

## MCT5200

## MCT5201

## MCT5210

## MCT5211

### Description

The MCT52XX series consists of a high-efficiency AlGaAs, infrared emitting diode, coupled with an NPN phototransistor in a six pin dual-in-line package.

The MCT52XX is well suited for CMOS to LSTT/TTL interfaces, offering 250%  $CTR_{CE(SAT)}$  with 1 mA of LED input current. When an LED input current of 1.6 mA is supplied data rates to 20K bits/s are possible.

The MCT52XX can easily interface LSTTL to LSTTL/TTL, and with use of an external base to emitter resistor data rates of 100K bits/s can be achieved.

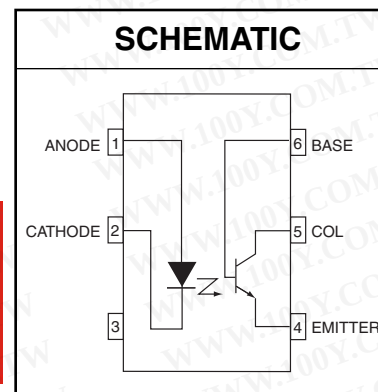
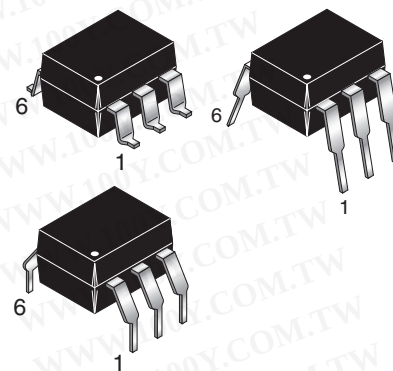
### Features

- High  $CTR_{CE(SAT)}$  comparable to Darlington
- CTR guaranteed 0°C to 70°C
- High common mode transient rejection 5kV/μs
- Data rates up to 150 kbits/s (NRZ)
- Underwriters Laboratory (UL) recognized (file #E90700)
- VDE recognized (file #94766)
- Add option 300 (e.g., MCT5211.300)

### Applications

- CMOS to CMOS/LSTTL logic isolation
- LSTTL to CMOS/LSTTL logic isolation
- RS-232 line receiver
- Telephone ring detector
- AC line voltage sensing
- Switching power supply

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| Parameters                                                                             | Symbol              | Device     | Value          | Units       |
|----------------------------------------------------------------------------------------|---------------------|------------|----------------|-------------|
| TOTAL DEVICE                                                                           |                     |            |                |             |
| Storage Temperature                                                                    | T <sub>STG</sub>    | All        | -55 to +150    | °C          |
| Operating Temperature                                                                  | T <sub>OPR</sub>    | All        | -55 to +100    | °C          |
| Lead Solder Temperature                                                                | T <sub>SOL</sub>    | All        | 260 for 10 sec | °C          |
| Total Device Power Dissipation @ 25°C (LED plus detector)<br>Derate Linearly From 25°C | P <sub>D</sub>      | All        | 260<br>3.5     | mW<br>mW/°C |
| EMITTER                                                                                |                     |            |                |             |
| Continuous Forward Current                                                             | I <sub>F</sub>      | All        | 50             | mA          |
| Reverse Input Voltage                                                                  | V <sub>R</sub>      | All        | 6              | V           |
| Forward Current - Peak (1 μs pulse, 300 pps)                                           | I <sub>F</sub> (pk) | All        | 3.0            | A           |
| LED Power Dissipation<br>Derate Linearly From 25°C                                     | P <sub>D</sub>      | All<br>All | 75<br>1.0      | mW<br>mW/°C |
| DETECTOR                                                                               |                     |            |                |             |
| Continuous Collector Current                                                           | I <sub>C</sub>      | All        | 150            | mA          |
| Detector Power Dissipation<br>Derate Linearly from 25°C                                | P <sub>D</sub>      | All<br>All | 150<br>2.0     | mW<br>mW/°C |

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**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  Unless otherwise specified.)

**INDIVIDUAL COMPONENT CHARACTERISTICS**

| Parameters                          | Test Conditions                                                      | Symbol                          | Device | Min | Typ** | Max | Units                |
|-------------------------------------|----------------------------------------------------------------------|---------------------------------|--------|-----|-------|-----|----------------------|
| <b>EMITTER</b>                      |                                                                      |                                 |        |     |       |     |                      |
| Input Forward Voltage               | ( $I_F = 5\text{ mA}$ )                                              | $V_F$                           | All    |     | 1.25  | 1.5 | V                    |
| Forward Voltage Temp. Coefficient   | ( $I_F = 2\text{ mA}$ )                                              | $\frac{\Delta V_F}{\Delta T_A}$ | All    |     | -1.75 |     | mV/ $^\circ\text{C}$ |
| Reverse Voltage                     | ( $I_R = 10\text{ }\mu\text{A}$ )                                    | $V_R$                           | All    | 6   |       |     | V                    |
| Junction Capacitance                | ( $V_F = 0\text{ V}$ , $f = 1.0\text{ MHz}$ )                        | $C_J$                           | All    |     | 18    |     | pF                   |
| <b>DETECTOR</b>                     |                                                                      |                                 |        |     |       |     |                      |
| Collector-Emitter Breakdown Voltage | ( $I_C = 1.0\text{ mA}$ , $I_F = 0$ )                                | $BV_{CEO}$                      | All    | 30  | 100   |     | V                    |
| Collector-Base Breakdown Voltage    | ( $I_C = 10\text{ }\mu\text{A}$ , $I_F = 0$ )                        | $BV_{CBO}$                      | All    | 30  | 120   |     | V                    |
| Emitter-Base Breakdown Voltage      | ( $I_C = 10\text{ }\mu\text{A}$ , $I_F = 0$ )                        | $BV_{EBO}$                      | All    | 5   | 10    |     | V                    |
| Collector-Emitter Dark Current      | ( $V_{CE} = 10\text{ V}$ , $I_F = 0$ , $R_{BE} = 1\text{ M}\Omega$ ) | $I_{CER}$                       | All    |     | 1     | 100 | nA                   |
| Capacitance Collector to Emitter    | ( $V_{CE} = 0$ , $f = 1\text{ MHz}$ )                                | $C_{CE}$                        | All    |     | 10    |     | pF                   |
| Collector to Base                   | ( $V_{CB} = 0$ , $f = 1\text{ MHz}$ )                                | $C_{CB}$                        | All    |     | 80    |     | pF                   |
| Emitter to Base                     | ( $V_{EB} = 0$ , $f = 1\text{ MHz}$ )                                | $C_{EB}$                        | All    |     | 15    |     | pF                   |

**ISOLATION CHARACTERISTICS**

| Characteristic                                 | Test Conditions                                                               | Symbol    | Device     | Min       | Typ** | Max | Units            |
|------------------------------------------------|-------------------------------------------------------------------------------|-----------|------------|-----------|-------|-----|------------------|
| Input-Output Isolation Voltage <sup>(10)</sup> | ( $f = 60\text{ Hz}$ , $t = 1\text{ min.}$ )                                  | $V_{ISO}$ | All        | 5300      |       |     | Vac(rms)         |
| Isolation Resistance <sup>(10)</sup>           | $V_{I-O} = 500\text{ VDC}$ , $T_A = 25^\circ\text{C}$                         | $R_{ISO}$ | All        | $10^{11}$ |       |     | $\Omega$         |
| Isolation Capacitance <sup>(9)</sup>           | $V_{I-O} = 0$ , $f = 1\text{ MHz}$                                            | $C_{ISO}$ | All        |           | 0.7   |     | pF               |
| Common Mode Transient Rejection – Output High  | $V_{CM} = 50\text{ V}_{P-P}$ , $R_L = 750\Omega$ , $I_F = 0$                  | $CM_H$    | MCT5210/11 |           | 5000  |     | V/ $\mu\text{s}$ |
|                                                | $V_{CM} = 50\text{ V}_{P-P}$ , $R_L = 1\text{ K}\Omega$ , $I_F = 0$           |           | MCT5200/01 |           |       |     |                  |
| Common Mode Transient Rejection – Output Low   | $V_{CM} = 50\text{ V}_{P-P}$ , $R_L = 750\Omega$ , $I_F = 1.6\text{ mA}$      | $CM_L$    | MCT5210/11 |           | 5000  |     | V/ $\mu\text{s}$ |
|                                                | $V_{CM} = 50\text{ V}_{P-P}$ , $R_L = 1\text{ K}\Omega$ , $I_F = 5\text{ mA}$ |           | MCT5200/01 |           |       |     |                  |

\*\*All typical  $T_A = 25^\circ\text{C}$

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**TRANSFER CHARACTERISTICS** ( $T_A = 0^\circ\text{C}$  to  $70^\circ\text{C}$  Unless otherwise specified.)

| DC Characteristics                                                        | Test Conditions                                                                                             | Symbol          | Device  | Min  | Typ** | Max | Units         |
|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|-----------------|---------|------|-------|-----|---------------|
| Saturated Current Transfer Ratio <sup>(1)</sup><br>(Collector to Emitter) | $I_F = 10\text{ mA}, V_{CE} = 0.4\text{ V}$                                                                 | $CTR_{CE(SAT)}$ | MCT5200 | 75   |       |     | %             |
|                                                                           | $I_F = 5\text{ mA}, V_{CE} = 0.4\text{ V}$                                                                  |                 | MCT5201 | 120  |       |     |               |
|                                                                           | $I_F = 3.0\text{ mA}, V_{CE} = 0.4\text{ V}$                                                                |                 | MCT5210 | 60   |       |     |               |
|                                                                           | $I_F = 1.6\text{ mA}, V_{CE} = 0.4\text{ V}$                                                                |                 | MCT5211 | 100  |       |     |               |
|                                                                           | $I_F = 1.0\text{ mA}, V_{CE} = 0.4\text{ V}$                                                                |                 |         | 75   |       |     |               |
| Current Transfer Ratio<br>(Collector to Emitter) <sup>(1)</sup>           | $I_F = 3.0\text{ mA}, V_{CE} = 5.0\text{ V}$                                                                | $CTR_{(CE)}$    | MCT5210 | 70   |       |     | %             |
|                                                                           | $I_F = 1.6\text{ mA}, V_{CE} = 5.0\text{ V}$                                                                |                 | MCT5211 | 150  |       |     |               |
|                                                                           | $I_F = 1.0\text{ mA}, V_{CE} = 5.0\text{ V}$                                                                |                 |         | 110  |       |     |               |
| Current Transfer Ratio<br>Collector to Base <sup>(2)</sup>                | $I_F = 10\text{ mA}, V_{CB} = 4.3\text{ V}$                                                                 | $CTR_{(CB)}$    | MCT5200 | 0.2  |       |     | %             |
|                                                                           | $I_F = 5\text{ mA}, V_{CB} = 4.3\text{ V}$                                                                  |                 | MCT5201 | 0.28 |       |     |               |
|                                                                           | $I_F = 3.0\text{ mA}, V_{CE} = 4.3\text{ V}$                                                                |                 | MCT5210 | 0.2  |       |     |               |
|                                                                           | $I_F = 1.6\text{ mA}, V_{CE} = 4.3\text{ V}$                                                                |                 | MCT5211 | 0.3  |       |     |               |
|                                                                           | $I_F = 1.0\text{ mA}, V_{CE} = 4.3\text{ V}$                                                                |                 |         | 0.25 |       |     |               |
| Saturation Voltage                                                        | $I_F = 10\text{ mA}, I_{CE} = 7.5\text{ mA}$                                                                | $V_{CE(SAT)}$   | MCT5200 |      |       | 0.4 | V             |
|                                                                           | $I_F = 5\text{ mA}, I_{CE} = 6\text{ mA}$                                                                   |                 | MCT5201 |      |       | 0.4 |               |
|                                                                           | $I_F = 3.0\text{ mA}, I_{CE} = 1.8\text{ mA}$                                                               |                 | MCT5210 |      |       | 0.4 |               |
|                                                                           | $I_F = 1.6\text{ mA}, I_{CE} = 1.6\text{ mA}$                                                               |                 | MCT5211 |      |       | 0.4 |               |
| AC Characteristics                                                        | Test Conditions                                                                                             | Symbol          | Device  | Min  | Typ   | Max | Units         |
| Propagation Delay<br>High to Low <sup>(3)</sup>                           | $R_L = 330\ \Omega, R_{BE} = \infty$                                                                        | $T_{PHL}$       | MCT5210 |      | 10    |     | $\mu\text{s}$ |
|                                                                           | $R_L = 3.3\text{ k}\Omega, R_{BE} = 39\text{ k}\Omega$                                                      |                 |         |      | 7     |     |               |
|                                                                           | $R_L = 750\ \Omega, R_{BE} = \infty$                                                                        |                 | MCT5211 |      | 14    |     |               |
|                                                                           | $R_L = 4.7\text{ k}\Omega, R_{BE} = 91\text{ k}\Omega$                                                      |                 |         |      | 15    |     |               |
|                                                                           | $R_L = 1.5\text{ k}\Omega, R_{BE} = \infty$                                                                 |                 |         |      | 17    |     |               |
|                                                                           | $R_L = 10\text{ k}\Omega, R_{BE} = 160\text{ k}\Omega$                                                      |                 |         |      | 24    |     |               |
|                                                                           | $V_{CE} = 0.4\text{ V}, V_{CC} = 5\text{ V},$<br>$R_L = \text{fig. 13}, R_{BE} = 330\text{ k}\Omega$        |                 | MCT5200 |      | 1.6   | 12  |               |
|                                                                           |                                                                                                             |                 | MCT5201 |      | 3     | 30  |               |
| Propagation Delay<br>Low to High <sup>(4)</sup>                           | $R_L = 330\ \Omega, R_{BE} = \infty$                                                                        | $T_{PLH}$       | MCT5210 |      | 0.4   |     | $\mu\text{s}$ |
|                                                                           | $R_L = 3.3\text{ k}\Omega, R_{BE} = 39\text{ k}\Omega$                                                      |                 |         |      | 8     |     |               |
|                                                                           | $R_L = 750\ \Omega, R_{BE} = \infty$                                                                        |                 | MCT5211 |      | 2.5   |     |               |
|                                                                           | $R_L = 4.7\text{ k}\Omega, R_{BE} = 91\text{ k}\Omega$                                                      |                 |         |      | 11    |     |               |
|                                                                           | $R_L = 1.5\text{ k}\Omega, R_{BE} = \infty$                                                                 |                 |         |      | 7     |     |               |
|                                                                           | $R_L = 10\text{ k}\Omega, R_{BE} = 160\text{ k}\Omega$                                                      |                 |         |      | 16    |     |               |
|                                                                           | $V_{CE} = 0.4\text{ V}, V_{CC} = 5\text{ V},$<br>$R_L = \text{fig. 13}, R_{BE} = 330\text{ k}\Omega$        |                 | MCT5200 |      | 18    | 20  |               |
|                                                                           |                                                                                                             |                 | MCT5201 |      | 12    | 13  |               |
| Delay Time <sup>(5)</sup>                                                 | $V_{CE} = 0.4\text{ V},$<br>$R_{BE} = 330\text{ k}\Omega,$<br>$R_L = 1\text{ k}\Omega, V_{CC} = 5\text{ V}$ | $t_d$           | MCT5200 |      | 0.5   | 7   | $\mu\text{s}$ |
|                                                                           |                                                                                                             |                 | MCT5201 |      | 1.1   | 15  |               |
| Rise Time <sup>(6)</sup>                                                  | $V_{CE} = 0.4\text{ V},$<br>$R_{BE} = 330\text{ k}\Omega,$<br>$R_L = 1\text{ k}\Omega, V_{CC} = 5\text{ V}$ | $t_r$           | MCT5200 |      | 1.3   | 6   | $\mu\text{s}$ |
|                                                                           |                                                                                                             |                 | MCT5201 |      | 2.5   | 20  |               |

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| TRANSFER CHARACTERISTICS (T <sub>A</sub> = 0°C to 70°C Unless otherwise specified.) (Continued) |                                                                                                     |                       |                |         |     |       |     |       |
|-------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|-----------------------|----------------|---------|-----|-------|-----|-------|
| DC Characteristics                                                                              | Test Conditions                                                                                     |                       | Symbol         | Device  | Min | Typ** | Max | Units |
| Storage Time <sup>(7)</sup>                                                                     | V <sub>CE</sub> = 0.4V,<br>R <sub>BE</sub> = 330 kΩ,<br>R <sub>L</sub> = 1 kΩ, V <sub>CC</sub> = 5V | I <sub>F</sub> = 10mA | t <sub>s</sub> | MCT5200 |     | 15    | 18  | μs    |
|                                                                                                 |                                                                                                     | I <sub>F</sub> = 5mA  |                | MCT5201 |     | 10    | 13  |       |
| Fall Time <sup>(8)</sup>                                                                        | V <sub>CE</sub> = 0.4V,<br>R <sub>BE</sub> = 330 kΩ,<br>R <sub>L</sub> = 1 kΩ, V <sub>CC</sub> = 5V | I <sub>F</sub> = 10mA | t <sub>f</sub> | MCT5200 |     | 16    | 30  | μs    |
|                                                                                                 |                                                                                                     | I <sub>F</sub> = 5mA  |                | MCT5201 |     | 16    | 30  |       |

\*\*All typicals at  $T_A = 25^\circ\text{C}$

**Notes**

1. DC Current Transfer Ratio ( $CTR_{CE}$ ) is defined as the transistor collector current ( $I_{CE}$ ) divided by the input LED current ( $I_F$ ) x 100%, at a specified voltage between the collector and emitter ( $V_{CE}$ ).
2. The collector base Current Transfer Ratio ( $CTR_{CB}$ ) is defined as the transistor collector base photocurrent ( $I_{CB}$ ) divided by the input LED current ( $I_F$ ) time 100%.
3. Referring to Figure 14 the  $T_{PHL}$  propagation delay is measured from the 50% point of the rising edge of the data input pulse to the 1.3V point on the falling edge of the output pulse.
4. Referring to Figure 14 the  $T_{PLH}$  propagation delay is measured from the 50% point of the falling edge of data input pulse to the 1.3V point on the rising edge of the output pulse.
5. Delay time ( $t_d$ ) is measured from 50% of rising edge of LED current to 90% of  $V_o$  falling edge.
6. Rise time ( $t_r$ ) is measured from 90% to 10% of  $V_o$  falling edge.
7. Storage time ( $t_s$ ) is measured from 50% of falling edge of LED current to 10% of  $V_o$  rising edge.
8. Fall time ( $t_f$ ) is measured from 10% to 90% of  $V_o$  rising edge.
9.  $C_{ISO}$  is the capacitance between the input (pins 1, 2, 3 connected) and the output, (pin 4, 5, 6 connected).
10. Device considered a two terminal device: Pins 1, 2, and 3 shorted together, and pins 5, 6 and 7 are shorted together.

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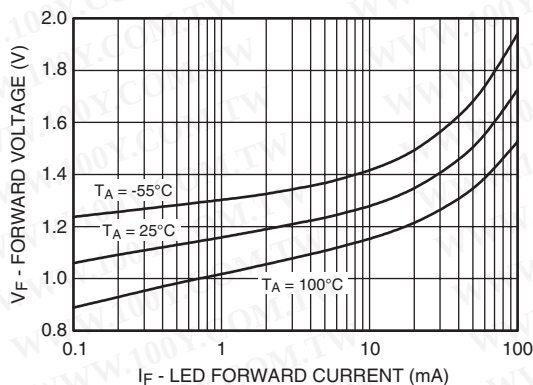
**MCT5201**

**MCT5210**

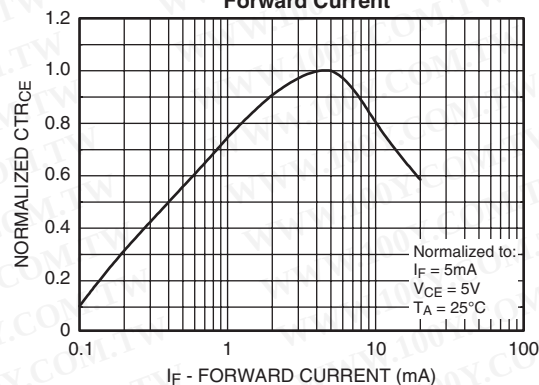
**MCT5211**

## TYPICAL PERFORMANCE GRAPHS

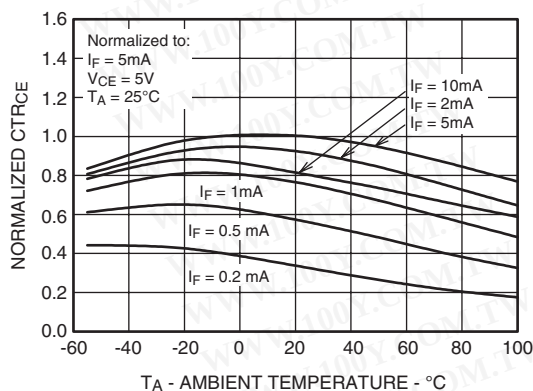
**Fig. 1 LED Forward Voltage vs. Forward Current**



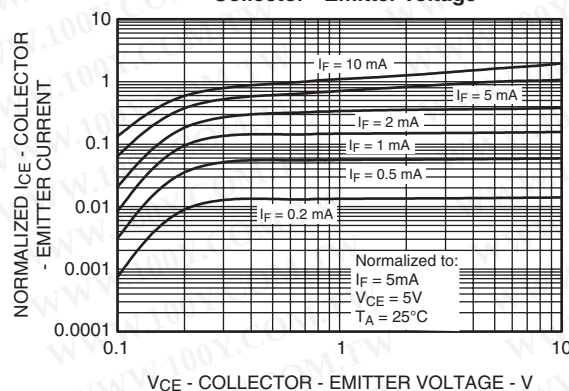
**Fig. 2 Normalized Current Transfer Ratio vs. Forward Current**



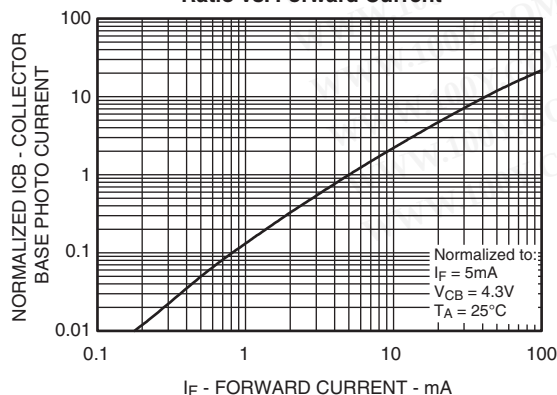
**Fig. 3 Normalized CTR vs. Temperature**



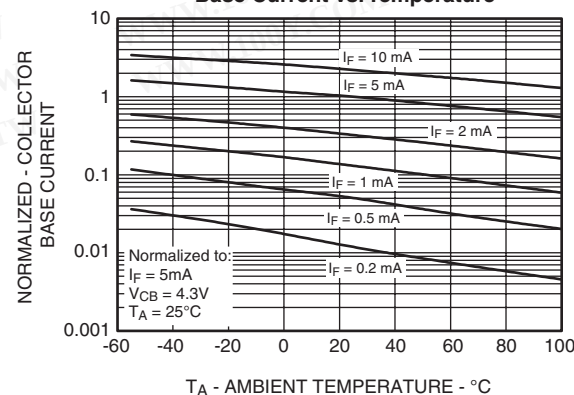
**Fig. 4 Normalized Collector vs. Collector - Emitter Voltage**



**Fig. 5 Normalized Collector Base Photocurrent Ratio vs. Forward Current**



**Fig. 6 Normalized Collector - Base Current vs. Temperature**



**MCT5200**

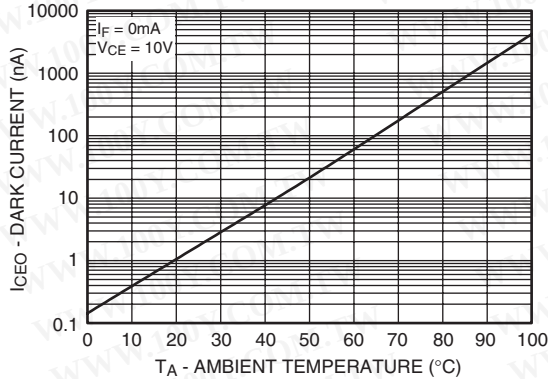
**MCT5201**

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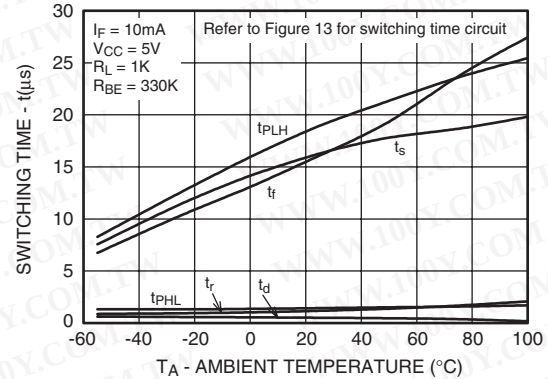
**MCT5211**

**TYPICAL PERFORMANCE GRAPHS (Continued)**

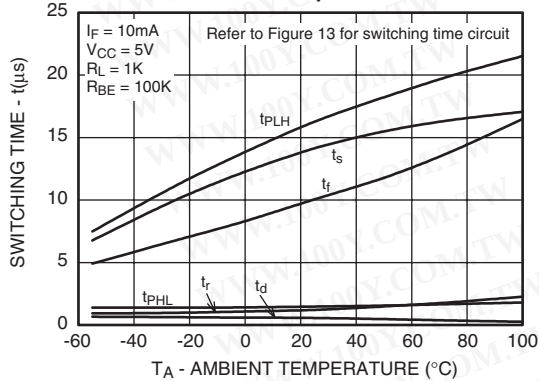
**Fig. 7 Collector-Emitter Dark Current vs. Ambient Temperature**



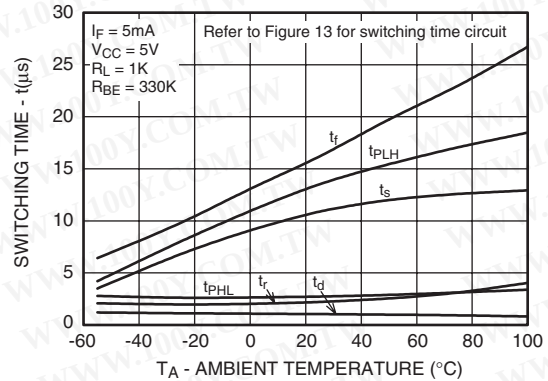
**Fig. 8 Switching Time vs. Ambient Temperature**



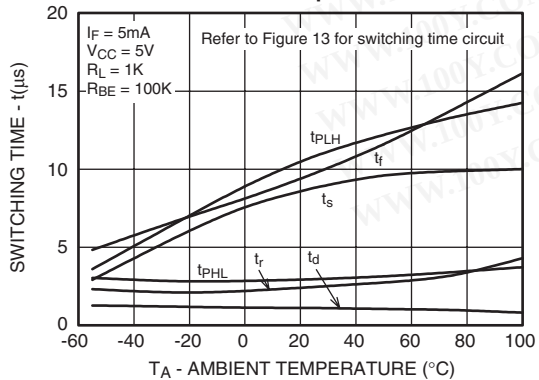
**Fig. 9 Switching Time vs. Ambient Temperature**



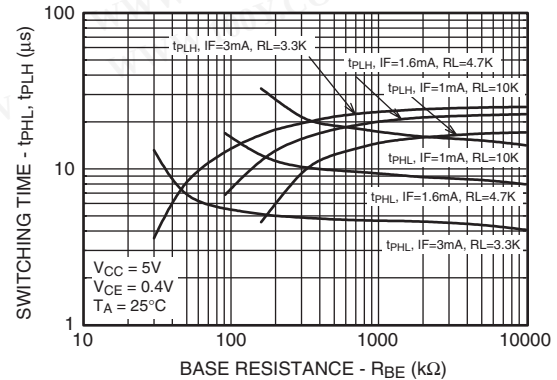
**Fig. 10 Switching Time vs. Ambient Temperature**



**Fig. 11 Switching Time vs. Ambient Temperature**



**Fig. 12 Turn-on Time vs. Base-Emitter Resistance**



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**TYPICAL ELECTRO-OPTICAL CHARACTERISTICS** (TA = 25°C Unless Otherwise Specified)

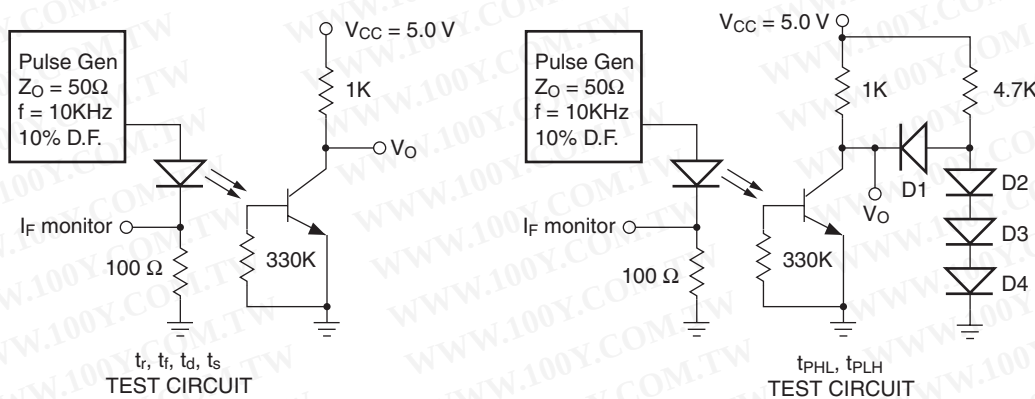


Figure 13.

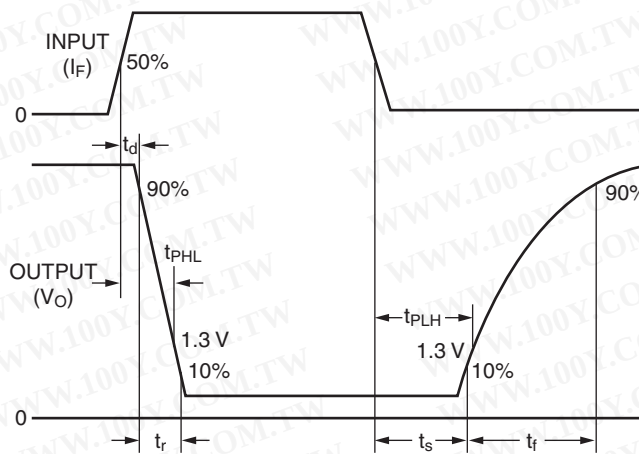


Figure 14. Switching Circuit Waveforms

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# LOW INPUT CURRENT PHOTOTRANSISTOR OPTOCOUPLEDERS

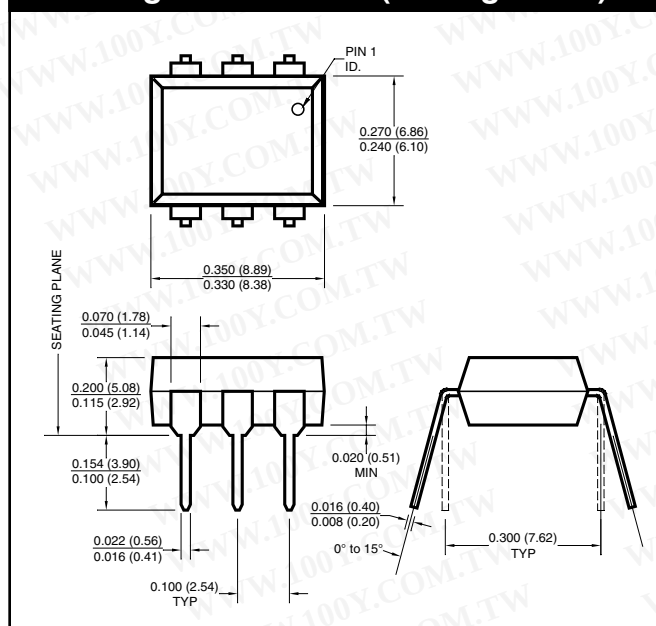
# MCT5200

# MCT5201

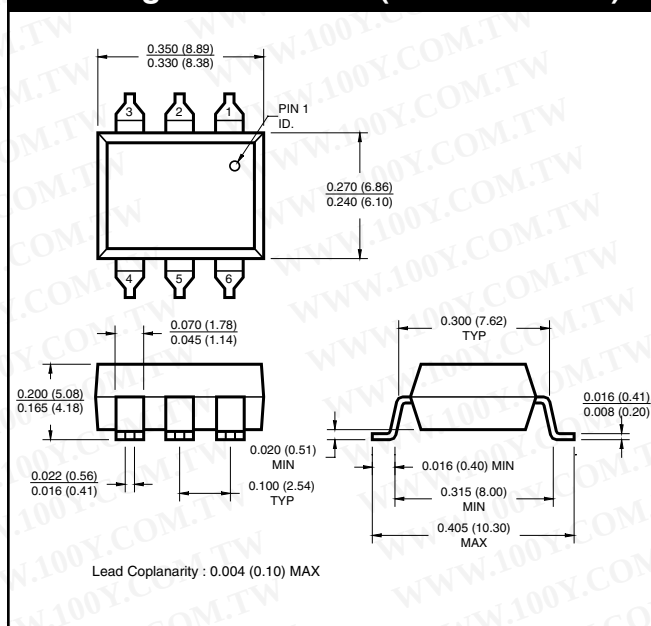
# MCT5210

# MCT5211

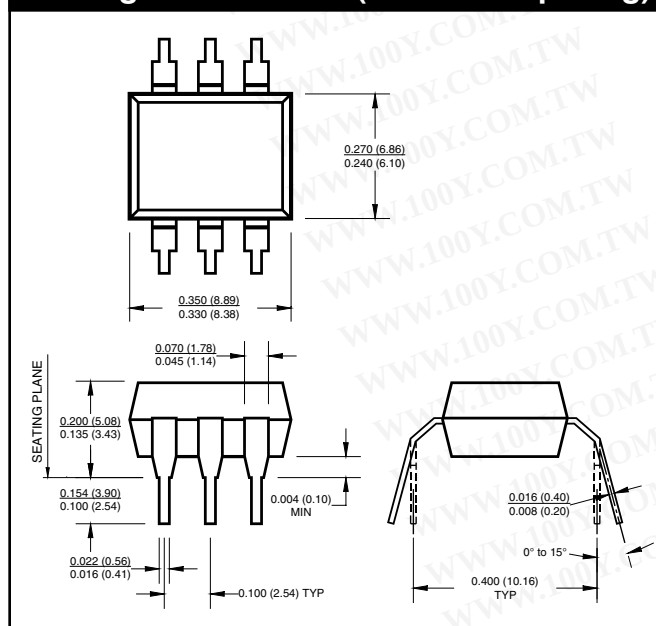
## Package Dimensions (Through Hole)



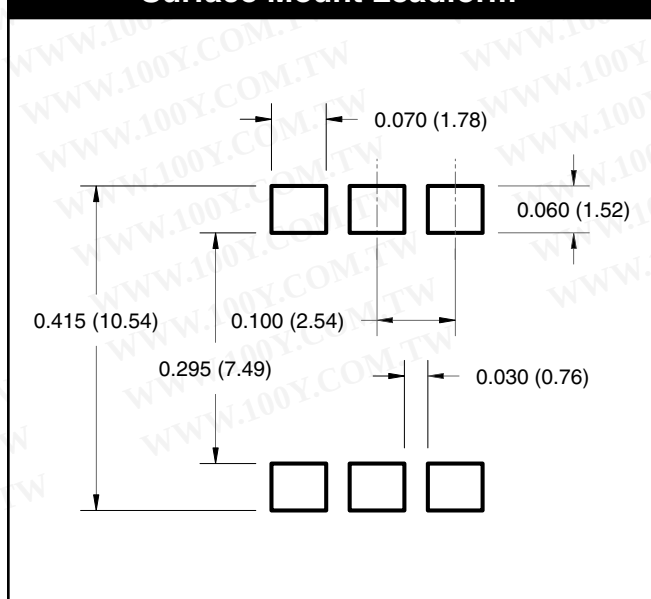
### Package Dimensions (Surface Mount)



### Package Dimensions (0.4" Lead Spacing)



## Recommended Pad Layout for Surface Mount Leadform



### Note

All dimensions are in inches (millimeters)

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**MCT5200**

**MCT5201**

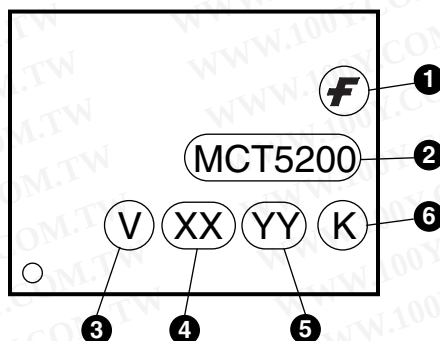
**MCT5210**

**MCT5211**

**ORDERING INFORMATION**

| Option | Order Entry Identifier | Description                            |
|--------|------------------------|----------------------------------------|
| S      | .S                     | Surface Mount Lead Bend                |
| SD     | .SD                    | Surface Mount; Tape and Reel           |
| W      | .W                     | 0.4" Lead Spacing                      |
| 300    | .300                   | VDE 0884                               |
| 300W   | .300W                  | VDE 0884, 0.4" Lead Spacing            |
| 3S     | .3S                    | VDE 0884, Surface Mount                |
| 3SD    | .3SD                   | VDE 0884, Surface Mount, Tape and Reel |

**MARKING INFORMATION**



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| Definitions |                                                                                        |
|-------------|----------------------------------------------------------------------------------------|
| 1           | Fairchild logo                                                                         |
| 2           | Device number                                                                          |
| 3           | VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table) |
| 4           | Two digit year code, e.g., '03'                                                        |
| 5           | Two digit work week ranging from '01' to '53'                                          |
| 6           | Assembly package code                                                                  |

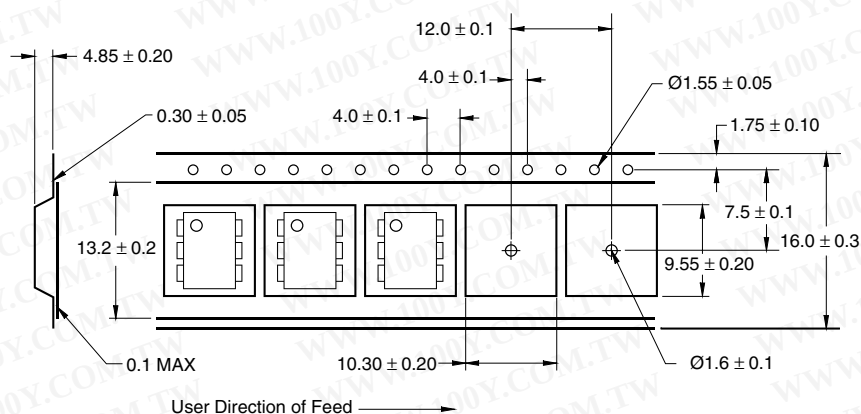
**MCT5200**

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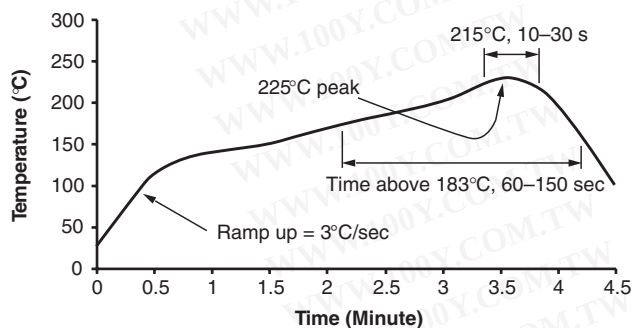
## Carrier Tape Specifications



### NOTE

All dimensions are in inches (millimeters)

## Reflow Profile (Black Package, No Suffix)



- Peak reflow temperature: 225°C (package surface temperature)
- Time of temperature higher than 183°C for 60–150 seconds
- One time soldering reflow is recommended

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