# M57159L-01

Hybrid IC for driving IGBT modules

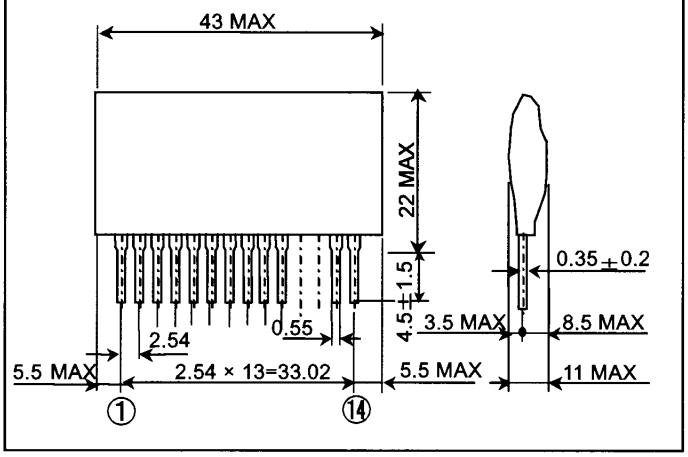
## DESCRIPTION

M57159L-01 is a hybrid IC to drive IGBT module. This hybrid IC is driven by two power supplies and provides the required electrical isolation between the input and output with an opto-coupler.

The protection system of this hybrid IC functions with a margin of time by built-in protection circuits to maintain a reverse bias for a predetermined time after the detection of an short-current .

Recommended IGBT modules: $V_{CES}$ = 600V/~150A class
$V_{CES}$ = 1200V/~75A class

**OUTLINE DRAWING** Dimensions: mm



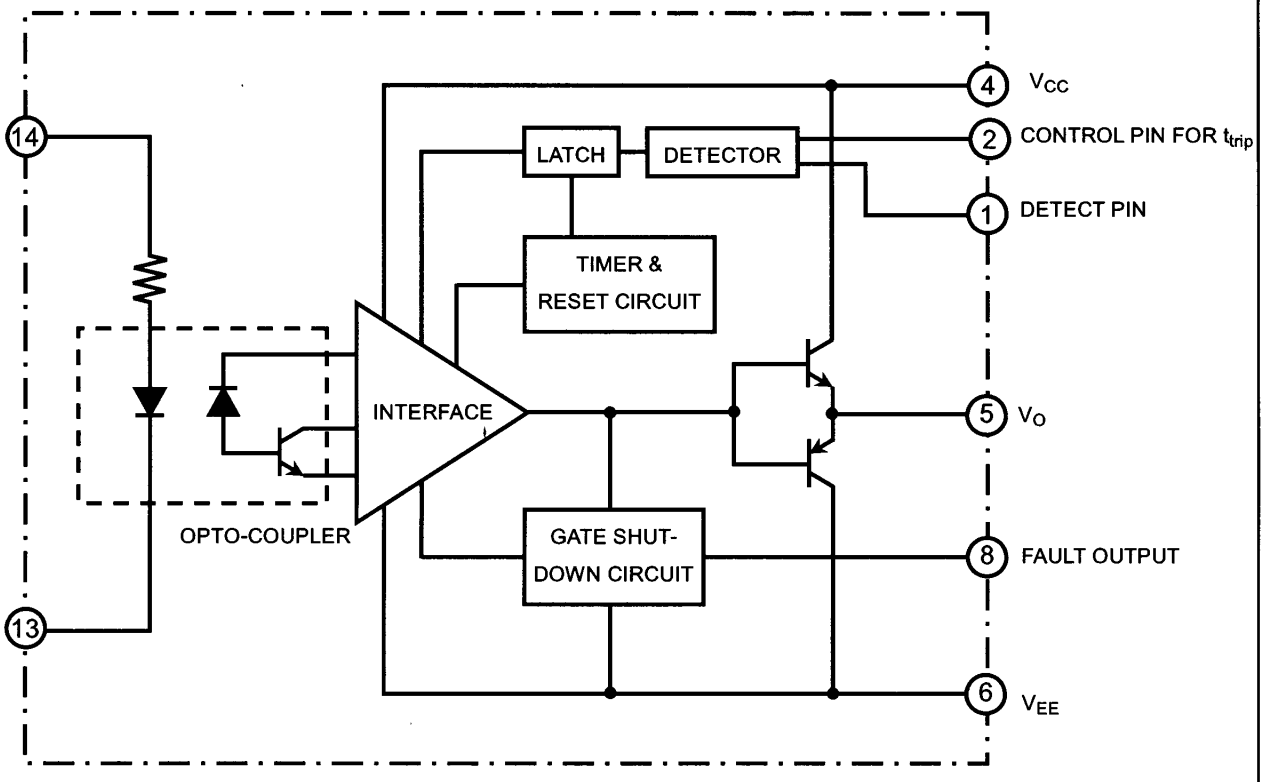

## FEATURES

- Built-in high CMR opto-coupler
- Built-in short-circuit protector (with timer-operated and reset circuit)
- Capability of adjusting time to control short-circuit detection
- Input-output isolation voltage: 2500Vrms for 1min

## APPLICATIONS

To drive IGBT modules for inverter or AC servo systems application.

## BLOCK DIAGRAM




Pin 3, 7, 9 and 10: NC

## MAXIMUM RATINGS (unless otherwise noted, Ta=25°C)

| Symbol | Parameter | Conditions | Ratings | Unit |
|---|---|---|---|---|
| $V_{CC}$ | Supply voltage | DC | 18 | V |
| $V_{EE}$ | | | -12 | V |
| $V_I$ | Input voltage | Applied between; 13pin and 14pin | -1 ~ +7 | V |
| $V_O$ | Output voltage | When the output voltage is "H" | $V_{CC}$ | V |
| $I_{OHP}$ | Output current | Pulse width 2μs, f ≤ 20kHz | -1.5 | A |
| $I_{OLP}$ | | | 1.5 | A |
| Viso | Isolation voltage | Sine wave voltage 60Hz, for 1min. | 2500 | Vrms |
| $T_C$ | Case temperature | | 85 | °C |
| Topr | Operating temperature | No condensation allowable | -20 ~ +60 | °C |
| Tstg | Storage temperature | No condensation allowable | -25 ~ +100 | °C |
| $I_{FO}$ | Fault output current | Inflow current at 8pin | 20 | mA |
| $V_{R1}$ | Input voltage at 1pin | | 50 | V |

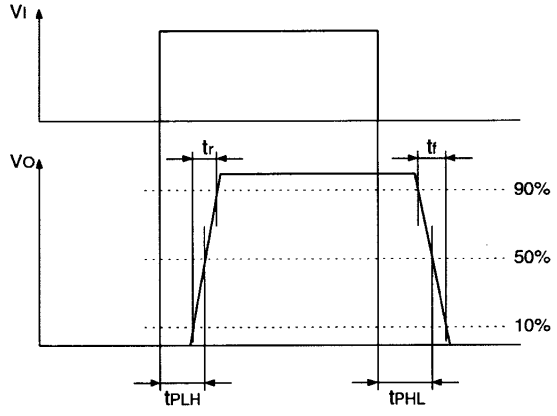
## ELECTRICAL CHARACTERISTICS (unless otherwise noted, Ta=25°C, $V_{CC}$ = 15V, $V_{EE}$ = -10V)

| Symbol | Parameter | Conditions | Limits | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| $V_{CC}$ | Supply voltage | Recommended range | 14 | 15 | — | V |
| $V_{EE}$ | | | -7 | — | -10 | V |
| $V_{IN}$ | Pull-up voltage on primary side | Recommended range | 4.75 | 5 | 5.25 | V |
| $I_{IH}$ | "H" input current | Recommended range | 15.2 | 16 | 19 | mA |
| f | Switching frequency | Recommended range | — | — | 20 | kHZ |
| $R_G$ | Gate resistance | Recommended range | 4.2 | — | — | „ |
| $I_{IH}$ | "H" input current | $V_{IN}$ = 5V | — | 16 | — | mA |
| $V_{OH}$ | "H" output voltage | — | 13 | 14 | — | V |
| $V_{OL}$ | "L" output voltage | — | -8 | -9 | — | V |
| $t_{PLH}$ | "L-H" propagation time | $I_{IH}$ = 16mA | — | 0.7 | 1.3 | μs |
| $t_r$ | "L-H" rise time | $I_{IH}$ = 16mA | — | 0.8 | 1.5 | μs |
| $t_{PHL}$ | "H-L" propagation time | $I_{IH}$ = 16mA | — | 0.7 | 1.3 | μs |
| $t_f$ | "H-L" fall time | $I_{IH}$ = 16mA | — | 0.3 | 0.6 | μs |
| $t_{timer}$ | Timer | From protection operation to cancel (Input sign is "L") | 1 | — | 2 | ms |
| $I_{FO}$ | Fault output current | Inflow current at 8pin, R = 4.7k„ | — | 5 | — | mA |
| $t_{trip1}$ | Short-circuit detection controlled time 1 | When the output rises, 1pin; Min 15V, 2pin; open | — | 2.4 | — | μs |
| $t_{trip2}$ | Short-circuit detection controlled time 2 (*) | When the output rises, 1pin; Min 15V, 2pin - 4pin; 1000pF | — | 2.8 | — | μs |
| $V_{SC}$ | Short-circuit detection voltage | Collector voltage of the module which detects a short-circuit | 15 | — | — | V |

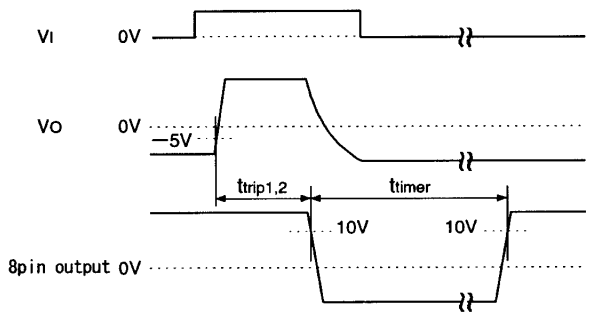
(*) The wiring length of the capacitor for changing short-circuit detection controlled time makes less than 5cm of round trip between pins 2 and 4.

## DEFINITION OF CHARACTERISTICS

(1) SWITCHING OPERATION

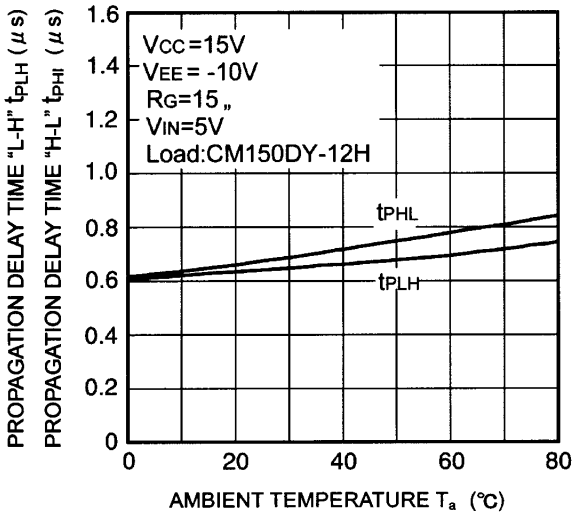



(2) OPERATION OF SHORT-CIRCUIT

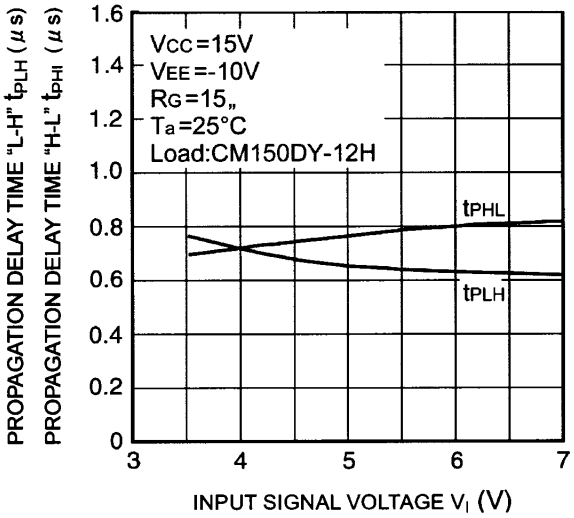


## TYPICAL CHARACTERISTICS

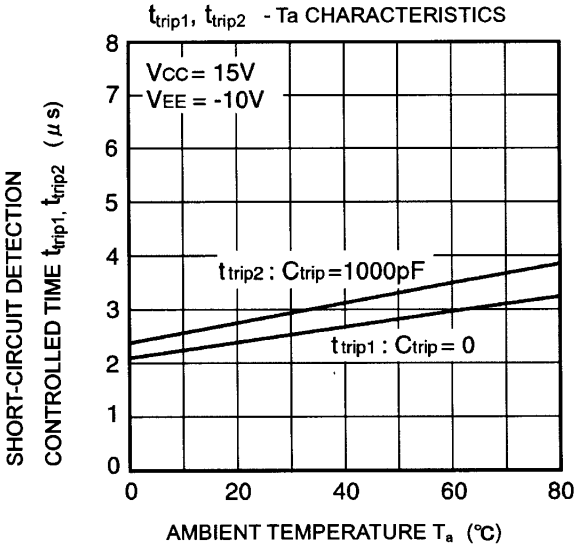
$t_{PLH}$, $t_{PHL}$ - Ta CHARACTERISTICS



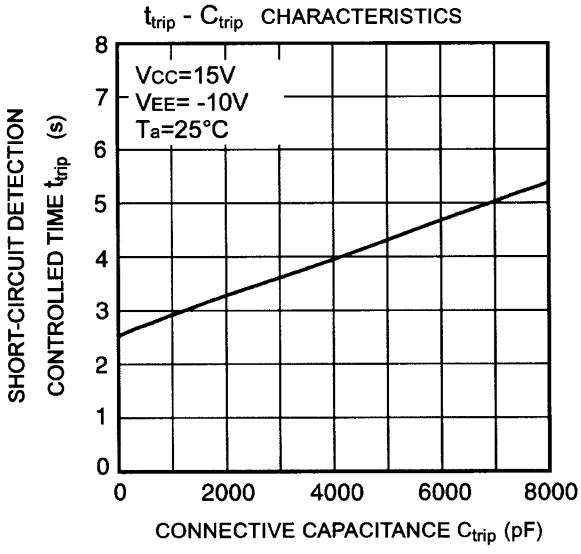

$t_{PLH}$, $t_{PHL}$ - $V_I$ CHARACTERISTICS



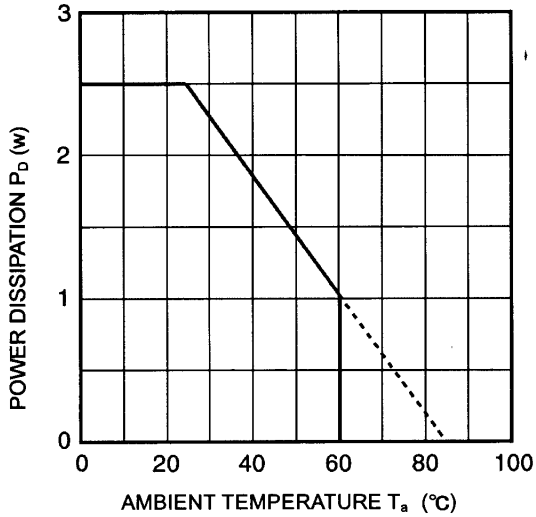

$t_{trip1}$, $t_{trip2}$ - Ta CHARACTERISTICS



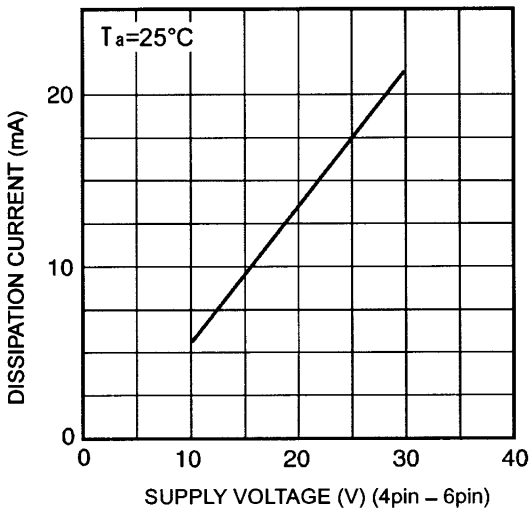

$t_{trip}$ - $C_{trip}$ CHARACTERISTICS




POWER DISSIPATION – AMBIENT TEMPERATURE
(MAXIMUN RATING)




DISSIPATION CURRENT – SUPPLY VOLTAGE
CHARACTERISTICS (4pin – 6pin) INPUT SIGNAL "L"



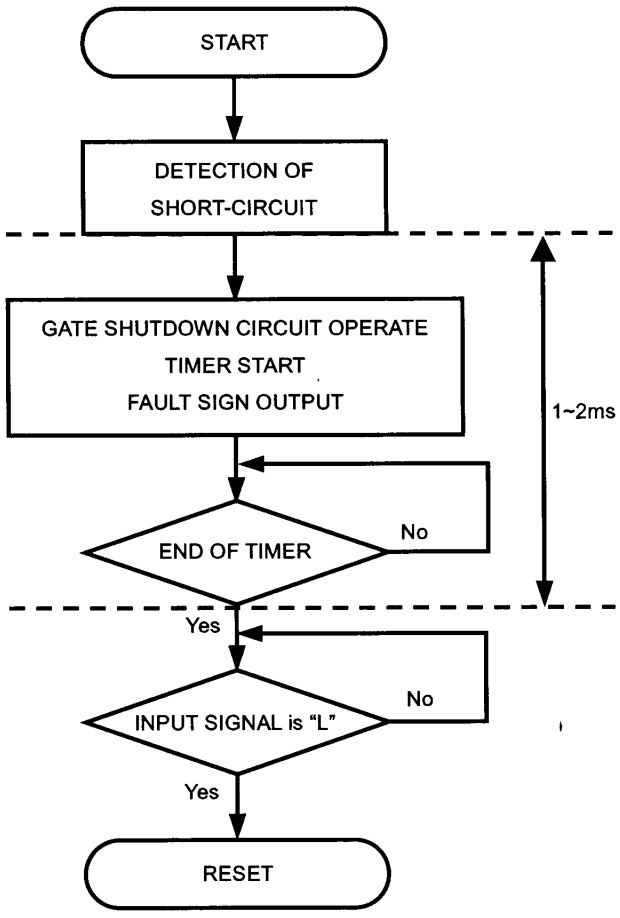
## OPERATION OF PROTECTION CIRCUIT

(1) The protection circuit of this hybrid IC is judged to be a sort-circuit state when gate potential is high and collect voltage is high, and gate voltage is dropped immediately. Moreover, the fault sign is output ("L" level) from 8pin to indicate the protection circuit operating simultaneously.

(2) In about 1 ~ 2ms after this hybrid IC detect of short-circuit, if the input sign is "L", this hybrid IC resets from the short-circuit protection condition and then restart switching operation. ("L" period needs up to 5μs)

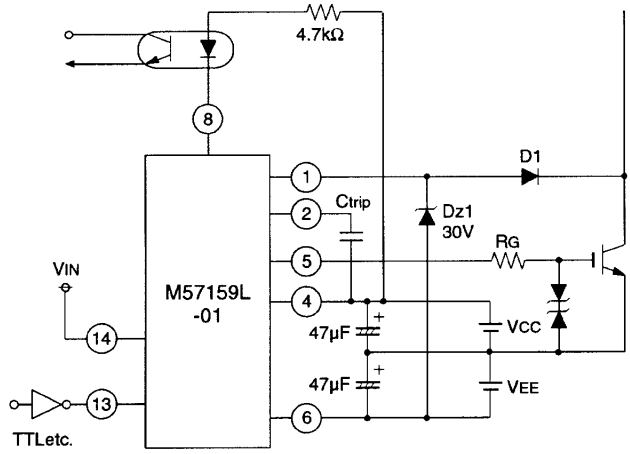
(3) In order to secure ON time of IGBT at the time of the output (5pin) standup, short-circuit detection control time is prepared. (typical: 2.4μs) It can be adjust by connecting capacity between pins 2 and 4.

## OPERATION FLOW OF DETECTING SHORTCIRCUIT




(*) When the short-circuit protection circuit is operating, the output voltage is about $-|V_{EE}| + 2V$.

## APPLICATION CIRCUIT EXAMPLE




f = 20kHz
D.F = 50%
$V_{IN}$ = 5V

$V_{CC}$ = 15V
$V_{EE}$ = 10V
$R_G$ = 15„
Ctrip = 0 ~ 3300pF
D1: First recovery diode (trr ≤ 0.2us)

## PRECATION

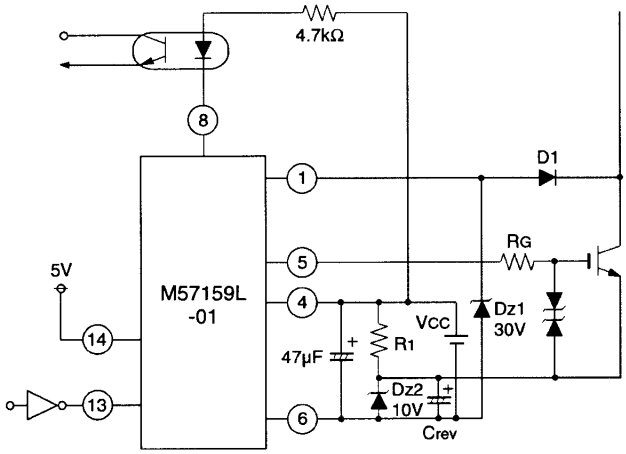
(1) Voltage compensate capacitors are provide as close as possible to this hybrid IC.

(2) D1 requires the approximately the same voltage of power modules.

(3) Since very high voltage is impressed to the pin 1 when D1 is reverse-recovered, there is a possibility of destroying an internal element. As mentioned above, the protection measure, such as inserting a Zener diode between pins 1 and 6, is required.

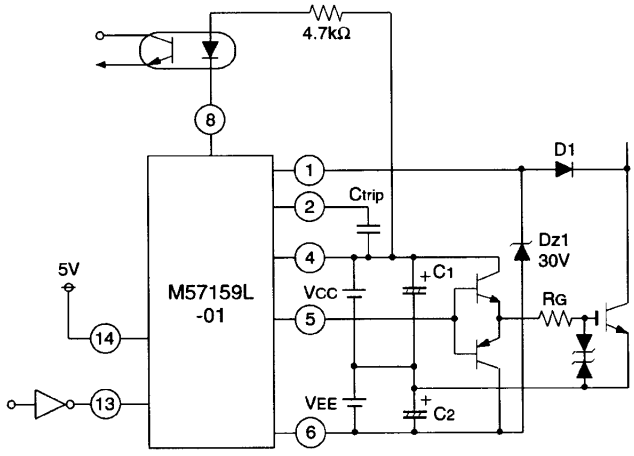
(4) In case pin 2 is operating, the wiring are expected to be wired as close as possible from pin 2 and pin 4. (Standard length: 5cm and less.)

## APPLICATION EXAMPLE OF SINGLE POWER SUPPLY




$V_{CC}$ = 25V
Crev = 47μF
R1 = 2.7k„
(*) Don't input the on sign till the provided (R1×Crev(s)) time is passed over after supply turn on.)

## APPLICATION EXAMPLE OF HIGH POWER MODULE




$V_{CC}$ = 15V
$V_{EE}$ = 10V
Ctrip = 1000pF
C1, C2 ≤ 100μH (Low impedance)

## FOR SAFETY USING

Great detail and careful attention are given to the production activity of Hics, such as the development, the quality of production, and in it's reliability. However the reliability of Hics depends not only on their own factors but also in their condition of usage. When handling Hics, please note the following cautions.

| CAUTIONS | |
|---|---|
| Packing | The materials used in packing Hics can only withstand normal external conditions. When exposed to outside shocks, rain and certain environmental contaminators, the packing materials will deteriorates. Please take care in handling. |
| Carrying | 1) Don't stack boxes too high. Avoid placing heavy materials on boxes.<br>2) Boxes must be positioned correctly during transportation to avoid breakage.<br>3) Don't throw or drop boxes.<br>4) Keep boxes dry. Avoid rain or snow.<br>5) Minimal vibration and shock during transportation is desirable. |
| Storage | When storing Hics, please observe the following notices or possible deterioration of their electrical characteristics, risk of solder ability, and external damage may occur.<br>1) Devices must be stored where fluctuation of temperature and humidity is minimal, and must not be exposed to direct sunlight. Store at the normal temperature of 5 to 30 degrees Celsius with humidity at 40 to 60%.<br>2) Avoid locations where corrosive gasses are generated or where much dust accumulates.<br>3) Storage cases must be static proof.<br>4) Avoid putting weight on boxes. |
| Extended storage | When extended storage is necessary, Hics must be kept non-processed. When using Hics which have been stored for more than one year or under severe conditions, be sure to check that the exterior is free from flaw and other damages. |
| Maximum ratings | To prevent any electrical damages, use Hics within the maximum ratings. The temperature, current, voltage, etc. must not exceed these conditions. |
| Polarity | To protect Hics from destruction and deterioration due to wrong insertion, make sure of polarity in inserting leads into the board holes, conforming to the external view for the terminal arrangement. |

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