

### DESCRIPTION

The MID400 is an optically isolated AC line-to-logic interface device. It is packaged in an 8-lead plastic DIP. The AC line voltage is monitored by two back-to-back GaAs LED diodes in series with an external resistor. A high gain detector circuit senses the LED current and drives the output gate to a logic low condition.

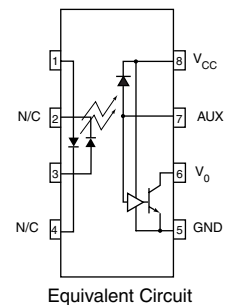
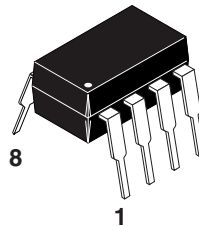
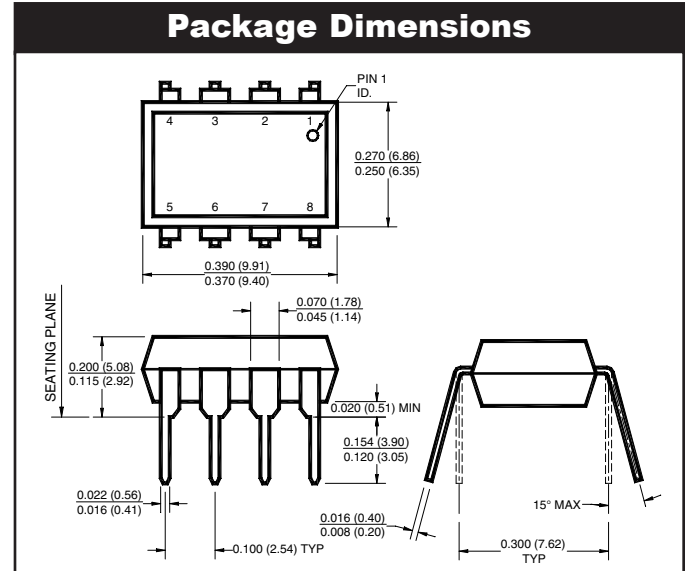
The MID400 has been designed solely for the use as an AC line **monitor**. It is recommended for use in any AC-to-DC control application where excellent optical isolation, solid state reliability, TTL compatibility, small size, low power, and low frequency operations are required.

### FEATURES

- Direct operation from any line voltage with the use of an external resistor.
- Externally adjustable time delay
- Externally adjustable AC voltage sensing level
- High voltage isolation between input and output
- Compact plastic DIP package
- Logic level compatibility
- UL recognized (File #E90700)

### APPLICATIONS

- Monitoring of the AC / DC "line-down" condition
- "Closed-loop" interface between electromechanical elements such as solenoids, relay contacts, small motors, and microprocessors
- Time delay isolation switch



ABSOLUTE MAXIMUM RATINGS		
Rating	Value	Unit
<b>EMITTER</b>		
RMS Current	25	mA
DC Current	±30	A
LED Power Dissipation @ T <sub>A</sub> = 25°C (P <sub>D</sub> )	45	mW
Derate above 70°C	2.0	mW/°C
<b>DETECTOR</b>		
Low Level Output Current (I <sub>OL</sub> )	20	mA
High Level Output Voltage (V <sub>OH</sub> )	7.0	V
Supply Voltage (V <sub>CC</sub> )	7.0	V
Detector Power Dissipation @ T <sub>A</sub> = 25°C (P <sub>D</sub> )	70	mW
Derate above 70°C	2.0	mW/°C
<b>TOTAL DEVICE</b>		
Storage Temperature	-55 to +125	°C
Operating Temperature	-40 to +85	°C
Lead Solder Temperature	260 for 10 sec	°C
Total Device Power Dissipation @ T <sub>A</sub> = 25°C (P <sub>D</sub> )	115	mW
Derate above 70°C	4.0	mW/°C
Surge Isolation	3550	VDC
	2500	V RMS
Steady State Isolation	3200	VDC
	2250	V RMS



## AC LINE MONITOR LOGIC-OUT DEVICE

### ELECTRICAL CHARACTERISTICS

(0°C to 70°C Free Air Temperature Unless Otherwise Specified—All Typical Values Are At 25°C)

#### INDIVIDUAL COMPONENT CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	TEST CONDITIONS
<b>INPUT</b>						
LED Forward Voltage	$V_f$			1.5	V	$I_f = \pm 30$ mA DC
<b>DETECTOR</b>						
Logic Low Output Supply Current	$I_{CCL}$			3.0	mA	$I_{IN} = 4.0$ mA RMS $V_o = \text{Open}$ , $V_{CC} = 5.5$ V $24 \text{ V} \leq V_{I(ON)}$ , RMS $\leq 240$ V
Logic High Output Supply Current	$I_{CCH}$			0.80	mA	$I_{IN} = 0.15$ mA RMS $V_{CC} = 5.5$ V $V_{I(OFF)}$ , RMS $\geq 5.5$ V

#### TRANSFER CHARACTERISTICS

DC CHARACTERISTICS	SYMBOL	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Logic Low Output Voltage	$V_{OL}$		.18	0.40	V	$I_{IN} = I_{I(ON)}$ , RMS $I_o = 16$ mA, $V_{CC} = 4.5$ V $24 \text{ V} \leq V_{I(ON)}$ , RMS $\leq 240$ V
Logic High Output Current	$I_{OH}$		.02	100	$\mu$ A	$I_{IN} = 0.15$ mA RMS $V_o = V_{CC} = 5.5$ V $V_{I(OFF)}$ , RMS $\geq 5.5$ V
On-state RMS Input Voltage	$V_{I(ON)}$ , RMS	90			V	$V_o = 0.4$ V, $I_o = 16$ mA $V_{CC} = 4.5$ V, $R_{IN} = 22$ K $\Omega$
Off-state RMS Input Voltage	$V_{I(OFF)}$ , RMS			5.5	V	$V_o = V_{CC} = 5.5$ V, $I_o \leq 100$ $\mu$ A, $R_{IN} = 22$ K $\Omega$
On-state RMS Input Current	$I_{I(ON)}$ , RMS	4.0			mA	$V_o = 0.4$ V, $I_o = 16$ mA $V_{CC} = 4.5$ V $24 \text{ V} \leq V_{I(ON)}$ , RMS $\leq 240$ V
Off-state RMS Input Current	$I_{I(OFF)}$ , RMS			.15	mA	$V_o = V_{CC} = 5.5$ V, $I_o \leq 100$ $\mu$ A, $V_{I(OFF)}$ , RMS $\geq 5.5$ V

#### TRANSFER CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN	TYP	MAX	UNITS	TEST CONDITIONS
<b>SWITCHING TIME</b> ( $T_A = +25^\circ\text{C}$ )						
Turn-On Time	$t_{ON}$		1.0		mS	$I_{IN} = 4.0$ mA RMS $I_o = 16$ mA, $V_{CC} = 4.5$ V $R_{IN} = 22$ K $\Omega$ (See Test Circuit 2)
Turn-Off Time	$t_{OFF}$		1.0		mS	$I_{IN} = 4.0$ mA RMS $I_o = 16$ mA, $V_{CC} = 4.5$ V $R_{IN} = 22$ K $\Omega$ (See Test Circuit 2)

#### ISOLATION CHARACTERISTICS ( $T_A = +25^\circ\text{C}$ )

CHARACTERISTICS	SYMBOL	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Surge Isolation Voltage	$V_{ISO}$	3550			VDC	Relative Humidity $\leq 50\%$ , $I_{IC} \leq 10$ $\mu$ A
		2500			VACRMS	1 Second, 60 Hz
Steady State Isolation Voltage	$V_{ISO}$	3200			VDC	Relative Humidity $\leq 50\%$ , $I_{IC} \leq 10$ $\mu$ A
		2250			VACRMS	1 Minute, 60 Hz
Isolation Resistance	$R_{ISO}$	$10^{11}$			$\Omega$	$V_{I,O} = 500$ VDC
Isolation Capacitance	$C_{ISO}$		2		pF	$f = 1$ MHz

(RMS = True RMS Voltage at 60 Hz, THD  $\leq 1\%$ .)



## AC LINE MONITOR LOGIC-OUT DEVICE

### DESCRIPTION/APPLICATIONS

The input of the MID400 consists of two back-to-back LED diodes which will accept and convert alternating currents into light energy. An integrated photo diode-detector amplifier forms the output network. Optical coupling between input and output provides 3550 V DC voltage isolation. A very high current transfer ratio, (defined as the ratio of the DC output current and the DC input current) is achieved through the use of a high gain amplifier. The detector amplifier circuitry operates from a 5 V DC supply and drives an open collector transistor output. The switching times are intentionally designed to be slow in order to enable the MID400, when used as an AC line monitor, to respond only to changes of input voltage exceeding many milliseconds. The short period of time during zero-crossing which occurs once every half cycle of the power line is completely ignored. To operate the MID400, always add a resistor,  $R_{IN}$ , in series with the input (as shown in test circuit 1) to limit the current to the required value. The value of the resistor can be determined by the following equation:

$$R_{IN} = \frac{V_{IN} - V_F}{I_{IN}}$$

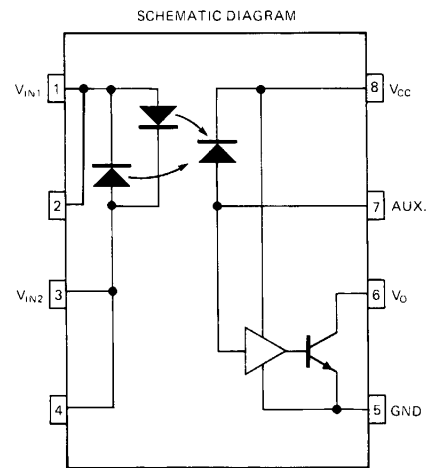
Where  $V_{IN}$  (RMS) is the input voltage.

$V_F$  is the forward voltage drop across the LED.

$I_{IN}$  (RMS) is the desired input current required to sustain a logic "O" on the output.

### PIN DESCRIPTION

DESIGNATION	PIN #	FUNCTION
$V_{IN1}, V_{IN2}$	1, 3	Input terminals.
$V_{CC}$	8	Supply voltage, output circuit.
AUX.	7	Auxiliary terminal.
		Programmable capacitor input to adjust AC voltage sensing level and time delay.
$V_O$	6	Output terminal; open collector.
GND	5	Circuit ground potential.



C1473B

NOTE: DO NOT CONNECT PIN 2 AND 4

**GLOSSARY**

**VOLTAGES**

$V_{I(ON)}$ RMS	On-state RMS input voltage The RMS voltage at an input terminal for a specified input current with output conditions applied that according to the product specification will cause the output switching element to be sustained in the on-state within one full cycle.
$V_{I(OFF)}$ RMS	Off-state RMS input voltage The RMS voltage at an input terminal for a specified input current with output conditions applied that according to the product specification will cause the output switching element to be sustained in the off-state within one fill cycle.
$V_{OL}$	Low-level output voltage The voltage at an output terminal for a specific output current $I_{OL}$ with input conditions applied that according to the product specification will establish a low-level at the output.
$V_{OH}$	High-level output voltage The voltage at an output terminal for a specified output current $I_{OH}$ with input conditions applied that according to the product specification will establish a high-level at the output.
$V_F$	LED forward voltage The voltage developed across the LED when input current $I_F$ is applied to the anode of the LED.

**CURRENTS**

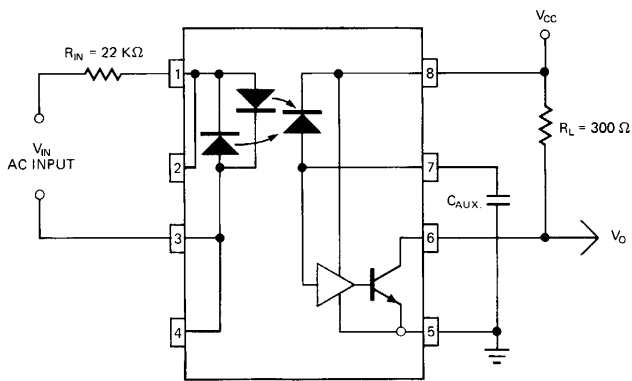
$I_{I(ON)}$ RMS	On-state RMS input current The RMS current flowing into an input with output conditions applied that according to the product specification will cause the output switching element to be sustained in the on-state within one full cycle.
$I_{I(OFF)}$ RMS	Off-state RMS input current The RMS current flowing into an input with output conditions applied that according to the product specification will cause the output switching element to be sustained in the off-state within one full cycle.
$I_{OH}$	High-level output current The current flowing into * an output with input conditions applied that according to the product specification will establish a high-level at the output.
$I_{OL}$	Low-level output current The current flowing into * an output with input conditions applied that according to the product specification will establish a low-level at the output.
$I_{CCL}$	Supply current, output low The current flowing into * the $V_{CC}$ supply terminal of a circuit when the output is at a low-level voltage.
$I_{CH}$	Supply current, output high The current flowing into * the $V_{CC}$ supply terminal of a circuit when the output is at a high-level voltage.

**DYNAMIC CHARACTERISTICS**

$t_{ON}$	Turn-on time The time between the specified reference points on the input and the output voltage waveforms with the output changing from the defined high-level to the defined low-level.
$t_{OFF}$	Turn-off time The time between the specified reference points on the input and output voltage waveforms with the output changing from the defined low-level to the defined high-level.

\*Current flowing out of a terminal is a negative value.

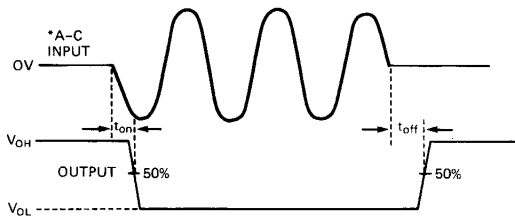
**OPERATING SCHEMATICS**



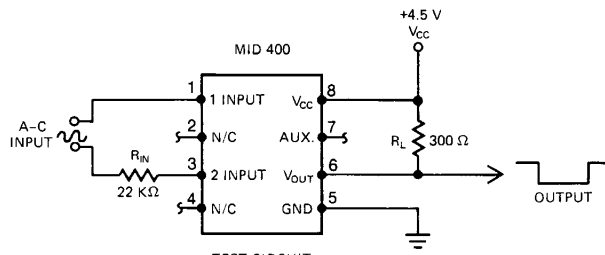
INPUT CURRENT VS. CAPACITANCE, C<sub>AUX</sub>. CIRCUIT

C1478A

Test Circuit 1



\*INPUT TURNS ON AND OFF AT ZERO CROSSING.



TEST CIRCUIT

C1479B

Test Circuit 2  
MID400 Switching Time

**TYPICAL CURVES**

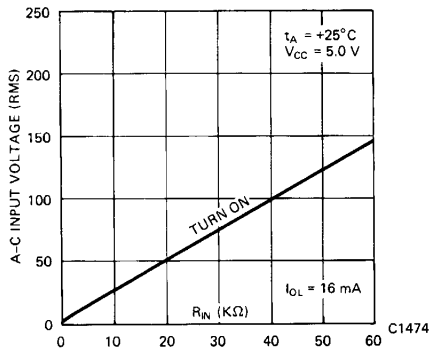


Fig. 2. Input Voltage vs. Input Resistance

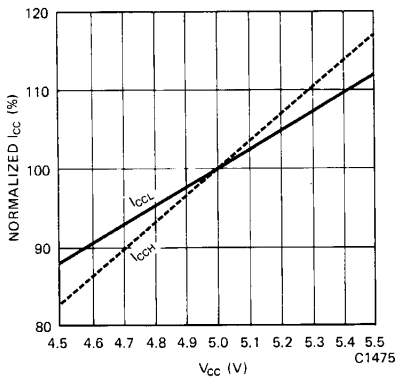
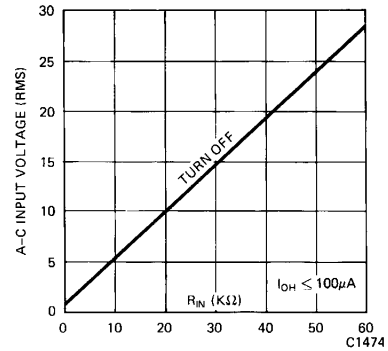


Fig. 3. Supply Current vs. Supply Voltage

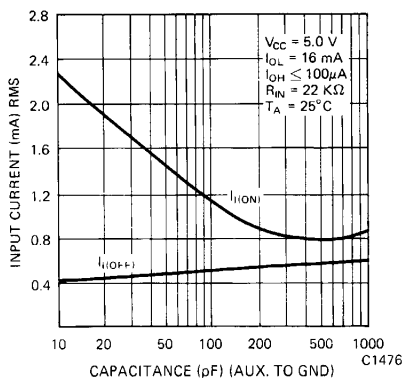


Fig. 4. Input Current vs. Capacitance  
(See test circuit 1)

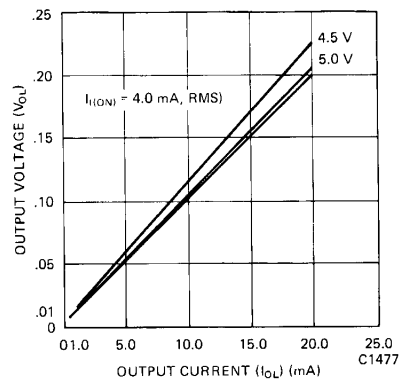


Fig. 5. Output Voltage vs. Output Current