AMPLIFIED WIRELESS SOLUTIONS, INC

**Submittal Number: 27 60 07 and 27 60 02**

Puyallup Parking Garage

Sturgeon Electric

Contract #: 72573

AWS Project #: 10385

# Distributed Antenna System

## Specification Section: 27 60 02 and 27 60 07

**July 26, 2021**


**SUBCONTRACTOR**

Amplified Wireless Solutions, Inc.

5760 SE Gaitgill Court

Milwaukie, OR 97267


**Submittal 27 60 07 and 27 60 02**

CITY OF PUYALLUP STATE OF WASHINGTON

**Reviewed for Fire Code Compliance**

By David Drake

| | |
|---|---|
| **Building Permit No.** | F-21-0093 |
| **Date of Approval** | 8/24/2021 |

THE APPROVED CONSTRUCTION PLANS AND ALL ENGINEERING MUST BE POSTED ON THE JOB AT ALL INSPECTIONS IN A VISIBLE AND READILY ACCESSIBLE LOCATION.

Approval of submitted plans is not an approval of omissions or oversight by this office or noncompliance with any applicable regulations of local government. The contractor is responsible for making sure that the building complies with all applicable building codes and regulations of the local government.

*For Review and Approval Stamping*

**Submittal Number: 27 60 07 and 27 60 02**
Puyallup Parking Garage
Sturgeon Electric
Contract #: 72573
AWS Project #: 10385

# LIST OF REQUIRED SUBMITTALS

## Distributed Antenna System

### Specification Section: 27 60 02 and 27 60 07

| | Para. No. | Item Description | Submitted Herein | Submitted Previously | Future Submittal | Close Out Document |
|---|---|---|---|---|---|---|
| | 1.1 | Certificates | X | | | |
| | 2.1 | Test Equipment | X | | | |
| | 3.1 | Statement of Work | X | | | |
| | 4.1 | Acceptance Test Plan | X | | | |
| | 5.1 | Shop Drawings | X | | | |
| | 6.1 | RF Link Budget | X | | | |
| | 7.1 | Drawings for Donor Antenna and Grounding | X | | | |
| | 8.1 | Product Data Sheets | X | | | |
| | 9.1 | Maintenance Service Contract | | | X | |
| | 10.1 | Permit Drawings/Letter of Authorization | | | X | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

The undersigned, acting on behalf of Amplified Wireless Solutions, Inc., certifies that this submittal (Submittal Number: 27 60 07 and 27 60 02) has been reviewed and is approved; products have been verified as being as specified, field measurements and field construction criteria have been or will be coordinated, and the submittal is in compliance with the contract.

**NAME OF SUBCONTRACTOR:** Amplified Wireless Solutions, Inc.

**AUTHORIZED SIGNATURE:**

**TITLE OR POSITION:** Operations Manager

**DATE:** January 19, 2021

AMPLIFIED WIRELESS SOLUTIONS, INC

**Submittal Number: 27 60 07 and 27 60 02**
Puyallup Parking Garage
Sturgeon Electric
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AWS Project #: 10385

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**Submittal Number: 27 60 07 and 27 60 02**
Puyallup Parking Garage
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Contract #: 72573
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# TAB # 1

Distributed Antenna System

**Specification Section: 27 60 02 and 27 60 07**
Para. No. 1.1 Certificates

iBWAVE DESIGN CERTIFIED LEVEL 2

# iBWAVE CERTIFICATION PROGRAM
## iBWAVE DESIGN

**Aaron Baxter**

Participated and successfully completed **Level 2**.
This certification is valid until 2021-06-09

CONGRATULATIONS ON YOUR SUCCESSFUL COMPLETION.

Bicsi®

18.00 for Event ID: OV-IBW-CAN-0216-2

2018-06-10

Date

iBwave Learning Center

**Georges Kechichian**, Senior Vice-President, Engineering, iBwave Solutions Inc.

iBwave

iBwave Solutions Inc. T +1 514 397 0606 F +1 514 409 2499, 7075, Robert-Joncas, Suite 95, Montreal, Qc H4M 2Z2 Canada, info@ibwave.com www.ibwave.com

Comba

keeps you connected

THIS IS TO CERTIFY THAT

*Amplified Wireless Solutions*

HAS SUCCESSFULLY COMPLETED THE REQUIRED TRAINING,
AND IS CERTIFIED TO INSTALL AND COMMISSION
COMBA CRITICALPOINT™ PUBLIC SAFETY EQUIPMENT

Augustin Chang, President

1/2018

Date

AMPLIFIED WIRELESS SOLUTIONS, INC

**Submittal Number: 27 60 07 and 27 60 02**
Puyallup Parking Garage
Sturgeon Electric
Contract #: 72573
AWS Project #: 10385

# TAB # 2

Distributed Antenna System

**Specification Section: 27 60 02 and 27 60 07**
Para. No. 2.1 Test Equipment

Anritsu envision : ensure

490 Jarvis Drive, Morgan Hill, CA 95037-2809, USA Phone: 1-800-ANRITSU Fax: 408-776-8024

# Certificate of Calibration
# Standard Calibration

The product listed below has been calibrated in accordance with the documented procedures and is certified in compliance with ISO/IEC 17025 and ANSI/NCSL Z540.1. Accuracy of test equipment and standards is traceable to national and/or international standards, national metrology institutes (e.g., NIST, NPL, NMIJ, NIM), or derived from ratio type self calibration techniques.

The Anritsu suggested calibration interval is 12 months*.
Based on that interval, the Calibration Due Date is 30-January-2021.

| | | | |
|---|---|---|---|
| Model: | S412E | Customer Id: | 10115894 |
| Serial Number: | 1804035 | Customer: | AMPLIFIED WIRELESS SOLUTIONS<br>5760 SE GAITGILL COURT<br>MILWAUKIE, OR 97267 |
| Calibration Date: | 30-January-2020 | Issue Date: | 30-January-2020 |
| Repair Order: | CA224476 | Customer PO: | AMEX 1123 SULLIVAN |
| Temperature: | 24 °C (limit 18°C to 28°C) | Calibrated By: | ANRITSU AMERICAS<br>SALES COMPANY<br>490 JARVIS DRIVE<br>MORGAN HILL, CA 95037-2809 |
| Rel. Humidity: | 33 % (limit 10% to 80% Non Condensing) | | |
| Test Procedure: | GPRG 73256 | | |
| Procedure Rev: | v5.30 | | |
| Subcontractor Used: | No | | |

Calibrated on-site at customer's location? ☐

**As Received Condition**

Physical Condition: Good

Within Tolerance: Yes

See note below if Out of Tolerance and/or describe physical condition if poor:

**As Shipped Condition**

Within Tolerance: Yes

See note below if a Limited Cal was performed or the product was returned un-repaired:

**Certificate Number:** US00150713

Calibrated By: Richard Broers

Signature: Richard Broers

Approved By: Keely Lozano, Customer Service

Signature: Keely Lozano

* *This suggestion is based on Anritsu's global experience with this product. Your application may require a different calibration interval due to factors such as required accuracy, control limits, connector wear or other factors in your measurement process.*

**Anritsu is accredited to ISO17025 through A2LA and registered to ISO9001 by NQA.**

# CERTIFICATE of ACHIEVEMENT

This is to certify that

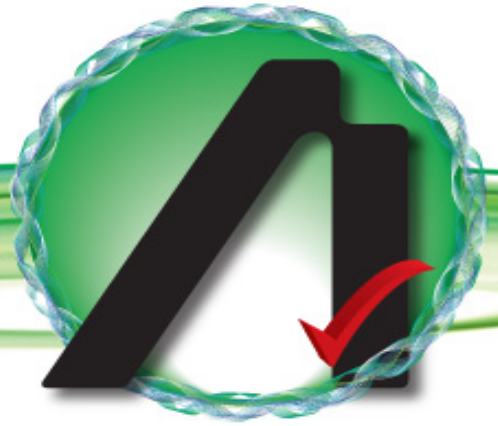
## Jim Muzynoski

has completed the online course

Site Master Line Sweep Online Prep for In-Person Training

June 21, 2017

Course Grade: 85.95 %



Anritsu

YApGTmYMQk

This certificate proves completion of online coursework. It is NOT equivalent to Anritsu Certification.

Cut Along This Line

**UNITED STATES OF AMERICA**
**FEDERAL COMMUNICATIONS COMMISSION**

## General Radiotelephone Operator License

ATTN: JAMES D MUZYNOSKI
MUZYNOSKI, JAMES D
5760 SE GAITGILL COURT
MILWAUKIE, OR 97267

**FCC Registration Number (FRN):** 0026458026

**Special Conditions / Endorsements**

NONE

| Grant Date | Effective Date | Print Date | Expiration Date |
|---|---|---|---|
| 05-03-2017 | 05-03-2017 | 05-03-2017 | |

| File Number | Serial Number |
|---|---|
| 0007759940 | PG00054949 |

THIS LICENSE IS NOT TRANSFERABLE

(Licensee's Signature)

**FCC 605-FRC - May 2007**

Cut Along This Line

*Licensee: This is your radio authorization in sizes suitable for your wallet and for framing. Carefully cut the documents along the lines as indicated and sign immediately upon receipt. They are not valid until signed.*

*The Commission suggests that the wallet size version be laminated (or another similar document protection process) after signing. The Commission has found under certain circumstances, laser print is subject to displacement.*

Cut Along This Line

Cut Along This Line

| Serial Number | Grant Date | Expiration Date |
|---|---|---|
| PG00054949 | 05-03-2017 | |

**FCC Registration Number (FRN)**
0026458026

ATTN: JAMES D MUZYNOSKI
MUZYNOSKI, JAMES D
5760 SE GAITGILL COURT
MILWAUKIE, OR 97267

**General Radiotelephone Operator License**

**FCC 605-FRC - May 2007**

Fold Here

| File Number | Print Date | Effective Date |
|---|---|---|
| 0007759940 | 05-03-2017 | 05-03-2017 |

**THIS LICENSE IS NOT TRANSFERABLE**
**Special Conditions / Endorsements:**
NONE

(Licensee's Signature)
**FEDERAL COMMUNICATIONS COMMISSION**

Cut Along This Line

Cut Along This Line

**Conditions:**
Pursuant to §309(h) of the Communications Act of 1934, as amended, 47 U.S.C. §309(h), this license is subject to the following conditions: This license shall not vest in the licensee any right to operate the station nor any right in the use of the frequencies designated in the license beyond the term thereof nor in any other manner than authorized herein. Neither the license nor the right granted thereunder shall be assigned or otherwise transferred in violation of the Communications Act of 1934, as amended. See 47 U.S.C. § 310(d). This license is subject in terms to the right of use or control conferred by §706 of the Communications Act of 1934, as amended. See 47 U.S.C. §606.



**Conditions:**
Pursuant to §309(h) of the Communications Act of 1934, as amended, 47 U.S.C. §309(h), this license is subject to the following conditions: This license shall not vest in the licensee any right to operate the station nor any right in the use of the frequencies designated in the license beyond the term thereof nor in any other manner than authorized herein. Neither the license nor the right granted thereunder shall be assigned or otherwise transferred in violation of the Communications Act of 1934, as amended. See 47 U.S.C. § 310(d). This license is subject in terms to the right of use or control conferred by §706 of the Communications Act of 1934, as amended. See 47 U.S.C. §606.

**Submittal Number: 27 60 07 and 27 60 02**
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AWS Project #: 10385

# TAB # 3

Distributed Antenna System

**Specification Section: 27 60 02 and 27 60 07**
Para. No. 3.1 Statement of Work

**Scope of Work:**

To provide a custom designed solution to enhance the indoor Public Safety radio coverage with a distributed antenna system to improve radio frequency signal loss caused by materials inside a building.

A single donor antenna is mounted on the roof and pointed in the direction of the desired donor site which is tuned to the desired frequency (See Design Notes for city specific requirements). The frequencies are then carried through the 1/2" coaxial cable to the bi-directional amplifier (BDA). The Class A BDA filters and amplifies the desired frequencies through 1/2" coaxial cable and indoor antennas installed in strategic locations along with antennas to attain higher than the required -95 dBm over 95% of the coverage area. CCN is a P25 Phase 2 System. The system is designed and will be tested for maximum BER of 2.0% per TSB-88C.

**Code:**

International Fire Code Section 510

Applicable Provisions of NFPA 1221, National Fire Alarm Signaling Code (NFPA contents regards DAS/BDA requirement were moved to NFPA 1221)

**Building Information:**

Building Name: Puyallup Parking Garage

Address: West Stewart Avenue, Puyallup, WA

Number of Floors: 4

Total Square Feet: 136,871

**Design Notes:**

New Construction

**Delivered Audio Quality (DAQ):**

This radio coverage system provides a minimum quality level of 3.4 (DAQ "3.4") on each floor of the building.

**Supported Frequencies and Channels**

**This Design Supports:**

700 MHz Frequencies as Required

First Net Capable

Pierce County Frequencies as Required

20% Spare

DAS System has 20 dB of isolation

**Cable and Component Testing**

Perform and record a sweep test of every cable section using an FDR sweep, by utilizing a 50 ohm load terminator on the end of each cable.

Test all sections of cable with 2 connectors at common frequency bands for application (765-855 MHz Etc. to cover 700/800 frequencies)

On test results no return loss at any connector along the cable segment shall be greater than 20 db. If more a cable check needs to be done on the run for bends or tears if present replace bad section and re -test cable.

Low Passive Intermodulation (Low PIM): All Components used in South Transit radio system shall be low PIM certified. Sound Transit considers Low PIM a device that shows in components under -155 dBc measured with 2 X 20 W carriers method.

Bending radius shall be set by the product specifications.

Testing shall meet TSB-88C and DCM requirements.

**General Notes and Procedures**

1. Plans are not scaled and for outline only, unless otherwise noted.

2. Before submission of pre-construction drawings, the site will be visited and confirmed that the work will be completed as presented before construction begins.

3. All equipment and materials will be installed in accordance with the manufacturer recommendations unless indicated otherwise or where dictated local codes or regulations are needed.

4. All work performed and materials installed shall be in accordance with all applicable codes, regulations and city ordinances, mechanical and electrical systems will be installed in accordance with all city and state municipal and utility company specifications.

5. The project manager will supervise and direct the work with great attention to detail. Also be solely responsible for all construction methods, techniques and procedures and for coordinating all portions of the project with the site and landlord's authorized contact.

6. All construction shall be in accordance with the City of Puyallup municipal code and all adopted state codes including addendums specifically set forth by the City of Puyallup.

7. Details are intended to show final result of design. Minor modifications may be required as project is installed.

8. As a general rule, the project manager will keep the area clean, hazard free and dispose of garbage properly.

9. Penetrations of roof membranes shall be patched/flashed and made watertight to protect the property owner.

10. All circuits to be used to power the DAS shall be approved by the electrical engineer for 120V power for the DAS and provide #2 bare copper ground at the head-end equipment location..

11. Bend radius of 1/2" coax has a minimum of 10" per manufacturer specs.

12. Provide fire stopped pathways between floors for vertical risers from equipment IDF closets to antenna raceway.

13. Any or all sleeves or penetrations through a fire rated wall will be sealed with Hilti firestop assembly or equivalent. Fireproofing shall meet the fire-code survivability requirement.

14. Antenna placement and cable routing is a design schematic only. The actual antenna install location is to be within 10' of design drawing.

15. Secondary backup capable of 24 hour runtime per City of Puyallup Fire Code and NFPA 1221.

16. It is the installers responsibility to follow and abide by the code and policy requirements set forth by the City of Puyallup fire codes.

17. The system shall support at minimum the local channels for CCN, plus 20% spare and FirstNet.

18. Frequencies used by City of Puyallup may change as a result of FCC order, or other operational requirements of City of Puyallup. In the event of such frequency change and upon notification by the municipality, the building owner shall modify or expand the DAS at their own expense.

19. Secondary backup power requirements are set in NFPA 1221 and have been accounted for.

PCS Structural Solutions

Seattle | 1011 Western Avenue, Suite 810 | Seattle, WA 98104 | 206.292.5076
Tacoma | 1250 Pacific Avenue, Suite 701 | Tacoma, WA 98402 | 253.383.2797
Portland | 101 SW Main Street, Suite 280 | Portland, OR 97204 | 503.232.3746

www.pcs-structural.com

# STRUCTURAL CALCULATIONS

FOR

# SOUND TRANSIT PARKING GARAGE ELECTICAL EQUIPMENT SUPPORT PUYALLUP, WASHINGTON

PREPARED BY
PCS STRUCTURAL *SOLUTIONS*

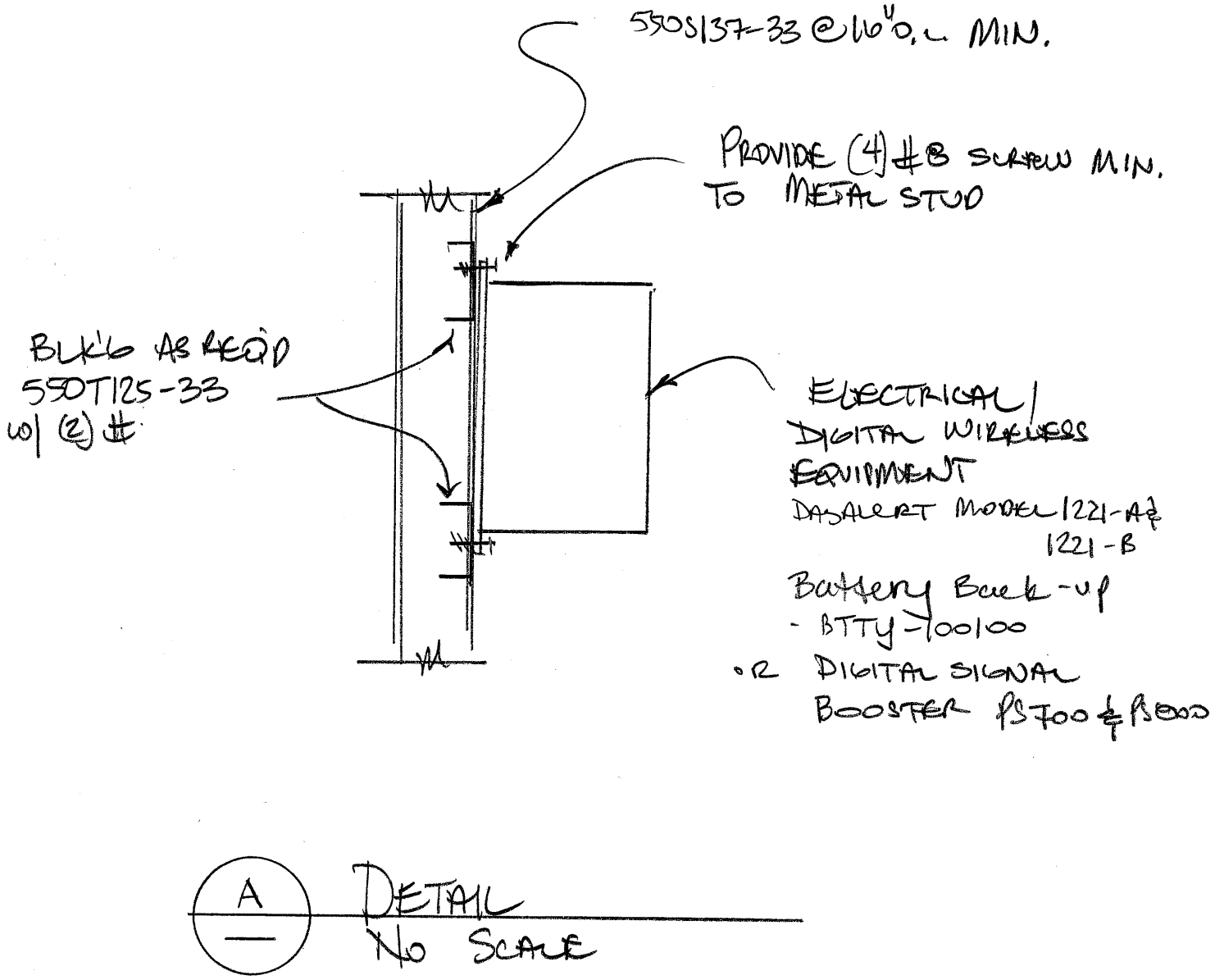

JULY 26, 2021
21-470

PCS Structural Solutions

Project: Puyallup Garage Job No: 21-470

Subject: _____ Sheet _____ Name: CAH

Originating Office: ☐ Seattle ☑ Tacoma ☐ Portland Date: 7/26/21




A — DETAIL

NO SCALE

PCS Structural Solutions

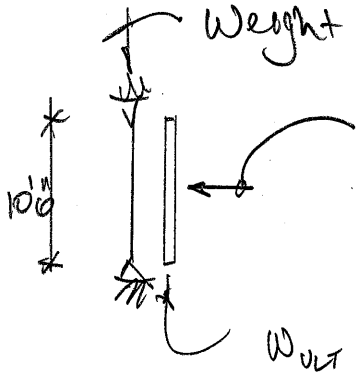
Project: Puyallup Garage Job No: 21-470
Subject: Sheet Name: LAA
Originating Office: ☐ Seattle ☑ Tacoma ☐ Portland Date: 7/26/21

2015 IBC - information based on kPFF

SEISMIC
SITE CLASS = F
$S_S$ = 1.25 g
$S_1$ = 0.48 g
$S_{DS}$ = 0.70 g
$S_{D1}$ = 0.65 g

WIND
$V_{ULT}$ = 110 mph
wall pressure = 36 psf
wall pressure = 44 psf near corners

Review Equipment on metal stud wall




$$f_p = \frac{0.4 S_{DS} I_{ap}}{R_p}\left[1 + 2\frac{z}{h}\right] W_p = .52 W_p$$

$W_{ULT}$ = 44psf × 1.33'

$W_{EQ}$ = 5 psf

$a_p$ = 1.0
$R_p$ = 1.5
$I_p$ = 1.0
z = 30'
h = 42'

Equipment

| | | WEIGHT | $f_p$ |
|---|---|---|---|
| DASAlert | MODEL 1221-A & 1221-B | 12 lbs | = 6 lb |
| BATTERY BACK up | - BTTY-100/100 | 210 lbs | = 105 lb |
| Digital Signal Booster | PS700 + PS600 | = 53 lbs | = 27 lb |

From next page, provide 5505137-30 spaced @ 16" o.c. to support equipment

PCS Structural Solutions

Project: Puyallup Garage Job No: 21-470

Subject: Sheet Name: LAH

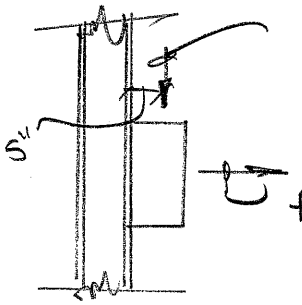
Originating Office: ☐ Seattle ☑ Tacoma ☐ Portland Date: 7/26/21

Check anchorage of equipment to metal stud

#8 screw $T_{all} = 70$ lb

$V_{all} = 150$ lb

Check anchorage - (use battery pack - conservative)




$\frac{210\text{ lb}}{2\text{ studs}} = 105$ lb

$fp = \frac{105\text{ lb}}{2\text{ studs}} = 53$ lb

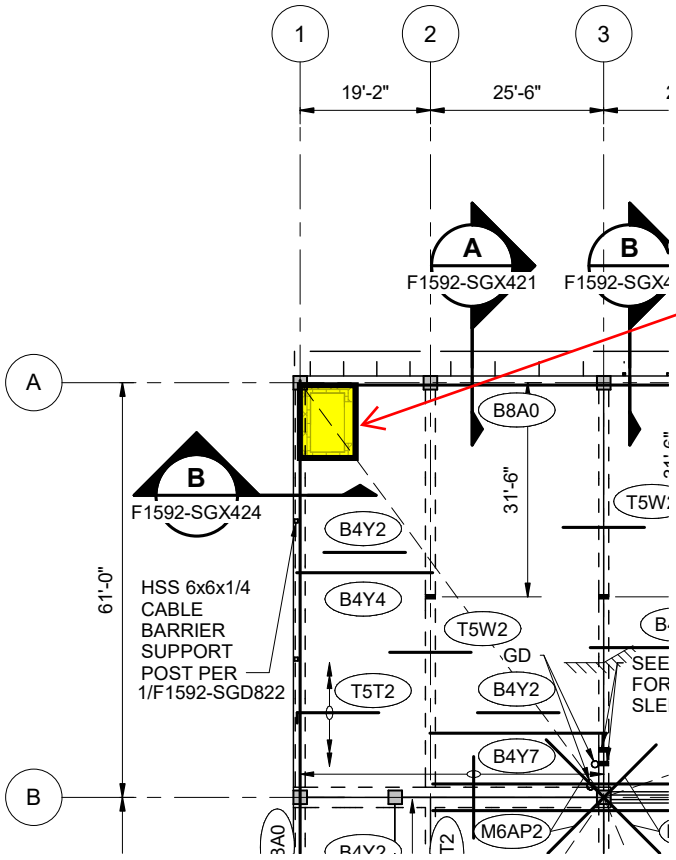
$V = \frac{105}{4\text{ screws}} = 26\ \frac{\text{lb}}{\text{screw}} < V_{all} = 150$ lb/screw, ok

$T = \frac{M}{d} \pm T = \frac{210(1/2)(5")}{20"} + \frac{53}{2} = 53$ lb $< T_{all} = 70$ lb

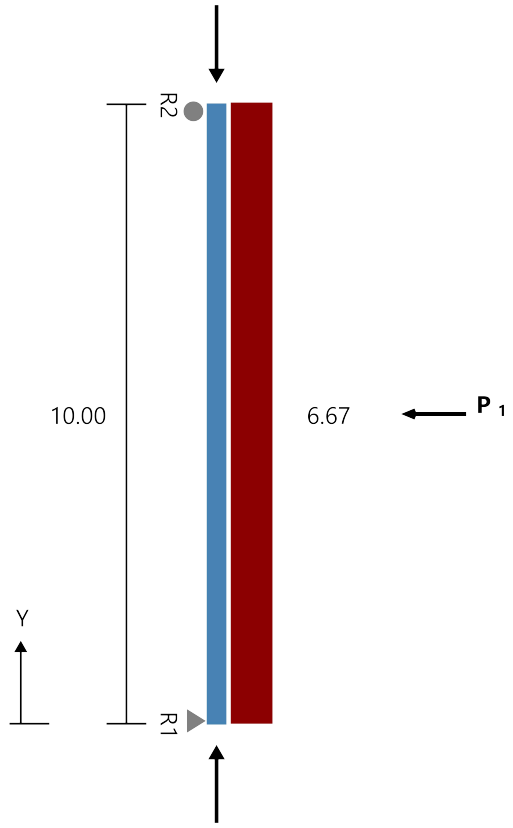
Combined $= \frac{53}{70} + \frac{26}{150} = 0.93 < 1.0$, okay

Provide (4) #8 screws minimum

This is for the 4th floor electrical equipment room, shown in yellow.




The exterior walls are constructed with metal studs




**Section :** 550S137-33 (33 ksi) Single C Stud
**Maxo =** 746.0 Ft-Lb **Va =** 698.5 lb **I =** 1.28 in^4

Loads have not been modified for strength checks
Loads have been multiplied by 0.70 for deflection calculations

**Bridging Connectors - Design Method = AISI S100**

| Span/CantiLever | Simpson Strong-Tie Bridging Connector | Stress Ratio |
|---|---|---|
| Span | N/A | - |

**Shear and Web Crippling Checks**

**Bending and Shear (Unstiffened):** 23.7% Stressed @P1
**Bending and Shear (Stiffened):** NA
**Web Stiffeners Required?:** No

| Point Loads | P1 |
|---|---|
| Load(lb) | 37 |
| X-Dist.(ft) | 5.00 |

**Simpson Strong-Tie® Connectors**

| Support | Rx(lb) | Ry(lb) | Simpson Strong-Tie® Connector | Connector Interaction | Anchor Interaction |
|---|---|---|---|---|---|
| R1 | 51.83 | 105 | FCB43.5 Min(4#12-14) & (2) #12 SST X to A36 Steel | 20.77 % | 23.32 % |
| R2 | 51.83 | 0 | SCB45.5(2) & (2) #12 SST X to A36 Steel | 10.58 % | 6.52 % |

* Reference catalog for connector and anchor requirement notes as well as screw placements requirement

**Flexural and Deflection Check**

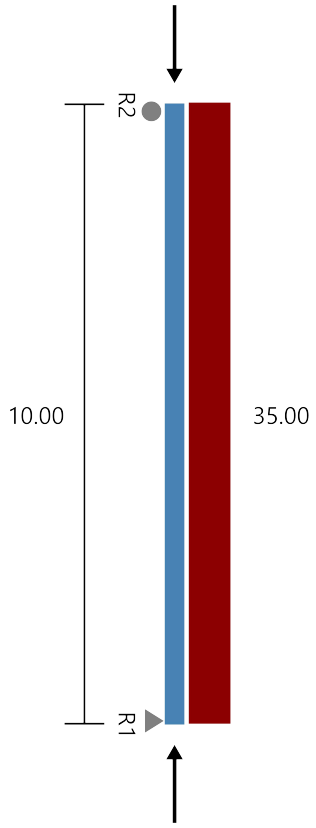
| Span | Mmax Ft-Lb | Mmax/ Maxo | Mpos Ft-Lb | Bracing (in) | Ma(Brc) Ft-Lb | Mpos/ Ma(Brc) | Deflection (in) | Deflection Ratio |
|---|---|---|---|---|---|---|---|---|
| Span | 175.8 | 0.236 | 175.8 | 48.0 | 680.3 | 0.258 | 0.052 | L/2291 |

**Distortional Buckling Check**

| Span | K-phi lb-in/in | Lm Brac in | Ma-d Ft-Lb | Mmax/ Ma-d |
|---|---|---|---|---|
| Span | 0.00 | 120.0 | 623.6 | 0.282 |

**Combined Bending and Axial Load Details**

| Span | Axial Ld (lb) | Bracing(in) KyLy | KtLt | Max KL/r | K-phi (lb-in/in) | Lm Bracing (in) | Allow load(lb) | P/Pa | Intr. Value |
|---|---|---|---|---|---|---|---|---|---|
| Span | 105.0(c) | 48.0 | 48.0 | 102 | 0.0 | 120.0 | 1907.3(c) | 0.06 | 0.34 |




**Section :** 550S137-33 (33 ksi) Single C Stud
**Maxo =** 746.0 Ft-Lb **Va =** 698.5 lb **I =** 1.28 in^4

Loads have not been modified for strength checks
Loads have been multiplied by 0.70 for deflection calculations

**Bridging Connectors - Design Method = AISI S100**

| Span/CantiLever | Simpson Strong-Tie Bridging Connector | Stress Ratio |
|---|---|---|
| Span | N/A | - |

**Shear and Web Crippling Checks**

**Bending and Shear (Unstiffened):** 25.1% Stressed @R1
**Bending and Shear (Stiffened):** NA
**Web Stiffeners Required?:** No

**Simpson Strong-Tie® Connectors**

| Support | Rx(lb) | Ry(lb) | Simpson Strong-Tie® Connector | Connector Interaction | Anchor Interaction |
|---|---|---|---|---|---|
| R1 | 175 | 105 | FCB43.5 Min(4#12-14) & (2) #12 SST X to A36 Steel | 37.09 % | 38.81 % |
| R2 | 175 | 0 | SCB45.5(2) & (2) #12 SST X to A36 Steel | 35.71 % | 22.01 % |

* Reference catalog for connector and anchor requirement notes as well as screw placements requirement

**Flexural and Deflection Check**

| Span | Mmax Ft-Lb | Mmax/ Maxo | Mpos Ft-Lb | Bracing (in) | Ma(Brc) Ft-Lb | Mpos/ Ma(Brc) | Deflection (in) | Deflection Ratio |
|---|---|---|---|---|---|---|---|---|
| Span | 437.5 | 0.586 | 437.5 | 48.0 | 674.4 | 0.649 | 0.146 | L/824 |

**Distortional Buckling Check**

| Span | K-phi lb-in/in | Lm Brac in | Ma-d Ft-Lb | Mmax/ Ma-d |
|---|---|---|---|---|
| Span | 0.00 | 120.0 | 623.6 | 0.702 |

**Combined Bending and Axial Load Details**

| Span | Axial Ld (lb) | Bracing(in) KyLy | Bracing(in) KtLt | Max KL/r | K-phi (lb-in/in) | Lm Bracing (in) | Allow load(lb) | P/Pa | Intr. Value |
|---|---|---|---|---|---|---|---|---|---|
| Span | 105.0(c) | 48.0 | 48.0 | 102 | 0.0 | 120.0 | 1907.3(c) | 0.06 | 0.76 |

# PS 700 + PS 800
# DIGITAL SIGNAL BOOSTERS

## DH7S-A
## DH7S-D

### Product Features


- Supports Public Safety 700 & 800 MHz in single or dual band versions
- FirstNet Band 14 available
- Upgradeable options: single to dual band, low to high power, class B to class A
- Channel Selective, software programmable or adjustable bandwidths
- Fully digital signal boosters, FPGA based
- US and Canada 700MHz band compatible, software adjustable
- Auto diagnostic
- Automatic gain control per band, per channel, per time slot
- Oscillation detection with alarm and auto-shutdown
- Antenna Isolation measurement feature
- Antenna Isolation alarm
- Built-in input and output spectrum analyzer
- Weatherproof enclosure, IP67/NEMA4X
- NFPA compliant with dry contact alarms
- Uplink and downlink squelch, per channel and per time slot on channel selective mode
- User adjustable gain control, UL and DL independent, per band, per channel and per time slot on channel selective mode
- PS700 and PS800 High capacity versions (64 channels)
- UL2524 2nd Edition Listing with SGS, Nationally Recognized Testing Laboratory (NRTL) approved by OSHA for UL2524.
- IFC 2015, 2018, 2021 Edition
- NFPA 72 2013 Edition, NFPA 1221 2016 2019 Edition

### Applications

- For P25 Phase I & Phase II, DMR, NXDN and Conventional systems.
- Indoor coverage: buildings, schools, hospitals, casinos, tunnels, metro stations.
- Outdoor coverage: oil rigs, stadiums, dense urban areas, rural areas.

| Specification | Value |
|---|---|
| Type | Single and Dual Band Digital Signal Boosters |
| Frequency range | 758-775 / 788-805 MHz or 764-776 / 794-806 MHz (software adjustable) & 806-824 / 851-869MHz |
| Passband BW. min | Channel Selective (150KHz, 100Khz, 75KHz, 62.5KHz, 50KHz, 37.5KHz, 25KHz and 12.5KHz) or 100KHz to full band (depends of configuration) |
| Number of Passband | PS700 + FirstNet Class B: 1 FirstNet + 1 BWA<br>PS700 + FirstNet Class A: 32 channel filters + 1 FirstNet + 1 BWA<br>PS700 + FirstNet High Capacity: 64 filters + 1 FirstNet<br>PS800 Class B: 2 BWA<br>PS800 Class A: 32 channel filters + 2 BWA<br>PS800 + High Capacity: 64 filters<br>PS700 + FirstNet + PS800: Class B: 2 BWA per band<br>PS700 + FirstNet + PS800: Class A: 32 channel filters + 2 BWA per band |
| Channel Filter Options | 150KHz, 100Khz, 75KHz, 62.5KHz, 50KHz, 37.5KHz, 25KHz and 12.5KHz |
| BWA Filters | Adjustable from 100KHz to fullband in step in steps of 50KHz |
| Gain, maximum | 85 dB |
| Passband ripple | +/- 2.0 dB |
| Gain, manual control | 30dB range, digitally controlled in 1dB steps, per link, per band |
| Antenna isolation | Max Gain + 20dB |

# PS 700 + PS 800
# DIGITAL SIGNAL BOOSTERS

# DH7S-A
# DH7S-D

| | |
|---|---|
| Composite output power, DL | +33dBm or +27dBm (depending on configuration) per band |
| Composite output power, UL | +27dBm |
| IMD | < -13dBm |
| Noise figure | 9.0dB max |
| Group delay | Channel Selective 150KHz, 11.5µS<br>Channel Selective 100KHz, 13.5µS<br>Channel Selective 75KHz, 16.0µS<br>Channel Selective 62.5KHz, 18.0µS<br>Channel Selective 50KHz, 21.0µS<br>Channel Selective 37.5KHz, 25.5µS<br>Channel Selective 25KHz, 35.0µS<br>Channel Selective 12.5KHz, 61.5µS<br>or Band Selective: 3.5 to 6.5µS, depending on BWA |
| Maximum input power, no damage | +5dBm (UL), +5dBm (DL) |
| Maximum input power, normal operation | 0dBm (UL), 0dBm (DL) |
| Connectors | N(f) as standard |
| RF Input/Output impedance | 50Ω |
| Uplink squelch function | Yes, user selectable, to avoid UL noise when no carriers present, per band, per time slot and per channel (on channel selective mode) |
| Self diagnostic platform | Microprocessor based |
| Alarms | Yes, amplifiers status, power amplifiers status, power supply failure, temperature, AGC, RF overload, donor antenna failure, VSWR Indoor, oscillation. |
| Local management and supervising | Local access via USB and Ethernet (web browser) |
| Remote management and supervising | Remote access via Ethernet |
| RoHS compliance | Yes |
| Power Supply | AC 110 VAC, 50/60 Hz or DC +24VDC & -48VDC (depending on configuration) |
| Power consumption | 80W in dual band, 62W in single band |
| Housing | IP67 / NEMA4X |
| Temperature range | -13° to 131° F • -25° to +55° C |
| Cooling | Natural convection |
| Weight | 52.9 lbs • 24 kg |
| Dimension | 17.7 x 17.3 x 5.1 in • 450 x 440 x 130 mm |
| Mounting | Wall or pole mounting (Rack mounting option available) |
| MTBF | 250000 hours |

| **Configurations** | **CLASS A** | | | |
|---|---|---|---|---|
| **Bands** | **+33 dBm AC** | **+33 dBm DC** | **+27 dBm AC** | **+27 dBm DC** |
| 700 + FirstNet | DH7S-A-733A | DH7S-D-733A | DH7S-A-727A | DH7S-D-727A |
| 800 MHz | DH7S-A-S33A | DH7S-D-S33A | DH7S-A-S27A | DH7S-D-S27A |
| 800 + 700 + FirstNet | DH7S-A-7S33A | DH7S-D-7S33A | DH7S-A-7S27A | DH7S-D-7S27A |
| 700MHz High Capacity | DH7S-A-733AH | DH7S-D-733AH | DH7S-A-727AH | DH7S-D-727AH |
| 800MHz High Capacity | DH7S-A-S33AH | DH7S-D-S33AH | DH7S-A-S27AH | DH7S-D-S27AH |

| **Configurations** | **CLASS B** | | | |
|---|---|---|---|---|
| **Bands** | **+33 dBm AC** | **+33 dBm DC** | **+27 dBm AC** | **+27 dBm DC** |
| 700 + FirstNet | DH7S-A-733B | DH7S-D-733B | - | - |
| 800 MHz | DH7S-A-S33B | DH7S-D-S33B | - | - |
| 800 + 700 + FirstNet | DH7S-A-7S33B | DH7S-D-7S33B | DH7S-A-7S27B | DH7S-D-7S27B |

# BATTERY BACKUP SYSTEMS

## BTTY Series

### Product Features

- NFPA Compliant
- Up to 24 hour version
- Batteries included
- AC Input, 24 Volt DC Output
- NEMA-4 Rated BBU Enclosure
- Up to 4 Annunciators may be connected to one BBU
- Tamper Proof with Lock and Key Accessibility
- Flush Wall Mounted Annunciators


| Specification | Value |
|---|---|
| Type | Battery Backup Unit |
| Input | 120 VAC 50/60 Hz |
| Size | 24 x 20 x 10 in |

| Specifications | BTTY-100050 |
|---|---|
| Storage capacity | 100W / 12hs |
| Annunciator | AC Power Normal<br>AC Power Failure<br>Battery Capacity <30%<br>Battery Charger Fail<br>Donor Antenna Disconnection<br>Donor Antenna Malfunction<br>RF Emitter Fail<br>System Component Fail |
| Max Load | 270 W (contact Fiplex for battery duration at different loads) |
| Batteries | Included |
| BDA Annunciator | Built in, port for additional external annunciators |
| Weight (batteries included) | 150lbs |

| Specifications | BTTY-100100 |
|---|---|
| Storage capacity | 100 W / 24 hs or 200 W / 12 hs |
| Annunciator | AC Power Normal<br>AC Power Failure<br>Battery Capacity <30%<br>Battery Charger Fail<br>Donor Antenna Disconnection<br>Donor Antenna Malfunction<br>RF Emitter Fail<br>System Component Fail |
| Max Load | 270 W (contact Fiplex for battery duration at different loads) |
| Batteries | Included |
| BDA Annunciator | Built in, port for additional external annunciators |
| Weight (batteries included) | 210lbs |



DOC BD105.02 • 12152020 • FS

# NFPA-Compliant Public Safety Radio Enhancement System Monitoring Unit and Annunicator Panel

NFPA MEMBER

## DASalert Models 1221-A & 1221-B

**Meets NFPA-72 (2010, 2013 & 2016) and current NFPA-1221 codes for a**

## Dedicated Annunciator and Monitoring Panel


Displays Status of:

- **BDA**
- **Donor Antenna**
- **AC Power**
- **Battery Capacity**
- **Battery Charger**
- **System Status**

Includes Form-C relay contacts to interface with any fire alarm system

Monitors communications link for integrity

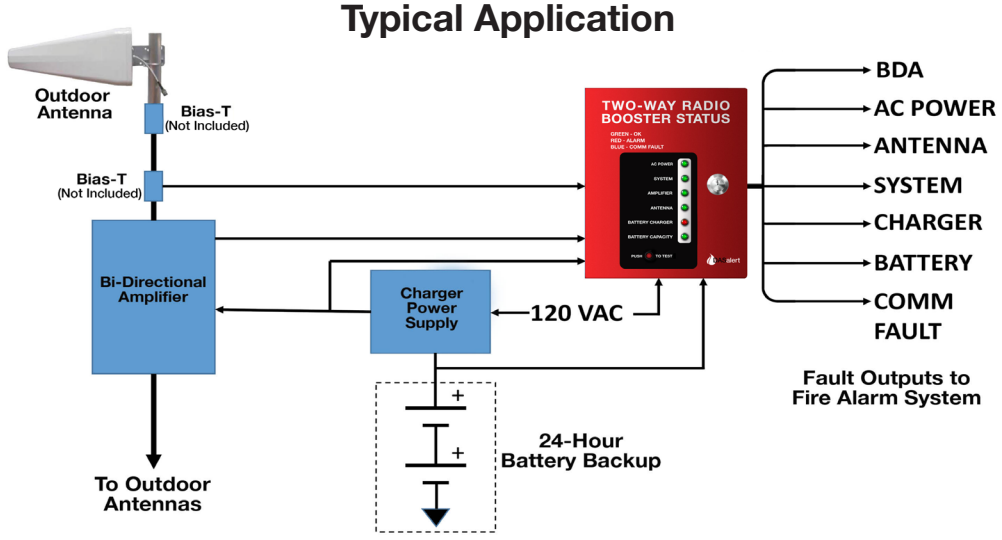
Includes independent circuitry to check antenna, AC power, battery capacity, charger and overall system status

Mates with or augments monitoring of any BDA, antenna, charger, battery or UPS

Low cost, easy to install and program
Small size NEMA-4: 10”H x 8”W x 4”D

Backed up by internal battery (included)

## Model 1221-A Monitor and Annunciator Panel Typical Application



## Excerpted from NFPA 2012 (2016 Edition): Similar requirements in NFPA-72 (2010, 2013, 2016)

### Standard for Installation, Maintenance, and Use of Emergency Services Communications System

**9.6.13.2 Dedicated Panel.**

(1) A dedicated monitoring panel shall be provided within the fire command center to annunciate the status of all RF emitting devices and system component locations. The monitoring panel shall provide visual and labeled indications of the following for each system component and RF emitting device:

**(a) Normal ac power**
**(b) Loss of normal ac power**
**(c) Battery charger failure**
**(d) Low battery capacity (to 70 percent depletion)**
**(e) Donor antenna malfunction**
**(f) Active RF emitting device malfunction**
**(g) System component malfunction**

(2) The communications link between the dedicated monitoring panel and the two-way radio communications enhancement system must be monitored for integrity.

## Specifications

| | | | |
|---|---|---|---|
| **Dimensions** | 10” x 8” x 4” | **Fault inputs from Radio Enhancement System** | Donor Antenna OK / Fail |
| **Weight** | 11.7 lbs | | Amplifier OK / Fail |
| | | | Charger OK / Fail |
| | | | Battery Capacity OK / Low |
| | | | AC Power ON / OFF |
| **Form C Dry Relay Outputs to Fire Alarm System** | AC Power | | |
| | System (Summary Alarm) | **Analog Inputs** | Donor Antenna Sense |
| | Amplifier (BDA) | | DAS Battery +/- |
| | Antenna | | |
| | Battery Charger | **Certifications** | UL: E194432, ETL: 4001276 |
| | Battery Capacity | | |
| | Communications Fault | **Power** | 15 VDC (180 ma) from supplied Power Supply |

**Submittal Number: 27 60 07 and 27 60 02**
Puyallup Parking Garage
Sturgeon Electric
Contract #: 72573
AWS Project #: 10385

# TAB # 4

Distributed Antenna System

**Specification Section: 27 60 02 and 27 60 07**
Para. No. 4.1 Acceptance Test Plan

# ACCEPTANCE TEST PLAN

## AMPLIFIED WIRELESS SOLUTIONS

"Bringing amplification of the outside world into your everyday environment"

# 1. ACCEPTANCE TEST PLAN

## 1.1. Equipment Setup

This section I intended to provide a guideline for the setup of the test equipment. This setup may change based on the make and model number being used to perform tests. When conflicts arise between this document and the manufacturers recommended testing procedures, the manufacturers requirements shall be utilized.

- Spectrum analyzer with unity gain (0dB, frequency specific) dipole receive antenna shall be used for acceptance testing.
- The test equipment shall have been calibrated within 1 year of the test date.
- Test equipment shall be allowed to stabilize in test environment prior to calibration for a minimum of thirty minutes. Any change in temperature can void the calibration.
- Signal generator must be connected to the Head end downlink (TX) interface via tested and approved coaxial cabling and connectors. The control channel from the base station can be used as a signal source as well.
- Verify that all remote units for the area under test are ON.

## 1.2. Acceptance Test Procedure

Acceptance test procedure. Where an emergency responder radio coverage system is required, and upon completion of installation, the building owner shall have the radio system tested to verify that two-way coverage on each floor of the building is not less than 95 percent and 100% in all critical areas. The test procedure shall be conducted as follows:

- Each floor of the building shall be divided into a grid of 20 approximately equal test areas.
- The test shall be conducted using a calibrated portable radio of the latest brand and model used by the agency talking through the agency's radio communications system.
- Failure of not more than two nonadjacent test areas shall not result in failure of the test.
- In the event that three of the test areas fail the test, to be more statistically accurate, the floor shall be permitted to be divided into 40 equal test areas. Failure of not more than four nonadjacent test areas shall not result in failure of the test. If the system fails the 40-area test, the system shall be altered to meet the 90-percent coverage requirement.
- A test location approximately in the center of each test area shall be selected for the test, with the radio enabled to verify two-way communications to and from the outside of the building through the public agency's radio communications system. Once the test location has been selected, that location shall represent the entire test area. Failure in the selected test location shall be considered failure of that test area. Additional test locations shall not be permitted.

- The gain values of all amplifiers shall be measured and the test measurement results shall be kept on file with the building owner so that the measurements can be verified during annual tests. In the event that the measurement results become lost, the building owner shall be required to rerun the acceptance test to reestablish the gain values.
- As part of the installation a spectrum analyzer or other suitable test equipment shall be utilized to ensure spurious oscillations are not being generated by the subject signal booster. This test shall be conducted at the time of installation and subsequent annual inspections.
- The testing procedure shall meet the fire code requirements
- Testing shall meet TSB-88C and DCM requirements.
- Beyond what is defined in the fire-code as critical areas, Sound Transit have their own critical areas defined in the DCM that shall be tested accordingly.
- The contractor shall submit the tile distribution to ST for approval before performing any testing.

### 1.3. Documentation

This section I intended to provide a guideline for the testing documentation. The guidelines listed below may be changed to meet specific requirements of the project or the Authority Having Jurisdiction (AHJ). The documentation shall meet ST Design Technology Manual, DCM, and Section 27 requirements.

- Test frequency and power must be recorded corresponding to the date and time of each site walk measurement.
- Test results shall be saved with frequency span +/- 20 MHz relative to the center/measured frequency.
- Each floor of the building shall be divided into a grid of 20 approximately equal test areas. Each grid will be labelled on the prints numbered 01-20
- Test results shall be saved in native format with the file name indicating the floor, grid number tested and an alphanumeric identifier if multiple tests are made in the same grid:
    - Example: The second test in Grid 15 on Floor 3 shall be labeled, FL3-15-B. FL3 identifies it as the 3rd floor, 15 identifies Grid 15 and B identifies it as the second test.
- Upon completion of testing all test results and prints shall be saved and submitted in PDF format.

AMPLIFIED WIRELESS SOLUTIONS, INC

**Submittal Number: 27 60 07 and 27 60 02**
Puyallup Parking Garage
Sturgeon Electric
Contract #: 72573
AWS Project #: 10385

# TAB # 5

Distributed Antenna System

**Specification Section: 27 60 02 and 27 60 07**
Para. No. 5.1 Shop Drawings

# Emergency Responder Radio Coverage System (ERRCS) for Sound Transit Puyallup Parking Garage

Puyallup, WA

Revision history

| | | |
|---|---|---|
| 1 | 5/26/2021 | George Yeater |
| Updated Antennae Locations | | |
| 2 | 6/15/2021 | George Yeater |
| Updated Parts | | |

Project name

Sound Transit Puyallup Parking Garage

Designer name

Aaron Baxter

Plan name

Cover Sheet

7/19/2021

# Uplink Calculations 700/800 MHz

| | | | | | |
|---|---|---|---|---|---|
| Frequency | 772 | MHz | BDA Max. Comp. Output Power (UL): | 27 | dBm |
| Channel count: | 7 | | BDA Max. Channel Output Power (UL): | 18.54902 | dBm |
| Donor RSSI: | -52 | dBm | BDA Max. Comp. Output Power (DL): | 33 | dBm |
| Distance to Donor Site | 2.14 | miles | BDA Max. Channel Output Power (DL): | 24.54902 | dBm |
| Donor Antenna Gain: | 11 | dBi | BDA DL Gain: | 70 | dB |
| Donor Coax Length: | 40 | ft | BDA UL Gain: | 65 | dB |
| Donor Coax Loss db/100ft: | 2.07 | dB | BDA Noise Figure | 5 | dB |
| Building Enviremnont (N): | 3.1 | | Min. Building Coverage: | -95 | dBm |
| Estimated Passive DAS Loss: | 24.34 | dB | Min. Received Signal at Donor Site: | -95 | dBm |
| DAS Antenna to Mobile Distance: | 90 | ft | Noise Floor In-Building (Environment): | -133 | dBm |
| Mobile Power: | 35 | dB | Required dB below Noise Floor at Donor Site | 20 | dB |

Input Requierd

| Pathloss Guidline (VPL) | |
|---|---|
| N | Buidling Examples |
| 2.8 | Open Warehouse, Convention Center |
| 3.1 | Parking Garage, Airport, Mall |
| 3.4 | Newer Office Building, Hotel |
| 3.7 | Hospital, Older Gov. Bldg., Univeristy, High School, Justice Center |
| 4 | Prison |

Downlink

| | | In | Out | Coax Loss | BDA Gain | | Passive Loss | Out | Path Loss to Mobile | Received DL Power |
|---|---|---|---|---|---|---|---|---|---|---|
| | | -52 | -41 | 0.83 | -41.83 | 24.55 | 24.34 | 0.20902 | 74.84 | -74.63 |
| Public safety donor site | |  | | |  | |  | | |  |
| Est. Received UL Power | Free Space Loss | Out | In | Coax Loss | BDA Gain | | Passive Loss | In | Path Loss to Antenna | Mobile Power |
| -90.01 | 101.00 | 10.99 | -0.01 | 0.828 | 0.82 | -64.18 | 24.34 | -39.84 | 74.84 | 35 |
| Est. Noise | | Noise Out | Noise In | | Noise Out | Noise In | | Noise In | Noise Floor Building | Theoretical Noise Floor |
| -153.86 | | -52.86 | -63.86 | | -63.03 | -133.03 | | -133 | -133 | -133.03 |

Uplink

| | | | | | |
|---|---|---|---|---|---|
| Frequency | 853 | MHz | BDA Max. Comp. Output Power (UL): | 27 | dBm |
| Channel count: | 7 | | BDA Max. Channel Output Power (UL): | 18.54902 | dBm |
| Donor RSSI: | -52 | dBm | BDA Max. Comp. Output Power (DL): | 33 | dBm |
| Distance to Donor Site | 2.14 | miles | BDA Max. Channel Output Power (DL): | 24.54902 | dBm |
| Donor Antenna Gain: | 11 | dBi | BDA DL Gain: | 70 | dB |
| Donor Coax Length: | 40 | ft | BDA UL Gain: | 65 | dB |
| Donor Coax Loss db/100ft: | 2.07 | dB | BDA Noise Figure | 5 | dB |
| Building Enviremnont (N): | 3.1 | | Min. Building Coverage: | -95 | dBm |
| Estimated Passive DAS Loss: | 24.34 | dB | Min. Received Signal at Donor Site: | -95 | dBm |
| DAS Antenna to Mobile Distance: | 90 | ft | Noise Floor In-Building (Environment): | -133 | dBm |
| Mobile Power: | 35 | dB | Required dB below Noise Floor at Donor Site | 20 | dB |

Input Requierd

| Pathloss Guidline (VPL) | |
|---|---|
| N | Buidling Examples |
| 2.8 | Open Warehouse, Convention Center |
| 3.1 | Parking Garage, Airport, Mall |
| 3.4 | Newer Office Building, Hotel |
| 3.7 | Hospital, Older Gov. Bldg., Univeristy, High School, Justice Center |
| 4 | Prison |

Downlink

| | | In | Out | Coax Loss | BDA Gain | | Passive Loss | Out | Path Loss to Mobile | Received DL Power |
|---|---|---|---|---|---|---|---|---|---|---|
| | | -52 | -41 | 0.83 | -41.83 | 24.55 | 24.34 | 0.20902 | 75.71 | -75.50 |
| Public safety donor site | |  | | |  | |  | | |  |
| Est. Received UL Power | Free Space Loss | Out | In | Coax Loss | BDA Gain | | Passive Loss | In | Path Loss to Antenna | Mobile Power |
| -91.68 | 101.80 | 10.12 | -0.88 | 0.828 | -0.05 | -65.05 | 24.34 | -40.71 | 75.71 | 35 |
| Est. Noise | | Noise Out | Noise In | | Noise Out | Noise In | | Noise In | Noise Floor Building | Theoretical Noise Floor |
| -154.66 | | -52.86 | -63.86 | | -63.03 | -133.03 | | -133 | -133 | -133.03 |

Uplink

Revision history
1 5/26/2021 George Yeater
Updated Antennae Locations
2 6/15/2021 George Yeater
Updated Parts

Project name
Sound Transit Puyallup Parking Garage

Designer name
Aaron Baxter

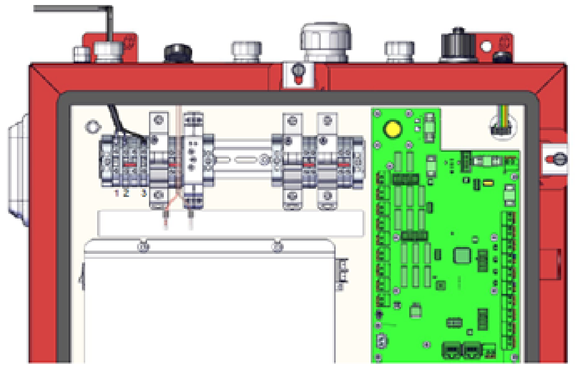
Plan name
Details

7/19/2021

1) BDA/Active RF Emitter Fail
2) Donor Antenna Disconnection
3) Loss of normal AC Power
4) DC Charger Fail
5) Low Battery Alarm

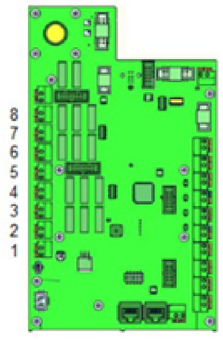
## Wiring Diagram

AC Main Power



1 = EARTH; 2 = NEUTRAL; 3 = LINE

Dry contacts to Fire Panel




1 = BATTERY CHARGER FAIL
2 = LOSS OF NORMAL AC POWER
3 = NORMAL AC POWER
4 = DONOR ANTENNA DISCONNECTION
5 = LOSS OF BATTERY CAPACITY
6 = DONOR ANTENNA MALFUNCTION
7 = ACTIVE RF MALFUNCTION
8 = SYSTEM COMPONENT FAIL

Rele Specifications:
- Max Current: 300mA
- Max Voltage: 24VDC

## Battery Backup Calculations - 12 Hour Requirement

| REQUIRED BATTERY CAPACITY CALCULATIONS | | | | | |
|---|---|---|---|---|---|
| Item Description | watts | volts | amps | hours | Required Capacity (Ah) |
| DH7S Series BDAs | 80 | 24 | 3.3 | 12 | 40 |

| REQUIRED BATTERY CAPACITY CALCULATIONS | | | | | |
|---|---|---|---|---|---|
| Item Description | watts | volts | amps | hours | Required Capacity (Ah) |
| DH14 Series BDAs | 100 | 24 | 4.2 | 12 | 50 |

## Battery Backup Calculations - 24 Hour Requirement

| REQUIRED BATTERY CAPACITY CALCULATIONS | | | | | |
|---|---|---|---|---|---|
| Item Description | watts | volts | amps | hours | Required Capacity (Ah) |
| DH7S Series BDAs | 80 | 24 | 3.3 | 24 | 80 |

| REQUIRED BATTERY CAPACITY CALCULATIONS | | | | | |
|---|---|---|---|---|---|
| Item Description | watts | volts | amps | hours | Required Capacity (Ah) |
| DH14 Series BDAs | 100 | 24 | 4.2 | 24 | 100 |

Revision history
1 5/26/2021 George Yeater
Updated Antennae Locations
2 6/15/2021 George Yeater
Updated Parts

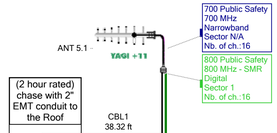
Project name
Sound Transit Puyallup Parking Garage

Designer name
Aaron Baxter

Plan name
Battery Backup Runtime Calculation

7/19/2021

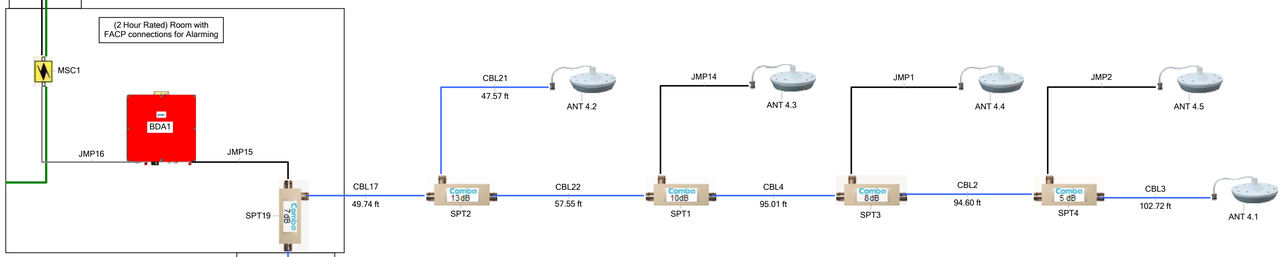
F5



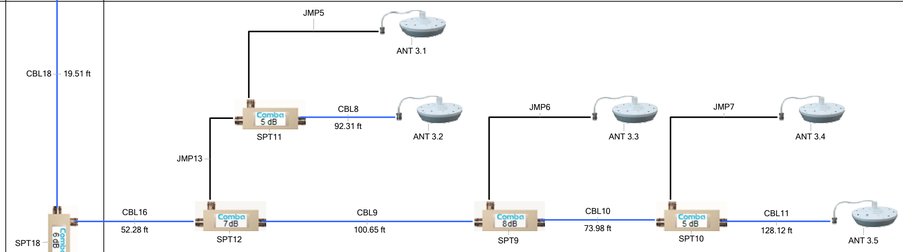

Cables legend

- FMP29-3131-W03
- FMP29-31N1-W03
- ICA12-50JPL
- LCF12-50J
- RG-142 NM-NM-3'
- #6 Ground Wire

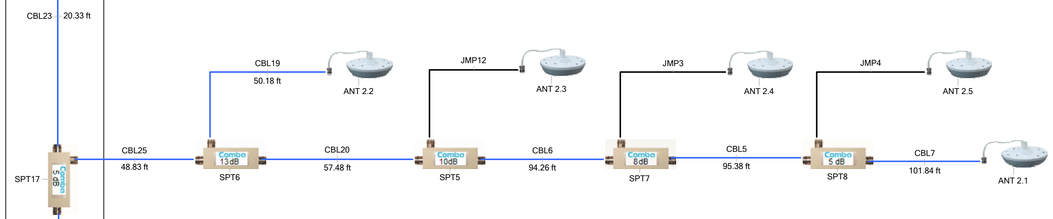
F4



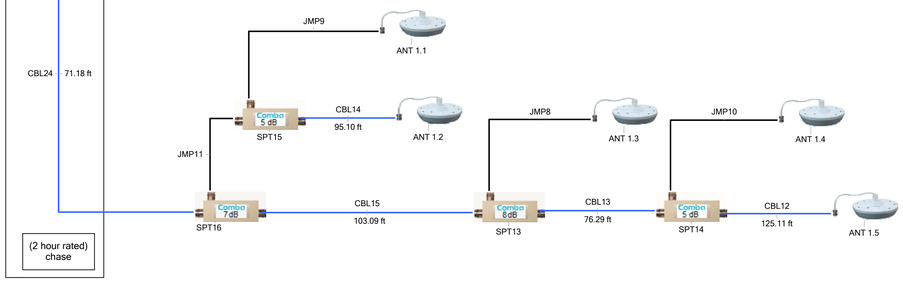

F3




F2




F1




Revision history

| | | | |
|---|---|---|---|
| 1 | 5/26/2021 | George Yeater | Updated Antennae Locations |
| 2 | 6/15/2021 | George Yeater | Updated Parts |

Project name

Sound Transit Puyallup Parking Garage

Designer name

Aaron Baxter

Plan name

Design plan

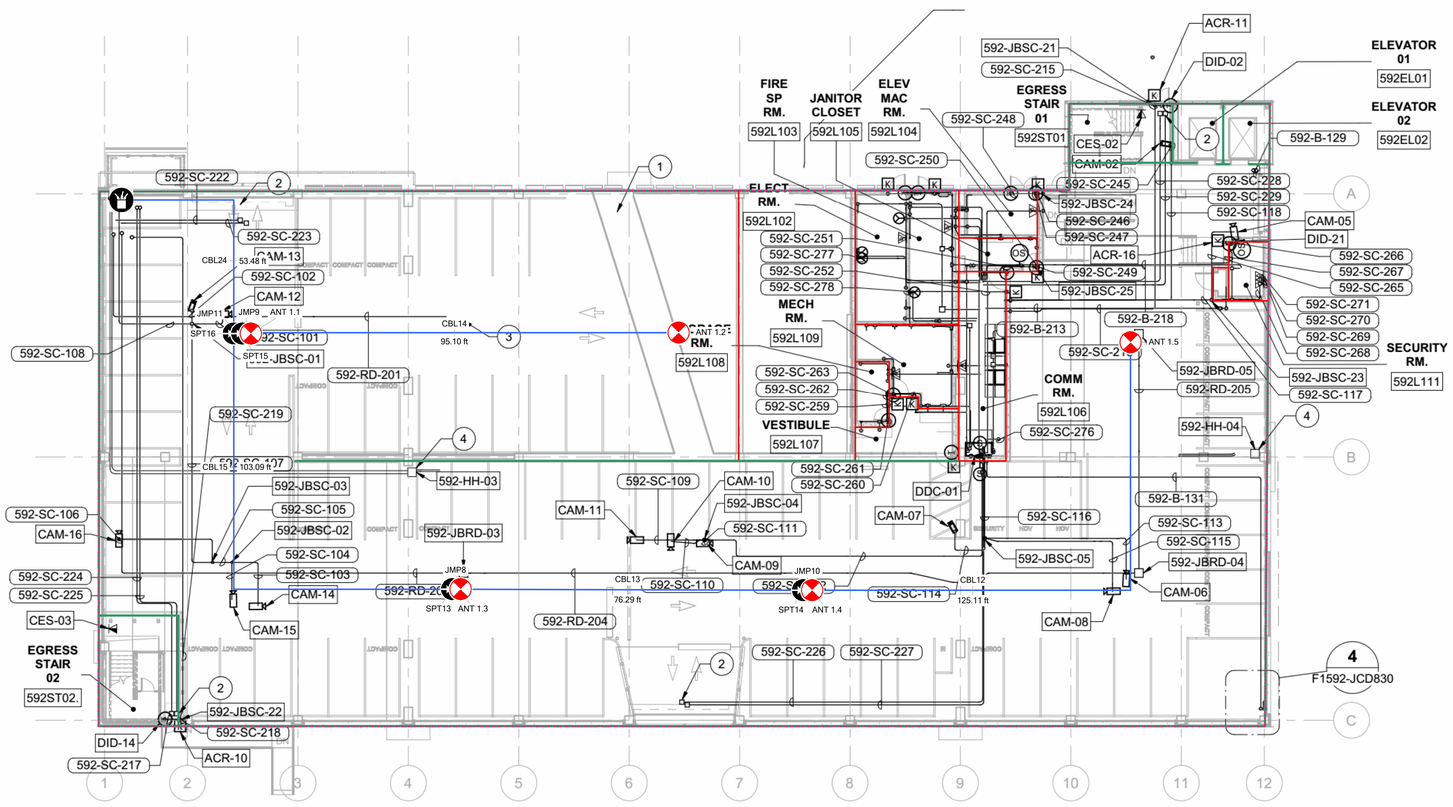
7/19/2021

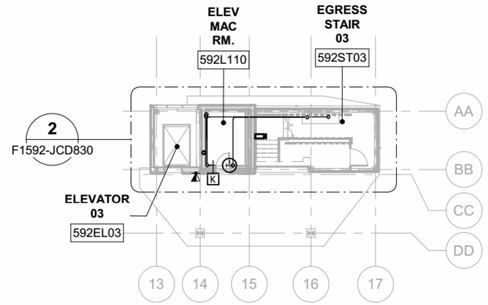
## GENERAL NOTES:

1. CEILING MOUNTED CONDUITS SHALL PENETRATE THE MIDDLE THIRD OF OF BEAM DEPTH, AS PER PENETRATION CRITERIA STATED IN STRUCTURAL DRAWINGS.

## CONSTRUCTION NOTES:

1. SLOPED RAMP; CONDUIT CONTINUES ON LEVEL ABOVE.
2. CONDUITS FOR FUTURE OWNER PROVIDED EQUIPMENT.
3. RADIO EQUIPMENT JUNCTION BOX, TYP.
4. 2'x2'x2' HANDHOLE, FLUSH WITH GRADE/SLAB, STEEL LID, MARKED "SYSTEMS".




2' 0' 8' 16' 32'
SCALE IN FEET
32.00 ft

3/31/2021 7:20:30 AM
C:\Users\shawn\OneDrive - Rushing\Documents\Revit User Files\2020 Revit\S317-F1592-E-v2020_shawn.tuthill.rvt

Pictograms legend
- Antenna
- Riser
- Splitter

Cables legend
- FMP29-3131-W03
- ICA12-50JPL

# ISSUED FOR CONSTRUCTION

| No. | DATE | DSN | CHK | APP | REVISION |
|---|---|---|---|---|---|
| 0 | 04/05/2021 | DN | TT | TT | ISSUED FOR CONSTRUCTION |

DESIGNED BY: D. NAUSNER
DRAWN BY: S. TUTHILL
CHECKED BY: T. THAYER
APPROVED BY: T. THAYER

TODD D. THAYER STATE OF WASHINGTON 41904 REGISTERED PROFESSIONAL ENGINEER

RUSHING Engineering - Essentials - Delivery

HENSEL PHELPS Plan. Build. Manage.
kpff

SUBMITTED BY: SARA ROBERTS
DATE: 04/05/2021
REVIEWED BY: GREG SHIMIZU

LINE IS 1" AT FULL SCALE

PACKAGE # DP-5 GARAGE, PED BRIDGE AND ABUTMENT

SOUNDTRANSIT

SCALE: 1/16" = 1'-0"
FILENAME: S317-F1592-E_v2020
CONTRACT No.: RTA/CN 0612-18
DATE: 04/05/2021
SUBMITTAL DATE: 04/05/2021

PUYALLUP STATION PARKING
CONTRACT RTA/CN 0612-18
PUYALLUP STATION PARKING AND ACCESS IMPROVEMENTS
SYSTEMS
COMMUNICATI
LEVEL 1 -

DRAWING No.: F1592-JCP101
FACILITY ID: F1592
SHEET No: REV:

AWS

Revision history
1 5/26/2021 George Yeater
Updated Antennae Locations
2 6/15/2021 George Yeater
Updated Parts

Project name: Sound Transit Puyallup Parking Garage
Designer name: Aaron Baxter
Plan name: F1

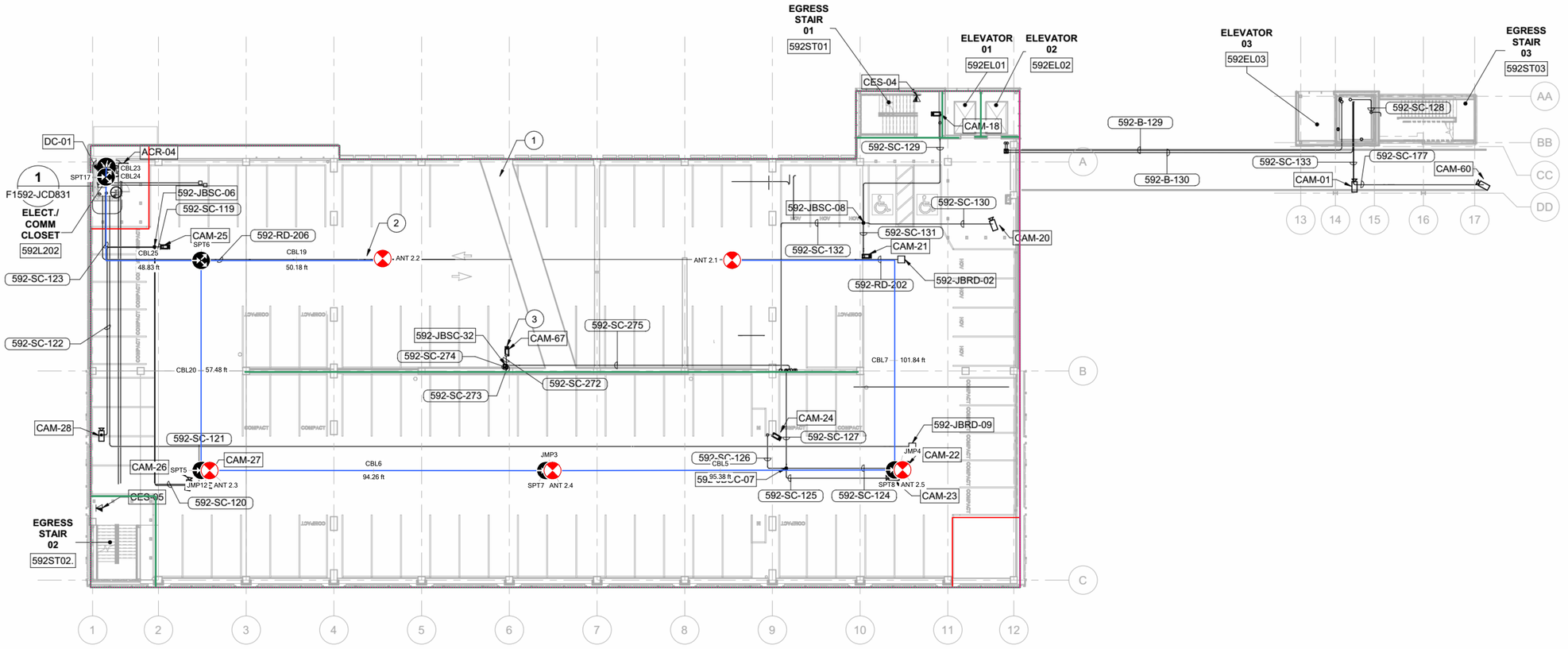
7/19/2021

## GENERAL NOTES:

1. CEILING MOUNTED CONDUITS SHALL PENETRATE THE MIDDLE THIRD OF OF BEAM DEPTH, AS PER PENETRATION CRITERIA STATED IN STRUCTURAL DRAWINGS.

## CONSTRUCTION NOTES:

1. SLOPED RAMP; CONDUIT CONTINUES ON LEVEL ABOVE.
2. RADIO EQUIPMENT JUNCTION BOX, TYP.
3. 180 DEGREE TYPE CAMERA.




2' 0' 8' 16' 32'

SCALE IN FEET
32.00 ft

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RUSHING Engineering - Essentials - Delivery

HENSEL PHELPS Plan. Build. Manage.
kpff

SUBMITTED BY: SARA ROBERTS
DATE: 04/05/2021
REVIEWED BY: GREG SHIMIZU

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

PACKAGE # DP-5
GARAGE, PED BRIDGE AND ABUTMENT
DATE: 04/05/2021

SCALE: 1/16" = 1'-0"
FILENAME: S317-F1592-E_v2020
CONTRACT No.: RTA/CN 0612-18
SUBMITTAL DATE: 04/05/2021

**PUYALLUP STATION PARKING**
**CONTRACT RTA/CN 0612-18**
PUYALLUP STATION PARKING AND ACCESS IMPROVEMENTS
SYSTEMS
COMMUNICATI
LEVEL 2

DRAWING No.: F1592-JCP201
FACILITY ID: F1592
SHEET No: REV:

Pictograms legend
- Antenna
- Riser
- Splitter

Cables legend
- FMP29-3131-W03
- ICA12-50JPL

Revision history
1 5/26/2021 George Yeater
Updated Antennae Locations
2 6/15/2021 George Yeater
Updated Parts

Project name: Sound Transit Puyallup Parking Garage
Designer name: Aaron Baxter
Plan name: F2

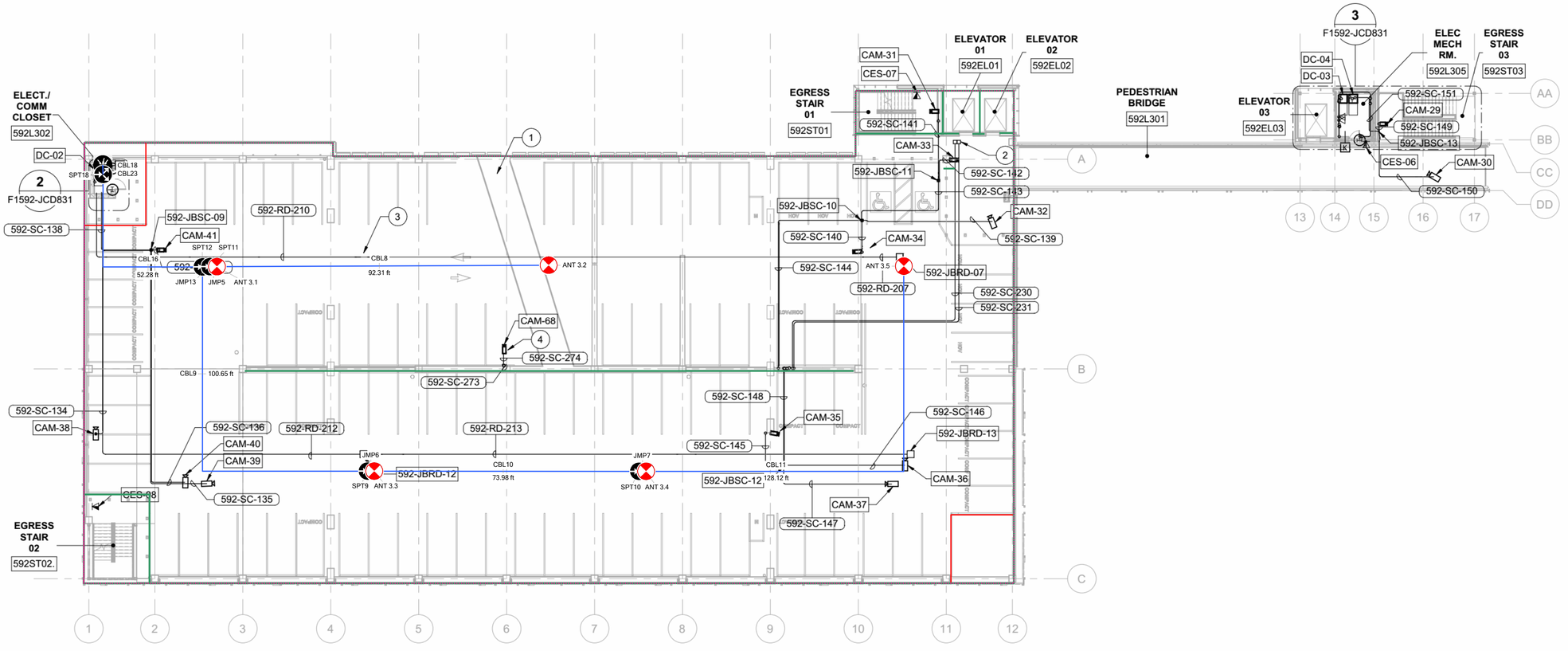
7/19/2021

## GENERAL NOTES:

1. CEILING MOUNTED CONDUITS SHALL PENETRATE THE MIDDLE THIRD OF OF BEAM DEPTH, AS PER PENETRATION CRITERIA STATED IN STRUCTURAL DRAWINGS.

## CONSTRUCTION NOTES:

1. SLOPED RAMP; CONDUIT CONTINUES ON LEVEL ABOVE.
2. CONDUITS FOR FUTURE OWNER PROVIDED EQUIPMENT.
3. RADIO EQUIPMENT JUNCTION BOX, TYP.
4. 180 DEGREE TYPE CAMERA.




N

2' 0' 8' 16' 32'

SCALE IN FEET
32.00 ft

# ISSUED FOR CONSTRUCTION

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RUSHING Engineering - Essentials - Delivery

SUBMITTED BY: SARA ROBERTS

HENSEL PHELPS Plan. Build. Manage.
kpff

DATE: 04/05/2021
REVIEWED BY: GREG SHIMIZU

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

DATE: 04/05/2021

PACKAGE # DP-5 GARAGE, PED BRIDGE AND ABUTMENT

SCALE: 1/16" = 1'-0"
FILENAME: S317-F1592-E_v2020
CONTRACT No.: RTA/CN 0612-18
SUBMITTAL DATE: 04/05/2021

**PUYALLUP STATION PARKING**
**CONTRACT RTA/CN 0612-18**
PUYALLUP STATION PARKING AND ACCESS IMPROVEMENTS
SYSTEMS
COMMUNICATI
LEVEL 3 .

DRAWING No.: F1592-JCP301
FACILITY ID: F1592
SHEET No: REV:

Pictograms legend
- Antenna
- Riser
- Splitter

Cables legend
- FMP29-3131-W03
- ICA12-50JPL

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AWS

Revision history
1 5/26/2021 George Yeater
Updated Antennae Locations
2 6/15/2021 George Yeater
Updated Parts

Project name: Sound Transit Puyallup Parking Garage
Designer name: Aaron Baxter
Plan name: F3

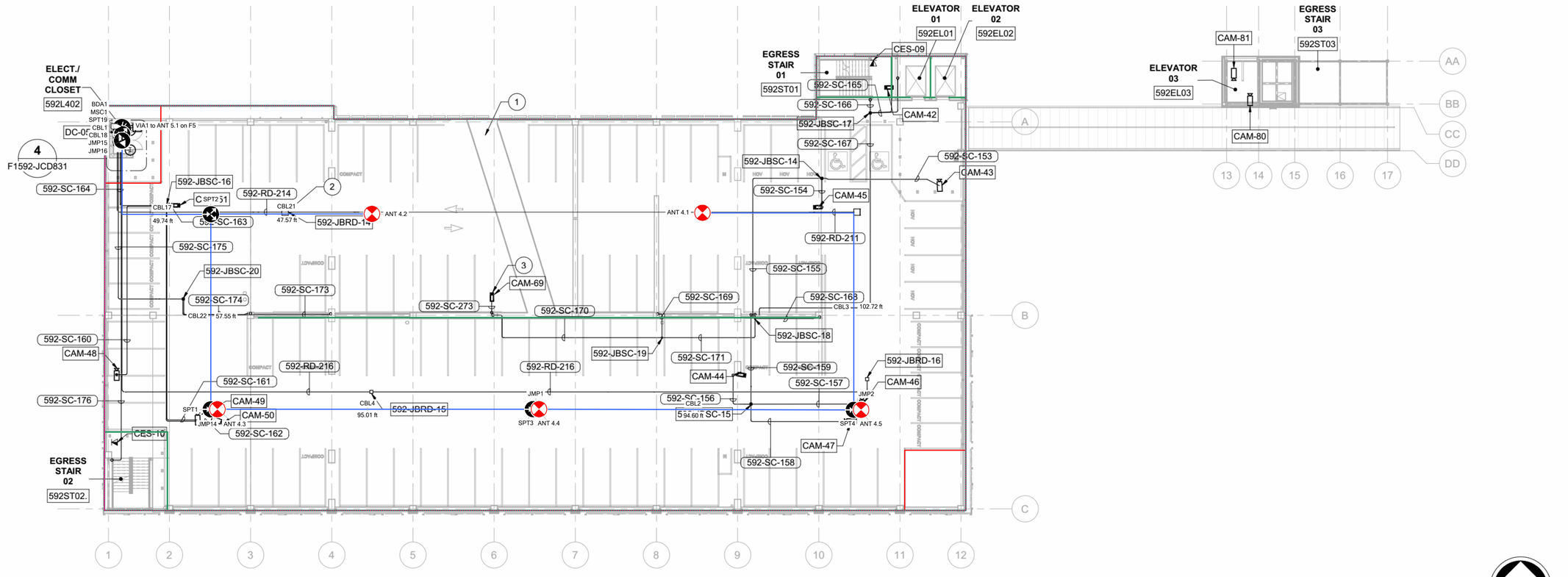
7/19/2021

## GENERAL NOTES:

1. CEILING MOUNTED CONDUITS SHALL PENETRATE THE MIDDLE THIRD OF OF BEAM DEPTH, AS PER PENETRATION CRITERIA STATED IN STRUCTURAL DRAWINGS.

## CONSTRUCTION NOTES:

1. SLOPED RAMP; CONDUIT CONTINUES ON LEVEL ABOVE.
2. RADIO EQUIPMENT JUNCTION BOX, TYP.
3. 180 DEGREE TYPE CAMERA.




2' 0' 8' 16' 32'
32.00 ft
SCALE IN FEET

**Pictograms legend**
- Antenna
- BDA
- Miscellaneous
- Riser
- Splitter
- Via

**Cables legend**
- FMP29-3131-W03
- FMP29-31N1-W03
- ICA12-50JPL
- LCF12-50J
- RG-142 NM-NM-3'

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DRAWN BY: S. TUTHILL
CHECKED BY: T. THAYER
APPROVED BY: T. THAYER

TODD D. THAYER — STATE OF WASHINGTON — 41904 — REGISTERED PROFESSIONAL ENGINEER

RUSHING Engineering - Essentials - Delivery

HENSEL PHELPS Plan. Build. Manage.
kpff

SUBMITTED BY: SARA ROBERTS
DATE: 04/05/2021
REVIEWED BY: GREG SHIMIZU

LINE IS 1" AT FULL SCALE

PACKAGE # DP-5 GARAGE, PED BRIDGE AND ABUTMENT

SOUNDTRANSIT

SCALE: 1/16" = 1'-0"
FILENAME: S317-F1592-E_v2020
CONTRACT No.: RTA/CN 0612-18
DATE: 04/05/2021
SUBMITTAL DATE: 04/05/2021

**PUYALLUP STATION PARKING**
**CONTRACT RTA/CN 0612-18**
PUYALLUP STATION PARKING AND ACCESS IMPROVEMENTS
SYSTEMS
COMMUNICATI
LEVEL 4 -

DRAWING No.: F1592-JCP401
FACILITY ID: F1592
SHEET No: REV:

AWS

Revision history
1 5/26/2021 George Yeater
Updated Antennae Locations
2 6/15/2021 George Yeater
Updated Parts

Project name: Sound Transit Puyallup Parking Garage
Designer name: Aaron Baxter
Plan name: F4

7/19/2021



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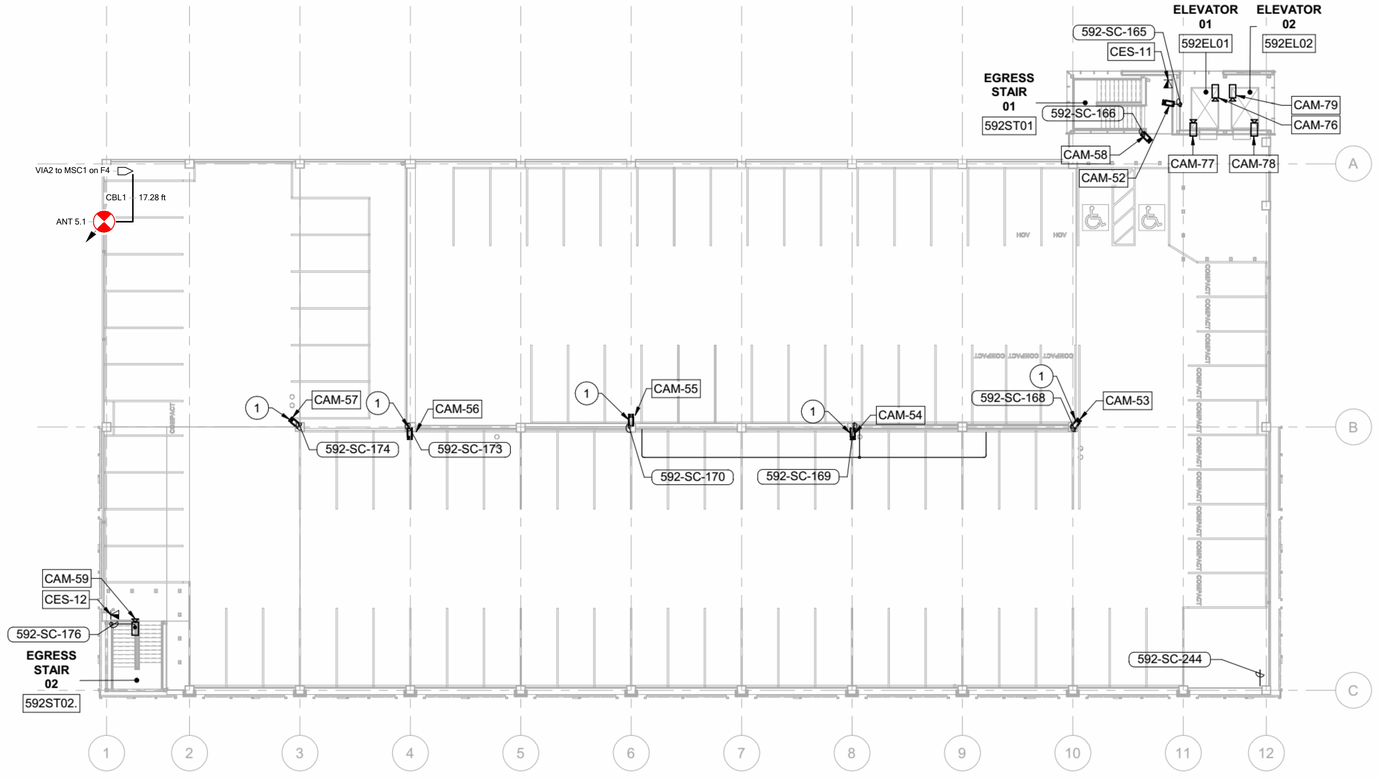
**CONSTRUCTION NOTES:**

(1) 180 DEGREE TYPE CAMERA.




N

2' 0' 8' 16' 32'

32.00 ft

SCALE IN FEET

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TODD D. THAYER STATE OF WASHINGTON 21904 REGISTERED PROFESSIONAL ENGINEER

RUSHING Engineering - Essentials - Delivery

HENSEL PHELPS Plan. Build. Manage.

kpff

LINE IS 1" AT FULL SCALE

SUBMITTED BY: SARA ROBERTS
DATE: 04/05/2021
REVIEWED BY: GREG SHIMIZU
DATE: 04/05/2021

PACKAGE # DP-5 GARAGE, PED BRIDGE AND ABUTMENT

SOUNDTRANSIT

SCALE: 1/16" = 1'-0"
FILENAME: S317-F1592-E_v2020
CONTRACT No.: RTA/CN 0612-18
SUBMITTAL DATE: 04/05/2021

**PUYALLUP STATION PARKING**
**CONTRACT RTA/CN 0612-18**
PUYALLUP STATION PARKING AND ACCESS IMPROVEMENTS
SYSTEMS
COMMUNICATI
LEVEL 5 -

DRAWING No.: F1592-JCP501
FACILITY ID: F1592
SHEET No: REV:

Pictograms legend
- Antenna
- Offair
- Via

Cables legend
- LCF12-50J

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AWS

Revision history
1 5/26/2021 George Yeater
Updated Antennae Locations
2 6/15/2021 George Yeater
Updated Parts

Project name: Sound Transit Puyallup Parking Garage
Designer name: Aaron Baxter
Plan name: F5

7/19/2021

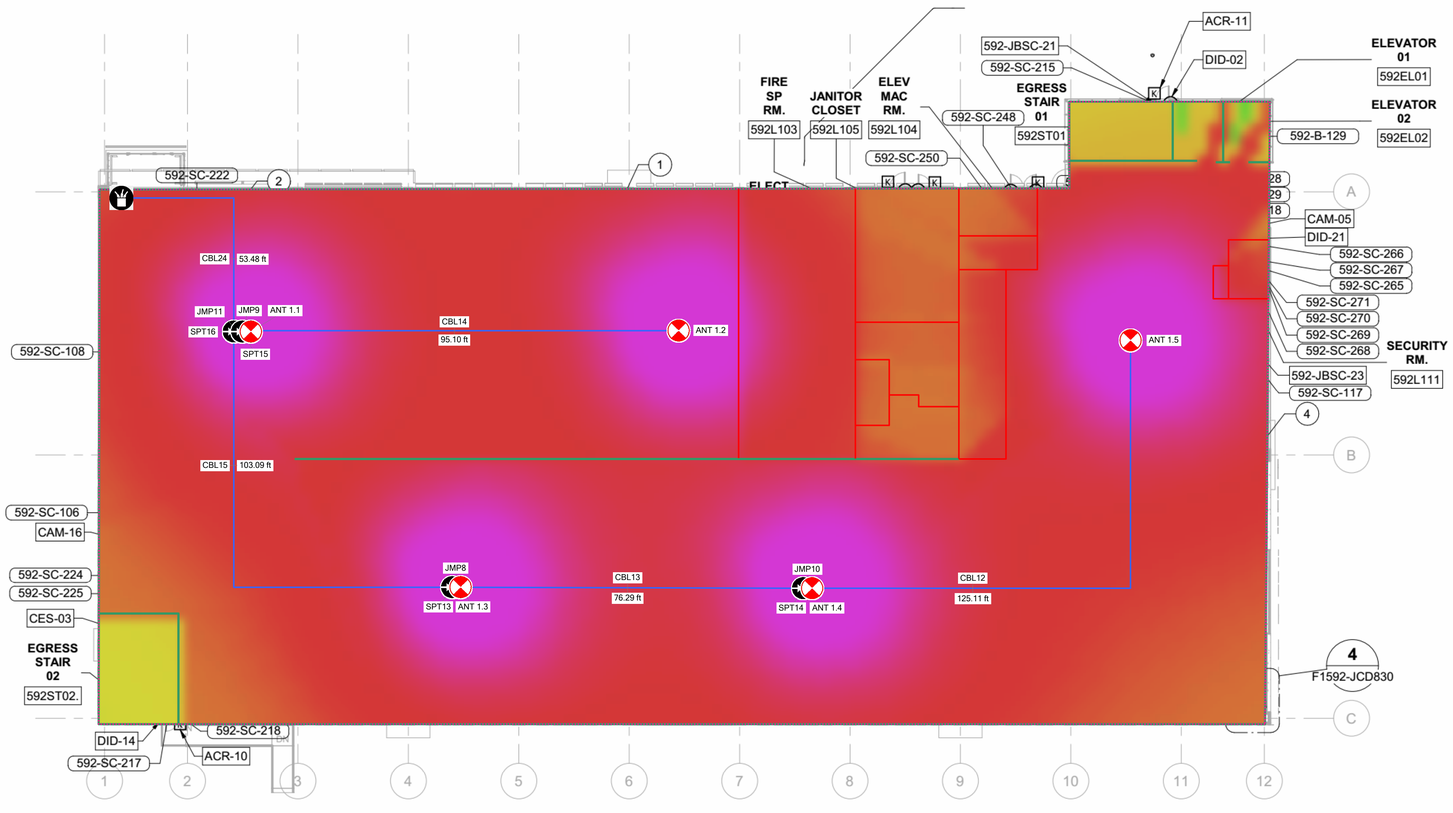
# Modeled Using Cost-231

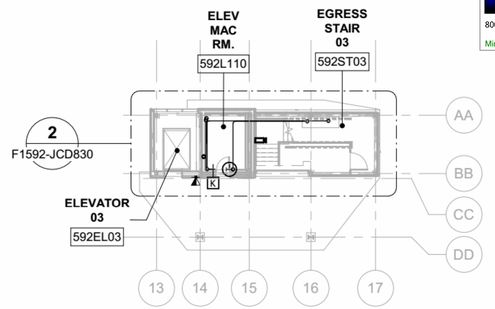
**GENERAL NOTES:**

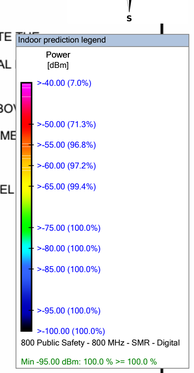
1. CEILING MOUNTED CONDUITS SHALL PENETRATE [illegible] MIDDLE THIRD OF OF BEAM DEPTH, AS PER PENETRATION CRITERIA STATED IN STRUCTURAL

**CONSTRUCTION NOTES:**

1. SLOPED RAMP; CONDUIT CONTINUES ON LEVEL ABO
2. CONDUITS FOR FUTURE OWNER PROVIDED EQUIPME
3. RADIO EQUIPMENT JUNCTION BOX, TYP.
4. 2'x2'x2' HANDHOLE, FLUSH WITH GRADE/SLAB, STEEL MARKED "SYSTEMS".




2' 0' 8' 16' 32'
SCALE IN FEET
32.00 ft

Pictograms legend
- Antenna
- Riser
- Splitter

Cables legend
- FMP29-3131-W03
- ICA12-50JPL

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DRAWN BY: S. TUTHILL
CHECKED BY: T. THAYER
APPROVED BY: T. THAYER

TODD D. THAYER — STATE OF WASHINGTON — 21904 — REGISTERED PROFESSIONAL ENGINEER

RUSHING Engineering - Essentials - Delivery
SUBMITTED BY: SARA ROBERTS

HENSEL PHELPS Plan. Build. Manage.
kpff
DATE: 04/05/2021
REVIEWED BY: GREG SHIMIZU

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT
DATE: 04/05/2021

SCALE: 1/16" = 1'-0"
FILENAME: S317-F1592-E_v2020
CONTRACT No.: RTA/CN 0612-18
SUBMITTAL DATE: 04/05/2021

**PACKAGE # DP-5 GARAGE, PED BRIDGE AND ABUTMENT**

**PUYALLUP STATION PARKING**
**CONTRACT RTA/CN 0612-18**
PUYALLUP STATION PARKING AND ACCESS IMPROVEMENTS
SYSTEMS
COMMUNICATI
LEVEL 1 -

DRAWING No.: F1592-JCP101
FACILITY ID: F1592
SHEET No: REV:

Revision history
1 5/26/2021 George Yeater Updated Antennae Locations
2 6/15/2021 George Yeater Updated Parts

Project name: Sound Transit Puyallup Parking Garage
Designer name: Aaron Baxter
Plan name: F1

7/19/2021

# Modeled Using Cost-231

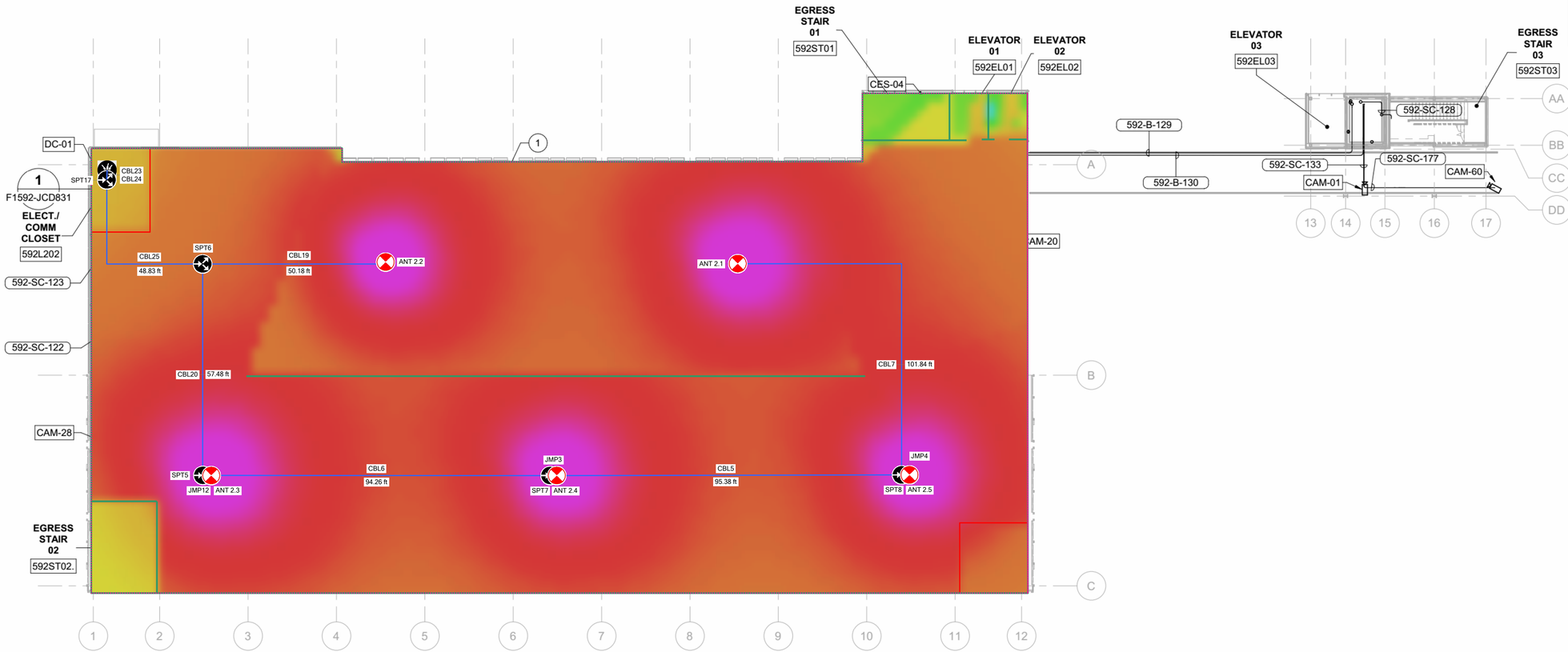
**GENERAL NOTES:**

1. CEILING MOUNTED CONDUITS SHALL PENETRATE THE MIDDLE THIRD OF OF BEAM DEPTH, AS PER PENET CRITERIA STATED IN STRUCTURAL DRAWINGS.

**CONSTRUCTION NOTES:**

1. SLOPED RAMP; CONDUIT CONTINUES ON LEVEL ABO
2. RADIO EQUIPMENT JUNCTION BOX, TYP.
3. 180 DEGREE TYPE CAMERA.

Indoor prediction legend
Power [dBm]
>-40.00 (3.3%)
>-50.00 (36.4%)
>-55.00 (91.6%)
>-60.00 (96.7%)
>-65.00 (98.5%)
>-75.00 (99.9%)
>-80.00 (100.0%)
>-85.00 (100.0%)
>-95.00 (100.0%)
>-100.00 (100.0%)
800 Public Safety - 800 MHz - SMR - Digital
Min -95.00 dBm: 100.0 % >= 100.0 %




N

2' 0' 8' 16' 32'
SCALE IN FEET
32.00 ft

Pictograms legend
Antenna
Riser
Splitter

Cables legend
FMP29-3131-W03
ICA12-50JPL

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APPROVED BY: T. THAYER

TODD D. THAYER STATE OF WASHINGTON 41904 REGISTERED PROFESSIONAL ENGINEER

RUSHING Engineering - Essentials - Delivery

HENSEL PHELPS Plan. Build. Manage.
kpff

SUBMITTED BY: SARA ROBERTS
DATE: 04/05/2021
REVIEWED BY: GREG SHIMIZU
DATE: 04/05/2021

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

PACKAGE # DP-5 GARAGE, PED BRIDGE AND ABUTMENT

SCALE: 1/16" = 1'-0"
FILENAME: S317-F1592-E_v2020
CONTRACT No.: RTA/CN 0612-18
SUBMITTAL DATE: 04/05/2021

**PUYALLUP STATION PARKING**
**CONTRACT RTA/CN 0612-18**
PUYALLUP STATION PARKING AND ACCESS IMPROVEMENTS
SYSTEMS
COMMUNICATI
LEVEL 2 -

DRAWING No.: F1592-JCP201
FACILITY ID: F1592
SHEET No: REV:

AWS

Revision history
1 5/26/2021 George Yeater
Updated Antennae Locations
2 6/15/2021 George Yeater
Updated Parts

Project name: Sound Transit Puyallup Parking Garage
Designer name: Aaron Baxter
Plan name: F2

7/19/2021

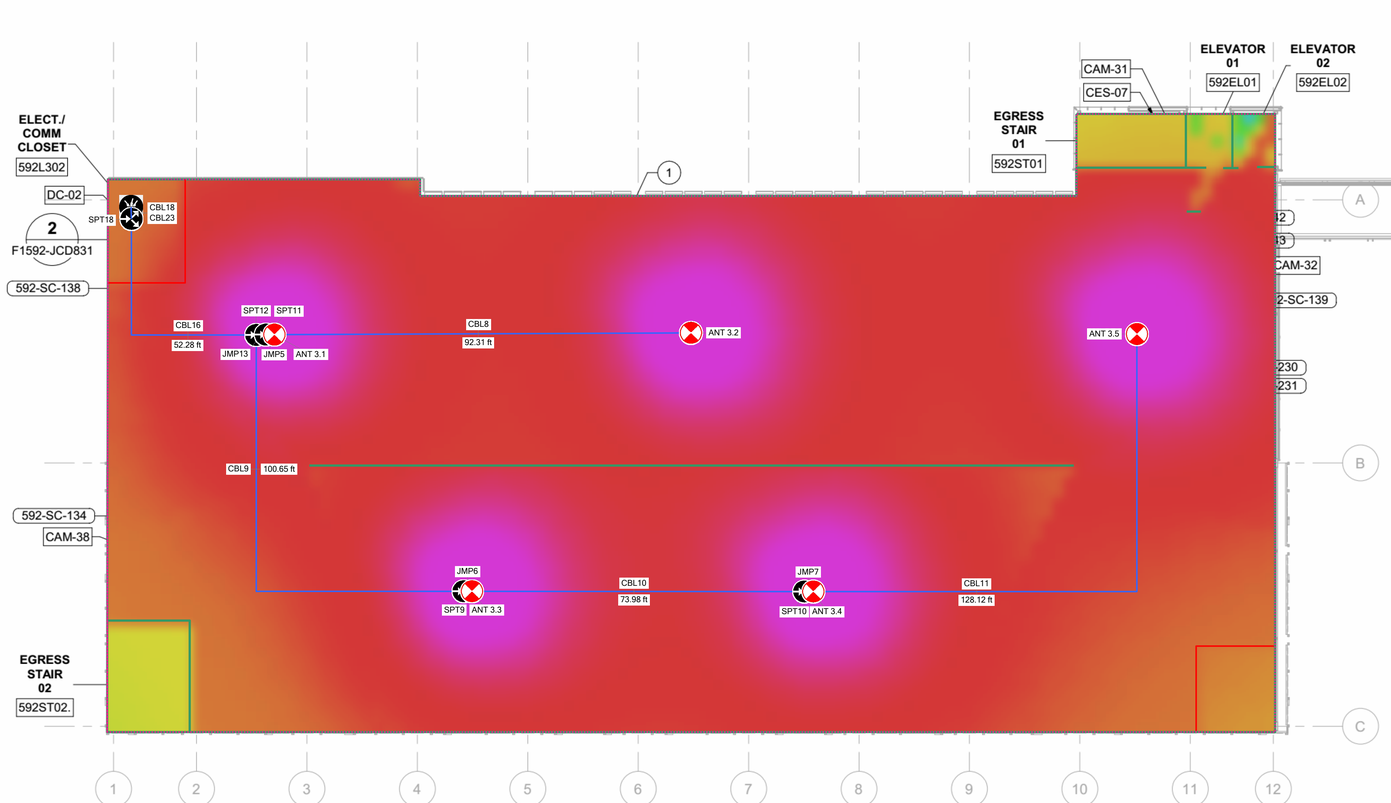
# Modeled Using Cost-231

**GENERAL NOTES:**

1. CEILING MOUNTED CONDUITS SHALL PENETRATE THE MIDDLE THIRD OF OF BEAM DEPTH, AS PER PENETRATION CRITERIA STATED IN STRUCTURAL DRAWINGS.

**CONSTRUCTION NOTES:**

1. SLOPED RAMP; CONDUIT CONTINUES ON LEVEL ABOVE
2. CONDUITS FOR FUTURE OWNER PROVIDED EQUIPMENT
3. RADIO EQUIPMENT JUNCTION BOX, TYP.
4. 180 DEGREE TYPE CAMERA.




Indoor prediction legend

Power [dBm]

- >-40.00 (5.5%)
- >-50.00 (62.0%)
- >-55.00 (94.9%)
- >-60.00 (97.1%)
- >-65.00 (98.5%)
- >-75.00 (100.0%)
- >-80.00 (100.0%)
- >-85.00 (100.0%)
- >-95.00 (100.0%)
- >-100.00 (100.0%)

800 Public Safety - 800 MHz - SMR - Digital

Min -95.00 dBm: 100.0 % >= 100.0 %

SCALE IN FEET
32.00 ft

Pictograms legend
- Antenna
- Riser
- Splitter

Cables legend
- FMP29-3131-W03
- ICA12-50JPL

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APPROVED BY: T. THAYER

TODD D. THAYER — STATE OF WASHINGTON — 41904 — REGISTERED PROFESSIONAL ENGINEER

RUSHING Engineering - Essentials - Delivery
SUBMITTED BY: SARA ROBERTS

HENSEL PHELPS Plan. Build. Manage.
kpff
DATE: 04/05/2021
REVIEWED BY: GREG SHIMIZU

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT
DATE: 04/05/2021

PACKAGE # DP-5 GARAGE, PED BRIDGE AND ABUTMENT

SCALE: 1/16" = 1'-0"
FILENAME: S317-F1592-E_v2020
CONTRACT No.: RTA/CN 0612-18
SUBMITTAL DATE: 04/05/2021

**PUYALLUP STATION PARKING**
**CONTRACT RTA/CN 0612-18**
PUYALLUP STATION PARKING AND ACCESS IMPROVEMENTS
SYSTEMS
COMMUNICATI
LEVEL 3

DRAWING No.: F1592-JCP301
FACILITY ID: F1592
SHEET No: REV:

Revision history
1 5/26/2021 George Yeater
Updated Antennae Locations
2 6/15/2021 George Yeater
Updated Parts

Project name: Sound Transit Puyallup Parking Garage
Designer name: Aaron Baxter
Plan name: F3

7/19/2021

# Modeled Using Cost-231

**GENERAL NOTES:**

1. CEILING MOUNTED CONDUITS SHALL PENETRATE THE MIDDLE THIRD OF OF BEAM DEPTH, AS PER PENET CRITERIA STATED IN STRUCTURAL DRAWINGS.

**CONSTRUCTION NOTES:**

1. SLOPED RAMP; CONDUIT CONTINUES ON LEVEL ABO
2. RADIO EQUIPMENT JUNCTION BOX, TYP.
3. 180 DEGREE TYPE CAMERA.

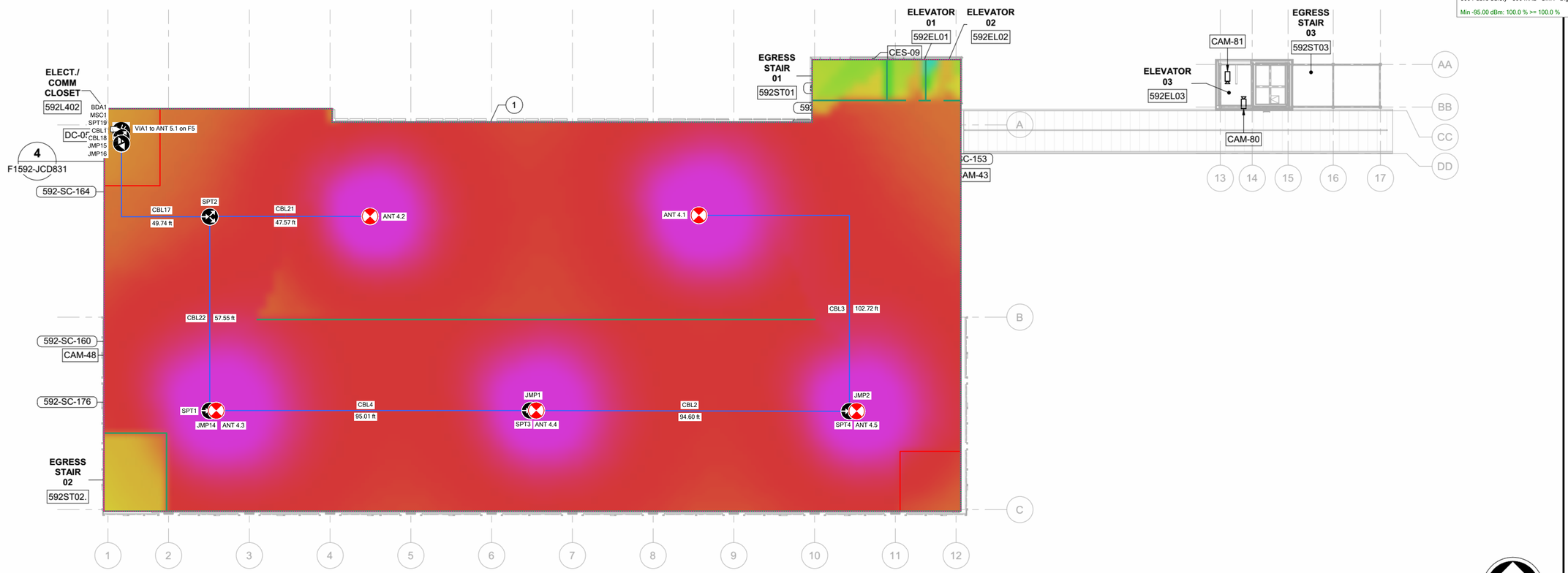
Indoor prediction legend

Power [dBm]

- >-40.00 (5.6%)
- >-50.00 (62.4%)
- >-55.00 (95.6%)
- >-60.00 (97.8%)
- >-65.00 (99.0%)
- >-75.00 (99.9%)
- >-80.00 (100.0%)
- >-85.00 (100.0%)
- >-95.00 (100.0%)
- >-100.00 (100.0%)

800 Public Safety - 800 MHz - SMR - Digital

Min -95.00 dBm: 100.0 % >= 100.0 %




N

2' 0' 8' 16' 32'

32.00 ft

SCALE IN FEET

Pictograms legend

- Antenna
- BDA
- Miscellaneous
- Riser
- Splitter
- Via

Cables legend

- FMP29-3131-W03
- FMP29-31N1-W03
- ICA12-50JPL
- LCF12-50J
- RG-142 NM-NM-3'

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APPROVED BY: T. THAYER

TODD D. THAYER STATE OF WASHINGTON 41904 REGISTERED PROFESSIONAL ENGINEER

RUSHING Engineering - Essentials - Delivery

SUBMITTED BY: SARA ROBERTS

HENSEL PHELPS Plan. Build. Manage.

kpff

DATE: 04/05/2021

REVIEWED BY: GREG SHIMIZU

LINE IS 1" AT FULL SCALE

SOUNDTRANSIT

DATE: 04/05/2021

PACKAGE # DP-5

GARAGE, PED BRIDGE AND ABUTMENT

SCALE: 1/16" = 1'-0"
FILENAME: S317-F1592-E_v2020
CONTRACT No.: RTA/CN 0612-18
SUBMITTAL DATE: 04/05/2021

**PUYALLUP STATION PARKING**
**CONTRACT RTA/CN 0612-18**
PUYALLUP STATION PARKING AND ACCESS IMPROVEMENTS
SYSTEMS
COMMUNICATI
LEVEL 4

DRAWING No.: F1592-JCP401
FACILITY ID: F1592
SHEET No: REV:

AWS

Revision history
1 5/26/2021 George Yeater Updated Antennae Locations
2 6/15/2021 George Yeater Updated Parts

Project name: Sound Transit Puyallup Parking Garage
Designer name: Aaron Baxter
Plan name: F4

7/19/2021

**Submittal Number: 27 60 07 and 27 60 02**
Puyallup Parking Garage
Sturgeon Electric
Contract #: 72573
AWS Project #: 10385

# TAB # 6

Distributed Antenna System

**Specification Section: 27 60 02 and 27 60 07**
Para. No. 6.1 RF Link Budget

# Link Budget Report

**Project name:** Sound Transit Puyallup Parking Garage **Design company:**

**Project creation date:** 7/19/2021 **Designer:** Aaron Baxter

DAS link budget report

| ID | Model | Length (feet) | 700 MHz - Narrowband - Sector N/A Gain/loss (dB) | (dBm) | 800 MHz - SMR - Digital - Sector 1 Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ANT 1.1** | | | | | | | | | | | | |
| ANT 1.1 (dBd) | AD-OMNI-SISO-4310 | - | 0.10 | 0.20 | 1.25 | 1.14 | - | - | - | - | - | - |
| MS RSSI [dBm] | - | - | -74.91 | - | -75.14 | - | - | - | - | - | - | - |
| MS signal range [feet] | - | - | 241.43 | - | 235.60 | - | - | - | - | - | - | - |
| JMP9 | FMP29-3131-W03 | Jumper | -0.35 | 0.10 | -0.37 | -0.11 | - | - | - | - | - | - |
| SPT15 | DC-H05-OMD300C(I) | - | -5.00 | 0.45 | -5.00 | 0.26 | - | - | - | - | - | - |
| JMP11 | FMP29-3131-W03 | Jumper | -0.35 | 5.45 | -0.37 | 5.26 | - | - | - | - | - | - |
| SPT16 | DC-H07-OMD300C(I) | - | -7.00 | 5.80 | -7.00 | 5.63 | - | - | - | - | - | - |
| CBL24 | ICA12-50JPL | 71.18 | -1.46 | 12.80 | -1.56 | 12.63 | - | - | - | - | - | - |
| SPT17 | DC-H05-OMD300C(I) | - | -2.30 | 14.26 | -2.30 | 14.19 | - | - | - | - | - | - |
| CBL23 | ICA12-50JPL | 20.33 | -0.43 | 16.56 | -0.46 | 16.49 | - | - | - | - | - | - |
| SPT18 | DC-H06-OMD300C(I) | - | -1.70 | 16.99 | -1.70 | 16.95 | - | - | - | - | - | - |
| CBL18 | ICA12-50JPL | 19.51 | -0.41 | 18.69 | -0.44 | 18.65 | - | - | - | - | - | - |
| SPT19 | DC-H07-OMD300C(I) | - | -1.50 | 19.11 | -1.50 | 19.09 | - | - | - | - | - | - |
| JMP15 | FMP29-31N1-W03 | Jumper | -0.35 | 20.61 | -0.37 | 20.59 | - | - | - | - | - | - |
| BDA1 | DH7S-D-7S33A | - | 81.58 | 20.96 | 81.62 | 20.96 | - | - | - | - | - | - |
| JMP16 | RG-142 NM-NM-3' | Jumper | -0.57 | -60.62 | -0.57 | -60.66 | - | - | - | - | - | - |
| MSC1 | CGXZ-36NFNF-A | - | -0.10 | -60.05 | -0.10 | -60.09 | - | - | - | - | - | - |
| CBL1 | LCF12-50J | 38.32 | -0.95 | -59.95 | -0.99 | -59.99 | - | - | - | - | - | - |

| DAS link budget report | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Model | Length (feet) | 700 MHz - Narrowband - Sector N/A Gain/loss (dB) | (dBm) | 800 MHz - SMR - Digital - Sector 1 Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) |
| Donor (ANT 5.1) | CSI-AY/746-896/11 (11dBi Yagi 746-896MHz) | - | 11.00 | -59.00 | 11.00 | -59.00 | - | - | - | - | - | - |
| **ANT 1.2** | | | | | | | | | | | | |
| ANT 1.2 (dBd) | AD-OMNI-SISO-4310 | - | 0.10 | 1.31 | 1.25 | 2.14 | - | - | - | - | - | - |
| MS RSSI [dBm] | - | - | -73.80 | - | -74.14 | - | - | - | - | - | - | - |
| MS signal range [feet] | - | - | 266.34 | - | 257.40 | - | - | - | - | - | - | - |
| CBL14 | ICA12-50JPL | 95.10 | -1.94 | 1.21 | -2.07 | 0.89 | - | - | - | - | - | - |
| SPT15 | DC-H05-OMD300C(I) | - | -2.30 | 3.15 | -2.30 | 2.96 | - | - | - | - | - | - |
| JMP11 | FMP29-3131-W03 | Jumper | -0.35 | 5.45 | -0.37 | 5.26 | - | - | - | - | - | - |
| SPT16 | DC-H07-OMD300C(I) | - | -7.00 | 5.80 | -7.00 | 5.63 | - | - | - | - | - | - |
| CBL24 | ICA12-50JPL | 71.18 | -1.46 | 12.80 | -1.56 | 12.63 | - | - | - | - | - | - |
| SPT17 | DC-H05-OMD300C(I) | - | -2.30 | 14.26 | -2.30 | 14.19 | - | - | - | - | - | - |
| CBL23 | ICA12-50JPL | 20.33 | -0.43 | 16.56 | -0.46 | 16.49 | - | - | - | - | - | - |
| SPT18 | DC-H06-OMD300C(I) | - | -1.70 | 16.99 | -1.70 | 16.95 | - | - | - | - | - | - |
| CBL18 | ICA12-50JPL | 19.51 | -0.41 | 18.69 | -0.44 | 18.65 | - | - | - | - | - | - |
| SPT19 | DC-H07-OMD300C(I) | - | -1.50 | 19.11 | -1.50 | 19.09 | - | - | - | - | - | - |
| JMP15 | FMP29-31N1-W03 | Jumper | -0.35 | 20.61 | -0.37 | 20.59 | - | - | - | - | - | - |
| BDA1 | DH7S-D-7S33A | - | 81.58 | 20.96 | 81.62 | 20.96 | - | - | - | - | - | - |
| JMP16 | RG-142 NM-NM-3' | Jumper | -0.57 | -60.62 | -0.57 | -60.66 | - | - | - | - | - | - |
| MSC1 | CGXZ-36NFNF-A | - | -0.10 | -60.05 | -0.10 | -60.09 | - | - | - | - | - | - |
| CBL1 | LCF12-50J | 38.32 | -0.95 | -59.95 | -0.99 | -59.99 | - | - | - | - | - | - |
| Donor (ANT 5.1) | CSI-AY/746-896/11 (11dBi Yagi 746-896MHz) | - | 11.00 | -59.00 | 11.00 | -59.00 | - | - | - | - | - | - |

| DAS link budget report | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Model | Length (feet) | 700 MHz - Narrowband - Sector N/A Gain/loss (dB) | (dBm) | 800 MHz - SMR - Digital - Sector 1 Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) |
| **ANT 1.3** | | | | | | | | | | | | |
| ANT 1.3 (dBd) | AD-OMNI-SISO-4310 | - | 0.10 | 0.95 | 1.25 | 1.76 | - | - | - | - | - | - |
| MS RSSI [dBm] | - | - | -74.16 | - | -74.52 | - | - | - | - | - | - | - |
| MS signal range [feet] | - | - | 257.92 | - | 249.05 | - | - | - | - | - | - | - |
| JMP8 | FMP29-3131-W03 | Jumper | -0.35 | 0.85 | -0.37 | 0.51 | - | - | - | - | - | - |
| SPT13 | DC-H08-OMD300C(I) | - | -8.00 | 1.20 | -8.00 | 0.89 | - | - | - | - | - | - |
| CBL15 | ICA12-50JPL | 103.09 | -2.11 | 9.20 | -2.24 | 8.89 | - | - | - | - | - | - |
| SPT16 | DC-H07-OMD300C(I) | - | -1.50 | 11.30 | -1.50 | 11.13 | - | - | - | - | - | - |
| CBL24 | ICA12-50JPL | 71.18 | -1.46 | 12.80 | -1.56 | 12.63 | - | - | - | - | - | - |
| SPT17 | DC-H05-OMD300C(I) | - | -2.30 | 14.26 | -2.30 | 14.19 | - | - | - | - | - | - |
| CBL23 | ICA12-50JPL | 20.33 | -0.43 | 16.56 | -0.46 | 16.49 | - | - | - | - | - | - |
| SPT18 | DC-H06-OMD300C(I) | - | -1.70 | 16.99 | -1.70 | 16.95 | - | - | - | - | - | - |
| CBL18 | ICA12-50JPL | 19.51 | -0.41 | 18.69 | -0.44 | 18.65 | - | - | - | - | - | - |
| SPT19 | DC-H07-OMD300C(I) | - | -1.50 | 19.11 | -1.50 | 19.09 | - | - | - | - | - | - |
| JMP15 | FMP29-31N1-W03 | Jumper | -0.35 | 20.61 | -0.37 | 20.59 | - | - | - | - | - | - |
| BDA1 | DH7S-D-7S33A | - | 81.58 | 20.96 | 81.62 | 20.96 | - | - | - | - | - | - |
| JMP16 | RG-142 NM-NM-3' | Jumper | -0.57 | -60.62 | -0.57 | -60.66 | - | - | - | - | - | - |
| MSC1 | CGXZ-36NFNF-A | - | -0.10 | -60.05 | -0.10 | -60.09 | - | - | - | - | - | - |
| CBL1 | LCF12-50J | 38.32 | -0.95 | -59.95 | -0.99 | -59.99 | - | - | - | - | - | - |
| Donor (ANT 5.1) | CSI-AY/746-896/11 (11dBi Yagi 746-896MHz) | - | 11.00 | -59.00 | 11.00 | -59.00 | - | - | - | - | - | - |

| DAS link budget report | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Model | Length (feet) | 700 MHz - Narrowband - Sector N/A Gain/loss (dB) | (dBm) | 800 MHz - SMR - Digital - Sector 1 Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) |
| **ANT 1.4** | | | | | | | | | | | | |
| ANT 1.4 (dBd) | AD-OMNI-SISO-4310 | - | 0.10 | 1.18 | 1.25 | 1.90 | - | - | - | - | - | - |
| MS RSSI [dBm] | - | - | -73.93 | - | -74.38 | - | - | - | - | - | - | - |
| MS signal range [feet] | - | - | 263.38 | - | 252.02 | - | - | - | - | - | - | - |
| JMP10 | FMP29-3131-W03 | Jumper | -0.35 | 1.08 | -0.37 | 0.65 | - | - | - | - | - | - |
| SPT14 | DC-H05-OMD300C(I) | - | -5.00 | 1.43 | -5.00 | 1.02 | - | - | - | - | - | - |
| CBL13 | ICA12-50JPL | 76.29 | -1.56 | 6.43 | -1.67 | 6.02 | - | - | - | - | - | - |
| SPT13 | DC-H08-OMD300C(I) | - | -1.20 | 8.00 | -1.20 | 7.69 | - | - | - | - | - | - |
| CBL15 | ICA12-50JPL | 103.09 | -2.11 | 9.20 | -2.24 | 8.89 | - | - | - | - | - | - |
| SPT16 | DC-H07-OMD300C(I) | - | -1.50 | 11.30 | -1.50 | 11.13 | - | - | - | - | - | - |
| CBL24 | ICA12-50JPL | 71.18 | -1.46 | 12.80 | -1.56 | 12.63 | - | - | - | - | - | - |
| SPT17 | DC-H05-OMD300C(I) | - | -2.30 | 14.26 | -2.30 | 14.19 | - | - | - | - | - | - |
| CBL23 | ICA12-50JPL | 20.33 | -0.43 | 16.56 | -0.46 | 16.49 | - | - | - | - | - | - |
| SPT18 | DC-H06-OMD300C(I) | - | -1.70 | 16.99 | -1.70 | 16.95 | - | - | - | - | - | - |
| CBL18 | ICA12-50JPL | 19.51 | -0.41 | 18.69 | -0.44 | 18.65 | - | - | - | - | - | - |
| SPT19 | DC-H07-OMD300C(I) | - | -1.50 | 19.11 | -1.50 | 19.09 | - | - | - | - | - | - |
| JMP15 | FMP29-31N1-W03 | Jumper | -0.35 | 20.61 | -0.37 | 20.59 | - | - | - | - | - | - |
| BDA1 | DH7S-D-7S33A | - | 81.58 | 20.96 | 81.62 | 20.96 | - | - | - | - | - | - |
| JMP16 | RG-142 NM-NM-3' | Jumper | -0.57 | -60.62 | -0.57 | -60.66 | - | - | - | - | - | - |
| MSC1 | CGXZ-36NFNF-A | - | -0.10 | -60.05 | -0.10 | -60.09 | - | - | - | - | - | - |
| CBL1 | LCF12-50J | 38.32 | -0.95 | -59.95 | -0.99 | -59.99 | - | - | - | - | - | - |
| Donor (ANT 5.1) | CSI-AY/746-896/11 (11dBi Yagi 746-896MHz) | - | 11.00 | -59.00 | 11.00 | -59.00 | - | - | - | - | - | - |

| DAS link budget report | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Model | Length (feet) | 700 MHz - Narrowband - Sector N/A Gain/loss (dB) | (dBm) | 800 MHz - SMR - Digital - Sector 1 Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) |
| **ANT 1.5** | | | | | | | | | | | | |
| ANT 1.5 (dBd) | AD-OMNI-SISO-4310 | - | 0.10 | 1.68 | 1.25 | 2.25 | - | - | - | - | - | - |
| MS RSSI [dBm] | - | - | -73.43 | - | -74.03 | - | - | - | - | - | - | - |
| MS signal range [feet] | - | - | 275.29 | - | 259.99 | - | - | - | - | - | - | - |
| CBL12 | ICA12-50JPL | 125.11 | -2.55 | 1.58 | -2.72 | 1.00 | - | - | - | - | - | - |
| SPT14 | DC-H05-OMD300C(I) | - | -2.30 | 4.13 | -2.30 | 3.72 | - | - | - | - | - | - |
| CBL13 | ICA12-50JPL | 76.29 | -1.56 | 6.43 | -1.67 | 6.02 | - | - | - | - | - | - |
| SPT13 | DC-H08-OMD300C(I) | - | -1.20 | 8.00 | -1.20 | 7.69 | - | - | - | - | - | - |
| CBL15 | ICA12-50JPL | 103.09 | -2.11 | 9.20 | -2.24 | 8.89 | - | - | - | - | - | - |
| SPT16 | DC-H07-OMD300C(I) | - | -1.50 | 11.30 | -1.50 | 11.13 | - | - | - | - | - | - |
| CBL24 | ICA12-50JPL | 71.18 | -1.46 | 12.80 | -1.56 | 12.63 | - | - | - | - | - | - |
| SPT17 | DC-H05-OMD300C(I) | - | -2.30 | 14.26 | -2.30 | 14.19 | - | - | - | - | - | - |
| CBL23 | ICA12-50JPL | 20.33 | -0.43 | 16.56 | -0.46 | 16.49 | - | - | - | - | - | - |
| SPT18 | DC-H06-OMD300C(I) | - | -1.70 | 16.99 | -1.70 | 16.95 | - | - | - | - | - | - |
| CBL18 | ICA12-50JPL | 19.51 | -0.41 | 18.69 | -0.44 | 18.65 | - | - | - | - | - | - |
| SPT19 | DC-H07-OMD300C(I) | - | -1.50 | 19.11 | -1.50 | 19.09 | - | - | - | - | - | - |
| JMP15 | FMP29-31N1-W03 | Jumper | -0.35 | 20.61 | -0.37 | 20.59 | - | - | - | - | - | - |
| BDA1 | DH7S-D-7S33A | - | 81.58 | 20.96 | 81.62 | 20.96 | - | - | - | - | - | - |
| JMP16 | RG-142 NM-NM-3' | Jumper | -0.57 | -60.62 | -0.57 | -60.66 | - | - | - | - | - | - |
| MSC1 | CGXZ-36NFNF-A | - | -0.10 | -60.05 | -0.10 | -60.09 | - | - | - | - | - | - |
| CBL1 | LCF12-50J | 38.32 | -0.95 | -59.95 | -0.99 | -59.99 | - | - | - | - | - | - |
| Donor (ANT 5.1) | CSI-AY/746-896/11 (11dBi Yagi 746-896MHz) | - | 11.00 | -59.00 | 11.00 | -59.00 | - | - | - | - | - | - |

| DAS link budget report | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Model | Length (feet) | 700 MHz - Narrowband - Sector N/A Gain/loss (dB) | (dBm) | 800 MHz - SMR - Digital - Sector 1 Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) |
| **ANT 2.1** | | | | | | | | | | | | |
| ANT 2.1 (dBd) | AD-OMNI-SISO-4310 | - | 0.10 | -1.29 | 1.25 | -0.75 | - | - | - | - | - | - |
| MS RSSI [dBm] | - | - | -76.40 | - | -77.03 | - | - | - | - | - | - | - |
| MS signal range [feet] | - | - | 211.45 | - | 199.38 | - | - | - | - | - | - | - |
| CBL7 | ICA12-50JPL | 101.84 | -2.08 | -1.39 | -2.22 | -2.00 | - | - | - | - | - | - |
| SPT8 | DC-H05-OMD300C(I) | - | -2.30 | 0.69 | -2.30 | 0.22 | - | - | - | - | - | - |
| CBL5 | ICA12-50JPL | 95.38 | -1.95 | 2.99 | -2.08 | 2.52 | - | - | - | - | - | - |
| SPT7 | DC-H08-OMD300C(I) | - | -1.20 | 4.94 | -1.20 | 4.60 | - | - | - | - | - | - |
| CBL6 | ICA12-50JPL | 94.26 | -1.93 | 6.14 | -2.05 | 5.80 | - | - | - | - | - | - |
| SPT5 | DC-H10-OMD300C(I) | - | -0.80 | 8.07 | -0.80 | 7.85 | - | - | - | - | - | - |
| CBL20 | ICA12-50JPL | 57.48 | -1.18 | 8.87 | -1.26 | 8.65 | - | - | - | - | - | - |
| SPT6 | DC-H13-OMD300C(I) | - | -0.50 | 10.05 | -0.50 | 9.91 | - | - | - | - | - | - |
| CBL25 | ICA12-50JPL | 48.83 | -1.01 | 10.55 | -1.07 | 10.41 | - | - | - | - | - | - |
| SPT17 | DC-H05-OMD300C(I) | - | -5.00 | 11.56 | -5.00 | 11.49 | - | - | - | - | - | - |
| CBL23 | ICA12-50JPL | 20.33 | -0.43 | 16.56 | -0.46 | 16.49 | - | - | - | - | - | - |
| SPT18 | DC-H06-OMD300C(I) | - | -1.70 | 16.99 | -1.70 | 16.95 | - | - | - | - | - | - |
| CBL18 | ICA12-50JPL | 19.51 | -0.41 | 18.69 | -0.44 | 18.65 | - | - | - | - | - | - |
| SPT19 | DC-H07-OMD300C(I) | - | -1.50 | 19.11 | -1.50 | 19.09 | - | - | - | - | - | - |
| JMP15 | FMP29-31N1-W03 | Jumper | -0.35 | 20.61 | -0.37 | 20.59 | - | - | - | - | - | - |
| BDA1 | DH7S-D-7S33A | - | 81.58 | 20.96 | 81.62 | 20.96 | - | - | - | - | - | - |
| JMP16 | RG-142 NM-NM-3' | Jumper | -0.57 | -60.62 | -0.57 | -60.66 | - | - | - | - | - | - |
| MSC1 | CGXZ-36NFNF-A | - | -0.10 | -60.05 | -0.10 | -60.09 | - | - | - | - | - | - |
| CBL1 | LCF12-50J | 38.32 | -0.95 | -59.95 | -0.99 | -59.99 | - | - | - | - | - | - |

| DAS link budget report | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Model | Length (feet) | 700 MHz - Narrowband - Sector N/A Gain/loss (dB) | (dBm) | 800 MHz - SMR - Digital - Sector 1 Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) |
| Donor (ANT 5.1) | CSI-AY/746-896/11 (11dBi Yagi 746-896MHz) | - | 11.00 | -59.00 | 11.00 | -59.00 | - | - | - | - | - | - |
| **ANT 2.2** | | | | | | | | | | | | |
| ANT 2.2 (dBd) | AD-OMNI-SISO-4310 | - | 0.10 | -3.38 | 1.25 | -2.44 | - | - | - | - | - | - |
| MS RSSI [dBm] | - | - | -78.49 | - | -78.72 | - | - | - | - | - | - | - |
| MS signal range [feet] | - | - | 175.55 | - | 171.63 | - | - | - | - | - | - | - |
| CBL19 | ICA12-50JPL | 50.18 | -1.04 | -3.48 | -1.10 | -3.69 | - | - | - | - | - | - |
| SPT6 | DC-H13-OMD300C(I) | - | -13.00 | -2.45 | -13.00 | -2.59 | - | - | - | - | - | - |
| CBL25 | ICA12-50JPL | 48.83 | -1.01 | 10.55 | -1.07 | 10.41 | - | - | - | - | - | - |
| SPT17 | DC-H05-OMD300C(I) | - | -5.00 | 11.56 | -5.00 | 11.49 | - | - | - | - | - | - |
| CBL23 | ICA12-50JPL | 20.33 | -0.43 | 16.56 | -0.46 | 16.49 | - | - | - | - | - | - |
| SPT18 | DC-H06-OMD300C(I) | - | -1.70 | 16.99 | -1.70 | 16.95 | - | - | - | - | - | - |
| CBL18 | ICA12-50JPL | 19.51 | -0.41 | 18.69 | -0.44 | 18.65 | - | - | - | - | - | - |
| SPT19 | DC-H07-OMD300C(I) | - | -1.50 | 19.11 | -1.50 | 19.09 | - | - | - | - | - | - |
| JMP15 | FMP29-31N1-W03 | Jumper | -0.35 | 20.61 | -0.37 | 20.59 | - | - | - | - | - | - |
| BDA1 | DH7S-D-7S33A | - | 81.58 | 20.96 | 81.62 | 20.96 | - | - | - | - | - | - |
| JMP16 | RG-142 NM-NM-3' | Jumper | -0.57 | -60.62 | -0.57 | -60.66 | - | - | - | - | - | - |
| MSC1 | CGXZ-36NFNF-A | - | -0.10 | -60.05 | -0.10 | -60.09 | - | - | - | - | - | - |
| CBL1 | LCF12-50J | 38.32 | -0.95 | -59.95 | -0.99 | -59.99 | - | - | - | - | - | - |
| Donor (ANT 5.1) | CSI-AY/746-896/11 (11dBi Yagi 746-896MHz) | - | 11.00 | -59.00 | 11.00 | -59.00 | - | - | - | - | - | - |

| DAS link budget report | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Model | Length (feet) | 700 MHz - Narrowband - Sector N/A Gain/loss (dB) | (dBm) | 800 MHz - SMR - Digital - Sector 1 Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) |
| **ANT 2.3** | | | | | | | | | | | | |
| ANT 2.3 (dBd) | AD-OMNI-SISO-4310 | - | 0.10 | -1.38 | 1.25 | -0.47 | - | - | - | - | - | - |
| MS RSSI [dBm] | - | - | -76.49 | - | -76.75 | - | - | - | - | - | - | - |
| MS signal range [feet] | - | - | 209.76 | - | 204.36 | - | - | - | - | - | - | - |
| JMP12 | FMP29-3131-W03 | Jumper | -0.35 | -1.48 | -0.37 | -1.72 | - | - | - | - | - | - |
| SPT5 | DC-H10-OMD300C(I) | - | -10.00 | -1.13 | -10.00 | -1.35 | - | - | - | - | - | - |
| CBL20 | ICA12-50JPL | 57.48 | -1.18 | 8.87 | -1.26 | 8.65 | - | - | - | - | - | - |
| SPT6 | DC-H13-OMD300C(I) | - | -0.50 | 10.05 | -0.50 | 9.91 | - | - | - | - | - | - |
| CBL25 | ICA12-50JPL | 48.83 | -1.01 | 10.55 | -1.07 | 10.41 | - | - | - | - | - | - |
| SPT17 | DC-H05-OMD300C(I) | - | -5.00 | 11.56 | -5.00 | 11.49 | - | - | - | - | - | - |
| CBL23 | ICA12-50JPL | 20.33 | -0.43 | 16.56 | -0.46 | 16.49 | - | - | - | - | - | - |
| SPT18 | DC-H06-OMD300C(I) | - | -1.70 | 16.99 | -1.70 | 16.95 | - | - | - | - | - | - |
| CBL18 | ICA12-50JPL | 19.51 | -0.41 | 18.69 | -0.44 | 18.65 | - | - | - | - | - | - |
| SPT19 | DC-H07-OMD300C(I) | - | -1.50 | 19.11 | -1.50 | 19.09 | - | - | - | - | - | - |
| JMP15 | FMP29-31N1-W03 | Jumper | -0.35 | 20.61 | -0.37 | 20.59 | - | - | - | - | - | - |
| BDA1 | DH7S-D-7S33A | - | 81.58 | 20.96 | 81.62 | 20.96 | - | - | - | - | - | - |
| JMP16 | RG-142 NM-NM-3' | Jumper | -0.57 | -60.62 | -0.57 | -60.66 | - | - | - | - | - | - |
| MSC1 | CGXZ-36NFNF-A | - | -0.10 | -60.05 | -0.10 | -60.09 | - | - | - | - | - | - |
| CBL1 | LCF12-50J | 38.32 | -0.95 | -59.95 | -0.99 | -59.99 | - | - | - | - | - | - |
| Donor (ANT 5.1) | CSI-AY/746-896/11 (11dBi Yagi 746-896MHz) | - | 11.00 | -59.00 | 11.00 | -59.00 | - | - | - | - | - | - |

| DAS link budget report | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Model | Length (feet) | 700 MHz - Narrowband - Sector N/A Gain/loss (dB) | (dBm) | 800 MHz - SMR - Digital - Sector 1 Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) |
| **ANT 2.4** | | | | | | | | | | | | |
| ANT 2.4 (dBd) | AD-OMNI-SISO-4310 | - | 0.10 | -2.11 | 1.25 | -1.32 | - | - | - | - | - | - |
| MS RSSI [dBm] | - | - | -77.22 | - | -77.60 | - | - | - | - | - | - | - |
| MS signal range [feet] | - | - | 196.62 | - | 189.47 | - | - | - | - | - | - | - |
| JMP3 | FMP29-3131-W03 | Jumper | -0.35 | -2.21 | -0.37 | -2.57 | - | - | - | - | - | - |
| SPT7 | DC-H08-OMD300C(I) | - | -8.00 | -1.86 | -8.00 | -2.20 | - | - | - | - | - | - |
| CBL6 | ICA12-50JPL | 94.26 | -1.93 | 6.14 | -2.05 | 5.80 | - | - | - | - | - | - |
| SPT5 | DC-H10-OMD300C(I) | - | -0.80 | 8.07 | -0.80 | 7.85 | - | - | - | - | - | - |
| CBL20 | ICA12-50JPL | 57.48 | -1.18 | 8.87 | -1.26 | 8.65 | - | - | - | - | - | - |
| SPT6 | DC-H13-OMD300C(I) | - | -0.50 | 10.05 | -0.50 | 9.91 | - | - | - | - | - | - |
| CBL25 | ICA12-50JPL | 48.83 | -1.01 | 10.55 | -1.07 | 10.41 | - | - | - | - | - | - |
| SPT17 | DC-H05-OMD300C(I) | - | -5.00 | 11.56 | -5.00 | 11.49 | - | - | - | - | - | - |
| CBL23 | ICA12-50JPL | 20.33 | -0.43 | 16.56 | -0.46 | 16.49 | - | - | - | - | - | - |
| SPT18 | DC-H06-OMD300C(I) | - | -1.70 | 16.99 | -1.70 | 16.95 | - | - | - | - | - | - |
| CBL18 | ICA12-50JPL | 19.51 | -0.41 | 18.69 | -0.44 | 18.65 | - | - | - | - | - | - |
| SPT19 | DC-H07-OMD300C(I) | - | -1.50 | 19.11 | -1.50 | 19.09 | - | - | - | - | - | - |
| JMP15 | FMP29-31N1-W03 | Jumper | -0.35 | 20.61 | -0.37 | 20.59 | - | - | - | - | - | - |
| BDA1 | DH7S-D-7S33A | - | 81.58 | 20.96 | 81.62 | 20.96 | - | - | - | - | - | - |
| JMP16 | RG-142 NM-NM-3' | Jumper | -0.57 | -60.62 | -0.57 | -60.66 | - | - | - | - | - | - |
| MSC1 | CGXZ-36NFNF-A | - | -0.10 | -60.05 | -0.10 | -60.09 | - | - | - | - | - | - |
| CBL1 | LCF12-50J | 38.32 | -0.95 | -59.95 | -0.99 | -59.99 | - | - | - | - | - | - |
| Donor (ANT 5.1) | CSI-AY/746-896/11 (11dBi Yagi 746-896MHz) | - | 11.00 | -59.00 | 11.00 | -59.00 | - | - | - | - | - | - |

| DAS link budget report | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Model | Length (feet) | 700 MHz - Narrowband - Sector N/A Gain/loss (dB) | (dBm) | 800 MHz - SMR - Digital - Sector 1 Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) |
| **ANT 2.5** | | | | | | | | | | | | |
| ANT 2.5 (dBd) | AD-OMNI-SISO-4310 | - | 0.10 | -2.26 | 1.25 | -1.60 | - | - | - | - | - | - |
| MS RSSI [dBm] | - | - | -77.37 | - | -77.88 | - | - | - | - | - | - | - |
| MS signal range [feet] | - | - | 194.01 | - | 184.86 | - | - | - | - | - | - | - |
| JMP4 | FMP29-3131-W03 | Jumper | -0.35 | -2.36 | -0.37 | -2.85 | - | - | - | - | - | - |
| SPT8 | DC-H05-OMD300C(I) | - | -5.00 | -2.01 | -5.00 | -2.48 | - | - | - | - | - | - |
| CBL5 | ICA12-50JPL | 95.38 | -1.95 | 2.99 | -2.08 | 2.52 | - | - | - | - | - | - |
| SPT7 | DC-H08-OMD300C(I) | - | -1.20 | 4.94 | -1.20 | 4.60 | - | - | - | - | - | - |
| CBL6 | ICA12-50JPL | 94.26 | -1.93 | 6.14 | -2.05 | 5.80 | - | - | - | - | - | - |
| SPT5 | DC-H10-OMD300C(I) | - | -0.80 | 8.07 | -0.80 | 7.85 | - | - | - | - | - | - |
| CBL20 | ICA12-50JPL | 57.48 | -1.18 | 8.87 | -1.26 | 8.65 | - | - | - | - | - | - |
| SPT6 | DC-H13-OMD300C(I) | - | -0.50 | 10.05 | -0.50 | 9.91 | - | - | - | - | - | - |
| CBL25 | ICA12-50JPL | 48.83 | -1.01 | 10.55 | -1.07 | 10.41 | - | - | - | - | - | - |
| SPT17 | DC-H05-OMD300C(I) | - | -5.00 | 11.56 | -5.00 | 11.49 | - | - | - | - | - | - |
| CBL23 | ICA12-50JPL | 20.33 | -0.43 | 16.56 | -0.46 | 16.49 | - | - | - | - | - | - |
| SPT18 | DC-H06-OMD300C(I) | - | -1.70 | 16.99 | -1.70 | 16.95 | - | - | - | - | - | - |
| CBL18 | ICA12-50JPL | 19.51 | -0.41 | 18.69 | -0.44 | 18.65 | - | - | - | - | - | - |
| SPT19 | DC-H07-OMD300C(I) | - | -1.50 | 19.11 | -1.50 | 19.09 | - | - | - | - | - | - |
| JMP15 | FMP29-31N1-W03 | Jumper | -0.35 | 20.61 | -0.37 | 20.59 | - | - | - | - | - | - |
| BDA1 | DH7S-D-7S33A | - | 81.58 | 20.96 | 81.62 | 20.96 | - | - | - | - | - | - |
| JMP16 | RG-142 NM-NM-3' | Jumper | -0.57 | -60.62 | -0.57 | -60.66 | - | - | - | - | - | - |
| MSC1 | CGXZ-36NFNF-A | - | -0.10 | -60.05 | -0.10 | -60.09 | - | - | - | - | - | - |
| CBL1 | LCF12-50J | 38.32 | -0.95 | -59.95 | -0.99 | -59.99 | - | - | - | - | - | - |

| DAS link budget report | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Model | Length (feet) | 700 MHz - Narrowband - Sector N/A Gain/loss (dB) | (dBm) | 800 MHz - SMR - Digital - Sector 1 Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) |
| Donor (ANT 5.1) | CSI-AY/746-896/11 (11dBi Yagi 746-896MHz) | - | 11.00 | -59.00 | 11.00 | -59.00 | - | - | - | - | - | - |
| **ANT 3.1** | | | | | | | | | | | | |
| ANT 3.1 (dBd) | AD-OMNI-SISO-4310 | - | 0.10 | -0.98 | 1.25 | 0.00 | - | - | - | - | - | - |
| MS RSSI [dBm] | - | - | -76.09 | - | -76.28 | - | - | - | - | - | - | - |
| MS signal range [feet] | - | - | 217.27 | - | 213.10 | - | - | - | - | - | - | - |
| JMP5 | FMP29-3131-W03 | Jumper | -0.35 | -1.08 | -0.37 | -1.25 | - | - | - | - | - | - |
| SPT11 | DC-H05-OMD300C(I) | - | -5.00 | -0.73 | -5.00 | -0.87 | - | - | - | - | - | - |
| JMP13 | FMP29-3131-W03 | Jumper | -0.35 | 4.27 | -0.37 | 4.13 | - | - | - | - | - | - |
| SPT12 | DC-H07-OMD300C(I) | - | -7.00 | 4.62 | -7.00 | 4.50 | - | - | - | - | - | - |
| CBL16 | ICA12-50JPL | 52.28 | -1.08 | 11.62 | -1.15 | 11.50 | - | - | - | - | - | - |
| SPT18 | DC-H06-OMD300C(I) | - | -6.00 | 12.69 | -6.00 | 12.65 | - | - | - | - | - | - |
| CBL18 | ICA12-50JPL | 19.51 | -0.41 | 18.69 | -0.44 | 18.65 | - | - | - | - | - | - |
| SPT19 | DC-H07-OMD300C(I) | - | -1.50 | 19.11 | -1.50 | 19.09 | - | - | - | - | - | - |
| JMP15 | FMP29-31N1-W03 | Jumper | -0.35 | 20.61 | -0.37 | 20.59 | - | - | - | - | - | - |
| BDA1 | DH7S-D-7S33A | - | 81.58 | 20.96 | 81.62 | 20.96 | - | - | - | - | - | - |
| JMP16 | RG-142 NM-NM-3' | Jumper | -0.57 | -60.62 | -0.57 | -60.66 | - | - | - | - | - | - |
| MSC1 | CGXZ-36NFNF-A | - | -0.10 | -60.05 | -0.10 | -60.09 | - | - | - | - | - | - |
| CBL1 | LCF12-50J | 38.32 | -0.95 | -59.95 | -0.99 | -59.99 | - | - | - | - | - | - |
| Donor (ANT 5.1) | CSI-AY/746-896/11 (11dBi Yagi 746-896MHz) | - | 11.00 | -59.00 | 11.00 | -59.00 | - | - | - | - | - | - |

| DAS link budget report | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Model | Length (feet) | 700 MHz - Narrowband - Sector N/A Gain/loss (dB) | (dBm) | 800 MHz - SMR - Digital - Sector 1 Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) |
| **ANT 3.2** | | | | | | | | | | | | |
| ANT 3.2 (dBd) | AD-OMNI-SISO-4310 | - | 0.10 | 0.18 | 1.25 | 1.06 | - | - | - | - | - | - |
| MS RSSI [dBm] | - | - | -74.93 | - | -75.22 | - | - | - | - | - | - | - |
| MS signal range [feet] | - | - | 240.90 | - | 234.06 | - | - | - | - | - | - | - |
| CBL8 | ICA12-50JPL | 92.31 | -1.89 | 0.08 | -2.01 | -0.19 | - | - | - | - | - | - |
| SPT11 | DC-H05-OMD300C(I) | - | -2.30 | 1.97 | -2.30 | 1.83 | - | - | - | - | - | - |
| JMP13 | FMP29-3131-W03 | Jumper | -0.35 | 4.27 | -0.37 | 4.13 | - | - | - | - | - | - |
| SPT12 | DC-H07-OMD300C(I) | - | -7.00 | 4.62 | -7.00 | 4.50 | - | - | - | - | - | - |
| CBL16 | ICA12-50JPL | 52.28 | -1.08 | 11.62 | -1.15 | 11.50 | - | - | - | - | - | - |
| SPT18 | DC-H06-OMD300C(I) | - | -6.00 | 12.69 | -6.00 | 12.65 | - | - | - | - | - | - |
| CBL18 | ICA12-50JPL | 19.51 | -0.41 | 18.69 | -0.44 | 18.65 | - | - | - | - | - | - |
| SPT19 | DC-H07-OMD300C(I) | - | -1.50 | 19.11 | -1.50 | 19.09 | - | - | - | - | - | - |
| JMP15 | FMP29-31N1-W03 | Jumper | -0.35 | 20.61 | -0.37 | 20.59 | - | - | - | - | - | - |
| BDA1 | DH7S-D-7S33A | - | 81.58 | 20.96 | 81.62 | 20.96 | - | - | - | - | - | - |
| JMP16 | RG-142 NM-NM-3' | Jumper | -0.57 | -60.62 | -0.57 | -60.66 | - | - | - | - | - | - |
| MSC1 | CGXZ-36NFNF-A | - | -0.10 | -60.05 | -0.10 | -60.09 | - | - | - | - | - | - |
| CBL1 | LCF12-50J | 38.32 | -0.95 | -59.95 | -0.99 | -59.99 | - | - | - | - | - | - |
| Donor (ANT 5.1) | CSI-AY/746-896/11 (11dBi Yagi 746-896MHz) | - | 11.00 | -59.00 | 11.00 | -59.00 | - | - | - | - | - | - |

| DAS link budget report | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Model | Length (feet) | 700 MHz - Narrowband - Sector N/A Gain/loss (dB) | (dBm) | 800 MHz - SMR - Digital - Sector 1 Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) |
| **ANT 3.3** | | | | | | | | | | | | |
| ANT 3.3 (dBd) | AD-OMNI-SISO-4310 | - | 0.10 | -0.19 | 1.25 | 0.68 | - | - | - | - | - | - |
| MS RSSI [dBm] | - | - | -75.30 | - | -75.60 | - | - | - | - | - | - | - |
| MS signal range [feet] | - | - | 233.13 | - | 226.32 | - | - | - | - | - | - | - |
| JMP6 | FMP29-3131-W03 | Jumper | -0.35 | -0.29 | -0.37 | -0.57 | - | - | - | - | - | - |
| SPT9 | DC-H08-OMD300C(I) | - | -8.00 | 0.06 | -8.00 | -0.19 | - | - | - | - | - | - |
| CBL9 | ICA12-50JPL | 100.65 | -2.06 | 8.06 | -2.19 | 7.81 | - | - | - | - | - | - |
| SPT12 | DC-H07-OMD300C(I) | - | -1.50 | 10.12 | -1.50 | 10.00 | - | - | - | - | - | - |
| CBL16 | ICA12-50JPL | 52.28 | -1.08 | 11.62 | -1.15 | 11.50 | - | - | - | - | - | - |
| SPT18 | DC-H06-OMD300C(I) | - | -6.00 | 12.69 | -6.00 | 12.65 | - | - | - | - | - | - |
| CBL18 | ICA12-50JPL | 19.51 | -0.41 | 18.69 | -0.44 | 18.65 | - | - | - | - | - | - |
| SPT19 | DC-H07-OMD300C(I) | - | -1.50 | 19.11 | -1.50 | 19.09 | - | - | - | - | - | - |
| JMP15 | FMP29-31N1-W03 | Jumper | -0.35 | 20.61 | -0.37 | 20.59 | - | - | - | - | - | - |
| BDA1 | DH7S-D-7S33A | - | 81.58 | 20.96 | 81.62 | 20.96 | - | - | - | - | - | - |
| JMP16 | RG-142 NM-NM-3' | Jumper | -0.57 | -60.62 | -0.57 | -60.66 | - | - | - | - | - | - |
| MSC1 | CGXZ-36NFNF-A | - | -0.10 | -60.05 | -0.10 | -60.09 | - | - | - | - | - | - |
| CBL1 | LCF12-50J | 38.32 | -0.95 | -59.95 | -0.99 | -59.99 | - | - | - | - | - | - |
| Donor (ANT 5.1) | CSI-AY/746-896/11 (11dBi Yagi 746-896MHz) | - | 11.00 | -59.00 | 11.00 | -59.00 | - | - | - | - | - | - |

| DAS link budget report | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Model | Length (feet) | 700 MHz - Narrowband - Sector N/A Gain/loss (dB) | (dBm) | 800 MHz - SMR - Digital - Sector 1 Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) |
| **ANT 3.4** | | | | | | | | | | | | |
| ANT 3.4 (dBd) | AD-OMNI-SISO-4310 | - | 0.10 | 0.09 | 1.25 | 0.87 | - | - | - | - | - | - |
| MS RSSI [dBm] | - | - | -75.02 | - | -75.41 | - | - | - | - | - | - | - |
| MS signal range [feet] | - | - | 239.06 | - | 230.03 | - | - | - | - | - | - | - |
| JMP7 | FMP29-3131-W03 | Jumper | -0.35 | -0.01 | -0.37 | -0.38 | - | - | - | - | - | - |
| SPT10 | DC-H05-OMD300C(I) | - | -5.00 | 0.34 | -5.00 | -0.01 | - | - | - | - | - | - |
| CBL10 | ICA12-50JPL | 73.98 | -1.52 | 5.34 | -1.62 | 4.99 | - | - | - | - | - | - |
| SPT9 | DC-H08-OMD300C(I) | - | -1.20 | 6.86 | -1.20 | 6.61 | - | - | - | - | - | - |
| CBL9 | ICA12-50JPL | 100.65 | -2.06 | 8.06 | -2.19 | 7.81 | - | - | - | - | - | - |
| SPT12 | DC-H07-OMD300C(I) | - | -1.50 | 10.12 | -1.50 | 10.00 | - | - | - | - | - | - |
| CBL16 | ICA12-50JPL | 52.28 | -1.08 | 11.62 | -1.15 | 11.50 | - | - | - | - | - | - |
| SPT18 | DC-H06-OMD300C(I) | - | -6.00 | 12.69 | -6.00 | 12.65 | - | - | - | - | - | - |
| CBL18 | ICA12-50JPL | 19.51 | -0.41 | 18.69 | -0.44 | 18.65 | - | - | - | - | - | - |
| SPT19 | DC-H07-OMD300C(I) | - | -1.50 | 19.11 | -1.50 | 19.09 | - | - | - | - | - | - |
| JMP15 | FMP29-31N1-W03 | Jumper | -0.35 | 20.61 | -0.37 | 20.59 | - | - | - | - | - | - |
| BDA1 | DH7S-D-7S33A | - | 81.58 | 20.96 | 81.62 | 20.96 | - | - | - | - | - | - |
| JMP16 | RG-142 NM-NM-3' | Jumper | -0.57 | -60.62 | -0.57 | -60.66 | - | - | - | - | - | - |
| MSC1 | CGXZ-36NFNF-A | - | -0.10 | -60.05 | -0.10 | -60.09 | - | - | - | - | - | - |
| CBL1 | LCF12-50J | 38.32 | -0.95 | -59.95 | -0.99 | -59.99 | - | - | - | - | - | - |
| Donor (ANT 5.1) | CSI-AY/746-896/11 (11dBi Yagi 746-896MHz) | - | 11.00 | -59.00 | 11.00 | -59.00 | - | - | - | - | - | - |

| DAS link budget report | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Model | Length (feet) | 700 MHz - Narrowband - Sector N/A Gain/loss (dB) | (dBm) | 800 MHz - SMR - Digital - Sector 1 Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) |
| **ANT 3.5** | | | | | | | | | | | | |
| ANT 3.5 (dBd) | AD-OMNI-SISO-4310 | - | 0.10 | 0.53 | 1.25 | 1.15 | - | - | - | - | - | - |
| MS RSSI [dBm] | - | - | -74.58 | - | -75.13 | - | - | - | - | - | - | - |
| MS signal range [feet] | - | - | 248.51 | - | 235.94 | - | - | - | - | - | - | - |
| CBL11 | ICA12-50JPL | 128.12 | -2.61 | 0.43 | -2.78 | -0.10 | - | - | - | - | - | - |
| SPT10 | DC-H05-OMD300C(I) | - | -2.30 | 3.04 | -2.30 | 2.69 | - | - | - | - | - | - |
| CBL10 | ICA12-50JPL | 73.98 | -1.52 | 5.34 | -1.62 | 4.99 | - | - | - | - | - | - |
| SPT9 | DC-H08-OMD300C(I) | - | -1.20 | 6.86 | -1.20 | 6.61 | - | - | - | - | - | - |
| CBL9 | ICA12-50JPL | 100.65 | -2.06 | 8.06 | -2.19 | 7.81 | - | - | - | - | - | - |
| SPT12 | DC-H07-OMD300C(I) | - | -1.50 | 10.12 | -1.50 | 10.00 | - | - | - | - | - | - |
| CBL16 | ICA12-50JPL | 52.28 | -1.08 | 11.62 | -1.15 | 11.50 | - | - | - | - | - | - |
| SPT18 | DC-H06-OMD300C(I) | - | -6.00 | 12.69 | -6.00 | 12.65 | - | - | - | - | - | - |
| CBL18 | ICA12-50JPL | 19.51 | -0.41 | 18.69 | -0.44 | 18.65 | - | - | - | - | - | - |
| SPT19 | DC-H07-OMD300C(I) | - | -1.50 | 19.11 | -1.50 | 19.09 | - | - | - | - | - | - |
| JMP15 | FMP29-31N1-W03 | Jumper | -0.35 | 20.61 | -0.37 | 20.59 | - | - | - | - | - | - |
| BDA1 | DH7S-D-7S33A | - | 81.58 | 20.96 | 81.62 | 20.96 | - | - | - | - | - | - |
| JMP16 | RG-142 NM-NM-3' | Jumper | -0.57 | -60.62 | -0.57 | -60.66 | - | - | - | - | - | - |
| MSC1 | CGXZ-36NFNF-A | - | -0.10 | -60.05 | -0.10 | -60.09 | - | - | - | - | - | - |
| CBL1 | LCF12-50J | 38.32 | -0.95 | -59.95 | -0.99 | -59.99 | - | - | - | - | - | - |
| Donor (ANT 5.1) | CSI-AY/746-896/11 (11dBi Yagi 746-896MHz) | - | 11.00 | -59.00 | 11.00 | -59.00 | - | - | - | - | - | - |

| DAS link budget report | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Model | Length (feet) | 700 MHz - Narrowband - Sector N/A Gain/loss (dB) | (dBm) | 800 MHz - SMR - Digital - Sector 1 Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) |
| **ANT 4.1** | | | | | | | | | | | | |
| ANT 4.1 (dBd) | AD-OMNI-SISO-4310 | - | 0.10 | 0.72 | 1.25 | 1.31 | - | - | - | - | - | - |
| MS RSSI [dBm] | - | - | -74.39 | - | -74.97 | - | - | - | - | - | - | - |
| MS signal range [feet] | - | - | 252.80 | - | 239.29 | - | - | - | - | - | - | - |
| CBL3 | ICA12-50JPL | 102.72 | -2.10 | 0.62 | -2.24 | 0.06 | - | - | - | - | - | - |
| SPT4 | DC-H05-OMD300C(I) | - | -2.30 | 2.72 | -2.30 | 2.30 | - | - | - | - | - | - |
| CBL2 | ICA12-50JPL | 94.60 | -1.93 | 5.02 | -2.06 | 4.60 | - | - | - | - | - | - |
| SPT3 | DC-H08-OMD300C(I) | - | -1.20 | 6.96 | -1.20 | 6.66 | - | - | - | - | - | - |
| CBL4 | ICA12-50JPL | 95.01 | -1.94 | 8.16 | -2.07 | 7.86 | - | - | - | - | - | - |
| SPT1 | DC-H10-OMD300C(I) | - | -0.80 | 10.10 | -0.80 | 9.93 | - | - | - | - | - | - |
| CBL22 | ICA12-50JPL | 57.55 | -1.18 | 10.90 | -1.26 | 10.73 | - | - | - | - | - | - |
| SPT2 | DC-H13-OMD300C(I) | - | -0.50 | 12.08 | -0.50 | 11.99 | - | - | - | - | - | - |
| CBL17 | ICA12-50JPL | 49.74 | -1.03 | 12.58 | -1.09 | 12.49 | - | - | - | - | - | - |
| SPT19 | DC-H07-OMD300C(I) | - | -7.00 | 13.61 | -7.00 | 13.59 | - | - | - | - | - | - |
| JMP15 | FMP29-31N1-W03 | Jumper | -0.35 | 20.61 | -0.37 | 20.59 | - | - | - | - | - | - |
| BDA1 | DH7S-D-7S33A | - | 81.58 | 20.96 | 81.62 | 20.96 | - | - | - | - | - | - |
| JMP16 | RG-142 NM-NM-3' | Jumper | -0.57 | -60.62 | -0.57 | -60.66 | - | - | - | - | - | - |
| MSC1 | CGXZ-36NFNF-A | - | -0.10 | -60.05 | -0.10 | -60.09 | - | - | - | - | - | - |
| CBL1 | LCF12-50J | 38.32 | -0.95 | -59.95 | -0.99 | -59.99 | - | - | - | - | - | - |
| Donor (ANT 5.1) | CSI-AY/746-896/11 (11dBi Yagi 746-896MHz) | - | 11.00 | -59.00 | 11.00 | -59.00 | - | - | - | - | - | - |

| DAS link budget report | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Model | Length (feet) | 700 MHz - Narrowband - Sector N/A Gain/loss (dB) | (dBm) | 800 MHz - SMR - Digital - Sector 1 Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) |
| **ANT 4.2** | | | | | | | | | | | | |
| ANT 4.2 (dBd) | AD-OMNI-SISO-4310 | - | 0.10 | -1.30 | 1.25 | -0.30 | - | - | - | - | - | - |
| MS RSSI [dBm] | - | - | -76.41 | - | -76.59 | - | - | - | - | - | - | - |
| MS signal range [feet] | - | - | 211.22 | - | 207.38 | - | - | - | - | - | - | - |
| CBL21 | ICA12-50JPL | 47.57 | -0.98 | -1.40 | -1.05 | -1.55 | - | - | - | - | - | - |
| SPT2 | DC-H13-OMD300C(I) | - | -13.00 | -0.42 | -13.00 | -0.51 | - | - | - | - | - | - |
| CBL17 | ICA12-50JPL | 49.74 | -1.03 | 12.58 | -1.09 | 12.49 | - | - | - | - | - | - |
| SPT19 | DC-H07-OMD300C(I) | - | -7.00 | 13.61 | -7.00 | 13.59 | - | - | - | - | - | - |
| JMP15 | FMP29-31N1-W03 | Jumper | -0.35 | 20.61 | -0.37 | 20.59 | - | - | - | - | - | - |
| BDA1 | DH7S-D-7S33A | - | 81.58 | 20.96 | 81.62 | 20.96 | - | - | - | - | - | - |
| JMP16 | RG-142 NM-NM-3' | Jumper | -0.57 | -60.62 | -0.57 | -60.66 | - | - | - | - | - | - |
| MSC1 | CGXZ-36NFNF-A | - | -0.10 | -60.05 | -0.10 | -60.09 | - | - | - | - | - | - |
| CBL1 | LCF12-50J | 38.32 | -0.95 | -59.95 | -0.99 | -59.99 | - | - | - | - | - | - |
| Donor (ANT 5.1) | CSI-AY/746-896/11 (11dBi Yagi 746-896MHz) | - | 11.00 | -59.00 | 11.00 | -59.00 | - | - | - | - | - | - |

| DAS link budget report | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Model | Length (feet) | 700 MHz - Narrowband - Sector N/A Gain/loss (dB) | (dBm) | 800 MHz - SMR - Digital - Sector 1 Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) |
| **ANT 4.3** | | | | | | | | | | | | |
| ANT 4.3 (dBd) | AD-OMNI-SISO-4310 | - | 0.10 | 0.65 | 1.25 | 1.61 | - | - | - | - | - | - |
| MS RSSI [dBm] | - | - | -74.46 | - | -74.67 | - | - | - | - | - | - | - |
| MS signal range [feet] | - | - | 251.17 | - | 245.66 | - | - | - | - | - | - | - |
| JMP14 | FMP29-3131-W03 | Jumper | -0.35 | 0.55 | -0.37 | 0.36 | - | - | - | - | - | - |
| SPT1 | DC-H10-OMD300C(I) | - | -10.00 | 0.90 | -10.00 | 0.73 | - | - | - | - | - | - |
| CBL22 | ICA12-50JPL | 57.55 | -1.18 | 10.90 | -1.26 | 10.73 | - | - | - | - | - | - |
| SPT2 | DC-H13-OMD300C(I) | - | -0.50 | 12.08 | -0.50 | 11.99 | - | - | - | - | - | - |
| CBL17 | ICA12-50JPL | 49.74 | -1.03 | 12.58 | -1.09 | 12.49 | - | - | - | - | - | - |
| SPT19 | DC-H07-OMD300C(I) | - | -7.00 | 13.61 | -7.00 | 13.59 | - | - | - | - | - | - |
| JMP15 | FMP29-31N1-W03 | Jumper | -0.35 | 20.61 | -0.37 | 20.59 | - | - | - | - | - | - |
| BDA1 | DH7S-D-7S33A | - | 81.58 | 20.96 | 81.62 | 20.96 | - | - | - | - | - | - |
| JMP16 | RG-142 NM-NM-3' | Jumper | -0.57 | -60.62 | -0.57 | -60.66 | - | - | - | - | - | - |
| MSC1 | CGXZ-36NFNF-A | - | -0.10 | -60.05 | -0.10 | -60.09 | - | - | - | - | - | - |
| CBL1 | LCF12-50J | 38.32 | -0.95 | -59.95 | -0.99 | -59.99 | - | - | - | - | - | - |
| Donor (ANT 5.1) | CSI-AY/746-896/11 (11dBi Yagi 746-896MHz) | - | 11.00 | -59.00 | 11.00 | -59.00 | - | - | - | - | - | - |

| DAS link budget report | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Model | Length (feet) | 700 MHz - Narrowband - Sector N/A Gain/loss (dB) | (dBm) | 800 MHz - SMR - Digital - Sector 1 Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) |
| **ANT 4.4** | | | | | | | | | | | | |
| ANT 4.4 (dBd) | AD-OMNI-SISO-4310 | - | 0.10 | -0.09 | 1.25 | 0.74 | - | - | - | - | - | - |
| MS RSSI [dBm] | - | - | -75.21 | - | -75.54 | - | - | - | - | - | - | - |
| MS signal range [feet] | - | - | 235.12 | - | 227.44 | - | - | - | - | - | - | - |
| JMP1 | FMP29-3131-W03 | Jumper | -0.35 | -0.19 | -0.37 | -0.51 | - | - | - | - | - | - |
| SPT3 | DC-H08-OMD300C(I) | - | -8.00 | 0.16 | -8.00 | -0.14 | - | - | - | - | - | - |
| CBL4 | ICA12-50JPL | 95.01 | -1.94 | 8.16 | -2.07 | 7.86 | - | - | - | - | - | - |
| SPT1 | DC-H10-OMD300C(I) | - | -0.80 | 10.10 | -0.80 | 9.93 | - | - | - | - | - | - |
| CBL22 | ICA12-50JPL | 57.55 | -1.18 | 10.90 | -1.26 | 10.73 | - | - | - | - | - | - |
| SPT2 | DC-H13-OMD300C(I) | - | -0.50 | 12.08 | -0.50 | 11.99 | - | - | - | - | - | - |
| CBL17 | ICA12-50JPL | 49.74 | -1.03 | 12.58 | -1.09 | 12.49 | - | - | - | - | - | - |
| SPT19 | DC-H07-OMD300C(I) | - | -7.00 | 13.61 | -7.00 | 13.59 | - | - | - | - | - | - |
| JMP15 | FMP29-31N1-W03 | Jumper | -0.35 | 20.61 | -0.37 | 20.59 | - | - | - | - | - | - |
| BDA1 | DH7S-D-7S33A | - | 81.58 | 20.96 | 81.62 | 20.96 | - | - | - | - | - | - |
| JMP16 | RG-142 NM-NM-3' | Jumper | -0.57 | -60.62 | -0.57 | -60.66 | - | - | - | - | - | - |
| MSC1 | CGXZ-36NFNF-A | - | -0.10 | -60.05 | -0.10 | -60.09 | - | - | - | - | - | - |
| CBL1 | LCF12-50J | 38.32 | -0.95 | -59.95 | -0.99 | -59.99 | - | - | - | - | - | - |
| Donor (ANT 5.1) | CSI-AY/746-896/11 (11dBi Yagi 746-896MHz) | - | 11.00 | -59.00 | 11.00 | -59.00 | - | - | - | - | - | - |

| DAS link budget report | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Model | Length (feet) | 700 MHz - Narrowband - Sector N/A Gain/loss (dB) | (dBm) | 800 MHz - SMR - Digital - Sector 1 Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) |
| **ANT 4.5** | | | | | | | | | | | | |
| ANT 4.5 (dBd) | AD-OMNI-SISO-4310 | - | 0.10 | -0.23 | 1.25 | 0.48 | - | - | - | - | - | - |
| MS RSSI [dBm] | - | - | -75.34 | - | -75.80 | - | - | - | - | - | - | - |
| MS signal range [feet] | - | - | 232.32 | - | 222.23 | - | - | - | - | - | - | - |
| JMP2 | FMP29-3131-W03 | Jumper | -0.35 | -0.33 | -0.37 | -0.77 | - | - | - | - | - | - |
| SPT4 | DC-H05-OMD300C(I) | - | -5.00 | 0.02 | -5.00 | -0.40 | - | - | - | - | - | - |
| CBL2 | ICA12-50JPL | 94.60 | -1.93 | 5.02 | -2.06 | 4.60 | - | - | - | - | - | - |
| SPT3 | DC-H08-OMD300C(I) | - | -1.20 | 6.96 | -1.20 | 6.66 | - | - | - | - | - | - |
| CBL4 | ICA12-50JPL | 95.01 | -1.94 | 8.16 | -2.07 | 7.86 | - | - | - | - | - | - |
| SPT1 | DC-H10-OMD300C(I) | - | -0.80 | 10.10 | -0.80 | 9.93 | - | - | - | - | - | - |
| CBL22 | ICA12-50JPL | 57.55 | -1.18 | 10.90 | -1.26 | 10.73 | - | - | - | - | - | - |
| SPT2 | DC-H13-OMD300C(I) | - | -0.50 | 12.08 | -0.50 | 11.99 | - | - | - | - | - | - |
| CBL17 | ICA12-50JPL | 49.74 | -1.03 | 12.58 | -1.09 | 12.49 | - | - | - | - | - | - |
| SPT19 | DC-H07-OMD300C(I) | - | -7.00 | 13.61 | -7.00 | 13.59 | - | - | - | - | - | - |
| JMP15 | FMP29-31N1-W03 | Jumper | -0.35 | 20.61 | -0.37 | 20.59 | - | - | - | - | - | - |
| BDA1 | DH7S-D-7S33A | - | 81.58 | 20.96 | 81.62 | 20.96 | - | - | - | - | - | - |
| JMP16 | RG-142 NM-NM-3' | Jumper | -0.57 | -60.62 | -0.57 | -60.66 | - | - | - | - | - | - |
| MSC1 | CGXZ-36NFNF-A | - | -0.10 | -60.05 | -0.10 | -60.09 | - | - | - | - | - | - |
| CBL1 | LCF12-50J | 38.32 | -0.95 | -59.95 | -0.99 | -59.99 | - | - | - | - | - | - |
| Donor (ANT 5.1) | CSI-AY/746-896/11 (11dBi Yagi 746-896MHz) | - | 11.00 | -59.00 | 11.00 | -59.00 | - | - | - | - | - | - |

| System link budget | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Downlink | Model | 700 MHz - Narrowband - Sector N/A Gain/loss (dB) | (dBm) | 800 MHz - SMR - Digital - Sector 1 Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) | Gain/loss (dB) | (dBm) |
| **OffAir1 (800 MHz - SMR - Digital - Sector 1)** | | | | | | | | | | | |
| Isotropic offset | - | - | - | 2.15 | -59.00 | - | - | - | - | - | - |
| OffAir- Donor Gain (dBd) | CSI-AY/746-896/11 (11dBi Yagi 746-896MHz) | - | - | 8.85 | -61.15 | - | - | - | - | - | - |
| Measured RSSI | - | - | - | - | -70.00 | - | - | - | - | - | - |
| Power out | - | - | - | - | -59.00 | - | - | - | - | - | - |
| **OffAir2 (700 MHz - Narrowband - Sector N/A)** | | | | | | | | | | | |
| Isotropic offset | - | 2.15 | -59.00 | - | - | - | - | - | - | - | - |
| OffAir- Donor Gain (dBd) | CSI-AY/746-896/11 (11dBi Yagi 746-896MHz) | 8.85 | -61.15 | - | - | - | - | - | - | - | - |
| Measured RSSI | - | - | -70.00 | - | - | - | - | - | - | - | - |
| Power out | - | - | -59.00 | - | - | - | - | - | - | - | - |

| System legend |
|---|
| 700 Public Safety / Narrowband / 700 MHz / 1 / Nb. of channels: 16 / Nb. of sources: 1 |
| 800 Public Safety / Digital / 800 MHz - SMR / PS - NPSPAC / Sector number:1 / Nb. of channels: 16 / Nb. of sources: 1 |

| Calculation legend |
|---|
| 700 MHz - Narrowband - Sector N/A / MS RSSI [dBm] (at 98.43 [feet]) / MS signal range [feet] (for -85.00 [dBm]) |
| 800 MHz - SMR - Digital - Sector 1 / MS RSSI [dBm] (at 98.43 [feet]) / MS signal range [feet] (for -85.00 [dBm]) |

# Cable Routing Report

**Project name:** Sound Transit Puyallup Parking Garage **Design company:**

**Project creation date:** 7/19/2021 **Designer:** Aaron Baxter

| ID | Cable from (Source side) | | | Cable to (Mobile side) | | | Cable Info | | | Length (feet) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Part ID | Part conn | Floor | Part ID | Part conn | Floor | Type | Model | Manufacturer | Est. + 20 % | Measured |
| CBL1 | ANT 5.1 | Ant | F5 | MSC1 | Antenna | F4 | Coaxial | LCF12-50J | RFS | 45.98 | |
| CBL14 | SPT15 | Through | F1 | ANT 1.2 | Ant | F1 | Coaxial | ICA12-50JPL | RFS | 114.12 | |
| JMP10 | SPT14 | Tap | F1 | ANT 1.4 | Ant | F1 | Coaxial | FMP29-3131-W03 | ConductRF | Jumper | |
| CBL15 | SPT16 | Through | F1 | SPT13 | Common | F1 | Coaxial | ICA12-50JPL | RFS | 123.71 | |
| CBL16 | SPT18 | Tap | F3 | SPT12 | Common | F3 | Coaxial | ICA12-50JPL | RFS | 62.74 | |
| CBL17 | SPT19 | Tap | F4 | SPT2 | Common | F4 | Coaxial | ICA12-50JPL | RFS | 59.69 | |
| CBL18 | SPT19 | Through | F4 | SPT18 | Common | F3 | Coaxial | ICA12-50JPL | RFS | 23.42 | |
| JMP11 | SPT16 | Tap | F1 | SPT15 | Common | F1 | Coaxial | FMP29-3131-W03 | ConductRF | Jumper | |
| JMP12 | SPT5 | Tap | F2 | ANT 2.3 | Ant | F2 | Coaxial | FMP29-3131-W03 | ConductRF | Jumper | |
| CBL19 | SPT6 | Tap | F2 | ANT 2.2 | Ant | F2 | Coaxial | ICA12-50JPL | RFS | 60.21 | |
| CBL20 | SPT6 | Through | F2 | SPT5 | Common | F2 | Coaxial | ICA12-50JPL | RFS | 68.97 | |
| JMP13 | SPT12 | Tap | F3 | SPT11 | Common | F3 | Coaxial | FMP29-3131-W03 | ConductRF | Jumper | |
| JMP14 | SPT1 | Tap | F4 | ANT 4.3 | Ant | F4 | Coaxial | FMP29-3131-W03 | ConductRF | Jumper | |
| CBL21 | SPT2 | Tap | F4 | ANT 4.2 | Ant | F4 | Coaxial | ICA12-50JPL | RFS | 57.09 | |
| CBL22 | SPT2 | Through | F4 | SPT1 | Common | F4 | Coaxial | ICA12-50JPL | RFS | 69.06 | |
| CBL23 | SPT18 | Through | F3 | SPT17 | Common | F2 | Coaxial | ICA12-50JPL | RFS | 24.40 | |
| CBL24 | SPT17 | Through | F2 | SPT16 | Common | F1 | Coaxial | ICA12-50JPL | RFS | 85.41 | |
| CBL25 | SPT17 | Tap | F2 | SPT6 | Common | F2 | Coaxial | ICA12-50JPL | RFS | 58.59 | |
| CBL13 | SPT13 | Through | F1 | SPT14 | Common | F1 | Coaxial | ICA12-50JPL | RFS | 91.55 | |
| JMP15 | BDA1 | To Mobile | F4 | SPT19 | Common | F4 | Coaxial | FMP29-31N1-W03 | ConductRF | Jumper | |
| JMP9 | SPT15 | Tap | F1 | ANT 1.1 | Ant | F1 | Coaxial | FMP29-3131-W03 | ConductRF | Jumper | |
| CBL12 | SPT14 | Through | F1 | ANT 1.5 | Ant | F1 | Coaxial | ICA12-50JPL | RFS | 150.14 | |

| ID | Cable from (Source side) | | | Cable to (Mobile side) | | | Cable Info | | | Length (feet) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Part ID | Part conn | Floor | Part ID | Part conn | Floor | Type | Model | Manufacturer | Est. + 20 % | Measured |
| JMP1 | SPT3 | Tap | F4 | ANT 4.4 | Ant | F4 | Coaxial | FMP29-3131-W03 | ConductRF | Jumper | |
| CBL2 | SPT3 | Through | F4 | SPT4 | Common | F4 | Coaxial | ICA12-50JPL | RFS | 113.52 | |
| JMP2 | SPT4 | Tap | F4 | ANT 4.5 | Ant | F4 | Coaxial | FMP29-3131-W03 | ConductRF | Jumper | |
| CBL3 | SPT4 | Through | F4 | ANT 4.1 | Ant | F4 | Coaxial | ICA12-50JPL | RFS | 123.27 | |
| CBL4 | SPT1 | Through | F4 | SPT3 | Common | F4 | Coaxial | ICA12-50JPL | RFS | 114.01 | |
| JMP3 | SPT7 | Tap | F2 | ANT 2.4 | Ant | F2 | Coaxial | FMP29-3131-W03 | ConductRF | Jumper | |
| CBL5 | SPT7 | Through | F2 | SPT8 | Common | F2 | Coaxial | ICA12-50JPL | RFS | 114.46 | |
| JMP4 | SPT8 | Tap | F2 | ANT 2.5 | Ant | F2 | Coaxial | FMP29-3131-W03 | ConductRF | Jumper | |
| CBL6 | SPT5 | Through | F2 | SPT7 | Common | F2 | Coaxial | ICA12-50JPL | RFS | 113.11 | |
| CBL7 | SPT8 | Through | F2 | ANT 2.1 | Ant | F2 | Coaxial | ICA12-50JPL | RFS | 122.21 | |
| JMP5 | SPT11 | Tap | F3 | ANT 3.1 | Ant | F3 | Coaxial | FMP29-3131-W03 | ConductRF | Jumper | |
| CBL8 | SPT11 | Through | F3 | ANT 3.2 | Ant | F3 | Coaxial | ICA12-50JPL | RFS | 110.77 | |
| CBL9 | SPT12 | Through | F3 | SPT9 | Common | F3 | Coaxial | ICA12-50JPL | RFS | 120.78 | |
| JMP6 | SPT9 | Tap | F3 | ANT 3.3 | Ant | F3 | Coaxial | FMP29-3131-W03 | ConductRF | Jumper | |
| CBL10 | SPT9 | Through | F3 | SPT10 | Common | F3 | Coaxial | ICA12-50JPL | RFS | 88.78 | |
| JMP7 | SPT10 | Tap | F3 | ANT 3.4 | Ant | F3 | Coaxial | FMP29-3131-W03 | ConductRF | Jumper | |
| CBL11 | SPT10 | Through | F3 | ANT 3.5 | Ant | F3 | Coaxial | ICA12-50JPL | RFS | 153.75 | |
| JMP8 | SPT13 | Tap | F1 | ANT 1.3 | Ant | F1 | Coaxial | FMP29-3131-W03 | ConductRF | Jumper | |

| ID | Cable from (Source side) | | | Cable to (Mobile side) | | | Cable Info | | | Length (feet) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Part ID | Part conn | Floor | Part ID | Part conn | Floor | Type | Model | Manufacturer | Est. + 20 % | Measured |
| JMP16 | MSC1 | Equipment | F4 | BDA1 | To Base | F4 | Coaxial | RG-142 NM-NM-3' | Tessco Technologies | Jumper | |

**Total (feet) :**

| Estimated* | Measured |
|---|---|
| 0.00 | 0.00 |

*Only rows with a measured length are considered

| Estimated | Measured** |
|---|---|
| 2,269.74 | 2,269.74 |

**Rows without a measured length use the estimated length

# Cross-Reference

**Project name:** Sound Transit Puyallup Parking Garage
**Project creation date:** 7/19/2021
**Design company:**
**Designer:** Aaron Baxter

| ID | Type | Manufacturer | Model | Description | Floor |
|---|---|---|---|---|---|
| SPT13 | Splitter | Comba | DC-H08-OMD300C(I) | (N.America)(Passive) Wideband Directional Coupler DC-H08-OMD300C(I)<br><br>Low PIM(-161dBc), 555-3800MHz, 4.3-10 Female, 300W<br>• Wideband design covering 555-3800MHz<br>• Available in 5, 6, 7, 8, 10, 13, 15 & 20dB values<br>• Suitable for indoor/outdoor environment<br>• High reliability and low insertion loss | F1 |
| SPT14 | Splitter | Comba | DC-H05-OMD300C(I) | (N.America)(Passive) Wideband Directional Coupler DC-H05-OMD300C(I)<br><br>Low PIM(-161dBc), 555-3800MHz, 4.3-10 Female, 300W<br>• Wideband design covering 555-3800MHz<br>• Available in 5, 6, 7, 8, 10, 13, 15 & 20dB values<br>• Suitable for indoor/outdoor environment<br>• High reliability and low insertion loss | F1 |

| ID | Type | Manufacturer | Model | Description | Floor |
|---|---|---|---|---|---|
| SPT15 | Splitter | Comba | DC-H05-OMD300C(I) | (N.America)(Passive) Wideband Directional Coupler DC-H05-OMD300C(I)<br><br>Low PIM(-161dBc), 555-3800MHz, 4.3-10 Female, 300W<br>• Wideband design covering 555-3800MHz<br>• Available in 5, 6, 7, 8, 10, 13, 15 & 20dB values<br>• Suitable for indoor/outdoor environment<br>• High reliability and low insertion loss | F1 |
| SPT16 | Splitter | Comba | DC-H07-OMD300C(I) | (N.America)(Passive) Wideband Directional Coupler DC-H07-OMD300C(I)<br><br>Low PIM(-161dBc), 555-3800MHz, 4.3-10 Female, 300W<br>• Wideband design covering 555-3800MHz<br>• Available in 5, 6, 7, 8, 10, 13, 15 & 20dB values<br>• Suitable for indoor/outdoor environment<br>• High reliability and low insertion loss | F1 |
| SPT5 | Splitter | Comba | DC-H10-OMD300C(I) | (N.America)(Passive) Wideband Directional Coupler DC-H10-OMD300C(I)<br><br>Low PIM(-161dBc), 555-3800MHz, 4.3-10 Female, 300W<br>• Wideband design covering 555-3800MHz<br>• Available in 5, 6, 7, 8, 10, 13, 15 & 20dB values<br>• Suitable for indoor/outdoor environment<br>• High reliability and low insertion loss | F2 |

| ID | Type | Manufacturer | Model | Description | Floor |
|---|---|---|---|---|---|
| SPT6 | Splitter | Comba | DC-H13-OMD300C(I) | (N.America)(Passive) Wideband Directional Coupler DC-H13-OMD300C(I)<br><br>Low PIM(-161dBc), 555-3800MHz, 4.3-10 Female, 300W<br>• Wideband design covering 555-3800MHz<br>• Available in 5, 6, 7, 8, 10, 13, 15 & 20dB values<br>• Suitable for indoor/outdoor environment<br>• High reliability and low insertion loss | F2 |
| SPT7 | Splitter | Comba | DC-H08-OMD300C(I) | (N.America)(Passive) Wideband Directional Coupler DC-H08-OMD300C(I)<br><br>Low PIM(-161dBc), 555-3800MHz, 4.3-10 Female, 300W<br>• Wideband design covering 555-3800MHz<br>• Available in 5, 6, 7, 8, 10, 13, 15 & 20dB values<br>• Suitable for indoor/outdoor environment<br>• High reliability and low insertion loss | F2 |
| SPT8 | Splitter | Comba | DC-H05-OMD300C(I) | (N.America)(Passive) Wideband Directional Coupler DC-H05-OMD300C(I)<br><br>Low PIM(-161dBc), 555-3800MHz, 4.3-10 Female, 300W<br>• Wideband design covering 555-3800MHz<br>• Available in 5, 6, 7, 8, 10, 13, 15 & 20dB values<br>• Suitable for indoor/outdoor environment<br>• High reliability and low insertion loss | F2 |

| ID | Type | Manufacturer | Model | Description | Floor |
|---|---|---|---|---|---|
| SPT17 | Splitter | Comba | DC-H05-OMD300C(I) | (N.America)(Passive) Wideband Directional Coupler DC-H05-OMD300C(I)<br><br>Low PIM(-161dBc), 555-3800MHz, 4.3-10 Female, 300W<br>• Wideband design covering 555-3800MHz<br>• Available in 5, 6, 7, 8, 10, 13, 15 & 20dB values<br>• Suitable for indoor/outdoor environment<br>• High reliability and low insertion loss | F2 |
| SPT9 | Splitter | Comba | DC-H08-OMD300C(I) | (N.America)(Passive) Wideband Directional Coupler DC-H08-OMD300C(I)<br><br>Low PIM(-161dBc), 555-3800MHz, 4.3-10 Female, 300W<br>• Wideband design covering 555-3800MHz<br>• Available in 5, 6, 7, 8, 10, 13, 15 & 20dB values<br>• Suitable for indoor/outdoor environment<br>• High reliability and low insertion loss | F3 |
| SPT10 | Splitter | Comba | DC-H05-OMD300C(I) | (N.America)(Passive) Wideband Directional Coupler DC-H05-OMD300C(I)<br><br>Low PIM(-161dBc), 555-3800MHz, 4.3-10 Female, 300W<br>• Wideband design covering 555-3800MHz<br>• Available in 5, 6, 7, 8, 10, 13, 15 & 20dB values<br>• Suitable for indoor/outdoor environment<br>• High reliability and low insertion loss | F3 |

| ID | Type | Manufacturer | Model | Description | Floor |
|---|---|---|---|---|---|
| SPT11 | Splitter | Comba | DC-H05-OMD300C(I) | (N.America)(Passive) Wideband Directional Coupler DC-H05-OMD300C(I)<br><br>Low PIM(-161dBc), 555-3800MHz, 4.3-10 Female, 300W<br>• Wideband design covering 555-3800MHz<br>• Available in 5, 6, 7, 8, 10, 13, 15 & 20dB values<br>• Suitable for indoor/outdoor environment<br>• High reliability and low insertion loss | F3 |
| SPT12 | Splitter | Comba | DC-H07-OMD300C(I) | (N.America)(Passive) Wideband Directional Coupler DC-H07-OMD300C(I)<br><br>Low PIM(-161dBc), 555-3800MHz, 4.3-10 Female, 300W<br>• Wideband design covering 555-3800MHz<br>• Available in 5, 6, 7, 8, 10, 13, 15 & 20dB values<br>• Suitable for indoor/outdoor environment<br>• High reliability and low insertion loss | F3 |
| SPT18 | Splitter | Comba | DC-H06-OMD300C(I) | (N.America)(Passive) Wideband Directional Coupler DC-H06-OMD300C(I)<br><br>Low PIM(-161dBc), 555-3800MHz, 4.3-10 Female, 300W<br>• Wideband design covering 555-3800MHz<br>• Available in 5, 6, 7, 8, 10, 13, 15 & 20dB values<br>• Suitable for indoor/outdoor environment<br>• High reliability and low insertion loss | F3 |

| ID | Type | Manufacturer | Model | Description | Floor |
|---|---|---|---|---|---|
| SPT1 | Splitter | Comba | DC-H10-OMD300C(I) | (N.America)(Passive) Wideband Directional Coupler DC-H10-OMD300C(I)<br><br>Low PIM(-161dBc), 555-3800MHz, 4.3-10 Female, 300W<br>• Wideband design covering 555-3800MHz<br>• Available in 5, 6, 7, 8, 10, 13, 15 & 20dB values<br>• Suitable for indoor/outdoor environment<br>• High reliability and low insertion loss | F4 |
| SPT2 | Splitter | Comba | DC-H13-OMD300C(I) | (N.America)(Passive) Wideband Directional Coupler DC-H13-OMD300C(I)<br><br>Low PIM(-161dBc), 555-3800MHz, 4.3-10 Female, 300W<br>• Wideband design covering 555-3800MHz<br>• Available in 5, 6, 7, 8, 10, 13, 15 & 20dB values<br>• Suitable for indoor/outdoor environment<br>• High reliability and low insertion loss | F4 |
| SPT3 | Splitter | Comba | DC-H08-OMD300C(I) | (N.America)(Passive) Wideband Directional Coupler DC-H08-OMD300C(I)<br><br>Low PIM(-161dBc), 555-3800MHz, 4.3-10 Female, 300W<br>• Wideband design covering 555-3800MHz<br>• Available in 5, 6, 7, 8, 10, 13, 15 & 20dB values<br>• Suitable for indoor/outdoor environment<br>• High reliability and low insertion loss | F4 |

| ID | Type | Manufacturer | Model | Description | Floor |
|---|---|---|---|---|---|
| SPT4 | Splitter | Comba | DC-H05-OMD300C(I) | (N.America)(Passive) Wideband Directional Coupler DC-H05-OMD300C(I)<br><br>Low PIM(-161dBc), 555-3800MHz, 4.3-10 Female, 300W<br>• Wideband design covering 555-3800MHz<br>• Available in 5, 6, 7, 8, 10, 13, 15 & 20dB values<br>• Suitable for indoor/outdoor environment<br>• High reliability and low insertion loss | F4 |
| SPT19 | Splitter | Comba | DC-H07-OMD300C(I) | (N.America)(Passive) Wideband Directional Coupler DC-H07-OMD300C(I)<br><br>Low PIM(-161dBc), 555-3800MHz, 4.3-10 Female, 300W<br>• Wideband design covering 555-3800MHz<br>• Available in 5, 6, 7, 8, 10, 13, 15 & 20dB values<br>• Suitable for indoor/outdoor environment<br>• High reliability and low insertion loss | F4 |

**Total of 19 Parts**

# Equipment List Report

**Project name:** Sound Transit Puyallup Parking Garage **Design company:**
**Project creation date:** 5/11/2021 **Designer:** Aaron Baxter

| Type | Manufacturer | Model | Description | Qty |
|---|---|---|---|---|
| Antenna | Cellular Specialties, Inc | CSI-AY/746-896/11 (11dBi Yagi 746-896MHz) | Yagi Antenna Public Safety 700/800 (746-896MHz) 11 dBi | 1 |
| Antenna | CommScope | CELLMAX-O-CPUSE | Cell-Max In-Building Antenna System - Omnidirectional Inbuilding Antenna, 698–960 MHz and 1710–2700 MHz - N-Female | 20 |
| Cable | RFS | LCF12-50J | CELLFLEX - 1/2" Low-Loss Foam Coaxial Cable, Halogene Free, Polyethylen, PE, not Flame Retardant | 75 |
| Cable | Tessco Technologies | RG-142 NM-NM-3' | Teflon Jumper Cable 3' RG142 N-Male / N-Male - Dual Silver Shields - Brown Tinted FEP Jacked | 16 |
| Cable | RFS | ICA12-50JPL | ClearFillLine - 1/2in Low Loss Air Dialectric Cable - Plenum Rated/ Indoor/ Outdoor Usage/ Color Blue<br>UV rated to ASTM G155<br>Meets/ Exceeds: Steiner Tunnel Test Method UL 910, NFC 820-53 (a) CMP, NFPA 262 | 2400 |
| Connector | RFS | NM-LCF12-D01 | N Male OMNI FIT Connector for LCF12-50 Cable | 60 |
| Connector | RFS | NF-LCF12-D01 | N Female OMNI FIT Connector for LCF12-50 Cable | 3 |
| Power Supply | Comba | CPBBUV1-48055-UL | DC Power battery backup | 1 |
| Miscellaneous | PolyPhaser | CGXZ-36NFNF-A | 400-1200 MHz Lightning Protector | 1 |
| Repeater | Comba | RX78V1-A3348-UL | (N.America)(PS BDA)(Class A) CriticalPoint™ Public Safety Bi-Directional Amplifier 2W<br><br>Dual Band 700+800MHz Class A BDA/Repeater, 788-805/758-775MHz, 32 Channel, 33dBm DL, 24dBm UL, 806-824/851-869MHz, 32 Channel, 33dBm DL, 24dBm UL, - | 1 |
| Splitter | Comba | DC-R10-ON300C(XH) | (N.America)(Passive) 10 dB Directional Coupler, 698-2700 MHz, N-Female Connectors<br>300W and PIM less than -153dBc @ 2x43dBm. | 2 |
| Splitter | Comba | DC-R13-ON300C(XH) | (N.America)(Passive) 13 dB Directional Coupler, 698-2700 MHz, N-Female Connectors<br>300W and PIM less than -153dBc @ 2x43dBm. | 2 |

| | | | | |
|---|---|---|---|---|
| Splitter | Comba | DC-R08-ON300C(XH) | (N.America)(Passive) 8 dB Directional Coupler, 698-2700 MHz, N-Female Connectors<br>300W and PIM less than -153dBc @ 2x43dBm. | 4 |
| Splitter | Comba | DC-R05-ON300C(XH) | (N.America)(Passive) 5 dB Directional Coupler, 698-2700 MHz, N-Female Connectors<br>300W and PIM less than -153dBc @ 2x43dBm. | 9 |
| Splitter | Comba | DC-R06-ON300C(XH) | (N.America)(Passive) 6 dB Directional Coupler, 698-2700 MHz, N-Female Connectors<br>300W and PIM less than -153dBc @ 2x43dBm. | 1 |
| Splitter | Comba | DC-R07-ON300C(XH) | (N.America)(Passive) 7 dB Directional Coupler, 698-2700 MHz, N-Female Connectors<br>300W and PIM less than -153dBc @ 2x43dBm. | 1 |
| Miscellaneous | Rohn | FRMMAT | Non Pen roof mount Mat | 1 |
| Miscellaneous | Rohn | FRM | Non Pen roof mount | 1 |
| Miscellaneous | Tessco Technologies | 415105 | Universal Ground Bar | 1 |
| Miscellaneous | Tessco Technologies | 41669 | Standard Grounding Kit 1/2" Coax | 1 |
| Panel | DAS Alert | Model: 1221-A | DAS Annunciator Panel | 1 |
| Attenuator | MECA Electronics | 603-10-1 | Type - N, DC-6GHz, 10dB Attenuator, 5 Watts | 1 |

**Submittal Number: 27 60 07 and 27 60 02**
Puyallup Parking Garage
Sturgeon Electric
Contract #: 72573
AWS Project #: 10385

# TAB # 7

Distributed Antenna System

**Specification Section: 27 60 02 and 27 60 07**
Para. No. 7.1 Drawings for Donor Antenna and Grounding

**Sound Transit has adopted Motorola R56 Standards for all its radio related facilities. Any existing or new facility shall comply with the R56 recommendation.**

**Submittal Number: 27 60 07 and 27 60 02**
Puyallup Parking Garage
Sturgeon Electric
Contract #: 72573
AWS Project #: 10385

# TAB # 8

Distributed Antenna System

**Specification Section: 27 60 02 and 27 60 07**
Para. No. 8.1 Product Data Sheets

**Donor Antenna/Indoor Antenna**
**Donor Antenna Cable/Indoor Plenum Rated Cable**
**Male Cable Connector/Female Cable Connector**
**Lightning Protector**
**24 Hour Battery Backup**
**700/800 Amplifier**
**Coax Bias-Tee/DAS Annunciator Panel**

# 746-896 MHz Yagi Antenna (11 dBi)

## Model Numbers

- CSI-AY/746-896/11

## Frequency Range

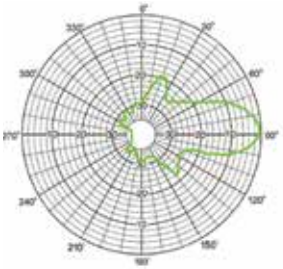
- 746-896 MHz

## Features & Benefits

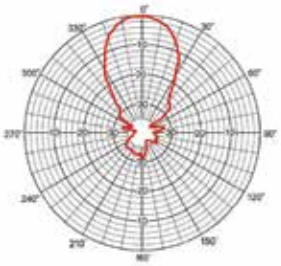
- 11 dBi Gain
- 8 Elements
- Hermetically Sealed Driven Element
- Rugged Lightweight Design
- Stainless Steel Hardware
- Broad Bandwidth

746-896 MHz Yagi Antenna, 11 dBi

## Radiation Patterns



Vertical



Horizontal

## Electrical Specifications

| | |
|---|---|
| Gain | 11 dBi |
| VSWR | <1.7:1 |
| Horizontal Beamwidth | 48° |
| Vertical Beamwidth | 42° |
| Polarization | Vertical |
| Maximum Input Power | 100 Watts |
| Electrical Downtilt | 0° |
| Front-back Ratio | >16 dB |

Specifications subject to change without notice.

## Mechanical Specifications

| | |
|---|---|
| Number of Elements | 8 |
| Connector | N-Female |
| Lightning Protection | Direct Ground |
| Rated Wind Speed | 134 mph (200 kph) |
| Dimensions | 33.1 x 8 x 2.2 in |
| Antenna Weight | 1.76 lbs |
| Mounting Hardware | U-Bolt |
| Included Mounting Hardward Fits 1 7/8" OD Pipe | |

WESTELL

# Product Specification

## AD-OMNI-SISO-4310

4.3-10 Low-Profile Omni-Directional Indoor Serving Antenna

- Covers all major commercial bands (698~960 / 1710~2700MHz)
- Less than 2” in height
- Includes ceiling mount

### Electrical Specification

| | 698 – 790MHz | 790 – 960MHz | 1710 – 2180MHz | 2300 – 2700MHz |
|---|---|---|---|---|
| **Gain** | 2.25 ± 0.35 dBi | 3.4 ± 0.5 dBi | 4.4 ± 1 dBi | 4.45 ± 0.85 dBi |
| **VSWR** | ≤ 1.8dB : 1 | | ≤ 1.7dB : 1 | |
| **Horizontal Beamwidth** | 360° | | | |
| **Intermodulation** | ≤ -150 dBc (2 tones x 43dBm) | | | |
| **Impedance** | 50Ω | | | |
| **Polarization** | Linear H/V | | | |
| **Power Rating** | 50W (Max) | | | |

### Mechanical Specification

| | |
|---|---|
| **Dimension** | Diameter : < 8.43" (214mm) \| Height : < 1.96“ (50 mm) \| Flat at bottom |
| **Weight** | 1 lb. (without bracket) |
| **Connectors** | 4.3-10 Female with Pigtail Cable (12” length) |
| **Radome Color** | White |
| **Radome Material** | PC/ABS (halogen free) |
| **Mounting** | Ceiling |
| **Operating Temperature** | -40° F ~ +158° F (-40° C ~ +70° C) |
| **Environmental Conditions** | Indoor |
| **Flammability Rating** | UL 94-V0 |





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**TECHNICAL/CUSTOMER SUPPORT** +1 800. 313. 9345
www.adrftech.com | 3116 West Vanowen Street, Burbank, CA 91505 USA

PRODUCT DATASHEET

# LCF12-50J

1/2" CELLFLEX® Low-Loss Foam-Dielectric Coaxial Cable

CELLFLEX® 1/2" low loss flexible cable

FEATURES / BENEFITS

- **Low Attenuation**
  The low attenuation of CELLFLEX® coaxial cable results in highly efficient signal transferin your RF system.
- **Complete Shielding**
  The solid outer conductor of CELLFLEX® coaxial cable creates a continuous RFI/EMI shield that minimizes system interference.
- **Low VSWR**
  Special low VSWR versions of CELLFLEX® coaxial cables contribute to low system noise.
- **Outstanding Intermodulation Performance**
  CELLFLEX® coaxial cable's solid inner and outer conductors virtually eliminate intermods. Intermodulation performance is also confirmed with state-of-the-art equipment at the RFS factory.
- **High Power Rating**
  Due to their low attenuation, outstanding heat transfer properties and temperature stabilized dielectric
  materials, CELLFLEX® cable provides safe long term operating life at high transmit power levels.
- **Wide Range of Application**
  Typical areas of application are: feedlines for broadcast and terrestrial microwave antennas, wireless cellular, PCS and ESMR base stations, cabling of antenna arrays, and radio equipment interconnects.

1/2" CELLFLEX® Low-Loss Foam Dielectric Coaxial Cable

## Technical features

| | | |
|---|---|---|
| **APPLICATIONS** | | |
| **Applications** | | OEM jumpers, Main feed transitions to equipment, GPS lines, intended for outdoor usage |
| **STRUCTURE** | | |
| **Cable Type** | | Foam-Dielectric, Corrugated |
| **Size** | | 1/2 |
| **Jacket Option** | | Black |
| **Inner Conductor** | mm (in) | 4.8 (0.19) |
| **Dielectric** | mm (in) | 11.3 (0.44) |
| **Outer Conductor** | mm (in) | 13.8 (0.54) |
| **Jacket** | mm (in) | 15.8 (0.62) |
| **TESTING AND ENVIRONMENTAL** | | |
| **Fire Performance** | | Halogen free, outdoor-rated |
| **Installation Temperature** | °C(°F) | -40 to 60 (-40 to 140) |
| **Storage Temperature** | °C(°F) | -70 to 85 (-94 to 185) |
| **Operation Temperature** | °C(°F) | -50 to 85 (-58 to 185) |

## ELECTRICAL SPECIFICATIONS

| | | |
|---|---|---|
| **Impedance, Ohm** | Ω | 50 +/- 1 |
| **Maximum Frequency** | GHz | 8.8 |
| **Velocity, percent** | % | 88 |
| **Capacitance** | pF/m (pF/ft) | 76 (23.2) |
| **Inductance, uH/m (uH/ft)** | µH/m (µH/ft) | 0.19 (0.058) |
| **Peak Power Rating** | kW | 38 |
| **RF Peak Voltage** | Volts | 1950 |
| **Jacket Spark** | Volt RMS | 8000 |
| **Inner Conductor dc Resistance, Ω/km (Ω/kft)** | Ω/1000 m (Ω/1000 ft) | 1.62 (0.5) |
| **Outer Conductor dc Resistance, ohm/1000 m (Ohm/1000 ft)** | Ω/1000 m (Ω/1000 ft) | 3.55 (1.08) |
| **Return Loss (VSWR) Performance** | | Standard for 40-2700, 3300-4200, 4400-5925 MHz, Premium according to B-Class |
| **Min. Return Loss (Max. VSWR)** | dB (VSWR) | Standard 20 (1.222), Premium 24 (1.135) / 23 (1.152) |
| **Phase Stabilized** | | Phase stabilized and phase matched cables and accessories are available upon request. |
| **Temperature & Power** | | Standard |

## MECHANICAL SPECIFICATIONS

| | | |
|---|---|---|
| **Cable Weight, Nominal** | kg/m (lb/ft) | 0.187 (0.13) |
| **Minimum Bending Radius, Single Bend** | mm (in) | 70 (3) |
| **Minimum Bending Radius, Repeated Bends** | mm (in) | 125 (5) |
| **Bending Moment, Nm (lb-ft)** | Nm (lb*ft) | 6.5 (4.79) |
| **Tensile Strength** | N (lb) | 1100 (247) |
| **Recommended / Maximum Clamp Spacing** | m (ft) | 0.6 / 1 (2 / 3.25) |

## ATTENUATION AND POWER RATING

| Frequency, MHz | dB per 100m | dB per 100ft | Power, kW |
|---|---|---|---|
| **1** | 0.21 | 0.07 | 35.30 |
| **1.5** | 0.26 | 0.08 | 28.80 |
| **2** | 0.30 | 0.09 | 25 |
| **10** | 0.68 | 0.21 | 11.10 |
| **20** | 0.96 | 0.29 | 7.83 |
| **30** | 1.18 | 0.36 | 6.37 |
| **50** | 1.53 | 0.47 | 4.91 |
| **88** | 2.04 | 0.62 | 3.68 |
| **100** | 2.18 | 0.66 | 3.45 |
| **108** | 2.27 | 0.69 | 3.31 |
| **150** | 2.69 | 0.82 | 2.80 |
| **174** | 2.90 | 0.88 | 2.59 |
| **200** | 3.12 | 0.95 | 2.41 |
| **300** | 3.85 | 1.17 | 1.95 |
| **400** | 4.48 | 1.37 | 1.68 |
| **450** | 4.77 | 1.45 | 1.57 |
| **500** | 5.04 | 1.54 | 1.49 |
| **512** | 5.11 | 1.56 | 1.47 |
| **600** | 5.56 | 1.69 | 1.35 |
| **700** | 6.03 | 1.84 | 1.24 |
| **750** | 6.26 | 1.91 | 1.20 |
| **800** | 6.48 | 1.98 | 1.16 |
| **824** | 6.58 | 2.01 | 1.14 |
| **894** | 6.88 | 2.10 | 1.09 |
| **900** | 6.91 | 2.10 | 1.09 |
| **925** | 7.01 | 2.14 | 1.07 |
| **960** | 7.15 | 2.18 | 1.05 |
| **1000** | 7.31 | 2.23 | 1.03 |
| **1250** | 8.25 | 2.52 | 0.91 |
| **1400** | 8.78 | 2.68 | 0.86 |
| **1500** | 9.12 | 2.78 | 0.82 |
| **1700** | 9.77 | 2.98 | 0.77 |
| **1800** | 10.10 | 3.07 | 0.75 |
| **2000** | 10.70 | 3.26 | 0.70 |
| **2100** | 11 | 3.35 | 0.68 |
| **2200** | 11.30 | 3.44 | 0.67 |
| **2400** | 11.80 | 3.61 | 0.63 |
| **2500** | 12.10 | 3.69 | 0.62 |
| **2600** | 12.40 | 3.78 | 0.61 |
| **2700** | 12.70 | 3.86 | 0.59 |

| | | | |
|---|---|---|---|
| **3000** | 13.40 | 4.09 | 0.56 |
| **3500** | 14.70 | 4.47 | 0.51 |
| **4000** | 15.80 | 4.83 | 0.47 |
| **5000** | 18 | 5.50 | 0.42 |
| **6000** | 20.10 | 6.12 | 0.37 |
| **7000** | 22 | 6.70 | 0.34 |
| **8000** | 23.80 | 7.26 | 0.32 |
| **8800** | 25.20 | 7.69 | 0.30 |

External Document Links

Notes

06/14

# Low PIM

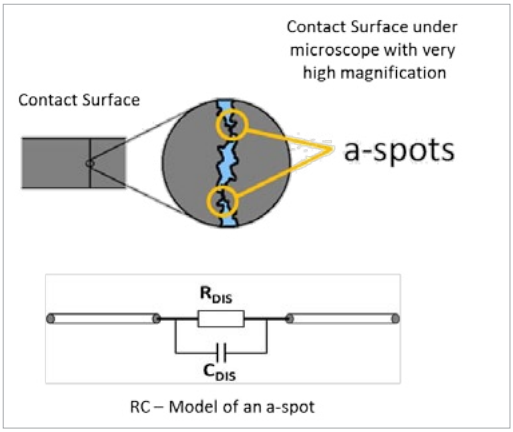
ConductRF Advice & Support

## PIM: Components, Material, Handling & Testing

by Wolfgang Damm | AWT Global

New connector surfaces look and feel very smooth, but the picture changes quickly when viewed under a microscope. The atomic lattice size of metals is often no more than 25 Angstroms (0.0000025 mm) wide. Machined metal surfaces will never have such a degree of smoothness. Metallic surfaces look indeed very rough under high magnification. That causes surfaces of mated connectors to touch only at a few spots, called asperities. Tightening connectors applies localized pressure to these asperities, which causes them to deform. Deformations increases the contact area, but it is still limited to some load-bearing areas, so called a-spots. They add up, but their overall area is still by several orders of magnitude smaller than the apparent contact surface of connectors.

Simplified, a-spots can be regarded as electrical RC models and a mated connector can be seen as network of thousands of unequal RC circuits. Such a network does not behave in a linear way. Passing currents of different frequencies will respond differently, causing passive intermodulation.



RC – Model of an a-spot

Structural material discontinuity causes also discontinuity in current flow. Regardless of the contact material, discontinuity in electron flow is characterized by:

- Constriction Resistance due to bending of current lines of flow in the vicinity of an a-spot.
- Tunnel Resistance due to conduction through thin insulating contaminant layers via tunnel effect.
- Contact Capacitance between the two essentially parallel equipotential surfaces.

Lengths of the constrictions are very short, so inductive effects are small compared to capacitive and resistive effects.

## Skin Effect

Skin effect is called the property of alternating current to show higher current density closer to a conductor surface. Current flows mainly at the skin of the conductor between the outer surface and a level called the skin depth. Skin effect is caused by eddy currents that are induced by the changing

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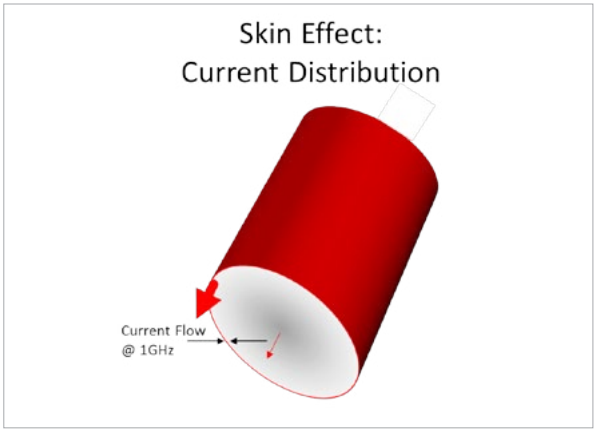



magnetic field of alternating current. The effect is more pronounced with higher frequencies. At 1 GHz, on a silver plated surface, around 98% of the current density occurs within approximately 0.01 mm of material depth. For comparison: an average human hair has a diameter of 0.08 mm, 8 times larger in diameter than the skin depth at 1 GHz. This fact underlines the importance of connector plating. It serves not only as protection for the connector but carries almost all of the current in RF systems.

The remarkably diminutive skin depth of conductors at high frequencies is very susceptible to scratches in the material. Even if only on a microscopic scale, the tiniest groove, dent or jag interferes with homogeneous flow of current and with that, causes unwanted passive intermodulation.

# Working With Low PIM Components

Whether connectors, cables or components, low PIM components are precision building blocks of RF networks. Low PIM products require manufacturing processes that meet highest standards, 100% quality sampling, carefully handling and shipping with sufficient protection. These components have to be treated carefully also in the field to avoid degrading or damage. Since components like duplexers or loads are often hermetically sealed, their internal elements are relative protected, but their connectors are exposed. This is also the case for cables. This chapter is about treating connectors of cables and component ports.

# Mechanical Damage

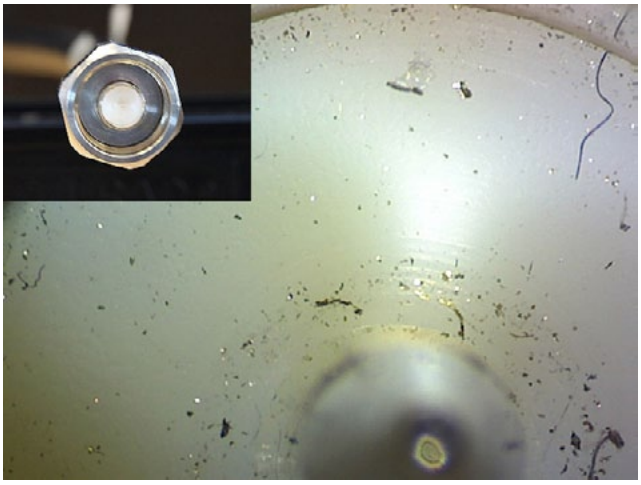
Mechanical damage can be inflicted by a variety of events. Dropping a component is the most obvious mishap, but it can occur already in the factory and during shipment if loose components are allowed to bump into each other. A less obvious cause is improper connector tightening. RF connectors are designed in a way that they can be screwed on almost completely by hand. Wrenches are to be used only for the last half turn. It clearly indicates non-parallel mating of connectors if it is too tough to screw them on by hand. This can be caused by too short or too long cables, which apply sideways pulling or pushing forces to connectors. If RF connectors do not turn easily during mating, their threads and connecting parts are forced against their counterpart surfaces, causing extreme friction and even deforming. High forces can chip of parts of the plating. These conducting chips are alien bodies that interfere with the current flow in the RF path, causing passive intermodulation distortions. Cables' geometry is paramount for proper functioning. It can be damaged by external force ( denting) or too tight bending radii. A good practice is to install release cable loops to avoid both, forces at the connectors and too tight cable bents. Such loops cost a bit more material, but the investment goes a long way as the installation tends to be more reliable over time. After connectors are pre-tightened by hand, they have to be mated with a torque wrench to apply exactly the right tightening force. Connections with too little torque result in insufficient contact force, too much torque causes contact areas to deform. Both are consecutively resulting in passive intermodulation distortion.

### *Working with low PIM components*

- Prevent mechanical damage
- No touching of RF conductors with bare fingers
- Avoid alien bodies of all kind
- Avoid humidity
- Avoid electrical damage

# Alien Bodies

Alien bodies like dust, dirt, metal chips can very easily find their way into connectors. Base station sites or in-building installations are never dust free, and dust and dirt kernels are difficult to avoid. Keeping protection caps on connectors helps. It is suggested to wipe connectors always with alcohol wipes and dry them with moist free canned air before mating. While connector dust might not be visible to the bare eye, dark areas of used wipes will clearly show that it has been there. Connectors of test equipment, measurement cables and low PIM terminations have to be cleaned frequently with alcohol wipes and dried with moist free air.



The N-Connector in the small image top left looks clean with bare eyes. The view though a microscope reveals however many alien bodies that can be a serious source of passive intermodulation distortion.

# Humidity

Humidity and moisture are creeping enemies of low PIM networks. Over time they cause oxidation. While initial measurements may look good, connectors with accidentally enclosed humidity and moisture will degrade. An often overseen but common source of humidity is human breath. It is tempting to blow into a connector to remove a little dust fluff. Never do it. Exhaled air has a relative humidity of 100%!

# No Touching of RF conductors

Sweat cools the body and skin lubricates itself with oily matter. What is helpful to maintain our health is adverse to proper function of RF connectors. Even minuscule amounts can alter PIM performance of connector contact areas. Low PIM RF conductors are very susceptible to such external influences. There is a good reason why manufacturers of low PIM components require their workers to wear gloves.

# Electrical Damage

Electrical damage is easily overseen but often cause of serious PIM problems. It can happen by applying power levels to a device that exceed its actual power rating. Without question, that has to be avoided. Another occurrence that happens sometimes unintentionally is mating and disconnecting connectors under RF power. If this happens, spark discharges are unavoidable. They cause craters in the material, altering current flow significantly, which is a source of PIM.

# Connector Wear

Connector wear is an issues that concerns test equipment including PIM analyzers, test cables and low PIM terminations. It is no so much an issue for field installations because connectors of low pim components are mated only a few times, for initial system measurements and final mating. Test equipment at the other hand, is in permanent use and has to endure many mating cycles.

Manufacturers guarantee typically 500 mating cycles with sustainable PIM ratings before connectors start to degrade. The reason is clearly not low quality but the fact that asperities can undergo only a limited number of deformation cycles. Furthermore, attrition of conductors' plating due to mechanical friction reduces the thickness of the plating steadily.

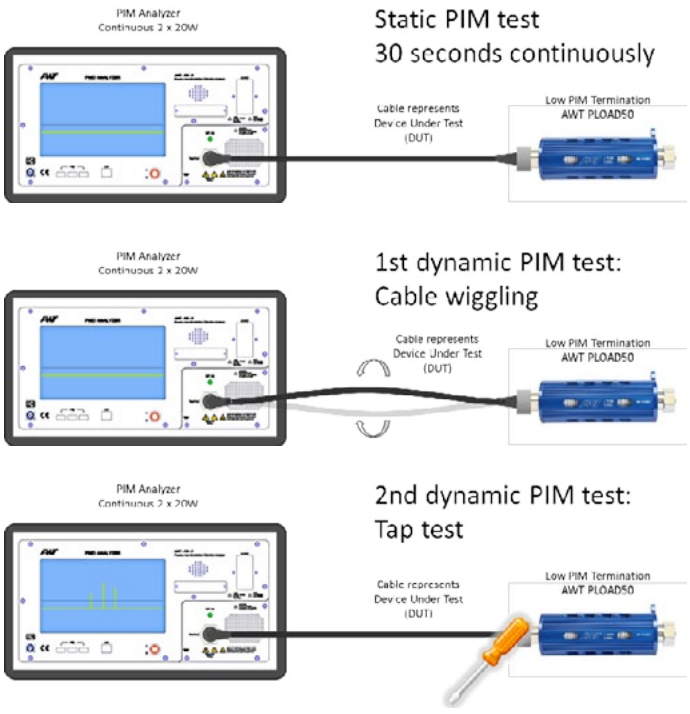

Connector Saver mounted on a PIM analyzer that has been used very frequently. The Saver shows strong usage marks, but replacement is easy and the port connector of the valuable analyzer has been fully protected.

# Testing Low PIM Components & Networks

Low PIM components are a key factor when building telecommunication networks with lowest passive inter-modulation interferences. However, 60% of all PIM issues are not caused by faulty components but are man made and happen during installation. This particularly because RF-cables are usually assembled in the field.

Unintended scratches in the plating, chipping, entrapped dust are just a few of many issues that can occur. The only way to ensure that base station installations operate at the expected low pim levels is to conduct thorough PIM tests of both, individual RF branches and the complete installation. Three simple PIM tests have gained general acceptance and serve as excellent reference for both, installation and component testing. The tests are described below. They will detect virtually all sources of PIM in cables, connectors and components.

The static test analyzes both, components and cables. PIM analyzers that deliver continuous 2 x 20W measurement signals are connected to the Device Under Test (DUT). PIM measurements are performed for at least 30 seconds, ensuring to fully energize the system and also apply thermal stress to the tested components, similar to a live telecommunications signal. This test detects bad materials, scratched surfaces and alien bodies like dust or metal chips in the RF path.




Measurement values of static tests need to be below the required limit, but they should also be stable. The signal should not alter too much during the measurement. Changes of 2-4 dB are acceptable, higher swings - even if they are within the required limits - can be an indicator for (future) PIM problems.

The first dynamic test, also called wiggle test, checks the quality of assemblies between cables and connectors. Tested cables are moved in a circular way (turn diameter about 10 cm). The test is to be conducted with at least 10 turns in each direction. Wiggle tests detect loose contacts and poor workmanship of cable assemblies. They find also bad soldering and shielding cracks. PIM measurements must be stable throughout the test. Correct cable-connector assemblies will endure this mechanical stress test easily.

The second dynamic test, is also known as tap test. It requires PIM analyzers to be set to PIM versus time mode. PIM readings are continuously shown over a time axis in this mode. A harder device, made of wood or plastic material but not metal, is used to tap 10 times at all connectors. Field technicians use often the handle of a screw driver for this test. It is hard but does not dent or scratch the connectors. PIM readings should stay stable during this test. Possible contaminations like dust, metal chips or other alien bodies in the connectors will cause spikes in the reading whenever the connectors are tapped. Remedy is to open the connectors again, clean them with alcohol wipes and dry them with moisture free pressured air. Afterwards the tap test has to be repeated.

ConductRF has developed significant expertise in building Low PIM products for many applications including Intsllaed DAS systems. Less well known is our support of the PIM test Cable Market, where we build performance Low PIM cables for providers of PIM test equipment. Though these cables are not generally available from us directly, the expertise we employ in building them is applied to every other PIM connector and Cable assembly we supply. We Know.... Results Count!

# Low PIM 50Ω RF Cables

## Hand Formable - FMP Series

## for ConductRF Low PIM Connectors

**Low Passive Intermod under -155dBc**
**Superior Cable Shielding**
**Stable Performance when Formed**
**Direct Solder Connector Attachment**
**Optimized Performance to 6GHz**

| Characteristic | FMP29 |
|---|---|
| Center Conductor | Silver Plated Copper |
| Dielectric | PTFE |
| 1st Shield | Tin Soaked Copper Braid |
| Cable Jacket | Blue FEP |
| Shielding | >95dB |
| Temp Range | -55C to +135C |
| Cable Jacket OD | 0.160" |
| Min Bend Radius | 0.400" |
| Max Power at 900MHz | 325W |
| Capcitance | 29 pf/ft |
| VSWR max | 1.40:1 |
| IL/Max Pwr-800MHz | 10.1db/100ft - 380W |
| IL/Max Pwr-1900MHz | 16.7db/100ft - 250W |
| IL/Max Pwr-2200MHz | 18.8db/100ft - 205W |
| IL/Max Pwr-5800MHz | 34.1db/100ft - 112W |

Images for illustration only, Data subject to change.

ConductRF FMP series Low PIM Hand Formable RF cable assemblies provides the Cellular and In-Building Wireless system designers with a versatile solution to cabling and configurations needs for optimum Antenna placement. In recognition that PIM is caused by nonlinearity of components in the RF construction, these assemblies have been designed to minimize these effects and maximize the elements that minimize PIM. Utilizing ConductRF's new Low PIM Direct Solder Attachment Connectors, we can provide high performance solutions operating up to 6GHz in configurations for Low PIM including Straight, Right Angle, Bulkhead and Panel attachment. Performance better than -155dBc is validated through 100% testing. Using FEP jacketed hand formable cable, these cables may be bent in to fixed shapes to enable specific dressing and lay of cable within a system without suffering a natural spring effect experienced with flexible cables. DAS Designers can download ConductRF Vex Files from [iBwave.com](iBwave.com)

FMP29-N1NF-W03

FMP29-YZYZ-WYY

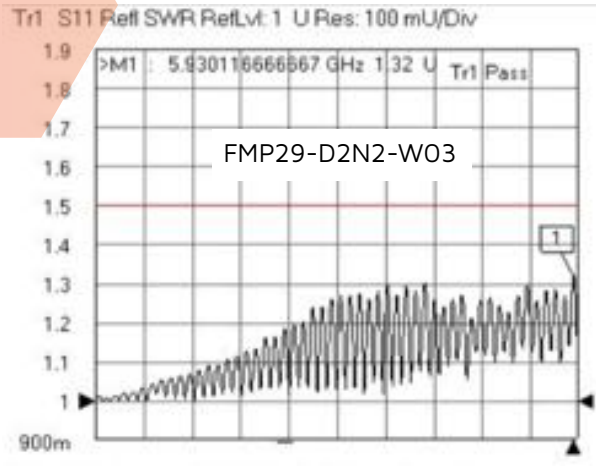
YY = Length in Feet

Y
S = SMA
Q = QMA
N = Type-N
D = 7/16
4 = 4.1/9.5
3 = 4.3/10

Z
1 = Straight Male
2 = R/A Male
3 = Bulkhead Mount
4 = Panel Mount
F = Straight Female

W
W = Tri-Metal

RoHS COMPLIANT





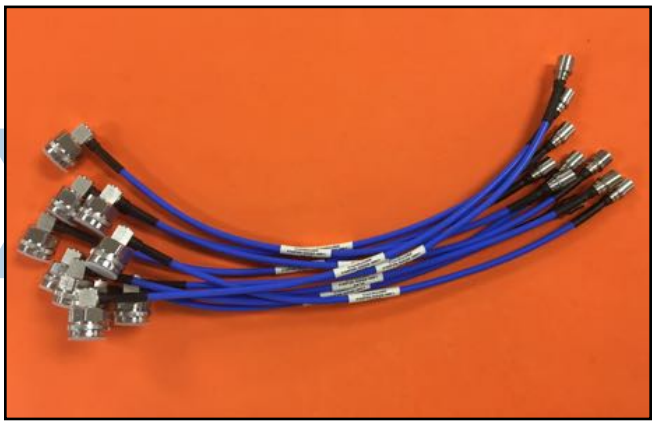

Sales@ConductRF.com - Tel: +1 978-374-6840 - www.ConductRF.com

# Low PIM 50Ω RF Jumpers

## PN Series – Flexible Double Shielded Cables

## Plenum Rated Solutions for DAS

**Low Passive Intermod under -155dBc**
**Superior Cable Shielding**
**Stable Performance when Flexed**
**Optimized Connectors Attachment**
**Performance Options for 3GHz & 6GHz**
**UL910 Plenum Rated Cable**



| Characteristic | PN(A/B)44 | PN(A/B)29 |
|---|---|---|
| Center Conductor | Bare Copper | |
| Dielectric | Taped PTFE | |
| 1st Shield | Tin Plated Copper Flat Braid | |
| 2nd Shield | Tin Plated Copper Round Braid | |
| Cable Jacket | Blue FEP | |
| Shielding | >80dB | |
| Temp Range | -55C to +105C | |
| Cable Jacket OD | 0.265" | 0.160" |
| Min Bend Radius | 1.375" | 0.750" |
| Max Power at 900MHz | 700W | 390W |
| Capcitance | 28.2 pf/ft | 26.7 pf/ft |
| 1GHz Attn/100ft-A&B | <7.6dB | <12.6dB |
| 2GHz Attn/100ft-A&B | <12.3dB | <20.1dB |
| 3GHz Attn/100ft-A&B | <15.8dB | <25.2dB |
| 6GHz Attn/100ft-B | <20.0dB | <29.0dB |

Images for illustration only, Data subject to change.

ConductRF PN series Low PIM flexible RF cable assemblies provides the Cellular and In-Building Wireless system designers with a versatile solution to connecting and configuring network needs for optimum Antenna placement and overall performance. These assemblies have been designed to minimize these effects of Passive Intermodulation, PIM. Utilizing ConductRF's new Low PIM Direct Solder Attachment Connectors, we provide high performance solutions for Low PIM interconnect including Straight, Right Angle, Bulkhead and Panel attachment. Performance better than -155dBc is validated through 100% testing at our factory. Cable options are available for either DC to 3GHz or 6GHz with a VSWR better than 1.20:1 with straight connectors. New options include mini DIN variants 4.1/9.5 and 4.3/10. The cable has a durable FEP Jackets and is Plenum rated to UL910 so is ideal for In-Building DAS applications Vex files can be downloaded at iBwave.com.

iBWAVE

PNA29-N1NF-W03

PNXXX-YZYZ-WYY

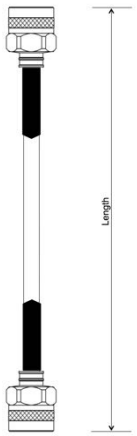
XXX
A44 = 0.265" with FEP Jacket DC-3GHz
A29 = 0.160" with FEP Jacket DC-3GHz
B44 = 0.265" with FEP Jacket DC-6GHz
B29 = 0.160" with FEP Jacket DC-6GHz

Y
S = SMA
Q = QMA
N = Type-N
D = 7/16
4 = 4.1/9.5
3 = 4.3/10

Z
1 = Straight Male
2 = R/A Male
3 = Bulkhead Mount
4 = Panel Mount
F = Straight Female

W
W = Tri-Metal

YY = Length in Feet



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RADIO FREQUENCY SYSTEMS
The Clear Choice®

# 1/2" ClearFill®Line Aluminum Plenum-Rated Air-Dielectric Coaxial Cable for In-Building Applications

**ClearFill®Line 1/2" low-loss air dielectric cable, Plenum-rated, CMP**

## FEATURES / BENEFITS

- **Supports Multiple RF Signals**
- **Complete Shielding**
  The solid outer conductor of the ClearFill®Line coaxial cable creates a continuous RFI/EMI shield that minimizes system interference.
- **Outstanding Intermodulation Performance**
  RFS coaxial cable's solid inner and outer conductors virtually eliminate intermods. Intermodulation performance is also confirmed with state-of-the-art equipment at the RFS factory.
- **Wide Range of Applications**
  Typical areas of application are feedlines for plenum-space installations within occupied buildings or structures but also suitable for outdoor use due to jacket UV rating.

**1/2" Aluminum Plenum-Rated In-Building Cable**

## Technical Features

| | | |
|---|---|---|
| **APPLICATIONS** | | |
| **Applications** | | Suitable for plenum in-building/public safety or outdoor usage |
| **STRUCTURE** | | |
| **Cable Type** | | Air-Dielectric, Corrugated |
| **Size** | | 1/2" |
| **Inner Conductor** | mm (in) | 4.8 (0.19) Copper-Clad Aluminum Wire |
| **Dielectric** | mm (in) | 11.8 (0.464) Extruded Polyethylene |
| **Outer Conductor** | mm (in) | 13.8 (0.54) Corrugated Aluminum |
| **Jacket** | mm (in) | 15.93 (0.627) Plenum Rated / Color White<br>UV rated to ASTM G155 |
| **ELECTRICAL SPECIFICATIONS** | | |
| **Impedance** | Ω | 50 +/- 1 |
| **Maximum Frequency** | GHz | 6.0 |
| **Velocity** | % | 91.0 |
| **Capacitance** | pF/m (pF/ft) | 75 (22.86) |
| **Inductance** | µH/m (µH/ft) | 0.19 (0.058) |
| **Peak Power Rating** | kW | 40.0 |
| **RF Peak Voltage** | Volts | 2000.0 |
| **Jacket Spark** | Volt RMS | 8000.0 |
| **Inner Conductor dc Resistance** | Ω/1000 m (Ω/1000 ft) | 1.48 (0.45) |
| **Outer Conductor dc Resistance** | Ω/1000 m (Ω/1000 ft) | 2.29 (0.7) |
| **Return Loss (VSWR) Performance** | | 24.3 (1.13) @ 698-960 MHz<br>24.3 (1.13) @ 1700-2155 MHz |
| **Temperature & Power** | | High Power Rating |
| **MECHANICAL SPECIFICATIONS** | | |
| **Cable Weight** | kg/m (lb/ft) | 0.19 (0.13) |
| **Minimum Bending Radius, Single Bend** | mm (in) | 125 (5) |
| **Minimum Bending Radius, Repeated Bends** | mm (in) | 254 (10) |
| **Bending Moment** | Nm (lb*ft) | 5.4 |
| **Tensile Strength** | N (lb) | 549 (150) |
| **Recommended / Maximum Clamp Spacing** | m (ft) | 0.5 / 0.9 (1.8 / 3) |

RADIO FREQUENCY SYSTEMS
The Clear Choice®

# 1/2" ClearFill®Line Aluminum Plenum-Rated Air-Dielectric Coaxial Cable for In-Building Applications

## ATTENUATION AND POWER RATING

| Frequency MHz | Attenuation dB/100m | Attenuation dB/100ft | Power kW |
|---|---|---|---|
| 0.5 | 0.16 | 0.05 | 40.00 |
| 1 | 0.23 | 0.071 | 32.80 |
| 1.5 | 0.28 | 0.087 | 26.80 |
| 2 | 0.33 | 0.101 | 23.20 |
| 10 | 0.74 | 0.226 | 10.30 |
| 20 | 1.06 | 0.322 | 7.22 |
| 30 | 1.30 | 0.395 | 5.89 |
| 50 | 1.68 | 0.514 | 4.55 |
| 88 | 2.25 | 0.687 | 3.40 |
| 100 | 2.41 | 0.734 | 3.18 |
| 108 | 2.51 | 0.764 | 3.05 |
| 150 | 2.98 | 0.907 | 2.57 |
| 174 | 3.22 | 0.98 | 2.38 |
| 200 | 3.46 | 1.05 | 2.21 |
| 300 | 4.29 | 1.31 | 1.79 |
| 400 | 5.00 | 1.52 | 1.53 |
| 450 | 5.32 | 1.62 | 1.44 |
| 500 | 5.63 | 1.72 | 1.36 |
| 512 | 5.71 | 1.74 | 1.34 |
| 600 | 6.22 | 1.90 | 1.23 |
| 700 | 6.76 | 2.06 | 1.14 |
| 750 | 7.02 | 2.14 | 1.09 |
| 800 | 7.28 | 2.22 | 1.06 |
| 824 | 7.40 | 2.25 | 1.04 |
| 894 | 7.74 | 2.36 | 0.993 |
| 900 | 7.76 | 2.37 | 0.99 |
| 925 | 7.88 | 2.40 | 0.976 |
| 960 | 8.05 | 2.45 | 0.955 |
| 1000 | 8.23 | 2.51 | 0.934 |
| 1250 | 9.32 | 2.84 | 0.826 |
| 1400 | 9.93 | 3.03 | 0.776 |
| 1500 | 10.30 | 3.15 | 0.749 |
| 1700 | 11.10 | 3.38 | 0.695 |
| 1800 | 11.50 | 3.49 | 0.671 |
| 2000 | 12.20 | 3.71 | 0.634 |
| 2100 | 12.50 | 3.81 | 0.619 |
| 2200 | 12.80 | 3.92 | 0.605 |
| 2300 | 13.20 | 4.02 | 0.587 |
| 2400 | 13.50 | 4.12 | 0.574 |
| 2500 | 13.80 | 4.22 | 0.562 |
| 2600 | 14.20 | 4.31 | 0.546 |
| 2700 | 14.50 | 4.41 | 0.535 |
| 3000 | 15.40 | 4.69 | 0.505 |
| 3500 | 16.90 | 5.14 | 0.461 |
| 3600 | 17.10 | 5.22 | 0.456 |
| 4000 | 18.30 | 5.56 | 0.427 |
| 4500 | 19.60 | 5.97 | 0.399 |
| 5000 | 20.90 | 6.36 | 0.376 |
| 5500 | 22.10 | 6.74 | 0.356 |
| 6000 | 23.30 | 7.11 | 0.339 |

Attenuation at 20°C (68°F) cable temperature; tolerance +/- 5% max.; Mean power rating at 40°C (104°F) ambient temperature

## TESTING AND ENVIRONMENTAL

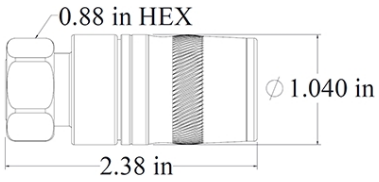
| | |
|---|---|
| **Fire Performance** | Flame Retardant, Plenum-rated, CMP |
| **Regulatory Compliance** | NEC Article 800 Communication Circuits<br>ETL Listed to UL444<br>Canadian CSA C.22.2/FT6 |
| **Installation Temperature** | -20 to 60 (-4 to 140) °C(°F) |
| **Storage Temperature** | -40 to 85 (-40 to 185) °C(°F) |
| **Operation Temperature** | -40 to 85 (-40 to 185) °C(°F) |

## External Document Links

## Notes

# UPL-4MT-12

## *4.3-10 Male Torque Connector for 1/2" Plenum Cable*




Installation video

Installation instructions

Contact technical support:
1-888-201-6073
techsupport@jmawireless.com

| General | Specification |
|---|---|
| **Interface/gender** | 4.3-10 Male, torque type |
| **Cables supported**[1] | Andrew HL4RP, HL4RPV, AL4RPV; RFS ICA12-50JPL/-50JPL/-50JPLLW, HCA12, HUBER+SUHNER SUCOFEED 1/2 PW, LS/Superior Essex LHF12DPV, Rosenberger RLCX-SL012R, Eupen EC4-50PL; Belden RA500P |
| **Weight** | 125.2 g \| 0.276 lb |
| **JMA Weather Protection System** | N/A |

| Tools required | JMA part number | Comment |
|---|---|---|
| **Cable preparation** | SP-12PL | Bit "PL" all cables |
| **Connector compression** | HCG-FRAMESET-1/2, HCG-CC | Insert D |
| **Torque wrench** | TQ-78-F8 | 8 lbf·ft \| 10.85 N·m |

| Frequency band | VSWR | Return loss (dB) |
|---|---|---|
| **555–1000 MHz** | 1.02 | 40 |
| **1000–2700 MHz** | 1.03 | 36 |
| **2700–3800 MHz** | 1.05 | 32 |
| **3800–6000 MHz** | 1.08 | 28 |

| Electrical | Specification | Comment |
|---|---|---|
| **Connector impedance** | 50 ohm | |
| **Operating frequency band** | DC–6 GHz | |
| **3rd order IMD dynamic, (PIM)** | -161 dBc, typical | IEC 60237-02 |
| **DC test voltage** | 2500 V | |
| **Center contact resistance** | ≤1.0 milliohm | |
| **Outer contact continuity** | 1.0 milliohm max. | |
| **Average power** | 600 W @ 900 MHz | |
| **Peak power, max.** | 15 kW | |
| **Insertion loss, typical** | 0.05 dB | Per connector |
| **Shielding effectiveness** | < -120 dB | @ 0-1 GHz |

| Mechanical | Specification | Comment |
|---|---|---|
| **Pull force combined** | .89 kN \| > 200 lb | Cable limited |
| **Cable retention torque** | 6.7 N·m \| 5 lbf·ft | Cable limited |
| **Interface durability** | 100 cycles | IEC 61169-4:9.5 |

| Environmental | Specification | Test |
|---|---|---|
| **Operating temperature** | -55 °C to +85 °C (-67 °F to 185 °F) | |
| **Storage temperature** | -55 °C to +85 °C (-67 °F to 185 °F) | |
| **Accelerated UV** | 1000 hr | ASTM G154 |
| **Immersion test method** | Mated & unmated, IP68 | IEC 60529:2001 & ANSI/SCTE 60 |
| **Water jetting test method** | Mated & unmated, IP66 | IEC 60529:2001 |
| **Mechanical shock test method** | Pass | IEC 60068-2-27 |
| **Thermal shock test method** | Pass | IEC 60068-2-14 |
| **Vibration test method** | 100 m/s$^2$, 2 Hz to 200 Hz | IEC 61169-1:2003 |
| **Corrosion test method** | 1000 hr | IEC 60068-2-11 |

[1]For cable types not listed, please contact JMA Technical Support.

02/13/20


+1 315.431.7100 customerservice@jmawireless.com

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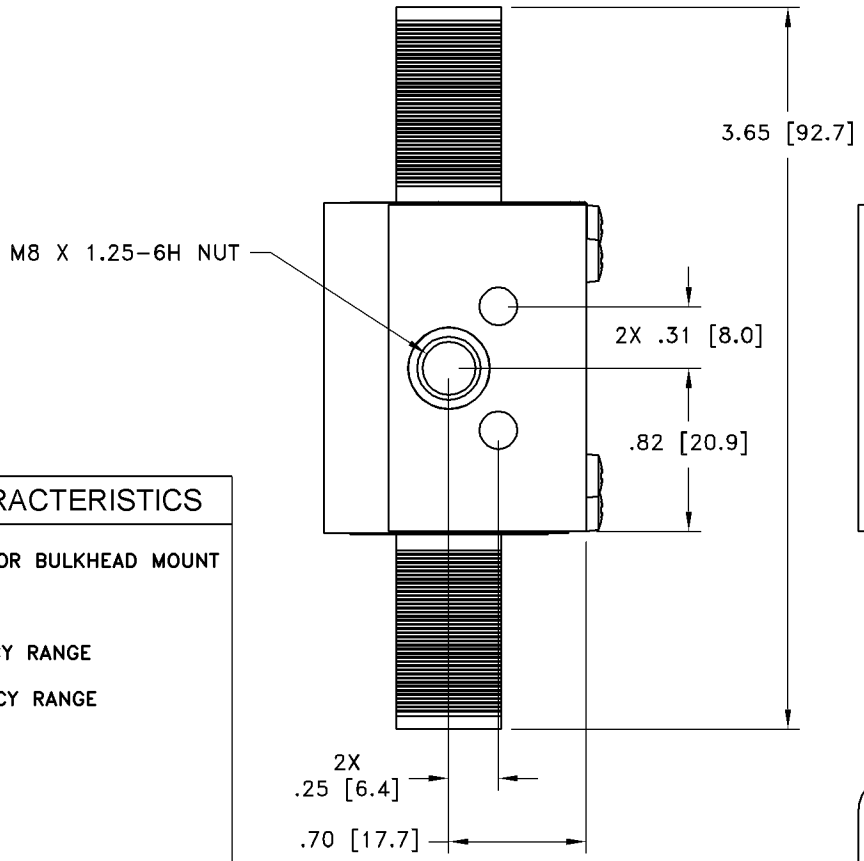
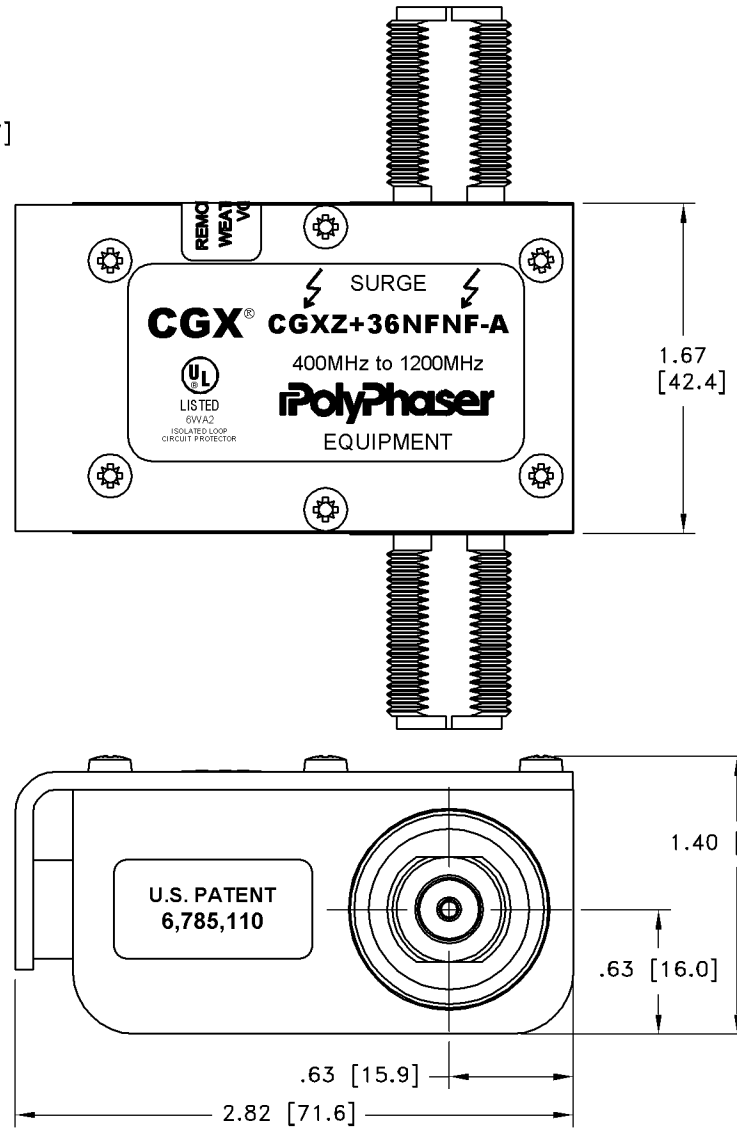
| REVISIONS | | | | |
|---|---|---|---|---|
| REV LTR | DATE | ENG | MKTG | Q.A. |
| B | 05/18/07 SH | KCB | CP | LJ |




## MAXIMUM CHARACTERISTICS

APPLICATION:
**WEATHERIZED, FLANGE OR BULKHEAD MOUNT**

FREQUENCY RANGE:
**400MHz TO 1200MHz**

VSWR:
**≤1.1:1 OVER FREQUENCY RANGE**

INSERTION LOSS:
**≤0.1dB OVER FREQUENCY RANGE**

POWER:
**300 WRMS AVERAGE**

TURN ON:
**+40Vdc**

TURN ON TIME:
**4ns FOR 2kV/ns**

MAX. SURGE:
**20kA IEC 61000-4-5 8/20µs WAVEFORM**

THROUGHPUT ENERGY:
**≤1500µJ FOR 3kA, 8/20µs WAVEFORM**

USER VOLTAGE:
**+36Vdc MAX**

USAGE CURRENT:
**≤4.0A CONTINUOUS**

RELATIVE HUMIDITY:
**TO 95%**

ENVIRONMENTAL:
**MEETS IEC 60529 IP67**
**MEETS BELLCORE #TA-NWT-000487 PROCEDURE 4.11, WIND DRIVEN (120MPH) RAIN INTRUSION TEST.**

TEMPERATURE:
**-50°C TO +85°C STORAGE/OPERATING**

CUSTOMER APPROVAL: _____ DATE: _____

ALL DIMENSIONS SHOWN ABOVE ARE FOR REFERENCE ONLY.

| | | | | | | |
|---|---|---|---|---|---|---|
| DRAFTER R. SWART | DATE 02/07/06 | PolyPhaser P.O. BOX 9000 MINDEN, NV 89423 TEL: 775-782-2511 FAX: 775-782-4476 | | | | |
| MECH ENGINEER R. DUNNING | DATE 04/24/06 | DWG NO/PART NO/DESCRIPTION | | | | |
| ELEC ENGINEER K. BARTEL | DATE 04/24/06 | CGXZ+36NFNF-A CUSTOMER PRINT | | | | |
| MARKETING S. DOTTER | DATE 04/24/06 | | | | | |
| QUALITY DEPT R. MATHEUS | DATE 04/24/06 | CAGE CODE 61114 | FILE NAME -C1 | SCALE 1/1 | SHEET 1 OF 1 | |

# BATTERY BACKUP SYSTEMS

## BTTY Series

### Product Features

- NFPA Compliant
- Up to 24 hour version
- Batteries included
- AC Input, 24 Volt DC Output
- NEMA-4 Rated BBU Enclosure
- Up to 4 Annunciators may be connected to one BBU
- Tamper Proof with Lock and Key Accessibility
- Flush Wall Mounted Annunciators


| Specification | Value |
|---|---|
| Type | Battery Backup Unit |
| Input | 120 VAC 50/60 Hz |
| Size | 24 x 20 x 10 in |

| Specifications | BTTY-100050 |
|---|---|
| Storage capacity | 100W / 12hs |
| Annunciator | AC Power Normal<br>AC Power Failure<br>Battery Capacity <30%<br>Battery Charger Fail<br>Donor Antenna Disconnection<br>Donor Antenna Malfunction<br>RF Emitter Fail<br>System Component Fail |
| Max Load | 270 W (contact Fiplex for battery duration at different loads) |
| Batteries | Included |
| BDA Annunciator | Built in, port for additional external annunciators |
| Weight (batteries included) | 150lbs |

| Specifications | BTTY-100100 |
|---|---|
| Storage capacity | 100 W / 24 hs or 200 W / 12 hs |
| Annunciator | AC Power Normal<br>AC Power Failure<br>Battery Capacity <30%<br>Battery Charger Fail<br>Donor Antenna Disconnection<br>Donor Antenna Malfunction<br>RF Emitter Fail<br>System Component Fail |
| Max Load | 270 W (contact Fiplex for battery duration at different loads) |
| Batteries | Included |
| BDA Annunciator | Built in, port for additional external annunciators |
| Weight (batteries included) | 210lbs |



DOC BD105.02 • 12152020 • FS

# PS 700 + PS 800
# DIGITAL SIGNAL BOOSTERS

## DH7S-A
## DH7S-D

### Product Features


- Supports Public Safety 700 & 800 MHz in single or dual band versions
- FirstNet Band 14 available
- Upgradeable options: single to dual band, low to high power, class B to class A
- Channel Selective, software programmable or adjustable bandwidths
- Fully digital signal boosters, FPGA based
- US and Canada 700MHz band compatible, software adjustable
- Auto diagnostic
- Automatic gain control per band, per channel, per time slot
- Oscillation detection with alarm and auto-shutdown
- Antenna Isolation measurement feature
- Antenna Isolation alarm
- Built-in input and output spectrum analyzer
- Weatherproof enclosure, IP67/NEMA4X
- NFPA compliant with dry contact alarms
- Uplink and downlink squelch, per channel and per time slot on channel selective mode
- User adjustable gain control, UL and DL independent, per band, per channel and per time slot on channel selective mode
- PS700 and PS800 High capacity versions (64 channels)
- UL2524 2nd Edition Listing with SGS, Nationally Recognized Testing Laboratory (NRTL) approved by OSHA for UL2524.
- IFC 2015, 2018, 2021 Edition
- NFPA 72 2013 Edition, NFPA 1221 2016 2019 Edition

### Applications

- For P25 Phase I & Phase II, DMR, NXDN and Conventional systems.
- Indoor coverage: buildings, schools, hospitals, casinos, tunnels, metro stations.
- Outdoor coverage: oil rigs, stadiums, dense urban areas, rural areas.

| Specification | Value |
|---|---|
| Type | Single and Dual Band Digital Signal Boosters |
| Frequency range | 758-775 / 788-805 MHz or 764-776 / 794-806 MHz (software adjustable) & 806-824 / 851-869MHz |
| Passband BW. min | Channel Selective (150KHz, 100Khz, 75KHz, 62.5KHz, 50KHz, 37.5KHz, 25KHz and 12.5KHz) or 100KHz to full band (depends of configuration) |
| Number of Passband | PS700 + FirstNet Class B: 1 FirstNet + 1 BWA<br>PS700 + FirstNet Class A: 32 channel filters + 1 FirstNet + 1 BWA<br>PS700 + FirstNet High Capacity: 64 filters + 1 FirstNet<br>PS800 Class B: 2 BWA<br>PS800 Class A: 32 channel filters + 2 BWA<br>PS800 + High Capacity: 64 filters<br>PS700 + FirstNet + PS800: Class B: 2 BWA per band<br>PS700 + FirstNet + PS800: Class A: 32 channel filters + 2 BWA per band |
| Channel Filter Options | 150KHz, 100Khz, 75KHz, 62.5KHz, 50KHz, 37.5KHz, 25KHz and 12.5KHz |
| BWA Filters | Adjustable from 100KHz to fullband in step in steps of 50KHz |
| Gain, maximum | 85 dB |
| Passband ripple | +/- 2.0 dB |
| Gain, manual control | 30dB range, digitally controlled in 1dB steps, per link, per band |
| Antenna isolation | Max Gain + 20dB |

# PS 700 + PS 800
# DIGITAL SIGNAL BOOSTERS

# DH7S-A
# DH7S-D

| | |
|---|---|
| Composite output power, DL | +33dBm or +27dBm (depending on configuration) per band |
| Composite output power, UL | +27dBm |
| IMD | < -13dBm |
| Noise figure | 9.0dB max |
| Group delay | Channel Selective 150KHz, 11.5µS<br>Channel Selective 100KHz, 13.5µS<br>Channel Selective 75KHz, 16.0µS<br>Channel Selective 62.5KHz, 18.0µS<br>Channel Selective 50KHz, 21.0µS<br>Channel Selective 37.5KHz, 25.5µS<br>Channel Selective 25KHz, 35.0µS<br>Channel Selective 12.5KHz, 61.5µS<br>or Band Selective: 3.5 to 6.5µS, depending on BWA |
| Maximum input power, no damage | +5dBm (UL), +5dBm (DL) |
| Maximum input power, normal operation | 0dBm (UL), 0dBm (DL) |
| Connectors | N(f) as standard |
| RF Input/Output impedance | 50Ω |
| Uplink squelch function | Yes, user selectable, to avoid UL noise when no carriers present, per band, per time slot and per channel (on channel selective mode) |
| Self diagnostic platform | Microprocessor based |
| Alarms | Yes, amplifiers status, power amplifiers status, power supply failure, temperature, AGC, RF overload, donor antenna failure, VSWR Indoor, oscillation. |
| Local management and supervising | Local access via USB and Ethernet (web browser) |
| Remote management and supervising | Remote access via Ethernet |
| RoHS compliance | Yes |
| Power Supply | AC 110 VAC, 50/60 Hz or DC +24VDC & -48VDC (depending on configuration) |
| Power consumption | 80W in dual band, 62W in single band |
| Housing | IP67 / NEMA4X |
| Temperature range | -13° to 131° F • -25° to +55° C |
| Cooling | Natural convection |
| Weight | 52.9 lbs • 24 kg |
| Dimension | 17.7 x 17.3 x 5.1 in • 450 x 440 x 130 mm |
| Mounting | Wall or pole mounting (Rack mounting option available) |
| MTBF | 250000 hours |

| **Configurations** | **CLASS A** | | | |
|---|---|---|---|---|
| **Bands** | **+33 dBm AC** | **+33 dBm DC** | **+27 dBm AC** | **+27 dBm DC** |
| 700 + FirstNet | DH7S-A-733A | DH7S-D-733A | DH7S-A-727A | DH7S-D-727A |
| 800 MHz | DH7S-A-S33A | DH7S-D-S33A | DH7S-A-S27A | DH7S-D-S27A |
| 800 + 700 + FirstNet | DH7S-A-7S33A | DH7S-D-7S33A | DH7S-A-7S27A | DH7S-D-7S27A |
| 700MHz High Capacity | DH7S-A-733AH | DH7S-D-733AH | DH7S-A-727AH | DH7S-D-727AH |
| 800MHz High Capacity | DH7S-A-S33AH | DH7S-D-S33AH | DH7S-A-S27AH | DH7S-D-S27AH |

| **Configurations** | **CLASS B** | | | |
|---|---|---|---|---|
| **Bands** | **+33 dBm AC** | **+33 dBm DC** | **+27 dBm AC** | **+27 dBm DC** |
| 700 + FirstNet | DH7S-A-733B | DH7S-D-733B | - | - |
| 800 MHz | DH7S-A-S33B | DH7S-D-S33B | - | - |
| 800 + 700 + FirstNet | DH7S-A-7S33B | DH7S-D-7S33B | DH7S-A-7S27B | DH7S-D-7S27B |

# PS 700 + PS 800
# DIGITAL SIGNAL BOOSTERS

# DH7S-A
# DH7S-D

## Available Upgrades

| MODELS Replace "X" for A: AC or D: DC | DESCRIPTION | PWR from +27dBm to +33dBm. Same Class and Band | From Class B to Class A. Same Band and PWR | From Single to Dual Band. Same Class and PWR | From Class B to Class A and from Single to Dual Band. Same Power | From +27dBm to +33dBm and from Single to Dual Band. Same Class | PWR from +27dBm to +33dBm and from Class B to Class A |
|---|---|---|---|---|---|---|---|
| DH7S-X-7S27B | PS800 + 700 MHz + FirstNet, Dual Band +27dBm p/b, Class B, 2 Adj sub band p/b, NFPA | ● | ● | | | | ● |
| DH7S-X-733B | PS700 MHz + FirstNet, Single Band +33dBm, Class B, 2 Adj sub band, NFPA | | ● | ● | ● | | |
| DH7S-X-S33B | PS800 MHz, Single Band +33dBm, Class B, 2 Adj sub band, NFPA | | ● | ● | ● | | |
| DH7S-X-7S33B | PS800 + 700 MHz + FirstNet, Dual Band +33dBm p/b, Class B, 2 Adj sub band p/b, NFPA | | ● | | | | |
| DH7S-X-727A | PS700 MHz + FirstNet, Single Band +27dBm, Class A, 32 filters + 2 Adj sub band, NFPA | ● | | ● | | ● | |
| DH7S-X-S27A | PS800 MHz, Single Band +27dBm, Class A, 32 filters + 2 Adj sub band, NFPA | ● | | ● | | ● | |
| DH7S-X-7S27A | PS800 + 700 MHz + FirstNet, Dual Band +27dBm p/b, Class A, 32 filters p/b + 2 Adj sub band, NFPA | ● | | | | | |
| DH7S-X-733A | PS700 MHz + FirstNet, Single Band +33dBm, 32 filters + 2 Adj sub band, NFPA | | | ● | | | |
| DH7S-X-S33A | PS800 MHz, Single Band +33dBm, Class A, 32 filters + 2 Adj sub band, NFPA | | | ● | | | |

| Upgrades Code | Description |
|---|---|
| UPGR-DH7S-7S27B-7S33B | CONFIGURATION UPGRADE DH7S FAMILY. From PS700, +27dBm, Class B to PS700, +33dBm, Class B |
| UPGR-DH7S-7S27B-7S27A | CONFIGURATION UPGRADE DH7S FAMILY. From PS700&PS800, +27dBm, Class B to PS700&PS800, +27dBm, Class A |
| UPGR-DH7S-7S27B-7S33A | CONFIGURATION UPGRADE DH7S FAMILY. From PS700&PS800, +27dBm, Class B to PS700&PS800, +33dBm, Class A |
| UPGR-DH7S-733B-733A | CONFIGURATION UPGRADE DH7S FAMILY. From PS700, +33dBm, Class B to PS700, +33dBm, Class A |
| UPGR-DH7S-S33B-S33A | CONFIGURATION UPGRADE DH7S FAMILY. From PS800, +33dBm, Class B to PS800, +33dBm, Class A |
| UPGR-DH7S-7S33B-7S33A | CONFIGURATION UPGRADE DH7S FAMILY. From PS700&PS800, +33dBm, Class B to PS700&PS800, +33dBm, Class A |
| UPGR-DH7S-733B-7S33B | CONFIGURATION UPGRADE DH7S FAMILY. From PS700, +33dBm, Class B to PS700&PS800, +33dBm, Class B |
| UPGR-DH7S-S33B-7S33B | CONFIGURATION UPGRADE DH7S FAMILY. From PS800, +33dBm, Class B to PS700&PS800, +33dBm, Class B |
| UPGR-DH7S-733A-7S33A | CONFIGURATION UPGRADE DH7S FAMILY. From PS700, +33dBm, Class A to PS700&PS800, +33dBm, Class A |
| UPGR-DH7S-S33A-7S33A | CONFIGURATION UPGRADE DH7S FAMILY. From PS800, +33dBm, Class A to PS700&PS800, +33dBm, Class A |
| UPGR-DH7S-733B-7S33A | CONFIGURATION UPGRADE DH7S FAMILY. From PS700, +33dBm, Class B to PS700&PS800, +33dBm, Class A |
| UPGR-DH7S-S33B-7S33A | CONFIGURATION UPGRADE DH7S FAMILY. From PS800, +33dBm, Class B to PS700&PS800, +33dBm, Class A |
| UPGR-DH7S-727A-733A | CONFIGURATION UPGRADE DH7S FAMILY. From PS700, +27dBm, Class A to PS700, +33dBm, Class A |
| UPGR-DH7S-S27A-S33A | CONFIGURATION UPGRADE DH7S FAMILY. From PS800, +27dBm, Class A to PS800, +33dBm, Class A |
| UPGR-DH7S-7S27A-7S33A | CONFIGURATION UPGRADE DH7S FAMILY. From PS700&PS800, +27dBm, Class A to PS700&PS800, +33dBm, Class A |
| UPGR-DH7S-727A-7S27A | CONFIGURATION UPGRADE DH7S FAMILY. From PS700, +27dBm, Class A to PS700&PS800, +27dBm, Class A |
| UPGR-DH7S-S27A-7S27A | CONFIGURATION UPGRADE DH7S FAMILY. From PS800, +27dBm, Class A to PS700&PS800, +27dBm, Class A |
| UPGR-DH7S-727A-7S33A | CONFIGURATION UPGRADE DH7S FAMILY. From PS700, +27dBm, Class A to PS700&PS800, +33dBm, Class A |
| UPGR-DH7S-S27A-7S33A | CONFIGURATION UPGRADE DH7S FAMILY. From PS800, +27dBm, Class A to PS700&PS800, +33dBm, Class A |



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

# Wideband Directional Coupler

## DC-Hxx-OMD300C(I)

### Low PIM(-161dBc), 555-3800MHz, 4.3-10 Female, 300W


- Wideband design covering 555-3800MHz
- Available in 5, 6, 7, 8, 10, 13, 15 & 20dB values
- Suitable for indoor/outdoor environment
- High reliability and low insertion loss

### *Electrical Specification*

| Product Model | DC-H05-OMD 300C(I) | DC-H06-OMD 300C(I) | DC-H07-OMD 300C(I) | DC-H08-OMD 300C(I) | DC-H10-OMD 300C(I) | DC-H13-OMD 300C(I) | DC-H15-OMD 300C(I) | DC-H20-OMD 300C(I) |
|---|---|---|---|---|---|---|---|---|
| **Frequency (MHz)** | 555-3800 | | | | | | | |
| **Coupling (dB)** | 5.0 | 6.0 | 7.0 | 8.0 | 10.0 | 13.0 | 15.0 | 20.0 |
| **Coupling Tolerance (dB)** | ± 1.0 | ± 1.0 | ± 1.0 | ± 1.2 | ± 1.2 | ± 1.3 | ± 1.3 | ± 1.5 |
| **Insertion Loss (dB)** | ≤ 2.4 | ≤ 1.8 | ≤ 1.6 | ≤ 1.2 | ≤ 0.8 | ≤ 0.5 | ≤ 0.4 | ≤ 0.3 |
| **Directivity (dB)** | ≥20 @555-2700MHz, ≥18 @2700-3800MHz | | | | | | | |
| **VSWR @ all ports** | ≤ 1.20 @555-2700MHz, ≤ 1.25 @2700-3800MHz | | | | | | | |
| **PIM (dBc)** | ≤ -161 @ 2 x 43dBm | | | | | | | |
| **Reflection Power, max (W)** | 35 | 40 | 50 | 70 | 100 | 200 | 200 | 200 |
| **Average Power, max (W)** | 300 | | | | | | | |
| **Peak Power, max (W)** | 1000 | | | | | | | |
| **Impedance (ohm)** | 50 | | | | | | | |

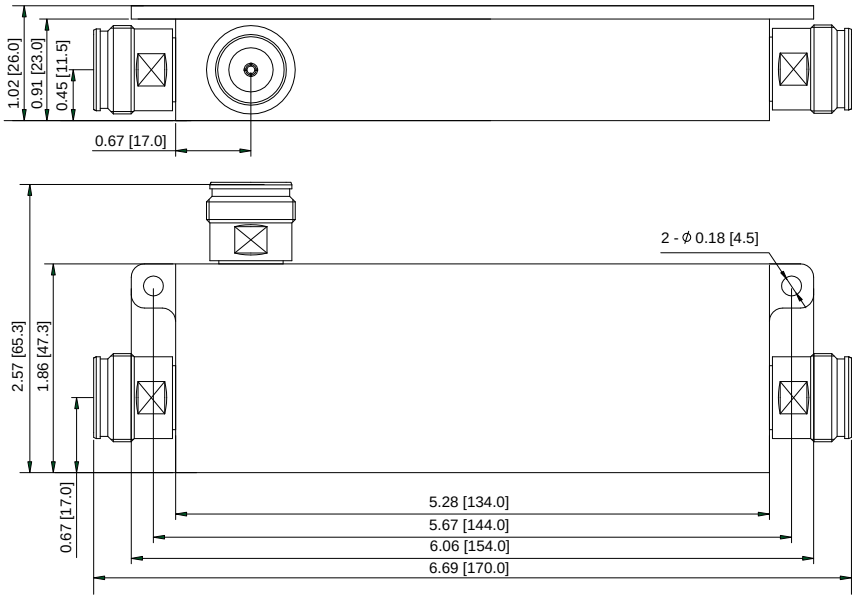
### *Mechanical Specification*

| | |
|---|---|
| **Dimension (in/mm)** | 6.69x2.57x1.02 / 170.0x65.3x26.0 |
| **Weight (lb/kg)** | 1.0 / 0.45 |
| **Connector** | 4.3-10 Female |

### *Environment & Compliance*

| | |
|---|---|
| **Application** | Indoor / Outdoor |
| **Operating Temperature** | -35°C to +85°C |
| **Environment** | IP65 |
| **Relative Humidity** | Up to 100% |
| **RoHS** | Compliant |

### *Outline Drawing*



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Tel: +1 866 802 7961, combausa@comba-telecom.com, Fax: +1 408 526 0181

# NFPA-Compliant Public Safety Radio Enhancement System Monitoring Unit and Annunicator Panel

NFPA MEMBER

## DASalert Models 1221-A & 1221-B

**Meets NFPA-72 (2010, 2013 & 2016) and current NFPA-1221 codes for a**

## Dedicated Annunciator and Monitoring Panel


Displays Status of:

- **BDA**
- **Donor Antenna**
- **AC Power**
- **Battery Capacity**
- **Battery Charger**
- **System Status**

Includes Form-C relay contacts to interface with any fire alarm system

Monitors communications link for integrity

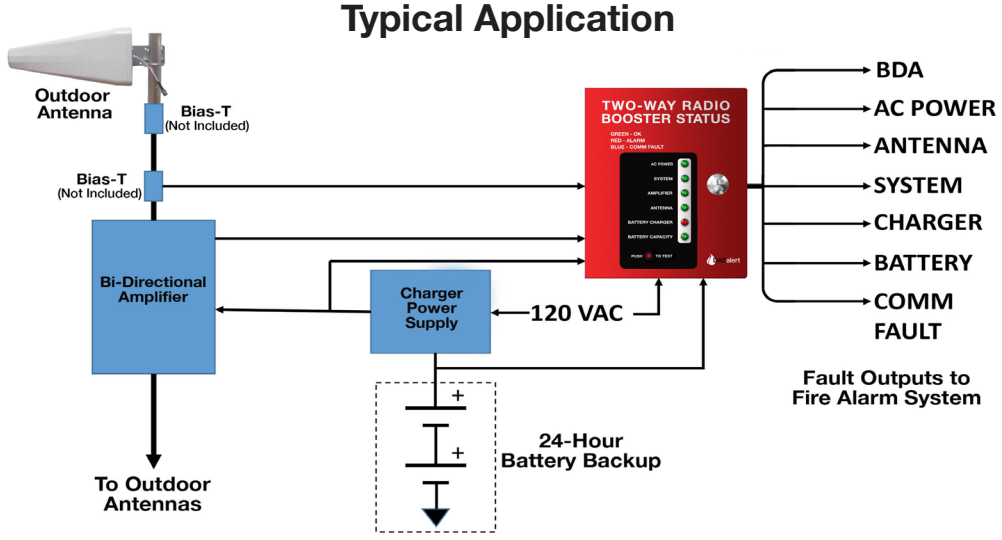
Includes independent circuitry to check antenna, AC power, battery capacity, charger and overall system status

Mates with or augments monitoring of any BDA, antenna, charger, battery or UPS

Low cost, easy to install and program
Small size NEMA-4: 10”H x 8”W x 4”D

Backed up by internal battery (included)

## Model 1221-A Monitor and Annunciator Panel Typical Application



## Code Requirements

The current edition of the NFPA 1221 fire code (shown below) and NFPA-72 (2010, 2013 & 2016) describe the requirements for monitoring the performance of Public Safety in-building two-way Radio Enhancement Systems with a dedicated panel. This panel is required to be located in the fire command center but some jurisdictions require that it be located in the same room as the Radio Enhancement System.

These panels are designed to meet all these requirements. In addition, Model 1221-A contains additional circuitry to enhance and augment the alarm sensing capabilities of the BDA and the DAS backup emergency power supply if they are not code compliant.

## Fault Signaling Relays

Some DAS components are not configured with the appropriate Form-C alarm relays that can interface properly with all Fire Alarm Systems. This unit provides these alarm relays. They can be programmed to mate with any Fire Alarm System with their 'normally OFF' or 'normally ON' states for any 'fail safe' convention that is required by the Fire Alarm System.

## Enclosure & Power Requirements

The enclosure is NEMA-4 rated consistent with the other requirements of the code and a small backup battery (included) inside the panel provides over 24 hours of service if this is needed to supplement loss of primary power. Primary power is provided by an AC socket-mounted 15 VDC power supply (included).

## Communication Integrity

Per code, fault detection cables between the Radio Enhancement System and the panel are monitored to detect open circuits or short circuits to ground. If this condition is detected the panel will trigger a fault alarm to the Fire Alarm System signaling the loss of communications integrity.

## **Antenna Monitoring** (Model 1221-A)

If the bi-directional amplifier (BDA) in the Radio Enhancement System does not have the capability to monitor donor antenna faults, the panel can provide this by adding external Bias-Ts in line with the antenna. The panel will detect common faults such as open circuits, short circuits, disconnected or severed cables leading to the antenna without impacting the RF performance of the system.

## Installation

This panel provides an economical easy-to-install solution to meeting the code requirements and the flexibility to interface with and augment, if required, the fault detection and alarm signaling capabilities of a large variety of standard components used in these systems. The small size and light-weight enclosure can be wall-mounted into any installation.

---

# Model Comparison

| Module | Model 1221 A | Model 1221 B |
|---|---|---|
| Annunciator System with FORM-C relay outputs to main fire alarm installation | ✓ | ✓ |
| Alternative Donor Antenna Failure Sense Module (Bias-T fittings not included) | ✓ | |
| Alternative DAS Battery Capacity Sense Module | ✓ | |
| Alternative DAS Battery Charger Failure Sense Module | ✓ | |
| Annunciator System Backup Battery (8 Ahr) | ✓ | ✓ |
| Annunciator System Power Supply and Battery Charger | ✓ | ✓ |
| Price | $1499.00 | $999.00 |

## Models 1221A and 1221B Module Descriptions

### Annunciator System with FORM-C relay outputs to main fire alarm system
*(Models 1221A & Model 1221B)*

This is the basic annunciator system that accepts ALARM signaling from external relays contained in the DAS equipment. The system accepts relay signaling indicating the following alarms:

- Loss of AC Power
- Amplifier Problems
- Antenna Problems
- DAS Battery Capacity below 30%
- DAS Battery Charger Fail
- Communications Faults
- Summary System Alarm

The annunciator system provides FORM-C dry relay contacts to provide alarm signaling with any fire alarm installation. The system will operate with DAS installations that include multiple amplifiers, antennas and power sources, and includes circuitry to detect communications faults (open or short circuits) with the DAS equipment.

### Annunciator System Backup Battery

Both models are shipped with an 8 Ahr rechargeable SLA battery that mounts inside the enclosure to provide over  24 hours of backup power.

### Annunciator System Power Supply and Charger

Both models are shipped with an external 15 VDC power supply and battery charger that can be connected to any 120 VAC power outlet. The battery charger includes indicators that show the health of the panel's backup battery. The need to replace this battery can be signaled to the building's main fire alarm system.

### Alternative Donor Antenna Failure Sense Module
*(Model 1221-A only)*

This module provides a means of detecting open circuit, short circuits, disconnected, severed or lose connector problems in the antenna feed from the donor. This circuitry utilizes external bias-T fittings (not included). Multiple antennas can be connected in parallel to the same monitoring port.

*Model 1221A should be used if your amplifier or other components in your installation do not have the means of detecting donor antenna problems.*

### Alternative DAS Battery Capacity Sense Module
*(Model 1221-A only)*

If your installation has a backup battery to provide emergency DAS power in the event of an AC power failure it must be monitored to detect when it has less than 30 % capacity left to power the system when primary power is lost.

*Model 1221A should be used if your emergency power unit does not have this capability.*

### Alternative DAS Battery Charger Failure Sense Module
*(Model 1221-A only)*

If your installation has a backup battery to provide emergency DAS power in the event of an AC power failure, the battery charger must be monitored to detect if it has failed or is degraded.

*Model 1221A should be used if your charger unit does not have this capability.*

## Excerpted from NFPA 2012 (2016 Edition): Similar requirements in NFPA-72 (2010, 2013, 2016)

### Standard for Installation, Maintenance, and Use of Emergency Services Communications System

**9.6.13.2 Dedicated Panel.**

(1) A dedicated monitoring panel shall be provided within the fire command center to annunciate the status of all RF emitting devices and system component locations. The monitoring panel shall provide visual and labeled indications of the following for each system component and RF emitting device:

**(a) Normal ac power**
**(b) Loss of normal ac power**
**(c) Battery charger failure**
**(d) Low battery capacity (to 70 percent depletion)**
**(e) Donor antenna malfunction**
**(f) Active RF emitting device malfunction**
**(g) System component malfunction**

(2) The communications link between the dedicated monitoring panel and the two-way radio communications enhancement system must be monitored for integrity.

## Specifications

| | | | |
|---|---|---|---|
| **Dimensions** | 10” x 8” x 4” | **Fault inputs from Radio Enhancement System** | Donor Antenna OK / Fail |
| **Weight** | 11.7 lbs | | Amplifier OK / Fail |
| | | | Charger OK / Fail |
| | | | Battery Capacity OK / Low |
| | | | AC Power ON / OFF |
| **Form C Dry Relay Outputs to Fire Alarm System** | AC Power | | |
| | System (Summary Alarm) | **Analog Inputs** | Donor Antenna Sense |
| | Amplifier (BDA) | | DAS Battery +/- |
| | Antenna | | |
| | Battery Charger | **Certifications** | UL: E194432, ETL: 4001276 |
| | Battery Capacity | | |
| | Communications Fault | **Power** | 15 VDC (180 ma) from supplied Power Supply |

**Submittal Number: 27 60 07 and 27 60 02**
Puyallup Parking Garage
Sturgeon Electric
Contract #: 72573
AWS Project #: 10385

# TAB # 9

Distributed Antenna System

**Specification Section: 27 60 02 and 27 60 07**
Para. No. 9.1 Maintenance Service Contract

**Item shall be included as part of future submittal package.**

AMPLIFIED WIRELESS SOLUTIONS, INC

**Submittal Number: 27 60 07 and 27 60 02**

Puyallup Parking Garage
Sturgeon Electric
Contract #: 72573
AWS Project #: 10385

# TAB # 10

Distributed Antenna System

**Specification Section: 27 60 02 and 27 60 07**

Para. No. 10.1 Permit Drawings/Letter of Authorization

**Item shall be included as part of future submittal package.**
**Shall be provided once shop drawings have been approved and submitted to the AHJ for Approval**