City of Maricopa

Technical Proposal
Digital Microwave Backbone

March 11, 2016

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March 11, 2016

Kimberly Clark, Communications Manager
The City of Maricopa
Communications Department
39675 West Civic Center Plaza South
Maricopa, AZ 85138

Dear Ms. Clark:

Microwave Networks, Inc., (MNI) is pleased to present this proposal for a mission critical microwave link providing connectivity between your facility at Maricopa FS 575 and the Maricopa Dispatch Center.

Microwave Networks is offering a turnkey proposal to include FCC Frequency Coordination, path surveys, full installation, testing and acceptance as well all the components needed for a fully installed and optimized mission critical microwave link.

The proposal is offered under the terms of the Arizona State Contract ADSPO13-055852, and is valid for 30 calendar days from the date of this cover letter. The terms of the offer are as stipulated in the AZ contract, Net 30 days with Deliver of 45 days upon receipt of the order. The offer is $59,017.00 plus applicable taxes and freight.

The City of Maricopa may accept this offer by issuing to Microwave Networks Incorporated, a purchase order in the amount of $59,017.00 with the terms and conditions of the Arizona State Contract: ADSPO13-055852.

It is our honor to serve you and demonstrate our expertise in the field of Microwave Network solutions. Should you have any questions regarding this proposal please contact Bobbie Wagner, Sales Director at (214) 300-1862.

Sincerely,

Bobbie Wagner
Sales Director
Microwave Networks, Inc

Microwave Networks

4000 Greenbriar Stafford, TX 77477
Ph.: 281-263-6500; Fx: 281-263-6406
Sales Contact: Bobbie Wagner
System Engineer: Itai Farchi
Quote: BW_IF60112-50
Date: 12-Jan-16
Currency: US Dollars
PRICE AND MATERIAL LIST

Customer: City of Maricopa
Contact: City of Maricopa/Paul Punske
Location: Houston, TX
FCA: Stafford, Texas
Validity: 60 Days
Delivery: 45-60 Days ARO
Payment Terms: Master Contract ADSPO13-055852

Item	Model	Description	Unit Price	Maricopa FS575k	Maricopa Dispatch	Total Q-ty	Extended Price
1.00	**Proteus Microwave Radio Terminals**						
1.01	J11PC2-045E-NN0-EX32-C	Proteus MX, 11 GHz Gigabit Ethernet Radio, Hot Standby Protected, Split Mount, 32 x DS1/E1, Licensed for 45 Mbps in 10 MHz Channel	$10,291	1	1	2	$20,582
1.02	9900464-00	Telect, ELF-0000-2400, 1RU Shelf	$138	1	1	2	$276
1.03	9901587-00	Telect, ELF-1008-1800, 8-Port, DSX1 RJ45 Module	$250	1	1	2	$500
1.04	9901481-00	Telect, ELF-0000-0001, Faceplate	$14	2	2	4	$56
1.05	8108760-10	CHAMP Connector 24 GA Cable, AMT-MX, 32 E1/DS1 (2 cables required), 10' (3m)	$51	2	2	4	$204
						Radios Total:	**$21,618**
2.00	**Cables and Connectors for Proteus Microwave Radio Terminals**						
2.01	9901731-01	High Performance Antenna, Andrew, VHLP3-11W, 11 GHz,CPR90G	$1,394	1		1	$1,394
2.02	9901731-00	High Performance Antenna, Integrated, Andrew, VHLP3-11W, 11 GHz,CPR90G	$1,394		1	1	$1,394
2.03	9901433-00	Andrew, PM-SU4-63,Universal Pipe Mount, 4.5"x 63"	$342	1		1	$342
2.04	9901622-00	Andrew I/B Strut Kit (VSTRUT-P3KIT), PL & PAR Antennas	$163	1	1	2	$326
2.05	9900641-00	RG8 A/U Cable (LMR-400) -per foot")	$2	12	400	412	$824
2.06	9900642-00	N-type connector , straight, for IDU/ODU cable LMR 400	$17	2	6	8	$136
2.07	9901414-00	TNC-type connector - LMR 400, Right Angle (for M-Series IDUs)	$33	2	2	4	$132
2.08	9900648-00	Ground kit for LMR400 Cable	$66		6	6	$396
2.09	9900398-00	In Line N-Connector Surge Suppressor	$147		2	2	$294
2.10	8708272-11	Rack Mount Kit, 11 GHz	$658	1		1	$658
2.11	8708292-XX	Waveguide Extender Kit, 11 GHz, Top, Diplexer, SPU-RFU Gap 1 RU	$159	1	1	2	$318
2.12	9901777-01	MicroTech,MTPS90FHN36B,11G 3' Flex,UG40B-CPR	$450	1		1	$450
2.13	9901721-00	Eupen, EU90, Elliptical Waveguide, 10.5-11.7 GHz - per foot	$17	160		160	$2,720
2.14	9901721-01	Eupen, EU90CPR90G, 11GHz Elliptical Waveguide Connector	$364	2		2	$728
2.15	9901721-02	Eupen, GK-S85, 11GHz Standard Grounding Kit, EU90	$33	3		3	$99
2.16	9901721-04	Eupen, PW90FF90, Pressure Window, EU90	$118	1		1	$118
2.17	9901721-03	Eupen, HG-85, 11GHz Hoisting Grip	$39	1		1	$39
2.18	9900102-00	Andrew, Connector Re-attachment Kit, EW90	$17	1		1	$17
2.19	9901721-06	Eupen, BH-85, Butterfly Hangers, EU90	$28	6		6	$168
2.20	9901723-14	Eupen, HK-100-10, Hardware Kit, 3/8"x1"	$13	6		6	$78
2.21	9901723-08	Eupen, TR-SK12, Threaded Rod Support, 3/8"x12"	$14	3		3	$42
2.22	9901721-07	Eupen, AA-SL, Angle Adapters	$56	2		2	$112
2.23	9901721-05	Eupen, BA-90-1A, Waveguide Boot Assembly, EU90	$22	1		1	$22
						Antennas, Cables and Connectors Total:	**$10,807**
4.00	**Power System**						
4.01	DSCTOM0402008	FLATPACK S POWER SYSTEM FRONT/REAR WIRE 40AMP MAX, -48 Vdc, 2RU, Dual AC, 2Pos, 10 pos breaker, 2 LVBD, Smartpack Contrlr, **Redundant**	$1,334		1	1	$1,334
						DC Power Systems Total:	**$1,334**
						Equipment Total:	**$33,759**
5.00	**Services**						
5.01	PATH SURVEY	Path and Site Survey	$4,950			1	$4,950
5.02	FREQ COORD	Frequency Coordination & FCC Licensing Assistance	$1,900			1	$1,900
5.03	INSTALL	Installation of Antenna & Transmission lines	$21,406			1	$21,406
5.04	INSTALL	Installation of Radio & DC Power Systems	$15,400			1	$15,400
5.05	PROGRAM MGMT	Program Management	$1,602			1	$1,602
5.06	CONCESSION	Management Concession on Services	-$20,000			1	-$20,000
						Services Total:	**$25,258**
Grand Total, FCA: Stafford, Texas							**$59,017**

Executive Summary

Microwave Networks Incorporated is a trusted global provider of wireless infrastructure and last-mile transmission solutions. We design, manufacture, install, and service licensed and unlicensed, point-to-point and point-to-multipoint microwave systems. We offer access and backhaul wireless turnkey solutions for public safety TDM, IP, MPLS/IP and LTE networks.

As TDM circuit switched point-to-point microwave converges and evolves to packet switched IP technology and carrier grade Ethernet, new IP based QoS metrics, operations, and maintenance procedures emerge. Microwave Networks is at the cutting edge of IP product development, operations, and maintenance methods, ensuring reliable performance for demanding real-time voice, data, and video applications.

Based on over 40 years of microwave s experience, Microwave Networks delivers peace-of-mind support services that maximize your operational and capital investments in microwave and ensure consistent network reliability.

Microwave Networks is pleased to present this proposal to the City of Maricopa. The products and services contained within provide for not only the immediate requirements for the paths included, but also set the stage for future growth and an easy expansion of this critical infrastructure. Microwave Networks' position as a global leader in mission critical microwave radio technology, coupled with our extensive experience as a microwave backhaul provider for federal, state and local public safety organizations and agencies make us the ideal partner. Thank you for your consideration and we look forward to partnering in your success.

PROPOSED SOLUTION

Microwave Networks is pleased to offer a full turnkey microwave backhaul for City of Maricopa based on the Proteus MX Digital Microwave. The combined IP/TDM proposed solution provides end-to-end, best in class, flexible and scalable service architecture.

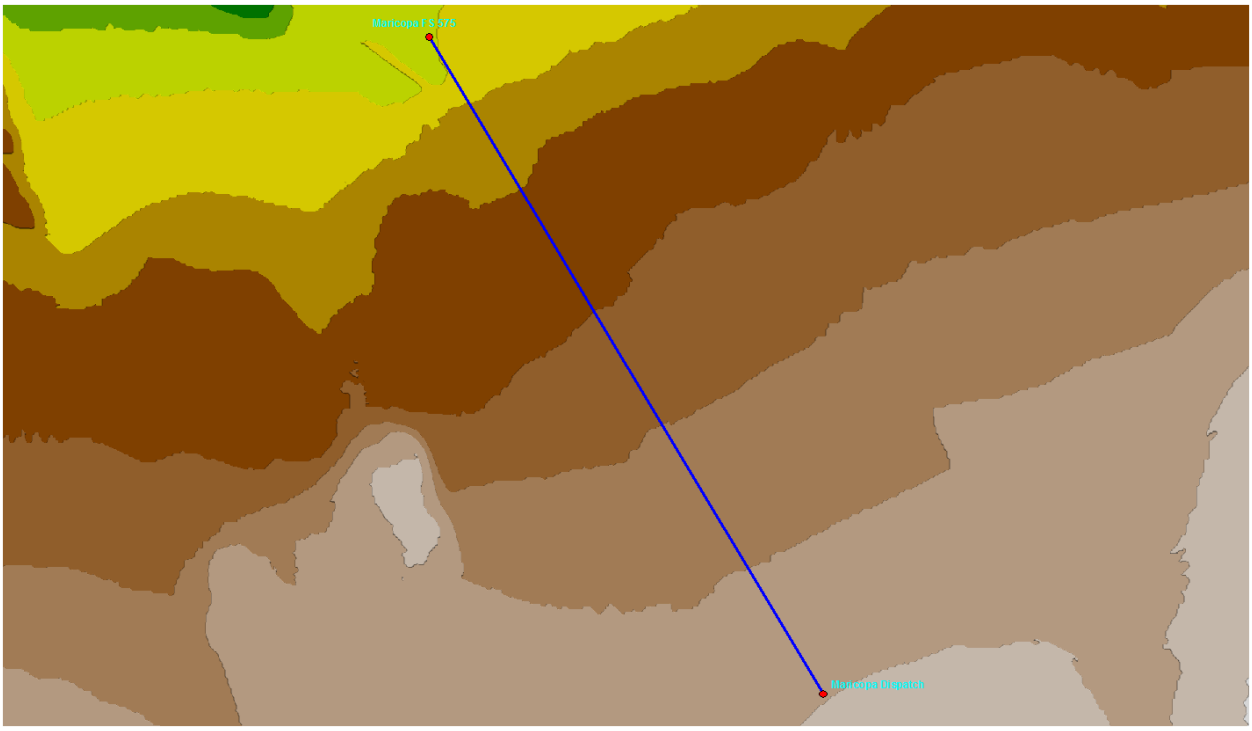
The microwave link proposed were designed and calculated using Proteus MX radios in the 11 GHz bands.

The proposed radio links were calculated at 45 Mbps with an annual two-way reliability goal of 99.9999% using 10 MHz channels. The attached Path Calculations show Adaptive Code and Modulation (ACM) results for all the possible modulations in the 10 MHz bandwidth, with throughputs up to 45 Mbps. Please notice that our throughputs are calculated using only 1518 byte Ethernet frames, in a mixed size packet scenario, the throughputs achieved by the Proteus MX radios are usually higher than our published figures.

The antennas and dehydrators used are of the Commscope (Andrew) brand and the elliptical waveguide to interconnect the radio and antenna is of the Eupen brand. The DC power is provided by Eltek's Flatpack S Rectifier Systems.

SYSTEM MAP

Microwave Network Link Map



RADIO EQUIPMENT AND LINK DATA SUMMARY

Path	Site name	TR Antenna model	TR Antenna diameter (ft)	TR Antenna height (ft)	TR TX line model	TR TX line length (ft)	Effective fade margin (dB)	Radio model	Path length (mi)	Two-Way Annual Availability (%)
1	Maricopa FS 575	VHLP3-11W	3	140	EU 90	160	44.62	Proteus MX / Split Indoor/ 10 MHz/ HSBY/ High Power	1.8	99.9999
	Maricopa Dispatch	VHLP3-11W	3	30			44.62	Proteus MX / Split Mount/ 10 MHz/ HSBY/ High Power		

MICROWAVE EQUIPMENTY AVAILABILITY

Microwave Equipment Availability

Proteus MX Repeater MTBF Calculation.
733982 Hours 83.788 Yers

MTBF = Mean Time Between Failures
MTTR = Mean time to repair / replace a failed to degraded module
MTTR (Assumed

$$\text{Unavailability} = 1 - \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}}$$

$$\text{Unavailability} = 1 - \frac{733982}{733982 + 6}$$

Microwave Terminal Unavailabilty= 0.000008175%

PATH DESIGN CONSIDERATIONS

All paths are designed with 45 Mbps radio throughput (our Path Calculations show ACM values for throughputs up to 45 Mbps). All paths are engineered to meet or exceed an annual two-way availability of 99.9999% at a BER of 10E-6 using the Vigants-Barnett model. The preliminary calculations for path performance are based on Microwave Networks published 10E-6 receiver threshold levels. Bellcore Standard transmission engineering practices, formulas and topographic data are the foundation of these calculations. Clearance criteria used to determine preliminary antenna centerlines are:

- K = 4/3 @ 100% F1, K=2/3 @ 30%
- 1/3” Arc USGS terrain data

- 30 meter NLCD 2001/2011 clutter data

Before system implementation a microwave path engineering survey will be conducted on all paths. The objective of this survey is "information verification" to confirm the information to be used for clearance and engineering performance objectives. This confirmation includes site location (latitude/longitude coordinates), elevation above mean sea level (AMSL), accurate measurement of path obstructions along the path (i.e. trees and buildings, electrical transmission lines, cellular towers, the presence of reflective surfaces) and general compilation of local climate information.

At locations with existing towers, pre-determined azimuths and centerlines will be checked for availability/adaptability in terms of proposed antenna mounting.

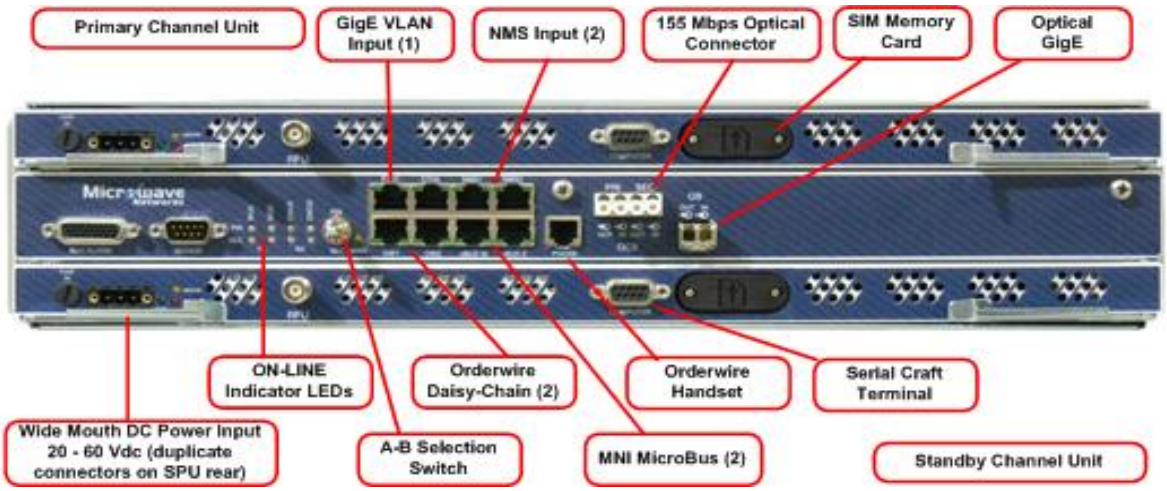
PROTEUS MX FEATURES

Microwave Networks solution is capable to provide hybrid networks of native TDM and native Ethernet links up to 350 mbps total capacity per channel.

The key significant advantages are:

- Fully Protected. No shared components between main and standby units. True No Single Point of Failure.
- Forward Error Correction for improved receiver threshold.
- A powerful Transversal Equalizer to provide high tolerance to dispersive fades, and in some configurations, transmit pre-distortion and Trellis Coding for higher overall system gain.
- TDM: up to 32 x DS1 Native
- Ethernet: Up to 12 x 10/100/1000Base-T interfaces (FE/GbE), Auxiliary channels, support up to 10K byte Jumbo Frames.
- Network Management: SNMP based element manager software for integration into other NMS platforms, for comprehensive network management.
- Native IP and Native TDM
- Innovative Quality of Service features
- Integrated L2 Ethernet switch
- 6-350 Mbps per radio carrier
- 2.5-60 MHz channel bandwidth
- 6-38 GHz licensed frequency
- Hitless Adaptive Coding & Modulation (ACM)

- Encryption: AES 128/256
- FIPS 140-2
- RADIUS
- Pay as You Grow**-** The Pay-as-you-grow model allows you to upgrade your capacity through a license key. There is no need to add new hardware. License keys can be purchased to enable increased capacity or additional features.



Proteus MX 1+1 Signal Processing Unit

Figure 3: Proteus MX 1+1 Signal Processing Unit - Back

The Proteus MX ODU is a light weight radio that is designed for both performance and reliability. Direct mount antenna interface is supported with following Antennas (1-6ft). The same antenna can be used for direct or remote mount configurations. The ODU designed to support multiple capacities, frequencies, modulation schemes, and configurations for various network requirements. It operates in the 6 to 38 GHz bands and supports capacities of from 6-350 Mbps.

Figure 4: Proteus MX ODU 1+1 RF Unit

DS-1 DEMARCATION POINTS

The proposed Telect ELF multifunctional connectivity system includes optical patch, splice and combination panels for high-density, low circuit count environments. Three 12-port modules fit in the standard 1 RU ELF chassis, or a single module can be housed in the wall-mount ELF unit. The system is ideal for remote sites, wireless sites or other limited-space applications.

ANTENNA SYSTEM

The antennas proposed for this system are Commscope (Andrew) in various sizes to achieve the desired reliability. All the antennas are Category "A" per US FCC part 101

At Maricopa FS 575, the connection between the Proteus MX radio and the Antenna is done using Eupen Elliptical waveguide and the corresponding accessories. At Dispatch the connection will be LDF2-50 coaxial cable.

POWER SYSTEM

Our proposal includes one Eltek Flatpack S DC redundant rectifier at the dispatch location to provide 48 VDC to the microwave radio. The Flatpack S rectifiers have an efficiency of up to 91%. This high efficiency translates into significant, ongoing AC power savings for the life of the system. The assembly will contain individual DC circuit breakers, distribution panel), voltage and current continuous metering capabilities, high/low DC voltage disconnect switching and all necessary maintenance and management alarm and control functions. Chargers will be provided in redundant arrangement with units of identical capacity and type working on a load-sharing basis during normal operation. Solid state monitoring by the power board will be continuous and automatic switchover employed in the event of failure of either unit. Upon switchover the surviving rectifier will be able to carry the entire site load plus growth and provide 24 hour recharge in the event of any loss of AC power.

Figure 4- Eltek Flatpack S Shelf with redundant rectifiers

SPARES

Spares are not included in this proposal. As the maintaining agency, the RWC will maintain a set of system spares.

SERVICES

Microwave Networks is also proposing full Turnkey Installation services to support the microwave network including:

- Path Survey Engineering and Technical Report
- Program Management
- FCC Frequency Coordination and Licensing
- Project Engineering
- Manufacturing
- Installation of Antenna Systems, Radios, DC Power System
- Acceptance Test Plan
- Integration and Cutover
- 2 year factory warranty
- Free 24/7 Telephone technical support

COMPANY BACKGROUND AND EXPERIENCE

Microwave Networks Incorporated (MNI) is a leading U.S. manufacturer of wireless transmission equipment and support services with a 50+ year history in the industry. The main headquarters are located in Stafford, Texas a suburb of Houston.

MNI's legacy can be traced back to the early days of the industry where they led advancements in microwave technology, including the introduction of analog microwave radios in the 1940s and the initial licensing of 2 GHz digital microwave radios in the 1970s.

The name of the company has changed over that time from the early days of Motorola Microwave, Telesciences, Avantek, California Microwave, and now Microwave Networks Incorporated. MNI is privately held by Koor Industries, an investment holding company with a focus on high-tech, high-growth companies with a substantial stake in telecommunications. To date, we have shipped over 150,000 terminals installed in 40 countries.

Sales

Sales and System Engineer teams are headquartered in the Stafford facility with other sales offices strategically located around the world. Most U.S. sales are handled by a direct sales force in regionally assigned locations throughout the country. International sales are also handled through direct channels as well as strategic partner arrangements.

The sales organization is supported by a group of very experienced system engineers to help customize specific needs and to provide the assurance of a well designed system. These engineers are also part of a larger customer support team designed to give start to finish support from your initial purchase through the life of your products.

Engineering

MNI's Engineering Department is staffed by experienced professionals trained in all aspects of microwave and telecommunications design and is engaged in industry-leading research and development projects.

The research and development group consists of program-oriented groups made up of engineering managers, electrical engineers, senior staff engineers, mechanical designers and technicians. This staff is supported by the latest sophisticated computerized technology that provides fully automated mechanical and electrical design as well as schematic capture and design control for generating paperless schematics and bills of material.

Marketing

The marketing group's functions include marketing communications, product and system related services, assessment of market needs, product research, product planning and analysis and systems support. It consists of product management, marketing communications and technical publications.

The product management group takes ownership of all products and manages each product's development through its life cycle. Weekly product review meetings are held during new product development to ensure adherence to specifications and schedule.

Customer Support

As mentioned earlier, the Customer Support Department is responsible for system/proposal engineering, order administration, program management, field services, field technical support, customer services, quality programs, quality control and customer training.

- Program Management (PM)

  A major contribution of the customer support organization is program management. The Program Manager provides input at the proposal stage to the System Engineers who provide the customers with the response to proposals or quotes. The PM also coordinates the sales orders with the Project Engineer who provides the drawings and equipment lists. The Program Manager reviews the performance calculations, path feasibility studies, frequency coordination and other system considerations. By providing full system integration and design, the group provides customers optimum reliability and system performance. From system design to final test, MNI's program managers are a prime customer interface and a single source of contact for all system considerations for full turnkey projects. This ensures smooth communications between the customer and MNI and orderly project implementation.

- Field Services

  MNI's field services include installation, on-site service, maintenance and repair by authorized personnel. These field personnel are available to assist customers with on-site problems and concerns from initial installation through years of operation.

- Training

Training services provided by customer support offer customers insights and techniques to maintain and service their systems. These training programs are the same as those provided to our authorized service vendors for detailed installation, maintenance and troubleshooting procedures. Training is offered in Stafford or at the customer's site.

Manufacturing

MNI's wireless radio manufacturing facility is located in Stafford, Texas, USA and is ISO 9001:2008 certified. The facility is designed to provide a smooth and efficient material flow from receipt of order to completion and shipment of products under the guideline of our ISO certification. Once an order is received, the equipment is assembled and tested into customer-configured radios. A detailed report of test results is shipped with each radio. MNI also provides an integration service for our customers. The radios are rack-mounted and cabled, and ancillary equipment (such as customer-specified equipment, multiplex, cross connects or alarm system) is added. Our typical lead times on vary from 45 to 60 days; this can be decreased if an adequate forecast is received. Our facility can manufacture in excess of 120 fully protected terminals per month or more if required.

Microwave Networks Incorporated is privately held by Koor Industries.

Headquarters, Marketing, Manufacturing and Research & Development

4000 Greenbriar, Suite 100-A

Stafford, Texas 77477

Tel: 281-263-6500

Fax: 281-263-6406

Number of Sales Representatives	10+
Number of Worldwide MNI Installations	150,000+ terminals
Number of Countries with MNI installations	40+
Number of Employees	50+
DUNS Number	07-799-2183

SUMMARY

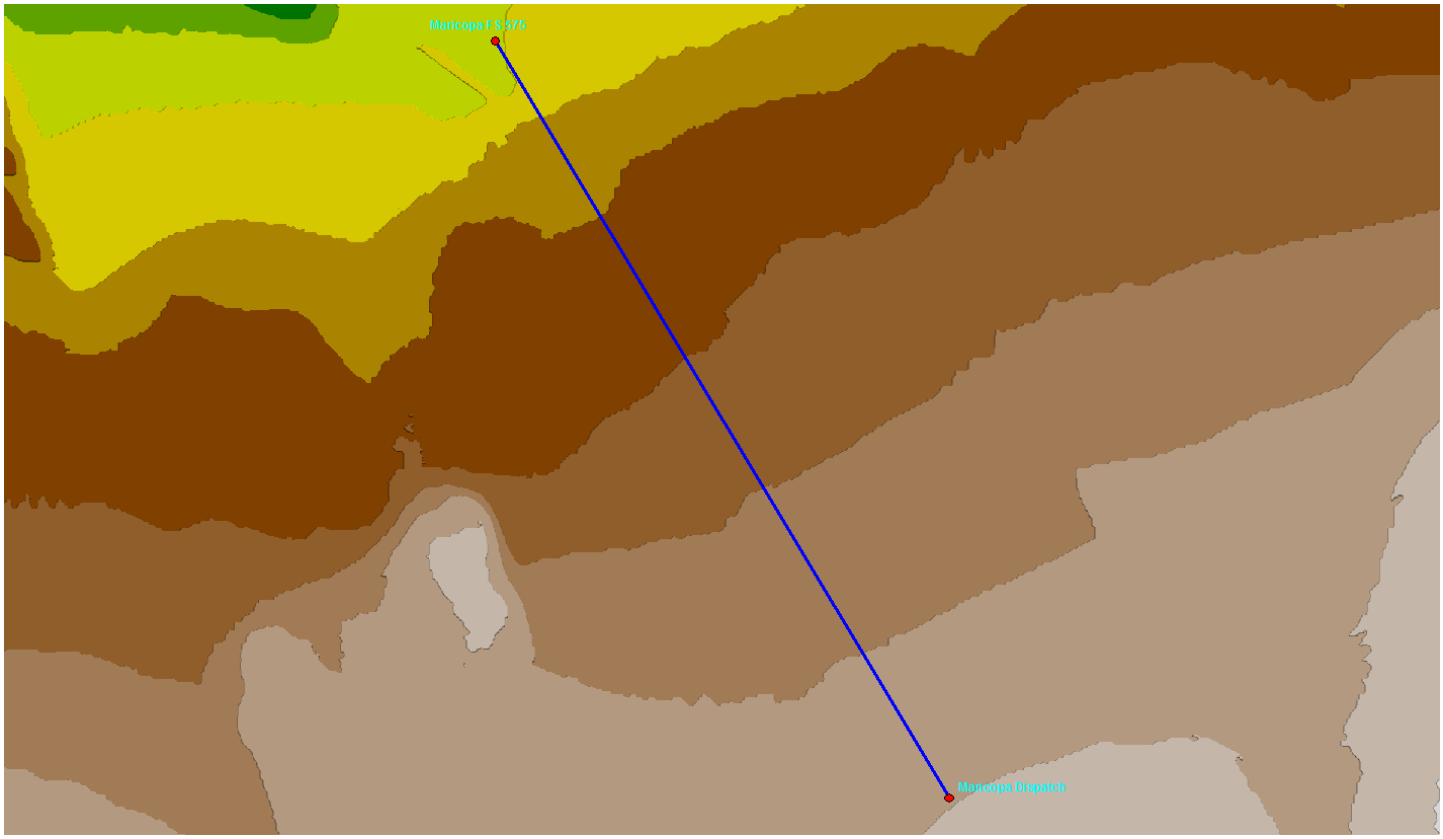
Microwave Networks offers this detailed system design and proposal as an experienced systems integrator, having supplied EF&I services on thousands of projects around the world for the last 40+ years. Our tradition of trusted performance and reliability, established through cooperation with strategic partners has resulted in successful deployments of the most complex and sensitive networks in North America and around the globe. The proposed system is intended to meet the end-to-end channel requirements now and well into the future. We look forward to demonstrating our expertise; we are committed to providing exemplary service and support to the City of Maricopa for years to come.

APPENDICES

PATH CALCULATION

Please find the Path Calculations on the following pages.

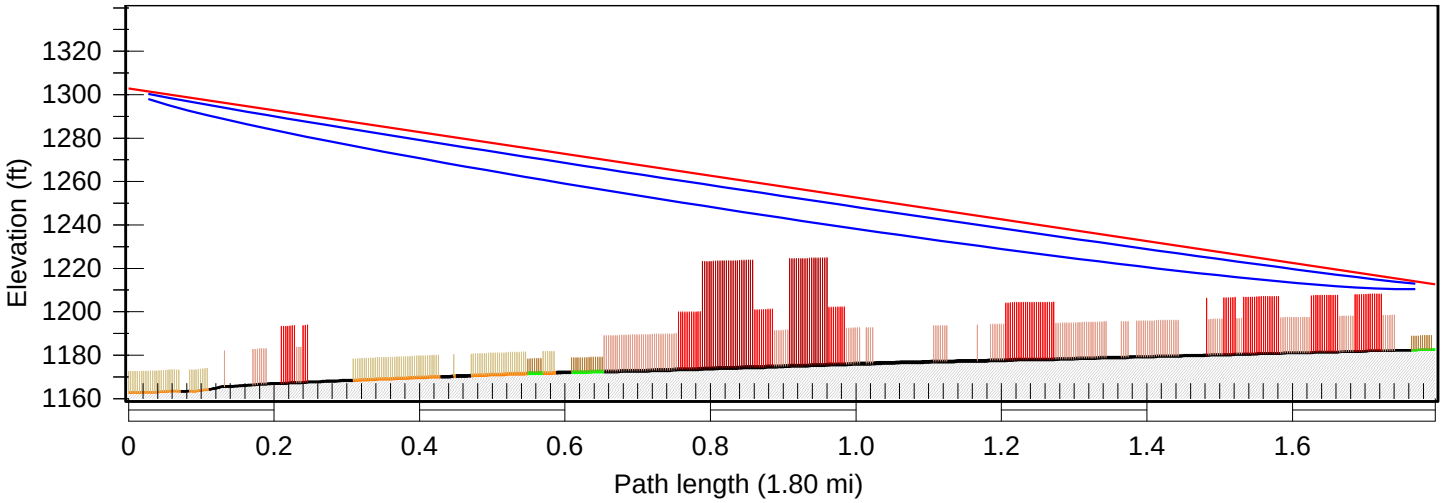
System Map



Contents

1. Path Information

Path	Site name	TR Antenna model	TR Antenna diameter (ft)	TR Antenna height (ft)	TR TX line model	TR TX line length (ft)	Effective fade margin (dB)	Radio model	Path length (mi)	Two-Way Annual Availability (%)
1	Maricopa FS 575	VHLP3-11W	3	140	EU 90	160	44.62	Proteus MX / Split Indoor/ 10 MHz/ HSBY/ High Power	1.8	99.9999
	Maricopa Dispatch	VHLP3-11W	3	30			44.62	Proteus MX / Split Mount/ 10 MHz/ HSBY/ High Power		



Maricopa FS 575	
Latitude	33 03 55.23 N
Longitude	112 03 38.06 W
Azimuth	148.94°
Elevation	1163 ft ASL
Antenna CL	140.0 ft AGL

Frequency (MHz) = 11200.0
K = 1.33, 0.67
%F1 = 100.00, 30.00

Maricopa Dispatch	
Latitude	33 02 34.85 N
Longitude	112 02 40.58 W
Azimuth	328.95°
Elevation	1182 ft ASL
Antenna CL	30.0 ft AGL

2. Maricopa FS 575-Maricopa Dispatch

	Maricopa FS 575	Maricopa Dispatch
Latitude	33 03 55.23 N	33 02 34.85 N
Longitude	112 03 38.06 W	112 02 40.58 W
True azimuth (°)	148.94	328.95
Vertical angle (°)	-0.55	0.54
Elevation (ft)	1162.74	1182.49
Antenna model	VHLP3-11W (TR)	VHLP3-11W (TR)
Antenna file name	7166	7166
Antenna gain (dBi)	38.40	38.40
Antenna diameter (ft)	0.00	0.00
Antenna height (ft)	140.00	30.00
TX line model	EU 90	
TX line unit loss (dB/100 ft)	2.89	
TX line length (ft)	160.00	
TX line loss (dB)	4.62	
Connector loss (dB)	0.25	
Circulator branching loss (dB)	1.90	1.90
Frequency (MHz)	11200.00	
Polarization	Vertical	
Path length (mi)	1.80	
Free space loss (dB)	122.67	
Atmospheric absorption loss (dB)	0.05	
Net path loss (dB)	54.59	54.59
Configuration	Hot-Standby	Hot-Standby
Radio model	MX/S/11G/10M/HP	MX/S/11G/10M/HP
Radio file name	mxs11-10-hp	mxs11-10-hp
Emission designator	10M0D7W	10M0D7W
Climatic factor	1.00	
Terrain roughness (ft)	20.00	
C factor	3.29	
Average annual temperature (°F)	71.02	
Fade occurrence factor (Po)	5.341E-004	
Polarization	Vertical	
Rain region	Phoenix, Arizona	

	TX power (dBm)		RX threshold level (dBm)		EIRP (dBm)		Receive signal (dBm)		Thermal fade margin (dB)		Flat fade margin - multipath (dB)	
64 QAM 45 Mbps	23.00	23.00	-76.50	-76.50	54.63	59.50	-31.59	-31.59	44.91	44.91	44.91	44.91
32 QAM 35 Mbps	26.00	26.00	-80.00	-80.00	57.63	62.50	-28.59	-28.59	51.41	51.41	51.41	51.41
16 QAM 25 Mbps	26.00	26.00	-84.50	-84.50	57.63	62.50	-28.59	-28.59	55.91	55.91	55.91	55.91
8 QAM 19.1 Mbps	27.00	27.00	-86.00	-86.00	58.63	63.50	-27.59	-27.59	58.41	58.41	58.41	58.41
QPSK 12.7 Mbps	27.00	27.00	-91.50	-91.50	58.63	63.50	-27.59	-27.59	63.91	63.91	63.91	63.91

	Worst month multipath		Annual multipath		Annual rain		Total annual (2 way)	Time in mode (2 way)
64 QAM 45 Mbps	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999
32 QAM 35 Mbps	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0000
16 QAM 25 Mbps	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0000
8 QAM 19.1 Mbps	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0000
QPSK 12.7 Mbps	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0000

Multipath fading method - Vigants - Barnett
Rain fading method - Crane

PROTEUS MX SPECIFICATIONS SHEET

Please find the Proteus MX Specifications Sheets on the following pages.

Microwave Networks

Proteus MX

- True 1+1 Mission Critical redundancy in a Licensed Band backhaul radio
- Integrated native TDM and IP with Ring Protection
- MPLS Compatible

Intelligent Bandwidth for Evolving Networks

The convergence of voice, data, and video networks is rapidly changing the wireless telecommunications landscape. Network operators must protect existing infrastructure investments while quickly moving to provide ever increasing capacity and new IP based services. Microwave Networks, Inc. is ready to extend your core infrastructure investments, reduce costs, and simplify operations with our unique mission critical microwave solutions.

The Proteus MX is Microwave Networks, Inc. fourth generation Ethernet/TDM hybrid backhaul radio platform. It offers carrier-class Ethernet along with native TDM in a single, feature rich, and extremely flexible platform allowing easy and cost effective migration from legacy TDM networks to either TDM/Ethernet or full Gigabit Ethernet networks.

The Proteus MX is designed specifically for mission critical applications. It features 100% redundancy of all traffic and overhead channels with automatic switchover and the security of AES encryption and RADIUS user authentication. Its unique combination of up to twelve GigE ports, an integrated add/drop native TDM mux, DS1 loop protection, Ethernet Rapid Ring Protection and Adaptive Code Modulation to increase throughput while protecting critical traffic, sets Proteus MX apart from other radios. Whether you're keeping pace with growing traffic demands or regularly reconfiguring radio-link payload for new services, the Proteus MX is designed to adapt to your needs at the lowest cost of ownership.

MADE IN U. S. A.

LTE Migration

With Proteus MX, migrating from existing TDM to new IP-based 4G/LTE networks is simple, convenient, and economical. Proteus MX's unmatched TDM traffic management combines carrier class Ethernet with software-based configuration and easy, in-field upgrades which give network providers full control over how and when to make the transition to IP, maximizing return on investment.

TDM and IP Convergence

- Input options up to twelve Gigabit Ethernet ports along with up to 32 native DS1 ports in the same hardware.
- Software-selected bandwidth, modulation, capacity, channel frequency and output power.
- Increase capacity through simple software license upgrade w/o hardware changes.
- The security of 256-bit AES payload encryption.
- VLAN using IEEE 802.1p & 802.1Q for Traffic Class priorities (QoS), port-based and tag-based VLAN.
- Adaptive Code Modulation to maintain critical traffic during adverse path conditions.
- MPLS and LTE compatible.

Integrated Traffic Management

- Dynamic Payload Mapping™ suite of features:

  Integrated add/drop mux from DS3.

  Self-healing individual DS1 loop protection and Ethernet Rapid Ethernet Ring Protection for ring network topologies.

  Detailed traffic routing and cross-connect across the hop and between co-located terminals.

- Microbus™ single cable TDM interface simplifies connections and reduces expense at repeater and nodal sites.

  Only local DS1 tributaries need to be terminated.

  The remaining TDM payload is passed among terminals using the Microbus™ high-speed serial interface on a Cat-5 cable.

Reliability and Management

- Errorless diversity switching protection.
- Complete hot-standby protection; 100% redundancy of all active components.
- Front panel removable license card retains terminal configuration and performance history during changeovers.
- Secure Network Management with SNMPv3.
- RADIUS user authentication.
- Built-in chart recorder, spectrum analyzer, and constellation viewer for diagnostics and link performance monitoring.

System Specification

Operating Frequencies (GHz)	T/R Spacing (MHz)
5.925 - 7.125	All FCC, ETSI and ITU spacings
7.125 - 7.900	154, 160, 161, 196
7.900 – 8.500	119, 126, 208, 266, 311.32
10.70 – 11.70	490, 530
12.75 – 13.25	266
14.40 - 15.35	315, 420, 475, 490, 640, 644, 728
17.70 - 19.70	1008, 1010, 1560
21.20 - 23.60	1008, 1200, 1232
24.20 - 26.50	800, 1008
37.00 - 40.00	700, 1260
Frequency Stability	+/- 10 ppm (.001 %)
RX overload	- 20 dBm for < 10-6 BER
Residual BER	Better than 10^{-12}
Altitude	15,000 ft.
Power Consumption (max.)	Split-mount: 80 W non-protected, 166 W protected All-indoor: 120 W non-protected, 250 W protected

RF Unit and Antenna

	Split Mount Outdoor Unit (ODU)	**All Indoor RF Unit**
Frequencies	6, 7, 8, 11, 13, 15, 18, 23, 26 and 38 GHz	6, 7, 8, and 11 GHz
Configuration	Split-mount; SPU inside / ODU outside	All indoor rack mounted
Dimensions	10.2 in. diameter; 5.9 in. deep	7.0 in. x 19 in. x 11.5 in. (4RU)
Weight	11 lbs.	27 lbs.
Temperature		
Full Performance	-27°F to 131°F (-33° C to +55° C)	+23° F to +122° F (-5° C to +50° C)
Operational	-67°F to 131°F (-55° C to +55° C)	
Humidity	Up to 100%	95% (no condensation)
Output Power Control	-4 dBm to Max	+8 dBm to Max
SPU to ODU Interface	TNC female (SPU); N-type female (ODU)	
Recommended Cable	LMR-400 or RG-8A/U equivalent; 50 Ohms	
Max. SPU to ODU distance	850 feet using LMR-400	
Intermediate Frequencies	SPU to ODU - 350 MHz; ODU to SPU - 140 MHz	
Antenna Diameter (ft.)	1, 2, 3, 4 & 6 - Integrated	Remote mount with elliptical waveguide;
Antenna Connection Options	Integrated push-fit or remote mounting	6 GHz: CMR-137F, CPR-137F; 7/8 GHz: UG-51/U; 11 GHz: CPR-90, UG-39/U

Signal Processing Unit (SPU)

Data Line Interface	32xDS1 (2 x 64-pin Telco) ; 4xDS3 (8 x 75-ohm BNC) ; 155 Mbps (optical LC; SM or MM)
Gigabit Ethernet	MX: 4 x 10/100/1000 BaseT Gigabit Ethernet ports or 3 x 10/100/1000BaseT + 1 x 1000BaseT Optical (SFP) MX12: 12 x 10/100/1000 BaseT Gigabit Ethernet ports
FEC & Coding	Low Density Parity Check (LDPC)
Auxiliary Interfaces	
Digital Engineering Orderwire	Integrated Digital or External RS-422 Digital O/W; 2 x RJ-45 jacks for daisy chain/external connection
Auxiliary Data Channels	2 x RS-232 up to 19.2 kbps async; 1 x RS-422 at 64 kbps async (not available if EOW configured)
Relay Alarm Outputs	4 x Form-C relays, NO & NC contacts, (software mapped)
External Inputs	6 x TTL floating inputs
Configuration Memory	Removable SD FLASH memory card (store link/terminal data & performance history)
Dimensions (h x w x d)	Dimensions (h x w x d) 3.5 in. x 19 in. x 11.2 in. (2RU)
Weight	18 lbs.
Temperature	+23° F to +122° F (-5° C to +50° C)
Humidity	Up to 95% non-condensing
Input Power	+/- 19 to +/- 60 volts DC

Specifications are subject to change without notice.

Management

Protocol	SNMPv3 (supports SNMP v1 and v2)
Authentication	RADIUS (client)
Element Manager (EM)	Java based management software; access radio through any local/remote management
NMS Interface	2 x RJ-45; 10/100/1000 BaseT; for access and bridging, configurable for in-band or out-of-band operation
Command Line Interface	RS-232 serial DB-9; for local VT-100 type interface or TELNET access
Modem (PPP)	RS-232 serial DB9; for dial-up access
Management IP Routing	RIP2 dynamic routing or static route maps
NMS Compatibility	OpenView™, NetView™, SNMPc™ or other SNMP-based NMS; Motorola MOSCAD

Standards Compliance

Safety	EN 60950
EMI/EMC	EN 301 489; EN 300 385
RF	EN 302 217-2
MAC QoS	IEEE P802.1p
VLAN	IEEE 802.1Q
Substation Environment	IEEE 1613 (Class 1)
Power Supply	EN 300 132-2
Storage	ETS 300 019-1-1 (Class 1.1E)
Transport	ETS 300 019-1-2 (Class 2.1E)
Environmental - SPU	ETS 300 019-1-3 (Class 3.1E)

ANTENNA SPECIFICATIONS SHEETS

Please find the Antenna Specification Sheets on the following pages.

Product Specifications

COMMSCOPE®

on the go

VHLP3-11W-6WH

1.0 m | 3 ft ValuLine® High Performance Low Profile Antenna, single-polarized, 10.125–11.700 GHz, CPR90G, white antenna, polymer white radome without flash, standard pack—one-piece reflector

General Specifications

Packing	Standard pack
Radome Color	White
Radome Material	Polymer
Reflector Construction	One-piece reflector
Antenna Input	CPR90G
Antenna Color	White
Antenna Type	VHLP - ValuLine® High Performance Low Profile Antenna, single-polarized
Diameter, nominal	1.0 m | 3 ft
Flash Included	No
Polarization	Single

Electrical Specifications

Beamwidth, Horizontal	2.0 °
Beamwidth, Vertical	2.0 °
Cross Polarization Discrimination (XPD)	30 dB
Electrical Compliance	Brazil Anatel Class 2 | Canada SRSP 310.5 | ETSI 302 217 Class 3 | US FCC Part 101A | US FCC Part 101B
Front-to-Back Ratio	64 dB
Gain, Low Band	37.2 dBi
Gain, Mid Band	38.4 dBi
Gain, Top Band	39.0 dBi
Operating Frequency Band	10.125 – 11.700 GHz
Radiation Pattern Envelope Reference (RPE)	7164 | 7166
Return Loss	17.7 dB
VSWR	1.30

Mechanical Specifications

Fine Azimuth Adjustment	±15°
Fine Elevation Adjustment	±15°
Mounting Pipe Diameter	115 mm | 4.5 in
Net Weight	24 kg | 53 lb
Side Struts, Included	0
Side Struts, Optional	1 inboard
Wind Velocity Operational	180 km/h | 112 mph
Wind Velocity Survival Rating	250 km/h | 155 mph

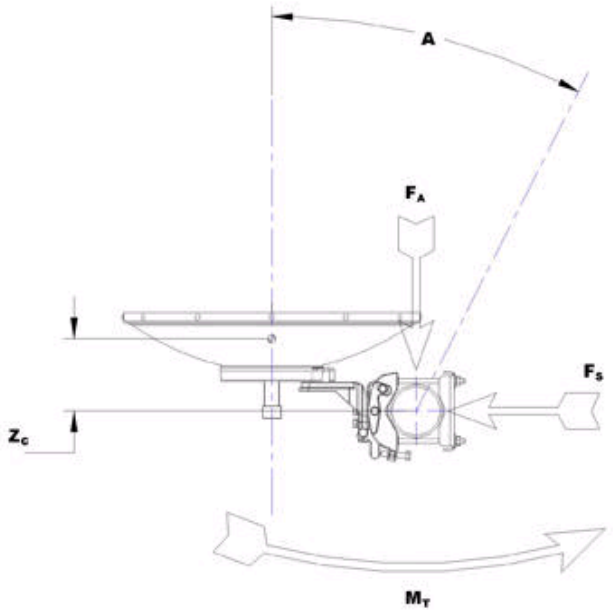
Wind Forces At Wind Velocity Survival Rating

Angle α for MT Max	0 °
Axial Force (FA)	2979 N | 670 lbf
Side Force (FS)	936 N | 210 lbf
Twisting Moment (MT)	1184 N•m
Weight with 1/2 in (12 mm) Radial Ice	46 kg | 101 lb
Zcg with 1/2 in (12 mm) Radial Ice	220 mm | 9 in
Zcg without Ice	324 mm | 13 in

Product Specifications

VHLP3-11W-6WH

Wind Forces At Wind Velocity Survival Rating Image



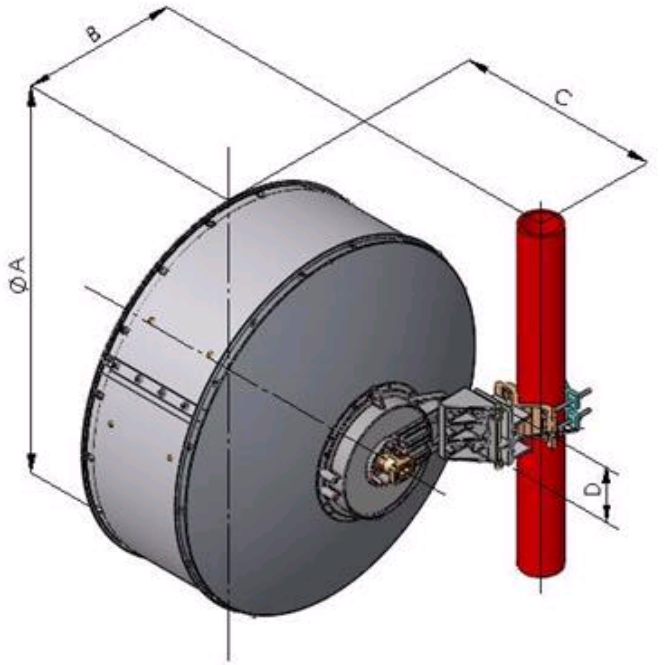
Packed Dimensions

Gross Weight, Packed Antenna	30.8 kg | 67.9 lb
Height	106.3 cm | 41.9 in
Length	119.8 cm | 47.2 in
Volume	467365.0 cc
Width	36.7 cm | 14.4 in

Product Specifications

VHLP3-11W-6WH

Antenna Dimensions And Mounting Information



Dimensions in Inches (mm)				
Antenna Size, ft (m)	A	B	C	D
3(0.9)	39.4 (1000)	17.5 (445)	24.3 (617)	6.3 (160)

Regulatory Compliance/Certifications

Agency	Classification
ISO 9001:2008	Designed, manufactured and/or distributed under this quality management system

* Footnotes

Axial Force (FA)	Maximum forces exerted on a supporting structure as a result of wind from the most critical direction for this parameter. The individual maximums specified may not occur simultaneously. All forces are referenced to the mounting pipe.
Cross Polarization Discrimination (XPD)	The difference between the peak of the co-polarized main beam and the maximum cross-polarized signal over an angle twice the 3 dB beamwidth of the co-polarized main beam.
Front-to-Back Ratio	Denotes highest radiation relative to the main beam, at 180° ±40°, across the band. Production antennas do not exceed rated values by more than 2 dB unless stated otherwise.
Gain, Mid Band	For a given frequency band, gain is primarily a function of antenna size. The gain of Andrew antennas is determined by either gain by comparison or by computer integration of the measured antenna patterns.

Product Specifications

VHLP3-11W-6WH

Operating Frequency Band	Bands correspond with CCIR recommendations or common allocations used throughout the world. Other ranges can be accommodated on special order.
Packing	Andrew standard packing is suitable for export. Antennas are shipped as standard in totally recyclable cardboard or wire-bound crates (dependent on product). For your convenience, Andrew offers heavy duty export packing options.
Radiation Pattern Envelope Reference (RPE)	Radiation patterns determine an antenna's ability to discriminate against unwanted signals under conditions of radio congestion. Radiation patterns are dependent on antenna series, size, and frequency.
Return Loss	The figure that indicates the proportion of radio waves incident upon the antenna that are rejected as a ratio of those that are accepted.
Side Force (FS)	Maximum side force exerted on the mounting pipe as a result of wind from the most critical direction for this parameter. The individual maximums specified may not occur simultaneously. All forces are referenced to the mounting pipe.
Twisting Moment (MT)	Maximum forces exerted on a supporting structure as a result of wind from the most critical direction for this parameter. The individual maximums specified may not occur simultaneously. All forces are referenced to the mounting pipe.
VSWR	Maximum; is the guaranteed Peak Voltage-Standing-Wave-Ratio within the operating band.
Wind Velocity Operational	The wind speed where the antenna deflection is equal to or less than 0.1 degrees. In the case of ValuLine antennas, it is defined as a maximum deflection of 0.3 x the 3 dB beam width of the antenna.
Wind Velocity Survival Rating	The maximum wind speed the antenna, including mounts and radomes, where applicable, will withstand without permanent deformation. Realignment may be required. This wind speed is applicable to antenna with the specified amount of radial ice.

DC POWER SUPPLY AND BATTERIES SPECIFICATIONS SHEETS

Please find the DC Power Supply and Batteries Specification Sheets on the following pages.

Compact HE 1U power systems

Increasing network speed demands flexible and expandable DC power solutions. Due to its small size, high efficiency, reliability and wide range of communication, the Flatpack S System is the key for future needs. The shallow depth makes the system suitable for most cabinets and thereby excellent as a replacement unit.

FLATPACK S 1U SYSTEMS

1U x 19” 48V – 2R/3R

Doc CTOS0X01.DS3 – v3

APPLICATIONS

TELECOM – MOBILE / WIRELESS

- RADIO BASE STATIONS/ CELL SITES
- LTE / 4G / WIMAX
- DISTRIBUTED ANTENNA SYSTEMS
- MICROWAVE
- BROADBAND

TELECOM – FIXED

- TELEPHONY SERVERS / SWITCHES
- FIBER OPTICS / FTTX
- MICROWAVE
- CABLE
- BROADBAND

SMARTPACK S CONTROLLER

FLATPACK S 48V 1800W RECTIFIER

KEY FEATURES

- COMPLETE SYSTEM
  - SMARTPACK S CONTROLLER
  - RECTIFIERS
  - BATTERY DISTRIBUTION
  - LOAD DISTRIBUTION
- 262 MM SYSTEM DEPTH
- 1U HEIGHT
- HOT PLUGGABLE RECTIFIERS
- HOT PLUGGABLE CONTROLLER
- ADVANCED CONTROL AND MONITORING THROUGH ETHERNET PORT
- 2R (40A) LOAD OPTIONS
  - 7 X 20A MCB DRAWER (OPTIONAL LVLD)
  - 4 X 20A MCB FRONT
  - 7 X 15A FUSE FRONT
- 3R (100A) LOAD OPTIONS
  - 2 X 80A

FLATPACK S 1U SYSTEMS

1U X 19” 48V – 2R/3R

Model	1 Controller + 2 Rectifiers	1 Controller + 3 Rectifiers
Part number	CTOS0201.xxx	CTOS0301.xxx
INPUT DATA		
Voltage	100 - 250V_{AC}	100 - 250V_{AC}
Mains Configuration	230V_{AC}, 1 phase or 2 x 1phase	230V_{AC}, 3 x 1 phase or 3 phase(Δ) 230/400V_{AC}, 3 phase (Y)
Mains Connection	2,5mm^2 Terminal blocks, rear connection	
Frequency	45 to 66Hz	
OUTPUT DATA		
Voltage	- 48Vdc	- 48Vdc
Max. Current	40A	100A
BATTERY DISTRIBUTION		
LVBD	Default	Default
Breaker (Plug-in type) maximum size	2 x 40A[1)]	2 x 80A[1)]
Connection (rear)	16mm^2 Terminal blocks	M6 cable lug
LOAD DISTRIBUTION		
Rear connections	N/A	2 x 80A, M6 cable lug
Rear cabel entry, front access Connections, screw terminals Optional LVLD	7 x 20A MCB [2)] 7 X 4mm^2 on MCB 1 and 2	N/A
Front connections Plug-able screw terminals	4 x 20A MCB / 7 x 15A Fuse 4mm^2	N/A
CONTROL & MONITORING		
Smartpack S	6x Input/Output and Ethernet, See Smartpack S datasheet	
MECHANICAL DATA		
Dimensions (W/H/D)	19"/1U/262mm Recommended minimum cabinet depth, 300 mm	
Weight, including controller and distributions, excluding rectifiers	5.3 kg [11.7 lbs]	5.2 kg [11.5 lbs]
DESIGN STANDARDS		
Electrical safety	UL 60950-1, EN 60950-1	
EMC	ETSI EN 300 386 V.1.4.1 EN 61000-6-1 (immunity, light industry) EN 61000-6-2 (immunity, industry) EN 61000-6-3 (emission, light industry) EN 61000-6-4 (emission, industry)	
Environment	ETSI EN 300 019-2-1 Class 1.2 ETSI EN 300 019-2-2 Class 2.3 ETSI EN 300 019-2-3 Class 3.2	

1) If only one string is used, one of the battery breakers can be configured as a load breaker.
2) Drawer solution, front access for actual connection, but cables enters from rear

Eltek — Gråterudveien 8, PB 2340 Strømsø, 3003 Drammen, Norway Phone: +47 32 20 32 00

NSB 100FT *Red Battery®*

Long float life at elevated temperatures

Red Star Technology® uses pure lead plates to deliver **exceptionally long float life even at elevated temperatures.**

- Pure lead AGM technology delivers long float life for telecom applications even at elevated temperatures
- 15 year float life at 20°C (68°F)
- EUROBAT design life definition: Long Life (12+ years)
- High energy density
- Operating temperature range:
  -40°C to +65°C (-40°F to 149°F)
- State-of-the-art automated manufacturing ensures consistency and reliability
- Advanced 3 stage terminal design to ensure leak-free operation - female M8 brass terminals provide maximum performance
- 2 year shelf life at 25°C (77°F)
- High modulus Polyphenylene Oxide (PPO) plastic materials designed to withstand extended elevated operating temperatures and maintain high battery compression essential for reliable operation
  - Non-halogenated, thermally sealed plastic casing
  - Flame retardant (UL 94 V0) and LOI of at least 28%
- Integral handles and front access terminals ensure ease of installation and maintenance
- Approved as non-hazardous cargo for ground, sea, and air transport - DOT 49CFR173.159(d), (i) and (ii)

Visit our website to find out more **www.northstarbattery.com**

NorthStar®

Form: SES-542-53-03 Issued: 05-14-15 ECO-100527

NSB 100FT *Red Battery®*

Nominal Technical Specifications

Electrical

	International Standard 20°C (68°F)	North American Standard 25°C (77°F)
8 hour capacity to 1.75 VPC	98 Ah	100 Ah
10 hour capacity to 1.80 VPC	99 Ah	100 Ah
Float Voltage	2.29 +/- 0.02 Volts/Cell	2.27 +/- 0.02 Volts/Cell
Nominal Voltage	12 V	
Impedance (1kHz)	3.9 mΩ @ 25°C (77°F)	
Conductance	1,298 S	
Short Circuit Current	3,500 A	

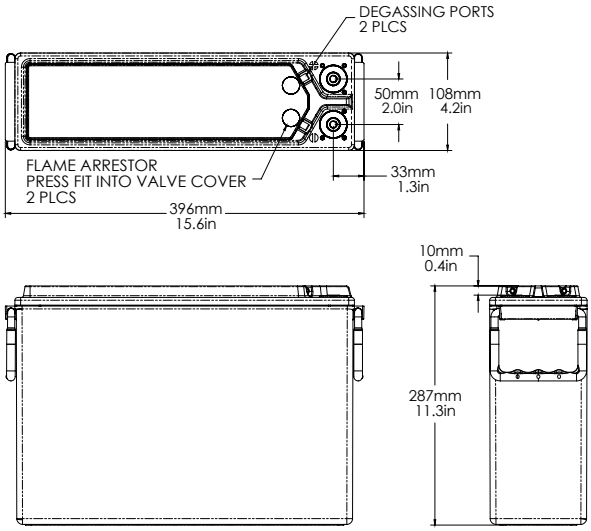
Dimensions

Height	287 mm (11.3 in)	Weight	33 kg (72 lbs)
Width	108 mm (4.2 in)	Terminal	Female M8 x 1.25
Depth	396 mm (15.6 in)	Terminal Torque	8.0 Nm (71 in-lbs)

Ah Capacity Ratings @ 25°C (77°F)

Capacity Discharge / hours	1	2	4	8	10
Capacity @ 25°C / Ah	81	88	94	100	100
End of Discharge / VPC	1.70	1.75	1.75	1.75	1.80

Drawings



All NorthStar batteries are compliant with: Telcordia SR4228, IEC 60896; Bellcore GR-63-Core, Issue 1; British, German, and Russian telecom standards; UL approved. NorthStar is registered to ISO 9001 and ISO 14001.

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asia@northstarsitetel.com
Tel: +60 3 6419 0711

www.northstarbattery.com

Form: SES-542-53-03 Issued: 05-14-15 ECO-100527

STANDARD WARRANTY STATEMENT

Products manufactured by Microwave Networks Incorporated ("MNI") are warranted to be free from defect in material and workmanship under normal use and service for a period of two (2) years from the date of shipment. In the event of a defect during the warranty period, Buyer will return the defective item to the MNI depot repair facility for repair or replacement. Repair at MNI's option may include the replacement of parts or equipment and all replaced parts or equipment shall be the property of MNI. Parts or equipment replaced during the warranty period are warranted for the remainder of the original applicable warranty period or ninety (90) days, whichever is greater. This expressed warranty is extended by MNI to the original Buyer for commercial, industrial or governmental use. Such action on the part of MNI shall be the full extent of MNI's liability and Buyer's exclusive remedy for breach of warranty. Expenses of Buyer such as travel expenses are not covered by this warranty.

This warranty extends only to products manufactured by MNI, and it is expressly conditioned upon the equipment having been installed in accordance with the installation practices accepted by the telecommunications industry, the standard installation and configuration practices recommended by MNI, and the equipment having been maintained in accordance with MNI recommended standard maintenance practices. Vendor products and other equipment not manufactured by MNI are excluded, but carry their own separate limited warranties.

This warranty shall automatically terminate if the product is used in other than its normal and customary use, has been subject to misuse, accident, neglect, or damage, is improperly disassembled, improper alterations or repairs, or if nonconforming parts are used in the product, unless done by a service facility authorized by MNI to perform warranty service. The warranty for Network Management Systems (NMS) shall automatically terminate if software is altered, added, or removed from the platform without the prior approval of MNI. NMS provided by MNI do not include virus protection software and this warranty does not cover damages caused by computer viruses.

Because each radio system is unique, MNI disclaims liability for range, coverage, or operation of a system as a whole under this warranty. This warranty shall not cover any damages caused by Acts of God including, but not limited to, flood, lightning, seismic activity; and events of *Force Majeure* such as fire, explosion, war, civil disturbance et al.

THIS MNI WARRANTY IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EITHER EXPRESSED OR IMPLIED, WHICH ARE SPECIFICALLY EXCLUDED, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

An authorization to return products under this warranty must be obtained from a MNI Customer Service Representative prior to making shipment to MNI's service location, and all returns shall be shipped freight pre-paid. MNI shall be responsible for return freight charges only on repaired and replaced products found to be defective.

In the event that MNI provides services only, MNI warrants the performance and specifications of such services but does not warrant that services performed will fulfill the total system requirement of the Buyer.

CUSTOMER SUPPORT

Technical support is available 24 hours per day, seven days a week. Experienced Technical Support Engineers are available in the USA from 8:00am – 5:00pm (Central Time) Monday through Friday. At all other times, our Technical Support Engineers will return your call within 30 minutes whenever you have a traffic affecting emergency.

Technical Support is guaranteed for current products or products on Additions and Maintenance status. Support on Manufacture-Discontinued (MD) products will vary depending on age of product, available material, available spares, etc. Telephone Technical Support on MD products may be subject to a charge depending upon duration and nature of assistance.

During Business Hours:

U.S. and Canada

Toll Free: 1-888-225-4762 / 6429

TEL: 281-263-6500

FAX: 281-263-6730

Outside U.S. and Canada

TEL: 281-263-6501

FAX: 281-263-6730

After Business Hours:

U.S. and Canada

Toll Free: 1-888-225-4762 / 6429

FAX: 281-263-6730

Outside U.S. and Canada

TEL: 281-263-6501

FAX: 281-263-6730

Repair / Exchange Service

Standard Repair

MNI provides module repair service at no charge for items under warranty. Modules out of warranty are repaired on a fee basis. The standard repair turnaround for products currently being manufactured is typically 21working days from receipt of module.

Emergency Repair

Emergency repair is available with a 24-hour turnaround on current manufactured products.

Emergency Exchange

Emergency exchange turnaround time is 24 hours for non-frequency sensitive products and 48 hours for frequency sensitive modules (subject to the availability). There is no charge for Warranty exchange.

Manufactured Discontinued products are subject to the availability of parts. Standard and Emergency repair time frames do not necessarily apply to manufacture discontinued products, frequency specific modules, assemblies, and radios.