# PCB-4000A

## 1+1 Phase Combiner
## Installation and Operation Manual

Part Number MN-PCB-4000A
Revision 2

IMPORTANT NOTE: The information contained in this document supersedes all previously published information regarding this product. Product specifications are subject to change without prior notice.

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# Revision History

| Rev | Date | Description |
|---|---|---|
| - | 5-2017 | Initial Release. |
| 1 | 2-2018 | Added remote commands STB, STA, STV, TPE, TPS, and RFD to Chapter 5.<br>Updated Table 6.1, Management Information Base Files, in Chapter 6.<br>Updated Appendix A to add Mounting Bracket Kit, part number KT-0021261 and update cable assembly in Table A-2 and A-5.<br>Updated Preface Product Support and Comtech EF Data Headquarters information. |
| 2 | 2-2018 | Added default line for IPA, IPG, and SPA commands. |

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Acronym List

| Acronym | Description |
|---|---|
| AOF | Amplitude Offset |
| EIA | Electronic Industries Association |
| GND | Ground |
| HPOD | High Powered Outdoor Amplifier |
| LED | Light Emitting Diode |
| M&C | Monitor and Control |
| NMS | Network Management System |
| OID | Object Identifiers |
| PCB | Printed Circuit Board |
| PCCB | Phase Combiner Control Box |
| RMA | Return Marerial Authorization |
| RS | Recommended Standard |
| SNMP | Simple Network Management System |
| SSPA | Solid State Power Amplifier |
| VSWR | Voltage Standing Wave Ratio |
| WG | Waveguide |

# PREFACE

## About this Manual

This manual provides installation and operation information for the Comtech EF Data PCB-4000A 1+1 Phase Combiner. This is an informational document intended for the persons responsible for the operation and maintenance of the PCB-4000A.

Comtech EF Data has reviewed this manual thoroughly in order to provide an easy-to-use guide to your equipment. All statements, technical information, and recommendations in this manual and in any guides or related documents are believed reliable, but the accuracy and completeness thereof are not guaranteed or warranted, and they are not intended to be, nor should they be understood to be, representations or warranties concerning the products described. Further, Comtech EF Data reserves the right to make changes in the specifications of the products described in this manual at any time without notice and without obligation to notify any person of such changes.

This is an informational document intended for the persons responsible for the operation and maintenance of the modem.

## Conventions and References

## Patents and Trademarks

See all of Comtech EF Data's Patents and Patents Pending at http://patents.comtechefdata.com.

## Warnings, Cautions, and Notes

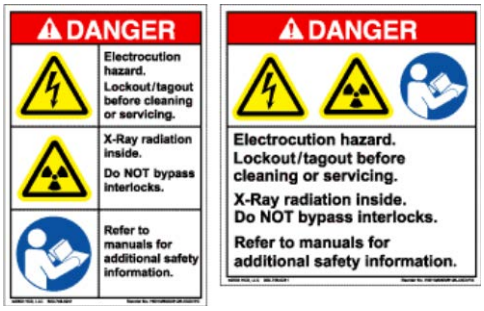
A **WARNING** indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.

A **CAUTION** indicates a hazardous situation that, if not avoided, may result in minor or moderate injury. **CAUTION** may also be used to indicate other unsafe practices or risks of property damage.

A **NOTE:** gives you important information about a task or the equipment.

A **REFERENCE** directs you to important operational information or details furnished elsewhere, either in the manual or in adjunct Comtech EF Data publications.

## Examples of Multi-Hazard Notices







## Recommended Standard Designations

Electronic Industries Association (EIA) designations supersede Recommended Standard (RS) designations. Reference to the old RS designations (e.g., RS-232) may appear where it might concern actual text displayed on the unit's rear panel, Serial Interface, or Web Server Interface pages. All other references in the manual use the EIA designations.

## Metric Conversion

Metric conversion information is provided on the inside back cover of this manual. Comtech EF Data provides this information to assist the user in cross-referencing non-Metric to Metric conversions.

# Safety and Compliance

## Electrical Safety Notice

***Double pole / neutral fusing is used on the prime power supply input.***

This equipment is designed to minimize exposure of personnel to hazards. For further information, contact the Comtech EF Data Customer Support Department. The persons responsible for the operation and maintenance of the PCB-4000A must:

- Know how to work around, with, and on high voltage equipment.
- Exercise every precaution to ensure personnel safety.
- Exercise extreme care when working near high voltages.
- Be familiar with the warnings presented in this manual.

## Product Support

**For all product support, please call:**
+1.240.243.1880
+1.866.472.3963 (toll free USA)
**By email:**
techsupport@comtechefdata.com

## Comtech EF Data Headquarters

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**+1.480.333.2200**

## Warranty Policy

Comtech EF Data products are warranted against defects in material and workmanship for a specific period from the date of shipment, and this period varies by product. In most cases, the warranty period is two years. During the warranty period, Comtech EF Data will, at its option, repair or replace products that prove to be defective. Repairs are warranted for the remainder of the original warranty or a 90 day extended warranty, whichever is longer. Contact Comtech EF Data for the warranty period specific to the product purchased.

For equipment under warranty, the owner is responsible for freight to Comtech EF Data and all related customs, taxes, tariffs, insurance, etc. Comtech EF Data is responsible for the freight charges only for return of the equipment from the factory to the owner. Comtech EF Data will return the equipment by the same method (i.e., Air, Express, Surface) as the equipment was sent to Comtech EF Data.

All equipment returned for warranty repair must have a valid RMA number issued prior to return and be marked clearly on the return packaging. Comtech EF Data strongly recommends all equipment be returned in its original packaging.
Comtech EF Data Corporation's obligations under this warranty are limited to repair or replacement of failed parts, and the return shipment to the buyer of the repaired or replaced parts.

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The warranty does not cover damage or loss incurred in transportation of the product. The warranty does not cover replacement or repair necessitated by loss or damage from any cause beyond the control of Comtech EF Data Corporation, such as lightning or other natural and weather-related events or wartime environments.

The warranty does not cover any labor involved in the removal and or reinstallation of warranted equipment or parts on site, or any labor required to diagnose the necessity for repair or replacement.

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A fixed charge established for each product will be imposed for all equipment returned for warranty repair where Comtech EF Data Corporation cannot identify the cause of the reported failure.

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Comtech EF Data Corporation's warranty, as stated is in lieu of all other warranties, expressed, implied, or statutory, including those of merchantability and fitness for a particular purpose. The buyer shall pass on to any purchaser, lessee, or other user of Comtech EF Data Corporation's products, the aforementioned warranty, and shall indemnify and hold harmless Comtech EF Data Corporation from any claims or liability of such purchaser, lessee, or user based upon allegations that the buyer, its agents, or employees have made additional warranties or representations as to product preference or use.

The remedies provided herein are the buyer's sole and exclusive remedies. Comtech EF Data shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

# Chapter 1. INTRODUCTION

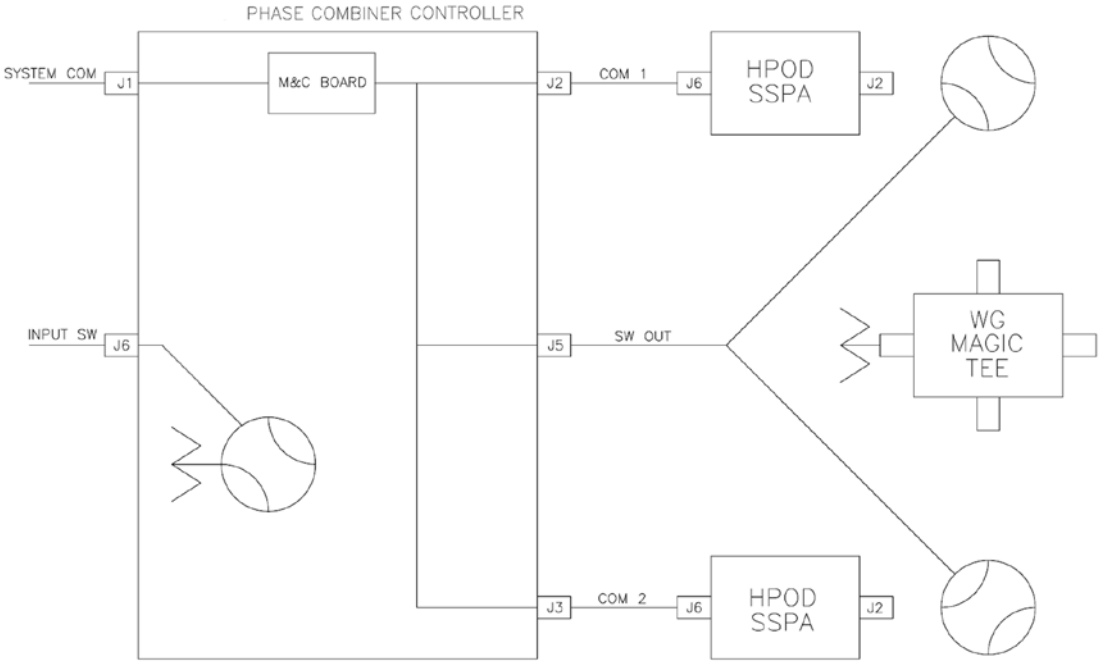
## 1.1 Overview

Phase combining is a traditional technique that cost effectively increases the available output power of an amplifier system. The PCB-4000A 1+1 Phase Combiner (Figure 1-1), together with two Solid State Power Amplifiers (SSPAs), form a complete 1+1 phase combined system that doubles the available output power. The PCB-4000A also features a “soft fail” configuration; i.e., if one SSPA experiences a failure, the total output power will be reduced by only 3 dB, rather than 6 dB.

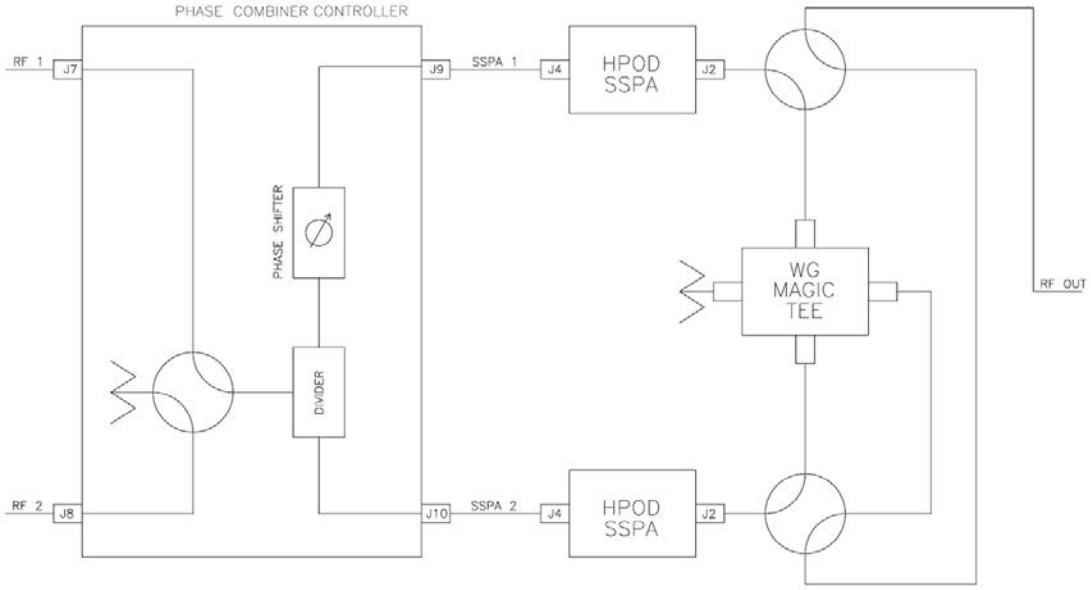

**Figure 1-1. PCB-4000A 1+1 Phase Combined System**

## 1.2 Functional Description

The PCB-4000A is available in a C-Band version. Contact Comtech EF Data for X-band and Ku-band versions. The box may be included in a top-level system assembly or as a subassembly kit. For application examples, see **Appendix A. ASSEMBLY KITS**.




**Monitor & Control (M&C) System Interconnect**




**RF System Interconnect**

**Figure 1-2. Combined System Block Diagrams**

The block diagrams shown in Figure 1-2 depict the major components of the 1:1 phase combined system. (These diagrams employ High Powered Outdoor Amplifiers (HPODs) as the designated SSPAs.)

The Phase Combiner Control Box (PCCB) contains a microprocessor-based Monitor and Control (M&C) circuit board to control the system. Interconnection is as follows:

- The PCCB communicates with each SSPA via control cables that are attached from the PCCB "**SSPA COM 1 | J2**" and "**SSPA COM 2 | J3**" connectors to each SSPA.
- Through this connection, the PCCB receives its prime power to operate. A +24V signal from each SSPA is diode OR'ed to provide redundant operating power for the PCCB.
- A "Y" cable connects to the "**SSPA SW OUT | J5**" connector for control of the waveguide switches. M&C communication with the PCCB is accomplished via the "**SYSTEM COM | J1**" connector.

***To avoid ambiguities, all communication to each SSPA is also accomplished via the PCCB M&C.***

The PCCB provides a weatherized housing for the necessary input RF components. System interconnection is as follows:

- An input RF redundancy switch, controlled via the "**RF INPUT SWITCH | J6**" connector, selects which RF path is directed to the output.
- The output RF signal is fed into an in-phase divider, which equally splits the signal in phase and amplitude to the "**SSPA OUT 1 | J9"** and "**SSPA OUT 2 | J10"** output connectors.
  - The RF path to the "**SSPA OUT 1 | J9"** output connector contains a manually adjustable phase shifter. This phase shifter is used to equalize the phase difference of each SSPA signal path to achieve maximum system output power. It is accessible via a small cover panel. This critical component is factory set and should only be adjusted, if needs arise, by carefully following an appropriate alignment procedure.

**See Chapter 3. OPERATION and ADJUSTMENT PROCEDURES for operational and alignment information.**

  - The RF path to the "**SSPA OUT 2 | J10"** output connector contains a length of coaxial cable that is factory manufactured to provide equal phase length paths from the RF input to each PCCB output when the adjustable phase shifter is set to its midpoint. This provides a maximum adjustable phase range.

There are also several isolators inside the PCCB that maintain good system Voltage Standing Wave Ratio (VSWR). Do not alter any RF cable inside (or outside) of the box that is part of the RF signal path.

- The RF signals from the PCCB are fed to the RF input of the respective SSPA via a set of phase-matched cables. Again, the phase length (and matching) of these cables is essential to system operation and no substitutes should be used. The routing should not be such to cause extreme bends.
- The output waveguide combining system consists of balanced waveguide lengths, two waveguide transfer switches, a "Magic-Tee" combiner with termination, and couplers for test and alignment.

## 1.3 Theory of Operation

As mentioned previously, phase combining is a common technique to increase the available output power of an amplifier system. Referring back to **Figure 1-2**, when two signals of equal phase and amplitude are fed into the “Magic-Tee” combiner, the individual power of each SSPA is summed at the output port and cancelled in the termination port.

In real systems, the phase and amplitude of the two signals are never exactly equal, so there is a small amount of power that is absorbed by the load termination. This terminated port is sometimes referred to as the “wasted” power port. In practice, however, it is possible to keep phase and amplitude imbalances at low enough levels such that overall combining losses are only in the 0.2 to 0.5 dB range.

**Figure 1-3** shows the effects of phase imbalance on the power combining efficiency.

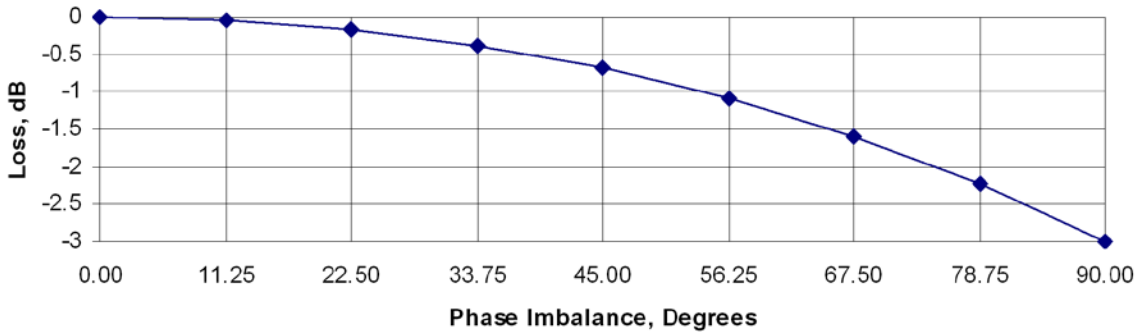



**Figure 1-3. Combining Loss vs. Phase Imbalance Summary of Specifications**

### 1.3.1 Phase and Gain Equalization

***Phase and gain equalization are performed at the factory, and no user intervention is required unless an amplifier or other critical system component, such as the phase combiner box, needs to be replaced.***

The following paragraphs are provided for informational purposes only.

**See Chapter 3. OPERATION and ADJUSTMENT PROCEDURES for operational and alignment information.**

Naturally, two separate amplifiers are likely to have different phase and gain characteristics. The PCB-4000A 1+1 system is designed such that the phase difference between the two amplifier paths is compensated by adjusting the phase shifter in the PCCB. This is done at the factory for the full amplifier bandwidth, and should not normally require further adjustment in the field unless an amplifier has been replaced.

### 1.3.2 System Gain

The gains of the amplifiers are calibrated at the factory to provide optimum system performance. The amplifier gain difference is automatically compensated for by the PCCB M&C System. Upon power up, the M&C reads the gain of each individual amplifier as calibrated at the factory, and automatically attenuates the amplifier with the most gain so as to be equal with the lower gain unit.

For example, if SSPA #1 had a factory-calibrated gain setting of 76 dB, and SSPA #2 had a factory-calibrated gain setting of 73 dB, the M&C system would automatically set the attenuation setting of SSPA#1 to 3 dB to equalize the system gain. Although not generally needed or recommended, a user input gain offset setting is also provided for system fine-tuning.

**See Chapter 3. OPERATION and ADJUSTMENT PROCEDURES for operational and alignment information.**

Due to the power divider and cable losses, the overall gain of the system will be less than the individual gain of each amplifier. Please refer to the system test data sheet for actual system gain.

### 1.3.3 System Attenuation

The PCB-4000A makes it easy to adjust the overall system gain. Upon input of the requested attenuation setting, the PCB-4000A automatically adjusts the gain of each SSPA accordingly, resulting in the desired attenuation value while maintaining optimum power combining conditions.

The SSPAs included in the system are calibrated over a range 10 dB beyond specification (30 dB vs. 20 dB). As explained above, a portion of the 30 dB range is required for gain equalization. Therefore, the maximum allowable attenuation in a 1+1 system is software limited to 24 dB, but still exceeds system specifications.

### 1.3.4 Soft Fail Protection

In the event of a failure of one of the SSPAs, the PCB-4000A controls the waveguide switches such that the good unit's power is routed around the "Magic-Tee" combiner directly to the output port. This results in only a 3 dB power loss, or "soft failure". Without the waveguide switches, a failure in one unit would result in a 6 dB power loss.

## 1.4 Dimensional Envelope

***All dimensions are in English units; metric units are shown in parentheses. This figure is typical for the C-Band versions of the PCB-4000A.***

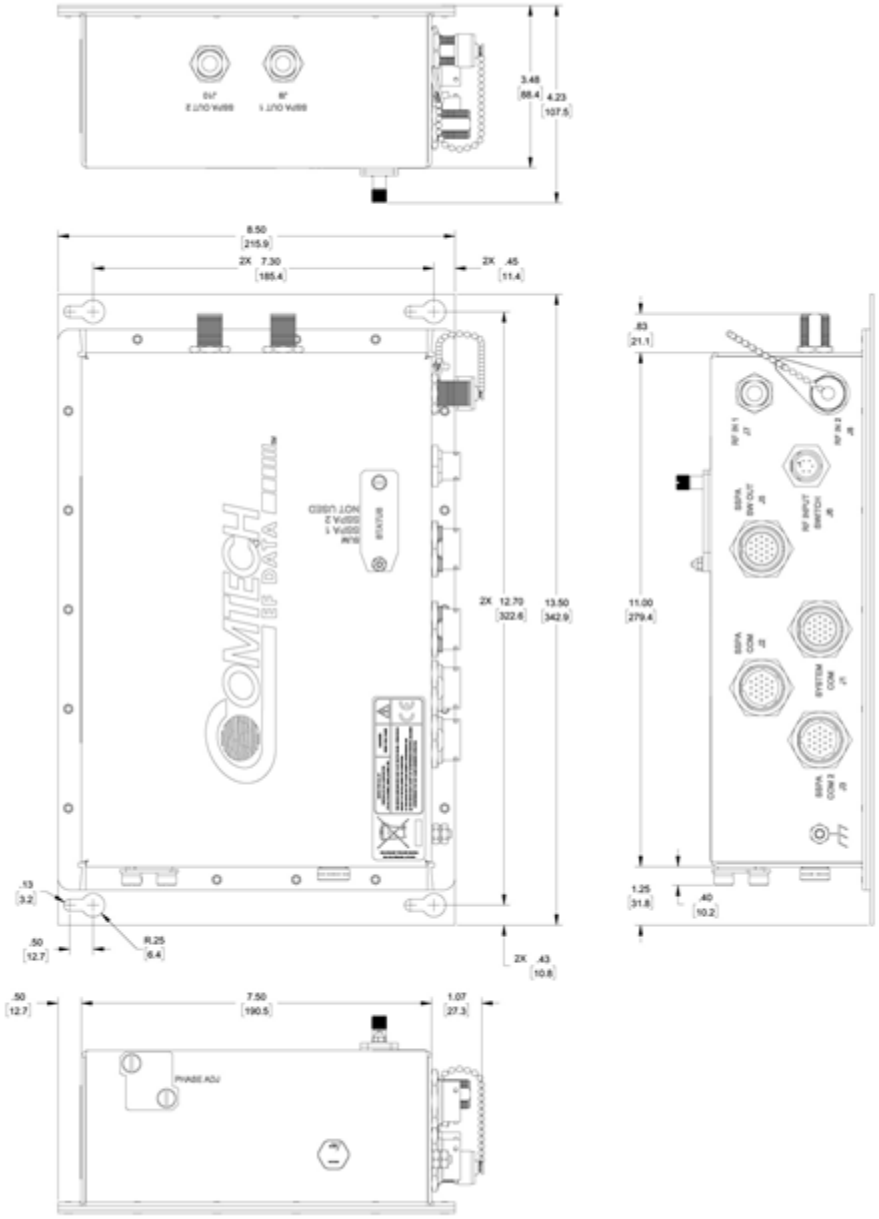


**Figure 1-4. PCB-4000A Dimensional Envelope**

# Chapter 2. EXTERNAL CONNECTORS

## 2.1 Overview

**See Chapter 3. OPERATION and ADJUSTMENT PROCEDURES and Appendix A. ASSEMBLY KITS for basic installation and operational examples.**

**See Chapter 5. SERIAL REMOTE CONTROL for information about the remote M&C.**

This chapter summarizes the connectors provided for all necessary external connections between the PCB-4000A and other equipment. **Table 2-1** lists the external connectors grouped according to service function. Refer to Figure 3-2 for External Connectors illustration.

**Table 2-1. External Connectors**

| Connector Group (Chapter Sect.) | Name / Ref Des | Connector Type | Function |
|---|---|---|---|
| M&C (Sect. 2.2) | SYSTEM COM \| J1 | 19-pin Circular Connector | Customer EIA-232 and discrete interface |
| | SSPA COM 1 \| J2 | 19-pin Circular Connector | Connects to SSPAs |
| | SSPA COM 2 \| J3 | | |
| | SSPA SW OUT \| J5 | 19-pin Circular Connector | Connects to both waveguide switches |
| | RF INPUT SWITCH \| J6 | 6-pin Circular Connector | Drive input, selects either RF IN 1 or RF IN 2 |
| RF (Sect. 2.4) | RF IN 1 \| J7 | Type 'N' | RF Inputs to PCCB |
| | RF IN 2 \| J8 | | |
| | SSPA OUT 1 \| J9 | Type 'N' | RF Outputs to SSPAs |
| | SSPA OUT 2 \| J10 | | |
| Power/Ground (Sect 2.5) | AC | Pin 'R' on SSPA COM 1 J1, SSPA COM 2 J3 | See Sect. 2.4.1 for AC power provision note |
| | Ground | #10-32 stud | Common Chassis Ground |

***To maintain compliance with the European EMC Directive (EN55022, EN50082-1), properly shielded cables are required for data I/O.***

## 2.2 Monitor and Control (M&C) Interface Connectors

***All M&C connectors are found on the front panel of the PCCB box.***

### 2.2.1 SYSTEM COM | J1 Connector


The 19-pin circular **SYSTEM COM | J1** connector, type MS3112E14-19S, serves as the primary input between the user and the PCCB for controlling and monitoring both SSPAs. Its pinout specification is provided in Table 2-2.

**Mating connector:** ITT Cannon MS3116J14-19P
(CEFD P/N CN/MS3116J14-19P)

**Table 2-2. Connector J1 Pinouts**

| Pin # | Signal Function | Signal Name / Description |
|---|---|---|
| A | ETH_+TX | Customer communications interface |
| B | ETH_-TX | Customer communications interface |
| C | ETH_+RX | Customer communications interface |
| D | ETH_-RX | Customer communications interface |
| E | RS232_RD | Customer communications interface |
| F | Spare | Reser4ved for future use |
| G | RS232_TD | Customer communications interface |
| H | System Fault NO | When there is a summary fault in the PCB-4000, this pin (NO) will be tied to the Fault Common pin. |
| J | System Fault NC | When there is not a summary fault in the PCB-4000, this pin (NC) will be tied to the Fault Common pin. |
| K | Fault Common | |
| L | SSPA 1 Fault NO | When there is a fault with SSPA 1, this pin (NO) will be tied to the Fault Common pin. |
| M | SSPA 1 Fault NC | When there is not a fault with SSPA 1, this pin (NC) will be tied to the Fault Common pin. |
| N | Spare | Reserved for future use |
| P | SSPA 2 Fault NO | When there is a fault with SSPA 2, this pin (NO) will be tied to the Fault Common pin. |
| R | SSPA 2 Fault NC | When there is not a fault with SSPA 2, this pin (NC) will be tied to the Fault Common pin. |
| S | System Mute | SSPA will be muted if this pin is grounded |
| T | SSPA 3 Fault NO | (NOTE: This pin is reserved for use with 1:2 systems only.) |
| U | SSPA 3 Fault NC | (NOTE: This pin is reserved for use with 1:2 systems only.) |
| V | Ground | GND |

## 2.2.2 SSPA COM 1 | J2 and SSPA COM 2 | J3 Connectors

The 19-pin circular **SSPA COM 1 | J2** and **SSPA COM 2 | J3** connectors, type MS3112E14-19S, serve as the primary input/output interfaces between the PCCB and its specified SSPA. The typical pinout specification is provided in Table 2-3.

**Mating connector:** ITT Cannon MS3116J14-19P
(P/N CN/MS3116J14-19P)

**Table 2-3. Connectors J2 and J3 Pinouts**

| Pin # | Signal Function | Signal Name / Description | Direction |
|---|---|---|---|
| A | NC | | |
| B | NC | | |
| C | NC | | |
| D | NC | | |
| E | RS232_RD | Provides for Comm between PCB and SSPA | Input |
| F | NC | | |
| G | RS232_TD | Provides for Comm between PCB and SSPA | Output |
| H | Switch Inhibit Output | Provides a hardware mute input to SSPA with switch fault | Output |
| J | NC | | |
| K | Ground | GND | |
| L | SUMFLT_NO | Monitors SSPA summary fault relay | Input |
| M | NC | | |
| N | Ground | GND | |
| P | ONLINE_STATUS | Used by PCB for online status indication | Input |
| R | +24V | Bias voltage from SSPA | Input |
| S | Mute Control | Allow for customer inhibit. Tied to Pin S of System Comm (J1) connector | |
| T | NC | | |
| U | NC | | |
| V | NC | | |

## 2.3 SSPA SW OUT | J5 Connector


The 19-pin circular **SSPA SW OUT | J5** connector, type MS3112E14-19S, connects via a "Y" cable to the SSPA #1 and SSPA #2 waveguide switches. The typical pinout specification is provided in Table 2-4.

**Mating connector:** ITT Cannon MS3116J14-19P (P/N CN/MS3116J14-19P)

**Table 2-4. Connector J5 Pinouts**

| Pin # | Signal Function | Signal Name / Description | Direction |
|---|---|---|---|
| A | Pos1, SW1 Drive | | Output |
| B | Ground | GND | |
| C | POS2, SW1, Drive | | Output |
| D | POS1, SW1, Indicator | | Input |
| E | Ground | GND | |
| F | POS2, SW1, Indicator | | Input |
| G | NC | | |
| H | POS1, SW2, Drive | | Output |
| J | Ground | GND | |
| K | POS2, SW2, Drive | | Output |
| L | POS1, SW2, Indicator | | Input |
| M | Ground | GND | |
| N | POS2, SW2, Indicator | | Input |
| P | NC | | |
| R | NC | | |
| S | NC | | |
| T | NC | | |
| U | NC | | |
| V | NC | | |

### 2.3.1 RF INPUT SWITCH | J6 Connector


The PCCB contains a built-in selector switch – a latching 28 VDC coaxial unit. The switch position is selected by the 6-pin circular **RF INPUT SWITCH | J6** connector (P/N CN/MS-PT07M6PC). Its pinout specification is provided in Table 2-5.

**Mating connector:** ITT Cannon MS3116J10-6S (P/N CN/MS3116J10-6S)

**Table 2-5. Connector J6 Pinouts**

| Pin # | Signal Function | Signal Name / Description | Direction |
|---|---|---|---|
| A | POS1, Drive | | Input |
| B | Ground | GND | |
| C | POS2, Drive | | Input |
| D | POS1, Indicator | | Output |
| E | Ground | GND | |
| F | POS2, Indicator | | Output |

## 2.4 RF Interface Connectors

### 2.4.1 RF IN 1 | J7 and RF IN 2 | J8 Connectors


The Type 'N' **RF IN 1 | J7** and **RF IN 2 | J8** connectors serve as RF signal input interfaces to the PCCB. Note that:

- The PCCB selects the **RF IN 1 | J7** input when the **RF INPUT SWITCH | J6 POS1** Signal Function is activated.
- The PCCB selects the **RF IN 2 | J8** input when the **RF INPUT SWITCH | J6 POS2** Signal Function is activated.

### 2.4.2 SSPA OUT 1 | J9 Connector


The Type 'N' **SSPA OUT | J9** connector, located on the left side panel of the PCCB, provides the RF signal output from the PCCB to SSPA #1.

### 2.4.3 SSPA OUT 2 | J10 Connector


The Type 'N' **SSPA OUT 2 | J10** connector, located on the right side panel of the PCCB, provides the RF signal output from the PCCB to SSPA #2.

## 2.5 Power and Ground Interfaces

### 2.5.1 AC Power

The PCB-4000A derives its power from the SSPAs. Each SSPA provides a +24V signal line via cables interconnecting the SSPAs to the **SSPA COM 1 | J2** and **SSPA COM 2 | J3** connectors (Pin 'R' – see Table 2-3). These two signals are "diode OR'ed" to provide redundancy.

***Although the PCCB will turn on and function with only one SSPA is powered on, the system does not provide optimum output power unless both SSPAs are powered on.***

### 2.5.2 Ground Connector

A #10-32 stud is provided on the front panel of the PCCB for connecting a common chassis ground among equipment.

**Notes:**

# Chapter 3. OPERATION AND ADJUSTMENT PROCEDURES

**Comtech EF Data recommends that only qualified personnel familiar with high-power amplifiers, test equipment, and phase-combined systems attempt the procedures provided in this chapter. Furthermore, before attempting any of these procedures, it is strongly advised to:**

- **Read Chapter 1. INTRODUCTION to become familiar with system terminology and Theory of Operation.**
- **Read Chapter 2. EXTERNAL CONNECTORS to become familiar with the external connectors and their functionality.**
- **Read Chapter 5. SERIAL REMOTE CONTROL to become familiar with the serial remote control commands and queries.**

## 3.1 Overview

**Chapter 1. INTRODUCTION**

As indicated in **Chapter 1. INTRODUCTION**, the PCB-4000A 1+1 Phase Combiner system is aligned at the factory using a network analyzer. The in-factory adjustments are based on the specific arrangement of the SSPAs within the system. To ensure proper system operation and performance, it is mandatory that the components are installed in the same positions as was done in the factory. See Figure 3-1 for an assembly example.

Although the techniques featured in this chapter afford easy adjustment and setting of the phase shifter for optimum output power combining over the full amplifier bandwidth, ***alignment in the field is generally not required and it is strongly cautioned against making unneeded adjustments***.

However, if an amplifier or other critical system component is replaced (e.g., the PCB-4000A unit), the procedures provided in this chapter explain the steps necessary to restore proper system operation. This chapter also provides a verification procedure in the event that proper system operation confirmation is required.

***It is recommended that only qualified personnel familiar with high-power amplifiers, test equipment, and phase combined systems attempt these procedures.***

## 3.2 System Assembly, Cabling Connections, and Installation

### 3.2.1 1+1 Phase Combiner System Assembly

Figure 3-1 shows an example of the PCB-4000A deployed in a typical 1+1 phase combined system (see **Appendix A. ASSEMBLY KITS** for details on band-specific system applications).

**Figure 3-1. PCB-4000A 1+1 Phase Combiner System Assembly Example**

## 3.2.2 PCCB Cabling Connections


**Figure 3-2. PCB-4000A External Connectors - Front**


**Figure 3-3. PCB-4000A External Connectors – Right Side**


**Figure 3-4. PCB-4000A – Left Side**

## 3.2.3 System Component Installation and Interconnection

Refer to Figure 3-1 through Figure 3-3 to perform the follow these steps:

| Step | Procedure |
|---|---|
| 1 | Install the SSPAs in their respective positions as detailed in the factory datasheet and in accordance with Figure 3-1. The specific serial numbered SSPA that was aligned in Position 1 at the factory must also now be installed in Position 1; the same applies to the SSPA in Position 2. Refer to cable and component labeling to assure correct installation. It is suggested that any mounting hardware used in the installation process not be fully tightened until the entire system is installed. |
| 2 | Attach the Waveguide (WG) combining network to the mounting structure and to each SSPA. For assembly details, see Appendix A. ASSEMBLY KITS. Take care to install the provided WG gaskets at each SSPA output. It may be necessary to slightly adjust each SSPA to prevent undue stress on the waveguide structure. Tighten all hardware when proper alignment is achieved. |
| 3 | Assemble the PCB-4000A PCCB to the mounting structure. |
| 4 | Install the Type 'N' RF Phase Matched Coaxial Cables (CEFD P/N CA/RF11872-1). Each cable is labeled according to its destination SSPA:<br>• Connect the cable labeled "SSPA1" from the PCCB Type 'N' port labeled "SSPA OUT 1 \| J9" to the RF Input port on SSPA #1.<br>• Repeat this task for the cable labeled "SSPA2", connecting it between the PCCB Type 'N' port labeled "SSPA OUT 1 \| J10" and the RF Input port on SSPA #2.<br><br>*Make sure to correctly install all RF cabling, as any "cross" connections will cause system malfunction.* |

| Step | Procedure |
|---|---|
| 5 | Install the "COM" Cable (CEFD P/N CA/WR11966-2) between each of the following PCCB connectors and their corresponding SSPA "COM" ports:<br>• (PCCB) "SSPA COM 1 \| J2" to SSPA #1<br>• (PCCB) "SSPA COM 2 \| J3" to SSPA #2 |
| 6 | Install a WG Switch Control "Y" Cable (CEFD P/N CA/WR12013-1) between the PCCB connector labeled "SSPA SW OUT \| J5" and the two WG switches as shown in Figure 3-1. Pay particular attention to ensure that the ends labeled "SW1" and "SW2" are connected, respectively, to WG Switch #1 and #2. |
| 7 | Install the user-provided RF Input Switch control cable (if applicable) to the PCCB "RF INPUT SWITCH \| J6". |
| 8 | Properly terminate the WG system output port, review all cables for proper connections, and ensure that all mounting hardware is tightened. |

### 3.2.4 LED Status Operation

The PCB-4000A features four Light-Emitting Diode (LED) indicators – three are operational, with the fourth reserved for future applications. Each LED provides visual cues to the operational, online, and offline status of the system.

Figure 3-5 illustrates the location of the LED indicators. Located on the top of the PCB-4000A enclosure under a pivoting protective plate, view the LEDs by first loosening the captive screw that keeps the plate in place, and then swiveling the plate to reveal the LED display window.


**Figure 3-5. LED Indicators**

The behavior of the LEDs, as they appear under varying operational conditions, is as follows:

**Table 3-1. LED Descriptions**

| LED * | Color / Behavior | Description |
|---|---|---|
| SUM (LED 1) | Green | Phase Combiner has no summary fault. |
| | Red | A Summary Fault has occurred. |
| SSPA 1 (LED 2) -or- SSPA 2 (LED 3) | Green | SSPA is unfaulted, unmated. |
| | Orange | SSPA is unfaulted but muted. |
| | Red | SSPA is faulted. |
| (LED 4) | *Inoperable* (always dark), reserved for future use | |

* If LED light is blinking, this indicates there is a switch fault.

## 3.3 Initial System Setup and Verification

Verify that the system has been assembled, that all cables have been connected, and that the output port is terminated in a broadband high power load as depicted in **Figure 1-2** block diagram in **Chapter 1. INTRODUCTION**. If the system is "live" and you desire only to verify operation, see **Section 3.5**.

Verify the overall system performance by measuring the ratio of the transmitted power to that of the power being dissipated by the "dummy" load. Adjust the gain and amplitude balance if necessary.

Follow these steps:

| Step | Procedure |
|---|---|
| 1 | In the normal 1+1 phase combiner mode, the RED=X remote command setting should be set to "1". Verify the setting is accurate by querying the system (see Chapter 5. SERIAL REMOTE CONTROL). |
| 2 | A. Attach a power meter to the Combined Output Power Test Coupler (Figure 3-1).<br>B. Apply a low-level signal at center frequency; making sure the output signal (at the system output port –not the coupled port) will be at least 10 dB below Prated.<br>C. Measure the output power and include the coupler correction factor. |
| 3 | A. Attach a power meter to the Wasted ("Load") Power Test Coupler (Figure 3-1).<br>B. Measure the power and include coupler correction factor. |
| 4 | *If the Wasted ("Load") power level is 15-20 dB below the transmitted power, the system is operating correctly.*<br>If the ratio is below 10 dB, proceed to the gain and phase alignment procedures that follow in this chapter. |
| 5 | A. Slowly increase the input power until the desired operating output power is achieved.<br>B. Again, verify the appropriate ratio of the transmitted to dissipated power. |
| 6 | If desired, repeat Steps 1 through 5 at different frequencies to verify proper full bandwidth operation. |

## 3.4 Gain or Amplitude Balance Verification and Alignment

***This procedure is generally not necessary if all parameters of Section 3.3 have been met.***

As a result of the configuration of the waveguide switches in a 1+1 system, it is possible to measure the individual gain of each SSPA path by switching each SSPA individually to the output load.

This procedure assumes that the output port is terminated and that data will be taken using the Combined Output Power and Wasted Power Test Couplers (Figure 3-1).

Follow these steps:

| Step | Task |
|---|---|
| 1 | A. Attach a power meter to the Combined Output Test Coupler (Figure 3-1).<br>B. Apply a low-level signal at center frequency, making sure the output signal will be at least 10 dB below Prated. |
| 2 | To measure only the individual gain of SSPA#1, SSPA#2 must by *bypassed* by changing the state of the waveguide switches via remote control (for detailed remote command and query information, see Chapter 5. SERIAL REMOTE CONTROL):<br>A. Execute remote command RED=0;<br>B. Execute remote command BYP=2.<br>The output of SSPA#1 will be sent to the system output, while SSPA#2 will be muted and directed to the "wasted" port. |
| 3 | Record the amplitude or gain level of SSPA#1. |
| 4 | Execute remote command BYP=1 to measure the individual gain of SSPA#2. This time, the output of SSPA#2 will be sent to the system output, while SSPA#1 will be muted and directed to the "wasted" port. |
| 5 | Record the amplitude or gain level of SSPA#2. |
| 6 | Compare the levels of the two paths. Typically, the gains of each SSPA will be within ± 1 dB at center frequency. If the above test is performed at other frequencies, it is reasonable to assume that the gain difference may be greater. |

## 3.5 Amplitude Alignment (as necessary)

Even if the difference of each individual SSPA path is greater than ±1 dB, amplitude adjustment may not be necessary to meet all parameters of **Section 0**. However, if these parameters have *not* been met, then fine tuning adjustment is advisable.

***If the system is to be used in a narrow frequency range, you may also wish to optimize the gain balance over this narrow range.***

Follow these steps:

| Step | Task |
|---|---|
| 1 | If Steps 1 through 6 in Section 3.4 have not been completed, perform them *now*. |
| 2 | Again, insure the input signal is at center frequency and that the output power level is approximately Prated -10 dB. |
| 3 | Alternately toggle between remote commands BYP=1 and BYP=2 to measure the gains of each SSPA path. Note which path has the greater amount of gain. |
| 4 | Use the Amplitude Offset (AOF) remote command/query to equalize the gain between the 2 paths. For example, if SSPA 1 has 2 dB excess gain:<br>A. Query the offset of SSPA 1 using remote query AOF?1.<br>The unit should respond with a gain offset ranging between 0 and 6. Record this value, and then add 2 dB. For this example, assume SSPA 1 responded with 1 dB. Adding 2 dB of required additional offset to the existing 1 dB of offset results in 3 dB of required offset.<br>B. Now send remote command AOF=1,3.00. |
| 5 | Proceed to the Phase Alignment procedure (Section 3.6) if anything has been changed or altered that may affect the phase alignment. Otherwise, verify proper operation via the LED Indicators as detailed in Section 3.2.4. |

## 3.6 Phase Alignment

***As the system is aligned at the factory, this step is typically not required unless it is necessary to replace one of the SSPAs or other critical path components. Make sure to meet all parameters of Section 0 before performing this adjustment.***

This procedure assumes that the system installation is complete and that the output port terminates in a broadband high power load.

Verify the overall system performance by measuring the ratio of the transmitted power to that of the power being dissipated by the "dummy" load. If necessary, adjust the phase balance by trimming the phase shifter, which is located inside the PCCB box and accessible via a secured cover labeled **PHASE ADJ** on the left side of the box.

Follow these steps:

| Step | Task |
|---|---|
| 1 | Ensure the system is set to 1+1 phase combined mode by issuing remote command RED=1 (see Chapter 5. SERIAL REMOTE CONTROL). |
| 2 | A. Attach a power meter to the Combined Output Test Coupler (Figure 3-1).<br>B. Apply a low-level signal at center frequency, making sure the output signal (at the system output port – not the coupled port) will be at least 10 dB below Prated.<br>C. Measure the output power and include the coupler correction factor. |
| 3 | A. Attach a power meter to the Wasted ("Load") Power Test Coupler (Figure 3-1).<br>B. Measure the power and include coupler correction factor. |
| 4 | If the Wasted ("Load") power level is 15-20 dB below the transmitted power, the system is operating correctly. However, if the ratio is below 10-15 dB, proceed to the align the phase shifter:<br>A. Remove the PHASE ADJ cover panel (Figure 3-4) located on the left side of the PCCB box.<br>B. Utilizing the supplied socket and screwdriver, first loosen the phase shifter lock nut.<br>C. Slowly adjust the phase shifter by turning the screwdriver. The system is aligned at the operating frequency when the transmitted to "wasted" power ratio is maximized. If it is not possible to view the transmitted and "wasted" power simultaneously, it is recommended to minimize the "wasted" power. Generally, the "wasted" power reading will be more sensitive to phase shifter adjustments. |
| 5 | A. Achieve the desired operating output power by slowly increasing the input power.<br>B. Verify the appropriate ratio of the transmitted to dissipated power once more. |
| 6 | Verify that the system works over the full bandwidth by injecting a signal at the start and stop frequencies as well. The ratio of the transmitted to "wasted" power should be 15-20 dB, but is not likely to be as good as it was at the adjustment (center) frequency. If acceptable full bandwidth performance is not measured, it may be necessary to repeat Steps 2 through 5 for the start, stop, and center frequencies – realizing that optimum performance at any one particular frequency must be sacrificed slightly to achieve full bandwidth operation. |
| 7 | Make sure the lock nut on the phase shifter is tightly secured by using the supplied socket, and then replace the cover panel. |

## 3.7 System Online and Transmitting

This procedure assumes that the system installation is complete and that access to the system output port is unavailable due to current system traffic.

To check for proper operation, measure and compare the difference in power transmitted *versus* the power dissipated in the load termination.

Follow these steps:

| Step | Task |
|---|---|
| 1 | A. Attach a power meter to the Combined Output Test Coupler (Figure 3-1).<br>B. Measure the output power and include the coupler correction factor. |
| 2 | A. Attach a power meter to the Wasted ("Load") Power Test Coupler (Figure 3-1).<br>B. Measure the power and include the coupler correction factor. |
| 3 | The Wasted ("Load") power level should be 15-20 dB below the power being transmitted to the antenna. |

# Chapter 4. UPDATING FIRMWARE

## 4.1 Update Firmware via the Internet

***To ensure optimal performance, it is important to operate the PCB-4000A with its latest available firmware.***

The PCB-4000A 1+1 Phase Combiner is factory-shipped with the latest version of operating firmware. If a firmware update is needed, it can be acquired by download from the Comtech EF Data Web site (www.comtechefdata.com) or from Comtech EF Data Customer Support, during normal business hours, via e-mail or on CD by standard mail delivery.

The PCB-4000A Firmware Update process is as follows:

- Ethernet FTP Upload
- Download and Extract the Firmward Update
- Firmware Upgrade

## 4.2 Ethernet FTP Upload Procedure

### 4.2.1 Setup for the Firmware Download

Do these steps:

1. Locate and identify the exterior connectors on the Phase Combiner Control Box (PCCB).
2. Connect the PCB-4000A to a user-supplied PC.

*User-supplied items needed:*

- A Microsoft Windows-based PC, equipped with an available serial port, and running a terminal emulator program (e.g., Tera Term or HyperTerminal).
- A serial adapter cable for connecting the PC to the PCB-4000A. If needed, the CA/WR12243-1 System Programming Cable is available from Comtech EF Data. Contact CEFD Customer Support for ordering information.

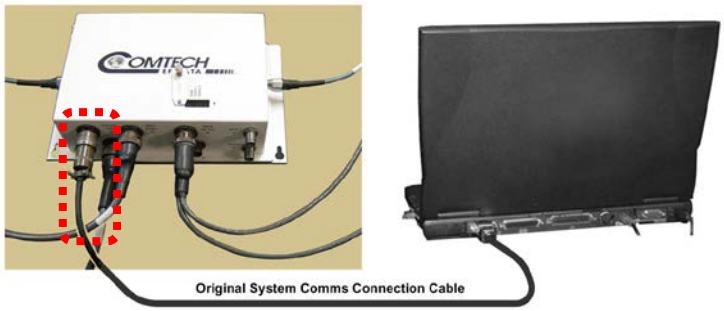



**Figure 4-1. Typical Unit to PC Connection**

a. Connect the user PC serial port to the PCB-4000A "**SYSTEM COM | J1**" port.

b. **On the PC:** Open the terminal emulator program.

**Refer to your terminal emulator program HELP feature or user guide for operating and configuration instructions.**

Configure the utility program serial port communication and terminal display operation:

- **9600 or 19200 bps (Baud Rate)**
- **8 Data Bits**
- **1 Stop Bit**
- **Parity = NO**
- **Port Flow Control = NONE**
- **Display New line Rx/Tx: CR**
- **Local Echo = ON**

c. Energize the PCB-4000A (the PCB-4000A derives its power from the SSPAs).

3. Obtain the firmware number for the PCB-4000A.
   - **On the PC:** Via serial remote control, obtain the firmware number by using the **<1/FRW?** query.

**See Chapter 5. SERIAL REMOTE CONTROL for information and instructions on using remote commands and queries via the PCB-4000A Serial Interface.**

4. Create a temporary folder (subdirectory) on the user PC for the firmware archive download.

- ***Drive letter "c:" is used in these examples. Any valid, writable drive letter can be used.***
- ***Typical for all tasks: Type the command without quotes, and then press Enter to execute.***

There are several ways you may use create a temporary folder on a Windows-based PC:

a. Use the Windows Desktop to create and rename the temporary folder.
   - Right-click anywhere on the desktop to open the popup submenu, and then select **New > Folder** to create the temporary folder. The new folder will be created on the desktop.
   - Right-click on the new folder and then select "**Rename**" from the popup submenu. Rename this folder to "**temp**" or some other convenient, unused name.

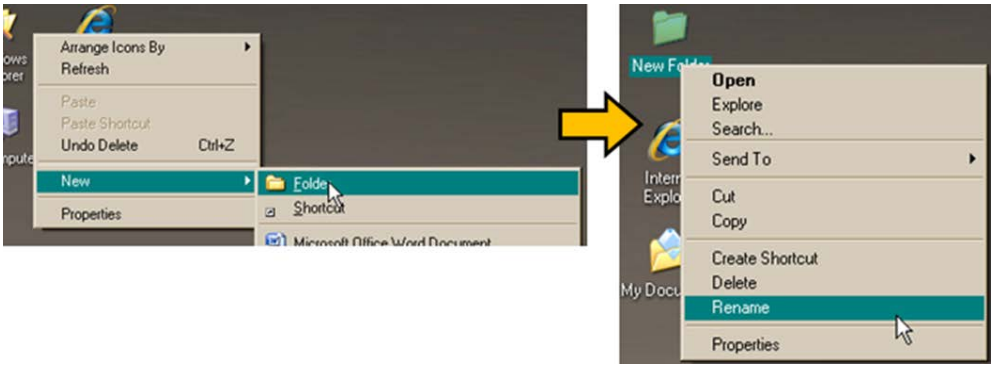



**Figure 4-2. Temporary Folder Setup using Windows Desktop**

b. Use Windows Explorer to create and rename the temporary folder.

- Select **File > New > Folder** to create the temporary folder. The new folder will be created in the active folder.
- Right-click the "**New Folder**" folder name, and then rename this folder to "**temp**" or some other convenient, unused name.

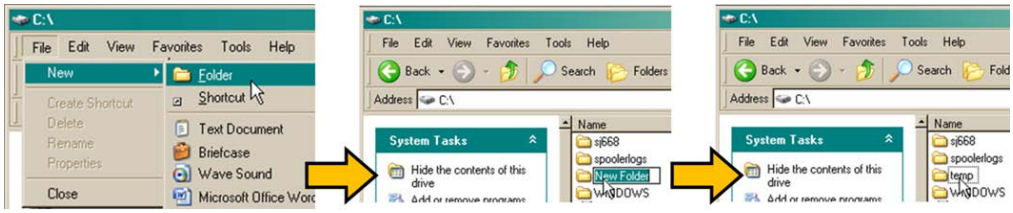



**Figure 4-3. Temporary Folder Setup using Windows Explorer**

c. Use the **'Run'** and **'Browse'** windows to create and rename the temporary folder.

- Select **[Start]** on the Windows task bar, and then click the **Run...** icon. The '**Run**' window will open.
- Click **[Browse]** in the '**Run**' window. The '**Browse**' window will open.
- Click the **Create New Folder** icon in the '**Browse**' window. The new folder will be created.
- Right-click the "**New Folder**" folder name, and then rename this folder to "**temp"** or some other convenient, unused name.

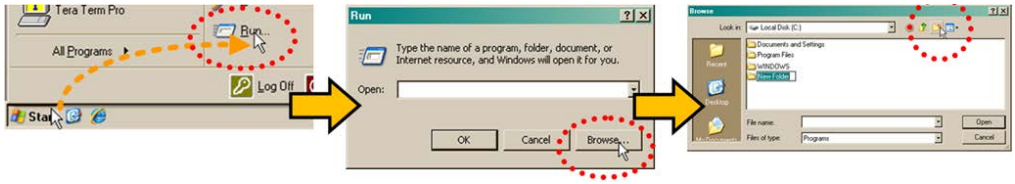



**Figure 4-4. Temporary Folder Setup using 'Run' and 'Browse'**

d. Use Windows Command-line to create the temporary folder.

- **First,** click **[Start]** on the Windows taskbar, and then click the '**Run...**' icon (or, depending on Windows OS versions *prior* to Windows 95, click the '**MS-DOS Prompt**' icon from the Main Menu).
- **Next,** open a **Command-line** window…
  - o For Windows 95 or Windows 98 – Type "**command**".
  - o For any Windows OS versions later than Windows 98 – Type "**cmd**" or "**command**".
  - o Alternately, from **[Start]**, select **All Programs > Accessories > Command Prompt**.
  - o Finally, from the Command-line '**c:\>'** prompt, type "**mkdir temp**" or "**md temp**" (*mkdir* and *md* stand for *make directory*), and then click **[OK]**.

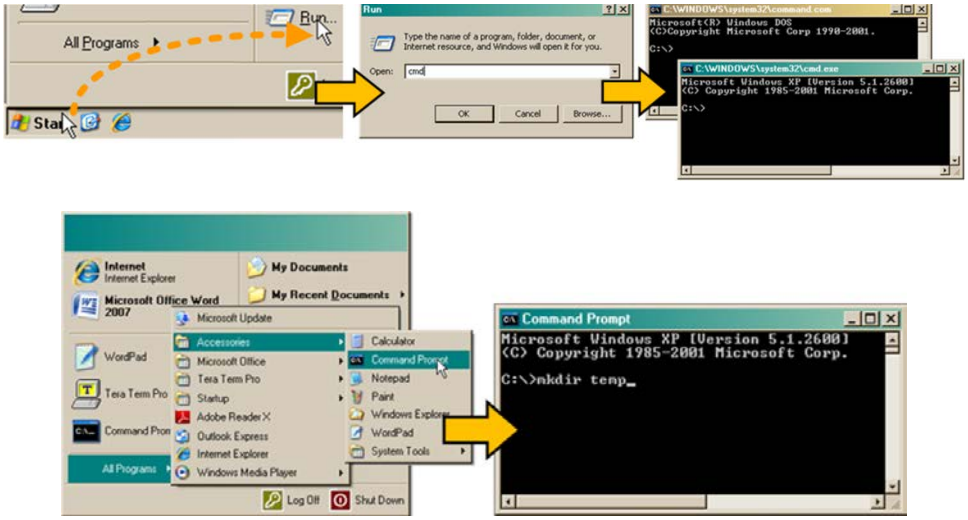



**Figure 4-5. Temporary Folder Setup using Windows Command Line**

There should now be a "temp" folder created and available for placement of the firmware file download.

## 4.3 Download and Extract the Firmware Update

1. First, download the firmware update file from the Comtech EF Data Web site:
   a. Go online to www.comtechefdata.com.
   b. On the ***Main*** page – under ***Support Information*** or the ***Support*** tab, select the ***Software Downloads*** hyperlink.
   c. On the ***Software Downloads*** page – click **Download Flash and Software Update Files**.
   d. On the ***Flash Updates Index*** page – select the **(Select a Product Line) Amplifiers** hyperlink.
   e. Under the **PCB-4X00A** heading, select the **PCB-4000A (1+1 Phase Combiner)** product hyperlink.
   f. Select the appropriate firmware archive EXE or ZIP file download hyperlink.

- **About Firmware Numbers, File Versions, and Formats:** The Comtech EF Data Web site catalogues its firmware update files by product type (e.g., router, modem, etc.), the specific model, and optional hardware configurations.

  The download hyperlink for the PCB-4000A base unit firmware appears as **FW-0021045x.zip**, where '**x**' denotes the revision letter.

- **About File Archive Formats:** Comtech EF Data provides its downloadable files in two compressed archive formats: ***.exe** (self-extracting) and ***.zip** (compressed).

  The ***.exe** file does not require a file archiver and compression utility program such as PKZIP for Windows, WinZip, ZipCentral, etc. (PKZIP for DOS is not supported due to file naming conventions). **Comtech EF Data does not provide this utility program.**

  Some firewalls do not allow the download of *.exe files. Download the *.zip file instead, and extract the firmware files from the archive download with a user-supplied utility program. For detailed information on handling archived files, refer to the utility program Help documentation.

   g. Download the firmware archive file to the temporary folder.

- Once the **EXE** or **ZIP** hyperlink is selected the '**File Download'** window opens and prompts selection of **[Open]** or **[Save]**:
  - Click **[Open]** to turn over file extraction to the user-supplied utility program. Be sure to extract the firmware files to the "**temp**" folder created earlier.
  - Click **[Save]** to open the '**Save As'** window. Be sure to select and **[Save]** the archive ***.exe** or ***.zip** file to the "**temp**" folder created earlier.
  - Otherwise, click **[Cancel]** to quit and exit the file download process.


**Figure 4-6. Download Firmware Archive File**

2. Extract the firmware files from the archive file.

   a. (If not already done with **File Download > [Open]**) Extract the firmware files from the downloaded ***.exe** or ***.zip** archive file with the user-supplied utility program:

   b. Double-click on the archive file name, and then follow the prompts provided by the user-supplied utility program. Extract, at a minimum, four files:
      - FW-0021045*_Bulk_v*_*_*.zip, where "*_*_*" is the version (bulk image file).
      - FW10874-2-.mib (Comtech EF Data MIB file)
      - FW-0021047*.mib (PCB-4X00A MIB file), where "*" is the revision.
      - PCB-4X00A_ReleaseNotes_v*_*_*.doc, where "*" is the version (release notes).

3. Confirm availability of the firmware files in the temporary folder.

   There are several ways you may view the contents of the temporary folder on a Windows-based PC.

   a. From the Windows Desktop:
      - Double-left-click the "**temp"** folder saved to the Windows Desktop.
      - Use **Windows Explorer** to locate, and then double-left-click the "**temp**" folder.
      - Use the **'Browse'** window (**[Start] > ...Run > [Browse]**) to locate, and then double-click the "**c:\temp**" folder.

   b. Using Command-line:
      - Type "**cd c:\temp**" at the Command-line prompt to change to the temporary directory created earlier using Command-line.
      - Type "**dir**" to list the files extracted to the temporary directory from the downloaded archive file.

***The firmware files have been successfully downloaded and are now available for transfer to the PCB-4000A.***

## 4.4 Firmware Upgrade

1. With the System Programming cable (CEFD P/N CA/WR12243-1) connected, verify the communication and connection by issuing a **"ping"** command to the modem.

    a. Locate the IP address of the unit remotely by using **<1/IPA?**.

    b. Select the **"Start"** button on the Windows toolbar and select the **"Run…"** option.

    c. From WinXP or Windows7, type **"cmd"** or use the **"DOS Prompt"** or **"Command Prompt"** icons in the Start Menu.

    d. Change the temporary directory created earlier to **"cd C:\temp"**.

    e. Use **"dir"** to show the files previously downloaded.

2. Initiate an FTP session with the unit using a DOS window.

    a. Using the PC, type **"ftp xxx.xxx.xxx.xxx"** where **"xxx.xxx.xxx.xxx"** is the IP address of the unit, obtained previously in step 1.a.

    b. Type **"comtech"** for the user name and **"comtech"** for the password to complete the login.

    c. Verify the FTP transfer is binary by typing **"bin"**.

    d. Type **"prompt"**, then type "hash" to initiate the file transfers.

3. Type **"put FW-0021045*_Bulk_v*_*_*.zip"** to begin the file transfers.

4. Type **"bye"** and close the DOS window to terminate the FTP session.

5. Verify the FTP upgrade using **<1/SWR?** serial remote command.

6. Change the desired image to boot using the **<1/IMG=X** serial remote command, where X is 1 or 2, and then reboot the unit.

7. Verify the new software versions are booting by using **<1/RET?** The serial remote command response:

    **PCB-4X00A Phase Combiner Ver: X.X.X.**

8. Disconnect the System Programming cable (CEFD P/N CA/WR12243-1) and reconnect the original System Communications connection cable.

9. The LEDs on the top of the PCCB may illuminate GREEN (unmuted), ORANGE (muted), or RED (faulted) to indicate the current status of the PCCB, SSPA1, and SSPA2 operations.

**See Chapter 3. OPERATION and ADJUSTMENT PROCEDURES, Section 3.2.4, for additional information on the LED operation states.**

***The PCB-4000A Firmware Update Process is now complete.***

# Chapter 5. SERIAL REMOTE CONTROL

## 5.1 Overview

Remote monitor and control of the PCB-4000A 1+1 Phase Combiner is available only through an EIA-232 connection, and data is transmitted in asynchronous serial form using ASCII characters. Control and status information is transmitted in packets of variable length, in accordance with the structure and protocol defined in later sections.

### 5.1.1 EIA-232

The Controller device connects directly to the Target via a two-wire-plus-ground connection. Controller-to-Target data is carried, via EIA-232 electrical levels, on one conductor, and Target-to-Controller data is carried in the other direction on the other conductor.

## 5.2 Remote Commands and Queries Ovierview

### 5.2.1 Basic Protocol

All data is transmitted as asynchronous serial characters, suitable for transmission and reception by a UART. The asynchronous character is fixed at 8-N-1 (8 data bits, no parity, one stop bit). Only two baud rates are supported: 9600 baud and 19200 baud.

All data is transmitted in framed packets. The host Controller is assumed to be a user PC running a terminal emulator program or an ASCII dumb terminal that is in charge of the process of monitor and control. The Controller is the only device that is permitted to initiate, at will, the transmission of data. Targets are only permitted to transmit when they have been specifically instructed to do so by the Controller.

All bytes within a packet are printable ASCII characters, less than ASCII code 127. In this context, the Carriage Return and Line Feed characters are considered printable.

All messages from Controller-to-Target require a response – with one exception: This will be either to return data that has been requested by the Controller, or to acknowledge reception of an instruction to change the configuration of the Target.

### 5.2.2 Packet Structure

| Controller-to-Target | | | | | | |
|---|---|---|---|---|---|---|
| Start of Packet | Target Address | Address Delimiter | Instruction Code | Code Qualifier | Optional Arguments | End of Packet |
| <<br>ASCII code 60<br><br>(1 character) | <br><br>(4 characters) | /<br>ASCII code 47<br><br>(1 character) | <br><br>(3 characters) | = or ?<br>ASCII codes 61 or 63<br><br>(1 character) | <br><br>(n characters) | Carriage Return<br>ASCII code 13<br><br>(1 character) |

**Example:** <0412/MUT=1{CR}

| Target-to-Controller | | | | | | |
|---|---|---|---|---|---|---|
| Start of Packet | Target Address | Address Delimiter | Instruction Code | Code Qualifier | Optional Arguments | End of Packet |
| ><br>ASCII code 62<br><br>(1 character) | <br><br>(4 characters) | /<br>ASCII code 47<br><br>(1 character) | <br><br>(3 characters) | =, ?, !, or *<br>ASCII codes<br>61, 63, 33, or 42<br><br>(1 character) | <br><br>(From 0 to n characters) | Carriage Return, Line Feed<br>ASCII codes 13,10<br><br>(2 characters) |

**Example:** >0412/MUT={CR}{LF}

#### 5.2.2.1 Start of Packet

- **Controller-to-Target** – This is the character '<' (ASCII code 60).
- **Target-to-Controller** – This is the character '>' (ASCII code 62).

Because this is used to provide a reliable indication of the start of packet, these two characters may not appear anywhere else within the body of the message.

### 5.2.2.2 Target (Base) Address

Up to 9,999 devices can be uniquely addressed. In the EIA-232 application, the permissible range of values is 1 to 9999. It is programmed into a Target unit using serial remote control. The factory default target address is 1.

***The Controller sends a packet with the address of a Target – the destination of the packet. When the Target responds, the address used is the same address, to indicate to the Controller the source of the packet. The Controller does not have its own address.***

### 5.2.2.3 Virtual Address

Virtual Address is a method that allows the user to access the SSPA via the PCCB using any communications software. Virtual Address is supported in the EIA-232 application.

The following example depicts use of the virtual addressing scheme:

**<123V1/MUT?** *where:*

Base address = 123;
'V' = virtual address delimiter;
1 = virtual address of SSPA automatically set by the PCCB.

**Notes:**

1. Only four virtual commands can be used to program the individual SSPAs when in Phase Combined mode (RED=1):
   - CAA=
   - DAT=
   - TIM=
   - IAP=
2. All virtual queries can be directed to the individual SSPAs in any mode.
3. The following virtual commands can NEVER be used to program the individual SSPAs:
   - MUT=
   - ATT=

### 5.2.2.4 Address Delimiter

This is the “forward slash” character '**/**' (ASCII code 47).

### 5.2.2.5 Instruction Code

This three-character alphabetic sequence identifies the subject of the message. Wherever possible, the instruction codes have been chosen to have some significance. This aids in the readability of the message if seen in its raw ASCII form. Upper and lower case alphabetic characters (i.e., A-Z [ASCII codes 65-90], and a-z [ASCII codes 97-122]) may be used.

## 5.2.3 Instruction Code Qualifier

This single character further qualifies the preceding instruction code.

Code Qualifiers obey the following rules:

1. ***From Controller-to-Target***, the only permitted values are:

| Symbol | Definition |
|---|---|
| =<br>(ASCII code 61) | ‘=’ is used as the assignment operator, and is used to indicate that the parameter defined by the preceding byte should be set to the value of the argument(s) that follow it. For example: MUT=1 would mean 'enable the Mute function.' |
| ?<br>(ASCII code 63) | ‘?’ is used as the query operator, and is used to indicate that the Target should return the current value of the parameter defined by the preceding byte. For example: MUT? Would mean ‘return the current state of the Mute function.’ |

2. ***From Target-to-Controller***, the only permitted values are:

| Symbol | Definition |
|---|---|
| =<br>(ASCII code 61) | The = code is used in two ways:<br>First, if the Controller has sent a query code to a Target (for example: MUT? would mean ‘return the current state of the Mute function’), the Target would then respond with MUT=x, where ‘x’ represents the state in question (1 being ‘enabled’, 2 being ‘disabled).<br>Second, if the Controller sends an instruction to set a parameter to a particular value, then, providing the value sent in the argument is valid, the Target will acknowledge the message by replying with MUT= (with no message arguments). |

| Symbol | Definition |
|---|---|
| ?<br>(ASCII code 63) | The ? code is only used as follows:<br>If the Controller sends an instruction to set a parameter to a particular value, then, if the value sent in the argument is not valid, the Target will acknowledge the message by replying (for example) with MUT? (with no message arguments). This indicates that there was an error in the argument of the message sent by the Controller. |
| !<br>(ASCII code 33) | The ! code is only used as follows:<br>If the Controller sends an instruction code that the Target does not recognize, the Target will acknowledge the message by echoing the invalid instruction, followed by the ! character; for example, XYZ! |
| *<br>(ASCII code 42) | The * code is only used as follows:<br>If the Controller sends an instruction to set a parameter to a particular value, but then the value sent in the argument is valid but the target is in the wrong mode (e.g., Standby mode in Redundancy configuration or the Remote state is Ethernet Remote (LRS=3)), such that it will not permit that particular parameter to be changed at that time, the Target will acknowledge the message by replying (for example) with MUT* (with no message arguments). |
| #<br>ASCI code 35) | The # code is only used as follows:<br>If the controller sends an instruction code that the target cannot currently perform because of hardware resource issues, then the target will acknowledge the message by echoing the invalid instruction, followed by the # character; for example, MUT# (with no message arguments). |

### 5.2.4 Optional Message Arguments

Arguments are not required for all messages. Arguments are ASCII codes for the characters 0 to 9 (ASCII codes 48 to 57), period (ASCII code 46) and comma (ASCII code 44).

### 5.2.5 End of Packet

- **Controller-to-Target** – This is the ‘Carriage Return’ character (ASCII code 13).
- **Target-to-Controller** – This is the two-character sequence ‘Carriage Return’, ‘Line Feed’ (ASCII codes 13 and 10).

Both indicate the valid termination of a packet.

## 5.3 Remote Commands / Queries

**Index Notes: Column 'C'** = Command; **Column 'Q'** = Query; columns marked '**X**' designate instruction code as *Command only*, *Query only*, or *Command/Query*.

| CODE | C | Q | PAGE |
|---|---|---|---|
| AMP | X | X | 5–8 |
| AOF | X | X | 5–8 |
| ATT | X | X | 5–8 |
| BYP | X | X | 5–8 |
| CAA | X | - | 5–8 |
| CAS | - | X | 5–9 |
| CCS | - | X | 5–9 |
| CID | X | X | 5–9 |
| CMS | - | X | 5–9 |
| CUS | - | X | 5–10 |
| DAT | X | X | 5–10 |

| CODE | C | Q | PAGE |
|---|---|---|---|
| FBR | X | - | 5–15 |
| FRW | - | X | 5–10 |
| IAP | X | - | 5–13 |
| IMG | X | X | 5–15 |
| IPA | X | X | 5–14 |
| IPG | X | X | 5–14 |
| LNA | - | X | 5–10 |
| LRS | X | X | 5–13 |
| MAC | - | X | 5–14 |
| MUT | X | X | 5–10 |
| PNG | X | X | 5–14 |

| CODE | C | Q | PAGE |
|---|---|---|---|
| RAS | - | X | 5–11 |
| RCM | X | X | 5–13 |
| RCS | - | X | 5–11 |
| RED | X | X | 5–12 |
| RET | - | X | 5–12 |
| RFD | X | - | 5–16 |
| RMS | - | X | 5–12 |
| RSN | - | X | 5–12 |
| RUS | - | X | 5–12 |
| SBR | X | X | 5–12 |
| SFS | - | X | 5–13 |

| CODE | C | Q | PAGE |
|---|---|---|---|
| SPA | X | X | 5–13 |
| STA | X | X | 5–15 |
| STB | X | X | 5–15 |
| STV | X | X | 5–16 |
| SWR | - | X | 5–15 |
| TIM | X | X | 5–13 |
| TNA | - | X | 5–13 |
| TPE | X | X | 5–16 |
| TPS | X | X | 5–16 |
| TSC | - | X | 5–15 |
| WCM | X | X | 5–14 |

**Unless otherwise noted – In the tables that follow, these codes are used in the 'Response to Command' column**

= Message ok

? Received ok, but invalid arguments were found

* Message ok, but not permitted in current mode

| Parameter Type | Command (Instruction Code and qualifier) | Command Valid for PCB or SSPA | Arguments for Command or Response to Query | Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57) | Response to Command (Target to Controller) | Query (Instruction Code and qualifier) | Query Valid for PCB or SSPA | Response to Query (Target to Controller) |
|---|---|---|---|---|---|---|---|---|
| RF Power Amplifier State | AMP= | PCB | 1 byte,<br>value of 0, 1 | Command or Query.<br>Turns ON or OFF the SSPAs in the form AMP=x, where:<br>0 = Off<br>1 = On | AMP=<br>AMP?<br>AMP*<br>AMP# | AMP? | ALL | AMP=x<br>(see Description of Arguments for details) |
| Attenuation Offset | AOF= | PCB | 7 bytes,<br>alphanumeric | Command or Query.;<br>Sets attenuation offset for specified SSPA<br>*Command:* AOF=x,yy.yy where:<br>x=0 or 1 (SSPA number)<br>yy.yy=Attenuation offset<br>*Query:* AOF?<br>Example: AOF=1,01.50<br>Note: AOF command will not take values greater than 6 dB) | AOF=<br>AOF?<br>AOF*<br>AOF# | AOF? | PCB | AOF=x,yy.yy<br>(see Description of Arguments for details) |
| Attenuation | ATT= | PCB | 5 bytes,<br>numerical | Command or Query.<br>Valid attenuation level, in dB, at 0.25-dB step size as factory default.<br>Example: ATT=12.25<br>Note: The attenuation range is limited to a maximum of 24 dB. | ATT=<br>ATT?<br>ATT*<br>ATT# | ATT? | ALL | ATT=xx.xx<br>(see Description of Arguments for details) |
| Bypass SSPA | BYP= | PCB | 1 byte<br>value of 0, 1 or 2 | Command or Query.<br>*Command:* BYP=a, where:<br>a = 0 (No SSPA is bypassed)<br>1 (SSPA #1 is bypassed)<br>2 (SSPA #2 is bypassed)<br>• Command bypasses the SSPA specified by argument.<br>• Command works only in RED=0 mode.<br>*Query:* BYP?<br>• Query returns the number of the SSPA that is currently bypassed or offline.<br>• Query works in any RED mode. | BYP=<br>BYP?<br>BYP* (received ok but in the wrong RED mode) | BYP? | PCB | BYP=a<br>(see Description of Arguments for details) |
| Clear All Stored Alarms | CAA= | ALL | None | Command only.<br>Instructs the slave to clear all Stored Events.<br>This command takes no arguments. | CAA= | N/A | N/A | N/A |

| Parameter Type | Command (Instruction Code and qualifier) | Command Valid for PCB or SSPA | Arguments for Command or Response to Query | Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57) | Response to Command (Target to Controller) | Query (Instruction Code and qualifier) | Query Valid for PCB or SSPA | Response to Query (Target to Controller) |
|---|---|---|---|---|---|---|---|---|
| Concise Alarm Status | N/A | N/A | 11 bytes numerical with commas | Query only.<br>Used to Query the Alarm status of the unit, response is comma delimited.<br>Example: CAS=a,b,c,d,e,f,g'cr''lf' *where:*<br>a thru k = 0 or 1, 0 = OK 1 = FT<br>a = +24V Power Supply<br>b = +5V Power Supply<br>c = SSPA1<br>d = SSPA2<br>e = reserved<br>f = SW1 Absent FLT<br>g = SW2 Absent FLT | N/A | CAS? | ALL (Check SSPA manual for arguments returned from SSPA) | CAS=x….x (see Description of Arguments for details) |
| Concise Configuration Status | N/A | N/A | 24 bytes numerical | Query only.<br>Used to query the summarized version of RCS.<br>Example: CCS=aa.aa,b,c,d,e,f,g'cr''lf' where:<br>aa.aa = attenuation in dB<br>b = RF power amplifier state<br>c = mute state<br>d = redundancy/phase combine mode<br>e,f,g = SSPAs fault status (g is reserved (X)) | N/A | CCS? | SSPA (per MBT manual) | CCS=x….x (see Description of Arguments for details) |
| Circuit Identification | CID= | PCB | 24 bytes, alphanumeric | Command or Query.<br>Used to identify or name the unit or station. First line is limited to 24 characters. Second line is also limited to 24 characters. No carriage return between first line and second line. | CID=<br>CID? | CID? | ALL | CID=x…x (see Description of Arguments for details) |
| Concise Maintenance Status | N/A | N/A | 16 bytes numerical | Query only.<br>Used to Query the Maintenance status of the unit in concise format. Response is comma delimited.<br>Example: CMS=aa.a,b.b,c.c,d.d'cr''lf' where:<br>aa.a = +24V Power Supply<br>b.b = +5V Power Supply<br>c.c = +3.3V Power Supply<br>d.d = +1.5V Power Supply | N/A | CMS? | ALL (Check SSPA manual for arguments returned from SSPA) | CMS=x….x (see Description of Arguments for details) |

| Parameter Type | Command (Instruction Code and qualifier) | Command Valid for PCB or SSPA | Arguments for Command or Response to Query | Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57) | Response to Command (Target to Controller) | Query (Instruction Code and qualifier) | Query Valid for PCB or SSPA | Response to Query (Target to Controller) |
|---|---|---|---|---|---|---|---|---|
| Concise Utility Status | N/A | N/A | 11 bytes alphanumeric | Query only.<br>Used to Query the Maintenance status of the unit, response is comma delimited.<br>Example: CUS=aaaa,bbbb'cr''lf' where:<br>aaaa = Remote Unit Address<br>bbbb = Remote Baud Rate | N/A | CUS? | ALL (Check SSPA manual for arguments returned from SSPA) | CUS=x….x (see Description of Arguments for details) |
| Set RTC(Real-Time-Clock) Date | DAT= | ALL | 6 bytes, numerical | Command or Query.<br>A command in the form mmddyy, where; dd = day of the month, between 01 and 31, mm = month of the year, between 01 and 12 and yy = year, between 00 and 99 (2000 to 2099)<br>Example: DAT=042503 would be April 24, 2003 | DAT=<br>DAT?<br>DAT* | DAT? | ALL | DAT=xx (see Description of Arguments for details) |
| Retreive Firmware Number | N/A | N/A | 32 bytes | Query only.<br>Gets the Firmware Numbers of the unit.<br>Example: FRW='cr'<br>BULK=FW-0021045'cr'<br>MnC =FW-0021046'cr''lf' | N/A | FRW? | ALL | FRW= x….x (see Description of Arguments for details) |
| Retrieve next 5 unread Stored Alarms | N/A | N/A | 145 bytes | Query only.<br>The unit returns the oldest 5 Stored Events which have not yet been read over the remote control.<br>Reply format: Sub-body{CR}Sub-body{CR}Sub-body{CR}Sub-body{CR}Sub-body, where Sub-body= YYYYYYYYYY ZZ mmddyy hhmmss, *where:*<br>YYYYYYYYYY being the fault description.<br>ZZ being the alarm type.<br>FT = Fault<br>OK = Clear<br>IF = Information<br>If there are no new events, the unit will reply with LNA* | N/A | LNA? | SSPA | LNA=YY..ss (see Description of Arguments for details) |
| Mute State | MUT= | PCB | 1 byte, value of 0,1 | Command or Query.<br>Mute the SSPAs, where:<br>0 = Disabled,<br>1 = Enabled<br>2 = Inhibit asserted (Query only)<br>Example: MUT=1 | MUT=<br>MUT?<br>MUT* | MUT? | ALL | MUT=x (see Description of Arguments for details) |

| Parameter Type | Command (Instruction Code and qualifier) | Command Valid for PCB or SSPA | Arguments for Command or Response to Query | Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57) | Response to Command (Target to Controller) | Query (Instruction Code and qualifier) | Query Valid for PCB or SSPA | Response to Query (Target to Controller) |
|---|---|---|---|---|---|---|---|---|
| Retrieve Alarm Status | N/A | N/A | 53 bytes alphanumeric | Query only.<br>Used to Query the Alarm status of the unit.<br>Example: RAS='cr'<br>P24VT=OK'cr'<br>P5VLT=OK'cr'<br>SSPA1=OK'cr'<br>SSPA2=OK'cr'<br>SSPA3=NA'cr'<br>SW1FT=OK'cr'<br>SW2FT=OK''cr''lf' | N/A | RAS? | ALL (Check SSPA manual for arguments returned from SSPA) | RAS=x….x (see Description of Arguments for details) |
| Retrieve Configuration Status | N/A | N/A | 33 bytes alphanumeric | Query only.<br>Used to Query the configuration status.<br>Example: RCS='cr'<br>ATT=12.75'cr'<br>AMP=1'cr'<br>MUT=1'cr'<br>PCM=1,0'cr'<br>FLT=0,0,X'cr''lf' *where:*<br>ATT= attenuation in dB<br>AMP= RF power amplifier state, 0=OFF, 1=ON<br>MUT=RF mute state, 0=unmuted, 1=muted<br>PCM=Redundancy/Phase Combined mode,<br>0 = off<br>1 = 1:1 phase combine<br>2 = 1:2 phase combine (future)<br>3 = reserved<br>4 = reserved<br>FLT=X,Y,Z -> SSPAs fault state<br>X = SSPA#1 (1=faulted, 0=unfaulted)<br>Y = SSPA#2 (1=faulted, 0=unfaulted)<br>Z = reserved (X) | N/A | RCS? | SSPA (per MBT manual) | RCS=x….x (see Description of Arguments for details) |

| Parameter Type | Command (Instruction Code and qualifier) | Command Valid for PCB or SSPA | Arguments for Command or Response to Query | Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57) | Response to Command (Target to Controller) | Query (Instruction Code and qualifier) | Query Valid for PCB or SSPA | Response to Query (Target to Controller) |
|---|---|---|---|---|---|---|---|---|
| Redundancy /Phase Combine Mode | RED= | PCB | 1 byte, value of 0, 1,2,3 | Command or Query.<br>Set the redundancy/phase combine mode.<br>0 = Off<br>1 = 1:1 Phase combined<br>2 = reserved<br>3 = reserved<br>4 = reserved | RED=<br>RED? | RED? | PCB | RED=x (see Description of Arguments for details) |
| Retrieve Equipment Type | N/A | N/A | 35 bytes, alphanumeric | Query only.<br>The unit returns a string indicating the Model Number and the value of internal software revision installed.<br>Example: PCB-4000A Phase Combiner Ver: 1.1.1 | N/A | RET? | ALL | RET=x….x (see Description of Arguments for details) |
| Retrieve Maintenance Status | N/A | N/A | 42 bytes, alphanumeric | Query only.<br>Used to Query the maintenance status of the unit.<br>P24VT=23.5'cr'<br>P05VT=4.8'cr'<br>P03VT=3.3'cr'<br>P01VT=1.5'cr''lf' | N/A | RMS? | ALL (Check SSPA manual for arguments returned from SSPA) | RMS=*x….x* (see Description of Arguments for details) |
| Serial Number | N/A | PCB | 9 bytes, numerical 000000000 to 999999999 | Query only.<br>Used to Query the units 9 digit serial number.<br>Slave returns its S/N, in the form xxxxxxxxx.<br>Example: RSN=000000165 | N/A | RSN? | ALL | RSN=xxxxxxxxx (see Description of Arguments for details) |
| Retrieve Utility Status | N/A | N/A | 17 bytes alphanumeric | Query only.<br>Used to Query the utility status of the unit<br>Example: RUS='cr'<br>ADR=0001'cr'<br>BDR=9600'cr''lf' | N/A | RUS? | ALL (Check SSPA manual for arguments returned from SSPA) | RUS=x….x (see Description of Arguments for details) |
| Remote Baud Rate | SBR= | PCB | 4 bytes | Command or Query.<br>Set remote baud rate as follows:<br>9600 = 9600 baud<br>19K2 = 19200 baud | SBR=<br>SBR?<br>SBR# | SBR? | PCB | SBR=xx (see Description of Arguments for details) |

| Parameter Type | Command (Instruction Code and qualifier) | Command Valid for PCB or SSPA | Arguments for Command or Response to Query | Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57) | Response to Command (Target to Controller) | Query (Instruction Code and qualifier) | Query Valid for PCB or SSPA | Response to Query (Target to Controller) |
|---|---|---|---|---|---|---|---|---|
| Summary Fault Status | N/A | N/A | 1 byte, value of 0,1 | Query only.<br>Used to Query the status of the Summary Fault Relay.<br>Example: SFS=0 *where:*<br>0 = OK<br>1 = FT | N/A | SFS? | SSPA | SFS=x (see Description of Arguments for details) |
| Remote Address | SPA= | PCB | 4 bytes, numerical | Command or Query.<br>Set Physical Address-between 0001 to 9999.<br>Resolution 0001<br>Example: SPA=0412<br>Default: 1 | SPA=<br>SPA? | SPA? | PCB | SPA=x (see Description of Arguments for details) |
| Set RTC Time | TIM= | ALL | 6 bytes, numerical | Command or Query.<br>A command in the form hhmmss, indicating the time from midnight, where hh = hours, between 00 and 23; mm = minutes, between 00 and 59, and ss = seconds, between 00 and 59<br>Example: TIM=231259 would be 23 hours, 12 minutes and 59 seconds past midnight. | TIM =<br>TIM?<br>TIM * | TIM? | ALL | TIM=xx (see Description of Arguments for details) |
| Retrieve Number of unread Stored Alarms | N/A | N/A | 2 bytes, numerical | Query only.<br>Returns the number of Stored Events which remain unread, in the form xx.<br>Example reply: TNA=18 | N/A | TNA? | SSPA | TNA=xx (see Description of Arguments for details) |
| Initialize Stored Alarms Pointer | IAP= | ALL | None | Command only.<br>Resets internal pointer to allow LNA? Query to start at the beginning of the stored alarms log. | IAP=<br>IAP?<br>IAP* | N/A | N/A | N/A |
| Remote State | LRS= | PCB | 1 byte, value of 1 or 3 | Command or Query.<br>Used set the user's Remote state in the form x, where:<br>1=Serial Remote (RS-232)<br>3=Ethernet Remote<br>Example: LRS=1 (selects Serial Remote) | LRS<br>LRS?<br>LRS*<br>LRS# | LRS? | PCB | LRS=x (see Description of Arguments) |
| SNMP Read Community String | RCM= | PCB | Up to 20 characters, no spaces | Command or Query.<br>Sets or returns the SNMP Read Community string.<br>Example: RCM=public<br>Notes: Empty string is not allowed. | RCM=<br>RCM?<br>RCM# | RCM? | PCB | RCM=x…x (see Description of Arguments) |

| Parameter Type | Command (Instruction Code and qualifier) | Command Valid for PCB or SSPA | Arguments for Command or Response to Query | Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57) | Response to Command (Target to Controller) | Query (Instruction Code and qualifier) | Query Valid for PCB or SSPA | Response to Query (Target to Controller) |
|---|---|---|---|---|---|---|---|---|
| SNMP Write Community String | WCM= | PCB | Up to 20 characters, no spaces | Command or Query.<br>Sets or returns the SNMP Write Community string.<br>Example: WCM=private<br>Notes: Empty string is not allowed | WCM=<br>WCM?<br>WCM# | WCM? | PCB | WCM=x…x (see Description of Arguments) |
| IP Address | IPA= | PCB | 18 bytes numerical | Command or Query.<br>Used to set the IP Address and network prefix for the 10/100 Base T Ethernet management port, in the form aaa.bbb.ccc.ddd.yy, where permitted ranges are:<br>aaa = 0-223<br>bbb = 0-255<br>ccc = 0-255<br>ddd = 001-255<br>yy=08-30<br>Example: IPA=010.006.030.001.24<br>Default: 192.168.1.4.24 | IPA=<br>IPA?<br>IPA* | IPA? | PCB | IPA= aaa.bbb.ccc.ddd.yy (see Description of Arguments) |
| IP Gateway | IPG= | PCB | 15 bytes numerical | Command or Query.<br>Used to set the IP Gateway Address for the Ethernet management port, in the form aaa.bbb.ccc.ddd, where permitted ranges are:<br>aaa = 0-223<br>bbb = 0-255<br>ccc = 0-255<br>ddd = 001-255<br>Example: IPG=010.006.030.001<br>Default: 192.168.1.5 | IPG=<br>IPG?<br>IPG*<br>IPG# | IPG? | PCB | IPG= aaa.bbb.ccc.ddd (see Description of Arguments) |
| MAC Address | N/A | N/A | 12 bytes, alpha-numerical | Query only.<br>Used to query the unique MAC Address for the modem.<br>Example: MAC=0006B00001C2 | N/A | MAC? | PCB | MAC=aabbccddeeff (see Description of Arguments) |
| Ping Reply Enable | PNG= | PCB | 1 byte, value of 0 or 1 | Command or Query.<br>Used to Enable or Disable Ping reply in the form x, where:<br>0=Disable Ping Reply<br>1=Enable Ping Reply | PNG=<br>PNG?<br>PNG* | PNG? | PCB | PNG=x (see Description of Arguments) |

| Parameter Type | Command (Instruction Code and qualifier) | Command Valid for PCB or SSPA | Arguments for Command or Response to Query | Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57) | Response to Command (Target to Controller) | Query (Instruction Code and qualifier) | Query Valid for PCB or SSPA | Response to Query (Target to Controller) |
|---|---|---|---|---|---|---|---|---|
| Software Revision | N/A | N/A | 32 bytes | Query only.<br>Unit returns the firmware information for Boot, Image 1 (Bulk1) and Image 2 (Bulk2) installed in the unit.<br>Example: SWR=Boot:1.1.1Bulk1:1.1.1Bulk2:1.1.1 | N/A | SWR? | PCB | SWR=x...x (see description of arguments) |
| Software Image | IMG= | N/A | 1 byte, value of 1 or 2 | Command or Query.<br>Used to set the active software image for the next reboot in the form x, where:<br>1=Boot from Bulk Image #1 for next reboot<br>2=Boot from Bulk Image #2 for next reboot | IMG=<br>IMG?<br>IMG*<br>IMG# | IMG? | PCB | IMG=x (see Description of Arguments) |
| Force Reboot | FRB= | PCB | None | Command only.<br>Force a hard reset of the unit in 5 seconds. | FRB=<br>FRB?<br>FRB*<br>FRB# | N/A | N/A | N/A |
| Terminal Status Change | N/A | N/A | 1 byte, value of 0 or 1 | Query only.<br>Unit returns the configuration change state since last time it's queried in the form x, where:<br>0=Unit configuration has not been changed since last query.<br>1=Unit configuration has been changed since last query. | N/A | TSC? | PCB | TSC=x (see Description of Arguments) |
| SNMP Trap Destination IP Address 1 | STA= | PCB | 15 bytes, Numerical | Command or Query.<br>Used to set the IP address of the first SNMP Trap destination IP Address 1<br>Where traps will be sent in the form:<br>xxx.xxx.xxx.xxx is the IP addresss<br>Example:<br><1/STA=010.006.030.001<br>When not configured, returns >0001/STA=0.0.0.0 | STA=<br>STA! | STA=xxx.xxx.xxx.xxx<br><br>(See description of arguments) | PCB | STA=xxx.xxx.xxx.xxx<br><br>(See description of arguments) |
| SNMP Trap Destination IP Address 2 | STB= | PCB | 15 bytes, Numerical | Command or Query.<br>Used to set the IP address of the first SNMP Trap destination IP Address 2<br>Where traps will be sent, in the form:<br>xxx.xxx.xxx.xxx is the IP addresss<br>Example:<br><1/STB=010.006.030.001<br>When not configured, returns >0001/STB=0.0.0.0 | STB =<br>STB! | STB? | PCB | STB=xxx.xxx.xxx.xxx<br><br>(See description of arguments) |

| Parameter Type | Command (Instruction Code and qualifier) | Command Valid for PCB or SSPA | Arguments for Command or Response to Query | Description of Arguments (Note that all arguments are ASCII numeric codes – i.e., ASCII codes between 48 and 57) | Response to Command (Target to Controller) | Query (Instruction Code and qualifier) | Query Valid for PCB or SSPA | Response to Query (Target to Controller) |
|---|---|---|---|---|---|---|---|---|
| SNMP Trap Version | STV= | PCB | 1 byte | Command or Query.<br>SNMP Trap Version that will be used to send traps.<br>1 = SNMP Trap Version 1<br>2 = SNMP Trap Version 2<br>Example: <1/STV=0 | STV =<br>STV! | STV? | PCB | STV =x<br><br>(See description of arguments) |
| Time Protocol Enable | TPE= | PCB | 1 byte, numerical | Command or Query.<br>0 = Time protocol disabled<br>1 = Time protocol enabled<br>Example: TPE=1 (Time protocol enabled)<br>Default Value: 255 or 0 | TPE=<br>TPE? | TPE? | PCB | TPE=x<br>(see description of arguments) |
| Time Protocol Server | TPS= | PCB | 15 bytes, alpha-numeric | Command or Query.<br>Used to set the Time Server IP address for the Unit. Tx Ethernet management port, in the format:<br>xxx.xxx.xxx.xxx, where:<br>xxx.xxx.xxx.xxx is the Time server IP address<br>Example: TPS=192.168.001.005<br>Default Value: 255.255.255.255 or 0.0.0.0 | TPS=<br>TPS? | TPS? | PCB | TPS=<br>xx.xxx.xxx.xxx.<br>yy (see description of arguments) |
| Restore Factory Defaults | RFD= | PCB | None | Command only.<br>Restores factory defaults in the NVRAM<br>Example: RFD='cr' | RFD=<br>RFD?<br>RFD* | N/A | PCB | N/A |

# Chapter 6. ETHERNET-BASED REMOTE PRODUCT MANAGEMENT

## 6.1 Overview

Ethernet-based Remote Product Management is available using the **SYSTEM COM | J1** connector.

***PROCEED WITH ETHERNET-BASED REMOTE PRODUCT MANAGEMENT ASSUMING THAT:***

- ***The PCB-4000A is operating with the latest version firmware files.***
- ***The PCB-4000A is connected to a user-supplied, Windows-based PC, and:***
  - ***The PC Ethernet port is connected to the PCB-4000A SYSTEM COM | J1 connector.***

## 6.2 Ethernet Management Interface Protocols

The user PC facilitates access to Ethernet-based remote monitor and control (M&C) of the PCB-4000A through the Simple Network Management Protocol (SNMP**).** This *non-secure interface* requires a user-supplied Network Management System (NMS) and a user-supplied Management Information Base (MIB) File Browser.

SNMP user interface is only available when the unit's Local/Remote state is set to Ethernet Remote through LRS serial remote command (LRS=3).

## 6.3 SNMP Interface

The SNMP is an Internet-standard protocol for managing devices on IP networks. An SNMP managed network consists of three key components:

- **The managed device.** This includes the PCB-4000A.
- **The SNMP Agent.** The software that runs on the PCB-4000A. The SNMP Agent supports both **SNMPv1** and **SNMPv2c**.
- **The user-supplied NMS.** The software that runs on the manager.

### 6.3.1 Management Information Base (MIB) Files

MIB files are used for SNMP remote management of a unique device. A MIB file consists of a tree of nodes called Object Identifiers (OIDs). Each OID provides remote management of a particular function. These MIB files should be compiled in a user-supplied MIB Browser or SNMP Network Monitoring System server. The following MIB files are associated with the PCB-4000A:

**Table 6-1. Management Information Base Files**

| MIB File/Name<br>(where 'x' is revision letter) | Description |
|---|---|
| FW-0021074*.mib<br>ComtechEFData MIB file | ComtechEFData MIB file gives the root tree for ALL Comtech EF Data products and consists of only the following OID:<br>Name: comtechEFData<br>Type: MODULE-IDENTITY<br>OID: 1.3.6.1.4.1.6247<br>Full path:<br>iso(1).org(3).dod(6).internet(1).private(4).enterprises(1).comtechEFData(6247)<br>Module: ComtechEFData |
| FW-0021047*.mib<br>PCB-4X00A MIB file | MIB file consists of all of the OIDs for management of the unit functions. |
| FW-0021048*.mib<br>PCB-4X00A MIB file | MIB file consists of all of the OIDs for traps of the unit functions. |

### 6.3.2 SNMP Community Strings

**CAUTION – In SNMP v1/v2c, the SNMP Community String is sent unencrypted in the SNMP packets. Caution must be taken by the network administrator to ensure that SNMP packets travel only over a secure and private network if security is a concern.**

The PCB-4000A uses Community Strings as a password scheme that provides authentication before gaining access to the Agent MIBs. They are used to authenticate users and determine access privileges to the SNMP Agent.

Type the SNMP Community String into the user-supplied MIB Browser or Network Node Management software.

Two Community Strings are defined for SNMP access:

- **Read Community default = public**
- **Write Community default = private**

The Read and Write Community Strings can be configured using serial remote command RCM and WCM when remote state is at Serial Remote.

***For proper SNMP operation, the PCB-4000A MIB files must be used with the associated version of the unit. Refer to the PCB-4000A FW Release Notes for information on the required FW/SW compatibility.***

# Appendix A. ASSEMBLY KITS

## A.1 Overview

This appendix provides a reference to the Comtech EF Data accessory and assembly kits that satisfy installation requirements for a PCB-4000A 1+1 Phase Combined System – an example is shown as Figure A-1.

The PCB-4000A 1+1 Phase Combiner stand alone unit is available in a C-Band version only. Contact Comtech EF Data for X-Band or Ku-Band versions. The PCCB may be available as a top assembly line item or as a kit subassembly item.


**Figure A-1. PCB-4000A 1+1 Phase Combined System**

## A.1.1 Summary of Available Assemblies

Table A-1 outlines availability of assembly kits for the PCB-4000A. This includes common subassemblies that may be shared amongst the available configurations. Note that since the model of the SSPA pair deployed within a 1+1 Phase Combined System may vary, the illustrations provided herein either show installed SSPAs for reference purposes only, or otherwise intentionally omit the depiction of any installed SSPA.

**Table A-1. Appendix Figure Quick Reference**

| Assembly Type | Sect. | CEFD Part No. | Description |
|---|---|---|---|
| C-Band | A.2.1 | KT-0000055 | C-Band 1+1 Phase Combined HPOD Top Assembly Kit |
| | A.2.2 | KT-0021171 | C-Band 1:1 Phase Combiner Box and Bracket Kit<br>(Item No. 3 of KT-0000055 Top Assembly Kit) |
| | A.2.3 | KT-0000054 | C-Band 1:1 Phase Combined Waveguide and Switches, HPOD<br>(Item No. 4 of KT-0000055 Top Assembly Kit) |
| | A.2.4 | KT-0021179 | Vertical Mounting Frame Kit |
| | Not Shown | PL-0022667 | C-Band 1:1 Combiner Box<br>(Item No. 9 of KT-0021171) |
| Common | A.3.1 | PL/12319-1 | HPOD 1:1 Redundancy Pole Mount Kit.<br>(Use in connection with KT-0000055 Top Assembly Kit) |
| | A.3.2 | KT-0000017 | 1:2 Redundant HPOD Mounting Kit.<br>(Item No. 1 of KT-0000055 Top Assembly Kit) |
| | A.3.3 | KT/12300-1 | Uni-Strut Mount HPOD Mounting Bracket Kit.<br>(Item No. 2 of KT-0000055 Top Assembly Kit) |
| | A.3.4 | KT-0021261 | Vertical Uni-Strut HPOD Mounting Bracket Kit<br>(Item No. 2 of KT-0021171 Top Assembly Kit) |

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## A.2 C-Band Unit Assemblies

### A.2.1 C-Band 1+1 Phase Combined HPOD Top Assembly Kit (KT-0000055)

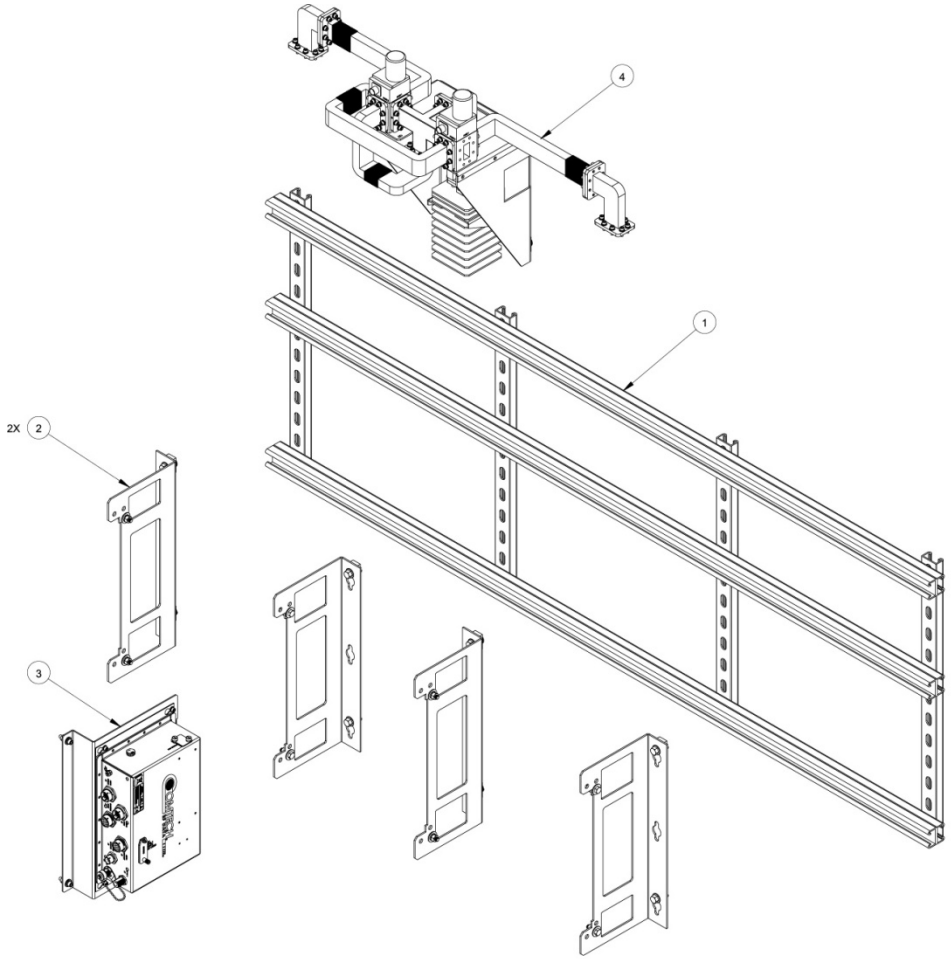


**Figure A-2. C-Band 1+1 Phase Combined HPOD Top Assembly Kit (KT-0000055)**

**Table A-2. C-Band 1+1 Phase Combined HPOD Top Assembly Kit - BOM (KT-0000055)**

| See Figure A-2 | | | |
|---|---|---|---|
| Item No. | QTY | CEFD Part No. | Description |
| 1 | 1 | KT-0000017 | 1:2 Unistrut Mounting Kit |
| 2 | 2 | KT/12300-1 | HPOD Mounting Bracket Kit |
| 3 | 1 | KT-0021171 | C-Band Phase Combiner Box and Bracket Kit |
| 4 | 1 | KT-0000054 | C-Band 1:1 HPOD Waveguide and Switch Kit |
| N/A | 2 | CA/RF11872-1* | Cable Assembly, Ku-Band RF IN |
| N/A | 2 | CA-0021592* | Cable Assembly, SSPA to Combiner Box |
| N/A | 1 | CA/WR12013-1* | Cable Assembly, Switches, Combined System |
| N/A | A/R | HW/TW14.5HDBLK | Cable Ties |

Notes:

1. A/R = As Required
2. *See Chapter 3. OPERATION and ADJUSTMENT PROCEDURES for information on making cable connections in a 1+1 Phase Combiner System.

## A.2.2 Phase Combiner Box and Bracket Kit (KT-0021171)

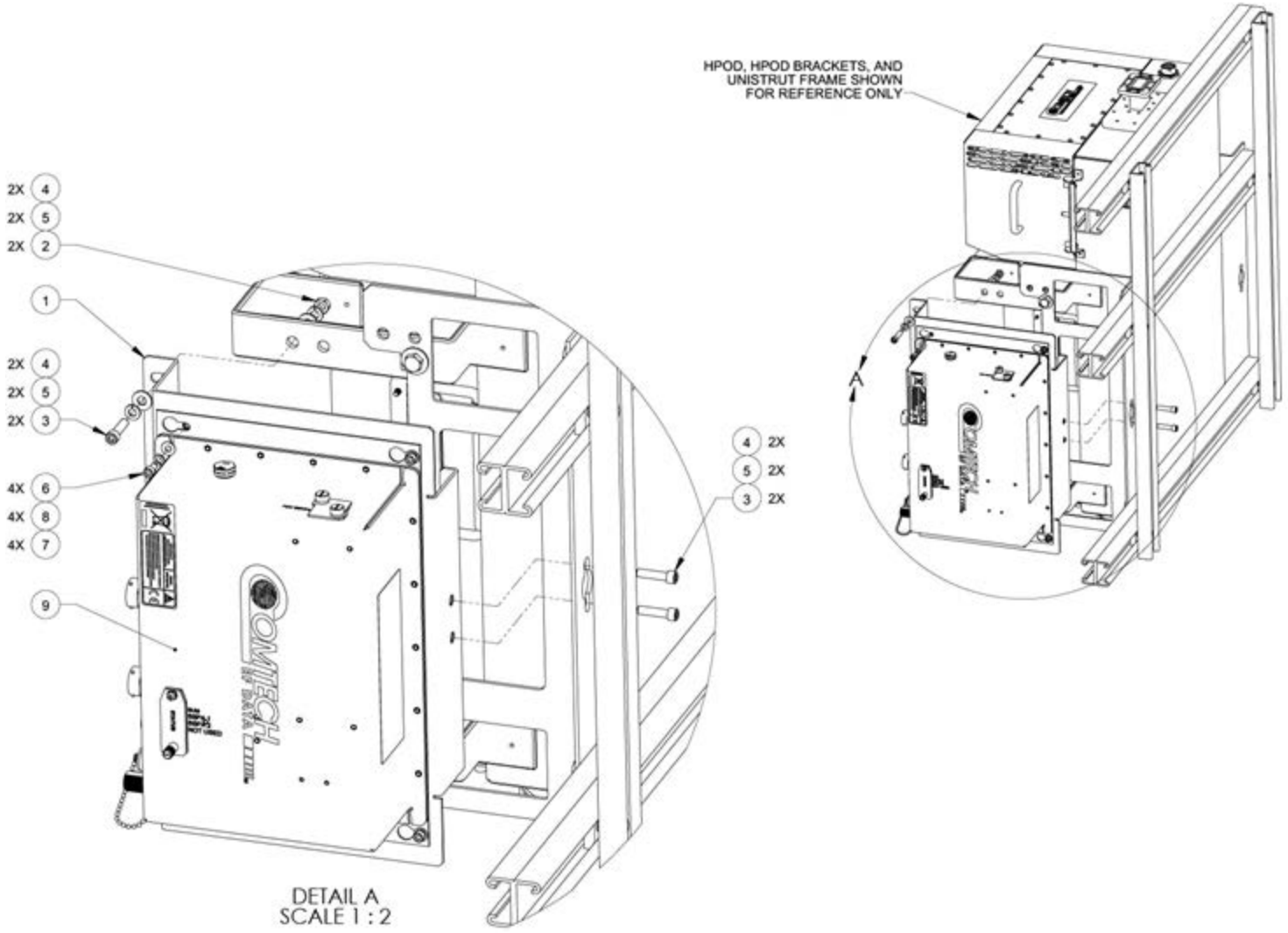


**Figure A-3. Phase Combiner Box and Bracket Kit (KT-0021171)**

**Table A-3. Phase Combiner Box and Bracket Kit – BOM (KT-0021171)**

| See Figure A-3 | | | | |
|---|---|---|---|---|
| Item No. | QTY | U/M | CEFD Part No. | Description |
| 1 | 1 | EA | FP-0022138 | Bracket, HPOD Phase Combiner |
| 2 | 2 | EA | HW/1/4-20HEXNUT | 1/4-20 HEXNUT,SS |
| 3 | 4 | EA | HW/1/4-20X1SHCS | 1/4X20X1 Socket HD Cap Screws |
| 4 | 6 | EA | HW/1/4-FLT | 1/4 Flat Washer |
| 5 | 6 | EA | HW/1/4-SPLIT | 1/4 Split Washer |
| 6 | 4 | EA | HW/10-32X3/8SH | 10-32 x 3/8 Socket Head Cap, SS |
| 7 | 4 | EA | HW/10-FLT | #10 Flat Washer, SS |
| 8 | 4 | EA | HW/10-SPLIT | #10 Split Lock Washers, SS |
| 9 | 1 | EA | PL-0022667 | Combiner Box, 1:1 C-Band |

## A.2.3 C-Band 1:1 Phase Combined Waveguide and Switches, HPOD (KT-0000054)

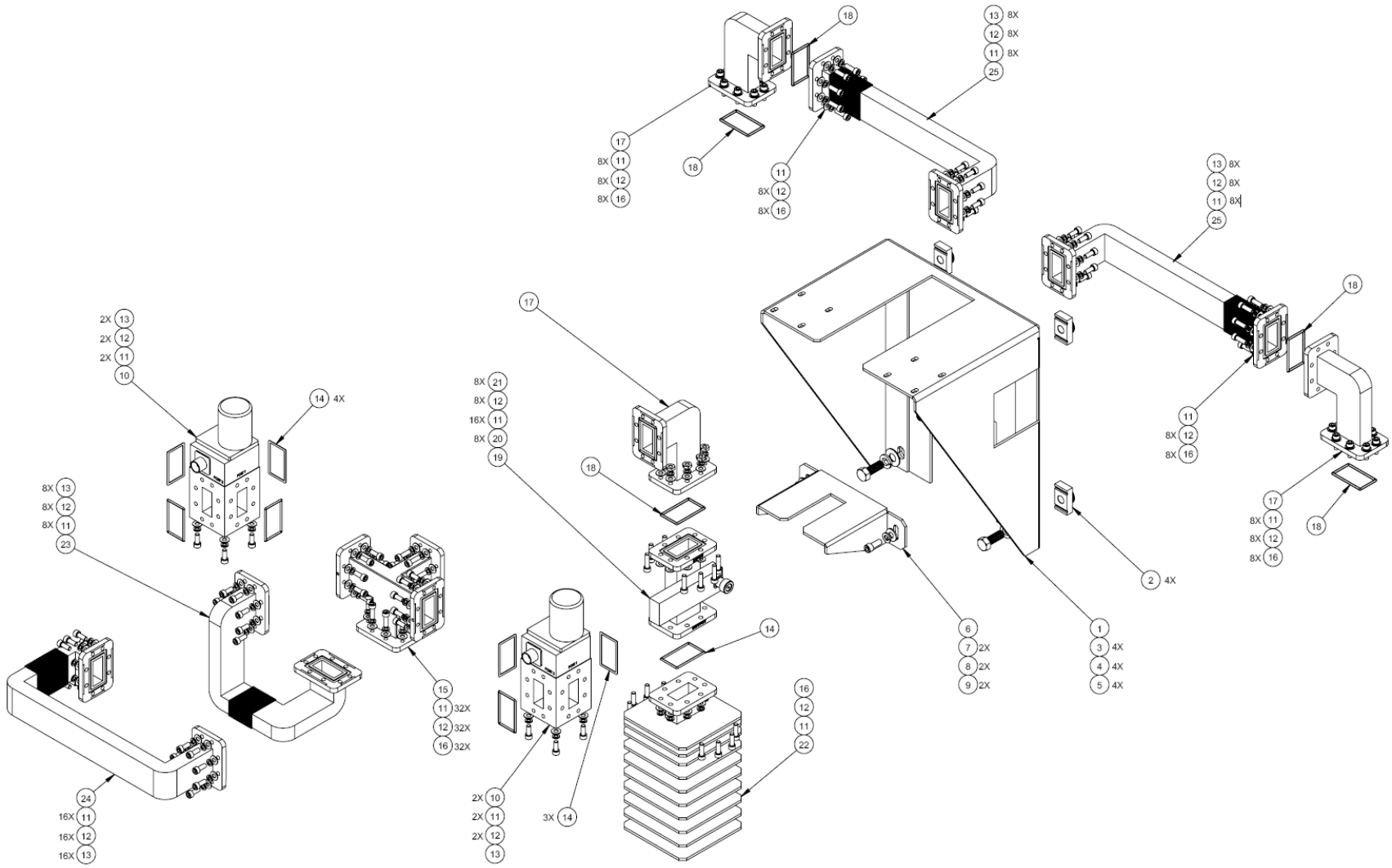

**Figure A-4. C-Band 1:1 Phase Combined Waveguide and Switches, HPOD (KT-0000054)**

**Table A-4. C-Band 1:1 Phase Combined Waveguide and Switches, HPOD - BOM (KT-0000054)**

| See Figure A-4 | | | |
|---|---|---|---|
| Item No. | QTY | CEFD Part No. | Description |
| 1 | 1 | FP-0000414 | MOUNTING BRACKET, DUAL VERTICAL SWITCHES, CPR-137 |
| 2 | 4 | HW/3/8SPRINGNUT | SPRINGNUT, 3/8-16, SHORT SPRING, SS (P3300) |
| 3 | 4 | HW/3/8-FLT | 3/8 FLAT WASHER, SS |
| 4 | 4 | HW/3/8-SPLIT | 3/8 SPLIT LOCK WASHER SS |
| 5 | 4 | HW/3/8-16X1BLT | 3/8 - 16 HEX HEAD BOLT, 1.0 LONG, SS |
| 6 | 1 | FP-0000416 | SUPPORT BRACKET, CPR-137 TERMINATION |
| 7 | 2 | HW/1/4-FLT | 1/4 FLAT WASHER |
| 8 | 2 | HW/1/4-SPLIT | 1/4 SPLIT WASHER |
| 9 | 2 | HW/1/4-20X5/8SHCS | SCREW, 1/4-20 X 5/8 SHCS, SCREW, 1/4-20 X 5/8 SHCS, SS |
| 10 | 2 | SW/WGS28V-137S | SW WAVEGUIDE, CPR137, +28V SEALED |
| 11 | 136 | HW/10-FLT | #10 FLAT WASHER SS |
| 12 | 128 | HW/10-SPLIT | #10 SPLIT LOCK WASHER SS |
| 13 | 64 | HW/10-32X1/2SH | #10-32X1/2 SOCKET HEAD CAP SCREW, SS |
| 14 | 9 | GA/CPR-137-R-H-C | GASKET, D SHAPE, CPR-137, HALF THICKNESS, CONDUCTIVE |
| 15 | 1 | HW-0000131 | RF MAGIC TEE, COUPLER, 5.85-6.425 GHz, WR-137G, C-BAND, 4 WAY |
| 16 | 56 | HW/10-32X5/8SHC | #10-32 X 5/8 SOCKET HEAD CAP SCREW, SS |
| 17 | 3 | FP-0000410 | WAVEGUIDE, CPRG-137, H-BEND ELBOW |
| 18 | 9 | GA/CPR137-R-F-C | GASKET, ROUND, CPR137, FULL THICKNESS, CONDUCTIVE |
| 19 | 1 | RF/CG-137-40-N | RF CROSSGUIDE, WR137, 40DB, N FEMALE, GROOVED |
| 20 | 8 | HW/10-32X3/4SH | #10-32X3/4 SOCKET HEAD CAP SCREW, SS |
| 21 | 8 | HW/10-32HEXNUT | #10-32 HEX NUT, SS |
| 22 | 1 | RF/C-TERM1000W | RF TERMINATION, LOAD, 1000 WATT, CPRG-137 |
| 23 | 1 | FP-0000411 | WAVEGUIDE, CPRG-137, SWITCH TO MAGIC TEE |
| 24 | 1 | FP-0000408 | WAVEGUIDE, CPRG-137, SWITCH TO SWITCH |
| 25 | 2 | FP-0000409 | WAVEGUIDE, CPRG-137, E-BEND ELBOW |

## A.2.4 Vertical Mounting Frame Kit (KT-0021179)

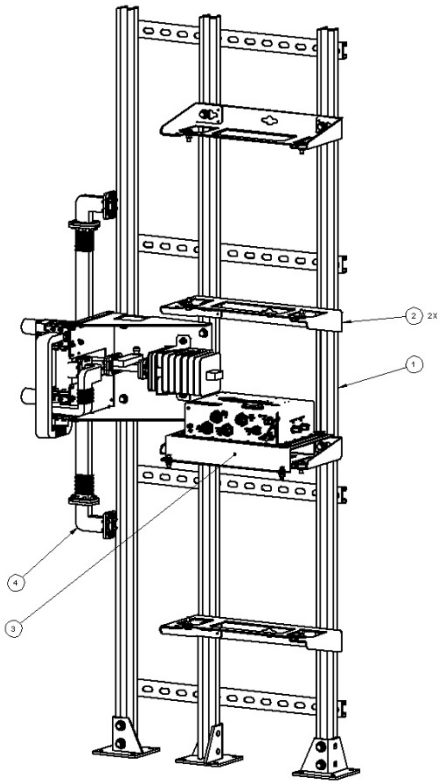


**Figure A-5. Vertical Mounting Frame Kit (KT-0021179)**

**Table A-5. Vertical Mounting Frame Kit – BOM (KT-0021179)**

| See Figure A-5 | | | |
|---|---|---|---|
| Item No. | QTY | CEFD Part No. | Description |
| 1 | 1 | KT-0021175 | MOUNTING KIT, 1:2 REDUNDANT HPOD, INDOOR MTG FRAME, VERTICAL WITH POST BASES |
| 2 | 2 | KT-0021261 | MOUNTING BRACKET KIT, UNI STRUT MOUNT HPOD |
| 3 | 1 | KT-0021171 | KIT, 1:1 PHASE COMBINER BOX AND BRACKET, C-BAND |
| 4 | 1 | KT-0000054 | 1:1 PHASE COMBINED C-BAND WAVEGUIDE & SWITCHES, HPOD |
| N/A | 2 | CA/RF11872-1 | RF IN, MATCHED SET, 1:2 KU-BAND |
| N/A | 2 | CA-0021592 | SSPA TO COMBINER BOX |
| N/A | 1 | CA/WR-12013-1 | CABLE ASSY, SWITCHES, COMBINED SYSTEM |
| N/A | A/R | LB/CABLE-1RFIN | LABEL, CABLE, RF INPUT, SSPA #1 ID LABEL PRINT IN HOUSE, (ROHS) |
| N/A | A/R | LB/CABLE-2RFIN | LABEL, CABLE, RF INPUT, SSPA #2 ID LABEL PRINT IN HOUSE, (ROHS) |
| N/A | A/R | LB/HPODSSPA-1 | LABEL, HPOD, SSPA #1 ID LABEL PRINT IN HOUSE,<br>USE BRADY LABEL LAT-21-773-1 (ROHS) |
| N/A | A/R | LB/HPODSSPA-2 | LABEL, HPOD, SSPA #2 ID LABEL PRINT IN HOUSE, (ROHS) |

## A.3 Common Kit Subassemblies

### A.3.1 HPOD 1:1 Redundancy Pole Mount Kit (PL/12319-1)

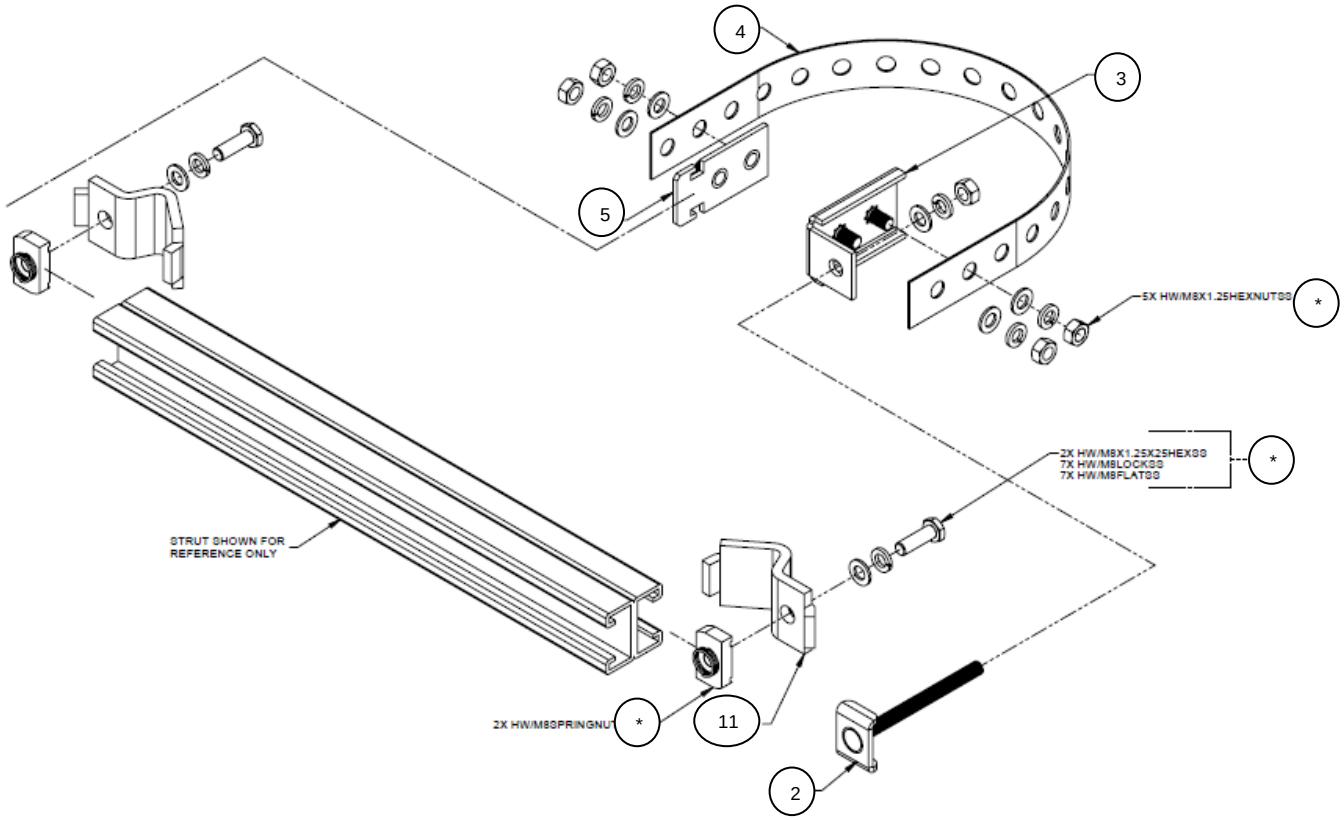


**Figure A-6. HPOD 1:1 Redundancy Pole Mount Kit (PL/12319-1)**

**Table A-6. HPOD 1:1 Redundancy Pole Mount Kit - BOM (PL/12319-1)**

| See Figure A-6 | | | |
|---|---|---|---|
| Item No. | QTY | CEFD Part No. | Description |
| - | N/A | N/A | Strut (Shown for reference only) |
| 2 | 1 | FP/BR0072 | Bracket, Strap Tensioner |
| 3 | 1 | FP/BR0070 | Strap, Termination, Pole Mounting Kit |
| 4 | 1 | FP/BR0071 | Bracket, Modification, 1-1/4 Strap (TRIM TO REQUIRED LENGTH) |
| 5 | 1 | FP/BR0069 | Strap, Fixed, Pole Mounting Kit |
| 11 | 2 | HW/PIPEBLOCK | Pipe Block, 2/8 inch, 1 and 5/8 unistrut channel |
| * | 1 | KT-0020905 | Kit, Commn Purchase Hardware Kit for CSAT PL/12319-1 and AS/0414. See Table A-7. |

**Table A-7. Hardware Kit (KT-0020905)**

* This is part of the HPOD 1:1 Redundancy Pole Mount Kit, Part No. PL/12319-1.

| See Figure A-6 | | | |
|---|---|---|---|
| Item No. | QTY | CEFD Part No. | Description |
| 6 | 2 | HW/M8X1.25X25HEXSS | Bolt, Hex head, M8X1.25X25, SS |
| 7 | 7 | HW/M8FLATSS | Washer, Flat, M8, SS, METRIC |
| 8 | 7 | HW/M8LOCKSS | Washer, Split Lock, M8, SS, METRIC |
| 9 | 2 | HW/M8SPRINGNUT | Spring Nut, M8X1.25 |
| 10 | 5 | HW/M8X1.25MMHEXNUTSS | Nut, Hex M8X1.25X16MM, SS |

## A.3.2 1:2 Redundant HPOD Mounting Kit (KT-0000017)

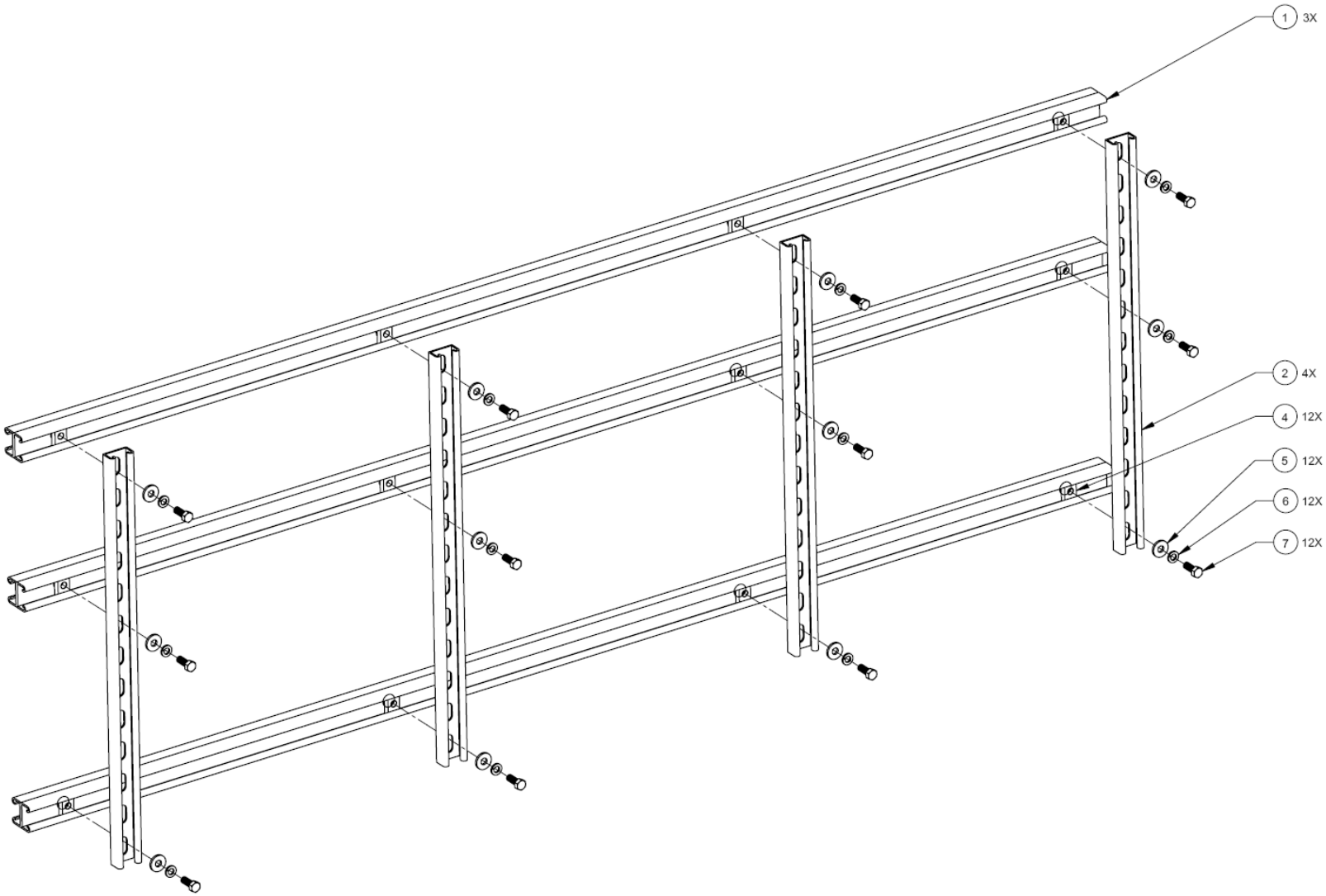


**Figure A-7. 1:2 Redundant HPOD Mounting Kit (KT-0000017)**

**Table A-8. 1:2 Redundant HPOD Mounting Kit - BOM (KT-0000017)**

| See Figure A-7 | | | |
|---|---|---|---|
| Item No. | QTY | CEFD Part No. | Description |
| 1 | 3 | FP-0000134 | Unistrut, Dual Channel, 74.13" LG |
| 2 | 4 | FP/BR11932-1 | Bracket, Unistrut, SS, 26.25" LG |
| 4 | 12 | HW/3/8SPRINGNUT | Spring Nut, 3/8-16, Short Spring, SS (P3300) |
| 5 | 12 | HW-0000069 | Washer, Flat, Thick, 3/8, SS |
| 6 | 12 | HW/3/8-SPLIT | Washer, Lock, Split, 3/8, SS |
| 7 | 12 | HW/3/8-16X1BLT | Bolt, Hex Head, 3/8 x 1" LG, SS |

## A.3.3 Uni-Strut Mount HPOD Mounting Bracket Kit (KT/12300-1)

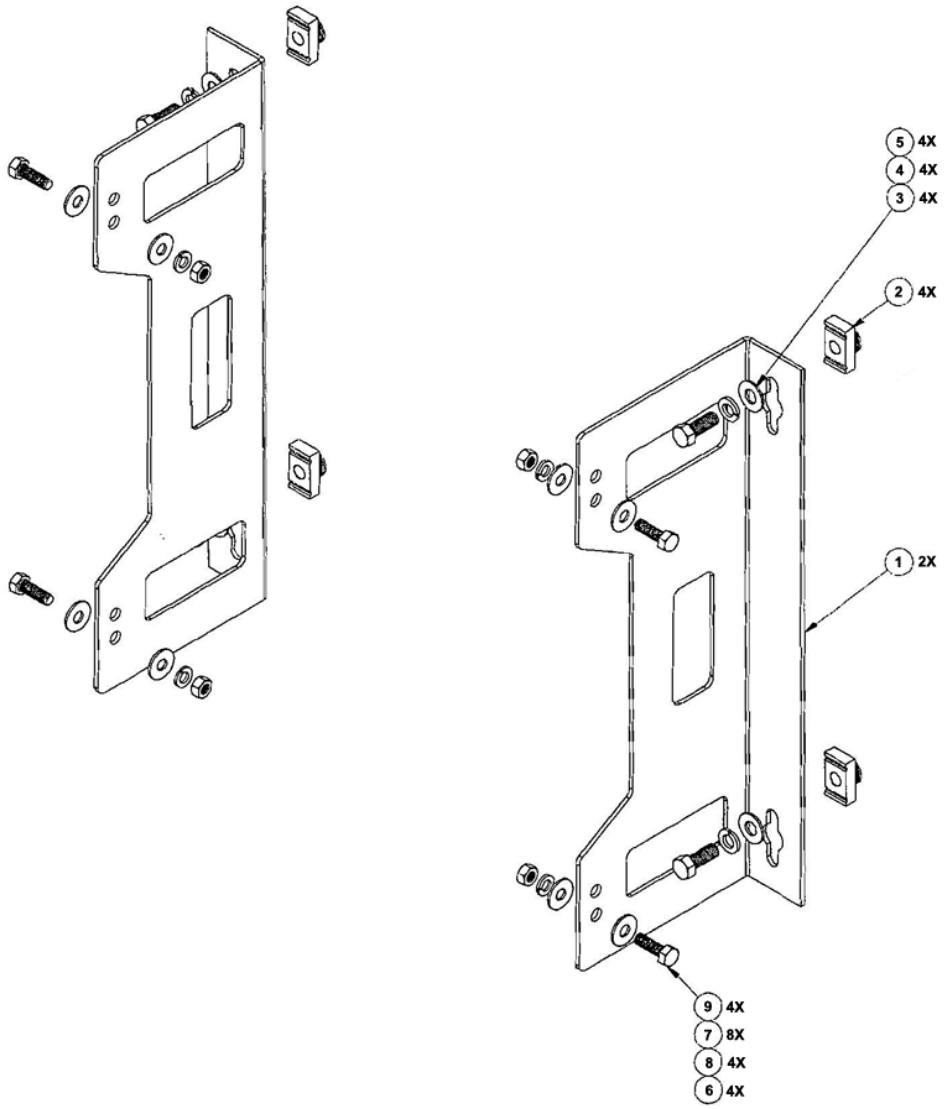


**Figure A-8. Uni-Strut Mount HPOD Mounting Bracket Kit (KT/12300-1)**

**Table A-9. Uni-Strut Mount HPOD Mounting Bracket Kit - BOM (KT/12300-1)**

| See Figure A-8 | | | |
|---|---|---|---|
| Item No. | QTY | CEFD Part No. | Description |
| 1 | 2 | FP/BR12239-1 | Bracket, Unistrut |
| 2 | 4 | HW/3/8SPRINGNUT | Spring Nut, 3/8-16, Short Spring, SS (P3300) |
| 3 | 4 | HW/3/8-FLT | Washer, Flat, 3/8 |
| 4 | 4 | HW/3/8-SPLIT | Washer, Lock, Split, 3/8, SS |
| 5 | 4 | HW/3/8-16X1BLT | Bolt, Hex Head, 3/8-16 x 1" LG, SS |
| 6 | 4 | HW/5/16-18HEXNT | Nut, Hex, 5/16-18, SS |
| 7 | 8 | HW/5/16-Flat | Washer, Flat, 5/16, SS |
| 8 | 4 | HW/5/16-SPLIT | Washer, Lock, Split, 5/16, SS |
| 9 | 4 | HW/5/16-18X1BLT | Bolt, Hex Head, 5/16-18 x 1" LG, SS |

## A.3.4 Vertical Frame Uni-Strut Mount HPOD Mounting Bracket Kit (KT-0021261)

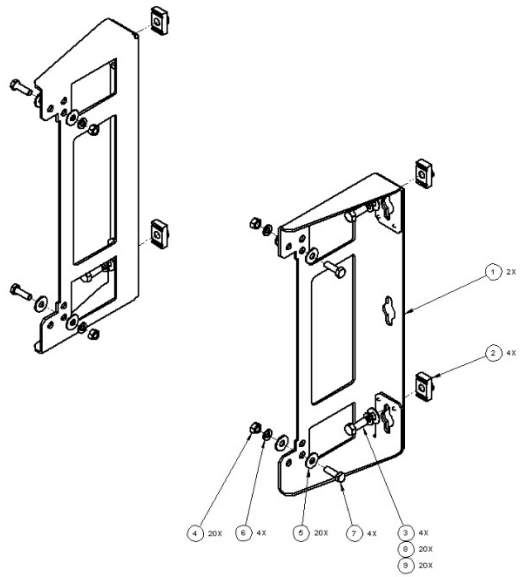


**Figure A-9. Vertical Frame Uni-Strut Mount HPOD Mounting Bracket Kit (KT-0021261)**

**Table A-10. Vertical Frame Uni-Strut Mount HPOD Mounting Bracket Kit (KT-0021261)**

| See Figure A-9 | | | |
|---|---|---|---|
| Item No. | QTY | CEFD Part No. | Description |
| 1 | 2 | FP-0022325 | Mounting Bracket, HPOD & LPOD PS-2, with Gussets |
| 2 | 4 | HW/3/8SPRINGNUT | Spring Nut, 3/8-16, Short Spring, SS (P3300 Channel) |
| 3 | 4 | HW/3/8-16X1BLT | Bolt, Hex Head, 3/8-16 x 1" LG, SS |
| 4 | 4 | HW/5/16-18HEXNT | Nut, Hex, 5/16-18, SS |
| 5 | 8 | HW/5/16-FLT | Washer, Flat, 5/16, SS |
| 6 | 4 | HW/5/16-SPLIT | Washer, Lock, Split, 5/16, SS |
| 7 | 4 | HW/5/16-18X1BLT | Bolt, Hex Head, 3/8-16 x 1" LG, SS |
| 8 | 4 | HW/3/8-FLT | Washer, Flat, 3/8, SS<br>Replacerd HW/3/8Flat on 10-25-00 |
| 9 | 4 | HW/3/8-SPLIT | Washer, Lock, Split, 3/8, SS |


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