

Single-Channel: 6N135, 6N136, HCPL-2503, HCPL-4502 Dual-Channel: HCPL-2530, HCPL-2531 High Speed Transistor Optocouplers

Features

- High speed—1MBit/s
- Superior CMR—10kV/μs
- Dual-Channel HCPL-2530/HCPL-2531
- Double working voltage—480V RMS
- CTR guaranteed 0–70°C
- U.L. recognized (File # E90700)

Applications

- Line receivers
- Pulse transformer replacement
- Output interface to CMOS-LSTTL-TTL
- Wide bandwidth analog coupling

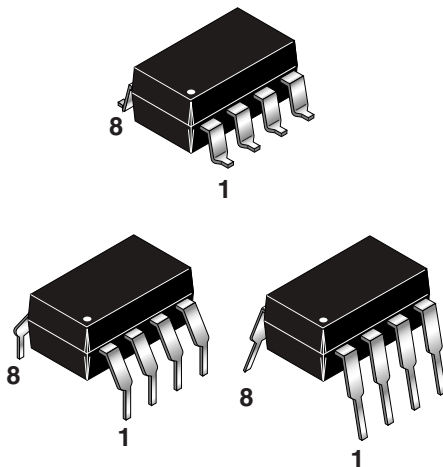
Description

The HCPL-4502/HCPL-2503, 6N135/6 and HCPL-2530/HCPL-2531 optocouplers consist of an AlGaAs LED optically coupled to a high speed photodetector transistor.

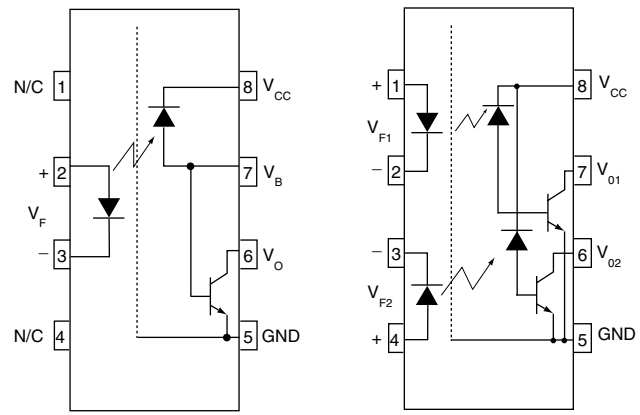
A separate connection for the bias of the photodiode improves the speed by several orders of magnitude over conventional phototransistor optocouplers by reducing the base-collector capacitance of the input transistor.

An internal noise shield provides superior common mode rejection of 10kV/μs. An improved package allows superior insulation permitting a 480V working voltage compared to industry standard of 220V.

Package



Schematic



6N135, 6N136, HCPL-2503, HCPL-4502

HCPL-2530/HCPL-2531

Pin 7 is not connected in
Part Number HCPL-4502

Absolute Maximum Ratings ($T_A = 25^\circ\text{C}$ unless otherwise specified)

| Symbol | Parameter | Condition | Value | Units |
|-----------------|--------------------------------------------------------------|---------------------------------------------------|----------------|------------------|
| T_{STG} | Storage Temperature | | -55 to +125 | $^\circ\text{C}$ |
| T_{OPR} | Operating Temperature | | -55 to +100 | $^\circ\text{C}$ |
| T_{SOL} | Lead Solder Temperature | | 260 for 10 sec | $^\circ\text{C}$ |
| EMITTER | | | | |
| I_F (avg) | DC/Average Forward Input Current Each Channel ⁽¹⁾ | | 25 | mA |
| I_F (pk) | Peak Forward Input Current Each Channel ⁽²⁾ | 50% duty cycle, 1ms P.W. | 50 | mA |
| I_F (trans) | Peak Transient Input Current Each Channel | $\leq 1 \mu\text{s}$ P.W., 300pps | 1.0 | A |
| V_R | Reverse Input Voltage Each Channel | | 5 | V |
| P_D | Input Power Dissipation Each Channel | 6N135/6N136 and HCPL-2503/4502 | 100 | mW |
| | | HCPL-2530/2531 ⁽³⁾ | 45 | |
| DETECTOR | | | | |
| I_O (avg) | Average Output Current Each Channel | | 8 | mA |
| I_O (pk) | Peak Output Current Each Channel | | 16 | mA |
| V_{EBR} | Emitter-Base Reverse Voltage | 6N135, 6N136 and HCPL-2503 only | 5 | V |
| V_{CC} | Supply Voltage | | -0.5 to 30 | V |
| V_O | Output Voltage | | -0.5 to 20 | V |
| I_B | Base Current | 6N135, 6N136 and HCPL-2503 only | 5 | mA |
| PD | Output Power Dissipation Each Channel | 6N135, 6N136, HCPL-2503, HCPL-4502 ⁽⁴⁾ | 100 | mW |
| | | HCPL-2530, HCPL-2531 | 35 | mW |

Notes:

1. Derate linearly above 70°C free-air temperature at a rate of $0.8\text{mA}/^\circ\text{C}$.
2. Derate linearly above 70°C free-air temperature at a rate of $1.6\text{mA}/^\circ\text{C}$.
3. Derate linearly above 70°C free-air temperature at a rate of $0.9\text{mW}/^\circ\text{C}$.
4. Derate linearly above 70°C free-air temperature at a rate of $2.0\text{mW}/^\circ\text{C}$.

Electrical Characteristics ($T_A = 0$ to 70°C Unless otherwise specified)**Individual Component Characteristics**

| Symbol | Parameter | Test Conditions | Device | Min. | Typ.* | Max. | Unit |
|-------------------------|--------------------------------------------|---------------------------------------------------------------------------------------------|------------------------------------------|------|-------|------|----------------------------|
| EMITTER | | | | | | | |
| V_F | Input Forward Voltage | $I_F = 16\text{mA}$, $T_A = 25^\circ\text{C}$ | | | 1.45 | 1.7 | V |
| | | $I_F = 16\text{mA}$ | | | | 1.8 | |
| B_{VR} | Input Reverse Breakdown Voltage | $I_R = 10\ \mu\text{A}$ | | 5.0 | | | V |
| $\Delta V_F/\Delta T_A$ | Temperature Coefficient of Forward Voltage | $I_F = 16\text{mA}$ | | | -1.6 | | $\text{mV}/^\circ\text{C}$ |
| DETECTOR | | | | | | | |
| I_{OH} | Logic High Output Current | $I_F = 0\text{mA}$, $V_O = V_{CC} = 5.5\text{V}$, $T_A = 25^\circ\text{C}$ | All | | 0.001 | 0.5 | μA |
| | | $I_F = 0\text{mA}$, $V_O = V_{CC} = 15\text{V}$, $T_A = 25^\circ\text{C}$ | 6N135 6N136 HCPL-4502 HCPL-2503 | | 0.005 | 1 | |
| | | $I_F = 0\text{mA}$, $V_O = V_{CC} = 15\text{V}$ | All | | | 50 | |
| I_{CCL} | Logic Low Supply Current | $I_F = 16\text{mA}$, $V_O = \text{Open}$, $V_{CC} = 15\text{V}$ | 6N135 6N136 HCPL-4502 HCPL-2503 | | 120 | 200 | μA |
| | | $I_{F1} = I_{F2} = 16\text{mA}$, $V_O = \text{Open}$, $V_{CC} = 15\text{V}$ | HCPL-2530 HCPL-2531 | | 200 | 400 | |
| I_{CCH} | Logic High Supply Current | $I_F = 0\text{mA}$, $V_O = \text{Open}$, $V_{CC} = 15\text{V}$, $T_A = 25^\circ\text{C}$ | 6N135 6N136 HCPL-4502 HCPL-2503 | | | 1 | μA |
| | | $I_F = 0\text{mA}$, $V_O = \text{Open}$, $V_{CC} = 15\text{V}$ | 6N135 6N136 HCPL-4502 HCPL-2503 | | | 2 | |
| | | $I_F = 0\text{mA}$, $V_O = \text{Open}$, $V_{CC} = 15\text{V}$ | HCPL-2530 HCPL-2531 | | 0.02 | 4 | |

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

Transfer Characteristics ($T_A = 0$ to 70°C Unless otherwise specified)

| Symbol | Parameter | Test Conditions | Device | Min. | Typ.* | Max. | Unit | |
|------------------------------------------------------------------------|---------------------------------------|---------------------------------------------------------------------------------------------------|---------------------------------|--------------------|-------|------|------|---|
| COUPLED | | | | | | | | |
| CTR | Current Transfer Ratio ⁽⁵⁾ | $I_F = 16\text{mA}$, $V_O = 0.4\text{V}$, $V_{CC} = 4.5\text{V}$, $T_A = 25^\circ\text{C}$ | 6N135 HCPL-2530 | 7 | 18 | 50 | % | |
| | | | 6N136 HCPL-4502 HCPL-2531 | 19 | 27 | 50 | % | |
| | | | HCPL-2503 | 12 | 27 | | % | |
| | | $I_F = 16\text{mA}$, $V_{CC} = 4.5\text{V}$ | $V_{OL} = 0.4\text{V}$ | 6N135 | 5 | 21 | | % |
| | | | $V_{OL} = 0.5\text{V}$ | HCPL-2530 | | | | |
| | | | $V_{OL} = 0.4\text{V}$ | 6N136 HCPL-4502 | 15 | 30 | | % |
| | | | $V_{OL} = 0.5\text{V}$ | HCPL-2531 | | | | |
| | $V_{OL} = 0.4\text{V}$ | HCPL-2503 | 9 | 30 | | % | | |
| V_{OL} | Logic LOW Output Voltage | $I_F = 16\text{mA}$, $I_O = 1.1\text{mA}$, $V_{CC} = 4.5\text{V}$, $T_A = 25^\circ\text{C}$ | 6N135 | | 0.18 | 0.4 | V | |
| | | | HCPL-2530 | | 0.18 | 0.5 | | |
| | | $I_F = 16\text{mA}$, $I_O = 3\text{mA}$, $V_{CC} = 4.5\text{V}$, $T_A = 25^\circ\text{C}$ | 6N136 HCPL-2503 | | 0.25 | 0.4 | | |
| | | | HCPL-2531 | | 0.25 | 0.5 | | |
| | | $I_F = 16\text{mA}$, $I_O = 0.8\text{mA}$, $V_{CC} = 4.5\text{V}$ | 6N135 HCPL-2530 | | | 0.5 | | |
| $I_F = 16\text{mA}$, $I_O = 2.4\text{mA}$, $V_{CC} = 4.5\text{V}$ | HCPL-4502 HCPL-2531 | | | 0.5 | | | | |

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

Note:

5. Current Transfer Ratio is defined as a ratio of output collector current, I_O , to the forward LED input current, I_F , times 100%.

Switching Characteristics ($T_A = 0$ to 70°C unless otherwise specified., $V_{CC} = 5\text{V}$)

| Symbol | Parameter | Test Conditions | Device | Min. | Typ.* | Max. | Unit |
|-----------|-------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|----------------------------------------------|------|--------|------|------------------------|
| T_{PHL} | Propagation Delay Time to Logic LOW | $T_A = 25^\circ\text{C}$, $R_L = 4.1\text{k}\Omega$, $I_F = 16\text{mA}^{(6)}$ (Fig. 7) | 6N135 HCPL-2530 | | 0.45 | 1.5 | μs |
| | | $R_L = 1.9\text{k}\Omega$, $I_F = 16\text{mA}$, $T_A = 25^\circ\text{C}^{(7)}$ (Fig. 7) | 6N136 HCPL-4502 HCPL-2503 HCPL-2531 | | 0.45 | 0.8 | μs |
| | | $R_L = 4.1\text{k}\Omega$, $I_F = 16\text{mA}^{(6)}$ (Fig. 7) | 6N135 HCPL-2530 | | | 2.0 | μs |
| | | $R_L = 1.9\text{k}\Omega$, $I_F = 16\text{mA}^{(7)}$ (Fig. 7) | 6N136 HCPL-4502 HCPL-2503 HCPL-2531 | | | 1.0 | μs |
| T_{PLH} | Propagation Delay Time to Logic HIGH | $T_A = 25^\circ\text{C}$, ($R_L = 4.1\text{k}\Omega$, $I_F = 16\text{mA}^{(6)}$) (Fig. 7) | 6N135 HCPL-2530 | | 0.5 | 1.5 | μs |
| | | $R_L = 1.9\text{k}\Omega$, $I_F = 16\text{mA}^{(7)}$ (Fig. 7) $T_A = 25^\circ\text{C}$ | 6N136 HCPL-4502 HCPL-2503 HCPL-2531 | | 0.3 | 0.8 | μs |
| | | $R_L = 4.1\text{k}\Omega$, $I_F = 16\text{mA}^{(6)}$ (Fig. 7) | 6N135 HCPL-2530 | | | 2.0 | μs |
| | | $R_L = 1.9\text{k}\Omega$, $I_F = 16\text{mA}^{(7)}$ (Fig. 7) | 6N136 HCPL-4502 HCPL-2503 HCPL-2531 | | | 1.0 | μs |
| ICM_H | Common Mode Transient Immunity at Logic High | $I_F = 0\text{mA}$, $V_{CM} = 10V_{P-P}$, $R_L = 4.1\text{k}\Omega$, $T_A = 25^\circ\text{C}^{(8)}$ (Fig. 8) | 6N135 HCPL-2530 | | 10,000 | | $\text{V}/\mu\text{s}$ |
| | | $I_F = 0\text{mA}$, $V_{CM} = 10V_{P-P}$, $R_L = 1.9\text{k}\Omega$, $T_A = 25^\circ\text{C}^{(8)}$ (Fig. 8) | 6N136 HCPL-4502 HCPL-2503 HCPL-2531 | | 10,000 | | $\text{V}/\mu\text{s}$ |
| ICM_L | Common Mode Transient Immunity at Logic Low | $I_F = 16\text{mA}$, $V_{CM} = 10V_{P-P}$, $R_L = 4.1\text{k}\Omega$, $T_A = 25^\circ\text{C}^{(8)}$ (Fig. 8) | 6N135 HCPL-2530 | | 10,000 | | $\text{V}/\mu\text{s}$ |
| | | $I_F = 16\text{mA}$, $V_{CM} = 10V_{P-P}$, $R_L = 1.9\text{k}\Omega^{(8)}$ (Fig. 8) | 6N136 HCPL-4502 HCPL-2503 HCPL-2531 | | 10,000 | | $\text{V}/\mu\text{s}$ |

** All Typicals at $T_A = 25^\circ\text{C}$ **Notes:**

- The $4.1\text{k}\Omega$ load represents 1 LSTTL unit load of 0.36mA and $6.1\text{k}\Omega$ pull-up resistor.
- The $1.9\text{k}\Omega$ load represents 1 TTL unit load of 1.6mA and $5.6\text{k}\Omega$ pull-up resistor.
- 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., $V_O > 2.0\text{V}$). 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., $V_O < 0.8\text{V}$).

Isolation Characteristics ($T_A = 0$ to 70°C Unless otherwise specified)

| Symbol | Characteristics | Test Conditions | Min | Typ** | Max | Unit |
|-----------|-----------------------------------------|--------------------------------------------------------------------------------------------------------------|------|-----------|-----|---------------|
| I_{I-O} | Input-Output Insulation Leakage Current | Relative humidity = 45%, $T_A = 25^\circ\text{C}$, $t = 5\text{s}$, $V_{I-O} = 3000\text{VDC}^{(9)}$ | | | 1.0 | μA |
| V_{ISO} | Withstand Insulation Test Voltage | $RH \leq 50\%$, $T_A = 25^\circ\text{C}$, $I_{I-O} \leq 2\ \mu\text{A}$, $t = 1\ \text{min.}^{(9)}$ | 2500 | | | V_{RMS} |
| R_{I-O} | Resistance (Input to Output) | $V_{I-O} = 500\text{VDC}^{(9)}$ | | 10^{12} | | Ω |
| C_{I-O} | Capacitance (Input to Output) | $f = 1\ \text{MHz}^{(9)}$ | | 0.6 | | pF |
| HFE | DC Current Gain | $I_O = 3\text{mA}$, $V_O = 5\text{V}^{(9)}$ | | 150 | | |
| I_{I-I} | Input-Input Insulation Leakage Current | $RH \leq 45\%$, $V_{I-I} = 500\text{VDC}^{(10)}$ $t = 5\ \text{s}$, (HCPL-2530/2531 only) | | 0.005 | | μA |
| R_{I-I} | Input-Input Resistance | $V_{I-I} = 500\ \text{VDC}^{(10)}$ (HCPL-2530/2531 only) | | 10^{11} | | Ω |
| C_{I-I} | Input-Input Capacitance | $f = 1\text{MHz}^{(10)}$ (HCPL-2530/2531 only) | | 0.03 | | pF |

Notes:

9. Device is considered a two terminal device: Pins 1, 2, 3 and 4 are shorted together and Pins 5, 6, 7 and 8 are shorted together.
10. Measured between pins 1 and 2 shorted together, and pins 3 and 4 shorted together.

Fig. 1 Normalized CTR vs. Forward Current

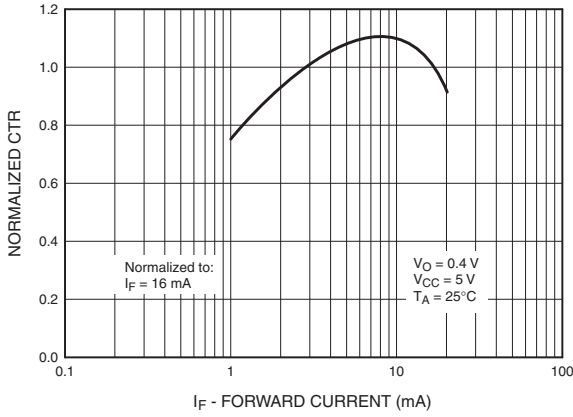


Fig. 2 Normalized CTR vs. Temperature

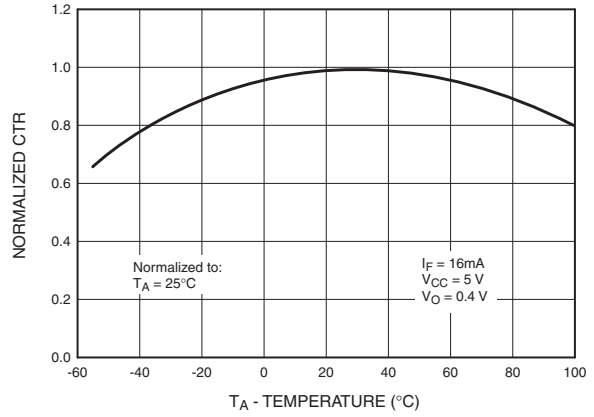


Fig. 3 Output Current vs. Output Voltage

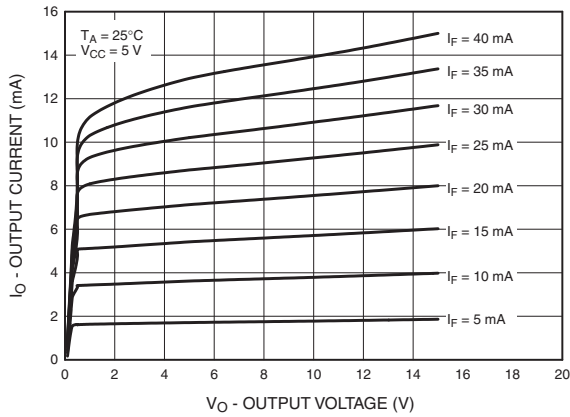


Fig. 4 Logic High Output Current vs. Temperature

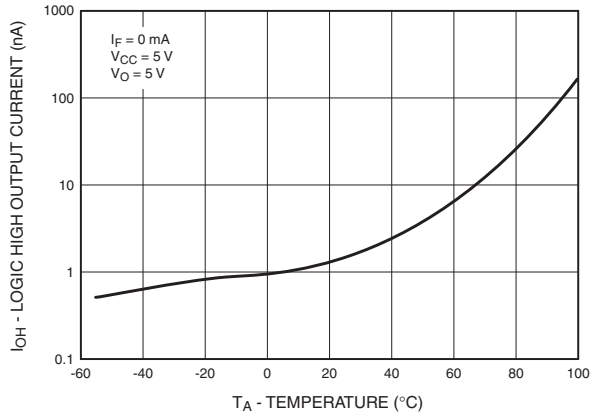


Fig. 5 Propagation Delay vs. Temperature

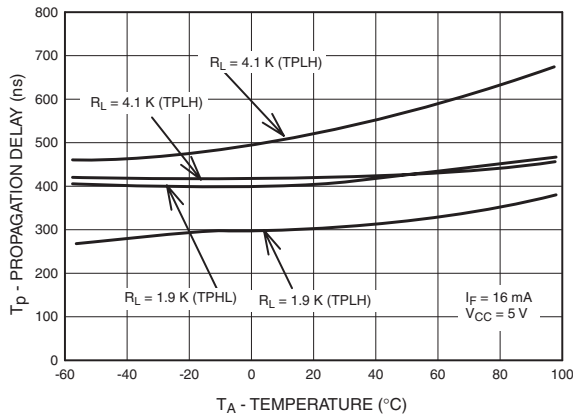
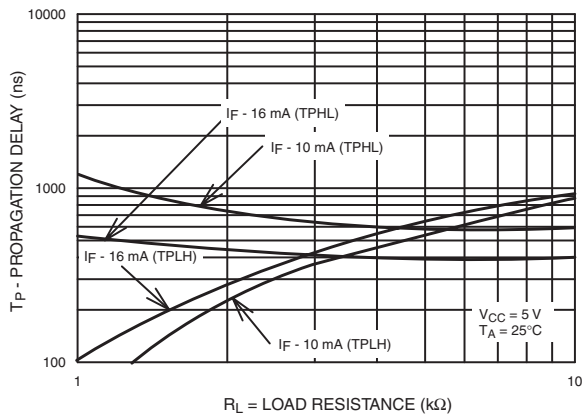


Fig. 6 Propagation Delay vs. Load Resistance



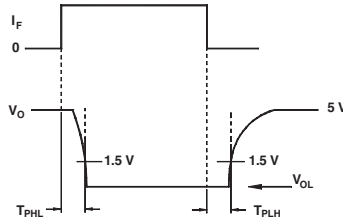
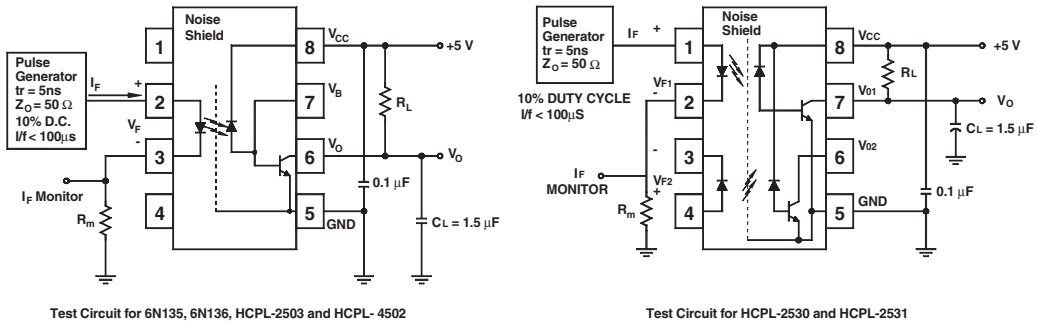


Fig. 7 Switching Time Test Circuit

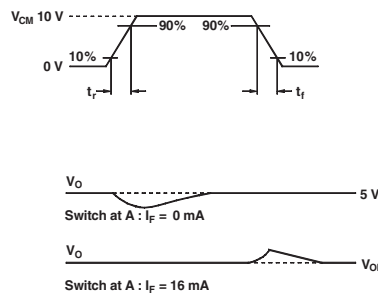
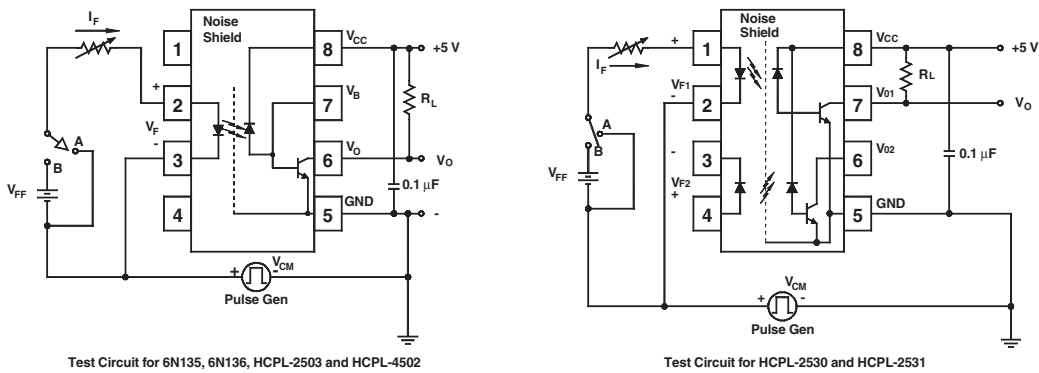
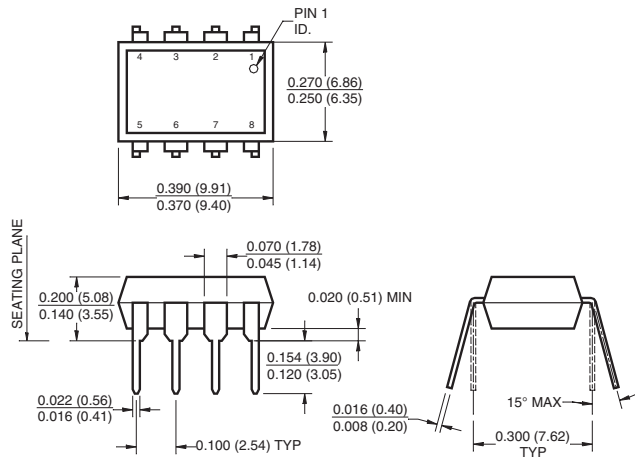


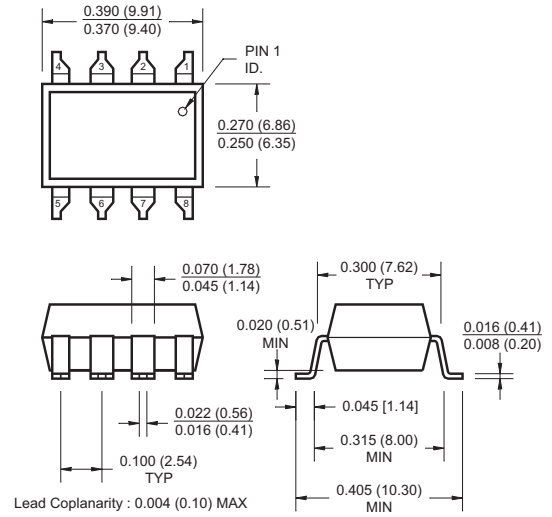
Fig. 8 Common Mode Immunity Test Circuit

Package Dimensions All dimensions are in inches (millimeters)

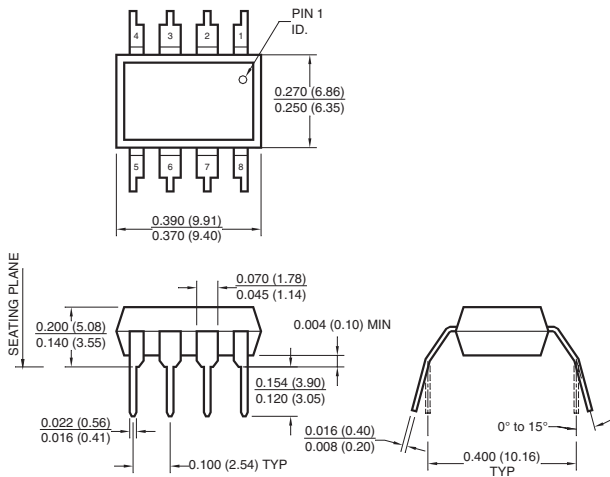
Through Hole



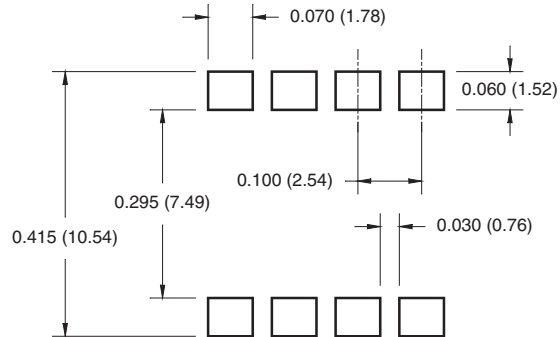
Surface Mount



0.4" Lead Spacing



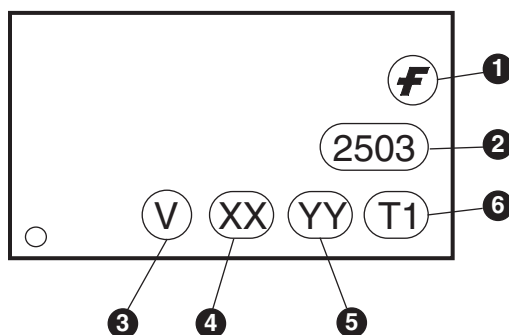
Recommend Pad Layout for Surface Mount Leadform



Ordering Information

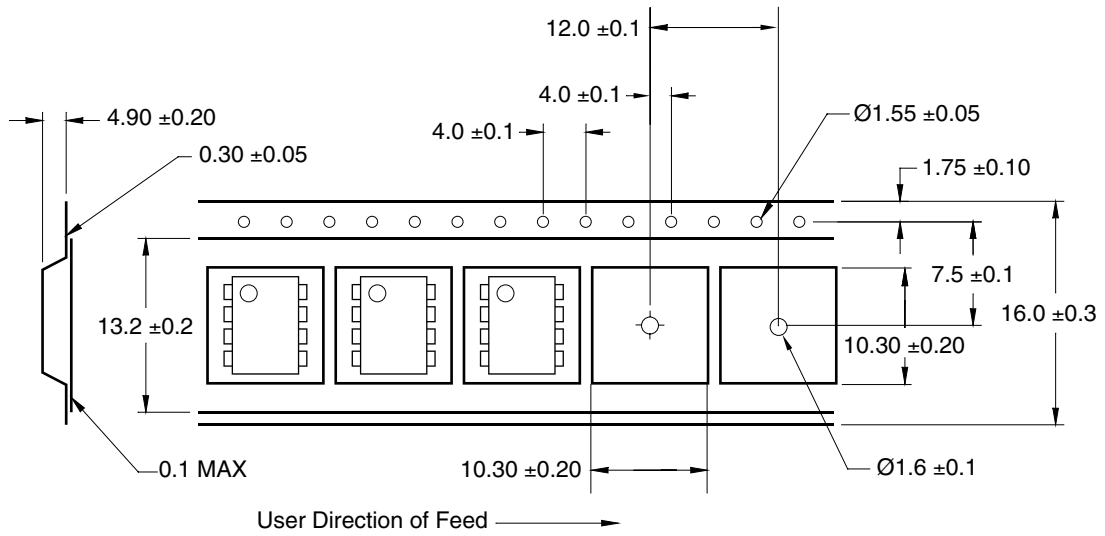
| Option | Example Part Number | Description |
|--------|---------------------|---------------------------------------|
| S | 6N135S | Surface Mount Lead Bend |
| SD | 6N135SD | Surface Mount; Tape and reel |
| W | 6N135W | 0.4" Lead Spacing |
| V | 6N135V | VDE0884 |
| WV | 6N135WV | VDE0884; 0.4" lead spacing |
| SV | 6N135SV | VDE0884; surface mount |
| SDV | 6N135SDV | VDE0884; surface mount; tape and reel |

Marking Information

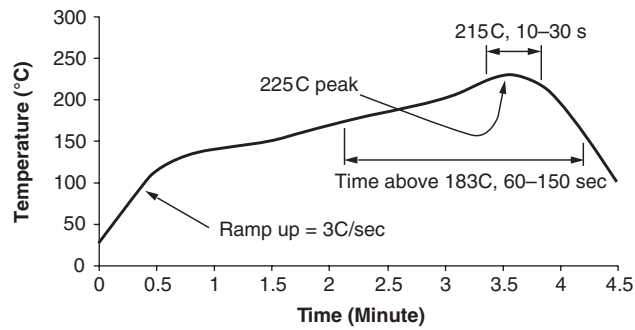


| Definitions | |
|-------------|----------------------------------------------------------------------------------------|
| 1 | Fairchild logo |
| 2 | Device number |
| 3 | VDE mark (Note: Only appears on parts ordered with VDE option – See order entry table) |
| 4 | Two digit year code, e.g., '03'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

Carrier Tape Specifications



Reflow Profile



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

TRADEMARKS

The following are registered and unregistered trademarks Fairchild Semiconductor owns or is authorized to use and is not intended to be an exhaustive list of all such trademarks.

| | | | | |
|--------------------------------------|---------------------|---------------------|------------------|-----------|
| ACEx™ | FACT Quiet Series™ | OCX™ | SILENT SWITCHER® | UniFET™ |
| ActiveArray™ | GlobalOptoisolator™ | OCXPro™ | SMART START™ | UltraFET® |
| Bottomless™ | GTO™ | OPTOLOGIC® | SPM™ | VCX™ |
| Build it Now™ | HiSeC™ | OPTOPLANAR™ | Stealth™ | Wire™ |
| CoolFET™ | I ² C™ | PACMAN™ | SuperFET™ | |
| CROSSVOLT™ | i-Lo™ | POP™ | SuperSOT™-3 | |
| DOMET™ | ImpliedDisconnect™ | Power247™ | SuperSOT™-6 | |
| EcoSPARK™ | IntelliMAX™ | PowerEdge™ | SuperSOT™-8 | |
| E ² CMOS™ | ISOPLANAR™ | PowerSaver™ | SyncFET™ | |
| EnSigna™ | LittleFET™ | PowerTrench® | TCM™ | |
| FACT™ | MICROCOUPLER™ | QFET® | TinyBoost™ | |
| FAST® | MicroFET™ | QST™ | TinyBuck™ | |
| FASTr™ | MicroPak™ | QT Optoelectronics™ | TinyPWM™ | |
| FPS™ | MICROWIRE™ | Quiet Series™ | TinyPower™ | |
| FRFET™ | MSX™ | RapidConfigure™ | TinyLogic® | |
| | MSXPro™ | RapidConnect™ | TINYOPTO™ | |
| Across the board. Around the world.™ | | μSerDes™ | TruTranslation™ | |
| The Power Franchise® | | ScalarPump™ | UHC™ | |
| Programmable Active Droop™ | | | | |

DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. FAIRCHILD 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. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used herein:

- 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 instructions for use provided in the labeling, can be reasonably expected to result in significant injury to the user.
- 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.

PRODUCT STATUS DEFINITIONS

Definition of Terms

| Datasheet Identification | Product Status | Definition |
|--------------------------|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Advance Information | Formative or In Design | This datasheet contains the design specifications for product development. Specifications may change in any manner without notice. |
| Preliminary | First Production | This datasheet contains preliminary data, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design. |
| No Identification Needed | Full Production | This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design. |
| Obsolete | Not In Production | This datasheet contains specifications on a product that has been discontinued by Fairchild semiconductor. The datasheet is printed for reference information only. |

Rev. I20