12.0 USER'S MANUAL

Cable AML

Installation and Maintenance Manual

Indoor Broadband Transmitter

Model: ITX02-2000

INSTALLATION AND MAINTENANCE MANUAL

for

Indoor Broadband Transmitter

Model: ITX02-2000

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1.0 INTRODUCTION

The ITX02-2000 shown in Figure 1 is a solid-state broadband transmitter, which converts a VHF, input signal of 222 to 408 MHz to a microwave signal of 2.5 to 2.686 GHz.

The ITX02-2000 transmitter consists of eight assemblies:

1. **Driver Chassis -** for converting the incoming VHF signal to microwave. The Driver chassis contains all components necessary for upconversion, i.e. local oscillator, mixer, as well as bandpass and notch filters.
2. **Power Amplifier -** input signal is amplified to a maximum level consistent with the Carrier to Composite Triple Beat (C/CTB) specification by state of the art GaAs FET microwave power amplifiers in a parallel, power-quadrupling configuration. The power amplifiers are protected from failure due to overheating by an internal temperature sensor. The sensor circuit automatically switches off the amplifier when the amplifier temperature exceeds 167 degrees F (75 degrees C).
3. **Power supply system -** a redundant 12 VDC system consisting of three current sharing modules with hot-plug replacement capability. Each module has an 84 Amp capability. Only two modules are required to run the system, making the third one a built-in spare. A +5 VDC voltage regulator is used to power the power amplifier TTL circuit. The Driver chassis and fans are powered by the +12 VDC power supply.
4. **Monitoring and Diagnostic Circuits -** To facilitate operational monitoring and diagnostics of: VHF input, VHF output, Driver RF output, and Transmitter RF output. Diagnostic DC voltages can also be continuously monitored with the built-in meter on the Meter Panel.
5. **On-Delay Timer Assembly** - Delays power to the amplifier. This is done to avoid a big current surge when the transmitter is first turned on.
6. **Internal Downconverter** - For ease of monitoring the Transmitter's output, a downconverter has been mounted inside. The downconverter takes a sample of the output and converts it to VHF. This VHF output signal can then be measured with a Field Strength Meter or a TV monitor.

The ITX02-2000 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 this specification.

Complete specifications are listed in Section 6.0.

Figure 1. ITX02-2000 Broadband Transmitter.

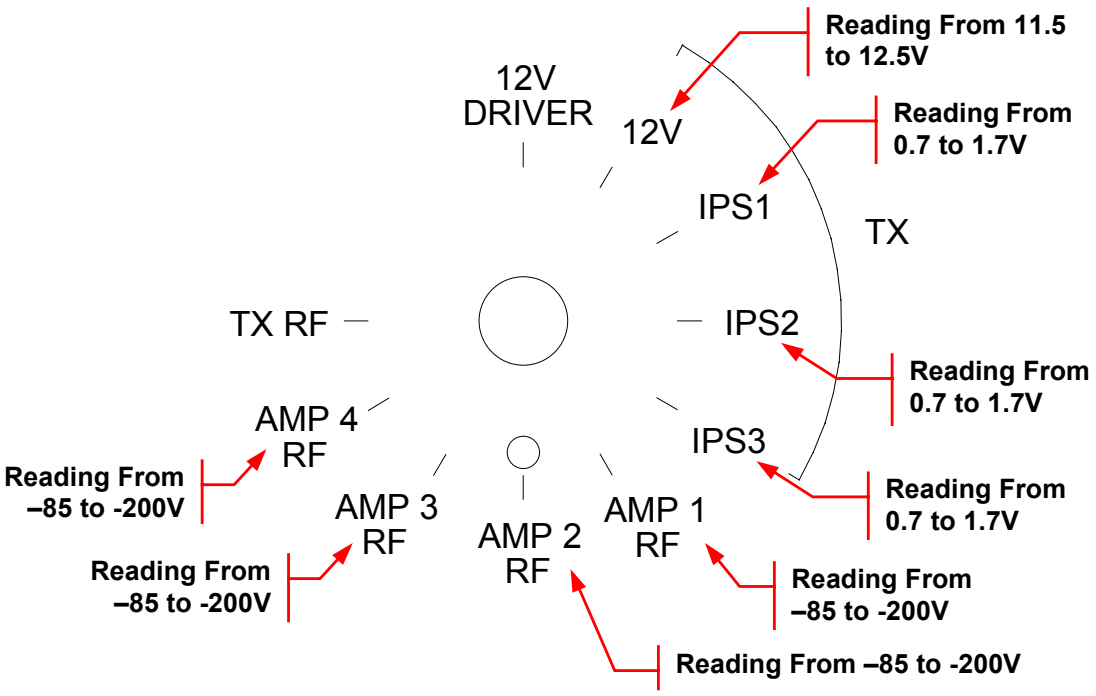

Figure 2. Dial and Expected Readings.

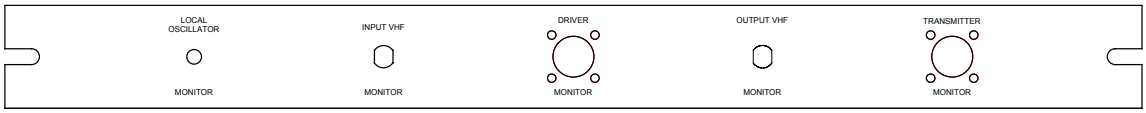

Figure 3. MMDS Rack Monitor Panel.

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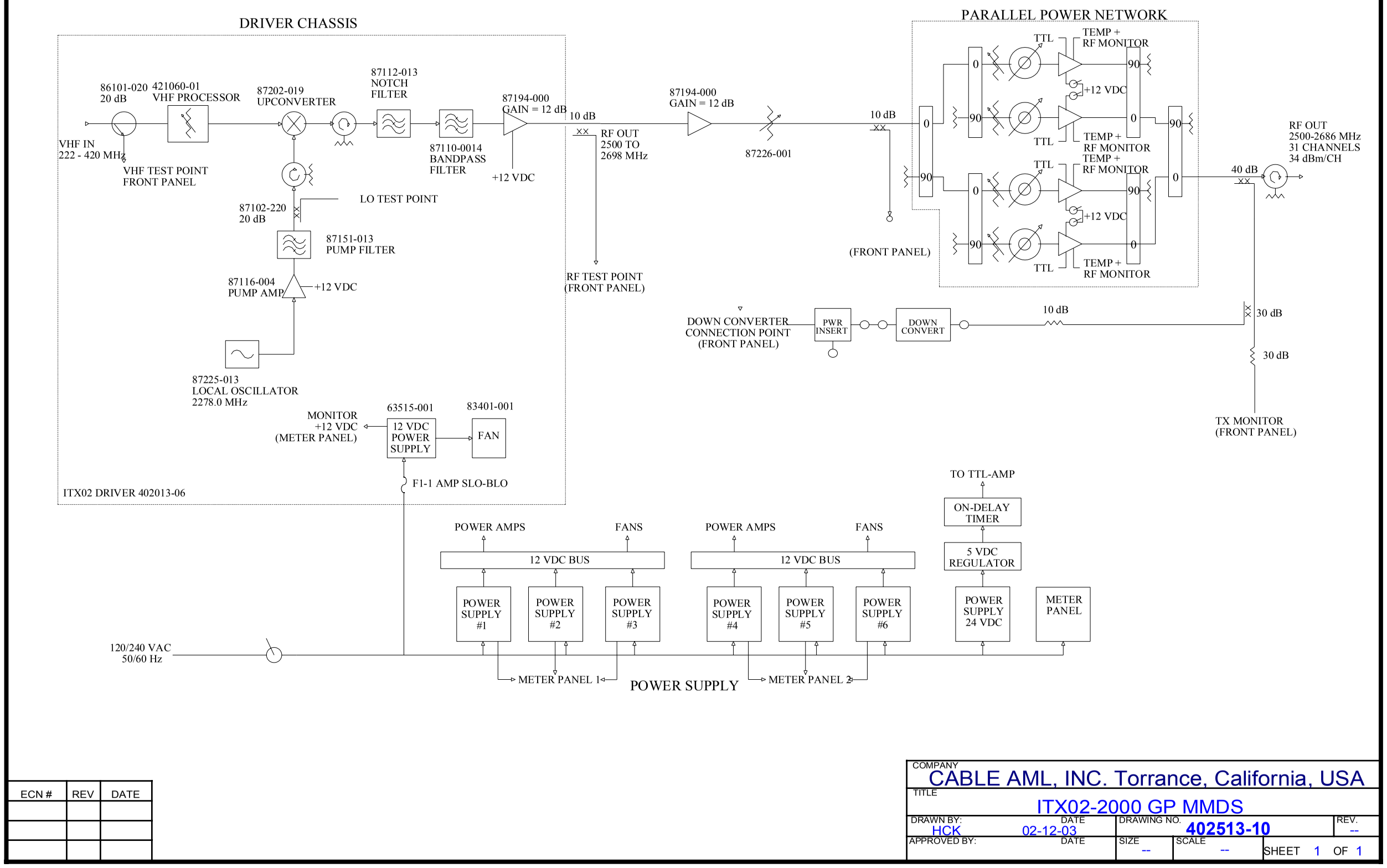

Figure 4. ITX02-2000 Block Diagram.

2.0 CIRCUIT DESCRIPTIONS

The ITX02-2000 Transmitter consists of the following circuits or modules:

1. MMDS Transmitter Driver
2. Power Amplifier
3. Power Supply System (three +12 VDC current sharing modules and one +24 VDC power supply)
4. Monitoring and Diagnostic Circuits - connectors and switches.
5. On-Delay Timer Assembly.
6. Internal Downconverter.

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

2.1 MMDS Transmitter Driver

The MMDS Driver is comprised of the following major functional circuits or modules:

1. Local Oscillator (LO)
2. Upconverter/Mixer
3. Filter Assembly
4. Microwave Low Noise Amplifier
5. DC Diagnostics
6. Power Supply

Local Oscillator (LO)

The microwave *local oscillator* is a crystal oscillator and frequency multiplier encapsulated in a single enclosure. The output of the LO provides pump power to the signal upconverter. The LO is powered by a +12 VDC power supply. The long-term frequency stability of the oscillator is 5 parts per million per year.

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 bandpass filter is tuned to pass the upper sideband. The notch filter is tuned to attenuate the local oscillator leakage without affecting the output signal.

Microwave Low Noise Amplifier

A Low Noise Amplifier accomplishes the amplification with minimum distortion.

DC Diagnostics Circuit

Certain test points in the transmitter can be monitored externally at the Remote Monitor output multi-pin connector on the front panel. These DC diagnostics are connected to the output connector through a signal conditioning circuit. The signal conditioning circuit is a network of resistors that provides short circuit protection for the transmitter diagnostic sources. The output connector is designed for use with diagnostic test boxes such as the Cable AML DTB - 1, the WRM-2, or the RM-2A. The test points and corresponding connector pin connections are shown in the Transmitter Block Diagram.

Power Supply

The power supply for the MMDS Driver is +12 VDC.

2.2 Power Amplifier Chains

The power amplifier consists of four GaAs FET microwave power amplifier that amplifies the input signal to a maximum level consistent with the Carrier to Composite Triple Beat (C/CTB) specification. The power amplifier is protected from failure due to overheating by an internal temperature sensor. The sensor circuit automatically switches off the amplifier input power when the amplifier temperature exceeds 167°F (75°C). The power amplifiers are arranged in a quadruple power configuration which results in an overall IP3 increase of 5 dB. The gain of the amplifiers is 56 dB with an IP3 of 69.5 dBm. The amplifiers have a TTL circuit, which enables the user to shut down the amplifiers for testing purposes. +5VDC = “ON”

2.3 Power Supply Assembly

The transmitter has a 12 VDC redundant power supply system consisting of three current-sharing modules with hot-plug replacement capability. Each module has an 84 Amp capability. Only two modules in each mainframe are needed to run the transmitter. A 24 VDC power supply powers the internal downconverter and also supplies voltage to a 5 VDC voltage regulator, which is used with the Transistor-Transistor-Logic (TTL) of the power amp. A separate +12 VDC power supply is used for the Driver.

2.4 Diagnostic Circuits1

The ITX02-2000 transmitter has several connectors and switches.

Connectors - there are "test point" and "monitor" output connectors on the front panel. Their position in the circuitry is shown in Figure 3.

1See Data Manual for nominal values of diagnostic signals.

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

1. +12 VDC of Driver power supply (volts)
2. +12 VDC buss (volts)
3. Current monitor #1, see Data manual for scale factor
4. Current monitor #2, see Data manual for scale factor
5. Current monitor #3, see Data manual for scale factor
6. RF Detector at Amp #1 (volts)
7. RF Detector at Amp #2 (volts)
8. RF Detector at Amp #3 (volts)
9. RF Detector at Amp #4 (volts)
10. RF Detector TX Output (volts)

Amplifier Power "On/Off" Switch Panel - this panel is located behind a "blank" front panel as shown in Figure 1. For access to this panel, the "blank" front panel must be removed. The switches are intended to cut off power to the amplifiers. Their position in the circuitry can be seen in the Figure 4.

2.5 On-Delay Timer Assembly

A set of relay's and timer's 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.

2.6 Internal Downconverter

For ease of monitoring the Transmitter output, a downconverter has been mounted inside the Transmitter. The downconverter takes a sample of the output and converts it to VHF. This VHF output signal can then be measured with a Field Strength Meter or a TV monitor.

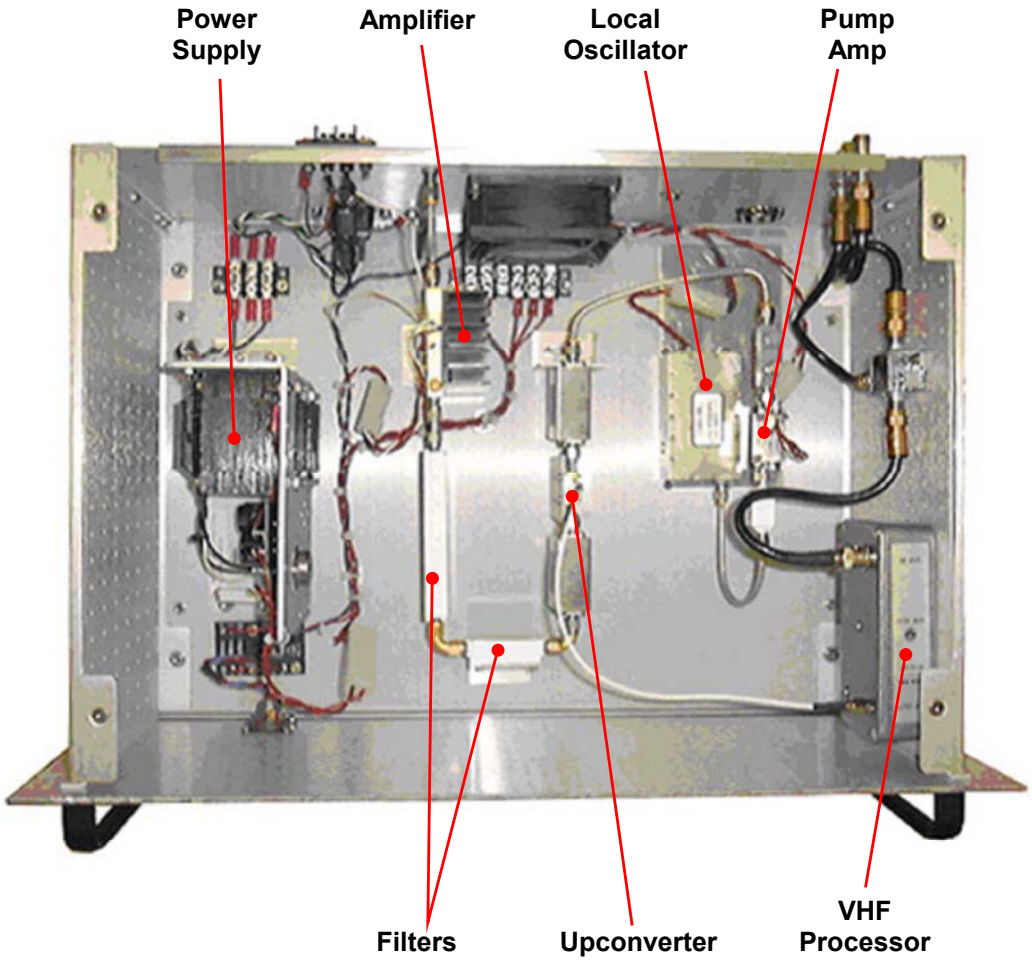

Figure 5. Driver Chassis Component Layout.

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.**

!!!!! CAUTION !!!!! CAUTION !!!!! CAUTION !!!!!

Transmitters shipped installed in a standard EIA Enclosed Equipment Relay Rack may have foam blocks inserted between modules inside the rack to protect the unit during transportation. These blocks must be removed before operation otherwise they will impede the flow of cooling air and may affect the performance of the transmitter.

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.

Position floor-mounted enclosed equipment racks on a flat surface with enough space at the rear to swing open the access door.

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. Some 220/240 VAC units can be connected directly to 220/240 VAC power mains and some utilize step-down transformers furnished with the unit. **If the local power mains are 220/240 VAC and the unit is shipped with a step-down transmitter, connect the mains to the transformer only!**

3.4 Operating and Diagnostic Connections

Figure 4 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.
- RF Input - The transmitter's input connector on the rear panel is type F female, to which the VHF inputs are connected.

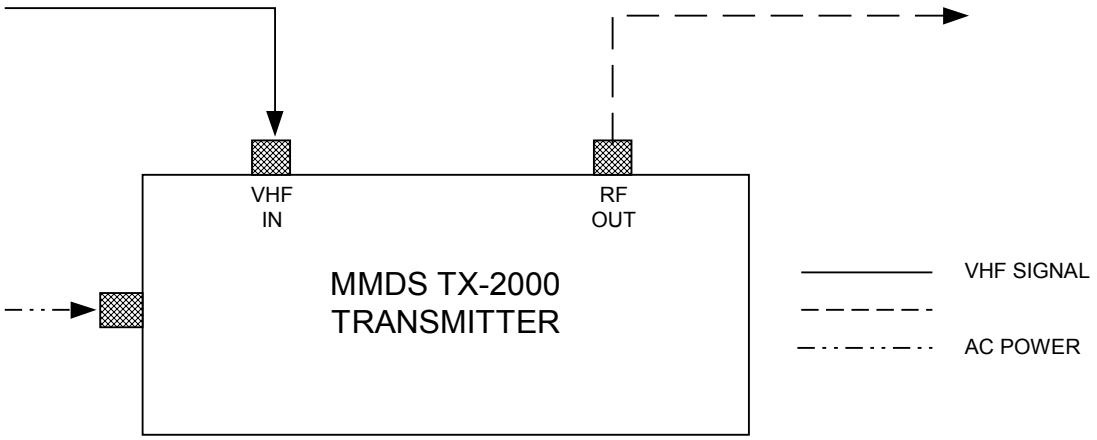

Figure 6. MMDS Installation Block Diagram.

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.

For operating in three phase current please note that the circuit breaker WILL NOT be used, the 4 jumpers on the AC input terminal block must be removed, and The AC wires must be connected as shown in Figure 7.

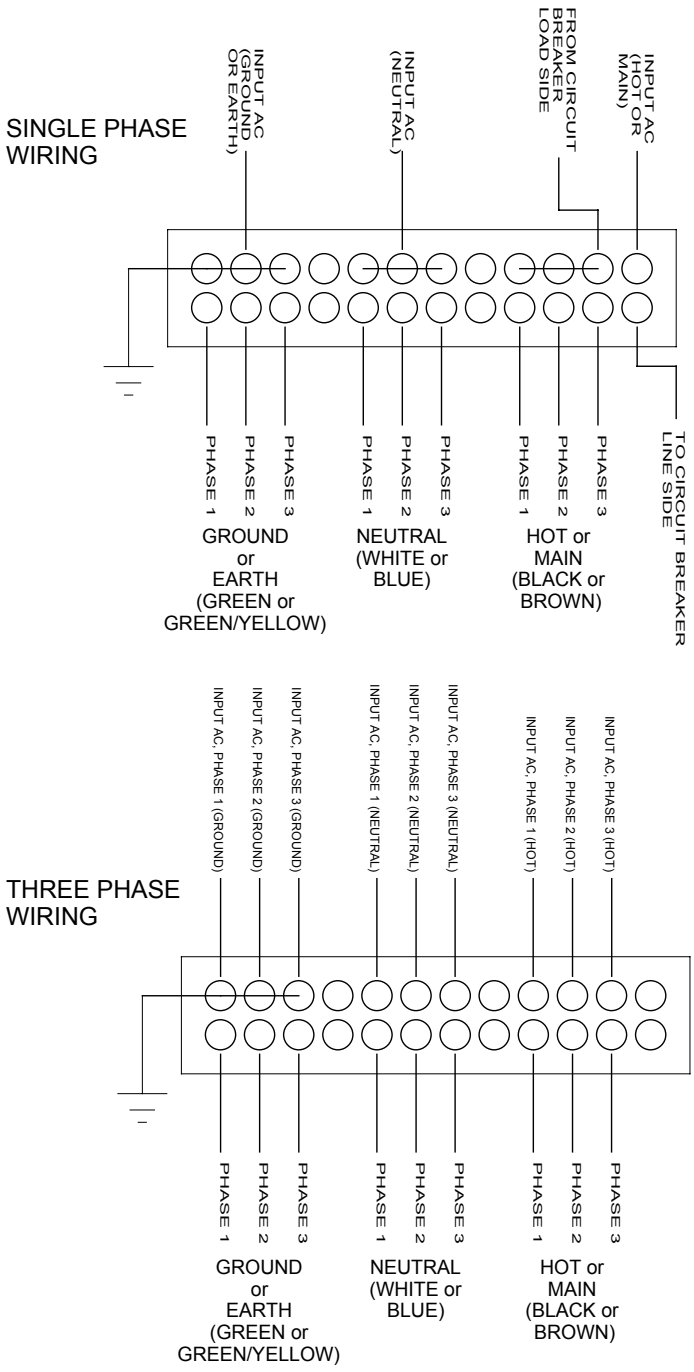

Figure 7. AC Input Wiring Diagram.

Diagnostic Connections

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

- **RF Diagnostics -** Two RF test point output "N" connectors for Driver RF output and Transmitter Monitor output are provided on the front panel. The locations in the circuitry are shown in Figure 5
- **XO and VHF Input Test Points -** Crystal oscillator (XO) monitor, VHF input and output signal test point "F" connectors are provided on the front panel.

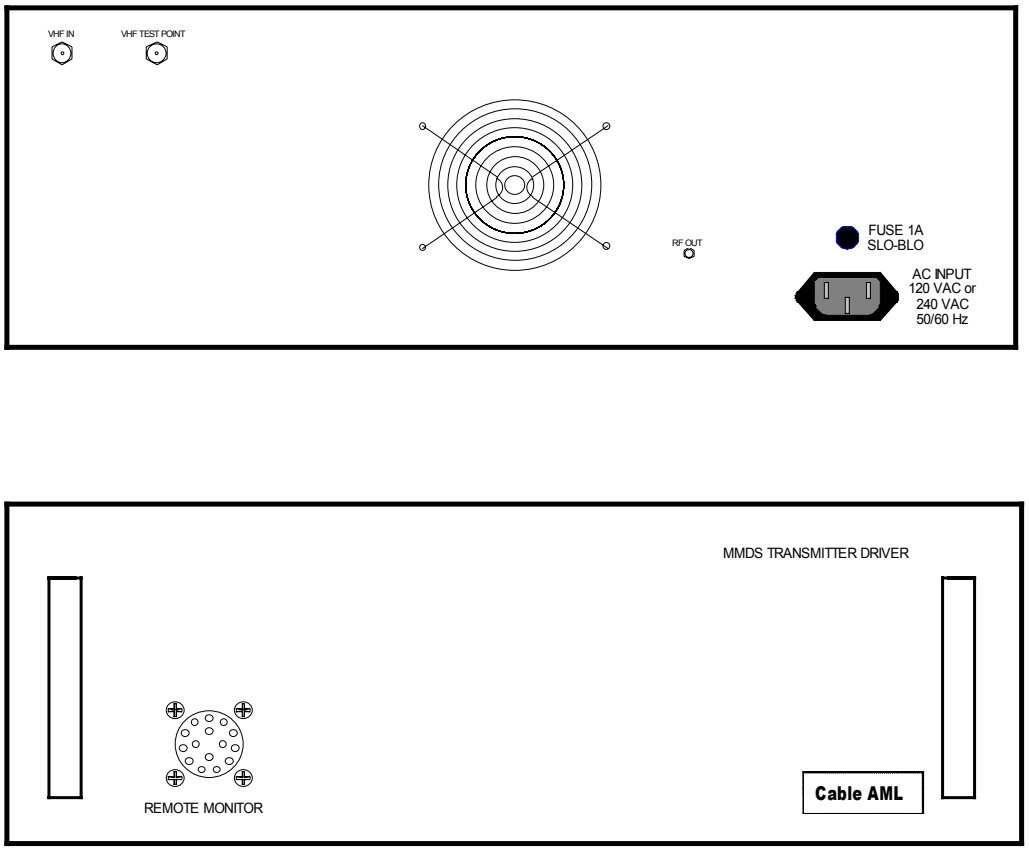

Figure 8. Driver Chassis Front And Rear Panels.

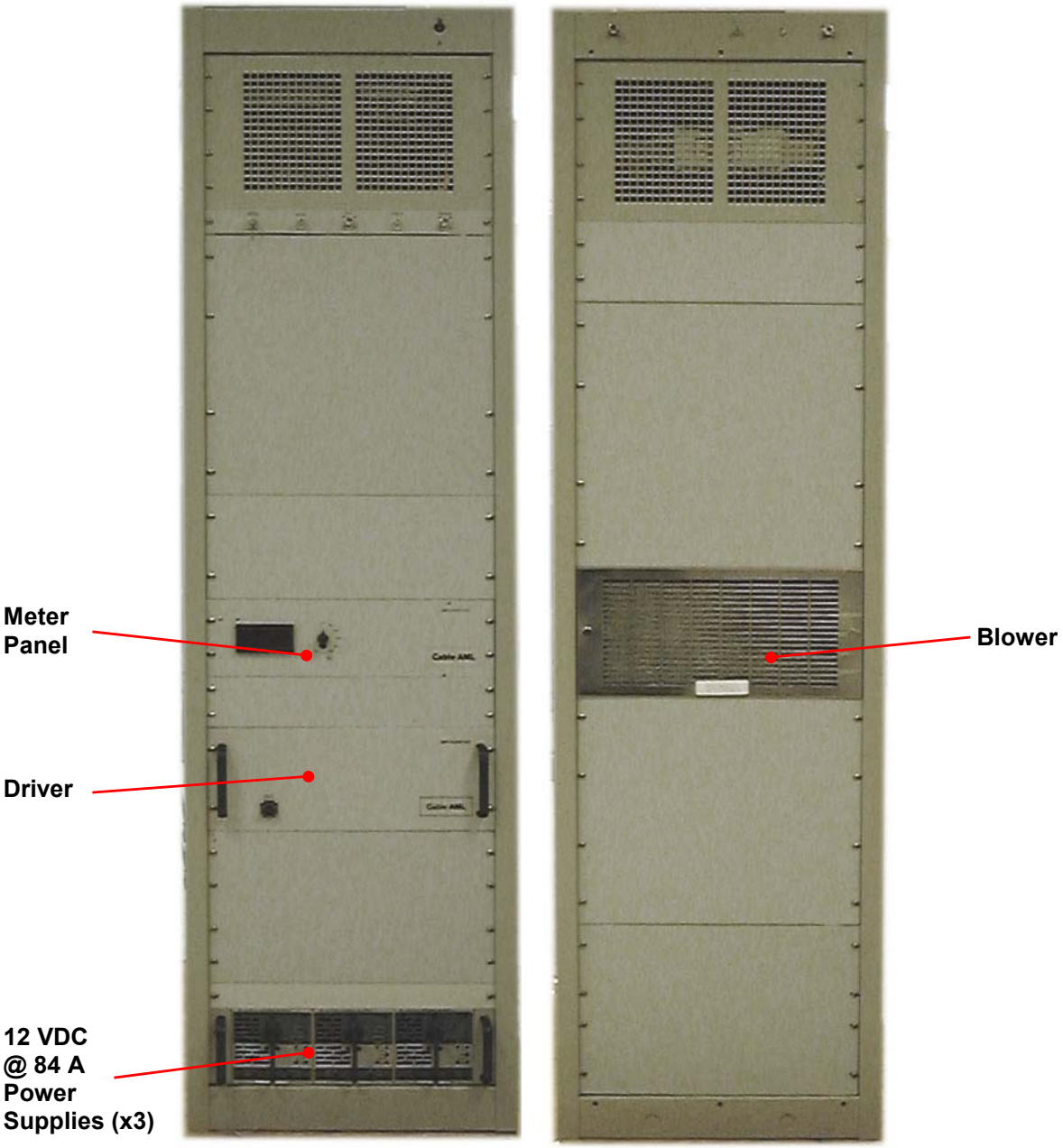

Figure 9. ITX02-2000 Rack (Front and Back).

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4.0 OPERATION

The ITX02-2000 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 ITX02-2000 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 ITX02-2000 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. **DO NOT EXCEED THE INPUT LEVEL SPECIFIED IN THE TRANSMITTER DATA SHEET.**

If it is not convenient to control the input level by means of external pads, it can be controlled by an internal attenuator located in the Driver Chassis (see Figure 5).

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 IN OTHER SYSTEM PARAMETERS.

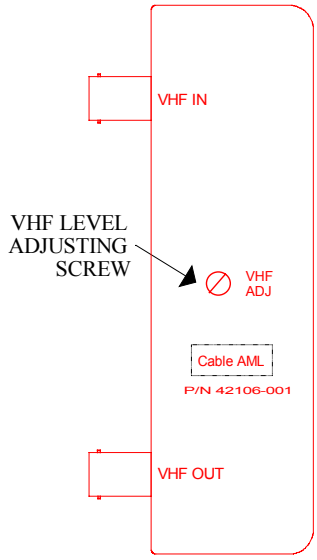

Figure 10.
Output Level Adjustment.

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 10. 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.

4.2 Ambient Conditions

The ITX02-2000 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 input power when the temperature exceeds a factory set threshold of 167 degrees F (75 degrees C). If the cause of overheating is fan failure, the failed unit should be replaced prior to applying power

5.0 MAINTENANCE & TROUBLESHOOTING

5.1 Maintenance

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 input attenuation should be verified before making significant adjustments in the transmitter.

5.2 External Troubleshooting

In the event of low or no output from the transmitter, the following items should be checked first:

1. Verify the frequency and level of the VHF input signal at VHF Monitor Test Point on the Monitor panel. Incorrect input frequencies may produce output frequencies that are unable to pass through the filters or the power amplifier.
2. Verify the AC power input by checking the fans on the power supplies for motion.
3. Check the transmitter meter panel for +12 VDC reading.
4. Check the output power and of the power amplifier.

   Note: The expected values of diagnostic signals are listed in the Data Manual.

5.3 Internal Troubleshooting

Internal troubleshooting is the last step in resolving equipment problems and is necessary only should internal components fail. If a +12 VDC reading is not obtained from the external DC diagnostic test at the Driver, internal troubleshooting may be required.

!!!!! 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.

Lack of Driver +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 strip. If 12 VDC 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 returns to 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 lift 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 Amplifier

If the amplifier output is too low, check for 12 VDC and available current. Verify that the amplifier was not cut off due to excessive temperature.

Fan Not Operating

If a fan is not operating, check for proper voltage on the internal terminal strip. If adequate voltage is not available, check the transformer.

6.0 SPECIFICATIONS

ITX02-2000

Transmitter	
Input Frequency[2]:	222 to 408 MHz
Input Level (80 channel loading):	+20 dBmV (-29 dBm)
Output Frequency[2]:	2.5 to 2.686 GHz
Output Level for 50 dB C/CTB: (measured with CW carriers)[3]	

Channels	Average Power DBm/Channel	Peak Power dBm/Channel	C/N (dB)
9	40.5	43.0	72.5
12	39.0	41.5	71.0
18	37.0	39.5	69.0
24	35.0	37.5	67.0
30	34.0	36.5	66.0

Local Oscillator Frequency[2:]	2278 MHz
Frequency Response:	±1.5 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:	2500 VA RMS
Mounting:	Enclosed Equipment Rack
Weight:	450 lb. (205 kg)
Dimensions:	22” rack W x 84” H x 27” D (55.9 cm rack W x 213.4 cm H x 68.6 cm D)

[1]Specifications subject to change without prior notice.

[2]Other frequencies available.

[3]The C/CTB with modulated carriers is approximately 6 dB better than with CW carriers.