MITSUBISHI HYBRID ICs

M57925L

HYBRID IC FOR DRIVING TRANSISTOR MODULES

DESCRIPTION
M57925L is a Hybrid Integrated Circuit designed for driving Transistor Modules QM30DY, QM50DY, etc., in an Inverter application. This device operates as an isolation amplifier for Transistor Modules due to the electrical isolation between the input and output, and features a small outline of 10-pin SIP.

FEATURES
- Electrical isolation between input and output with integrated opto-coupler. \( V_{iso} = 2500\text{Vrms} \)
- Propagation delay time: \( t_{PLH} = 2\mu s \text{ (TYP)} \) \( t_{PLH} = 4\mu s \text{ (TYP)} \)
- Large load and sink current driving capability: \( I_{OH} = -1\text{A (MAX)} \) \( I_{OLP} = -3\text{A (MAX)} \)
- Applicable with TTL input
- Small outline, 10-pin SIP package

APPLICATION
To drive Transistor Modules for Inverter applications

OUTLINE DRAWING
Dimensions in mm

BLOCK DIAGRAM

CIRCUIT DIAGRAM
ABSOLUTE MAXIMUM RATINGS (Ta=–20 ~ +70°C, unless otherwise noted)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Ratings</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCC</td>
<td>Supply voltage</td>
<td>DC</td>
<td>14</td>
<td>V</td>
</tr>
<tr>
<td>VEE</td>
<td>Supply voltage</td>
<td>DC</td>
<td>–6</td>
<td>V</td>
</tr>
<tr>
<td>VI</td>
<td>Input voltage</td>
<td>Between terminals ① and ②</td>
<td>–1 ~ 7</td>
<td>V</td>
</tr>
<tr>
<td>IOH</td>
<td>Output current</td>
<td>–1</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>IOLP</td>
<td></td>
<td>Pulse width 10µs, Freq. 2kHz, peak value</td>
<td>3</td>
<td>A</td>
</tr>
<tr>
<td>VISO</td>
<td>Isolation voltage</td>
<td>Sinewave voltage 60Hz/ min. Ta=25°C</td>
<td>2500</td>
<td>Vrms</td>
</tr>
<tr>
<td>TJ</td>
<td>Junction temperature</td>
<td></td>
<td>100</td>
<td>°C</td>
</tr>
<tr>
<td>TTOP</td>
<td>Operating temperature</td>
<td></td>
<td>–20 ~ +70</td>
<td>°C</td>
</tr>
<tr>
<td>TSTG</td>
<td>Storage temperature</td>
<td></td>
<td>–25 ~ +100</td>
<td>°C</td>
</tr>
</tbody>
</table>

ELECTRICAL CHARACTERISTICS (Ta=25°C, VCC=8V, unless otherwise noted)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test conditions</th>
<th>Limits</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIH</td>
<td>“H” input current</td>
<td>V1=5V</td>
<td>Min. 12</td>
<td>mA</td>
</tr>
<tr>
<td>IOH</td>
<td>“H” output current</td>
<td>Rext=9Ω</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>IOLP</td>
<td>“L” output peak current</td>
<td>Rex=10µF, R2=1Ω</td>
<td>– 2</td>
<td>A</td>
</tr>
<tr>
<td>PD</td>
<td>Internal power dissipation</td>
<td>IOH=–0.5A, IOLP=1A, f=2kHz, D.F.=50%</td>
<td>– 0.35</td>
<td>W</td>
</tr>
<tr>
<td>TPLH</td>
<td>“L-H” propagation delay time</td>
<td>V1=0→4V, TJ=100°C</td>
<td>– 4</td>
<td>µs</td>
</tr>
<tr>
<td>tr</td>
<td>“L-H” rise time</td>
<td>V1=0→4V, TJ=100°C</td>
<td>–</td>
<td>2</td>
</tr>
<tr>
<td>TPDL</td>
<td>“H-L” propagation delay time</td>
<td>V1=5→0V, TJ=100°C</td>
<td>– 4</td>
<td>µs</td>
</tr>
<tr>
<td>tf</td>
<td>“H-L” fall time</td>
<td>V1=5→0V, TJ=100°C</td>
<td>–</td>
<td>3</td>
</tr>
</tbody>
</table>
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### PERFORMANCE CURVES

#### PROPAGATION DELAY TIME VS. AMBIENT TEMPERATURE (TYPICAL)

- **CONDITION**: 
  - $V_{CC}=10V$, $V_{EE}=-4V$
  - $R_{ex}=9Ω$, $R_{2}=1Ω$
  - $I_{PLH}=V_{IH}=5V$
  - $I_{PLH}=V_{IN}=0V$
  - $f=2000Hz$, $D.F.=50%$

- **Graph**:
  - X-axis: Ambient Temperature $T_a$ (°C)
  - Y-axis: Propagation Delay Time $t_{PLH}$ (µs)

#### INTERNAL POWER DISSIPATION VS. “H” DUTY FACTOR (TYPICAL)

- **CONDITION**: 
  - $V_{CC}=10V$, $V_{EE}=-4V$
  - $I_{OH}=0.3A$

- **Graph**:
  - X-axis: “H” Duty Factor $D.F.$ (%)
  - Y-axis: Internal Power Dissipation $P_D$ (mW)

#### ALLOWABLE POWER DISSIPATION VS. AMBIENT TEMPERATURE (MAXIMUM RATING)

- **CONDITION**: 
  - $V_{CC}=10V$, $V_{EE}=-4V$
  - $V_{IH}=5V$, $V_{LO}=1.5V$

- **Graph**:
  - X-axis: Ambient Temperature $T_a$ (°C)
  - Y-axis: Allowable Power Dissipation $P_D$ (W)

### PERFORMANCE CURVES

#### PROPAGATION DELAY TIME VS. REVERSE SUPPLY VOLTAGE (TYPICAL)

- **CONDITION**: 
  - $V_{CC}=10V$, $V_{EE}=-4V$
  - $I_{PLH}=V_{IH}=5V$
  - $I_{PLH}=V_{IN}=0V$
  - $f=2000Hz$, $D.F.=50%$

- **Graph**:
  - X-axis: Reverse Supply Voltage $V_{EE}$ (V)
  - Y-axis: Propagation Delay Time $t_{PLH}$ (µs)

#### INTERNAL POWER DISSIPATION VS. “H” DUTY FACTOR (TYPICAL)

- **CONDITION**: 
  - $V_{CC}=10V$, $V_{EE}=-4V$
  - $I_{OH}=0.45A$

- **Graph**:
  - X-axis: “H” Duty Factor $D.F.$ (%)
  - Y-axis: Internal Power Dissipation $P_D$ (mW)

#### “H” OUTPUT CURRENT VS. “H” LIMITING RESISTOR (TYPICAL)

- **CONDITION**: 
  - $V_{CC}=10V$, $V_{EE}=-4V$
  - $V_{IH}=5V$, $V_{LO}=1.5V$

- **Graph**:
  - X-axis: “H” Limiting Resistor $R_{ext}$ (Ω)
  - Y-axis: “H” Output Current $I_{OH}$ (mA)

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*Figures and data are typical values and may vary depending on specific conditions.*

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"L" OUTPUT PEAK CURRENT VS. REVERSE SUPPLY VOLTAGE (TYPICAL)

"L" OUTPUT PEAK CURRENT IOLP (A)

REVERSE SUPPLY VOLTAGE VEE (V)

CONDITION
VCC=10V, VEE=–4V

FOR TRANSISTOR MODULES

R2=1Ω
R3=3.3Ω
R4=18Ω
FOR QM30DY

R2=1Ω
R3=6Ω
R4=18Ω
FOR QM50DY

"H" OUTPUT VOLTAGE VS. REVERSE SUPPLY VOLTAGE (TYPICAL)

REVERSE SUPPLY VOLTAGE VEE (V)

"L" OUTPUT VOLTAGE VOL (V)

"H" DUTY FACTOR D. F. (%)

POWER DISSIPATION OF Rext VS. "H" DUTY FACTOR (TYPICAL)

AVERAGE POWER DISSIPATION OF Rext (W)

"H" DUTY FACTOR D. F. (%)

CONDITION
VCC=10V, VEE=–4V

VOL=1.6V

IOLP=0.9A
FOR QM50DY

IOLP=0.45A
FOR QM30DY

OUTPUT CHARACTERISTIC OF FULL WAVE RECTIFYING CIRCUIT WITH CENTER-TAPPED TRANSFORMER (FOR REFERENCE)

AVERAGE LOAD CURRENT ILOAD (A)

OUTPUT VOLTAGE VO (V)

RIPPLE AMPLITUDE

VOL

LOAD: QM50DY

T: 8V, 1AX2 CENTER-TAPPED TRANSFORMER
C1: 4700µF, C2: 470µF

T = CENTER-TAPPED TRANSFORMER
Vc = VCC
Ic = ILOAD
Ic = IC
T: 1AX2 CENTER-TAPPED TRANSFORMER
C1: 4700µF, C2: 470µF
EXPLANATION OF FUNCTION
(cf. Fig. 2, 3, 4, and 5)

(1) With low input level \( (V_{in}=0 \sim 1\text{V}) \)
   \[ \text{Tr1 \ldots OFF, Tr2 \ldots ON} \]
   The base terminal of transistor module is reverse biased with respect to its emitter by reverse power supply \( V_{EE} \).

(2) With high input level \( (V_{in}=4 \sim 5\text{V}) \)
   \[ \text{Tr1 \ldots ON, Tr2 \ldots OFF} \]
   The base terminal of transistor module is forward biased and driven by the current \( I_{OH} \) through the resistor \( R_{ext} \).

(3) With low input level \( (V_{in}=0 \sim 1\text{V}) \)
   \[ \text{Tr1 \ldots OFF, Tr2 \ldots ON} \]
   The base terminal of transistor module is reverse biased as stated in (1) after flowing reverse recovery pulse current \( I_{OLP} \). The steady reverse base current is limited by the internal base-emitter resistor \( R_{Be} \) of the transistor module.

Typical application circuit

Typical operating waveform

\[ \text{Note: } I_{OH} \text{ and } I_{OLP} \text{ correspond to base forward current } I_{B1} \text{ and base reverse current } I_{B2} \text{ of the transistor module to be driven respectively.} \]