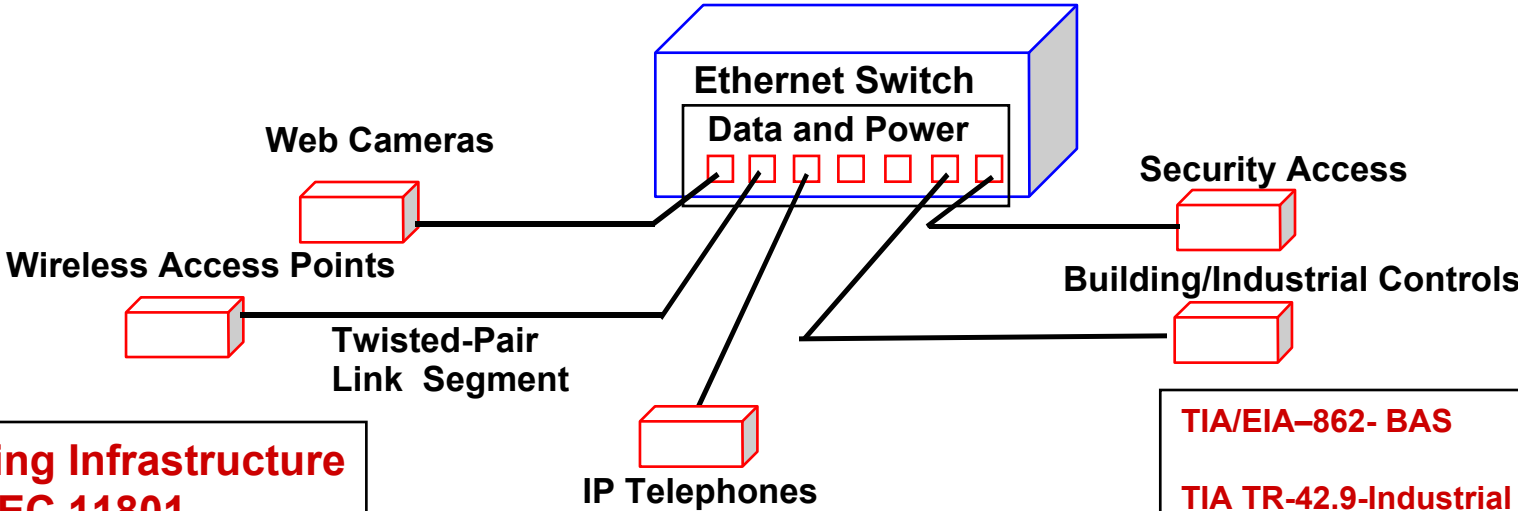

Call For Interest PoE- plus

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Powering Ethernet Devices Over Data Cabling

IEEE 802.3af

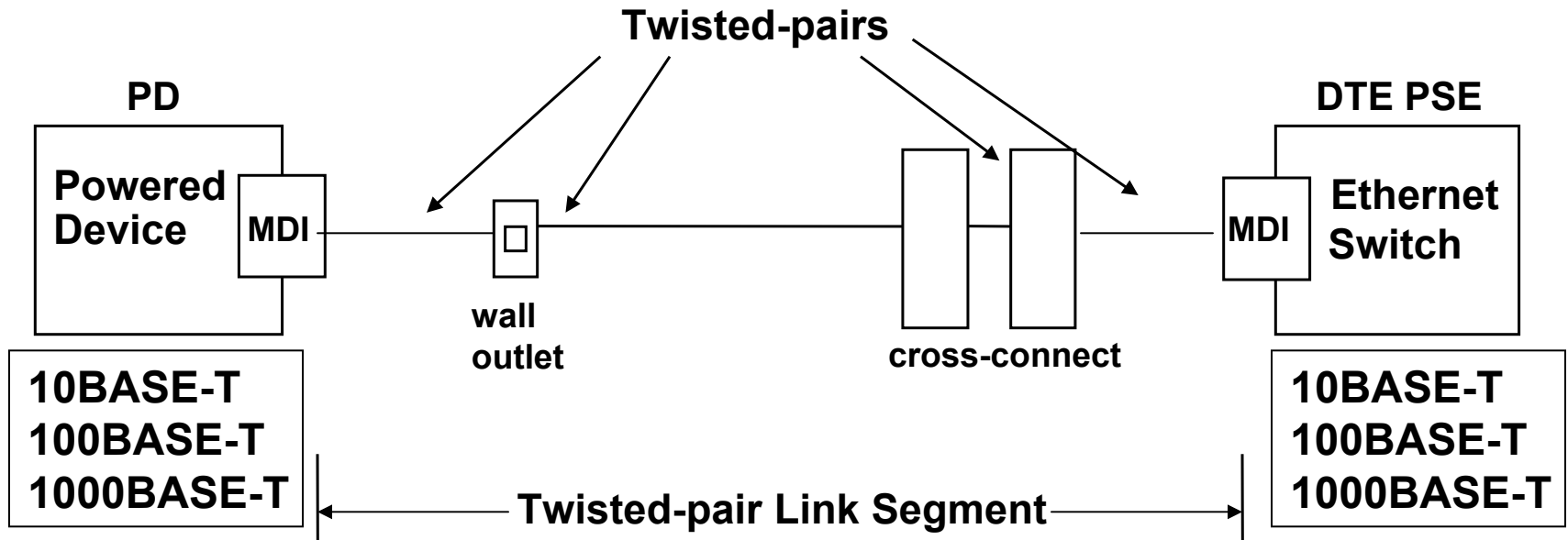


Cabling Infrastructure
ISO/IEC 11801
TIA/EIA-568

TIA/EIA-862- BAS
TIA TR-42.9-Industrial Telecommunications Infrastructure
ISO/IEC standard for industrial cabling - ISO/IEC 24702

Applications of Powering over Ethernet

IEEE 802.3af - Twisted-pair Link Segment with DTE power



Powered Device

- VOIP Phone
- Wireless Access Points
- etc...

****Cabling channels as specified in ISO/IEC 11801 and ANSI/TIA/EIA-568 exclude the equipment connectors and may include an optional consolidation point connector. The building cable is referred to as horizontal cable.**

Electrical

UTP Cables:

- ANSI/TIA/EIA-568-B.2, The resistance of any conductor shall not exceed 9.38 ohms per 100 m (328 ft) at or corrected to a temperature of 20 °C.
- .4 % increase per degree C (DC correction-ASTM Test Method B 193-(.393%))

DC loop=

| Temp degC | Conductor | DC Loop | %increase |
|-----------|-----------|---------|-----------|
| 20.00 | 9.38 | 18.76 | |
| 30.00 | 9.76 | 19.51 | 4 |
| 40.00 | 10.13 | 20.26 | 8 |
| 50.00 | 10.51 | 21.01 | 12 |
| 60.00 | 10.88 | 21.76 | 16 |
| 65.00 | 11.07 | 22.14 | 18 |

Table 1

- ANSI/TIA/EIA-568-B.2, 4.3.4.2 DC resistance unbalance: shall not exceed 5% (20 degree C) measured per ASTM D 4566
- ANSI/TIA/EIA-568-B.2, 4.3.4.4 Capacitance unbalance: pair-to-ground: The capacitance unbalance to ground of any horizontal cable pair at 1 kHz, at or corrected to a temperature of 20 deg C, shall not exceed 330 pF per 100 m

Connectors

- **ANSI/TIA/EIA-568-A, Section 10.4.4.4, DC Resistance: shall not exceed .3 ohm, measured per ASTM D 4566.**
- **ANSI/TIA/EIA-568-B.2. , 0.3 ohm for category 3 connecting hardware**
• **and 0.2 ohm for category 5e connecting hardware at 20 °C ± 3 °C**
- **Contact Resistance - initial - \leq 2.5 milliohm - after reliability tests**
• **change of \leq 5 milliohm**
- **IEC 60603-7 - current capacity for connectors – per pin**
• **@20 degree c - 1.8 A (@0 - 2.2 A, @ 40 - 1.4 A, @60- .75 A)**
- **UL 1863 - 250 v**

Safety

- SELV - CSA C22.2 No. 950/UL1950 (CEI/IEC 60950)

1.2.8.5 Safety Extra-Low Voltage (SELV) Circuit:

-60VDC

- Equipment classified as a Limited Power Source in accordance with IEC publication 60950.

Link Segment DCR

Link Segment (4 connectors):

•DC Resistance

Table 2

| | 90 meters | 90 meters | 4 connectors | 100 meter channel |
|-------|-----------|-----------|----------------------------|-------------------------------|
| degC | conductor | loop | 2x(4x.3 ohm per connector) | with 10m ScTP patch (2.8 ohm) |
| 20.00 | 8.44 | 16.88 | 2.40 | 22.08 |
| 30.00 | 8.78 | 17.56 | 2.40 | 22.76 |
| 40.00 | 9.12 | 18.23 | 2.40 | 23.43 |
| 50.00 | 9.46 | 18.91 | 2.40 | 24.11 |
| 60.00 | 9.79 | 19.59 | 2.40 | 24.79 |
| 65.00 | 9.96 | 19.92 | 2.40 | 25.12 |

100 ohm ScTP patch cords and cross-connect:

•TIA/EIA/IS-729- DC resistance - For 26 AWG conductors, the resistance of the conductors shall not exceed 14 ohm per 100 meters (328 ft) at or corrected to a temperature of 20 C. (DC correction-ASTM Test Method B 193-(.393%))

Max DC Loop = ~25 ohm

ISO/IEC 11801:2002(E)-Generic cabling for customer premises

6.4.7 Direct current (d.c.) loop resistance

The d.c. loop resistance of each pair of a channel shall meet the requirements in Table 16.

When required, the d.c. loop resistance shall be measured according to IEC 61935-1.

Table 16 – Direct current (d.c.) loop resistance for channel

| Maximum d.c. loop resistance Ω | | | | | |
|--|---------|---------|---------|---------|---------|
| Class A | Class B | Class C | Class D | Class E | Class F |
| 560 | 170 | 40 | 25 | 25 | 25 |

6.4.8 Direct current (d.c.) resistance unbalance

The d.c. resistance unbalance between the two conductors within each pair of a channel shall not exceed 3 % for all classes. This shall be achieved by design.

ISO/IEC 11801:2002(E)-Generic cabling for customer premises

6.4.9 Current carrying capacity

The minimum current carrying capacity for channels of Classes D, E and F shall be 0,175 A d.c. per conductor for all temperatures at which the cabling will be used. This shall be achieved by an appropriate design.

6.4.10 Operating voltage

The channels of classes D, E and F shall support an operating voltage of 72 V d.c. between any conductors for all temperatures at which the cabling is intended to be used.

6.4.11 Power capacity

The channels of classes D, E and F shall support the delivery of a power of 10 W per pair for all temperatures at which the cabling is intended to be used.

POWER TO THE LOAD 

802.3af - DTE Power Delivery

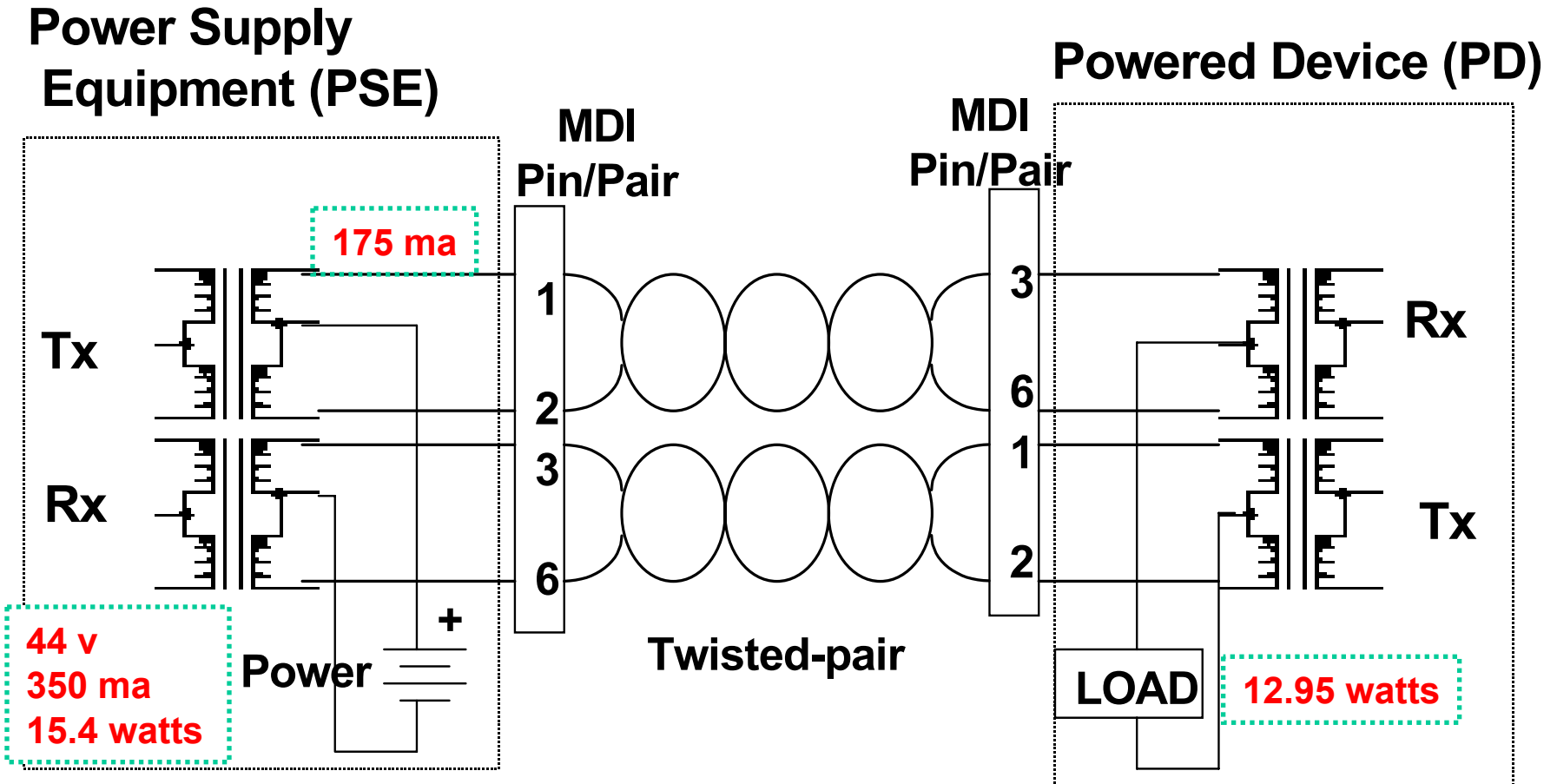
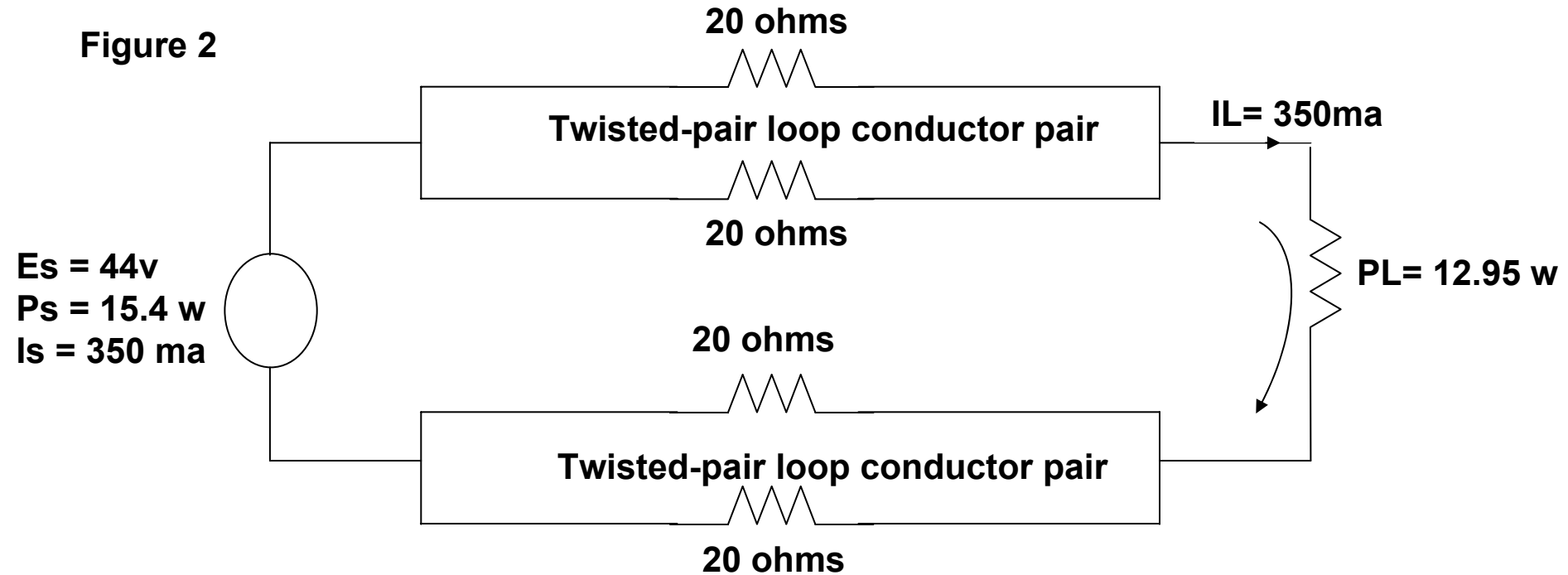


Figure 1

IEEE 802.3af-DTE Power Specification Reference

Figure 2



Max power at the output of the power supply: $15.4\text{ watts} = 44\text{V} \cdot .35\text{A}$

For a 20 ohm loop resistance (2 pair):

Max Power dissipated in the cable: $(0.35^2) \cdot 20 = 2.45\text{ w}$

Power at the powered device: $= 15.4 - 2.45 = 12.95\text{ w}$

PART 68- Sec. 68.215 -

CONNECTION OF TERMINAL EQUIPMENT TO THE TELEPHONE NETWORK Maximum Continuous Current Capacity of PVC Insulated Copper Wire,

| Wire size, AWG | Circular mils | Maximum current, amperes |
|----------------|------------------|--------------------------------|
| 26..... | 254.1 | 1.3 |
| 24..... | 404.0 | 2.1 |
| 22..... | 642.4 | 5.0 |

The table assumes a 45 deg. C temperature rise for wire sizes 22 AWG or larger, and a 40 deg. C rise for wire sizes smaller than 22 AWG, for poly-vinyl chloride insulating materials, and should be regarded as establishing maximum values to be derated accordingly in specific installations where ambient temperatures are in excess of 25 deg. C: **Note:** The total current in all conductors of multiple conductor cables may not exceed 20% of the sum of the individual ratings of all such conductors.

Interpretation of PART 68- Sec. 68.215 -

_____ conductor @ 65 deg.: _____
^

| 40 deg. C Temperature rise assumed due to current

|
| _____ conductor initially @ 25 deg. C: _____ I=2.1A>> ___

Following the guidance in the note:

Note: The total current in all conductors of multiple conductor cables may not exceed 20% of the sum of the individual ratings of all such conductors.

Sum of all conductors for 4 Pair cable=8 conductors x (2.1) = 16.8A

20% of the sum of the individual ratings = 16.8 A*.2=3.36 A

Rating for “single conductor” initially @ 25 deg. C= 3.36/8=.42A

PoE-Plus Power Specification Reference (example)

PL= 30 W

DCR Loop = 12.5 ohm

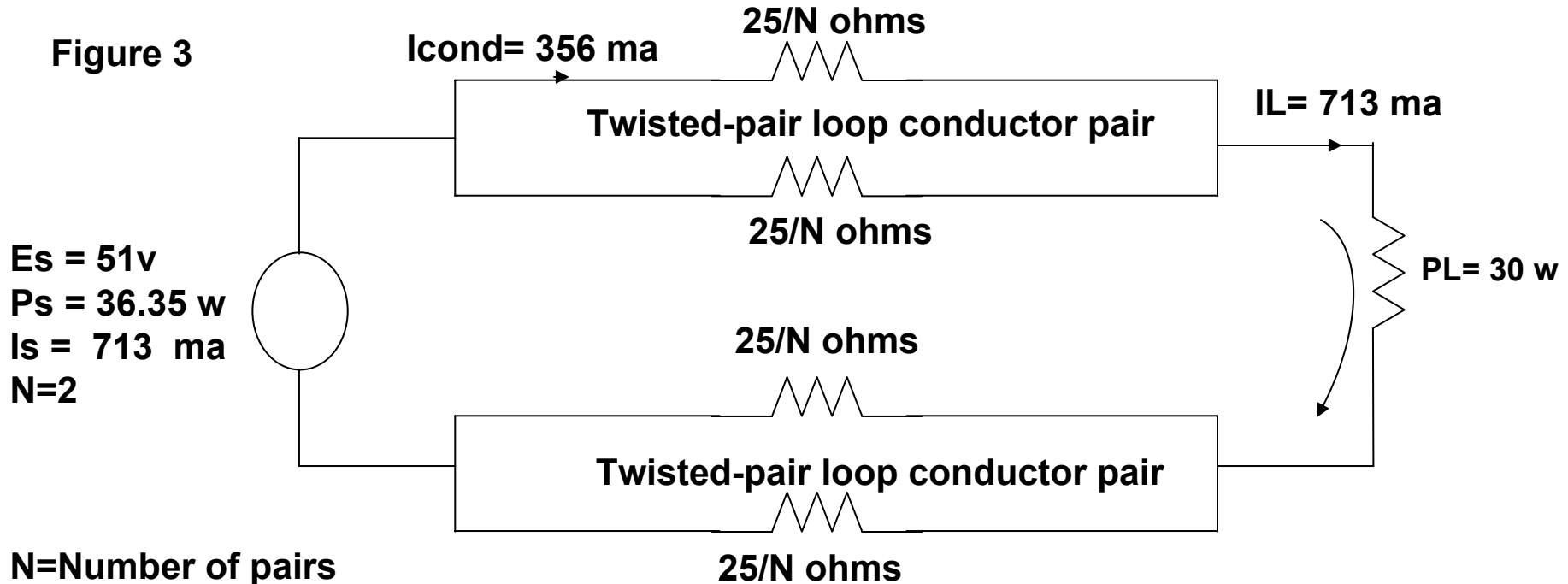
| | Es | IL (A) | IL Conductor (A) |
|--------------------------|-----------|--------------|------------------|
| 802.3af Minimum V | 44 | 0.925 | 0.462 |
| | 45 | 0.883 | 0.442 |
| | 46 | 0.847 | 0.424 |
| | 47 | 0.815 | 0.407 |
| | 48 | 0.786 | 0.393 |
| | 49 | 0.759 | 0.380 |
| | 50 | 0.735 | 0.368 |
| Minimum Voltage | 51 | 0.713 | 0.356 |
| | 52 | 0.692 | 0.346 |
| | 53 | 0.673 | 0.336 |
| Nominal Voltage | 54 | 0.655 | 0.327 |
| | 55 | 0.638 | 0.319 |
| | 56 | 0.622 | 0.311 |
| Maximum Voltage | 57 | 0.607 | 0.304 |
| | 58 | 0.593 | 0.297 |
| | 59 | 0.580 | 0.290 |
| | 60 | 0.567 | 0.283 |

Reference: Circuit Model Figure 3

Table 3

PoE-Plus Power Specification Reference

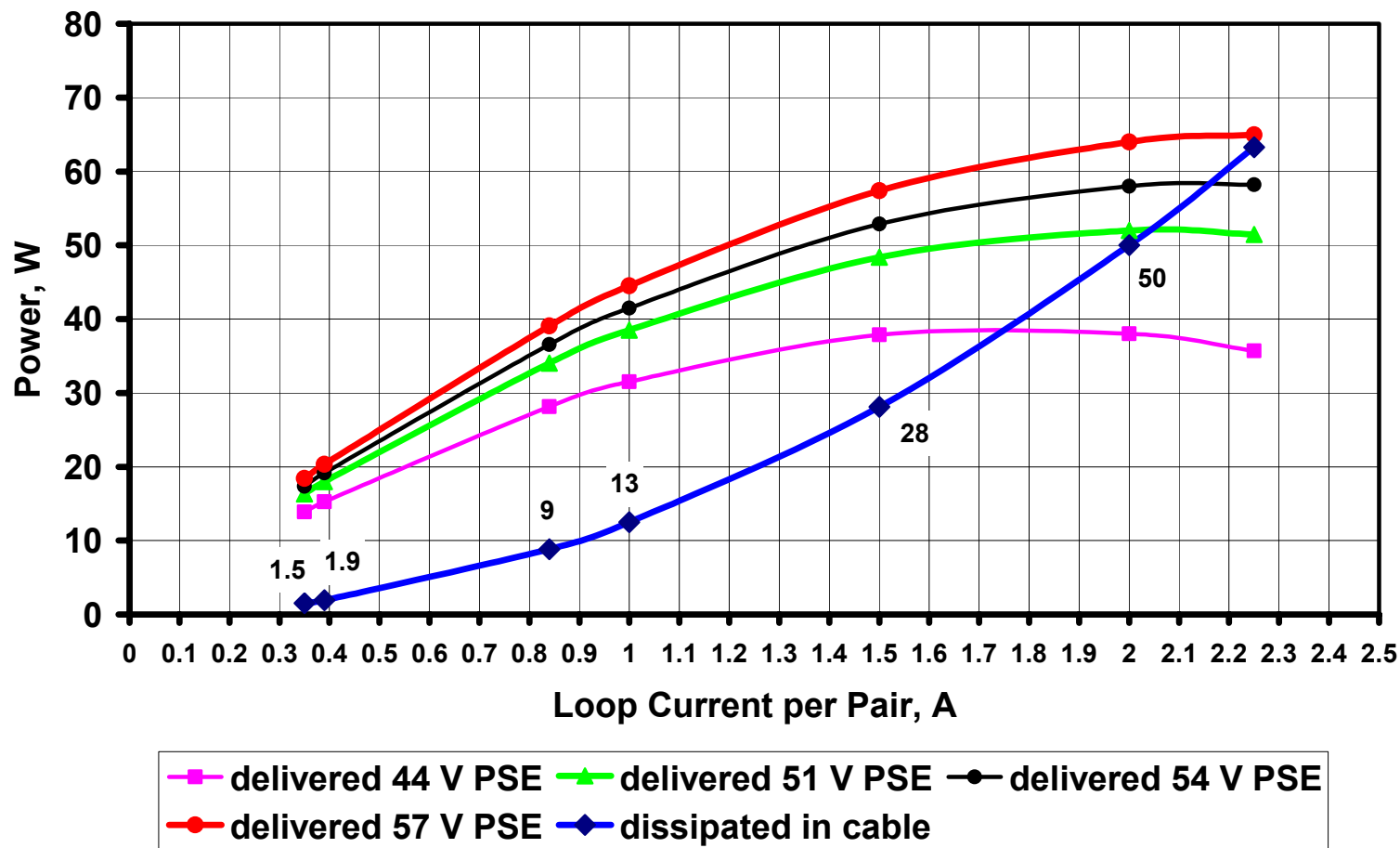
Figure 3



| | N = 2 | N = 4 |
|--------|---------------|---------------|
| | 12.5 ohm Loop | 6.25 ohm loop |
| PS | 36.35 | 32.55 |
| Pcable | 6.35 | 2.55 |
| PL | 30 W | 30 W |
| IL | 0.713 A | 0.638 A |
| Icond | 0.356 A | 0.160 A |

CFI PoEplus

2 Pair Power Delivered vs Current



Assumptions: Loop resistance per pair 12.5 Ohms

CFI PoEplus

Conclusions

- **It's reasonable to consider increasing the 802.3af max power level at the input of the powered device to 30 w or more.... (a factor of two increase)**
- **Study group to investigate critical operational parameters**
 - **Numbers of pairs required**
 - **Transformer issues**
 - **Balance**
 - **Cable current capacity derating where ambient temperatures are in excess of 25 deg. C**
 - **Bundled and hybrid cables, shielded cables, cables in conduit**
 - **System Issues; deployment**