ethertronics
AN AVX GROUP COMPANY

DATASHEET
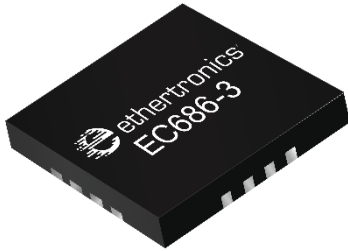Part No. EC686-3
Product: Switch & Tune™
EtherChip™ Family

Part No. EC686-3
EtherChip Switch & Tune™
100 MHz to 3000 MHz
Supports: GSM, WCDMA, LTE, BT, Wi-Fi, RFID

Ethertronics' EtherChip EC686-3™ using Ether Switch&Tune™ technology and high-performance RF switching solves the challenges facing today's wireless industry and product designers. EC686-3 allows an RF front-end to cover global bands and seamlessly improve performance in a dynamically changing RF environment by employing active tuning. EC686-3 can be used in a variety of applications including wireless devices, cell phones, and M2M Products.

Ether Switch&Tune™ technology and EC686-3 provide wider global band coverage (including LTE) with a single antenna element using parasitic loading and active tuning techniques to improve RF front-end performance, especially for stringent low band (LTE) antenna efficiency requirements. Combining Ethertronics' extensive antenna systems expertise and proprietary algorithms, the EC686-3 can seamlessly adjust the characteristics of a wireless antenna to:

- Cover all 2G/3G/4G cellular, Bluetooth®, GSM, ISM and RFID bands
- Retune the antenna for frequency shifts
- Reduce the antenna's physical volume by up to 50 percent without performance tradeoffs

Covering all 2G/3G/4G Cellular, Bluetooth®, GSM, ISM, and RFID bands
100 MHz to 3000 MHz

KEY BENEFITS
Operation Frequency
100 MHz to 3000 MHz
RF Switch
SP4T (shunt less architecture)
Ultra-low R_{ON} (900 mΩ)
Exceptional linearity (IIP3 +80 dBm)
Flexible Control Interface
GPIO
Small Package
Total package size is 2.0 x 2.0 x 0.5 mm^3
Package type is QFN 16-pin
Environmental Compliance
RoHS2 Directive 2011/65/EU
REACH Substances of Very High Concern (SVHC) regulation (EC) No 1907/2006

APPLICATIONS
- Cellphones
- Tablets and Notebooks
- M2M Products
- Other Wireless Devices

Global Operation and Design Support

EC686-3 is supported by a full set of product documentation, and when needed, by the expertise of RF engineers who have integrated hundreds of antenna and RF system designs into wireless devices.
Ethertronics' global operations encompass an integrated network of design centers which provide local customer support.

Mechanical Specifications & Ordering Part Number

Ordering Part Number	EC686-3
Dimensions (mm)	2.0 x 2.0 x 0.5
Operating Temperature (ºC)	-40 to + 85
Package	QFN-16 Pin

EtherChip Switch&Tune™ specifications
Ethertronics produces a wide variety of standard chipset to meet user needs

Main Specifications

Electrical specification at 25 ºc, Vdd = 2.8 V, RFC = Ground
RF Performance measured using reflected power method through ports RF1 through FR4

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Operating Frequency	f0	700		3000	MHz	
Startup Time	tSU			30	us	Time from VDD within specification to all performance within specification. DC path to ground at RF ports.
RON	RON		900		mΩ	RFC to ON RF Port
COFF	COFF		300		fF	RFC to OFF RF Port, 1950 MHz
Second Harmonic	2f0		-65		dBm	f0 @ 836 MHz, + 35 dBm
			-61		dBm	f0 @ 1950 MHz, + 33 dBm
			-78		dBm	f0 @ 2535 MHz, + 23 dBm
Third Harmonic	3f0		-61		dBm	f0 @ 836 MHz, + 35 dBm
			-60		dBm	f0 @ 1950 MHz, + 33 dBm
			-90		dBm	f0 @ 2535 MHz, + 23 dBm
Third Order Intercept Point	IIP3		80		dBm	TX: 836 MHz, +20 dBm Blocker: 791 MHz, -15 dBm RX: 881 MHz
			78		dBm	TX: 1950 MHz, +20 dBm Blocker: 1760 MHz, -15 dBm RX: 2140 MHz
Second Order Intercept Point	IIP2		132		dBm	TX: 836 MHz, +26 dBm Blocker: 1717 MHz, -20 dBm RX: 881 MHz
			124		dBm	TX: 1950 MHz, +26 dBm Blocker: 4090 MHz, -20 dBm RX: 2140 MHz
Harmonic Knee Point	HKP		42		dBm	836 MHz
Switching Time	tSW		5		us	50% control to 10%/90% RF. DC path to ground at RF ports.

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Operating Ranges

Operation should be restricted to the limits shown in the following Operating Ranges table.

Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage	V_{DD}	2.3	2.8	4.8	V
Supply Current	I_{DD}		90		µA
Control Voltage High	V_{IH}	1.3	1.7	2.3	V
Control Voltage Low	V_{IL}	0		0.4	V
Operating Temperature	T_{OP}	-40		+85	°C
Storage Temperature	T_{ST}	-65		+150	°C
Input Control Current	V_{IH}		1	10	µA

Absolute Maximum Ratings

Exceeding maximum ratings may cause permanent damage.

Parameter	Symbol	Min	Max	Unit
Supply Voltage	VDD	-0.5	5	V
Control Voltage		-0.5	3.0	V
ESD Voltage (HBM, MIL	HBM	1k		V

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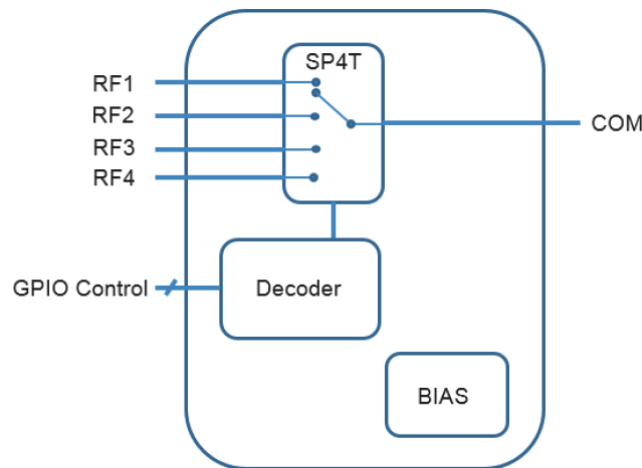
Digital Interface

The EC686-3 supports a GPIO digital interface. EC686-3 GPIO control provides the unique feature of having conventional switch control with only two pin input (allowing the remaining two pins to stay at default), or full 16 state control when using all four pins. Truth table logic is shown in the table below.

EC686- 3 (GPIO) Truth Table

GPIO Inputs				Path State			
GPIO3	GPIO2	GPIO1	GPIO0	RF1	RF2	RF3	RF4
0	0	0	0	OFF	OFF	OFF	ON
0	0	0	1	OFF	OFF	OFF	OFF
0	0	1	0	ON	ON	OFF	OFF
0	0	1	1	OFF	OFF	ON	ON
0	1	0	0	OFF	ON	OFF	OFF
0	1	0	1	OFF	ON	OFF	ON
0	1	1	0	OFF	ON	ON	OFF
0	1	1	1	OFF	ON	ON	ON
1	0	0	0	ON	OFF	OFF	OFF
1	0	0	1	ON	OFF	OFF	ON
1	0	1	0	ON	OFF	ON	OFF
1	0	1	1	ON	OFF	ON	ON
1	1	0	0	OFF	OFF	ON	OFF
1	1	0	1	ON	ON	OFF	ON
1	1	1	0	ON	ON	ON	OFF
1	1	1	1	ON	ON	ON	ON

Block Diagram

The EC686-3 block diagram provides a versatile implementation for many different antenna configurations supported by the Ethertronics.

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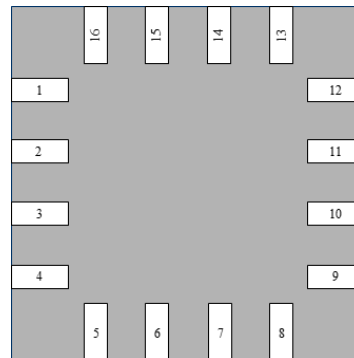5501 Oberlin Drive, Suite 100 San Diego, CA 92121 - USA

EtherChip Switch&Tune™ specifications
Ethertronics produces a wide variety of standard chipset to meet user needs

Mechanical Overview and Pin Configuration (Top View)

Size (mm)	2.0 x 2.0 x 0.5
Mounting	Surface Mount
Packaging	Tape & Reel

EC686-3 Footprint
-Top View-

GPIO Pin Description

Pin Number	Pin Name	Pin Type	Description
1	RFC	Input	RF Common Input
2	RFC	Input	RF Common Input
3	VDD	Power	Power Supply
4	GND	Ground	Ground
5	GPIO3	Input	GPIO Input
6	GPIO2	Input	GPIO Input
7	GPIO1	Input	GPIO Input
8	GPIO0	Input	GPIO Input
9	GND	Ground	Ground
10	NC	No connect	No internal connection, ground in application
11	RFC	Input	RF Common Input
12	RFC	Input	RF Common Input
13	RF4	Output	RF Output 4
14	RF3	Output	RF Output 3
15	RF2	Output	RF Output 2
16	RF1	Output	RF Output 1

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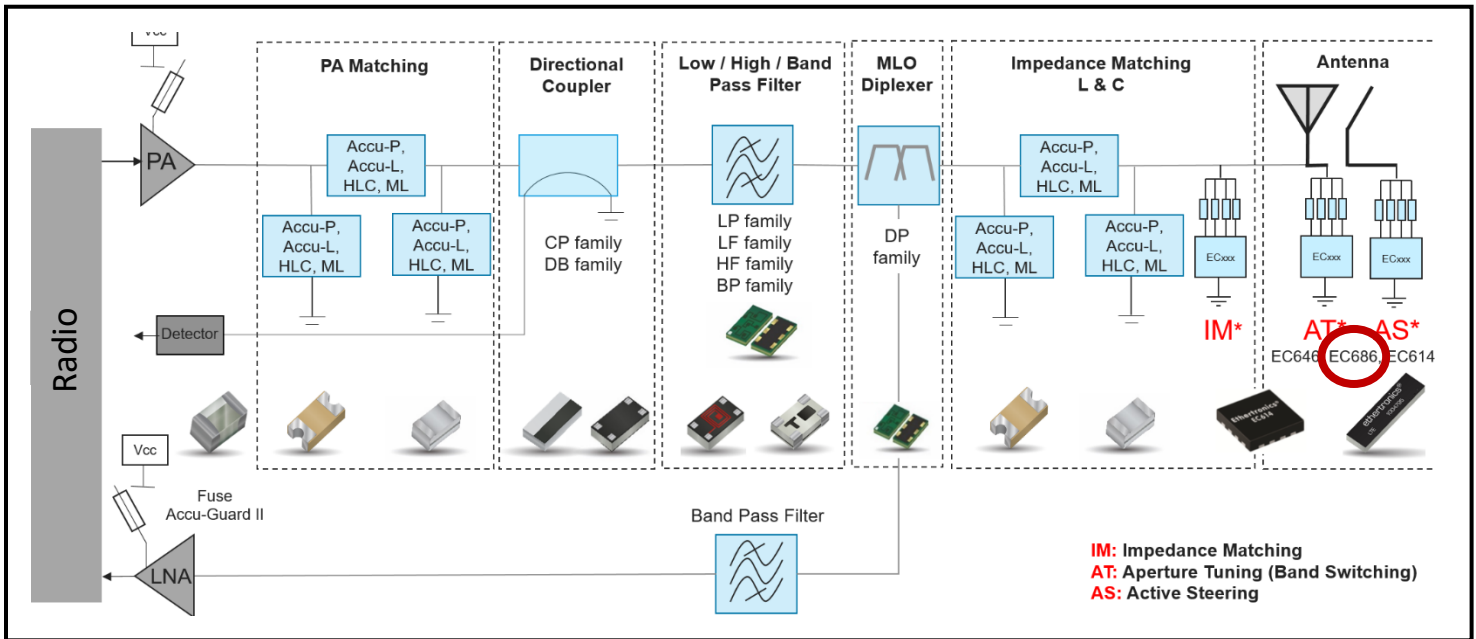5501 Oberlin Drive, Suite 100 San Diego, CA 92121 - USA

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Application Support

AVX provides a broad range of components and products to meet the needs of high-performance RF front-end solutions across the increasing diversity of wireless applications. Supported applications and functions include power amplifier matching, directional coupling, filtering and duplexing, impedance matching, and active and passive antenna solutions.

As shown in the diagram below, the EC686-3 RF switch is particularly well-suited for active antenna tuning applications. Ethertronics will work with your engineering team to create an optimal solution for your application, including custom antennas (using Ethertronics' proprietary antenna technology), custom software as needed, and an EC686-3 implementation configured for your specific performance requirements.
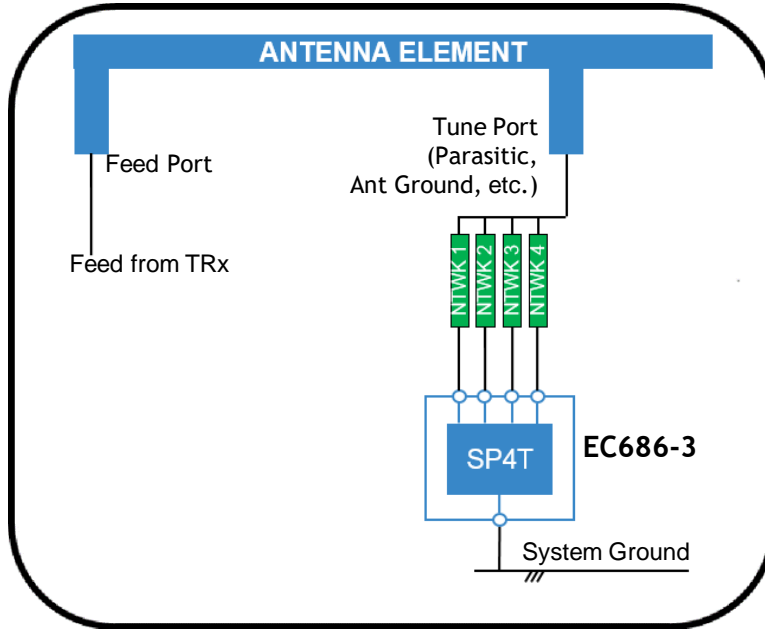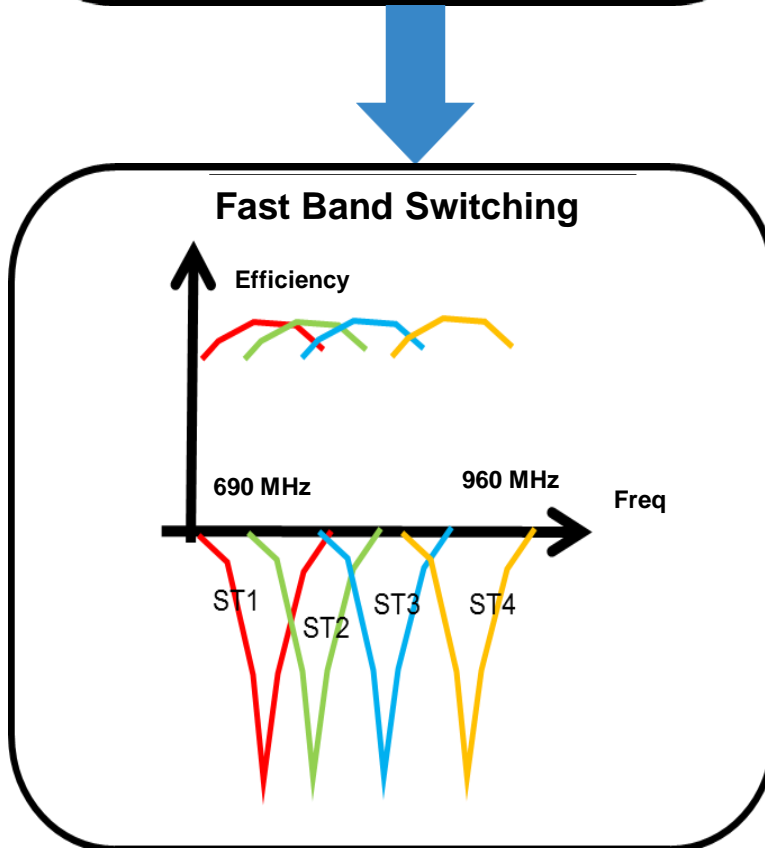

AVX RF Front-End Product Families

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Application Example

ANTENNA ELEMENT

Feed Port

Tune Port
(Parasitic,
Ant Ground, etc.)

Feed from TRx

NTWK 1
NTWK 2
NTWK 3
NTWK 4

SP4T   **EC686-3**

System Ground

NTWK 1-4 are tuning networks
(Typically Single L, C or an open)
Only RF connections shown

Fast Band Switching

Efficiency

690 MHz   960 MHz

Freq

ST1   ST2   ST3   ST4

Grounding the RFC port is the
recommended configuration providing
high integrity RF board layout and
best performance.

There are many potential applications.
In the commonly used low band, band
switching example shown, application
designs must be adjusted to the
specific antenna characteristics.

Please contact your FAE for additional
support.

EtherChip Switch&Tune™ specifications
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Pin Layout

Top View

TOP VIEW

Bottom View
View M-M
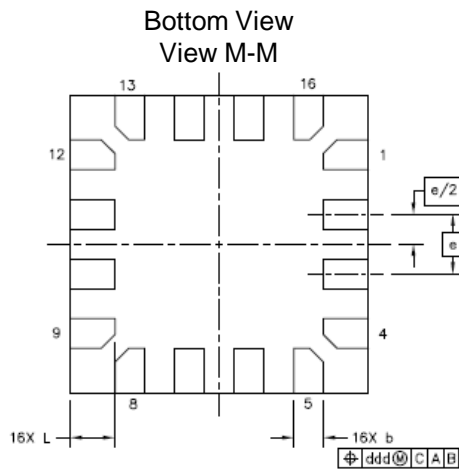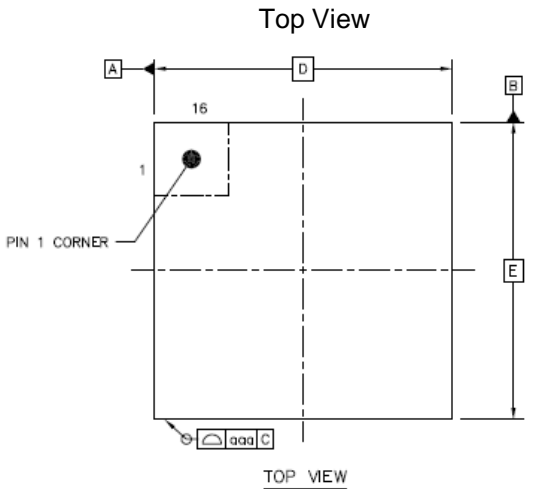
	Symbols	Dimensions in Millimeters		
		MIN	**NOM**	**MAX**
Total thickness	A	——	0.5	
Stand off	A1	0	0.035	0.05
L/f thickness	A3	0.127 REF.		
Lead width	b	.15	0.2	0.25
Body size	D	2 BSC		
	E	2 BSC		
Lead pitch	e	0.4 BSC		
Lead length	L	0.25	0.3	0.35
Package edge tolerance	aaa	0.1		
Mold flatness	bbb	0.1		
Coplanarity	ccc	0.08		
Lead offset	ddd	0.1		

Side View

SEATING PLANE
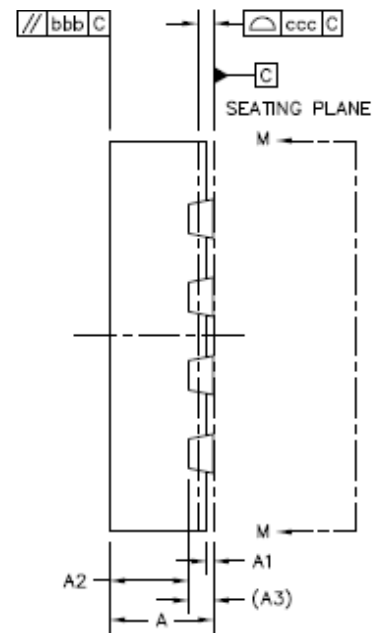
1. All dimensions are in millimetres
2. M: the maximum allowable corner on the molded plastic body corners.
3. Dimension 'd' does not include mold protrusions or gate burrs. Mold protrusions and gate burrs shall not exceed 0.15mm per side.
4. Dimension 'e' does not include interterminal mold protrusions or terminal protrusions. Interterminal mold protrusions and/or terminal protrusions shall not exceed 0.20mm per side.
5. Dimension 'b' applies to plated terminals. Dimension 'a1' is primarily terminal plating but may or may not include a small protrusion of terminal below the bottom surface of the package.
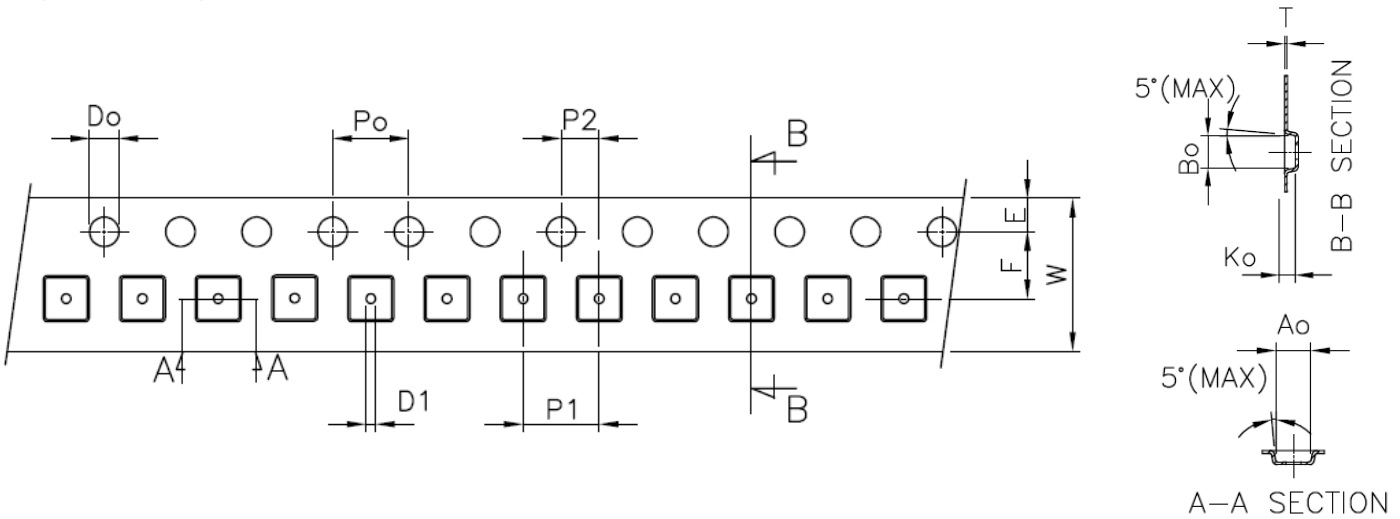6. JEDEC STANDARD MO-220

EtherChip Switch&Tune™ specifications
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Packaging Information

Tape & Reel Specifications

Unit: mm

Symbol	Ao	Bo	Ko	Po	P1	P2	T
Spec	2.20±0.05	2.20±0.05	0.70±0.05	4.00±0.10	4.00±0.10	2.20±0.05	0.25±0.05
Symbol	E	F	Do	D1	W	10Po	
Spec	1.75±0.10	3.50±0.05	1.50	0.50	8.00	40.0±0.20	

Notes:
1. ALL DIMENSIONS ARE IN MILLIMETERS
2. 10 Sprocket hole pitch cumulative tolerance is ±0.20mm.
3. Carrier camber shall be not more than 1mm per 250mm.
4. Ao & Bo measured on a place in the middle of the corner radii.
5. Ko measured from a place on the inside bottom of the pocket to top surface of carrier.
6. Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole.
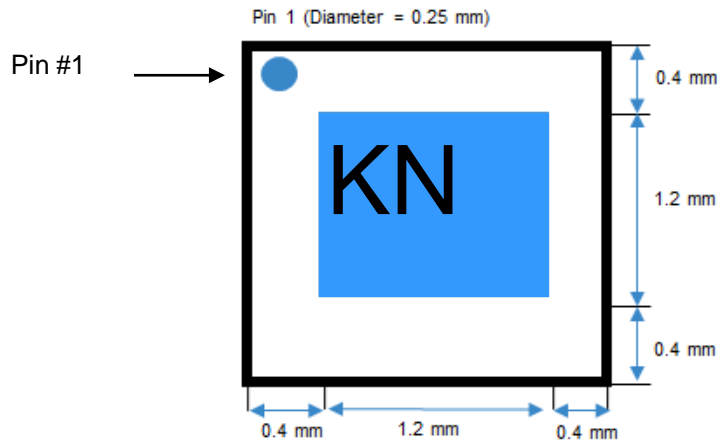7. Surface resistivity ≥ $1.0*10^5$ & ≤ $1.0*10^8$ ohm/sq.

EtherChip Switch&Tune™ specifications
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Product Marking Codes and Ordering Information

Dash Number	Marking Code	Function
-3	KN	GPIO

Order Code	Package	Model Description	Shipping Method
EC686-3	16-Lead QFN 2 X 2 X 0.45 mm³	GPIO	3000 units/T&R

Marking Code

Pin 1 (Diameter = 0.25 mm)

Pin #1

KN

0.4 mm

1.2 mm

0.4 mm

0.4 mm   1.2 mm   0.4 mm
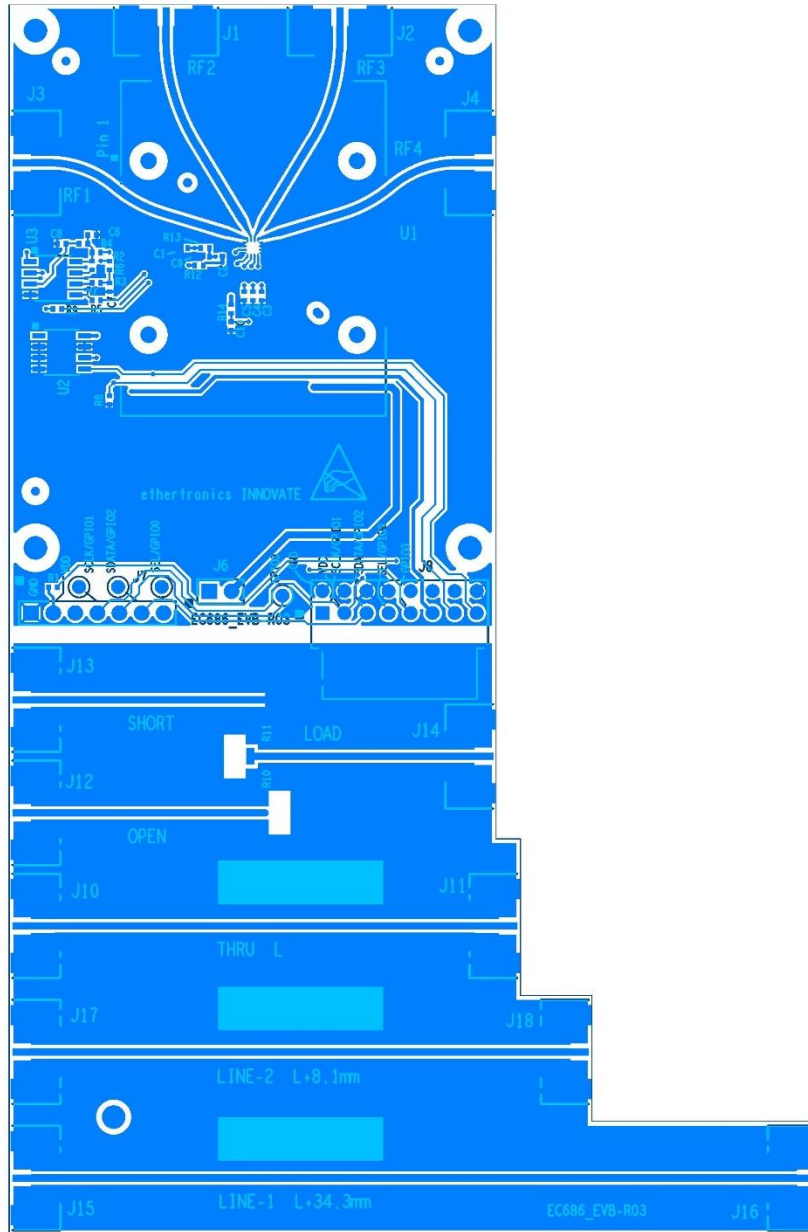
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Evaluation Board

EC686-3 Evaluation Board (PN: EC686-3-01)
Available through your FAE or Sales Engineer.