HT1613A
Timer with Dialer Interface

Patent Number: 84545 (R.O.C.)
Patent Pending: 08/214, 079 (U.S.A.)

Features

- Operating voltage: 1.2V~1.7V
- Low operating current (3 uA, 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), same as hand-held calculator type
- 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
- Uses 32768 Hz output buffer
- Eight ICONs:
  - LOGO1~3, INUSE, HANDFREE, HOLD, ICON1, ICON2
- Four option pads for icon flash
  - Flash or not
  - 1s On/1s Off or 2s On/2s Off
- Three pads for operation mode option
  - $\overline{\text{RT}}$ for real time
  - $\overline{\text{ACT}}$ for auto change to timer mode
  - $\overline{\text{EPN}}$ for extension telephone number display
- Quick start of OSC when power is on
- Auto 1/2 V_{DD} generation to LCD for 3V application
- Blinking cursor waits for dialing number
- Last call time display

Applications

- Timers, clocks and watches
- LCD display drivers
- Telephone display interface
- Instrument display

General Description

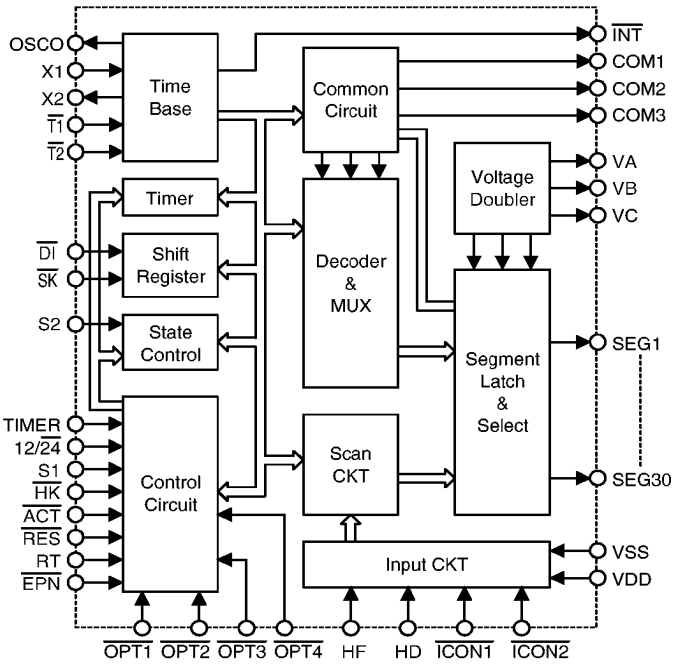
The HT1613A is a CMOS chip designed for dialer interfaces driving 8 or 10-digit LCDs. Various functions, such as real time clock, dial number and conversation time display are provided.

The HT1613A can display the real time or be blank by default. When answering a telephone call, the timer is activated to tell users how long the conversation has taken.

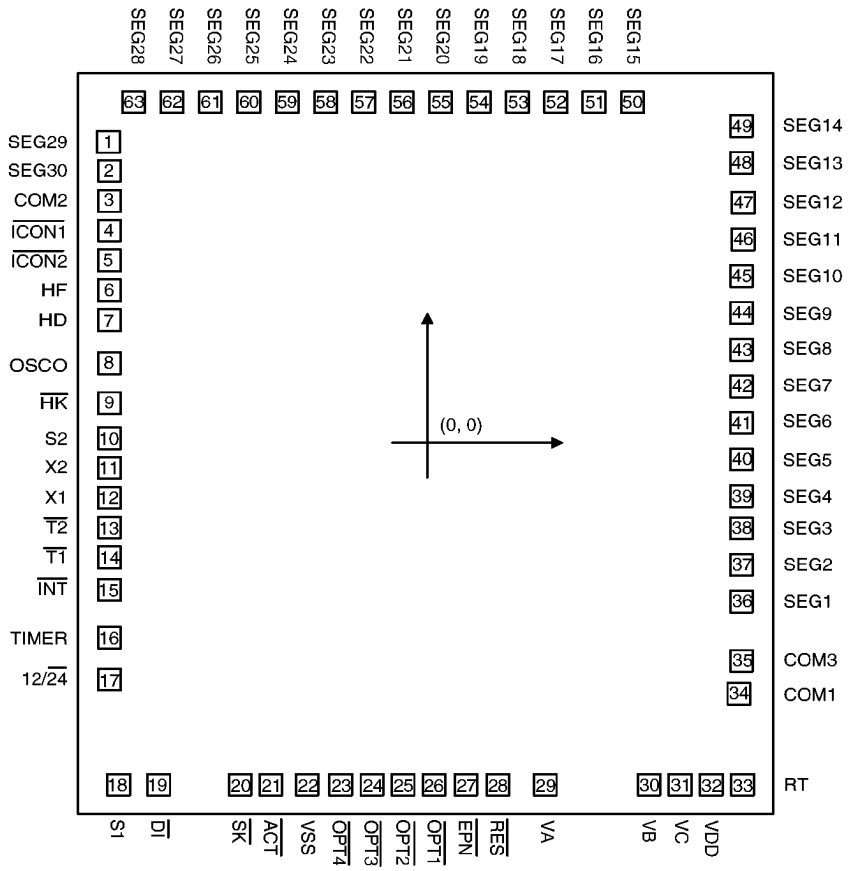
The HT1613A receives dialing data from the dialer and displays the phone number on the LCD from left to right each time a phone call is made. By adding a TIMER key, the HT1613A can provide the stopwatch and timer reset/hold functions. Rrefer to the functional description for details.

The HT1613A also supply eight icons, LOGO1~LOGO3, INUSE, HANDFREE, HOLD and two special icons, for telephone dialer or other applications.

Block Diagram



Pad Assignment



Chip size: 146 × 162 (mil)^2

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

Pad Coordinates

Unit: mil

Pad No.	X	Y	Pad No.	X	Y	Pad No.	X	Y
1	–67.83	66.85	22	–25.58	–76.07	43	66.77	20.70
2	–67.57	60.39	23	–18.44	–76.07	44	66.77	28.86
3	–67.57	53.76	24	–11.81	–76.07	45	66.77	37.02
4	–67.57	47.13	25	–5.18	–76.07	46	67.11	45.18
5	–67.57	40.50	26	1.45	–76.07	47	67.11	53.34
6	–67.57	33.87	27	8.16	–76.07	48	66.77	62.18
7	–67.57	27.24	28	14.96	–76.07	49	66.77	70.34
8	–67.57	17.68	29	25.08	–76.07	50	43.60	75.69
9	–67.57	8.76	30	47.09	–76.07	51	35.44	75.69
10	–67.57	0.98	31	53.72	–76.07	52	27.28	75.69
11	–67.57	–5.65	32	60.35	–76.07	53	19.13	75.69
12	–67.57	–12.28	33	66.98	–76.07	54	10.97	75.69
13	–67.57	–18.91	34	66.21	–55.80	55	2.81	75.69
14	–67.57	–25.54	35	66.77	–48.53	56	–5.36	75.69
15	–67.57	–32.72	36	66.77	–35.36	57	–13.52	75.69
16	–67.57	–43.35	37	66.77	–27.20	58	–21.67	75.69
17	–67.57	–52.66	38	66.77	–19.04	59	–29.83	75.69
18	–65.62	–76.07	39	66.77	–11.94	60	–37.99	75.69
19	–57.12	–76.07	40	66.77	–3.78	61	–46.15	75.69
20	–39.87	–76.07	41	66.77	4.38	62	–54.31	75.69
21	–33.24	–76.07	42	66.77	12.54	63	–62.47	75.69

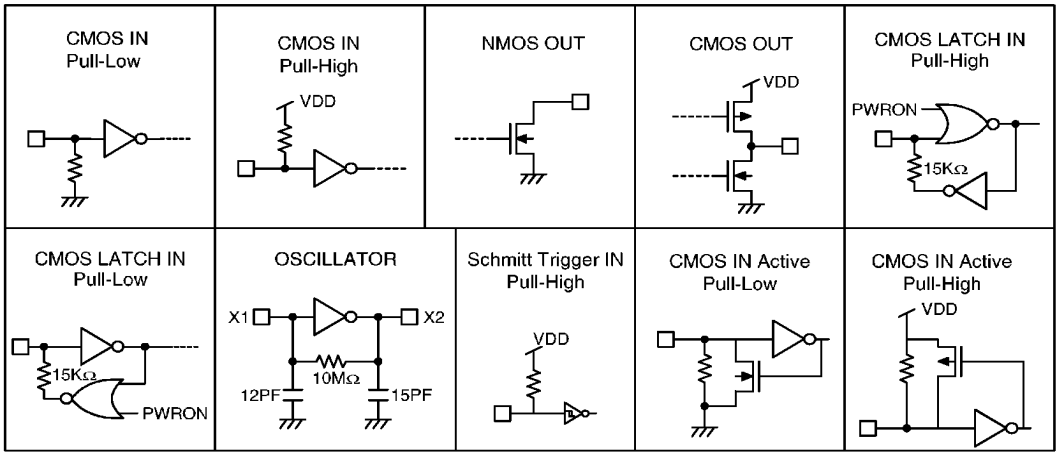
Pad Description

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	Schmitt Trigger IN Pull-High	Hook switch detector input Active low
HF	I	CMOS IN Active Pull-High	Hand Free icon input, Low=inactive, High=active
HD	I	CMOS IN Active Pull-High	HOLD icon input, Low=inactive, High=active
$\overline{ICON1}$	I	CMOS IN Active Pull-High	ICON1 icon input, Active low
$\overline{ICON2}$	I	CMOS IN Active Pull-High	ICON2 icon input, Active low
S1	I	Schmitt Trigger IN Active Pull-Low	Clock setting switch Hour or minute can be selected (flashes when selected) for S2 adjustment

Pad Name	I/O	Internal Connection	Description
$\overline{RES}$	I	Schmitt Trigger IN Pull-High	System initialization pin (active low) The pull-high resistance is 200kΩ typ.
12/$\overline{24}$	I	Schmitt Trigger IN Active Pull-Low	12-hour or 24-hour format option pad, connected to VDD for 12-hour format
S2	I	Schmitt Trigger IN Active Pull-Low	Clock adjusting switch, Active high Hour or minute digits can be adjusted with this key depending on the S1 selection
$\overline{DI}$	I	Schmitt Trigger IN Pull-High	Serial data input pad (connected to the dialer) Data should be valid at the falling edge of $\overline{SK}$
$\overline{SK}$	I	Schmitt Trigger IN Pull-High	Clock input pad (connected to the dialer) Input data is latched at the falling edge of $\overline{SK}$ input
RT	I	CMOS LATCH IN Pull-Low	Real time selection pin VDD: With real time mode Floating: Without real time mode
$\overline{EPN}$	I	CMOS LATCH IN Pull-High	Extension phone number display selection pin VSS: Without extension phone number display Floating: With extension phone number display
$\overline{ACT}$	I	CMOS LATCH IN Pull-High	In the dialing number display mode, auto change to timer mode selection VSS: Auto change to timer mode Floating: Manual change to timer mode
$\overline{T1}$	I	CMOS IN Pull-High	Test pad (connected to VSS for production test)
$\overline{T2}$	I	CMOS IN Pull-High	Test pad (connected to VSS for production test)
X1	I	OSC	32768Hz crystal oscillator input
X2	O	OSC	32768Hz crystal oscillator output
TIMER	I	Schmitt Trigger IN Active Pull-Low	Timer reset and start/hold toggle control input pad
$\overline{INT}$	O	NMOS OUT	Interrupt output, 2Hz (default) or 16Hz (by mask option)
VA	O	CMOS OUT	Voltage doubler, connected to external capacitor
VB	O	CMOS OUT	Voltage doubler, connected to external capacitor
VC	O	CMOS OUT	Voltage doubler, connected to external capacitor
$\overline{OPT4}$	I	CMOS IN Active Pull-High	Pad for flash rate selection. Pull high High=2s On/2s Off, Low=1s On/1s Off

Pad Name	I/O	Internal Connection	Description
$\overline{OPT3}$	I	CMOS IN Active Pull-High	Option pad for setting hold-line icon/hand-free icon to flash or not Open: no flash (default) V_{SS}: flash
$\overline{OPT2}$	I	CMOS IN Active Pull-High	Option pad for setting ICON2 to flash or not Open: no flash (default) V_{SS}: flash
$\overline{OPT1}$	I	CMOS IN Active Pull-High	Option pad for setting ICON1 to flash or not Open: no flash (default) V_{SS}: flash
OSCO	O	CMOS	32768Hz buffered output
VDD	I	—	Positive power supply
VSS	I	—	Negative power supply (GND)

Approximate internal connection circuits



Absolute Maximum Ratings*

Supply Voltage ..... –0.3V to 5V
Storage Temperature..... –50°C to 125°C
Input Voltage..... V_{SS}–0.3V to V_{DD}+0.3V
Operating Temperature..... –20°C to 75°C

*Note: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of this device at these or any other conditions above those indicated in the operational sections of this specification is not implied and exposure to absolute maximum rating conditions for extended periods may affect device reliability.

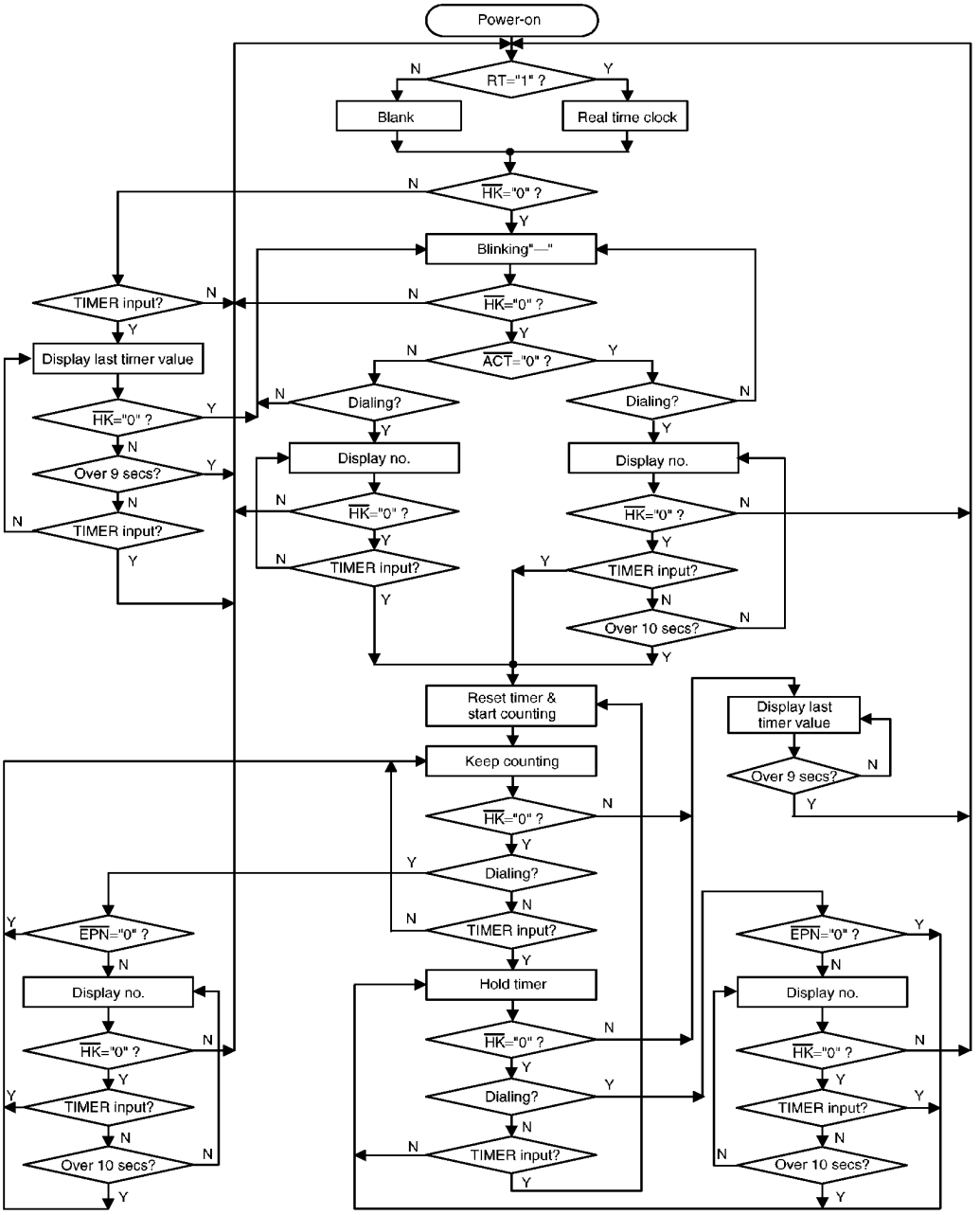
Electrical Characteristics

(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~1.7V	—	V_{SS}	—	$0.2V_{DD}$	V
V_{IH}	Input High Voltage	1.2V~1.7V	—	$0.8V_{DD}$	—	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_{HI1}	Pull-High Resistance ($\overline{HK}$, $\overline{DI}$, $\overline{SK}$)	1.5V	V_{IN}=0V	—	1	—	MΩ
R_{HI2}	Pull-High Resistance $\overline{HF}$, $\overline{HD}$, $\overline{ICON1}$, $\overline{ICON2}$, $\overline{OPT1}$, $\overline{OPT2}$, $\overline{OPT3}$, $\overline{OPT4}$	1.5V	V_{IN}=0V	—	5	—	MΩ
R_{HI3}	Pull-High Resistance ($\overline{RES}$)	1.5V	V_{IN}=0V	100	200	400	kΩ
R_{LO}	Pull-Low Resistance (TIMER, S1, S2, 12/$\overline{24}$)	1.5V	V_{IN}=1.5V	—	5	—	MΩ
F_{OSC}	System Frequency	1.5V	Crystal=32768Hz	—	32768	—	Hz

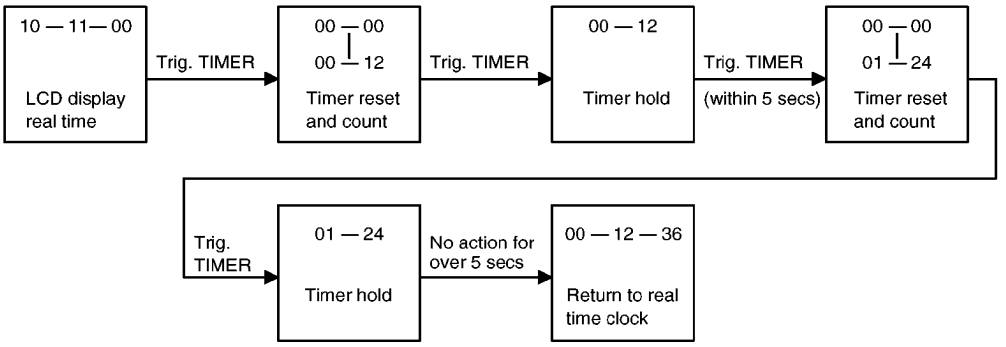
Functional Description

Operational flow chart

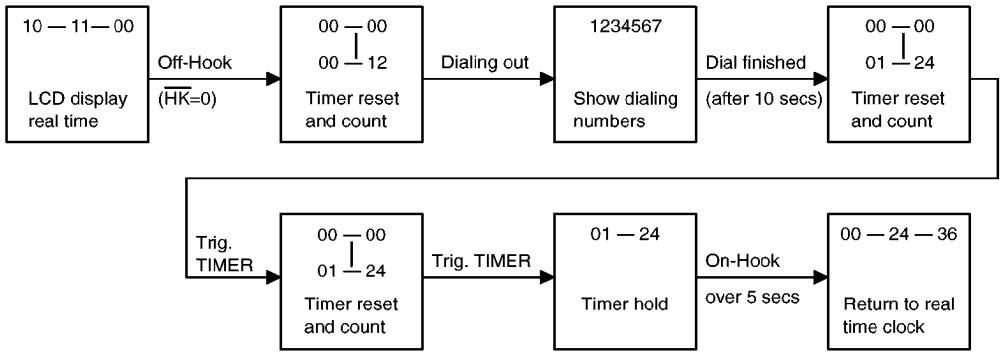


TIMER key function

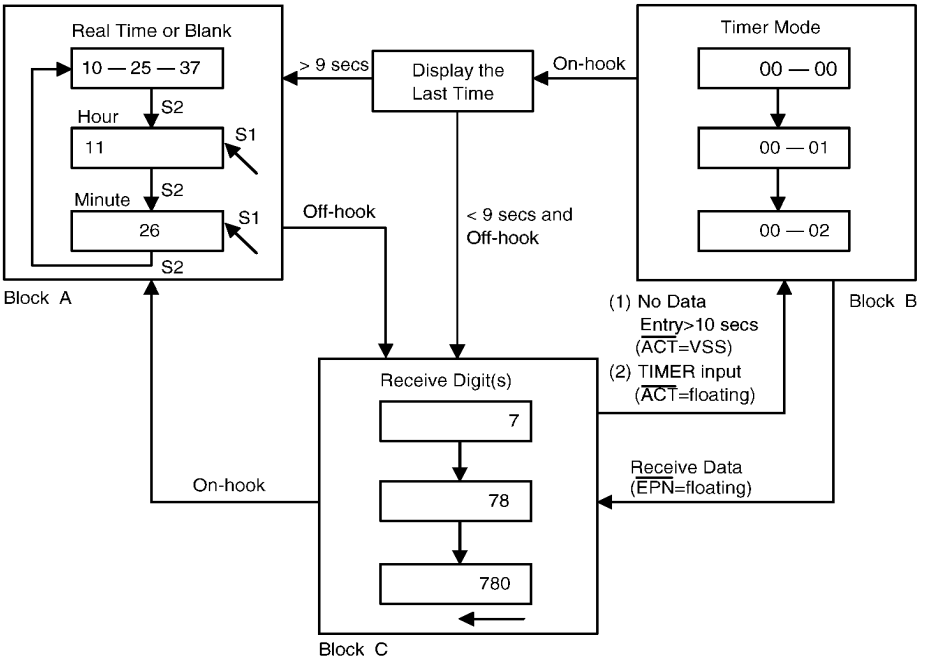
The TIMER key is used to start/stop the timer (toggle). In real time mode, it can perform a stop-watch function.



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



On-hook & Off-hook



Note:

Block A shows the switches S1 and S2 that are used for setting and selecting when RT=VDD (Real time mode). S1 and S2 are disabled when RT= floating (Blank mode).

Block B illustrates a timer mode when TIMER input $\overline{ACT}$= floating or when there's no data entry>10 secs ($\overline{ACT}$=VSS). Once in the timer mode, the timer resets and starts to count the conversation time ($\overline{ACT}$= floating).

Block C displays blinking "—", after Off-Hook, dialing data is received and displayed on the LCD from left to right.

Data & Timing

- For telephone application

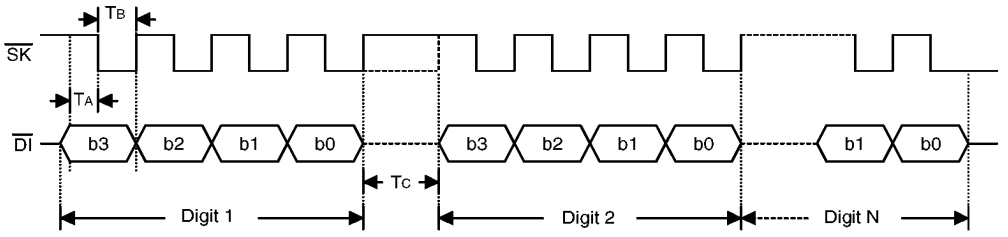
  The HT1613A is designed to display telephone numbers derived from the HT93XXX series telephone dialers. The corresponding data is illustrated in the following table.

Key-In	Data Code				Display
	b3	b2	b1	b0	
Blank	0	0	0	0	Blank
1	0	0	0	1	1
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 HT1613A 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 diagram. Before the data is transmitted to the HT1613A, the $\overline{HK}$ pin should be pulled-low or continuously kept low. The HT1613A 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 HT1613A, the $\overline{SK}$ pin is set low to avoid switching to the timer mode.

- Data latch timing



ICON table

Item	On Hook	Off Hook
LOGO1	ON	Flash
LOGO2	Flash	ON
LOGO3	Flash	OFF
INUSE	OFF	ON
HANDFREE	When HF=1, HFICON=On or flash; when HF=0, HFICON=Off	
HOLD	When HD=1, HDICON=On or flash; when HD=0, HDICON=Off	
ICON1	When $\overline{\text{ICON1}}$=0, ICON1=On or flash; when $\overline{\text{ICON1}}$=1, ICON1=Off	
ICON2	When $\overline{\text{ICON2}}$=0, ICON2=On or flash; when $\overline{\text{ICON2}}$=1, ICON2=Off	

Note:

On/Off of LOGO1~3 and INUSE are directly controlled by $\overline{\text{HK}}$ pad.

Other icons are controlled by the corresponding input pads.

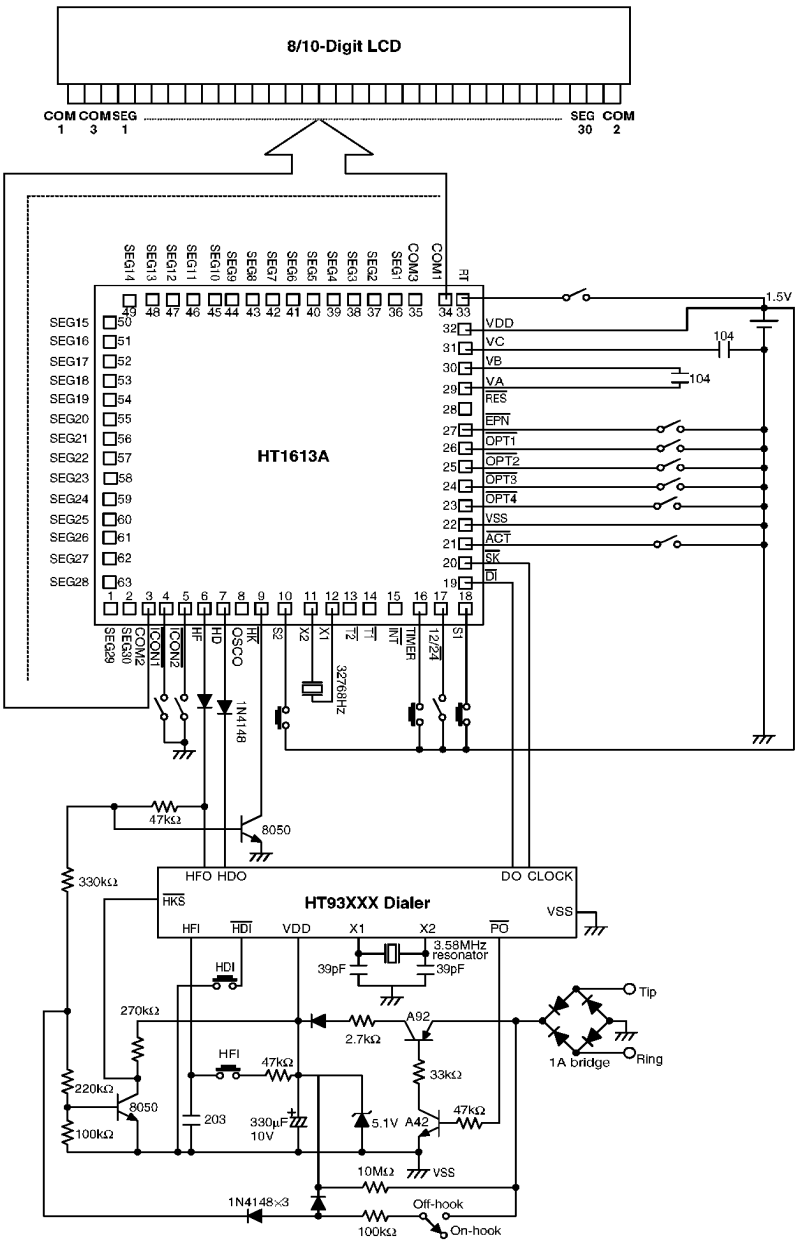
$\overline{\text{OPT1~2}}$ pads control the flash of ICON1~2, the default is no flash.

$\overline{\text{OPT3}}$ controls the flash of HOLD and HANDFREE icons, the default is no flash.

$\overline{\text{OPT}}$ selects the flash rate to be 1s-on/1s-off or 2s-on/2s-off, the default is 2s On/2s Off.

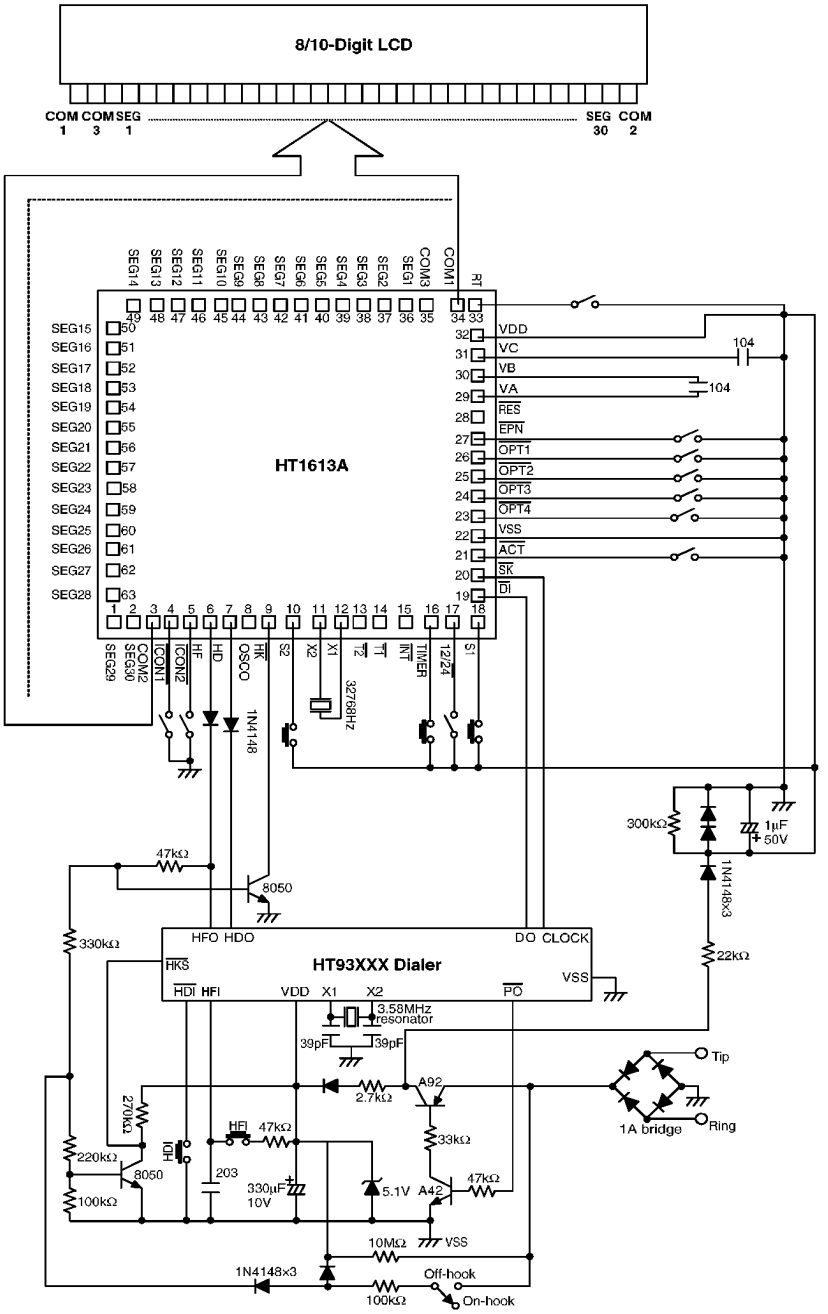
Application Circuits

For telephone interfacing (with batteries)



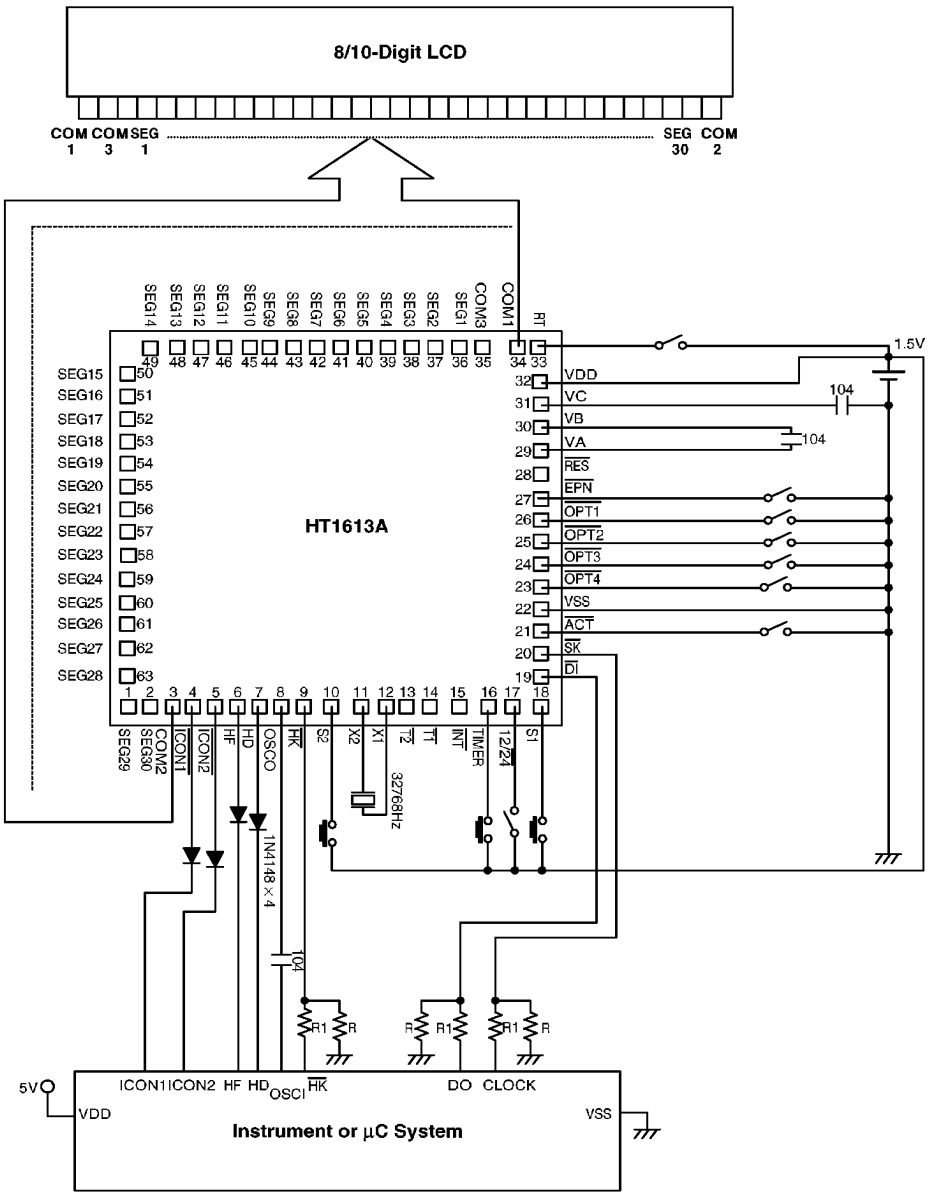
* The IC substrate should be connected to VDD in the PCB layout artwork.

For telephone interfacing (without batteries)



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

For instrument or μC use



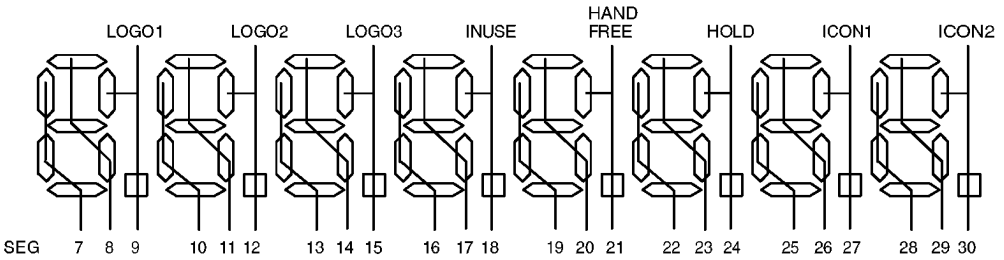
* The IC substrate should be connected to VDD in the PCB layout artwork.

Note: To drive $\overline{SK}$, $\overline{DI}$, and $\overline{HK}$, 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

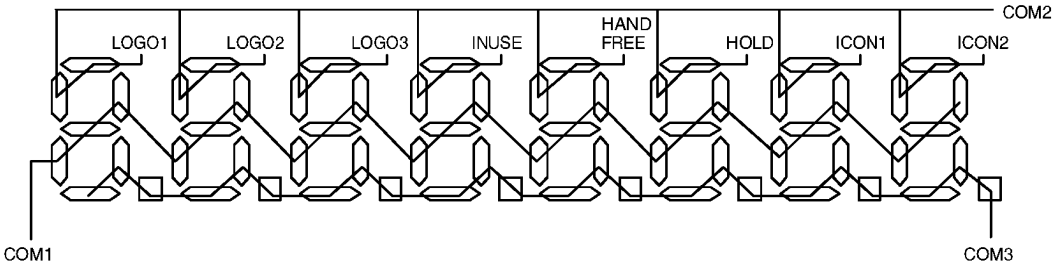
For 8-digit application

• Segment electrode side

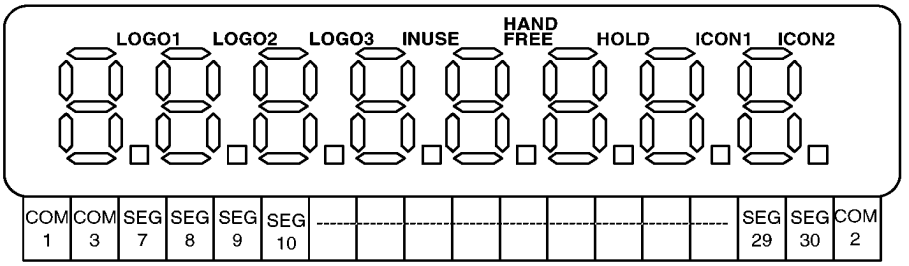


LCD driving system 1/2 bias, 1/3 duty, 3V

• Common electrode side

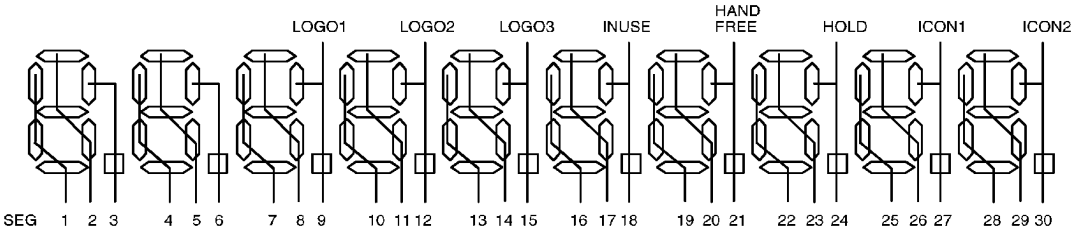


• LCD connection



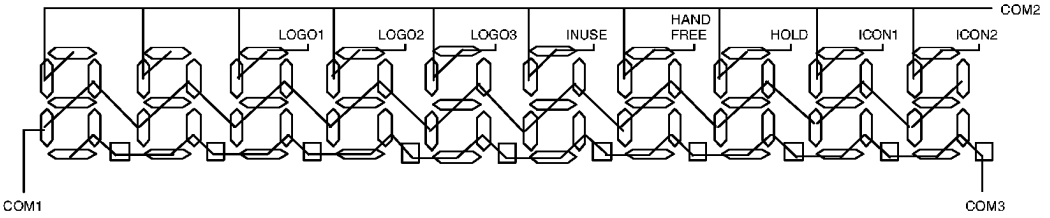
For 10-digit application

• Segment electrode side



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

• Common electrode side



• LCD connection