



# 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

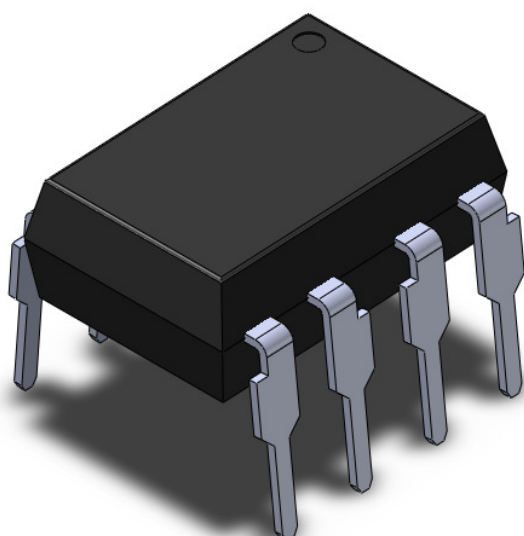
- Line receivers
- Telecommunication equipment
- High speed logic ground isolation
- Feedback loop in switch-mode power supplies
- Home appliances

### 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.

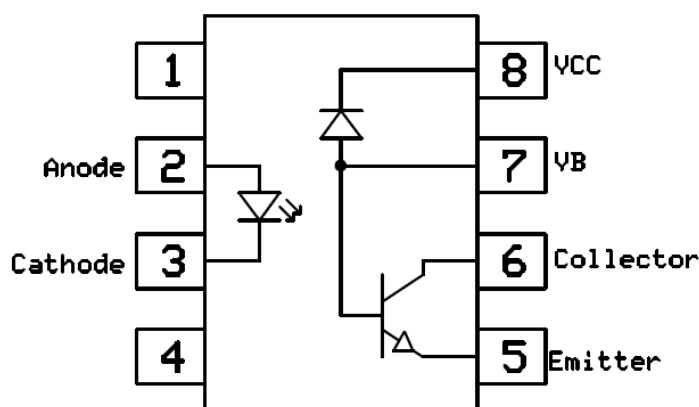
The devices are packaged in an 8-pin DIP package and also available in gullwing (400mil) and surface mount lead forming.

### Package Outline



Note: Different bending options available. See package dimension.

### Schematic



6N135 / 6N136

Pin 7 not connected for CT4502/CT4503



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### Absolute Maximum Rating at 25°C

<b>Symbol</b>	<b>Parameters</b>	<b>Ratings</b>	<b>Units</b>	<b>Notes</b>
V <sub>ISO</sub>	Isolation voltage *1	5000	V <sub>RMS</sub>	
T <sub>OPR</sub>	Operating temperature	-55 ~ +100	°C	
T <sub>STG</sub>	Storage temperature	-55 ~ +125	°C	
T <sub>SOL</sub>	Soldering temperature *2	260	°C	
<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	



# 6N135, 6N136, CT4502, CT4503

## 1Mbit/s High Speed Phototransistor Optocoupler

### 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		



# 6N135, 6N136, CT4502, CT4503

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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						$I_F=16\text{mA}, V_O=0.4\text{V}, V_{CC}=4.5\text{V},$ $T_A=25^\circ\text{C}$	19
		6N135	5	-	-			V	
		6N136 CT4502 CT4503							
$V_{OL}$	Logic Low Output Voltage	6N135	-	0.18	0.4	V			
		6N136 CT4502 CT4503							
		6N135	-	-	0.5			V	
		6N136 CT4502 CT4503							



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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

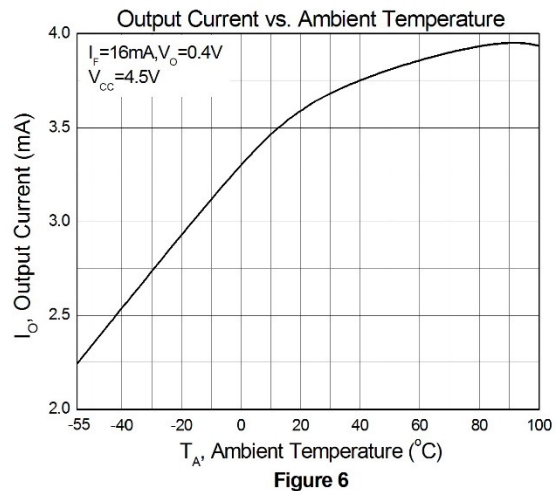
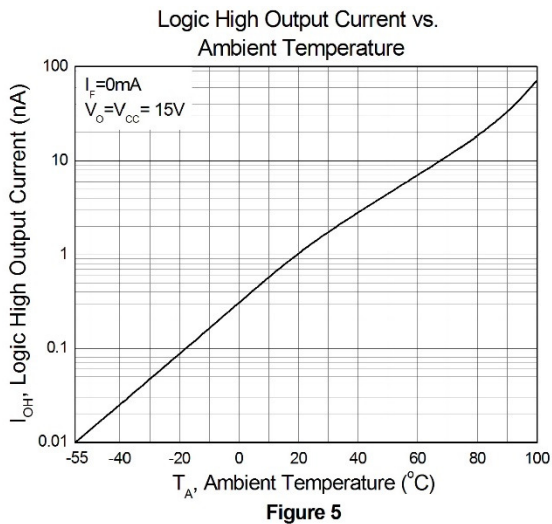
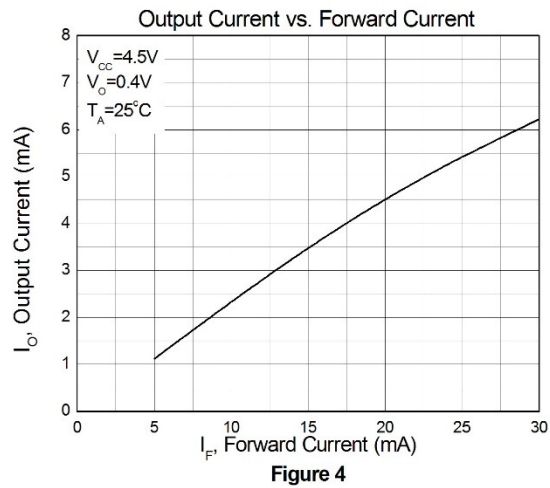
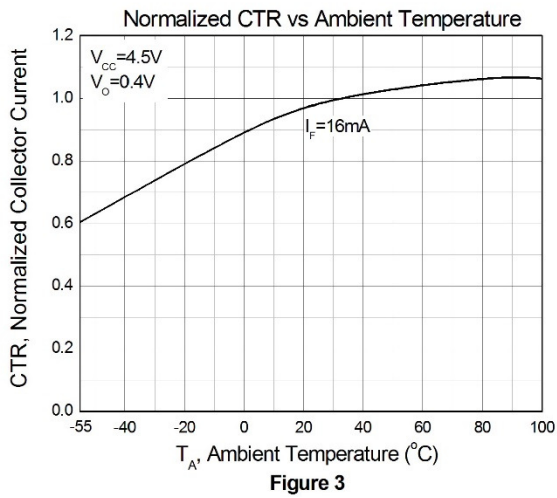
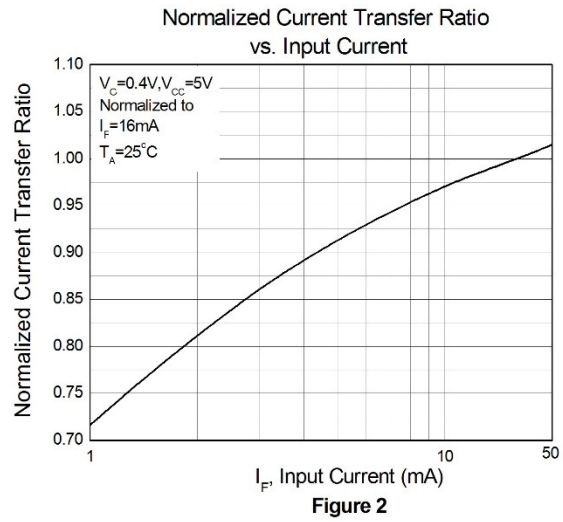
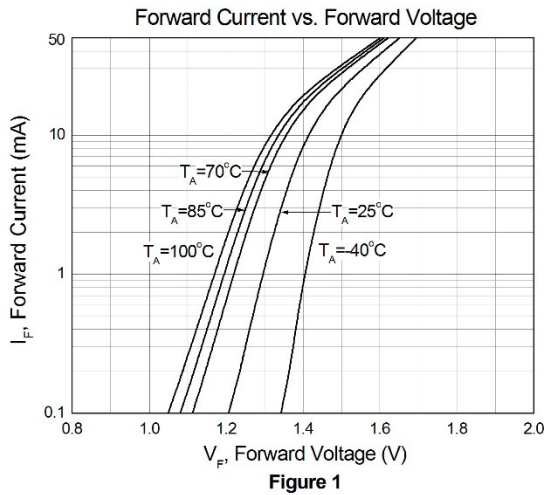
Symbol	Parameters		Test Conditions	Min	Typ	Max	Units	Notes
$T_{PHL}$	Propagation Delay Time Logic High to Logic Low	6N135	$R_L=4.1\text{K}\Omega$ , $T_A=25^\circ\text{C}$	-	0.35	1.5	$\mu\text{s}$	
			$R_L=4.1\text{K}\Omega$	-	-	2.0		
		6N136 CT4502 CT4503	$R_L=1.9\text{K}\Omega$ , $T_A=25^\circ\text{C}$	-	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	$I_F = 16\text{mA}$ , $V_{CM}=1500\text{Vp-p}$ , $R_L=1.9\text{K}\Omega$ , $T_A=25^\circ\text{C}$	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 1Mbit/s High Speed Phototransistor Optocoupler

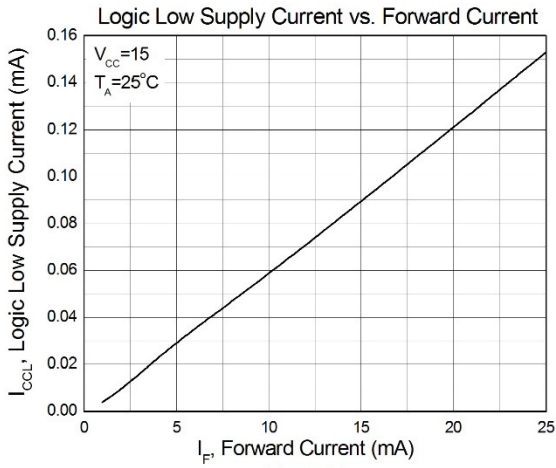


Figure 7

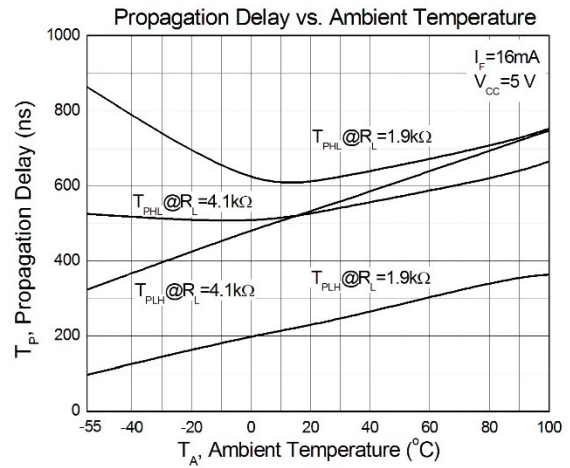


Figure 8

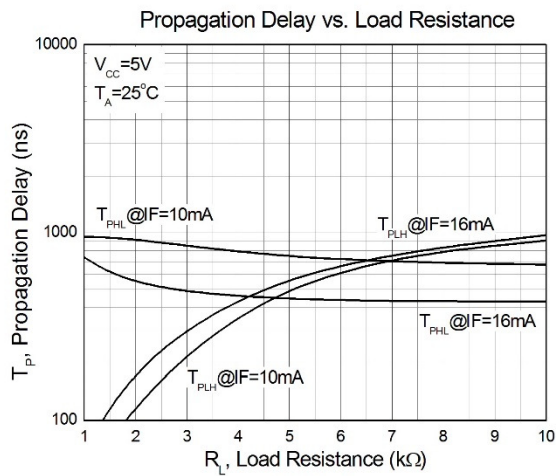
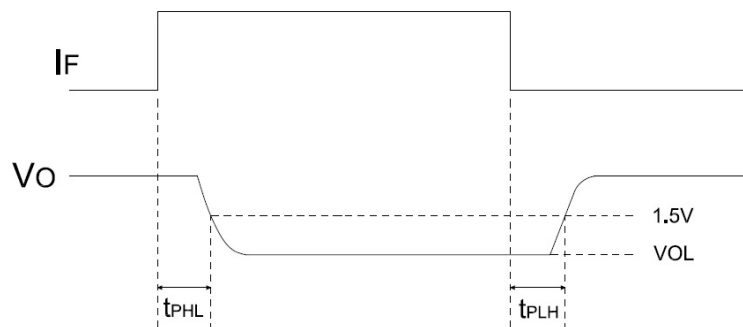
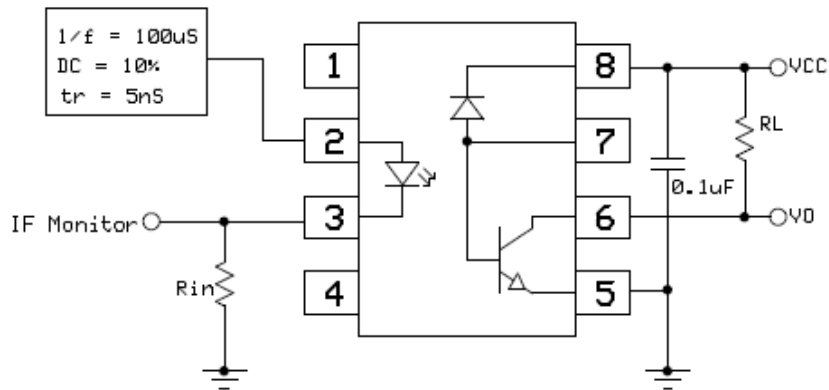


Figure 9



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

## Test Circuits



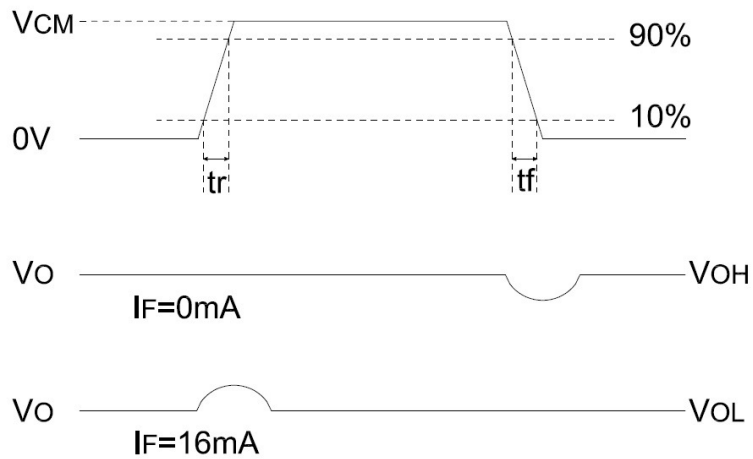
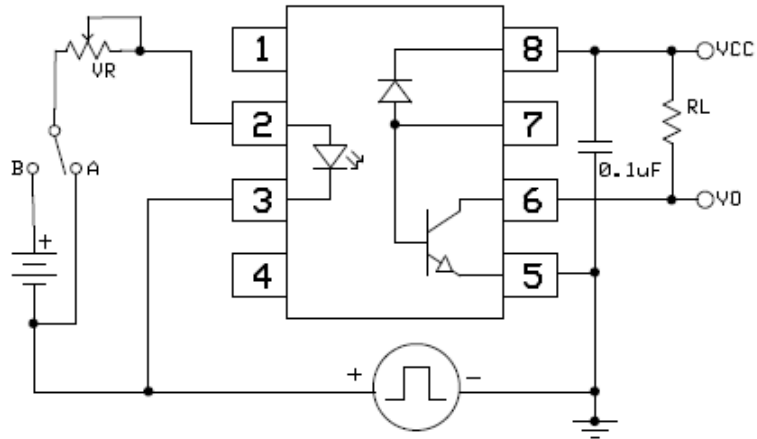
Switching Time Test Circuit





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

## Test Circuits



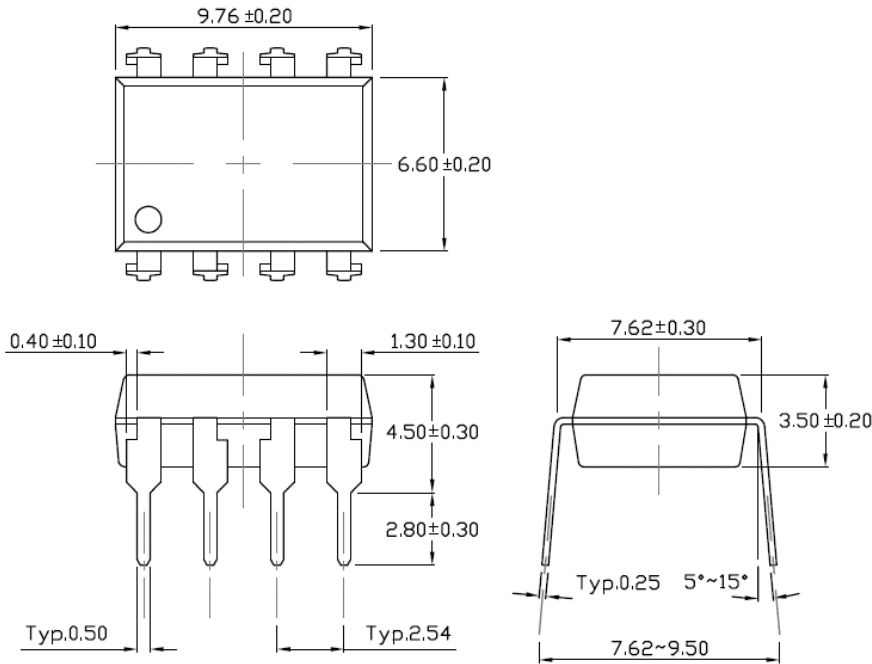
CMR Test Circuit



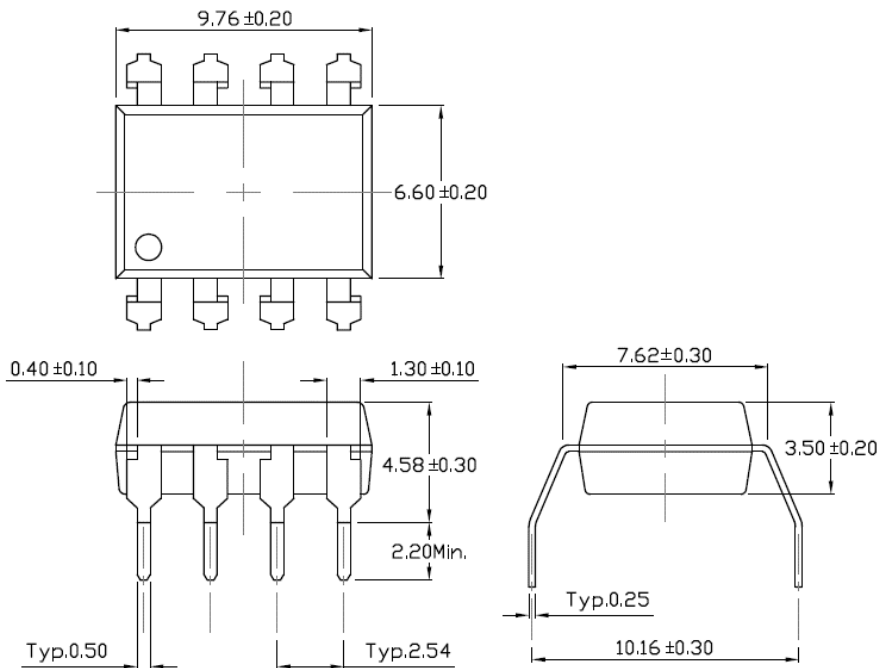
# 6N135, 6N136, CT4502, CT4503 1Mbit/s High Speed Phototransistor Optocoupler

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

### Standard DIP – Through Hole



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

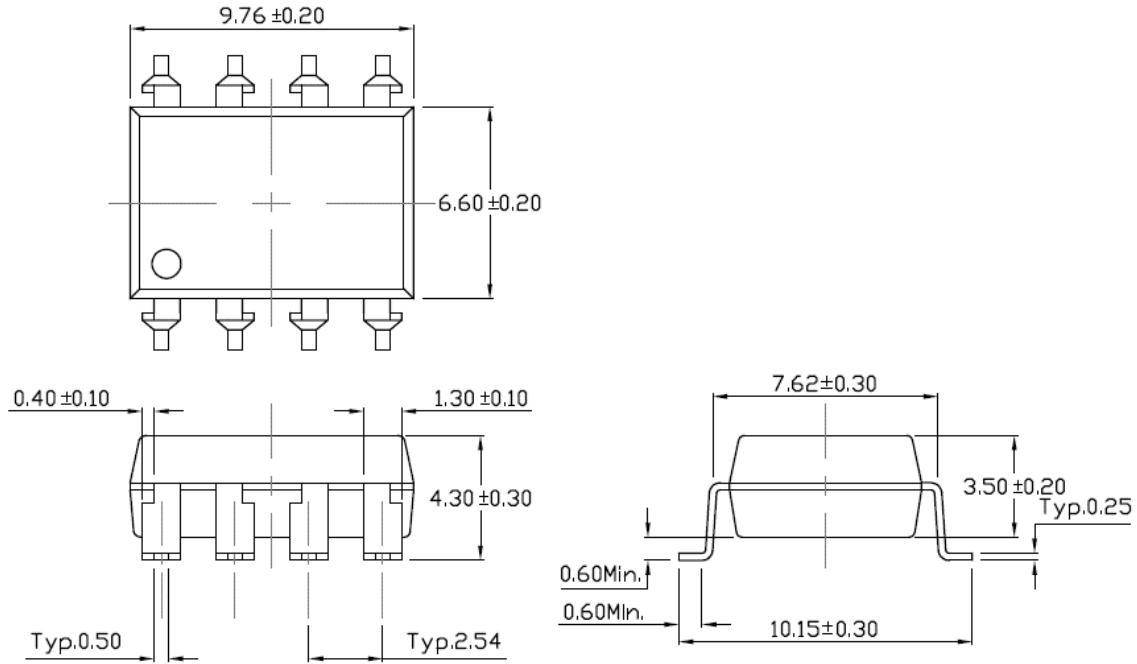




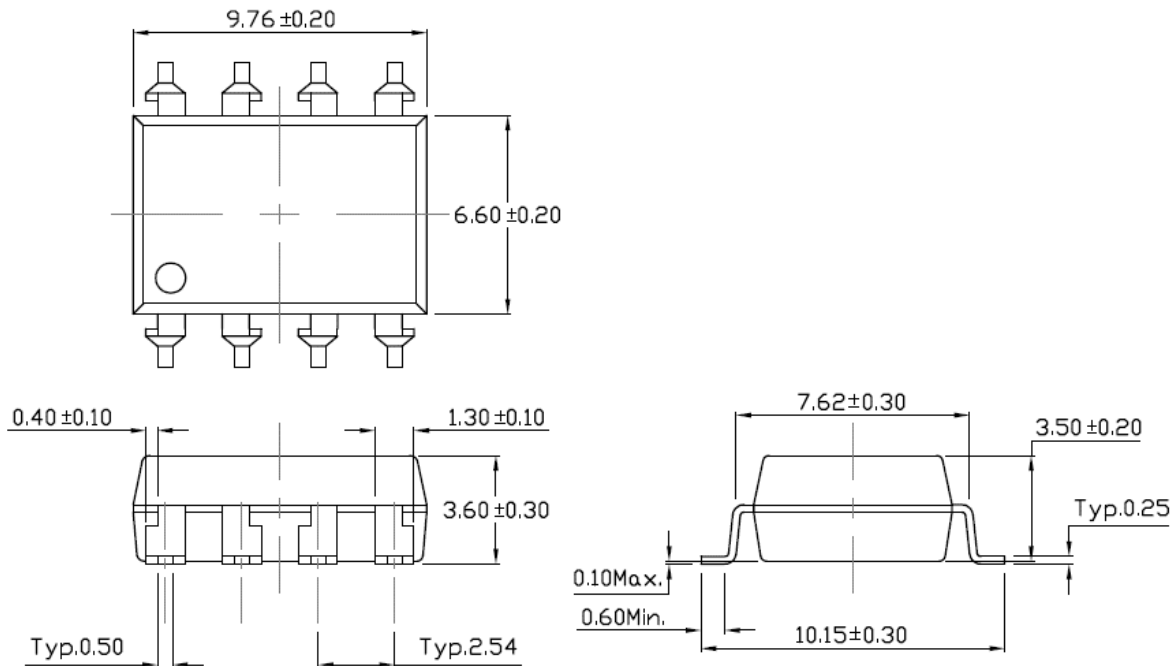
# 6N135, 6N136, CT4502, CT4503

## 1Mbit/s High Speed Phototransistor Optocoupler

### Surface Mount Lead Forming (S Type)



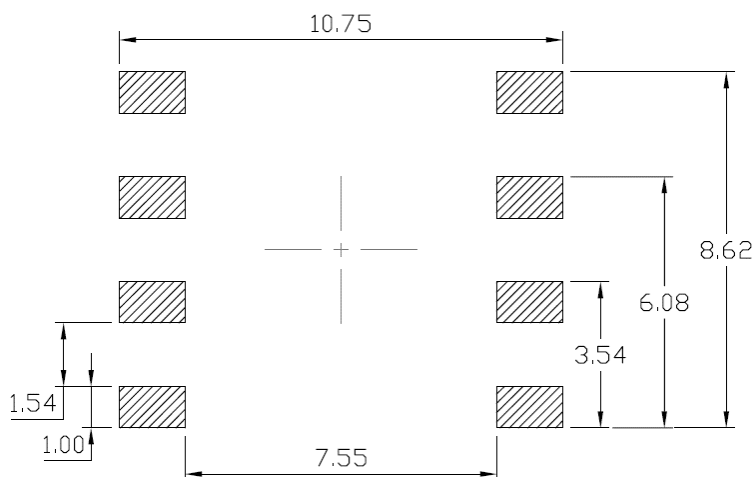
### Surface Mount (Low Profile) Lead Forming (SL Type)



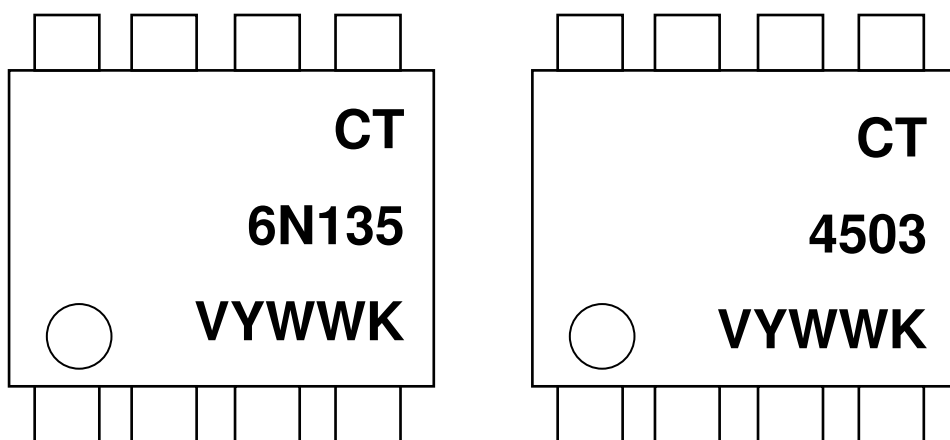


# 6N135, 6N136, CT4502, CT4503 1Mbit/s High Speed Phototransistor Optocoupler

## Recommended Solder Mask Dimensions in mm unless otherwise stated



## Device Marking



- CT : Denotes "CT Micro"
- 6N135 : Product Number
- 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)

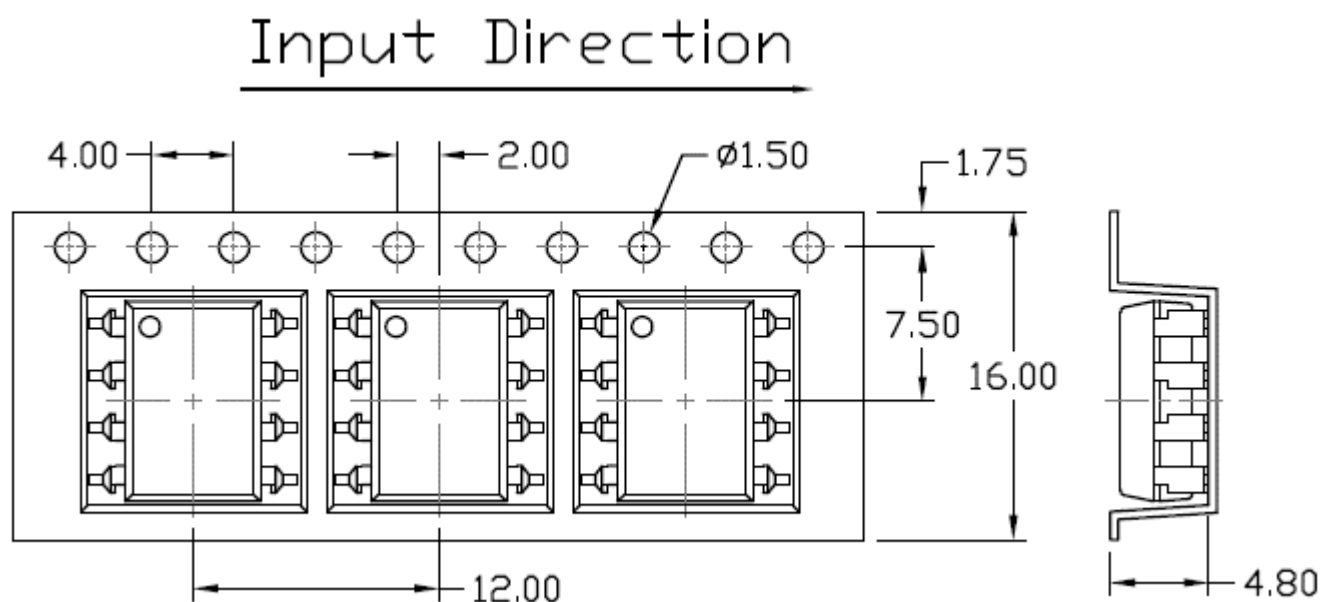
<b>Option</b>	<b>Description</b>	<b>Quantity</b>
None	Standard 8 Pin Dip	40 Units/Tube
M	Gullwing (400mil) Lead Forming	40 Units/Tube
S(T1)	Surface Mount Lead Forming – With Option 1 Taping	1000 Units/Reel
S(T2)	Surface Mount Lead Forming – With Option 2 Taping	1000 Units/Reel
SL(T1)	Surface Mount (Low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



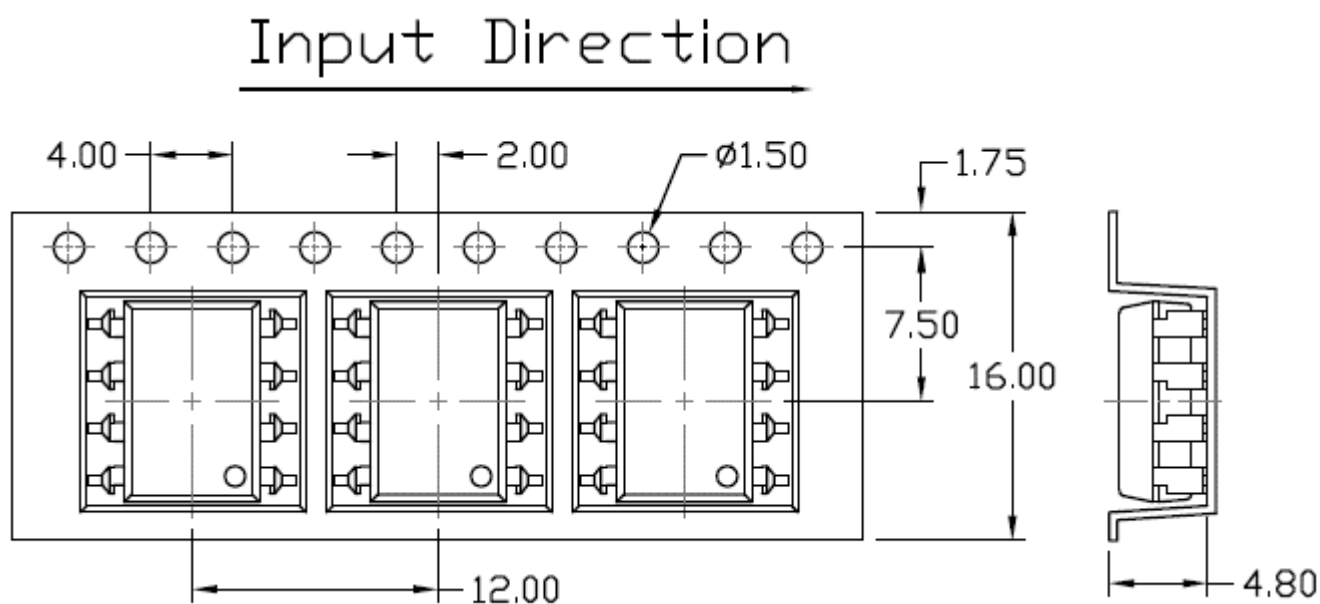
# 6N135, 6N136, CT4502, CT4503 1Mbit/s High Speed Phototransistor Optocoupler

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

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



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

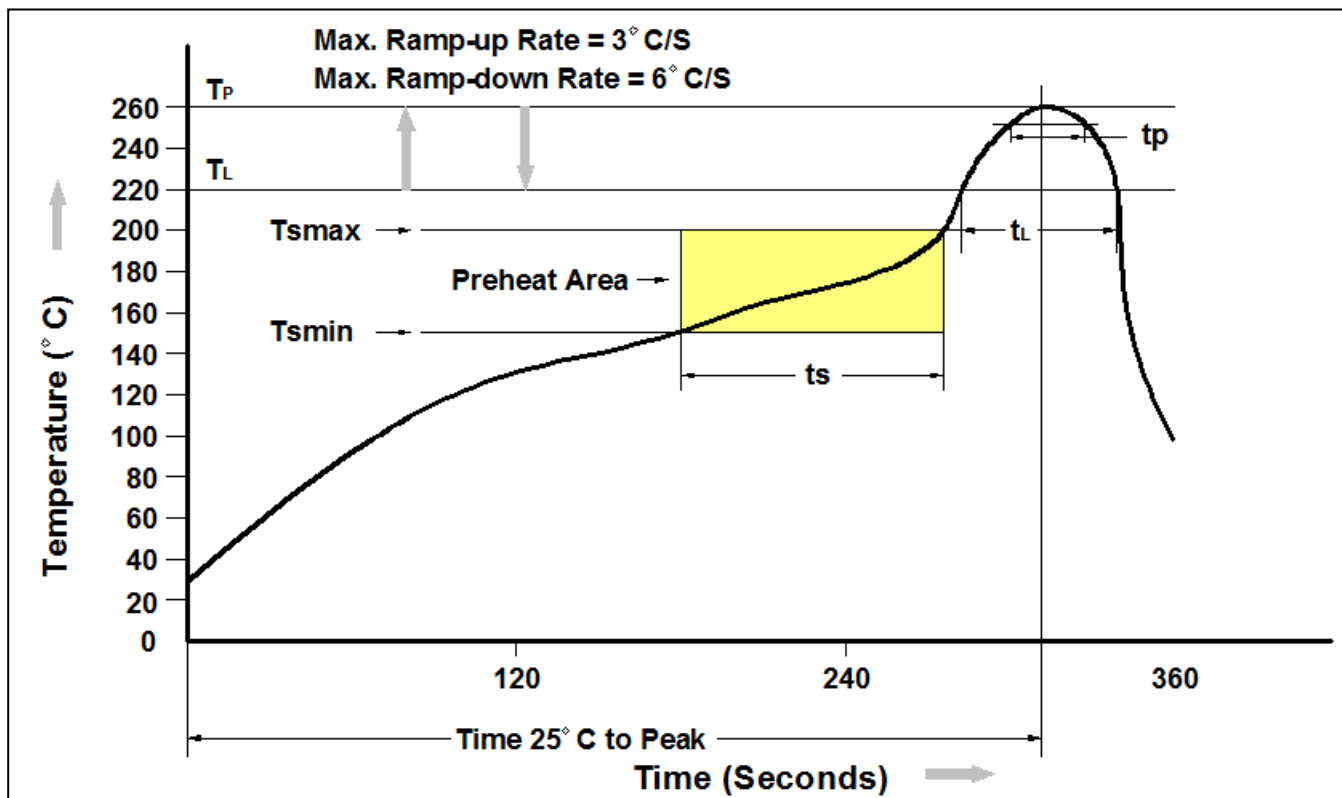




# 6N135, 6N136, CT4502, CT4503

## 1Mbit/s High Speed Phototransistor Optocoupler

### Reflow Profile



Profile Feature	Pb-Free Assembly Profile
Temperature Min. (Tsmmin)	150 °C
Temperature Max. (Tsmmax)	200 °C
Time (ts) from (Tsmmin to Tsmmax)	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.*