AMI®

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S2709A

VACUUM FLUORESCENT DIGITAL CLOCK FOR AUTOMOTIVE APPLICATIONS

Features

- ☐ Uses Inexpensive 4MHz Crystal
- ☐ Direct Drive to Green or Blue Vacuum Fluorescent Display
- ☐ Low Standby Power Dissipation When Display is Switched Off With Ignition
- ☐ Variable Brightness Tracks Other Dash Lights

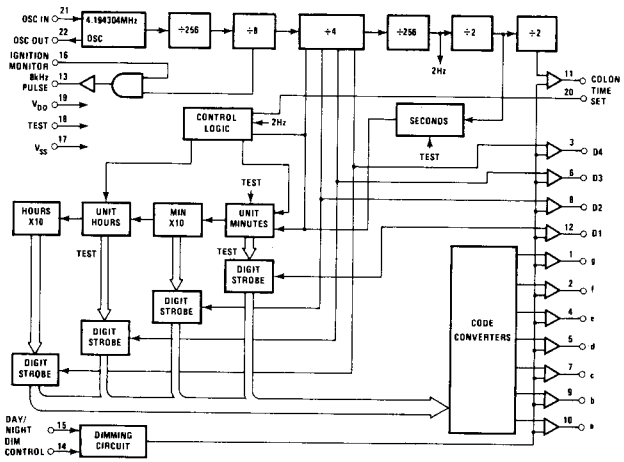
Applications

- ☐ In Dash Automobile Clocks
- ☐ Tape Players, CB Radio Units
- ☐ Automotive After Market Clocks
- ☐ Aircraft, Marine Panel Clocks
- ☐ Portable Instrumentation Clocks

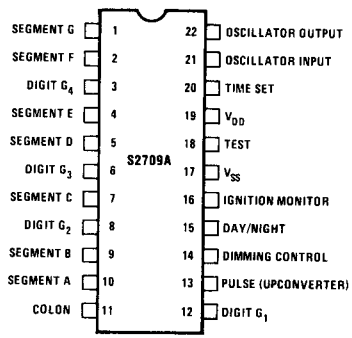
Functional Description

The S2709A vacuum fluorescent clock is a monolithic MOS integrated circuit utilizing P-Channel low threshold, enhancement mode and ion-implanted depletion mode devices. The circuit interfaces directly with 4 digit multiplexed vacuum fluorescent displays and requires only a single nominal 12V power supply. The timekeeping function operates from a 4MHz crystal controlled input. The display format is 12 hours with colon and leading zero blanking. An up-converter output is provided by the circuit to generate increased display driving voltage. A brightness control input allows variation of the display intensity. An ignition monitor input controls the upconverter operation and inhibits time setting. The S2709A is normally supplied in a 22-lead plastic dual-in-line package.

Block Diagram



Pin Configuration



Operational Description

Refer to the block diagram and Figure 1, Typical Application.

Oscillator Input (Pin 21) and Output (Pin 22) — The crystal controlled oscillator operates at a frequency of 4.194304 MHz to increase accuracy and reduce external component costs due to the less expensive quartz crystal. The frequency is controlled by a quartz crystal and fixed capacitor upconverter output (pin 13). This method allows accurate frequency tuning of the crystal oscillator without loading down the oscillator circuit. The feedback and phase shift resistors are integrated to further reduce external component costs. The internal oscillator inverter drives a counter chain that performs the timekeeping function.

Time Setting Input (Pin 20) — To prevent tampering, time setting is inhibited until the ignition monitor (pin 16) is held at a logic high level (V_{SS}).

Normal timekeeping is provided by allowing the time set pin to float externally. (Unloaded, this pin will alternate between V_{DD} and V_{SS} in phase with the unit minutes digit strobe [pin 12] during normal timekeeping.) If the time set pin is held at a logic high level (V_{SS}), the minutes counter advances at a 2Hz rate without carry to hours. If the time set pin is held at a logic low level (V_{DD}) the hours counter advances at a 2Hz rate.

It is possible to reset the hours, minutes and internal seconds counter by applying a logic low level (V_{DD}) to the test input (pin 18) during the time that the ignition monitor input is at a logic low level (V_{SS}). This reset state (time 1:00) is used for testing purposes.

Upconverter Pulse Output (Pin 13) — The clock circuit and vacuum fluorescent display drive normally operate at 25V when the ignition monitor pin is held at a logic high level (V_{SS}). The automobile battery voltage (12V) is doubled by an external upconverter circuit triggered by an 8kHz output pulse having a 28% duty cycle. The voltage, whether 12V or 25V, is applied to the circuit via the V_{SS} input (pin 17).

When the ignition monitor pin is held at a logic low level (V_{DD}) the upconverter is disabled. This drops the V_{SS} supply to 12V allowing the clock to operate while the display drive is decreased, lowering power dissipation. As the battery voltage drops (due to engine starting, cold temperature, or aging) timekeeping is maintained down to approximately 7V with no loss of the memory down to 5V. However, below 10V the upconverter will not be inhibited by the ignition monitor input.

Note that low standby power dissipation (60mW typical @ V_{SS} = 12V, and no output loads) is accomplished by turning off the filament voltage to the display when the auto ignition switch is off.

Ignition Monitor (Pin 16) — Along with preventing the already mentioned time setting function, the ignition monitor when held at a logic low level (V_{DD}) inhibits the 8kHz upconverter output pulse (pin 13) as long as the supply (V_{SS}) is above 10V. This pin is normally connected to the auto accessory switch.

The ignition monitor input can be protected against power supply transients by using 47KΩ external series resistance (See Figure 1).

Day/Night Display Control Input (Pin 15) — As seen in Figure 2, the display brightness is controlled via both pin 15 and the dimming control input (pin 14). The day/night input is connected to the automobile parking or headlights switch such that when these lights are off (V_{IN} low) the decoded segment and the digit outputs are from V_{SS} to V_{SS} – 2.0 volts. When the parking or headlights are switched on (V_{IN} high) the internal day/night logic enables the dimming input to control the segment and digit output voltage and brightness by allowing adjustable current to flow as controlled by the dash lights rheostat.

The day/night input can be protected from power supply transients by using 47KΩ external series resistance (See Figure 1).

Display Dimming Control Input (Pin 14) — The display dimming input is connected to the automobile dashboard light dimming rheostat through a series resistor. This allows the fluorescent display to track the dimming characteristics of the incandescent dashboard light (See Figure 2). The display dimming control is inhibited unless the day/night input (pin 15) is held at a logic high level (V_{SS}).

Display Drivers (Pins 1 through 12) — The 12 hour display format is comprised of four digits with leading zero blanking and a flashing colon. Each digit contains 7 segments with individual segments coded in the conventional manner (See Figure 1). The display is multiplexed with each digit output (G1, G2, G3 and G4) being strobed for a time period of approximately 0.5mS. Figure 3 shows the minimum output current as a function of output voltage for the digit (grid) and segment outputs.

The colon output (pin 11) is designed to have an unobtrusive flash while still indicating that the clock is functioning normally. The colon flash is accomplished in a 2 second period of 1-1/2 seconds on the 1/2 second off.

Electrical Characteristics

Symbol	Characteristics/Conditions	V_{DD} V	0°C to 70°C			Unit
			Min.	Typ.	Max.	
V_{SS}	Operating Supply Range V_{DD} = 0.0V (Refer to Upconverter Pulse Output)		7.0		28	V
I_{SS}	Supply Current	12			12	mA
	(No Loads On Outputs)	25			15	mA
	Oscillator Frequency			4.194304		MHz
	Display Outputs					
	Multiplex Rate			512		Hz
	Duty Cycle (Each Digit Per Cycle)			18.8		%
	Output Current (Day/Night = LOW)					
I_{OH}	Digits, V_{OH} = 24V	25			−6.0	mA
I_{OL}	V_{OL} = 2V	25	40			μA
I_{OH}	Segments & Colon, V_{OH} = 24V	25			−1.5	mA
I_{OL}	V_{OL} = 2V	25	10			μA
	Output Voltage (V[Pin 14]−V(Digit or Seg)					
	Day/Night = High, V(Pin 14≥/4V)					
ΔV_O	Digits (R_L = 8.2KΩ to V_{DD})	25			1	V
ΔV_O	Segment (R_L = 100KΩ to V_{DD})	25			1	V
	Upconverter Pulse Output					
	Pulse Frequency			8192		Hz
	Duty Cycle			25		%
	Output Current					
I_{OH}	V_{OH} = 8V	10			−1.5	mA
I_{OH}	V_{OH} = 23V	25			−3.0	mA
I_{OL}	V_{OL} = 1V	25	6.0			μA
	Time Set Input/Output					
	Input Voltage (No Load)					
V_{IH}	High	25	24		1	V
V_{IL}	Low	25	0		1	V
	Output Current					
I_{OH}	V_{OH} = 18V	25	−6.0		−2.0	mA
	Output Frequency			512		Hz
	Duty Cycle			25		%
	Ignition Monitor Input and Day/Night Input					
	Input Voltage					
V_{IH}	High	9.0 to 25	6.5		V_{SS}	V
V_{IL}	Low	9.0 to 25	0		2.0	V
I_{IH}	Input Current (Pull Down) V_{IH} = 12V	25	2		20	μA

Figure 1. Typical Application