muRata
INNOVATOR IN ELECTRONICS

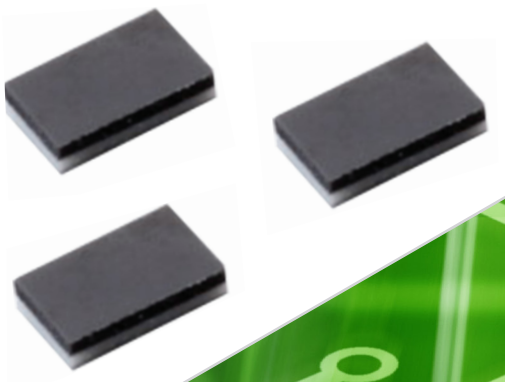
Application Guide

RFID devices for PCB management

Production, logistics, inventory, quality control, authentication, warranty & returns, and recycling control

LXMS Series

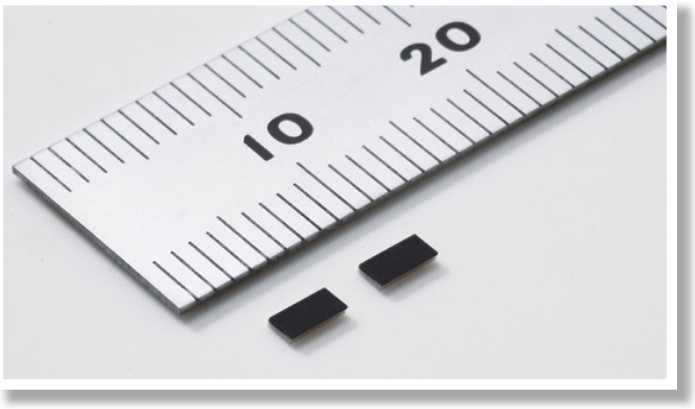
MAGICSTRAP®



RFID *Smart PCB with RFID tag function*

Murata's MAGICSTRAP® is the latest in UHF RFID chip development, designed to be placed on the printed circuit board (PCB). The integrated module eliminates many of the frustrations previously encountered by design engineers looking to incorporate RFID into their project.

By following some basic and simple guidelines, the antenna is designed into the PCB's ground plane. This represents a permanent and cost effective antenna solution. Once mounted, information can be stored and retrieved on MAGICSTRAP® using any EPCglobal Gen2 / ISO 18000-6C compatible UHF Reader/Writer.



Features

- *Compact Size (3.2 x 1.6 x 0.7mm)*
- *Operating Frequency – 860-960MHz*
- *512 bits user memory*
- *EPC Global Gen2 / ISO 18000-6C compatible*
- *Secure with long data retention*
- *4 to 5 meter read range is possible*
- *Utilizes ground as PCB ground as antenna*
- *Reference antenna designs available*
- *ESD protection up to >2kV*
- *Fully RoHS compliant*

MAGICSTRAP® Use Cases

MAGICSTRAP®

PCB Traceability

Warranty Tracking

Inventory Control

Product Authenticity

Firmware Revision Tracking

Applications

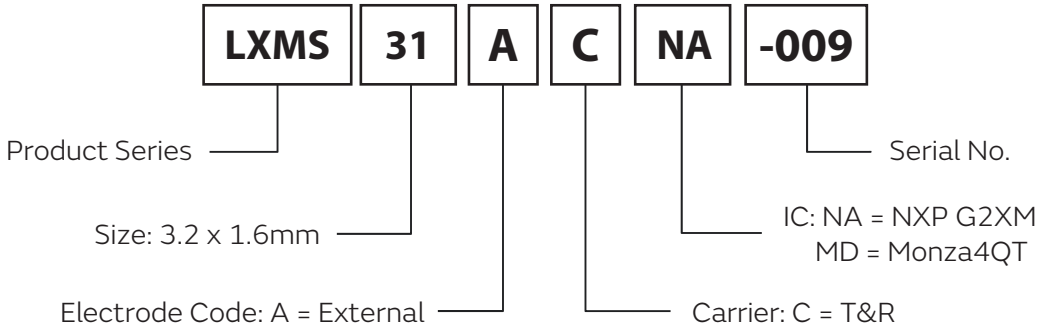
- *IT – PC, Server, Modem, Mobile phone*
- *Consumer – STB, DTV, DVD, audio*
- *Automotive – instrument panel, audio...*
- *Industry – smart meters, inverters*
- *Home appliances – stove, refrigerator*
- *EMS – value added services*
- *Specialty applications – durable tags*
- *Gaming – portable, stationary*

Product Lineup

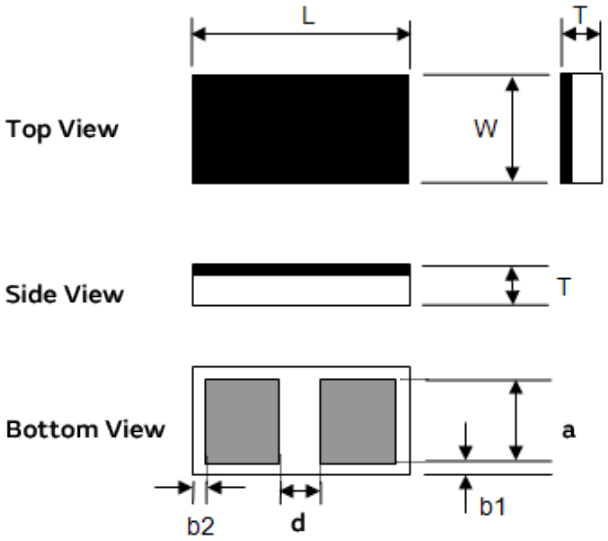
Part Number	Type *	IC	EPC	User Memory	TID	Op Temp
LXMS31ACNA-009	1	NXP G2XM	up to 240 bits	512 bits	64 bits	-40°C to +85°C
LXMS31ACNA-010	2					
LXMS31ACNA-011	3					
LXMS31ACNA-012	4					
LXMS31ACMD-141	1	Impinj Monza4QT	up to 128 bits	512 bits	64 bits	
LXMS31ACMD-142	2					
LXMS31ACMD-143	3					
LXMS31ACMD-144	4					

* Type refers to the impedance value and recommended antenna reference design

Part Number Breakdown

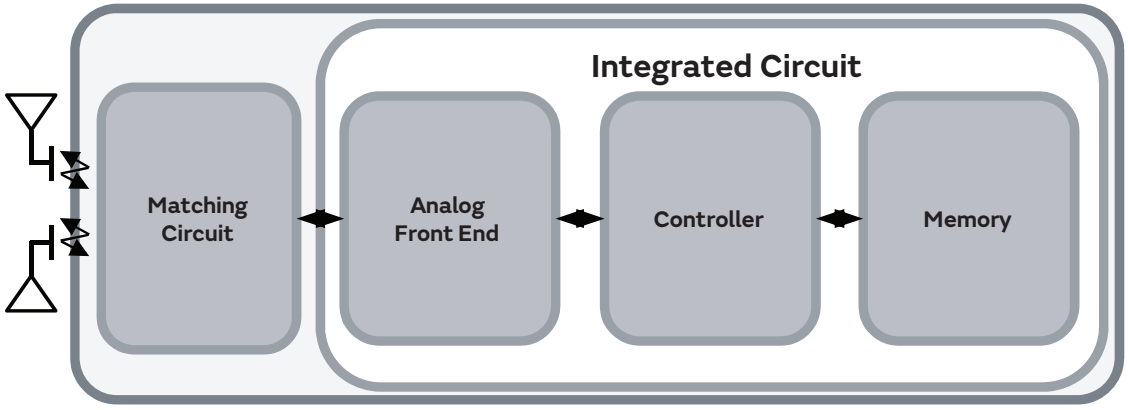


Dimensions (mm)



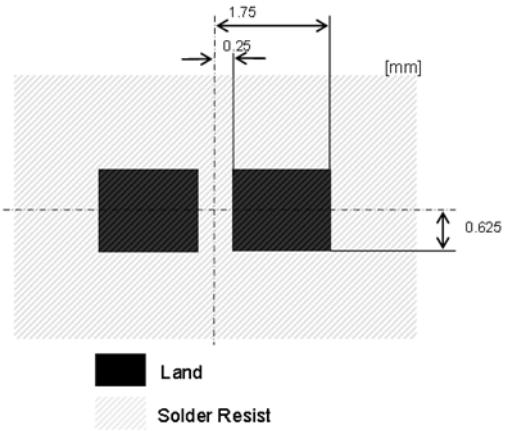
Mark	Dimensions	Mark	Dimensions
L	3.2 ± 0.2	b1	0.18 ± 0.18
W	1.6 ± 0.2	b2	0.18 ± 0.18
T	0.7 max.	d	0.7 ± 0.1
a	1.25 ± 0.1	-	-

MAGICSTRAP® Block Diagram

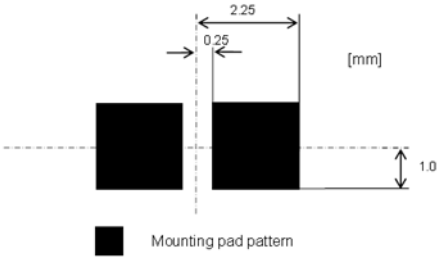


Recommended Land Pattern Design

Recommended land pattern (SMT process)



Recommended land pattern (adhesive attachment)



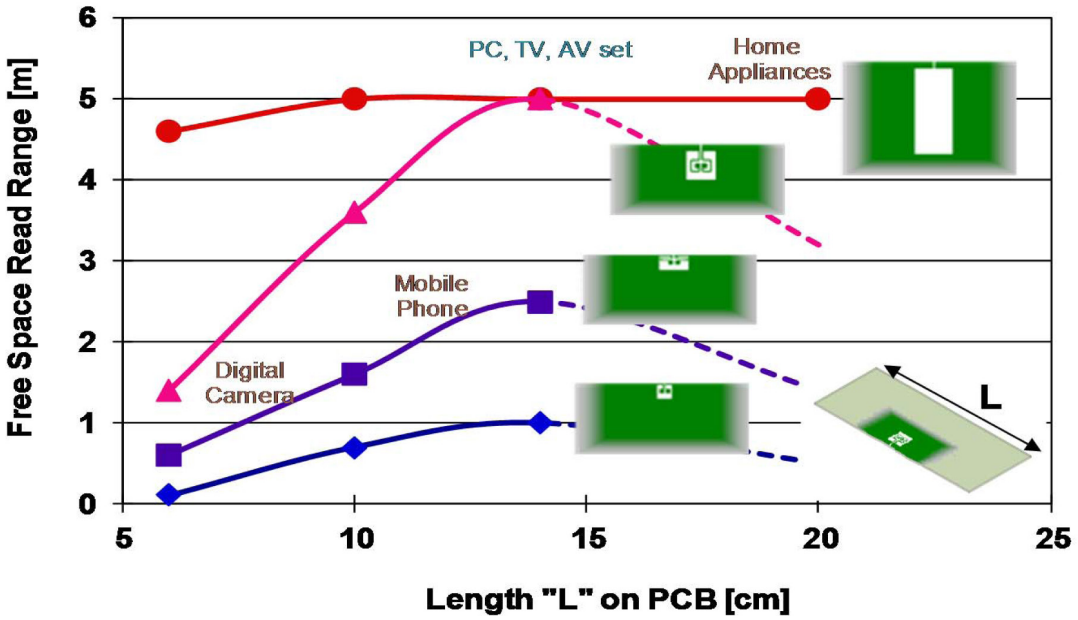
Electrical Parameters

- *Frequency Range: 865 – 955MHz*
- *Minimum operating power: -8dBm*
- *Electrical characteristics at minimum operating power (Ta=25C, unit: Ω)*

Parameter / MAGICSTRAP® P/N			LXMS31ACNA-009 LXMS31ACMD-141	LXMS31ACNA-010 LXMS31ACMD-142	LXMS31ACNA-011 LXMS31ACMD-143	LXMS31ACNA-012 LXMS31ACMD-144
Impedance Value	@866.6MHz	R	15	12	25	80
		X	-45	-107	-200	-405
	@915.0MHz	R	25	12	25	80
		X	-45	-107	-200	-420
	@953.0MHz	R	30	9	20	60
		X	-48	-105	-195	-425

Read Range

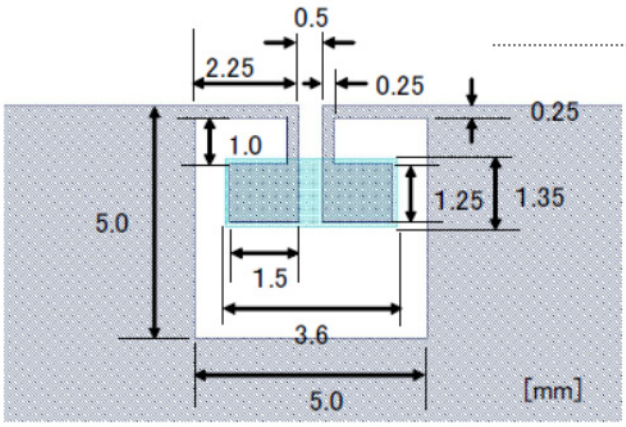
4W EIRP @ 915MHz

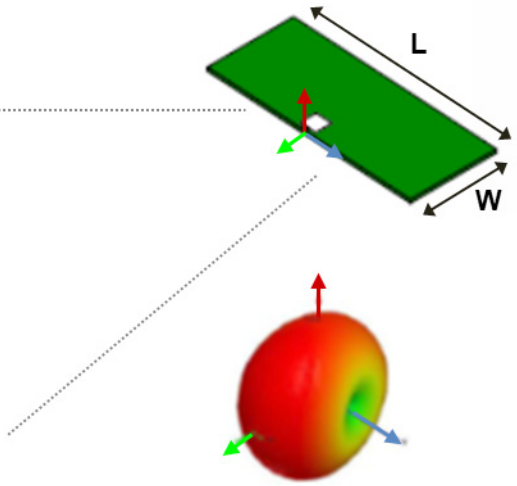


Note: Distances measured with 4W EIRP reader, 6dBi circularly polarized antenna, at 915 MHz; MAGICSTRAP® using NXP G2XL/M.

Reference Antenna Design and Performance

Type 1





Directivity

Actual Read Range

PCB Size L x W	USA (m)	Japan (m)
20 x 6cm	0.5	0.4
14 x 4cm	1.0	0.8
10 x 4cm	0.7	0.5
6 x 4cm	0.1	0.1

30dBm, 6dB1 (4W EIRP) w/circularly polarized wave

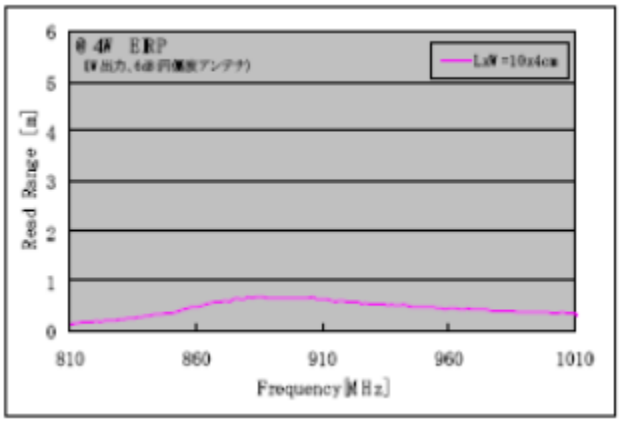
*Reader/Writer: CSL-461

** 2mm read range is available with loop antenna

PCB Size L x W	USA (cm)	Japan (cm)
20 x 6cm	3.0	1.0
14 x 4cm	10.0	0.8
10 x 4cm	**	**
6 x 4cm	**	**

10dBm, 6dB1 (40mW EIRP) w/linearly polarized wave

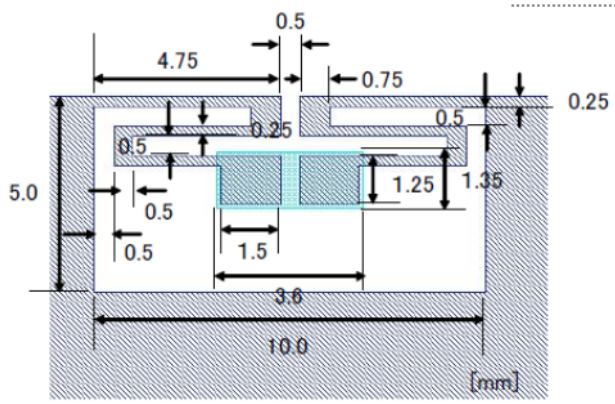
Read Range (m) by Freq (MHz)

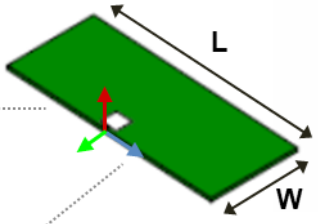


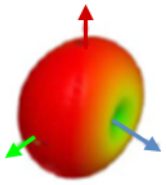
Simulation according to min. operating power

Reference Antenna Design and Performance

Type 2







Directivity

Actual Read Range

PCB Size L x W	USA (m)	Japan (m)
20 x 6cm	1.4	1.1
14 x 4cm	2.5	2.0
10 x 4cm	1.6	1.6
6 x 4cm	0.6	0.5

30dBm, 6dB1 (4W EIRP) w/circularly polarized wave

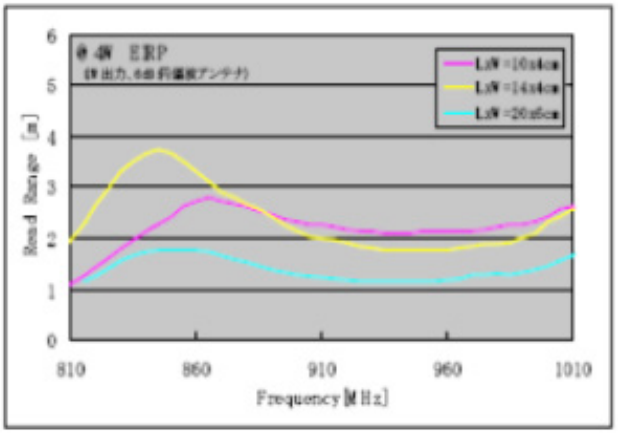
*Reader/Writer: CSL-461

** 2mm read range is available with loop antenna

PCB Size L x W	USA (cm)	Japan (cm)
20 x 6cm	5	3
14 x 4cm	20	10
10 x 4cm	5	10
6 x 4cm	**	**

10dBm, 6dB1 (40mW EIRP) w/linearly polarized wave

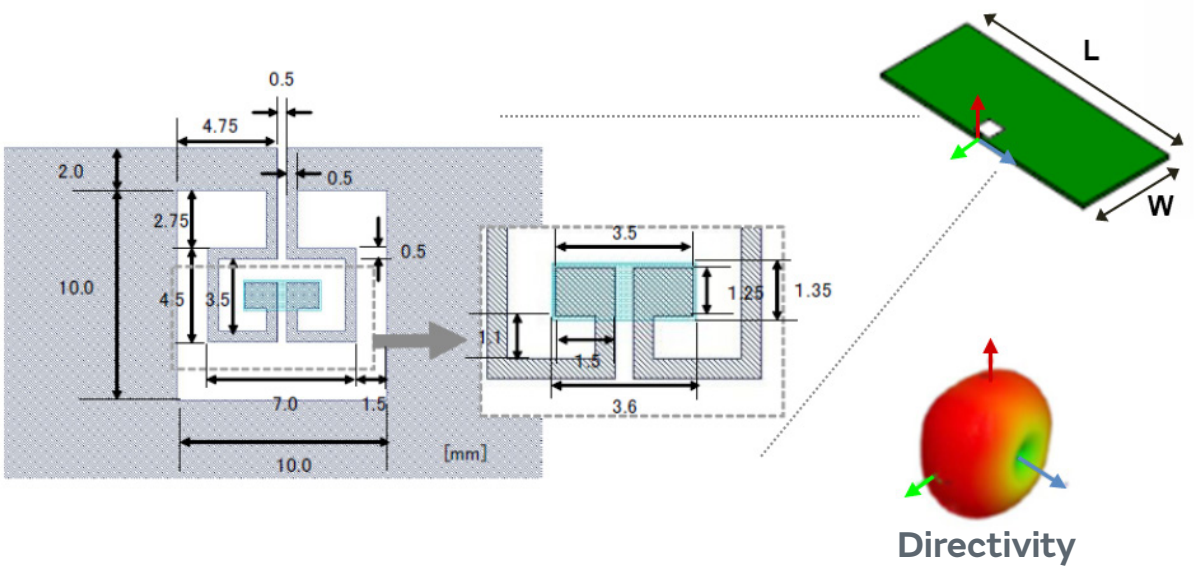
Read Range (m) by Freq (MHz)



Simulation according to min. operating power

Reference Antenna Design and Performance

Type 3



Directivity

Actual Read Range

PCB Size L x W	USA (m)	Japan (m)
20 x 6cm	3.2	2.6
14 x 4cm	5.0	4.3
10 x 4cm	3.6	3.6
6 x 4cm	1.4	1.4

30dBm, 6dB1 (4W EIRP) w/circularly polarized wave

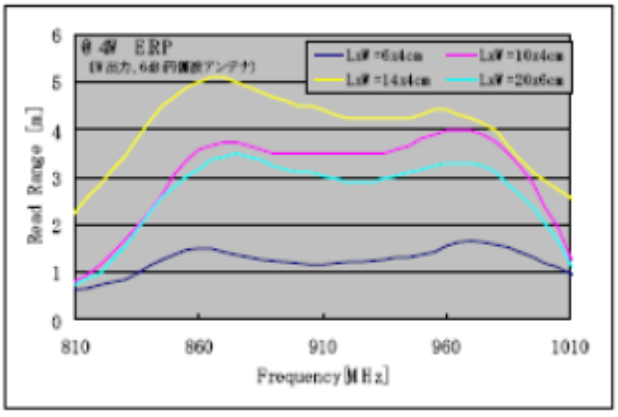
*Reader/Writer: CSL-461

** 2mm read range is available with loop antenna

PCB Size L x W	USA (cm)	Japan (cm)
20 x 6cm	40	30
14 x 4cm	60	45
10 x 4cm	40	30
6 x 4cm	15	15

10dBm, 6dB1 (40mW EIRP) w/linearly polarized wave

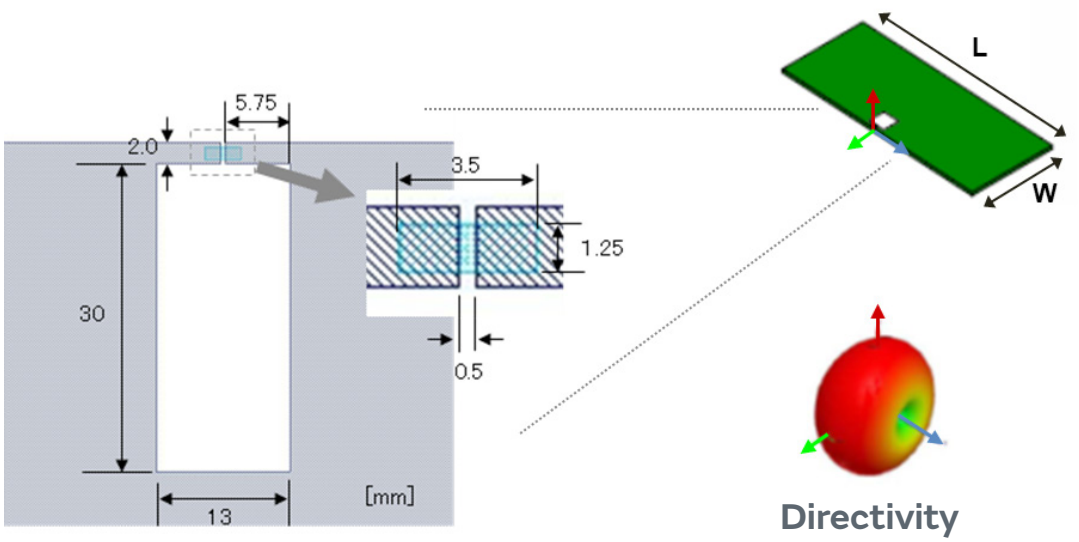
Read Range (m) by Freq (MHz)



Simulation according to min. operating power

Reference Antenna Design and Performance

Type 4



Actual Read Range

PCB Size L x W	USA (m)	Japan (m)
20 x6 cm	5.0	3.0
14 x 4cm	5.0	3.0
10 x 4cm	5.0	3.0
6 x 4cm	4.6	3.5

30dBm, 6dB1 (4W EIRP) w/circularly polarized wave

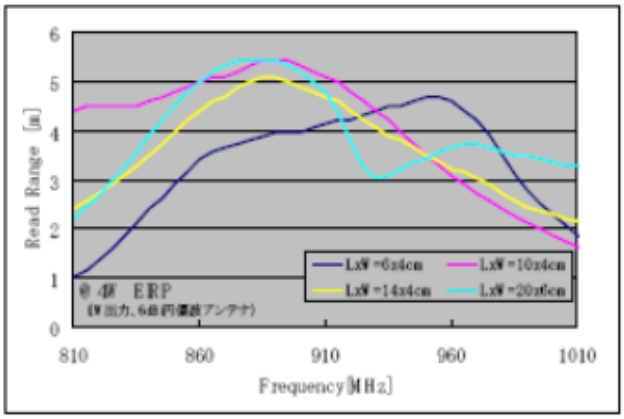
*Reader/Writer: CSL-461

** 2mm read range is available with loop antenna

PCB Size L x W	USA (cm)	Japan (cm)
20 x 6cm	40	20
14 x 4cm	45	30
10 x 4cm	50	30
6 x 4cm	50	40

10dBm, 6dB1 (40mW EIRP) w/linearly polarized wave

Read Range (m) by Freq (MHz)

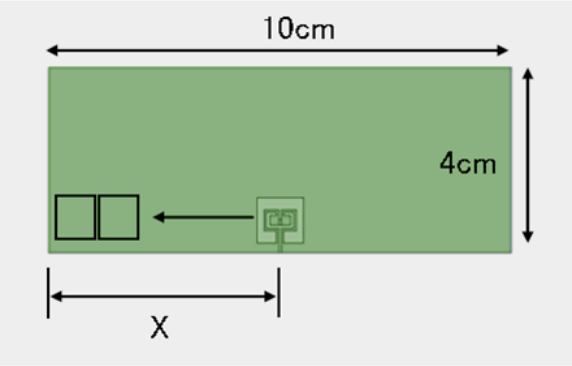


Simulation according to min. operating power

PCB Design Rules to Maximize Read Range

1 – Position of MAGICSTRAP® on PCB:

MAGICSTRAP® should be centered on the long side of the PCB to maximize read range. The following illustrates the relationship between "X" length and read range using Type-3 board design.



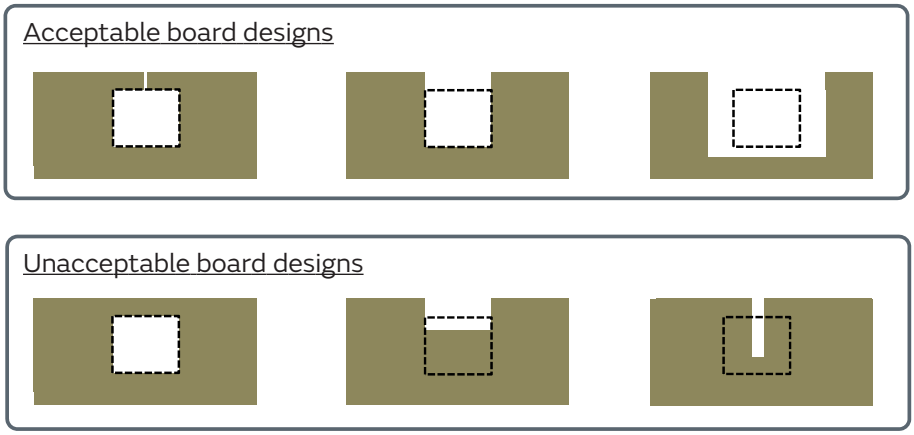
Length "X" (cm)	Read Range (m)
5	3.6
2	2.5
1	1.6

2 – Eliminate conductive material under MAGICSTRAP®:

All layers beneath MAGICSTRAP® should be free of conductive material. This area should be equal or larger then the top layer antenna design to maximize read range. The example below is using Type 3 design.

Top PCB Layer (antenna interface)

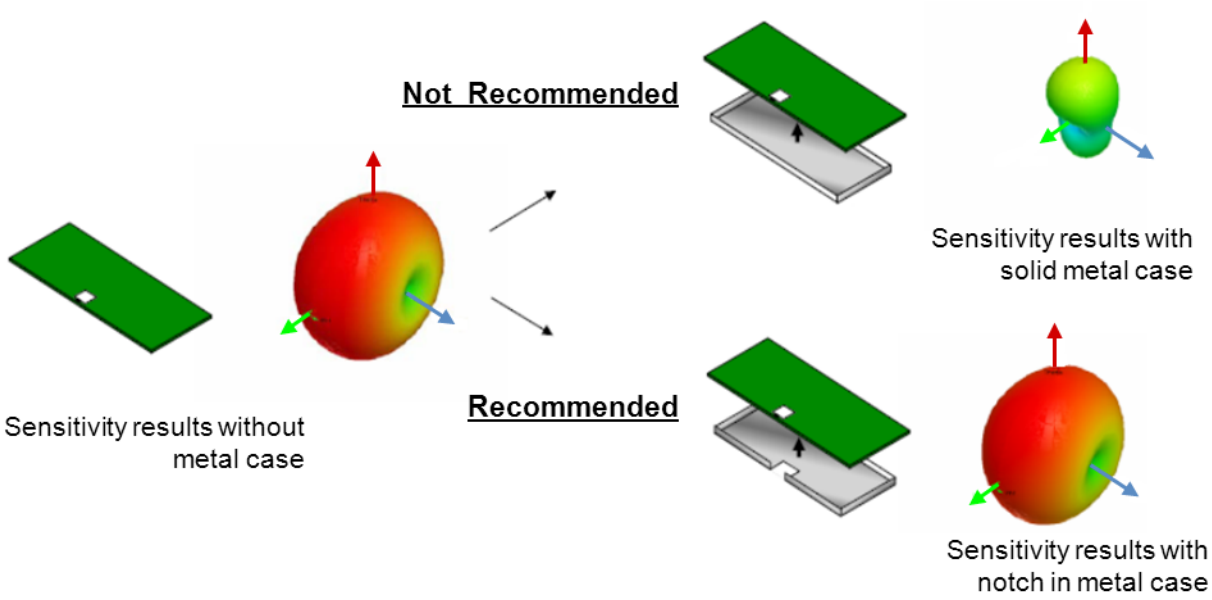
Other Layers



PCB Design Rules to Maximize Read Range

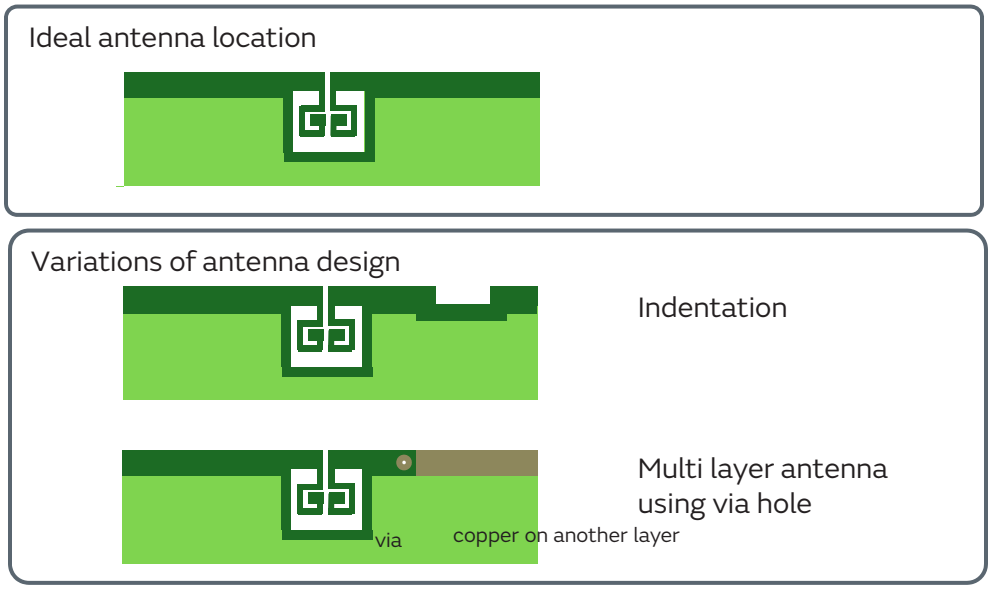
3 – Metal enclosure under printed circuit board:

When the PCB is in close proximity to the metal enclosure, sensitivity is reduced. Removing material directly under the MAGICSTRAP® antenna pattern will greatly improve sensitivity.



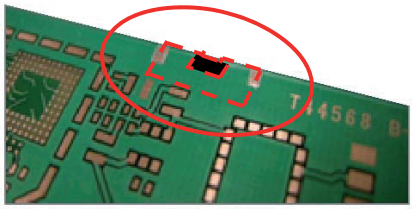
4 – Antenna location on PCB

Location of the PCB antenna should be located closest to the edge of the PCB, as shown below in dark green. Variations of ideal design are also acceptable.

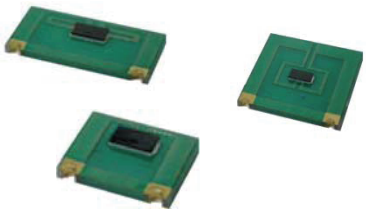


Prototyping using MAGICSTRAP®

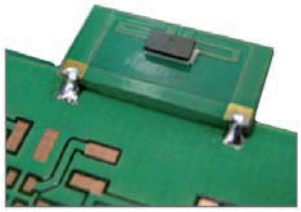
Select board location for MAGICSTRAP® and remove resist material



Select one of Murata's Mini-PCB prototype boards based on desired read range and available board space



Solder the Mini-PCB prototype board, verify functionality and performance using reader / writer

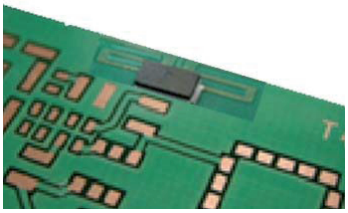


Good enough?

no

ok

Incorporate reference design and produce PCB



Global locations

For details please visit www.murataamericas.com

Note

1 Export Control

For customers outside Japan:

No Murata products should be used or sold, through any channels, for use in the design, development, production, utilization, maintenance or operation of, or otherwise contribution to (1) any weapons (Weapons of Mass Destruction [nuclear, chemical or biological weapons or missiles] or conventional weapons) or (2) goods or systems specially designed or intended for military end-use or utilization by military end-users.

For customers in Japan:

For products which are controlled items subject to the "Foreign Exchange and Foreign Trade Law" of Japan, the export license specified by the law is required for export.

2 Please contact our sales representatives or product engineers before using the products in this catalog for the applications listed below, which require especially high reliability for the prevention of defects which might directly damage a third party's life, body or property, or when one of our products is intended for use in applications other than those specified in this catalog.

1. *Aircraft equipment*
2. *Undersea equipment*
3. *Medical equipment*
4. *Traffic signal equipment*
5. *Data-processing equipment*
6. *Aerospace equipment*
7. *Power plant equipment*
8. *Transportation equipment (vehicles, trains, ships, etc.)*
9. *Disaster prevention / crime prevention equipment*
10. *Application of similar complexity and/or reliability requirements to the applications listed above*

3 Product specifications in this catalog are as of August 2013. They are subject to change or our products in it may be discontinued without advance notice. Please check with our sales representatives or product engineers before ordering. If there are any questions, please contact our sales representatives or product engineers.

4 Please read rating and & CAUTION (for storage, operating, rating, soldering, mounting and handling) in this catalog to prevent smoking and/or burning, etc.

5 This catalog has only typical specifications. Therefore, please approve our product specifications or transact the approval sheet for product specifications before ordering.

6 Please note that unless otherwise specified, we shall assume no responsibility whatsoever for any conflict or dispute that may occur in connection with the effect of our and/or a third party's intellectual property rights and other related rights in consideration of your use of our products and/or information described or contained in our catalogs. In this connection, no representation shall be made to the effect that any third parties are authorized to use the rights mentioned above under licenses without our consent.

7 No ozone depleting substances (ODS) under the Montreal Protocol are used in our manufacturing process.

Murata Manufacturing Co., Ltd.

www.murata.com

muRata
INNOVATOR IN ELECTRONICS