

TOSHIBA Photocoupler GaAs Ired & Photo-Transistor

# TLP521-1, TLP521-2, TLP521-4

Programmable Controllers

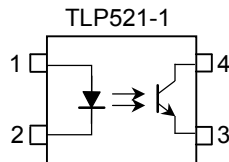
AC/DC-Input Module

Solid State Relay

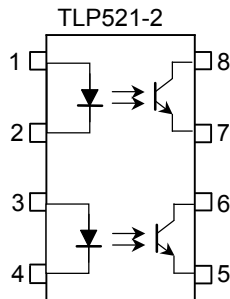
The TOSHIBA TLP521-1, -2 and -4 consist of a photo-transistor optically coupled to a gallium arsenide infrared emitting diode. The TLP521-2 offers two isolated channels in an eight lead plastic DIP package, while the TLP521-4 provides four isolated channels in a sixteen plastic DIP package.

- Collector-emitter voltage: 55 V (min)
- Current transfer ratio: 50% (min)  
Rank GB: 100% (min)
- Isolation voltage: 2500 Vrms (min)
- UL recognized  
made in Japan: UL1577, file No. E67349  
made in Thailand: UL1577, file No. E152349

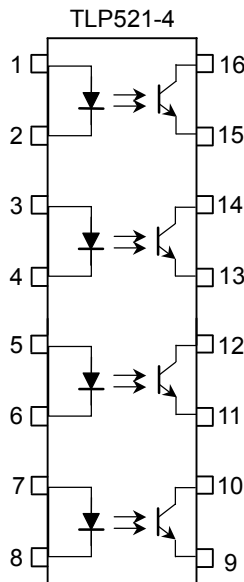
## Pin Configurations (top view)



1 : Anode  
2 : Cathode  
3 : Emitter  
4 : Collector

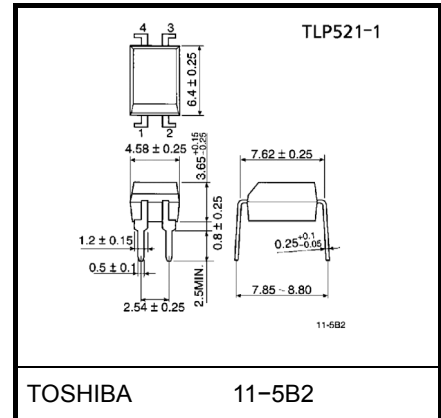


1, 3 : Anode  
2, 4 : Cathode  
5, 7 : Emitter  
6, 8 : Collector

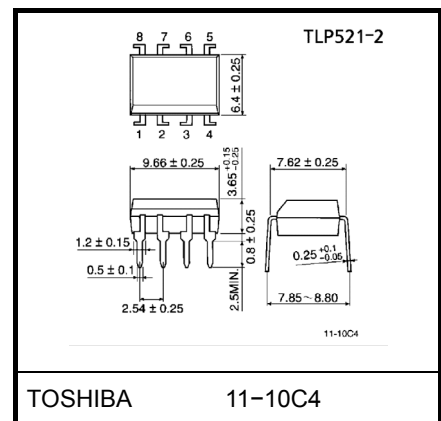


1, 3, 5, 7 : Anode  
2, 4, 6, 8 : Cathode  
9, 11, 13, 15 : Emitter  
10, 12, 14, 16 : Collector

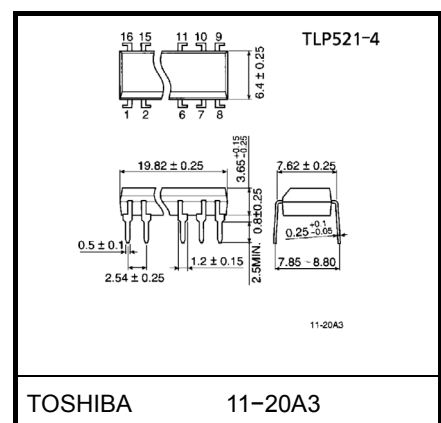
Unit in mm



Weight: 0.26 g



Weight: 0.54 g



Weight: 1.1 g

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## Absolute Maximum Ratings (Ta = 25°C)

| Characteristic                                                         |                                                                              | Symbol                        | Rating                                       |                                    | Unit                  |
|------------------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------|----------------------------------------------|------------------------------------|-----------------------|
|                                                                        |                                                                              |                               | TLP521-1                                     | TLP521-2<br>TLP521-4               |                       |
| LED                                                                    | Forward current                                                              | $I_F$                         | 70                                           | 50                                 | mA                    |
|                                                                        | Forward current derating                                                     | $\Delta I_F / ^\circ\text{C}$ | -0.93 (Ta $\geq 50^\circ\text{C}$ )          | -0.5 (Ta $\geq 25^\circ\text{C}$ ) | mA / $^\circ\text{C}$ |
|                                                                        | Pulse forward current                                                        | $I_{FP}$                      | 1 (100 $\mu$ 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                                              |                                                                              | $T_{stg}$                     | -55~125                                      |                                    | $^\circ\text{C}$      |
| 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                                        |                                                                              | $P_T$                         | 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: 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).

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

## Recommended Operating Conditions

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

Note: Recommended operating conditions are given as a design guideline to obtain expected performance of the device. Additionally, each item is an independent guideline respectively. In developing designs using this product, please confirm specified characteristics shown in this document.

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| Type                 | Classi-<br>fication (*1) | Current Transfer Ratio (%)<br>(I <sub>C</sub> / I <sub>F</sub> )  |     | Marking Of<br>Classification                                          |
|----------------------|--------------------------|-------------------------------------------------------------------|-----|-----------------------------------------------------------------------|
|                      |                          | I <sub>F</sub> = 5mA, V <sub>CE</sub> = 5V, T <sub>a</sub> = 25°C |     |                                                                       |
|                      |                          | Min                                                               | Max |                                                                       |
| TLP521               | A                        | 50                                                                | 600 | Blank, Y, Y <sup>■</sup> , G, G <sup>■</sup> , B, B <sup>■</sup> , GB |
|                      | Rank Y                   | 50                                                                | 150 | Y, Y <sup>■</sup>                                                     |
|                      | Rank GR                  | 100                                                               | 300 | G, G <sup>■</sup>                                                     |
|                      | Rank BL                  | 200                                                               | 600 | B, B <sup>■</sup>                                                     |
|                      | Rank GB                  | 100                                                               | 600 | G, G <sup>■</sup> , B, B <sup>■</sup> , GB                            |
| TLP521-2<br>TLP521-4 | A                        | 50                                                                | 600 | Blank, GR, BL, GB                                                     |
|                      | Rank GB                  | 100                                                               | 600 | GR, BL, GB                                                            |

\*1: Ex. rank GB: TLP521-1 (GB)

(Note): Application type name for certification test, please use standard product type name, i.e.

TLP521-1 (GB): TLP521-1, TLP521-2 (GB): TLP521-2

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**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)**

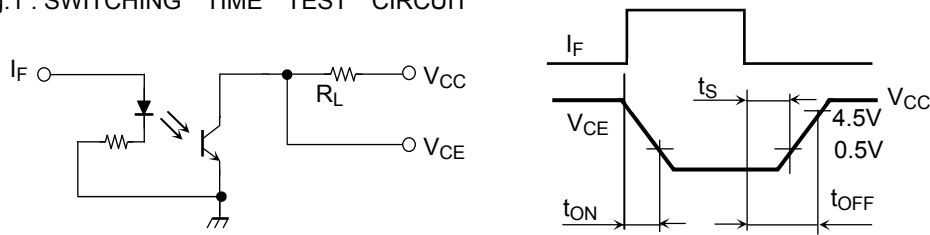
| Characteristic                | Symbol | Test Condition                               | Min  | Typ.      | Max | Unit     |
|-------------------------------|--------|----------------------------------------------|------|-----------|-----|----------|
| Capacitance (input to output) | $C_S$  | $V_S = 0, f = 1 \text{ MHz}$                 | —    | 0.8       | —   | pF       |
| Isolation resistance          | $R_S$  | $V_S = 500 \text{ V}, \text{R.H.} \leq 60\%$ | —    | $10^{11}$ | —   | $\Omega$ |
| Isolation voltage             | $BV_S$ | AC, 1 minute                                 | 2500 | —         | —   | Vrms     |
|                               |        | AC, 1 second, in oil                         | —    | 5000      | —   |          |
|                               |        | DC, 1 minute, in oil                         | —    | 5000      | —   | Vdc      |

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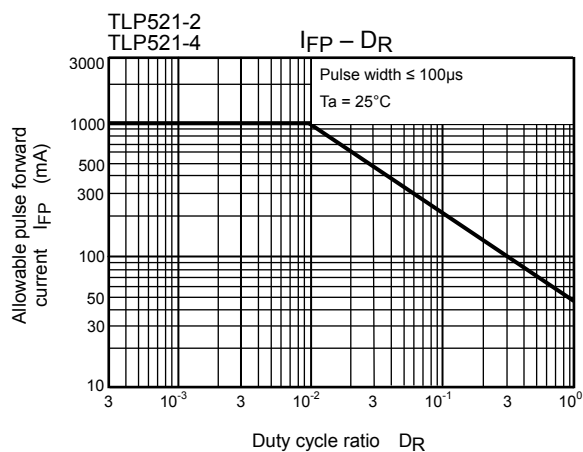
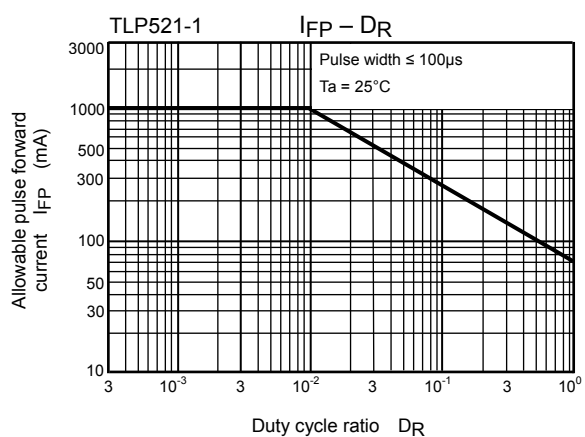
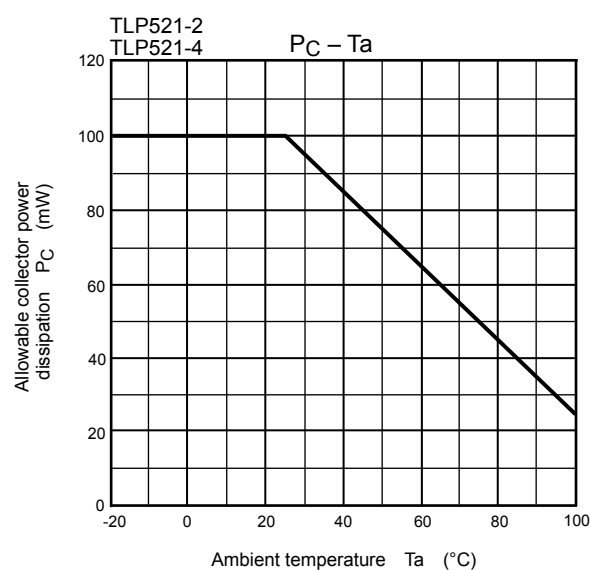
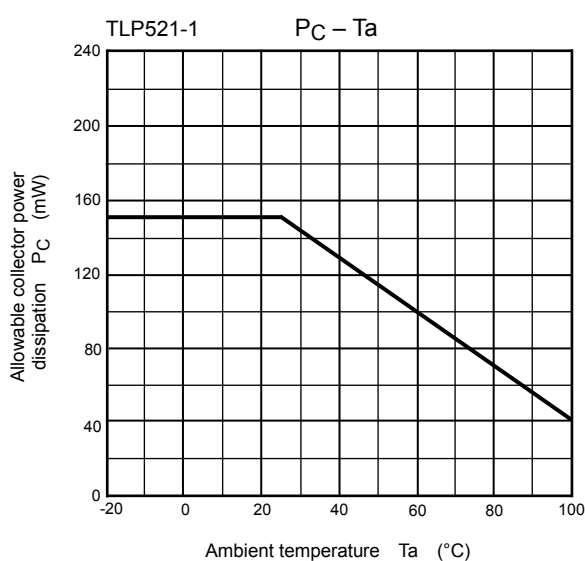
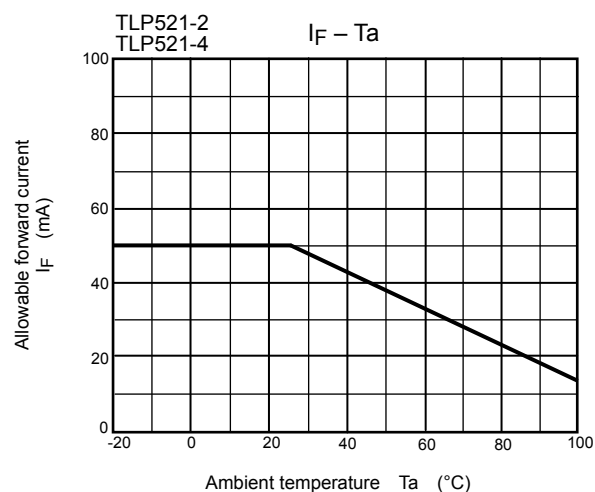
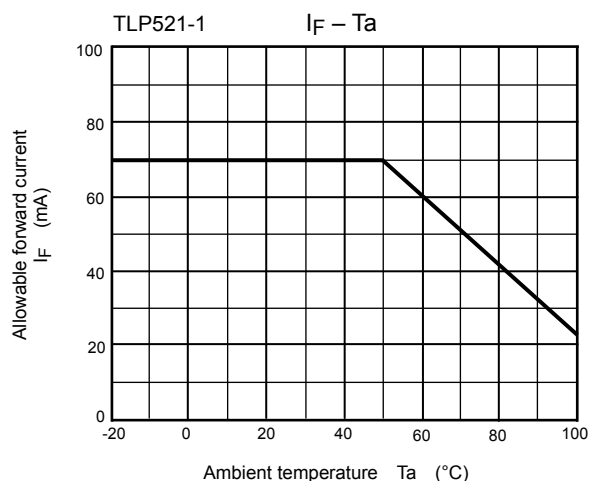
Switching Characteristics (Ta = 25°C)

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

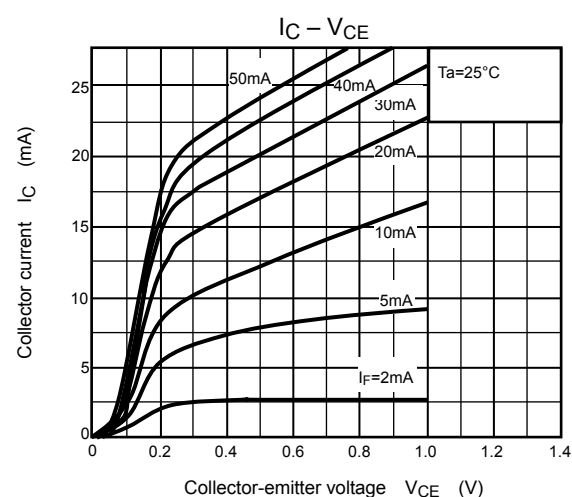
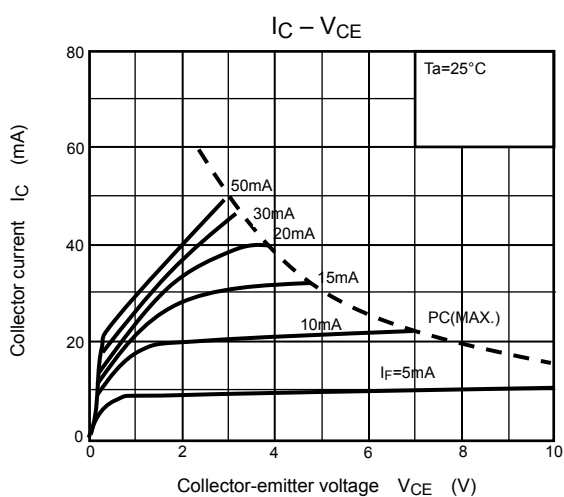
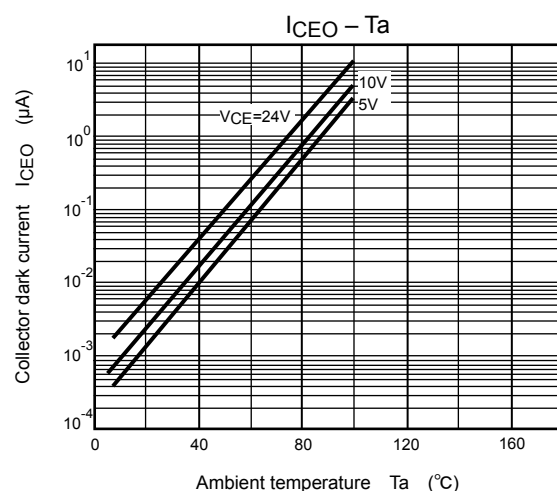
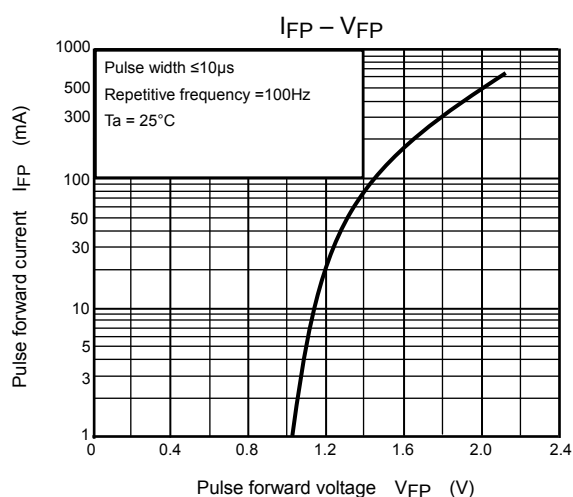
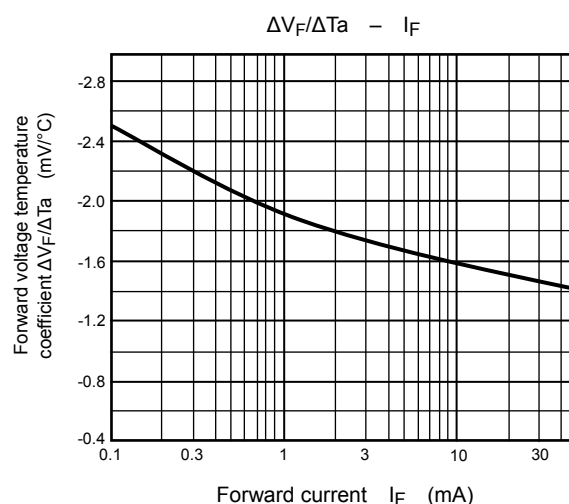
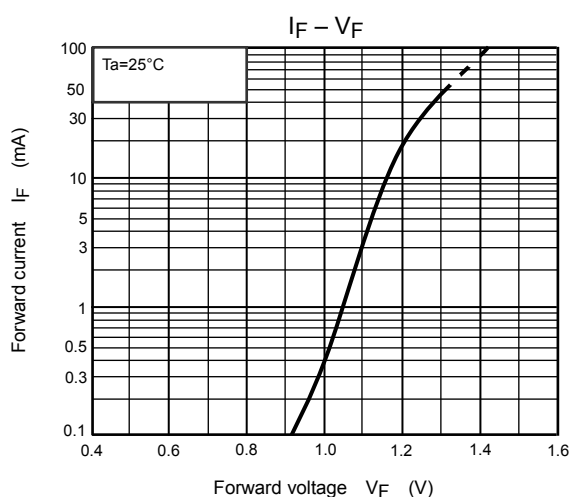
Fig.1 : SWITCHING TIME TEST CIRCUIT



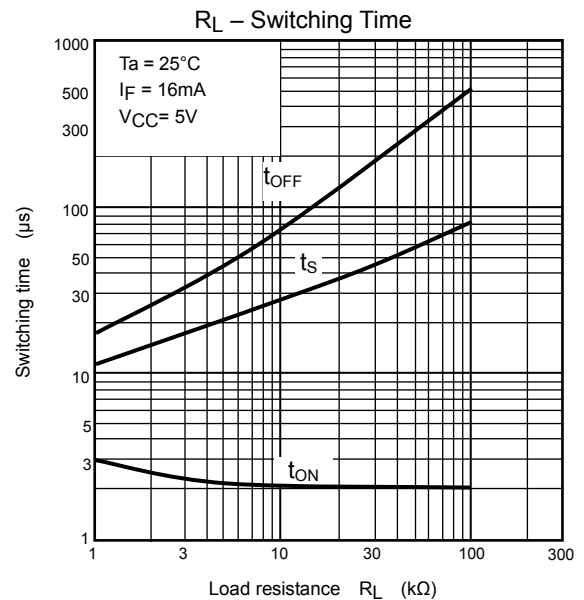
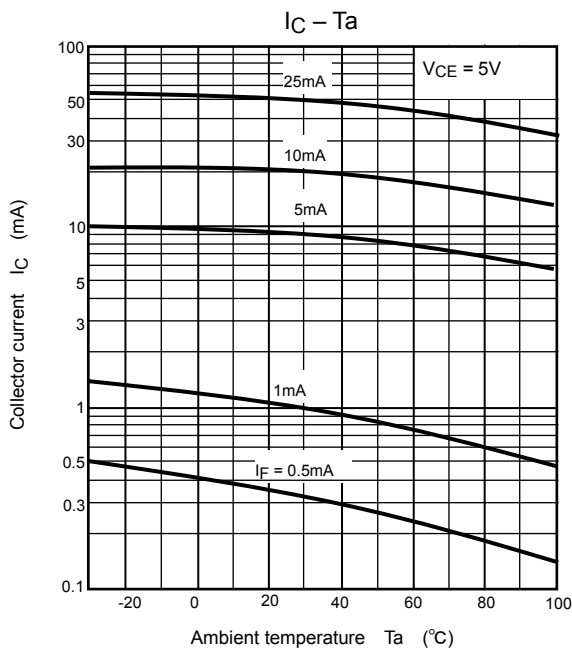
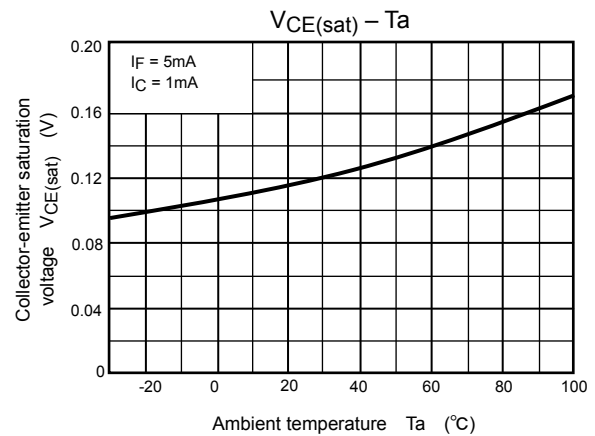
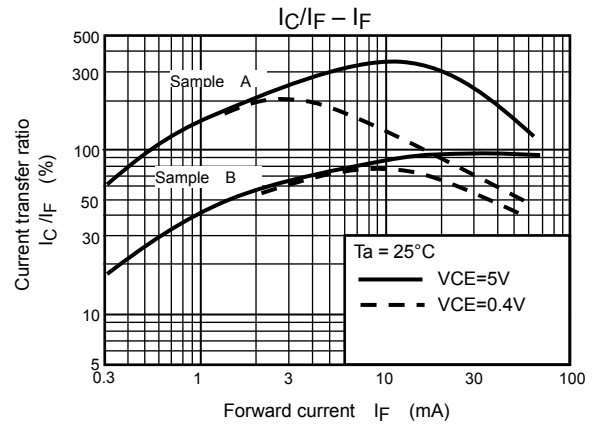
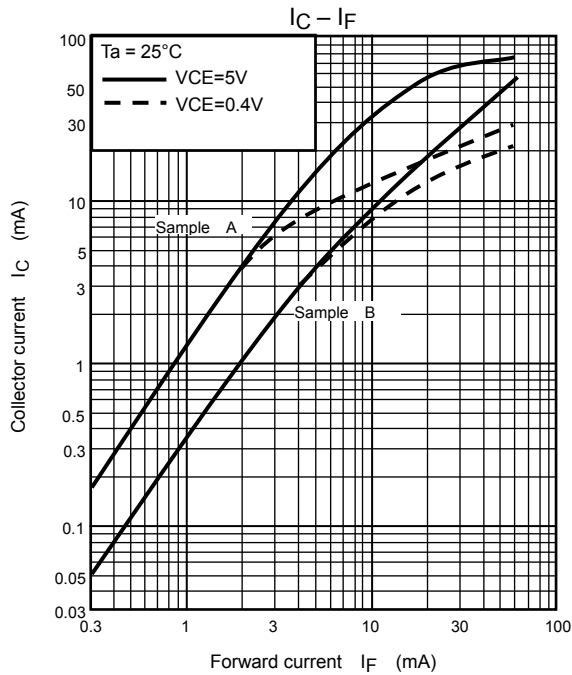
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