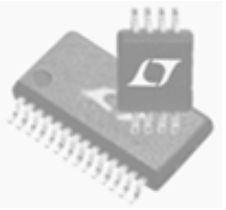
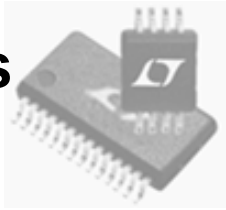


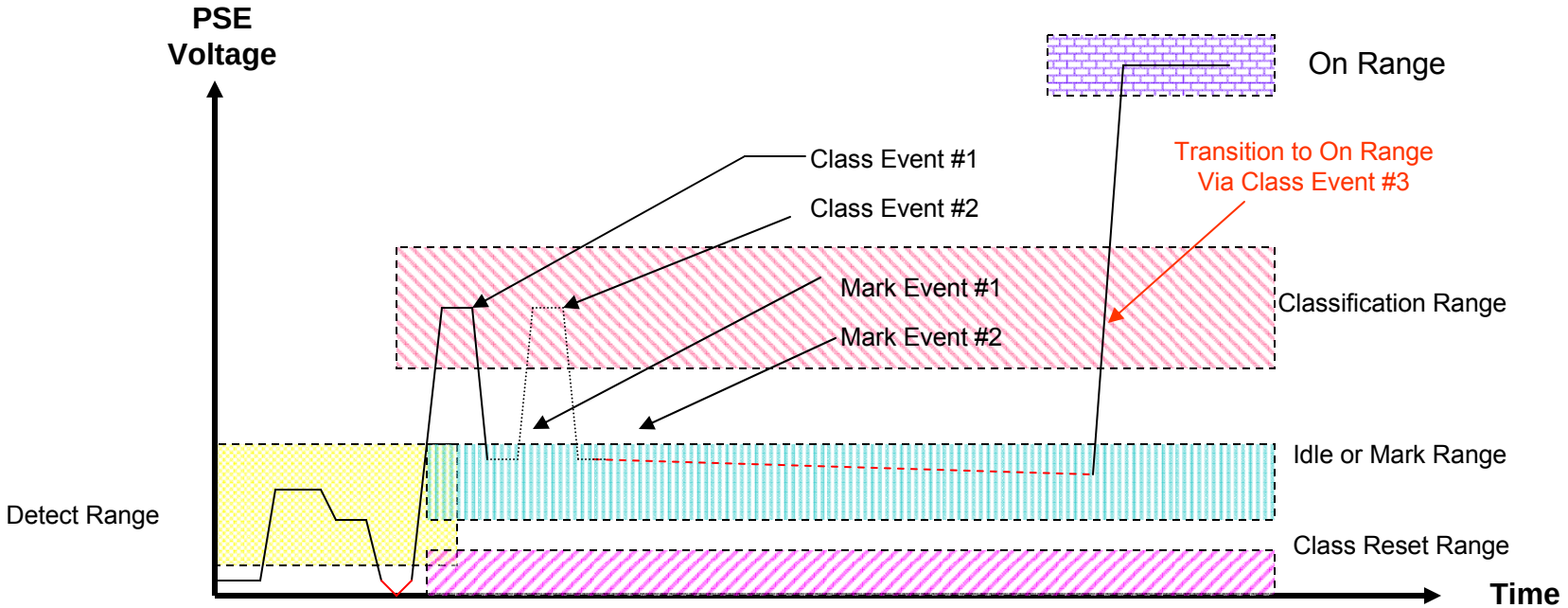
PoE Plus
IEEE 802.3at
Classification Ad Hoc
Extended Classification Using Two Classification Events

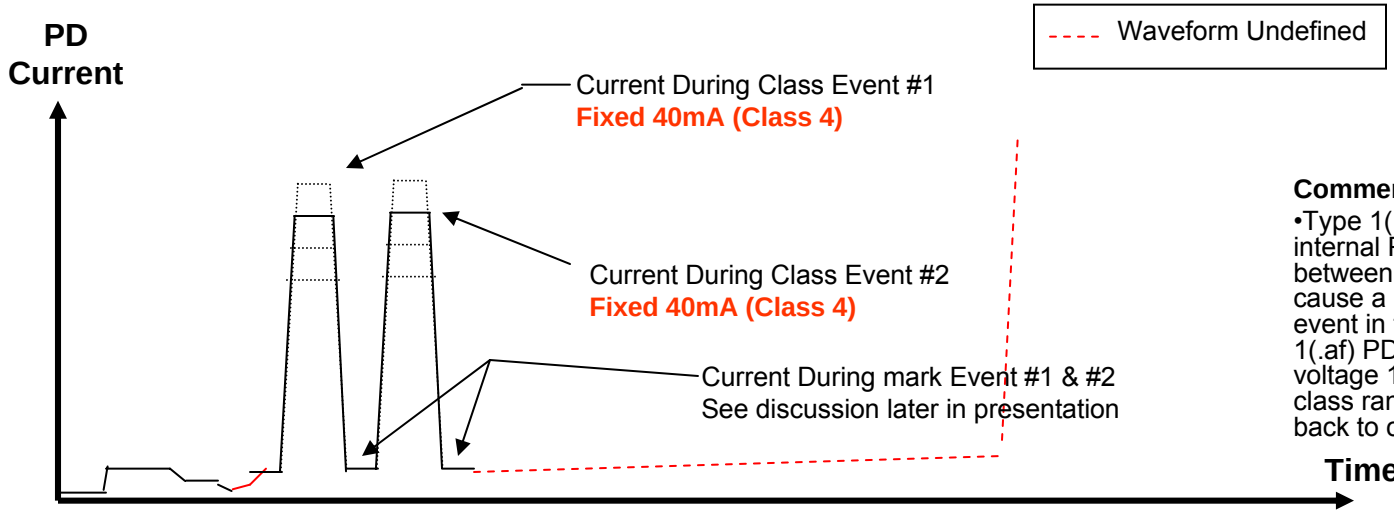
Dave Dwelley
Clay Stanford
Linear Technology

May 28, 2007
Geneva

802.3at Classification Using Two Classification Events







Comment

•Type 1(.af) PD may not pull internal PD supply down quickly between pulses but this doesn't cause a problem. With the Mark event in the Signature range, Type 1(.af) PD might "float" at some voltage 10-20V, but will return to class range when PSE drives port back to class voltage.

PoEP: IEEE 802.3at
Two Event Rules

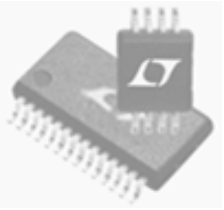
Type 2 (.at) PD Rules:

- PD is behind diode bridge so fall time is controlled by internal PD circuits and not PSE port voltage. Therefore a Type 2 (.at) PD is required to pull the internal supply down using the classification event current until the PD detects the Mark event. Once the PD has detected the Mark, the PD can stop pulling down on the port. Note that in this scenario, the port voltage may not discharge all the way down to the Mark range and this is not a problem.
- If the port voltage goes to reset range, PD state engine is reset and the PD will go to the detect state.

Type 2 (.at) System Rules:

- Type 2 (.at) PSE is the master, generating port voltage. Type 2 (.at) PD is slaved to Type 2 (.at) PSE , responding with port current.
- System is designed so that Type 2 (.at) PD spends a limited amount of time in the Mark range in case Type 2 (.at) PD is using dynamic memory which requires power to maintain state.
- Type 2 (.at) PSE must transition from 2nd event through Class Event 3 to Power On without going down into Reset range.

PoEP: IEEE 802.3at
Two-Event Type 1/2 (.af/.at) Interaction



Type 2 (.at) PSE with Type 1 (.af) PD:

- If a Type 2(.at) PSE sees class 0, 1, 2, or 3, it assumes Type 1(.af) PD and powers per .af spec, i.e. 15.4W, 4W, 7W, 15.4W respectively.
  - Note: Type 1(.af) PD that uses class 4 (in error) will get powered with 30W by a Type 2(.at) PSE. This is a minor annoyance with this class scheme and is considered acceptable.
  - If a Type 2(.at) PSE sees class 4, and it is using layer 1 only for classification, it must ping twice.
  - If a Type 2(.at) PSE sees class 0,1,2, or 3, it has the option of pinging either one or two times.

May06 motion to include 2W class and July06 motion for ~9W class will not be supported.

Type 2(.at) PSE with Type 2(.at) PD:

- Type 2(.at) PSEs should see class 4 when connected to a Type 2(.at) PD.
- Type2(.at) PSE only using L1 will ping twice to signal to the Type 2(.at) PD that it is a Type 2 PSE.
- If a Type 2(.at) PSE sees inconsistent class results (i.e. 4-1, 4-2, etc), the behavior is non-compliant and PSE action is undefined.

.Type 1 (.af) PSE with Type 2 (.at) PD:

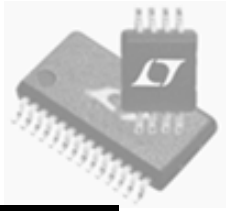
- If a Type 1(.af) PSE sees a Type 2 (.at) PD, it will see class 4 and power at 15.4W.

Motion from March 2006

The IEEE 802.3at Task Force affirms that a PD requiring more than 12.95W will support a Layer-1 Classification extension and a Layer-2 Classification mechanism.

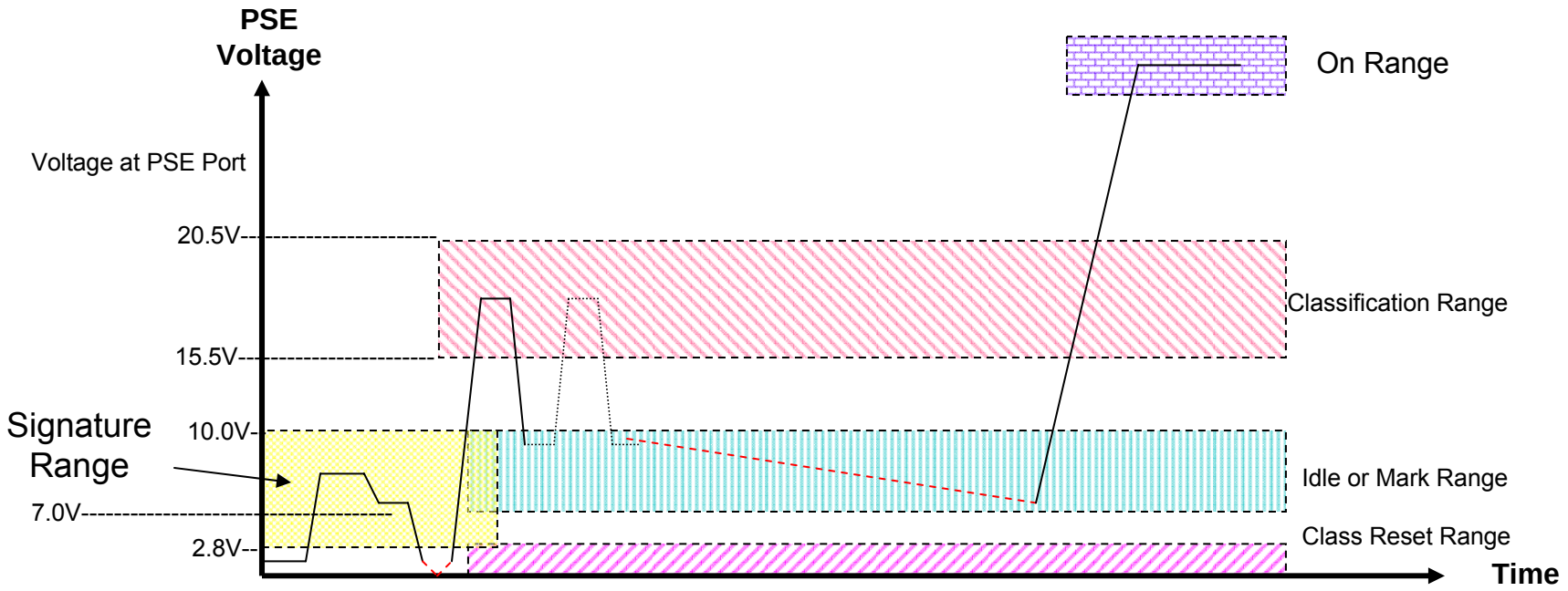
Endpoint PSEs must support Layer-2 classification or Layer-1 classification extension for PDs requiring more than 12.95W.

All Possible PSE/PD Combinations



PSE TYPE	PD TYPE	COMMENTS
Type 1(.af)	Type 1(.af)	Existing 802.3af system, class 0, 1, 2, or 3.
Type 1(.af)	Type 2(.at)	Type 1(.af)PSE sees class 4 and powers per 802.3af specification, i.e. 15.4W. Type 2(.at) PD can only assume Type 1 PSE and must operate with 15.4W and alert user not enough power.
Type 2(.at) L1 i.e. high power midspan	Type 1(.af)	Type 2(.at) PSE sees class 0, 1, 2, 3 and powers per 802.3af specification.
Type 2(.at) L1 i.e. high power midspan	Type 2(.at)	Type 2(.at) PSE sees class 4 and powers with maximum allowable 802.3at power level. Type 2(.at) PD sees two class pings and knows Type 2 PSE connected. Power information is known before PD is powered.
Type 2(.at) L2 i.e. end point PSE	Type 1(.af)	Type 2(.at) PSE sees class 0, 1, 2, 3 and powers per 802.3af specification. Layer 2 communication fails to establish. Power level is maintained at .af levels. PD sees af behavior and operates under .af specs.
Type 2(.at) L2 i.e. end point PSE	Type 2(.at)	Type 2(.at) PSE sees class 4 and powers with 15.4W. Layer 2 communication is established and mutual identification is established. High power operation begins.

Voltage Ranges and Timing Specification



PSE and PD Voltage Ranges

PSE VOLTAGE SPECIFICATIONS		
FUNCTION	MIN (V)	MAX(V)
Classification	15.5[1]	20.5[1]
Mark	7.0	10
Low Reset Range	0	2.8[1]
High Reset Range	--	--

PD VOLTAGE SPECIFICATIONS		
FUNCTION	MIN (V)	MAX(V)
Classification	14.5[1]	20.5[1]
Mark	6.9[2]	10[3]
Low Reset Range	0	2.8[3]
High Reset Range	30[1,4]	

Notes on Calculations

1. Value from 802.3af specification.
2. Assume cable max resistance = 20ohms so as to also work with .af systems.
   Cable drop max = 2mA (mark current max) * 20ohms = .04V~=0.1V.
   With 7V at PSE, may only be ~6.9V at PD.
3. PD Mark and Reset limits are not equivalent to PD signature range (2.7V-10.1V). PD upper limits are equal to PSE upper limits.
4. Reset high occurs when powered PD drops below PD power supply turn off voltage.

Timing Specification

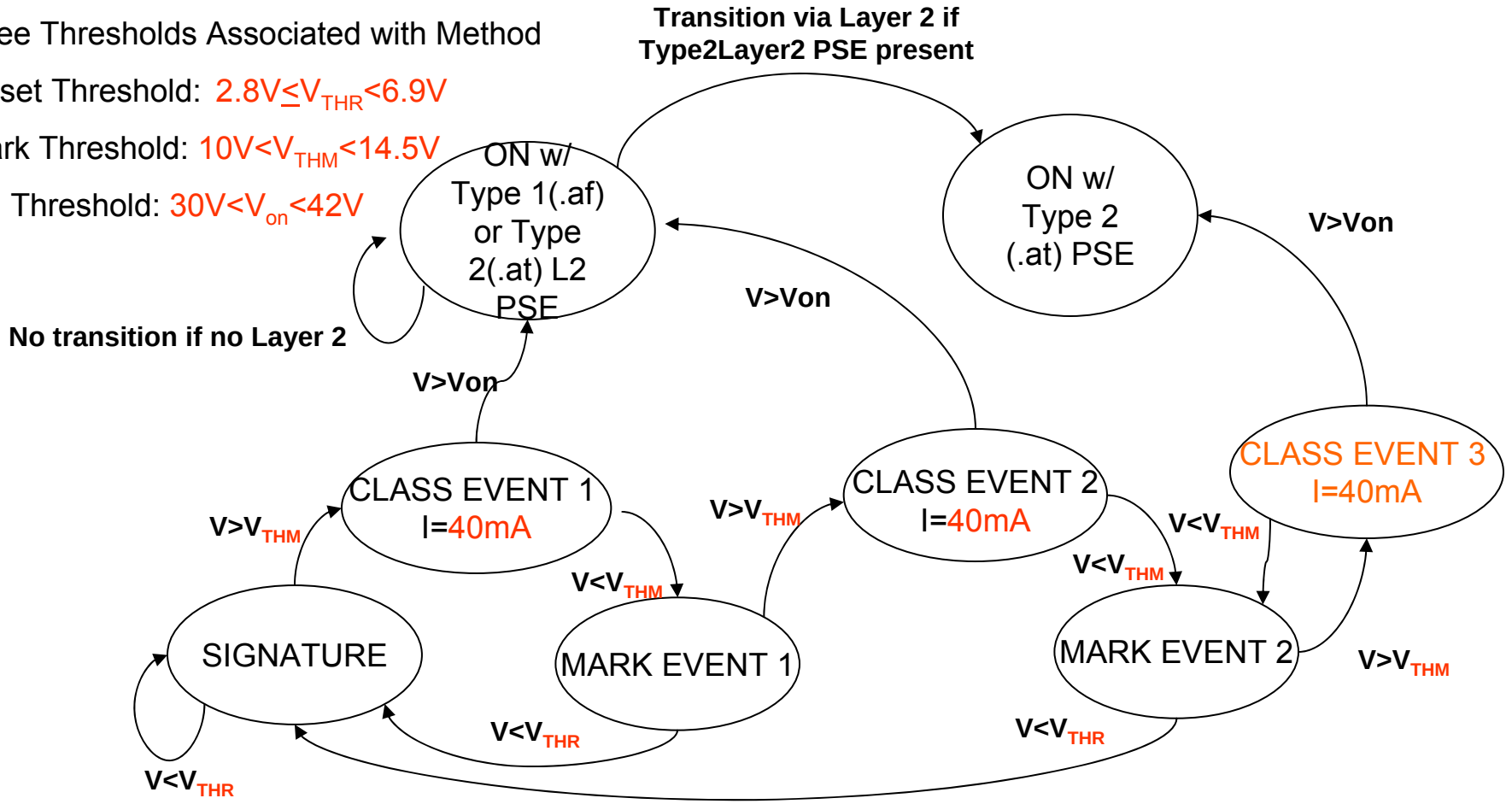
TIMING SPECIFICATIONS		
EVENT	MIN (ms)	MAX (ms)
1st Class	6	30
1st Mark	6	12
2nd Class	6	30
2nd Mark	6	12
TOTAL (for reference only)	24ms	84ms

Note 1. Time from end of detection until power on is limited by section 33.2.8.13.

Classification State Engine in PD

Three Thresholds Associated with Method

- Reset Threshold: $2.8V \leq V_{THR} < 6.9V$
- Mark Threshold: $10V < V_{THM} < 14.5V$
- On Threshold: $30V < V_{on} < 42V$



Class Event 3 exists to create a defined behavior for Type 2(.at) PDs when pinged repeatedly. This allows future expansion of the classification mechanism with a known response from Type 2(.at) PDs. PD transitions through Class Event 3 during power on.

PD Behavior During Mark Event

PD current to be: $0.25mA < I_{PD} < 2.0\ mA$

- Limiting range of PD current during Mark state eases PSE requirements.

PD Current

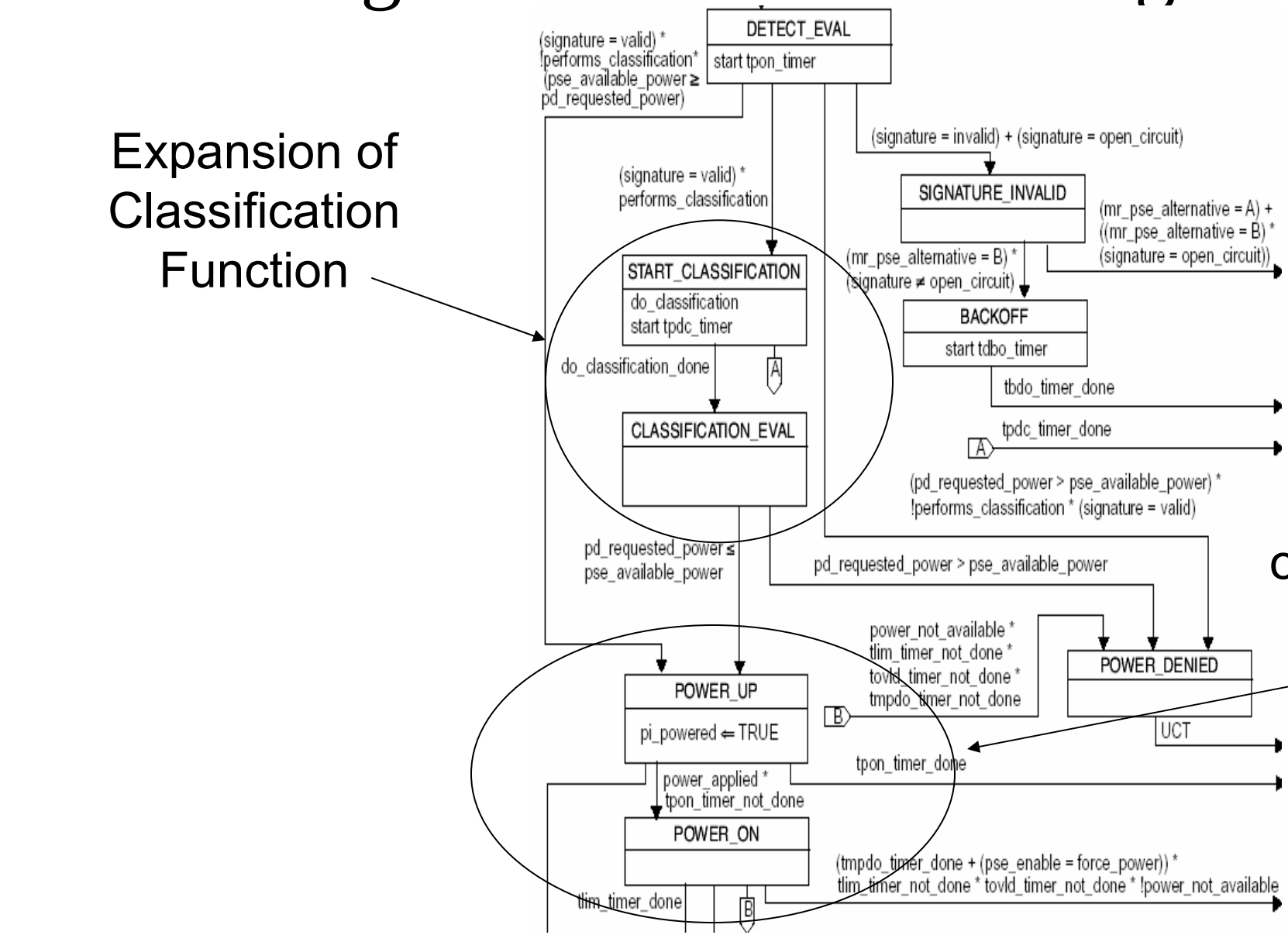
With Type 2 PDs, the current is a function of the state of the PD*:

- Type 2 PDs will draw Class 4 current when in the Class state. The port voltage while in the Class state can range from 20.5V down to near 10V, depending on implementation.
- Type 2 PDs will draw 0.25-2mA when in the Mark state. The port voltage while in the Mark state can range from 7V up to near 15.5V, depending on implementation.

*The state of the PD transitions based on port voltage.

Existing 802.3af PSE State Engine

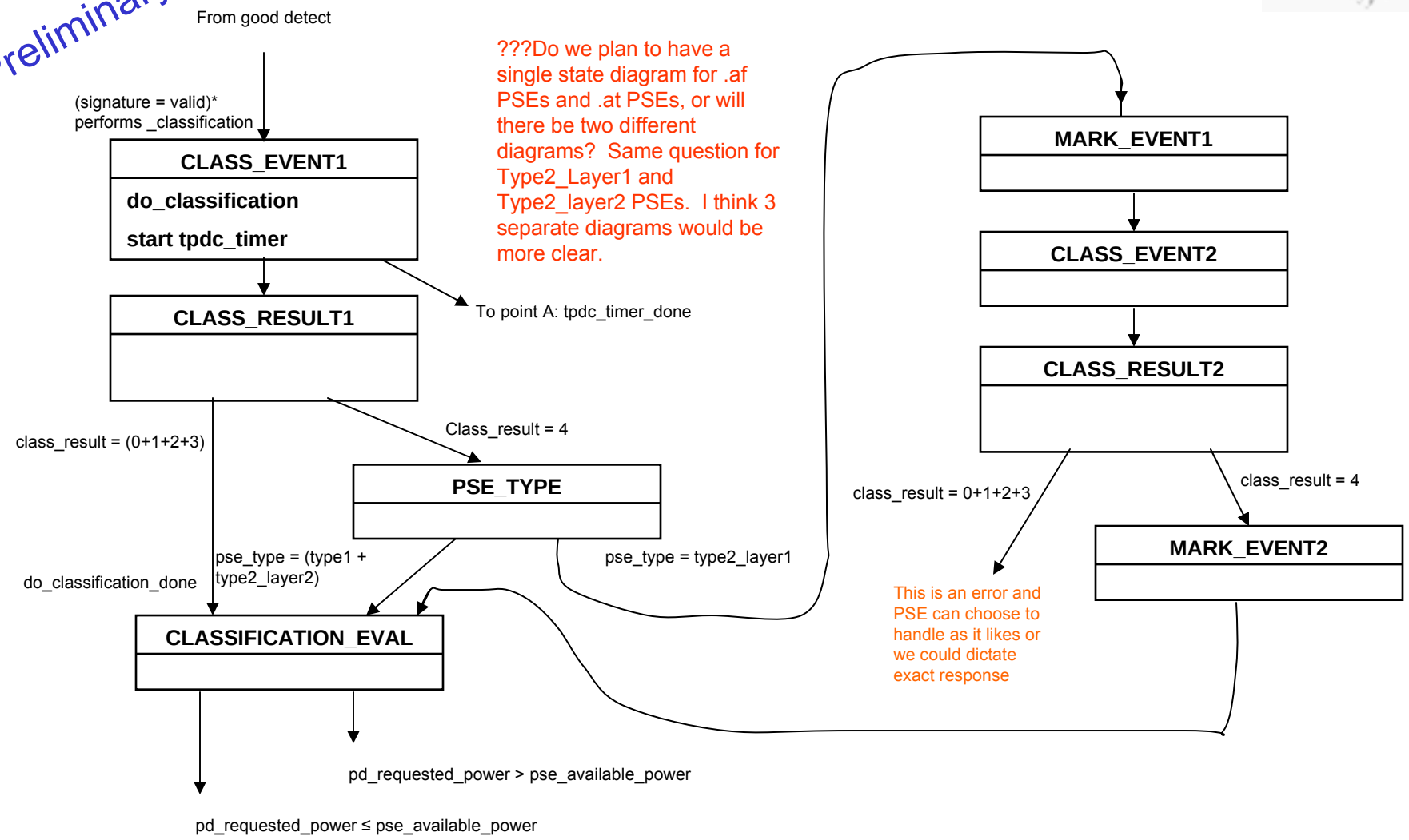
Expansion of Classification Function



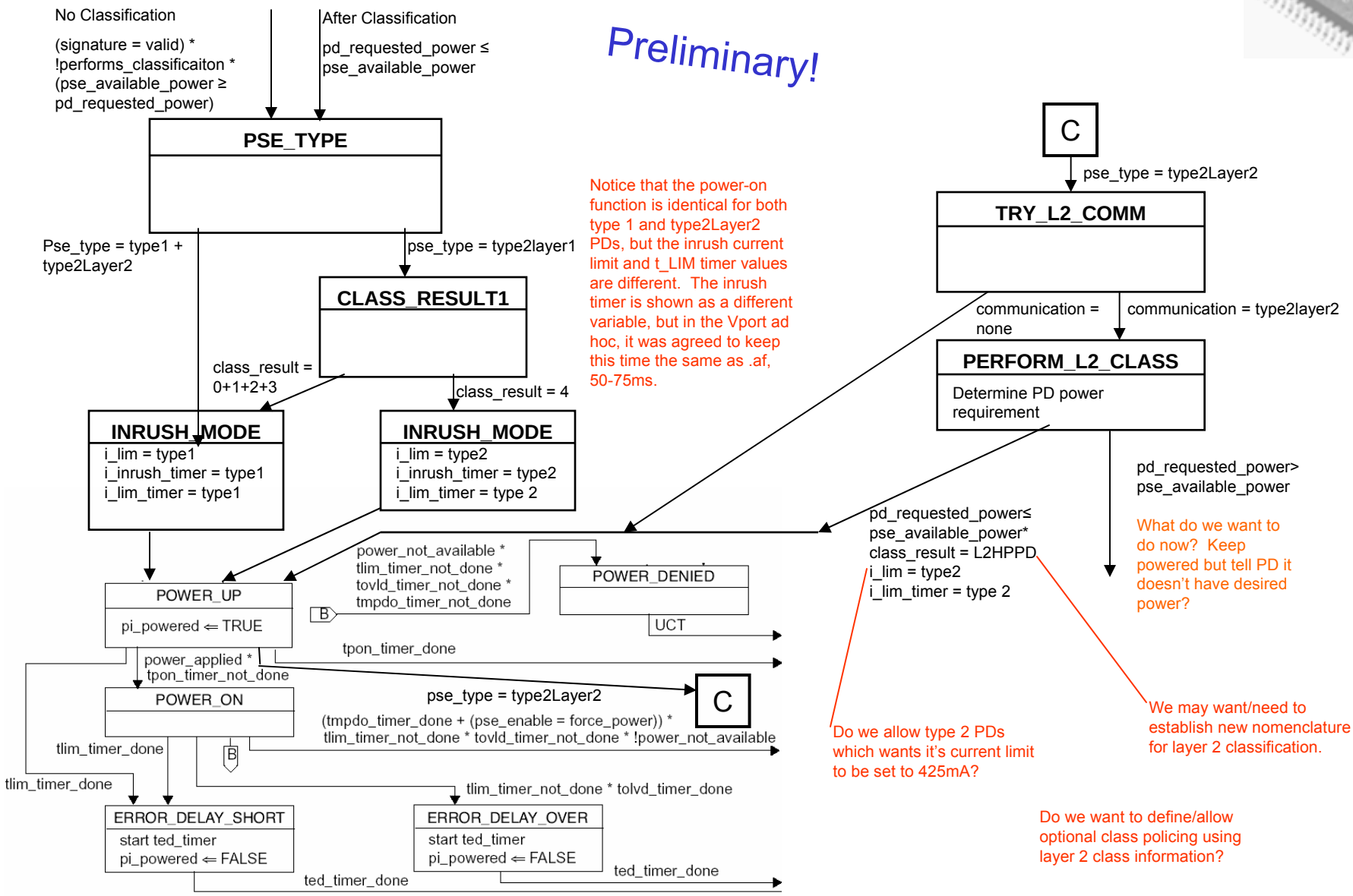
Expansion of Power On Function

Expanded PSE Classification State Engine

Preliminary!

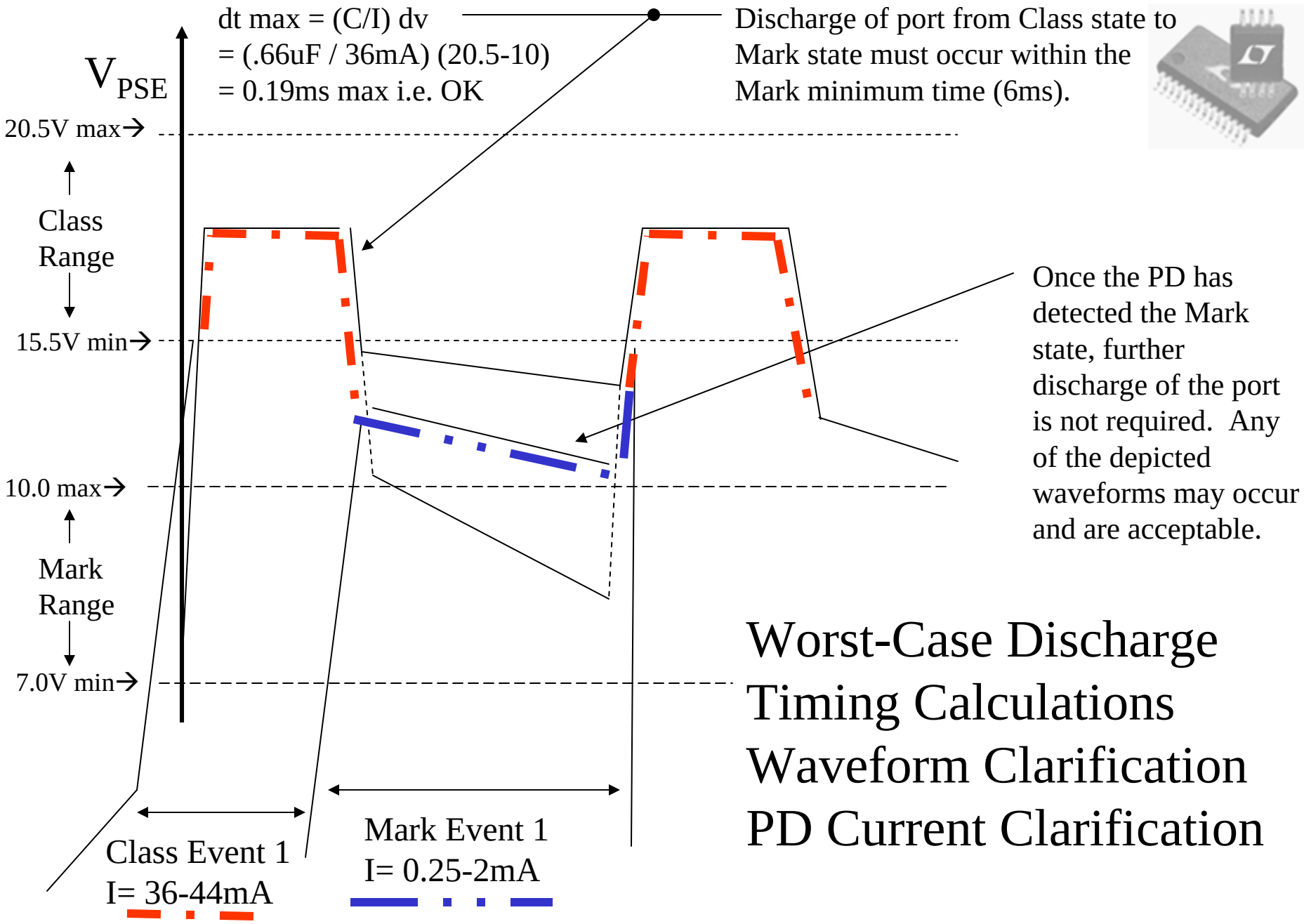


Expanded PSE Power-On State Engine



Addendum

Supporting Material



Worst-Case Discharge Timing Calculations Waveform Clarification PD Current Clarification