Focus on Non-standard (>25.5W Delivered) PoE

Updated for 2Q12 Customer Presentations

Texas Instruments

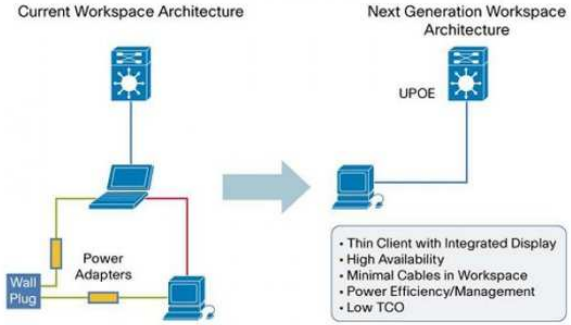
PSE PORTFOLIO

PSE Market Trends & Strategy Summary

- Current WIP aimed at introducing a competitive portfolio of **fully** compliant 802.3at controllers
- Future concepts aimed at addressing one or more of the following trends:
  - Higher Flexibility (Open Source System Software, Different Memory Architecture)
  - Higher Power (uPoE, PoE++, HDBaseT, “5 Play,” etc.)
  - Higher Integration (Internal FETs…but NOT isolation, PMIC)
  - Lower Cost (Higher Digital Content)
- Investigating market interest in “Open Source” system software

Ethernet Switches

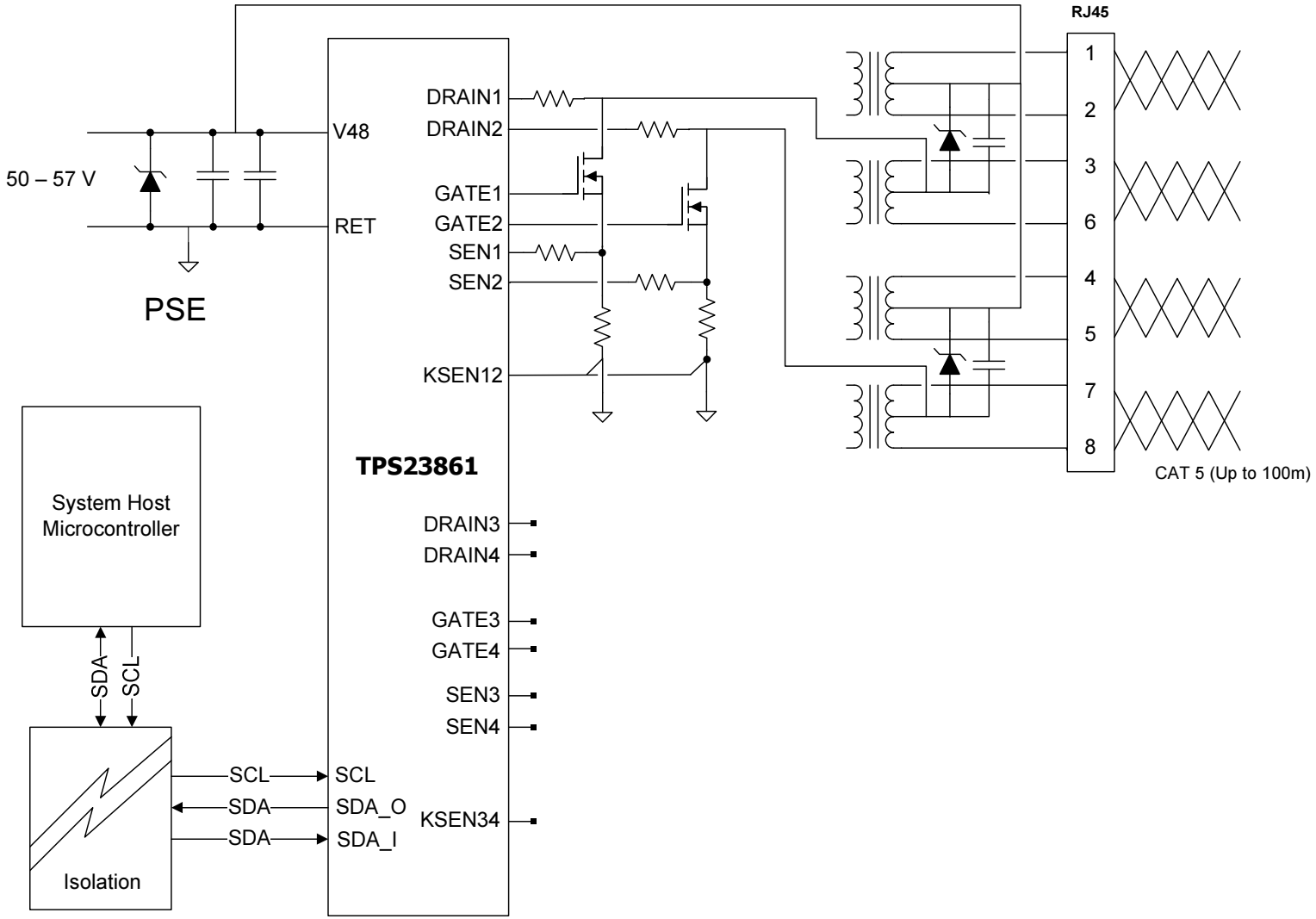
Midspans & Splitters



UPoE Concept

HDBaseT Concept

TPS23861 as 4-Pair PSE



PD PORTFOLIO

PD Market Trends & Strategy Summary

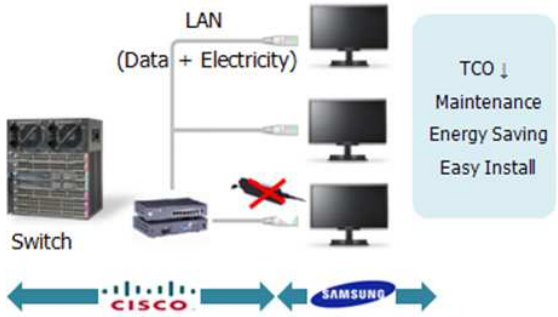
- Current WIP aimed at introducing compliant 802.3at PD solutions and addressing growing trend for “green” end equipment
  - TPS2378 is our first 802.3 at compliant, “PD only,” solution
  - TPS2379 aimed at higher power (>25.5W) “PD only” applications
  - TPS23751/2 aimed at customers most concerned with high efficiency
- Future concepts aimed at addressing one or more of the following trends:
  - Lower Cost
  - Higher Power Standards (uPoE)
  - The right degree of integration (NexFETs, DC/DC Controller (?), Isolation)
- Security camera TAM is growing fastest (they are where the IP phone market was 5 years ago)
- Use of strong UNH-IOL relationship to deliver Interoperability Reports at RTM
- Building “mini-IOL” in Manchester in order to improve software/firmware time to market and FA resolution abilities

Security Cameras

“Low-End” IP Phones

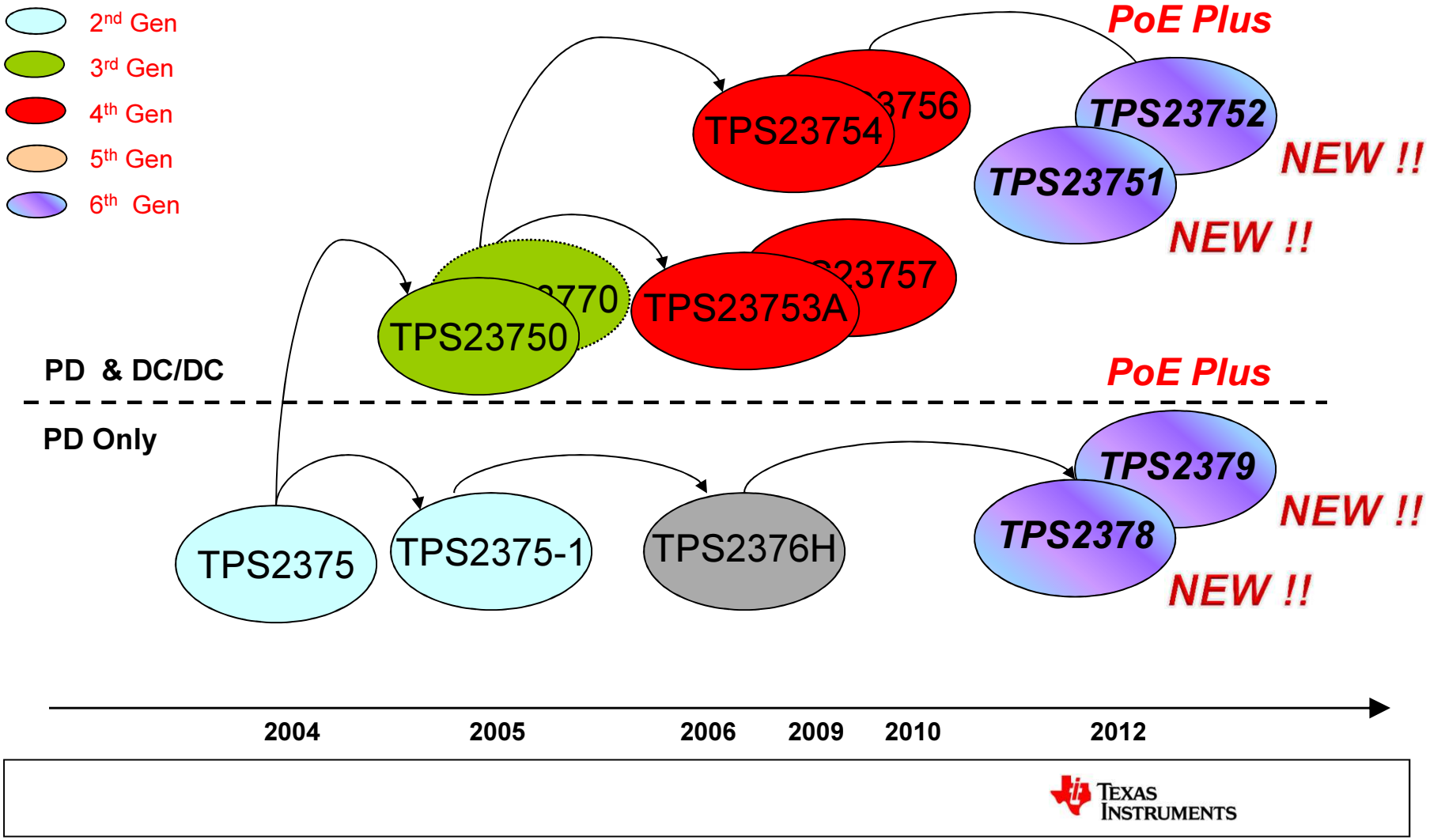
Wireless Access Points

“High-End” IP Phones



uPoE Concept

PD Product Portfolio



PD Product Portfolio

Powered Device Only

Feature	2375	2376	2377	2376-H	2378	2379
PD Type	1	1	1	1	2	2
PoE inrush limit	Program	Program	Program	Program	140 mA	140 mA
PoE current limit (min)	405 mA.	405 mA	405 mA	650 mA	850 mA	850 mA
PoE turn on threshold	39.3 V	2.49 V	35.1 V	2.49 V	38.1 V	38.1 V
PoE turn off threshold	30.5 V	1.93 V	30.5 V	1.93 V	32.0 V	32.0 V
PoE disable	No	No	No	No	Yes	Yes
PoE & Adapter priority	No	No	No	No	Yes	No
Foldback	Latch -1 Inrush	Latch	Latch -1 Inrush	Inrush	Delay w / Inrush	Delay w / Inrush
Auxiliary gate driver	No	No	No	No	No	Yes
Power Good / Converter Disable	PG	PG	PG	PG	CD	CD
Package	SO-8 TSSOP-8	SO-8 TSSOP-8	SO-8 TSSOP-8	So-8 PowerPad	So-8 PowerPad	So-8 PowerPad

TPS2378

IEEE 802.3at PoE Interface (PD only)

NEW !!

Features

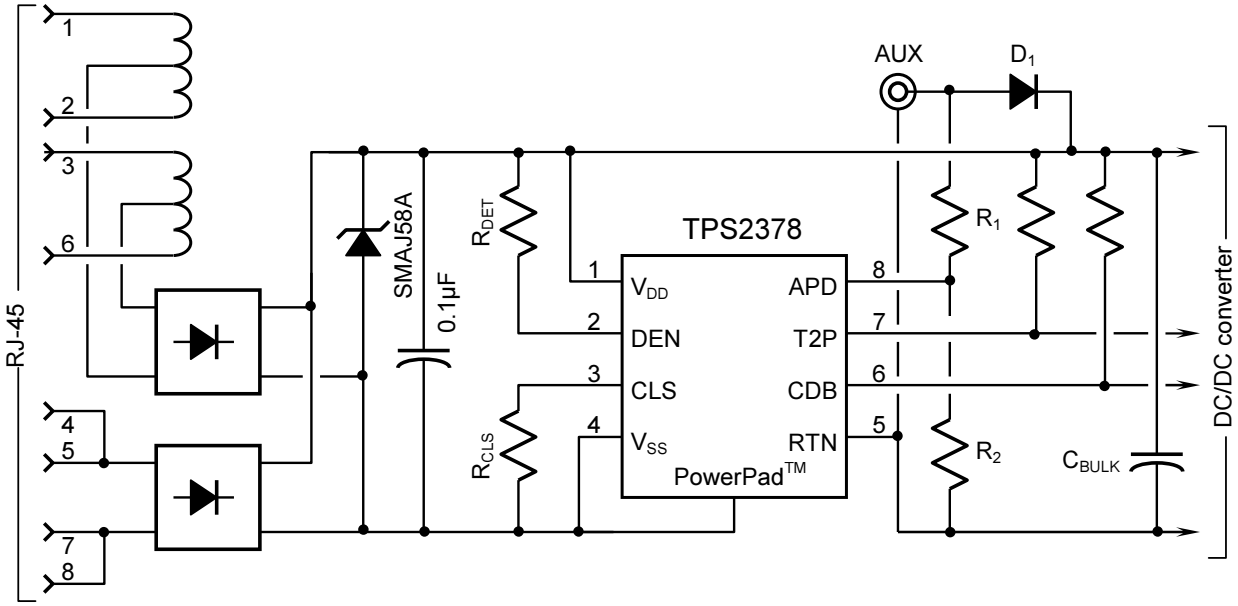
- IEEE 802.3at type-2 h/w classification
- Integrated **0.5 Ω 100 V** low-side switch
- Adapter **ORing support**
- 15 kV system-level ESD capability
- 1A (nom) current limit
- 8-pin PowerPad™ SOIC package

Benefits

- Standard compliant solution for PDs over 13 W
- Efficient and robust solution
- Simple, low cost ac adapter priority
- Eases meeting IEC61000-4-2 ESD requirements
- Permits custom designs that require higher power
- Small, thermally efficient, high voltage spacing

Applications

- IEEE 802.3at compliant
- VoIP telephones
- Access points
- Security cameras
- Pico-base stations



Texas Instruments

TPS2378 Competitive Analysis

Feature	Texas Instruments TPS2378	Linear Tech LTC4265	Maxim MAX5969A/B
UVLO Turn on	40.0 V(max)	37.2 V(max)	35.4 V(max) 38.6 V(max)
Supply Current	0.50 mA	1.35 mA	0.55 mA
H/W Class	2- Event	2- Event	2- Event
PD Inrush Current Limit	140 mA	100 mA	135 mA
PD Current Limit	850 mA (min)	No	720 mA (min)
PD Switch (max)	0.75 Ω (270 mW)	1.0 Ω (360 mW)	1.0 Ω (360 mW)
Voltage Range	100 V	100 V	100 V
Priority	Adapter	Adapter	Adapter
Disable	√	√	No
Type-2 PSE / Adaptor Indicator	√	Type-2 PSE Indicator only	√
Footprint mm^2	5 mm x 6 mm	4 mm x 3 mm	3 mm x 3 mm
Safety Spacing	0. 87 mm	0.25 mm	0.25 mm
Package	SO-8 PowerPad	DFN-12	TDFN-10
1K Price	1.00	$2.21	$1.21/$1.68

TPS2379

IEEE 802.3at PoE Interface (PD only)

NEW !!

Features

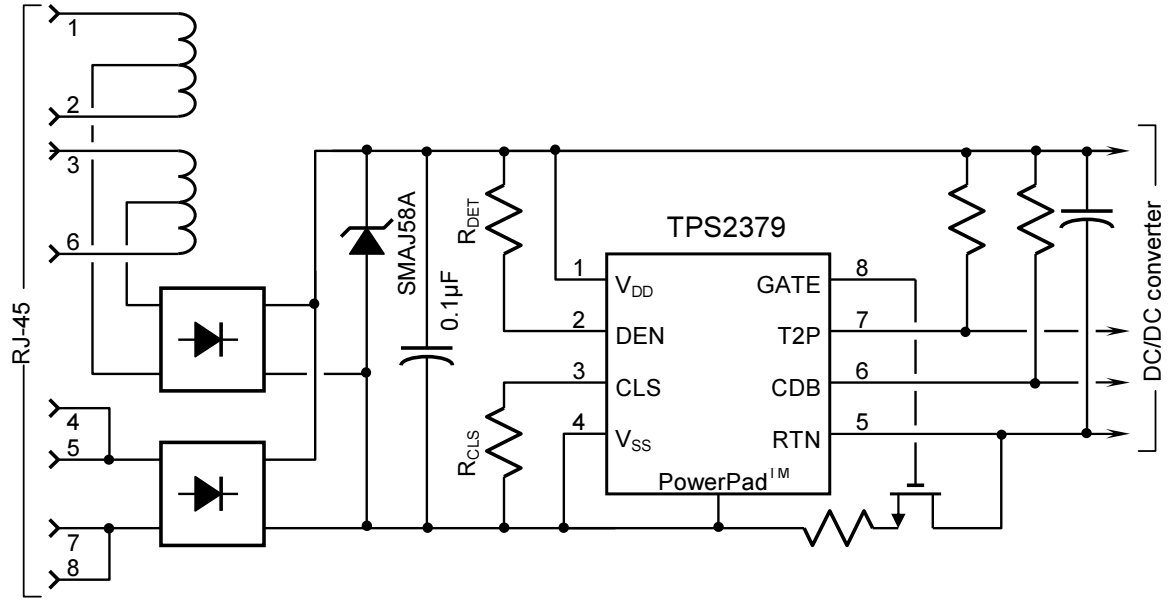
- IEEE 802.3at type-2 h/w classification
- Integrated **0.5 Ω 100 V** low-side switch
- **Auxiliary Gate Driver** for High Power Expansion
- 15 kV system-level ESD capability
- 1A (nom) current limit
- 8-pin PowerPad™ SOIC package

Benefits

- Standard compliant solution for PDs over 13 W
- Efficient and robust solution
- Simple, low cost ac adapter priority
- Eases meeting IEC61000-4-2 ESD requirements
- Permits custom designs that require higher power
- Small, thermally efficient, high voltage spacing

Applications

- IEEE 802.3at compliant
- VoIP telephones
- Access points
- Security cameras
- Pico-base stations



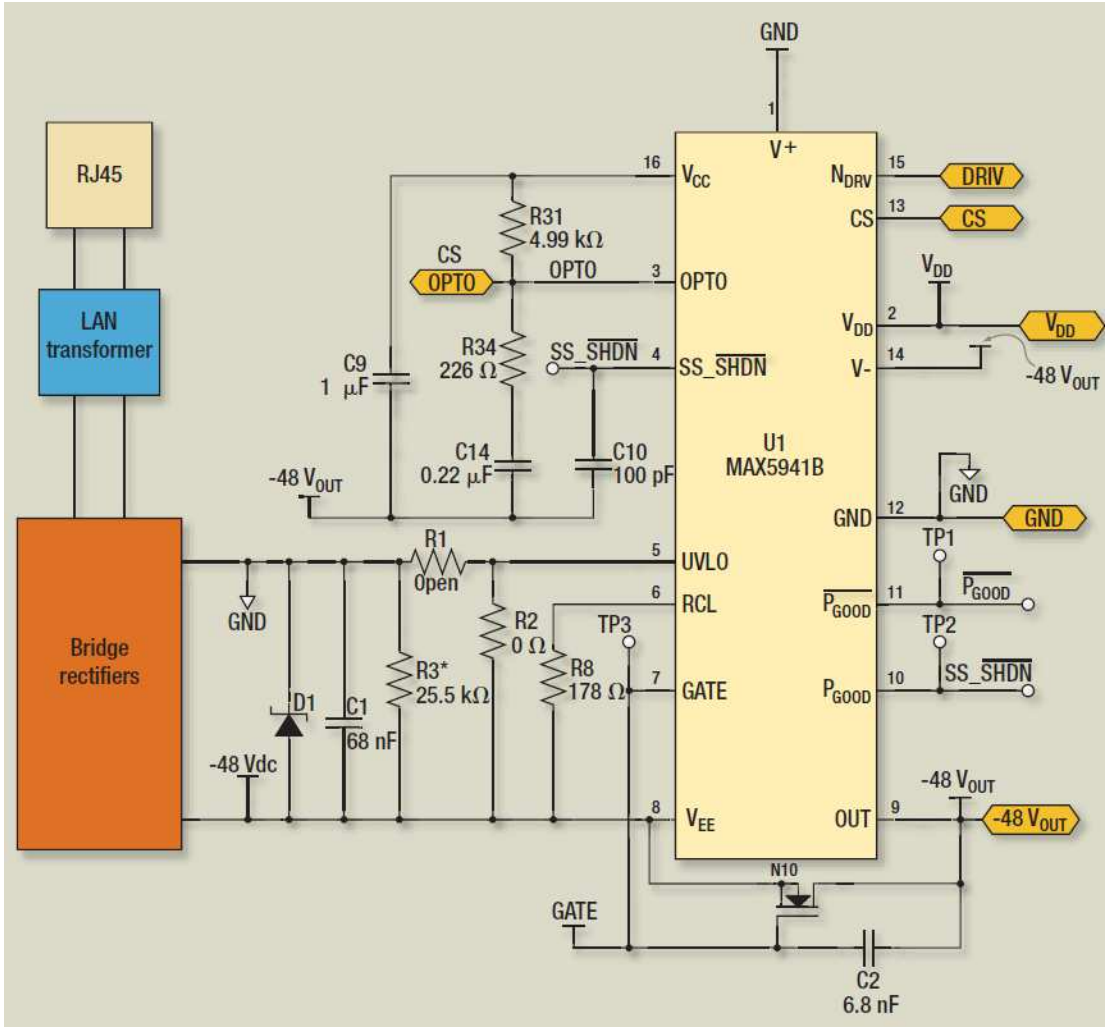
Texas Instruments

TPS2379
Competitive Analysis

- TPS2379 is the first single Powered Device which is designed to handle higher than 25.5W power in POE application and currently no other semiconductor vendor has similar product.

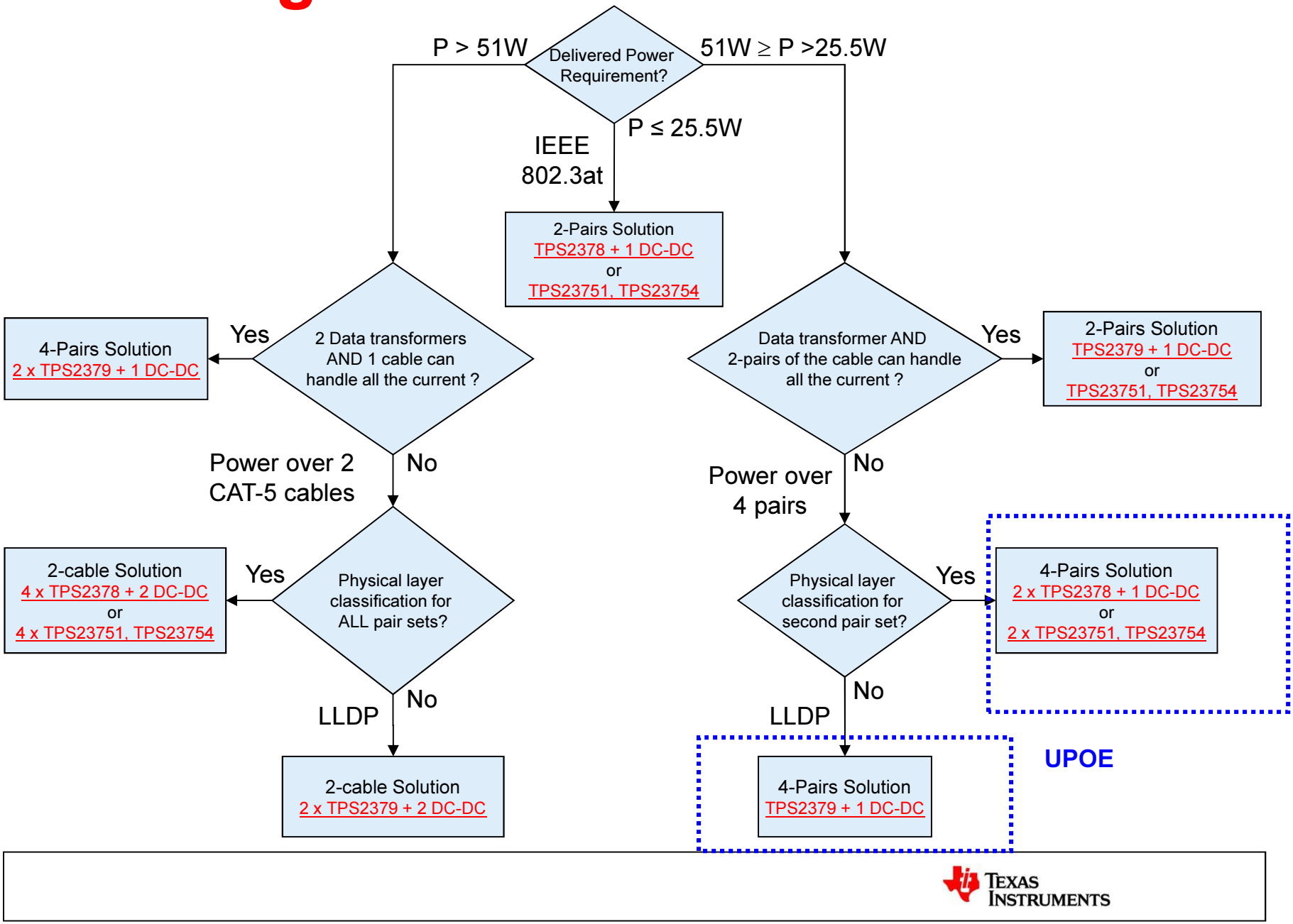
MAX5941B with External FET to achieve 30W Was Published

- Can not achieve real .at type POE function because MAX5941 is an .af type compliant PD
- No current limit protect PD from over-current fault
- Once the external FET is turn on, there is no reliable mechanism to switch it off under output short circuit condition
- More components are required

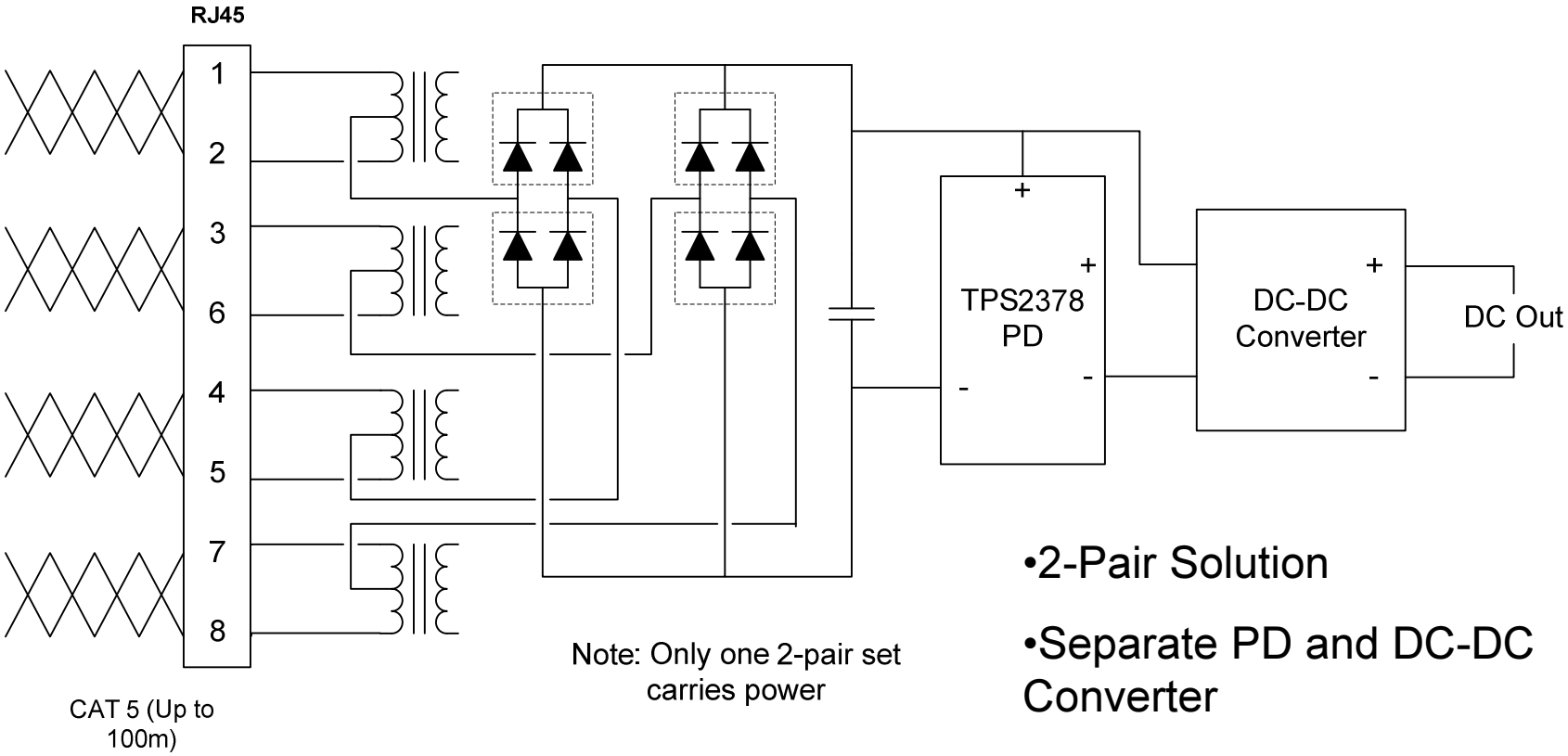


PD DESIGN SELECTOR TREE

PD Design – Decision Tree

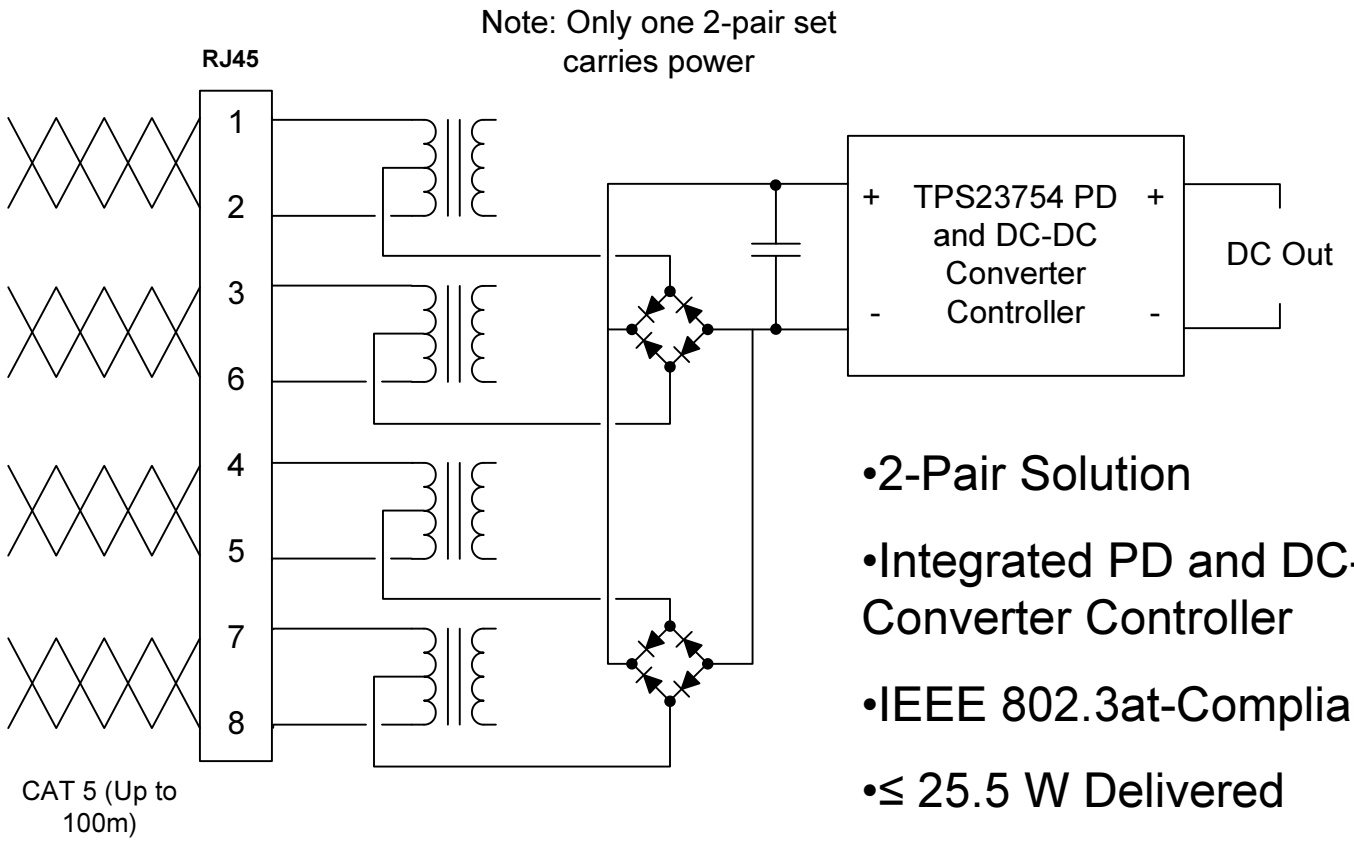


2-Pair Solution for ≤25W: TPS2378 PD + DC-DC Converter



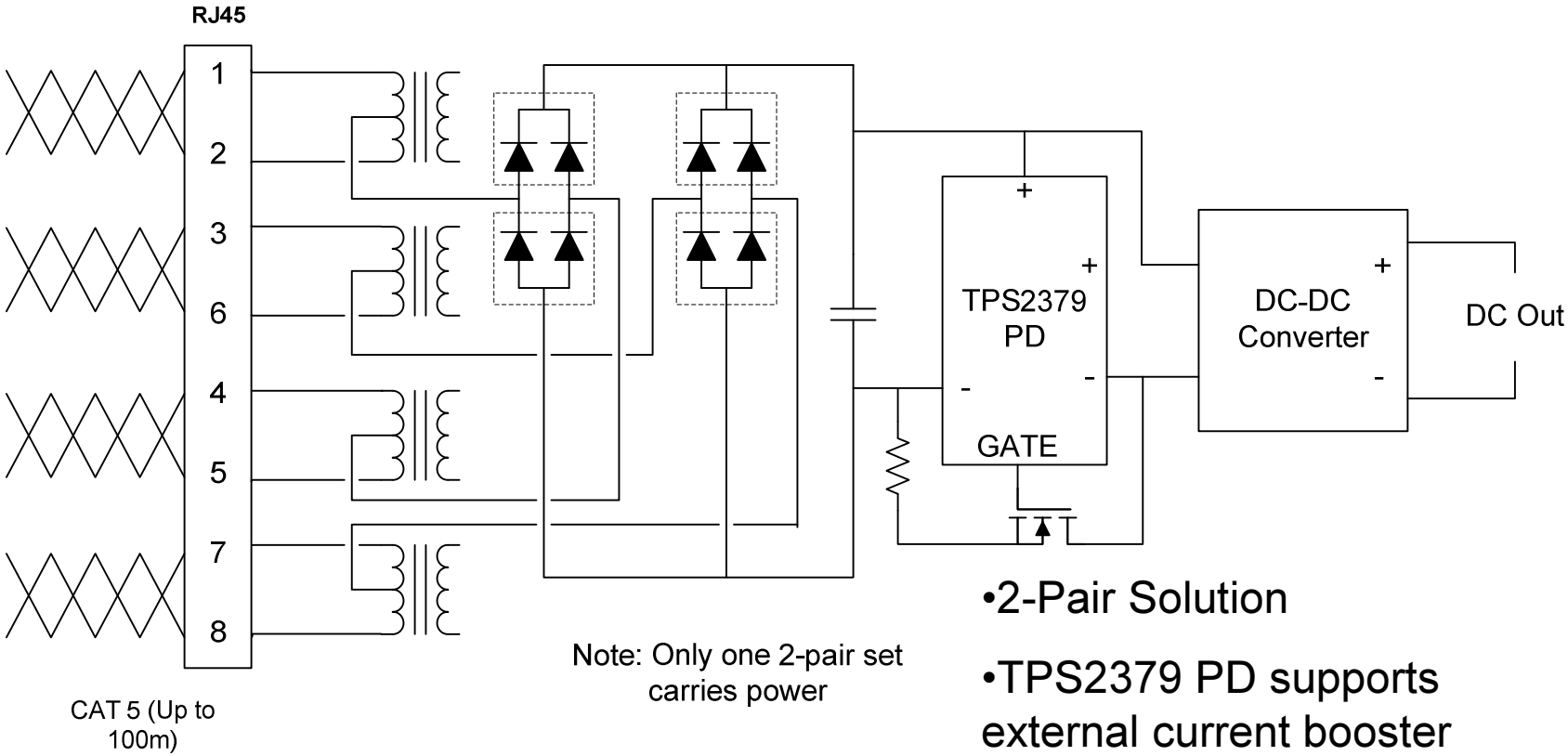
- 2-Pair Solution
- Separate PD and DC-DC Converter
- IEEE 802.3at-Compliant
- ≤ 25.5 W Delivered

2-Pair Solution for ≤25W : TPS23754 Integrated PD and DC-DC Converter Controller



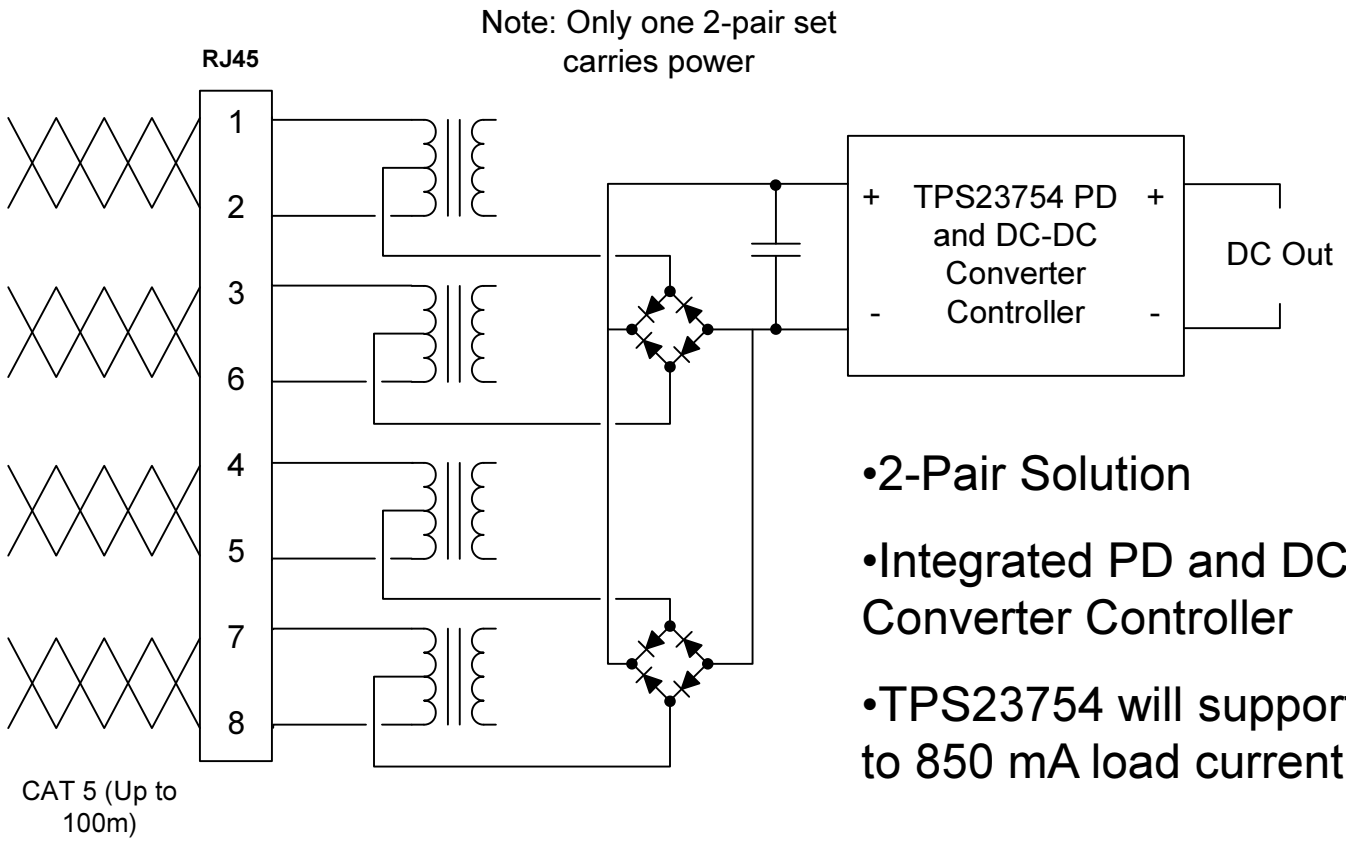
- 2-Pair Solution
- Integrated PD and DC-DC Converter Controller
- IEEE 802.3at-Compliant
- ≤ 25.5 W Delivered

2 Pair Solution for 25-51W: TPS2379 PD with Current Booster + DC-DC Converter



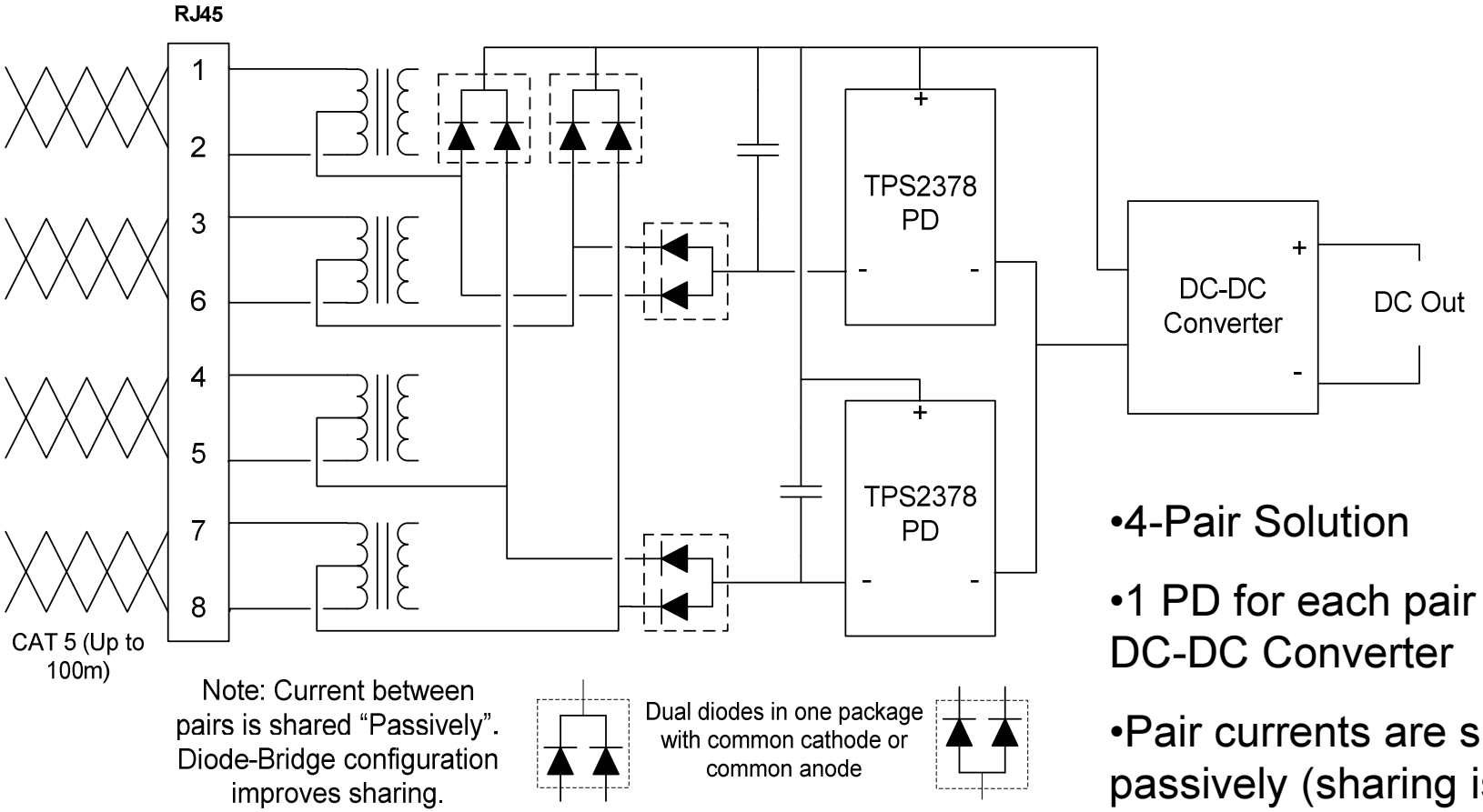
- 2-Pair Solution
- TPS2379 PD supports external current booster
- > 25.5 W Delivered

2-Pair Solution < 33W: TPS23754 Integrated PD + DC-DC Converter Controller



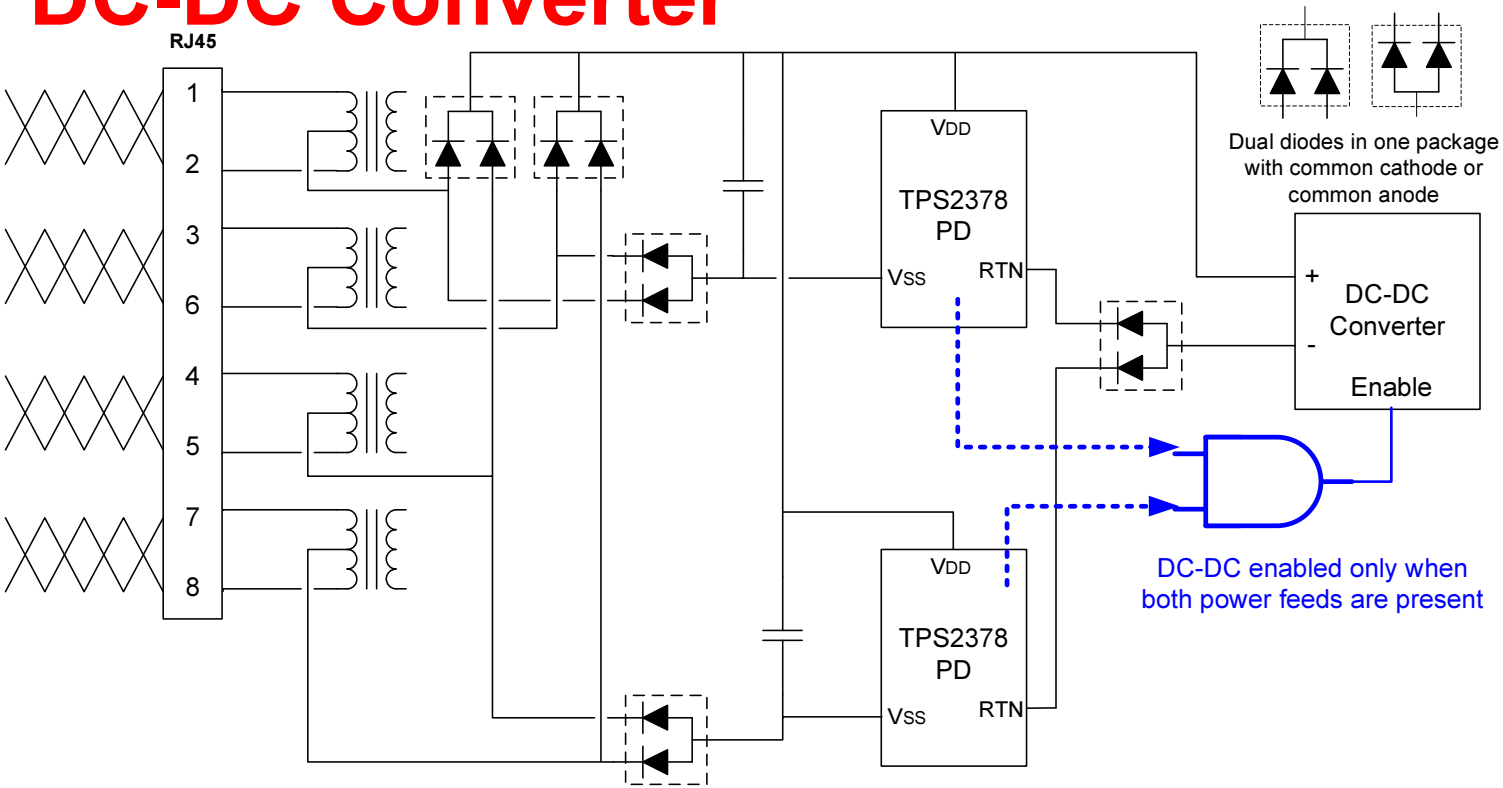
- 2-Pair Solution
- Integrated PD and DC-DC Converter Controller
- TPS23754 will support up to 850 mA load current

4-Pair Solution for 25-51W: 2 TPS2378 PDs + DC-DC Converter



- 4-Pair Solution
- 1 PD for each pair + 1 DC-DC Converter
- Pair currents are shared passively (sharing is not precise).

4-Pair Solution for 25-51W: 2 TPS2378 PDs + DC-DC Converter

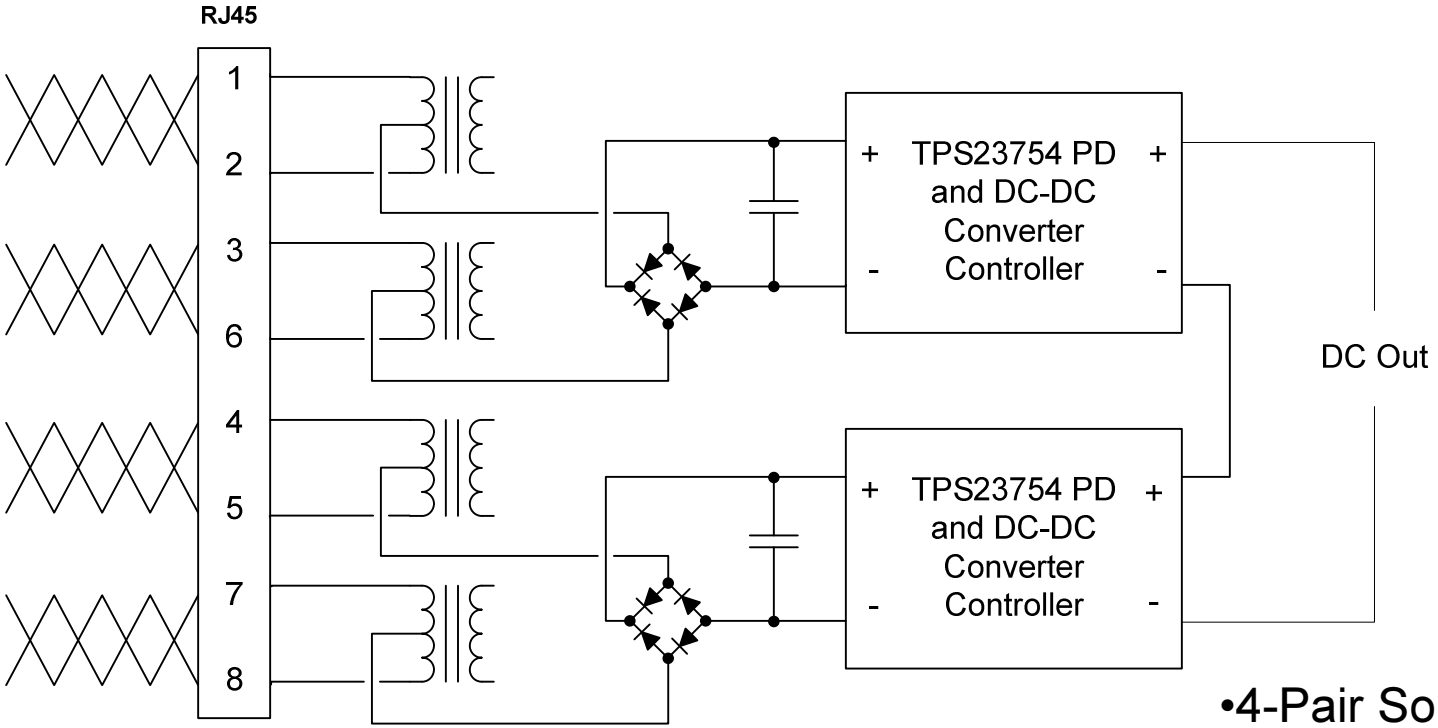


Forced 4-pair Implementation

- Supports devices which **do not have LLDP capabilities**.
- Physical layer signature required on both pair sets .
- One pair set is detected, classified (class 4) then turned ON.

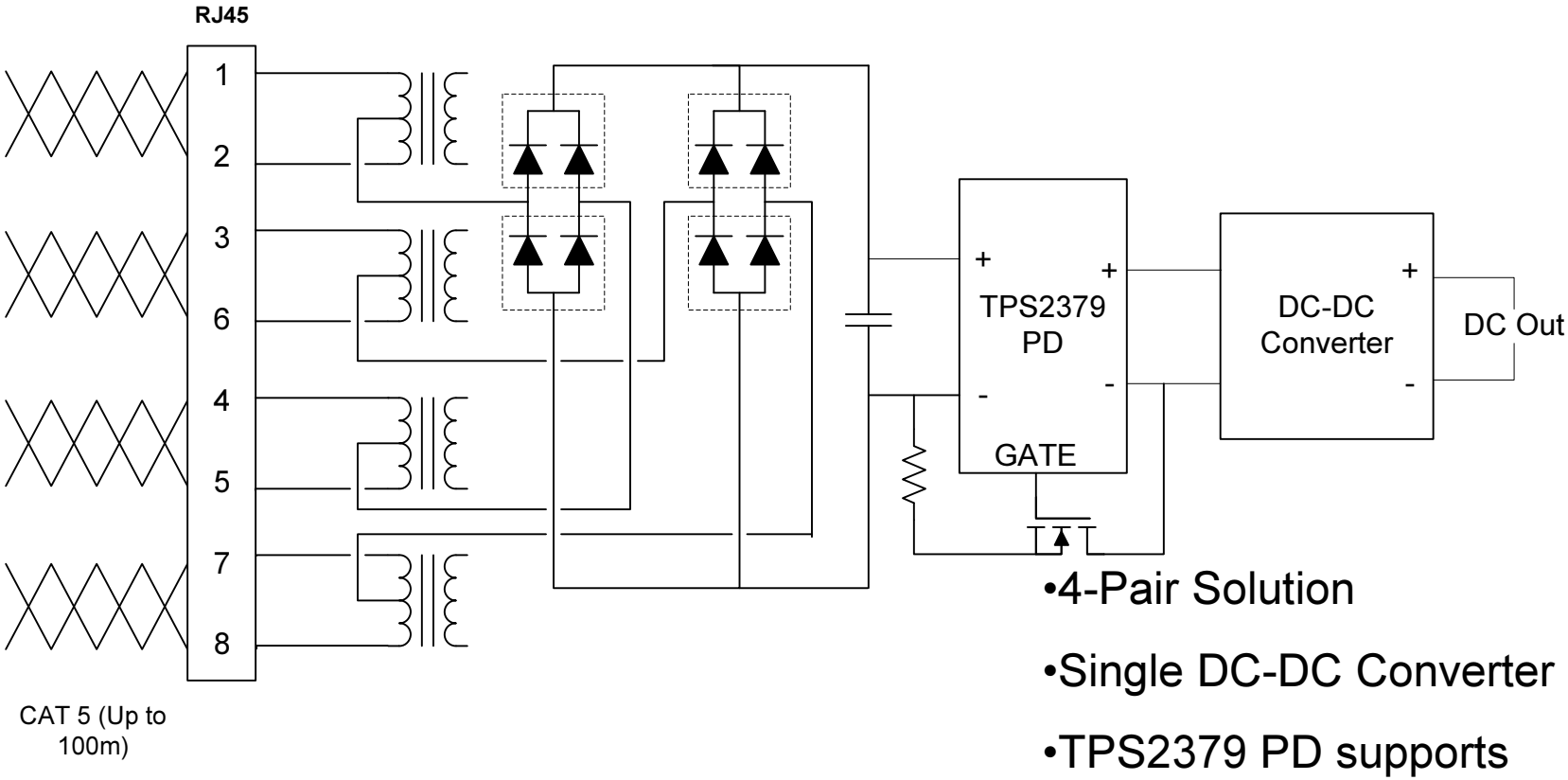
  Note: Only **one-**finger class is used by the UPOE PSE (there isn't 2-finger class with UPOE).
- As long as only one 2-pair set is powered, the consumption must be minimal, just enough to keep the PSE port ON
- Then, detect/class on second pair set (this must be possible while the first 2-pair is already powered). If class 4 => apply power.
- Enable DC-DC converter(s) and Link Controller

4-Pair Solution for 25-51W: 2 TPS23754 Integrated PD and DC-DC Converter Controller



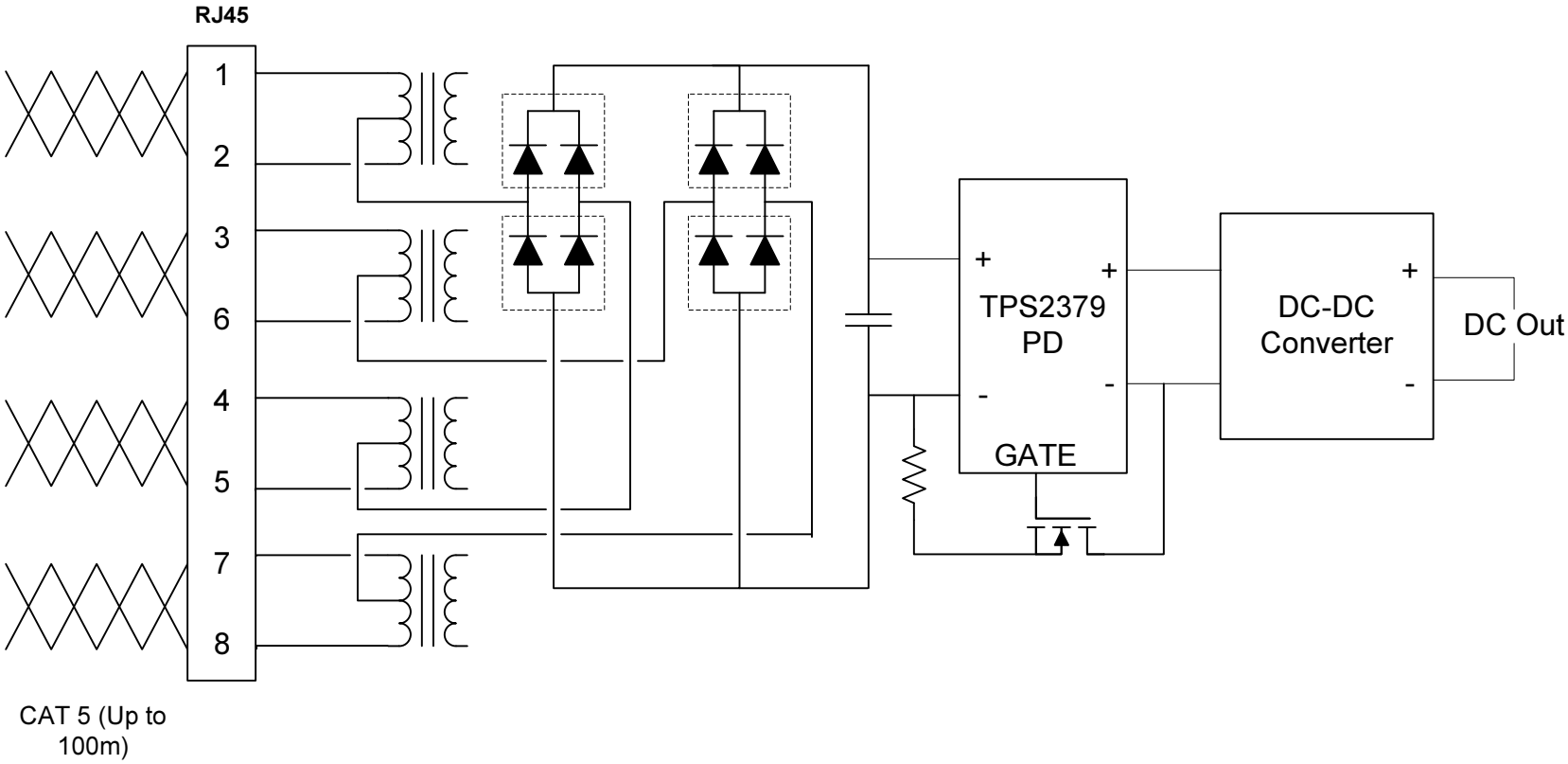
- 4-Pair Solution
- 1 integrated PD and DC-DC Controller for each pair
- Pair currents are shared actively

4-Pair Solution for 25-51W: TPS2379 PD with Current Booster + DC-DC Converter



- 4-Pair Solution
- Single DC-DC Converter
- TPS2379 PD supports external current booster
- Passive (*i.e.*, imprecise) current sharing between pairs

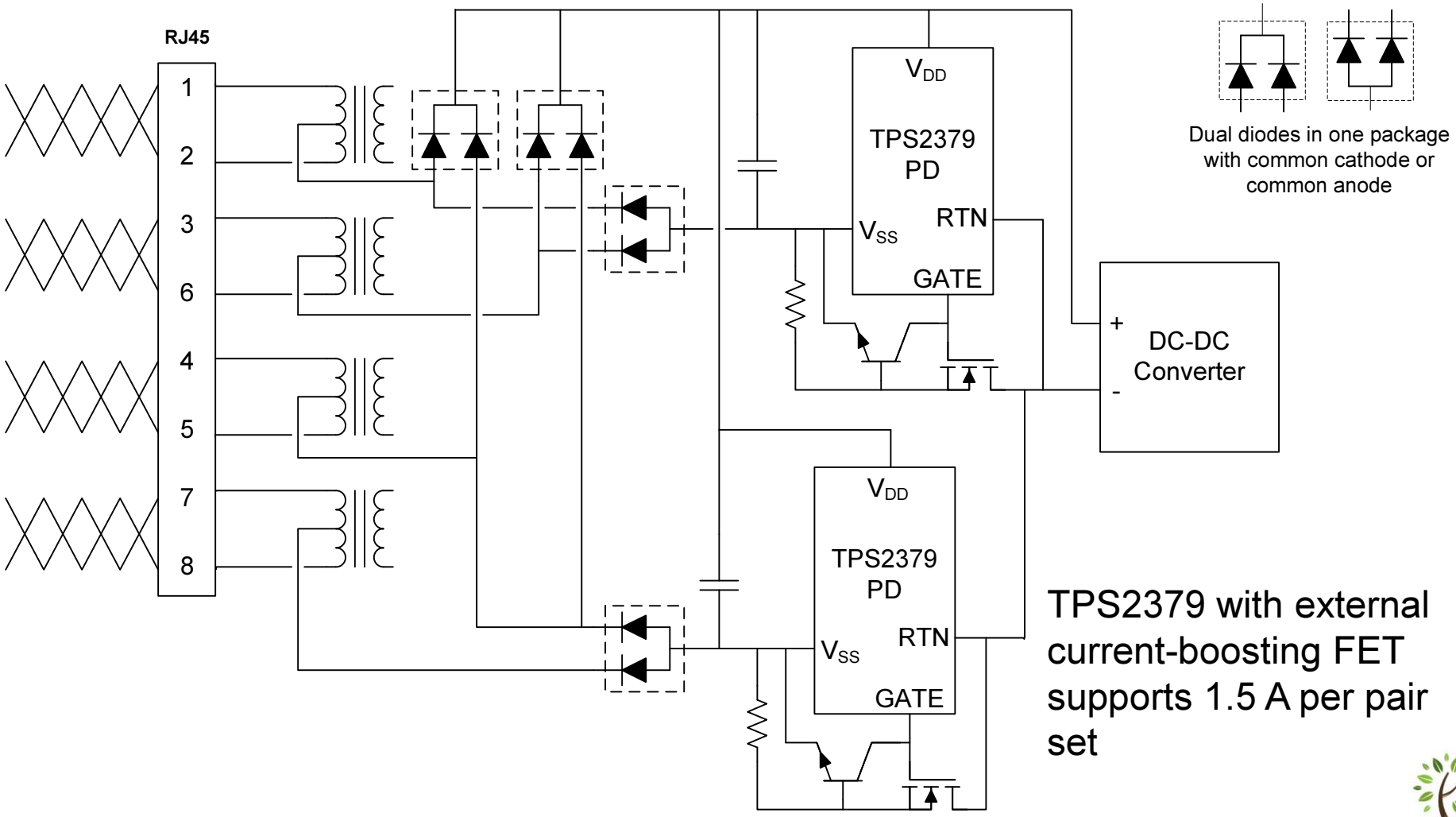
4-Pair Solution for 25-51W: TPS2379 PD with Current Booster + DC-DC Converter



LLDP-Supported 4 Pair Implementation

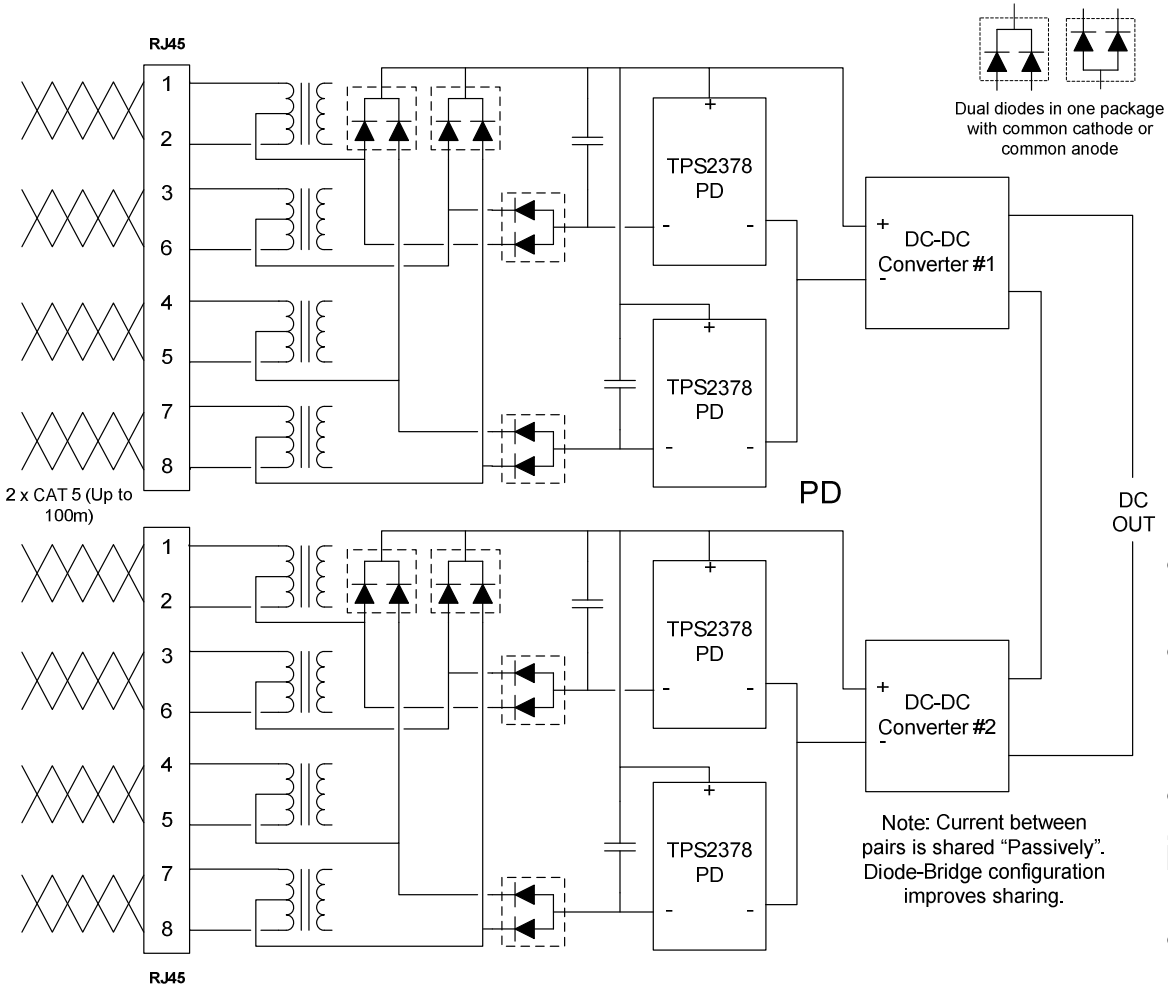
- To support devices having LLDP capabilities
- Detect/Class on first 2-pairs. If valid (class 0-4) => turn ON this 2-pair, up to 15.4W
- LLDP negotiation for up to 30W per 2-pair, 4-pairs total => turn ON second 2-pair set

4-Pair Solution for >51W: 2 TPS2379 PDs with Current Booster + DC-DC Converter



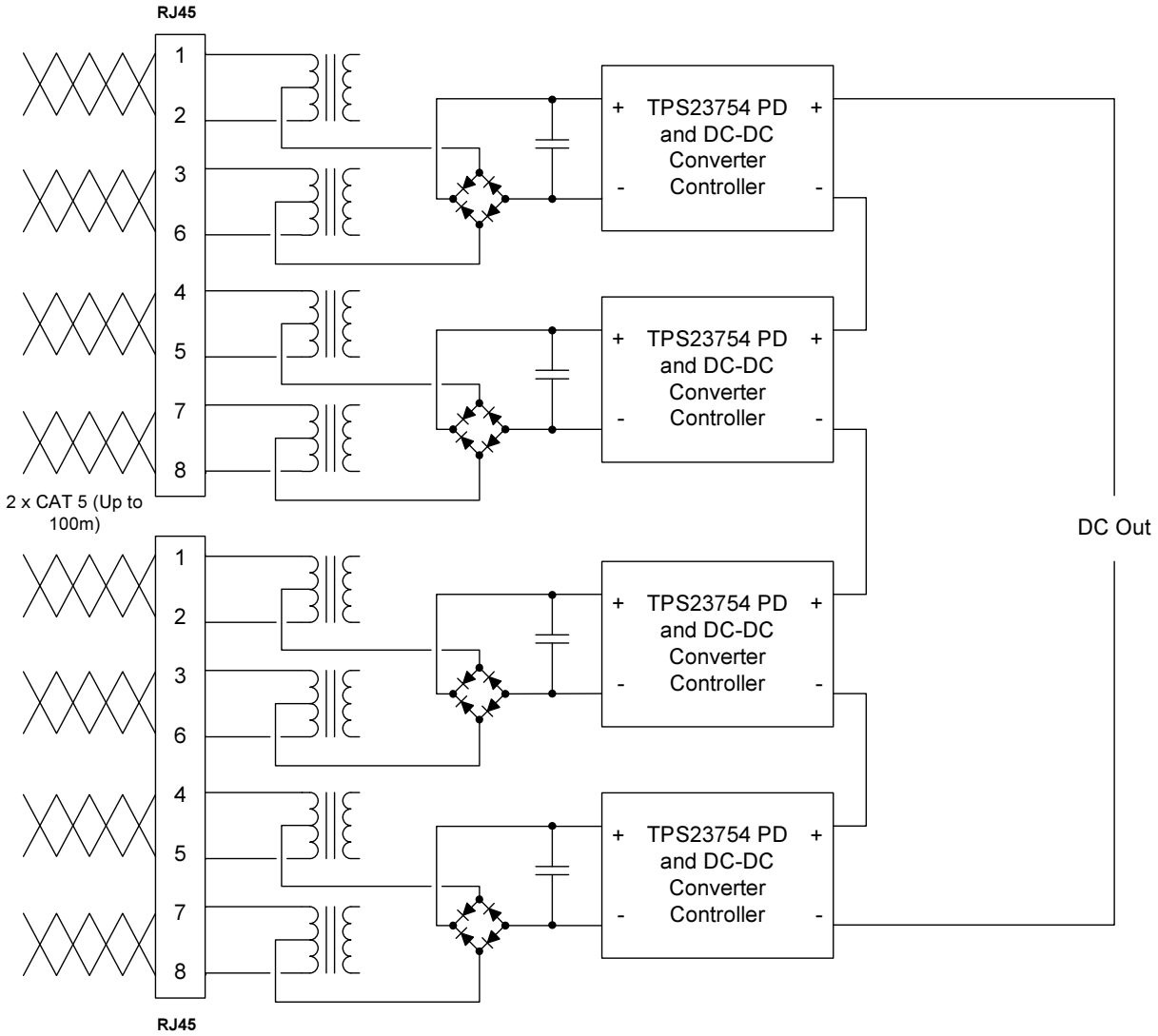
TPS2379 with external current-boosting FET supports 1.5 A per pair set

2-Cable Solution for 51-100W: 2 TPS2378 PDs + 1 DC-DC Converter for each Cable



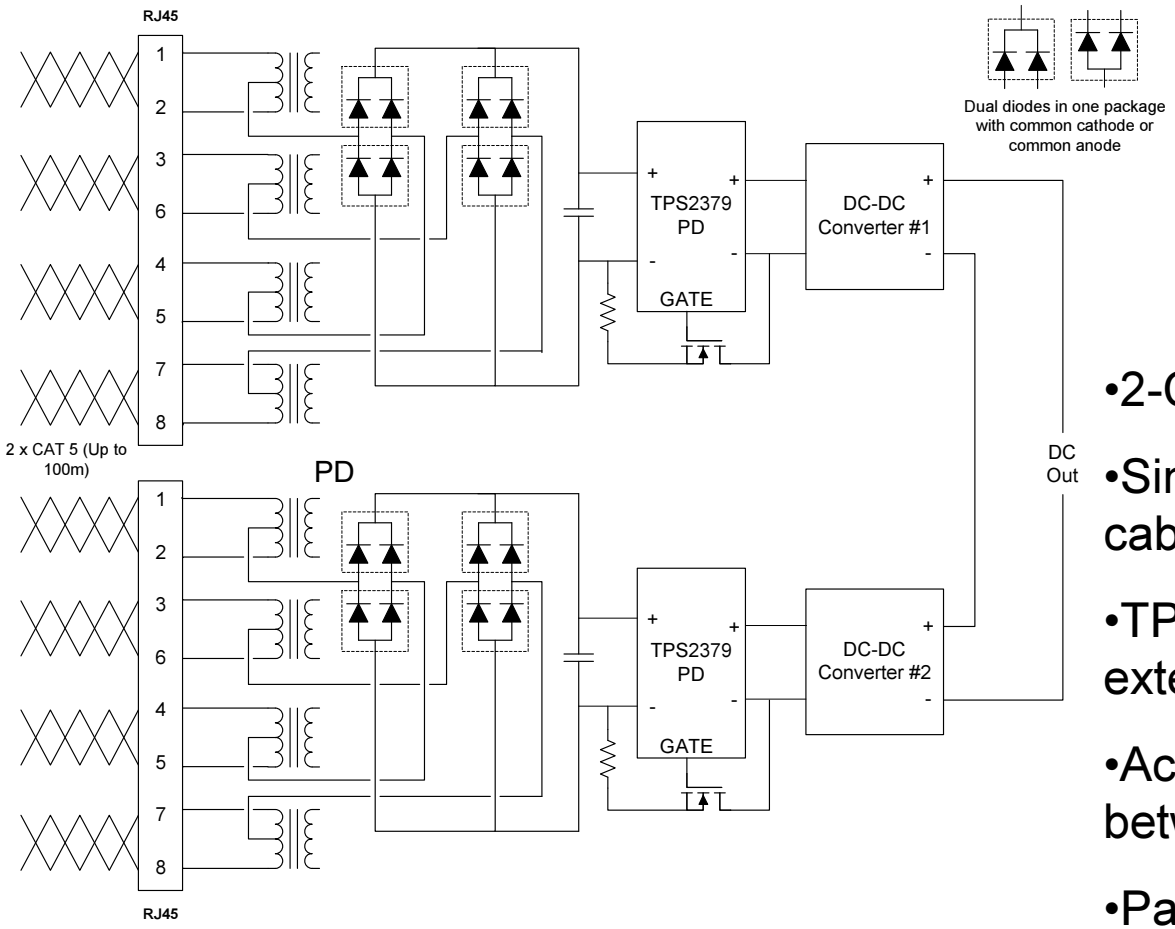
- 2-Cable Solution
- 1 PD for each pair + 1 DC-DC Converter per cable
- Total current within a cable is shared actively.
- Pair currents within each cable are shared passively.

2-Cable Solution for 51-100W: Separate TPS23754 PD + DC-DC Controller for each Pair



- 2-Cable Solution
- 1 integrated PD and DC-DC Controller for each pair
- Pair currents an cable currents are shared actively

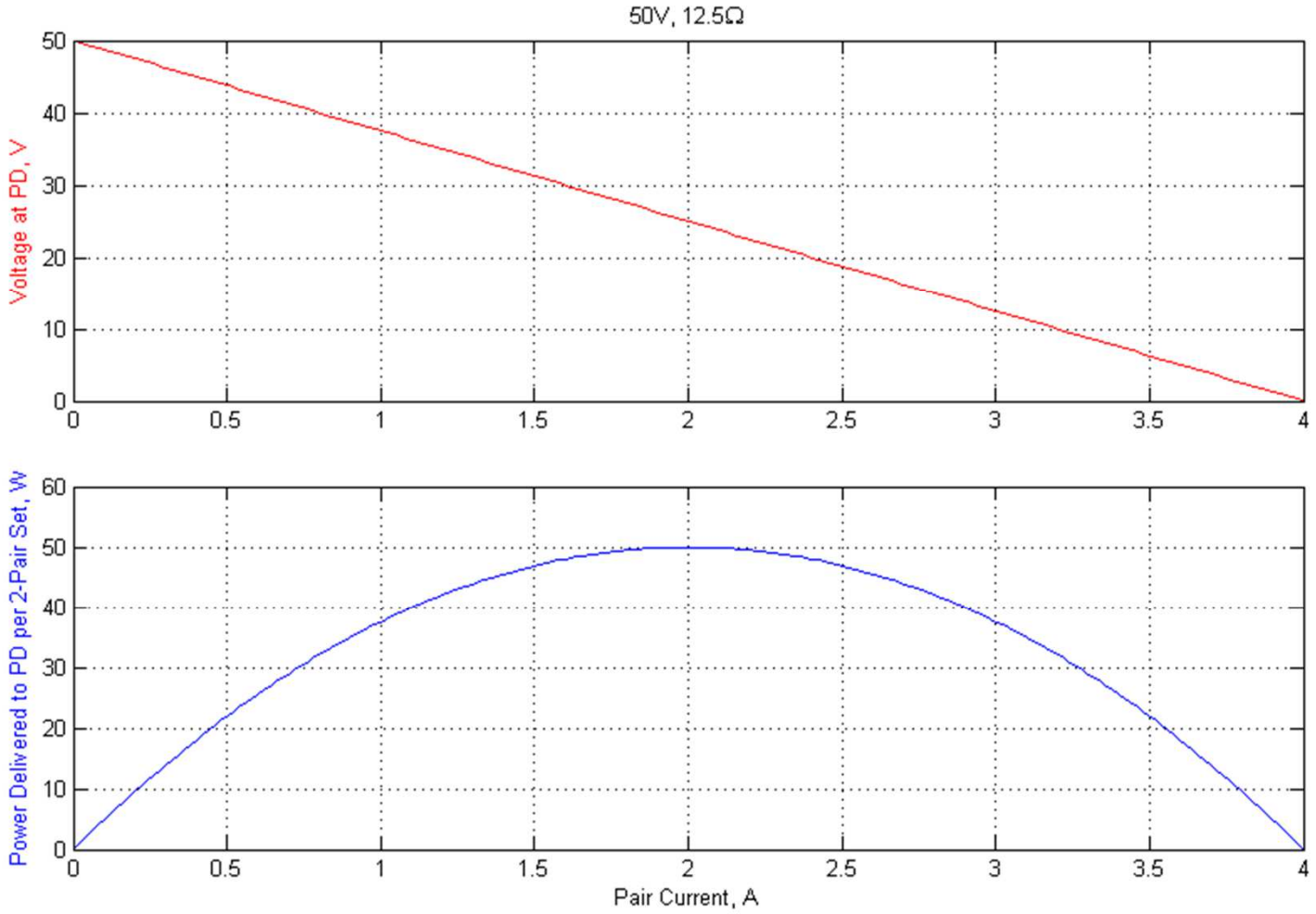
2-Cable Solution for 51-100W: TPS2379 PD with Current Booster + DC-DC Converter for each cable



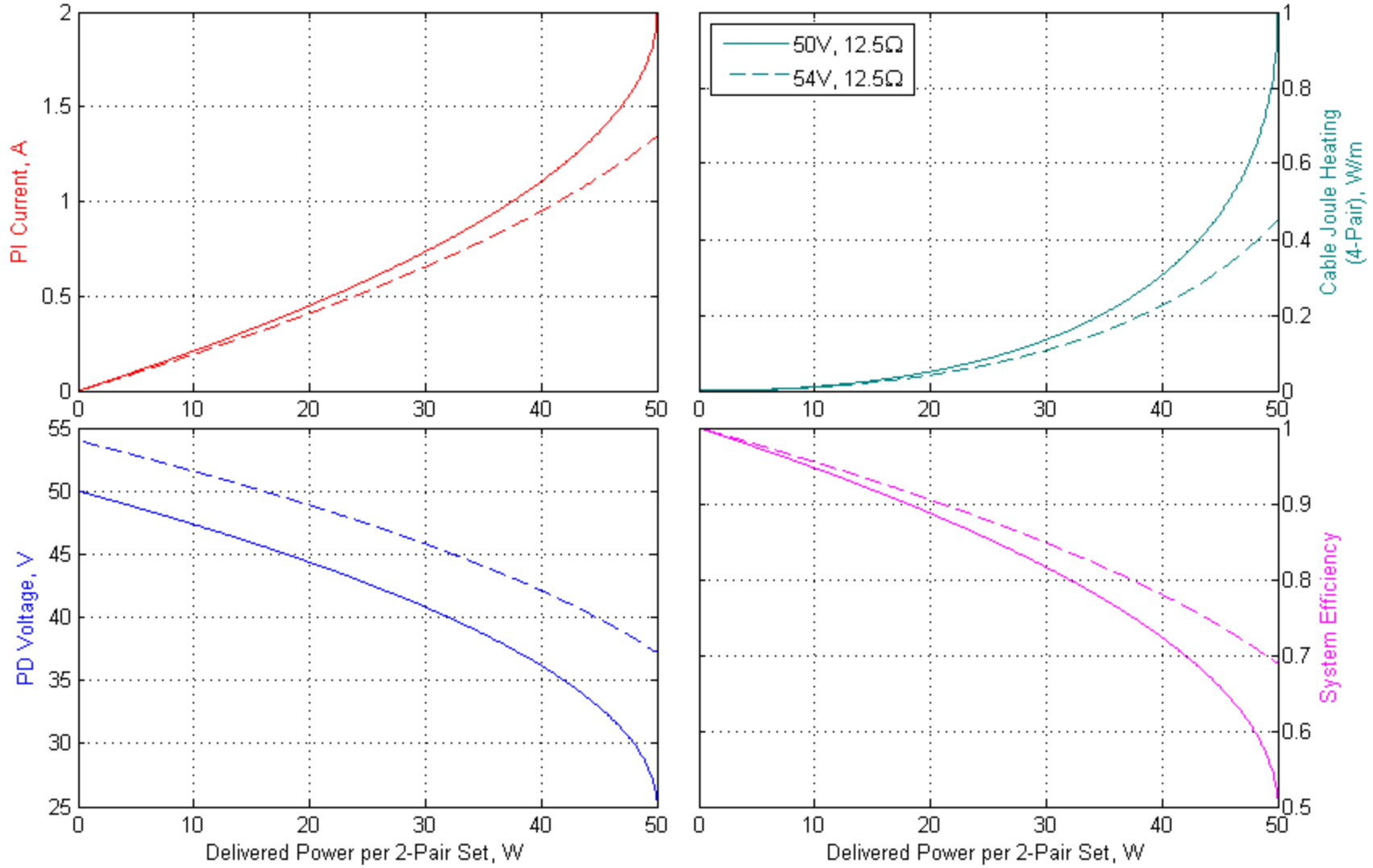
- 2-Cable Solution
- Single DC-DC converter per cable
- TPS2379 PD supports external current booster
- Active current-sharing between cables
- Passive (*i.e.*, imprecise) current sharing between pairs

>25.5 Delivered Systems

PoE Power Capability is Limited by the Source Voltage and Cable Resistance



PoE System Power Performance



PoE System Power Performance (con't)

50 V PSE Power; 12.5 Ω Loop Resistance per Pair Set

2-Pair Delivered Power, W	4-Pair Delivered Power, W	Current per Pair, A	Delivered Voltage,V	4-Pair Cable-Heating Loss, W/m	System Efficiency, %
13	26	0.28	46.5	0.02	93
25.5	51	0.60	42.5	0.09	85
30	60	0.74	40.8	0.14	82
35	70	0.90	38.7	0.20	77
40	80	1.11	36.2	0.31	72
45	90	1.37	32.9	0.47	66
50	100	2.00	25	1.0	50

PoE System Power Performance (con't)

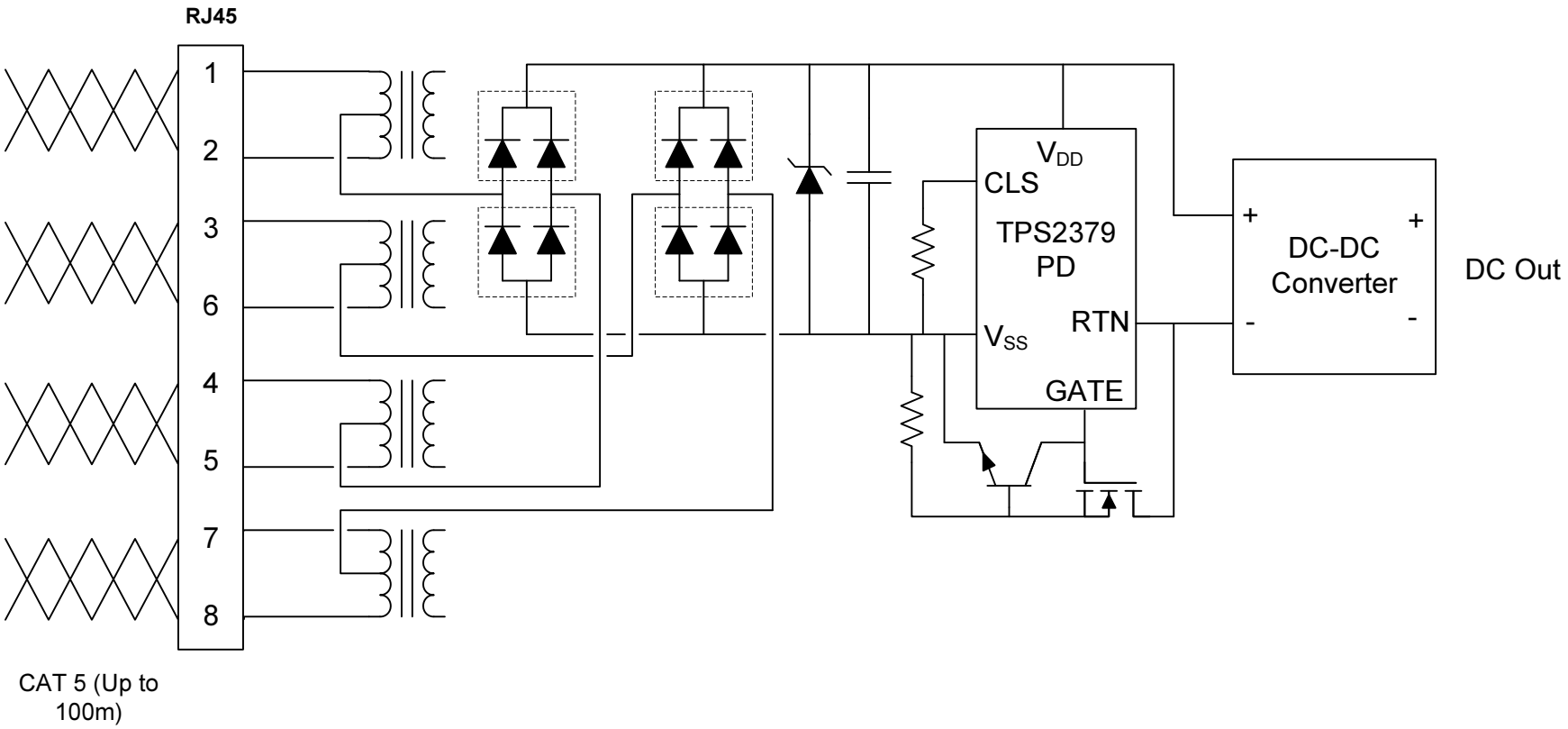
12.5 Ω Loop Resistance per Pair Set

PSE Voltage	4-Pair Delivered Power, W	Current per Pair, A	Delivered Voltage,V	4-Pair Cable-Heating Loss, W/m	System Efficiency, %
50	60	0.74	40.8	0.14	82
	70	0.90	38.7	0.20	77
	80	1.11	36.2	0.31	72
54	60	0.65	45.8	0.11	85
	70	0.79	44.1	0.16	82
	80	0.95	42.1	0.23	78
	90	1.13	39.9	0.32	74

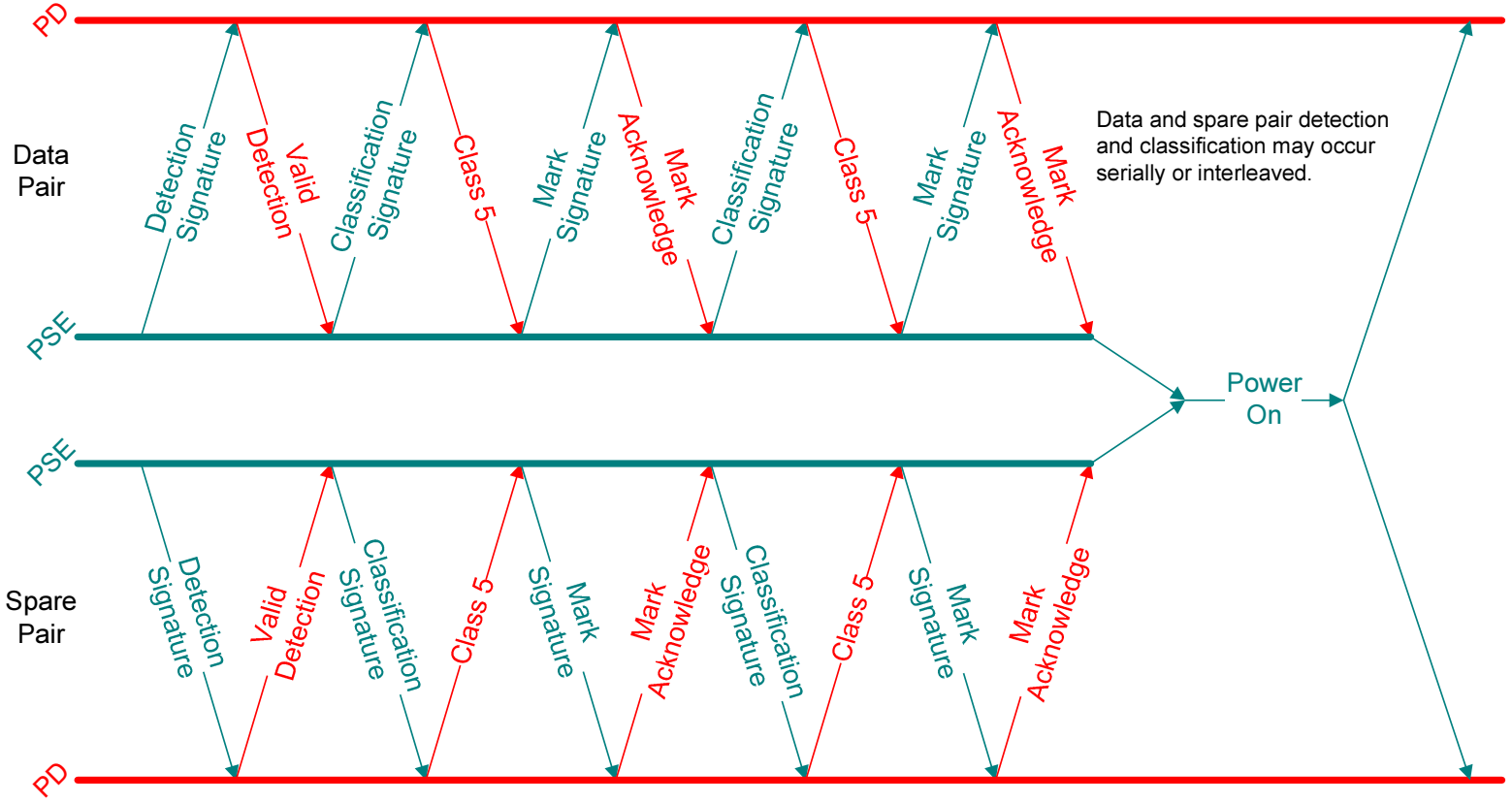
Practical Higher-Power PoE System with Components in the Pipeline

- Use TPS23861 Quad-Port PSE
  - Use 2 ports to support a 4-pair PoE channel.
  - Use standard detection technique for each pair set.
  - Use Class 5 classification with two events to establish high-power request at PD and compliance at PSE.
  - Use built-in 4-pair support options to support cable- and load-fault protection as well as disconnect.
- Use TPS2379 High-Power PD Interface
  - Use diode bridges to ‘OR’ pair sets.
  - Set classification current to Class 5 (resistor value).
  - Use external FET for higher current.

TPS2379 as 4-Pair PD



TI High-Power Classification Scheme

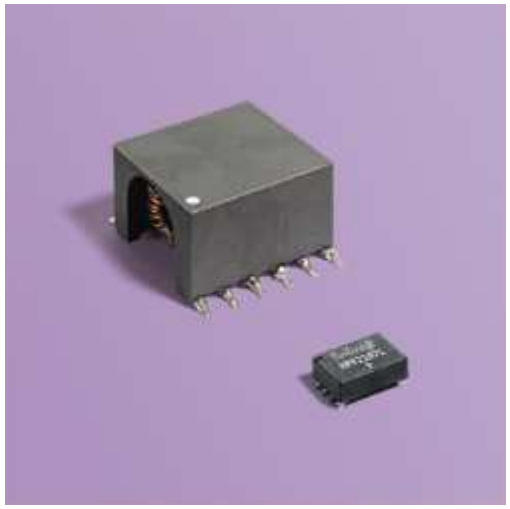


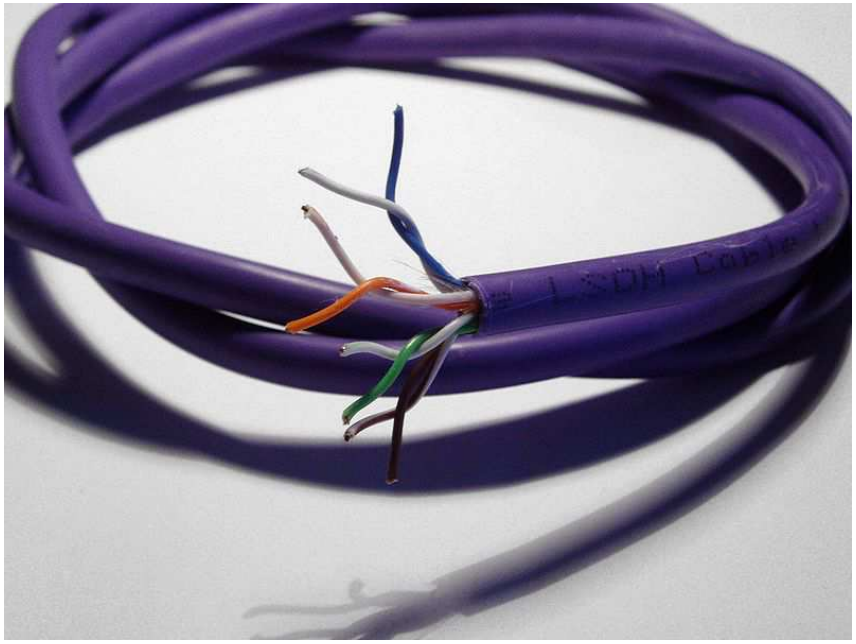
PoE State	PSE Signature	UoM
Detection	2.8 – 10 V	V
Classification	15.5 – 20.5	V
Mark	7 - 10	V

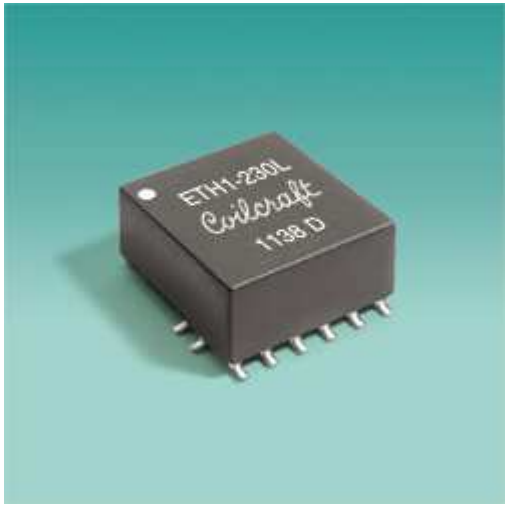
PD Response	PD Signature	UoM
Valid Detect	23.7 – 26.3	kΩ
Class 5*	52 - 58	mA
Mark Acknowledge	0.25 - 4	mA

*Class 5 is not defined in IEEE 802.3at, but it is within the range of I_{class_LIM} permitted in the standard.

High-Power PoE Support Components

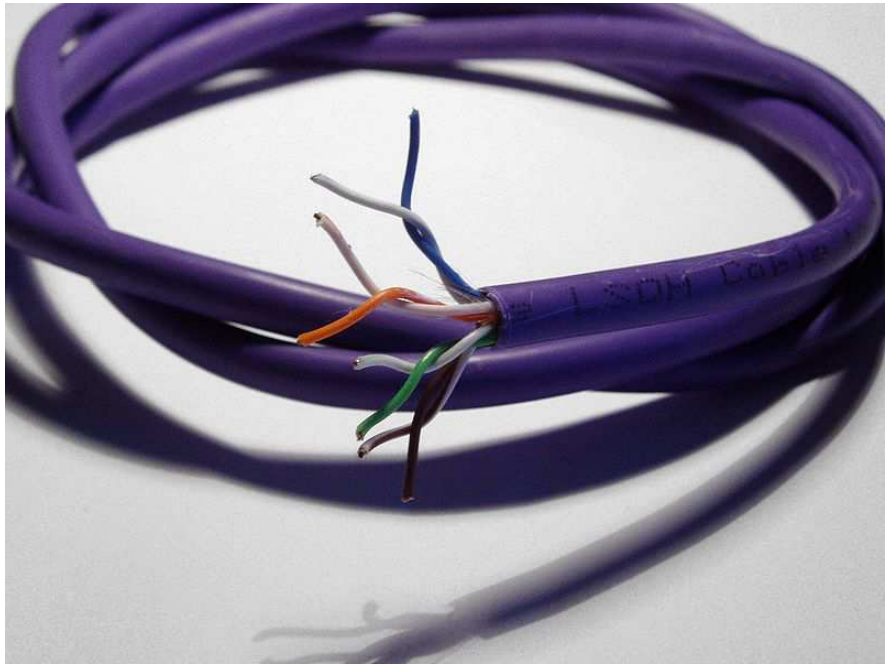






CAT-5e Cable

- Large installed base.
- IEEE 802.3at standard allows for 12.5Ω loop resistance per pair set.
- Measured <10C° temperature rise with 4 pairs conducting 0.6 A

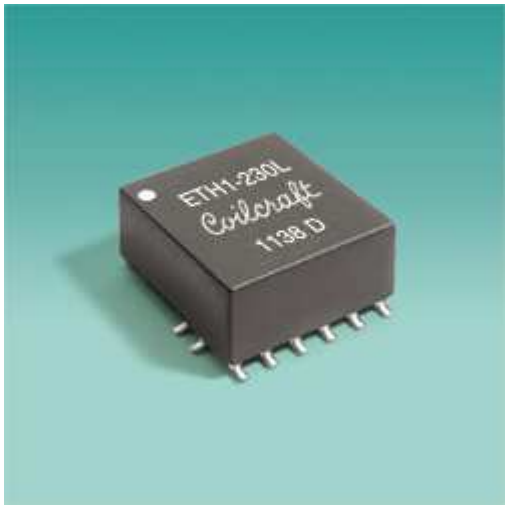


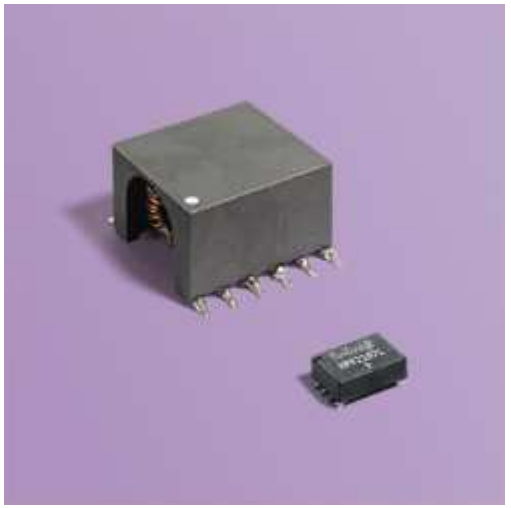
RJ-45 Connector

- Typically rated for 0.6A/contact at 65°C.
- Typically >500 connect-disconnect cycles at rated current.

Magnetics

- High-power magnetics available for 1-1.5A per-pair applications (4-pair operation requires 2 each).





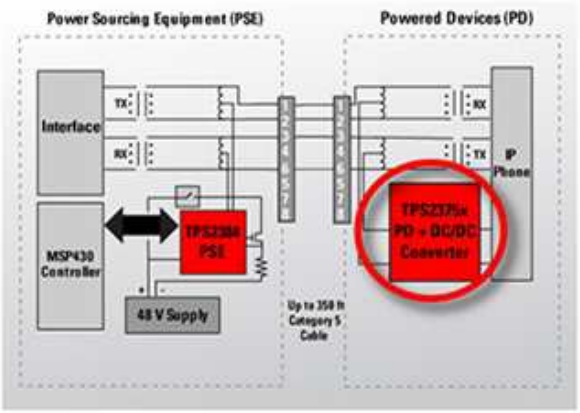
www.ti.com/poe

Power-over-Ethernet (PoE) Solutions for both ends of the cable!

Power Over Ethernet (PoE) Solutions for High-Powered Devices and Power Sourcing Equipment

TI offers a complete portfolio of PoE ICs for Power Sourcing Equipment (PSE) and Powered Devices (PDs). With solutions for a variety of PoE applications such as VoIP telephones, security cameras, thin/zero-client monitors, RFID readers and wireless access points; our controllers enable IEEE 802.3af, IEEE 802.3at and Universal Power over Ethernet (UPOE) compliant solutions. We also offer reference designs, topical application notes and open-source Link-Layer Discovery Protocol (LLDP) software (coming soon!) to make our PoE solutions easy to design-in. Check out our latest PoE family members – the TPS2378 and TPS2379 – aimed at equipment requiring >25.5W of delivered PoE power today!

TI PoE PD Portfolio



Key Features

- PoE PD + DC/DC converter in one package
- Isolated designs supported, including forward and flyback
- 100-V SOI process for entire family of PD controllers
- System-level ESD testing
- Intelligent integration for most robust design
- IEEE802.3af and 802.3at -compliant devices

Key Applications

- Power Over Ethernet (PoE)
- IP Phone: Wireless
- Camera: Surveillance Analog
- RFID Reader
- Video Conferencing: IP-Based HD

Guides

Power Management Guide
(slvt145.pdf, 8.92 MB)
Download

Application Notes

- PoE Powered Device for 24 VAC Building Power Applications
  (slua477.htm, 8 KB)
  10 Sep 2008
- Designing with the TPS23753 Powered Device and Power Supply Controller
  (slva305.htm, 8 KB)
  07 Jul 2008
- Advanced Adapter ORing Solutions using the TPS23753
  (slva306.htm, 8 KB)
  03 Jul 2008
- Designing an EMI Compliant PoE with Isolated Flyback
  (slua469.htm, 8 KB)
  20 May 2008
- Practical Guidelines EMI Compliant PoE
  (slua454.htm, 8 KB)
  27 Mar 2008

E2E community forums

- PoE

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