UNIGEN CORP. WIRELESS MODULE PRODUCTS

PART NUMBER FAMILY:
UGWR2US SERIES

JUNO-LPA WIRELESSUSB™ RADIO MODULE

Issue Date: 29 June 2004

Revision: 1.0

Revision History

Rev. No.	History	Issue Date	Remarks
1.0	Released	29 June 2004	First Production Release

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REFERENCE DOCUMENTATION:

The Unigen JUNO-LPA WirelessUSB™ UGWRL2US module adaptation of the Cypress Semiconductor CYWUSB6935 LR 2.4GHz DSSS Radio SOC with the addition of a power amplifier is represented in this document. The detail provided is information for using JUNO-LPA in a digital electronic device and is only a "companion" document to Cypress Semiconductors' documentation for the above noted part.

The CYWUSB6935 LR 2.4GHz DSSS Radio SOC information and technical details (ex. register settings, timing, application interfaces, clocking and power management, etc.) may be obtained from the Cypress Semiconductor web site or contacting Cypress's authorized sales representatives.

The following is a list of required documents and locations known at the time of publication that accompany this datasheet.

- The CYWUSB6935 LR 2.4GHz DSSS Radio SOC Datasheet – CUWUSB6935.pdf
  http://www.cypress.com/cfuploads/img/products/cywusb6935.pdf

- The JUNO-LPA WirelessUSB™ Radio Module User Manual – USBWR2US User Manual_v10.pdf
  http://www.unigen.com/download/USBWR2US%20User%20Manual_v0911.pdf

Additional documentation for the Cypress Semiconductor CYWUSB6935 LR 2.4GHz DSSS Radio SOC device and the Unigen JUNO-LPA WirelessUSB™ UGWRL2US module may be obtained by contacting agents or representatives of the respective companies.

INTRODUCTION:

Unigen JUNO-LPA WirelessUSB™ UGWRL2US modules represent the convergence of emerging wireless connectivity solutions and the USB "Plug-N-Play" ease of operation. WirelessUSB, as created by Cypress Semiconductor, is a low-cost, 2.4GHz communication protocol designed for use in commercial, industrial, consumer, and computer product applications needing highly reliable data connectivity.

JUNO-LPA modules combine Cypress Semiconductor's wireless and USB expertise with Unigen's module design, manufacturing, and testing proficiency to create production ready, pre-certified modules that are easily integrated into existing, and new product designs.

JUNO-LPA modules offer immediate, drop-in design solutions and use the native Operating System HID drivers to seamlessly enumerate and operate mouse, keyboard, and gaming devices, or other devices using the HID specification for communication with the host systems.

WirelessUSB™ - UGWR2US

Solutions for a Real Time World

Data Sheet

FEATURES:

- **CYWUSB6935 LR 2.4GHz DSSS Radio SOC**

- **Operates in the 2.4 to 2.483GHz, unlicensed frequency range (ISM – Industrial, Scientific and Medical)**

- **-95dBm receive sensitivity**

- **Up to +23dBm Output Power**

- **Range of up to 1000+ meters with appropriate antenna**

- **Data Rate of 62.5kbits/sec**

- **SPI interface**
  (up to 2MHz data rate)

- **Operating Voltage Requirement**
  2.7 – 3.6Vdc

- **Dual DSSS reconfigurable Baseband Correlators**

- **Small PCBA Design:**
  UGWR1US
  1.29″ (32.76mm) by 1.30″ (33.02mm)

- **Complete Radio Module**
  Just add a tested antenna.
  PN. – UGADL1B1M1 or UGADA0B1M1

- **Agency Pre-Certification**
  FCC/EU/ETSI/Industry Canada
  Module certified to FCC/EU compliance specifications limiting your agency compliance time and cost.

- **FCC Radio Certification**
  Grandfathered to end-device manufactures

DESCRIPTION:

JUNO-LPA WirelessUSB™UGWR2US Module is a tightly integrated, low-cost, high-reliability 2.4GHz TX/RX radio module for use in commercial, industrial, consumer, and computer product applications.

JUNO-LPA uses the Cypress Semiconductor CYWUSB6935 LR 2.4GHz DSSS Radio SOC device coupled with precise RF power amplifier to achieve highly reliable data communication at 1000 meter distances.

JUNO-LPA is a complete solution requiring only integration into an existing, or new device. A WirelessUSB device may require no additional software drivers, as it can use the OS native USB device drivers to enable supported device classes.

JUNO-LPA is less than 1.5"sq and is available for horizontal or vertical mounting directly to the device PCB. JUNO-LPA is also available in bare-board configuration for alternate application.

Regulatory Compliance:

JUNO-LPA modules are 100% tested for functional operation and pre-certified for regulatory compliance. The JUNO-LPA is FCC certified for "Modular Approval". Details for product application and use of this certification are noted in the JUNO-LPA User Manual. Digital electronic device makers need only submit to the appropriate agencies for their customary certification.

JUNO-LPA is certified for operation with an antenna of up to 2db gain, and the certification is available from the Federal Communications Commission web site for documentation purposes. Approved antennae, noted in the Ordering Section are available from Unigen.

FUNCTIONAL BLOCK DIAGRAM:

JUNO-LPA Functional Block Diagram

Pin	Signal
Pin 1	PDn
2	GND
3	SCK
4	X13OUT
5	MOSI
6	MISO
7	IRQ
8	SSn
9	RSTn
10	GND
11	RX2
12	TX2
13	TST
14	VDET
15	RX1
16	SLOPE SEL
17	TX1
18	VCC
19	VCC_AMP
20	GND

XTAL

CYWUSB6935
WirelessUSB™ Radio SOC
Baseband and RF Function

RF Filter Circuitry

RF Out
RF In
RF Out
RF In
PA CTL

Power Amplifier

ANT 1
ANT 2
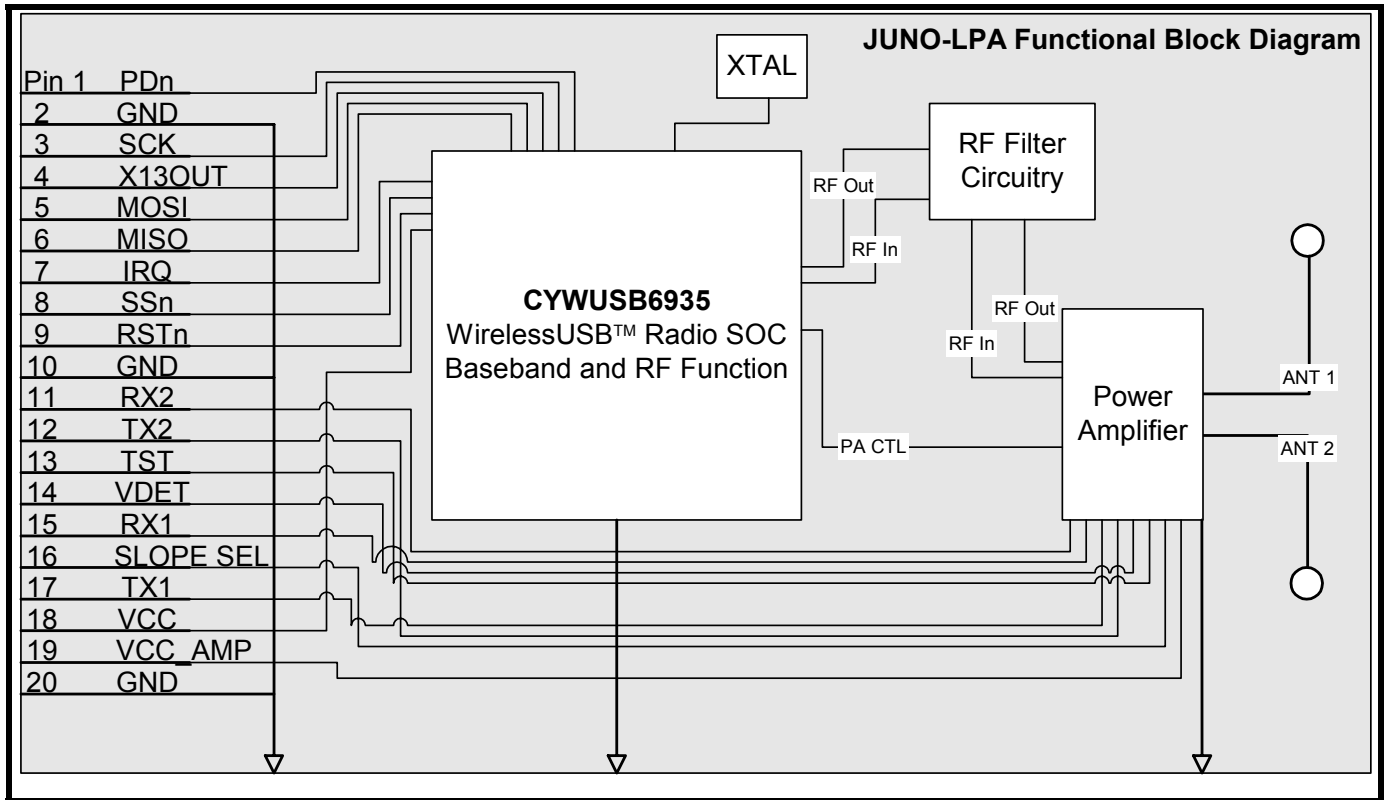
Figure 1 – Functional Block Diagram

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ABSOLUTE MAXIMUM RATINGS:

Symbol	Definition	Min.	Max.	Unit
V_{CC}	Supply Voltage – Radio SOC	-0.3	3.9	V_{DC}
V_{CC_AMP}	Supply Voltage – Power Amplifier	-0.3	3.9	V_{DC}
SLOPE_SEL	Slope Select Pin	-0.3	3.9	V_{DC}
T_{OC}	Commercial Operating Temperature Range	-20	70	°C
T_{OI}	Industrial Operating Temperature Range	-40	85	°C
T_S	Storage Temperature Range	-40	125	°C
V_{LI}	V_{DC} to Logic Inputs	-0.3	V_{CC} + 0.3	V_{DC}
V O/Hi-Z	V_{DC} to Outputs in Hi-Z state	-0.3	V_{CC} + 0.3	V_{DC}
SDVD	Static Discharge Voltage Digital		>4000	V_{DC}
SDVR	Static Discharge Voltage RF		>4000	V_{DC}

Table 1 – Maximum Values

These are stress ratings only. Exposure to stresses beyond these maximum ratings may cause permanent damage to, or affect the reliability of this module. Avoid using the module outside the recommended operating conditions defined below. This module is ESD sensitive and should be handled and/or used in accordance with proper ESD mitigation.

RECOMMENDED OPERATING CONDITIONS:

Symbol	Description	Value			
		Min.	Typ.*	Max.	Unit
V_{CC}	Supply Voltage	2.7	3.0	3.6	V_{DC}
T_{OC}	Commercial Operating Temperature Range	-20	25	70	°C
T_{OI}	Industrial Operating Temperature Range	-40	25	85	°C
GND	Ground Voltage		0		V_{DC}

Table 2 – Operating Values

DC ELECTRICAL CHARACTERISTICS:

Symbol	Description	Condition(s)	Value			Unit
			Min.	Typ.*	Max.	
V_{CC}	Supply Voltages		2.7	3.0	3.6	V_{DC}
$V_{OH}1$	Voltage Output High 1	At $I_{OH} = -100.0\mu A$	V_{CC}-0.1	V_{CC}		V_{DC}
$V_{OH}2$	Voltage Output High 2	At $I_{OH} = -2.0$ mA	2.4	3.0		V_{DC}
V_{OL}	Voltage Output Low	At $I_{OL} = 2.0$ mA		0.0	0.4	V_{DC}
V_{IH}	Voltage Input High		2.0		V_{CC}	V_{DC}
V_{IL}	Voltage Input Low		-0.3		0.8	V_{DC}
I_{IL}	Input Leakage Current	0 < VIN < VCC	-1	0.30	+1	µA
I_{SLEEP}	Power-down current consumption	PD = Low		3.26	10	µA
TX AVG $I_{CC}1$	Mean transmitter current consumption [1]	no handshake		6.0		mA
TX AVG $I_{CC}2$	Mean transmitter current consumption [2]	w/handshake		10.0		mA
RX I_{CC} (Peak)	Current consumption during receive			60.0		mA
TX I_{CC} (Peak)	Current consumption during transmit			140	170	mA
MTBF		Calculated			>87,600	Hours

Table 3 – Electrical Characteristics

[*]= Measured with 3.0V_{CC} at 25ºC

[1]= Mean Icc when transmitting a 5-byte packet (3 data bytes + 2 bytes of protocol) every 10ms using the Wireless USB LS 1-way protocol.

[2]= Mean Icc when transmitting a 5-byte packet (3 data bytes + 2 bytes of protocol) every 10ms using the Wireless USB LS 2-way protocol.

ANTENNA:

JUNO-LPA requires the addition of an antenna for radio operation. JUNO-LPA achieved FCC "Modular Approval" for use in Digital Electronic Devices in combination with the noted antennae. Use of antennae other than these listed can required recertification of the module in the end-product. (See "Agency Certification" in this document for brief information). The **JUNO-LPA WirelessUSB™ Radio Module User Manual** contains complete regulatory compliance information.

Customers may obtain antennae (part numbers UGADL1B1M1 or UGADA0B1M1) with the following properties:

Item	Property
Coaxial Cable Type	4.13mm high freq.
Cable Length	11.81" (300mm) – other lengths available
Connector	Mini Coaxial
Frequency Range	2.4000~2.4835GHz
Impedance	50Ω (Typ.)
VSWR	2.0 max. over full range of operation
Return Loss	-10dB max.
Gain	2.0dBi - calculated
Maximum Power	1W
Electrical Wave	½ λ Dipole

Table 4 – Antenna Characteristics

Antenna Switch Control Logic Table:

JUNO-LPA requires at least one (1) and a maximum of two (2) external antennae for radio transmission and reception.

The table below represents the switch control settings for TX/RX selection between the two antennae, when JUNO-LPA is so configured.

Conditions - Pin HIGH = V$_{CC}$_AMP; Pin Low = GND

JP1 Wiring Logic				Operational Mode			
TX1	TX2	RX1	RX2	TXRF – ANT1	TXRF – ANT2	RXRF – ANT1	RXRF – ANT2
HIGH	LOW	LOW	LOW	**ON**	OFF	OFF	OFF
LOW	**HIGH**	LOW	LOW	OFF	**ON**	OFF	OFF
LOW	LOW	**HIGH**	LOW	OFF	OFF	**ON**	OFF
LOW	LOW	LOW	**HIGH**	OFF	OFF	OFF	**ON**

Table 5 – Antenna Switch Control Logic

Note:
TX1 = JP1-Pin 17
TX2 = JP1-Pin 12
RX1 = JP1-Pin 15
RX2 = JP1-Pin 11

Switch Control Characteristics

Conditions - V$_{CC}$_AMP = 3.3V$_{DC}$

Symbol	Parameter	Conditions	Min.	Max.	Unit
V$_{CTL\_ON}$	Control Voltage	ON State	2.5	3.6	V$_{DC}$
V$_{CTL\_OFF}$	Control Voltage	OFF State	0.0	0.5	V$_{DC}$
SW$_{ON}$	Low Loss Switch Control Voltage	High State = V$_{CTL\_ON}$ - V$_{CTL\_OFF}$	2.5	V$_{CC}$_AMP	V$_{DC}$
SW$_{OFF}$	High Loss Switch Control Voltage	Low State = V$_{CTL\_OFF}$ - V$_{CTL\_ON}$	0.0	0.3	V$_{DC}$
I$_{CTL\_ON}$	Switch Control Bias Current – RF Yes	RF Applied (Any TX/RX = HIGH)		100	µA
I$_{CTL\_ON}$	Switch Control Bias Current – RF No	No RF (Any TX/RX = HIGH)		30	µA
C$_{CTL}$	Control Input Capacitance			100	pF

Table 6 – Antenna Switch Control Characteristics

RADIO PARAMETERS:

Parameter Description	Condition	Min.	Typ.	Max	Unit
RF Frequency Range		2.400		2.483	GHz
Radio Receiver (T = 25ºC, V_{CC} = 3.3V, fosc = 13.000MHz, X13OUT off, 64 chips/bit, Threshold Low = 8, Threshold High = 56, BER ≤10^{-3}					
Sensitivity			-95		dBm
Maximum Received Signal		-20	-10		dBm
RSSI Value for PWR_{in} >-40dBm			28-31		
RSSI Value for PWR_{in} <-95dBm			0-10		
Interference Performance					
Co-channel Interference rejection Carrier-to-Interference (C/I)	C = −60 dBm		11		dB
Adjacent (1 MHz) channel selectivity C/I 1 MHz	C = −60 dBm		3		dB
Adjacent (2 MHz) channel selectivity C/I 2 MHz	C = −60 dBm		-30		dB
Adjacent (> 3 MHz) channel selectivity C/I > 3 MHz	C = −67 dBm		-40		dB
Image[22] Frequency Interference, C/I Image	C = −67 dBm		-20		dB
Adjacent (1 MHz) interference to in-band image frequency, C/I image ±1 MHz	C = −67 dBm		-25		dB
Out-of-band Blocking Interference Signal Frequency					
30MHz − 2399MHz except (FO/N & FO/N± 1MHz)	C = −67 dBm		-30		dBm
2498MHz − 12.75GHz, except (FO*N & FO*N±1MHz)	C = −67 dBm		-20		dBm
Intermodulation	C = −67 dBm, Δf = 5, 10MHz		-39		dBm
Spurious Emission					
30MHz − 1GHz				-57	dBm
1GHz − 12.75GHz (except 4.8GHz − 5.0GHz)				-47	dBm
4.8GHz − 5.0GHz				-37	dBm
Radio Transmitter (T = 25ºC, V_{CC} = 3.3V, fosc = 13.000MHz)					
Maximum RF Transmit Power	PA = 7		0		dBm
RF Power Control Range			30		dB
RF Power Range Control Step Size	Seven steps, monotonic		4.3		dB
Frequency Deviation	PN Code Pattern 10101010		270		kHz
Frequency Deviation	PN Code Pattern 11110000		320		kHz
Zero Crossing Error			±125		ns
Occupied Bandwidth	100-kHz resolution bandwidth, -6dBc	500			kHz
Initial Frequency Offset			±75		kHz
In-Band Spurious					
Second Channel Power (±=2MHz)				-30	dBm
≥ Third Channel Power (≥3 MHz)				-40	dBm
Non-Harmonically Related Spurs					
30MHz − 12.75GHz				-57	dBm
Harmonic Spurs					
Second Harmonic				-20	dBm
Third Harmonic				-30	dBm
Fourth and Greater Harmonics				-47	dBm

Table 7 − Radio Characteristics

PIN ASSIGNMENTS:

Pin#	Function	I/O	Description
1	PDn	I	Power Down
2	GND	-	Module Ground
3	SCK	I	SPI Input Clock
4	X13OUT	O/Hi-Z	Output Clock
5	MOSI	I	SPI Data Input from MCU
6	MISO	O/Hi-Z	SPI Data Output to MCU
7	IRQ	O	Interrupt Request
8	SSn	I	SPI Slave Select Enable
9	RSTn	I	Module Reset
10	GND	-	Module Ground
11	RX2	I	Antenna 2 RX Control
12	TX2	I	Antenna 2 TX Control
13	TST	O	Internal Test Pin for V_{REG} monitor of PA
14	VDET	O	Power Detect Output
15	RX1	I	Antenna 1 RX Control
16	SLOPE SEL	I	Positive/Negative Slope Detection
17	TX1	I	Antenna 1 TX Control
18	Vcc	-	Module Input Power
19	Vcc_AMP	-	Power supply to Power Amp Circuitry
20	GND	-	Module Ground

Table 8 – JUNO-LPA Pin Assignments

PIN FUNCTIONS:

MOSI: SPI Input from MCU
Receives commands/data from the device microcontroller.

MISO: SPI Output to MCU
Transmits requests/data to the device microcontroller.

SSn: SPI Slave Select Enable Input
SPI enable

IRQ: Interrupt Request
The Interrupt Request Pin Select bits are used to determine the drive method of the IRQ pin

GND: Module Ground
Ground to equal 0Vdc

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RSTn: Module Reset
Active LOW reset switch

SCK: SPI Input Clock

X13OUT: System Clock
On-board XTL clock output of 13MHz

PACTL: Power Amplifier Control
Enables/disables external power amplification circuitry, where available

PDn: Power Down
Driving signal LOW will put the module in SUSPEND MODE (X13OUT = 0 when PDn is LOW)

Vcc: Module Input Power
Vcc range 2.7 to 3.6Vdc

Vcc_AMP: Power supply input for power amplifier

TX1: Transmit Antenna #1
Input for control of TX Antenna #1

TX2: Transmit Antenna #2
Input for control of TX Antenna #2

RX1: Receive Antenna #1
Input for control of RX Antenna #1

RX2: Receive Antenna #2
Input for control of RX Antenna #2

SLOPE SEL: Positive/Negative Slope Select
Input for determining positive or negative slope of VDET

VDET: Power Detect Output
Power output voltage detector

TST: Internal Test Pin for V_{REG} monitor of PA
Output from power amplifier for monitoring the internal voltage regulator

AGENCY CERTIFICATIONS:

The Unigen JUNO-LPA UGWR2US WirelessUSB Module is tested and pre-certified for compliance with applicable Federal and International Regulatory Agency requirements. JUNO-LPA has received a "Modular Approval" certification for the radio function. This certification may be used by the Digital Electronic Device manufacturer by grant for the end-device containing JUNO-LPA. The grant is only applicable to the module's radio function in the end-product and does not supplant the other regulatory agency requirements concerning digital emissions certifications, where required. Contact the appropriate regulatory agency for relevant product requirements as needed.

The ***Unigen JUNO-LPA UGWR2US WirelessUSB Module User Manual*** contains information concerning the digital and analog emissions testing and details application of the "Modular Approval" grant. The table below summarizes the regulatory agency tests performed for receipt of respective certifications.

Regulatory Agencies:

Agency	Test Performed	Type	Limit	Result	Margin
EU	Radiated Spurious Emissions	30-12.75MHz Transmit Mode	EN 300 328	PASS	-4.6dB @ 4804MHz
		30-12.75MHz Transmit Mode	EN 300 328	PASS	-4.9 @ 177.01MHz
FCC 15.247	Radiated Emissions	30 25,000 Spurious Emissions	FCC Part 15.209/15.247 (c)	PASS	Results on File
		6dB Bandwidth	15.247(a)	PASS	960kHz
		99% Bandwidth	IC RSS-210	PASS	1.175MHz
		Output Power	15.247(b)	PASS	7.2dBm
		Power Spectral Density (PSD)	15.247(d)	PASS	3.06dBm
		Bandedge	FCC Part 15.209 /15.247(c)	PASS	Results on File
		Out of band	15.247(c)	PASS	Results on File
EU	Radio Performance Test	Output Power, Power spectral density at normal conditions	EN 300 328-1	PASS	Results on File
		Frequency Range at normal conditions	EN 300 328-1	PASS	Results on File
		Output Power over extreme conditions	EN 300 328-1	TBT	
		Frequency Range over extreme conditions	EN 300 328-1	TBT	
		Conducted spurious emissions, 30MHz - 12750MHz, transmit mode	EN 300 328-1	PASS	Results on File
		Conducted spurious emissions, 30MHz - 12750MHz, receive/stand-by mode	EN 300 328-1	PASS	Results on File
	Radiated Spurious Emissions	30 - 12,750 MHz -Spurious Emissions Transmit Mode	EN 300 328 V1.2.1	PASS	Results on File
		30 - 12,750 MHz -Spurious Emissions Receive Mode	EN 300 328 V1.2.1	PASS	Results on File

Table 9 – Regulatory Agency Certifications

Regulatory Compliance Statement:

The Unigen JUNO-LPA UGWR2US WirelessUSB module has been tested against the relevant requirements of standards: EN 300 328, EN 301 489-17, FCC part 15 and Industry Canada RSS-210. The module is certified by the regulatory authorities in the USA and Canada and complies with the applicable essential requirements of the Radio & Telecommunication Terminal Equipment (R&TTE) directive in the EU. The module can thus be incorporated into products sold worldwide with little or no additional testing of the module itself. ***The end product must meet the appropriate technical requirements that apply to that product type but re-certification of the radio module is not required in the USA and Canada.***
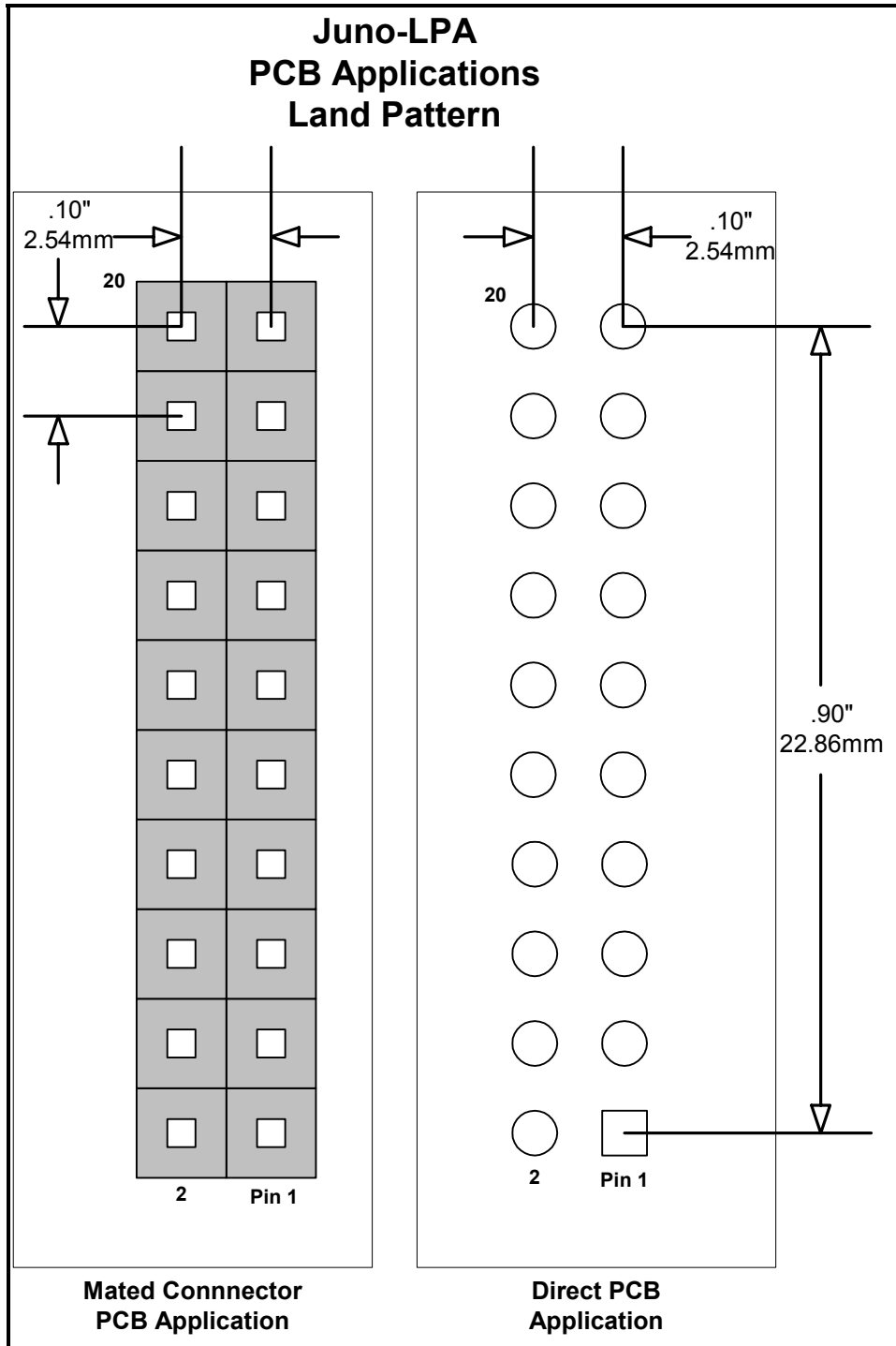
In the EU, the integrator is responsible for evaluating their product type per the essential performance requirements of the R&TTE directive (except those associated with the module), declaring compliance and then notifying the member states prior to marketing the product (because the module uses a frequency band that is not harmonized in the EU). It is the responsibility of the module integrator to obtain the necessary approvals to sell products incorporating this module in other countries outside of North America and the EU. The report of measurements performed on the module in compliance with the FCC rules and EN standards can be used in these submittals (as the requirements in many other markets around the world are based in part or in whole on the standards prevalent in North America and the EU).

MECHANICAL CHARACTERISTICS:

Item	Description	Specification
1	PCB Material	FR-4
2	PCB Layers	4
3	Connector Type	Straight thru-hole or header, mirrored through hole or header, bare. Please see Table 4 for pin assignments
4	PCB Number	1
5	Flammability Rating	UL94 V-0
6	UGWR2US Dimensions	1.29" x 1.30" x 0.54" (32.76 mm x 33.02mm x 13.72mm)
7	Antenna Cable Connector	GSC Ultra-Miniature
8	Mating Connectors	2x10 Female Header
9	User Serviceable Parts	None

Table 10 – Mechanical Description

WirelessUSB™ - UGWR2US

MECHANICAL DRAWINGS:

Juno-LPA
PCB Applications
Land Pattern

Figure 2 – Juno-LPA Land Pattern

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**Juno-LPA Mirrored
PCB Applications
Land Pattern**

.10"
2.54mm

20

.10"
2.54mm

20

.90"
22.86mm

Pin 1   2

Pin 1   2

**Mated Connnector
PCB Application**
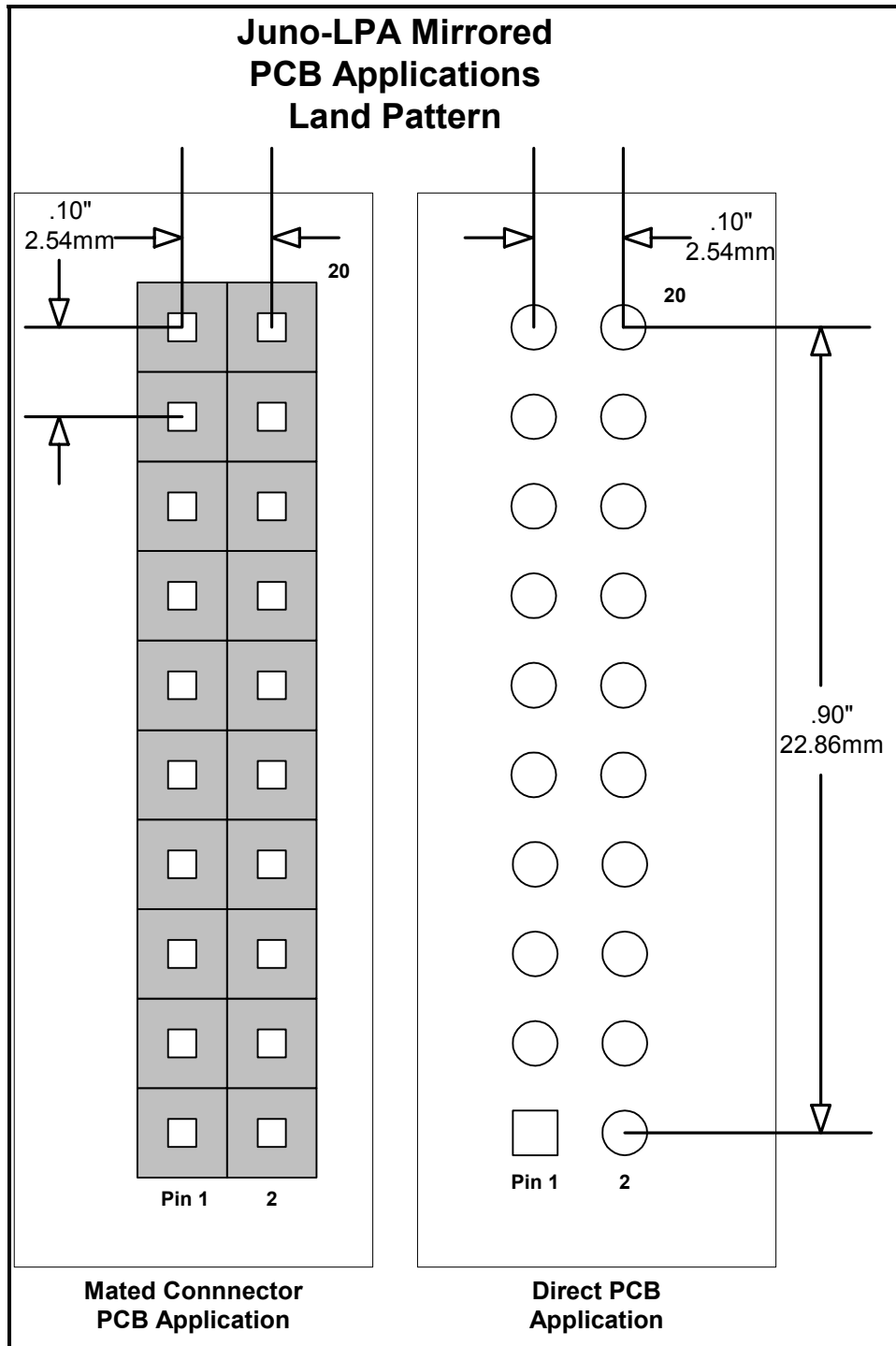
**Direct PCB
Application**

Figure 3 – Juno-LPA Mirrored Land Pattern

PHYSICAL DIMENSIONS:
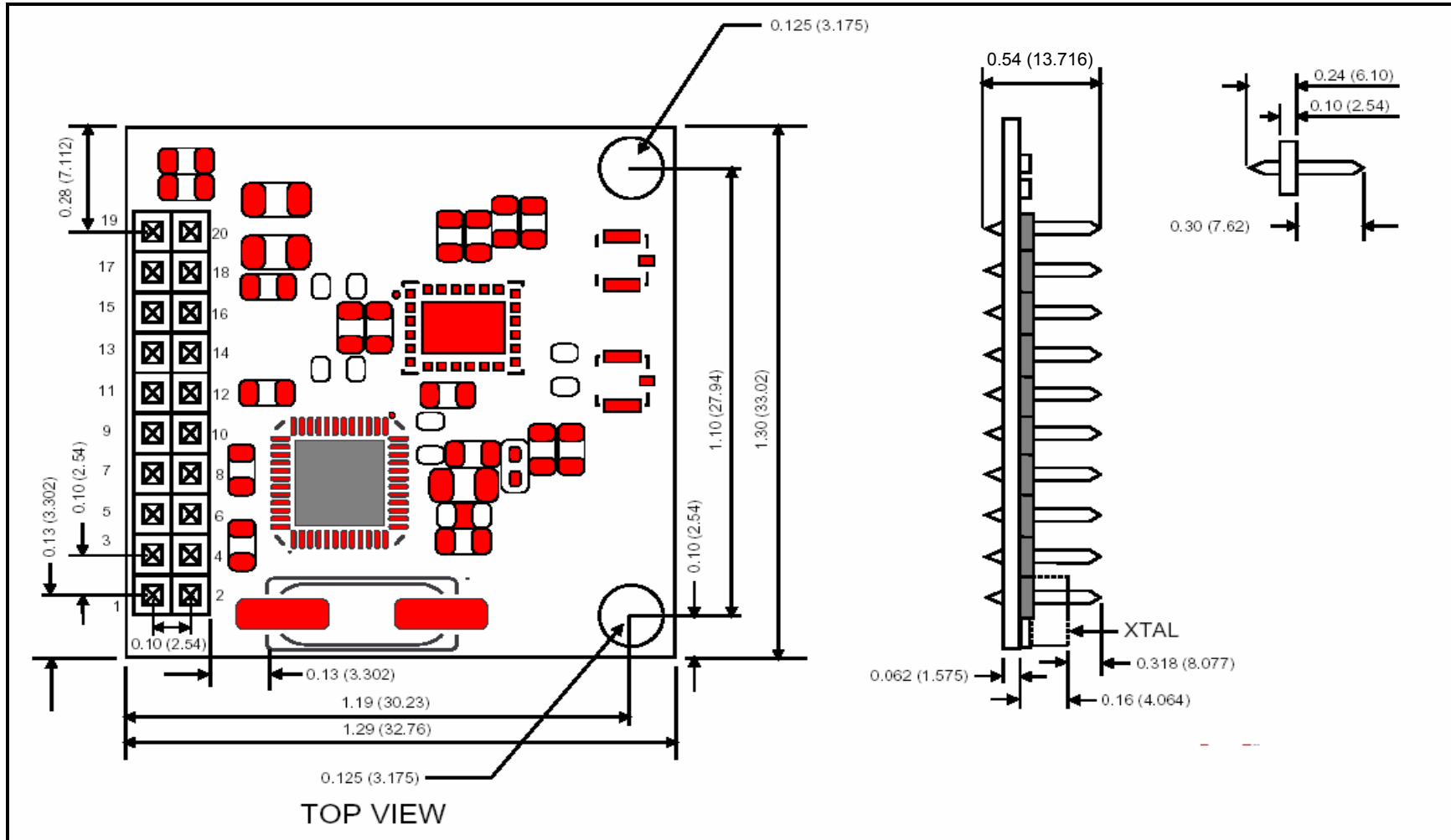
Figure 4 – Juno-LPA Dimensions
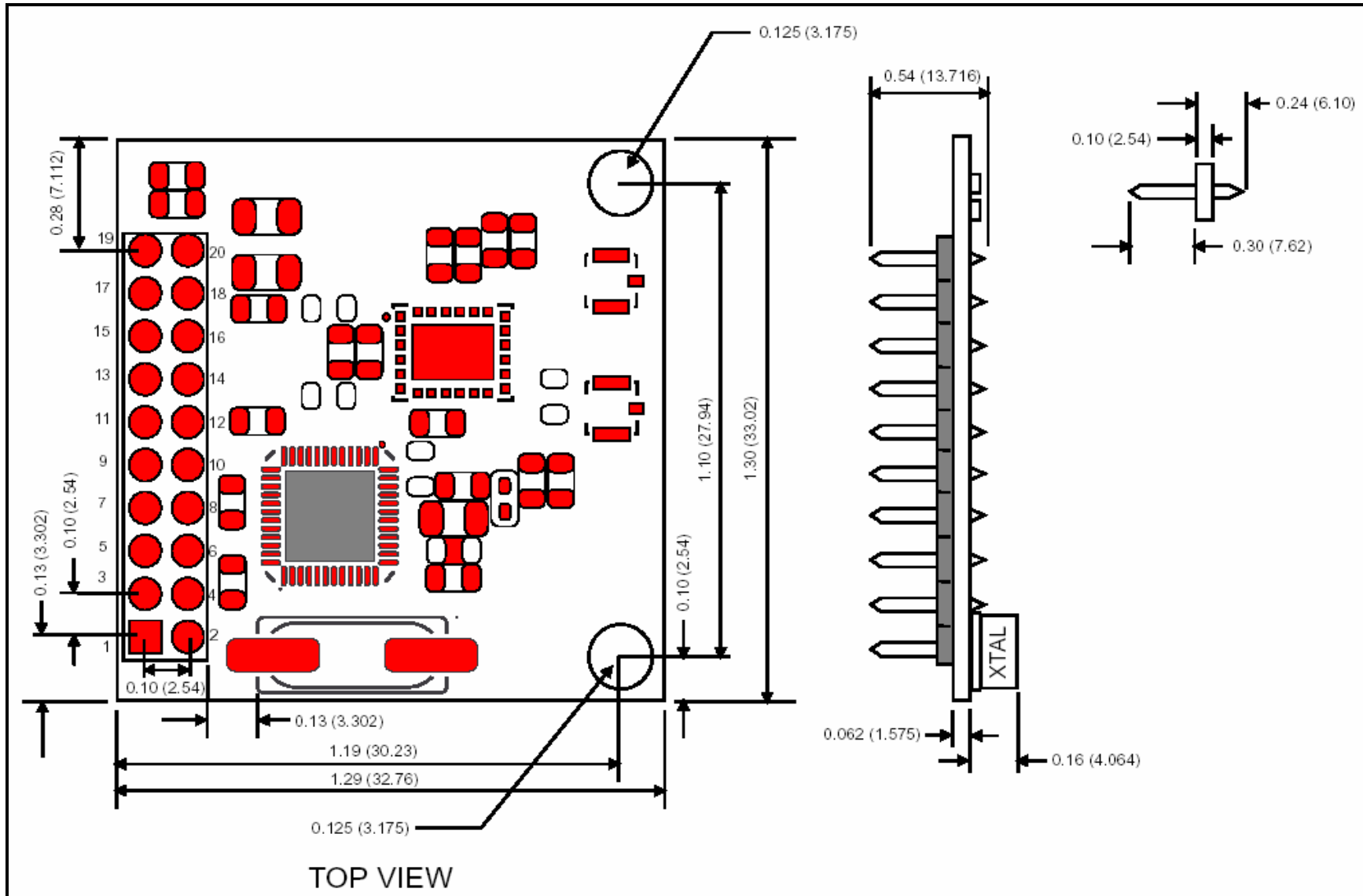
Figure 5 – Juno-LPA Mirrored Dimensions

ORDERING INFORMATION:*

JUNO-LPA WirelessUSB™ Module

Unigen Product Group – Wireless -	Form Factor	WirelessUSB Tech*	Connection	Connector Type	Voltage
UGW	R	2US	HC HP BB	2x10 Header Mirrored 2x10 Header Bare – No connector	**33**=3.3Vdc

*Module based on the Cypress Semiconductor CYWUSB6935-48 WirelessUSB™ LR 2.4GHz DSSS Radio SoC device.

Antennae

Unigen Product Group – Antennae –	Technology	Form Factor (Appearance)	Frequency / Gain	Coaxial Cable Type	Cable Length	Connector Type	Special Requirements
UGA	**D=** Dipole Antenna Module	**L1=** 3.5" desktop **A0=** 4" Swivel Whip **C1=** 7.75" Swivel Whip	**B1=** 2.4GHz, 2.0dBi **B2=** 2.4GHz, 5.0dBi	**M1=** 1.13mm HF	**050=** 50mm **100=** 100mm **150=** 150mm **200=** 200mm **250=** 250mm **300=** 300mm	**M=** Mini Coax	**None=** Default **F=** EMI core and PVC

Table 11 – Part Number Listings

Contact your Unigen Sales Representative for additional information or visit the Nexus™ Wireless Products section of our web site (www.unigen.com).

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