TOTAL IONIZING DOSE Test Report

BC817-25,215 - 500mA NPN Transistor from NXP/Nexperia

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1 INTRODUCTION

This report presents the total ionizing dose results of **BC817-25,215** a **500mA NPN Transistor from NXP/Nexperia**.

2 DOCUMENTS

APPLICABLE AND REFERENCE DOCUMENTS
BJTs COTS TID test plan
Datasheet **BC817** from Nexperia

3 PART REFERENCES

REFERENCES	
Type:	BC817-25,215
Manufacturer:	NXP/Nexperia
Function:	500 mA general-purpose transistors
Technology:	Bipolar NPN Silicon
PARTS PROCUREMENT	
Packaging:	SOT23 (TO-236AB)
Date Code:	batch no. 01: Nov-2018 batch no. 02: Jan-2018 batch no. 04: Jun-2020
Distributor:	batch no. 01: Farnell batch no. 02: RS Components batch no. 04: Mouser
Number of Parts:	3 x 10 irradiated and 3 x 1 ref

4 DOSIMETRY AND IRRADIATION FACILITY

IRRADIATION FACILITY	
Source:	Co60
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
VCE0(BR), VCB0(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

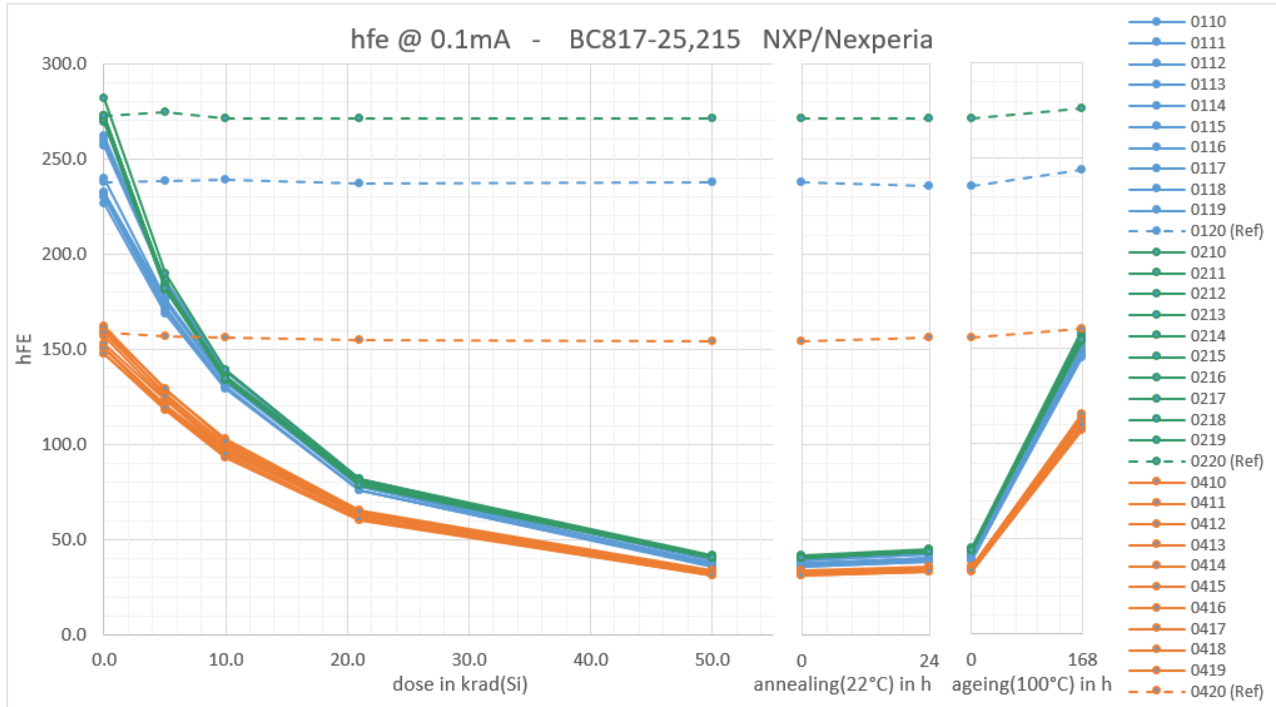
PARAMETERS	SYMBOLS	TEST CONDITIONS
Forward Current Transfer Ratio	hfe1	Ic= 0.1mA, Vce = 1V
	hfe2	Ic= 1mA, Vce = 1V
	hfe3	Ic= 10mA, Vce = 1V
	hfe4	Ic= 100mA, Vce = 1V
	hfe5	Ic= 500mA, Vce = 1V
Collector-Emitter Breakdown Voltage	VCE0 (BR)	Ic = 10mA
Collector-Base Breakdown Voltage	VCB0 (BR)	Ic = 10uA
Collector-Emitter Saturation Voltage	VCE (sat)	Ib = 50mA, Ic = 500mA

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 @ 0.1 mA

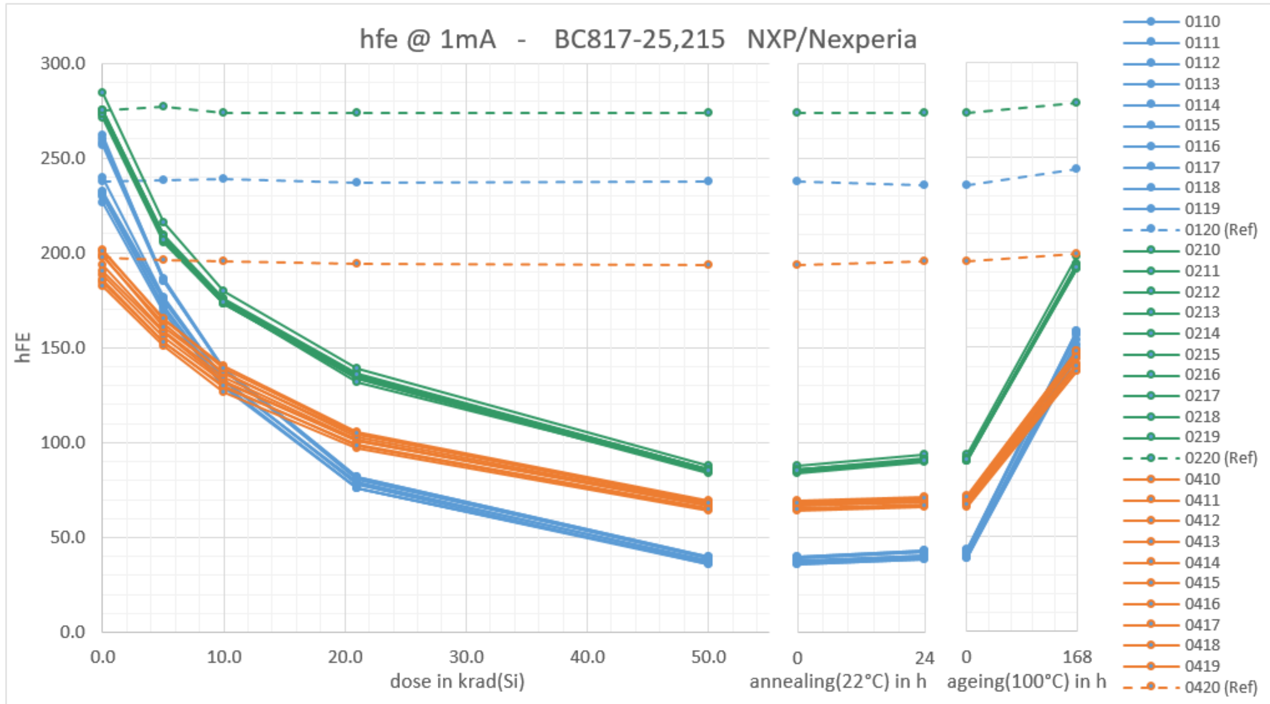


hfe @ 0.1mA	BC817-25,215 NXP/Nexperia Farnell **Nov-2018**						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0110	232.2	175.9	132.8	78.2	35.8	38.8	153.9
0111	239.5	176.7	133.4	78.5	37.7	40.8	151.3
0112	229.9	170.7	129.7	76.0	36.6	39.5	145.5
0113	230.3	172.2	130.5	76.1	36.3	39.3	147.7
0114	258.0	185.4	138.0	80.5	39.1	42.4	156.8
0115	262.0	185.1	139.0	81.6	39.5	42.9	158.2
0116	256.7	185.1	138.6	81.0	39.2	42.8	157.4
0117	260.2	186.4	139.1	81.9	39.7	43.3	158.8
0118	231.4	174.4	132.3	78.9	37.4	40.6	149.4
0119	226.6	168.7	129.1	75.9	36.0	38.9	146.7
0120 (Ref)	237.3	238.3	238.9	237.2	237.8	235.6	243.9
Average	242.68	178.07	134.26	78.86	37.72	40.93	152.55
s	14.640	6.821	4.050	2.325	1.536	1.784	5.068
Average+3s	286.60	198.53	146.41	85.83	42.33	46.29	167.76
Average-3s	198.76	157.60	122.11	71.89	33.11	35.58	137.35

hfe @ 0.1mA	BC817-25,215 NXP/Nexperia RS **Jan-2018**						
	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
DUT	0.0	5.1	10.0	21.0	50.0		
0210	269.0	181.3	134.6	80.0	40.3	43.9	155.6
0211	272.4	184.0	135.9	81.0	41.1	44.5	154.1
0212	271.4	182.8	135.0	80.5	40.8	44.2	155.5
0213	270.6	182.0	134.2	80.0	40.4	43.9	156.6
0214	272.5	183.4	135.7	80.8	41.0	44.6	155.7
0215	281.9	189.5	138.8	82.2	42.0	45.4	159.6
0216	271.1	181.8	133.8	79.7	40.6	44.0	156.1
0217	272.0	182.8	135.0	80.4	40.8	44.2	156.0
0218	271.9	183.0	135.2	80.6	41.0	44.5	153.8
0219	270.1	181.9	134.2	78.7	40.7	44.1	154.2
0220 (Ref)	272.4	274.3	271.1	271.1	270.9	271.0	276.4
Average	272.30	183.24	135.24	80.39	40.88	44.33	155.73
s	3.550	2.346	1.399	0.913	0.478	0.452	1.646
Average+3s	282.95	190.28	139.44	83.13	42.31	45.68	160.67
Average-3s	261.65	176.20	131.04	77.65	39.44	42.97	150.80

hfe @ 0.1mA	BC817-25,215 NXP/Nexperia Mouser **Jun-2020**						
	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
DUT	0.0	5.0	10.0	21.0	50.0		
0410	147.8	118.7	94.6	61.6	31.8	33.7	106.8
0411	151.0	120.9	96.0	62.6	32.6	34.4	108.3
0412	153.0	123.5	97.1	63.0	32.5	34.3	110.1
0413	156.5	123.9	98.6	63.3	32.6	34.5	113.0
0414	158.9	126.3	99.4	64.5	33.3	35.2	113.9
0415	162.3	128.2	102.9	65.5	33.7	35.6	114.9
0416	160.6	125.2	100.1	63.7	32.8	34.7	112.7
0417	161.4	128.9	101.5	64.8	33.2	35.1	115.4
0418	147.5	117.9	92.9	60.1	31.2	33.1	107.7
0419	149.9	119.4	95.2	61.0	31.5	33.3	109.5
0420 (Ref)	159.1	156.6	156.0	154.7	154.3	156.0	160.4
Average	154.89	123.29	97.83	63.01	32.51	34.40	111.25
s	5.753	3.937	3.231	1.723	0.799	0.830	3.133
Average+3s	172.15	135.10	107.53	68.18	34.90	36.89	120.65
Average-3s	137.64	111.47	88.14	57.84	30.11	31.91	101.85

8.2 hfe @ 1 mA

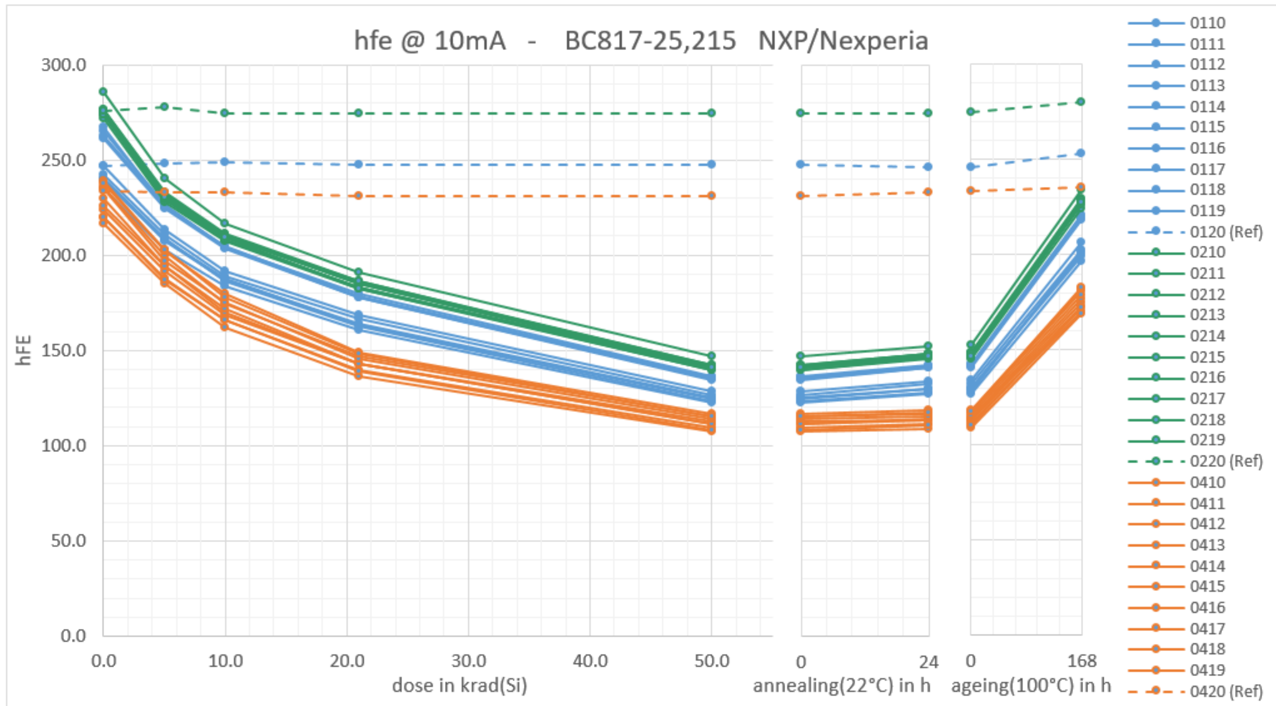


hfe @ 1mA	BC817-25,215 NXP/Nexperia Farnell **Nov-2018**						
	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
DUT	0.0	5.1	10.0	21.0	50.0		
0110	232.2	175.9	132.8	78.2	35.8	38.8	153.9
0111	239.5	176.7	133.4	78.5	37.7	40.8	151.3
0112	229.9	170.7	129.7	76.0	36.6	39.5	145.5
0113	230.3	172.2	130.5	76.1	36.3	39.3	147.7
0114	258.0	185.4	138.0	80.5	39.1	42.4	156.8
0115	262.0	185.1	139.0	81.6	39.5	42.9	158.2
0116	256.7	185.1	138.6	81.0	39.2	42.8	157.4
0117	260.2	186.4	139.1	81.9	39.7	43.3	158.8
0118	231.4	174.4	132.3	78.9	37.4	40.6	149.4
0119	226.6	168.7	129.1	75.9	36.0	38.9	146.7
0120 (Ref)	237.3	238.3	238.9	237.2	237.8	235.6	243.9
Average	242.68	178.07	134.26	78.86	37.72	40.93	152.55
s	14.640	6.821	4.050	2.325	1.536	1.784	5.068
Average+3s	286.60	198.53	146.41	85.83	42.33	46.29	167.76
Average-3s	198.76	157.60	122.11	71.89	33.11	35.58	137.35

hfe @ 1mA	BC817-25,215 NXP/Nexperia RS **Jan-2018**						
	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
DUT	0.0	5.1	10.0	21.0	50.0		
0210	271.0	205.6	172.9	134.0	84.0	89.8	191.1
0211	275.2	209.5	175.8	136.5	85.8	91.5	192.2
0212	274.1	208.2	174.6	135.4	85.1	91.0	193.1
0213	272.8	206.5	173.1	134.2	84.2	90.2	192.7
0214	275.0	208.8	175.3	136.0	85.6	91.4	194.0
0215	284.5	215.8	179.7	139.1	88.0	93.4	198.2
0216	273.3	206.7	172.9	134.1	84.9	90.2	192.9
0217	274.5	208.2	174.7	135.4	85.1	90.8	193.5
0218	274.5	208.4	174.7	136.0	85.5	91.1	191.5
0219	272.8	207.0	173.7	132.1	84.9	90.6	192.1
0220 (Ref)	274.8	276.7	273.7	273.7	273.5	273.5	278.8
Average	272.30	183.24	135.24	80.39	40.88	44.33	155.73
s	3.550	2.346	1.399	0.913	0.478	0.452	1.646
Average+3s	282.95	190.28	139.44	83.13	42.31	45.68	160.67
Average-3s	261.65	176.20	131.04	77.65	39.44	42.97	150.80

hfe @ 1mA	BC817-25,215 NXP/Nexperia Mouser **Jun-2020**						
	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
DUT	0.0	5.0	10.0	21.0	50.0		
0410	184.3	152.7	129.3	99.3	65.5	67.4	137.6
0411	188.3	155.7	131.6	101.2	67.2	68.7	139.7
0412	190.0	158.4	132.7	101.2	66.5	68.7	141.5
0413	193.8	158.8	134.5	101.7	66.8	69.1	144.3
0414	198.1	162.9	136.4	103.9	68.6	70.6	146.7
0415	201.6	164.9	140.6	105.6	69.5	71.5	147.7
0416	198.9	160.9	136.8	102.9	67.7	69.8	144.8
0417	200.5	165.5	139.0	104.8	68.4	70.7	148.2
0418	182.6	151.0	126.8	96.7	64.0	66.1	137.4
0419	185.6	153.0	129.9	98.4	64.6	66.8	139.9
0420 (Ref)	197.5	195.9	195.4	194.0	193.5	195.6	199.1
Average	154.89	123.29	97.83	63.01	32.51	34.40	111.25
s	5.753	3.937	3.231	1.723	0.799	0.830	3.133
Average+3s	172.15	135.10	107.53	68.18	34.90	36.89	120.65
Average-3s	137.64	111.47	88.14	57.84	30.11	31.91	101.85

8.3 hfe @ 10 mA

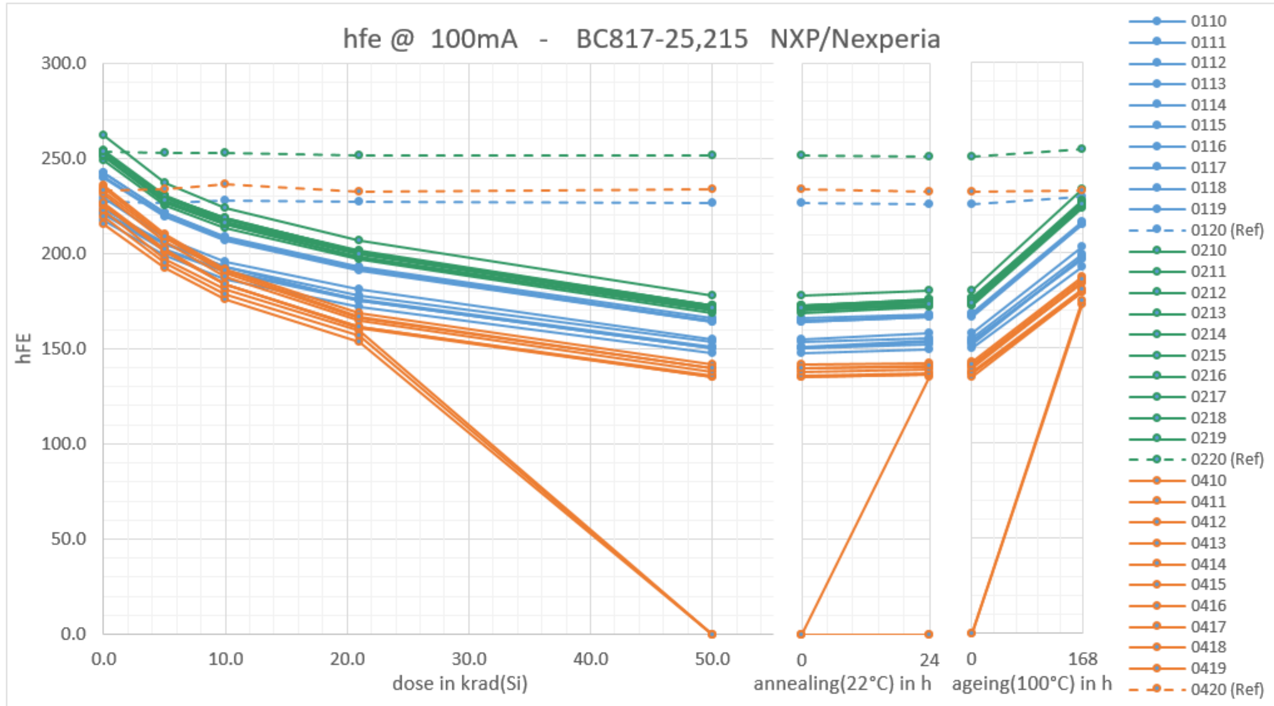


hfe @ 10mA	BC817-25,215 NXP/Nexperia Farnell Nov-2018						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0110	240.0	208.8	186.4	162.9	123.4	127.9	202.2
0111	246.9	213.2	191.7	168.7	128.6	134.1	206.5
0112	239.5	207.2	187.2	164.1	125.1	130.1	199.4
0113	239.7	207.8	187.5	163.6	124.5	129.5	200.8
0114	262.8	226.0	203.9	178.0	134.9	141.1	218.6
0115	266.9	225.4	204.5	178.7	135.6	141.7	220.4
0116	261.4	224.6	203.4	177.6	134.7	140.9	218.4
0117	265.0	226.6	204.1	179.6	136.3	142.6	220.8
0118	242.0	210.4	188.9	166.6	126.8	132.3	202.5
0119	235.1	203.0	183.7	160.5	122.4	127.2	196.8
0120 (Ref)	246.6	247.8	248.6	247.1	247.7	245.8	253.1
Average	249.93	215.31	194.12	170.03	129.23	134.74	208.63
s	12.541	9.263	8.711	7.618	5.572	6.203	9.745
Average+3s	287.56	243.10	220.25	192.88	145.94	153.35	237.87
Average-3s	212.31	187.52	167.99	147.17	112.51	116.13	179.40

hfe @ 10mA	BC817-25,215 NXP/Nexperia RS Jan-2018						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0210	271.6	227.9	207.2	182.7	139.4	145.5	224.4
0211	276.3	232.9	211.5	186.5	142.1	148.3	227.4
0212	275.2	231.5	210.0	185.0	141.1	147.4	228.1
0213	273.5	229.1	207.8	183.0	139.8	146.0	226.6
0214	276.0	232.1	210.8	185.9	142.1	148.4	229.4
0215	285.4	240.0	216.3	190.8	146.8	152.3	234.1
0216	274.1	229.7	208.0	183.3	141.3	146.6	227.2
0217	275.5	231.5	210.3	185.1	141.4	147.8	228.5
0218	275.7	231.7	210.2	186.1	141.9	148.0	226.4
0219	273.9	230.1	209.1	182.1	140.7	146.9	227.2
0220 (Ref)	275.8	277.6	274.6	274.6	274.5	274.5	279.9
Average	275.72	231.65	210.13	185.05	141.67	147.72	227.91
s	3.701	3.292	2.573	2.556	2.016	1.870	2.555
Average+3s	286.82	241.52	217.85	192.72	147.72	153.33	235.58
Average-3s	264.61	221.77	202.41	177.38	135.63	142.11	220.25

hfe @ 10mA	BC817-25,215 NXP/Nexperia Mouser Jun-2020						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0410	219.6	187.6	165.8	140.0	109.3	111.5	170.3
0411	224.0	191.3	168.7	143.2	112.9	113.2	172.9
0412	225.7	194.0	169.8	142.8	111.2	113.7	174.8
0413	229.4	194.3	171.8	143.2	111.7	114.2	177.1
0414	235.5	199.8	174.8	146.7	115.4	116.8	181.1
0415	238.8	201.9	179.7	149.2	117.0	118.5	182.1
0416	235.2	197.2	175.1	145.6	114.0	115.7	178.6
0417	237.5	202.4	177.8	148.2	115.1	117.4	182.5
0418	216.6	184.9	162.3	136.4	107.3	109.0	169.1
0419	219.9	187.3	166.3	139.1	108.2	110.5	172.0
0420 (Ref)	233.9	233.1	232.8	231.2	230.7	233.2	235.6
Average	228.21	194.07	171.20	143.45	112.20	114.05	176.05
s	8.187	6.256	5.619	4.122	3.243	3.117	4.964
Average+3s	252.77	212.84	188.06	155.82	121.93	123.40	190.94
Average-3s	203.65	175.30	154.35	131.09	102.47	104.70	161.15

8.4 hfe @ 100 mA



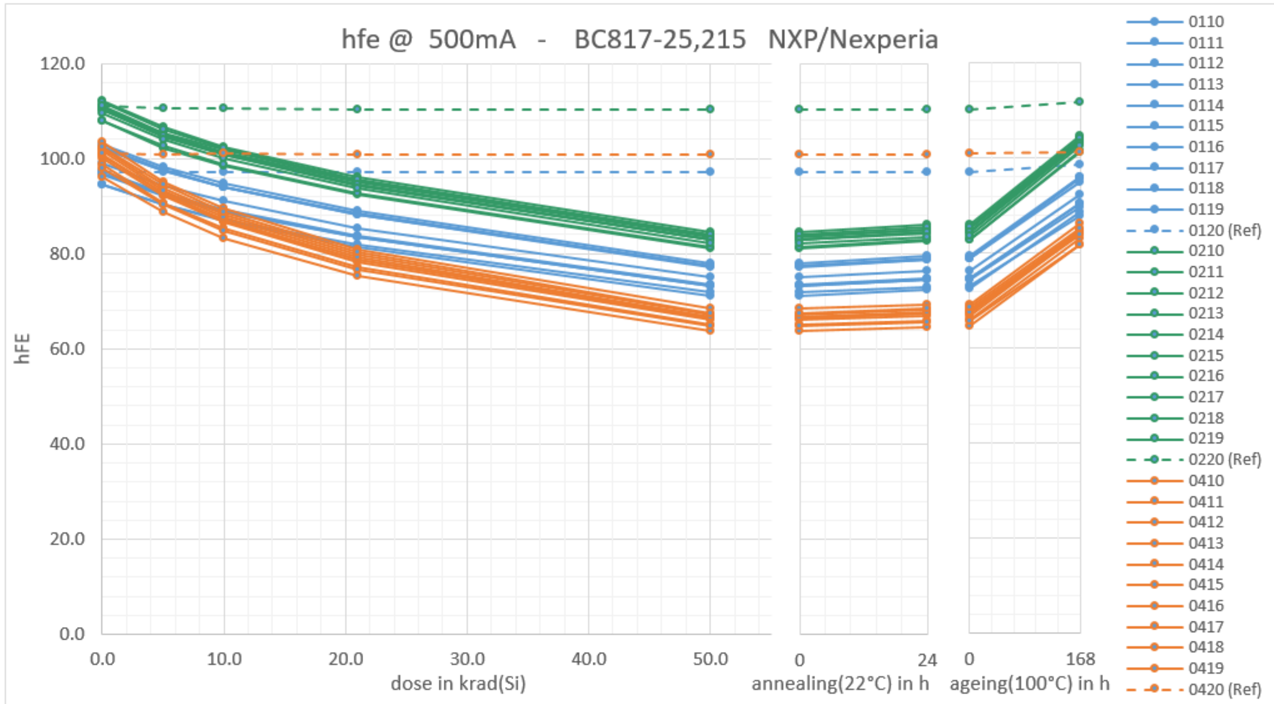
hfe @ 100mA	BC817-25,215 NXP/Nexperia Farnell Nov-2018						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0110	221.3	204.9	192.7	175.5	150.2	151.9	198.0
0111	228.7	207.8	195.8	180.9	155.1	158.1	202.9
0112	221.1	202.1	190.7	175.9	150.7	153.9	196.3
0113	220.8	201.7	190.3	175.4	150.5	153.4	197.0
0114	240.1	219.7	207.4	191.6	164.0	166.9	214.7
0115	242.1	220.9	207.8	192.0	164.6	167.5	215.9
0116	239.7	219.3	206.7	191.2	164.0	166.6	214.8
0117	242.1	221.4	208.9	192.8	165.7	168.0	216.5
0118	223.4	205.4	192.8	178.1	153.3	155.5	199.0
0119	217.1	198.6	186.5	172.0	147.5	149.8	192.8
0120 (Ref)	226.8	226.5	227.8	226.8	226.6	225.7	229.4
Average	229.65	210.17	197.95	182.53	156.56	159.17	204.79
s	10.216	9.082	8.721	8.365	7.181	7.296	9.528
Average+3s	260.29	237.42	224.11	207.63	178.10	181.06	233.38
Average-3s	199.00	182.93	171.79	157.44	135.02	137.28	176.21

hfe @ 100mA	BC817-25,215 NXP/Nexperia RS Jan-2018						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0210	249.0	225.2	213.4	196.8	168.8	172.2	223.6
0211	253.8	230.1	217.9	201.5	172.5	175.9	227.1
0212	252.9	228.9	216.7	199.9	172.1	174.7	226.2
0213	250.6	226.6	215.2	197.6	170.2	172.9	224.2
0214	253.3	229.9	218.7	200.6	172.8	175.3	227.6
0215	262.2	237.1	224.0	206.5	177.7	180.3	233.5
0216	251.6	227.2	215.2	198.4	170.7	173.0	224.6
0217	253.4	229.0	217.6	200.4	172.6	176.0	226.1
0218	253.4	230.0	218.5	200.6	171.7	174.6	226.1
0219	251.4	227.5	216.1	199.4	171.4	173.4	225.4
0220 (Ref)	253.3	252.5	252.9	251.1	251.5	250.4	254.6
Average	253.17	229.15	217.32	200.18	172.06	174.82	226.45
s	3.512	3.222	2.881	2.677	2.348	2.318	2.777
Average+3s	263.70	238.81	225.96	208.21	179.11	181.77	234.78
Average-3s	242.63	219.48	208.68	192.14	165.02	167.87	218.12

hfe @ 100mA	BC817-25,215 NXP/Nexperia Mouser Jun-2020						
			krad(Si)			annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0410	222.2	196.7	181.1	159.1	0.0*	134.9	179.5
0411	225.2	200.6	183.9	161.1	135.0	136.5	179.8
0412	225.3	201.2	184.0	160.9	135.0	136.5	179.3
0413	226.4	201.9	183.8	161.2	135.9	137.1	181.0
0414	232.0	207.7	189.5	165.7	139.5	140.5	184.1
0415	235.5	209.9	191.9	168.8	141.7	142.6	187.6
0416	230.7	205.9	187.7	164.6	138.0	139.1	184.5
0417	234.4	209.0	190.8	166.9	140.0	141.0	186.0
0418	215.2	192.5	175.5	153.5	0.0*	0.0*	173.1
0419	218.9	195.1	178.4	156.7	0.0*	0.0*	174.7
0420 (Ref)	232.8	233.6	236.0	232.5	233.5	232.2	232.5
Average	226.59	202.06	184.65	161.85	96.50	110.81	180.96
s	6.670	6.023	5.362	4.747	66.624	58.450	4.704
Average+3s	246.60	220.13	200.74	176.09	296.37	286.16	195.07
Average-3s	206.58	183.99	168.57	147.61	-103.37	-64.54	166.85

* Obviously incorrect measurement result is due to the fact that the UNIMET M3000 can no longer set the collector current correctly at lower currents and low amplification.

8.5 hfe @ 500 mA

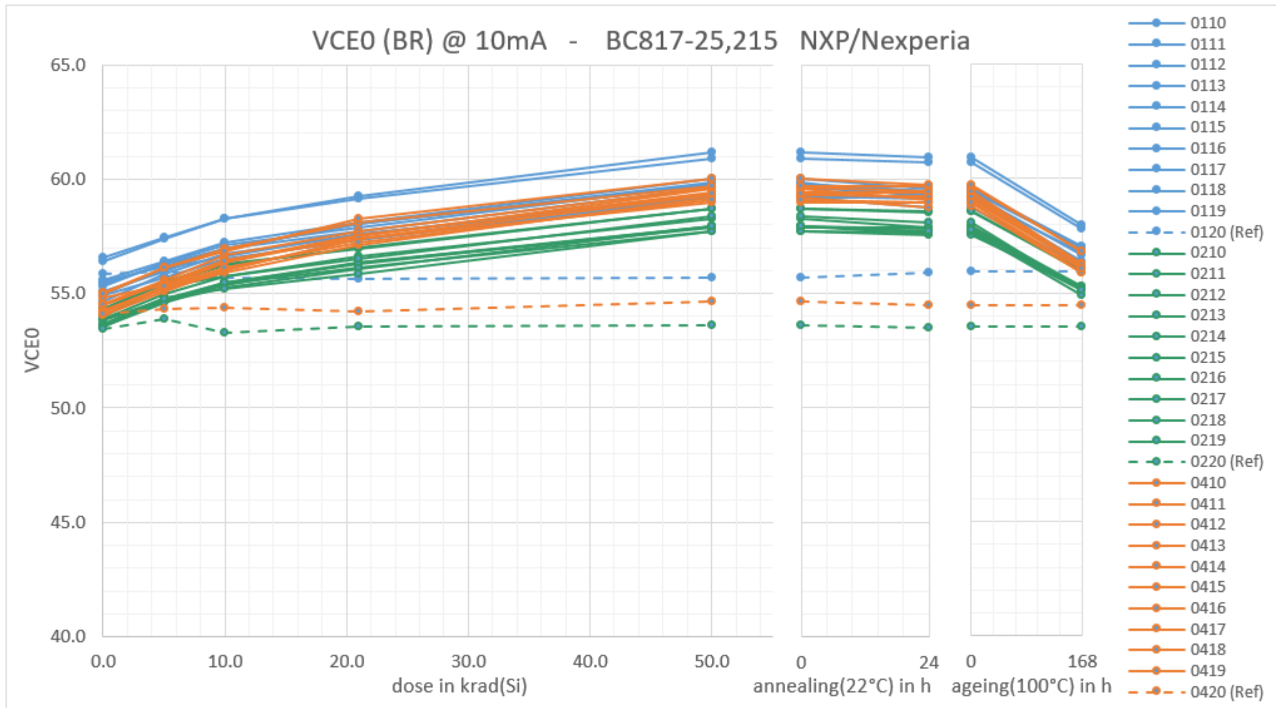


hfe @ 500mA	BC817-25,215 NXP/Nexperia Farnell Nov-2018						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0110	94.4	90.2	87.0	81.4	71.2	72.5	88.5
0111	99.1	94.2	91.0	85.4	75.0	76.4	92.4
0112	96.6	92.0	88.8	83.4	73.2	74.6	89.6
0113	96.8	92.3	89.0	83.6	73.1	74.6	90.6
0114	102.2	97.5	94.1	88.1	77.3	78.8	94.9
0115	102.1	97.4	94.0	88.2	77.5	78.9	96.0
0116	102.3	97.6	94.1	88.4	77.5	78.9	95.8
0117	102.9	98.1	94.7	88.9	78.0	79.4	96.0
0118	94.6	90.2	87.0	81.8	71.8	73.1	87.8
0119	97.4	92.7	89.2	83.8	73.4	74.8	90.6
0120 (Ref)	97.2	97.1	97.2	97.1	97.2	97.0	98.7
Average	98.86	94.22	90.88	85.31	74.79	76.19	92.22
s	3.326	3.171	3.078	2.876	2.585	2.626	3.250
Average+3s	108.84	103.73	100.12	93.94	82.55	84.07	101.97
Average-3s	88.88	84.71	81.65	76.68	67.04	68.32	82.47

hfe @ 500mA	BC817-25,215 NXP/Nexperia RS Jan-2018						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0210	107.8	102.1	98.5	92.4	81.2	82.8	101.6
0211	111.0	105.4	101.7	95.2	83.6	85.1	103.9
0212	110.8	105.1	101.4	95.0	83.4	85.1	103.9
0213	108.0	102.6	98.8	92.6	81.4	82.9	101.2
0214	110.2	104.7	100.9	94.5	82.9	84.5	103.8
0215	112.2	106.5	102.5	96.0	84.5	86.0	104.8
0216	110.2	104.4	100.8	94.3	82.9	84.3	103.3
0217	111.7	106.1	102.1	95.6	84.0	85.5	104.2
0218	110.4	104.9	101.1	94.5	82.9	84.5	103.1
0219	109.5	103.9	100.1	93.8	82.2	83.6	102.7
0220 (Ref)	111.0	110.6	110.6	110.4	110.3	110.2	111.7
Average	110.17	104.56	100.81	94.40	82.91	84.42	103.25
s	1.434	1.390	1.319	1.185	1.063	1.071	1.127
Average+3s	114.48	108.73	104.77	97.95	86.10	87.63	106.63
Average-3s	105.87	100.39	96.86	90.85	79.72	81.20	99.87

hfe @ 500mA	BC817-25,215 NXP/Nexperia Mouser Jun-2020						
			krad(Si)			annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0410	98.6	90.7	85.4	77.3	65.2	66.0	83.2
0411	100.0	92.0	86.5	78.3	66.1	66.9	84.2
0412	100.5	92.5	86.9	78.6	66.4	67.4	84.4
0413	100.7	92.7	87.0	78.7	66.6	67.5	84.8
0414	102.0	93.7	88.1	79.7	67.2	68.2	84.7
0415	103.4	95.0	89.4	80.9	68.4	69.3	86.2
0416	101.5	93.2	87.6	79.2	66.7	67.7	83.9
0417	102.5	94.4	88.6	80.3	67.6	68.6	85.2
0418	96.2	88.8	83.3	75.4	63.7	64.7	81.8
0419	97.9	90.2	84.8	76.7	64.7	65.7	81.9
0420 (Ref)	101.0	100.9	101.1	100.8	100.9	100.9	101.1
Average	100.35	92.33	86.76	78.49	66.26	67.17	84.03
s	2.218	1.966	1.843	1.672	1.391	1.407	1.418
Average+3s	107.00	98.23	92.29	83.51	70.43	71.40	88.29
Average-3s	93.70	86.44	81.23	73.48	62.08	62.95	79.78

8.6 VCEo (BR) @ 10mA

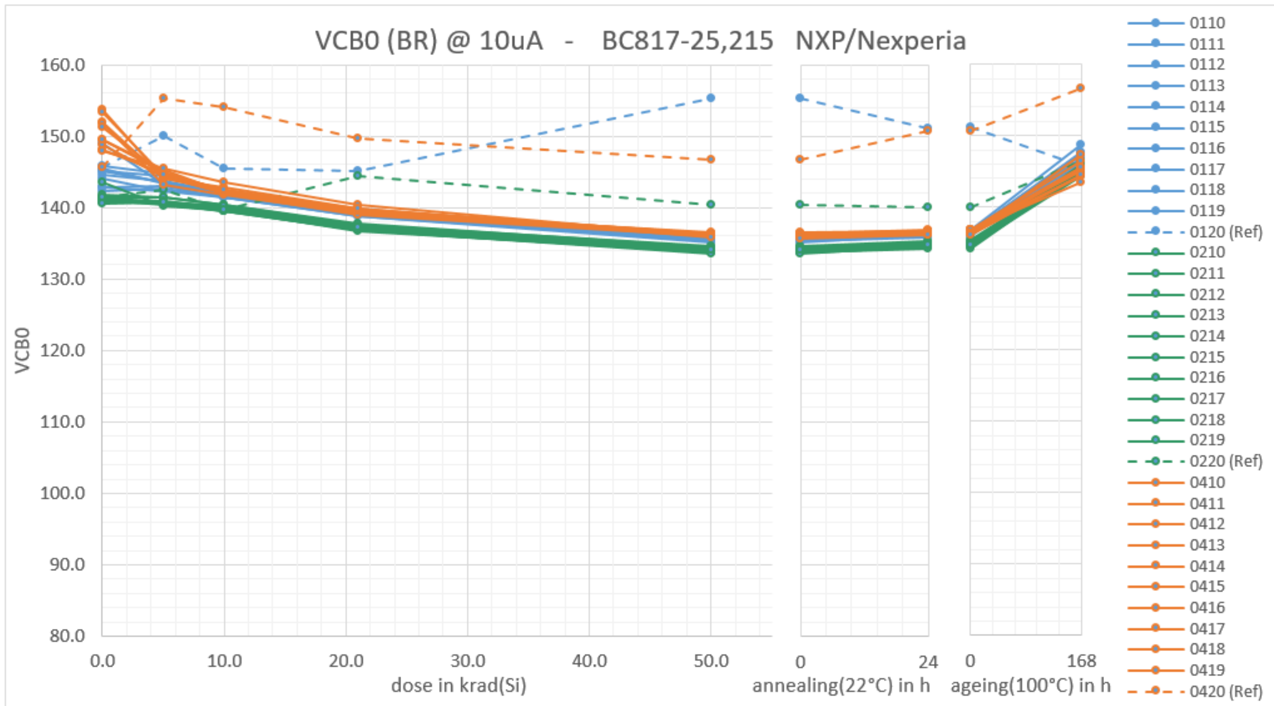


VCEO (BR) @ 10mA BC817-25,215 NXP/Nexperia Farnell Nov-2018							
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0110	56.4	57.4	58.3	59.3	61.1	60.9	57.9
0111	55.5	56.2	57.0	58.0	59.8	59.4	57.0
0112	55.3	56.4	57.1	57.9	59.8	59.5	57.0
0113	55.6	56.4	57.2	58.1	60.0	59.6	57.0
0114	54.7	55.8	56.7	57.5	59.3	59.2	56.2
0115	55.0	56.1	56.6	57.6	59.2	59.2	56.4
0116	55.4	56.3	57.0	58.1	59.9	59.2	56.7
0117	55.0	55.7	56.5	57.3	59.2	58.7	56.2
0118	56.6	57.5	58.2	59.1	60.9	60.7	57.8
0119	55.1	56.0	56.9	57.7	59.7	59.3	56.7
0120 (Ref)	55.9	55.9	55.7	55.7	55.7	55.9	55.9
Average	55.45	56.36	57.16	58.07	59.87	59.58	56.88
s	0.615	0.594	0.615	0.648	0.674	0.702	0.612
Average+3s	57.29	58.15	59.01	60.01	61.89	61.69	58.72
Average-3s	53.60	54.58	55.32	56.13	57.85	57.48	55.04

VCE0 (BR) @ 10mA BC817-25,215 NXP/Nexperia RS Jan-2018							
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0210	54.3	55.5	56.3	57.0	58.7	58.6	55.9
0211	53.8	54.8	55.4	56.4	57.9	57.9	55.2
0212	53.5	54.7	55.5	56.3	57.9	57.8	55.2
0213	54.3	55.4	56.2	57.0	58.7	58.6	56.0
0214	53.9	54.7	55.2	56.1	57.9	57.6	55.1
0215	53.9	55.0	55.8	56.6	58.3	57.9	55.3
0216	53.6	54.6	55.4	56.1	57.7	57.5	55.3
0217	53.7	54.8	55.2	55.9	57.7	57.7	54.9
0218	53.5	54.8	55.5	56.4	58.0	57.7	55.2
0219	54.0	55.3	55.8	56.5	58.4	58.1	55.1
0220 (Ref)	53.5	53.9	53.3	53.6	53.6	53.5	53.5
Average	53.86	54.95	55.63	56.42	58.12	57.94	55.32
s	0.301	0.344	0.382	0.368	0.370	0.369	0.354
Average+3s	54.76	55.98	56.77	57.53	59.23	59.04	56.38
Average-3s	52.95	53.92	54.48	55.32	57.01	56.83	54.26

VCE0 (BR) @ 10mA BC817-25,215 NXP/Nexperia Mouser Jun-2020							
			krad(Si)			annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0410	54.5	55.6	56.7	57.7	59.6	59.5	56.3
0411	54.2	55.3	56.3	57.5	59.6	59.1	56.2
0412	54.5	55.5	56.4	57.4	59.3	59.3	56.3
0413	54.8	55.3	56.4	57.5	59.4	59.4	56.1
0414	54.0	55.1	56.0	57.4	59.0	59.0	55.9
0415	54.1	55.2	55.9	57.1	59.2	58.8	55.9
0416	54.3	55.2	56.0	57.4	59.4	59.2	56.2
0417	54.2	55.3	56.1	57.3	59.1	59.0	56.1
0418	55.0	56.1	56.9	58.1	59.7	59.7	56.8
0419	55.0	56.1	56.8	58.3	60.0	59.7	56.8
0420 (Ref)	54.1	54.3	54.4	54.2	54.6	54.5	54.5
Average	54.47	55.48	56.37	57.57	59.43	59.25	56.25
s	0.358	0.358	0.353	0.371	0.310	0.323	0.327
Average+3s	55.55	56.55	57.43	58.68	60.36	60.22	57.23
Average-3s	53.40	54.41	55.31	56.46	58.50	58.29	55.27

8.7 VCBo (BR) @ 10uA

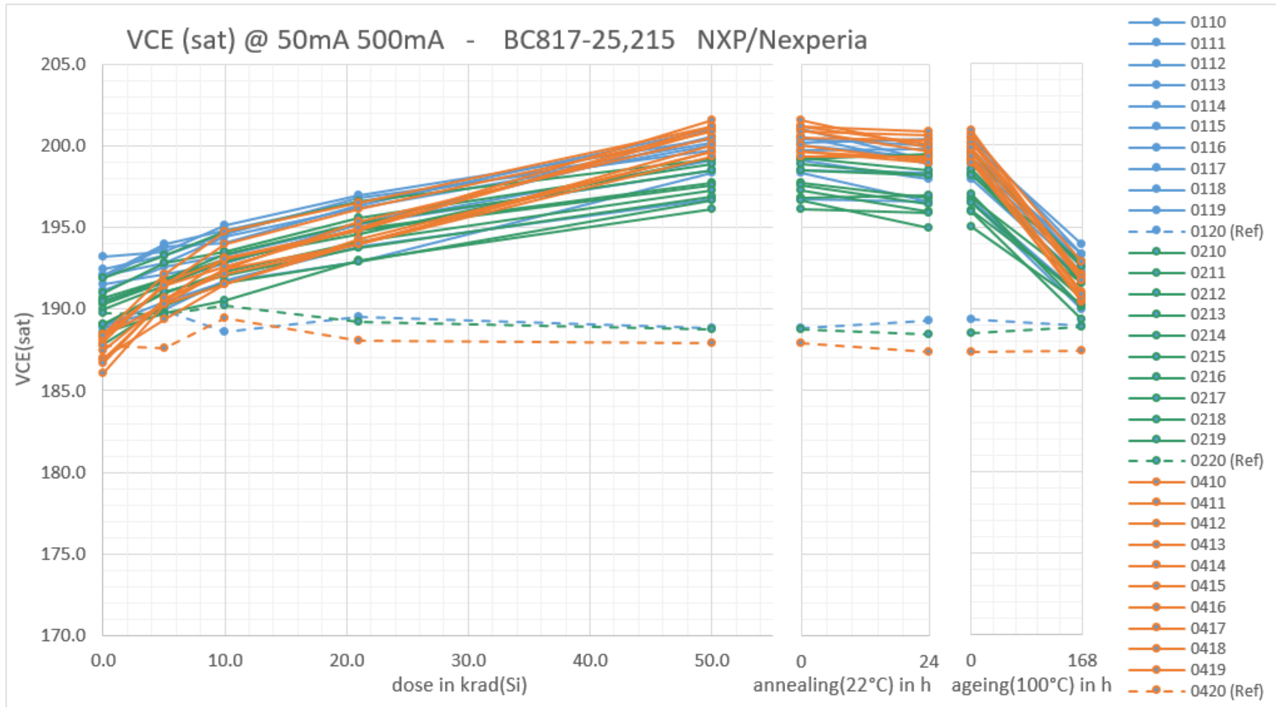


VCB0 (BR) @ 10uA	BC817-25,215 NXP/Nexperia Farnell Nov-2018						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0110	145.9	144.7	142.4	139.6	136.0	136.6	146.4
0111	144.5	143.6	142.2	139.2	136.0	136.8	148.7
0112	148.9	143.1	142.0	139.2	135.6	136.6	146.8
0113	145.4	143.4	142.0	139.3	136.0	136.4	147.7
0114	142.8	142.3	141.7	139.0	135.3	135.9	147.3
0115	144.1	142.4	141.5	139.1	135.6	136.5	146.1
0116	142.9	143.0	141.4	138.9	135.1	136.2	147.3
0117	142.3	142.7	141.5	138.8	135.5	136.1	147.5
0118	145.1	143.6	142.2	139.5	135.9	136.6	146.6
0119	145.1	144.4	142.3	139.4	136.0	136.6	147.6
0120 (Ref)	145.7	150.0	145.5	145.2	155.3	151.1	145.7
Average	144.69	143.34	141.91	139.21	135.71	136.42	147.20
s	1.927	0.801	0.352	0.263	0.323	0.285	0.743
Average+3s	150.47	145.74	142.97	140.00	136.67	137.27	149.43
Average-3s	138.91	140.94	140.85	138.42	134.74	135.56	144.97

VCB0 (BR) @ 10uA	BC817-25,215 NXP/Nexperia RS Jan-2018					
	krad(Si)				annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0210	141.5	141.4	140.3	137.5	134.6	135.4	145.2
0211	143.5	140.3	139.7	136.7	134.0	134.6	144.8
0212	141.0	140.3	139.5	136.9	133.7	134.5	144.8
0213	141.7	141.4	140.4	137.7	134.5	135.1	146.0
0214	140.7	140.7	139.8	136.9	133.7	134.2	145.0
0215	141.3	140.9	140.1	137.2	134.0	134.9	144.7
0216	140.9	140.6	139.8	137.0	134.1	135.0	145.4
0217	141.3	140.6	139.6	136.9	133.6	134.5	144.3
0218	140.9	140.7	140.3	137.4	134.2	134.9	144.9
0219	140.5	140.7	139.5	137.2	134.1	134.7	144.9
0220 (Ref)	141.5	142.5	139.7	144.5	140.3	140.0	146.4
Average	141.33	140.77	139.89	137.15	134.05	134.78	144.98
s	0.856	0.394	0.353	0.319	0.310	0.334	0.450
Average+3s	143.90	141.95	140.95	138.11	134.98	135.78	146.34
Average-3s	138.76	139.59	138.83	136.19	133.12	133.78	143.63

VCB0 (BR) @ 10uA	BC817-25,215 NXP/Nexperia Mouser Jun-2020						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0410	149.5	144.9	142.3	139.7	136.3	136.8	146.5
0411	148.1	144.8	142.5	139.7	136.3	136.7	145.2
0412	153.7	144.1	142.5	139.3	136.3	136.9	145.0
0413	152.0	144.0	142.8	139.9	136.3	136.8	144.4
0414	151.8	143.2	141.9	139.1	136.3	136.8	145.5
0415	148.7	144.3	142.1	139.4	136.6	136.8	143.4
0416	153.3	144.4	142.0	139.0	136.1	136.3	145.6
0417	149.4	145.2	142.2	139.5	136.2	136.4	144.3
0418	148.0	145.5	143.5	140.4	136.0	136.3	147.4
0419	151.2	144.6	142.5	139.8	135.7	136.1	144.6
0420 (Ref)	145.6	155.3	154.0	149.7	146.7	150.7	156.6
Average	150.57	144.51	142.43	139.58	136.20	136.57	145.19
s	2.112	0.649	0.466	0.401	0.221	0.275	1.146
Average+3s	156.90	146.46	143.83	140.78	136.86	137.39	148.63
Average-3s	144.23	142.56	141.03	138.37	135.53	135.74	141.75

8.8 VCE (sat) @ 50mA 500mA



VCE (sat) @ 50mA 500mA	BC817-25,215 NXP/Nexperia Farnell Nov-2018						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0110	191.9	193.8	194.0	196.4	201.0	199.1	192.9
0111	191.5	192.1	192.8	195.2	198.5	198.4	192.2
0112	189.0	190.0	191.8	193.8	196.8	196.6	190.8
0113	189.0	190.4	191.6	192.9	198.3	196.5	190.0
0114	193.2	193.5	195.1	197.0	200.4	200.0	193.9
0115	192.1	193.9	194.8	196.6	200.2	200.4	193.3
0116	192.5	193.3	194.5	196.8	199.7	199.8	192.8
0117	192.0	192.8	194.4	196.2	200.1	199.3	193.3
0118	191.2	192.6	193.2	195.2	200.6	198.9	192.5
0119	190.5	191.6	192.8	195.2	199.1	197.9	191.8
0120 (Ref)	188.8	189.9	188.6	189.5	188.9	189.3	188.9
Average	191.27	192.40	193.52	195.50	199.46	198.68	192.36
s	1.410	1.369	1.255	1.351	1.293	1.345	1.206
Average+3s	195.50	196.51	197.28	199.55	203.34	202.72	195.97
Average-3s	187.04	188.29	189.75	191.44	195.58	194.65	188.74

VCE (sat) @ 50mA 500mA	BC817-25,215 NXP/Nexperia RS Jan-2018						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0210	191.9	193.3	194.7	196.6	199.2	199.5	192.5
0211	190.3	191.7	192.9	194.9	197.7	196.8	191.5
0212	190.7	191.8	193.3	195.3	198.5	198.2	191.6
0213	191.0	192.8	193.5	195.6	198.9	198.2	192.8
0214	190.0	191.4	193.0	194.8	197.6	196.4	190.7
0215	189.1	191.0	192.3	194.1	197.3	196.0	190.8
0216	189.1	191.0	192.1	193.8	196.8	197.0	190.1
0217	188.5	189.7	190.5	193.0	196.1	195.9	189.4
0218	187.8	190.2	191.6	192.9	196.6	195.0	190.2
0219	190.5	191.9	193.0	194.6	199.3	198.5	191.5
0220 (Ref)	189.8	189.6	190.2	189.2	188.8	188.5	188.8
Average	189.87	191.49	192.69	194.54	197.79	197.14	191.13
s	1.243	1.079	1.151	1.149	1.120	1.410	1.093
Average+3s	193.60	194.72	196.14	197.99	201.14	201.38	194.41
Average-3s	186.15	188.25	189.23	191.09	194.43	192.91	187.84

VCE (sat) @ 50mA 500mA	BC817-25,215 NXP/Nexperia Mouser Jun-2020						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0410	188.3	190.3	192.4	195.4	200.5	200.4	192.1
0411	187.0	189.4	191.5	194.3	199.7	199.2	190.4
0412	187.5	190.5	193.2	194.8	200.9	199.6	191.0
0413	188.0	191.6	193.0	194.8	201.2	200.1	191.9
0414	186.9	190.5	192.4	194.0	200.0	199.0	190.6
0415	186.0	190.3	191.5	194.0	199.6	199.0	190.7
0416	188.2	191.5	194.0	196.1	200.9	200.6	192.9
0417	186.7	190.7	192.1	194.0	199.4	199.3	190.8
0418	188.5	192.1	194.8	196.5	201.2	200.9	191.7
0419	188.3	191.4	192.6	195.0	201.6	199.9	191.7
0420 (Ref)	187.7	187.6	189.4	188.1	187.9	187.4	187.4
Average	187.54	190.81	192.74	194.89	200.48	199.80	191.37
s	0.846	0.809	1.029	0.887	0.769	0.690	0.815
Average+3s	190.08	193.24	195.83	197.54	202.79	201.86	193.82
Average-3s	185.00	188.38	189.65	192.23	198.18	197.73	188.93

9 CONCLUSION

The test results of the BC817-25,215 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 breakdown voltage between the Collector-Emitter and Collector-Base can be determined at the measured operating points, but it is still within the tolerances specified in the data sheet.

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

10 APPENDIX - EXTRACT FROM THE DATA SHEET

BC817; BC817W; BC337

45 V, 500 mA NPN general-purpose transistors

Rev. 06 — 17 November 2009 Product data sheet

1. Product profile

1.1 General description

NPN general-purpose transistors.

Table 1. Product overview

Type number	Package		PNP complement
	NXP	JEITA	
BC817	SOT23	-	BC807
BC817W	SOT323	SC-70	BC807W
BC337[1]	SOT54 (TO-92)	SC-43A	BC327

[1] Also available in SOT54A and SOT54 variant packages (see Section 2).

1.2 Features

- High current
- Low voltage

1.3 Applications

- General-purpose switching and amplification

1.4 Quick reference data

Table 2. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{CEO}	collector-emitter voltage	open base; I_C = 10 mA		-	-	45	V
I_C	collector current (DC)			-	-	500	mA
I_{CM}	peak collector current			-	-	1	A
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 1 V	[1]	-	-	-	
	BC817; BC817W; BC337			100	-	600	
	BC817-16; BC817-16W; BC337-16			100	-	250	
	BC817-25; BC817-25W; BC337-25			160	-	400	
	BC817-40; BC817-40W; BC337-40			250	-	600	

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

3. Ordering information

Table 4. Ordering information

Type number[1]	Package		
	Name	Description	Version
BC817	-	plastic surface mounted package; 3 leads	SOT23
BC817W	SC-70	plastic surface mounted package; 3 leads	SOT323
BC337[2]	SC-43A	plastic single-ended leaded (through hole) package; 3 leads	SOT54

[1] Valid for all available selection groups.

[2] Also available in SOT54A and SOT54 variant packages (see Section 2 and Section 9).

4. Marking

Table 5. Marking codes

Type number	Marking code[1]
BC817	6D*
BC817-16	6A*
BC817-25	6B*
BC817-40	6C*
BC817W	6D*
BC817-16W	6A*
BC817-25W	6B*
BC817-40W	6C*
BC337	C337
BC337-16	C33716
BC337-25	C33725
BC337-40	C33740

[1] * = -: made in Hong Kong
* = p: made in Hong Kong
* = t: made in Malaysia
* = W: made in China

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5. Limiting values

Table 6. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
V_{CBO}	collector-base voltage	open emitter		-	50	V
V_{CEO}	collector-emitter voltage	open base; I_C = 10 mA		-	45	V
V_{EBO}	emitter-base voltage	open collector		-	5	V
I_C	collector current (DC)			-	500	mA
I_{CM}	peak collector current			-	1	A
I_{BM}	peak base current			-	200	mA
P_{tot}	total power dissipation					
	BC817	$T_{amb} \leq 25$ °C	[1][2]	-	250	mW
	BC817W	$T_{amb} \leq 25$ °C	[1][2]	-	200	mW
	BC337	$T_{amb} \leq 25$ °C	[1][2]	-	625	mW
T_{stg}	storage temperature			−65	+150	°C
T_j	junction temperature			-	150	°C
T_{amb}	ambient temperature			−65	+150	°C

[1] Transistor mounted on an FR4 printed-circuit board, single-sided copper, tin-plated and standard footprint.

[2] Valid for all available selection groups.

6. Thermal characteristics

Table 7. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient						
	BC817	$T_{amb} \leq 25$ °C	[1][2]	-	-	500	K/W
	BC817W	$T_{amb} \leq 25$ °C	[1][2]	-	-	625	K/W
	BC337	$T_{amb} \leq 25$ °C	[1][2]	-	-	200	K/W

[1] Transistor mounted on an FR4 printed-circuit board, single-sided copper, tin-plated and standard footprint.

[2] Valid for all available selection groups.

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7. Characteristics

Table 8. Characteristics

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

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_{CBO}	collector-base cut-off current	I_E = 0 A; V_{CB} = 20 V		-	-	100	nA
		I_E = 0 A; V_{CB} = 20 V; T_j = 150 °C		-	-	5	µA
I_{EBO}	emitter-base cut-off current	I_C = 0 A; V_{EB} = 5 V		-	-	100	nA
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 1 V	[1]				
	BC817; BC817W; BC337			100	-	600	
	BC817-16; BC817-16W; BC337-16			100	-	250	
	BC817-25; BC817-25W; BC337-25			160	-	400	
	BC817-40; BC817-40W; BC337-40			250	-	600	
h_{FE}	DC current gain	I_C = 500 mA; V_{CE} = 1 V	[1]	40	-	-	
V_{CEsat}	collector-emitter saturation voltage	I_C = 500 mA; I_B = 50 mA	[1]	-	-	700	mV
V_{BE}	base-emitter voltage	I_C = 500 mA; V_{CE} = 1 V	[2]	-	-	1.2	V
C_c	collector capacitance	I_E = i_e = 0 A; V_{CB} = 10 V; f = 1 MHz		-	3	-	pF
f_T	transition frequency	I_C = 10 mA; V_{CE} = 5 V; f = 100 MHz		100	-	-	MHz

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

[2] V_{BE} decreases by approximately 2 mV/K with increasing temperature.

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