

# TLP718

Isolated Bus Drivers

High Speed Line Receivers

Microprocessor System Interfaces

The Toshiba TLP718 consists of a GaAlAs light-emitting diode and an integrated high-gain, high-speed photodetector. This unit is a 6-pin SDIP. The TLP718 is 50% smaller than the 8-PIN DIP and meets the reinforced insulation class requirements of international safety standards. Therefore the mounting area can be reduced in equipment requiring safety standard certification.

The detector has a totem pole output stage to provide both source and sink driving. The detector IC has an internal shield that provides a guaranteed common-mode transient immunity of 10 kV /  $\mu$ s.

The TLP718 is inverter logic type. For buffer logic type, the TLP715 is in line-up.

- Inverter logic type (totem pole output)
- Guaranteed performance over temperature : -40 to 100°C
- Power supply voltage : 4.5 to 20 V
- Input current:  $I_{FHL} = 3\text{mA}$  (Max.)
- Switching time (  $t_{pHL}$  /  $t_{pLH}$  ) : 250 ns (Max.)
- Common-mode transient immunity :  $\pm 10\text{ kV}/\mu\text{s}$  (Min)
- Isolation voltage : 5000 Vrms (Min)
- UL recognized  
UL1577, File No.E67349
- c-UL recognized  
CSA Component Acceptance Service No. 5A, File No.E67349
- Option (D4)  
TÜV recognized / VDE under application : DIN EN60747-5-5

Maximum Operating Insulation Voltage : 890V<sub>pk</sub>

Highest Permissible Over Voltage : 8000V<sub>pk</sub>

**(Note) : When a EN60747-5-5 approved type is needed,**

**Please designate "Option(D4)"**

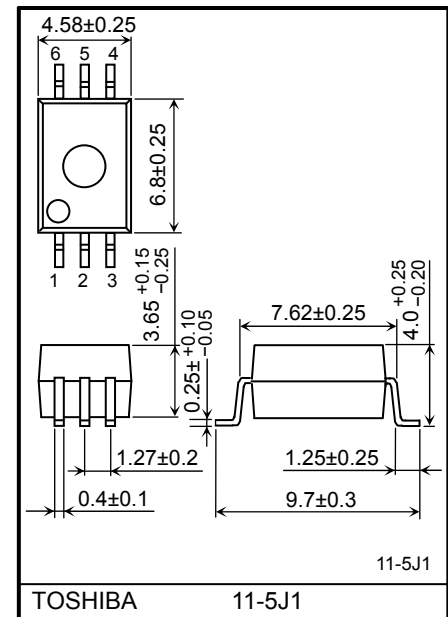
- Construction Mechanical Rating

|                      | 7.62 mm pitch<br>standard type | 10.16 mm pitch<br>TLPXXXF type |
|----------------------|--------------------------------|--------------------------------|
| Creepage Distance    | 7.0 mm (Min)                   | 8.0 mm (Min)                   |
| Clearance            | 7.0 mm (Min)                   | 8.0 mm (Min)                   |
| Insulation Thickness | 0.4 mm (Min)                   | 0.4 mm (Min)                   |

### Truth Table

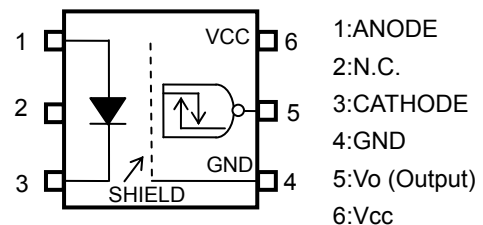
| Input | LED | Tr1 | Tr2 | Output |
|-------|-----|-----|-----|--------|
| H     | ON  | OFF | ON  | L      |
| L     | OFF | ON  | OFF | H      |

Unit in mm

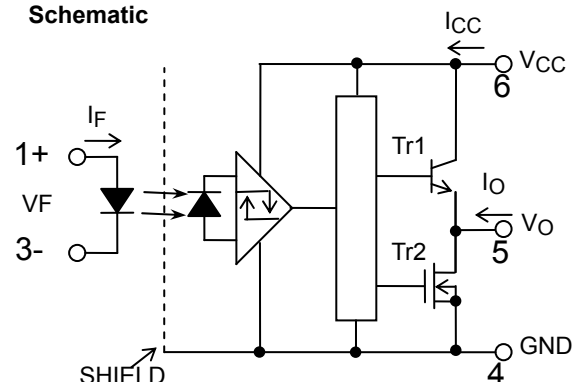


Weight:0.26 g (typ.)

### Pin Configuration (Top View)



### Schematic



0.1  $\mu$ F bypass capacitor must be connected between pins 6 and 4. (Note 5)

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

| CHARACTERISTIC                                                 |                                         | SYMBOL               | RATING     | UNIT             |
|----------------------------------------------------------------|-----------------------------------------|----------------------|------------|------------------|
| LED                                                            | Forward Current (Ta ≤ 83°C)             | I <sub>F</sub>       | 20         | mA               |
|                                                                | Forward Current Derating (Ta ≥ 83°C)    | ΔI <sub>F</sub> /ΔTa | -0.48      | mA/°C            |
|                                                                | Peak Transient Forward Current (Note 1) | I <sub>FPT</sub>     | 1          | A                |
|                                                                | Reverse Voltage                         | V <sub>R</sub>       | 5          | V                |
|                                                                | Junction Temperature                    | T <sub>J</sub>       | 125        | °C               |
| DETECTOR                                                       | Output Current 1 (Ta ≤ 25°C)            | I <sub>O1</sub>      | 25 / -15   | mA               |
|                                                                | Output Current 2 (Ta ≤ 100°C)           | I <sub>O2</sub>      | 13 / -13   | mA               |
|                                                                | Output Voltage                          | V <sub>O</sub>       | -0.5 to 20 | V                |
|                                                                | Supply Voltage                          | V <sub>CC</sub>      | -0.5 to 20 | V                |
|                                                                | Junction Temperature                    | T <sub>J</sub>       | 125        | °C               |
| Operating Temperature Range                                    |                                         | T <sub>opr</sub>     | -40 to 100 | °C               |
| Storage Temperature Range                                      |                                         | T <sub>stg</sub>     | -55 to 125 | °C               |
| Lead Solder Temperature (10 s)                                 |                                         | T <sub>sol</sub>     | 260        | °C               |
| Isolation Voltage (AC, 1 min., R.H. ≤ 60%, Ta = 25°C) (Note 2) |                                         | BVs                  | 5000       | V <sub>rms</sub> |

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: Pulse width PW ≤ 1us, 300pps.

Note 2: Device Considered a two terminal device : pins 1,2 and 3 shorted together and pins 4,5 and 6 shorted together.

## Recommended Operating Conditions

| CHARACTERISTIC        | SYMBOL               | MIN | TYP. | MAX | UNIT |
|-----------------------|----------------------|-----|------|-----|------|
| Input Current, ON     | I <sub>F</sub> (ON)  | 4.5 | -    | 10  | mA   |
| Input Voltage, OFF    | V <sub>F</sub> (OFF) | 0   | -    | 0.8 | V    |
| Supply Voltage*       | V <sub>CC</sub>      | 4.5 | -    | 20  | V    |
| Operating Temperature | T <sub>opr</sub>     | -40 | -    | 100 | °C   |

\* This item denotes operating ranges, not meaning of recommended operating conditions.

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.

## Electrical Characteristics

(Unless otherwise specified, Ta = -40 to 100°C, V<sub>CC</sub> = 4.5 to 20 V.)

| CHARACTERISTIC                                     | SYMBOL                     | TEST CIRCUIT | CONDITION                                            |                                          | MIN  | TYP. * | MAX | UNIT  |
|----------------------------------------------------|----------------------------|--------------|------------------------------------------------------|------------------------------------------|------|--------|-----|-------|
| Input forward voltage                              | V <sub>F</sub>             | —            | I <sub>F</sub> = 5 mA , Ta = 25°C                    |                                          | 1.4  | 1.6    | 1.7 | V     |
| Temperature coefficient of forward voltage         | ΔV <sub>F</sub> /ΔTa       | —            | I <sub>F</sub> = 5 mA                                |                                          | —    | -2.0   | —   | mV/°C |
| Input reverse current                              | I <sub>R</sub>             | —            | V <sub>R</sub> = 5 V , Ta = 25°C                     |                                          | —    | —      | 10  | μA    |
| Input capacitance                                  | C <sub>T</sub>             | —            | V = 0 V, f = 1 MHz, Ta = 25°C                        |                                          | —    | 45     | —   | pF    |
| Logic LOW output voltage                           | V <sub>OL</sub>            | 1            | I <sub>OL</sub> = 3.5 mA , I <sub>F</sub> = 5 mA     |                                          | —    | 0.2    | 0.6 | V     |
| Logic HIGH output voltage                          | V <sub>OH</sub><br>(Note3) | 2            | I <sub>OH</sub> = -2.6 mA,<br>V <sub>F</sub> = 0.8 V | V <sub>CC</sub> = 4.5 V                  | 2.7  | 3.5    | —   | V     |
|                                                    |                            |              |                                                      | V <sub>CC</sub> = 20 V                   | 17.4 | 19     | —   |       |
| Logic LOW supply current                           | I <sub>CCL</sub>           | 3            | I <sub>F</sub> = 5 mA                                |                                          | —    | —      | 3.0 | mA    |
| Logic HIGH supply current                          | I <sub>CCH</sub>           | 4            | V <sub>F</sub> =0V                                   |                                          | —    | —      | 3.0 | mA    |
| Logic LOW short circuit output current             | I <sub>OSL</sub>           | 5            | I <sub>F</sub> = 5 mA                                | V <sub>CC</sub> = V <sub>O</sub> = 5.5 V | 15   | 80     | —   | mA    |
|                                                    |                            |              |                                                      | V <sub>CC</sub> = V <sub>O</sub> = 20 V  | 20   | 90     | —   |       |
| Logic HIGH short circuit output current<br>(Note4) | I <sub>OSH</sub>           | 6            | V <sub>F</sub> = 0 V,<br>V <sub>O</sub> = GND        | V <sub>CC</sub> = 5.5 V                  | -5   | -15    | —   | mA    |
|                                                    |                            |              |                                                      | V <sub>CC</sub> = 20 V                   | -10  | -20    | —   |       |
| Input current logic LOW output<br>(Note4)          | I <sub>FHL</sub>           | —            | I <sub>O</sub> = 3.5 mA, V <sub>O</sub> < 0.6 V      |                                          | —    | 0.4    | 3   | mA    |
| Input voltage logic HIGH output                    | V <sub>FLH</sub>           | —            | I <sub>O</sub> = -2.6 mA, V <sub>O</sub> > 2.4V      |                                          | 0.8  | —      | —   | V     |
| Input current hysteresis                           | I <sub>HYS</sub>           | —            | V <sub>CC</sub> = 5 V                                |                                          | —    | 0.05   | —   | mA    |

\* All typical values are at Ta=25°C, V<sub>CC</sub>=5 V unless otherwise specifiedNote 3: V<sub>OH</sub> = V<sub>CC</sub> - V<sub>O</sub> [V]

Note 4: Duration of output short circuit time should not exceed 10 ms.

Note 5: A ceramic capacitor (0.1 μF) should be connected from pin 6 to pin 4 to stabilize the operation of the high gain linear amplifier. Failure to provide the bypassing may impair the switching property. The total lead length between capacitor and coupler should not exceed 1 cm.

## Isolation Characteristics (Ta = 25°C)

| CHARACTERISTIC              | SYMBOL          | TEST CONDITION                              | MIN                | TYP.             | MAX | UNIT             |
|-----------------------------|-----------------|---------------------------------------------|--------------------|------------------|-----|------------------|
| Capacitance input to output | C <sub>S</sub>  | V = 0V, f = 1 MHz (Note 2)                  | —                  | 1.0              | —   | pF               |
| Isolation resistance        | R <sub>S</sub>  | R.H. ≤ 60%, V <sub>S</sub> = 500 V (Note 2) | 1×10 <sup>12</sup> | 10 <sup>14</sup> | —   | Ω                |
| Isolation voltage           | BV <sub>S</sub> | AC, 1 minute                                | 5000               | —                | —   | V <sub>rms</sub> |
|                             |                 | AC, 1 second, in oil                        | —                  | 10000            | —   |                  |
|                             |                 | DC, 1 minute, in oil                        | —                  | 10000            | —   | V <sub>dc</sub>  |

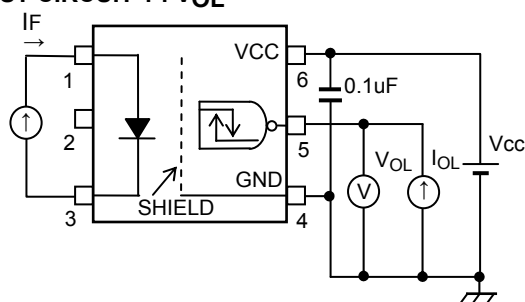
## Switching Characteristics

(Unless otherwise specified,  $T_a = -40$  to  $100^\circ\text{C}$ ,  $V_{CC} = 4.5$  to  $20$  V)

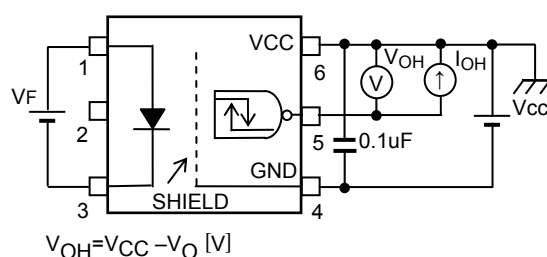
| CHARACTERISTIC                                      | SYMBOL                | TEST CIRCUIT | CONDITION                                                                     | MIN    | TYP. * | MAX | UNIT |
|-----------------------------------------------------|-----------------------|--------------|-------------------------------------------------------------------------------|--------|--------|-----|------|
| Propagation delay time to logic HIGH output         | $t_{pLH}$             | 7,8          | $I_F = 3 \rightarrow 0$ mA                                                    | 30     | 120    | 250 | ns   |
| Propagation delay time to logic LOW output          | $t_{pHL}$             |              | $I_F = 0 \rightarrow 3$ mA                                                    | 30     | 120    | 250 | ns   |
| Switching time dispersion between ON and OFF        | $ t_{pHL} - t_{pLH} $ |              | —                                                                             | —      | —      | 220 | ns   |
| Rise Time (10 – 90 %)                               | $t_r$                 |              | $I_F = 3 \rightarrow 0$ mA, $V_{CC} = 5$ V                                    | —      | 30     | —   | ns   |
| Fall Time (90 – 10 %)                               | $t_f$                 |              | $I_F = 0 \rightarrow 3$ mA, $V_{CC} = 5$ V                                    | —      | 30     | —   | ns   |
| Common-mode transient Immunity at HIGH level output | $CM_H$                | 9            | $V_{CM} = 1000$ Vp-p, $I_F = 0$ mA, $V_{CC} = 20$ V, $T_a = 25^\circ\text{C}$ | 10000  | —      | —   | V/us |
| Common-mode transient Immunity at LOW level output  | $CM_L$                |              | $V_{CM} = 1000$ Vp-p, $I_F = 5$ mA, $V_{CC} = 20$ V, $T_a = 25^\circ\text{C}$ | -10000 | —      | —   | V/us |

\*All typical values are at  $T_a = 25^\circ\text{C}$ .

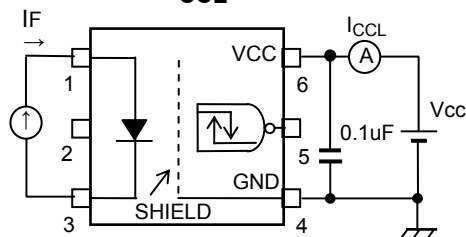
TEST CIRCUIT 1 :  $V_{OL}$



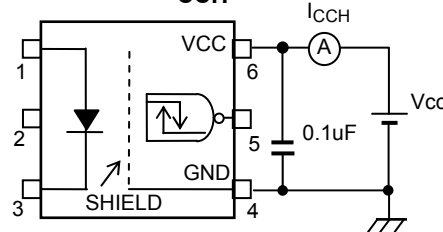
TEST CIRCUIT 2 :  $V_{OH}$



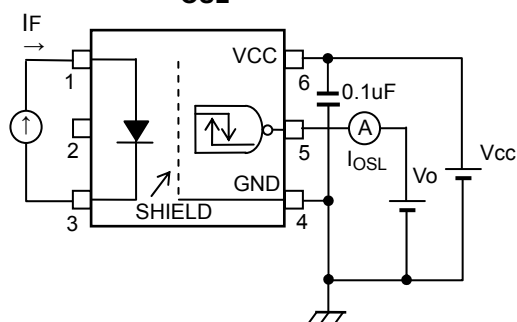
TEST CIRCUIT 3 :  $I_{CCL}$



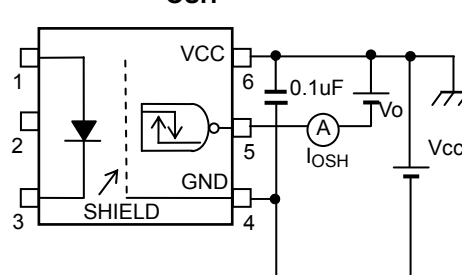
TEST CIRCUIT 4 :  $I_{CCH}$



TEST CIRCUIT 5 :  $I_{OSL}$

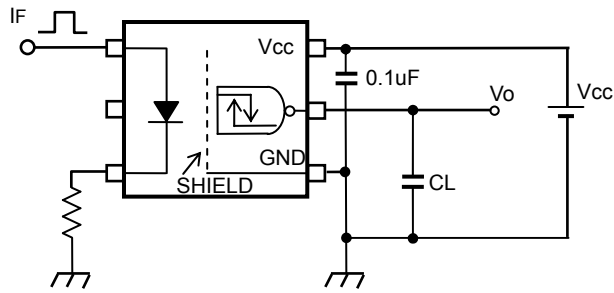


TEST CIRCUIT 6 :  $I_{OSH}$

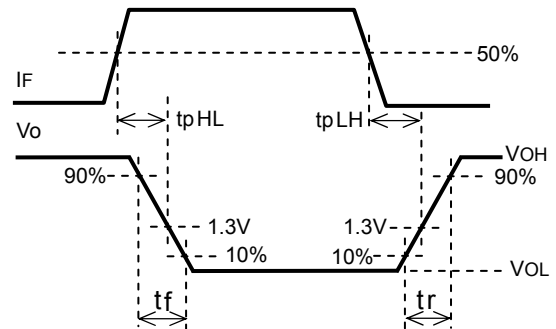


## TEST CIRCUIT 7: Switching Time Test Circuit

$I_F = 3 \text{ mA (P.G)}$   
( $f = 50 \text{ kHz}$ , duty=50%  
less than  $t_r = t_f = 5 \text{ ns}$ )

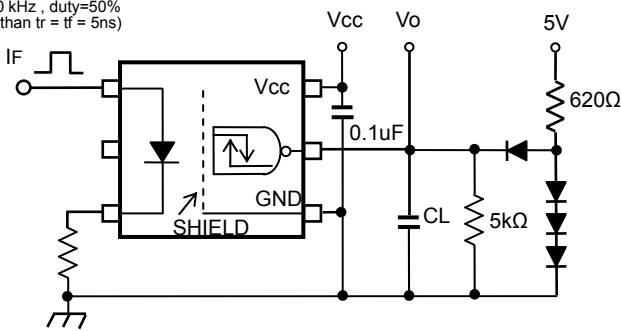


CL: stray capacitance of probe and wiring (to 15 pF)

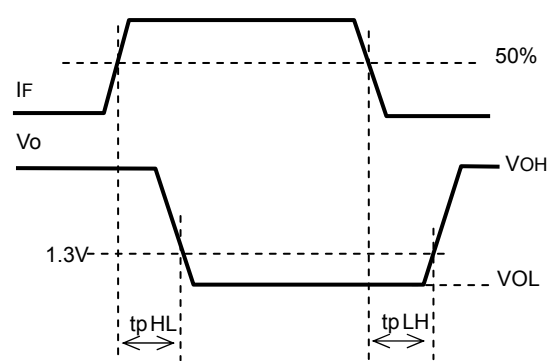


## TEST CIRCUIT 8: Switching Time Test Circuit

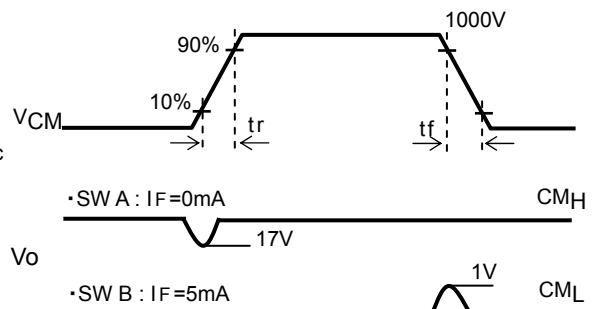
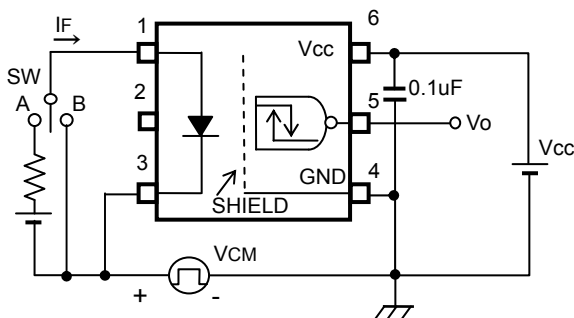
$I_F = 3 \text{ mA (P.G)}$   
( $f = 50 \text{ kHz}$ , duty=50%  
less than  $t_r = t_f = 5 \text{ ns}$ )



CL: stray capacitance of probe and wiring (to 15 pF)



## TEST CIRCUIT 9: Common-Mode Transient Immunity Test Circuit



$$CM_H = \frac{800(V)}{t_r (\mu s)} \quad CM_L = -\frac{800(V)}{t_f (\mu s)}$$

$CM_H$  ( $CM_L$ ) is the maximum rate of rise (fall) of the common mode voltage that can be sustained with the output voltage in the high (low) state.

## EN60747-5-5 Option:(D4)

Types : TLP718, TLP718F

Type designations for "option: (D4)", which are tested under EN60747 requirements.

Ex.: TLP718 (D4-TP,F)

D4 : EN60747 option

TP : Standard tape & reel type

F : [[G]]/RoHS COMPATIBLE

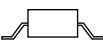
Note: Use TOSHIBA standard type number for safety standard application.

Ex.: TLP718 (D4-TP,F) → TLP718

### EN60747 Isolation Characteristics

| Description                                                                                                                                                                                                              |             | Symbol                           | Rating                                          | Unit           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------------------------------|-------------------------------------------------|----------------|
| Application classification                                                                                                                                                                                               |             |                                  |                                                 |                |
| for rated mains voltage $\leq 300V_{rms}$<br>for rated mains voltage $\leq 600V_{rms}$                                                                                                                                   |             |                                  | I-IV<br>I-III                                   | —              |
| Climatic classification                                                                                                                                                                                                  |             |                                  | 40/ 100 / 21                                    | —              |
| Pollution degree                                                                                                                                                                                                         |             |                                  | 2                                               | —              |
| Maximum operating insulation voltage                                                                                                                                                                                     | TLPxxx type | $V_{IORM}$                       | 890                                             | Vpk            |
|                                                                                                                                                                                                                          | TLPxxxFtype |                                  | 1140                                            |                |
| Input to output test voltage, method A<br>$V_{pr}=1.5 \times V_{IORM}$ , type and sample test<br>$t_p=10s$ , partial discharge $<5pC$                                                                                    | TLPxxx type | $V_{pr}$                         | 1335                                            | Vpk            |
|                                                                                                                                                                                                                          | TLPxxxFtype |                                  | 1710                                            |                |
| Input to output test voltage, method B<br>$V_{pr}=1.875 \times V_{IORM}$ , 100% production test<br>$t_p=1s$ , partial discharge $<5pC$                                                                                   | TLPxxx type | $V_{pr}$                         | 1670                                            | Vpk            |
|                                                                                                                                                                                                                          | TLPxxxFtype |                                  | 2140                                            |                |
| Highest permissible overvoltage<br>(transient overvoltage, $t_{pr} = 60s$ )                                                                                                                                              |             | $V_{TR}$                         | 8000                                            | Vpk            |
| Safety limiting values (max. permissible ratings in case of<br>fault, also refer to thermal derating curve)<br>current (input current $I_F$ , $P_{Si} = 0$ )<br>power (output or total power dissipation)<br>temperature |             | $I_{Si}$<br>$P_{Si}$<br>$T_{Si}$ | 300<br>700<br>150                               | mA<br>mW<br>°C |
| Insulation resistance,<br>$V_{IO}=500V$ , $T_a=25^\circ C$<br>$V_{IO}=500V$ , $T_a=100^\circ C$<br>$V_{IO}=500V$ , $T_a=T_{Si}$                                                                                          |             | $R_{Si}$                         | $\geq 10^{12}$<br>$\geq 10^{11}$<br>$\geq 10^9$ | $\Omega$       |

Insulation Related Specifications

|                              |     | <br>7.62mm pitch<br>TLPxxx type | <br>10.16mm pitch<br>TLPxxxF type |
|------------------------------|-----|-------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| Minimum creepage distance    | Cr  | 7.0mm                                                                                                             | 8.0mm                                                                                                                |
| Minimum clearance            | Cl  | 7.0mm                                                                                                             | 8.0mm                                                                                                                |
| Minimum insulation thickness | ti  | 0.4mm                                                                                                             |                                                                                                                      |
| Comperative tracking index   | CTI | 175                                                                                                               |                                                                                                                      |

- 1. If a printed circuit is incorporated, the creepage distance and clearance may be reduced below this value. (e.g.at a standard distance between soldering eye centres of 7.5mm). If this is not permissible, the user shall take suitable measures.
- 2. This photocoupler is suitable for ‘safe electrical isolation’ only within the safety limit data. Maintenance of the safety data shall be ensured by means of protective circuits.

Marking on product for EN60747 : 4

Marking Example :

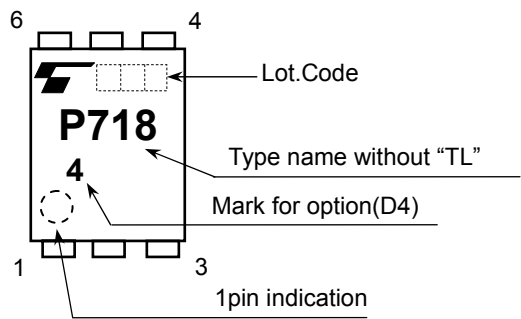


Figure 1 Partial discharge measurement procedure according to EN60747  
Destructive test for qualification and sampling tests.

Method A

(for type and sampling tests,  
destructive tests)

$t_1, t_2$  = 1 to 10 s  
 $t_3, t_4$  = 1 s  
 $t_p$ (Measuring time for  
partial discharge) = 10 s  
 $t_b$  = 12 s  
 $t_{ini}$  = 60 s

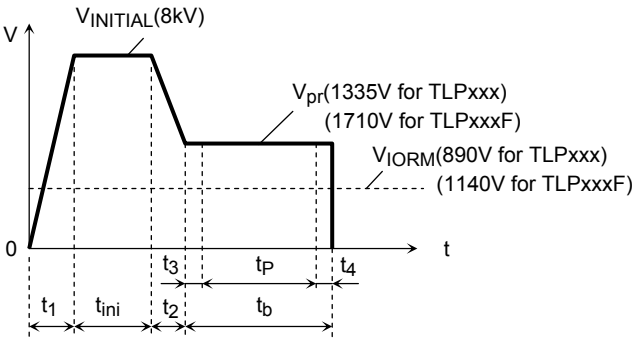


Figure 2 Partial discharge measurement procedure according to EN60747  
Non-destructive test for 100% inspection.

Method B

(for sample test, non-  
destructive test)

$t_3, t_4$  = 0.1 s  
 $t_p$ (Measuring time for  
partial discharge) = 1 s  
 $t_b$  = 1.2 s

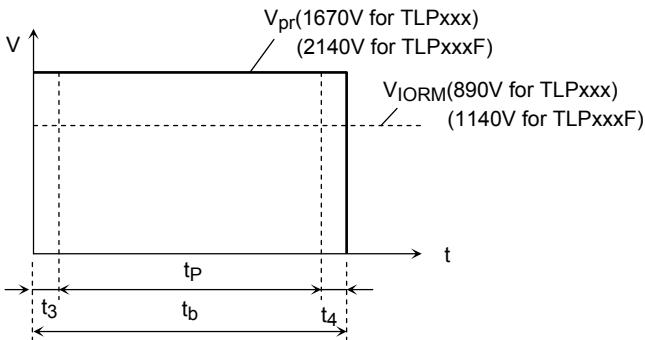
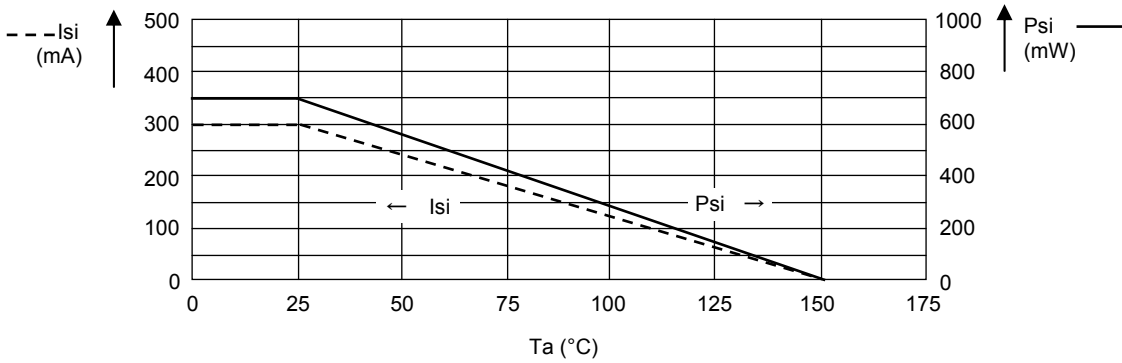


Figure 3 Dependency of maximum safety ratings on ambient temperature





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