

# PWRLink™ II 4800T Series Optical Transmitter Product Manual

Manual Part No.: 700-0051934

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# ATTENTION AVERTISSEMENT ACHTUNG

Pursuant to the pertinent sections of Title 21, (United States) Code of Federal Regulations (CFR), Chapter I, Subchapter J, and administered by the Center for Devices and Radiological Health (CDRH), operation under the Food and Drug Administration (FDA), this product, which produces or receives an optical signal, composed of Laser Radiation, complies with 21 CFR Chapter I, Subchapter J, as applicable to Class I Laser Products with a Class 3B Hazard.

**Note!**



**This laser warning is included in all Harmonic manuals. The intended use of all Harmonic products, including those products that do not contain lasers, are in systems that contain lasers. Therefore this warning is important for the safety of all persons operating or maintaining the equipment.**

INTENDED MEANING SIGNIFICATION BEDEUTUNG	INTERNATIONAL SYMBOL SYMBOLE INTERNATIONALES INTERNATIONALES SYMBOL
<p><b>DANGER:</b> Invisible Laser Radiation, when open or when operating with fiber disconnected. <b>AVOID DIRECT EXPOSURE TO THE BEAM.</b> Never operate unit with a broken fiber or with a fiber connector disconnected.</p> <p><b>DANGER:</b> Les rayons laser sont invisibles à l'oeil. <b>NE PAS S'EXPOSER DIRECTEMENT AU FAISCEAU.</b> Ne jamais utiliser l'appareil lorsque la fibre est interrompue ou un connecteur endommagé ou déconnecté.</p> <p><b>VORSICHT:</b> Unsichtbare Laserstrahlung, wenn Abdeckung geöffnet oder Glasfaserkabel entfernt. <b>DIREKTEN KONTAKT MIT DEM STRAGL VERMEDIDEN.</b> Das Gerät nicht einschalten, wenn das Glasfaserkabel beschädigt oder nicht angelchlossen ist.</p>	
<p><b>CAUTION:</b> There are no user serviceable parts inside. Refer all servicing to qualified service personnel. Other than those specific measurements, adjustments and tests specified in the manual, make <b>NO</b> attempt to modify or alter any circuit or assembly in any manner.</p> <p><b>ATTENTION:</b> Toute intervention sur cet équipement est formellement déconseillée par le fabricant. En dehors de réglages décrits dans le manuel, l'utilisateur doit contacter une personne qualifiée par le fabricant pour toute modification ou réparation.</p> <p><b>VORSICHT:</b> Es sind keine zu wartenden Teile im Gerät, alle Wartungsarbeiten nur von qualifiziertem Personal ausführen lassen. Ex dürfen nur die im Handbuch spezifisch aufgeführten Messungen, Justierungen und Tests vom Benutzer vorgenommen werden. Unter keinen Umständen, dürfen Modifikationen oder Änderungen jeglicher Art am Gerät unternommen werden.</p>	  

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# 1

## Overview

### 1.1 About This Manual

This instruction manual is a complete guide to installation, configuration and operation of PWRLink™ II 4800T series optical transmitters. The models that are covered by this manual are listed in Appendix A, Section A.2.

- Chapter 1 provides a description of the PWRLink II transmitter.
- Chapter 2 describes the installation procedure.
- Chapter 3 introduces the user interfaces.
- Chapter 4 describes how to set up and configure the transmitter.
- Chapter 5 outlines maintenance procedures.
- Chapter 6 provides instructions on what to do in the event of problems.
- Appendix A provides complete technical specifications.
- Appendix B shows additional user interface details.
- Appendix C provides a list of Harmonic's offices.

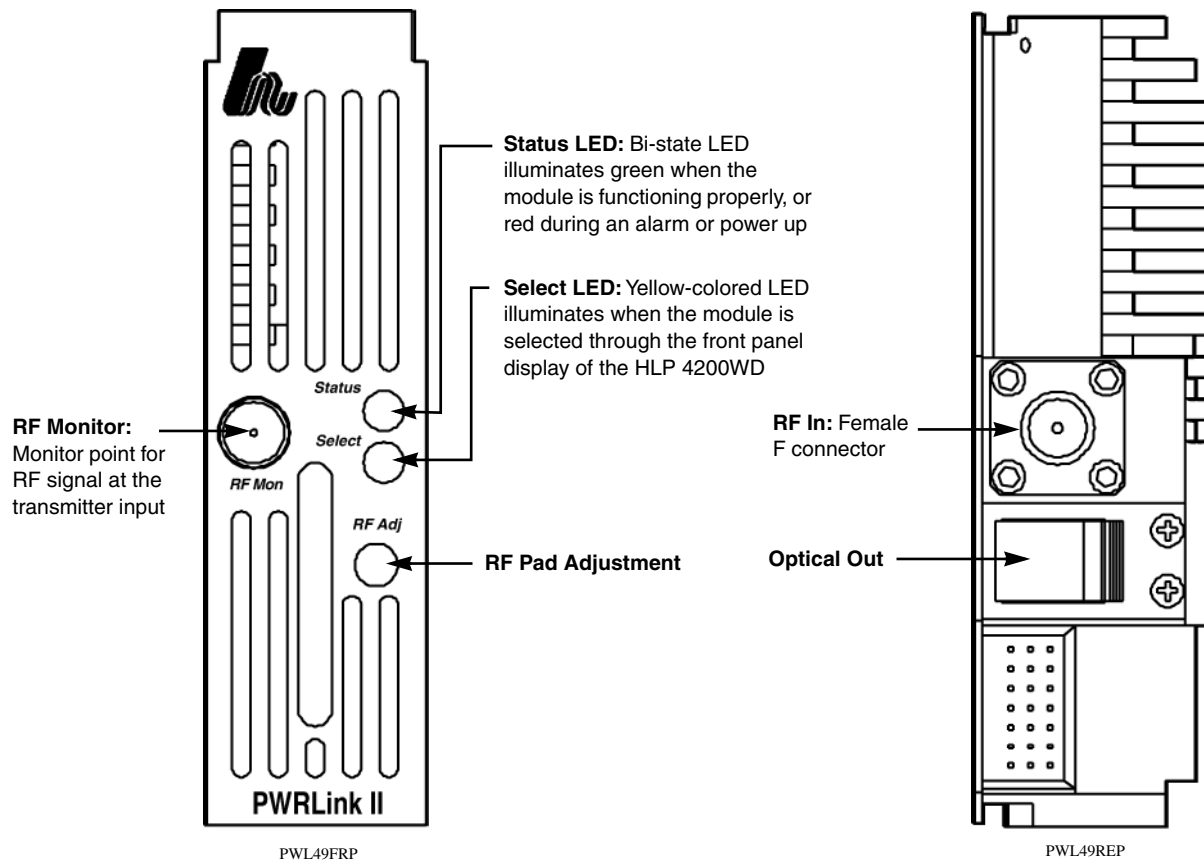
### 1.2 Description

The PWRLink II 4800T transmitter is a compact plug-in module designed for use in the Harmonic HLP 4200 equipment platform. An HMC 4000 module carrier is needed to mount the transmitter in the platform. Harmonic has optimized the PWRLink II 4800T series family of transmitter modules for high-performance transmission of RF broadband information over optical fiber networks.

The PWL 4800T has the following key features:

- Transmission bandwidth from 45 MHz to 870 MHz
- Optical performance with 76 PAL (System B/G) analog channels plus additional digital loading
- Internal monitoring and control using 32-bit microprocessor
- Local control of operating parameters—provided by the HLP 4200 platform
- Remote control and monitoring—provided by NETWatch Site Controller
- Autosetup feature that adjusts RF pad for optimum modulation performance
- Automatic gain control and manual gain control modes of operation

Figure 1-1 shows front and rear panel features of the PWL 4800T transmitter module.

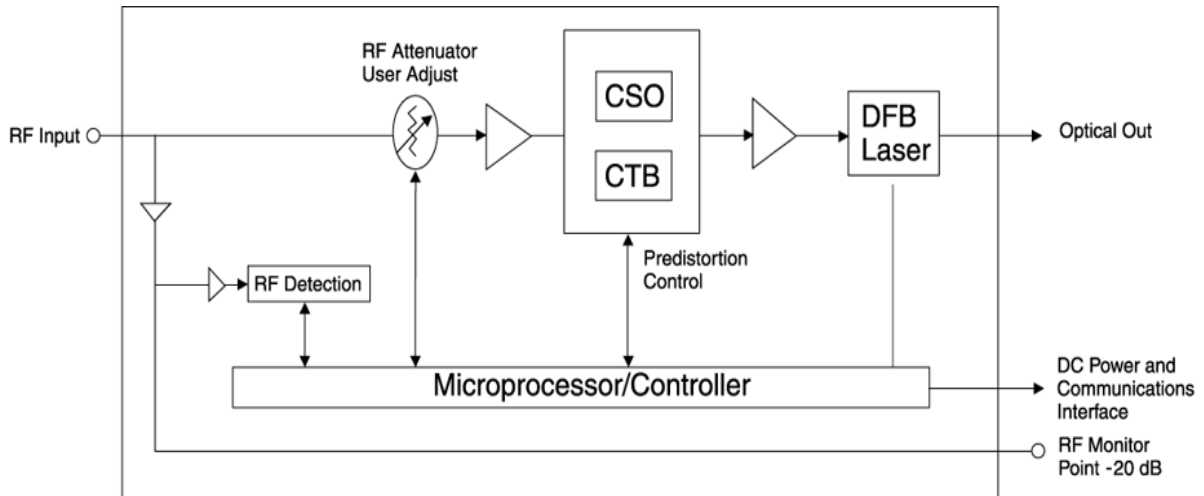


**Figure 1-1. PWL 4800T front and rear panel features**

Transmitter performance is optimized by combining state-of-the-art 1310 nm DFB (distributed feedback) laser technology and patented pre-distortion linearization circuitry. Harmonic has designed the PWRLink II family for integration into networks with advanced element management systems; each transmitter module employs a microprocessor-based communication and monitoring architecture. Figure 1-2 is a block diagram of the PWL 4800T transmitter.

The transmitter's microprocessor continuously monitors and controls all critical transmitter parameters in order to optimize performance over both time and temperature changes. The microprocessor-controlled parameters include:

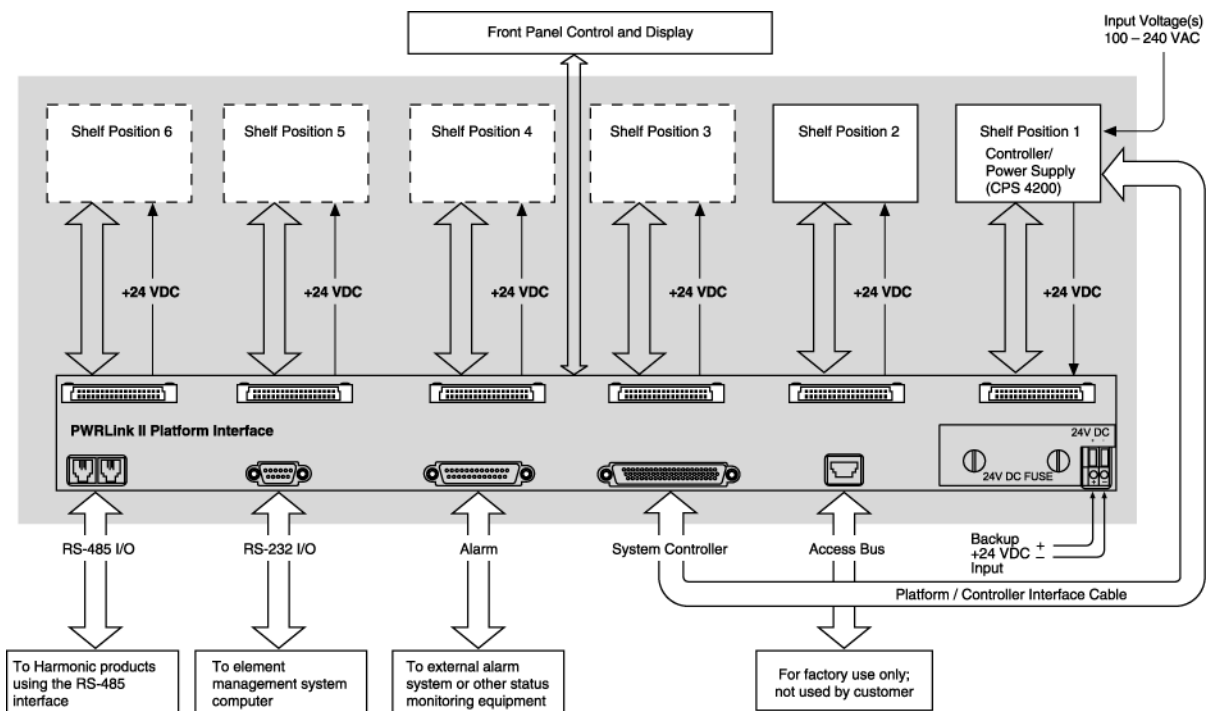
- Input signal attenuation pad
- Laser power, temperature, and bias
- Electrical circuit temperature and setpoints



PWL48BLD

**Figure 1-2. PWL 4800T block diagram**

The PWL 4800T transmitter is a compact plug-in module that mounts easily in Harmonic's HLP 4200 platform via the HMC 4000 module carrier. See Figure 1-3 for a functional diagram of the HLP 4200 platform. The transmitter module draws power from the platform's 24 VDC power bus, and communicates with the platform controller via the platform communication bus.



HL42FD

**Figure 1-3. HLP 4200 functional diagram**

For additional information on the HLP 4200 platform and its associated communication and power buses, see the *HLP 4200 Product Manual*. For further information on the platform controller and power supply options, see the *CPS 4200* or *CPS 4248* manual.

## 1.3 Applications

The PWRLink II DFB transmitter is designed to operate alone or with other systems, depending on the application:

- Alone, in local distribution and narrowcasting applications
- In combination with Harmonic's MAXLink™ 1550 nm transmission system, for complete broadband network solutions

The PWL 4800T provides an ultra-linear RF input-to-optical output (1310 nm) response for the simultaneous transmission of analog video and digital signals in the 45 to 870 MHz frequency band.

The 1310 nm optical signal transmitted by a PWRLink II module can be received by optical receivers and nodes manufactured by Harmonic or other major broadband equipment manufacturers. To learn more about equipment compatibility and broadband network design and optimization, contact customer service. See Appendix C, *Harmonic Inc. – Offices*.



# Installing the PWRLink II Transmitter

This chapter describes how to:

- Receive and inspect the PWRLink II transmitter
- Install the transmitter module in the HLP 4200 platform
- Connect the fiber cable
- Connect the RF broadband input
- Test RF signal input

## 2.1 Receiving and Inspecting

As you unpack your unit, inspect the shipping container and equipment for damage. Save the shipping material for future use.

If the container or the equipment is damaged, notify both the freight carrier and Harmonic. See Appendix C, *Harmonic Inc. – Offices* for contact information.

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**CAUTION:** Before removing equipment from its antistatic bag, touch a ground point for several seconds. A suitable ground point is an unpainted part of the chassis of a grounded piece of equipment.

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## 2.2 Installing the Transmitter Module

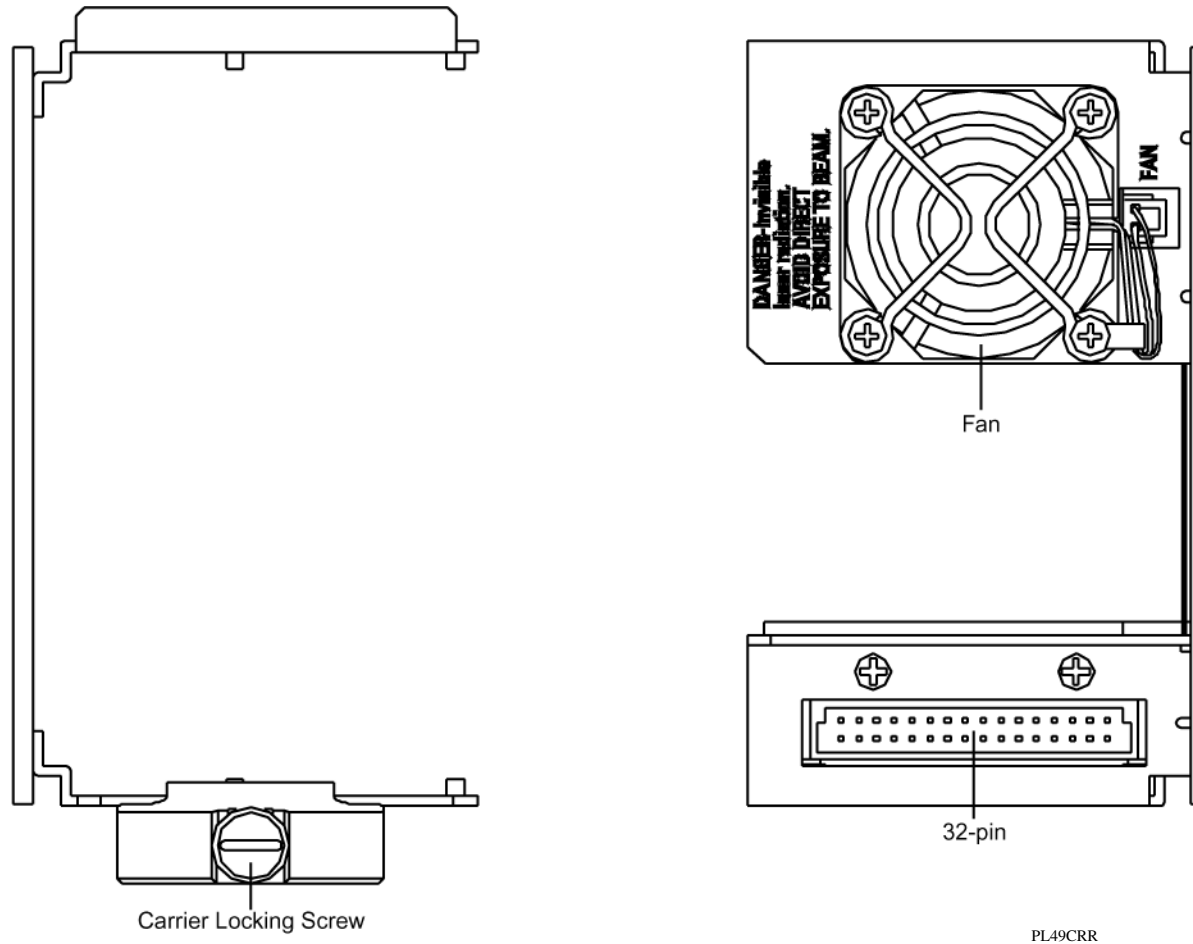
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**CAUTION:** To protect yourself from potential injury and to protect the equipment from further damage, do not perform any operational tests if the equipment appears to be damaged.

---

The PWRLink II transmitter module plugs into the HMC 4000 module carrier, shown in Figure 2-1 on page 2-2. The transmitter module is held in the carrier by a spring-loaded tab on the front handle of the carrier. You can place the HMC 4000 carrier into any desired position in the HLP 4200 platform.

The PWRLink II module can be plugged into the carrier either with the carrier already mounted in the HLP 4200 platform, or prior to mounting the carrier into the platform. The HLP 4200 platform can be powered and operational during the plug-in process.



**Figure 2-1. HMC 4000 module carrier front and rear panel features**

To install the transmitter module in the HMC 4000 carrier:

- Insert the transmitter into the carrier until it locks into position.

To remove the transmitter module from the HMC 4000 carrier:

- Press down the spring-loaded tab on the carrier, then pull out the module.

To install the HMC 4000 carrier in the HLP 4200 platform:

1. Lower the HLP 4200 platform's control/display panel.
2. Slide the HMC 4000 carrier into any available slot in the platform until it is properly seated.
3. Lock the carrier into position with the carrier locking screw, shown in Figure 2-1.

The PWRLink II transmitter receives power from the HMC 4000 carrier. The carrier is powered by the +24 VDC bus of the HLP 4200.

For additional information on the HLP 4200 platform, see the *HLP 4200 Instruction Manual*. For additional information on platform controllers and/or power supply options, see the respective Harmonic manual for each component.

## 2.3 Connecting the Fiber Cable

The optical output connector of the PWRLink II transmitter is located on the rear of the module, as shown in Figure 1-1 on page 1-2.

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**DANGER:** Invisible Laser Radiation. **AVOID EXPOSURE TO BEAM.**  
Never operate unit with a broken fiber or with a fiber connector disconnected.

---

To connect fiber optic cable to the transmitter output:

1. Verify that the transmitter module has been mounted into the HLP 4200 platform, as described in Section 2.2.
2. Determine the connector type on the PWRLink II transmitter. The standard optical connector recommended by Harmonic is SC/APC. Other connector types can be special ordered.
3. Verify that the type of connector on the fiber cable is the same as what is on the PWRLink II transmitter, for example the SC/APC.
4. Verify that the fiber cable connector has been cleaned properly. If the fiber cable connector needs to be cleaned, follow the cleaning procedure outlined in Section 5.1.1 *Cleaning Patch Cord or Pigtail Fiber Optical Connectors* on page 5-2.
5. Verify that the PWRLink II optical connector has not been exposed to any contamination. If you suspect that the connector may have been exposed to contamination (for example, by a dirty fiber cable connector), follow the cleaning procedure outlined in Section 5.1.2 *Cleaning Transmitter Module Optical Connectors* on page 5-2.

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**NOTE:** Any contamination of either the fiber cable or PWRLink II transmitter connector can significantly degrade optical link performance. This degradation will most likely manifest itself as poor carrier-to-noise (CNR) performance.

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6. For SC-type optical connectors, note the key characteristics of the mating connectors and align them accordingly. Gently insert the fiber cable connector into that of the PWRLink II transmitter until the connector clicks into place.  
For FC-type optical connectors, note the key characteristics of the mating connectors and align them accordingly. Gently insert the fiber cable connector into that of the PWRLink II transmitter and tighten the rotating sleeve of the connector. *Do not overtighten!*

## 2.4 Connecting the RF Broadband Input

The PWRLink II transmitter broadband RF connector is located on the rear panel of the module, as shown in Figure 1-1 on page 1-2.

The PWRLink II female F connector accepts a 75 ohm impedance coaxial cable terminated with a male F-type connector. The male F connector on the cable should have a center pin diameter in the range of 0.64 mm to 0.8 mm. Insert

the signal source connector into the PWRLink II module RF input connector and tighten securely. The input video signal level must be between 16 dBmV and 22 dBmV per analog video channel based on 76 PAL channels.

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**NOTE:** To ensure performance integrity, use RG-59 coaxial cable. Use of a connector with a center pin diameter greater than 0.8 mm can damage the input RF connector.

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## 2.5 Testing RF Signal Input

Once you have connected the RF signal source, you can use the RF monitor to verify the presence of the RF signal input to the transmitter. The RF monitor is a test connector (female F-type) located on the front panel of the transmitter module, as shown in Figure 1-1 on page 1-2. The monitor level is 20 dB below the input level to the transmitter  $\pm 1$  dB.

## User Interface Options

This chapter describes:

- HLP 4200WD display
- NETWatch Site Controller
- Front panel RF adjustment
- Front panel LED indicators

Each PWRLink II transmitter module employs a microprocessor, which makes it easy for you to communicate with and control the transmitter. This chapter describes three options for such communication and control. The options are:

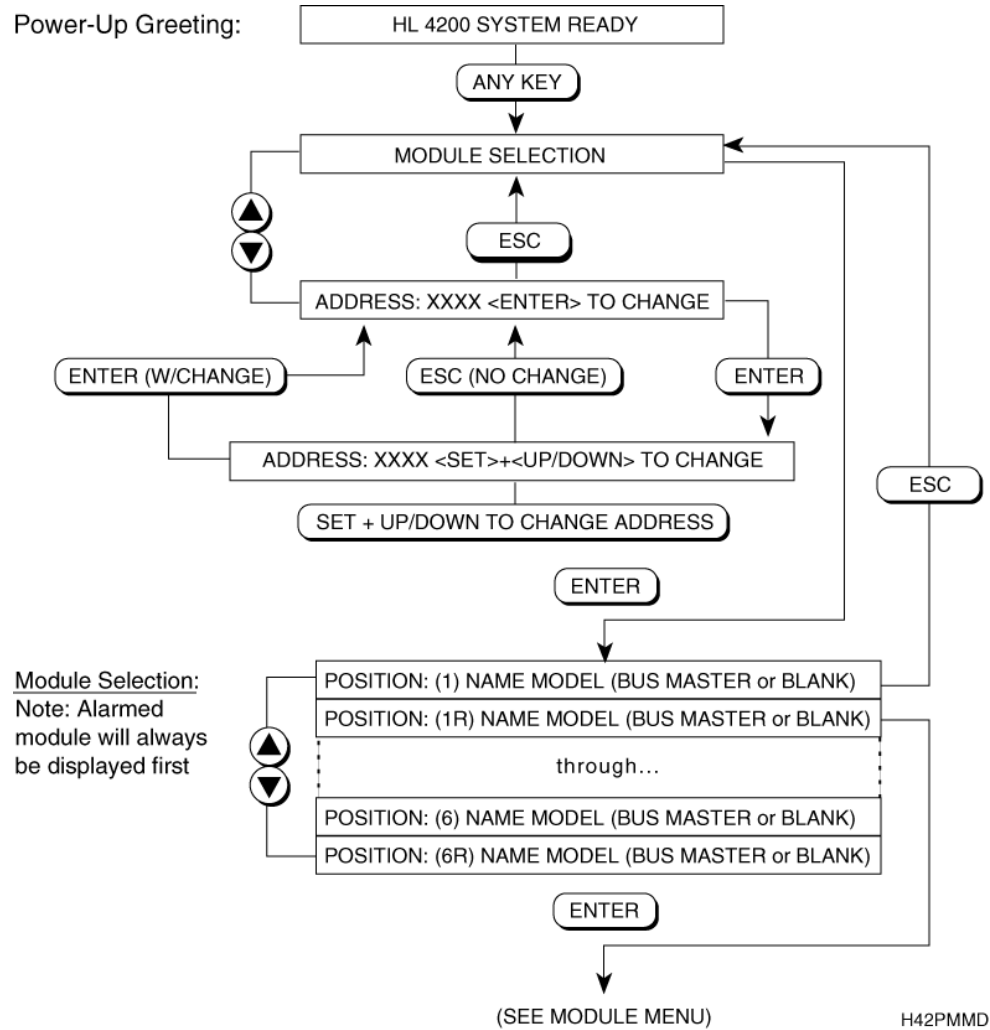
- **HLP 4200WD push buttons and display**  
The HLP 4200WD interface provides the most comprehensive means of monitoring and controlling PWRLink II transmitter performance. The Autsetup and Reset to Factory Settings commands are available only through this interface. For initial setup of the transmitter, Harmonic recommends using the HLP 4200WD display, if available.
- **NETWatch Site Controller Element Management System**  
Once installed and configured, NETWatch Site Controller provides a straightforward way to monitor and control a network of multiple PWRLink II transmitters, either locally or remotely.
- **PWRLink II transmitter front panel RF adjustment**  
The RF adjustment potentiometer on the front panel of each PWRLink II transmitter module (shown in Figure 1-1 on page 1-2 as RF Pad Adjustment) can be used to set the internal RF pad level. Use this interface only if the first two interface options are not available.

### 3.1 HLP 4200WD Display

The PWRLink II transmitter can be configured and monitored conveniently via the push buttons and LCD display of the HLP 4200WD equipment platform.

Figure 3-1 on page 3-2 provides a flowchart of the commands and messages in the Main menu, which is at the top of the HLP 4200 WD platform interface hierarchy. In this figure, push-button commands are framed in ovals, and resultant display messages are framed in rectangular boxes.

Use the Main menu to scan through platform positions and select a specific transmitter module to monitor and control. The Main menu also allows you to set the platform address for communication with NETWatch Site Controller. Instructions for navigating the Main menu are provided in Section 4.4.1 *Step-by-Step Setup Instructions* on page 4-7.



**Figure 3-1. HLP 4200WD platform Main menu display**

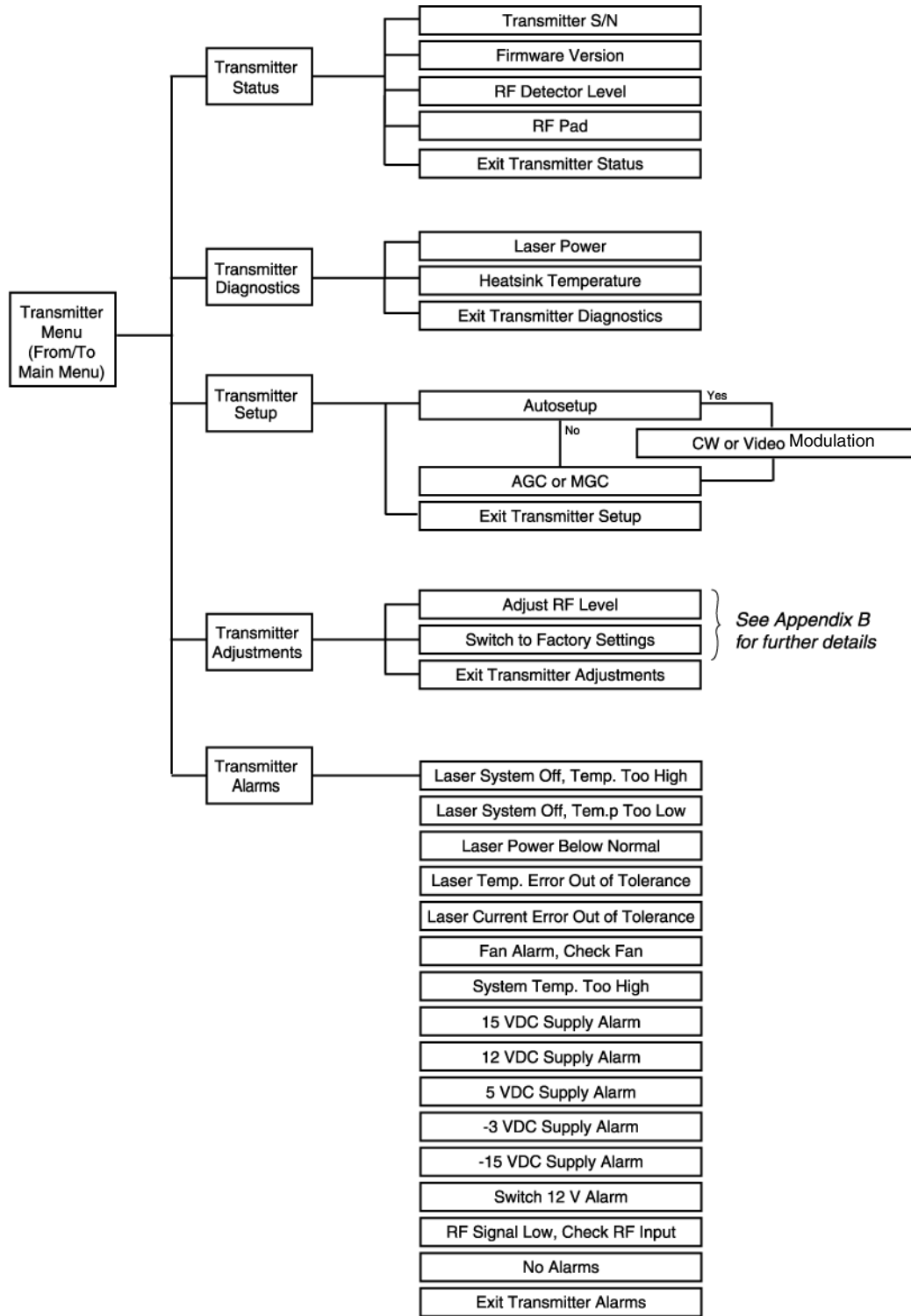
After you navigate the HLP 4200WD's Main menu and select a specific PWRLink II module, the Transmitter menu appears. The Transmitter menu is organized into four sub-menus:

- Transmitter Status
- Transmitter Setup
- Transmitter Adjustments
- Transmitter Alarms

These sub-menus are described below in Section 3.1.1 through Section 3.1.4. Figure 3-2 shows the information and controls available in the Transmitter menu. For further details, see Appendix B, *HLP 4200WD Menu Display*, which contains a fully detailed chart of the menu display.

The status and control parameters in the Transmitter menu apply only to the specific transmitter module that is selected. Use the HLP 4200WD's ▲ and ▼ buttons to scroll through the menus. Use the Enter button to make a selection. Use the Esc button to escape any menu.

For further information on using the HLP 4200WD display interface, see the *HLP 4200 Instruction Manual*.



PWL49UI1

Figure 3-2. HLP 4200WD platform Transmitter menu display chart



### 3.1.1 Transmitter Status

The Transmitter Status menu lets you obtain the transmitter serial number, firmware version, and basic operating mode parameters.

### 3.1.2 Transmitter Setup

The Transmitter Setup menu allows you to:

- Run the Autosetup routine.
- Select Manual Gain Control (MGC) or Automatic Gain Control (AGC) mode of operation.
- Configure the transmitter in either CW or Video mode.

### 3.1.3 Transmitter Adjustments

The Transmitter Adjustments menu allows you to:

- Adjust and optimize the RF pad settings
- Restore all transmitter parameters to the original factory settings

### 3.1.4 Transmitter Alarms

The Transmitter Alarms menu displays the active alarms in the transmitter.

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**NOTE:** If an alarm condition is triggered in a specific transmitter module, when that transmitter is selected through the HLP 4200WD interface, the display automatically jumps to the alarm message within the Transmitter Alarms menu.

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## 3.2 NETWatch Site Controller

Harmonic's NETWatch Site Controller provides a complete element management system, including a Windows™-based GUI and communications package for monitoring and controlling a network of multiple PWRLink II transmitters either remotely or locally. For information on installing and using this system, consult the *NETWatch Site Controller Instruction Manual*.

### 3.3 Front Panel RF Adjustment

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**NOTE:** Harmonic recommends that you use the front panel RF Adjustment control only if the interface options described in Section 3.1 and Section 3.2 are not available.

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The PWRLink II transmitter front panel includes an RF adjustment control, labeled *RF Adj*, as shown in Figure 1-1 on page 1-2. The RF adjustment potentiometer provides screwdriver-adjustable control of the input signal RF pad.

The RF pad adjustment potentiometer provides the following options:

- Each clockwise turning step of the RF adjustment switch increases the RF attenuation by 0.1 dB.
- Each counterclockwise step of the switch decreases the RF attenuation by 0.1 dB.
- Each full turn has 10 steps, equal to 1.0 dB.

Note that the RF adjustment switch works by communicating with the microprocessor, which in turn adjusts the pad value.

### 3.4 Front Panel LED Indicators

The PWRLink II transmitter front panel includes two LEDs, as shown in Figure 1-1 on page 1-2.

- The *Status* LED illuminates red if an alarm condition exists within the transmitter, and for a short period during power up. The *Status* LED illuminates green if no alarm condition exists and the transmitter is operating normally.

One type of alarm condition is the *RF signal low* alarm. The *Status* LED indicates an alarm (red) whenever the RF composite power level at the input of the transmitter falls below 28 dBmV. If the level rises above the 28 dBmV threshold, the *Status* LED illuminates green.

- The *Select* LED illuminates yellow when the transmitter module is selected via the front panel controls of the HLP 4200WD.

# 4

## Transmitter Setup

This chapter describes how to set up a PWRLink II 4800T series transmitter for optimum performance. Any of the three user interface options described in Chapter 3, *User Interface Options*, can be used for transmitter setup. The first half of this chapter describes transmitter features and setup options. The second half of the chapter details the setup procedure for each of the three user interface options.

This chapter describes:

- Factory-optimized settings of the PWRLink II transmitter
- Fine tuning the transmitter
- Autoseup, Automatic Gain Control, and Manual Gain Control
- How to set up via the HLP 4200WD display
- How to set up via NETWatch Site Controller
- How to set up via the transmitter's front panel controls

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**NOTE:** For initial setup of the transmitter, Harmonic recommends using the HLP 4200WD platform's push buttons and display, if available. If you are using another platform (such as HLP 4200ND) that does not have a display, NETWatch Site Controller can be used for transmitter setup. In the event that neither of those interface options is available, you can adjust the RF level via the front panel of the PWRLink II transmitter.

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Before proceeding with the instructions outlined in this chapter, ensure that you have installed the transmitter properly into the HLP 4200 platform, as described in Chapter 2, *Installing the PWRLink II Transmitter*.

## 4.1 Factory-Optimized Settings

The Harmonic factory optimizes the performance of each model in the PWL 4800T series (PWL 4802T through PWL 4814T) prior to shipment.

The factory setup is listed in Table 4-1.

**Table 4-1: Factory Setup**

Loading	76 unmodulated System B/G (PAL) channels from 45 to 870 MHz; 100 MHz digital information -10 dBc down from analog channels
RF input level	16 dBmV per video channel
Link loss	100% fiber link (example: PWL 4814T is tested over 14 dB of fiber)
Harmonic receiver	HRM 3811

The Harmonic factory-optimized setup procedure balances:

- CNR (carrier-to-noise) performance
- CSO (composite second order) distortion performance
- CTB (composite triple beat) distortion performance

Once the Harmonic factory optimizes a PWL 4800T transmitter, the factory settings are written into the transmitter's memory. These settings allow the transmitter to achieve the performance given in Appendix A at factory setup for any model in the PWL 4800T series of transmitters.

These factory settings include:

- Internal RF pad value (user adjustable)
- Laser bias (not user adjustable)
- Laser current (not user adjustable)
- Laser temperature (not user adjustable)
- Others

### 4.1.1 Returning to Factory Settings

If at any time the transmitter's settings are changed, you can always return the transmitter to the original factory settings through the HLP 4200WD display interface. In the Transmitter Adjustments Menu, select the Return to Factory Settings option. Follow the procedure in Section 4.4.3 *Resetting the Transmitter to Factory Defaults*.

When the transmitter reverts to the factory-optimized settings:

- If the transmitter is in AGC mode, the internal RF pad level automatically adjusts to get the adequate drive level to the laser for optimized performance.
- If the transmitter is in MGC mode, the transmitter reverts to factory settings based on Table 4-1, *Factory Setup*, on page 4-2, regardless of the actual RF input level. For the best performance, you must adjust the input level to 16 dBmV per channel. For instructions, see Section 4.4.2 *Fine Tuning the Transmitter* on page 4-8.

**Example**

In the case of a transmitter with the following setup:

- Loading: 76 unmodulated PAL B/G channels from 45 to 870 MHz and 100 MHz digital loading  $-10$  dBc down
- PAL B/G carriers RF input level:  $+18$  dBmV per channel
- Factory optimized pad value at 16 dBmV per channel: 5.5 dB

In this example, the input level at 18 dB/ch is higher than the factory setting of 16 dBmV/ch and there are two options for resetting the factory settings:

- If you use MGC ⊕ Reset to Factory Settings ⇒ Pad value will be 5.5 dB.
- If you use AGC ⊕ Reset to Factory Settings ⇒ Pad value will be  $5.5 + (18-16) = 7.5$  dB.

If you use MGC ⊕ Reset to Factory Settings, the pad value will be 5.5 dB. The laser is overdriven. To optimize the transmitter's performance, you need to adjust the RF input level to the factory setting, 16 dBmV/ch.

Using AGC ⊕ Reset to Factory Settings provides the adequate drive level to the laser with a pad value of 7.5 dB.

## 4.2 Fine Tuning Each Transmitter

Fine tuning each transmitter is recommended to precisely fit your specific requirements or preference. You can modify the transmitter configuration to trade off CNR performance for improved CSO and CTB distortion performance. Specifically, if you increase the RF pad by 1 dB, the following results occur:

- Transmitter CNR decreases by 1 dB
- CSO decreases by approximately 1 dB
- CTB decreases by approximately 2 dB

You can adjust the RF level by using any of the three interface options. For the RF adjustment procedure using each of the interface options, see *4.4.2 Fine Tuning the Transmitter*, *4.5 Setup via NETWatch Site Controller* or *4.6 Setup via the Transmitter's Front Panel Controls*.

## 4.3 Autoseup, Automatic Gain Control, and Manual Gain Control

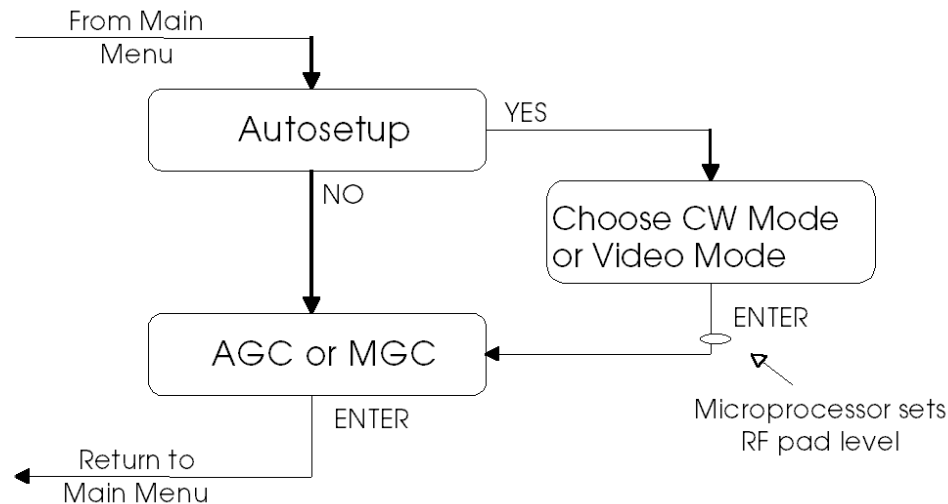
The *Autoseup* feature enables you to quickly set the internal drive level to the laser as close as possible to the optimal value determined at the Harmonic factory. The transmitter operates in either the Automatic Gain Control (AGC) mode or the Manual Gain Control (MGC) mode.

### 4.3.1 Autsetup

#### What does Autsetup achieve?

The Autsetup feature calibrates and automatically adjusts the internal RF pad for very close-to-optimum modulation performance.

#### How does Autsetup operate?



**Figure 4-1. Autsetup via the HLP 4200 front panel**

The Autsetup procedure works in three steps:

1. When you enter the Autsetup command via the HLP 4200WD front panel, the transmitter's internal microprocessor measures the input drive level to the transmitter. Then, it sets the attenuator pad so that the average RF drive level to the laser is at the same optimal value determined at the Harmonic factory using CW carriers.
2. Once this is done, the menu asks you to choose between CW Mode and Video Mode.
  - By entering CW Mode, you leave the current internal RF pad value as it stands.
  - By entering Video Mode, you add 3 dB to the current internal RF pad value.
3. Finally, you need to select AGC or MGC mode of operation. See Section 4.3.2 *Automatic Gain Control (AGC) and Manual Gain Control (MGC)*.

#### What if the video loading is less than 76 PAL B/G carriers?

When the number of video channels is below 76 and you require better CNR, you can increase the input level as shown in Figure 4-2 on page 4-5. The Autsetup procedure will measure the RF input level and adjust the pad value for operation as close as possible to optimum performance.

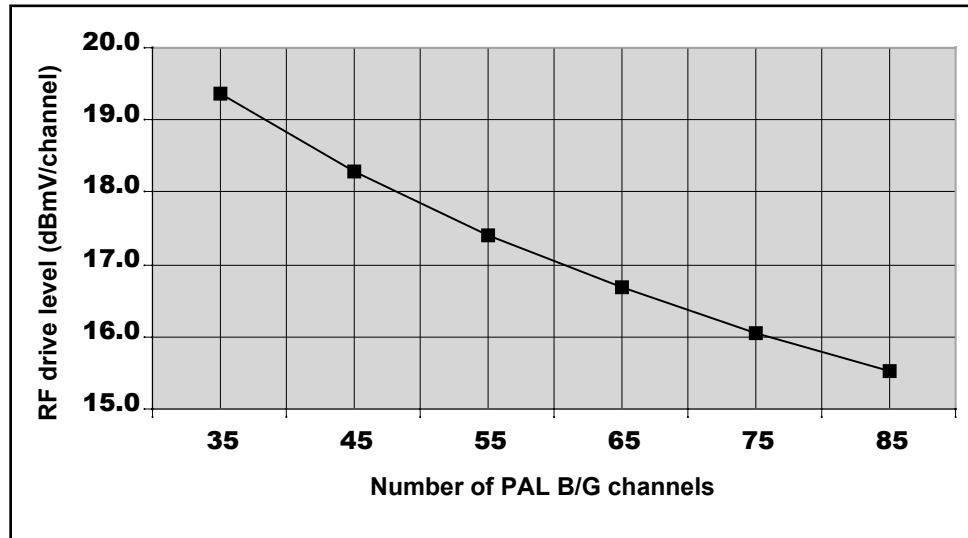


Figure 4-2. RF drive level as a function of channel loading

Even if you plan to add more video channels in the future, Harmonic recommends that you use 16 dBmV/ch to ensure that the system is easy to upgrade.

#### When should CW Mode or Video Mode be used?

It depends on the loading.

#### Example

In the case of a transmitter with the following setup:

- Loading: 76 PAL B/G channels from 45 to 870 MHz and 100 MHz digital loading  $-10$  dBc down.
- RF input level:  $+18$  dBmV/ch.
- Factory optimized pad value at 16 dBmV/ch: 5.5 dB.

**In the case of CW unmodulated carriers:** Harmonic recommends running Autosetup in CW Mode. In the factory, the transmitter is optimized using unmodulated carriers. Therefore, running Autosetup in CW Mode with the same channel load as the factory will bring the pad level back close to the optimal value. In this case, if you use Autosetup  $\oplus$  CW Mode  $\Rightarrow$  Pad value will be  $5.5 + (18-16) = 7.5$  dB.

**In the case of modulated carriers:** There are typically two different targets when setting up the transmitter with modulated carriers:

Target 1:

- Achieve the maximum possible modulation for the transmitter with better CNR, typically 3 dB higher than for unmodulated carriers
- The average CSO and CTB will be the same as the unmodulated case
- Preferably no digital loading on top of the video carriers

This target can be achieved by setting up the transmitter with modulated carriers in the CW Mode. In this case, if you use Autoseup ⊕ CW Mode ⇒ Pad value will be  $5.5 + (18-16) = 7.5$  dB.

Target 2:

- Achieve the same CNR as you would with unmodulated carriers
- The average CSO and CTB will be better than they would be with unmodulated carriers
- Digital loading

This target can be achieved by setting up the transmitter with modulated carriers in the Video Mode. In this case, if you use Autoseup ⊕ Video Mode ⇒ Pad value will be  $5.5 + (18-16) + 3 = 10.5$  dB.

### 4.3.2 **Automatic Gain Control (AGC) and Manual Gain Control (MGC)**

The AGC function operates by measuring the input RF level to the transmitter and continuously adjusting the RF pad to maintain constant drive level to the laser. When you select AGC, the input level to the transmitter laser remains at its previously established value.

When you use AGC mode with the PWL 4800T, Harmonic recommends that you drive the transmitters 3 dB harder so that they can better compensate for the increased variation in the RF input signal. For example, for 76 PAL B/G channels, use an RF input level of 19 dBmV/channel.

In MGC mode, the internal RF pad value of the transmitter is kept at a fixed value regardless of the input RF level variation.

---

**NOTE:** You can adjust the drive level of the laser in either AGC or MGC mode by changing the RF pad. For instructions, see Section 4.2 *Fine Tuning Each Transmitter* on page 4-3. After you have adjusted the pad, the transmitter will continue to operate in the same mode (AGC or MGC).

---



## 4.4 Setup via HLP 4200WD Display

This section provides instructions for setting up the PWRLink II 4800T series of transmitters via the push buttons and LCD display of the HLP 4200WD equipment platform. To quickly and easily set up and review the PWRLink II monitoring and control parameters, use the HLP 4200WD front panel. For a detailed description of this interface, see Section 3.1 *HLP 4200WD Display* on page 3-1.

### 4.4.1 Step-by-Step Setup Instructions

1. Verify that the PWRLink II transmitter module is properly installed in the HLP 4200 platform. Instructions are provided in Section 2.2 *Installing the Transmitter Module* on page 2-1.
2. Verify that the HLP 4200WD is powered on and that no alarm conditions exist within the transmitter module; make sure that the Status LED on the front panel is green.
3. Verify that the RF input level per analog carrier is within the range of 16 to 22 dBmV/channel based on 76 PAL B/G channels.
4. Verify that the RF input signal has been properly connected to the transmitter. See Section 2.4 *Connecting the RF Broadband Input* on page 2-3.
5. On the HLP 4200WD, press the Esc button until the display reads `MODULE SELECTION`, then press Enter.
6. Press the ▲ or ▼ button until the display indicates the transmitter module you wish to set up, then press Enter.
7. Press ▲ or ▼ until the display reads `TRANSMITTER SETUP`, then press Enter. The message appears, `RUN AUTOSETUP? YES <SET+UP/DN> TO CHOOSE`.
8. Hold down the Set button and press ▲ or ▼ until the value you want is displayed—`YES` to run autoselection or `NO` to skip autoselection—then press Enter. For details of the autoselection feature, see Section 4.3.1. If you choose `NO` to autoselection, skip to Step 10.
9. The message appears, `VIDEO MODULATION <SET+UP/DN> FOR CW`. Hold down the Set button and press ▲ or ▼ until the value you want is displayed—`CW MODULATION` or `VIDEO MODULATION`—then press Enter. The transmitter's microprocessor adjusts the RF pad level.
10. The message appears, `AGC CONTROL <SET+UP/DN> FOR AGC`. Hold down the Set button and press ▲ or ▼ until the value you want is displayed—`AGC` or `MGC`— then press Enter. For details of the AGC feature, see Section 4.3.2 *Automatic Gain Control (AGC) and Manual Gain Control (MGC)*.
11. To exit the Transmitter Setup menu, press Enter.

## 4.4.2 Fine Tuning the Transmitter

The setup instructions described in Section 4.4.1 will normally bring the transmitter to optimal operating conditions. Fine tuning each transmitter to the specific requirements or preference and adjustable performance (CNR, CSO, CTB) is recommended.

If the factory-optimized RF level is not suitable for your particular application, you can use the following procedure to adjust the internal RF pad.

You can adjust the RF level while in either AGC or MGC mode. See the appropriate section. Pad adjustment does not alter the current mode of operation (AGC or MGC).

For details of the results of the RF adjustment see Section 4.2 *Fine Tuning Each Transmitter* on page 4-3.

To adjust the RF level via the HLP 4200WD push buttons and display:

1. Press the ▲ or ▼ button until the display reads `MODULE SELECTION`, then press Enter.
2. Press ▲ or ▼ until the display indicates the transmitter module you wish to adjust, then press Enter.
3. Press ▲ or ▼ until the display reads `TRANSMITTER ADJUSTMENTS`, then press Enter.
4. Press ▲ or ▼ until the display reads `ADJUST RF LEVEL`, then press Enter.
5. The current RF pad setting is displayed with the instruction `<SET+UP/DN> TO CHANGE`.
6. Hold down the Set button and press ▲ or ▼ until the RF pad value you want is displayed, then press Enter.
7. To exit RF adjustment, press Enter.

## 4.4.3 Resetting the Transmitter to Factory Defaults

The factory-optimized settings are described in Section 4.1 *Factory-Optimized Settings* on page 4-2.

To return the transmitter to factory settings:

1. On the HLP 4200WD, press the ▲ or ▼ button until the display reads `MODULE SELECTION`, then press Enter.
2. Press ▲ or ▼ until the display indicates the transmitter module you wish to reset, then press Enter.
3. Press ▲ or ▼ until the display reads `TRANSMITTER ADJUSTMENTS`, then press Enter.
4. Press ▲ or ▼ until the display reads `SWITCH TO FACTORY SETTINGS`, then press Enter.
5. A message appears, telling you that all settings will be changed. Press Enter.
6. A message appears, `<ESC> TO ABORT OR <SET+UP/DN> TO SWITCH`. Hold down the Set button and press ▲ or ▼, then press Enter.
7. A confirmation message appears. Press Enter.

The transmitter reverts to the factory-optimized settings:

- If the transmitter is in AGC mode, the internal RF pad level adjusts to get the adequate drive level to the laser for optimized performance.
- If the transmitter is in MGC mode, the transmitter reverts to factory settings based on Table 4-1, *Factory Setup*, on page 4-2, regardless of the actual RF input level. For the best performance, you must adjust the input level to 16 dBmV per channel. For instructions, see Section 4.4.2 *Fine Tuning the Transmitter* on page 4-8.

## 4.5 Setup via NETWatch Site Controller

If you are using a platform that does not have a display (such as the HLP 4200ND), you can use NETWatch Site Controller for transmitter setup. For details on communication with the PWRLink II transmitter through the NETWatch Site Controller element management system, consult the *NETWatch Site Controller Instruction Manual*.

To use NETWatch Site Controller to set up the PWRLink II transmitter:

1. Verify that the PWRLink II transmitter module is properly installed in the HLP 4200 platform. Instructions are provided in Section 2.2 *Installing the Transmitter Module* on page 2-1.
2. Verify that the platform is powered on and that no alarm conditions exist within the transmitter module; make sure that the module icon in the NETWatch display is green.
3. Select automatic gain control (AGC) mode of operation.
4. Set the RF input level to the value given in Table 4-1, *Factory Setup*, on page 4-2.
5. Select manual gain control (MGC) mode of operation.

## 4.6 Setup via the Transmitter's Front Panel Controls

This section provides instructions for setting up the PWRLink II transmitter via the RF adjustment control on the front panel of the transmitter module. Use this interface only when the first two setup options, described in Section 4.4 and Section 4.5, are not available.

---

**NOTE:** For initial setup of the transmitter, Harmonic recommends that you use the HLP 4200WD platform display interface, if available, and that you follow the setup procedure in Section 4.4

---

If you are using an equipment platform that has been configured without a display (such as HLP 4200ND) and NETWatch Site Controller is not available, follow the procedure below to set up the PWL 4800T series transmitter module:

1. Verify that the transmitter module is properly installed in the platform. See Section 2.2 *Installing the Transmitter Module* on page 2-1.
2. Verify that the RF input level to the transmitter is in the 16 to 22 dBmV range.

3. Verify that the RF input signal is properly connected to the transmitter. See Section 2.3 *Connecting the Fiber Cable* on page 2-3.
4. Using the *RF Adj* control on the front panel, adjust the RF input level to the value given in Table 4-1, *Factory Setup*, on page 4-2. For further details on how to use the RF adjustment switch see Section 3.3 *Front Panel RF Adjustment* on page 3-6.

# 5

## Maintenance

This chapter describes how to:

- Clean fiber optic connectors
- Replace the fan in the PWRLink II transmitter

### 5.1 Cleaning Fiber Optic Connectors

---

**DANGER:** The fiber cable carries invisible laser radiation. **AVOID EXPOSURE TO THE BEAM.** Never operate a unit that has a broken fiber or a disconnected fiber connector.

---

Dirty optical connectors are the leading source of poor performance in a broadband optical fiber network. Dirty optical connectors lead to optical signal loss and reflections, which in turn can seriously degrade carrier-to-noise (CNR) performance and, in some cases, distortion performance.

Therefore, Harmonic recommends that you clean all mating fiber connectors, before connecting them to an optical transmitter.

In addition, if you suspect that the optical connector of a PWL 4800T module may have been exposed to contamination (by a dirty fiber cable connector, for example), you should properly clean the PWL 4800T optical connector before connecting optical fiber.

---

**CAUTION:** Improper cleaning of an optical connector can do more harm than good. Never use a clean-air product to spray air onto the surface of an optical connector. Spraying air onto an optical connector can cause condensation on the connector surface, leaving water spots and trapping dust. Failing to wipe a connector on dry lens paper immediately after wiping on paper wet with isopropyl alcohol can also lead to condensation on the connector. Using low-grade cleaning paper or other cloth to wipe an optical connector can leave microscopic fibers on the optical connector surface.

---

### 5.1.1 Cleaning Patch Cord or Pigtail Fiber Optical Connectors

To clean optical connectors, Harmonic recommends using a fiber optic connector cleaning cartridge (such as NTT Cletop). If a cleaning cartridge is not available, follow these steps to clean the optical connector of a patch cord or pigtail.

1. Fold a piece of unused dry lens cleaning paper twice, for a 4-ply thickness.
2. Use a drop of high-grade isopropyl alcohol to wet part of the paper.
3. Lay the connector on the lens cleaning paper with the tip touching the paper.
4. In one continuous motion, pull the connector across the paper from the wet part to the dry part.

### 5.1.2 Cleaning Transmitter Module Optical Connectors

Follow these steps to properly clean the optical connector of a PWRLink II transmitter module:

1. Remove the transmitter module from the HLP 4200 platform.
2. Remove the optical connector plate, including the Optical Out shutter, by unscrewing the two screws. See Figure 1-1 on page 1-2.
3. Pull the connector plate away, removing it *no more than 3 inches* from the back plate of the unit, and release the internal optical connector from the internal bulkhead adaptor. *Pulling the connector out more than 3 inches may cause breakage of the fiber.*  
The end of the internal fiber connector can now be cleaned.
4. Fold a piece of unused dry lens cleaning paper twice, for a 4-ply thickness.
5. Use a drop of high-grade isopropyl alcohol to wet part of the paper.
6. Lay the connector on the lens cleaning paper with the tip touching the paper.
7. In one continuous motion, pull the connector across the paper from the wet part to the dry part.
8. Once the cleaning is complete, re-insert the internal fiber connector into the bulkhead adaptor and press the two parts together carefully.
9. Carefully replace the connector plate.
10. Screw the two plate screws back in the Optical Out shutter.

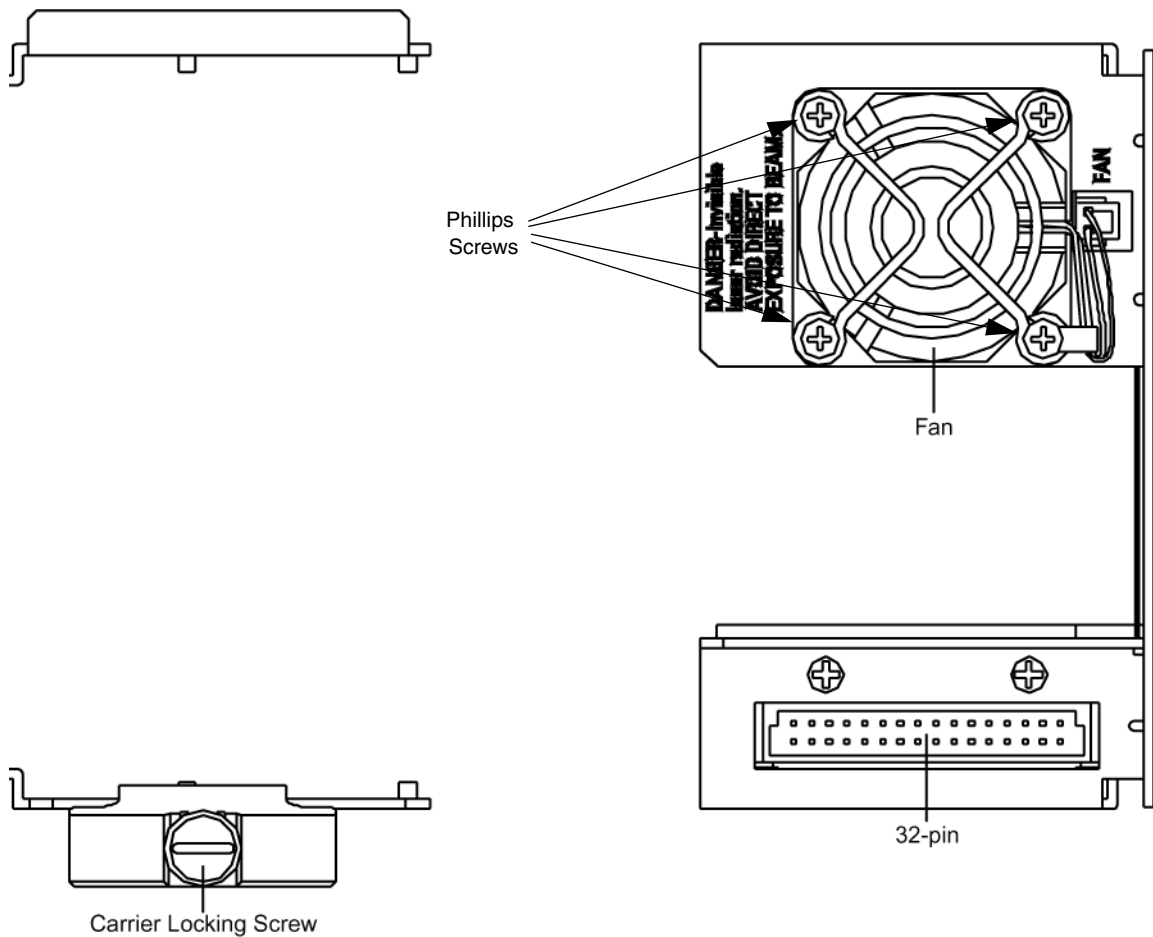
## 5.2 Fan Replacement

**NOTE:** The fan assembly mounted on the HMC 4000 carrier may be replaced without removing or disabling the PWRLink II transmitter module. Under normal headend and central office environmental conditions, the transmitter can operate without fan cooling for a limited time.

Should a fan failure occur, contact Harmonic's technical service (see Section Section 6.2).

To replace the fan:

1. Disconnect the fan's power cable.
2. Remove the four Phillips head screws, shown in Figure 5-1, that secure the fan to the module housing.
3. Replace the failed fan unit with a new fan unit.
4. Secure the new fan unit with the four Phillips head screws.
5. Reconnect the power cable.



PL49CRR

**Figure 5-1. Fan replacement**





# 6

## Troubleshooting

This chapter describes:

- How to troubleshoot the PWRLink II transmitter
- How to return the unit for service
- Warranty
- Limitations of warranty
- Exclusive remedies

### 6.1 Troubleshooting

Should a problem occur, check the following:

1. View the Status LED on the transmitter's front panel to determine if an alarm condition is indicated. See *Front Panel LED Indicators* on page 3-6.
2. View the HLP 4200WD front panel display to determine if an alarm condition is indicated.
3. Confirm that the PWRLink II transmitter is receiving power.
4. Confirm that the controller cable is connected to the transmitter module and the HLP 4200.

### 6.2 In Case of Problems

If you continue to have a problem, contact Harmonic's Customer Service department (see Appendix C, *Harmonic Inc. – Offices*, for contact information). A service technician will assist you in determining whether a fault exists with the unit.

If the service technician determines that you need to return the unit, she or he will issue you a Return Material Authorization Number. Please make note of this number, and keep it in a safe place. You must include it on the shipping container when returning the unit, and with all correspondence regarding the unit.

To return the unit, send it to the Harmonic Corporate Headquarters, and add the note: Atten: Customer Service.

The return address is:   Harmonic Inc.  
                                  549 Baltic Way  
                                  Sunnyvale, CA 94089  
                                  Atten: Customer Service  
                                  RMA no. \_\_\_\_\_

## 6.3       **Warranty Summary**

This Harmonic Inc. hardware product is warranted against defects in material and workmanship for twelve (12) months from the date of shipment. Harmonic Inc. will, at its option, either repair or replace products that prove to be defective.

We shall have no liability or responsibility to the customer or any other person with respect to any loss or damage caused or alleged to be caused directly or indirectly by equipment or software sold or furnished by us. Read instructions carefully. No liability will be assumed for any damage caused by improper installation.

The information in this document is subject to change without notification. The content of this document is protected by copyright. No part of this document may be reproduced or copied by any means without the permission of Harmonic Inc.

For warranty or repair, return this product to a service facility designated by Harmonic Inc. The Buyer shall prepay shipping charges to Harmonic Inc., and Harmonic Inc. shall pay shipping to return the product to the buyer. However, the Buyer shall pay all shipping charges, duties and taxes for products returned to Harmonic Inc. from another country.

Harmonic Inc. warrants that its software, as well as firmware designated by Harmonic Inc. for use with the product, will execute its programming instructions when installed properly.

Harmonic Inc. does not warrant that the operation of the product or software or firmware will be uninterrupted or error free.

## 6.4       **Limitations of Warranty**

The foregoing warranty shall not apply to defects resulting from abuse, neglect by the Buyer, improper installation or application by the Buyer, the Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product or improper site penetration or maintenance.

**No other warranty is expressed or implied. Harmonic Inc. specifically disclaims the implied warranties or merchantability and fitness for a particular purpose.**

## 6.5       **Exclusive Remedies**

The remedies provided herein are the Buyer's sole and exclusive remedies. Harmonic Inc. shall not be liable for any direct, indirect, special, incidental or consequential damages, whether based upon contract, tort or any other legal theory.

# Appendix A

## Technical Specifications

### A.1 Link Performance

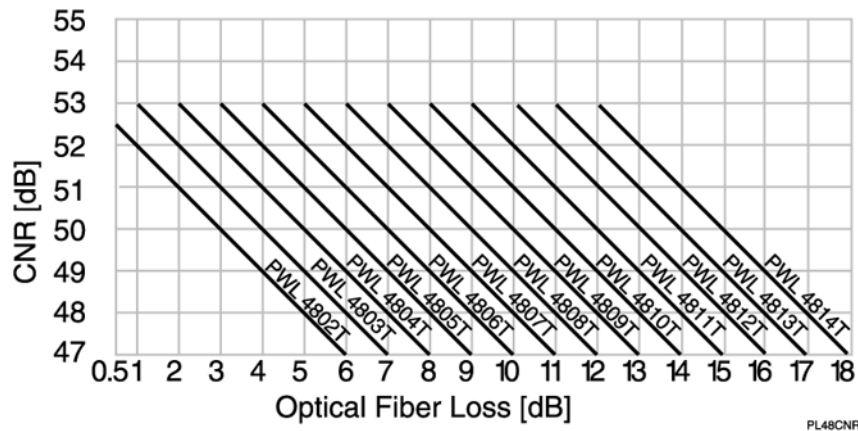
Carrier-to-Noise (CNR): Shown in Figure A-1

Carrier-to-CSO: >64 dB<sup>1,2</sup>

Carrier-to-CTB: >68 dB<sup>1,2</sup>

When the link includes optical splitter loss, add 0.1 dB to CNR for every 1 dB of splitter loss.

In Figure A-1, CNR and optical fiber loss are plotted against each other for a transmitter with 76 PAL (System B/G) channels<sup>3,4,5</sup> running.



**Figure A-1. PWRLink II 4800T series CNR vs. optical fiber loss**

1. These performance specifications are typical, given for 100% fiber optical links. Subtract 1dB from CSO and CTB for worst-case performance.
2. Performance expected at +25°C. For operation over the entire temperature range, subtract 2dB from CSO and CTB worst-case performance specifications.
3. Optical link defined as PWL 4800T series transmitters + 100% fiber link + HRM 3811 optical receiver.
4. Specifications for 76 unmodulated System B/G (PAL) channels and 100 MHz digital loading at -10 dBc down from analog channels.
5. Typical CNR degeneration of 0.5 dB when digital loading is -6 dB below the analog carriers.

---

## A.2 Optical Output

Wavelength: 1300 to 1320 nm

Flatness: <1 dB peak-to-valley

Eye protection: Safety shutter

Optical return loss: <-65 dB for SC/APC connectors, <-55 dB for other connectors

**Table A-1: Optical Power**

Transmitter Model	Optical Power (dBm)	Optical Power (mW)
PWL 4802T	2.5 ±0.5	1.8 (1.6 to 2.0)
PWL 4803T	4.0 ±0.5	2.5 (2.2 to 2.8)
PWL 4804T	5.0 ±0.5	3.2 (2.8 to 3.5)
PWL 4805T	5.5 ±0.5	3.5 (3.2 to 4.0)
PWL 4806T	6.0 ±0.5	4.0 (3.5 to 4.5)
PWL 4807T	7.0 ±0.5	5.0 (4.5 to 5.6)
PWL 4808T	8.0 ±0.5	6.3 (5.6 to 7.1)
PWL 4809T	9.0 ±0.5	7.9 (7.1 to 8.9)
PWL 4810T	9.75 ±0.75	9.4 (7.9 to 11.2)
PWL 4811T	10.5 ±1.0	11.2 (8.9 to 14.1)
PWL 4812T	11.0 ±1.0	12.6 (10.0 to 15.8)
PWL 4813T	11.5 ±1.0	14.1 (11.2 to 17.8)
PWL 4814T	12.0 ±1.0	15.8 (12.6 to 20.0)

## A.3 RF Input

Input level range per video channel:

PWL 4802T to PWL 4814T: 16 to 22 dBmV

Operational bandwidth: 45 to 870 MHz

RF attenuator adjustment range: 10 dB

Impedance: 75 ohm

Return loss: >16 dB

Level control: Manual (MGC)/Automatic (AGC)

## A.4 User Interface

### Front panel

Bi-state status LED: Normal = Green, Alarm = Red

Module selection indicator: Yellow LED

RF attenuation adjustment

Monitor point:

Monitor port to RF input: -20 dB

Flatness:  $\pm 1.0$  dB

Return loss: >16 dB

Connector type: Female F

### Rear panel

RF input connector type: Female F

Optical output (for connector types available, see Section A.8)

### Element Management System—NETWatch Site Controller

Interface: RS-485, RS-232C connectors (in HLP 4200)

Carrier: Externally generated

## A.5 Power Requirements

Nominal: +24 VDC; supplied by HLP 4200 bus

Maximum: +28 VDC

Consumption: 22 Watts maximum

## A.6 Environmental

Operating temperature<sup>1</sup>: 0° to +50° C (+32° to +122° F)

Storage temperature: -40° to +70° C (-40° to +158° F)

Automatic fan adjustment at: 40° & 50° C (104° & 122° F)

Relative humidity: 85% non-condensing

Over temperature laser protection: Software and hardware

- 
1. For operation over entire temperature range, subtract 2 dB from CSO and CTB worst-case performance specifications.

---

## A.7 Physical

Dimensions: 1.3" W x 4.4" H x 11.7" D (3.3 cm W x 11.2 cm H x 29.7 cm D)

Weight: 1.64 kg (3.6 lbs)

Mounting: HLP 4200 platform, one half-module slot

Optical connector type: SC/APC, FC/APC, SC/UPC, FC/UPC, E2000

RF connector type: Standard F, RG-59 cable type (accepts 0.64 to 0.8 mm center conductor diameter)

## A.8 Models Available

PWL 4802T through PWL 4814T

PWL 48xxT-zz

xx = Model Number: 02 to 14

zz = Connector Type: AS, AF, US, UF or AE

AS = SC/APC

AF = FC/APC

US = SC/UPC

UF = FC/UPC

AE = E2000



## Appendix B

# HLP 4200WD Menu Display

Figure B-1 and Figure B-2 provide a flowchart of the commands and messages in the Transmitter Menu of the HLP 4200WD platform display.

In these figures, push-button commands are framed in ovals, and resultant display messages are framed in rectangular boxes. Use the HLP 4200WD's ▲ and ▼ buttons to scroll through the menus. Use the Enter button to make a selection. Use the Esc button to escape any menu.

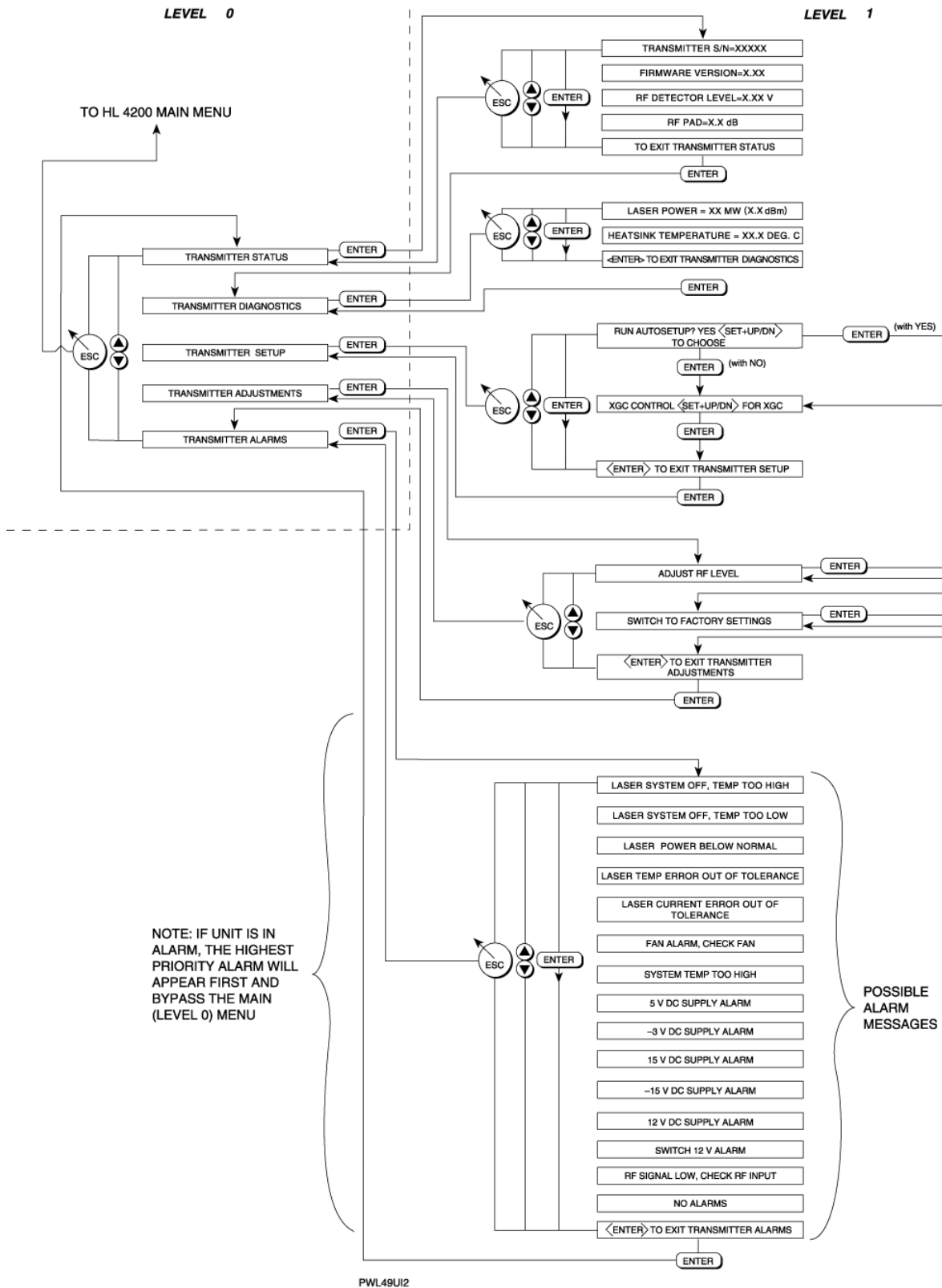


Figure B-1. HLP 4200WD platform Transmitter menu display, levels 0 and 1



LEVEL 2

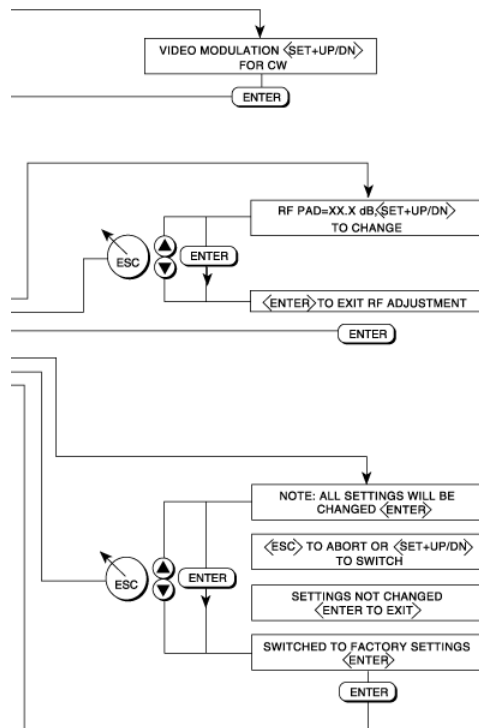


Figure B-2. HLP 4200 WD platform Transmitter menu display, level 2

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