



## 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

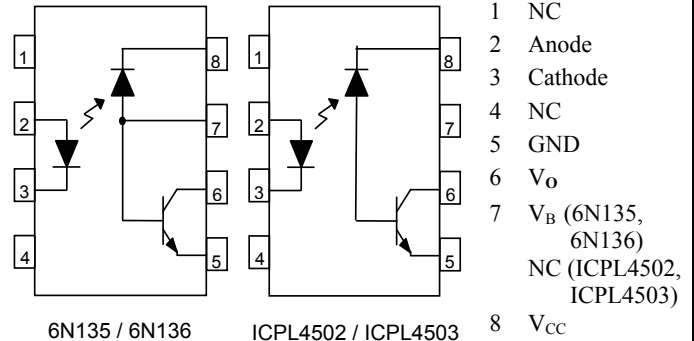
- High speed 1Mbit/s
- High AC Isolation Voltage 5000V<sub>rms</sub>
- Guaranteed performance from 0°C to 70°C
- Wide Operating temperature range -55°C to 100°C
- Pb Free and RoHS Compliant
- UL File E91231
- VDE Approval Certificate No. 40044376 for 6N135 and 6N136, with suffix "V"

### 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



A 0.1μF bypass Capacitor shall be connected between V<sub>CC</sub> and GND.

### ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 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	5000V <sub>RMS</sub>
Operating Temperature	-55 to 100 °C
Storage Temperature	-55 to 125 °C
Lead Soldering Temperature (10s)	260°C

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## 6N135, 6N136, ICPL4502, ICPL4503

### ELECTRICAL CHARACTERISTICS ( $T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$ unless otherwise specified)

#### INPUT

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

#### OUTPUT

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

\* Typical values at  $T_A = 25^\circ\text{C}$



## 6N135, 6N136, ICPL4502, ICPL4503

### ELECTRICAL CHARACTERISTICS ( $T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$ unless otherwise specified)

#### COUPLED

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

#### ISOLATION

Parameter	Symbol	Test Condition	Min	Typ.*	Max	Unit
Insulation Voltage	$V_{ISO}$	$T_A = 25^\circ\text{C}$ , RH = 40 % to 60%, $t = 1 \text{ min}$ ,	5000			$V_{RMS}$

\* Typical values at  $T_A = 25^\circ\text{C}$



**6N135, 6N136, ICPL4502, ICPL4503**

**ELECTRICAL CHARACTERISTICS ( $T_A = 0^\circ\text{C}$  to  $70^\circ\text{C}$  unless otherwise specified)**

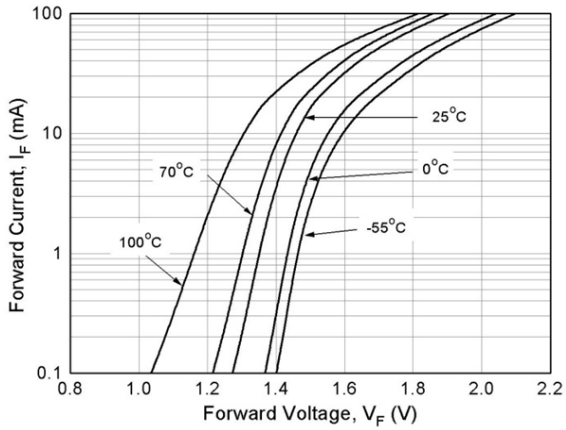
**Switching Characteristics ( $T_A = 0^\circ\text{C}$  to  $70^\circ\text{C}$ ,  $I_F = 16\text{mA}$ ,  $V_{CC} = 5\text{V}$  unless otherwise specified)**

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

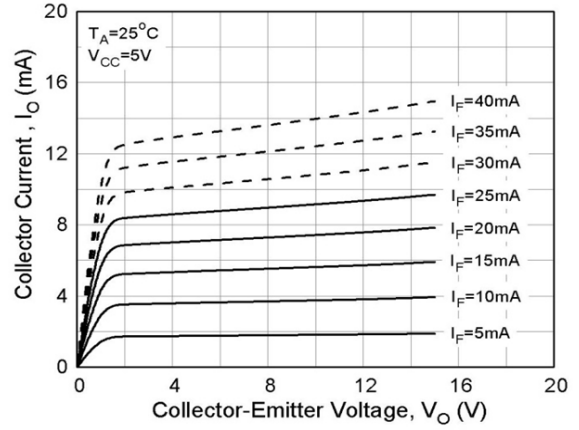
\* Typical values at  $T_A = 25^\circ\text{C}$



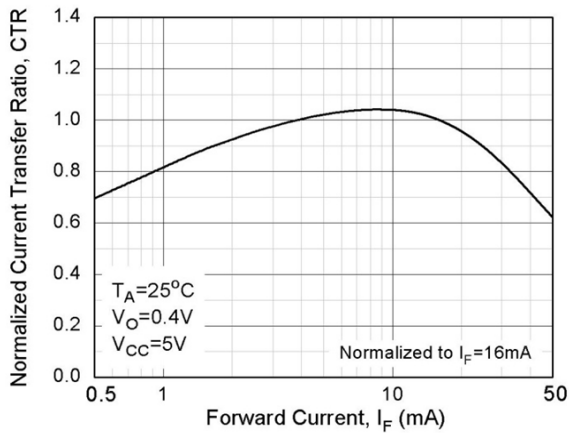
**6N135, 6N136, ICPL4502, ICPL4503**



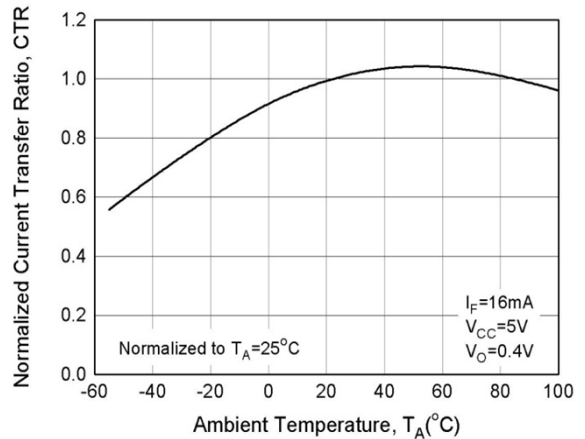
**Fig 1 Forward Current vs Forward Voltage**



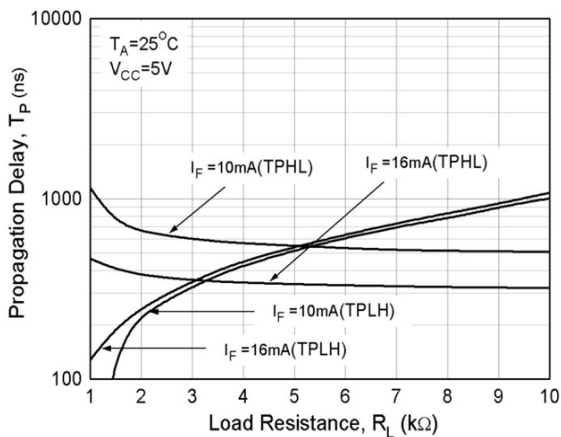
**Fig 2 Output Current vs Output Voltage**



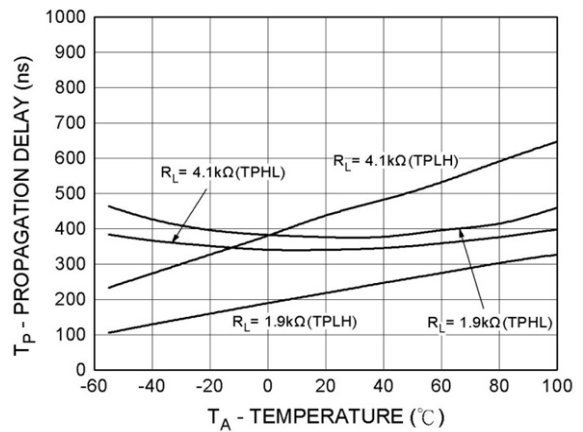
**Fig 3 Normalized CTR vs Forward Current**



**Fig 4 Normalized CTR vs  $T_A$**



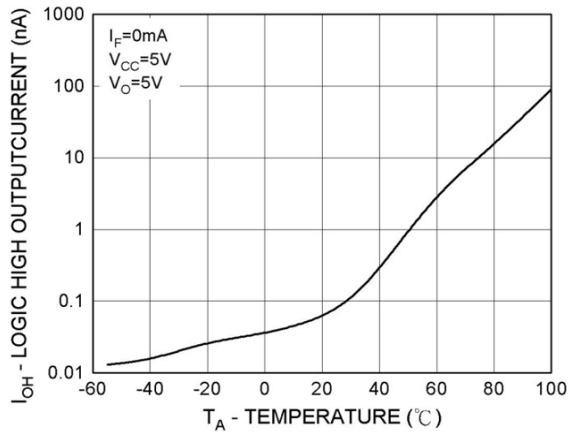
**Fig 5 Propagation Delay vs Load Resistance**



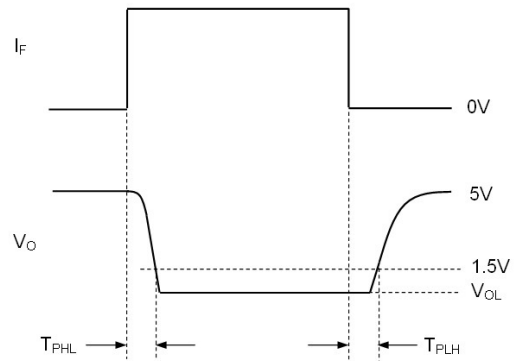
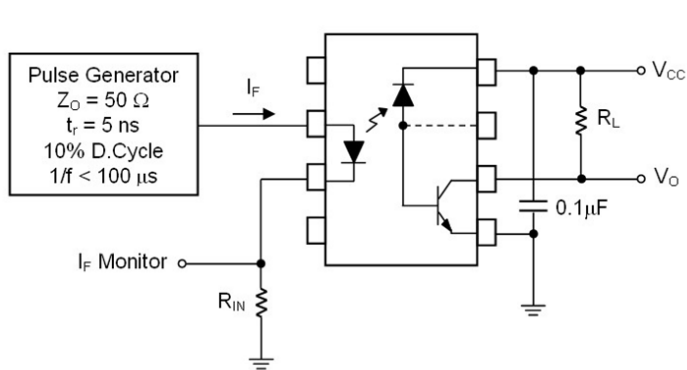
**Fig 6 Propagation Delay vs  $T_A$**



**6N135, 6N136, ICPL4502, ICPL4503**



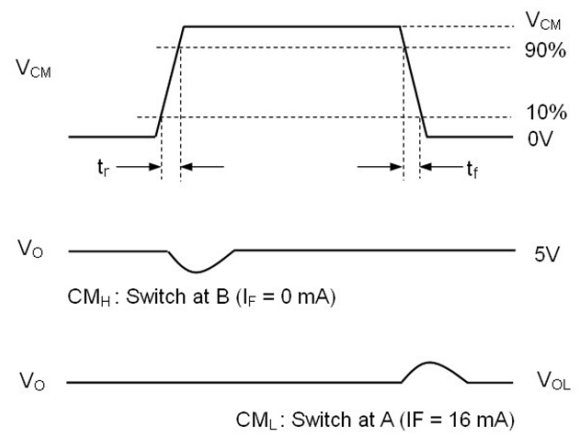
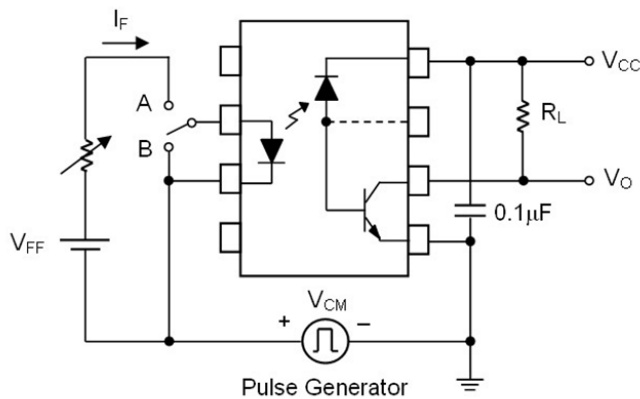
**Fig 7 Logic High Output Current vs T<sub>A</sub>**



**Switching Time Test Circuit**



## 6N135, 6N136, ICPL4502, ICPL4503



**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.,  $V_O < 0.8V$ ).



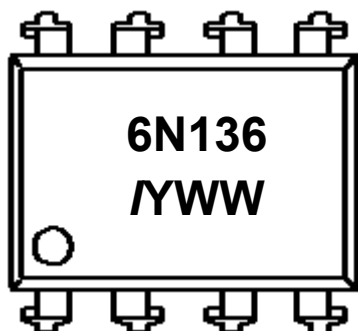
**6N135, 6N136, ICPL4502, ICPL4503**

**ORDER INFORMATION**

<b>6N135, 6N136, ICPL4502, ICPL4503 (UL Approval)</b>			
<b>After PN</b>	<b>PN</b>	<b>Description</b>	<b>Packing quantity</b>
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

<b>6N135V, 6N136V (UL and VDE Approvals)</b>			
<b>After PN</b>	<b>PN</b>	<b>Description</b>	<b>Packing quantity</b>
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  
 I denoted Isocom

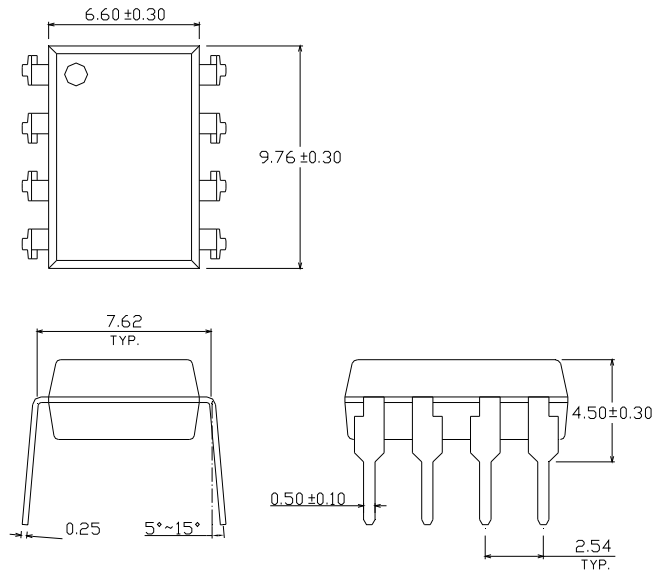




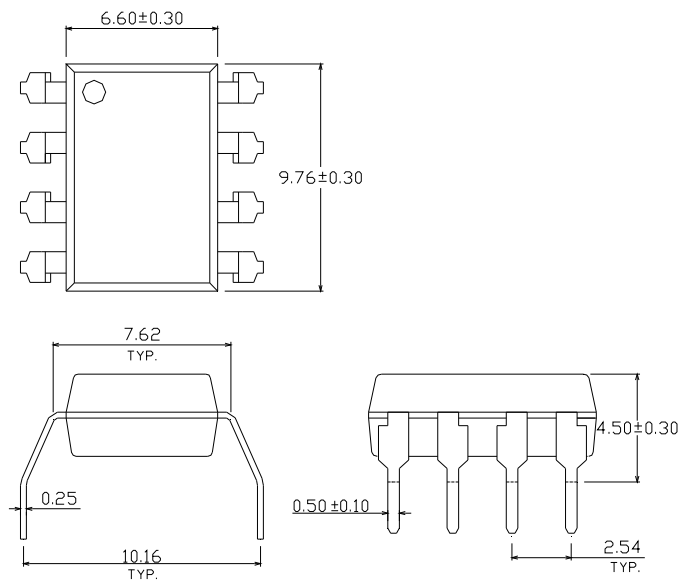
**6N135, 6N136, ICPL4502, ICPL4503**

**PACKAGE DIMENSIONS (mm)**

**DIP**



**G-Form**

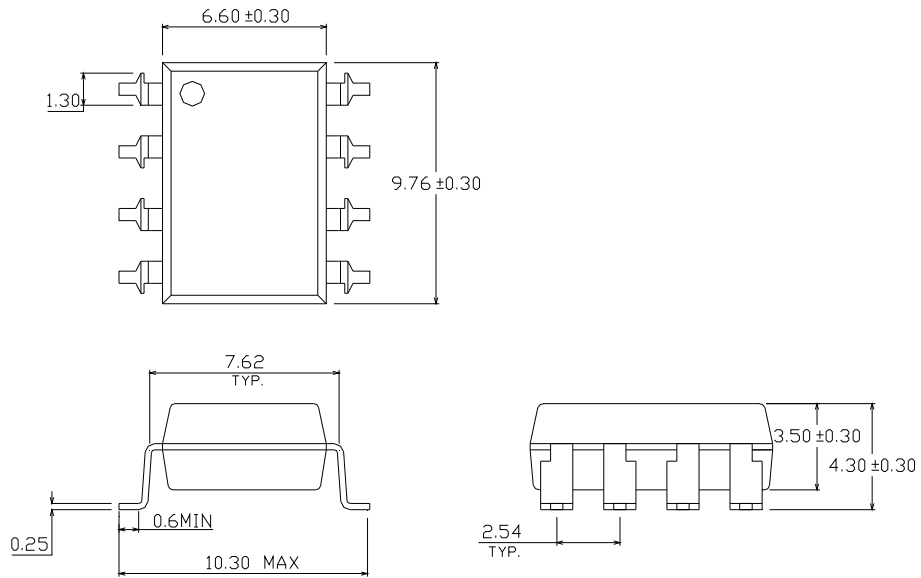




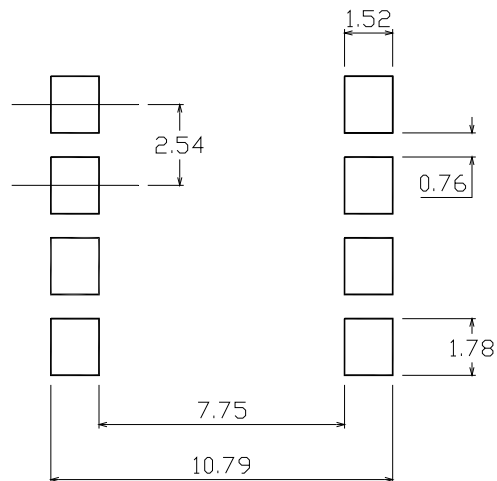
**6N135, 6N136, ICPL4502, ICPL4503**

**PACKAGE DIMENSIONS (mm)**

**SMD**



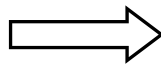
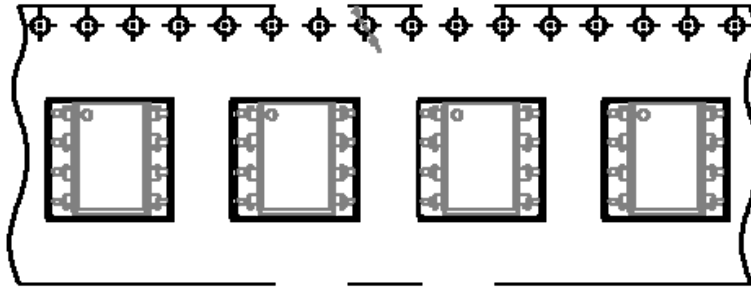
**RECOMMENDED PAD LAYOUT FOR SMD (mm)**



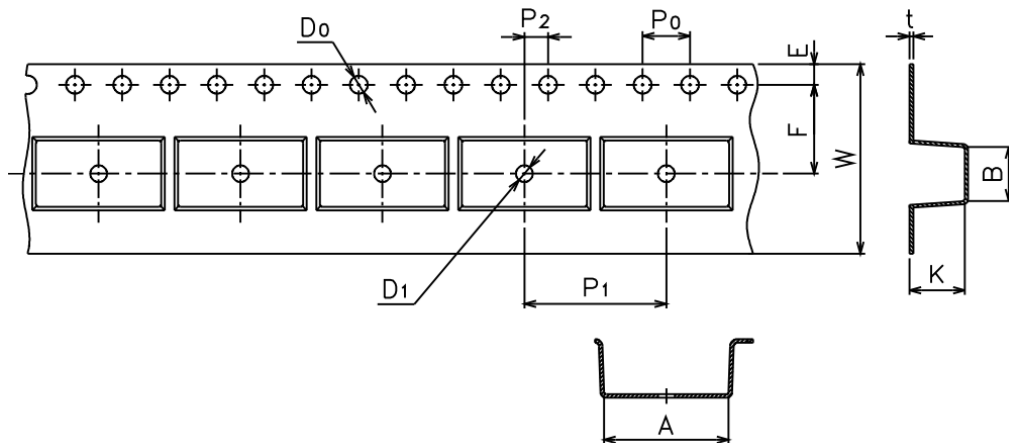


**6N135, 6N136, ICPL4502, ICPL4503**

**TAPE AND REEL PACKAGING**



**Direction of feed from reel**

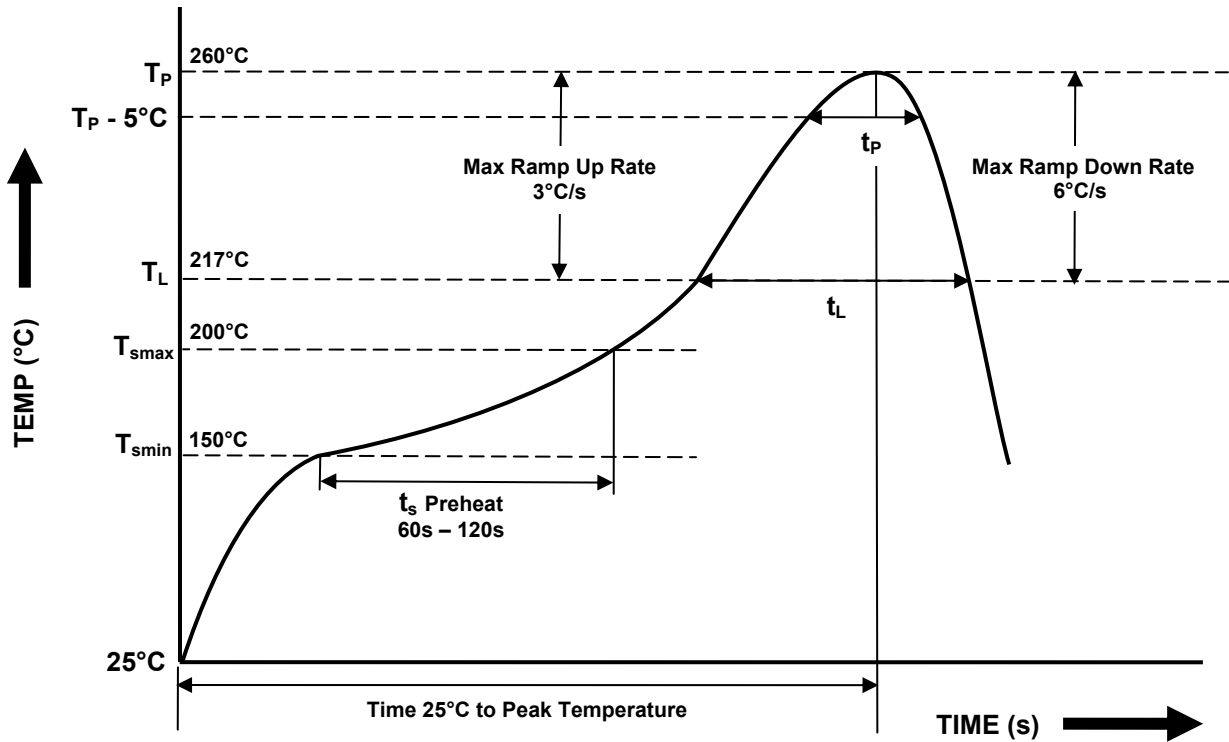


Dimension No.	<b>A</b>	<b>B</b>	<b>D<sub>0</sub></b>	<b>D<sub>1</sub></b>	<b>E</b>	<b>F</b>
Dimension( mm)	10.4±0.1	10.0±0.1	1.5±0.1	1.5±0.1	1.75±0.1	7.5±0.1
Dimension No.	<b>P<sub>0</sub></b>	<b>P<sub>1</sub></b>	<b>P<sub>2</sub></b>	<b>t</b>	<b>W</b>	<b>K</b>
Dimension (mm)	4.0±0.1	12.0±0.1	2.0±0.1	0.4±0.1	16.0 ±0.3 / -0.1	4.5±0.1



**6N135, 6N136, ICPL4502, ICPL4503**

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



Profile Details	Conditions
<b>Preheat</b>	
- Min Temperature ( $T_{SMIN}$ )	150°C
- Max Temperature ( $T_{SMAX}$ )	200°C
- Time $T_{SMIN}$ to $T_{SMAX}$ ( $t_s$ )	60s - 120s
<b>Soldering Zone</b>	
- Peak Temperature ( $T_P$ )	260°C
- Liquidous Temperature ( $T_L$ )	217°C
- Time within 5°C of Actual Peak Temperature ( $T_P - 5^\circ\text{C}$ )	30s
- Time maintained above $T_L$ ( $t_L$ )	60s - 100s
- Ramp Up Rate ( $T_L$ to $T_P$ )	3°C/s max
- Ramp Down Rate ( $T_P$ to $T_L$ )	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



