# 6N135, 6N136, ICPL4502, ICPL4503

## DESCRIPTION

The 6N135, 6N136, ICPL4502 and ICPL4503 devices each consists 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 increases the speed by several orders of magnitude over conventional phototransistor couplers by reducing the base-collector capacitance of the input transistor.

## FEATURES

- High speed 1Mbit/s
- High AC Isolation Voltage 5000$V_{rms}$
- Guaranteed performance from 0°C to 70°C
- Wide Operating temperature range -55°C to 100°C
- Pb Free and RoHS Compliant
- UL File E91231
- VDE Approval Certificate No. 40044376 for 6N135 and 6N136, with suffix "V"

## APPLICATIONS

- Line Receivers
- Telecommunication Equipments
- Power Transistor Isolation in Motor Drives
- Replacement of Low Speed Phototransistor Optocouplers
- Feedback Loop in Switch Mode Power Supplies
- High Speed Logic Ground Isolation
- Home Appliances

## ORDER INFORMATION

- 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

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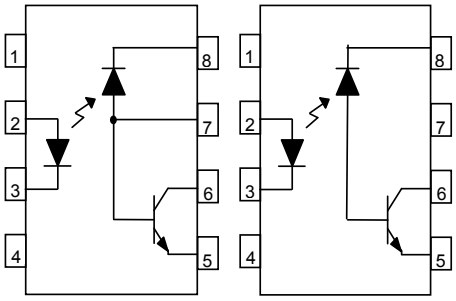


6N135 / 6N136 ICPL4502 / ICPL4503

1 NC
2 Anode
3 Cathode
4 NC
5 GND
6 $V_O$
7 $V_B$ (6N135, 6N136)
NC (ICPL4502, ICPL4503)
8 $V_{CC}$

**A 0.1µF bypass Capacitor shall be connected between $V_{CC}$ and GND.**

## 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 | 25mA |
| Forward Peak Current (50% duty cycle, 1ms pulse width) | 50mA |
| Peak Transient Current (≤1µs pulse width, 300pps) | 1A |
| Reverse Voltage | 5V |
| Power dissipation | 45mW |
| **Output** | |
| Output Current | 8mA |
| Peak Output Current | 16mA |
| Emitter-Base Reverse Voltage (6N135 and 6N136) | 5V |
| Base Current (6N135 and 6N136) | 5mA |
| Supply Voltage | -0.5V to 30V |
| Output Voltage | -0.5V to 20V |
| Power Dissipation | 100mW |
| **Total Package** | |
| Isolation Voltage | 5000$V_{RMS}$ |
| Operating Temperature | -55 to 100 °C |
| Storage Temperature | -55 to 125 °C |
| Lead Soldering Temperature (10s) | 260°C |


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## ELECTRICAL CHARACTERISTICS ($T_A$ = 0°C to 70°C unless otherwise specified)

### INPUT

| Parameter | Symbol | Test Condition | Min | Typ.* | Max | Unit |
|---|---|---|---|---|---|---|
| Forward Voltage | $V_F$ | $I_F$ = 16mA | | 1.45 | 1.8 | V |
| Reverse Voltage | $V_R$ | $I_R$ = 10µA | 5.0 | | | V |
| Forward Voltage Temperature Coefficient | $\Delta V_F/\Delta T_A$ | $I_F$ = 16mA | | -1.9 | | mV/°C |

### OUTPUT

| Parameter | Symbol | Test Condition | Min | Typ.* | Max | Unit |
|---|---|---|---|---|---|---|
| Logic High Output Current | $I_{OH}$ | $I_F$ = 0mA, $V_O$ = $V_{CC}$ = 5.5V, $T_A$ = 25°C | | 0.001 | 0.5 | µA |
| | | $I_F$ = 0mA, $V_O$ = $V_{CC}$ = 15V, $T_A$ = 25°C | | 0.01 | 1 | |
| | | $I_F$ = 0mA, $V_O$ = $V_{CC}$ = 15V | | | 50 | |
| Logic Low Output Voltage | $V_{OL}$ | 6N135<br>$I_F$ = 16mA, $I_O$ = 1.1mA, $V_{CC}$ = 4.5V, $T_A$ = 25°C | | 0.18 | 0.4 | V |
| | | $I_F$ = 16mA, $I_O$ = 0.8mA, $V_{CC}$ = 4.5V, | | | 0.5 | |
| | | 6N136 / ICPL4502 / ICPL4503<br>$I_F$ = 16mA, $I_O$ = 3mA, $V_{CC}$ = 4.5V, $T_A$ = 25°C | | 0.25 | 0.4 | |
| | | $I_F$ = 16mA, $I_O$ = 2.4mA, $V_{CC}$ = 4.5V | | | 0.5 | |
| Logic Low Supply Current | $I_{CCL}$ | $I_F$ = 16mA, $V_O$ = Open, $V_{CC}$ = 15V | | 140 | 200 | µA |
| Logic High Supply Current | $I_{CCH}$ | $I_F$ = 0mA, $V_O$ = Open, $V_{CC}$ = 15V, $T_A$ = 25°C | | 0.01 | 1 | µA |
| | | $I_F$ = 0mA, $V_O$ = Open, $V_{CC}$ = 15V | | | 2 | |

* Typical values at $T_A$ = 25°C

## ELECTRICAL CHARACTERISTICS ($T_A$ = 0°C to 70°C unless otherwise specified)

### COUPLED

| Parameter | Symbol | Test Condition | Min | Typ.* | Max | Unit |
|---|---|---|---|---|---|---|
| Current Transfer Ratio | CTR | 6N135 | 7 | | 50 | % |
| | | 6N136 / ICPL4502 / ICPL4503 | 19 | | 50 | |
| | | $I_F$ = 16mA, $V_O$ = 0.4V<br>$V_{CC}$ = 4.5V, $T_A$ = 25°C | | | | |
| | | 6N135 | 5 | | | |
| | | 6N136 / ICPL4502 / ICPL4503 | 15 | | | |
| | | $I_F$ = 16mA, $V_O$ = 0.5V<br>$V_{CC}$ = 4.5V | | | | |

### ISOLATION

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

* Typical values at $T_A$ = 25°C

## ELECTRICAL CHARACTERISTICS ($T_A$ = 0°C to 70°C unless otherwise specified)

### Switching Characteristics ($T_A$ = 0°C to 70°C, $I_F$ = 16mA, $V_{CC}$ = 5V unless otherwise specified)

| Parameter | Symbol | Test Condition | Min | Typ.* | Max | Unit |
|---|---|---|---|---|---|---|
| Propagation Delay Time to Logic Low | $T_{PHL}$ | 6N135<br>$R_L$ = 4.1kΩ, $T_A$ = 25°C<br>$R_L$ = 4.1kΩ | | 0.35 | 1.5<br>2.0 | µs |
| | | 6N136 / ICPL4502 / ICPL4503<br>$R_L$ = 1.9kΩ, $T_A$ = 25°C<br>$R_L$ = 1.9kΩ | | 0.35 | 0.8<br>1.0 | |
| Propagation Delay Time to Logic High | $T_{PLH}$ | 6N135<br>$R_L$ = 4.1kΩ, $T_A$ = 25°C<br>$R_L$ = 4.1kΩ | | 0.5 | 1.5<br>2.0 | µs |
| | | 6N136 / ICPL4502 / ICPL4503<br>$R_L$ = 1.9kΩ, $T_A$ = 25°C<br>$R_L$ = 1.9kΩ | | 0.3 | 0.8<br>1.0 | |
| Common Mode Transient Immunity at Logic High | $CM_H$ | 6N135<br>$I_F$ = 0mA, $V_{CM}$ = 10Vp-p,<br>$R_L$ = 4.1kΩ, $T_A$ = 25°C | 1000 | | | V/µs |
| | | 6N136 / ICPL4502<br>$I_F$ = 0mA, $V_{CM}$ = 10Vp-p,<br>$R_L$ = 1.9kΩ, $T_A$ = 25°C | 1000 | | | |
| | | ICPL4503<br>$I_F$ = 0mA, $V_{CM}$ = 1500Vp-p,<br>$R_L$ = 1.9kΩ, $T_A$ = 25°C | 15000 | 20000 | | |
| Common Mode Transient Immunity at Logic Low | $CM_L$ | 6N135<br>$I_F$ = 16mA, $V_{CM}$ = 10Vp-p,<br>$R_L$ = 4.1kΩ, $T_A$ = 25°C | 1000 | | | V/µs |
| | | 6N136 / ICPL4502<br>$I_F$ = 16mA, $V_{CM}$ = 10Vp-p,<br>$R_L$ = 1.9kΩ, $T_A$ = 25°C | 1000 | | | |
| | | ICPL4503<br>$I_F$ = 16mA, $V_{CM}$ = 1500Vp-p,<br>$R_L$ = 1.9kΩ, $T_A$ = 25°C | 15000 | 20000 | | |

* Typical values at $T_A$ = 25°C

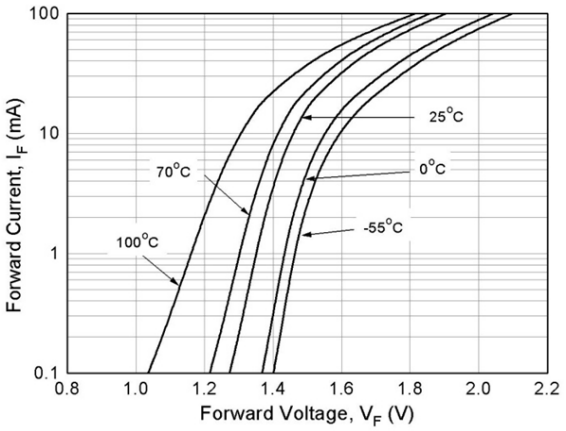



Fig 1 Forward Current vs Forward Voltage

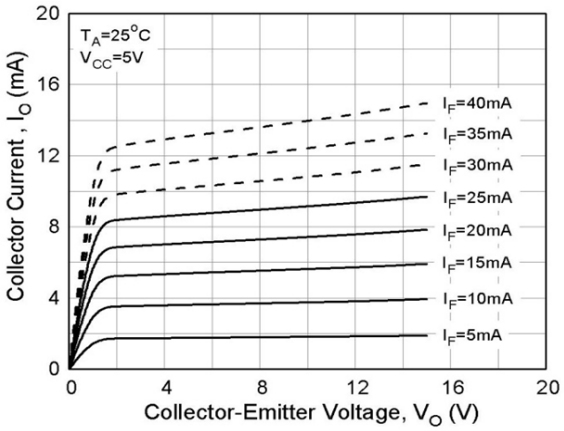



Fig 2 Output Current vs Output Voltage

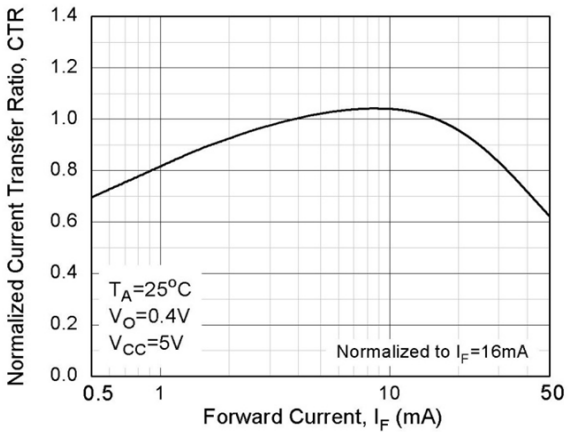



Fig 3 Normalized CTR vs Forward Current

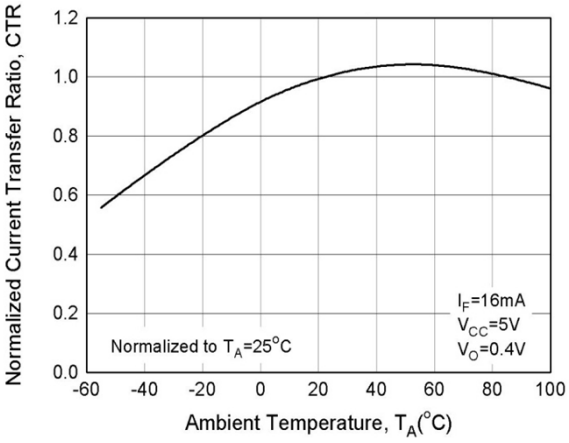



Fig 4 Normalized CTR vs $T_A$

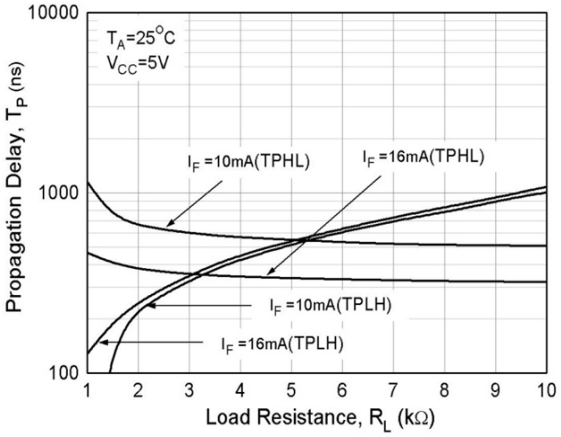



Fig 5 Propagation Delay vs Load Resistance

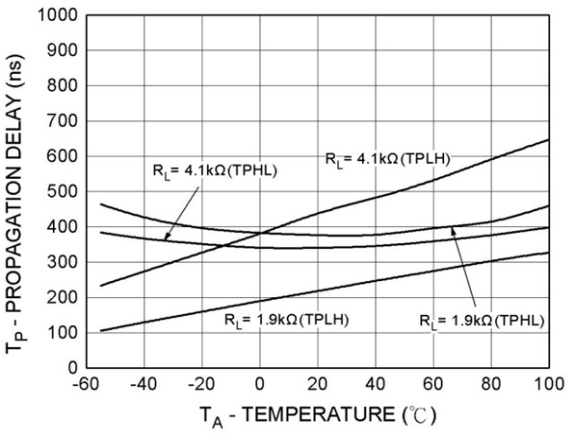



Fig 6 Propagation Delay vs $T_A$

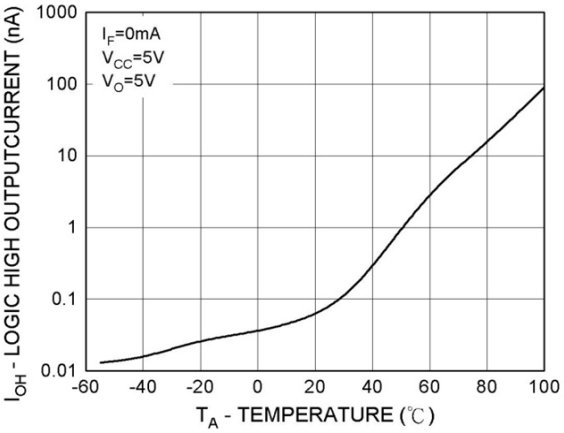
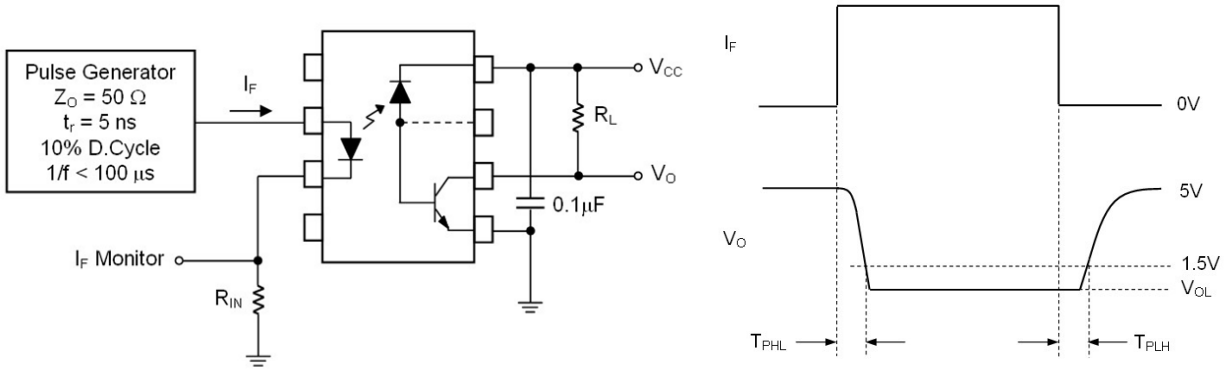
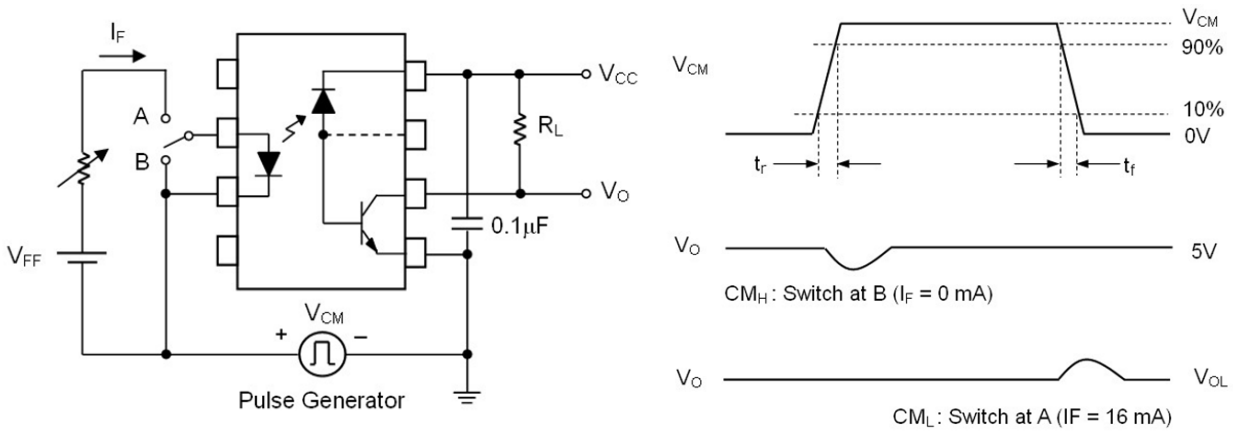



**Fig 7 Logic High Output Current vs $T_A$**




**Switching Time Test Circuit**




**Common Mode Transient Immunity Test Circuit**

**Note:**

Common mode transient immunity in logic high level is the maximum tolerable (positive) $dV_{CM}/dt$ on the leading edge of the common mode pulse signal $V_{CM}$, to assure that the output will remain in a logic high state (i.e., $V_O > 2.0V$).

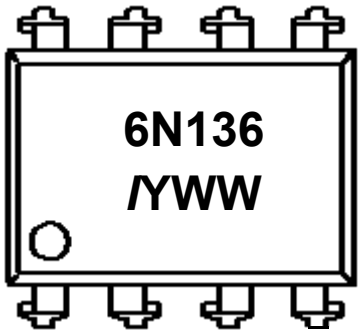
Common mode transient immunity in logic low level is the maximum tolerable (negative) $dV_{CM}/dt$ on the trailing edge of the common mode pulse signal, $V_{CM}$, to assure that the output will remain in a logic low state (i.e., $V_O < 0.8V$).

## ORDER INFORMATION

| 6N135, 6N136, ICPL4502, ICPL4503 (UL Approval) | | | |
|---|---|---|---|
| **After PN** | **PN** | **Description** | **Packing quantity** |
| None | 6N135, 6N136, ICPL4502, ICPL4503 | Standard Dip8 | 45 pcs per tube |
| G | 6N135G, 6N136G, ICPL4502G, ICPL4503G | 10mm Lead Spacing | 45 pcs per tube |
| SM | 6N135SM, 6N136SM, ICPL4502SM, ICPL4503SM | Surface Mount | 45 pcs per reel |
| SMT&R | 6N135SMT&R, 6N136SMT&R, ICPL4502SMT&R, ICPL4503SMT&R | Surface Mount Tape & Reel | 1000 pcs per reel |

| 6N135V, 6N136V (UL and VDE Approvals) | | | |
|---|---|---|---|
| **After PN** | **PN** | **Description** | **Packing quantity** |
| None | 6N135V, 6N136V | Standard Dip8 | 45 pcs per tube |
| G | 6N135VG, 6N136VG | 10mm Lead Spacing | 45 pcs per tube |
| SM | 6N135VSM, 6N136VSM | Surface Mount | 45 pcs per reel |
| SMT&R | 6N135VSMT&R, 6N136VSMT&R | Surface Mount Tape & Reel | 1000 pcs per reel |

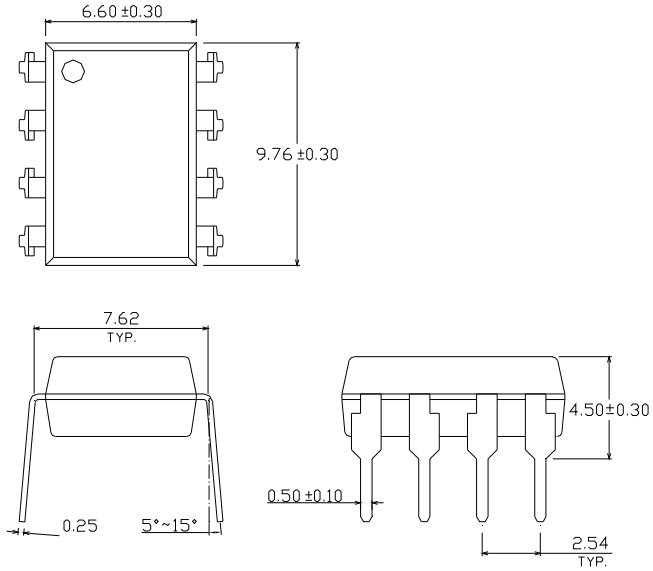
## DEVICE MARKING (Example : 6N136)



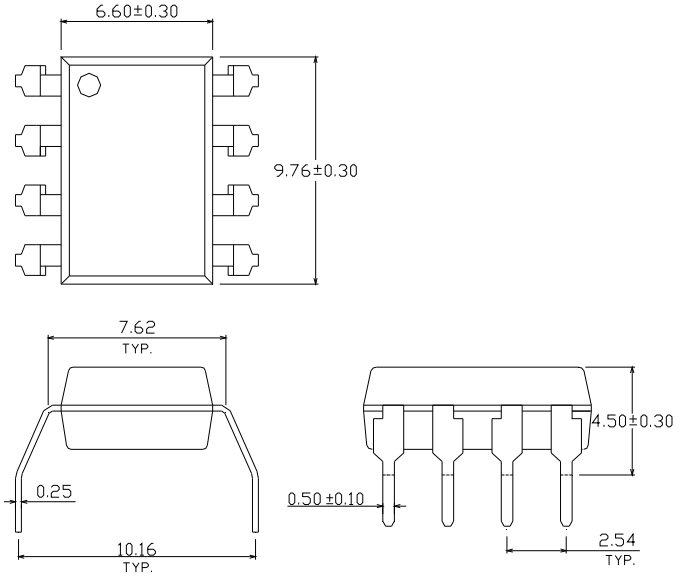

| | |
|---|---|
| 6N136 | denotes Device Part Number |
| Y | denotes 1 digit Year code |
| WW | denotes 2 digit Week code |
| / | denoted Isocom |

## PACKAGE DIMENSIONS (mm)

### DIP

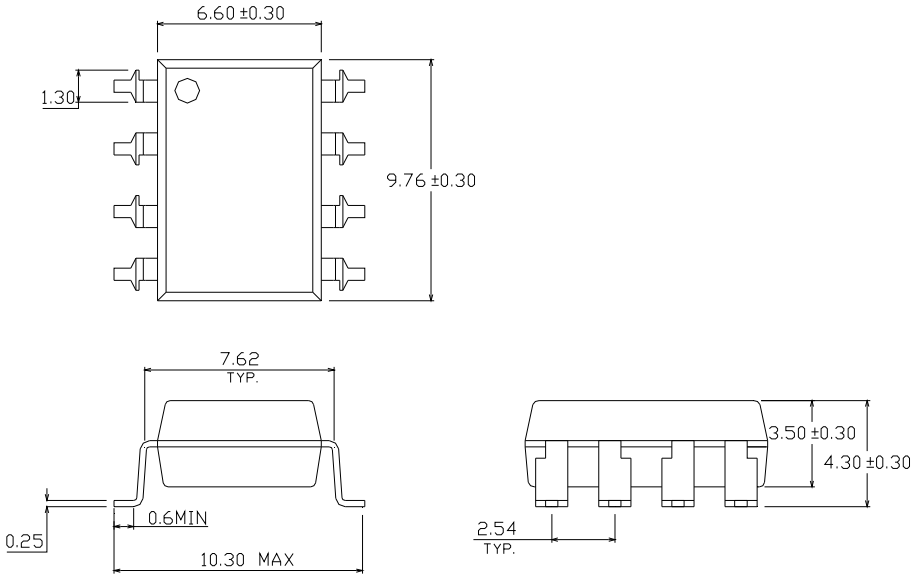



### G-Form

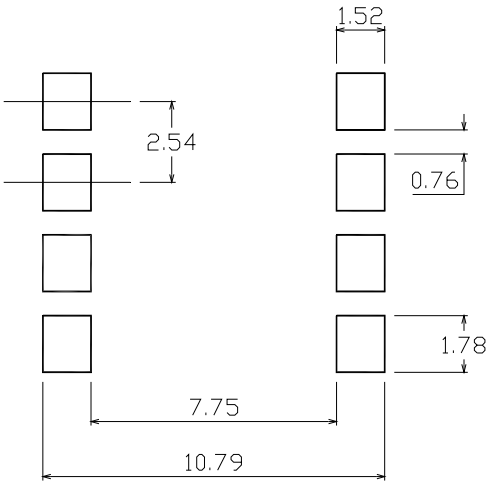


## PACKAGE DIMENSIONS (mm)

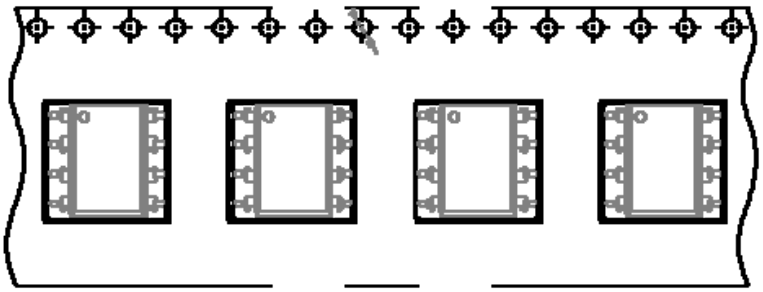
**SMD**



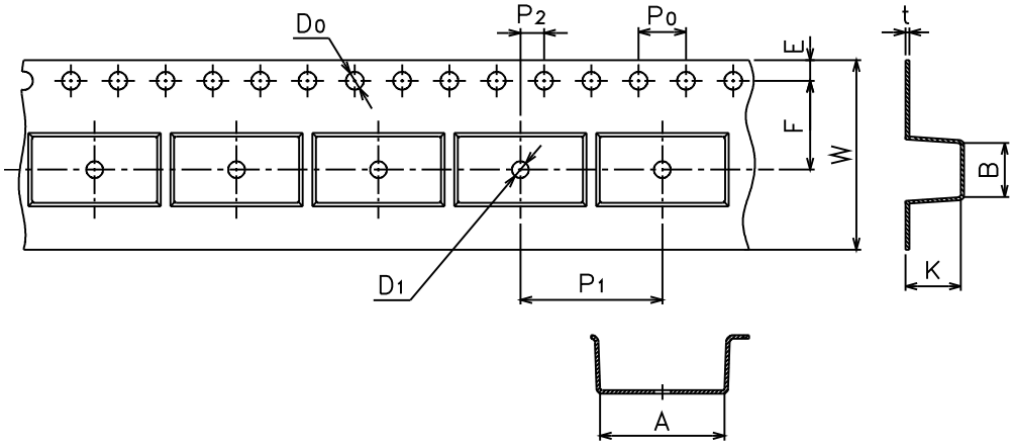

## RECOMMENDED PAD LAYOUT FOR SMD (mm)



## TAPE AND REEL PACKAGING

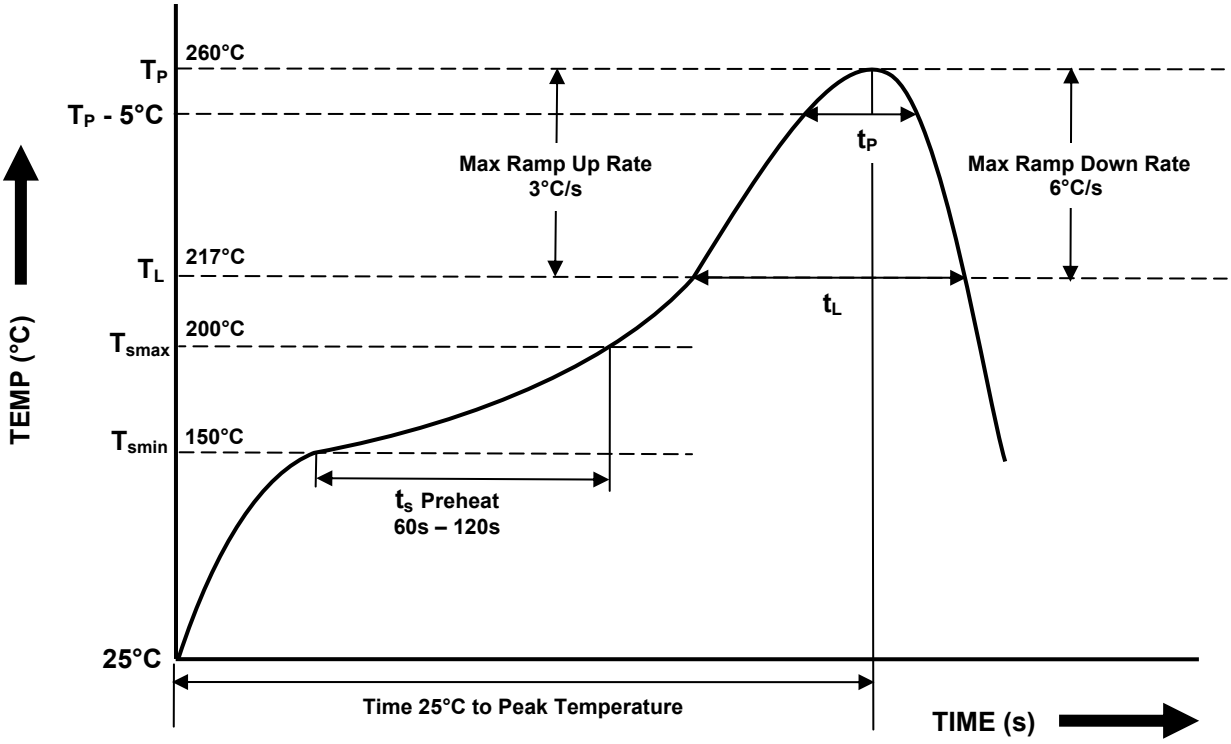


**Direction of feed from reel**




| 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 |

## REFLOW SOLDERING TEMPERATURE PROFILE
## (One Time Reflow Soldering is Recommended)




| 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>- 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>217°C<br>30s<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 |

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- Do not immerse device body in solder paste.

ISOCOM COMPONENTS

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