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Optional Cable Resistance Measurement (CRM) - Part 2

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Presentation Outline

- Reference for previous work: stewart_0918_01b
- Ensuring Stability - Overview
- Margining Measured Cable Resistance
- Sample Calculations for Cable Resistance
- Compliance test steps for CRM
- Modify Clause 104.7
- Optional SCCP command for PSE read back

Ensuring Stability - Overview

- After measuring the cable resistance, PSE allocates power to PD
  - This is the maximum allowed power while maintaining stability
  - (See stewart_0918_01b for details of power allocation)
  - (See darshan_3bu_1_0914 for details of stability)
- However, cable resistance can increase due to increase in environmental temperature

- Issue: A given constant power drawn by PD, P_{PD}, may cause instability at increased R_{cable}
  - Ambient temperature fluctuations may cause increases in R_{cable}
- Remedy: Margin the measured Cable resistance for a stated temperature rise

Margining Cable Resistance Measurement (CRM)

- Assumptions (Reference: darshan_01_0118_Rev002)
  - Max Temperature rise (T_{rise}) = 15℃
  - Copper Temperature Coefficient (α) = 0.00393 Ω/℃
- Cable Resistance Rise Coefficient:
  - $K_{CRR} = 1 + (\alpha \times T_{rise}) = 1.06$
- Measured Cable Resistance is then margined as
  - $R_{CABLE\_MARGINED} = R_{CABLE\_MEAS} \times K_{CRR}$
  - (See next slides for details)
- High Reliability Applications
  - Special applications, operating over a broader temperature range, can increase T_{rise} and K_{CRR} at their discretion

Modify Table 104.8

- Modify Table 104.8 to include Cable Resistance Coefficient

Table 104-8 SCCP electrical requirements

Item	Parameter	Symbol	Unit	Min	Max	PSE/PD type	Additional Information
1	PSE Pull-up Voltage	V_{PUP}	V	$V_{good\_PSE\_max}$	5	All	See Table 104-1
2	PSE Pull-up Current	I_{PUP}	mA	9	16	All	
3	Input Logic High Voltage	V_{TH}	V	3	-	All	
4	Input Logic Low Voltage	V_{TL}	V	-	1	~~All~~ A, B,C,D, Type E PD	
					2	Type E PSE	
5	Sink Current	I_L	mA	30	-	All	$V_{port} > 0.8V$
…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…
22	Cable Resistance Coefficient	K_{CRR}	NA	1.06	-	Type E PSE	PSEs that support Cable resistance measurement

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Sample Calculations for Cable Resistance Measurement (CRM)

- $R_{CABLE\_MEAS} = \frac{V_{MEAS\_PSE,min} - V_{report\_PD,max}}{I_{MEAS\_PSE,min}}$
- $R_{CABLE\_MARGINED} = R_{CABLE\_MEAS} \times K_{CRR}$
- $R_{CABLE} = \text{Min}\ ((R_{CABLE\_MARGINED}), R_{LOOP(CLASS\text{-}max)})$
- If $P_{PD\_REQ} > P_{PD(max)}$
  - $P_{PD\_ASSIGN} = \text{Min}\ \{P_{PD\_REQ}\ , (P_{CLASS(min)} - (I_{PI(MAX)}{}^2 \times R_{CABLE}))\}$
    - Note: When $R_{CABLE} = R_{LOOP(CLASS\text{-}max)}$; $(P_{CLASS(min)} - I_{PI(MAX)}{}^2 \times R_{CABLE}) = P_{PD(max)}$
- Else $(P_{PD\_REQ} \leq P_{PD(max)})$
  - $P_{PD\_ASSIGN} = P_{PD\_REQ}$
- Sample: $P_{PSE\_ALLOC} = V_{PSE(min)} \times \frac{V_{PSE(min)} - \sqrt{(V_{PSE(min)}{}^2 - 4 \times R_{CABLE} \times P_{PD\_ASSIGN})}}{2 \times R_{CABLE}}$

Sample PSE compliance test for Cable Resistance Measurement (CRM)

- PD is connected using cable with less than maximum dc loop resistance
  - eg $R_{CABLE\_ACTUAL} = (R_{LOOP,MAX} / 2)$
- PSE Performs CRM
  - PD requests maximum power based on PD class
    - $P_{PD\_REQ} = P_{class(min)}$
  - PSE allocates P_{PSE_ALLOC}, P_{PD_ASSIGN} based on CRM
- PSE powers PD
  - PD draws P_{PD_ASSIGN}
  - Cable resistance is increased to $R_{CABLE\_ACTUAL} \times K_{CRR}$
  - Power Output at PSE shall not exceed $P_{class(min)}$

Modify Clause 104.7

► Modify Clause 104.7

Implementation of SCCP by PSEs and PDs that present a valid detection signature is optional. PDs that present an invalid detection signature as specified in Table 104–6 shall implement SCCP. The PSE acts as a master during the SCCP exchange, controlling the PD that acts as the slave device. SCCP is a current-sinking, wired-OR (e.g., open-drain or open-collector), half-duplex bidirectional serial data bus. The PSE sources the required pull-up current. PDs can derive power from the PSE's pull-up current during classification via the PD PI.

Measurement of initial cable resistance, $R_{cable\_initial}$, by PSEs and PDs that implement SCCP is optional. PSEs and PDs that implement cable resistance measurement shall support the VOLT_POWER_INFO and POWER_ASSIGN registers (Table 104.10, 104.11). PSEs that implement cable resistance measurement shall report assigned power through PSE Status Register 2 (See 45.2.7b.3).

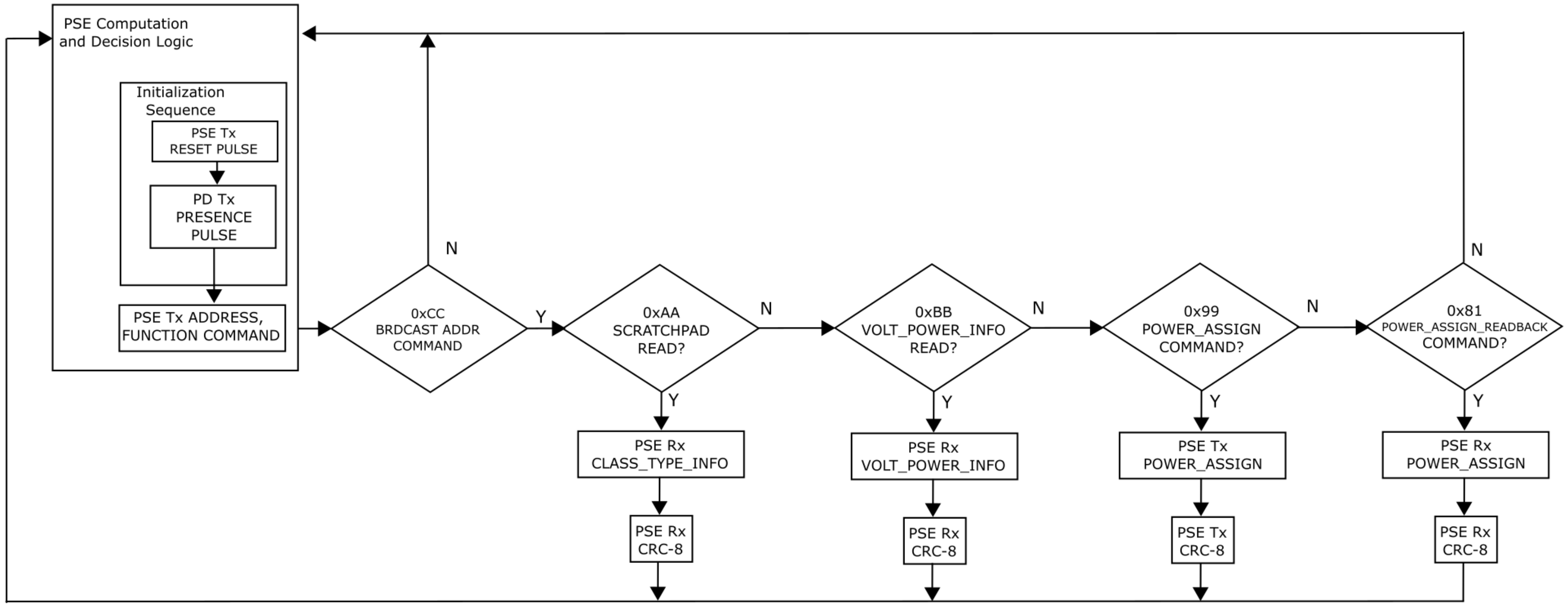
A PSE that implements cable resistance measurement shall assign a PD Assigned Power which results in a PSE output power, in the XX state, of less than $P_{class(min)}$ when:

- PD input power consumption is equal to PD Assigned Power, and
- the cable resistance is increased to $R_{autoclass}$ as defined in Equation 104-X

$$R_{autoclass} = \text{Minimum}\left(R_{loop(max)}, R_{cable\_initial} \times K_{CRR} \right) \qquad \text{(Equation 104-X)}$$

Optional SCCP command for PSE read back

- Add One SCCP Command:
  - 0x81 : POWER_ASSIGN_READBACK
- Allows the PSE to ensure that assigned power was successfully received by PD
- Replace Figure 104-13 with the figure shown on this slide



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Thank You!

QUESTIONS? FEEDBACK?