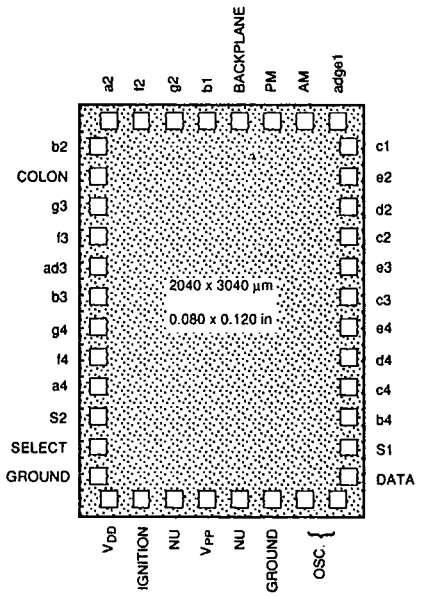
5615 AND 5616

T-49-15-02

2-FUNCTION, 4-DIGIT LCD AUTOMOTIVE CLOCKS—PROGRAMMABLE

SCL5615HN/HW or SCL5616HN/HW



Dwg. PC-001

ABSOLUTE MAXIMUM RATINGS

Supply Current, I_{DD} ..... **2.0 mA**
Input Voltage Range, V_{IN}
(except V_{PP}) ..... **-0.3 V to V_{DD}**
(Programming
Power Voltage, V_{PP}) ..... **18.5 V**
Input Current (except V_{PP}), I_{IN} ..... **±10 mA**
Power Dissipation, P_D ..... **300 mW**
Operating Temperature Range,
T_A ..... **-40°C to +85°C**
Storage Temperature Range,
T_S ..... **-65°C to +150°C**

Caution: These CMOS devices have static protection, but are susceptible to damage if exposed to extremely high static electrical charges.

The SCL5615EP/HN/HW and SCL5616EP/HN/HW are 2-function digital automotive clock circuits. Fabricated on a single monolithic chip using silicon-gate CMOS PROM technology, they offer low cost, low power, and high reliability. Both circuits include digital frequency correction, stored in the internal nonvolatile memory, for easy adjustment of the oscillator nominal frequency.

Both devices are supplied in chip (suffix 'HN') or wafer form (suffix 'HW'), or in 40-lead plastic chip carriers (suffix 'EP'). They are rated for continuous operation over the automotive temperature range of -40°C to +85°C.

FEATURES

- Digital Tuning of Crystal Frequency
- PROM for Storing Frequency Correction Information
- 12 or 24 Hour Timekeeping Option (SCL5616EP/HN/HW only)
- Flashing Colon
- Two Switches Control All Setting Functions
- High Noise Immunity
- Internal Power-Up Reset Circuitry
- Internal Voltage Regulation

Always order by complete part number:

Part Number	Function	Style
SCL5615EP	12 Hour mode	40-Lead PLCC
SCL5615HN		Dice in Waffle Pack
SCL5615HW		Dice in Wafer Form
SCL5616EP	12 or 24 Hour mode	40-Lead PLCC
SCL5616HN		Dice in Waffle Pack
SCL5616HW		Dice in Wafer Form

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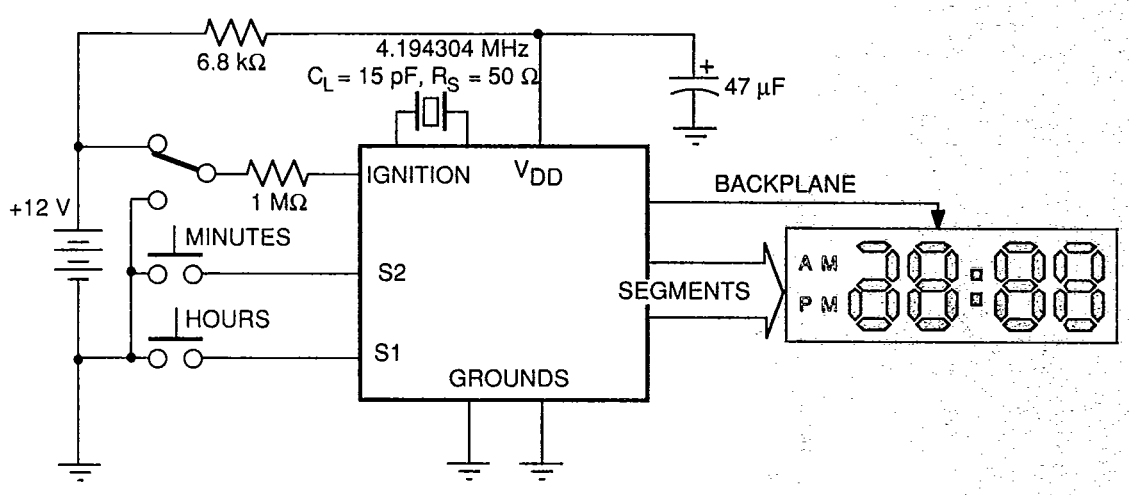
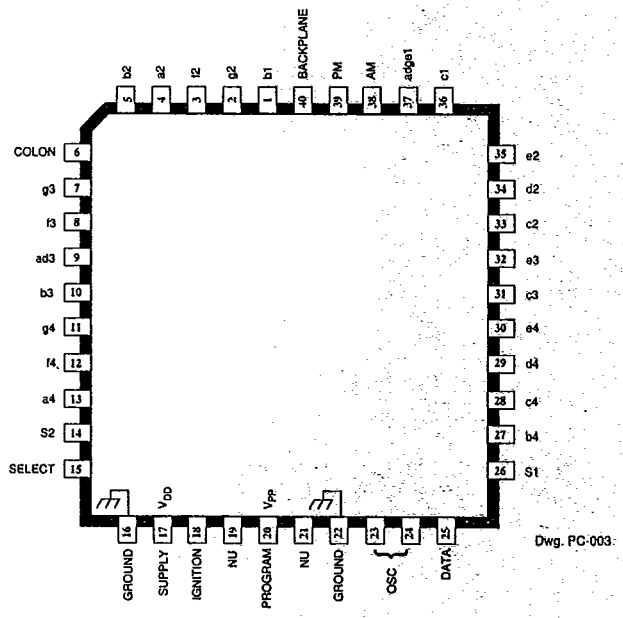
TYPICAL APPLICATION



SCL5615EP or SCL5616EP



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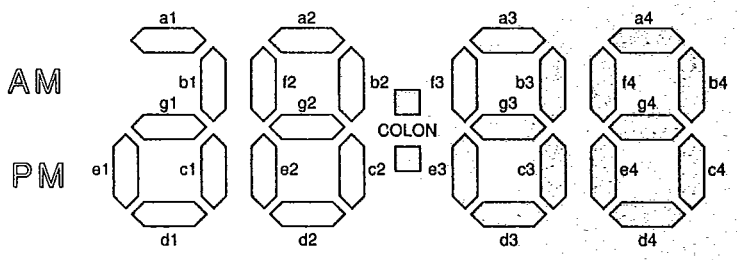
ELECTRICAL CHARACTERISTICS at T_A = -40°C to +85°C, in Typical Application (unless otherwise noted).

Characteristic	Symbol	Test Conditions	Limits			
			Min.	Typ.	Max.	Units
Operating Voltage Range	V_{DD}	T_A = +25°C	4.5	—	—	V
Zener Voltage	V_{DD}	I_{DD} = 1.0 mA	5.5	—	6.8	V
Segment Output Current	I_{OUT}	V_{DD} = 5.0 V, V_{OUT} = 4.8 V	-20	—	—	µA
		V_{DD} = 5.0 V, V_{OUT} = 0.2 V	120	—	—	µA
Backplane Output Current	I_{OUT}	V_{DD} = 5.0 V, V_{OUT} = 4.8 V	-80	—	—	µA
		V_{DD} = 5.0 V, V_{OUT} = 0.2 V	240	—	—	µA
LCD Drive Signal	V_{DISP}	V_{DD} ≥5.0 V	4.0	—	—	V
Input Current	I_{IN}	S1, S2, DATA, or SELECT	-55	—	-700	µA
Oscillator Frequency	f_{OSC}		—	4.194 304	—	MHz
Oscillator Starting Time	t_{OSC}	V_{DD} = Zener voltage	—	—	200	ms
Oscillator Stability	Δf_{OSC}	ΔV_{DD} = ±100 mV	—	—	±1.0	ppM
Backplane Frequency	f_{BP}		—	64	—	Hz
Switch Debounce Time	t_{DB}		0	—	62.5	ms
Osc. Feedback Resistance	R_{OSC}		—	16	—	MΩ
Osc. Input Capacitance	C_{OSCI}		—	15	—	pF
Osc. Output Capacitance	C_{OSCO}		—	30	—	pF
Supply Current	I_{DD}	V_{DD} = 5.0 V	—	—	1.0	mA

NOTE: Negative current is defined as coming out of (sourcing) the specified device terminal.

DISPLAY FORMAT



Dwg. OC-001

5615 AND 5616
2-FUNCTION, 4-DIGIT LCD AUTOMOTIVE CLOCKS

T-49-15-02

FUNCTIONAL DESCRIPTION
DATA Logic Levels are V_{DD} and Ground

Power-Up Reset. When power up occurs, the hours and minutes counters are reset, and the clock starts running:

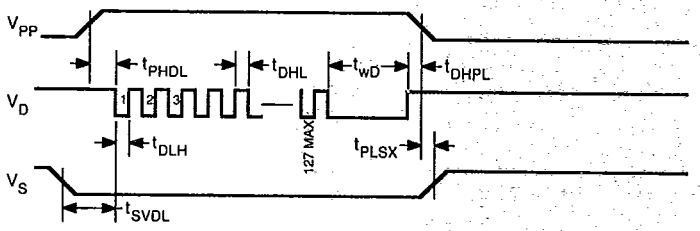
Device	Operation
SCL5615EP/HN/HW	24-Hour mode and counting starts from 0:00
SCL5616EP/HN/HW	12-Hour mode and counting starts from 1:00 AM

Programming Modes. Data is loaded by pulling DATA low (1 µs pulse duration) n times to set the desired bits for frequency correction into the data input register. This information is latched in the RAM, thus allowing the testing of the oscillator frequency adjustment without storing the selected pattern in the PROM cells. The data latched in the RAM is stored in the PROM cells when DATA is held low for a minimum of 10 ms.

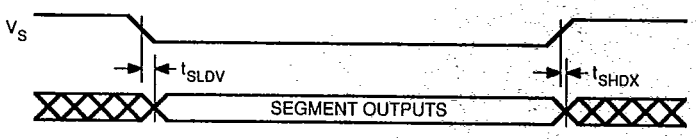
The data stored in the data input register is cleared on any SELECT transition (low to high or high to low). It is also cleared when the program power voltage (V_{PP}) is reduced from 18 V to V_{DD}. Clearing the data input register does not affect the data latched in the RAM.

Program V_{PP}	DATA V_D	SELECT V_S	Operation
18 V	Pulse	Ground	DATA load for frequency correction
18 V	Ground	V_{DD}	DATA store
V_{DD}	V_{DD}	Ground	Verify stored data

FREQUENCY CORRECTION



VERIFY CYCLE ($V_{PP} = V_{DD}$)



Dwg. WC-001-1

5615 AND 5616
2-FUNCTION, 4-DIGIT LCD AUTOMOTIVE CLOCKS

T-49-15-02

Frequency Correction. The on-chip oscillator circuit increases the crystal frequency approximately 40 ppm. This ensures that the typical crystal will operate within the tuning range. With V_S at ground, data pulses are then used to trim the internal clock frequency by 2 to 254 ppm to the required value. The quantity of data pulses needed (1 to 127) is

$$n = \frac{f_{BP} - 64}{128 \times 10^{-6}}$$

where f_{BP} is the measured frequency at BACKPLANE. Prior to trimming, it must be between 64.000 128 Hz and 64.016 256 Hz.

Operating Modes. The operating modes of the clock are controlled by the voltages applied to V_{PP}, SELECT, IGNITION, and switches S1 and S2.

Program V_{PP}	SELECT V_S	S1	S2	IGNITION	Mode
V_{DD}	V_{DD}	Open	Open	X	Clock running
V_{DD}	V_{DD}	Ground	Ground	12 V	Diagnostic
18 V	Ground	Open	Open	X	Programming

X = Irrelevant, ground or 12 V

Clock Running Mode. During the clock running mode, setting functions are achieved by either momentary or continuous operation of switches S1 and S2, which are enabled by IGNITION. Hours or minutes are incremented on S1 or S2 (respectively) depression and continue at a 1 Hz rate while the switch is depressed.

S1	S2	IGNITION	Operation
Open	Open	X	Clock running
X	X	Ground	Setting disabled
Ground	Open	12 V	Set hours
Open	Ground	12 V	Set Minutes
Ground	Ground	12 V	Change counting sequence (12 to 24 hour or 24 to 12 hour; SCL5616EP/HN/HW only)

X = Irrelevant, ground or 12 V for IGNITION, ground or open for S1 and S2

Diagnostic Mode. To enter the diagnostic mode, S1 and S2 are operated with IGNITION connected to 12 V. All segments are displayed for as long as S1 and S2 are depressed. On opening S1 and S2, the clock will leave the diagnostic mode and go through a power-up sequence. In the SCL5616EP/HN/HW, the counting sequence will change (from 12 hour to 24 hour or from 24 hour to 12 hour). To inhibit the power-up reset, hold the DATA input low (ground). The counting mode will change without resetting the hours or minutes counters. The counting sequence is forced to 12 hour in the SCL5615EP/HN/HW. In that case, operation of S1 or S2 will not affect the counting sequence.

Stored Data Verification. In the verify mode, the complement value of the information stored in the PROM cells is brought out directly to the segment output terminals for easy verification of the stored data. If a bit is programmed (high), the appropriate segment output is turned ON (low). The segments represent the binary equivalent of the number of frequency correction data pulses entered.

Frequency Selection Pulses	64	32	16	8	4	2	1
Segment	b4	c4	d4	e4	c3	e3	c2

RECOMMENDED FLASH PROGRAMMING CHARACTERISTICS at T_A = +25°C, Logic Levels are V_{DD} and Ground (except PROGRAM High)

Characteristic	Symbol	Min.	Max.	Units
PROGRAM High (18 V) to DATA Low	t_{PHDL}	1.0	—	µs
SELECT Valid to DATA Low	t_{SVDL}	25	—	µs
DATA Low to DATA High	t_{DLH}	1.0	1.5	µs
DATA High to DATA Low	t_{DHL}	1.0	—	µs
DATA Store Pulse Duration	t_{wD}	10	—	ms
DATA High to PROGRAM Low	t_{DHPL}	1.0	—	µs
PROGRAM Low to SELECT Change	t_{PLSX}	1.0	—	µs
SELECT Low (Verify) to DATA Valid	t_{SLDV}	—	1.0	µs
DATA Hold from End of Verify	t_{SHDX}	—	10	ns