

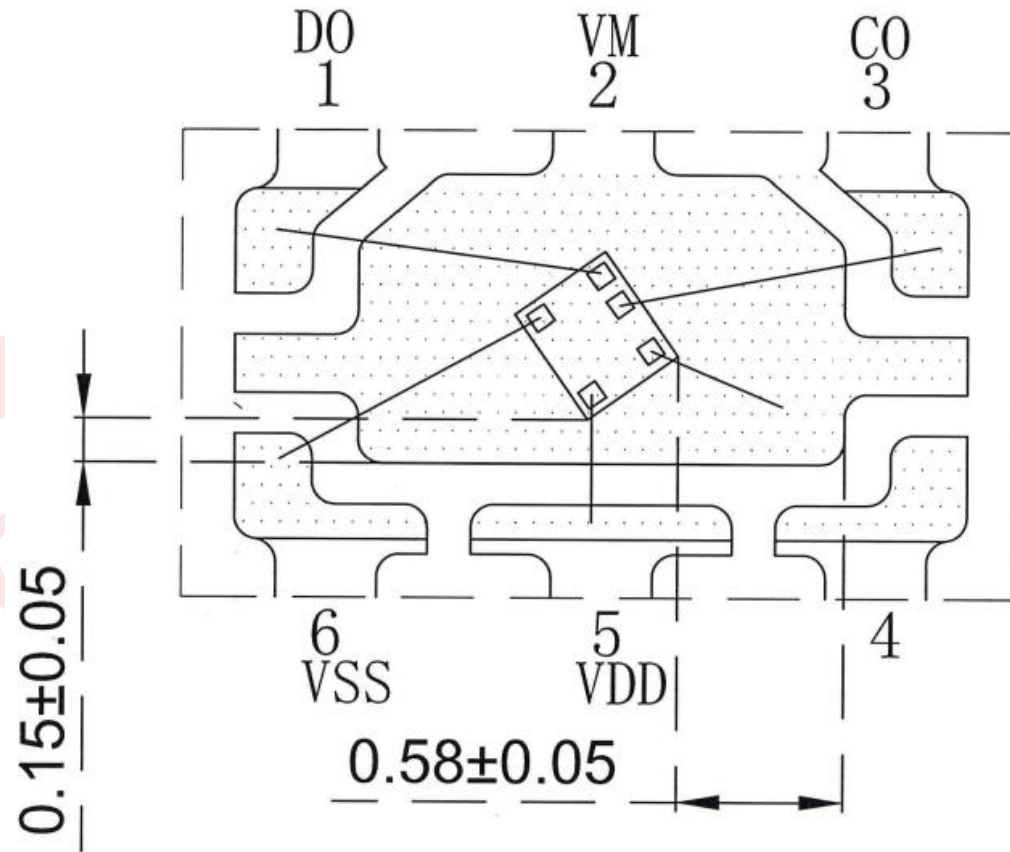
Circuit Design Electrical Reference Manual for CP01A (Statistics of CP01A FT)

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CorePower Technology Co., Ltd.

2023/02/25

CP01A Electrical Package Layout



CP01A Electrical performance

Vcu (CP01A after package and Final Test):

Parameter Model	Overcharge detection	Overcharge delayed release	Over-discharge detection	Over-discharge delayed release	Discharge overcurrent detection 1	Charge function to 0V battery
	Voltage	Voltage	Voltage	Voltage	Voltage	-
	Vcu	Vhc(Vcu-Vcd)	Vdl	Vhd(Vdl-Vdh)	Viov1	V0CH
CP01A-4300A	4.300V+- 25mV	200mV+- 25mV	2.500V+-50mV	400mV+-50mV	0.150V+-15mV	V0CH,Allow
CP01A-4275A	4.275V+- 25mV	200mV+- 25mV	2.500V+-50mV	400mV+-50mV	0.150V+-15mV	V0CH,Allow
CP01A-4300B	4.300V+-100mV	200mV+-100mV	2.500V+-100mV	400mV+-100mV	0.150V+-30mV	V0CH,Allow
CP01A-4275B	4.275V+-100mV	200mV+-100mV	2.500V+-100mV	400mV+-100mV	0.150V+-30mV	V0CH,Allow

-bin1 SPEC: 4.300v+-25mV

-bin2 SPEC: (eng. lot 4.100v~4.275v)

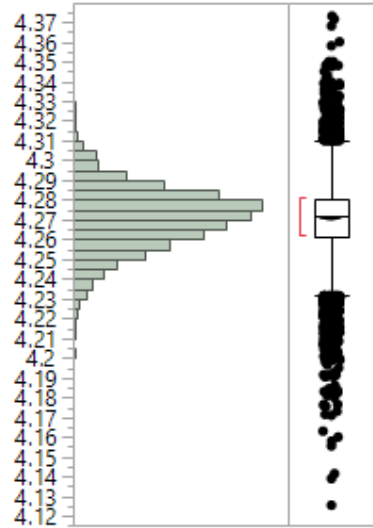
-bin3 SPEC: (eng. lot 4.325v~4.500v)

CP01A FT statistics (Excluding open/short)

- Vcu, Vhc, tcu, Vdl, Vhd, tdl
- Viov1, tiov1, Viov2, tiov2, Vshort, tshort
- Vcha, tcha
- lope, lpnd
- Rvmd, Rvms, Rcoh, Rcol, Rdoh, Rdol
- VOINH (VOCHA)

Distributions

Vcu



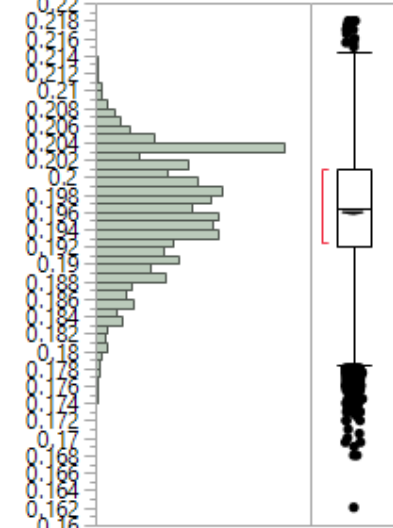
Quantiles

100.0%	maximum	4.373
99.5%		4.3175
97.5%		4.301
90.0%		4.289
75.0%	quartile	4.2805
50.0%	median	4.2715
25.0%	quartile	4.261
10.0%		4.2505
2.5%		4.2355
0.5%		4.2165
0.0%	minimum	4.1255

Summary Statistics

Mean	4.2705488
Std Dev	0.0166877
Std Err Mean	0.0001119
Upper 95% Mean	4.2707682
Lower 95% Mean	4.2703295
N	22233

Vhc



Quantiles

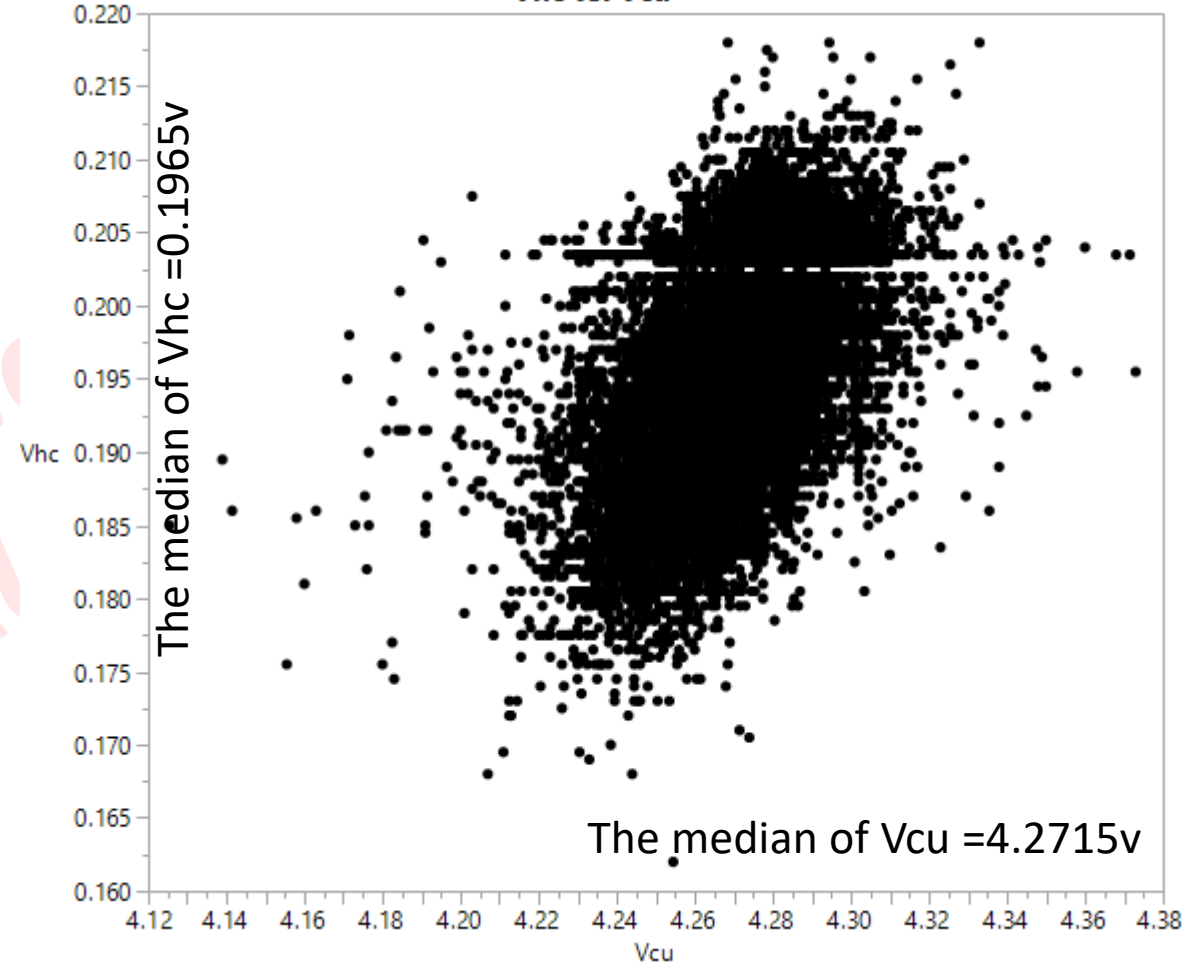
100.0%	maximum	0.218
99.5%		0.2105
97.5%		0.207
90.0%		0.2035
75.0%	quartile	0.201
50.0%	median	0.1965
25.0%	quartile	0.192
10.0%		0.1875
2.5%		0.1825
0.5%		0.1775
0.0%	minimum	0.162

Summary Statistics

Mean	0.1959263
Std Dev	0.0064644
Std Err Mean	4.3354e-5
Upper 95% Mean	0.1960113
Lower 95% Mean	0.1958413
N	22233

Vcu: Overcharge Detection Voltage.
Vhc: Overcharge Hysteresis Voltage.

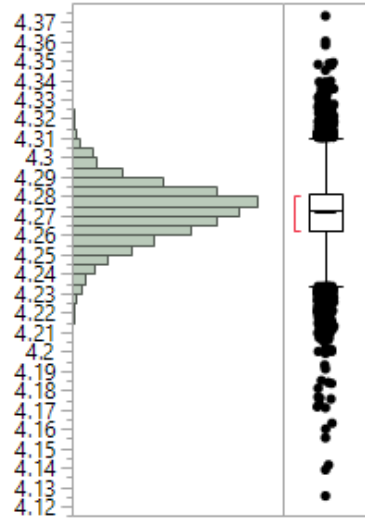
Vhc vs. Vcu



The Vcu offset between CP2 and FT is 30mv.

Distributions

Vcu



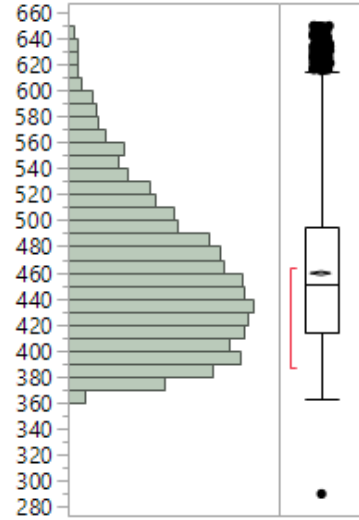
Quantiles

100.0%	maximum	4.373
99.5%		4.315
97.5%		4.301
90.0%		4.289
75.0%	quartile	4.2815
50.0%	median	4.273
25.0%	quartile	4.2625
10.0%		4.2525
2.5%		4.239
0.5%		4.223
0.0%	minimum	4.1255

Summary Statistics

Mean	4.2717341
Std Dev	0.0156955
Std Err Mean	0.0001219
Upper 95% Mean	4.2719731
Lower 95% Mean	4.2714952
N	16582

TCU



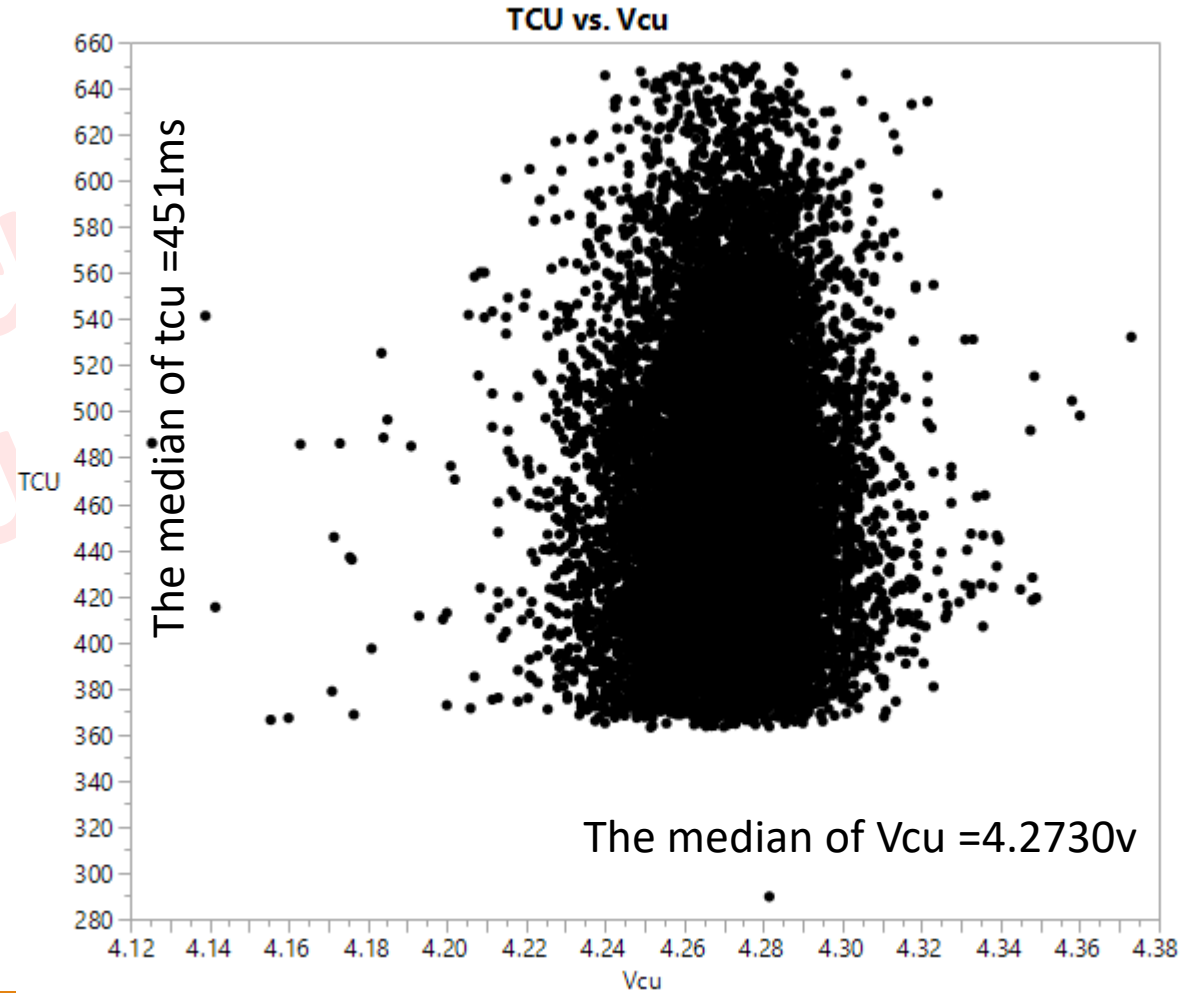
Quantiles

100.0%	maximum	649.44
99.5%		631.83165
97.5%		591.87275
90.0%		541.56
75.0%	quartile	494.4475
50.0%	median	450.78
25.0%	quartile	414.06
10.0%		390.33
2.5%		375.87
0.5%		369.00745
0.0%	minimum	289.8

Summary Statistics

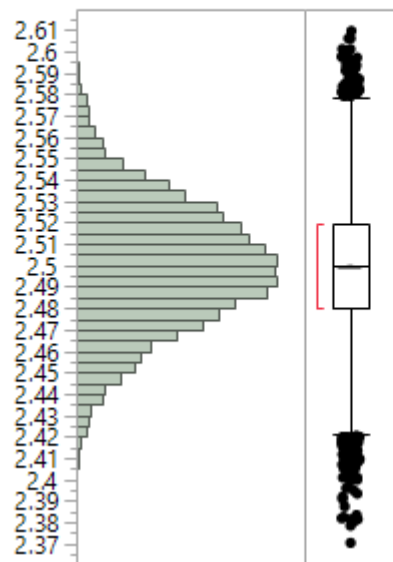
Mean	459.1729
Std Dev	57.741007
Std Err Mean	0.4484003
Upper 95% Mean	460.05182
Lower 95% Mean	458.29399
N	16582

Vcu: Overcharge Detection Voltage.
tcu: Overcharge Detection delay time.



Distributions

VDL



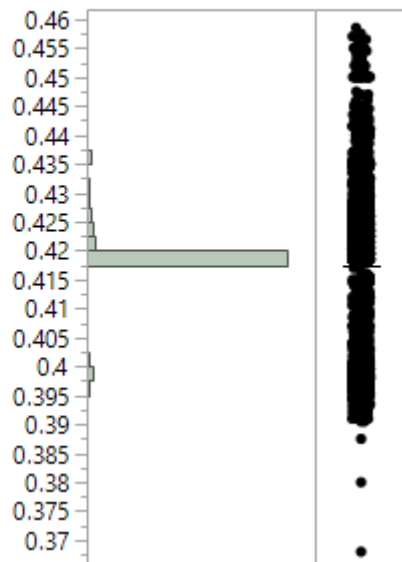
Quantiles

100.0%	maximum	2.6095
99.5%		2.577
97.5%		2.5575
90.0%		2.5365
75.0%	quartile	2.5195
50.0%	median	2.4995
25.0%	quartile	2.48
10.0%		2.461
2.5%		2.4395
0.5%		2.421
0.0%	minimum	2.3705

Summary Statistics

Mean	2.4993212
Std Dev	0.0296725
Std Err Mean	0.000217
Upper 95% Mean	2.4997466
Lower 95% Mean	2.4988958
N	18695

VHD



Quantiles

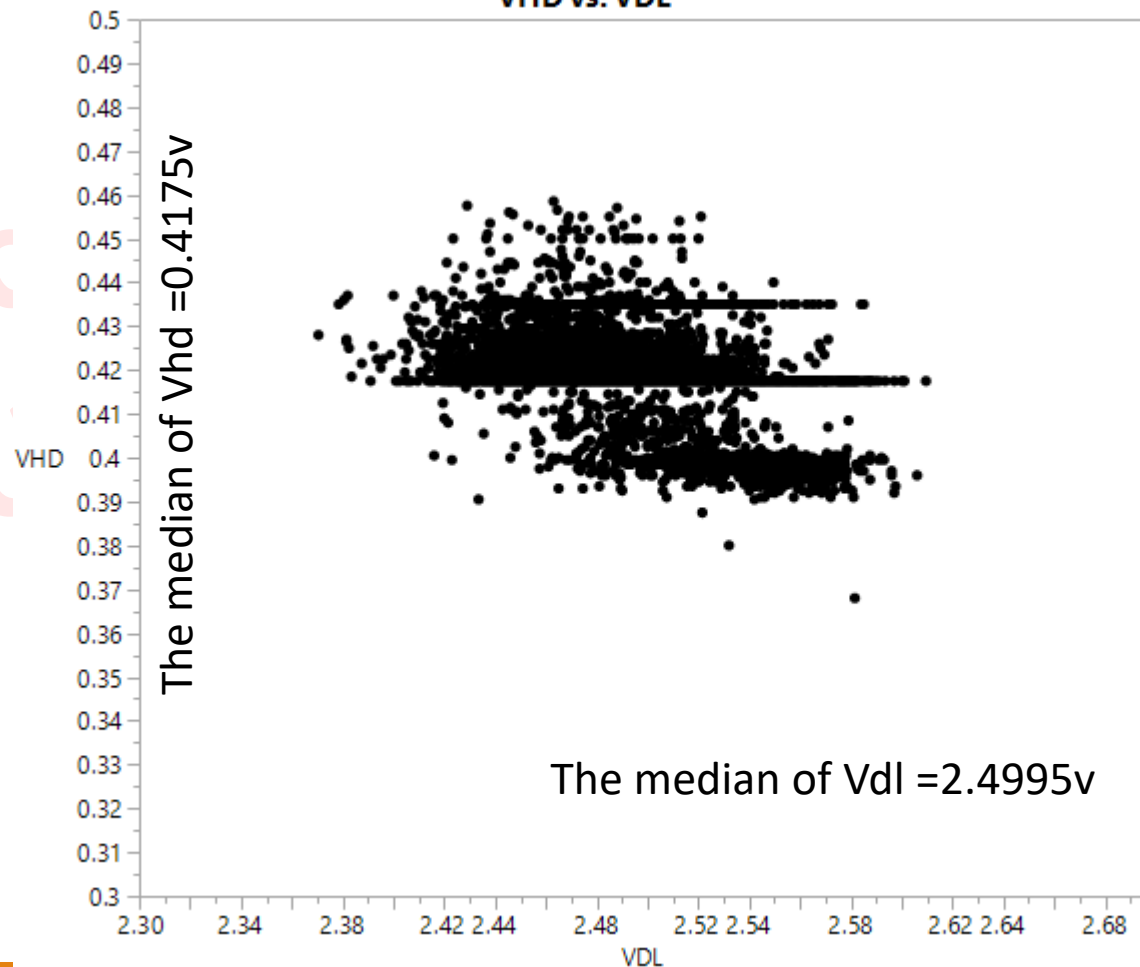
100.0%	maximum	0.4585
99.5%		0.44
97.5%		0.435
90.0%		0.4215
75.0%	quartile	0.4175
50.0%	median	0.4175
25.0%	quartile	0.4175
10.0%		0.4175
2.5%		0.3985
0.5%		0.395
0.0%	minimum	0.368

Summary Statistics

Mean	0.4176833
Std Dev	0.0059912
Std Err Mean	4.3818e-5
Upper 95% Mean	0.4177692
Lower 95% Mean	0.4175974
N	18695

Vdl: Overdischarge Detection Voltage.
Vhd: Overdischarge Hysteresis Voltage.

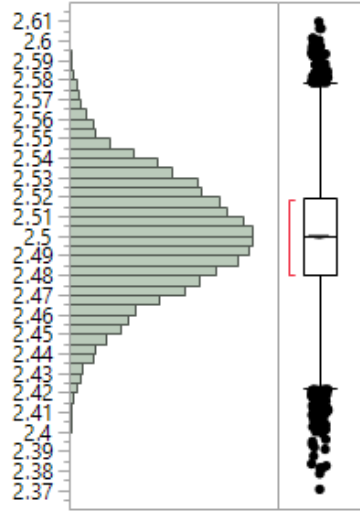
VHD vs. VDL



Vdl: Overdischarge Detection Voltage.
tdl: Overdischarge Detection delay time.

Distributions

VDL



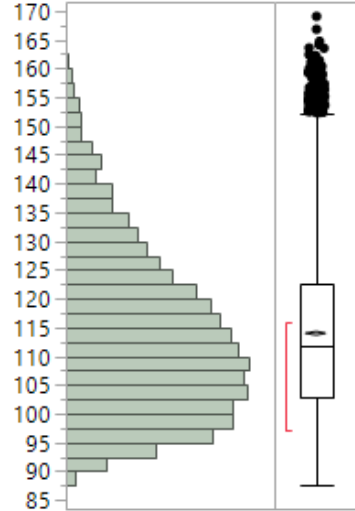
Quantiles

100.0%	maximum	2.6095
99.5%		2.577
97.5%		2.557
90.0%		2.536
75.0%	quartile	2.5195
50.0%	median	2.5
25.0%	quartile	2.4805
10.0%		2.4615
2.5%		2.4395
0.5%		2.421
0.0%	minimum	2.3705

Summary Statistics

Mean	2.4995476
Std Dev	0.0294989
Std Err Mean	0.0002291
Upper 95% Mean	2.4999968
Lower 95% Mean	2.4990985
N	16572

TDL



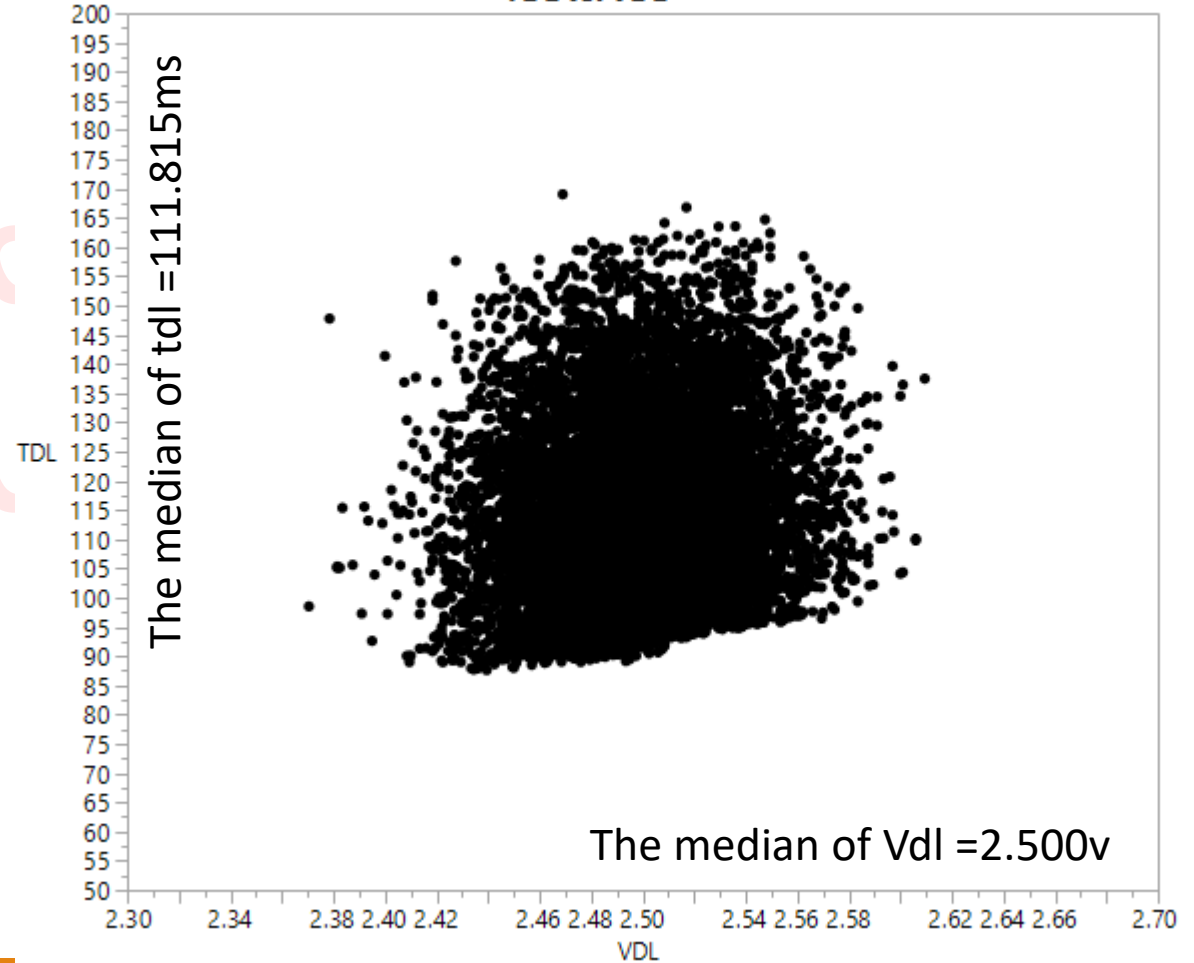
Quantiles

100.0%	maximum	169.05
99.5%		155.75565
97.5%		146.57675
90.0%		134.24
75.0%	quartile	122.65
50.0%	median	111.815
25.0%	quartile	102.89
10.0%		97.073
2.5%		92.98
0.5%		90.29
0.0%	minimum	87.65

Summary Statistics

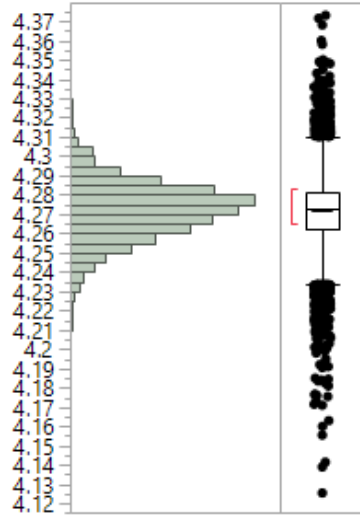
Mean	113.94425
Std Dev	14.272618
Std Err Mean	0.1108705
Upper 95% Mean	114.16156
Lower 95% Mean	113.72693
N	16572

TDL vs. VDL



Distributions

Vcu



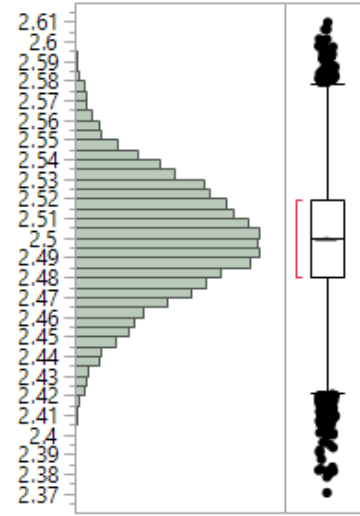
Quantiles

100.0%	maximum	4.373
99.5%		4.318
97.5%		4.3015
90.0%		4.289
75.0%	quartile	4.2815
50.0%	median	4.273
25.0%	quartile	4.2625
10.0%		4.2525
2.5%		4.2385
0.5%		4.2215
0.0%	minimum	4.1255

Summary Statistics

Mean	4.2716044
Std Dev	0.0160259
Std Err Mean	0.0001172
Upper 95% Mean	4.2718341
Lower 95% Mean	4.2713746
N	18695

VDL



Quantiles

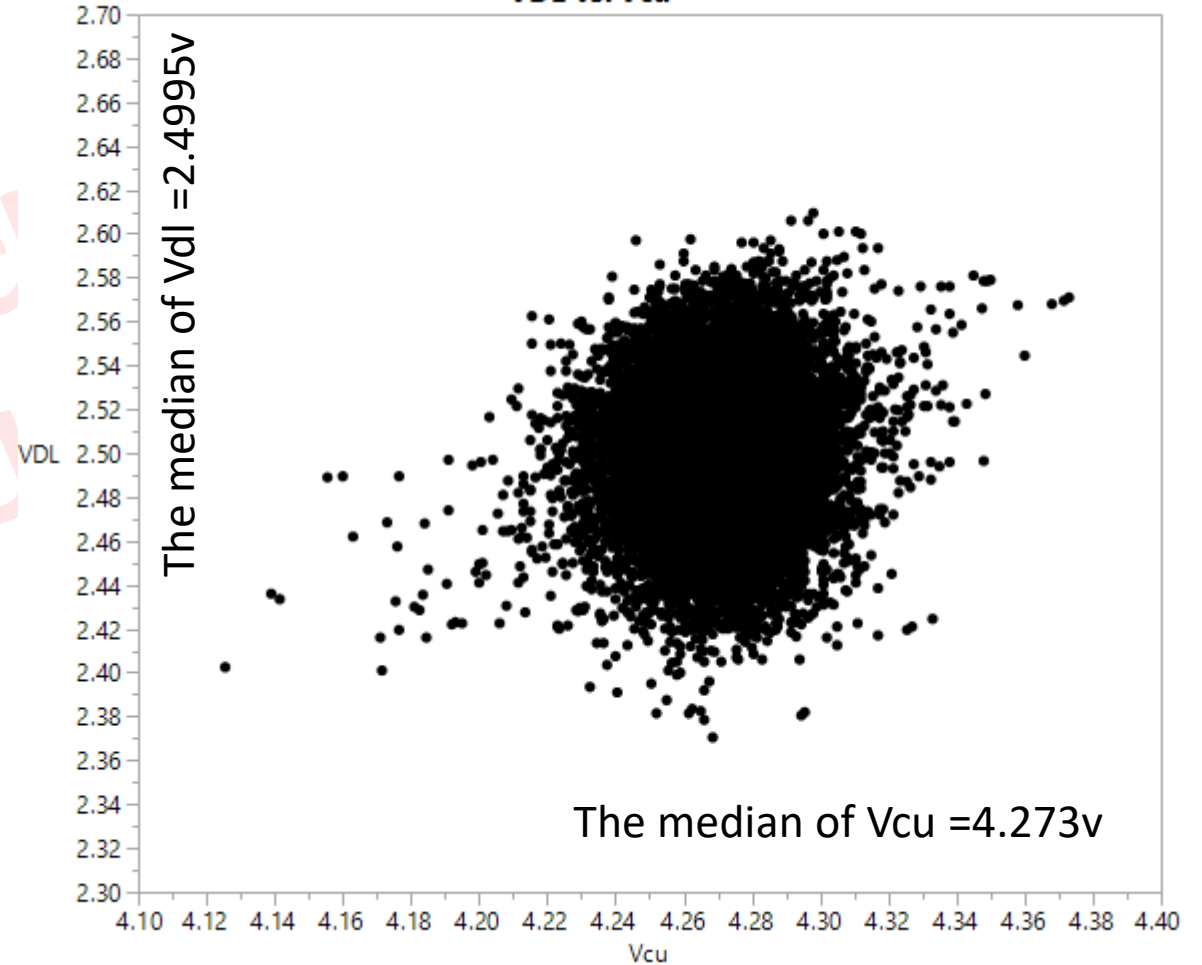
100.0%	maximum	2.6095
99.5%		2.577
97.5%		2.5575
90.0%		2.5365
75.0%	quartile	2.5195
50.0%	median	2.4995
25.0%	quartile	2.48
10.0%		2.461
2.5%		2.4395
0.5%		2.421
0.0%	minimum	2.3705

Summary Statistics

Mean	2.4993212
Std Dev	0.0296725
Std Err Mean	0.000217
Upper 95% Mean	2.4997466
Lower 95% Mean	2.4988958
N	18695

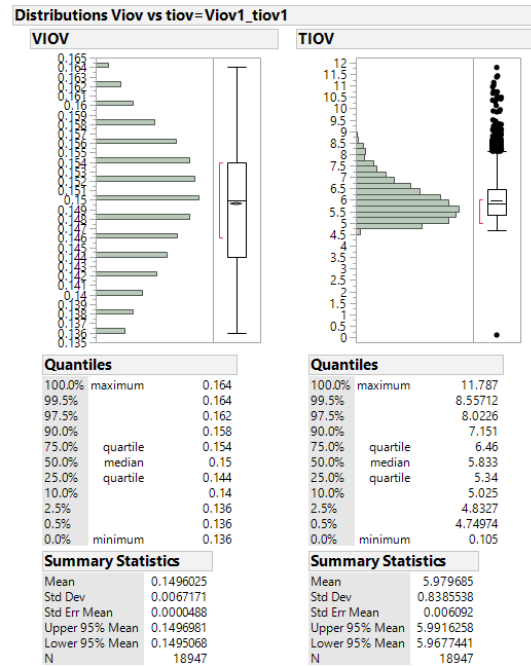
Vcu: Overcharge Detection Voltage.
Vdl: Overdischarge Hysteresis Voltage.

VDL vs. Vcu



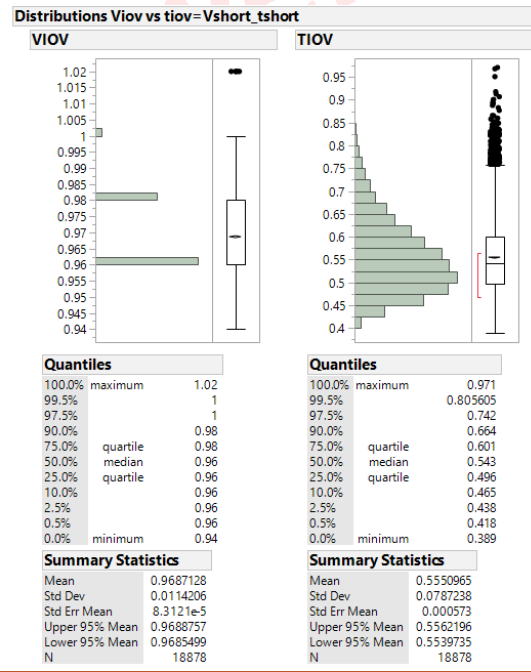
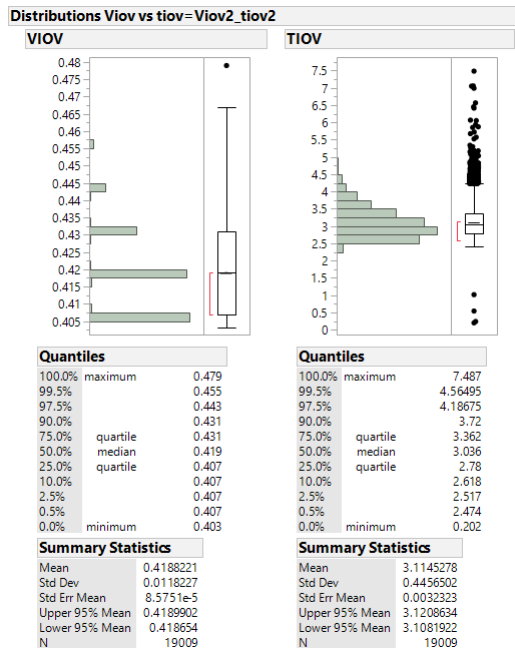
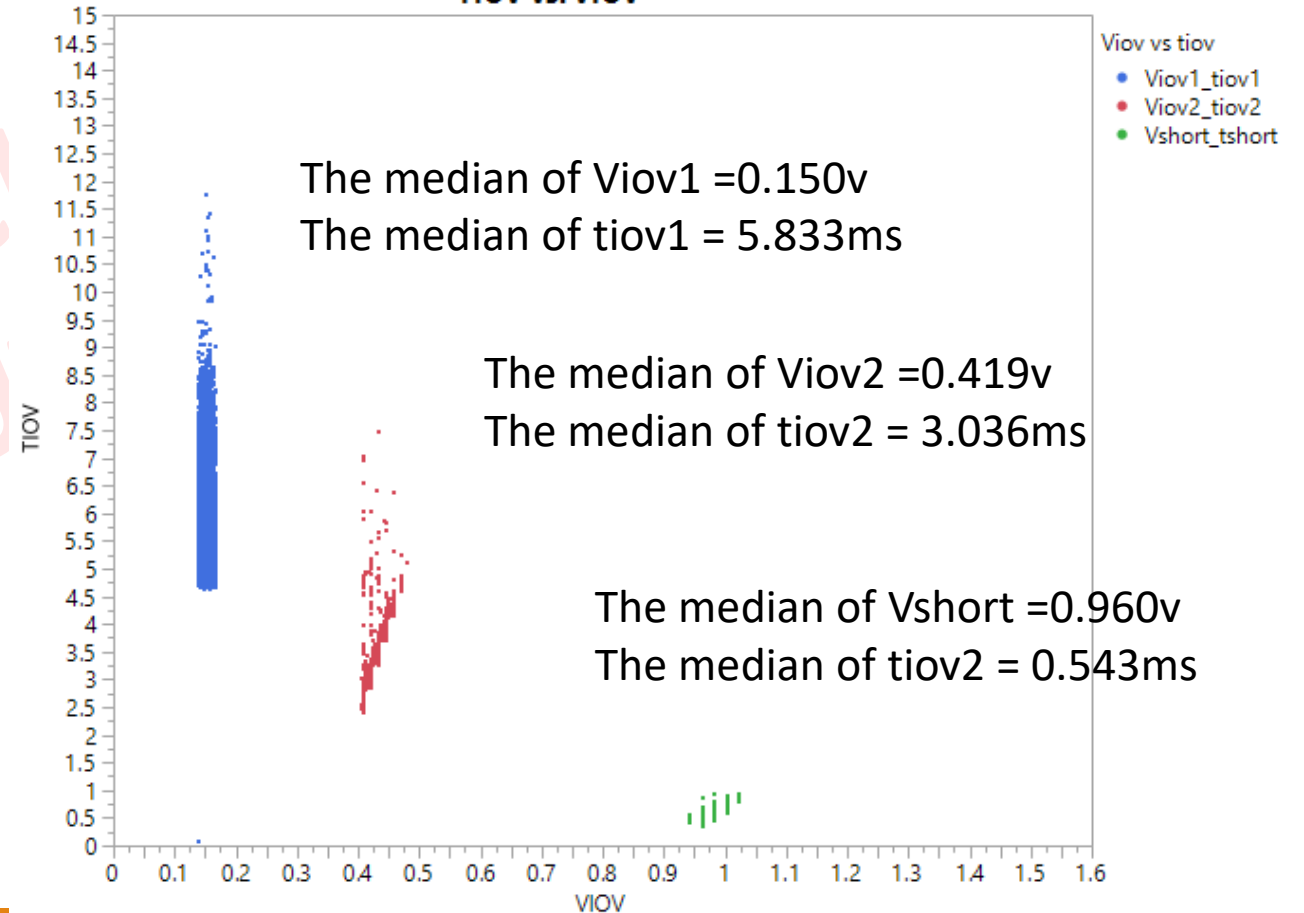
CP01A FT statistics (Excluding open/short)

- Vcu, Vhc, tcu, Vdl, Vhd, tdl
- Viov1, tiov1, Viov2, tiov2, Vshort, tshort
- Vcha, tcha
- Iope, Ipnd
- Rvmd, Rvms, Rcoh, Rcol, Rdoh, Rdol
- VOINH (VOCHA)



Viovs1: Overcurrent 1 Detection Voltage.
 Viovs2: Overcurrent 2 Detection Voltage.
 Vshort: Load Short-Circuiting Detection Voltage.
 tiouv1: Overcurrent 1 detection delay time.
 tiouv2: Overcurrent 2 detection delay time.
 tshort: Load short-circuiting detection delay time.

TIOV vs. VIOV





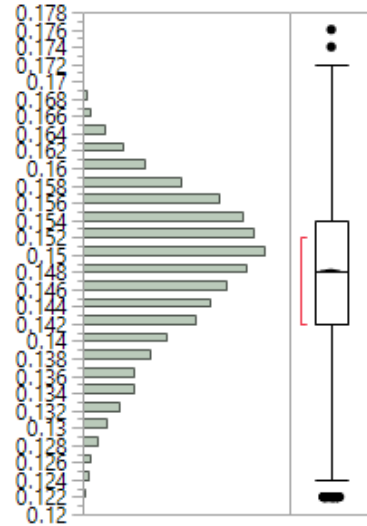
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Viov1: Overcurrent 1 Detection Voltage.

Distributions

VIOV1

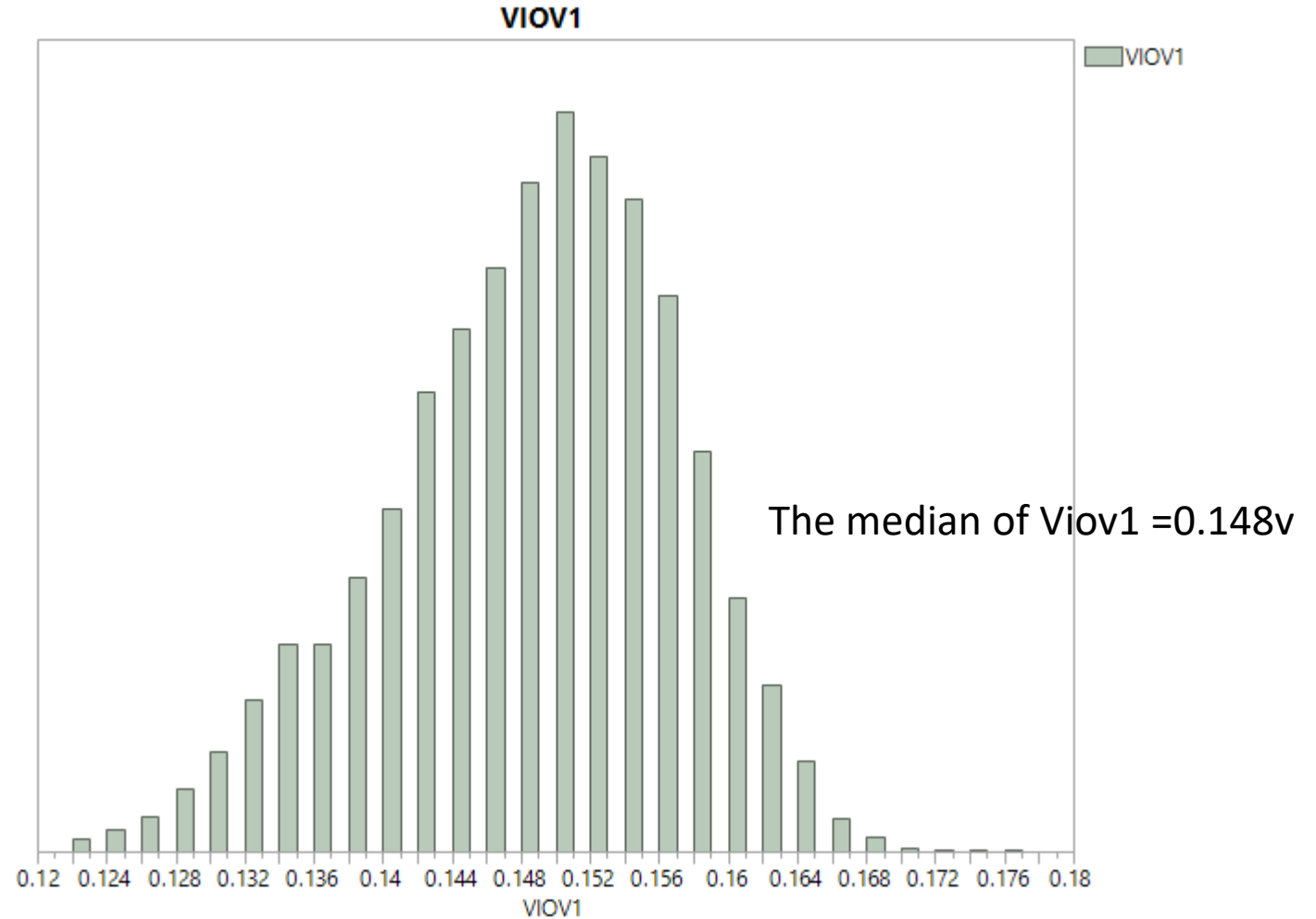


Quantiles

100.0%	maximum	0.176
99.5%		0.166
97.5%		0.162
90.0%		0.158
75.0%	quartile	0.154
50.0%	median	0.148
25.0%	quartile	0.142
10.0%		0.136
2.5%		0.13
0.5%		0.126
0.0%	minimum	0.122

Summary Statistics

Mean	0.1480779
Std Dev	0.0082932
Std Err Mean	5.3626e-5
Upper 95% Mean	0.148183
Lower 95% Mean	0.1479727
N	23916



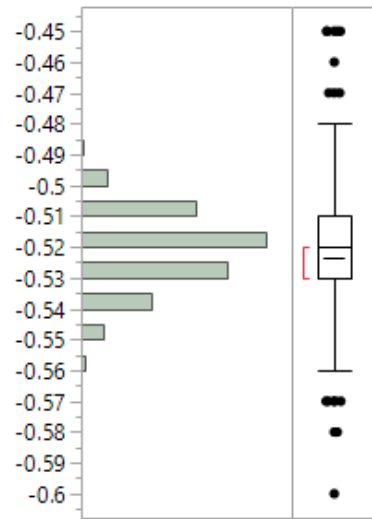
CP01A FT statistics (Excluding open/short)

- Vcu, Vhc, tcu, Vdl, Vhd, tdl
- Viov1, tiov1, Viov2, tiov2, Vshort, tshort
- Vcha, tcha
- lope, lpnd
- Rvmd, Rvms, Rcoh, Rcol, Rdoh, Rdol
- VOINH (VOCHA)

Vcha: Charger Detection Voltage.
tcha: Charger Detection delay time.

Distributions

VCHA



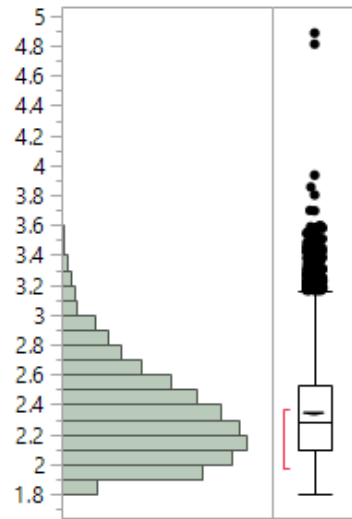
Quantiles

100.0%	maximum	-0.45
99.5%		-0.5
97.5%		-0.5
90.0%		-0.51
75.0%	quartile	-0.51
50.0%	median	-0.52
25.0%	quartile	-0.53
10.0%		-0.54
2.5%		-0.55
0.5%		-0.56
0.0%	minimum	-0.6

Summary Statistics

Mean	-0.523386
Std Dev	0.012336
Std Err Mean	0.0000905
Upper 95% Mean	-0.523209
Lower 95% Mean	-0.523563
N	18583

TCHA_T

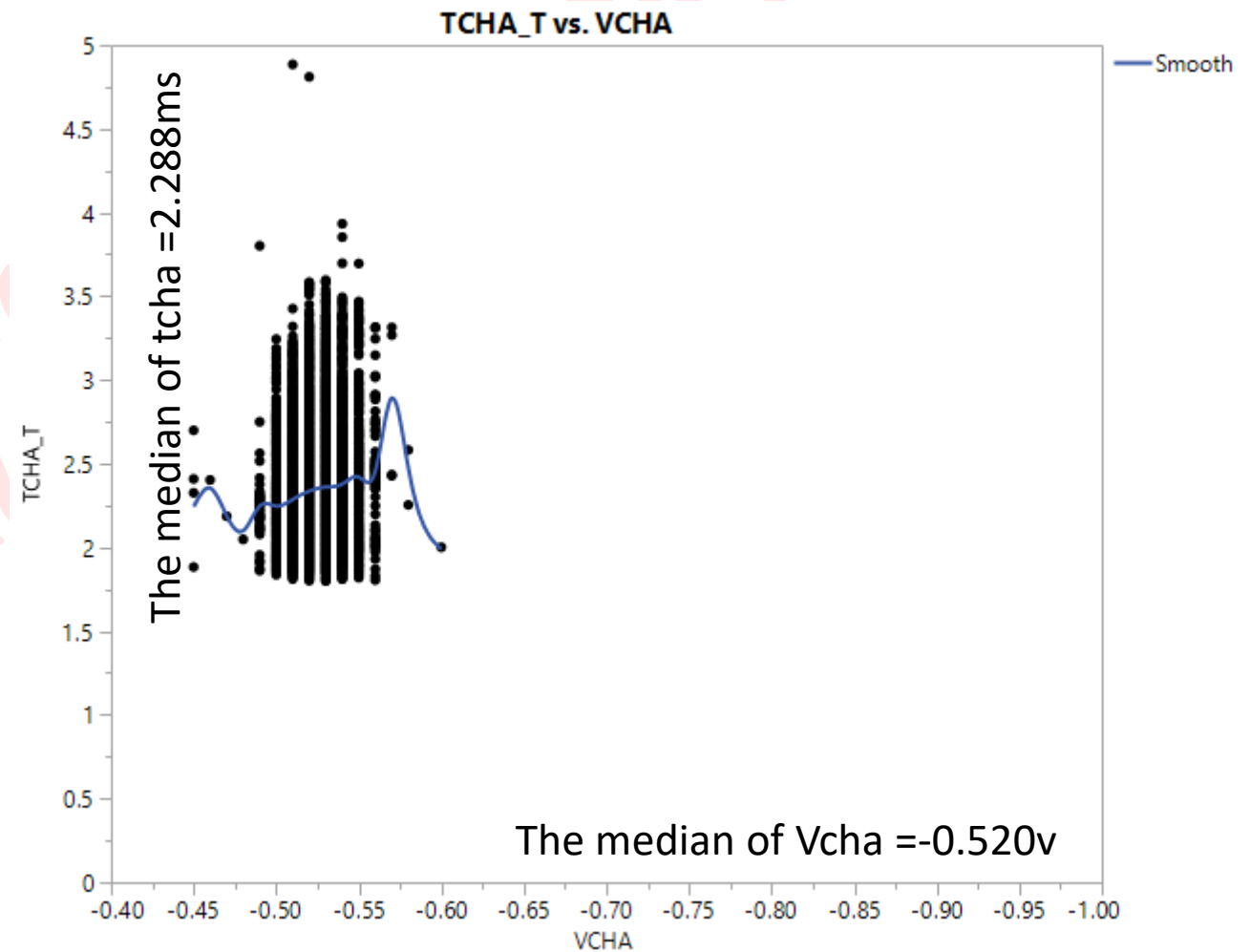


Quantiles

100.0%	maximum	4.885
99.5%		3.32608
97.5%		3.064
90.0%		2.778
75.0%	quartile	2.524
50.0%	median	2.288
25.0%	quartile	2.099
10.0%		1.9774
2.5%		1.897
0.5%		1.84692
0.0%	minimum	1.8

Summary Statistics

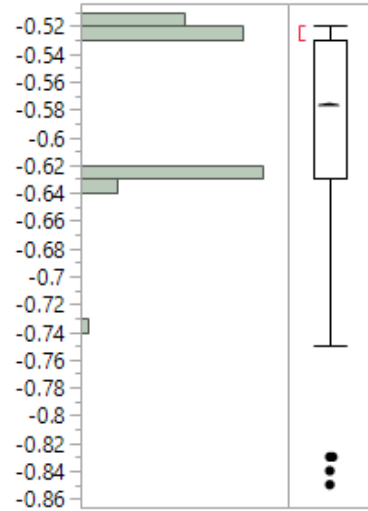
Mean	2.3386472
Std Dev	0.3127408
Std Err Mean	0.0022942
Upper 95% Mean	2.343144
Lower 95% Mean	2.3341504
N	18583



Vab_cha: Abnormal Charger Current Detection Voltage.
tab_cha: Abnormal Charger Current Detection delay time.

Distributions

VAB_CHA



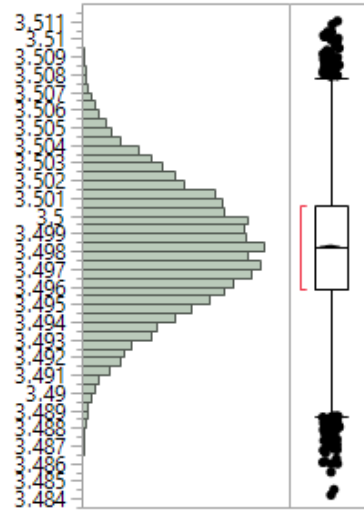
Quantiles

100.0%	maximum	-0.52
99.5%		-0.52
97.5%		-0.52
90.0%		-0.52
75.0%	quartile	-0.53
50.0%	median	-0.53
25.0%	quartile	-0.63
10.0%		-0.63
2.5%		-0.64
0.5%		-0.74
0.0%	minimum	-0.85

Summary Statistics

Mean	-0.576713
Std Dev	0.0568083
Std Err Mean	0.0004167
Upper 95% Mean	-0.575896
Lower 95% Mean	-0.577529
N	18583

TAB_CHA



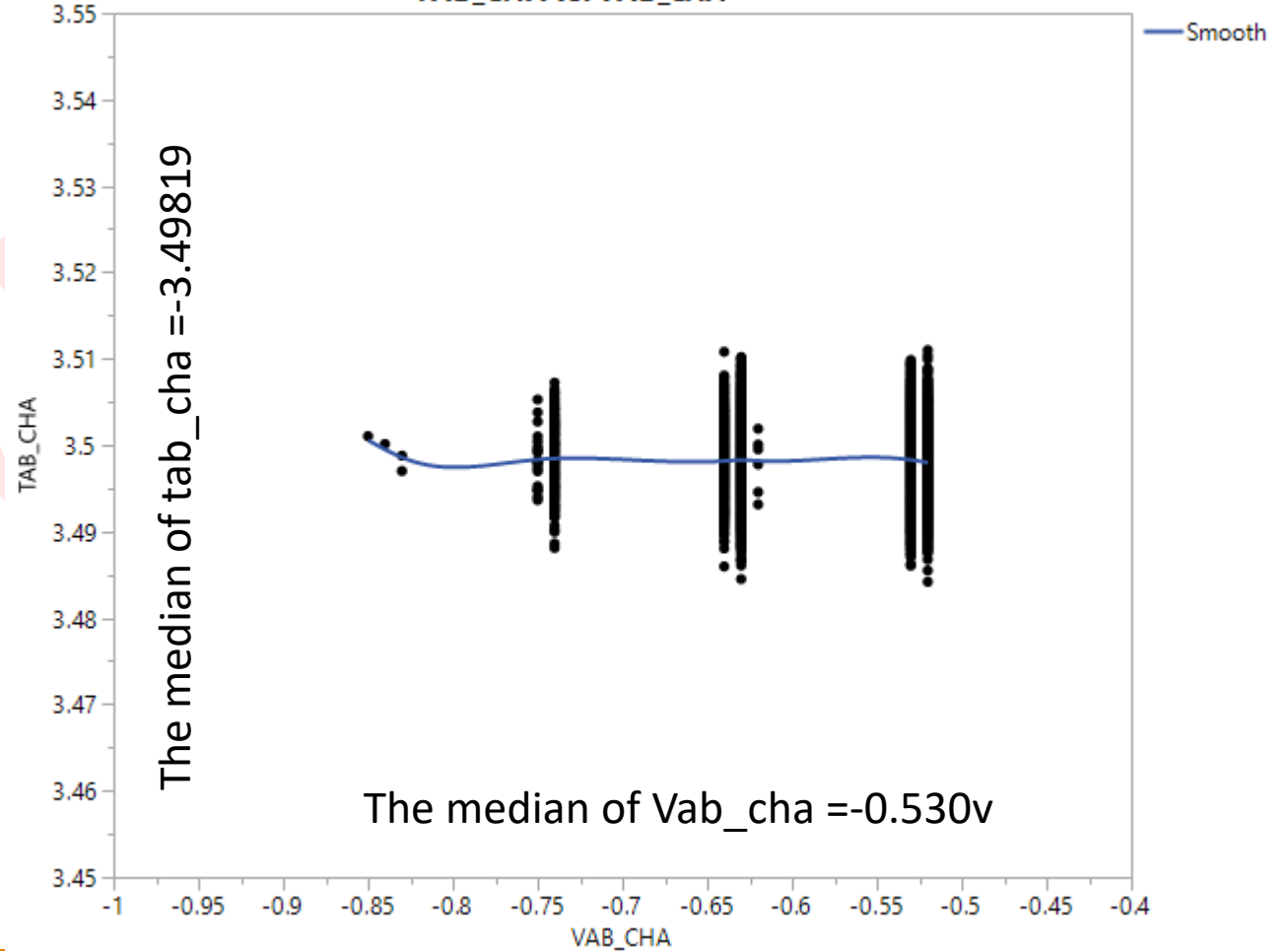
Quantiles

100.0%	maximum	3.511
99.5%		3.5071616
97.5%		3.50505
90.0%		3.50273
75.0%	quartile	3.50062
50.0%	median	3.49819
25.0%	quartile	3.49584
10.0%		3.4937
2.5%		3.49141
0.5%		3.4891484
0.0%	minimum	3.484

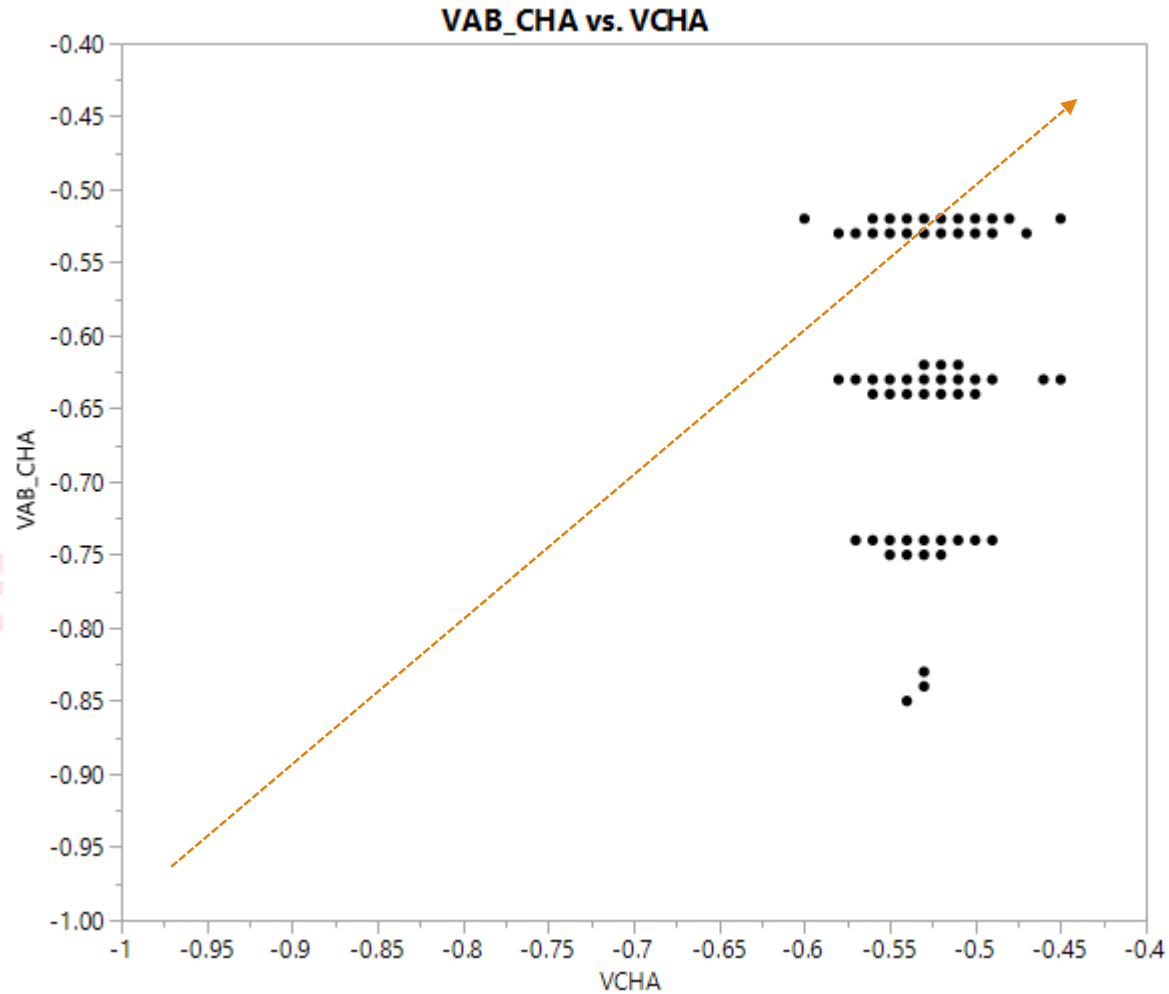
Summary Statistics

Mean	3.4982188
Std Dev	0.0035002
Std Err Mean	2.5676e-5
Upper 95% Mean	3.4982692
Lower 95% Mean	3.4981685
N	18583

TAB_CHA vs. VAB_CHA



Vcha: Abnormal Charger Current Detection Voltage.
tcha: Abnormal Charger Current Detection delay time.



CP01A FT statistics (Excluding open/short)

- Vcu, Vhc, tcu, Vdl, Vhd, tdl
- Viov1, tiov1, Viov2, tiov2, Vshort, tshort
- Vcha, tcha
- lope, lpnd
- Rvmd, Rvms, Rcoh, Rcol, Rdoh, Rdol
- VOINH (VOCHA)

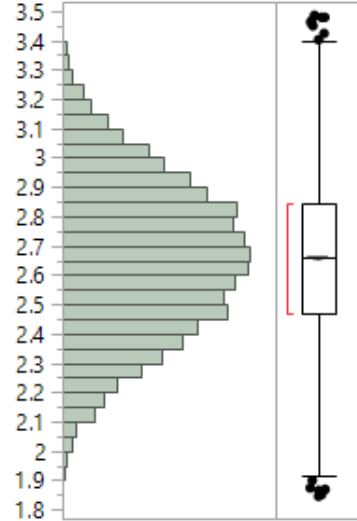


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Distributions

IOPE



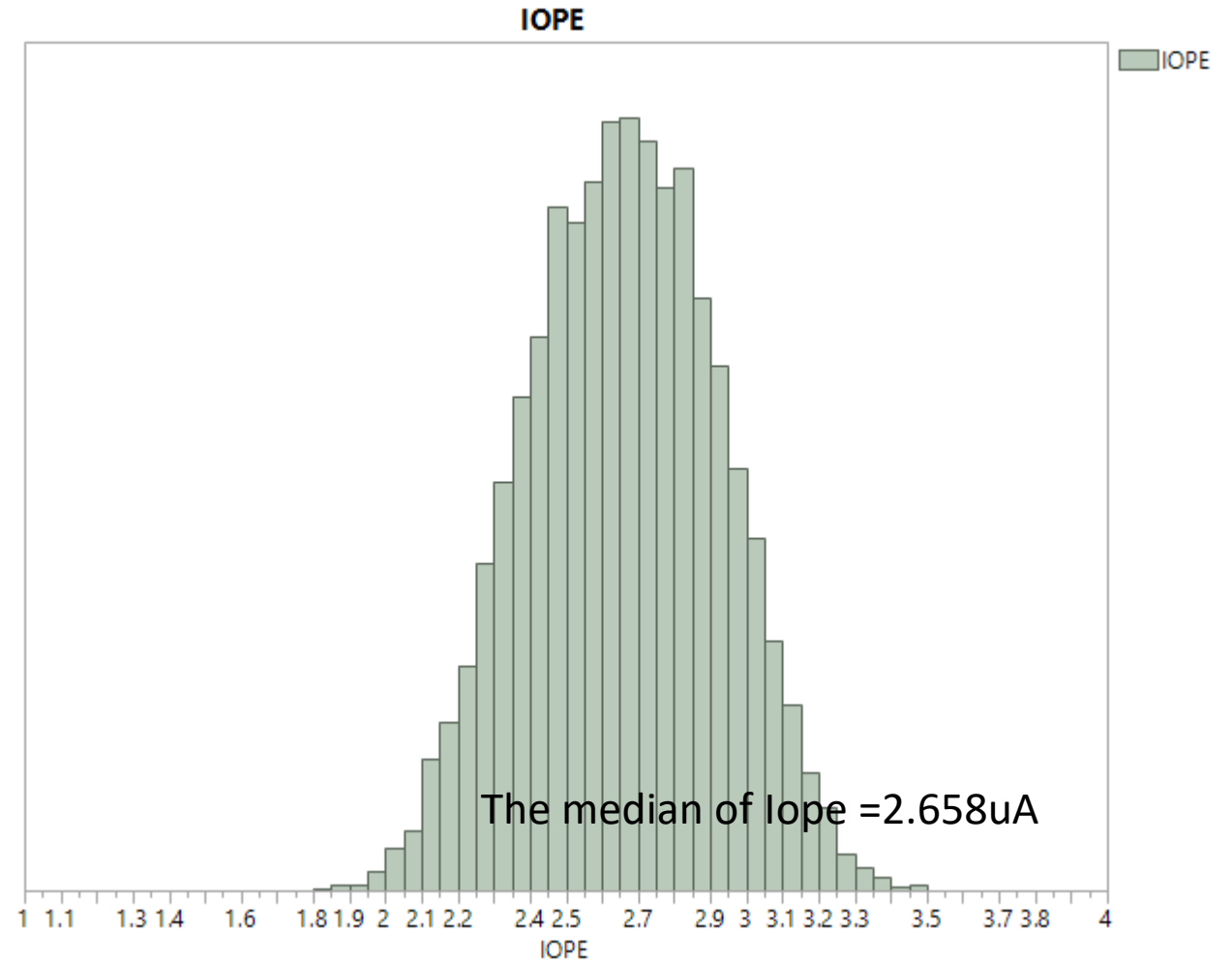
Quantiles

100.0%	maximum	3.4849
99.5%		3.2711178
97.5%		3.15155
90.0%		2.99756
75.0%	quartile	2.84211
50.0%	median	2.65847
25.0%	quartile	2.47026
10.0%		2.31585
2.5%		2.1563925
0.5%		2.0396488
0.0%	minimum	1.84535

Summary Statistics

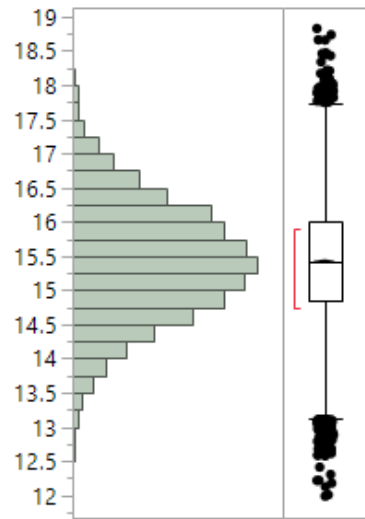
Mean	2.6572729
Std Dev	0.2599745
Std Err Mean	0.0020539
Upper 95% Mean	2.6612989
Lower 95% Mean	2.653247
N	16021

lope: Normal Operation Current Consumption.



Distributions

IPDN



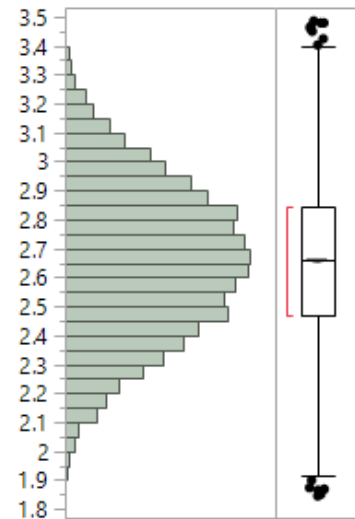
Quantiles

100.0%	maximum	18.8261
99.5%		17.6651075
97.5%		17.0886
90.0%		16.5027
75.0%	quartile	16.0028
50.0%	median	15.41485
25.0%	quartile	14.8472
10.0%		14.3472
2.5%		13.7151
0.5%		13.1458
0.0%	minimum	11.9895

Summary Statistics

Mean	15.418587
Std Dev	0.8535532
Std Err Mean	0.0067387
Upper 95% Mean	15.431796
Lower 95% Mean	15.405379
N	16044

IOPE



Quantiles

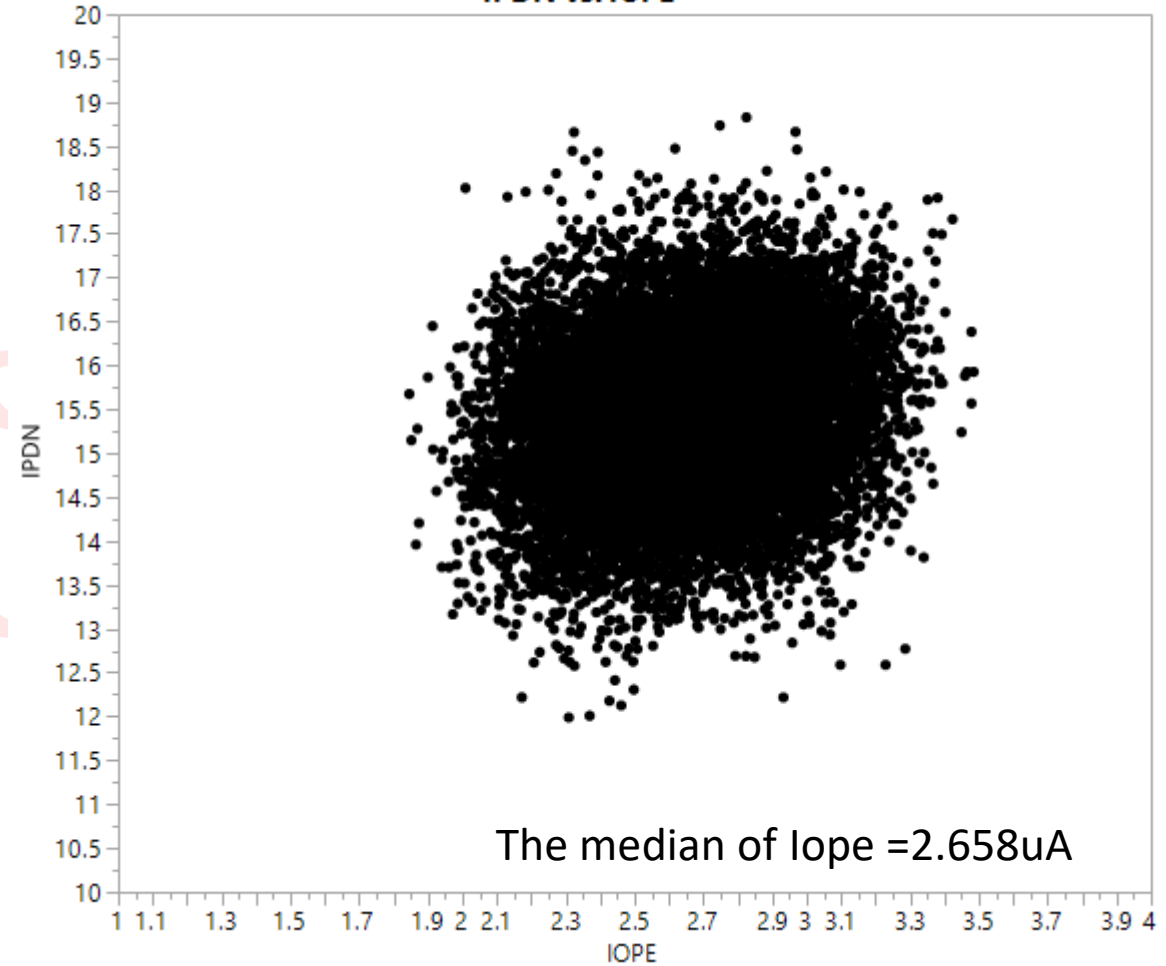
100.0%	maximum	3.4849
99.5%		3.2711178
97.5%		3.15155
90.0%		2.99756
75.0%	quartile	2.84211
50.0%	median	2.65847
25.0%	quartile	2.47026
10.0%		2.31585
2.5%		2.1563925
0.5%		2.0396488
0.0%	minimum	1.84535

Summary Statistics

Mean	2.6572729
Std Dev	0.2599745
Std Err Mean	0.0020539
Upper 95% Mean	2.6612989
Lower 95% Mean	2.653247
N	16021

IoPe: Normal Operation Current Consumption.
Ipdn: Power-down Current Consumption.

IPDN vs. IOPE



Currently Ipdn is >10uA due to avoid mask flow out.
In production, Ipdn will become lower enough <3uA.

CP01A FT statistics (Excluding open/short)

- Vcu, Vhc, tcu, Vdl, Vhd, tdl
- Viov1, tiov1, Viov2, tiov2, Vshort, tshort
- Vcha, tcha
- lope, lpnd
- Rvmd, Rvms, Rcoh, Rcol, Rdoh, Rdol
- VOINH (VOCHA)

Rvmd: Internal Resistance between VM and VDD.

Rvms: Internal Resistance between VM and VSS.

Rcoh: CO pin Resistance "H".

Rcol: CO pin Resistance "L".

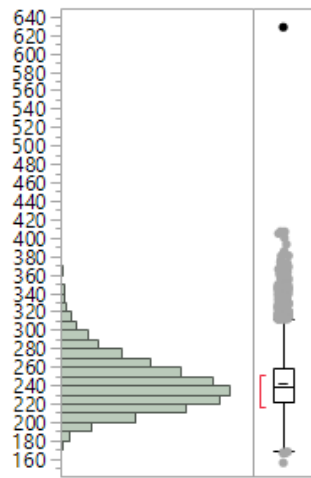
Rdoh: DO pin Resistance "H".

Rdol: DO pin Resistance "L".

Ltd.

Distributions

RVMD



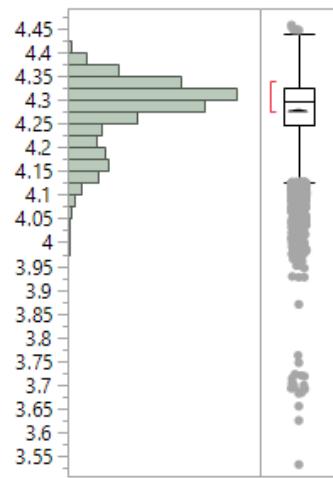
The median of Rvmsd=239k ohm

Quantiles		
100.0%	maximum	628.497
99.5%		339.90715
97.5%		306.674525
90.0%		278.45
75.0%	quartile	258.006
50.0%	median	238.7
25.0%	quartile	222.272
10.0%		209.561
2.5%		197.026625
0.5%		185.317035
0.0%	minimum	155.679

Summary Statistics

Mean	242.02223
Std Dev	28.249407
Std Err Mean	0.2194431
Upper 95% Mean	242.45236
Lower 95% Mean	241.59209
N	16572

RVMS



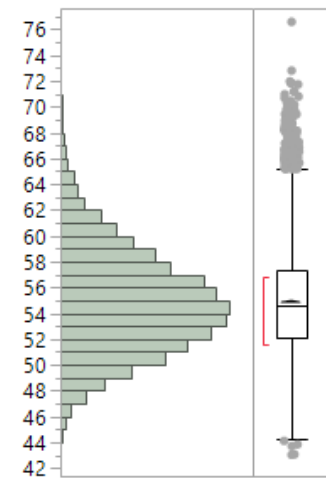
The median of Rvms =4.3k ohm

Quantiles		
100.0%	maximum	4.45722
99.5%		4.4039424
97.5%		4.3789
90.0%		4.349854
75.0%	quartile	4.32469
50.0%	median	4.29673
25.0%	quartile	4.2453875
10.0%		4.160921
2.5%		4.1096665
0.5%		4.0316971
0.0%	minimum	3.53227

Summary Statistics

Mean	4.2761476
Std Dev	0.074963
Std Err Mean	0.0005823
Upper 95% Mean	4.277289
Lower 95% Mean	4.2750062
N	16572

RCOH



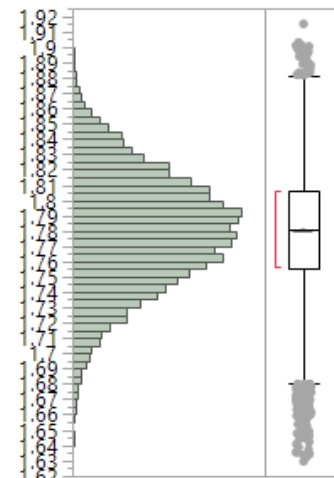
The median of Rcoh =52k ohm

Quantiles		
100.0%	maximum	76.592
99.5%		66.8372535
97.5%		63.4993
90.0%		60.10547
75.0%	quartile	57.3291
50.0%	median	54.6053
25.0%	quartile	52.0968
10.0%		50.0861
2.5%		47.9723
0.5%		46.3105235
0.0%	minimum	43.0251

Summary Statistics

Mean	54.895877
Std Dev	3.9424673
Std Err Mean	0.0306253
Upper 95% Mean	54.955906
Lower 95% Mean	54.835848
N	16572

RCOL



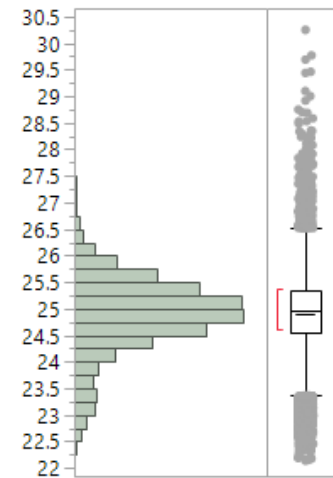
The median of Rcol =1.7k ohm

Quantiles		
100.0%	maximum	1.91523
99.5%		1.8721959
97.5%		1.8517
90.0%		1.82774
75.0%	quartile	1.80607
50.0%	median	1.78089
25.0%	quartile	1.75563
10.0%		1.73175
2.5%		1.70264475
0.5%		1.67385705
0.0%	minimum	1.62938

Summary Statistics

Mean	1.7801508
Std Dev	0.037835
Std Err Mean	0.0002939
Upper 95% Mean	1.7807269
Lower 95% Mean	1.7795747
N	16572

RDOH



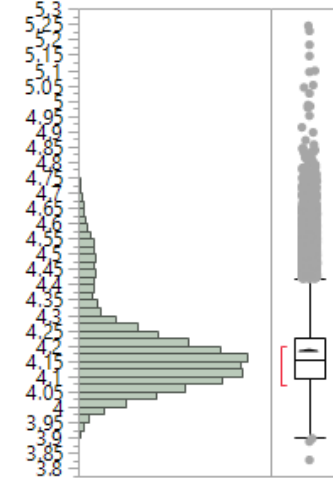
The median of Rdoh =25k ohm

Quantiles		
100.0%	maximum	30.2502
99.5%		27.185438
97.5%		26.2136
90.0%		25.7005
75.0%	quartile	25.33945
50.0%	median	24.96055
25.0%	quartile	24.5522
10.0%		23.9504
2.5%		23.0464
0.5%		22.6487
0.0%	minimum	22.1393

Summary Statistics

Mean	24.895521
Std Dev	0.7583546
Std Err Mean	0.0058909
Upper 95% Mean	24.907068
Lower 95% Mean	24.883974
N	16572

RDOL



The median of Rdoh =4.2k ohm

Quantiles		
100.0%	maximum	5.24478
99.5%		4.69382235
97.5%		4.56931
90.0%		4.377666
75.0%	quartile	4.22495
50.0%	median	4.15448
25.0%	quartile	4.09488
10.0%		4.04692
2.5%		3.99710775
0.5%		3.95258605
0.0%	minimum	3.82634

Summary Statistics

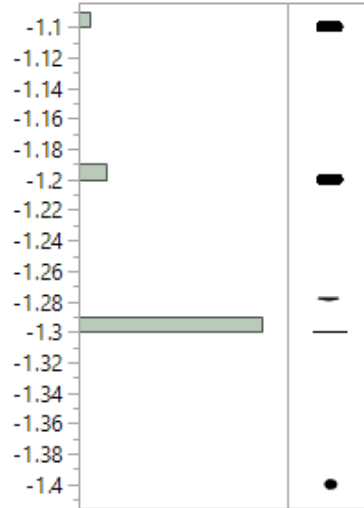
Mean	4.1828592
Std Dev	0.1404401
Std Err Mean	0.0010909
Upper 95% Mean	4.1849976
Lower 95% Mean	4.1807208
N	16572

CP01A FT statistics (Excluding open/short)

- Vcu, Vhc, tcu, Vdl, Vhd, tdl
- Viov1, tiov1, Viov2, tiov2, Vshort, tshort
- Vcha, tcha
- lope, lpnd
- Rvmd, Rvms, Rcoh, Rcol, Rdoh, Rdol
- VOINH (VOCHA)

Distributions

V0CHA



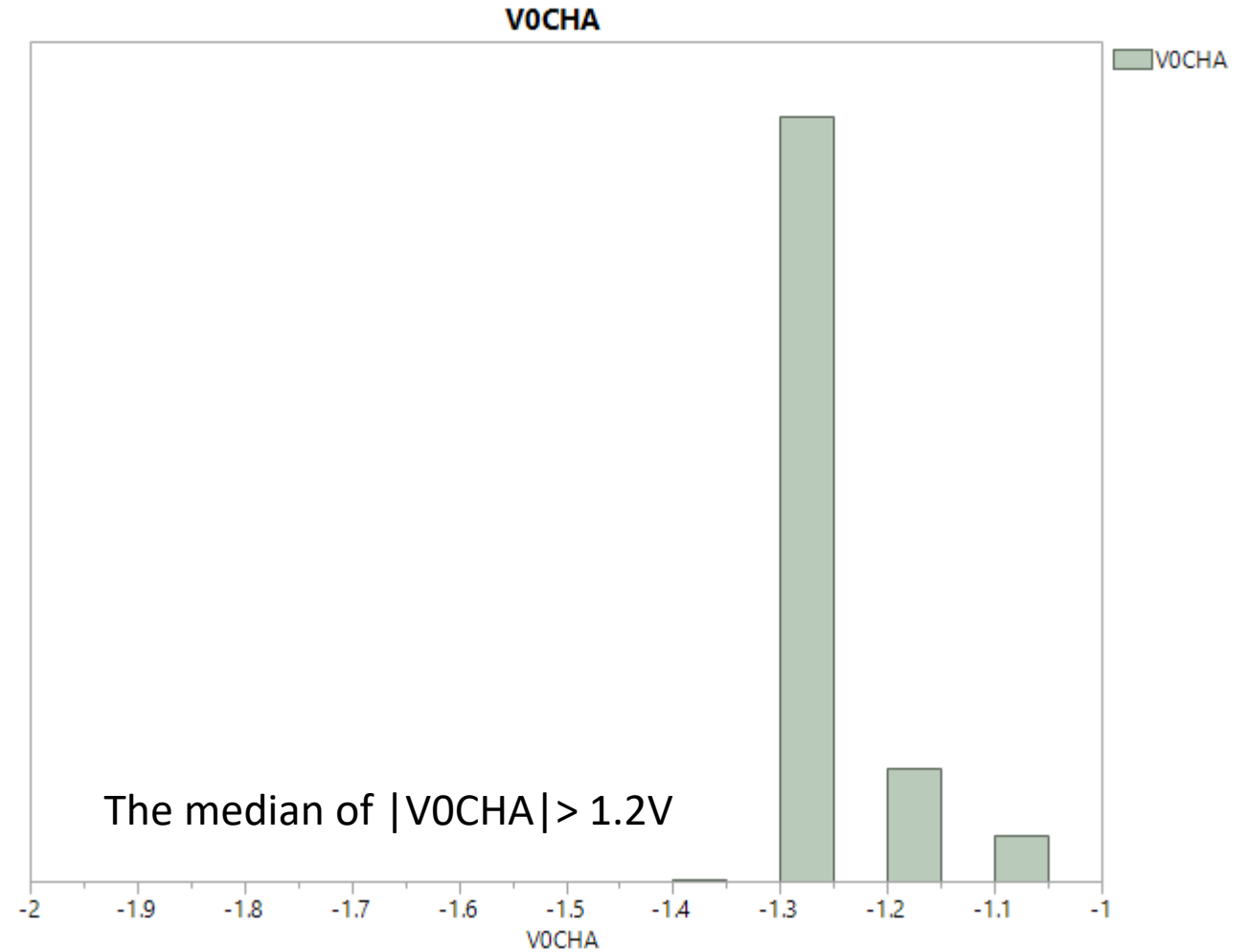
Quantiles

100.0%	maximum	-1.1
99.5%		-1.1
97.5%		-1.1
90.0%		-1.2
75.0%	quartile	-1.3
50.0%	median	-1.3
25.0%	quartile	-1.3
10.0%		-1.3
2.5%		-1.3
0.5%		-1.3
0.0%	minimum	-1.4

Summary Statistics

Mean	-1.278464
Std Dev	0.0513625
Std Err Mean	0.0003768
Upper 95% Mean	-1.277726
Lower 95% Mean	-1.279203
N	18583

V0CHA: 0V battery Change Starting Charger Voltage.



End