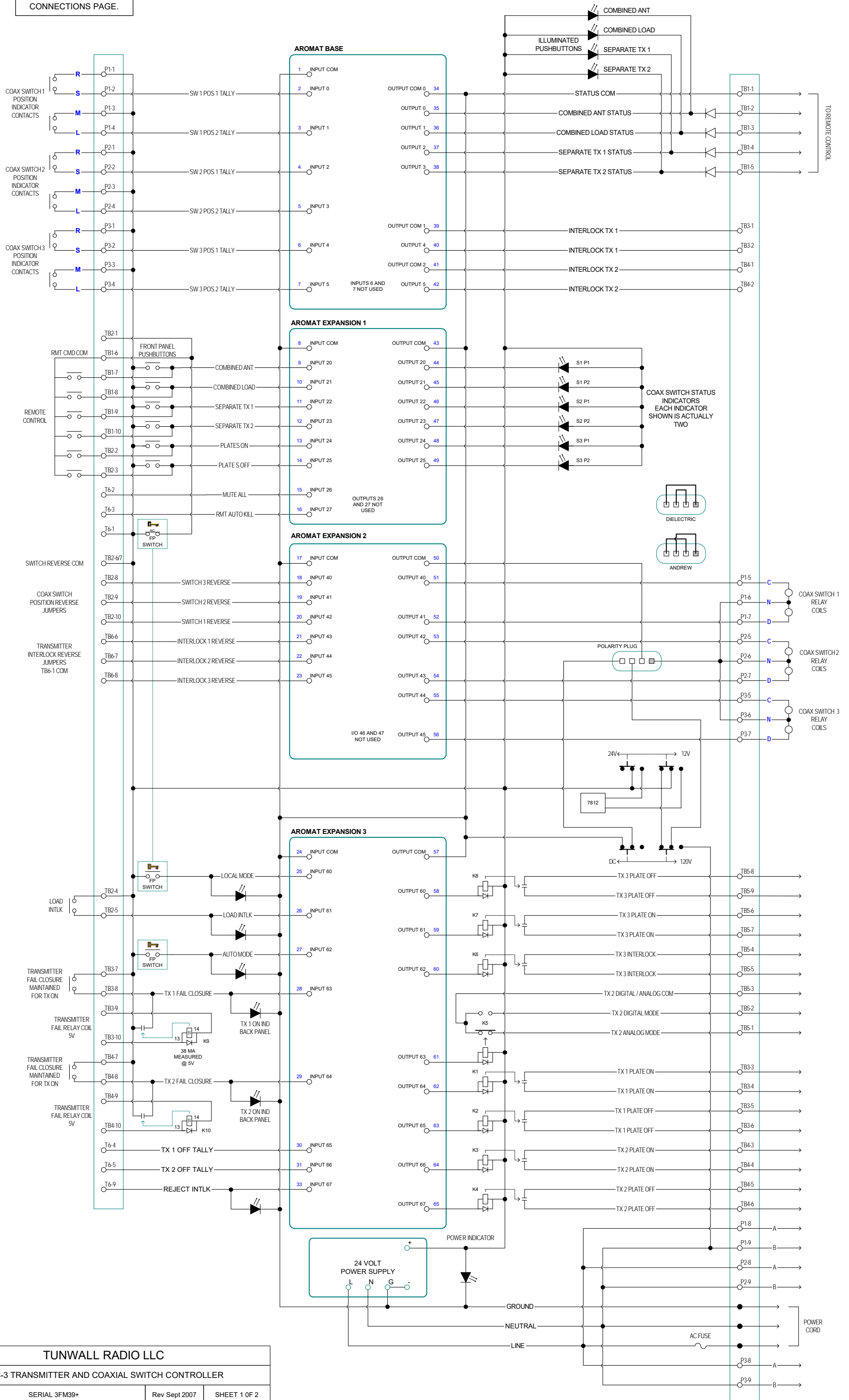
COMMAND POLARITY

The header plug labeled "polarity" on the interconnect board is to reverse DC polarity for Andrew/ERI coax switches. The Dielectric configuration shown on the schematic diagram is used for any switch other than Andrew/ERI, as of the time this manual was assembled.

INPUT AND OUTPUT CONNECTIONS MARKED WITH LETTERS ARE TO DIELECTRIC 50000 SWITCH. FOR 60000 OR OTHER SWITCHES, SEE THE CONNECTIONS PAGE.

TRC-3 3-SWITCH TRANSMITTER AND COAXIAL SWITCH CONTROLLER

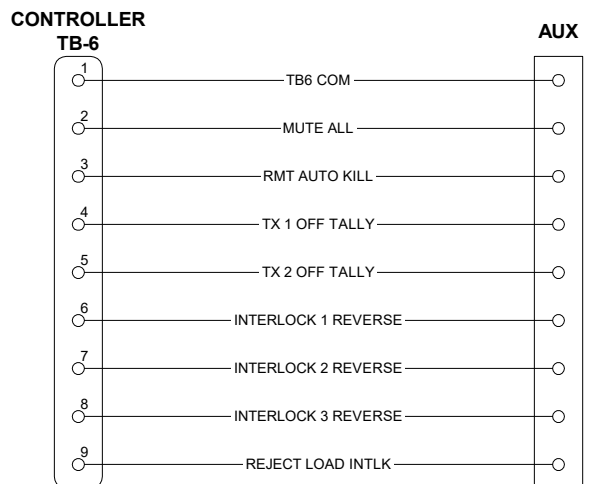
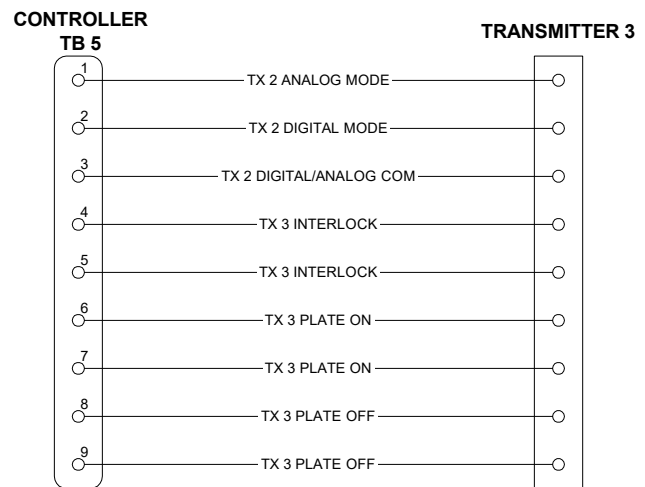
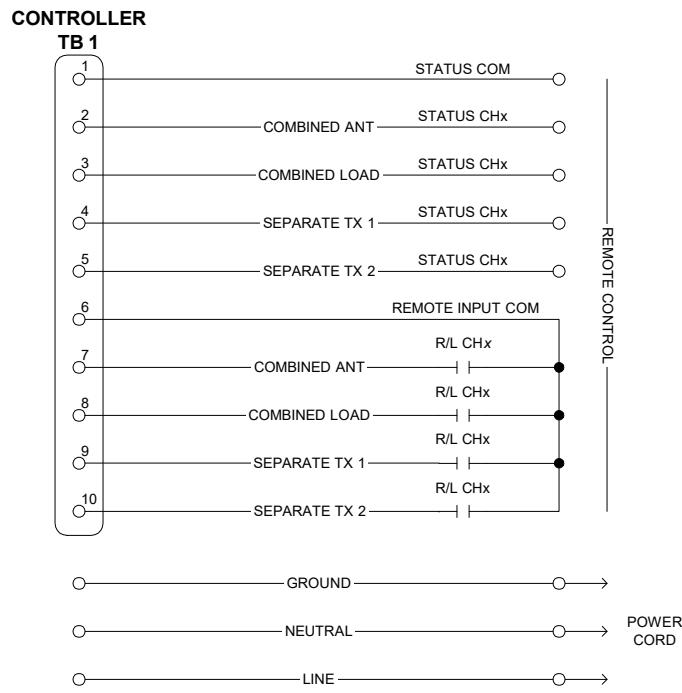
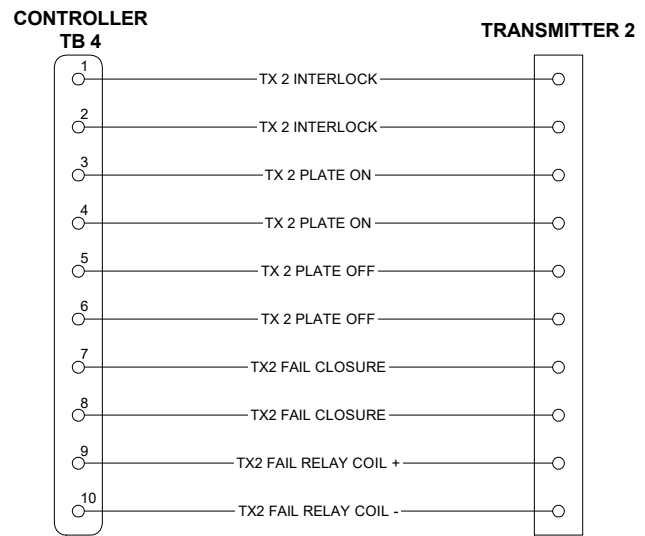
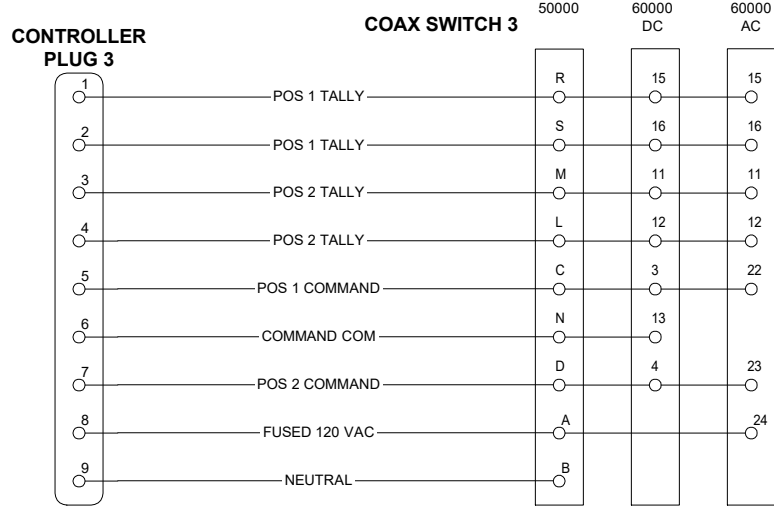
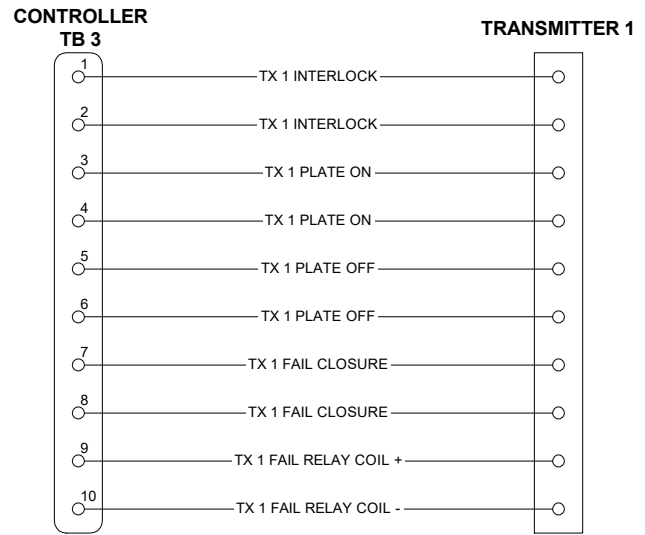
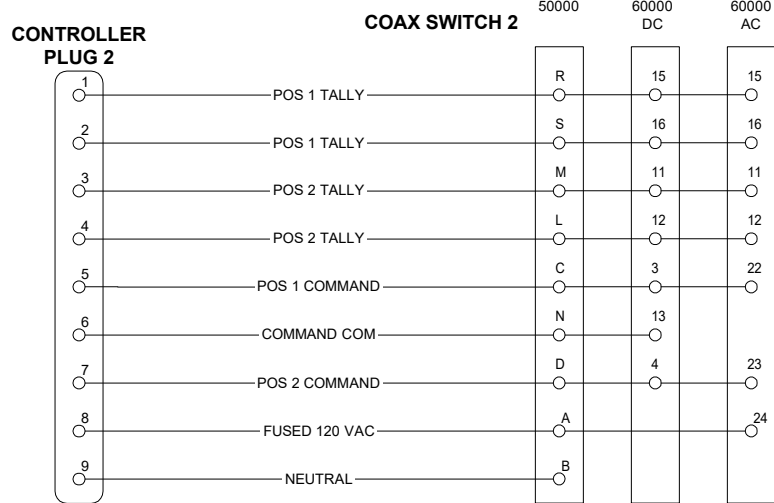
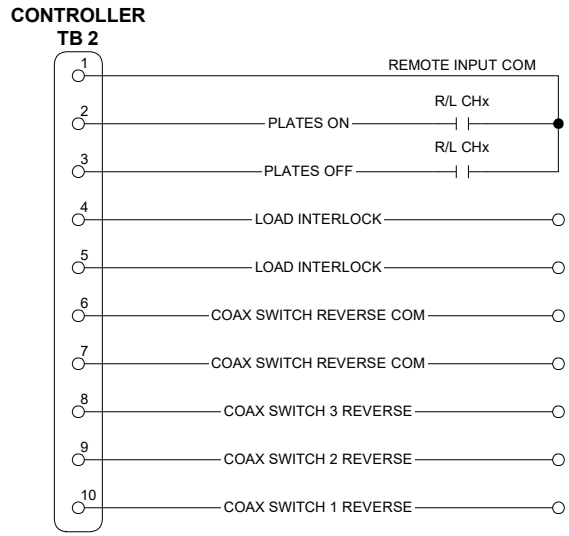
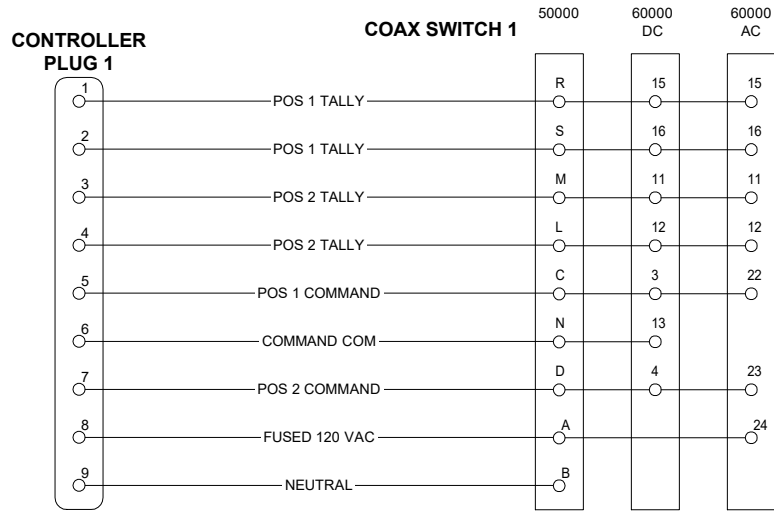
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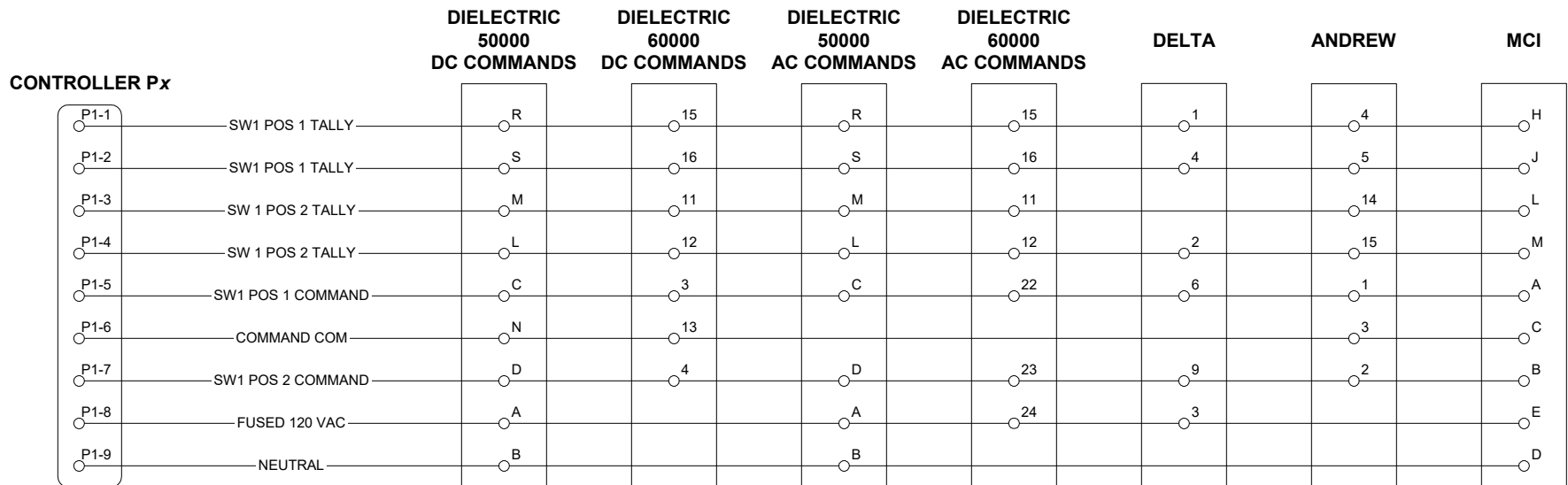
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TRC-3 TRANSMITTER AND COAXIAL SWITCH CONTROLLER		
SERIAL 3FM39+	Rev Sept 2007	SHEET 1 OF 2
DRAWN BY S. TUNWALL		

SWITCH AND REMOTE CONTROL CONNECTIONS

12



COAX SWITCH CONNECTIONS FOR FM CONTROLLERS



13

ANDREW REQUIRES REVERSE POLARITY HEADER

ANDREW 24VDC ONLY

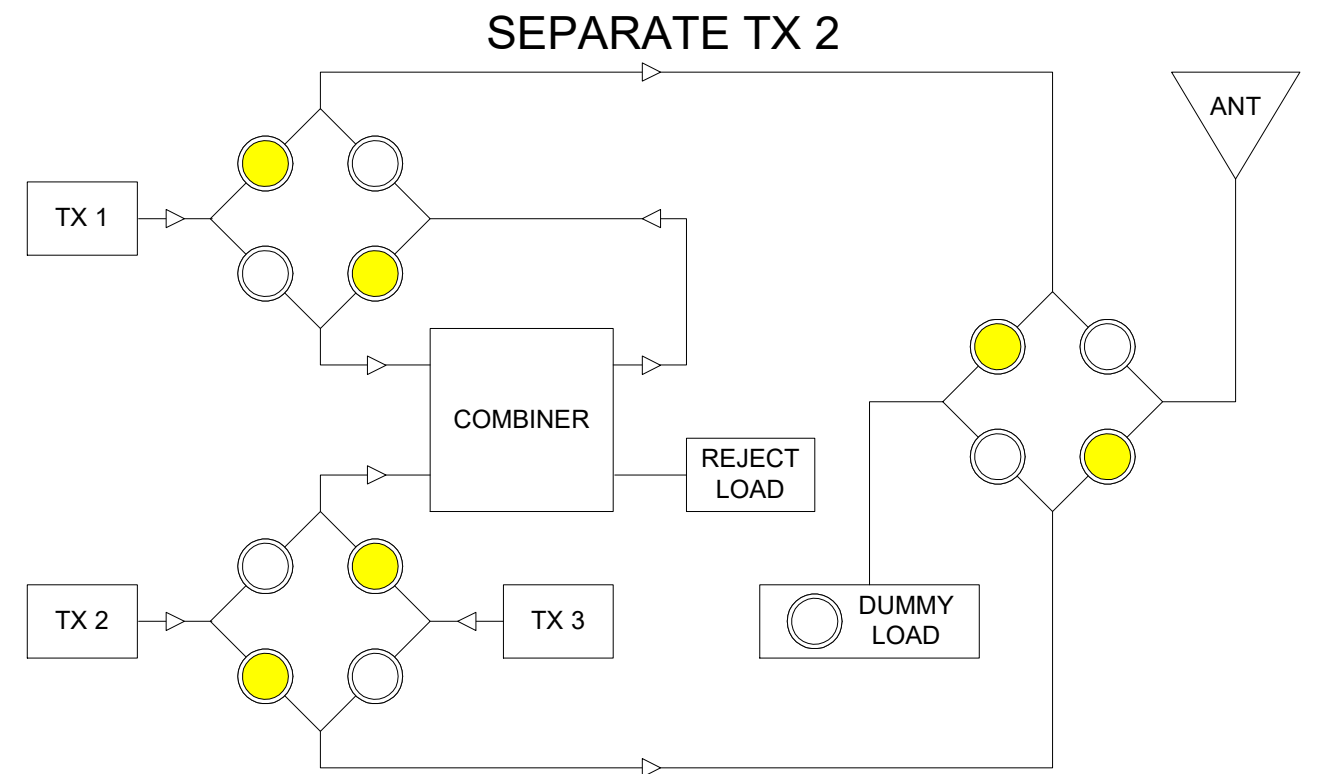
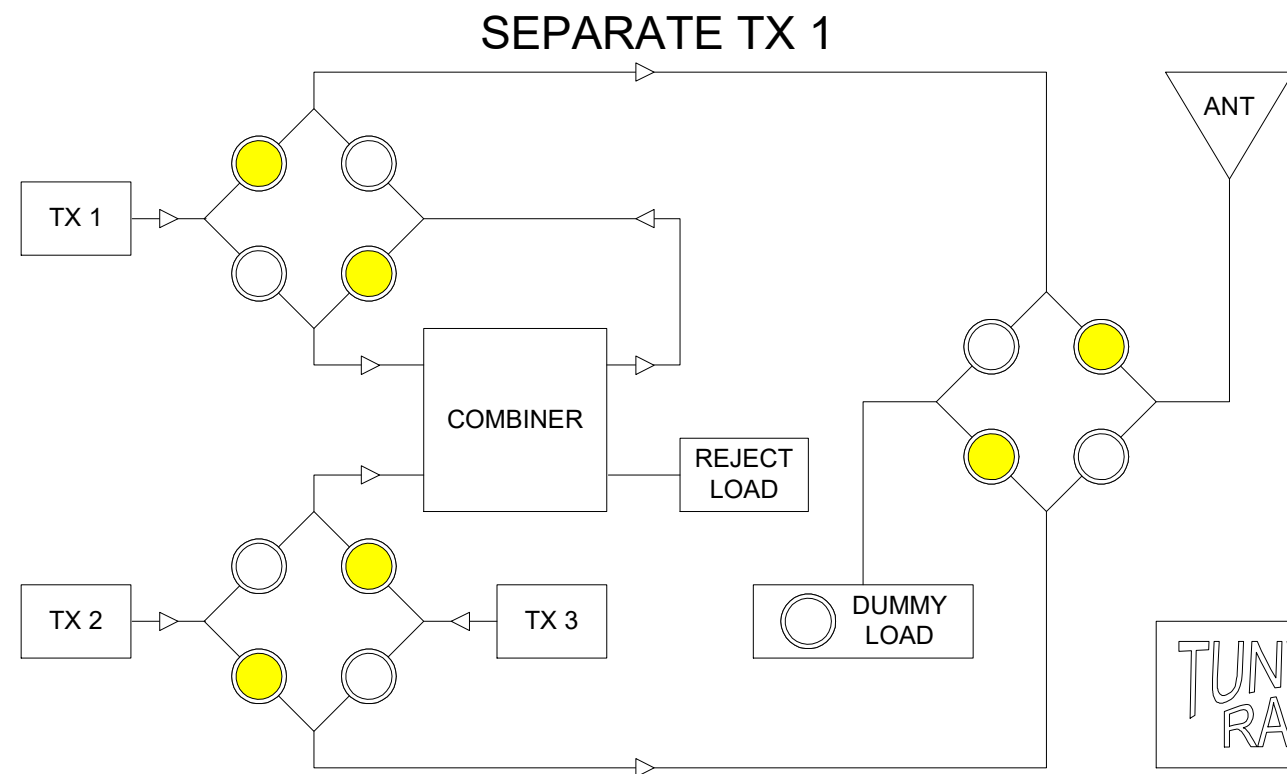
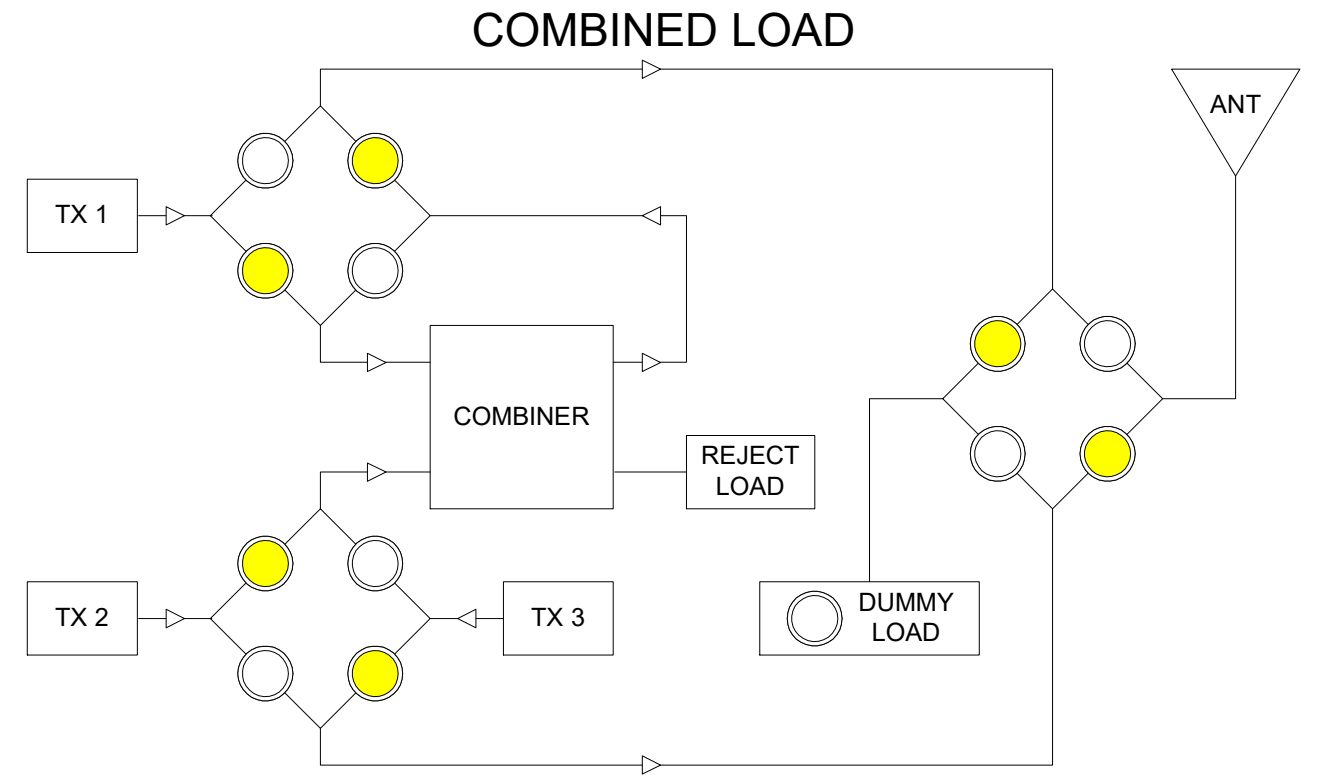
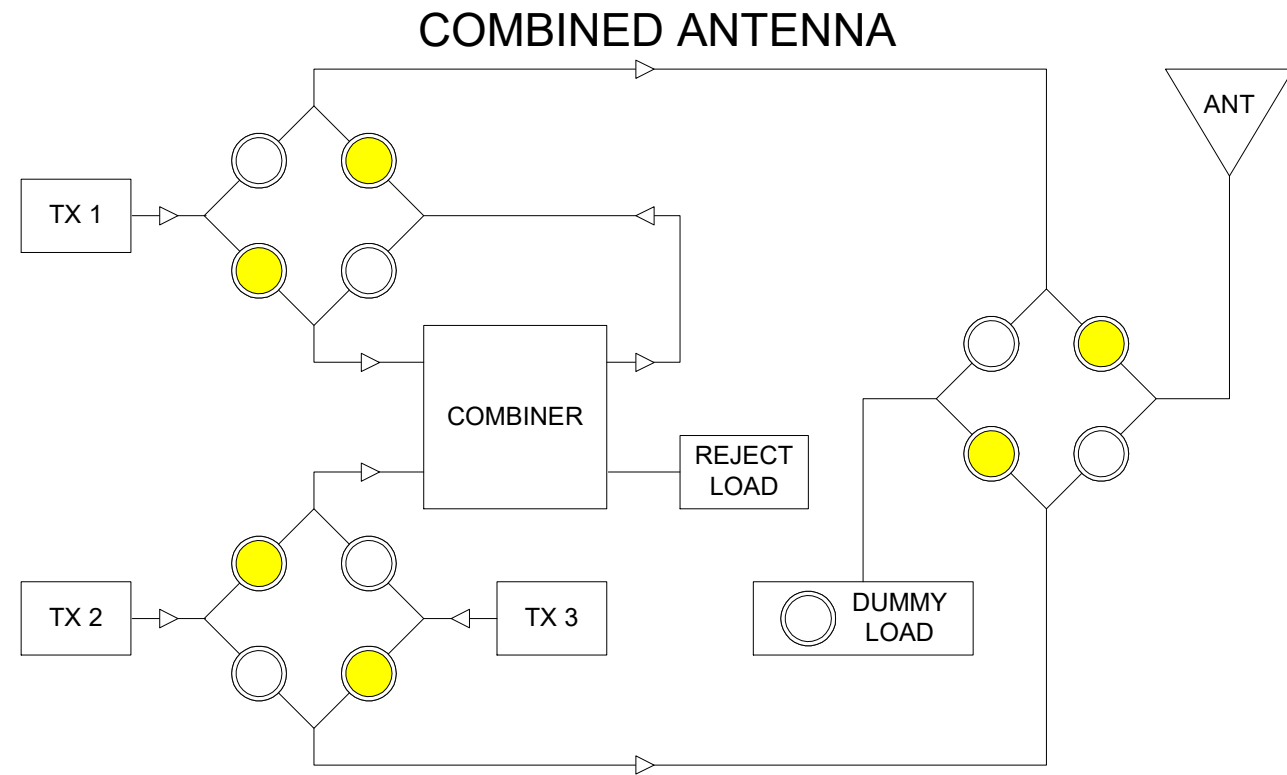
DELTA 120VAC ONLY

MCI MAY HAVE 5V CONTROL RELAY - CHANGE TO 12V OR 24V

TERMINAL NUMBERS FOR DELTA, ANDREW, MCI MAY NOT BE CORRECT FOR EVERY MODEL

FRONT PANEL INDICATORS

TRC-3



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LOGIC TABLES TRC-3

TRANSMITTER INTERLOCK LOGIC TABLES FOR ALL COMBINATIONS OF COAX SWITCH REVERSE JUMPERS ON TB2

CAN ALSO BE USED AS COMMAND LOGIC TABLES-

SWITCH CABLES ARE ALL WIRED THE SAME; THE CONTROLLER IS SET TO WORK WITH COAX SWITCH POSITIONS BY REAR PANEL JUMPERS

RUN = INTERLOCK TERMINALS CLOSED, TRANSMITTER ENABLED

MUTE = TRANSMITTER NEVER ENABLED

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

15

NO JUMPERS

SYSTEM COMMANDS	SWITCHES			TRANSMITTER INTERLOCKS		
				TX 1	TX 2	TX 3
COMBINED ANTENNA	SW1 POS1	SW2 POS1	SW3 POS1	RUN	RUN	MUTE L
COMBINED LOAD	SW1 POS1	SW2 POS1	SW3 POS2	MUTE L	MUTE L	RUN
	SW1 POS1	SW2 POS2	SW3 POS1	INVALID		
	SW1 POS1	SW2 POS2	SW3 POS2			
	SW1 POS2	SW2 POS1	SW3 POS1			
	SW1 POS2	SW2 POS1	SW3 POS2			
SEPARATE TX 1	SW1 POS2	SW2 POS2	SW3 POS1	RUN	MUTE L	MUTE
SEPARATE TX 2	SW1 POS2	SW2 POS2	SW3 POS2	MUTE L	RUN	MUTE

REVERSE SW1 JUMPER

SYSTEM COMMANDS	SWITCHES			TRANSMITTER INTERLOCKS		
				TX 1	TX 2	TX 3
COMBINED ANTENNA	SW1 POS2	SW2 POS1	SW3 POS1	RUN	RUN	MUTE L
COMBINED LOAD	SW1 POS2	SW2 POS1	SW3 POS2	MUTE L	MUTE L	RUN
	SW1 POS1	SW2 POS1	SW3 POS1	INVALID		
	SW1 POS1	SW2 POS1	SW3 POS2			
	SW1 POS2	SW2 POS2	SW3 POS1			
	SW1 POS2	SW2 POS2	SW3 POS2			
SEPARATE TX 1	SW1 POS1	SW2 POS2	SW3 POS1	RUN	MUTE L	MUTE
SEPARATE TX 2	SW1 POS1	SW2 POS2	SW3 POS2	MUTE L	RUN	MUTE

REVERSE SW3 JUMPER

SYSTEM COMMANDS	SWITCHES			TRANSMITTER INTERLOCKS		
				TX 1	TX 2	TX 3
COMBINED ANTENNA	SW1 POS1	SW2 POS1	SW3 POS2	RUN	RUN	MUTE L
COMBINED LOAD	SW1 POS1	SW2 POS1	SW3 POS1	MUTE L	MUTE L	RUN
	SW1 POS1	SW2 POS2	SW3 POS1	INVALID		
	SW1 POS1	SW2 POS2	SW3 POS2			
	SW1 POS2	SW2 POS1	SW3 POS1			
	SW1 POS2	SW2 POS1	SW3 POS2			
SEPARATE TX 1	SW1 POS2	SW2 POS2	SW3 POS2	RUN	MUTE L	MUTE
SEPARATE TX 2	SW1 POS2	SW2 POS2	SW3 POS1	MUTE L	RUN	MUTE

REVERSE SW1 SW3 JUMPERS

SYSTEM COMMANDS	SWITCHES			TRANSMITTER INTERLOCKS		
				TX 1	TX 2	TX 3
COMBINED ANTENNA	SW1 POS2	SW2 POS1	SW3 POS2	RUN	RUN	MUTE L
COMBINED LOAD	SW1 POS2	SW2 POS1	SW3 POS1	MUTE L	MUTE L	RUN
	SW1 POS1	SW2 POS1	SW3 POS1	INVALID		
	SW1 POS1	SW2 POS1	SW3 POS2			
	SW1 POS2	SW2 POS2	SW3 POS1			
	SW1 POS2	SW2 POS2	SW3 POS2			
SEPARATE TX 1	SW1 POS1	SW2 POS2	SW3 POS2	RUN	MUTE L	MUTE
SEPARATE TX 2	SW1 POS1	SW2 POS2	SW3 POS1	MUTE L	RUN	MUTE

REVERSE SW2 JUMPER

SYSTEM COMMANDS	SWITCHES			TRANSMITTER INTERLOCKS		
				TX 1	TX 2	TX 3
COMBINED ANTENNA	SW1 POS1	SW2 POS2	SW3 POS1	RUN	RUN	MUTE L
COMBINED LOAD	SW1 POS1	SW2 POS2	SW3 POS2	MUTE L	MUTE L	RUN
	SW1 POS1	SW2 POS1	SW3 POS1	INVALID		
	SW1 POS1	SW2 POS1	SW3 POS2			
	SW1 POS2	SW2 POS2	SW3 POS1			
	SW1 POS2	SW2 POS2	SW3 POS2			
SEPARATE TX 1	SW1 POS2	SW2 POS1	SW3 POS1	RUN	MUTE L	MUTE
SEPARATE TX 2	SW1 POS2	SW2 POS1	SW3 POS2	MUTE L	RUN	MUTE

REVERSE SW1 SW2 JUMPERS

SYSTEM COMMANDS	SWITCHES			TRANSMITTER INTERLOCKS		
				TX 1	TX 2	TX 3
COMBINED ANTENNA	SW1 POS2	SW2 POS2	SW3 POS1	RUN	RUN	MUTE L
COMBINED LOAD	SW1 POS2	SW2 POS2	SW3 POS2	MUTE L	MUTE L	RUN
	SW1 POS1	SW2 POS2	SW3 POS1	INVALID		
	SW1 POS1	SW2 POS2	SW3 POS2			
	SW1 POS2	SW2 POS1	SW3 POS1			
	SW1 POS2	SW2 POS1	SW3 POS2			
SEPARATE TX 1	SW1 POS1	SW2 POS1	SW3 POS1	RUN	MUTE L	MUTE
SEPARATE TX 2	SW1 POS1	SW2 POS1	SW3 POS2	MUTE L	RUN	MUTE

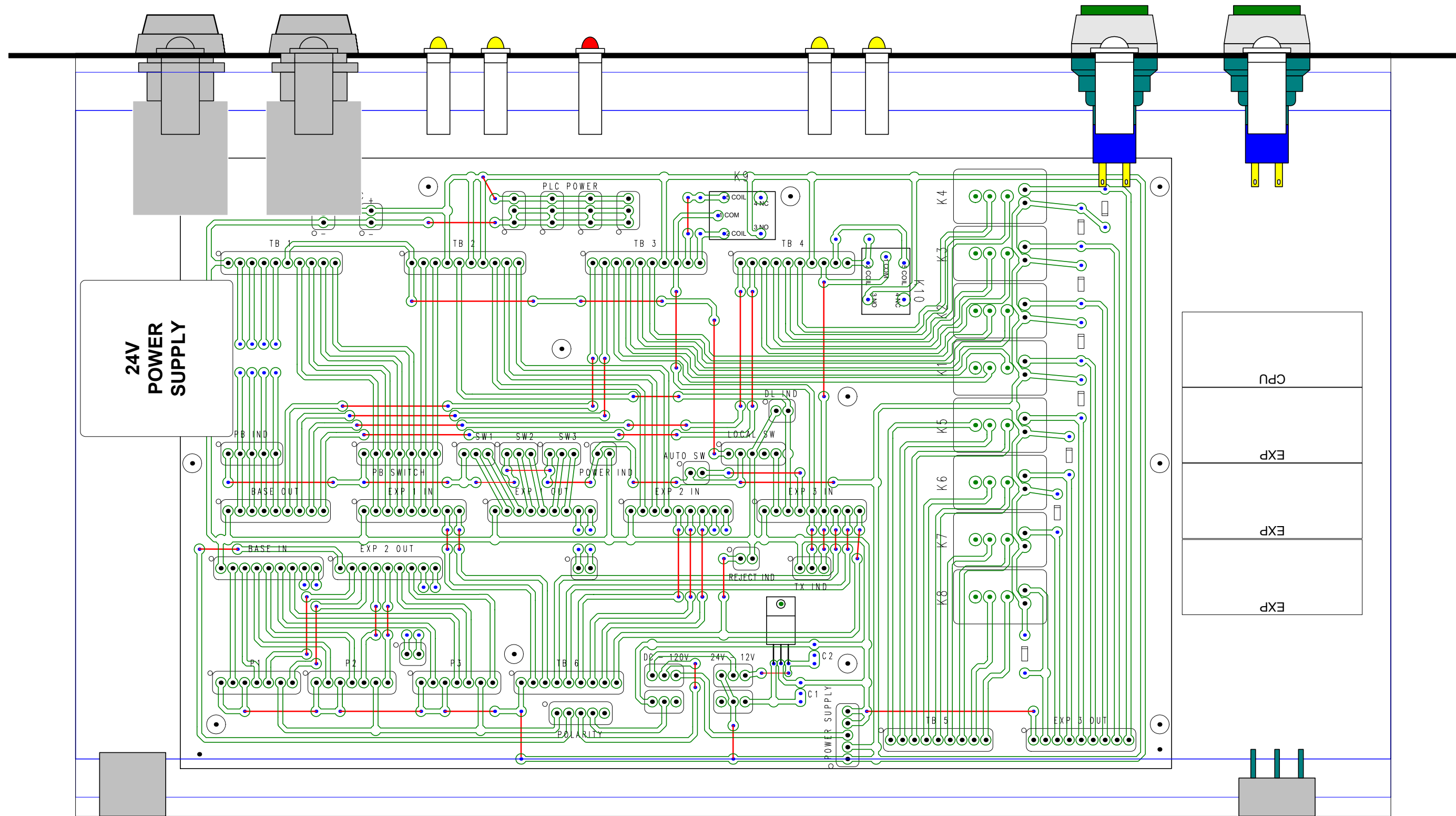
REVERSE SW2 SW3 JUMPERS

SYSTEM COMMANDS	SWITCHES			TRANSMITTER INTERLOCKS		
				TX 1	TX 2	TX 3
COMBINED ANTENNA	SW1 POS1	SW2 POS2	SW3 POS2	RUN	RUN	MUTE L
COMBINED LOAD	SW1 POS1	SW2 POS2	SW3 POS1	MUTE L	MUTE L	RUN
	SW1 POS1	SW2 POS1	SW3 POS1	INVALID		
	SW1 POS1	SW2 POS1	SW3 POS2			
	SW1 POS2	SW2 POS2	SW3 POS1			
	SW1 POS2	SW2 POS2	SW3 POS2			
SEPARATE TX 1	SW1 POS2	SW2 POS1	SW3 POS2	RUN	MUTE L	MUTE
SEPARATE TX 2	SW1 POS2	SW2 POS1	SW3 POS1	MUTE L	RUN	MUTE

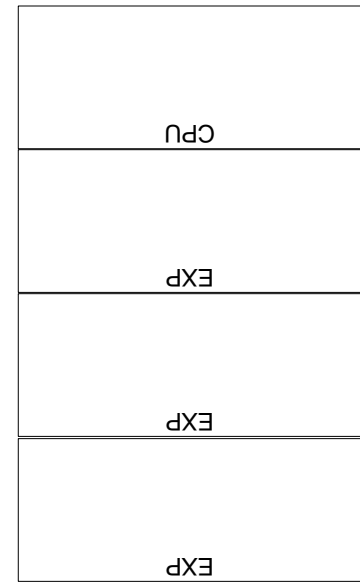
REVERSE SW1 SW2 SW3 JUMPERS

SYSTEM COMMANDS	SWITCHES			TRANSMITTER INTERLOCKS		
				TX 1	TX 2	TX 3
COMBINED ANTENNA	SW1 POS2	SW2 POS2	SW3 POS2	RUN	RUN	MUTE L
COMBINED LOAD	SW1 POS2	SW2 POS2	SW3 POS1	MUTE L	MUTE L	RUN
	SW1 POS1	SW2 POS2	SW3 POS1	INVALID		
	SW1 POS1	SW2 POS2	SW3 POS2			
	SW1 POS2	SW2 POS1	SW3 POS1			
	SW1 POS2	SW2 POS1	SW3 POS2			
SEPARATE TX 1	SW1 POS1	SW2 POS1	SW3 POS2	RUN	MUTE L	MUTE
SEPARATE TX 2	SW1 POS1	SW2 POS1	SW3 POS1	MUTE L	RUN	MUTE





**24V
POWER
SUPPLY**



TUNWALL RADIO LLC			
TRC-3			
	3-SWITCH FM CONTROLLER	Sept 2007	Component layout
DRAWN BY	S. TUNWALL		

Instruction Manual

IB 016

DIELECTRIC

MODEL 50000

MOTORIZED

COAXIAL SWITCHES

1 $\frac{5}{8}$ & 3 $\frac{1}{8}$

DIELECTRIC COMMUNICATIONS

RAYMOND, MAINE, 04071 ■ TEL 207-655-4555 ■ TWX 710-229-6890

TABLE OF CONTENTS

Section	Title	Page
1.	General Description	2
2.	Specifications	2
3.	Theory of Operation	3
4.	Installation	3
5.	Operation	5
6.	Maintenance and Repair	5
7.	Replacement Parts	6
8.	Ancillary Equipment	6

LIST OF ILLUSTRATIONS

Figure No.	Title	Page
1.	Model 50000 3-1/8 4 Port Transfer Switch .. Inside front cover	
2.	Outline Drawing, Model 50000 1-5/8 and 3-1/8 Coaxial Switch	4
3.	Schematic Diagram, Model 50000 Coaxial Switch	7

Model 50000
 Motorized Coaxial Switch

1. GENERAL DESCRIPTION.

The Model 50000 Coaxial Switch provides reliable and fast switching of coaxial transmission line systems. It is a motor driven, rotary type, and can be controlled locally and/or remotely.

The switch is equipped with a manual over-ride, a mechanical position indicator, and is fully protected with auxiliary read-out and inter-lock circuits.

Operable in any position and having a minimum of moving parts, 100,000 cycles are normal without failure.

EIA male flanges are standard with adapters available to mate with unflanged or semiflex transmission lines.

2. SPECIFICATIONS.

Size	1 5/8	3 1/8
Frequency Range	DC - 900 MHz	DC - 900 MHz
Characteristic Impedance	50 ohm	50 ohm
VSWR Maximum	1:05.1	1.05:1
Insertion Loss	0.1 db	0.1 db
Power Rating Peak Average @ 30 MHz @ 300 MHz @ 900 MHz	150 kw 25 kw 6 kw 4 kw	500 kw 90 kw 30 kw 15 kw
Switching Time, nominal	2 seconds	2 seconds
Isolation	60 db	60 db
R.F. Connectors	EIA Male	EIA Male
Drive Motor Current 1 ϕ - 50/60 Hz @ 115V AC @ 230V AC	3.5 Amp., start; 0.5 Amp., run 1.5 Amp., start; 0.3 Amp., run	
Control Relay Power D.C. Coils A.C. Coils	1.2 Watts 2.7 Volt Amps.	
Auxiliary Switch Ratings @ 125V DC @ 250V AC	0.3 Amp. 10.0 Amps	
Net Weight	42 lb. - 19 kg.	54 lb. - 24.5 kg.
Gross Packed Weight	48 lb. - 21.7 kg.	65 lb. - 29.5 kg.
Gross Packed Cube	3.58 ft. ³ - .10 m ³	3.58 ft. ³ - .10 m ³

3. THEORY OF OPERATION.

The Model 50000 Coaxial Switch is a rotary type switch having an aluminum R.F. cavity common to all ports. The rotor assembly contains two inner conductor blades and a common isolating ground plane which oscillates 90° to accomplish the switching function and provide isolation between transmission line paths.

The rotor is driven by a gear motor and slip clutch mechanism. When the motor is activated by connection through the control relay, it will rotate 90° until the mechanism reaches a positive stop. Simultaneously an auxiliary switch is activated to interrupt the motor circuit. Any inertia of the drive is absorbed by slippage of the clutch mechanism.

Auxiliary switches are positioned at each end of travel and are adjusted so that in the closing mode they do not activate until the R.F. contacts are ready to accept power. Conversely, in the opening mode, the auxiliary contacts open prior to the R.F. contact to prevent the breaking of the switch under R.F. power.

4. INSTALLATION.

The switch may be mounted in any convenient position using the four (4) mounting holes shown in Figure 2. Orient the R.F. ports to meet the required transmission line layout.

The manual operate handle should be in an accessible location for emergency switching in the event of control power failure.

Provide twelve (12) inches clearance above the top of the motor drive cover to allow for removal for maintenance.

After the switch is properly mounted in position, remove hardware and protective covers from the R.F. connectors. Attach adapters or EIA female flanged lines to the switch ports and re-install hardware. CAUTION -- Tighten bolts evenly and do not exceed torque ratings of eleven (11) foot pounds on the 1-5/8 and twenty (20) foot pounds on the 3-1/8.

NOTE: The R.F. contacts of the switch flanges protrude above the flange surface, and when properly connected there will be a space between the flanges at the bolt circle. Tightening beyond rated torque will destroy both the switch flange and the mating transmission line flange.

Activate the R.F. switch manually to both positions to be sure rotor moves freely and reaches the positive stops.

Attach electrical supply wiring and control wiring to the removable MS3108B jack supplied with each switch. Refer to Figure 3 for proper connections.

Attach jack to plug and check readout and interlock circuits with continuity tester or ohm meter for proper operation.

Apply correct supply voltage.

Place R.F. switch rotor mechanism in approximately mid-position using manual operate knob.

Momentarily apply correct voltage to pins C and N (observe polarity) and check that position indicator starts to move toward position one. If rotation is incorrect check wiring; if correct, apply control voltage continuously to pins C and N.

Model 50000
 Motorized Coaxial Switch

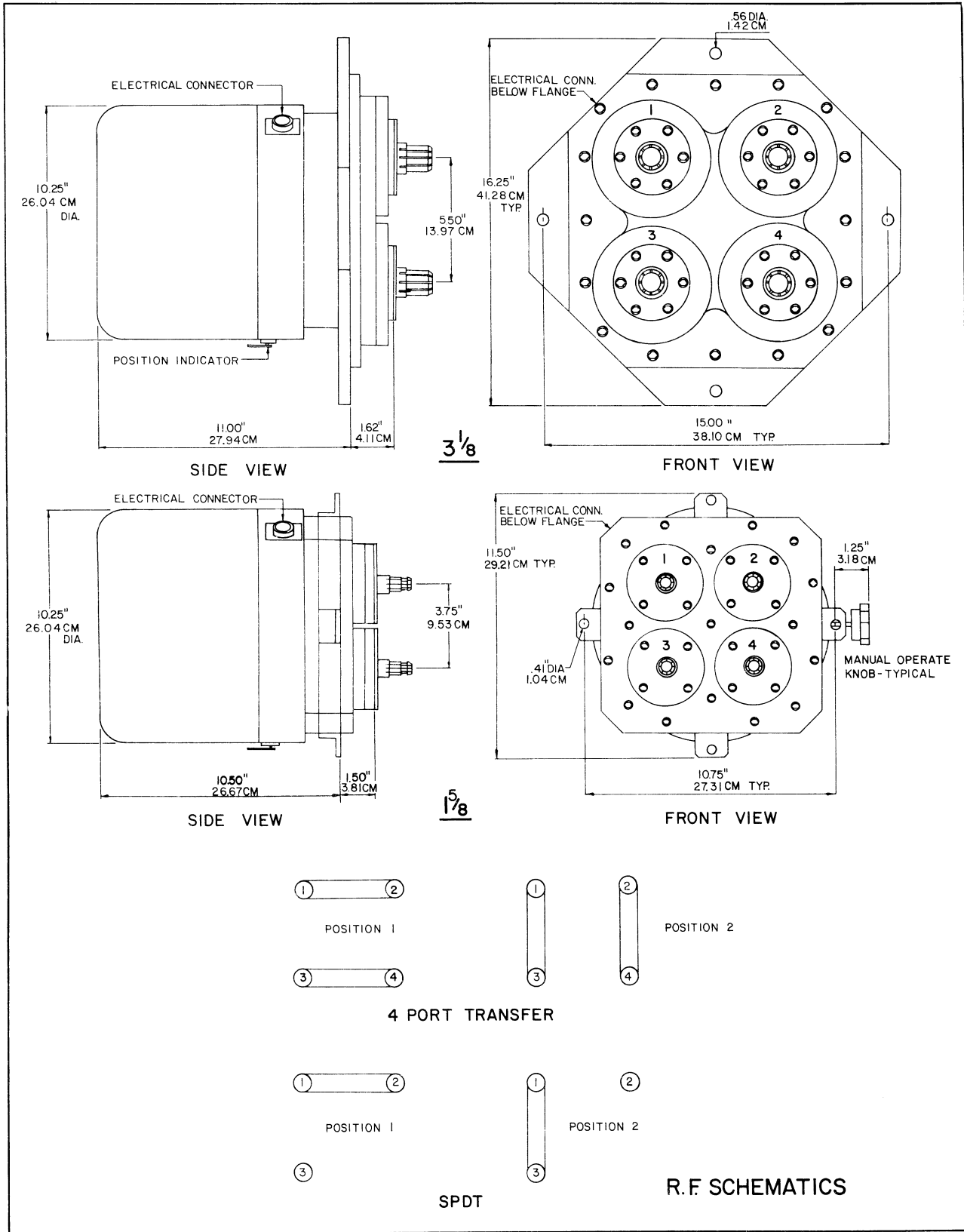
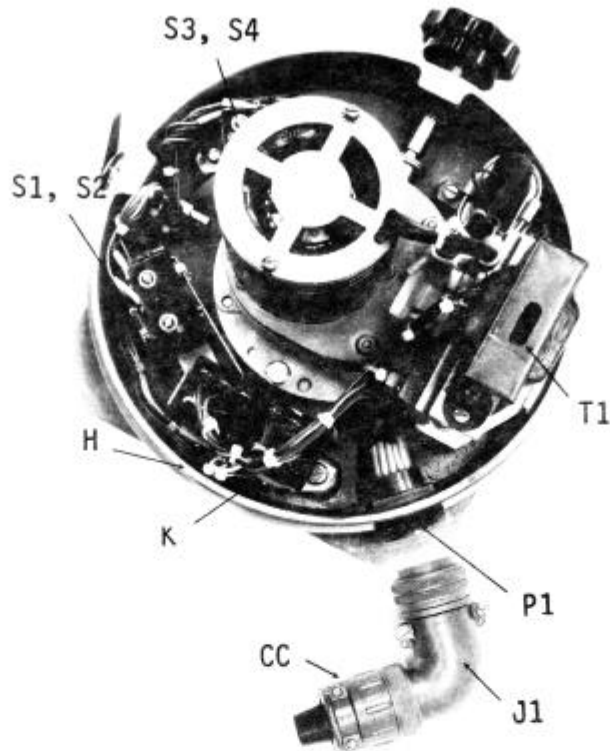


Figure 2. Outline Drawing Model 50000 1-5/8 and 3-1/8 Coaxial Switch

Model 50000
 Motorized Coaxial Switch



7. REPLACEMENT PARTS.

T1	Transformer, 220V-110V	A19636-1
S1, S2, S3, S4	Auxiliary Switch	A44876-1
K	Relay Assembly - 240V AC	B44624-501
	120V AC	B44624-502
	110V DC	B44624-503
	24V DC	B44624-504
	12V DC	B44624-505
P1	Plug	A44867-1
J1	Jack	A23561-1
CC	Cable Clamp	A19720-1
H	Harness Assembly (includes S1, S2, S3, S4, P1 and Relay sockets)	A44586-501

8. ANCILLARY EQUIPMENT.*

Adapter	3-1/8 EIA-F to 3-1/8 No Flange, 6" long	B44900-502
Adapter	3-1/8 EIA-F to 3-1/8 EIA-F, 6" long	C7999-501
Transition	3-1/8 EIA-F to 1-5/8 EIA-F, 6" long	B25623-501
Transition	3-1/8 EIA-M to Type N-F	C14397-503
Adapter	1-5/8 EIA-F to 1-5/8 No Flange, 6" long	B44920-502
Adapter	1-5/8 EIA-F to 1-5/8 EIA-F, 6" long	D30997-1
Transition	1-5/8 EIA-M to Type N-F	C21109-503

* All components listed are copper; similar items having aluminum outer conductors are available. Contact Dielectric Communications for a complete line of coaxial and waveguide transmission lines and components.

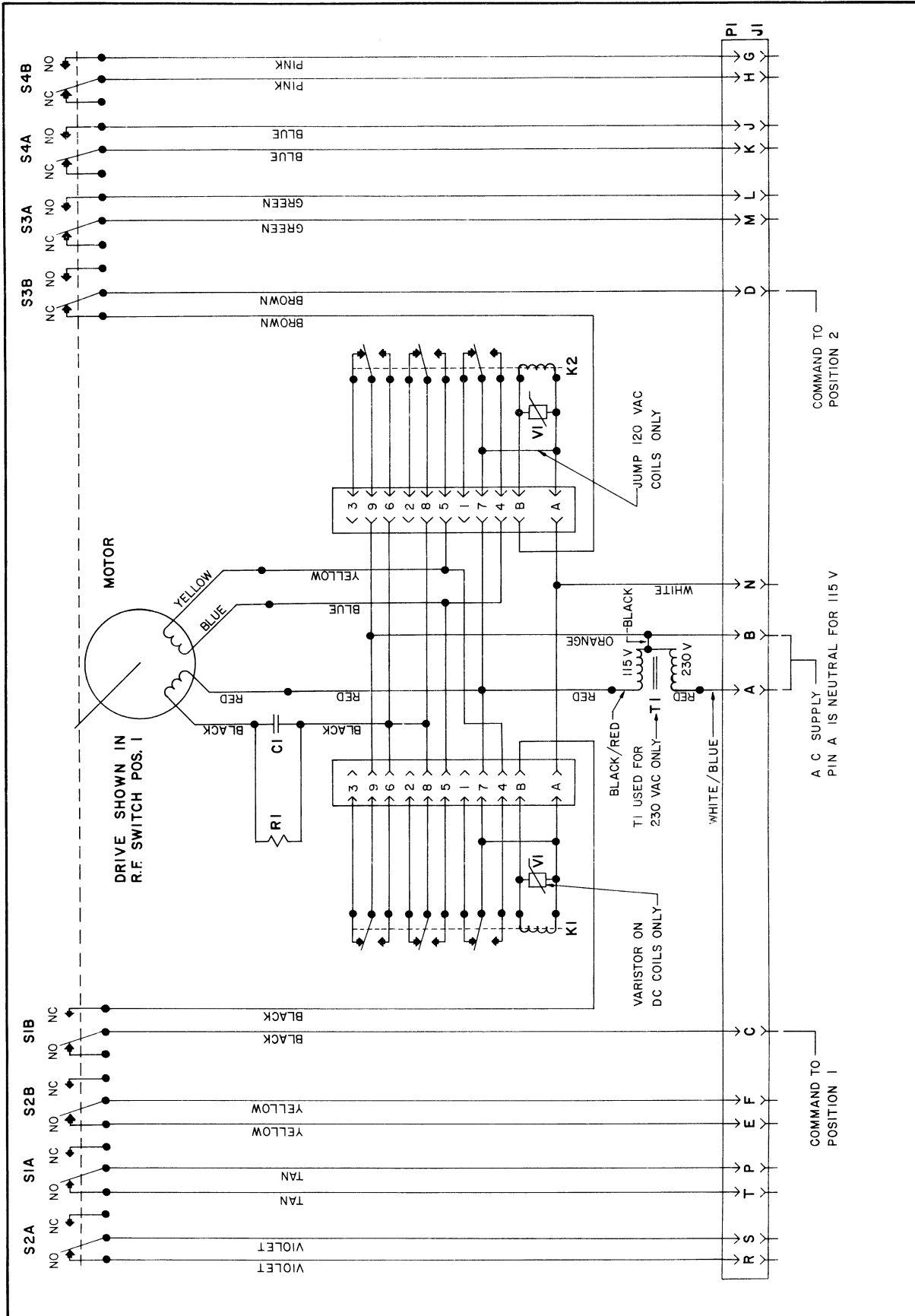


Figure 3. Schematic Diagram Model 50000 Coaxial Switch



IB-426-Rev D
P/N 85171

Model 60000
Motorized Coaxial Switches
1 5/8", 3 1/8", 4 1/16" and 6 1/8"

Instruction Manual

2/10/03

Table of Contents

1.0	General Description	2
2.0	Specifications	3
3.0	Theory of Operation	3
4.0	Installation	3
5.0	Operation	3-4
6.0	Maintenance and Repairs	4
7.0	Ancillary Equipment	5
Fig. 1	Outline Drawing	6
Fig.2	Wiring Diagram	7
	Wiring Table	8
	Wiring Details	9

Note: All specifications are for reference only. Consult factory for details.

WARNING

All Electrical and RF work must be done in accordance with local and national codes and safety requirements.

1.0 General Description

The Model 60000 Coaxial Switch provides reliable and fast switching of coaxial transmission line systems. It is a motor driven rotary type and can be controlled locally or remotely.

Operable in any position and having a minimum of moving parts, the switch will routinely operate through 1,000,000 cycles without failure.

The switch is equipped with a manual over-ride, mechanical position indicators and with auxiliary read-out circuits.

EIA male flanges are standard with adaptors available to mate with unflanged or semiflex transmission lines.

2.0 Specifications

	1 5/8"	3 1/8"	4 1/16"	6 1/8" 50 Ohm	6 1-8" 75 Ohm
Frequency Range	DC-900 MHz	DC-900 MHz	DC-800 MHz	DC-800 MHz	DC-800 MHz
Characteristic Impedance	50 Ohm	50 Ohm	50 Ohm	50 Ohm	75 Ohm
VSWR Max.	1.05:1				
Insertion Loss	0.1 dB max.				
Power Rating	150 kw	500 kw	1000 kw	2000 kw	1500 kw
Peak	25 kw	90 kw	150 kw	300 kw	225 kw
Average at 30 MHz	6 kw	30 kw	50 kw	100 kw	75 kw
Average at 300 MHz	4 kw	15 kw	25 kw	45 kw	38 kw
Average at 900 MHz					
Switching Time (nominal)	3 seconds	3 seconds	3 seconds	4 seconds	4 seconds
Isolation	60 dB				
RF Connectors	EIA Male				
Drive Motor Current 1Ø -50/60 Hz at 115 V AC at 230 V AC	Run Current 115 Nom. .6 AMP 230 Nom. .5 AMP			Start 115 Nom. 1.25 AMP 230 Nom. .9 AMP	
Auxiliary Switch Ratings	120 VAC 3A				
	28 VDC 3A				
Net Weight	36 lbs 16 kg	47 lbs 21.5 kg	60 lbs 27 kg	130 lbs 59 kg	120 lbs 54 kg
Gross Packed Weight	48 lbs 21.7 kg	65 lbs 29.5 kg	85 lbs 38 kg	185 lbs 84 kg	170 lbs 77 kg
Gross Packed Cube	3.58 ft ³ .10 m ³	3.58 ft ³ .10 m ³	9 ft ³ .26 m ³	12.6 ft ³ .35 m ³	12.6 ft ³ .35 m ³

3.0 Theory of Operation

The Model 60000 Coaxial Switch is a rotary type switch having an aluminum RF cavity common to all ports. The rotor assembly contains two inner conductor blades and a common isolating ground plane which oscillates 90° to accomplish the switching function and provide isolation between transmission line paths.

The rotor is driven by a gear motor. When the motor is activated by connection through the control, it will rotate 90°.

Six normally open microswitches are provided for position confirmation. The rotor activates these microswitches; and they must not be used for transmitter interlocking. **One must ensure that RF power is off before a position command is activated. Dielectric cannot be responsible for failure or burnout of switches switched under power.**

3.1 Inside the Drive

The drive used on the 60000 switches is an AC power segregated AC/DC command actuator. The drive is operated by 115 VAC, OR 230 vac and controlled by 12-24 VDC or 115/230 VAC. The different voltages can be selected without removing the cover. See the schematic for pin out for the configuration required. Do not apply AC and DC commands to the drive at the same time.

There is no need to open the switch unless local push button operation is required.

4.0 Installation

1. The switch may be mounted in any convenient position using the four mounting holes shown in Figure 1. Orient the RF ports to meet the required transmission line layout.

2. The manual operate handle stub should be in an accessible location for manual switching in the event of control power failure. Provide a minimum of eight inches of clearance above the top of the motor drive cover to allow for removal.

3. After the switch is properly mounted in position, remove hardware and protective covers from the RF connectors.

4. Attach adaptors or EIA female flanged lines to the switch ports and re-install hardware.

5. Note: The RF contact of the switch flanges protrudes above the flange surface and when properly connected there will be a space between the flanges at the bolt circle. Tightening beyond rated torque will destroy both the switch flange and the mating transmission line flange.

CAUTION

Tighten bolts evenly and do not exceed torque rating of eleven (11) foot pounds on the 1 5/8" switch or twenty (20) foot pounds on the 3 1/8", 4 1/16" and 6 1/8" switches.

5.0 Operation

The 1 5/8", 3 1/8", 4 1/16" AND 6-1/8" Model 60000 switches will change positions in approximately three seconds upon command.

The interlock circuits should be employed to prevent RF power being applied unless a legitimate RF transmission line path has been completed through the switch to an antenna or dummy load. Ensure that RF is off before the switch is commanded for position change.

Warning! User must remove all RF power before switching!

The 60000 series can be operated in four ways.

1. Locally with the cover removed.
2. Locally with the S60 Pendant. This device does not include any provisions for interlocks.
3. Remotely with connection through the Amp connector.
4. Manually with a 3/8" wrench or optional hand wheel.

To operate the switch locally with cover removed:

- A. Remove AC power and remove the cover.
- B. Set the "Man Run" switch to "Man". Plug in AC power
- C. Press either the "CW or CCW" button to desired position and hold until the motor stops.
- D. Reset "Man Run" switch to "Run" and replace cover when done.

To operate with the S60 Pendant:

- A. Connect Amp connector and AC power.
- B. The active side pilot light will illuminate.
- C. Select the desired position. Indicator lights will change status as switch moves.

To operate through Amp connector:

- A. Connect Amp connector and apply AC power.
- B. Connect control end cable and operate through control.

To operate manually:

- A. Assure AC power and Amp connectors are unplugged.
- B. Using wrench or hand wheel press down and turn until pointer on cover lines up with desired position.

6.0 Maintenance and Repairs

The Model 60000 Switch requires no periodic maintenance. However, after the initial installation is complete, the cover should be removed and the switch inspected for loose electrical connections and/or auxiliary switch hardware.

WARNING

Removal of the cover may expose live electrical terminals (240V AC maximum).

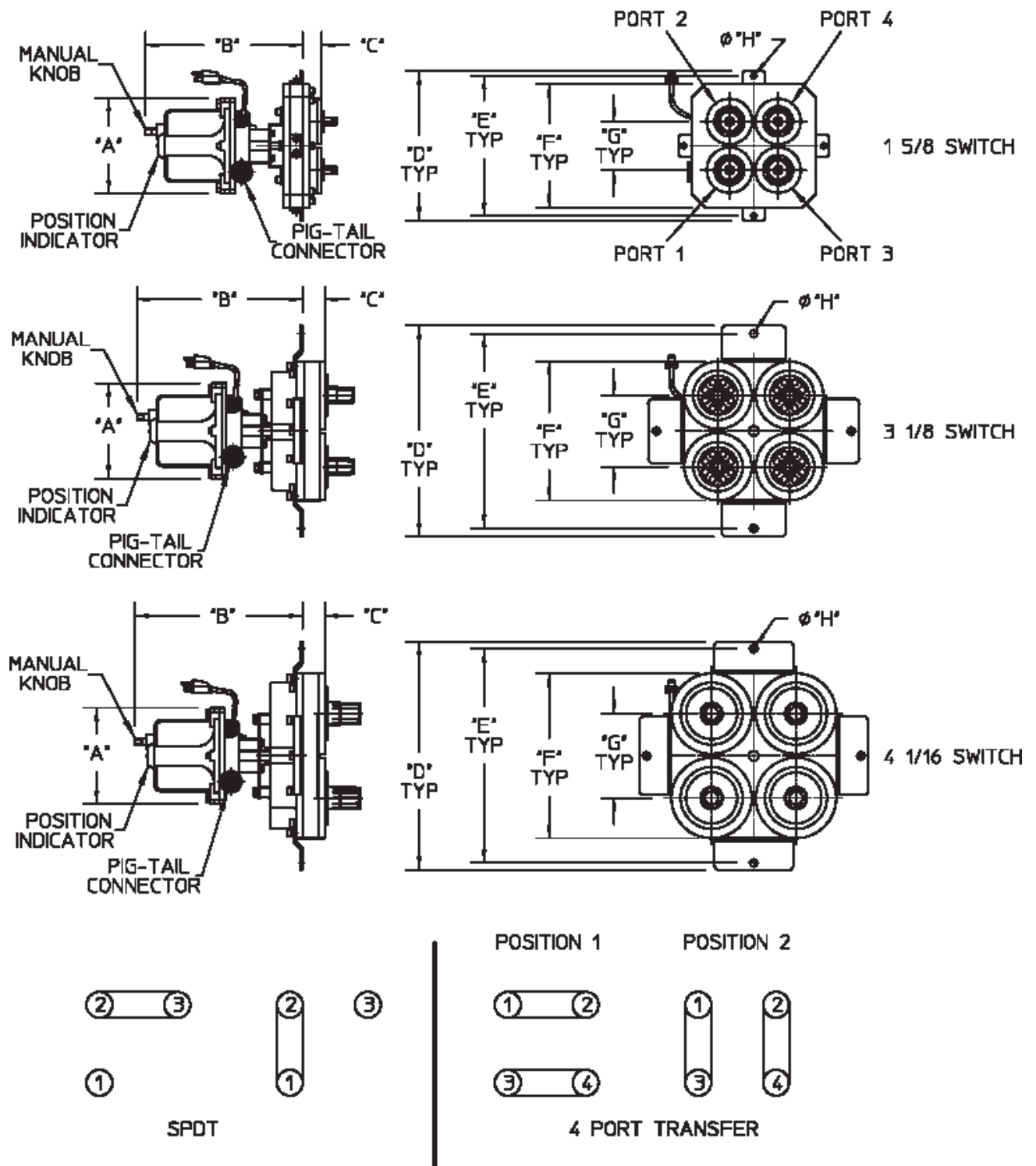
Some sub-assemblies of the units are sealed at the factory after test; breaking these seals voids any warranty and field repair of these assemblies is not recommended.

7.0 Ancillary Equipment*

	Description	Part Number
Adaptors		
1 5/8" EIA-F	to 1 5/8" no flange, 6" large	B-44920-502
	to 1 5/8" EIA-F, 6" large	D-30997-001
3 1/8" EIA-F	to 3 1/8" no flange, 6" large	B-44900-502
	to 3 1/8" EIA-F, 6" large	C-7999-501
4 1/16" EIA-F		
Transitions		
1 5/8" EIA-M	to Type N-F	C-21109-503
3 1/8" EIA-F	to 1 5/8" EIA-F, 6" large	B-25623-501
3 1/8" EIA-M	to Type N-F	C-14397-503
4 1/16" EIA-F		
Cable		
	Dual Switch Controller to 60000 Switch-25'	0101873-025
	Dual Switch Controller to 60000 Switch-50'	0101873-050
	To adapt 60000 switch CPC 24 pin to 16 pin AMP CPC ("Type C")	85156
	To adapt 60000 switch to 50000 amphenol connector	85144
S60 Pendant Control	10' AMP connector cable, AC power cable, and switch box.	85145
Extension Cable	25' Eight conductor cable assembly for longer S60 pendant applications.	85157

*All components are copper; similar items having aluminum outer conductors are available. Contact Dielectric Communications for a complete line of coaxial and waveguide transmission lines and components.

NOTE: PORT LOCATIONS
TYPICAL ALL SWITCHES



SWITCH	'A'	'B'	'C'	'D'	'E'	'F'	'G'	'H'
1-5/8	7.38	12.13	1.50	11.50	10.75	9.50	3.75	.41
3-1/8	7.38	12.75	1.74	16.25	15.00	10.69	5.50	.56
4-1/16	7.38	12.88	1.72	17.56	16.50	12.69	6.50	.56

Figure 1

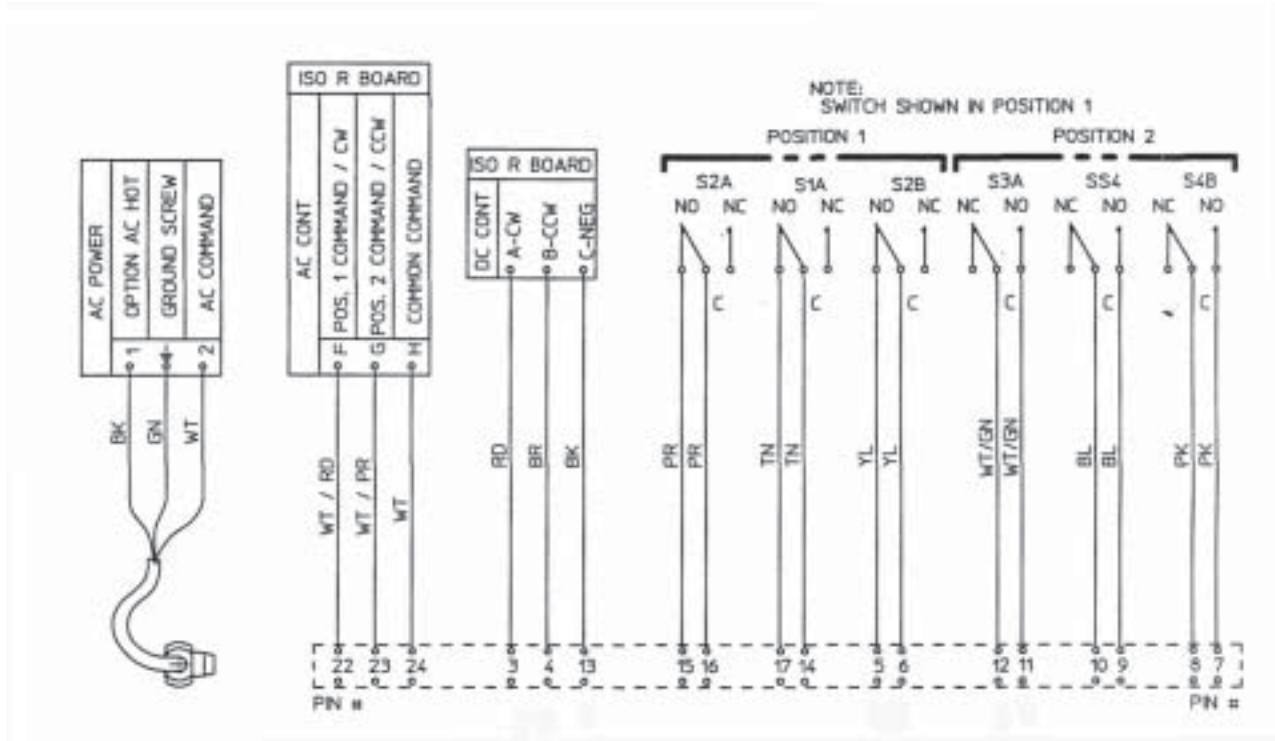


Figure 2

Note:

1. The actuator only requires a 1/2 second command pulse to latch the control in. A maintained command will not harm the unit.
2. Do not apply AC and DC commands at the same time.
3. For AC command between 110 VAC and 230 VAC, hook the common AC conductor to Pin 13 and position 1 and 2 commands to pins 22 and 23.
4. For DC command between 12 and 24 VDC, hook the negative conductor to pin 13 and the position 1 and position 2 to pins 3 and 4.

The actuator has been tested to operate at 10% less than the rated input voltage and is dual rated for 50/60 Hz operation.

WIRING TABLE

50000 PIN #	50000 SWITCH	50000 COLOR	DUAL SWITCH CONTROLLER	WAVEGUIDE SW	UNIVERSAL CONTROL PANEL	60000 PIN #	60000 SWITCH	60000 COLOR
	COMMENT		66982	DC Com AC Mot PIN #	48112-501		COMMENT	
					TB-4 Terminal #			
R	POS # 1 CONTACT S2A NO	VIO	15	J	15	15	POS # 1 CONTACT S2A NO	PR
S	POS # 1 CONTACT S2A COM	VIO	16	S	16	16	POS # 1 CONTACT S2A COM	PR
T	POS # 1 CONTACT S1A NO	TAN	17	F	17	17	POS # 1 CONTACT S1A NO	TN
P	POS # 1 CONTACT S1A COM	TAN	14	G	14	14	POS # 1 CONTACT S1A COM	TN
E	POS # 1 CONTACT S2B NO	YEL	5	Q	5	5	POS # 1 CONTACT S2B NO	YL
F	POS # 1 CONTACT S2B COM	YEL	6	P	6	6	POS # 1 CONTACT S2B COM	YL
C	COMMAND FOR POS #1	W/BLK	3	U	3	3	DC COMMAND FOR POS #1 (+)	RD
A	AC POWER	W/BLK	1	N/A	Used on 50, not on 60	N/A	N/A	N/A
B	AC POWER	WHT	2	N/A	Used on 50, not on 60	N/A	N/A	N/A
N	COMMAND COMMON	ORG	13	R	13	13	DC COMMAND COMMON (-)	BK
D	COMMAND FOR POS # 2	BRN	4	V	4	4	DC COMMAND FOR POS # 2 (+)	BR
M	POS # 2 CONTACT S3A COM	W/GRN	12	B	12	12	POS # 2 CONTACT S3A COM	WT/GRN
L	POS # 2 CONTACT S3A NO	W/GRN	11	A	11	11	POS # 2 CONTACT S3A NO	WT/GRN
K	POS # 2 CONTACT S4A COM	BLU	10	L	10	10	POS # 2 CONTACT S4A COM	BL
J	POS # 2 CONTACT S4A NO	BLU	9	M	9	9	POS # 2 CONTACT S4A NO	BL
H	POS # 2 CONTACT S4B COM	PNK	8	D	8	8	POS # 2 CONTACT S4B COM	PK
G	POS # 2 CONTACT S4B NO	PNK	7	E	7	7	POS # 2 CONTACT S4B NO	PK
						1	RESERVED FOR HEATER	
						2	RESERVED FOR HEATER	
						18	N/A	N/A
						19	N/A	N/A
						20	N/A	N/A
						21	N/A	N/A
						22	AC COMMAND POS # 1	WT/RD
						23	AC COMMAND POS # 2	WT/PR
						24	AC COMMAND COMMON	WT

Wiring Details

