

Chapter 2 System Description

The 420A is a complete 100 watt high band VHF solid-state internally diplexed television transmitter that operates at a nominal visual output power of 100 watts peak sync and an average aural output power of 10 watts at a 10 dB A/V ratio, 10% sound.

The 420A has been submitted for type acceptance to the FCC; the relevant FCC identifier for the 420A is _____.

2.1 420A System Overview

The 420A (1066428) consists of (A1) a 100-watt, high-band VHF exciter/amplifier tray (1066308) and (A2) a bandpass filter assembly.

The exciter/modulator section of the 100-watt, high-band VHF exciter/amplifier tray operates using either baseband audio and video inputs. However, if the (optional) 4.5 MHz composite input kit (1273-1128) is purchased, the 4.5 MHz composite input or the baseband video and audio inputs are used to produce a diplexed, modulated, on-channel frequency visual + aural RF output. The switching between the 4.5 MHz generated by the baseband inputs or by the 4.5 MHz composite input is accomplished by a relay, on the sync tip clamp modulator board. The relay is controlled by a baseband select which connects to J18-6 and 7 on the rear of the tray. To operate the transmitter with the (optional) 4.5 MHz composite input kit using baseband inputs, the baseband video must be connected to J1 or J2, the baseband audio must be connected to the proper input jack, and a baseband select must be connected to J18-6 and 7. To operate the transmitter with the (optional) 4.5 MHz composite input kit using the 4.5 MHz composite input, the 4.5 MHz composite input must be

connected to J1 or J2 and the baseband select must be removed from J18-6 and 7.

The exciter/modulator section of the tray takes the baseband audio and video inputs, or the (optional) 4.5 MHz composite input, and produces a combined 45.75 MHz + 41.25 MHz IF output that connects to J32 on the ALC board. The combined IF output of the ALC board connects to the mixer/amplifier assembly where it is upconverted and filtered to the on-channel frequency visual + aural RF output. The RF is filtered and amplified in the amplifier section to the 100-watt output power level. The RF output is filtered in the bandpass filter assembly and fed to the antenna via the transmission line.

The exciter and upconverter section of the tray operate when the circuit breaker CB1 is on, but the amplifier section only operates when the transmitter is in Operate. This occurs because the switching power supply that supplies the operating voltages to the amplifier section has an inhibit command applied to it, shutting it off as long as the transmitter is in Standby.

2.1.1 Exciter Section

The baseband video and audio inputs to the transmitter connect to the rear panel of the tray. The baseband video or the (optional) 4.5 MHz composite input connects to jack (J2), which is a loop-through connected to jack (J1). By removing the termination jumper on the sync tip clamp/modulator board, jack (J1) can be used as a connection for the baseband video or the 4.5 MHz composite input to another transmitter. The baseband audio input connects to the terminal block (TB1) for balanced

audio or to the BNC jack (J3) for composite audio, which is a loop-through connected to jack (J13). There are also connections for the remote monitoring and operation of the transmitter at the "D"-connector jacks (J10 and J11).

The baseband audio connects to (A4) the aural IF synthesizer board (1265-1303), in the exciter section, which provides the amplification for each of the three possible audio inputs and the amplifier circuit that supplies the single audio output. The board has the 4.5 MHz VCO and the aural modulation circuitry that produces the modulated 4.5 MHz output. The board also contains a PLL circuit to maintain the precise 4.5 MHz separation between the aural (41.25 MHz) and visual (45.75 MHz) IF frequencies. The video input or 4.5 MHz composite input to the exciter section connects to (A5) the sync tip clamp/modulator board (1265-1302) that takes the video input and produces a sync tip clamped and modulated visual IF + aural IF output at the output jack J20. If the optional 4.5 MHz composite input is purchased, the input is directed out of the sync tip clamp/modulator board to the (A24) composite 4.5 MHz filter board (1227-1244) and the (A25) 4.5 MHz bandpass filter board (1265-1307). These two boards process the 4.5 MHz composite input and produce the video that connects back to the sync tip clamp/modulator board at J27. The clamp portion of the board maintains a constant peak of sync level of the video signal over varying average picture levels (APL). The modulator portion of the board contains the circuitry that generates an amplitude-modulated, vestigial-sideband IF signal output at 45.75 MHz.

The 45.75 MHz is generated by (A7) the IF oven oscillator board (1191-1404) and connected (+5 dBm) to the sync tip clamp/modulator board. The combined visual IF + aural IF output (0 dBm) connects to J32 on (A8) the ALC board and then through relays to the rest of the

ALC board. The ALC board gives the operator control over the output power level of the transmitter by adjusting the level of the combined IF signal. The IF connects out of the board at J3 and is directed to (A9) an IF phase corrector board (1227-1250). The IF signal is phase corrected as needed and fed back to the ALC board.

2.1.2 Upconverter Section

The output of the ALC board (0 dBm) connects to (A11-A1) the filter/mixer board (1150-1102), in the (A11) mixer/amplifier enclosure (1065007), which takes the LO and heterodynes it with the combined IF. This signal is then fed to the high-band VHF filter/amplifier board, high output (1064150), that amplifies the RF signal and feeds it to the (A23) high-band amplifier heatsink assembly (1065008). The crystal frequency needed to generate the LO is produced by (A14-A1) the channel oscillator board (1145-1201) in (A14) the channel oscillator assembly (1145-1202). The crystal frequency (+5 dBm) from the oscillator is multiplied four times by (A15-A1) the x4 multiplier board (1174-1112), in (A15) the multiplier enclosure (1235-1101), which produces the LO signal.

2.1.3 Amplifier Section

The RF output of the upconverter section (+11 dBm) is fed to the amplifier section of the transmitter. The amplifier section consists of an (A23) amplifier heatsink assembly (1065008) and associated components. The first stage of the amplifier section amplifies the RF to +31 dBm in (A23-A1) a high-band VHF amplifier board assembly (1065812) that consists of a high-band VHF amplifier board (1218-1201) and associated components. The RF is divided by the (A23-A2) 2-way combiner assembly (1064485) and fed to two parallel (A23-A3 and A23-A4) high-band VHF amplifier board assemblies (1065812). The amplified signals are fed to another (A23-

A5) 2-way combiner board. The RF output from the 2-way combiner board (+51 dBm) is fed through (A31) an output coupler board (1088-1104) that provides a forward power sample to (A19) the visual/aural metering board (1265-1309). A forward sample connects to the transmitter control board that supplies the voltage sample to the front panel meter of the tray. The reject port of the output coupler board provides the reject sample to the visual/aural metering board. The metering board connects the reflected sample to the transmitter control board for VSWR cutback and front panel-reflected metering for the tray.

2.1.4 Bandpass Filter Assembly

The output from the (A1) 100-watt, high-band VHF exciter/amplifier tray is fed to the input of the (A2) bandpass filter assembly. The signal is fed to the (A2-A1) 5-section bandpass filter with traps and then through (A2-A2) a high-band VHF coupler assembly that provides a filtered RF sample for test purposes.

2.1.5 Operational Voltages

The transmitter needs an AC input of 115 or 230 VAC at 10 amps connected to it, through the AC power plug, in order to operate. The tray is set at the factory to operate at the proper input voltage. This is accomplished by setting the (A1) power entry module to the correct line voltage.

2.1.6 Configuration of the Power Entry Module AC Input

For 115 volts, verify that 115V is indicated on the rear panel cover on the power entry module. If it is not, gently open the cover, remove the fuse assembly, and reinsert it so that 115V is visible with the cover closed.

For 230 volts, verify that 230V is indicated on the rear panel cover on the power entry module. If it is not, gently

open the cover, remove the fuse assembly, and reinsert it so that 230V is visible with the cover closed.

The input AC voltage connects from the jack (J14), which is part of (A1) the power entry module on the rear of the tray, to (CB1) a 10-amp circuit breaker that is also on the rear of the tray. The switched AC is wired through (A1) the power entry module. This module contains two fuses, one on each line, to the terminal block (TB2). TB2 has four MOVs mounted to the terminal block, one connected from each leg of the input AC to ground and one across each of the two legs, for surge and transient voltage protection of the tray.

The input AC is wired from TB2 to (A28) the switching power supply and to (A2) a toroid transformer. The (A28) switching power supply (1063547) provides the +48 VDC to operate the amplifier assemblies and also to (A10) the +48 VDC fan in the tray. The step-down toroid (A2) supplies two 16 VAC outputs, through the terminal block (TB2), to (A3) the +12V(4A)/-12V(1A) power supply board (1265-1312). The AC connects on the board to two full-wave bridge networks for +12 VDC and one full-wave bridge network for -12 VDC. The rectified DC from the +12 VDC full-wave bridge networks is connected to the (U1-U4) current limiting voltage regulator ICs. The rectified DC from the -12 VDC full-wave bridge network is connected to the (U5) current limiting voltage regulator ICs. The ± 12 VDC outputs connect to the rest of the boards in the tray through jacks (J3-J8).

2.1.7 Control and Status

Meters, switches, and LED indicators are mounted on (A17) the transmitter control board (1068933). The control board is attached to the back of the front panel to allow for the switches and the LEDs to be operated or viewed from the front of the tray. The (S1) Operate/Standby switch controls the output of the transmitter by applying or removing the inhibit command to the switching power supply that provides the DC supply voltages to the amplifier section.

In Operate, the green LED (DS2) is on and the inhibit command is removed. When in Standby, the amber LED (DS1) is on and the inhibit command is applied. Switch (S2) is an Automatic/Manual switch that controls the operation of the

transmitter by the presence of the video input signal. When the switch is in Automatic, the green LED (DS3) is lit and, if the video input signal is lost, the transmitter automatically switches to Standby after a short delay. When the video input signal returns, the transmitter immediately switches back to Operate. In Manual, the amber LED (DS4) is lit and the operation of the transmitter is controlled by the front panel switches. During normal operation of the transmitter, switch S2 should be in the Auto position.

The front panel of the tray also has LEDs that indicate Video Fault (Loss) (red LED [DS9]) and VSWR Cutback (amber LED [DS7]). The meters, switches, and LEDs found in the 420A are described in the following tables.

Table 2-1. Meters

METER	FUNCTION
METER (A18) (mounted on the front panel)	Displays power in terms of a percentage of the calibrated output power level. A full-scale reading is 120%. A reading of 100% is equivalent to the full-rated peak of sync visual output power, 100 watts. Also reads % Exciter, % Reflected, and % Aural Power along with the ALC voltage, video, and audio levels.
SWITCH (S3), METER (mounted on the front panel)	Selects the desired % Power, ALC voltage, video, or audio level reading
ALC (0-1 V)	Displays the ALC voltage level (.85 VDC)
% EXCITER (0-120)	Displays the % Exciter Output power (level needed to attain 100% output power)
% REFLECTED (0-120)	Displays the % Reflected Output power (<10%)
% VISUAL POWER (0-120)	Displays the % Visual Output power of the transmitter (100%=100 watts peak of sync)
% AURAL POWER (0-120)	Displays the % Aural Output power of the transmitter (100%=10 watts at 10 dB A/V ratio)
VIDEO (0-1V)	Displays the video level (1V at white with .3V sync only, -40 IRE)
AUDIO (0-100kHz)	Displays the audio level (± 25 kHz balanced or ± 75 kHz composite); will not read if only the 4.5 MHz composite input kit is used

Table 2-2. Switches (mounted on the front panel)

SWITCH	FUNCTION
TRANSMITTER (S1)	The momentary contact switch (S1) applies a ground to K1, latching relay, located on the transmitter control board.
OPERATE/STANDBY	K1 will switch either to Operate or to Standby depending on which direction S1 is pushed. When switched to Operate, the inhibit command is removed from the switching power supply. This allows the switching power supply to apply 48V to the amplifier boards. When switched to standby, the power supply is disabled.
MODE SELECT (S2)	The momentary contact switch (S2) applies a ground to latching relay K2, on the transmitter control board.
AUTO/MANUAL	K2 will switch the transmitter to the Automatic or Manual mode depending on which direction S2 is pushed. In Automatic, the video fault command from the ALC board will control the operation of the transmitter. The transmitter will switch to Standby after a slight delay, if the input video is lost, and will switch back to Operate when the video is restored. In Manual, the transmitter is controlled by the operator using the front panel Operate/Standby switch or by remote control.

Table 2-3. Adjustments

ADJUSTMENT	DESCRIPTION
GAIN (A20-R1)	Adjusts the gain of the RF output using the ALC board when the IF ALC circuit is Enabled

Table 2-4. Control Indicators (LEDs mounted on the front panel)

INDICATOR	FUNCTION
OPERATE (DS2 GREEN)	Indicates that the transmitter is in Operate
STANDBY (DS1 AMBER)	Indicates that the transmitter is in Standby
AUTO (DS3 GREEN)	Indicates that the transmitter is in Automatic mode; switches to Standby if the input video signal is lost
MANUAL (DS4 AMBER)	Indicates that the transmitter is in Manual mode; will not automatically switch to Standby if the input video signal is lost

Table 2-5. Status Indicators (LEDs mounted on the front panel)

INDICATOR	FUNCTION
VIDEO LOSS (DS9 RED)	Indicates that the input video has been lost to the transmitter. The fault is generated on the ALC board.
VSWR CUTBACK (DS7 AMBER)	Indicates that the reflected power level of the transmitter has increased above 20%; this will automatically cut back the output power level to 20%. The fault is generated on the transmitter control board.

Table 2-6. Samples (BNC connectors mounted on the front panel)

SAMPLE	DESCRIPTION
f(s)	A sample of the channel oscillator output taken from the sample jack of the channel oscillator assembly. The (f_c) channel RF frequency equals four times the crystal frequency (f_s) minus the (f_{IF}) IF frequency.
f(IF)	A sample of the 45.75 MHz output from the IF carrier oven oscillator board
f(IC)	A sample of the 4.5 MHz intercarrier output from the aural IF synthesizer board
EXCITER O/P	An output power sample of the exciter taken from the VHF filter/amplifier board, high output

2.1.8 Input and Remote Connections

The baseband video and audio inputs alone or, if the (optional) 4.5 MHz composite input kit (1273-1326) is purchased, the 4.5 MHz composite input or the baseband video input and audio

input to the transmitter, connect to the rear of the tray. The baseband video input, or the 4.5 MHz composite input, connects to jacks J1 or J2, which are loop-through connected. The baseband audio input connects to TB1 for balanced audio or to jacks J3 or J13, which are

loop-through connected, for composite, stereo, audio. To use the 4.5 MHz composite input kit, the baseband audio can remain connected to the VHF exciter even if the 4.5 MHz composite input kit is used, but the baseband video must be disconnected from J1 or J2 and the 4.5 MHz composite input connected to J1 or J2. The baseband select command must also be removed from J18-6 and 7.

Remote monitoring and operation of the transmitter is provided through the jacks (J10 and J11) on the rear of the tray. Jack (J11) should have a dummy plug connected to it, with a jumper connected between pins 23 and 24, that provides the interlock needed to operate the transmitter. If this jumper is missing, the transmitter will not switch to Operate. If

remote connections are made to the transmitter, they should be made through the plug in J11 or to J10 in the positions noted in Table 2-7.

Note: If the optional 4.5 MHz composite input kit is purchased, the baseband select connects to J18, pins 6 and 7, on the back of the tray.

The remote interface connections for the 420A transmitter are listed in Table 2-7. These connections are made to jack (J11), the 37-position, "D"-connector, or to jack (J10), the 25-position, "D"-connector, on the rear panel of the tray.

Note: Only the pins called out in Table 2-7 are utilized in this transmitter.

Table 2-7. Remote Interface Connections

Table 2-7. Remote Interface Connections		
FUNCTION	REMOTE JACK/PIN NUMBER	INTERFACE TYPE
Transmitter Enable Interlock	J11-24	J11-24 and 23 must be jumpered together for normal operation; (1176-1038) jumper jack should be used.
Transmitter Enable Interlock Rtn	J11-23	
Remote Control Commands		
Transmitter Standby (Disable)	J11-22	Contact closure
Transmitter Standby/Operate Rtn	J11-21	
Transmitter Operate (Enable)	J11-20	Contact closure
Transmitter Manual	J11-9	Contact closure
Transmitter Auto/Manual Rtn	J11-36	
Transmitter Auto	J11-8	Contact closure
Power Level Raise (optional)	J10-11	Contact closure
Pwr Lvl Raise/Lower Rtn (optional)	J10-13	
Power Level Lower (optional)	J10-12	Contact closure

Table 2-7. Remote Interface Connections

FUNCTION	REMOTE JACK/PIN NUMBER	INTERFACE TYPE
Modulator Select (optional)	J11-10	Contact closure
Modulator Select Rtn (optional)	J11-30	
Remote Status Indications		
Transmitter Operate (Enable) Ind	J10-3	50 mA max. current sink
Operate/Standby Ind Return	J10-16	
Transmitter Standby (Disable) Ind	J10-4	50 mA max. current sink
Transmitter Auto Indicator	J11-7	50 mA max. current sink
Auto/Manual Indicator Return	J11-32	
Transmitter Manual Indicator	J11-6	50 mA max. current sink
VSWR Cutback Indicator	J11-37	50 mA max. current sink
VSWR Cutback Indicator Return	J11-35	
Video Loss (Fault) Indicator	J11-25	50 mA max. current sink
Video Loss (Fault) Ind. Rtn	J11-31	
Receiver Fault (optional)	J11-12	
Remote Metering		
Visual Output Power	J11-26	1V full scale At 1k Ω source resistance
Visual Output Power Rtn	J11-28	
Aural Output Power	J11-27	1V full scale At 1k Ω source resistance
Aural Output Power Rtn	J11-29	
Reflected Power	J10-5	1V full scale At 1k Ω source resistance
Power Rtn	J10-22	
Exciter Output Power	J10-10	1V full scale At 1k Ω source resistance
Power Rtn	J10-22	