Description

The ELM440 is an 8 pin digital divider integrated circuit, that provides both 60Hz and 1Hz outputs from a common 3.58MHz NTSC colourburst crystal.

Externally, the designer need only provide the crystal and two appropriate loading capacitors, as well as a suitably bypassed power supply. Internal oscillator circuits then use this reference frequency to precisely derive a stable 60Hz signal. This signal is then further divided to provide a 1Hz output.

The ELM440 can also be locked in synchronism to an external 60 or 120 Hz line frequency signal. If derived from the electrical grid voltage, this results in excellent long-term stability, as the power generation frequency is traceable to national standards. The transition to or from sync-lock with this external signal occurs automatically.
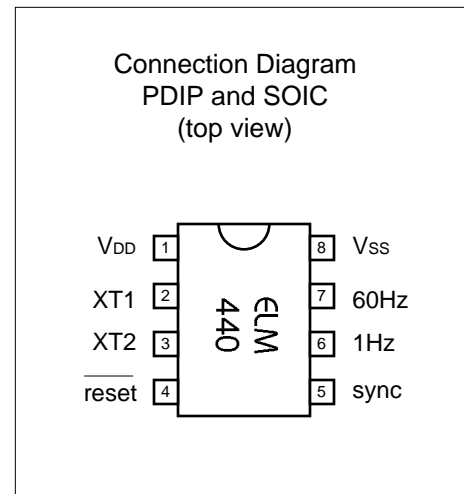
A reset input is also provided to restart the internal counters, if desired. An active low signal on this pin will force both outputs to an open or tristate condition.
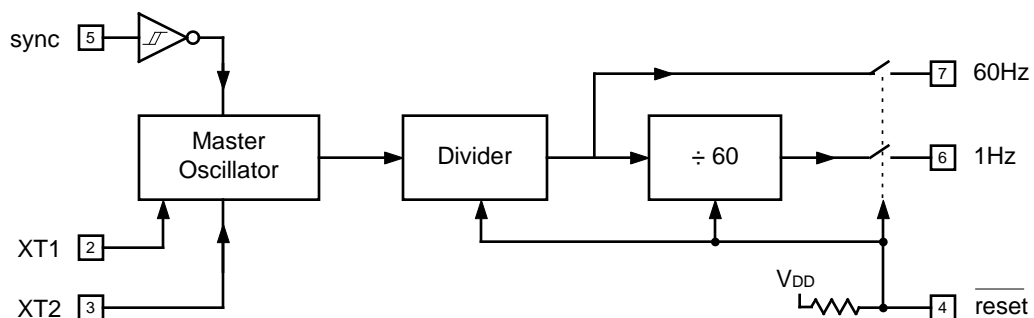
Applications

- Stable 60Hz and 1Hz reference sources
- Master oscillator for clock / timekeeping functions
- DC powered backup 60Hz reference signal

Features

- Low power CMOS design
- Wide supply range - 3.0 to 5.5 volt operation
- Generates both 60Hz and 1Hz references
- Automatically synchronizes to the line frequency for long term stability, when it's available
- Uses a standard 3.58MHz crystal for the time reference if there is no sync input
- High current drive outputs - up to 25 mA

Connection Diagram
PDIP and SOIC
(top view)

V_{DD}	1	8	V_{SS}
XT1	2	7	60Hz
XT2	3	6	1Hz
reset	4	5	sync

ELM 440

Block Diagram

Pin Descriptions

V_{DD} (pin 1)

This pin is the positive supply pin, and should always be the most positive point in the circuit. Internal circuitry connected to this pin is used to provide power on reset of the microprocessor, so an external reset signal is not required. Refer to the Electrical Characteristics section for further information.

XT1 (pin 2) and XT2 (pin 3)

A 3.579545MHz NTSC television colourburst crystal is connected between these two pins. Crystal loading capacitors (typically 27pF) will also normally be connected between each of the pins and Vss.

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reset (pin 4)

This pin can optionally be used to reset the circuit by applying a logic low level to it. While held low, both outputs are placed in an open or tristate condition. If unused, this pin should be left open (as a pullup resistor is provided) or connected to V_{DD}.

sync (pin 5)

The synchronizing reference is (optionally) applied to this pin. Slowly varying sinusoidal waveforms may be applied to this input, as the input circuitry is of the Schmitt trigger type. The input frequency can be either 60Hz or 120Hz (as would be obtained from a full wave rectifier), as internal circuitry will adjust to each. If this input is not used, the pin should be connected to either V_{DD} or V_{SS}.

1Hz (pin 6)

The output on this pin is a 1Hz signal of nominally 50% duty cycle.

60Hz (pin 7)

The output on this pin is a 60Hz signal of approximately 50% duty cycle. Actual duty cycle will vary by up to 2% from ideal due to the type of algorithm used to maintain sync-lock. This algorithm also contributes to a slight variation in period that is automatically corrected for every four cycles. Typical timekeeping functions will normally not be affected by either variation.

V_{SS} (pin 8)

Circuit common is connected to this pin. This is the most negative point in the circuit.

Ordering Information

These integrated circuits are available in either the 300 mil plastic DIP format, or in the 200 mil SOIC surface mount type of package. To order, add the appropriate suffix to the part number:

300 mil Plastic DIP.............................. ELM440P   200 mil SOIC.................................... ELM440SM

Absolute Maximum Ratings

Storage Temperature....................... -65°C to +150°C

Ambient Temperature with
Power Applied...................................-40°C to +85°C

Voltage on V_{DD} with respect to V_{SS}............ 0 to +7.5V

Voltage on any other pin with
respect to V_{SS}........................... -0.6V to (V_{DD} + 0.6V)

Note:

Stresses beyond those listed here will likely damage the device. These values are given as a design guideline only. The ability to operate to these levels is neither inferred nor recommended.

Electrical Characteristics

All values are for operation at 25°C and a 5V supply, unless otherwise noted. For further information, refer to note 1 below.

Characteristic	Minimum	Typical	Maximum	Units	Conditions
Supply Voltage, V_{DD}	3.0	5.0	5.5	V	
V_{DD} rate of rise	0.05			V/ms	see note 2
Average Supply Current, I_{DD}		0.60	2.4	mA	V_{DD} = 5V
		0.35	2.4	mA	V_{DD} = 3V
Reset pin internal pullup resistance	300	470	600	K	see note 3
Input low voltage	V_{SS}		0.15 V_{DD}	V	
Input high voltage	0.85 V_{DD}		V_{DD}	V	
Input current	- 0.5		+ 0.5	mA	sync input only, see note 4
Output low voltage			0.6	V	Current (sink) = 8.7mA
Output high voltage	V_{DD} - 0.7			V	Current (source) = 5.4mA
Output Duty Cycle		50		%	any output

Notes:

1. This integrated circuit is produced with a Microchip Technology Inc.'s PIC12C5XX as the core embedded microcontroller. For further device specifications, and possibly clarification of those given, please refer to the appropriate Microchip documentation.

2. This spec must be met in order to ensure that a correct power on reset occurs. It is quite easily achieved using most common types of supplies, but may be violated if one uses a slowly varying supply voltage, as may be obtained through direct connection to solar cells, or some charge pump circuits.

3. The value of the pullup resistance is supply and temperature dependent.

4. This specification represents current flowing through the protection diodes when applying large voltages to the sync input (pin 5) through a current limiting resistance. Currents quoted are the maximum continuous.

Example Application

The ELM440 can be easily configured to provide a 60Hz output as shown in Figure 1 below. A 3.579545MHz crystal is connected to the integrated circuit, along with suitable loading capacitors, and the 60Hz output is then taken from pin 7. Pin 5 is grounded, as no reference signal is supplied. As usual, it is also good practise to place a bypass capacitor across the power supply as well.

Figure 2 shows how easily this circuit can be modified to operate in synchronism with the AC power line. A reference signal is taken from one half of a 16Vrms CT transformer winding through a 47K resistor. Both circuits share a common Vss. The resistor was chosen to limit peak currents in this circuit to about 0.24 mA, which is well within the IC's capabilities. The ELM440 will continue to use this signal as it's reference, as long as it is available. Upon loss of the AC, the circuit will automatically switch over to using the crystal as a reference.

Using a rectifier circuit for the reference signal can pose some problems if one is not careful. Full-wave circuits can be particularly troublesome as all of the diodes may cease to conduct after the peak of the waveform, and the input voltage level is then essentially floating. In this case, at minimum, a large value (470K) resistor should also be connected between the sync input and Vss, to provide a ground reference during these times.

Both circuits shown are simple, leaving little room for change. One modification that might be considered for either is to replace one of the fixed value capacitors with a variable one, in order to be able to trim the oscillator frequency for greater accuracy.
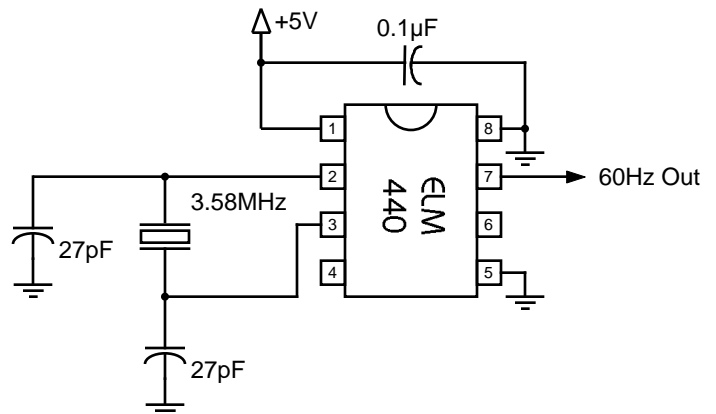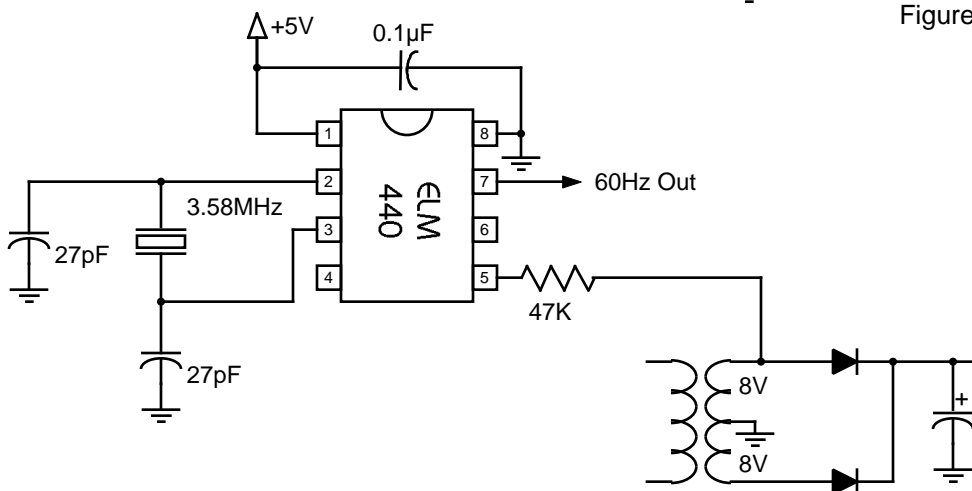

Figure 1. Typical Connections

Figure 2. Using the Sync Input