6N137, CT2601
10MBit/s High Speed Logic Gate Optocoupler

Features
- High speed 10MBit/s
- High isolation voltage between input and output (Viso=5000 Vrms)
- Guaranteed performance from -40°C to 85°C
- Wide operating temperature range of -55°C to 100°C
- Regulatory Approvals
  - UL - UL1577 (E364000)
  - VDE - EN60747-5-5(VDE0884-5)
  - CQC – GB4943.1, GB8898
  - IEC60065, IEC60950

Description
The 6N137, CT2601 optocouplers consist of a 850 nm AlGaAs LED, optically coupled to a very high speed integrated photo-detector logic gate with a strobable output. This output features an open collector, there by permitting wired OR outputs. The switching parameters are guaranteed over the temperature range of -40°C to +85°C. A maximum input signal of 5mA will provide a minimum output sink current of 13mA (fan out of 8).

Applications
- Line receivers
- Telecommunication equipment
- Feedback loop in switch-mode power supplies
- Home appliances

Package Outline

Schematic

Note: Different lead forming options available. See package dimension.
### 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</td>
<td>5000</td>
<td>V RMS</td>
<td>1</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</td>
<td>260</td>
<td>°C</td>
<td>2</td>
</tr>
</tbody>
</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>50</td>
<td>mA</td>
</tr>
<tr>
<td>VR</td>
<td>Reverse voltage</td>
<td>5</td>
<td>V</td>
</tr>
<tr>
<td>PI</td>
<td>Power dissipation</td>
<td>100</td>
<td>mW</td>
</tr>
</tbody>
</table>

**Detector**

<table>
<thead>
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<th>Parameters</th>
<th>Ratings</th>
<th>Units</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO</td>
<td>Power dissipation</td>
<td>85</td>
<td>mW</td>
<td></td>
</tr>
<tr>
<td>IO</td>
<td>Average Output current</td>
<td>50</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>VO</td>
<td>Output voltage</td>
<td>7.0</td>
<td>V</td>
<td>1min(Max.)</td>
</tr>
<tr>
<td>VCC</td>
<td>Supply voltage</td>
<td>7.0</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>VE</td>
<td>Enable Input Voltage Not to Exceed VCC by more than 500mV</td>
<td>5.5</td>
<td>V</td>
<td></td>
</tr>
</tbody>
</table>

**Notes**

1. AC for 1 minute, RH = 40 ~ 60%.
2. For 10 second peak
## Electrical Characteristics

*TA* = -40 - 85°C (unless otherwise specified). Typical values are measured at *TA* = 25°C and *VCC*=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>VF</td>
<td>Forward voltage</td>
<td>IF = 10mA</td>
<td>-</td>
<td>1.4</td>
<td>1.6</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>VR</td>
<td>Reverse Voltage</td>
<td>IR = 10μA</td>
<td>5.0</td>
<td>-</td>
<td>-</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>ΔVF/ΔTA</td>
<td>Temperature coefficient of forward voltage</td>
<td>IF =10mA</td>
<td>-</td>
<td>-1.8</td>
<td>-</td>
<td>mV/^°C</td>
<td></td>
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</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>ICCH</td>
<td>Logic High Supply Current</td>
<td>IF=0mA, <em>VCC</em>=0.5V, <em>VCC</em>=3.3V</td>
<td>-</td>
<td>4.0</td>
<td>10</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>IF=0mA, <em>VCC</em>=0.5V, <em>VCC</em>=5.5V</td>
<td>-</td>
<td>6.5</td>
<td>10</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>ICLL</td>
<td>Logic Low Supply Current</td>
<td>IF=10mA, <em>VCC</em>=0.5V, <em>VCC</em>=3.3V</td>
<td>-</td>
<td>5.5</td>
<td>13</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>IF=10mA, <em>VCC</em>=0.5V, <em>VCC</em>=5.5V</td>
<td>-</td>
<td>8.8</td>
<td>13</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>VEH</td>
<td>High Level Enable Voltage</td>
<td>IF=10mA, <em>VCC</em>=3.3V</td>
<td>2.0</td>
<td>-</td>
<td>-</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>IF=10mA, <em>VCC</em>=5.5V</td>
<td>2.0</td>
<td>-</td>
<td>-</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>VEL</td>
<td>Low Level Enable Voltage</td>
<td>IF=10mA, <em>VCC</em>=3.3V</td>
<td>-</td>
<td>-</td>
<td>0.8</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>IF=10mA, <em>VCC</em>=5.5V</td>
<td>-</td>
<td>-</td>
<td>0.8</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>IEH</td>
<td>High Level Enable Current</td>
<td><em>VCE</em>=2.0V, <em>VCC</em>=3.3V</td>
<td>-</td>
<td>-0.2</td>
<td>-1.6</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>VCE</em>=2.0V, <em>VCC</em>=5.5V</td>
<td>-</td>
<td>-0.53</td>
<td>-1.6</td>
<td>mA</td>
<td></td>
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<tr>
<td>IEL</td>
<td>Low Level Enable Current</td>
<td><em>VCE</em>=0.5V, <em>VCC</em>=3.3V</td>
<td>-</td>
<td>-0.42</td>
<td>-1.6</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>VCE</em>=0.5V, <em>VCC</em>=5.5V</td>
<td>-</td>
<td>-0.75</td>
<td>-1.6</td>
<td>mA</td>
<td></td>
</tr>
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</table>

### 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>IFT</td>
<td>Input Threshold Current</td>
<td><em>VCC</em>=3.3V, <em>VCE</em>=0.6V, * <em>VCC</em>=2.0V, <em>I0</em>=13mA</td>
<td>-</td>
<td>1.6</td>
<td>5</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>VCC</em>=5.5V, <em>VCE</em>=0.6V, * <em>VCC</em>=2.0V, <em>I0</em>=13mA</td>
<td>-</td>
<td>2.5</td>
<td>5</td>
<td>mA</td>
<td></td>
</tr>
</tbody>
</table>
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| \( I_{OH} \) | Logic High Output Current | \( I_f = 250\mu A, V_O = V_{CC} = 3.3\,V, V_E = 2.0\,V \) | - | 7.0 | 100 | \( \mu A \) |
| \( V_{OL} \) | Low Level Output Voltage | \( I_f = 5mA, V_{CC} = 3.3\,V, V_E = 2.0\,V, I_O = 13mA \) | - | 0.45 | 0.6 | \( V \) |

Electrical Characteristics

\( T_A = -40 - 85^\circ C \) (unless otherwise specified). Typical values are measured at \( T_A = 25^\circ C, V_{CC} = 5V \) and \( I_f = 7.5mA \)

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>Output Propagation Delay High to Low</td>
<td>( C_L = 15pF, R_L = 350,\Omega V_{CC} = 3.3,V )</td>
<td>-</td>
<td>34</td>
<td>75</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>( C_L = 15pF, R_L = 350,\Omega V_{CC} = 5.5,V )</td>
<td>-</td>
<td>34</td>
<td>75</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>( T_{PLH} )</td>
<td>Output Propagation Delay Low to High</td>
<td>( C_L = 15pF, R_L = 350,\Omega V_{CC} = 3.3,V )</td>
<td>-</td>
<td>50</td>
<td>75</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>( C_L = 15pF, R_L = 350,\Omega V_{CC} = 5.5,V )</td>
<td>-</td>
<td>39</td>
<td>75</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>( P_{WD} )</td>
<td>Pulse Width Distortion</td>
<td>( C_L = 15pF, R_L = 350,\Omega V_{CC} = 3.3,V )</td>
<td>-</td>
<td>5</td>
<td>34</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>( C_L = 15pF, R_L = 350,\Omega V_{CC} = 5.5,V )</td>
<td>-</td>
<td>16</td>
<td>34</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>( T_r )</td>
<td>Output Rise Time</td>
<td>( C_L = 15pF, R_L = 350,\Omega V_{CC} = 3.3,V )</td>
<td>-</td>
<td>37</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>( C_L = 15pF, R_L = 350,\Omega V_{CC} = 5.5,V )</td>
<td>-</td>
<td>37</td>
<td>-</td>
<td>ns</td>
<td></td>
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<tr>
<td>( T_f )</td>
<td>Output Fall Time</td>
<td>( C_L = 15pF, R_L = 350,\Omega V_{CC} = 3.3,V )</td>
<td>-</td>
<td>10</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>( C_L = 15pF, R_L = 350,\Omega V_{CC} = 5.5,V )</td>
<td>-</td>
<td>10</td>
<td>-</td>
<td>ns</td>
<td></td>
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<tr>
<td>( T_{ELH} )</td>
<td>Enable Propagation Delay Low To High</td>
<td>( V_{EH} = 3.5,V, C_L = 15pF, R_L = )</td>
<td>-</td>
<td>15</td>
<td>-</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>( T_{EHL} )</td>
<td>Enable Propagation Delay High To Low</td>
<td>( 350,\Omega )</td>
<td>-</td>
<td>15</td>
<td>-</td>
<td>ns</td>
<td></td>
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<tr>
<td>( C_{MH} )</td>
<td>Common Mode Transient Immunity at Logic High</td>
<td>( I_f = 0mA, V_{CM} = 50Vp-p, V_{OH} = 2.0,V, R_L = 350,\Omega )</td>
<td>6N137</td>
<td>10000</td>
<td>-</td>
<td>V/( \mu s )</td>
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<tr>
<th>CML</th>
<th>Common Mode Transient Immunity at Logic Low</th>
<th>6N137</th>
<th>10000</th>
<th>-</th>
<th>V/µs</th>
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<tr>
<td></td>
<td>IF=7.5mA, VCM= 50Vp-p, VOL= 0.8V, Rₐ= 350Ω</td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td>CT2601</td>
<td>5000</td>
<td>10000</td>
<td>-</td>
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</table>
Typical Characteristic Curves

**Figure 1**
LED Forward Current vs. Forward Voltage

**Figure 2**
Input Threshold Current vs. Ambient Temperature

**Figure 3**
Input Threshold Current vs. Ambient Temperature

**Figure 4**
Low Level Output Current vs. Ambient Temperature

**Figure 5**
Low Level Output Voltage vs. Ambient Temperature
Typical Characteristic Curves

Low Level Output Voltage vs. Ambient Temperature

- $I_o = 5\text{mA}$
- $V_c = 5.5\text{V}$
- $V_i = 2\text{V}$

$V_o = 16\text{mA}$
$I_o = 12.8\text{mA}$

High Level Output Voltage vs. Ambient Temperature

- $I_o = 250\text{\mu A}$
- $V_c = 3.3\text{V}$
- $V_i = 3.5\text{V}$
- $V_i = 2.0\text{V}$

High Level Output Current vs. Ambient Temperature

- $I_o = 250\text{\mu A}$
- $V_c = 3.3\text{V}$

Output Voltage vs. Forward Current

- $V_c = 3.3\text{V}$

Propagation Delay vs. Forward Current

- $V_c = 3.3\text{V}$
- $T_i = 25^\circ C$
6N137, CT2601
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Figure 13: Propagation Delay vs. Forward Current

Figure 14: Rise And Fall Time vs. Ambient Temperature

Figure 15: Rise And Fall Time vs. Ambient Temperature

Figure 16: Propagation Delay vs. Ambient Temperature

Figure 17: Propagation Delay vs. Ambient Temperature

Figure 18: Pulse Width Distortion vs. Ambient Temperature
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**Figure 19**

Pulse Width Distortion vs. Ambient Temperature

- \( I_c = 7.5 mA \)
- \( V_{cc} = 5 V \)
- \( R = 4 k\Omega \)
- \( R = 1 k\Omega \)

**Figure 20**

Enable Propagation Delay vs. Ambient Temperature

- \( I_c = 7.5 mA \)
- \( V_{cc} = 3.3 V \)
- \( T_{pp} @ R = 4k\Omega \)
- \( T_{pp} @ R = 1k\Omega \)
- \( T_{pp} @ R > 350\Omega \)
- \( T_{pp} @ R = 550\Omega \)

**Figure 21**

Enable Propagation Delay vs. Ambient Temperature

- \( I_c = 7.5 mA \)
- \( V_{cc} = 5 V \)
- \( T_{pp} @ R = 4k\Omega \)
- \( T_{pp} @ R = 1k\Omega \)
- \( T_{pp} @ R > 350\Omega \)
- \( T_{pp} @ R = 550\Omega, 1k\Omega, 2k\Omega \)
Test Circuits

Switching Time Test Circuit
Test Circuits

Enable Switching Time Test Circuit
6N137, CT2601
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Test Circuits

CMR Test Circuit
Package Dimension  *Dimensions in mm unless otherwise stated*

**Standard DIP – Through Hole**

![Standard DIP – Through Hole Diagram]

**Gullwing (400mil) Lead Forming – Through Hole (M Type)**

![Gullwing (400mil) Lead Forming – Through Hole (M Type) Diagram]
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10MBit/s High Speed Logic Gate Optocoupler

Surface Mount Lead Forming (S Type)

Surface Mount (Low Profile) Lead Forming (SL Type)
Wide Surface Mount Forming (Low Profile) – SLM Type

Recommended Solder Mask *Dimensions in mm unless otherwise stated*
Device Marking

Note:
CT : Denotes “CT Micro”
6N137 : Product Number
2601 : Product Number
V : VDE Option
Y : Fiscal Year
WW : Work Week
K : Production Code

Ordering Information

6N137(V)(Y)(Z)-G ; CT2601(V)(Y)(Z)-G

CT = Denotes “CT Micro”
6N137 = Part Number
2601 = Part Number
V = VDE Option ( V or None)
Y = Lead form option (S, SL, M, SLM or none)
Z = Tape and reel option (T1, T2 or none)
G = Material option (G: Green, None: Non-green)
# 6N137, CT2601

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<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Standard 8 Pin Dip</td>
<td>40 Units/Tube</td>
</tr>
<tr>
<td>M</td>
<td>Gullwing (400mil) Lead Forming</td>
<td>40 Units/Tube</td>
</tr>
<tr>
<td>S(T1)</td>
<td>Surface Mount Lead Forming – With Option 1 Taping</td>
<td>1000 Units/Reel</td>
</tr>
<tr>
<td>S(T2)</td>
<td>Surface Mount Lead Forming – With Option 2 Taping</td>
<td>1000 Units/Reel</td>
</tr>
<tr>
<td>SL(T1)</td>
<td>Surface Mount (Low Profile) Lead Forming – With Option 1 Taping</td>
<td>1000 Units/Reel</td>
</tr>
<tr>
<td>SL(T2)</td>
<td>Surface Mount (Low Profile) Lead Forming – With Option 2 Taping</td>
<td>1000 Units/Reel</td>
</tr>
<tr>
<td>SLM(T1)</td>
<td>Surface Mount (Gullwing) Lead Forming – With Option 1 Taping</td>
<td>1000 Units/Reel</td>
</tr>
<tr>
<td>SLM(T2)</td>
<td>Surface Mount (Gullwing) Lead Forming – With Option 2 Taping</td>
<td>1000 Units/Reel</td>
</tr>
</tbody>
</table>
Carrier Tape Specifications  *Dimensions in mm unless otherwise stated*

Option S(T1) & SL(T1)

```
   4.00   2.00  Ø1.50   1.75

       7.50
       16.00

       12.00

       4.80
```

Option S(T2) & SL(T2)

```
   4.00   2.00  Ø1.50   1.75

       7.50
       16.00

       12.00

       4.80
```
Option SLM(T1)

Option SLM(T2)
Wave soldering (follow the JEDEC standard JESD22-A111)

One time soldering is recommended within the condition of temperature.
Temperature: 260+0/-5°C.
Time: 10 sec.
Preheat temperature: 25 to 140°C.
Preheat time: 30 to 80 sec.

Iron soldering (follow the standard MIL-STD 202G, Method 210F)

Allow single lead soldering in every single process.
One time soldering is recommended. Temperature: 350+±10°C
Time: 5 sec max.
Reflow Profile

Profile Feature | Pb-Free Assembly Profile
---|---
Temperature Min. (Tsmin) | 150°C
Temperature Max. (Tsmax) | 200°C
Time (ts) from (Tsmin to Tsmax) | 60-120 seconds
Ramp-up Rate (tl to tp) | 3°C/second max.
Liquidous Temperature (Tl) | 217°C
Time (tL) Maintained Above (Tl) | 60 – 150 seconds
Peak Body Package Temperature | 260°C +0°C / -5°C
Time (tp) within 5°C of 260°C | 30 seconds
Ramp-down Rate (Tp to Tl) | 6°C/second max
Time 25°C to Peak Temperature | 8 minutes max.
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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.