Classification Using Hysteresis

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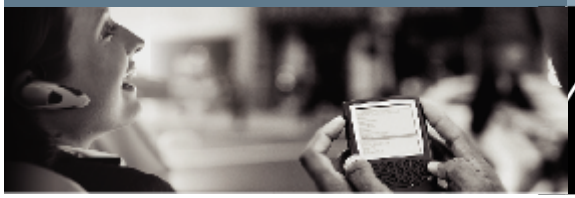


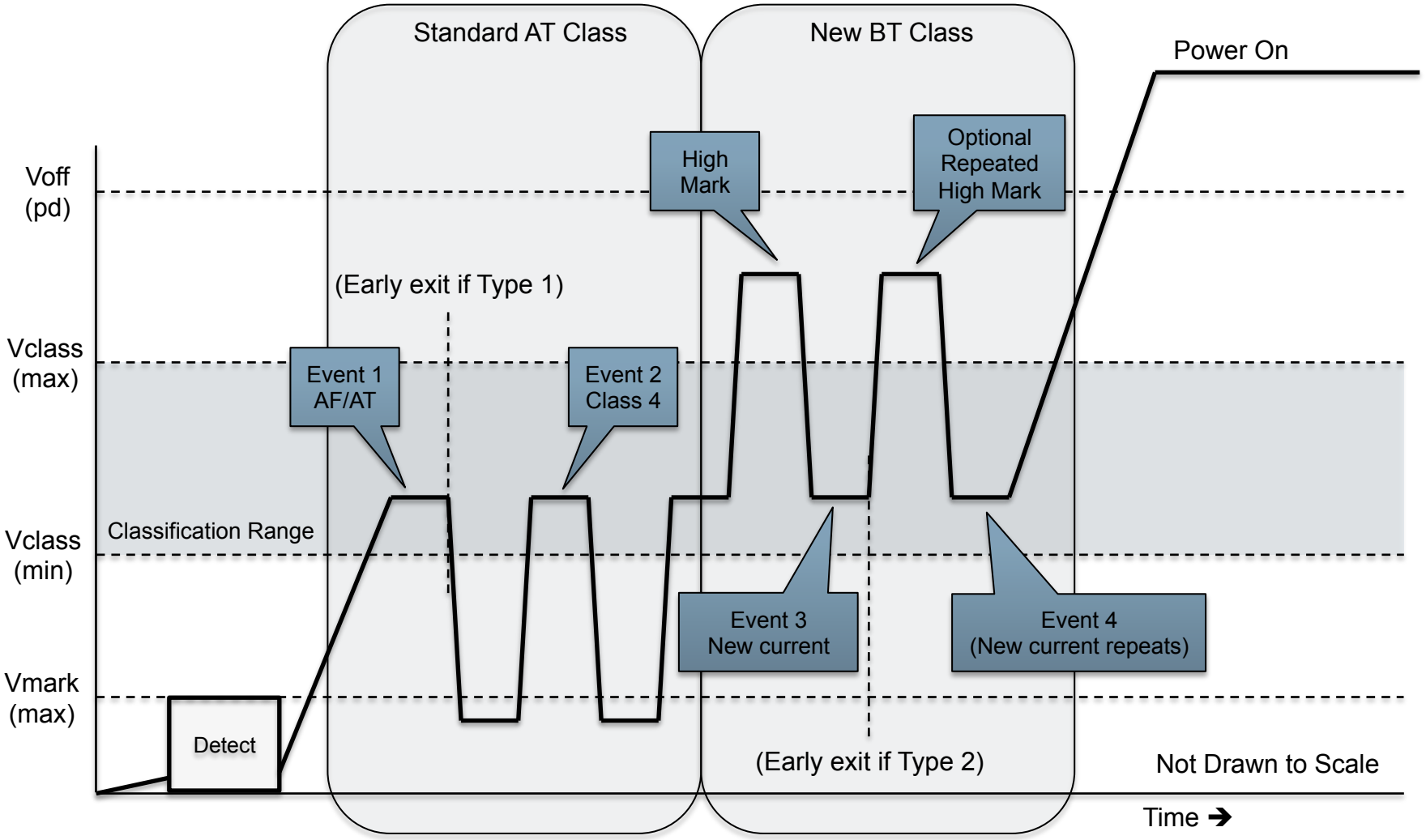
Classification Expansion

- We need a new set of physical layer Class codes in BT…
  - Mutual ID of new Types
  - New power levels within new Types
- For many reasons, it is desirable to reuse as much of the existing Class scheme as possible
  - Must remain backwards compatible with existing Type 1/2 classification

Proposal: PD Signature with Hysteresis

- PD signature:
  - Voltage enters class range from below: PD shows standard Class signature (AT Class 4 for new types)
  - Voltage enters class range from above: PD shows new class current (TBD)
  - Static in time: always responds the same way to the same test
- PSE classification behavior:
  - Runs standard AT 2-event class test (does not exceed Vclass_max)
  - PSE raises voltage to between Vclass_max and Voff_pd for Tmark and then returns to class voltage range
  - Measure class current = new PD class
  - Repeat high mark cycle as needed for PD Mutual ID

New Scheme – PSE Waveforms



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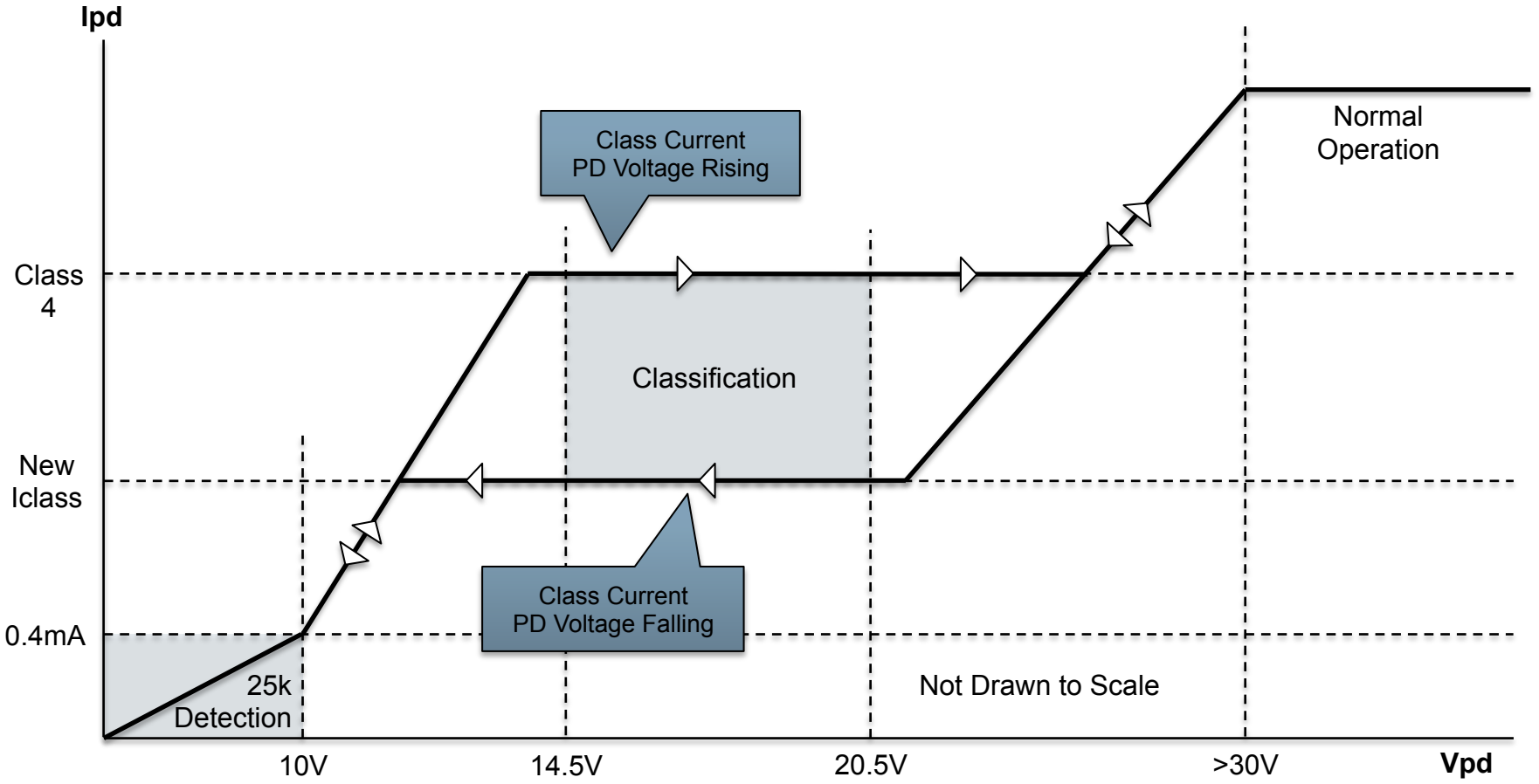
PD Curve Trace



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More Details

- Scheme starts with standard Class test
  - Type 1, Type 2 PDs will respond normally
    - Optional early exit if Class 0/1/2/3 found at first event
    - Optional early exit if Class 4 found at third event
- Return to class voltage from High Mark after 2nd event signals to Type 3+ PDs that PSE is Type 3+
- Additional high mark pulse(s) can carry extra information to Type 3+ PDs
  - Mutual ID for Type 4 (more events)
  - Power demotion
  - Other?

New Classes Using AF-Sized Bins

PD Type	First Event	Second Event	Third Event	Fourth Event (if used)	Result
AF	Class 0-3	(Early exit)	N/A	N/A	Backwards compatible
AT	Class 4	Class 4	Class 4	(Early exit)	Backwards compatible
BT	Class 4	Class 4	Class 1	Class 1	New Class 1
BT	Class 4	Class 4	Class 2	Class 2	New Class 2
BT	Class 4	Class 4	Class 3	Class 3	New Class 3

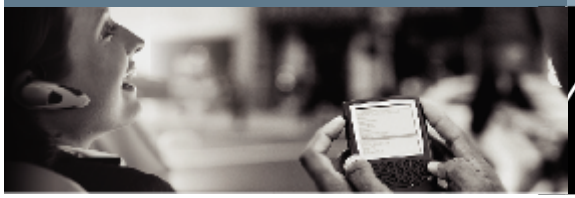
Relative Classification

- Original AF Class bands are quite wide to allow for component tolerances: only 3 new classes
- New class current can be measured relative to Class 4 current – smaller class current bins possible
  - Class 4 (first two events, 40mA nominal) doubles as calibration current
  - 9mA - 30mA range available (bottom of Class 1 to top of Class 3)
    - Class 4 range unused to accommodate existing Type 2 PDs
    - Class 0 range unused to avoid possible legacy PD UVLO range
  - 5% steps give 8 new classes + 1 for future expansion (for example)
    - See Annex for details
    - Smaller % steps = more classes

New Classes - Enhanced

PD Type	First Event	Second Event	Third Event	Fourth Event (if used)	Result
AF	Class 0-3	(Early exit)	N/A	N/A	Backwards compatible
AT	Class 4	Class 4	Class 4	(Early exit)	Backwards compatible
BT	Class 4	Class 4	25% of Class 4	25% of Class 4	New Class 1
BT	Class 4	Class 4	30% of Class 4	30% of Class 4	New Class 2
BT	Class 4	Class 4	35% of Class 4	35% of Class 4	New Class 3
…	…	…	…	…	…
BT	Class 4	Class 4	60% of Class 4	60% of Class 4	New Class 8
BT	Class 4	Class 4	65% of Class 4	65% of Class 4	Future Expansion

Thank You!



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Annex: Relative Class Step Details

percentage	class 4 nom 40.0E-3	class 4 min 36.0E-3	class 4 max 44.0E-3
5.00%	2.0E-3	1.8E-3	2.2E-3
10.00%	4.0E-3	3.6E-3	4.4E-3
15.00%	6.0E-3	5.4E-3	6.6E-3
20.00%	8.0E-3	7.2E-3	8.8E-3
25.00%	10.0E-3	9.0E-3	11.0E-3
30.00%	12.0E-3	10.8E-3	13.2E-3
35.00%	14.0E-3	12.6E-3	15.4E-3
40.00%	16.0E-3	14.4E-3	17.6E-3
45.00%	18.0E-3	16.2E-3	19.8E-3
50.00%	20.0E-3	18.0E-3	22.0E-3
55.00%	22.0E-3	19.8E-3	24.2E-3
60.00%	24.0E-3	21.6E-3	26.4E-3
65.00%	26.0E-3	23.4E-3	28.6E-3
70.00%	28.0E-3	25.2E-3	30.8E-3
75.00%	30.0E-3	27.0E-3	33.0E-3
80.00%	32.0E-3	28.8E-3	35.2E-3
85.00%	34.0E-3	30.6E-3	37.4E-3
90.00%	36.0E-3	32.4E-3	39.6E-3
95.00%	38.0E-3	34.2E-3	41.8E-3
100.00%	40.0E-3	36.0E-3	44.0E-3

min usable:	9.0E-3
max usable:	30.0E-3
worst case step:	1.8E-3

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