2.0 OPERATIONAL DESCRIPTION

This section should include any operational or technical descriptions regarding how the device operates, is modulated, or meets specific requirements. Some examples of operational descriptions include:

2.1 General Description

The ITX21-100 shown in Figure 4 is a solid-state broadband transmitter that converts a VHF input signal of 116-122 MHz to a microwave signal of 2156-2162 MHz.

The ITX21-100transmitter consists of the following.

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.

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 ITX21-100 transmitter 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.

2.2 Technical Specifications

ITX21-100

<table>
<tr><th colspan="2">Transmitter</th></tr>
<tr><td>Input Frequency:</td><td>116-122 MHz</td></tr>
<tr><td>Nominal Input Level for 1 TV:</td><td>+40 dBmV</td></tr>
<tr><td>Output Frequency:</td><td>2156-2162 MHz</td></tr>
<tr><td></td><td>
<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>
</td></tr>
<tr><td>Local Oscillator Frequency:</td><td>2278 MHz</td></tr>
<tr><td>Frequency Response:</td><td>±1 dB</td></tr>
<tr><td>Frequency Stability:</td><td>0.0005%</td></tr>
<tr><td>Input Return Loss:</td><td>15 dB</td></tr>
<tr><td>Input Connector:</td><td>Type "F"</td></tr>
<tr><td>Output Return Loss:</td><td>18 dB</td></tr>
<tr><td>Output Connector:</td><td>Type "N"</td></tr>
<tr><td>Temperature Range:</td><td>60° to 100°F (16° to 38°C)</td></tr>
<tr><td>Humidity:</td><td>95% max.</td></tr>
<tr><td>Primary Power:</td><td>120/240 VAC, 50/60Hz (per customer specification)</td></tr>
<tr><td>Power Consumption:</td><td>840 VA RMS</td></tr>
<tr><td>Mounting:</td><td>EIA Standard Relay Rack</td></tr>
<tr><td>Weight:</td><td>56 lb. (25.4 kg)</td></tr>
<tr><td>Dimensions:</td><td>19" W x 12.5" H x 24" D
(48.3cm W x 31.8cm H x 61cm D)</td></tr>
</table>

The ITX21-100 Transmitter 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.

2.3 Upconverter Section

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

6. Hybrid Local Oscillator
7. Upconverter/ Mixer
8. 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.

2.4 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.

2.5 Power Supply Assembly

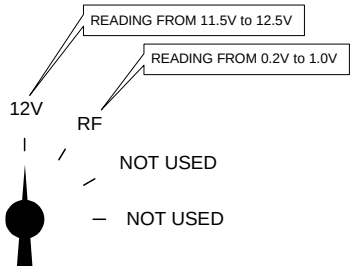
Two +12 VDC and one +24 VDC power supplies are used to provide the DC voltage. A +12 VDC linear power supply is used to provide power to the internal downconverter and Local Oscillator. A 5 VDC regulator is only used for the TTL switch for the power amplifier. The MDS downconverter is powered by a 24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

2.6 Diagnostic Circuits[1]

The ITX21-100 transmitter 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 1. 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

2.7 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.

2.8 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.

1See Data Manual for nominal values of diagnostic signals.

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 2. 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.

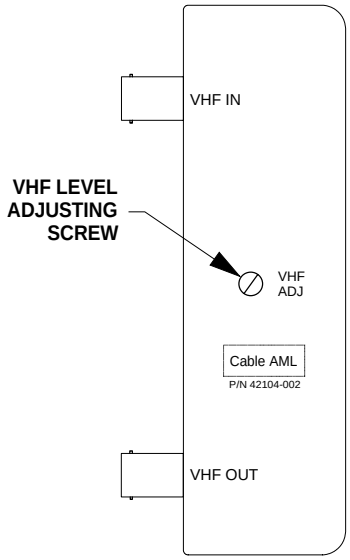


Figure 2. Output Level Adjustment.

2.9 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.

2.10 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.