USER GUIDE

Cab-n-Connect A100

A3

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CAB-N-CONNECT A100 - USER GUIDE

Disclaimer

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Revision History

Revision	Brief Description of Changes	Date of Issue
0.1	Initial Draft	2016-May-30th
0.2	Updates to Draft	2016-June-1st
A	Release to Rev A	2016-September-19th
A1	Update to Section 3.5.1 Update to Section 4.1.3 Update to Section 4.1.5 Table 12	2016-September-30th
A2	Corrected “SMA-RP” to “SMA Female” for J3 – J8 SMA connection throughout document	2017-July-14th
A3	Updated FCC information	2017-August-22nd

Symbols

The following symbols may be used in this manual

DANGER

DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

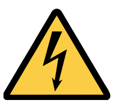
WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

CAUTION indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTICE

NOTICE indicates a property damage message.



Electric Shock!

This symbol and title warn of hazards due to electrical shocks (> 60 V) when touching products or parts of them. Failure to observe the precautions indicated and/or prescribed by the law may endanger your life/health and/or result in damage to your material.

Please refer also to the "High-Voltage Safety Instructions" portion below in this section.

ESD Sensitive Device!

This symbol and title inform that the electronic boards and their components are sensitive to static electricity. Care must be taken during all handling operations and inspections of this product in order to ensure product integrity at all times.

HOT Surface!

Do NOT touch! Allow to cool before servicing.

This symbol indicates general information about the product and the user manual.

This symbol also indicates detail information about the specific product configuration.

This symbol precedes helpful hints and tips for daily use.

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1. Introduction

The Cab-n-Connect A100 (a.k.a. A100) is a network distribution system designed specifically for commercial aircraft applications. The Cabin Wireless Access Point ('CWAP') supports IEEE 802.11a/b/g/n/ac wireless standards utilizing an enterprise grade Commercial-Off-The-Shelf (COTS) Wireless Access Point. The Cab-n-Connect A100 provides a bridge between IEEE 802.3 wired Ethernet LANs and IEEE 802.11a/b/g/n/ac compliant wireless client devices.

The Cab-n-Connect A100 is provided with aircraft level discrete inputs and outputs to facilitate event notification and equipment status to and from other aircraft systems, including remote control ON/OFF. The product is equipped with a power supply unit capable of operating at 115VAC, 47 – 800Hz power with a 200msec holdup capability for power interruptions. The Cab-n-Connect A100 requires no active cooling system, and has capabilities for built-in diagnostics reporting. The unit communicates to a host server by a wired connection over a 10/100/1000Base-T interface.

1.1 802.11AC TECHNOLOGY

The 802.11ac technology builds on 802.11n, delivering up to four times the bandwidth through new technology advancements. 3X3 Multiple-Input Multiple-Output (MIMO) allows 3-spatial streams of data to be sent simultaneously to a single mobile device, substantially improving bandwidth efficiency and utilization. 256 QAM modulation gives the 802.11ac radio an additional performance boost, and works hand-in-hand with MIMO technology to boost the bandwidth of the 802.11n radio to 802.11ac speeds. Since 802.11ac operates only in the 5 GHz band, interference from 2.4 GHz devices is finally eliminated — from Bluetooth headsets to microwave ovens. The wireless networks can support an unprecedented number of users and applications — including voice and video — allowing you to confidently deploy the Bring Your Own Device (BYOD) network on the aircraft.

The dual radio Cab-n-Connect A100 provides the simplest path to next generation Wi-Fi. The 802.11ac radio readies you to support new 5 GHz mobile devices, while the 802.11n radio ensures support for all existing mobile devices —including 2.4 GHz clients.

Your users will experience a more robust wireless connection than ever before, thanks to improved beamforming. Beamforming creates the most efficient path for data transmission between an access point and a mobile device. Previously, the transmitting beamformer worked alone to define this path. Now, the receiver also assists, a process known as sounding. The result is a stronger connection that enables faster data transmission. Application throughput and performance are improved, along with mobile device battery power.

1.2 MAIN FUNCTIONAL DIFFERENCES FROM PREVIOUS GENERATION CAB-N-CONNECT

The following table provides the main feature and performance differences between the Cab-n-Connect products.

See Section 11 for important details related to transitioning from an original Cab-n-Connect **to the** Cab-n-Connect **A100.**

Table 1: Cab-n-Connect A100 vs. previous Cab-n-Connect -- Features & Performance Comparison

	PN: 73001011-xxx **Cab-n-Connect A100 (802.11ac)**	**PN: 73001000-xxx** **Cab-n-Connect 802.11n**
Wireless Standard	802.11ac and 802.11a/b/g/n	802.11a/b/g/n
Spatial Streams	3 spatial streams	2 spatial streams
Channel Bonding	Support for 20/40/80 MHz channels	Support for 20/40 MHz channels
Modulation Rate	256-QMA	64-QAM
Data Rates Supported	**802.11b/g:** 1,2,5.5,11,6,9,12,18,24,36,48 and 54Mbps **802.11a:** 6,9,12,18,24,36,48, and 54Mbps **802.11n:** MCS 0-23 up to 450 Mbps **802.11ac:** MCS 0-9 up to 1.3 Gbps	**802.11b/g:** 1,2,5.5,11,6,9,12,18,24,36,48, and 54Mbps **802.11a:** 6,9,12,18,24,36,48, and 54Mbps **802.11n:** MCS 0-15 up to 300Mbps **802.11ac:** N/A
Clients per Radio	256 clients per radio 512 clients total	128 clients per radio 256 clients total
Antenna Configuration	Internal Antenna & External Antenna (User-configurable)	External Antenna Only
Global FCC SKU	Support for all country code regulatory compliance	Three (3) different SKUs required for regulatory compliance
IP Strapping	Fixed IP address based on discrete input configuration	N/A
Failover	Ethernet failover in a daisy-chain configuration	N/A

1.3 STANDARDS

Table 2: Standards

Standard	Description
ARINC 763-3	Network Server System
D6-36440	Boeing Standard Cabin Systems Requirement Document FED-STD-595 Colors Used in Federal Procurement
IEEE 802.11a	Wireless LAN Media Access Control (MAC) and Physical Layer (PHY) Specifications – High-speed Physical Layer in the 5 GHz Band.
IEEE 802.11b	Physical and Media Access Control (MAC) layer definition for ISO 7 stack communications devices.
IEEE 802.11g	IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 11: Wireless LAN Media Access Control (MAC) and Physical Layer (PHY) Specifications: Further Higher Data Rate Extension in the 2.4 GHz Band.
IEEE 802.11n	IEEE Standard for Information Technology - Telecommunications and information exchange between systems-Local and metropolitan area networks-Specific requirements-Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications. IEEE 802.1x Port-Based Network Access Control
IEEE 802.3	Information Exchange Between Systems—Local and Metropolitan Area Networks—Specific Requirements—Part 3: Carrier Sense Multiple Access With Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications. RTCA/DO-254 Design Assurance Guidance For Airborne Electronic Hardware
RTCA/DO-160F/G	Environmental Conditions and Test Procedures For Airborne Equipment RTCA/DO-178B Software Considerations in Airborne Systems and Equipment
FAR-25.853a Cert	Federal Aviation Regulations for Flammability ISO 9001/2008 International Organization for Standardization, Quality Management ANSI/IPC-A-620 Acceptability of Electronic Assemblies ANSI/J-STD-002 Solderability Tests for Component Leads MIL-C-5542 Chemical Conversion Coatings on Aluminum and Aluminum Alloys

1.4 SUPPORT DOCUMENTATION

Documentation listed available under NDA

Table 3: Support Documentation

Document Number	Description
73001011	Cab-n-Connect A100 LRU Drawing (installation drawing)
73001011-MDL	Master Drawing List
73001011-DDP	Declaration of Design & Performance
73001011-MTBF	Mean Time Between Failure
1060-6171	Failure Mode and Effects Analysis
25744	Flammability Report
73001011-CMM	Component Maintenance Manual
73001011-QTP	DO-160 Qualification Test Plan
73001011-QTR	DO-160 Qualification Test Report
MN-002674-01	WiNG 5.8.2 System Reference Guide
MN-002675-01	WiNG 5.8.2 CLI Reference Guide
MN-002677-01	WiNG 5.8.2 Product Reference Guide

NOTICE Check with the factory for latest product revisions or for additional documentation

2. Technical Support

The team of Product Specialists, Engineers and Technical support personnel at Kontron and/or its subsidiaries are available for technical support. We are committed to making our product easy to use and will help you use our products in your systems.

Please consult our Web site at http://www.kontron.com/support for the latest product documentation, utilities, drivers and support contacts.

2.1 IMPORTANT INSTRUCTIONS

The following general instructions should always be followed in order to assure the proper operation of the unit, the safety of operators and the preservation of warranty coverage.

Only a competent technician familiar with electro-mechanical assemblies should be performing any testing or troubleshooting of the unit. For detailed interconnection of power and signal wiring refer to the sections on Physical I/O (Sec.4) and Starting Up (Sec.3)

Do not remove any identification plates, serial numbers or warning labels

2.2 PRECAUTIONS FOR INSTALLING THE SYSTEM

NOTICE

Follow the corresponding instructions in this manual when installing/mounting the Cab-n-Connect A100 platform

Observe all specified dimensions required for mounting included in the drawing with outline dimensions (A100 LRU DWG, 73001011)

When installing the Cab-n-Connect A100, there must be at least 40 mm (approximately 1.575") free space around the exposed surfaces of the enclosure to prevent the system overheating.

Leave approximately 4.0" (100 mm) of free space to the front of the unit in order to have access to the connector interfaces to properly connect the peripherals.

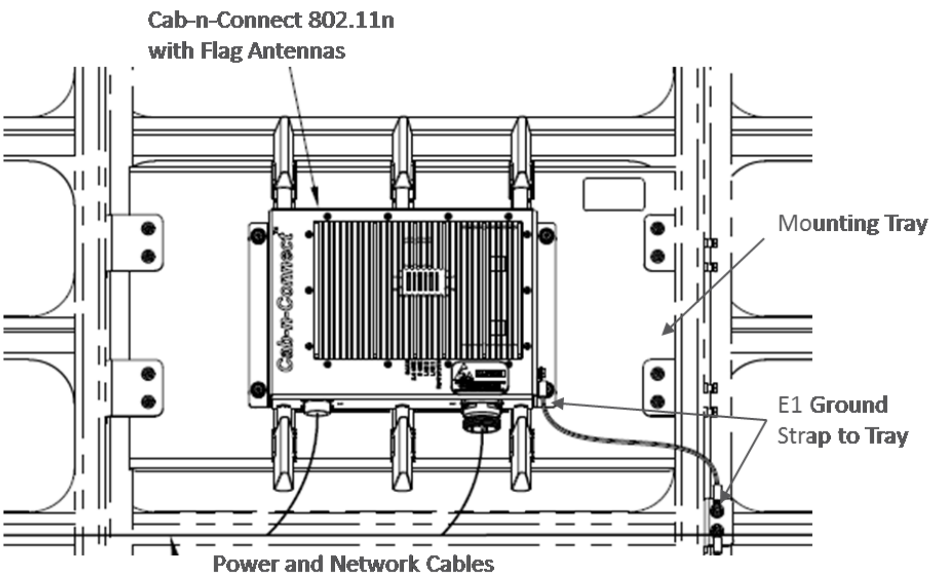
The platform must be firmly attached to a clean flat and solid mounting surface. Use proper fastening materials suitable for the mounting surface. Ensure that the mounting surface type and the used mounting solution safely support the load of the Cab-n-Connect A100 and the attached components.

Follow the local/national regulations for grounding. A ground bonding measurement (between Cab-n-Connect A100 chassis ground and the mounting surface) should be conducted to ensure proper safety and EMI characteristics are maintained. It is recommended that the bonding measurement be < 2.5 milliohms for proper EMI and safety considerations.

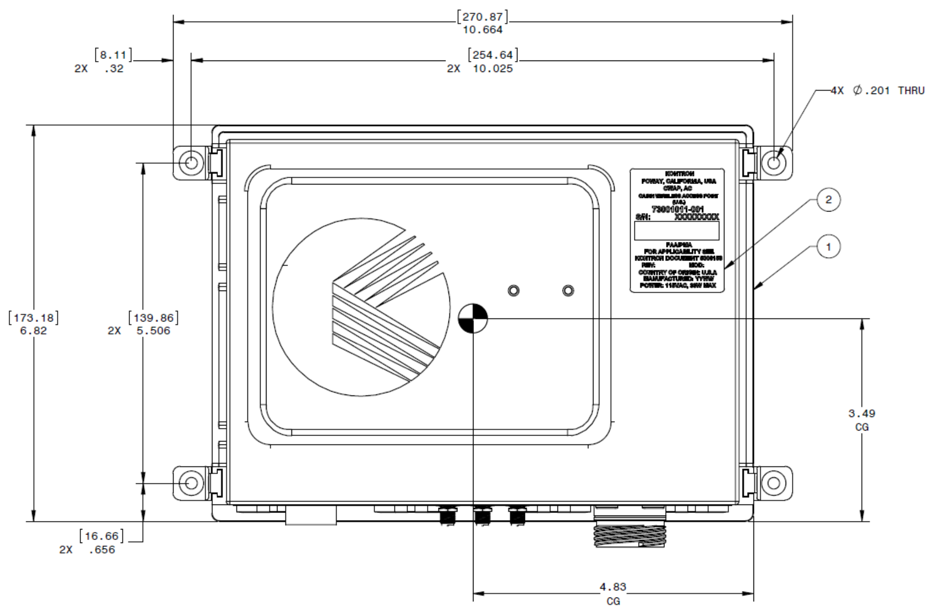
The voltage feeds must not be overloaded. Adjust the cabling and the external overcharge protection to correspond with the electrical data indicated on the type label.

The original Cab-n-Connect type is typically mounted in the crown of the aircraft as shown in the following diagram.

The Cab-n-Connect A100 can mount in the same orientation on aircraft (and now without the need for the 6 external Flag Antennas) as the footprint for the four (4) mounting points are identical (backwards compatible). The two mating cables (for J1 and J2) can also be re-used as they are also backwards compatible, but please make sure to refer to Section-11 of this document ("Transitioning from a Cab-n-Connect to a new Cab-n-Connect A100") as some of the pin functions within J1 connector have changed which could affect the installation.



There are four (4) Cab-n-Connect A100 mounting fasteners which are supplied along with each Cab-n-Connect A100 within the (PN: 1060-2698) "Cab-n-Connect Hardware Kit".
This kit contains 10-32 type hardware which require 36 in-lbs of torque.
Note: The E1 Ground-strap position also requires a 10-32 fastener (not-supplied).

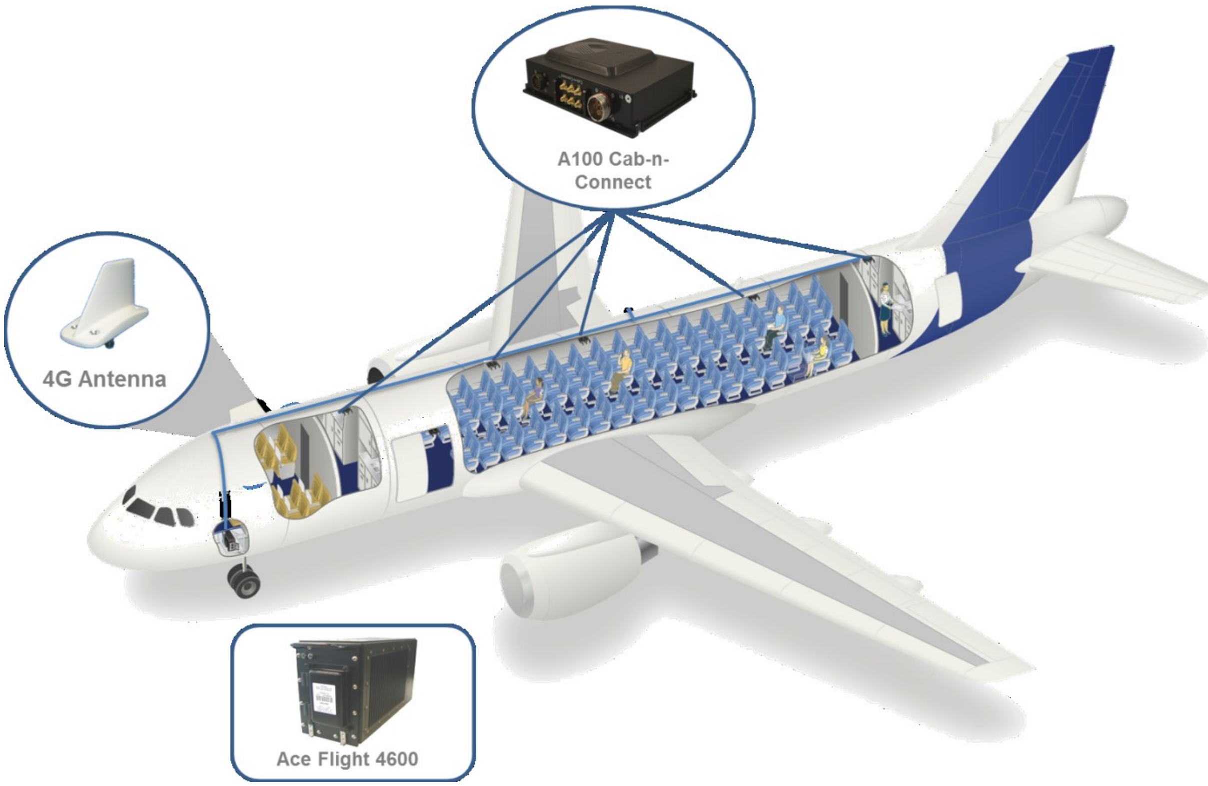


2.3 PRODUCT DESCRIPTION

The Cab-n-Connect A100 is a network distribution system designed specifically for commercial aircraft applications. The cabin wireless access point (Cab-n-Connect A100) supports IEEE 802.11a/b/g/n/ac wireless standards utilizing an enterprise grade Commercial-Off-The-Shelf (COTS) Wireless Access Point. The Cab-n-Connect A100 provides a bridge between IEEE 802.3 wired Ethernet LANs and IEEE 802.11a/b/g/n/ac compliant wireless client devices.

The Cab-n-Connect A100 provides aircraft level discrete inputs and outputs to facilitate event notification and equipment status to and from other aircraft systems, including remote control ON/OFF. The product is equipped with a power supply unit capable of operating at 115VAC, 47 – 800Hz power with a 200msec holdup capability for power interruptions. The Cab-n-Connect A100 requires no active cooling system, and has capabilities for built-in diagnostics reporting. The unit communicates to a host server by a wired connection over a 10/100/1000Base-T interface.

Figure 1 In-Flight Entertainment Equipment Diagram


A100 Cab-n-
Connect
4G Antenna
Ace Flight 4600

2.4 GENERAL

The Cab-n-Connect A100 is an LRU used to facilitate onboard wireless access using IEEE 802.11a/b/g/n/ac wireless standards. Depending on the system configuration requirements, one or more Cab-n-Connect A100 units are used to provide the wireless communications to users throughout the aircraft. The Cab-n-Connect A100 units communicate with an onboard Server via IEEE 802.3 wired Ethernet and provide a bridge to end users via multiple RF interfaces supporting compliant wireless communication.

The Cab-n-Connect A100 utilizes 115VAC/47-800Hz (AC input power) and supports six dual-band (2.4GHz and 5GHz) RF antennas in a 3 x 3 MIMO configuration. The Cab-n-Connect A100 can facilitate a high-throughput connection to passenger wireless devices in support of Audio/Video-on-Demand (AVOD) IFE applications and air-to-ground communications.

The Cab-n-Connect A100 includes aircraft level discrete inputs and outputs to facilitate event notification and equipment status to and from other aircraft systems, including remote control ON/OFF. The product is equipped with a power supply unit capable of operating at 97-134VAC, 47 – 800Hz power with a 200msec holdup capability for power interruptions. The Cab-n-Connect A100 requires no active cooling system and has capabilities for built-in diagnostics reporting. The Cab-n-Connect A100 physical envelope is designed to comply with the general requirements of ARINC 763-3. The unit communicates to a host server by wired connection over one switched 10/100/1000Base-T interface.

Cab-n-Connect A100 system consists of the following major components and subsystems:

- COTS Enterprise Wireless Access Point (AP-7532) with integral radio cards
- Avionics Power Supply Assembly
- Signal Interface Board for discrete signal conditioning and OFF/ON functionality
- Status Indicators (LEDs)
- External connection points for: Power and I/O, 2 Ethernet and 6 external antennas

2.5 PHYSICAL CHARACTERISTICS

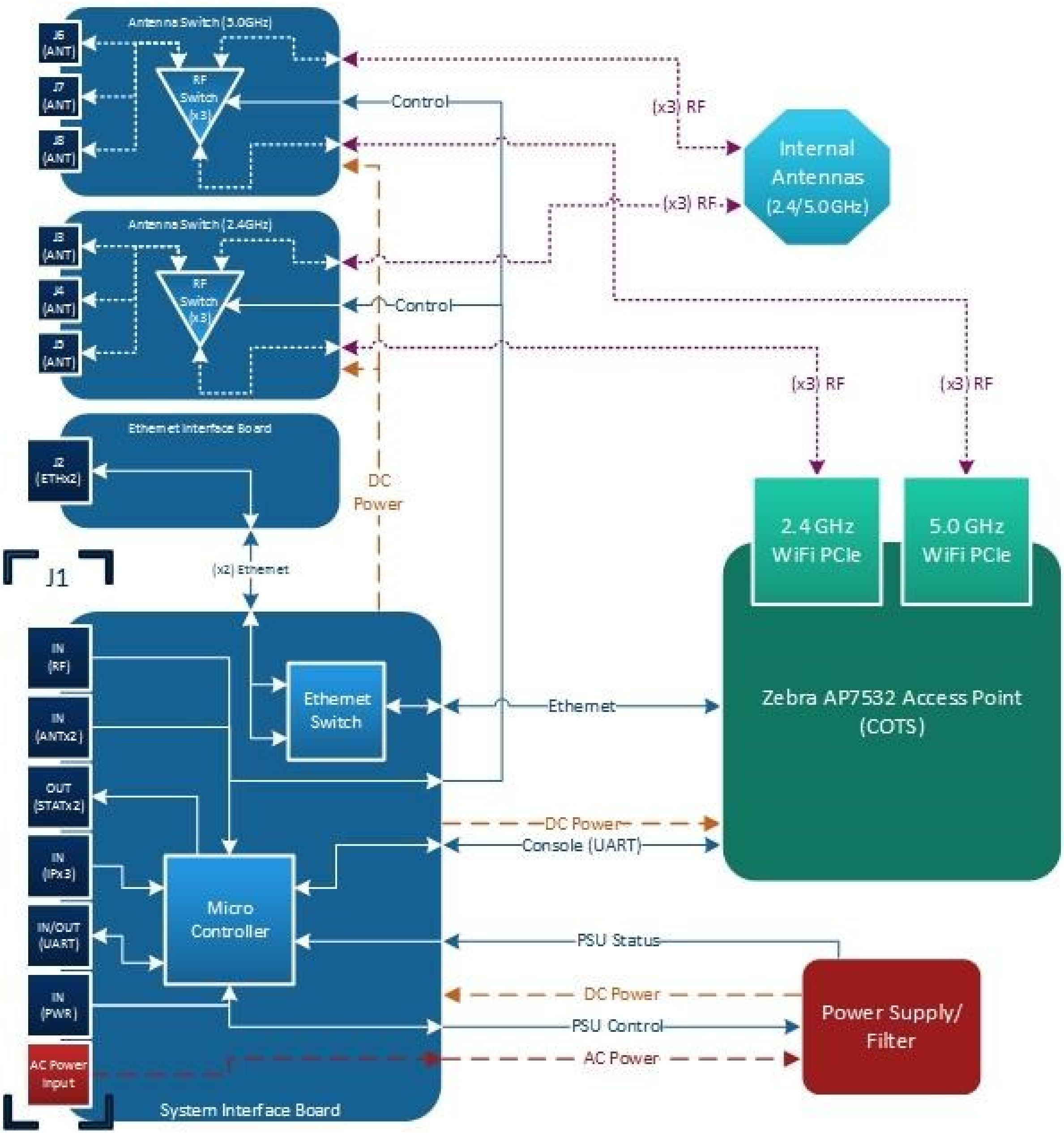
The Cab-n-Connect A100 has the following physical characteristics.

Table 4: Physical Characteristics

Feature	Description
Input Power	97-134 AC Volts, 47-800Hz 30W (0.26A) max power
Electrical Interfaces	J1: Signal/Power Interface J2: Ethernet 4-way Quadrax J3 – J8: SMA Female RF (Coaxial)
Weight	4.35 Lbs | 1.9 KG
Dimensions	10.66” (271 mm)W x 6.82” (173 mm)D x 2.34” (59.4 mm)H
Operating Temperature	-15°C to +55°C
Storage Temperature	-40°C to +85°C

2.6 FUNCTIONAL BLOCK DIAGRAM

Figure 2 Cab-n-Connect A100 System Block Diagram



3. Starting Up

The system is ready to use out-of-the-box when received directly from Kontron.

An External A100 Lab Cable Kit PN: 5007840-1 (containing 2 lab cable assemblies) can be ordered separately (see Table 5 below).

Note: For building the cable harness for aircraft installations the pin-out and mating connector information is provided in the Physical I/O section (Sec.4).

The system is conduction-cooled and requires no additional fan assist if operated in the defined environmental conditions. The unit may get warm and/or hot to the touch and should be handled with caution during use.

Under-temperature protection:
There is an internal temperature sensor that prevents damage to the A100's system components by preventing the unit from turning on below -20°C (+/-2°C).

Over-temperature protection:
The DC outputs of the A100 internal power supply will be disabled if an internal temperature of +100°C (+/-7°C) is detected. The A100 will return to normal operation once the temperature condition drops within the acceptable range.

3.1 EQUIPMENT

For the lab, Part number **73001011-001** (**Lab Unit – Non-PMA – Not for Flight**) should be used with the External cable kit part number 5007840-1.

Note: This same cable kit may be used with a standard 73001011-101 type PMA unit (in a lab environment) as well.

Table 5: Orderable Part Numbers

Part Number	Description
73001011-001	Cab-n-Connect, A100, LAB UNIT (Not for Flight)
73001011-101	Cab-n-Connect, A100, PMA
5007840-1	KIT, EXTERNAL A100 CABLES (1 ea cable assemblies 5007808-1 + 5006862-1)

3.2 BASIC "QUICK-START" A100 SETUP SUMMARY/OVERVIEW

The outline below shows the Basic Quick-Start, high-level overview of a basic-***StaticIP***-setup mainly geared at first-time users of a A100 while only needing the following items:

a) A100 unit
b) A100 External Cabling Kit (5007840-1)
c) Laptop/PC (Host) – Note: Our example assumes a Linux laptop is used
d) AC Power Source (115VAC 60Hz-400Hz) **WARNING: NEVER CONNECT A100 to 220VAC !**

The 4 ways that the A100 can set an IP Address are the following:

a) Via **DHCP** (from a DHCP Server) – This is the typical method to use.
b) Using the "**ZERO CONFIG**" method of deriving the IP from A100 MAC Address
c) Via the **IP-Strapping** method (via J1 connector)
d) Entering the A100 Serial Console and programming a **Static IP** Address

As we did not want to assume or require the user to have a pre-configured **DHCP Server** to connect to (and to avoid deriving the IP Address via a **ZERO CONFIG** method or via the **IP-Strapping** method) we've chosen the most straightforward "**Static IP**" method (Method 'd' directly above) for the purposes of quickly enabling this standalone setup.

Basic Quick-Start Outline of setting a Static IP Address and connecting via Web Browser

1. Connect hardware and cabling
    a. Setup Serial Console Connection on Laptop/PC (Sec 3.3) (Baud: 115200 8,N,1)
    b. Refer to the connection-diagram in (Sec 3.4) for all cabling connections

2. Apply AC Power to A100
    a. Verify A100 top-cover LED's (Amber and Green) illuminate
    b. Verify A100 Serial output to host's console on Laptop/PC
    c. It takes the A100 (WiNG) about 2 minutes and 20 seconds to boot WiNG

3. Enter Maintenance-mode (via A100 Console Serial)
    a. Enter Maintenance-mode "+h"
    b. Manually set a Static IP Address on the A100 (Ex. 10.1.1.10/24)
       (See "NOTICE" in Sec 3.5.1 to Manually set Static IP of A100)
    c. Exit from Maintenance-mode "+h"

4. Setup the Laptop/PC Ethernet Network
    a. Change your host's local IP Address to be on same subnet (Ex. 10.1.1.1)
       as the A100

5. Connect to Access Point GUI (WiNG) (per Sec 3.5.1)
    a. Enter the new static A100 IP Address into Web Browser URL address bar
    b. Note that you may need to accept a Network Security Exception to connect

6. Log into Access Point via GUI (WiNG) (per Sec 3.5.1)
    a. Change A100 (WiNG) password from default (Default password: admin123)
    b. Enter WiNG Configuration Menu
        i. Enter a AP Name
        ii. Enter a Country Code

7. Refer to latest WiNG Access Point System Reference Guide for further information.

The remainder of this Section 3 goes into the additional detail and operational notes related to powering-on, booting-up and the other settings/options of the A100.

3.3 CONNECTING AND USING THE CONSOLE PORT

Ensure that the P2 connector (DB9 Female) of 5007808-1 cable assembly is installed correctly and secured to the serial port on a PC/Laptop.

Reminder: For the A100 console to accept and pass along user serial-input, you must be in **Maintenance-mode**:

To enter Maintenance-mode, type "**+h**"
To exit Maintenance-mode, type "**+h**"

Open a terminal application and set the console port settings per following table:

Table 6: Console Port Settings

Name	Description
Port	COMx (COM port dependent on user connection)
Baud Rate	115200
Data	8 bit
Parity	None
Stop	1 bit
Flow	None

3.4 SETUP HARDWARE AND CONNECT CABLING

The power source should be switched **OFF** via a 2-pole AC circuit protection device to make sure NO VOLTAGE is present at the terminals BEFORE connecting to the J1 connector.

NOTICE

The specified voltage input range is from
97 to 134 VAC, 47 - 800 Hz, single-phase power.

DO NOT connect to 220 VAC

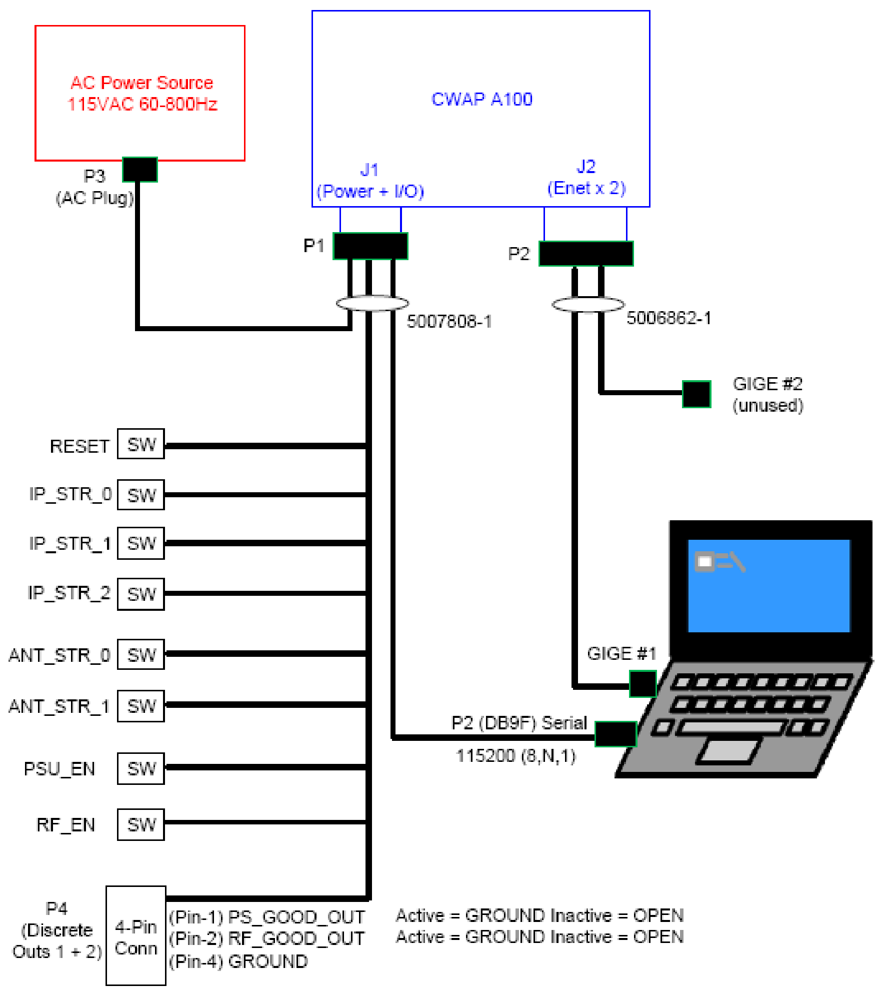
The power source must supply a minimum of 30 W.

The power source must be switched off with a 2-pole AC circuit protection device that must be easily accessible.

Ambient temperature must be above -20°C for the A100 to turn on.

The connection diagram below shows how to connect a A100 to a Laptop/PC in a lab environment by utilizing the 2 cables contained in the External Cable Kit (5007840-1)

Figure 3 Basic "Quick-Start" Standalone A100 Connection Diagram



The 5007808-1 (J1) lab cable assembly has 2x discrete Inputs, 4x ip-strapping input bits and 2x antenna-strapping input bits broken out to 8x convenient toggle-switches for the user to utilize in a lab environment to verify A100 functionality options.
It also has a 4 pin female connector for measuring the 2x A100 discrete Outputs.
Additionally, this cable has a standard 3-prong AC Plug (for connection to a standard AC wall outlet) and a standard DB9 Female for the RS-232 Console Serial connection.

Note: If you were a previous/existing user of the original units (PN: 73001000-XXX), those came with the 5006863-1 type external J1 lab console-serial/ac-power cable.
The 5006863-1 cable has NO switches but instead simply "loops-back" (i.e. bypasses) the two discrete Inputs (PSU_EN and RF_EN) in order for the Cab-n-Connect *(or* Cab-n-Connect *A100) to turn on immediately when AC power is applied (i.e. without user switch-inputs required).*
Therefore, the 5006863-1 cable can be used on J1 of the new Cab-n-Connect *A100, but is limited to only providing the connections to AC Power and Serial Console.*

From this point, this guide will assume you are using a 5007808-1 type J1 cable assembly as it is more appropriate and functional when lab testing the Cab-n-Connect A100.

NOTICE

The specified voltage input range is from
97 to 134 VAC, 47 - 800 Hz, single-phase power.

DO NOT connect to 220 VAC

The power source must supply a minimum of 30 W.
The power source must be switched off with a 2-pole AC circuit protection device that must be easily accessible.
Ambient temperature must be above -20°C for the A100 to turn on.

Properly install the P1 circular cable assembly connector of 5007808-1 cable assembly to the J1 connector of the Cab-n-Connect A100.
See diagram in Section 3.4

IMPORTANT: For this exercise, make sure ALL 8 of the toggle switches of 5007808-1 cable assembly are set to OFF prior to applying AC power.
See diagram in Section 3.4

Connect the AC Power Plug end of the 5007808-1 to the **unpowered** / **circuit-protected** AC power source (Note: AC power source not provided).
See diagram in Section 3.4

Notice: Do NOT PLUG into a 220VAC OUTLET as DAMAGE to A100 will occur.

Note: Prior to applying AC Power, if not already established, please setup a console-serial-connection per Section 3.3 parameters, ***first.***

Power Up Sequence – Verify Serial Output to Console

1. Switch **ON** the **AC power source** via the external 2-pole AC circuit protection device.
   Note: At this point, NOTHING visual occurs because the **PSU_EN Switch** is **OFF**.
2. On 5007808-1 cable assembly, now turn **PSU_EN Switch** to **ON**
   Note: This PSU_EN input enables the A100's internal Power Supply DC outputs as long as the environment is greater than -20'C ambient temperature.

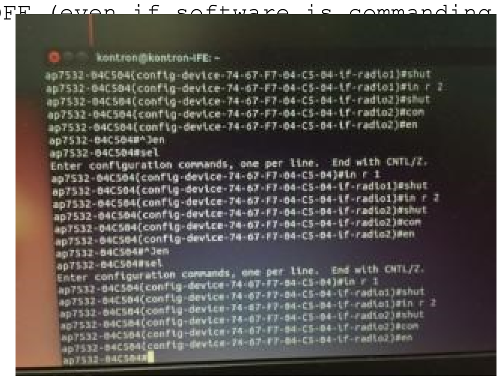
Within 1 second, powering-on (turning PSU_EN ON) should cause the following to occur:

a) BOTH (Amber and Green) LED's on A100 top-cover illuminate **ON** (SOLID)

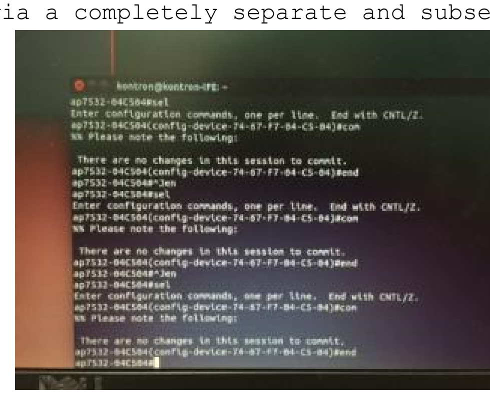
b) Console Serial output from A100 will be displayed in your console window

i) By default, the A100 Serial connection is in **'Normal-mode'** where it's IGNORING all console serial inputs (from you, the user) but is displaying/showing all serial activity (commands) between the internal micro-controller and the (WAP) Access Point's console port.

ii) As the **RF_EN Switch** is still **OFF** (5007808-1 cable assembly), the internal micro-controller will continually repeat sending serial commands to the Access Point (approx. every 10 seconds) which are continually commanding both Radios to turn "OFF". You should start seeing these Radio OFF messages (photo below) about 2:20 minutes after power-on. (Note: This mode is provided as a feature for the A100 user so that this **RF_EN Input** can provide an overriding "hardware" input to command both Radio's OFF (even if software is commanding the Radios to turn ON).



iii) Now, turn the **RF_EN Switch** to **ON** (5007808-1 cable assembly). The internal micro-controller will still continually repeat sending serial commands (approx. every 10 seconds), but now both Radios are <u>not</u> being commanded OFF (therefore both Radios now have the <u>*ability*</u> to be commanded ON via a completely separate and subsequent software event(s)).



Entering and Existing the A100 Console-Serial "Maintenance-mode" (CLI)

1. Now connected successfully to the Console-Serial port, remember that the A100 default-serial-state is in '**Normal-mode**' where it's IGNORING all console-serial inputs (from you, the user, via J1) but is displaying/showing all serial activity (commands) between the internal micro-controller and the internal (WAP) Access Point's console port.

2. In order for the A100's **micro-controller** to accept and pass along console-serial inputs (i.e. to gain access to the CLI of the Access Point) the user must enter "**Maintenance-mode**" which is quite simple and uses the same command "**+h**" for both entering and exiting the A100 Maintenance-mode:
   To enter Maintenance-mode, type "**+h**"
   To exit Maintenance-mode, type "**+h**"
   Note: You can tell you are in Maintenance-mode by hitting the ***ENTER*** key a a couple times in order to verify a prompt is returned each time.
   Note: While in "**Maintenance-mode**" the micro-controller does <u>not</u> issue commands to the Wireless Access Point's serial-console.

3. While in the Maintenance-mode, simply type "**?**" for a list of available commands. See latest WiNG CLI Reference Guide for further information on the use of the CLI commands.

4. While in "**Maintenance-mode**", you can set the A100 **Static IP** address by accessing the CLI and performing the steps per the following ***NOTICE***:

NOTICE

Manually set Static IP Address of A100

If you are not using a DHCPD server and need to set a static IP address, the procedure is as follows (Note: The ip/mask can be modified as desired).

Access the CLI via the serial port and perform the following commands:

1. "enable"
2. "self"
3. "interface vlan1"
4. "ip address **10.1.1.10/24**"
5. "commit"

This will set VLAN1 to a static address.
If you wish this change to persist over the <u>next</u> reboot of the A100, perform this last step:

6. "write memory"

3.5 WING 5.8 GUI

The Cab-n-Connect A100 uses a Graphical User Interface (GUI) that can be accessed via a Web Browser on a client connected to the subnet that system is configured on.

Note: By default, the Cab-n-Connect A100 will want to request its IP Address from a DHCP server and this is how a typical user configures the Cab-n-Connect A100(s) for use on aircraft.
See Section 6.5 for more information regarding DHCP.

In the default configuration, GigE1 (GE1) connection is assigned to the native VLAN1

VLAN1 will obtain an address via **dhcpd**.

You can obtain this address via your dhcpd-server, or display it via the CLI
(via the serial port connection) with the command “show interface”.

Once you have obtained the IP address, you can enter that into your
Web Browser URL Address bar to access the WiNG GUI.

3.5.1 Basic Configuration via the Web Browser interface

Once the system is powered on, complete the following steps to get the Cab-n-Connect A100 up and running in order to access management functions:

1. By default, the A100 will want to request its IP Address from a DHCP server, but if DHCP resources are unavailable a "Zero Config" IP address can be derived. Using Zero Config, the **last two** octets in the IP address are the decimal equivalent of the **last two** bytes (octets) in the A100's hardcoded MAC address.

For example:

- MAC address - 00:C0:23:00:**F0:0A** (MAC is factory-programmed)
- Zero-config IP address - 169.254.**240.10** (IP derived from MAC address)

To derive the A100's IP address using its hardcoded MAC address:

a. Open a Windows calculator by selecting **Start > All Programs > Accessories > Calculator.** This menu path may vary slightly depending on your version of Windows.

b. With the Calculator displayed, select **View > Scientific** or **Programmer** depending on your version of Windows. Select the **Hex** radio button.

c. Enter a hex byte of the Access Point's MAC address. For example, "**F0**".

d. Select the **Dec** radio button. The calculator converts "**F0**" into decimal "**240**".

e. Repeat this process for the last Access Point MAC address octet "**0A**" which will convert into decimal "**10**".

This is how we end up with IP Address 169.254.**240.10** as converted from the unique MAC Address of the Access Point

As mentioned previously, another option is to set a **Static IP** Address via the CLI.

NOTICE **Manually set Static IP Address of A100**

If you are not using a DHCPD server and need to set a static IP address, the procedure is as follows (Note: The ip/mask can be modified as desired).

Access the CLI via the serial port and perform the following commands:

1. "enable"
2. "self"
3. "interface vlan1"
4. "ip address **10.1.1.10/24**"
5. "commit"

This will set VLAN1 to a static address.
If you wish this change to persist over the next reboot of the A100, perform this last step:

6. "write memory"

---

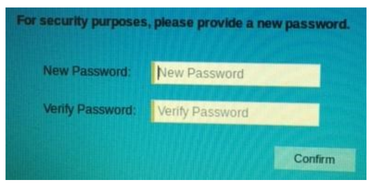
2. Now that you've programmed or determined what the A100's IP Address is, you may now enter that IP Address into your host's Web Browser URL address bar. Depending on the web browser, you may need to enter HTTPS:// before the IP address (example: HTTPS:// 169.254.240.10).

The following (A100) Access Point Login (WiNG) screen displays:

Enter the default username "admin" in the ***Username*** field.

Enter the default password "admin123" in the ***Password*** field.

Note: If this is the first time the interface has been accessed, a screen displays prompting for the user to provide a new Password + Verify it (Confirm):



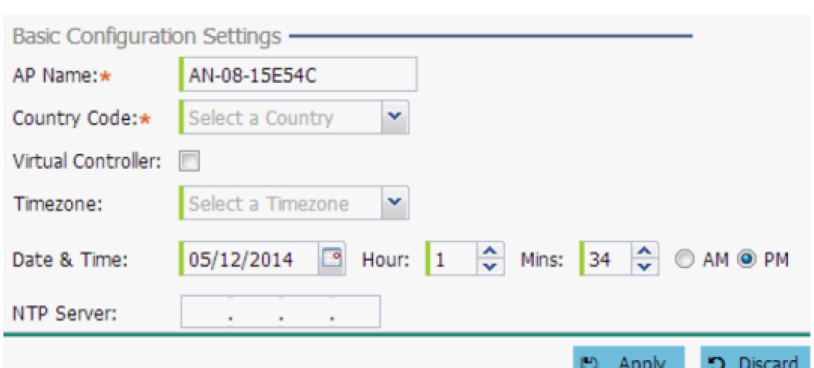
3. Select the Login ***Login*** button to load the management interface.

4. Select the Country Code specific to this A100's location.

Selecting the country code is required for legal operation. Each country has its own regulatory restrictions concerning electromagnetic emissions and the maximum RF signal strength that can be transmitted. By law, commercial access points have specific SKU's that allow only certain countries to be available for selection (for example, separate SKUs are used for US, EU, APAC, etc). The Kontron A100 has been FCC approved to be used on aircraft allowing operation in all countries under one part number SKU. In order to legally operate in different countries, the A100 supports global country code configuration changes based on input of the geographical location of the aircraft.

NOTE: At some point in the A100's initial setup, the default password should be changed to enhance the security of the Access Point managed network. Refer to the ***Configuration > Management*** screen to change the default password to a more secure password.

5. Expand the ***Configuration*** menu item and select ***Basic***.



6. Set the following Basic Configuration Settings for this Access Point:

- **AP Name** - Provide an AP Name used as this Access Point's network identifier. If setting this Access Point as a Virtual Controller, each Access Point managed by this Virtual Controller lists this Access Point's AP Name as its own.
  The AP Name is a required parameter.

- **Country Code** - If the Country Code was not set when the Access Point was initially powered on, set the Country Code now to ensure the Access Point's legal operation.

> ***NOTE:*** The Access Point's wireless capabilities are disabled until the required country code is set.

- **Virtual Controller** -Select this option to define this Access Point as a Virtual Controller capable of managing and provisioning up to 24 Access Points of the same type. If selecting this Access Point as a Virtual Controller, those Access Points managed by this Virtual Controller will list this Access Point's AP Name as its own. Only one Virtual Controller can be designated.

- **Timezone** - Use the drop-down menu to specify the geographic time zone where the Access Point is deployed. Different geographic time zones have daylight savings time adjustments, so specifying the time zone correctly is important to account for geographic time changes.

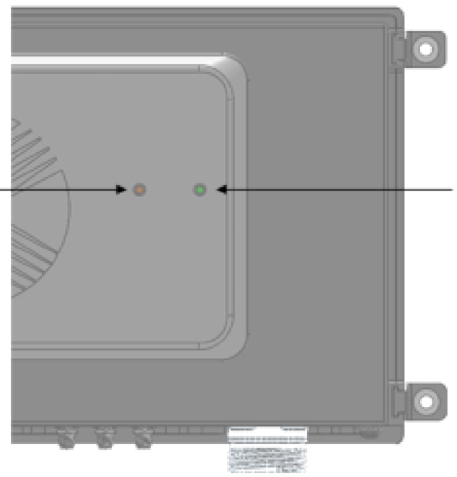
- **Date & Time** - Set the date, hour and minute for the Access Point's current system time. Specify whether the current time is in the AM or PM.

- **NTP Server** - Optionally provide the IP address of a NTP server resource. Network Time Protocol (NTP)manages time and/or network clock synchronization within the Access Point managed network. NTP is a client/server implementation. Access Points (NTP clients) periodically synchronize their clock with a master clock (an NTP server). For example, an Access Point resets its clock to 07:04:59 upon reading a time of 07:04:59 from its designated NTP server.

7. Select ***Apply*** to implement the updates.

3.6 ACCESS POINT LED INDICATORS (ON TOP-COVER)

The Access Point LED activity indicators are located on the top of the housing and are visible when viewing the top of the A100 enclosure. These Cab-n-Connect A100 top-cover LED's activities are not synchronized with either of the A100's Discrete Outputs.



The Access Point LEDs provide a status display indicating error conditions, transmission, and network activity for the 5 GHz 802.11ac (AMBER) and the 2.4 GHz 802.11n (GREEN) radios.

Table 7: Access Point LED Description

Task	5 GHz Activity LED (AMBER)	2.4 GHz Activity LED (GREEN)
Unconfigured Radio	**ON**	**ON**
Normal Operation	If this radio band is enabled: **Blink at 2 second interval** If this radio band is disabled: **OFF** If there is activity on this band: **Rapid Blinking**	If this radio band is enabled: **Blink at 2 second interval** If this radio band is disabled: **OFF** If there is activity on this band: **Rapid Blinking**
Firmware Update	**ON**	**ON**
Locate AP Mode	LEDs blink in an alternating green, red and amber pattern using an irregular blink rate.	LEDs blink in an alternating green, red and amber pattern using an irregular blink rate.

NOTE: The function of the LED activity is controlled by the WING version of the firmware and is subject to change based on the WING version used.

4. Physical I/O

The following sections provide information on the external Physical I/O for the Cab-n-Connect A100 system. During troubleshooting, problems with cable assemblies should be checked as a potential cause before proceeding to other troubleshooting steps. If it is determined that a cable assembly or other interconnection wire is found to be at fault, then the offending harness assembly must be replaced for normal operation to be expected to occur.

Table 8: I/O Definition

Ref	A100 Connector Type	Signal Type	Part Number	Manuf.	Mating Connector
J1	Signal & Power Interface	AC Input Power and Aircraft Interfaces	MS3112E14-18P	MIL-DTL-26482	MS3116E14-18S
J2	4-way Quadrax	Ethernet (GbE x2)	CA140266-62	ITT CANNON	CA140266-57
J3 – J8	SMA Female	RF (coaxial)	Multiple AVL	Multiple AVL	Multiple AVL

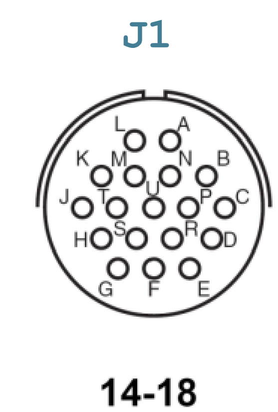
4.1 A100 CONNECTOR J1

This connector includes the power input, aircraft discretes and maintenance interface, designated as J1.

The following table illustrates the pin-outs for this J1 connector (MS3112E14-18P), with pin definitions.

Table 9: J1 Connector Pin Definitions

Ref	Signal	Description
A	ANT_STRAP_1	ANTENNA SELECTION (2.4 GHz)
B	GND	GROUND
C	DIS_IN_2	PSU_EN (INPUT)
D	DIS_OUT_2	RF STATUS OUT (OUTPUT)
E	DIS_OUT_1	PSU STATUS OUT (OUTPUT)
F	DIS_IN_1	RF_EN (INPUT)
G	GND	GROUND
H	RX	RS232 RECEIVE DATA
J	TX	RS232 TRANMIT DATA
K	GND	GROUND
L	RESET	SYSTEM RESET
M	115VAC LINE	115VAC LINE
N	115VAC NEUTRAL	115VAC NEUTRAL
P	IP_STRAP_0	IP_ADDRESS_STRAP (BIT 0)
R	IP_STRAP_1	IP_ADDRESS_STRAP (BIT 1)
S	IP_STRAP_2	IP_ADDRESS_STRAP (BIT 2)
T	ANT_STRAP_0	ANTENNA SELECTION (5 GHz)
U	GND	GROUND



4.1.1 Antenna Strapping (selecting External Antenna options)

The A100 has an internal RF-switch that allows the RF path of the radios to be routed either to the internal antennas or optionally to the A100's (6) front-panel SMA Female connectors for routing the RF out to remote/external antennas.

As mentioned, the **default** setting of the A100 is for **internal** antenna operation for both the 2.4GHz and 5GHz radios.

The system can be configured for defining the antenna configuration of the A100 by strapping the J1 mating connector's **ANT_STRAP_1** and **ANT_STRAP_0** signals to a GROUND in order to apply a "1", as applicable. By default, both ANT_STRAPS are OPEN to GROUND (0).

The following table provides the corresponding strapping configuration.

Table 10: Antenna Strapping Table

ANT_STRAP_1 (J1-A) for 2.4Ghz	ANT_STRAP_0 (J1-T) for 5Ghz	2.4GHz Radio	5GHz Radio
*0	*0	*Internal	*Internal
0	1	Internal	**External**
1	0	**External**	Internal
1	1	**External**	**External**

*Default configuration
Strap signal is connected to GROUND = 1
Strap signal is open/un-connected to GROUND = 0
The GROUND state is equivalent to A100 GROUND Pins (J1 pins: B, G, K or U)

4.1.2 Avionics Discrete Inputs / Outputs

The A100 system provides two (2) standard GROUND/OPEN (active-low) type Discrete Inputs and two (2) standard GROUND/OPEN (active-low) type Discrete Outputs as defined in ARINC 763-3, paragraph 2.9.6.

The Avionics Discrete Input and Output signals are provided on the A100's J1 connector and defined as:

- **DIS_IN_2** (PSU Enable Input "PSU_EN") (J1-C)
- **DIS_IN_1** (RF Enable Input "RF_EN") (J1-F)
- **DIS_OUT_1** (PSU Status Output) (J1-E)
- **DIS_OUT_2** (RF Status Output) (J1-D)

Both Discrete Outputs are "LOW" (approx. 100 ohms to GROUND) when they are 'active' or "OPEN" when they are inactive (as defined in ARINC 763-3, paragraph 2.9.4).

If/when either of these outputs are being used to be connect to 1 external LED (each), a (+) Positive Voltage (and a current limiting resistor) must be supplied by the user (along with the LED itself) since the A100 outputs can only provide GROUND or OPEN.

A "LOW" is potentially equivalent to A100 GROUND Pins (J1 pins: B, G, K or U).

Each Discrete Output is capable of sinking 20mA of current (i.e. for LED operation).
See Section 11 for a graphical view of using external LED's with the new A100.

*Note: Each A100 Discrete Output contains an **internal** current-limiting resistor of 75-ohms, so this 75-ohm value must be <u>subtracted</u> from the total/overall current-limiting resistance calculated via individual LED manufacturer formulas.*

4.1.2.1 Discrete Input DIS_IN_2 (PIN C)"PSU ENABLE Input"

PSU Enable Discrete Input "PSU_EN" (DIS_IN_2)(J1-C):
The default state of DIS_IN_2 (**PSU_EN**) Discrete Input is "OPEN".
This signal is used to assert the internal Power Supply DC outputs ON and/or OFF.
When the PSU Enable (PSU_EN) Discrete Input is set "CLOSED" to GROUND (per ARINC 763-3, paragraph 2.9.4), the A100 power supply enables its DC outputs.
The GROUND state is equivalent to A100 GROUND Pins (J1 pins: B, G, K or U)
Note: Only this PSU_EN input itself needs to be asserted in order to power on the A100 (i.e. The state of the RF_EN input (DIS_IN_1) is ignored for enabling power on).

4.1.2.2 Discrete Input DIS_IN_1 (PIN F)"RF ENABLE Input"

RF Enable Discrete Input "RF_EN" (DIS_IN_1)(J1-F):
The default state of DIS_IN_1 (**RF_EN**) Discrete Input is "OPEN".
This signal is used to disable the Wireless Access Point's RF Radios (when OPEN / OFF).
An "OPEN" state acts to power OFF the RF Radios by the micro-controller issuing repetitive serial commands to the WAP console serial port.
For the RF Radios to have the *ability* to be commanded to an ON (Transmit) state, this discrete input must be set to a standard "CLOSED" to GROUND state (as defined in ARINC 763-3, paragraph 2.9.4).

The GROUND state is equivalent to A100 GROUND Pins (J1 pins: B, G, K or U)
Note: It requires a separate (software) event in order to actually command the Radios to an ON (transmitting) state; the RF_EN input only enables this "ability", but it does <u>not</u> turn either of the Radios ON by only the actuation of the RF_EN input itself.

Table 11: A100 Discrete Input / Output Logic Table == Resultant Condition

PSU_EN (PSU Enable) INPUT	RF_EN (RF Enable) INPUT	=	PSU Status OUTPUT	RF Status OUTPUT	=	Resultant A100 Condition	
						WAP POWER	2 Top Cover WAP Radio LED's
*(off)	*(off)	=	*(open)	*(open)	=	(off)	(not active)
(off)	ON	=	(open)	(open)	=	(off)	(not active)
ON	(off)	=	GROUND >Steady<	(open)	=	ON	BOTH ON / ACTIVE
ON	ON	=	GROUND >Steady<	GROUND >Steady<	=	ON	BOTH ON / ACTIVE
*** Default Discrete State (even with AC Power Applied)**							

4.1.2.3 RF Enable Modes of Operation

With the A100, there are three possible modes of operation when enabling RF on the radios.

a. **Network-only approach**

In a Network-only approach, both RF_Enable and PSU_Enable are strapped to GROUND. The A100 is loaded with a startup-configuration file that disables all radios upon startup. The radios are controlled solely via SNMP or scripted SSH cli commands. Advantages to this approach is that there are no wiring for discretes (other than strapping them). The disadvantage to this approach is that it relies on a network connection between A100 and Server to disable/enable radios.

b. **Discrete-only approach**

In a Discrete-only approach, only the RF-Enable is strapped to GROUND.
The A100 radios are controlled by changing the state of PSU_Enable input discrete.
The disadvantage to this approach is that it requires waiting for the A100 to reboot in order for the radios to be enabled.

c. **Mixed approach**

In a Mixed approach, the PSU-Enable is strapped to GROUND and the A100 radios are disabled via RF-enable input discrete.
The advantage to this approach is that disabling the A100 radios is not dependent on a working network connection. The disadvantage to this approach is that it requires a two-step process to enable radios after they've been disabled:

1) The RF-enable discrete input is toggled back to ON (connected to GROUND) and then
2) Use SNMP or scripted SSH CLI commands to turn radios back on|
(which requires a working network connection to the A100).

4.1.2.4 Discrete Output DIS_OUT_1 (PIN E)"PSU STATUS OUT"

The default (and/or unpowered) state for DIS_OUT_1 ("PSU_Status_Out") is "OPEN".

The conditions to activate the DIS_OUT_1 / PSU Status Out as a "LOW" are as follows:

- The PSU Enable ("PSU_EN")(DIS_IN_2)(J1-C) discrete input is enabled (this allows the A100 internal power supply to enable its DC outputs).
    - Appropriate AC Power is applied/connected to the correct J1 pins
    - The PSU is <u>not</u> indicating a fault
    - The ambient environment must be above -20'C (+/- 2'C)

4.1.2.5 Discrete Output DIS_OUT_2 (PIN D)"RF STATUS OUT"

The default (and/or unpowered) state for DIS_OUT_2 ("RF Status Out") is "OPEN".

The conditions to activate the DIS_OUT_2 / RF Status Out as a "LOW" are as follows:

- The PSU Enable ("PSU_EN")(DIS_IN_2)(J1-C) discrete input is enabled (this allows the A100 internal power supply to enable its DC outputs).
    - Appropriate AC Power is applied/connected to the correct J1 pins
    - The PSU is <u>not</u> indicating a fault
    - The ambient environment must be above -20'C (+/- 2'C)
- The RF Enable ("RF_EN")(DIS_IN_1)(J1-F) discrete input is enabled (which also enables the *ability* for both or either radios to be turned ON via a separate software command).

4.1.3 System Reset

A system-reset signal (Pin L) is available on the J1 connector and is designed to simply "reset" (reboot) the A100 when toggled (connected) to GROUND. It is necessary to hold this pin to GROUND until the DIS_OUT_1 (PSU Status Output) goes high to initiate the reset.
This reset will still maintain the last valid configuration/user-password.

To fully-reset the unit to a factory-default state, this is performed (via software) in the CLI. See Section 6 for further information on resetting to factory-default.

4.1.4 Aircraft Power Input

The system supports 97 to 134 VAC, 47 - 800 Hz, single-phase power via 115VAC LINE (**Pin M**) and 115VAC NEUTRAL (**Pin N**) on the A100 J1 connector.

Note: Grounding point "E1" is provided on the A100 chassis body that should be used to strap the unit to the aircraft-frame at each A100 aircraft installation point.

NOTICE

The specified voltage input range is from
97 to 134 VAC, 47 - 800 Hz, single-phase power.

DO NOT connect to 220 VAC

The power source must supply a minimum of 30 W.
The power source must be switched off with a 2-pole AC circuit protection device that must be easily accessible.
Ambient temperature must be above -20°C for the A100 to turn on.

4.1.5 IP Strapping

The IP Address for the system is determined on boot-up from the IP address bits that are connected in the external cable assembly that is connecting to A100 J1. This feature allows the position of each A100 in the aircraft to be identified deterministically by a pre-determined IP Address (see table below).

The system can be configured for defining the IP address of the system by strapping the applicable “IP_STRAP” type signals to GROUND within the J1 mating connector. The following table provides the IP address of the corresponding strapping configuration.
Up to (7) seven fixed IP addresses are possible with this feature.

The IP Strapping feature is one that is typically used when connecting multiple A100’s in a Daisy-Chain network configuration.
Refer to Section 4.3 for information on Daisy-Chain network configuration.

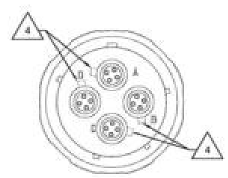
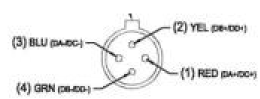
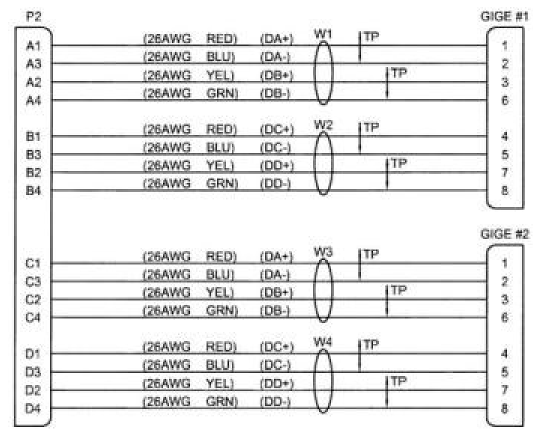
Table 12: IP Strapping Table

IP_STRAP_2 (J1-S)	**IP_STRAP_1 (J1-R)**	**IP_STRAP_0 (J1-P)**	**Resultant IP address**
*0	*0	*0	No IP set
0	0	1	192.168.0.1/24
0	1	0	192.168.0.2/24
0	1	1	192.168.0.3/24
1	0	0	192.168.0.4/24
1	0	1	192.168.0.5/24
1	1	0	192.168.0.6/24
1	1	1	192.168.0.7/24
***Default configuration** **Strap signal is connected to GROUND = 1** **Strap signal is open/un-connected = 0**			

4.2 A100 CONNECTOR J2

The 2 GbE (Gigabit Ethernet) ports are connected via the A100's J2 connector.
The following table illustrates the pin-outs for this Quadrax connector (PN CA140266-62), with pin definitions.

Table 13: J2 Connector Definition

PIN	SIGNAL	PIN	SIGNAL	PINOUT	DIAGRAM
A-1	ENET1_DA+	**C-1**	ENET2_DA+	 	
A-2	ENET1_DB+	**C-2**	ENET2_DB+		
A-3	ENET1_DA-	**C-3**	ENET2_DA-		
A-4	ENET1_DB-	**C-4**	ENET2_DB-		
B-1	ENET1_DC+	**D-1**	ENET2_DC+		
B-2	ENET1_DD+	**D-2**	ENET2_DD+		
B-3	ENET1_DC-	**D-3**	ENET2_DC-		
B-4	ENET1_DD-	**D-4**	ENET2_DD-		

4.3 DAISY-CHAIN

The system supports an Ethernet daisy-chain configuration. If the network is connected in this manner and an adjacent A100 fails in the chain, the data from the adjacent A100 will still remain connected (i.e. passing-through the failed A100) to the Content Server along the Gigabit Ethernet cable through the failed A100's internal 2 port Ethernet Switch. The configuration can support up to two (2) adjacent A100 failures.

The diagram below provides an example of a failure in a four (4) A100 installation where a Loss of AC Input power has occurred to the middle two A100's (#2 and #3), but shows that WiFi and Gig-E Enet communications are non-interrupted from the two remaining active A100's (#1 and #4) to the Content Server.
Note: Normally Daisy-Chain configurations will use the IP-Strapping feature
See Section 4.1.5 for IP-Strapping information

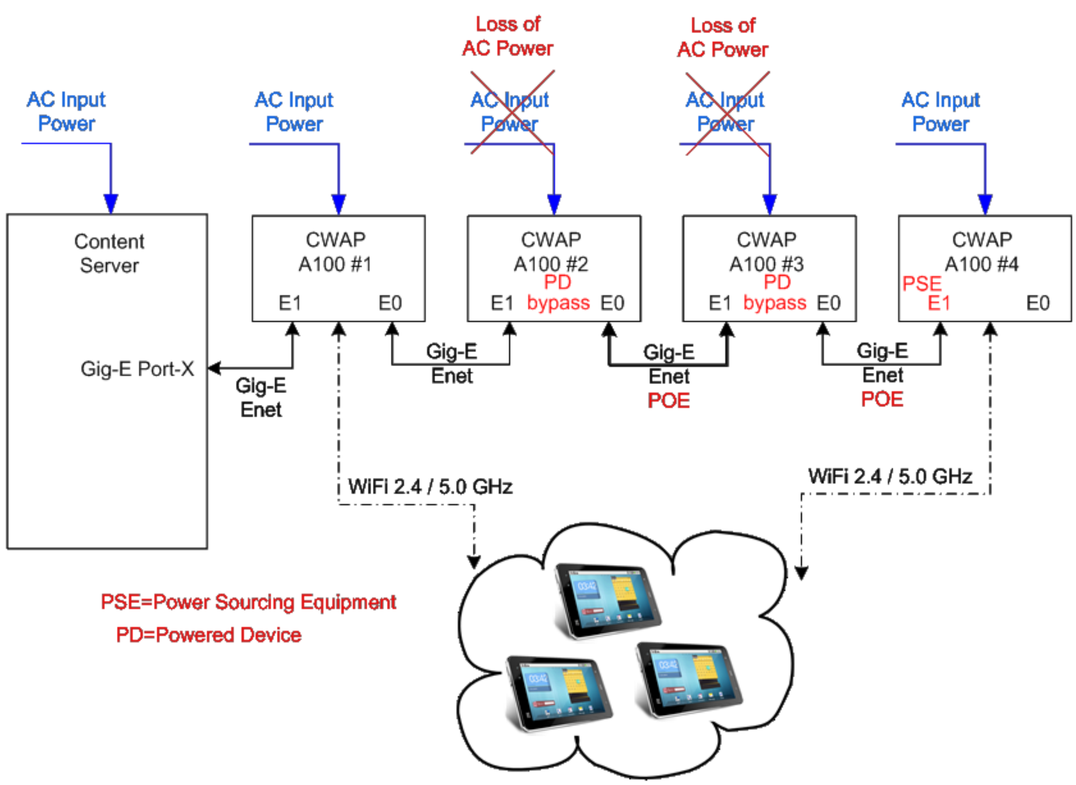
In this example of an AC Input failure:

a) A100 #4 (PSE) powers the internal A100 2-port Ethernet Switch of both A100 #3(PD) and A100 #2(PD) via its Power-Over-Ethernet (POE) capability.

b) The WiFi connectivity/coverage from A100 #1 and #4 remain active/operational.

c) The WiFi connectivity/coverage from A100 #2 and #3 are disabled/non-operational.

d) The internal Wireless Access Points of A100 #2 and #3 are un-powered/OFF.



4.4 INTERNAL ANTENNAS

The A100 system supports fixed internal antennas for both radios.

4.4.1 Internal Antenna Gain & Pattern Tests

Power level and the antenna determine where and how powerful the Radio Frequency signal is in any given place in the environment. An antenna gives the wireless system three fundamental properties:

- Gain

  A measure of increase in power introduced by the antenna, over a theoretical antenna that transmits the RF energy equally in all directions.

- Direction

  The shape of the antenna transmission pattern. Different antenna types have different radiation patterns that provide various amounts of gain in different directions.

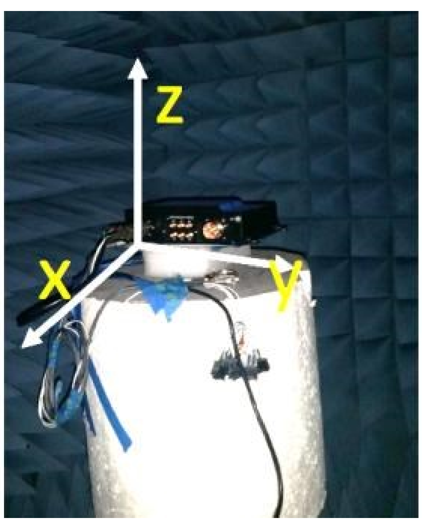
- Polarization

  Indicates the direction of the electric field. An RF signal has both an electric and magnetic field. If the electric field is orientated vertically, the wave is said to be vertically polarized.

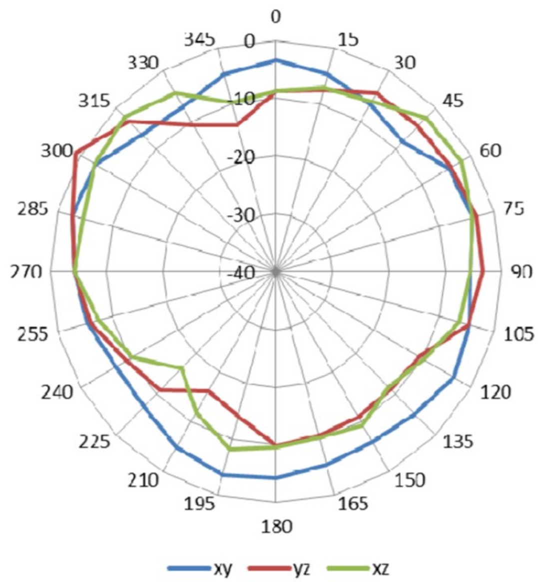
A good analogy for an antenna is the reflector in a flashlight. The reflector concentrates and intensifies the light beam in a particular direction similar to what a parabolic dish antenna does to an RF source in a radio system.

Gain and direction mandate range, speed, and reliability; polarization affects reliability and isolation of noise.

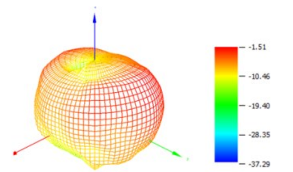
The following diagram shows the orientation during the radiation testing.



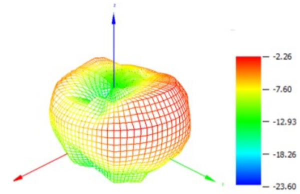
4.4.2 Radiation Pattern of 2.4GHz



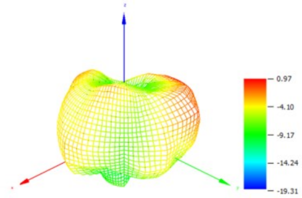
2D Radiation Pattern



Antenna 1 (Blue) 3D Radiation Pattern

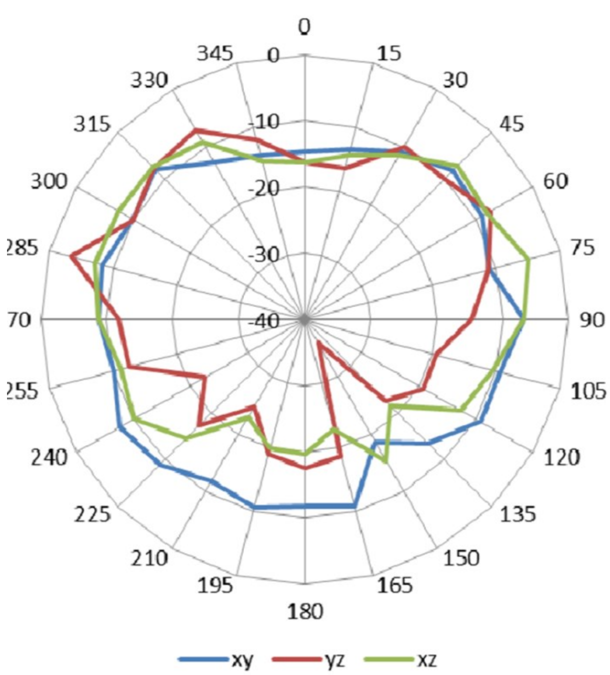


Antenna 2 (Red) 3D Radiation Pattern

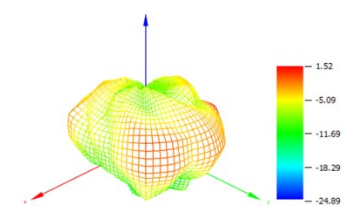


Antenna 3 (Yellow) 3D Radiation Pattern

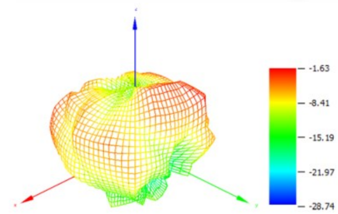
4.4.3 Radiation Pattern of 5GHz



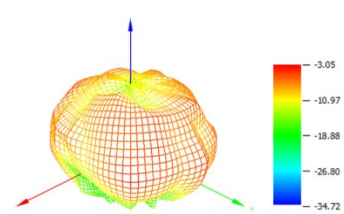
2D Radiation Pattern



Antenna 4 (Black) 3D Radiation Pattern



Antenna 5 (Green) 3D Radiation Pattern



Antenna 6 (White) 3D Radiation Pattern

4.5 REMOTE ANTENNA

The system provides six (6) RF, SMA Female type coax connectors for connection to 2.4GHz and 5GHz compatible antennas. Input impedance of the SMA connectors is 50Ω.

The Radio to Antenna configuration is as follows:

Table 14: Radio to SMA Connection

Radio	Frequency	Antennas
Radio 1	**2.4 GHz**	J3, J4, J5
Radio 2	**5.0 GHz**	J6, J7, J8

Table 15: SMA Characteristics

Electrical Properties	Description
Frequency Range	2.4GHz -2.5GHz; 4.9GHz – 5.825GHz
Impedance	50Ω Nominal
Cable loss	0.18dB Max @ 2.4GHz – 2.5GHz 0.32dB Max @ 4.9GHz – 5.825GHz
Polarization	Linear, Vertical
Cable	RG-178 Coaxial Cable
Connector	SMA, Female, straight plug

4.6 RADIOS

The system's radios have the following capabilities.

- Dual band radios; supports 256-QAM
- 3X3 MIMO with 3 Spatial Streams
- 20, 40 and 80 MHz Channels
- 1.9 Gbps data rates on dual concurrent radio operations
- Packet Aggregation (AMSDU, AMPDU)
- Reduced Interface Spacing
- MIMO Power Save (Static and Dynamic)
- Advanced forward error correction coding: STBC, LDPC
- 802.11ac transmit beamforming
- Maximal Ratio Combining (MRC)

The A100 has the following radio characteristics:

Table 16: Radio Characteristics

Feature	Description
Operating Channels	2.4 GHz band: Channel 1 - 13 5.2GHz band: Channel 36 - 165 *Operating frequencies depend on country regulatory compliance
Data Rates Supported	802.11b/g: 1,2,5.5,11,6,9,12,18,24,36,48 and 54Mbps 802.11a: 6,9,12,18,24,36,48, and 54Mbps 802.11n: MCS 0-23 up to 450 Mbps 802.11ac: MCS 0-9 up to 1.3 Gbps
Wireless Medium	Direct Sequence Spread Spectrum (DSSS), Orthogonal Frequency Division Multiplexing (OFDM) Spatial multiplexing (MIMO)
Network Standards	IEEE 802.11a/b/g/n/ac, 802.11d and 802.11i WPA2, WMM and WMM-UAPSD, L2TPv3, Client VPN, MESH, Captive Portal Server
Networking Specifications	Layer 2 and Layer 3 Layer 3 routing, 802.1q, DynDNS, DHCP server/ client, BOOTP client, PPPoE and LLDP
Maximum Available Transmit Power	Maximum available conducted transmit power all chains: 2.4GHz: + 20dBm 5.2GHz: + 20dBm
Transmit Power Adjustment	1dB increments

4.7 EXTERNAL CABLE KIT

Kontron has available an external interface cable kit for lab units. The orderable item is **KIT-PN: 5007840-1** and consists of two cable assemblies, **5007808-1** and **5006862-1**. Details of the individual cables included in the external cable kit are listed below.

Table 17: A100 External Cable Kit / Cables Definition

Cable PN	Qty	Description	Length	External Connector
5007840-1	**Kit, External A100 Cables** contains:			
5007808-1	1	Cable Assy, External, **P1** AC PWR / SIGNAL (for connection to A100 **J1**)	6ft (3.67m)	***MS3116J14-18S** (solder)
5006862-1	1	Cable Assy, External, **P2** GIG-E, 2-PORTS (for connection to A100 **J2**)	6ft (3.67m)	**CA140266-57** Qty.1 **244-0011-000** Qty.4 (Mfr: ITT Cannon)

* MS3126F14-18S (crimp-style) may also be used

5. System Diagnostic and Self-Test

The system supports system diagnostic software, which test the full functionality of the unit as well as application software responsible for statistical reporting and analysis.

5.1 POWER-ON SELF-TEST

Upon power up, the A100 performs a Power-On self-test to verify system operation before becoming operational. Detected errors result in a non-operational condition.
During the Power-On self-test, the following are verified and checked:

- Boot image
- Data bus
- Address bus
- DDR device test
- Clear RAM
- Copy RAM

5.2 OBTAINING STATUS INFORMATION

Additionally, there are three other ways to obtain BIT and status information:

- Command Line Interface (CLI) over RS232 console or Ethernet
- Graphical User Interface (GUI) over Ethernet
- SNMP calls over Ethernet

5.3 OTHER PARAMETERS MONITORED

The onboard micro-controller also continuously monitors the following parameters which can be accessible over the console-serial interface:

- PSU GOOD
- PSU Over Temperature
- RF Status – Radio 1 & 2
- Antenna Select – Antenna 1 & 2
- IP Strapping 1, 2 & 3

6. Firmware

6.1 WING 5.8

The enterprise grade WiNG 5.8 Operating System offers a distributed architecture that extends QoS, security and mobility services to the A100's for better direct routing and network resilience. That means no bottleneck at the wireless controller, no latency issues for voice applications and no jitter in your streaming video. WiNG 5.8 enhances the application performance over the network and features a high-speed data plane - moving small and large packets with a minimal amount of latency. The WiNG 5 OS distributes the controller intelligence through the network of access points, ensuring the network is redundant by design and self-healing in real time. WiNG 5.8 includes key features needed to ensure reliable delivery of high bit-rate and low latency applications:

- **Built in Capacity Controls:** WiNG 5 supports standardized WMM access control; and exceeds the standards with performance aware SmartLoad balancing, application aware SmartRF, and client aware RoamAssist. The high degree of network and device awareness is a hallmark of the WiNG 5 OS and the A100 leverages this technology to distribute Capacity Controls throughout the network.
- **Hierarchical Management**: As networks grow in size to accommodate more devices and emphasis on applications, the need for a hierarchical management system is more apparent. Using the WiNG 5 distributed intelligence architecture, provisioning and network visibility on the aircraft can be centrally managed with a minimal amount of WAN bandwidth.
- **Application Visibility and Control**: Within each WiNG 5.8 access point is the extensible WiNG dataplane. WiNG access points provides accounting, reports and control for the applications, not just the wireless clients. By setting limits on low priority applications, critical applications are ensured to get the bandwidth required.
- **Web-based Captive Portal:** This highly scalable web-based Captive Portal is ready for any size enterprise, able to manage the identity of two million client devices. Captive Portal makes it easy for your guests to register. Pages can be customized for the guest's specific device — such as a smartphone, tablet or laptop, providing the best viewing experience. A customizable registration form lets you define the information you want to collect — such as name, phone number, email address, as well as demographic information —and whether fields are mandatory or optional.

6.1.1 GAP-Free Security

The A100 secures all your wireless transmissions, ensuring compliance with the government and industry regulations, such as PCI in retail and HIPAA in healthcare. The network is protected every second of every day with comprehensive integrated security features that include layer 2-7 stateful packet filtering firewall, AAA RADIUS services, a VPN gateway and location-based access control.

6.1.2 Flexible WIPS Sensor Support

Radio Share and Off-Channel Scan Enables a single A100 to perform double duty as an access point and a sensor to allow either or both radios to carry client data and act as a sensor, providing dual-band sensing without adding cost.

6.1.3 Roaming Assistance

Enables a sticky-free client WLAN network and improves network performance.

6.1.4 802.11r Fast Roaming

Supports fast roaming between access points for mobile clients.

6.1.5 SMART-RF

Allows the WLAN to automatically and intelligently adapt to changes in the RF environment to protect performance and eliminate unforeseen gaps in coverage. Senses potential interference from Wi-Fi and non Wi-Fi sources (such as faulty antennas and neighboring access point failures) and automatically adjusts channels and power as needed.

6.1.6 Smart Load Balancing

Distributes clients evenly across access points and bands, improving overall network performance.

6.2 FACTORY RESET

From the A100 serial-console (while in Maintenance-mode):
The (CLI) commands to perform a reset to factory-default settings:

1. enable
2. erase startup-config (Note: When prompted to confirm command, type "y")
3. reload (Note: When prompted to confirm command, type "y")

This will then reset the system to the original/factory-default settings.

6.3 GLOBAL COUNTRY CODE

The A100 can operate in more than one country through the course of a single flight. To support this requirement the A100 has FCC authorization to support all global country code settings.

The A100 country code can be dynamically changed from the server.
When the country code changes, only the Radios will reset, not the entire A100.

Important: For the Radios to turn ON, the channel must be legal for that Country (Code). If an illegal channel is selected, the Radios will turn OFF / stay OFF until corrected.

From the A100 serial-console (while in Maintenance-mode): ***Next page has full list***
The (CLI) commands to display the full list of Country Codes supported under WiNG:

1. enable
2. config
3. rf-domain default
4. country-code ?

The (CLI) commands in order to change a Country Code (Example: "us"):

```
        1.  enable
        2.  config
        3.  rf-domain default
        4.  country-code us
        5a. commit              <<<< non-persistent (lost after a reboot)
(or)    5b. commit write        <<<< persistent (to maintain after reboot)
```

Recommendations for setting Country Codes dynamically on aircraft:

1. Do not set a country-code in the startup-config file (this keeps the Radios OFF upon startup).
2. Set country-code via CLI or SNMP based on ARINC data (altitude) and discrete inputs (WOW).
   Use the "non-persistent" mode, so if power cycles the A100 comes up with Radios OFF.

Table 18: Full List of Global Country Codes available in WiNG

The 2 letter ISO-3166 country code

WORD	
ae	United Arab Emirates
ag	Antigua and Barbuda
ai	Anguilla
al	Albania
an	Dutch Antilles
ar	Argentina
at	Austria
au	Australia
ba	Bosnia-Herzegovina
bb	Barbados
bd	Bangladesh
be	Belgium
bf	Burkina Faso
bg	Bulgaria
bh	Bahrain
bj	Benin
bm	Bermuda
bn	Brunei
bo	Bolivia
bq	Bonaire St Eust
br	Brazil
bs	Bahamas
bw	Botswana
by	Belarus
ca	Canada
ch	Switzerland
cl	Chile
cm	Cameroon
cn	China
co	Colombia
cr	Costa Rica
cw	Curacao
cx	Christmas Island
cy	Cyprus
cz	Czech Republic
de	Germany
dk	Denmark
do	Dominican Republic
dz	Algeria
ec	Ecuador
ee	Estonia
eg	Egypt
es	Spain
fi	Finland
fk	Falkland Islands
fm	Micronesia
fr	France
g1	Generic 1
g2	Generic 2
g3	Generic 3
g4	Generic 4
g5	Generic 5
g6	Generic 6
g7	Generic 7
gb	United Kingdom
gd	Grenada
ge	Georgia
gf	French Guiana
gh	Ghana
gp	Guadaloupe
gr	Greece
gt	Guatemala
gy	Guyana
hk	Hong Kong
hm	Heard and McDonald
hn	Honduras
hr	Croatia
ht	Haiti
hu	Hungary
id	Indonesia
ie	Ireland
il	Israel
in	India
io	British Indian Ocean
iq	Iraq
ir	Iran
is	Iceland
it	Italy
jm	Jamaica
jo	Jordan
jp	Japan
jw	Japan
ke	Kenya
kh	Cambodia
kn	St Kitts and Nevis
kr	South Korea
kw	Kuwait
ky	Cayman Islands
kz	Kazakhstan
la	Laos
lb	Lebanon
li	Liechtenstein
lk	Sri Lanka
lr	Liberia
lt	Lithuania
lu	Luxembourg
lv	Latvia
ly	Libya
ma	Morocco
mc	Monaco
md	Moldova
me	Montenegro
mk	Macedonia
mn	Mongolia
mo	Macau
mq	Martinique
mr	Mauritania
ms	Montserrat
mt	Malta
mu	Mauritius
mv	Maldives
mx	Mexico
my	Malaysia
na	Namibia
ne	Niger
nf	Norfolk Islands
ng	Nigeria
ni	Nicaragua
nl	Netherlands
no	Norway
np	Nepal
nu	Niue Island
nz	New Zealand
om	Oman
pa	Panama
pe	Peru
ph	Philippines
pk	Pakistan
pl	Poland
pn	Pitcairn
ps	Palestine
pt	Portugal
pw	Palau
py	Paraguay
qa	Qatar
re	Reunion
ro	Romania
rs	Serbia
ru	Russia
sa	Saudi Arabia
se	Sweden
sg	Singapore
si	Slovenia
sj	Svalbard Jan Mayen
sk	Slovak Republic
sm	San Marino
sn	Senegal
st	Sao Tome
sv	El Salvador
sx	St Maarten
sy	Syria
tc	Turks and Caicos
tg	Togo
th	Thailand
tk	Tokelau
tn	Tunisia
tr	Turkey
tt	Trinidad & Tabago
tw	Taiwan
ua	Ukraine
ug	Uganda
us	United States
uy	Uruguay
va	Vatican City
ve	Venezuela
vg	British Virgin Is.
vn	Vietnam
ye	Yemen
za	South Africa
zm	Zambia

6.4 CONFIGURATION PROFILES AND UPGRADING WING FIRMWARE (FW)

Configuration Profiles enable administrators to assign a common set of configuration parameters, policies, WLANs, wireless and security parameters to the access point.

6.5 HOW TO PUSH CONFIGURATION OR FW UPDATES FROM THE SERVER

If using dhcpd to configure an IP address of the A100, there are options available to both load a configuration file and to load a firmware revision for the A100. In the case of a configuration file, TFTP is used to download a configuration file from the server. If that configuration file differs from the existing configuration then the new one is loaded, and the system reboots with the new configuration. In the case of a firmware update, only the name of the file is compared to the current version of firmware running (this is faster than downloading the full firmware file on every boot). If the names differ, the new firmware is loaded via TFTP from the server, and the system reboots with the new firmware. Dual-bank firmware maintains robustness in the operation.

Neither of these features are available if using a static IP addresses on the system (i.e. either from a preloaded configuration file or via IP strapping).

6.5.1 WiNG5X -- How to DHCP (Example: isc-dhcp-server)

The minimal contents of a /etc/dhcp/dhcpd.conf file would be:

```
####################################################################
        option option186 code 186 = text;
        option option187 code 187 = text;
        option option188 code 188 = text;

        subnet 10.1.020.0 netmask 255.255.255.0 {
                range 10.1.020.10 10.1.020.99;
                option option186 "tftp://10.1.20.1";
                option option187 "AP7532-5.8.2.0-030R.img";
                option option188 "startx-config1";
        }
####################################################################
```

In this case it would load FW (firmware) **AP7532-5.8.2.0-030R.img** if it differed in name from the current running firmware, and load **startx-config1** as the new **startup-config** if it differed from the last loaded **startup-config**.

Example of Manual loading of **startup-config** would be:

copy tftp://10.1.20.1/startx-config1 startup-config (Note: See Sec 6.5.3 on TFTP)

IMPORTANT RESTRICTION: The A100 (AP7532) must only be programmed with firmware that is at version **AP7532-5.8.2.0-030R.img or above**.

Some background on how it works: (Refer to WiNG System Reference Guide for additional info)
TFTP'ing of the A100 configuration file (which is small) happens on every boot. The file is then compared with the existing startup-config, and if different, it is replaced and the A100 reboots. If a file somehow got only partially loaded (when the A100 rebooted or power cycled) it would again compare the file, find it differed, repeat the process.

Loading of A100 firmware file (which is BIG) happens only when the name of the file differs from the firmware filename which is on the non-booted bank. If they differ (the names - not the file contents), the new firmware file is loaded into the opposite bank and the A100 reboots into this opposite bank.

6.5.2 Manually programming FW to both Primary & Secondary banks

Whenever installing or upgrading the WiNG firmware, both banks should be upgraded.

Remember: Whatever bank you are booted from, the upgrade will upgrade the OPPOSING bank:
--When booted from Primary bank, running the FW upgrade will program the Secondary bank.
--When booted from Secondary bank, running the FW upgrade will program the Primary bank.

Example of Manual loading of a **new FW** image would be:
upgrade tftp://10.1.20.1/AP7532-5.8.2.0-030R.img (Note: See Sec 6.5.3 on TFTP)

Typically, default mode should be set to boot from the **Primary** bank, so please make sure to set this correctly at the end of the upgrade process (similar to the process below).

The following are step-by-step instructions to upgrade the WiNG FW onto both the Primary and Secondary banks:

(1) Boot the A100 with Console-Serial cable connected and operational
Remember you must Enter a "+h" in order to enter the A100 Maintenance-mode
(2) Must be in "enable" mode (Enter "en")
(3) Force booting the next boot from the Primary bank (Enter "boot system primary")
(4) Write memory (Enter "write mem")
(5) POWER CYCLE A100 system (Turn "PSU_EN" OFF the turn "PSU_EN" ON)
(6) Confirm A100 is booting from Primary bank by reviewing serial output on screen
A100 should report:
"Running Primary software, version X.X.X.X-XXXR"
(where "X" depends on the currently installed FW version)
"Alternate software Secondary, version X.X.X.X-XXXR"
(where "X" depends on the currently installed FW version)

(*) *Remember you must Enter a "+h" in order to enter the A100 Maintenance-mode*

(7) Must be in "enable" mode (Enter "en")
(8) Now booted from Primary bank, run the upgrade to Program the Secondary bank
*) Enter "upgrade tftp://10.1.20.1/AP7532-5.8.2.0-030R.img" (See Sec 6.5.3 on TFTP)
(9) Force booting the next boot from the Secondary bank (Enter "boot system secondary")
(10) Write memory (Enter "write mem")
(11) POWER CYCLE A100 system (Turn "PSU_EN" OFF the turn "PSU_EN" ON)
(12) Confirm booting from Secondary bank by reviewing serial console output on screen
A100 should report:
"Running Secondary software, version X.X.X.X-XXXR"
(where "X" matches on the FW version you just programmed)
"Alternate software Primary, version X.X.X.X-XXXR"
(where "X" depends on the currently installed FW version)

(**) Remember you must Enter a "+h" in order to enter the A100 Maintenance-mode

(13) Must be in "enable" mode (Enter "en")
(14) Now booted from Secondary back, run the upgrade to Program the Primary bank
*) Enter "upgrade tftp://10.1.20.1/AP7532-5.8.2.0-030R.img" (See Sec 6.5.3 on TFTP)
(15) Force booting the next boot from the Primary bank (Enter "boot system primary")
(16) Write memory (Enter "write mem")
(17) POWER CYCLE A100 system (Turn "PSU_EN" OFF the turn "PSU_EN" ON)
(18) Confirm booting from Primary bank by reviewing serial console output on screen
A100 should report:
"Running Primary software, version X.X.X.X-XXXR"
(where "X" matches on the FW version you just programmed)
"Alternate software Secondary, version X.X.X.X-XXXR"
(where "X" matches on the FW version you just programmed)

6.5.3 Setting up a Linux TFTP Server for proper operation

From our experience, setting up the TFTP Server can be complicated, so we have provided the following section which appears to work consistently.

1. On a Linux host, you must get and install the tftpd-daemon:
   "apt-get install tftpd-hpa"
2. You must verify the contents of the **/etc/default/tftpd-hpa** file match the **tftpd-hpa** file that was included during the **apt-get** above.

   The **tftpd-hpa** file contents should be the following:

   ```
   #####################################################

   # /etc/default/tftpd-hpa

   TFTP_USERNAME="tftp"
   TFTP_DIRECTORY="/tftpboot"
   TFTP_ADDRESS="[::]:69"
   TFTP_OPTIONS="--secure"

   #####################################################
   ```
3. Create (or verify) a directory at **/tftpboot**
   This is where the file you want to TFTP goes (ex. **AP7532-5.8.2.0-030R.img**)
4. Since the config for TFTP_OPTIONS says **"—secure"**,
   the name "tftpboot" does <u>not</u> have to be included in the calling process.

   That is, **"—secure"** makes the tftpboot daemon grab the file from the directory listed in the **tftpd-hpa** file.

   Therefore, <u>do NOT include "/tftpboot"</u> in the command that you send to the A100.

7. Technical Data

7.1 DO-160 TESTING

The system has been qualified to the following DO-160G tests. For further details, see Qualification Test Plan (QTP) and Qualification Test Report (QTR).

Table 19: DO-160G Testing

Requirement	RTCA/DO-160G Paragraph/ Equipment Category
Ground Survival and Short Term Low Temp. Operating	4.5.1, CAT A1
Low Temperature Operating	4.5.2, CAT A1
Ground Survival and Short Term High Temp. Operating	4.5.3, CAT A1
High Temperature Operating	4.5.4, CAT A1
Altitude	4.6.1, CAT A1
Overpressure	4.6.3, CAT A1
Operational Shock	7.2.1, CAT B
Crash Safety	7.3.1 (Impulse) 7.3.3 (Sustained)
Vibration (Random)	8.5.2, CAT S, Curve C
Power Input	16.0, CAT A (WF)H
Emission of Radio Frequency Energy (Radiated and Conducted)	21.0, CAT M

7.2 DESIGN AND CONSTRUCTION

The system is designed and constructed in accordance with the general requirements of RTCA/DO-254 to the extent that it does not conflict with the requirements specified herein.

7.3 INTERCHANGEABILITY

The components of the system are physically and functionally interchangeable in accordance with RTCA/DO-254. Parts or components of the same part number procured as defined in this document are physically and functionally interchangeable without calibration, selection, or adjustment to fit. Only those tools generally available for preventative and corrective maintenance at the specified level are required for the removal and replacement of interchangeable items.

7.4 MATERIALS

All materials used in the construction of the system are inherently non-nutrient to fungus and do not support combustion. The materials are of the best commercial quality, and will not blister, corrode, crack, soften, or show other immediate latten defects that affect the storage, operation, or environmental capabilities of the unit after any or all of the test specified.

Materials used in the system have been selected in accordance with the appropriate flammability requirements of Code of Federal Regulations FAR-25.853a.

7.5 GROUNDING AND BONDING

Electrical grounding and bonding of the unit follows standard avionics industry design practices, ensuring proper grounding for electrical safety and for Electromagnetic Interference (EMI) control and compliance and is in compliance with D6-36440D 7.3.2.4.

7.6 WORKMANSHIP

Workmanship, including ANSI/IPC-A-620 soldering, is designed to meet ANSI/J-STD-002 and RTCA/DO-254.

7.7 SAFETY

The system is designed to meet the safety requirements of RTCA/DO-254

7.8 PROTECTIVE DEVICES

A fuse is utilized on the power line to conform to the recommendations of RTCA/DO-254. Two temperature sensors are located on the power supply assembly to protect the internal electronics from an over-temperature or under-temperature condition. Additionally, a separate temperature sensor is in place to enable/disable the unit based on low ambient temperatures (below -20°C).

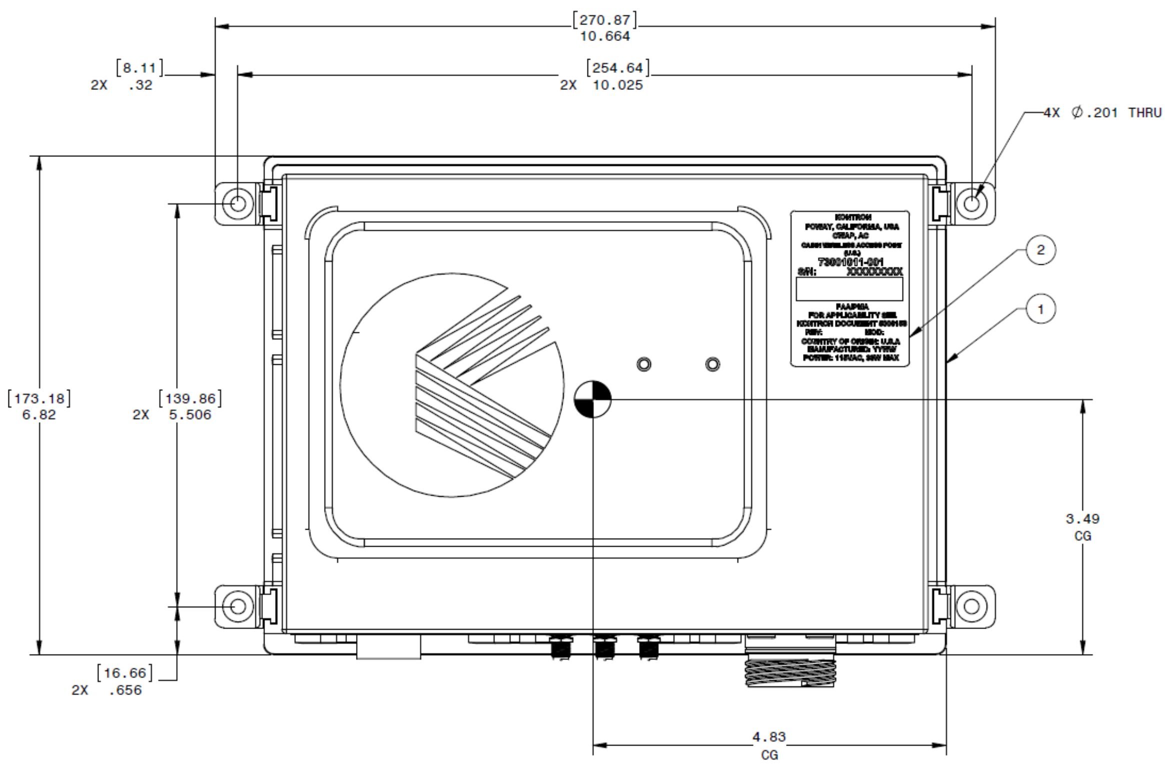
7.9 HUMAN ENGINEERING

Human Engineering design criteria and principles were applied in the design of the A100, so as to achieve safe, reliable and effect performance by operator, maintenance and control personnel. RTCA/DO-254 shall be utilized as guidelines in applying human engineering design criteria.

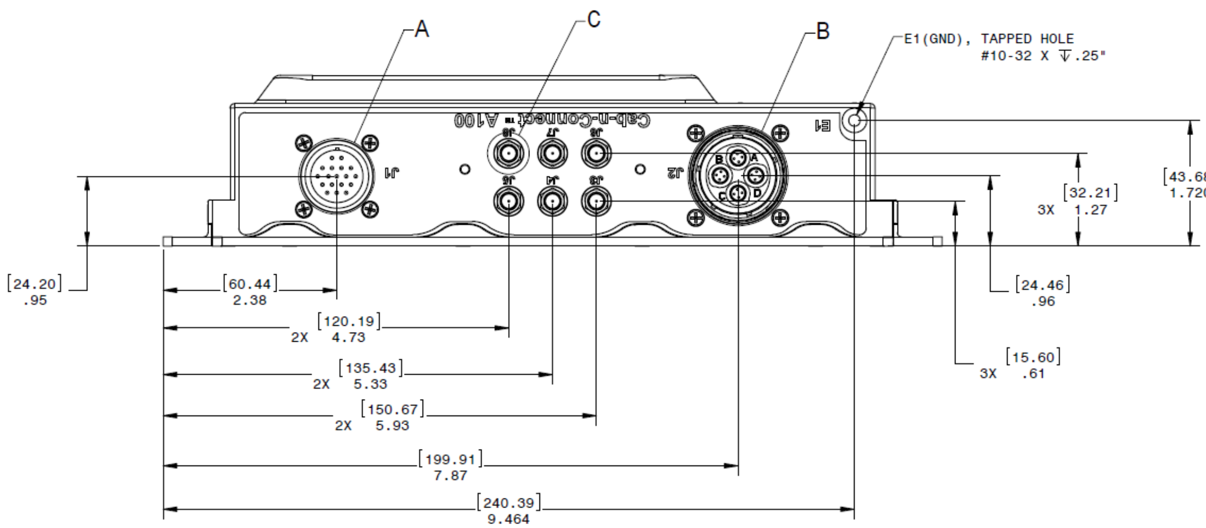
7.10 MECHANICAL DESIGN & DIMENSIONS

The A100’s mounting fasteners (4x) and E1 ground strap location use 10-32 hardware which require 36 in-lbs of torque.

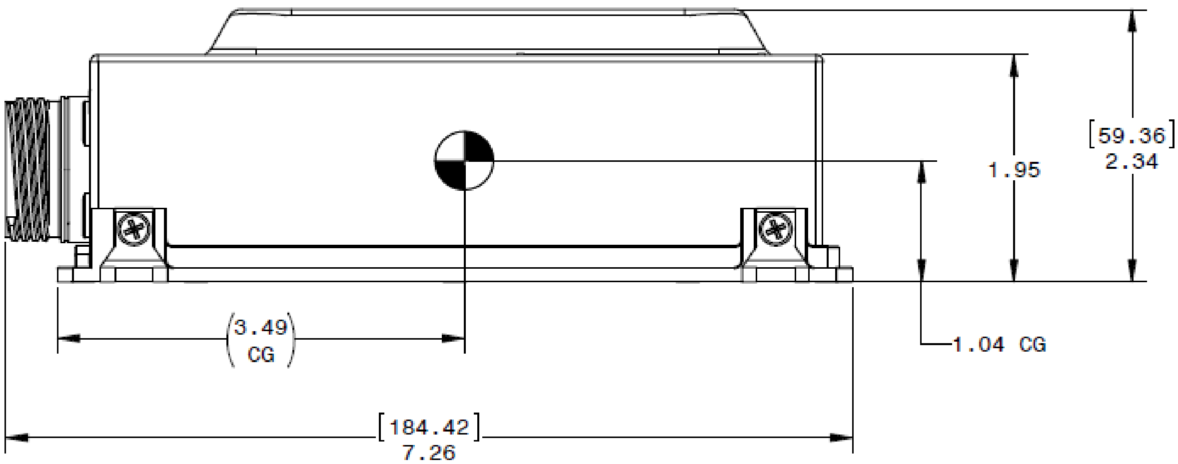
7.10.1Top View



7.10.2Front View



7.10.3Side View



8. Reliability and Maintainability

8.1 RELIABILITY

The Mean Time Between Failure (MTBF) for the unit is greater than 65,000 operating hours, Telcordia (AIC), AC - Airborne Inhabit Cargo, Commercial, @ 30°C.

8.2 MAINTAINABILITY

The A100 is considered a Line Replaceable Unit (LRU) and is repairable only by Kontron or an authorized repair facility.
Periodic maintenance of the A100 is not required.

8.3 MEAN TIME TO REPAIR (MTTR)

Repair time will not exceed 30 minutes, which entails replacement of the LRU. The time to gain access to the LRU is not included.

8.4 PRODUCTION TESTING

Production units are subjected a production Factory Acceptance Test (FAT) prior to shipment. This test ensures that all elements of the product are functional and capable of performing as stated and that the unit is free from any manufacturing defects.

8.5 SPECIAL TEST AND EXAMINATIONS

Qualification testing has been performed to verify that the A100 meets the requirements of this document.
Kontron retains a Qualification Test Report (QTR) for the A100.

Operational compatibility is verified during Factory Acceptance Testing (FAT).

8.6 SPECIAL TOOLS

Special tools are not required for the installation, replacement, tuning, or adjustment of electronic parts. Special tools are defined as those not listed in the federal supply catalog.

9. Regulatory Information

9.1 FREQUENCY OF OPERATION – FCC AND IC

9.1.1 5Ghz Only

9.1.1.1 Industry Canada Statement

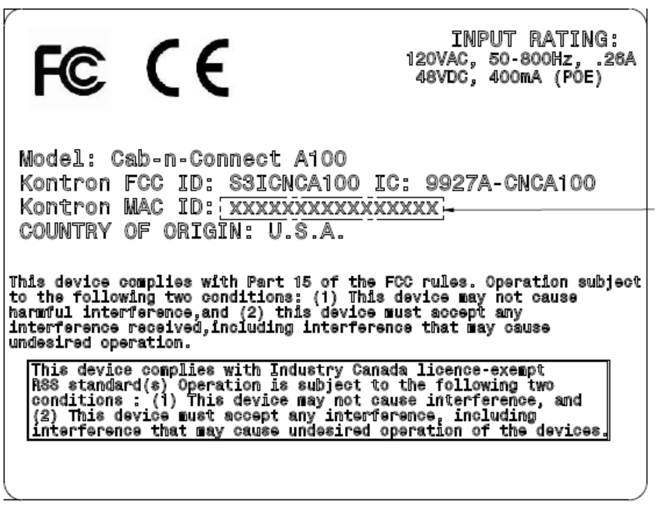
Caution: The device for the band 5150-5250 MHz is only for indoor usage to reduce potential for harmful interference to co-Channel mobile satellite systems. High power radars are allocated as primary users (meaning they have priority) of 5250-5350 MHz and 5650-5850 MHz and these radars could cause interference and/or damage to LE-LAN devices.

9.1.2 2.4GHz Only

The range of channels is limited by firmware.

9.1.3 Example FCC Label

At this time the FCC label on the unit is pending.



9.2 RF EXPOSURE GUIDELINES

9.2.1 Safety Information

Reducing RF Exposure – Use Properly

Only operate the device in accordance with the instructions supplied.

9.2.2 International

The device complies with internationally recognized standards covering human exposure to electromagnetic fields from radio devices.

9.2.3 EU

9.2.3.1 Remote and Standalone Antenna Configurations

To comply with EU RF exposure requirements, antennas that are mounted externally at remote locations or operating near users at stand-alone desktop of similar configurations must operate with a minimum separation distance of 20cm from all persons.

9.2.4 US and Canada

9.2.4.1 Co-located statement

To comply with FCC RF exposure compliance requirements, the antenna used for this transmitter must not be co-located or operating in conjunction with any other transmitter/antenna except those already approved in this filling.

To satisfy US and Canadian RF exposure requirements, a transmitting device must operate with a minimum separation distance of 30cm or more from a person's body.

9.2.4.2 Radiation Exposure Statement

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 30cm between the radiator and your body.

9.2.4.3 Remote and Standalone Antenna Configurations

To comply with FCC RF exposure requirements, Antennas that are mounted externally must be professionally installed at a fixed location and operate with a minimum distance of 30cm from all persons. To comply with FCC Antenna requirements, the Antenna must be adjusted such that the RF emission lobes are below 30 degrees elevation.

9.3 RADIO FREQUENCY INTERFERENCE REQUIREMENTS - FCC

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 radiate 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 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 of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

---

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user’s authority to operate this equipment.

For product available in the USA/Canada market, only channel 1-11 can be operated. Selection of other channels is not possible.

This device is restricted for indoor use.

9.3.1 Radio Transmitters (Part 15)

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

9.3.2 Radio Frequency Interference Requirements – Canada

CAN ICES-3 (B)/NMB-3(B)

9.3.2.1 Radio Transmitters

For RLAN Devices:

The use of 5 GHz RLAN’s, for use in Canada, have the following restrictions:

- Restricted Band 5.60 – 5.65 GHz

This device complies with RSS 210 of Industry Canada. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

In accordance with the regulations of Industry Canada, this radio transmitter can operate with an antenna of a type and a maximum gain (or lower) approved for the transmitter by Industry Canada. With the aim of reducing the risk of radio interference to other users, the chosen antenna type and its gain should be selected so that the equivalent isotropically radiated power (e.i.r.p.) does not exceed the intensity necessary for the establishment of a satisfactory connection.

In compliance with respective local regulatory law, AP software provides professional installers the option to configure the antenna type and antenna gain for approved antennas.

10. Performance Testing

The following section provides performance test data focused primarily on video streaming to various client devices. Most of this testing is performed at the Kontron System Integration Lab in Poway, California.

10.1 VERIWAVE THROUGHPUT TESTING

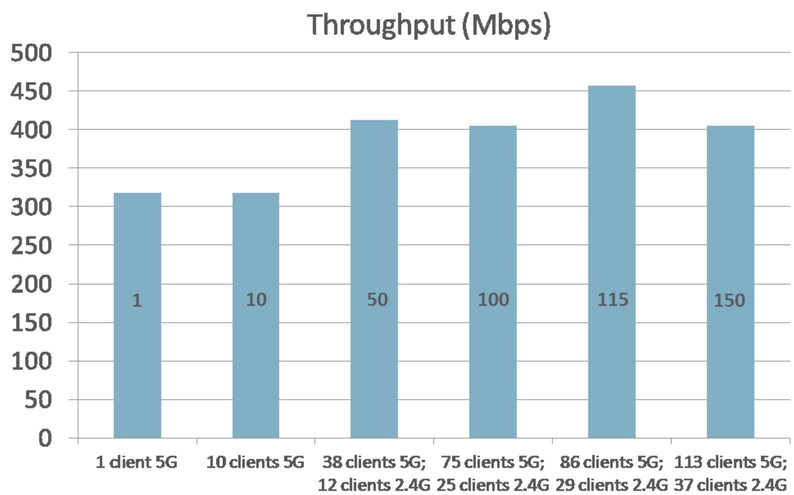
The Veriwave test suite is used for stress testing the wireless access point based on client count and configuration. In this test, the radios are configured as follows:

- 5GHz Band: 40MHz, 2x Spatial Streams, 1384 Frame Size, Short Guard Interval
- 2.4GHz Band: 20 MHz, 1x Spatial Stream, 1384 Frame Size, Short Guard Interval

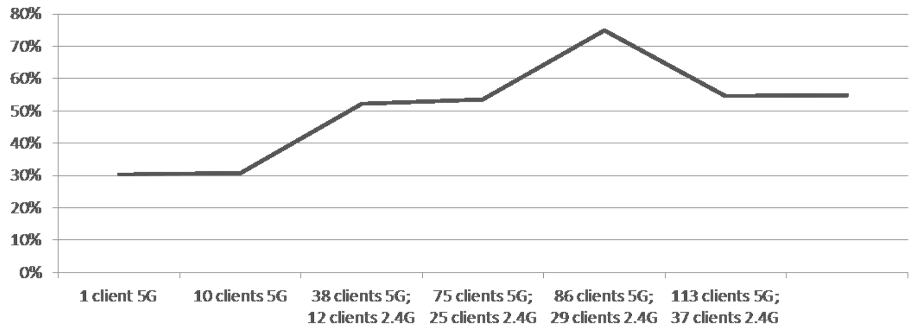
This particular type of testing eliminates RF-Contention from the client wireless devices and demonstrates the hardware limitations.

At about 115 clients, the aggregate throughput starts to decline indicating a performance peak at the radio device since the CPU and memory are at acceptable allocation levels. The CPU and memory utilization during this stress testing are shown below.

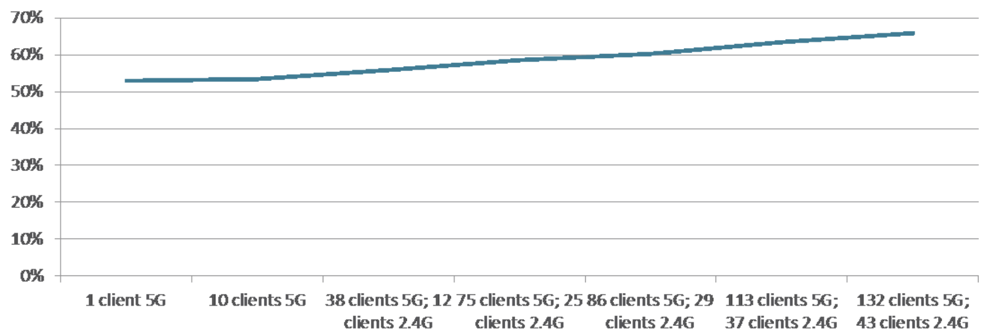
10.1.1Veriwave Throughput Testing Results



10.1.2CPU Utilization

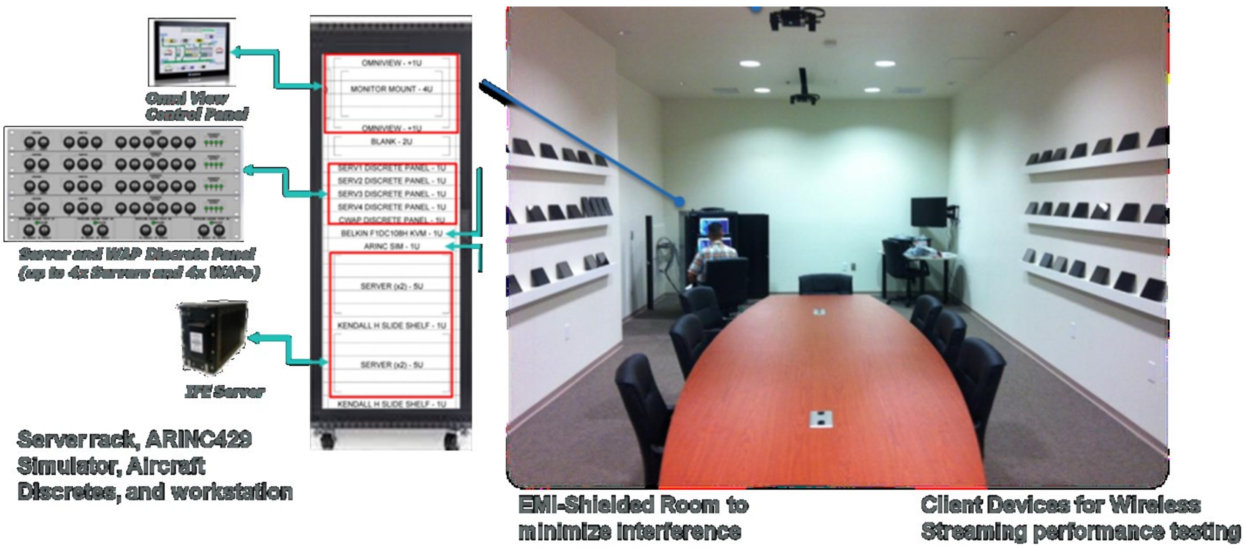


10.1.3Memory Utilization



10.2 SYSTEM INTEGRATION LAB (SIL) TESTING

The Kontron System Integration Lab (SIL) in Poway, California is a shielded environment for testing Wi-Fi equipment for engineering purposes and for supporting Kontron’s Avionics customer testing. The shielded environment provides a stable lab environment for conducting tests on Wi-Fi devices for study, comparison, and analysis with minimum external signal interference. The room measures 23’ x 13’ and the
Cab-n-Connect A100 is mounted 8’ above from the ceiling.



10.2.1Client Devices

The following client devices are used in the Kontron SIL.

- Kindle 8.9 802.11n (2S)
- iPad 802.11n (1S)
- iPad Air 2 802.11ac (2S)
- Nexus 9 802.11ac (2S)
- Macbook Pro 802.11ac (3S)
- Laptop 802.11ac (1S)

10.2.2Test Equipment

The Kontron ACE Flight Server is used for the video streaming testing. It has an Intel Core i7-2610UE, 16GB RAM, Integrated Broadcom L2/L3 Switch.

- OS: Ubuntu v12.04.3, Kernel v3.2.0-29
- Apache HTTP Server
- Video Segmenter (ffmpeg)
- iPerf application

10.3 5GHZ IPERF TESTING

The iPerf software application is used to run a data throughput test over TCP on the 5GHz radio. Multiple runs are conducted for more accurate results in each test case.

The system has been tested with multiple vendor 802.11ac devices along with Veriwave WiFi hardware as shown in the chart on the right.

Performance depends on the client device number of spatial streams defined as follows:

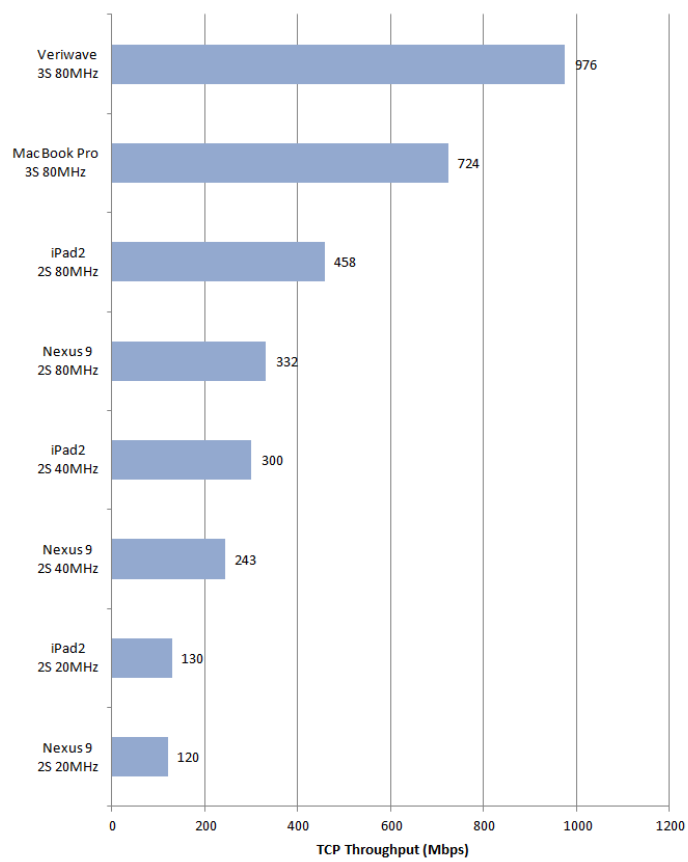
- 1S = 1x stream
- 2S = 2x streams
- 3S = 3x streams

Performance also depends on the client device ability to channel-bond, 20MHz, 40MHz or 80MHz.

Currently, most 802.11ac consumer client devices on the market are 1S (single stream) devices. Higher end tablets like the iPad 2 or Nexus 9 support 2S (two streams). The Veriwave and Mac Book Pro results demonstrate the highest performance throughput capability of the A100 with the ability of 3S (3 streams).

The following test results are shown for single device throughput testing.

10.3.15GHz iPerf Test Results



10.4 ONE (1) A100 HD VIDEO STREAMING RESULTS

In this scenario, mixed 802.11n and 802.11ac client devices are used to run an HD video streaming test of simultaneous 1-Mbps streams via one (1) A100.

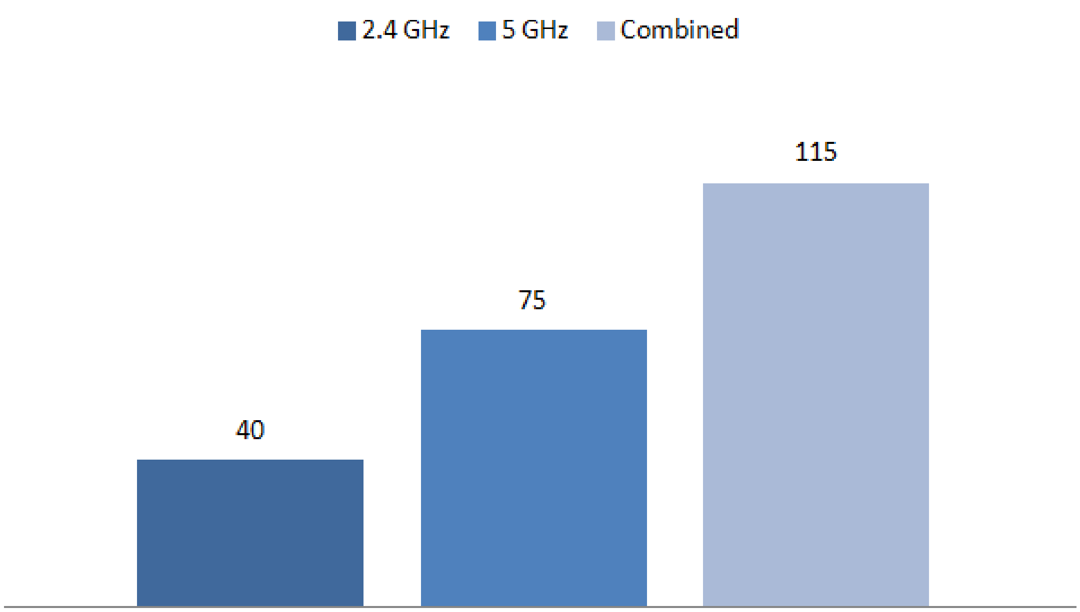
10.4.1Criteria

A successful test run is for all client devices to display continuous HD video without freeze or artifacts. The test scenario is to add devices until the video on one or more devices pause or halt.

For consistency of results, multiple test runs are used with a mix of single stream and dual stream 802.11n and 802.11ac client devices. The data rate measurements from the client to the server over the radios were also monitored during the test.

10.4.2 Results

The results of the testing showed that up to 115 clients can be supported in this scenario with 40 clients running on the 2.4Ghz radio and 75 clients running on the 5GHz radio.



10.5 THREE (3) A100 HD VIDEO STREAMING RESULTS

In this scenario, mixed 802.11n and 802.11ac client devices are used to run an HD video streaming test of simultaneous 1-Mbps streams via one (1) A100.

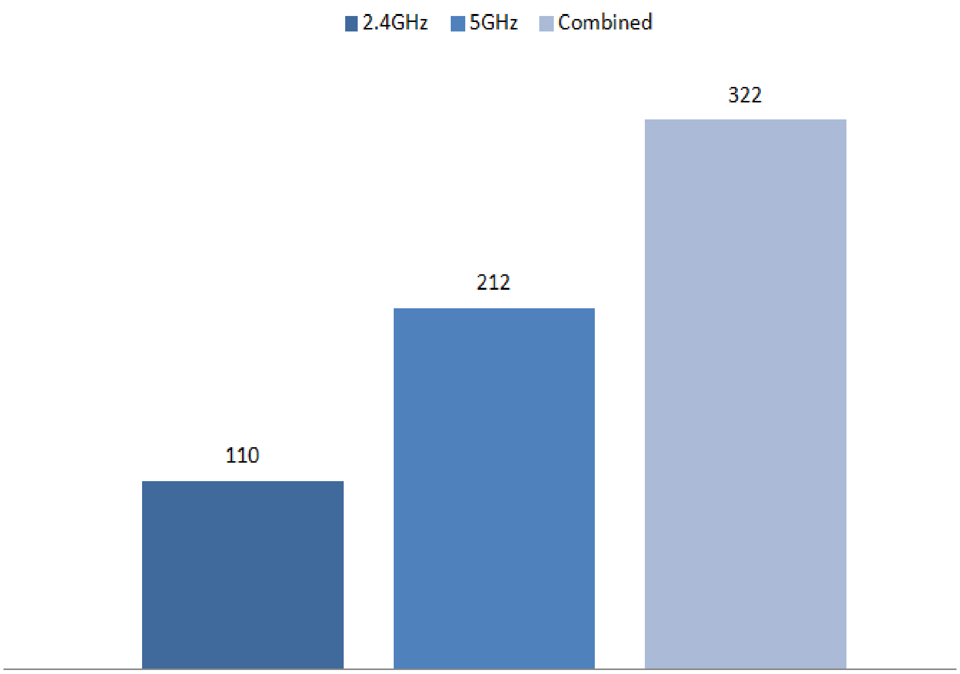
10.5.1Criteria

A successful test run is for all client devices to display continuous HD video without freeze or artifacts. The test scenario is to add devices until the video on one or more devices pause or halt.

For consistency of results, multiple test runs are used with a mix of single stream and dual stream 802.11n and 802.11ac client devices. The data rate measurements from the client to the server over the radios were also monitored during the test.

10.5.2Results

Over 320 clients can be supported in this scenario with 110 clients running on the 2.4Ghz radio and 212 clients running on the 5GHz radio. The radios are set to non-overlapping channels and optimal power settings to minimize any co-channel interference. The increase interference and collisions decreases the aggregate throughput.



10.6 THROUGHPUT FAQS

This section documents the common questions and best practices regarding performance of the A100.

10.6.1What is the difference between Throughput and Data Rate?

Data Rate is the speed at which packets traverse the network. It's synonymous to the speed of car. Throughput on the other hand is the efficiency of the network. It's synonymous to how many lanes and cars a highway can support.

10.6.2In wireless networks how is Throughput and Data Rate correlated?

There is no exact formula but as a rule of thumb, the effective TCP throughput is roughly half the average data rate of the network.

10.6.3What would be the effective throughput of one device?

An example would be an iPad2 which is capable of 65Mbps data rates; the net achievable TCP throughput would be between 35-40Mbps (assuming no interference).

10.6.4What happens when 30 devices connect to the same channel on the A100?

Since 802.11 is a shared half-duplex medium and the total channel limit is 35-40Mbps in the example of the iPad2, all iPads will get a share of the 35-40Mbps. One important point to note is with 30 iPads the probability of wireless packets colliding (RF- Contention) increases leading to slightly less throughput.

10.7 POWER, CHANNEL AND INTERFERENCE FAQS

10.7.1How much power should be set on the radios?

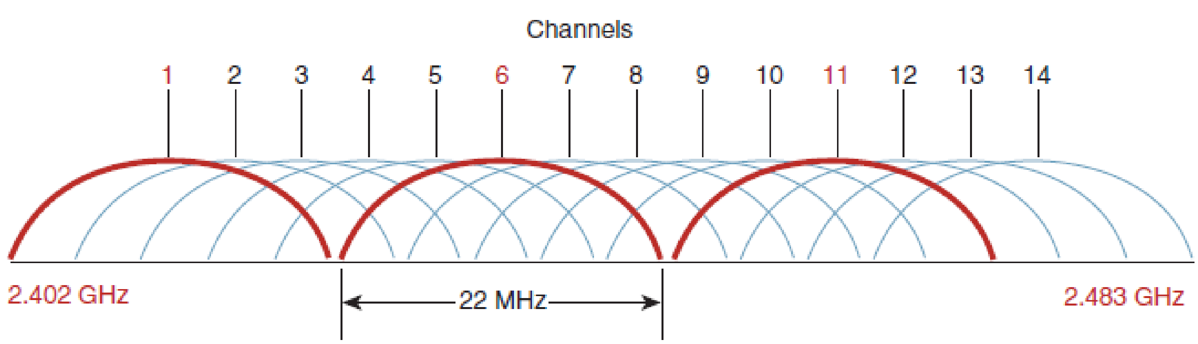
The power setting should be based on the following two factors:

- Client devices can see the A100 with -60dbm or better signal
- Power should be low enough to reduce interference with neighboring A100's

Typical power setting in a narrow body aircraft with three (3) A100's evenly spaced is between 3-6 dBm. It is recommended to start at 1 dBm (lowest setting), measure performance and adjust from there.

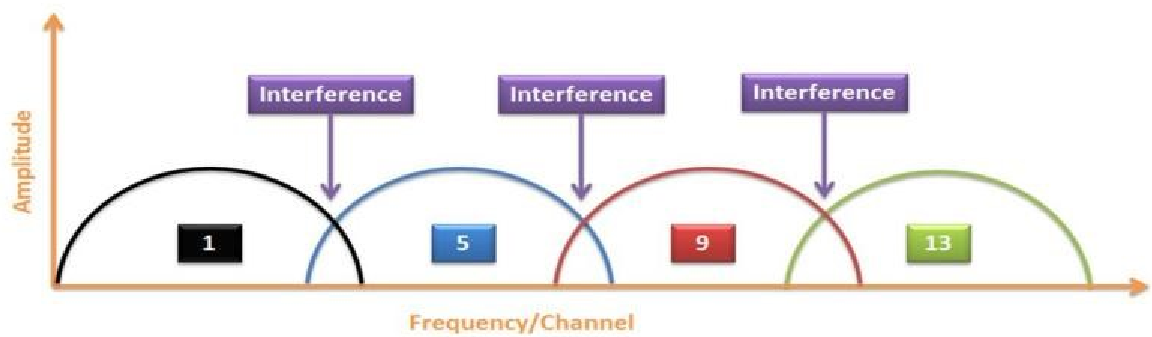
10.7.2What is the Recommended Channels for 2.4GHz?

The best channels to use on the 2.4Ghz radio is Channel 1, 6 and 11. The Main Lobes of these channels don't overlap and hence reduce co-channel interference as shown in the following diagram.



10.7.3Can Channels 1, 5, 9 and 11 be used?

They can be used but lower overall performance is to be expected because the main lobes of the channels overlap as shown in the following diagram and increase co-channel interference.



10.7.4Is there any interference between channels 1, 6 and 11?

If the A100's are close to each other and the power is high, there can be co-channel interference. This is because the side lobes of 1-6 and 6-11 overlap. However, this degradation can be minimized by optimal placement (spacing) of A100's and setting the right power.

10.8 802.11AC FAQS

10.8.1What is 802.11ac?

802.11ac was ratified in January 2014. 802.11ac is a single standard, but will be delivered by the industry in multiple phases. Most of the 802.11ac standard is delivered in what is known as wave 1.

10.8.2What are the main differences between 802.11n and 802.11ac?

802.11ac operates only in the 5GHz band and makes enhancements to several aspects in 802.11n:

- 256QAM vs. 64QAM
- Up to 8 bonded channels
- 8 Spatial Streams
- Downstream MU-MIMO
- Standardized Transmit Beamforming vs. non-standardized in 802.11n

10.8.3Is 802.11ac backwards compatible?

Yes, 802.11a/n client devices will be able to connect to 802.11ac access points and will benefit from standardized Airtime fairness in 802.11ac access points.

10.8.4How does 802.11ac compare to 802.11n from a security standpoint? WEP and WPA?

Both 802.11n and 802.11ac support the same security protocols defined by 802.11i specification. WiNG 5.8 supports dynamic WEP to secure legacy devices in certain markets.

10.8.5What is the benefit of 256QAM?

256-QAM allows packing more bits into each transmission, 802.11ac increases the payload in each packet. More payload means fewer packets required to send the same data. More is better.

10.8.6Is 802.11ac better suited for backbone deployment?

The high bit rate and 80MHz or 160MHz channel set certainly lends itself to backhaul applications using a narrow beam antenna. Additionally, MESH networks with a single channel will benefit from the increased bit rate. However, 802.11ac provides significantly more wireless capacity for client devices. The additional speed of 802.11ac allows more clients to connect.

10.8.7Does 11ac help improve the performance of 11n devices in any way?

802.11ac includes a standardized airtime fairness that will improve performance for mixed networks with 11n and 11ac clients.

10.8.8How does Multiple User MIMO (MU-MIMO) work?

MU-MIMO allows for a certain amount of parallelism in how data is transmitted to client devices improving system throughput and performance over a traditional MIMO system. In practical terms, we expect to see between 50 and 250 percent improvement in overall network capacity.

10.8.9What are the biggest differences between 802.11ac and 802.11ad ?

The single biggest difference is that 802.11ac is 5GHz and backwards compatible with 5GHz 802.11a/n devices while 802.11ad operates at 60GHz and has no backwards compatibility with existing technology. 802.11ac includes some of the modes originally envisioned for 802.11ad, known as VHT modulations or Very High Throughput

11. Transitioning from a Cab-n-Connect to the Cab-n-Connect A100

A number of changes and improvements were made during the development of the A100 (73001011-101).

If your current installation or experience has only involved the original Cab-n-Connect (73001000-XXX), then these differences should be understood and accounted for, especially if planning to use the new A100 as a "drop-in-replacement" for an original Cab-n-Connect.

11.1 GROUND PIN ASSIGNMENTS WITHIN THE A100 J1 CONNECTOR

The original Cab-n-Connect J1 Ground Pin assignments are J1: B, G, K, P, R, S, T, U
The A100 J1 Ground Pin assignments are J1: B, G, K, U

A100 J1-pins P, R, S, T are now assigned for IP_STRAP_0,1,2 and ANT_STRAP_0
(Also, the A100 utilizes pin A for ANT_STRAP_1 (unassigned previously)).
If any of the J1-pins (P, R, S, T) were being used as "GROUND" before (with a),
they now need to re-wired to use only J1-pins B, G, K or U for the A100.

Refer to Section 4.1 for the entire pin assignment-list for A100 J1.
Refer to diagram on next page for a graphical depiction of this change.

11.2 DISCRETE INPUT FUNCTIONALITY

The original Cab-n-Connect needed both Discrete Inputs (**PSU_EN** and **RF_EN**) to be connected to GROUND in order to allow the Cab-n-Connect to power ON the internal WAP board.

The new Cab-n-Connect A100 requires only Discrete Input (**PSU_EN**) to be connected to GROUND in order to allow the Cab-n-Connect A100 to power ON the internal WAP board. The **RF_EN** Discrete Input is now ignored in the logic required in order to power ON the A100 itself.

Note: The electrical polarity of the Discrete Inputs of the Cab-n-Connect A100 has remained un-changed from the original Cab-n-Connect (they are still "GROUND / OPEN" inputs). If your Cab-n-Connect application has **PSU_EN** + **RF_EN** strapped to Ground, the Cab-n-Connect A100 is backward compatible.

Refer to Section 4.1.4 for further information on Cab-n-Connect A100 Discrete Inputs

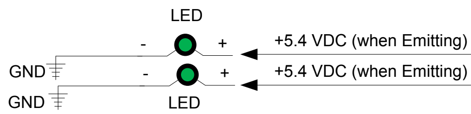
11.3 DISCRETE OUTPUT FUNCTIONALITY AND POLARITY

The original Cab-n-Connect Discrete Outputs (**PSU Status Out** and **RF Status Out**) were both intended to drive external LED's and thus would supply a POSITIVE DC voltage (at approximately +5.4VDC) when emitting / active (or a GROUND when in-active). Therefore, the user only had to supply a "GROUND" on the opposite side of each user-supplied external LED for proper (electrical) operation.

The Cab-n-Connect A100 has changed both Discrete Outputs (**PSU Status Out** and **RF Status Out**) to follow the ARINC 763 standard to now be the "GROUND / OPEN" type.
For both Discrete Outputs, they are "OPEN" by default and will now supply a GROUND when emitting / active. Therefore, to drive an external LED, the user will now instead need to supply the POSITIVE DC voltage (along with an in-line current-limiting resistor) on the opposite side of each user-supplied external LED for proper (electrical) operation.
Note-1: Each of the A100 Discrete Outputs can sink 20mA of current.
Note-2: Each of the A100 Discrete Outputs has an internal current-limiting resistor (75-ohms). Therefore, this 75-ohms needs to be subtracted during the calculation of the LED manufacturer's recommended overall current-limiting requirement for each circuit.

Refer to Section 4.1.4 for further information on A100 Discrete Outputs.
Refer to diagram on next page for a graphical depiction of this change.

Original CWAP (802.11n)



User is required to supply the external LED's and GROUND when using Discrete Outputs to drive LED indications.

J1

D	RF/LRU Status Out (Discrete Output) (DIS_OUT_2)
E	PSU Status Out (Discrete Output) (DIS_OUT_1)
C	PSU EN (Discrete Input) (DIS_IN_2)
F	RF EN (Discrete Input) (DIS_IN_1)
M	115 VAC LINE
N	115 VAC NEUTRAL
B	GROUND / CHASSIS
G	GROUND
K	GROUND
P	GROUND
R	GROUND
S	GROUND
T	GROUND
U	GROUND
H	RS-232 Transmit (TxD)
J	RS-232 Receive (RxD)
L	CWAP Factory Reset

CWAP
PN: 73001000-XXX

J2

Gig-E #1

Gig-E #2

If / When transitioning
from the original CWAP (73001000-XXX) type
to the new CWAP A100 (73001011-101) type,
please notice the following electrical (polarity) and funcdtionality changes that have occurred relative to the J1 pins / functions:

1A) The CWAP A100 Discrete Outputs have been changed to follow the ARINC 763 specification in order to be GROUND / OPEN.
They no longer supply the positive voltage from Pins D and E in order to drive external LED's. The user must supply the positive voltage (source), the current limiting resistors and the LED's now.

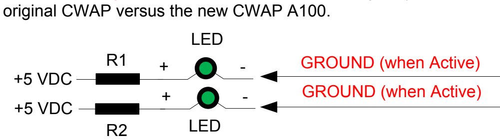
1B) Additionally, the Functionality of the Discrete Inputs and Discrete Outputs has also changed. The new CWAP A100 now requires that only the PSU EN input to be enabled (Grounded) in order to turn the CWAP ON. On the previous CWAP, both the PSU EN and the RF EN had to be enabled.
The new CWAP A100 PSU Status Output discrete will activate (connect to approx. 120 ohms to Ground) when the PSU EN input is enabled (grounded) and CWAP A100 itself is powered ON.
The new CWAP A100 RF/LRU Status Output discrete will activate (connect to approx. 120 ohms to Ground) when the RF EN input is enabled/grounded.
With the CWAP A100, there is now NO correlation of the unit's top-cover LED's to the RF/LRU Status Output discrete (which simply stays on (solid) if enabled).

2) The CWAP A100 pins P,R,S,T have been re-assigned as indicated. These 4 pins all used to be GROUNDS for the original CWAP.

3) The CWAP A100 pin A has been assigned for ANT_STRAP_1
The original CWAP had pin A as unassigned / not-connected.

In these two diagrams, GREEN simply indicates GROUNDS
and RED indicates that a change has occurred from what was originally assigned in the original CWAP versus the new CWAP A100.

New CWAP A100 (802.11ac)



User is required to supply the external LED's and current limiting resistors when using Discrete Outputs to drive LED indications.

The CWAP A100 discrete outputs can sink 20mA (each).

J1

A	ANT_STRAP_1
D	RF/LRU Status Out (Discrete Output) (DIS_OUT_2)
E	PSU Status Out (Discrete Output) (DIS_OUT_1)
C	PSU EN (Discrete Input) (DIS_IN_2)
F	RF EN (Discrete Input) (DIS_IN_1)
M	115 VAC LINE
N	115 VAC NEUTRAL
B	GROUND / CHASSIS
G	GROUND
K	GROUND
P	IP_STRAP_0
R	IP_STRAP_1
S	IP_STRAP_2
T	ANT_STRAP_0
U	GROUND
H	RS-232 Transmit (TxD)
J	RS-232 Receive (RxD)
L	CWAP Factory Reset

CWAP A100
PN: 73001011-101

J2

Gig-E #1

Gig-E #2

11.4 OTHER GENERAL OPERATIONAL DIFFERENCES OF CAB-N-CONNECT A100

11.4.1 Different default password

- The original Cab-n-Connect default username and password are:
  - un: adminp
  - pw: Motorola
- The Cab-n-Connect A100 default username and password are:
  un: admin
  pw: admin123

11.4.2 Different default console-serial baud rate

- The original Cab-n-Connect default console-serial baud rate: 19200
- The Cab-n-Connect A100 default console-serial baud rate: 115200

11.4.3 Different default console-serial operation

- The original Cab-n-Connect default console-serial was directly connected to the internal OEM WAP board, so nothing additional was required.
- The Cab-n-Connect A100 default console-serial is now connected to the internal micro-controller of the Cab-n-Connect A100 (which also connects to the OEM WAP).
  - The default **'Normal-mode'** of the serial-port is that only the micro-controller itself is sending/receiving serial commands/data to the OEM WAP console-port (as part of the Cab-n-Connect A100 system control).
  - In this **'Normal-mode'** (if/when connected to the A100 console-serial port), the user can only see the commands being sent by the micro-controller to the internal OEM WAP and no serial input is accepted by the user in this default mode.
  - In order to accept serial-input (i.e. to access the CLI), the micro-controller must be placed into 'Maintenance-mode':
    - To enter Maintenance-mode, type "**+h**"
    - To exit Maintenance-mode, type "**+h**" (returns to **'Normal-mode'**)

---

*Note: You can tell you are in Maintenance-mode by hitting the **ENTER** key a couple times in order to verify a prompt is returned each time.*

11.4.4 Update an existing config-file (Cab-n-Connect) to a new Config-file (Cab-n-Connect A100).

If you have an existing ap7131 config (Cab-n-Connect) - you can modify it for the ap7532 based Cab-n-Connect A100 by doing the following simple steps:

1. Within Config-file, replicate (copy) the section of the startup-config file
```
profile ap71xx default-ap71xx
...
!
```

2. Rename this new section
```
profile ap7532 default-ap7532
...
!
```

This now gives you one section for the Cab-n-Connect (ap71xx) and a new section for the Cab-n-Connect A100's (ap7532).

Next, read below to update semantics for the Cab-n-Connect A100 section settings.

11.4.5 New semantics for "WIDE" channels in Cab-n-Connect A100 configuration file section

For channel specifications within the "ap7532" section only, update all notations for wide (40Mhz) or double-wide (80Mhz) channels from ("+") to ("w") or ("ww"):

Example: Change "channel 36+" notation to now be "channel 36w",
for any channels that you use the 40 mhz notation.

```
old way:   "channel 36+"  <<<< for 40Mhz channel

new way:   "channel 36w"  <<<< for 40Mhz channel or
new way:   "channel 36ww" <<<< for 80Mhz channel
```

Note: A 20Mhz channel doesn't change in syntax "channel 36"

You now end up with a single startup-config file that can load onto <u>either</u> a Cab-n-Connect or a Cab-n-Connect A100.

12. Support and Service

12.1 TECHNICAL SUPPORT

Technicians and engineers from Kontron Embedded Modules GmbH and/or its subsidiaries are available for technical support. We are committed to making our product easy to use and will help you use our products in your systems.

Please consult our Web site at http://www.kontron.com/support for the latest product documentation, utilities, drivers.

12.2 RETURNING DEFECTIVE MERCHANDISE

Please use the website to obtain latest information on returning merchandise.

http://us.kontron.com/support/rma-information

All equipment returned to Kontron must have a Return Material Authorization (RMA) number assigned exclusively by Kontron. Kontron cannot be held responsible for any loss or damage caused to the equipment received without an RMA number. The Buyer accepts responsibility for all freight charges for the return of goods to Kontron's designated facility. Kontron will pay return freight charges back to the Buyer's location in the event that the equipment is repaired or replaced within the warranty period stipulated herewith.

To request a Return Material Authorization (RMA) number

- Be prepared to supply the unit serial number, reason for return and original ship date
- Place call to 800-480-0044 to receive RMA number (toll free in the US and Canada) "OR"
- E-mail the information to support@us.kontron.com to receive RMA number
- RMA Request Form (found on website)
- Return defective material (unless instructed otherwise with issuance of RMA) to:

  Kontron America

  14118 Stowe Dr

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  Attn: (RMA number)

About Kontron

Kontron, a global leader in embedded computing technology and trusted advisor in IoT, works closely with its customers, allowing them to focus on their core competencies by offering a complete and integrated portfolio of hardware, software and services designed to help them make the most of their applications.

With a significant percentage of employees in research and development, Kontron creates many of the standards that drive the world's embedded computing platforms; bringing to life numerous technologies and applications that touch millions of lives. The result is an accelerated time-to-market, reduced total-cost-of-ownership, product longevity and the best possible overall application with leading-edge, highest reliability embedded technology

Kontron is a listed company. Its shares are traded in the Prime Standard segment of the Frankfurt Stock Exchange and on other exchanges under the symbol "KBC". For more

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