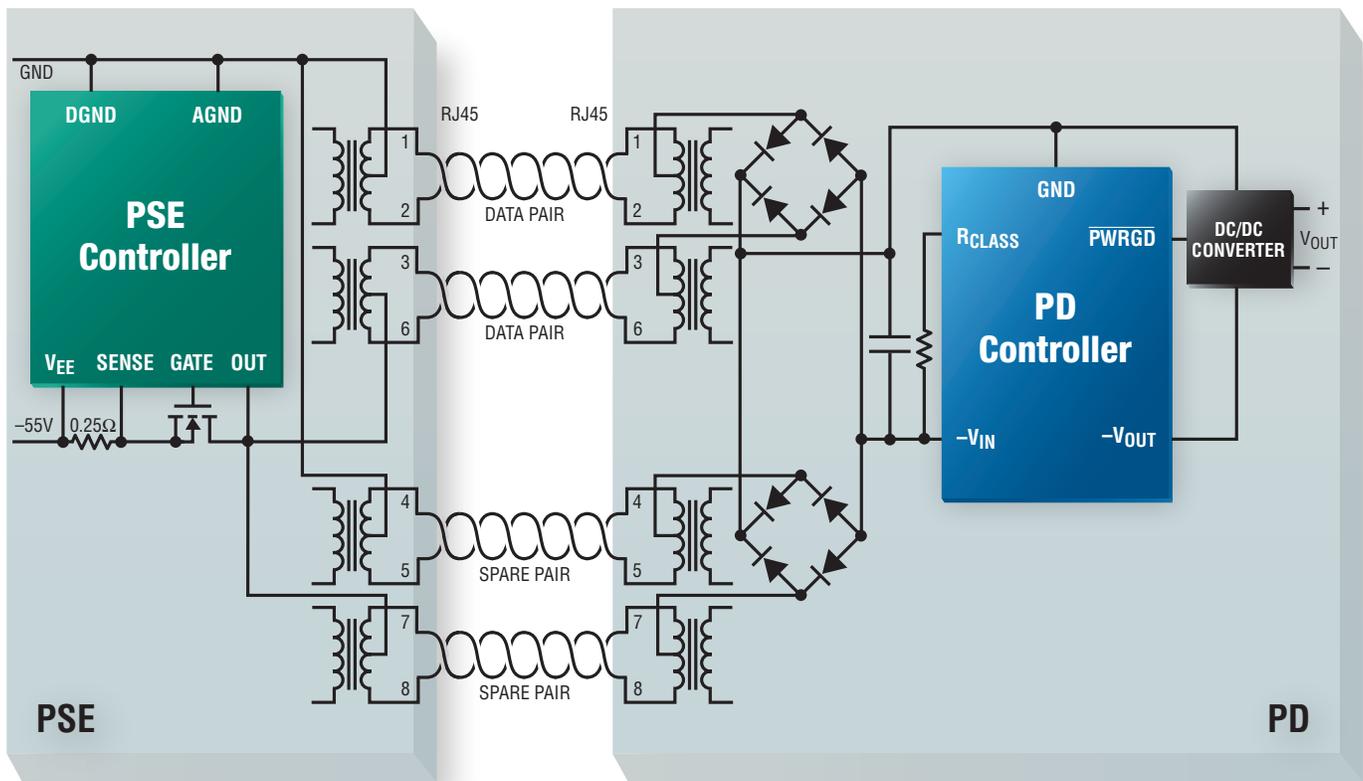


# Power over Ethernet Solutions



## PoE Benefits

- ⚡ **Power and Data Over a Single Ethernet Cable**
  - Simplified Wire Management
  - Reach Difficult Locations
  - High Port Density
- ⚡ **Up to 123W of Delivered Power**
  - More End Application Features
  - Only 1 Port and 1 Cable Required
- ⚡ **Central Power Management**
  - Remotely Power Nodes On/Off
  - Monitor and Measure Energy Usage
  - Adjust Load Profiles or Settings On-the-Fly

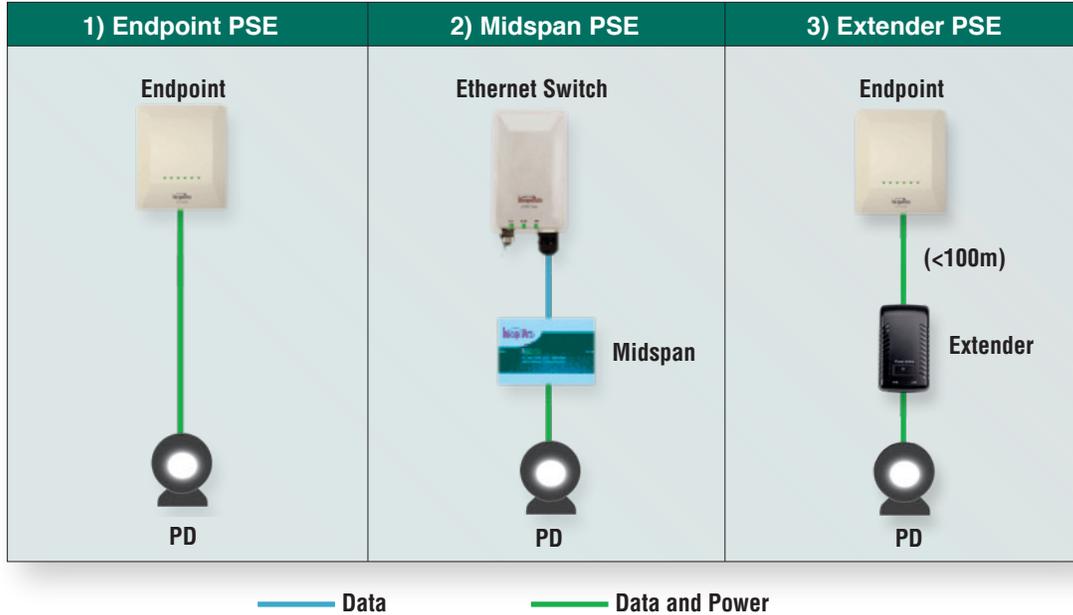


LT, LT, LTC, LTM, Linear Technology and the Linear logo are registered trademarks and LTPoE++ is a trademark of Analog Devices, Inc. All other trademarks are the property of their respective owners.

# Power Sourcing Equipment (PSE)

## PSE Types

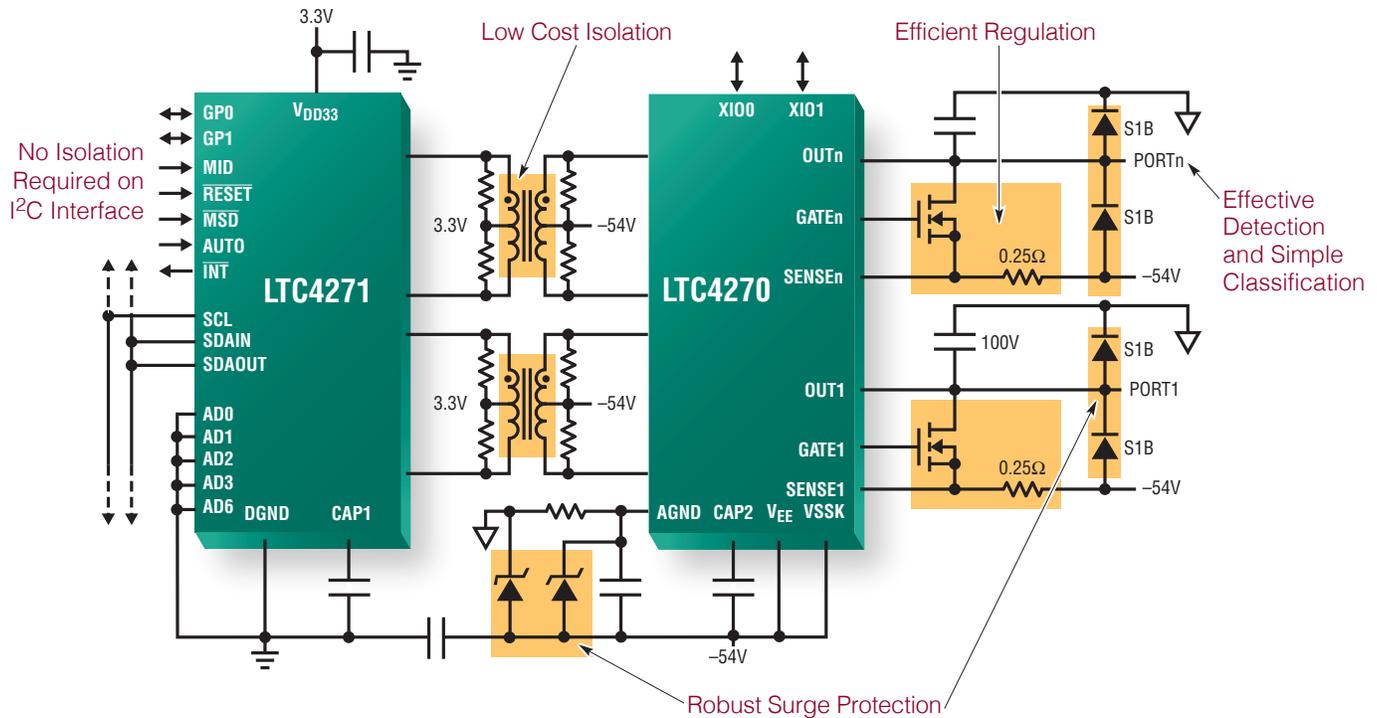
- 1) Endpoint—provides data and power, typically used to build new PoE networks.
- 2) Midspan (Injector)—provides power and passes data, typically used to add PoE capability to existing non-PoE networks.
- 3) Extender (Power Forwarder)—provides data and power, typically used to extend PoE networks beyond 100m.



## PSE Controllers

 <b>IEEE</b> Requirements		 <b>LINEAR</b> TECHNOLOGY Solutions	
<b>Isolation</b>	Isolate supply and communications from chassis ground.	The 8-port LTC®4290/LTC4271 and 12-port LTC4270/LTC4271 PSE chipsets eliminate up to six expensive opto-couplers and an isolated supply by using less expensive (and more reliable) 10/100 Ethernet transformers.	
<b>Detection</b>	Detect valid PD signatures (25kΩ) using a 2-point current or 2-point voltage detection scheme, as well as reject invalid PD signatures (<15kΩ and >33kΩ).	Linear Technology PSE controllers use a 4-point (two voltages and two currents) detection scheme to eliminate false-positives that could power invalid PDs, including NICs or shorted ports. Detection of legacy PDs that predate the original IEEE 802.3af standard can also be manually enabled on a per port basis.	
<b>Classification</b>	Type 1 PSEs can use a 1-event hardware classification scheme to detect optional PD classification signatures and limit the power draw. Type 2 or greater PSEs can use either hardware or software—link layer discovery protocol (LLDP)—classification schemes.	Linear Technology PSE controllers use up to 5-event hardware classification to classify PDs; this avoids the development costs and complexity of LLDP.	
<b>Regulation</b>	Regulate port power-up to 15.4W for Type 1 PDs and 30W for Type 2.	Linear Technology PSE controllers use external MOSFETs and sense resistors to regulate voltages and currents to IEEE standards, resulting in lower total channel resistance (higher efficiency) and increased robustness.	
<b>Protection</b>	No requirement.	Linear Technology PSE controllers have 70V to 80V port pins and come with standard or custom recommendations for guarding against surge.	

## PSE Example: Isolated 12-Port PSE Chipset



## Extended Power

Linear Technology PSE and PD controllers provide up to 90W of power at the PD's RJ45 input, while ensuring backward compatibility and interoperability with Type 1 and 2 equipment. Type 3 and 4 equipment and LTPoE++ controllers operate exclusively.

DEVICE	PSE					
	STANDARD	802.3bt				
	TYPE	TYPE 1	TYPE 2	TYPE 3	TYPE 4	
PD	802.3bt	TYPE 1	13W	13W	13W	13W
		TYPE 2	13W	25.5W	25.5W	25.5W
		TYPE 3	13W	25.5W	40W, 51W	40W, 51W
		TYPE 4	13W	25.5W	40W, 51W	62W, 71W

DEVICE	PSE							
	STANDARD	802.3at		LTPoE++				
		TYPE	TYPE 1	TYPE 2	38.7W	52.7W	70W	90W
PD	802.3at	TYPE 1	13W	13W	13W	13W	13W	13W
		TYPE 2	13W	25.5W	25.5W	25.5W	25.5W	25.5W
	LTPoE++	38.7W	13W	25.5W	38.7W	38.7W	38.7W	38.7W
		52.7W	13W	25.5W	–	52.7W	52.7W	52.7W
		70W	13W	25.5W	–	–	70W	70W
	90W	13W	25.5W	–	–	–	90W	

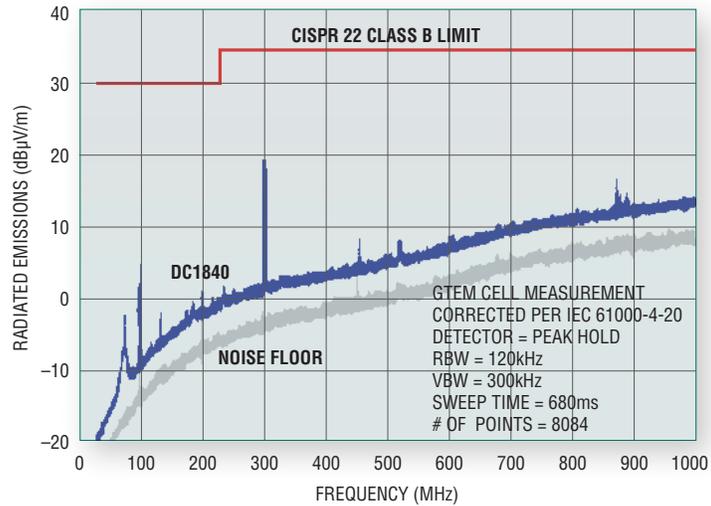
Mode	Auto Pin	Detect/Class	Power-Up	Automatic I <sub>CUT</sub> /I <sub>LIM</sub> Assignment
AUTO	1	Enabled at Reset	Automatically	Yes
Semi-auto	0	Host Enabled	Upon Request	No
Manual	0	Once Upon Request	Upon Request	No
Shutdown	0	Disabled	Disabled	No

## Advanced Power Management Software and Hardware

Linear Technology PSEs support a variety of operating modes and include per-port current monitoring, supply monitoring, one second current averaging and field-upgradeable firmware. Linear Technology provides C libraries for customer systems at multiple levels, from control of basic PSE operation to management of overallocated and prioritized PoE switch systems.

## Low EMI

Linear Technology PSEs use preventative techniques to minimize electromagnetic interference (EMI). For example, the blue line in the graph shows the GTEM radiated emissions scan for the 12-port LTC4270/LTC4271 demo board (DC1840), which is safely below the CISPR 22 Class B limit, represented by the red line, with some appreciable margin to spare.



## PSE Controller Selection

Part Number	Number of Ports	Internal Isolation	Standard			PD Input Power	Packages	Demo Boards
			LTPoE++	PoE+	PoE			
LTC4270A/LTC4271	12	•	•	•	•	90W	7 × 8 QFN-52 / 4 × 4 QFN-24	DC1679 + SB002
LTC4270B/LTC4271	12	•		•	•	25.5W	7 × 8 QFN-52 / 4 × 4 QFN-24	DC1840
LTC4270C/LTC4271	12	•			•	13W	7 × 8 QFN-52 / 4 × 4 QFN-24	DC1680 + SB021
LTC4290A/LTC4271	8	•	•	•	•	90W	6 × 6 QFN-40 / 4 × 4 QFN-24	DC1679 + SB073
LTC4290B/LTC4271	8	•		•	•	25.5W	6 × 6 QFN-40 / 4 × 4 QFN-24	DC1843
LTC4290C/LTC4271	8	•			•	13W	6 × 6 QFN-40 / 4 × 4 QFN-24	DC1680 + SB090
LTC4266A	4		•	•	•	90W	5 × 7 QFN-38	DC1815
LTC4266	4			•	•	25.5W	5 × 7 QFN-38, SSOP-36	DC1366
LTC4266C	4				•	13W	5 × 7 QFN-38	
LTC4279	1		•	•	•	123W	4 × 5 QFN-20, SO-16	DC2541, DC2579
LTC4274A	1		•	•	•	90W	5 × 7 QFN-38	DC1814
LTC4274	1			•	•	25.5W	5 × 7 QFN-38	DC1567
LTC4274C	1				•	13W	5 × 7 QFN-38	
LTC4263	1				•	13W	4 × 3 DFN-14, SO-14	DC981A/B

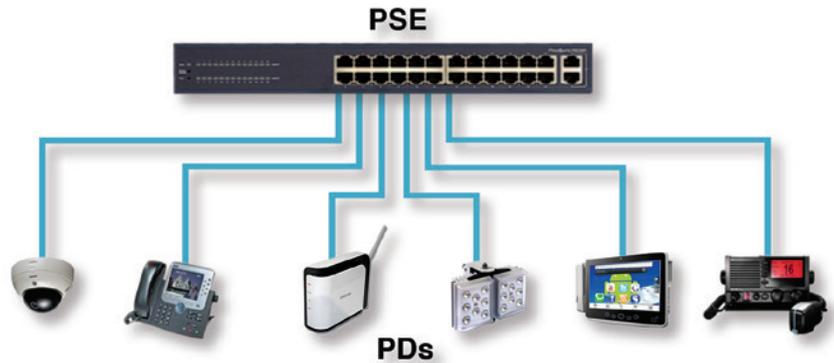
## Cabling and Magnetics

Standard	PD Input Power	# of Cables Required	Pairs Used (Out of 4)	Cable Bundle Size	Rec Cable Type	Max Cable Current	Magnetics
PoE (IEEE 802.3af)	13W	1	2	100	CAT-5	350mA	Standard
PoE+ (IEEE 802.3at)	25.5W					600mA	
PoE++ (IEEE 802.3bt)	40W	1	4	80	CAT-5e	900mA	High Power
	51W					1.2A	
	62W					1.45A	
	71W					1.72A	
Linear Technology LTPoE++	38.7W	1	4	100	CAT-5e	777mA	
	52.7W					1.1A	
	70W					1.5A	
	90W					2.2A	
				25			

# Powered Device (PD)

## PD Examples

- Security Cameras
- Access Points, Femtocells and Antennas
- IP Telephony (VoIP) and Call Stations
- HVAC, Lighting and Signage
- Medical Equipment
- Touchscreen Panels and Infotainment
- Point-of-Sale Readers and RFID Readers

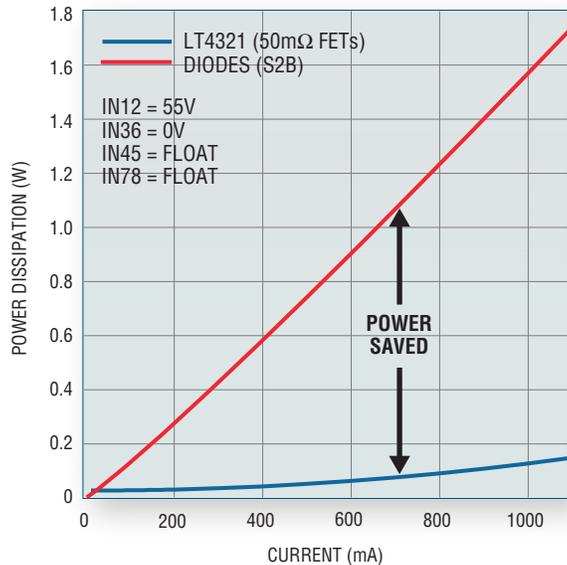
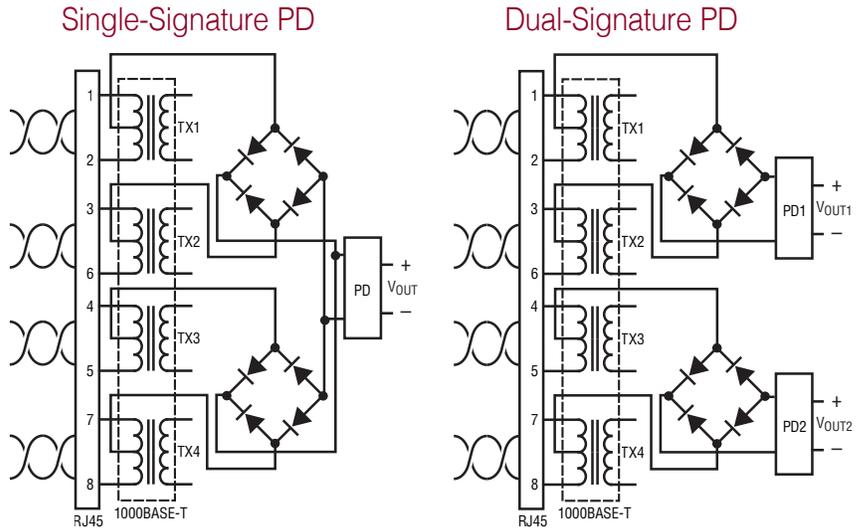


## PD Controllers

 <b>IEEE</b> Requirements		 <b>LINEAR</b> TECHNOLOGY Solutions	
<b>Isolation</b>	Isolate supply and communications from chassis ground.	Linear Technology PDs with integrated DC/DC converters support isolated forward and flyback topologies. Linear Technology's active-clamp forward configuration reduces costly transformer count and sizes, while the no-opto flyback configuration eliminates expensive and unreliable opto-couplers that are typically used in the feedback circuitry.	
<b>Detection</b>	Present a signature (25kΩ) to PSE.	All Linear Technology PD controllers integrate a 25kΩ signature resistor to simplify designs.	
<b>Classification</b>	Type 1 PDs can support 1-event hardware classification. Type 2 or greater PDs must support both hardware and software—link layer discovery protocol (LLDP)—classification.	All Linear Technology PD controllers support up to 5-event hardware classification, letting the PSE know that it is an IEEE or LTPoE++ PD; this avoids the development costs and complexity of LLDP.	
<b>Polarity Correction</b>	Power can be applied to either the data or spare pairs in the Ethernet cable.	Linear Technology's LT®4321 ideal diode bridge controller replaces the two diode bridge rectifiers, typically found at the RJ45 input, with MOSFETs to correct polarity, increase efficiency and eliminate heat issues.	
<b>Regulation</b>	No requirement.	Linear Technology offers PD controllers without DC/DC controllers, providing designers with the flexibility to choose their own DC/DC controllers, as well as PD controllers that integrate high efficiency DC/DC controllers to simplify designs.	
<b>Protection</b>	No requirement.	All Linear Technology PD controllers have 100V port pins, thermal protection and come with standard recommendations for guarding against surge. Newer devices support a maximum junction temperature range of -40°C to 125°C.	

## Simple Topology

All Linear Technology PD controllers use a single-signature PD topology to simplify designs and reduce costs. IEEE 802.3bt also introduced the dual-signature PD topology, which is a complex and costly implementation that calls for two PD controllers, two detection resistors and two classification results to support two independent PD loads. Both single and dual PD topologies can support two loads.

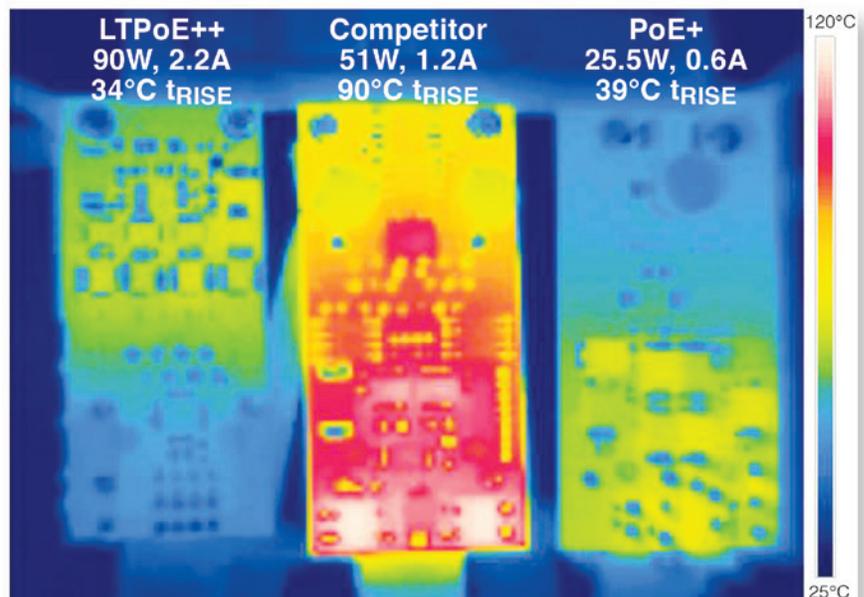


## Very Efficient

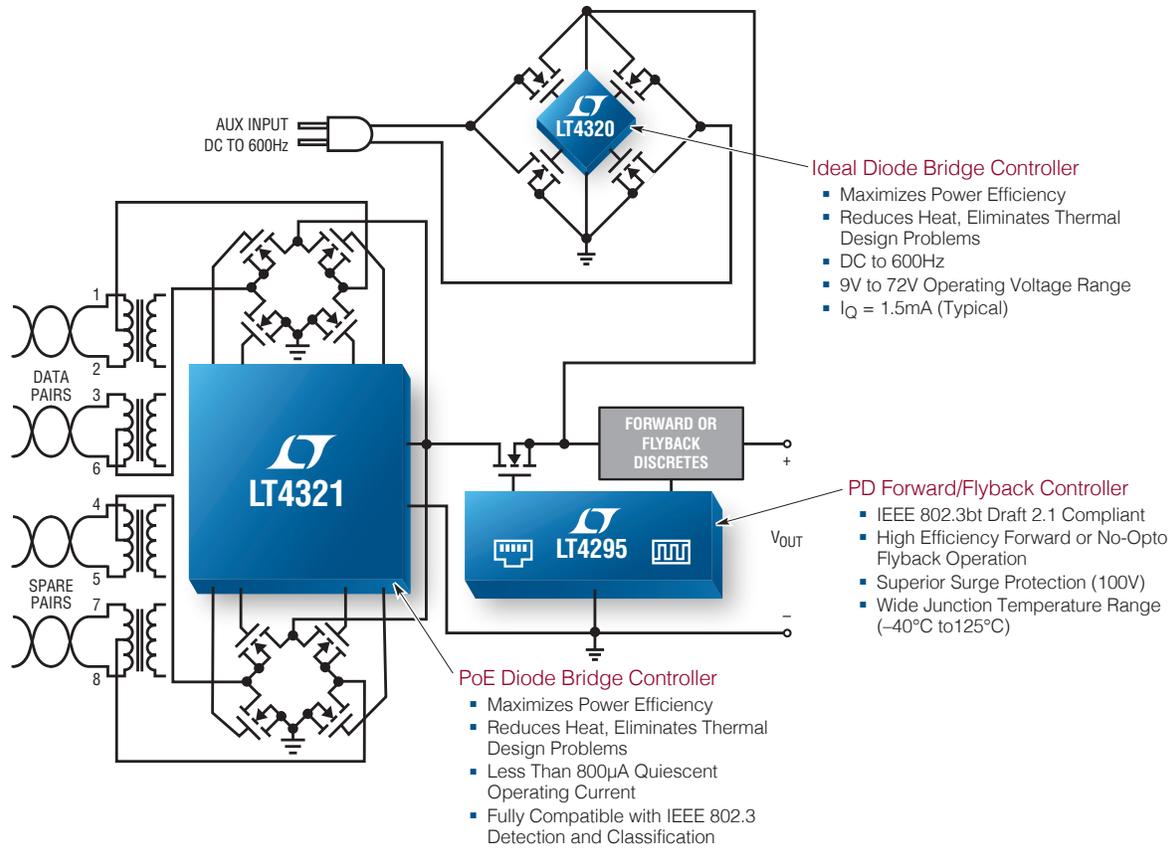
Using low resistance components, including low  $R_{DS(ON)}$  MOSFETs controlled by the LT4321 ideal diode bridge controller, Linear Technology PDs provide up to 94% efficiency from the RJ45 input to the load, for simplified thermal designs and more power to the load. The load is able to harness more energy, and designs more easily stay within power budgets.

## Extremely Low Heat

Linear Technology PD solutions generate much less heat while delivering much more power than alternatives. Linear Technology's latest generation of PD controllers utilize external MOSFETs and sense resistors to enable users to choose low resistance components in order to minimize heat dissipation, while increasing efficiency and reliability. Similarly, the LT4320 and LT4321 diode bridge controllers replace diodes with MOSFETs to lower channel resistance and improve thermal performance.



# PD Example: High Efficiency PoE++ PD Solution with 12VDC and 24VAC Auxiliary Input



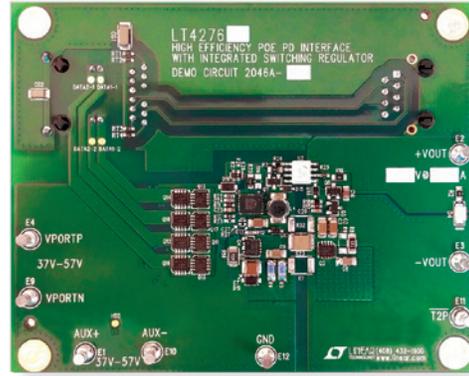
## PD Controller Selection

Part Number	Standard	PD Input Power				Integrated DC/DC Controller	DC/DC Topology	Integrated Hot Swap MOSFET	Temp Range	Package Dimensions
		90W	71W	25.5W	13W					
LTC4257	PoE				•			•	C, I	3 x 3 DFN-8, SO-8
LTC4267	PoE				•	•	Flyback	•	C, I	5 x 3 DFN-16, SO-16
LTC4265	PoE+			•	•			•	C, I	4 x 3 DFN-12
LTC4269-1	PoE+			•	•	•	Flyback	•	C, I	7 x 4 DFN-32
LTC4269-2	PoE+			•	•	•	Forward	•	C, I	7 x 4 DFN-32
LTC4278	PoE+			•	•	•	Flyback	•	C, I	7 x 4 DFN-32
LT4275A	LTPoE++	•		•	•				I, H	3 x 3 DFN-10, MSOP-10
LT4275B	PoE+			•	•				I, H	3 x 3 DFN-10, MSOP-10
LT4275C	PoE				•				I, H	3 x 3 DFN-10, MSOP-10
LT4276A	LTPoE++	•		•	•	•	Forward, Flyback		I, H	4 x 5 QFN-28
LT4276B	PoE+			•	•	•	Forward, Flyback		I, H	4 x 5 QFN-28
LT4276C	PoE				•	•	Forward, Flyback		I, H	4 x 5 QFN-28
LT4294	PoE++		•	•	•				I, H	3 x 3 DFN-10, MSOP-10
LT4295	PoE++		•	•	•	•	Forward, Flyback		I, H	4 x 5 QFN-28

\*All Linear Technology PD Controllers integrate a signature resistor.

## PD Demo Boards

- Complete ready to copy-and-paste reference designs, including schematics, BOMs and layout files
- Simultaneously evaluate PD controllers and ideal diode bridges
- Magnetics sized and specified for exact load voltages and currents
- Compatible with existing Linear Technology PSE demo boards



IC Part Number	Standard	PD Input Power	Output (V/I)	Input Voltage	Input-to-Output Efficiency	Demo Board Part Number
LTC4267	PoE	3.84W	3.3V/1A	38V to 57V	75.0%	DC804B-A
LTC4267	PoE	13W	3.3V/2.6A	37V to 57V	78.0%	DC917A
LTC4267	PoE	13W	12V/0.9A	37V to 57V	85.0%	DC1145B
LTC4267	PoE	13W	1.8V/2.5A, 2.5V/1.5A, 3.3V/0.5A	37V to 57V	76.0%	DC859A
LTC4265	PoE+	25.5W	-	37V to 57V	-	DC1415
LTC4269-1	PoE+	25.5W	3.3V/6.6A	37V to 57V	89.0%	DC1335A-A
LTC4269-1	PoE+	25.5W	5V/4.5A	37V to 57V	91.0%	DC1335B-B
LTC4269-1	PoE+	25.5W	12V/2A	37V to 57V	90.8%	DC1335B-C
LTC4269-2	PoE+	25.5W	5V/4.6A	37V to 57V	92.5%	DC1351B
LTC4278	PoE+	25.5W	5V/4.5A	9V to 57V	89.0%	DC1561
LT4275C/LT4321	PoE	13W	-	37V to 57V	-	DC2093A-C
LT4275B/LT4321	PoE+	25.5W	-	37V to 57V	-	DC2093A-B
LT4275A/LT4321	LTPoE++	90W	-	37V to 57V	-	DC2093A-A
LT4275A/LT4321/LTM®8027	LTPoE++	38.7W	12V/3A	37V to 57V	90.0%	DC2125A
LT4276C/LT4321	PoE	13W	5V/2.3A	37V to 57V	90.0%	DC2046A-F
LT4276B/LT4321	PoE+	25.5W	3.3V/6.8A	37V to 57V	90.0%	DC2046A-A
LT4276B/LT4321	PoE+	25.5W	5V/4.7A	37V to 57V	92.0%	DC2046A-B
LT4276B/LT4321	PoE+	25.5W	12V/1.9A	37V to 57V	92.0%	DC2046A-C
LT4276B/LT4321	PoE+	25.5W	24V/1A	37V to 57V	92.0%	DC2046A-D
LT4276A/LT4321	LTPoE++	38.7W	5V/7A	37V to 57V	92.0%	DC2046A-E
LT4276A/LT4321	LTPoE++	70W	5V/13A	37V to 57V	92.5%	DC2262A-A
LT4276A/LT4321	LTPoE++	90W	12V/7A	37V to 57V	93.5%	DC2262A-B
LT4276B/LT4321/LT4320	PoE+	25.5W	12V/1.9A	9V to 57V	92.0%	DC2047A-A
LT4295/LT4321	PoE++	40W	12V/3A	37V to 57V	92.0%	DC2475A-A
LT4295/LT4321	PoE++	51W	12V/3.9A	37V to 57V	91.5%	DC2539A-A
LT4295/LT4321	PoE++	62W	24V/2.3A	37V to 57V	92.0%	DC2476A-A
LT4295/LT4321	PoE++	71W	24V/2.7A	37V to 57V	92.0%	DC2476A-A
LT4295/LT4321	PoE++	71W	12V/5.5V	37V to 57V	93.0%	DC2584A-A
LT4294/LT4321	PoE++	71W	-	37V to 57V	99.0%	DC2583A