TOTAL IONIZING DOSE Test Report

BC817 - 500mA NPN Transistor from Infineon

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

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1 INTRODUCTION

This report presents the total ionizing dose results of **BC817** a **500mA NPN Transistor from Infineon**.

2 DOCUMENTS

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

3 PART REFERENCES

REFERENCES	
Type:	BC817K25E6327HTSA1 and BC817K40E6327HTSA1
Manufacturer:	Infineon
Function:	500 mA general-purpose transistors
Technology:	Bipolar NPN Silicon
PARTS PROCUREMENT	
Packaging:	SOT23 (TO-236AB)
Date Code:	batch no. 09: Nov-2018 batch no. 10: Jan-2019 batch no. 12: Aug-2018
Distributor:	batch no. 09: Farnell batch no. 10: RS Components batch no. 12: 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

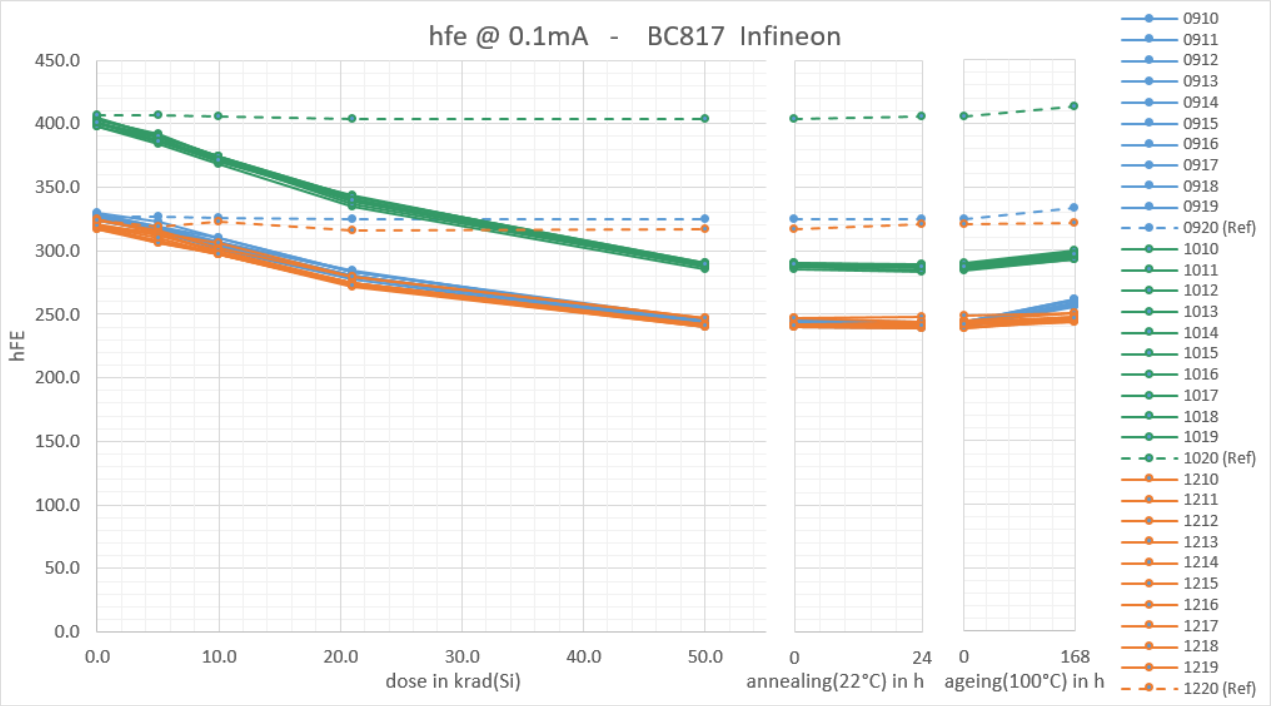
PARAMETERS	SYMBOLS	TEST CONDITIONS
Forward Current Transfer Ratio	hfe1	Ic= 0.1mA, Vce = 1V
	hfe2	Ic= 1mA, Vce = 1V
	hfe3	Ic= 10mA, Vce = 1V
	hfe4	Ic= 100mA, Vce = 1V
	hfe5	Ic= 500mA, Vce = 1V
Collector-Emitter Breakdown Voltage	VCEo (BR)	Ic = 10mA
Collector-Base Breakdown Voltage	VCBo (BR)	Ic = 10uA
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

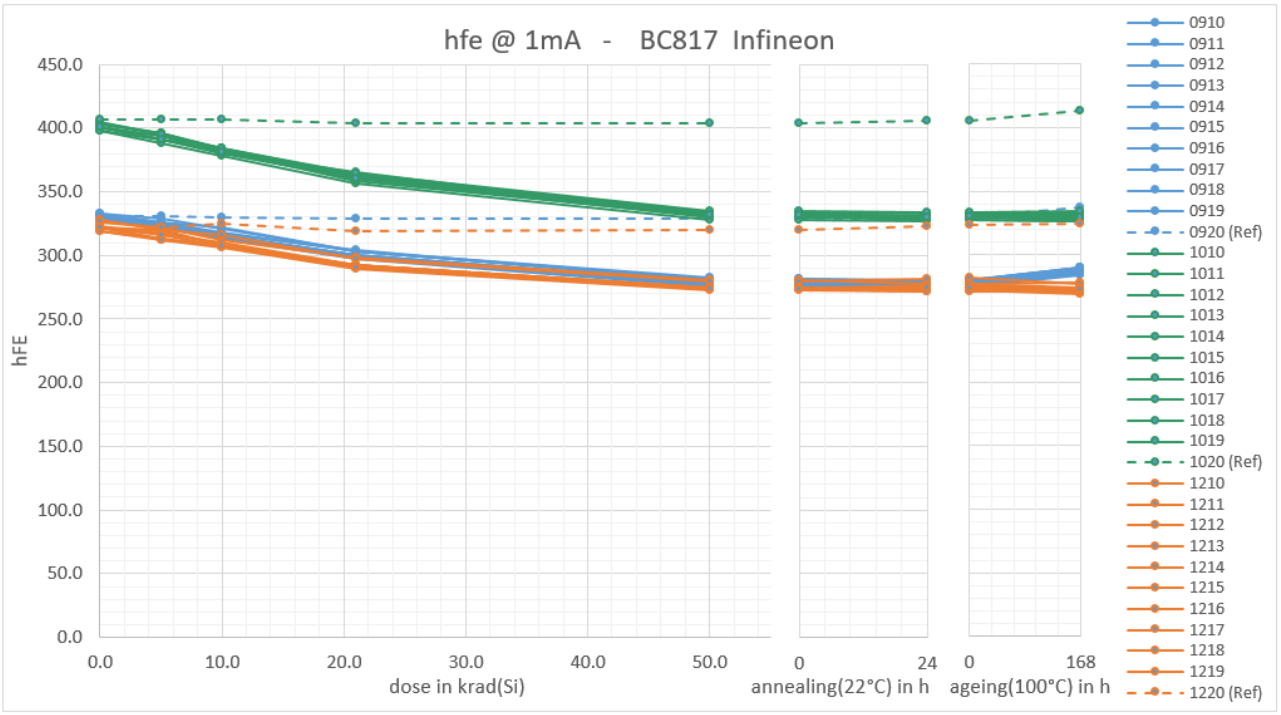


hfe @ 0.1mA	BC817 K25E6327HTSA1 Infineon Farnell Nov-2018						
	krad(Si)					annealing	ageing (100°C,
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	168h)
0910	328.7	318.7	306.8	283.5	245.6	243.6	261.0
0911	326.7	316.2	304.4	280.5	241.6	240.9	258.0
0912	329.6	322.4	310.2	283.3	244.6	243.5	261.0
0913	326.2	316.4	304.9	280.4	242.2	241.2	258.5
0914	328.9	319.0	310.3	283.3	244.4	243.3	260.3
0915	324.1	316.1	302.4	279.7	240.7	239.7	257.8
0916	328.1	317.8	305.7	284.0	243.3	242.7	256.8
0917	325.1	314.6	302.9	279.3	240.6	240.4	256.4
0918	324.1	315.0	301.6	277.8	240.0	239.4	255.4
0919	326.6	316.9	304.2	280.7	242.8	242.3	258.5
0920 (Ref)	326.7	326.5	325.8	324.6	324.9	324.9	333.7
Average	326.81	317.30	305.34	281.25	242.58	241.70	258.36
s	1.962	2.310	2.996	2.132	1.879	1.597	1.938
Average+3s	332.70	324.23	314.33	287.65	248.22	246.49	264.18
Average-3s	320.92	310.38	296.35	274.86	236.95	236.90	252.55

hfe @ 0.1mA	BC817 K40E6327HTSA1 Infineon RS Jan-2019						
	krad(Si)					annealing	ageing (100°C,
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	168h)
1010	400.3	386.3	370.4	343.8	288.8	287.7	295.6
1011	400.8	386.5	373.2	338.4	287.1	286.0	293.8
1012	397.9	383.7	368.1	335.2	285.2	283.9	293.3
1013	403.5	391.0	374.4	342.2	290.3	288.7	298.7
1014	399.4	389.4	370.1	339.1	289.0	288.2	294.8
1015	398.0	386.1	372.6	336.8	287.5	284.6	292.8
1016	402.8	391.6	373.1	340.7	289.1	287.4	296.2
1017	400.7	389.4	373.8	340.4	288.8	287.7	297.7
1018	404.4	390.3	374.1	342.6	290.8	289.6	300.3
1019	400.6	386.3	371.0	339.7	289.1	287.3	296.5
1020 (Ref)	406.5	406.2	406.1	403.2	403.8	405.5	412.9
Average	400.84	388.06	372.10	339.89	288.58	287.12	295.97
s	2.161	2.597	2.066	2.649	1.631	1.774	2.414
Average+3s	407.33	395.86	378.29	347.84	293.47	292.44	303.21
Average-3s	394.36	380.27	365.90	331.94	283.69	281.79	288.73

hfe @ 0.1mA	BC817 K25E6327HTSA1 Infineon Mouser Aug-2018						
	krad(Si)					annealing	ageing (100°C,
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	168h)
1210	318.8	312.9	298.3	274.9	241.5	241.4	247.4
1211	317.1	307.6	297.3	272.9	241.7	240.0	243.2
1212	323.6	315.9	302.3	280.0	246.7	244.1	250.4
1213	319.5	313.8	298.4	274.6	241.3	241.2	243.8
1214	319.8	307.5	297.4	274.5	241.7	243.0	245.7
1215	325.2	313.7	305.8	279.2	246.6	248.3	250.2
1216	317.1	305.7	296.8	271.4	240.0	239.0	244.1
1217	318.9	305.7	298.5	272.3	240.3	238.7	245.4
1218	320.7	311.6	300.1	274.8	241.3	243.8	247.7
1219	319.7	310.3	297.5	272.9	240.9	241.4	246.5
1220 (Ref)	324.3	319.4	322.6	316.1	317.1	321.0	321.6
Average	320.04	310.47	299.23	274.75	242.20	242.07	246.43
s	2.575	3.665	2.810	2.815	2.411	2.852	2.501
Average+3s	327.77	321.47	307.66	283.19	249.43	250.63	253.93
Average-3s	312.32	299.48	290.80	266.30	234.97	233.52	238.93

8.2 hfe @ 1 mA

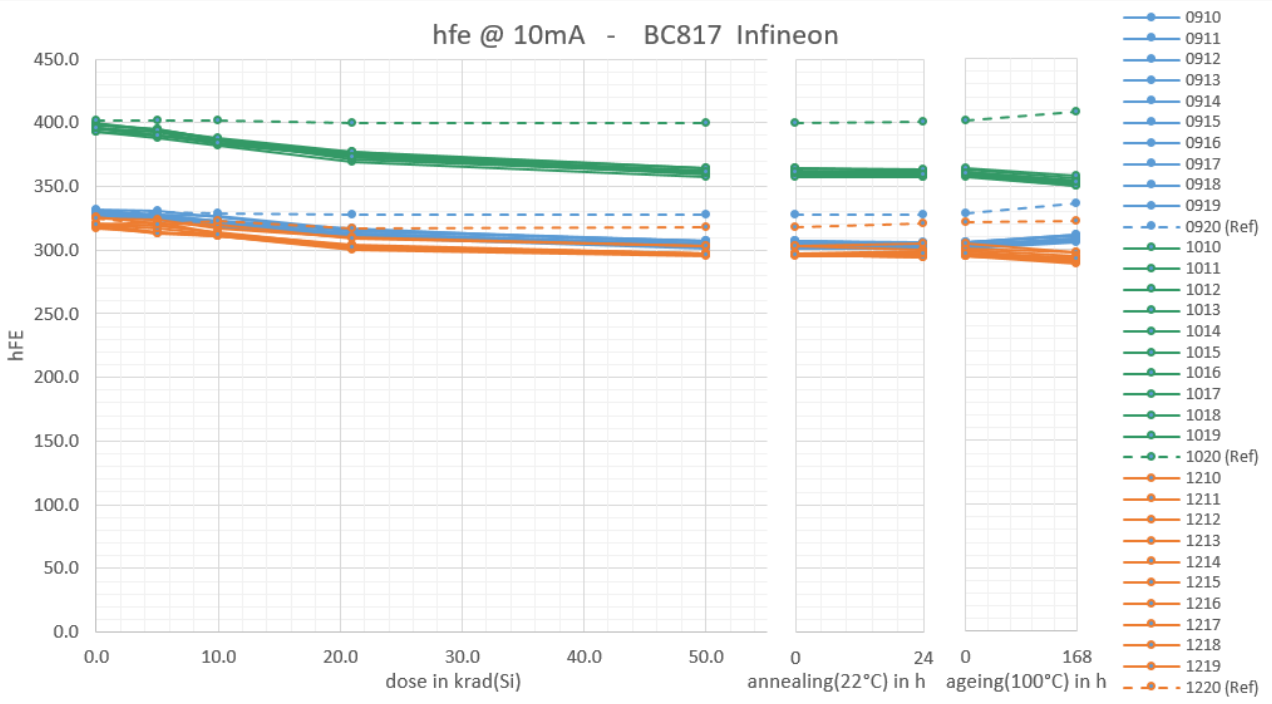


hfe @ 1mA	BC817 K25E6327HTSA1 Infineon Farnell Nov-2018						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0910	332.1	325.6	317.7	303.0	282.0	279.9	290.1
0911	330.2	323.3	315.4	300.3	278.0	277.3	287.3
0912	332.8	329.1	320.8	302.8	281.1	280.1	290.2
0913	329.8	323.5	316.0	300.1	278.4	277.5	287.7
0914	332.4	326.1	321.4	303.1	280.9	279.8	289.8
0915	328.1	323.4	313.7	299.5	277.1	276.0	287.0
0916	331.8	325.1	317.0	303.9	279.8	279.3	286.2
0917	328.6	321.6	313.8	298.9	276.5	276.6	285.5
0918	327.6	321.9	312.6	297.4	276.0	275.5	284.4
0919	330.2	324.0	315.3	300.3	278.9	278.6	287.7
0920 (Ref)	330.8	330.5	329.8	328.6	329.0	328.9	337.6
Average	330.36	324.36	316.39	300.92	278.87	278.06	287.59
s	1.885	2.215	2.930	2.151	2.043	1.711	1.987
Average+3s	336.01	331.01	325.18	307.37	285.00	283.20	293.55
Average-3s	324.70	317.72	307.60	294.47	272.74	272.93	281.63

hfe @ 1mA	BC817 K40E6327HTSA1 Infineon RS Jan-2019						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
1010	400.3	391.0	380.3	364.8	331.1	330.6	328.8
1011	400.6	390.9	383.1	359.9	329.9	329.3	327.3
1012	397.9	388.4	378.2	356.8	328.0	327.0	326.5
1013	403.4	395.7	384.1	363.6	333.7	332.4	332.2
1014	399.3	393.7	379.8	360.2	331.5	331.0	327.8
1015	398.0	390.8	382.4	358.4	330.5	327.9	326.1
1016	402.6	396.2	383.1	362.5	332.5	331.1	329.8
1017	400.7	393.9	383.7	361.6	331.6	330.6	330.8
1018	404.5	395.1	384.3	364.2	334.3	333.3	333.9
1019	400.6	390.8	380.9	360.8	331.7	330.1	329.2
1020 (Ref)	406.4	406.3	406.2	403.5	404.0	405.6	412.8
Average	400.79	392.64	382.00	361.27	331.49	330.34	329.23
s	2.173	2.606	2.079	2.588	1.810	1.893	2.503
Average+3s	407.31	400.46	388.24	369.04	336.92	336.02	336.74
Average-3s	394.27	384.83	375.77	353.51	326.06	324.66	321.72

hfe @ 1mA	BC817 K25E6327HTSA1 Infineon Mouser Aug-2018						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
1210	321.1	318.5	307.9	292.5	274.1	274.1	274.3
1211	319.2	313.1	306.7	290.0	274.0	272.3	269.4
1212	326.2	322.0	312.3	298.1	280.2	277.5	277.9
1213	321.6	320.2	308.0	292.2	274.0	274.2	270.4
1214	321.7	313.1	306.9	292.0	274.2	275.8	272.2
1215	327.5	319.7	315.6	297.1	280.0	281.9	277.5
1216	319.3	311.6	306.5	289.1	272.9	272.0	270.9
1217	321.4	311.8	308.2	290.2	273.3	271.6	272.4
1218	322.8	317.4	309.7	292.4	274.1	277.0	274.5
1219	322.0	316.0	307.2	290.6	273.7	274.4	273.4
1220 (Ref)	326.5	321.8	324.8	318.5	319.6	323.3	324.0
Average	322.28	316.34	308.91	292.43	275.06	275.07	273.31
s	2.665	3.780	2.923	2.966	2.684	3.112	2.842
Average+3s	330.27	327.68	317.68	301.33	283.12	284.41	281.84
Average-3s	314.28	305.00	300.14	283.53	267.01	265.74	264.78

8.3 hfe @ 10 mA

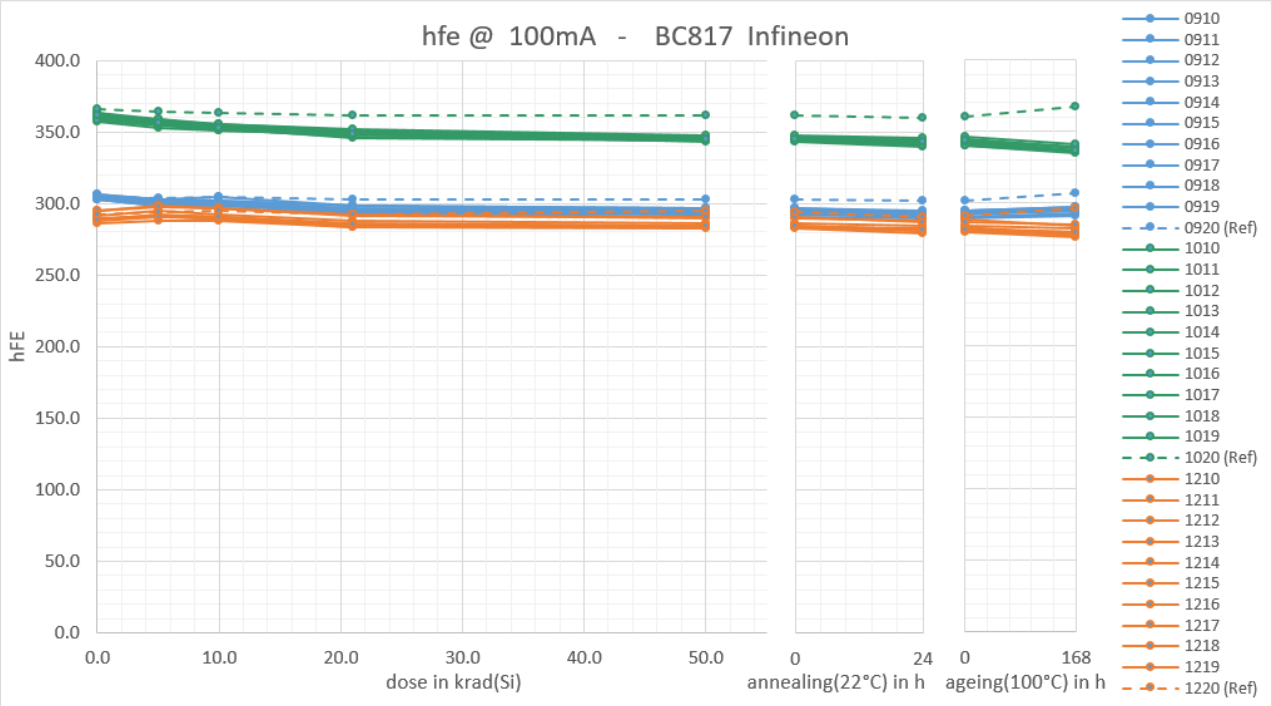


hfe @ 10mA	BC817 K25E6327HTSA1 Infineon Farnell Nov-2018						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0910	330.9	327.5	323.0	315.4	307.6	305.4	311.2
0911	329.1	325.2	320.8	313.0	303.8	303.0	308.6
0912	331.5	330.7	325.9	315.4	306.8	305.8	311.5
0913	328.8	325.5	321.4	312.7	303.9	303.1	308.8
0914	331.2	327.9	326.5	315.8	306.7	305.6	311.0
0915	327.1	325.4	319.2	312.2	302.6	301.5	308.0
0916	330.8	327.1	322.4	316.6	305.5	305.0	307.5
0917	327.4	323.5	319.1	311.3	301.7	301.9	306.3
0918	326.4	323.7	317.9	309.9	301.3	300.8	305.4
0919	329.1	325.8	320.6	312.8	304.4	304.2	308.9
0920 (Ref)	329.8	329.5	328.9	327.8	328.1	328.0	336.2
Average	329.23	326.25	321.67	313.52	304.42	303.64	308.72
s	1.848	2.153	2.837	2.167	2.195	1.823	2.063
Average+3s	334.78	332.71	330.18	320.02	311.01	309.11	314.91
Average-3s	323.69	319.79	313.16	307.02	297.84	298.17	302.53

hfe @ 10mA	BC817 K40E6327HTSA1 Infineon RS Jan-2019						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
1010	395.7	390.0	383.6	377.1	360.6	360.4	352.5
1011	395.9	389.9	386.2	372.7	359.7	359.3	351.3
1012	393.2	387.5	381.5	369.6	357.8	356.9	350.0
1013	398.7	394.5	387.3	376.4	363.8	362.7	356.3
1014	394.7	392.5	383.0	372.7	360.9	360.5	351.2
1015	393.3	389.7	385.5	371.0	360.0	357.8	349.7
1016	397.9	394.9	386.5	375.5	362.7	361.4	353.6
1017	396.1	392.8	386.8	374.2	361.4	360.5	354.4
1018	399.8	394.2	387.7	377.1	364.5	363.5	358.0
1019	396.1	389.9	384.1	373.4	361.2	359.8	352.7
1020 (Ref)	401.8	401.7	401.5	399.3	399.8	401.2	408.0
Average	396.14	391.58	385.23	373.98	361.27	360.28	352.96
s	2.162	2.522	2.058	2.572	1.986	2.016	2.668
Average+3s	402.62	399.15	391.41	381.69	367.23	366.33	360.96
Average-3s	389.65	384.02	379.06	366.26	355.31	354.23	344.95

hfe @ 10mA	BC817 K25E6327HTSA1 Infineon Mouser Aug-2018						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
1210	319.4	319.8	312.5	303.9	296.8	296.8	294.2
1211	317.4	314.3	311.1	301.0	296.5	294.6	288.8
1212	324.6	323.4	317.2	309.7	303.5	300.6	298.1
1213	319.7	322.1	312.6	303.5	296.8	297.0	290.2
1214	319.7	314.3	311.3	303.1	296.7	298.4	291.8
1215	325.7	321.2	320.1	308.7	303.1	305.0	297.7
1216	317.5	313.0	311.0	300.5	295.7	294.9	290.7
1217	319.5	313.3	312.8	301.7	296.3	294.5	292.3
1218	320.9	318.5	314.0	303.6	296.8	299.7	294.4
1219	320.2	317.3	312.0	302.1	296.5	297.3	293.2
1220 (Ref)	324.4	320.1	322.9	316.9	317.9	321.4	322.3
Average	320.46	317.71	313.47	303.78	297.87	297.86	293.14
s	2.708	3.849	2.968	3.080	2.880	3.258	3.060
Average+3s	328.58	329.25	322.38	313.02	306.51	307.64	302.32
Average-3s	312.33	306.16	304.57	294.54	289.23	288.09	283.96

8.4 hfe @ 100 mA

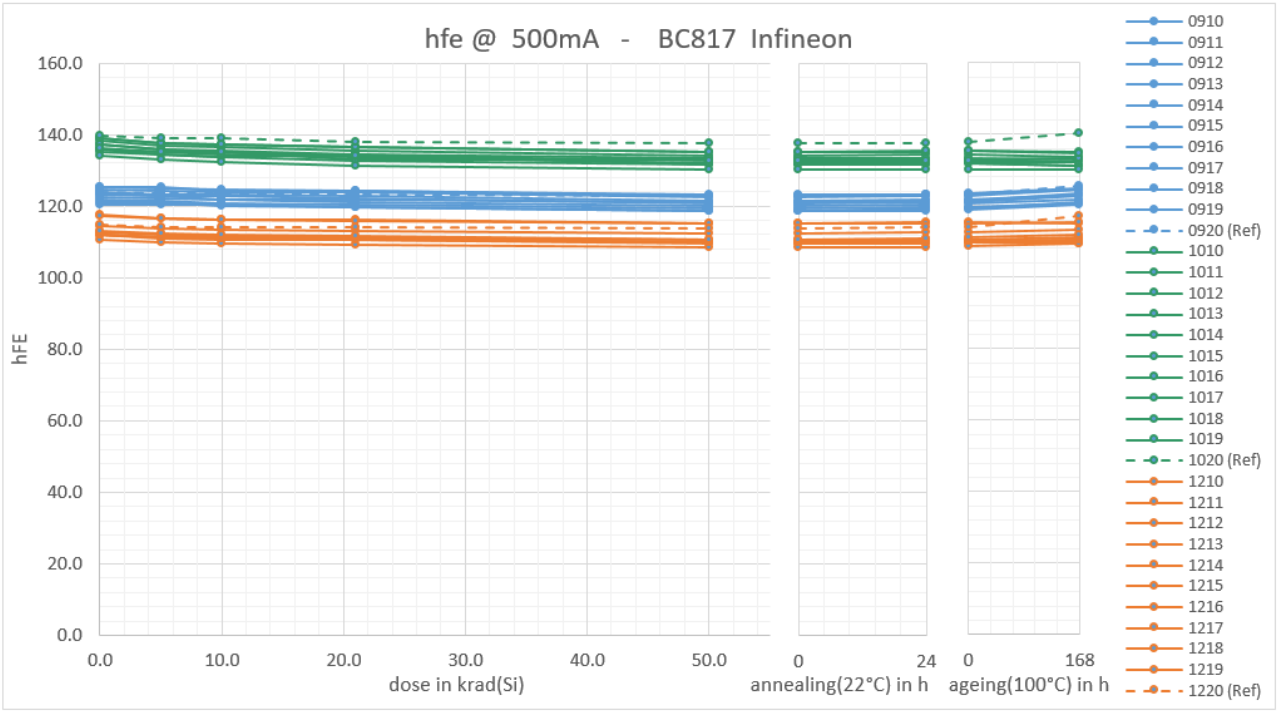


hfe @ 100mA	BC817 K25E6327HTSA1 Infineon Farnell Nov-2018						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0910	305.6	302.7	304.7	298.7	294.6	294.3	296.6
0911	304.6	300.9	300.0	294.9	292.5	292.0	294.3
0912	306.1	302.4	302.1	298.6	297.0	294.5	296.8
0913	303.8	300.7	299.0	295.3	293.2	292.6	294.3
0914	306.7	302.8	301.8	298.0	296.4	294.4	297.0
0915	303.0	300.4	298.9	294.4	294.2	290.6	292.9
0916	305.8	302.4	300.7	296.8	295.2	293.6	295.4
0917	302.6	298.7	298.2	294.2	292.4	290.4	292.3
0918	302.4	298.4	296.6	292.9	290.8	289.2	291.3
0919	303.9	300.9	299.1	296.1	294.9	292.5	296.4
0920 (Ref)	304.8	303.9	304.4	302.8	303.0	301.8	307.1
Average	304.45	301.03	300.12	295.99	294.11	292.41	294.73
s	1.551	1.580	2.296	1.980	1.905	1.857	2.048
Average+3s	309.10	305.77	307.01	301.93	299.83	297.99	300.88
Average-3s	299.79	296.29	293.23	290.05	288.39	286.84	288.59

hfe @ 100mA	BC817 K40E6327HTSA1 Infineon RS Jan-2019						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
1010	360.1	359.2	354.0	348.4	343.9	343.4	336.7
1011	360.8	355.0	352.5	345.7	343.6	342.1	335.8
1012	356.9	352.3	351.2	348.8	343.0	340.0	335.1
1013	362.3	357.9	355.1	350.6	346.4	344.7	339.2
1014	358.6	355.1	351.3	348.3	344.7	341.3	336.4
1015	358.3	354.7	351.6	346.4	344.3	340.2	335.4
1016	362.9	357.1	354.7	350.0	345.3	344.3	338.0
1017	361.6	356.7	352.0	349.5	344.5	343.1	336.1
1018	363.5	359.2	355.3	351.8	347.0	346.0	340.7
1019	361.3	356.0	352.8	348.7	344.6	343.5	336.2
1020 (Ref)	366.0	363.8	363.0	361.1	361.7	360.1	367.3
Average	360.64	356.33	353.06	348.82	344.73	342.86	336.98
s	2.134	2.153	1.591	1.815	1.240	1.967	1.784
Average+3s	367.04	362.79	357.84	354.27	348.45	348.76	342.33
Average-3s	354.24	349.87	348.29	343.38	341.01	336.96	331.63

hfe @ 100mA	BC817 K25E6327HTSA1 Infineon Mouser Aug-2018						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
1210	291.5	294.5	292.4	287.6	285.7	284.1	282.0
1211	288.8	291.2	288.7	284.8	283.5	282.9	276.9
1212	295.1	298.4	296.8	292.4	290.1	288.3	284.0
1213	288.7	292.2	290.1	285.3	283.6	281.3	278.5
1214	288.8	291.2	290.6	285.5	283.8	281.6	278.3
1215	295.1	297.1	296.9	291.5	290.8	287.1	285.1
1216	286.5	287.8	287.6	283.4	282.2	279.4	276.4
1217	287.6	290.3	289.3	283.8	283.5	280.6	278.0
1218	289.5	291.2	290.5	285.8	284.8	282.0	279.8
1219	288.8	291.8	290.3	285.2	284.6	281.4	280.0
1220 (Ref)	292.2	294.4	294.9	292.4	294.4	290.9	295.9
Average	290.05	292.56	291.33	286.53	285.27	282.87	279.92
s	2.956	3.208	3.185	3.083	2.884	2.842	2.935
Average+3s	298.92	302.18	300.88	295.78	293.92	291.39	288.73
Average-3s	281.18	282.93	281.77	277.28	276.61	274.34	271.12

8.5 hfe @ 500 mA

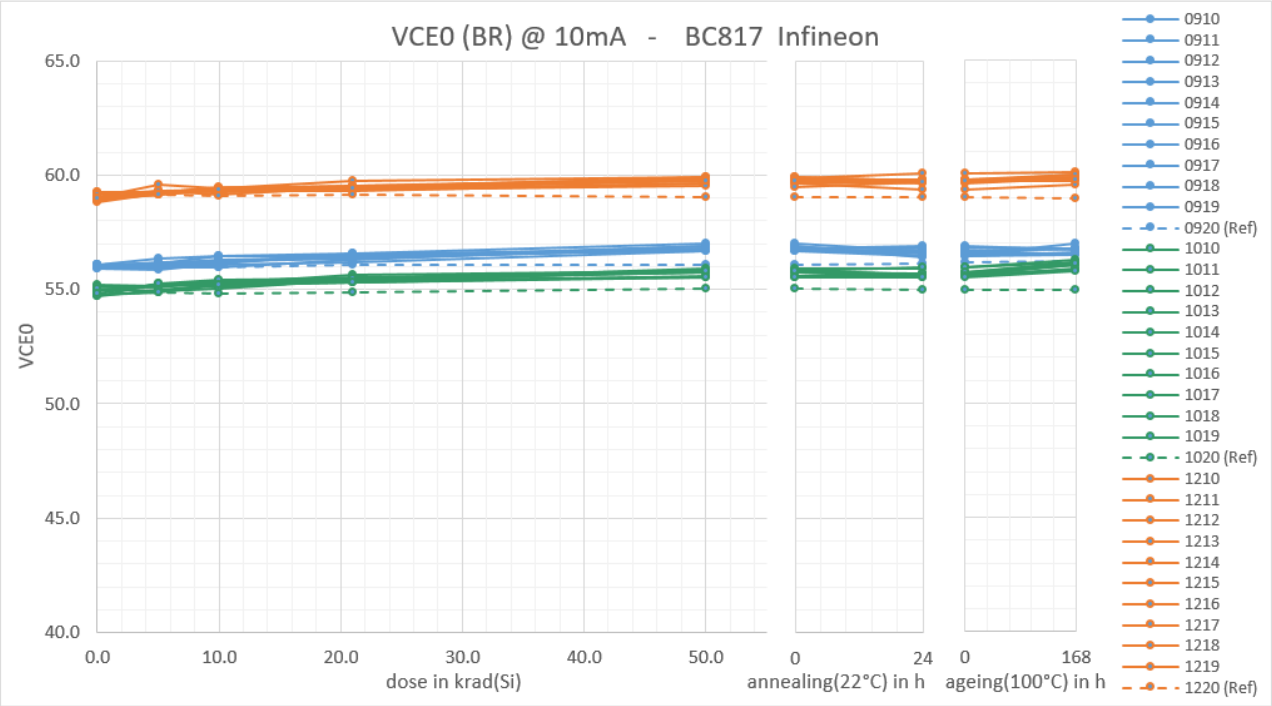


hfe @ 500mA	BC817 K25E6327HTSA1 Infineon Farnell Nov-2018						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0910	125.3	125.3	124.3	124.3	123.2	123.2	124.5
0911	123.2	122.7	121.8	122.0	121.1	121.1	122.7
0912	125.4	125.0	124.7	124.2	123.0	123.3	125.0
0913	122.6	122.3	121.7	121.3	120.1	120.5	121.7
0914	124.5	124.3	123.9	123.7	122.4	122.9	124.5
0915	121.1	121.0	120.1	119.8	118.7	119.3	121.0
0916	123.9	123.3	123.3	122.9	121.5	121.7	123.0
0917	121.7	121.4	120.8	120.5	119.3	119.6	120.7
0918	120.5	120.3	120.3	119.7	118.6	118.7	120.1
0919	123.4	123.0	122.7	122.3	120.8	121.3	123.6
0920 (Ref)	123.7	123.6	123.4	123.2	123.0	123.2	125.4
Average	123.16	122.85	122.36	122.07	120.88	121.15	122.67
s	1.683	1.681	1.670	1.726	1.685	1.637	1.738
Average+3s	128.20	127.89	127.37	127.25	125.93	126.06	127.89
Average-3s	118.11	117.80	117.35	116.89	115.82	116.23	117.46

hfe @ 500mA	BC817 K40E6327HTSA1 Infineon RS Jan-2019						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
1010	139.0	137.5	137.2	136.6	135.2	135.2	134.8
1011	135.7	134.5	133.8	134.5	131.7	131.7	131.0
1012	137.2	135.9	135.2	133.1	132.9	132.7	133.4
1013	135.2	134.3	133.8	132.7	131.5	131.7	131.0
1014	138.3	137.0	136.4	135.4	134.1	134.3	133.8
1015	135.9	135.0	134.3	133.6	131.9	132.2	132.2
1016	133.9	132.9	132.2	131.4	130.2	130.2	130.2
1017	137.4	135.7	135.5	134.3	133.2	133.2	132.7
1018	136.3	135.2	135.0	134.1	132.6	132.6	133.1
1019	138.8	137.5	137.4	136.6	135.2	135.4	134.6
1020 (Ref)	139.8	139.0	138.8	138.1	137.5	137.7	140.2
Average	136.77	135.55	135.07	134.23	132.85	132.92	132.69
s	1.663	1.504	1.630	1.667	1.625	1.637	1.570
Average+3s	141.76	140.07	139.96	139.23	137.72	137.83	137.40
Average-3s	131.78	131.04	130.18	129.22	127.97	128.01	127.98

hfe @ 500mA	BC817 K25E6327HTSA1 Infineon Mouser Aug-2018						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
1210	114.4	113.7	113.5	113.1	112.2	112.6	113.2
1211	112.0	111.4	111.1	110.9	109.9	109.8	110.2
1212	117.6	116.6	116.3	116.2	115.3	115.5	115.1
1213	112.1	111.1	111.2	110.9	110.0	110.0	110.4
1214	111.9	111.0	110.5	110.5	109.6	109.7	109.5
1215	117.2	116.6	116.0	115.9	115.0	115.1	115.4
1216	110.5	109.9	109.6	109.1	108.4	108.5	109.2
1217	112.0	111.4	111.0	110.5	109.8	109.9	110.5
1218	112.6	112.0	111.7	111.4	110.5	110.5	111.2
1219	113.0	112.2	112.1	111.6	110.8	111.0	111.7
1220 (Ref)	114.7	114.2	114.2	114.0	113.6	114.0	117.0
Average	113.32	112.58	112.31	112.01	111.15	111.28	111.65
s	2.374	2.311	2.271	2.346	2.302	2.370	2.218
Average+3s	120.44	119.52	119.12	119.04	118.06	118.39	118.30
Average-3s	106.20	105.65	105.50	104.97	104.25	104.17	104.99

8.6 VCEo (BR) @ 10mA

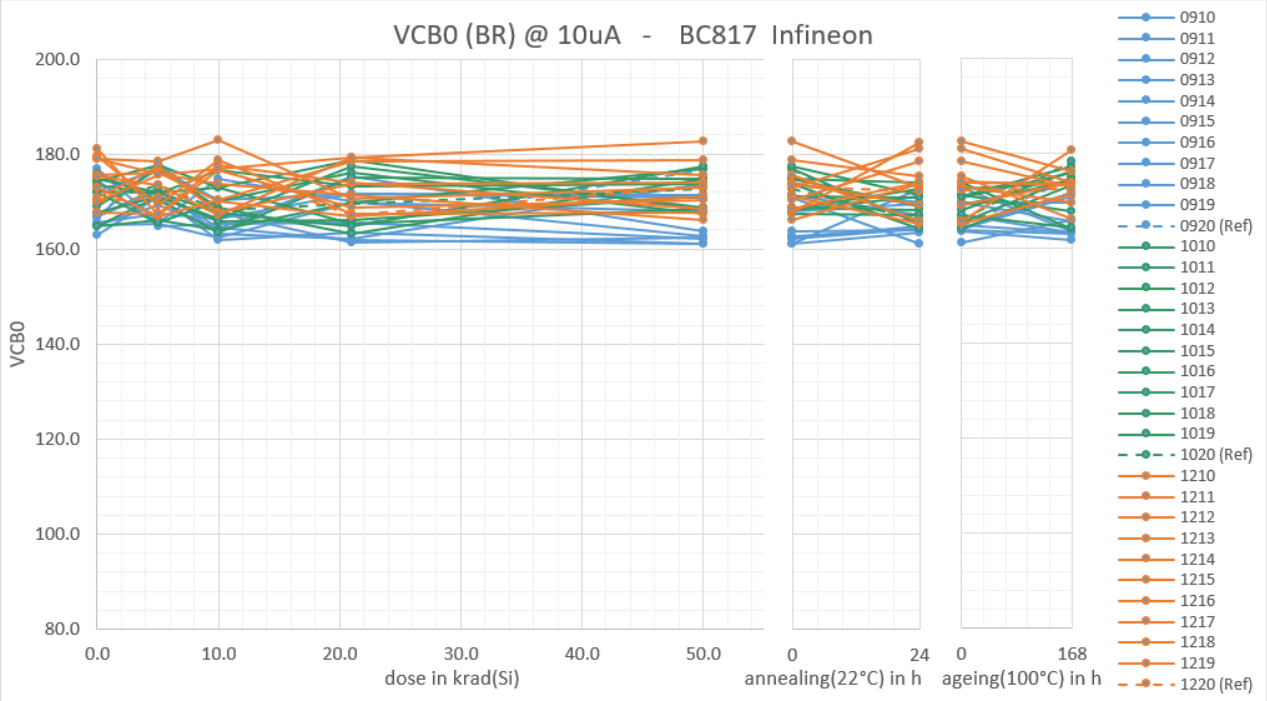


VCE0 (BR) @ 10mA	BC817 K25E6327HTSA1 Infineon Farnell Nov-2018						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0910	55.9	55.9	56.1	56.6	56.7	56.4	56.6
0911	56.0	56.1	56.2	56.4	56.7	56.7	56.8
0912	55.9	55.9	56.0	56.3	56.9	56.4	56.5
0913	56.1	56.2	56.3	56.4	56.9	56.5	57.0
0914	56.0	56.0	56.1	56.2	56.7	56.7	56.5
0915	56.1	56.4	56.5	56.5	56.7	56.7	56.8
0916	56.0	56.0	56.2	56.5	56.8	56.9	56.7
0917	56.1	56.0	56.2	56.4	56.8	56.8	56.8
0918	56.1	56.1	56.5	56.6	57.0	56.7	56.8
0919	56.0	56.2	56.3	56.4	56.7	56.5	56.6
0920 (Ref)	56.1	56.1	56.0	56.1	56.1	56.1	56.2
Average	56.02	56.08	56.23	56.42	56.79	56.64	56.69
s	0.063	0.140	0.156	0.124	0.110	0.160	0.152
Average+3s	56.20	56.50	56.70	56.79	57.12	57.12	57.15
Average-3s	55.83	55.66	55.76	56.05	56.46	56.16	56.24

VCE0 (BR) @ 10mA	BC817 K40E6327HTSA1 Infineon RS Jan-2019						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
1010	54.8	55.2	55.1	55.4	55.8	55.5	55.9
1011	55.0	55.2	55.3	55.3	55.9	55.7	56.0
1012	54.9	55.2	55.3	55.6	55.8	55.6	56.1
1013	55.2	55.1	55.3	55.4	55.9	55.9	56.3
1014	54.8	54.8	55.2	55.3	55.6	55.6	55.8
1015	55.0	55.1	55.3	55.5	55.7	55.7	56.1
1016	55.2	55.1	55.4	55.5	55.8	55.9	56.2
1017	55.0	54.9	55.1	55.4	55.5	55.7	56.1
1018	54.7	55.2	55.4	55.5	55.8	55.6	56.1
1019	54.7	55.0	55.2	55.3	55.5	55.5	55.8
1020 (Ref)	54.8	54.9	54.8	54.9	55.0	55.0	55.0
Average	54.93	55.10	55.25	55.43	55.73	55.68	56.04
s	0.172	0.138	0.116	0.101	0.138	0.150	0.160
Average+3s	55.44	55.52	55.60	55.73	56.15	56.13	56.52
Average-3s	54.41	54.69	54.90	55.12	55.32	55.24	55.56

VCE0 (BR) @ 10mA	BC817 K25E6327HTSA1 Infineon Mouser Aug-2018						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
1210	59.0	59.3	59.3	59.4	59.7	59.7	59.7
1211	59.3	59.2	59.4	59.5	59.9	60.1	60.1
1212	58.8	59.2	59.3	59.3	59.6	59.4	59.6
1213	59.0	59.2	59.4	59.5	59.9	59.7	59.9
1214	59.2	59.2	59.5	59.4	59.8	59.6	59.8
1215	58.9	59.3	59.3	59.4	59.5	59.7	59.9
1216	59.0	59.3	59.4	59.7	59.9	59.7	60.0
1217	59.1	59.6	59.4	59.5	59.7	59.8	59.9
1218	59.1	59.3	59.1	59.4	59.8	59.8	60.0
1219	59.0	59.1	59.4	59.4	59.8	59.7	59.8
1220 (Ref)	59.0	59.1	59.1	59.2	59.0	59.0	58.9
Average	59.04	59.27	59.36	59.46	59.76	59.72	59.86
s	0.151	0.120	0.097	0.116	0.128	0.170	0.152
Average+3s	59.49	59.63	59.65	59.81	60.14	60.23	60.32
Average-3s	58.58	58.91	59.06	59.11	59.37	59.21	59.40

8.7 VCB0 (BR) @ 10uA

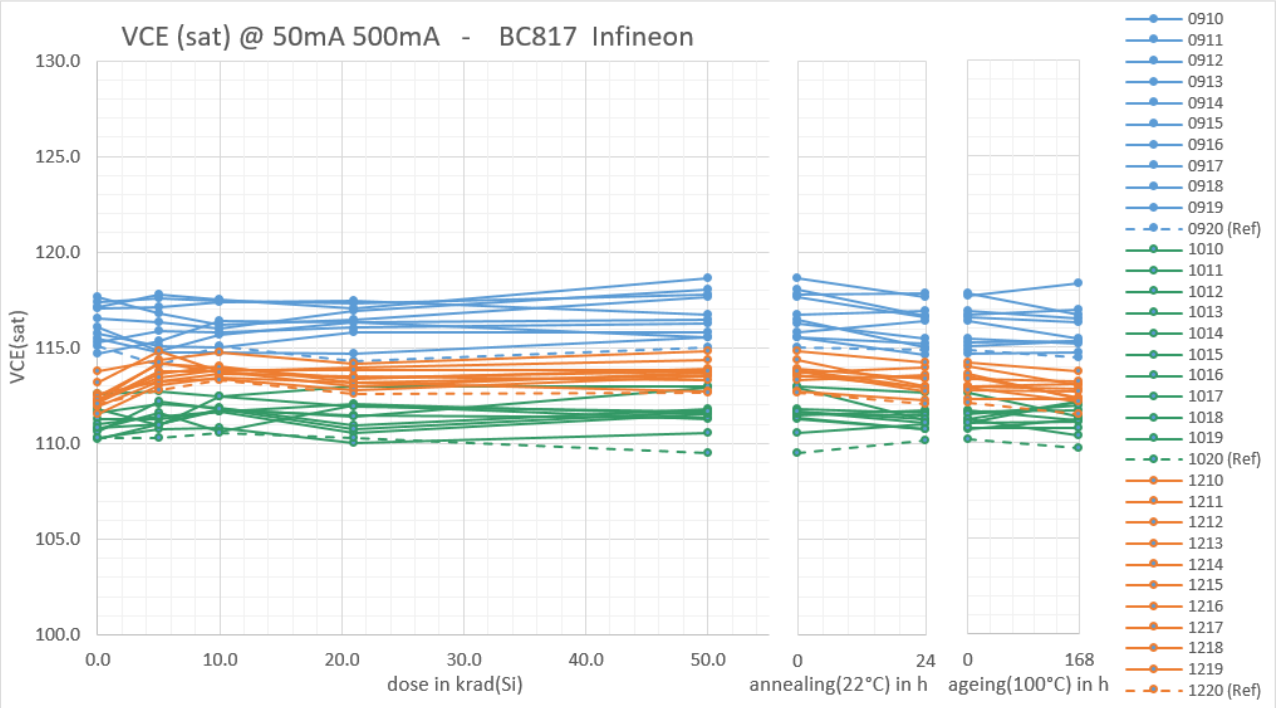


VCB0 (BR) @ 10uA	BC817 K25E6327HTSA1 Infineon Farnell Nov-2018						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0910	166.7	178.1	167.7	161.5	162.4	164.8	163.2
0911	165.5	167.4	166.5	171.5	171.3	167.1	163.5
0912	163.0	171.2	162.0	163.5	161.2	163.6	161.9
0913	167.0	172.2	164.5	161.9	161.0	172.7	163.7
0914	166.9	172.9	163.2	162.3	173.7	169.8	165.8
0915	172.1	176.9	170.4	171.6	170.9	161.2	166.1
0916	165.2	169.2	164.2	175.3	163.8	164.0	163.1
0917	176.9	165.7	174.9	170.0	162.6	164.2	171.8
0918	174.5	164.9	165.3	165.7	162.1	164.2	171.0
0919	165.0	165.3	162.4	169.8	167.9	169.6	169.8
0920 (Ref)	166.8	177.9	167.2	165.1	176.6	165.1	174.6
Average	168.27	170.37	166.10	167.30	165.69	166.12	165.98
s	4.581	4.736	4.002	4.945	4.783	3.565	3.615
Average+3s	182.01	184.57	178.11	182.14	180.04	176.82	176.83
Average-3s	154.52	156.16	154.10	152.47	151.35	155.42	155.13

VCB0 (BR) @ 10uA	BC817 K40E6327HTSA1 Infineon RS Jan-2019						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
1010	172.2	171.8	173.0	165.4	168.6	172.7	173.9
1011	164.9	166.1	164.0	169.7	177.0	165.4	174.8
1012	174.3	177.7	173.0	178.8	168.1	171.0	177.2
1013	174.9	172.0	167.7	164.8	177.3	171.3	167.8
1014	173.4	171.7	176.7	173.3	173.7	164.2	173.5
1015	164.9	171.1	166.4	177.3	168.8	168.2	176.3
1016	167.8	171.1	165.8	166.1	171.1	170.8	176.1
1017	169.0	177.0	168.8	163.1	174.9	173.9	164.1
1018	172.0	165.6	170.0	176.0	167.5	167.1	164.5
1019	175.8	170.3	163.6	175.0	174.8	169.1	174.4
1020 (Ref)	169.9	173.5	168.3	169.6	172.7	166.1	178.3
Average	170.90	171.42	168.91	170.95	172.17	169.36	172.24
s	4.027	3.867	4.281	5.815	3.801	3.160	4.922
Average+3s	182.98	183.02	181.75	188.39	183.57	178.84	187.01
Average-3s	158.82	159.82	156.07	153.50	160.77	159.88	157.48

VCB0 (BR) @ 10uA	BC817 K25E6327HTSA1 Infineon Mouser Aug-2018						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
1210	170.8	177.4	167.8	173.7	174.0	169.3	174.0
1211	179.1	175.7	173.6	171.3	166.2	173.9	173.7
1212	175.7	176.2	170.1	166.8	171.1	165.2	171.4
1213	179.6	169.1	178.7	167.5	167.7	182.5	176.2
1214	178.8	178.6	182.9	170.5	172.9	181.0	173.9
1215	170.1	175.7	176.8	179.3	175.5	165.7	180.7
1216	181.0	167.3	176.6	168.6	170.4	178.5	173.2
1217	172.9	166.9	170.4	178.4	178.6	175.3	166.3
1218	175.2	173.4	167.1	179.2	182.7	173.0	169.7
1219	167.8	167.3	177.7	173.9	168.4	174.0	173.5
1220 (Ref)	170.1	170.7	176.9	167.3	173.3	172.2	172.5
Average	175.09	172.76	174.15	172.91	172.76	173.85	173.25
s	4.562	4.616	5.207	4.776	5.148	5.884	3.788
Average+3s	188.78	186.61	189.78	187.24	188.20	191.50	184.61
Average-3s	161.41	158.91	158.53	158.58	157.32	156.19	161.89

8.8 VCE (sat) @ 50mA 500mA



VCE (sat) @ 50mA 500mA	BC817 K25E6327HTSA1 Infineon Farnell Nov-2018						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
0910	114.7	115.4	116.4	116.4	115.5	115.2	115.3
0911	117.0	117.1	117.4	117.4	116.7	116.9	116.5
0912	115.5	114.8	114.8	114.7	115.5	114.6	114.7
0913	116.1	114.8	115.7	116.3	116.5	115.0	115.4
0914	115.3	115.9	115.8	116.0	116.3	115.5	115.2
0915	116.6	116.3	116.0	116.9	118.1	116.7	116.9
0916	115.7	115.1	115.0	115.8	115.8	116.4	115.4
0917	117.1	117.8	117.5	117.1	118.6	117.7	118.3
0918	117.4	117.6	117.4	117.3	117.8	117.8	116.7
0919	117.6	116.8	116.2	116.5	117.7	116.6	116.3
0920 (Ref)	115.1	114.1	115.1	114.3	115.0	114.9	114.5
Average	116.30	116.14	116.23	116.44	116.85	116.24	116.08
s	0.984	1.128	0.982	0.811	1.111	1.106	1.083
Average+3s	119.25	119.53	119.17	118.87	120.18	119.56	119.33
Average-3s	113.35	112.76	113.28	114.01	113.51	112.93	112.83

VCE (sat) @ 50mA 500mA	BC817 K40E6327HTSA1 Infineon RS Jan-2019						
	krad(Si)					annealing	ageing
DUT	0.0	5.1	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
1010	110.3	110.8	110.8	110.0	110.6	111.0	111.1
1011	110.8	111.6	110.6	112.0	111.3	110.7	111.3
1012	111.3	111.3	111.7	110.6	111.5	111.7	111.2
1013	111.6	112.1	111.9	111.0	111.8	111.6	111.7
1014	110.2	111.0	111.7	111.5	111.3	110.8	110.8
1015	110.6	112.2	111.8	111.4	112.9	111.2	112.2
1016	112.6	112.7	112.4	113.0	113.0	112.7	111.4
1017	111.0	111.4	111.7	112.1	111.6	111.5	112.0
1018	110.8	111.0	111.8	110.7	111.6	111.3	110.4
1019	111.8	110.9	112.5	112.0	111.7	111.1	112.2
1020 (Ref)	110.3	110.3	110.6	110.3	109.5	110.2	109.8
Average	111.08	111.50	111.68	111.42	111.72	111.36	111.40
s	0.738	0.653	0.592	0.868	0.720	0.565	0.595
Average+3s	113.30	113.45	113.46	114.02	113.88	113.05	113.19
Average-3s	108.87	109.54	109.90	108.82	109.56	109.66	109.62

VCE (sat) @ 50mA 500mA	BC817 K25E6327HTSA1 Infineon Mouser Aug-2018						
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
1210	112.2	113.8	113.8	113.0	113.7	114.0	113.0
1211	112.0	113.3	113.4	112.8	113.5	113.5	112.3
1212	111.5	113.1	113.5	113.2	112.7	112.3	112.3
1213	113.2	114.8	113.8	114.0	114.4	113.0	113.1
1214	112.1	113.7	114.0	113.2	113.6	112.9	112.9
1215	112.6	113.2	113.6	113.5	113.3	113.6	112.3
1216	113.8	114.3	114.8	114.2	114.8	114.2	113.7
1217	112.3	113.4	113.8	113.8	113.9	112.9	112.2
1218	112.5	114.2	114.0	113.4	113.9	113.4	113.2
1219	112.2	114.2	113.7	113.4	113.8	112.7	112.7
1220 (Ref)	112.1	112.8	113.3	112.6	112.7	112.1	111.5
Average	112.44	113.80	113.83	113.44	113.75	113.24	112.77
s	0.638	0.582	0.390	0.456	0.561	0.590	0.505
Average+3s	114.35	115.55	115.00	114.81	115.44	115.01	114.29
Average-3s	110.52	112.05	112.66	112.07	112.07	111.47	111.26

9 CONCLUSION

The test results of the BC817 from Infineon 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.

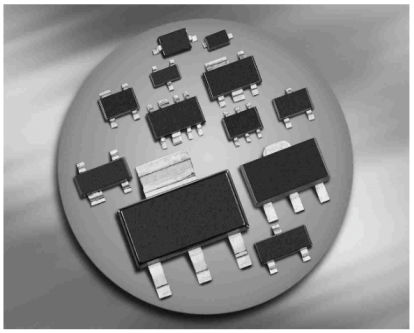
The CE saturation voltage increases slightly over the radiation dose but still stays inside the specification.

10 APPENDIX - EXTRACT FROM THE DATA SHEET

BC817K.../BC818K...

NPN Silicon AF Transistor

- For general AF applications
- High collector current
- High current gain
- Low collector-emitter saturation voltage
- Pb-free (RoHS compliant) package
- Qualified according AEC Q101



Type	Marking	Pin Configuration						Package
BC817K-16	6As	1 = B	2 = E	3 = C	-	-	-	SOT23
BC817K-16W	6As	1 = B	2 = E	3 = C	-	-	-	SOT323
BC817K-25	6Bs	1 = B	2 = E	3 = C	-	-	-	SOT23
BC817K-25W	6Bs	1 = B	2 = E	3 = C	-	-	-	SOT323
BC817K-40	6Cs	1 = B	2 = E	3 = C	-	-	-	SOT23
BC817K-40W	6Cs	1 = B	2 = E	3 = C	-	-	-	SOT323
BC818K-16W	6Es	1 = B	2 = E	3 = C	-	-	-	SOT323
BC818K-40	6Gs	1 = B	2 = E	3 = C	-	-	-	SOT23

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Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CEO}		V
BC817...		45	
BC818...		25	
Collector-base voltage	V_{CBO}		
BC817...		50	
BC818...		30	
Emitter-base voltage	V_{EBO}	5	
Collector current	I_C	500	mA
Peak collector current	I_{CM}	1000	
Base current	I_B	100	
Peak base current	I_{BM}	200	
Total power dissipation-	P_{tot}		mW
$T_S \leq 115$ °C, BC817K, BC818K		500	
$T_S \leq 130$ °C, BC817KW, BC818KW		250	
Junction temperature	T_j	150	°C
Storage temperature	T_{stg}	-65 ... 150	

Thermal Resistance

Parameter	Symbol	Value	Unit
Junction - soldering point[1)]	R_{thJS}		K/W
BC817K, BC818K		≤ 70	
BC817KW, BC818KW		≤ 80	

[1]For calculation of R_{thJA} please refer to Application Note AN077 (Thermal Resistance Calculation)

Electrical Characteristics at T_A = 25°C, unless otherwise specified

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
DC Characteristics					
Collector-emitter breakdown voltage	$V_{(BR)CEO}$				V
I_C = 10 mA, I_B = 0 , BC817...		45	-	-	
I_C = 10 mA, I_B = 0 , BC818...		25	-	-	
Collector-base breakdown voltage	$V_{(BR)CBO}$				-
I_C = 10 µA, I_E = 0 , BC817...		50	-	-	
I_C = 10 µA, I_E = 0 , BC818...		30	-	-	
Emitter-base breakdown voltage	$V_{(BR)EBO}$	5	-	-	V
I_E = 10 µA, I_C = 0					
Collector-base cutoff current	I_{CBO}				µA
V_{CB} = 25 V, I_E = 0		-	-	0.1	
V_{CB} = 25 V, I_E = 0 , T_A = 150 °C		-	-	50	
Emitter-base cutoff current	I_{EBO}	-	-	100	nA
V_{EB} = 4 V, I_C = 0					
DC current gain[1)]	h_{FE}				-
I_C = 100 mA, V_{CE} = 1 V, h_{FE}-grp.16		100	160	250	
I_C = 100 mA, V_{CE} = 1 V, h_{FE}-grp.25		160	250	400	
I_C = 100 mA, V_{CE} = 1 V, h_{FE}-grp.40		250	350	630	
I_C = 500 mA, V_{CE} = 1 V, all h_{FE}-grps.		40	-	-	
Collector-emitter saturation voltage[1)]	V_{CEsat}	-	-	0.7	V
I_C = 500 mA, I_B = 50 mA					
Base emitter saturation voltage[1)]	V_{BEsat}	-	-	1.2	
I_C = 500 mA, I_B = 50 mA					

[1]Pulse test: t < 300µs; D < 2%

Electrical Characteristics at T_A = 25°C, unless otherwise specified

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
AC Characteristics					
Transition frequency I_C = 50 mA, V_{CE} = 5 V, f = 100 MHz	f_T	-	170	-	MHz
Collector-base capacitance V_{CB} = 10 V, f = 1 MHz	C_{cb}	-	3	-	pF
Emitter-base capacitance V_{EB} = 0.5 V, f = 1 MHz	C_{eb}	-	40	-	