Manual, High Power Outdoor SSPAs

Drawing Number: 211670
Revision R
ECO 18899

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Outdoor SSPAs, General Information

Teledyne Paradise Datacom
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http://www.paradisedatacom.com/xml/216595/216595-1.xml

USE AND DISCLOSURE OF DATA
EAR99 Technology Subject to Restrictions Contained in http://www.paradisedatacom.com/xml/216594/216594-1.xml.

Introduction

This section provides the general information for the Teledyne Paradise Datacom Outdoor Solid State Power Amplifier (SSPA) family of products, including the Compact Outdoor SSPA and High Power Outdoor SSPA.

Specifications

Refer to the SSPA's specification sheet for complete specifications. The latest revision of the specification sheets for the Compact Outdoor SSPA and High Power Outdoor SSPA are available on the Teledyne Paradise Datacom web site: www.paradisedata.com.

Inspection

When the unit is received, an initial inspection should be completed. First ensure that the shipping container is not damaged. If it is, have a representative from the shipping company present when the container is opened. Perform a visual inspection of the equipment to make sure that all items on the packing list are enclosed. If any damage has occurred or if items are missing, contact:

Teledyne Paradise Datacom
328 Innovation Blvd., Suite 100
State College, PA 16803 USA
Phone: +1 (814) 238-3450
Fax: +1 (814) 238-3829

Shipment

To protect the SSPA Chassis during shipment, use high quality commercial packing methods. When possible, use the original shipping container and its materials. Reliable commercial packing and shipping companies have facilities and materials to adequately repack the instrument.

Safety Considerations

Potential safety hazards exist unless proper precautions are observed when working with this unit. To ensure safe operation, the user must follow the information, cautions and warnings provided in this manual as well as the warning labels placed on the unit itself.

High Voltage Hazards

High Voltage, for the purpose of this section, is any voltage in excess of 30V. Voltages above this value can be hazardous and even lethal under certain circumstances. Care should be taken when working with devices that operate at high voltage.

⚠ **All probes and tools that contact the equipment should be properly insulated to prevent the operator from coming in contact with the voltage.**

⚠ **The work area should be secure and free from nonessential items.**

⚠ **Operators should never work alone on high voltage devices. There should always be another person present in the same work area to assist in the event of an emergency.**

⚠ **Operators should be familiar with procedures to employ in the event of an emergency, i.e., remove all power, CPR, etc.**

⚠ **An AC powered unit will have 115 VAC or 230 VAC entering through the AC power connector. Caution is required when working near this connector, the AC circuit breaker, or the internal power supply.**

High Current Hazards

Many high power devices are capable of producing large surges of current. This is true at all voltages, but needs to be emphasized for low voltage devices. Low voltage devices provide security from high voltage hazards, but also require higher current to provide the same power. High current can cause severe injury from burns and explosion. The following precautions should be taken on devices capable of discharging high current:

⚠ **Remove all conductive personal items (rings, watches, medals, etc.)**

⚠ **The work area should be secure and free of non-essential items.**

⚠ **Wear safety glasses and protective clothing.**

⚠ **Operators should never work alone on high risk devices. There should always be another person present in the same area to assist in the event of an emergency.**

> ⚠️ **Operators should be familiar with procedures to employ in the event of an emergency, i.e., remove all power, CPR, etc.**

Large DC currents are generated to operate the RF Module inside of the enclosure. Extreme caution is required when the enclosure is open and the amplifier is operating. Do not touch any of the connections on the RF modules when the amplifier is operating. Current in excess of 60 Amperes may exist on any one connector.

RF Transmission Hazards

RF transmissions at high power levels may cause eyesight damage and skin burns. Prolonged exposure to high levels of RF energy has been linked to a variety of health issues. Please use the following precautions with high levels of RF power.

> ⚠️ **Always terminate the RF input and output connector prior to applying prime AC input power.**

> ⚠️ **Never look directly into the RF output waveguide.**

> ⚠️ **Maintain a suitable distance from the source of the transmission such that the power density is below recommended guidelines in ANSI/IEEE C95.1. The power density specified in ANSI/IEEE C95.1-1992 is 10 mW/cm2. These requirements adhere to OSHA Standard 1910.97.**

> ⚠️ **When a safe distance is not practical, RF shielding should be used to achieve the recommended power density levels.**

Electrical Discharge Hazards

An electric spark can not only create ESD reliability problems, it can also cause serious safety hazards. The following precautions should be followed when there is a risk of electrical discharge:

> ⚠️ **Follow all ESD guidelines**

> ⚠️ **Remove all flammable material and solvents from the area.**

> ⚠️ **All probes and tools that contact the equipment should be properly insulated to prevent electrical discharge.**

> ⚠️ **The work area should be secure and free from nonessential items.**

> ⚠️ **Operators should never work alone on hazardous equipment. There should always be another person present in the same work area to assist in the event of an emergency.**

⚠ **Operators should be familiar with procedures to employ in the event of an emergency, i.e., remove all power, CPR, etc.**

High Leakage Current

The equipment may have more than 3.5 mA leakage current. Make sure a connection to earth ground is present before applying prime power, and after removing prime power.

High Potential for Waveguide Arcing

As with all systems which utilize high power signals within waveguide, the potential exists for an electric arc to form. To minimize this risk, Teledyne Paradise Datacom requires all waveguide be pressurized and dehydrated.

Waveguide Pressurization/Dehydration

When working with high power amplifier systems that operate into waveguide, the inadvertent creation of arcs is always a concern. An arc in waveguide is the air discharge breakdown due to the ionization of the air molecules by electrons. This breakdown in waveguide occurs when the rate of electron production becomes greater than the loss of electrons to diffusion to the surrounding walls.

It is extremely difficult to precisely predict the power levels at which the breakdown occurs. It is dependent on a variety of factors but the primary factors are:

- Waveguide temperature and atmospheric pressure
- Components in the Waveguide Transmission System such as: Flanges, Bends, Tees, Combiners, Filters, Isolators, etc.
- Load VSWR presented to the amplifier.

When operating such a high power amplifier system it is imperative that the waveguide transmission system be dehydrated and pressurized. Operation with an automatic air dehydrator will provide dry pressurized air to ensure that condensation cannot form in the waveguide. Also the higher the pressure that can be maintained in the waveguide; the higher the power handling is in the waveguide system. Most commonly available air dehydrators are capable of providing pressures of 0.5 to 7.0 psig (25-362 mmHg).

At low power levels (uniform field distribution), low pressure can give good results. For non-uniform conditions, highly localized breakdown can occur. In this case the waveguide system will require much higher pressure. This occurs with bends, waveguide flange joints. If line currents flow across a small gap introduced by poor tolerances, flange mismatch, poorly soldered bends, field strengths in excess of that in the main line can occur in the gap. Pressurization with air or high dielectric gases can increase the power handling by factors of 10 to 100.

In High Power Amplifier systems an arc will travel from where it is ignited back to the amplifier. Typical arc travel speed is on the order of 20 ft/sec. Increasing the waveguide pressure can reduce the speed of arc travel. It is difficult to get an accurate calculation of the amount of pressurization needed, but it is a good practice to get as much pressure as your system can handle. All high power systems that meet the criteria of **Table 1** are pressure tested at the factory to 1.5 psig.

⚠ **Important! As a guide we recommend using the power levels in Table 1 as the threshold levels where special attention be given to dehydration and the overall simplification of waveguide system design.**

Table 1: Recommended Output Power Thresholds

Satcom Band	Frequency Range	Amplifier Output Power	Waveguide
S Band	1.7-2.6 GHz	> 10 kW	WR430
C-Band	5.7 - 6.7 GHz	> 2 kW	WR137
X-Band	7.9-8.4 GHz	> 1kW	WR112
Ku-Band	13.75-14.5 GHz	> 500W	WR75
Ka-Band	27-31 GHz	> 100W	WR28

It is a common misconception to look up the maximum theoretical power handling of a particular type of waveguide and assume that this is the maximum power handling. This may be the case for a straight waveguide tube with ideal terminations but these values must be significantly de-rated in practical systems. Phase combined amplifier systems can be particularly sensitive to the potential for waveguide arcing. This is due to the numerous bends, magic tees, multiple waveguide flange joints, and other waveguide components. **Table 2** shows the power handling capability of some popular waveguide components normalized to the waveguide power rating. From this table, we can see how a practical waveguide system's power handling will de-rate significantly.

Table 2: De-rating of W/G Components Relative to Straight W/G

Waveguide Component	Relative Power Rating
H Plane Bend	0.6 to 0.9
E Plane Bend	0.97
90-Degree Twist	0.8 to 0.9
Magic Tee	0.80
E-Plane Tee	0.06
H-Plane Tee	0.80

Cross Guide Coupler	0.21

Most waveguide systems have many of these components integrated before reaching the antenna feed. It is not uncommon for a Satcom waveguide network to de-rate to 5% of the straight waveguide power rating.

The load VSWR also has an impact on the breakdown threshold in waveguide networks. Standing waves degrade the power handling of any transmission line network. The graph of **Figure 4** shows the rapid degradation of waveguide breakdown vs. load VSWR. The chart shows that for a 2.0:1 load VSWR, the breakdown potential will be half of what it would be with a perfectly matched load. This can degrade even more when high Q elements such as band pass filters are included in the waveguide network.
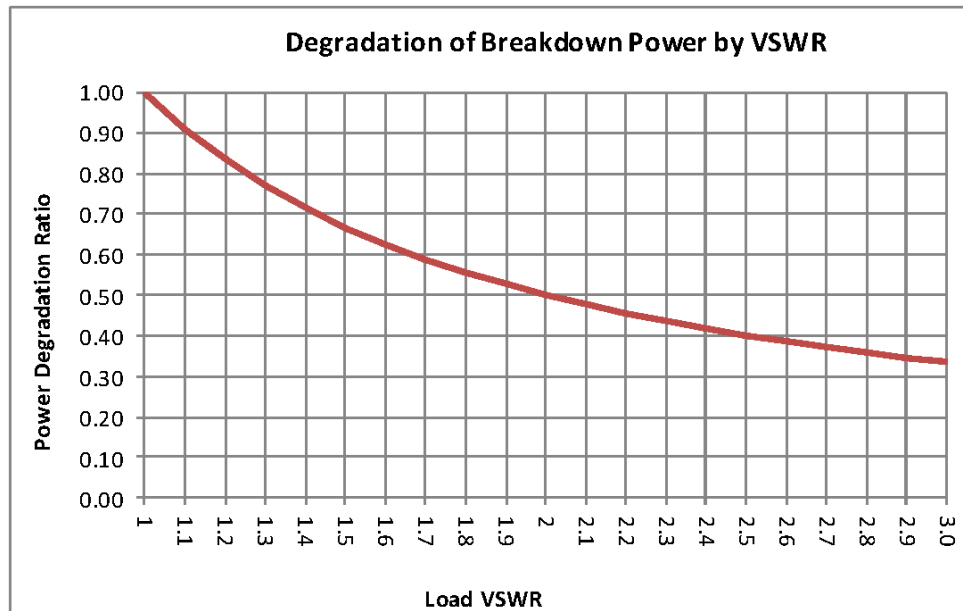

Figure 1: Degradation of Breakdown Power by VSWR

There are many factors to consider with high power amplifier systems in terms of the output waveguide network. Especially when using HPA systems with output power levels of **Table 2**, it is imperative to ensure that the output waveguide network is pristinely clean and dry. An appropriate dehydrator should be used with capability of achieving adequate pressure for the system's output power. Take extra precaution to make sure that any waveguide flange joints that are not already in place at the factory are properly cleaned, gasket fitted, and aligned. A properly designed and maintained waveguide network will ensure that no arcing can be supported and will provide many years of amplifier service life.

Unit Description, High Power Outdoor SSPA

Introduction

This section contains operating information including a description of the Teledyne Paradise Datacom H-Series High Power Outdoor SSPA, its connectors and their functions.

Description of Unit

Figure 1 shows an outline drawing of a typical H-Series High Power Outdoor SSPA. The unit enclosure has overall dimensions of 27.5 inches (698.5 mm) by 16.5 inches (419.1 mm) by 9.335 inches (237.1 mm).
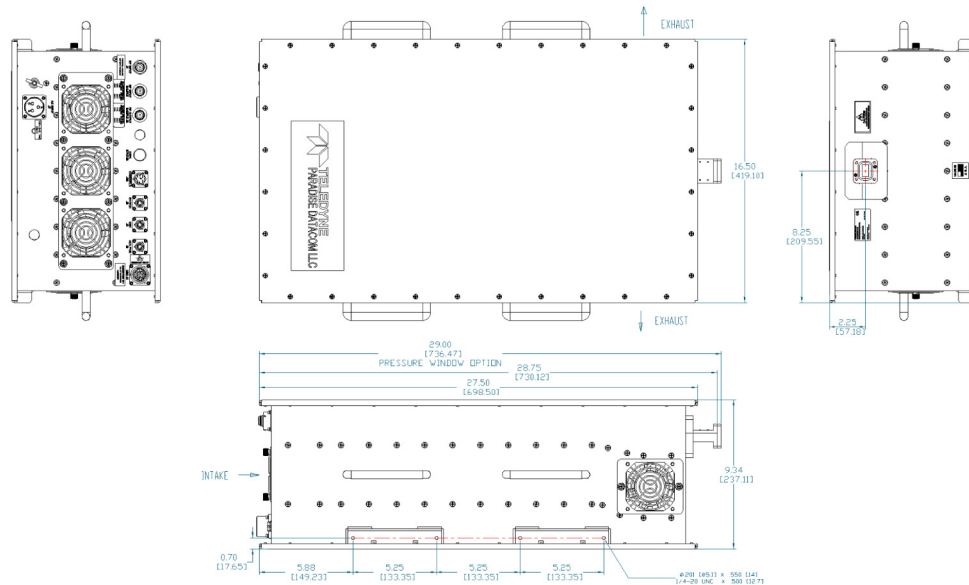
Figure 1: Outline Drawing, Ku-Band High Power Outdoor SSPA

The enclosure is sealed to prevent water and debris intrusion, and has an ingress protection rating of IP54. A series of fans provides circulation of ambient air through the enclosure to cool the internal RF module.

A status indicator is located above the intake fan panel. When the unit is operating normally, the status indicator illuminates green. If the unit enters a fault condition, the status indicator illuminates red. Fault conditions may be monitored remotely through the Monitor & Control connector (Port J4).

Installation of Unit

When installing the H-Series High Power Outdoor SSPA, consider the following:

- There should be at least 8" clearance between the intake fans and any surface, and 8" clearance from the SSPA's exhaust fans.
- The SSPA should never be enclosed in such a manner that restricts airflow.
- Regular inspection and cleaning of the fans and heatsink is required.
- Normal operating range of the SSPA is -40 to +60 °C.
- The unit will start up in a muted state. To unmute the amplifier, pins V and B of Port J4 need to be shorted.

A series of mounting holes are located along the sides of the unit that include the lifting handles, and on the sides of the unit that include the intake and exhaust fans. If utilizing the mounting holes on the sides that include the fans, ensure the mounting brackets do not interfere with the air circulation into and out of the unit.

⚠ **Warning! The SSPA should never be mounted in such a way that the intake fans face up. Doing so will void the warranty.**

The H-Series High Power Outdoor SSPA weighs between 100 and 140 lbs. (45.5 - 63.6 kg), depending on the power level of the unit. If mounting the unit to a boom or king post, ensure the mounting brackets and surface are capable of supporting the weight of the unit. At least two persons are required to lift the unit into position for mounting purposes.

Instructions on assembling a mounting frame for a redundant system are detailed in a separate installation manual, drawing number 215534.

Connectors

Figure 2 and Figure 3 show the connectors available on the unit.
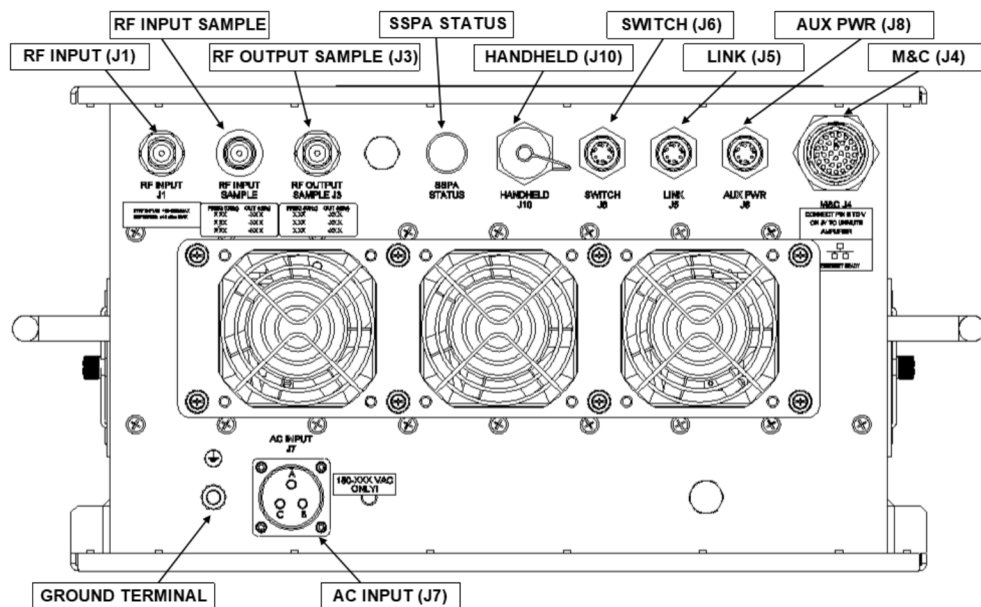
Figure 2: Outline Drawing, I/O Panel and Exhaust Fans
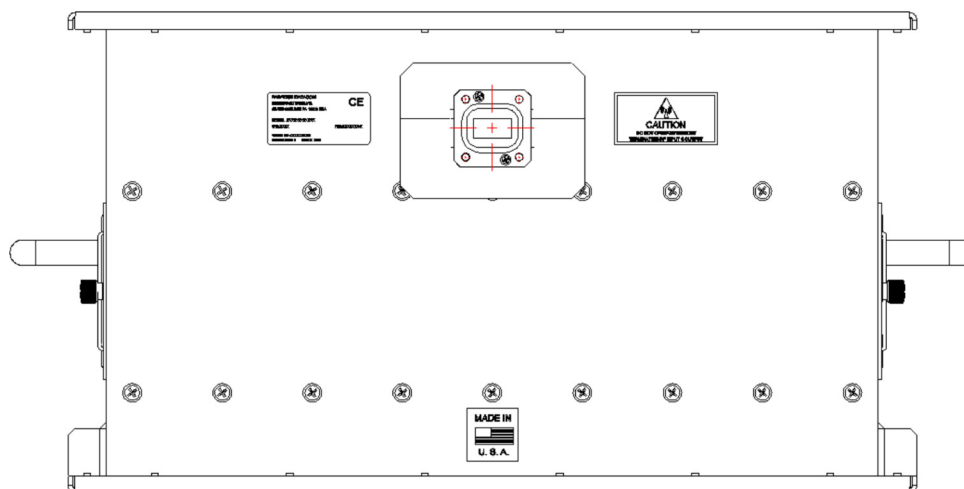
Figure 3: Outline Drawing, RF Output

RF Input Port (J1) [Type N (F)]

The Type N (F) connector shown at the top left of Figure 2-2 is the RF Input connector. The High Power Outdoor SSPA has a default maximum nominal gain of 75 dB minimum. Therefore the maximum input signal required to saturate the amplifier can be calculated as:

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Input Power = Psat - 75 dB
```

For example, a 250 W Ku-Band High Power Outdoor amplifier has a Psat of 54.0 dBm. Therefore the maximum input power should be limited to -21 dBm. Slightly higher input power levels will not damage the amplifier but will result in greater distortion in the output signal.

⚠ **Warning! Maximum RF input that should be introduced at this connector is +15 dBm.**

An optional L-Band input is available for units with an internal block up converter.

RF Output (J2)

The RF Output shown in Figure 3 is a WR-75 waveguide flange with 0.206" diameter through holes, used with Ku-Band amplifiers. C-Band amplifiers utilize a CPRG-137 waveguide flange with 0.206" diameter through holes. X-Band SSPAs use CPRG-112 waveguide flanges with 0.206" diameter through holes. S-Band amplifiers have Type N (F) connectors.

Warning! RF Hazards apply when power is applied to the unit. Do not operate the unit without having a termination or mating connection on the RF Output Port. Do not look directly into the RF Output waveguide.

RF Output Sample Port (J3) [Type N (F)]

The Type N (F) connector at port J3 is the RF Output Sample port, and provides a coupled sample of the RF output signal. A calibration label is affixed next to this connector.

M&C Connector (J4) [MS3112E18-32S]

The Monitor and Control connector at Port J4 is a 32-pin MS-type circular connector. The pin-outs for this connector are shown in Table 1.

See the SSPA Operational Basics section for details on special functions available on Port J4.

Table 1: M&C Port (J4) Pin-Outs

Signal	Type	Function	Pin	Notes
Mute Input	Closure to Ground	Disables DC Power to HPA	B	Unit powers up muted; This line must be pulled to ground (V) to enable amplifier
Auxiliary Input	Closure to Ground	Auxiliary Input	P	
Summary Alarm	Form C Relay	Closed on Fault	L	L-a : normally open
Summary Alarm	Form C Relay	Common	a	
Summary Alarm	Form C Relay	Open on Fault	b	a-b : normally closed
Auxiliary Alarm	Form C Relay	Closed on Fault	N	N-Z : normally open
Auxiliary Alarm	Form C Relay	Common	Z	
Auxiliary Alarm	Form C Relay	Open on Fault	M	Z-M : normally closed
Low RF Fault Output	Open Collector	High on Fault	G	Requires external pull-up
10 Base-T TX-			W	See the Remote Control Protocol Section
10 Base-T RX-			H	
10 Base-T RX+			J	
10 Base-T TX+			X	
Spare Input	Analog Input		S	+5V max.
Fan Fault	Analog Output	Fan Alarm	R	
Gain Adjust Input	Analog Input	Adjust amplifier gain over 20 dB range	A	2.5 VDC = Max Gain 75 dB; 0.5 VDC = Min Gain 55 dB
Block Up Converter Alarm	Open Collector	High on Fault	f	Requires external pull-up
RS-232/RS-485 Select	Closure to Ground	Selects Serial Communication	D	Default is RS-485; pull to ground (d) to enable RS-232
RS-485 TX- or RS-232 OUT	Serial TX Output	Serial Link Data Port	E	See the Remote Control Protocol Section
RS-485 RX- or RS-232 IN	Serial RX Input	Serial Link Data Port	F	See the Remote Control Protocol Section

RS-485 TX +	Serial TX Output	Serial Link Data Port	T	See the Remote Control Protocol Section
RS-485 RX+	Serial RX Input	Serial Link Data Port	U	See the Remote Control Protocol Section
Ground	Signal Ground	Common Signal Return	V	Chassis Ground
Ground	Signal Ground	Isolated Common Ground	d	Ground for Signals D, E & F
Baud Select 0	Closure to Ground	Select Baud Rate and Protocol	j	See Operational Basics Section, Table 1
Baud Select 1	Closure to Ground	Select Baud Rate and Protocol	e	See Operational Basics Section, Table 1
PGM Switch		Flash Firmware Port	g	Reserved for Programming
PGM CLK		Flash Firmware Port	c	Reserved for Programming
PGM-Sout		Flash Firmware Port	K	Reserved for Programming
PGM-Sin		Flash Firmware Port	Y	Reserved for Programming
PGM +5V		Flash Firmware Port	h	Reserved for Programming
PGM Enable		Flash Firmware Port	C	Reserved for Programming

The M&C connector contains a series of contact closures for monitoring amplifier faults as well as TVS protected inputs for controlling some amplifier functions. Inputs react on the closure to ground. Minimum closure time is 50mS. It requires a mating connector, MS3116F18-32P, which is supplied with the unit.

⚠ **Note: The RF output of the internal amplifier module is disabled until the Mute Input (J4 - Pin B) is pulled to Ground (J4 - Pin V).**

⚠ **Note: Different manufacturers of the MS3116F18-32P circular connector use different labeling conventions, and pin "j" may appear to be pin "l". This manual uses the convention of pin "j".**

Link Port (J5) [MS3112E10-6S]

The interface connector is used to connect two amplifiers when used in a 1:1 redundant system. It is a 6 pin circular connector, MS3112E10-6S. It requires a mating connector, MS3116F10-6P. A link cable is provided with a 1:1 Redundancy Kit, which can be purchased separately. See Table 2.

Table 2: Link Port (J5) Pin-Outs

Pin # on J5	Connection
A	LINK OUT
B	LINK IN
C, D, E	NO CONNECTION
F	GND

Switch Port (J6) [MS3112E10-6S]

When used in a 1:1 redundant system, the waveguide switch must be connected to the switch port of each amplifier (MS3112E10-6S). See Table 3. It mates with MS3116F10-6P.

Table 3: Switch Port (J6) Pin-Outs

Pin # on J6	Connection
A, B, D	NO CONNECTION

C	+28 VDC
E	POS 2
F	POS 1

AC Input Connector (J7) [MS3102E20-19P]

The prime power connector at Port J7 is a 3-pin MS-type connector, and provides universal AC input by using auto-sensing power supplies. The AC input can operate over a range of 180-265 VAC, at 47 to 63 Hz. See the product datasheet for power requirements for your model. The power supply is also power factor corrected, enabling the unit to achieve a power factor greater than 0.9. The pin-outs for this connector are shown in Table 4.

Table 4: AC Line Input Connector (J7) Pin-Outs

Pin # on J7	Connection
A	L1
B	GND
C	L2/N

⚠ **Warning! Always terminate the RF input and output connectors prior to applying prime AC input power!**

Leakage current may exceed 3.5 mA. A connection to earth ground must be made prior to connecting AC mains. Likewise, when removing AC mains, keep earth ground connected.

For the connection to earth ground, use a 12 AWG cable, UL rated for outdoor use. Connect to the chassis ground stud using the supplied hardware. Tighten all hardware securely with a wrench.

2.3.7.1 Power Cable Construction

Construct a power cable using the supplied MS3106F20-19S mating connector for J7. Use a three-conductor, 25A, 12 AWG cable, UL rated for outdoor use. When constructing the cable, discard the connector grommet, but keep the plastic ferrule. Connect the black conductor to terminal A (L1) of the connector, the white conductor to terminal C (L2/N) of the connector, and the green (protective earth ground) connector to terminal B (GND) of the connector. Tighten the metal end-bell and fill with potting compound.

⚠ **Warning! The protective earth pin B must be connected to AC mains earth for both safety and EMC regulation compliance.**

⚠ **Note: For safety purposes, an isolation switch may be included in the power cable to serve as a disconnect device in the event of an emergency or for unit servicing. The amplifier itself has no on/off switch. When AC power is applied to the unit, the unit's power supplies and microcontroller are enabled. The internal amplifier module is disabled until the Mute Line Input (J4, Pin B) is pulled to Ground (J4, Pin V).**

AUX PWR Port (J8) [MS3112E10-6S]

The 6-socket MS-type female connector at this port is capable of supplying auxiliary power. This port is intended for use with factory-configured systems. Consult with the factory prior to making any connection to this port. Table 2-5 shows the pin outs for the AUX PWR Port (J8).

Table 5: +15 VDC Output Port (J8) Pin-Outs

Pin # on J7	Connection
A	External Fault In
B	Fault Pull-up
C	+15V LNA

D	Ground
E	+15V External
F	Ground

Handheld Connector (J10) [MS3112E12-8S]

This port is used to connect to a RCH-1000 Universal Handheld Controller. The controller is shipped with a Communication Cable (L212640-2) which connects between the J10 connector of the amplifier and the eight-pin UltraLock connector of the RCH-1000. Table 6 shows the connector pin-outs for the Handheld Connector (J10). See drawing number 211668 for operation instructions for the RCH-1000 Universal Handheld Controller.

Table 6: +15 VDC Output Port (J8) Pin-Outs

Pin # on J7	Connection
A	RS-485 -
B	RS-485 +
C	+15 VDC
D	No Connection
E	Enable
F	Ground
G	No Connection
H	No Connection

Chassis Ground Terminal

A chassis ground terminal is provided on the intake fan side of the amplifier. A 1/4-20 threaded terminal is provided for equipment grounding.

RF Input Sample Port (optional) [Type N (F)]

This is a Type N (F) connector which provides a coupled sample of the RF Input. A calibration label is affixed to the enclosure next to this connector.

Physical Features

In addition to the I/O connectors, the H-Series High Power Outdoor SSPA features include a summary alarm indicator and removable fan trays.

Summary Alarm Indicator

A summary alarm indicator LED is located on the input side of the amplifier. When the SSPA is operating, this indicator illuminates GREEN. When in a fault condition, it illuminates RED. When an external mute signal is detected, the indicator will blink GREEN if operating, or RED if the amplifier is in a fault condition. X-Band units do not include this indicator.

Airflow and Removable Fan Trays

The H-Series High Power Outdoor amplifier's cooling system represents a landmark in microwave telecommunication amplifiers. It features a unique system of heatsinks that have been computer optimized to provide extremely efficient cooling of all of the system's functional blocks. The cooling system is based on a forced convection technique in which a series of fans provide the air intake and exhaust.

A minimum clearance of 8 inches (203 mm) should be maintained between each fan tray and any mounting surface. This will ensure that there is no forced re-circulation of airflow from exhaust to intake.

The fans should be examined periodically and any obstruction or debris should be cleared. Inadequate air flow can cause the amplifier to overheat and cause a temperature fault. See the Maintenance and Troubleshooting section for instructions on how to clean the fan trays and heatsink. In system configurations, ensure that each unit in the system has sufficient ambient airflow, and adequate space to maintain the fans for each unit.

Spare fan assemblies are available from Teledyne Paradise Datacom. The intake fan assembly is part number L213271-1. The exhaust fan assembly is part number L213272-1, and there are two of these per amplifier.

Waveguide Pressure Window (option)

Ku-Band units may be ordered with an optional waveguide pressure window at the RF Output (J2). This option is necessary for installations where the amplifier is connected to a pressurized transmission line (up to 15 PSI). All systems include a pressure window.

Outdoor SSPAs, Quick-Start

Teledyne Paradise Datacom
Drawing Number: 216595-2 Revision -
RA 7714
06 November 2019

Introduction

Teledyne Paradise Datacom Outdoor SSPAs are available with a standard Ethernet & RS-232/RS-485 interface. This section summarizes the connections to a remote computer for various remote communications.

See the appropriate description of the Compact Outdoor or High Power Outdoor connections to Port J4.

Quick-Start Cables

For convenience all amplifiers ship with a 'Quick-Start' communications cable. This allows the user to immediately connect the amplifier to a PC and begin operation. Ethernet ready units ship with a Quick-Start cable fitted with a 10-base T connector as shown in Figure 1.
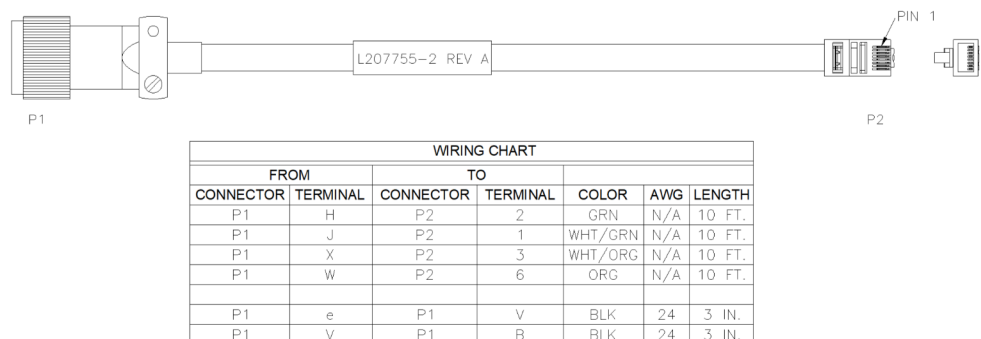

WIRING CHART						
FROM		TO				
CONNECTOR	TERMINAL	CONNECTOR	TERMINAL	COLOR	AWG	LENGTH
P1	H	P2	2	GRN	N/A	10 FT.
P1	J	P2	1	WHT/GRN	N/A	10 FT.
P1	X	P2	3	WHT/ORG	N/A	10 FT.
P1	W	P2	6	ORG	N/A	10 FT.
P1	e	P1	V	BLK	24	3 IN.
P1	V	P1	B	BLK	24	3 IN.

Figure 1: Quick-Start Cable, Ethernet (207755)

Customers may request a Quick-Start cable configured for RS-232 communications and fitted with 9-pin D-sub connector as shown in Figure 2.
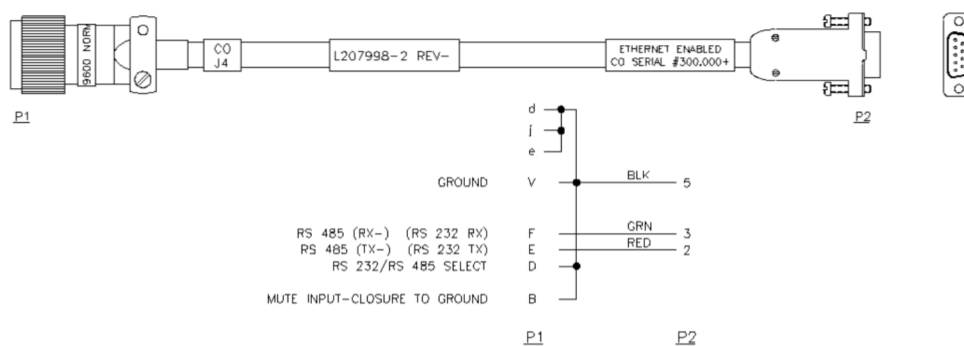

Figure 2: Quick-Start Cable, RS-232 (207998)

Quick-Start Connections

This section describes the necessary steps to communicate with an amplifier using either the Ethernet or RS-232 Quick-Start cables and the Teledyne Paradise Datacom Universal M&C Software. The Universal M&C Software is a free Windows-based application that can be downloaded from the company web site, www.paradisedata.com.

⚠ **Note: The amplifier has no on/off switch or circuit breaker in the AC Input path. As soon as AC power is applied, the unit's power supplies and microcontroller are enabled. However, the RF output of the internal amplifier module is disabled until the Mute Line Input (J4 - Pin B) is pulled to Ground (J4 - Pin V). Both the Ethernet Quick-Start and RS-232 Quick-Start cables provide this connection.**

Set PC Configuration

To set your Windows-based PC to remotely communicate with the amplifier, perform the following steps:

If using Windows XP:

1. Open the PC's Control Panel (Start Menu > Settings > Control Panel);
2. Double-click on the Network Connections icon;
3. Right-click on the Local Area Connection icon and select Properties;
4. Select Internet Protocol (TCP/IP) and click on the Properties button;
5. Select "Use the following IP address" and enter the following information:
..... IP address: 192.168.0.1
..... Subnet mask: 255.255.255.0
6. Click the "OK" button and close out of the Control Panel windows.

If using Windows 7 or beyond:

1. Click on the Windows icon in the lower left corner and select Control Panel;
2. Click on the Network and Sharing Center link;
3. Click on the Local Area Connection link;
4. Click on the Properties button;
5. Select Internet Protocol Version 4 (TCP/IP v4) and click on the Properties button;
6. Select "Use the following IP address" and enter the following information:
..... IP address: 192.168.0.1
..... Subnet mask: 255.255.255.0
7. Click the "OK" button and close out of all of the Control Panel windows.

Quick-Start Ethernet Connection

The following steps outline how to quickly connect to the amplifier using the Ethernet Quick-Start cable.

1. Unpack the amplifier and connect the RF Input and RF Output.
2. Ensure the J1 RF Output port is properly terminated.
3. Connect the chassis ground and provide AC input power to connector J7.
4. When shipped from the factory, the amplifier is set to start up muted.
5. Connect the supplied Quick-Start Control Cable from Port J4 to the Ethernet port on your computer. This connection will unmute the amplifier. Review the cable schematic in Figure 1.
6. Launch the Windows-based Teledyne Paradise Datacom Universal M&C Software.

> ⚠ **IMPORTANT! If the unit is powered up with the Ethernet Quick Start Cable connected to Port J4, the following default conditions apply to the unit:**
>
> • **IPNET Interface**
> • **Gateway: 192.168.0.1**
> • **IP Address: 192.168.0.9**
> • **Subnet Mask: 255.255.255.0**
> • **Local Port: 1007**
> • **IP Lock: 255.255.255.255**
> • **Web password: paradise**
> • **Read Community: public**
> • **Write Community: private**
> • **Amplifier is unmuted**

Quick-Start RS-232 Connection

The following steps outline how to quickly connect to the amplifier using the RS-232 Quick Start cable.

1. Unpack the amplifier and connect the RF Input and RF Output.
2. Ensure the J1 RF Output port is properly terminated.
3. Connect the chassis ground and provide AC input power to connector J7.
4. When shipped from the factory, the amplifier is set to start up muted.
5. Connect the supplied Quick-Start Control Cable from Port J4 of the SSPA to one of the COM ports on your computer. This connection will unmute the amplifier. Review the cable schematic in Figure 2.
6. Launch the Windows-based Teledyne Paradise Datacom Universal M&C Software.

> ⚠ **IMPORTANT! If the unit is powered up with the RS-232 Quick Start Cable connected to Port J4, the following default conditions apply to the unit:**
>
> • **Normal Protocol**
> • **RS-232 Communication**
> • **Baud rate: 9600**
> • **Amplifier is unmuted**

Communication Links using RS-232 are typically good up to 30 ft. (9 m) in length. Installations exceeding this length can use the RS-485 mode which will allow serial control up to 4000 ft. (1200 m).

Setting Custom IP Address

The following steps show how to set custom IP settings to the amplifier. This procedure assumes the user has downloaded and installed the Teledyne Paradise Datacom Universal M&C application.

1. Remove power to the unit.
2. Connect the Quick-Start cable (207755) between Port J4 of the unit and the RJ45 Ethernet port on your computer.
3. Ensure the J1 RF Output port is properly terminated.
4. Connect the chassis ground and provide AC input power to connector J7.
5. The amplifier will power up with the default IP settings.
6. Launch the Universal M&C application.
7. Connect to the unit as described above.
8. Navigate to the Settings tab.
9. Set the Protocol to IPNet. With the Quick-Start cable attached, the setting will show that it is set already set to IPNet. You will need to re-select IPNet.
10. Navigate to the IP Setup tab.
11. Modify the IP settings (IP Address, Gateway Address, Subnet Mask, Local Port, IP Lock Address) to those that will work within your network.
12. Click on the "Change IP Settings" button.
13. Remove the Quick-Start cable.
14. Cycle power to the unit.
15. Reconnect the Quick-Start cable or other cable to Port J4 of the unit.

⚠ **IMPORTANT! If the Quick Start cable is attached to Port J4 of the unit before power is applied, the unit will always start up with the default IP settings. Teledyne Paradise Datacom recommends that the operator build a custom cable that leaves Port J4 pins "j" and "e" unpopulated. This custom cable will prevent the default settings from being used if the unit experiences an unexpected power cycle.**

Universal M&C Operation

Teledyne Paradise Datacom provides a free version of its Universal Monitor and Control (M&C) Software available for download from its web site. Install the software on a PC running Windows 7 or later.

Navigate to the Support > Downloads page and click on the latest version of the sofware to download the zip file.

Unzip the package and run the setup.exe file. This launches the Universal M&C Software installer. Follow the prompts and agree to the license agreement to install the application. When complete, close the installer.

See the Universal M&C Instruction section for directions on how to use the Universal M&C software with your unit.

Web-based M&C

The most basic method of communication with the outdoor unit is via a web browser, which accesses the built-in web pages served from the amplifier's embedded web server. Starting with firmware version 6.40, the application no longer requires Java.

The web interfaces uses a standard hypertext transfer protocol on port 80. The web interface is compatible with most modern web browsers, such as Firefox, Chrome or Internet Explorer, which support asynchronous JavaScript XML transactions (aka AJAX).

Once the host PC has been configured and connected to the amplifier using the Quick Start cable, the user may open a web browser page, select File > Open, and enter the IP address of the networked amplifier into the browser's address field. The default IP address is 192.168.0.9. See Figure 3.
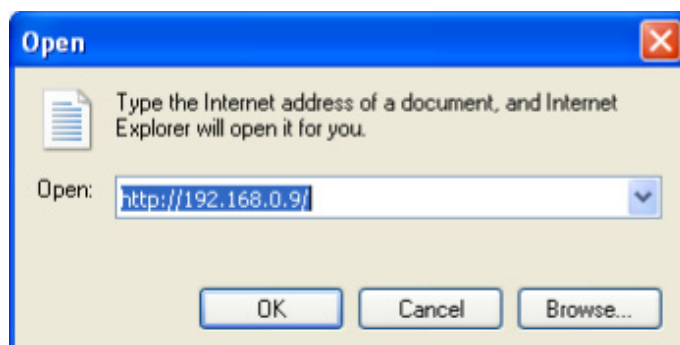
Figure 3: Enter IP Address for Amplifier (Default is 192.168.0.9)

A security login window will appear. Enter the default username (admin) in the User Name field. See Figure 4.
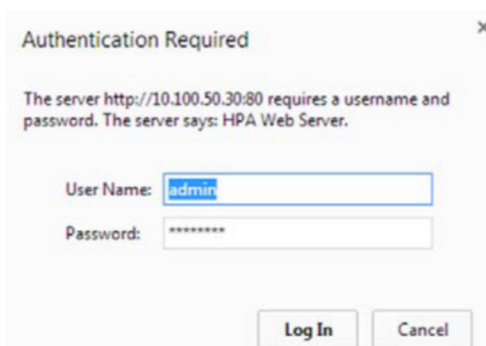

Figure 4: Web Interface Login Window

The User Name is fixed and cannot be changed by the operator. In the Password field, enter the web password assigned to the unit. The factory default password is **paradise**. The User Name and Password are case sensitive. The password may be changed at any time and may comprise up to 15 alpha-numeric characters. If you forget the web password you will need to connect to SSPA via Universal M&C to verify it.

Click on the [Log In] button to open the M&C control in the web browser.

Navigating the Web M&C

The Web M&C application contains several tabs which display various information about the connected amplifier:

- Status tab: A Read-Only view of critical device operation conditions (voltages, current consumption, attenuation) and fault alarm statuses.
- Communication Settings tab: Read/Write listings of communication related parameters, including: IP, SNMP, Web settings as well as serial port settings.
- General Settings tab: Read/Write listings of all redundancy and amplifier specific settings.
- Fault Settings tab: Read/Write listing of fault operation related settings;

> ⚠ **Note: While the image of a Compact Outdoor SSPA is shown in the Web M&C windows, the software is valid for use with both the Compact Outdoor and High Power Outdoor amplifiers.**

Status Tab

Upon opening, the browser window displays the Status tab, which shows the major conditions and faults affecting the connected amplifier. See Figure 5.
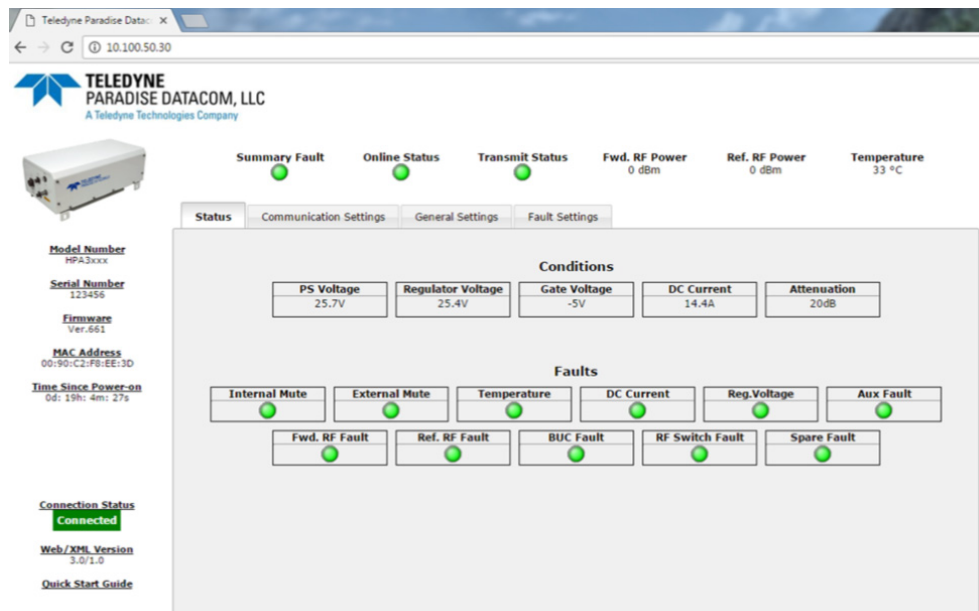

Figure 5: Status and Faults Window

Fault indicators are either colored green when no fault condition exists, or red when a fault condition exists.

The top bar of SSPA Monitor and Control application shows whether the connected unit is exhibiting a summary fault, and also displays the device's online status, transmit status, Forward and Reflected RF power (if available) and RF module core temperature. This information is displayed regardless of which tab is selected.

The left side of the window displays unit model and serial number, firmware build, device MAC address and device up time since last I/O card power up or reboot. The connection status is also displayed, along with the Web/XML version, and a link to the quick-start guide. This information is displayed regardless of which tab is selected.
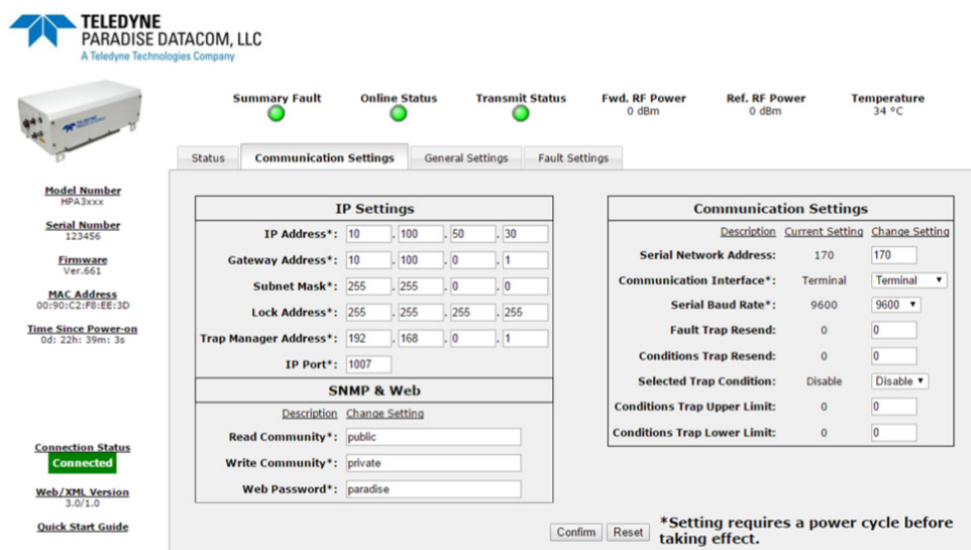
Communications Settings Tab

Figure 6: Communication Settings Window

The Communication Settings window, shown in Figure 6, displays the current values of the following parameters:

- IP Settings (IP Address, Gateway Address, Subnet Mask, Lock Address, Trap Manager Address and IP Port)
- SNMP Read/Write Communities and Web Password
- Serial Network Address
- Communication Interface Type
- Baud Rate
- SNMP Trap Conditions

⚠️ **Note: Changes to certain settings (marked with an asterisk in Figure 6) require a power cycle of the unit before the new setting will take effect.**

General Settings Tab

Figure 7: General Settings Window

The General Settings window, as shown in Figure 7, displays the Amplifier and Redundancy Settings. Amplifier Settings include: Gain Control; Attenuation Level adjustment (in dB); Automatic Level Control (ALC) RF Level (in dBm); Mute Setting (Mute clear or Mute set); and Fan Speed selection (High, Low or Auto).

⚠️ **Note: The High Power Outdoor SSPA initially starts up in the Muted state; Change the Mute Setting in the General Settings tab to enable Transmit RF.**

Redundancy Settings include: Operation Mode (Standalone, 1:1 Redundant, Dual 1:1, or Maintenance Switch); Hierarchical Address (HPA1 or HPA2); Standby Select (Online or Standby); Standby Mode (Hot Standby or Cold Standby); and Switch Mute (Switch Mute On or Switch Mute Off).

⚠️ **Note: The Standby Select setting allows the operator to select whether the unit should start up as the online amplifier or the standby amplifier. When in a redundant system configuration, if the Standby Select setting is changed from the Online state to the Standby state, the system will drive the switch so that another amplifier in the system is in the Online state. Only the Online amplifier can give away its Online state. This setting is saved upon unit shut-down, and the unit will start up in the last saved state.**

⚠️ **Note: When multiple High Power Outdoor SSPAs of certain high RF power levels are set up in a redundant configuration, the Switch Mute setting should be turned on. See Section 8.1.2.2.**

Fault Settings Tab

Figure 8: Fault Settings Window

The Fault Settings window, as shown in Figure 8, allows the user to adjust the fault settings for the connected amplifier.

In the box at left, use the pull-down menus to select the desired Fault Type, Handling, or Logic parameters. Enter new values for the Forward or Reflected RF Fault Levels.

In the box at right, use the pull-down menus to select the desired Auxiliary Fault Type and Logic and the desired BUC Fault Type and Logic.

Click the [Confirm] button to save the fault settings, or the [Reset] button to rever to the previously saved settings.

⚠ **Warning! Take care when setting the Fwd.RF Flt Level or Ref.RF Flt Level values. If the values are set within the normal operating levels for your amplifier, unnecessary fault conditions may be triggered.**

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Outdoor SSPAs, Operational Basics

Introduction

The Teledyne Paradise Datacom outdoor amplifier is available with a standard RS-232/RS-485 serial communications interface or an optional Ethernet & RS-232/RS-485 interface. This section summarizes the connections to a remote computer for various remote communications.

Remote Communication Connections

Ethernet ready outdoor units can be identified by either serial number or label. Units with serial numbers greater than 300,000 are Ethernet ready. Also Ethernet ready units have the following label affixed adjacent to the M&C connector, J4.
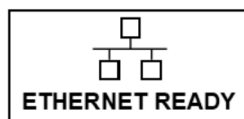
Figure 1: Ethernet Ready Label

Ethernet ready units can be configured for either RS-232, RS-485, or Ethernet communications. The units cannot be used with multiple communication protocols simultaneously. The user must select one of the three formats. Non-Ethernet units can be configured for either RS-232 or RS-485 communications.

Figure 2 shows the proper configuration of J4 for Ethernet communication.
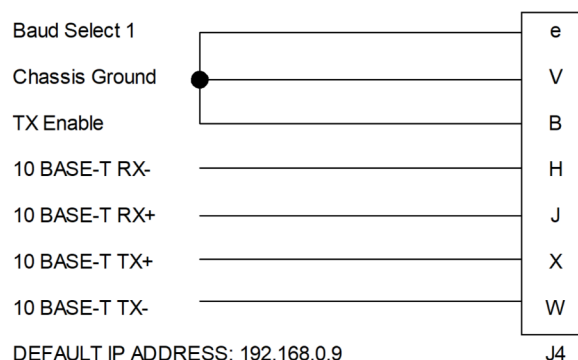
Figure 2: J4 Connections for Ethernet Communication

Figure 3 shows the proper configuration of J4 for communication over RS-485.
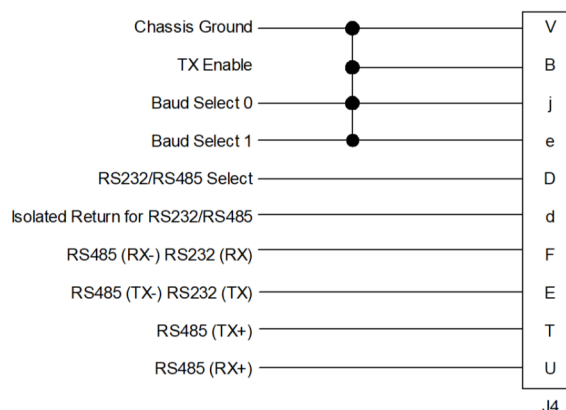
Figure 3: J4 Connections for RS-485 Communication

Figure 4 shows the proper configuration of J4 for communication over RS-232.
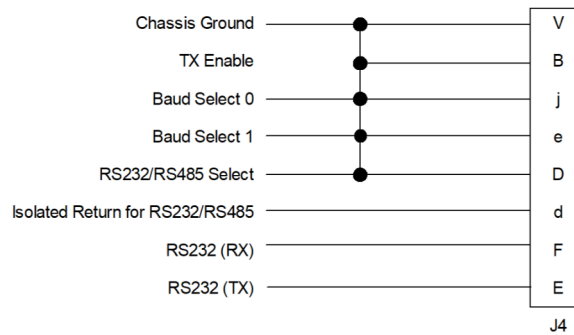
Figure 4: J4 Connections for RS-232 Communication

Legacy Compact Outdoor SSPAs

Compact Outdoor SSPAs with serial numbers of less than 300,000 did not include isolated grounds for RS-232/RS-485 serial communications. The remote communication connections are slightly different and outlined in Figures 5 and 6.

Figure 5 shows the proper configuration of J4 for communication over RS-485 for legacy units.
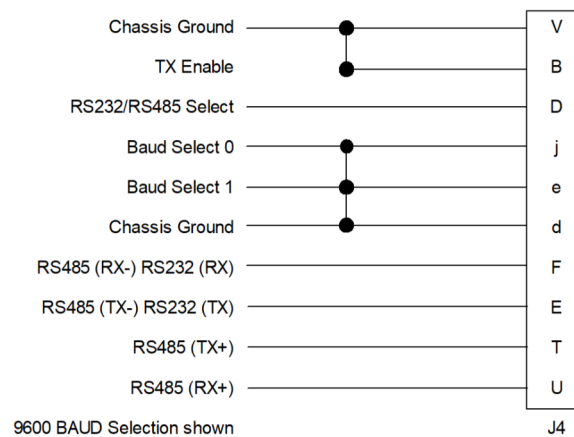
Figure 5: J4 Connections for RS-485 Communication for S/N < 300,000

Figure 6 shows the proper configuration of J4 for communication over RS-232 for legacy units.
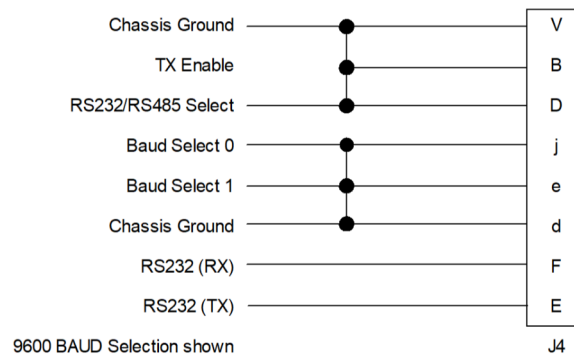
Figure 6: J4 Connections for RS-232 Communication for S/N < 300,000

Compact Outdoor SSPAs in Legacy Systems

The isolated return for RS-232/RS-485 systems that exists on Compact Outdoor SSPAs with serial numbers 300,000 and above will require an additional connection on J4 when used in systems that have Monitor and Control cables designed to be used with units with serial numbers < 300,000.

Figure 7 shows the required connection between the chassis ground and the isolated ground (pin V to pin d).

```
Chassis Ground ──────────●──────────  V
                         │
TX Enable ───────────────┘            B

RS232/RS485 Select ──────────────────  D

Baud Select 0 ───────────●──────────  j
                         │
Baud Select 1 ───────────●──────────  e
                         │
Isolated Return for RS232/RS485 ─●───  d

RS485 (RX-) RS232 (RX) ──────────────  F

RS485 (TX-) RS232 (TX) ──────────────  E

RS485 (TX+) ─────────────────────────  T

RS485 (RX+) ─────────────────────────  U

9600 BAUD Selection shown            J4
```

Figure 7: J4 Connections for RS-485 Communications for Compact Outdoor SSPAs of Serial Numbers > 300,000 in systems with M&C cables designed for Compact Outdoor SSPAs of Serial Numbers < 300,000

If it is not possible to modify the existing cable harness or otherwise externally connect the chassis ground Pin V to the isolated return at Pin d as shown in Figure 7, consult the factory for other options.

Port J4 Pin-outs

Refer to Table 1 in the Unit Description section for the pin-outs for Port J4.

Interface Control Pins, J4

The selected interface is controlled by a combination of internal SSPA settings and Interface control pins: Baud1 (Pin e) and Baud0 (Pin j) on the J4 M&C connector (See Table 1). The operator may modify the connections to these pins to have some control over t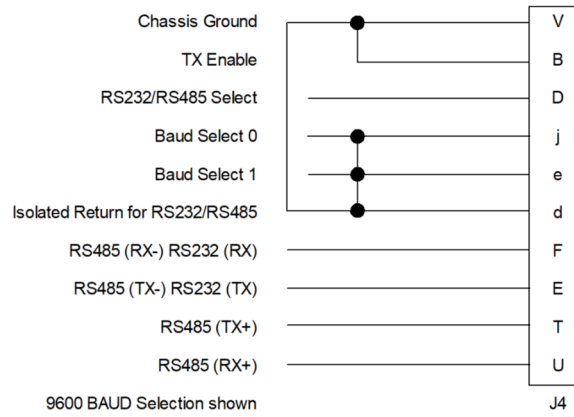he serial interface, bypassing EEPROM settings for Protocol, Baud Rate or Network Address. This feature becomes important if the operator accidentally selects the wrong protocol or baud rate of the SSPA and wants to revert the unit to a known state.

Table 1: Interface Selection (Serial Numbers < 400,000)

Baud0 (Pin j) State	Baud1 (Pin e) State	Selected Interface
Open	Open	Interface selected by Internal SSPA settings.
Closure to Chassis ground	Open	Interface is forced to Ethernet interface. IP address is software selectable. Protocol is forced to Normal (HTTP web supported).
Open	Closure to Chassis ground	Interface is forced to Ethernet interface. IP address is fixed to 192.168.0.9. Protocol is forced to Normal (HTTP web supported).
Closure to Chassis ground	Closure to Chassis ground	Interfaced is forced to 9600 Baud serial.

> ⚠ **Note: The state of these pins is sensed by the SSPA unit only at power up! Changing the state of these pins during normal unit operation will not affect the selected type of interface.**

Compact Outdoor units with the 4th generation of I/O cards allow the use of multiple concurrent interfaces. These units have serial numbers greater than 400,000 or firmware version 6.00 and above. By default, most available interfaces will be kept on and can be used simultaneously without any limiting factors. Legacy NDSat interface is disabled by default, but is still available as a specific selection.

For compatibility purposes, some legacy protocol selection is still available. Selecting SNMP protocol will disable IPNet operation and internal web page function; Selecting NDSat protocol will disable Normal serial protocol. Terminal mode protocol was re-introduced to the protocol stack with version 6.60. Selecting Terminal mode will disable Normal protocol operation over serial port. IPNet, web and SNMP interfaces will continue to operate normally. It is possible to use Baud Select pins j and e to force specific IP address and protocol. See Table 2.

Table 2: Interface Selection (Serial Numbers > 399,999)

Baud0 (Pin j) State	Baud1 (Pin e) State	Selected Interface
Open	Open	Interface, Baud Rate and IP Address are all selected by internal SSPA settings.
Closure to Chassis ground	Open	Interface, Baud Rate and IP Address are all selected by internal SSPA settings.
Open	Closure to Chassis ground	IPNet, Web, SNMP and Serial interfaces with Normal protocol will be enabled. IP Address is fixed to 192.168.0.9. Baud rate is selectable by internal SSPA settings.
Closure to Chassis ground	Closure to Chassis ground	IPNet, Web, SNMP and Serial interfaces with Normal protocol will be enabled. IP Address is fixed to 192.168.0.9. Baud rate is fixed to 9600.

Pins j and e on the J4 M&C connector have internal pull-ups and if left disconnected will remain in logic high state. The reverting function of the SSPA is active only on initial power-up. Any alterations to the pins' state after start-up will allow the SSPA to use internal EEPROM settings to select the baud rate and protocol.

Automatic Addressing

Pins j and e on the J4 M&C connector are also used for automatic addressing (for I/O board firmware levels of 3.50 or later).

To turn on automatic addressing:

1. Connect to the SSPA over serial interface;
2. Set the SSPA unique network address to 170 (Hex 0xAA);
3. Cycle the unit's power. The unit will start with default baud rate of 9600 and Standard String Protocol selection. Pins j and e now will determine the SSPA unique address (See Table 3).

Table 3: Unique Network Address Hardware Select

Jumper 1	Jumper 2	SSPA Unique Address
j-d	e-V	1
j-d	none	2
none	e-V	3
none	none	4

> ⚠ **Note: SSPA address in EEPROM must be set to 0xAA in order to activate the Unique Network Address Hardware Select option.**

Reverting Unit to Known Interface State

If it is ever necessary to revert the SSPA to a known interface state, follow the steps below:

1. Turn off the SSPA;
2. Establish wire jumpers to the M&C connector (J4) according to the desired protocol selection as shown in Table 1 or Table 2;
3. Turn on the SSPA and remove the jumpers;
4. Connect to the SSPA over serial protocol and use the Universal M&C application to select the desired settings for protocol and baud rate. Settings will take effect on the next SSPA power-up.

FSK interface allows the selection of Normal and VSAT protocols.

> ⚠ **Note: For proper FSK interface operation, the SSPA internal settings must be selected to 9600 Baud and Normal protocol. Do not make a connection to interface control pins Baud1 and Baud0!**

> ⚠ **Note: For maximum ESD protection of a SSPA's Serial interface internal circuit, the RS-232/RS-485 interface is isolated from the SSPA chassis ground. Serial interface has a separate interface ground pin (Pin d on the J4 connector). Connecting this pin to common ground will effectively disable the protection circuit and may cause interface failure.**

> ⚠ **All interface lines are equipped with transient suppression devices. Adding extra transient protection to communication lines is not required and may cause interface failure!**

Amplifier Enable (Mute/Unmute) (J4)

The outdoor unit has no on/off switch or circuit breaker in the AC Input path. As soon as AC power is applied to J7, the unit's power supplies and microcontroller are enabled. The operator will be able to observe the forced convection cooling fans running. However, the internal amplifier module is disabled until the Mute Line Input (J4, Pin B) is pulled to Ground (J4, Pin V).

If it is desired to have the RF enabled every time the AC input is applied, a permanent connection can be made from J4-Pin B and Pin V.

> ⚠ **RF Hazards apply! Never look into an open waveguide when the amplifier is operating!**

Gain Adjust Input (J4)

The outdoor unit is equipped with an internal attenuator, allowing up to 20.0 dB of attenuation to be applied to the RF signal path, with 0.1 dB accuracy. Typically it will allow user to set SSPA linear gain from maximum 75 dB to minimum 55 dB (refer to the product spec sheet for details).

The SSPA attenuator can be controlled by several methods:

1. Attenuation level controlled over remote interface (factory default mode);
2. Attenuation level set by analog voltage between pins A and V on the Port J4 M&C connector;
3. Attenuation level automatically controlled by ALC (Automatic Level Control) function;

The desired method of attenuation control mode must be set over remote interface.

Attenuation control over remote interface (Serial, IP, Web or SNMP) is the default method of controlling SSPA linear gain. In this method of control, the specific attenuation is selected using the Embedded Web page or Universal M&C GUI, or sent as a remote control command. The SSPA will retain the selected attenuation level in non-volatile internal memory until a new command or selection is issued by the user.

In analog voltage control mode, the user needs to apply positive voltage between (J4, Pin A) and Ground (J4, Pin V) from an external source. The applied voltage will be translated to the SSPA attenuation level and will determine the linear gain of SSPA unit as follows:

```
2.5 VDC = Maximum Gain: 75 dB (Attenuator set to 0 dB);
0.5 VDC = Minimum Gain: 55 dB (Attenuator set to 20 dB);
```

Voltage increments by 0.1V in a range between 0.5 to 2.5V will reduce the amount of attenuation by 0.1 dB steps. Voltages below and above this limit will be treated as lower and upper limits of adjustment range. Gain adjust input typically has 20 kOhm pull down to the signal ground. Hence, with no external voltage applied, the SSPA will default to minimum gain (55 dB).

Automatic Level Control

Teledyne Paradise Datacom introduced an Automatic Level Control (ALC) feature with firmware version 6.40. This feature controls the RF output of the amplifier based on a user assigned value.

Upon activation, the ALC function will take over control of the amplifier's internal attenuator and maintain the RF output level set point. The Forward RF alarm level is set automatically to the selected ALC output. The Forward RF alarm function will also be set to 15% Window mode. If the Forward RF alarm is not needed, it could be deactivated or set to a different level or function after ALC mode is set.

> ⚠ **Note: When Automatic Level Control is engaged, the user's ability to modify the amplifier's attenuation setting is disabled.**

The ALC circuit will have the greatest ability to adjust for positive and negative RF input level changes when the amplifier's gain level is typically at the midrange value of 65 dB (with the Internal attenuator set to 10 dB).

The ALC function has the ability to accurately control the RF output power over a 15 dB range from Psat, with an accuracy of 1 dB. ALC will operate over a 20 dB range, but the accuracy of the last 5 dB will suffer. For example, if the saturated power from the amplifier is 59 dBm, the lowest accurate power setting during ALC control is 44 dBm.

The ALC function in Compact Outdoor and High Power Outdoor SSPAs includes the capability of adjusting the ALC level without having to disable the ALC function.

> ⚠ **Note: When operating in N+1 mode, Automatic Level Control is disabled.**

Setting ALC Using Universal M&C Software

- Connect the unit to a PC running the Teledyne Paradise Datacom Universal M&C application (Universal M&C version 6.3 or later);
- Add the unit to the Universal M&C application;
- Make sure Gain Control is set to either External or Serial Port.
- Set unit attenuation to 10.0 dB (see Figure 8);

Figure 8: Set Gain Control to External or Serial Port and Attenuation to 10.0 dB

- Adjust the input signal to achieve the desired RF output and allow amplifier output to stabilize;

> ⚠ **Note: If the ALC level is set outside the amplifier's detectable forward RF range, the ALC Level will automatically reset to either the maximum or minimum value, depending on whether the setting was higher or lower than the detectable range.**

- Change the Gain Control setting to ALC Control (see Figure 9);

Figure 9: Change Gain Control Setting to ALC Control

Note that when ALC Control is initially set, the Forward RF Fault settings will change:

- Forward RF Fault Status setting will change to Fifteen Percent Window;
- Forward RF Fault Handling setting will change to Major Fault in Online Mode;
- Forward RF Fault Threshold setting will change to match the ALC Level setting to the nearest whole number. Note that this adjustment only occurs when first setting ALC Control. See below for the procedure to follow if changing the ALC Level during normal operation.

To change the ALC Level while the unit/system is operating:

- Change the Forward RF Fault Status setting to Disable (see Figure 10);
- Change the ALC Level to the new desired setting;
- Change the Forward RF Fault Threshold setting to the same value as the new ALC Level;
- Change the Forward RF Fault Status setting to Fifteen Percent Window;
- Make sure the Forward RF Fault Handling setting is set to Major Fault in Online Mode.

Figure 10: Disable Forward RF Fault Status

Alarms (J4)

A variety of alarm signals are present at the M&C connector, J4. Both Form-C relays and open collector outputs are available. An amplifier summary alarm is available in both Form C relay and open collector output. Detailed internal faults are available in open collector form and include: voltage, current, and over-temperature.

Summary Alarm (J4) Form C Contacts

The Summary Alarm is accessible in both Form C relay and open collector format. The form C relay is "energized" under normal operating conditions and "deenergized" when a fault condition exists.

Auxiliary Alarm (J4) Form C Contacts

The Auxiliary Alarm relay is an end user alarm that can be used to signal an alarm condition that is dependent on the state of the Auxiliary Input (J4, Pin P).

The Auxiliary Input is a contact closure to ground. When this input is pulled to ground the Auxiliary Alarm relay is energized (Normal State). When the Auxiliary Input is open circuited the Auxiliary Alarm relay is de-energized (Alarm State).

One example usage of the Auxiliary Alarm in non-Ethernet units is that it could be used to signal one of the detail alarms (voltage, current, or temperature) by connecting the appropriate open collector alarm output to the Auxiliary Input. This programs the Auxiliary Alarm relay to be either a voltage, current, or temperatue Form C relay alarm.

Open Collector Alarm Outputs (J4)

The open collector alarm outputs will require external pull-up resistors (unless connected to the Auxiliary Input). They are capable of sinking up to 20 mA current at 30 VDC. The open collector outputs are pulled to ground under normal operating conditions and switch to high impedance state during an alarm condition.

- Low RF Alarm: follows state of Auxiliary Input as described above;
- BUC Alarm: high when amplifier's internal regulator voltage falls below its acceptable level.

RF Power Detector (J4, Pin R)

The RF Power Detector is an analog output voltage that is proportional to the RF output power. The maximum output voltage is 4.0 VDC which corresponds to the maximum (saturated) output power from the amplifier. This detected voltage is useful over a 20 dB range of output power. This feature is available in units with serial numbers between 300,000 and 399,999.

Fan Speed Control (J4, Pin R)

GaN units with serial numbers greater than 399,999 are equipped with a Fan Speed Control option. The fan speed control circuit is shared with the RF power detector analog output (J4, Pin R). This pin remains not connected on units with the fan speed control option installed.

Available control options: Auto, High, Low, and Default/Off

- Auto: This setting allows the unit to control the cooling fan speed according to the internal RF module temperature. If the module plate temperature remains below 50 °C, the fan speed will be set to minimum. If the registered module plate temperature is above 50 °C, unit will gradually increase the fan speed. Fan speed will reach maximum at a plate temperature of 65 °C.
- High: This option sets the fan speed to maximum. Air velocity will remain at the same level regardless of other operation parameters.
- Low: This option sets the fan speed to minimum. Air velocity will remain at the same level regardless of other operation parameters.
- Default/Off: This setting should be set on units without the fan speed control option. It will allow proper functioning of the RF power monitor analog output. Applying this setting on units with the fan speed control option allows the fan speed to be proportional to the output RF level. Fan speed will be set at the minimum when output RF is below a detectable level. Fan speed will gradually increase when RF output increases within the detectable RF range. Fan speed will be at maximum level when unit reaches saturated power (Psat).

L-Band Operation

Introduction

Teledyne Paradise Datacom SSPAs are available with various L-Band up converter options. The primary up converter option is the Zero dBm Block Up Converter, ZBUC. The ZBUC ® block up converter is offered in C-Band, X-Band, and Ku-Band configurations. The ZBUC converter offers ultra low phase noise for applications where phase noise is an overriding factor.

The type of ZBUC converter housed within your SSPA is indicated by its model number, as shown in Figure 1. The example in Figure 1 shows a 200W 3RU C-Band Rack Mount SSPA with Internal Reference ZBUC converter. For a full description of the configuration matrix, refer to the specification sheet for your amplifier.
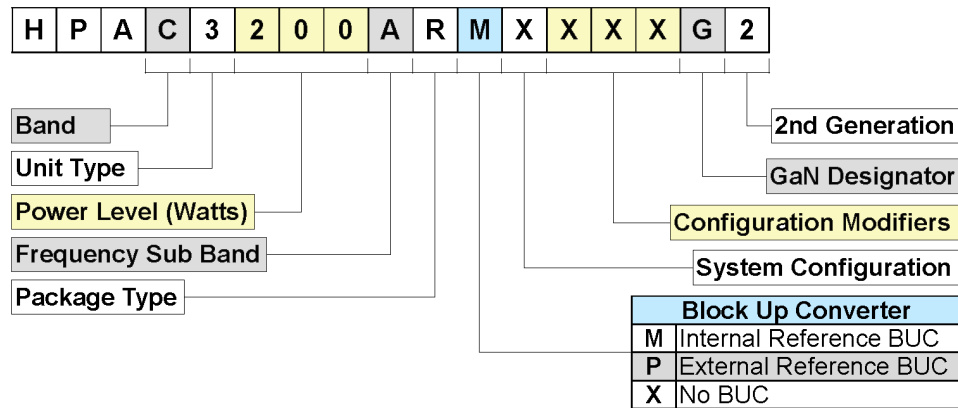
Figure 1: Configurator, RM SSPA, BUC Options

The block up converters are high performance frequency translation devices which provide excellent phase noise and spurious performance.

The ZBUC converter utilizes Teledyne Paradise Datacom's proprietary "Smart Reference Technology". Smart Reference Technology allows the system user to change reference frequency and power level or choose internal or external reference without requiring any system configuration. An internal ZBUC converter adds about 1.7 pounds to the overall weight of the SSPA.

In rack mountable amplifiers, the block up converter is powered from a +15 VDC supply available from the Back Plane Board Assembly of the SSPA. The Block Up Converter is simply cascaded with the SSPA at the input of the amplifier. Figure 2 shows the basic block diagram of the rack mount SSPA.
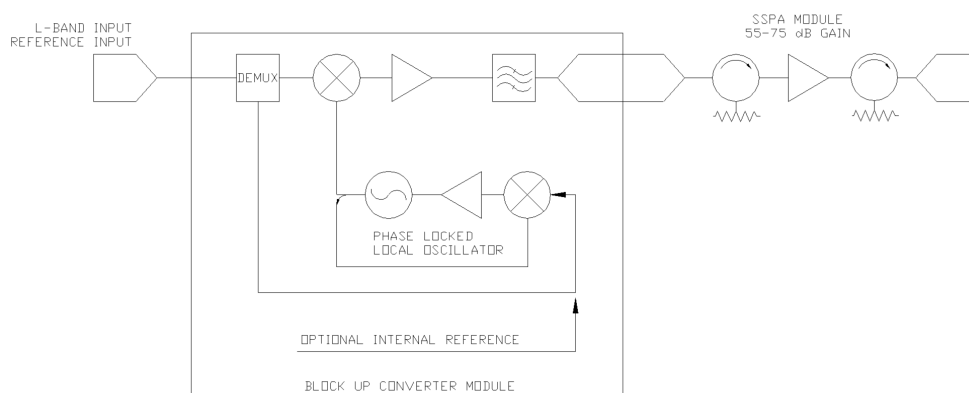
Figure 2: Block Diagram, BUC/SSPA System

In outdoor amplifiers, the block up converter is powered from a +15 VDC supply available on the Fan Boost Converter board assembly. The Block Up Converter is simply cascaded with the SSPA at the input of the amplifier.

It is important to remember the requirement of a 10 MHz reference oscillator when operating an SSPA with ZBUC converter (SSPB). If the 10 MHz reference is not present, the M&C will report a BUC alarm and the SSPA module will mute. This ensures that no spurious or 'off frequency' transmission could originate from the unit.

> ⚠ **Note: Unless the ZBUC converter has the built-in internal reference option, if there is no 10 MHz reference signal present on the IFL input there will be no output signal from the SSPA.**

ZBUC Converter Features

This section describes the features available in the Teledyne Paradise Datacom ZBUC converter. The ZBUC converter is available as an option for the C-Band, X-Band and Ku-Band SSPA. Table 1 shows the specifications for the respective frequency plans.

Table 1: zBUC Converter Frequency Specifications

Band	Frequency Plan	IF Input	LO Frequency	RF Output
C	Sub-Band "A"	950 - 1525 MHz	4.900 GHz	5.850 - 6.425 GHz
C	Sub-Band "B"	950 - 1825 MHz	4.900 GHz	5.850 - 6.725 GHz
C	Sub-Band "C"	950 - 1870 MHz	4.800 GHz	5.750 - 6.670 GHz
C	Sub-Band "E"	950 - 1250 MHz	5.475 GHz	6.425 - 6.725 GHz
C	Sub-Band "F"	950 - 1250 MHz	5.775 GHz	6.725 - 7.025 GHz
C	Sub-Band "G"	950 - 1675 MHz	4.800 GHz	5.750 - 6.475 GHz
C	Sub-Band "L"	950 - 1550 MHz	3.450 GHz	4.400 - 5.000 GHz
X	Sub-Band "A"	950 - 1450 MHz	6.950 GHz	7.900 - 8.400 GHz
X	Sub-Band "J"	1025 - 1800 MHz	6.100 GHz	7.125 - 7.900 GHz
KU	Sub-Band "A"	950 - 1450 MHz	13.050 GHz	14.00 - 14.50 GHz
KU	Sub-Band "B"	950 - 1700 MHz	12.800 GHz	13.75 - 14.50 GHz
KU	Sub-Band "D"	1350 - 1650 MHz	13.750 GHz	15.10 - 15.40 GHz
KU	Sub-Band "E"	1200 - 1450 MHz	11.800 GHz	13.00 - 13.25 GHz
KU	Sub-Band "F"	950 - 1450 MHz	11.800 GHz	12.75 - 13.25 GHz

⚠ **Note: Custom frequency plans are available upon request.**

ZBUC Converter Theory of Operation

The ZBUC converter is a low gain block up converter with a P1dB of 0 dBm. This topology allows the system to be integrated with little impact on the general electrical specifications of the SSPA module.

The ZBUC converter utilizes single up conversion from L-Band to the desired RF band. The local oscillator circuits are designed to maintain the lowest possible output phase noise. The frequency synthesizer utilizes industry leading technology which allows for phase noise performance previously unattainable in PLL design. See Table 2.

Table 2: zBUC Converter Local Oscillator Phase Noise

Offset	Guaranteed Max.	C-Band (typical)	X-Band (typical)	Ku-Band (typical)	Units
10 Hz	-30	-60	-58	-56	dBc/Hz
100 Hz	-60	-74	-70	-60	dBc/Hz
1 kHz	-70	-87	-80	-78	dBc/Hz
10 kHz	-80	-100	-94	-91	dBc/Hz
100 kHz	-90	-105	-97	-94	dBc/Hz
1 MHz	-90	-125	-122	-120	dBc/Hz

Band selectivity is accomplished using the most aggressive filtering possible while maintaining specified power and spurious performance.

Smart Reference Technology

Teledyne Paradise Datacom's ZBUC® block up converter comes standard with smart reference technology. Smart reference technology allows the system operator to change external system reference frequency without any system configuration required. The ZBUC converter will automatically sense and lock to a 10 MHz or 50 MHz system reference frequency. With the internal reference option installed, the ZBUC will operate with no external reference applied. In the event the system operator wishes to operate on external reference, the converter will automatically sense the presence of an external reference and switch to external reference mode. With the internal reference option installed, the internal reference also becomes a backup reference which will become active in the event that external system reference is lost.

External reference is applied to the ZBUC converter via the L-Band input IFL and is routed to the frequency synthesizer using the built-in demux circuitry.

Note: The external reference option requires the system operator to provide system reference to the ZBUC/SSPB. The system will not lock and will have no output without external reference applied.

⚠ **Note: Internal reference option allows for either internal or external reference operation.**

Bypassing Internal Reference for Alarm Purposes

For outdoor amplifiers which include the internal reference option, there may be cases where it is not desirable to allow the unit's internal reference to be selected automatically in the absence of an external reference.

Perform the following steps to bypass the internal reference:

1. Launch the Universal M&C application and connect to the outdoor unit over RS232 or RS485 comms.
2. Select the Settings tab in the Universal M&C window.
3. Change the BUC Reference setting to External.
4. Cycle power to the amplifier to save the new setting.

⚠ **Note: Changing this setting when communicating with the outdoor ampliifer over IPNET will not work properly. Communication must be over RS232 or RS485!**

Internal Crystal Reference Specs

The 10 MHz crystal reference used in the internal reference option of the zBUC converter has the following specifications:

```
Frequency Stability:
  ≤ ± 3 · 10-8 over temperature range -20 to +85 °C
  ≤ ± 1 · 10-9 aging per day (after 30 days)
  ≤ ± 6 · 10-8 aging per year (after 30 days)
Warm up time: 20 minutes @ 25 °C for better than ≤ ± 1 · 10-8
Phase Noise:
   10 Hz    -120 dBc/Hz
  100 Hz    -140 dBc/Hz
    1 KHz   -145 dBc/Hz
   10 KHz   -152 dBc/Hz
  100 KHz   -155 dBc/Hz
Frequency Accuracy: Factory preset to ± 3 · 10-8
```

FSK M&C (Outdoor SSPB only)

FSK Monitor and control comes standard with a ZBUC converter installed in an outdoor SSPB. This allows the outdoor amplifier to be fully and remotely monitored and controlled through the system's IFL. An embedded controller enables remote communication and fault detection via the IF input between the SSPA and a Teledyne Paradise Datacom Q-Series L-Band modem. This signal consists of a 650 KHz Frequency Shift Keyed carrier that is multiplexed onto the L-Band input IFL along with the 10 MHz reference signal.

The FSK input has a center frequency of 650 KHz with a ± 5% tolerance. The FSK deviation is ± 60 KHz, with +60 KHz being a "mark" and -60 KHz being a "space". The FSK input will work over an input power range of -5 to -15 dBm. The FSK characteristics are summarized below:

```
Frequency: 650 kHz ± 5%
FSK Deviation: ± 60 kHz nominal (+60 kHz mark)
Deviation Tolerance: ± 50 kHz minimum, ± 70 kHz maximum
Locking Range: ± 32.5 kHz
Input Level Range: -5 to -15 dBm
Start Tone Time: 10 ms minimum
```

Typical System Configuration

This section shows the Rack Mount SSPB in a common system application. Figure 3 shows the amplifier used with a Teledyne Paradise Datacom Q-Flex L-Band Modem.
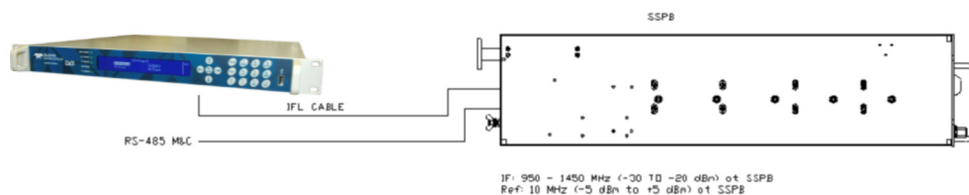
Figure 3: SSPB Chassis with Q-Flex Satellite Modem

IFL Cable Considerations

Consideration should be given to using a high quality IFL between the indoor and outdoor equipment. The system designer must always consider the total cable loss for a given length and also the implications of the slope of attenuation across the 950 to 1450 MHz bandwidth. Table 3 gives the approximate attenuation vs. frequency for a variety of cable types.

Table 3: Common Coaxial Cable Characteristics

Cable Type	Center Conductor DC Resistance per 1000 ft.	Outer Diameter (in)	Attenuation at 950 MHz dB per 100 ft.	Attenuation at 1450 MHz dB per 100 ft.	Slope across band for 100 ft. cable (dB)	Slope across band for 300 ft. cable (dB)
RG-214	1.7	0.425	7.8	11.3	3.5	10.5
Belden 8214	1.2	0.403	6.8	9.2	2.4	7.2
Belden 7733	0.9	0.355	5.8	8.3	2.5	7.5
Belden 9914	1.2	0.403	4.5	6.3	1.8	5.4
Belden 9913	0.9	0.403	4.2	5.6	1.4	4.2

It is recommended to use a quality grade of 50 ohm cable such as Belden 9913, 9914, or 7733. Check the manufacturer's technical data to make sure that the insulation is sufficient for the particular installation including the cable's temperature range. Also make sure the coaxial connector from the IFL cable to the amplifier input is wrapped with a weather sealing tape to prevent water intrusion into the coaxial cable.

BUC Reference in Redundant Systems

When redundant systems are configured with Block Up Converters, the systems engineer must be know whether the BUCs have internal 10 MHz reference oscillators or if they are configured for external 10 MHz reference only. When the Block Up Converter loses its 10 MHz reference, the converter will trigger an alarm condition. This alarm condition then disables (or mutes) the amplifier's RF output. This is done so that any uplinked signal does not drift off frequency or emit spurious outputs to the satellite.

Converters that have an internal 10 MHz reference oscillator will automatically switch to an externally applied reference. In this case, if the external reference is removed, the converter will switch to the internal reference and a BUC alarm will not be triggered.

This section shows various configuration options in which the 10 MHz BUC reference can be distributed to amplifiers in a redundant system. Particular attention need to be placed on 1:2 Redundant systems because the standby amplifier must have a 10 MHz reference so that it does not remain in a faulted condition.

Possible configurations include:

- Option 1: Internal Reference

- Option 2: Separate External Reference Supplied to Standby Amplifier

- Option 3: Single External Reference Diplexed to Each Amplifier

- Option 4: Individual External References Diplexed to Each Amplifier

Option 1: Internal Reference

The simplest configuration is to use Block Up Converters that have an internal 10 MHz reference oscillator. Each system input can have the IF signal and 10 MHz reference signal on the same input.

Option 1 is standard for all 1:2 systems using BUC option 'M' (internal reference), for 1:1 systems with input switching using BUC option 'M' (internal reference), and for 1:1 systems with input splitting using either BUC option 'M' (internal reference) or 'P' (external reference).

In the systems shown in Figure 4 and Figure 5, each online amplifier operates from its own internal reference oscillator but will automatically detect and switch to an external 10 MHz reference supplied at the RF input. The Standby amplifier operates only from its own internal reference oscillator.

Figure 4: 1:2 Redundant System, BUCs Have Internal Reference Oscillators
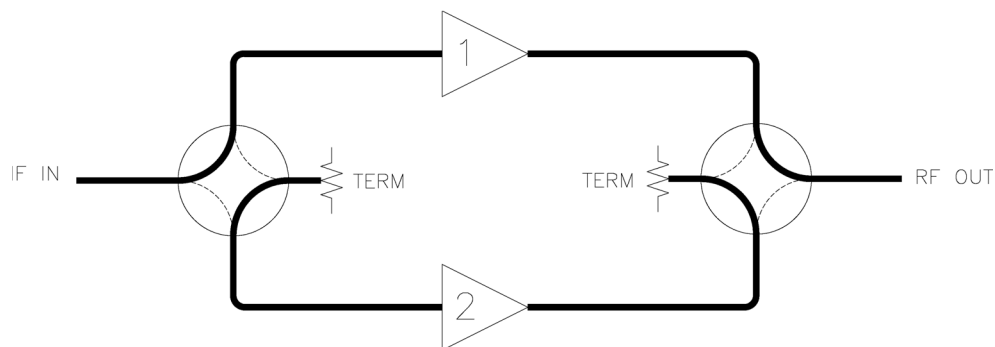
Figure 5: 1:1 Redundant System, Input Switching, Internal Reference BUCs

Figure 6 shows the standard configuration for 1:1 systems with input splitting. The SSPBs will automatically detect and switch to an external reference applied at the IF input.
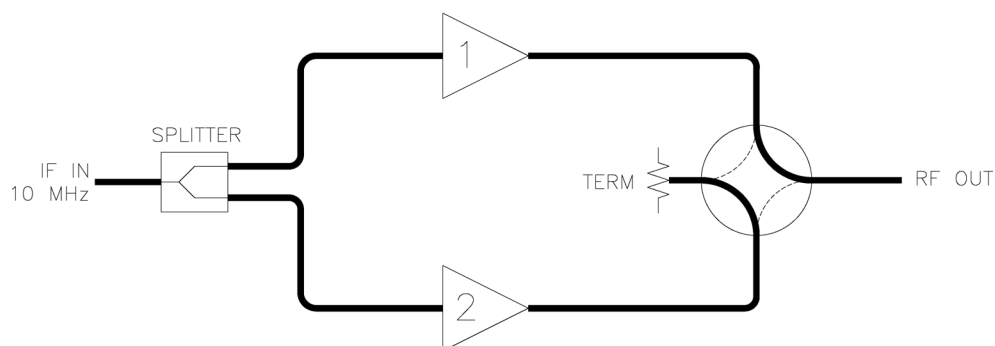

Figure 6: 1:1 Redundant System, Input Splitter, Internal or External Reference BUCs

Option 2: Separate External Reference Supplied to Standby Amplifier

This configuration can be used when the L-Band IF signal and 10 MHz are on the same input and the Block Up Converters are configured for an external reference only.

In this case, the 10 MHz input for the Standby amplifier is provided by the customer via a separate input, as shown in Figure 7 and Figure 8. In redundant systems, the input reference is diplexed onto the coaxial line feeding the input of the Standby amplifier.
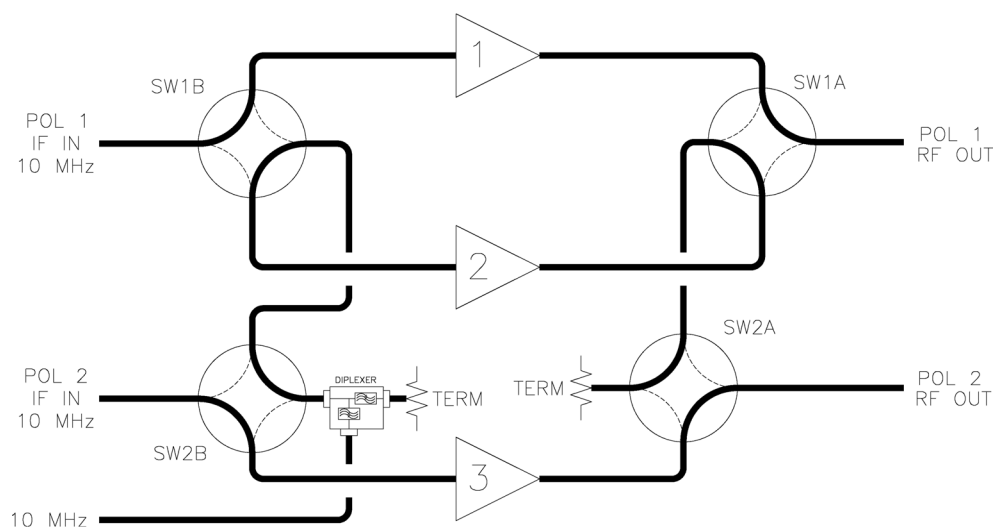

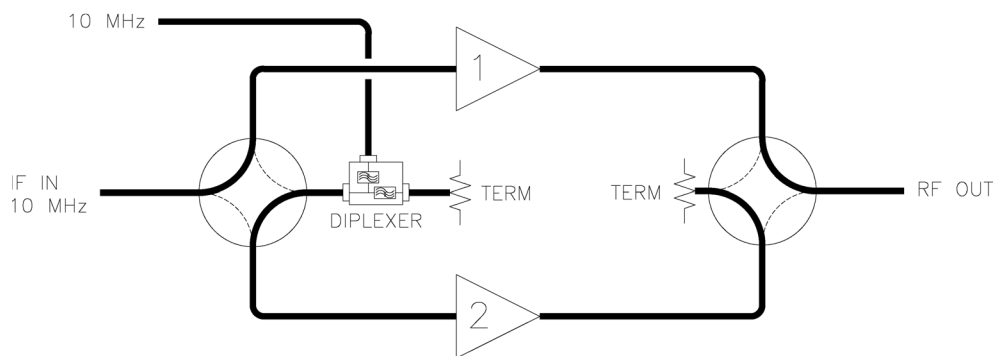**Figure 7: 1:2 Redundant System, Reference Diplexed to Standby Amplifier**

Figure 8: 1:1 Redundant System, Reference Diplexed to Standby Amplifier

Option 3: Single External Reference Diplexed to Each Amplifier

This configuration can be used when the L-Band IF signal and 10 MHz are on separate coaxial inputs, and the BUCs are configured for external reference.

Option 3 is standard for all 1:2 systems using BUC option 'P' (external reference) and for all 1:1 systems with input switching using BUC option 'P' (external reference).

In this case, a single 10 MHz reference input is split and diplexed to the IF input of each amplifier as shown in Figure 9 and Figure 10.
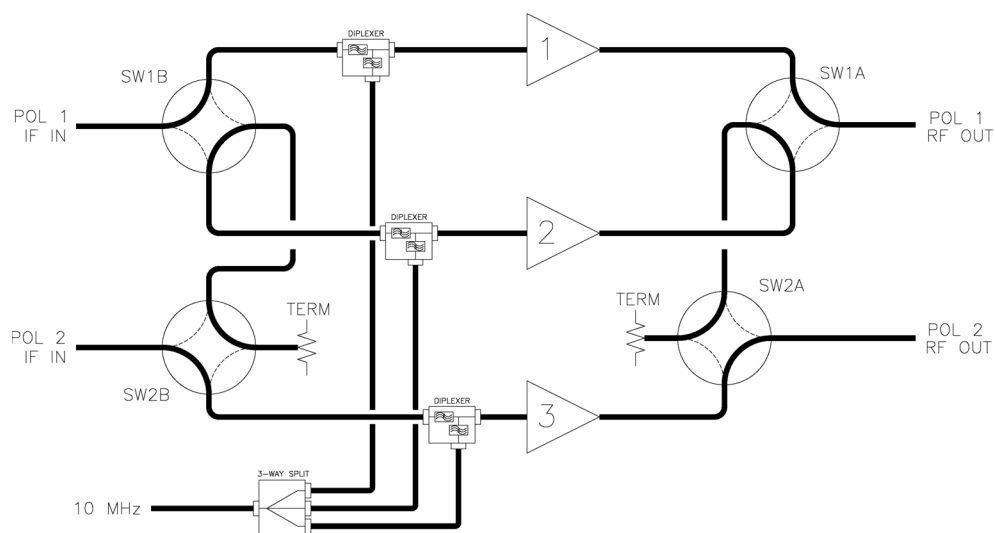

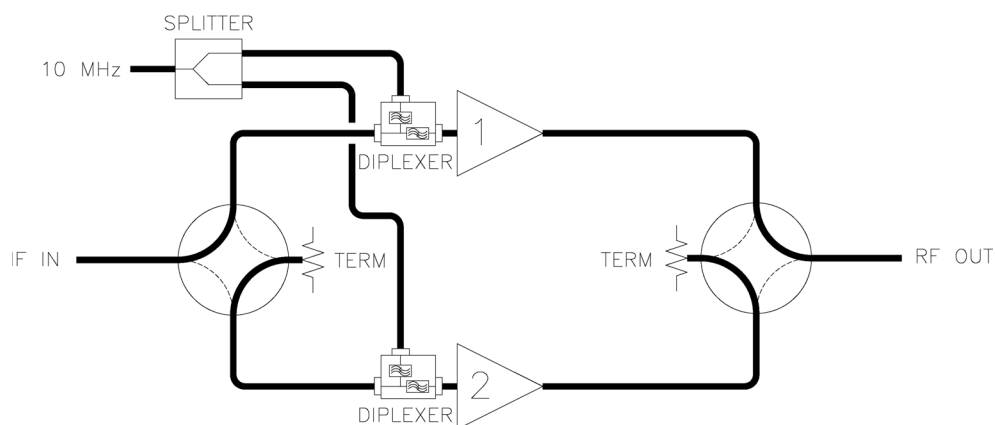**Figure 9: 1:2 Redundant System, Single Reference Diplexed to Each Amplifier**

Figure 10: 1:1 Redundant System, Single Reference Diplexed to Each Amplifier

Option 4: Individual External References Diplexed to Each Amplifier

This configuration can be used when the L-Band IF signal and 10 MHz are on separate coaxial inputs and the BUCs are configured for external reference.

In this case, individual 10 MHz references are diplexed to the IF input of each amplifier as shown in Figure 11 and Figure 12. This gives the systems engineer the greatest flexibility and control over the 10 MHz reference input to each SSPA.
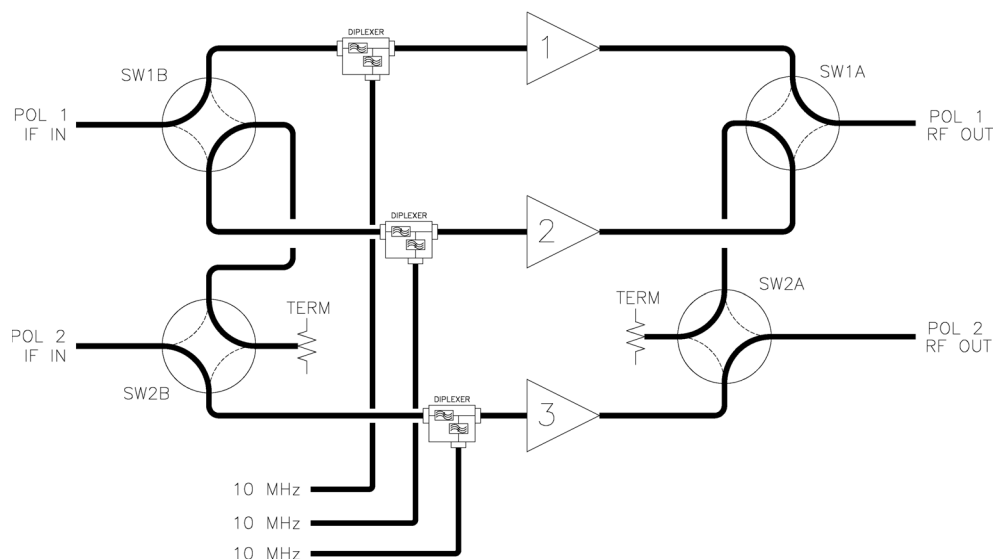

Figure 11: 1:2 Redundant System, Individual References Diplexed to Each Amplifier
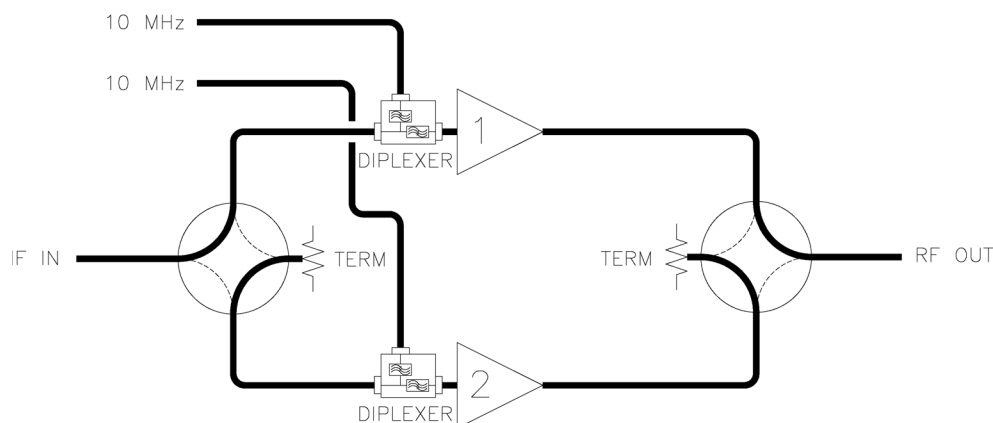

Figure 12: 1:1 Redundant System, Individual References Diplexed to Each Amplifier

Teledyne Paradise Datacom
Drawing Number 216594-3 Revision A
ECO 18855
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Maintenance and Troubleshooting, High Power Outdoor SSPA

Introduction

This section describes some of the standard maintenance practices that can be performed on the High Power Outdoor Amplifier and tips to troubleshoot common customer issues.

Cooling System Maintenance

It is recommended that the cooling system of the SSPA be checked at least once per month. If the amplifier is being operated in an environment that produces a large amount of dust and debris, this check should be performed more frequently.

The intake fans of the amplifier can pull airborne debris into the enclosure, and fill the spaces between the heatsink fans. As this debris builds up inside the amplifier, the airflow which is important in cooling the amplifier is impinged.

Blockage of the heatsink will cause the internal temperature of the amplifier module to rise above what is considered as normal operating conditions. While the amplifiers have thermal protection, long periods of elevated temperatures could reduce amplifier life.

The operator should visually inspect the fan intakes to make sure that they are free from any obstruction. The Windows-based M&C program can be used to check the amplifier base plate temperature. The base plate temperature should normally not exceed a 30°C to 35°C rise above the outside ambient temperature. If the base plate temperature exceeds this temperature rise, it is one indicator that the system's cooling system requires maintenance.

The heatsink fins in the exhaust path should also be visually inspected for excessive dirt and debris buildup. If it appears there is excessive debris in the heatsink; the fan tray can be removed to access the heatsink fins for cleaning.

⚠ **Warning! Failure to keep the fans and heatsink clear of debris will void your warranty.**

Fan Removal and Heatsink Cleaning

It is recommended to remove prime AC power from the amplifier when the fan trays are being removed. However, if necessary, the fan trays can be removed while the amplifier is operating.

> ⚠ **Warning! Use caution when handling the powered fans, to make sure that no clothing, jewelry or body parts are caught in the fan blades.**

The fans are connected to their power source by weatherized in-line circular connectors. Replacement fans with connectors can be provided for replacement.

Perform the following procedure when cleaning the amplifier's fan assemblies and heatsink.

- Using a screw driver, loosen the thumbscrews holding the fan tray in place. The intake fans use eight (8) thumbscrews; the exhaust fans use two (2) thumbscrews.
- Remove the fan tray.
- Unplug the fan power cord from the circular MIL connector.
- Use compressed air to dislodge any dust or debris lodged within the heatsink fins and the fan assembly. Ensure that the heatsink fins are free from all debris.
- Use a shop vacuum to collect all dust and debris from inside the enclosure.
- Plug the fan power cord into the circular MIL connector.
- Re-insert the front panel fan tray, taking care not to pinch the power cable between the fan tray and amplifier enclosure.
- Tighten the thumbscrews which hold the fan tray in place. Tighten to snug using a screw driver.

Fan Replacement

The intake fan assembly is located on the same side of the amplifier as the RF Input connector. The intake fan assembly uses three (3) fans to pull ambient air into the amplifier enclosure.

The intake fan power cable has a circular MIL connector (MS3116F10-6P) which connects to the circular MIL connector (PT02E10-6S) on the inside of the amplifier enclosure. See Figure 1. To order a replacement intake fan assembly, specify part number L213271-1.

Figure 1: Intake Fan Assembly; inset, Fan Power Connector

The exhaust fan assemblies are located on the same side of the amplifier as the handles. The exhaust fan assemblies use one (1) fan to blow air out of the amplifier enclosure.

The exhaust fan power cable has a circular MIL connector (MS3116F8-3P) which connects to the circular MIL connector (MS3112E8-3S) on the inside of the amplifier enclosure. See Figure 2. To order a replacement exhaust fan assembly, specify part number L213272-1.
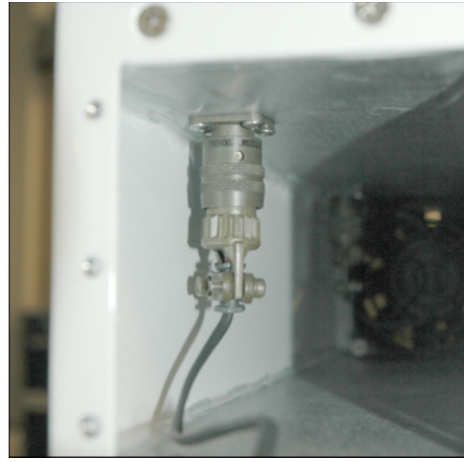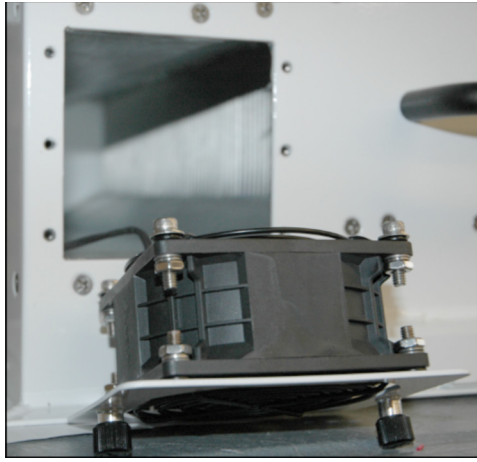
Figure 2: Exhaust Fan Assembly (left); Fan Power Connector (right)

Firmware Upgrade Procedure

Teledyne Paradise Datacom digital engineers continually strive to improve the performance of SSPA software and firmware. As this occurs, software and firmware upgrades are made available. The web upgrade is performed over the SSPA IP port and does not require any special software. It can be performed through any suitable web browser.

Web Upgrade Procedure

Important! Upgrading unit with incompatible firmware image may damage the equipment hardware. To ensure the proper firmware image file is used, contact Teledyne Paradise Datacom technical support. Write down your current firmware version. You may want to request an image file of the current firmware in case it becomes necessary to revert back to the original.

Connect the SSPA to PC 10/100 Base-T network adapter via a Quick-start Ethernet cable. With a Quick-start cable connected, the SSPA will use a fixed IP address, 192.168.0.9. Advanced users may use a custom cable and custom IP address. However, this procedure only covers connection over a fixed IP address.

Make sure unit is power cycled with Quick-start cable plugged in. It will ensure unit assumes fixed address, 192.168.0.9

Open a web browser window (Chrome, Firefox or IE are preferred). Enter the following address in the location window of the browser: 192.168.0.9/fw

The Upload Form is password protected. An authentication window should come up to ensure authorization. Use admin as user name and the HPA web login password (default password is **paradise**). Click the "Log in" button (see Figure 3).
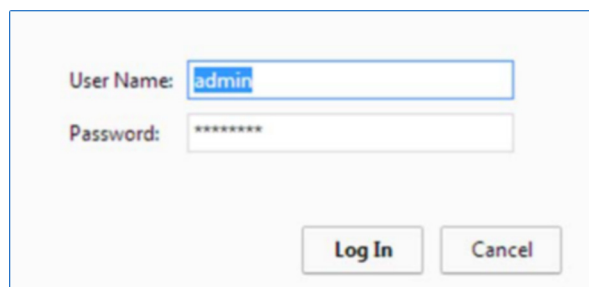
Figure 3: Web Upgrade Authentication Window

The firmware upload form will load in the browser window (See Figure 4). Click the "Choose File" button and select the firmware image code.bin file provided by technical support.

Figure 4: Firmware Upgrade Form

Click the "Upload" button. A warning message will appear; click the "OK" button (See Figure 5).
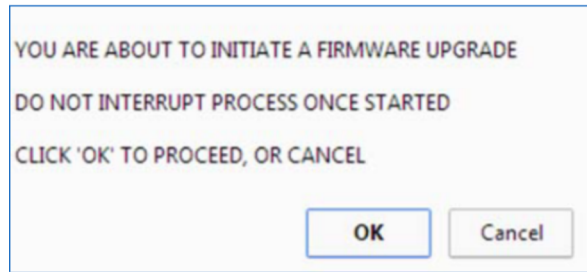
Figure 5: Proceed with Web Upgrade Prompt

The upload process will begin and the form will be informing about loading process. Do not interrupt this process and wait until its completion with positive or negative result. The process may take up to 15 minutes. When completed, the form will notify about end of process. See Figure 6.

Figure 6: Upload Completed Message

During the upgrade process, the HPA remains fully functional. The new firmware will stay dormant until the next reboot of the HPA control card. Reboot the controller card by cycling AC power to the HPA. Check installed version by logging to SSPA embedded web page.

Troubleshooting Guide

The following section describes solutions for some of the most common issues with the operation of the High Power Outdoor SSPA.

Unit doesn't power up

Cooling fans do not spin, and alarm LED lamps (if supplied) are off.

Possible causes:

- AC power is off;
- Unit which requires 220V AC operation is being powered from 110V AC grid;
- Unit is connected to an inadequate circuit breaker.
- Unit has no connection between chassis and earth ground or has inadequate earth ground.

Possible solutions:

- Check SSPA unit datasheet for AC power requirements. Provide the specified AC power for the unit.
- Re-check continuity between unit's chassis ground and earth ground. Earth ground connection is required for normal SSPA operation!

Unit powers on, LED lamp (if supplied) blinks (red or green)

Possible causes:

- Hardware mute not disabled.

Possible solutions:

- Connect Mute Line Input (J4, Pin B) to Ground (J4, Pin V) to disable hardware mute.
- Or, connect Quick Start cable or other properly constructed M&C cable which jumpers J4, Pin B and J4, Pin V.

Unit powers on, LED lamp (if supplied) glows red

Possible causes:

- SSPA peripheral alarms (Auxiliary, Spare, Forward RF, etc.) are set as Major alarms.
- Summary Alarm is caused by external reference BUC module.

Possible solutions:

- Connect to the SSPA unit via the Universal M&C software and disable peripheral alarms.
- In the case where the unit is equipped with an externally referenced BUC, provide the specified reference signal to the SSPA IF input.

Unit powers up, LED (if supplied) glows green, no RF

Possible causes:

- The SSPA is muted by an external signal or by an internal setting.
- The input RF signal is too low.
- The input signal is out of band.

Possible solutions:

- Make sure the J4 connector has a jumper installed between pins B and V.
- Connect to the unit via the Universal M&C and set the Mute setting to Off.
- Check the input RF signal level and frequency. Make sure the signal properties are appropriate for the unit.
- If Switch Mute is enabled, make sure SSPA is connected to a RF switch; otherwise, disable Switch Mute option.

Cannot connect to unit via remote interface

Possible causes:

- The SSPA remote control is set to a different interface setting.
- The interface cable is not wired properly or has a broken wire harness.
- A PC interface port malfunction.
- An incorrect version of the software is being used to control the unit.
- The selected SSPA protocol is no longer supported by the SSPA firmware.
- In the case of RS-232 interface: the wire harness is using the Chassis ground rather then a Com ground pin.
- In the case of IPNet or SNMP interface: PC ARP cache entry is set for different MAC/IP address pair.
- Universal Handheld Controller is plugged in to Port J10.

Possible solutions:

- In the case where SSPA communication settings have been accidentally set to a random configuration, establish a connection to the unit with a L207755 Quick Start cable in conjunction with the Universal M&C software. After establishing a communication link with the unit, adjust the following settings to the desired configuration: Serial Network address, Protocol Select, Baud rate (if Normal protocol was set in in the Protocol configuration), IP address, Subnet, Gateway, IP port and IP lock address (if IPNet or SNMP protocols were selected), Community Set and Community Get strings (if SNMP protocol was selected), web password (if IPNet was selected).
- Disconnect the Quick start cable, and cycle AC power to the unit with the custom cable harness plugged into the J4 M&C connector. Recheck custom control link.

- In the case of a RS-232 interface, make sure to use communication ground pin d from the J4 connector as the RS-232 ground.
- The SSPA RS-232 port is electrically isolated from chassis ground.

- In the case of IPNet, use 10Base-T approved cables (CAT5, CAT6) to make a connection to the unit. Maximum cable length should not exceed 300 ft. If an IP connection with custom IP addressing is desired, don't make any connection to interface selection pins j and e.
- In the case of SNMP interface, make sure that the SNMP community strings match between the SNMP NMS software and the unit. Default values for these strings are: public and private. Connect to the unit via the Universal M&C to check or change string values.
- In the case of IPNet or SNMP protocols, clear the PC ARP cache by issuing the following command in a Windows command line interface: arp -d. Binary and Terminal protocols are no longer supported. Use the currently available interfaces instead.

- Serial communication over Port J4 is prevented when using the Universal Handheld Controller plugged into Port J10. Unplug the controller to resume serial control over Port J4.

FSK link between modem and unit does not work

Possible cause:

- The unit is set to use Terminal Mode protocol.

Possible solution:

- Set the SSPB protocol setting field to "Normal" protocol or (and) remove any connection to SSPB interface select pins j and e on the J4 connector.
- Reset AC power.

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Outdoor SSPAs, Maintenance Switch Mode

Teledyne Paradise Datacom
Drawing Number: 216595-4 Revision -
RA 7714
06 November 2019

Introduction

An outdoor unit with firmware version 5.05 or beyond may be set up to use the switch control connector (Port J6) to control a single external maintenance waveguide switch (for example, to switch the output between an antenna and a dummy load).

Table 1 shows the pin-out of the Switch Port (J6).

Table 1: Switch Port (J6) Pin-Outs

Pin# on J6	Connection
A	N/C
B	N/C
C	+28 VDC
D	N/C
E	POS 2
F	POS 1

In Maintenance Switch Mode (see the System Settings Table, Data Address 1), a maintenance switch can be placed in Position 1 or Position 2 by toggling the unit's Redundant Startup State setting between the Online and Standby values. The actual state of the SSPA will be determined according to the currently selected hierarchical address.

If hierarchical address "HPA1" is selected, the SSPA will drive the switch to Position 1 when the Redundant Startup State is selected to the "Online" value. The switch will be driven to Position 2 when the Redundant Startup State is selected to "Standby".

For "HPA2", the "Online" and "Standby" selection position for the waveguide switch will be in-verted: Position 2 = "Online" state; Position 1 = "Standby" state.

Hardware Switch Position Control

Alternately, the LINK IN signal on Link Port (J5) can be used for hardware switch position control. Table 2 shows the pin-out for Link Port (J5).

Table 2: Link Port (J5) Pin-Outs

Pin# on J5	Connection
A	LINK OUT
B	LINK IN
C	N/C
D	N/C
E	N/C
F	GND

In order to use an external line control, the Redundant Startup State must be selected to the "Online" value. In this case, when the LINK IN signal is left unconnected, the SSPA will drive the waveguide switch to its "Online" state; when the LINK IN line is connected to a chassis ground, the switch will be driven to the "Standby" position.

"Online" and "Standby" switch positions still will be determined by the hierarchical address selection.

Outdoor SSPAs, Redundant System Operation

Teledyne Paradise Datacom
Drawing Number: 216595-5 Revision -
RA 7714
06 November 2019

Redundant System Concepts

Both the Compact Outdoor SSPA and High Power Outdoor SSPA are capable of operating in a variety of redundant system configurations. These include 1:1 and 1:2 as well as 1:1 with L-Band Block Up Converters. The amplifier has a built-in 1:1 redundancy controller, allowing it to be used in 1:1 redundant systems without a separate external controller. When used in a 1:2 redundant system a separate controller, RCP2-1200, is required. The three most common forms of 1:1 redundant system are shown in Figures 1 through 3.

Figure 1 shows a standard 1:1 system in which the RF input is transmitted through a transfer switch along with the output. Using this configuration the standby amplifier carries no traffic and simply is terminated by a 50 ohm resistive load at its input and by a waveguide termination at its output.
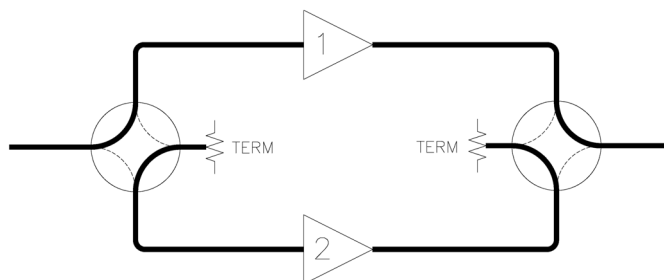
Figure 1: 1:1 Redundant System

With the system configured as in Figure 2, the RF input is passed through a microwave splitter. This keeps 'live' traffic on the standby amplifier and is useful for observing the traffic via the RF sample port on the standby amplifier.
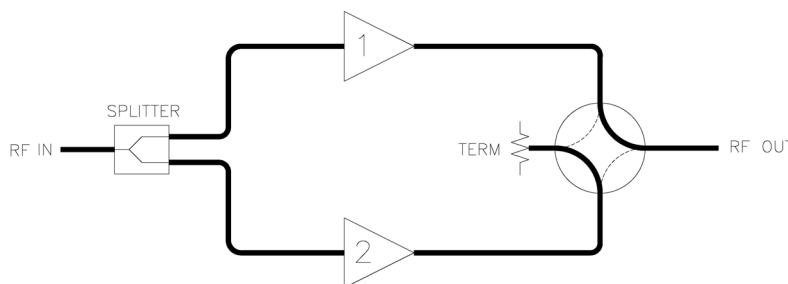
Figure 2: 1:1 Redundant System, with Input Splitter

The system shown in Figure 3 uses the same concept of the power splitter on the RF input. In this case the amplifiers are equipped with L-Band block up converters. L-Band input amplifiers use phase locked oscillators as the local oscillator to the up converter. Such systems must use a splitter at the input instead of a switch so that the reference input is always available to the standby amplifier. If the reference signal is lost the standby amplifier would report a BUC (Block Up Converter) fault.

Figure 3: 1:1 Redundant System, with L-Band Input and Input Splitter

Care must be taken when selecting the splitter for an L-Band input system. The splitter must be a wide band design capable of passing the 10 MHz or 50 MHz reference signal along with the 950 MHz to 1525 MHz traffic input. The reference frequency power level must be at least -10 dBm into each amplifier.

Outdoor Amplifiers in 1:1 Redundancy

The Outdoor amplifiers are ideally suited for a self-contained and cost effective 1:1 redundant system. Each amplifier has a built-in 1:1 redundant controller. The controller is activated via computer command from the Teledyne Paradise Datacom Universal M&C application. The amplifier may be purchased as a redundant system or upgraded in the field from a single thread amplifier to a 1:1 redundant system.

A redundancy kit may be purchased separately which includes the following components:

- Mounting Frame
- Waveguide Switch / Mounting Bracket
- Input Splitter
- Waveguide bends from amplifier to switch
- High Power Waveguide Termination
- Coaxial cables from splitter to Amplifier input
- Link Cable
- Switch Cable
- Waveguide Flange / Extension for RF Output

Hardware Setup

The hardware setup for an outdoor 1:1 Redundant System is very simple and involves the addition of (2) cables along with a redundancy switch. A schematic diagram of the redundancy setup is shown in Figure 4.
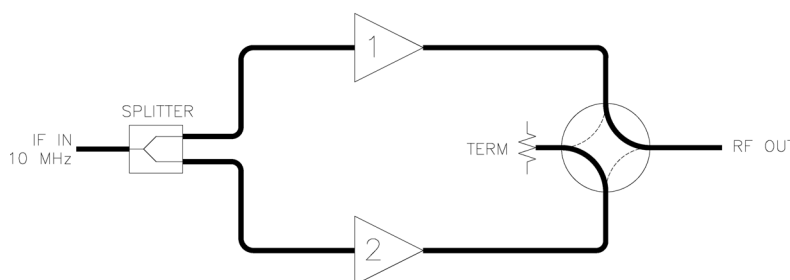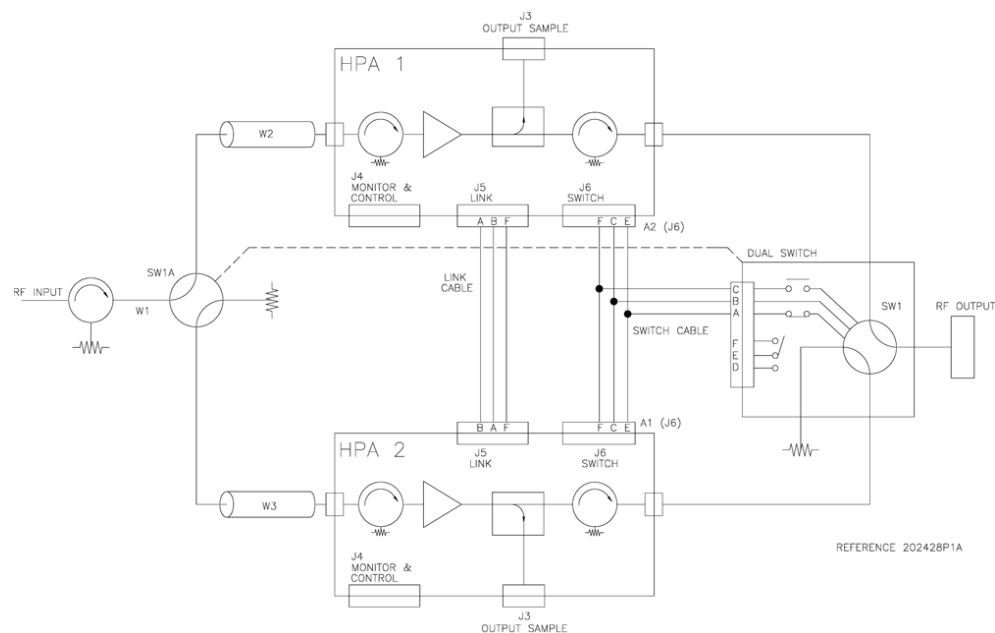

Figure 4: 1:1 Redundant System with Link Cable and Switch Cable Installed

The Link Cable is a simple (3) conductor crossover cable that allows the system to pass command and control between amplifiers. With the redundancy kit, this cable is supplied in a 26 inch (660 mm) length.

The Switch Cable is a "Tee" configuration and connects between each amplifier and the redundancy switch. The Redundancy Switch is a -28 VDC type. Therefore the controller in each outdoor amplifier is capable of supplying +28 VDC to the common voltage input. Either controller may then provide a (sink) return to engage either position 1 or position 2 of the redundancy switch.

Care must be observed when connecting this cable to the amplifiers. The cable end labeled "A1" must be connected to the amplifier whose output is connected to Port 3 of the waveguide switch. Likewise the cable end labeled "A2" must be connected to the amplifier whose output is connected to Port 1 of the waveguide switch. This is for proper identification purposes of the Redundancy Control Firmware used by each outdoor amplifier.

⚠ **Note: 1:1 Reundant Systems using Compact Outdoor amplifiers are typically shipped from the factory fully assembled. See drawing number 215534 for assembly instructions for a 1:1 Redundant System using High Power Outdoor amplifiers.**

Software Setup

To instruct the system amplifiers to operate in redundancy mode, it is necessary to temporarily connect each to a PC running the Teledyne Paradise Datacom Universal M&C Software to set up the redundant configuration.

There are three basic modes of Redundant System communication.

- Stand-Alone 1:1 Redundant System, No Computer Control

- PC Control using RS-232 and Paradise M&C Software

- PC Control using RS-485 and Paradise M&C Software

Stand-Alone 1:1 Redundant System

As Method 1 implies, it is possible to have a 1:1 system operate with no PC monitor and control. Initially, however, it is necessary to connect each amplifier up to a PC to configure it for redundant operation.

Figure 5 shows the redundant system with each amplifier enabled to use RS-232 communication with a PC. Each amplifier is shipped from the factory with a "Quick Start" cable that can be used for this purpose. If the amplifiers are purchased as a 1:1 Redundant System, this Software Setup procedure will have been set at the factory and it is not necessary to repeat this process.

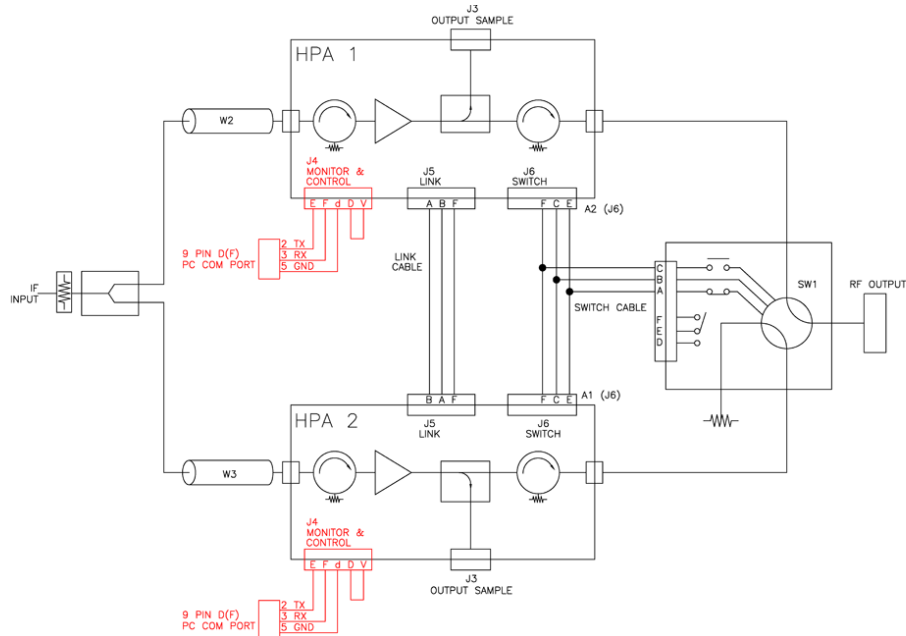**Figure 5: 1:1 Redundant System with RS-232 Communication to Each Amplifier**

Each amplifier can be configured for redundancy by the Teledyne Paradise Datacom Universal M&C software that ships along with each unit. Using the Quick-Start cable, connect each amplifier to the PC and run the M&C program. Select the "Settings" tab from the main form. The "Settings" window will appear as shown in Figure 6.
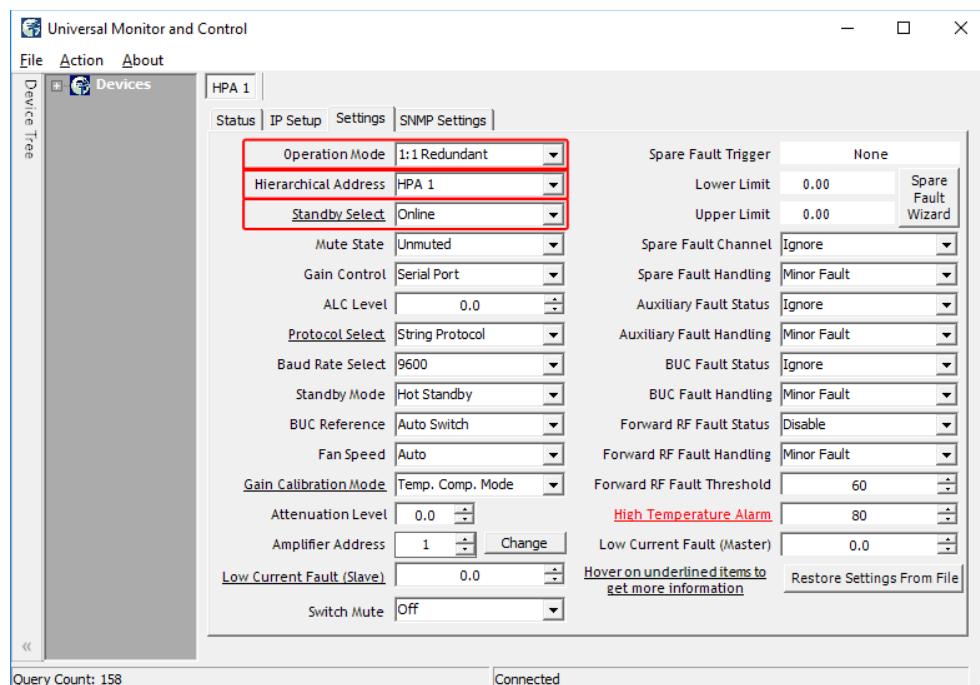
Figure 6: Universal M&C Application, Settings Tab

Set the System Mode for each SSPA to "1:1 Redundant" mode.

Assign a Hierarchical Address for each amplifier. HPA 1 means this SSPA will use the RF switch position 1 as its Online state position. HPA 2 will then use RF switch position 2 (Standby).

Set the Standby Select (formerly Redundant Startup State) setting for each amplifier. The amplifier which is desired to be online should be set to "Online". The other amplifier should be set to "Standby". Once the system is operating, changing the state of the "Online" amplifier to "Standby" will cause the system to drive the switch so that the other amplifier is in the "Online" state. Attempting to change the "Standby" amplifier to the "Online" state will have no effect. This setting is saved upon unit shut-down, and the unit will start up in the last saved state.

All settings are valid as soon as the operator sets them on the SSPA Settings window. The SSPA's redundant operation can be verified by monitoring the RF Switch Fault indicator as shown in Figure 14.

The Standby amplifier can be muted to have a "Cold Standby" condition. It keeps the SSPA module powered down for power savings while the microprocessor and fans remain operational. SSPAs with Parallel I/O board firmware version 3.50 or beyond are provided with a true cold standby mode. In this mode, the SSPA will be muted automatically. Cold standby mode has to be selected through a serial control interface (For details, see the System Settings Table, data address 20).

If the Standby amplifier switches to the Online state, it will automatically un-mute and transmit traffic. If the operator attempts to mute the Online amplifier a warning message will be displayed: "Muting this amplifier will not affect the Redundancy State of the system, do you really want to mute?"

Similarly, connect the second amplifier to the computer's COM port and perform the 1:1 selections on the SSPA Settings window. Just as with the first amplifier, make sure that the System mode is set to 1:1 redundant. Select a hierarchical address, HPA 1 or HPA 2 and a startup state.

The amplifiers may then be disconnected from the computer's COM port as the outdoor amplifiers' microcontroller is now programmed for 1:1 redundancy control. It is not necessary to run the Windows based M&C software with the redundant system. The M&C software is only a convenience for remote monitoring and control of the redundant system.

Switch Mute

The Switch Mute option was introduced into the SSPA control setup to overcome a problem with microwave arcing, which may potentially damage a switching component if switching RF power exceeds 400 Watts. This particular problem becomes a critical issue if coaxial RF pass switches are used.

When this mode is selected, as shown in Figure 7, the amplifier is momentarily muted during switchover to prevent arcing in the waveguide. The SSPA also will be forced to the mute state if the transfer switch malfunctions, is disconnected from SSPA or gets stuck between positions.
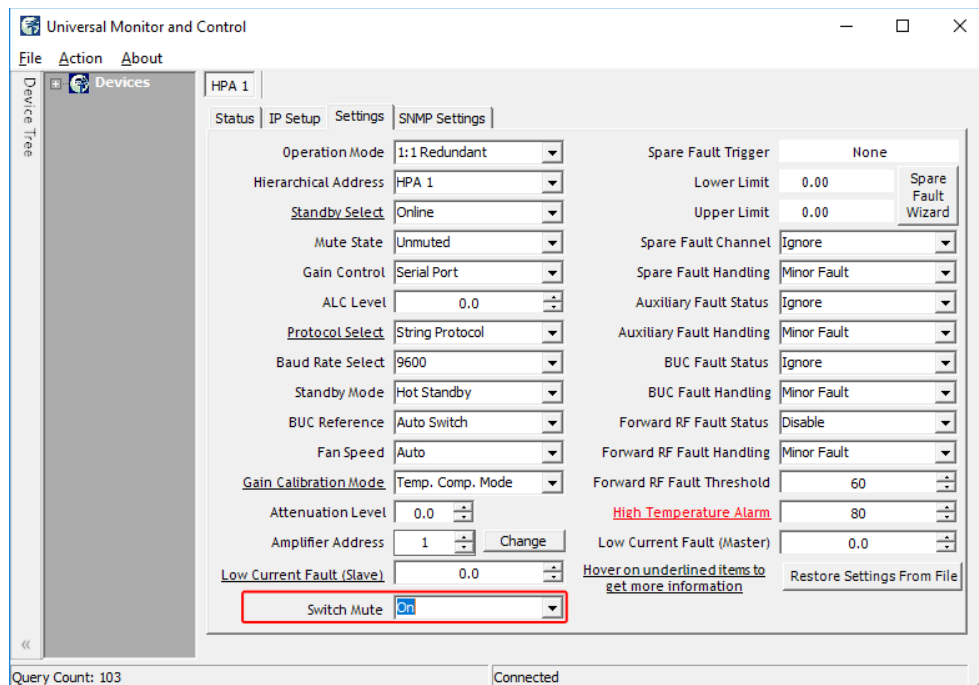
Figure 7: Enable Switch Mute Function

In general, all Teledyne Paradise Datacom SSPAs are well protected against high reflected power conditions which may take place during output microwave switchover. But with certainty, waveguide or coaxial switches will develop an internal electrical arc during switchover if the output power is significant. Such conditions will not lead to instant failure, but over time may diminish some critical RF switch characteristics.

If the switch mute feature is enabled, the system ability to output RF power will be bonded to the switch position sensing circuitry. This circuitry consists of the following components: a SSPA electronic switch position detector; a wiring harness between the SSPA and RF switch; and RF switch position sensors. Failure of any of these components will lead to a break in transmission.

In addition, a SSPA with the switch mute feature enabled will be forced to the mute state when used in standalone mode without a connected RF switch. Standalone units must be set with the switch mute option disabled, or set up in Standalone mode operation prior to using a SSPA without a connected RF switch.

PC Control using RS232 and Paradise M&C Software

In applications requiring remote monitor and control of the redundant system, the Teledyne Paradise Datacom Universal M&C program has a control panel that can be used for this purpose. To enable the 1:1 system to operate with the remote control software, first configure each amplifier for 1:1 redundant operation as previously described in the Stand-Alone 1:1 Redundant System section.

When using RS232, a separate COM port will be required for each amplifier. Therefore a computer with at least two COM ports is required for such a system. Systems using RS232 are limited by the length of the communication cable from the amplifiers to the computer. This is typically a maximum of 30 ft. (9 m) for most RS-232 device drivers. Systems requiring longer communication cable links should use RS-485 communication.

After starting the M&C program, select [Action] > [Add Unit] > [Compact Outdoor SSPA] or [High Power Outdoor SSPA], depending on unit type. See Figure 8. The Add New SSPA window will appear as shown in Figure 9.
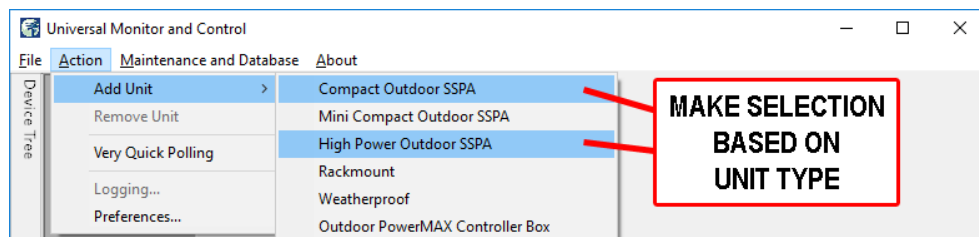
Figure 8: Universal M&C Program, Add Unit
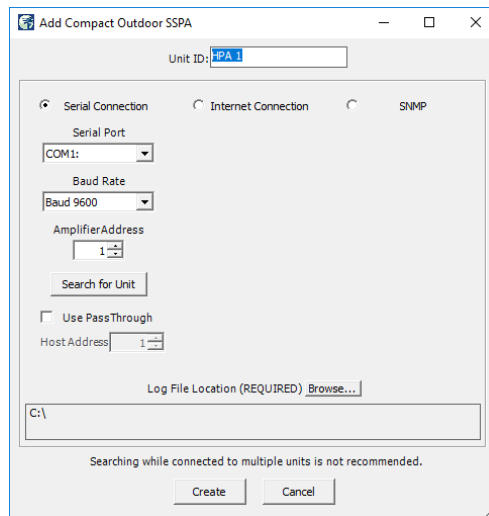
Figure 9: Universal M&C Program, Add Compact Outdoor SSPA (example)

From this screen choose the COM port and baud rate. The factory default baud rate is 9600. If a single SSPA is used, the Global network address setting should be used.

After the COM port has been selected, click the Create button. This will launch the Monitor and Control display for the connected unit. If the SSPA is connected to a power source and turned on, the SSPA will begin communicating with the M&C program and its operating parameters (Status Tab) will be displayed, as shown in Figure 10.
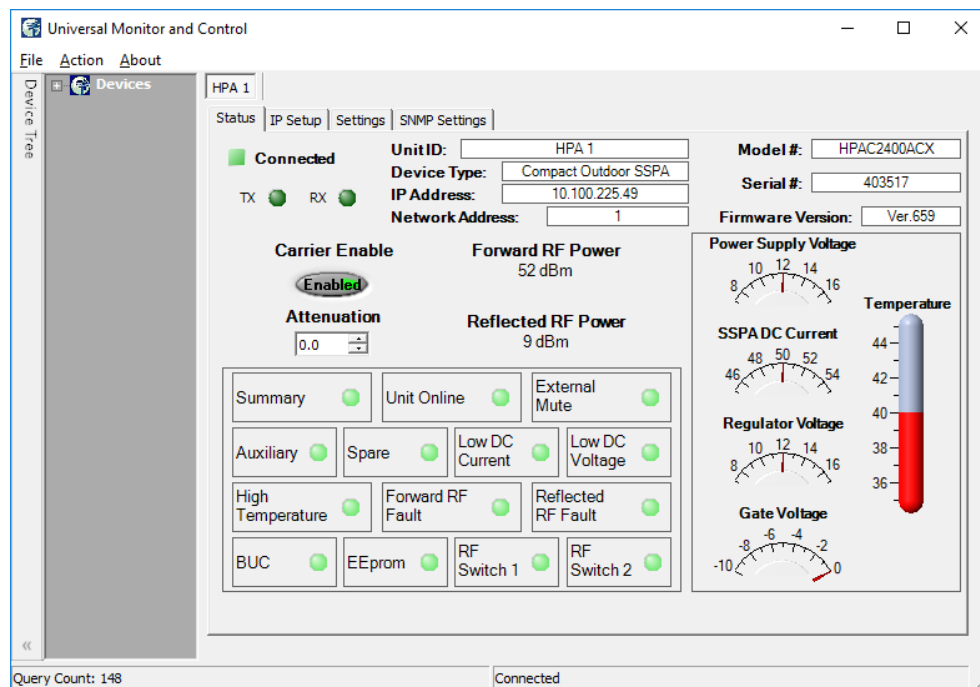
Figure 10: Universal M&C Program, Status Tab

Go back to the "Add New Local SSPA" window and select the correct COM port for the second amplifier. Its operation window will appear on the M&C program display. If either of the amplifiers is not communicating with the M&C Operation screen, debug the system to find the problem. Check the RS-232 connection from each amplifier to the appropriate COM port of the PC.

Once reliable communication has been established between each amplifier and the computer, the Redundancy Control Panel can be displayed. From the M&C program's main window, choose [Action] > [Internal Redundant System] > [1:1 Compact Outdoor SSPA System]. See Figure 11.
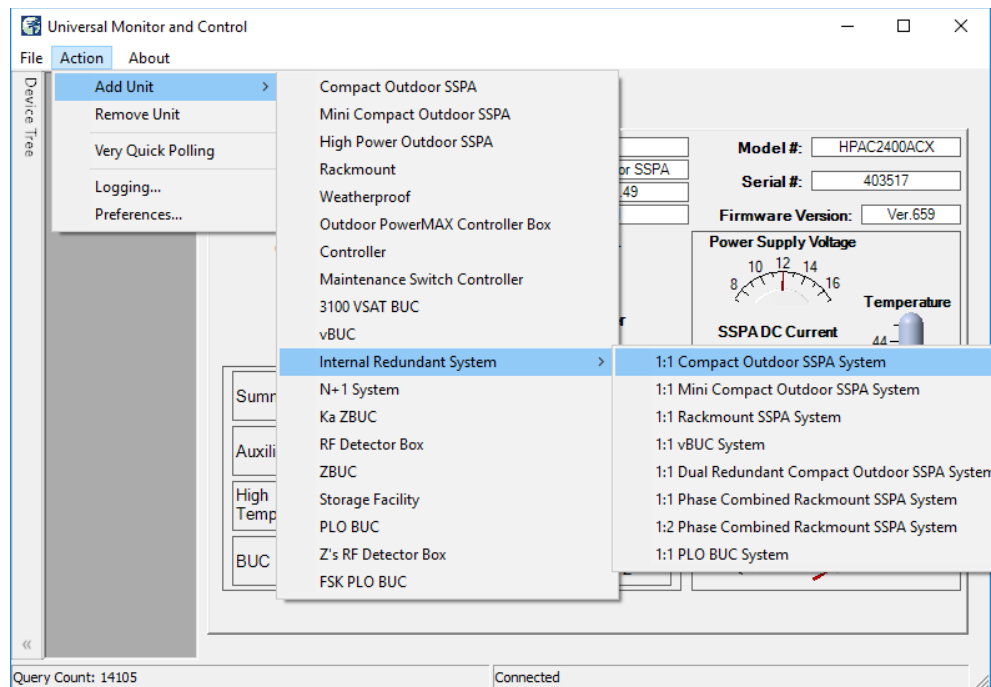
Figure 11: Universal M&C Program, Add 1:1 Compact Outdoor SSPA System

⚠ **Use the [1:1 Compact Outdoor SSPA System] setting for systems using either Compact Outdoor SSPAs or High Power Outdoor SSPAs.**

Select the amplifiers to be assigned as Unit 1 and Unit 2 and enter a name for the system. See Figure 12.
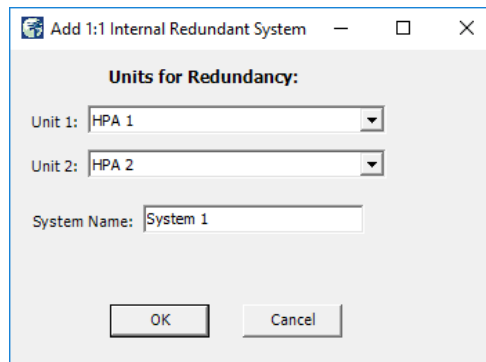
Figure 12: Universal M&C Program, Add 1:1 Compact Outdoor SSPA System

Note that either amplifier may be designated as Unit 1 or Unit 2. Each amplifier is identified by its ID number. The Unit ID number is a fixed number and cannot be changed. It is a unique encoded value determined by the particular amplifier's model number and serial number. If the ID number is forgotten, refer to the System Watcher window. This window continuously displays which amplifier, by ID number, is connected to each specific COM port. After the Control Panel has been configured the display will change to the view shown in Figure 13.
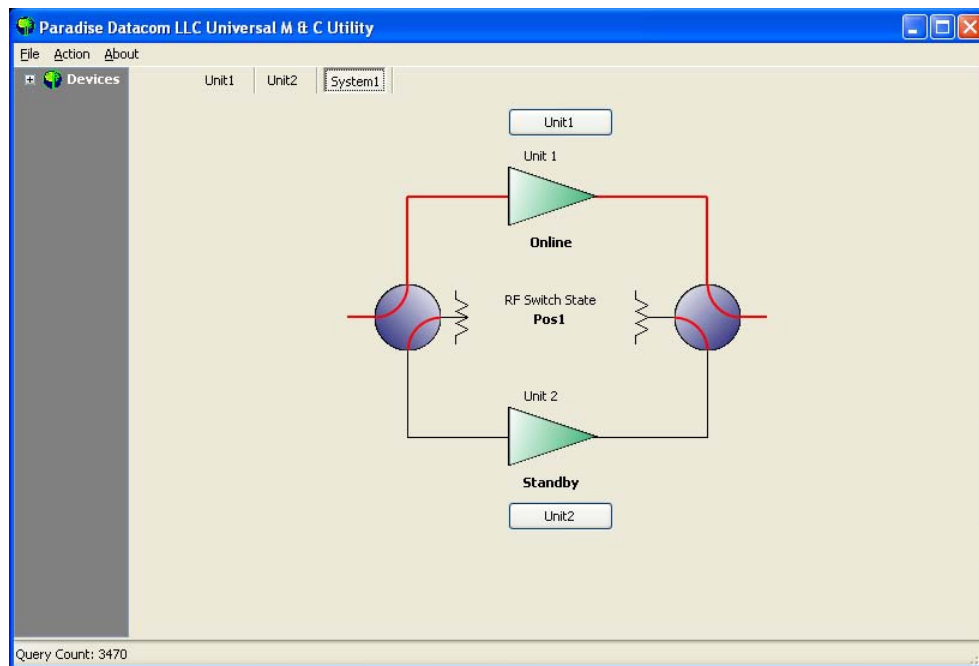
Figure 13: Universal M&C Program, Configured 1:1 Redundant System

From the Control Panel display all typical 1:1 system functions can be monitored and controlled. A particular SSPA can be put on line be selecting the command button for either amplifier. The online amplifier will be indicated by the "Online" notation. The standby amplifier will be listed as such as shown in Figure 13 (Unit 2).

A particular redundant configuration can be saved by going to the "File" menu and selecting "Save Configuration". Thus if the program is terminated and then restarted, it will immediately boot up with the Redundancy Control Panel display.

Each individual amplifier's characteristics can still be monitored and controlled from its respective "Operation" window. If the user attempts to Mute an on-line amplifier, a warning window will pop-up asking if this is a valid request. See Figure 14.

Figure 14: Universal M&C Program, Warning When Muting Online Amplifier

If the online amplifier enters a fault condition, the redundant switch will automatically route the signal to the Standby amplifier. The faulted amplifier will be colored red in the Redundancy Control Panel display. See Figure 15.
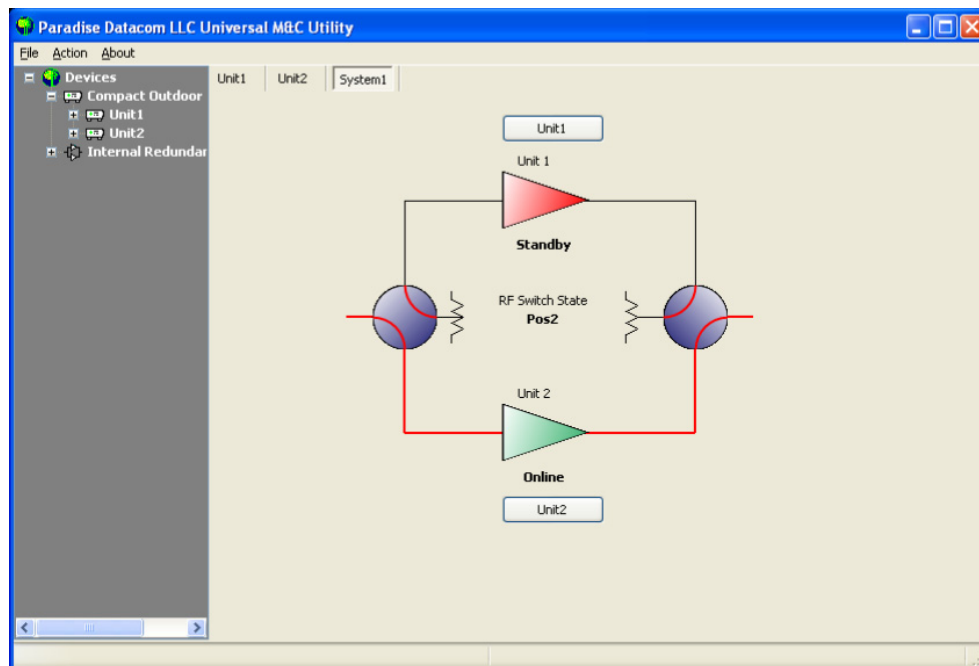
Figure 15: 1:1 Redundant System Display, Unit 1 Faulted

By clicking on the [Unit1] button (which will be labeled to correspond to the unit's name), the M&C Status window for Unit1 is activated, so the user may determine the cause of the fault. See Figure 16.
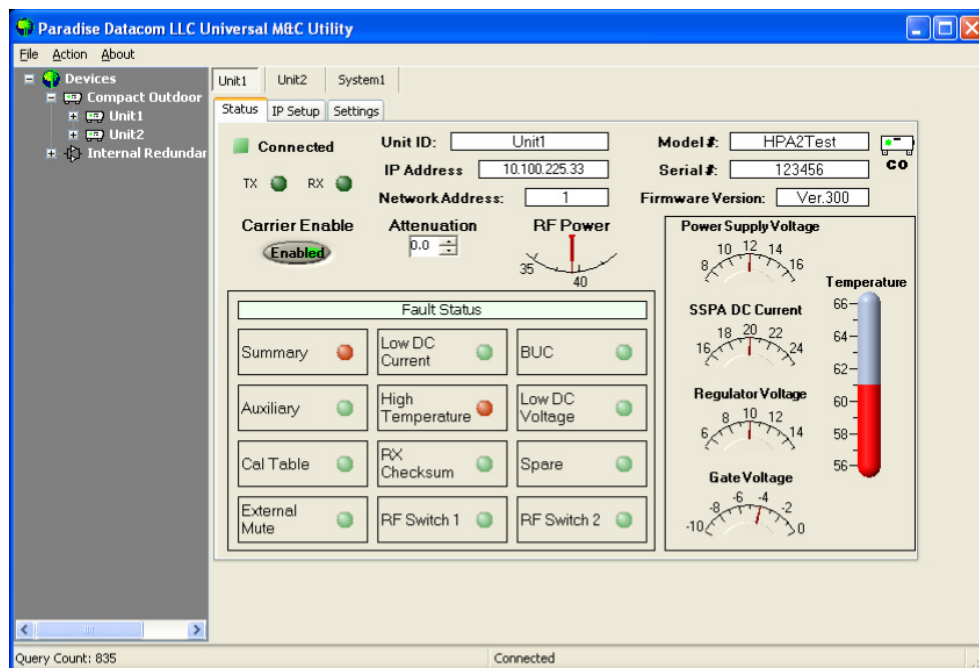
Figure 16: Unit1 Status Panel Showing Summary and Temperature Faults

Once the fault is cleared, Unit1 can be reactivated as the online unit by clicking on the triangular amplifier symbol for Unit2 in the System1 control panel.

If the redundant switch is manually rotated to the offline amplifier in a redundant system, an RF switch fault will occur. The system will not attempt to switch back to its original position. On the Redundancy Control Panel, both amplifiers will be colored red. The switch must be manually rotated back to the online amplifier.

PC Control using RS-485 and Paradise M&C Software

Applications requiring long cable runs between the computer and the 1:1 Redundant System may use RS-485 communication. The Compact Outdoor Amplifier's firmware supports networking on a RS-485 bus. This type of network can be used to support the 1:1 Redundant System.

The RS-485 link can typically be run up to 4000 ft. (1200 m) lengths. A good quality twisted pair cable should be used along with proper line terminations. There are no parallel end terminations in the amplifier's RS-485 interface. Any required cable terminations have to be added externally. Either full or half duplex RS-485 communication is supported. Schematics showing the proper wiring of each version are shown in Figures 17 and 18.

As in the stand-alone redundant system, each amplifier must be programmed for redundant system operation by using the RS-232 interface and M&C program. Similarly when networking SSPAs on a RS-485 network, each amplifier's address must be set before they can communicate over the network. Both of these steps should be performed together as part of the initial system setup.

Figure 17 shows a typical 1:1 Redundant System with RS-485 Full Duplex Communication.

Figure 17: 1:1 Redundant System with RS-485 Full Duplex Communication

Figure 18 shows a typical 1:1 Redundant System with RS-485 Half Duplex Communication.

Figure 18: 1:1 Redundant System with RS-485 Half Duplex Communication

Outdoor SSPA in 1:2 Redundancy

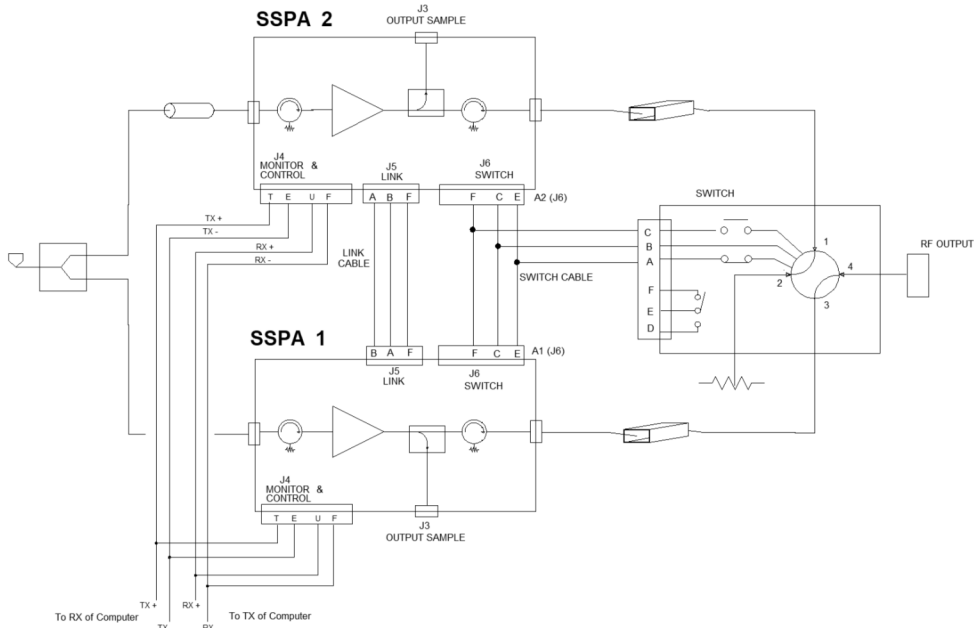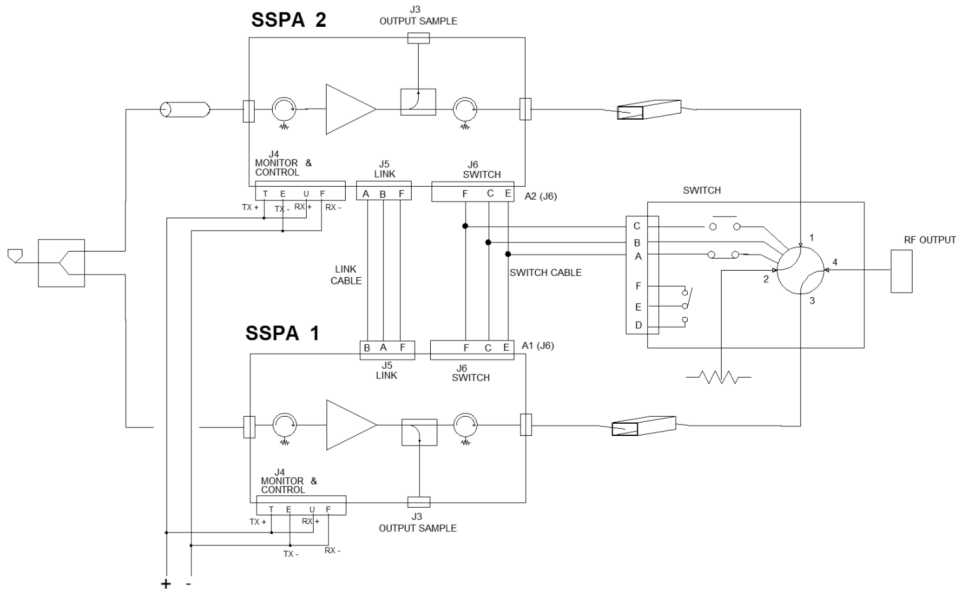The outdoor amplifier can also be configured in 1:2 Redundant Systems. A 1:2 Redundant System typically has two transmit paths, one on a horizontal polarity and the other on a vertical polarity. The system provides automatic switchover to the spare SSPA to either polarization path in case of a primary SSPA malfunction. In the case of two SSPA malfunctions, the backup SSPA can be switched to either polarization path, according to a polarization priority selection setting.

The standard 1:2 configuration has HPA1 online in the polarization 1 path, HPA3 online in the polarization 2 path, and HPA2 acting as spare backup for ether HPA1 or HPA3. A separate RCP2-1200 Redundant System controller is required to provide system control. The controller is used to constantly check the state of the controlled HPAs and, in case of malfunction, rotate the waveguide switches according to an internal logic table. The controller can be remotely located from the amplifiers at a distance of up to 500 ft. (152.4 m). Figure 19 shows a block diagram of a typical 1:2 Redundant System configuration.
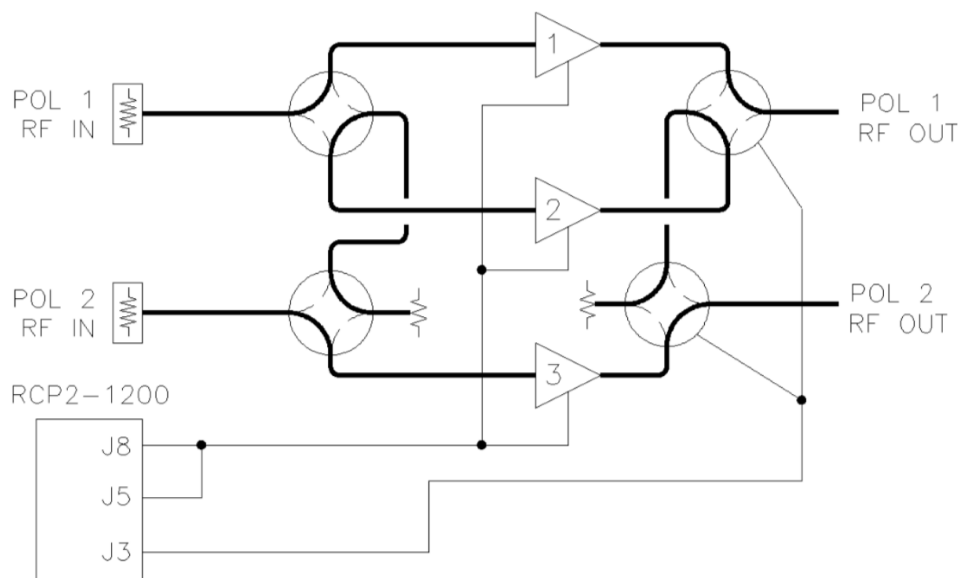
Figure 19: Block Diagram, 1:2 Redundant System

⚠ **Note: 1:1 Reundant Systems using Compact Outdoor amplifiers are typically shipped from the factory fully assembled. See drawing number 215534 for assembly instructions for a 1:1 Redundant System using High Power Outdoor amplifiers.**

Hardware Setup

The outdoor 1:2 Redundant System uses three SSPAs mounted to a uni-strut frame and a waveguide redundancy switch array. An indoor RCP2-1200 redundant system controller provides monitor and control functions.

A Switch Cable connects between the controller (Port J3) and each switch in the redundancy switch array. The redundancy switches are typically a -28 VDC type. The controller supplies +28 VDC over this cable to the common voltage input.

A Control Cable connects between the controller (Ports J5 and J8) and each HPA (Port J4) in the system, and is used to pass monitor and control signals.

All cable ends are marked with labels indicating to which port the connector must be mated. For proper system operation, all cables must be properly connected.

Software Setup

Operational settings for amplifiers configured for use in a redundant system are typically set up at the factory prior to shipment. If the user is using an amplifier not configured for a redundant system, the amplifier settings must be changed for such use. Temporarily connect the amplifier to a PC running the Teledyne Paradise Datacom Universal M&C Software to set up the redundant configuration.

There are two basic modes of 1:2 Redundant System communication.

1. PC Control using RS-232 and Paradise M&C Software
2. PC Control using RS-485 and Paradise M&C Software

Each outdoor amplifier is shipped from the factory with a "Quick Start" cable that can be used to change operational parameters. Using the Quick-Start cable, connect each amplifier to a PC running the Universal M&C software. Select the "Settings" tab from the main form, and assign the following parameters to each HPA.

- Operation Mode: Operation Mode must be set to "1:2 Redundant Mode"
- Hierarchical Address: Assign a unique address for each amplifier: HPA1, HPA2 and HPA3
- Standby Select: In 1:2 redundant systems, HPA2 is typically set as the standby amplifier, with HPA1 assigned to POL1 and HPA3 assigned to POL2. Once the system is operating, changing the state of HPA1 or HPA3 to "Standby" will cause the system to drive the switch so that HPA2 is in the "OnLine" state. Attempting to change the "Standby" amplifier to the "OnLine" state will have no effect. This setting is saved upon unit shut-down, and the unit starts up in the last saved state.
- Standby Mode: The Standby unit can be muted to have a "Cold Standby" condition. This setting keeps the SSPA module powered down for power savings while the microprocessor and fans remain operational. If the Standby amplifier switches to the Online state, it will automatically un-mute and transmit traffic. If the operator attempts to mute the Online amplifier a warning message will be displayed "You are about to mute the Online unit. Proceed with Mute?"

The above settings are valid as soon as the operator sets them on the SSPA Settings window. The SSPA's redundant operation can be verified by monitoring the RF Switch Fault indicator.

PC Control using Universal M&C Software

When using RS-232 or RS-485, a separate COM port will be required for each amplifier. Therefore a computer with at least three COM ports is required for such a system. Systems using RS-232 are limited by the length of the communication cable from the amplifiers to the computer. This is typically a maximum of 30 ft. (9 m) for most RS-232 device drivers. Systems requiring longer communication cable links should use RS-485 communication.

If connecting over an Internet connection, each amplifier must be assigned a unique IP address on the network.

After starting the M&C program, select [Action] > [Add Unit] > [Compact Outdoor SSPA] or [High Power Outdoor SSPA], depending on the type of unit used in the system. See Figure 20.
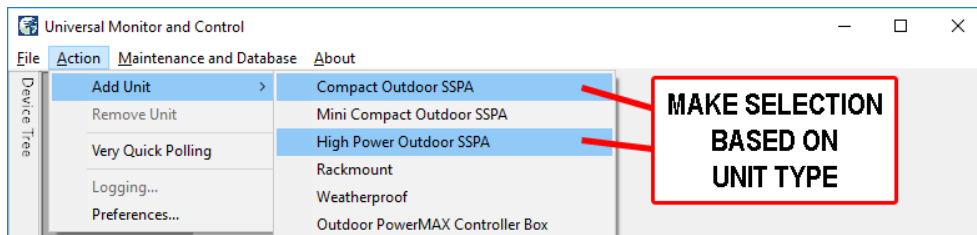
Figure 20: Universal M&C Program, Add Unit

The Add New SSPA window will appear as shown in Figure 21.
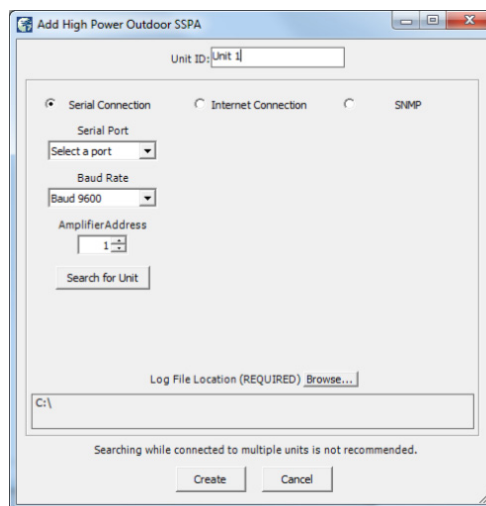
Figure 21: Universal M&C Program, Add Unit

From this screen, choose the COM port and baud rate. The factory default baud rate is 9600. If a single SSPA is used, the Global network address setting should be used.

After the COM port has been selected, the "Operation" window will be displayed. If the unit is connected to a power source and turned on, the SSPA will begin communicating with the M&C program and its operating parameters will be displayed, as shown in Figure 22.
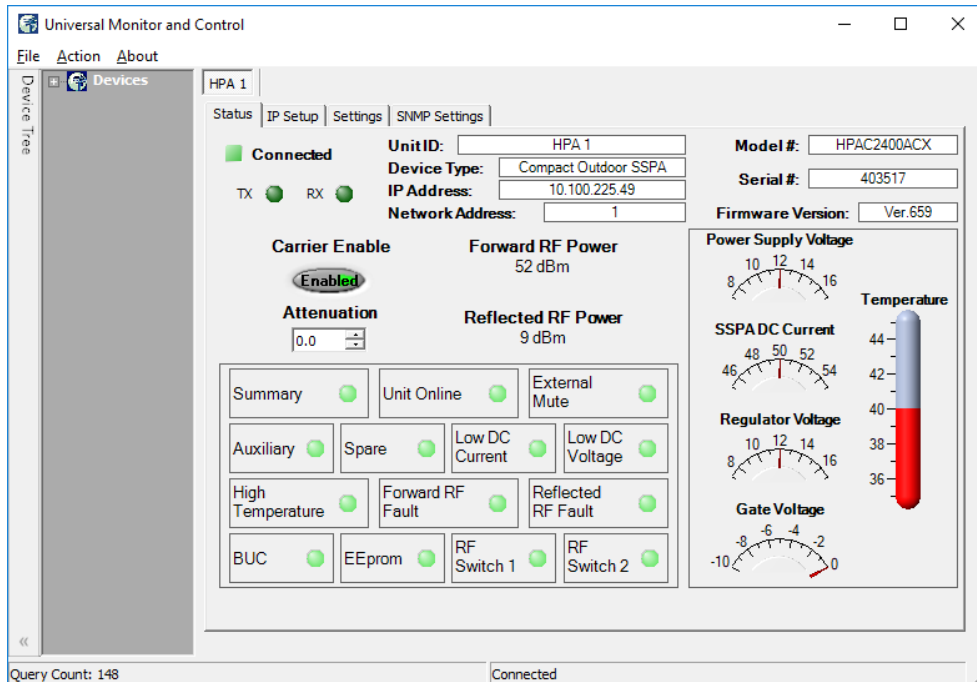
Figure 22: Universal M&C Program, Status Tab

Add each amplifier to the M&C program, selecting the correct COM ports for the other amplifiers. The operation windows will appear on the M&C program display. If any of the amplifiers is not communicating with the M&C Operation screen, debug the system to find the problem. Check the RS-232 connection from each amplifier to the appropriate COM port of the PC.

Once reliable communication has been established between each amplifier and the computer, the Redundancy Control Panel can be displayed. From the M&C program's main window, choose [Action] > [Add Unit] > [Controller]. See Figure 23.
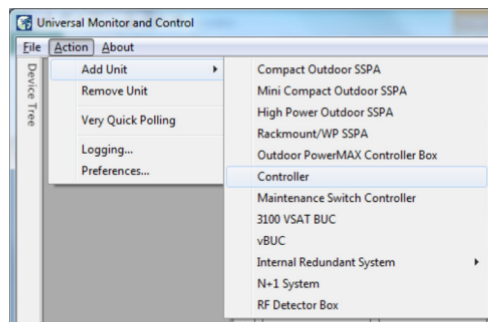
Figure 23: Universal M&C Program, Add Controller

The Redundant Control Panel window will then be displayed as in Figure 24. Note that once the Redundant Control Panel is enabled, the Main Menu on the M&C program changes.
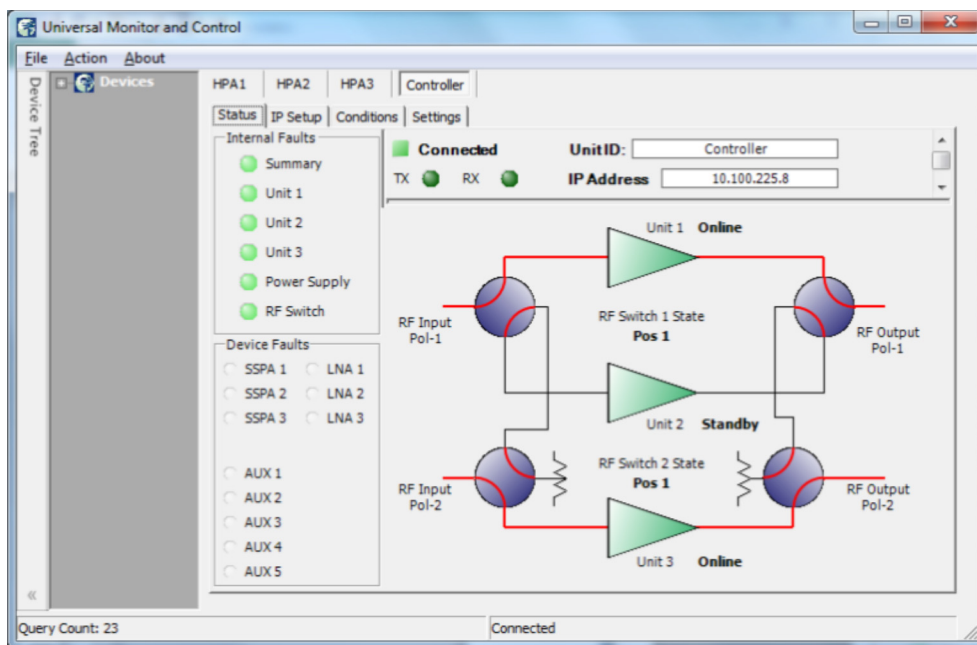
Figure 24: Universal M&C Program, Controller Status Window

See the section on SSPA Control with Universal M&C Software.

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Outdoor SSPAs, Phase Combined System Operation

Phase Combining Overview

Phase combining amplifiers has long been a popular means of increasing the output power of an amplifier system. Under high power microwave conditions it is common to utilize some form of waveguide hybrid coupler to combine the output power of two amplifiers. This coupler is generally a waveguide tee such as a four port magic tee. On the input side, common coaxial power splitters can be utilized to divide the power due to the lower power levels at the input of the system.

Figure 1 shows a typical block diagram of a phase combined amplifier pair. As long as the electrical delay, phase and amplitude of the two paths are kept within close tolerance of each other, the output power of the system will be twice the output power (+3 dB) of a single amplifier.
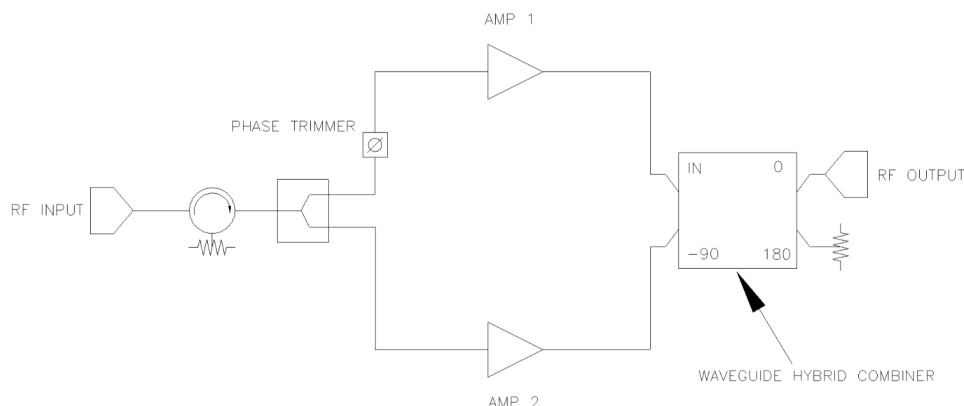
Figure 1: Block Diagram, 1:1 Phase Combined System

The main drawback of this approach is that in the event of an amplifier failure, the total output power decreases by 6 dB, or a factor of 4. This does not offer the system much in the way of redundant capability with such a large decrease in output power capability. The power decrease is due to the fact that with only one amplifier active, the output combiner acts as a power divider. The output power from the remaining amplifier is divided between the output of the system and the terminated port of the hybrid combiner. Thus only one half of the power from one amplifier reaches the output port which is 6 dB less than the combined output power from both amplifiers.

A high power system requiring a degree of redundancy needs some means of bypassing the combiner in the event of an amplifier failure. This would allow the full output power capacity of the remaining amplifier to reach the output. In this case the total RF output power would only decrease by 3 dB from the phase combined output power. A 3 dB reduction in output power is generally more tolerable to a system's link budget thereby giving the system a degree of redundancy.

A technique has been developed which accomplishes phase combining and provides redundancy with two waveguide transfer switches. A block diagram of such a system is shown in Figure 2.
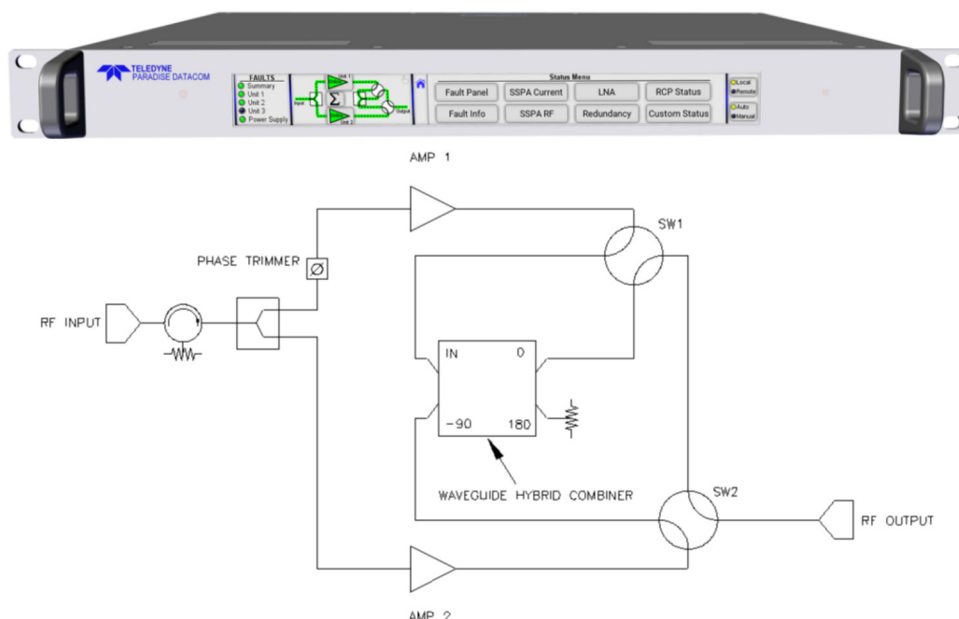
Figure 2: 1:1 Fixed Phase Combined System with FPRC-1100 Controller

This type of system is sometimes referred to as a "Fixed Phase" combined (FPC) system to differentiate it from the Variable Phase Combiner (VPC) systems commonly used with TWTAs. In the 1:1 Fixed Phase Combined system, the waveguide switches allow the amplifier outputs to either be directed into the combiner or bypass the combiner and connect directly to the RF output.

Teledyne Paradise Datacom has developed a series of controllers that greatly enhances the operation of the phase combined system. The FPRC-1100 Phase Combined System Controller is designed specifically to control 1 for 1 Fixed Phase Combined redundant amplifier systems. The FPRC-1200 Phase Combined System Controller allows remote control of 1 for 2 Fixed Phase Combined redundant amplifier systems.

Each controller can be used in either manual or automatic mode to monitor the system amplifiers for faults and operate the transfer switches. The controller has a very user friendly interface that allows the operator to monitor the composite output power of the system and adjust the gain of the amplifiers in 0.1 dB increments over a 20 dB range. The controller adjusts each amplifier in the system and keeps the amplitude of each balanced for optimal power combining. To the operator, the system appears as a single amplifier. The operator can choose between using the system as a phase combined system or a traditional redundant system.

1:1 FPC System Operation with FPRC-1100

Under normal 1:1 phase combined system operation, both HPA #1 and HPA #2 are on-line. Their output power is combined at the magic-tee waveguide combiner. The waveguide combiner has an integrated RF sample port that provides a sample of the RF output. This port feeds an RF attenuator/diode detector combination. The detector's output voltage is sent back to the Signal box via a coaxial cable and linked to the FPRC-1100 Redundant Controller.

The FPRC-1100 is a 1 RU high indoor controller that can remotely monitor and control the 1:1 Fixed Phase Combined system. The controller has a very user friendly interface that allows the operator to monitor the composite output power of the system and adjust the gain of the amplifiers in 0.1 dB increments over a 20 dB range. The controller adjusts each amplifier in the system and keeps the amplitude of each balanced for optimal power combining.

The FPRC-1100 can be used in automatic or manual mode. In manual mode if a fault occurs in one of the amplifiers, a fault will be indicated on the front panel but no waveguide switch change will occur. In automatic mode the controller will determine the appropriate waveguide switch positions and switch the remaining two amplifiers on line. This will ensure that the system is operating at full output power capability.

The FPRC-1100 front panel is shown in Figure 3. In most cases the user will place the controller in Auto mode so that the controller can determine the proper switch position in the event of an amplifier failure. The mimic display shows the position of each waveguide switch by lighting an LED in the waveguide switch path.

Figure 3: FPRC-1100 Phase Combined System Controller

⚠ **Note: See drawing number 216351 for detailed information on the installation and operation of the FPRC-1100 Phase Combined System Controller.**

1:1 FPC System Components

A block diagram of a 1:1 Fixed Phase Combined Amplifier System is shown in Figure 4.
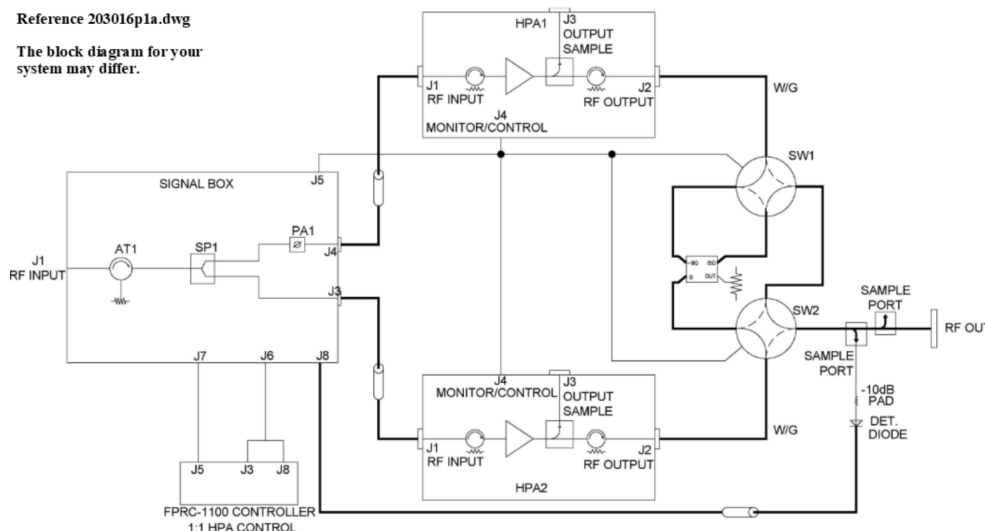
Figure 4: Block Diagram, 1:1 Fixed Phase Combined System with Signal Box, Typical

The system consists of:

- One (1) System Frame Assembly (uni-strut)
- Two (2) Compact Outdoor or High Power Outdoor Amplifiers
- One (1) Signal Box Assembly
- One (1) Waveguide/Switch Assembly
- Two (2) Cable Assemblies between SSPAs and Signal Box
- One (1) FPRC-1100 1:1 Phase Combined System Controller
- Two (2) Cable Assemblies between the Signal Box and FPRC-1100
- Two (2) AC Line cables
- One (1) Quick Start Ethernet Cable for test/debugging

Signal Box Assembly

The Signal Box Assembly contains the RF input isolator and splitter that routes the RF to each amplifier. It also routes the monitor and control signals from each amplifier back to the FPRC-1100 system controller.

The signal box also contains a phase shifter. This phase shifter is in cascade with the RF input to HPA #1. This allows the phase of the amplifiers to be adjusted to achieve optimum power combining. The amplifiers are phase adjusted at the factory to achieve the best balance of power across the full operating bandwidth.

The system should not normally require phase adjustment in the field unless an amplifier has been replaced. See the Phase Adjustment section for instructions on adjusting the phase.

1:1 FPC System with L-Band Input

The basic 1:1 Fixed Phase Combined system topology is very similar to a 1:1 redundant system and is shown in Figure 5.

Figure 5: Block Diagram, 1:1 Fixed Phase Combined System with L-Band Input, Typical

When in Automatic mode, the waveguide switches (SW1 and SW2) either direct each amplifier output to the waveguide phase combiner or, if lower output power is required, bypasses the combiner and sends an individual amplifier output to the system output.

The system shown in Figure 5 utilizes a RCP2-1100 redundant system controller for the redundant BUC system housed in the signal box, along with the FPRC-1100 phase combined system controller to control the SSPAs and output switch array.

A FPRC-1100 controller directs the HPA output switches and monitors the amplifiers. While the system is operating in phase combined mode, and an amplifier enters a fault condition, the controller will switch the faulted amplifier offline. This provides a soft-fail mode and results in a power decrease of 3 dB to the system output power.

The BUC switch (SW3) is driven by an indoor RCP2-1100 redundant system controller. When a BUC fault is detected, the switch is driven to place the faulted BUC offline without user intervention.

This system may also be operated via manual mode. This mode of operation may offer some benefits over automatic operation. When in manual mode, the amplifiers will not switch out of Phase Combined mode or switch to the operational amplifier without user intervention if an HPA fault occurs.

However, if a BUC fault occurs, the RCP2-1100 will direct SW3 to place the operational BUC online. A fault indicator will be present on the front panel of the RCP unit, but the system output would be unaffected by the BUC fault.

1:1 FPC System with L-Band Input Components

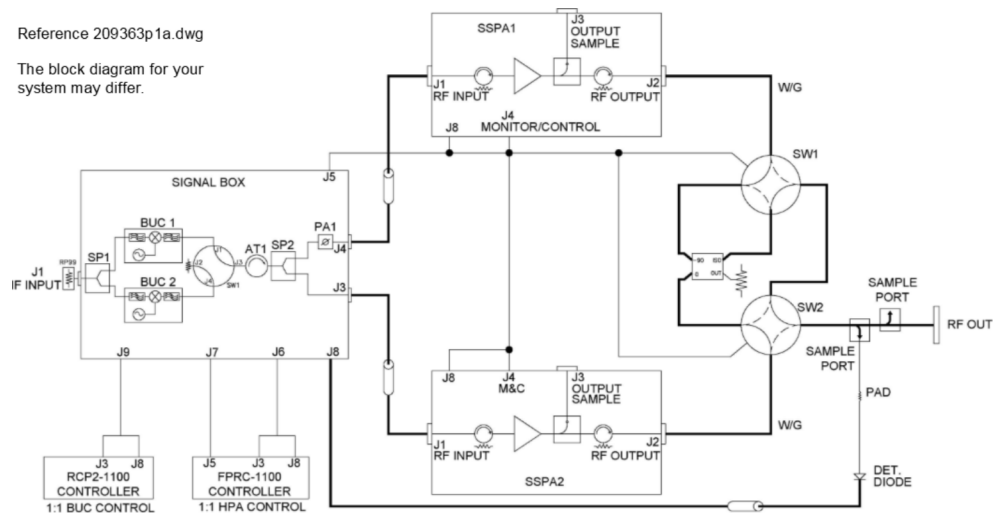A block diagram of a 1:1 Fixed Phase Combined Amplifier system with L-Band Input is shown in Figure 5.

The system consists of:

- One (1) System Frame Assembly (uni-strut)
- Two (2) Compact Outdoor Amplifiers
- One (1) Signal Box Assembly with 1:1 Redundant Block Up Converter System
- One (1) Waveguide/Switch Assembly
- One (1) Cable Assembly between SSPAs and Signal Box
- One (1) FPRC-1100 1:1 Phase Combined System Controller
- Two (2) Cable Assemblies between the Signal Box and FPRC-1100
- One (1) RCP2-1100 1:1 Redundant System Controller (for BUC system)
- One (1) Cable Assemblies between the Signal Box and RCP2-1100
- Four (4) AC Line cables (for controllers)
- One (1) Quick Start Ethernet Cable for test/debugging

Signal Box Assembly

The Signal Box Assembly contains the Redundant BUC System including the coaxial switch, the RF input isolator and splitter that routes the RF to each amplifier. It also routes the monitor and control signals from each amplifier back to the FPRC-1100.

The signal box also contains a phase shifter. This phase shifter is in cascade with the RF input to HPA #1. This allows the system to achieve optimum power combining and is factory set for the best possible combining across the full operating bandwidth of the amplifier.

The system should not normally require phase adjustment in the field unless an amplifier has been replaced. See the Phase Adjustment section for instructions on adjusting the phase.

Redundant BUC Operation

With the addition of an RCP2-1100 Redundant System controller, the BUCs function as an independent, fully redundant 1:1 system that is not affected by the status of the 1:1 phase combined SSPA system.

1:2 FPC Systems

The 1:2 Phase Combined Redundant System is a popular system architecture that enables Solid State Power Amplifiers to achieve higher output power levels while building in full-power redundancy. The basic system topology is similar to a 1:2 redundant system and is shown in Figure 6.
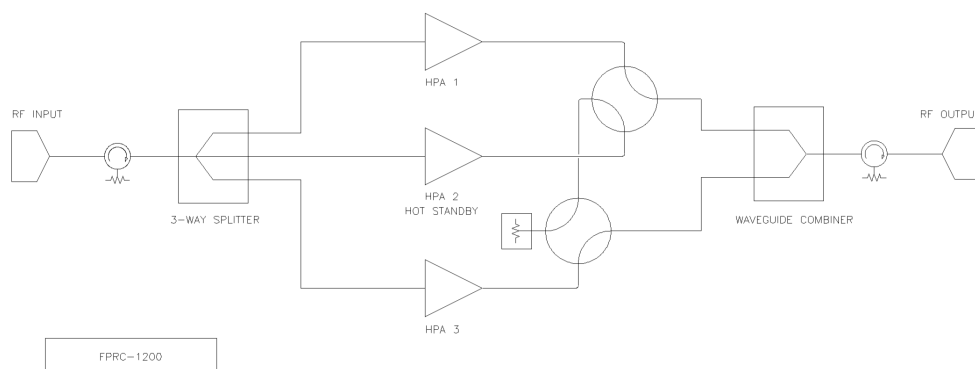
Figure 6: Block Diagram, 1:1 Fixed Phase Combined System, Typical

In this system, amplifiers #1 and #3 are normally online. The outputs of #1 and #3 are directed by the waveguide switches into a fixed phase combiner such as a waveguide "magic tee" style combiner. In the event of a failure of either on line amplifier, the standby amplifier, #2, can be switched in place of either #1 or #3 and the system maintains full output power.

The 1:2 Phase Combined System is controlled by an FPRC-1200 1:2 System Controller. Detailed information on the installation and operation of the FPRC-1200 can be found in the unit's operations manual, Teledyne Paradise Datacom drawing #216351.

The FPRC-1200 can be used in automatic or manual mode. In manual mode, if a fault occurs in one of the amplifiers, a fault will be indicated on the front panel but no waveguide switch change will occur. In automatic mode, the controller will determine the appropriate waveguide switch positions and switch the remaining two amplifiers online. This will ensure that the system is operating at full output power capability.

The output power of a phase combined system is roughly two times the output power of the single SSPA. Some loss in the transmission line (at the switches and combiners) should be expected which prevent a true doubling of output power.

System designers find that the 1:2 Phase Combined Amplifier System topology is a very cost effective solution to realizing high power amplifier systems. For example, it is less expensive to configure a 1 kW redundant system using (3) 500W amplifiers in a 1:2 Phase Combined system than it is to use (2) 1 kW amplifiers in a traditional 1:1 Redundant System.

1:2 FPC System Operation with FPRC-1200

Under normal 1:2 phase combined system operation, HPA #1 and HPA #3 are online, and HPA #2 is in standby mode as shown in Figure 7.

Figure 7: Block Diagram, 1:2 Phase Combined System with Signal Box, Typical

The output power of the online units is combined at the magic-tee waveguide combiner. The 1:2 system has an integrated RF sample port that provides a sample of the forward RF output and is calibrated over the system's operational frequency. A second port feeds an RF attenuator/detector combination. The resultant signal is sent back to the Signal box via a coaxial cable and linked to the FPRC-1200 Redundant Controller.
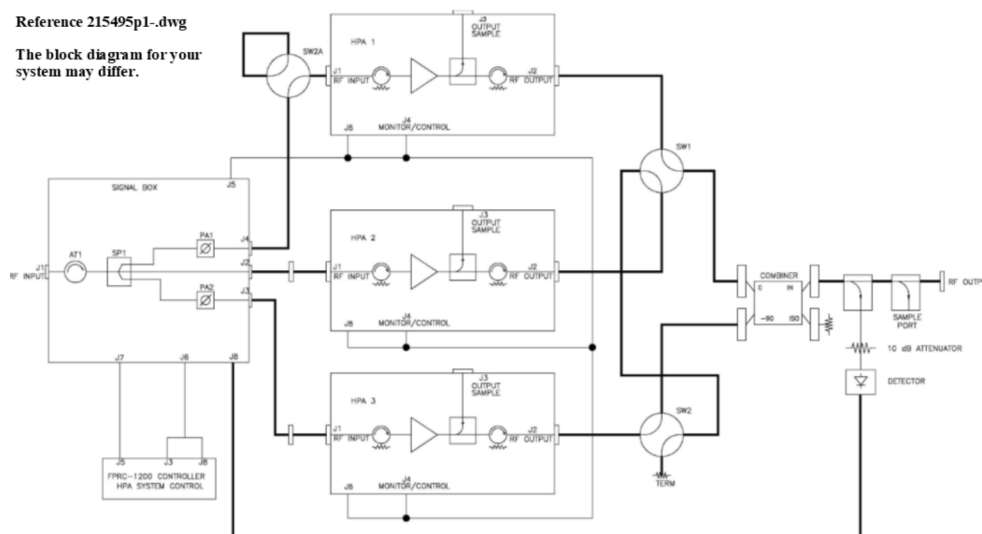
The FPRC-1200 is a 1 RU high indoor controller that can remotely monitor and control the 1:2 Fixed Phase Combined system. The controller has a very user friendly interface that allows the operator to monitor the composite output power of the system and adjust the gain of the amplifiers in 0.1 dB increments over a 20 dB range. The controller adjusts each amplifier in the system, keeping the amplitude of each balanced for optimal power combining.

The FPRC-1200 can be used in automatic or manual mode. In manual mode if a fault occurs in one of the amplifiers, a fault will be indicated on the front panel but no waveguide switch change will occur. In automatic mode the controller will determine the appropriate waveguide switch positions and switch the remaining two amplifiers on line. This will ensure that the system is operating at full output power capability.

The FPRC-1200 front panel is shown in Figure 8. In most cases the user will place the controller in Auto mode so that the controller can determine the proper switch position in the event of an amplifier failure. The mimic display shows the position of each waveguide switch by lighting an LED in the waveguide switch path.

Figure 8: System Controller Configured in FPRC-1200 1:2 Phase Combined Mode

In normal operation, HPA #2 should be selected as the standby amplifier. HPA #2 is the middle amplifier on the amplifier frame. This allows the outputs of HPA #1 and HPA #3 to be combined at the waveguide combiner. If HPA #1 or HPA #3 were to ever fail, HPA #2 would be switched in place of the failed amplifier, and the system will maintain full output power capability over the full operating bandwidth of the system. Figure 9 shows the FPRC-1200 front panel mimic display with HPA #2 selected as the standby amplifier.

Figure 9: FPRC-1200 Mimic Display with HPA #2 in Standby Mode

⚠ **Note: See drawing number 216351 for detailed information on the installation and operation of the FPRC-1100 Phase Combined System Controller.**

1:2 FPC System Components

The 1:2 Phase Combined Amplifier system, as shown in Figure 7, consists of:

- One (1) System Frame Assembly (uni-strut)
- Three (3) Compact Outdoor Amplifiers
- One (1) Signal Box Assembly
- One (1) Waveguide/Switch Assembly
- Three (3) Cable Assemblies between SSPAs and Signal Box
- One (1) FPRC-1200 1:2 Phase Combined System Controller
- Two (2) Cable Assemblies between the Signal Box and FPRC-1200
- Three (3) AC Line cables
- One (1) Quick Start Ethernet Cable for test/debugging

The FPRC-1200 controller is a 1RU external controller specifically designed to handle a 1:2 phase combined system. It not only handles all traditional fault monitoring and switching duties, but also provides an overall system monitor and control facility.

Signal Box Assembly

The Signal Box assembly contains the RF input isolator and three way splitter that routes the RF to each amplifier. The box also routes the monitor and control signals from each amplifier back to the FPRC-1200 system controller.

The signal box also contains two phase shifters. These phase shifters are in cascade with the RF inputs to HPA #1 and HPA #3. This allows the system to achieve optimum power combining and is factory set for the best possible combining across the full operating bandwidth of the amplifier.

The system should not normally require phase adjustment in the field unless an amplifier has been replaced. See the Phase Adjustment section for instructions on adjusting the phase.

1:2 FPC System with L-Band Input

The system shown in Figure 10 utilizes a RCP2-1100 redundant system controller for the redundant BUC system housed in the signal box, along with the FPRC-1200 phase combined system controller to control the SSPAs and output switch array.
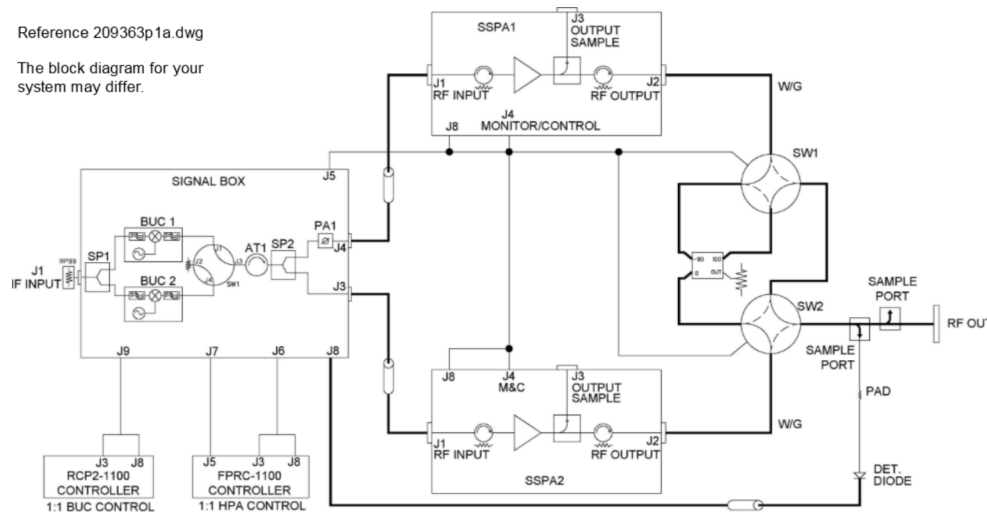

Figure 10: Block Diagram, 1:2 Phase Combined System with L-Band Input, Typical

The FPRC-1200 controller directs the HPA output switches and monitors the amplifiers. While the system is operating in phase combined mode, and an amplifier enters a fault condition, the controller will switch the faulted amplifier offline. This provides a soft-fail mode and results in no power decrease to the system output power.

The BUC switch is driven by an indoor RCP2-1100 redundant system controller. When a BUC fault is detected, the switch is driven to place the faulted BUC offline without user intervention.

This system may also be operated via manual mode. This mode of operation may offer some benefits over automatic operation. When in manual mode, the amplifiers will not switch out of Phase Combined mode or switch to the operational amplifier without user intervention if an HPA fault occurs.

However, if a BUC fault occurs, the RCP2-1100 will direct the BUC switch to place the operational BUC online. A fault indicator will be present on the front panel of the RCP unit, but the system output would be unaffected by the BUC fault.

1:2 FPC System with L-Band Input Components

The 1:2 Phase Combined Amplifier system shown in Figure 10 consists of:

- One (1) System Frame Assembly (uni-strut)
- Three (3) Compact Outdoor Amplifiers
- One (1) Signal Box Assembly with 1:1 Redundant Block Up Converter System
- One (1) Waveguide/Switch Assembly
- One (1) Cable Assembly between SSPAs and Signal Box
- One (1) FPRC-1200 1:1 Phase Combined System Controller
- Two (2) Cable Assemblies between the Signal Box and FPRC-1200
- One (1) RCP2-1100 1:1 Redundant System Controller (for BUC system)
- One (1) Cable Assembly between the Signal Box and RCP2-1100
- Four (4) AC Line cables (for controllers)
- One (1) Quick Start Ethernet Cable for test/debugging

Signal Box Assembly

The Signal Box Assembly contains the Redundant BUC System including the coaxial switch, the RF input isolator and splitter that routes the RF to each amplifier. It also routes the monitor and control signals from each amplifier back to the FPRC-1200.

The signal box also contains two phase shifters. These phase shifters are in cascade with the RF inputs to HPA #1 and HPA #3. This allows the system to achieve optimum power combining and is factory set for the best possible combining across the full operating bandwidth of the amplifier.

The system should not normally require phase adjustment in the field unless an amplifier has been replaced. See Section 8.6.2 for phase adjustment instructions.

Redundant BUC Operation

With the addition of an RCP2-1100 Redundant System controller, the BUCs function as an independent, fully redundant 1:1 system that is not affected by the status of the 1:1 phase combined SSPA system.

Phase Adjustment

The 1:1 or 1:2 phase combined system is phase adjusted for optimum performance across the operating frequency band at the factory, and no adjustments are typically needed except in the event that a SSPA has been replaced.

The SSPAs are manufactured to a delay specification, but an adjustment may be necessary to achieve the maximum output power in the system at the desired frequency of operation.

Phase Adjustment in 1:1 Phase Combined Systems

After installing the replacement amplifier, attach a power meter or spectrum analyzer to the cross-guide coupler at the output of the system. Apply a mid-band CW carrier and measure the power output of the system, making note of the sample port calibration label.

Alternately, you may use the FPRC-1100 controller's output power display (available by tapping the Status button on the touchscreen, tapping the SSPA RF button, and reviewing the displayed System Fwd RF value shown in the upper right of the display).

Remove the cover from the Signal Box and loosen the locking nut on the phase adjuster (7/16") knob and slowly rotate the knob clockwise. See Figure 11. Continue to rotate the knob until the output power is peaked. If no peak is found, rotate counter-clockwise until output peaks.
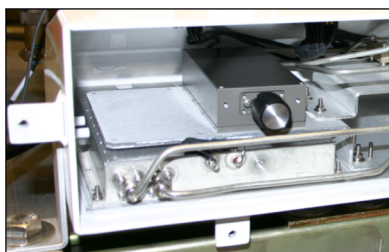
Figure 11: Phase Adjuster in Signal Box, 1:1 FPC Systems

For optimum performance across the entire frequency range of the SSPA system, repeat the steps above at the low end of the operating frequency band, and again at the high end of the operating frequency band. It may be necessary to find the best compromise in output power for broadband use.

The BUCs are outside the phase combined loop. Therefore, replacing a BUC will not impact the phase combining of the system, and no adjustment of the phase shifter is necessary.

Once the phase adjustments are complete, tighten the locking nut on the phase adjustment knob and securely fasten the cover back on to the Signal Box.

Phase Adjustment in 1:2 Phase Combined Systems

After installing the replacement amplifier, attach a power meter or spectrum analyzer to the cross-guide coupler at the output of the system. Apply a mid-band CW carrier to the system and measure the power output of the system, making note of the sample port calibration label.

Alternately, you may use the FPRC-1200 controller's output power display, available by tapping the Status button on the touchscreen, tapping the SSPA RF button, and reviewing the displayed System Fwd RF value shown in the upper right of the display.

The two phase adjusters are located inside the Signal Box and are labeled PA1 and PA2. See Figure 12. To make adjustments, first loosen the 7/16" locking nut on the phase adjuster knob.

Figure 12: Phase Adjuster in Signal Box, 1:1 FPC Systems

To adjust the phase combining, un-mute the amplifiers and, using the FPRC-1200, set HPA #1 as the standby amplifier. Apply a CW signal (mid-band). With HPA #2 and #3 power combined, phase adjuster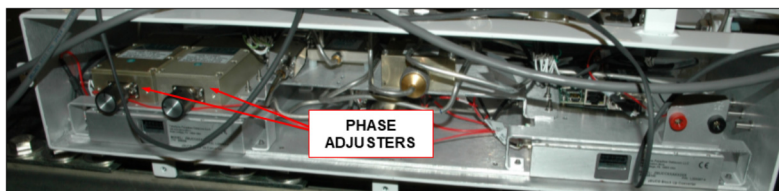 (PA2) will be used to maximize the output power. Vary phase adjuster 2 (PA2) to peak the power reading on the power meter or spectrum analyzer, or from the FPRC-1200 controller's output power display. Record the Pout. Measure and record the Pout at the system's low frequency, and again at the system's high frequency.

Next, select HPA #2 as the standby. This combines HPA #1 and HPA #3. Use phase adjuster (PA1) to optimize power. Vary phase adjuster 1 (PA1) to peak the power reading on the power meter or spectrum analyzer, or from the FPRC-1200 controller's output power display. Record the Pout.

Select HPA #3 as the standby amplifier. This combines HPA #1 and HPA #2. Measure the output power and record the Pout at the system's low frequency, mid-band, and high frequency.

Compare the output powers from all three phase combined configurations; the results should be similar. If the results differ, repeat the steps above to achieve the best balance for all three amplifier configurations across the operating frequency band. Choose the best compromise in power for all combinations so that if a switch-over on fault does occur, there is no noticeable increase or decrease in output power.

After phase combining is complete use the locking nut on each phase adjuster to secure the adjustment knob so no accidental changes to the combining occur.

Before placing the system back in operation, replace the cover to the Signal Box, and reconnect the detector and attenuator to the cross-guide coupler, ensuring the connection is sealed against moisture intrusion.

Outdoor SSPAs, Remote Control Protocol

Teledyne Paradise Datacom
Drawing Number: 216595-7 Revision -
RA 7714
06 November 2019

Overview

A system which includes an SSPA can be managed from a remote computer over a variety of remote control interfaces (see Figure 1).
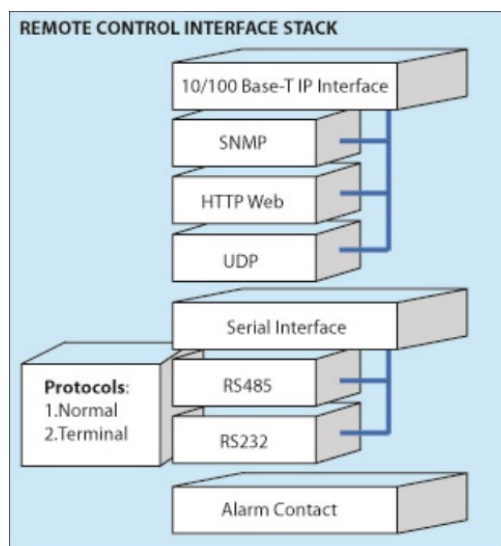
Figure 1: Remote Control Interface Stack

Serial interface can be selected between RS-232/RS-485, Ethernet 10/100Base-T or FSK over IFL input (FSK interface is available only on units with an optional L-Band block up converter). RS-232/RS-485 interface can be used in conjunction with Paradise CO SSPA serial protocol (aka Normal protocol) or Legacy Paradise VSAT BUC serial protocol (aka VSAT protocol).

> ⚠ **Note: Binary protocol used on previous generation units are no longer supported. Terminal protocol was re-introduced starting with version 6.60**

Outdoor SSPAs are capable of supporting simultaneous multiple remote control interfaces, depending on the protocol selection settings and drive of Baud0 and Baud1 pins on J4 M&C connector. See Table 2 under the **Operational Basics** section.

The Ethernet interface for units with firmware version 6.0 or later utilizes industry standard 10/100 Base-T IP protocol and supports the IPv4 addressing schema. Units with previous firmware versions use 10 Base-T IP protocol. Normally, straight-through Cat5e/Cat6 cable is used to connect the unit to a network hub, and a crossover Quick-Start cable is used to connect directly to a computer's Ethernet port.

> ⚠ **Note: The supplied Quick Start cable is a crossover cable designed to connect the unit directly to a PC's NIC card. Some network hubs and switches are not equipped with an auto cable sense feature and may not work with this cable!**

Serial Communication Protocol

This section describes the normal communication protocol between the CO SSPA and a host computer over RS-232/RS-485 serial interface. Serial port settings on the host computer must be configured for 8 bit data at no parity, with 1 stop bit. The baud rate should match the selected baud rate parameter on the SSPA unit.

Selection between the RS-232 and RS-485 interface depends on the state of pin D of the J4 M&C connector. Connect pins D and d to select RS232 interface. Otherwise SSPA will operate in RS485 mode.

The unit will only respond to properly formatted protocol packets. The basic communication packet is shown in Figure 2. It consists of a Header, Data, and Trailer sub-packet.
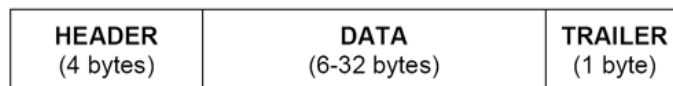
Figure 2: Basic Communication Packet

Header Sub-Packet

The Header packet is divided into three sub-packets which are the Frame Sync, Destination Address and Source Address packets (See Figure 3).
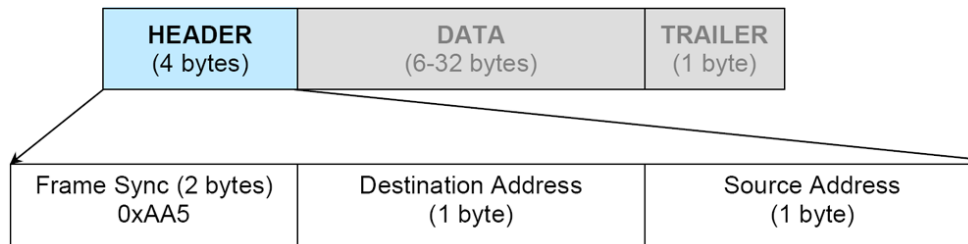
Figure 3: Header Sub-Packet

Frame Sync Word

The Frame Sync word is a two byte field that marks the beginning of a packet. This value is always 0xAA55. This field provides a means of designating a specific amplifier packet from others that may exist on the same network. It also provides a mechanism for a node to synchronize to a known point of transmission.

Destination Address

The destination address field specifies the node for which the packet is intended. It may be an individual or broadcast address. The broadcast address is 0xAA. This is used when a packet of information is intended for several nodes on the network. The broadcast address can be used in a single device connection when the host needs to determine the address of the amplifier. The amplifier will reply with its unique address.

Source Address

The source address specifies the address of the node that is sending the packet. All unique addresses, except the broadcast address, are equal and can be assigned to individual units. The host computer must also have a unique network address.

Data Sub-Packet

The data sub-packet is comprised of 6 to 32 bytes of information. It is further divided into seven (7) fields as shown in Figure 4. The first six (6) fields comprise the command preamble while the last field is the actual data.
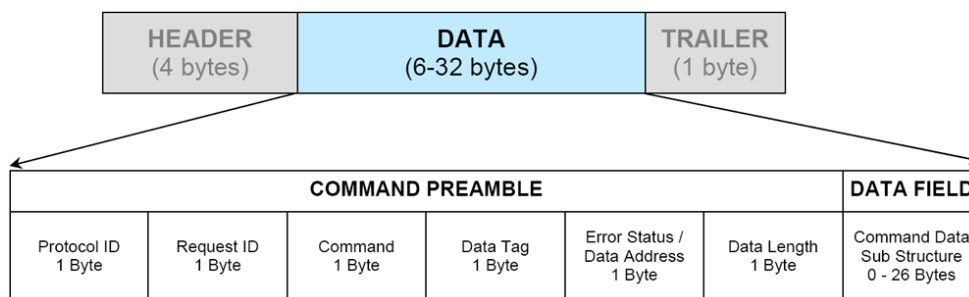
Figure 4: Data Sub-Packet

Protocol ID

This field provides backward compatibility with older generation equipment protocol. It should normally be set to zero (0). This field allows the amplifier to auto-detect other protocol versions, which may exist in the future.

Request ID

This is an application specific field. The amplifier will echo this byte back in the response frame without change. This byte serves as a request tracking feature.

Command

The SSPA protocol is a table based protocol. It allows the user to view and modify data tables located on the controlled device. Throughout the remainder of this description, "sender" will refer to the host PC, and "receiver" will refer to the SSPA unit.

Sender and receiver are limited to two commands and two command responses. The Get Request command issued by a command sender allows monitoring of existing conditions and parameters on the receiver. The Get Request frame should not have any bytes in the Data Filed and be no longer than 11 bytes.

The Response frame from the receiver will contain a Get Response designator in the Command field. If the receiver does not detect any errors in the Get Request frame, the requested data will be attached to the response frame. The length of the Get Response framevaries by the amount of attached data bytes. It may contain 11+N bytes where N is the amount of requested data bytes from a particular table, specified in Data Length field.

The Set Request command allows the sender to actively change parameters for the receiver's internal configuration. The Set Request frame must contain a number of bytes in the Data Field as specified in Data length field. The frame size must be 11+N bytes, where N is the length of the attached data structure. The receiver will respond with a frame where the command field will be set to a Set Response designator. The frame length is equal to the Request frame. The byte value for each command is given in Table 4.

Table 1: Command Byte Values

Command Name	Command Byte Value
Set Request	0
Get Request	1
Set Response	2
Get Response	3

Data Tag

The SSPA internal structure is organized in several tables, all of which share similar functionality and internal resources. To access the various tables, the data tag must be specified in the request frame. The data associated with certain tags is read only. Therefore only the "Get" command request would be allowed to access these data tags. The SSPA will return an error on attempts to issue a "Set" request to a read-only table tag. Various tables may contain values formatted either in 1 or 2 bytes format. See Table 5.

Table 2: Data Tag Byte Values

Tag Name	Byte Value	Field Length	Description
System Settings Tag	0	1 byte	This tag allows accessing various system settings on remote unit. Host access status: Full Read/Write access. Settings can be modified at any time. Some settings may require hardware reset of the remote SSPA unit.

System Threshold Tag	1	2 bytes	This tag allows access to the critical unit thresholds. Consult the factory before changing any of these settings.
System Conditions Tag	3	1 byte	This tag allows access to the unit's internal conditions flags, such as fault status or current system status. Host access status: Read only. This type of data cannot be set or modified remotely.
ADC Channel Access Tag	4	2 bytes	This tag allows access to the unit's internal Analog to Digital converter. Host access status: Read only. This type of data cannot be set or modified remotely.
Packet Wrapper	6	1 byte	This tag is not used in CO SSPA protocol.
Reserved	2,5	N/A	These tags are reserved for factory use only.

Data Address / Error Status / Local Port Frame Length

This field is a tag extension byte and specifies the first table element of the tagged data. If the Data Length is more than 1 byte, then all subsequent data fields must be accessed starting from the specified address. For example, if the requestor wants to access the amplifier's unique network address, it should set data tag 0 (System settings tag) and data address 8 (see System Settings Details table). If the following Data Length field is more than 1, then all subsequent Settings will be accessed after the Unique Network Address.

> ⚠ **Important! In the Response, the Frame Data Address field is replaced with the Error Status information. The various error codes are given in Table 6.**

Table 3: Error Status Byte

Error Code Name	Byte Value	Possible Cause
No Errors	0	Normal condition; no errors detected.
Data Frame Too Big	1	Specified Data length is too big for respondent buffer to accept.
No Such Data	2	Specified Data Address is out of bounds for this tag data.
Bad Value	3	Specified value not suitable for this particular data type.
Read Only	4	Originator tried to set a value which has read only status.
Bad Checksum	5	Trailer checksum not matched to calculated checksum.
Unrecognizable Error	6	Error presented in originator frame, but respondent failed to recognize it. All data aborted.

Data Length

This byte value specifies the number of bytes attached in the Data Field. For the Get command, it specifies the number of data bytes that have to be returned by the SSPA unit to a host PC in the Response frame. For Set commands, the value of this byte specifies the number of data fields to be accessed starting from the address specified in the Data Address byte. In general, the Data Length value plus the Data Address must not exceed the maximum data size particular tag.

Data Field

The actual data contained in the packet must be placed in this field. The "Get Request" type of command must not contain any Data Field. Any "Get Request" will be rejected if any data is present in the Data Field. Generally, the Bad Checksum error code will be added to the response from the amplifier if the word size of the information is 16-bits or 2-bytes. Each data word is placed in the frame with its least significant byte first. All data with length of 2 bytes must be represented as integer type with maximum value range from 32767 to (-32767).

Trailer Sub-Packet

The trailer component contains only one (1) byte called the Frame Check Sequence, shown in Figure 6. This field provides a checksum during packet transmission.
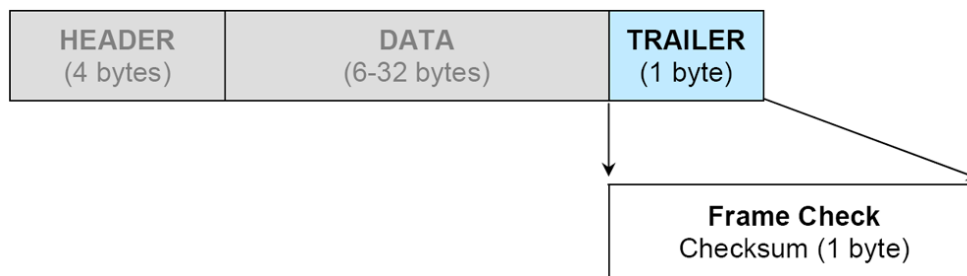
Figure 5: Trailer Sub-Packet

Frame Check

This value is computed as a function of the content of the destination address, source address and all Command Data Substructure bytes. In general, the sender formats a message frame, calculates the check sequence, appends it to the frame, then transmits the packet. Upon receipt, the destination node recalculates the check sequence and compares it to the check sequence embedded in the frame. If the check sequences are the same, the data was transmitted without error. Otherwise an error has occurred and some form of recovery should take place. In this case the amplifier will return a packet with the "Bad Checksum" error code set. Checksums are generated by summing the value of each byte in the packet while ignoring any carry bits.

A simple algorithm is given as:

```
Chksum=0
FOR byte_index=0 TO byte_index=packet_len-1
Chksum=(chksum+BYTE[byte_index]) MOD 256
NEXT byte_index
```

Timing issues

There is no maximum specification on the inter-character spacing in messages. Bytes in messages to amplifier units may be spaced as far apart as you wish. The amplifier will respond as soon as it has collected enough bytes to determine the message. Generally, there will be no spacing between characters in replies generated by unites. The maximum length of the packet sent to the amplifier node should not exceed 64 bytes, including checksum and frame sync bytes. Inter-message spacing must be provided for good data transmission. The minimum spacing should be 100 ms. This time is required for the controller to detect a "Line Cleared" condition with half duplex communications. Maximum controller respond time is 200 ms.

Request/Response Frame Structure

Table 7 outlines the request frame structure for the system amplifiers. Table 8 outlines the response frame structure for the system amplifiers.

Table 4: Request Frame Structure

Byte Position	Byte Value (Hex)	Description
1	0xAA	Frame Sync 1
2	0x55	Frame Sync 2
3	Destination Address	--
4	Source Address	--
5	Protocol Version	Protocol compatibility hole; must be set to 0
6	Request ID	Service Byte
7	Command	0 = Set Request; 1 = Get Request
8	Data Tag	0 = System Settings; 1 = System Thresholds; 2 = Temp. Sensor Settings; 3 = Conditions; 4 = ADC Data (reserved for factory use)
9	Data Address	Setting number; Sensor command; EEPROM address
10	Data Length	Total length of the data; Valid values: 1-30
11+N	Data	Actual Data
11+N+1	Checksum	Destination address + Source address + Protocol Version + Request ID + Command + Data Tag + Data Address + Data Length + Data

Table 5: Response Frame Structure

Byte Position	Byte Value (Hex)	Description
1	0xAA	Frame Sync 1
2	0x55	Frame Sync 2
3	Destination Address	--
4	Source Address	--
5	Protocol Version	Protocol compatibility hole; must be set to 0
6	Request ID	Service Byte
7	Command	2 = Set Response; 3 = Get Response
8	Data Tag	0 = System Settings; 1 = System Thresholds; 2 = Temp. Sensor Settings; 3 = Conditions; 4 = ADC Data (reserved for factory use)
9	Error Status	0 = No Errors; 1 = Too Big; 2 = No Such Data; 3 = Bad Value; 4 = Read Only; 5 = Bad Checksum; 6 = Unrecognized Error
10	Data Length	Total length of the data; Valid values: 1-30
11+N	Data	Actual Data
11+N+1	Checksum	Destination address + Source address + Protocol Version + Request ID + Command + Data Tag + Data Address + Data Length + Data

Settings, Conditions and Thresholds

Table 9 outlines the amplifier settings data values. Table 10 shows the amplifier condition data values. Table 11 describes the amplifier threshold data values.

The firmware version where a feature first became available is listed in parentheses in the following tables.

Table 6: System Settings Details

Data Address	Length (Bytes)	Description	Limits and Valid Values
1	1	System Operational Mode Designator	255 = Single Amplifier; 0 = 1:1 Redundant Mode; 1 = Dual 1:1 Redundant Mode (v. 3.60); 2 = Maintenance Switch (v. 6.00)
2	1	System Hierarchical Address	0 = HPA 1; 255 = HPA 2
3	1	Unit Start Up State (in Redundancy)	0 = Standby Amplifier; 1 = Online Amplifier
4	1	Mute State	0 = Mute Set (Transmit Disable); 255 = Mute Clear (Transmit Enable)
5	1	Attenuation Level (down from maximum gain)	0 = 0 dB attenuation; 200 = 20.0 dB attenuation; [1 bit for every 0.1 dB]
6	1	Module Gain Control Authority	0 = External Analog Voltage Gain Control; 1 = ALC Control (v. 6.40); 255 = Serial Port Gain Control
7	1	Amplifier Network Address	Valid Values: 0 - 255
8	1	High Temperature Alarm Threshold	Valid Values: 0 - 125 (in °C); Consult factory before changing setting
9	1	SSPA Module Calibration Mode	Reserved for Factory Use; 255 = Default
10	1	SSPA Spare Fault Status	0 to 7 = Fault on value of window on ADC channel; 8 = Fault on External Mute; 255 = Ignore Spare Fault
11	1	SSPA Spare Fault Handling	0 = Major Fault (triggers Summary fault); 1 = Major Fault with Mute (Transmit Disabled); 255 = Minor Fault (no effect on Summary Fault)
12	1	SSPA Auxiliary Fault Status	0 = Fault on Logic High State; 1 = Fault on Logic Low State; 2 = Startup in Low Z State; 3 = Startup in High Z State; 255 = Ignore Auxiliary Fault (v. 3.50)
13	1	SSPA Auxiliary Fault Handling	0 = Major Fault (triggers Summary fault); 1 = Major Fault with Mute (Transmit Disabled); 2 = Minor Fault with Mute (Transmit Disabled); 255 = Minor Fault (no effect on Summary Fault) (v. 3.50)
14	1	BUC Fault Status	0 = Fault on Logic High State; 1 = Fault on Logic Low State; 255 = Ignore BUC Fault
15	1	BUC Fault Handling	0 = Major Fault (triggers Summary fault); 1 = Major Fault with Mute (Transmit Disabled); 255 = Minor Fault (no effect on Summary Fault)
16	1	Protocol Select	0 = Terminal Protocol (v. 6.60); 3 = IPNet (Ethernet UDP + Web M&C); 4 = SNMP; 255 = Normal Protocol
17	1	Baud Rate Select	0 = 38400; 1 = 19200; 2 = 4800; 3 = 2400; 255= 9600
18	1	Reflected RF Fault Handling	0 = Minor Fault; 1 = Major Fault (triggers Summary fault); 255 = Disabled. (v. 6.05)
19	1	Reflected RF Fault Threshold	Valid Values: 0 - 80 (in dBm; value used as High threshold). (v. 6.20)
20	1	Standby Mode	0 = Cold Standby; 1 = Hot Standby (v. 3.50)
21	1	BUC Reference	0 = Autoswitch; 1 = External; 2 = Internal (v. 3.60)
22	1	Forward RF Fault Status	0 = Fault on Low RF Fault Threshold; 1 = 10% Forward RF Power Window; 2 = 15% Forward RF Power Window; 3 = Fault on High RF Threshold; 255 = Disabled

23	1	Forward RF Fault Handling	0 = Major Fault (Triggers Summary fault); 1 = Fault Online Unit Only (v. 6.30); 2 = Major Fault + Mute (triggers Summary fault, Transmit Disabled) (v. 6.37); 255 = Minor Fault (no effect on Summary fault)
24	1	Forward RF Fault Threshold	Valid Values: 0 - 80 (in dBm; value used as Low, Window center point, or High threshold, depending on Forward RF Fault Status - Address 22 - setting)
25	1	Fan Speed Control	0 = Fan Speed Low; 1 = Fan Speed High; 2 = Fan Speed Auto; 255 = Off/Default (RF Level Control). (v. 6.10, GaN units only)
26	1	Switch Mute	0 = Switch Mute On; 255 = Switch Mute Off. (v. 6.54)
27-28	2	Reserved for Factory Use	Valid values: 1 - 255
29	1	SSPA IP Address Byte 1 (MSB)	Valid Values: 1 - 255
30	1	SSPA IP Address Byte 2	Valid Values: 1 - 255
31	1	SSPA IP Address Byte 3	Valid Values: 1 - 255
32	1	SSPA IP Address Byte 4	Valid Values: 1 - 255
33	1	SSPA IP Gateway Byte 1	Valid Values: 1 - 255
34	1	SSPA IP Gateway Byte 2	Valid Values: 1 - 255
35	1	SSPA IP Gateway Byte 3	Valid Values: 1 - 255
36	1	SSPA IP Gateway Byte 4 (LSB)	Valid Values: 1 - 255
37	1	SSPA Subnet Mask Byte 1 (MSB)	Valid Values: 1 - 255
38	1	SSPA Subnet Mask Byte 2	Valid Values: 1 - 255
39	1	SSPA Subnet Mask Byte 3	Valid Values: 1 - 255
40	1	SSPA Subnet Mask Byte 4 (LSB)	Valid Values: 1 - 255
41	1	SSPA IP Port Byte 1 (MSB)	Valid Values: 1 - 255
42	1	SSPA IP Port Byte 2 (LSB)	Valid Values: 1 - 255
43	1	SSPA IP Lock Address Byte 1 (MSB)	Valid Values: 1 - 255
44	1	SSPA IP Lock Address Byte 2	Valid Values: 1 - 255
45	1	SSPA IP Lock Address Byte 3	Valid Values: 1 - 255
46	1	SSPA IP Lock Address Byte 4 (LSB)	Valid Values: 1 - 255

Table 7: System Conditions Details

Data Address	Length (Bytes)	Description	Limits and Valid Values
1	2	Tempcomp DAC Value	Valid Values: 0 - 1023
2	2	Present Temperature	± 125

Data Address	Length (Bytes)	Description	Limits and Valid Values
3	2	Fault, Mute, and State Conditions	For each bit listed below: (0 = fault clear; 1 = fault set), (0 = mute clear; 1 = mute set), (0 = standby state, 1 = online state). Lower Byte (Bit 0 = Summary Fault; Bit 1 = High Temperature Fault; Bit 2 = Low DC Current Fault; Bit 3 = Low DC Voltage Fault; Bit 4 = External Mute Status; Bit 5 = Internal Mute Status; Bit 6 = Forward RF Fault; Bit 7 = Reflected RF Fault). High Byte (Bit 0 = Block Up Converter Fault; Bit 1 = Spare Fault; Bit 2 = Auxiliary Fault; Bit 3 = Reserved; Bit 4 = RF Switch Control 1 state; Bit 5 = RF Switch Control 2 state; Bit 6 = Control board configuration (1 = Single control board; 0 = Master/Slave configuration); Bit 7 = Unit On Line State).
4	2	Present Attenuation Level	1 bit per 0.1 dB attenuation. Low Byte: 0 - 200; High Byte: always 0
5	2	Present RF Power Level	1 value per 0.1 dBm (i.e. 455 = 45.5 dBm). Valid Values: 0 - 1023
6	2	SSPA DC Current	1 value per 0.1 Amp. 200 Amp maximum
7	2	Regulator DC Voltage	1 value per 0.1 volt. 48 volt maximum
8	2	Power Supply Voltage	1 value per 0.1 volt. 60 volt maximum
9	2	Transistor Gate Voltage	1 value per 0.1 volt. ± 10 volt maximum (use 2s complement integer math)
10	2	SSPA DC Current (Slave Side)	1 value per 0.1 Amp. 240 Amp maximum
11	2	Regulator DC Voltage (Slave Side)	1 value per 0.1 volt. 48 volt maximum
12	2	Power Supply Voltage (Slave Side)	1 value per 0.1 volt. 60 volt maximum
13	2	Transistor Gate Voltage (Slave Side, High Power stages)	1 value per 0.1 volt. ± 10 volt maximum (use 2s complement integer math)
14	2	Transistor Gate Voltage (Slave Side, Pre-Amp stages)	1 value per 0.1 volt. ± 10 volt maximum (use 2s complement integer math)
15	2	SSPA DC Current (Master Side) (v.6.10 or better)	1 value per 0.1 Amp. 240 Amp maximum
16	2	Reflected RF Power Level (v.6.20) (Unit must be equipped with reflected power monitor option, otherwise value is irrelevant)	1 value per 0.1 dBm (i.e. 455 = 45.5 dBm). Valid Values: 0 - 1023

⚠ **Data Addresses 10 through 14 of Table 10 are valid only for the Master/Slave control board configuration (see System Condition Data Address 3, High Byte, Bit 6).**

Table 8: System Thresholds Details

Data Address	Length (Bytes)	Description	Limits and Valid Values
1*	2	Low Current Fault Threshold (Master Side)	Minimum value = 0; Maximum value = 1023
2*	2	Spare Fault Window, Lower Limit	Minimum value = 0; Maximum value = 1023
3*	2	Spare Fault Window, Upper Limit	Minimum value = 0; Maximum value = 1023
4*	2	Low Current Fault Threshold (Slave Side)	Minimum value = 0; Maximum value = 1023
5*	2	Low Regulator Voltage Threshold (Master Side)	Minimum value = 0; Maximum value = 1023

| 6* | 2 | Low Regulator Voltage Threshold (Slave Side) | Minimum value = 0; Maximum value = 1023 |
| 7* | 2 | ALC Level (dBm x 10) (v 6.40) | Minimum value = 0; Maximum value = 800 |

⚠ *** Consult the factory before changing any system threshold data values.**

⚠ **Note: In general, data length must be at least two (2) bytes to form an integer; the lower byte must come first. If an odd number of bytes arrived, the last data byte in the packet will be saved as the lower part of the integer; the upper part will be 0 by default.**

Serial Communication Examples

This section shows examples of communication exchanges between an Outdoor SSPA unit and a remote PC.

In these examples, the following assumptions exist:

- SSPA unit unique network address: 5;
- PC Host unique network address: 10;
- Request ID: 0x6F.

Example 1: Remote PC Requests Mute State of Connected Amplifier

Table 9: PC Request String

Byte Count	Value	Description
1	0xAA	Frame Sync Byte 1
2	0x55	Frame Sync Byte 2
3	0x05	Destination Address of SSPA Unit
4	0x0A	Source Address of Request Originating PC Host
5	0x00	Protocol Version Compatibility. Field must always be "0".
6	0x6F	Request ID byte is set by originator, will be echoed back by respondent.
7	0x01	Command field for "Get" type of the request.
8	0x00	"System Settings" tag indicates which data from respondent required in response frame.
9	0x04	Data Address field indicates the starting byte of the selected Data Tag being requested (4 = Mute State).
10	0x01	Data Length field indicates the total number of bytes of the selected Data Tag being requested.
11	0x84	Arithmetic checksum of bytes number 3 through 10.

Table 10: SSPA Response String

Byte Count	Value	Description
1	0xAA	Frame Sync Byte 1
2	0x55	Frame Sync Byte 2
3	0x0A	Destination Address of PC request originator
4	0x05	Source address of the respondent
5	0x00	Protocol Version Compatibility Field must be always 0
6	0x6F	Echo of the Originator's Request ID byte
7	0x03	Command field for "Get" type of the response
8	0x00	System Settings tag indicates which data from respondent included in response frame
9	0x00	Data Address field omitted, replaced with Error status code. 0 in this field indicates absence of errors
10	0x01	Data Length field indicates how many data bytes of the selected Data Tag was requested from the unit
11	0x01	Data field 1 contains data element 4 (Mute State) of the "System Settings"
12	0x83	Arithmetic checksum of bytes number 3 through 11

Example 2: Change Amplifier Attenuation

Table 11: PC Request String

Byte Count	Value	Description
1	0xAA	Frame Sync Byte 1

Byte Count	Value	Description
2	0x55	Frame Sync Byte 2
3	0x05	Destination Address of Compact Outdoor SSPA
4	0x0A	Source Address of PC sending Request String
5	0x00	Protocol Version Compatibility Field must always be 0
6	0x6F	Request ID byte is set by originator, will be echoed back by respondent
7	0x00	Command "Set request" designator
8	0x00	Data tag "0" indicates access to SSPA Settings
9	0x05	Data address 5 indicates access to SSPA attenuation
10	0x01	Data length is 1 byte
11	0xC8	Data 200 - 20.0 dB x 10 attenuation
12	0x4C	Arithmetic checksum of bytes 3 through 11

Table 12: SSPA Response String

Byte Count	Value	Description
1	0xAA	Frame Sync Byte 1
2	0x55	Frame Sync Byte 2
3	0x0A	Destination Address of PC Request originator
4	0x05	Source Address of the respondent
5	0x00	Protocol Version Compatibility Field must always be 0
6	0x6F	Echo of the originator Request ID byte
7	0x02	Command "Set response" designator
8	0x00	Data tag "0" was accessed
9	0x00	Data address omitted and replaced with Error status; 0 = no errors
10	0x01	Data length is 1 byte
11	0xC8	Data 200 - 20.0 dB x 10 attenuation successfully set
12	0x49	Arithmetic checksum of bytes 3 through 11

Example 3: Check Status of SSPA Faults and Conditions

Table 13: PC Request String

Byte Count	Value	Description
1	0xAA	Frame Sync Byte 1
2	0x55	Frame Sync Byte 2
3	0x05	Destination Address of Compact Outdoor SSPA
4	0x0A	Source Address of PC sending Request String
5	0x00	Protocol Version Compatibility Field must always be 0
6	0x6F	Request ID byte is set by originator, will be echoed back by respondent
7	0x01	Command "Get request" designator
8	0x03	Data tag "3" indicates access to SSPA Conditions
9	0x01	Data address 1 indicates the beginning of the Conditions table
10	0x12	Data length is 18 bytes (first 9 items of Conditions table)
11	0x95	Arithmetic checksum of bytes 3 through 10

Table 14: SSPA Response String

Byte Count	Value	Description

1	0xAA	Frame Sync Byte 1
2	0x55	Frame Sync Byte 2
3	0x0A	Destination Address of PC Request originator
4	0x05	Source Address of the respondent
5	0x00	Protocol Version Compatibility Field must always be 0
6	0x6F	Echo of the originator Request ID byte
7	0x03	Command "Get response" designator
8	0x03	Data tag "3" (System Conditions) was accessed
9	0x00	Error status; 0 = no errors
10	0x12	Data length is 18 byte
11	0x47	Tempcomp DAC Value, Low Byte
12	0x02	Tempcomp DAC Value, High Byte; DAC value = 583
13	0x1C	SSPA Internal Core Temp, Low Byte
14	0x00	SSPA Internal Core Temp, High Byte; Temp. = 28 °C
15	0x00	SSPA Fault Status, Low Byte
16	0x80	SSPA Fault Status, High Byte; See Table 10, Data Address 3
17	0xC8	SSPA Attenuation Level, Low Byte
18	0x00	SSPA Attenuation Level, High Byte; Attenuation = 200, or 20.0 dB
19	0x82	SSPA RF Power Level, Low Byte
20	0x01	SSPA RF Power Level, High Byte; Forward RF = 386, or 38.6 dB
21	0xB6	SSPA DC Current, Low Byte
22	0x02	SSPA DC Current, High Byte; DC Current = 69.4, or 69.4 A
23	0x67	Regulator DC Voltage, Low Byte
24	0x00	Regulator DC Voltage, High Byte; Voltage = 103, or 10.3 V
25	0x95	Power Supply Voltage, Low Byte
26	0x00	Power Supply Voltage, High Byte; Voltage = 149, or 14.9 V
27	0xD3	Transistor Gate Voltage, Low Byte
28	0xFF	Transistor Gate Voltage, High Byte; Voltage = -45, or -4.5 V
29	0x4C	Arithmetic checksum of bytes 3 through 28

Ethernet Interface

The Outdoor SSPA Ethernet Port (J9) supports several IP network protocols to provide a full-featured remote M&C interface over an Ethernet LAN.

- IPNet protocol - Redirection of standard Teledyne Paradise Datacom serial protocol over UDP transport layer protocol. This protocol is fully supported in the Teledyne Paradise Datacom Universal M&C software.
- SNMPv1 protocol - This protocol is intended for integration into large corporate NMS architectures.

In order to utilize either of the protocols listed above, the relevant interface option has to be turned on.

Of course, standard IP level functions such as ICMP Ping and ARP are supported as well. There is currently no support for dynamic IP settings, all IP parameters.

IPNet Interface

Satcom system integrators are recognizing the benefits of an Ethernet IP interface. These benefits include:

- Unsurpassed system integration capabilities;
- Widely available and inexpensive set of support equipment (network cable; network hubs);
- Ability to control equipment over Internet;
- Ease of use

General Concept

Implementation of the raw Ethernet interface is not practical due to the limitations it places on M&C capabilities by the range of a particular LAN. It is more practical to use an Ethernet interface in conjunction with the standard OSI (Open System Interconnect) model to carry a stack of other protocols. In an OSI layered stack, an Ethernet interface can be represented as a Data Link layer. All upper layers are resolved through a set of IP protocols. In order to keep data bandwidth as low as possible (which is important when M&C functions are provided through a low-bandwidth service channel) the IP/UDP protocol set is used as the Network/Transport layer protocol on Teledyne Paradise Datacom SSPAs.

UDP (User Datagram Protocol) was chosen over TCP (Transmission Control Protocol) because it is connectionless; that is, no end-to-end connection is made between the SSPA unit and controlling workstation when datagrams (packets) are exchanged.

Teledyne Paradise Datacom provides a Windows-based control application to establish UDP-based Ethernet communication with SSPAs. The control application manages the exchange of datagrams to ensure error-free communication. An attractive benefit of UDP is that it requires low overhead resulting in minimal impact to network performance. The control application sends a UDP request to the SSPA unit and waits for a response. The length of time the control application waits depends on how it is configured. If the timeout is reached and the control application has not heard back from the agent, it assumes the packet was lost and retransmits the request. The number of the retransmissions is user configurable.

The Teledyne Paradise Datacom RM SSPA Ethernet IP interface can use UDP ports from 0 to 65553 for sending and receiving. The receiving port needs to be specified through the front panel menu. For sending, it will use the port from which the UDP request originated. Of course, it is up to the user to select an appropriate pair of ports that are not conflicting with standard IP services. Paradise Datacom recommends usage of ports 1038 and 1039. These ports are not assigned to any known application.

As an application layer protocol (which actually carries meaningful data), the standard Teledyne Paradise Datacom RM SSPA serial protocol was selected. This protocol is extremely flexible and efficient. It is also media independent and can be easily wrapped into another protocol data frame. An example of the UDP frame with encapsulated Teledyne Paradise Datacom protocol frame is shown in Figure 6.
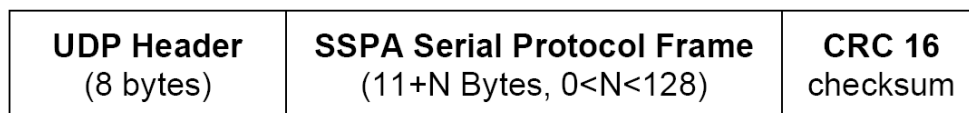
UDP Header (8 bytes)	SSPA Serial Protocol Frame (11+N Bytes, 0<N<128)	CRC 16 checksum

Figure 6: UDP Redirect Frame Example

A detailed OSI model for the RM SSPA M&C interface is represented in Table 18.

Table 15: OSI Model for Outdoor SSPA Ethernet IP Interface

OSI Layer	Protocol	Notes
Application	Paradise Datacom Serial Protocol	Frame structure described in the Serial Communication Protocol section above.

Transport	UDP	Connectionless transport service. MTU on target PC must be set to accommodate largest SSPA Serial Protocol Frame. Set MTU to a value larger than 127 bytes.
Network	IP	ARP, RARP and ICMP Ping protocols supported by RM SSPA controllers. Static IP Address only, no DHCP support.
Data Link	Ethernet	10/100 Base-T Network
Physical	Standard CAT5 (CAT6) Network Cable	Maximum node length 100 m

This set of Ethernet IP protocols is currently supported by the Teledyne Paradise Datacom Universal M&C software package. The software is supplied on CD with the unit, or can be download from company's web site, http://www.paradisedata.com.

Setting IPNet Interface

To set up the Compact Outdoor SSPA with custom IP parameters, the internal IP settings need to be modified by using Teledyne Paradise Datacom's Universal M&C, version 4.4.3 or later.

Troubleshooting IP Connectivity

Check IP connectivity to the SSPA unit. To do so on a Windows-based PC, open a Command Prompt window and type the following command: PING 192.168.0.9, then press the Enter key. If the unit is successfully found on the network, the request statistic will be displayed.

```
Microsoft Windows [Version 10.0.15063]
(C) Copyright 2017 Microsoft Corporation. All rights reserved.

C:\Users\johndoe>ping 192.168.0.9

Pinging 192.168.0.9 with 32 bytes of data:
Reply from 192.168.0.9: bytes=32 time<1ms TTL=128
Reply from 192.168.0.9: bytes=32 time<1ms TTL=128
Reply from 192.168.0.9: bytes=32 time<1ms TTL=128
Reply from 192.168.0.9: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.0.9:
        Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

If this step is successfully completed, a default Ethernet connection is set and ready to use.

If the unit does not answer on the ping command, check all hardware connections. Consult your network administrator for further details.

SNMP Interface

SNMP-based management was initially targeted for TCP/IP routers and hosts. However, the SNMP-based management approach is inherently generic so that it can be used to manage many types of systems. This approach has become increasingly popular for remote management and control solutions for various SSPA systems.

Teledyne Paradise Datacom devices with Ethernet interface support the most popular SNMPv1 format (SMIv1, RFC1155), SNMP Get, SNMP GetNext and SNMP Set commands. SNMP Traps are currently unsupported on units with serial numbers below 400000.

In order to utilize SNMP protocol, the operator has to enable this feature through the front panel or by remote serial protocol. SNMP uses the UDP fixed port 161.

The definition of managed objects described in the Management Information Base (MIB) file. The MIB file is available for download from the Downloads section of the Teledyne Paradise Datacom web site, http://www.paradisedata.com.

Interface

The Teledyne Paradise Datacom MIB is a table-based MIB, and is the same for all devices. The MIB table is designed to follow the same pattern as the tables for serial protocol. For additional information about OID values, refer to Table 11 through Table 13.

The text values in the tables help automatic value parsing within NMS or make the values readable through an MIB browser. All text value OIDs follow the same pattern:

```
1. For settings or parameters with discreet values:
   SettingName'ValueName1=xxx, ...,ValueNamex=xxx
   Example: ControlMode'Local=0,Remote=1
2. For settings or parameters with continuous values:
   SettingName'LowLimit..HighLimit
   Example: NetworkAddress'0..255
```

As with the serial protocol, the MIB allows access to a remote SSPA (default state) as well as to the RCP unit itself. To switch between the MIBs of those devices, the proper Device Type has to be selected (OID -1.3.6.1.4.1.20712.1.4).

SNMP MIB Tree

```
--paradiseDatacom(1.3.6.1.4.1.20712)
  |
  +--deviceINFO(1)
  |  |
  |  +-- r-n OctetString deviceID(1)
  |  +-- rwn OctetString deviceLocation(2)
  |  +-- r-n OctetString deviceRevision(3)
  |  +-- r-n Enumeration deviceType(4)
  |
  +--devices(2)
        |
        +--paradiseDevice(1)
        |  |
        |  +--settings(1)
        |  |  |
        |  |  +--settingsEntry(1) [settingIndex]
        |  |      |
        |  |      +-- rwn Integer32   settingIndex(1)
        |  |      +-- rwn Integer32   settingValue(2)
        |  |      +-- r-n OctetString settingTextValue(3)
        |  |
        |  +--thresholds(2)
        |  |  |
        |  |  +--thresholdsEntry(1) [thresholdIndex]
        |  |      |
        |  |      +-- rwn Integer32   thresholdIndex(1)
        |  |      +-- r-n Integer32   thresholdValue(2)
        |  |      +-- r-n Enumeration thresholdStatus(3)
        |  |      +-- r-n OctetString thresholdText(4)
        |  |
        |  +--conditions(3)
        |     |
        |     +--conditionsEntry(1) [conditionsIndex]
        |         |
        |         +-- rwn Integer32   conditionsIndex(1)
        |         +-- r-n Integer32   conditionsValue(2)
        |         +-- r-n Counter     conditionsEventCount(3)
        |         +-- r-n OctetString conditionsText(4)
        |
        +--paradiseDeviceA(2)
        |
        +--paradiseDeviceB(3)
        |
        +--paradiseDeviceC(4)
        |
        +--modem(5)
```

Description of MIB Entities

deviceINFO - This field includes general device information.

deviceID - Octet string type; maximum length -60; field specifies device model and serial number; read only access; OID -1.3.6.1.4.1.20712.1.1

deviceLocation - Octet string type; maximum length 60; field allows customer to store information about device physical location or any other textual information related to the device; read/write access; OID -1.3.6.1.4.1.20712.1.2

deviceRevision - Octet string type; maximum length 60; field specifies device firmware revision; read only access; OID -1.3.6.1.4.1.20712.1.3

deviceType - Enumeration, integer type; field allows simple detection of SNMP device type. Values: rmsspa(1), cosspa(2), rcp2fprc(3), rcp21000co(4), rcp21000rm(5), rcp21000rcp(6), buc(7), rbc(8), minicosspa(9); read only access; Setting the ID to any other value will default type to cosspa. OID -1.3.6.1.4.1.20712.1.4

⚠ **Note that both the Compact Outdoor SSPA and High Power Outdoor SSPA use deviceType = 2 (cosspa).**

devices - This field is subdivided into 5 branches: paradiseDevice, paradiseDeviceA, paradiseDeviceB paradiseDeviceC and modem. paradiseDevice branch currently is used for all Paradise Datacom LLC SNMP enabled devices except Modem. Branches for Devices A, B and C are reserved for future use.

paradiseDevice - Field contains tables that hold specific device information: Settings, Thresholds and Conditions. All table formats follow a common pattern: Index, Value, TextValue. The threshold table has an additional column for parameter validation. The conditions table has an extra column for event counters.

The Index column provides general table indexing; the Value column presents the current value of the relevant parameter; the TextValue column provides information about parameter name, measurement units and limits.

A value of "1" in the validation column of the thresholds table indicates the parameter is valid; a value of "2" indicates the parameter is invalid or "Not available".

The event counter column of the conditions table indicates how many times a value of a relevant parameter changed its state since system power-up.

settings - Table contains current device configuration and provides device management. Read/write access for settingsValue column.

thresholds - Table provides information about device internal limits and subsystems info. Read only.

conditions - Table details device fault status information. Read only.

Extended SNMP Operation

The SSPA is equipped with a DigitalCore5 control board and utilizes firmware version 6.00 and above. These units feature an extended SNMP MIB and support SNMP traps. This extended MIB covers several OID objects related to SNMP trap functions.

These units allow independent functioning of two SNMP traps (asynchronous notifications): Fault trap and Conditions trap. Both traps can be enabled or disabled by the operator. The operator can also specify how many times the same trap notification will be sent back to the SNMP manager.

The SNMP manager IP address is also selectable by the operator. This IP address must be specified in the relevant OID branch.

Every trap message is marked by the fixed trap community string "trap". This community name is not user selectable.

The Fault trap allows asynchronous notification of the SSPA fault state change. When enabled, trap notification will be sent to a manager every time either the summary fault state or a fault type is changed. The Last Fault Time ticks counter will be reset each time the summary fault changes its state to "Alarm" or when a new fault condition is detected. This counter also resets itself during device power-up. If no faults are present after device power-up, Fault Trap will issue a "Cold Start" notification to the manager.

The Condition Trap allows the unit to generate asynchronous notifications independent from the unit fault state. Currently, the following conditions can be used for this trap triggering: Forward RF Level, Reflected RF Level (for units equipped with a Reflected RF sensor), DC Current level, PS Voltage level, module plate temperature, LNA current (if an external LNA is powered through the SSPA auxiliary power port).

To enable this trap, set the Condition Trap Resend option to a non-zero value and determine the upper and lower limits for the condition window. Window values must be selected according to the relevant selected condition measured by the unit. For example: Temperature must be selected in degrees, RF power in tenth of dBms, etc.

After successful configuration, the SSPA will generate a notification every time the selected condition is outside the selected measurement window. For units with multiple measured parameters, the relevant condition location must be selected (i.e., units with two power supplies use 1 for PS1, and 2 for PS2). For other conditions, this value is "don't care".

Both traps will send a "Device Up Time" time stamp with every trap notification.

Extended SNMP MIB Tree

```
--paradiseDatacom(1.3.6.1.4.1.20712)
  |
  +--deviceINFO(1.3.6.1.4.1.20712.1)
  | |
  | +-- r-n OctetString deviceID(1.3.6.1.4.1.20712.1.1)
  | +-- rwn OctetString deviceLocation(1.3.6.1.4.1.20712.1.2)
  | +-- r-n OctetString deviceRevision(1.3.6.1.4.1.20712.1.3)
  | +-- r-n Enumeration deviceType(1.3.6.1.4.1.20712.1.4)
  | |
  | +--deviceTimeTicks(1.3.6.1.4.1.20712.1.5)
  | | |
  | | +-- r-n TimeTicks deviceUpTime(1.3.6.1.4.1.20712.1.5.1)
  | | +-- r-n TimeTicks deviceFaultTime(1.3.6.1.4.1.20712.1.5.2)
  | |
  | +--deviceCounters(1.3.6.1.4.1.20712.1.6)
  | | |
  | | +-- r-n Counter deviceSFaultCounter(1)
  | |
  | +--deviceFaultState(1.3.6.1.4.1.20712.1.7)
  | | |
  | | +-- r-n Enumeration deviceSummaryFault(1)
  | | +-- r-n Enumeration deviceLastFault(2)
  | |
  | +--deviceTrapedCondition(1.3.6.1.4.1.20712.1.8)
  | | |
  | | +-- r-n Integer32 deviceTrappedConditionValue(1)
  | |
  | +--deviceTrapControl(1.3.6.1.4.1.20712.1.9)
  | | |
  | | +-- rwn IpAddress deviceManagerIP(1)
  | | +-- rwn Integer32 deviceFaultsTrapResend(2)
  | | +-- rwn Integer32 deviceConditionTrapResend(3)
  | | +-- rwn Enumeration deviceConditionToMonitor(4)
  | | +-- rwn Integer32 deviceConditionULimit(5)
  | | +-- rwn Integer32 deviceConditionLLimit(6)
  | | +-- rwn Integer32 deviceConditionLocation(7)
  | |
  | +--deviceTraps(1.3.6.1.4.1.20712.1.10)
  | | |
  | | +-- (1.3.6.1.4.1.20712.1.10.0)
  | |
  | +--deviceFaultsTrap(1.3.6.1.4.1.20712.1.10.0.11)
  |     [deviceUpTime,deviceSummaryFault,deviceLastFault]
  | |
  | +--deviceConditionTrap(1.3.6.1.4.1.20712.1.10.0.12)
  |     [deviceUpTime,deviceConditionToMonitor,deviceTrappedConditionValue]
  |
  +--devices(2)
  |
  +--paradiseDevice(1)
  | |
  | +--settings(1)
  | | |
  | | +--settingsEntry(1) [settingIndex]
  | | |
  | | +-- rwn Integer32 settingIndex(1)
  | | +-- rwn Integer32 settingValue(2)
  | | +-- r-n OctetString settingTextValue(3)
  | |
  | +--thresholds(2)
  | | |
  | | +--thresholdsEntry(1) [thresholdIndex]
  | | |
  | | +-- rwn Integer32 thresholdIndex(1)
  | | +-- r-n Integer32 thresholdValue(2)
  | | +-- r-n Enumeration thresholdStatus(3)
  | | +-- r-n OctetString thresholdText(4)
  | |
  | +--conditions(3)
  | |
  | +--conditionsEntry(1) [conditionsIndex]
  | |
  | +-- rwn Integer32 conditionsIndex(1)
  | +-- r-n Integer32 conditionsValue(2)
  | +-- r-n Counter conditionsEventCount(3)
  | +-- r-n OctetString conditionsText(4)
  |
  +--paradiseDeviceA(2)
  |
```

```
+--paradiseDeviceB(3)
|
+--paradiseDeviceC(4)
|
+--modem(5)
```

Extended SNMP MIB Tree Elements in Detail

deviceRevision -- Octet string type; maximum length 60; field specifies device firmware revision; read only access; OID -1.3.6.1.4.1.20712.1.3

deviceUpTime -- Device total up time in hundredths of a second;

deviceFaultTime -- Time elapsed since deviceLastFault last state change in hundredths of second;

deviceSFaultCounter -- Counts number of Summary alarms since device power up;

deviceSummaryFault -- Enumerated value of device last detected fault condition. The following enumerated values are possible: coldStart(1), overTemp(2), badRegltr(3), lowDCCur(4), aux(5), buc(6), lna(7), hpa(8), lowFwdRF(9), highRefRF(10), nPlusOne (11), badPS(12), timeOut(13), other(14), noFaults(15);

deviceTrappedConditionValue -- Condition value trapped by deviceConditionTrap;

deviceManagerIP -- Trap recipient IP address;

deviceFaultsTrapResend -- Defines how many times deviceFaultsTrap will repeat the message. 0 - Disables trap triggering;

deviceConditionTrapResend -- Defines how many times condition trap will repeat the message. 0 - Disables trap triggering

deviceConditionToMonitor -- Enumerated value. Object defines which condition to trap. The following enumerations are possible: fwdRF(1), dcCurrent(2), voltagePS(3), temperature(4), lnaCur(5), refRF(6);

deviceConditionULimit -- Conditions upper trap limit. Trap will be sent when the condition exceeds this limit.

deviceConditionLLimit -- Conditions lower trap limit. Trap will be sent when condition falls below this limit.

deviceConditionLocation -- Parameter specifying condition measuring location in device containing multiple location of the same type (multiple PS, RF modules, LNAs etc.). Set to 0 for system-wide conditions, 1, ... n for relevant unit. For devices with single condition location parameter is "don't care".

deviceFaultsTrap -- Trap fires deviceFaultsTrapResend times when deviceLastFault or deviceSummaryFault state changes.

deviceConditionTrap -- Trap fires deviceConditionTrapResend times when value specified by deviceConditionToMonitor is outside of the window specified by deviceConditionULimit and deviceConditionLLimit. In the case of a device with multiple conditions of the same type, specify measurement location in deviceConditionLocation.

Table 16: SNMP Settings Values

settingIndex /settingValue	settingTextValue	Value OID 1.3.6.1.4.1.20712...	Description
1/INTEGER	SystemMode'1:1=0,Dual 1:1 = 1,MSwitch=2,StandAlone=255	2.1.1.1.2.1	System Operation mode
2/INTEGER	SystemHierarchicalAddress'HPA1=0, HPA2=255	2.1.1.1.2.2	System Hierarchical Address
3/INTEGER	CurrentState'UnitStandby=0,UnitOnline=255	2.1.1.1.2.3	Unit Start Up State in Redundancy
4/INTEGER	Mute'On=0,Off=255	2.1.1.1.2.4	Mute State
5/INTEGER	SSPAAttenuation(dBx10)'0..200	2.1.1.1.2.5	Attenuation Level
6/INTEGER	GainControl'Analog=0,ALC=1,Serial=255	2.1.1.1.2.6	Module Gain Control Authority
7/INTEGER	NetworkAddress'0..255	2.1.1.1.2.7	Amplifier Network Address
8/INTEGER	HighTempAlarmThreshold(C)'0..100	2.1.1.1.2.8	High Temperature Alarm Threshold
9/INTEGER	CalibrationMode'On=0,Off=255	2.1.1.1.2.9	SSPA Module Calibration Mode

10/INTEGER	SpareFaultCheck'ADCCh0-7=0..7, Ext.Mute=8,Ignore=255	2.1.1.1.2.10	SSPA Spare Fault Status
11/INTEGER	SpareFaultAction'MajorFault=0, Fault+Mute=1,MinorFault=255	2.1.1.1.2.11	SSPA Spare Fault Handling
12/INTEGER	AuxFaultCheck'LogicHigh=0, LogicLow=1,Ignore=255	2.1.1.1.2.12	SSPA Auxiliary Fault Status
13/INTEGER	AuxFaultAction'MajorFault=0, Fault+Mute=1,MinorFault=255	2.1.1.1.2.13	SSPA Auxiliary Fault Handling
14/INTEGER	BUCFaultCheck'LogicHigh=0, LogicLow=1,Ignore=255	2.1.1.1.2.14	Block Up Converter Fault Status
15/INTEGER	BUCFaultAction'MajorFault=0, Fault+Mute=1,MinorFault=255	2.1.1.1.2.15	Block Up Converter Fault Handling
16/INTEGER	ProtocolSelect'Terminal=0,NDSat=2, IPNet=3,SNMP=4,Normal=255	2.1.1.1.2.16	Protocol Select
17/INTEGER	BaudRate'38400=255,19200=1,4800=2, 2400=3,9600=255	2.1.1.1.2.17	Baud Rate Select
18/INTEGER	RefRFCheck'MinorFault=0,MajorFault=1, Disabled=255	2.1.1.1.2.18	Field reserved for factory use
19/INTEGER	RefRFFaultThreshold(dBm)'0...80	2.1.1.1.2.19	Field reserved for factory use
20/INTEGER	StandbyMode'ColdStandby=0, HotStandby=255	2.1.1.1.2.20	Standby Mode
21/INTEGER	BUCReference'Autoswitch=0,External=1, Internal=2,NA=255	2.1.1.1.2.21	BUC Reference
22/INTEGER	FwdRFCheck'LowRF=0,Window10%=1, Window15%=2,HighRF=3,Dis=255	2.1.1.1.2.22	Type of Forward RF Fault
23/INTEGER	RFFaultAction'Major=0,MajorOnlineOnly=1, Major+Mute=2,Minor=255	2.1.1.1.2.23	Forward RF Fault Handling
24/INTEGER	FrwdRFFaultThreshold(dBm)'0..80	2.1.1.1.2.24	Forward RF Fault Threshold Level (dBm)
25/INTEGER	FanSpeed'Low=0,High=1,Auto=2, RFLevelCtrl=255	2.1.1.1.2.25	Fan Speed Control (GaN units only)
26/INTEGER	SwitchMute'On=0,Off=255	2.1.1.1.2.26	Switch Mute (Ver 6.54)
27/INTEGER	Reserved'0..255	2.1.1.1.2.27	Field reserved for future use
28/INTEGER	Reserved'0..255	2.1.1.1.2.28	Field reserved for future use
29/INTEGER	IPAddressByte1'0..255	2.1.1.1.2.29	Device IP address byte1 (MSB)
30/INTEGER	IPAddressByte2'0..255	2.1.1.1.2.30	Device IP address byte2
31/INTEGER	IPAddressByte3'0..255	2.1.1.1.2.31	Device IP address byte3
32/INTEGER	IPAddressByte4'0..255	2.1.1.1.2.32	Device IP address byte4 (LSB)
33/INTEGER	IPGateWayByte1'0..255	2.1.1.1.2.33	Device Gateway address byte1 (MSB)
34/INTEGER	IPGateWayByte2'0..255	2.1.1.1.2.34	Device Gateway address byte2
35/INTEGER	IPGateWayByte3'0..255	2.1.1.1.2.35	Device Gateway address byte3
36/INTEGER	IPGateWayByte4'0..255	2.1.1.1.2.36	Device Gateway address byte4 (LSB)
37/INTEGER	IPSubnetByte1'0..255	2.1.1.1.2.37	Device Subnet Mask byte1 (MSB)
38/INTEGER	IPSubnetByte2'0..255	2.1.1.1.2.38	Device Subnet Mask byte2
39/INTEGER	IPSubnetByte3'0..255	2.1.1.1.2.39	Device Subnet Mask byte3

40/INTEGER	IPSubnetByte4'0..255	2.1.1.1.2.40	Device Subnet Mask byte4 (LSB)
41/INTEGER	IPPortByte1'0..255	2.1.1.1.2.41	Device Port address byte1 (MSB) (required only for IPNet Interface)
42/INTEGER	IPPortByte2'0..255	2.1.1.1.2.42	Device Port address byte2 (LSB) (required only for IPNet Interface)
43/INTEGER	IPLockByte1'0..255	2.1.1.1.2.43	Device IP lock address byte1 (MSB) (required only for IPNet Interface)
44/INTEGER	IPLockByte2'0..255	2.1.1.1.2.44	Device IP lock address byte2 (required only for IPNet Interface)
45/INTEGER	IPLockByte3'0..255	2.1.1.1.2.45	Device IP lock address byte3 (required only for IPNet Interface)
46/INTEGER	IPLockByte4'0..255	2.1.1.1.2.46	Device IP lock address byte4 (LSB) (required only for IPNet Interface)

Table 17: SNMP Threshold Values

thresholdIndex /thresholdValue	thresholdTextValue	Value OID 1.3.6.1.4.1.20712...	Description
1/INTEGER	* LowCurrentThresholdMaster'0..1023	2.1.2.1.2.1	Master Side Low DC Current Alarm Threshold (Amps x10)
2/INTEGER	* SpareFaultLowLimitThreshold'0..1023	2.1.2.1.2.2	Spare Fault Alarm Low Threshold
3/INTEGER	* SpareFaultHighLimitThreshold'0..1023	2.1.2.1.2.3	Spare Fault Alarm High Threshold
4/INTEGER	* LowCurrentThresholdSlave'0..1023	2.1.2.1.2.4	Slave Side Low DC Current Alarm Threshold (Amps x10)
5/INTEGER	* LowVoltageThresholdMaster'0..1023	2.1.2.1.2.5	Master Side Low Regulator Voltage Alarm Threshold (Volts x10)
6/INTEGER	* LowVoltageThresholdSlave'0..1023	2.1.2.1.2.6	Slave Side Low Regulator Voltage Alarm Threshold (Volts x10)
7/INTEGER	* ALCLevel(dBmx10)'0..800	2.1.2.1.2.7	ALC set level (dBm x10)

⚠ *** Consult factory before changing any Threshold value.**

Table 18: SNMP Condition Values

conditionIndex /conditionValue	conditionTextValue	Value OID 1.3.6.1.4.1.20712...	Description
1/INTEGER	DACCount'0..1023	2.1.3.1.2.1	Tempcomp DAC Control Output
2/INTEGER	SSPACoreTemperature(C)'-100..100	2.1.3.1.2.2	SSPA Core Temperature
3/INTEGER	FaultStateAgregateValue'0-65535	2.1.3.1.2.3	Aggregate Fault State of SSPA
4/INTEGER	SSPAAgregateAttenuation(dBx10)'0..200	2.1.3.1.2.4	Current SSPA Attenuation Level
5/INTEGER	ForwardRFPower(dBmx10)'0..800	2.1.3.1.2.5	Forward RF Forward Output (dBm)
6/INTEGER	SSPADCCurrent(Ampx10)'0..10000	2.1.3.1.2.6	SSPA DC Current Consumption
7/INTEGER	RegulatorVoltage(Voltx10)'0..600	2.1.3.1.2.7	DC Regulator Output Voltage
8/INTEGER	PSVoltage(Voltx10)'0..600	2.1.3.1.2.8	Main Power Supply Voltage

9/INTEGER	GASFETGateVoltage(Voltx10)'0..200	2.1.3.1.2.9	RF FET Bias Gate voltage
10/INTEGER	SSPADCCurrentSlave(Ampx10)'0..10000	2.1.3.1.2.10	SSPA DC Current Consumption (Slave side only, if not present always 0)
11/INTEGER	RegulatorVoltageSlave(Voltx10)'0..600	2.1.3.1.2.11	DC Regulator Output Voltage (Slave side only, if not present always 0)
12/INTEGER	PSVoltageSlave(Voltx10)'0..600	2.1.3.1.2.12	Slave Side Power Supply Voltage (if not present always 0)
13/INTEGER	GASFETGateVoltageSlave(Voltx10)'0..200	2.1.3.1.2.13	RF FET Bias Gate Voltage (Slave side, if not present always 0)
14/INTEGER	GASFETGateVoltagePreAmp(Voltx10)'0..200	2.1.3.1.2.14	RF FET Bias Pre-Amp Gate Voltage (Slave side, if not present always 0)
15/INTEGER	MasterCurrent(Ampx10)'0..10000	2.1.3.1.2.15	SSPA DC Current (Master Side) (Ver.6.10 or better)
16/INTEGER	RefRFPower(dBmx10)'0..800	2.1.3.1.2.16	Reflected RF Power Level (Ver.6.20) (Unit must be equipped with reflected power monitor option, otherwise value is irrelevant)

M&C via SNMP Protocol

Set up the Outdoor SSPA with custom IP parameters by modifying the internal IP settings using Teledyne Paradise Datacom's Universal M&C, version 4.4.3 or later. Use the default Read and Write Community settings, or check the boxes to modify them. See Figure 7.

Figure 7: Universal M&C - SNMP Settings Tab

The Protocol setting in the Settings tab of the Universal M&C needs to be set to SNMP, as shown in Figure 8.

Figure 8: Universal M&C - Settings Tab

Set the desired IP address, Subnet mask and Gateway parameters in the IP Settings tab. See Figure 9.

Figure 9: Universal M&C - IP Setup Tab

The unit will continue to use its default parameters until the unit is reset. To make the new parameters active, reset the Outdoor SSPA by removing its AC power. Unplug the Quick Start cable from the M&C connector. (If the unit is restarted with the Quick Start cable connected, it will always come up with default IP settings). Apply power to the SSPA. Re-plug the Quick Start cable into J4, and check connectivity with the custom IP settings.

If the custom IP settings will be used in normal operation, the user must construct an IP cable or modify the Quick Start cable by disconnecting the interface control pins (pins j and e, Baud Select 0 and Baud Select 1) from ground. In this configuration, the SSPA will always use the saved communication control settings rather then rolling back to the default configuration.

Connecting to a MIB Browser

For a MIB browser application example, we will be using the freeware browser GetIF, version 2.3.1. There are many other browsers available for download from http://www.snmplink.org/software/forenduser/#7.

1. Copy the provided Paradise Datacom LLC MIB file into the GetIF Mibs subfolder.
2. Start the GetIF application.
3. Select the unit IP address and community strings in the relevant text boxes on the Parameters tab (see Figure 10) and then click the Start button.
4. Select the MBrowser tab.
5. Click on 'iso' main entity on the MIB tree, then click the Start button.
6. See update data in output data box (Figure 11).
Select settingValue.5 entity (SSPA Mute), set the value to 1 and click the Set button.
7. Observe the Mute state on the SSPA change to a "Mute On" state. See Figure 14.
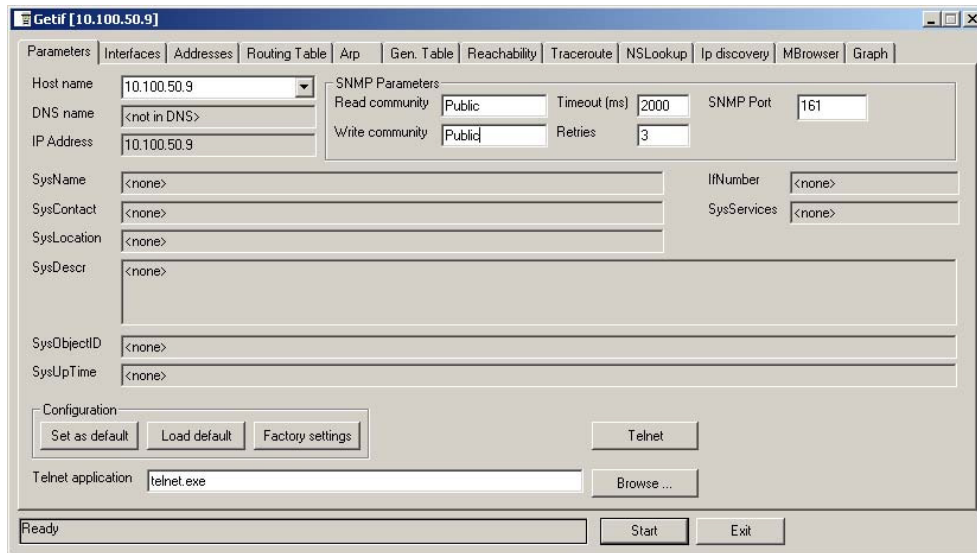
Figure 10: GetIf MBrowser Window
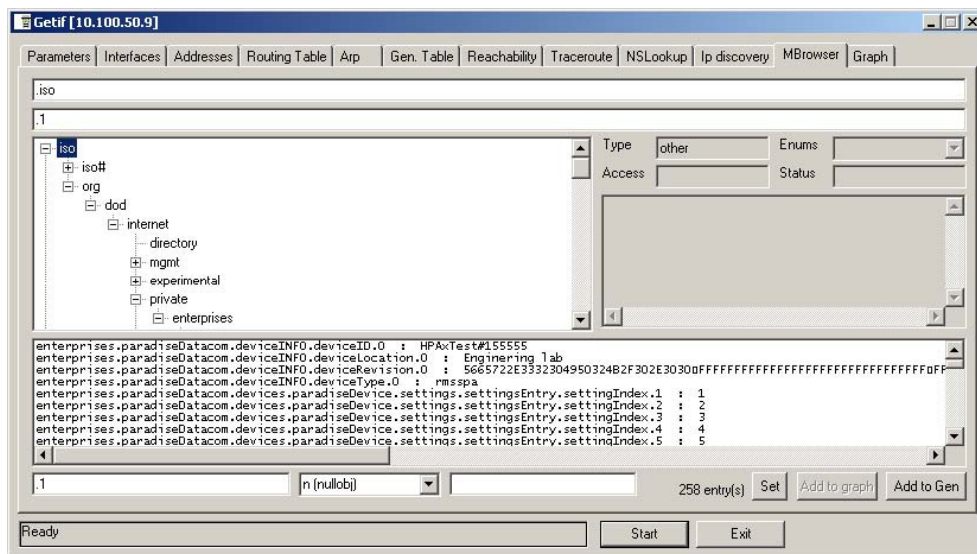
Figure 11: GetIf MBrowser Window, Assign settingValue.5 to a Value of '1'

SNMP V3 Implementation Issues in Paradise SSPAs

Simple Network Management Protocol (SNMP) is an interoperable standards-based protocol that allows for external monitoring of the Content Engine through an SNMP agent.

A SNMP-managed network consists of three primary components: managed devices, agents, and management systems. A managed device is a network node that contains a SNMP agent and resides on a managed network. Managed devices collect and store management information and use SNMP to make this information available to management systems that use SNMP. Managed devices include routers, access servers, switches, bridges, hubs, computer hosts, and printers.

An agent is a software module that has local knowledge of management information and translates that information into a form compatible with SNMP: the Management Information Base (MIB). The agent can send traps, or notification of certain events, to the manager.

Essentially, Teledyne Paradise Datacom SSPA is considered a "SNMP agent".

A manager is a software module that listens to the SNMP notifications sent by SNMP agents. The manager can also send requests to an agent to collect remote information from the Management Information Base (MIB).

The communication between the agent and the manager uses the SNMP protocol, which is an application of the ASN.1 BER (Abstract Syntax Notation 1 with Basic Encoding Rules), typically over UDP (for IP networks).

- Version 1 (SNMP V1, described in RFC 1157) is the initial implementation of SNMP.
- Version 2 (SNMP V2c, described in RFC 1902) is the second release of SNMP. It provides additions to data types, counter size, and protocol operations.
- Version 3 (SNMP V3, described in RFC 2271 through RFC 2275) is the most recent version of SNMP.

SNMP V1

SNMP version 1 (SNMPv1) is the initial implementation of the SNMP protocol. SNMPv1 operates over protocols such as User Datagram Protocol (UDP), Internet Protocol (IP), OSI Connectionless Network Service (CLNS), AppleTalk Datagram-Delivery Protocol (DDP), and Novell Internet Packet Exchange (IPX). SNMPv1 is widely used and is the de-facto network-management protocol in the Internet community.

The Teledyne Paradise Datacom SSPA family of products utilizes the most popular implementation, SNMP V1 over UDP transport layer.

SNMP V2

SNMPv2 (RFC 1441-RFC 1452) revises version 1 and includes some improvements in the areas of performance, security, confidentiality, and manager-to-manager communications. It introduced GetBulkRequest, an alternative to iterative GetNextRequests for retrieving large amounts of management data in a single request. However, the new party-based security system in SNMPv2, viewed by many as overly complex, was not widely accepted.

The format of the trap message was also changed in SNMPv2. To avoid these compatibility issues, the trap mechanism was not implemented in the Paradise Datacom SSPA MIB.

SNMP V3

Although SNMPv3 makes no changes to the protocol aside from the addition of cryptographic security, it looks much different due to new textual conventions, concepts, and terminology. SNMPv3 primarily added security and remote configuration enhancements to SNMP.

Problems with implementing SNMP V2 and V3 in Teledyne Paradise Datacom SSPA product family

Many embedded controllers and microprocessors that are used in electronic components such as amplifier modules do not have support for SNMP V2 or V3. This is due to the extensive memory resources required by the computation intensive cryptographic security of SNMP V3.

For this reason V3 has not gained widespread support amongst embedded MCU platform manufacturers. Existing port implementations are limited to very powerful ARM5 or above cores, running under full-scale OS systems (Linux, Android, etc.). At large, these configurations require external bulk RAM/FLASH to operate. This requirement ultimately affects the minimum device startup time (tens of seconds, due to the large boot BIOS) and working temperature range (mostly indoor).

As noted in Cisco's release notes about SNMP V3:

Unsolicited (asynchronous) notifications can be generated as
traps or inform requests (informs). Traps are messages
alerting the SNMP manager to a condition on the network.
Informs are traps that include a request for confirmation of
receipt from the SNMP manager. Notifications can indicate
improper user authentication, restarts, the closing of a
connection, loss of connection to a neighboring device, or
other significant events.

Traps are less reliable than informs because the receiver
does not send an acknowledgment when it receives a trap. The
sender does not know if the trap was received. An SNMP manager
that receives an inform, acknowledges the message with an SNMP
response protocol data unit (PDU). If the sender never
receives a response, the inform can be sent again. Thus,
informs are more likely to reach their intended destination.

Traps are often preferred even though they are less reliable
because informs consume more resources in the device and in
the network. Unlike a trap, which is discarded as soon as it
is sent, an inform must be held in memory until a response
is received or the request times out. Also, traps are sent
only once, whereas an inform may be resent several times.
The retries increase traffic and contribute to higher
overhead on the network. Use of traps and informs requires
a trade-off between reliability and resources. If it is
important that the SNMP manager receives every notification,
use informs, but if traffic volume or memory usage are
concerns and receipt of every notification is not required,
use traps.

Copied from SNMP Configuration Guide, Cisco IOS XE Release 3SE, 3 September 2019.

Terminal Mode Serial Protocol

The Teledyne Paradise Datacom Outdoor SSPAs utilize Terminal Mode Serial Protocol (TMSP) as a secondary serial protocol for management and control through a remote serial interface.

TMSP allows the user to access internal SSPA functions via a remote ASCII Terminal or its equivalent (such as HyperTerminal for Windows). TMSP is accomplished through either the RS-232 or RS-485, half duplex, serial communication link. US ASCII encoded character strings are used to represent commands and data massages.

A remote terminal or controller initiates a communication session and the SSPA Terminal takes action and returns a report of requested status. The SSPA terminal will not initiate communication and will transmit data only when commanded to do so. Prior to establishing the session with the SSPA Terminal, this mode must be enabled through the Universal M&C menu.

The remote terminal must be configured with serial settings that match the SSPA's serial port settings. For example, if the SSPA is set at 9600 Baud, the remote terminal must be also configured as ASCII terminal at 9600 Baud, no parity, 8 bit data with 1 stop bit serial connection. The SSPA will not echo back any incoming characters, so local echo must be enabled on the remote terminal.

To establish a remote control session with the SSPA terminal, the user must type "UNIT#XXX" in the terminal window (all letters must be in upper case), where XXX is the SSPA unique network address or the global call address (170). Press the "Enter" key on remote terminal keyboard.

The SSPA should answer with "Unit#XXX OnLine", with the first menu screen on the following lines. After a remote session is successfully established, the unit will stay connected as long as needed. The session interface is organized into menu screens.

To help the user navigate through the menu, the help string with the list of active keys always follows the menu strings. For example, the last transmission string on all informative menu screens will be:

```
Active Keys:(U)p+Enter;(D)own+Enter;(C)lrearFlt;(M)enu+Enter;(E)nd+Enter.
```

⚠ **Note: All letters must be in upper case!**

To refresh the current screen on the remote terminal, press the "Enter" key. To end a session, press "E" and the "Enter" key.

⚠ **Important! If multiple SSPA units are networked on the same serial link, do not establish a session with more than one SSPA at a time. If you do so you will not get any valid answer from any SSPA!**

Figure 12 shows an example screen shot of a terminal session.
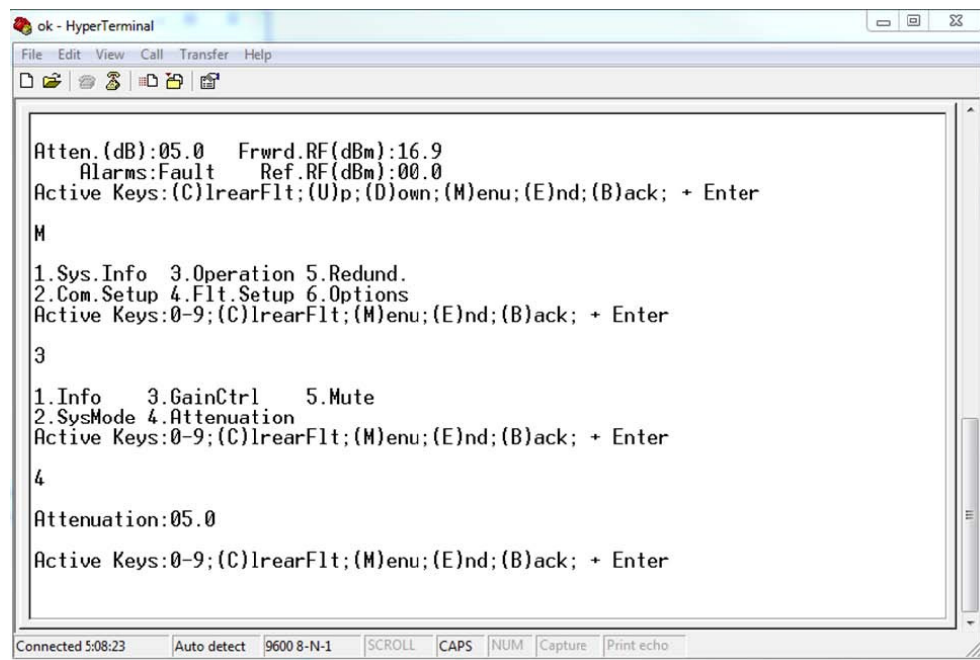
Figure 12: Terminal Mode Session Example

Terminal Mode Menu Structure

All High Power Outdoor TMSP menus are organized in logical sublevels: Informative and Main Menu Selection.

At the beginning of the session, the SSPA will prompt the user with the first menu of the Informative sublevel. The user can access the Main menu from any informative sublevel by sequentially selecting the "M" and "Enter" keys on the remote terminal keyboard.

There are five main levels of the menu selection, shown below:

1. Sys. Info - Shortcut to the Informative menu sublevel;
2. Com.Setup - Serial communication related settings;
3. Operation - SSPA operation related settings;
4. Fault Monitoring Setup - Fault handling settings;
5. Options -Optional settings.

System Information Sub-Menu

The informative sublevel of the menu structure contains six pages.

Sys Info Page 1

The page shows:

- Attenuation - SSPA current level of attenuation, measured in dB (Atten.(dB):XX.X) with an accuracy of 0.1 dB;
- Alarms - Summary alarm presence, "FAULT!" or "None" will be displayed de-pending on the state of the SSPA;
- Forward RF Power - Displayed in dBm with accuracy of 0.1 dBm;
- Reflected RF Power - Displayed in dBm with accuracy of 0.1dBm (if equipped).

Sys Info Page 2

The page shows a variety of alarm states which may be present within the SSPA. Fault val-ues are "Fault" or "Normal".

- Voltage - RF Module voltage regulator low voltage fault;
- Current - Low DC current fault;
- Temperature - High temperature fault;
- Fwd.RF - Forward RF fault (High, Low or Window, depending on the selected fault handling);

Sys Info Page 3

This page reflects various SSPA faults and conditions.

- BUC - Displays the block upconverter (BUC) fault (if equipped). Values "Fault" or "Normal";
- Aux - Displays the auxiliary fault condition. Values - "Fault" or "Normal";
- Int.Mute - Displays the internal mute condition (mute state controlled by internal SSPA hardware, such as serial protocol command or automatic over temperature shutdown). Values - "Off" or "On";
- Ext.Mute - Displays the external mute condition (Mute condition controlled by hardware jumper on M&C connector). Values - "On" or "Off";
- State - Displays the SSPA online state in a redundant system. Value - "Standby" or "Online";
- Ctrl - Displays the type of attenuation control. Values - "Analog" or "PC Ctrl".

Sys Info Page 4

This page shows the detailed information about the state of the SSPA's plate temperature and internal power supply characteristics.

- DCCur.(A) - The total DC current draw by the RF module from the main power supply with an accuracy of 0.1A. This value varies depending on the power level of SSPA. If the SSPA is in the mute state, the current drops to a 0 to 5A range.
- Regul.(V) - Displays the measured value of the internal RF module voltage regulator. The value in normal mode should be range from 8 to 10.5V. During SSPA mute period, this value drops to near 0V. Measurement is accurate to within 0.1V.
- Gate (V) - This value represents the negative GaAsFETs gate drive voltage. Normal value range is 1 to 6 V. The value reading may be affected by SSPA temperature changes and mute state.
- PS (V) - Displays the internal power supply voltage output. Normal range is 11 to 13 V, with an accuracy to within 0.1V.
- Temp(C) - Current base plate temperature, measured in Centigrade.

Sys Info Page 5

This page displays the SSPA serial communication and redundancy related settings.

- Prtcl. - Displays the type of default implemented serial protocol. Values: Normal, Terminal, IPNet or SNMP.
- Baud - Displays the default SSPA baud rate. Values: 2400, 4800, 9600, 19200, 38400.
- Addrs - Displays the SSPA serial network address. Values: 0 to 255.
- Unit - Displays the SSPA 1:1 redundancy topological factor. Values: "HPA1" or "HPA2".
- Mode - Displays the implemented redundancy mode. Values: "Standalone", "1:1" or "SinglSw".

Sys Info Page 6

This page displays the SSPA various miscellaneous settings and conditions.

- BUCLock - Displays current setting for internal BUC (if equipped) reference locking mechanism. Possible values: Ext for external reference only, Int for internal reference only and Auto for auto switching function between external and internal reference.
- StdbyMode - Displays current setting for type of redundancy standby function. Possible values: Cold or Hot.
- Spare - spare fault can reflect various fault conditions and events.
- RecordHighT(C) - Displays highest recorded baseplate temperature endured by the SSPA unit.

Communication Setup Sub-Menu

This menu allows the user to select the parameters for communication between the SSPA and the remote monitor and control station. All changes made on this menu will take effect only after a hardware reset of the SSPA controller card. This can be accomplished by either cycling power to the SSPA or by selecting the menu item from Terminal mode "Options" > "Reset" menu item.

- 1.Protocol - Selection allows user to select remote communication protocol. Nor-mal, Terminal, IPNet, SNMP or NDSat protocol selections are available. Refer to protocol description section for details. The factory default protocol is "Normal".
- 2.Baud - This item allows the user to select the desired baud rate for serial communication. Available baud rates include 2400, 4800, 9600, 19200 and 38400 Baud. The factory default baud rate is 9600.
- 3.Address - This selection allows the user to set the network address of the controller if used on a serial network. Choose from 1 to 255. The address 170 should not be selected; it is reserved for factory use.
- 4.IP Setup - Selection allows user to set up IP network parameters: IP address, Subnet, Gateway. As well as set and review web page password and various SNMP settings.

Operation Setup Sub-Menu

This menu allows the user to select the parameters for communication between the SSPA and the remote monitor and control station.

- 1.Info - Displays the unique SSPA ID tag as well as the firmware version of the controller card.
- 2.SysMode (System Mode) - Allows the user to select the SSPA redundancy mode. Choose Standalone,1:1, Dual 1:1 or Maintenance switch modes.
- 3.GainCtrl (Gain Control) - Menu selects the style of SSPA attenuation control. User may select between "Analog", "Serial" and "ALC" types of control. It also allows set ALC RF level when unit setup for ALC control mode.
- 4.Attenuation - Allows the user to set the SSPA attenuation level between 0 and 20 dB in steps of 0.1dB. In order to take effect, the SSPA must be configured for "Serial" type of attenuation control.
- 5.Mute - Selects the SSPA mute state. Selection values: "On" or "Off".

Fault Setup Sub-Menu

This menu allows the user to customize the Auxiliary fault setup.

- 1. Aux. Action - Allows the selection of the final effect of the auxiliary fault on an SSPA operation. Selection: Fault (Major Fault), Fault + Mute, Alert (Minor Fault), or Alert + Mute.
- 2. Aux. Check - Allows the user to select the fault-triggering event. Logic High - fault occurs on "open" unconnected state of auxiliary input line. Logic Low - fault occurs on "close" shorted to ground state of the auxiliary input line. Ignore - allows user to disable auxiliary fault checking.

Redundancy Sub-Menu

This menu allows user to select various settings related to SSPA redundancy operation.

- 1.Standby Select - Allows selecting Standby/Online modes for units operating in redundancy system
- 2.Standby Mode - Sets Cold or Hot standby operation for SSPA unit
- 3.Unit - Allows selecting redundancy topological factor: HPA1 or HPA2

Options Sub-Menu

This menu makes available functions to backup or restore settings.

- 1.Restore - Restores saved settings from two user backup locations.
- 2.Backup - Allows the user to create a backup of all settings into two separate nonvolatile memory backup locations.
- 3.Fan Speed - On units equipped with fans speed control option menu allows user to select desired fan speed. Auto - for temperature proportional fan speed, Low - fixed low speed, High - Fixed high speed, RFCtrl - for output RF level propor-tional fan speed control.
- 4.Reset - This menu allows the user to remotely reset the SSPA controller card MCU, which allows the SSPA to apply new communication settings. The aftermath of the action depends on the selection which was made prior reset. If the SSPA is in Terminal mode protocol, communication with the unit may be reestablished after 5 seconds from the reset time. If the SSPA is configured to be part of a 1:1 redundant system, the reset will cause the SSPA to go offline.

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Outdoor SSPAs, Performance Tests

Teledyne Paradise Datacom
Drawing Number: 216595-8 Revision -
RA 7714
06 November 2019

Introduction

This section describes some of the tests performed on production amplifiers before shipment. Where possible, Teledyne Paradise Datacom maintains computer automated RF test stations to ensure a high level of accuracy and consistency to production amplifier testing.

Standard Tests

All Teledyne Paradise Datacom Outdoor amplifiers must meet rigid specifications and undergo the following tests. Copies of the final test data are shipped along with the unit and/or system. Figures 1 through 3 show examples of the final test data for a 140W C-Band Compact Outdoor amplifier with an integrated block up converter.

Swept Gain

The amplifier gain is swept over the operating frequency range under small signal conditions to confirm the minimum gain and gain flatness specifications. The entire outdoor amplifier is tested in a temperature chamber from -40 °C to +55 °C and the gain is recorded. See Figure 1, item [1].
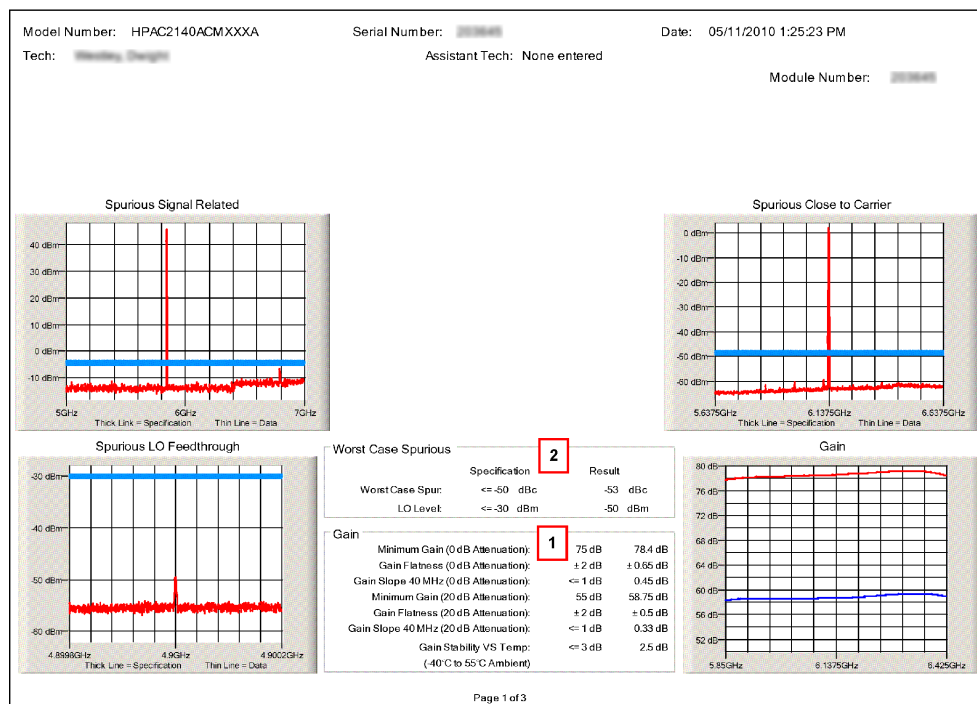
Figure 1: Spurious and Gain Data

Spurious

Spurious signals are undesirable byproducts of amplifiers caused by nonlinearities within the amplifier and other system level components such as switch mode power supplies. These unwanted signals cause signal management problems in system applications. Out-of-band spurious signals cause interference to other pieces of equipment. See Figure 1, item [2].

Input Return Loss

The input return loss is measured in all production amplifiers. This is a measure of how closely the amplifier is matched to its characteristic impedance. The input impedance of the amplifier is a nominal 50Ω. See Figure 2, item [1].
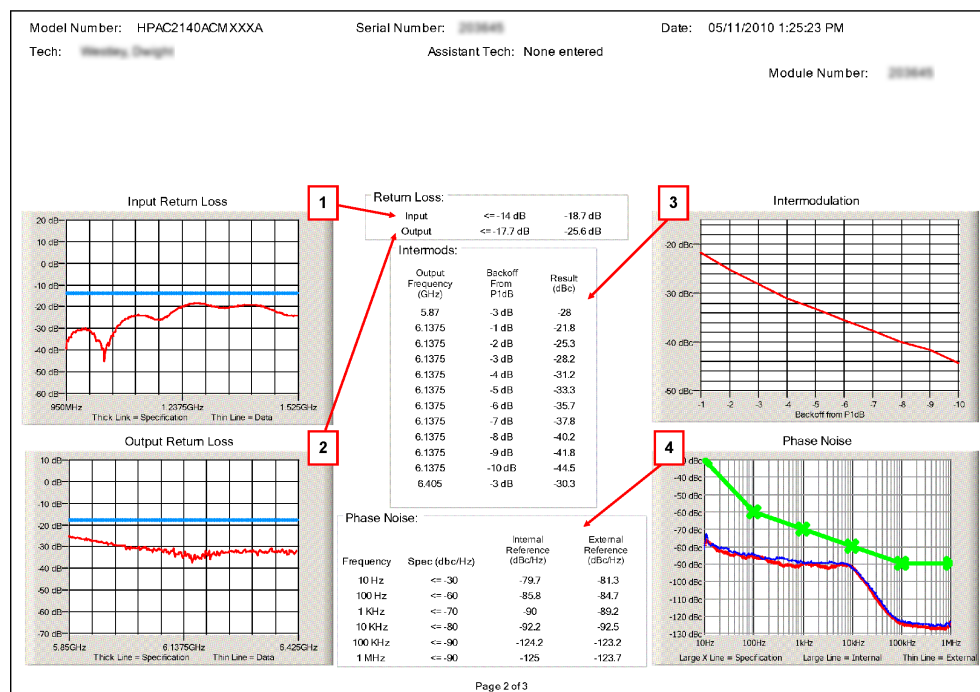
Figure 2: Return Loss, Intermodulation and Phase Noise Data

Output Return Loss

The output return loss is measured in all production amplifiers. This is a measure of how closely the amplifier is matched to its characteristic impedance. The output impedance of the amplifier is matched to the waveguide complex impedance. See Figure 2, item [2].

Intermodulation Distortion

Intermodulation distortion is one of the most important characteristics of a Solid State power amplifier system. Satellite communication systems must comply to certain distortion levels depending on the service involved. All production amplifiers are subjected to automated intermod testing. This is based on a standard two-tone intermod test in which the intermod level (IMD) is measured in dBc with respect the main tones and the highest third order intermod products.

Satcom amplifiers are typically used in some 'back-off' condition. This is the operating point at which the composite output power is 'backed-off' from the amplifier's P1dB, compression point. A curve of back-off vs. IMD level is especially useful in the selection of a power amplifier or determining the proper output power setting in a Satcom system.

Teledyne Paradise Datacom recognizes the importance of this back-off characteristic and provides a plot of back-off vs. IMD from 1 dB to 10 dB back from the amplifier's compression point. Figure 2, item [3], shows a typical back-off curve from a production test set.

Power Requirements

This test measures the power requirements of the unit over the various voltages appropriate for the unit under test. See Figure 3, item [1].
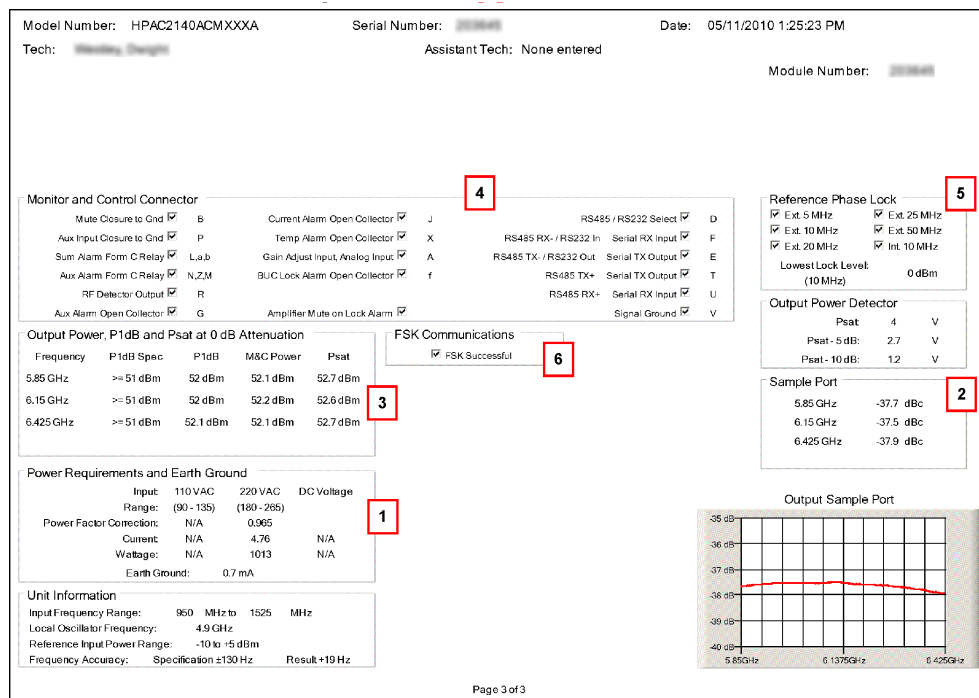
Figure 3: M&C, Output Power, Ground, Phase Lock and Misc. Data

Earth Ground

This test measures the leakage current and verifies that each pin on J8 is connected correctly. If the ISO/GND compatibility jumper is equipped, it verifies the jumper position. See Figure 3, item [1].

Sample Port

The RF Sample Port is measured at discrete frequencies across the band and a calibration label is placed near the Type N connector on the bottom of the unit. The sample port is approximately -40 dB from the RF output level. A label with the exact coupling ratio is attached to the amplifier chassis. See Figure 3, item [2].

P1dB and Psat

The 1dB Gain Compression Point is measured at discrete frequencies across the band to characterize the output power over the operating frequency range. The P1dB measurement is a guaranteed minimum specification.

As the input power increases, the output power limits to some maximum level. This is defined as the saturated output power or Psat. The Psat specification is a typical value and is not guaranteed. This is due to the variation that exists among microwave power semiconductors. The saturated output power is typically 0.5 dB to 1.0 dB above the P1dB value. See Figure 3, item [3].

I/O Test

This test verifies that the unit has the correct wiring on the MS connectors by testing faults, communications, and redundancy. See Figure 3, item [4].

Ethernet (if equipped)

Tests Ethernet communication, web monitor and control, and assigns a MAC address to the unit.

Tests for Units with Integrated zBUC

If the Compact Outdoor amplifier includes a block up converter (zBUC), the following tests are included.

Reference Lock

This test checks the external/internal references (if equipped), as well as lowest locking level at 10 MHz. See Figure 3, item [5].

FSK

Verifies FSK communication with the zBUC. See Figure 3, item [6].

Phase Noise

Tests phase noise using external and internal (if equipped) references. The unit is required to meet at each decade, as well as fall below the spec line determined by the decades. See Figure 2, item [4].

Microphonics

A spectrum analyzer is connected to the unit and is set to perform a max hold on the trace. A vibration is introduced to the unit, and the sidebands must meet the specification of ≤ -20 dBc.

Optional Tests

The following tests are performed on units at the request of the customer, usually to verify specific customer requirements.

Noise Figure

Using a noise figure meter, the unit is tested to verify it operates within specification.

Group Delay

The testing software measures the linear, parabolic, and ripple components to verify the unit is within specification.

AM/PM

The testing software measures the slope of the amplifier's insertion phase vs. output power.

Noise Power

Noise power is the total noise per bandwidth at the output of the unit when a signal is not present.

Harmonics

The testing software measures the 2nd and 3rd harmonics of the unit (as long as the frequency range is within the capabilities of the equipment).

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Unit Control with Universal M&C Software

Teledyne Paradise Datacom
Drawing Number: 216594-2 Revision A
ECO 18855
11 October 2019

Introduction

This section describes the control of a remote unit using Teledyne Paradise Datacom's free Windows-based Universal Monitor and Control software.

Download/Install Software

Teledyne Paradise Datacom provides a free version of its Universal Monitor and Control (M&C) Software available for download from its web site. Install the software on a PC running Windows 7 or later.

Navigate to the Support > Downloads page and click on the latest version of the sofware to download the zip file.

Unzip the package and run the setup.exe file. This launches the Universal M&C Software installer. Follow the prompts and agree to the license agreement to install the application. When complete, close the installer.

⚠ **By default the installer saves the software to C:\Program Files (x86)\Paradise Datacom. When running the installer, you can change the destination of the installation.**

The software may be used to remotely monitor and control any of the following Teledyne Paradise Datacom products:

- Rack mountable (RM) Amplifiers (3RU, 5RU, 7RU)

- Compact Outdoor (CO) Amplifiers

- High Power Outdoor (HPO) Amplifiers

- Indoor PowerMAX Amplifier Systems

- Outdoor PowerMAX Amplifier Systems

- System Controllers

Add RM Unit to Universal M&C

Launch the Teledyne Paradise Datacom Universal M&C software from the Programs Menu of your PC. During installation, a shortcut to the software may have been added to your desktop.

To add a new rack mountable amplifier, click the 'Action' menu and select 'Add Unit' from the pull-down menu. Select 'Rackmount' from the menu choices. See Figure 1.
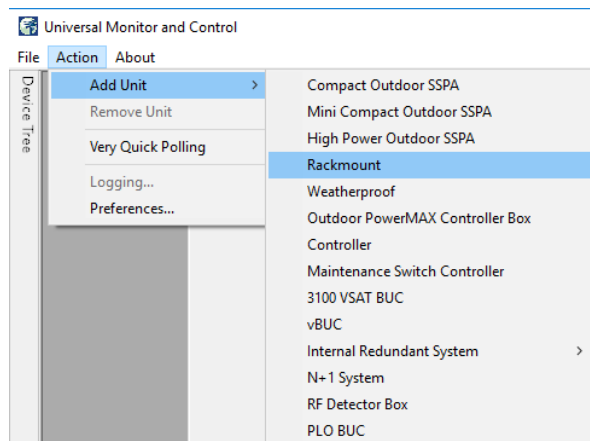
Figure 1: Universal M&C > Action > Add Unit > Rackmount

An 'Add Rackmount SSPA' dialog window will appear.

Enter a Unit ID (not required although it is recommended). If a Unit ID isn't entered the Unit ID will be assigned by the M&C.

To add a unit connected to a serial port you must supply a Port and a Baud Rate. See Figure 2.
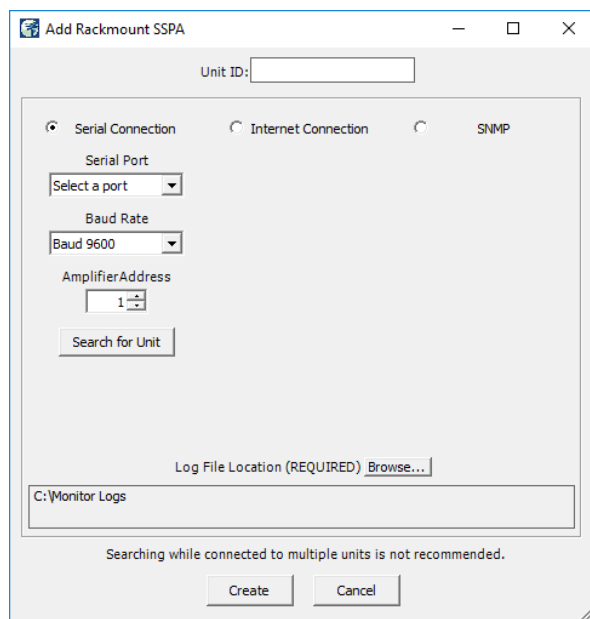
Figure 2: Select a COM Port and Baud Rate for Serial COMs

To add a unit connected via UDP (TCP/IP) you must supply either a Hostname or an IP Address. See Figure 3.

Figure 3: Enter IP Address and Port Address for UDP COMs

Specify the Unit's unique address in the Amplifier Address box. If you don't know the address of the unit you may search for it. Be aware that this search feature is only useful when you have only one unit connected to your PC at a time.

Choose a log file location by clicking the 'Browse...' button. The default is the "My Documents" folder. The log file name will be the UnitID and the extension ".log" appended to it. i.e. "Unit1.log".

Click on the 'Create' button to connect to the unit. The Universal M&C software will open a new window from which you can control and review the status of the connected unit.

Overview of RM SSPA M&C

Each SSPA in the Rackmount M&C has six screens:

- Status Tab

- Settings Tab

- Faults Tab

- IP Setup Tab

- N+1 Settings Tab

- SNMP Tab

Status Tab

The first screen is the "Status" tab, shown in Figure 4. The Status tab shows the current conditions (or state) of the connected SSPA. In addition, the Status tab allows the operator to change the Mute state of the carrier and allows adjustment of the on-board attenuator for gain control.
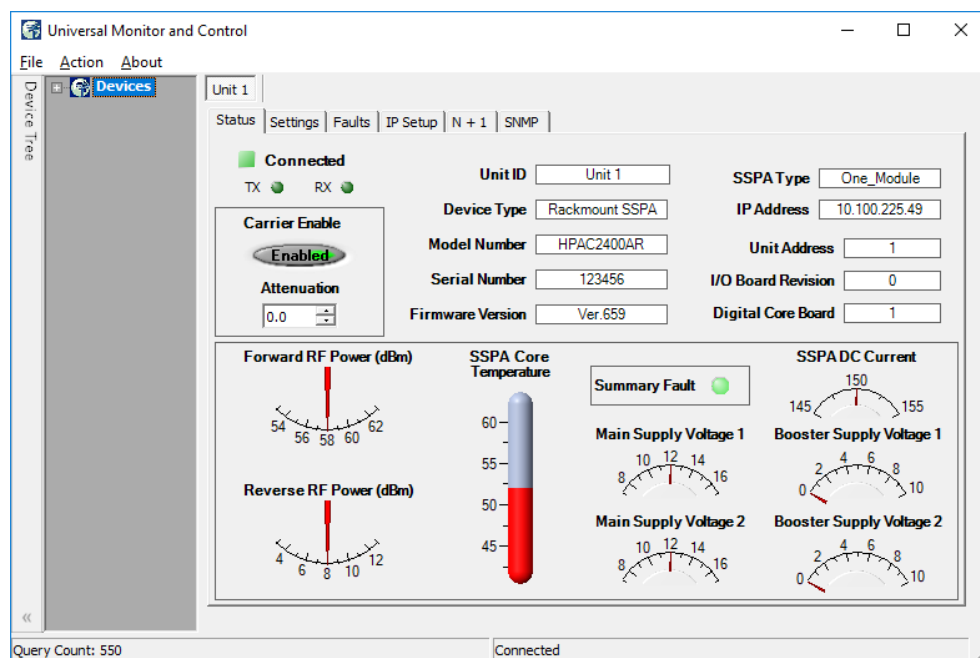
Figure 4: Universal M&C Software > Status Tab

Settings Tab

The second screen is the "Settings" tab, shown in Figure 5. It shows the user all available settings on the SSPA. All user-adjustable settings are allowed to be modified to suit the specific needs of the customer. However, it should be noted that the SSPA is configured for the customer at the factory.

If modification of any settings is necessary, details of each setting, condition and threshold are available in the Settings, Conditions and Thresholds description of the **Remote Control Protocol** section of any rack mountable amplifier manual.
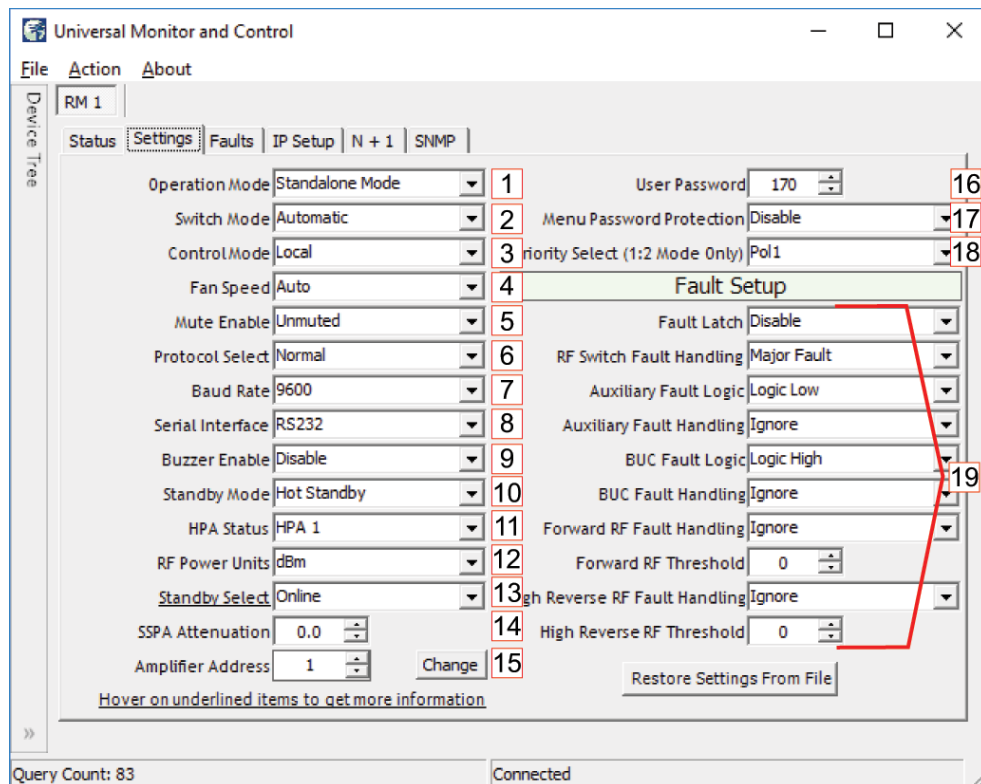
Figure 5: Universal M&C Software > Settings Tab

Operation Mode [1]

Select between Standalone Mode, (single unit), 1:1 Mode, 1:2 Mode, 1:1 Phase Combined or 1:2 Phase Combined.

If the amplifier will be configured in a redundant system and controlled with an external controller, each system amplifier should be set to Standalone Mode.

If the amplifier will be configured in a redundant system but will be controlled using internal control logic, each system amplifier should be set to the appropriate redundant mode. All amplifiers in the redundant system should be set to the same mode.

For more information on settings used for internal 1:1 redundancy mode, see the **Internal 1:1 Redundant System Operation** section.

For more information on settings used for internal 1:2 redundancy mode, see the **Internal 1:2 Redundant System Operation** section.

Switch Mode [2]

Select between Automatic switching, Manual switching or Switch Lock.

Control Mode [3]

Select between Local or Remote control.

Fan Speed [4]

Select between Low, High or Auto.

Mute Enable [5]

Select Muted or Unmuted.

Protocol Select [6]

Select Normal or Terminal. The operator will be asked to verify any to change to the Protocol Select setting. Communication with the amplifier may be affected.

Baud Rate [7]

Select a baud rate of 2400, 4800, 9600 (the default), 19200, or 38400. The operator will be asked to verify any to change to the Baud Rate setting. Communication with the amplifier may be affected.

Serial Interface [8]

Select the type of serial communications interface to use: RS232, RS485, IPNET or SNMP. The operator will be asked to verify any to change to the Serial Interface setting. Communication with the amplifier may be affected.

Buzzer Enable [9]

Enable or Disable the audible buzzer on the unit.

Standby Mode [10]

Select Hot Standby or Cold Standby. In Cold Standby mode, the RF module is muted when its Standby Select setting is set to Standby.

HPA Status [11]

Select HPA1, HPA2 or HPA3. For use in redundant systems.

RF Power Units [12]

Select the type of unit displayed on the front panel: dBm or Watts.

Standby Select [13]

Select the disposition of the amplifier in a redundant system: Standby or Online.

SSPA Attenuation [14]

The Gain Adjustment of the unit is adjustable here, from 0 to 20 in 0.1 dB steps.

Amplifier Address [15]

Sets a network address for the unit. Range is 0 to 255. Click the 'Change' button to change the address. The operator will be asked to verify any to change to the Amplifier Address setting. Communication with the amplifier may be affected.

User Password [16]

Sets a password for the unit. Range is 0 to 255.

Menu Password Protection [17]

Enable or Disable password protection for the unit.

Priority Select [18]

For use in 1:2 Mode only. Assign whether the standby unit will be switched to Pol1 or Pol2 if the amplifiers transmitting to both polarities exhibit failures and the standby unit must switch to one of the polarities. All units in a 1:2 configuration must use the same Priority Select setting.

Fault Setups [19]

The user may Enable or Disable fault latching, and set the fault logic and handling for RF Switch faults, Auxiliary faults, BUC faults, Forward RF faults and High Reverse RF faults. Logic settings are Logic Low or Logic High.

RF Switch Fault Handling settings include Ignore, Minor Fault, Major Fault, and Switchover Mute.

Auxiliary Fault Handling settings include Ignore, Minor Fault, Major Fault, Minor Fault with Mute, and Major Fault with Mute.

Forward RF Fault Handling settings include Ignore, Low RF Major Fault, Low RF Minor Fault, ALC On, High RF Major Fault, High RF Minor Fault, and High RF Major Fault with Mute.

High Reverse RF Fault Handling settings include Ignore, Major Fault, and Minor Fault.

The user can also set the threshold levels for Forward RF and High Reverse RF.

Faults Tab

The third screen is the "Faults" tab, shown in Figure 6. It shows the user the status of all faults on-board the SSPA. These include: Summary, Module # faults, Standby State (green = Online; red = Standby); Power Supply, Low DC Voltage and Current, Fans, BUC, High Temperature, Forward RF and High Reflected RF, Auxiliary, switch faults (for units configured in a redundant system), and optional faults.
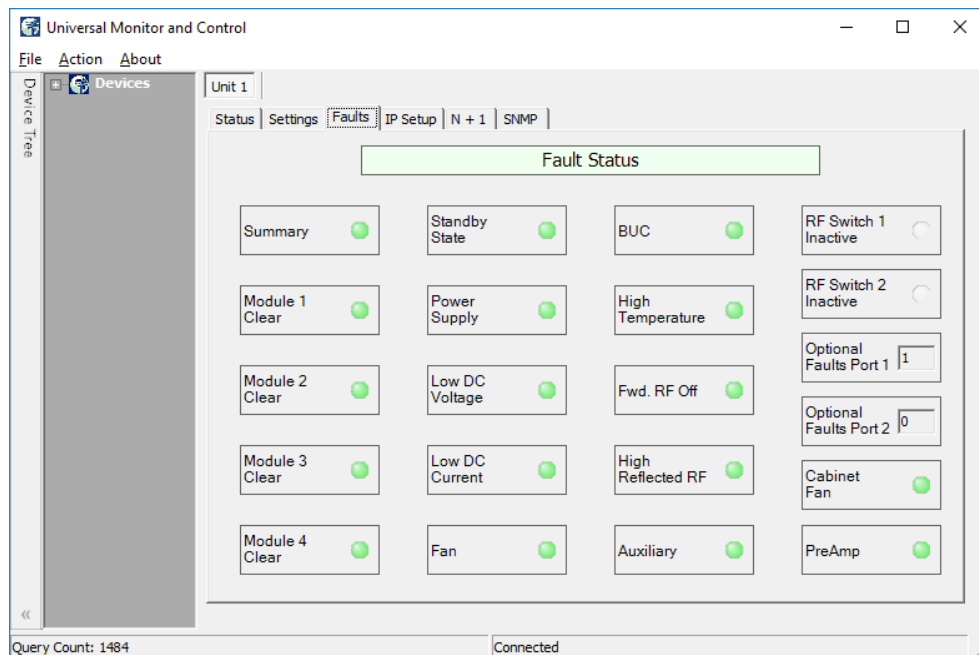
Figure 6: Universal M&C Software > Faults Tab

Each RF Module in the SSPA is monitored for faults in addition to the SSPA itself. If the SSPA does not include a module, non-existant modules will show up with a status of 'N/A' in the Module Status box, and the indicator will turn yellow.

IP Setup Tab

The fourth screen is the "IP Setup" screen, shown in Figure 7. It displays all of the TCP/IP settings on the SSPA.
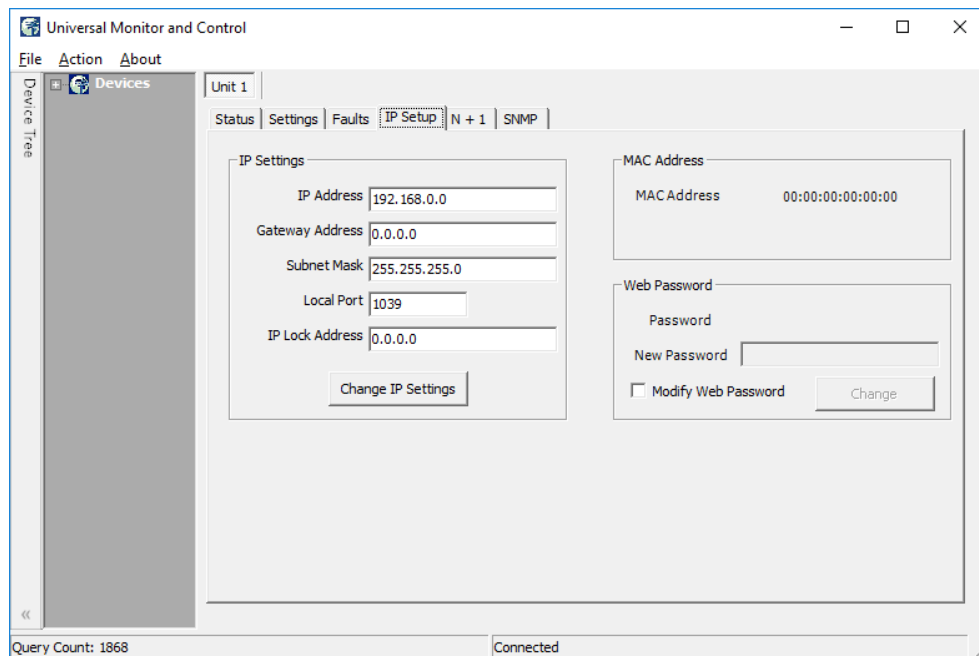
Figure 7: Universal M&C Software > IP Setup Tab

When the IP Address is modified, the SSPA must be reset for it to use the new IP Address. Until the SSPA is reset, it will use the old IP Address. The Local Port is the port that the SSPA uses for UDP requests. The SSPA also answers requests using the same port. If the Local Port is changed, the SSPA must be reset.

The Gateway Address and Subnet Mask are standard settings for TCP/IP communications. If either of these settings is changed, the SSPA must be reset for the new settings to take effect.

The IP Lock Address is used for security. If it is set to something besides 0.0.0.0 or 255.255.255.255 it will only answer the address it is set to. For example, if the IP Lock Address is 192.168.0.50, then a request from 192.168.0.100 will not be accepted. The IP Lock Address may be changed without resetting the SSPA.

N+1 Settings Tab

The fifth window is the "N+1 Settings and Conditions" tab, as shown in Figure 8. This screen is used for setting N + 1 system parameters, and monitoring N+1 system conditions. Note that only the master module in an N+1 system will show the N+1 Master settings.
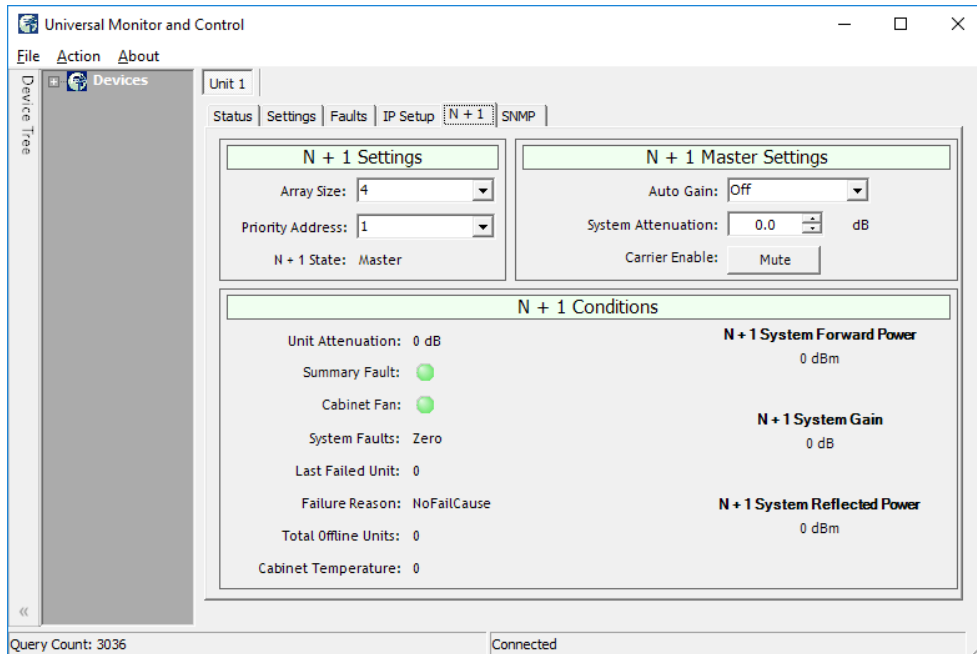
Figure 8: Universal M&C Software > N+1 tab

See the **Overview of the PowerMAX M&C** section for more information on Master/Slave functions using the N+1 Settings Tab.

SNMP Tab

The sixth window is the "SNMP Settings" tab, as shown in Figure 8. This screen is used for setting SNMP communication parameters, and for assigning trap conditions.
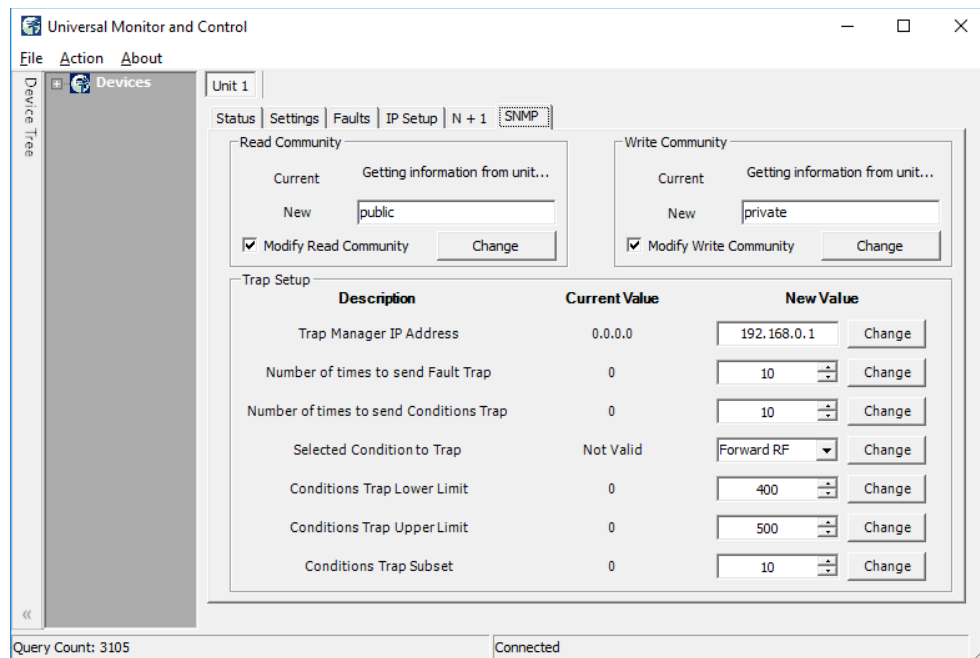
Figure 9: Universal M&C Software > SNMP tab

Add CO Unit to M&C

Launch the Teledyne Paradise Datacom Universal Monitor and Control software from the Programs Menu of your PC. Upon installation, a shortcut to the software may have been added to your desktop.

Click the 'Action' menu and select 'Add Unit' from the pull-down menu. Select 'Compact Outdoor SSPA' from the menu choices. See Figure 10.
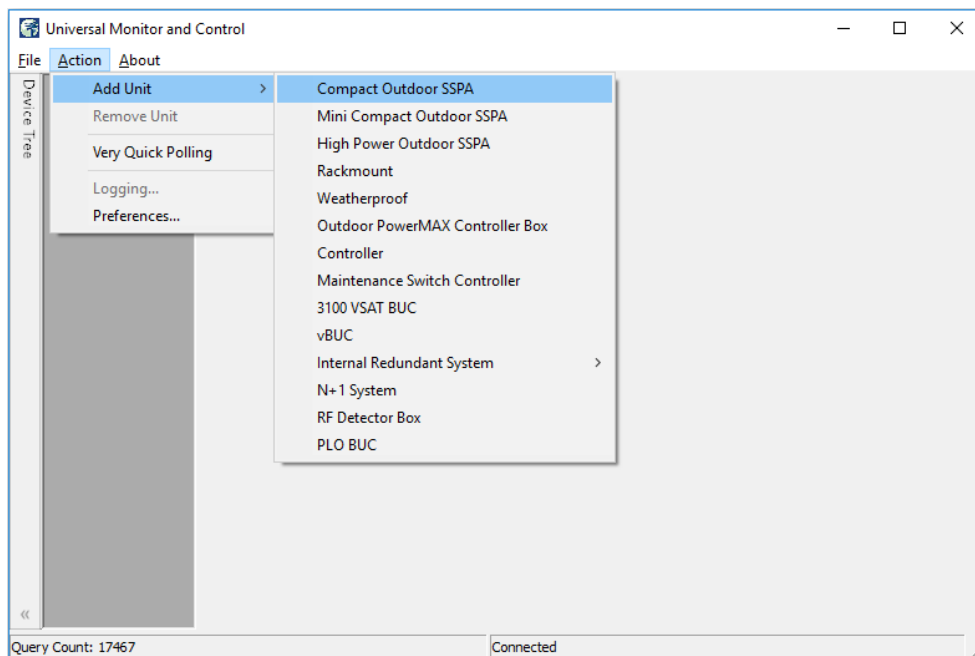
Figure 10: Universal M&C > Add Unit > Compact Outdoor SSPA

A new dialog window will open. Enter the following information where applicable: Unit ID; if using a RS-232 Connection, the Serial Port and Baud Rate. See Figure 11.

Figure 11: Add Compact Outdoor SSPA > Serial Connection

If using an Ethernet Connection, enter the unit's IP Address and Port number. See Figure 12.

Figure 12: Add Compact Outdoor SSPA > Internet Connection

Specify the unit's Address in the Amplifier Address box. If you don't know the address of the unit you may search for it. Be aware that this search feature is only useful when you have only one unit connected to your PC at a time.

If you wish to change the log file location, click on the 'Browse' button and navigate to the desired location.

Click on the 'Create' button to generate the operation window for this unit.

Overview of the CO M&C

The operational status, settings and conditions of the connected Compact Outdoor amplifier are displayed in the Universal M&C application's four tabs:

- Status Tab

- Settings Tab

- IP Setup Tab

- SNMP Settings Tab

Status Tab

The Universal M&C Software will initialize and open to the Status tab, the main monitoring display. See Figure 13. The Status tab shows the the current conditions (or state) of the Compact Outdoor SSPA. In addition, the status screen allow the user to alter the Mute condition of the carrier and adjust the on-board Attenuator for gain control.
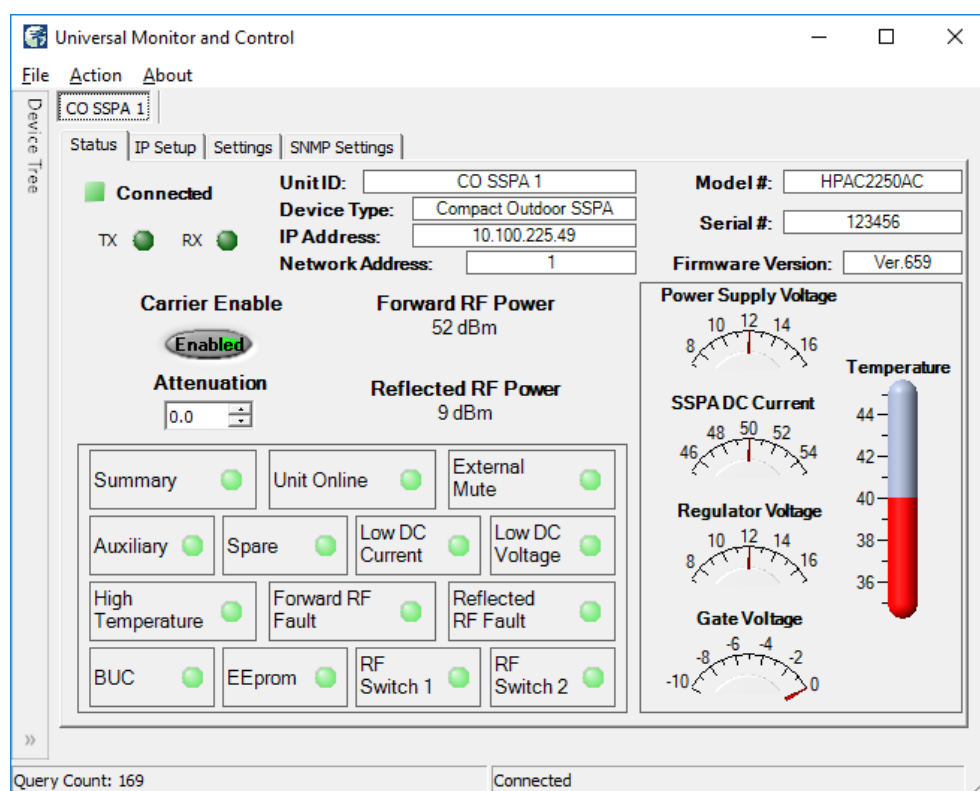
Figure 13: Compact Outdoor SSPA > Status Tab

Upon connection with a unit, the M&C application obtains and displays the unit ID, the amplifier's model number and serial number. The SSPA module's firmware version number is also displayed here for convenience.

The unit's network address and serial COM or IP address are also listed, which can be helpful in optimizing serial communications.

Signal Indicators

Three rows of indicators show the connection status of the connected amplifier. Top-most is an indicator that displays a green square when Connected, or a red square when Disconnected. Immediately below are two indicators for the TX and RX paths. The third row displays the mute state (Carrier Enable). The operator may click on the indicator to toggle between enabling or muting the amplifier. See Figure 14.
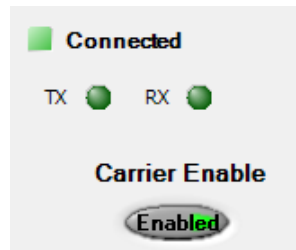
Figure 14: Status Tab > Signal Indicators

Fault Status Indicators

The Fault Status frame in the lower left side of the Status tab contains a 3x4 grid of SSPA fault lights. See Figure 15.
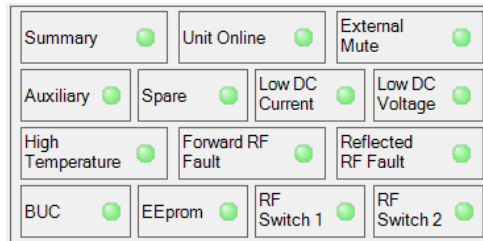
Figure 15: Status Tab > Fault Status Indicators

- Summary Alarm: The Summary Alarm is simply a logical 'OR' of any major alarm indicators.
- Unit Online: This is a status indicator that illuminates green when the unit is online.
- External Mute Alarm: The External Mute line gives an indication that the SSPA has been externally muted by J4-Pin B. This alarm can be configured to trigger a summary alarm if desired. Factory default is to signal a External Mute fault but no summary alarm.
- Auxiliary & Spare Alarms: The Auxiliary and Spare Alarms are configurable from the Settings Window.

These alarms can be configured to trigger a summary alarm. See the **Settings Tab** section.

- Low DC Current Alarm: The Current Fault is factory preset to alarm if the SSPA module current falls below 60% of its nominal value. This alarm will also trigger a summary alarm.
- Low DC Voltage Alarm: The Voltage Alarm is factory preset to alarm if the SSPA module current falls below 80% of its nominal value. This alarm will also trigger a summary alarm.
- High Temperature Alarm: The Temperature Fault indicator is factory preset to alarm at 80°C. The amplifier will continue to operate up to 90°C. Beyond 90°C the DC power will be interrupted to the SSPA module. This measure will protect the sensitive microwave transistors from catastrophic failure. The fans and monitor and control circuitry will continue to operate normally. This function has approximately a 5°C hysteresis window which will allow the amplifier to re-enable itself when the ambient temperature is reduced by 5°C. This alarm will also trigger a summary alarm.
- Forward RF Alarm: The Forward RF Fault Alarm indicates when the RF output of the amplifier falls below the threshold set in the Settings Window.
- BUC Alarm: The BUC fault is only active in units that are supplied with an optional L-Band Block Up Converter module. If the Up Converter's phase locked local oscillator loses lock, a BUC alarm is set and the amplifier is muted so that spurious RF cannot be transmitted. This alarm can be configured to trigger a summary alarm.
- EEPROM Alarm: The EEPROM Alarm is primarily used as a Fiber RX Link alarm for Compact Outdoor SSSPA units configured with a fiber-optic interface.
- RF Switch Alarms: The RF Switch 1 Alarm is only active if a 1:1 Redundant System has been configured in the M&C program. The RF Switch 2 Alarm is only active is a 1:2 Redundant System has been configured. These configurations are covered in Section 7.

Voltage, Current and Temperature Display

On the right side of the Status window is a thermometer display that reports the present baseplate temperature of the amplifier. The baseplate temperature typically experiences a 20-30 degree rise above ambient on the highest power Compact Outdoor amplifiers and 15-20 degree rise on lower power units. See Figure 16.
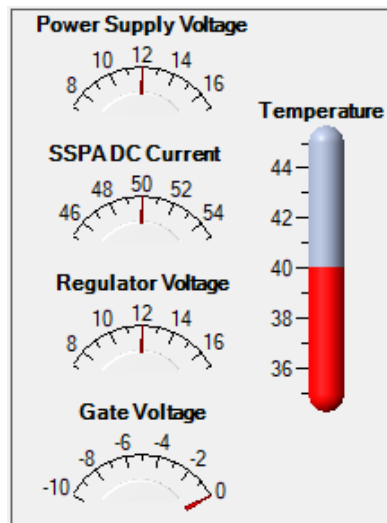
Figure 16: Status Tab > Signal Indicators

To the left of the thermometer display are several indicators that show various operating conditions of the Compact Outdoor Amplifier in real time. These indicators are helpful for any diagnostic procedures and consist of: Power Supply Voltage monitor SSPA DC Current monitor Regulator Voltage monitor Gate Voltage monitor.

The Power Supply voltage indicator displays the primary 12 volt power supply output. SSPA DC Current is the total current drawn by the microwave transistors. Regulator Voltage is the DC voltage of the drain circuitry that feeds the GaAs transistors. The Gate Voltage indicator monitors the DC voltage of the gate circuitry of the microwave GaAs transistors. These indicators provide direct access to the active device operating characteristics.

Gain Adjustment (Attenuation Control)

The Gain Attenuation Control is located above the Fault Condition Indicators and below the Carrier Enable status. See Figure 17.
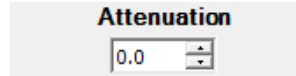
Figure 17: Status Tab > Attenuation Control

The gain can be adjusted by setting the Attenuation Control. An Attenuation Control of 0 dB is the maximum gain (typically 75 dB) setting on the amplifier. By setting the Attenuation Control to 20 dB; the gain is set to 55 dB. The Attenuation Control can be varied using the up/down arrows to the right of the displayed value or by typing a value between 0 and 20 in the field and hitting the Enter key.

Forward/Reflected RF Power Display

The Forward RF Power is displayed in the central part of the Operation window. This indicator reports the approximate forward output power of the amplifier. It uses the voltage from the RF Power Detector to determine a corresponding power level in dBm. The accuracy of the power indicator is ±1 dB at the mid-point of the specified band, with a single CW or QPSK carrier.

Units with the reflected power meter option also display the Reflected RF Power. See Figure 18.
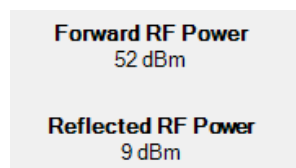
Figure 18: Status Tab > Forward/Reflected RF Power Display

Settings Tab

Figure 19 shows the Settings tab of the Universal M&C software. The Settings tab contains many of the global settings that are available in the SSPA.
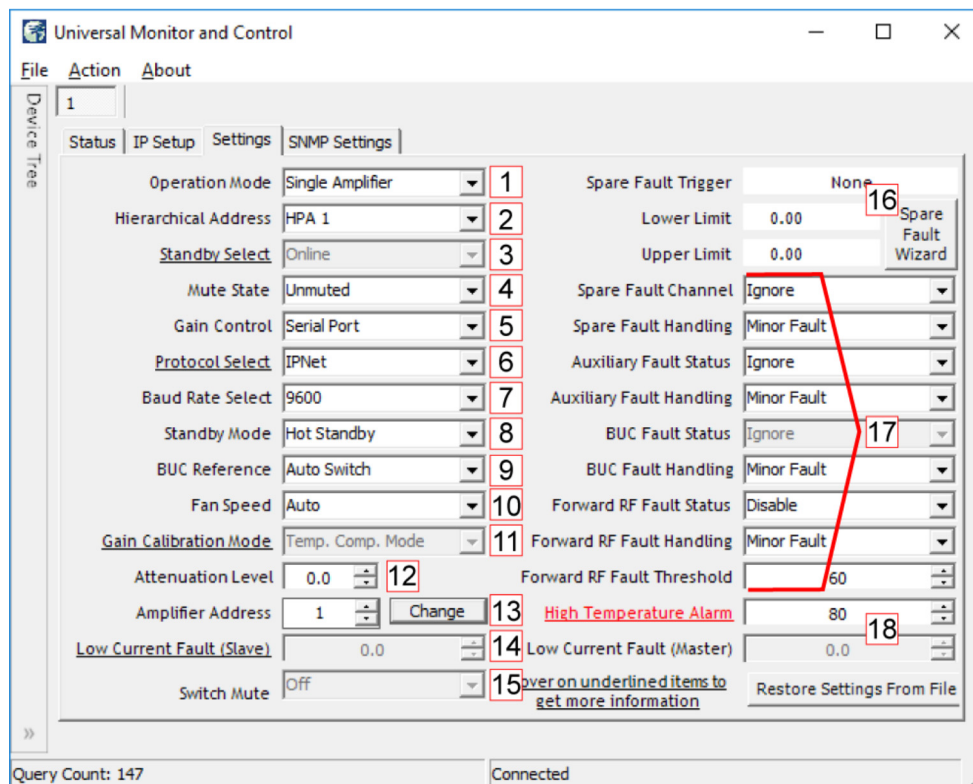
Figure 19: Compact Outdoor SSPA > Settings Tab

The Compact Outdoor amplifier will power up with the "last-state" settings before the unit was powered down. Whatever attenuation setting or mute state the amplifier was in when powered down will be the restored settings when the amplifier is powered back on.

Operation Mode [1]

Select between stand-alone (single unit), Dual 1:1 mode, 1:1 Redundant mode, or Maintenance Switch mode.

Hierarchical Address [2]

Identifies each amplifier in a redundant system as HPA 1, HPA2 or HPA 3.

Standby Select [3]

Selects whether the unit should start up as the online amplifier or the standby amplifier. When in a redundant system configuration, if the amplifier Standby Select state is changed from the Online state to the Standby state, the system will drive the switch so that another amplifier in the system is in the Online state. Only the Online amplfier can give away its Online state. This setting is saved upon unit shut-down, and the unit will start up in the last saved state.

Mute State [4]

Determines if the unit should start up muted (transmit disabled) or mute cleared (transmit enabled).

Gain Control [5]

Select between serial communication control of the unit's gain or analog voltage gain control via J4.

Protocol Select [6]

The operator may select either the standard string protocol, Terminal mode, IPNET or SNMP (as well as legacy Binary Mode and NDSatcom protocols). The operator will be asked to verify any change in protocol. Communication with the amplifier may be affected.

Baud Rate Select [7]

Sets the baud rate of the unit. The supported baud rates include: 2400, 4800, 9600, 19200, and 38400 baud. The factory default baud rate is 9600. The operator will be asked to verify any change to the baud rate. Communication with the amplifier may be affected.

Standby Mode [8]

Selects between Hot and Cold standby mode for units in redundant systems.

BUC Reference [9]

Selects between an Internal or External reference for an optional block up coverter integrated with the unit, or allows the unit to Auto-switch between Internal and External reference.

Fan Speed [10]

Selected GaN units are equipped with a Fan Speed Control option. The fan speed control circuit is shared with the RF power detector analog output (pin R on M&C connector J4). This pin remains not connected on units with the fan speed control option installed. Available control options: Auto, High, Low, Default/Off

- Auto - This setting allows the unit to control the cooling fan speed according to the internal RF module temperature. If the module plate temperature remains below 50 °C, the fan speed will be set to minimum. If the registered module plate temperature is above 50 °C, unit will gradually increase the fan speed. Fan speed will reach maximum at a plate temperature of 65 °C.
- High - This option sets the fan speed to maximum. Air velocity will remain at the same level regardless of other operation parameters.
- Low - This option sets the fan speed to minimum. Air velocity will remain at the same level regardless of other operation parameters.
- Default/Off - This setting should be set on units without the fan speed control option. It will allow proper functioning of the RF power monitor analog output. Applying this setting on units with the fan speed control option allows the fan speed to be proportional to the output RF level. Fan speed will be set at the minimum when output RF is below a detectable level. Fan speed will gradually increase when RF output increases within the detectable RF range. Fan speed will be at maximum level when unit reaches saturated power (Psat).

Gain Calibration Mode [11]

This feature is disabled for most users. Should be set for Temp. Comp. (Temperature Compensation) Mode. Consult the factory if set for Calibration Mode.

Attenuation Level [12]

The Gain Adjustment of the unit is adjustable here, from 0 to 20 in 0.1 dB steps.

Amplifier Address [13]

Sets a network address for the unit. Range is 0 to 255. Click the 'Change' button to change the address. The operator will be asked to verify any to change to the Amplifier Network Address. Communication with the amplifier may be affected.

Low Current Fault (Slave) [14]

This feature is not available on all units. Consult the factory.

Switch Mute [15]

This is a read-only view of the Switch Mute setting. Higher power amplifiers which include a maintenance switch or are configured in a system which includes a transfer switch may be set to mute on switch (setting = On) at the factory.

Spare Fault Wizard [16]

This feature allows the user to set the Spare Fault Trigger using the Spare Fault Wizard.

Click on the Spare Fault Wizard button, which opens a new window. See Figure 20. Select between the following fault triggers: Analog Gain Adjust Voltage, Gate Voltage, Regulator Voltage, Power Supply Voltage, SSPA Current, External Mute, or None.
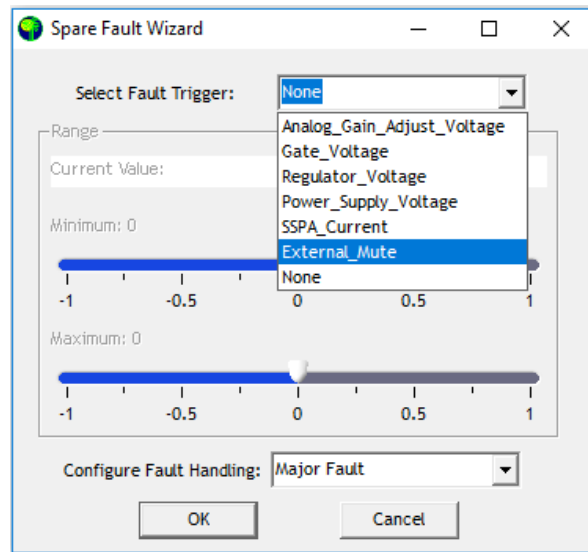
Figure 20: Spare Fault Wizard

Set the range of thresholds (maximum and minimum) that would trigger the selected fault, and configure the fault handling via a pull-down menu (Major Fault, Minor Fault, Major Fault plus Mute).

Click the OK button to set the fault trigger for the Spare Fault.

Fault Setups [17]

The user may also adjust the Spare, Auxiliary, BUC, and Forward RF Fault Status and Handling via the appropriate pull-down menus on the Settings Window.

- Spare/Auxiliary/BUC/Forward RF Fault Handling: Selects whether the associated fault should be a major or minor fault, and whether the fault should mute the unit. A minor fault will trigger a Spare/Auxiliary/BUC/Forward RF Fault alarm but not trigger a Summary Fault. A major fault will trigger both an Spare/Auxiliary/BUC/Forward RF Fault and a Summary Fault.
- Spare/Auxiliary/BUC Fault Status: Determines if the associated fault input should be ignored or enabled based on the available selections.
- Forward RF Threshold: Allows the user to assign the threshold at which a Forward RF Fault will be triggered.

Fault Thresholds [18]

Allows the user to set the limit for triggering the unit's Current Fault or High Temperature Fault.

- High Temperature Alarm Threshold: Range is 0 to 125 °C.
- Low Current Fault Threshold: This setting is factory pre-set.

⚠ **Take care not to adjust the High Temperature Alarm Threshold within the temperature range of the amplifier's normal operation. Doing so will trigger unneccessary high temperature alarm faults.**

IP Setup Tab

If the user wishes to set up the networked Compact Outdoor SSPA with custom IP settings, the internal IP settings need to be modified. Click on the IP Setup Tab. See Figure 21.
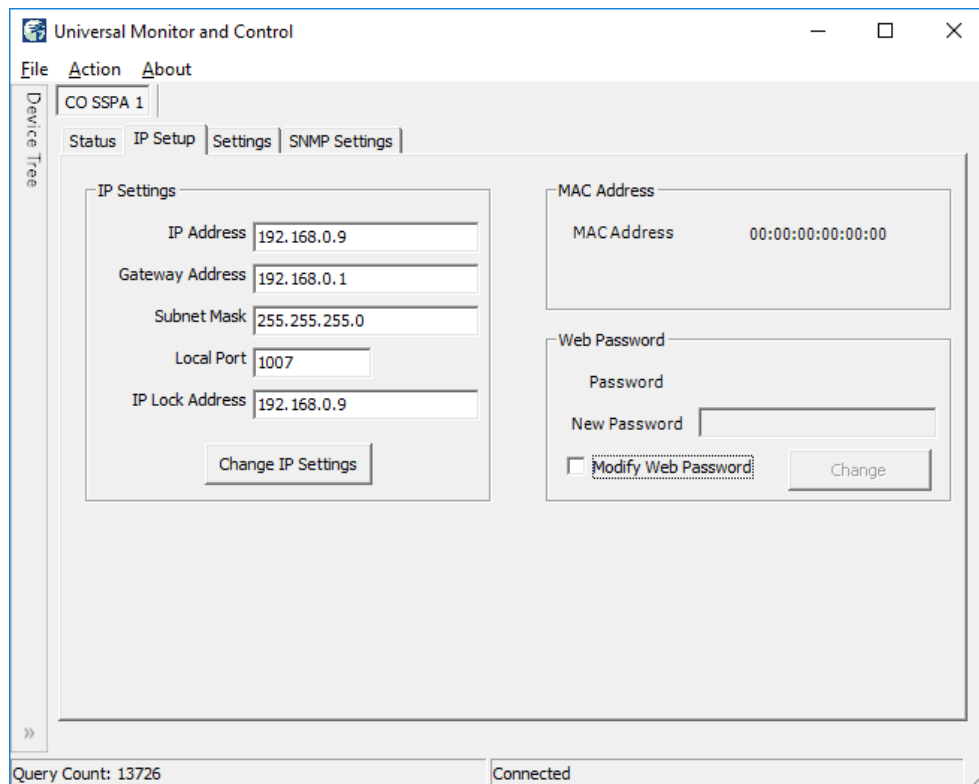
Figure 21: Compact Outdoor SSPA > IP Setup Tab

In this window, the user may enter custom IP settings, including the IP Address of the unit, the Gateway Address, the Subnet Mask and the Local Port.

The IP Lock Address allows the operator to set the IP address from which the amplifier will accept requests. This selection gives the operator the ability to increase the security measure for the IPNet protocol. The SSPA will only answer a request which comes from the assigned IP address.

To disable this feature in firmware versions prior to 6.00, set the Lock IP Address value to 0.0.0.0 or 255.255.255.255. The Lock IP address function was updated in firmware version 6.00 to allow "Binding" and "Masking" functions. "Binding" means that the first datagram re-trieved for this socket will bind to the source IP address and port number. Once binding has been set, the SSPA will answer to the bound IP source until the unit is restarted or reset. Without binding, the socket accepts datagrams from all source IP addresses. Address 0.0.0.0 allows all peers, but provides binding to the first detected IP source; Address 255.255.255.255 accepts all peers, without binding. If the Lock IP Address is a multicast address, then the amplifier will accept queries sent from any IP address of the multicast group.

Click on the 'Change IP Settings' button to save the entered settings into non-volatile memory.

The user may also modify the web password used when accessing the web-based remote M&C. Tick the 'Modify Web Password' checkbox to enable the New Password field. Enter a new password and click on the 'Change' button to save.

Using Custom IP Settings with Quick Start Cable

If the Quick Start Cable is connected to Port J4 when power is applied to the amplifier, it will use the default settings.

Default Settings with Quick Start Cable Connected:

```
Interface: IPNET
IP Address: 192.168.0.9
Local Port: 1007
Gateway: 192.18.0.1
Subnet Mask: 255.255.255.0
IP Lock: 255.255.255.255
Web password: paradise
Read Community: public
Write Community: private
Unit Starts Up: Unmuted
```

To use custom IP settings while using the Quick Start cable, remove power from the amplifier.

Unplug the Quick Start cable from the M&C connector, J4. (If the unit is restarted with the Quick Start cable connected, it will always come up with default IP settings).

Connect power to the SSPA.

Connect the Quick Start cable to J4, and check connectivity with the custom IP settings. Make sure that the Protocol setting in the Settings tab of the Universal M&C is set to IPNet.

If custom IP settings will be used in normal operation, the user will need to construct an IP cable or modify the Quick Start Cable by disconnecting the interface control pins (pins j and e, Baud Select 0 and Baud Select 1) from ground.

In this configuration, the SSPA will always use the saved communication control settings rather than the default configuration.

SNMP Settings Tab

The SNMP Settings Tab allows the operator to change the Read/Write Community strings and the Trap settings (if communicating over SNMP protocol). See Figure 22

Figure 22: Compact Outdoor SSPA > SNMP Settings Tab

The current Read/Write Community strings are displayed as read from the connected unit. Tick the Modify Read/Write Community checkbox to enable the New Read/Write Community field. Enter a new password and click on the 'Change' button to save.

Add HPO Unit to M&C

Launch the Teledyne Paradise Datacom Universal Monitor and Control software from the Programs Menu of your PC. Upon installation, a shortcut to the software may have been added to your desktop.

Click the 'Action' menu and select 'Add Unit' from the pull-down menu. Select 'High Power Outdoor SSPA' from the menu choices. See Figure 23.
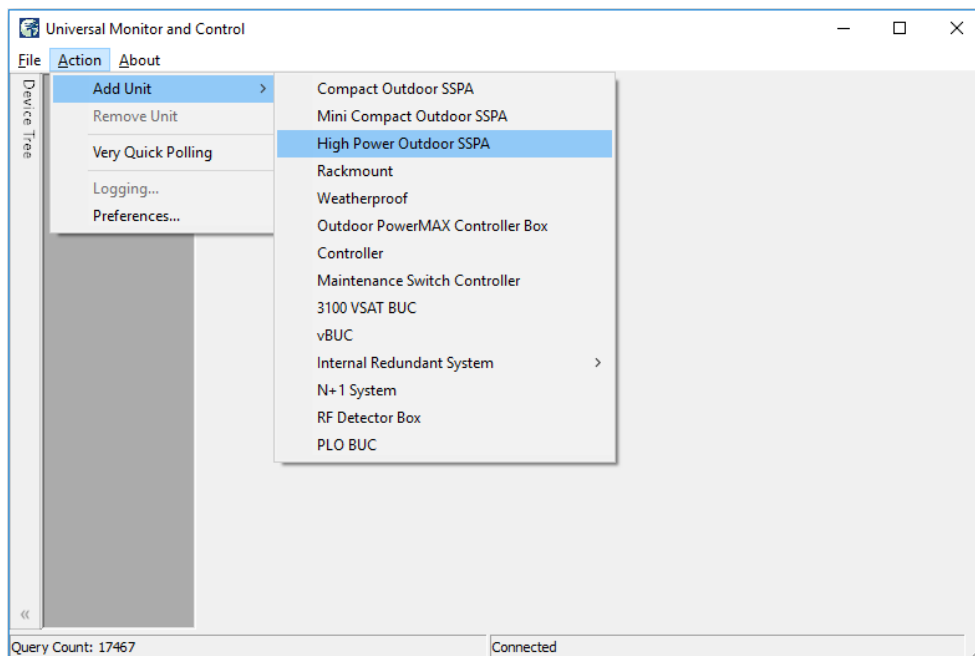
Figure 23: Universal M&C > Add Unit > High Power Outdoor SSPA

A new dialog window will open. Enter the following information where applicable: Unit ID; if using a RS-232 Connection, the Serial Port and Baud Rate. See Figure 24.
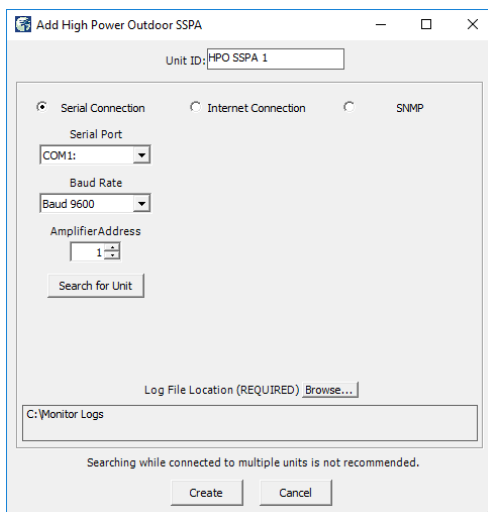
Figure 24: Add High Power Outdoor SSPA > Serial Connection

If using an Ethernet Connection, enter the unit's IP Address and Port number. See Figure 25.

Figure 25: Add High Power Outdoor SSPA > Internet Connection

Specify the unit's Address in the Amplifier Address box. If you don't know the address of the unit you may search for it. Be aware that this search feature is only useful when you have only one unit connected to your PC at a time.

If you wish to change the log file location, click on the 'Browse' button and navigate to the desired location.

Click on the 'Create' button to generate the operation window for this unit.

Overview of the HPO M&C

The H-Series High Power Outdoor SSPA uses the same protocol as the Compact Outdoor SSPA, and also the same structure of Universal M&C.

See the **Overview of the CO M&C** section when using the software with a High Power Outdoor SSPA.

Add Indoor PowerMAX System to M&C

Launch the Teledyne Paradise Datacom Universal M&C software from the Programs Menu of your PC. Upon installation, a shortcut to the software may have been added to your desktop. An Indoor PowerMAX system requires Universal M&C version 4.4.8b or later.

Add Each RM SSPA to M&C

Each individual amplifier in the PowerMAX System should first be added to the Universal M&C. Follow the instructions detailed in the **Add RM Unit to Universal M&C** section.

PowerMAX systems are typically configured with four, eight or 16 amplifiers.

Set the N+1 Settings for each individual unit to include the Array Size (four, eight or 16) for the PowerMAX System and the unique Priority Address for each unit. The amplifier assigned with the lowest Priority Address (typically 1) is granted the Master status for the N+1 system, and controls the other (Slave) amplifiers in the system.

Add PowerMAX System to M&C

To add the PowerMAX System, click the 'Action' menu and select 'Add Unit' from the pull-down menu. Select 'N+1 System' from the menu choices. See Figure 26.
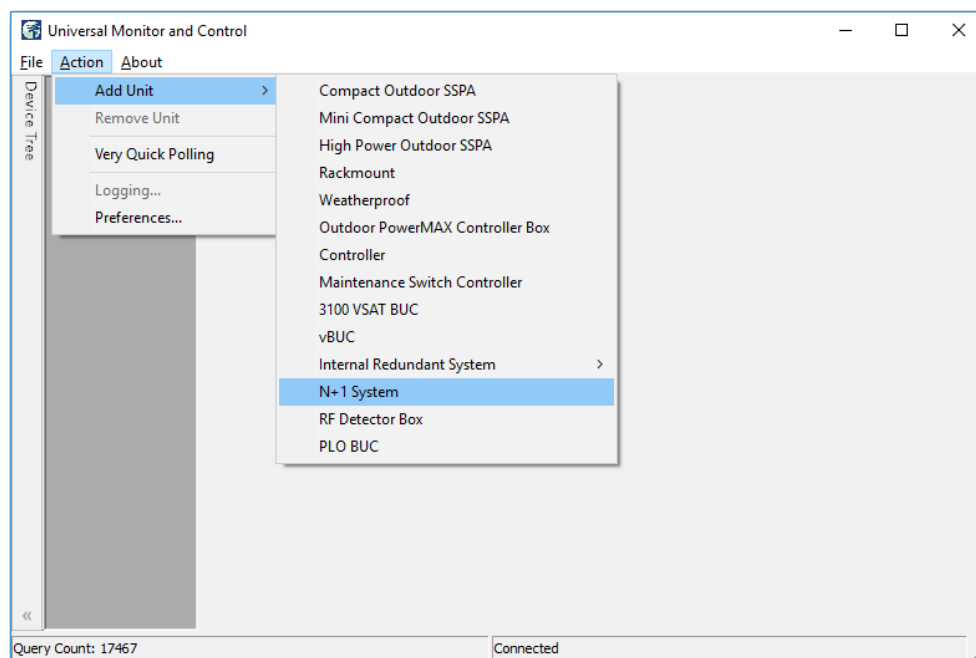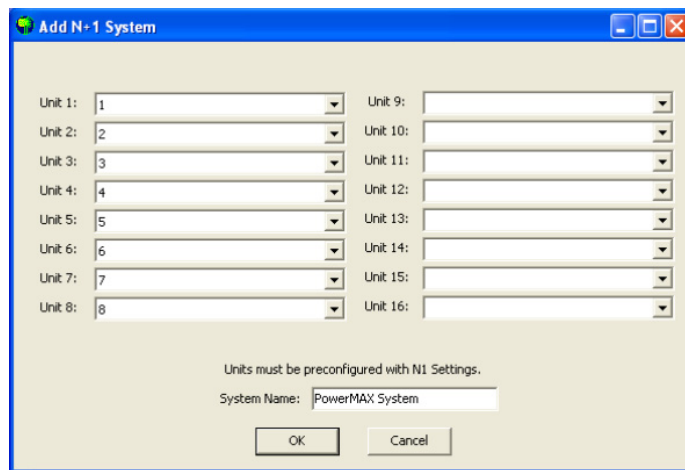
Figure 26: Universal M&C > Add Unit > N+1 System

A new 'Add N+1 System' dialog window will appear, as shown in Figure 27. If the individual amplifier N+1 settings were properly set, the Unit #s should automatically populate in ascending Priority Address order, using the Unit ID entered in the M&C. Otherwise, select the Unit # for each unit in the system and enter a System Name in the field at the bottom of the window. Click on the 'OK' button to initialize the system.

Figure 27: Add N+1 System Selection Window

⚠ **The System window may take several moments to load as the software collects and compiles the data from each unit in the system.**

Overview of the Indoor PowerMAX M&C

The N+1 System tab displays an overview of each unit in the system, and overall system performance. The Universal M&C screen shown in Figure 28 displays the N+1 system tab (labeled PowerMAX System), as well as tabs for each of the eight (8) SSPA units (labeled 1, 2, 3, 4, 5, 6, 7 and 8) being monitored.
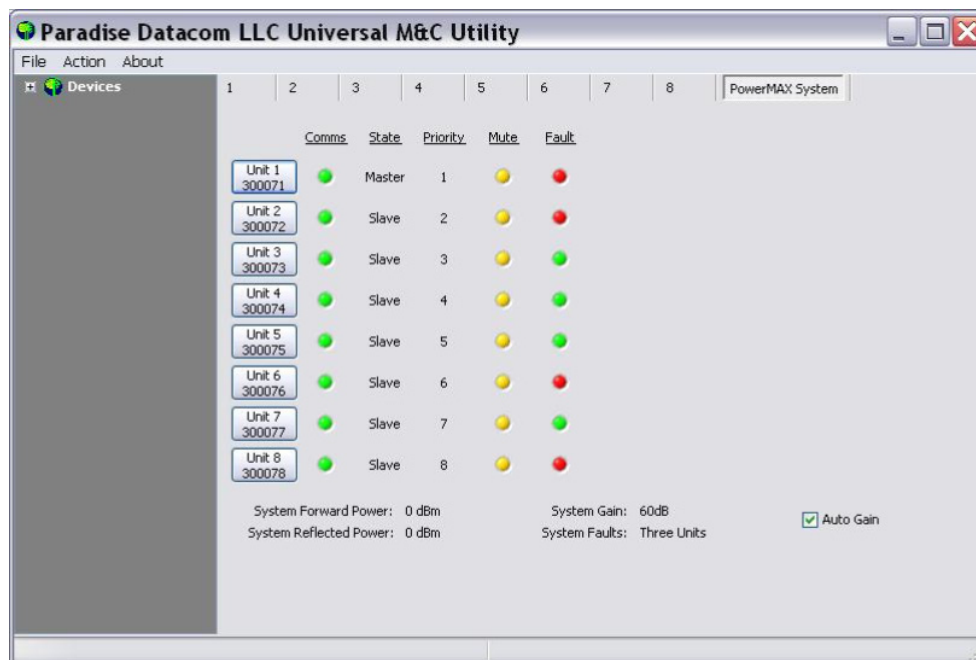
Figure 28: N+1 System Tab

For each unit in the system, the PowerMAX System tab displays the unit's serial number, comms status, master/slave state, N+1 priority in the system, mute state and fault state.

Also shown are the System Forward Power, Reflected Power, System Gain and number of System Faults. A checkbox at the lower right of the window allows the user to quickly enable or disable the Auto Gain function. See the Auto Gain description in the **Touchscreen Menu Structure** section.

By hovering the mouse over the individual unit buttons, as shown in Figure 29, the unit's condtions are detailed.
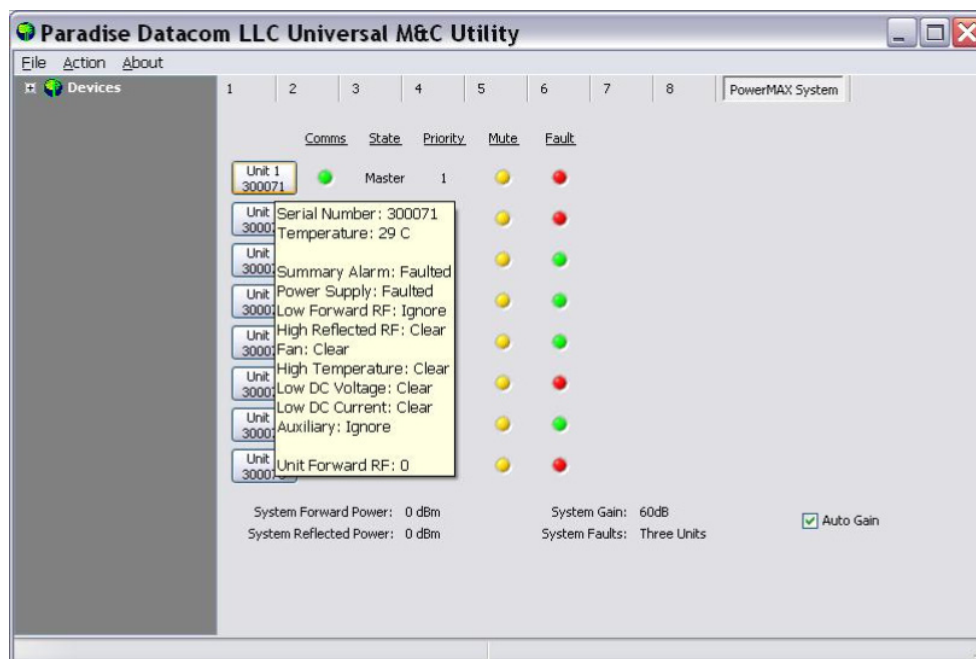
Figure 29: N+1 System Tab > Unit Info on Hover

Clicking on the Unit # button to switch to the Status tab for that unit. You may also click on the unit's tab to navigate to the M&C windows for that unit.

The N+1 tab for each unit shows the N+1 settings for that unit. Depending on whether the unit is assigned Master status or Slave status, the N+1 screen will show slightly different information. Figure 30 shows the display for the Master unit.
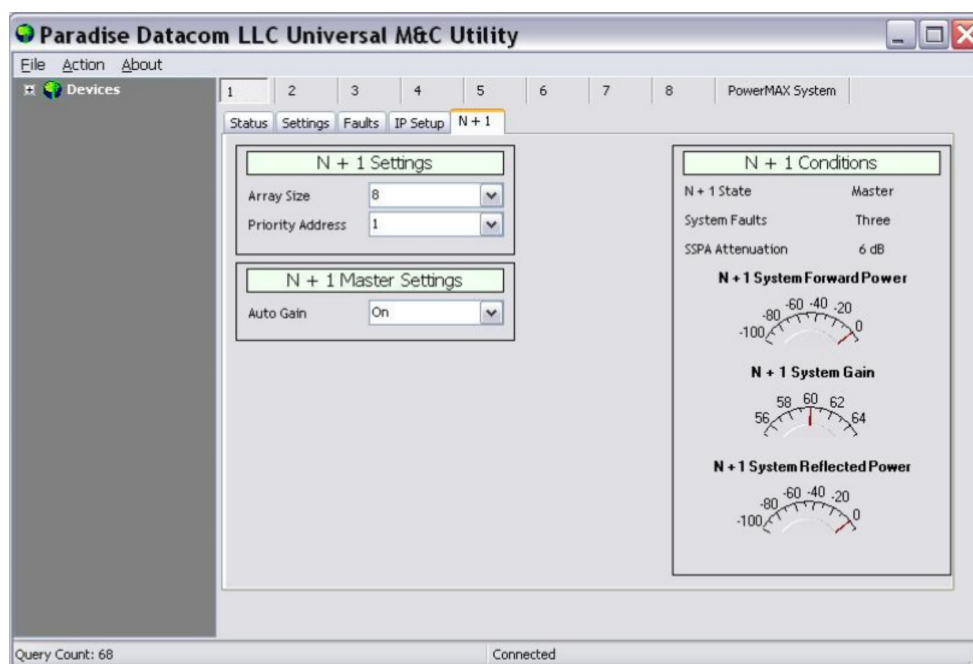
Figure 30: N+1 Tab > Master Unit

Figure 31 shows the display for the Slave units.
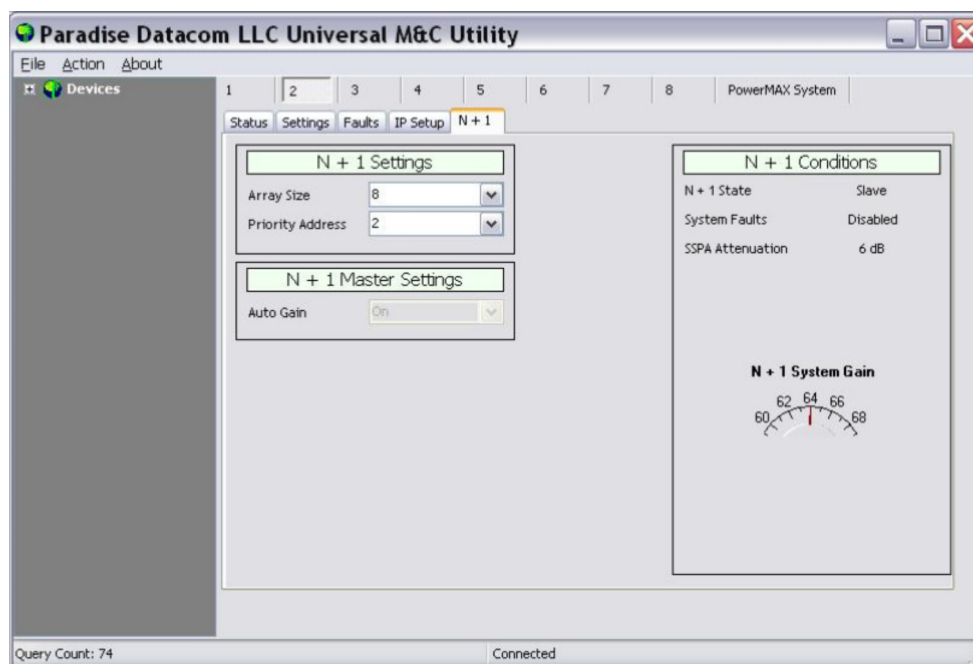
Figure 31: N+1 Tab > Slave Unit

Add Outdoor PowerMAX System to M&C

The Outdoor SSPA Controllers in an Outdoor PowerMAX system can be monitored by the Universal M&C Application. All information is read-only.

The operator must load each of the Outdoor SSPA Controllers individually. Refer to Table 1 for the default IP addresses to use.

Table 1: Outdoor SSPA Controllers, IP Addresses for Universal M&C

Controller ID	IP Address
Outdoor SSPA Controller 1 (Master)	192.168.0.11
Outdoor SSPA Controller 2 (Slave)	192.168.0.12

Launch the Teledyne Paradise Datacom Universal Monitor and Control software from the Programs Menu of your PC. Upon installation, a shortcut to the software may have been added to your desktop.

With the system operating, select the Action pull-down menu, select Add Unit, and select Outdoor PowerMAX Controller Box. See Figure 32.
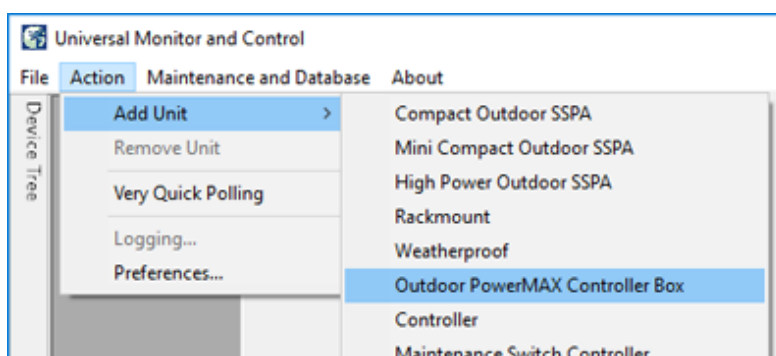
Figure 32: Universal M&C > Add Unit > Outdoor PowerMAX Controller Box

A new dialog window will open. Select the Internet connection. See Figure 33.
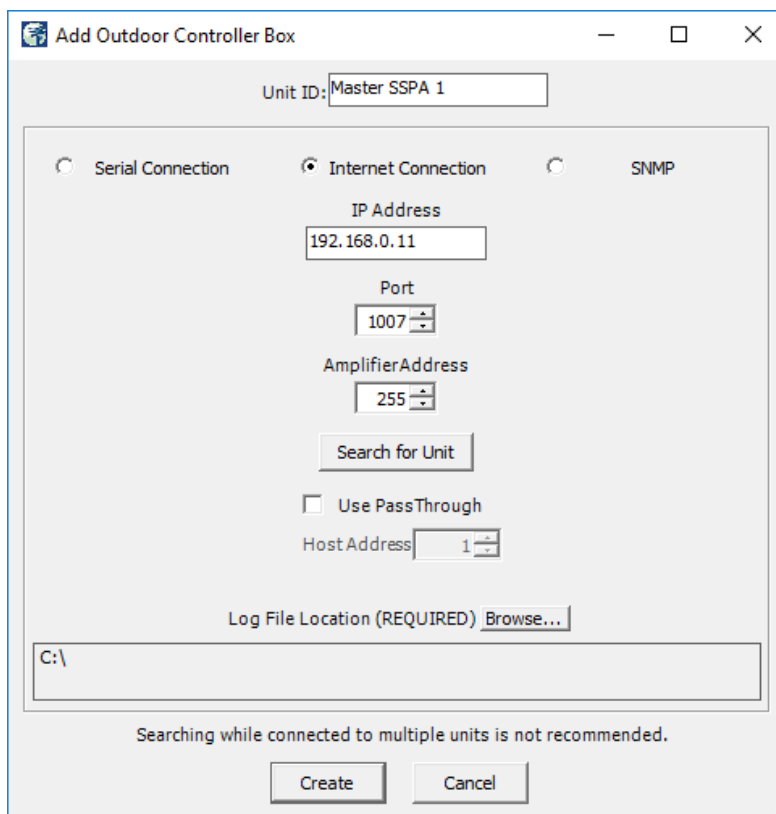
Figure 33: Add Outdoor PowerMAX Controller Box

Enter the Unit ID text that will be used to identify the unit in the M&C application. For example, "Master SSPA 1" for Controller 1.

Enter the IP address of the Master or Slave unit . Refer to Table 1.

Use the default port 1007, or change to reflect the local network.

Enter the global address (255) in the Amplifier Address field, and click on the [Search for Unit] button. The utility will locate the unit on the network. See Figure 34. Click on the [OK] button.
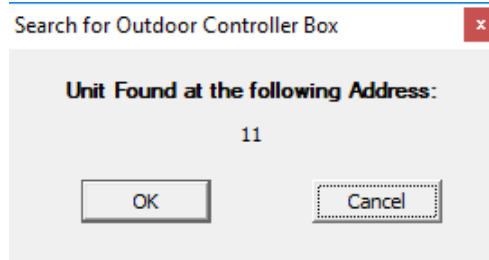
Figure 34: Dialog Window, Search for Outdoor Controller Box

Click on the [Create] button to open the M&C windows.

Repeat for each Outdoor SSPA Controller.

Overview of the Outdoor PowerMAX M&C

This section describes the information available in each of the Universal M&C screens for the Outdoor SSPA Controllers used in Outdoor PowerMAX systems.

Status Window for Outdoor SSPA Controllers

The Status Window for the Outdoor SSPA Controllers (Controller 1, typically the Master controller) shows the operational status of the array of four (4) SSPA modules for that system. See Figure 35.
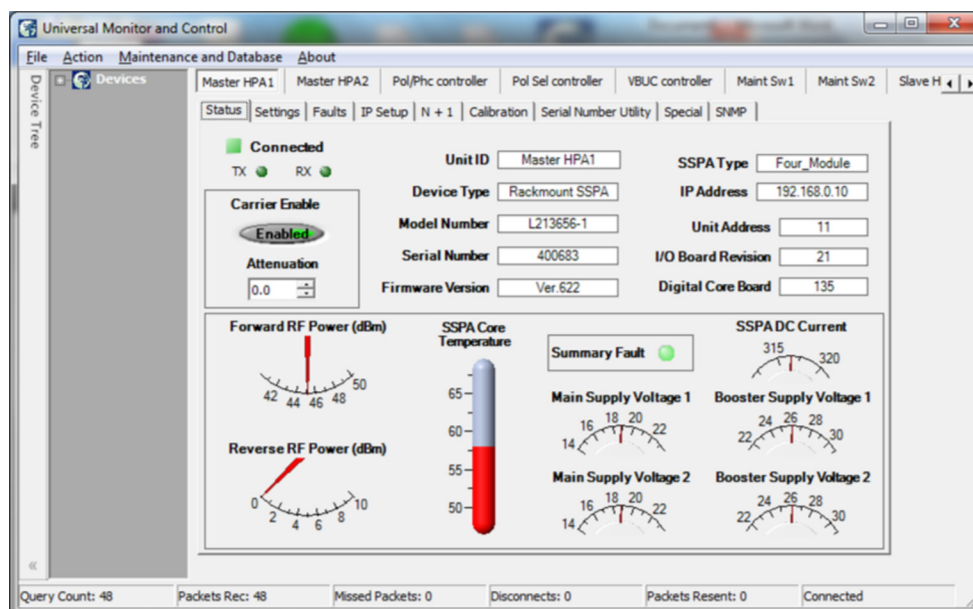
Figure 7-10: Status Window, Outdoor SSPA Controllers

Figure 35: Status Window, Outdoor SSPA Controllers

This window displays the Mute status (Carrier Enable, indicated by "Enabled", if unmuted, or "Muted"), Attenuation and Summary Fault status LED. Also included is information about the System Forward RF Power, Reverse RF Power, SSPA Core Temperature, Main Supply Voltages, DC Current and Booster Supply Voltages.

⚠️ **Note: Changes to Mute Status and Attenuation made in this window will be overwritten by the system.**

Settings Window for Outdoor SSPA Controllers

The Settings Window, shown in Figure 36, is common for all controllers, and is used to select the operation settings for the unit.
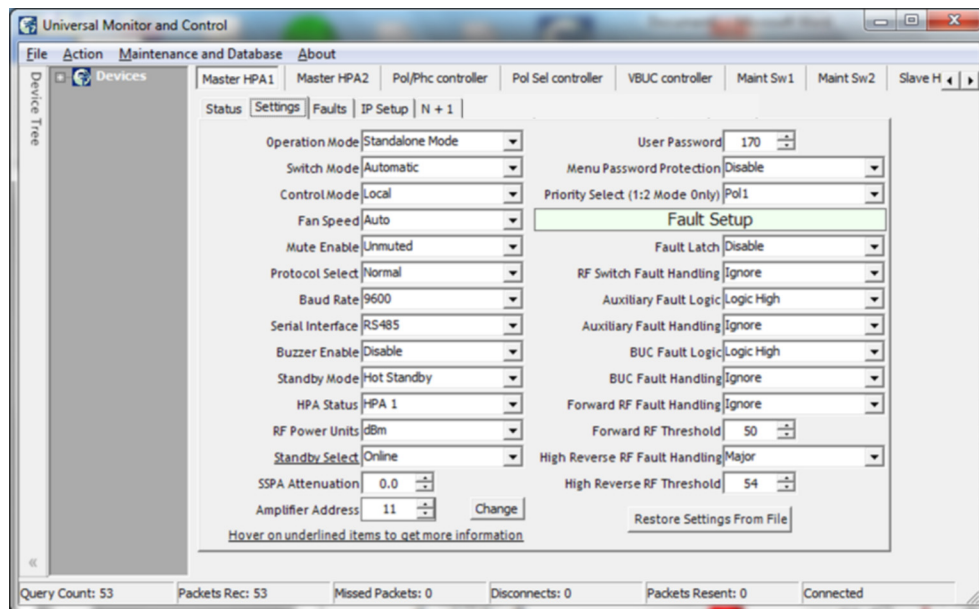
Figure 36: Settings Window, Outdoor SSPA Controllers

See your system manual for the required settings for each controller.

⚠ **Note: All settings are read-only. Changes made to settings in this window will be overwritten by the system.**

Faults Window for Outdoor SSPA Controllers

The Faults Window, shown in Figure 37, is common for all controllers, and is used to monitor the various fault conditions for the SSPA Modules connected to the unit.
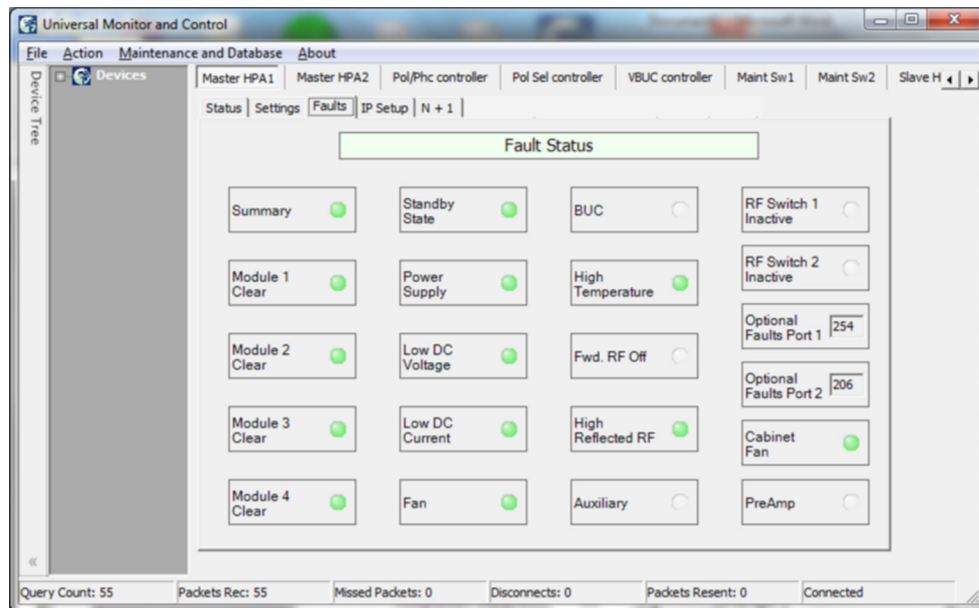
Figure 37: Faults Window, Outdoor SSPA Controllers

Table 2 shows how the fault LEDs in this window correspond with the SSPA Modules for the indicated Outdoor Controller.

Table 2: Identifying SSPA Module Faults in Universal M&C Faults Window

Module # Fault LED	SSPA Module

Module 1 for the Faults Window of Controller 1	SSPA 1.1
Module 2 for the Faults Window of Controller 1	SSPA 1.2
Module 3 for the Faults Window of Controller 1	SSPA 1.3
Module 4 for the Faults Window of Controller 1	SSPA 1.4
Module 1 for the Faults Window of Controller 2	SSPA 2.1
Module 2 for the Faults Window of Controller 2	SSPA 2.2
Module 3 for the Faults Window of Controller 2	SSPA 2.3
Module 4 for the Faults Window of Controller 2	SSPA 2.4

IP Setup Window for Outdoor SSPA Controllers

The IP Setup Window is common for all controllers, and is used to adjust the IP settings for the connected unit. The IP Address, Gateway Address, Subnet Mask, Local Port and IP Lock Address may all be modified. See Figure 38. Changes to these settings require a unit restart before they are applied.
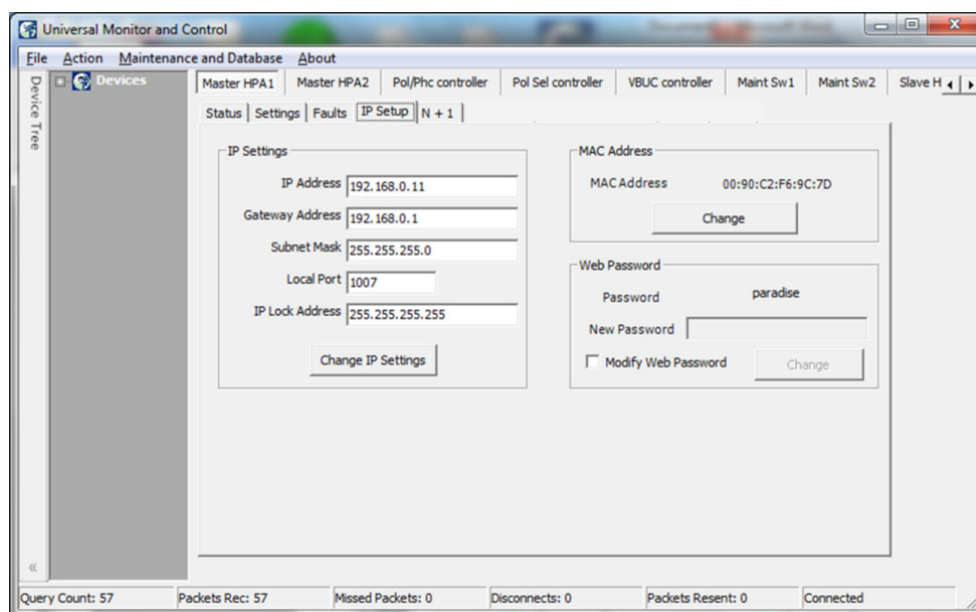
Figure 38: IP Setup Window, Outdoor SSPA Controllers

In addition, the operator may modify the read/write community and web passwords. The operator must check the box to unlock the field for the new password, then click on the [Change] button to implement the change.

Add RCP Unit to M&C

Launch the Universal M&C software. Click on the Action menu and select "Add Unit", then choose "Controller" from the pull-down menu. See Figure 39.
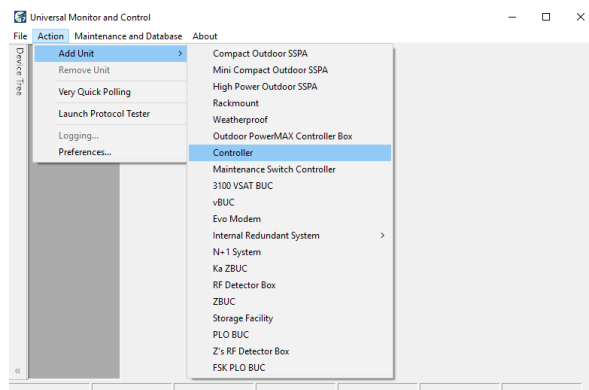
Figure 39: Universal M&C, Add New Controller Unit

A new dialog window will appear. See Figure 40. Select the method of communication (Serial Connection, Internet Connection, or SNMP).
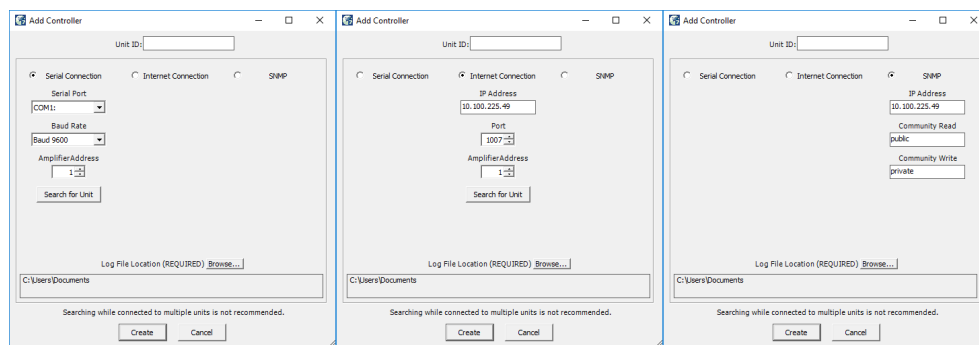
Figure 40: Add Controller (Serial, Internet or SNMP Connection)

For Serial Connections, select the Serial Port and Baud Rate, and select the amplifier address. If you don't know the address of the unit you may search for it. Click the Search for Unit button.

For Internet Connection, enter the IP address of the unit, and select the port and amplifier address. Click the Search for Unit button if you don't know the address of the unit.

> ⚠ **Note: The Search for Unit feature is only useful when you have only one unit connected to your PC at a time.**

For SNMP, enter the IP address of the unit and the community read/write passwords.

The default Community Read password is **public**.

The default Community Write password is **private**.

A Unit ID is not required although it is recommended. If a Unit ID isn't entered the Unit ID will be assigned by the M&C. Click the Create button to open the M&C windows.

Choose a log file location by clicking the Browse... button. The default is the "My Documents" folder. The log file name will be the UnitID and the extension ".log" appended to it. i.e. "Unit1.log".

Click on the Create button to open the M&C windows.

Overview of the RCP2 M&C

The Universal M&C user interface features five screens which are used to monitor and control the system.

- Status

- IP Setup

- Conditions

- Settings

- HPA Control Panel

Status Tab

The first screen is the "Status" window shown in Figure 41.
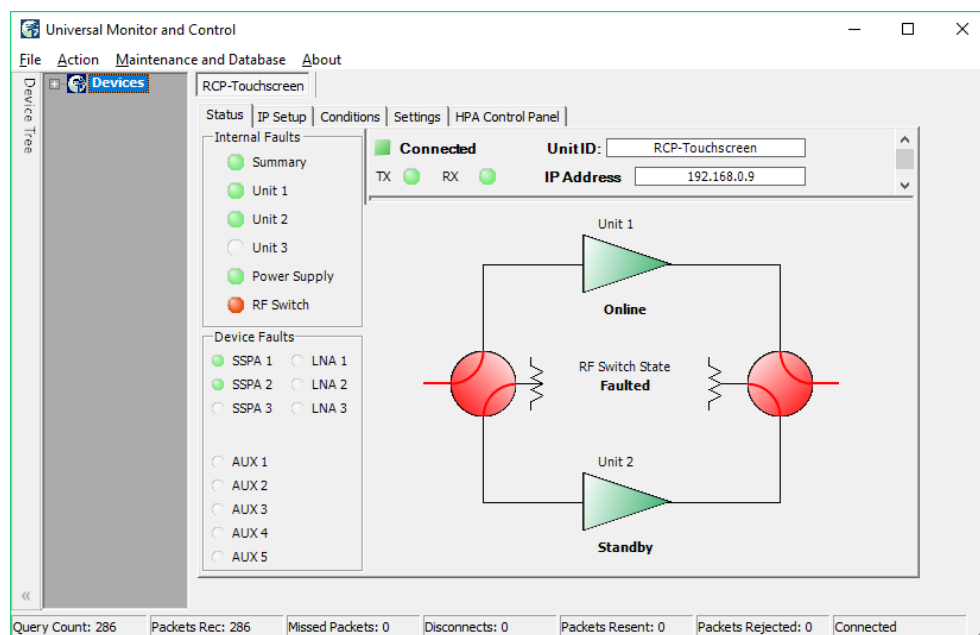
Figure 41: Universal M&C, Status Tab

The status screen reflects the Online/Standby status of each amplifier in the system, and the switch position of each waveguide switch in the system. In addition, Internal and Device fault indicators are displayed. When there is no fault condition on a given unit, the indicator illuminates green. When a fault condition exists, the indicator illuminates red.

⚠ **Note that in Figure 41 above, there is an RF Switch Fault. The RF Switch fault indicator is illuminated red in the Internal Faults panel, and the RF Switch State in the mimic panel shows "Faulted". In addition, the baseball switch icons are colored red to indicate a switch fault.**

The user may click on one of the triangular amplifier icons to set that amplifier as the Standby unit in the system.

IP Setup Window

The second screen is the "IP Setup" window, shown in Figure 42.
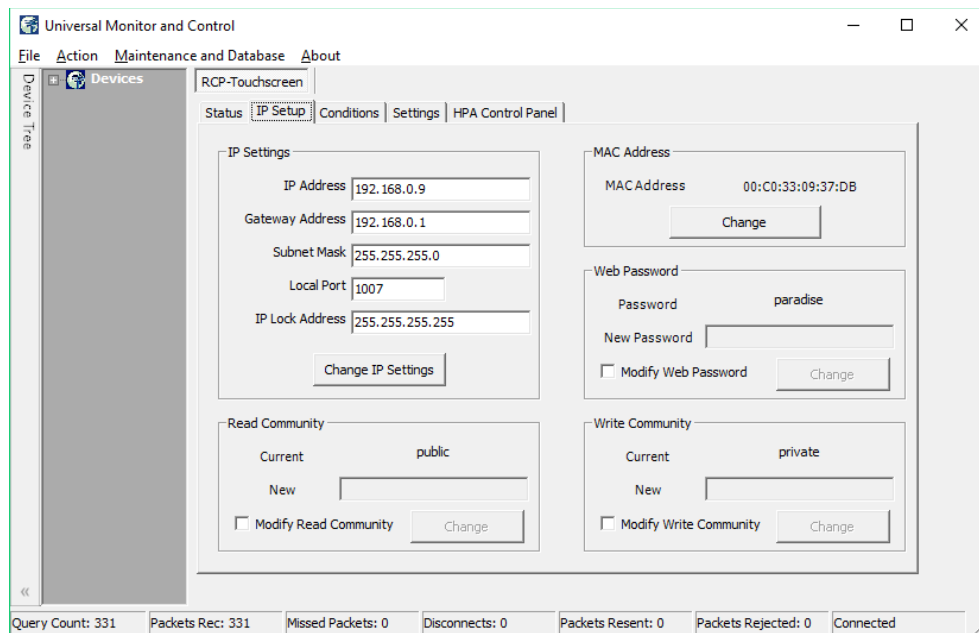
Figure 42: Universal M&C IP Setup Window

It shows the user all of the TCP/IP settings on the unit. When the IP Address is modified the unit must be reset for it to use the new IP Address. Until the unit is reset it will use the old IP Address. The Amplifier Local Port is the port that the unit monitors for UDP requests. The unit also answers requests using the same port.

If the Amplifier Local Port is changed the unit must be reset. The Gateway Address and Subnet Mask are standard settings for TCPI/IP communications. If either of these settings is changed the unit must be reset for the new settings to take effect. The IP Lock Address is used for security. If it is set to something besides 0.0.0.0 or 255.255.255.255 it will only answer the address it is set to. For example, if the IP Lock Address is 192.168.0.50 then a request from 192.168.0.100 will not be accepted. The IP Lock Address may be changed without resetting the unit.

Conditions Window

The third screen displays the Conditions of the units connected to the controller, as shown in Figure 43.
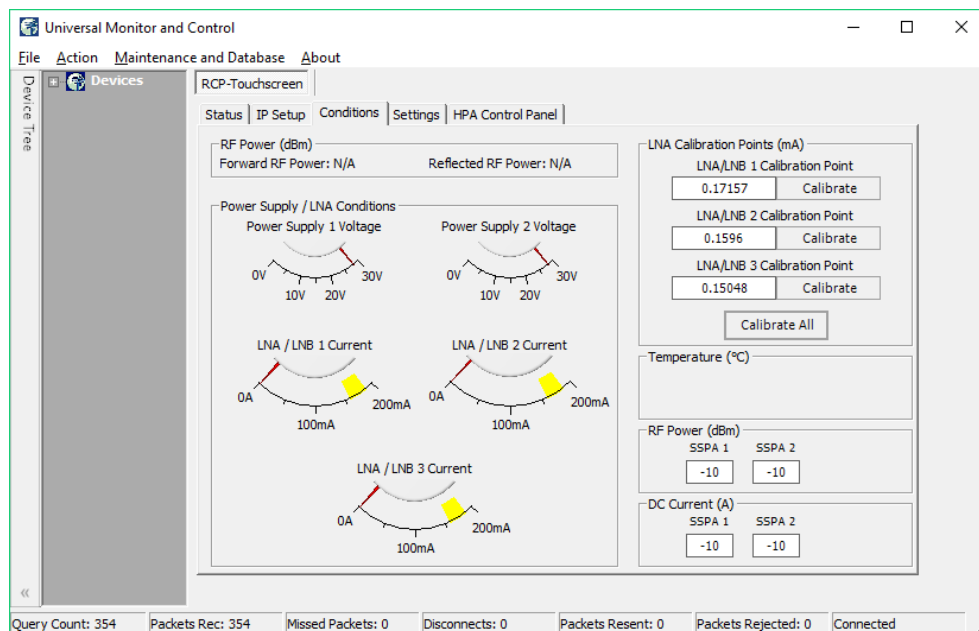
Figure 43: Universal M&C, Conditions Window

The system forward power, reflected power, power supply voltages and LNA/LNB currents and temperatures are all monitored. In addition, the calibration points of each LNA/LNB are displayed.

Settings Window

The fourth screen is the "Settings" screen, shown in Figure 44.
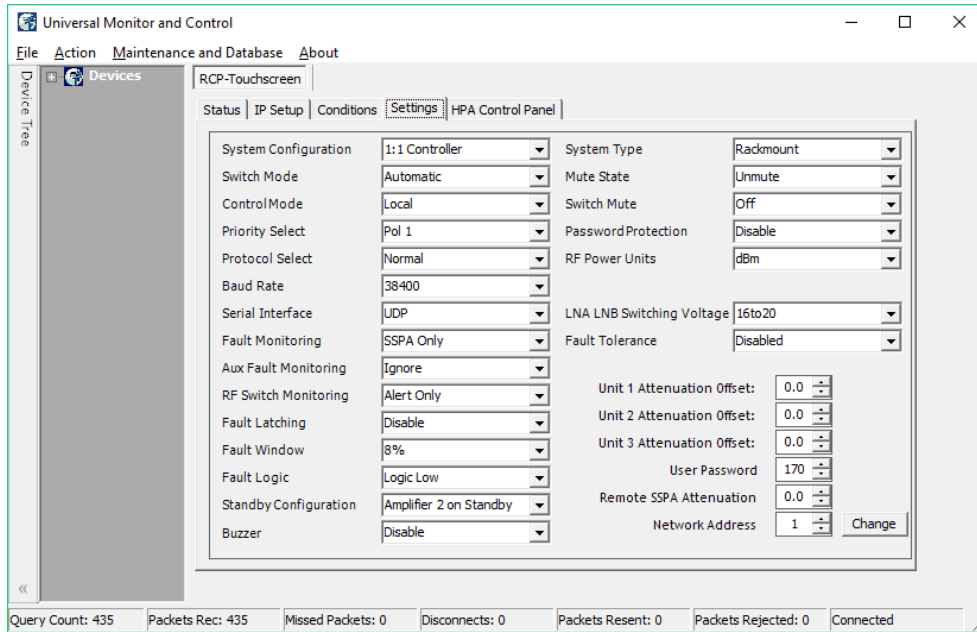
Figure 44: Universal M&C, Settings Window

It shows the user all available settings on the unit. All user-adjustable settings may be modified to suit the specific needs of the customer. However, it should be noted that the units are pre-configured for the customer at the factory. If modification of any settings is necessary, refer to the Table 7 of the **Remote Control Interface** section.

HPA Control Panel Window

The fifth screen is the "HPA Control Panel" screen, shown in Figure 45.
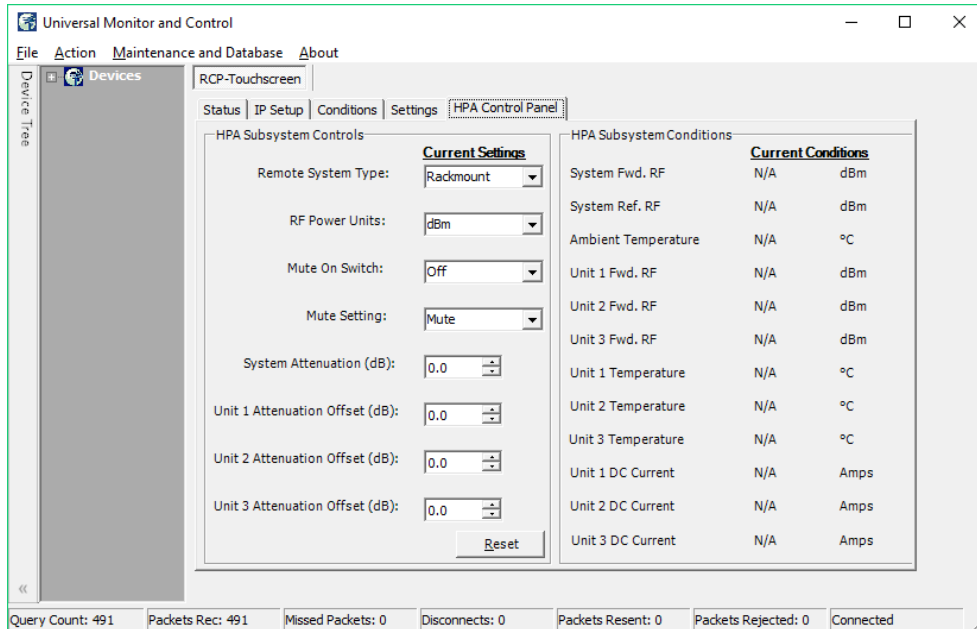
Figure 45: Universal M&C, HPA Control Panel Window

From this window, the user may select the type of amplifier used in the system, choose the RF power units displayed, mute or unmute the system, and set the attenuation levels of the system or individual amplifier offsets. The user may also monitor the forward RF, temperature and DC current conditions of the HPA subsystem.

Universal M&C Advanced Features

Universal M&C Preferences

The user can adjust certain preferences of the Universal Monitor and Control software. Click on the Action pull-down menu and select Preferences. See Figure 46.
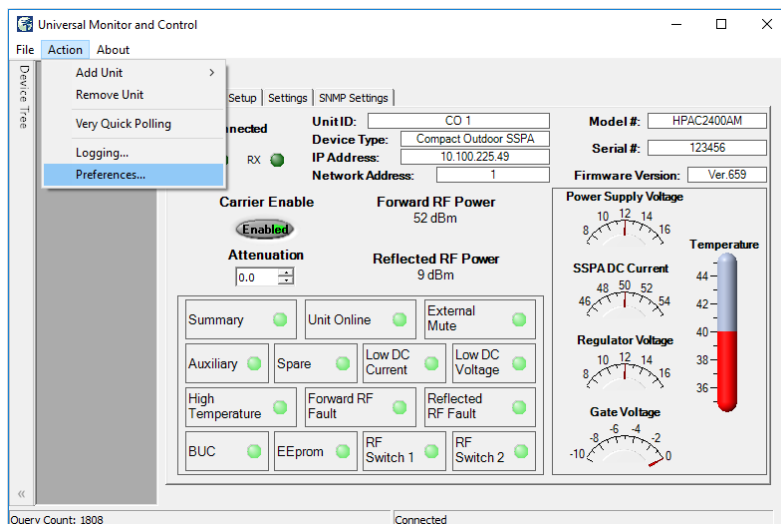
Figure 46: Universal M&C > Action > Preferences

Queries

Click on the Queries icon at left to open the Query Settings menu. Select the PC Source Address. Adjust the interval that the software queries the unit. Tick the Queries Enabled checkbox to begin sending queries to the connected unit. Note that if queries are disabled, there will be no communication with the unit at startup. Untick the bottom checkbox to disable commands on units set to Local Control Mode. See Figure 47.
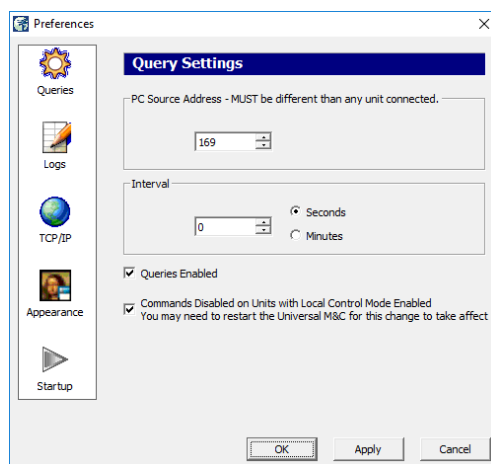
Figure 47: Universal M&C Preferences > Queries

Logs

Click on the Logs icon at left to open the Log Settings menu. Adjust the interval that selected parameters are recorded (in minutes or seconds). Tick the checkbox to enable logging. See Figure 48.
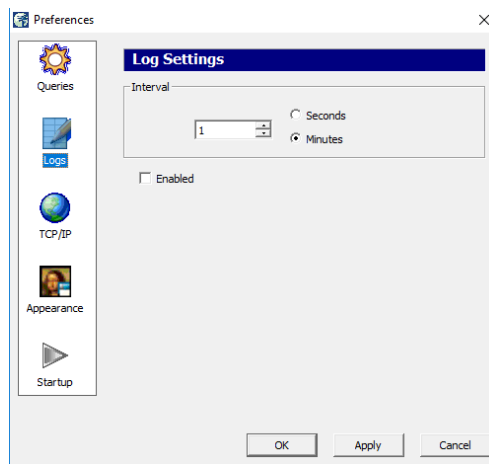
Figure 48: Universal M&C Preferences > Logs

TCP/IP

Click on the TCP/IP icon at left to open the TCP/IP Settings menu. Select the Local UDP Port (the software must be restarted to take effect). Note that each UDP address must be unique. Default Unit UDP Port is 1007. See Figure 49.
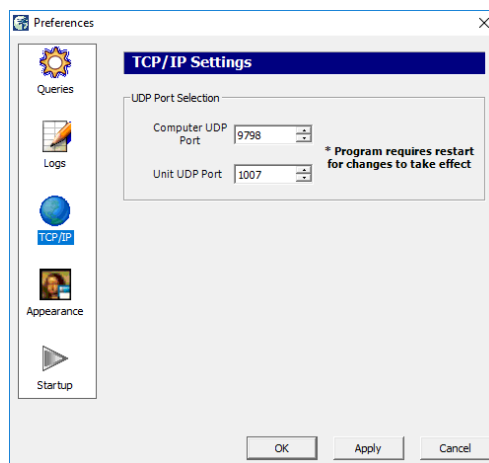
Figure 49: Universal M&C Preferences > TCP/IP

Appearance

Click on the Appearance icon at left to open the Appearance menu. Set the transparency of the M&C Windows. A setting of 0 indicates no transparency. Maximum value is 80. See Figure 50.
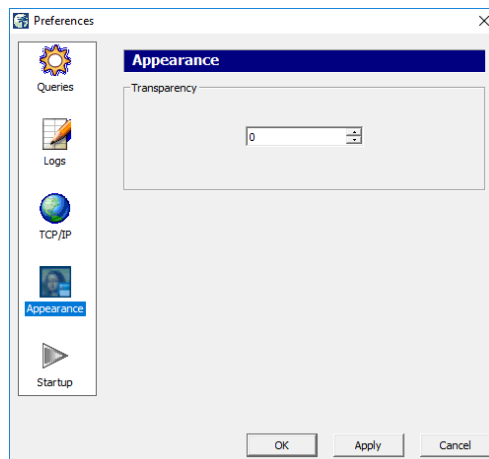
Figure 50: Universal M&C Preferences > Appearance

Startup

Click on the Startup icon at left to open the Startup menu. Tick the checkbox to enable auto-loading of the last-used device configuration. See Figure 51.
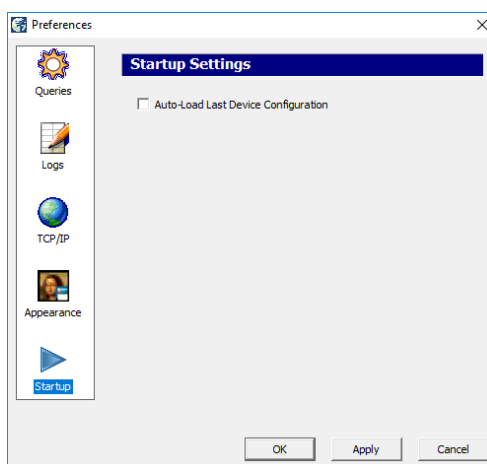
Figure 51: Universal M&C Preferences > Startup

Using the Device Logger

The Universal Logger may be used to show a real-time log of selected parameters. Before opening the logger, at least one unit must be connected and added to the Universal M&C. To open the Logger, click on the Action pull-down menu and select 'Logging...' as shown in Figure 52.
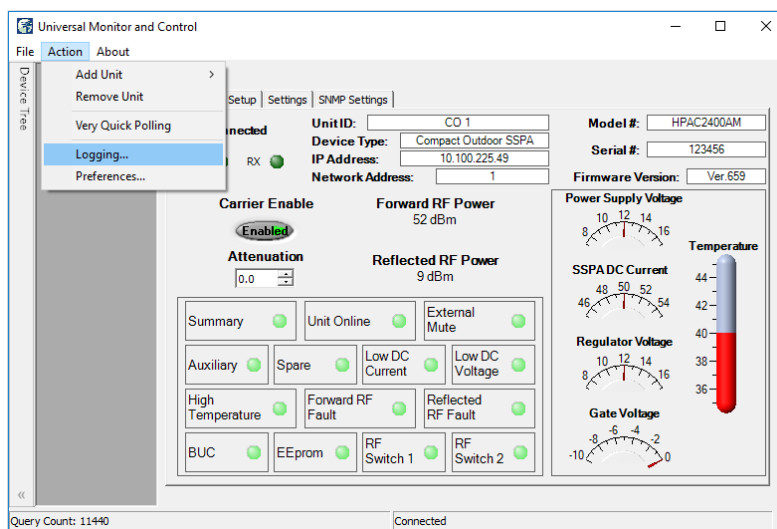
Figure 52: Universal M&C Action > Logging...

The Device Logger will open, as seen in Figure 53.
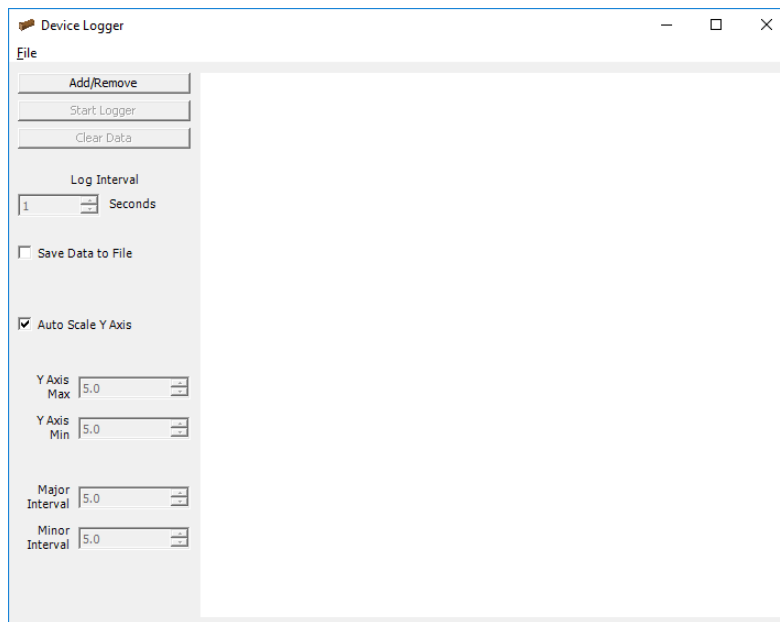
Figure 53: Universal M&C Device Logger Window

Click on the 'Add/Remove' button, which opens a new window as shown in Figure 54. Select the desired device in the Available Devices pull-down menu. Individually select which parameters to log (or remove unwanted parameters).
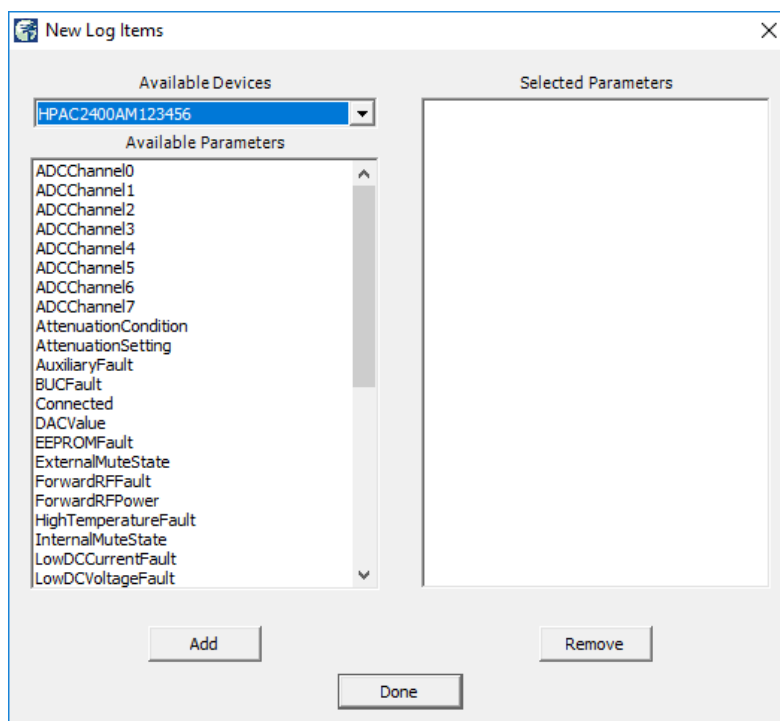
Figure 54: Universal M&C Device Logger > New Log Items Window

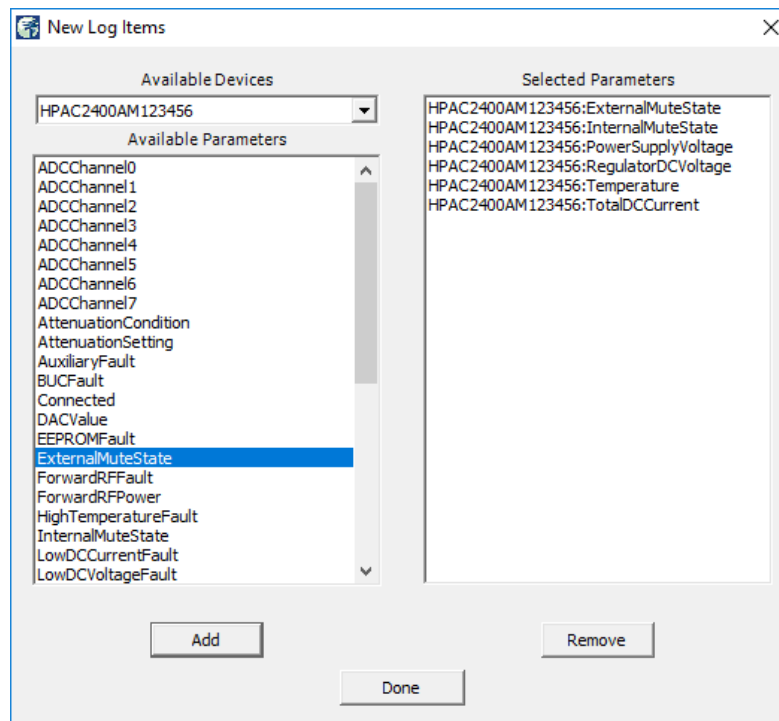After choosing the parameters, the Logger window will be similar to Figure 55. Click on the Done button to accept the list of selected parameters.

Figure 55: Universal M&C Device Logger > New Log Items > Items Selected

You may modify the log interval by entering the number of seconds between each record. Default interval is 1 second. Click on the Start Logging button to begin logging the selected parameters.
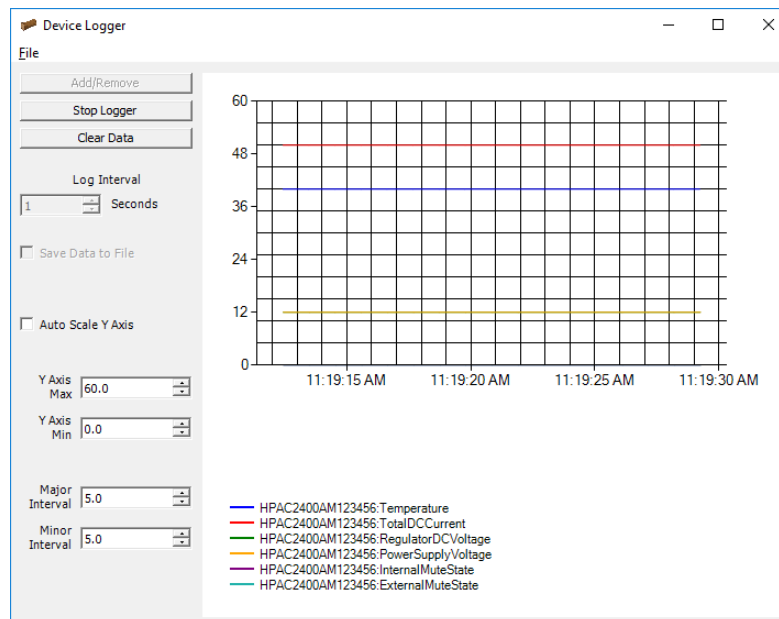

Figure 56: Universal M&C Device Logger > Start Logging

Click on the 'File' menu and select 'Print' to print the graph and legend as shown in Figure 56. You may stop, start, and clear the data at any time.

⚠ **While running the Logger, you may continue to use the Universal M&C to monitor the status of or make settings modifications to any connected unit.**

Saving M&C Configurations

The Universal M&C allows users to save multiple configurations to a variety of units. In addition, the software features a 'Load Last Configuration' option that will reload the last configuration used by the M&C.

Save a Single Configuration

To save a single configuration, add the desired units to the Universal M&C and select 'Save Configuration' from the 'File' menu. See Figure 57. After saving, a confirmation message will appear that states the success of the save. This saved configuration may be reloaded even after a computer restart. It is important to note that the Universal M&C will occasionally perform this save automatically.
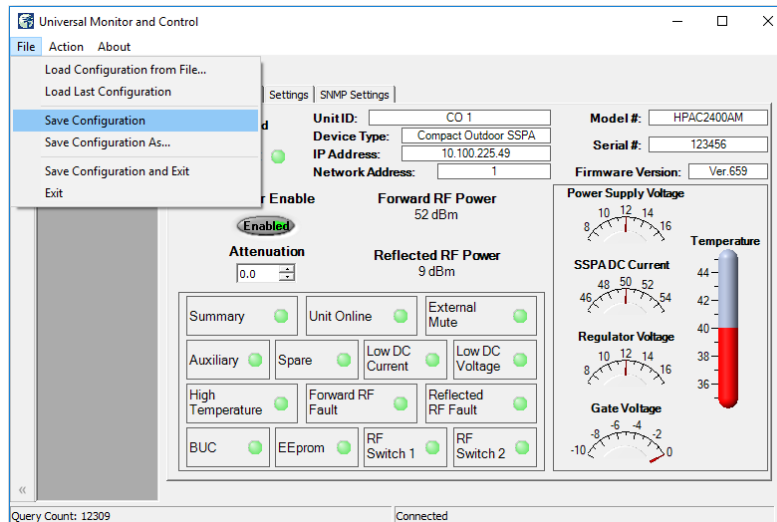
Figure 57: Universal M&C File > Save Configuration

To be certain the proper configuration is saved, select 'Save Configuration As...' from the 'File' menu, and navigate to a directory to which the file will be saved. You may wish to name the file with descriptive text about the connected unit.

Load the Last Configuration

To load the last configuration, select 'Load Last Configuration' from the 'File' menu. See Figure 58. The M&C will load whatever unit(s) were previously loaded. You may set the Universal M&C Preferences to automatically load the last configuration used by the Universal M&C software when the software is run. See the Startup Preferences section.
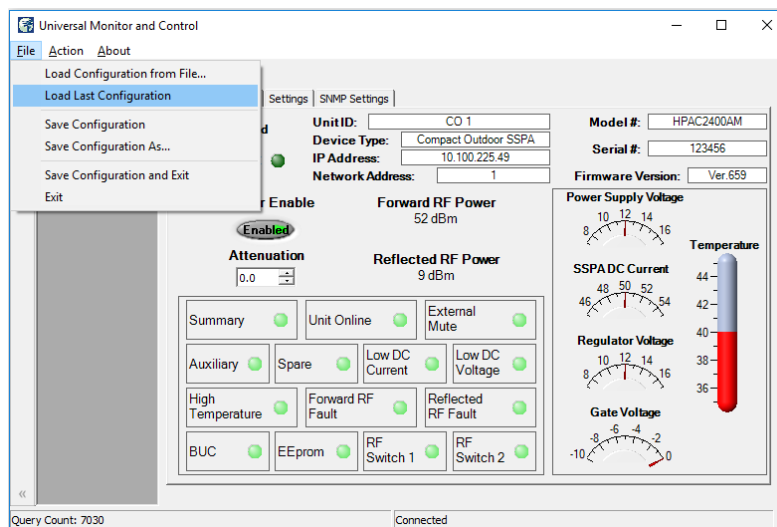

Figure 58: Universal M&C File > Load Last Configuration

Load a Configuration from a File

To load a specific configuration from a file, select 'Load Configuration from File...' from the 'File' menu. Select the location of the file as shown in Figure 59. Click the Open button to load the configuration to the Universal M&C.
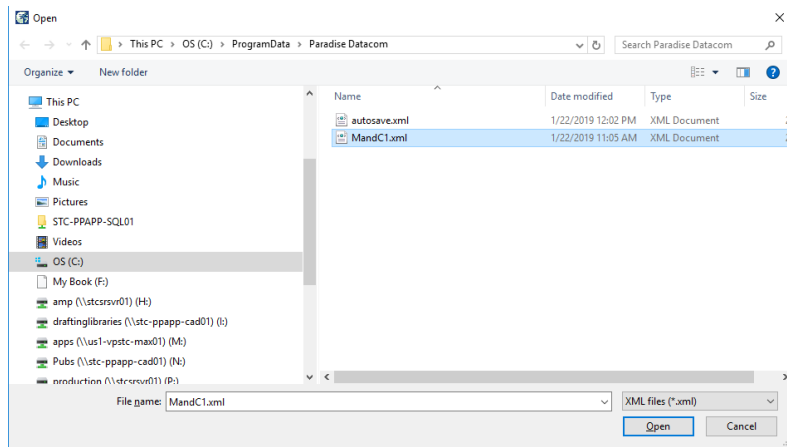
Figure 59: Universal M&C File > Load Configuration from File

Use and Disclosure of Data

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Teledyne Paradise Datacom, a division of Teledyne Defense Electronics LLC, is a single source for high power solid state amplifiers (SSPAs), Low Noise Amplifiers (LNAs), Block Up Converters (BUCs), and Modem products. Operating out of two primary locations, Witham, United Kingdom, and State College, PA, USA, Teledyne Paradise Datacom has a more than 20 year history of providing innovative solutions to enable satellite uplinks, battlefield communications, and cellular backhaul.

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