

# TECHNICAL DATA

AN EXCLUSIVE RADIO SHACK SERVICE TO THE EXPERIMENTER

## MA1026 Digital LED Alarm Clock/Thermometer Module

## Physical Dimensions inches (millimeters)

### Description

The MA-1026 is a digital clock thermometer module with a four-digit LED display. It can be used as a clock/thermometer, alarm clock, instrument panel clock, or appliance timer. It can also be interfaced with an external radio to make a complete clock/radio. The only external accessories needed are a transformer, switches, and a temperature sensor.

### Features

- .7" (1.8cm) LED Display
- "One-finger" 59 minute sleep counter setting
- 9 minute snooze alarm
- 24 hour alarm
- Simple fast/slow setting controls
- 6 display modes (temperature, time, seconds, alarm, sleep and lamp test)
- Selectable °C/°F, 12/24 hour, 50/60 Hz and fixed/flashing colon
- Display flashes to indicate AC power loss
- PM, colon, temperature, and alarm-on indicators.
- Bright/Dim or continuous brightness control
- 800 Hz alarm-tone with direct output to an 8-ohm speaker

### Typical Applications

- Clock radio timer
- Alarm clock
- Desk clock
- TV/Stereo timer
- Instrument panel clock
- Thermometer (°C or °F)

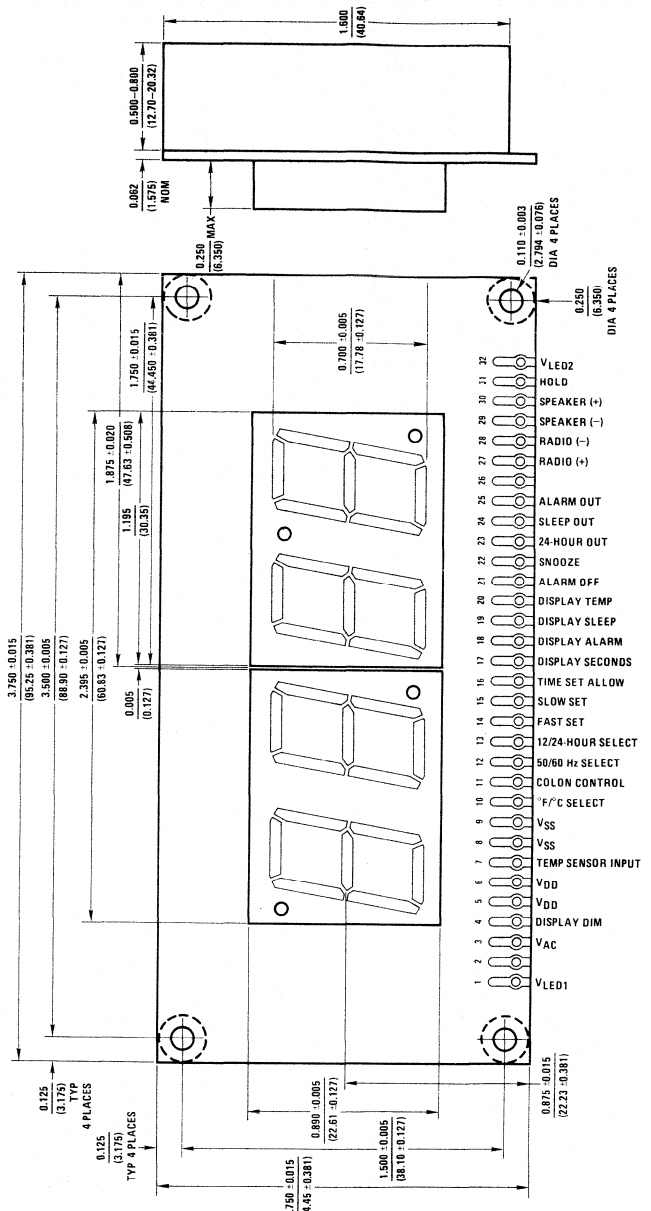
### Electrical Characteristics

$T_A = 25^\circ\text{C}$ ,  $V_{AC} = 10.5 \text{ Vrms}$ ,  $V_{SS} = 0\text{V}$ ,  $V_{LED} = 3.0\text{V}$ , unless otherwise specified.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
$V_{AC}$ MOS Supply Voltage	Fully Operational Temp/Clock	9.0	10.5	12.0	Vrms
$I_{AC}$ MOS Supply Current			10	15	$\text{mA}_{AVG}$
$V_{LED}$ LED Supply Voltage		2.5	3.0	3.5	Vrms x 2
$I_{LED}$ LED Supply Current	Lamp Test (All 30 Segments ON) Pin 4 Open (Max Brightness)		300		$\text{mA}_{AVG}$
$V_{BATT}$ MOS Supply Voltage	$V_{AC} = 0\text{V}$ $V_{LED} = 0\text{V}$ , Timekeeping Maintained	7.5	9.0	12.0	$V_{DC}$
$I_{BATT}$ MOS Supply Current	$V_{BATT} = 9.0 \text{ V}_{DC}$		5.0	10.0	$\text{mA}_{DC}$
Temp Sensor Input Voltage (Pin 7)	10 mV/°C (10k Input Resistance to $V_{SS}$ )	2.33	Note 2	3.63	V
Temp Sensor Input Current	1 $\mu\text{A}/^\circ\text{C}$	233	Note 2	363	$\mu\text{A}$
Temperature Display Range		-40		89	°C
		-40		193	°F
Thermometer Resolution			1		°C or °F
Thermometer Accuracy	$T_A = 25^\circ\text{C}$ (Notes 1 and 2)		$\pm 0.5$	$\pm 1$	°C
	$T_A$ Over Operating Range (Note 2)		$\pm 1$	$\pm 3$	°F
Radio Supply Input Current (Pin 27)				200	mA
Speaker Output Current	$R_L = 8 \Omega$ , 50% Duty Cycle	150			mA peak

**Note 1:** Does not include temperature sensor.

**Note 2:** The sensor input current must remain between 233  $\mu\text{A}$  and 363  $\mu\text{A}$  at a 1  $\mu\text{A}/^\circ\text{C}$  slope for proper temperature display. Similarly, the sensor input voltage must remain between 2.33V and 3.63V at a 10 mV/°C slope for proper temperature display.



### Absolute Maximum Ratings

Voltage at All Pins Except 1, 3 and 32  $V_{SS} - 0.3\text{V}$  to  $V_{SS} + 12\text{V}$   
 Voltage at Pins 1 and 32  $V_{SS} - 3\text{V}$  to  $V_{SS} + 6\text{V}$   
 Voltage at Pin 3  $V_{SS} - 17\text{V}$  to  $V_{SS} + 17\text{V}$   
 Operating Temperature Range (Note 1)  $0^\circ\text{C}$  to  $70^\circ\text{C}$   
 Storage Temperature Range  $-20^\circ\text{C}$  to  $+85^\circ\text{C}$   
 Terminal Temperature (Soldering, 5 seconds)  $230^\circ\text{C}$

## Functional Description

The various modes and functions are listed in Tables 1 and 2. Below is an abbreviated description of required electrical connections for each pin/function. (Refer also to Applications Schematics provided.)

**Mode Select Inputs (Pins 17, 18, 19 and 20):** With no input (pins open) hours:minutes is displayed. Connect appropriate pin to V<sub>SS</sub> for desired display mode (refer to Table 1).

**Time Setting Inputs (Pins 14, 15, and 16):** For FAST SET, connect V<sub>SS</sub> to pins 14 and 16 simultaneously. For SLOW SET, connect V<sub>SS</sub> to pins 15 and 16 simultaneously. Connecting all three pins to V<sub>SS</sub> resets time to 12:00:00 AM (if in time display mode); in sleep display mode it resets sleep to :59 minutes.

**50/60 Hz Select (Pin 12):** For 50 Hz operation, connect V<sub>SS</sub> to pin 12. For 60 Hz operation, leave pin 12 open.

**Colon Control (Pin 11):** For a flashing display (1 Hz), connect pin 11 to V<sub>DD</sub>. For a non-flashing display, connect pin 11 to V<sub>SS</sub>.

**12/24 Hour Display Select (Pin 13):** For a 12 Hour display, leave pin 13 unconnected OR connect it to V<sub>DD</sub>. For a 24 hour display format, connect pin 13 to V<sub>SS</sub>.

**NOTE:** When in the 12 Hour display format, the PM indicator (in the upper left of the display) is active.

**Snooze Input (Pin 22):** Momentarily connecting pin 22 to V<sub>SS</sub> will silence the Alarm (or Radio if connected). 8-9 minutes later, the Alarm will again sound. (Snooze input may be used up to 7 times in sequence during the 59 minutes following the Alarm Set time.)

**Alarm OFF Input (Pin 21):** Connecting pin 21 to V<sub>SS</sub> disables the Alarm (or Radio if connected). If the connection is momentary, the Alarm will reset itself to sound 24 hours later. Alarm is disabled as long as V<sub>SS</sub> is connected to pin 21. An Alarm indicator in the lower right corner lights when Alarm is set.

**Display Dim Output (Pin 4):** When pin 4 is left unconnected, the LED display will be at maximum brightness. Connecting pin 4 to V<sub>SS</sub> reduces brightness to 25%. Continuously variable brightness (between 25%-100%) is available by connecting a 10K Potentiometer (No. 271-215) between pin 4 and V<sub>SS</sub>.

**Temperature Sensor Input (Pin 7):** This input is active whenever the temperature mode is selected (Pin 20) Connect the temperature sensor (LM-334, R.S. 276-1734) between Pin 7 and V<sub>DD</sub> (refer to Schematic for details).

**°C/°F Select Input (Pin 10):** For Centigrade display (when temperature mode is selected), connect pin 10 to V<sub>SS</sub>. For Fahrenheit, connect pin 10 to V<sub>DD</sub>, or leave it unconnected.

**Hold Input (Pin 31):** When pin 31 is connected to V<sub>SS</sub>, the time will not advance. This input can be used for momentarily holding the clock while setting the time. This input is also used for connection of an internal crystal timebase for DC operation.

**Sleep/Radio Supply Outputs (Pins 24, 27 and 28):** Pin 24, sleep output, can be used to turn off a Radio after desired time interval (up to 59 minutes). (Turn off can be obtained manually by momentarily applying V<sub>SS</sub> to Pin 22; i.e. snooze.) See Schematic.

**Alarm/Speaker Outputs (Pins 25, 29 and 30):** When the alarm-set time and real-time are the same, an alarm tone appears at pin 25. This output drives the base of Q1, which drives an external 8 or 16-ohm speaker connected between pins 29 and 30. When activated, the alarm will sound for 59 minutes and reset itself to activate at the same time 24 hours later. The alarm tone can be deactivated by SNOOZE (pin 22 to V<sub>SS</sub>) or ALARM OFF (pin 21). The alarm tone is 800 Hz, gated by a 2 Hz square-wave.

**24 Hour Output (Pin 23):** When used in the 12 hour display format, this output produces a square-wave signal during AM and no output during PM. This output can be used for date recording or to drive an external day-date display.

**Table II. Control Setting Functions**

Selected Display Mode	Control Input	Control Function
Time and Seconds Display	Time Set Allow and Slow Set Simultaneously	Minutes advance at a 2 Hz rate and Seconds Counter is reset to :00.
	Time Set Allow and Fast Set Simultaneously	Minutes advance at a 60 Hz rate. Seconds Counter not affected.
	Time Set Allow and Fast and Slow Set Simultaneously	Hours, Minutes, and Seconds are reset to: 12:00:00 AM (12-Hour Mode) 0:00:00 (24-Hour Mode).
Alarm Display	Slow Set	Alarm Minutes Counter advances at a 2 Hz rate.
	Fast Set	Alarm Minutes Counter advances at a 60 Hz rate.
	Fast and Slow Set Simultaneously	Alarm Minutes and Hours Counters are reset to: 12:00 AM (12-Hour Mode) 0:00 (24-Hour Mode).
Sleep Display *	Slow Set	Sleep Counter is decremented at a 2 Hz rate.
	Fast Set	Sleep Counter is decremented at a 10 Hz rate.
	Fast and Slow Set Simultaneously	Sleep Counter is reset to 59 minutes.
Sleep Display and Alarm Display	All Outputs are Driven to Provide a Lamp Test.	

\*When contents of sleep counter are zero and sleep is the selected display mode, the sleep counter is set to 59 minutes.

**Table 1. Display Modes**

Selected Display Modes*	Digit No. 4	Digit No. 3	Digit No. 2	Digit No. 1
Time Display	Time 10's Hours, PM Ind.	Time Hours	Time 10's Minutes	Time Minutes, Alarm ON Ind.
Seconds Display (Pin 17)	Blanked	Time Minutes	Time 10's Seconds	Time Seconds
Alarm Display (Pin 17,18)	Alarm 10's Hours, PM Ind.	Alarm Hours	Alarm 10's Minutes	Alarm Minutes, Alarm ON Ind.
Sleep Display (Pin 19)	Blanked	Blanked	Sleep 10's Minutes	Sleep Minutes
Temp. Display (Pin 20)	100's Temp.	10's Temp.	1's Temp.	°C or °F
Alarm and Sleep (Pin 18, 19)	Lamp Test	Lamp Test	Lamp Test	Lamp Test

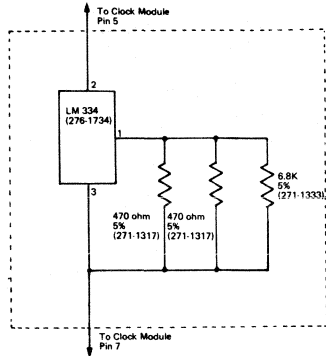
\*If more than one display mode input is applied, the display priorities are in the order of temperature, alarm or sleep, seconds, then time. Alarm and sleep have equal priority over seconds; however, when both alarm and sleep are applied, all outputs are ON, providing a lamp test. This display mode has priority over all others.

## Applications Information

### Temperature Sensor and Calibration

An LM334 Temperature Sensor (R.S. 276-1734) is required to provide input to the Temperature Display. Refer to Calibration Test Circuit.

### Calibration and Sensor Circuit

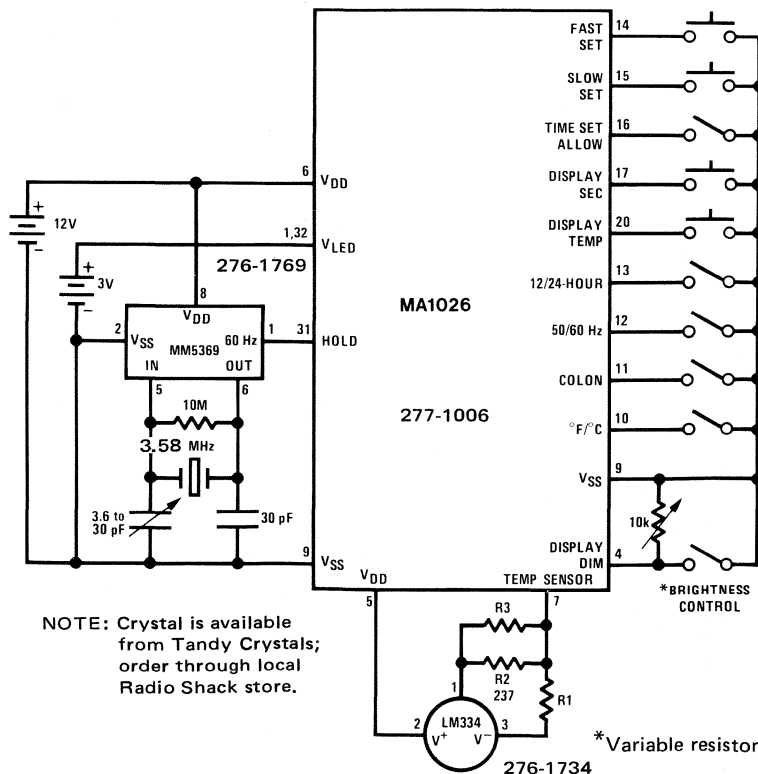


To calibrate the temperature display, an accurate source of DC voltage is required. Two good mercury cell batteries connected in series will provide 2.70 volts. Connect + to pin 5 of the Module and - to pin 7; adjust the control on the Module for a display reading of 2° C (36° F). Leave control at this setting. Remove battery connections.

Connect three resistors and LM334 sensor as shown (the entire sensor and resistor assembly must be packaged together, so resistors will be at same temperature as sensor). Position sensor assembly in environment of known temperature (e.g. water in which ice cubes are melting = 0°C/32°F); allow temperature to stabilize. If necessary, readjust control on Module for correct temperature display. This completes calibration.

It is a good idea to seal this adjustment setting so it will not be changed inadvertently (fingernail polish on the edge of the control should hold it in place).

### Instrument Panel Thermometer

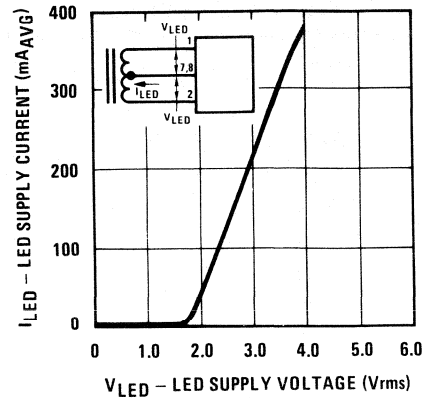


NOTE: Crystal is available from Tandy Crystals; order through local Radio Shack store.

\*Variable resistor or switch may be used.

## Typical Performance Characteristics

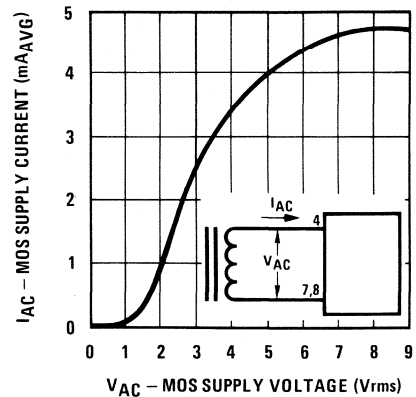
### Typical LED Supply Current vs LED Supply Voltage



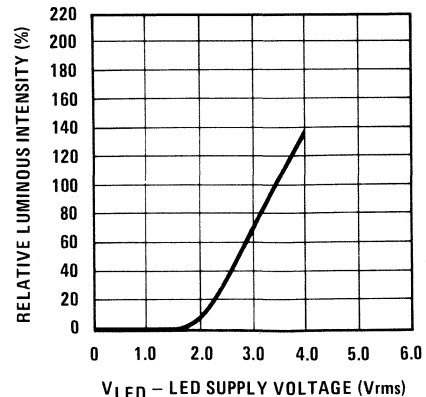
#### Conditions:

- Lamp test (all segments driven)
- Display dim (pin 6) open - maximum brightness

### Typical MOS Supply Current vs MOS Supply Voltage



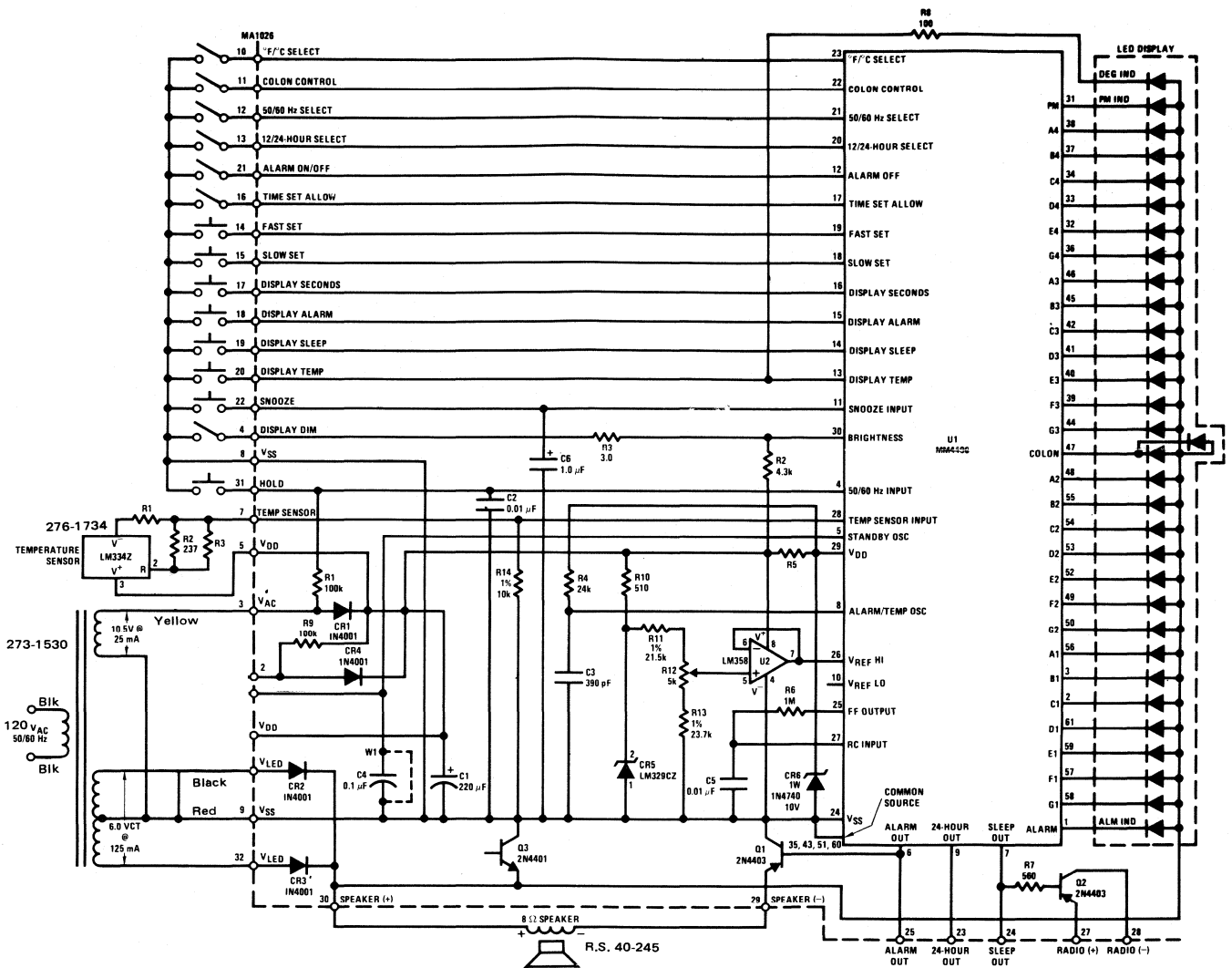
### Typical Relative Luminous Intensity vs LED Supply Voltage



#### Conditions:

- Lamp test (all segments driven)
- Display dim (pin 6) open - maximum brightness

# Schematic Diagram



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