AntennaFactor
by **Linx**

**Ultra Compact
Chip Antenna
Data Guide**

Wireless made simple®

Table of Contents

Data Guide

AntennaFactor
by **Linx**

Description

The exciting ANT-***-CHP family is among the world's smallest high-performance chip antennas. They are ideal for embedding in wireless products including Bluetooth, 802.11, Home RF, ZigBee and other popular standards. These tiny antennas use advanced Low Temperature Co-fired Ceramic (LTCC) technology and proprietary elements to achieve superior size and performance characteristics. The entire family is compatible with hand and reflow-assembly. Excellent electrical specifications, stability, and outstanding cost-effectiveness make CHP Series antennas the logical choice for a wide variety of applications.

0.26"
(6.5)

$AF_{2.4}$

0.09"
(2.2)

0.04'
(1.0)

Figure 1: 2.4GHz Dimensions

0.63"
(16.0)

AF_{xxx}

0.12"
(3.0)

0.07"
(1.7)

Figure 2: 868MHz and 916MHz Dimensions

Features

- Incredibly compact SMD package
- Superior LTCC technology
- 50Ω characteristic impedance
- Low loss
- Wide bandwidth
- Favorable linear polarization
- > Unity gain
- No external matching required
- Highly stable over temperature & time
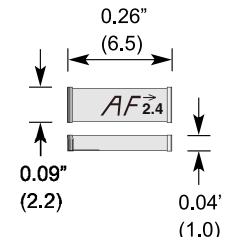- Hand and reflow-assembly compatible
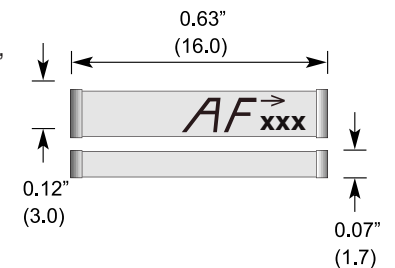- RoHS compliant
- Cost-effective

$AF_{2.4}$
2.45GHz
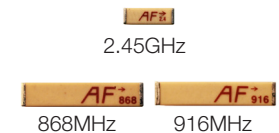
AF_{868} AF_{916}
868MHz   916MHz

Figure 3: Actual Sizes

Applications

- Bluetooth
- 802.11
- ZigBee
- Wireless PCMCIA cards
- Telemetry
- Data collection
- Industrial process monitoring
- Compact wireless products
- External antenna elimination

Ordering Information

Ordering Information	
Part Number	**Description**
ANT-868-CHP-x	868Mhz Chip Antenna
ANT-916-CHP-x	916MHz Chip Antenna
ANT-2.45-CHP-x	2.45GHz Chip Antenna

x = "T" for tape/reel, "B" for bulk

All parts are RoHS compliant.
Standard reel is 3,000pcs. (868/916MHz), 1,500pcs. (2.45GHz)
Quantities less than reel size are supplied in bulk.

Figure 4: Ordering Information

Electrical Specifications

Specifications			
Parameter	**2.45GHz**	**868MHz**	**916MHz**
Physical			
Dimensions (mm)	6.5(L) x 2.2(W) x 1.0(H)	16.0(L) x 3.0(W) x 1.7(H)	16.0(L) x 3.0(W) x 1.7(H)
Operating/Storage Temp	−40 to +85°C	−40 to +85°C	−40 to +85°C
Construction	LTCC	LTCC	LTCC
Electrical			
Center Frequency	2.45GHz	868MHz	916MHz
Bandwidth	180MHz	10MHz	10MHz
Wavelength	¼-wave	¼-wave	¼-wave
Pattern	Omni-directional	Omni-direction	Omni-directional
Polarization	Linear	Linear	Linear
VSWR	≤2.0 (Max.)	≤2.0 (Max.)	≤2.0 (Max.)
Maximum Gain	+0.5dBi	+0.5dBi	+0.5dBi
Impedance	50Ω	50Ω	50Ω
Power Handling	3W (Max.)	3W (Max.)	3W (Max.)

Figure 5: Ordering Information

Footprints

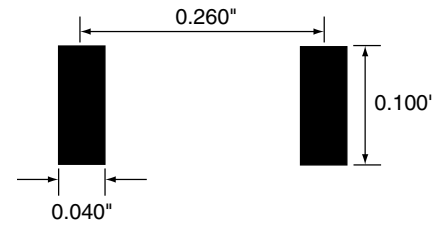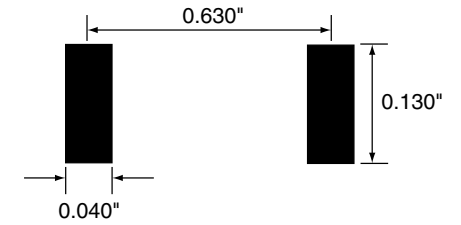Figure 6: 2.4GHz Footprint

Figure 7: 868MHz and 916MHz Footprint

Pin Configuration
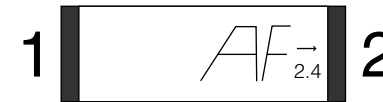
Figure 8: Pin Configuration

Pin Descriptions	
Pin Number	**Description**
1	Feed Termination This pin connects to the transmitter or receiver.
2	Solder Termination This pin is soldered down for physical support only. There is no electrical connection.

Figure 9: Pin Configurations

Theory of Operation

The CHP Series antennas utilize Low Temperature Cofired Ceramic (LTCC) technology to embed the antenna element into a ceramic substrate. Advances in this technology have resulted in materials that are extremely stable over time and temperature, producing an antenna that is highly reliable across a wide range of applications. The high-frequency characteristics of this technology enable exceptional performance in a very small package. The construction techniques for LTCC devices lends itself well to favorable pricing in high volume.

Layout Considerations

Proper layout is vital to ensure correct operation and optimum performance. Improper placement of planes, traces, or system components will result in nulls or complete de-tuning. Ideally, the antenna will be mounted on the board in such a way as to allow an unobstructed field of view. The area underneath the antenna must be free of components, traces, and planes. Components may be placed to the rear of the antenna in the ground plane counterpoise area. The feed trace from the RF stage to the antenna must be a microstrip trace or coax transmission line and should be kept as short as practical.

The layout of our reference jigs is illustrated on the following pages. While they demonstrate various aspects of a layout, it is not necessary to replicate them exactly. While your board size and layout may differ, it is important to recognize that the counterpoise plays an important role in resonance and stability since it acts, in essence, as part of the antenna. After your own layout is complete, the performance of the antenna in your specific product should be carefully checked using tools like a network analyzer. In some cases, the size of the product's PCB, proximity of the case, or other factors may make a custom version of the antenna necessary. Contact Linx for more information.
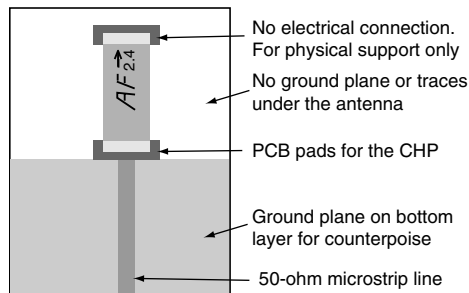

Figure 10: Layout

Microstrip Details

A transmission line is a medium whereby RF energy is transferred from one place to another with minimal loss. This is a critical factor, especially in high-frequency products like Linx RF modules, because the trace leading to the module's antenna can effectively contribute to the length of the antenna, changing its resonant bandwidth. In order to minimize loss and detuning, some form of transmission line between the antenna and the module should be used unless the antenna can be placed very close (<1/8in.) to the module. One common form of transmission line is a coax cable and another is the microstrip. This term refers to a PCB trace running over a ground plane that is designed to serve as a transmission line between the module and the antenna. The width is based on the desired characteristic impedance of the line, the thickness of the PCB and the dielectric constant of the board material. For standard 0.062in thick FR-4 board material, the trace width would be 111 mils. The correct trace width can be calculated for other widths and materials using the information in Figure 11 and examples are provided in Figure 12. Software for calculating microstrip lines is also available on the Linx website.
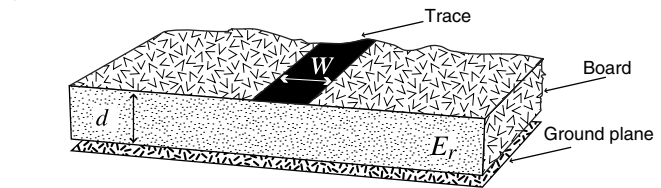
$$E_e = \frac{E_r + 1}{2} + \frac{E_r - 1}{2} \cdot \frac{1}{\sqrt{1 + 12d/W}}$$

$$Z_0 = \begin{cases} \dfrac{60}{\sqrt{E_e}} \cdot \ln\left(\dfrac{8d}{W} + \dfrac{W}{4d}\right) & \text{For} \quad \dfrac{W}{d} \leq 1 \\[4ex] \dfrac{120\pi}{\sqrt{E_e} \cdot \left(\dfrac{W}{d} + 1.393 + 0.667 \cdot \ln\left(\dfrac{W}{d} + 1.444\right)\right)} & \text{For} \quad \dfrac{W}{d} \geq 1 \end{cases}$$

E_r = Dielectric constant of PCB material

Figure 11: Microstrip Formulas

Example Microstrip Calculations

Dielectric Constant	Width / Height Ratio (W / d)	Effective Dielectric Constant	Characteristic Impedance (Ω)
4.80	1.8	3.59	50.0
4.00	2.0	3.07	51.0
2.55	3.0	2.12	48.8

Figure 12: Example Microstrip Calculations

Assembly Considerations

The antenna is RoHS Compliant and designed to support hand or automated assembly. To avoid damage to the part, the reflow solder guidelines found below should be carefully followed. The antenna is single ended meaning that one pad is electrically connected while the other is for mechanical support only. The antenna terminals are not interchangeable so the polarity indicated in the Pin Configuration section must be observed during assembly.

Hand Soldering

This antenna is designed for high-volume automated assembly, however, it may be successfully attached by hand assembly techniques. A hand-solder temperature of 225°C or lower should be used. Do not exceed a 10sec. heating time.

Reflow Temperature Profile

The single most critical stage in the automated assembly process is the reflow process. The reflow profile below should be closely followed since excessive temperatures or transport times during reflow will irreparably damage the antennas. Assembly personnel will need to pay careful attention to the oven's profile to ensure that it meets the requirements necessary to successfully reflow all components while still meeting the limits mandated by the antennas themselves.
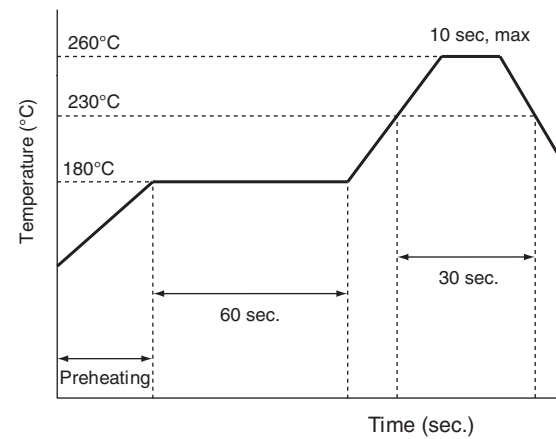
Reflow Soldering Profile

Figure 13: Reflow Soldering Profile

Warning: Pay attention to the absolute maximum solder times.

Absolute Maximum Solder Times
Hand Solder Temperature: TX +225ºC for 10 seconds
Hand Solder Temperature: RX +225ºC for 10 seconds
Recommended Solder Melting Point: +180ºC
Reflow Oven: +225ºC max (see Figure 13)

Figure 14: Absolute Maximum Solder Times
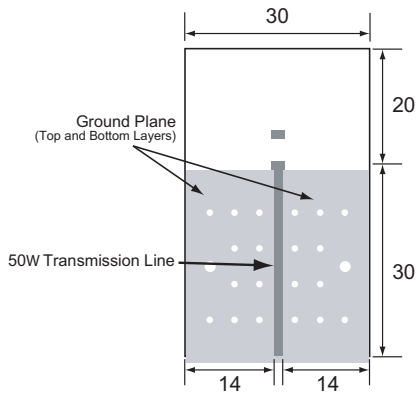
Test Boards

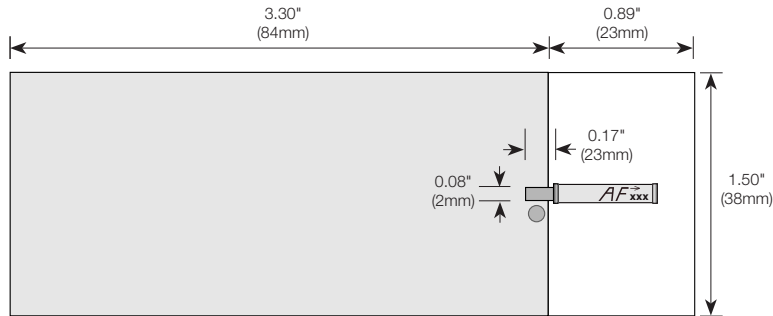Figure 15. 2.4GHz Test Board

Figure 16: 868MHz and 916MHz Test Board

VSWR Graphs

What is VSWR?

The Voltage Standing Wave Ratio (VSWR) is a measurement of how well an antenna is matched to a source impedance, typically 50-ohms. It is calculated by measuring the voltage wave that is headed toward the load versus the voltage wave that is reflected back from the load. A perfect match will have a VSWR of 1:1. The higher the first number, the worse the match, and the more inefficient the system. Since a perfect match cannot ever be obtained, some benchmark for performance needs to be set. In the case of antenna VSWR, this is usually 2:1. At this point, 88.9% of the energy sent to the antenna by the transmitter is radiated into free space and 11.1% is either reflected back into the source or lost as heat on the structure of the antenna. In the other direction, 88.9% of the energy recovered by the antenna is transferred into the receiver. As a side note, since the ":1" is always implied, many data sheets will remove it and just display the first number.

How to Read a VSWR Graph

VSWR is usually displayed graphically versus frequency. The lowest point on the graph is the antenna's operational center frequency. In most cases, this will be different than the designed center frequency due to fabrication tolerances. The VSWR at that point denotes how close to 50-ohms the antenna gets. Linx specifies the recommended bandwidth as the range where the typical antenna VSWR is less than 2:1.
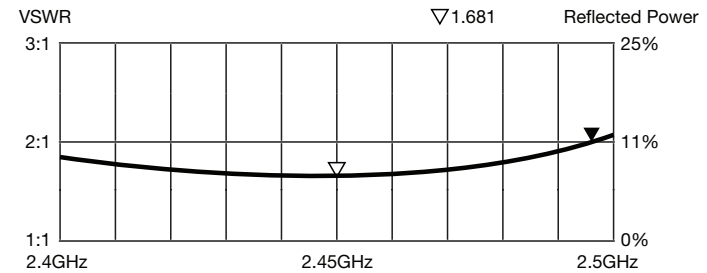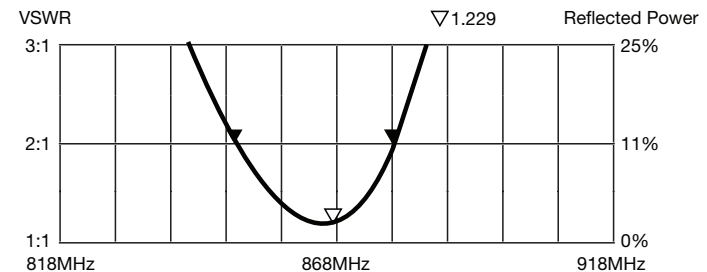

Figure 17: 2.4GHz Typical VSWR

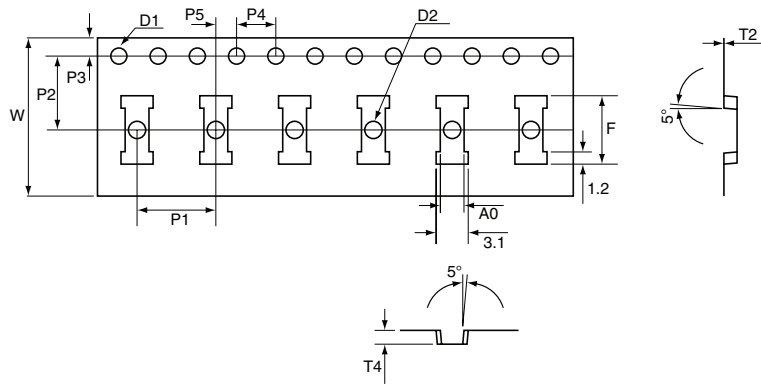Figure 18: 868MHz and 916MHz Typical VSWR

Tape Dimensions

Figure 19: 2.4GHz Tape Dimensions

2.4GHz Tape Dimensions			
Symbol	Dimension	Tolerance	Unit
A0	2.30	±0.10	mm
D1	1.50	±0.10 −0.00	mm
D2	1.50	±0.25 −0.00	mm
F	6.60	±0.10	mm
P1	8.00	±0.10	mm
P2	7.50	±0.10	mm
P3	1.75	±0.10	mm
P4	4.00	±0.10	mm
P5	2.00	±0.10	mm
T2	0.30	±0.05	mm
T4	1.30	±0.10	mm
W	16.00	±0.10	mm

Figure 20: 2.4GHz Tape Dimensions Table
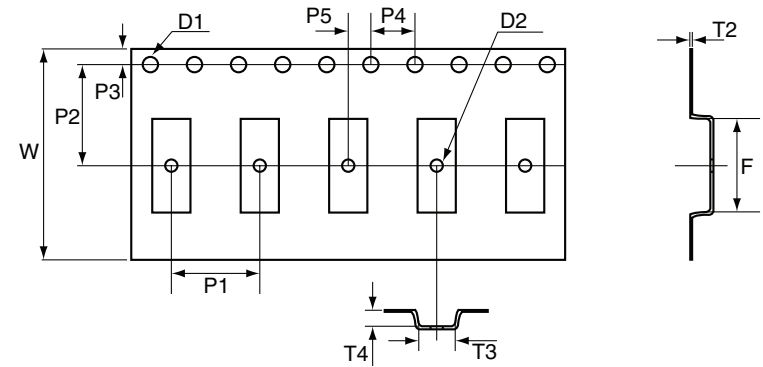
Figure 21: 868MHz and 916MHz Tape Dimensions

868MHz and 916MHz Tape Dimensions			
Symbol	Dimension	Tolerance	Unit
D1	1.50	±0.10	mm
D2	1.50	±0.10	mm
F	10.6	±0.10	mm
P1	8.00	±0.10	mm
P2	11.50	±0.10	mm
P3	1.75	±0.10	mm
P4	4.00	±0.10	mm
P5	2.00	±0.10	mm
T2	0.30	±0.05	mm
T3	3.30	±0.10	mm
T4	1.90	±0.10	mm
W	24.00	±0.30	mm

Figure 21: 868MHz and 916MHz Tape Dimensions Table

Reel Dimensions
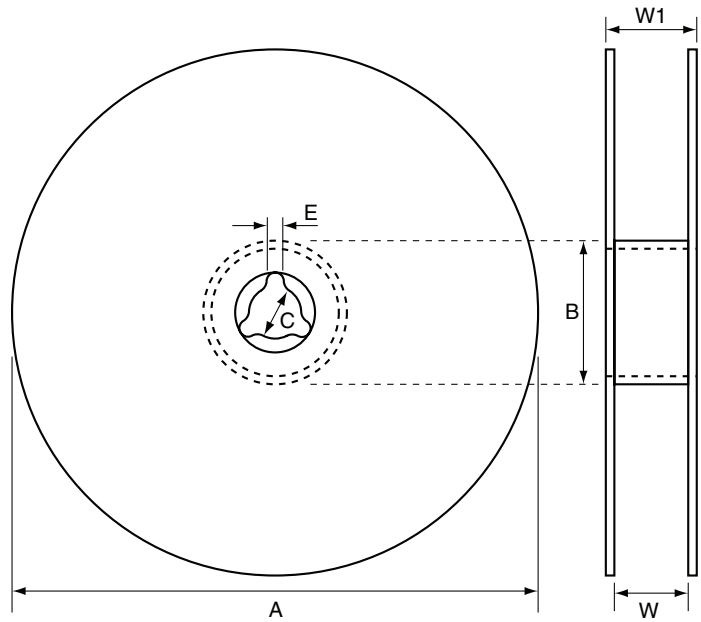
Figure 22: Reel Dimensions

Reel Dimensions			
Symbol	868/916MHz	2.45GHz	Unit
QTY per reel	3,000	1,500	pcs
Tape width	24	16	mm
A	330±1	180±1	mm
B	100±0.5	62±0.5	mm
C	13±0.5	13±0.2	mm
E	2.2±0.5	2.2±0.5	mm
W	24±0.5	16±0.5	mm
W1	28.9±0.2	20±0.2	mm

Figure 23: Reel Dimensions Table

Mismatch Conversion Table

Mismatch Conversion Table			
VSWR	Insertion Loss (dB)	Power Transmitted (%)	Power Reflected (%)
17.391	−6.87	20.57%	79.43%
11.610	−5.35	29.21%	70.79%
8.724	−4.33	36.90%	63.10%
6.997	−3.59	43.77%	56.23%
5.848	−3.02	49.88%	50.12%
5.030	−2.57	55.33%	44.67%
4.419	−2.20	60.19%	39.81%
3.946	−1.90	64.52%	35.48%
3.570	−1.65	68.38%	31.62%
3.010	−1.26	74.88%	25.12%
2.615	−0.97	80.05%	19.95%
2.323	−0.75	84.15%	15.85%
2.100	−0.58	87.41%	12.59%
1.925	−0.46	90.00%	10.00%
1.433	−0.14	96.84%	3.15%
1.222	−0.04	99.00%	1.00%
1.119	−0.01	99.68%	0.32%
1.065	0.00	99.90%	0.10%
1.034	0.00	99.97%	0.03%
1.020	0.00	99.99%	0.01%

Figure 24: Mismatch Conversion Table

AntennaFactor
by **Linx**

Linx Technologies
159 Ort Lane
Merlin, OR, US 97532

3090 Sterling Circle, Suite 200
Boulder, CO 80301

Phone: +1 541 471 6256
Fax: +1 541 471 6251
www.linxtechnologies.com

Disclaimer

Linx Technologies is continually striving to improve the quality and function of its products. For this reason, we reserve the right to make changes to our products without notice. The information contained in this Data Guide is believed to be accurate as of the time of publication. Specifications are based on representative lot samples. Values may vary from lot-to-lot and are not guaranteed. "Typical" parameters can and do vary over lots and application. Linx Technologies makes no guarantee, warranty, or representation regarding the suitability of any product for use in any specific application. It is Customer's responsibility to verify the suitability of the part for the intended application. At Customer's request, Linx Technologies may provide advice and assistance in designing systems and remote control devices that employ Linx Technologies RF products, but responsibility for the ultimate design and use of any such systems and devices remains entirely with Customer and/or user of the RF products.

LINX TECHNOLOGIES DISCLAIMS ANY AND ALL WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL LINX TECHNOLOGIES BE LIABLE FOR ANY CUSTOMER'S OR USER'S INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF OR RELATED TO THE DESIGN OR USE OF A REMOTE CONTROL SYSTEM OR DEVICE EMPLOYING LINX TECHNOLOGIES RF PRODUCTS OR FOR ANY OTHER BREACH OF CONTRACT BY LINX TECHNOLOGIES. CUSTOMER AND/OR USER ASSUME ALL RISKS OF DEATH, BODILY INJURIES, OR PROPERTY DAMAGE ARISING OUT OF OR RELATED TO THE USE OF LINX TECHNOLOGIES RF PRODUCTS, INCLUDING WITH RESPECT TO ANY SERVICES PROVIDED BY LINX RELATED TO THE USE OF LINX TECHNOLOGIES RF PRODUCTS. LINX TECHNOLOGIES SHALL NOT BE LIABLE UNDER ANY CIRCUMSTANCES FOR A CUSTOMER'S, USER'S, OR OTHER PERSON'S DEATH, BODILY INJURY, OR PROPERTY DAMAGE ARISING OUT OF OR RELATED TO THE DESIGN OR USE OF A REMOTE CONTROL SYSTEM OR DEVICE EMPLOYING LINX TECHNOLOGIES RF PRODUCTS.

The limitations on Linx Technologies' liability are applicable to any and all claims or theories of recovery asserted by Customer, including, without limitation, breach of contract, breach of warranty, strict liability, or negligence. Customer assumes all liability (including, without limitation, liability for injury to person or property, economic loss, or business interruption) for all claims, including claims from third parties, arising from the use of the Products. Under no conditions will Linx Technologies be responsible for losses arising from the use or failure of the device in any application, other than the repair, replacement, or refund limited to the original product purchase price. Devices described in this publication may contain proprietary, patented, or copyrighted techniques, components, or materials.

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Linx Technologies](#):
   [ANT-2.45-CHP-B](#) [ANT-2.45-CHP-T](#) [AEK-2.45-CHP](#) [AEK-868-CHP](#) [ANT-868-CHP-B](#) [ANT-916-CHP-B](#) [CMD-HHCP-433-MD](#) [AEK-LTE-CER](#) [AEK-DB1-nSP250](#)