BOARD OF SUPERVISORS AGENDA ITEM REPORT
CONTRACTS / AWARDS / GRANTS

○ Award ◉ Contract ○ Grant

Requested Board Meeting Date: 6/12/18

** = Mandatory, information must be provided*

or Procurement Director Award ☐

***Contractor/Vendor Name/Grantor (DBA):**
Simply Bits, LLC

***Project Title/Description:**
Tower and Rooftop License for Wireless Communications Facilities

***Purpose:**
Renewal of the License Agreement at 33 N. Stone Avenue to allow tenant to install, maintain, and operate communications equipment on the building rooftop. The current License Agreement expires on June 15, 2018. Included in the License renewal are five new panels on the tower. The existing equipment described in the current License Agreement will remain.

***Procurement Method:**
Revenue Contract "License Agreement" - BOS Policy D29.4 XI.H.

***Program Goals/Predicted Outcomes:**
Annual first year revenue of $15,488.80 with a 5% per year escalator beginning on year two.

***Public Benefit:**
General fund revenue.

***Metrics Available to Measure Performance:**
Complete monthly payments, paid on time, over a 5 year period.

***Retroactive:**
No

To: COB. 6-4-18
ver.- 1
pgs- (1)
Addendum

Contract / Award Information

Document Type: CTN Department Code: IT Contract Number (i.e.,15-123): CTN-IT-18-180

Effective Date: 6/12/2018 Termination Date: 6/12/2023 Prior Contract Number (Synergen/CMS): CTNITCMS140997

☐ **Expense Amount: $*** ☒ Revenue Amount: $ 85364.40

***Funding Source(s) required:** General Funds

Funding from General Fund? ○Yes ○No If Yes $ %

Contract is fully or partially funded with Federal Funds? ☐ Yes ☑ No

If Yes, is the Contract to a vendor or subrecipient?

Were insurance or indemnity clauses modified? ☐ Yes ☒ No

If Yes, attach Risk's approval.

Vendor is using a Social Security Number? ☐ Yes ☒ No

If Yes, attach the required form per Administrative Procedure 22-73.

Amendment / Revised Award Information

Document Type: Department Code: Contract Number (i.e.,15-123):

Amendment No.: AMS Version No.:

Effective Date: New Termination Date:

Prior Contract No. (Synergen/CMS):

○ Expense or ○ Revenue ○ Increase ○ Decrease Amount This Amendment: $

Is there revenue included? ○Yes ○No If Yes $

***Funding Source(s) required:**

Funding from General Fund? ○Yes ○No If Yes $ %

Grant/Amendment Information (for grants acceptance and awards) ○ Award ○ Amendment

Document Type: Department Code: Grant Number (i.e.,15-123):

Effective Date: Termination Date: Amendment Number:

☐ Match Amount: $ ☐ Revenue Amount: $

***All Funding Source(s) required:**

***Match funding from General Fund?** ○Yes ○No **If Yes $** **%**

***Match funding from other sources?** ○Yes ○No **If Yes $** **%**

***Funding Source:**

***If Federal funds are received, is funding coming directly from the Federal government or passed through other organization(s)?**

Contact: Jay Hogan/Dawn Dargan

Department: ITD Telephone: 724-2316/724-7590

Department Director Signature/Date: Mark C. Hayes 5/1/2018

Deputy County Administrator Signature/Date: 6-1-18

County Administrator Signature/Date: C. Barlow 6/1/18

(Required for Board Agenda/Addendum Items)

Pima County Department of Information Technology PROJECT: **LICENSE AGREEMENT** LICENSEE: **SIMPLY BITS, LLC** AMOUNT: **REVENUE $85,364.40** FUNDING: **GENERAL FUND**	CONTRACT NO. CTN-IT-18-180 AMENDMENT NO. _____ This number must appear on all invoices, correspondence and documents pertaining to this contract. **(STAMP HERE)**

TOWER AND ROOFTOP LICENSE
FOR WIRELESS COMMUNICATIONS FACILITIES

This License is entered into between Pima County ("Licensor"), a political subdivision of the State of Arizona, and the Simply Bits, LLC, ("Licensee"), and is effective upon execution by both parties, and terminates five years from the effective date unless sooner terminated or further extended pursuant to the provisions of the License. The parties agree as follows:

1. LICENSE – Licensor hereby grants non-exclusive permission to Licensee to install, maintain, operate, and remove certain communications equipment ("the Equipment") on the tower facility and described in **Exhibit A** – Equipment on Rooftop Facility, **Exhibit B** – Tower Drawing, **Exhibit C** – Rooftop Drawing, **Exhibit D** – Shelter Drawing, and **Exhibit E** – Data Sheets, at 33 N. Stone, Ave, Arizona ("the Site"). The Equipment will consist only of the equipment as described in Exhibit A, Exhibit B, Exhibit C, Exhibit D, and Exhibit E. Any modifications to Exhibit A, Exhibit B, Exhibit C, Exhibit D, and Exhibit E, or additions or changes made to the Equipment as described therein will be made only pursuant to a modification of this License pursuant to Paragraph 27.

2. SUITABILITY OF SITE – Licensee has visited and inspected the Site, accepts the physical condition thereof, and acknowledges that no representations or warranties have been made to Licensee by Licensor regarding the condition of the Site and/or the building, or regarding the suitability thereof for Licensee's use. Licensee is responsible for determining all aspects as to the acceptability and adequacy of the Site for Licensee's use.

3. INSTALLATIONS – Licensee will submit to Licensor, for Licensor's approval, detailed written plans and specifications as to installation of the Equipment. Licensor will not unreasonably withhold such approval. Licensee will perform the installation of the Equipment in accordance with **Exhibit F** - Special Conditions, Facility Rules and Regulations. The location at which the Equipment is installed will be determined by Licensor with consideration of the needs of Licensee. Licensee is solely responsible for ensuring that its Equipment is installed properly. Licensor will not be unreasonable in its requirements, said requirements being based on good engineering practices, space utilization, and engineering quality control of the Site and the requirements of Licensor, all as Licensee hereby acknowledges. Licensee will utilize the existing electric circuits at the Site. In the event that Licensee's power requirements exceed the existing capacity or power distribution, it will be Licensee's responsibility, with the consent of Licensor and performed according to code, to increase such capacity to meet its needs, provided

Licensor consents to such increase in capacity. In the event Licensor does not consent to such an increase in existing capacity within thirty days after the date upon which Licensee makes such request, Licensee may void this License by giving Licensor thirty days' written notice.

4. THIRD-PARTY INSTALLERS – Licensee must obtain Licensor's written consent to the use or employment of any third-party installer at the Site, which consent will not be unreasonably withheld. Any third-party installer must submit to Licensor a certificate of insurance naming Licensor as an additional insured and protecting itself and Licensor against any and all claims, demands, actions, judgments, costs, expenses, and liabilities that may arise out of or result, directly or indirectly, from its installation of Licensee's equipment at the Site. Such certificate of insurance must specifically indicate that the third-party installer has insurance specifically related to tower work if such installation involves a tower. Licensee is responsible and liable for any and all actions of any third-party installer, and for ensuring that the actions and work of any third-party installer are consistent with Licensee's obligations under this License and the exhibits hereto. Licensor has the right to disapprove any third-party installer. Licensee's sole remedies in the event of such disapproval by Licensor are (i) to seek Licensor consent to a different installer or subcontractor or (ii) to void this License by giving Licensor thirty days' written notice. Any actions and work by a third-party installer must be done in conformity with all applicable ordinances, codes, and technical standards, at Licensee's expense, and only with the consent of Licensor and performed according to code. All third-party installer crews must have in their possession an installation form issued to them by Licensor prior to the commencement of work at the Site. Licensee will notify Licensor at least twenty-four hours prior to the commencement of work by any third-party installer. Tower climbers must be OSHA certified by the CFRS 1926 standard.

5. INTERFERENCE – Licensee has satisfied itself and hereby warrants that the Equipment is of a type and frequency that will not cause damage to the Site or surrounding property, or cause damage to or interference with electronic or other equipment and/or the television or radio reception of Licensor or of residents and/or tenants of the Site. In the event the Equipment causes such damage or interference, Licensee will cooperate with Licensor in determining the source, and immediately will take all steps necessary to correct and eliminate the interference. If such interference cannot be eliminated within forty-eight hours after receipt of notice from Licensor to Licensee of the existence of such interference, Licensee will discontinue use of any equipment creating said interference (the "Interfering Equipment") by temporarily disconnecting the electric power and shutting down the Interfering Equipment (except for such intermittent operation as is necessary for the purpose of testing after the performance of any maintenance, repair, modification, replacement, or other action designed to correct such interference). If such interference is not corrected within thirty days after receipt of the aforesaid notice, Licensee will remove the Interfering Equipment from the Site. In the event that the cause of the interference cannot be pinpointed to a particular piece of equipment or system, Licensee will disconnect the electric power and shut down all of its Equipment until such time as the interference problem is corrected. If such interference is not corrected within thirty days after receipt of the aforesaid notice, Licensee will remove its equipment from the Site within an additional ten-day period. This License will then terminate without further obligation by either party, except with respect to those obligations then owing or past-due, and except as may otherwise be enumerated specifically herein. Licensor is not liable to Licensee for any interruption of service of Licensee or for interference with the operation of Licensee's equipment.

6. COMPLIANCE WITH STATUTES AND REGULATIONS – Licensee's equipment will be installed, operated, and maintained in accordance with the requirements and specifications of all laws, codes, and regulations of all governmental bodies and agencies having any jurisdiction there over, including any rules and/or orders now in effect or that hereafter may be issued by the Federal Communications Commission ("FCC") and/or the United States Environmental Protection Agency ("EPA"), and in compliance with the relevant standards promulgated by the American National Standards Institute ("ANSI") and the obligations imposed by this License and the exhibits hereto. It is Licensee's responsibility to know and conform to these laws, codes, regulations, standards, and requirements, and to obtain all required permits prior to the date of installation of any equipment.

7. SERVICES BY LICENSOR – In the event that Licensor provides repair, technical, removal, or other services (including but not being limited to legal or engineering services), directly or indirectly, to Licensee, Licensee will reimburse Licensor for Licensee's reasonable proportionate share (as determined by Licensor) of the expenses and costs incurred by Licensor in the provision of such services.

8. MAINTENANCE OF LICENSEE'S EQUIPMENT – Licensee will, at its own expense, operate and maintain any equipment that it installs at the Site in a safe condition, in good repair, and in a manner suitable to Licensor so as not to conflict with the use of the Site or surrounding areas by Licensor or any other authorized user thereof.

9. RESPONSIBILITY FOR LICENSEE'S EQUIPMENT – Any equipment installed by Licensee remains the property of Licensee. Licensee agrees that Licensor does not bear any responsibility for Licensee's equipment, the operation, care, or security thereof, or the services provided thereby. Licensee further agrees that it has no right to demand that Licensor or its agents or employees alter, maintain, or repair the Site, Licensee's equipment, or any other property or equipment, regardless of who might own or otherwise be responsible for such property or equipment. Licensee further acknowledges and agrees that Licensor does not bear any responsibility or liability to Licensee for construction means, techniques, sequences, or procedures in connection with any work performed on the Site or on any other property or equipment either by Licensor or by others.

10. ACCESS – Licensee will have access to the Site for the purpose of installing, operating, inspecting, servicing, maintaining, repairing, and removing its equipment between the hours of 8:00 a.m. and 5:00 p.m., Monday through Friday, except in the case of emergencies, in which case access will be permitted at any time subject to the reasonable security, safety, and identification procedures required by Licensor. Access shall be in accordance with **Exhibit G** – Procedures for Access to Pima County Rooftop Facilities. Licensor further grants Licensee a right of access to the areas where Licensee's connecting equipment is located for the purposes of installing, operating, maintaining, and repairing same. Only authorized engineers, employees, contractors, technicians, third-party installers, subcontractors, and agents of Licensee or the FCC, or persons under Licensee's direct supervision, will be permitted to enter the Site, and then only for the purposes of installing, operating, removing, servicing, repairing, inspecting, or maintaining Licensee's equipment.

11. TERM, RENEWAL, AND TERMINATION – This License runs for a period of five years from the effective date, unless extended or terminated as provided herein.

The License is renewable for an additional three (3) five-year periods upon the mutual written agreement of both parties.

In addition to any other termination provisions set forth in this License, Licensee may terminate this License under the following circumstances by providing at least thirty days' written notice to Licensor: (i) in the event the actions or equipment of a third party (*i.e.*, a party other than Licensor, Licensee, or the agents or employees of either) cause interference that results in a measurable diminution in the quality of Licensee's transmission or reception capability and that cannot be remedied after reasonable efforts to do so have been exhausted by Licensee and such third party, (ii) in the event that Licensee's FCC license is canceled or not renewed by the FCC through no fault of Licensee, or (iii) in the event that there is any unreasonable change to or denial of Licensee's access to the Site for the purposes of installing, modifying, inspecting, repairing, or removing Licensee's equipment.

Either party may terminate this License at any time with at least 90 days' notice to the other party.

12. LICENSE FEE – Licensee will pay LICENSOR $1,287.40 (one thousand, two hundred eighty-seven dollars and forty cents) per month on the first day of each calendar month, commencing on the first day of the first calendar month after the effective date and continuing thereafter for a total of sixty months (or such greater number of months as would be commensurate with any extension of the term of the License. Fee shall be in accordance with **Exhibit H** – License Fee Schedule. Licensor may, but is not required to send monthly invoices as a courtesy to Licensee. The License Fee is based upon the contents and nature of the Equipment, and may be subject to change in the event of a modification to this License or the exhibits hereto. There will be an annual increase in the License Fee of five percent (5%) with the first such increase to be effective with the first anniversary monthly payment, and the subsequent increases to take effect annually thereafter.

All payments will be made payable to:

Attn: Pima County Treasurer
Pima County Revenue Management
33 N. Stone
Mailstop – DT-BAB6-401
Tucson, AZ 85701

13. ADDITIONAL PAYMENTS – The License Fee set forth in Paragraph 12 is in addition to any other sums of money, charges, or other amounts required to be paid by Licensee, whether to Licensor or to any other entity. Such additional payments will include that portion, if any, of any tax (including excise tax), fee, or other assessment attributable to Licensee's use of the Site or to the Site generally.

14. EXCISE TAX – In addition to any other sums due under this License, Licensee will pay to Licensor, on or before December 1 of each year during the Term, any property-lease excise tax due under Title 42, Chapter 6, Article 5, Arizona Revised Statutes (A.R.S. §

42-6201, *et seq.*), as may be amended or re-numbered from time to time. Failure to pay any such taxes constitutes an event of default for which this License may be terminated, and penalties and interest shall accrue as provided by law. If this License is exempt from such excise tax pursuant to A.R.S. § 42-6208, Licensee will keep the information required by A.R.S. § 42-6204. Licensor will calculate the amount of tax on the applicable space and invoice Licensee separately therefore in time to meet the annual payment deadline of December 1.

15. UTILITIES – LICENSOR shall invoice Licensee, and Licensee shall reimburse LICENSOR monthly, for any costs for electricity used at the Site by Licensee's equipment. The amount of such electricity costs shall be equal to the total electric utility charges attributable to all equipment located in equipment shed C and to cooling the equipment shed in the previous billing cycle, divided by the total number of licensees, tenants, or occupants with equipment located in equipment shed at any one time during that billing cycle. However, Licensee shall have the option of installing, at its own cost, a separate meter to determine the electric utility charges attributable to its equipment, and of paying such costs directly to the utility company.

16. INSURANCE – Licensee shall carry adequate insurance to protect the parties hereto and Licensor against any and all claims, demands, actions, judgments, costs, expenses, and liabilities that may arise out of or result, directly or indirectly, from Licensee's use of the Site, except such liability as shall arise solely from the negligence of Licensor. Licensee must deliver to Licensor satisfactory proof of the following insurance coverages.

Commercial General Liability insurance with coverage in an amount not less than $2,000,000.00 per occurrence and aggregate covering the Premises and all activities thereon, endorsed to include Pima County as an additional insured. Business Automobile Liability coverage for owned, non-owned, and hired vehicles with limits in the amount of $1,000,000 combined single limit for vehicles used in the operations at the Premises. Workers' Compensation insurance for statutory coverage and limits for all persons employed or hired by Licensee to work on the Premises. Policy shall include Employers' Liability coverage in an amount not less than $1,000,000 per injury, illness, or disease. Workers' Compensation coverage is to include a waiver of subrogation.

Property Insurance – Business property insurance to include broad form "all risk" property coverage for Licensee's property with the full replacement cost of all Licensee property and improvements on the Premises with Licensor added as an additional insured. Prior to any installation, repair or replacement of parts, Licensee must furnish to Licensor a Certificate of Insurance documenting proof of Builder's Risk/Installation insurance that Licensee, or Licensee's contractor, has obtained to cover the project. Coverage to include broad form and "all risks" builder's risk/installation policy providing insurance while contractor is installing, repairing or replacing parts on the Tower. Licensor is to be included as an additional insured on Builders' Risk/Installation policy.

17. Licensee shall, during the term of this License, including any renewals and any holding-over thereafter, provide Licensor with current certificates of insurance evidencing that such insurance is in full force and effect, with policy endorsed to include Licensor as an additional insured, and is non-cancelable without at least thirty days' written notice to Licensor. The certificates of insurance as required herein must be presented to Licensor

within ten days of the effective date of this License and on each anniversary date thereof during the term of the License, including any renewals and any holding-over thereafter.

Modifications – Any modification or variation from the insurance requirements in this License shall be made by the licensing department in consultation with the Division of Risk Management. Such modification will not require a formal License amendment, but may be made by administrative action, and without the consent of Licensee, upon notice by Licensor. Licensee shall supply a certificate of insurance including the modification within ten (10) days from the date notice of the modification is received by Licensee. Such notice will be given pursuant to the terms of the License; if the License does not specify a notice procedure, Licensor may give notice by Certified U.S. Mail, E-Mail or Facsimile; Certified Receipt, E-Mail Receipt Confirmation or Facsimile Confirmation shall constitute proof of receipt of notice. Failure by Licensee to supply a modified certificate of insurance as required by this paragraph shall constitute material breach by Licensee and grounds for immediate termination of the License by Licensor. Licensee further hereby consents to the addition of the modified insurance requirements to the License.

18. RIGHTS TO EQUIPMENT – During the term of this License, provided that Licensee is not in default hereunder, Licensor will not claim any interest in, make claim to, or assert any right to the Equipment. Provided Licensee is not then in default of this License, Licensee may, at its election, have its Equipment removed on or before the expiration or termination of this License, provided that Licensee will repair any damage caused by said removal. In the case of damage to the Site, Licensee agrees to engage such contractor or contractors as Licensor may require to perform the necessary repairs, and to pay for any such repairs.

Any of Licensee's property remaining on the Site thirty days after the expiration or termination of this License becomes the property of Licensor, free of any claim by Licensee or any person claiming through Licensee. At the termination or expiration of the License, Licensee agrees to restore the Site to its original condition excepting only reasonable wear and tear thereof.

19. HOLDING OVER – Any holding over by Licensee after the expiration of the term hereof without the written consent of Licensor will be construed as a tenancy at sufferance, subject to all of the provisions of this License and at twice the monthly License Fee prevailing in the last month of the term hereunder (including any renewals thereof), and increasing at the same annual rate as provided in Paragraph 12. At all times during any holdover period, Licensor has the unilateral right to terminate this License and to remove Licensee's equipment.

20. INDEMNIFICATION – Licensee will indemnify, defend, and hold Licensor and its officers, elected officials, employees, agents, and contractors harmless from and against any and all suits, claims, liabilities, damages, and expenses of any kind or character (including, but not limited to, reasonable attorneys' fees and expenses incurred in the defense of Licensor), arising out of the injury to or death of any person, damage to any property, or infringement of any property rights, that may be alleged, charged, or otherwise asserted in connection with the installation, operation, removal, or maintenance of Licensee's equipment on or about the Site, or with any act, omission, or negligence of Licensee or Licensee's agents, employees, or contractors on or in the vicinity of the Site, except as said claims or demands may be the result of the negligence

of Licensor or its employees or agents. This indemnity survives any termination or expiration of this License.

Licensee further agrees to indemnify, hold harmless, and defend Licensor and its officers, elected officials, employees, agents, and contractors from and against any and all suits, claims, liabilities, damages, and expenses of any kind or character (including, but not limited to, reasonable attorneys' fees and expenses incurred in the defense of Licensor), arising out of any damage to the Site or surrounding property or out of interference with electronic or other equipment and/or the television or radio reception of Licensor or of residents and/or tenants of the Site. This indemnity survives any expiration or termination of this License.

Licensee further agrees to indemnify, hold harmless, and defend Licensor and its officers, elected officials, employees, agents, and contractors from and against any and all suits, claims, liabilities, damages, and expenses of any kind or character (including, but not limited to, reasonable attorneys' fees and expenses incurred in the defense of Licensor), arising out of any failure or alleged failure by Licensor to alter, maintain, or repair the Site, Licensee's equipment, or any other property or equipment, regardless or who might own or otherwise be responsible for such property or equipment, or out of the construction means, techniques, sequences, or procedures used in connection with any work performed on the Site or on any other property or equipment either by Licensor or by others. This indemnity survives any expiration or termination of this License.

Licensee further agrees to indemnify, hold harmless, and defend Licensor and its officers, elected officials, employees, agents, and contractors from and against any and all suits, claims, liabilities, damages, and expenses of any kind or character (including, but not limited to, reasonable attorneys' fees and expenses incurred in the defense of Licensor), arising out of any failure or alleged failure by Licensor or Licensee to implement or to abide by any safety program or programs.

21. REPAIRS – In addition to the repairs referred to in Paragraph 17, Licensee will repair any damage to the Site that results from or arises through the use and/or operation of its equipment at the site and/or the acts or negligence of Licensee or its agents, servants, contractors, or employees. Such repairs must be accomplished in a manner and by a contractor satisfactory to Licensor.

22. IMPROVEMENTS TO PREMISES – Licensor reserves the right to implement and utilize improvements in technology or management techniques that will provide for better management and use of the space and capacity of the Site, including (but not limited to) the use of combiners, special antennas, etc. Licensor may, in its discretion, require Licensee to incorporate such improvements into such systems as Licensee has installed and is operating at the Site. Licensee will, within ninety days of its receipt of LICENSOR's written demand to do so, either (i) incorporate such improvements or (ii) if the cumulative cost of such required improvements exceeds $4,000, give written notice of its intention to terminate this License upon the expiration of thirty days from the date of Licensor's receipt of such notice.

23. COORDINATION OF OPERATION – Licensor will make reasonable efforts to give Licensee advance notice (except in the case of emergency where advance notice cannot reasonably be given) of any planned shut downs for routine maintenance, and of any repairs, alterations, additions, or improvements to the Site that might materially

affect the operation of Licensee's facilities and equipment at the Site. Licensor will make reasonable efforts to minimize any inconvenience, loss, or expense to Licensee arising therefrom, but is not liable to Licensee or any of Licensee's customers for any such inconvenience, loss, or expense suffered by Licensee and/or Licensee's customers.

24. CASUALTY – In the event there is a total destruction of the Site by fire or other casualty, and the Site cannot, in Licensor estimation (which estimation shall be made within ten days from the date of such casualty), reasonably be restored within ninety days from the date of such casualty, or if Licensor chooses not to undertake such restoration, this License will terminate automatically upon the expiration of the ten-day period following the casualty, unless the parties otherwise agree. In the event of damage to the Site by casualty comprising less than a total destruction thereof, Licensee may terminate this License upon thirty days' written notice to Licensor if Licensor (i) chooses not to undertake, (ii) has not completed, or (iii) cannot reasonably be expected to complete the restoration of the Site within ninety days from the date of such casualty. If any casualty occurs during the last year of the term of this License or any renewal term thereof, Licensee may terminate the License upon thirty days' written notice to Licensor provided such notice is given within sixty days after the date of such casualty.

25. CONDEMNATION – In the event the Site or any significant portion thereof is condemned or otherwise subjected to a taking by any governmental authority exercising the power of eminent domain, unless Licensor and Licensee are permitted to continue their operations at the Site, this License will terminate as of the date upon which Licensor and/or Licensee are required by the governmental authority to cease their operation(s) at the Site. Licensee is entitled to seek its own award against the governmental authority only if such award will not result in a diminution of Licensor's award.

26. DEFAULT – In the event Licensee fails to comply with any of the provisions of this License or the exhibits hereto, or defaults in any of its obligations hereunder, LICENSOR may, at its option, terminate this License provided LICENSOR has given Licensee written notice of such default and Licensee has failed to cure the same within twenty days after receipt of such notice. Where, in LICENSOR's sole judgment, such default cannot reasonably be cured within such twenty-day period, LICENSOR will extend the time to cure such default for such period of time, not to exceed sixty days, as may be necessary to complete such cure, provided that Licensee must proceed promptly to cure the same and pursue such cure with all due diligence.

Licensor will not, except in an emergency, undertake to cure any default by Licensee until after the expiration of Licensee's time to cure such default as provided herein. Licensee will reimburse Licensor for any expenses incurred by Licensor in curing any default by Licensee.

In the event the default is non-payment of the License Fee by Licensee, Licensor will give notice to Licensee via hand delivery, overnight mail, electronic mail, or certified United States Mail of non-receipt of payment. In the event Licensee fails to make full payment of the License Fee then due within fifteen days from the date of delivery of such notice to Licensee, Licensor will have the right to disconnect, remove, and store Licensee's equipment. All costs and expenses incurred by Licensor in connection with such disconnection, removal, and storage will be reimbursed by Licensee. Such reimbursement by Licensee does not relieve Licensee of its obligation to pay the License Fees in default together with any additional expenses incurred by Licensor in connection

with the collection thereof. The rights and remedies of Licensor described in this Paragraph 26 and elsewhere in this License are not exhaustive and are in addition to any other rights or remedies that may exist now or in the future, at law or equity. Licensee will indemnify, release, defend, and hold harmless Licensor against all losses, costs (including reasonable attorneys' fees), damages, expenses, claims, demands, or liabilities arising out of or caused by, or alleged to have arisen out of or been caused by, the disconnection or removal by Licensor of Licensee's equipment pursuant to this Paragraph 25, or for any resulting impairment to or interruption of Licensee's services or operation.

Any three defaults by Licensee within a twelve-month period will be cause for termination of this License by Licensor without the extension of any cure period to Licensee.

27. MODIFICATIONS – Any addition, variation, or modification to this License is void and ineffective unless made in writing and signed by an authorized representative of each party.

28. PARTIES BOUND BY AGREEMENT – Subject to the provisions hereof, this License extends to and binds the heirs, executors, administrators, successors, and assigns of the parties hereto.

29. ASSIGNMENT – Without Licensor's written consent, Licensee does not have the right to assign this License, or to sublicense all or any part of its rights or obligations hereunder.

30. AUTHORITY TO SIGN – Licensee represents that the individual signing this License on behalf of Licensee presently has and will maintain full authority to enter into this License and to bind and obligate Licensee to the terms, rights, and obligations under this License.

31. NOTICES – All notices sent pursuant to this License must be in writing and will be sent to the other party at the following addresses, either by hand delivery, overnight mail, or Certified U.S. Mail, return-receipt requested:

PIMA COUNTY	SIMPLY BITS, LLC
Information Technology Department	Attn:
Attn: Contract Administrator	
150 W. Congress St., Sixth Floor	Address
Tucson, Arizona 85701	City, State Zip
(520) 724-7100	Phone
county.administrator@pima.gov	email

32. CAPTIONS – Any captions in this License are inserted only as a matter of convenience and for reference, and in no way define, limit, or describe the scope of this License or the intent of any provision thereof.

33. COMPLIANCE WITH LAWS – In the performance of its obligations under this License, Licensee will comply with all applicable federal, state, and local laws, rules, ordinances, regulations, standards, and Executive Orders. The laws and regulations of the State of Arizona govern the rights of the parties, the performance of this License, and any disputes hereunder. Any legal action relating to this License must be filed and

maintained in an Arizona Court, in Pima County, Arizona. Any changes in the governing laws, rules, and regulations during the term of this License apply, but do not require an amendment hereof.

34. NON-DISCRIMINATION – Licensee agrees to comply with all provisions and requirements of Arizona Executive Order 2009-09 which is hereby incorporated into this contract as if set forth in full herein including flow down of all provisions and requirements to any subcontractors. During the performance of this contract, Licensee will not discriminate against any employee, client or any other individual in any way because of that person's age, race, creed, color, religion, sex, disability or national origin.

35. LICENSEE HAS NO INTEREST OR ESTATE – Licensee agrees that it has no claim, interest, or estate at any time in the Site by virtue of this License or its use hereunder. Upon termination of this License, Licensee has no right of entry into or upon the Site.

36. CONFLICT OF INTEREST – This Agreement is subject to the provisions of A.R.S. section 38-511.

37. FORCE MAJEURE – Neither of the parties hereto are responsible for damages due to delay that is the result of a contingency beyond the reasonable control of either party, including, but not limited to, acts of nature, pestilence, strikes, embargoes, lockouts, boycotts, civil disturbance and disobedience, riots, war, revolution, acts of government, world shortage of qualified materials, accidents, fires, or floods. Upon the occurrence of such an event, the duties and obligations of the parties hereto will be suspended for so long as the event prevents proper performance under this License. However, if such suspension continues in excess of ninety days, the parties will meet and attempt to arrive at a mutually acceptable compromise within the spirit and intent of this License. In the absence of such compromise, this License will terminate.

38. ENTIRE AGREEMENT/SEVERABILITY – This document constitutes the entire agreement between the parties pertaining to the subject matter hereof, and all prior or contemporaneous agreements and understandings, oral or written, hereby are superseded and merged herein. This License may be modified, amended, altered, or extended only by a written amendment signed by the parties.

If any provision herein is deemed invalid, it will be considered deleted from this License and will not serve to invalidate the remaining provisions of this License to the fullest extent possible.

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IN WITNESS WHEREOF, the parties have executed this License.

PIMA COUNTY

Richard Elías, Chairman
Board of Supervisors

Date

ATTEST

Julie Castaneda, Clerk of the Board

Date

APPROVED AS TO FORM

Chris Straub, Deputy County Attorney

6-1-2018
Date

Simply Bits, LLC

Authorized Officer Signature

Bradley Feder - Member
Printed Name and Title

5-24-18
Date

APPROVED AS TO CONTENT

Mark C. Hayes (acting)
Dan Hunt, Chief Information Officer
Information Technology Department

6/1/2018
Date

EXHIBIT A
33 N. STONE AVENUE ROOFTOP
COMMUNICATIONS EQUIPMENT

10 Transmitters licensed by FCC to operate on 5400/5800/11000/18000 MHz.
10 Receivers licensed by FCC to operate on 5400/5800/11000/18000 MHz.

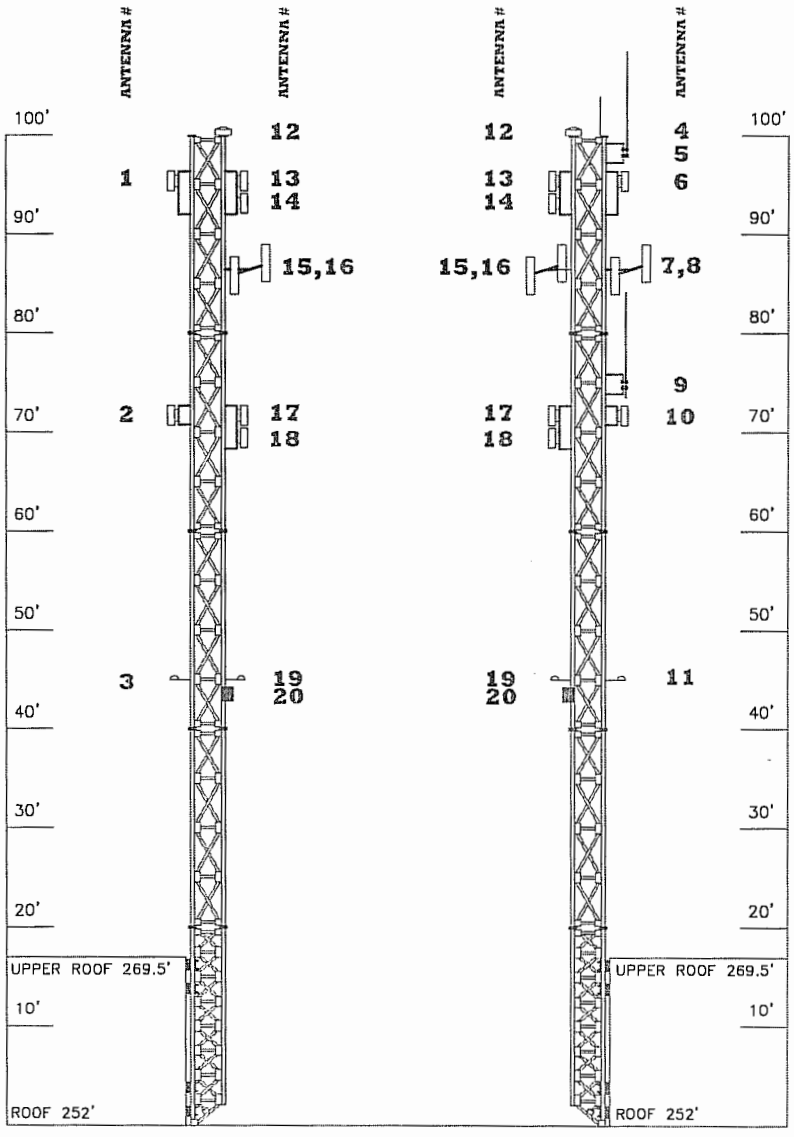
12 Transmission/receiver lines connecting the transmitter/receiver and the transmit/receive antennas, 3/8" in diameter.

Effective Radiated Power radiated by the transmit antennas will be ~6.0007 watts.

Licensee will be installing the following antenna(s):

Quantity	Type	Make	Model No	Size	Height	Diameter
3	Panel	Cambium	PMP450	24"	95	N/A
1	Panel	Cambium	PMP450	24"	93	N/A
3	Panel	Cambium	PMP450m	24"	72	N/A
1	Panel	Cambium	PMP450m	24"	70	N/A
1	Dish	RadioWaves	HPD2	N/A	Loc. K	2'
1	Dish	RadioWaves	HPD2	N/A	Loc. N	2'

EXHIBIT B-TOWER DRAWING



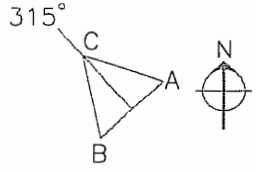
#	LEG	ELEVATION	TENANT–SHELTER	ANTENNA TYPE
1	A	95 FEET	SIMPLY BITS – C	1 PMP450 RADIO AND PANEL
2	A	72 FEET	SIMPLY BITS – C	1 PMP450 RADIO AND PANEL
3	A	45 FEET	N/A	MARKER LIGHT

#	LEG	ELEVATION	TENANT–SHELTER	ANTENNA TYPE
4	B	100 FEET	N/A	LIGHTNING ROD
5	B	97 FEET	ACTION COMM–C	OMNI ANTENNA
6	B	95 FEET	SIMPLY BITS–C	PMP450 RADIO AND PANEL
7	B	85 FEET	DEA – A	JANTEQ SUPERSECTOR PANEL
8	B	85 FEET	DEA – A	JANTEQ SUPERSECTOR PANEL
9	B	75 FEET	ACTION COMM–C	OMNI ANTENNA
10	B	72 FEET	SIMPLY BITS–C	PMP450 RADIO AND PANEL
11	B	45 FEET	N/A	MARKER LIGHT

#	LEG	ELEVATION	TENANT–SHELTER	ANTENNA TYPE
12	C	100 FEET	N/A	BEACON
13	C	95 FEET	SIMPLY BITS – C	PMP450 RADIO AND PANEL
14	C	93 FEET	SIMPLY BITS – C	PMP450 RADIO AND PANEL
15	C	85 FEET	DEA – A	JANTEQ SUPERSECTOR PANEL
16	C	85 FEET	DEA – A	JANTEQ SUPERSECTOR PANEL
17	C	72 FEET	SIMPLY BITS – C	PMP450 RADIO AND PANEL
18	C	70 FEET	SIMPLY BITS – C	PMP450 RADIO AND PANEL
19	C	45 FEET	N/A	MARKER LIGHT
20	C	43 FEET	N/A	MARKER LIGHT CONTROL BOX

GENERAL NOTES:

1. ANTENNA HEIGHTS ARE MEASURED FROM CENTERLINE



TOWER ORIENTATION

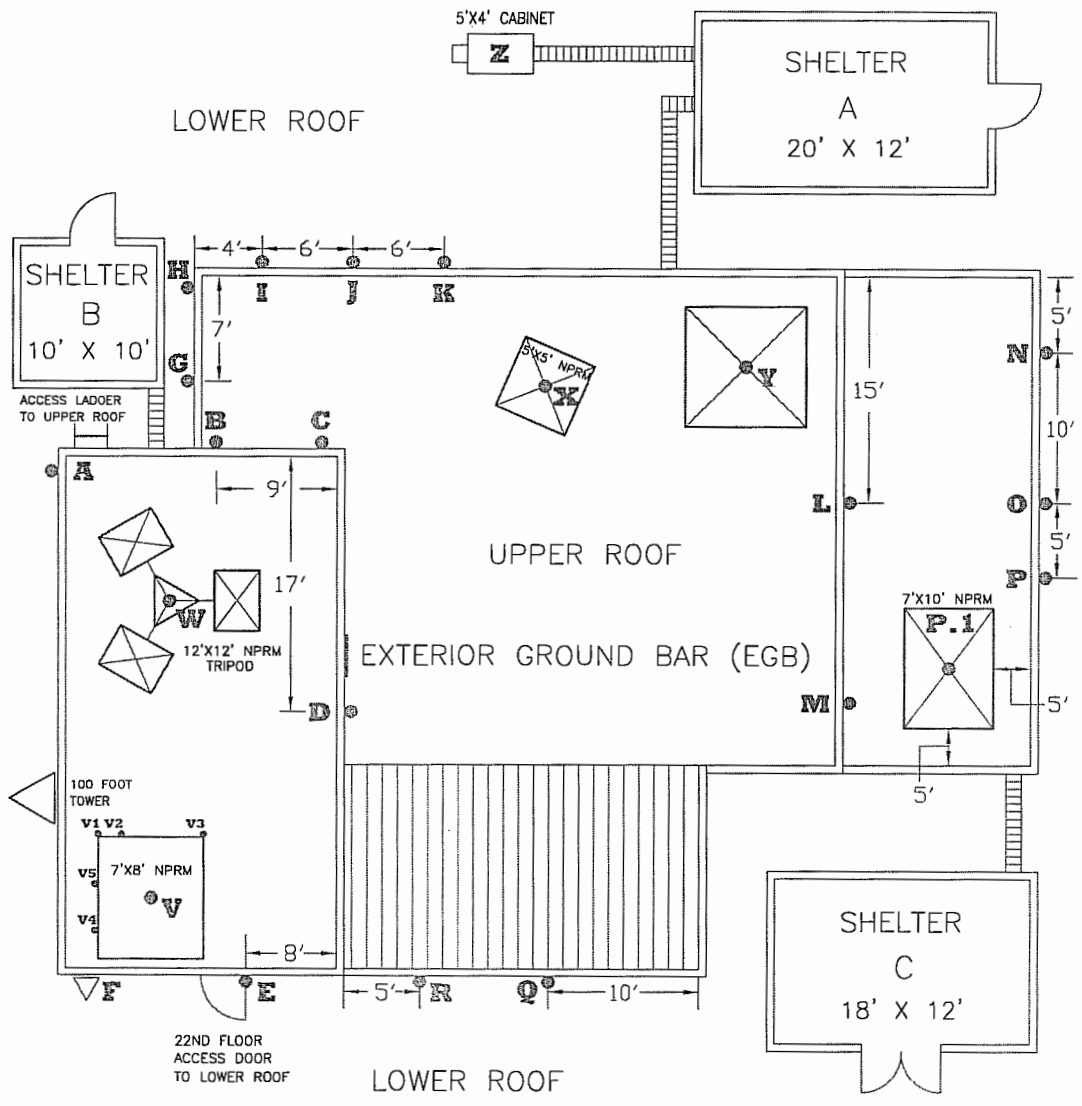
REV.	
1	11–25–2013 1ST REVISION
2	06–25–2014 ADD SPROKET @ 90' & 93' NOTE: DID NOT INSTALL
3	09–09–2014 SIMPLY BITS EQUIPMENT UPGRADE @ 95'
4	09–23–2016 ADD DEA @ 90'
5	04–11–2018 1. ADD SIMPLY BITS @ 93', 72, & 70' 2. REMOVE SPROCKET @ 45' & 48'

PIMA COUNTY INFORMATION TECHNOLOGY

TITLE:
EXHIBIT B–TOWER DRAWING
SIMPLY BITS, LLC
33 N. STONE AVENUE ROOFTOP LICENSE AGREEMENT

DRAWN BY: JH	SIZE: B	TOWER MANUFACTURER–DATE: CUSTOM–JUNE 2014	FILE NAME: BOFA TOWER REV5 041118
CHECKED BY: JH	SCALE: NONE	DATE: SEE REV BLOCK	SHEET: 1 OF 1
CHECKED BY:			

EXHIBIT C



LOC.	MOUNT	TENANT–SHELTER	DESCRIPTION
A	1.5" PIPE	SPROCKET–B	2 PMP450 PANELS/AP'S
B	4" PIPE	DAKOTAPRO–B	1 PANEL W/REFLECTOR
C	2" PIPE	VACANT	
D	2" PIPE	VACANT	
E	2" PIPE	VACANT	
F	40' TOWER	VACANT	
G	2" PIPE	VACANT	
H	4"" PIPE	DAKOTAPRO–B	3" DISH
I	1.5" PIPE	VACANT	
J	1.5" PIPE	OEM–A	PANEL
K	1.5" PIPE	SIMPLY BITS–C	2' DISH
L	1.5" PIPE	SPROCKET–B	2 PMP450 PANELS/AP'S
M	1.5" PIPE	DAKOTAPRO–B	2–24" DISHES
N	1.5" PIPE	SIMPLY BITS–C	2' DISH
O	1.5" PIPE	VACANT	
P	1.5" PIPE	OEM–A	PANEL
P.1	7'X10' NPRM 4" PIPE	DEA–A	4' DISH
Q	1.5" PIPE	OEM–A	PANEL
R	1.5" PIPE	VACANT	
V	7'X8' NPRM	DAKOTAPRO–B	SLED W/4 PIPE MOUNTS
V1	2.5" PIPE	DAKOTAPRO–B	3 PANELS W/REFLECTOR
V2	2.5" PIPE	DAKOTAPRO–B	24" DISH
V3	2.5" PIPE	DAKOTAPRO–B	3 PANELS W/REFLECTOR
V4	4" PIPE	DAKOTAPRO–B	4' DISH
V5	4" PIPE	DAKOTAPRO–B	24" DISH
W1	12'X12' NPRM TRIPOD 4" PIPE	SIMPLY BITS–C	FIBERAIR 2' DISH
W2	12'X12' NPRM TRIPOD 4" PIPE	FBI	RADIOWAVES 2' DISH
X	5'X5' NPRM 2" PIPE	VACANT	
Y	8'X8' NPRM 4" PIPE	SPROCKET–B	3' DISH & 2 PMP450 PANELS/AP'S
Z	CABINET	VACANT	

REV	
1	11–07–2013 1ST REVISION
2	06–25–2014 REMOVE SPROKET LOC'S A & L
3	10–16–2014 SIMPLY BITS UPGRADE ADD LOC'S J & K
4	03–24–15 SIMPLY BITS ADD PANEL LOCATION N
5	11–16–15 OEM INITIAL ADD PANELS LOC'S J & P & Q
6	09–23–16 DEA ADD DISH LOC'S P.1
7	02–01–17 REV TO ADD SPROCKET PANELS AT LOC'S AL NOT REMOVED IN REV 2
8	02–15–17 ADD SIMPLY BITS 1Gb
9	02–08–18 ADD FBI LOC W2

GENERAL NOTES:

1. CABLES SHALL FOLLOW CABLE PATH AND BE RUN ON BLOCKS WITH RUBBER INSULATION. CABLE SHALL BE SECURED.
2. NPRM's SHALL BE SET ON A RUBBER MAT TO PROTECT MEMBRANE.
3. ALL NPRM's SHALL BE BONDED TO THE EGB.
4. ALL MASTS WITH ACTIVE EQUIPMENT SHALL BE BONDED TO THE EGB.
5. ALL SURGE SUPRESSORS SHALL BE BONDED TO THE SHELTER EGB.
6. COORDINATE WITH COUNTY ENGINEER FOR USE OF EXISTING CABLE PATH.

SYMBOLS:

NPRM NON–PENETRATING ROOF MOUNT

NORTH

PIMA COUNTY
INFORMATION TECHNOLOGY

TITLE:
EXHIBIT C – ROOFTOP DRAWING
SIMPLY BITS, LLC
33 N. STONE AVENUE ROOFTOP LICENSE AGREEMENT

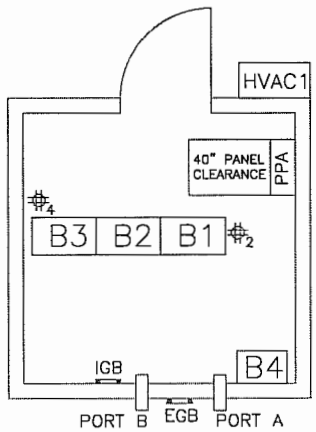
DRAWN BY: JH	SIZE: B	PROJECT NO.: NONE	FILE NAME: BOA ROOFTOP REV 9 050918 SB RENEWAL
CHECKED BY:			
CHECKED BY:	SCALE: NONE	DATE: MAY 9, 2018	SHEET: 1 OF 1

EXHIBIT D-ROOFTOP DRAWING

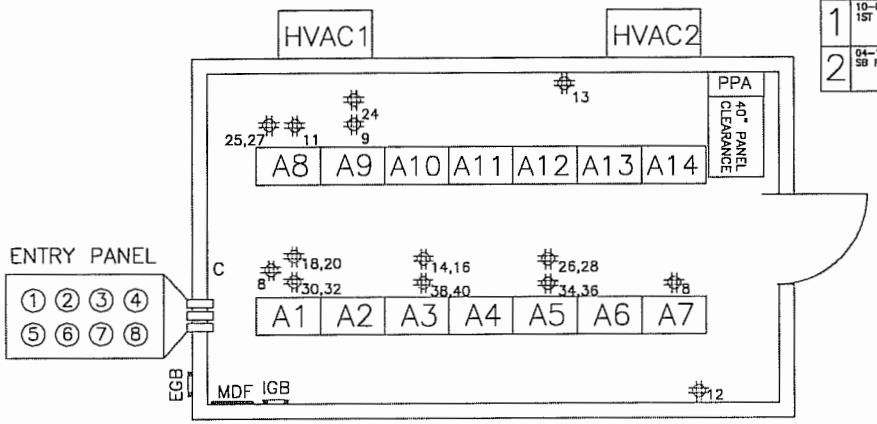
RACK	TENANT	CIRCUIT/PORT
A1	(V)	
A2	(V)	
A3	(V)	
A4	(V)	
A5	(V)	
A6	(V)	
A7	(V)	
A8	DEA	9,11/3,4,8
A9	(V)	
A10	(V)	
A11	(V)	
A12	(V)	
A13	(V)	
A14	(V)	

RACK	TENANT	CIRCUIT/PORT
B1	DAKOTAPRO	2/PORT A
B2	(V)	
B3	SPROCKET	4/PORT B
B4	DAKOTAPRO	2/PORT A

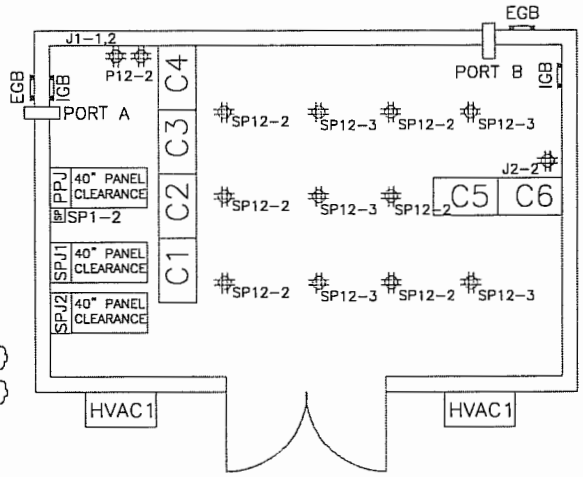
RACK	TENANT	CIRCUIT/PORT	
C1	ACTION COMM	P12-2/PORT A	
C2	ACTION COMM	J1-1,2/PORT A	
C3	ACTION COMM	J1-1,2/PORT A	
C4	ACTION COMM	J1-1,2/PORT A	
C5	SIMPLY BITS	J2-2/PORT B	REV 2
C6	SIMPLY BITS	J2-2/PORT B	REV 2



SHELTER B



SHELTER A



SHELTER C

GENERAL NOTES:
1. SUPPORT ROW A RACKS FROM LADDERWAY.
2. EACH OUTLET IS TENANT DEDICATED.
3. RACKS SHALL BE BONDED TO IGB.

SYMBOLS:
- PP — POWER PANEL
- FIRE ALARM ENUNCIATOR
- $\#_{10}$ — 20A QUADRAPLEX OUTLET W/CIRCUIT NUMBER
- MDF — TELEPHONE CLEC DEMARCATION POINT
- T — THERMOSTAT
- C — HVAC CONTROLLER
- (V) — VACANT
- EXTERIOR GROUND BAR (EGB)
- INTERIOR GROUND BAR (IGB)

REV	
1	10-02-2017 1ST REVISION
2	04-16-2018 SB RENEWAL

NORTH

PIMA COUNTY INFORMATION TECHNOLOGY

TITLE:
EXHIBIT D – SHELTER DRAWING
SIMPLY BITS, LLC
33 N. STONE AVENUE ROOFTOP LICENSE AGREEMENT

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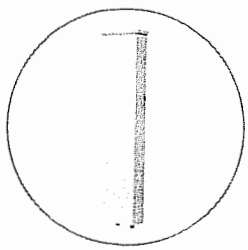
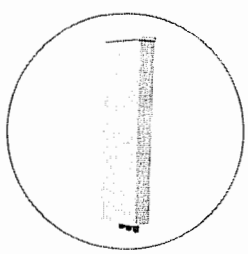
CHECKED BY:	SCALE: NONE	DATE: SEE REV BLOCK	SHEET 1 OF 1

Cambium Networks™

PMP 450 5 GHz Access Point Antenna



90 Degree Sector Antenna



60 Degree Sector Antenna

A wireless broadband communication system has many components; each one contributes to the overall performance and ultimately affects operator revenues. Well-designed components that complement each other will improve overall network performance, increase the longevity of the system and optimize operators' profits.

One of the principal considerations in a communications system is antennas. Their impact is enormous - using the wrong antenna will degrade the overall performance of an otherwise well engineered system, resulting in customer dissatisfaction.

At Cambium Networks, our antennas are engineered to address most typical network and terrain challenges and built to the highest level quality and reliability. The 5 GHz Access Point 60 and 90 degree sector antennas are specifically designed for use with the 5 GHz PMP 450 platform of products. As a result of their consistent front-to-back ratio in combination with power control and high gain, these antennas deliver optimized performance, including maximized spectral efficiency and easy installation.

Main Differentiators

» MAXIMIZED SPECTRAL EFFICIENCY enabled by the **front-to-back ratio** in the antenna portfolio in combination with **power control** provided by APs. This allows the signal from subscriber modules to arrive at the AP with the same receive power level, resulting in frequency reuse, maximized spectral efficiency in congested areas and increased subscribers with improved quality of service.

» CONSISTENT PERFORMANCE is empowered by the **null-fill** feature in the PMP 450 antennas. This capability insures the consistent coverage and performance for subscribers who are located very close and far below the AP. The balance of the energy distribution of antennas allows for a more uniform performance across the whole frequency range while guaranteeing a good signal quality for all subscribers.

» EASY INSTALLATION options offered by our antennas allow Cambium Networks' radios to simply collocate using a variety of mounting selections. As site density increases and traffic loading peaks, swapping and adding new equipment is cost-effective due to design compatibilities across product families.

Powerful Features

The **5 GHz Access Point Antenna** offers an ideal array of features - spectral efficiency, higher gain than other solutions, a capability to overcome environmental challenges and improved signal strength. This antenna provides 5 GHz multi-band flexibility.

2x2 Multiple Input and Multiple Output (MIMO) gives 5 GHz Access Point Antennas the benefits of dual stream operation for most channel conditions, provides interference mitigation by selecting the best signal quality and allows for successful deployment of wireless networks in difficult environments.

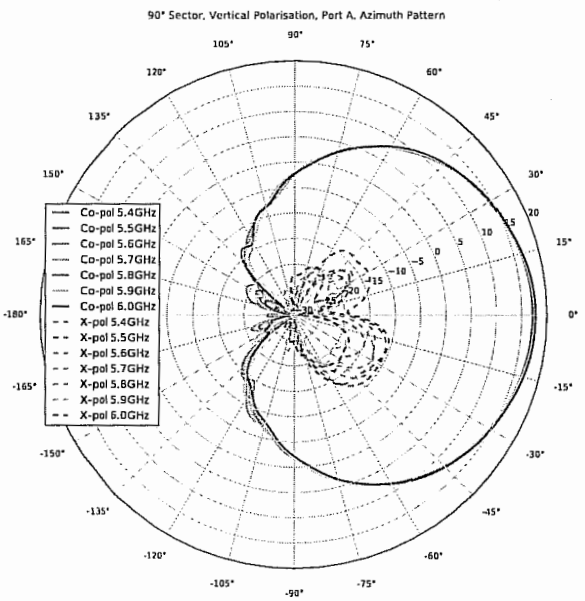
High gain directional solution used by 5 GHz Access Point Antennas effectively focuses the main 17 dBi lobe while minimizing side-lobe leakage. This targeted transmission increases capacity over other types of antennas and decreases the interference from adjacent sources, while assuring the best signal quality for customers.

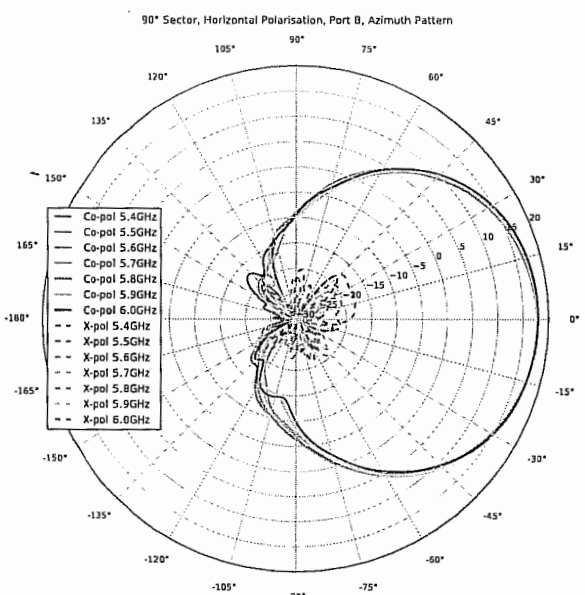
5 GHz Access Point Antennas are **outdoor-rated**. Cambium Networks perform rigorous set of environmental tests. We validate and guarantee the specifications and ensure their consistency with real life conditions.

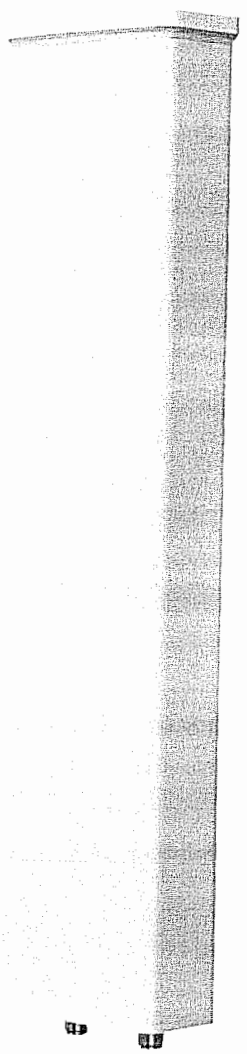
SPECIFICATIONS	85009324001	85009325001
FREQUENCY RANGE	5.4-6.0 GHz	5.4-6.0 GHz
ANTENNA TYPE	Access Point Sector	Access Point Sector
GAIN	17 dBi +1 dBi /-1 dBi	17 dBi +/- 1 dBi
VSWR	1.5:1 max	1.5:1 max
PORT TO PORT ISOLATION	33 dB	30 dB
6dB BEAMWIDTH-AZIMUTH	90°	60°
3dB BEAMWIDTH-AZIMUTH	65°	45°
3dB BEAMWIDTH-ELEVATION	6°	8°
ELEVATION NULL FILL	Down to -23°	Down to -25°
1ST NULL	-18dB min	-18dB min
2ND NULL	-33dB min	-33dB min
3RD NULL	-36dB min	-36dB min
AZIMUTH SIDELOBES	ETSI EN 302.326-3 SS2	ETSI EN 302.326-3 SS2
POLARIZATION	Dual Linear, Horizontal / Vertical	Dual Linear, Horizontal / Vertical
MAXIMUM INPUT POWER	30 W	30 W
INPUT IMPEDANCE	50 Ohms	50 Ohms
FRONT-TO-BACK RATIO	V-pol>32 dB, H-pol>35 dB	>35 dB
CROSS POLARIZATION	>28 dB	>25 dB
MECHANICAL SIZE (mm)	570h X 146w X 64d	468h X 146w X 64d
ANTENNA WEIGHT	2.9 kg (6.4 lb), w/o bracket kit	2.8 kg (6.2 lb), w/o bracket kit
MOUNTED ANT WEIGHT (w/ AP)	8.6 kg (19 lb)	8.4 kg (18.5 lb)
ANTENNA CONNECTOR	2 x N-Type Female, Straight	3 x Type N Female, Straight
WIND SURVIVAL	216 km/h (135 mph)	216 km/h (135 mph)
WIND LOADING (@216 km/h)	Front: 381 N (86 lbf) Side: 188 N (42 lbf)	Front: 318 N (72 lbf) Side: 160 N (36 lbf)
POLE MOUNTING HARDWARE	Quick Release, 1.5" TO 4.5" Dia. Pole	Quick Release, 1.5" TO 4.5" Dia. Pole
MECHANICAL DOWNTILT	0° TO 11°	0° TO 11°

90 Degree Sector Antenna - 85009324001

Azimuth Patterns

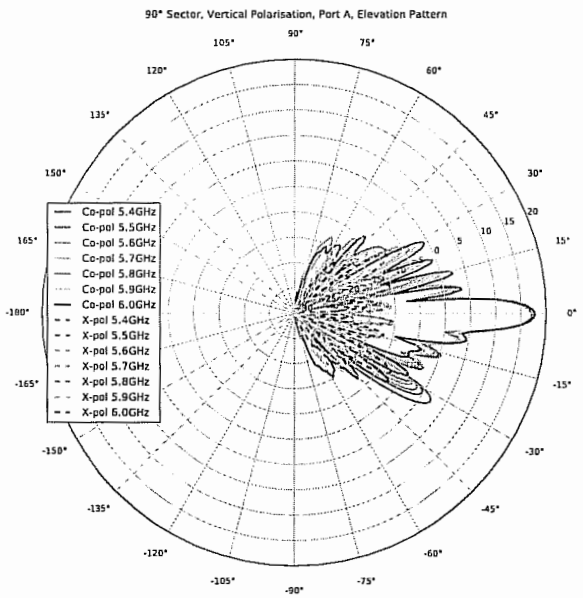


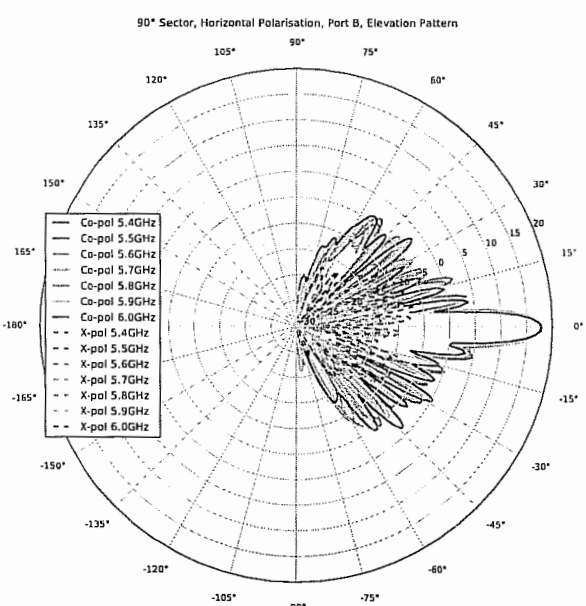


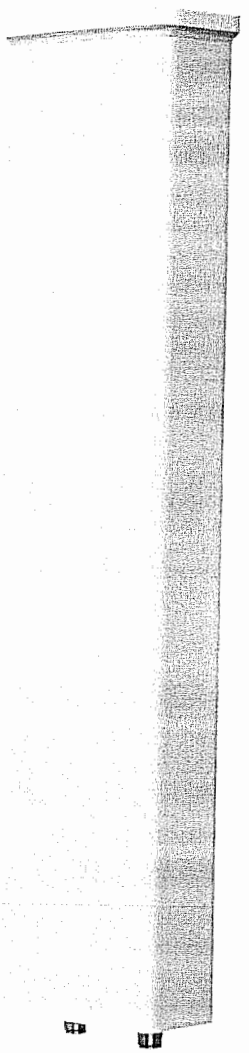


90 Degree Sector Antenna - 85009324001

Elevation Patterns



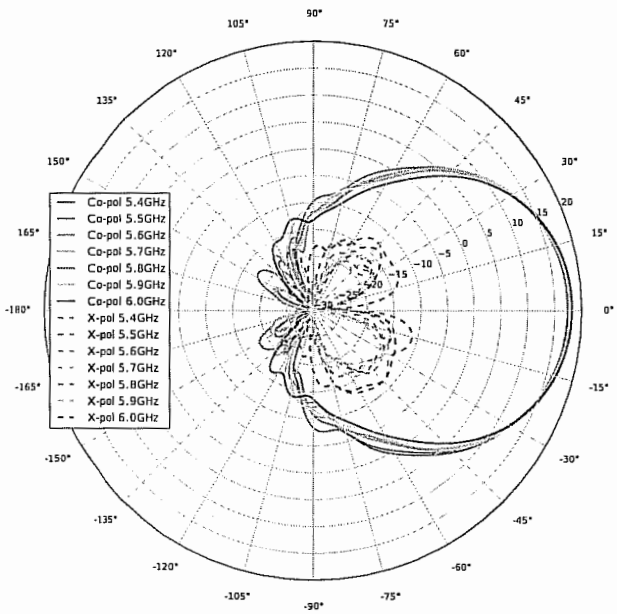




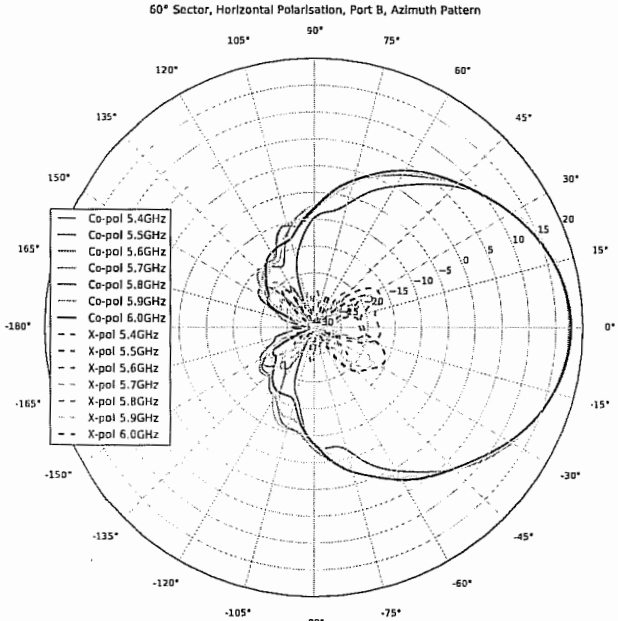
60 Degree Sector Antenna - 85009325001

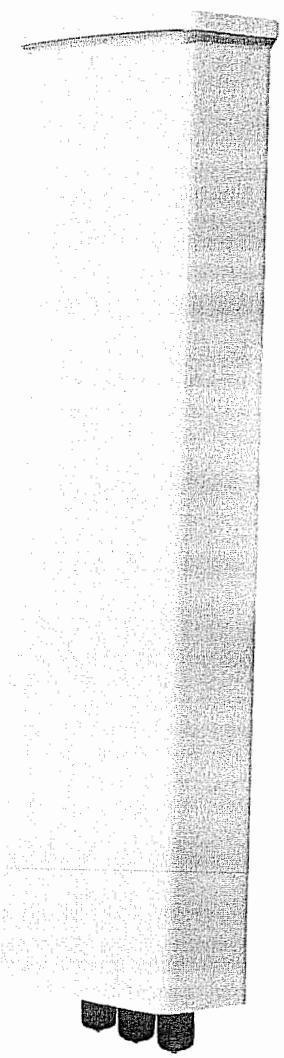
Azimuth Patterns

60° Sector, Vertical Polarisation, Port A, Azimuth Pattern



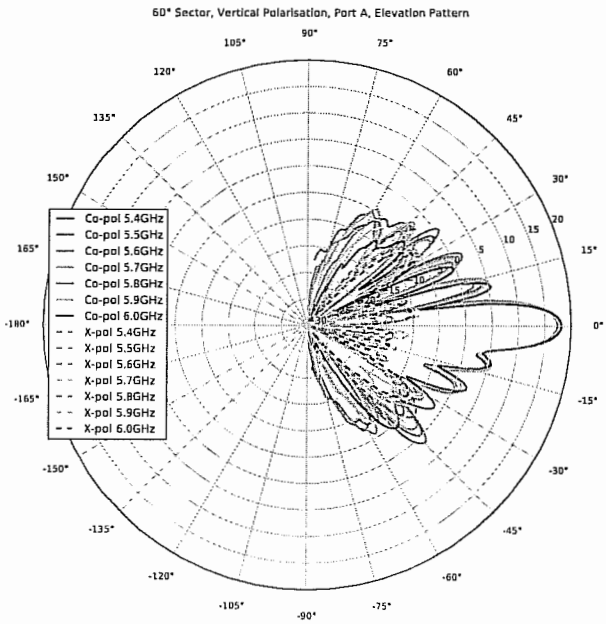
60° Sector, Horizontal Polarisation, Port B, Azimuth Pattern

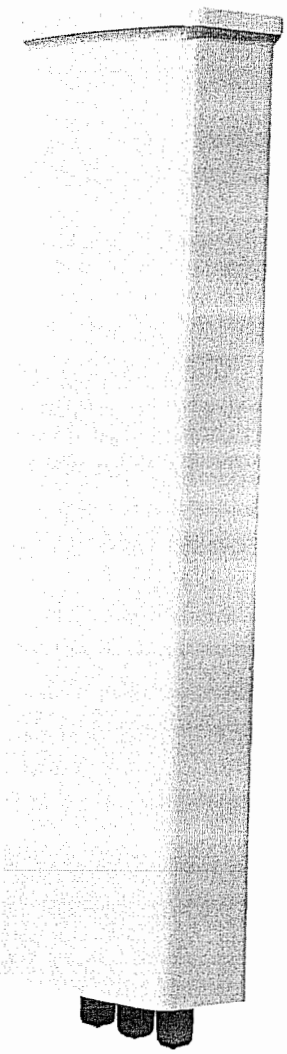


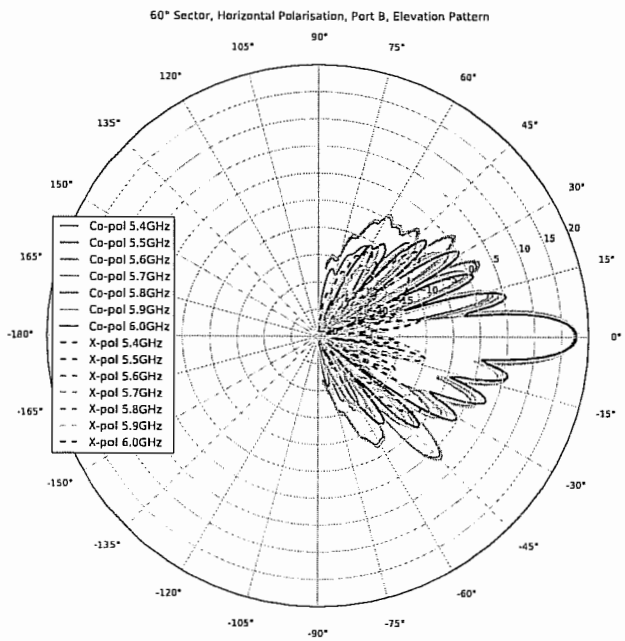


60 Degree Sector Antenna - 85009325001

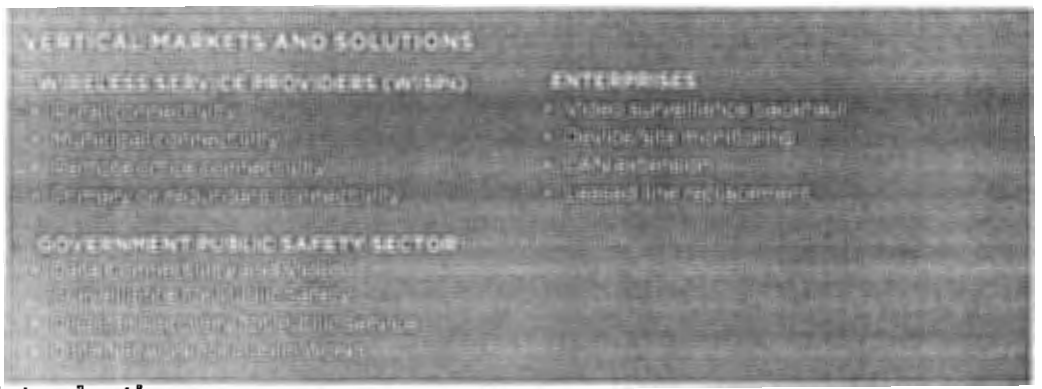
Elevation Patterns

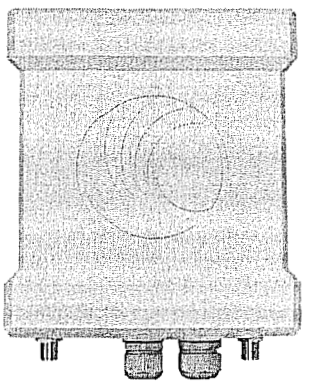






PMP 450 Access Point





PMP 450 Access Point

Introduction

The Cambium Networks PMP 450 is our industry-leading wireless access network platform. Our solution is ideal for industry verticals such as WISPs (Wireless Service Providers), Enterprises and the Government Public Safety Sector. Designed for fixed outdoor applications, the PMP 450 platform is optimized for rate, reach, reliability and throughput. It features the most resilient and effective set of wireless broadband technologies in the marketplace.

Available in most popular global bands, 2.4, 3.5 and 3.65, the Cambium Networks Point-to-Multipoint (PMP) 450 Access Point (AP) delivers a consistent and exceptionally high throughput - more than 250 Mbps per sector and more than 1.5 Gbps per tower.

From the innovative GPS Synchronization options to interoperability with existing portfolio modules, the PMP 450 provides flexible deployment options that make it an excellent fit for high capacity, high reliability networks.

Main Differentiators

» **MAXIMIZED SPECTRAL EFFICIENCY IN DENSE SERVICES AREAS** is enabled by our innovative GPS Sync Technology in combination with long range and high density coverage. This allows for configuration of more subscribers utilizing fewer access points, while preserving quality of service in spectrum-constrained environments. By lowering installation costs and maintenance, GPS Sync reduces operating expenses and improves growth and profitability.

» **OPTIMAL TRIPLE PLAY BACKHAUL** empowered by effective Quality of Service (QoS) management allows providers to confidently offer triple play services – VoIP (Voice over IP), video and data. Providing customers with excellent service ensures their continued loyalty and transforms them into advocates, helping WISPs and enterprises expand their business.

» **CARRIER-GRADE RELIABLE HARDWARE** by Cambium Networks is constructed from high quality industrial components; it is outdoor-rated and rigorously tested to satisfy the most difficult environmental conditions. With 40-year MTBF, our equipment standards are unsurpassed in industries requiring fixed wireless broadband.

Powerful Features

The Cambium Networks PMP 450 platform is designed for growth. It allows service providers to efficiently and cost-effectively offer popular multi-media services that maximize their revenue - high-speed data and cloud access, video on demand, reliable fixed voice and VoIP. The PMP 450 solution provides reliable coverage across large service areas in urban, suburban, rural and remote locations.

2x2 MIMO-OFDM technology allows dual stream operation for most channel conditions, guaranteeing successful deployment of wireless networks in challenging environments.

Low latency of 3 - 5 ms effectively supports video and VoIP services. **Flexible channel width** (from 5 to 40 MHz) allows users to select the most effective channel width for the current network environment. **256-QAM** modulation rate offers the unique ability to use the PMP 450 platform for services requiring fast and reliable transmission. **System performance** is ensured by vigorous testing with a com-patible set of radios, guaranteeing predictable link budget results. Cambium Networks specifications are consistent with real life conditions.

Specifications

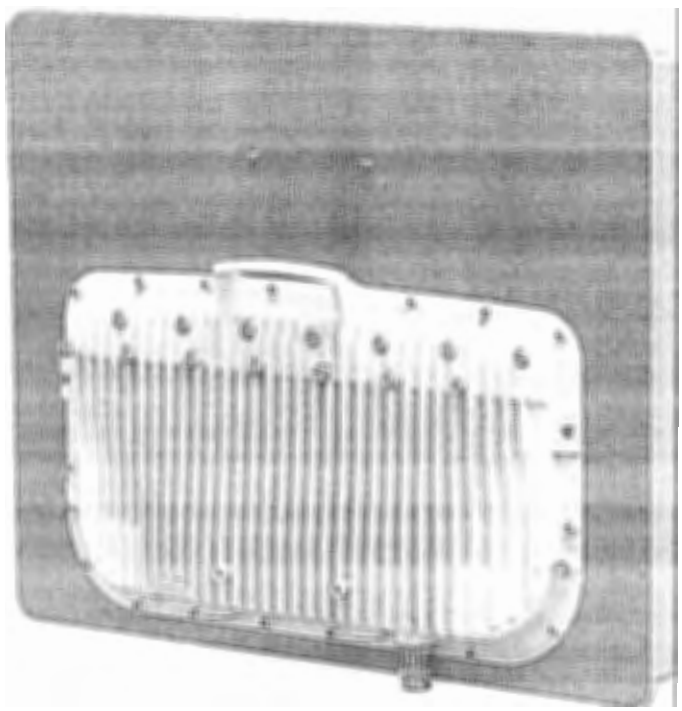
PRODUCT		
MODEL NUMBERS	**PMP 450 ACCESS POINT** C024045A001A, C024045A003A (2.4 GHz) C035045A001A, C035045A003A (3.3 – 3.6 GHz) C036045A001A, C036045A003A (3.55 – 3.8 GHz)	**PMP 450 ACCESS POINT LITE** C024045A011A (2.4 GHz) C034045A011A (3.3 - 3.6 GHz) C036045A011A (3.55 – 3.8 GHz) C000045K008A PMP 450 AP LITE UPGRADE KEY
SPECTRUM		
FREQUENCY RANGE	2400 - 2483.5 MHz	3300 – 3600 MHz 3550 – 3800 MHz
CHANNEL WIDTH	5 MHz, 10 MHz, 15 MHz, 20 MHz, 30 MHz or 40 MHz	5 MHz, 7 MHz, 10 MHz, 15 MHz, 20 MHz, 30 MHz or 40 MHz
CHANNEL SPACING	Selectable on 2.5 MHz increments	Configurable to 50 KHz

INTERFACE		
MAC (MEDIA ACCESS CONTROL) LAYER	Cambium Networks proprietary	
PHYSICAL LAYER	2x2 MIMO OFDM	
ETHERNET INTERFACE	10/100/1000BaseT, half/full duplex, rate auto negotiated (802.3 compliant)	
PROTOCOLS USED	IPv4, UDP, TCP, IP, ICMP, Telnet, SNMP, HTTP, FTP	
NETWORK MANAGEMENT	HTTP, HTTPS, Telnet, FTP, SNMP v3 (add line between this & v LAN)	
VLAN	802.1ad (DVLAN Q-inQ), 802.1Q with 802.1p priority, dynamic port VID	
PERFORMANCE		
SUBSCRIBERS PER SECTOR	UP TO 238	
ARQ	YES	
MODULATION LEVELS (ADAPTIVE)	MODULATION	SIGNAL TO NOISE REQUIRED (SNR, IN dB)
2X	QPSK	10
4X	16-QAM	17
6X	64-QAM	24
8X	256-QAM	32
MODULATION MODES (DYNNAMIC)	Dual Payload (higher throughput) MIMO-B or Single Payload (polarity diversity) MIMO-A	
MAXIMUM DEPLOYMENT RANGE	Up to 40 miles	
LATENCY	3 - 5 ms, typical	
GPS SYNCHRONIZATION	Yes, via Autosync (CMM3, CMM4, uGPS, iGPS)	
QUALITY OF SERVICE	Diffserv QoS	
LINK BUDGET		
ANTENNA BEAM WIDTH (SEE ANTENNA SPEC SHEET FOR MORE DETAIL & RPE)	2.4 GHz - 60° Sector (Dual Slant) 3 GHz - 90° Sector (Dual Slant)	
TRANSMIT POWER RANGE	-30 TO +22 dBm (combined, to EIRP limit by region) (1 dB interval) (+25 dBm FOR 3 GHz)	
ANTENNA GAIN	2.4 GHz - 17 dBi Dual Slant (Sector Antenna available for 60°) 3 GHz – 17 dBi Dual Slant (Sector Antenna available for 90°)	
MAXIMUM TRANSMIT POWER	+22 dBm combined (+25 dBm combined for 3 GHz)	

PHYSICAL	
ANTENNA CONNECTION	50 ohm, N-type
SURGE SUPPRESSION	IEC 61000-4-2 (ESD) 15kV (AIR), 8kV (contact) IEC 61000-4-4 (EFT) 40A (5/50 ns) IEC 61000-4-5 (Lightning) 25A (8/20 μs)
MEAN TIME BETWEEN FAILURE	> 40 Years
ENVIRONMENTAL	IP67, IP66
TEMPERATURE	-40°C TO +60°C (-40°F TO +140°F), 0-95% non-condensing
WEIGHT	2.5 kg (5.5 lbs)
DIMENSIONS (HxWxD)	27 x 21 x 7 cm (10.6" x 8.3" x 2.8")
TYPICAL POWER CONSUMPTION	11 W (2.4 GHz), 12 W (3 GHz)
MAXIMUM POWER CONSUMPTION	14 W (2.4 GHz), 15 W (3 GHz)
INPUT VOLTAGE	22 to 32 VDC
SECURITY	
ENCRYPTION	56-bit DES, FIPS-197 128-bit AES
CERTIFICATIONS	
INDUSTRY CANADA	109W-0004 (2.4 GHz) 109W-0008 (3.5 GHZ) 109W-0010 (3.65 GHz)
FCC ID	Z8H89FT0004 (2.4 GHz) Z8H89FT0010 (3.65 GHz)
CE	EN 302 326-2 V1.2.2 (3 GHz) EN 302 326-3 V1.3.1 (3 GHz)

PMP 450m Access Point

Cambium Networks industry-leading 450 platform adds Multi-User MIMO capability with *cn*Medusa™ technology.



Key Features:

- ***cn*Medusa™ technology** enhances sector capacity by combining a smart beamforming antenna array with multiple RF transmit and receive chains, effectively multiplying available capacity by more than three times.
- Capable of throughput of **over 550 Mbps** in a 20 MHz channel, and **more than 1 Gigabit per second** per sector when using a 40 MHz channel*.
- Multi-User MIMO more effectively uses available spectrum by simultaneous transmissions to multiple subscribers, increasing **spectral efficiency** to more than 40 bps/Hz.
- **Protect your investment** in the 450 platform equipment by continuing to utilize existing Subscriber Modules (both 450 and 450i SMs work with the 450m and cnMedusa technology, even prior generation 430 will connect)
- Dramatically reduce the effect of interference with **smart beamforming**
- **SFP** port allows for greater deployment flexibility, and AUX port allows for connection of camera or other PoE directly.
- The **Limited Version** can reduce capital investment until additional capacity is actually required. A 30-day trial of MU-MIMO operation is included, and a simple license key can permanently enable MU-MIMO operation when needed.

cnMedusa

WISPA 2017 Product of the Year

PRODUCT						
		RoW	US	EU	DES only	IC
Model Numbers	Integrated 90 degree sector	C050045A101A	C050045A102A	C050045A103A	C050045A104A	C050045A105A
	Limited Version	C050045A111A	C050045A112A	C050045A113A	C050045A114A	C050045A115A
SPECTRUM						
Channel Spacing	Configurable to 2.5 MHz channel spacing					
Frequency Range	5150-5925 MHz					
Channel Width	5, 10, 15, 20, 30* and 40* MHz					

INTERFACE

MAC (Media Access Control) Layer	Cambium Networks proprietary
Physical Layer	14x14 Multi-User MIMO OFDM
Ethernet Interface	100/1000BaseT, full duplex, rate auto negotiated (802.3 compliant), SFP support up to 2.5G BiDi
Protocols Used	IPv4, UDP, TCP, IP, ICMP, Telnet, SNMP, HTTP, FTP
Network Management	HTTP, HTTPS, Telnet, FTP, SNMP v3
VLAN	802.1ad (DVLAN Q-inQ), 802.1Q with 802.1p priority, dynamic port VID

PERFORMANCE

Subscriber Per Sector	Up to 238	
ARQ	Yes	
Modulation Levels (Adaptive)	MCS	Signal to Noise Required (SNR, in dB)
2X	QPSK	10
4X	16QAM	17
6X	64QAM	24
8X	256QAM	32
Maximum Deployment Range	Up to 40 miles (64 km)	
Latency	10 ms, typical	
GPS Synchronization	Yes, via Autosync (CMM5 or UGPS)	
Quality of Service	Diffserv QoS	

LINK BUDGET

Antenna Beam Width (Azimuth)	90° integrated sector (dual polarity, H+V)
Antenna Beam Width (Elevation)	2° Electrical Downtilt, 8° Elevation (with Null Fill)
Maximum EIRP	+42 dBm (or up to maximum allowed by regulation)

PHYSICAL

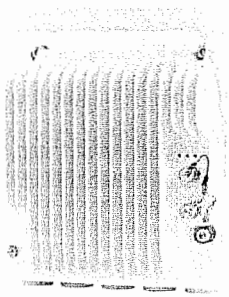
Antenna Connection	Integrated Sector Array	
Surge Suppression (with LPU)	EN61000-4-5: 1.2us/50us, 500 V voltage waveform Recommended external surge suppressor: Cambium Networks Model # C000065L007B	
Mean Time Between Failure	> 40 Years	
Environmental	IP67, IP66	
Temperature / Humidity	-40°C to +60°C (-40°F to +140°F), 0-95% non-condensing	
Weight	Integrated	Approx. 14.2 kg (31 lbs)
Wind Survival	124 mph / 200 kph	
Wind Loading - Front Facing	@ 90 mph / 144 kph	376N
	@ 110 mph / 177 kph	562 N
	@ 124 mph / 200 kph	780 N
Dimensions (HxWxD)	Integrated	52 x 65 x 11 cm (20.3" x 25.7" x 4.4")
Power Consumption	70 W typical, 80 W peak (up to 110 W max with AUX port PoE enabled)	
Input Voltage	42.5-59 V DC	
Mounting	Pole mount with included brackets	

SECURITY	
Encryption	FIPS-197 128-bit AES , 256-bit AES*
CERTIFICATIONS	
Industry Canada (ISEDC)	109A0-50450M (5.1, 5.2, 5.4, 5.8 GHz)
FCC ID	QWP-50450M (5.1, 5.2, 5.4, 5.8 GHz)
CE	EN 301 893 v1.8.1 + EN 301 893 v2.1.1 Clause 4.8 (5.4GHz)
	EN 302 502 v2.1.1 (5.8 GHz)

* Indicates Future Software Release

Cambium Networks™

PTP 820C Licensed Microwave Radio



All-Outdoor / Multi-Core

Specifications

RADIO

- 6-38 GHz
- 1+0 to 4+0, 1+1/2+2 HSB, E/W, 1+0 SD, 2+2 SD

Radio Features

- Multi-Carrier Adaptive Bandwidth Control (up to 2+0)
- Protection: 1+1/2+2 HSB
- QPSK to 2048 QAM w/ACM
- XPIC
- 2x2 / 4x4 MIMO
- Advanced Frequency Reuse (AFR)

ETHERNET

Ethernet Interfaces

- Traffic Interfaces – 1 x 10/100/1000Base-T (RJ-45) and 1x1000base-X (SFP) or 10/100/1000 Base-T (electrical SFP)
- Management Interface - 1 x 10/100 Base-T (RJ-45)
- Optical SFP Types - Optical 1000Base-LX (1310 nm) or SX (850nm)
  Note: SFP devices must be of industrial grade (-40°C to +85°C)

Ethernet Features

- MTU – 9600 Bytes
- Quality of Service
  - Multiple Classification criteria (VLAN ID, p-bits, IPv4, DSCP, IPv6 TC, MPLS EXP)
  - 8 priority queues
  - Deep buffering (configurable up to 64 Mbit per queue)
  - WRED
  - Hierarchical QoS – high service granularity*
  - P-bit marking/remarking
- 4K VLANs
- VLAN add/remove/translate
- Frame Cut Through – controlled latency and PDV for delay sensitive applications
- Header De-Duplication – Capacity boosting by eliminating inefficiency in all layers (L2, MPLS, L3, L4, Tunneling – GTP for LTE, GRE)
- Adaptive Bandwidth Notification (ABN)
- Network Resiliency - G.8032 and Multiple Spanning Tree Protocol (MSTP)*
- Ethernet OAM – ITU-T Y.1731 FM, ITU-T Y.1731 PM*

SYNCHRONIZATION

Synchronization Distribution

- Sync Distribution over any traffic interface (GE/FE)
- Sync-E (ITU-T G.8261, G.8262)
- SSM/ESMC Support for ring/mesh applications (ITU-T G.8264)
- Sync-E Regenerator mode, providing PRC grade (ITU-T G.811) performance for smart pipe applications.

IEEE-1588

- Optimized Transport for reduced PDV
- IEEE-1588 TC

STANDARD

MEF

- Carrier Ethernet 2.0 (CE 2.0)**

Supported Ethernet Standards

- 10/100/1000base-T/X (IEEE 802.3)
- Ethernet VLANs (IEEE 802.3ac)
- Virtual LAN (VLAN, IEEE 802.1Q)
- Class of service (IEEE 802.1p)
- Provider bridges (Q-in-Q – IEEE 802.1ad)
- Link aggregation (IEEE 802.3ad)
- Auto MDI/MDIX for 1000baseT
- RFC 1349: IPv4 TOS
- RFC 2474: IPv4 DSCP
- RFC 2460: IPv6 Traffic Classes

Security

- AES 256-bit Encryption
- Secured protocols (HTTPS, SNMPV3, SSH, SFTP)
- Radius authentication and authorization

Standards Compliance

- EMC: EN 301 489-1, EN 301 489-4, Class B (Europe), FCC 47 CFR, part 15, class B (US), ICES-003, Class B (Canada), TEC/EMI/TEL-001/01, Class B (India)
- Surge: EN61000-4-5, Class 4 (for PWR and ETH1/PoE ports)
- Safety: EN 60950-1, IEC 60950-1, UL 60950-1, CSA-C22.2 No.60950-1, EN 60950-22, UL 60950-22, CSAC22.2.60950-22
- Ingress Protection: IP66-compliant
- Storage: ETSI EN 300 019-1-1 Class 1.2
- Transportation: ETSI EN 300 019-1-2 Class 2.3

TECHNICAL SPECIFICATION

Mechanical Specifications

- Dimensions: 230mm(H), 233mm(W), 98mm(D), 6.5kg
- Pole Diameter Range (for Remote Mount Installation): 8.89 cm – 11.43 cm

Environmental Specifications

- -33°C to +55°C (-45°C to +60°C extended)

Power Input Specifications

- Standard Input: -48 VDC
- IDU DC Input range: -40 to -60 VDC

Power Consumption Specifications

- Maximum Power Consumption (2+0 Operation) 6 GHz: 65W; 7 GHz: 75W; 11 GHz: 65W; 13-15 GHz: 55W; 18-24 GHz: 48W; 26-38 GHz: 55W

PoE Injector Mechanical Specifications

- Dimensions – 134mm(H), 190mm(W), 62mm(D), 1 kg

PoE Injector Environmental Specifications

- 33°C to +55°C (-45°C to +60°C extended)

PoE Injector Power Input Specifications

- Standard Input: -48 or +24 VDC (Optional)
- DC Input range: ±(18/40.5 to 60) VDC (+18VDC extended range is supported as part of the nominal +24VDC support)

PoE Injector Interfaces

- GbE Data Port supporting 10/100/1000Base-T
- Power-Over-Ethernet (PoE) Port
- DC Power Port –40V to -60V (a PoE supporting two redundant DC feeds each supporting ±(18-60)V is available)

* Planned for future release.
** Certification pending.

Specifications

TRANSMIT POWER

	Frequency (GHz)									
Transmit Power (dBm)	6	7	8	10-11	13-15	18	23	24 UL HP	26	28-38
QPSK	28	28	28	26	24	22	20	18	21	18
8 PSK	28	28	28	26	24	22	20	18	21	18
16 QAM	28	27	27	26	23	21	20	18	20	17
32 QAM	27	26	26	25	22	20	20	18	19	16
64 QAM	27	26	26	25	22	20	20	18	19	16
128 QAM	27	26	26	25	22	20	20	18	19	16
256 QAM	27	26	24	25	20	20	18	16	17	14
512 QAM	25	24	24	24	20	18	18	16	17	14
1024 QAM	25	24	24	23	20	18	17	15	16	13
2048 QAM	23	22	22	21	18	16	16	14	15	12

RECEIVE SENSITIVITY

		Frequency (GHz)													
Modulation	Channel Spacing	6	7	8	10	11	13	15	18	23	24	26	28-31	32	38
QPSK	3.5 & 5 MHz	-96.5	-96.0	-96.0	-95.5	-96.5	-95.5	-94.5	-96.0	-95.0	-94.5	-94.5	-94.5	-94.0	-94.0
16 QAM		-90.0	-89.0	-89.0	-89.0	-89.5	-88.5	-88.0	-89.0	-88.0	-87.5	-88.0	-87.5	-87.5	-87.0
32 QAM		-86.5	-85.5	-85.5	-85.5	-86.0	-85.0	-84.5	-85.5	-84.5	-84.0	-84.5	-84.0	-84.0	-83.5
64 QAM		-83.0	-82.5	-82.5	-82.0	-83.0	-82.0	-81.0	-82.5	-81.5	-81.0	-81.0	-81.0	-80.5	-80.5
128 QAM		-79.5	-79.0	-79.0	-78.5	-79.5	-78.5	-77.5	-79.0	-78.0	-77.5	-77.5	-77.5	-77.0	-77.0
256 QAM		-76.5	-75.5	-75.5	-75.5	-76.5	-75.0	-74.5	-75.5	-75.0	-74.5	-74.5	-74.0	-74.0	-73.5
QPSK	7 MHz	-93.5	-93.0	-93.0	-92.5	-93.5	-92.5	-91.5	-93.0	-92.0	-91.5	-91.5	-91.5	-91.0	-91.0
8 PSK		-87.5	-87.0	-87.0	-86.5	-87.5	-86.5	-85.5	-87.0	-86.0	-85.5	-85.5	-85.5	-85.0	-85.0
16 QAM		-87.0	-86.5	-86.5	-86.0	-87.0	-86.0	-85.0	-86.5	-85.5	-85.0	-85.0	-85.0	-84.5	-84.5
32 QAM		-83.5	-83.0	-83.0	-82.5	-83.5	-82.5	-81.5	-83.0	-82.0	-81.5	-81.5	-81.5	-81.0	-81.0
64 QAM		-80.5	-80.0	-80.0	-79.5	-80.5	-79.5	-78.5	-80.0	-79.0	-78.5	-78.5	-78.5	-78.0	-78.0
128 QAM		-77.5	-76.5	-76.5	-76.5	-77.5	-76.0	-75.5	-76.5	-76.0	-75.5	-75.5	-75.0	-75.0	-74.5
256 QAM		-74.0	-73.5	-73.5	-73.0	-74.0	-73.0	-72.0	-73.5	-72.5	-72.0	-72.0	-72.0	-71.5	-71.5
512 QAM		-72.0	-71.5	-71.5	-71.0	-72.0	-71.0	-70.0	-71.5	-70.5	-70.0	-70.0	-70.0	-69.5	-69.5
1024 QAM (strong FEC)		-68.5	-68.0	-68.0	-67.5	-68.5	-67.5	-66.5	-68.0	-67.0	-66.5	-66.5	-66.5	-66.0	-66.0
1024 QAM (light FEC)		-68.0	-67.0	-67.0	-67.0	-67.5	-66.5	-66.0	-67.0	-66.0	-65.5	-66.0	-65.5	-65.5	-65.0
QPSK	10 MHz	-92.0	-91.5	-91.5	-91.0	-92.0	-91.0	-90.0	-91.5	-90.5	-87.0	-90.0	-90.0	-89.5	-89.0
8 PSK		-87.0	-86.0	-86.0	-86.0	-87.0	-85.5	-85.0	-86.0	-85.5	-81.5	-85.0	-84.5	-84.5	-84.0
16 QAM		-85.5	-85.0	-85.0	-84.5	-85.5	-84.5	-83.5	-85.0	-84.0	-80.5	-83.5	-83.5	-83.0	-82.5
32 QAM		-82.0	-81.5	-81.5	-81.0	-82.0	-81.0	-80.0	-81.5	-80.5	-77.0	-80.0	-80.0	-79.5	-79.0
64 QAM		-79.0	-78.5	-78.5	-78.0	-79.0	-77.5	-77.0	-78.5	-77.5	-74.0	-77.0	-77.0	-76.5	-76.0
128 QAM		-75.5	-75.0	-75.0	-74.5	-75.5	-74.5	-73.5	-75.0	-74.0	-70.5	-73.5	-73.5	-73.0	-72.5
256 QAM		-72.5	-72.0	-72.0	-71.5	-72.5	-71.5	-70.5	-72.0	-71.0	-67.5	-70.5	-70.5	-70.0	-69.5
512 QAM		-70.0	-69.5	-69.5	-69.0	-70.0	-68.5	-68.0	-69.5	-68.5	-65.0	-68.0	-68.0	-67.5	-67.0
1024 QAM (strong FEC)		-67.0	-66.5	-66.5	-66.0	-67.0	-66.0	-65.0	-66.5	-65.5	-62.0	-65.0	-65.0	-64.5	-64.0
1024 QAM (light FEC)		-66.5	-65.5	-65.5	-65.5	-66.5	-65.0	-64.5	-65.5	-65.0	-61.0	-64.5	-64.0	-64.0	-63.5
QPSK	14 MHz	-90.5	-90.0	-90.0	-89.5	-90.5	-89.5	-88.5	-90.0	-89.0	-88.5	-88.5	-88.5	-88.0	-88.0
8 PSK		-84.5	-84.0	-84.0	-83.5	-84.5	-83.5	-82.5	-84.0	-83.0	-82.5	-82.5	-82.5	-82.0	-82.0
16 QAM		-83.5	-83.0	-83.0	-82.5	-83.5	-82.5	-81.5	-83.0	-82.0	-81.5	-81.5	-81.5	-81.0	-81.0
32 QAM		-80.5	-79.5	-79.5	-79.5	-80.5	-79.0	-78.5	-79.5	-79.0	-78.5	-78.5	-78.0	-78.0	-77.5
64 QAM		-77.5	-76.5	-76.5	-76.5	-77.5	-76.0	-75.5	-76.5	-76.0	-75.5	-75.5	-75.0	-75.0	-74.5
128 QAM		-74.0	-73.5	-73.5	-73.0	-74.0	-73.0	-72.0	-73.5	-72.5	-72.0	-72.0	-72.0	-71.5	-71.5

		Frequency (GHz)													
Modulation	Channel Spacing	6	7	8	10	11	13	15	18	23	24	26	28-31	32	38
256 QAM	14 MHz	-71.5	-70.5	-70.5	-70.5	-71.0	-70.0	-69.5	-70.5	-69.5	-69.0	-69.5	-69.0	-69.0	-68.5
512 QAM		-68.5	-68.0	-68.0	-67.5	-68.5	-67.5	-66.5	-68.0	-67.0	-66.5	-66.5	-66.5	-66.0	-66.0
1024 QAM (strong FEC)		-65.5	-65.0	-65.0	-64.5	-65.5	-64.5	-63.5	-65.0	-64.0	-63.5	-63.5	-63.5	-63.0	-63.0
1024 QAM (light FEC)		-65.0	-64.0	-64.0	-64.0	-65.0	-63.5	-63.0	-64.0	-63.5	-63.0	-63.0	-62.5	-62.5	-62.0
QPSK	20 MHz	-89.0	-88.5	-88.5	-88.0	-89.0	-88.0	-87.0	-88.5	-87.5	-84.0	-87.0	-87.0	-86.5	-86.0
8 PSK		-84.0	-83.5	-83.5	-83.0	-84.0	-83.0	-82.0	-83.5	-82.5	-79.0	-82.0	-82.0	-81.5	-81.0
16 QAM		-82.5	-82.0	-82.0	-81.5	-82.5	-81.0	-80.5	-82.0	-81.0	-77.5	-80.5	-80.5	-80.0	-79.5
32 QAM		-79.0	-78.5	-78.5	-78.0	-79.0	-77.5	-77.0	-78.5	-77.5	-74.0	-77.0	-77.0	-76.5	-76.0
64 QAM		-76.0	-75.0	-75.0	-75.0	-76.0	-74.5	-74.0	-75.0	-74.5	-70.5	-74.0	-73.5	-73.5	-73.0
128 QAM		-73.0	-72.0	-72.0	-72.0	-73.0	-71.5	-71.0	-72.0	-71.5	-67.5	-71.0	-70.5	-70.5	-70.0
256 QAM		-70.0	-69.5	-69.5	-69.0	-70.0	-68.5	-68.0	-69.5	-68.5	-65.0	-68.0	-68.0	-67.5	-67.0
512 QAM		-67.5	-66.5	-66.5	-66.5	-67.5	-66.0	-65.5	-66.5	-66.0	-62.0	-65.5	-65.0	-65.0	-64.5
1024 QAM (strong FEC)		-64.5	-63.5	-63.5	-63.5	-64.5	-63.0	-62.5	-63.5	-63.0	-59.0	-62.5	-62.0	-62.0	-61.5
1024 QAM (light FEC)		-63.5	-63.0	-63.0	-62.5	-63.5	-62.5	-61.5	-63.0	-62.0	-58.5	-61.5	-61.5	-61.0	-60.5
2048 QAM		-60.0	-59.5	-59.5	-59.0	-60.0	-59.0	-58.0	-59.5	-58.5	-55.0	-58.0	-58.0	-57.5	-57.0
QPSK	25MHz	-87.5	-86.5	-86.5	-86.5	-87.0	-86.0	-85.5	-86.5	-85.5	-82.0	-85.5	-85.0	-85.0	-84.0
8 PSK		-82.5	-82.0	-82.0	-81.5	-82.5	-81.5	-80.5	-82.0	-81.0	-77.5	-80.5	-80.5	-80.0	-79.5
16 QAM		-80.5	-80.0	-80.0	-79.5	-80.5	-79.5	-78.5	-80.0	-79.0	-75.5	-78.5	-78.5	-78.0	-77.5
32 QAM		-77.5	-77.0	-77.0	-76.5	-77.5	-76.0	-75.5	-77.0	-76.0	-72.5	-75.5	-75.5	-75.0	-74.5
64 QAM		-74.5	-74.0	-74.0	-73.5	-74.5	-73.5	-72.5	-74.0	-73.0	-69.5	-72.5	-72.5	-72.0	-71.5
128 QAM		-71.5	-71.0	-71.0	-70.5	-71.5	-70.5	-69.5	-71.0	-70.0	-66.5	-69.5	-69.5	-69.0	-68.5
256 QAM		-68.5	-67.5	-67.5	-67.5	-68.5	-67.0	-66.5	-67.5	-67.0	-63.0	-66.5	-66.0	-66.0	-65.5
512 QAM		-66.0	-65.0	-65.0	-65.0	-66.0	-64.5	-64.0	-65.0	-64.5	-60.5	-64.0	-63.5	-63.5	-63.0
1024 QAM (strong FEC)		-63.0	-62.5	-62.5	-62.0	-63.0	-61.5	-61.0	-62.5	-61.5	-58.0	-61.0	-61.0	-60.5	-60.0
1024 QAM (light FEC)		-62.5	-61.5	-61.5	-61.5	-62.5	-61.0	-60.5	-61.5	-61.0	-57.0	-60.5	-60.0	-60.0	-59.5
2048 QAM		-58.5	-58.0	-58.0	-57.5	-58.5	-57.0	-56.5	-58.0	-57.0	-53.5	-56.5	-56.5	-56.0	-55.5
QPSK	28 MHz ACCP	-87.5	-87.0	-87.0	-86.5	-87.5	-86.5	-85.5	-87.0	-86.0	-85.5	-85.5	-85.5	-85.0	-85.0
8 PSK		-83.0	-82.5	-82.5	-82.0	-83.0	-82.0	-81.0	-82.5	-81.5	-81.0	-81.0	-81.0	-80.5	-80.5
16 QAM		-81.0	-80.5	-80.5	-80.0	-81.0	-79.5	-79.0	-80.5	-79.5	-79.0	-79.0	-79.0	-78.5	-78.0
32 QAM		-77.5	-77.0	-77.0	-76.5	-77.5	-76.0	-75.5	-77.0	-76.0	-75.5	-75.5	-75.5	-75.0	-74.5
64 QAM		-74.5	-74.0	-74.0	-73.5	-74.5	-73.0	-72.5	-74.0	-73.0	-72.5	-72.5	-72.5	-72.0	-71.5
128 QAM		-71.5	-70.5	-70.5	-70.5	-71.0	-70.0	-69.5	-70.5	-69.5	-69.0	-69.5	-69.0	-69.0	-68.5
256 QAM		-68.5	-67.5	-67.5	-67.5	-68.0	-67.0	-66.5	-67.5	-66.5	-66.0	-66.5	-66.0	-66.0	-65.5
512 QAM		-66.0	-65.0	-65.0	-65.0	-66.0	-64.5	-64.0	-65.0	-64.5	-64.0	-64.0	-63.5	-63.5	-63.0
1024 QAM (strong FEC)		-63.0	-62.5	-62.5	-62.0	-63.0	-61.5	-61.0	-62.5	-61.5	-61.0	-61.0	-61.0	-60.5	-60.0
1024 QAM (light FEC)		-62.0	-61.5	-61.5	-61.0	-62.0	-60.5	-60.0	-61.5	-60.5	-60.0	-60.0	-60.0	-59.5	-59.0
2048 QAM		-58.5	-58.0	-58.0	-57.5	-58.5	-57.0	-56.5	-58.0	-57.0	-56.5	-56.5	-56.5	-56.0	-55.5
QPSK	30 MHz & 28 MHz ACAP	-87.5	-87.0	-87.0	-86.5	-87.5	-86.0	-85.5	-87.0	-86.0	-85.5	-85.5	-85.5	-85.0	-84.5
8 PSK		-82.5	-81.5	-81.5	-81.5	-82.5	-81.0	-80.5	-81.5	-81.0	-80.5	-80.5	-80.0	-80.0	-79.0
16 QAM		-81.0	-80.0	-80.0	-80.0	-80.5	-79.5	-79.0	-80.0	-79.0	-78.5	-79.0	-78.5	-78.5	-77.5
32 QAM		-77.0	-76.5	-76.5	-76.0	-77.0	-76.0	-75.0	-76.5	-75.5	-75.0	-75.0	-75.0	-74.5	-74.0
64 QAM		-74.5	-73.5	-73.5	-73.5	-74.0	-73.0	-72.5	-73.5	-72.5	-72.0	-72.5	-72.0	-72.0	-71.0
128 QAM		-71.0	-70.5	-70.5	-70.0	-71.0	-70.0	-69.0	-70.5	-69.5	-69.0	-69.0	-69.0	-68.5	-68.0
256 QAM		-68.0	-67.5	-67.5	-67.0	-68.0	-67.0	-66.0	-67.5	-66.5	-66.0	-66.0	-66.0	-65.5	-65.0
512 QAM		-66.0	-65.5	-65.5	-65.0	-66.0	-64.5	-64.0	-65.5	-64.5	-64.0	-64.0	-64.0	-63.5	-63.0
1024 QAM (strong FEC)		-63.0	-62.0	-62.0	-62.0	-62.5	-61.5	-61.0	-62.0	-61.0	-60.5	-61.0	-60.5	-60.5	-59.5
1024 QAM (light FEC)		-62.0	-61.0	-61.0	-61.0	-62.0	-60.5	-60.0	-61.0	-60.5	-60.0	-60.0	-59.5	-59.5	-58.5
2048 QAM		-58.0	-57.5	-57.5	-57.0	-58.0	-56.5	-56.0	-57.5	-56.5	-56.0	-56.0	-56.0	-55.5	-55.0

		Frequency (GHz)													
Modulation	Channel Spacing	6	7	8	10	11	13	15	18	23	24	26	28-31	32	38
QP5K	40 MHz	-86.0	-85.5	-85.5	-85.0	-86.0	-85.0	-84.0	-85.5	-84.5	-84.0	-84.0	-84.0	-83.5	-83.5
8 P5K		-81.0	-80.5	-80.5	-80.0	-81.0	-79.5	-79.0	-80.5	-79.5	-79.0	-79.0	-79.0	-78.5	-78.0
16 QAM		-79.5	-79.0	-79.0	-78.5	-79.5	-78.0	-77.5	-79.0	-78.0	-77.5	-77.5	-77.5	-77.0	-76.5
32 QAM		-76.0	-75.0	-75.0	-75.0	-75.5	-74.5	-74.0	-75.0	-74.0	-73.5	-74.0	-73.5	-73.5	-73.0
64 QAM		-73.0	-72.0	-72.0	-72.0	-73.0	-71.5	-71.0	-72.0	-71.5	-71.0	-71.0	-70.5	-70.5	-70.0
128 QAM		-70.0	-69.0	-69.0	-69.0	-70.0	-68.5	-68.0	-69.0	-68.5	-68.0	-68.0	-67.5	-67.5	-67.0
256 QAM		-67.0	-66.0	-66.0	-66.0	-66.5	-65.5	-65.0	-66.0	-65.0	-64.5	-65.0	-64.5	-64.5	-64.0
512 QAM		-64.0	-63.5	-63.5	-63.0	-64.0	-62.5	-62.0	-63.5	-62.5	-62.0	-62.0	-62.0	-61.5	-61.0
1024 QAM (strong FEC)		-61.5	-61.0	-61.0	-60.5	-61.5	-60.0	-59.5	-61.0	-60.0	-59.5	-59.5	-59.5	-59.0	-58.5
1024 QAM (light FEC)		-60.5	-60.0	-60.0	-59.5	-60.5	-59.5	-58.5	-60.0	-59.0	-58.5	-58.5	-58.5	-58.0	-58.0
2048 QAM		-58.0	-57.0	-57.0	-57.0	-58.0	-56.5	-56.0	-57.0	-56.5	-56.0	-56.0	-55.5	-55.5	-55.0
QPSK	50 MHz	-85.5	-84.5	-84.5	-84.5	-85.0	-84.0	-83.5	-84.5	-83.5	-80.0	-83.5	-83.0	-83.0	-82.5
8 PSK		-80.0	-79.5	-79.5	-79.0	-80.0	-79.0	-78.0	-79.5	-78.5	-75.0	-78.0	-78.0	-78.0	-77.5
16 QAM		-78.5	-77.5	-77.5	-77.5	-78.0	-77.0	-76.5	-77.5	-76.5	-73.0	-76.5	-76.0	-76.0	-75.5
32 QAM		-74.5	-74.0	-74.0	-73.5	-74.5	-73.5	-72.5	-74.0	-73.0	-69.5	-72.5	-72.5	-72.5	-72.0
64 QAM		-71.5	-70.5	-70.5	-70.5	-71.5	-70.0	-69.5	-70.5	-70.0	-66.0	-69.5	-69.0	-69.0	-68.5
128 QAM		-68.5	-68.0	-68.0	-67.5	-68.5	-67.5	-66.5	-68.0	-67.0	-63.5	-66.5	-66.5	-66.5	-66.0
256 QAM		-66.0	-65.0	-65.0	-65.0	-66.0	-64.5	-64.0	-65.0	-64.5	-60.5	-64.0	-63.5	-63.5	-63.0
512 QAM		-63.5	-63.0	-63.0	-62.5	-63.5	-62.0	-61.5	-63.0	-62.0	-58.5	-61.5	-61.5	-61.5	-61.0
1024 QAM (strong FEC)		-60.0	-59.5	-59.5	-59.0	-60.0	-58.5	-58.0	-59.5	-58.5	-55.0	-58.0	-58.0	-58.0	-57.5
1024 QAM (light FEC)		-59.0	-58.0	-58.0	-58.0	-59.0	-57.5	-57.0	-58.0	-57.5	-53.5	-57.0	-56.5	-56.5	-56.0
2048 QAM		-57.0	-56.0	-56.0	-56.0	-56.5	-55.5	-55.0	-56.0	-55.0	-51.5	-55.0	-54.5	-54.5	-54.0
QPSK	56 MHz ACCP	-84.0	-83.5	-83.5	-83.0	-84.0	-83.0	-82.0	-83.5	-82.5	-82.0	-82.0	-82.0	-81.5	-81.5
8 PSK		-80.0	-79.5	-79.5	-79.0	-80.0	-79.0	-78.0	-79.5	-78.5	-78.0	-78.0	-78.0	-77.5	-77.5
16 QAM		-77.5	-77.0	-77.0	-76.5	-77.5	-76.5	-75.5	-77.0	-76.0	-75.5	-75.5	-75.5	-75.0	-75.0
32 QAM		-74.5	-73.5	-73.5	-73.5	-74.0	-73.0	-72.5	-73.5	-72.5	-72.0	-72.5	-72.0	-72.0	-71.5
64 QAM		-71.0	-70.5	-70.5	-70.0	-71.0	-70.0	-69.0	-70.5	-69.5	-69.0	-69.0	-69.0	-68.5	-68.5
128 QAM		-68.5	-67.5	-67.5	-67.5	-68.0	-67.0	-66.5	-67.5	-66.5	-66.0	-66.5	-66.0	-66.0	-65.5
256 QAM		-65.0	-64.5	-64.5	-64.0	-65.0	-64.0	-63.0	-64.5	-63.5	-63.0	-63.0	-63.0	-62.5	-62.5
512 QAM		-63.0	-62.5	-62.5	-62.0	-63.0	-61.5	-61.0	-62.5	-61.5	-61.0	-61.0	-61.0	-60.5	-60.0
1024 QAM (strong FEC)		-59.5	-59.0	-59.0	-58.5	-59.5	-58.5	-57.5	-59.0	-58.0	-57.5	-57.5	-57.5	-57.0	-57.0
1024 QAM (light FEC)		-58.5	-58.0	-58.0	-57.5	-58.5	-57.5	-56.5	-58.0	-57.0	-56.5	-56.5	-56.5	-56.0	-56.0
2048 QAM		-54.0	-53.5	-53.5	-53.0	-54.0	-53.0	-52.0	-53.5	-52.5	-52.0	-52.0	-52.0	-51.5	-51.5
QPSK	60 MHz & 56 MHz ACAP	-84.5	-84.0	-84.0	-83.5	-84.5	-83.0	-82.5	-84.0	-83.0	-82.5	-82.5	-82.5	-82.0	-81.5
8 PSK		-80.0	-79.0	-79.0	-79.0	-79.5	-78.5	-78.0	-79.0	-78.0	-77.5	-78.0	-77.5	-77.5	-77.0
16 QAM		-77.5	-77.0	-77.0	-76.5	-77.5	-76.0	-75.5	-77.0	-76.0	-75.5	-75.5	-75.5	-75.0	-74.5
32 QAM		-74.0	-73.0	-73.0	-73.0	-73.5	-72.5	-72.0	-73.0	-72.0	-71.5	-72.0	-71.5	-71.5	-71.0
64 QAM		-70.5	-70.0	-70.0	-69.5	-70.5	-69.5	-68.5	-70.0	-69.0	-68.5	-68.5	-68.5	-68.0	-68.0
128 QAM		-68.0	-67.0	-67.0	-67.0	-67.5	-66.5	-66.0	-67.0	-66.0	-65.5	-66.0	-65.5	-65.5	-65.0
256 QAM		-64.5	-64.0	-64.0	-63.5	-64.5	-63.5	-62.5	-64.0	-63.0	-62.5	-62.5	-62.5	-62.0	-62.0
512 QAM		-62.5	-62.0	-62.0	-61.5	-62.5	-61.5	-60.5	-62.0	-61.0	-60.5	-60.5	-60.5	-60.0	-60.0
1024 QAM (strong FEC)		-59.0	-58.5	-58.5	-58.0	-59.0	-58.0	-57.0	-58.5	-57.5	-57.0	-57.0	-57.0	-56.5	-56.5
1024 QAM (light FEC)		-58.0	-57.5	-57.5	-57.0	-58.0	-57.0	-56.0	-57.5	-56.5	-56.0	-56.0	-56.0	-55.5	-55.5
2048 QAM		-55.5	-54.5	-54.5	-54.5	-55.0	-54.0	-53.5	-54.5	-53.5	-53.0	-53.5	-53.0	-53.0	-52.5
QPSK	80 MHz	N/A	N/A	N/A	N/A	-83.5	N/A	N/A	-82.5	N/A	N/A	N/A	N/A	N/A	N/A
8 PSK		N/A	N/A	N/A	N/A	-78.0	N/A	N/A	-77.5	N/A	N/A	N/A	N/A	N/A	N/A
16 QAM		N/A	N/A	N/A	N/A	-76.5	N/A	N/A	-76.0	N/A	N/A	N/A	N/A	N/A	N/A
32 QAM		N/A	N/A	N/A	N/A	-73.0	N/A	N/A	-72.5	N/A	N/A	N/A	N/A	N/A	N/A
64 QAM		N/A	N/A	N/A	N/A	-70.0	N/A	N/A	-69.5	N/A	N/A	N/A	N/A	N/A	N/A
128 QAM		N/A	N/A	N/A	N/A	-67.0	N/A	N/A	-66.5	N/A	N/A	N/A	N/A	N/A	N/A
256 QAM		N/A	N/A	N/A	N/A	-64.5	N/A	N/A	-64.0	N/A	N/A	N/A	N/A	N/A	N/A
512 QAM		N/A	N/A	N/A	N/A	-61.5	N/A	N/A	-61.0	N/A	N/A	N/A	N/A	N/A	N/A
1024 QAM		N/A	N/A	N/A	N/A	-58.5	N/A	N/A	-58.0	N/A	N/A	N/A	N/A	N/A	N/A

ETHERNET THROUGHPUT

		Ethernet Throughput (Mbps)				Ethernet Throughput (Mbps)		
Modulation	Channel Size	No Compression	L2 Compression	Multi-Layer Compression	Channel Size	No Compression	L2 Compression	Multi-Layer Compression
QPSK	3.5 MHz & 5 MHz	3	3-4	4-11	7 MHz	8	8-10	9-27
8 PSK		N/A	N/A	N/A		13	13-14	13-40
16 QAM		8	8-9	9-26		18	18-20	19-S8
32 QAM		11	11-13	12-36		24	24-27	25-77
64 QAM		14	14-16	15-45		30	30-34	31-95
128 QAM		17	17-19	18-54		36	36-41	37-114
256 QAM		19	20-22	20-62		41	41-47	43-132
512 QAM		N/A	N/A	N/A		44	44-50	46-141
1024 QAM (strong FEC)		N/A	N/A	N/A		47	47-54	49-151
1024 QAM (light FEC)		N/A	N/A	N/A		50	51-57	53-161
QPSK	10 MHz	12	12-14	13-40	14 MHz	19	19-22	20-62
8 PSK		19	19-21	20-61		29	29-33	30-93
16 QAM		26	26-30	27-83		40	40-45	42-128
32 QAM		34	35-39	36-111		53	53-60	55-169
64 QAM		42	43-48	45-137		65	65-74	68-208
128 QAM		51	51-58	53-164		78	79-89	82-251
256 QAM		58	59-67	61-188		89	90-102	94-287
512 QAM		64	65-73	67-206		98	99-112	103-316
1024 QAM (strong FEC)		67	68-77	71-216		104	105-119	109-335
1024 QAM (light FEC)		72	72-82	75-230		111	111-126	116-355
QPSK	20 MHz	27	28-31	29-88	25 MHz	35	35-40	37-112
8 PSK		41	41-47	43-132		52	53-60	55-168
16 QAM		56	57-64	59-180		71	72-81	75-229
32 QAM		74	75-85	78-238		94	95-107	99-302
64 QAM		91	92-104	96-293		116	117-132	121-372
128 QAM		110	111-126	116-354		139	141-159	147-448
256 QAM		125	126-142	131-401		159	160-181	167-511
512 QAM		136	137-156	143-438		175	177-200	184-564
1024 QAM (strong FEC)		145	146-165	152-466		186	188-213	196-599
1024 QAM (light FEC)		154	155-176	162-495		198	199-226	208-636
2048 QAM		164	165-187	172-528		212	214-242	223-682
QPSK	28 MHz (ACCP)	40	40-45	42-127	30 MHz & 28 MHz (ACAP)	42	42-48	44-135
8 PSK		59	60-68	62-191		61	62-70	65-197
16 QAM		81	82-93	85-261		86	87-98	90-277
32 QAM		107	108-122	112-344		113	114-129	119-364
64 QAM		132	133-150	138-424		139	140-159	147-449
128 QAM		159	160-181	166-509		168	169-192	176-540
256 QAM		181	182-206	190-580		193	195-220	203-621
512 QAM		199	201-227	209-640		206	208-235	216-662
1024 QAM (strong FEC)		212	214-242	223-681		224	226-259	236-722
1024 QAM (light FEC)		225	227-257	236-723		238	240-271	250-764
2048 QAM		241	243--275	253-775		260	262-296	273-833

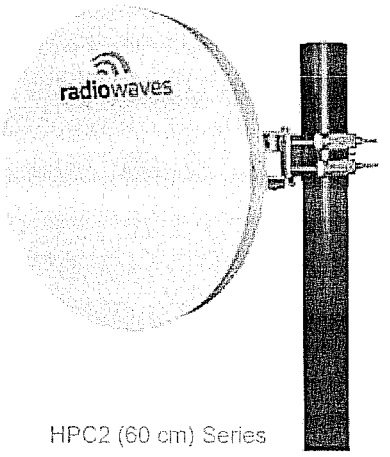
Modulation	Channel Size	No Compression	L2 Compression	Multi-Layer Compression	Channel Size	No Compression	L2 Compression	Multi-Layer Compression
QPSK	40 MHz	57	57-65	60-183	50 MHz	69	70-79	73-223
8 PSK		85	86-97	89-273		108	108-123	113-346
16 QAM		116	117-132	121-372		146	147-166	153-469
32 QAM		152	154-174	160-490		183	185-209	193-589
64 QAM		187	189-214	197-602		237	239-270	249-761
128 QAM		226	228-258	238-728		276	278-315	290-833
256 QAM		243	245-278	256-782		327	330-374	344-833
512 QAM		267	269-304	280-833		355	358-405	373-833
1024 QAM (strong FEC)		302	305-345	318-833		387	390-441	406-833
1024 QAM (light FEC)		321	324-366	337-833		411	414-468	431-833
2048 QAM		347	350-396	365-833		443	446-505	465-833
QPSK	56 MHz (ACCP)	81	82-93	86-262	60 MHz & 56 MHz (ACAP)	86	86-98	90-276
8 PSK		121	122-138	127-390		125	126-143	131-402
16 QAM		165	166-188	173-531		174	175-198	182-558
32 QAM		217	219-248	228-699		229	230-261	240-734
64 QAM		267	269-304	280-833		281	283-320	295-833
128 QAM		323	325-368	339-833		339	342-387	356-833
256 QAM		369	372-421	388-833		391	394-447	411-833
512 QAM		401	404-457	421-833		421	424-480	442-833
1024 QAM (strong FEC)		436	439-497	458-833		458	461-522	481-833
1024 QAM (light FEC)		462	466-528	486-833		486	490-555	511-833
2048 QAM		502	505-572	527-833		527	531-601	553-833
QPSK	80 MHz	113	114-129	119-363				
8 PSK		160	161-183	168-515				
16 QAM		228	230-260	240-733				
32 QAM		300	302-342	315-833				
64 QAM		367	369-418	385-833				
128 QAM		433	436-494	455-833				
256 QAM		499	503-569	524-833				
512 QAM		548	552-625	576-833				
1024 QAM		596	601-680	626-833				

HPC2 (60 CM) SERIES

Parabolic Antenna

High Performance Commercial Line

The HPC2 Series from RadioWaves, is part of the HPC Commercial Line of Value-Engineered High Performance Parabolic Antennas. The HPC2 has been optimized by design for cost effective implementations requiring 60 cm configurations. Designed for global applications the HPC2 Series provides a rugged solution with superior RF performance in frequency bands from 11 GHz to 38 GHz.



HPC2 (60 cm) Series

FEATURES

- Value priced for economical deployments
- Excellent RF performance
- Fully pre-assembled for *"fastest time to tower"*
- Compliant to ETSI and FCC standards
- Waveguide and direct mount interfaces available
- Wind ratings - 125 mph* / minimum operating and 155 mph / survival
- HPC antennas available in 30, 60 and 90 cm options
- RoHS compliant
- Three year warranty

GENERAL SPECIFICATIONS HPC2 (60 CM) SERIES

Model	HPC2-11RS	HPC2-13RS	HPC2-18RS	HPC2-23RS	HPC2-38RS
Antenna Type	Parabolic	Parabolic	Parabolic	Parabolic	Parabolic
Size, Nominzl	60 cm	60 cm	60 cm	60 cm	60 cm
P6lzrizzti6n	Single	Single	Single	Single	Single
Stzndzrd RF C6nnect6r Type	PBRr 20	PBRr 20	PBR220	PBR220	PBR320

ELECTRICAL SPECIFICATIONS

Operating Frequency Band	10.7 GHz - 11.7 GHz	12.745 GHz - 13.25 GHz	17.7 GHz - 19.7 GHz	21.2 GHz - 23.6GHz	37.0 GHz - 40.0 GHz
Half Power Beamwidth, Horizontzl	f .f	2.m	2.r	r .m	0.a
Hzlf Pow2r B2zmwidth, V2rticzl	f .f	2.m	2.r	r .m	0.a
CrossfPolzrizztion Discriminztion	f 0	f 0	f 0	f 0	f 0
Front to Bzck Rztio (FeBh	6r	62	6m	6o	64
Gzin, L6w Fr2qu2ncy	f f .8	f o.8	f 8.4	40	44.6
Gzin, q id Fr2qu2ncy	f 4.o	f 6	f 8.a	40.o	4o.2
Gzin, Hi4h Fr2qu2ncy	f o.2	f 6.2	f a.r	4r	4o.8
VBWR	≤1.3	≤1.3	≤1.3	≤1.3	≤1.3
R2turn L6ss	≤-17.7	≤-17.7	≤-17.7	≤-17.7	≤-17.7

* Note: StrSt reqSred

MECHANICAL SPECIFICATIONS

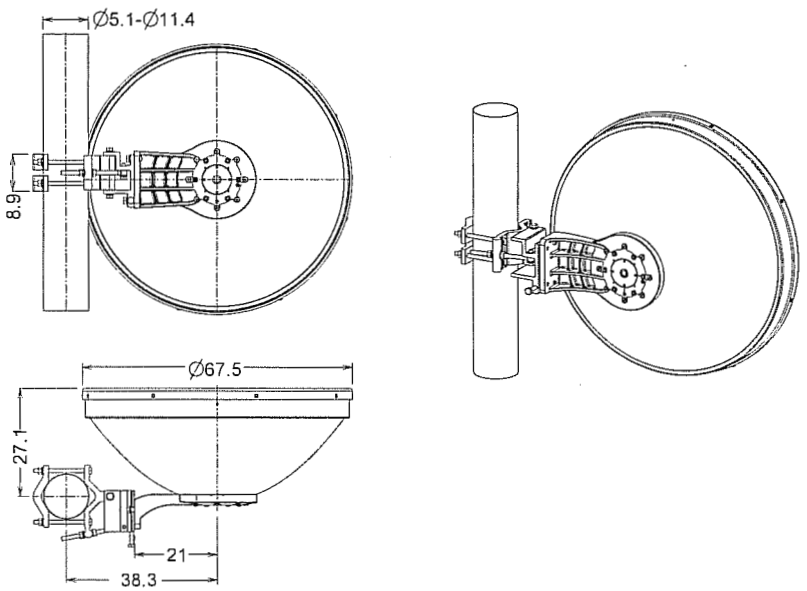
Model	HPC2-11RS	HPC2-13RS	HPC2-18RS	HPC2-23RS	HPC2-38RS
Fine Azimuth Adjustment	±15°	±15°	±15°	±15°	±15°
Fine Elevation Adjustment	±15°	±15°	±15°	±15°	±15°
Mounting Pipe Diameter, Min	Φ51 mm	Φ51 mm	Φ51 mm	Φ51 mm	Φ51 mm
Mounting Pipe Diameter, Max	Φ114 mm	Φ114 mm	Φ114 mm	Φ114 mm	Φ114 mm
Net Weight	9.7 kg	10 kg	10 kg	9.7 kg	9.7 kg
Wind Velocity Operational	90 mph	90 mph	90 mph	90 mph	90 mph
Wind Velocity Survival Rating	155 mph	155 mph	155 mph	155 mph	155 mph
Axial Force (FA)	301 lb	301 lb	301 lb	301 lb	301 lb
Side Force (FS)	154 lb	154 lb	154 lb	154 lb	154 lb
Twisting Moment (MT)	384 ft-lb	384 ft-lb	384 ft-lb	384 ft-lb	384 ft-lb
Operating Temperature Range	-45~ +60°C	-45~ +60°C	-45~ +60°C	-45~ +60°C	-45~ +60°C
Max Pressure, PSIG, (if waveguide interface)	10 PSIG	10 PSIG	10 PSIG	10 PSIG	10 PSIG

REGULATORY COMPLIANCE

Model	HPC2-11RS	HPC2-13RS	HPC2-18RS	HPC2-23RS	HPC2-38RS
FCC	US FCC Part 101B	US FCC Part 101B	US FCC Part 101B	US FCC Part 101A	US FCC Part 101A
ETSI	ETSI 302 217 Class 3	ETSI 302 217 Class 3	ETSI 302 217 Class 3	ETSI 302 217 Class 3	ETSI 302 217 Class 3
Industry Canada	NA	SRSP-312.7A	SRSP-317.8B	SRSP-321.8A	SRSP-338.6 OK
RoHS Compliant	Yes	Yes	Yes	Yes	Yes

SHIPPING INFORMATION

Model	HPC2-11RS	HPC2-13RS	HPC2-18RS	HPC2-23RS	HPC2-38RS
Package Type	Cardboard	Cardboard	Cardboard	Cardboard	Cardboard
Gross Weight	15 kg	15.2 kg	15.2 kg	15 kg	15 kg
Dimensions, L x W x H	75 cm x 75 cm x 44 cm	75 cm x 75 cm x 44 cm	75 cm x 75 cm x 44 cm	75 cm x 75 cm x 44 cm	75 cm x 75 cm x 44 cm
Shipping Volume	0.25 m^3	0.25 m^3	0.25 m^3	0.25 m^3	0.25 m^3



Contact Us: +1 978.459.8800 | www.radiowaves.com

EXHIBIT F
33 N. STONE AVENUE ROOFTOP
SPECIAL CONDITIONS, FACILITY RULES & REGULATIONS

I. Licensee must comply with the following special conditions:

A. Equipment and Antennas Installation:

1. All exterior transmission lines must be grounded at the following locations:
   a. at the top of the run immediately above the hoisting grip;
   b. at the bottom of the run above the horizontal transition;
   c. prior to the point of entry to the shelter; and
   d. if the vertical run is more than 250', additional hoisting grips and grounding kits are required as per manufacturer's specifications. Only manufacturer's grounding kits will be allowed for attachment. If the cable diameter is 7/8" or less, the cable must enter the shelter through the strike plate.
2. Transmission lines must be fastened to the rooftop facility's waveguide ladder or banjos using the proper mechanical hanger or snap-in hanger kit except on side arms and up small masts where stainless steel wraplock is permitted. Hoisting grips will be used at 200' vertical intervals, or more often as needed for proper cable support.
3. All installation, repair and maintenance conducted by licensee shall be in accordance with good engineering standards and in conformity with the requirement of the FCC or any other body having jurisdiction over Licensee.

B. It is vital that standards for interference protection of systems are used to reduce the possibility of interference. The standards below are minimum and must be installed by Licensee.

Frequency Range	Minimum of Reverse Isolation Required (Isolator)	Band Pass Cavity, Minimum Attenuation At 1 MHz from Tx frequency
25-54 MHz	20dB	30dB
66-88-MHz	25dB	20dB
88-108 MHz	25dB	25dB
130-108 MHz	50dB	25dB
400-512 MHz	50dB	15dB
806-960 MHz	50dB	15dB

Hybrid transmitter combining will have a band pass filter installed on the output with the following attenuation at 1 MHz from the transmit frequency: UHF/800000 MHz – 14dB.

Additional interference and isolation specifications may be required on a case-by-case basis as determined by Licensor at any time. All cavities are to be ¾ wave length, silver plated type.

Frequencies not included in the list above shall be dealt with on a case-by-case basis as determined within Licensor's reasonable discretions.

C. All interior cables must be ¼" or ½" superflex or 3/8" value flex manufactured by Andrew corp. or an acceptable equivalent. Kinked, cracked or split cables are prohibited. All antenna lines must have a jacketed, corrugated, solid outer, copper conductor. All transmit interconnection cable and jumpers must be solid copper outer conductor "superflex", hard-line or LMR-400. No braid shield type cable is permitted anywhere under any circumstances. Moreover, all inside cable must be run on cable trays or hangers by the designated route for that location. All lines must be color coded at both ends showing termination points. All AC line cords must be 3-conductor type with grounding plug attached. All outside cables must be run on the transmission ice bridge with appropriate hardware and boots. Additionally, Licensee is prohibited from running cables within the equipment building or the rooftop facility without Licensor's written permission.

D. Transmitters must meet the original manufacturer's specifications. All shields must remain in place. Transmitters must have a visual indication of transmitter operation and be identified with the following information: owner's name, contact name, contact's phone number, operating frequencies, a copy of Licensee's current FCC/ NTIA License for the equipment and the equipments model/serial number.

E. All equipment cabinets and racks must be grounded to the designated building grounding point using #6 stranded copper – green jacketed cable. All equipment cabinets and racks must be bolted securely to the floor and include seismic braces at the top of the rack.

F. Licensor does not provide any warranty against electrical surge. Therefore, Licensor recommends that Licensee install, at Licensee's expense, individual transient surge protection on each circuit used by Licensee.

G. All antennas installed must be mounted using the proper antenna manufacturer's mounting brackets. Licensee shall pay for all antennas mounts it utilizes at the rooftop facility.

H. All antennas must be installed according to the antenna manufacturer's and applicable rooftop facility manufacturer's specifications. Moreover, all antenna lines entering the equipment building must have a suitable lightning surge arrestor installed within two feet of the cable entry port. This surge arrestor must be bonded to the site grounding system.

I. Licensor requires that all equipment that lends itself to rack-mounting be performed to conserve floor space at Licensee's expense.

J. Licensee will operate its equipment with all shields attached, cabinet doors closed and side panels attached. Furthermore, unsealed batteries are not permitted at the rooftop facility. All external indicator lamps and LEDs must be operational and local speakers must remain off except during maintenance.

K. Neither Licensee nor any of its representatives shall interfere with any other entity's equipment in the equipment shed. Moreover, Licensee will not trip any electric service breakers for any reason without Licensor's prior approval.

L. All installations must be maintained in a neat and orderly manner. Doors to the equipment building must remain closed at all times. Access to equipment and antennas shall be by authorized personnel only.

M. Prior to the activation of its system at the rooftop facility, Licensee must submit a copy of its applicable FCC/NTIA License and all technical information pertaining to the equipment to be installed including accurate block diagrams showing operating frequencies, all system components (active or passive) with gains and losses in dB, and all power levels to Licensor.

N. Licensee must comply with the following rooftop facility rules and regulations, and access and security procedures for users:

1. Doorways, vestibules and other areas in and around the rooftop facility shall not be used for the disposal of trash or be obstructed by Licensee or used by Licensee for any other purpose than entrance to and exit from the rooftop facility.
2. The equipment shed shall be used only for the purpose for which it has been designed and no unsuitable materials such as rubbish, rags or sweepings shall be disposed of within. Damage to any such building by Licensee shall be at the liability of Licensee.
3. Signs, advertisements, graphics or notices are not allowed in or around the Rooftop facility.
4. Licensee will not make any alterations or physical additions in or to the Rooftop facility without the written permission of Licensor. Licensee will be required to conduct and submit an Interference & Inter-modulation Analysis (IIA), at the Licensee's expense, in addition to requirements outlined in section M above.
5. Movement in or out of the rooftop facility with any bulky equipment shall be restricted and allowed only at such times as designated by Licensor. Licensor will determine the method and routing of such items so as to ensure the safety of all concerned and that potential harm to the rooftop facility be

minimized. Advance notice of at least 24 hours is required for the movement of equipment.

6. Licensor shall have the authority to prescribe the maximum weight in any area and the manner in which equipment is placed.
7. Licensee shall not adjust, attempt to adjust or otherwise tamper with any temperature control thermostats in the equipment sheds. Licensor shall adjust thermostats as required to maintain building standard temperature.
8. At all times, Licensee will comply with all requirements necessary for the security of the rooftop facility.
9. Notwithstanding any other provisions to the contrary contained herein, no work shall be performed at the rooftop facility, with the exception of routine maintenance work performed strictly by qualified employees of Licensee, without prior written consent of Licensor. Any work involving the presence of Licensor's representative, will be billed to and paid by Licensee at the hourly market rate applicable to said representative at that time. Any violation of this policy will be considered a material breach by Licensee.
10. All routine service calls are to be scheduled between the hours of 8:00 a.m. and 5:00 p.m. weekdays.
11. No Cable Terminations or circuit interface equipment is to be installed in any area but the building main distribution frame (basement or roof) and the Licensee's rooftop equipment area. Inclusive of but not limited to: 66 mounting blocks; 110 mounting blocks; modems; net work interface devices; and CSU-DSU units.

O. Licensor reserves the right to rescind any of these rules and to make other rules if required for the safety and care of the rooftop facility and all licensees. Any changes to the rule and regulation will be done by formal written amendment. Upon notification to Licensee, such rules and regulations shall be binding upon Licensee in a manner as if originally herein prescribed.

EXHIBIT G
33 N. STONE AVENUE ROOFTOP
PROCEDURES FOR ACCESS TO PIMA COUNTY ROOFTOP FACILITIES

Access to the rooftop facilities is restricted and will only be permitted for authorized purposes.

Procedures for access:

Weekdays (8:00 a.m. – 5:00p.m.)

1. All Tenants will supply a list of authorized users. This list shall include the following:
    a. Name of Person
    b. Company
    c. Phone number
2. Email completed authorized user list to rooftops@pima.gov.
3. Prior to any work to be performed on any Pima County rooftop facility, tenant must
    a. Email rooftops@pima.gov with the following information at least 24 hours in advance of arrival:
        i. Name of company
        ii. Contact person, names of individuals performing work
        iii. Phone number
        iv. Preferred day/time to schedule work
        v. Type of work to be performed
        vi. Duration of work
4. IT will review the request and forward it to Facilities Management (if approved) to arrange access to the rooftop facilities for authorized users and notify tenant
5. You must present picture identification and company identification. This will be compared to the Authorized Users List that each tenant supplies.
6. ONLY AUTHORIZED USERS WILL BE ALLOWED ACCESS.

Weeknights, weekend and holiday:

Emergencies

This process is to be utilized for true emergency service affecting outages

1. Call 740-3085 – This will be forwarded to Central Plant operations. They will have access to the buildings 24-7.

2. Emergency access must be reported to rooftops@pima.gov by 8:00 a.m. the next business day to advise of any addition, removal, or modification of equipment/antennas that was required as a result of the emergency.

3. This process is for true emergencies. Any tenant utilizing the Emergency process to bypass the Weekday process will be notified and the lease may be terminated.

After Hours Maintenance

This process is to be utilized for service affecting maintenance during non-peak hours

1. Prior to any work to be performed on any Pima County rooftop facility, tenant must
    a. Email rooftops@pima.gov with the following information at least 24 hours in advance of arrival:
        i. Name of company
        ii. Contact person, names of individuals performing work
        iii. Phone number
        iv. Preferred day/time to schedule work
        v. Type of work to be performed
        vi. Duration of work
2. IT will review the request and forward it to Facilities Management (if approved) to arrange access to the rooftop facilities for authorized users and notify Tenant.
3. Call 740-3085 upon arrival for work being performed – This will be forwarded to Central Plant operations. They will have access to the buildings 24-7.

EXHIBIT H
33 N. STONE AVENUE ROOFTOP LICENSE FEE SCHEDULE

Site ID	Location	Type	Monthly Fee
33 N. Stone	33 N. Stone Avenue	*Antennas	*$884.40
		Shelter A Space, 10 SF	$403.00
		TOTAL MONTHLY	**$1,287.40**

MONTHLY PAYMENTS DUE

First Year	$1,287.40	
Second Year	$1,351.77	($1,287.40 plus 5%)
Third Year	$1,419.36	($1,351.77 plus 5%)
Fourth Year	$1,490.33	($1,419.36 plus 5%)
Fifth Year	$1,564.84	($1,490.33 plus 5%)

*** Tower and Rooftop Fee monthly charge**

(4) PMP450 panels ≤ 47" @ $67.00	=	$268.00 / month
Antenna C/L Height ≥ 90' (+ 50%)	=	$134.00 / month
Subtotal	=	*$402.00 / month*
(4) PMP450 panels ≤ 47" @ $67.00	=	$268.00 / month
Antenna C/L Height ≥ 60' & ≤ 90' (+ 30%)	=	$80.40 / month
Subtotal	=	*$348.40 / month*
(2) HPC2 2' dish @ $67.00	=	$134.00 / month
Total	**=**	**$884.40 / month**

**Does not include Shelter C monthly electrical charges which will be billed via Pima County Facilities Management, on a monthly basis, separately from the above monthly fee.