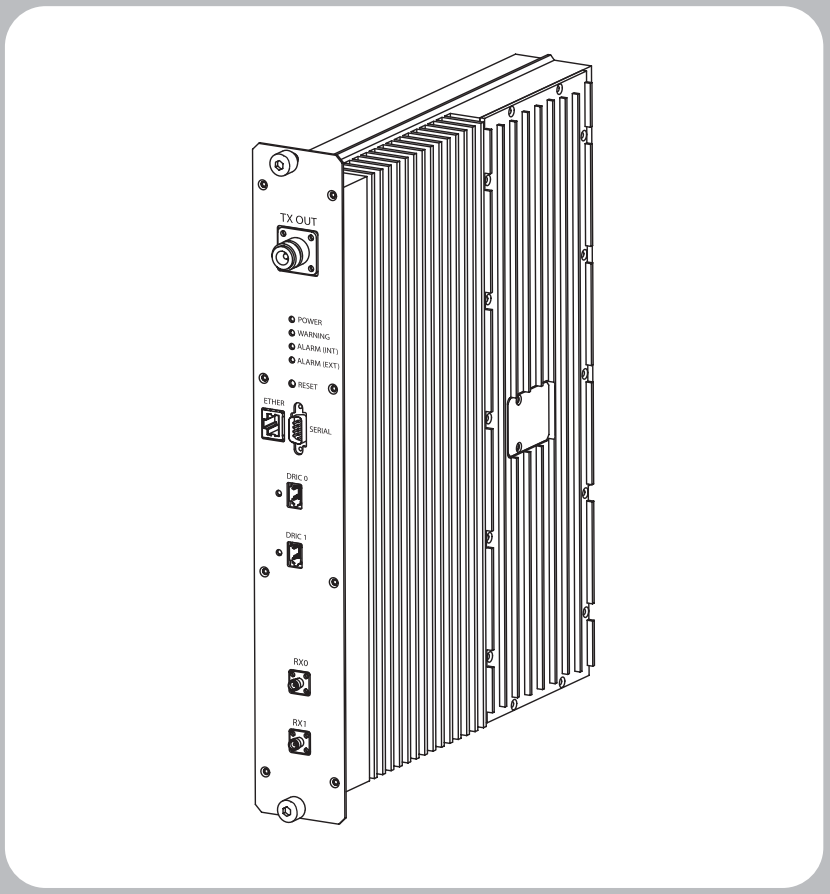

PRELIMINARY

EHP19
Integrated Power Transceiver
Installation and Service Manual

044-05210 Rev. A

September 2005

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Powerwave Technologies, and the Powerwave logo are registered trademarks.

This Powerwave product is intended only for installation in a RESTRICTED ACCESS LOCATION.

This Powerwave product is designed to operate within the normal operating (typical operating) ranges or conditions specified in this document. Operation of this equipment beyond the specified ranges in this document may cause:

- spurious emissions that violate regulatory requirements.
- the equipment to be automatically removed from service when maximum thresholds are exceeded.
- the equipment to not perform in accordance with its specifications.

It is the responsibility of the operator to ensure this equipment is properly installed and operated within Powerwave operating specifications to obtain proper performance from the equipment and to comply with regulatory requirements.

Warnings, Cautions, and Notes

Warnings, Cautions, and Notes are found throughout this manual where applicable. The associated icons are used to quickly identify a potential condition that could result in the consequences described below if precautions are not taken. Notes clarify and provide additional information to assist the user.

WARNING: This warning symbol means danger. You are in a situation that could cause bodily injury or death. Before working on any equipment, be aware of the hazards involved with electrical and RF circuits and be familiar with standard practices for preventing accidents.

CAUTION: The caution symbol means reader be careful. In this situation, the user might do something that could result in equipment damage or loss of data.

NOTE NOTE: The note symbol means reader take note. Notes contain helpful suggestions or references to material not covered in this document. Procedures are not contained in notes.

Revision Record

Revision Letter	Date of Change	Reason for Change
Rev. A	September, 2005	Preliminary Release

Chapter 1
Product Description

1.1 Introduction

This manual contains information and procedures for the installation, operation, and maintenance of the EHP19 Integrated Power Transceiver (IPT).

1.2 Scope of Manual

This manual is intended for use by service technicians familiar with similar types of equipment. It contains service information required for the equipment described and is current as of the printing date. Changes which occur after the printing date may be incorporated by a complete manual revision or alternatively as additions.

The manual is organized into the following chapters:

- Chapter 1 - Product Description
- Chapter 2 - Installation
- Chapter 3 - Operation
- Chapter 4 - Maintenance
- Chapter 5 - Specifications and Drawings

1.3 Functional Description

The IPT is a high efficiency RF single channel power amplifier with an internal analog pre-distorter for use with the Radio Base Station (RBS) digital pre-distorter system for RF output linearity. The IPT has an operational bandwidth of 60 MHz from 1930 MHz to 1990 MHz producing a typical output of 60.2 watts (47.8 dBm). The IPT is shown in Figure 1-1. Detailed functional and physical specifications for the IPT are listed in Chapter 5.

1.3.1 RF Interface

The IPT RF interfaces consist of the TX OUT port located on the top of the IPT front panel and the RX0 and RX1 ports located on the bottom of the IPT front panel.

1.3.2 Main Transceiver

The following circuits are part of the main transceiver section.

1.3.2.1 Customer Interface/CPRI Input

The incoming serial data stream from the customer interface (DRIC) front panel connector is applied to a Serialiser-Deserialiser (SerDes), converted into a parallel format and decoded. The customer interface also includes processing of the frame alignment, byte alignment and chip alignment, including delay adjustment. A clock acts as the frequency reference for the entire transmitter. The clock is extracted from the incoming signal using a phase locked loop (PLL). There are two outputs

from this block: control data and signal data. The control data determines parameters such as channel frequencies, signal ramp-up/ramp down and transmit power level. These functions are implemented in a Field Programmable Gate Array (FPGA).

1.3.2.2 Digital Up Converter (DUC)

The DUC modulates individual symbol streams from the signal data stream on to baseband carriers and applies root-raised cosine channel filtering. This function is implemented on an Application-Specific Standard Product (ASSP).

1.3.2.3 Crest Factor Reduction (CFR)

The CFR function is implemented in the FPGA. The CPR varies the DUC signals to reduce the peak-to average power of the transmit signal to allow the P-Mod to operate with higher efficiency ensuring the transmit signals stay in the occupied bandwidth/spectral mask limits.

1.3.2.4 Data Interpolation (INT)

The interpolation function, which is implemented in the FPGA, changes the sampling rate up to 92.16 Msps.

1.3.2.5 Digital Predistortion (DPD)

The DPD function, which uses an ASSP DPD engine, and a Digital Signal Processor (DSP), processes the forward path signal to compensate for the non-linearities in the forward path. The DPD function ensures that the transmitter operates at the correct power level over variations in supply voltage, load impedance, temperature and aging.

The DPD function also provides compensation for imperfections in the AUC such as differential delay, I-Q amplitude and phase balance and DC offset/carrier leakage. the linearisation lock function monitors the operation of the signal and turns off the transmitter if the system is not functioning correctly. The digital output signal from the DPD engine is converted back to an analog signal in a high-speed digital-to-analogue converter (DAC).

1.3.2.6 Analog Up Converter (AUC)

The AUC uses a direct-conversion architecture (I-Q modulator) to transform the I-Q baseband signals from the DPD up to the operating RF frequency.

1.3.2.7 Observation Path (OBS)

The OBS act as a high performance radio receiver tuned to the RF transmit frequency. The OBS converts the sampled RF transmit signal to a VHF intermediate frequency where it is sampled by a high-speed analogue-to-digital converter (ADC). The output of the ADC is fed to the DPD block, compared with the drive signal and then used to update the parameters in the DPD algorithms running on the DSP.

1.3.2.8 Clock Module

The FPGA high-speed serial interface (SerDes) extracts a timing clock from the incoming data stream, the transmit frequency stability depends on the accuracy of the incoming input signal. The recovered clock is used to synchronize a crystal oscillator used as a clean frequency reference for the timing functions on the TRx board (RF LOs, DAC and ADC clocks, Tx, Rx and lineariser signal processing clocks).

The reference is used as a direct reference for the RL local oscillators. Except for the digital clocks, the reference is passed to a PLL VCO, which is then subdivided. All RF PLLs include lock-detect signals to allow the transmitter to be turned off if there is a fault with a PLL.

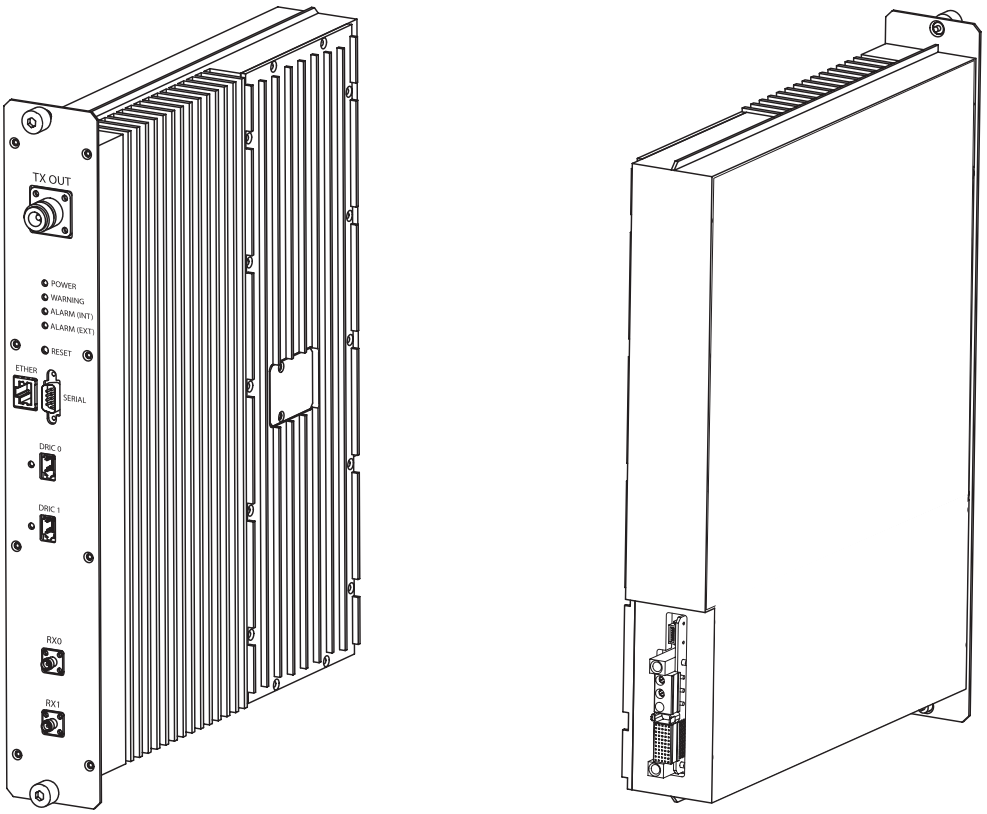

Figure 1-1 Integrated Power Transceiver Front and Rear Isometric View

1.3.3 Power Module

The P-Mod is a multi-stage amplifier, which amplifies the low level signal from the AUC up to the RF output power level of +47.8 dBm (60.25 W). The P-Mod consists of a two-stage pre-driver, a driver amplifier and an output stage. The bias currents are electronically calibrated during factory test and bias setting and temperature compensation are controlled by a master control unit on the P-Mod PCB. The P-Mod also includes a directional coupler, which allows a sample of the transmit signal to be fed to the observation path and an isolator, which protects the P-Mod from damage or potential oscillation under adverse RF load conditions. An RF switch allows either the observation signal or the reflected power from the antenna connector, measured at the third port of the isolator, to be passed to the TRx

1.3.4 Front Panel

The front panel contains a RESET switch and four status and alarm LEDs.

1.3.5 Operational States

The IPT has three operational states: Operational, Disabled and Not Ready.

The IPT remains in the Not Ready state during start-up until all parameters are met for the IPT to become operational.

The IPT is normally in the Operational state: no faults are present, the IPT internal temperature is within limits, appropriate DC power is applied, and the IPT is producing RF output. The green operational (O) LED on the Man Machine Interface is lit.

The Disabled state is ordered from the RBS (if there is a fault in the IPT or in other RBS units) or entered automatically when a critical hardware error is detected by the IPT. The Disabled state causes the IPT to shut down, but it can be enabled by the RBS if the fault is cleared.

1.3.6 State Transitions

The IPT has five state transitions: Reset, Status OK, Alarm, Disable, and Enable.

Reset initiates the Not Ready state. This state is entered when power is initially applied to the IPT or from a dedicated reset signal from the RBS to the IPT.

Status OK is entered from the Not Ready state and initiates the Operational state when commanded by the IPT

Alarm initiates the Disabled state from the Operational state if the IPT detects a hardware or temperature fault. The RBS reads the potential fault cause for fault logging.

Disable is ordered from the RBS to force the IPT to go to the Disabled state and shut down. Power on of the IPT after a Disable can only be ordered by the RBS through a RESET command.

Enable is ordered from the RBS to power on the IPT after it has been disabled. The IPT enters the Operational state after checking status and temperatures and re-perform start-up if required.

1.3.7 DC Power (DC)

DC power (-48 Vdc nominal) is supplied by the RBS to the IPT through the rear mounted connector. Refer to Table 1-1 for a description of the DC connector inputs.

Table 1-1 DC Power Connections

Pins	Signal Name	Description
1,2	GND (-48V_RTN)	DC plus (isolated from amplifier chassis)
3,4	-48V	DC minus (isolated from amplifier chassis)
5,6	GND (NC)	Not connected

1.3.7.1 Power Supply

The power supply assembly contains two subassemblies. The DC/DC converter produces regulated +28 Vdc, +9 Vdc and +6.5 Vdc from the -48 Vdc supply for the IPT internal supply. The low voltage supply uses the +6.5 Vdc from the DC/DC converter to provide regulated 3.3 Vdc, 1.8 Vdc and 1.5 Vdc reference level supplies.

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Chapter 2
Installation

2.1 Introduction

This chapter contains unpacking, inspection and installation instructions for the EHP19 Integrated Power Transceiver (IPT).

- Carefully read and understand all material in the chapter prior to installation.
- Review any government and local codes applicable to this installation.
- Before operating the equipment, read the operating instructions in Chapter 3.

2.2 Unpacking and Inspection

Perform the steps in Table 2-1 to unpack and inspect the IPT.

Table 2-1 IPT Unpacking and Inspection Instructions

Step	Action
1	Carefully open the container and remove the IPT.
2	Visually inspect the IPT for damage that may have occurred during shipment. Check for evidence of water damage, bent or warped chassis, loose screws or nuts, or extraneous packing material in connectors. If possible, inspect the equipment in the presence of the delivery person.
3	If possible, retain all packing material that can be reused for repackaging the components.

2.2.1 Damaged Equipment

If the equipment is damaged, a claim should be filed with the carrier when the extent of any damage is assessed. Contact the factory for a return material authorization (RMA). Refer to Chapter 4.

2.3 Installation Instructions

Perform the following to install the IPT.

WARNING: Ensure the RF power has been removed from the RF input cable before connecting the RF input cable.

Table 2-2 IPT Installation

Step	Action
1	Carefully slide the IPT into the subrack.
2	Secure the IPT in the subrack by tightening the thumbscrews.
3	Connect the TX cable, RX0 and RX1 cables as shown in Figure 2-1.

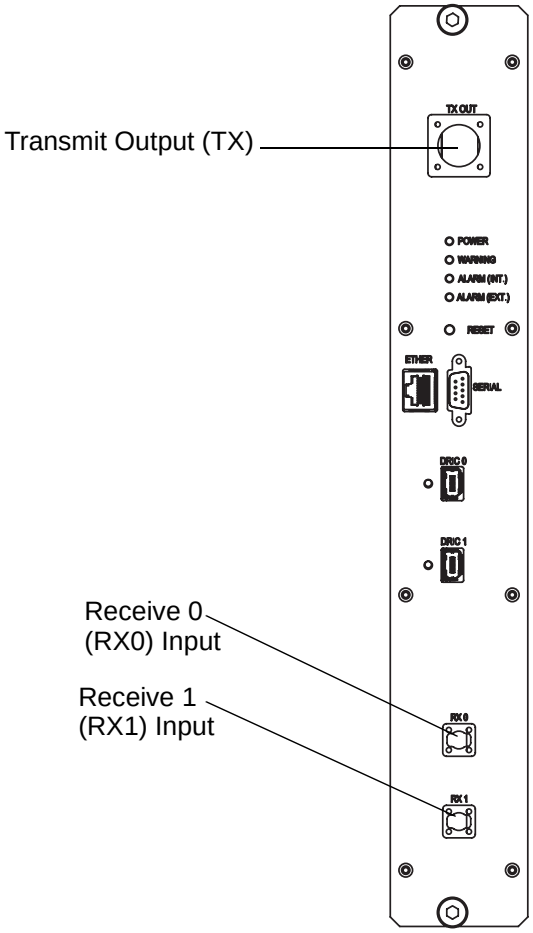

Figure 2-1 IPT Connector Locations

Chapter 3
Operation

3.1 Introduction

This chapter contains operating instructions for the EHP19 Integrated Power Transceiver (IPT).

3.2 Controls and Indicators

The IPT provides one switch, four LED indicators, one ethernet connector, one serial connector and two RS-485 connectors as shown in Figure 3-1.

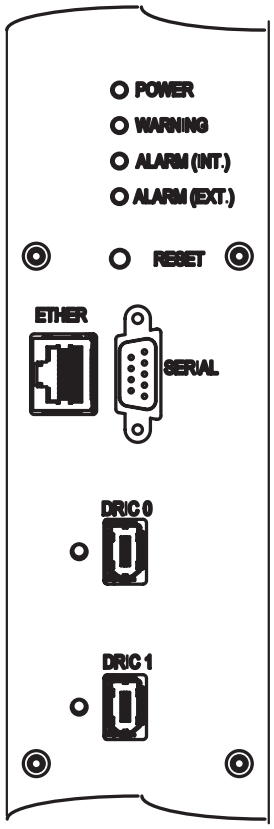

Figure 3-1 IPT Indicators and Controls

3.2.1 Reset Switch

The Reset recessed pushbutton switch allows the operator to reset the IPT control circuits.

3.2.2 Status and Alarm Indicators

MCPA alarm conditions are reported to the system as logic level signals through the rear connector. The front panel LED provides a visual reference for the operator of MCPA status. Refer to Table 3-1.

The IPT ALARM (INT.) lights when a IPT fault occurs. The IPT control logic provides the following alarms to the RBS when a fault occurs:

- Temperature out of range
- Voltage out of range
- Current out of range
- Open circuit (reported as a voltage out or range alarm)
- Short circuit (reported as a current out of range alarm)
- Hardware fault. A hardware fault always requires removal and replacement of the IPT to resolve the fault condition.

Some MCPA alarms are caused by faults external to the IPT such as an out of tolerance DC supply or RF supply. A major fault will disable the RF output of the IPT, a minor fault has no effect on the RF output. Conditions external to the IPT should be investigated before replacing the IPT.

3.3 Initial Start-Up and Operating Procedures

CAUTION: Before applying power, ensure the input and output of the system is properly terminated at 50 ohms. Do not operate the system without a load attached. Refer to Chapter 5 for input power requirements, excessive input power may damage the IPT.

No operator action is required during start-up and normal operations: the IPT powers up when -48 Vdc power is applied, the IPT internal temperature is within operating range, no faults are present, RF input and output are within specifications and the IPT is commanded to power up by the RBS logic. If the IPT does not power up or the ALARM (INT.) LED stays lit, refer to Paragraph 4.3 for troubleshooting instructions.

Chapter 4
Maintenance

4.1 Introduction

This chapter contains the periodic maintenance, troubleshooting and removal and replacement instructions for the EHP19 Integrated Power Transceiver (IPT).

NOTE Check your sales order and equipment warranty before attempting any service or repair activity. Do not break the seals on equipment under warranty or the warranty will be null and void. Do not return equipment for warranty or repair service until proper shipping instructions are received from the factory. Refer to Paragraph 4.5.

4.2 Periodic Maintenance

Recommended periodic maintenance requirements are listed in Table 4-1.

Table 4-1 Recommended Periodic Maintenance

Task	Interval	Action
Inspection of cables and connectors	12 months	Inspect signal and power connectors for frayed insulation. Check RF connectors for tightness.
Cleaning	As Required	Clean as required depending on equipment operating environment.

4.3 Troubleshooting

Perform the instructions in Table 4-2 if the IPT becomes inoperative.

Table 4-2 Troubleshooting

Step	Action
1	Press the IPT RESET button. Check to see if the fault clears.
2	Check for proper DC supply voltage.
3	Verify all RF connections are tight.
4	Verify that the MCPA does not have a major fault.
5	Contact your field representative or the factory if major fault does not clear.

4.4 Module Field Replacement

The IPT should be removed and replaced only by a qualified technician with experience maintaining RF power amplifiers and similar equipment.

4.4.1 IPT Removal and Replacement Procedure

Perform the following to remove and replace the IPT:

WARNING: Ensure the RF power has been removed from the RF input cable before disconnecting or reconnecting the RF input cable.

Table 4-3 IPT Removal and Replacement

Step	Action
1	DIsconnect cables at the TX, RX0 and RX1 inputs.
2	Loosen the thumbscrews and slide the IPT out of the subrack.
3	To replace the IPT, carefully slide the IPT back into the subrack slot, tighten the thumbscrews and replace the RF cables.

4.5 Return For Service Procedures

Perform the instructions in the following paragraphs to ensure optimum response when returning products to Powerwave.

4.5.1 Obtaining An RMA

A Return Material Authorization (RMA) number must be obtained prior to returning equipment to the factory for service. Contact Powerwave at (714) 466-1000 or send a fax to (714) 466-5800 for an RMA number. Failure to obtain the RMA number can result in delays in receiving repair service.

4.5.2 Repackaging For Shipment

Reuse the original package designed for shipping the amplifier to ensure safe shipment of the amplifier. Contact Powerwave for packing materials if the original packaging is not available.

Chapter 5
Specifications

5.1 Power Amplifier Unit (IPT) Specifications

Table 5-1 IPT Functional and Physical Specifications

Frequency Range	1925 to 1995 MHz
Instantaneous Bandwidth	5 MHz
Total Typical / Maximum Input Power	2.9 dBm (1.9 mW) typical / 12.0 dBm (15.8 mW) maximum
Total Output Power	26.3 watts typical / 33.1 watts maximum
Adjacent Channel Leakage Power Ratio	ACLR1 less than -33.5 dBc ACLR2 less than -54.8 dBc
RF Gain	42.3 dB +/- 2 dB over the frequency and temperature range
Gain Flatness	Less than 1.5 dB
Output Protection	Mismatch protected
Input Port Return Loss	Less than -15 dB
Harmonics	Less than -34 dBm / 1 Mhz
Out of Band Spurious	Lower -27 dBm / Higher -27 dBm
Duty Cycle	Continuous
DC Input Power	From -57.0 Vdc to -38.5 Vdc (-48 Vdc nominal) Current limit is 8 amps maximin for less than 10 milliseconds
Operating Temperature	-33 to +45 °C Normal Operation -45 to +55 °C Exceptional Operation* -50 to +60 °C Nondestructive Operation**
Storage Temperature	-25 to +55 °C
Operating Humidity	15 to 100% Normal Operation 8 to 100% Exceptional Operation* 5 to 100% Nondestructive Operation**
Storage Humidity	10 to 100 per cent
RBS / IPT communication	Dual I^2C serial bus, 0 to 100 KHz baud rate
RF Input Connector	SMA-Female
RF Output Connector	SMA-Female
Power Consumption	Less than 207 watts maximum during normal operation 186 watts typical, 60 watts maximum at low temperature start
Weight	7.3 lbs. (3.3 kg.)
Dimensions	14.6 in. (37.1 cm) wide by 2.1 in. (5.3 cm) high by 9.8 in. (24.9 cm) deep

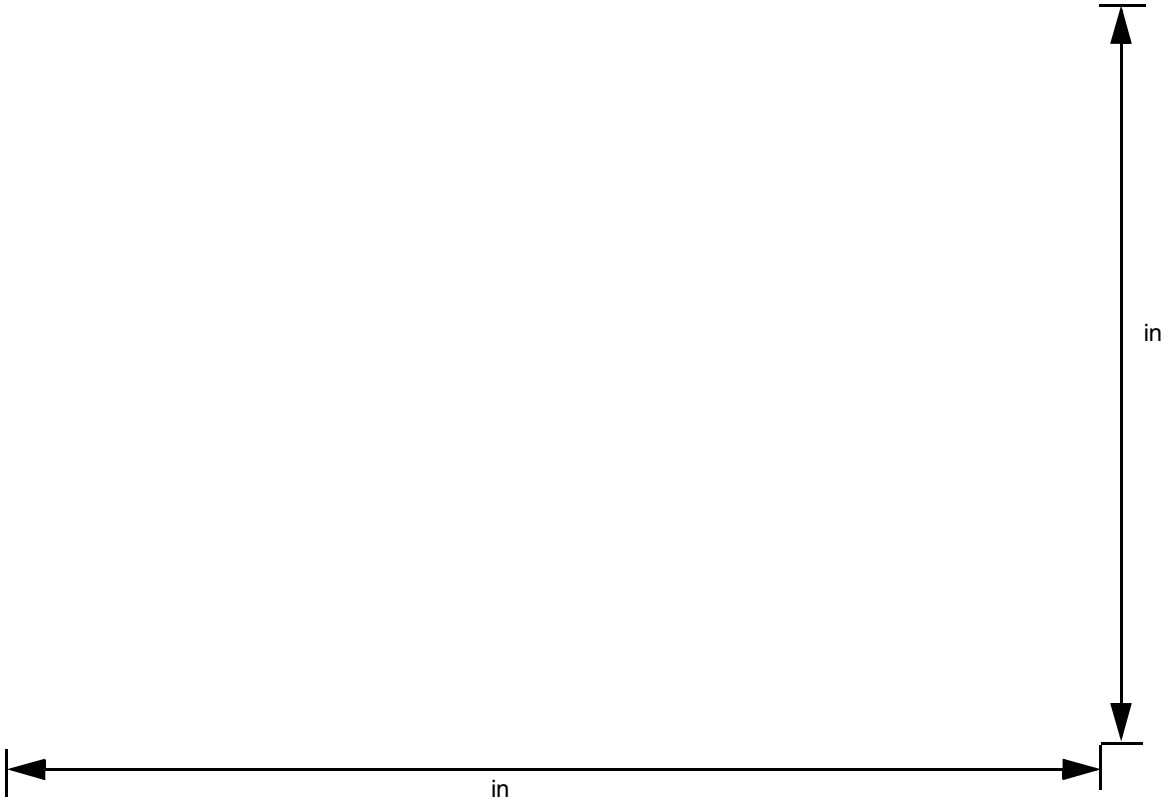

Figure 5-1 Model EHP19 IPT Front View

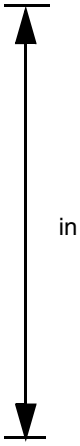

Figure 5-2 Model EHP19 IPT Side View

Chapter 5
Specifications

5.1 Specifications

Table 5-1 IPT Functional and Physical Specifications

Frequency Range	1930 to 1990 MHz
Instantaneous Bandwidth	15 MHz
Total Typical / Maximum Input Power	N/A
Total Output Power	60.2 watts (47.8 dBm) typical
Adjacent Channel Leakage Power Ratio	ACLR1 less than -33.5 dBc ACLR2 less than -54.8 dBc
RF Gain	N/A
Gain Flatness	Better than +/- 0.5 dB
Output Protection	Mismatch protected
Input Port Return Loss	N/A
Harmonics	Less than -34 dBm / 1 Mhz
Out of Band Spurious	Lower -27 dBm / Higher -27 dBm
Duty Cycle	Continuous
DC Input Power	From -57.6 Vdc to -38.4 Vdc (-48 Vdc nominal) Current limit is 10.1 amps, 9.8 amps typical (at -48 Vdc)
Operating Temperature	-33 to +45 °C Normal Operation -45 to +55 °C Exceptional Operation* -50 to +60 °C Nondestructive Operation**
Storage Temperature	-25 to +55 °C
Operating Humidity	15 to 100% Normal Operation 8 to 100% Exceptional Operation* 5 to 100% Nondestructive Operation**
Storage Humidity	10 to 100 per cent
RBS / IPT communication	
RF Input Connector	SMA-Female
RF Output Connector	SMA-Female
Power Consumption	Less than 207 watts maximum during normal operation 186 watts typical, 60 watts maximum at low temperature start
Weight	7.3 lbs. (3.3 kg.)
Dimensions	Refer to Figure Figure 5-1 and Figure 5-2

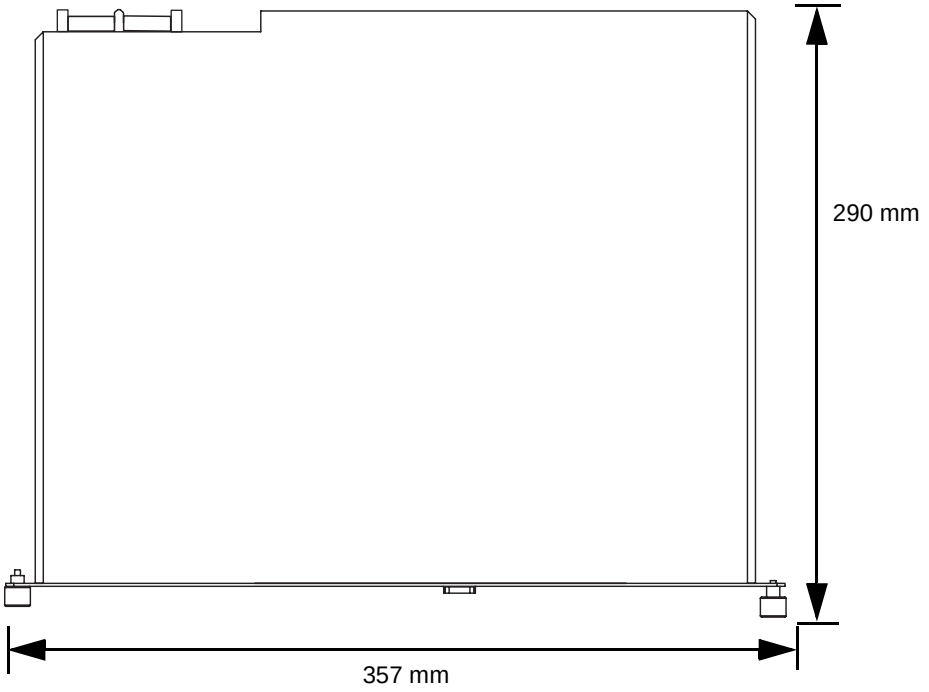

Figure 5-1 EHP19 IPT Side View

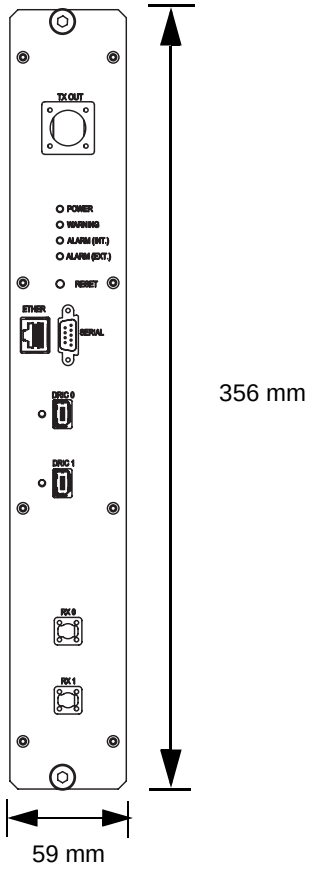

Figure 5-2 EHP19 IPT Front View

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