TOTAL IONIZING DOSE Test Report

BC857B,215 - 100mA PNP Transistor from NXP/Nexperia

Prepared by **Florian Krimmel**

Reference
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APPROVAL

Title TID Test Report BJT COTS	
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CHANGE LOG

Reason for change	Issue Nr.	Revision Number	Date

CHANGE RECORD

Issue Number 0	Revision Number 0		
Reason for change	**Date**	**Pages**	**Paragraph(s)**

DISTRIBUTION

Name/Organisational Unit

Table of contents:

1 INTRODUCTION

This report presents the total ionizing dose results of **BC857B,215** a **100mA PNP Transistor from NXP/Nexperia**.

2 DOCUMENTS

APPLICABLE AND REFERENCE DOCUMENTS
BJTs COTS TID test plan
Datasheet **BC857** from Nexperia

3 PART REFERENCES

REFERENCES	
Type:	BC857B,215
Manufacturer:	NXP/Nexperia
Function:	100 mA general-purpose transistors
Technology:	Bipolar PNP Silicon
PARTS PROCUREMENT	
Packaging:	SOT23 (TO-236AB)
Date Code:	batch no. 25: Dec-2019 batch no. 26: Feb-2019 batch no. 28: Feb-2020
Distributor:	batch no. 25: Farnell batch no. 26: RS Components batch no. 28: Mouser
Number of Parts: 3 x 10 irradiated and 3 x 1 ref	

4 DOSIMETRY AND IRRADIATION FACILITY

IRRADIATION FACILITY	
Source:	C060
Localization:	ESTEC, Netherlands
Dosimetry:	FARMER 2670 / 2571

IRRADIATION TIMING	
Total dose limit (krad(Si))	50
Level for measurement (krad(Si))	0, 5, 10, 21, 50
Dose rate (krad(Si)/h)	0.24

ANNEALING TIMING	
Annealing 22°C	24 h
Ageing 100°C	168h

5 TEST EQUIPMENT

PARAMETER	TEST EQUIPMENT
VCEo(BR), VCBo(BR), VCE(sat), hfe (Ic>50mA)	SZ UNIMET M300 Test adapter TA07B.1 SA 07.B.03/1
hfe (Ic<50mA)	Keysight B2912A Precision Source/Measure Unit

6 TEST PARAMETERS

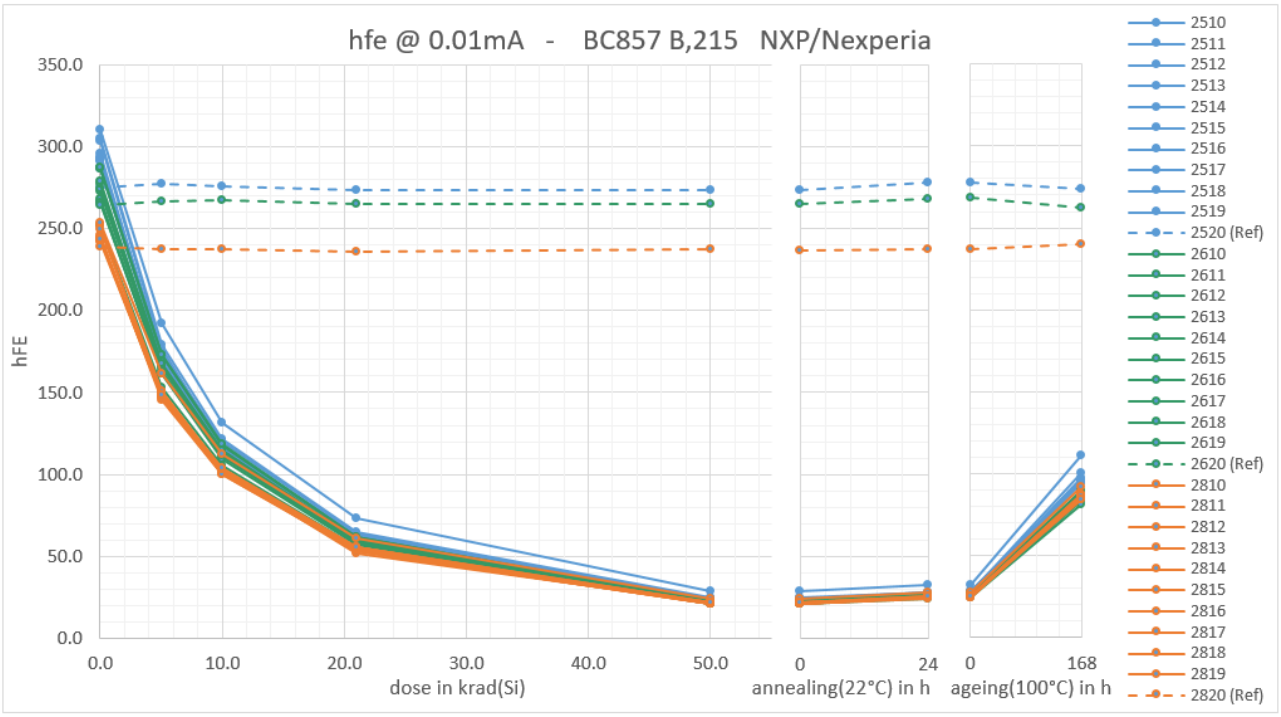
PARAMETERS	SYMBOLS	TEST CONDITIONS
Forward Current Transfer Ratio	hfe1	Ic= 0.01mA, Vce = 1V
	hfe2	Ic= 0.1mA, Vce = 1V
	hfe3	Ic= 1mA, Vce = 1V
	hfe4	Ic= 10mA, Vce = 1V
	hfe5	Ic= 100mA, Vce = 1V
Collector-Emitter Breakdown Voltage	VCEo (BR)	Ic = 10mA
Collector-Base Breakdown Voltage	VCBo (BR)	Ic = 10uA
Collector-Emitter Saturation Voltage	VCE (sat)	Ib = 5mA, Ic = 100mA

7 BIAS CONDITIONS

All samples were irradiated in unbiased condition. During the irradiation and during the annealing, a connection of all pins of the transistors was ensured by a conductive foam. During the aging at 100 °C aluminium foil was used to create a connection between all pins.

8 TEST RESULTS

8.1 hfe @ 0.01 mA

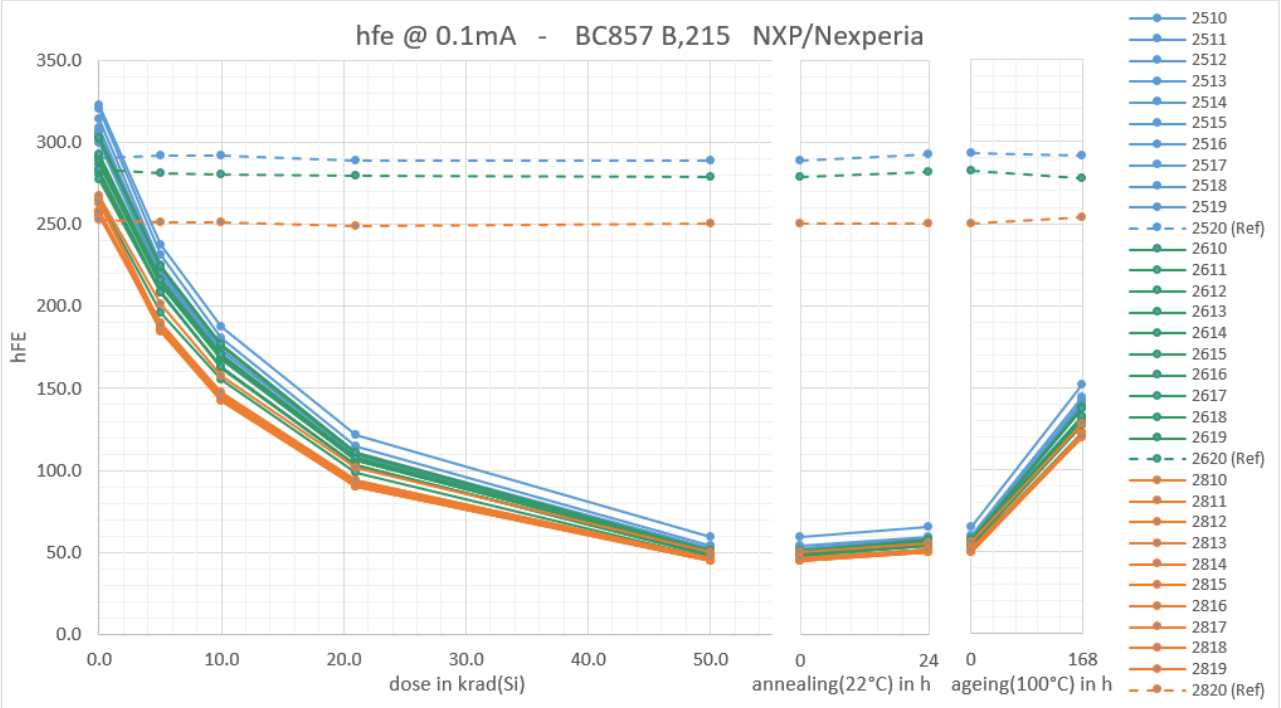


hfe @ 0.01mA	BC857 B,215 NXP/Nexperia Farnell Dec-2019						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2510	286.7	170.3	115.8	61.9	23.6	27.1	95.3
2511	304.8	179.0	121.9	64.9	24.7	28.2	96.6
2512	303.0	176.6	116.8	62.5	24.3	27.7	100.8
2513	292.1	168.7	115.1	61.3	23.1	26.6	94.6
2514	291.3	171.9	116.5	63.0	23.8	27.2	95.1
2515	295.8	171.4	115.6	60.9	23.6	27.0	96.2
2516	293.5	171.9	115.8	61.6	23.6	26.9	97.2
2517	287.4	174.0	118.1	62.6	23.8	27.1	95.5
2518	309.9	191.7	131.3	73.0	29.1	32.4	110.9
2519	291.6	174.7	120.0	64.0	24.4	28.2	95.1
2520 (Ref)	274.9	276.9	275.9	273.3	273.1	277.9	274.2
Average	295.61	175.00	118.68	63.57	24.39	27.85	97.72
s	7.749	6.623	4.927	3.539	1.718	1.684	4.983
Average+3s	318.86	194.87	133.46	74.19	29.54	32.90	112.66
Average-3s	272.37	155.14	103.90	52.96	19.23	22.80	82.77

hfe @ 0.01mA	BC857 B,215 NXP/Nexperia RS Feb-2019						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2610	266.3	161.6	110.9	57.6	21.5	25.3	83.3
2611	268.2	161.5	109.1	57.4	21.4	25.0	83.2
2612	252.1	153.1	105.8	55.3	20.8	24.3	81.5
2613	272.6	165.1	112.8	59.9	22.3	26.0	86.1
2614	274.3	166.8	113.3	59.7	22.0	26.0	86.1
2615	277.0	165.9	114.8	59.6	22.6	26.6	86.7
2616	286.4	172.8	117.9	61.4	22.8	26.7	89.8
2617	265.4	162.7	111.7	58.6	22.0	25.9	86.1
2618	278.4	167.6	114.4	60.5	22.6	26.5	86.7
2619	287.4	173.0	118.2	61.9	22.7	26.9	88.7
2620 (Ref)	264.4	266.2	266.9	265.1	264.9	268.2	262.6
Average	272.83	165.00	112.89	59.21	22.07	25.92	85.81
s	10.517	5.845	3.813	1.994	0.668	0.833	2.530
Average+3s	304.38	182.54	124.33	65.19	24.08	28.41	93.40
Average-3s	241.28	147.47	101.46	53.22	20.07	23.42	78.22

hfe @ 0.01mA	BC857 B,215 NXP/Nexperia Mouser Feb-2020						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2810	252.1	149.1	101.6	53.3	21.5	24.9	87.6
2811	242.0	147.4	102.7	54.6	21.6	25.1	86.0
2812	243.2	147.9	101.1	53.4	21.2	25.0	86.7
2813	249.4	150.8	102.1	52.1	22.1	25.2	87.7
2814	243.1	148.3	102.0	55.4	21.4	25.3	84.7
2815	245.6	145.7	100.1	53.5	21.5	24.7	86.6
2816	244.2	146.5	100.3	54.0	21.1	24.6	85.2
2817	253.5	161.4	112.0	61.3	24.4	28.0	92.0
2818	242.3	150.5	103.4	55.5	22.0	25.5	86.9
2819	243.5	148.5	103.6	55.9	21.8	25.4	84.4
2820 (Ref)	239.2	237.4	237.7	236.1	237.0	237.1	240.3
Average	245.89	149.61	102.88	54.88	21.87	25.39	86.77
s	4.193	4.431	3.413	2.539	0.934	0.959	2.154
Average+3s	258.46	162.90	113.11	62.50	24.67	28.26	93.24
Average-3s	233.31	136.32	92.64	47.26	19.06	22.51	80.31

8.2 hfe @ 0.1 mA

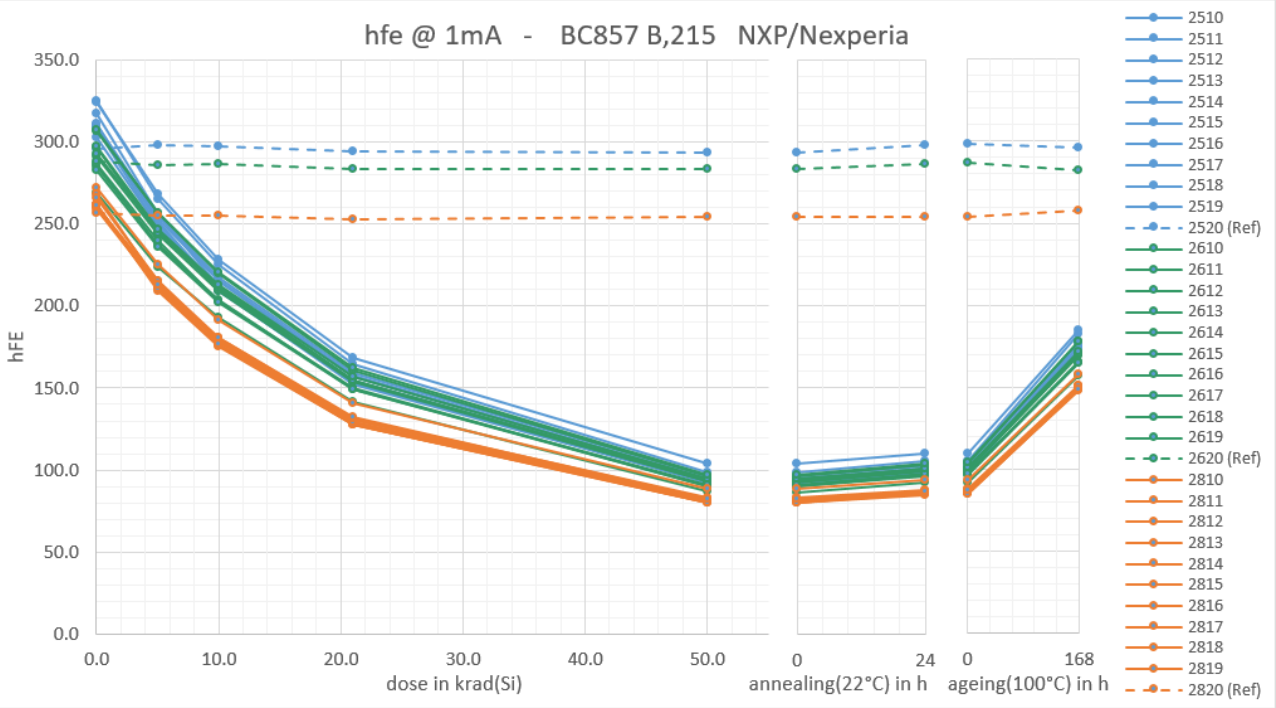


hfe @ 0.1mA	BC857 B,215 NXP/Nexperia Farnell Dec-2019						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2510	299.2	217.5	168.8	107.7	51.2	56.8	137.9
2511	320.4	231.5	180.3	114.3	53.8	59.7	144.0
2512	314.2	225.0	170.5	107.9	51.9	57.3	142.2
2513	305.0	217.1	168.7	106.9	50.4	56.0	137.3
2514	304.9	221.5	172.7	110.1	51.6	57.2	138.8
2515	308.8	220.1	169.2	106.0	50.7	56.3	139.6
2516	305.0	220.5	168.7	106.9	50.8	56.4	139.3
2517	304.6	223.7	173.6	109.4	51.6	57.2	139.2
2518	322.2	237.6	187.7	121.6	59.8	65.4	152.2
2519	306.3	224.2	175.8	111.2	52.8	58.6	141.1
2520 (Ref)	290.5	291.7	291.7	289.0	288.8	292.9	291.2
Average	309.06	223.85	173.60	110.20	52.46	58.08	141.17
s	7.470	6.387	6.244	4.706	2.788	2.800	4.383
Average+3s	331.47	243.01	192.33	124.31	60.82	66.48	154.32
Average-3s	286.65	204.69	154.87	96.08	44.09	49.68	128.02

hfe @ 0.1mA	BC857 B,215 NXP/Nexperia RS Feb-2019						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2610	280.0	208.2	163.1	103.0	48.3	54.4	127.4
2611	282.2	209.1	162.4	102.9	48.0	53.8	127.5
2612	264.8	196.2	155.2	98.3	46.5	52.1	122.5
2613	286.8	213.0	167.9	105.9	49.6	55.6	131.3
2614	288.7	215.7	169.1	106.5	49.5	55.7	131.1
2615	291.2	213.6	170.2	106.3	50.5	56.2	131.7
2616	301.9	223.9	175.9	109.9	51.2	57.5	137.7
2617	277.0	207.9	162.6	103.3	48.8	54.9	129.2
2618	292.6	216.0	171.0	107.8	50.5	56.5	132.6
2619	302.4	224.3	176.4	111.0	51.1	57.8	136.9
2620 (Ref)	283.1	280.7	280.2	279.1	278.8	282.2	277.5
Average	286.75	212.79	167.38	105.48	49.40	55.47	130.80
s	11.415	8.222	6.600	3.772	1.509	1.735	4.516
Average+3s	321.00	237.46	187.18	116.80	53.93	60.67	144.35
Average-3s	252.51	188.13	147.59	94.17	44.87	50.26	117.25

hfe @ 0.1mA	BC857 B,215 NXP/Nexperia Mouser Feb-2020						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2810	264.6	188.4	144.6	90.3	45.4	50.3	122.3
2811	255.0	186.4	145.7	92.3	45.6	51.0	121.4
2812	257.4	186.7	143.6	90.3	45.1	50.5	120.8
2813	262.4	189.2	144.6	91.6	45.7	50.8	122.1
2814	257.0	187.7	145.9	93.3	45.6	51.2	119.9
2815	258.2	184.5	142.6	90.3	44.9	50.1	120.4
2816	257.2	185.6	143.5	91.3	44.8	50.2	120.2
2817	267.5	201.0	157.4	101.8	50.5	55.9	128.2
2818	255.9	189.8	147.0	93.8	46.4	51.9	122.0
2819	257.3	188.0	147.5	94.0	46.3	51.7	120.5
2820 (Ref)	252.6	250.7	250.9	248.8	250.0	250.0	253.9
Average	259.25	188.73	146.22	92.90	46.05	51.36	121.78
s	4.144	4.606	4.214	3.423	1.664	1.708	2.398
Average+3s	271.69	202.55	158.87	103.17	51.04	56.48	128.98
Average-3s	246.82	174.92	133.58	82.64	41.06	46.23	114.59

8.3 hfe @ 1 mA

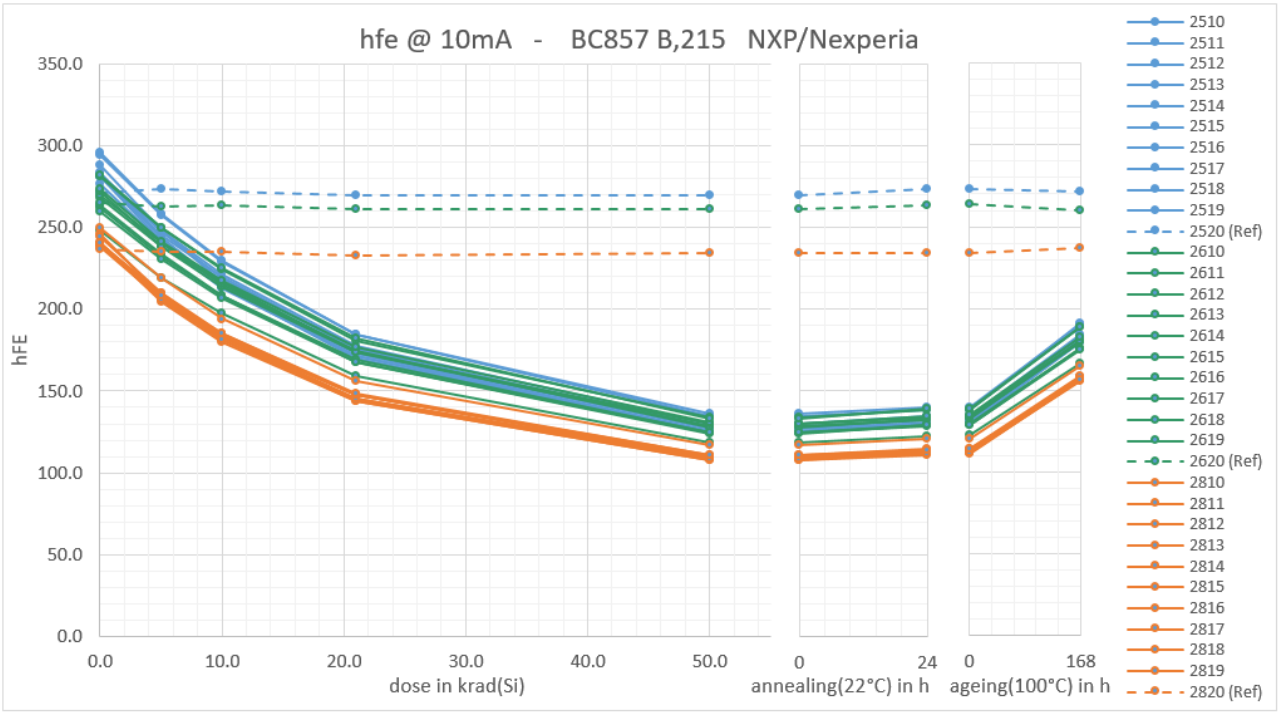


hfe @ 1mA	BC857 B,215 NXP/Nexperia Farnell Dec-2019						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2510	302.5	247.7	208.8	153.6	92.8	98.7	171.7
2511	324.5	265.2	225.2	164.6	98.9	105.2	182.6
2512	316.9	256.1	212.0	154.3	94.3	99.6	175.9
2513	307.8	247.9	210.2	153.6	92.4	98.7	171.9
2514	308.3	252.5	216.0	157.5	94.5	100.6	174.4
2515	311.2	250.6	210.1	151.9	92.4	98.5	173.3
2516	309.2	250.9	210.7	153.0	92.9	98.6	173.3
2517	308.1	254.8	215.1	156.8	94.5	100.7	174.2
2518	324.0	267.8	227.9	168.2	104.0	110.0	184.9
2519	309.8	255.1	217.5	158.9	96.0	102.5	176.4
2520 (Ref)	295.5	297.8	296.8	293.7	293.4	298.0	296.2
Average	312.21	254.86	215.33	157.23	95.27	101.30	175.85
s	7.275	6.771	6.570	5.346	3.678	3.706	4.444
Average+3s	334.03	275.17	235.04	173.27	106.30	112.42	189.18
Average-3s	290.38	234.55	195.62	141.20	84.24	90.18	162.52

hfe @ 1mA	BC857 B,215 NXP/Nexperia RS Feb-2019						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2610	284.5	237.7	203.9	149.2	90.3	97.2	165.3
2611	286.7	239.3	203.1	149.8	90.4	96.4	165.2
2612	268.8	223.6	192.6	141.3	86.7	92.1	156.9
2613	291.1	243.5	209.1	153.9	92.8	99.5	169.8
2614	292.9	246.0	210.6	154.8	93.3	99.9	169.3
2615	296.0	244.4	212.4	154.7	94.1	100.7	170.2
2616	306.4	256.6	219.6	160.5	96.4	103.4	177.9
2617	282.4	236.0	202.1	149.2	91.0	97.5	165.2
2618	296.9	246.6	212.8	156.6	94.4	101.2	171.6
2619	306.9	256.3	220.3	162.2	96.7	104.0	177.8
2620 (Ref)	287.6	285.5	286.0	283.6	283.4	286.6	282.5
Average	291.26	242.99	208.64	153.21	92.61	99.19	168.92
s	11.429	9.731	8.479	6.110	3.076	3.525	6.273
Average+3s	325.55	272.18	234.08	171.54	101.84	109.76	187.74
Average-3s	256.97	213.80	183.20	134.88	83.39	88.61	150.11

hfe @ 1mA	BC857 B,215 NXP/Nexperia Mouser Feb-2020						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2810	267.7	213.6	178.1	127.7	80.9	85.8	150.5
2811	258.7	211.1	179.0	129.4	81.0	86.4	150.2
2812	260.8	211.0	176.4	127.4	80.1	86.2	148.2
2813	265.9	215.0	178.0	130.9	81.8	86.6	150.7
2814	261.3	212.6	179.0	131.1	81.2	87.5	148.5
2815	261.7	209.1	175.0	127.5	80.3	85.0	148.7
2816	260.9	210.6	176.4	128.9	80.4	85.5	148.9
2817	271.7	225.3	190.9	140.6	88.5	93.9	157.8
2818	260.2	214.8	180.7	131.8	83.0	88.1	151.0
2819	261.5	212.8	180.7	132.2	82.8	87.4	148.7
2820 (Ref)	256.7	254.9	255.1	252.7	253.9	253.8	257.9
Average	263.03	213.58	179.43	130.75	82.00	87.23	150.32
s	4.076	4.526	4.444	3.916	2.485	2.533	2.810
Average+3s	275.26	227.16	192.76	142.50	89.45	94.83	158.75
Average-3s	250.80	200.00	166.10	119.00	74.54	79.64	141.88

8.4 hfe @ 10 mA

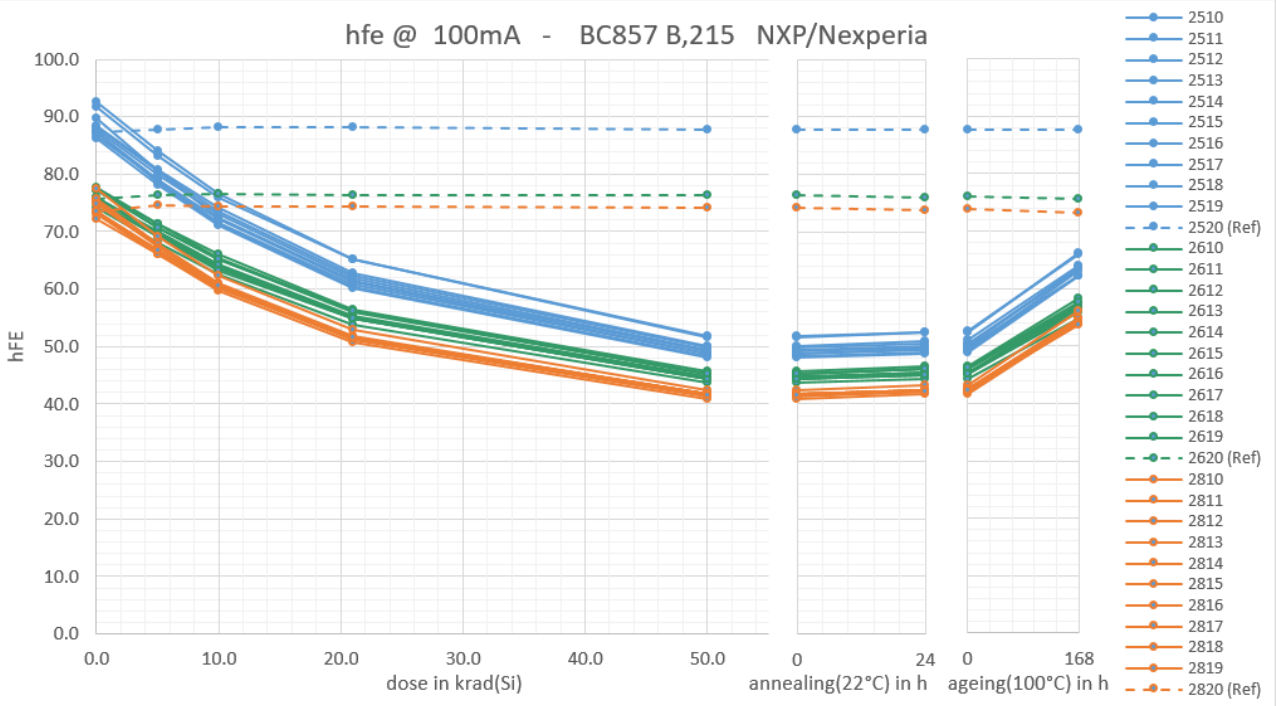


hfe @ 10mA	BC857 B,215 NXP/Nexperia Farnell Dec-2019						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2510	276.1	240.4	212.6	171.3	125.6	129.7	179.5
2511	295.9	257.7	229.5	184.2	134.3	138.4	191.2
2512	288.0	248.3	216.4	173.7	127.2	131.0	183.4
2513	280.6	241.2	214.7	172.7	125.6	130.1	179.6
2514	281.3	245.4	219.9	176.1	127.9	132.0	182.3
2515	283.3	243.4	214.7	170.1	125.0	129.4	180.9
2516	281.4	243.3	214.7	171.5	125.7	129.5	180.6
2517	281.1	247.1	219.2	175.5	128.1	132.3	182.0
2518	294.0	257.0	229.2	184.1	136.0	139.8	190.5
2519	282.8	247.8	221.4	177.4	129.8	134.4	184.2
2520 (Ref)	270.8	273.0	272.1	269.4	269.2	273.2	271.5
Average	284.45	247.16	219.24	175.66	128.52	132.65	183.44
s	6.264	5.996	6.003	5.024	3.812	3.756	4.206
Average+3s	303.24	265.15	237.25	190.73	139.96	143.92	196.05
Average-3s	265.66	229.17	201.23	160.59	117.09	121.39	170.82

hfe @ 10mA	BC857 B,215 NXP/Nexperia RS Feb-2019						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2610	261.9	232.1	208.5	167.7	124.0	129.3	175.8
2611	263.7	233.8	208.0	168.8	124.5	128.6	175.5
2612	248.2	218.9	197.2	159.1	118.8	122.4	166.7
2613	267.8	237.7	213.6	173.4	128.1	132.4	180.4
2614	269.7	240.1	215.3	174.5	128.0	133.2	179.7
2615	271.9	238.4	216.8	174.0	129.8	134.0	180.4
2616	281.2	249.8	224.1	180.8	133.5	138.4	188.6
2617	259.9	230.2	206.4	167.6	124.5	129.0	174.8
2618	273.0	240.9	217.4	176.4	130.4	134.8	182.3
2619	281.7	249.9	224.8	182.5	133.3	139.0	188.5
2620 (Ref)	264.6	263.0	263.4	261.2	261.0	263.8	260.3
Average	267.90	237.19	213.20	172.48	127.50	132.11	179.27
s	10.079	9.234	8.434	6.920	4.610	4.985	6.580
Average+3s	298.13	264.90	238.50	193.24	141.33	147.07	199.01
Average-3s	237.66	209.49	187.90	151.72	113.67	117.16	159.53

hfe @ 10mA	BC857 B,215 NXP/Nexperia Mouser Feb-2020						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2810	245.5	208.5	183.5	144.9	109.4	112.8	158.4
2811	238.1	206.2	183.2	145.4	109.0	112.7	157.8
2812	239.4	206.0	181.1	143.8	107.9	112.3	155.5
2813	244.0	209.9	183.2	147.9	109.9	113.1	158.2
2814	240.4	207.7	183.5	147.8	109.4	113.8	156.3
2815	240.5	204.6	180.0	144.1	108.1	111.2	156.4
2816	239.7	205.8	181.2	145.6	108.4	111.8	156.5
2817	249.6	218.7	194.0	156.3	117.3	120.5	165.1
2818	239.4	209.6	184.9	147.8	111.1	114.5	158.5
2819	240.6	208.0	184.9	148.3	110.9	113.9	156.4
2820 (Ref)	236.2	234.9	235.2	233.0	234.0	234.0	237.2
Average	241.73	208.50	183.96	147.20	110.15	113.66	157.92
s	3.554	3.988	3.882	3.612	2.730	2.603	2.735
Average+3s	252.40	220.47	195.61	158.04	118.34	121.47	166.13
Average-3s	231.07	196.54	172.31	136.37	101.96	105.85	149.72

8.5 hfe @ 100 mA

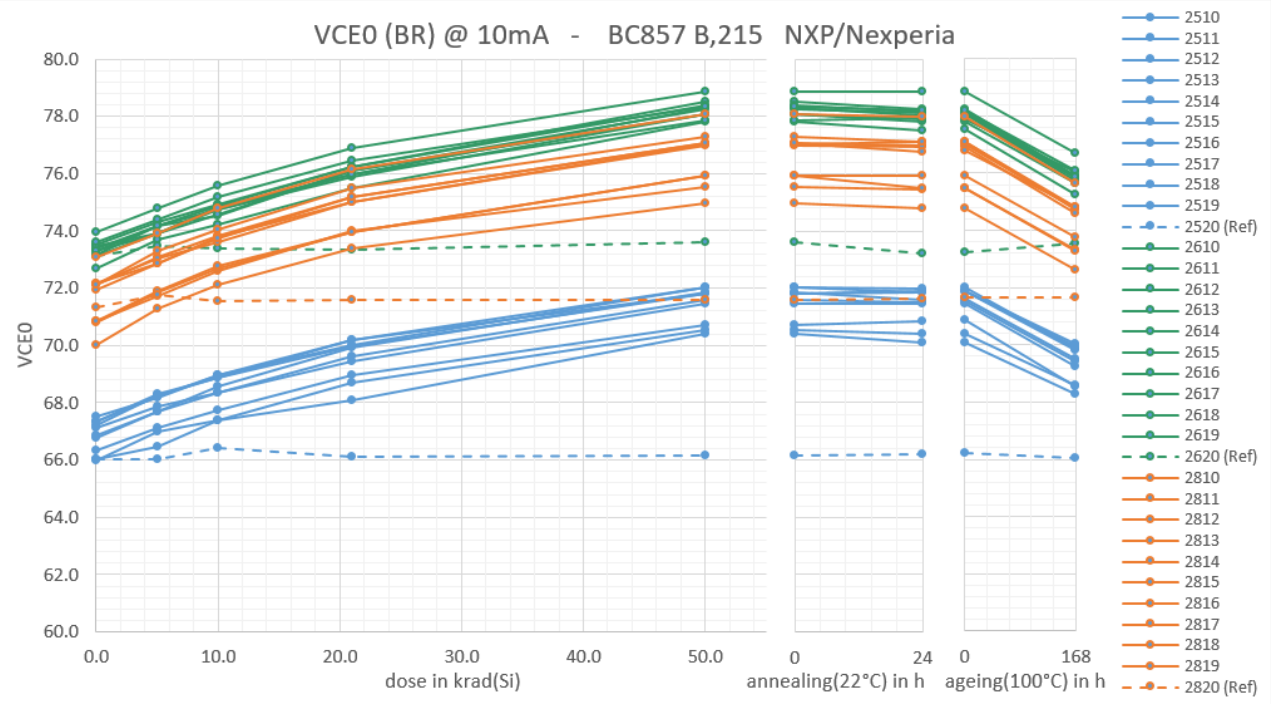


hfe @ 100mA	BC857 B,215 NXP/Nexperia Farnell Dec-2019						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2510	86.6	78.9	71.5	60.9	48.7	49.4	63.1
2511	92.5	84.1	76.6	65.1	51.7	52.4	66.2
2512	89.6	80.5	72.5	61.4	49.2	49.9	63.7
2513	87.3	78.9	72.2	61.2	48.8	49.6	62.3
2514	87.7	79.8	73.0	62.0	49.4	50.1	63.5
2515	87.3	78.6	71.2	60.3	48.4	49.1	62.3
2516	86.2	78.0	71.0	60.1	48.0	48.8	62.3
2517	88.1	80.5	73.5	62.3	49.8	50.5	63.3
2518	91.6	83.1	76.0	65.1	51.8	52.6	66.0
2519	88.5	80.8	74.1	62.7	50.0	51.0	64.1
2520 (Ref)	87.3	87.7	88.1	88.1	87.7	87.7	87.7
Average	88.55	80.32	73.16	62.12	49.57	50.35	63.69
s	2.082	1.960	1.918	1.777	1.284	1.312	1.391
Average+3s	94.80	86.20	78.92	67.46	53.42	54.28	67.86
Average-3s	82.30	74.44	67.41	56.79	45.72	46.42	59.52

hfe @ 100mA	BC857 B,215 NXP/Nexperia RS Feb-2019						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2610	75.2	69.1	63.7	54.8	44.4	45.1	57.3
2611	76.0	69.5	63.9	55.0	44.3	45.2	56.2
2612	74.1	67.9	62.5	53.7	43.6	44.3	54.8
2613	76.0	69.5	64.1	55.1	44.6	45.5	57.0
2614	77.1	71.2	65.3	56.2	45.3	46.1	57.1
2615	77.1	70.7	65.1	55.9	45.3	46.1	57.0
2616	76.0	70.0	64.3	55.4	44.8	45.5	56.5
2617	75.2	69.1	63.3	54.8	44.4	45.1	55.9
2618	77.7	71.2	66.0	56.5	45.7	46.5	58.3
2619	77.1	70.7	65.1	56.2	45.3	46.2	57.6
2620 (Ref)	75.7	76.3	76.6	76.3	76.3	76.0	75.7
Average	76.15	69.91	64.34	55.36	44.74	45.53	56.76
s	1.144	1.081	1.043	0.850	0.616	0.674	0.964
Average+3s	79.58	73.16	67.47	57.91	46.59	47.55	59.66
Average-3s	72.72	66.67	61.21	52.81	42.89	43.51	53.87

hfe @ 100mA	BC857 B,215 NXP/Nexperia Mouser Feb-2020						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2810	77.4	69.1	62.3	52.9	42.4	43.3	56.0
2811	73.5	66.4	60.3	51.3	41.3	42.1	54.7
2812	75.2	67.3	60.9	51.7	41.7	42.4	54.5
2813	75.7	67.7	61.0	51.9	41.8	42.4	54.8
2814	73.5	66.8	60.7	51.7	41.7	42.4	54.0
2815	74.9	67.3	60.9	51.7	41.8	42.4	54.8
2816	73.0	66.0	59.8	50.8	40.9	41.7	54.1
2817	72.2	66.0	60.1	51.4	41.5	42.2	53.8
2818	73.5	66.8	60.9	51.7	41.7	42.4	54.1
2819	73.3	66.8	60.7	51.5	41.6	42.3	53.7
2820 (Ref)	73.5	74.6	74.3	74.3	74.1	73.8	73.3
Average	74.23	67.01	60.76	51.63	41.63	42.37	54.46
s	1.546	0.917	0.677	0.531	0.382	0.397	0.692
Average+3s	78.87	69.76	62.79	53.23	42.78	43.56	56.54
Average-3s	69.59	64.25	58.73	50.04	40.48	41.18	52.39

8.6 VCEo (BR) @ 10mA

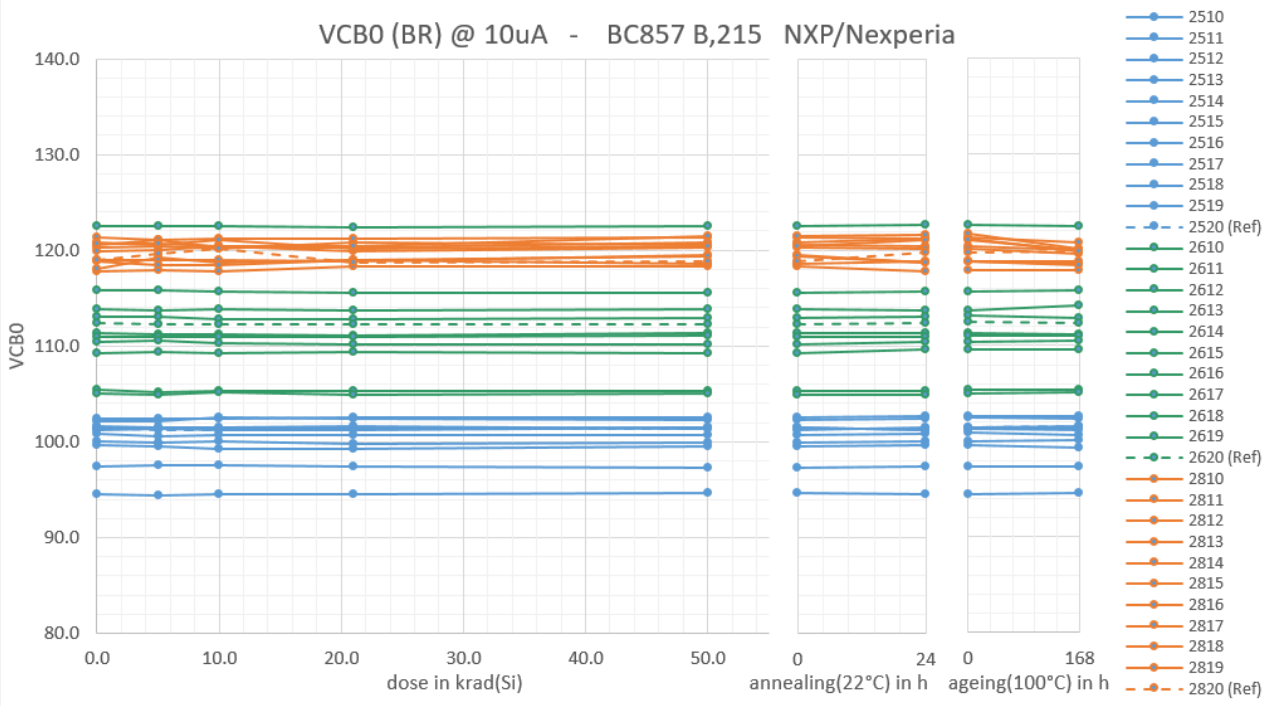


VCE0 (BR) @ 10mA	BC857 B,215	NXP/Nexperia	Farnell	Dec-2019			
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2510	67.3	68.3	68.9	70.2	71.8	71.9	69.8
2511	66.0	66.5	67.4	68.1	70.4	70.1	68.3
2512	66.8	67.7	68.6	69.9	71.9	71.6	69.5
2513	67.5	68.2	69.0	70.2	72.0	71.9	70.0
2514	67.1	67.9	68.3	69.6	71.6	71.5	69.4
2515	67.3	68.2	69.0	70.0	72.0	72.0	69.9
2516	67.2	68.3	68.9	70.0	71.8	71.9	69.9
2517	66.8	67.7	68.4	69.4	71.4	71.4	69.2
2518	66.0	67.0	67.4	68.7	70.6	70.4	68.6
2519	66.3	67.1	67.7	68.9	70.7	70.9	68.5
2520 (Ref)	66.0	66.0	66.4	66.1	66.2	66.2	66.0
Average	66.84	67.68	68.35	69.50	71.43	71.35	69.32
s	0.561	0.634	0.628	0.716	0.630	0.675	0.642
Average+3s	68.53	69.58	70.23	71.65	73.32	73.38	71.25
Average-3s	65.16	65.78	66.47	67.36	69.54	69.33	67.40

VCE0 (BR) @ 10mA	BC857 B,215 NXP/Nexperia RS Feb-2019						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2610	73.5	74.3	74.9	76.2	78.5	78.3	75.9
2611	73.1	73.9	74.8	75.9	78.1	77.8	75.6
2612	74.0	74.8	75.6	76.9	78.8	78.8	76.7
2613	73.3	74.2	74.9	76.2	78.4	78.1	75.9
2614	73.4	74.2	74.8	76.0	78.3	78.0	75.8
2615	73.2	74.2	74.5	76.1	78.1	77.9	76.1
2616	73.5	73.9	74.6	76.1	78.3	78.1	75.8
2617	73.6	74.4	75.2	76.4	78.3	78.2	76.1
2618	72.7	73.7	74.2	75.5	77.8	77.5	75.3
2619	73.3	73.9	74.8	76.0	77.9	77.9	75.9
2620 (Ref)	73.1	73.5	73.4	73.3	73.6	73.2	73.5
Average	73.35	74.15	74.82	76.13	78.24	78.08	75.90
s	0.339	0.316	0.379	0.369	0.307	0.347	0.363
Average+3s	74.37	75.09	75.96	77.24	79.16	79.12	76.99
Average-3s	72.33	73.20	73.69	75.03	77.32	77.04	74.81

VCE0 (BR) @ 10mA	BC857 B,215 NXP/Nexperia Mouser Feb-2020						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2810	70.0	71.3	72.1	73.4	75.0	74.8	72.6
2811	72.1	73.1	73.8	75.2	77.1	77.0	74.8
2812	70.8	71.7	72.6	74.0	75.6	75.5	73.3
2813	70.8	71.8	72.7	74.0	75.9	75.5	73.3
2814	72.1	73.0	73.6	75.0	77.0	77.1	74.7
2815	70.9	71.9	72.8	74.0	75.9	75.9	73.8
2816	72.0	72.9	73.8	75.0	77.0	76.9	74.6
2817	73.1	73.9	74.8	76.1	78.1	78.0	75.7
2818	72.2	72.9	73.7	75.2	77.1	76.8	74.8
2819	72.1	73.3	74.0	75.5	77.3	77.1	74.8
2820 (Ref)	71.3	71.8	71.6	71.6	71.6	71.7	71.6
Average	71.61	72.58	73.39	74.74	76.59	76.45	74.24
s	0.926	0.841	0.808	0.855	0.948	0.987	0.938
Average+3s	74.39	75.10	75.82	77.30	79.43	79.41	77.06
Average-3s	68.83	70.06	70.97	72.17	73.74	73.49	71.42

8.7 VCB0 (BR) @ 10uA

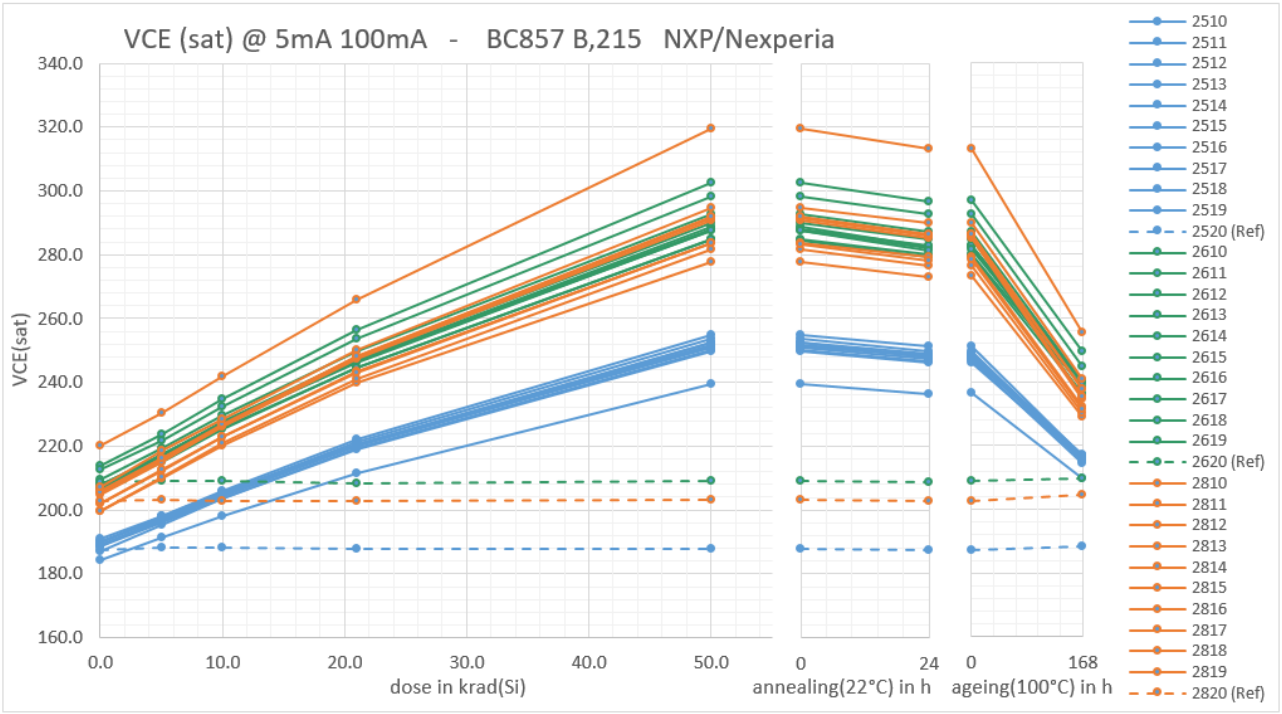


VCB0 (BR) @ 10uA BC857 B,215 NXP/Nexperia Farnell Dec-2019							
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2510	102.2	102.2	102.6	102.4	102.3	102.4	102.3
2511	94.5	94.4	94.6	94.6	94.7	94.5	94.6
2512	99.6	99.5	99.3	99.3	99.5	99.6	99.3
2513	102.5	102.4	102.5	102.5	102.5	102.6	102.6
2514	101.2	101.3	101.2	101.3	101.5	101.3	101.2
2515	101.6	101.5	101.5	101.6	101.3	101.5	101.6
2516	101.4	101.4	101.3	101.4	101.5	101.3	101.4
2517	100.9	100.6	100.7	100.7	100.7	100.9	100.7
2518	97.4	97.5	97.5	97.4	97.3	97.4	97.4
2519	100.1	99.9	100.0	99.8	100.0	100.0	100.1
2520 (Ref)	101.5	101.3	101.2	101.3	101.4	101.4	101.5
Average	100.14	100.07	100.12	100.09	100.14	100.15	100.12
s	2.461	2.461	2.460	2.489	2.452	2.494	2.477
Average+3s	107.52	107.46	107.50	107.56	107.50	107.63	107.55
Average-3s	92.75	92.69	92.74	92.62	92.78	92.67	92.69

VCB0 (BR) @ 10uA	BC857 B,215 NXP/Nexperia RS Feb-2019						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2610	113.9	113.7	113.8	113.7	113.8	113.7	114.1
2611	113.0	113.0	112.8	112.8	112.9	113.1	112.9
2612	122.6	122.6	122.6	122.4	122.6	122.6	122.5
2613	111.4	111.2	111.2	111.1	111.4	111.3	111.1
2614	110.9	110.9	111.0	110.9	111.0	111.0	111.0
2615	110.4	110.6	110.3	110.2	110.2	110.4	110.5
2616	105.4	105.2	105.3	105.3	105.3	105.4	105.4
2617	115.8	115.8	115.7	115.5	115.6	115.7	115.8
2618	109.3	109.4	109.2	109.4	109.3	109.6	109.6
2619	105.1	105.0	105.1	105.0	105.0	104.9	105.1
2620 (Ref)	112.4	112.2	112.3	112.3	112.3	112.5	112.3
Average	111.78	111.75	111.70	111.63	111.70	111.78	111.81
s	5.086	5.110	5.090	5.034	5.104	5.098	5.067
Average+3s	127.04	127.08	126.96	126.73	127.01	127.07	127.01
Average-3s	96.52	96.42	96.43	96.53	96.39	96.48	96.61

VCB0 (BR) @ 10uA	BC857 B,215 NXP/Nexperia Mouser Feb-2020						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2810	117.8	117.9	117.8	118.3	118.4	117.9	117.9
2811	120.3	120.4	120.2	120.8	120.6	120.4	119.9
2812	118.1	119.2	118.7	118.9	118.6	118.8	118.5
2813	118.9	119.0	118.9	118.9	119.4	118.8	118.8
2814	120.5	121.1	120.3	120.3	120.8	121.2	119.8
2815	118.9	118.5	118.5	119.0	119.3	118.7	118.4
2816	119.9	120.0	120.4	119.9	120.3	120.1	119.5
2817	121.4	121.1	121.2	121.2	121.3	121.3	120.8
2818	120.8	120.6	121.1	120.2	120.4	121.1	119.9
2819	120.7	120.7	120.4	120.4	121.5	121.7	120.1
2820 (Ref)	119.0	119.6	120.2	118.8	118.8	119.8	119.9
Average	119.74	119.85	119.75	119.79	120.07	119.98	119.36
s	1.231	1.119	1.171	0.962	1.086	1.338	0.910
Average+3s	123.43	123.20	123.26	122.68	123.33	124.00	122.09
Average-3s	116.05	116.49	116.24	116.91	116.81	115.97	116.63

8.8 VCE (sat) @ 5mA 100mA



VCE (sat) @ 5mA 100mA	BC857 B,215 NXP/Nexperia Farnell Dec-2019						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2510	189.7	197.7	205.2	220.4	252.7	248.8	217.0
2511	190.8	197.9	205.7	220.4	251.6	248.7	217.2
2512	187.2	195.4	203.6	219.4	250.1	246.7	214.6
2513	188.9	196.7	204.4	220.3	252.5	247.9	216.5
2514	189.2	197.0	204.2	220.2	251.3	248.1	215.2
2515	188.8	196.8	205.1	221.5	253.7	249.6	216.0
2516	189.9	198.2	205.8	222.3	254.8	251.2	216.7
2517	188.6	196.1	203.4	218.9	249.7	246.1	215.8
2518	184.1	191.4	198.1	211.6	239.6	236.5	209.5
2519	190.0	197.4	205.1	220.3	250.8	247.3	216.8
2520 (Ref)	187.5	188.1	188.2	187.7	187.7	187.4	188.5
Average	188.72	196.46	204.06	219.52	250.68	247.09	215.52
s	1.885	1.973	2.243	2.931	4.200	4.008	2.259
Average+3s	194.37	202.38	210.79	228.32	263.28	259.11	222.30
Average-3s	183.06	190.55	197.33	210.73	238.07	235.07	208.74

VCE (sat) @ 5mA 100mA	BC857 B,215 NXP/Nexperia RS Feb-2019						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2610	207.7	217.3	227.3	247.1	288.8	282.6	236.0
2611	208.0	216.9	227.5	247.7	289.8	284.8	240.2
2612	206.1	215.0	225.4	244.5	285.0	280.1	238.5
2613	209.5	219.3	229.8	249.7	292.6	287.1	240.2
2614	207.8	216.8	227.1	246.3	287.8	282.2	240.2
2615	207.5	216.9	227.6	246.9	287.8	282.9	240.4
2616	214.0	223.8	234.6	256.3	302.5	296.8	249.6
2617	207.7	217.4	227.3	246.7	287.7	281.4	239.8
2618	206.7	216.0	225.6	244.7	284.6	279.3	236.3
2619	212.5	221.9	232.4	253.5	298.2	292.6	244.9
2620 (Ref)	208.5	209.0	209.2	208.4	209.0	208.8	209.8
Average	208.76	218.13	228.46	248.34	290.47	285.00	240.61
s	2.555	2.724	2.951	3.820	5.746	5.676	4.011
Average+3s	216.42	226.30	237.31	259.80	307.71	302.02	252.64
Average-3s	201.09	209.95	219.61	236.88	273.23	267.97	228.58

VCE (sat) @ 5mA 100mA	BC857 B,215 NXP/Nexperia Mouser Feb-2020						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
2810	199.6	209.8	220.1	239.8	277.6	273.1	228.8
2811	205.4	215.6	226.0	247.5	290.7	285.2	234.6
2812	199.6	210.4	220.8	241.1	281.8	276.6	230.3
2813	201.8	212.4	222.8	243.3	283.5	279.2	232.4
2814	206.1	216.4	226.7	248.3	291.6	286.1	237.9
2815	201.9	212.5	222.8	243.0	283.4	278.2	231.5
2816	204.9	215.2	226.4	247.7	291.6	285.9	235.2
2817	220.0	230.2	242.0	266.1	319.6	313.1	255.3
2818	205.6	216.2	226.7	248.3	291.8	286.4	237.7
2819	207.2	218.5	228.4	250.1	294.8	289.8	240.7
2820 (Ref)	202.9	203.1	202.9	202.9	203.2	202.7	204.6
Average	205.20	215.73	226.27	247.52	290.64	285.36	236.44
s	5.857	5.807	6.187	7.386	11.592	11.095	7.600
Average+3s	222.77	233.15	244.83	269.68	325.42	318.64	259.24
Average-3s	187.63	198.31	207.71	225.36	255.86	252.07	213.64

9 CONCLUSION

The test results of the BC857B,215 from Nexperia indicate very similar behaviour for all the 3 different tested date codes, especially if you put the different initial gain value into consideration.

The gain of the transistors decreases continuously with increasing dose. This effect is particularly stronger at the lower collector currents. Whether the transistor can still be used at the maximum tested dose must be carefully considered for the respective application.

A change in the Collector-Emitter breakdown voltage can be determined at the measured operating points, but it is still within the tolerances specified in the data sheet.

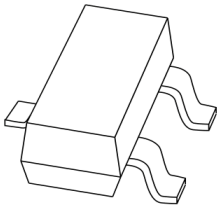
The Collector-Base voltage remains almost unchanged.

The CE saturation voltage increases slightly over the radiation dose but still stays inside the specification.

10 APPENDIX - EXTRACT FROM THE DATA SHEET

DISCRETE SEMICONDUCTORS

DATA SHEET



BC856; BC857; BC858
PNP general purpose transistors

Product data sheet
Supersedes data of 2003 Apr 09

2004 Jan 16

NXP founded by Philips

PNP general purpose transistors BC856; BC857; BC858

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 65 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a SOT23 plastic package.
NPN complements: BC846, BC847 and BC848.

MARKING

TYPE NUMBER	MARKING CODE(1)
BC856	3D*
BC856A	3A*
BC856B	3B*
BC857	3H*
BC857A	3E*
BC857B	3F*
BC857C	3G*
BC858B	3K*

Note

1. * = p: made in Hong Kong.
   * = t: made in Malaysia.
   * = W: made in China.

PINNING

PIN	DESCRIPTION
1	base
2	emitter
3	collector

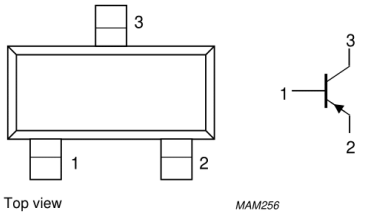


Fig.1 Simplified outline (SOT23) and symbol.

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
BC856	–	plastic surface mounted package; 3 leads	SOT23
BC857	–	plastic surface mounted package; 3 leads	SOT23
BC858	–	plastic surface mounted package; 3 leads	SOT23

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 60134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC856		–	−80	V
	BC857		–	−50	V
	BC858		–	−30	V
V_{CEO}	collector-emitter voltage	open base			
	BC856		–	−65	V
	BC857		–	−45	V
	BC858		–	−30	V
V_{EBO}	emitter-base voltage	open collector	–	−5	V
I_C	collector current (DC)		–	−100	mA
I_{CM}	peak collector current		–	−200	mA
I_{BM}	peak base current		–	−200	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C; note 1	–	250	mW
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		−65	+150	°C

Note

1. Transistor mounted on an FR4 printed-circuit board, standard footprint.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	TYPICAL	UNIT
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air; note 1	500	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board, standard footprint.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector-base cut-off current	V_{CB} = –30 V; I_E = 0	–	–1	–15	nA
		V_{CB} = –30 V; I_E = 0; T_j = 150 °C	–	–	–4	μA
I_{EBO}	emitter-base cut-off current	V_{EB} = –5 V; I_C = 0	–	–	–100	nA
h_{FE}	DC current gain	I_C = –2 mA; V_{CE} = –5 V				
	BC856		125	–	475	
	BC857		125	–	800	
	BC856A; BC857A		125	–	250	
	BC856B; BC857B; BC858B		220	–	475	
	BC857C		420	–	800	
V_{CEsat}	collector-emitter saturation voltage	I_C = –10 mA; I_B = –0.5 mA	–	–75	–300	mV
		I_C = –100 mA; I_B = –5 mA; note 1	–	–250	–650	mV
V_{BEsat}	base-emitter saturation voltage	I_C = –10 mA; I_B = –0.5 mA	–	–700	–	mV
		I_C = –100 mA; I_B = –5 mA; note 1	–	–850	–	mV
V_{BE}	base-emitter voltage	I_C = –2 mA; V_{CE} = –5 V	–600	–650	–750	mV
		I_C = –10 mA; V_{CE} = –5 V	–	–	–820	mV
C_c	collector capacitance	V_{CB} = –10 V; I_E = I_e = 0; f = 1 MHz	–	4.5	–	pF
f_T	transition frequency	V_{CE} = –5 V; I_C = –10 mA; f = 100 MHz	100	–	–	MHz
F	noise figure	I_C = –200 μA; V_{CE} = –5 V; R_S = 2 kΩ; f = 1 kHz; B = 200 Hz	–	2	10	dB

Note

1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.02$.