



TOTAL IONIZING DOSE Test Report

BC857 - 100mA PNP Transistor from Infineon

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1 INTRODUCTION

This report presents the total ionizing dose results of **BC857** a **100mA PNP Transistor** from **Infineon**.

2 DOCUMENTS

APPLICABLE AND REFERENCE DOCUMENTS

BJTs COTS TID test plan

Datasheet **BC857** from Infineon

3 PART REFERENCES

REFERENCES

Type: BC857CE6327HTSA1

Manufacturer: Infineon

Function: 100 mA general-purpose transistors

Technology: Bipolar PNP Silicon

PARTS PROCUREMENT

Packaging: SOT23 (TO-236AB)

Date Code: batch no. 33: Jun-2017
batch no. 34: Feb-2018
batch no. 36: Oct-2016

Distributor: batch no. 33: Farnell
batch no. 34: RS Components
batch no. 36: 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
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

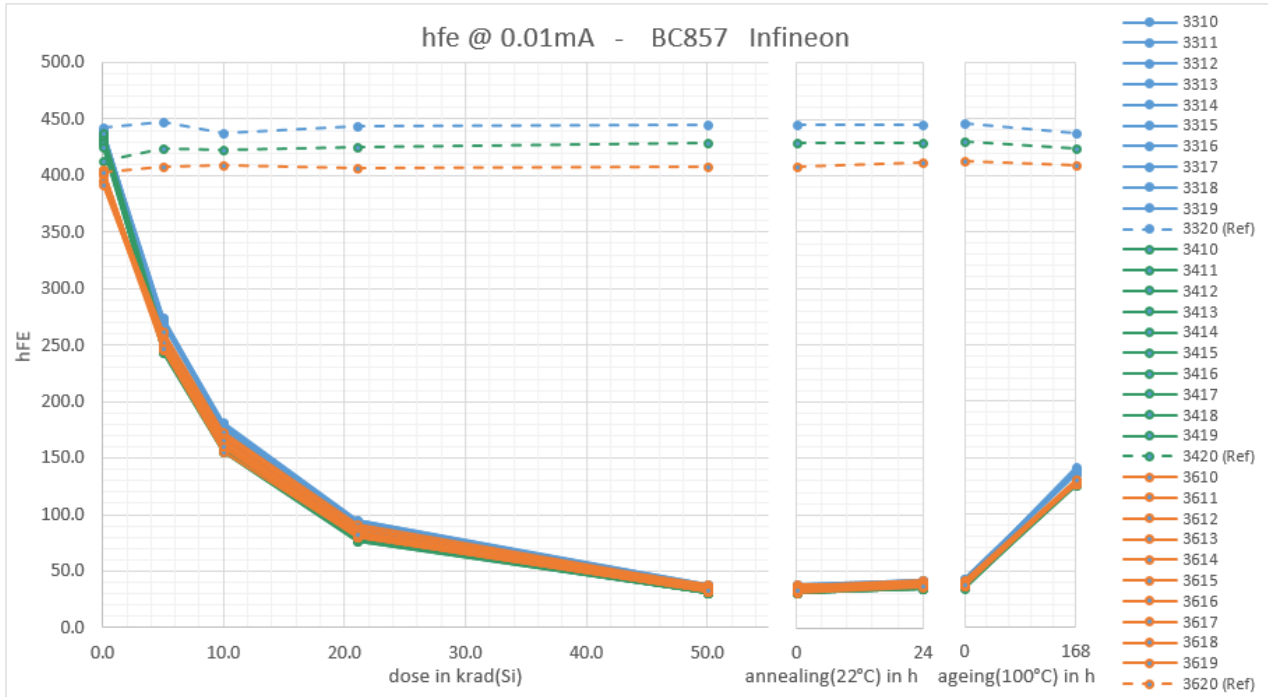
7 BIAS CONDITIONS

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 CE6327HTSA1 Infineon Farnell Jun-2017					
DUT	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
	0.0	5.0	10.0	21.0	50.0		
3310	430.3	269.8	180.4	95.2	37.6	42.7	138.0
3311	440.1	268.3	176.1	90.7	36.1	41.2	135.4
3312	438.7	262.5	167.6	86.0	33.8	39.8	142.2
3313	436.2	271.3	177.5	91.6	36.2	40.9	139.4
3314	437.1	273.0	180.3	93.5	38.0	42.5	138.5
3315	434.5	272.8	181.3	95.3	37.9	42.6	137.5
3316	434.5	271.0	179.6	93.0	36.6	41.4	138.7
3317	438.7	273.9	178.7	91.4	36.5	41.2	137.4
3318	436.2	271.7	177.9	90.6	36.4	41.1	137.3
3319	439.5	269.8	176.2	92.5	36.6	41.1	138.9
3320 (Ref)	442.2	448.0	437.0	444.3	445.1	445.6	437.8
Average	436.57	270.41	177.55	91.96	36.58	41.43	138.33
s	2.961	3.268	3.910	2.680	1.186	0.891	1.776
Average+3s	445.45	280.22	189.28	100.00	40.14	44.10	143.66
Average-3s	427.68	260.61	165.82	83.91	33.02	38.76	133.00

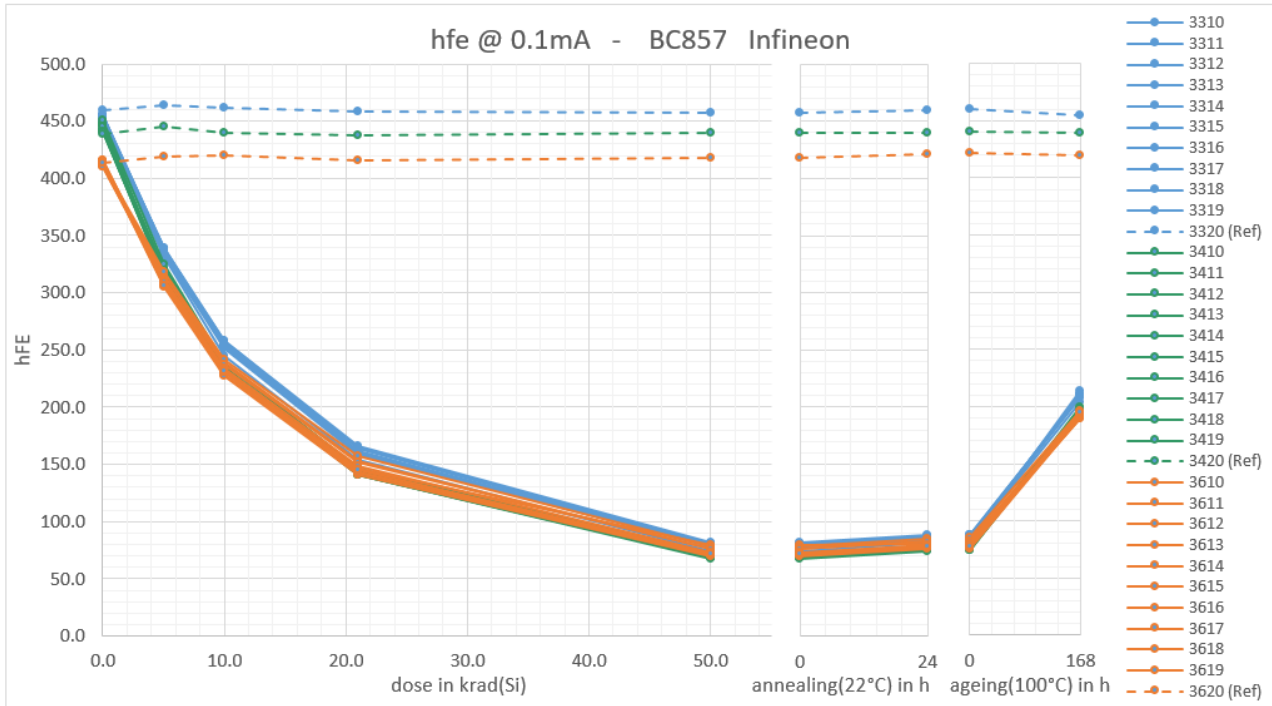


hfe @ 0.01mA BC857 CE6327HTSA1 Infineon RS Feb-2018							
DUT	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
	0.0	5.0	10.0	21.0	50.0		
3410	429.4	244.1	157.4	77.4	30.4	35.2	127.8
3411	427.6	248.7	158.3	79.5	31.2	35.8	125.7
3412	432.8	247.5	157.8	78.7	31.2	36.1	126.7
3413	432.6	243.3	155.4	77.0	31.2	34.6	127.7
3414	431.9	243.6	155.5	77.1	30.6	35.0	127.4
3415	429.6	254.8	161.9	81.0	32.2	36.6	125.9
3416	433.6	248.0	156.8	78.4	30.6	35.3	129.6
3417	428.4	249.8	159.0	79.5	31.2	36.3	126.4
3418	425.5	248.1	156.5	78.0	30.7	35.3	128.6
3419	438.0	257.4	160.7	80.8	32.3	36.9	128.5
3420 (Ref)	413.1	424.5	423.2	424.8	429.3	429.5	424.1
Average	430.95	248.53	157.93	78.73	31.17	35.71	127.45
s	3.579	4.610	2.137	1.436	0.649	0.746	1.264
Average+3s	441.69	262.36	164.35	83.04	33.12	37.95	131.24
Average-3s	420.21	234.70	151.52	74.42	29.22	33.48	123.65

hfe @ 0.01mA BC857 CE6327 Infineon Mouser Oct-2016							
DUT	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
	0.0	5.0	10.0	21.0	50.0		
3610	400.4	257.5	170.2	89.1	36.1	40.8	126.9
3611	404.6	249.7	163.6	84.2	38.5	38.9	127.0
3612	395.0	262.6	173.4	91.7	37.2	41.8	131.0
3613	401.1	254.9	168.5	88.1	35.8	40.3	126.6
3614	405.0	249.7	159.3	80.7	32.3	36.9	128.6
3615	404.6	246.6	161.5	81.1	32.4	37.1	129.2
3616	395.7	246.1	155.8	79.9	31.6	36.4	128.1
3617	404.3	248.0	160.6	80.5	32.4	37.0	128.9
3618	391.9	251.6	165.1	84.9	34.2	38.7	128.3
3619	404.0	247.4	160.5	83.1	33.3	37.5	131.1
3620 (Ref)	402.9	407.7	409.0	406.6	408.3	412.1	408.5
Average	400.66	251.41	163.85	84.33	34.37	38.51	128.57
s	4.806	5.388	5.453	4.077	2.387	1.871	1.550
Average+3s	415.08	267.58	180.21	96.56	41.53	44.13	133.22
Average-3s	386.24	235.25	147.49	72.10	27.21	32.90	123.92



8.2 hfe @ 0.1 mA



hfe @ 0.1mA BC857 CE6327HTSA1 Infineon Farnell Jun-2017							
DUT	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
	0.0	5.0	10.0	21.0	50.0		
3310	445.8	331.8	255.2	165.0	80.7	87.7	207.7
3311	455.0	333.1	251.8	158.5	78.0	84.3	204.2
3312	455.0	331.5	245.2	153.8	74.5	81.8	213.4
3313	454.7	337.5	254.2	160.3	78.9	85.0	210.2
3314	454.0	337.6	257.7	163.8	80.8	87.2	209.0
3315	451.0	339.4	258.3	166.0	81.5	87.8	208.7
3316	451.0	338.4	256.7	162.0	79.2	85.8	210.2
3317	454.5	339.1	255.2	160.9	79.0	85.5	209.6
3318	452.8	335.9	253.5	159.0	78.8	85.2	208.1
3319	455.1	338.2	253.0	160.5	79.2	85.4	210.2
3320 (Ref)	459.0	463.8	461.7	458.7	457.7	460.0	454.5
Average	452.89	336.25	254.07	160.98	79.06	85.59	209.12
s	2.938	3.031	3.747	3.538	1.948	1.778	2.353
Average+3s	461.70	345.35	265.31	171.59	84.90	90.92	216.18
Average-3s	444.08	327.16	242.83	150.37	73.21	80.25	202.06

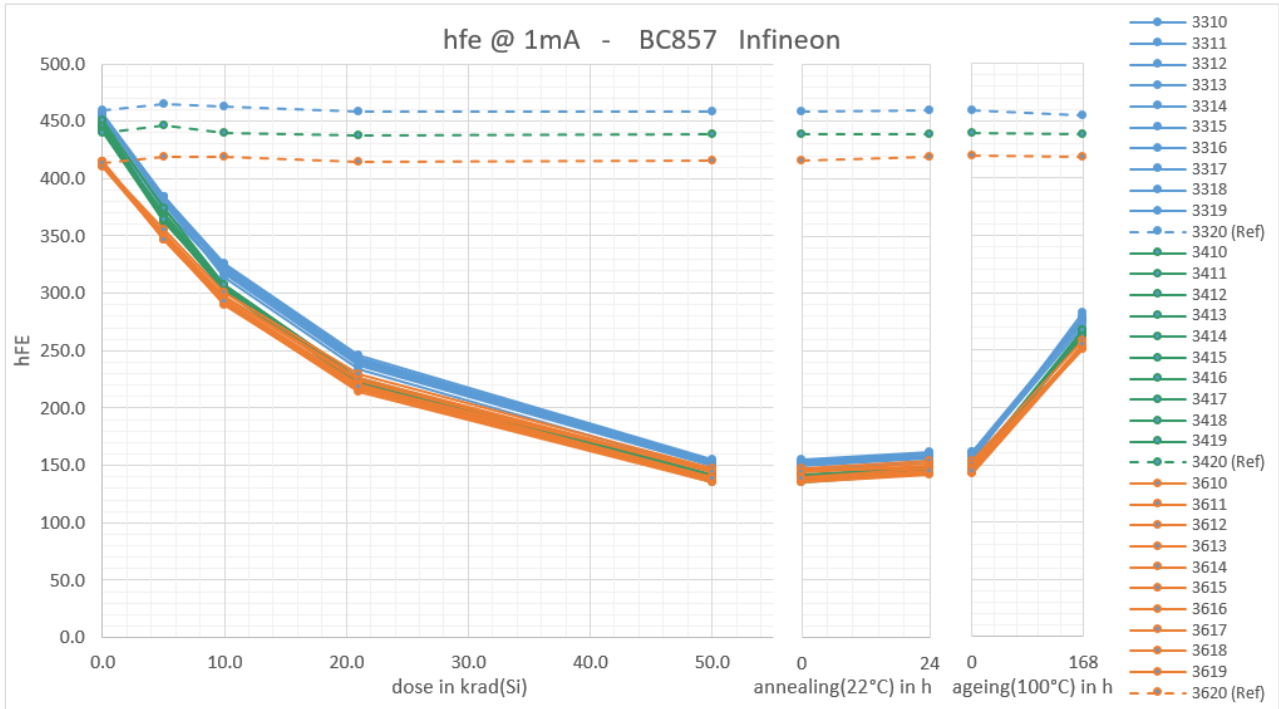


hfe @ 0.1mA BC857 CE6327HTSA1 Infineon RS Feb-2018							
DUT	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
	0.0	5.0	10.0	21.0	50.0		
3410	442.1	312.8	233.7	141.1	68.1	75.1	196.2
3411	440.4	315.1	234.3	144.7	69.4	76.2	193.8
3412	447.2	316.4	234.6	144.0	69.8	77.0	195.3
3413	441.9	312.6	231.6	141.2	67.7	74.1	196.2
3414	446.9	314.0	231.7	141.0	68.6	74.8	197.3
3415	442.4	321.6	237.8	146.0	71.4	77.5	194.9
3416	446.3	316.1	233.0	143.0	68.6	75.5	199.6
3417	444.8	316.9	234.8	144.4	69.4	76.3	194.5
3418	441.3	314.8	232.1	142.5	68.7	75.3	196.4
3419	450.6	324.3	238.2	146.1	71.7	78.3	198.2
3420 (Ref)	438.4	445.4	439.6	437.7	440.1	440.2	439.7
Average	444.40	316.45	234.19	143.40	69.34	76.01	196.23
s	3.280	3.774	2.338	1.950	1.344	1.309	1.764
Average+3s	454.24	327.78	241.20	149.25	73.37	79.94	201.52
Average-3s	434.56	305.13	227.18	137.55	65.31	72.09	190.94

hfe @ 0.1mA BC857 CE6327 Infineon Mouser Oct-2016							
DUT	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
	0.0	5.0	10.0	21.0	50.0		
3610	411.5	315.1	239.1	153.2	76.7	83.3	191.5
3611	415.1	307.0	232.1	146.7	79.2	80.1	189.5
3612	412.5	317.9	242.1	156.8	78.7	84.9	195.7
3613	410.2	311.4	237.0	152.2	76.5	82.7	189.5
3614	415.5	308.1	228.6	143.1	70.6	77.0	191.7
3615	415.5	309.0	231.4	143.5	70.6	77.4	192.7
3616	413.3	305.4	227.8	141.3	69.5	76.1	190.8
3617	414.9	307.3	230.2	142.9	70.8	77.1	191.9
3618	409.8	309.1	234.3	148.0	73.4	80.0	192.9
3619	414.3	306.5	231.6	145.4	71.9	77.9	195.0
3620 (Ref)	413.7	418.8	419.7	415.9	417.6	421.5	419.7
Average	413.27	309.68	233.41	147.31	73.79	79.68	192.12
s	2.167	4.008	4.652	5.173	3.657	3.079	2.055
Average+3s	419.77	321.71	247.37	162.83	84.76	88.91	198.29
Average-3s	406.77	297.66	219.46	131.79	62.81	70.44	185.96



8.3 hfe @ 1 mA



hfe @ 1mA BC857 CE6327HTSA1 Infineon Farnell Jun-2017							
DUT	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
	0.0	5.0	10.0	21.0	50.0		
3310	447.0	373.4	318.4	242.7	153.3	160.5	274.5
3311	455.2	377.0	317.5	237.3	149.6	156.5	271.1
3312	456.1	380.7	313.7	234.0	145.5	153.5	282.3
3313	456.4	384.4	322.4	240.4	151.3	157.6	279.3
3314	454.9	381.2	325.2	244.0	153.7	160.7	277.1
3315	452.5	384.3	325.9	245.6	154.6	161.4	276.2
3316	452.5	383.8	325.1	241.9	151.6	158.7	277.7
3317	455.2	384.4	322.9	240.5	151.4	158.3	277.6
3318	453.7	381.1	320.2	238.3	150.7	157.6	275.2
3319	455.8	383.6	319.7	240.3	151.6	158.5	278.1
3320 (Ref)	459.4	464.8	463.2	457.9	458.8	459.5	454.5
Average	453.93	381.39	321.10	240.52	151.33	158.34	276.91
s	2.775	3.666	3.918	3.369	2.531	2.286	2.992
Average+3s	462.26	392.39	332.85	250.63	158.92	165.20	285.88
Average-3s	445.61	370.39	309.34	230.41	143.74	151.48	267.93

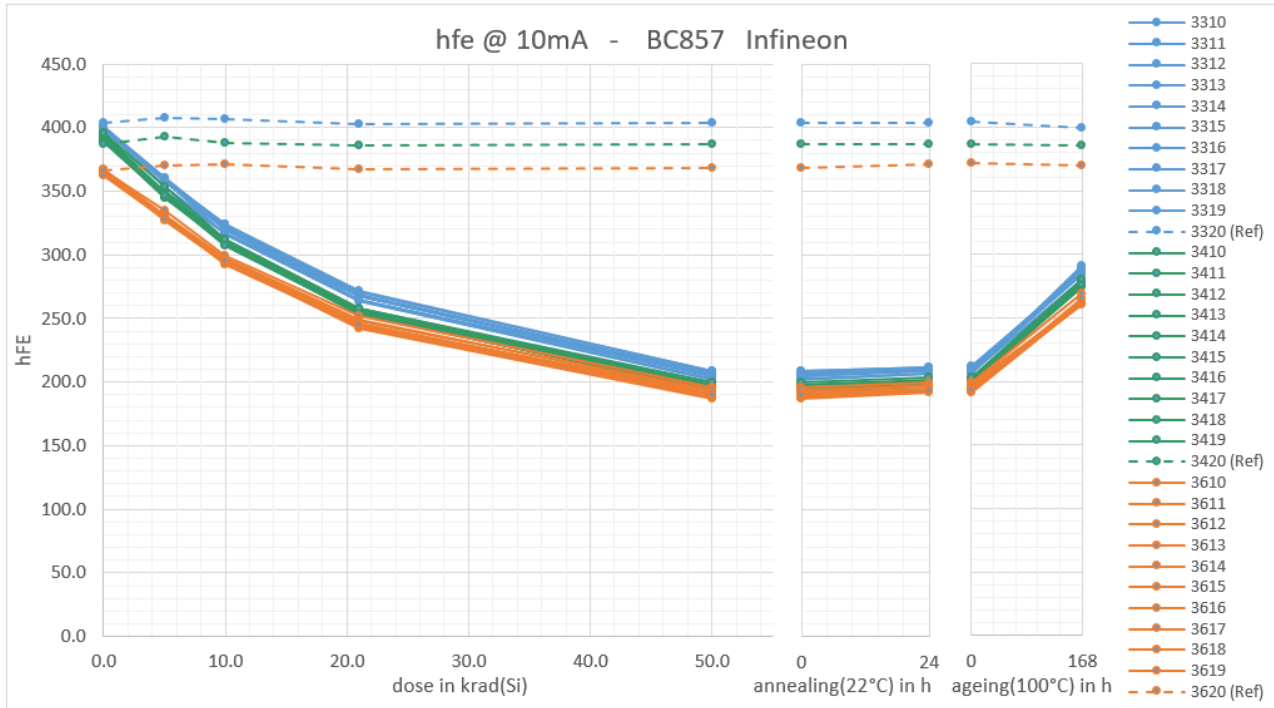


hfe @ 1mA BC857 CE6327HTSA1 Infineon RS Feb-2018							
DUT	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
	0.0	5.0	10.0	21.0	50.0		
3410	442.5	361.7	304.7	220.5	136.2	144.3	263.7
3411	441.0	363.4	304.6	224.4	137.8	145.6	261.6
3412	448.3	365.7	306.5	224.2	138.9	147.5	264.2
3413	444.4	363.3	302.8	220.6	135.4	143.2	264.0
3414	446.8	363.9	302.9	220.5	137.5	144.0	265.0
3415	442.4	369.5	307.2	225.2	140.5	147.6	263.1
3416	446.5	365.9	303.7	222.8	137.2	145.0	267.2
3417	445.8	366.5	305.5	224.2	138.2	146.0	263.0
3418	441.6	364.3	302.0	221.4	136.7	144.3	263.9
3419	450.3	373.9	307.2	226.4	141.5	149.0	267.1
3420 (Ref)	439.4	445.8	440.1	437.7	438.9	439.0	438.4
Average	444.95	365.80	304.68	223.02	137.98	145.64	264.29
s	3.091	3.574	1.881	2.161	1.891	1.869	1.764
Average+3s	454.22	376.52	310.32	229.51	143.65	151.24	269.58
Average-3s	435.68	355.08	299.04	216.54	132.31	140.03	259.00

hfe @ 1mA BC857 CE6327 Infineon Mouser Oct-2016							
DUT	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
	0.0	5.0	10.0	21.0	50.0		
3610	411.2	352.7	297.6	225.8	145.1	151.3	252.9
3611	414.5	346.4	291.8	219.4	146.2	147.4	250.4
3612	412.8	356.0	300.2	229.1	147.6	153.7	258.5
3613	411.2	349.5	295.8	224.5	144.0	150.1	251.2
3614	414.6	349.0	289.6	216.3	136.4	143.5	252.9
3615	414.9	350.1	293.2	217.0	136.9	143.9	254.2
3616	412.9	346.5	290.7	214.5	134.9	142.0	251.7
3617	414.2	348.7	292.4	216.3	136.8	143.7	252.9
3618	409.7	348.0	294.0	220.5	140.0	146.9	253.8
3619	413.8	346.7	293.0	218.9	138.3	144.9	255.8
3620 (Ref)	413.2	418.4	419.4	414.3	415.8	419.5	418.1
Average	412.97	349.35	293.83	220.25	140.62	146.74	253.43
s	1.768	3.011	3.227	4.770	4.657	3.860	2.362
Average+3s	418.27	358.38	303.51	234.56	154.60	158.32	260.52
Average-3s	407.67	340.32	284.15	205.94	126.65	135.16	246.34



8.4 hfe @ 10 mA



hfe @ 10mA		BC857 CE6327HTSA1 Infineon Farnell Jun-2017						
	krad(Si)					annealing	ageing	
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)	
3310	393.1	349.7	316.9	267.3	205.0	209.1	283.9	
3311	399.3	353.7	317.4	264.0	202.8	206.8	280.5	
3312	400.6	358.3	316.2	264.0	202.1	206.3	290.6	
3313	400.9	360.5	322.0	268.0	206.5	209.2	288.7	
3314	399.4	357.1	323.6	270.5	208.4	211.4	287.1	
3315	397.9	359.5	324.1	271.3	208.7	211.8	286.0	
3316	397.9	359.2	323.7	268.8	206.5	209.9	287.4	
3317	399.9	360.1	322.2	267.7	206.1	209.6	287.3	
3318	398.4	357.3	319.8	265.1	204.9	208.4	285.1	
3319	400.1	359.4	319.8	267.5	206.2	209.2	287.7	
3320 (Ref)	403.2	407.9	406.9	402.8	403.7	404.1	399.5	
Average	398.75	357.48	320.58	267.41	205.73	209.17	286.42	
s	2.231	3.372	2.981	2.476	2.119	1.731	2.785	
Average+3s	405.44	367.60	329.52	274.84	212.08	214.36	294.77	
Average-3s	392.05	347.37	311.64	259.98	199.37	203.98	278.06	

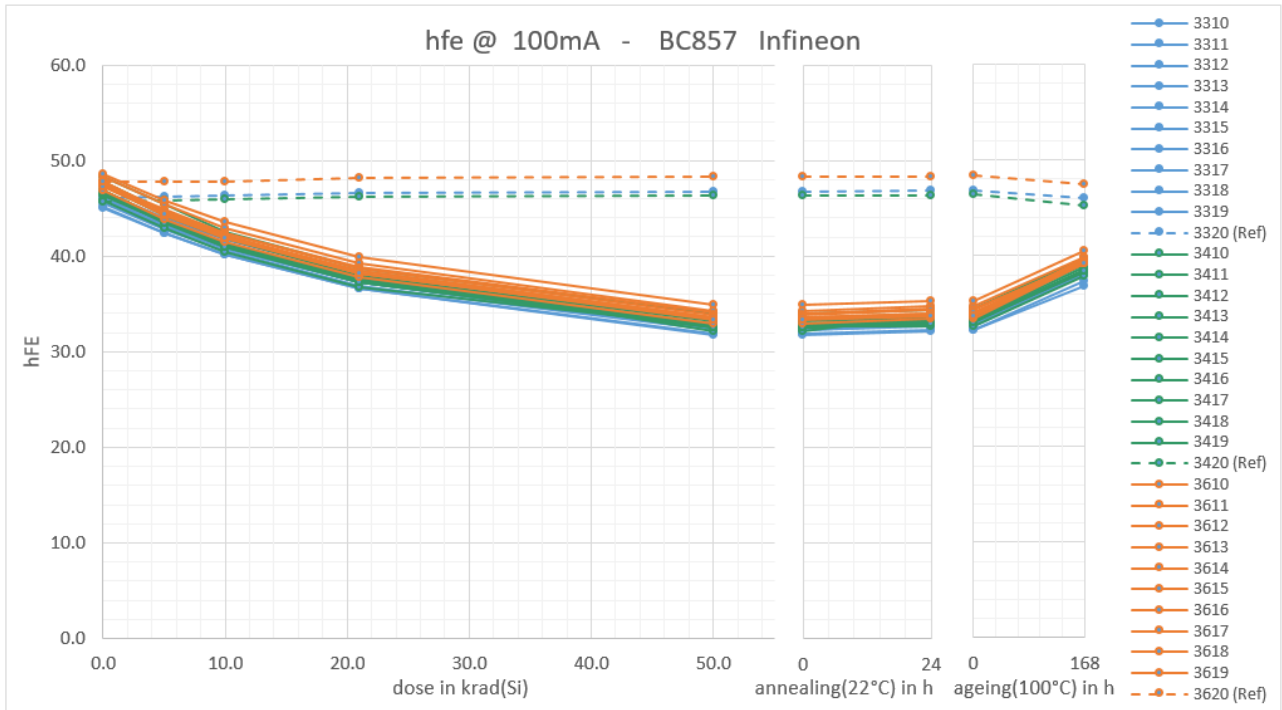


hfe @ 10mA BC857 CE6327HTSA1 Infineon RS Feb-2018							
DUT	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
	0.0	5.0	10.0	21.0	50.0		
3410	389.5	344.2	309.4	252.8	193.3	198.0	276.0
3411	388.5	345.1	309.3	256.6	194.5	199.4	274.0
3412	394.8	348.1	312.0	257.6	197.5	201.9	277.1
3413	390.7	345.4	308.2	253.9	193.2	197.2	276.3
3414	392.7	345.8	308.3	253.8	195.3	198.2	277.5
3415	389.8	350.0	311.1	256.4	197.4	201.1	276.6
3416	393.1	347.8	309.2	256.0	194.9	199.3	279.4
3417	392.7	348.1	310.6	256.7	195.2	199.7	276.0
3418	389.1	346.4	307.3	254.3	194.5	198.1	276.3
3419	396.0	353.6	311.8	257.9	199.4	203.2	280.0
3420 (Ref)	386.8	392.5	388.0	385.9	387.0	387.0	385.6
Average	391.70	347.44	309.71	255.61	195.53	199.63	276.91
s	2.541	2.781	1.604	1.763	1.967	1.912	1.728
Average+3s	399.32	355.78	314.52	260.90	201.43	205.37	282.10
Average-3s	384.08	339.09	304.90	250.32	189.63	193.89	271.73

hfe @ 10mA BC857 CE6327 Infineon Mouser Oct-2016							
DUT	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
	0.0	5.0	10.0	21.0	50.0		
3610	363.5	331.2	297.1	249.0	193.1	197.9	262.8
3611	366.6	327.1	293.2	244.5	193.1	194.2	260.1
3612	365.8	334.6	299.6	252.2	195.4	199.3	268.9
3613	363.9	328.9	295.9	248.2	193.5	197.2	261.2
3614	366.5	329.9	292.4	243.7	188.5	192.6	262.6
3615	366.8	330.9	295.6	243.4	187.9	193.0	263.8
3616	365.2	328.0	293.9	242.2	187.1	191.4	261.1
3617	366.5	329.9	295.4	243.5	189.1	192.6	262.4
3618	362.5	328.2	295.2	245.6	190.6	194.9	263.7
3619	366.0	327.8	294.9	244.9	189.9	193.1	265.4
3620 (Ref)	365.8	370.4	371.4	367.0	368.4	371.4	369.6
Average	365.32	329.66	295.32	245.71	190.81	194.61	263.19
s	1.530	2.209	2.045	3.131	2.807	2.648	2.536
Average+3s	369.91	336.28	301.46	255.10	199.23	202.56	270.80
Average-3s	360.73	323.03	289.19	236.32	182.39	186.67	255.58



8.5 hfe @ 100 mA



hfe @ 100mA BC857 CE6327HTSA1 Infineon Farnell Jun-2017							
DUT	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
	0.0	5.0	10.0	21.0	50.0		
3310	45.9	43.3	41.1	37.5	32.8	33.2	38.2
3311	45.1	42.4	40.1	36.6	31.8	32.2	36.9
3312	46.4	43.3	40.8	37.2	32.5	32.8	38.5
3313	46.0	43.2	40.8	37.3	32.5	32.8	38.1
3314	46.1	43.4	41.1	37.7	32.8	33.3	38.2
3315	46.7	44.0	41.8	38.1	33.3	33.7	38.2
3316	45.9	43.3	40.9	37.3	32.5	33.0	38.2
3317	45.9	43.1	40.8	37.2	32.3	32.7	38.0
3318	45.2	42.4	40.2	36.6	31.9	32.3	37.4
3319	45.6	42.8	40.5	36.9	32.2	32.6	38.0
3320 (Ref)	46.1	46.2	46.3	46.6	46.7	46.8	46.0
Average	45.85	43.13	40.80	37.24	32.46	32.87	37.95
s	0.502	0.471	0.471	0.464	0.441	0.455	0.470
Average+3s	47.36	44.54	42.22	38.63	33.78	34.23	39.36
Average-3s	44.35	41.72	39.39	35.85	31.14	31.50	36.54

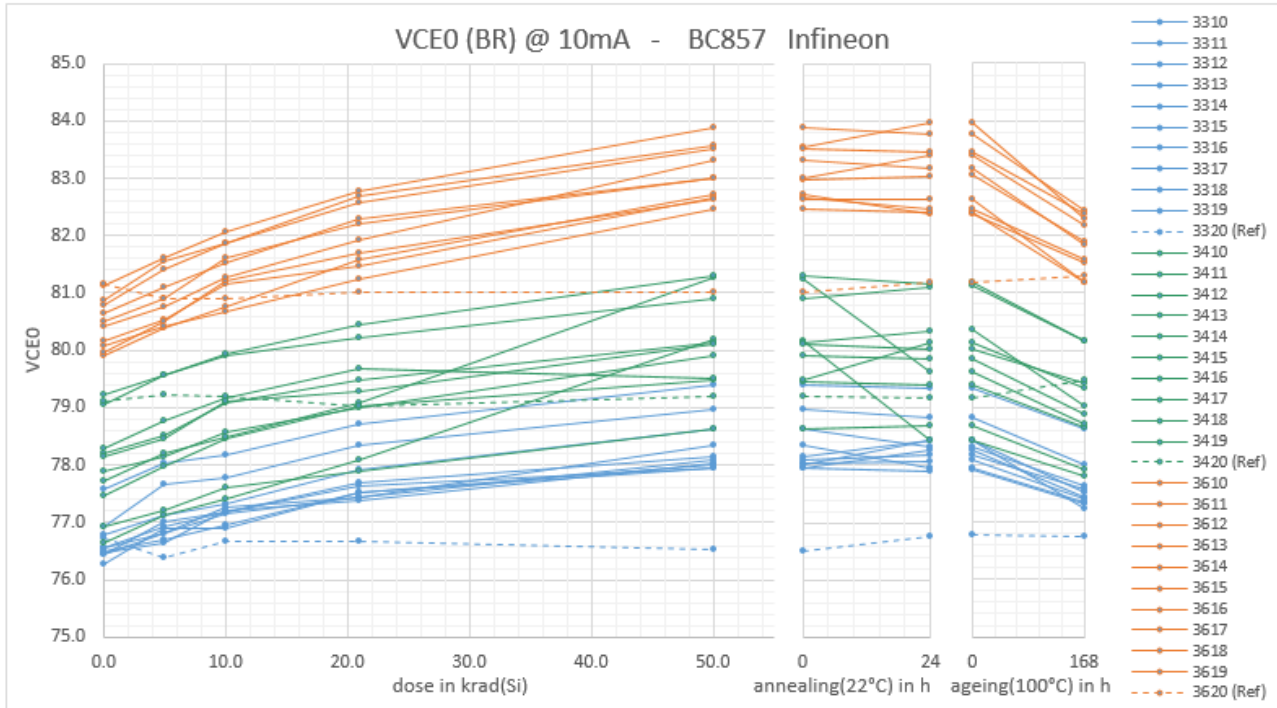


hfe @ 100mA BC857 CE6327HTSA1 Infineon RS Feb-2018							
DUT	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
	0.0	5.0	10.0	21.0	50.0		
3410	47.4	44.3	41.9	38.0	33.2	33.6	39.0
3411	46.6	43.6	41.2	37.5	32.6	33.1	38.2
3412	47.8	44.7	42.1	38.2	32.1	33.9	39.2
3413	45.9	42.9	40.4	36.7	32.7	32.6	37.8
3414	46.8	43.7	41.2	37.4	32.8	33.1	38.5
3415	46.4	43.6	41.1	37.5	32.7	33.3	38.5
3416	46.5	43.6	41.0	37.2	32.6	33.1	38.5
3417	46.8	43.7	41.3	37.8	32.9	33.4	38.8
3418	46.6	43.4	40.9	37.2	32.5	33.0	38.4
3419	48.4	45.4	42.5	38.8	33.9	34.4	39.7
3420 (Ref)	45.7	45.9	46.0	46.2	46.3	46.4	45.3
Average	46.91	43.89	41.37	37.63	32.81	33.35	38.67
s	0.732	0.699	0.628	0.578	0.485	0.503	0.543
Average+3s	49.10	45.99	43.26	39.36	34.27	34.86	40.30
Average-3s	44.71	41.79	39.49	35.89	31.36	31.84	37.04

hfe @ 100mA BC857 CE6327 Infineon Mouser Oct-2016							
DUT	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
	0.0	5.0	10.0	21.0	50.0		
3610	47.6	44.9	42.4	38.9	34.0	34.4	39.2
3611	48.2	45.5	42.9	39.2	34.2	34.7	39.8
3612	48.6	45.9	43.6	39.9	34.9	35.3	40.5
3613	47.6	44.7	42.4	38.7	33.9	34.3	39.4
3614	46.8	43.8	41.5	37.8	33.0	33.4	39.1
3615	47.6	44.6	42.1	38.2	33.5	33.8	39.7
3616	47.8	44.6	42.0	38.2	33.5	33.9	39.2
3617	47.8	44.7	42.2	38.5	33.6	33.9	39.5
3618	47.4	44.3	41.9	38.4	33.6	34.0	39.3
3619	47.2	44.4	41.8	38.2	33.4	33.7	39.1
3620 (Ref)	47.8	47.8	47.8	48.1	48.4	48.4	47.5
Average	47.65	44.71	42.30	38.58	33.75	34.15	39.48
s	0.500	0.585	0.603	0.617	0.528	0.552	0.431
Average+3s	49.16	46.47	44.10	40.43	35.34	35.81	40.77
Average-3s	46.15	42.96	40.49	36.73	32.17	32.50	38.19



8.6 VCEo (BR) @ 10mA



VCEo (BR) @ 10mA BC857 CE6327HTSA1 Infineon Farnell Jun-2017							
DUT	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
	0.0	5.0	10.0	21.0	50.0		
3310	77.6	78.0	78.2	78.7	79.4	79.3	78.6
3311	76.9	77.7	77.8	78.3	79.0	78.8	78.0
3312	76.3	76.9	76.9	77.5	78.0	77.9	77.3
3313	76.6	76.8	77.3	77.4	78.3	77.9	77.3
3314	76.5	76.6	77.2	77.4	78.0	78.1	77.4
3315	76.5	76.7	77.0	77.5	78.0	78.4	77.2
3316	76.4	76.8	77.1	77.4	78.1	78.2	77.6
3317	76.6	76.9	77.2	77.7	78.1	78.4	77.5
3318	76.8	77.1	77.3	77.9	78.6	78.3	77.6
3319	76.5	77.0	77.2	77.6	78.0	78.3	77.4
3320 (Ref)	76.7	76.4	76.7	76.7	76.5	76.8	76.7
Average	76.65	77.07	77.31	77.76	78.35	78.37	77.60
s	0.377	0.447	0.387	0.444	0.494	0.436	0.415
Average+3s	77.78	78.41	78.47	79.09	79.84	79.68	78.85
Average-3s	75.52	75.72	76.15	76.43	76.87	77.06	76.36

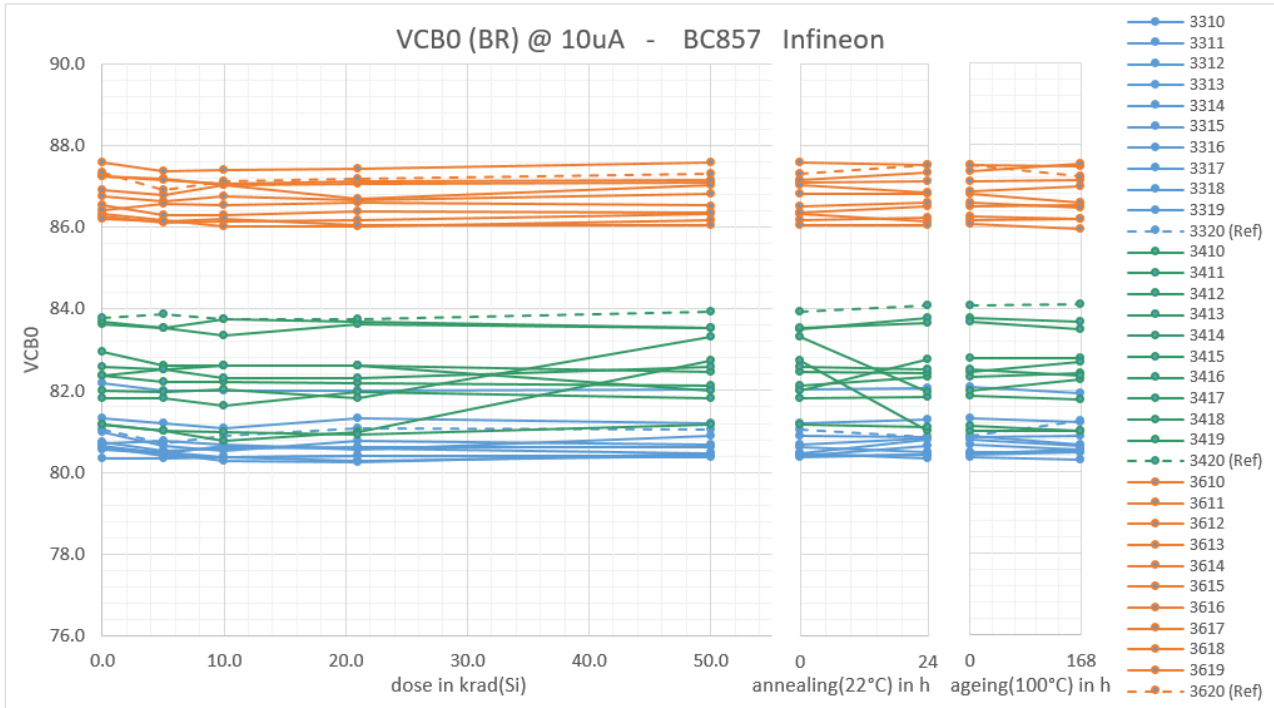


VCEO (BR) @ 10mA BC857 CE6327HTSA1 Infineon RS Feb-2018							
DUT	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
	0.0	5.0	10.0	21.0	50.0		
3410	77.5	78.0	78.5	79.0	79.5	79.4	78.6
3411	77.9	78.2	78.6	79.0	79.9	79.8	78.9
3412	76.7	77.1	77.4	78.1	80.2	78.4	77.8
3413	78.3	78.8	79.2	79.7	79.5	80.1	79.3
3414	77.7	78.2	78.5	79.1	81.3	79.6	78.7
3415	79.1	79.6	79.9	80.2	80.9	81.1	80.2
3416	78.2	78.5	79.1	79.5	80.1	80.4	79.0
3417	78.2	78.5	79.1	79.3	80.1	80.0	79.4
3418	79.2	79.6	79.9	80.5	81.3	81.2	80.2
3419	76.9	77.2	77.6	77.9	78.6	78.7	77.9
3420 (Ref)	79.1	79.2	79.2	79.0	79.2	79.2	79.5
Average	77.96	78.35	78.77	79.22	80.14	79.88	79.01
s	0.821	0.828	0.852	0.809	0.840	0.903	0.810
Average+3s	80.42	80.84	81.33	81.65	82.66	82.59	81.44
Average-3s	75.49	75.87	76.22	76.79	77.62	77.17	76.58

VCEO (BR) @ 10mA BC857 CE6327 Infineon Mouser Oct-2016							
DUT	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
	0.0	5.0	10.0	21.0	50.0		
3610	79.9	80.4	80.8	81.6	82.7	82.4	81.5
3611	80.1	80.4	80.7	81.2	82.5	82.4	81.2
3612	80.2	80.5	81.1	81.5	82.7	82.5	81.6
3613	80.5	80.9	81.6	82.2	83.0	83.0	81.9
3614	80.9	81.6	81.9	82.7	83.6	84.0	82.3
3615	80.0	80.5	81.2	81.7	82.6	82.6	81.2
3616	80.4	80.8	81.3	81.9	83.3	83.2	81.8
3617	80.7	81.1	81.5	82.3	83.0	83.4	82.2
3618	81.1	81.6	82.1	82.8	83.9	83.8	82.4
3619	80.8	81.4	81.9	82.6	83.5	83.5	82.4
3620 (Ref)	81.2	80.9	80.9	81.0	81.0	81.2	81.3
Average	80.44	80.91	81.40	82.04	83.07	83.07	81.84
s	0.416	0.478	0.466	0.544	0.470	0.578	0.470
Average+3s	81.69	82.35	82.79	83.67	84.48	84.80	83.25
Average-3s	79.20	79.48	80.00	80.41	81.66	81.33	80.43



8.7 VCBo (BR) @ 10uA



VCBo (BR) @ 10uA BC857 CE6327HTSA1 Infineon Farnell Jun-2017							
DUT	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
	0.0	5.0	10.0	21.0	50.0		
3310	82.2	82.0	82.0	82.0	82.0	82.1	81.9
3311	81.3	81.2	81.1	81.3	81.2	81.3	81.2
3312	80.6	80.5	80.3	80.2	80.5	80.3	80.3
3313	80.3	80.4	80.4	80.4	80.4	80.4	80.5
3314	80.6	80.4	80.4	80.4	80.4	80.4	80.5
3315	81.0	80.7	80.5	80.8	80.7	80.8	80.9
3316	80.6	80.5	80.6	80.6	80.5	80.8	80.6
3317	80.7	80.5	80.6	80.6	80.6	80.5	80.5
3318	80.7	80.8	80.7	80.6	80.9	80.9	80.7
3319	80.6	80.5	80.4	80.3	80.4	80.7	80.5
3320 (Ref)	81.0	80.7	80.9	81.1	81.1	80.9	81.3
Average	80.86	80.73	80.69	80.71	80.75	80.82	80.77
s	0.529	0.512	0.512	0.544	0.516	0.524	0.481
Average+3s	82.45	82.27	82.23	82.35	82.30	82.40	82.21
Average-3s	79.28	79.20	79.15	79.08	79.21	79.25	79.32

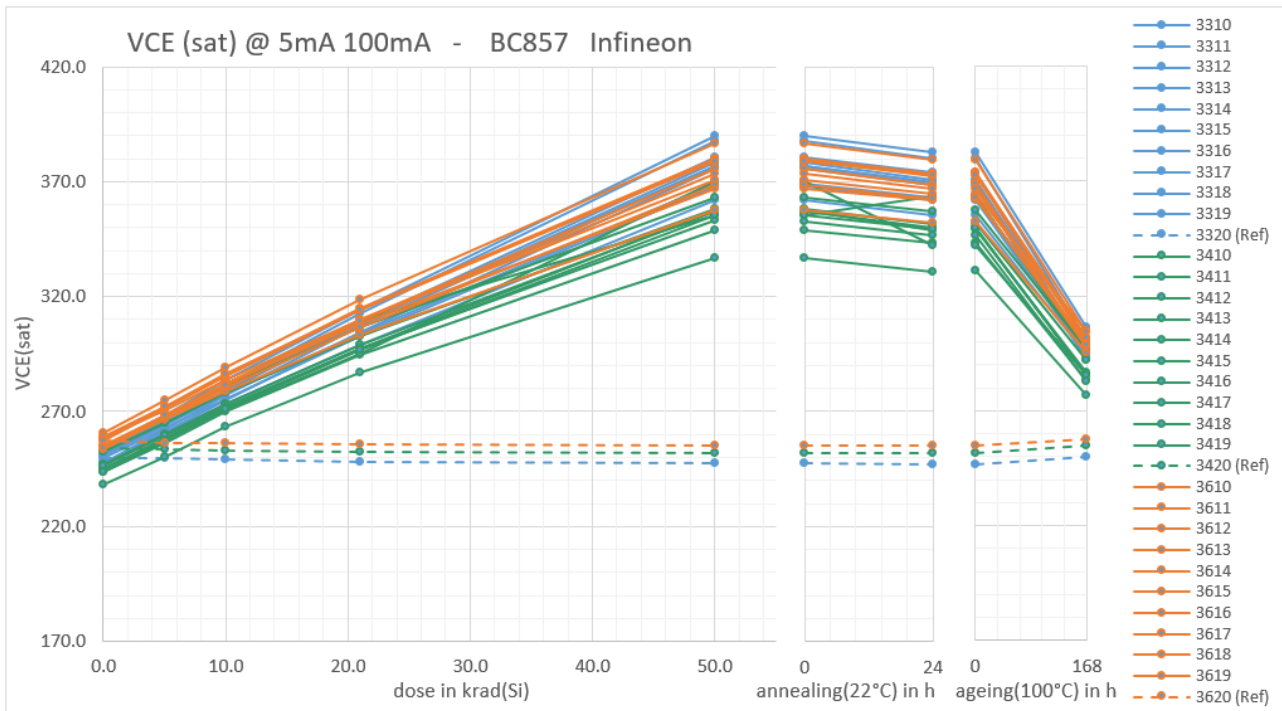


VCBO (BR) @ 10uA BC857 CE6327HTSA1 Infineon RS Feb-2018							
DUT	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
	0.0	5.0	10.0	21.0	50.0		
3410	81.8	81.8	81.6	82.0	81.8	81.8	81.8
3411	82.4	82.2	82.2	82.2	82.1	82.3	82.4
3412	81.2	81.0	80.8	81.0	82.7	81.0	81.0
3413	82.9	82.6	82.6	82.6	82.0	82.8	82.8
3414	82.0	82.0	82.0	81.8	83.3	82.0	82.3
3415	83.6	83.5	83.7	83.7	83.5	83.8	83.7
3416	82.6	82.5	82.6	82.6	82.4	82.4	82.7
3417	82.4	82.5	82.3	82.3	82.6	82.5	82.4
3418	83.7	83.5	83.3	83.6	83.5	83.7	83.5
3419	81.2	81.0	81.0	80.9	81.2	81.1	81.0
3420 (Ref)	83.8	83.9	83.8	83.7	83.9	84.1	84.1
Average	82.37	82.28	82.22	82.27	82.52	82.34	82.34
s	0.883	0.871	0.938	0.930	0.780	0.923	0.897
Average+3s	85.02	84.89	85.04	85.06	84.86	85.11	85.04
Average-3s	79.72	79.67	79.41	79.48	80.18	79.57	79.65

VCBO (BR) @ 10uA BC857 CE6327 Infineon Mouser Oct-2016							
DUT	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
	0.0	5.0	10.0	21.0	50.0		
3610	86.3	86.2	86.0	86.0	86.2	86.2	86.2
3611	86.3	86.1	86.1	86.2	86.3	86.1	86.2
3612	86.6	86.3	86.3	86.4	86.4	86.5	86.5
3613	86.8	86.6	86.8	86.6	86.8	86.8	86.6
3614	87.3	87.2	87.0	87.1	87.1	87.1	87.1
3615	86.2	86.1	86.2	86.0	86.0	86.1	85.9
3616	86.4	86.6	86.5	86.6	86.5	86.6	86.5
3617	86.9	86.8	87.0	86.7	87.0	86.9	87.0
3618	87.6	87.4	87.4	87.4	87.6	87.5	87.5
3619	87.2	87.2	87.0	87.1	87.1	87.3	87.5
3620 (Ref)	87.3	86.9	87.1	87.2	87.3	87.5	87.2
Average	86.74	86.64	86.64	86.62	86.70	86.71	86.70
s	0.481	0.469	0.482	0.481	0.499	0.499	0.556
Average+3s	88.19	88.04	88.09	88.06	88.20	88.21	88.37
Average-3s	85.30	85.23	85.19	85.18	85.21	85.22	85.04



8.8 VCE (sat) @ 5mA 100mA



VCE (sat) @ 5mA 100mA		BC857 CE6327HTSA1 Infineon Farnell Jun-2017					
DUT	krad(Si)					annealing (22°C, 24h)	ageing (100°C, 168h)
	0.0	5.0	10.0	21.0	50.0		
3310	249.9	262.6	275.4	302.9	368.1	361.8	294.1
3311	253.9	268.3	283.9	314.3	389.8	382.6	306.7
3312	247.7	262.3	277.3	307.1	376.9	369.6	292.2
3313	251.3	265.3	279.0	308.1	378.1	370.5	297.3
3314	251.1	264.0	277.5	304.2	369.2	363.2	296.4
3315	247.4	260.5	273.3	299.3	361.8	355.2	294.3
3316	253.6	266.9	280.7	308.8	376.8	369.6	297.9
3317	247.6	261.0	274.9	304.5	375.6	368.3	293.9
3318	252.7	266.2	281.6	312.7	387.6	380.1	300.9
3319	251.0	264.6	279.0	309.0	380.6	373.9	296.1
3320 (Ref)	250.0	249.5	249.3	248.1	247.3	246.9	250.2
Average	250.61	264.18	278.25	307.08	376.45	369.47	296.97
s	2.426	2.594	3.272	4.534	8.551	8.231	4.196
Average+3s	257.89	271.96	288.07	320.68	402.10	394.17	309.56
Average-3s	243.33	256.40	268.44	293.47	350.80	344.78	284.38



VCE (sat) @ 5mA 100mA		BC857 CE6327HTSA1 Infineon RS Feb-2018					
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
3410	243.5	256.2	269.9	294.9	349.1	343.3	283.6
3411	254.5	268.1	280.8	306.5	363.2	357.2	296.9
3412	245.2	258.1	270.6	295.0	370.4	342.1	285.4
3413	254.1	268.0	282.0	309.3	355.4	363.5	296.6
3414	244.6	258.2	271.4	297.4	357.8	349.0	286.6
3415	252.5	264.8	278.1	302.9	358.2	351.8	292.1
3416	246.8	260.3	273.4	299.3	357.0	349.9	285.8
3417	246.6	259.8	272.2	297.2	352.9	346.5	283.1
3418	243.8	257.5	270.9	296.8	355.7	349.5	285.5
3419	238.3	250.5	263.6	287.1	336.6	331.0	277.0
3420 (Ref)	254.2	253.5	253.3	252.5	251.9	251.7	254.8
Average	246.99	260.15	273.28	298.63	355.64	348.39	287.26
s	5.210	5.498	5.544	6.344	8.826	8.787	6.235
Average+3s	262.62	276.65	289.91	317.66	382.11	374.75	305.96
Average-3s	231.36	243.66	256.64	279.60	329.16	322.03	268.55

VCE (sat) @ 5mA 100mA		BC857 CE6327 Infineon Mouser Oct-2016					
	krad(Si)					annealing	ageing
DUT	0.0	5.0	10.0	21.0	50.0	(22°C, 24h)	(100°C, 168h)
3610	258.6	270.4	283.5	310.1	370.8	364.7	304.6
3611	255.3	268.1	282.0	308.2	367.1	362.1	300.1
3612	254.7	266.8	278.7	303.4	357.3	352.4	295.7
3613	253.9	266.9	280.4	306.7	368.5	362.7	298.3
3614	260.7	274.7	289.4	318.9	386.4	379.4	304.5
3615	257.3	271.4	285.3	314.4	379.7	372.6	299.9
3616	257.4	271.6	286.1	315.1	380.1	373.7	301.7
3617	253.5	267.1	281.6	310.1	375.6	368.7	297.4
3618	254.3	268.4	281.8	309.5	373.4	366.8	298.6
3619	259.0	272.4	286.4	314.6	379.0	372.9	301.8
3620 (Ref)	257.2	256.5	256.3	255.7	254.9	255.0	257.8
Average	256.46	269.79	283.51	311.09	373.81	367.60	300.27
s	2.495	2.717	3.235	4.629	8.279	7.649	2.922
Average+3s	263.95	277.94	293.22	324.98	398.64	390.54	309.04
Average-3s	248.98	261.63	273.80	297.21	348.97	344.65	291.51

9 CONCLUSION

The test results of the BC857 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 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.

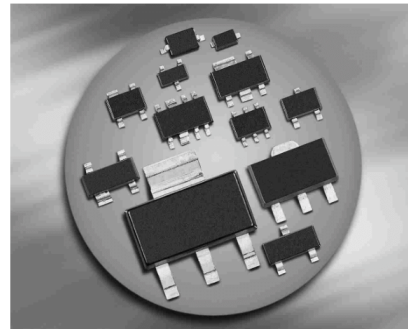
10 APPENDIX - EXTRACT FROM THE DATA SHEET



BC857...-BC860...

PNP Silicon AF Transistor

- For AF input stages and driver applications
- High current gain
- Low collector-emitter saturation voltage
- Low noise between 30 hz and 15 kHz
- Complementary types:
BC847...-BC850... (NPN)
- Pb-free (RoHS compliant) package
- Qualified according AEC Q101¹⁾



¹BC857BL3 is not qualified according AEC Q101

Type	Marking	Pin Configuration						Package
BC857A	3Es	1=B	2=E	3=C	-	-	-	SOT23
BC857B	3Fs	1=B	2=E	3=C	-	-	-	SOT23
BC857BL3*	3F	1=B	2=E	3=C	-	-	-	TSLP-3-1
BC857BW	3Fs	1=B	2=E	3=C	-	-	-	SOT323
BC857C	3Gs	1=B	2=E	3=C	-	-	-	SOT23
BC857CW	3Gs	1=B	2=E	3=C	-	-	-	SOT323
BC858A	3Js	1=B	2=E	3=C	-	-	-	SOT23
BC858B	3Ks	1=B	2=E	3=C	-	-	-	SOT23
BC858BW	3Ks	1=B	2=E	3=C	-	-	-	SOT323
BC858C	3Ls	1=B	2=E	3=C	-	-	-	SOT23
BC858CW	3Ls	1=B	2=E	3=C	-	-	-	SOT323
BC859C	4Cs	1=B	2=E	3=C	-	-	-	SOT23
BC860B	4Fs	1=B	2=E	3=C	-	-	-	SOT23
BC860BW	4Fs	1=B	2=E	3=C	-	-	-	SOT323
BC860CW	4Gs	1=B	2=E	3=C	-	-	-	SOT323

* Not qualified according AEC Q101



BC857...-BC860...

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage BC857..., BC860... BC858..., BC859...	V_{CEO}	45 30	V
Collector-base voltage BC857..., BC860... BC858..., BC859...	V_{CBO}	50 30	
Emitter-base voltage	V_{EBO}	5	
Collector current	I_C	100	mA
Peak collector current, $t_p \leq 10$ ms	I_{CM}	200	
Total power dissipation $T_S \leq 71$ °C, BC857-BC860 $T_S \leq 135$ °C, BC857BL3 $T_S \leq 124$ °C, BC857W-BC860W	P_{tot}	330 250 250	mW
Junction temperature	T_j	150	°C
Storage temperature	T_{stg}	-65 ... 150	

Thermal Resistance

Parameter	Symbol	Value	Unit
Junction - soldering point ¹⁾ BC857-BC860 BC857BL3 BC857W-BC860W	R_{thJS}	≤ 240 ≤ 60 ≤ 105	K/W

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



BC857...-BC860...

Electrical Characteristics at $T_A = 25^\circ\text{C}$, unless otherwise specified

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
DC Characteristics					
Collector-emitter breakdown voltage $I_C = 10\text{ mA}, I_B = 0$, BC857..., BC860... $I_C = 10\text{ mA}, I_B = 0$, BC858..., BC859...	$V_{(BR)CEO}$	45 30	- -	- -	V
Collector-base breakdown voltage $I_C = 10\text{ }\mu\text{A}, I_E = 0$, BC857..., BC860... $I_C = 10\text{ }\mu\text{A}, I_E = 0$, BC858..., BC859...	$V_{(BR)CBO}$	50 30	- -	- -	
Emitter-base breakdown voltage $I_E = 1\text{ }\mu\text{A}, I_C = 0$	$V_{(BR)EBO}$	5	-	-	
Collector-base cutoff current $V_{CB} = 45\text{ V}, I_E = 0$ $V_{CB} = 30\text{ V}, I_E = 0, T_A = 150\text{ }^\circ\text{C}$	I_{CBO}	- -	- -	0.015 5	μA
DC current gain ¹⁾ $I_C = 10\text{ }\mu\text{A}, V_{CE} = 5\text{ V}, h_{FE}\text{-grp.A}$ $I_C = 10\text{ }\mu\text{A}, V_{CE} = 5\text{ V}, h_{FE}\text{-grp.B}$ $I_C = 10\text{ }\mu\text{A}, V_{CE} = 5\text{ V}, h_{FE}\text{-grp.C}$ $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}, h_{FE}\text{-grp.A}$ $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}, h_{FE}\text{-grp.B}$ $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}, h_{FE}\text{-grp.C}$	h_{FE}	- - - 125 220 420	140 250 480 180 290 520	- - - 250 475 800	-
Collector-emitter saturation voltage ¹⁾ $I_C = 10\text{ mA}, I_B = 0.5\text{ mA}$ $I_C = 100\text{ mA}, I_B = 5\text{ mA}$	V_{CEsat}	- -	75 250	300 650	mV
Base emitter saturation voltage ¹⁾ $I_C = 10\text{ mA}, I_B = 0.5\text{ mA}$ $I_C = 100\text{ mA}, I_B = 5\text{ mA}$	V_{BEsat}	- -	700 850	- -	
Base-emitter voltage ¹⁾ $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}$ $I_C = 10\text{ mA}, V_{CE} = 5\text{ V}$	$V_{BE(ON)}$	600 -	650 -	750 820	

¹⁾Pulse test: $t < 300\mu\text{s}; D < 2\%$



BC857...-BC860...

Electrical Characteristics at $T_A = 25^\circ\text{C}$, unless otherwise specified

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
AC Characteristics					
Transition frequency $I_C = 20\text{ mA}, V_{CE} = 5\text{ V}, f = 100\text{ MHz}$	f_T	-	250	-	MHz
Collector-base capacitance $V_{CB} = 10\text{ V}, f = 1\text{ MHz}$	C_{cb}	-	1.5	-	pF
Emitter-base capacitance $V_{EB} = 0.5\text{ V}, f = 1\text{ MHz}$	C_{eb}	-	8	-	
Short-circuit input impedance $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}, f = 1\text{ kHz}, h_{FE}\text{-grp.A}$ $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}, f = 1\text{ kHz}, h_{FE}\text{-grp.B}$ $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}, f = 1\text{ kHz}, h_{FE}\text{-grp.C}$	h_{11e}	-	2.7 4.5 8.7	-	k Ω
Open-circuit reverse voltage transf. ratio $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}, f = 1\text{ kHz}, h_{FE}\text{-grp.A}$ $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}, f = 1\text{ kHz}, h_{FE}\text{-grp.B}$ $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}, f = 1\text{ kHz}, h_{FE}\text{-grp.C}$	h_{12e}	-	1.5 2 3	-	10^{-4}
Short-circuit forward current transf. ratio $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}, f = 1\text{ kHz}, h_{FE}\text{-grp.A}$ $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}, f = 1\text{ kHz}, h_{FE}\text{-grp.B}$ $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}, f = 1\text{ kHz}, h_{FE}\text{-grp.C}$	h_{21e}	-	200 330 600	-	-
Open-circuit output admittance $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}, f = 1\text{ kHz}, h_{FE}\text{-grp.A}$ $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}, f = 1\text{ kHz}, h_{FE}\text{-grp.B}$ $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}, f = 1\text{ kHz}, h_{FE}\text{-grp.C}$	h_{22e}	-	18 30 60	-	μS
Noise figure $I_C = 0.2\text{ mA}, V_{CE} = 5\text{ V}, f = 1\text{ kHz},$ $\Delta f = 200\text{ Hz}, R_S = 2\text{ k}\Omega, \text{ BC859, BC850}$	F	-	1	4	dB
Equivalent noise voltage $I_C = 200\text{ mA}, V_{CE} = 5\text{ V}, R_S = 2\text{ k}\Omega,$ $f = 10\text{...}50\text{ Hz}, \text{ BC860}$	V_n	-	-	0.11	μV