# CTW138, CTW139

# Low Input Current Photodarlington Coupler

## Features

- Low current – 0.5mA
- Superior CTR-2000%
- CTR guaranteed 0–70℃
- Regulatory Approvals
  - UL - UL1577 (E364000)
  - VDE - EN60747-5-5(VDE0884-5)
  - CQC – GB4943.1, GB8898
  - IEC60065, IEC60950

## Applications

- Digital logic ground isolation
- Telephone ring detector
- EIA-RS-232C line receiver
- High common mode noise line receiver
- Current loop receiver

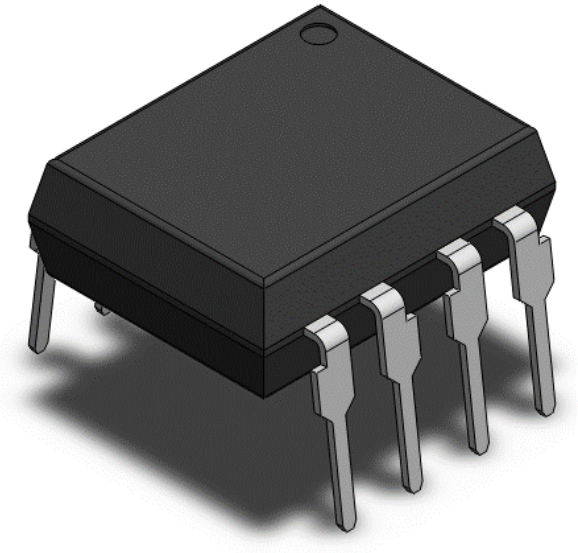
## Description

The CTW138 & CTW139 optocouplers consist of an AlGaAs LED optically coupled to a high gain split darlington photodetector.

The combination of a very low input current of 0.5mA and a high current transfer ratio of 2000% makes this family particularly useful for input interface to MOS, CMOS, LSTTL and EIA RS232C, while output compatibility is ensured to CMOS as well as high fan-out TTL requirements.

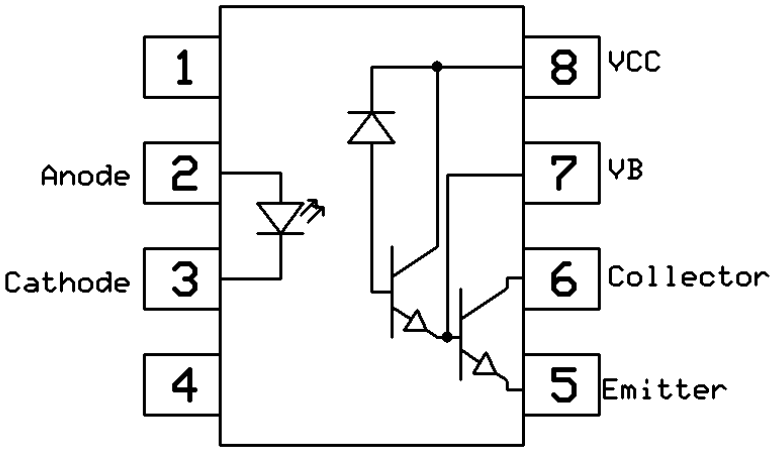
The devices are packaged in an 8-pin widebody package and also available in surface mount lead forming option.

## Package Outline



*Note: Different lead forming options available. See package dimension.*

## Schematic




CTW138 / CTW139

## Absolute Maximum Rating at 25°C

| *Symbol* | *Parameters* | | *Ratings* | *Units* | *Notes* |
|---|---|---|---|---|---|
| $V_{ISO}$ | Isolation voltage | | 5000 | $V_{RMS}$ | |
| $T_{OPR}$ | Operating temperature | | -55 ~ +100 | °C | |
| $T_{STG}$ | Storage temperature | | -55 ~ +125 | °C | |
| $T_{SOL}$ | Soldering temperature | | 260 | °C | |
| **Emitter** | | | | | |
| $I_F$ | Forward current | | 25 | mA | |
| $I_{FP}$ | Peak forward current (50% duty, 1ms P.W) | | 50 | mA | |
| $I_{F(TRANS)}$ | Peak transient current (≤1μs P.W,300pps) | | 1 | A | |
| $V_R$ | Reverse voltage | | 5 | V | |
| $P_C$ | Power dissipation | | 40 | mW | |
| **Detector** | | | | | |
| $P_D$ | Power dissipation | | 100 | mW | |
| $V_{EBR}$ | Emitter-Base reverse voltage | | 0.5 | V | |
| $I_O$ | Output Current | | 60 | mA | |
| $V_O$ | Output voltage | CTW138 | -0.5 to 7 | V | |
| | | CTW139 | -0.5 to 18 | V | |
| $V_{CC}$ | Supply voltage | CTW138 | -0.5 to 7 | V | |
| | | CTW139 | -0.5 to 18 | V | |

## Electrical Characteristics *$T_A$ = 0 - 70℃, $V_{CC}$=4.5V (unless otherwise specified).*

### Emitter Characteristics

| *Symbol* | *Parameters* | *Test Conditions* | *Min* | *Typ* | *Max* | *Units* | *Notes* |
|---|---|---|---|---|---|---|---|
| $V_F$ | Forward voltage | $I_F$ = 16mA | - | 1.45 | 1.6 | V | |
| $I_R$ | Reverse Current | $V_R$ = 5V | - | - | 5 | μA | |
| $\Delta V_F/\Delta T_A$ | Temperature coefficient of forward voltage | $I_F$ =16mA | - | -1.8 | - | mV/℃ | |

### Detector Characteristics

| *Symbol* | *Parameters* | | *Test Conditions* | *Min* | *Typ* | *Max* | *Units* | *Notes* |
|---|---|---|---|---|---|---|---|---|
| $I_{OH}$ | Logic High Output Current | CTW139 | $I_F$=0mA, $V_O$=$V_{CC}$=18V, | - | 0.008 | 80 | μA | |
| | | CTW138 | | - | - | 200 | | |
| $I_{CCL}$ | Logic Low Supply Current | | $I_F$=1.6mA, $V_O$=Open, $V_{CC}$=18V | - | 0.5 | 1.4 | mA | |
| $I_{CCH}$ | Logic High Supply Current | | $I_F$=0mA, $V_O$=Open, $V_{CC}$=18V | - | 0.04 | 8 | μA | |

### Transfer Characteristics

| *Symbol* | *Parameters* | | *Test Conditions* | *Min* | *Typ* | *Max* | *Units* | *Notes* |
|---|---|---|---|---|---|---|---|---|
| CTR | Current Transfer Ratio | CTW139 | $I_F$=0.5mA, $V_O$=0.4V, | 400 | 2500 | - | % | |
| | | CTW138 | $I_F$=1.6mA, $V_O$=0.5V, | 300 | 2000 | - | | |
| | | CTW139 | | 500 | 2000 | - | | |
| $V_{OL}$ | Logic Low Output Voltage | CTW139 | $I_F$= 0.5mA, $I_O$= 2mA | - | 0.04 | 0.4 | V | |
| | | | $I_F$= 1.6mA, $I_O$= 8mA | - | 0.08 | 0.4 | | |
| | | | $I_F$= 5mA, $I_O$= 15mA | - | 0.11 | 0.4 | | |
| | | | $I_F$= 12mA, $I_O$= 24mA | - | 0.16 | 0.4 | | |
| | | CTW138 | $I_F$= 1.6mA, $I_O$= 4.8mA | - | 0.05 | 0.4 | | |

## Electrical Characteristics *$T_A$ = 0 - 70℃, $V_{CC}$= 5V (unless otherwise specified).*

### Switching Characteristics

| *Symbol* | *Parameters* | | *Test Conditions* | | *Min* | *Typ* | *Max* | *Units* | *Notes* |
|---|---|---|---|---|---|---|---|---|---|
| $T_{PHL}$ | High to Low Propagation Delay | CTW139 | $I_F$= 0.5mA, | | - | - | 30 | µs | |
| | | | $R_L$= 4.7kΩ | $T_A$= 25$^0$C | - | 4.8 | 25 | | |
| | | | $I_F$= 12mA, | | - | - | 2 | | |
| | | | $R_L$= 250Ω | $T_A$= 25$^0$C | - | 0.2 | 1 | | |
| | | CTW138 | $I_F$= 1.6mA, | | - | - | 15 | | |
| | | | $R_L$= 2.2kΩ | $T_A$= 25$^0$C | - | 1.35 | 10 | | |
| $T_{PLH}$ | Low to High Propagation Delay | CTW139 | $I_F$= 0.5mA, | | - | - | 90 | µs | |
| | | | $R_L$= 4.7kΩ | $T_A$= 25$^0$C | - | 15 | 60 | | |
| | | | $I_F$= 12mA, | | - | - | 10 | | |
| | | | $R_L$= 250Ω | $T_A$= 25$^0$C | - | 1.6 | 7 | | |
| | | CTW138 | $I_F$= 1.6mA, | | - | - | 50 | | |
| | | | $R_L$= 2.2kΩ | $T_A$= 25$^0$C | - | 7.6 | 35 | | |
| $CM_H$ | Common Mode Transient Immunity at Logic High | | $I_F$ = 0mA, \|VCM\| = 10$V_{P-P}$, $T_A$ = 25℃,$R_L$ = 2.2kΩ | | 1,000 | - | - | V/µs | |
| $CM_L$ | Common Mode Transient Immunity at Logic Low | | $I_F$ = 1.6mA, \|VCM\| = 10$V_{P-P}$, $T_A$ = 25℃,$R_L$ = 2.2kΩ | | 1,000 | - | - | | |

## Typical Characteristic Curves

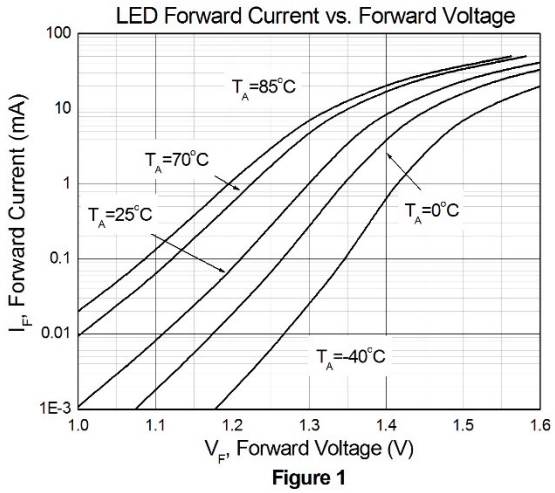



**Figure 1**

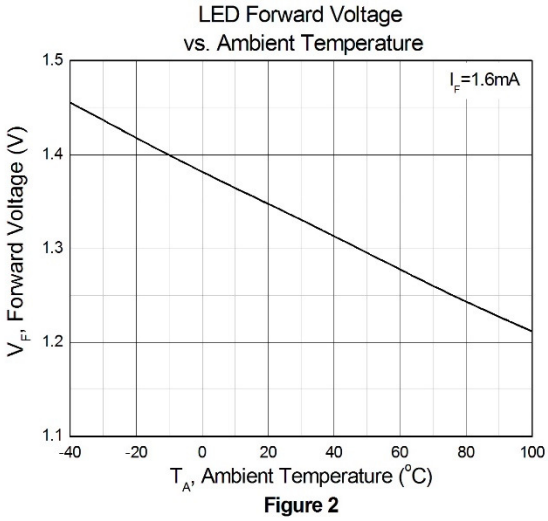



**Figure 2**

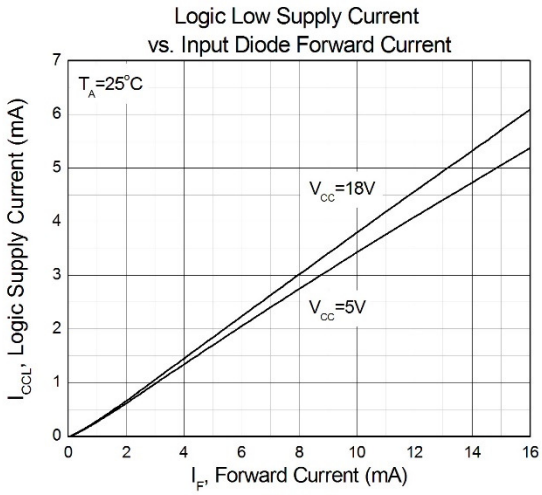



**Figure 3**

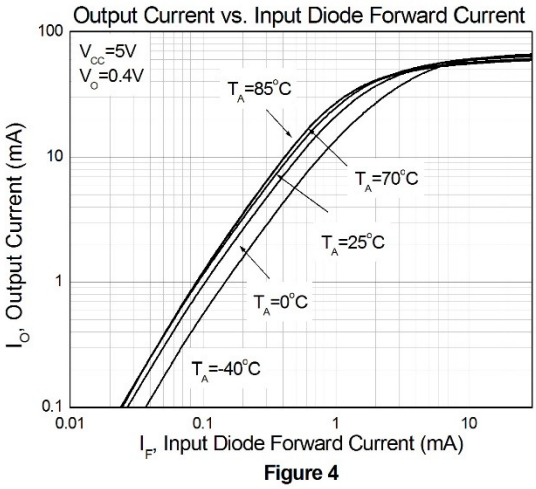



**Figure 4**

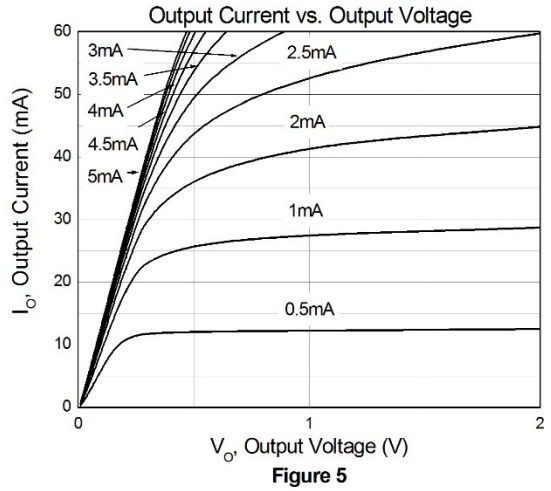



**Figure 5**

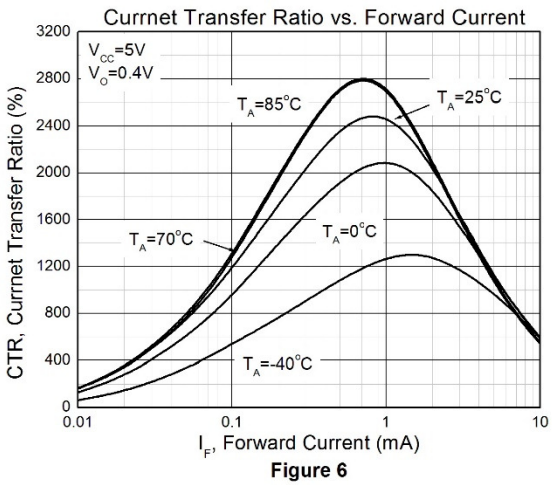



**Figure 6**

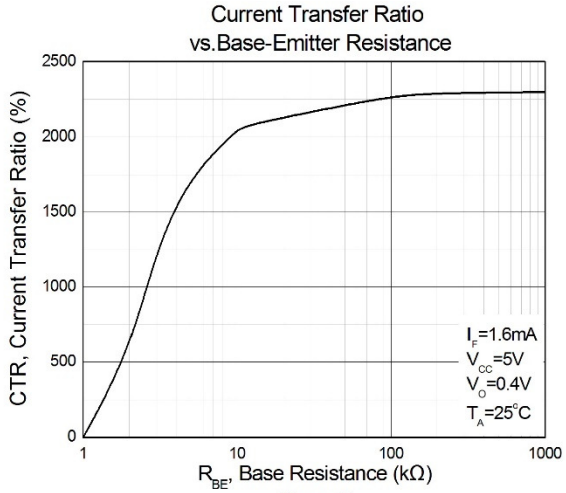



**Figure 7**

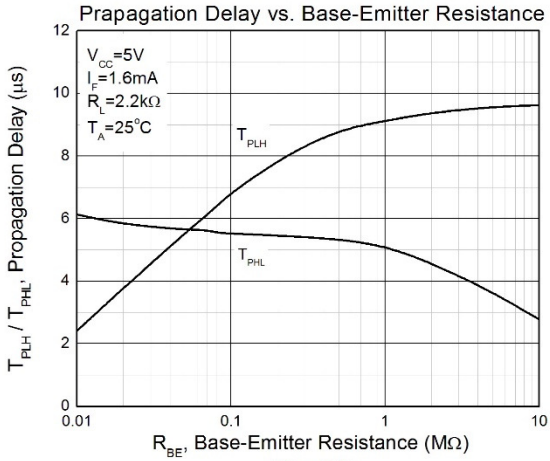



**Figure 8**

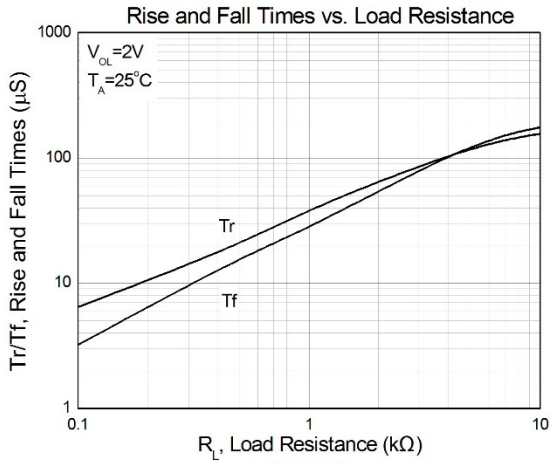



**Figure 9**

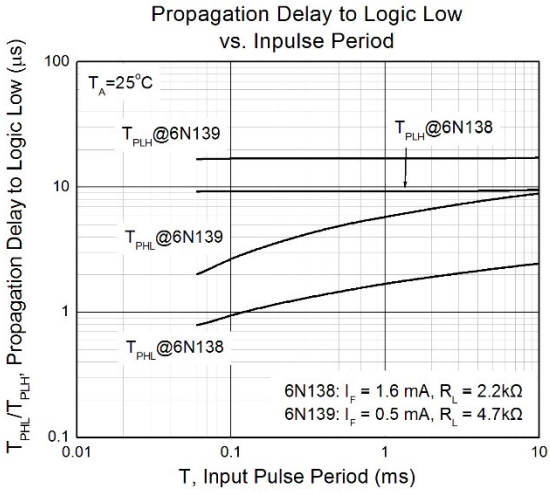



**Figure 10**

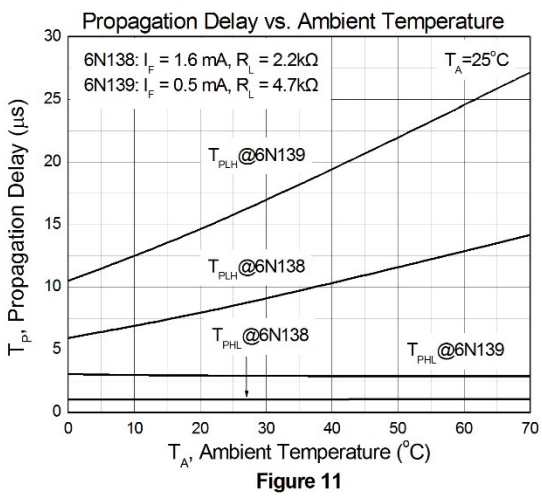



**Figure 11**

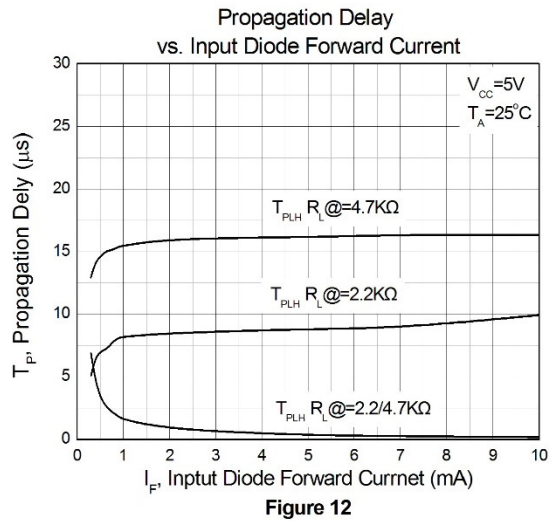
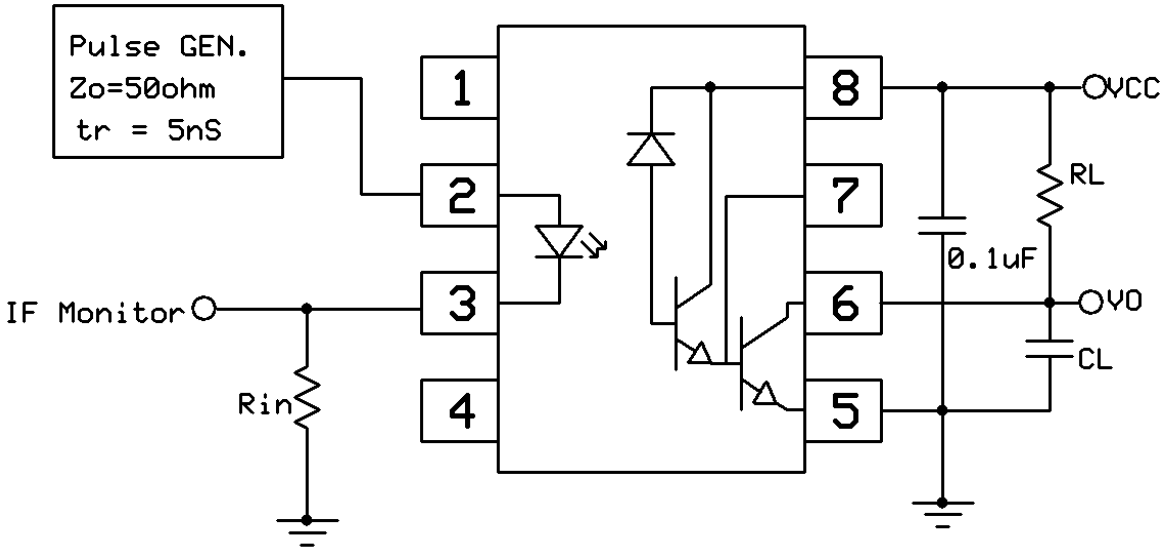
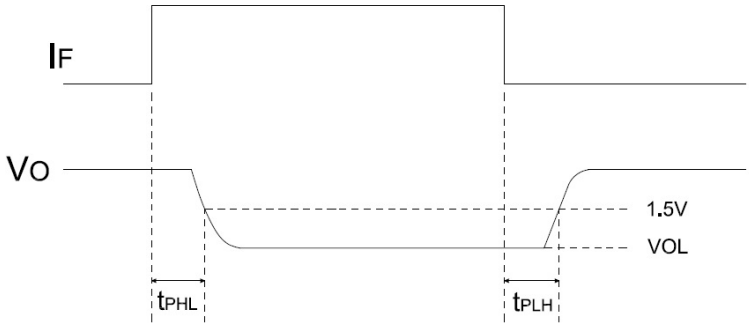



**Figure 12**

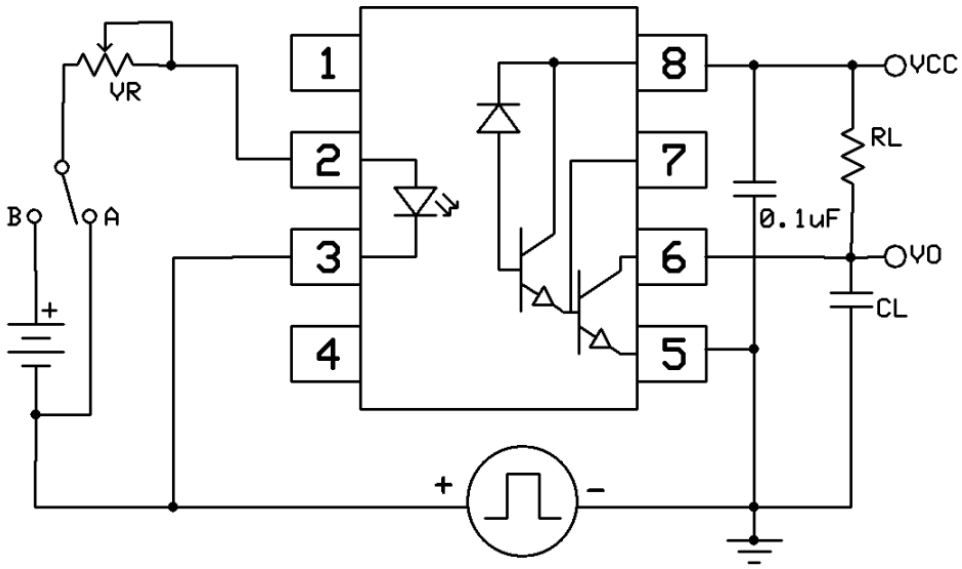
## Test Circuits

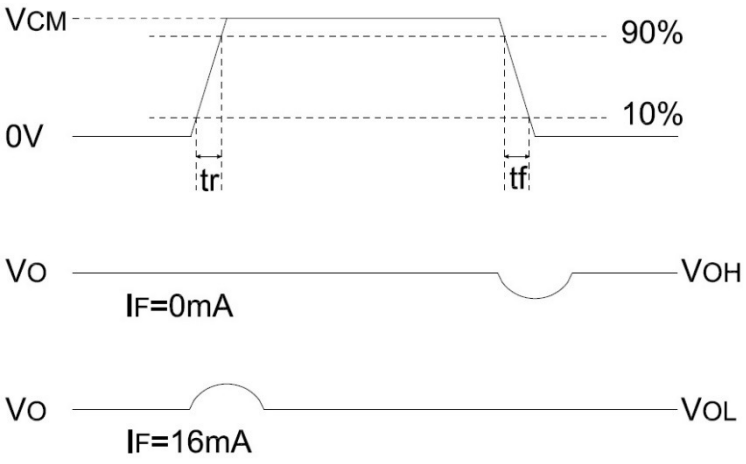



Switching Time Test Circuit

## Test Circuits

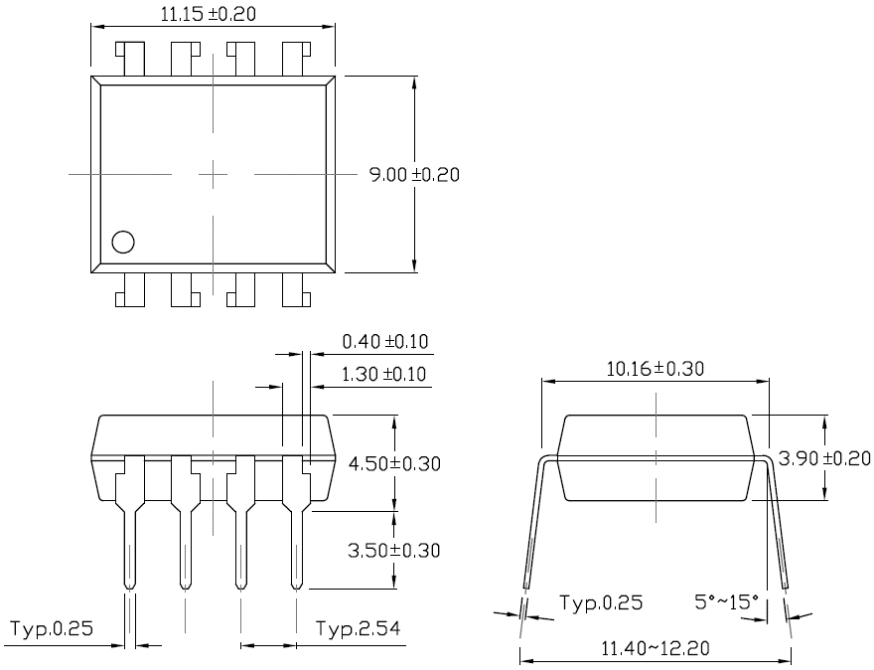


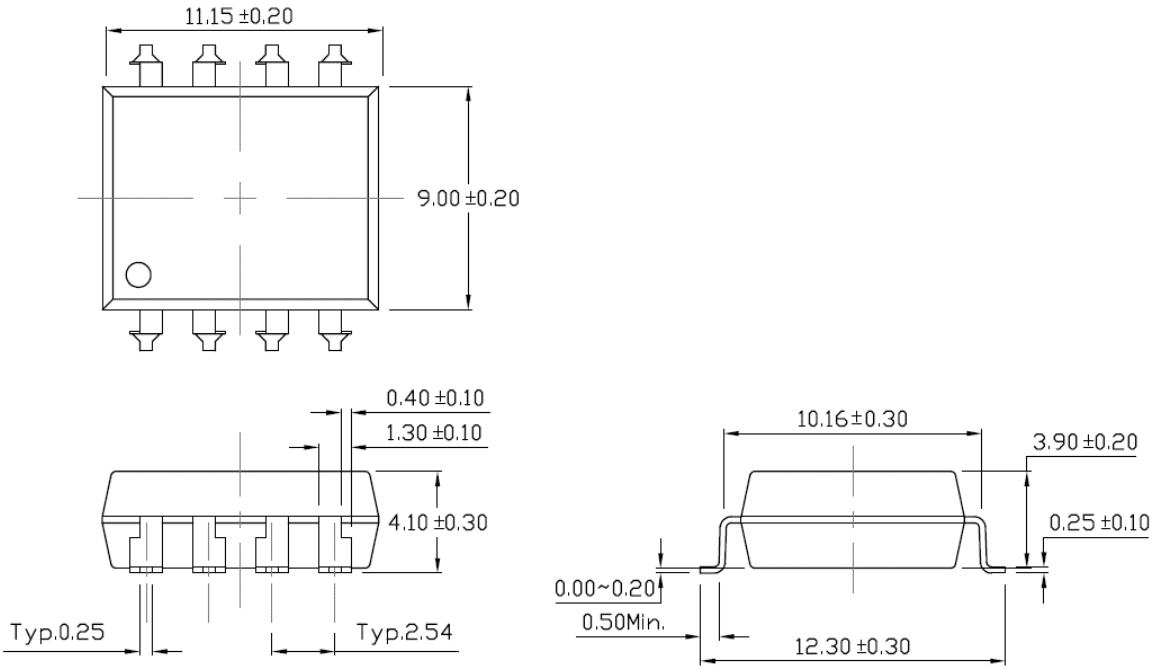

CMR Test Circuit

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

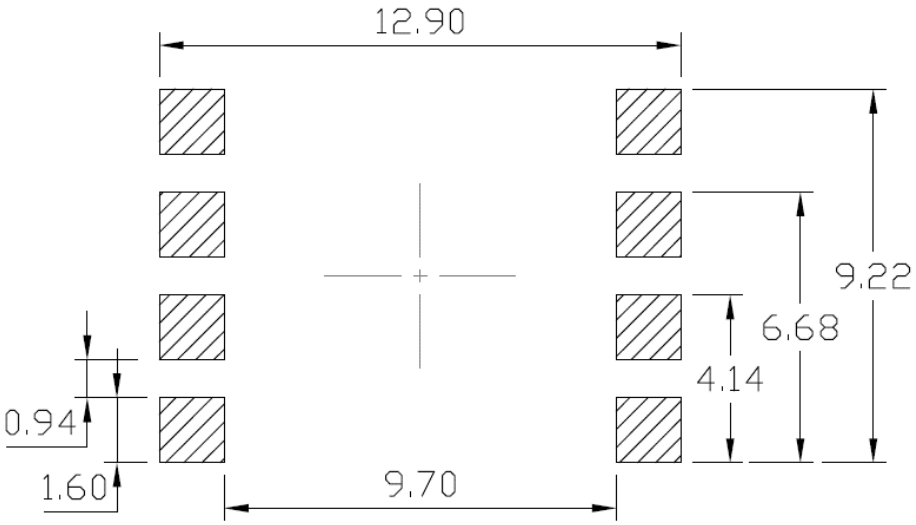
### Standard DIP – Through Hole



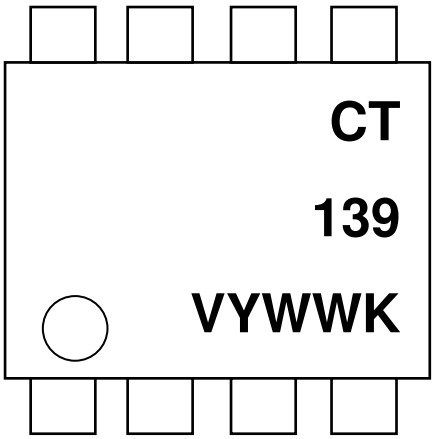

### Surface Mount Lead Forming (SL Type)



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




## Device Marking




| | |
|---|---|
| CT | : Denotes “CT Micro” |
| 139 | : Product Number (138, or 139) |
| V | : VDE Option |
| Y | : Fiscal Year |
| WW | : Work Week |
| K | : Production Code |

## Ordering Information

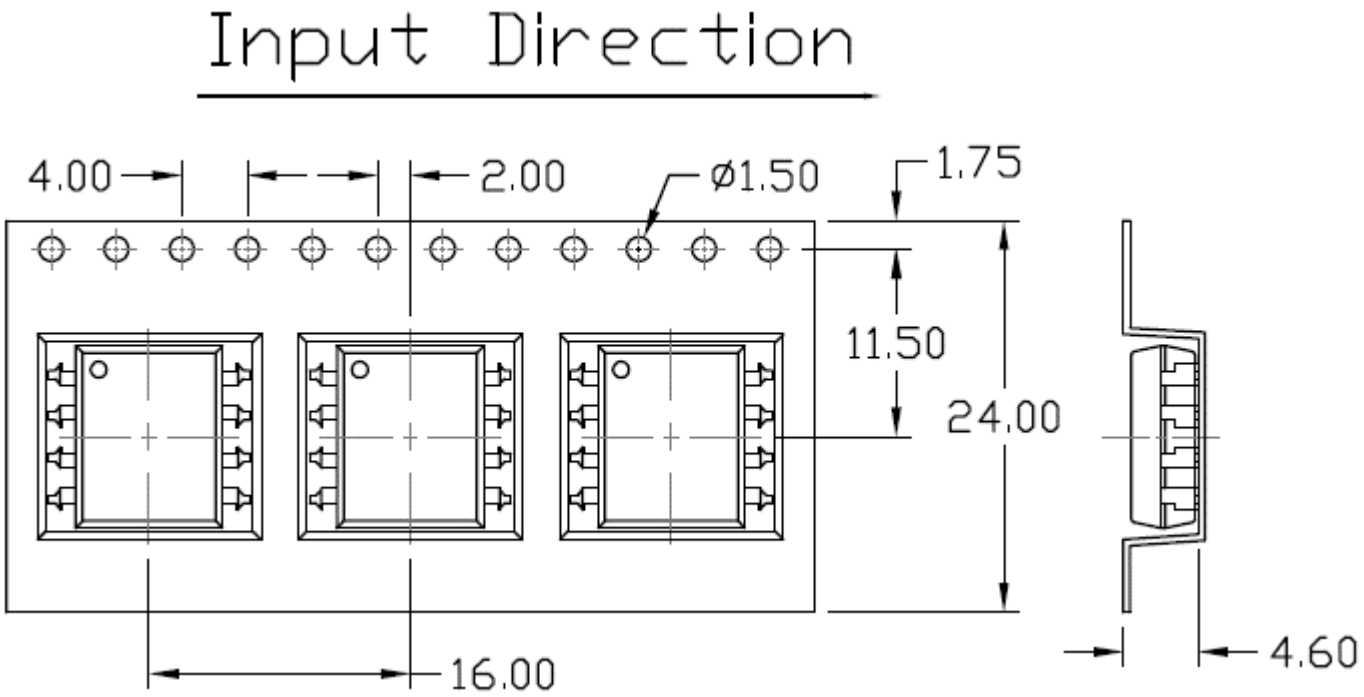
CTW13X(V)(Y)(Z)

X = Part No. (8 or 9)
V = VDE Option ( V or None)
Y = Lead form option (SL or none)
Z = Tape and reel option (T1, T2 or none)

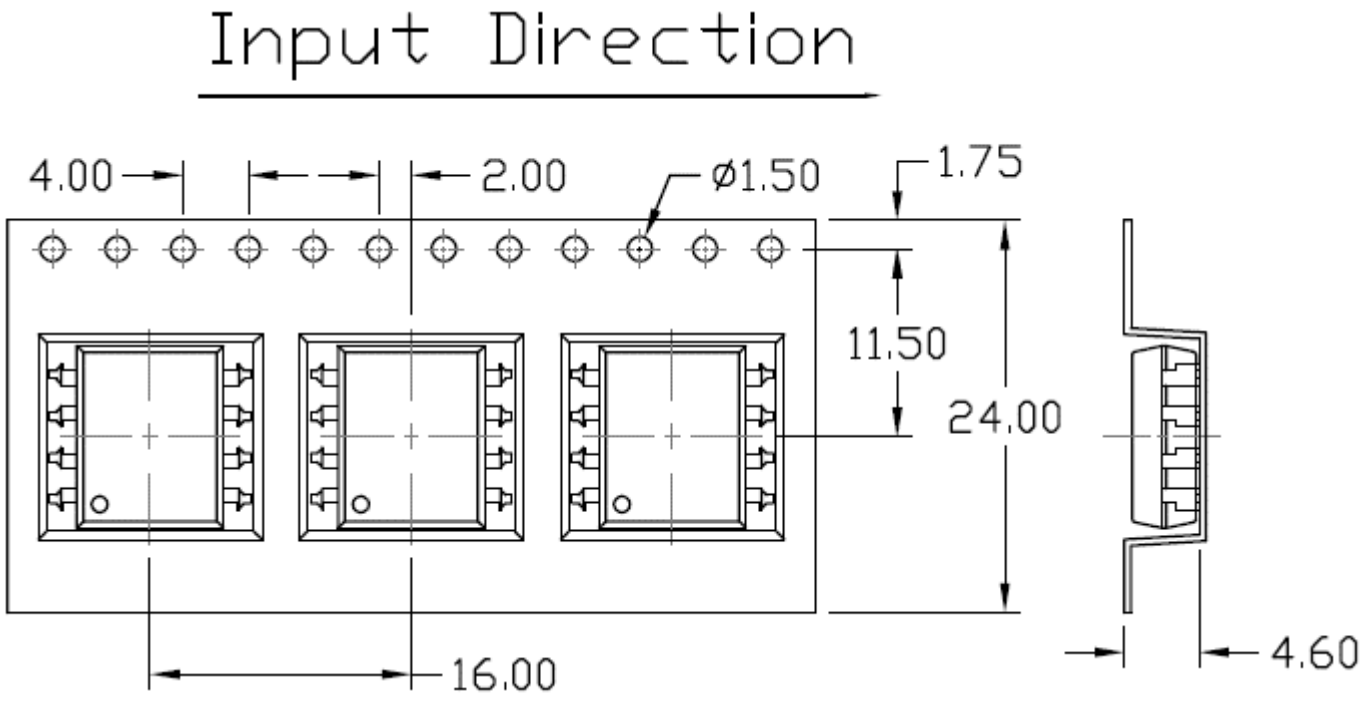
| *Option* | *Description* | *Quantity* |
|---|---|---|
| None | Standard 8 Pin Widebody Dip | 40 Units/Tube |
| SL(T1) | Surface Mount Lead Forming – With Option 1 Taping | 750 Units/Reel |
| SL(T2) | Surface Mount Lead Forming – With Option 2 Taping | 750 Units/Reel |

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

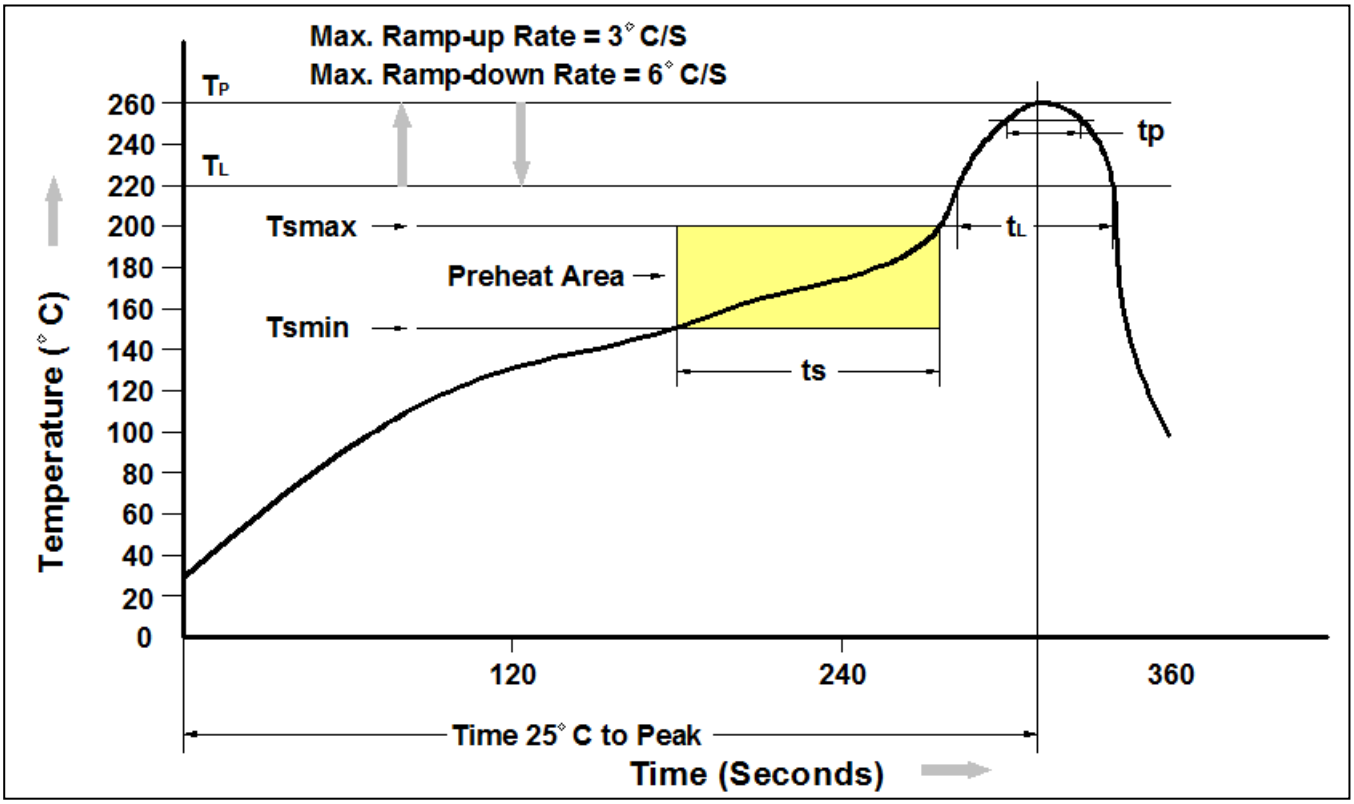
### Option SL(T1)




### Option SL(T2)



## Reflow Profile




| Profile Feature | Pb-Free Assembly Profile |
|---|---|
| Temperature Min. (Tsmin) | 150℃ |
| Temperature Max. (Tsmax) | 200℃ |
| Time (ts) from (Tsmin to Tsmax) | 60-120 seconds |
| Ramp-up Rate ($t_L$ to $t_P$) | 3℃/second max. |
| Liquidous Temperature ($T_L$) | 217℃ |
| Time ($t_L$) Maintained Above ($T_L$) | 60 – 150 seconds |
| Peak Body Package Temperature | 260℃ +0℃ / -5℃ |
| Time ($t_P$) within 5℃ of 260℃ | 30 seconds |
| Ramp-down Rate ($T_P$ to $T_L$) | 6℃/second max |
| Time 25℃ to Peak Temperature | 8 minutes max. |

## DISCLAIMER

**CT MICRO RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION OR DESIGN. CT MICRO DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS.**

---

**CT MICRO ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT EXPRESS WRITTEN APPROVAL OF CT MICRO INTERNATIONAL CORPORATION.**

1. *Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instruction for use provided in the labelling, can be reasonably expected to result in significant injury to the user.*
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.*