



# 6N135, 6N136, CT4502, CT4503

## 1Mbit/s High Speed Phototransistor Optocoupler

### Features

- High speed 1MBit/s
- High isolation voltage between input and output (Viso=5000 Vrms )
- Guaranteed CTR performance from 0°C to 70°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

### Applications

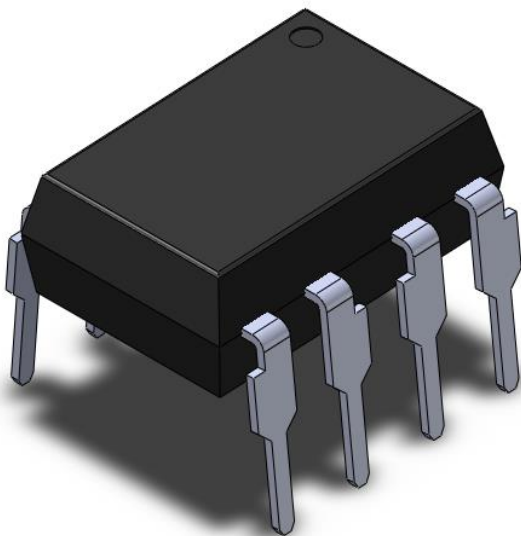
- Line receivers
- Telecommunication equipment
- High speed logic ground isolation
- Feedback loop in switch-mode power supplies
- Home appliances

### Description

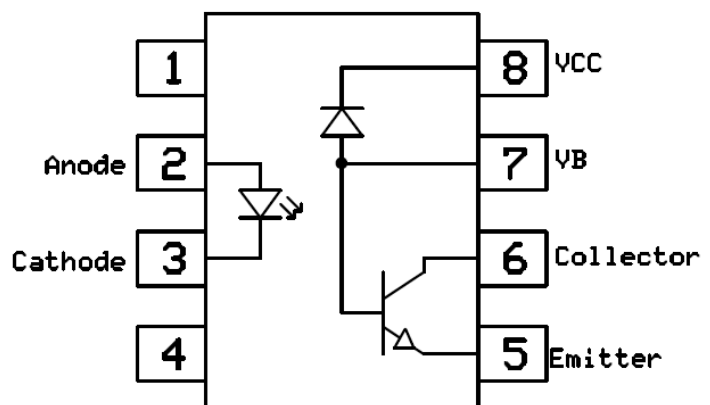
The 6N135, 6N136, CT4502 and CT4503 devices each consist of an infrared emitting diode, optically coupled to a high speed photo detector transistor. A separate connection for the photodiode bias and output-transistor collector increase the speed by several orders of magnitude over conventional phototransistor couplers by reducing the base-collector capacitance of the input transistor.

The devices are packaged in an 8-pin DIP package and also available in gullwing (400mil) and surface mount lead forming.

### Package Outline



### Schematic



6N135 / 6N136

Pin 7 not connected for CT4502/CT4503

Note: Different bending options available. See package dimension.



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### Absolute Maximum Rating at 25°C

Symbol	Parameters	Ratings	Units	Notes
V <sub>ISO</sub>	Isolation voltage	5000	V <sub>RMS</sub>	1
T <sub>OPR</sub>	Operating temperature	-55 ~ +100	°C	
T <sub>STG</sub>	Storage temperature	-55 ~ +125	°C	
T <sub>SOL</sub>	Soldering temperature	260	°C	2
<b>Emitter</b>				
I <sub>F</sub>	Forward current	25	mA	
I <sub>FP</sub>	Peak forward current (50% duty, 1ms P.W)	50	mA	
I <sub>F(TRANS)</sub>	Peak transient current (≤1μs P.W,300pps)	1	A	
V <sub>R</sub>	Reverse voltage	5	V	
P <sub>D</sub>	Power dissipation	40	mW	
<b>Detector</b>				
P <sub>D</sub>	Power dissipation	100	mW	
V <sub>EBR</sub>	Emitter-Base reverse voltage	5	V	
I <sub>B</sub>	Base current	5	mA	
I <sub>O(AVG)</sub>	Average Output current	8	mA	
I <sub>O(Peak)</sub>	Peak Output current	16	mA	
V <sub>O</sub>	Output voltage	-0.5 to 20	V	
V <sub>CC</sub>	Supply voltage	-0.5 to 30	V	

#### Notes

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



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### Electrical Characteristics

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

#### Emitter Characteristics

Symbol	Parameters	Test Conditions	Min	Typ	Max	Units	Notes
$V_F$	Forward voltage	$I_F = 16\text{mA}$	-	1.45	1.6	V	
$V_R$	Reverse Voltage	$I_R = 10\mu\text{A}$	5.0	-	-	V	
$\Delta V_F/\Delta T_A$	Temperature coefficient of forward voltage	$I_F = 16\text{mA}$	-	-1.8	-	mV/ $^\circ\text{C}$	

#### Detector Characteristics

Symbol	Parameters	Test Conditions	Min	Typ	Max	Units	Notes
$I_{OH}$	Logic High Output Current	$I_F=0\text{mA}$ , $V_O=V_{CC}=5.5\text{V}$ , $T_A=25^\circ\text{C}$	-	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		
$I_{CCL}$	Logic Low Supply Current	$I_F=16\text{mA}$ , $V_O=\text{Open}$ , $V_{CC}=15\text{V}$	-	140	200	$\mu\text{A}$	
$I_{CCH}$	Logic High Supply Current	$I_F=0\text{mA}$ , $V_O=\text{Open}$ , $V_{CC}=15\text{V}$ , $T_A=25^\circ\text{C}$	-	0.01	1	$\mu\text{A}$	
		$I_F=0\text{mA}$ , $V_O=\text{Open}$ , $V_{CC}=15\text{V}$	-	-	2		



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### Electrical Characteristics

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### Transfer Characteristics

Symbol	Parameters	Test Conditions	Min	Typ	Max	Units	Notes	
CTR	Current Transfer Ratio	6N135	7	-	50	%		
		6N136 CT4502 CT4503						$I_F=16\text{mA}, V_O=0.4\text{V}, V_{CC}=4.5\text{V},$ $T_A=25^\circ\text{C}$
		6N135	5	-	-			
		6N136 CT4502 CT4503						
$V_{OL}$	Logic Low Output Voltage	6N135	-	0.18	0.4	V		
		6N136 CT4502 CT4503						
		6N135	-	-	0.5			
		6N136 CT4502 CT4503						
		$I_F=16\text{mA}, I_O=2.4\text{mA},$ $V_{CC}=4.5\text{V}$	-	-	0.5			



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### Electrical Characteristics

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

### Switching Characteristics

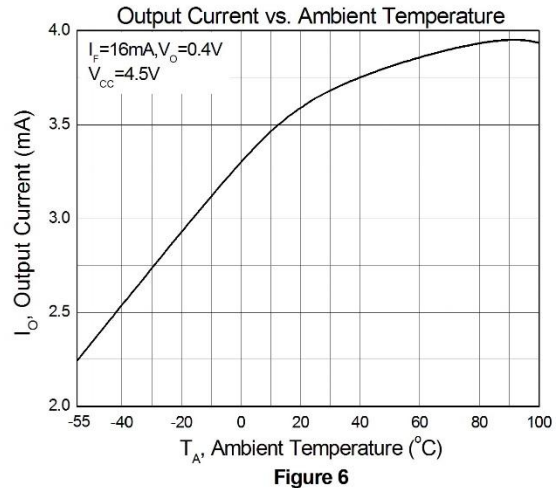
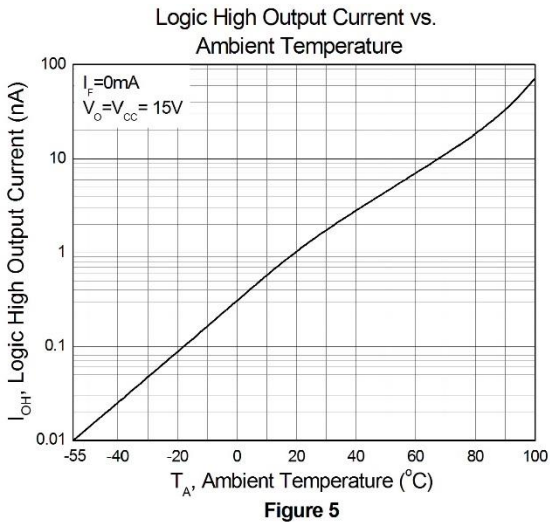
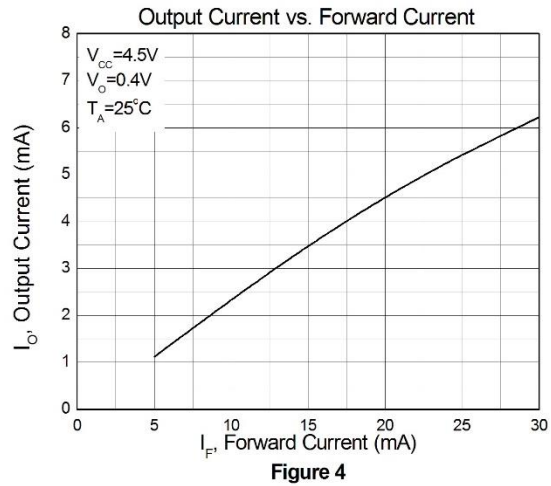
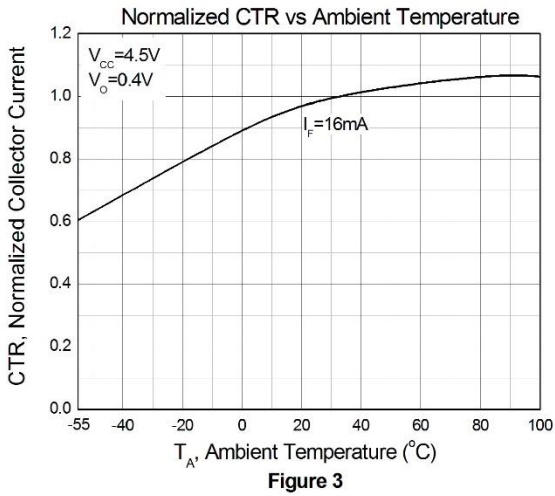
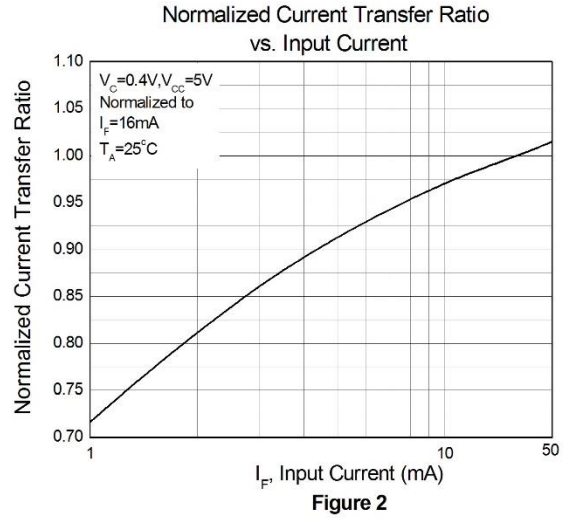
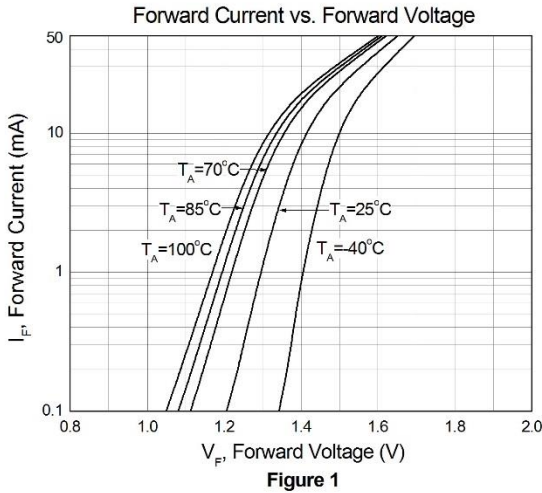
Symbol	Parameters		Test Conditions	Min	Typ	Max	Units	Notes
$T_{PHL}$	Propagation Delay Time Logic High to Logic Low	6N135	$R_L=4.1\text{K}\Omega$ , $T_A=25^\circ\text{C}$	-	0.35	1.5	$\mu\text{s}$	
			$R_L=4.1\text{K}\Omega$	-	-	2.0		
		6N136 CT4502 CT4503	$R_L=1.9\text{K}\Omega$ , $T_A=25^\circ\text{C}$	-	0.35	0.8		
			$R_L=1.9\text{K}\Omega$	-	-	1.0		
$T_{PLH}$	Propagation Delay Time Logic Low to Logic High	6N135	$R_L=4.1\text{K}\Omega$ , $T_A=25^\circ\text{C}$	-	0.5	1.5	$\mu\text{s}$	
			$R_L=4.1\text{K}\Omega$	-	-	2.0		
		6N136 CT4502 CT4503	$R_L=1.9\text{K}\Omega$ , $T_A=25^\circ\text{C}$	-	0.3	0.8		
			$R_L=1.9\text{K}\Omega$	-	-	1.0		
$CM_H$	Common Mode Transient Immunity at Logic High	6N135	$I_F = 0\text{mA}$ , $V_{CM}=10\text{Vp-p}$ , $R_L=4.1\text{K}\Omega$ , $T_A = 25^\circ\text{C}$	1,000	-	-	$\text{V}/\mu\text{s}$	
		6N136 CT4502	$I_F = 0\text{mA}$ , $V_{CM}=10\text{Vp-p}$ , $R_L=1.9\text{K}\Omega$ , $T_A = 25^\circ\text{C}$	1,000	-	-		
		CT4503	$I_F = 0\text{mA}$ , $V_{CM}=1500\text{Vp-p}$ , $R_L=1.9\text{K}\Omega$ , $T_A = 25^\circ\text{C}$	15,000	20,000			
$CM_L$	Common Mode Transient Immunity at Logic Low	6N135	$I_F = 16\text{mA}$ , $V_{CM}=10\text{Vp-p}$ , $R_L=4.1\text{K}\Omega$ , $T_A = 25^\circ\text{C}$	1,000	-	-	$\text{V}/\mu\text{s}$	
		6N136 CT4502	$I_F = 16\text{mA}$ , $V_{CM}=10\text{Vp-p}$ , $R_L=1.9\text{K}\Omega$ , $T_A = 25^\circ\text{C}$	1,000	-	-		
		CT4503	$I_F = 16\text{mA}$ , $V_{CM}=1500\text{Vp-p}$ , $R_L=1.9\text{K}\Omega$ , $T_A = 25^\circ\text{C}$	15,000	20,000			



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### Typical Characteristic Curves





# 6N135, 6N136, CT4502, CT4503

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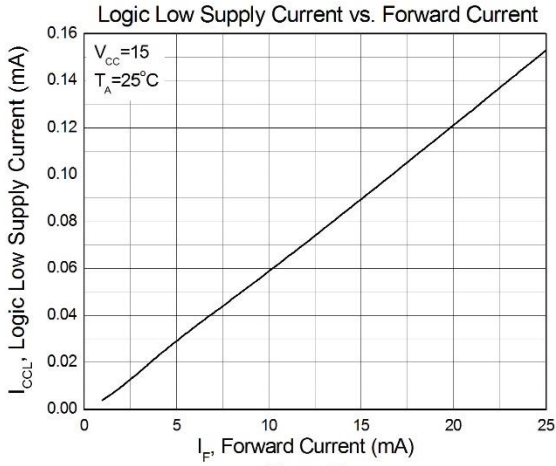


Figure 7

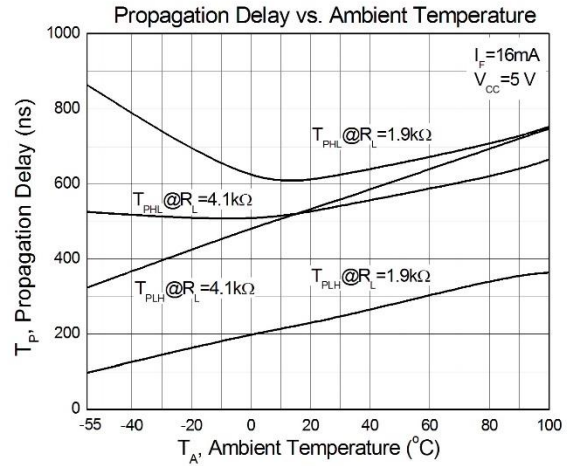


Figure 8

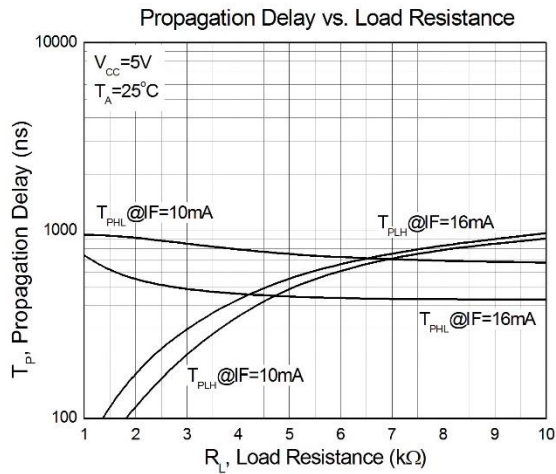
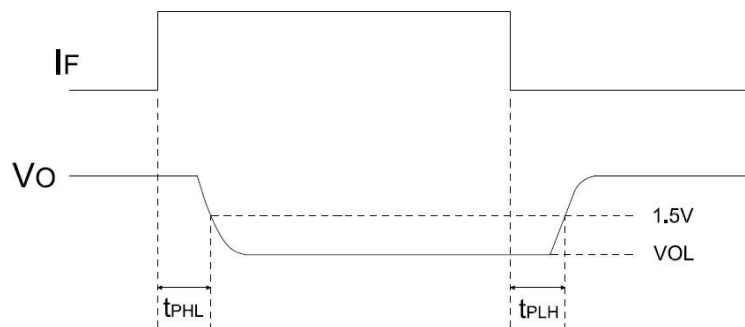
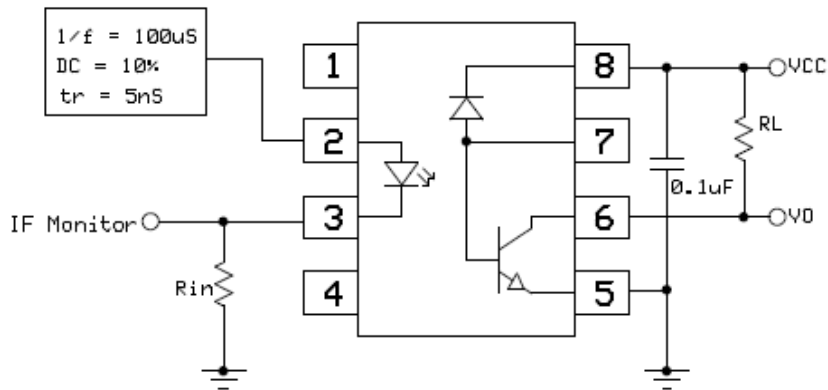


Figure 9



# 6N135, 6N136, CT4502, CT4503 1Mbit/s High Speed Phototransistor Optocoupler

## Test Circuits



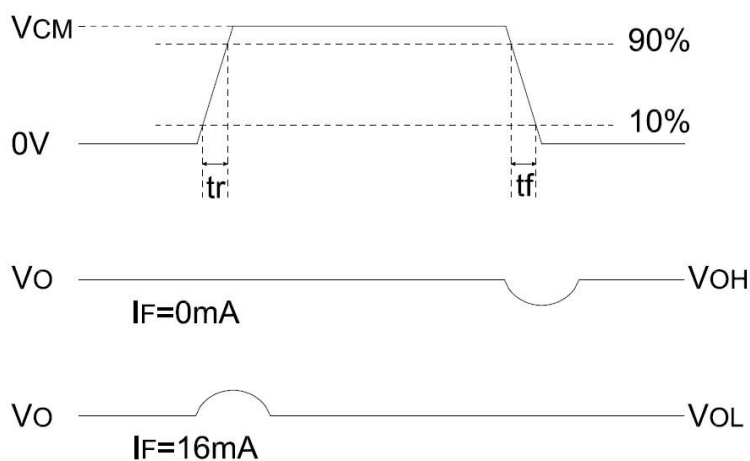
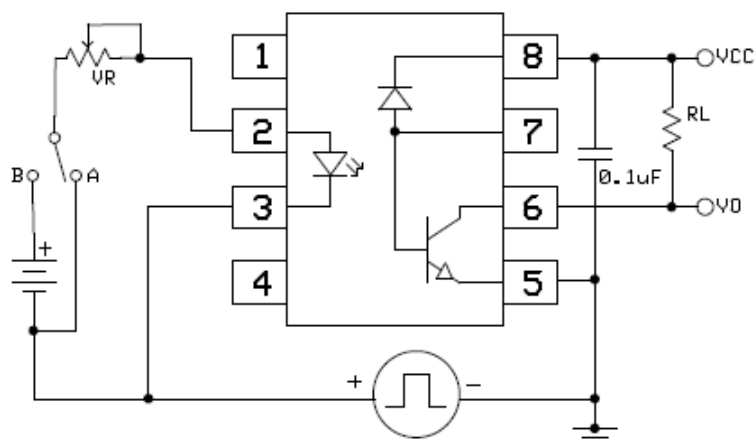
Switching Time Test Circuit





# 6N135, 6N136, CT4502, CT4503 1Mbit/s High Speed Phototransistor Optocoupler

## Test Circuits



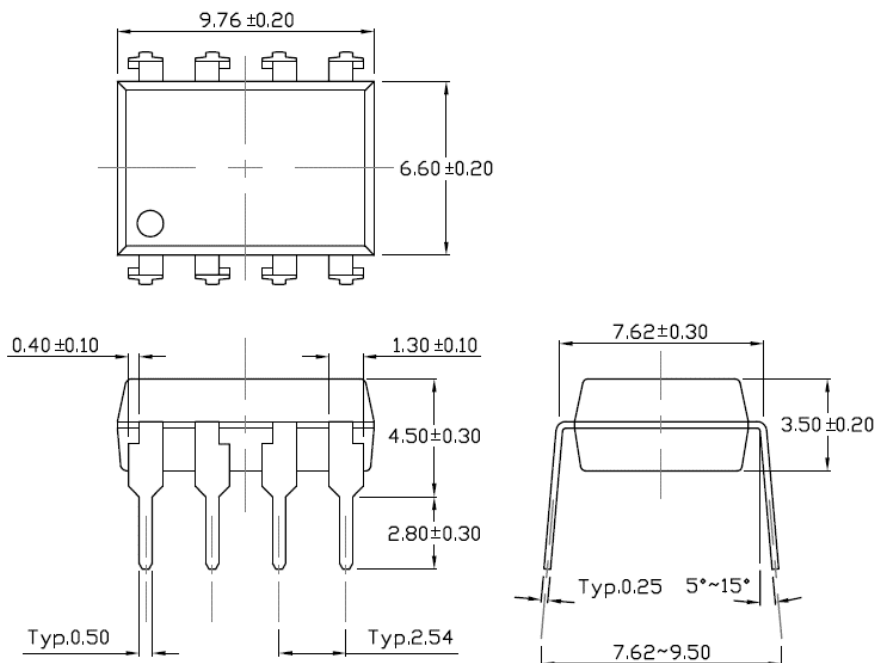
CMR Test Circuit



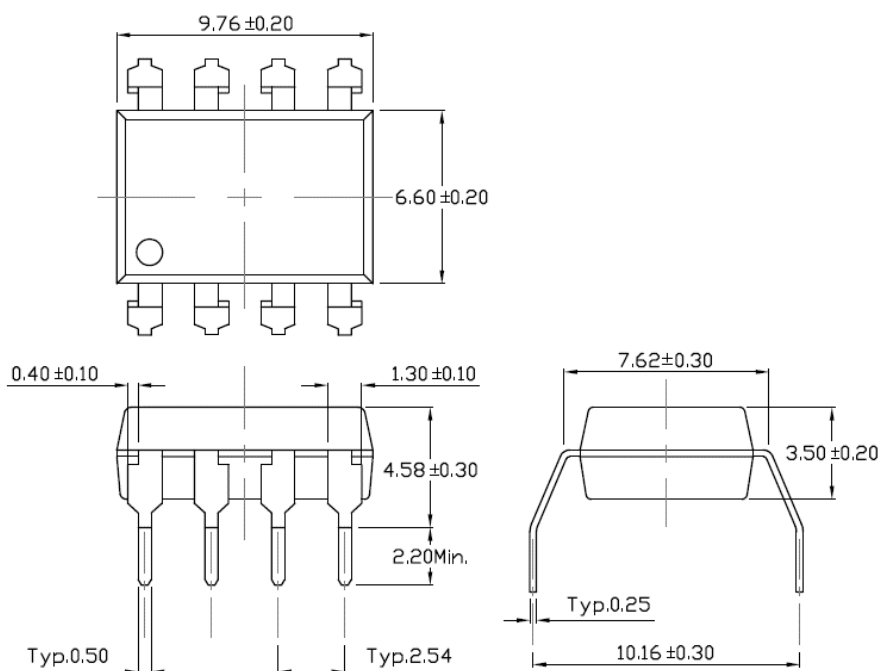
# 6N135, 6N136, CT4502, CT4503 1Mbit/s High Speed Phototransistor Optocoupler

## Package Dimension *Dimensions in mm unless otherwise stated*

### Standard DIP – Through Hole



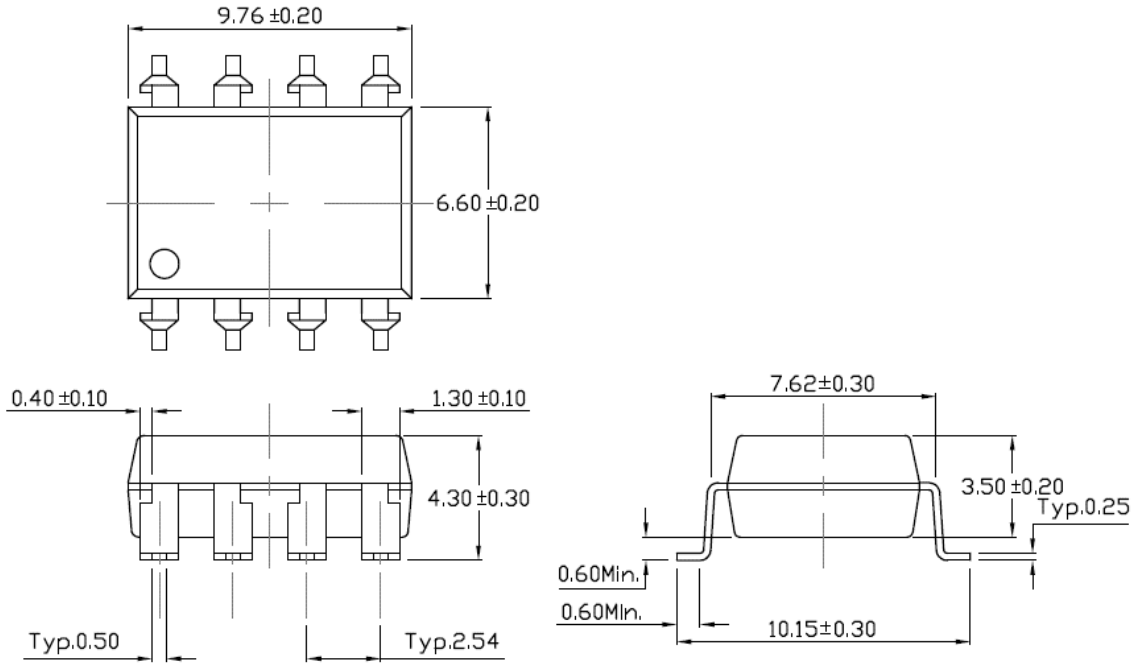
### Gullwing (400mil) Lead Forming – Through Hole (M Type)



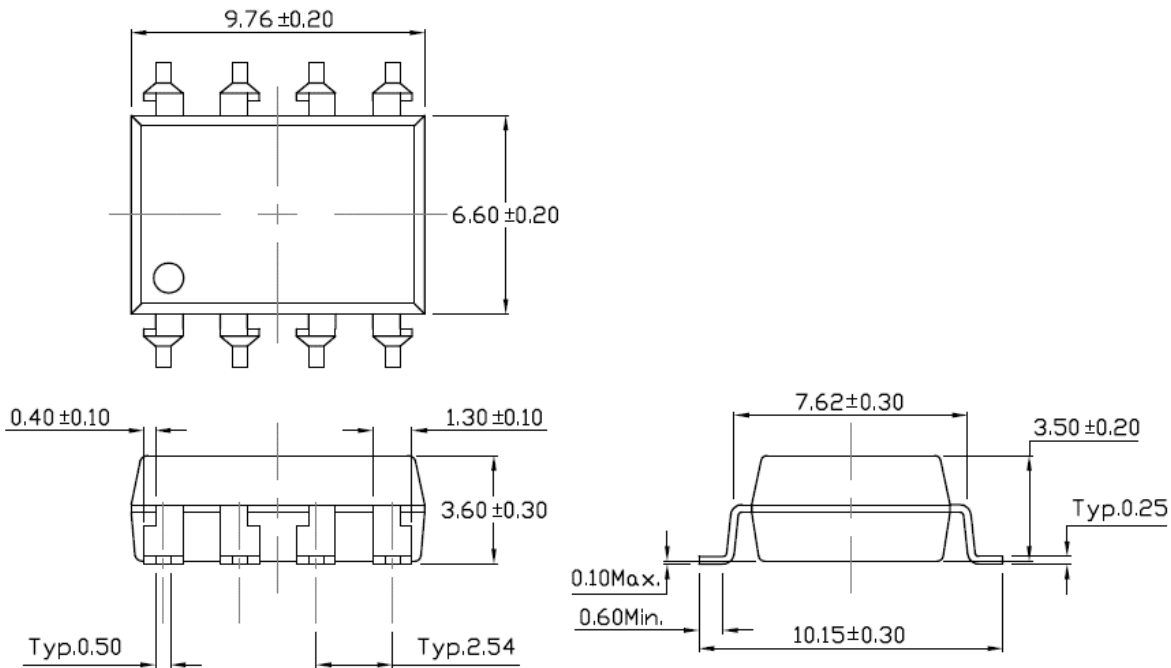


# 6N135, 6N136, CT4502, CT4503 1Mbit/s High Speed Phototransistor Optocoupler

## Surface Mount Lead Forming (S Type)



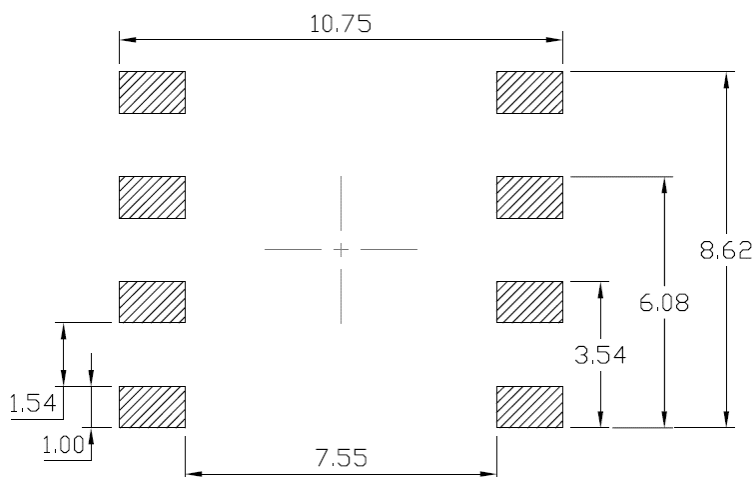
## Surface Mount (Low Profile) Lead Forming (SL Type)



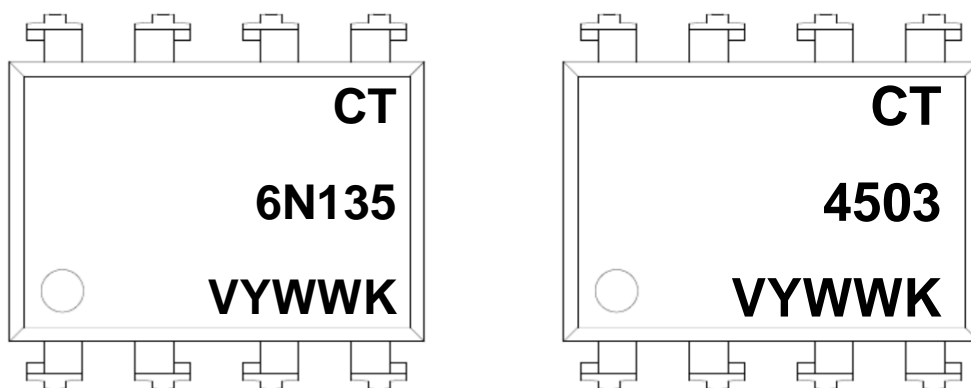


# 6N135, 6N136, CT4502, CT4503 1Mbit/s High Speed Phototransistor Optocoupler

## Recommended Solder Mask *Dimensions in mm unless otherwise stated*



## Device Marking



- CT : Denotes "CT Micro"
- 6N135 : Product Number
- 4503 : Product Number
- V : VDE Option
- Y : Fiscal Year
- WW : Work Week
- K : Production Code



# 6N135, 6N136, CT4502, CT4503

## 1Mbit/s High Speed Phototransistor Optocoupler

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### Ordering Information

6N13X(V)(Y)(Z) or CT450X(V)(Y)(Z)

X = Part No. (5,6 for 6N13X series), (2,3 for CT450X series)

V = VDE Option ( V or None)

Y = Lead form option (S, SL, M or none)

Z = Tape and reel option (T1, T2 or none)

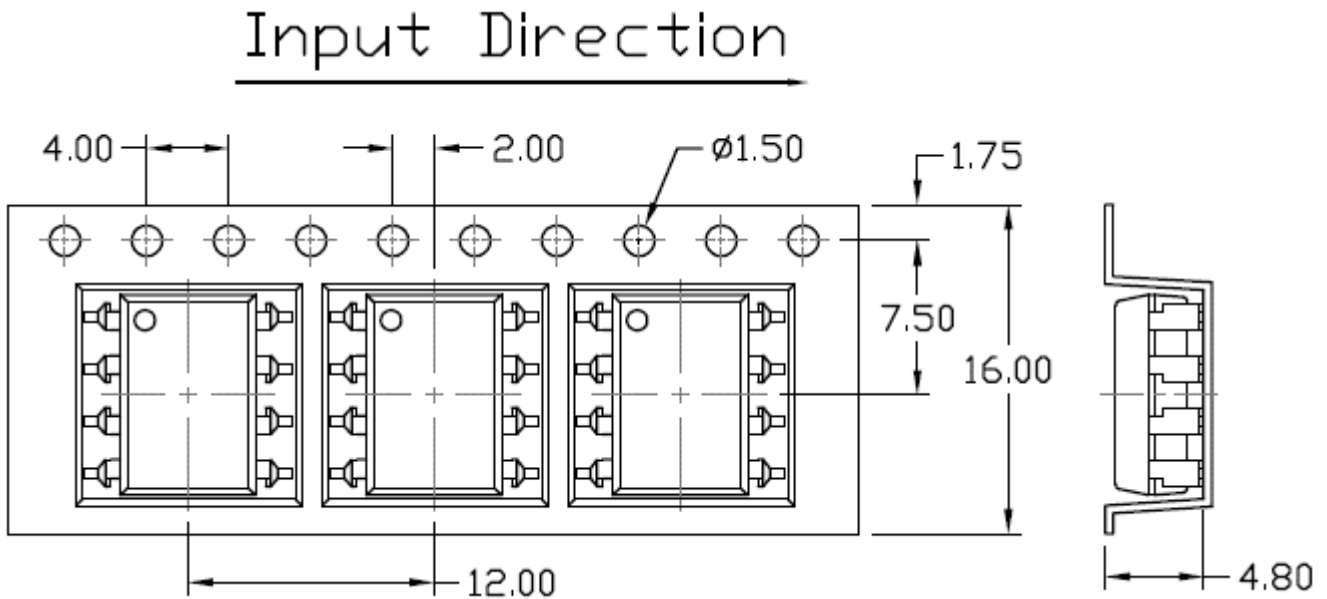
<b>Option</b>	<b>Description</b>	<b>Quantity</b>
None	Standard 8 Pin Dip	40 Units/Tube
M	Gullwing (400mil) Lead Forming	40 Units/Tube
S(T1)	Surface Mount Lead Forming – With Option 1 Taping	1000 Units/Reel
S(T2)	Surface Mount Lead Forming – With Option 2 Taping	1000 Units/Reel
SL(T1)	Surface Mount (Low Profile) Lead Forming– With Option 1 Taping	1000 Units/Reel
SL(T2)	Surface Mount (Low Profile) Lead Forming– With Option 2 Taping	1000 Units/Reel



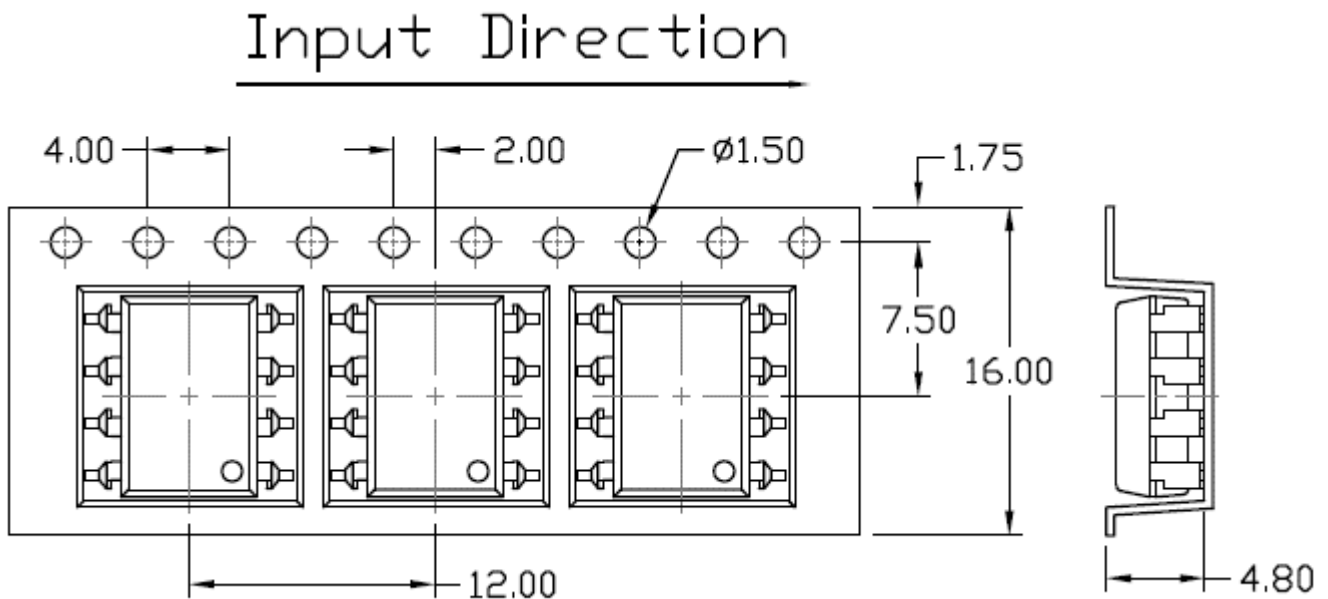
# 6N135, 6N136, CT4502, CT4503 1Mbit/s High Speed Phototransistor Optocoupler

## Carrier Tape Specifications *Dimensions in mm unless otherwise stated*

### Option S(T1) & SL(T1)



### Option S(T2) & SL(T2)





# 6N135, 6N136, CT4502, CT4503 1Mbit/s High Speed Phototransistor Optocoupler

## Wave soldering (follow the JEDEC standard JESD22-A111)

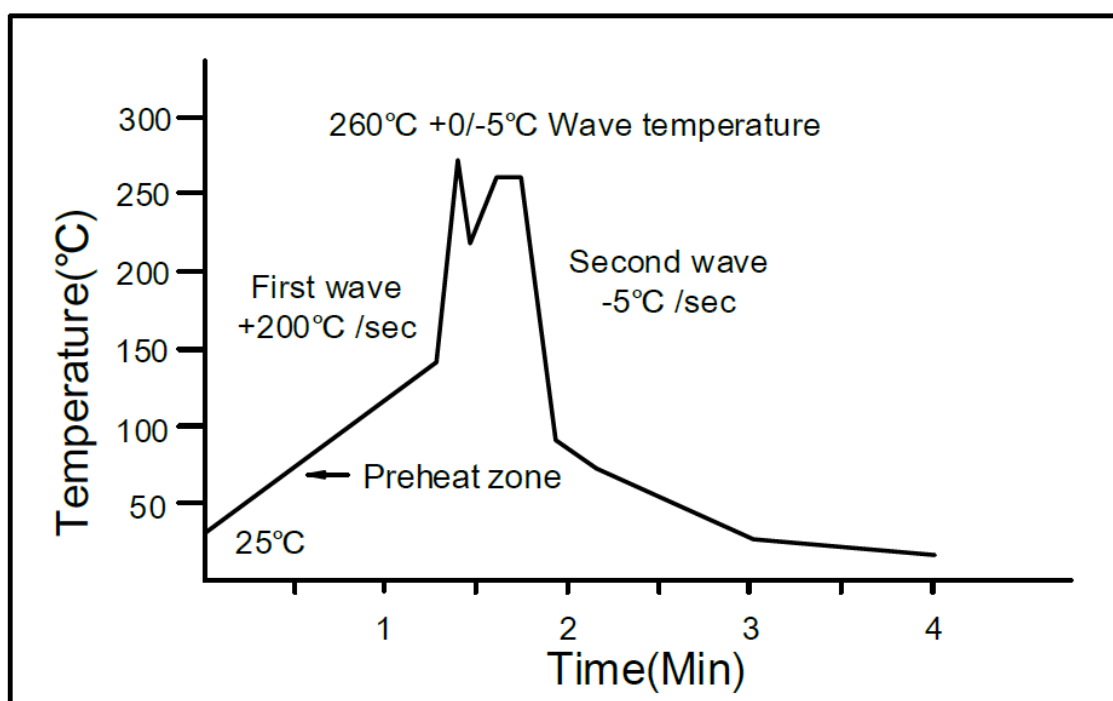
One time soldering is recommended within the condition of temperature.

Temperature:  $260 \pm 5^\circ\text{C}$ .

Time: 10 sec.

Preheat temperature: 25 to  $140^\circ\text{C}$ .

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:  $350 \pm 10^\circ\text{C}$

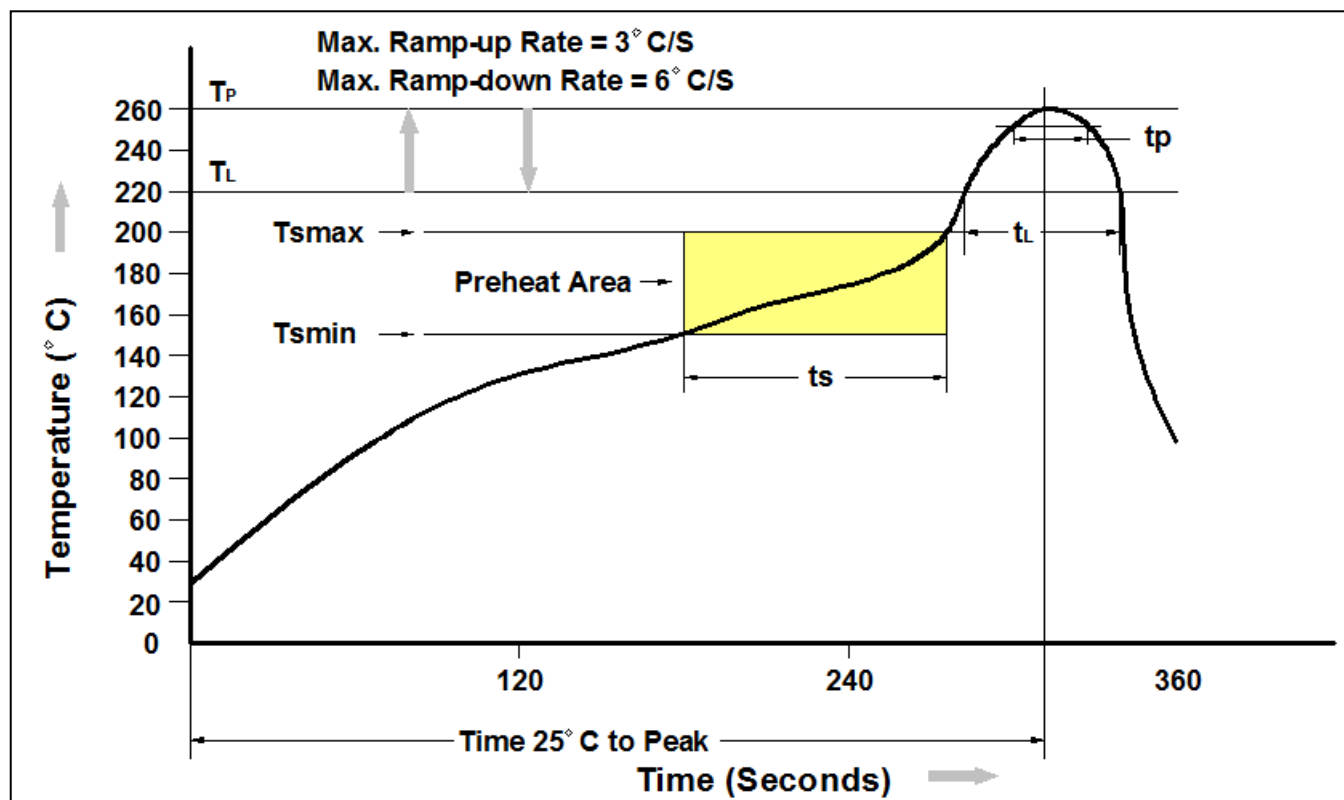
Time: 5 sec max.



# 6N135, 6N136, CT4502, CT4503

## 1Mbit/s High Speed Phototransistor Optocoupler

### 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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