LigoWave Licensed

Product Purchasing Guide

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Contents

About This Guide

Purpose

The purpose of this document is to introduce distributors, sales channels, and customers to the LigoWave licensed backhaul products. This document will explain the components of the products, process in purchasing, and steps needed to release the product to end users.

Definitions, Acronyms and Abbreviations

The following typographic conventions and symbols are used throughout this document:

Additional information that may be helpful but which is not required.

Important information that should be observed.

Ligowave Support

If you have any questions about the product please contact the LigoWave sales department.

Introduction

The LigoPTP 620S is split architecture, 7-23 GHz product platform designed to provide high capacity transmission, flexibility, and convenience for wireless communication networks. The PTP 620S digital point-to-point radios represent a new microwave radio product line that is designed to address universal applications for both Ethernet and TDM platforms. This advanced technology platform is designed to provide a flexible, cost-effective platform for customers now and into the future.

The PTP 620S equipment is based upon a common platform to support a wide range of network interfaces and configurations, with capacities up to 2 E1 / T1 (optional) and Gigabit Ethernet Full Duplex capacity up to 310 Mbps (620 Mbps aggregate). The radio family is spectrum and data rate scalable, enabling service providers or organizations to employ appropriate system gain with spectral efficiency and channel availability for optimal network connectivity. The PTP 620S series digital radios enable network operators (mobile and private), government and access service providers to offer a portfolio of secure and scalable wireless applications for data, video, and voice services.

The PTP 620S digital radio family is composed of a LigoWave Software Controlled Smart IDU and an Outdoor Unit (ODU). The IDU is designed to be frequency independent, and the ODU is designed to be capacity independent. The PTP 620S IDU allows selection for multiple capacity options, modulation types, radio frequency channels and transmit output power levels to accommodate and adhere to world-wide regulatory and spectral efficiency requirements. The IDU supports 1 Gigabit Ethernet port for customer traffic as well as an additional Fast Ethernet port for management traffic. The IDU also supports an optional module for adding 2 E1 or 2 T1 ports to the unit for quick and easy provisioning of TDM traffic over the link.

The PTP 620S Digital Radio includes integrated Operations, Administration, Maintenance, and Provisioning (OAM&P) functionality and design features enabling simple commissioning when the radio network is initially set up in the field or at the customer's premises.

Key Features

Cost Effective Design

Up to 620 Mbps data throughput (310 Mbps full duplex)

No speed-based license fees – get full capacity out of the box

Wide frequency range support from 7-23 GHz

Flexible channel sizes from 3.5MHz to 56MHz

ANSI and ETSI channel plans supported enabling worldwide support

Auto-rate support (ACM) enables robust links

One Common IDU for all Capacities/Frequencies

Antennas available*:

PTP X-620S-ANT-1: includes 1 ft. diameter, slip-fit waveguide antenna

PTP X-620S-ANT-2: includes 2 ft. diameter, slip-fit waveguide antenna

PTP X-620S-ANT-3: includes 3 ft. diameter, slip-fit waveguide antenna

PTP X-620S-ANT-4: includes 4 ft. diameter, slip-fit waveguide antenna

PTP X-620S-ANT-6: includes 6 ft. diameter, slip-fit waveguide antenna (special order)

User-Friendly Management System with support for Telnet, Web, and SNMP

Optional cost effective E1/T1 module for up to 2 E1/T1 support

Software Controllable Capacities between T1/E1 and Ethernet

Very compact, yet powerful IDU saves space

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*Antenna availability varies based on local regulations.

System Components

Indoor Unit

The Indoor Unit (IDU) is stored indoors and is connected directly to the ODU via LMR cabling. The IDU is powered by -48V DC.

The IDU is not frequency dependent. The same IDU may be used for all LigoWave licensed products.

Outdoor Unit

The Outdoor Unit (ODU) is mounted outdoors and is attached directly to the antenna. It is connected to the IDU via LMR cable. The IDU powers and controls the ODU through the LMR connection.

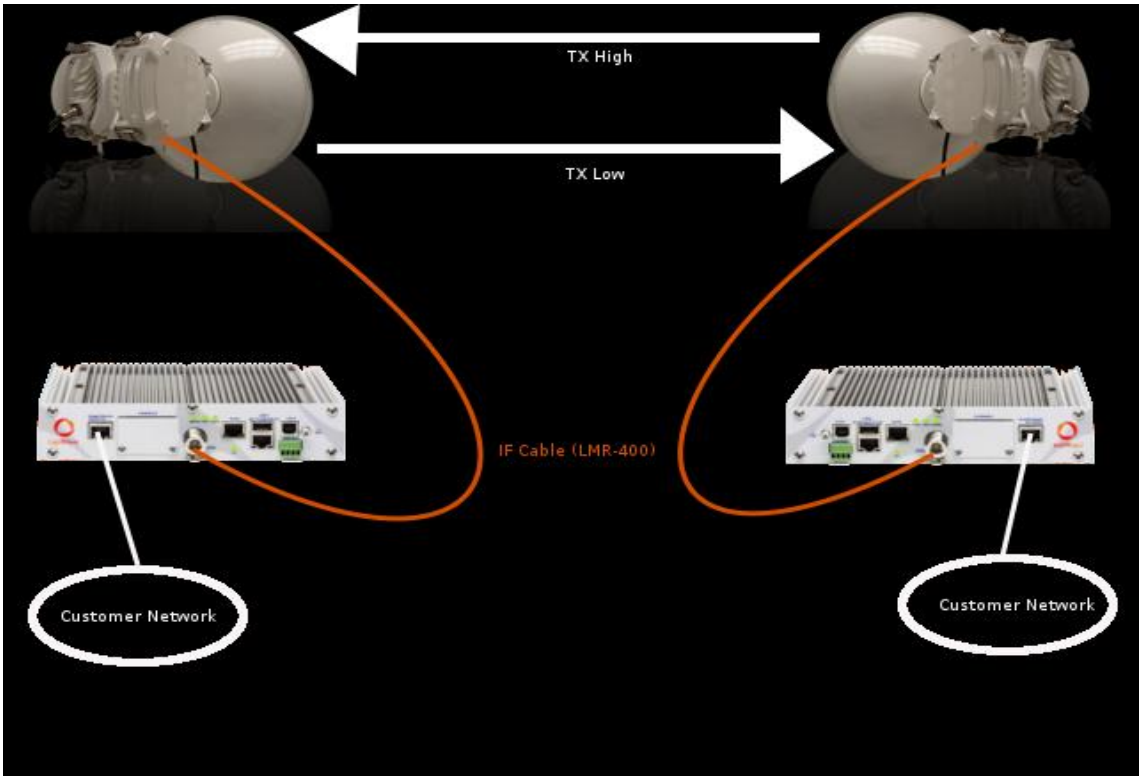
The ODU is frequency specific and also specific to the transmit/receive spacing that is controlled by the internal diplexer. Please note that frequency ranges for the ODUs are absolutes so ½ of the desired channel bandwidth must be added and deducted to the center frequency and these frequencies must also be in the frequency range of the ODU.

Antenna

Antennas are provided in different sizes and gains for each frequency. Typically the size of the antenna may range from 1' (0.3m) to 6' (2m). The antenna attaches directly to the mounting structure via the mounting bracket. The ODU then attaches directly to the antenna, thus there is no additional mounting hardware required for the ODU.

E1/T1 Module

The LigoWave licensed backhauls natively support passing the traffic of 2 E1/T1 links with the E1/T1 add-on module. This module is installed directly in the IDU and must be installed separately. 2 of these modules are required per link (one on each side) and use RJ-45 jacks for termination of the E1/T1.



Purchasing Process

Selecting the ODU

1. The first step in the process is determining which frequency to use (11GHz, 18GHz, etc). This will be the radio band as labeled by *X* in the LigoWave Pricing Guide for the ODU (*PTP X-620S-ODU*) and the Antenna (*PTP X-620S-ANT-Y*) Where X is the band, and Y is the size (in feet). As a general rule, lower frequencies will allow for longer links than higher frequencies due to the fact that rain has less of an impact on lower frequencies versus higher frequencies. Ligowave encourages the use of its free online link planning tool for determining link requirements (http://www.ligowave.com/linkcalc). Currently the available options are as follows (please contact Ligowave for additional frequencies):
    - 7GHz
    - 8GHz
    - 11GHz
    - 13GHz
    - 15GHz
    - 18GHz
    - 23GHz
2. After determining the band, the sub-band (exact frequencies) will need to be chosen. This may be based on availability in the licensed spectrum in your area. This process may need to be coordinated by a licensed frequency coordinator in your area depending on regulatory rules.

    The frequency coordinator will do the necessary research to determine if other operators exist in your area and if any new links are possible. If new links are possible, the coordinator will assign your link a frequency pair (low-tx and high-tx).
3. With the band and exact frequencies determined, it is then possible to order the exact equipment necessary to complete the link. For model numbers please refer to the LigoWave Licensed Part Numbers in Appendix A.

    For example, if you are assigned frequencies 10960MHz and 11450MHz, you will choose the following options from the spreadsheet:

LW-S110490BN-0H110-C0	Lo	B WR	10795	10975	490	180
LW-S110490BP-0H110-C0	Hi	B WR	11285	11465	490	180

Selecting the IDU

The IDU is frequency independent and is the same for all orders.

Selecting the Antenna

The antenna is based on the band used (7, 8, 11, 13, 15, 18, 23 (GHz)) as well as the antenna size. The larger the antenna, the higher the gain and also note that higher frequency antennas will have higher gain than lower frequency antennas, given the same size.

When selecting the antenna, use model number **PTP X-620S-ANT-Y** where **X** is the band, and **Y** is the size (1, 2, 3, 4, or 6 feet).

See Appendix B for more details on the LigoWave antenna specifications.

Appendix A

7GHz

Part Number	TX Hi/Lo	Sub-band	Waveguide	TX Range (Min)	TX Range (Max)	T/R Spacing	Diplexer Range
LW-S070196AN-0H100-C0	Lo	A	WC	7093	7149	196	56
LW-S070196AP-0H100-C0	Hi	A	WC	7289	7345	196	56
LW-S070196BN-0H100-C0	Lo	B	WC	7121	7177	196	56
LW-S070196BP-0H100-C0	Hi	B	WC	7317	7373	196	56
LW-S070196CN-0H100-C0	Lo	C	WC	7149	7205	196	56
LW-S070196CP-0H100-C0	Hi	C	WC	7345	7401	196	56
LW-S070196DN-0H100-C0	Lo	D	WC	7177	7233	196	56
LW-S070196DP-0H100-C0	Hi	D	WC	7373	7429	196	56
LW-S070196EN-0H100-C0	Lo	E	WC	7205	7261	196	56
LW-S070196EP-0H100-C0	Hi	E	WC	7401	7457	196	56
LW-S070161AN-0H100-C0	Lo	A	WC	7114	7177	161	63
LW-S070161AP-0H100-C0	Hi	A	WC	7275	7338	161	63
LW-S070161BN-0H100-C0	Lo	B	WC	7149	7212	161	63
LW-S070161BP-0H100-C0	Hi	B	WC	7310	7373	161	63
LW-S070161CN-0H100-C0	Lo	C	WC	7184	7247	161	63
LW-S070161CP-0H100-C0	Hi	C	WC	7345	7408	161	63
LW-S070161DN-0H100-C0	Lo	D	WC	7219	7282	161	63
LW-S070161DP-0H100-C0	Hi	D	WC	7380	7443	161	63
LW-S070161EN-0H100-C0	Lo	E	WC	7239	7302	161	63
LW-S070161EP-0H100-C0	Hi	E	WC	7400	7463	161	63
LW-S070161FN-0H100-C0	Lo	F	WC	7274	7337	161	63
LW-S070161FP-0H100-C0	Hi	F	WC	7435	7498	161	63

LW-S070161GN-0H100-C0	Lo	G	WC	7309	7372	161	63
LW-S070161GP-0H100-C0	Hi	G	WC	7470	7533	161	63
LW-S070161HN-0H100-C0	Lo	H	WC	7344	7407	161	63
LW-S070161HP-0H100-C0	Hi	H	WC	7505	7568	161	63
LW-S070161IN-0H100-C0	Lo	I	WC	7414	7477	161	63
LW-S070161IP-0H100-C0	Hi	I	WC	7575	7638	161	63
LW-S070161JN-0H100-C0	Lo	J	WC	7449	7512	161	63
LW-S070161JP-0H100-C0	Hi	J	WC	7610	7673	161	63
LW-S070161KN-0H100-C0	Lo	K	WC	7484	7547	161	63
LW-S070161KP-0H100-C0	Hi	K	WC	7645	7708	161	63
LW-S070161LN-0H100-C0	Lo	L	WC	7519	7582	161	63
LW-S070161LP-0H100-C0	Hi	L	WC	7680	7743	161	63
LW-S070161MN-0H100-C0	Lo	M	WC	7539	7602	161	63
LW-S070161MP-0H100-C0	Hi	M	WC	7700	7763	161	63
LW-S070161NN-0H100-C0	Lo	N	WC	7574	7637	161	63
LW-S070161NP-0H100-C0	Hi	N	WC	7735	7798	161	63
LW-S070161ON-0H100-C0	Lo	O	WC	7609	7672	161	63
LW-S070161OP-0H100-C0	Hi	O	WC	7770	7833	161	63
LW-S070161PN-0H100-C0	Lo	P	WC	7644	7707	161	63
LW-S070161PP-0H100-C0	Hi	P	WC	7805	7868	161	63
LW-S070154AN-0H100-C0	Lo	A	WC	7428	7484	154	56
LW-S070154AP-0H100-C0	Hi	A	WC	7582	7638	154	56
LW-S070154BN-0H100-C0	Lo	B	WC	7470	7526	154	56
LW-S070154BP-0H100-C0	Hi	B	WC	7624	7680	154	56
LW-S070154CN-0H100-C0	Lo	C	WC	7512	7568	154	56
LW-S070154CP-0H100-C0	Hi	C	WC	7666	7722	154	56
LW-S070160AN-0H100-C0	Lo	A	WC	7433.5	7496.5	160	63
LW-S070160AP-0H100-C0	Hi	A	WC	7593.5	7656.5	160	63
LW-S070160BN-0H100-C0	Lo	B	WC	7478.5	7541.5	160	63

LW-S070160BP-0H100-C0	Hi	B	WC	7638.5	7701.5	160	63
LW-S070160CN-0H100-C0	Lo	C	WC	7526	7589	160	63
LW-S070160CP-0H100-C0	Hi	C	WC	7686	7749	160	63
LW-S070168AN-0H100-C0	Lo	A	WC	7443	7499	168	56
LW-S070168AP-0H100-C0	Hi	A	WC	7611	7667	168	56
LW-S070168BN-0H100-C0	Lo	B	WC	7485	7541	168	56
LW-S070168BP-0H100-C0	Hi	B	WC	7653	7709	168	56
LW-S070168CN-0H100-C0	Lo	C	WC	7527	7583	168	56
LW-S070168CP-0H100-C0	Hi	C	WC	7695	7751	168	56
LW-S070245AN-0H100-C0	Lo	A	WC	7400	7484	245	84
LW-S070245AP-0H100-C0	Hi	A	WC	7645	7729	245	84
LW-S070245BN-0H100-C0	Lo	B	WC	7484	7568	245	84
LW-S070245BP-0H100-C0	Hi	B	WC	7729	7813	245	84
LW-S070245CN-0H100-C0	Lo	C	WC	7568	7652	245	84
LW-S070245CP-0H100-C0	Hi	C	WC	7813	7897	245	84

8GHz

Part Number	TX Hi/Lo	Sub-band	Waveguide	TX Range (Min)	TX Range (Max)	T/R Spacing	Diplexer Range
LW-S080119AN-0H100-C0	Lo	A	WC	8279	8307	119&126*	28
LW-S080119AP-0H100-C0	Hi	A	WC	8398	8426	119&126*	28
LW-S080119BN-0H100-C0	Lo	B	WC	8293	8321	119&126*	28
LW-S080119BP-0H100-C0	Hi	B	WC	8412	8440	119&126*	28
LW-S080119CN-0H100-C0	Lo	C	WC	8307	8335	119&126*	28
LW-S080119CP-0H100-C0	Hi	C	WC	8426	8454	119&126*	28
LW-S080119DN-0H100-C0	Lo	D	WC	8321	8349	119&126*	28
LW-S080119DP-0H100-C0	Hi	D	WC	8440	8468	119&126*	28
LW-S080119EN-0H100-C0	Lo	E	WC	8335	8363	119&126*	28
LW-S080119EP-0H100-C0	Hi	E	WC	8454	8482	119&126*	28
LW-S080119FN-0H100-C0	Lo	F	WC	8349	8377	119&126*	28
LW-S080119FP-0H100-C0	Hi	F	WC	8468	8496	119&126*	28
LW-S080208AN-0H100-C0	Lo	A	WC	8043	8113	208	70
LW-S080208AP-0H100-C0	Hi	A	WC	8251	8321	208	70
LW-S080208BN-0H100-C0	Lo	B	WC	8099	8169	208	70
LW-S080208BP-0H100-C0	Hi	B	WC	8307	8377	208	70
LW-S080208CN-0H100-C0	Lo	C	WC	8155	8225	208	70
LW-S080208CP-0H100-C0	Hi	C	WC	8363	8433	208	70
LW-S080208DN-0H100-C0	Lo	D	WC	8211	8281	208	70
LW-S080208DP-0H100-C0	Hi	D	WC	8419	8489	208	70
LW-S080266AN-0H100-C0	Lo	A	WC	7905	8024	266	119
LW-S080266AP-0H100-C0	Hi	A	WC	8171	8290	266	119
LW-S080266BN-0H100-C0	Lo	B	WC	8017	8136	266	119
LW-S080266BP-0H100-C0	Hi	B	WC	8283	8402	266	119
LW-S080311AN-0H100-C0	Lo	A	WC	7731	7867	311.32	136

LW-S080311AP-0H100-C0	Hi	A	WC	8042	8178	311.32	136
LW-S080311BN-0H100-C0	Lo	B	WC	7835	7971	311.32	136
LW-S080311BP-0H100-C0	Hi	B	WC	8146	8282	311.32	136

11GHz

Part Number	TX Hi/Lo	Sub-band	Waveguide	TX Range (Min)	TX Range (Max)	T/R Spacing	Diplexer Range
LW-S110490AN-0H010-C0	Lo	A	WR	10675	10855	490	180
LW-S110490AP-0H010-C0	Hi	A	WR	11165	11345	490	180
LW-S110490BN-0H010-C0	Lo	B	WR	10795	10975	490	180
LW-S110490BP-0H010-C0	Hi	B	WR	11285	11465	490	180
LW-S110490CN-0H010-C0	Lo	C	WR	10915	11095	490	180
LW-S110490CP-0H010-C0	Hi	C	WR	11405	11585	490	180
LW-S110490DN-0H010-C0	Lo	D	WR	11035	11215	490	180
LW-S110490DP-0H010-C0	Hi	D	WR	11525	11705	490	180
LW-S110500AN-0H010-C0	Lo	A	WR	10700	10890	490&500*	190
LW-S110500AP-0H010-C0	Hi	A	WR	11200	11390	490&500*	190
LW-S110500BN-0H010-C0	Lo	B	WR	10855	11045	490&500*	190
LW-S110500BP-0H010-C0	Hi	B	WR	11355	11545	490&500*	190
LW-S110500CN-0H010-C0	Lo	C	WR	11010	11200	490&500*	190
LW-S110500CP-0H010-C0	Hi	C	WR	11510	11700	490&500*	190
LW-S110530AN-0H010-C0	Lo	A	WR	10675	10855	530	180
LW-S110530AP-0H010-C0	Hi	A	WR	11205	11385	530	180
LW-S110530BN-0H010-C0	Lo	B	WR	10795	10975	530	180
LW-S110530BP-0H010-C0	Hi	B	WR	11325	11505	530	180
LW-S110530CN-0H010-C0	Lo	C	WR	10915	11135	530	220
LW-S110530CP-0H010-C0	Hi	C	WR	11445	11665	530	220
LW-S110530DN-0H010-C0	Lo	D	WR	11035	11215	530	180
LW-S110530DP-0H010-C0	Hi	D	WR	11565	11745	530	180

13GHz

Part Number	TX Hi/Lo	Sub-band	Waveguide	TX Range (Min)	TX Range (Max)	T/R Spacing	Diplexer Range
LW-S130266AN-0H110-C0	Lo	A	WR	12751	12814	266	63
LW-S130266AP-0H110-C0	Hi	A	WR	13017	13080	266	63
LW-S130266BN-0H110-C0	Lo	B	WR	12807	12870	266	63
LW-S130266BP-0H110-C0	Hi	B	WR	13073	13136	266	63
LW-S130266CN-0H110-C0	Lo	C	WR	12863	12926	266	63
LW-S130266CP-0H110-C0	Hi	C	WR	13129	13192	266	63
LW-S130266DN-0H110-C0	Lo	D	WR	12919	12982	266	63
LW-S130266DP-0H110-C0	Hi	D	WR	13185	13248	266	63

15GHz

Part Number	TX Hi/Lo	Sub-band	Waveguide	TX Range (Min)	TX Range (Max)	T/R Spacing	Diplexer Range
LW-S150315AN-0H110-C0	Lo	A	WR	14627	14732	315	105
LW-S150315AP-0H110-C0	Hi	A	WR	14942	15047	315	105
LW-S150315BN-0H110-C0	Lo	B	WR	14725	14844	315	119
LW-S150315BP-0H110-C0	Hi	B	WR	15040	15159	315	119
LW-S150315CN-0H110-C0	Lo	C	WR	14823	14928	315	105
LW-S150315CP-0H110-C0	Hi	C	WR	15138	15243	315	105
LW-S150420AN-0H110-C0	Lo	A	WR	14501	14613	420	112
LW-S150420AP-0H110-C0	Hi	A	WR	14921	15033	420	112
LW-S150420BN-0H110-C0	Lo	B	WR	14606	14725	420	119
LW-S150420BP-0H110-C0	Hi	B	WR	15026	15145	420	119
LW-S150420CN-0H110-C0	Lo	C	WR	14718	14837	420	119
LW-S150420CP-0H110-C0	Hi	C	WR	15138	15257	420	119
LW-S150420DN-0H110-C0	Lo	D	WR	14816	14928	420	112
LW-S150420DP-0H110-C0	Hi	D	WR	15236	15348	420	112
LW-S150490AN-0H110-C0	Lo	A	WR	14403	14522	490	119
LW-S150490AP-0H110-C0	Hi	A	WR	14893	15012	490	119
LW-S150490BN-0H110-C0	Lo	B	WR	14515	14634	490	119
LW-S150490BP-0H110-C0	Hi	B	WR	15005	15124	490	119
LW-S150490CN-0H110-C0	Lo	C	WR	14627	14746	490	119
LW-S150490CP-0H110-C0	Hi	C	WR	15117	15236	490	119
LW-S150490DN-0H110-C0	Lo	D	WR	14739	14858	490	119
LW-S150490DP-0H110-C0	Hi	D	WR	15229	15348	490	119
LW-S150475AN-0H110-C0	Lo	A	WR	14500	14668	475	168
LW-S150475AP-0H110-C0	Hi	A	WR	14975	15143	475	168
LW-S150475BN-0H110-C0	Lo	B	WR	14660	14828	475	168

LW-S150475BP-0H110-C0	Hi	B	WR	15135	15303	475	168
LW-S150475CN-0H110-C0	Lo	C	WR	14715	14883	475	168
LW-S150475CP-0H110-C0	Hi	C	WR	15190	15358	475	168
LW-S150640AN-0H110-C0	Lo	A	WR	14500	14610	640	110
LW-S150640AP-0H110-C0	Hi	A	WR	15140	15250	640	110
LW-S150640BN-0H110-C0	Lo	B	WR	14605	14715	640	110
LW-S150640BP-0H110-C0	Hi	B	WR	15245	15355	640	110
LW-S150644AN-0H110-C0	Lo	A	WR	14400	14512	644	112
LW-S150644AP-0H110-C0	Hi	A	WR	15044	15156	644	112
LW-S150644BN-0H110-C0	Lo	B	WR	14498	14610	644	112
LW-S150644BP-0H110-C0	Hi	B	WR	15142	15254	644	112
LW-S150644CN-0H110-C0	Lo	C	WR	14596	14708	644	112
LW-S150644CP-0H110-C0	Hi	C	WR	15240	15352	644	112
LW-S150728AN-0H110-C0	Lo	A	WR	14500	14615	728	115
LW-S150728AP-0H110-C0	Hi	A	WR	15228	15343	728	115

18GHz

Part Number	TX Hi/Lo	Sub-band	Waveguide	TX Range (Min)	TX Range (Max)	T/R Spacing	Diplexer Range
LW-S181010AN-0H110-C0	Lo	A	WR	17685	17985	1010&1008*	300
LW-S181010AP-0H110-C0	Hi	A	WR	18695	18995	1010&1008*	300
LW-S181010BN-0H110-C0	Lo	B	WR	17930	18230	1010&1008*	300
LW-S181010BP-0H110-C0	Hi	B	WR	18940	19240	1010&1008*	300
LW-S181010CN-0H110-C0	Lo	C	WR	18180	18480	1010&1008*	300
LW-S181010CP-0H110-C0	Hi	C	WR	19190	19490	1010&1008*	300
LW-S181010DN-0H110-C0	Lo	D	WR	18400	18700	1010&1008*	300
LW-S181010DP-0H110-C0	Hi	D	WR	19410	19710	1010&1008*	300
LW-S181560AN-0H110-C0	Lo	A	WR	17700	18000	1560	300
LW-S181560AP-0H110-C0	Hi	A	WR	19260	19560	1560	300
LW-S181560BN-0H110-C0	Lo	B	WR	17840	18140	1560	300
LW-S181560BP-0H110-C0	Hi	B	WR	19400	19700	1560	300
LW-S181560CN-0H110-C0	Lo	C	WR	17700	18140	1560	440
LW-S181560CP-0H110-C0	Hi	C	WR	19260	19700	1560	440

23GHz

Part Number	TX Hi/Lo	Sub-band	Waveguide	TX Range (Min)	TX Range (Max)	T/R Spacing	Diplexer Range
LW-S231008AN-0H110-C0	Lo	A	WR	22000	22314	1008	314
LW-S231008AP-0H110-C0	Hi	A	WR	23008	23322	1008	314
LW-S231008BN-0H110-C0	Lo	B	WR	22286	22600	1008	314
LW-S231008BP-0H110-C0	Hi	B	WR	23294	23608	1008	314
LW-S231200AN-0H110-C0	Lo	A	WR	21200	21530	1200	330
LW-S231200AP-0H110-C0	Hi	A	WR	22400	22730	1200	330
LW-S231200BN-0H110-C0	Lo	B	WR	21490	21820	1200	330
LW-S231200BP-0H110-C0	Hi	B	WR	22690	23020	1200	330
LW-S231200CN-0H110-C0	Lo	C	WR	21780	22110	1200	330
LW-S231200CP-0H110-C0	Hi	C	WR	22980	23310	1200	330
LW-S231200DN-0H110-C0	Lo	D	WR	22070	22400	1200	330
LW-S231200DP-0H110-C0	Hi	D	WR	23270	23600	1200	330
LW-S231232AN-0H110-C0	Lo	A	WR	21200	21500	1232	300
LW-S231232AP-0H110-C0	Hi	A	WR	22432	22732	1232	300
LW-S231232BN-0H110-C0	Lo	B	WR	21472	21786	1232	314
LW-S231232BP-0H110-C0	Hi	B	WR	22704	23018	1232	314
LW-S231232CN-0H110-C0	Lo	C	WR	21779	22093	1232	314
LW-S231232CP-0H110-C0	Hi	C	WR	23011	23325	1232	314
LW-S231232DN-0H110-C0	Lo	D	WR	22086	22386	1232	300
LW-S231232DP-0H110-C0	Hi	D	WR	23318	23618	1232	300

Appendix B

Antenna Specifications

Size	Frequency (GHz)	Part Number	Frequency Range (GHz)	Gain at Center Frequency (dBi)	HPBW (degrees)
1 ft. (0.3 m)	13	LW-PTP-13-620S-ANT-1	12.75 – 13.25	29.5	5.4
	15	LW-PTP-15-620S-ANT-1	14.4 – 15.35	30.7	4.7
	18	LW-PTP-18-620S-ANT-1	17.7 – 19.7	32.7	3.7
	23	LW-PTP-23-620S-ANT-1	21.2 – 23.6	34.3	3.1
2 ft. (0.6 m)	7	LW-PTP-7-620S-ANT-2	7.05 – 8.5	30.6	4.7
	8	LW-PTP-8-620S-ANT-2	7.05 – 8.5	30.6	4.7
	11	LW-PTP-11-620S-ANT-2	10.6 – 11.8	34.1	3.2
	13	LW-PTP-13-620S-ANT-2	12.75 – 13.25	35.5	2.6
	15	LW-PTP-15-620S-ANT-2	14.4 – 15.35	36.7	2.3
	18	LW-PTP-18-620S-ANT-2	17.7 – 19.7	38.7	1.8
	23	LW-PTP-23-620S-ANT-2	21.2 – 23.6	40.3	1.5
4 ft. (1.2 m)	7	LW-PTP-7-620S-ANT-4	7.05 – 8.5	36.9	2.2
	8	LW-PTP-8-620S-ANT-4	7.05 – 8.5	36.9	2.2
	11	LW-PTP-11-620S-ANT-4	10.6 – 11.8	40.1	1.5
	13	LW-PTP-13-620S-ANT-4	12.75 – 13.25	41.4	1.3
	15	LW-PTP-15-620S-ANT-4	14.4 – 15.35	42.6	1.2
	18	LW-PTP-18-620S-ANT-4	17.7 – 19.7	44.6	0.9
	23	LW-PTP-23-620S-ANT-4	21.2 – 23.6	46.1	0.8
6 ft. (1.8 m)	7	LW-PTP-7-620S-ANT-6	7.05 – 8.5	40.3	1.5
	8	LW-PTP-8-620S-ANT-6	7.05 – 8.5	40.3	1.5
	11	LW-PTP-11-620S-ANT-6	10.6 – 11.8	43.7	1.1
	13	LW-PTP-13-620S-ANT-6	12.75 – 13.25	44.9	0.9
	15	LW-PTP-15-620S-ANT-6	14.4 – 15.35	46.0	0.8
	18	LW-PTP-18-620S-ANT-6	17.7 – 19.7	47.2	0.7
	23	LW-PTP-23-620S-ANT-6	21.2 – 23.6	48.8	0.5