# HT1611/HT1611C
## Timer with Dialer Interface

## Features

- Operating voltage: 1.2V~1.7V
- Low operating current: 3μA (typ.)
- Dialing number and conversation time display
- Conversation timer (59 mins and 59 secs max.)
- 8 or 10-digit LCD display driver, 3V, 1/2 bias, 1/3 duty

- (8-digit hand-held calculator LCD used for 8-digit applications)
- Real time clock with stopwatch
- Built-in dialer interface
- 12-hour or 24-hour format
- Two-button sequential operation for real time clock setting
- Uses 32768Hz crystal

## Applications

- Timers, clocks, watches
- LCD display drivers

- Telephone display interface
- Instrument display

## General Description

The HT1611/HT1611C is a CMOS chip designed for dialer interfaces driving 8 or 10-digit LCDs. Various functions, such as real time clock, dialing number and conversation time display are provided.

The real time is displayed by default. When answering a telephone call, the timer is activated to tell users how long the conversation has taken. After the telephone is hung up, the total conversation time is shown for about 5 seconds and then the real time is displayed again. When making a phone call, the HT1611/HT1611C receives the dialing data from the dialer and displays the phone number from left to right on the LCD. However, if there is no dialing action within 10 seconds, it restarts the timer again. By adding a TIMER key, the HT1611/HT1611C can provide a stopwatch function and timer reset/hold functions (for details, refer to the functional description).
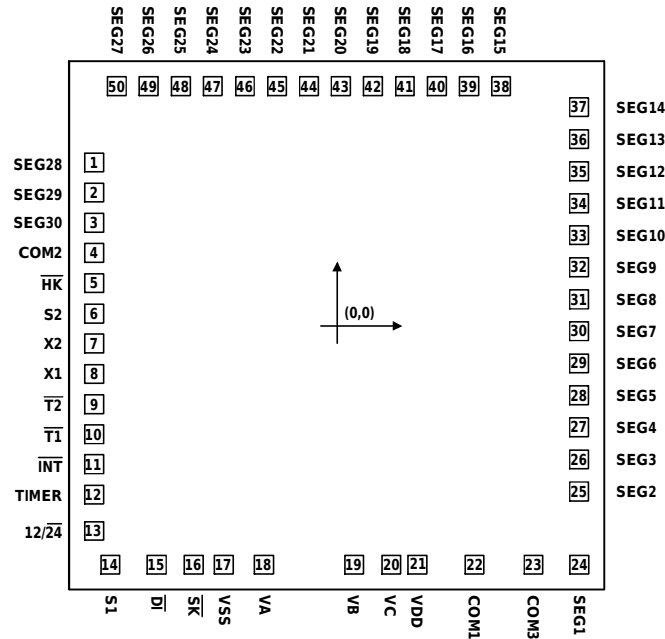
15th Apr '99

## Block Diagram
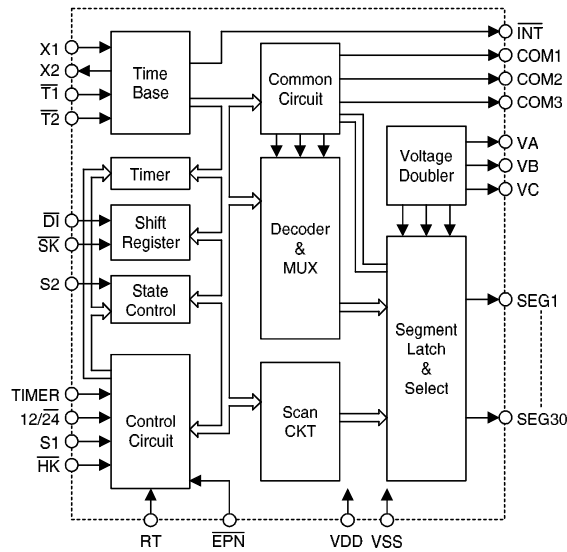


## Pad Assignment

### HT1611
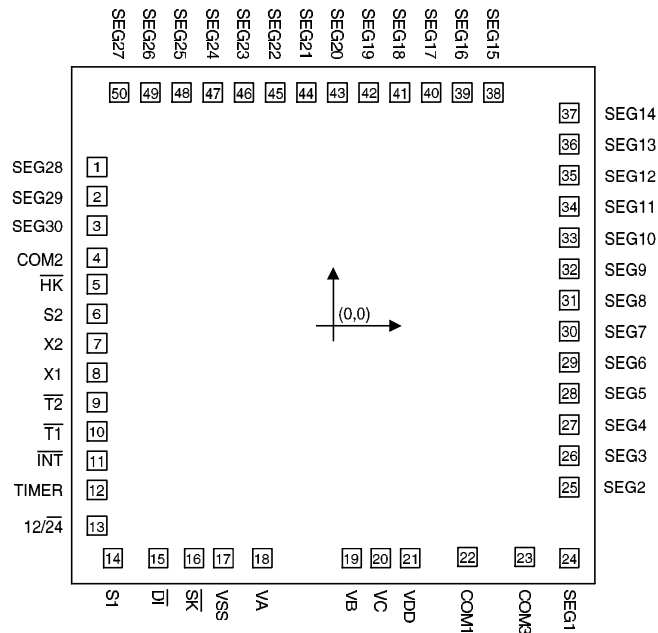


**Chip size: $136 \times 134$ (mil)$^2$**

\* The IC substrate should be connected to VDD in the PCB layout artwork.

**HT1611C**



Chip size: $122.5 \times 124.9$ (mil)$^2$

\* The IC substrate should be connected to VDD in the PCB layout artwork.

## Pad Coordinates

**HT1611**

Unit: mil

| Pad No. | X | Y | Pad No. | X | Y | Pad No. | X | Y |
|---|---|---|---|---|---|---|---|---|
| 1 | −61.92 | 41.65 | 18 | −18.66 | −60.80 | 35 | 61.63 | 39.46 |
| 2 | −61.92 | 33.98 | 19 | 4.72 | −60.80 | 36 | 61.63 | 47.60 |
| 3 | −61.92 | 26.30 | 20 | 12.36 | −60.80 | 37 | 61.63 | 55.79 |
| 4 | −61.92 | 17.85 | 21 | 20.00 | −60.80 | 38 | 41.78 | 61.14 |
| 5 | −61.92 | 10.95 | 22 | 34.98 | −60.46 | 39 | 33.62 | 61.14 |
| 6 | −61.92 | 3.17 | 23 | 50.02 | −60.46 | 40 | 25.46 | 61.14 |
| 7 | −61.92 | −4.53 | 24 | 61.67 | −60.80 | 41 | 17.30 | 61.14 |
| 8 | −61.92 | −12.22 | 25 | 61.63 | −42.18 | 42 | 9.14 | 61.14 |
| 9 | −61.92 | −19.96 | 26 | 61.63 | −33.98 | 43 | 0.98 | 61.14 |
| 10 | −61.92 | −27.60 | 27 | 61.63 | −25.82 | 44 | −7.18 | 61.14 |
| 11 | −61.92 | −35.26 | 28 | 61.63 | −17.66 | 45 | −15.34 | 61.14 |
| 12 | −61.92 | −42.95 | 29 | 61.63 | −9.50 | 46 | −23.50 | 61.14 |
| 13 | −61.92 | −52.26 | 38 | 61.63 | −1.34 | 47 | −31.66 | 61.14 |
| 14 | −57.80 | −60.80 | 39 | 61.63 | 6.80 | 48 | −39.82 | 61.14 |
| 15 | −45.90 | −60.80 | 31 | 61.63 | 14.98 | 49 | −47.98 | 61.14 |
| 16 | −36.50 | −60.80 | 32 | 61.63 | 23.14 | 50 | −56.14 | 61.14 |
| 17 | −28.86 | −60.80 | 33 | 61.63 | 31.30 | | | |

**HT1611C**                                                                                         Unit: mil

| Pad No. | X | Y | Pad No. | X | Y | Pad No. | X | Y |
|---------|-------|--------|---------|--------|--------|---------|-------|-------|
| 1 | −55.73 | 37.50 | 18 | −16.79 | −54.72 | 35 | 55.46 | 35.51 |
| 2 | −55.73 | 30.58 | 19 | 3.90 | −54.72 | 36 | 55.46 | 42.86 |
| 3 | −55.73 | 23.66 | 20 | 12.43 | −54.72 | 37 | 55.46 | 50.20 |
| 4 | −55.73 | 16.77 | 21 | 18.40 | −54.72 | 38 | 37.60 | 55.02 |
| 5 | −55.73 | 9.85 | 22 | 31.48 | −54.72 | 39 | 30.26 | 55.02 |
| 6 | −55.73 | 2.85 | 23 | 45.02 | −54.72 | 40 | 22.91 | 55.02 |
| 7 | −55.73 | −4.07 | 24 | 55.50 | −54.72 | 41 | 15.57 | 55.02 |
| 8 | −55.73 | −11.00 | 25 | 55.46 | −37.96 | 42 | 8.22 | 55.02 |
| 9 | −55.73 | −17.96 | 26 | 55.46 | −30.58 | 43 | 0.88 | 55.02 |
| 10 | −55.73 | −24.84 | 27 | 55.46 | −23.24 | 44 | −6.46 | 55.02 |
| 11 | −55.73 | −31.73 | 28 | 55.46 | −15.89 | 45 | −13.81 | 55.02 |
| 12 | −55.73 | −38.65 | 29 | 55.46 | −8.55 | 46 | −21.15 | 55.02 |
| 13 | −55.73 | −47.03 | 30 | 55.46 | −1.21 | 47 | −28.50 | 55.02 |
| 14 | −52.02 | −54.72 | 31 | 55.46 | 6.14 | 48 | −35.84 | 55.02 |
| 15 | −41.35 | −54.72 | 32 | 55.46 | 13.48 | 49 | −43.18 | 55.02 |
| 16 | −32.86 | −54.72 | 33 | 55.46 | 20.83 | 50 | −50.53 | 55.02 |
| 17 | −25.97 | −54.72 | 34 | 55.46 | 28.17 | | | |

## Pad Description

| Pad Name | I/O | Internal Connection | Description |
|----------|-----|---------------------|-------------|
| SEG1~SEG30 | O | CMOS OUT | LCD segment signal output pads |
| COM1~COM3 | O | CMOS OUT | LCD common signal output pads |
| $\overline{HK}$ | I | CMOS IN Pull-high | Hook switch detector input Active low |
| S2 | I | CMOS IN Pull-low | Clock adjusting switch Active high |
| X2 | O | OSCILLATOR | 32768Hz crystal oscillator output |
| X1 | I | OSCILLATOR | 32768Hz crystal oscillator input |
| $\overline{T2}$ | I | CMOS IN Pull-high | Test pad (connected to VSS for production test) |
| $\overline{T1}$ | I | CMOS IN Pull-high | Test pad (connected to VSS for production test) |
| $\overline{INT}$ | O | NMOS OUT | Interrupt output, 2Hz (default) or 16Hz (by mask option) |
| TIMER | I | CMOS IN Pull-low | Timer reset and start/hold toggle control input pad |
| $12/\overline{24}$ | I | CMOS IN Pull-low | 12-hour or 24-hour format option pad, connected to VDD for 12-hour format |

| Pad Name | I/O | Internal Connection | Description |
|---|---|---|---|
| S1 | I | CMOS IN Pull-low | Clock setting switch<br>Active high |
| $\overline{\text{DI}}$ | I | CMOS IN Pull-high | Serial data input pad (connected to the dialer)<br>Data should be valid at the falling edge of $\overline{\text{SK}}$ |
| $\overline{\text{SK}}$ | I | CMOS IN Pull-high | Clock input pad (connected to the dialer) |
| VA | O | CMOS OUT | Voltage doubler, connected to the external capacitor |
| VB | O | CMOS OUT | Voltage doubler, connected to the external capacitor |
| VC | O | CMOS OUT | Voltage doubler, connected to the external capacitor |
| VDD | I | — | Positive power supply |
| VSS | I | — | Negative power supply (GND) |

**Approximate internal connection circuit**
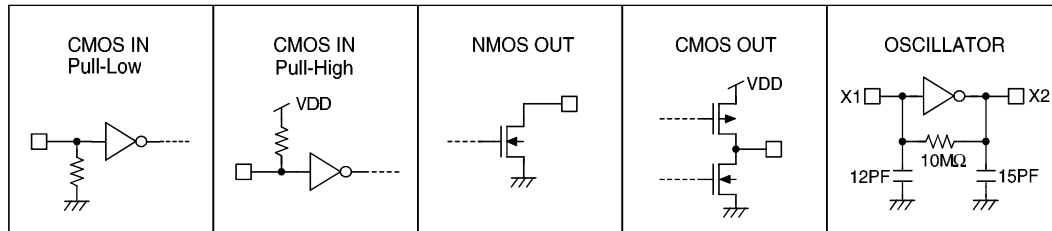


## Absolute Maximum Ratings

Supply Voltage ................................ −0.3V to 5V

Input Voltage ..................... $V_{SS}$−0.3 to $V_{DD}$+0.3

Storage Temperature ............... −50°C to 125°C

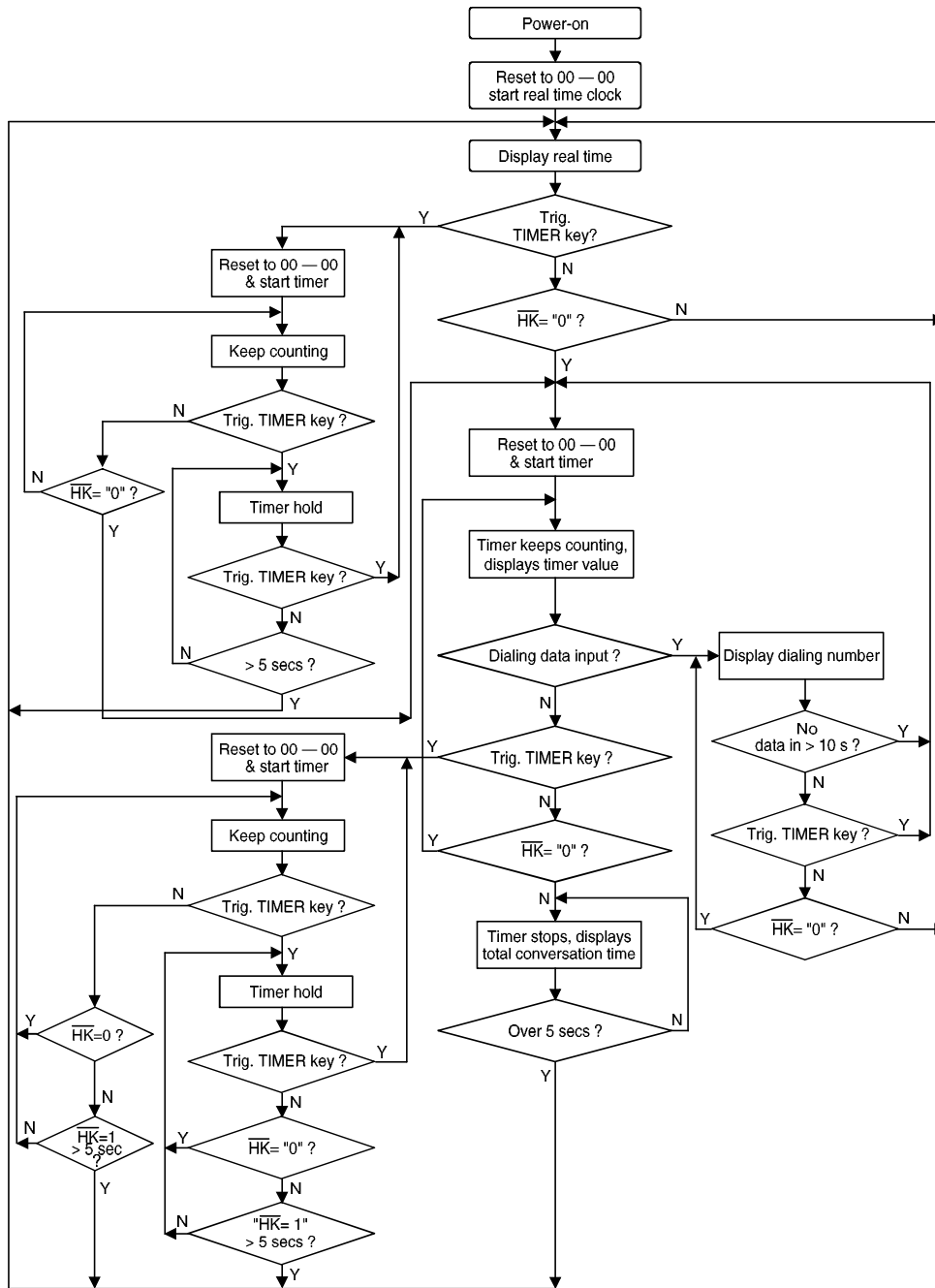Operating Temperature ............. −20°C to 75°C

Note: These are stress ratings only. Stresses exceeding the range specified under "Absolute Maximum Ratings" may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

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## Electrical Characteristics

$f_{OSC}$=32768Hz, Ta=25°C

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| | | $V_{DD}$ | Conditions | | | | |
| $V_{DD}$ | Operating Voltage | — | — | 1.2 | 1.5 | 1.7 | V |
| $V_{IL}$ | Input Low Voltage | 1.2V~17V | — | $V_{SS}$ | — | $0.2V_{DD}$ | V |
| $V_{IH}$ | Input High Voltage | 1.2V~17.V | — | $0.8V_{DD}$ | | $V_{DD}$ | V |
| $I_{STB}$ | Standby Current | 1.5V | $V_{\overline{HK}}$=Floating (or $V_{DD}$) | — | 0.1 | 1 | μA |
| $I_{DD}$ | Operating Current | 1.5V | No load | — | 3 | 10 | μA |
| $I_{OL}$ | Output Sink Current of $\overline{INT}$ | 1.5V | $V_O$=0.3V | 500 | 1000 | — | μA |
| $T_A$ | Data Setup Time | 1.5V | — | 1 | — | — | μs |
| $T_B$ | Data Hold On Time | 1.5V | — | 2 | — | — | μs |
| $T_C$ | Inter Digit Time | 1.5V | — | 5 | — | — | μs |
| $T_{DB}$ | Debounce Time ($\overline{HK}$, S1, S2, TIMER) | 1.5V | — | — | 31.25 | — | ms |
| $R_{HI}$ | Pull-high Resistance ($\overline{HK}$, $\overline{DI}$, $\overline{SK}$) | 1.5V | $V_{IN}$=0V | — | 1 | — | MΩ |
| $R_{LO}$ | Pull-low Resistance (TIMER, S1, S2, 12/$\overline{24}$) | 1.5V | $V_{TIMER}$=1.5V | — | 5 | — | MΩ |
| $f_{OSC}$ | System Frequency | 1.5V | Crystal=32768Hz | — | 32768 | — | Hz |

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## Functional Description

**Operational flow chart**

```
                              Power-on
                                 │
                       Reset to 00 — 00
                      start real time clock
                                 │
                         Display real time
                                 │
                          ┌──────┴──────┐
                    Y     │    Trig.    │
              ┌───────────┤  TIMER key? │
              │           └──────┬──────┘
              │                  │ N
   Reset to 00 — 00        ┌─────┴─────┐        N
   & start timer           │  HK= "0" ?│────────────────────┐
        │                  └─────┬─────┘                     │
        │                        │ Y                         │
   Keep counting                 │                           │
        │                 Reset to 00 — 00                   │
   ┌────┴────┐ N          & start timer                      │
   │Trig.TIMER│                  │                           │
   │  key ?   │           Timer keeps counting,              │
   └────┬────┘            displays timer value               │
    N   │ Y                      │                           │
┌──────┐│               ┌────────┴───────┐   Y              │
│HK="0"│                │Dialing data input?├──── Display dialing number
│  ?   │                └────────┬───────┘          │
└──────┘    Timer hold           │ N                │
    Y          │          ┌──────┴──────┐ Y      ┌──┴───┐ Y
         ┌─────┴────┐     │Trig.TIMER key?│      │  No  │
         │Trig.TIMER│ Y   └──────┬──────┘        │data in > 10 s ?│
         │  key ?   ├─           │ N             └──┬───┘
         └─────┬────┘       ┌─────┴─────┐ Y         │ N
               │ N          │  HK= "0" ?│        ┌───┴────┐ Y
         ┌─────┴────┐       └─────┬─────┘        │Trig.TIMER key?│
         │ > 5 secs ?│ N          │ N            └───┬────┘
         └─────┬────┘      Timer stops, displays     │ N
               │ Y         total conversation time ┌─┴────┐ N
                              │                    │HK="0"?│
                       ┌──────┴──────┐ N           └─┬────┘
   Reset to 00 — 00    │ Over 5 secs ?│              │ Y
   & start timer       └──────┬──────┘
        │                     │ Y
   Keep counting
        │
   ┌────┴────┐ N
   │Trig.TIMER│
   │  key ?   │
   └────┬────┘
    Y   │ Y
┌──────┐│  Timer hold
│HK=0 ?││     │
└──────┘  ┌───┴────┐ Y
    N     │Trig.TIMER key?│
┌──────┐  └───┬────┘
│HK=1  │      │ N
│>5 sec│  ┌───┴────┐ Y
│  ?   │  │ HK= "0" ?│
└──────┘  └───┬────┘
    Y         │ N
          ┌───┴────┐ N
          │"HK= 1" │
          │> 5 secs?│
          └───┬────┘
              │ Y
```

**On-hook & off-hook**



Notes: Block A shows the switches S1 and S2 that are used for setting and selecting.

Block B illustrates a timer mode when Off-Hook; timer resets and starts to count the conversation time.

In Block C, the dialing data is received and displayed on the LCD from left to right after Off-Hook. When the entry interval is over 10 seconds, it resets the timer and starts to count.
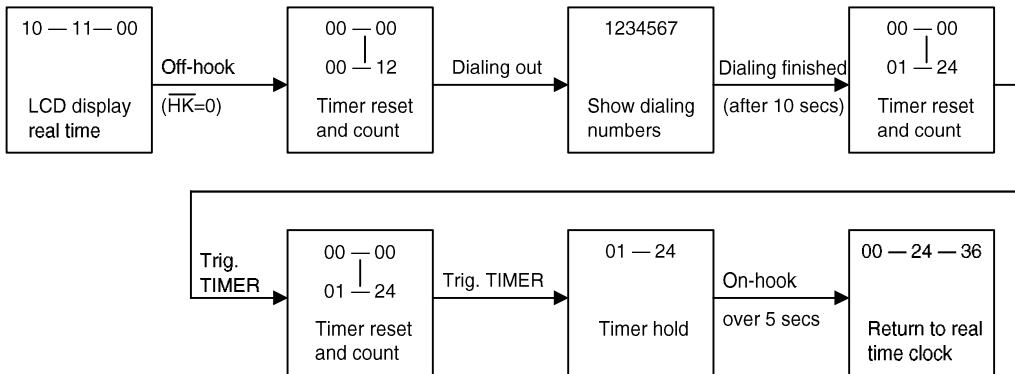
**TIMER key function**

The TIMER key is used to start/stop the timer (toggle). In real time mode, it can perform a stopwatch function.
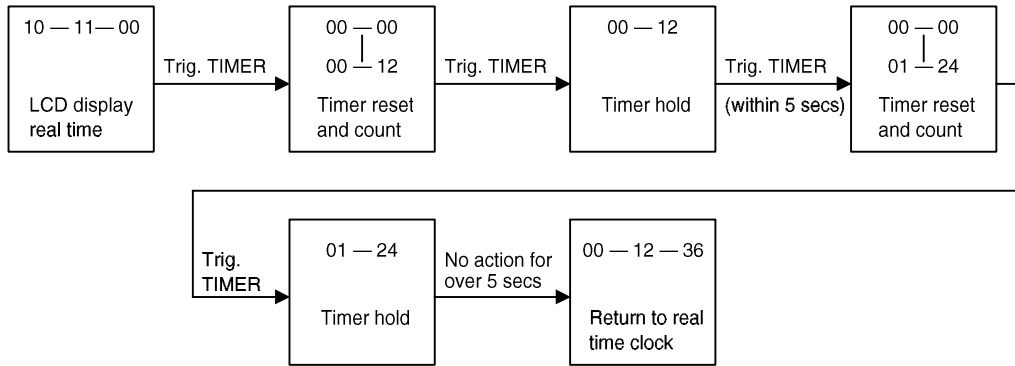


In the conversation timer mode, it can reset or hold the timer.

**Data & Timing**

• For telephone application

The HT1611/HT1611C is designed to display telephone numbers derived from the HT93XXX series telephone dialers. The corresponding data is illustrated in the following table.

| Key-In | Data Code | | | | Display |
|---|---|---|---|---|---|
| | b3 | b2 | b1 | b0 | |
| Blank | 0 | 0 | 0 | 0 | Blank |
| 1 | 0 | 0 | 0 | 1 | I |
| 2 | 0 | 0 | 1 | 0 | 2 |
| 3 | 0 | 0 | 1 | 1 | 3 |
| 4 | 0 | 1 | 0 | 0 | 4 |
| 5 | 0 | 1 | 0 | 1 | 5 |
| 6 | 0 | 1 | 1 | 0 | 6 |
| 7 | 0 | 1 | 1 | 1 | 7 |
| 8 | 1 | 0 | 0 | 0 | 8 |
| 9 | 1 | 0 | 0 | 1 | 9 |
| 0 | 1 | 0 | 1 | 0 | 0 |
| * | 1 | 1 | 0 | 1 | ⌐ |
| # | 1 | 1 | 0 | 0 | ⌐ |
| F | 1 | 0 | 1 | 1 | F |
| P | 1 | 1 | 1 | 0 | P |
| | 1 | 1 | 1 | 1 | − |

• For instrument or µC application

The HT1611/HT1611C is also capable of displaying BCD data generated from instrument or a µC system. The corresponding data and timing is shown in the Data latch timing. Before the data is transmitted to the HT1611/HT1611C, the $\overline{HK}$ pin should be pulled-low or continuously kept low. The HT1611 is then ready to receive the data. At the falling edge of the clock the data is shifted in to the IC. After all the data is sent to the HT1611/HT1611C, the $\overline{SK}$ pin is set low to avoid switching to the timer mode.
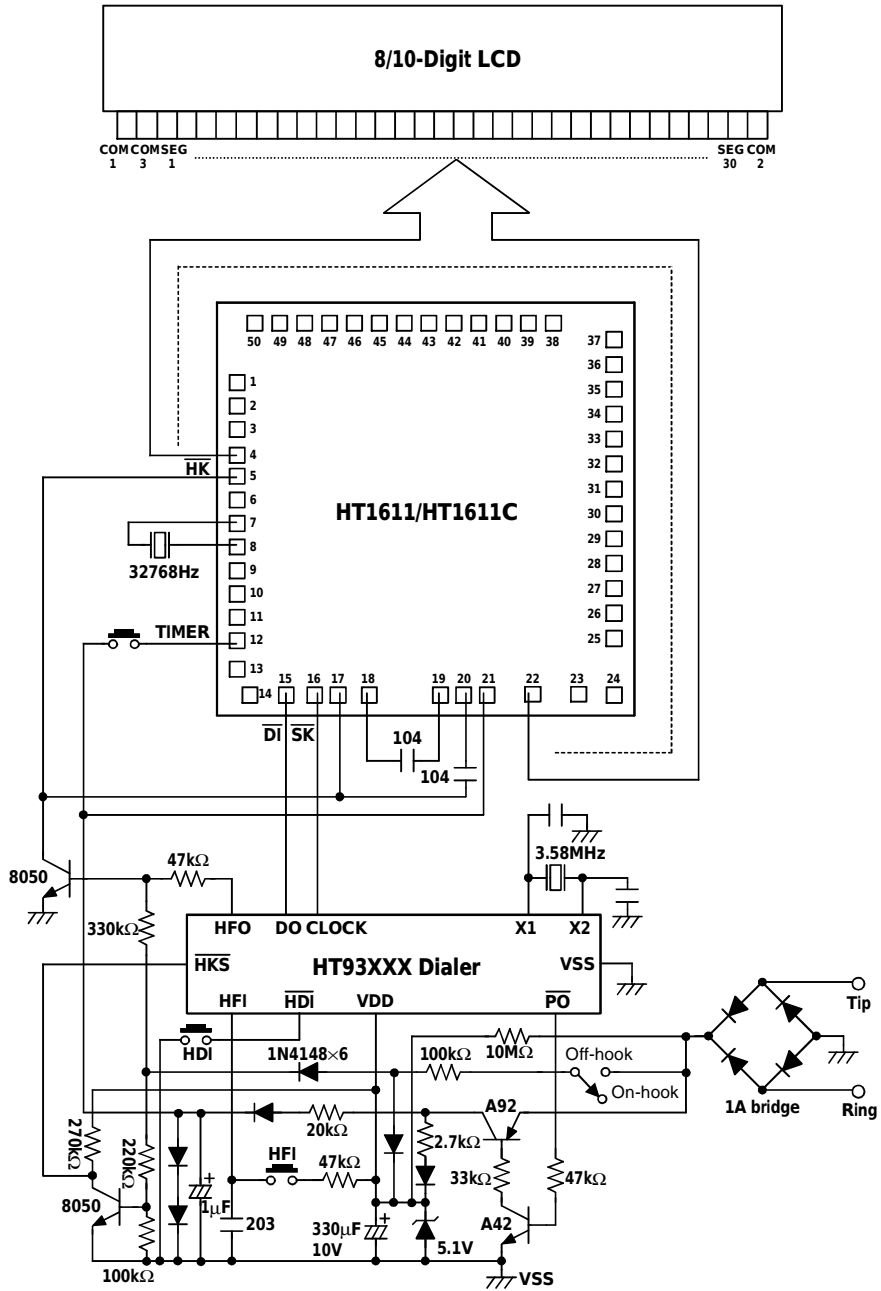
• Data latch timing
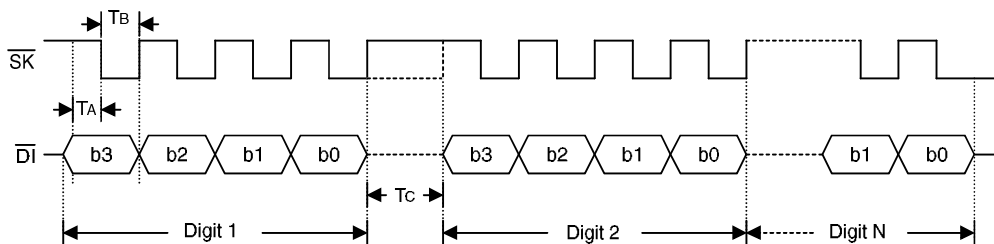
## Application Circuits

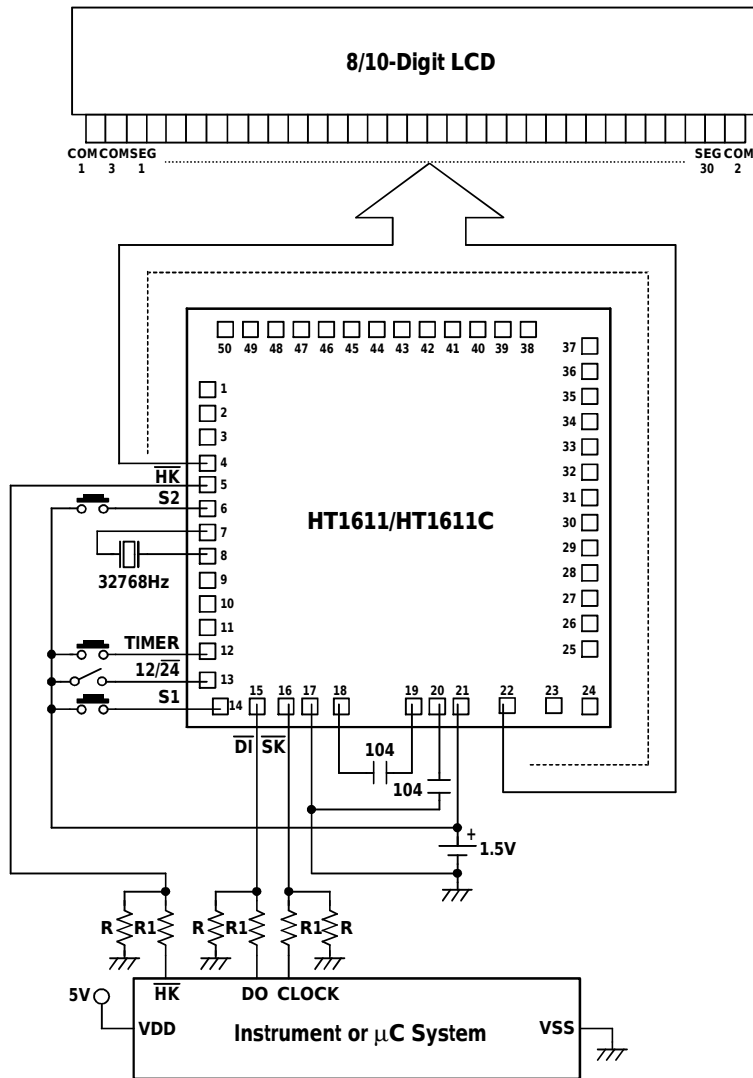**For telephone interfacing (with batteries)**
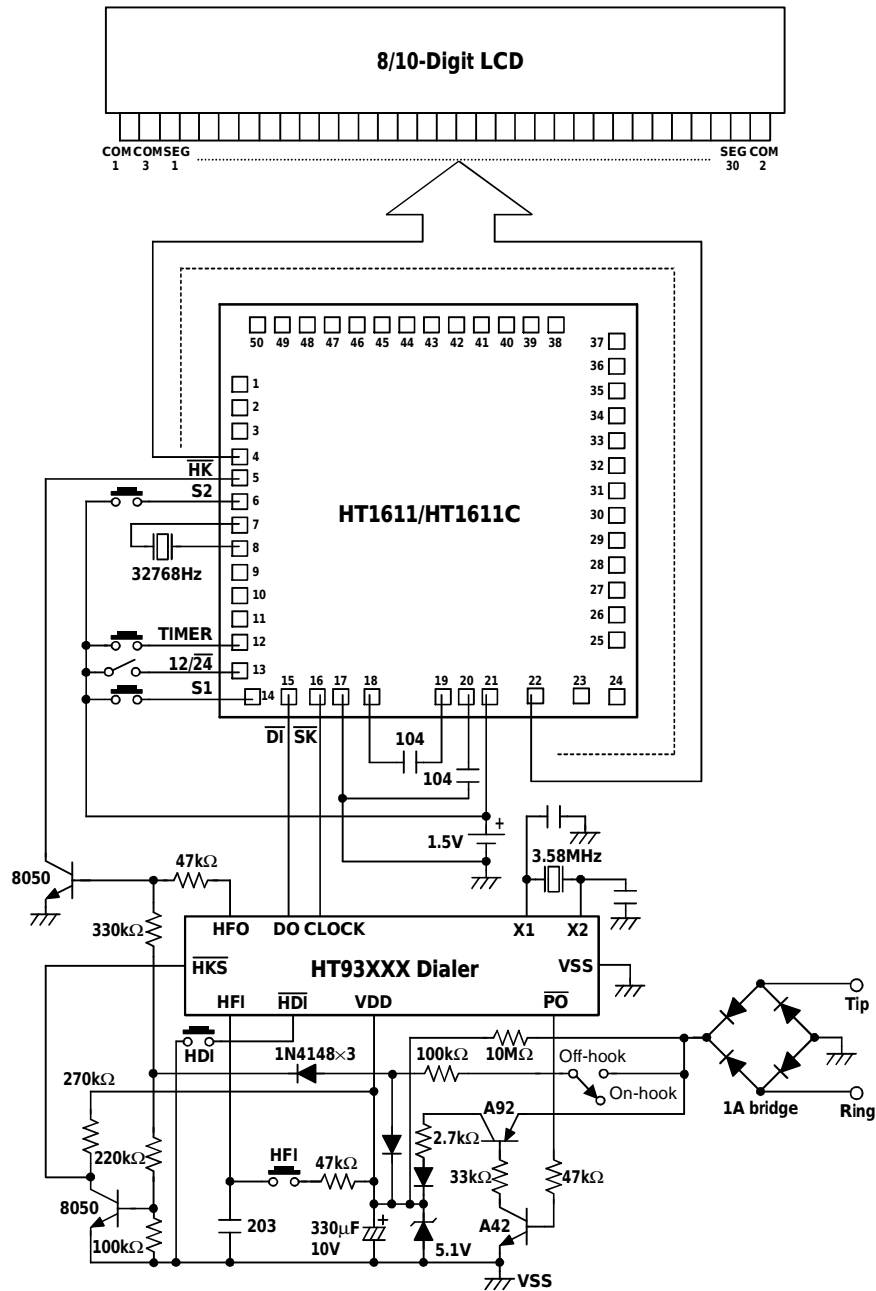


\* The IC substrate should be connected to VDD in the PCB layout artwork.

**For telephone interfacing (without batteries)**



\* The IC substrate should be connected to VDD in the PCB layout artwork.

**For instrument or μC use**



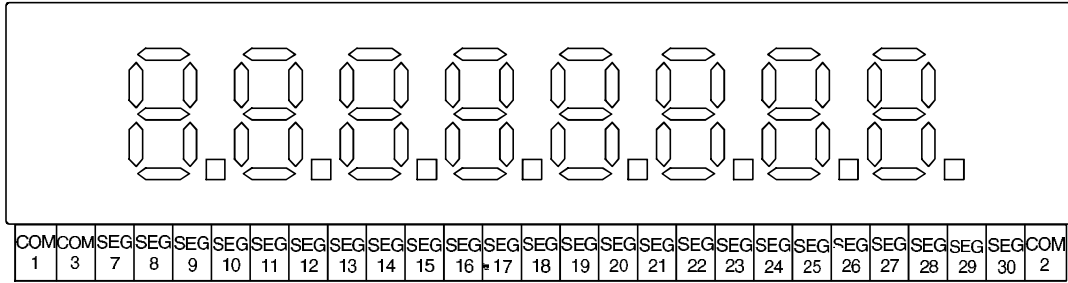* The IC substrate should be connected to VDD in the PCB layout artwork.

Notes: To drive $\overline{SK}$, $\overline{DI}$, $\overline{HK}$, an open drain NMOS output structure is recommended.

To drive $\overline{SK}$, $\overline{DI}$ and $\overline{HK}$ with a CMOS output structure, a voltage divider is needed (R=4.3kΩ, R1=10kΩ).

## LCD Configuration

**For 8-digit application**
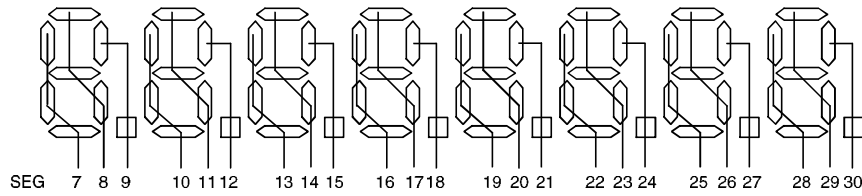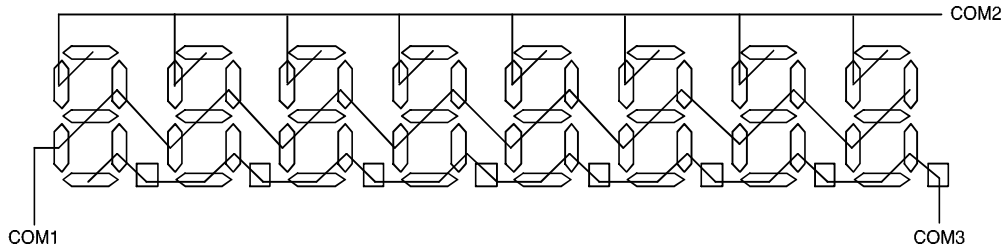
• Segment electrode side



| COM 1 | COM 3 | SEG 7 | SEG 8 | SEG 9 | SEG 10 | SEG 11 | SEG 12 | SEG 13 | SEG 14 | SEG 15 | SEG 16 | SEG 17 | SEG 18 | SEG 19 | SEG 20 | SEG 21 | SEG 22 | SEG 23 | SEG 24 | SEG 25 | SEG 26 | SEG 27 | SEG 28 | SEG 29 | SEG 30 | COM 2 |

LCD driving system 1/2 bias, 1/3 duty, 3V

• Common electrode side



SEG 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

• LCD connection



COM2

COM1 COM3

**For 10-digit application**

• Segment electrode side



| COM 1 | COM 3 | SEG 1 | SEG 2 | SEG 3 | SEG 4 | SEG 5 | SEG 6 | SEG 7 | SEG 8 | SEG 9 | SEG 10 | SEG 11 | SEG 12 | SEG 13 | SEG 14 | SEG 15 | SEG 16 | SEG 17 | SEG 18 | SEG 19 | SEG 20 | SEG 21 | SEG 22 | SEG 23 | SEG 24 | SEG 25 | SEG 26 | SEG 27 | SEG 28 | SEG 29 | SEG 30 | COM 2 |

LCD driving system 1/2 bias, 1/3 duty, 3V

• Common electrode side



SEG   1   2   3     4   5   6     7   8   9    10 11 12    13 14 15    16 17 18    19 20 21    22 23 24    25 26 27    28 29 30

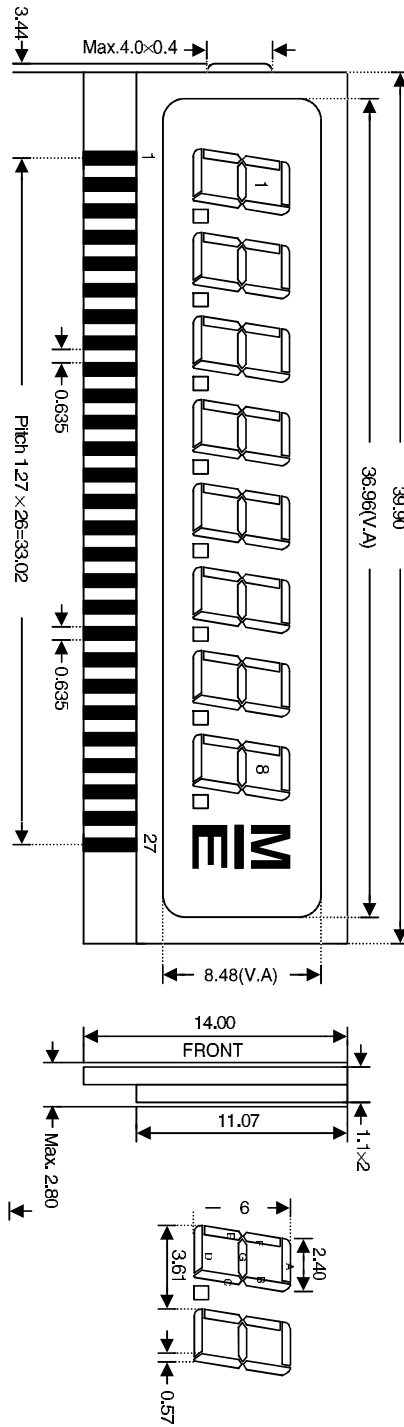• LCD connection



COM2

COM1

COM3
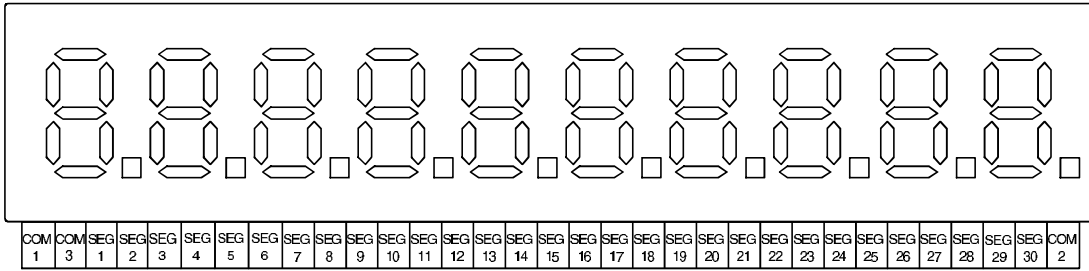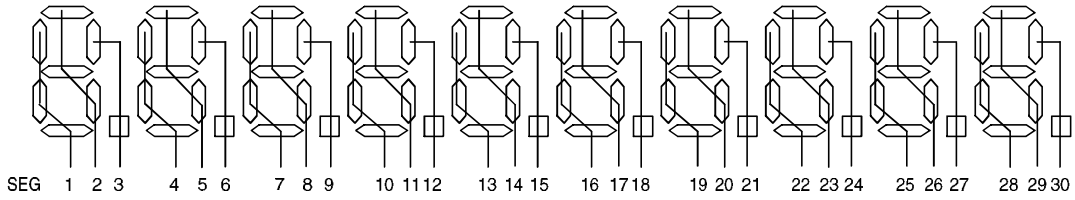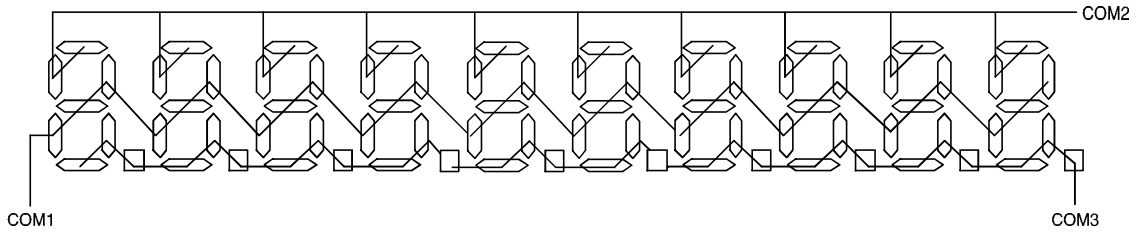
**SW1611M8**
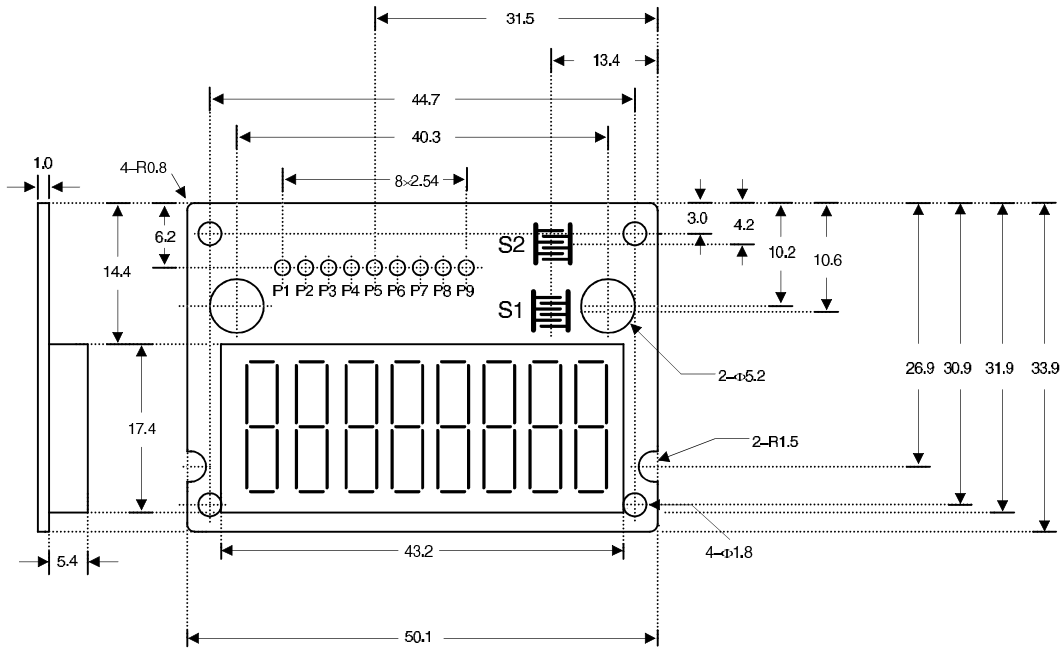


P1: 12/$\overline{24}$
P2: VSS (GND)
P3: $\overline{SK}$ (CLOCK INPUT)
P4: $\overline{DI}$ (DATA INPUT)
P5: $\overline{HK}$ (ON/OFF HOOK)
P6: S2 (ADJ; HOUR/MINUTE ADJUST)
P7: TIMER (TIMER RESET/RESTART)
P8: S1 (SET; MODE SETTING)
P9: VDD (1.5V)
Unit: m/m
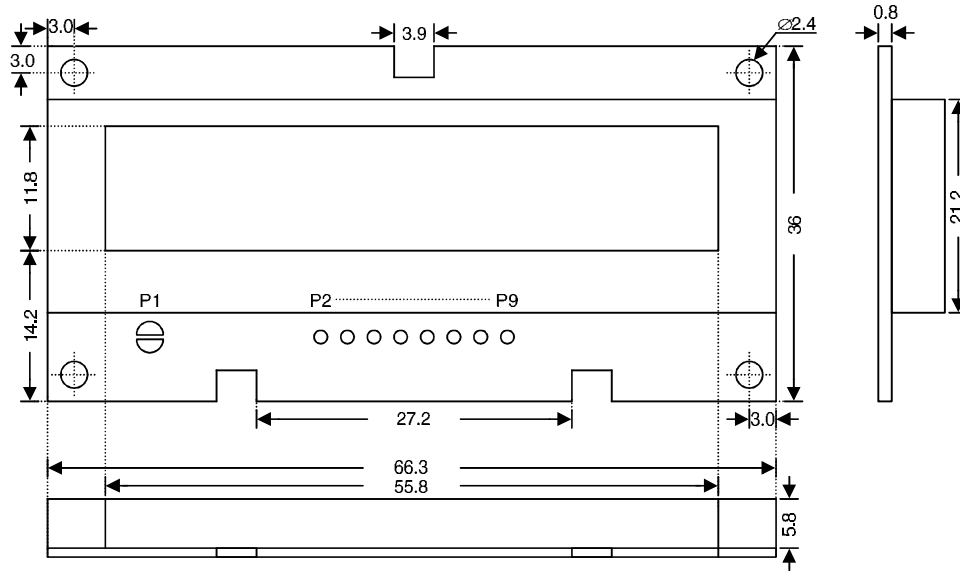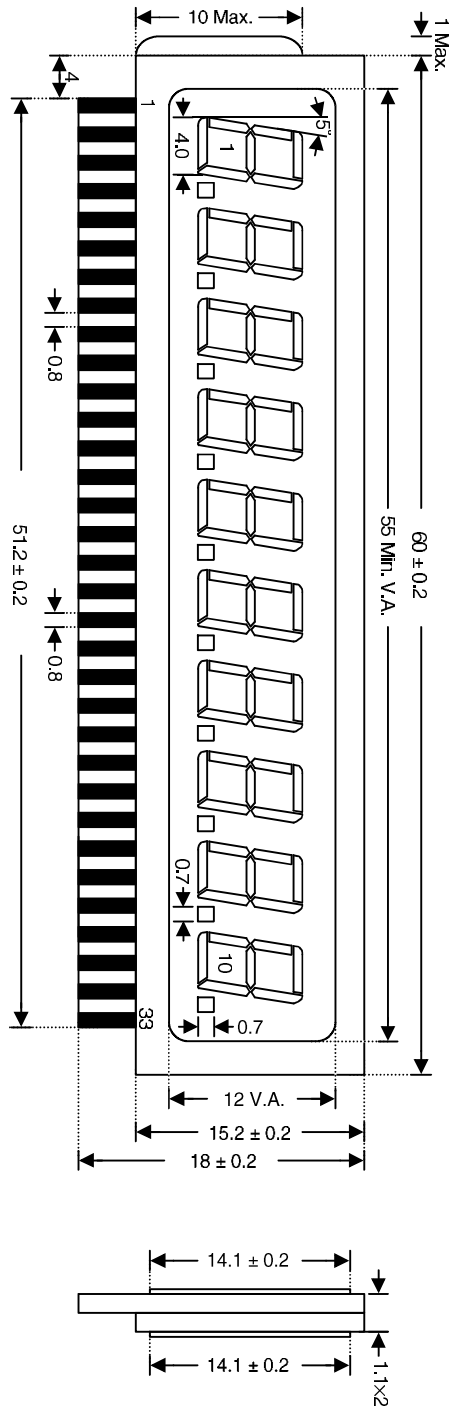Tolerance: 0~5m/m : ±0.1m/m ( Typ. )
         5~50m/m : ±0.2m/m (Typ. )

**Note:** Tolerances unless otherwise specified: ±0.20
Viewing angle: 6:00 o'clock
Polarizer: Reflective
Bias: 1/2 Duty:1/3
Operating temperature: 0°C to 55°C
Storage temperature: −20°C to 60°C

| Pin | COM0 | COM1 | COM2 |
|-----|------|------|------|
| 1 | COM0 |  |  |
| 2 |  | COM1 |  |
| 3 | 1F | 1E | 1D |
| 4 | 1A | 1G | 1C |
| 5 | 1B |  | 1. |
| 6 | 2F | 2E | 2D |
| 7 | 2A | 2G | 2C |
| 8 | 2B |  | 2. |
| 9 | 3F | 3E | 3D |
| 10 | 3A | 3G | 3C |
| 11 | 3B |  | 3. |
| 12 | 4F | 4E | 4D |
| 13 | 4A | 4G | 4C |
| 14 | 4B |  | 4. |
| 15 | 5F | 5E | 5D |
| 16 | 5A | 5G | 5C |
| 17 | 5B |  | 5. |
| 18 | 6F | 6E | 6D |
| 19 | 6A | 6G | 6C |
| 20 | 6B | — | 6. |
| 21 | 7F | 7E | 7D |
| 22 | 7A | 7G | 7C |
| 23 | 7B | M | 7. |
| 24 | 8F | 8E | 8D |
| 25 | 8A | 8G | 8C |
| 26 | 8B | E | 8. |
| 27 |  |  | COM2 |

Dimension callouts (mechanical drawing):
- Max.4.0×0.4
- 3.44
- 36.96(V.A)
- 39.90
- 0.635
- 0.635
- Pitch 1.27×26=33.02
- 8.48(V.A)
- 14.00 — FRONT
- 11.07
- Max.2.80
- 1.1×2
- 6
- 3.61
- 2.40
- 0.57

**SW1611M10**



P1: 12/$\overline{24}$
P2: $\overline{SK}$ (CLOCK INPUT)
P3: $\overline{DI}$ (DATA INPUT)
P4: VSS (GND)
P5: $\overline{HK}$ (ON/OFF HOOK)
P6: S2 (ADJ:HOVR/MINUTE ADJUST)
P7: TIMER (TIMER RESET/RESTART)
P8: S1 (SET: MODE SETTING)
P9: VDD (1.5V)

**HOLTEK**

### Pin assignment

| Pin | COM1 | COM2 | COM3 |
|-----|------|------|------|
| 1 | COM1 | | |
| 2 | | | COM3 |
| 3 | 1E | 1F | 1D |
| 4 | 1G | 1A | 1C |
| 5 | 1B | | P1 |
| 6 | 2E | 2F | 2D |
| 7 | 2G | 2A | 2C |
| 8 | 2B | | P2 |
| 9 | 3E | 3F | 3D |
| 10 | 3G | 3A | 3C |
| 11 | 3B | | P3 |
| 12 | 4E | 4F | 4D |
| 13 | 4G | 4A | 4C |
| 14 | 4B | | P4 |
| 15 | 5E | 5F | 5D |
| 16 | 5G | 5A | 5C |
| 17 | 5B | | P5 |
| 18 | 6E | 6F | 6D |
| 19 | 6G | 6A | 6C |
| 20 | 6B | | P6 |
| 21 | 7E | 7F | 7D |
| 22 | 7G | 7A | 7C |
| 23 | 7B | | P7 |
| 24 | 8E | 8F | 8D |
| 25 | 8G | 8A | 8C |
| 26 | 8B | | P8 |
| 27 | 9E | 9F | 9D |
| 28 | 9G | 9A | 9C |
| 29 | 9B | | P9 |
| 30 | 10E | 10F | 10D |
| 31 | 10G | 10A | 10C |
| 32 | 10B | | P10 |
| 33 | | | COM2 |

Note: Polarizer: Reflective
Voltage: 3V, 1/3 duty, 1/2 bias
Viewing direction: 6 o'clock
Operating temperature: 0°C to 50°C

Mechanical dimensions: 10 Max., 1 Max., 4, 0.8, 51.2 ± 0.2, 0.8, 0.7, 4.0, 5°, 55 Min. V.A., 60 ± 0.2, 12 V.A., 15.2 ± 0.2, 18 ± 0.2, 14.1 ± 0.2, 14.1 ± 0.2, 1.1×2