Cable AML

Installation and Maintenance Manual

Indoor Broadband Transmitter

Model: ITX21-100

INSTALLATION AND MAINTENANCE MANUAL

for

Indoor Broadband Transmitter

Model: ITX21-100

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TABLE OF CONTENTS

Section Page

LIST OF ILLUSTRATIONS

LIST OF TABLES

1.0 INTRODUCTION

The ITX21-100 shown in Figure 1 is a solid-state broadband transmitter that converts a VHF input signal of 119 MHz to a microwave signal of 2.159 GHz.

The ITX21-100transmitter consists of the following assemblies (refer to Figure 2).

1. **Upconverter** – for converting the incoming VHF signal to microwave. The upconverter section contains all components necessary for upconversion, i.e. local oscillator, mixer, as well as band-pass and notch filters.
2. **Power Amplifier** – The amplification is accomplished with minimum distortion by a state of the art linearised Gallium Arsenide FET microwave power amplifier. The power amplifier is protected from failure due to overheating by an internal temperature sensor. The sensor circuit automatically switches off the amplifier D.C. power when the amplifier temperature exceeds 158 degrees F (70 degrees C).
3. **Power supply system** – The microwave modules are powered from a +12 VDC switching power supply. The local oscillator is powered from a +12 VDC linear power supply. A 24 VDC power supply powers the downconverter. A +5 VDC voltage regulator is used to for the power amplifier's TTL circuit.
4. **Monitoring and Diagnostic Circuits** – Depending on the configuration of the compact transmitter, the input and output can be continuously monitored without interruption of service with a standard TV set or a field strength meter by means of a front panel dual function coaxial connector. Diagnostic DC voltages can also be continuously monitored via a front panel meter with a selectable switch or a rear panel multi-pin connector.
5. **On-Delay Timer Assembly** – Upon start-up of the compact transmitter, a binary counter is used to delay voltage to the power amplifier. This gives the +12 VDC switching power supply time to stabilize.

The ITX21-100transmitter can be equipped to operate on either 120 or 240 VAC at 50 to 60 Hz. This option is specified by customer request, and each unit is shipped according to this specification.

Complete specifications are listed in Section 6.0.

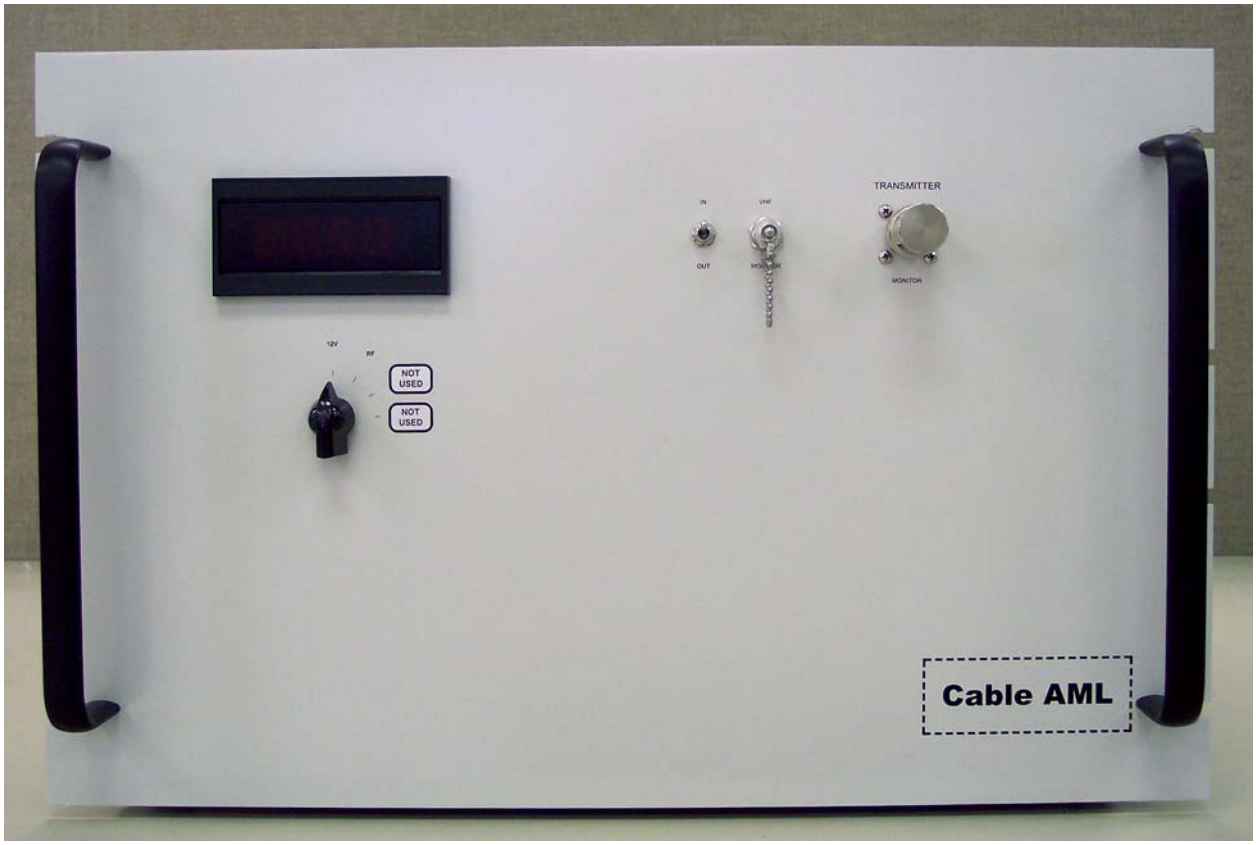

Figure 1. ITX21-100 Broadband Transmitter.

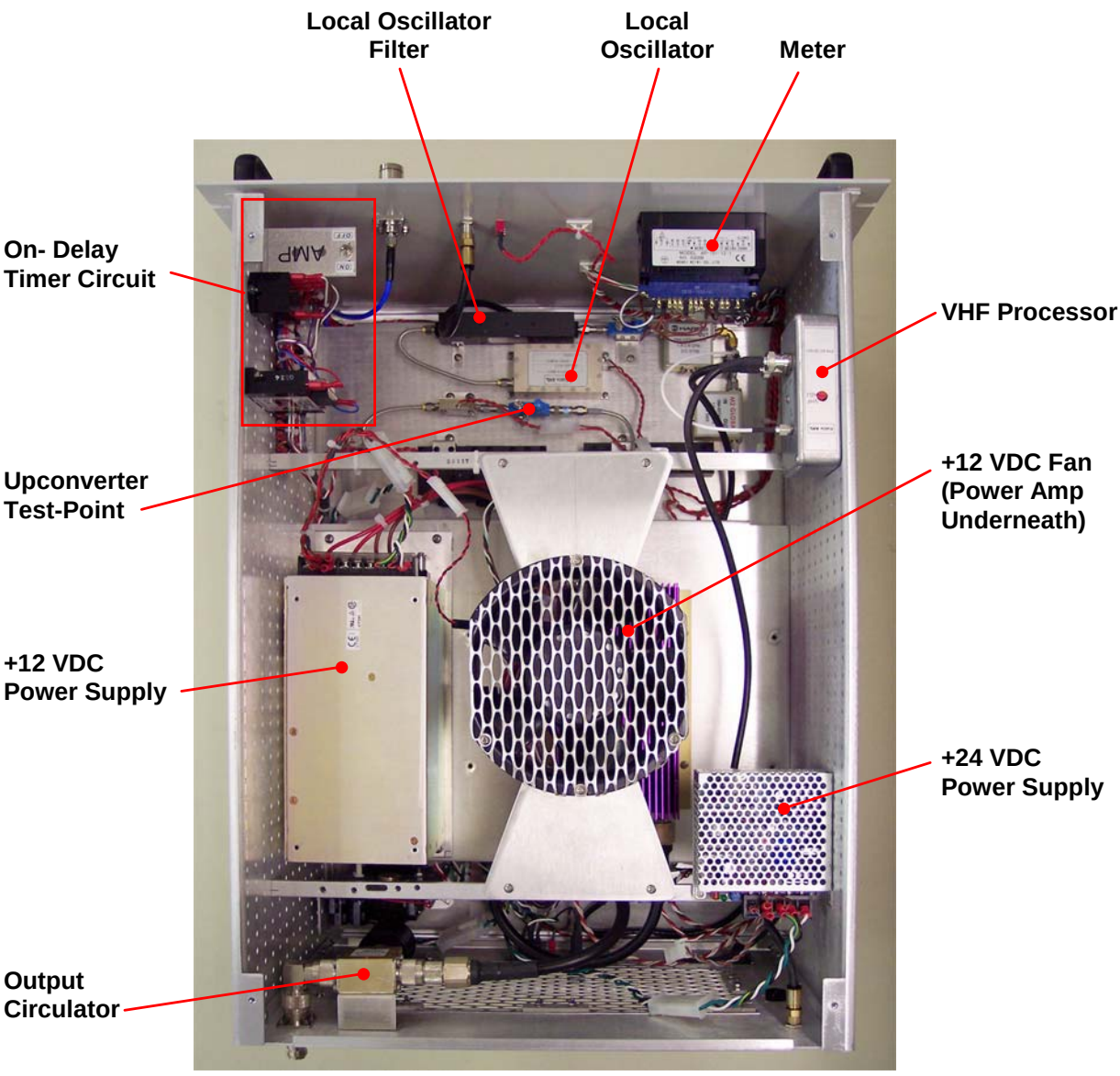

Figure 2. ITX21-100 Component Layout.

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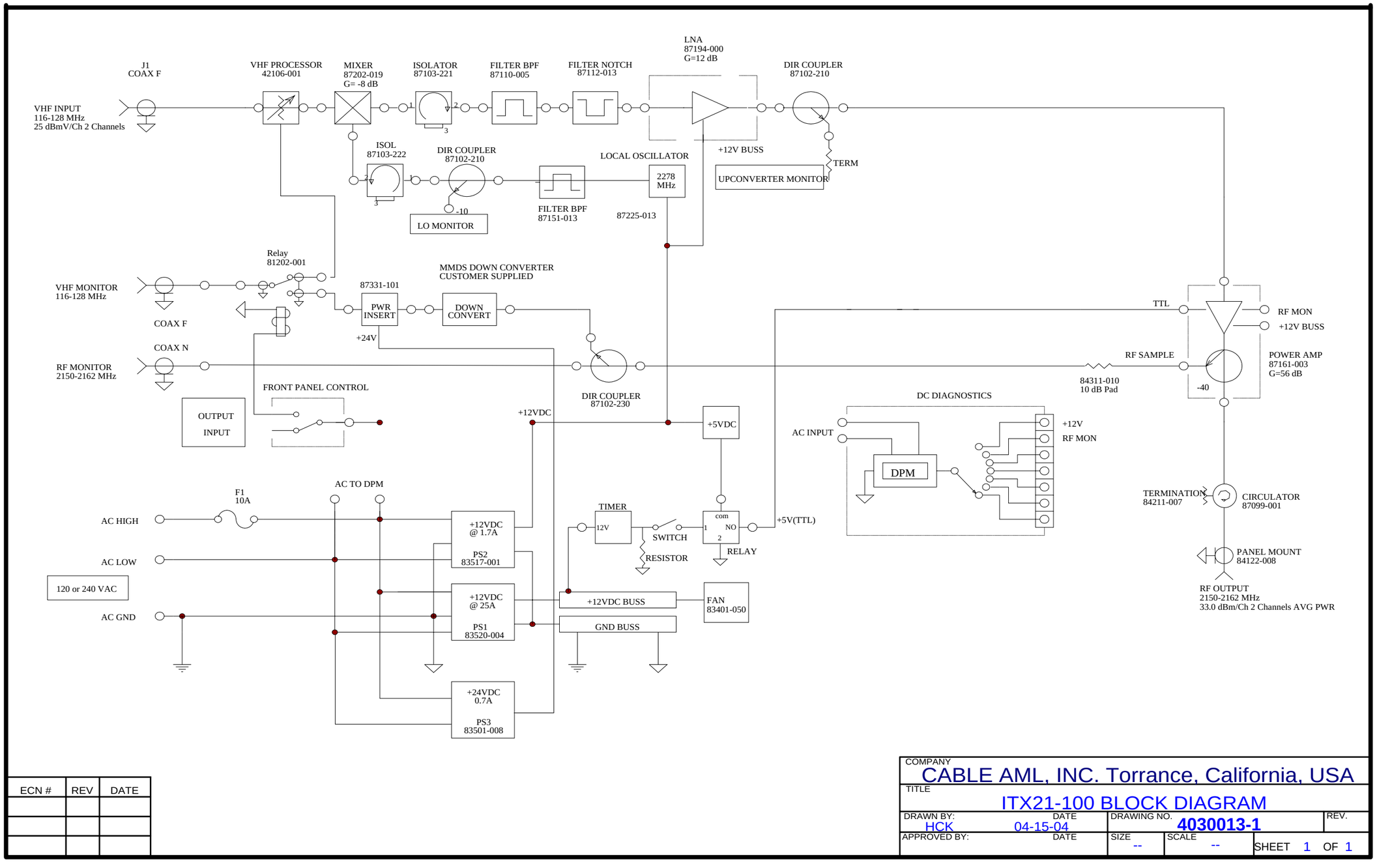

Figure 3. ITX21-100 Block Diagram.

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2.0 CIRCUIT DESCRIPTION

The ITX21-100Transmitter consists of the following circuits or modules:

1. Upconverter Section
2. Power Amplifier
3. Power Supply System
4. Monitoring and Diagnostic Circuits - connectors and switches.
5. On-Delay Timer Assembly.

In addition, microwave isolators and filters are used as necessary to ensure the stability and purity of transmitted signals.

2.1 Upconverter Section

The Upconverter Section is comprised of the following major functional circuits or modules:

1. Hybrid Local Oscillator
2. Upconverter/ Mixer
3. Filter Assembly

Hybrid Local Oscillator – The local oscillator consists of a crystal oscillator, frequency multiplier, and a band pass filter all encapsulated in solid 6061-T6 aluminum. The output of the local oscillator provides pump power to the signal upconverter. The local oscillator is powered by +12 VDC.

Upconverter Mixer – The translation from VHF to microwave frequencies takes place here. The mixer is also called an "upper sideband upconverter". The desired output of the upconverter is a signal at a frequency, which is the sum of the local oscillator, and VHF input frequencies. The upconverter also generates unwanted signals which have to be filtered out, among them the "lower sideband", LO leakage, and others.

Filter Assembly – There are two filters. The group band-pass filter is tuned to pass the upper sideband. The notch filter is tuned to attenuate the local oscillator leakage without affecting the output signal.

2.2 Power Amplifier Chains

The power amplifier is a state of the art linearised device with a 1 dB compression point of 100-Watts average (50 dBm). The design incorporates four stages of amplification in series, each incorporating pre-matched GaAs (Gallium Arsenide) power modules. The total gain is approximately 40 dB. In addition to the microwave circuits, the amplifier includes DC voltage regulator circuits, output RF monitoring circuits, and TTL-actuated power-off capabilities. The TTL circuit uses a 5VDC voltage regulator to turn the power amplifier’s voltage regulators on or off. +5VDC to the power amplifier will activate the TTL circuit, causing the amplifier to turn itself off.

2.3 Power Supply Assembly

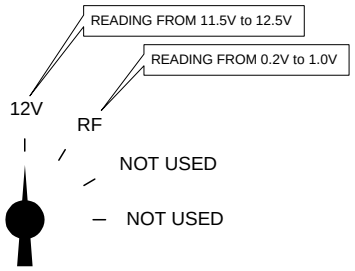
Two +12 VDC and one +24 VDC power supplies are used to provide the DC voltage. A +12 VDC linear power supply is used to provide power to the internal downconverter and Local Oscillator. A 5 VDC regulator is only used for the TTL switch for the power amplifier. The MDS downconverter is powered by a 24 VDC power supply. A +12 VDC switching power supply is used to power everything else in the compact transmitter.

2.4 Diagnostic Circuits1

The ITX21-100transmitter has several connectors and switches.

Connectors - There are two monitor connectors on the front panel. The transmitter's input and output at VHF can be viewed at the "VHF MONITOR" port on the front panel. Selection is by a toggle switch, which energizes a 12 VDC coaxial relay. The "INPUT" position selects a sample of the VHF input directly. The "OUTPUT" position selects the VHF spectrum downconverted from a sample of the microwave output of the power amplifier. The downconversion is performed by an internal MDS downconverter with the same LO as the compact transmitter. The transmitters output at microwave can be viewed at the "RF MONITOR" port on the front panel. The signal is a sample of the power amplifiers output thru a 40 dB coupler.

DC Voltage Diagnostics – DC voltage diagnostic signals can be read using the built- in meter on the front panel. The functions available are shown below:



1. +12 VDC of power supply, volts
2. RF detector of power amp, volts

Figure 4. DC Diagnostics Switch Positions.

Power "On/Off" Switch Panel – The power amp switch applies +5VDC to the power amplifier's TTL circuit, which shuts down the power amplifier.

2.5 On-Delay Timer Assembly

A relay and binary counter is used to delay power to the amplifier. This is so the +12 VDC power supply has a chance to stabilize upon start up of the Transmitter. The counter is set for an 8 second delay upon start up of the transmitter.

1See Data Manual for nominal values of diagnostic signals.

3.0 INSTALLATION

3.1 Unpacking

Inspect shipment for obvious damage then carefully check for other possible shipping damage such as bent or loose connections that may result in signal leakage. **If any damage is suspected, notify Cable AML and the shipper before proceeding with installation of the equipment.**

Check the packing list against the parts shipped and verify that the correct material has been received. Communicate any discrepancies to Cable AML immediately.

3.2 Location

All transmitters should be installed in an area with adequate ventilation to provide the necessary airflow into the unit. The rubber feet installed on the chassis are for bench testing convenience.

Each rack mountable chassis unit (to be installed by customer) should be assembled in rack with at least 6 inches free space above them. This allows removal of hole plugs in the top covers for access to the adjusting screws of the VHF processor module.

A support bar has been provided to help with the weight of the transmitter should it be installed in a rack. It should be placed near the rear of the transmitter.

3.3 Input Voltage Requirements

Cable AML transmitters can be equipped to operate on either 120 or 240 VAC at either 50 or 60 Hz. This option is specified by customer request, and each unit is shipped according to this specification.

3.4 Operating and Diagnostic Connections

Figure 6 shows the locations of connectors on the rear and front panels of the transmitter.

Operating Connections

- RF Output – The transmitter's output connector on the rear panel is type N coaxial, to which the output cable to the transmit antenna is connected.
- VHF Input – The transmitter's input connector on the rear panel is type F female, to which the VHF inputs are connected.

AC Power connections – This unit is equipped with an AC power cord that is wired for single-phase operation. It is necessary to attach a plug to the power cord before putting the unit into operation. It is important that the following color code be followed when wiring up the transmitter!!

The **BLACK** or **BROWN** wire is **HOT** or **MAIN** lead.

The **WHITE** or **BLUE** wire is the **NEUTRAL** lead.

The **GREEN** or **GREEN/YELLOW** is the **GROUND** or **EARTH** lead.

Table 1. Typical Channel Loading for ITX21-100 Input/Output Levels[2]

Number Of Channels	Input Level To Transmitter	Output Level From Transmitter
9	31.5 dBmV/Channel	27.5 dBm/Channel
12	30.0 dBmV/Channel	26.0 dBm/Channel
18	28.0 dBmV/Channel	24.0 dBm/Channel
24	26.0 dBmV/Channel	22.0 dBm/Channel
30	25.0 dBmV/Channel	21.0 dBm/Channel

Diagnostic Connections

Diagnostic connections, not essential to the normal operation of the transmitter, are made at the front panel of the transmitter.

RF Diagnostics – A type N connector is provided on the front panel for the RF monitor point. The location is shown in Figure 5.

VHF Input/Output Test Point – VHF input and output signal test point "F" connector is provided on the front panel. A toggle switch is used to switch between input and output VHF signals.

Figure 5. Front Panel Connection Points.

2 See Data Manual for actual values.

Figure 6. Rear Panel Connection Points.

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4.0 OPERATION

The ITX21-100 transmitter requires no adjustments when used in the configuration recommended in the Data Manual. To properly operate the transmitter, simply apply the required AC power and input signal. The ITX21-100 transmitter can be equipped to operate on either 120 or 240 VAC at 50 or 60 Hz. This option is specified by customer request, and each unit is shipped according to these specifications.

4.1 Output Level Setting

The output power for each ITX21-100 Transmitter Unit depends entirely on the input level. If the input level at VHF is higher than the recommended value, both the output power and the CTB (Composite Triple Beat) distortion will increase. For every one dB of higher input level there will be one dB of higher output power and two dB higher distortion.

CONSEQUENTLY, IT IS NOT RECOMMENDED TO CHANGE OR ADJUST THE TRANSMITTER OUTPUT LEVELS UNLESS THERE ARE SIGNIFICANT CHANGES IN THE NUMBER OF INPUT CHANNELS OR OTHER SYSTEM PARAMETERS.

A Microwave Power Meter or Spectrum Analyzer is required to set the Output Level. It should be connected to the transmitter output monitor connector on the front panel.

The output level can then be set by adjusting the VHF Processor Module's level set attenuator labeled "VHF ADJ" for the required output level required by the system design. The adjusting screw is shown in Figure 7. If a power meter is not available, the transmitter output monitor reading can be used in conjunction with a table provided with the transmitter performance data sheets provided in the Data Manual.

Observe the output of the transmitter with the spectrum analyzer. Using the "VHF ADJ" set the channel levels to the desired level. An individual channel that is out of line with the others must be adjusted at its source.

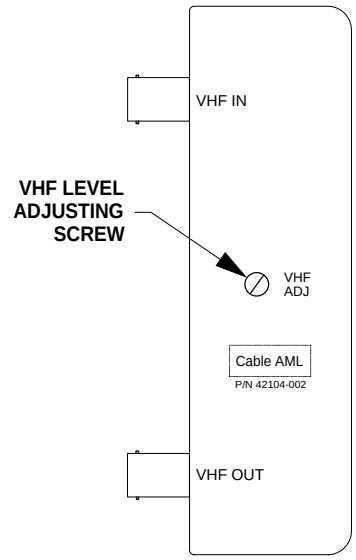

Figure 7. Output Level Adjustment.

4.2 Ambient Conditions

The ITX21-100 transmitter is designed to operate with no external cooling devices. Internal cooling fans maintain component temperatures at desirable levels when ambient conditions are in the range specified in Section 6.0 - Specifications.

4.3 Thermal Sensor Switch

To protect the power amplifier from overheating due to fan failure or excessive ambient temperature, an internal temperature sensor automatically cuts off DC input power to the power amplifier when the temperature exceeds a factory set threshold of 158°F (70°C). If the cause of overheating is fan failure, the failed unit should be replaced prior to applying power.

5.0 MAINTENANCE AND TROUBLESHOOTING

5.1 Maintenance

Maintenance is not normally required for the ITX21-100 after initial installation. However input and output power levels should be measured periodically and adjustments made if necessary.

The output power level should be measured and adjusted as described in Section 4.0 of this manual. The VHF input levels should be verified before making significant adjustments in the transmitter. If the VHF input level is correct and the transmitters output cannot be set properly, external troubleshooting is necessary as described in the next section.

5.2 External Troubleshooting

In the event of low or no output from the transmitter, first verify the following:

1. Verify the AC power input by checking the fan on the transmitter for motion. If not operating then check the line fuse on the back panel.
2. Frequency and level of the VHF input.
    - Incorrect input frequencies may produce output frequencies that are unable to pass through the two filters or the power amplifier.

If these items are found acceptable, check the VHF Transmitter Monitor output:

1. With the selector switch in the INPUT position, the output will be a replica of the VHF input signals, but about 20 dB lower. If the Transmitter Monitor INPUT selection produces low or no output, recheck item #1 above.
2. With the selector switch in the OUTPUT position, the output should be a replica of the VHF input signals, but about 5-10 dB higher. If the Transmitter Monitor OUTPUT selection produces low or no output, check the DC diagnostics on the front panel meter.

DC Diagnostics (Figure 4 lists expected values for each function)

NO +12 VDC. Internal troubleshooting is necessary.

If source tuning does not eliminate the transmitter output malfunction then internal troubleshooting is necessary.

5.3 Internal Troubleshooting

Remove the cover of the transmitter.

WARNING

Internal troubleshooting requires that:

- **Power remains on.**
- **Transmitter cover is removed.**

CONTACT WITH LINE VOLTAGE CAN BE FATAL!

It is recommended that internal troubleshooting be limited to personnel skilled in maintenance of microwave transmitters or receivers.

IF IT IS NECESSARY TO REPLACE COMPONENTS, THE REPLACEMENT OF PARTS SHOULD BE DONE WITH THE EXTERNAL AC POWER DISCONNECTED.

⌘

Internal Quick Check.

A quick check should show that the fan is operating and the power amplifier and its power supply are warm to the touch.

Lack of +12 VDC

If internal trouble shooting is required due to lack of +12 VDC in the external DC diagnostic test then check for internal +12 VDC on the terminal strips. If either of these voltages is missing, first disconnect the wires from the power supply output terminals and recheck the voltage.

If the power supply voltage with no load is not +12 VDC then the power supply is defective and should be replaced.

If the voltage is normal, the load on the power supply is too high causing the supply to go into crowbar and shut down. At this point, examine the wiring harness for an obvious wiring fault. If no fault is found, then one of the modules supplied by that power supply is shorted internally and should be replaced. To identify the module remove the DC power wire for each module one at a time from the terminal block until the DC power bus is restored to normal.

Power Amplifiers not Warm

If the amplifier fins are cool, then check for AC at the input to the amplifier power supply. If AC is present at the input to the power supply and the amplifier is cool then replace the amplifier.

Power Supplies O.K. and Power Amplifier Warm, but Low or No Output

Check all internal RF connections. For the SMA connectors, a 5/16" open-end wrench is required. "Finger-tight" is not acceptable for microwave connections.

Check the power level at the DRO test point. If the level is 3 dB or more below the value specified in the test data sheet (nominally +5 dBm) then the DRO is defective and should be replaced.

Source Power and Upconverter LO Power O.K.

Reconnect all lines. Disconnect the output line at the upconverter and measure its output at microwave. If no or low output is observed, the upconverter is defective.

Upconverter Output O.K.

Check the output at the filter assembly feeding the power amplifier. This should be 1 to 2 dB lower than measured out of the upconverter. If there is no output at this point, the VHF input or pump frequencies are wrong.

Filter Assembly Output O.K.

Remove the SMA coaxial cable on the 40 dB directional coupler at the output of the power amplifier. Measure the microwave power at the coupler output. It should be about 10 dB above the power measured at the upconverter or filter assembly output. If not, the amplifier is defective. Replace the power amplifier and its power supply.

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6.0 SPECIFICATIONS

ITX21-100

Transmitter	
Input Frequency[2]:	119 MHz
Nominal Input Level for 1 TV:	+40 dBmV
Output Frequency[2]:	2.159 GHz
Output Level for 50 dB C/IM: (measured with CW carriers)[3]	<table><tr><th>Channels</th><th>Average Power dBm/Channel</th><th>Peak Power dBm/Channel</th><th>C/N (dB)</th></tr><tr><td>1</td><td>37.5</td><td>40.0</td><td>64.5</td></tr></table>
Local Oscillator Frequency[2:]	2278 MHz
Frequency Response:	±1 dB
Frequency Stability:	0.0005%
Input Return Loss:	15 dB
Input Connector:	Type "F"
Output Return Loss:	18 dB
Output Connector:	Type "N"
Temperature Range:	60° to 100°F (16° to 38°C)
Humidity:	95% max.
Primary Power:	120/240 VAC, 50/60Hz (per customer specification)
Power Consumption:	840 VA RMS
Mounting:	EIA Standard Relay Rack
Weight:	56 lb. (25.4 kg)
Dimensions:	19" W x 12.5" H x 24" D (48.3cm W x 31.8cm H x 61cm D)

[1] Specifications subject to change without prior notice.
[2] Other frequencies available.
[3] The C/CTB with modulated carriers are approximately 6 dB better than with CW carriers.