

# Complex Midium Power Transistors ( $\pm 50V/\pm 1A$ )

## QS6Z5

### ● Structure

NPN/PNP Silicon epitaxial planar transistor

### ● Features

#### 1) Low saturation voltage

$$V_{CE(sat)} = 0.35V \text{ (Max.) } (I_C / I_B = 500mA / 25mA)$$

$$V_{CE(sat)} = -0.40V \text{ (Max.) } (I_C / I_B = -500mA / -25mA)$$

#### 2) High speed switching

### ● Applications

 Low Frequency Amplifier  
 Driver

### ● Packaging specifications

|      |                              |       |
|------|------------------------------|-------|
| Type | Package                      | TSMT6 |
|      | Code                         | TR    |
|      | Basic ordering unit (pieces) | 3000  |

### ● Absolute maximum ratings (Ta = 25°C)

&lt;Tr.1&gt;

| Parameter                 | Symbol    | Limits      | Unit |
|---------------------------|-----------|-------------|------|
| Collector-base voltage    | $V_{CBO}$ | 50          | V    |
| Collector-emitter voltage | $V_{CEO}$ | 50          | V    |
| Emitter-base voltage      | $V_{EBO}$ | 6           | V    |
| Collector current         | DC        | $I_C$       | A    |
|                           | Pulsed    | $I_{CP} *1$ | A    |

&lt;Tr.2&gt;

| Parameter                 | Symbol    | Limits      | Unit |
|---------------------------|-----------|-------------|------|
| Collector-base voltage    | $V_{CBO}$ | -50         | V    |
| Collector-emitter voltage | $V_{CEO}$ | -50         | V    |
| Emitter-base voltage      | $V_{EBO}$ | -6          | V    |
| Collector current         | DC        | $I_C$       | A    |
|                           | Pulsed    | $I_{CP} *1$ | A    |

&lt;Tr.1 and Tr.2&gt;

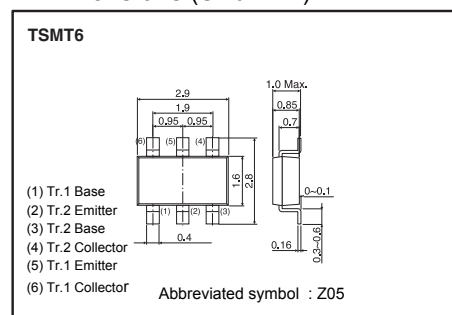
| Parameter                    | Symbol    | Limits      | Unit      |
|------------------------------|-----------|-------------|-----------|
| Power dissipation            | $P_D *2$  | 0.5         | W/Total   |
|                              | $P_D *3$  | 1.25        | W/Total   |
|                              | $P_D *3$  | 0.9         | W/Element |
| Junction temperature         | $T_j$     | 150         | °C        |
| Range of storage temperature | $T_{stg}$ | -55 to +150 | °C        |

 \*1  $P_w=10ms$ , Single Pulse

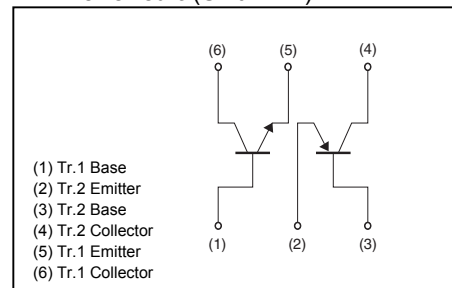
\*2 Mounted on a recommended land.

\*3 Mounted on a 40 x 40 x 0.7[mm] ceramic board.

### ● Dimensions (Unit : mm)



### ● Inner circuit (Unit : mm)



●Electrical characteristics (Ta = 25°C)

<Tr.1>

| Parameter                            | Symbol             | Min. | Typ. | Max. | Unit          | Conditions                                                                                              |
|--------------------------------------|--------------------|------|------|------|---------------|---------------------------------------------------------------------------------------------------------|
| Collector-emitter breakdown voltage  | $BV_{CEO}$         | 50   | -    | -    | V             | $I_C = 1\text{mA}$                                                                                      |
| Collector-base breakdown voltage     | $BV_{CBO}$         | 50   | -    | -    | V             | $I_C = 100\mu\text{A}$                                                                                  |
| Emitter-base breakdown voltage       | $BV_{EBO}$         | 6    | -    | -    | V             | $I_E = 100\mu\text{A}$                                                                                  |
| Collector cut-off current            | $I_{CBO}$          | -    | -    | 1    | $\mu\text{A}$ | $V_{CB} = 50\text{V}$                                                                                   |
| Emitter cut-off current              | $I_{EBO}$          | -    | -    | 1    | $\mu\text{A}$ | $V_{EB} = 4\text{V}$                                                                                    |
| Collector-emitter saturation voltage | $V_{CE(sat)}^{*1}$ | -    | 130  | 350  | mV            | $I_C = 500\text{mA}$ , $I_B = 25\text{mA}$                                                              |
| DC current gain                      | $h_{FE}$           | 180  | -    | 450  | -             | $V_{CE} = 2\text{V}$ , $I_C = 50\text{mA}$                                                              |
| Transition frequency                 | $f_T^{*1}$         | -    | 360  | -    | MHz           | $V_{CE} = 10\text{V}$<br>$I_E = -200\text{mA}$ , $f = 100\text{MHz}$                                    |
| Collector output capacitance         | $C_{ob}$           | -    | 7    | -    | pF            | $V_{CB} = 10\text{V}$ , $I_E = 0\text{A}$<br>$f = 1\text{MHz}$                                          |
| Turn-on time                         | $t_{on}^{*2}$      | -    | 40   | -    | ns            | $I_C = 0.5\text{A}$ , $I_{B1} = 50\text{mA}$ ,<br>$I_{B2} = -50\text{mA}$ , $V_{CC} \approx 10\text{V}$ |
| Storage time                         | $t_{stg}^{*2}$     | -    | 410  | -    | ns            |                                                                                                         |
| Fall time                            | $t_f^{*2}$         | -    | 75   | -    | ns            |                                                                                                         |

\*1 Pulsed

\*2 See switching time test circuit

<Tr.2>

| Parameter                            | Symbol             | Min. | Typ. | Max. | Unit          | Conditions                                                                                                |
|--------------------------------------|--------------------|------|------|------|---------------|-----------------------------------------------------------------------------------------------------------|
| Collector-emitter breakdown voltage  | $BV_{CEO}$         | -50  | -    | -    | V             | $I_C = -1\text{mA}$                                                                                       |
| Collector-base breakdown voltage     | $BV_{CBO}$         | -50  | -    | -    | V             | $I_C = -100\mu\text{A}$                                                                                   |
| Emitter-base breakdown voltage       | $BV_{EBO}$         | -6   | -    | -    | V             | $I_E = -100\mu\text{A}$                                                                                   |
| Collector cut-off current            | $I_{CBO}$          | -    | -    | -1   | $\mu\text{A}$ | $V_{CB} = -50\text{V}$                                                                                    |
| Emitter cut-off current              | $I_{EBO}$          | -    | -    | -1   | $\mu\text{A}$ | $V_{EB} = -4\text{V}$                                                                                     |
| Collector-emitter saturation voltage | $V_{CE(sat)}^{*1}$ | -    | -200 | -400 | mV            | $I_C = -500\text{mA}$ , $I_B = -25\text{mA}$                                                              |
| DC current gain                      | $h_{FE}$           | 180  | -    | 450  | -             | $V_{CE} = -2\text{V}$ , $I_C = -50\text{mA}$                                                              |
| Transition frequency                 | $f_T^{*1}$         | -    | 400  | -    | MHz           | $V_{CE} = -10\text{V}$<br>$I_E = 200\text{mA}$ , $f = 100\text{MHz}$                                      |
| Collector output capacitance         | $C_{ob}$           | -    | 12   | -    | pF            | $V_{CB} = -10\text{V}$ , $I_E = 0\text{A}$<br>$f = 1\text{MHz}$                                           |
| Turn-on time                         | $t_{on}^{*2}$      | -    | 40   | -    | ns            | $I_C = -0.5\text{A}$ , $I_{B1} = -50\text{mA}$ ,<br>$I_{B2} = 50\text{mA}$ , $V_{CC} \approx -10\text{V}$ |
| Storage time                         | $t_{stg}^{*2}$     | -    | 250  | -    | ns            |                                                                                                           |
| Fall time                            | $t_f^{*2}$         | -    | 35   | -    | ns            |                                                                                                           |

\*1 Pulsed

\*2 See switching time test circuit

●Electrical characteristic curves (Ta=25°C)

〈Tr.1〉

Fig.1 Ground Emitter Propagation Characteristics

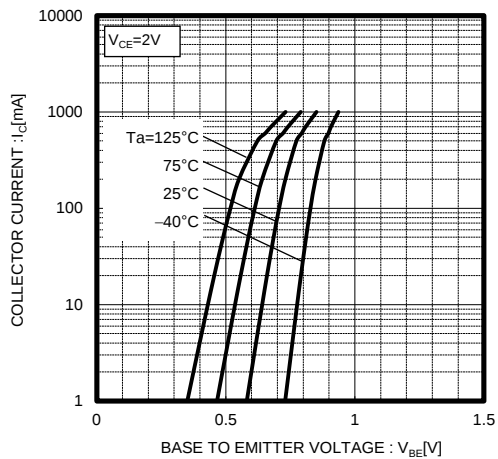


Fig.2 Typical Output Characteristics

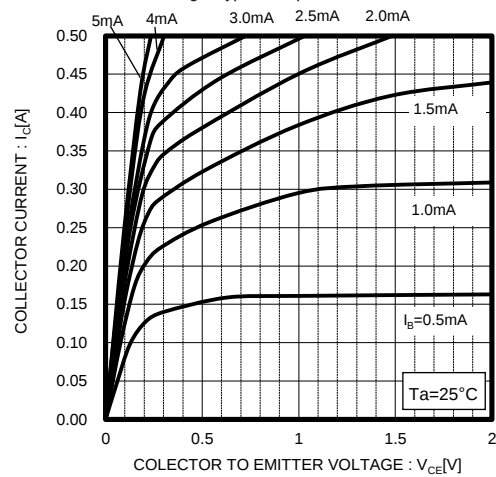


Fig.3 DC Current Gain vs. Collector Current ( I )

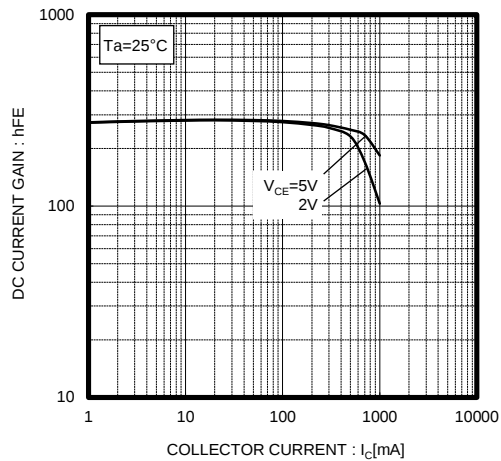


Fig.4 DC Current Gain vs. Collector Current ( II )

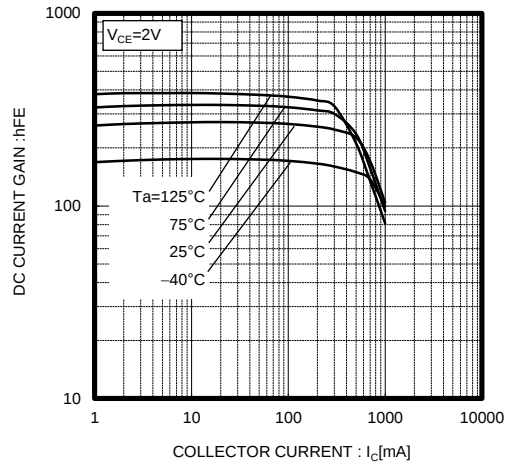


Fig.5 Collector-Emitter Saturation Voltage vs. Collector Current ( I )

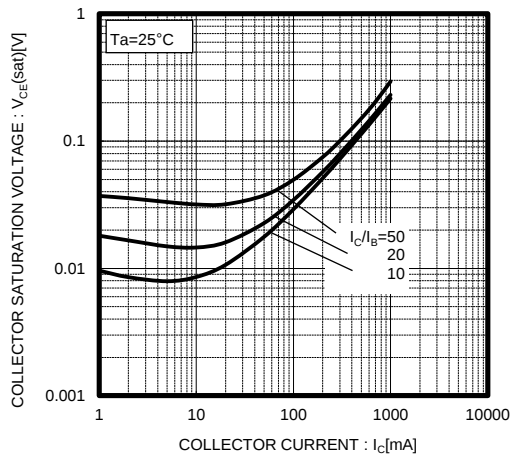


Fig.6 Collector-Emitter Saturation Voltage vs. Collector Current(II)

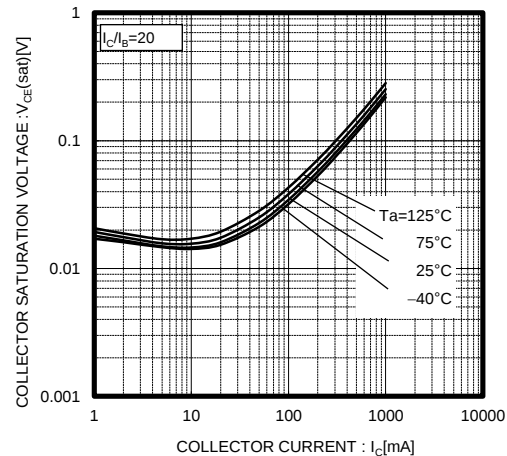


Fig.7 Emitter input capacitance vs. Emitter-Base Voltage  
Collector output capacitance vs. Collector-Base

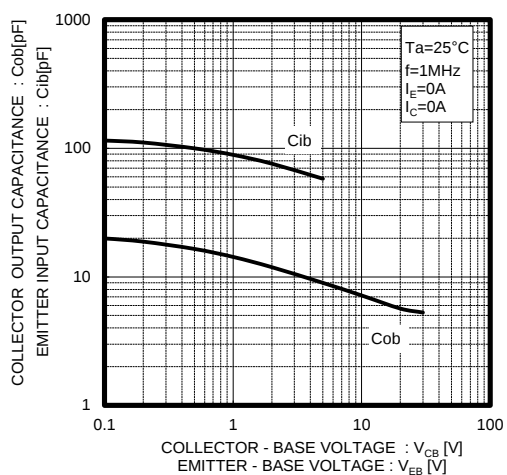


Fig.8 Gain Bandwidth Product vs. Emitter

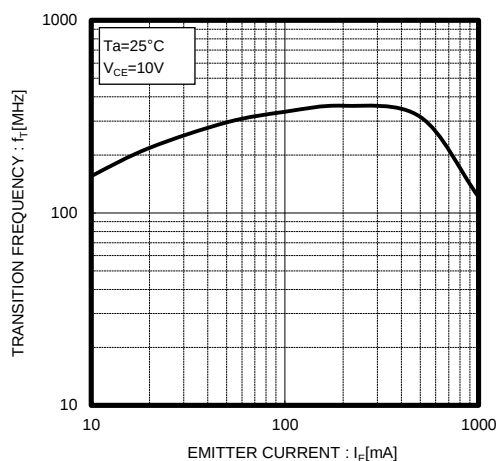
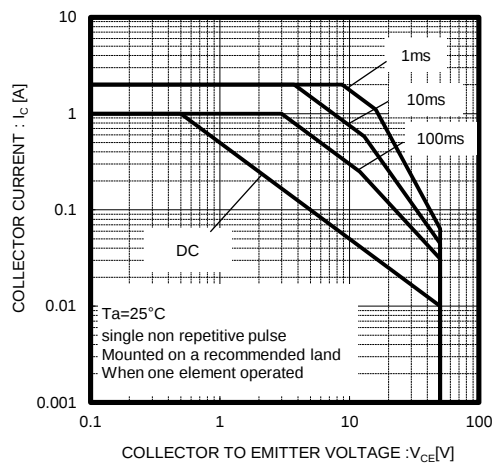


Fig.9 Safe Operating Area



〈Tr.2〉

Fig.1 Ground Emitter Propagation Characteristics

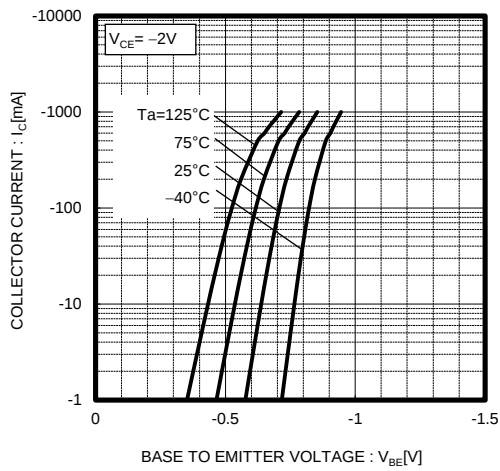


Fig.2 Typical Output Characteristics

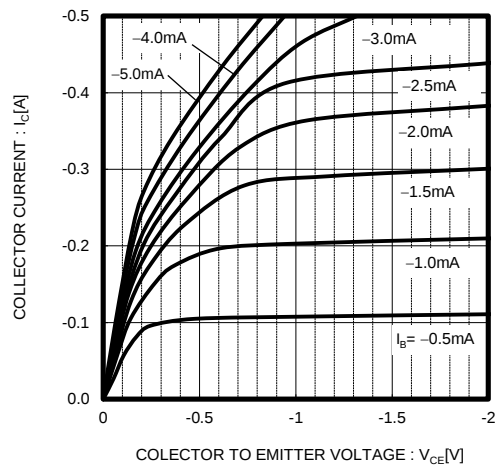


Fig.3 DC Current Gain vs. Collector Current ( I )

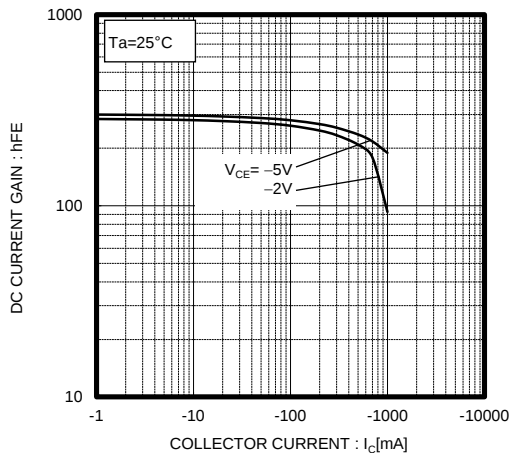


Fig.4 DC Current Gain vs. Collector Current ( II )

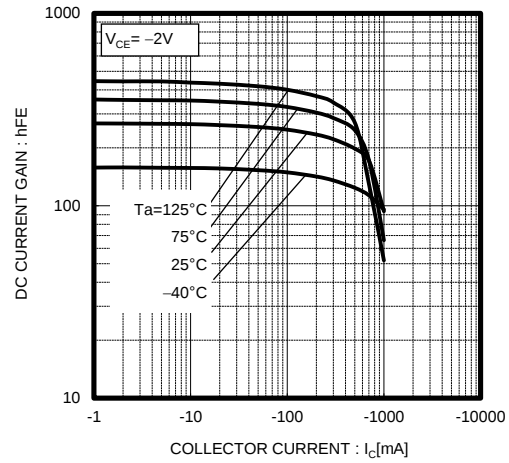


Fig.5 Collector-Emitter Saturation Voltage vs. Collector Current ( I )

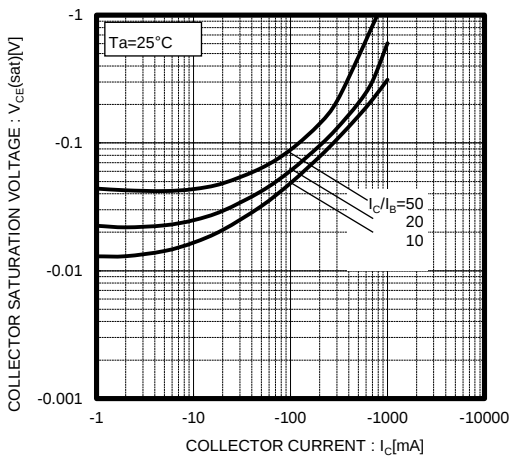


Fig.6 Collector-Emitter Saturation Voltage vs. Collector Current ( II )

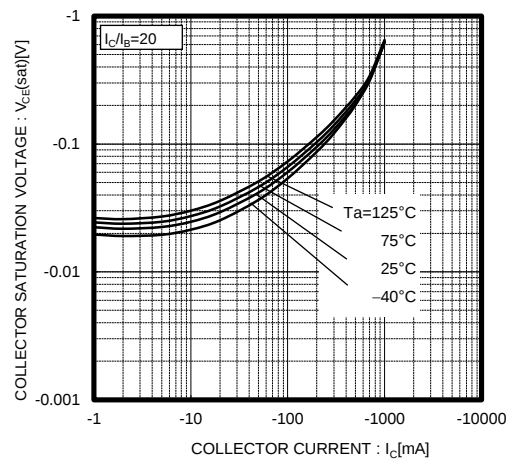


Fig.7 Emitter Input Capacitance vs. Emitter-Base Voltage  
Collector Output Capacitance vs. Collector-Base Voltage

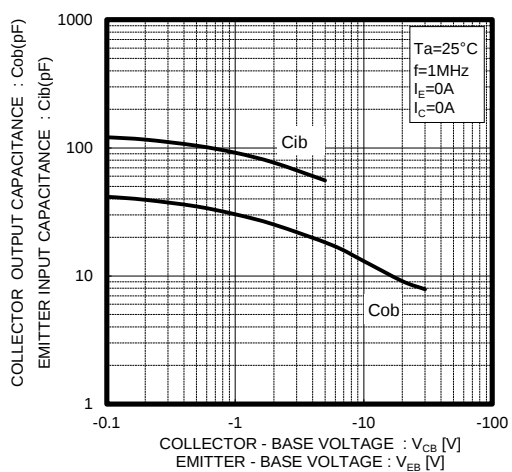


Fig.8 Gain Bandwidth Product vs. Emitter

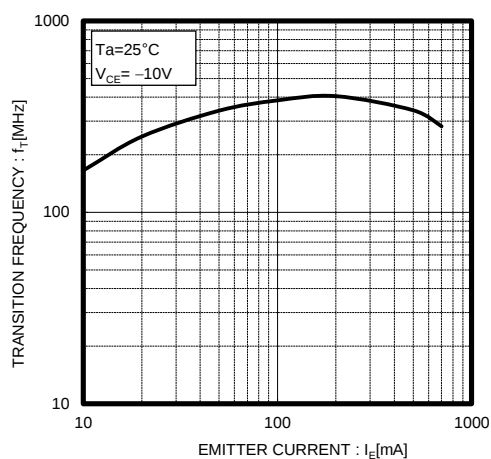
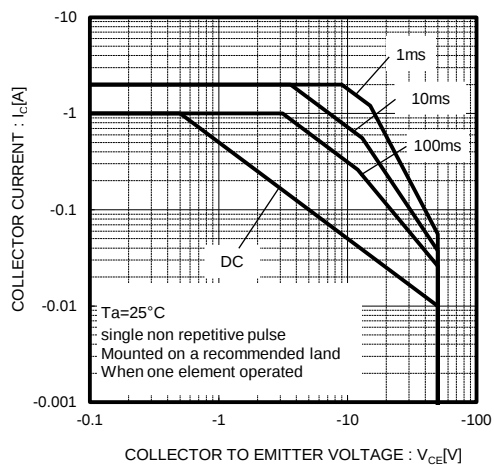
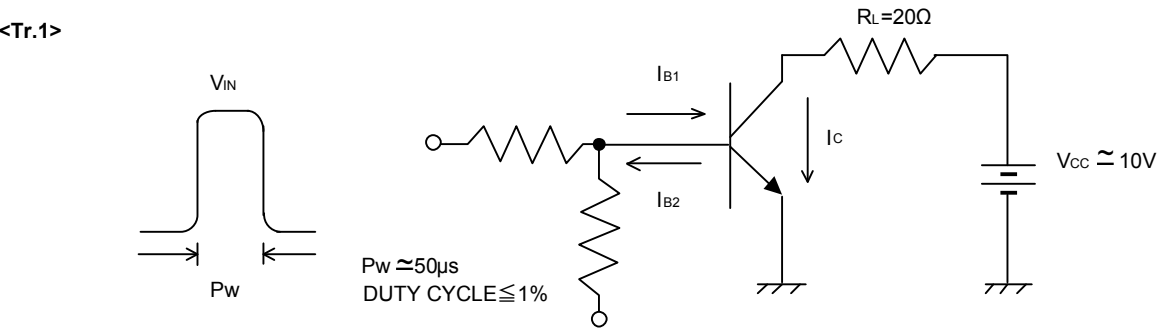


Fig.9 Safe Operating Area

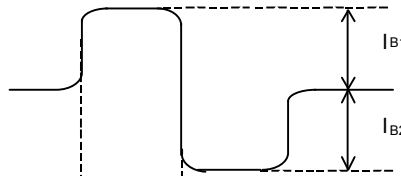


● Switching time test circuit

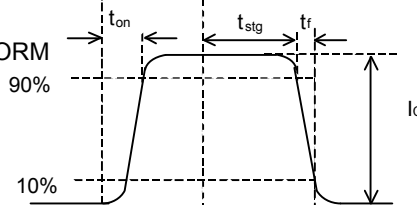
<Tr.1>



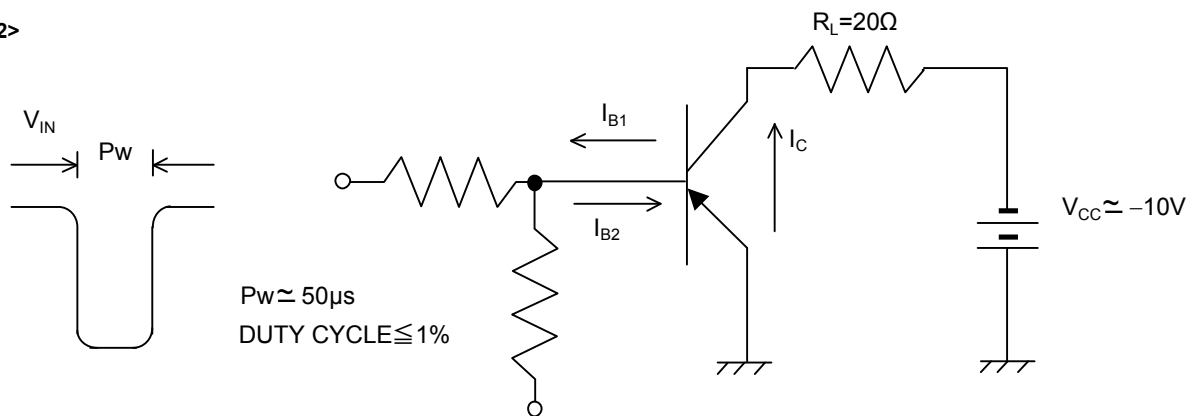
BASE CURRENT WAVEFORM



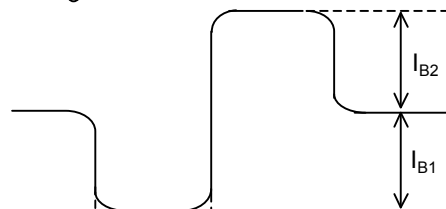
COLLECTOR CURRENT WAVEFORM



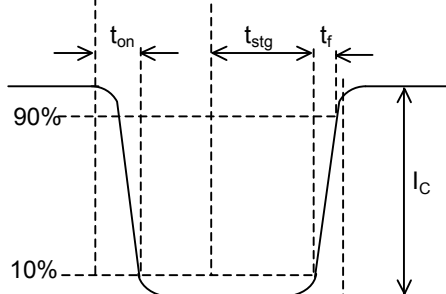
<Tr.2>



BASE CURRENT WAVEFORM



COLLECTOR CURRENT WAVEFORM



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