

Intelibs, Inc

Small Remote Unit Product manual

DAS Version : 1.7.1 09-12-2013

Contents

1	Introduction		
2	Pro	duct l	Description
2	2.1	Exte	rnal interface ports and Status Indicators7
2	2.2	Мос	dules9
2	2.3	Med	hanical Drawing9
2	2.4	Tech	nnical Specifications
	2.4	.1	General specifications
	2.4	.2	Frequency allocation
	2.4	.3	RF specifications12
	2.4	.4	Power Specifications
2	2.5	Inst	allation13
	2.5	.1	Installation Requirements13
	2.5	.2	Installation Tools
	2.5	.3	Item Check List
	2.5	.4	Wall Mounting
	2.5	.5	Antenna15
	2.5	.6	Power cable16
	2.5	.7	Optic cable
2	2.6	SRU	power setting
	2.6	.1	Down Link power setting
	2.6	.2	Up Link power setting
2	2.7	Con	figuration and Maintenance19
	2.7	.1	Bluetooth connection
	2.7	.2	Web interface
3	Ар	bendix	I. Ancillary Devices – Antenna, Cable and other Passive Device
4	Hu	man R	F Exposure – Maximum Permissible Exposure Evaluation

FCC WARNING

This equipment generates or uses radio frequency energy. Changes or modifications to this equipment may cause harmful interference unless the modifications are expressly approved in the instruction manual. The user could lose the authority to operate this equipment if an unauthorized change or modification is made.

This is NOT a CONSUMER device. It is designed for installation by FCC LICENSEES and QUALIFIED INSTALLER. You MUST have an FCC LICENSE or express consent of an FCC Licensee to operate this device. Unauthorized use may result in significant forfeiture penalties including penalties in excess of \$100,000 for each continuing violation.

INFORMATION TO THE USER

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can generate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that the interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- · Reorient or relocate the receiving antenna.
- · Increase the separation between the equipment and receiver.
- · Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- · Consult the dealer for technical assistance.

Suitable for use in environmental air space in accordance with Section 300-22 (c) of the National Electrical Code, and Sections 2-128, 12-010 (3), and 12-100 of the Canadian Electrical Code, Part 1, C22.1.

CAUTION Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment. This equipment is intended for use only with Intelibs Hybrid DAS systems.

Important health and safety precautions

When using this product, the safety precautions below must be taken to avoid possible legal liabilities and damages. Retain and follow all product safety and operating instructions. Observe all warnings in the operating instructions included with the device.

DANGER Only use antennas, transceivers and chargers approved by Intelibs. The use of any non-approved antenna, transceiver and charger may be dangerous.

DANGER Allow only authorized personnel to service the DAS. Unauthorized service can invalidate the warranty.

CAUTION Any modification of this product, including opening the unit, is prohibited and will void your warranty. Any use of the product or its components for purposes not expressly authorized by this document, including any use in an airplane or any other aviation application, is prohibited and will void your warranty.

NOTE When using your device for prolonged periods of time, the device may become warm. In most cases, this condition is normal and therefore should not be interpreted as a problem with the device.

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1 Introduction

Small Remote Unit (SRU) is part of the Hybrid Distributed Antenna Systems (HDAS) to provide remote RF coverage solution from the Radio Hub Unit (RHU) fed by the RF source via wireline connection. SRU is built on a small form factor with a single antenna port for dual band frequencies with the following features:

- Multi-Technology support
- Low Power consumption fed by PoE or local AC adaptor
- 23 dBm + 23 dBm Tx Power per band
- Easy antenna installation
- SNMP based remote management support
- Single mode Fiber fed with 10 Km distance
- Auto Gain Control
- Band and Sub-channel filtering using DSP

Including SRU, Hybrid DAS is comprised of the following subsystems:

- RHU (Radio Hub Unit): Interface unit between RF source and Remote Units, Convert RF signal to optical waves.
- FHU (Fiber Hub Unit): Fiber distribution and aggregation interface between RHU and multiple SRUs. Each FHU supports up to 8 SRU and total up to 32 SRUs by two level FHU configurations
- SRU (Small Remote Unit): Small power (23 dBm per band, 26 dBm in dual band) remote unit
- RU (Remote Unit): High power (40 dBm per band) remote unit for outdoor/indoor
- MU (Master Unit): Element management server

As illustrated in Figure 1-1, Hybrid DAS network is comprised of RHU, FHU and SRU. Each RHU can support up to 16 pair of SRU's that can cover up to 500Ksf² indoor space.



Figure 1-1 RHU-FHU-SRU/RU network diagram

2 Product Description

As shown in Figure 2-1, SRU is a compact platform with the natural heat convection. As unified form factor, SRU services multiple technologies on a single platform with Dual band operating frequencies. It can be mounted on the wall, ceiling or 19" rack. Variety of the service antenna can be used from short monopole antenna (e.g. rubber ducky antenna) to indoor multi-band ceiling Omni antenna (or panel antenna).



Figure 2-1 SRU system

2.1 External interface ports and Status Indicators

SRU has all interface connections at topside of the enclosure, which includes optic, antennas, power, and maintenance port. Figure 2-2 shows the front panel of SRU.



Figure 2-2 Top and bottom side SRU

Table 2-1 Interface ports

Port	Connector type	Position	Description
Power	DC Power Jack	Тор	12V DC inlet, AC/DC converter or PoE adapter
Debug	USB	Тор	Serial interface for GUI and debugging
Optic	FC/APC	Тор	Optic fiber connection with FHU
LTE	SMA-Female	Тор	LTE Uplink/Downlink RF signal interface
ANT	SMA-Female	Bottom	Omni ANT connection

Table 2-2 Status indicator LEDs

Name	Normal state	Abnormal state	Description
Power	Green	Off	Power injection status
RUN	Green/Blinking	Off	CPU working status
Alarm	Green	RED	Major Alarm status

2.2 Modules

SRU is comprised of several internal modules as follows;

- Optic module Performs E/O (or O/E) conversion for FWD and RVS signals.
- MCU Board Monitors the status of modules in SRU and controls the configurable parameters of the SRU modules.
- Quadruplexer cavity filter passes FWD and RVS path PCS/Cellular frequency bands.
- RF Transceiver controls the gain of FWD path of PCS/Cellular frequency bands.

2.3 Mechanical Drawing











Figure 2-3 Exterior in 3-dimension

2.4 Technical Specifications

2.4.1 General specifications

Table 2-3 General Specifications

Specification	Values	Remarks
Dimensions	89(H) x 175.8(W) x 263.8(D) mm	without holder bracket
Weight	4.6 Kg	
ANT and RF connector	SMA-type Female	
Optic port	FC/APC type	
GUI port	USB B-type	
Input Supply Voltage	12V DC	PoE adapter/splitter
Operating Temperature	-20 ~ +50 °C	
Humidity	5 ~ 80% Relatively	

2.4.2 Frequency allocation

2.4.2.1 1900 MHz band

Table 2-4 First and last channel center frequency information of 1900MHz band

	GSM 1900			WCDMA 1900			CDMA 1900		
Band Edge	CH No.	CH Center freq. (MHz)			CH Center freq. (MHz)			CH Center freq. (MHz)	
2080		Down Link	Up Link	CH NO.	Down Link	Up Link	CH NO.	Down Link	Up Link
First CH	512	1930.2	1850.2	9662	1932.4	1852.4	25	1931.25	1851.25
Last CH	810	1989.8	1909.8	9938	1987.6	1907.6	1175	1988.75	1908.75





2.4.2.2 850 MHz band

		GSM 850		WCDMA 850			CDMA 850		
Band Edge		CH Center fre	eq. (MHz)		CH Center fre	eq. (MHz)		CH Center freq. (MHz)	
	CH NO.	Down Link	Up Link	CH NO.	Down Link	Up Link	CH NO.	Down Link	Up Link
First CH	128	869.2	824.2	139	871.4	826.4	1013	869.7	824.7
Last CH	251	893.8	848.8	240	891.6	846.6	777	893.31	848.31

Table 2-5 First and last channel center frequency information of 850MHz band



Figure 2-5 Frequency allocation of 850 MHz band

2.4.3 **RF specifications**

Table 2-6 Dual band specifications

ltem	Specification	Remarks
Downlink Frequency	869 ~ 894 MHz, 1930 ~ 1990 MHz	
Uplink Frequency	824 ~ 849 MHz, 1850 ~ 1910 MHz	
Operating Bandwidth	Cellular: 25MHz BW	
	PCS: 60MHz BW	
DL Output Power	+26dBm/composite @ANT Port	Dual Band Output Power
Optical wavelength	SRU: DL 1310/UL 1550nm	WDM included
Optic Module Gain	OdB w/ passive device loss	Optic Module Gain FHU ~ SRU
Available optical fiber loss	2dBo (2Km) max.	Including connector loss.
Gain ripple over each band	2 dB Peak to Peak	Gain flatness over 25MHz BW
Gain flatness over Dual Band	+/- 2dB(4dBp-p)	Gain flatness of 850/1900MHz
Attenuator Control Range	0 ~ 30dB	Optic loss Compensation
Gain Control Step Size	1 dB	±0.7 dB tolerance at 0 ~ 25dB
Input VSWR	1.5: 1 Max.	All of RF Port
Frequency Stability	±0.01 ppm	
System Delay	500nsec max.	
EVM	5% max.	
Rho	0.998 min.	
Spurious Emissions	Comply to 3GPP, 3GPP2 and FCC	
Rx Noise Figure	5 dB @UL Gain 40dB	@ Room temperature
Rx max. input level	-40dBm	CW -30dBm can be receivable
System Gain	DL 45~47dB/UL 50~52dB	Gain ±2dB @-20~50°C

2.4.4 **Power Specifications**

Table 2-7 Power specifications

Item	Specification
Rated Input Voltage	12 V DC
Permissible range	Tolerance ±10%
Dower consumption	30 W, maximum
Power consumption	27 W, typical

2.5 Installation

2.5.1 Installation Requirements

Before and during installation, the following should be carefully verified in order to avoid any problem:

- Faulty Cabling/Connectors: Fiber cable and connectors must be verified prior to plugging into the SRU
- Dirty Connectors and ports
- Faulty Small Remote Unite (SRU) components
- RF source equipment issue
- External RF Interface problem such as antenna port
- Wrong or Improper Ethernet cable for POE input

The following guidelines are required when the Headend unit is installed on the 19" rack:

- Locate the equipment with the space for the sufficient airflow to prevent build-up from the overheating. Do not compromise the amount of airflow required for safe operation of the equipment.
- Verify the power connection and Fiber cables prior to turning on the systems.

WARNING: Equipment loading must be verified prior to mounting the equipment on the wall or 19" rack.

2.5.1.1 General Safety Precautions

The following precautions apply to the SRU:

- The units have no user-serviceable parts. Faulty or failed units are fully replaceable through Intelibs.
- When the Fiber cable is connected to the equipment, the connectors must be free from the dust and connected according to the cable manufacturer's instructions. (WARNING: For the safety, DO NOT conduct eye-contact at the connector ends of the fibers or the port of the FHU and SRU unless equipped with protection goggle. Invisible infrared radiation may be present at the front panel of the RHU, FHU and SRU. Do not remove the fiber port dust caps unless the port is going to be used. Do not stare directly into a fiber port.)
- When the service antenna is connected to the SRU, SMA connector must be firmly tightened. (Caution: Do NOT over tighten the connector.)
- The PoE Ethernet cable should be run with the maximum no more than 300 feet distance. It is only for in-building use only.

2.5.2 Installation Tools

Table 2-8 Installation tools

Torque Wrench	Torque Wrench	ESD Gloves	4ea of 5m SMA cable	
FC/APC-SC/APC Optic Fiber, 10m	Ground wire line	2ea of ANT RF Cable	Wire Stripper & Cutter	
	*	\bigcirc		
Rubber Mallet	Digital Multi-meter	Screw Driver	Optic connector cleaner	
		100		

2.5.3 Item Check List

Check that all the following items have been included with the box delivered. If anything is missing, please contact Intelibs.

Table 2-9 Item check list

SRU	PoE splitter	PoE adapter	AC power cable
SRU equipment with bracket: 1 ea	PoE splitter: 1 ea	PoE adapter: 1 ea	AC power cable: 1 ea

2.5.4 Wall Mounting

SRU supports wall mount. The following diagrams illustrate the methods for mounting SRU in a typical wall. The brackets for wall mount are provided with SRU system.



Figure 2-6 Wall mounting

2.5.5 Antenna

SRU uses various antennas depends on its application and environment. SRU provides one antenna port "ANT" at the rear side of the system. Figure 2-9 shows antenna connection with swivel blade antenna.



Figure 2-7 Antenna connection

2.5.6 Power cable

SRU uses 12V DC power, and DC power adapter/splitter set using PoE (Power over Ethernet) technology are provided with the system. The PoE adapter converts AC input to 48V DC, and delivers DC power via UTP5 Ethernet cable up to 330 feet. The PoE splitter receives 48V DC power via UTP5 Ethernet cable, and converts 48V to 12V DC. The power connection diagram is described in Figure 2-8.



Figure 2-8 Power connection

Power connection sequence is as follows:

- ① Connects UPT5 cable to "OUT" port of PoE adapter.
- 2 Connects UTP5 cable to "IN" port of PoE splitter.
- ③ Connects one end of power cable to PoE adapter's AC inlet, and the other side of power cable to AC outlet.
- ④ Verify the LED status on PoE splitter and adapter
- (5) Connects DC output connector to "Power" port of SRU.

2.5.7 Optic cable

SRU provides one optic port for uplink, "Optic" port, and optic connector type is FC-APC (Angle Physical Type). While connecting the optic cable, align the FC type connector at latch and hole position, then plug in and rotate clockwise tightly.





Figure 2-10 and 2-11 shows optic connection of RHU-FHU-SRU equipment.

Figure 2-10 Optic cabling when cascading DAS systems with one FHU



Figure 2-11 Optic cabling when cascading DAS systems with two-stage FHU

Please refer to the SRU Installation Guide for details.

2.6 SRU power setting

2.6.1 Down Link power setting

1. Connect the power cable to SRU



2. Connect USB cable to manage SRU through Laptop.



3. Execute application program and open GUI screen of SRU

19

🞐 DUAL SRU-0		
General	PCS Band Cellular Band	
Version 1.0.0.0	Tx-PCS	
VzW DUAL-SRU	📕 Path Use 🛛 🚺 HPA On/O	r
Name	TOTATT 16.5 3 OUT PW	R 22.5
2013-07-16 13:22:08	USR ATT 16.5 OUT UPR	25.0
Environment	ALC ATT 0.0 OUT LWR	1.0
User Connect	IN PWR -17.0 ALC	23.0
PSU	TC ATT 0.0 ASD	25.0
TMPCUR 34	Rx-PCS	
TMPUPR 61	Protection On/Off	
Optic	IN PWP 70.0 OPWR	-30.0
LDPWR 6.0		-50.0
LDLWR 0.0	CW 600 TCATT	0.0
PDPWR 0.5	ATT 20.0 AGC AT	T 0.0 T
PDLWR -8.0		

- 4. Decrease the DL "USER ATT(①)" to 30dB(Minimum gain) and verify that antenna is connected at antenna port of SRU properly.
- 5. Press the "HPA On/Off(2)" button to turn HPA on
- 6. Monitor the output power level from "OUT PWR(③)" parameter and tune up "USR ATT(①)" to set the proper output power level of SRU.

2.6.2 Up Link power setting

- 1. Use the "ATT(④)" to control Uplink gain.
- 2. Uplink gain is very important parameter because uplink is connected to RF source of BTS. If you have wrong uplink gain set BTS receiver sensitivity may be degraded by SRU uplink gain.
- 3. Try to minimize uplink gain with mobile Tx power.

2.7 Configuration and Maintenance

SRU can be configured in three ways via remote internet connection or local serial port connection.

- SNMPv3 interface through the internet
- Web interface through the internet
- Local management interface through the internet, serial connection, and Bluetooth

Master Unit is a remote management system that provides SNMP v3 and Web interface, and maintains all functions of optical DAS system including configurations, monitoring, and real time alarm reporting.

LMT (Local Management Terminal) is local management interface through IP network, serial interface, and Bluetooth.

The configuration and maintenance for SRU is performed by accessing RHU system through any interfaces provided by RHU.

Figure below describes a typical DAS management system network and the entities.



Figure 2-12 DAS management network and entities

	Functions	SNMPv3	Web	LMT
	Serial interface			0
	IP address assignment			0
On-site installation	ID assignment (for Remote Unit)			0
	System Password			0
System Registration	System Registration/Unregister	0		
Site/Location setting	DAS system's site and location information		0	
	Capture and restore the configuration		0	
Remote/Local	Parameters settings and retrieval	0	0	0
management	F/W upgrade	0		0
	Alarms	0	0	0
A la 1999 a	Alarm history		0	
Alarms	Current Alarm	0	0	0
lleer management	Creation & Deletion of users	0	0	
User management	Password management	0	0	0

Table 2-10 DAS management entities and their functions





Figure 2-13 is an example of DAS network using LMT to configure DAS system. Followings sections describes how to configure and manage FHU system using LMT via Bluetooth connection or using Web Interface via Internet.



2.7.1.1 Configuring FHU/SRU

If one of Bluetooth or Ethernet connection has been established, LMT is ready to start. Launch the Local Management application by clicking the icon "Cherry" and follows the steps below.

<u>Step 1</u>

- Launch the application "Cherry".
- Enter the password, click "Login".
- Click "Connect" icon on the left top corner of window.





<u>Step 2</u>

- Select the connection parameters as follows:
 - Repeater Types: VzW Dual Band Small Power INB System
 - Connected Device: SRHU [Dual Band]
 - Connections
 - o Serial Port: The port number established via Bluetooth or
 - o UDP: IP address for the Ethernet interface

Select Target Repeater Systems	Select Target Repeater Systems
Please choose your Repeter Systems Select Done	Please choose your Repeter Systems Select Done
Repeater Types:	Repeater Types:
VzW Dual Band Small Power INB System	VzW Dual Band Small Power INB System
Connected Device: SRHU [Dual Band]	Connected Device: SRHU [Dual Band]
Connections:	Connections:
© Serial Port	C Serial Port
CUDP	• UDP 192 . 168 . 10 . 11

<u>Step 3</u>

• If "Repeater Browser" window appears, click DUAL-SRHU system.

Determinent	
OLAL SRIU	
Installed ALL	
at the second	

<u>Step 4</u>

• Select "Install Remote" tab to install FHU and SRU, then click "Refresh" button.

ite <u>View Window H</u> elp ni det det "st inn man ma inn Marian Beland and and and and and and and and and	41 m 9	Eile View Window Help		4 1 10 9	
		DUAL-SRHU			
PCS Band Cellular Band Ins	stall Remote	General	PCS Band Cellular Band	Install Remote	Second in 1997
Version 0.0.1.2 FHU Install / Link Status	Repeater Network Configuration	Version 0.0.1.2	FHU Install / Link Status	Repeater Network Configuration	
VW/DUALSRW IPRUA IPRUA Calling IPRUA IPRUA 2013440113552 IPRUA IPRUA Diffusion IPRUA IPRUA IPRUA IPRUA IPRUA IPRUA IPRUA IPRUA IPRU	Retrain Deate AI	V00/DUL, GR4U Name 2013-04-01135522 Environment PSU TuP-DUR TuP-DUR OF# LDPAR POUNR POUNR POUNR POUNR	FNU-0 FNU-0 FNU-0 FNU-0 FNU-2 FNU-0 FNU-2 FNU-10 FNU-2 FNU-10 FNU-2 FNU-10 FNU-2 FNU-10 FNU-2 FNU-10 FNU-10 FNU-10 FNU-10	Reteal Information	

<u>Step 5</u>

- At "Repeater Network Configuration" window, click "click to add" text.
- In the "Install Information" select "FHU".
- Select FHU ID from the FHU drop down list. FHU's ID is provided by manufacturer.

		A Restored and the second seco	Cherry for vive distais - 1	DOALShinoj	
Eile View Window Help			<u>File View Window Hel</u>	p	
98 🕷 🕷 💰 🔲 📴 🗉		44 W 8	RE 🚧 🚧 🎩 🛄 🛄		hi 22 2
DUAL-SRHU			D- DUAL-SRHU		
General	PCS Band Cellular Band In	stall Remote	General	PCS Band Cellular Band	Install Remote
Version 0.0.1.2	FHU Install / Link Status	Repeater Network Configuration	Version 0.0.1.2	FHU Install / Link Status	Repeater Network Configuration
WIN DULLSBHJ Name 2013-84-91 1402-41 Enironmet User Conect P3U THPUR ULPAR LDURR LDURR POVR PDVR PDVR PDVR	PRU-0 PRU-0 PRU-0 PRU-0 PRU-2 PRU-0 PRU-2 PRU-10 PRU-2 PRU-10 PRU-3 PRU-11 PRU-4 PRU-12 PRU-4 PRU-13 PRU-4 PRU-14 PRU-5 PRU-15 PRU-6 PRU-16 PRU-7 PRU-76 PRU-8 PRU-17 PRU-9 PRU-18 PRU-9 PRU-18 <	Refeat) Defeteral Defeteral Instal information: PRU C PRU C SRU Instal information: C PRU C SRU Instal information: C PRU	Very DUAL-SRHJ Name 2013-04-0114.05.03 Environment User Conned PBU Threuse Dopse DDVR DDVR DDVR PDUVR PDVR 45	PRU-0 PPU-3 PRU-0 PPU-9 PRU-2 PPU-10 PRU-3 PPU-11 PRU-4 PPU-12 PRU-4 PPU-13 PRU-4 PPU-14 PRU-5 PPU-14 PRU-4 PPU-15 PRU-6 PPU-14 PRU-7 PRU-74 PRU-7 PRU-74	Bit is used Referato Install information. PRU Center All PRU Center All

<u>Step 6</u>

- If FHU's ID is selected, click "Install" button at "Install Information".
- After Install, click "Refresh" button to display installed equipment.
- If FHU is installed properly, at "FHU Install / Link Status" panel a check box on the left side of FHU's ID turns to GREEN, otherwise it turns to RED.

P DUAL-SRHU		
General	PCS Band Cellular Band	Install Remote
Version 0.0.1.2	FHU Install / Link Status	Repeater Network Configuration
V2W DUAL-SRHU Name 2013-04-01 14:07:38 Environment User Connect PSU TUPCO IP TUPCO IP	FHU-0 FHU-8 FHU-1 FHU-8 FHU-2 FHU-10 FHU-3 FHU-11 FHU-4 FHU-12 FHU-5 FHU-13 FHU-6 FHU-14 FHU-7 FHU-15	⊜⊊ RHU └ + click to add
Dptc 80 LDPWR 7.5 LDLWR 5.0	RU-nstall / Link Status RU-0 RU-8 RU-1 RU-9 RU-2 RU-10 RU-3 RU-11	Remests Install Information
PDPWR 4.5 PDLWR -5.0	RU-4 RU-12 RU-5 RU-13 RU-6 RU-14 RU-7 RU-15	RHU → FHU 0 ^C FHU Delete All ^C SRU Install ^C HRU

DUAL-SRHU		
ieneral	PCS Band Cellular Band In	nstall Remote
Version 0.0.1.2	FHU Install / Link Status	Repeater Metwork Continuation
V2W DUAL-SRHU Name 2013-04-01 14:11:48 invironment	FHU-0 FHU-8 FHU-1 FHU-9 FHU-2 FHU-10 FHU-3 FHU-11 FHU-4 FHU-12	A RHU FIL-0.097-0 : click to add FIL-0.097-1 : click to add FIL-0.097-2 : click to add FIL-0.097-2 : click to add
User Connect PSU TMPCUR 42	FHU-5 FHU-13 FHU-6 FHU-14 FHU-7 FHU-15 FUInstall / Link Status	
PIC	RU-0 RU-8 RU-1 RU-9 RU-2 RU-10 RU-2 RU-10	
LDLWR 5.0 PDPWR 4.5 PDLWR -5.0	RU-4 RU-12 RU-5 RU-13 RU-6 RU-14	Refresh Install information: € PHU FHU-0 ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■

<u>Step 7</u>

• Click "click to add" text on FHU's port that SRU attached, then select "SRU" and click drop-down box to select SRU's ID. SRU's ID is provided by manufacturer.

DUAL-SRHU			DUAL-SRHU		
General	PCS Band Cellular Band In	astall Remote	General	PCS Band Cellular Band	nstall Remote
Version 0.0.1.2	FHU Install / Link Status	Repeater Network Configuration	Wesion 0.0.12	FHU Install / Link Status	Repeater Network Configuration
V2W DUAL-SRHU Name 2013-04-01 14:24:02 Environment User Connect PSU TMPCUR 42 TMPCUR 42	FHU-0 FHU-8 FHU-1 FHU-9 FHU-2 FHU-10 FHU-3 FHU-11 FHU-3 FHU-12 FHU-5 FHU-12 FHU-5 FHU-13 FHU-6 FHU-14 FHU-7 FHU-15 FHU-5 FHU-15	A FHU FHU 0.0FF.0 : click to add FHU 0.0FF.2 : click to add FHU 0.0FF.3 : click to add FHU 0.0FF.3 : click to add	VSW DUAL-SRHU Name 2013-04-01 14:25:35 Environment User Connect PSU TWPCUR 42	FHU-0 FHU-8 FHU-1 FHU-9 FHU-2 FHU-9 FHU-2 FHU-1 FHU-5 FHU-11 FHU-5 FHU-12 FHU-5 FHU-13 FHU-6 FHU-14 FHU-7 FHU-15 FHU-15 FHU-15	 G FINU CFIN0 FIN0.0PF0: click to add FIN0.0PF12: click to add FIN0.0PF12: click to add FIN0.0PF2: click to add
ppic LDPWR 7.5 LDLWR 5.0 PDPWR 4.5 PDLWR -5.0	RU-0 RU-8 RU-1 RU-9 RU-2 RU-10 RU-3 RU-11 RU-4 RU-12 RU-5 RU-13 RU-6 RU-14 RU-7 RU-15	Ratesh Patal Information C Pieu Delen All Pieu C - Seu Matal C - Neu	Deptic Optic LDPWR 7.5 LDLWR 5.0 PDPWR 4.5 PDLWR -5.0	RU-0 RU-8 RU-1 RU-9 RU-2 RU-10 RU-3 RU-11 RU-4 RU-12 RU-5 RU-13 RU-6 RU-14 RU-7 RU-15	Refrant Install Information: PHJ Detete All FHJ-0.1 -> SRU-1 6 SRU FBU.1 Install 7 HRU 7 HRU 7 HRU

<u>Step 8</u>

- If SRU's ID is chosen, then press "Install" button. After Install, press "Refresh".
- If SRU is installed properly, a small box on the left side of SRU's ID turns to GREEN, otherwise it turns to RED.

DUAL-SRHU		
ieneral	PCS Band Cellular Band	nstall Remote
Version 0.0.1.2	FHU Install / Link Status	Repeater Network Configuration
V2W DUAL-SRHU Name 2013-04-01 14:25:35 mirronment User Connect PSU TMPCUR 42 TMPCUR 42 TMPUPR 80	FNU-0 FNU-3 FNU-1 FNU-3 FNU-2 FNU-10 FNU-3 FNU-11 FNU-4 FNU-12 FNU-5 FNU-13 FNU-6 FNU-14 FNU-7 FNU-15 RU-4 FNU-7 FNU-7 FNU-15	G A HU FIU 3.0PT3 : click to add FIU 3.0PT3 : click to add
Dptic	RU-0 RU-8 RU-1 RU-9 RU-2 RU-10 RU-3 RU-11	Instal Information:
PDPWR 4.5 PDLWR -5.0	RU-4 RU-12 RU-5 RU-13 RU-6 RU-14 RU-7 RU-15	PHU-01→SRU-1 ⊂ PHU Delete All FHU-01→SRU-1 ⊂ SRU SRU-1 ▼ Install ⊂ HRU

Install PCS Band Cchluar Band Install Remete Vertion 0.12 HH Install Lues Bands Bands and Status Vertion PR04 PR04 PR04 PR04 PR04	DUAL-SRHU		
Head Head <th< th=""><th>General</th><th>PCS Band Cellular Band</th><th>install Remote</th></th<>	General	PCS Band Cellular Band	install Remote
VIDUL-GRHU PRUA PRUA PRUA Name NBA - FRUA OPT-0: click to add DISUL-01143/220 - R04.1 - FRUA OPT-0: click to add DISUL-01143/220 - R04.1 - FRUA OPT-0: click to add DISUL-01143/220 - R04.1 - R04.1 PRUA - R04.3 - R04.1 PRUA	Version 0.0.1.2	FHU Install / Link Status	Repeater Metwork Configuration
	VW DUK_SRH0 Name 2013-04-01 14:36:29 Environment User Connect PSU TMPCUR TMPUPR 80	FNU-0 FNU-3 FNU-1 FNU-3 FNU-2 FNU-10 FNU-3 FNU-11 FNU-4 FNU-12 FNU-5 FNU-13 FNU-6 FNU-14 FNU-5 FNU-15 FNU-6 FNU-15 RU Install / Link Status	= FLIGHTHE0 = GFTHE0.0PF19: click to add G SRU-1 = FHU-0.0PF2: click to add = FHU-0.0PF2: click to add
	LDLWR 5.0 PDPWR 4.5	RU-3 RU-11 RU-4 RU-12 RU-5 RU-13	Refresh RHU Delete All
DU/UR 5.0 RU-3 RU-1 Refersh Install information: PDPWR 4.5 RU-12 Refersh RH-U PDIVR 4.5 RU-12 Delete All	Potent	RU-6 RU-14	

<u>Step 9</u>

• At "Repeater Browser" window, click the DAS system to be managed, then the selected DAS system's control window will pop up.

Cherry for VzW 0.1.0.3 - [Rpeater Browser]	Cherry for V2W 0.1.0.3 -	(DUAL FHU-0)			
Eile Yiew Window Help	Elle View Window He	lφ			
22222222222222222222222222222222222222	985 986 986 48 💷 🖬	·····································	1 🚮 Al 🗷 🕈		
B Rpeater Browser	80 Renater Browser	D- DUAL FHU-0			
	B G DUAL-SRHU	General	DUAL Band LTE		
	- 🙀 DUAL SF	Wersion 10.0.0	Optic - SRU		
		Vov DUAL-FHU	LDPWR 7.0		
		Name	LOLWR 0.0	Sector Sector Sector	
		2013-04-01 14:45:28	PD Status		
		Environment	PDPWR -		
		User Connect	POLWR	0.0	
		TMPCUR 53	TE-DUAL BAND	RI - DUAL BAND	
		TMPUPR 78	Path USE		
		Opec-RHU (Dual Band)	ATT 15.5	ATT 10.0	
		LOPWR 7.0	OUT PWR -27.5	OUT PWR -30.0	
	Installed ALL	LDUWR 0.0	OUT UPR 0.0	OUT UPR 0.0	
Instance rece	Instance ALL	PDPWR 1.0	OUTLWR -30.0	2	
		POLWR -10.0	TCATT 0.0	TC ATT 0.0	
()-00	9 m	1	U]	
Ready UDP (10.1.10.21)	NUM Ready			UDP (10.1.30.21)	NUM

If connection is established successfully, then all parameters of SRU can be set by LMT terminal, and all status information can be reported to LMT. SRU's status and parameters controllable by LMT are described in Table 2-11, 2-12, and 2-13.

Status group	Parameters	LED	Settable	Description
General	Version			Firmware Version of the DAS system
Version 1.0.0.0	DAS Type			The type of the DAS system
VzW DUAL-SRU				Set following information of the DAS
Name	Name		V	- Name
2013-04-01 16:47:17				- Model Number

Table 2-11 General/Environment/Optic

25

				- Serial Number
	Time/UpTime			Current time or Up-time
Environment	User Connect	V		Connection status with the DAS
User Connect	PSU	٧		Status of Power Supply Unit
PSU	TMPCUR			Current chassis temperature of the DAS system
TMPCUR 39 TMPUPR 81	TMPUPR	٧	v	Set temperature upper limit, and display its value and alarm status.
	LDPWR	V		Current output power of LD (Laser Diode) of optic module connected to SRU.
Optic	LDLWR	v	v	Set the lower limit of output power of LD, and display its value and alarm status.
PDPWR 0.5 PDLWR -11.0	PDPWR	v		Current input power of PD (Photo Detector) of optic module connected to SRU.
	PDLWR	v	v	Set the lower limit of input power of PD, and display its value and alarm status.

Table 2-12 Tx-PCS/Cellular

Status group	Parameters	LED	Clickable	Description
PCS Band Callulas Band	PCS Band			Selects PCS channel
	Cellular Band			Selects Cellular channel
	Path Use	v	V	Turning On/Off of usage of the channel, and
		v	•	display its status
	TOTATT			Downlink total attenuation value
	USR ATT		V	Set user configurable downlink attenuation value
				Downlink ALC (Automatic Level Control)
	ALCATI			attenuation value
	IN PWR			Downlink input power from RHU or FHU
Tx-PCS	TC ATT			Displays downlink temperature compensation
Path Use HPA On/Off			V	attenuation value, and enable/disable downlink
TOTATT 5.5 OUT PWR 0.0				temperature compensation.
ALCATT 0.0 OUT LWR 0.0	HPA On/Off	٧	V	Enable/disable downlink HPA (High Power Amp).
IN PWR -40.0 ALC 23.0 TC ATT -1.0 ASD 10.0	OUT PWR			Downlink output power
		N	N	Set upper limit of downlink output power, and
		v	v	displays its value and alarm status
		N	N	Set lower limit of downlink output power, and
		v	v	displays its value and alarm status
	ALC	N	N	Set ALC (Automatic Level Control) function's
		v	v	activation level, and enable/disable ALC.
		N	N	Set ASD (Automatic Shut Down) function's
		v	v	activation level, and enable/disable ASD.

Table 2-13 Rx-PCS/Cellular

Status group	Parameters	LED	Clickable	Description
Rt-PCS Protection On/Off IN PWR -70.0 OPWR -40.0	Protection On/Off	٧	٧	Enable/disable uplink Protection function.
AGC 0.0	IN PWR			Uplink input power

IN UPR	v	٧	Set upper limit of uplink input power, and displays its value and alarm status
CW	v	V	Enable/disable uplink Pilot, and selects uplink CW channel.
ATT		V	Set uplink attenuation, and displays its value.
OPWR			Uplink output power
AGC	v	v	Set AGC (Automatic Gain Control) function's activation level, and enable/disable AGC.
TC ATT	v	v	Displays uplink temperature compensation attenuation value, and enable/disable uplink temperature compensation.
AGC ATT			AGC (Automatic Gain Control) attenuation

Following is one example of LMT operation which sets the upper limit of SRU chassis' temperature.

<u>Step 1</u>

- At "Repeater Browser" window, click the DAS system to be managed, then the selected DAS system's control window will pop up.
- Click the temperature upper limit box which is on the right side of "TMPUPR". A number in the box represents current upper limit of chassis' temperature.



<u>Step 2</u>

 Select TMPUPR value by clicking up/down button or enter temperature upper limit. Then click "Set" button.

-	and the second s	100		0.1
Т	emperature Upper Limit - [DUAL SRU-1]	81	-	Se

• The result of operation displays at the bottom of the window.

	×
81	÷ Set
	81

• Click close button on the upper right corner of the window to exit the command window.

Tem	perature Upper Limit - [DUAL SRU-1]	81	-	Set

The small color box on the left side of "TMPUPR" represents current status of upper limit of SRU chassis' temperature. If the box is GREEN, operating status is in normal condition. If the box is RED, "TMPUPR" alarm occurred and remains.

2.7.2 Web interface

Master Unit provides comprehensive management of the Intelibs optical DAS systems via Web GUI. Master Unit provides following functions for Web clients:

- Hierarchical view of the DAS systems
- Alarms histories
- Current Alarms
- SNMP agent settings
- Site and location information settings
- Web user settings
- Capture and restore the configuration of the DAS systems
- Parameter settings of the DAS systems

The web GUI is divided into two parts, a menu panel and a Parameter view panel. The menu panel is on the left side of main window, and the other side is the parameter view panel as shown in Figure 2-15.



Figure 2-15 Web GUI

The menu panel contains following menu functions:

- Home: Introductions of Intelibs, Inc, and brief introduction of GUI usage.
- DAS systems: Hierarchical view of registered DAS systems.
- Alarm history: Alarm log of all registered DAS systems.

30

- Alarms: Current alarms of all registered DAS systems.
- SNMP settings: SNMP environment settings such as trap IP, community, V3 user, etc.
- Site settings: Assign site and location information to each registered Das systems.
- User settings: Add/delete web user and change user's password
- Support: Intelibs' support information.
- About us: Redirect to Intelibs' web page.
- Log Off: Logging off current user's session.

Before using web interface, followings should be assigned and set correctly:

- Master Unit's IP address
- RHU system's IP address
- Master Unit's IP address on RHU system

Figure 2-16 shows web interface flow over IP network.



Figure 2-16 Web interface flow

If IP network connection is established successfully, then parameters of SRU can be set by Web browser, and all status information can be reported to Web browser.

Following is one example of Web operation which sets the upper limit of SRU chassis' temperature.

<u>Step 1</u>

• Open Web browser such as Internet Explorer or Chrome.

• Enter Master Unit's IP address that is assigned for Web interface. Usually the IP address is global IP or private IP if web client is on the same network where Master Unit is.



<u>Step 2</u>

• Enter Login ID and Password. (Please contact Intelibs for login ID and password)

The web interface provides two level user access, privileged or not. Privileged users can retrieve and change the advanced parameters that control the DAS system. For example, "TMPUPR" parameter is an advanced parameter that requires privileged user login.



• If ID/PWD matches, Web interface goes to Home page.



Step 3

• Click "DAS systems" menu box to see the Hierarchy view of DAS systems.



<u>Step 4</u>

• Select a DAS system to control and monitor at the hierarchy view.



<u>Step 5</u>

• Select "Advanced Mode" check box to display advanced parameters, for example "Chassis High Temperature Alarm Threshold" in the parameter view panel.



<u>Step 6</u>

• Enter numbers for "Chassis High Temperature Alarm Threshold". Then click "Set" button.

http://10.1.10	D+ BCX BH	ome - Intelibs DAS Wel	o I ×			(U)
5.00				RTNE	RS	
Home	Diff Barratas Terra	Diff. Constant Name	Correct Days	Decembration de	_	
DAS systems	DAS SRU DualBand	SRU new version	General	FHU new versio	n FOPT-01	
- Bulling and lab	Location					
RHU test lab	1500 Stony Brook rd.	Stony Brook NY 11794				
EHU new version	Advanced Mode S	ave Configuration	Rest	ore Configuration	Alarm	
SRU new version			Save Rest	ore Configuration	Alarm	
MHU test lab	General information 8	RF channel setting				
S250-CDMA-MHU	General	PCS Cellular				
S C2 IOT test r1 : VzV	Parameter	Parameter Value Set			Set	
C2 IOT test r2 : VzV	V RL Venice			1000		
	Version			1.0.0.0		E
< [> System Name		3	KU new version	(iset)	
Alarm History	Model Number			SRU-DUAL	_	
Alarms	Senal Number		DB	sRU201206002	_	
Aidinis	System Description		SRU for D	ual-Band [VzW]	_	
SNMP Settings	System IP Address			Not Avaliable	_	
Site Settings	Environment	Heurittie:Sec)	aur 0 haure 50 mi	utes 62 conser		
User Settings	Byseet Nede	Hour Min. Sec)	ays o nours oo mi	It is not second	-	
Support	Character Comparent Tomate			to new version		
About He	Chassis Current Temp	erature		40 C		
About Us	Chassis High Tempera	ture Alarm Inreshold		80 C	set	
	Chassis High Tempera	ture Alarm				

<u>Step 7</u>

• If confirmation window pops up, click "OK" button to confirm changing the parameter value.



• Then result window will pop up.



The column "Chassis High Temperature Alarm" represents upper limit of SRU chassis' temperature. If the value box is GREEN, operating status is in normal condition. If the box is ORANGE, this indicates "TMPUPR" alarm is turned on.

3 Appendix I. Ancillary Devices – Antenna, Cable and other Passive Device

Intelibs does not provide the ancillary device, however the following or equivalent devices are recommended:

- Recommended Antenna:
 - o Larson Dipole Antenna

Frequency [MHz]	698-960/1710-2170/ 2500-2700
Nominal Impedance [Ω]	50
VSWR	2.5:1
Gain [dBi]	0 Min-2 Max
Polarization	Linear Vertical
Radiation Pattern	Omni
Power Rating [W]	3

Electrical Specifications

o Commscope



Electrical Specifications			
Frequency Band, MHz	698–800	800–960	1710–2700
Gain, dBi	1.5	1.5	5.0
Beamwidth, Horizontal, degrees	360	360	360
VSWR Return Loss, dB	1.8 10.9	1.5 14.0	1.5 14.0
Input Power per Port, maximum, watts	50	50	50
Polarization	Vertical	Vertical	Vertical
Impedance	50 ohm	50 ohm	50 ohm

- PoE Ethernet Cable and Adaptor:
 - CAT6e or equivalent cable is recommended.

Phihong PoE Adaptor (POE61U-560DG-R) and Splitter (POE-45-120-R) or equivalent products



- Coaxial Cable:
 - o RG142 or equivalent coaxial cables
- Fiber Cable:
 - o FC/APC optical cable

4 Human RF Exposure – Maximum Permissible Exposure Evaluation

The recent FCC developed guideline for evaluation of the human exposure to the RF emissions. The maximum permission Exposure (MPE) for power density of the transmitter operating RF ranges between 300 KHz and 100 GHz. As the Intelibs SRU belongs to the fixed equipment, Analysis has been conducted to evaluate the MPE from the distance greater than 20 Cm as the fixed equipment required.

Antenna gain is restricted to 1.5W ERP (2.49 W EIRP) in order to satisfy RF exposure compliance requirements. If higher than 1.5W ERP, routing MPE evaluation is needed. The antenna should be installed to provide at least 20 cm from all persons to satisfy MPE requirements of FCC Part 2, 2, 1091.

SRU transmits far below that FCC power density restricts. FCC defines power output limits at 20 cm distance for various frequency ranges:

- Over 300 MHz to 1.5 GHz the limit is determined by frequency /1500
- Above 1.5 GHz the limit is 1 mW/cm^2

The basic equation for determining power density is:

 $S = PG/4(pie)R^2$

Were S is power density, which is mW/Cm^2

PG, the transmitted power from the antenna indentified as EIRP (Equivalent Isotropically Radiated Power)

R is the distance of interest from the antenna.

Typical Installation Example:

As the typical height of a floor is assumed as 10 foot high, an average person is assumed 6 foot high, the distance from antenna to body is 4 feet (112 cm).

For PCS 1900 band, the maximum power output per carrier is assumed 23 dBm. With the assumption of 5 dBi antenna is used, PG in the equation is equal to 28 dBm EIRP.

Using S = PG/4pieR^2

 $S = 0.63/(4*3.14)*112^2 = 4\mu W$

Also worst case with the assumption of minimum distance of 20 cm according to FCC regulation:

S = 0.63/(4*3.14)*20^2 = 0.1mW

37

Limited Warranty

Intelibs, Inc ("Intelibs") offers a standard two year warranty from defects in material and installation. INTELIBS may at any time exclude from this Agreement any Hardware or Software which (1) has been modified, repaired or serviced by anyone other than Intelibs' service staff without the prior written approval of Intelibs, (2) has been subjected to unusual physical or electrical stress, whether such stress results from accident, neglect, misuse, lightning, failure of electrical power, air conditioning, humidity control, transportation, the making of specification or configuration changes requested by Customer, or any other cause other than or other with the System or (4) has been moved from the place of installation. When the system has been improperly modified, repaired, stressed, used or moved as described above, Intelibs may, at its option and subject to the approval of the Customer, perform such corrective work, including any repairs, replacements and adjustments, as are in Vendor's opinion necessary to restore the System to the condition it would have been in if subjected only to normal wear and tear at the Customer's expense.

Index

AC Power specifications	12
Advanced Mode	34
AGC	28
Alarm history	30
Bluetooth	19, 22
DAS management network	20
DAS Type	27
FC-APC	16
FHU	5
Hierarchical view	30
IN ATT	28
IN LWR	28
IN PWR	28
IN UPR	28
LDLWR	27
LDPWR	27
Link Antenna connection	15
LMT	.20, 21, 22, 27
Local management interface	19
Mounting methods	15

MU	5
Optic cable connection	17
OUT PWR	28
PDLWR	27
PDPWR	27
Power cable connection	16
PSU	27
Rated Input Voltage	12
RHU	5
RU	5
Site settings	31
SNMP settings	31
SNMPv3	19, 21
SRU	5
TMPCUR	27
TMPUPR	. 27, 29, 32
User settings	31
Version	27
Web interface	19
Web interface flow	31



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