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Clause 104 Modifications

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ANALOG DEVICES



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}		$P_{\text{PD(max)}}$		
	min	max	$R_{\text{Loop}} = 65\Omega$	$R_{\text{Loop}} = 25\Omega$	$R_{\text{Loop}} = 9.5\Omega$
24V Nominal	20V	30V	Class 10 1.23W	Class 11 3.2W	Class 12 8.4W
SELV Maximum	50V	58V	Class 13 7.7W	Class 14 20W	Class 15 52W

Modified Power Class Table

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

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

									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 $T_{\text{power_dly}}$ 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 $T_{\text{power_dly}}$ 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 to 15 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

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

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			

Bit(s)	Name	Description		R/W
...
13.2.14:911	Reserved	Value always zero		RO
13.2.10:9	PD Extended Class	10	9	Reserved
		1	1	
		1	0	
		0	1	
		0	0	
...

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, 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. Values of 01 and 1x are reserved.”

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 and 13. The link segment dc loop resistance shall be less than 25 ohm for classes 11 and 14. The link segment dc loop resistance shall be less than 9.5 ohm for Classes 12 and 15.”

Modified Power Class Table - Editor's Version

► Modify Table 104-1a as shown below:

Class	10	11	12	13	14	15
$V_{PSE(max)}$ (V)	36 30	36 30	36 30	60 58	60 58	60 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)	169 92	102 240	155 632	400 231	254 600	388 1579
$P_{class(min)}$ (W)	3.38 1.85	2.04 4.8	3.1 12.63	20 11.54	12.7 30	19.4 79
$V_{PD(min)}$ (V)	13.92 14	13.98 14	13.96 14	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	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:

Item	Parameter	Symbol	Unit	Min	Max	Class	Type	Additional Information
...
6	Short-circuit time limit	T _{LIM}	ms	10	75	All- Classes 0 to 9	All	...
				50	75	Classes 10 to 15		
7	Inrush time	T _{Inrush}	ms	3.17	3.87	All- Classes 0 to 9	All	See 104.4.6.4
				50	75	Classes 10 to 15		
...

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

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)			-	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)			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)	T _{power_dly}	ms	1.46	-	All	See 104.5.6.2
	Inrush enable delay time (Classes 10 to 15)			80			
...

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 15)				5.5		
...

Thank You!

QUESTIONS? FEEDBACK?