

System Requirements Specification:

700/800 NEXT GENERATION PUBLIC SAFETY BDA (DAS)

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1. PURPOSE

This document is intended to provide technical specifications for a 700/800 ½ Watt per band Next Generation Public Safety Bi-directional Amplifier (BDA). The BDA addresses an emerging market need for a low cost highly integrated solution.

To date, Public Safety BDA OEMs have all provided varying solutions that are based on well-known industry norms that have not fundamentally changed in the last 25 years. The purpose of this specification is to allow maximum creative design flexibility to the OEM while meeting key market requirements.

2. PRODUCT GOALS, COMPETITION

The following are the product goals, which will provide market differentiation over Westell's competitors:

GOALS:

1. Industry lowest cost;
2. High level of integration, significantly reducing part numbers and sub-assemblies, decreasing assembly and test time. Cost shall always be considered as a priority over the level of high integration;
3. Reduced feature set targeting the majority of the market while utilizing current product for market fringes;
4. DC input power only. AC power, Battery backup and battery management, external to the BDA;
5. Industry lowest power;
6. Industry lowest form factor and weight;
7. Ease of use and installation;

COMPETITION

Westell competitors include, but are not limited to, Honeywell, ADRF, Comba, Cel-Fi, Nextivity, Fiplex

- **Cel-Fi:**

https://www.cel-fi.com/wp-content/uploads/2021/09/SOLORED_datasheet.pdf
<https://support.cel-fi.com/hc/en-us/articles/5868138688027-SOLO-RED-Installation-and-User-Guide>

- **Nextivity**

<https://fcc.report/FCC-ID/YETL41-7EB/>

- **Fiplex**

<https://fcc.id/P3TDH7S-00X>

- **Comba**

<https://fcc.report/FCC-ID/PX8RX78V2F-B/6106189.pdf>

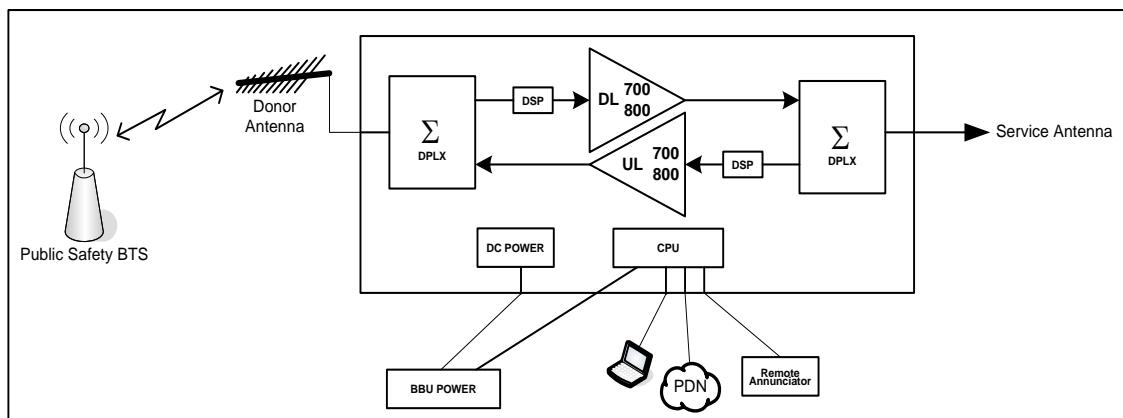
3. SYSTEM OVERVIEW

The overall system is depicted below. The internal system components are for conceptual purposes only (recognizing the goal of a high level of integration). Detailed interfaces will be included later in this specification.

The BDA allows a public safety base station transceiver (BTS) to transmit and receive PS radio signals to an area where this coverage is not readily available. This could be due to distance, terrain, material blocking, etc. The BDA is used to avoid the unnecessary expense of deploying an additional BTS for an application where the actual required capacity is very low.

In its simplest form, the BDA receives, through a donor antenna, BTS signals and amplifies them into the desired coverage area; this is referred to as the downlink (DL). The BDA also receives signals from users in the desired coverage area, from a service antenna, and amplifies them back to the BTS through the donor antenna; this is referred to as the uplink (UL). The UL and DL are combined onto the shared donor and service antennas. This is accomplished through the use of duplexers (DPLX) or some other means.

Both the 700 and 800 bands UL and DL provide filtering to better isolate specific radio channels and improve RF power efficiency. Each band can provide up to 64 channel filters that are provisioned via digital signal processing (DSP). The selectable channel bandwidths will then be **75 kHz - 150 kHz for Class B operation and GSM / CDMA/ LTE (5 MHz)**. These channels are selected anywhere within the 700 and 800 MHz bands. An additional wideband mode shall be available providing the passing of the entire 700 and 800 band without channel filtering.



External interfaces include:

- Power and alarms from a battery backed-up DC source
- Local and web based user interface and monitoring
- Alarm relay connectivity
- Interface to a remote annunciator per UL 2524 requirements.

Not all of these interfaces are implemented depending on the specific application.

4. TOP LEVEL SYSTEM REQUIREMENTS

4.1 RF REQUIREMENTS

R: Requirement - absolutely necessary

O: Objective – **ONLY** if product cost is not increased

| ITEM | Description |
|-------|---|
| R1 | Shall be dual band to support both 700 MHz and 800 MHz Public Safety Bands |
| R3 | Shall support 700 MHz Public Safety Band UL 799-806 MHz DL 769-776 MHz |
| R4 | Shall support 800 MHz Public Safety Band UL 806-824 MHz DL 851-869 MHz |
| R5 | Shall support independent single band operation for either 700 MHz or 800 MHz band through software selection |
| R5.5 | Shall be software selectable as Class A or Class B for each band independently. |
| R6 | Shall support UL and DL 800 band Class A digital filtering bandwidth of 12.5 and 75kHz |
| O6.1 | Shall support UL and DL 800 band Class A digital filtering bandwidth of 12.5, 25, 50, 75kHz |
| R6.2 | Shall support UL and DL 700 band Class A digital filtering bandwidths of 12.5 and 75kHz |
| R6.3 | Shall support UL and DL 700 band Class A digital filtering bandwidth of 12.5, 25, 50, 75kHz |
| R6.4 | Shall support UL and DL 800 band Class B digital filtering bandwidths of 75-150 kHz |
| R6.91 | Shall support 64 total filters shared between 700 and 800 in the UL and DL |
| R6.92 | Shall have the sum of 700 and 800 UL and DL equal 64 filters |
| R7 | Shall support 0,8,16,24,32,40, 48,56 and 64 800 band Class A channelized filters in the UL and DL (64,56,48,40,32,24, 16,8 and 0 remain for 700) |
| R7.2 | Shall support 0,8,16,24,32,40, 48,56 and 64 700 band Class A channelized filters-in the UL and DL (64,56,48,40,32, 24,16,8 and 0 remain for 800) |
| R7.4 | Shall support 0,8,16,24,3240,, 48,56 and 64 800 band Class B channelized filters in the UL and DL (64,56,48,40,32, 24,16,8 and 0 remain for 700) |
| R7.6 | Shall support 0,8,16,24,32,40, 48,56 and 64 700 band Class B channelized filters-in the UL and DL (64,56,48,40,32,24, 16,8 and 0 remain for 800) |
| R7.8 | Shall support 700 and 800 wideband mode. Entire 700 and 800 band is passed with no channelized filters. But USER selectable AGC LEVEL is still supported. |
| R8 | Shall allow the frequency and bandwidth of each 800 and 700 band Class A channelized filter to be independently selectable by the user |
| R8.2 | Shall allow the frequency and bandwidth of each 800 and 700 band Class B channelized filter to be independently selectable by the user |
| R9 | Shall only allow filters to be implemented in defined allowed states |
| R9.3 | Shall only allow either a UL or DL center frequency to be entered and automatically mirror either the DL or UL center frequency and bandwidth |
| R12 | Shall support up to 90dB of gain in the DL and 80dB in the UL |
| R13 | Shall support up to 30db of manual attenuation in 1dB increments for the UL and DL independently configurable for each channel filter Class A and Class B |
| R13.1 | Shall support up to 30 dB manual composite gain adjustment in 1 dB increments for the UL and DL 700 and 800 bands. |
| R14 | Shall support 1/2 W (27dBm) output power per band in the DL |
| R14.1 | Shall support 1/4W (24dBm) per band in the UL |
| R15 | Shall support a max input power of -20 dBm (DL) and -10 dBm (UL) without overdrive |
| R15.2 | Shall support a max input power of +20 dBm in the UL and DL without damage |
| R16 | Shall meet a VSWR of 1.5:1 |
| R17 | Shall meet a noise figure of < 6 dB at max gain for UL and DL |
| R18 | Shall meet a propagation delay of < 15 us for Class B operation |
| R19 | Shall meet a gain accuracy of +/- 1.5 dB |
| R20 | Shall support input and output power detection on Donor and Service ports |
| R20.2 | Shall support power measurement for each individual filter channel |
| R20.4 | Shall support power measurement for P25 phase 2 TDMA |
| R21 | Shall meet pass band ripple of 3 dB pk-pk |
| R22 | Shall meet sub band filter ripple of 1.5 dB pk-pk |
| R24 | Shall support squelch thresholds in UL for each band per filter |
| R24.1 | Shall support P25 phase 2, timeslot-by-timeslot squelch control per filter |
| R25 | Shall support DL and UL USER selectable AGC LEVEL (output power limit) |
| R26 | Shall support P25 phase 2, timeslot-by-time slot AGC LEVEL CONTROL |
| R28 | Shall support STANDARD MODE USER set AGC LEVEL – See Section 7 |
| R30 | Shall support DYNAMIC MODE USER set AGC LEVEL – See Section 7 |

4.2 MECHANICAL, ENVIRONMENTAL, AND POWER REQUIREMENTS

| ITEM | Description |
|------|--|
| R100 | BDA enclosure shall be less than 7.9 liters (480 cu. in.) |
| O110 | BDA enclosure shall be (WXHxD) 381 mm X 203 mm X 102 mm (15 in. X 8 in. X 4 in) |
| O120 | BDA enclosure may use plastics if cost effective vs. metal |
| R130 | BDA enclosure shall weigh less than 10 pounds |
| R140 | BDA operating temperature -30 to + 50 degC |
| R150 | BDA enclosure shall be self-cooling by natural convection |
| R160 | BDA enclosure shall have no internal fans |
| R170 | BDA enclosure shall be painted red (RAL-3001) in color |
| R180 | BDA enclosure shall have an easy access hinged captive door |
| R190 | BDA enclosure shall have all external power and signaling interfaces on the bottom end cap, RF connectors may be on top end cap. |
| R200 | BDA enclosure shall support wall mounting using integrated flange mounts |
| R210 | BDA shall have individual packaging, wall mount template and mounting screws with labeling and QR code for documentation |
| R215 | BDA packaging must include all cables, glands, fittings and wiring for installation |
| R220 | BDA packaging must withstand drop test - The packaged equipment shall not sustain any physical damage or deteriorate in functional performance when subjected to a 1-meter free-fall on 3-sides and 3 corners. |
| R225 | BDA shall be power by 12 VDC |
| O227 | BDA may be powered by either 12VDC or 24 VDC if it does not add significant cost |
| R230 | BDA must have an internal DC power switch |
| R235 | BDA shall have a maximum power dissipation of 70 W |

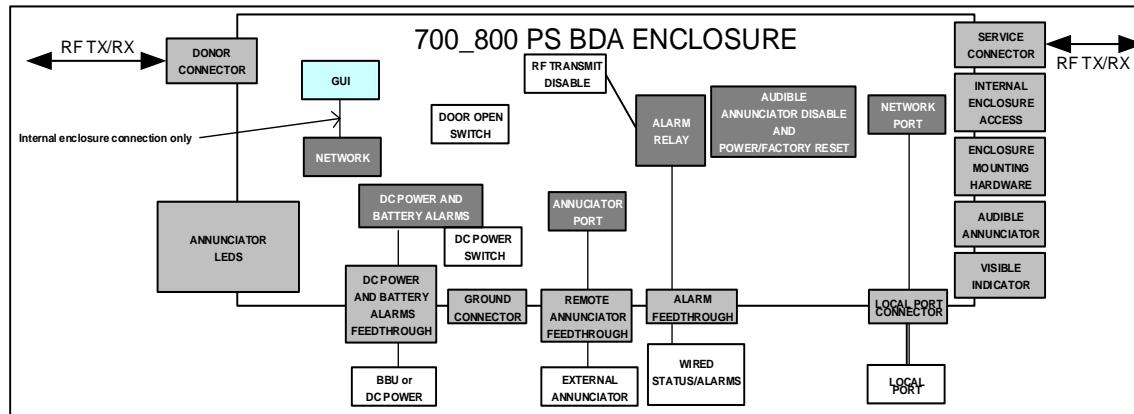
4.3 REGULATORY REQUIREMENTS

| ITEM | Description |
|------|--|
| R300 | BDA shall meet FCC Title 47 CFR Part §90.219 |
| O305 | BDA shall meet ISED RSS-131 if no additional cost is added |
| R310 | BDA shall meet UL 2524, Second Edition, January 2019 |
| R320 | BDA shall meet NFPA 1221 and 72 2019 |

4.4 GENERAL RFI/RFQ REQUIREMENTS

| ITEM | Description |
|------|---|
| R330 | BDA shall interface with Westell provided BBU |
| R335 | BDA shall interface with Westell provided remote annunciator (C40-ANNUNC) |
| R338 | BDA shall provide a local, WEB-BASED GUI port for status and provisioning |
| O337 | BDA should have a build option for duplexer that can support RF split for DAS Donor BDA |
| O338 | BDA should have a population option for communicating with DAS Remotes daisy chain and star configuration for up to 30 BDA's with combination of daisy chain and star |
| O339 | OEM should describe what Optical remote or DAS mux can be supported along with existing remotes and high level pricing |
| R340 | BDA shall have a Warranty period of 36 months |
| R350 | Target cost <\$3000 (100 units per year), <\$2700/unit (300 units per year), \$ 2400 (500 units per year), \$ 2100 (1000 units per year) |
| | |
| | |
| | |
| | |

5. SYSTEM INTERFACE REQUIREMENTS



5.1 INTEGRATED ENCLOSURE INTERFACES

The BDA has 12 (twelve) user interfaces integrated into the enclosure and accessible when the unit is installed and the enclosure is shut.

5.1.1 CONNECTORS

The BDA has 4 (four) connector interfaces: **(1, 2) DONOR and SERVICE** - The BDA provides improved communication coverage to a limited service area in both the UL and DL of the system through two air interfaces. In the DL, the DONOR port receives signals from the PS base station, amplifies them and retransmits the amplified signals out the SERVICE port to the intended service area. In the UL, the SERVICE port receives signals from the intended service area, amplifies them and sends the amplified signals out of the DONOR port to the PS base station; **(3) GROUND** – The BDA enclosure shall have one chassis ground interface allowing for UL NFPA recognized installation grounding; **(4) LOCAL PORT** – The BDA enclosure has one fixed connector port allowing a physical connection for communications with the BDA to provision, configure and commission the BDA through a web based GUI.

5.1.2 FEEDTHROUGHS

The BDA enclosure has 3 (three) feedthrough interfaces: **(1) DC POWER** and **BATTERY ALARMS** – The BDA has one DC Power feedthrough for DC power and associated UL2524 status and alarms. **(2) REMOTE ANNUNCIATOR** – The BDA enclosure has one feedthrough that is unwired for access to provide power and alarm signaling to a remote annunciator that may or may not be utilized. If utilized the user must terminate the status and alarm cable through the connector internal to the enclosure; **(3) ALARM** – The BDA enclosure has one feedthrough to provide wired connection to one status signal and 7 UL2524 required alarms and additional alarms. If any of these wired connections are utilized the user must terminate these to the alarm relay connector internal to the enclosure.

5.1.3 MECHANICAL HARDWARE INTERFACES

The BDA enclosure has 2 (two) mechanical hardware interfaces: **(1) INTERNAL ENCLOSURE ACCESS** which allows the user to access the inside of the enclosure physically, and; **(2) ENCLOSURE MOUNTING HARDWARE** which allows the user to mount the enclosure in a variety of physical environments.

5.1.4 AUDIBLE ANNUNCIATOR

The BDA has 1 (one) audible interface. This is not external to the enclosure but is defined as an external enclosure interface since the user will be able to hear the audible buzzer external to the enclosure per UL 2524 guidelines for 7 defined alarm signals associated with the corresponding alarm feedthrough. Regardless of the user utilizing external alarm wires through the interface the audible signal will be present for all alarm conditions.

5.1.5 VISIBLE INDICATOR

The BDA has 1 (one) visible LED indicator collocated with the other front panel LEDs.

5.1.6 FRONT PANEL ANNUNCIATOR LEDS

The BDA has 11 LEDs that visibly display UL2524 and other custom alarms and status.

5.2 INTERNAL INTERFACES

5.2.1 USER ACCESSABLE

The BDA enclosure has 6 (six) internal interfaces only available to the user through the INTERNAL ENCLOSURE ACCESS interface: **(1) NETWORK PORT (NMS)** allowing for a physical connection to a network port for remote system monitoring. The local port is internal only with no associated feedthrough; **(2) DC POWER and BATTERY ALARMS** allows the user to physically wire BBU alarm leads and 12 VDC external power through the BATTERY FEEDTHROUGH ; **(3) ALARM RELAY AND I/O** - Allows the user to physically connect to external wires from as defined in the USER ACCESSABLE INTERNAL INTERFACES; **(4) ANNUNCIATOR PORT** – Allows physical connection for serial communication and powering of the Westell, external annunciator through the REMOTE ANNUNCIATOR FEEDTHROUGH; **(5) AUDIBLE ANNUNCIATOR DISABLE and POWER/FACTORY RESET** - Allows the user through a button to either perform (a) temporary disable of the enclosure's AUDIBLE ANNUNCIATOR, (b) a soft reset by cycling power, or (c) a factory reset; **(6) DC POWER SWITCH**.

5.3 DOOR OPEN

Switched or sensor circuitry will provide an alarm signal if the enclosure door is open.

5.4 RF TRANSMITTER DISABLE

In certain situations, a user may decide to activate an external switch providing an external contact closure. This action will disable PSR RF transmit operation, but will allow control of the PSR through the GUI.

5.5 GRAPHICAL USER INTERFACE

The BDA has one, web-based GUI that controls the provisioning, configuration and commissioning of the system and is used by the user for troubleshooting and maintenance.

6. USER INTERFACE SPECIFICATIONS

6.1 INTEGRATED ENCLOSURE INTERFACES

6.1.1 CONNECTORS

All connectors will be on the bottom endplate of the enclosure (unless noted otherwise) providing adequate clearance for tools and fingers.

| NAME | DESCRIPTION | TYPE | LEVEL |
|---------|--|--|---------------------------|
| DONOR | TRIPLEXED – TX 700+800 MHZ BAND UL : RX 700 MHZ BAND DL : RX 800 MHz BAND DL RX | RF INPUT/OUTPUT N FEMALE | 50 Ohms |
| SERVICE | TRIPLEXED – RX 700+800 MHZ BAND UL: TX 700 MHZ BAND DL: TX 800 MHz BAND DL | RF INPUT/OUTPUT N FEMALE | 50 Ohms |
| GROUND | Ground stud with locking nuts to allow for a wired ground lug. (Note: Ground stud may be located on the lower side of the enclosure, as close to the lower end plate as possible, but wire and wiring lug shall not interfere with door hinge mechanism operation).  | Screw, Hex Head, Full Thread, 1/4-20, Steel Nut, Keps, 1/4-20, Steel Nut, Hex Full, 1/4-20 Steel | GND |
| LOCAL | Used for temporary system access | IP RJ-45 FEMALE CONEC 17-101754 or equivalent with protective cover | 10/100 Base-T Ethernet |

6.1.2 FEEDTROUGHS

All feedthroughs will be on the bottom endplate of the enclosure providing adequate clearance for tools and fingers.

| NAME | DESCRIPTION | TYPE – See Note |
|-----------------------------|--|-----------------|
| DC POWER and BATTERY ALARMS | UL 2524 Installations 3/4" Non-metallic Conduit Fitting | PN: Heyco 8404 |
| | Non-UL2524 Installations 3/4" UL Listed Cord Grip | PN: Heyco M3234 |
| REMOTE ANNUNCIATOR | UL 2524 Installations 1/2" Non-metallic Conduit Fitting | PN: Heyco 8402 |
| | Non-UL2524 Installations 1/2" UL Listed Cord Grip | PN: Heyco M3231 |
| ALARM | Non-UL2524 Installations 3/4" UL Listed Cord Grip | PN: Heyco 8404 |

Note – All parts may have equivalent part numbers as long as they are UL recognized

6.1.3 MECHANICAL INTERFACES

6.1.3.1 Internal Enclosure Access

The user will be provided an easy way to access the internal enclosure interfaces.

- Access will not require any special tools;
- Access must provide full visibility of internal interfaces;
- Access will have captive hardware;
- Access will have a hinged door;
- Access must provide a keyed latching mechanism;
- The key for the latching mechanism must be captive (non-removable) in the lock when the latch is open (unlocked). It can only be removed when latch is closed and locked to prevent losing the key as specified by the UL2524 specification.
- Removal of the latch from the enclosure shall only be allowed when the latch is unlocked. When the latch is locked no tools shall be allowed to be used to remove the latch from the enclosure.
- Hinged door will remain open by friction or hardware allowing user the use of both hands;
- Reasonable practice will be put in place to protect sensitive circuitry;
- There must be a clearly visible ESD ground point for a user to clip on an ESD wrist strap.

6.1.3.2 Enclosure Mounting Hardware

The user will be provided an enclosure mounting kit.

- Mounting kit will not require any special tools;
- Mounting kit shall allow for wall mounting;
- Screws shall be provided
- Wall mounting template shall be provided.

6.1.4 AUDIBLE ANNUNCIATOR

Upon activation of any of the alarms a buzzer internal to the BDA enclosure (or some other audible annunciator) shall sound for a period of 1 second at 10 second intervals. Deactivation or masking of individual audible alarms shall be provided in the software GUI. If any of the alarms are masked in the software GUI, that alarm shall not cause the audible alarm to sound. There is no decibel level requirement for the audible signal. But the buzzer needs to have UL Recognition. Alarm should be audible within a 15' radius when the door of the enclosure is closed and locked.

6.1.5 VISIBLE INDICATOR

The BDA enclosure will have 1 (one) LED, SYSTEM, on the front panel of the enclosure. The LEDs are defined as follows:

6.1.5.1 SYSTEM

The SYSTEM LED will be labeled as **SYSTEM**.

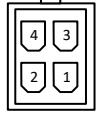
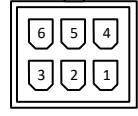
The SYSTEM LED is a tricolor LED – green, yellow, red

| STATE | LED |
|---|--------|
| SYSTEM NORMAL – POWER ON | GREEN |
| ANY ALARM DETECTED – SYSTEM OPERATIONAL | YELLOW |
| ANY ALARM DETECTED SYSTEM NOT OPERATIONAL | RED |
| ALARM RELAY INTERFACE ALARM ACTIVE BUT MASKED | GREEN |
| NO DC POWER PRESENT | OFF |

6.2 INTERNAL INTERFACES

All internal interfaces are accessed by qualified personnel through the INTERNAL ENCLOSURE ACCESS INTERFACE.

6.2.1 USER ACCESSABLE

| NAME | DESCRIPTION | TYPE | LEVEL |
|----------------|--|---|---|
| NETWORK PORT | Remote monitoring | IP RJ-45 FEMALE | 10/100 Base-T Ethernet |
| DC POWER | 4 Position Connector | Molex Connector 50-36-1768 Pins 1, 2 = +12 VDC. Pins 3, 4 = RTN.  VIEWED FROM FACE ON | 12 VDC See Note |
| BATTERY ALARMS | 6 Position Connector | Molex Connector 50-36-1778 Pin 1 = AC FAIL COMMON Pin 2 = BCL COMMON Pin 3 = CF COMMON Pin 4 = AC FAIL Pin 5 = BATTERY CAPACITY LOW Pin 6 = CHARGER FAIL  VIEWED FROM FACE ON | CONTACT CLOSURES |
| ALARM RELAY | 11 Dry contacts 33 Position Terminal Lug(s) | Each contact 3 positions 16-18 GA. Common (C) Normally Open (NO) and Normally Closed (NC) – ease of installation and cost should be considered | Form C See Figure 6 - "BDA LED, Relay and Controls" below |
| | OFF-NORMAL | STATUS | |
| | LOSS OF AC POWER | ALARM | |
| | BATTERY CAPACITY LOW | ALARM | |
| | BATTERY CHARGER FAIL | ALARM | |
| | RF EMITTER FAIL | ALARM | |
| | DONOR ANTENNA MALFUNCTION | ALARM | |

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| | | | | |
|---|---|---------|---|--|
| | DONOR ANTENNA DISCONNECTION | ALARM | OUTPUT | |
| | SYSTEM COMPONENT FAIL | ALARM | OUTPUT | |
| | OSCILLATION DETECTION | ALARM | OUTPUT | |
| | CUSTOM 1 | ALARM | OUTPUT | |
| | CUSTOM 2 | ALARM | OUTPUT | |
| RF TRANSMITTER DISABLE | UL and DL HPAs DISABLE | CONTROL | INPUT | CONTACT CLOSURE DETECTION |
| ANNUNCIATOR PORT | Serial Communications and Power with External Annunciator – The Remote Annunciator is a Westell controlled product and the interface specification will be made available to the OEM. | | RJ-45 Female Output Input for comms check | >1000 m distance 28 VDC RS-485 Serial Data |
| AUDIBLE ANNUNCIATOR DISABLE and POWER/FACTORY RESET | Audible Annunciator disable Button pressed and released momentarily (less than 3 seconds) will temporarily disable the BDA enclosure audible annunciator for 24 hours. The audible annunciator will remain disabled unless: (1) An alarm clears and then reappears or (2) A new alarm appears or (3) button is again momentarily pressed. In case number 3, an audible "chirp" shall alert the user of successful cancellation of the audible annunciator disable. Power Reset Button pressed then released between 3 and 8 seconds will cause a system reboot. Factory Reset Button pressed greater than 10 seconds will cause a factory reset and system reboot. | | PUSH-BUTTON The button should be easily accessible but provide some mechanism that an accidental user movement will not cause an unintended reset, such as side guards or sufficient activation force needed. The PCB should be clearly marked or silkscreened near the button MUTE + POWER/FACTORY RESET | |

A suggested Terminal Block: An equivalent or other OEM suggested component is welcomed.

<http://www.brter.com/> (Part name : BR-762C2)

6.2.2 ALARM TESTING

Alarm testing via the software GUI must be provided for the 7 alarms listed in 6.5 column 3 via a software “button” to activate that alarm. Activation will report alarms to the dry contacts, enclosure audible annunciator, front panel and remote annunciator LEDs and SNMP, and within the GUI. When the alarm test is deactivated the alarm will reset to its present state.

A TEST ALL FUNCTION will cycle through each alarm test at 5 second intervals.

6.3 ALARM INTERACTIONS – STANDARD SYSTEM

| GUI/SNMP ALARM | BDA ACTION | BDA DRY CONTACT, AUDIBLE ANNUNCIATOR REMOTE ANNUNCIATOR and FRONT PANEL LEDs |
|---|-----------------------------|--|
| NO DC PRESENT– BATTERY DEPLETED SYSTEM DEAD | NA – SYSTEM DEAD | NA – SYSTEM DEAD |
| DONOR ANTENNA DISCONNECT | NONE | DONOR ANTENNA DISCONNECT RF EMITTER FAIL |
| OSCILLATION DETECTION - SERVICE AFFECTING | 700 & 800 RF SHUTDOWN | SYSTEM COMPONENT FAIL RF EMITTER FAIL |
| OVER TEMPERATURE | 700 & 800 RF SHUTDOWN | SYSTEM COMPONENT FAIL RF EMITTER FAIL |
| UL AMPLIFIER FAIL | 700 & 800 UL+DL RF SHUTDOWN | RF EMITTER FAIL |
| DL 700 AMPLIFIER FAIL | 700 DL RF SHUTDOWN | RF EMITTER FAIL |
| DL 800 AMPLIFIER FAIL | 800 DL RF SHUTDOWN | RF EMITTER FAIL |
| DONOR ANTENNA MALFUNCTION | NONE | DONOR ANTENNA MALFUNCTION |
| OSCILLATION DETECTION – REDUCED GAIN | NONE | SYSTEM COMPONENT FAIL |
| LOSS OF RA COMMUNICATIONS | NONE | SYSTEM COMPONENT FAIL |
| BATTERY CAPACITY LOW | NONE | BATTERY CAPACITY LOW |
| BATTERY CHARGER FAILURE | NONE | BATTERY CHARGER FAIL |
| LOSS OF AC POWER | NONE | LOSS OF AC POWER |
| DOOR OPEN | NONE | N/A |

| | |
|-------------------------------------|---|
| CRITICAL ALARM Service Affecting | WARNING Service unaffected or degraded |
|-------------------------------------|---|

The above alarm interactions are the allowable states that the dry contacts, enclosure audible annunciator and remote annunciator and LEDs will be in.

6.4 AUDIBLE ANNUNCIATOR ALARM MASKING

In certain cases the user may wish to mask the BDA audible annunciator. This masking permanently masks “mutes” the alarms. This can only be performed through the GUI. Any alarm can be unmasked at a later time.

6.4.1 UL 2524

To be compliant with UL 2524, no audible alarms are to be masked by the end user although they will be allowed to do so. It is the responsibility of the end user to operate the BDA system in compliance with UL 2524.

6.4.2 NON UL 2524

All BDA enclosure audible alarms may be masked. The following table depicts the Westell suggested masking guidelines:

| ALARM | MASK ALLOWED | WESTELL SUGGESTED | WESTELL SUGGESTED CASE |
|---------------------------|--------------|-------------------|--|
| LOSS OF AC POWER | YES | YES | No AC power, user is supplying their own DC power plant. |
| BATTERY CAPACITY LOW | YES | YES | User is supplying DC power only – no BBU |
| BATTERY CHARGER FAIL | YES | YES | User is supplying DC power only – no BBU |
| RF EMITTER FAIL | YES | NO | NA |
| DONOR ANTENNA MALFUNCTION | YES | YES | System is on edge of downlink noise range from base station causing false alarms when DL signal is not present. User accepts risk. |
| DONOR ANTENNA DISCONNECT | YES | YES | System is on edge of downlink noise range from base station causing false alarms when DL signal is not present. User accepts risk. |
| SYSTEM COMPONENT FAIL | YES | NO | NA |
| OSCILLATION DETECTION | YES | NO | |

6.5 USER SELECTED SPECIAL ALARMS/INTERACTIONS

The GUI allows for certain alarm behaviors to be enabled for certain geographical regions.

6.5.1 OSCILLATION DETECTION

In addition to the Oscillation detection as already described, a user selected Oscillation detection shall also cause the BDA RF EMITTER FAIL LED and the Remote Annunciator RF EMITTER FAIL LED to flash.

6.5.2 SERVICE ANTENNA DISCONNECT

If the SERVICE PORT VSWR exceeds a threshold of 6:1(return loss < 3 dB), the BDA SYSTEM COMPONENT FAIL alarm will enable and the BDA SYSTEM COMPONENT FAIL LED and the Remote Annunciator SYSTEM COMPONENT FAIL LED SHALL flash.

6.5.3 BATTERY DISCONNECT

If the battery is disconnected the BATTERY CHARGER FAIL and BATTERY CAPACITY LOW alarm shall be enabled on the BDA and Remote annunciator. These alarms are generated in the BBU and sent to the BDA.

6.5.4 LOSS OF AC POWER

If the system loses AC power, the LOSS of AC POWER and BATTERY CAPACITY Alarms shall be enabled. These alarms are generated in the BBU and sent to the BDA.

6.8 GRAPHICAL USER INTERFACE

The web/browser-based GUI is developed and controlled by Westell focusing on user experience. The OEM partner is required to interface to this GUI for all end user configuration and monitoring.

Westell controls the API specification for the GUI and provides this to the OEM.

The OEM may have their own GUI for factory/engineering use. However, the end user will never be provided access to this. In addition, Westell should not ever need to access the OEM GUI unless jointly trouble shooting a field or factor issue with the customer.

7. SYSTEM SPECIFICATIONS

7.1 RF AND ELECTRICAL

| ITEM | PARAMETER | DESCRIPTION | UNIT | NOTES |
|------|--|-------------------|------|---|
| 1 | 700 DL Freq. Band | 769-775 | MHz | |
| 2 | 700 UL Freq. Band | 799-805 | MHz | |
| 5 | 800 DL Freq. Band | 851-869 | MHz | |
| 6 | 800 UL Freq. Band | 806-824 | MHz | |
| 7 | B2I & B9B | Narrow & wideband | | CW/ P25 Phase 1 (12.5 kHz x n, n= 6-12), GSM ,CDMA, LTE 5 MHz |
| 9 | Class A Channelized Filter BW | 12.5 and 75 | kHz | |
| 10 | Class A Filter Rejections | | | |
| | 12.5 kHz @ $\Delta f > 30$ kHz | >50 | | |
| | 75 kHz @ $\Delta f > 210$ kHz | >50 | | |
| 11 | Class A System Group Delay for each filter | | | |
| | 12.5kHz | <60 | | |
| | 75kHz | <15 | | |
| 12 | Number of DL Class B Filters per Band | 48 | | Total of 64 filters shared between bands |
| 13 | Number of UL Class B Filters per Band | 48 | | Total of 64 filters shared between bands |
| 13.2 | Class B Channelized Filter BW | 0.150 | MHz | |
| 13.4 | Class B Filter Rejections | | | |
| | 0.150MHz @ $\Delta f > 210$ kHz | >50 | | |
| 13.6 | Class B Group Delay for each filter | | | |
| | 0.150MHz | <15 | | |
| 14 | Wideband Mode Rejection | >60 | dB | @ >1 Mhz outside passband edges defined in ITEMS 1,2,5 and 6. |
| 14.2 | Wideband Mode Group Delay | <10 | uS | |
| 16 | System Gain DL | 90 | dB | |
| 17 | System Gain UL | 80 | dB | |
| 18 | UL and DL Composite Gain Adjustment per Band | 30 | dB | 1 dB steps – Attenuation adjustment per band |
| 18.5 | UL and DL Gain Adjustment per Channel (Filter) | 30 | dB | 1 dB steps – Attenuation adjustment |
| 19 | Gain Accuracy | +/- 1.5 | dB | |
| 20 | Frontend AGC Range | 30 | dB | Composite AGC to not saturate ADC input |
| 20.1 | USER set AGC LEVEL Range | 27 to – 3dBm | | Controlled by DSP per channel |
| 20.2 | AGC LEVEL response time | < 1.0 | ms | Response time per channel filter |
| 21 | DL 700MHz Band System Output Power | 27 | dBm | |
| 21.1 | DL 800MHz Band System Output Power | 27 | dBm | |
| 22 | UL 700MHz Band System Output Power | 24 | dBm | |
| 22.1 | UL 800MHz System Output Power | 24 | dBm | |
| 23 | DL Noise Figure | <6 | dB | At full gain |
| 24 | UL Noise Figure | <6 | dB | At full gain |
| 25 | DL OIP3 | 42.5 | dBm | Two tones at 24 dBm each; |
| 26 | UL OIP3 | 38 | dBm | Two tones at 21 dBm each; |
| 27 | DL 1 dB Compression | 32.5 | dBm | |
| 28 | UL 1 dB Compression | 28 | dBm | Each Band |

NEXT GENERATION 700/800 PUBLIC SAFETY BDA

| | | | | |
|------|--|-------------|------|---|
| 29 | DL Max Input Power Without Overdrive | -10 | dBm | |
| 30 | UL Max Input Power Without Overdrive | +10 | dBm | |
| 30.1 | UL DL Max Input Power Without Damage | +20 | dBm | |
| 31 | Pass Band Ripple | 3 | dB | pk-pk – Entire band; |
| 32 | Class A channel ripple | 1.5 | dB | pk-pk |
| 33 | Class B channel ripple | 1.5 | dB | pk-pk |
| 34 | EVM - TDMA | 4% | % | P25 phase 1 and phase 2 modulation |
| 35 | Spurious | <-13 | dBm | FCC Title 47 Part 90.219 |
| 37 | UL Squelch Threshold | -70 to -100 | dBm | Per Class A and B Channel, must have a disable |
| 37.2 | UL Squelch response time (on) | < 1.0 | ms | P25 phase 2 timeslot-by-timeslot +/- 3 dB threshold |
| 37.4 | UL squelch response time (off) | < 1.0 | ms | P25 phase 2 timeslot-by-timeslot +/- 3 dB threshold |
| 38 | Impedance | 50 | Ohms | |
| 40 | Donor and Service Port VSWR | 1.5:1 | | |
| 42 | 800 DL to UL Isolation | 110 | dB | |
| 43 | 700 DL to UL Isolation | 110 | dB | |
| 45 | 700+800 UL to 700 and 800 DL Isolation | 110 | dB | 700 and 800 UL will be a common band due to guard band separation |

7.2 UL AND DL USER SET AGC LEVEL

AGC LEVEL is used to limit the total output power of the BDA in the DL and UL. This is completely independent of frontend AGC which is an automatic composite input power control that protects saturating the ADC (analog to digital converter). Front AGC is invisible to the user.

AGC LEVEL is controlled solely by the DSP on a channel by channel basis. There are two modes of AGC LEVEL control: (1) STANDARD, (2) DYNAMIC. The modes are selected by the user in the GUI.

7.2.1 STANDARD MODE AGC LEVEL CONTROL

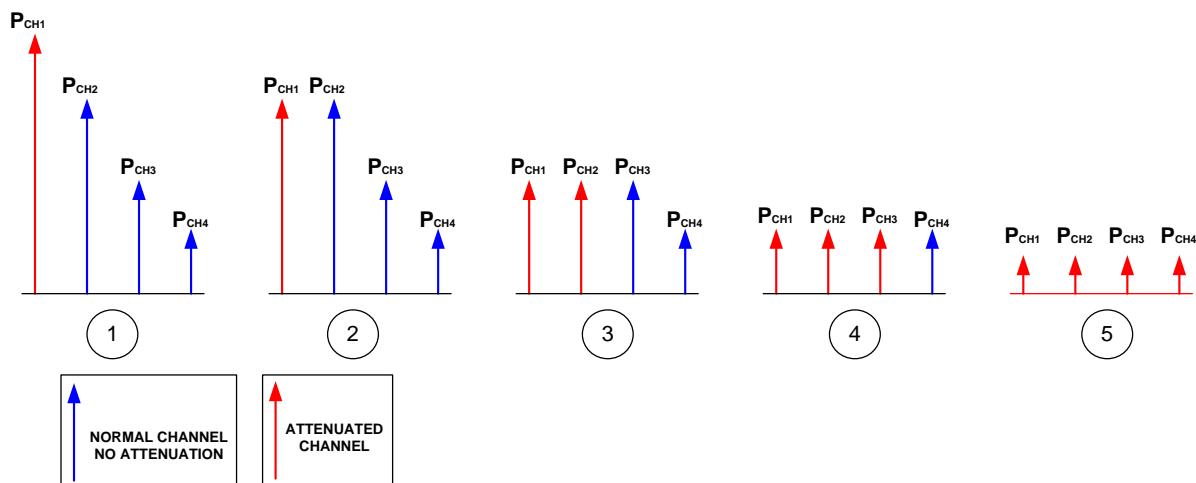
In STANDARD MODE, the DSP will limit the output power of each DSP channel filter to:

USER AGC LEVEL – $10\log(\text{number of enabled channels})$

7.2.2 DYNAMIC MODE AGC LEVEL CONTROL

In DYNAMIC MODE, the DSP will limit the output power of each DSP channel filter so that:

The sum of the power of all the DSP channel filters is \leq USER AGC LEVEL; this method ONLY attenuates the strongest signals in order of highest to lowest power levels, this is depicted below for a 4 (four) DSP channel filter system:



IF $P_{CH1}+P_{CH2}+P_{CH3}+P_{CH4} > \text{USER AGC LEVEL}$

1 to 2: Attenuate P_{CH1} until $P_{CH1}+P_{CH2}+P_{CH3}+P_{CH4} \leq \text{AGC LEVEL}$ **OR** $P_{CH1}=P_{CH2}$

2 to 3: Attenuate P_{CH1} and P_{CH2} until $P_{CH1}+P_{CH2}+P_{CH3}+P_{CH4} \leq \text{AGC LEVEL}$ **OR** $P_{CH1}=P_{CH2}=P_{CH3}$

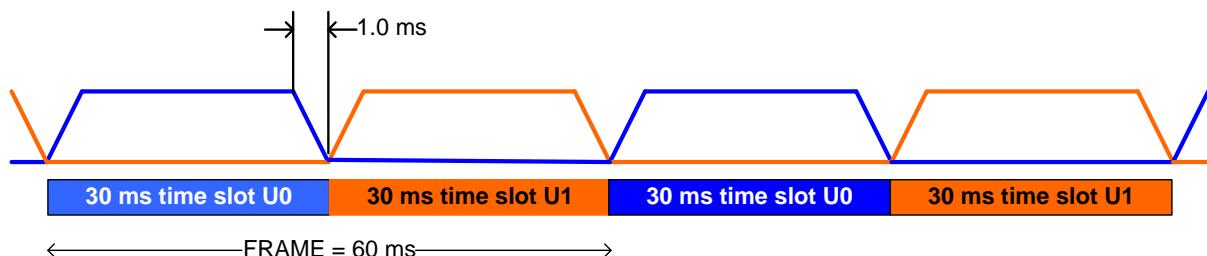
3 to 4: Attenuate P_{CH1} , P_{CH2} and P_{CH3} until $P_{CH1}+P_{CH2}+P_{CH3}+P_{CH4} \leq \text{USER AGC LEVEL}$ **OR** $P_{CH1}=P_{CH2}=P_{CH3}=P_{CH4}$

4 to 5: Attenuate P_{CH1} , P_{CH2} , P_{CH3} and P_{CH4} until $P_{CH1}+P_{CH2}+P_{CH3}+P_{CH4} \leq \text{USER AGC LEVEL}$

7.2.3 AGC LEVEL CONTROL RESPONSE TIME

To be compliant with P25 phase 2 operation, the AGC LEVEL control response time must be less than 1.0 ms. This means that the DSP must be able to detect DSP channel filter power changes, and perform the STANDARD or DYNAMIC mode calculations and adjust the filter attenuation within 1.0 ms to stay under the AGC LEVEL.

The time slot structure is shown below:



7.3 UL SQUELCH RESPONSE TIME

The user will set one UL SQUELCH value in the GUI that will be applied to each DSP channel filter. As with the AGC LEVEL Control Response ON and OFF Time, must be less than 1.0 ms.

7.4 REAL TIME CLOCK

A RTC must be provided so that accurate time is kept in the GUI within reasonable blackout period for time stamps and system logs. The RTC must keep time in the absence of power for 72 hours. Batteries are not allowed to power the RTC in absence of power. A Ultra/supercapacitor shall be utilized.

7.5 MECHANICAL, POWER AND ENVIRONMENTAL SPECIFICATIONS

| ITEM | PARAMETER | DESCRIPTION | UNIT | NOTES |
|------|-----------------------|--------------|--------------|--|
| 2 | Volume | <7.9 <480 | L cu. in. | |
| 3 | Weight | <10 | lbs | Without bracket |
| 4 | Operating Temperature | -30 to +50 | deg C | Natural convection, vertically mounted orientation. Warm up time necessary for system start up below -30 deg C |
| 5 | Operating Humidity | 5 to 95 | % | Non-condensing |
| 6 | Mounting | Wall | | Shall have keyhole mounting brackets similar to current product |
| 7 | Operating Voltage | 11.3 to 13.0 | VDC | Battery voltage from 30% to 100% capacity. 12 VDC nominal |
| 8 | Power Consumption | <70 | W | At fully rated RF output power @ 12 VDC |



7.6 ASTHETICS

The enclosure shall have a clean look with no obtrusions other than required by this document.

7.6.1 PAINT TYPE AND COLOR

RAL 3001 Signal Red
Powder Coat

8. REGULATORY AND COMPLIANCE

- UL 2524, Second Edition, January 2019
- UL 50/Type 4X
- NFPA 1221 and 72 2019
- FCC Title 47 CFR Part §90.219, since the BDA is capable of Class B operation it must be listed as Class B only with Class A operation being a less stringent subset of Class B.

9. ACCESSORY KITS

The following table shows the items that are physically installed on the BDA and those that are shipped along with the BDA packaging as optional accessories and miscellaneous accessories.

| Area | Item | Quantity |
|------------------------|--|-------------------------------|
| Installed Fittings | 1/2" Non-metallic Conduit Fitting - UL2524 Installations PN: Heyco 8402 or UL equivalent | 1pc - DC POWER/BATTERY ALARMS |
| | | 1pc - REMOTE ANNUNCIATOR |
| | 3/4" Non-metallic Conduit Fitting - UL2524 Installations PN: Heyco 8404 or UL equivalent | 1pc - ALARM |
| | | |
| Accessory Kit Fittings | 1/2" UL Listed Cord Grip - Non UL2524 Installations PN: Heyco M3231 or UL equivalent | 1pc - DC POWER/BATTERY ALARMS |
| | | 1pc - REMOTE ANNUNCIATOR |
| | 3/4" UL Listed Cord Grip - Non UL2524 Installations PN: Heyco M3234 or UL equivalent | 1pc - ALARM |
| | | |
| Accessory Kit Misc | AC Power 3 Wire Up to 16 AWG, 6 ft | |
| | Cat5e Ethernet cable, 2.0M | 1 |
| | SS 5/16" x 1" Hex Head Wood Screw | 4 |
| | SS 5/16" Washer | 4 |
| | Cabinet Keys | 2 |

1. FCC and ISED Mandatory

1.1 FCC Warning States

1.1.1 FCC Part 15.19 Warning

The 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.

1.1.2 FCC Booster warning Label

1) Part 90 Signal Boosters – THIS IS A 90.219 CLASS B DEVICE

WARNING. This is NOT a CONSUMER device. It is designed for installation by FCC LICENSEES and QUALIFIED INSTALLERS. You MUST have an FCC LICENSE or express consent of an FCC Licensee to operate this device. You MUST register Class B signal boosters (as defined in 47 CFR 90.219) online at www.fcc.gov/signal-boosters/registration. Unauthorized use may result in significant forfeiture penalties, including penalties in excess of \$100,000 for each continuing violation.

1.1.3 FCC Booster warning statements

Use of unauthorized antennas, cables, and/or coupling devices not conforming with ERP/EIRP and/or indoor-only restrictions is prohibited.

Home/ personal use are prohibited

Only 50 ohm rated antennas, cables and passive equipment shall be used with this remote. Any equipment attached to this device not meeting this standard may cause degradation and unwanted signals in the bi-directional system. All components connected to this device must operate in the frequency range of this device.

1.1.4 FCC Part 15 Class A

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense.

1.1.5 RF Radiation Exposure

This equipment complies with RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 40 cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. RF exposure will be addressed at time of installation and the use of higher gain antennas require larger separation distances.

(DL: Max. peak gain 3 dBi, UL: Max. peak gain 11 dBi)

FCC Part 15.21 statement

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