Potential Issues with the D1.0 Class Table

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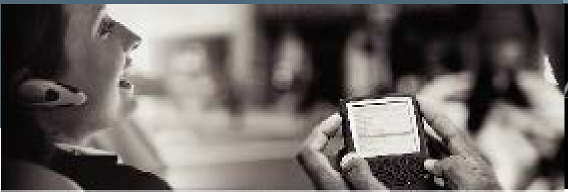

Presentation Objectives

- Discuss potential issues regarding the class table in D1.0.
- Solicit proposals and comments with remedies for addressing these issues.

Some Issues with the D1.0 Class Table

- $R_{loop(max)}$ needs to be increased for several classes in order to support the 26 & 22 AWG reference channel use cases.
- There is currently no defined class that is compatible with the 12V automotive battery crank voltage requirement of 6V.
- The D1.0 class table defines R_{loop} as the sum of R_{PSE} and R_{cable} instead of simply R_{cable}.

Automotive Reference Channel Use Cases Recap[1]

- AWG 26 wire is sufficient to meet 802.3bp insertion loss baseline proposal for a 15m reference channel
  - Cable DC resistance: 0.14 Ω/m at 20°C
  - Cable loop resistance 15m × 2 × 0.14 Ω/m $\Rightarrow$ 4.2 Ω at 20°C
- AWG 22 wire is sufficient to meet 802.3bp insertion loss baseline proposal for a 40m reference channel
  - Cable DC resistance: 0.0553 Ω/m at 20°C
  - Cable loop resistance 40m × 2 × 0.0553 Ω/m $\Rightarrow$ 4.43 Ω at 20°C

[1]IEEE 802.3 PPoDL Wire gauges for automotive applications (mueller_3bu_01_0114.pdf)

$R_{loop(max)}$ Needs to be Increased for Some Classes in order to Support Reference Channel Use Cases

- Options for increasing $R_{loop(max)}$ include increasing $V_{PSE(min)}$, reducing min P_{PD}/P_{PSE} (K), or both.
- Class II (12V) example: increasing $V_{PSE(min)}$ to 14V and constraining K>0.7 increases $R_{loop(max)}$ to 8.2Ω.

Table 104–1—System class power requirements matrix for PSE, PI, and PD

	System class							
	I (12V)	II (12V)	II (24V)	III (24V)	III (48V)	IV (48V)	V (48V)	VI
$V_{PSE(max)}$ (V)[1]	14	14	28	28	56	56	56	
$V_{PSE(min)}$ (V)[1]	9	9	18	18	36	36	36	
$I_{PI(max)}$ (A)	0.28	0.69	0.35	0.69	0.35	0.87	2.08	
$R_{Loop(max)}$ (Ω)[2]	6.5	2.6	10.4	5.2	20.7	8.3	3.5	
$V_{PD(min)}$ (V)	7.2	7.2	14.4	14.4	28,8	28.8	28.8	
P_{PSE} (W)[3]	2.5	6.25	6.25	12.5	12.5	31.25	75	
P_{PD} (W)[4]	2	5	5	10	10	25	60	

[1]V_{PSE} is the open circuit voltage measured at the PSE PI.
[2]R_{Loop} is defined as the sum of the PSE source resistance, R_{PSE}, and link segment round trip resistance, and the maximum resistance of the link segment wire pair (per unit length) is given by:

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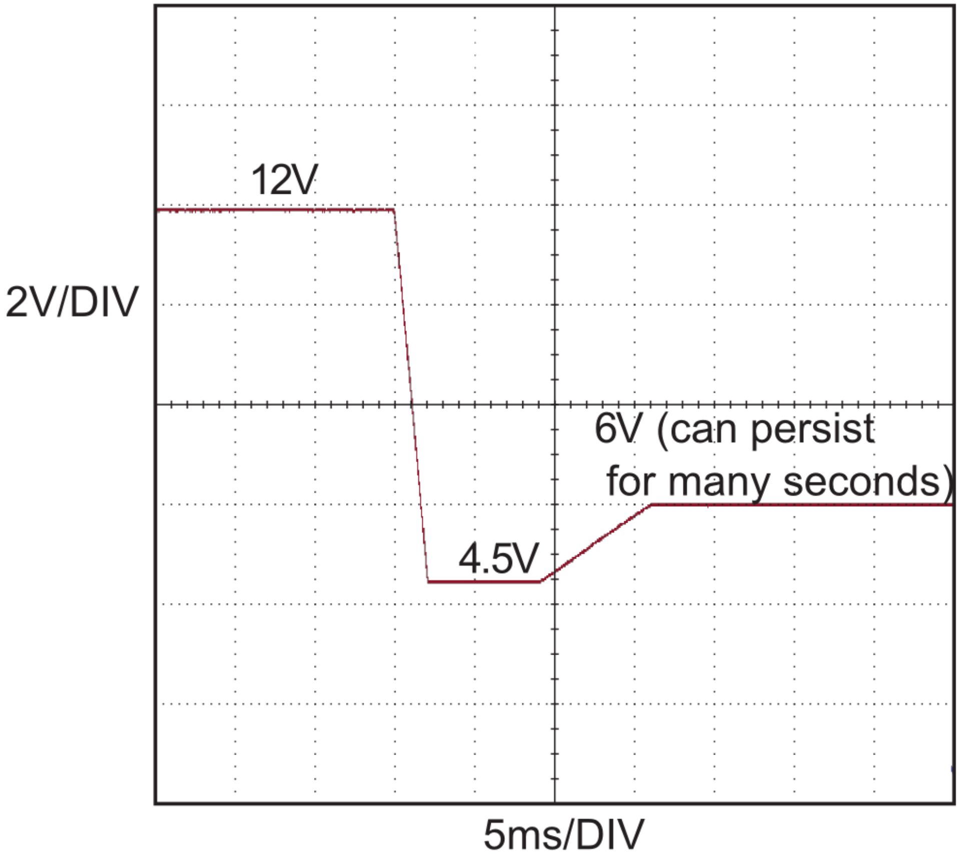
12V Automotive Battery Cold Crank Requirements

- Normal operation may be required during cold crank.
- The initial dip to 4.5V can be tolerated if enough charge storage is available.
- 6V can last for up to 20 seconds, hence the requirement to operate at 6V indefinitely.

12V V_{bat} During Cold Crank



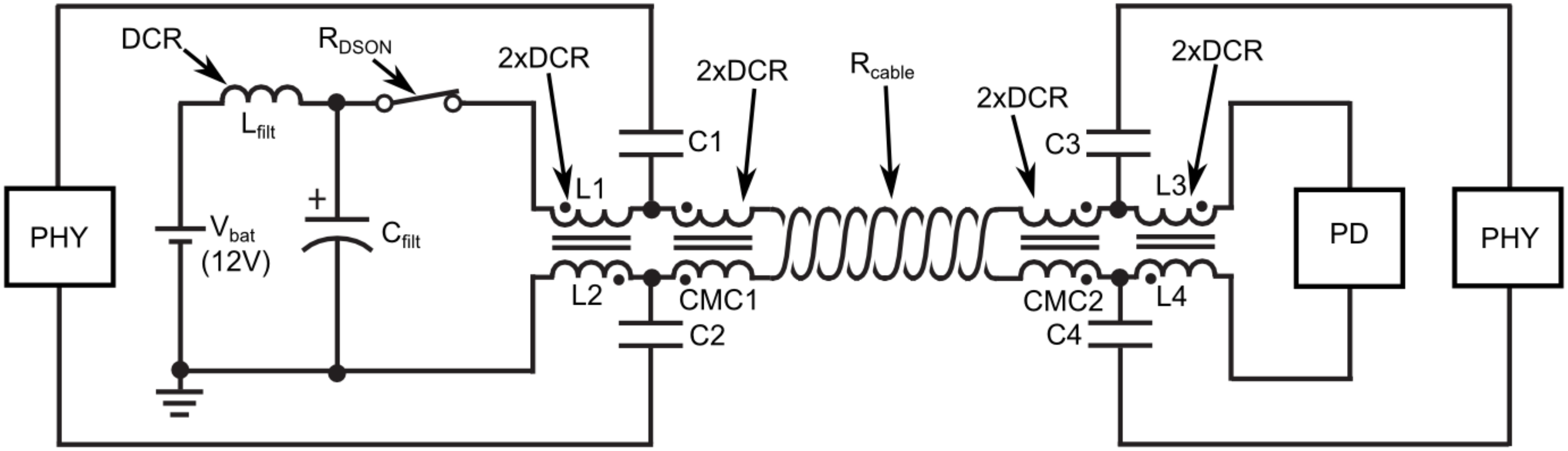
How Much PoDL can be Delivered from 6V?

- With the current loop stability constraint of K > 0.8, our reference channel use cases may be problematic over temperature for P_{PD} as low as 1W.
- Relaxing the K min constraint allows the R_{PSE} + R_{cable} to be increased, but DC loop stability is reduced.

	P_{PD}/P_{PSE} (K)			
P_{PD} (W)	0.8	0.7	0.6	0.5
1	5.80 Ω	7.6 Ω	8.6 Ω	9 Ω
2	2.90 Ω	3.80 Ω	4.30 Ω	4.50 Ω
3	1.93 Ω	2.53 Ω	2.87 Ω	3.00 Ω
4	1.45 Ω	1.90 Ω	2.15 Ω	2.25 Ω
5	1.16 Ω	1.52 Ω	1.72 Ω	1.80 Ω

Maximum R_{PSE}+R_{chan} vs. K and P_{PD} for V_{PSE}=6V

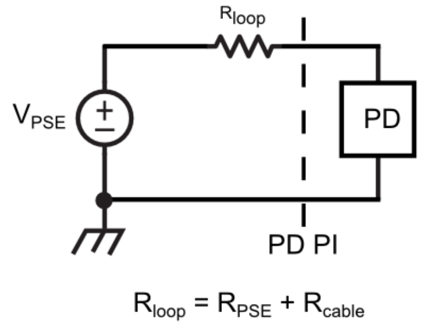
Series Resistance Limits PoDL from a 12V Battery V_{PSE} during Cold Crank



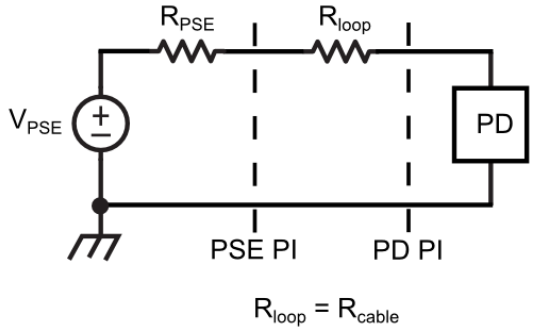
- Series resistance from magnetics DCRs, MOSFET on-resistance(s), and wire resistance must be limited in order to deliver the required power…
- …but when designing for cold crank, the benefit of adding a boost converter between the battery and the PSE should also be considered.

R_{loop}, R_{PSE}, & R_{cable} in the D1.0 Class Table

- R_{loop} in the D1.0 class table is defined as the sum of R_{PSE} and R_{cable}.
- Setting R_{loop}=R_{cable} is desirable for non-engineered systems.
- But $R_{cable(max)}$ will be reduced by $R_{PSE(max)}$.
- What is a reasonable value for $R_{PSE(max)}$?



a) Existing class table R_{loop} definition



b) Alternative R_{loop} definition

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Summary

- Potential issues with the D1.0 class table were discussed.
- Additional reference channel use cases may need to be considered.
- Existing power class limits may need to be modified.
- Power delivery is very limited during cold crank.
- R_{loop} can be redefined as just R_{cable}, but $R_{cable(max)}$ will be reduced by $R_{PSE(max)}$.
- Presentations and comments **with** proposed remedies regarding the class table are welcome!

Questions?