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Clause 104 Modifications

GITESH BHAGWAT, HEATH STEWART, ANDY GARDNER

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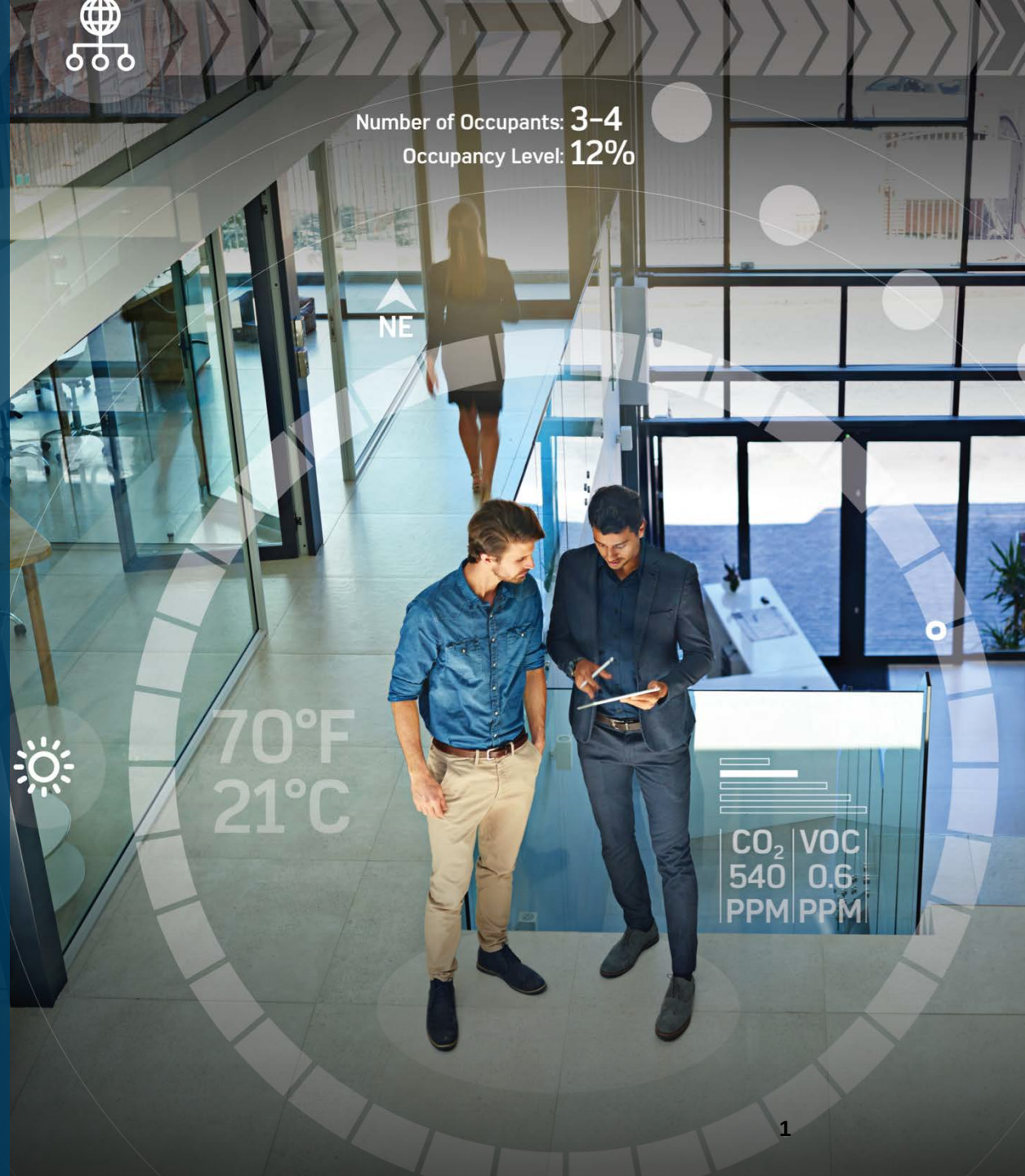

Loop Resistance Values and New Power Classes

- Refer: www.ieee802.org/3/cg/public/Mar2019/stewart_3g_01b_0319.pdf
- Changes required to remedy R_{LOOP} offer opportunity to rethink classes

End Market	V_{PSE}		$P_{PD(max)}$		
	min	max	R_{Loop} = 65Ω	R_{Loop} = 25Ω	R_{Loop} = 9.5Ω
24V Nominal	20V	30V	**Class 10** 1.23W	**Class 11** 3.2W	**Class 12** 8.4W
50V Maximum	42V	50V	**Class 13** 5.5W	**Class 14** 14W	**Class 15** 36.7W
SELV Maximum	50V	58V	**Class 16** 7.7W	**Class 17** 20W	**Class 18** 52W

Modified Power Class Table

- Modified Table 104-1a is as shown below:

Class	10	11	12	13	14	15	16	17	18
$V_{PSE(max)}$ (V)	30	30	30	50	50	50	58	58	58
$V_{PSE\_OC(min)}$ (V)	20	20	20	42	42	42	50	50	50
$V_{PSE(min)}$ (V)	20	20	20	42	42	42	50	50	50
$I_{PI(max)}$ (mA)	92	240	632	194	504	1326	231	600	1579
$P_{class(min)}$ (W)	1.85	4.8	12.63	8.14	21.17	55.71	11.54	30	79
$V_{PD(min)}$ (V)	14	14	14	29.4	29.4	29.4	35	35	35
$P_{PD(max)}$ (W)	1.23	3.2	8.4	5.5	14	36.7	7.7	20	52

									Equivalent Cable Lengths		
AWG	**Limit**	**Length**	**R/m**	**Rloop**	**tRise**	**Rloop @ tRise**	**Rconn, total**	**Rloop margined**	**14AWG**	**18AWG**	**24AWG**
14	1000	400	0.0092	7.36	35	8.37	1.13	**9.5**	400	158	39
18	1000	400	0.0233	18.64	35	21.2	3.8	**25**	1000	400	99
24	499	300	0.0938	56.28	35	64.02	0.98	**65**	1000	1000	300

T_{Inrush} and T_{power_dly} Modification Justification

- Inrush time under 4ms was designed for fast power up requirement in automotive systems
- Short inrush time is not required for non-automotive systems
- To accommodate 10BASE-T1L channel:
  - In Table 104-4 PSE output requirements
    - Increase T_{Inrush} and T_{LIM} to 50 to 75ms
  - In Table 104-7 PD Power Supply Limits
    - Modify T_{power_dly} min to 80ms

SCCP Threshold Modification
Justification

- PSE max Pull-up Voltage of 5V was chosen to accommodate Classes 0 and 1 which have low $V_{PD(min)}$
- Classes 10 to18 have higher $V_{PD(min)}$
- PSEs can reuse detection circuitry if V_{PUP} is raised to 5.5V

Table 104–3—PSE PI detection state electrical output requirements

Item	Parameter	Symbol	Unit	Min	Max	Additional information
1	Open circuit voltage	V_{OC}	V	4.75	5.5	

- Thus, modify Table 104-8
  - Increase V_{PUP} to 5.5V to match V_{OC}

Modify 30.15.1.1.6

- Modify 30.15.1.1.6 aPoDLPSEDetectedPDPowerClass
- Insert the following new entries in section of 30.15.1.1.6 after the entry for “Class 15":

class10	Class 10 PoDL PD
class11	Class 11 PoDL PD
class12	Class 12 PoDL PD
class13	Class 13 PoDL PD
class14	Class 14 PoDL PD
class15	Class 15 PoDL PD
class16	Class 16 PoDL PD
class17	Class 17 PoDL PD
class18	Class 18 PoDL PD

- And modify:

“BEHAVIOUR DEFINED AS:

A read-only value that indicates the class of the detected PoDL PD as specified in Table 104–1 and Table 104-1a. This value is only valid while a PD is being powered, that is the attribute aPoDLPSEPowerDetectionStatus is reporting the enumeration “deliveringPower”.

If a Clause 45 MDIO Interface to the PoDL PSE function is present, then this attribute may be derived from the PD Class and PD Extended Class bits specified in 45.2.9.2.8 and 45.2.9.3.1a.”

Power Classes in MDIO Registers

- Modify Table 45-340 PoDL PSE Status 1 and Table 45-341 PoDL PSE Status 2 Register Bit Definitions as shown below

Table 45–340—PoDL PSE Status 1 register bit definitions

Bit(s)	Name	Description					R/W
…	…	…					…
13.1.6:3	PD Class	6	5	4	3		RO
		1	1	1	1	~~=Class code 15~~ Extend to Status 2 Register	
		1	1	1	0	=Class code 14	
		1	1	0	1	=Class code 13	
		1	1	0	0	=Class code 12	
		1	0	1	1	=Class code 11	
		1	0	1	0	=Class code 10	
		1	0	0	1	=Class code 9	
		1	0	0	0	=Class code 8	
		0	1	1	1	=Class code 7	
		0	1	1	0	=Class code 6	
		0	1	0	1	=Class code 5	
		0	1	0	0	=Class code 4	
		0	0	1	1	=Class code 3	
		0	0	1	0	=Class code 2	
		0	0	0	1	=Class code 1	
		0	0	0	0	=Class code 0	

Table 45–341—PoDL PSE Status 2 register bit definitions

Bit(s)	Name	Description			R/W
…	…	…			…
13.2.14:~~35~~	Reserved	Value always zero			RO
13.2.4:3	PD Extended Class	4	3		RO
		1	1	=Class code 18	
		1	0	=Class code 17	
		0	1	=Class code 16	
		0	0	=Class code 15	
…	…	…	…	…	…

Modify 45.2.9.2.8 PD Class (13.1.6:3) and Add 45.2.9.3.1a PD Extended Class (13.2.4:3)

Modify 45.2.9.2.8 PD Class (13.1.6:3)

" When read as 0000 a Class 0 PD is indicated, when read as 0001 a Class 1 PD is indicated, when read as 0010 a Class 2 PD is indicated, when read as 0011 a Class 3 PD is indicated, when read as 0100 a Class 4 PD is indicated, when read as 0101 a Class 5 PD is indicated, when read as 0110 a Class 6 PD is indicated, when read as 0111 a Class 7 PD is indicated, when read as 1000 a Class 8 PD is indicated, and when read as 1001 a Class 9 PD is indicated, when read as 1010 a Class 10 PD is indicated, when read as 1011 a Class 11 PD is indicated, when read as 1100 a Class 12 PD is indicated, when read as 1101 a Class 13 PD is indicated, when read as 1110 a Class 14 PD is indicated, and when read as 1111 ~~a Class 15 PD is indicated~~ the Class will be as indicated by the PD Extended Class (13.2.4:3) bits."

Add 45.2.9.3.1a PD Extended Class (13.2.4:3)

"When read as 00 a Class 15 PD is indicated, when read as 01 a Class 16 PD is indicated, when read as 10 a Class 17 PD is indicated, and when read as 11 a Class 18 PD is indicated. "

Corrected Loop Resistance Values

- Modify 104.2 Link segment:
  - Change “The link segment dc loop resistance shall be less than 59 ohm for Classes 10 and 13. The link segment dc loop resistance shall be less than 39 ohm for classes 11 and 14. The link segment dc loop resistance shall be less than 36 ohm for classes 12 and 15.”
  - To “The link segment dc loop resistance shall be less than 65 ohm for classes 10, 13 and 16. The link segment dc loop resistance shall be less than 25 ohm for classes 11, 14 and 17. The link segment dc loop resistance shall be less than 9.5 ohm for Classes 12, 15 and 18 ”

Modified Power Class Table - Editor's Version

- Modify Table 104-1a as shown below:

Class	10	11	12	13	14	15	16	17	18
$V_{PSE(max)}$ (V)	~~36~~ 30	~~36~~ 30	~~36~~ 30	50	50	50	~~60~~ 58	~~60~~ 58	~~60~~ 58
$V_{PSE\_OC(min)}$ (V)	20	20	20	42	42	42	50	50	50
$V_{PSE(min)}$ (V)	20	20	20	42	42	42	50	50	50
$I_{PI(max)}$ (mA)	~~169~~ 92	~~102~~ 240	~~155~~ 632	194	504	1326	~~400~~ 231	~~254~~ 600	~~388~~ 1579
$P_{class(min)}$ (W)	~~3.38~~ 1.85	~~2.04~~ 4.8	~~3.1~~ 12.63	8.14	21.17	55.71	~~20~~ 11.54	~~12.7~~ 30	~~19.4~~ 79
$V_{PD(min)}$ (V)	~~13.92~~ 14	~~13.98~~ 14	~~13.96~~ 14	29.4	29.4	29.4	~~35.6~~ 35	~~35.01~~ 35	~~34.87~~ 35
$P_{PD(max)}$ (W)	~~2.35~~ 1.23	~~1.43~~ 3.2	~~2.16~~ 8.4	5.5	14	36.7	~~14.24~~ 7.7	~~8.89~~ 20	~~13.53~~ 52
~~Cable mm (AWG)~~	~~1.02 (18)~~	~~1.63 (14)~~	~~0.51 (24)~~	~~1.02 (18)~~	~~1.63 (14)~~	~~0.51 (24)~~			
~~Cable length (m)~~	~~1000~~	~~1000~~	~~300~~	~~1000~~	~~1000~~	~~300~~			

T_{Inrush} Modification

- Modify T_{Inrush} and T_{LIM} in Table 104-4 PSE output requirements as shown below:

Table 104-4 - PSE output requirements

Item	Parameter	Symbol	Unit	Min	Max	Class	Type	Additional Information
…	…	…	…	…	…	…	…	…
6	Short-circuit time limit	T_{LIM}	ms	10 50	75 75	~~All~~ Classes 0 to 9 Classes 10 to 18	All	…
7	Inrush time	T_{Inrush}	ms	3.17 50	3.87 75	~~All~~ Classes 0 to 9 Classes 10 to 18	All	See 104.4.6.4
…	…	…	…	…	…	…	…	…

Turn On and Turn Off Thresholds for PDs

- Modify Table 104-7 PD Power Supply Limits to add Turn On and Turn Off thresholds for PDs

Table 104-7- PD Power Supply Limits

Item	Parameter	Symbol	Unit	Min	Max	PD Type	Additional Information
…	…	V_{On}	V	-	…	All	See 104.5.6.2
4f	Power supply turn on voltage (Classes 10, 11, and 12)			-	19.2		
4g	Power supply turn on voltage (Classes 13, 14, and 15)			-	41		
4h	Power supply turn on voltage (Classes 16, 17, and 18)			-	49		
…	…	V_{off}	V	…	-		
5f	Power supply turn off voltage (Classes 10, 11, and 12)			11.2	-		
5g	Power supply turn off voltage (Classes 13, 14, and 15)			23.5	-		
5h	Power supply turn off voltage (Classes 16, 17, and 18)			28	-		
…	…	…	…	…	…	…	…

T_{power_dly} Modification

- Modify T_{power_dly} in Table 104-7 PD Power Supply Limits

Table 104-7- PD Power Supply Limits

Item	Parameter	Symbol	Unit	Min	Max	PD Type	Additional Information
…	…	…	…	…	…	…	…
7	Inrush enable delay time (Classes 0 to 9) Inrush enable delay time (Classes 10 to 18)	T_{power_dly}	ms	1.46 75	-	All	See 104.5.6.2
…	…	…	…	…	…	…	…

SCCP Threshold Modification

- Modify Table 104-8 as shown below:

Table 104-8 SCCP electrical requirements

Item	Parameter	Symbol	Unit	Min	Max	PSE/PD type	Additional Information
1	PSE Pull-up Voltage (Classes 0 to 9)	V_{PUP}	V	$V_{good\_PSE\_max}$	5	All	See Table 104-1
	PSE Pull-up Voltage (Classes 10 to 18)				5.5		
…	…	…	…	…	…	…	…

Power Classes in SCCP

- Modify Table 104-9 as shown:

Table 104-9- CLASS_TYPE_INFO Register Table

Bit(s)	Name	Description											R/W
b[15:12]	Type	15	14	13	12								RO
		1	1	1	0	= Type A							
		1	1	0	1	= Type B							
		1	0	1	1	= Type C							
		0	1	1	1	= Type D							
		1	1	0	0	= Type E							
b[11]	pd_faulted	1- error condition has occurred… 0 - no error condition detected											RO/LH
b[10]	Cable Resistance Measurement	1- Cable resistance measurement enabled 0 - Cable resistance measurement disabled											RO
b[9:0]	Class	9	8	7	6	5	4	3	2	1	0		RO
		1	1	1	1	1	1	1	1	1	0	=Class 0	
		1	1	1	1	1	1	1	1	0	1	=Class 1	
		1	1	1	1	1	1	1	0	1	1	=Class 2	
		1	1	1	1	1	1	0	1	1	1	=Class 3	
		1	1	1	1	1	0	1	1	1	1	=Class 4	
		1	1	1	1	0	1	1	1	1	1	=Class 5	
		1	1	1	0	1	1	1	1	1	1	=Class 6	
		1	1	0	1	1	1	1	1	1	1	=Class 7	
		1	0	1	1	1	1	1	1	1	1	=Class 8	
		0	1	1	1	1	1	1	1	1	1	=Class 9	
		0	0	0	0	0	0	0	0	0	1	=Class 10	
		0	0	0	0	0	0	0	0	1	0	=Class 11	
		0	0	0	0	0	0	0	0	1	1	=Class 12	
		0	0	0	0	0	0	0	1	0	0	=Class 13	
		0	0	0	0	0	0	0	1	0	1	=Class 14	
		0	0	0	0	0	0	0	1	1	0	=Class 15	
		0	0	0	0	0	0	0	1	1	1	=Class 16	
		0	0	0	0	0	0	1	0	0	0	=Class 17	
		0	0	0	0	0	0	1	0	0	1	=Class 18	

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QUESTIONS? FEEDBACK?