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Discussion on Integrating APL and Clause 104 power

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Objective

- Switch / Host Port with:
- Ethernet Data 10BASE-T1L and 100BASE-T1L
- Power per IEEE802.3 Clause 104 (PoDL / SPoE) **AND** IEC TS 63444 (“APL”)

Power per IEEE802.3 Clause 104
(extracts from spec quoted for IEEE802.3 ad-hoc discussion only)

- PSE / PD type A to F
  - 10BASE-T1S, 10BASE-T1L, 100BASE-T1, 1000BASE-T1, 2.5GBBASE-T1, …
  - Clear mapping of data technology to PSE/PD type
  - (Clause 104.1.3)
  - PSE / PD type A to F
- PSE / PD Classes 0 to 15
  - Is there a clear relation between PSE/PD type or data technology and power class?
- Clause 104.4:

The PSE provides power to the PD. The PSE's main functions are as follows:

a) To search the link segment for a PD
b) To supply power to a detected PD through the link segment
c) To monitor the power applied to a link segment
d) To remove the full operating voltage when no longer required, when transitioning to the SLEEP state, or when a short-circuit or other fault is detected

- PSE state diagram 104.4.4.6
- PD state diagram 104.5.4.6
  - Both include "detection" and "classification"
  - Detection ~ PD "signature"
    - Correct voltage (4.05 to 4.7V at PSE PI) @ specified probe current (9 to 16mA)
  - Classification ~ SCCP (Serial Communication Classification Protocol)
    - Performed at maximum 5V (Classes 0 to 9) / 5.5V (Classes 10 to 15)

Table 104–1—Class power requirements matrix for PSE, PI, and PD for classes 0 through 9

	12 V unregulated PSE		12 V regulated PSE		24 V unregulated PSE		24 V regulated PSE		48 V regulated PSE	
Class	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
$V_{PSE(max)}$ (V)[a]	18	18	18	18	36	36	36	36	60	60
$V_{PSE\_OC(min)}$ (V)[b]	6	6	14.4	14.4	12	12	26	26	48	48
$V_{PSE(min)}$ (V)	5.6	5.77	14.4	14.4	11.7	11.7	26	26	48	48
$I_{PI(max)}$ (mA)[c]	101	227	249	471	97	339	215	461	735	1 360
$P_{Class(min)}$ (W)[d]	0.566	1.31	3.59	6.79	1.14	3.97	5.59	12	35.3	65.3
$V_{PD(min)}$ (V)	4.94	4.41	12	10.6	10.3	8.86	23.3	21.7	40.8	36.7
$P_{PD(max)}$ (W)[e]	0.5	1	3	5	1	3	5	10	30	50

Table 104–2—Class power requirements matrix for PSE, PI, and PD for classes 10 through 15

Class	**10**	**11**	**12**	**13**	**14**	**15**
$V_{PSE(max)}$ (V)	30	30	30	58	58	58
$V_{PSE\_OC(min)}$ (V)	20	20	20	50	50	50
$V_{PSE(min)}$ (V)	20	20	20	50	50	50
$I_{PI(max)}$ (mA)	92	240	632	231	600	1579
$P_{class(min)}$ (W)	1.85	4.8	12.63	11.54	30	79
$V_{PD(min)}$ (V)	14	14	14	35	35	35
$P_{PD(max)}$ (W)	1.23	3.2	8.4	7.7	20	52

Power per IEEE802.3 Clause 104
(extracts from spec quoted for IEEE802.3 ad-hoc discussion only)

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- Clause 104.4.5

When in the DETECTION state, the PSE shall complete detection of a valid PD signature within T_{det} as specified in Table 104–6. If a valid signature is not detected and classification is not performed, the PSE shall wait at least $T_{Restart}$ before reattempting detection. If a valid signature is detected and classification is not performed, the PSE may proceed to the POWER_UP state. A PSE may successfully detect a PD but then opt not to power the detected PD.

- 104.5.6 PD classification and mutual identification between the PSE and PD

A PD may be classified by the PSE based on SCCP information provided by the PD. The intent of PD classification is to provide information about the voltage and power required by the PD during operation. SCCP classification may also be used to establish mutual identification between a PSE and a PD. See 104.7 for more information about SCCP.

- Is there anything explicitly defined that would prevent PD class 0 to 3 being supplied by up to 58V via detection only (as opposed to SCCP) mechanism?

- Maybe a need to amend Clause 104 regardless of "APL integration" ?

Power per IEC TS 63444 (“APL”)
(extracts from spec quoted for IEEE802.3 ad-hoc discussion only)

- The “APL” device accepts power supply voltage between
  - 9.0V to 15V (Class A)
  - 10.6V to 15V (Class C)
- The “APL” device will draw current between
  - 20mA to 55.56mA (Class A)
  - 20mA and 95mA (Class C)
  - Power-up to the specified range of current in max. 1 second
- The “APL” device has no other defined “signature” and does not support classification
- The “APL” devices may not be compliant with IEEE802.3 clause 146.8.5. (They may not withstand without damage voltage between 0Vdc and 60dc with the source current limited to 2000mA.)

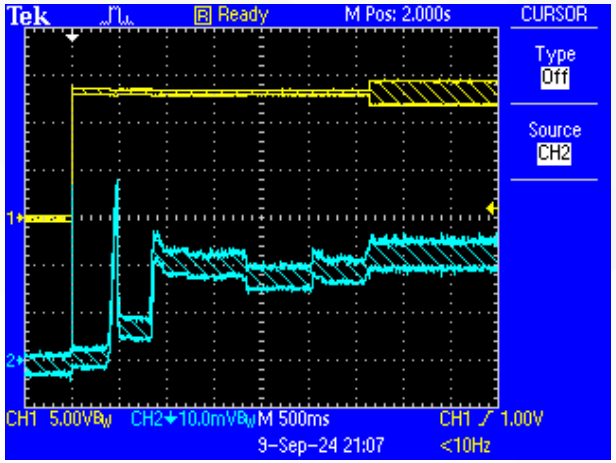
More information available from published source

https://library.fieldcommgroup.org/10186/TS10186/1.0/

For specification refer to the latest IEC TS 63444

Power Class	A	C
Power Source		
$U_{PS(MAX)}(V_{DC})$	15	15
$U_{PS(MIN)}(V_{DC})$	9.6	11.61
$I_{PS(MAX)}(mA)$	55.56	95
Power Load		
$U_{PL(MIN)}(V_{DC})$	9.0	10.6
$I_{PL(MIN)}(mA)$	20	
$I_{PL(MAX)}(mA)$	**	

** If the voltage at the load port drops below $U_{PL(MIN)}$, a load port shall under no circumstance Draw more current than the minimum supply current $I_{PS(MIN)}$ of the power source port, the load port is designed for.



A typical device power up:

Yellow trace power source voltage

Blue trace current from power source to the device.

Top Level Thoughts

- Maintain the spirit of Clause 104.4:
  - … The PSE's main functions are as follows:

a) To search the link segment for a PD
b) To supply power to a detected PD through the link segment
c) To monitor the power applied to a link segment
d) To remove the full operating voltage when no longer required, when transitioning to the SLEEP state, or when a short-circuit or other fault is detected

- Provide the powered device the power condition that it requires, e.g.
  - "APL" class C device max 15Vdc, up to 95mA current
  - Class 12 device 14 to 30Vdc, up to 632mA current

- Keep the system safe to operate

Possible Top-Level Proposal

- Define a combined PSE
- Mandate SCCP.
- Limit to Clause 104 devices Class 10 to 15
- Exclude Clause 104 signature detection
- Define a new state diagram for the combined PSE

  E.g. below, would need to be more detailed and drawn as a state diagram
  - Attempt to detect PD using SCCP (per present specification, at ~5V levels, <16mA current
    - If SCCP successful, proceed to power up with voltage / current limit
    - Otherwise:
  - Attempt to detect PD per APL specification (<15V, <100mA current), for duration of 1 second
    - Is successful, proceed to power up with voltage / current for APL device
    - Necessary assumption that a classifying PD device connected during APL detection would not power up
      - Refer "Table 104–11—PD power supply limits", items 4f and 4g would need addition of min. limits
      - Those limits non-overlapping the max voltage provided for APL devices
  - If no device detected, repeat…
  - When powered up, detect over current, disconnection etc.

Challenges / Questions

- Could all systems (or defined relevant cases) be considered safe with <15V < ~100mA be present on port/cable periodically/repeatedly for duration >1 second as part of APL device detection?
- Would it be possible and acceptable to exclude power classes 0 to 9 from the new defined PSE ?
  - These devices may present behaviour similar to APL devices
- Would it be acceptable to add “min.” limits to Table 104–11—PD, items 4f and 4g ?
  - To avoid overlap with the max voltage provided for APL devices
- Would relatively slow detection of any PD be acceptable?
  - >> 1 second after PSE power-up / PD plug-in
- Can we justify this work in IEEE802.3dg
  - The clause 104 seems like at least a good starting point for IEEE802.3dg
  - Maybe better to proceed with something that we know needs to be modified, and keep it under this working group control, rather than relying on other working group schedule?

Next Steps

- Need consideration, inputs and discussion from SPoE / PoDL experts
- Need consideration, inputs and discussion from experts on safety in any related standards
  - Specifically related to fire safety
- Need formal liaison with team maintaining the “APL” port specification IEC TS 63444 ?
- Can we continue this activity within IEEE802.3dg ?

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Thank You