

# High Speed Optocouplers

## Technical Data

**CNW135  
CNW136  
CNW4502  
CNW4503**

*new*

### Features

- 5000 Vrms/1 Minute Insulation Withstand Capability
- Worldwide Safety Approval  
UL1577 (File No. E55361)  
VDE 0884 Certification  
( $V_{IORM} = 1 \text{ kV}_{RMS}$ )  
VDE 860/805/806/804/750-1/  
IEC950  
BSI according to  
BS 415/7002/6301  
SETI-SEMKO-NEMKO  
DEMKO according to IEC  
65/380/950/335
- High Speed: 1 Mbit/s
- TTL Compatible
- Performance Guaranteed over Temperature 0°C to 70°C
- Pin Compatible with 6N135/6 and HCPL-4502/3
- Very High Common Mode Rejection for CNW4503
- Line Receivers (15 K V/ $\mu$ s Common Mode Transient Immunity and Low Input-Output Capacitance of 0.6 pF)
- Analog Signal Ground Isolation (Integrated Photon Detector Provides Improved Linearity over Phototransistor Type)

### Applications

- High Voltage Insulation
- Video Signal Isolation

- Feedback Element in Switched Mode Power Supplies
- High Speed Logic Ground Isolation - TTL/TTL, TTL/CMOS, TTL/LSTTL
- Power Transistors Isolation in Motor Drives
- Replaces Pulse Transformers
- Replaces Slow Phototransistor Isolators (Pins 2-7 of the CNW135/6 Conforms to Pins 1-6 of 6 Pin Phototransistor Couplers. Pin 8 can be Tied to any Available Bias Voltage of 1.5 V to 30 V for High Speed Operation)

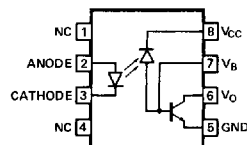
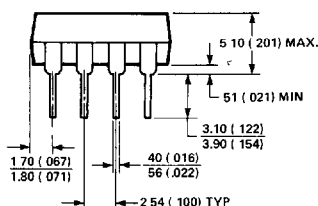
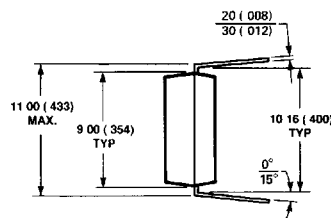
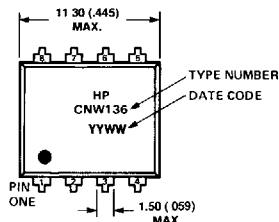
### Description

These devices are high voltage and fast switching optocouplers consisting of an AlGaAs LED and a silicon photodetector. A wide body encapsulation is used to provide creepage and clearance dimensions suitable for safety approval by regulatory agencies worldwide.

The CNW135 is for use in TTL/CMOS, TTL/LSTTL or wide bandwidth analog applications.

Current transfer ratio (CTR) for the CNW135 is 7% minimum at  $I_F = 16 \text{ mA}$ .

### Package Outline



DIMENSIONS IN MILLIMETERS AND (INCHES)

The CNW136 is designed for high speed TTL/TTL applications. A standard 16 mA TTL sink current through the input LED will provide enough output current for 1 TTL load and a 5.6K pullup resistor. CTR of the CNW136 is 19% minimum at  $I_F = 16$  mA. Selection for higher CTR is available.

The CNW4502/3 provides the electrical and switching performance of the CNW136, increased ESD protection and increased transient immunity.

## Regulatory Information

These products feature a wide body 8 PIN DIP. This package was specifically designed to meet regulatory requirements worldwide. The CNW135/6 and CNW4502/3\* have been approved by the following organizations:

UL – Covered under UL component recognition FILE E55361  
VDE – Approved according to VDE 0884 (marks License No. 70975)

Complies for reinforced insulation at 250 V AC with:  
DIN IEC 380/VDE 0806  
DIN IEC 435/VDE 0805 "ENTWURF"  
DIN 57804/VDE 0804 (isolation group C)  
DIN VDE 0860 (HD 195 S6)  
DIN IEC 601 Teil 1/VDE 0750-1  
DIN VDE 0160  
EN 60950/IEC950

NORDIC – Tested for applications (reinforced insulation) – Class II applications for plugable apparatus in normal tight execution.

-SETI-SEMKO-NEMKO-DEMKO-According to IEC 65-IEC380-IEC950-IEC335

BSI – Certification according to BS415:1990, BS7002:1989 and BS6301: 1982 for class II applications.

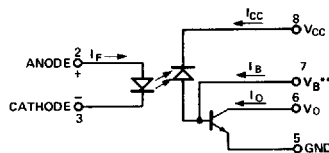
\*Pending SETI and SEMKO approval

## Absolute Maximum Ratings

|                                                        |                                        |
|--------------------------------------------------------|----------------------------------------|
| Storage Temperature .....                              | -55°C to +125°C                        |
| Operating Temperature .....                            | -55°C to 85°C                          |
| Lead Solder Temperature .....                          | 260°C for 10s<br>(up to seating plane) |
| Average Input Current – $I_F$ .....                    | 100 mA                                 |
| Peak Transient Input Current – $I_F$ .....             | 1.0 A<br>(≤1 μs pulse width, 300 Hz)   |
| Reverse Input Voltage – $V_R$ (Pin 3-2) .....          | 5 V                                    |
| Input Power Dissipation (up to 70°C) .....             | 250 mW*                                |
| Average Output Current – $I_O$ (Pin 6) .....           | 10 mA                                  |
| Emitter-Base Reverse Voltage (Pin 5-7) .....           | 5 V                                    |
| Output Voltage – $V_O$ (Pin 6-5) .....                 | -0.5 V to 20 V                         |
| Supply Voltage – $V_{CC}$ (Pin 8-5) .....              | -0.5 V to 30 V                         |
| Base Current – $I_B$ (Pin 7, except HCPL-4502/3) ..... | 5 mA                                   |
| Output Power Dissipation .....                         | 100 mW                                 |

\*Derate at 5.0 mW/°C for operating temperatures above 70°C.

## Schematic



\*\*Note: For CNW4502/3, Pin 7 is not connected.

**CAUTION:** The small junction sizes inherent to the design of this bipolar component increases the component's susceptibility to damage from electrostatic discharge (ESD). It is advised that normal static precautions be taken in handling and assembly of this component to prevent damage and/or degradation which may be induced by ESD.

## VDE 0884 Insulation Characteristics

| Description                                                                                                                                                                                                                                           | Symbol                                   | Characteristic    | Unit                    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|-------------------|-------------------------|
| Installation classification per DIN VDE 0109/12.83, Table 1<br>for rated mains voltage $\leq 600 V_{RMS}$<br>for rated mains voltage $\leq 1000 V_{RMS}$                                                                                              |                                          | I-IV<br>I-III     |                         |
| Climatic Classification                                                                                                                                                                                                                               |                                          | 55/100/21         |                         |
| Pollution Degree (DIN VDE 0109/12.83)                                                                                                                                                                                                                 |                                          | 2                 |                         |
| Maximum Working Insulation Voltage                                                                                                                                                                                                                    | $V_{IORM}$                               | 1414<br>1000      | $V_{PEAK}$<br>$V_{RMS}$ |
| Input to Output Test Voltage, Method b*<br>$V_{PR} = 1.6 \times V_{IORM}$ , 100% Production Test with $t_p = 1$ sec,<br>Partial Discharge $< 5$ pC                                                                                                    | $V_{PR}$                                 | 2263<br>1600      | $V_{PEAK}$<br>$V_{RMS}$ |
| Input to Output Test Voltage, Method a*<br>$V_{PR} = 1.2 \times V_{IORM}$ , Type and sample test,<br>$t_p = 60$ sec, Partial Discharge $< 5$ pC                                                                                                       | $V_{PR}$                                 | 1697<br>1200      | $V_{PEAK}$<br>$V_{RMS}$ |
| Highest Allowable Overvoltage*<br>(Transient Overvoltage, $t_{TR} = 10$ sec)                                                                                                                                                                          | $V_{TR}$                                 | 8000              | $V_{PEAK}$              |
| Safety-Limiting Values<br>(Maximum values allowed in the event of a failure,<br>also see Figure 9)<br>Case Temperature<br>Current (Input Current $I_F$ , $P_{SI} = 0$ )<br>Output Power (obtained by setting pin 8 = 5.5 V,<br>pins 7, 6, 5 = ground) | $T_{SI}$<br>$I_{SI}$<br>$P_{SI, OUTPUT}$ | 150<br>400<br>700 | $^{\circ}C$<br>mA<br>mW |
| Insulation Resistance at $T_{SI}$ , $V_{IO} = 500$ V<br>$V_{IO} = 500$ V                                                                                                                                                                              | $R_{IS}$                                 | $\geq 10^9$       | $\Omega$                |

\*Refer to the front of the optocoupler section of the HP Optoelectronics Designer's Catalog, under Product Safety Regulations Section, (VDE 0884) for a detailed description.

**Note:** Isolation characteristics are guaranteed only within the safety maximum ratings which must be ensured by protective circuits in the application.

## Insulation Related Specifications

| Parameter                                          | Symbol | Value | Units | Conditions                                            |
|----------------------------------------------------|--------|-------|-------|-------------------------------------------------------|
| Min. External Clearance<br>(External Air Gap)      | L(IO1) | 9.6   | mm    | Measured from input terminals to output terminals     |
| Min. External Creepage<br>(External Tracking Path) | L(IO2) | 10.0  | mm    | Measured from input terminals to output terminals     |
| Min. Internal Clearance<br>(Internal Plastic Gap)  |        | 1.0   | mm    | Through insulation distance<br>conductor to conductor |
| Min. Internal Creepage<br>(Internal Tracking Path) |        | 4.0   | mm    | Measured from input terminals to output terminals     |
| Comparative Tracking<br>Index                      | CTI    | 200   | volts | DIN IEC 112/VDE 0303 PART 1                           |
| Isolation Group<br>(per DIN VDE 0109)              |        | IIIa  |       | Material group (DIN VDE 0109)                         |

## Electrical Specifications

Over Recommended Temperature ( $T_A = 0^\circ\text{C}$  to  $70^\circ\text{C}$ ) unless otherwise specified. (See note 8.)

| Parameter                                  | Symbol                          | Device                       | Min.      | Typ.*     | Max. | Units                      | Test Conditions                                                      |                                                                       |                                                   | Fig.    | Note |
|--------------------------------------------|---------------------------------|------------------------------|-----------|-----------|------|----------------------------|----------------------------------------------------------------------|-----------------------------------------------------------------------|---------------------------------------------------|---------|------|
| Current Transfer Ratio                     | CTR                             | CNW135                       | 7         | 18        | 150  | %                          | $T_A = 25^{\circ}\text{C}$                                           | $V_O = 0.4\text{ V}$                                                  | $I_F = 16\text{ mA}$ ,<br>$V_{CC} = 4.5\text{ V}$ | 1, 2, 4 | 1    |
|                                            |                                 |                              |           |           |      |                            | $V_O = 0.5\text{ V}$                                                 |                                                                       |                                                   |         |      |
|                                            |                                 | CNW136<br>CNW4502<br>CNW4503 | 19        | 50        | 150  | %                          | $T_A = 25^{\circ}\text{C}$                                           | $V_O = 0.4\text{ V}$                                                  |                                                   |         |      |
|                                            |                                 |                              | 15        |           |      |                            | $V_O = 0.5\text{ V}$                                                 |                                                                       |                                                   |         |      |
| Logic Low Output Voltage                   | $V_{OL}$                        | CNW135                       |           | 0.1       | V    | $T_A = 25^{\circ}\text{C}$ | $I_O = 1.1\text{ mA}$                                                | $I_F = 16\text{ mA}$ ,<br>$V_{CC} = 4.5\text{ V}$                     |                                                   |         |      |
|                                            |                                 |                              |           |           |      |                            | $I_O = 0.8\text{ mA}$                                                |                                                                       |                                                   |         |      |
|                                            |                                 | CNW136<br>CNW4502<br>CNW4503 |           | 0.1       | V    | $T_A = 25^{\circ}\text{C}$ | $I_O = 3.0\text{ mA}$                                                |                                                                       |                                                   |         |      |
|                                            |                                 |                              |           |           |      |                            | $I_O = 2.4\text{ mA}$                                                |                                                                       |                                                   |         |      |
| Logic High Output Current                  | $I_{OH}$                        |                              |           | 0.002     | 0.5  | $\mu\text{A}$              | $T_A = 25^{\circ}\text{C}$                                           | $V_O = V_{CC} = 5.5\text{ V}$                                         | $I_F = 0\text{ mA}$                               | 6       |      |
|                                            |                                 |                              |           |           | 1    |                            | $T_A = 25^{\circ}\text{C}$                                           | $V_O = V_{CC} = 15\text{ V}$                                          |                                                   |         |      |
|                                            |                                 |                              |           |           | 50   |                            |                                                                      |                                                                       |                                                   |         |      |
| Logic Low Supply Current                   | $I_{CCL}$                       |                              |           | 70        | 200  | $\mu\text{A}$              | $I_F = 16\text{ mA}$ , $V_O = \text{Open}$ , $V_{CC} = 15\text{ V}$  |                                                                       |                                                   |         |      |
| Logic High Supply Current                  | $I_{CCH}$                       |                              |           |           | 1    | $\mu\text{A}$              | $T_A = 25^{\circ}\text{C}$                                           | $I_F = 0\text{ mA}$ , $V_O = \text{Open}$ ,<br>$V_{CC} = 15\text{ V}$ |                                                   |         |      |
|                                            |                                 |                              |           |           | 2    |                            |                                                                      |                                                                       |                                                   |         |      |
| Input Forward Voltage                      | $V_F$                           |                              | 1.45      | 1.68      | 1.85 | V                          | $T_A = 25^{\circ}\text{C}$                                           | $I_F = 16\text{ mA}$                                                  |                                                   | 3       |      |
|                                            |                                 |                              | 1.35      |           | 1.95 |                            |                                                                      |                                                                       |                                                   |         |      |
| Input Reverse Breakdown Voltage            | $BV_R$                          |                              | 5         |           |      | V                          | $I_R = 10\text{ }\mu\text{A}$<br>$T_A = 25^{\circ}\text{C}$          |                                                                       |                                                   |         |      |
| Temperature Coefficient of Forward Voltage | $\frac{\Delta V_F}{\Delta T_A}$ |                              |           | 1.9       |      | mV/<br>$^{\circ}\text{C}$  | $I_F = 16\text{ mA}$                                                 |                                                                       |                                                   |         |      |
| Input Capacitance                          | $C_{IN}$                        |                              |           | 90        |      | pF                         | $f = 1\text{ MHz}$ , $V_F = 0\text{ V}$                              |                                                                       |                                                   |         |      |
| Input-Output Insulation Voltage            | $V_{ISO}$                       |                              | 5000      |           |      | $V_{RMS}$                  | $RH \leq 50\%$ , $t = 1\text{ min.}$ ,<br>$T_A = 25^{\circ}\text{C}$ |                                                                       |                                                   | 2, 7    |      |
| Resistance (Input-Output)                  | $R_{LO}$                        |                              | $10^{12}$ | $10^{13}$ |      | $\Omega$                   | $T_A = 25^{\circ}\text{C}$                                           | $V_{LO} = 500\text{ VDC}$                                             |                                                   |         | 2    |
|                                            |                                 |                              | $10^{11}$ |           |      |                            | $T_A = 100^{\circ}\text{C}$                                          |                                                                       |                                                   |         |      |
| Capacitance (Input-Output)                 | $C_{LO}$                        |                              |           | 0.5       | 0.6  | pF                         | $f = 1\text{ MHz}$                                                   |                                                                       |                                                   | 2       |      |
| Transistor DC Current Gain                 | $h_{FE}$                        |                              |           | 180       |      |                            | $V_O = 5\text{ V}$ , $I_O = 3\text{ mA}$                             |                                                                       |                                                   |         |      |
|                                            |                                 |                              |           | 160       |      |                            | $V_O = 0.4\text{ V}$ , $I_B = 40\text{ }\mu\text{A}$                 |                                                                       |                                                   |         |      |

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

## Switching Specifications

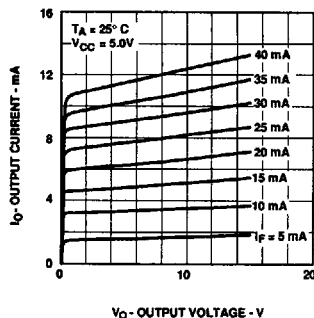
Over Recommended Temperature ( $T_A = 0^\circ\text{C}$  to  $70^\circ\text{C}$ ),  $V_{CC} = 5\text{ V}$ ,  $I_F = 16\text{ mA}$ , unless otherwise specified.

| Parameter                                                            | Sym.             | Device            | Min.   | Typ.*   | Max. | Units | Test Conditions          |                                                                              | Fig.        | Note    |
|----------------------------------------------------------------------|------------------|-------------------|--------|---------|------|-------|--------------------------|------------------------------------------------------------------------------|-------------|---------|
| Propagation Delay<br>Time to Logic Low<br>at Output                  | t <sub>PHL</sub> | CNW135            |        | 0.2     | 1.5  | μs    | T <sub>A</sub> = 25°C    | R <sub>L</sub> = 4.1 kΩ                                                      | 5, 8,<br>11 | 4, 5    |
|                                                                      |                  |                   |        | 2.0     |      |       |                          |                                                                              |             |         |
|                                                                      |                  | CNW136<br>CNW4502 |        | 0.2     | 0.8  |       | T <sub>A</sub> = 25°C    | R <sub>L</sub> = 1.9 kΩ                                                      |             |         |
|                                                                      |                  |                   |        | 1.0     |      |       |                          |                                                                              |             |         |
| Propagation Delay<br>Time to Logic High<br>at Output                 | t <sub>PLH</sub> | CNW135            |        | 0.6     | 1.5  | μs    | T <sub>A</sub> = 25°C    | R <sub>L</sub> = 4.1 kΩ                                                      | 5, 8,<br>11 | 4, 5    |
|                                                                      |                  |                   |        | 2.0     |      |       |                          |                                                                              |             |         |
|                                                                      |                  | CNW136<br>CNW4502 |        | 0.35    | 0.8  |       | T <sub>A</sub> = 25°C    | R <sub>L</sub> = 1.9 kΩ                                                      |             |         |
|                                                                      |                  |                   |        | 1.0     |      |       |                          |                                                                              |             |         |
| Common Mode Tran-<br>sient Immunity at<br>Logic High Level<br>Output | CM <sub>H</sub>  | CNW135            | 1,000  |         |      | V/μs  | R <sub>L</sub> = 4.1 kΩ  | I <sub>F</sub> = 0 mA,<br>T <sub>A</sub> = 25°C,<br>V <sub>CM</sub> = 10 V   | 12          | 3, 4, 5 |
|                                                                      |                  | CNW136            | 1,000  |         |      |       | R <sub>L</sub> = 1.9 kΩ  |                                                                              |             |         |
|                                                                      |                  | CNW4502           | 1,000  | ≥10,000 |      |       | V <sub>CM</sub> = 10 V   | I <sub>F</sub> = 0 mA,<br>T <sub>A</sub> = 25°C,<br>R <sub>L</sub> = 1.9 kΩ  | 12          | 3, 4    |
|                                                                      |                  | CNW4503           | 15,000 | 30,000  |      |       | V <sub>CM</sub> = 1500 V |                                                                              |             |         |
| Common Mode Tran-<br>sient Immunity at<br>Logic Low Level<br>Output  | CM <sub>L</sub>  | CNW135            | 1,000  |         |      | V/μs  | R <sub>L</sub> = 4.1 kΩ  | I <sub>F</sub> = 16 mA,<br>T <sub>A</sub> = 25°C,<br>V <sub>CM</sub> = 10 V  | 12          | 3, 4, 5 |
|                                                                      |                  | CNW136            | 1,000  |         |      |       | R <sub>L</sub> = 1.9 kΩ  | V <sub>CM</sub> = 10 V                                                       |             |         |
|                                                                      |                  | CNW4502           | 1,000  | 10,000  |      |       | V <sub>CM</sub> = 10 V   | I <sub>F</sub> = 16 mA,<br>T <sub>A</sub> = 25°C,<br>R <sub>L</sub> = 1.9 kΩ | 12          | 3, 4    |
|                                                                      |                  | CNW4503           | 15,000 | 30,000  |      |       | V <sub>CM</sub> = 1500 V |                                                                              |             |         |
| Bandwidth                                                            | BW               | CNW135<br>CNW136  |        | 11      |      | MHz   | See Test Circuit         |                                                                              | 7, 10       | 6       |

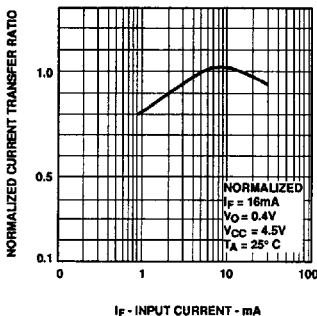
\*All typicals are at  $T_A = 25^\circ\text{C}$ .

### Notes:

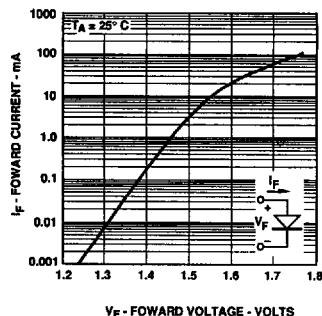
1. CURRENT TRANSFER RATIO in percent is defined as the ratio of output collector current,  $I_O$ , to the forward LED input current,  $I_F$ , times 100.
2. Device considered a two-terminal device: Pins 1, 2, 3, and 4 shorted together and Pins 5, 6, 7, and 8 shorted together.
3. Common mode transient immunity in Logic High level is the maximum tolerable (positive)  $dV_{CM}/dt$  on the leading edge of the common mode pulse  $V_{CM}$ , 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.  $V_O > 0.8\text{ V}$ ).
4. The 1.9 k $\Omega$  load represents 1 TTL unit load of 1.6 mA and the 5.6 k $\Omega$  pull-up resistor.
5. The 4.1 k $\Omega$  load represents 1 LSTTL unit load of 0.36 mA and 6.1 k $\Omega$  pull-up resistor.
6. The frequency at which the ac output voltage is 3 dB below the low frequency asymptote.
7. In accordance with UL 1577, each optocoupler is proof tested by applying an insulation test voltage of  $\geq 6000\text{ Vrms}$  for one second (leakage detection current limit,  $I_{LO} \leq 5\text{ }\mu\text{A}$ ). This test is performed before the 100% Production test shown in the VDE 0884 Insulation Characteristics Table.
8. Use of a 0.1  $\mu\text{F}$  bypass capacitor connected between pins 5 and 8 is recommended for operation.



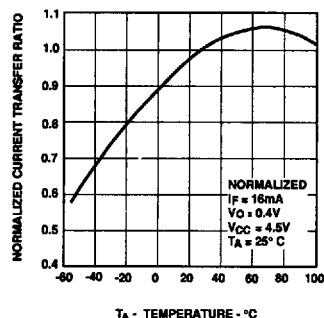
**Figure 1. DC and Pulsed Transfer Characteristics.**



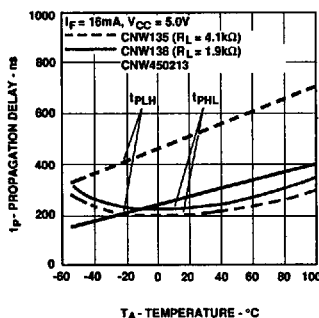
**Figure 2. Current Transfer Ratio vs. Input Current**



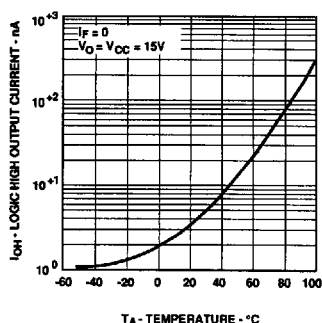
**Figure 3. Input Current vs. Forward Voltage.**



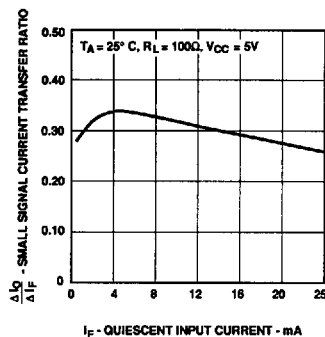
**Figure 4. Current Transfer Ratio vs. Temperature.**



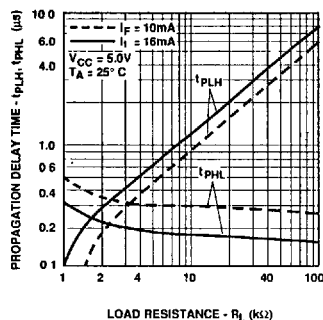
**Figure 5. Propagation Delay vs. Temperature.**



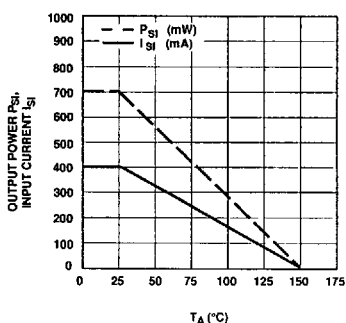
**Figure 6. Logic High Output Current vs. Temperature.**



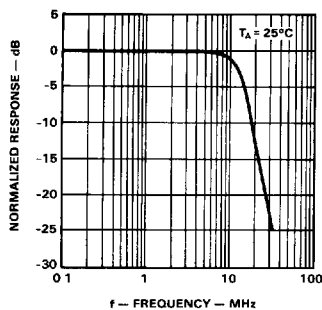
**Figure 7. Small-Signal Current Transfer Ratio vs. Quiescent Input Current.**



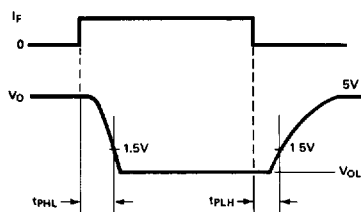
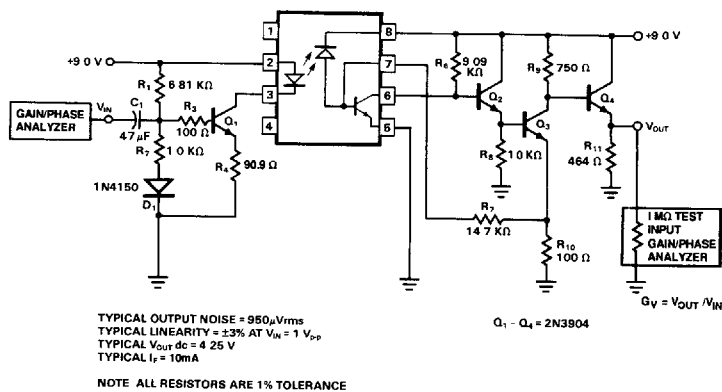
**Figure 8. Propagation Delay Time vs. Load Resistance.**



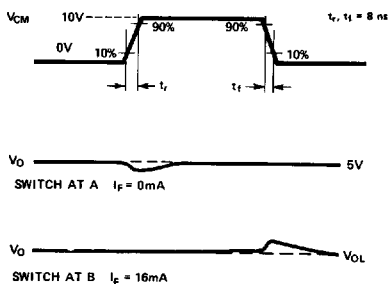
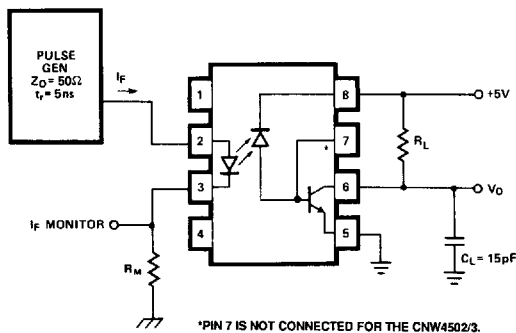
**Figure 9. Dependence of Safety Maximum Ratings with Ambient Temperature.**



**Figure 10. Frequency Response.**  
(CNW135/6)



**Figure 11. Switching Test Circuit.**



**Figure 12. Test Circuit for Transient Immunity and Typical Waveforms.**