



RJ45 Jacks with Integrated Magnetics, PoE and Discrete Magnetics

Ruud van den Brink Feb 22nd, 2019



EVERY CONNECTION COUNTS



Agenda

- Ethernet Basics
- Ethernet Port Build Up
- Why RJ45 with Integrated Magnetics ?
- RJ45 Jack with Integrated Magnetics Build Up
- RJ45 Jack with Integrated Magnetics with PoE
- Discrete Magnetics for Discrete build up of the Ethernet port
- Customer Benefits, Advantages and Features
- Competitors
- TE's RJ45 Jacks with Integrated Magnetics Portfolio
- Marketing Collateral
- Application Examples
- Questions to Ask Your Customer

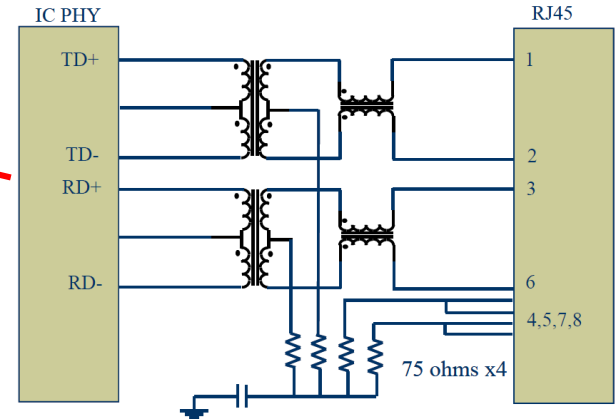
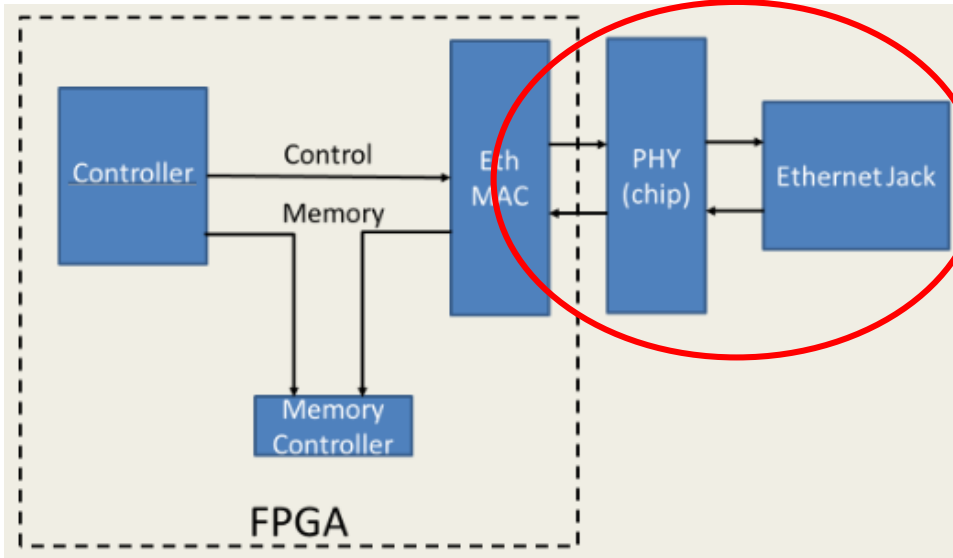
Ethernet Basics

- Ethernet is the basis of LAN networks
- The Institute for Electrical and Electronic Engineers (IEEE) defined the Ethernet standard as IEEE 802.3

Maximum Frequency	EIA/TIA		ISO/IEC		IEEE 802.3 Media Systems
	Components	Channel	Components	Channel	
16 MHz	Cat 3	Cat 3	Cat 3	Class C	10Base-T
100 MHz	Cat 5e (Cat 5)	Cat 5e (Cat 5)	Cat 5e (Cat 5)	Class D	100Base-TX 1GBase-T
250 MHz	Cat 6	Cat 6	Cat 6	Class E	1GBase-T
500 MHz	Cat 6A EIA/TIA 568-C.2	Cat 6A EIA/TIA 568-C.2	Cat 6A ISO/IEC 11801 ed. 2002 adm.2	Class EA ISO/IEC 11801 ed. 2002 adm.1	10GBase-T IEEE 802.3an
600 MHz	N/A	N/A	Cat 7	Class F	10GBase-T
1.000 MHz	N/A	N/A	Cat 7A	Class FA	40GBase-T (under discussion)
1.600 MHz / 2.000 MHz	N/A	N/A	Cat 8.1	Class I	40GBase-T
			Cat8.2	Class II	40GBase-T

Covered by
TE Portfolio

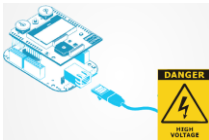
Ethernet Port Buildup



Why are Magnetics needed ?

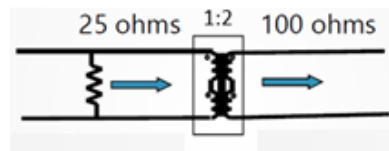
Electrical isolation

To isolate and offset the signal voltage from MAC and from RJ45 to protect the MAC and other devices (e.g., switches) from being damaged by high voltage at the line.



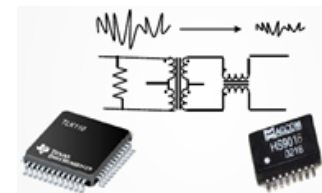
Impedance match

To maximize efficiency of signal transmission between user's host circuitry and cable



Signal Integrity

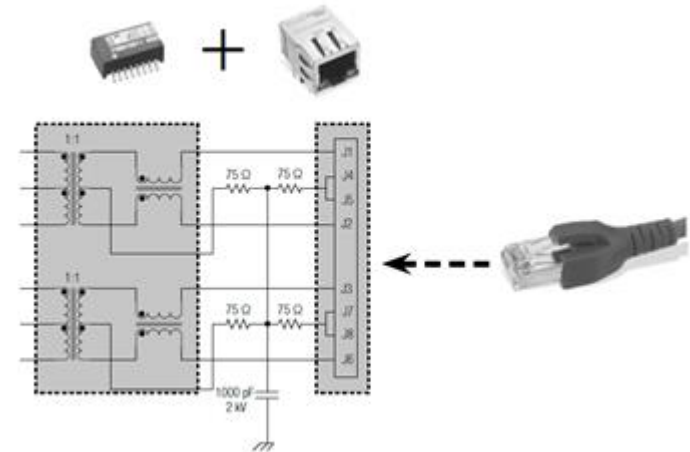
To filter EMI and common mode noise



Why Jacks with Integrated Magnetics ?

Advantages

- ✓ Quick and easy (proven) design
- ✓ Smaller BOM and hence lower production (assembly) cost
- ✓ Better electromagnetic compatibility (EMC) shielding of sensitive cable-side signals by the metal shield
- ✓ Smaller footprint
- ✓ Smaller form-factor

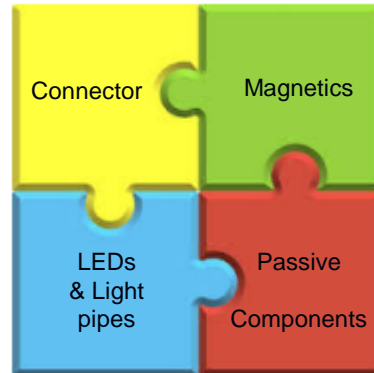
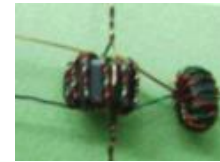


RJ45 with Integrated Magnetics Buildup

RJ45 connector



Magnetic components (Common Mode Choke + Isolation Transformers)



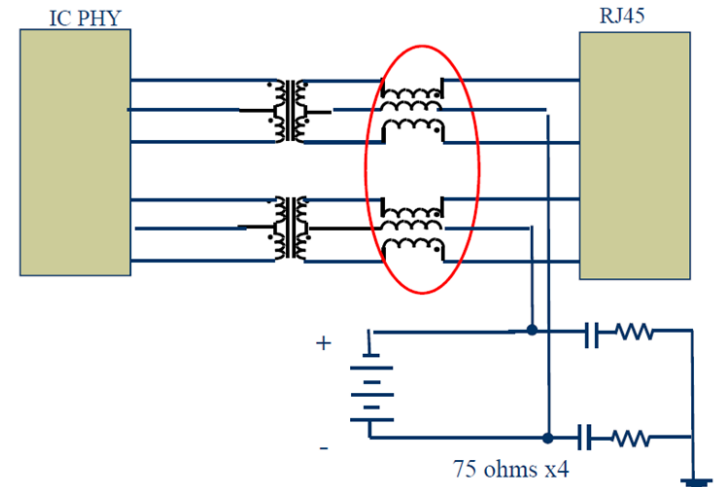
LEDs or light pipes (optional)



Decoupling capacitor (optional)
Termination resistors

RJ45 Jacks with Integrated Magnetics PoE+

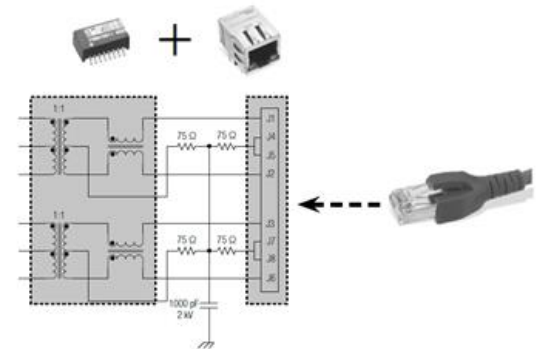
- For customer that want to remote power their devices over the Ethernet connection:
 - E.g. Cameras
 - Support of PoE+
- Current portfolio supports PoE+
- Option (upon request) for PoE++ with improved wiring



Type	Standards	Max. current	Number of energized pairs	Power at Source	Power at device	Max. Data Rate	Standard ratified
PoE	IEEE802.3af Type 1	350mA	2	15.4W	13W	1000Base-T	2003
PoE+	IEEE802.3at Type 2	600mA	2	30W	25.5W	1000Base-T	2009
PoE++ (4PPoE)	IEEE802.3bt Type 3 IEEE802.3bt Type 4	600mA 960mA	4	60W 90 W	51W 71.3W	10GBase-T	Expected 2016-2017
No IEEE standard	Cisco UPOE HDBaseT (www.hdbaset.org)	600mA >1000mA	4	60 W >100W	51 W >100W	Varies	Exists to-day –no official ratification

Discrete Magnetics

- Discrete buildup of the Ethernet port
- For customer that want to make their own designs:
 - Different over-voltage requirements
 - Own layout for specific EMI/Si requirements
- One to one replacements for existing solutions with:
 - Better price point
 - Improved reliability
 - Improved processability
 - Support of PoE+
- Customization options possible depending on commercial conditions



Customer Benefits, Advantages and Features of TE Jacks with Integrated Magnetics (and PoE+)

- **Improved Reliability**
 - Extended temp range: -40..85 degrees C
 - High corrosion resistance: 30u inch Gold
 - Improved EMI and Si: 3 wire choke (for PoE+)
 - No DOA: 100% end of line testing
 - All LED versions use light pipes
- **Improved Processability**
 - 260 degrees C reflow solderable: LCP materials
 - T&R and Tray packaging
- **Service**
 - Long lifetime, Low MoQ and short leadtime on preferred portfolio
- **Portfolio**
 - Most common Form Factors and LED combinations

Customer Benefits, Advantages and Features of TE Discrete Magnetics

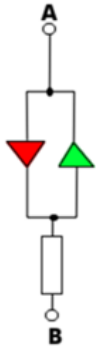
- **Improved Reliability**
 - Extended temp range: -40..105 degrees C
 - Improved EMI and Si: 3 wire choke for PoE+
 - No DOA: 100% end of line testing
- **Improved Processability**
 - 260 degrees C reflow solderable: LCP materials
 - T&R packaging
- **Service**
 - Long lifetime, Low MoQ and short leadtime on preferred portfolio
- **Portfolio**
 - Most common port configurations, transmission speeds and PoE+
 - Upon request THT versions can be made available

RJ45 with Integrated Magnetics

LED Configurations

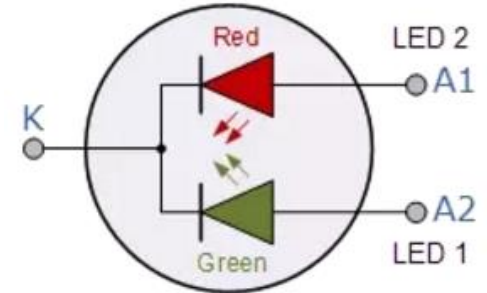
TE Configuration of Choice:
Least PINs required

Duo LED with 2 legs

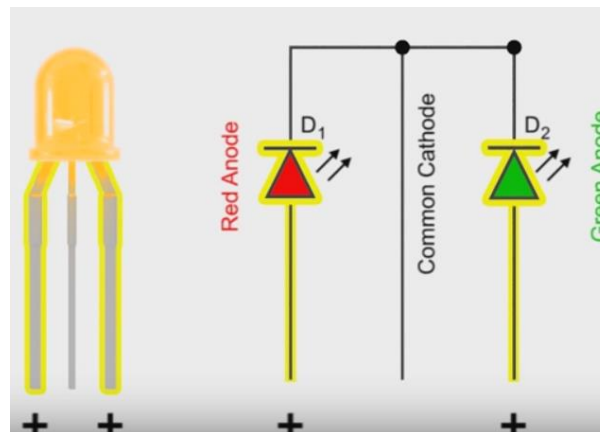


A	B	LED
0	0	Off
0	1	Green
1	0	Red
1	1	off

Duo LED with 3 legs

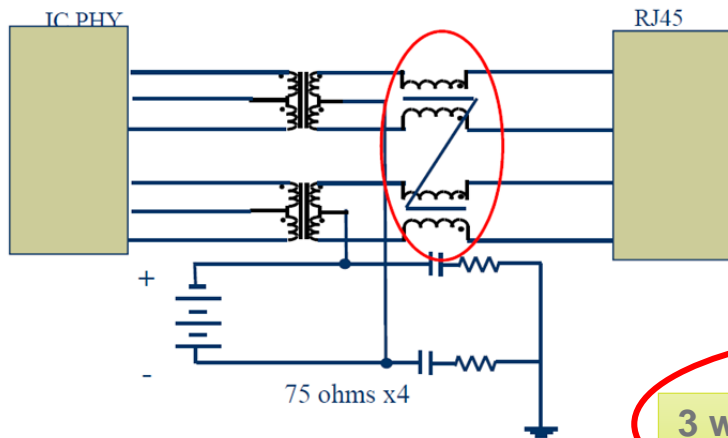


Tri color LED with 3 legs

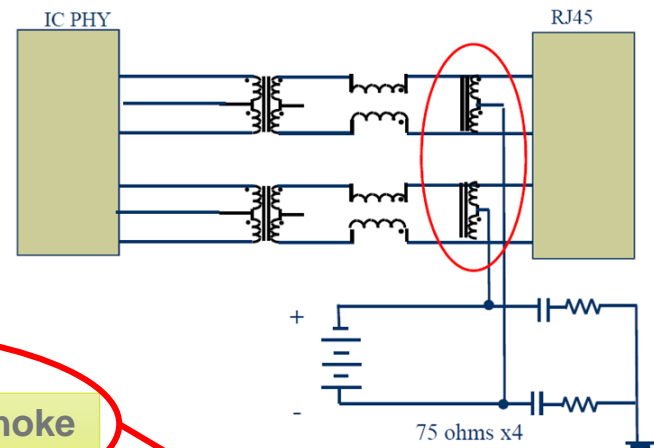


RJ45 with Integrated Magnetics for PoE Common Choke Configurations

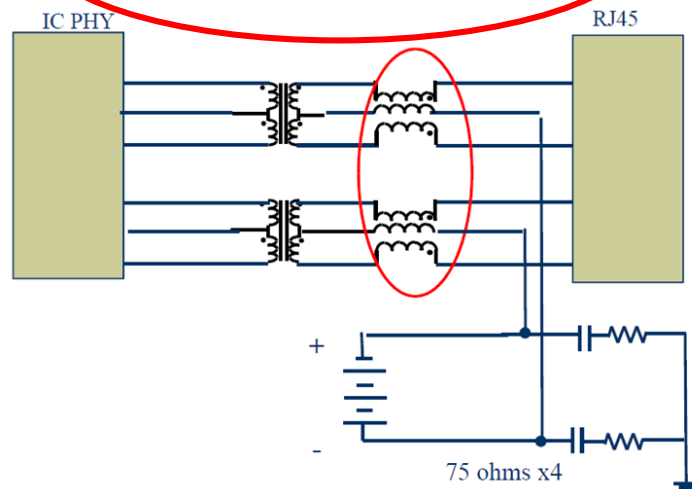
1 shared common mode choke



2-Auto transformer



3 wired common mode choke



TE Configuration of Choice:
Least number of components
Best performance on saturation

RJ45 with Integrated Magnetics

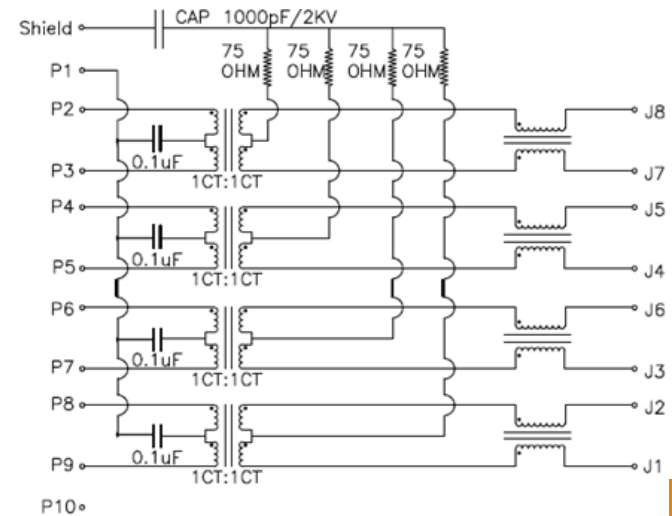
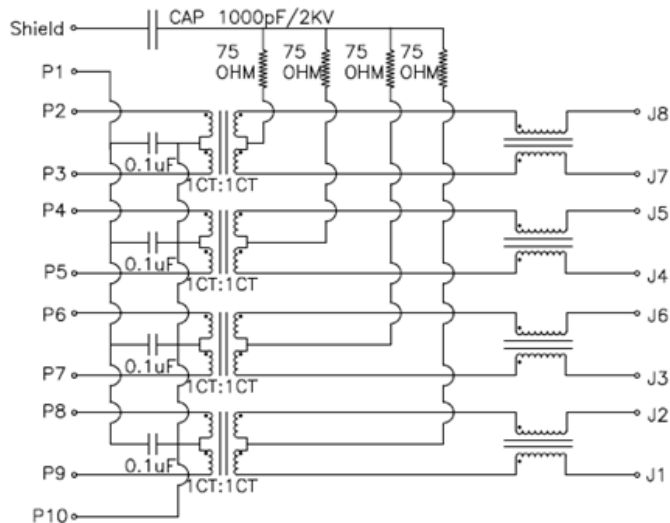
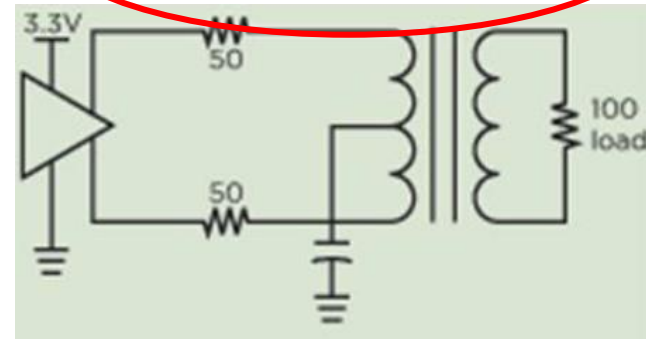
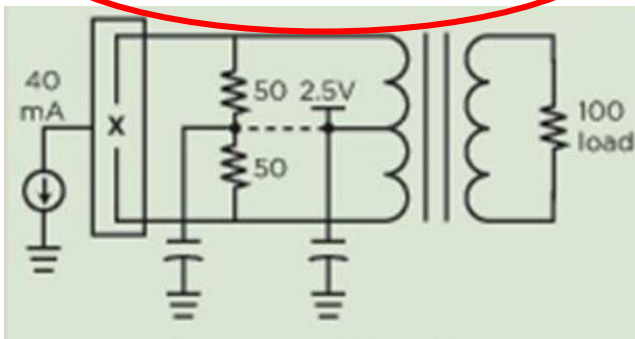
Supported Line Driver Configurations

Supported by some P/Ns

Supported by All P/Ns

Current mode driver

Voltage mode driver



RJ45 Jack Competitors



Supplier	10/100/1000	1x1 Str	1x1 vert	1x2	2x1	other conf	Low Profile	Panel Flanges	No Panel Flanges
TE						2x4			
ERNI						1x4	1/104		
Pulse						2x4; 2x6; 2x8		?	?
Belfuse									
Molex						2x4; 2x6			



Major differentiator

Supplier	LEDs	No LEDs	THT	THR	SMT	Tab up	Tab down	PoE	PoE+	-40..+85 degrees	30uinch gold over 50 uinch nickel
TE								tbd	tbd		
ERNI								8/104		Only 9/66 1x1 Only 1/35 multipt	
Pulse				Only few 1x1	?			Only 100Base-Tx 1x1	Only few 1000Base-T		
Belfuse				?							
Molex											?

- Competitors are focusing on Datacom applications.
- Industrial customers feel they are not supported well.
- Pricing regarded competitive by customers.



Discrete Magnetics Competitors



Supplier	10/100/1000	1x1 Str	1x1 vert	1x2	2x1	other conf	Low Profile	Panel Flanges	No Panel Flanges
TE						2x4			
ERNI						1x4	1/104		
Pulse						2x4; 2x6; 2x8		?	?
Belfuse									
Molex						2x4; 2x6			



Major differentiator

LEDs	No LEDs	THT	THR	SMT	Tab up	Tab down	PoE	PoE+	-40..+85 degrees	30uinch gold over 50 uinch nickel
							8/104		Only 9/66 1x1 Only 1/35 multiprt	
			Only few 1x1	?			Only 100Base-Tx 1x1	Only few 1000Base-T		
			?							
										?

- Competitors are focusing on Datacom applications.
- Industrial customers feel they are not supported well.
- Pricing regarded competitive by customers.



TE Portfolio (Preferred)

Preferred (differences compared to standard)
Service
MoQ, PPQ, SQFP (preferred 1 reel or tray)
L/T 1 Day
Sample room

TE Portfolio (Changes to Standard)

Conditions to make the changes to standard portfolio			
Other Features requests	Impact	OPEX/Tooling	Needed Volumes
Higher Temp (105), 125 not possible	High Impact		500kU
material change (PBT) Cost Down	High Impact		500kU
Remove spring fingers	Low Impact		MoQ
Changes to wiring (Enabling POE)	Low impact		MoQ
Additional shield solder legs	Mid Impact	16kUSD	10kU
SMT	High Impact	50kUSD	500kU
Different Pin Length	3.5mm @ MoQ=2500 supported now	Other lengths Tooling required	100kU
Increase height	High Impact	22kUSD	500kU
Different LED Colors	Low Impact	No	MoQ
Integration of PoE semiconductors in connectors	Not possible		

New P/Ns need a SFDC opportunity and will be executed as a Type 0 lite project

TE's Portfolio RJ45 Jacks with Magnetics (T&R) Preferred portfolio

TE PN	Description	Speed	Ports	Orientation	Tab	LEDs	Packaging	Voltage Mode	Current Mode
2301994-1	RJ45 JACK INT.MAG. 10/100 1x1 INV.	10/100	1	R/A	Up	No	T&R	No	Yes
2301994-2	RJ45 JACK INT.MAG. 10/100 LED 1x1 INV.	10/100	1	R/A	Up	YES	T&R	No	Yes
2301994-3	RJ45 JACK INT.MAG. 10/100 1x1 INV.	10/100	1	R/A	Up	No	T&R	No	Yes
2301994-4	RJ45 JACK INT.MAG. 10/100 1x1	10/100	1	R/A	Down	No	T&R	No	Yes
2301994-5	RJ45 JACK INT.MAG. 1Gb 1x1 INV.	1G	1	R/A	Up	No	T&R	Yes	Yes
2301994-6	RJ45 JACK INT.MAG. 1Gb 1x1	1G	1	R/A	Down	No	T&R	Yes	Yes
2301994-7	RJ45 JACK INT.MAG. 1Gb 1x1	1G	1	R/A	Down	No	T&R	No	Yes
2301994-8	RJ45 JACK INT.MAG. 10/100 LED 1x1 INV.	10/100	1	R/A	Up	Yes	T&R	No	Yes
2301994-9	RJ45 JACK INT.MAG. 10/100 LED 1x1	10/100	1	R/A	Down	Yes	T&R	No	Yes
1-2301994-0	RJ45 JACK INT.MAG. 1Gb LED 1x1	1G	1	R/A	Up	Yes	T&R	Yes	Yes
1-2301994-1	RJ45 JACK INT.MAG. 1Gb LED 1x1 INV. low	1G	1	R/A	Down	Yes	T&R	Yes	Yes
2301995-1	RJ45 JACK INT.MAG. Gb 1x1 VERT.	1G	1	Vertical	-	No	T&R	Yes	Yes
2301995-2	RJ45 JACK INT.MAG. 10/100 1x1 VERT.	10/100	1	Vertical	-	No	T&R	No	Yes
2301995-3	RJ45 JACK INT.MAG. 10/100 LED 1x1 VERT.	10/100	1	Vertical	-	Yes	T&R	No	Yes
2301995-4	RJ45 JACK INT.MAG. 1Gb LED 1x1 VERT.	1G	1	Vertical	-	Yes	T&R	Yes	Yes

Yellow: Preferred P/N

TE's Portfolio RJ45 Jacks with Magnetics and PoE+ (T&R)

Preferred portfolio

TE PN	Description	Speed	Ports	Orientation	Tab	LEDs	Packaging
2337992-3	RJ45 JACK INT.MAG. 10/100 1x1 INV.	10/100	1	R/A	Up	YES	T&R
2337992-4	RJ45 JACK INT.MAG. 10/100 LED 1x1 INV.	10/100	1	R/A	Down	YES	T&R
2337992-5	RJ45 JACK INT.MAG. 10/100 1x1 INV.	1G	1	R/A	Up	YES	T&R
2337992-8	RJ45 JACK INT.MAG. 10/100 1x1	1G	1	R/A	Down	YES	T&R
2337993-2	RJ45 JACK INT.MAG. 1Gb 1x1 INV.	10/100	1	Vertical	-	YES	T&R
2337994-3	RJ45 JACK INT.MAG. 1Gb 1x1	10/100	2	R/A	Up	YES	T&R
2337994-4	RJ45 JACK INT.MAG. 1Gb 1x1	10/100	2	R/A	Down	YES	T&R

Yellow: Preferred P/N

TE's Portfolio Discrete Magnetics (and PoE+) (T&R)

Preferred portfolio

TE PN	Description	Speed	Ports	PoE+	Packaging
2337822-1	DISCR.ETH.MAG. 10/100 SINGLE SMT	10/100	1	NO	T&R
2337826-1	DISCR.ETH.MAG. 10/100 QUAD SMT	10/100	4	NO	T&R
2337822-4	DISCR.ETH.MAG. 10/100 SINGLE SMT POE	10/100	1	YES	T&R
2337822-2	DISCR.ETH.MAG. 1GB SINGLE SMT	1G	1	NO	T&R
2337824-2	DISCR.ETH.MAG. 1GB DUAL SMT	1G	2	NO	T&R
2337822-5	DISCR.ETH.MAG. 1GB SINGLE SMT POE	1G	1	YES	T&R
2337824-4	DISCR.ETH.MAG. 1GB DUAL SMT POE	1G	2	YES	T&R
5-2337822-1	DISCR.ETH.MAG. 10/100 SINGLE SMT	10/100	1	NO	T&R
5-2337826-1	DISCR.ETH.MAG. 10/100 QUAD SMT	10/100	4	NO	T&R
5-2337822-4	DISCR.ETH.MAG. 10/100 SINGLE SMT POE	10/100	1	YES	T&R
5-2337822-2	DISCR.ETH.MAG. 1GB SINGLE SMT	1G	1	NO	T&R
5-2337824-2	DISCR.ETH.MAG. 1GB DUAL SMT	1G	2	NO	T&R
5-2337822-5	DISCR.ETH.MAG. 1GB SINGLE SMT POE	1G	1	YES	T&R
5-2337824-4	DISCR.ETH.MAG. 1GB DUAL SMT POE	1G	2	YES	T&R

Yellow: Preferred P/N

Application Examples

Industrial

- PLC Controllers
- Network Interfaces
- Motor Control
- All industrial equipment with Rj45 connectivity requirements

Telecommunications/Networking

- Telephones
- Routers
- Servers
- Switches
- Printers

Commercial

- Set-top Boxes
- Point of Sale (PoS) Terminal
- Internet of Things (IoT) applications



Camera and Vision



Access Points



Set top box



Point of Sale (PoS) Terminal

Questions to Ask Your Customer

- Is the Rj45 port build up discrete or are integrated solution required ?
- What is the required transmission rate (10/100 Base-T, Gigabit, 10Gig) ?
- Will the application require Power over Ethernet ?
- What is the PHY chip (Physical layer transceiver chip) used ?
 - Is it current or voltage driven ?
- What is the port count and configuration ?
 - Single port (tab up or tab down), ganged (tab up or tab down)
 - or dual row stacked ?
- Are LED's needed ?
 - If so, what color & configuration (single or bi-color) ?
- Is Reflow or Wave Solder needed ? (TE products are all reflow capable)

Marketing Collateral and Support

- Full Product Landing Page on <http://www.te.com/us-en/products/connectors/intersection/industrial-rj45/industrial-rj45-integrated-magnetic-jacks.html?source=header-match&variant=b&tab=pgp-story>
- Parts are protected under Protect TENGO
- Samples of all preferred products
- Product Flyer
- Training
- Demo Kits (2330604-1)
- Ready Set Go (Channel)
- Product Cross reference
- Application support
 - Specially trained FAEs (Hacan Hyving, Giuseppe Esposito)
 - Engineering (Anne Cristel Ngoumgang Madjo)



Dzieki Ačiū TACK! þakka þér fyrir Takk
Danke! Teşekkürler Salamat Mahalo
Cảm ơn bạn 谢谢您 dhanayawad Grazie
Хвала Kiitos Bedankt mulțumesc! Спасибо
Σε ευχαριστώ 감사합니다 obrigado! Hyala
Go raibh maith agat
THANK YOU!
ありがとうございました
Domo merci! Благодаря a dank!
Paldies תודה Toda TĀNAN vd'aka! Asante

BACKUP SLIDES

RJ45 Jack with Integrated Magnetics

Connector materials

Housing: LCP Black UL94 V-0

Insert: LCP Black UL94 V-0

Shield: Brass

Shield plating: Nickel

Contacts: Copper Alloy

Contacts plating: Selective gold min. 0.76 μ m (30 μ inch) in contact area over min. 1.27 μ m (50 μ inch) Nickel

Solder pin:

Solder pin plating: 3.05 μ m (120 μ inch) Tin over 1.02 μ m (40 μ inch) Nickel over all.

Shielding pin plating: Nickel

Connector placement and soldering

Reflow soldering

RJ45 Jacks with integrated Magnetics are soldered using reflow or equivalent soldering techniques according to IPC/JEDEC J-STD-020D. The temperatures and exposure time shall be within the ranges specified in the table

SOLDERING PROCESS	TEMPERATURE		TIME (At Max Temp)
	CELSIUS	FAHRENHEIT	
Reflow Soldering	260	500	10 Seconds

Connector placement

- RJ45 Jack with integrated magnetics are available in Tape & Reel packaging as well as Tray packaging for **Pick and Place** applications.
- Pick and Place allows to accurately place large numbers of small, or large components quickly and accurately onto circuit boards.

PHY transceiver

- PHY is an abbreviation for the physical layer of the OSI model and refers to the circuitry required to implement physical layer functions such as 10Base-T, 100Base-T and 1000Base-T.
- It connects a link layer device (often called MAC as an abbreviation for media access control) to a physical medium such as copper cable or optical fiber .

Top 3 suppliers



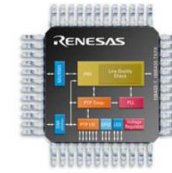
Overview on industrial focus



Micro chip



Texas Instruments



Renesas



Micro chip



Texas Instrument



Industrial Ethernet solutions that drive connectivity.

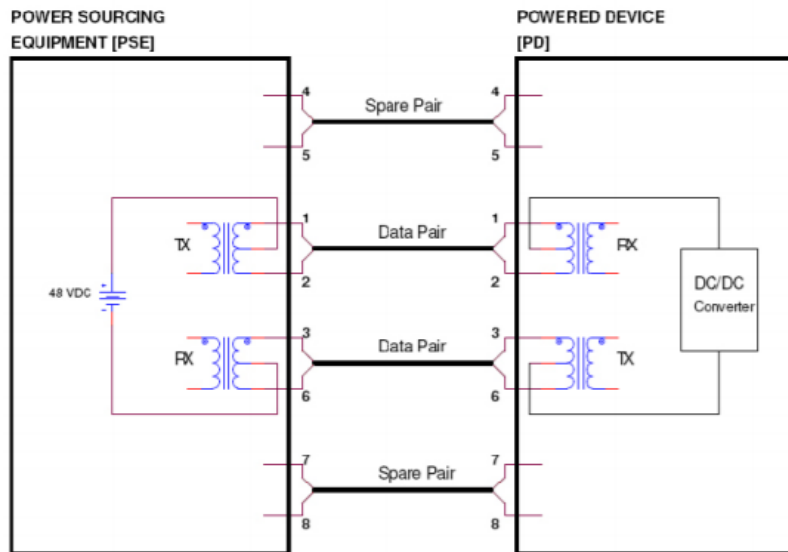
Start Now

Innovasic

PoE transmission types

Alternative A (Phantom feed)

Power is carried over the data pairs (1/2 & 3/6) using the "Phantom Feeding" method



Alternative B (Spare pair feed)

Alternative B separates the data and the power conductors, making troubleshooting easier. It also makes full use of all four twisted pair, copper wires.

