AC LINE MONITOR LOGIC-OUT DEVICE

MID400

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.

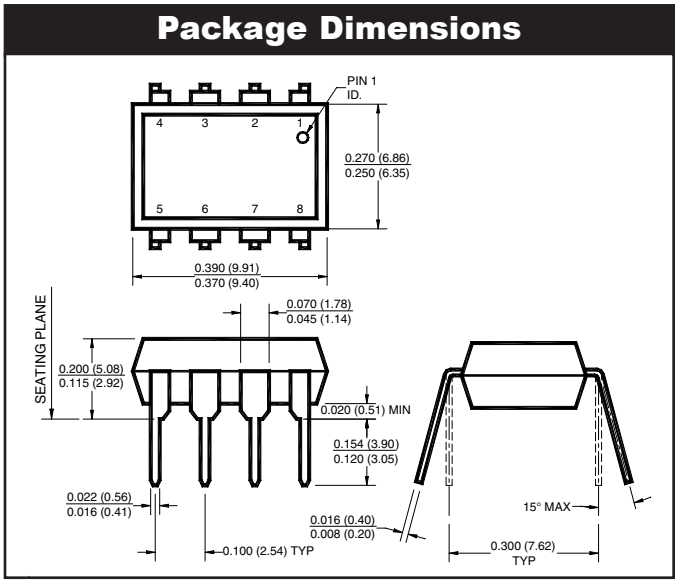
FEATURES

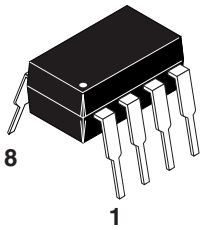
- Direct operation from any line voltage with the use of an external resistor.
- Externally adjustable time delay
- Externally adjustable AC voltage sensing level
- High voltage isolation between input and output
- Compact plastic DIP package
- Logic level compatibility
- UL recognized (File #E90700)

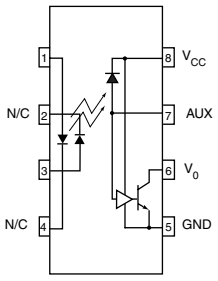
APPLICATIONS

- 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

Package Dimensions







Equivalent Circuit

ABSOLUTE MAXIMUM RATINGS

Rating	Value	Unit
EMITTER		
RMS Current	25	mA
DC Current	±30	A
LED Power Dissipation @ T_A = 25°C (P_D)	45	mW
Derate above 70°C	2.0	mW/°C
DETECTOR		
Low Level Output Current (I_{OL})	20	mA
High Level Output Voltage(V_{OH})	7.0	V
Supply Voltage (V_{CC})	7.0	V
Detector Power Dissipation @ TA = 25°C (P_D)	70	mW
Derate above 70°C	2.0	mW/°C
TOTAL DEVICE		
Storage Temperature	-55 to +125	°C
Operating Temperature	-40 to +85	°C
Lead Solder Temperature	260 for 10 sec	°C
Total Device Power Dissipation @ TA = 25°C (P_D)	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

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
INPUT LED Forward Voltage	V_F			1.5	V	I_F = ±30 mA DC
DETECTOR Logic Low Output Supply Current	I_{CCL}			3.0	mA	I_{IN}=4.0 mA RMS, V_O=Open, V_{CC}=5.5 V, 24 V≤$V_{I(ON)}$ RMS≤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≥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 V≤$V_{I(ON)}$RMS≤240 V
Logic High Output Current	I_{OH}		.02	100	μA	I_{IN}=0.15 mA RMS, V_O=V_{CC}=5.5 V, $V_{I(OFF)}$RMS≥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 KΩ
Off-state RMS Input Voltage	$V_{I(OFF)}$RMS			5.5	V	V_O=V_{CC}=5.5 V, I_O≤100μA, R_{IN}=22 KΩ
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 V≤$V_{I(ON)}$RMS≤240 V
Off-state RMS Input Current	$I_{I(OFF)}$RMS			.15	mA	V_O=V_{CC}=5.5 V, I_O≤100μA, $V_{I(OFF)}$RMS≥5.5 V

TRANSFER CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN	TYP	MAX	UNITS	TEST CONDITIONS
SWITCHING TIME (T_A=+25°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 KΩ (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 KΩ (See Test Circuit 2)

ISOLATION CHARACTERISTICS (T_A=+25°C)

CHARACTERISTICS	SYMBOL	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Surge Isolation Voltage	V_{ISO}	3550			VDC	Relative Humidity≤50%, I_{I-O}≤10μA
		2500			VACRMS	1 Second, 60 Hz
Steady State Isolation Voltage	V_{ISO}	3200			VDC	Relative Humidity≤50%, I_{I-O}≤10μA
		2250			VACRMS	1 Minute, 60 Hz
Isolation Resistance	R_{ISO}	10^{11}			Ω	V_{I-O}=500 VDC
Isolation Capacitance	C_{ISO}		2		pF	f=IMHZ

(RMS=True RMS Voltage at 60 Hz, THD ≤ 1%.)

QT OPTOELECTRONICS

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:

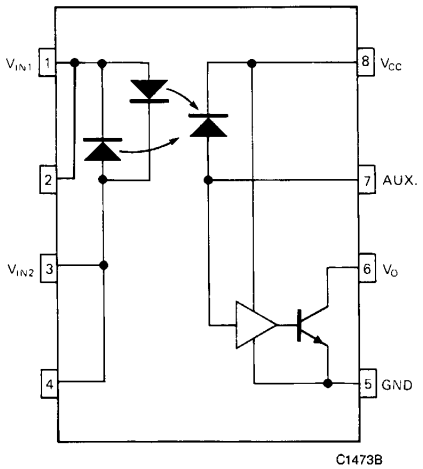
$$R_{IN} = \frac{V_{IN} - V_F}{I_{IN}}$$

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.

SCHEMATIC DIAGRAM



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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_{CCH} — 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

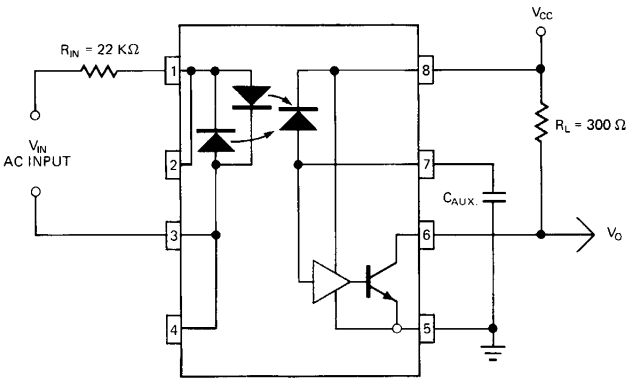
The time between the specified reference points on the input and the output voltage waveforms with the output changing from the defined high-level to the defined low-level.

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.*

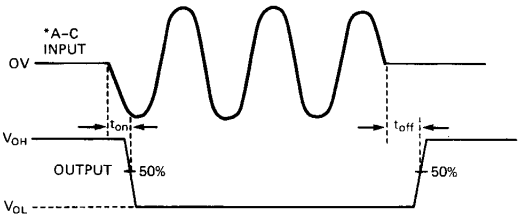
OPERATING SCHEMATICS



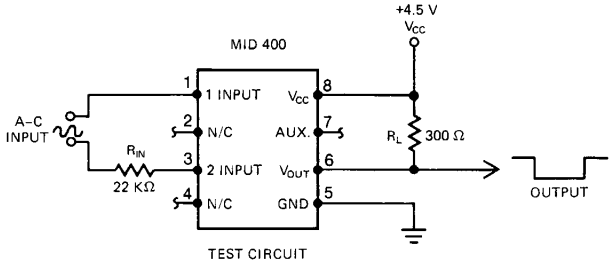
INPUT CURRENT VS. CAPACITANCE, $C_{AUX.}$ CIRCUIT

C1478A

Test Circuit 1



*INPUT TURNS ON AND OFF AT ZERO CROSSING.



TEST CIRCUIT

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Test Circuit 2
MID400 Switching Time

TYPICAL CURVES

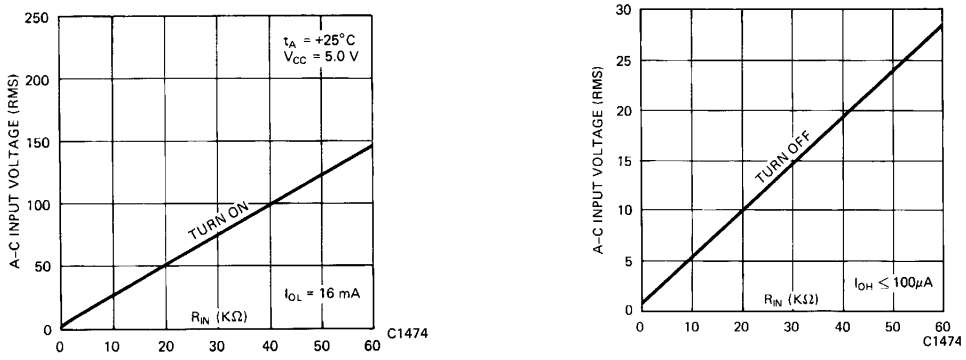

Fig. 2. Input Voltage vs. Input Resistance

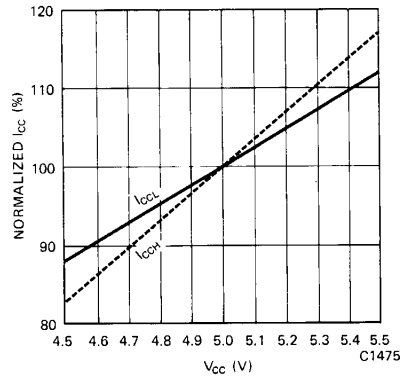

Fig. 3. Supply Current vs. Supply Voltage

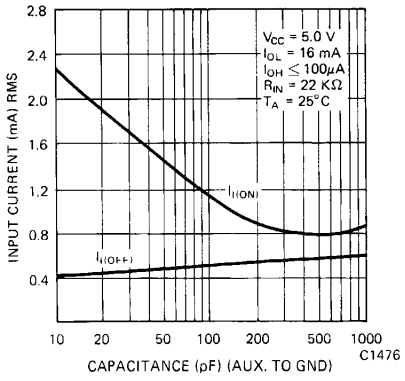

Fig. 4. Input Current vs. Capacitance (See test circuit 1)

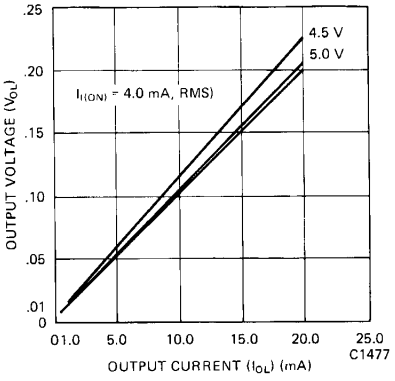

Fig. 5. Output Voltage vs. Output Current