

TOSHIBA Photocoupler GaAs Ired & Photo-Transistor

## TLP504A, TLP504A-2

Programmable Controllers

AC / DC-Input Module

Solid State Relay

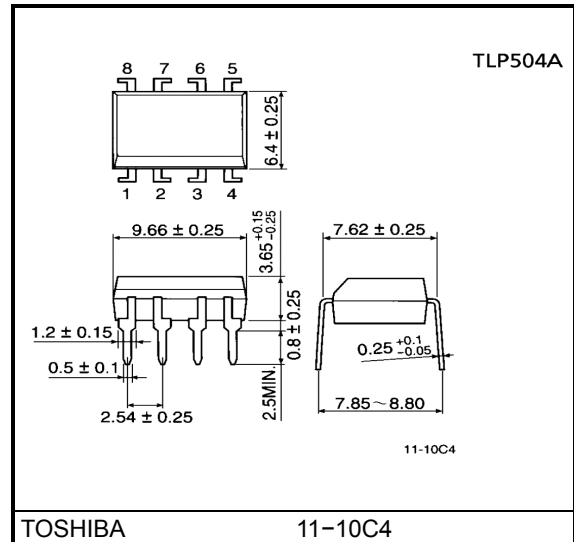
Unit in mm

The TOSHIBA TLP504A and TLP504A-2 consists of a photo-transistor optically coupled to a gallium arsenide infrared emitting diode.

The TLP504A offers two isolated channels in a eight lead plastic DIP package, while the TLP504A-2 provides four isolated channels in a sixteen plastic DIP package.

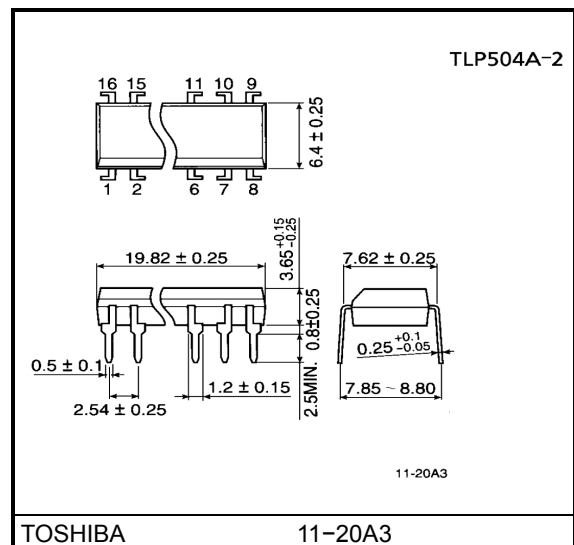
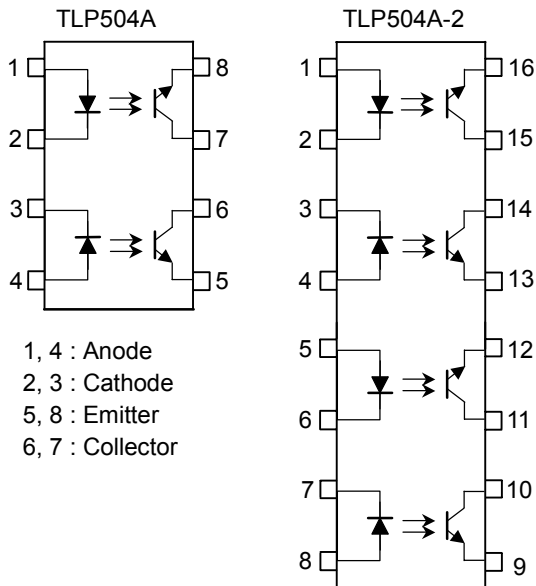
- Collector-emitter voltage: 55 V (min.)
- Current transfer ratio: 50% (min.)  
Rank GB: 100% (min.)
- Isolation voltage: 2500 Vrms (min.)
- UL recognized: UL1577,

File no. E67349



Weight: 0.54 g

### Pin Configurations (top view)



Weight: 1.1 g

## Maximum Ratings (Ta = 25°C)

| Characteristic                                                         |                                                                              | Symbol                        | Rating                                       |                                    | Unit                  |
|------------------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------|----------------------------------------------|------------------------------------|-----------------------|
|                                                                        |                                                                              |                               | TLP504A                                      | TLP504A-2                          |                       |
| LED                                                                    | Forward current                                                              | $I_F$                         | 60                                           | 50                                 | mA                    |
|                                                                        | Forward current derating                                                     | $\Delta I_F / ^\circ\text{C}$ | -0.7 (Ta $\geq 39^\circ\text{C}$ )           | -0.5 (Ta $\geq 25^\circ\text{C}$ ) | mA / $^\circ\text{C}$ |
|                                                                        | Pulse forward current                                                        | $I_{FP}$                      | 1 (100 $\mu\text{s}$ pulse, 100pps)          |                                    | A                     |
|                                                                        | Reverse voltage                                                              | $V_R$                         | 5                                            |                                    | V                     |
|                                                                        | Junction temperature                                                         | $T_j$                         | 125                                          |                                    | $^\circ\text{C}$      |
| Detector                                                               | Collector-emitter voltage                                                    | $V_{CEO}$                     | 55                                           |                                    | V                     |
|                                                                        | Emitter-collector voltage                                                    | $V_{ECO}$                     | 7                                            |                                    | V                     |
|                                                                        | Collector current                                                            | $I_C$                         | 50                                           |                                    | mA                    |
|                                                                        | Collector power dissipation (1 circuit)                                      | $P_C$                         | 150                                          | 100                                | mW                    |
|                                                                        | Collector power dissipation derating (1 circuit Ta $\geq 25^\circ\text{C}$ ) | $\Delta P_C / ^\circ\text{C}$ | -1.5                                         | -1.0                               | mW / $^\circ\text{C}$ |
|                                                                        | Junction temperature                                                         | $T_j$                         | 125                                          |                                    | $^\circ\text{C}$      |
| Storage temperature range                                              |                                                                              | $T_{stg}$                     | -55~150                                      |                                    | $^\circ\text{C}$      |
| Operating temperature range                                            |                                                                              | $T_{opr}$                     | -55~100                                      |                                    | $^\circ\text{C}$      |
| Lead soldering temperature                                             |                                                                              | $T_{sol}$                     | 260 (10 s)                                   |                                    | $^\circ\text{C}$      |
| Total package power dissipation                                        |                                                                              | $R_T$                         | 250                                          | 150                                | mW                    |
| Total package power dissipation derating (Ta $\geq 25^\circ\text{C}$ ) |                                                                              | $\Delta P_T / ^\circ\text{C}$ | -2.5                                         | -1.5                               | mW / $^\circ\text{C}$ |
| Isolation voltage                                                      |                                                                              | $BV_S$                        | 2500 (AC, 1min., R.H. $\leq 60\%$ ) (Note 1) |                                    | Vrms                  |

(Note 1) Device considered a two terminal device: LED side pins shorted together and detector side pins shorted together.

## Recommended Operating Conditions

| Characteristics       | Symbol    | Min. | Typ. | Max. | Unit             |
|-----------------------|-----------|------|------|------|------------------|
| Supply voltage        | $V_{CC}$  | —    | 5    | 24   | V                |
| Forward current       | $I_F$     | —    | 16   | 20   | mA               |
| Collector current     | $I_C$     | —    | 1    | 10   | mA               |
| Operating temperature | $T_{opr}$ | -25  | —    | 85   | $^\circ\text{C}$ |

**Individual Electrical Characteristics (Ta = 25°C)**

| Characteristic |                                     | Symbol        | Test Condition                                  | Min. | Typ. | Max. | Unit          |
|----------------|-------------------------------------|---------------|-------------------------------------------------|------|------|------|---------------|
| LED            | Forward voltage                     | $V_F$         | $I_F = 10 \text{ mA}$                           | 1.0  | 1.15 | 1.3  | V             |
|                | Reverse current                     | $I_R$         | $V_R = 5 \text{ V}$                             | —    | —    | 10   | $\mu\text{A}$ |
|                | Capacitance                         | $C_T$         | $V = 0, f = 1 \text{ MHz}$                      | —    | 30   | —    | pF            |
| Detector       | Collector-emitter breakdown voltage | $V_{(BR)CEO}$ | $I_C = 0.5 \text{ mA}$                          | 55   | —    | —    | V             |
|                | Emitter-collector breakdown voltage | $V_{(BR)ECO}$ | $I_E = 0.1 \text{ mA}$                          | 7    | —    | —    | V             |
|                | Collector dark current              | $I_{CEO}$     | $V_{CE} = 24 \text{ V}$                         | —    | 10   | 100  | nA            |
|                |                                     |               | $V_{CE} = 24 \text{ V}, T_a = 85^\circ\text{C}$ | —    | 2    | 50   | $\mu\text{A}$ |
|                | Capacitance collector to emitter    | $C_{CE}$      | $V = 0, f = 1 \text{ MHz}$                      | —    | 10   | —    | pF            |

**Coupled Electrical Characteristics (Ta = 25°C)**

| Characteristic                       | Symbol                   | Test Condition                                          | Min. | Typ. | Max. | Unit |
|--------------------------------------|--------------------------|---------------------------------------------------------|------|------|------|------|
| Current transfer ratio               | $I_C / I_F$              | $I_F = 5 \text{ mA}, V_{CE} = 5 \text{ V}$<br>Rank GB   | 50   | —    | 600  | %    |
|                                      |                          |                                                         | 100  | —    | 600  |      |
| Saturated CTR                        | $I_C / I_F (\text{sat})$ | $I_F = 1 \text{ mA}, V_{CE} = 0.4 \text{ V}$<br>Rank GB | —    | 60   | —    | %    |
|                                      |                          |                                                         | 30   | —    | —    |      |
| Collector-emitter saturation voltage | $V_{CE (\text{sat})}$    | $I_C = 2.4 \text{ mA}, I_F = 8 \text{ mA}$              | —    | —    | 0.4  | V    |
|                                      |                          | $I_C = 0.2 \text{ mA}, I_F = 1 \text{ mA}$<br>Rank GB   | —    | 0.2  | —    |      |
|                                      |                          |                                                         | —    | —    | 0.4  |      |

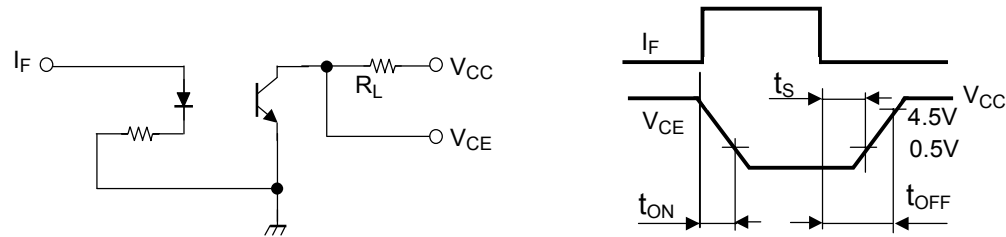
**Isolation Characteristics (Ta = 25°C)**

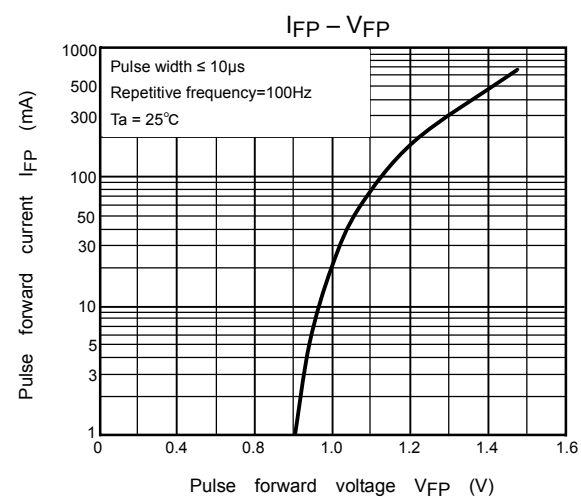
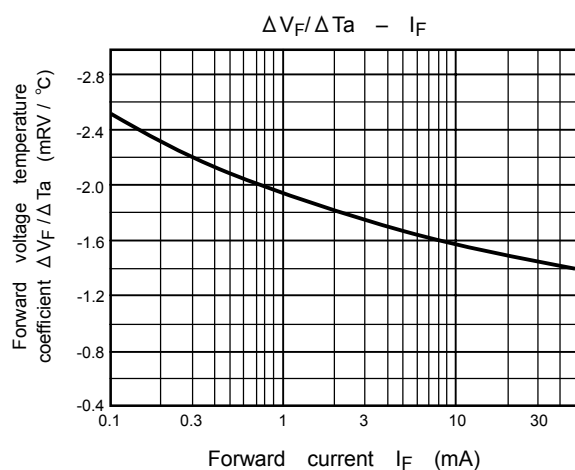
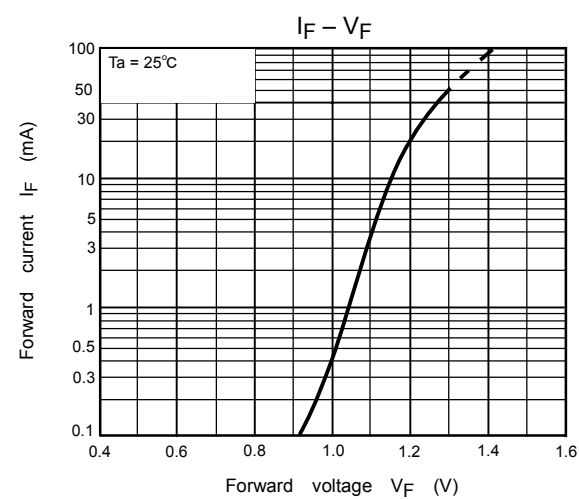
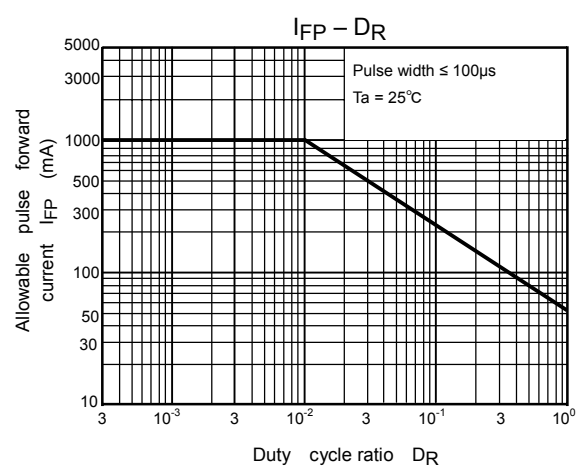
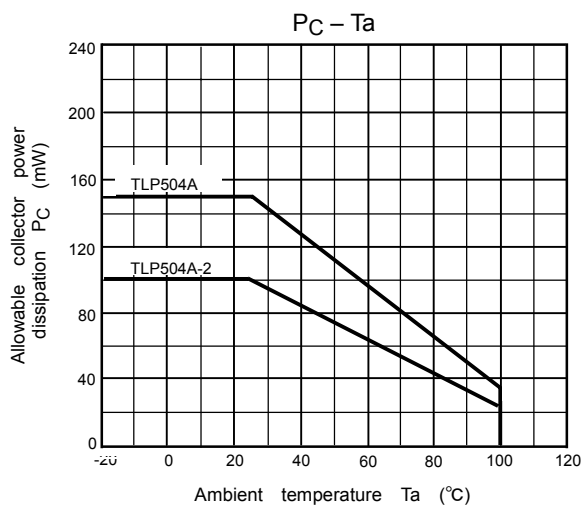
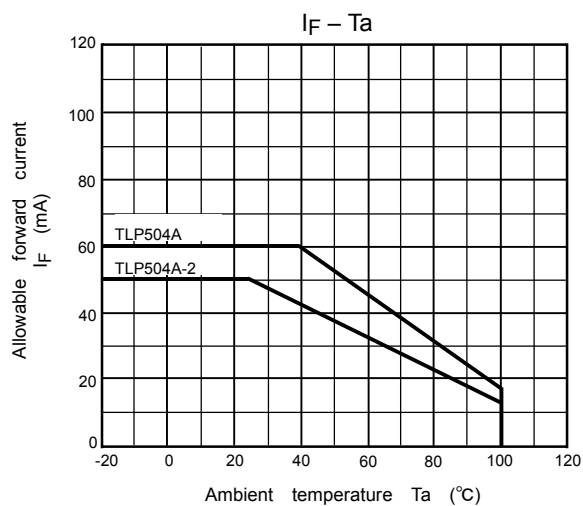
| Characteristic              | Symbol | Test Condition               | Min.               | Typ.      | Max. | Unit      |
|-----------------------------|--------|------------------------------|--------------------|-----------|------|-----------|
| Capacitance input to output | $C_S$  | $V_S = 0, f = 1 \text{ MHz}$ | —                  | 0.8       | —    | pF        |
| Isolation resistance        | $R_S$  | $V_S = 500 \text{ V}$        | $5 \times 10^{10}$ | $10^{14}$ | —    | $\Omega$  |
| Isolation voltage           | $BV_S$ | AC, 1 minute                 | 2500               | —         | —    | $V_{rms}$ |
|                             |        | AC, 1 second, in oil         | —                  | 5000      | —    |           |
|                             |        | DC, 1 minute, in oil         | —                  | 5000      | —    | Vdc       |

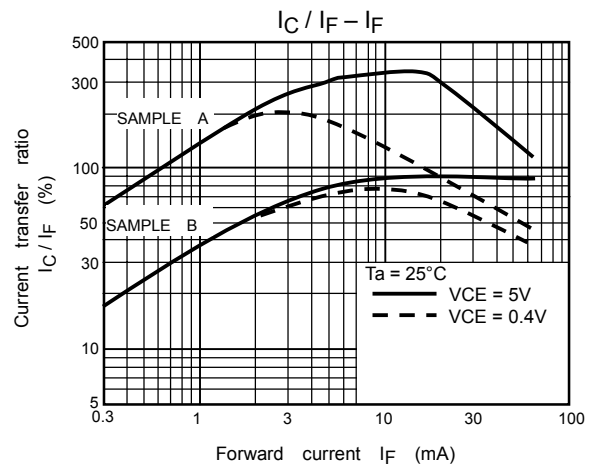
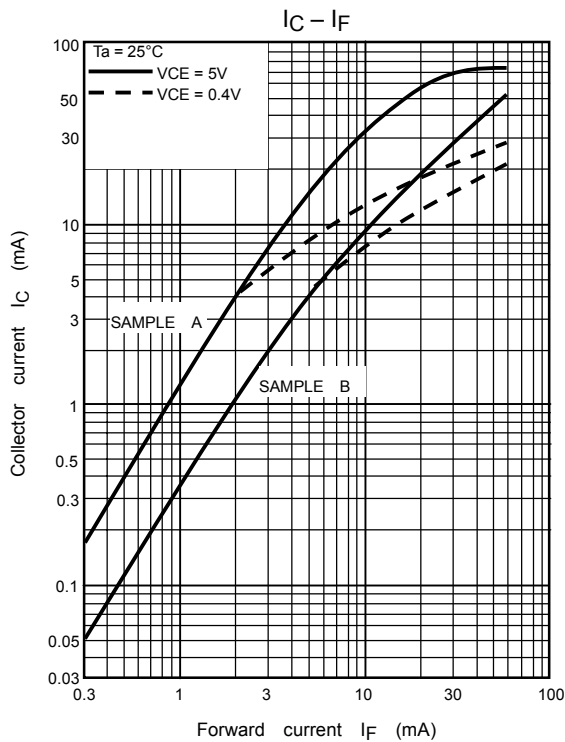
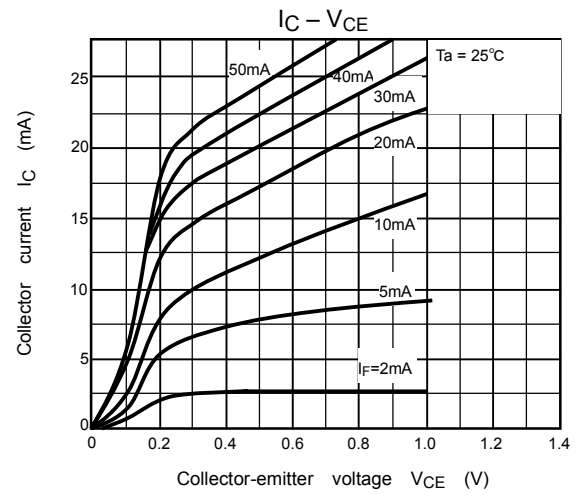
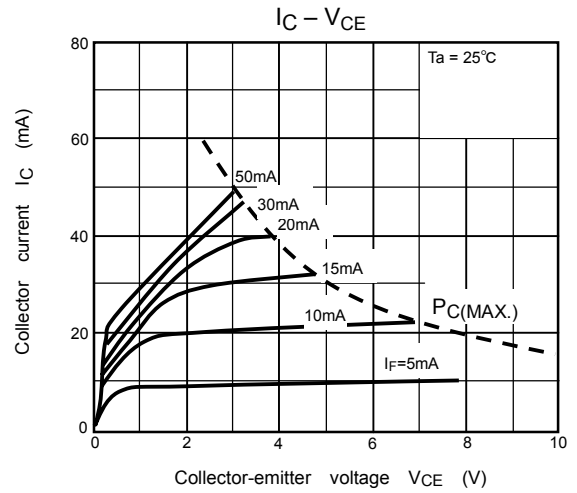
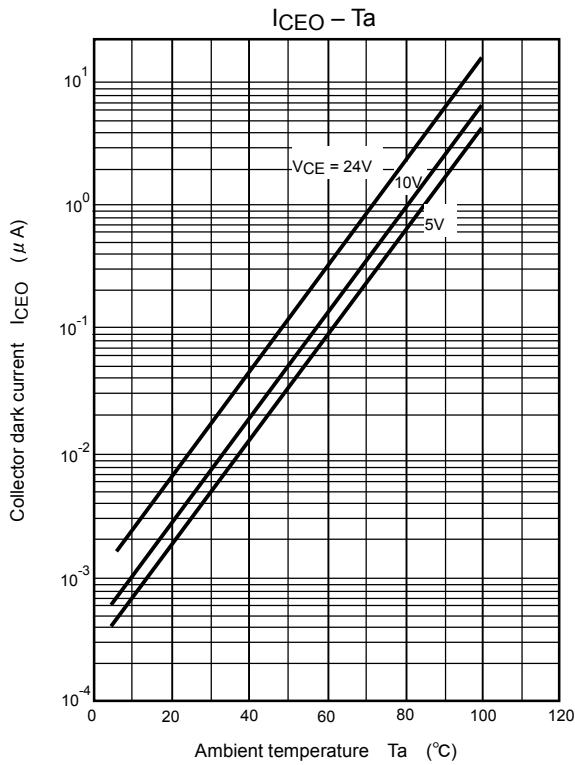
Switching Characteristics (Ta = 25°C)

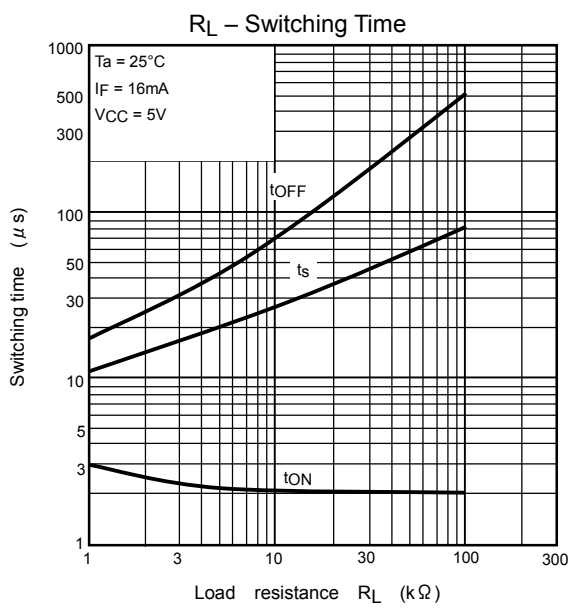
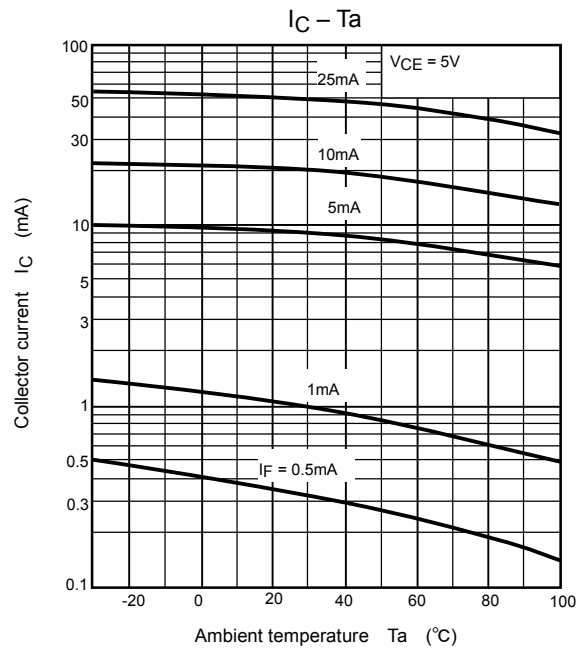
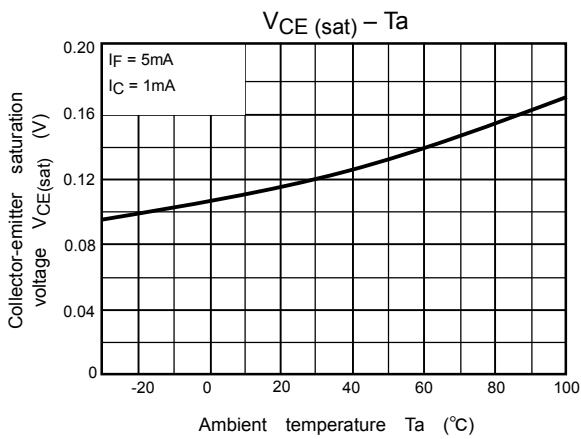
| Characteristic | Symbol    | Test Condition                                                                     | Min. | Typ. | Max. | Unit          |
|----------------|-----------|------------------------------------------------------------------------------------|------|------|------|---------------|
| Rise time      | $t_r$     | $V_{CC} = 10\text{ V}, I_C = 2\text{ mA}$<br>$R_L = 100\Omega$                     | —    | 2    | —    | $\mu\text{s}$ |
| Fall time      | $t_f$     |                                                                                    | —    | 3    | —    |               |
| Turn-on time   | $t_{on}$  |                                                                                    | —    | 3    | —    |               |
| Turn-off time  | $t_{off}$ |                                                                                    | —    | 3    | —    |               |
| Turn-on time   | $t_{ON}$  | $R_L = 1.9\text{ k}\Omega$<br>$V_{CC} = 5\text{ V}, I_F = 16\text{ mA}$<br>(Fig.1) | —    | 2    | —    | $\mu\text{s}$ |
| Storage time   | $t_s$     |                                                                                    | —    | 15   | —    |               |
| Turn-off time  | $t_{OFF}$ |                                                                                    | —    | 25   | —    |               |

Fig. 1 Switching time test circuit









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