



## V --- THEORY OF OPERATION (Page 1 of 5)

### A. INTRODUCTION

The UTX5K ULTRA transmitter was designed to meet or exceed all FCC applicable specifications for TV broadcast equipment. Special attention was given to the selection of sub-assemblies and components to achieve maximum reliability and minimum down time. The construction of the UTX5K ULTRA is BASIC and MODULAR with most components field replaceable. Special emphasis was placed on "KEEPING IT SIMPLE" and returning to more traditional transmitter layouts and instrumentation.

This transmitter was designed for Analog (NTSC) transmission with provisions and options available to convert to Digital Service at a later date if necessary.

Refer to the UTX5K ULTRA block diagram for an overview of the transmitter architecture. This will give the technician basic information needed to understand the operation of the transmitter and the function of each subassembly.

SEE SECTION VI.A FOR PARTS LIST AND BLOCK DIAGRAM.

### B. ADCIS5 AC DISTRIBUTION

The ADCIS5 is the primary AC power inlet for the transmitter. The UTX5K ULTRA transmitter was designed for Standard 208 to 230 VAC 3-Phase using a FIVE (5) wire connection. The transmitter can be Optionally powered as 220 to 240 VAC Single Phase using a four (4) wire connection.

| <u>Standard</u>                         | <u>Optional</u>                           |
|-----------------------------------------|-------------------------------------------|
| --- 3 wires for 208 - 240 VAC 3 Phase   | --- 2 wires for 220 -240 VAC Single Phase |
| --- 1 wire for neutral connection       | --- 1 wire for neutral connection         |
| --- 1 wire for safety ground connection | --- 1 wire for safety ground connection   |

**CAUTION:** Connection to the AC Primary source must be made using all five wires listed above. Follow the wiring instruction given in TRANSMITTER INSTALLATION Section III.3. If not followed, severe damage to the transmitter and, or, electrical shock could result.

The ACDIS5 performs the following functions:

1. Provides a primary AC power breaker point to shutdown the transmitter.
2. Provides 208 VAC power to each of the 2.2KW DC power supplies with individual breaker points for added safety.
3. Provides 110 VAC circuits for Modulator, ADP500, ABS (as necessary) and AUX Power where needed.

SEE SECTION VI.B FOR SCHEMATIC AND PARTS LIST

### C. PS12KW POWER SUPPLY

The UTX5K ULTRA transmitter is designed with over 12 KW of DC power. To achieve this level, the modules mounted in the power supply in the transmitter rack consist of six (6) AC2008 power units with two (2) AC2009 main frame assemblies each of which are capable of managing three (3) 2 KW modules.

The power modules are "HOT PLUGGABLE" and can be removed or installed without turning off the transmitter.

Each power supply module has OVER VOLTAGE, OVER CURRENT AND OVER TEMPERATURE protection as well as a fault signal in the event of a failure.

REFER TO MANUFACTURER'S MANUAL FOR MODEL # TWRI6004 PROVIDED WITH THE UTX5K ULTRA.



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#### D. ADP500 AND PAS6 PERFORMANCE MONITOR

The ADP500 and PAS6 Performance Monitor provides the following functions:

1. Monitors FORWARD AND REFLECTED POWER to the hybrid combiner and presents it as a percentage of power rating. The transmitter comes set to 100% P-Sync power based on the ratings of the transmitter.
2. Provides a HIGH ANTENNA VSWR MONITOR in the event of an antenna or coax failure where the reflected power exceeds 25% the transmitter will shut down. The front panel LED will change from green to red in case of a fault.
3. Provides current monitoring of all the pallets used in the six (6) PA1K power amplifier assemblies. The current levels can be read directly from the multi-meter on the front panel. Individual pallets are selectable on the ADP500 and the PA assemblies are selected using the PAS6. In normal operation, a PA FAULT is indicated by going from green to red. RED indicates that the current level is below 500 ma and a transistor could have failed. To read the actual current, select the appropriate PA Bank using the PAS6. The ADP500 will now display status of each pallet in that PA. The multi-meter will read the actual current.
4. A PA INHIBIT switch is provided for failure diagnostic purposes. When activated, this switch allows the technician to monitor the bias currents for each pallet. These readings were recorded at the factory and are found on the Transmitter Test Report, DC Test Report Section. This is the best way to troubleshoot possible transistor problems. When in the PA INHIBIT mode, the RF PWR OFF LED will change from green to red indicating that the "SHUTDOWN LINE" is at TTL 0 state and the output power has been reduced to near zero.
5. An RF MONITOR port (BNC) is available to connect a spectrum analyzer for monitoring the output signal.
6. METER SELECTION SWITCHES

The PAS6 is used to select the appropriate PA Module (PA1K) for performance display on the ADP500. PA designations are PA1 starting from the top row going left to right with PA6 located on the bottom (3rd) row down on the right side when viewed from the front of the transmitter rack.

The rotary switch on the ADP500 is the detail selector for the multi-meter. The various positions are defined as follows:

|                   |                                                                                                                                                                                       |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PA1 thru PA5..... | Reads PA Pallet currents as selected<br>Typical reading in INHIBIT MODE 1.5 to 2.5 A<br>Typical reading SMPTE BARS 5-7 A for PA1 thru PA4<br>Typical reading SMPTE BARS 2-3 A for PA5 |
| PA6.....          | No Connection                                                                                                                                                                         |
| PS VOLTS.....     | Reads DC voltage applied to PA stages<br>Typical reading would be +29 to 33 VDC                                                                                                       |
| P FWRD.....       | Reads PA output power in P-Sync percentage of rating<br>Full power reading would be 100%                                                                                              |



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7. METER SELECTION SWITCHES

- P RFLD..... Reads PA output power being returned from the load and displayed as a percentage of forward power. Typical reading would be < 5% indicated.
- P AURAL..... Reads the AURAL POWER component as a percentage of forward power. Typical reading would be 5%
- AUX 1 & AUX 2..... Not used in this configuration.

E. RC8 REMOTE MONITOR AND CONTROL WITH ABS

This equipment is OPTIONAL and can be used to satisfy FCC remote control requirements.

The Remote Monitor is used to monitor the operational status of the transmitter and will allow the operator to turn RF on or off and adjust power levels remotely. The following items are monitored or controlled:

1. Transmitter on/off function
2. Power output level monitor and adjust
3. AC Line Voltage status - With ABS you can be notified if there is a power failure at the site.
4. Various other custom options are available. Specify these at the time the transmitter is purchased and they will be included if possible.

Remote monitoring requires a phone line connection. Information can be accessed via a PC Terminal.

The Auxiliary power unit requires a battery connection. A common car battery (12 VDC) can be used with a charger as an ABS. This will run the Monitor and provide access to transmitter status for several hours.

A manual for this equipment is provided by the Manufacturer and is included in the UTX5K ULTRA package shipped with the transmitter. **The manual is only included if this option was purchased for delivery with the transmitter.**

REFER TO INSTRUCTION MANUAL PROVIDED WITH THIS PACKAGE.

F. MA2000 MODULATOR

The heart of any TV Transmitter is the MODULATOR. This equipment receives the video and audio signals as well as any control signals needed. The base band signals are converted to RF with an output on the desired operating channel.

Detail operation of the Modulator with schematics and parts list are provided by the equipment manufacturer and included in the UTX5K ULTRA package shipped with the transmitter.

REFER TO INSTRUCTION MANUAL PROVIDED WITH THIS PACKAGE.



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G. UDR100AC 100 WATT DRIVER AMPLIFIER

The RF output from the MA2000 Modulator is applied to the input of the UDR100AC driver amplifier. This amplifier increases the drive level to that required for each of the six (6) PA1K power amplifiers to make rated power. The UDR100AC is powered by 110 VAC.

REFER TO SECTION VI.C. FOR SCHEMATIC DIAGRAM AND PARTS LIST.

H. S6 6-WAY SPLITTER

The S6 Splitter is an 6-Way in-phase broadband splitter. This splitter provides an equal split of drive power to each of the six (6) PA1K power amplifiers in each transmitter rack.

SEE SECTION VI.G. FOR PARTS LIST

I. MFA2PA POWER AMPLIFIER HOUSING

The MFA2PA is the main RF Power Amplifier housing which accommodates two (2) PA1K Amplifiers. The housing includes the following:

- 2 each 330 CFM cooling fans
- 2 each Air filter assemblies
- 2 each Front panel status PC boards
- 1 each Main chassis
- 2 each Mechanical slide assemblies
- 1 each AC Filtered inle for cooling fans

SEE SECTION VI.D FOR SCHEMATICS AND PARTS LIST

I-1. PA1K POWER AMPLIFIER

The PA1K is the main RF Power Amplifier Assembly used in the UTX5K ULTRA. Each amplifier assembly is made up of one (1) U250LD power pallet and two (2) U500LDA power pallets. These amplifiers are operated in Class A/AB or sometimes referred to as "HARD AB". This refers to the bias levels to achieve best linearity.

Each PA1K amplifier assembly includes the following:

- 1 each U250LD power pallets
- 2 each U500LDA power pallets
- 1 each Phase and gain matching circuit
- 1 each 2-Way in-phase splitter
- 1 each 2-Way in-phase combiner
- 1 each Circulator
- 1 each Power distribution module (1A0025)
- 2 each Thermal sensors
- 1 each Remote monitor port (DB9)
- 1 each Front panel status port (Molex)
- 1 each Filtered DC input port
- 1 each Type N Panel mounted RF Input port
- 1each DIN 7/16 Panel mounted RF Output port

SEE SECTION VI.E. FOR SCHEMATICS AND PARTS LIST



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J. UC6KWN 6-WAY COMBINER

The UC6KW is an 6-Way in-phase combiner. The combiners are specifically designed for the channel designated transmitter frequency. This is a closed unit and cannot be serviced.

SEE SECTION VI.G. FOR PARTS LIST

K. BPU10K UHF BAND PASS FILTER

This Band Pass filter was designed to meet FCC Certification requirements with minimum loss of RF Power. The BPU10KW comes tuned and tested to the operating frequency of the transmitter and should not be adjusted without proper equipment. Replacement filters are available as P/N BPUKW UHF (+CHANNEL NUMBER).

L. DC7KW DIRECTIONAL COUPLER

The DC7KW Directional Coupler provides for insertion monitoring of forward and reflected RF power, between the output combiner and the bandpass filter, and is sent to the ADP500 for display.

M. AUX MONITOR PANEL

The auxiliary monitor panel provides analog meter measurements for the primary DC supply. The total power supply current and voltage are displayed on these meters. These measurements serve as a good indication of the operation of the transmitter final power amplifiers.

Each power supply has a current monitor output. These outputs are accessible on the AUX5 front panel. Each (PS I Share) test point will indicate a relative amount of current being supplied from the power supply. This is not a calibrated or accurate measurement that is scaled from the current capability of the power supply. This is also a second-level diagnostic tool for use by qualified technicians.

In the event of an EMERGENCY, a SHUTDOWN SWITCH located on the AUX5 will shut down the transmitter and remove all power starting from the MAIN 3-P BREAKER. To turn the transmitter on, it is necessary to RECYCLE the SHUTDOWN SWITCH before the transmitter MAIN BREAKER can be turned on.

N. FP6 FUSE AND SHUNT PANEL

The FP6 serves as a DC SUMMING POINT for all current coming from the power supplies. After being summed, the current passes through a 1000 AMP precision shunt which is used for measuring the total supply current and voltage being applied to the transmitter power amplifiers. At this point, the DC power is distributed to each PA1K amplifier assembly through a series 125 amp fuse.

**NOTICE: BEFORE ANY SERVICE WORK IS PERFORMED ON THE FP6 ALL POWER TO THE TRANSMITTER MUST BE TURNED OFF FOR SAFETY.**