CTM452, CTM453
5 Pin Mini-Flat
1 Mbit/s High Speed Transistor Coupler

Features
- High speed 1Mbit/s
- High isolation voltage between input and output (Viso=3750 Vrms)
- Guaranteed CTR performance from 0°C to 70°C
- Wide operating temperature range of -55°C to 100°C
- Green Package
- Regulatory Approvals
  - UL - UL1577 (E364000)
  - VDE - EN60747-5-5(VDE0884-5)
  - CQC – GB4943.1, GB8898
  - IEC60065, IEC60950

Description
The CTM452 and CTM453 devices each consist of an infrared emitting diode, optically coupled to a high speed photo detector transistor. A separate connection for the photodiode bias and output-transistor collector increase the speed by several orders of magnitude over conventional phototransistor couplers by reducing the base-collector capacitance of the input transistor.
The devices are packaged in a Mini-Flat package.

Applications
- Line receivers
- Telecommunication equipment
- Feedback loop in switch-mode power supplies
- Home appliances
- High speed logic ground isolation

Package Outline

Schematic

![Schematic Diagram]
### Absolute Maximum Rating at 25°C

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameters</th>
<th>Ratings</th>
<th>Units</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>VISO</td>
<td>Isolation voltage *1</td>
<td>3750</td>
<td>V_RMS</td>
<td></td>
</tr>
<tr>
<td>TOPR</td>
<td>Operating temperature</td>
<td>-55 ~ +100</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>TSTG</td>
<td>Storage temperature</td>
<td>-55 ~ +125</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>TSOL</td>
<td>Soldering temperature *2</td>
<td>260</td>
<td>°C</td>
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</table>

#### Emitter

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameters</th>
<th>Ratings</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>IF</td>
<td>Forward current</td>
<td>25</td>
<td>mA</td>
</tr>
<tr>
<td>IFP</td>
<td>Peak forward current (50% duty, 1ms P.W)</td>
<td>50</td>
<td>mA</td>
</tr>
<tr>
<td>IFTRANS</td>
<td>Peak transient current (≤1μs P.W,300pps)</td>
<td>1</td>
<td>A</td>
</tr>
<tr>
<td>VR</td>
<td>Reverse voltage</td>
<td>5</td>
<td>V</td>
</tr>
<tr>
<td>PD</td>
<td>Power dissipation</td>
<td>45</td>
<td>mW</td>
</tr>
</tbody>
</table>

#### Detector

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameters</th>
<th>Ratings</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD</td>
<td>Power dissipation</td>
<td>100</td>
<td>mW</td>
</tr>
<tr>
<td>I_O(AVG)</td>
<td>Average Output current</td>
<td>8</td>
<td>mA</td>
</tr>
<tr>
<td>I_O (Peak)</td>
<td>Peak Output current</td>
<td>16</td>
<td>mA</td>
</tr>
<tr>
<td>VO</td>
<td>Output voltage</td>
<td>0.5 to 20</td>
<td>V</td>
</tr>
<tr>
<td>VCC</td>
<td>Supply voltage</td>
<td>0.5 to 30</td>
<td>V</td>
</tr>
</tbody>
</table>
## Electrical Characteristics

\( T_A = 0 - 70^\circ C \) (unless otherwise specified). Typical values are measured at \( T_A = 25^\circ C \) and \( V_{CC}=5V \)

### Emitter Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameters</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_F )</td>
<td>Forward voltage</td>
<td>( I_F = 16mA )</td>
<td>-</td>
<td>1.45</td>
<td>1.6</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>( V_R )</td>
<td>Reverse Voltage</td>
<td>( I_R = 10\mu A )</td>
<td>5.0</td>
<td>-</td>
<td>-</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>( \Delta V_F/\Delta T_A )</td>
<td>Temperature coefficient of forward voltage</td>
<td>( I_F = 16mA )</td>
<td>-</td>
<td>-1.6</td>
<td>-</td>
<td>mV/^\circ C</td>
<td></td>
</tr>
</tbody>
</table>

### Detector Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameters</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I_{OH} )</td>
<td>Logic High Output Current</td>
<td>( I_F=0mA, V_O=V_{CC}=5.5V, T_A=25^\circ C )</td>
<td>-</td>
<td>0.001</td>
<td>0.5</td>
<td>( \mu A )</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>( I_F=0mA, V_O=V_{CC}=15V, T_A=25^\circ C )</td>
<td>-</td>
<td>0.01</td>
<td>1</td>
<td>( \mu A )</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>( I_F=0mA, V_O=V_{CC}=15V )</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>( \mu A )</td>
<td></td>
</tr>
<tr>
<td>( I_{CCL} )</td>
<td>Logic Low Supply Current</td>
<td>( I_F=16mA, V_O=Open, V_{CC}=15V )</td>
<td>-</td>
<td>120</td>
<td>200</td>
<td>( \mu A )</td>
<td></td>
</tr>
<tr>
<td>( I_{CCH} )</td>
<td>Logic High Supply Current</td>
<td>( I_F=0mA, V_O=Open, V_{CC}=15V, T_A=25^\circ C )</td>
<td>-</td>
<td>0.01</td>
<td>1</td>
<td>( \mu A )</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>( I_F=0mA, V_O=Open, V_{CC}=15V )</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>( \mu A )</td>
<td></td>
</tr>
</tbody>
</table>
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Electrical Characteristics

$T_A = 0 - 70^\circ C$ (unless otherwise specified). Typical values are measured at $T_A = 25^\circ C$ and $V_{CC}=5V$

Transfer Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameters</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTR</td>
<td>Current Transfer Ratio</td>
<td>$I_F=16mA$, $V_O=0.4V$, $V_{CC}=4.5V$, $T_A=25^\circ C$</td>
<td>20</td>
<td>-</td>
<td>50</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_F=16mA$, $V_O=0.5V$, $V_{CC}=4.5V$</td>
<td>15</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Logic Low Output Voltage</td>
<td>$I_F=16mA$, $I_O=3mA$, $V_{CC}=4.5V$, $T_A=25^\circ C$</td>
<td>-</td>
<td>-</td>
<td>0.4</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_F=16mA$, $I_O=2.4mA$, $V_{CC}=4.5V$</td>
<td>-</td>
<td>-</td>
<td>0.5</td>
<td></td>
<td></td>
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</tbody>
</table>

Electrical Characteristics

$T_A = 0 - 70^\circ C$ (unless otherwise specified). Typical values are measured at $T_A = 25^\circ C$ and $V_{CC}=5V$

Switching Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameters</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_{PHL}$</td>
<td>Propagation Delay Time Logic High to Logic Low</td>
<td>$I_F=16mA$, $R_L=1.9K\Omega$, $T_A=25^\circ C$</td>
<td>-</td>
<td>0.35</td>
<td>0.8</td>
<td>$\mu s$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_F=16mA$, $R_L=1.9K\Omega$</td>
<td>-</td>
<td>-</td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$T_{PLH}$</td>
<td>Propagation Delay Time Logic Low to Logic High</td>
<td>$I_F=16mA$, $R_L=1.9K\Omega$, $T_A=25^\circ C$</td>
<td>-</td>
<td>0.3</td>
<td>0.8</td>
<td>$\mu s$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_F=16mA$, $R_L=1.9K\Omega$</td>
<td>-</td>
<td>-</td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$CM_H$</td>
<td>Common Mode Transient Immunity at Logic High</td>
<td>CTM452</td>
<td>$I_F = 0mA$, $V_{CM}=10V_{p-p}$, $R_L=1.9K\Omega$, $T_A=25^\circ C$</td>
<td>5,000</td>
<td>-</td>
<td>-</td>
<td>$V/\mu s$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CTM453</td>
<td>$I_F = 0mA$, $V_{CM}=1500V_{p-p}$, $R_L=1.9K\Omega$, $T_A=25^\circ C$</td>
<td>15,000</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>$CM_L$</td>
<td>Common Mode Transient Immunity at Logic Low</td>
<td>CTM452</td>
<td>$I_F = 16mA$, $V_{CM}=10V_{p-p}$, $R_L=1.9K\Omega$, $T_A=25^\circ C$</td>
<td>5,000</td>
<td>-</td>
<td>-</td>
<td>$V/\mu s$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CTM453</td>
<td>$I_F = 16mA$, $V_{CM}=1500V_{p-p}$, $R_L=1.9K\Omega$, $T_A=25^\circ C$</td>
<td>15,000</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>
CTM452, CTM453

5 Pin Mini-Flat

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Typical Characteristic Curves

- **Forward Current vs. Forward Voltage**
  - $T_a=70^\circ C$
  - $T_a=85^\circ C$
  - $T_a=100^\circ C$
  - $T_a=40^\circ C$

- **Normalized CurrentTransfer Ratio vs. Input Current**
  - $V_c=0.4V, V_e=5V$
  - Normalized to
  - $I_e=16mA$
  - $T_a=25^\circ C$

- **Normalized CTR vs. Ambient Temperature**
  - $I_e=16mA$
  - $V_o=4.5V$
  - $V_o=0.4V$

- **Output Current vs. Forward Current**
  - $V_e=4.5V$
  - $V_o=0.4V$
  - $T_a=25^\circ C$

- **Logic High Output Current vs. Ambient Temperature**
  - $I_e=10mA$
  - $V_o=5V$
  - $V_o=15V$

- **Output Current vs. Ambient Temperature**
  - $I_e=16mA$
  - $V_e=0.4V$
  - $V_o=4.5V$

Figure 1

Figure 2

Figure 4

Figure 5

Figure 6
Typical Characteristic Curves

- **Logic Low Supply Current vs. Ambient Temperature**
  - $I_{CC}=16\text{mA}$
  - $V_{CC}=5\text{V}$
  - $V_{OL}=15\text{V}$

- **Propagation Delay vs. Ambient Temperature**
  - $I_{CC}=16\text{mA}$
  - $V_{CC}=5\text{V}$
  - $R_{L}=1.9\text{k}\Omega$

- **Propagation Delay vs. Load Resistance**
  - $T_{P}=25^\circ\text{C}$
  - $V_{CC}=5\text{V}$

- **Normalized Response vs. Frequency**
  - $I_{CC}=16\text{mA}$
  - $V_{CC}=5\text{V}$
  - $T_{P}=25^\circ\text{C}$
  - $RL=100\text{k}\Omega$
  - $RL=220\text{k}\Omega$
  - $RL=1\text{k}\Omega$
  - $RL=47\text{k}\Omega$
  - $RL=1\text{k}\Omega$

Figure 7
Figure 8
Figure 9
Figure 10
Test Circuits

1/f = 100μS
DC = 10%
tr = 5ns

Switching Time Test Circuit
CTM452, CTM453
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Test Circuits

CMR Test Circuit
CTM452, CTM453
5 Pin Mini-Flat
1 Mbit/s High Speed Transistor Coupler

Package Dimension Dimensions in mm unless otherwise stated

Recommended Solder Mask Dimensions in mm unless otherwise stated
CTM452, CTM453
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Marking Information

CT M453 VYWWK

Note:
CT : Denotes “CT Micro”
M453 : Product Number
V : VDE Option
Y : Fiscal Year
WW : Work Week
K : Production Code

Ordering Information

CTM45X(V)(Z)

X = Part No. (X=2 or 3)
V = VDE Option (V or none)
Z = Tape and reel option (T1, T2, T3 or T4)

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>Quantity</th>
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<tbody>
<tr>
<td>T1</td>
<td>Surface Mount Lead Forming – With Option 1 Tapping</td>
<td>3000 Units/Reel</td>
</tr>
<tr>
<td>T2</td>
<td>Surface Mount Lead Forming – With Option 2 Tapping</td>
<td>3000 Units/Reel</td>
</tr>
<tr>
<td>T3</td>
<td>Surface Mount Lead Forming – With Option 3 Tapping</td>
<td>3000 Units/Reel</td>
</tr>
<tr>
<td>T4</td>
<td>Surface Mount Lead Forming – With Option 4 Tapping</td>
<td>3000 Units/Reel</td>
</tr>
</tbody>
</table>
Carrier Tape Specifications *Dimensions in mm unless otherwise stated*

**Option T1**

Input Direction

4.00 - 2.00 - \( \phi 1.50 \) - 1.75

8.00

**Option T2**

Input Direction

4.00 - 2.00 - \( \phi 1.50 \) - 1.75

8.00
Option T3

**Input Direction**

4.00 \(\rightarrow\) 2.00 \(\rightarrow\) 1.50 \(\phi\) \(\rightarrow\) 5.50

8.00

12.00

2.48

---

Option T4

**Input Direction**

4.00 \(\rightarrow\) 2.00 \(\rightarrow\) 1.50 \(\phi\) \(\rightarrow\) 5.50

8.00

12.00

2.48
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Reflow Profile

<table>
<thead>
<tr>
<th>Profile Feature</th>
<th>Pb-Free Assembly Profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Min. (Tmin)</td>
<td>150°C</td>
</tr>
<tr>
<td>Temperature Max. (Tmax)</td>
<td>200°C</td>
</tr>
<tr>
<td>Time (ts) from (Tmin to Tmax)</td>
<td>60-120 seconds</td>
</tr>
<tr>
<td>Ramp-up Rate (tl to tp)</td>
<td>3°C/second max.</td>
</tr>
<tr>
<td>Liquidous Temperature (Tl)</td>
<td>217°C</td>
</tr>
<tr>
<td>Time (tl) Maintained Above (Tl)</td>
<td>60 – 150 seconds</td>
</tr>
<tr>
<td>Peak Body Package Temperature</td>
<td>260°C +0°C / -5°C</td>
</tr>
<tr>
<td>Time (tp) within 5°C of 260°C</td>
<td>30 seconds</td>
</tr>
<tr>
<td>Ramp-down Rate (Tp to Tl)</td>
<td>6°C/second max</td>
</tr>
<tr>
<td>Time 25°C to Peak Temperature</td>
<td>8 minutes max.</td>
</tr>
</tbody>
</table>
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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.