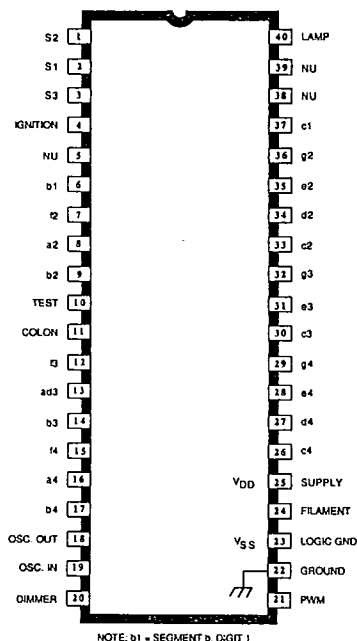


5233/38, T-49-15-02  
5458/63/74, 5604

## 2-FUNCTION, 4-DIGIT VF AUTOMOTIVE CLOCKS

SCL5604E



Dwg. PC-002

### ABSOLUTE MAXIMUM RATINGS

Logic Supply Current,  $I_{SS}$  ..... -7.0 mA  
 Total Supply Current,  $I_{DD}$  ..... 20 mA  
 Input Voltage Range (Ref.  $V_{SS}$ ),  
 $V_{IN}$  ..... -0.5 V to  $V_{DD} + 0.5$  V  
 Input Current,  $I_{IN}$  .....  $\pm 10$  mA  
 Package 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.

These devices are 2-function digital automotive clock circuits fabricated on a single monolithic chip using CMOS technology. They feature low cost, low power, and high reliability. The six devices in this series offer a variety of display and setting options and provide all of the functions normally desired in a 4-digit automotive clock.

All versions provide a push-button "time tone" setting that will zero the minutes and seconds counters if the displayed time is within two minutes of the hour. This feature allows the user to instantly set the clock according to the time tone commonly provided on radio stations.

The display driver outputs will directly drive standard vacuum fluorescent displays. A dimmer input controls the display intensity by varying the pulse width rather than by lowering the output voltage. This technique results in a more uniform display intensity. The rise and fall times of the output drivers are optimized to reduce RF interference.

All devices are supplied in a 40-pin dual in-line plastic package with 0.600" (15.24 mm) row centers and are rated for continuous operation over the automotive temperature range of -40°C to +85°C. Other packages are available on special order.

### FEATURES

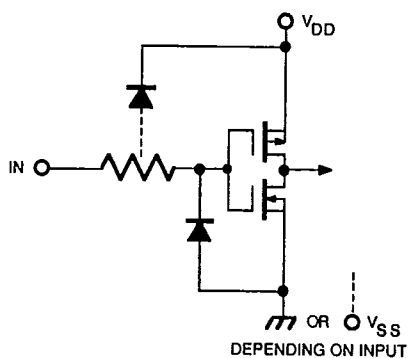
- Push-Button "Time Tone" Setting
- Variable Pulse-Width Display Dimming
- 12- or 24-Hour Timekeeping Option
- Rollover Protection on Minutes Set
- High Noise Immunity
- Diode Protection on all Inputs
- RFI/EMI Minimized

Always order by complete part number, e.g. SCL5233E.

**5233/38, 5458/63/74, 5604**  
**2-FUNCTION, 4-DIGIT VF AUTOMOTIVE CLOCKS**

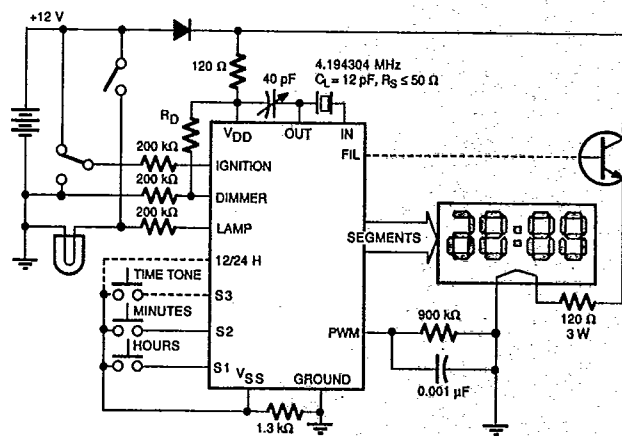
T-49-15-02

**TYPICAL INPUT CIRCUITRY**



Dwg. EP-010-8

**TYPICAL APPLICATION**



Dwg. EG-003

**ELECTRICAL CHARACTERISTICS** at  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ,  $V_{SS} = 0\text{ V}$ ,  
in Typical Application (unless otherwise noted).

| Characteristic                | Symbol          | Test Conditions                                                | Limits |          |      |                      |
|-------------------------------|-----------------|----------------------------------------------------------------|--------|----------|------|----------------------|
|                               |                 |                                                                | Min.   | Typ.     | Max. | Units                |
| Min. Operating Voltage        | $V_{DD}$        | $T_A = +25^\circ\text{C}$                                      | 4.5    | —        | —    | V                    |
|                               |                 | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$               | 5.0    | —        | —    | V                    |
| Zener Voltage                 | $V_{Z1}$        | $I_{SS} = -6.0\text{ mA}$ , $T_A = +25^\circ\text{C}$          | 6.2    | 6.9      | 7.5  | V                    |
|                               | $V_{Z2}$        | $I_{GND} = -17\text{ mA}$ , $T_A = +25^\circ\text{C}$          | 15     | 16.5     | 18   | V                    |
| Output Breakdown Voltage      | $V_{(BR)DS}$    | $I_{OUT} = -5\text{ } \mu\text{A}$ , $T_A = +25^\circ\text{C}$ | 15     | —        | —    | V                    |
| Segment Output Current        | $I_{OUT}$       | $V_{DD} = 6.0\text{ V}$ , $V_{OUT} = 5.5\text{ V}$             | -150   | —        | —    | $\mu\text{A}$        |
| Filament Output Current       | $I_{FIL}$       | $V_{DD} = 6.0\text{ V}$ , $V_{FIL} = 5.0\text{ V}$             | -2.0   | —        | —    | mA                   |
| Oscillator Frequency          | $f_{OSC}$       | $T_A = +25^\circ\text{C}$                                      | —      | 4.194304 | —    | MHz                  |
| Input Resistance              | $R_{IN}$        | S1, S2, or S3 only                                             | 300    | —        | —    | k $\Omega$           |
| Switch Debounce Time          | $t_{DB}$        |                                                                | 0      | 31       | 62.5 | ms                   |
| Segment Switching Time        | $t_r$           | $\Delta V_{OUT} = 5.0\text{ V}$                                | 1.0    | —        | —    | $\mu\text{s}$        |
| Zener Temperature Coefficient | $\Delta V_{Z1}$ | $T_A = +25^\circ\text{C}$                                      | —      | +6.0     | —    | mV/ $^\circ\text{C}$ |
| Supply Current                | $I_{DD}$        | $V_{DD} = 5.0\text{ V}$ , $T_A = +25^\circ\text{C}$            | —      | —        | 1.0  | mA                   |

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

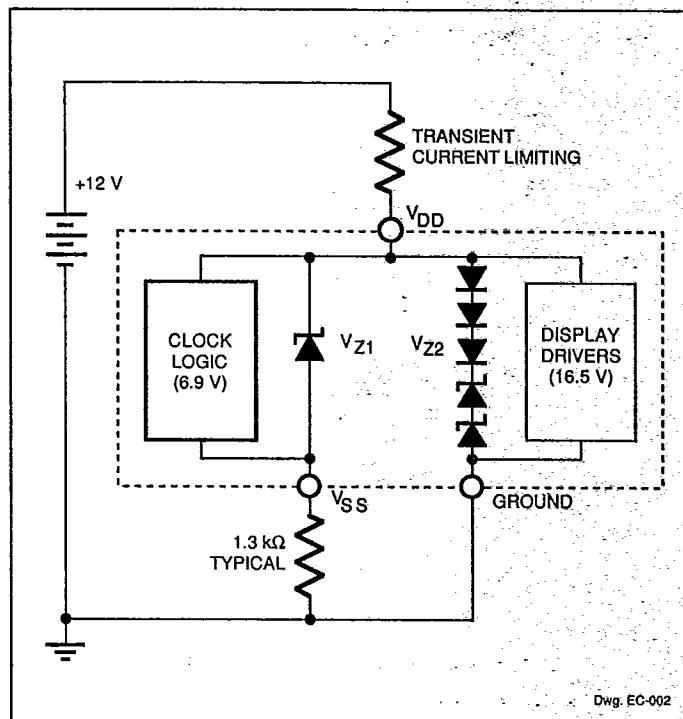
# 5233/38, 5458/63/74, 5604

## 2-FUNCTION, 4-DIGIT V.F. AUTOMOTIVE CLOCKS

T-49-15-02

### FUNCTIONAL DESCRIPTION

- V<sub>DD</sub>** The positive supply.
- V<sub>SS</sub>** The clock logic reference; current limiting is normally required.
- GROUND** Power ground.
- 12/24 H** A switch or hard wiring here controls the clock timebase: Open = 24 h, Low (V<sub>SS</sub>) = 12 h. This function is not available in the SCL5604E and that device operates in the 12-hour mode only.
- S1** Pulling S1 Low (V<sub>SS</sub>) increments the hours as shown in the table.
- S2** Pulling S2 Low (V<sub>SS</sub>) increments the minutes as shown in the table.
- S3** Momentary switch for time tone, to start clock, and display command. This switch is required for the A5238EA, optional for all other devices.



| Clock Version        | S1 (Set Hours)                            | S2 (Set Minutes)                                       | S3                                          | Colon               |
|----------------------|-------------------------------------------|--------------------------------------------------------|---------------------------------------------|---------------------|
| SCL5233E             | one increment per depression              | one increment per depression, start clock              | optional ... time tone and display command* | steady              |
| SCL5238E             | one increment per depression              | one increment per depression                           | time tone, display command*, start clock    | steady              |
| SCL5458E             | one increment per depression              | one increment per depression, start clock              | optional ... time tone and display command* | one second flashing |
| SCL5463E             | one increment per second while depressed  | one increment per second while depressed, start clock  | optional ... time tone and display command* | one second flashing |
| SCL5474E<br>SCL5604E | two increments per second while depressed | two increments per second while depressed, start clock | optional ... time tone and display command* | steady              |

\* See IGNITION

**5233/38, 5458/63/74, 5604**  
**2-FUNCTION, 1-DIGIT VF AUTOMOTIVE CLOCKS**

7-49-15-02

For all devices except the SCL5238E, the first depression of S2 stops the clock and resets the seconds. Simultaneous depressions of S1 and S2 reset the clock to the 1:00:00 state; the clock restarts when S2 is released. With the SCL5238E, after the first depression of S2, if more than four seconds elapse between S1 or S2 depressions, the entire display flashes at a one-second rate to indicate that the clock has been reset. Simultaneous depressions of S1 and S2 reset the clock to the 1:00:00 state; the clock restarts when S3 is operated.

If the clock is running and the time is within two minutes after the hour, depressing S3 causes seconds and minutes to reset, and the hour to remain the same. If the time is within two minutes before the hour, depressing S3 causes seconds and minutes to reset and the hour to increment by one. The clock resumes operation in the real time mode when S3 is released. Any operation outside the  $\pm 2$  minute window will not affect the clock.

**LAMP** Controls display brightness in conjunction with IGNITION.

**IGNITION** Controls display brightness in conjunction with LAMP.

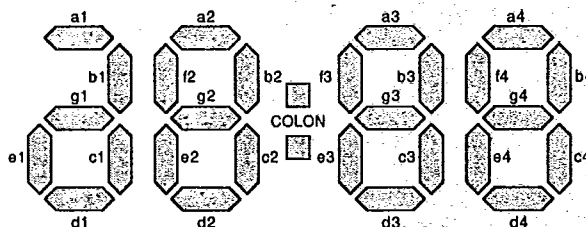
| IGNITION Input | LAMP Input                                               |                                                      |
|----------------|----------------------------------------------------------|------------------------------------------------------|
|                | 12 V (ON)                                                | Ground (OFF)                                         |
| 12 V (ON)      | 50% brightness†, dimmer enabled, S1, S2, S3 enabled      | 100% brightness, dimmer disabled, S1, S2, S3 enabled |
| Ground (OFF)   | 50% brightness†, display command enabled, dimmer enabled | display OFF, display command enabled                 |

† 25% for SCL5604E

With IGNITION at ground (OFF), a depression of S3 will turn ON the display for  $4 \pm 1$  seconds at 100% brightness. The time tone function is disabled when the IGNITION input is ground.

**FILAMENT** The enable output for the VF display filament. If S3 is omitted, the discrete transistor can also be omitted if the display filament is connected directly to the 12 V supply through the accessory switch.

**SEGMENTS** The output drives for the VF display segments.

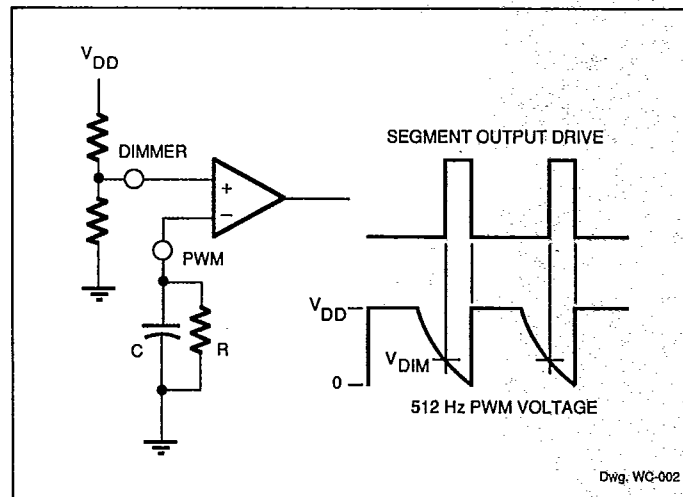


Dwg. OC-001-1

**5233/38, 5458/63/74, 5604**  
**2-FUNCTION, 4-DIGIT VF AUTOMOTIVE CLOCKS**

T-49-15-02

- COLON** The output drive for the VF display colon. For the SCL5233E, SCL5238E, SCL5474E, and SCL5604E the colon is steady; for the SCL5458E and SCL5463E the colon is in a one-second flashing mode.
- DIMMER** A voltage input to control the display brightness. This can be from a fixed ( $R_D$ ) or light-dependent resistor divider, or a linear voltage control signal.
- PWM** An RC network for controlling the display duty cycle (dimming).

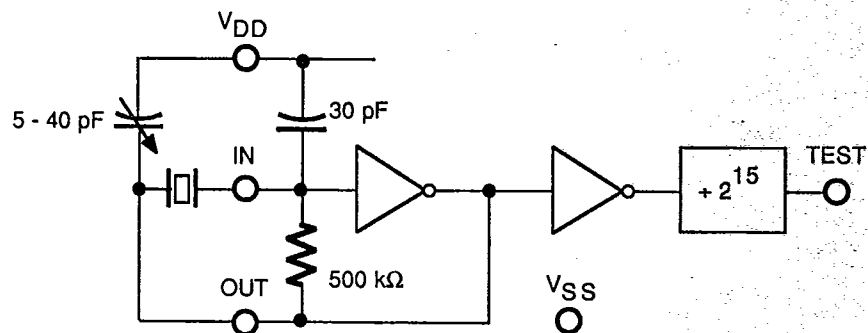


| $R_D$           | or | $V_{DIM}/V_{DD}$ | Per Cent Duty Cycle (at $T_A = +25^\circ\text{C}$ ) |                        |
|-----------------|----|------------------|-----------------------------------------------------|------------------------|
|                 |    |                  | $RC = 0.9 \text{ ms}$                               | $RC = 1.72 \text{ ms}$ |
| 370 k $\Omega$  |    | 0.35             | 1                                                   | 0                      |
| 245 k $\Omega$  |    | 0.45             | 10                                                  | 0                      |
| 165 k $\Omega$  |    | 0.55             | 20                                                  | 0                      |
| 108 k $\Omega$  |    | 0.65             | 29                                                  | 4                      |
| 67 k $\Omega$   |    | 0.75             | 36                                                  | 20                     |
| 35 k $\Omega$   |    | 0.85             | 42                                                  | 33                     |
| 10.5 k $\Omega$ |    | 0.95             | 48                                                  | 45                     |

- IN & OUT** These are the oscillator connections for the external crystal and frequency adjustment.
- TEST** This is a test point for adjustment of the crystal oscillator frequency. When properly aligned, the output at this terminal is a 128 Hz square-wave signal.

**5233/38, 5458/63/74, 5604**  
**2-FUNCTION, 4-DIGIT VFL AUTOMOTIVE CLOCKS**

T-49-15-02



Dwg. EC-004

**PIN DESIGNATIONS**

| Pin | SCL5604E | All Other Devices | Pin | SCL5604E | All Other Devices |
|-----|----------|-------------------|-----|----------|-------------------|
| 1   | S2       | S2                | 21  | PWM      | PWM               |
| 2   | S1       | LAMP              | 22  | GROUND   | DIMMER            |
| 3   | S3       | adeg1             | 23  | $V_{SS}$ | OSC. IN           |
| 4   | IGNITION | 12/24 H           | 24  | FILAMENT | OSC. OUT          |
| 5   | NU       | c1                | 25  | $V_{DD}$ | b4                |
| 6   | b1       | g2                | 26  | c4       | a4                |
| 7   | f2       | e2                | 27  | d4       | f4                |
| 8   | a2       | d2                | 28  | e4       | b3                |
| 9   | b2       | c2                | 29  | g4       | ad3               |
| 10  | TEST     | g3                | 30  | c3       | f3                |
| 11  | COLON    | e3                | 31  | e3       | COLON             |
| 12  | f3       | c3                | 32  | g3       | TEST              |
| 13  | ad3      | g4                | 33  | c2       | b2                |
| 14  | b3       | e4                | 34  | d2       | a2                |
| 15  | f4       | d4                | 35  | e2       | f2                |
| 16  | a4       | c4                | 36  | g2       | b1                |
| 17  | b4       | $V_{DD}$          | 37  | c1       | NU                |
| 18  | OSC. OUT | FILAMENT          | 38  | NU       | IGNITION          |
| 19  | OSC. IN  | $V_{SS}$          | 39  | NU       | S3                |
| 20  | DIMMER   | GROUND            | 40  | LAMP     | S1                |

NU = Internal connection, do not use.