

Bipolar Transistors Silicon PNP Epitaxial Type (PCT Process)(Bias Resistor built-in Transistor)

# RN2414/15/16/17/18

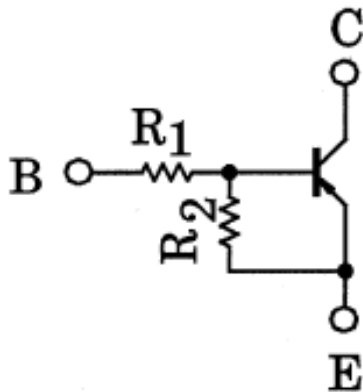
## 1. Applications

- Switching
- Inverter Circuits
- Interfacing
- Driver Circuits

## 2. Features

- (1) AEC-Q101 qualified (Please see the orderable part number list)
- (2) The integrated bias resistor reduces the number of external parts required, making it possible to reduce system size and assembly time.
- (3) Toshiba offers transistors with a wide range of resistance to accommodate various circuit designs.
- (4) Complementary to RN1414 to RN1418

## 3. Equivalent Circuit



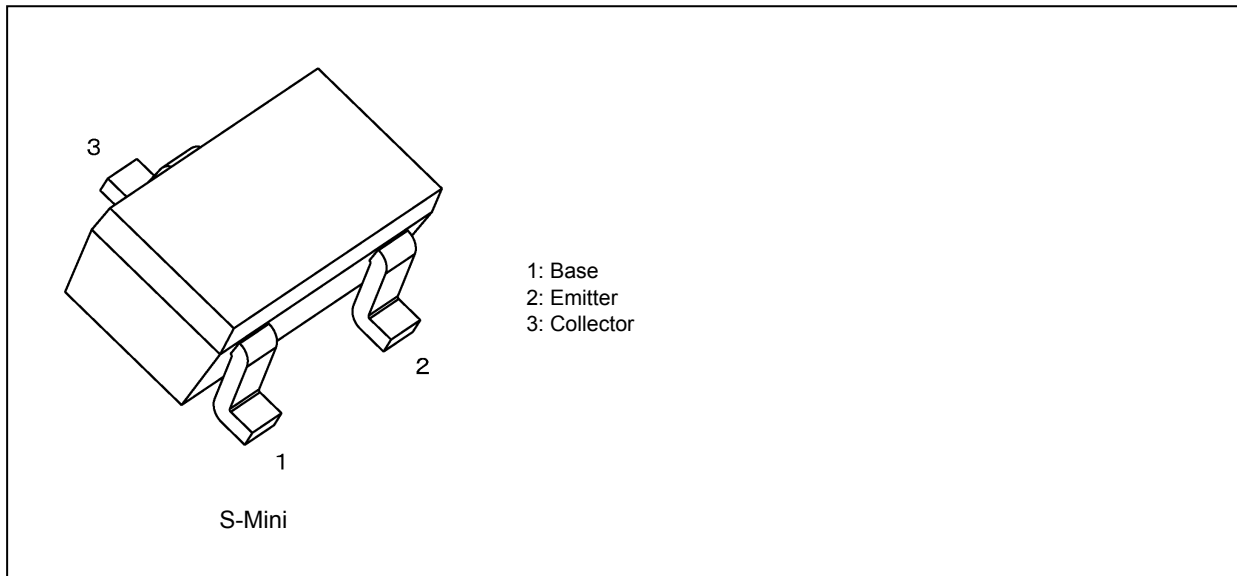
## 4. Bias Resistor Values

| Part No. | R1 (kΩ) | R2 (kΩ) |
|----------|---------|---------|
| RN2414   | 1       | 10      |
| RN2415   | 2.2     | 10      |
| RN2416   | 4.7     | 10      |
| RN2417   | 10      | 4.7     |
| RN2418   | 47      | 10      |

Start of commercial production

1994-08

## 5. Packaging and Pin Assignment



## 6. Orderable part number

| Orderable part number |                 | AEC-Q101 | Note     | Note                    |
|-----------------------|-----------------|----------|----------|-------------------------|
| RN2414                | RN2414(TE85L,F) | —        |          | General Use             |
|                       | —               | YES      | (Note 1) | Unintended Use (Note 1) |
| RN2415                | RN2415,LF       | —        |          | General Use             |
|                       | RN2415,LXGF     | YES      | (Note 1) | Unintended Use (Note 1) |
|                       | RN2415,LXHF     | YES      |          | Automotive Use          |
| RN2416                | RN2416,LF       | —        |          | General Use             |
|                       | RN2416,LXGF     | YES      | (Note 1) | Unintended Use (Note 1) |
|                       | RN2416,LXHF     | YES      |          | Automotive Use          |
| RN2417                | RN2417,LF       | —        |          | General Use             |
|                       | RN2417,LXGF     | YES      | (Note 1) | Unintended Use (Note 1) |
|                       | RN2417,LXHF     | YES      |          | Automotive Use          |
| RN2418                | RN2418,LF       | —        |          | General Use             |
|                       | RN2418,LXGF     | YES      | (Note 1) | Unintended Use (Note 1) |
|                       | RN2418,LXHF     | YES      |          | Automotive Use          |

Note 1: For more information, please contact our sales or use the inquiry form on our website.

### 7. Absolute Maximum Ratings (Note) (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

| Characteristics             |               | Symbol    | Rating     | Unit             |
|-----------------------------|---------------|-----------|------------|------------------|
| Collector-base voltage      | RN2414~RN2418 | $V_{CBO}$ | -50        | V                |
| Collector-emitter voltage   |               | $V_{CEO}$ | -50        |                  |
| Emitter-base voltage        | RN2414        | $V_{EBO}$ | -5         | V                |
|                             | RN2415        |           | -6         |                  |
|                             | RN2416        |           | -7         |                  |
|                             | RN2417        |           | -15        |                  |
|                             | RN2418        |           | -25        |                  |
| Collector current           | RN2414~RN2418 | $I_C$     | -100       | mA               |
| Collector power dissipation |               | $P_C$     | 200        | mW               |
| Junction temperature        |               | $T_j$     | 150        | $^\circ\text{C}$ |
| Storage temperature         |               | $T_{stg}$ | -55 to 150 |                  |

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

### 8. Electrical Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

| Characteristics                      |                            | Symbol        | Test Condition   | Min   | Typ. | Max   | Unit       |
|--------------------------------------|----------------------------|---------------|--|-------|------|-------|------------|
| Collector cut-off current            | RN2414~<br>RN2418          | $I_{CBO}$     | $V_{CB} = -50\text{ V}, I_E = 0\text{ mA}$                   | —     | —    | -100  | nA         |
|                                      |                            | $I_{CEO}$     | $V_{CE} = -50\text{ V}, I_B = 0\text{ mA}$                   | —     | —    | -500  |            |
| Emitter cut-off current              | RN2414                     | $I_{EBO}$     | $V_{EB} = -5\text{ V}, I_C = 0\text{ mA}$                    | -0.35 | —    | -0.65 | mA         |
|                                      | RN2415                     |               | $V_{EB} = -6\text{ V}, I_C = 0\text{ mA}$                    | -0.37 | —    | -0.71 |            |
|                                      | RN2416                     |               | $V_{EB} = -7\text{ V}, I_C = 0\text{ mA}$                    | -0.36 | —    | -0.68 |            |
|                                      | RN2417                     |               | $V_{EB} = -15\text{ V}, I_C = 0\text{ mA}$                   | -0.78 | —    | -1.46 |            |
|                                      | RN2418                     |               | $V_{EB} = -25\text{ V}, I_C = 0\text{ mA}$                   | -0.33 | —    | -0.63 |            |
| DC current gain                      | RN2414 ~ RN2416,<br>RN2418 | $h_{FE}$      | $V_{CE} = -5\text{ V}, I_C = -10\text{ mA}$                  | 50    | —    | —     | —          |
|                                      | RN2417                     |               |  | 30    | —    | —     |            |
| Collector-emitter saturation voltage | RN2414~<br>RN2418          | $V_{CE(sat)}$ | $I_C = -5\text{ mA}, I_B = -0.25\text{ mA}$                  | —     | -0.1 | -0.3  | V          |
| Input voltage (ON)                   | RN2414                     | $V_{I(ON)}$   | $V_{CE} = -0.2\text{ V}, I_C = -5\text{ mA}$                 | -0.5  | —    | -2.0  | V          |
|                                      | RN2415                     |               |  | -0.6  | —    | -2.5  |            |
|                                      | RN2416                     |               |  | -0.7  | —    | -2.5  |            |
|                                      | RN2417                     |               |  | -1.5  | —    | -3.5  |            |
|                                      | RN2418                     |               |  | -2.5  | —    | -10.0 |            |
| Input voltage (OFF)                  | RN2414                     | $V_{I(OFF)}$  | $V_{CE} = -5\text{ V}, I_C = -0.1\text{ mA}$                 | -0.3  | —    | -0.9  | V          |
|                                      | RN2415                     |               |  | -0.3  | —    | -1.0  |            |
|                                      | RN2416                     |               |  | -0.3  | —    | -1.1  |            |
|                                      | RN2417                     |               |  | -0.3  | —    | -3.0  |            |
|                                      | RN2418                     |               |  | -0.5  | —    | -5.7  |            |
| Transition frequency                 | RN2414~<br>RN2418          | $f_T$         | $V_{CE} = -10\text{ V}, I_C = -5\text{ mA}$                  | —     | 200  | —     | MHz        |
| Collector output capacitance         | RN2414~<br>RN2418          | $C_{ob}$      | $V_{CB} = -10\text{ V}, I_E = 0\text{ mA}, f = 1\text{ MHz}$ | —     | 3.0  | 6.0   | pF         |
| Input resistance                     | RN2414                     | $R_1$         | -  | 0.7   | 1.0  | 1.3   | k $\Omega$ |
|                                      | RN2415                     |               |  | 1.54  | 2.2  | 2.86  |            |
|                                      | RN2416                     |               |  | 3.29  | 4.7  | 6.11  |            |
|                                      | RN2417                     |               |  | 7.0   | 10.0 | 13.0  |            |
|                                      | RN2418                     |               |  | 32.9  | 47.0 | 61.1  |            |
| Resistor ratio                       | RN2414                     | R1/R2         | -  | —     | 0.1  | —     | —          |
|                                      | RN2415                     |               |  | —     | 0.22 | —     |            |
|                                      | RN2416                     |               |  | —     | 0.47 | —     |            |
|                                      | RN2417                     |               |  | —     | 2.13 | —     |            |
|                                      | RN2418                     |               |  | —     | 4.7  | —     |            |

9. Marking

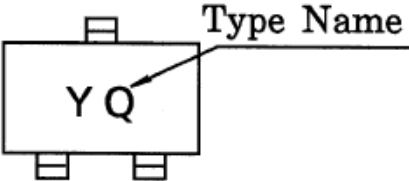


Fig. 9.1 Marking RN2414

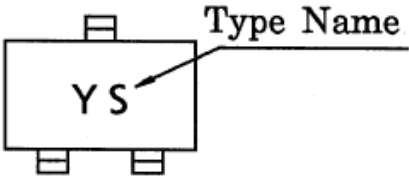


Fig. 9.2 Marking RN2415

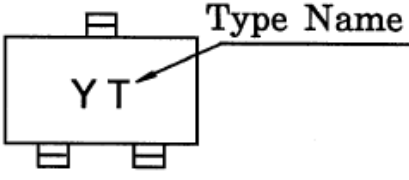


Fig. 9.3 Marking RN2416

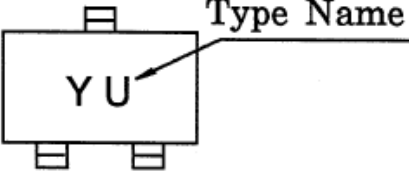


Fig. 9.4 Marking RN2417

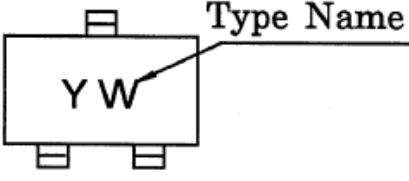


Fig. 9.5 Marking RN2418

### 10. Characteristics Curves (Note)

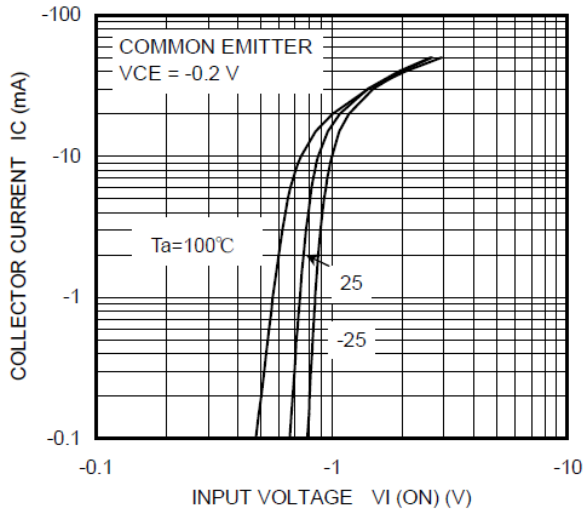


Fig. 10.1 RN2414  $I_C$ - $V_{I(ON)}$

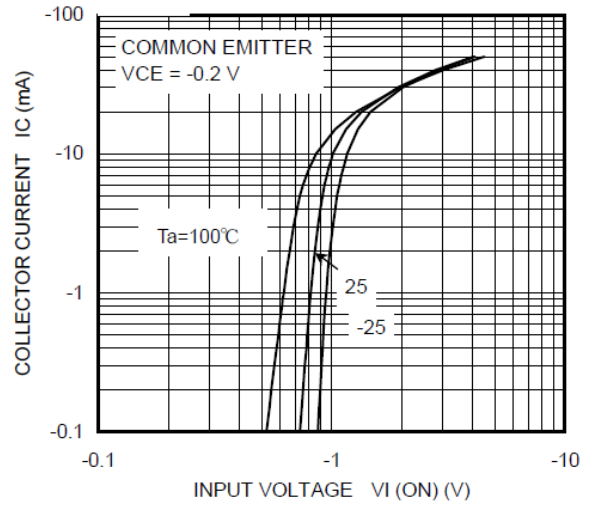


Fig. 10.2 RN2415  $I_C$ - $V_{I(ON)}$

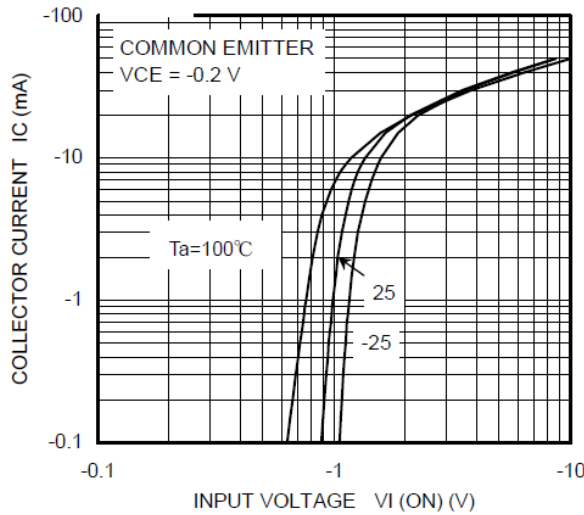


Fig. 10.3 RN2416  $I_C$ - $V_{I(ON)}$

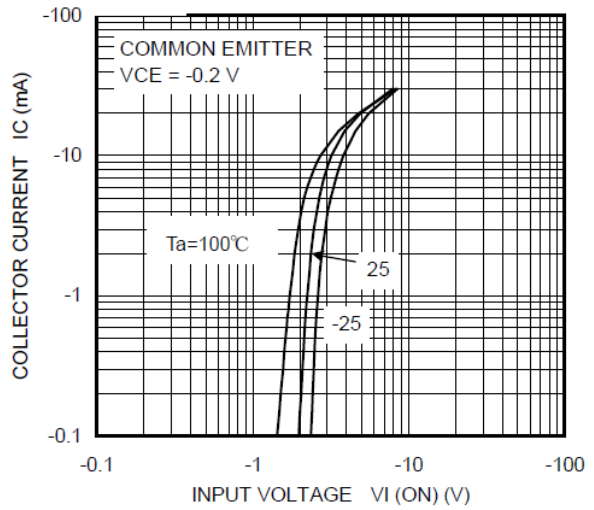


Fig. 10.4 RN2417  $I_C$ - $V_{I(ON)}$

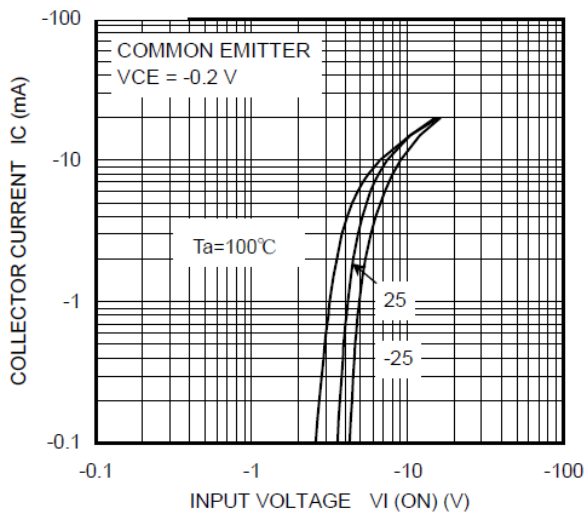


Fig. 10.5 RN2418  $I_C$ - $V_{I(ON)}$

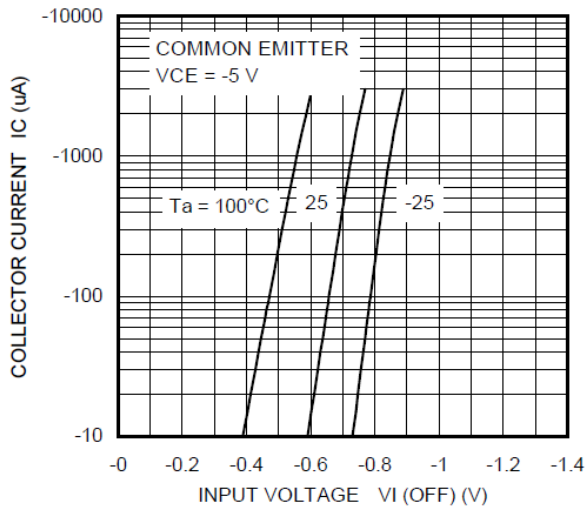


Fig. 10.6 RN2414  $I_C$ - $V_{I(OFF)}$

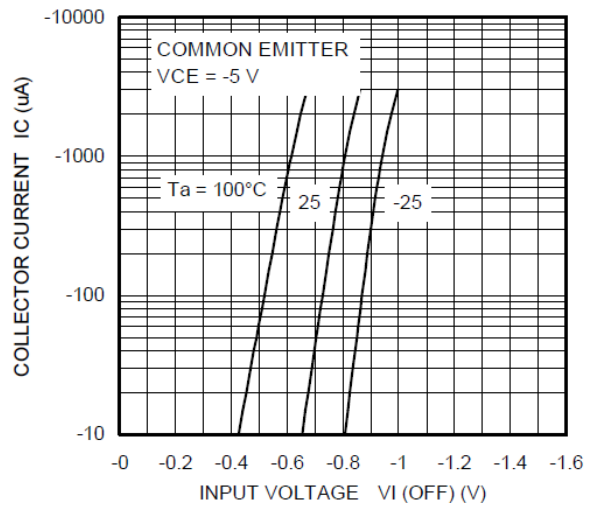


Fig. 10.7 RN2415  $I_C$ - $V_{I(OFF)}$

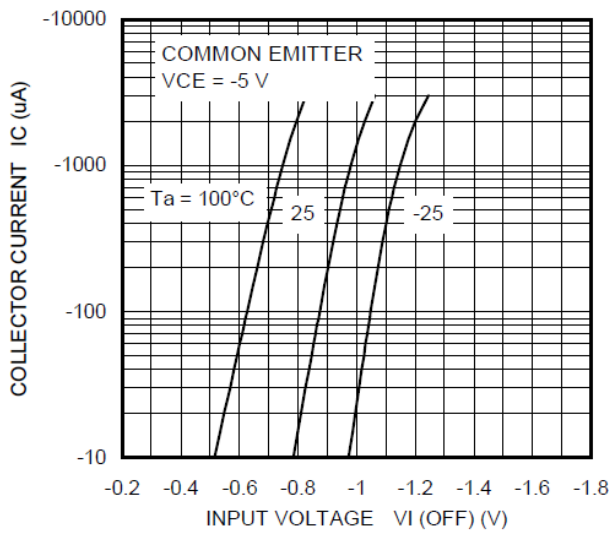


Fig. 10.8 RN2416  $I_C$ - $V_{I(OFF)}$

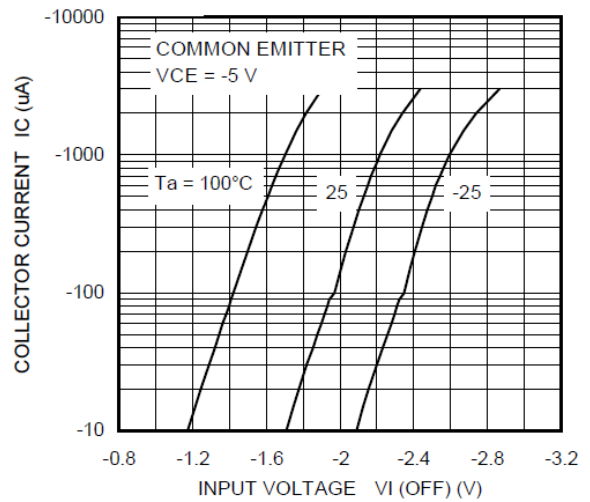


Fig. 10.9 RN2417  $I_C$ - $V_{I(OFF)}$

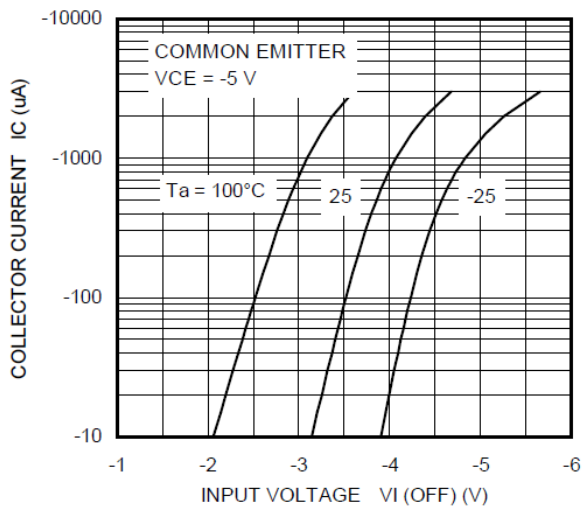


Fig. 10.10 RN2418  $I_C$ - $V_{I(OFF)}$

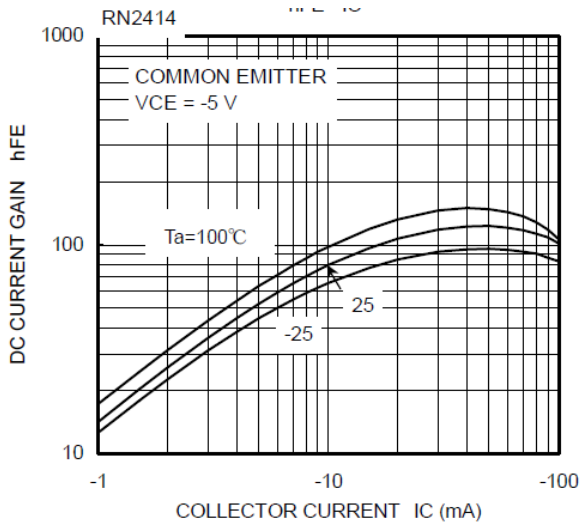


Fig. 10.11 RN2414  $h_{FE}-I_C$

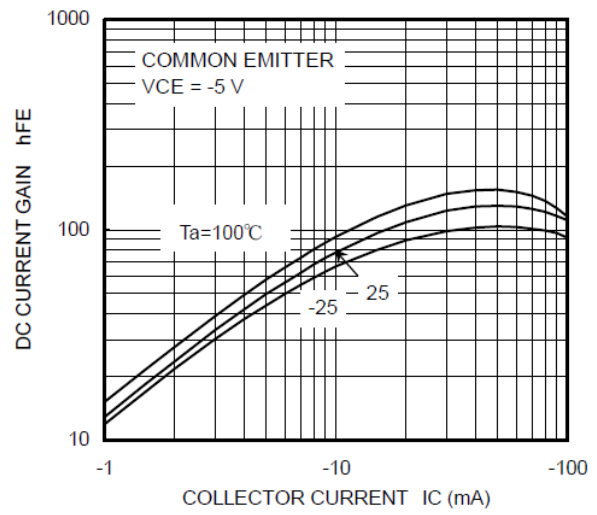


Fig. 10.12 RN2415  $h_{FE}-I_C$

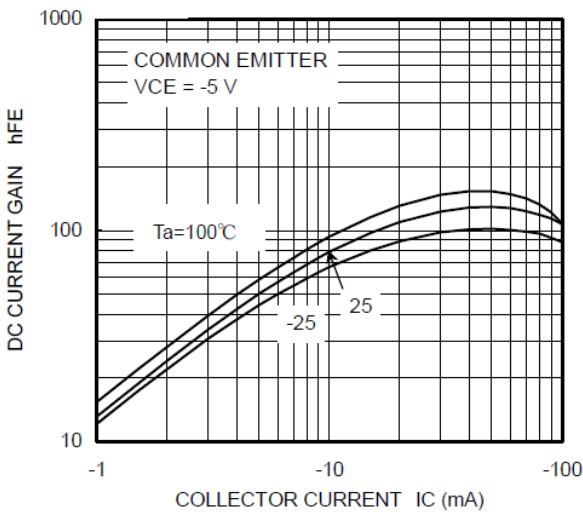


Fig. 10.13 RN2416  $h_{FE}-I_C$

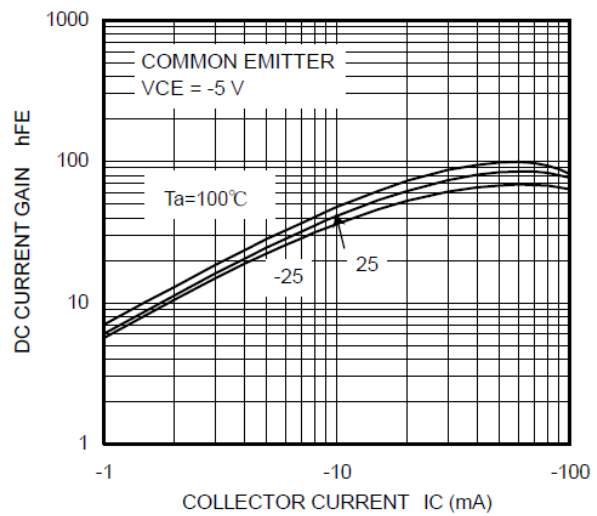


Fig. 10.14 RN2417  $h_{FE}-I_C$

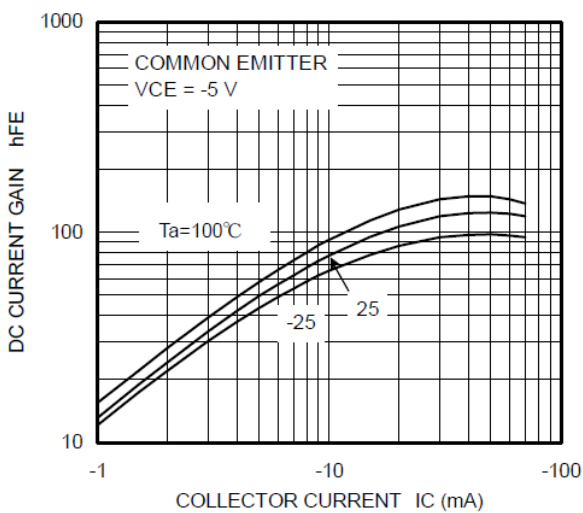


Fig. 10.15 RN2418  $h_{FE}-I_C$



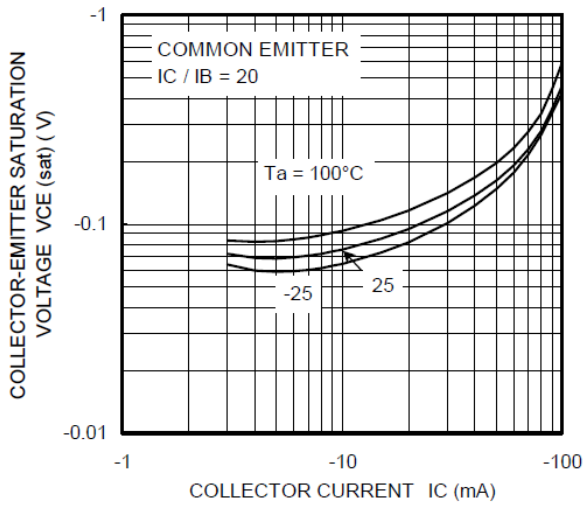


Fig. 10.16 RN2414  $V_{CE(sat)}$ - $I_C$

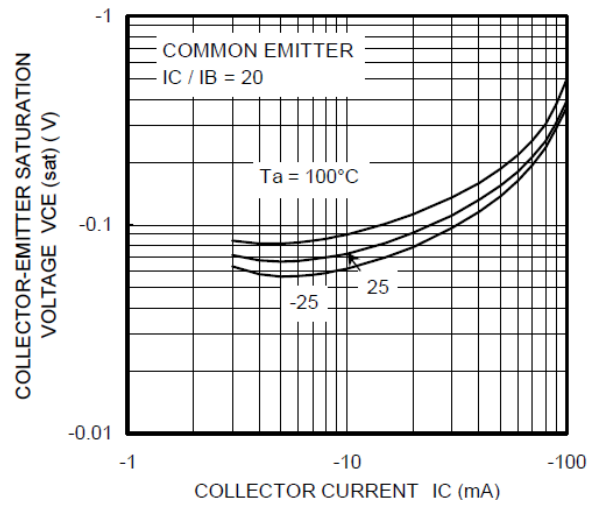


Fig. 10.17 RN2415  $V_{CE(sat)}$ - $I_C$

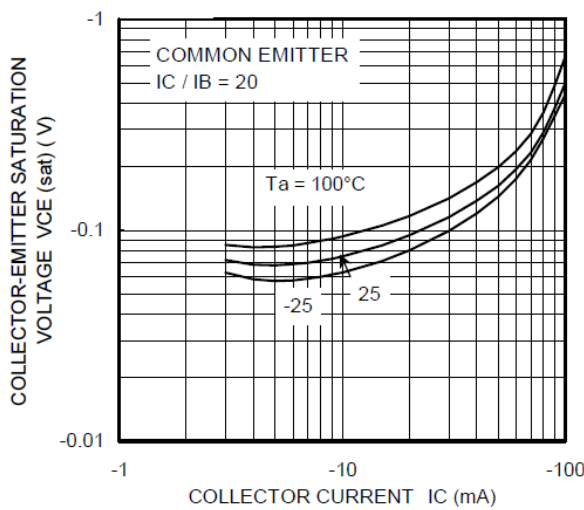


Fig. 10.18 RN2416  $V_{CE(sat)}$ - $I_C$

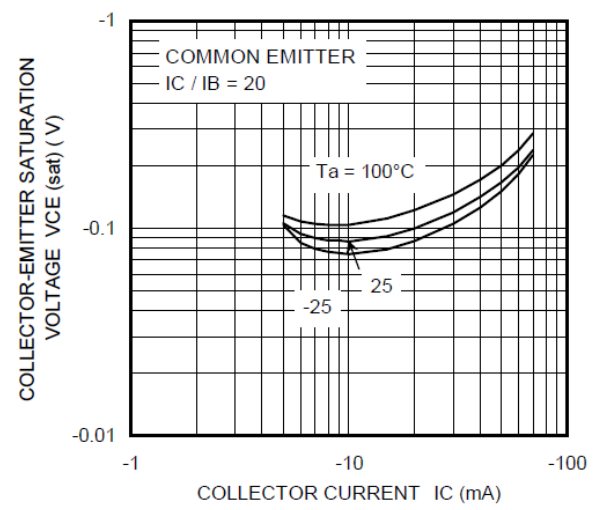


Fig. 10.19 RN2417  $V_{CE(sat)}$ - $I_C$

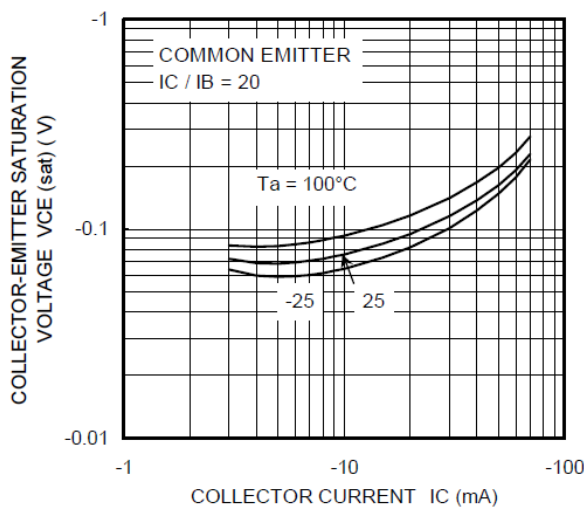
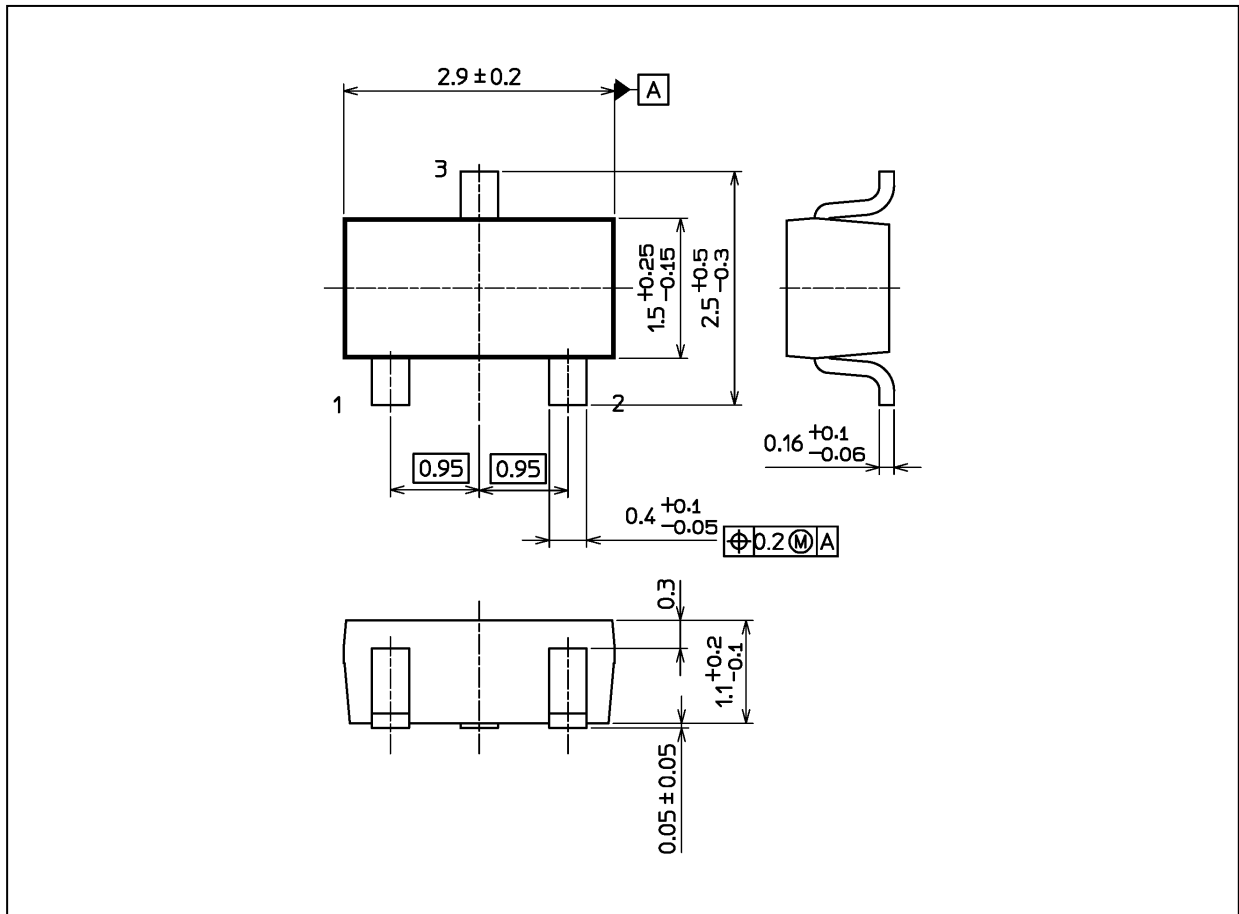


Fig. 10.20 RN2418  $V_{CE(sat)}$ - $I_C$

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

## Package Dimensions

Unit: mm



Weight: 12 mg (typ.)

| Package Name(s)  |
|------------------|
| TOSHIBA: 2-3F1S  |
| Nickname: S-Mini |

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