

# Discovery Thresholds

Michael Paul

## IEEE P802.3da Objectives - continued

9. Specify optional plug-and-play power distribution over the mixing segment
10. Define a method to detect at least one MPD before applying full operating power
11. Specify device characteristics necessary to enable addition and/or removal of a node or set of nodes to a powered mixing segment with a bounded interruption

[Source: 802d3da\\_objectives.pdf \(ieee802.org\)](#)

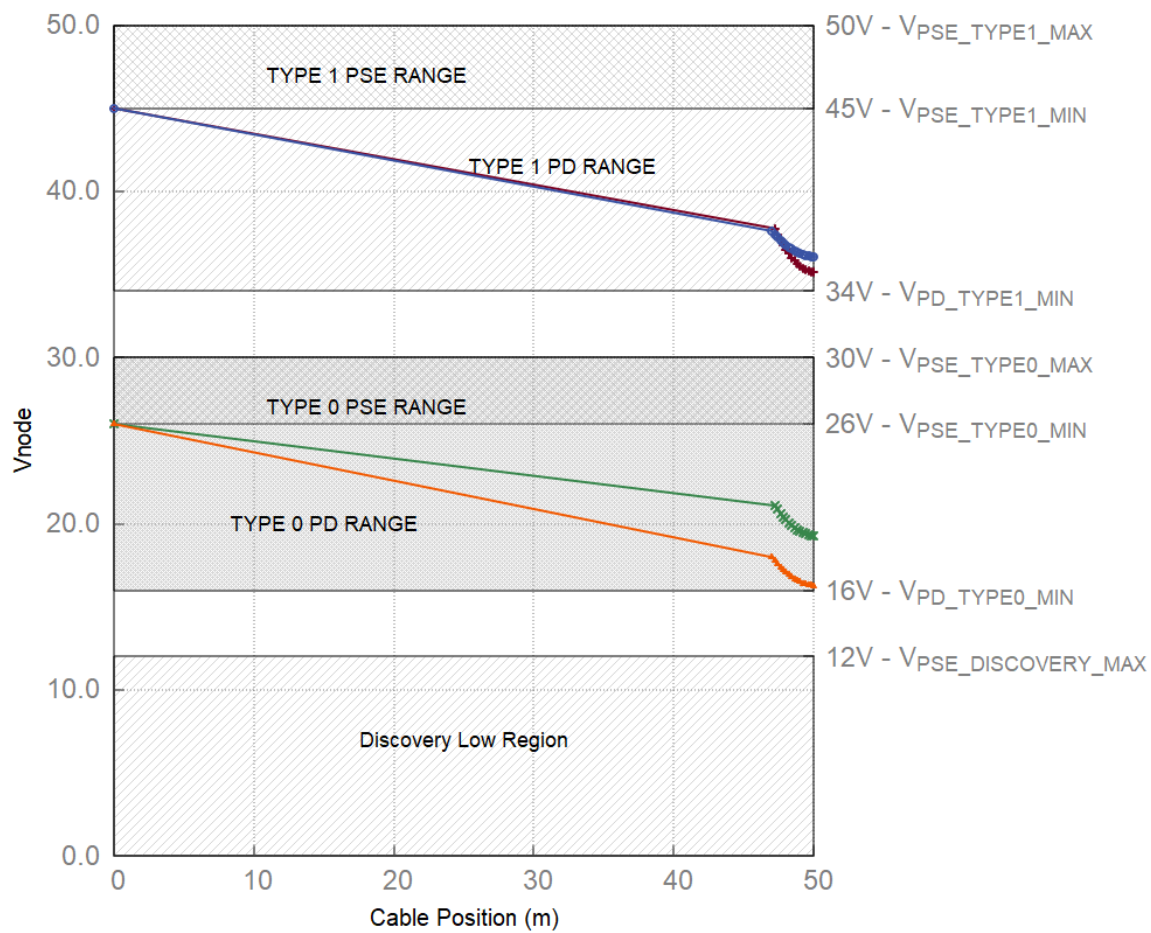
- ▶ Discovery state machines are described for MPSE and MPD
- ▶ Some MPSE discovery parameters are defined
  - Many TBDs
  - Need to update most parameters
- ▶ No MPD discovery parameters are defined
  - Subsection “169.5.4 MPD Discovery” is empty
    - Need descriptive text and a table
  - Various table references in the MPD state machine section are ‘TBD’
- ▶ Background presentation on MPoE Discovery
  - [Paul\\_da\\_01\\_20230712.pdf](#)

- ▶ Gain telemetry before power up
  - Debug link issues
    - Overloaded link – Too much load
    - Shorted link
    - No MPDs connected / open link
    - Incompatible MPSE / MPDs
      - Some MPDs not accepting power after power-up
    - Back-fed power into PSE
    - Etc...
- ▶ Discovery is not mutual identification
- ▶ Discovery is not power negotiation
- ▶ Ensure remote experts can aid non-expert installers
  - Gain rudimentary knowledge on why power may not be working when data path is not available
  - Report exceptions up the stack for system logs
- ▶ Requires that compliant PDs respond to discovery

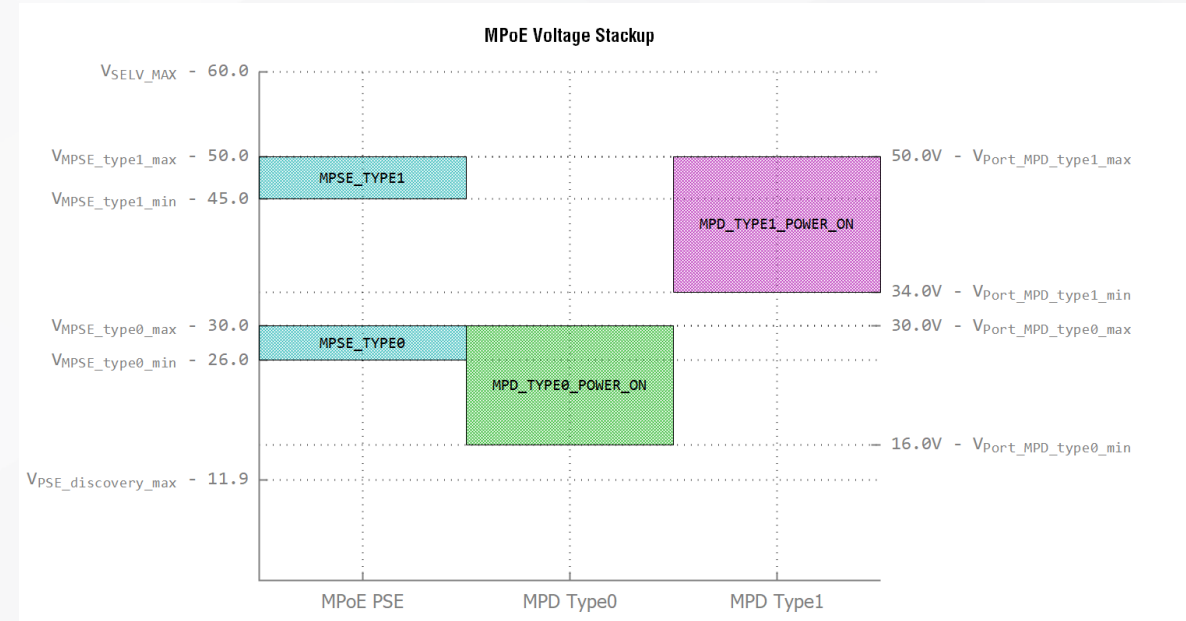
- ▶ Discovery system must be
  - Low cost
  - Low risk
    - Keep wide margins between operating regions
- ▶ Proposed physical layer signaling is a modified version of PoE classification
  - Borrow approximate thresholds
  - Borrow approximate margins
  - Borrow approximate operation regions
- ▶ Necessary MPD discovery hardware
  - ~1mA Current source
  - State memory
    - 5 bits
  - Comparator
    - Shared with power on threshold
  - Timer
    - Shared with inrush backoff timer

# Operating Regions

# Presently Defined Powering Regions



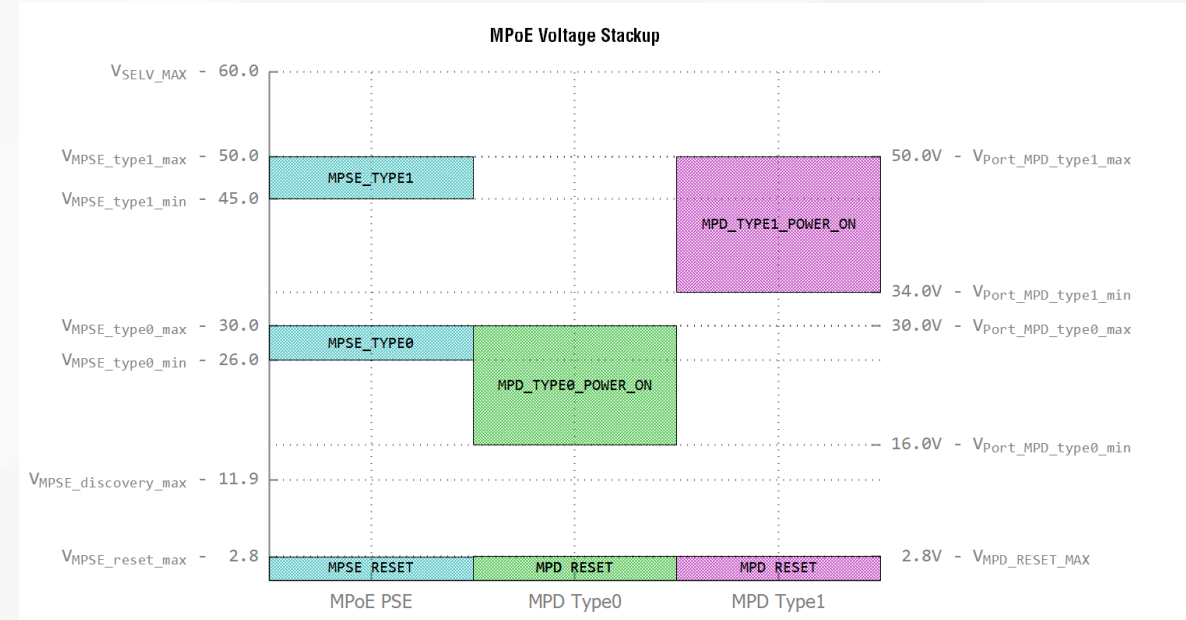
Graph Source: [mpaul-01\\_da\\_2023\\_11\\_13.pdf, slide8](#)



Operating regions redrawn in separate columns depending on PSE / TYPE0 MPD / TYPE1 MDP  
Starting point for this presentation

# Add Reset Regions

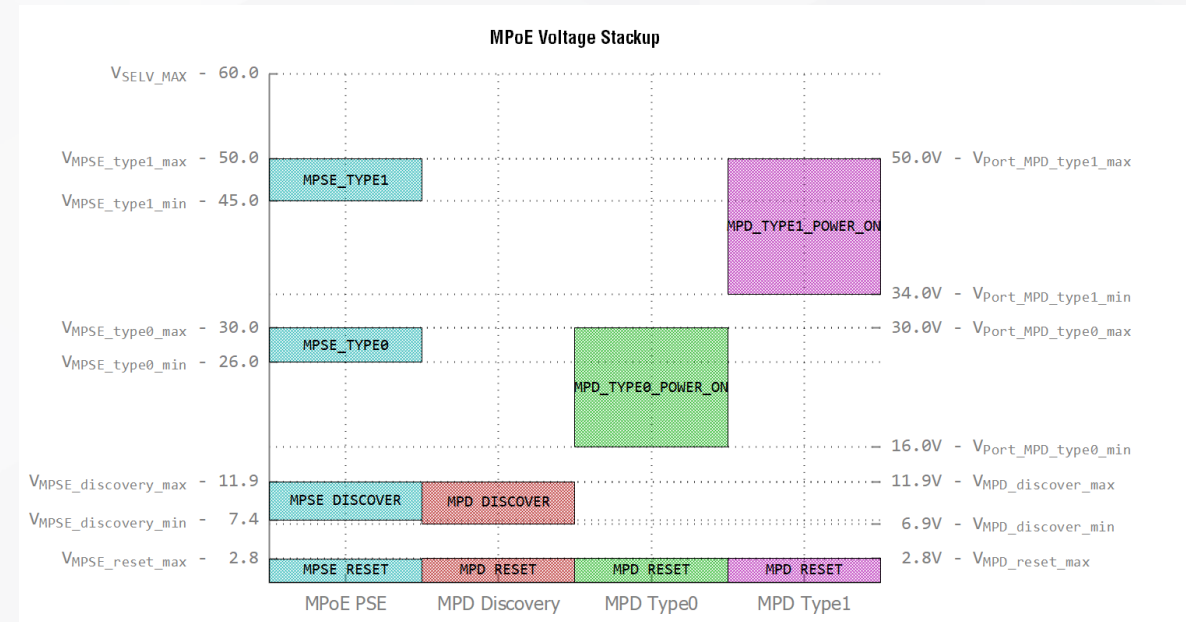
- ▶ Use same reset thresholds as PoE
  - Clause 33 and Clause 145
- ▶  $V_{MPSE\_reset\_max} = 2.8V$
- ▶  $V_{MPD\_reset\_max} = 2.8V$





# Add Discovery Low Region

- ▶ Add the discover low region
  - $V_{MPD\_discover}$  needs margins between  $V_{Port\_MPD\_TYPE0}$  and  $V_{MPD\_reset}$
  - 4.1V Gaps to other operating regions
    - Consistent with PoE Class / Mark thresholds
- ▶ Cable Drop From PSE to MPDs
  - $16 \text{ nodes} * 2\text{mA} * 12\Omega = 0.288\text{V}$
  - 0.5V Drop Margin allocated to cable drop in  $MPD\_DISCOVER\_LOW$  region



# POWER\_ON, HOLDOFF, and NO\_POWER States (1/2)

- ▶ When MPD voltage enters  $V_{Port\_MPD\_TYPE0}$  region
- ▶ MPDs wait  $T_{inrush\_backoff}$  for the mixing segment voltage to settle

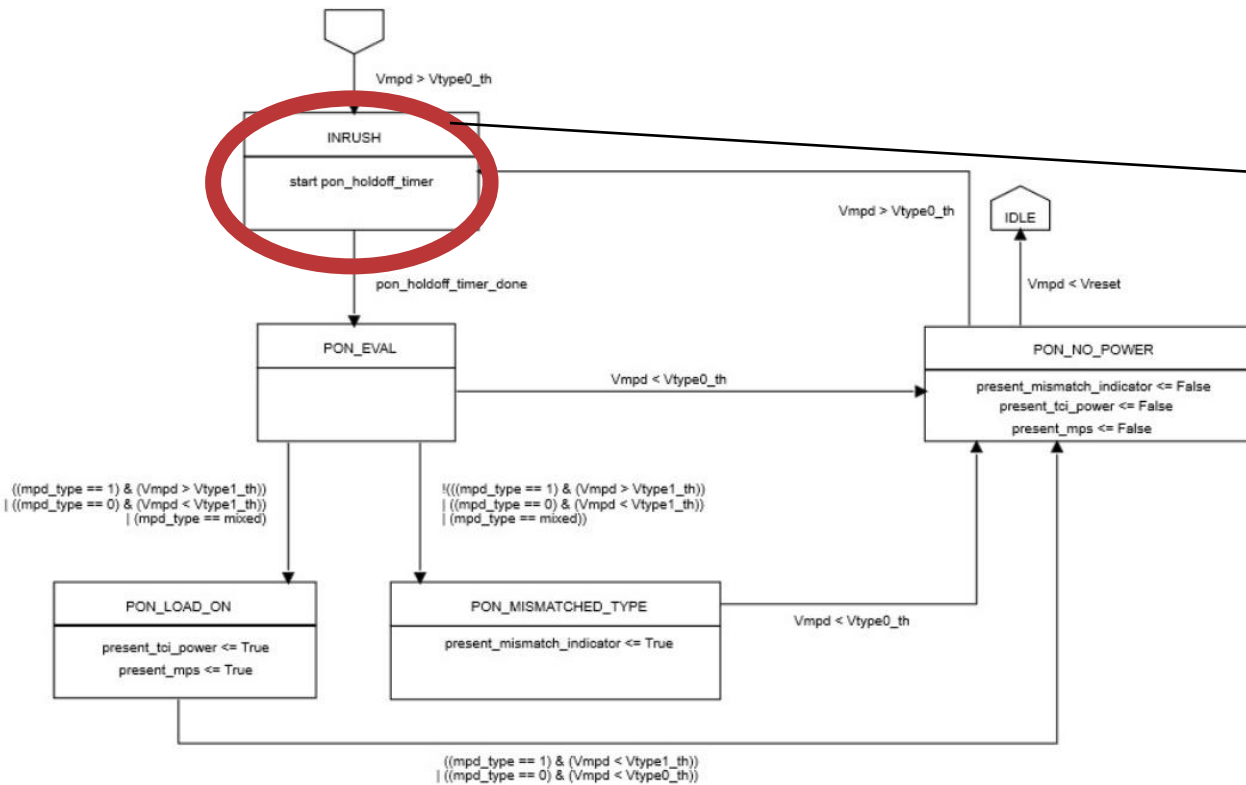
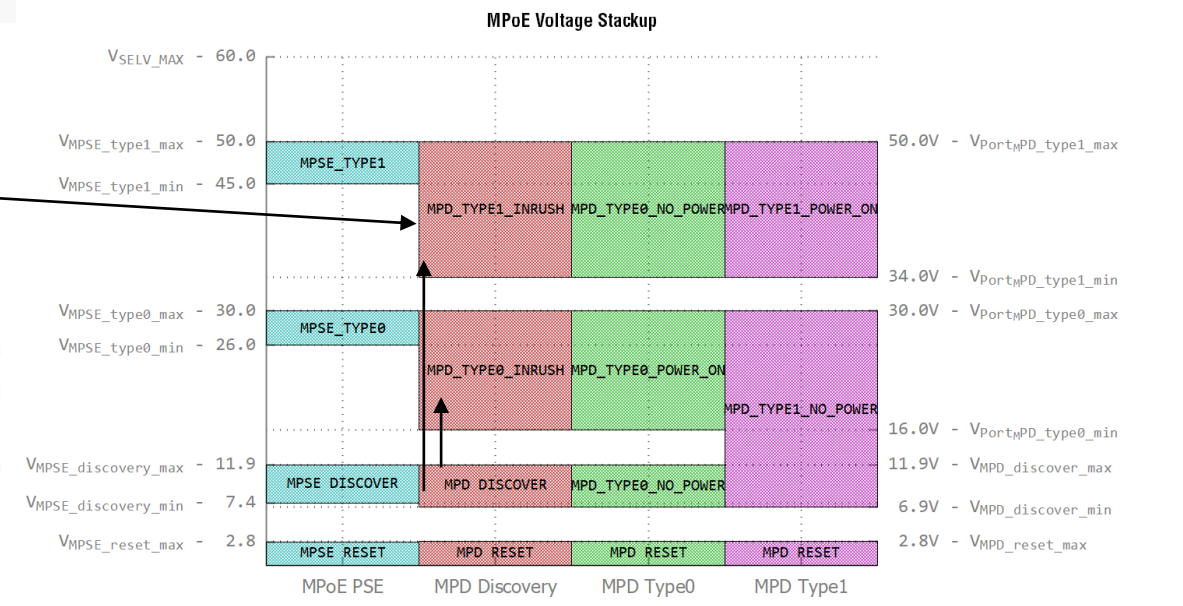
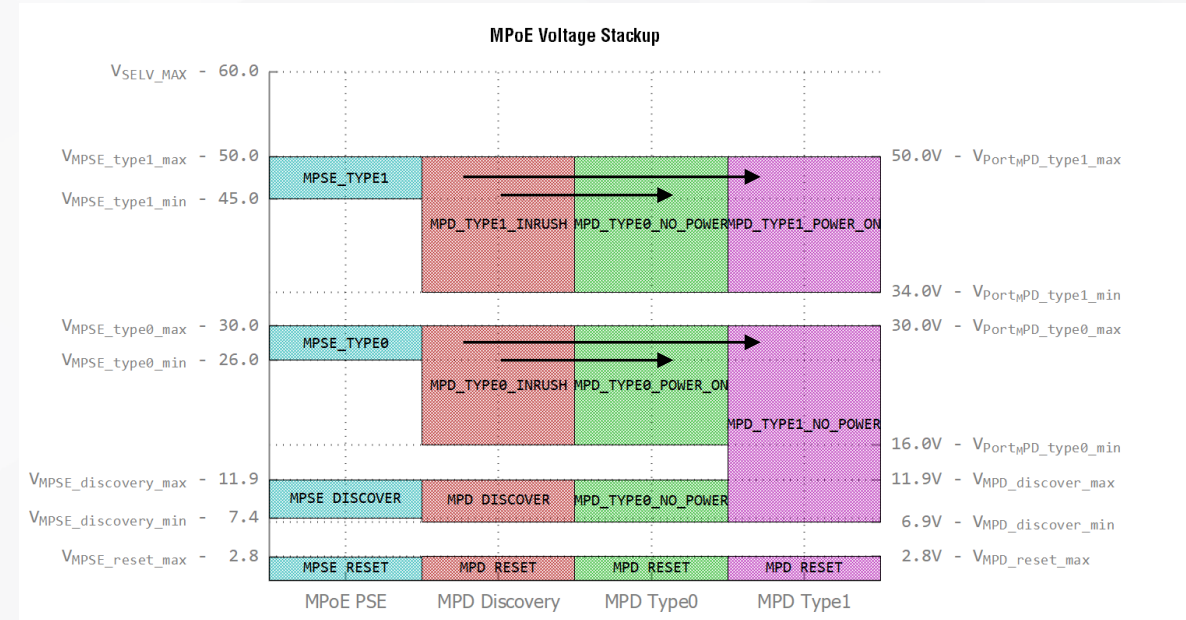


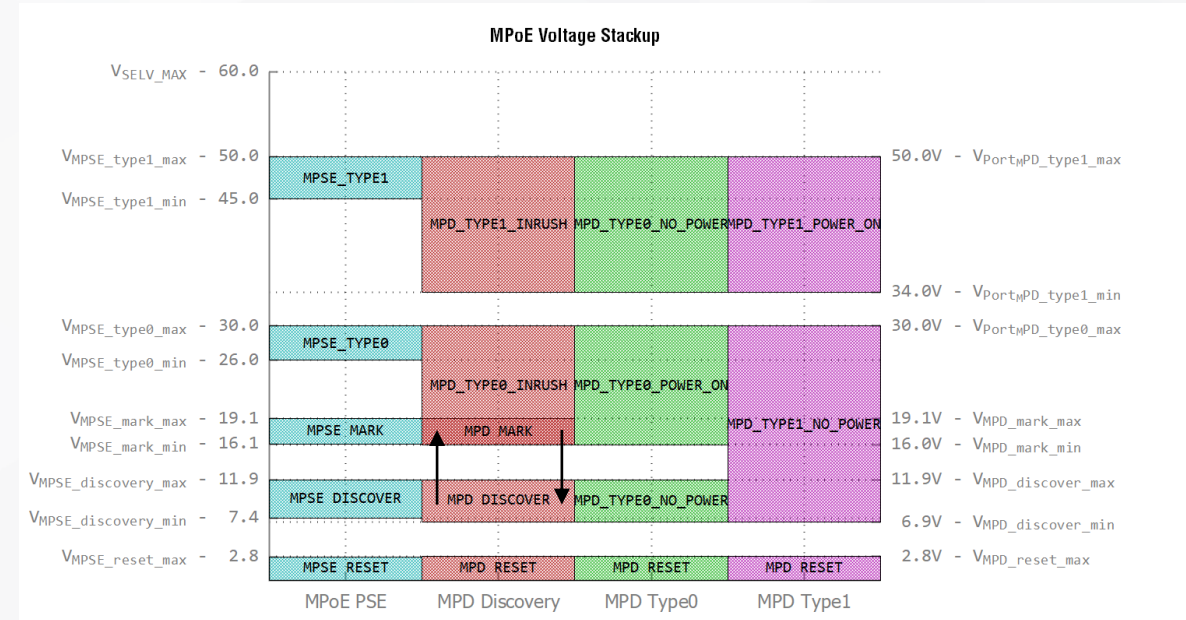
Figure 169-7—Top Level PD state diagram (continued)



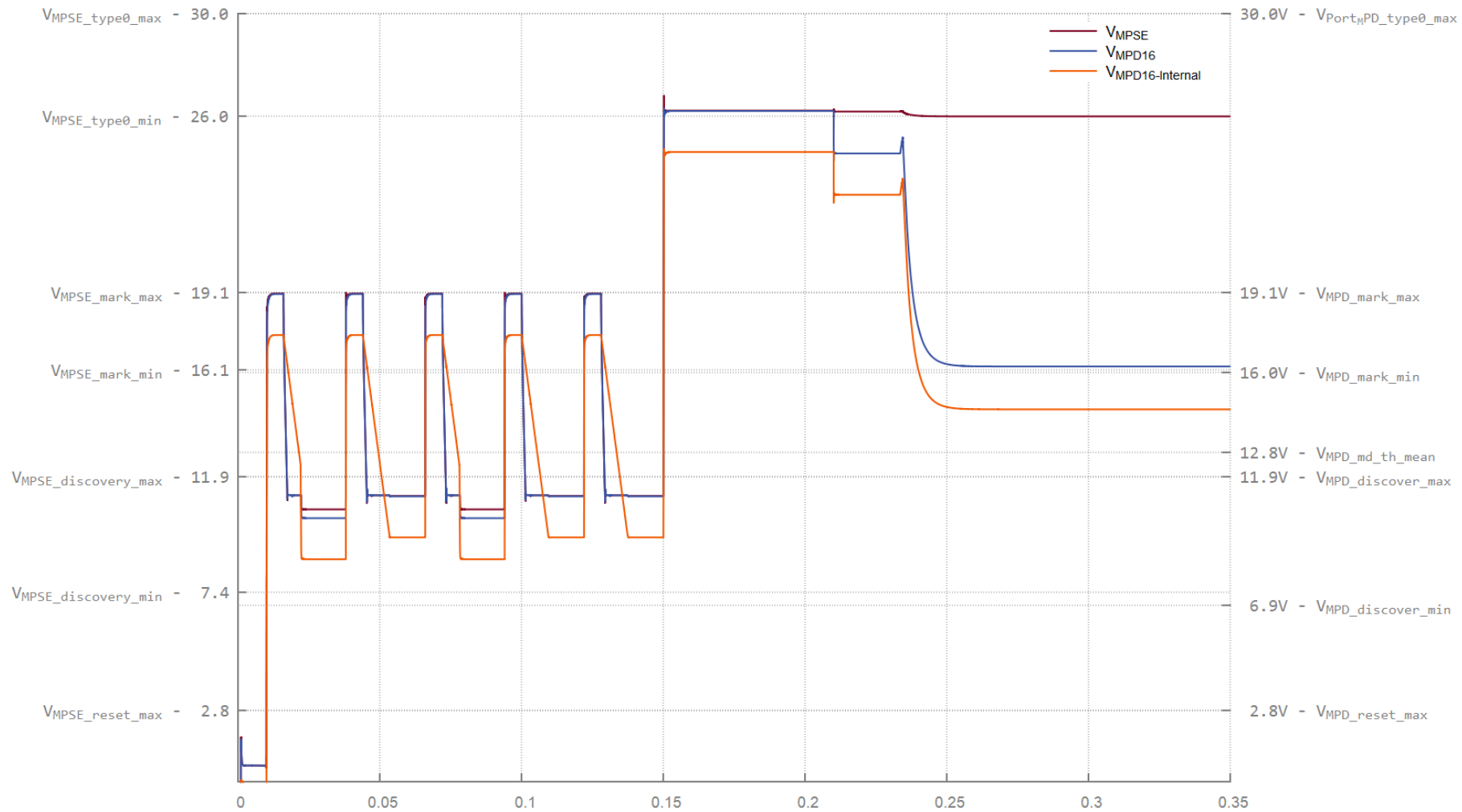
- ▶ After  $T_{inrush\_backoff}$  ,
  - MPDs may enter POWER\_ON region and begin sourcing power
  - If the MPSE and MPD types are incompatible, the MPD enters a NO\_POWER state
- ▶ Hot added MPDs will immediately enter MPD\_TYPE $n$ \_INRUSH state and will not participate in Discovery



- ▶  $V_{MPD\_MARK}$  overlaps  $V_{Port\_MPD\_TYPE0}$
- ▶ Use same current draw in both states
  - $I_{MPD\_mark}$
- ▶  $V_{MPD\_mark\_min} = V_{Port\_MPD\_TYPE0\_min}$ 
  - Maintain wide separation between POWER\_ON and MPD\_DISCOVER regions
  - Transition from MPD\_MARK to MPD\_TYPE0\_POWER\_ON after  $T_{inrush\_backoff}$
- ▶ Reuse DISCOVER->POWER\_ON comparator



# Discovery / Power-Up Transient – Type 0 System



# Discovery Timing

## ► Rise / Fall times

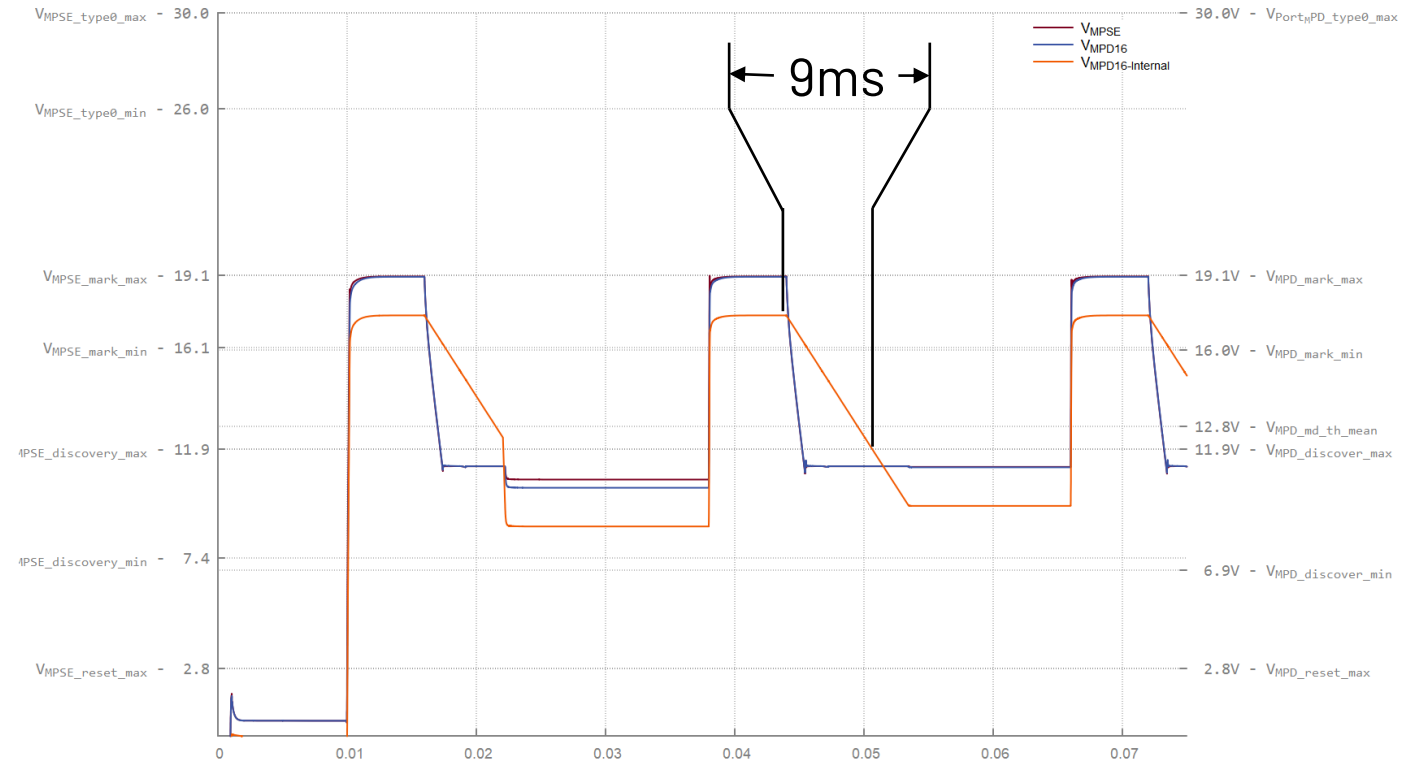
### ■ Rise time

- Dominated by  $I_{\text{Discover\_lim}}$ 
  - >50mA

### ■ Fall time

- $T = C * V / I$ 
  - $V_{\text{MPD\_mark\_max}} - V_{\text{MPD\_discover\_max}}$
  - $C_{\text{MPD\_discover\_max}}$
  - $I_{\text{MPD\_discover\_min}}$
  - $120\text{nF} * (19.1 - 11.9) / 100\text{e-6} = 8.64\text{ms}$

## ► Allow 9ms for MPD to settle





- ▶ 100nF value comes from rule of thumb
  - Really Required?
- ▶ Use 10nF instead?
  - Speed MPD Mark – Discovery discharge
  - Disturb the system less during a hot-plug event
    - Help with TF Objective 11



## ► Rise / Fall times

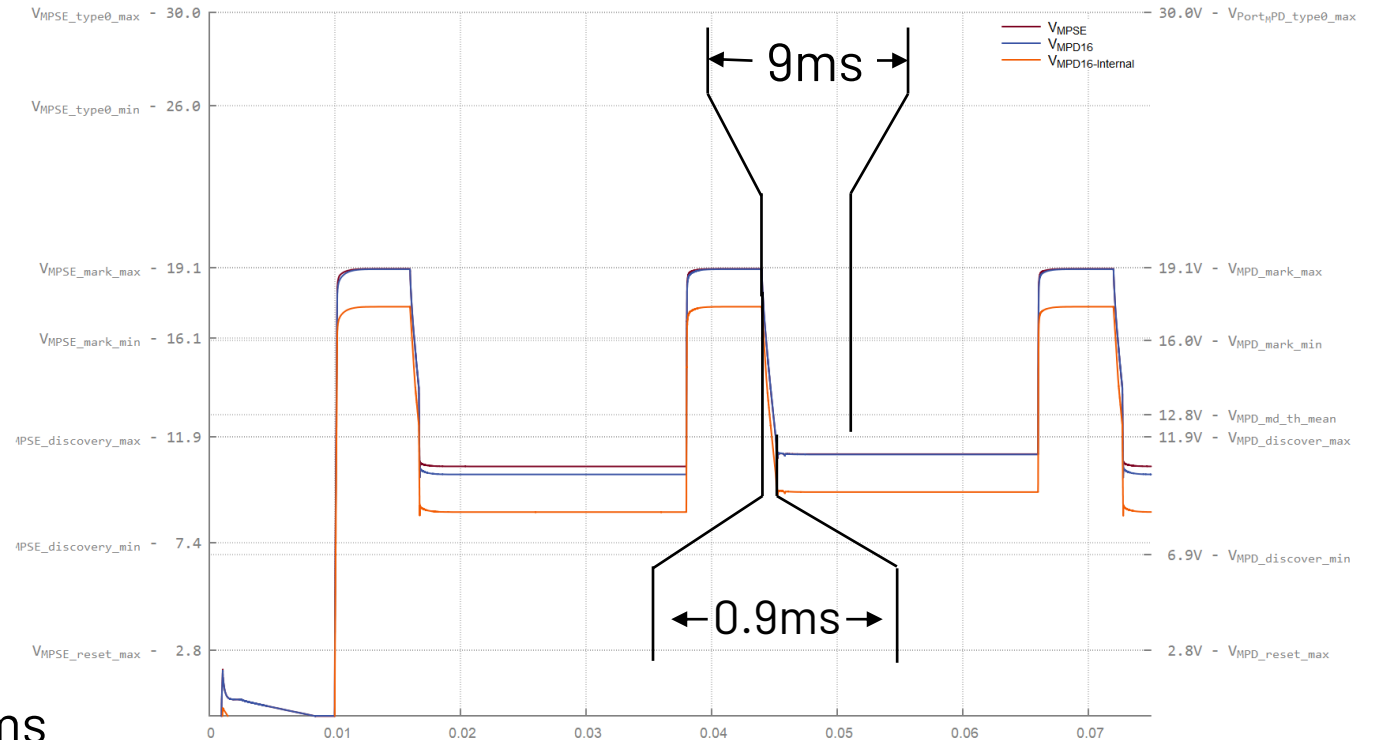
### ■ Rise time

- Dominated by  $I_{Discover\_lim}$ 
  - >50mA

### ■ Fall time

- $T = C * V / I$ 
  - $V_{MPD\_mark\_max} - V_{MPD\_discover\_max}$
  - $C_{MPD\_discover\_max}$
  - $I_{MPD\_discover\_min}$
  - $12.0nF * (19.1-11.9) / 100e-6 = 0.864ms$

## ► Allow 0.9ms for MPD to settle



# Clause 169 Updates

# Update “Table 169-3—MPSE Discovery Parameters”

Item	Parameter	Symbol	Min	Max	Units	Additional Information
1	Discovery high mark voltage	$V_{\text{Mark}}$	16.1	19.1	V	
2	Discovery low mark voltage	$V_{\text{Discovery}}$	7.4	11.9	V	
3	Discovery current limit	$I_{\text{Discovery\_LIM}}$	50	100	mA	
4	Discovery high event time	$T_{\text{Discovery\_high}}$	7	-	ms	
5	Discovery low event time	$T_{\text{Discovery\_low}}$	20	TBD	ms	MP_NOTE: 18ms for 100nF PD settling + 2ms for measurement stabilization
6	Discovery time	$T_{\text{Discovery}}$	-	TBD	ms	MP_NOTE: finalize after other timing parameters are solid
7	Discovery backoff time	$T_{\text{Backoff}}$	150	-	ms	
8	Mark short circuit threshold	$I_{\text{Mark\_short}}$	3	4	mA	
9	Discovery all MPD present range	$I_{\text{MPD\_present}}$	0.8	40	mA	$I_{\text{Discovery}}-I_{\text{Mark}}$
10	MPD type present	$I_{\text{Type\_present}}$	0.8	40	mA	$I_{\text{Discovery}}-I_{\text{Tare}}$
11	Mark Measurement Delay	$T_{\text{mark\_measure}}$	7		ms	MP_NOTE: 1ms longer than MPD mark stability time
12	Discovery Measurement Delay	$T_{\text{discover\_measure}}$	10	-	ms	Based on Mark-Discover Fall time (100nF Cpd)
13	Discovery Reset	$V_{\text{MPSE\_reset}}$	0	2.8	V	

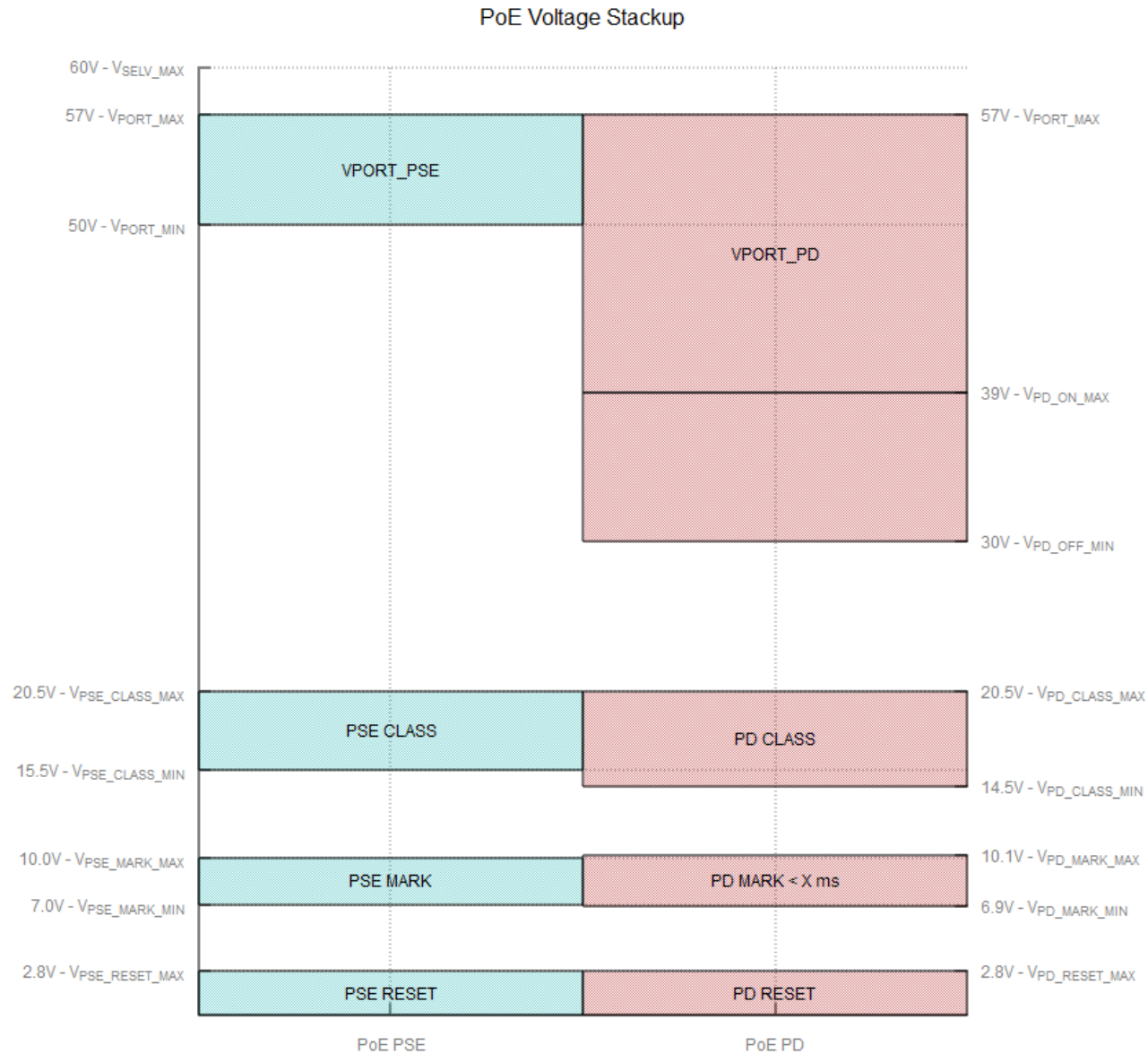
► Green values are changes in the table

# Add New Table in Subsection "169.4.5 MPD Discovery"

Item	Parameter	Symbol	Min	Max	Units	Additional Information
1	Mark Event Voltage	$V_{\{MPD\_mark\}}$	16	19.1	V	
2	Discovery Event Voltage	$V_{\{MPD\_discover\}}$	6.9	11.9	V	
3	Mark Event Current	$I_{\{MPD\_mark\}}$	100	200	uA	
4	Discovery Event Current	$I_{\{MPD\_discover\}}$	1	2	mA	
5	Discovery reset threshold	$V_{\{MPD\_reset\}}$	2.8	6.9	V	
6	MPD discovery stability time	$T_{\{MPD\_discover\}}$	-	9	ms	MP_NOTE: Calculated for 100nF decoupling cap
7	MPD mark stability time	$T_{\{MPD\_mark\}}$	-	6	ms	MP_NOTE: From Clause 33

# Appendix Slides

# PoE Voltage Stackup (Clause 145)



## ► Diodes

- S1B @ -40C, 100mA
  - $V_f \approx 0.9V$
  - $2 \cdot V_f = 1.8V$

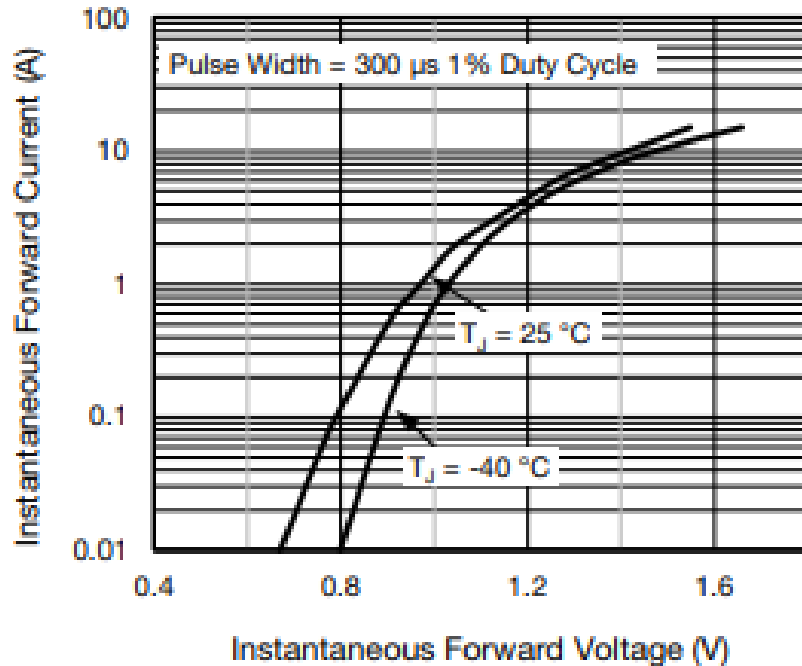


Fig. 3 - Typical Instantaneous Forward Characteristics

## ► Cable Offset

- 30mA @ 12 $\Omega$
- 0.36V

## ► Diodes

- S1B @ -40C, 100mA
  - $V_f \approx 0.9V$
  - $2 \cdot V_f = 1.8V$

►  $2 \cdot V_f + V_{cable} = 2.26V$