# 6N137, ICPL2601, ICPL2611

## DESCRIPTION

The 6N137, ICPL2601 and ICPL2611 devices each consists of an infrared emitting diode, optically coupled to a high speed integrated photo detector logic gate with a strobable output.

## FEATURES

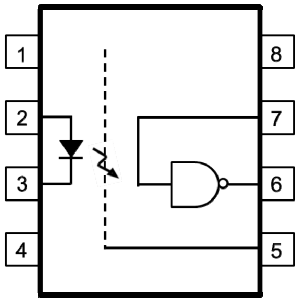
- High Speed 10Mbit/s
- Minimum Common Mode Transient Immunity 10kV/µs for ICPL2611
- High AC Isolation Voltage 5000$V_{RMS}$
- Guaranteed Performance from -40°C to 85°C
- Logic Gate Output
- Pb Free and RoHS Compliant
- UL File E91231 for 6N137 and ICPL2601
- VDE File 40044376 for 6N137
- Safety Approvals Pending for ICPL2611

## APPLICATIONS

- Line Receivers, Data Communication
- LSTTL to TTL, LSTTL or 5V CMOS
- Data Multiplexing
- Pulse Transformer Replacement
- Switch Mode Power Supplies
- Ground Loop Elimination
- Computer Peripheral Interface

## ORDER INFORMATION

- Add V after PN for VDE Approval for 6N137 only
- Add G after PN for 10mm Lead Spacing
- Add SM after PN for Surface Mount
- Add SMT&R after PN for Surface Mount Tape & Reel




1 NC
2 Anode
3 Cathode
4 NC
5 GND
6 $V_O$
7 $V_E$
8 $V_{CC}$

**A 0.1µF bypass Capacitor must be connected between Pins 8 and 5.**

## ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25°C)

**Stresses exceeding the absolute maximum ratings can cause permanent damage to the device.**
**Exposure to absolute maximum ratings for long periods of time can adversely affect reliability.**

| | |
|---|---|
| **Input** | |
| Forward Current | 50mA |
| Reverse Voltage | 5V |
| Power dissipation | 100mW |
| **Output** | |
| Output Current | 50mA |
| Output Voltage | 7.0V |
| Supply Voltage | 7.0V |
| Enable Input Voltage (maximum 500mV above $V_{CC}$) | 5.5V |
| Power Dissipation | 85mW |
| **Total Package** | |
| Isolation Voltage | 5000$V_{RMS}$ |
| Operating Temperature | -40 to 85 °C |
| Storage Temperature | -55 to 125 °C |
| Lead Soldering Temperature (10s) | 260°C |


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## Truth Table

| Input | Enable | Output |
|---|---|---|
| H | H | L |
| L | H | H |
| H | L | H |
| L | L | H |
| H | NC | L |
| L | NC | H |

## Recommended Operating Conditions

| Parameter | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| Operating Temperature | $T_A$ | - 40 | 85 | °C |
| Supply Voltage | $V_{CC}$ | 4.5 | 5.5 | V |
| Input Current, High Level | $I_{F(ON)}$ | 5 | 10 | mA |
| Input Current, Low Level | $I_{F(OFF)}$ | 0 | 250 | µA |
| Enable Voltage, High Level | $V_{EH}$ | 2.0 | $V_{CC}$ | V |
| Enable Voltage, Low Level | $V_{EL}$ | 0 | 0.8 | V |

## ELECTRICAL CHARACTERISTICS ($T_A$ = -40 to 85°C unless otherwise specified)

### INPUT

| Parameter | Symbol | Test Condition | Min | Typ.* | Max | Unit |
|---|---|---|---|---|---|---|
| Forward Voltage | $V_F$ | $I_F$ = 10mA | | 1.4 | 1.8 | V |
| Forward Voltage Temperature Coefficient | $\Delta V_F/\Delta T$ | $I_F$ = 10mA | | −1.8 | | mV/°C |
| Reverse Voltage | $V_R$ | $I_R$ = 10µA | 5.0 | | | V |
| Input Capacitance | $C_{IN}$ | $V_F$ = 0V, f = 1MHz | | 60 | | pF |

### OUTPUT

| Parameter | Symbol | Test Condition | Min | Typ.* | Max | Unit |
|---|---|---|---|---|---|---|
| High Level Supply Current | $I_{CCH}$ | $I_F$ = 0mA, $V_{CC}$ = 5.5V<br>$V_E$ = 0.5V | | 7 | 10 | mA |
| Low Level Supply Current | $I_{CCL}$ | $I_F$ = 10mA, $V_{CC}$ = 5.5V | | 9 | 13 | mA |
| High Level Output Current | $I_{OH}$ | $I_F$ = 250µA, $V_{CC}$ = 5.5V,<br>$V_E$ = 2.0V, $V_O$ = 5.5V | | 2.1 | 100 | µA |
| Low Level Output Voltage | $V_{OL}$ | $I_F$ = 5mA, $V_{CC}$ = 5.5V,<br>$V_E$ = 2.0V, $I_{OL}$ = 13mA | | 0.35 | 0.6 | V |
| High Level Enable Current | $I_{EH}$ | $V_{CC}$ = 5.5V, $V_E$ = 2.0V | | -0.6 | -1.6 | mA |
| Low Level Enable Current | $I_{EL}$ | $V_{CC}$ = 5.5V, $V_E$ = 0.5V | | -0.8 | -1.6 | mA |
| High Level Enable Voltage | $V_{EH}$ | $I_F$ = 10mA, $V_{CC}$ = 5.5V | 2.0 | | | V |
| Low Level Enable Voltage | $V_{EL}$ | $I_F$ = 10mA, $V_{CC}$ = 5.5V | | | 0.8 | V |

### COUPLED

| Parameter | Symbol | Test Condition | Min | Typ.* | Max | Unit |
|---|---|---|---|---|---|---|
| Input Threshold Current | $I_{FT}$ | $V_{CC}$ = 5.5V, $V_O$ = 0.6V<br>$V_E$ = 2.0V, $I_{OL}$ = 13mA | | 2.5 | 5 | mA |

* Typical values at $T_A$ = 25°C

## ELECTRICAL CHARACTERISTICS ($T_A$ = -40 to 85°C unless otherwise specified)

### SWITCHING ($I_F$ = 7.5mA, $V_{CC}$ = 5V unless otherwise specified)

| Parameter | Symbol | Test Condition | Min | Typ.* | Max | Unit |
|---|---|---|---|---|---|---|
| Propagation Delay Time to High Output Level | $t_{PLH}$ | $R_L$ = 350Ω, $C_L$ = 15pF, $T_A$ = 25°C | | 35 | 75 | ns |
| Propagation Delay Time to Low Output Level | $t_{PHL}$ | | | 40 | 75 | |
| Pulse Width Distortion | $\|t_{PHL} - t_{PLH}\|$ | $R_L$ = 350Ω, $C_L$ = 15pF | | 5 | 35 | |
| Output Rise Time (10% to 90%) | $t_r$ | | | 40 | | |
| Output Fall Time (90% to 10%) | $t_f$ | | | 10 | | |
| Enable Propagation Delay Time to High Output Level | $t_{ELH}$ | $V_{EH}$ = 3.5V, $R_L$ = 350Ω, $C_L$ = 15pF | | 15 | | |
| Enable Propagation Delay Time to Low Output Level | $t_{EHL}$ | | | 15 | | |

* Typical values at $T_A$ = 25°C

## ELECTRICAL CHARACTERISTICS ($T_A$ = -40 to 85°C unless otherwise specified)

### SWITCHING ($I_F$ = 7.5mA, $V_{CC}$ = 5V unless otherwise specified)

| Parameter | Symbol | Test Condition | Min | Typ.* | Max | Unit |
|---|---|---|---|---|---|---|
| Common Mode Transient Immunity at Logic High | $CM_H$ | 6N137<br>$I_F$ = 0mA, $V_{OH}$ = 2.0V, $R_L$ = 350Ω, $V_{CM}$ = 10Vp-p, $T_A$ = 25°C | | 5000 | | V/µs |
| | | ICPL2601<br>$I_F$ = 0mA, $V_{OH}$ = 2.0V, $R_L$ = 350Ω, $V_{CM}$ = 50Vp-p, $T_A$ = 25°C | 5000 | | | |
| | | ICPL2611<br>$I_F$ = 0mA, $V_{OH}$ = 2.0V, $R_L$ = 350Ω, $V_{CM}$ = 400Vp-p, $T_A$ = 25°C | 10000 | | | |
| | | ICPL2611<br>High CMR Test Circuit<br>$I_F$ = 0mA, $V_{OH}$ = 2.0V, $R_L$ = 350Ω, $V_{CM}$ = 400Vp-p, $T_A$ = 25°C | 20000 | | | |
| Common Mode Transient Immunity at Logic Low | $CM_L$ | 6N137<br>$I_F$ = 7.5mA, $V_{OL}$ = 0.8V, $R_L$ = 350Ω, $V_{CM}$ = 10Vp-p, $T_A$ = 25°C | | 5000 | | V/µs |
| | | ICPL2601<br>$I_F$ = 7.5mA, $V_{OL}$ = 0.8V, $R_L$ = 350Ω, $V_{CM}$ = 50Vp-p, $T_A$ = 25°C | 5000 | | | |
| | | ICPL2611<br>$I_F$ = 7.5mA, $V_{OL}$ = 0.8V, $R_L$ = 350Ω, $V_{CM}$ = 400Vp-p, $T_A$ = 25°C | 10000 | | | |
| | | ICPL2611<br>High CMR Test Circuit<br>$I_F$ = 7.5mA, $V_{OL}$ = 0.8V, $R_L$ = 350Ω, $V_{CM}$ = 400Vp-p, $T_A$ = 25°C | 20000 | | | |

* Typical values at $T_A$ = 25°C

## ELECTRICAL CHARACTERISTICS ($T_A$ = -40 to 85°C unless otherwise specified)

### ISOLATION

| Parameter | Symbol | Test Condition | Min | Typ.* | Max | Unit |
|---|---|---|---|---|---|---|
| Insulation Voltage | $V_{ISO}$ | RH = 40% - 60%, $T_A$ = 25°C t = 1 min, | 5000 | | | $V_{RMS}$ |

* Typical values at $T_A$ = 25°C

**Note :**

- $V_{CC}$ supply must be bypassed by a 0.1µF capacitor or larger with good high frequency characteristic and should be connected as close as possible to the package $V_{CC}$ and GND pins.
- Enable Input – No pull up resistor required as the device has an internal pull up resistor.
- $t_{PLH}$ is measured from the 3.75mA level on the HIGH to LOW transition of the input current pulse to the 1.5 V level on the LOW to HIGH transition of the output voltage pulse.
- $t_{PHL}$ is measured from the 3.75mA level on the LOW to HIGH transition of the input current pulse to the 1.5 V level on the HIGH to LOW transition of the output voltage pulse.
- $t_r$ Rise time is measured from the 10% to the 90% levels on the LOW to HIGH transition of the output pulse.
- $t_f$ Fall time is measured from the 90% to the 10% levels on the HIGH to LOW transition of the output pulse.
- $t_{ELH}$ is measured from the 1.5V level on the HIGH to LOW transition of the input Enable voltage pulse to the 1.5V level on the LOW to HIGH transition of the output voltage pulse.
- $t_{EHL}$ is measured from the 1.5V level on the LOW to HIGH transition of the input Enable voltage pulse to the 1.5V level on the HIGH to LOW transition of the output voltage pulse.
- $CM_H$ – The maximum tolerable rate of rise of the Common Mode voltage to ensure the output will remain in the HIGH state (i.e., $V_O$ > 2.0V).
- $CM_L$ – The maximum tolerable rate of rise of the Common Mode voltage to ensure the output will remain in the LOW output state (i.e., $V_O$ < 0.8V).

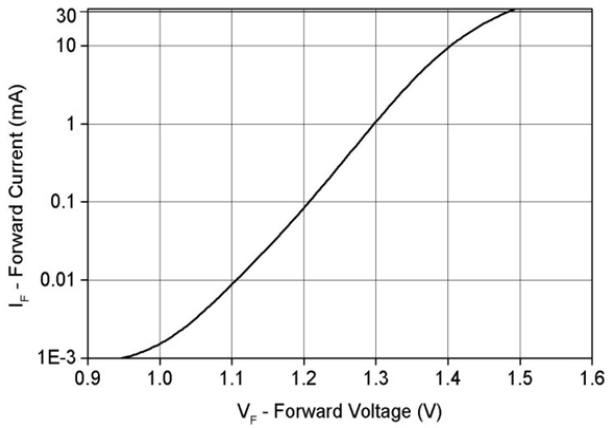



**Fig 1 Forward Current vs Forward Voltage**

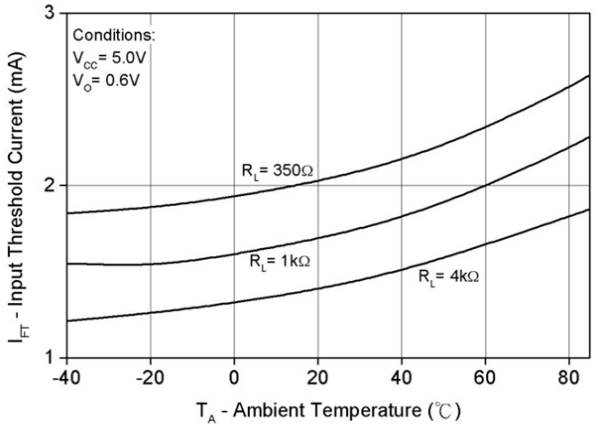



**Fig 2 Input Threshold Current vs $T_A$**

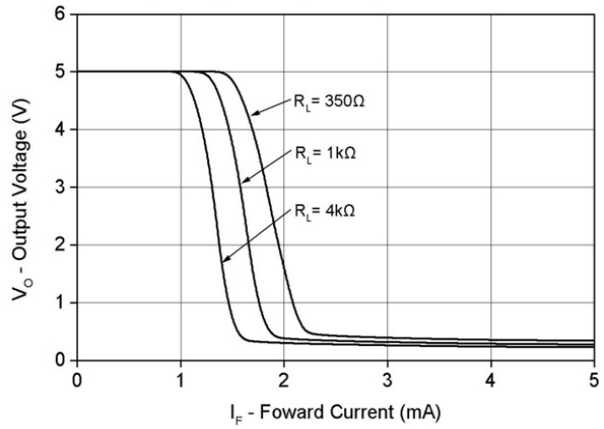



**Fig 3 Output Voltage vs Forward Current**

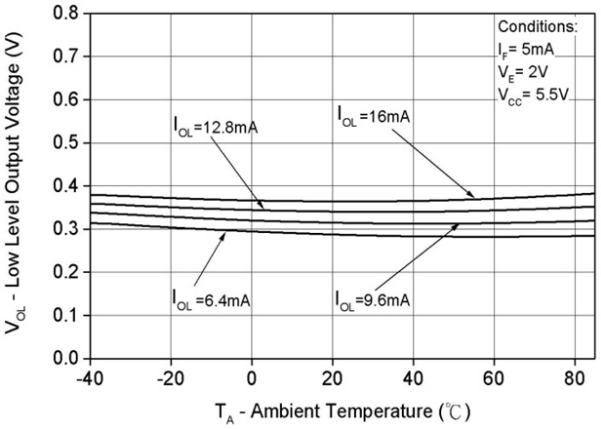



**Fig 4 Output Low Level Voltage vs $T_A$**

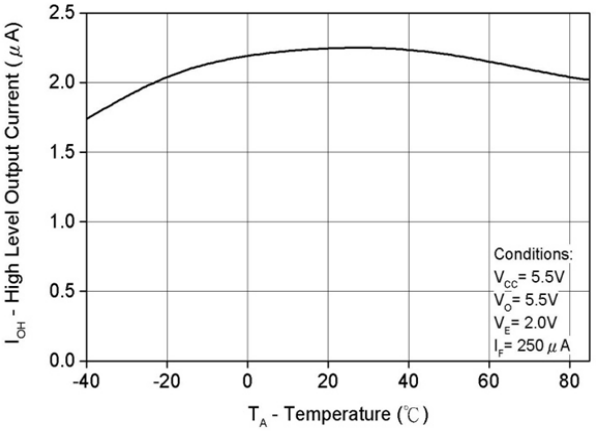



**Fig 5 Output High Level Current vs $T_A$**

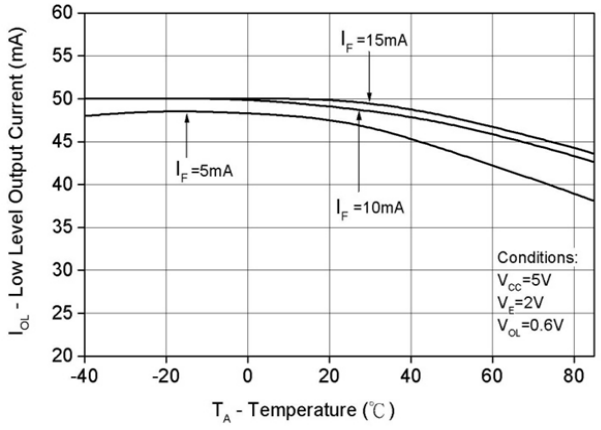



**Fig 6 Output Low Level Current vs $T_A$**

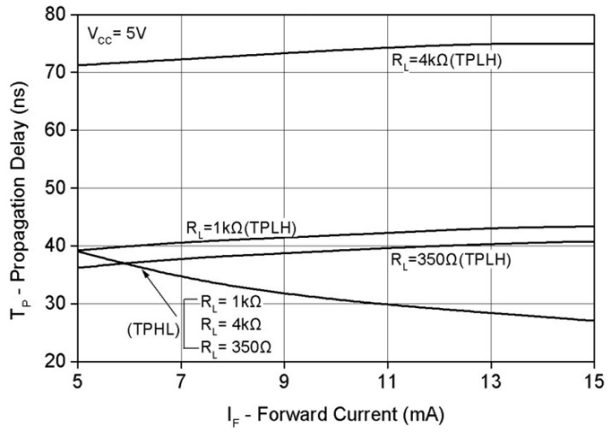



**Fig 7 Propagation Delay vs Forward Current**

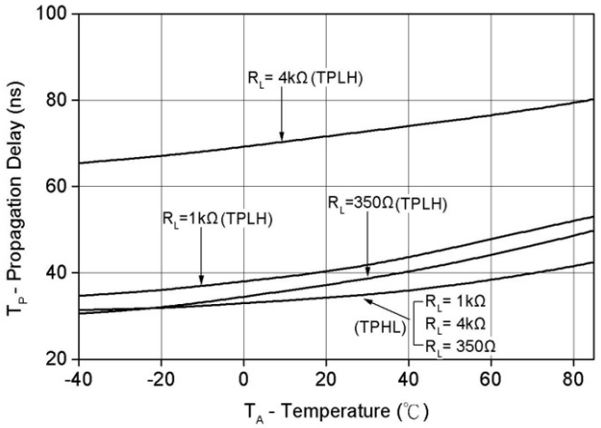



**Fig 8 Propagation Delay vs $T_A$**

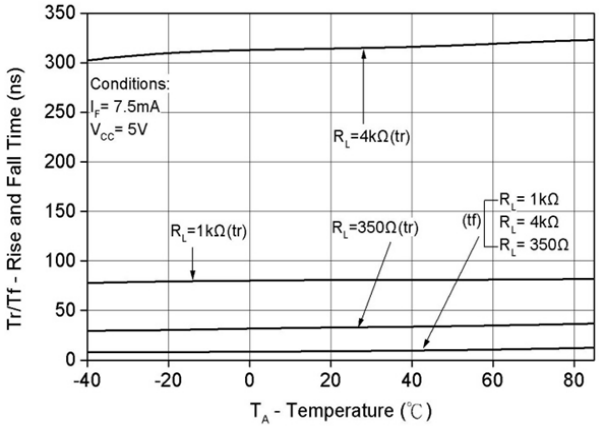



**Fig 9 Rise / Fall Time vs $T_A$**

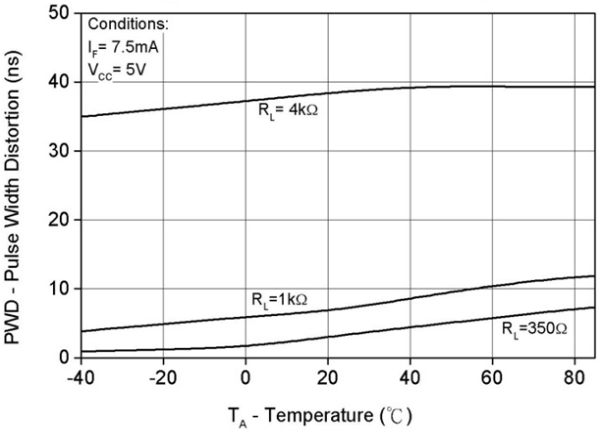



**Fig 10 Pulse Width Distortation vs $T_A$**

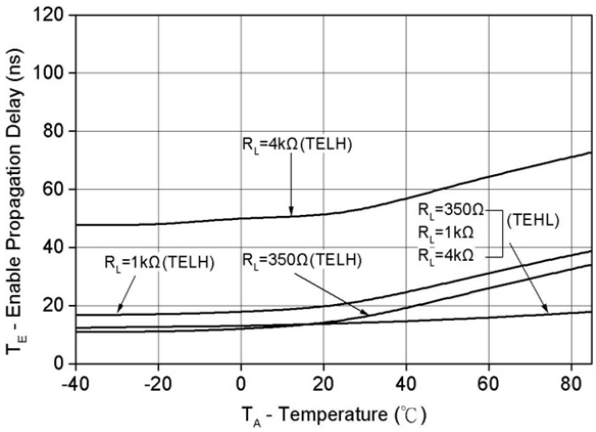
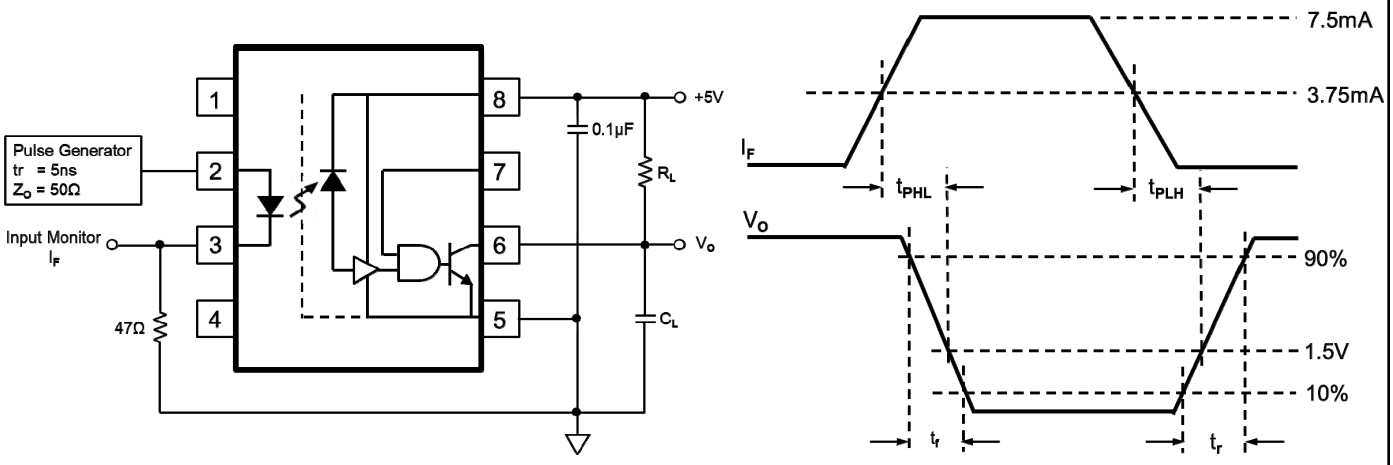
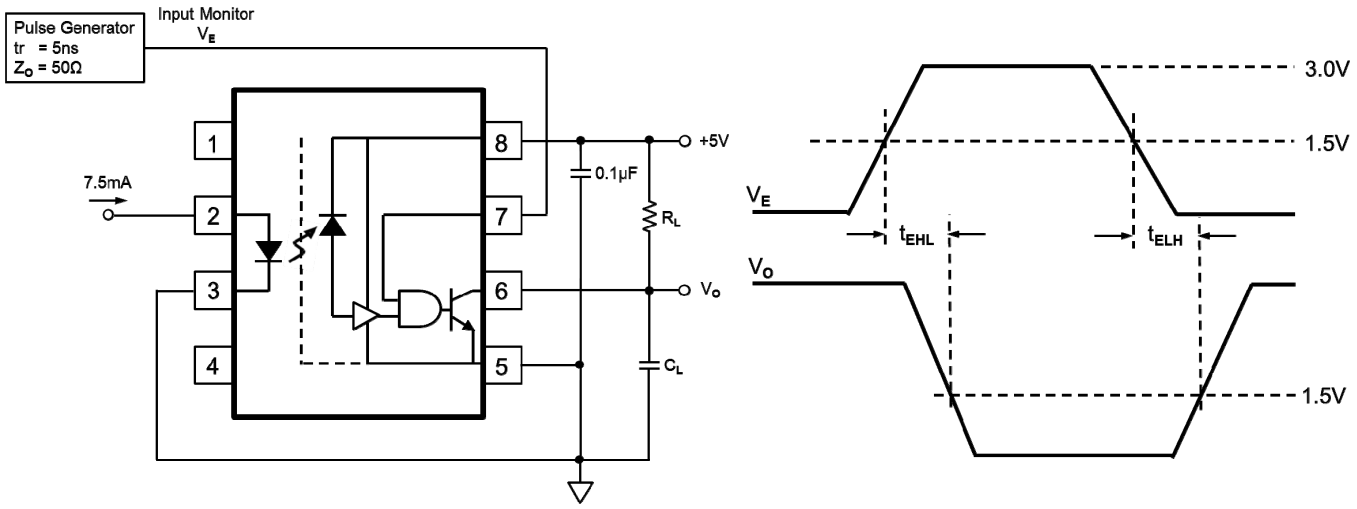


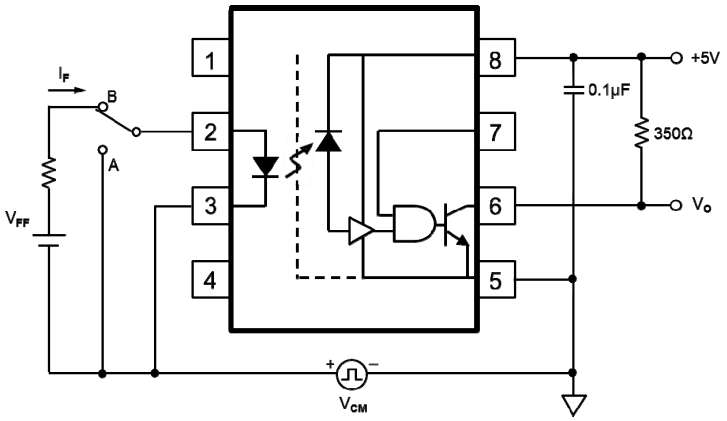

**Fig 11 Enable Propagation Delay vs $T_A$**

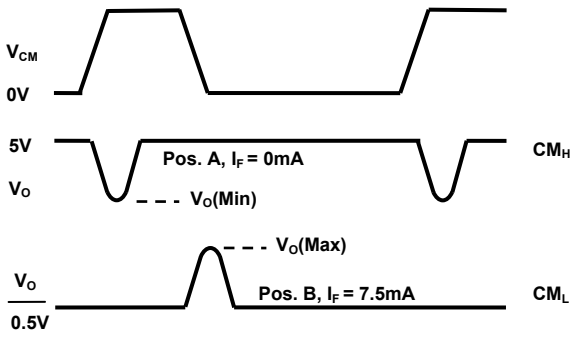



**$t_r$, $t_f$, $t_{PLH}$ and $t_{PHL}$ Test Circuit**

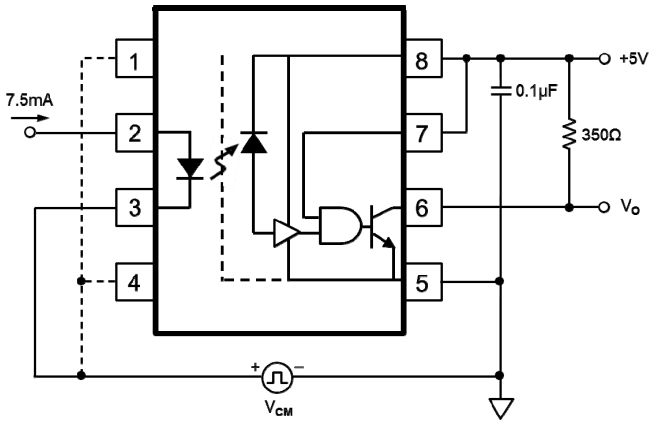



**CMR Test Circuit**




**CMR Test Circuit**




**High CMR Test Circuit for ICPL2611**

## ORDER INFORMATION

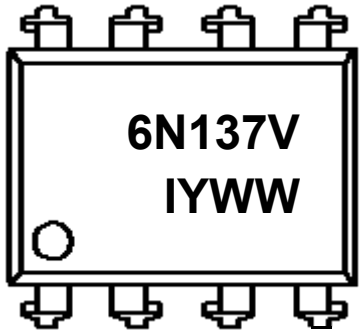
| UL Approval | | | |
|---|---|---|---|
| **After PN** | **PN** | **Description** | **Packing quantity** |
| None | 6N137, ICPL2601 | Standard DIP8 | 45 pcs per tube |
| G | 6N137G, ICPL2601G | 10mm Lead Spacing | 45 pcs per tube |
| SM | 6N137SM, ICPL2601SM | Surface Mount | 45 pcs per tube |
| SMT&R | 6N137SMT&R, ICPL2601SMT&R | Surface Mount Tape & Reel | 1000 pcs per reel |
| **NOTE : 6N137V may be supported when ordering 6N137** | | | |

| UL and VDE Approvals | | | |
|---|---|---|---|
| **After PN** | **PN** | **Description** | **Packing quantity** |
| None | 6N137V | Standard DIP8 | 45 pcs per tube |
| G | 6N137VG | 10mm Lead Spacing | 45 pcs per tube |
| SM | 6N137VSM | Surface Mount | 45 pcs per tube |
| SMT&R | 6N137VSMT&R | Surface Mount Tape & Reel | 1000 pcs per reel |

| Safety Approval Pending | | | |
|---|---|---|---|
| **After PN** | **PN** | **Description** | **Packing quantity** |
| None | ICPL2611 | Standard DIP8 | 45 pcs per tube |
| G | ICPL2611G | 10mm Lead Spacing | 45 pcs per tube |
| SM | ICPL2611SM | Surface Mount | 45 pcs per tube |
| SMT&R | ICPL2611SMT&R | Surface Mount Tape & Reel | 1000 pcs per reel |

**DEVICE MARKING**

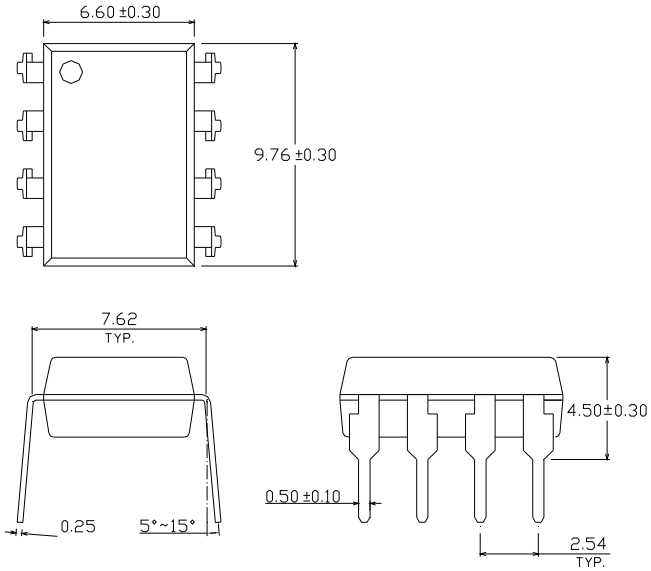
**Example : 6N137V**



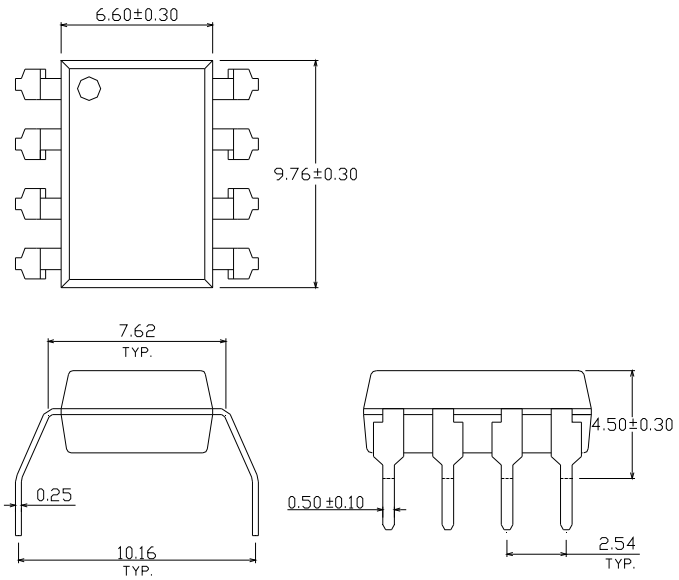

| | |
|---|---|
| 6N137V | denotes Device Part Number |
| **I** | denotes Isocom |
| Y | denotes 1 digit Year code |
| WW | denotes 2 digit Week code |

## PACKAGE DIMENSIONS (mm)

### DIP

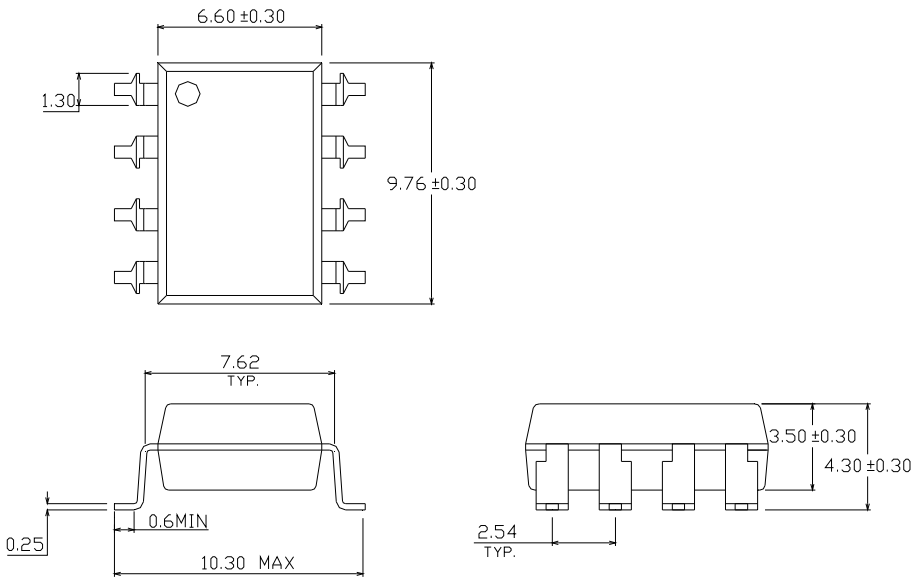



### G-Form

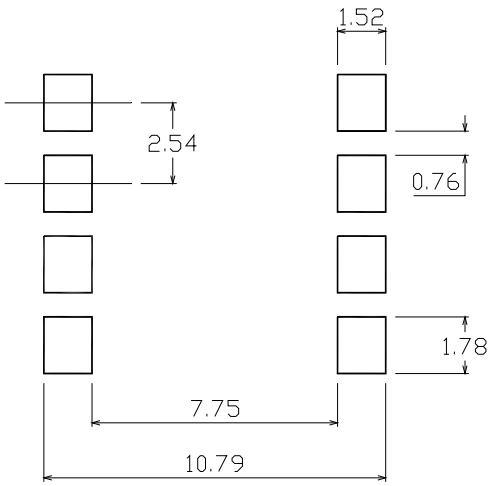


## PACKAGE DIMENSIONS (mm)

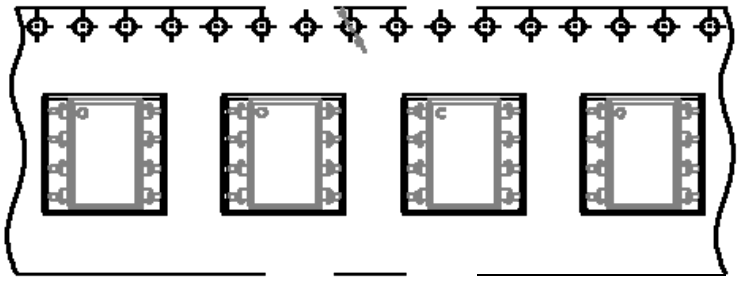
**SMD**



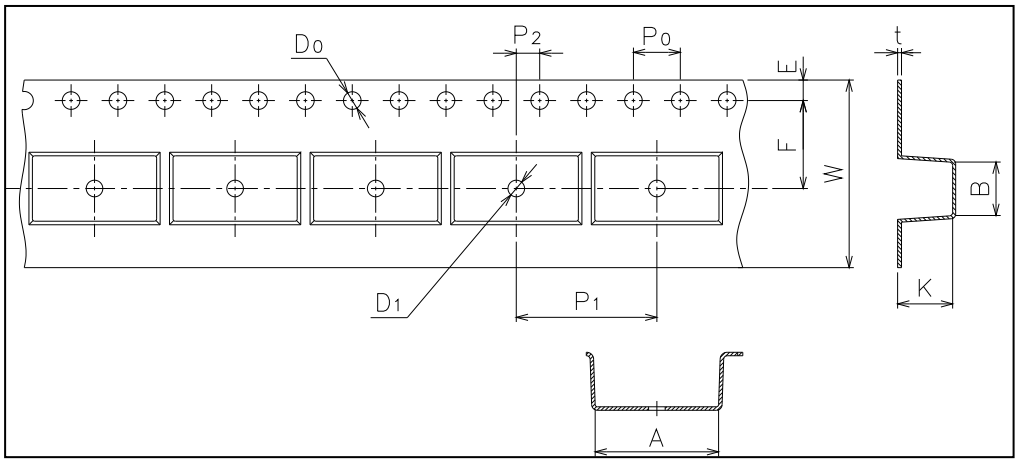

## RECOMMENDED PAD LAYOUT FOR SMD (mm)



## TAPE AND REEL PACKAGING

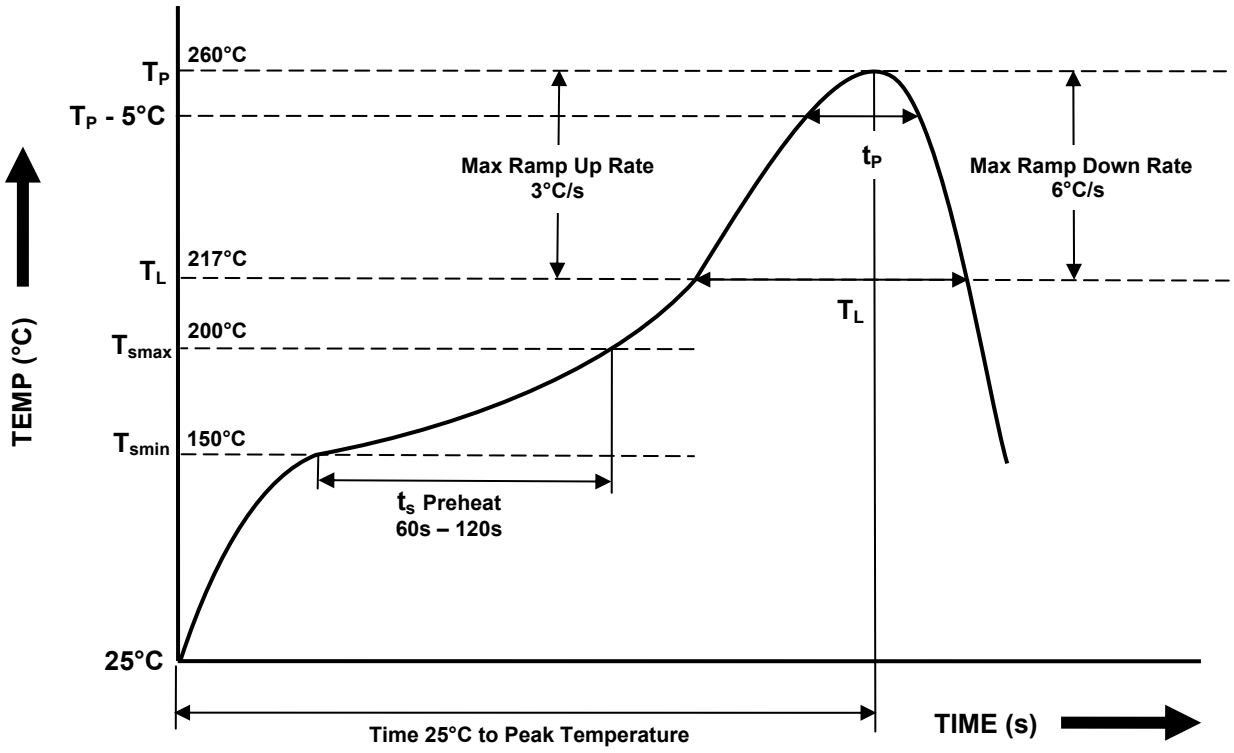


**Direction of feed from reel**




| Dimension No. | A | B | $D_0$ | $D_1$ | E | F |
|---|---|---|---|---|---|---|
| Dimension( mm) | 10.4±0.1 | 10.0±0.1 | 1.5±0.1 | 1.5±0.1 | 1.75±0.1 | 7.5±0.1 |
| Dimension No. | $P_0$ | $P_1$ | $P_2$ | t | W | K |
| Dimension (mm) | 4.0±0.1 | 12.0±0.1 | 2.0±0.1 | 0.4±0.1 | 16.0 ±0.3 / -0.1 | 4.5±0.1 |

**IR REFLOW SOLDERING TEMPERATURE PROFILE**
**One Time Reflow Soldering is Recommended.**
**Do not immerse device body in solder paste.**




| Profile Details | Conditions |
|---|---|
| **Preheat**<br>- Min Temperature ($T_{SMIN}$)<br>- Max Temperature ($T_{SMAX}$)<br>- Time $T_{SMIN}$ to $T_{SMAX}$ ($t_s$) | <br>150°C<br>200°C<br>60s - 120s |
| **Soldering Zone**<br>- Peak Temperature ($T_P$)<br>- Time at Peak Temperature<br>- Liquidous Temperature ($T_L$)<br>- Time within 5°C of Actual Peak Temperature ($T_P$ – 5°C)<br>- Time maintained above $T_L$ ($t_L$)<br>- Ramp Up Rate ($T_L$ to $T_P$)<br>- Ramp Down Rate ($T_P$ to $T_L$) | <br>260°C<br>10s max<br>217°C<br>30s max<br>60s - 100s<br>3°C/s max<br>6°C/s max |
| Average Ramp Up Rate ($T_{smax}$ to $T_P$) | 3°C/s max |
| Time 25°C to Peak Temperature | 8 minutes max |

ISOCOM COMPONENTS

# DISCLAIMER

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In developing your designs, please ensure that Isocom Components products are used within specified operating ranges as set forth in the most recent Isocom Components products specifications.

The Isocom Components products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These Isocom Components products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury (“Unintended Usage”). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation Instruments, traffic signal instruments, combustion control instruments, medical Instruments, all types of safety devices, etc... Unintended Usage of Isocom Components products listed in this document shall be made at the customer’s own risk.

Gallium arsenide (GaAs) is a substance used in the products described in this document. GaAs dust and fumes are toxic. Do not break, cut or pulverize the product, or use chemicals to dissolve them. When disposing of the products, follow the appropriate regulations. Do not dispose of the products with other industrial waste or with domestic garbage.

The products described in this document are subject to the foreign exchange and foreign trade laws.

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