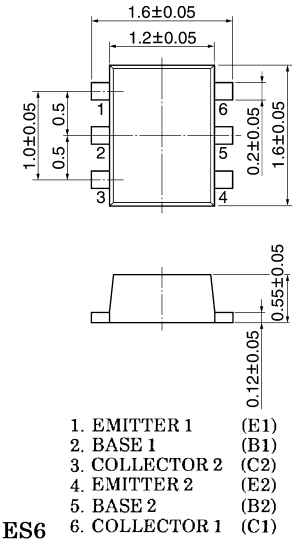
TOSHIBA Transistor Silicon NPN・PNP Epitaxial Type
(PCT process) (Bias Resistor Built-in Transistor)

RN4990HFE, RN4991HFE

Switching, Inverter Circuit, Interface Circuit and
Driver Circuit Applications

- Two devices are incorporated into an Extreme-Super-Mini (6 pin) package.
- Incorporating a bias resistor into a transistor reduces parts count. Reducing the parts count enables the manufacture of ever more compact equipment and lowers assembly cost.

Unit: mm



1. EMITTER 1 (E1)
2. BASE 1 (B1)
3. COLLECTOR 2 (C2)
4. EMITTER 2 (E2)
5. BASE 2 (B2)
6. COLLECTOR 1 (C1)

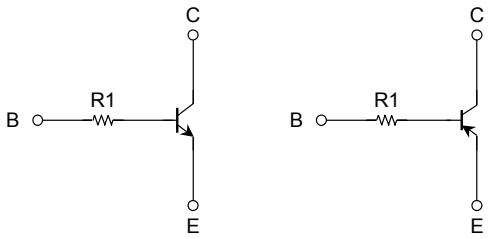
ES6

JEDEC	—
JEITA	—
TOSHIBA	2-2N1G

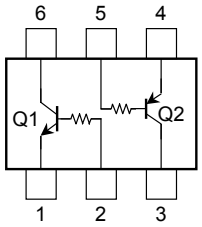
Weight: 0.003g (typ.)

Equivalent Circuit

Q1 **Q2**



Equivalent Circuit (top view)



Maximum Ratings (Ta = 25°C) (Q1)

Characteristics	Symbol	Rating	Unit
Collector-base voltage	V_{CBO}	40	V
Collector-emitter voltage	V_{CEO}	40	V
Emitter-base voltage	V_{EBO}	5	V
Collector current	I_C	100	mA

Maximum Ratings (Ta = 25°C) (Q2)

Characteristics	Symbol	Rating	Unit
Collector-base voltage	V_{CBO}	−30	V
Collector-emitter voltage	V_{CEO}	−30	V
Emitter-base voltage	V_{EBO}	−5	V
Collector current	I_C	−100	mA

Maximum Ratings (Ta = 25°C) (Q1, Q2 common)

Characteristics	Symbol	Rating	Unit
Collector power dissipation	P_C (Note)	100	mW
Junction temperature	T_j	150	°C
Storage temperature range	T_{stg}	−55~150	°C

Note: Total rating

Electrical Characteristics (Ta = 25°C) (Q1)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Collector cut-off current	I_{CBO}	V_{CB} = 40 V, I_E = 0	—	—	100	nA
Emitter cut-off current	I_{EBO}	V_{EB} = 5 V, I_C = 0	—	—	100	nA
DC current gain	h_{FE}	V_{CE} = 5 V, I_C = 1 mA	300	—	—	
Collector-emitter saturation voltage	$V_{CE\ (sat)}$	I_C = 5 mA, I_B = 0.25 mA	—	0.06	0.15	V
Transition frequency	f_T	V_{CE} = 10 V, I_C = 5 mA	—	250	—	MHz
Collector output capacitance	C_{ob}	V_{CB} = 10 V, I_E = 0, f = 1 MHz	—	3	—	pF

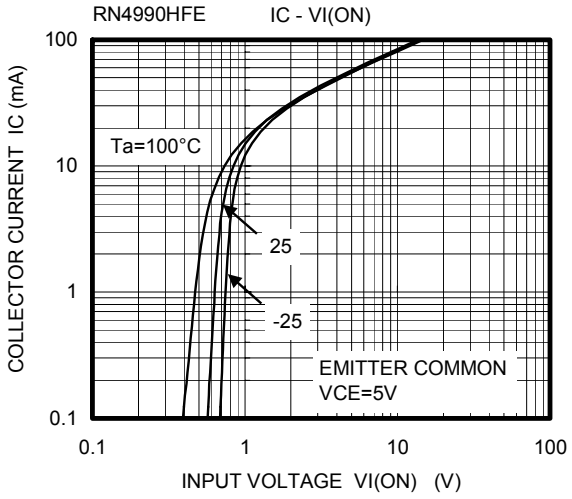
Electrical Characteristics (Ta = 25°C) (Q2)

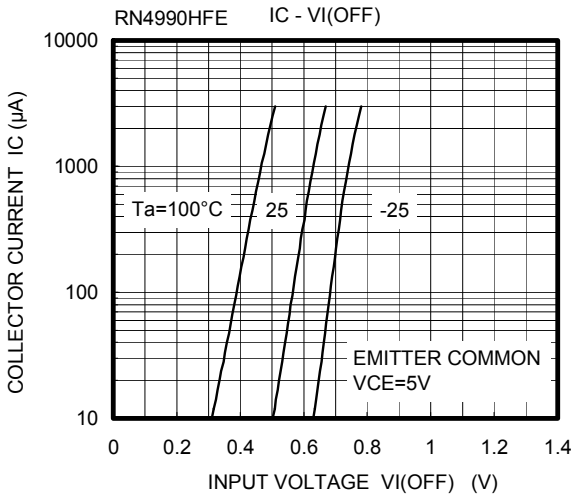
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Collector cut-off current	I_{CBO}	V_{CB} = −30 V, I_E = 0	—	—	−100	nA
Emitter cut-off current	I_{EBO}	V_{EB} = −5 V, I_C = 0	—	—	−100	nA
DC current gain	h_{FE}	V_{CE} = −5 V, I_C = −1 mA	300	—	—	
Collector-emitter saturation voltage	$V_{CE\ (sat)}$	I_C = −5 mA, I_B = −0.25 mA	—	−0.06	−0.15	V
Transition frequency	f_T	V_{CE} = −10 V, I_C = −5 mA	—	200	—	MHz
Collector output capacitance	C_{ob}	V_{CB} = −10 V, I_E = 0, f = 1 MHz	—	3	—	pF

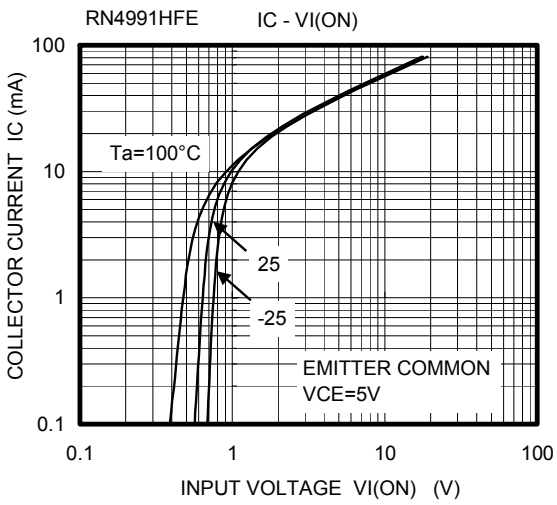
Electrical Characteristics (Ta = 25°C) (Q1, Q2 common)

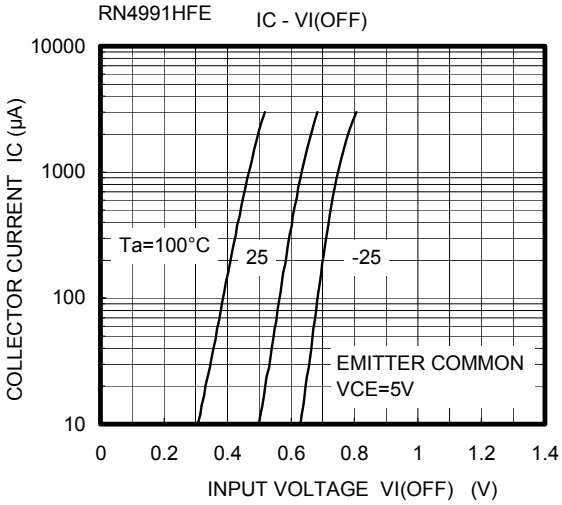
Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Input resistor	RN4990HFE	R1	—	3.76	4.7	5.64	kΩ
	RN4991HFE			8	10	12	

Q1

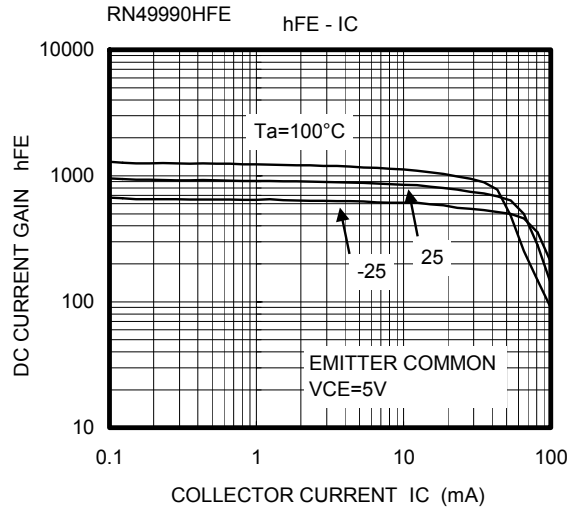

RN4990HFE IC - VI(ON)
COLLECTOR CURRENT IC (mA)
100
10
1
0.1
Ta=100°C
25
-25
EMITTER COMMON
VCE=5V
0.1
1
10
100
INPUT VOLTAGE VI(ON) (V)

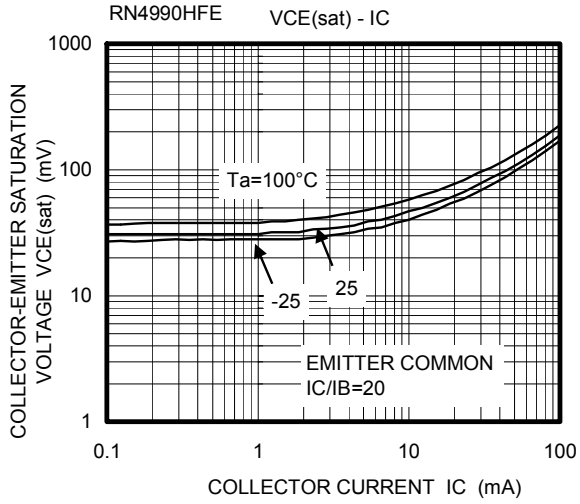

RN4990HFE IC - VI(OFF)
COLLECTOR CURRENT IC (μA)
10000
1000
100
10
Ta=100°C
25
-25
EMITTER COMMON
VCE=5V
0
0.2
0.4
0.6
0.8
1
1.2
1.4
INPUT VOLTAGE VI(OFF) (V)

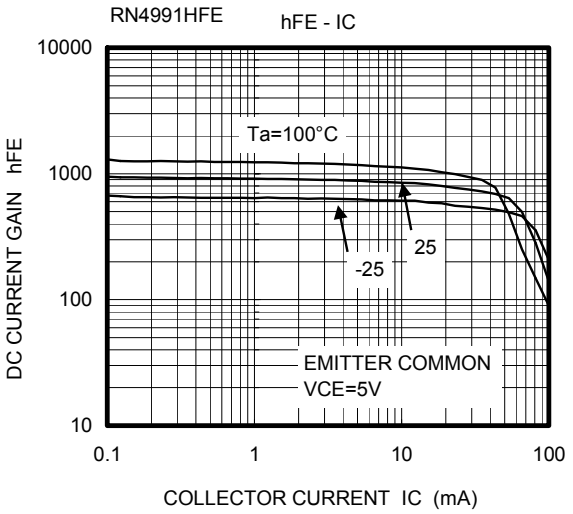

RN4991HFE IC - VI(ON)
COLLECTOR CURRENT IC (mA)
100
10
1
0.1
Ta=100°C
25
-25
EMITTER COMMON
VCE=5V
0.1
1
10
100
INPUT VOLTAGE VI(ON) (V)

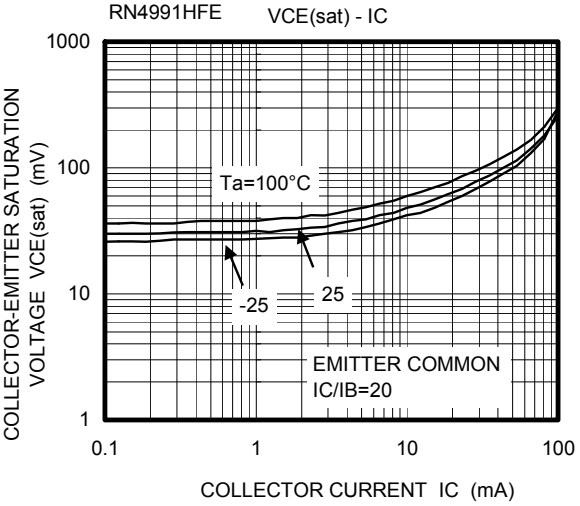

RN4991HFE IC - VI(OFF)
COLLECTOR CURRENT IC (μA)
10000
1000
100
10
Ta=100°C
25
-25
EMITTER COMMON
VCE=5V
0
0.2
0.4
0.6
0.8
1
1.2
1.4
INPUT VOLTAGE VI(OFF) (V)

Q1

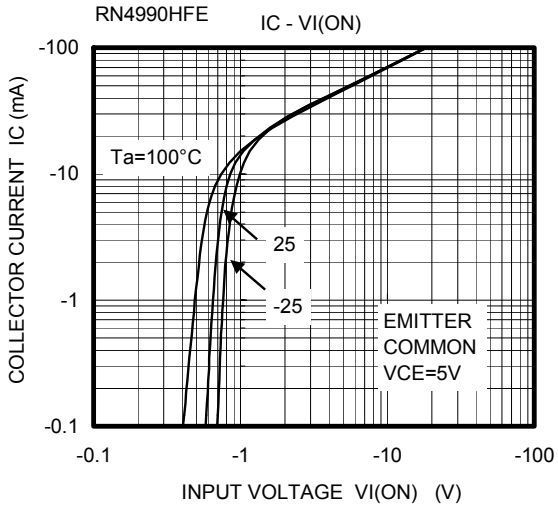

RN49990HFE
hFE - IC
DC CURRENT GAIN hFE
COLLECTOR CURRENT IC (mA)
Ta=100°C
-25
25
EMITTER COMMON
VCE=5V
10000
1000
100
10
0.1
1
10
100

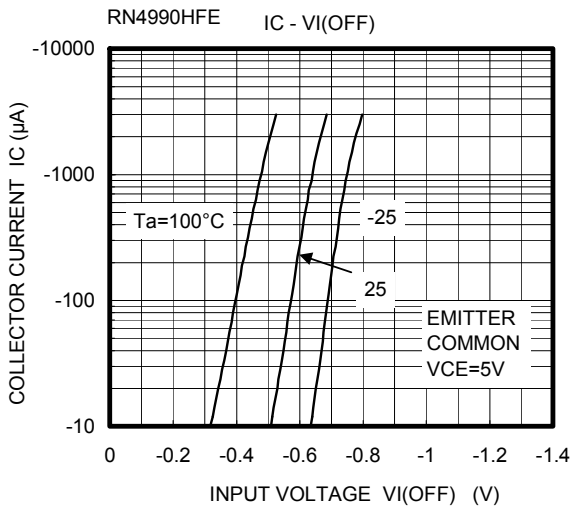

RN4990HFE
VCE(sat) - IC
COLLECTOR-EMITTER SATURATION VOLTAGE VCE(sat) (mV)
COLLECTOR CURRENT IC (mA)
Ta=100°C
-25
25
EMITTER COMMON
IC/IB=20
1000
100
10
1
0.1
1
10
100

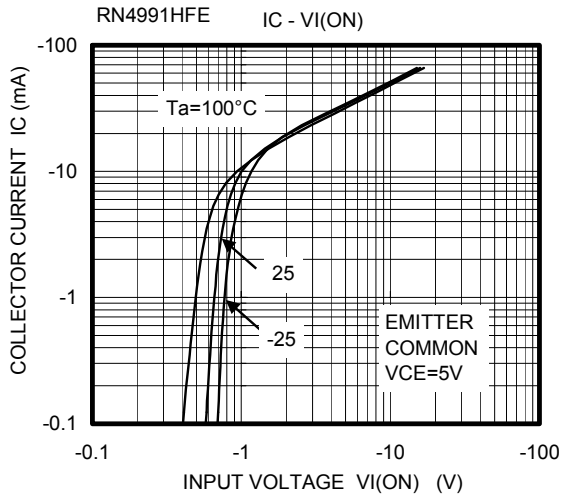

RN4991HFE
hFE - IC
DC CURRENT GAIN hFE
COLLECTOR CURRENT IC (mA)
Ta=100°C
-25
25
EMITTER COMMON
VCE=5V
10000
1000
100
10
0.1
1
10
100

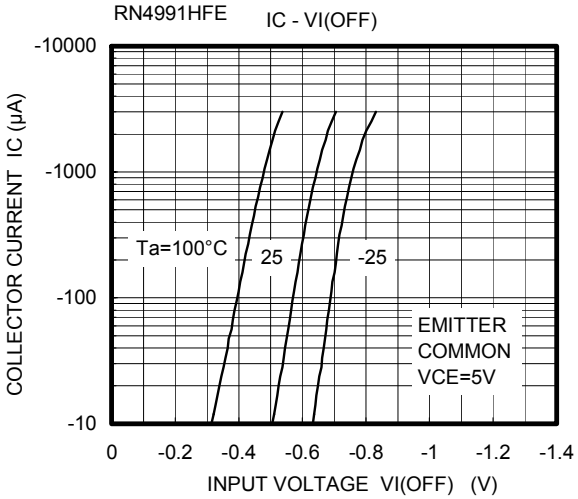

RN4991HFE
VCE(sat) - IC
COLLECTOR-EMITTER SATURATION VOLTAGE VCE(sat) (mV)
COLLECTOR CURRENT IC (mA)
Ta=100°C
-25
25
EMITTER COMMON
IC/IB=20
1000
100
10
1
0.1
1
10
100

Q2

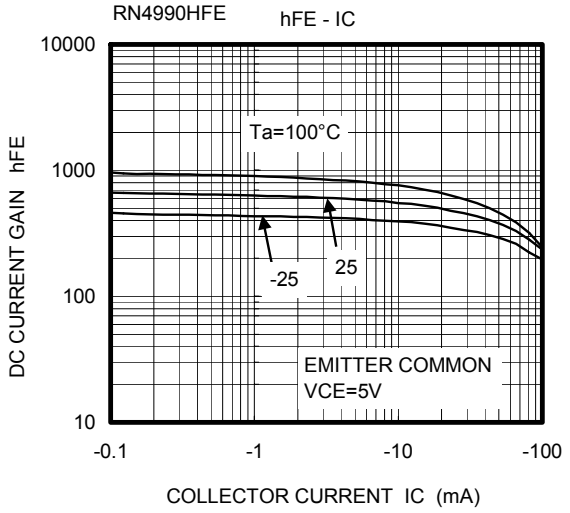

RN4990HFE
IC - VI(ON)
COLLECTOR CURRENT IC (mA)
-100
-10
-1
-0.1
Ta=100°C
25
-25
EMITTER
COMMON
VCE=5V
-0.1
-1
-10
-100
INPUT VOLTAGE VI(ON) (V)

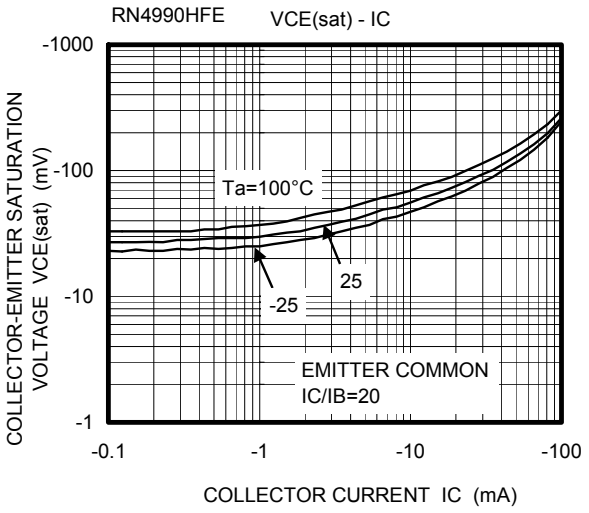

RN4990HFE
IC - VI(OFF)
COLLECTOR CURRENT IC (μA)
-10000
-1000
-100
-10
Ta=100°C
-25
25
EMITTER
COMMON
VCE=5V
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
INPUT VOLTAGE VI(OFF) (V)

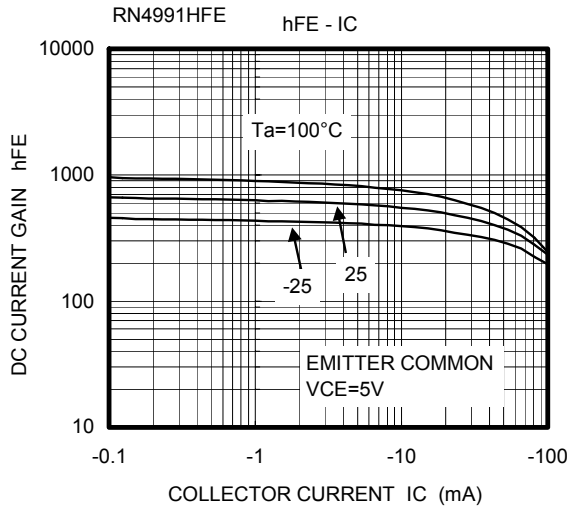

RN4991HFE
IC - VI(ON)
COLLECTOR CURRENT IC (mA)
-100
-10
-1
-0.1
Ta=100°C
25
-25
EMITTER
COMMON
VCE=5V
-0.1
-1
-10
-100
INPUT VOLTAGE VI(ON) (V)

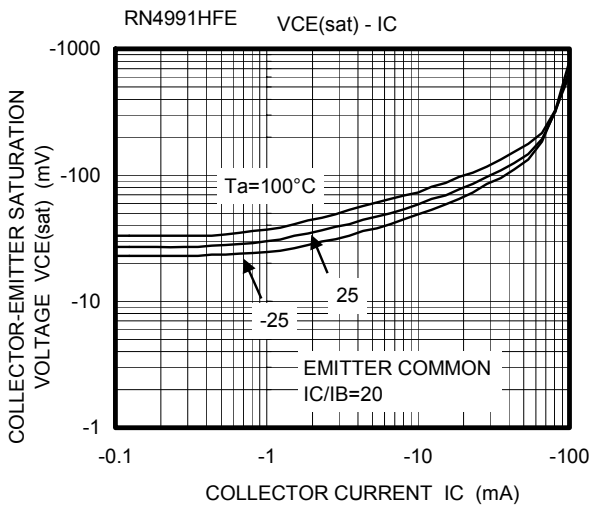

RN4991HFE
IC - VI(OFF)
COLLECTOR CURRENT IC (μA)
-10000
-1000
-100
-10
Ta=100°C
25
-25
EMITTER
COMMON
VCE=5V
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
INPUT VOLTAGE VI(OFF) (V)

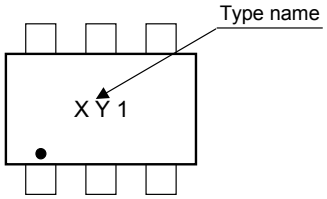
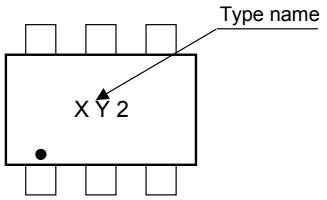
Q2


RN4990HFE
hFE - IC
DC CURRENT GAIN hFE
10000
1000
100
10
Ta=100°C
-25
25
EMITTER COMMON
VCE=5V
-0.1
-1
-10
-100
COLLECTOR CURRENT IC (mA)


RN4990HFE
VCE(sat) - IC
COLLECTOR-EMITTER SATURATION VOLTAGE VCE(sat) (mV)
-1000
-100
-10
-1
Ta=100°C
-25
25
EMITTER COMMON
IC/IB=20
-0.1
-1
-10
-100
COLLECTOR CURRENT IC (mA)


RN4991HFE
hFE - IC
DC CURRENT GAIN hFE
10000
1000
100
10
Ta=100°C
-25
25
EMITTER COMMON
VCE=5V
-0.1
-1
-10
-100
COLLECTOR CURRENT IC (mA)


RN4991HFE
VCE(sat) - IC
COLLECTOR-EMITTER SATURATION VOLTAGE VCE(sat) (mV)
-1000
-100
-10
-1
Ta=100°C
25
-25
EMITTER COMMON
IC/IB=20
-0.1
-1
-10
-100
COLLECTOR CURRENT IC (mA)

Type Name	Marking
RN4990HFE	
RN4991HFE	

RESTRICTIONS ON PRODUCT USE

030619EAA

- The information contained herein is subject to change without notice.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of TOSHIBA or others.
- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
  In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the “Handling Guide for Semiconductor Devices,” or “TOSHIBA Semiconductor Reliability Handbook” etc..
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury (“Unintended Usage”). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer’s own risk.
- TOSHIBA products should not be embedded to the downstream products which are prohibited to be produced and sold, under any law and regulations.