

DL8015

4-DIGIT COUNT DOWN/UP TIMER

GENERAL DESCRIPTION

The DL8015 is a 4-digit count down/up timer CMOS IC. It can directly drive 4-digit LCD with 1/4 duty cycle and 1/2 bias voltage. It can count down from the set-in time (Max. time is 99m59s or 79m59s) to zero and alarming for 32 seconds (or 64 seconds). Count up cycle is 100 minutes or 80 minutes.

The DL8015 can be widely applied in pillbox timer, kitchen timer, parking alarm timer etc..

FUNCTIONS

- Single battery operation (1.2V ~ 1.8V)
- 4-digit LCD display (XX_mXX_s)
- MIN, SEC set independently
- Max. set-in time 99m59s or 79m59s
- Reset function
- START/STOP function
- Directly drive buzzer
- Alarming at 2048 X 4X 1 Hz for 32 seconds or 64 seconds
- Count-down/up mode or only count-down mode selectable
- Memory function
- 32768 Hz quartz crystal time base
- Built-in voltage doubler
- CMOS structure with low power consumption
- High ESD and Latch up immunity
- Key tone

PIN DESCRIPTION

START/STOP	Start or stop counting control pin with memory function. It is internally pulled down to Vss. The timer will start counting down/up when this key is pressed. During counting down/up, the timer will pause when this key is pressed and then continue counting down/up when it is pressed again. The timer will start counting up when it is pressed if the timer displays 00M00S. During alarming, pressing the key will interrupt alarming and display the previously set-in time (so-called memory function).
MIN	Minutes setting pin for count down mode. MIN can set minutes independently. It is internally pulled down to Vss. Minute is advanced one when the key pressed once. It will be advanced at a rate of 8Hz if MIN pressed for more than 125ms. During counting down/up, the timer will pause when MIN is pressed and will be advanced if pressed again, and then the timer will start counting down from the new set-in time when START/STOP is pressed. During alarming, pressing MIN can interrupt the alarming, and the timer displays 00M00S. Then pressing START/STOP the time will display the previously set-in time. The timer will be reset at any time if MIN and SEC are pressed simultaneously.
SEC	Seconds setting pin for count down mode. SEC can set seconds independently. It is internally pulled down to Vss. Second is advanced one when SEC pressed once. It will be advanced at a rate of 8Hz if SEC pressed for more than 125ms. During counting down/up, the timer will pause when SEC is pressed and will be advanced if pressed again, and then the timer will start counting down from the new set-in time when START/STOP is pressed. During alarming, pressing SEC can interrupt the alarming, and the timer displays 00M00S. Then pressing START/STOP the timer will displays the previously set-in time. The timer will be reset at any time if MIN and SEC are pressed simultaneously.
OSCI, OSCO	Oscillator input and output pins. A 32768 Hz quartz crystal oscillator is connected to the pins to generate system timing.
VDD, Vss	Power supply pins. VDD is positive power supply. Vss is Ground.
BD	Buzzer driving pin. It can directly drive buzzer without external transistor.
VC	Voltage doubler output pin.
VA, VB	Voltage doubler capacitor pins.

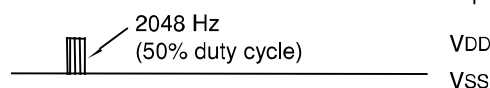
DL8015

SEG1~SEG8	LCD segments driving pins.
COM1-COM4	LCD common driving pins.
TST1, TST2	Test pins
OPT1	Bonding option for max. counting time. The max. time will be 99 minutes 59 seconds when OPT1 is disconnected (internally pulled up to VDD), or 79 minutes and 59 seconds when it is connected to Vss.
OPT2	Bonding option for alarm duration. The alarm time will be 32 seconds when OPT2 is disconnected (internally pulled up to VDD), or 64 seconds when it is connected to Vss.
OPT3	Bonding option for counting up/down or only down mode. Count-down/up mode when OPT3 is disconnected (internally pulled up to VDD), or only count-down mode without count-up when it is connected to Vss.

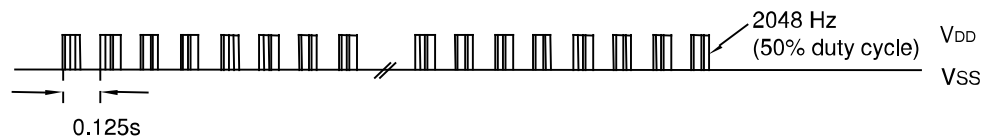
FUNCTIONAL DESCRIPTION

- Power On
After power on, the timer displays 00M00S with an alarming sound.
- Time Setting
The minutes and seconds of counting-down time can be set independently at any time except both MIN and SEC are pressed simultaneously. The max. counting down time is 99 minutes and 59 seconds (or 79 minutes and 59 seconds by OPT1). The resolution of counting is 1 second.
When MIN or SEC is pressed once, the minute or second is advanced once. It will continue advancing at a rate of 8Hz if one of them is pressed for more than 125ms.
- Operation Mode
 - Count-down / up mode:
After time set-in, the timer will start counting down and M and S flash at the rate of 1Hz when the START/STOP is pressed. During counting down or up, the timer will pause counting when any key is pressed, then continue when START/STOP is pressed again. If displays 00M00S, the timer starts counting up when START/STOP is pressed.
During counting down or up, the timer will pause counting when MIN or SEC is pressed. And the timer updates the set-in time value if MIN or SEC is pressed at this cause. For example, when counting down or up to 12M:30S, the timer is paused counting when MIN or SEC is pressed and the timer displays 12M:30S. The time will update to 12M31S if SEC is pressed once or 13M30S if MIN is pressed once. Then pressing STORT/STOP the timer will count down from 12M31S or 13M:30S.
 - Count-down mode:
After time set-in, the timer will start counting down and M and S flash at the rate of 1Hz when the START/STOP is pressed. During counting down, the timer is paused counting when any key is pressed, then continue counting down when START/STOP is pressed.
During counting down, the timer will pause counting when MIN or SEC is pressed. And the timer updates the set-in time value if MIN or SEC is pressed at this cause. For example, when counting down to 12M:30S, the timer is paused counting when MIN or SEC is pressed and the timer displays 12M:30S. The time will update to 12M31S if SEC is pressed once or 13M30S if MIN is pressed once. Then pressing STORT/STOP the timer will count down from 12M31S or 13M:30S.
- Alarm and Memory

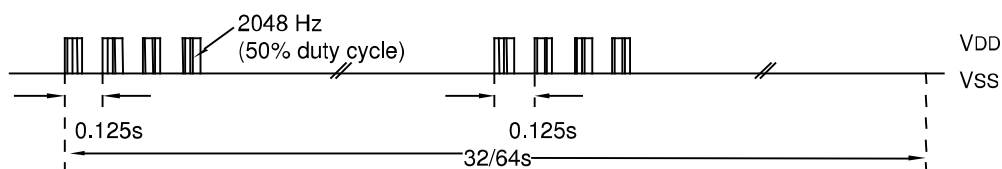
BD outputs waveform below when SEC or MIN or START/STOP is pressed once.



BD outputs waveform below if SEC or MIN is pressed for more than 1 second.



When the timer counts down to zero, it will alarm for 32 seconds (or 64 seconds, optional) as the waveform below and the timer displays 00M00S during alarming.



DL8015

5. Reset

The timer will be clear and outputs 00M00S at any time even during counting down or up when MIN and SEC keys are pressed simultaneously.

ABSOLUTE MAXIMUM RATINGS(Ta = 25 °C)

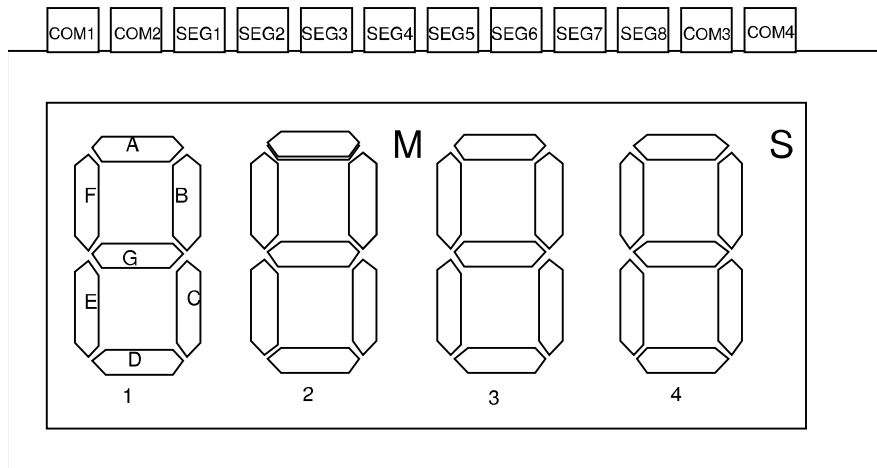
Parameter	Symbol	Limits
Power supply voltage range	V _{SS} - V _{DD}	-0.3 V to +1.8V
Input voltage range	V _{in}	V _{SS} -0.3 to V _{DD} +0.3
Operating temperature range	TA	-20 to +60°C
Storage temperature range	T _{stg}	-40 to +70°C

DC ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, Ta = 25°C, V_{dd} = 1.5V, V_{ss} = 0V, F_{osc} = 32768 Hz)

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Operating voltage range	V _{DD}	1.2	1.5	1.8	V	-
Doubler Output Voltage	V _C	-1.2	-1.5	-1.8	V	-
Supply current	I _{DIS}	-	1.8	3.0	μA	LCD is off (V _{DD} = 1.3V)
LCD Driving Current	I _{LCD}	0.1	-	-	μA	
LCD Display Frequency	F _d	-	64	-	Hz	V _{dd} =1.3V LCD is on
Alarm Output and touch tone Drive Current	I _{BD}	15	-	-	mA	V _o = 0.5V
Alarm Output Frequency	F _{BD}	-	2048x8 x1	-	Hz	-
Frequency Stability	Δ f/f	-	-	10	ppm	V _{DD} = 1.3V to 1.8V
Oscillator Built-in Capacitor	C _D	-	20	-	pF	-
Oscillator Start up Time	T _{OSC}	-	-	1.5	sec	V _{DD} = 1.3V

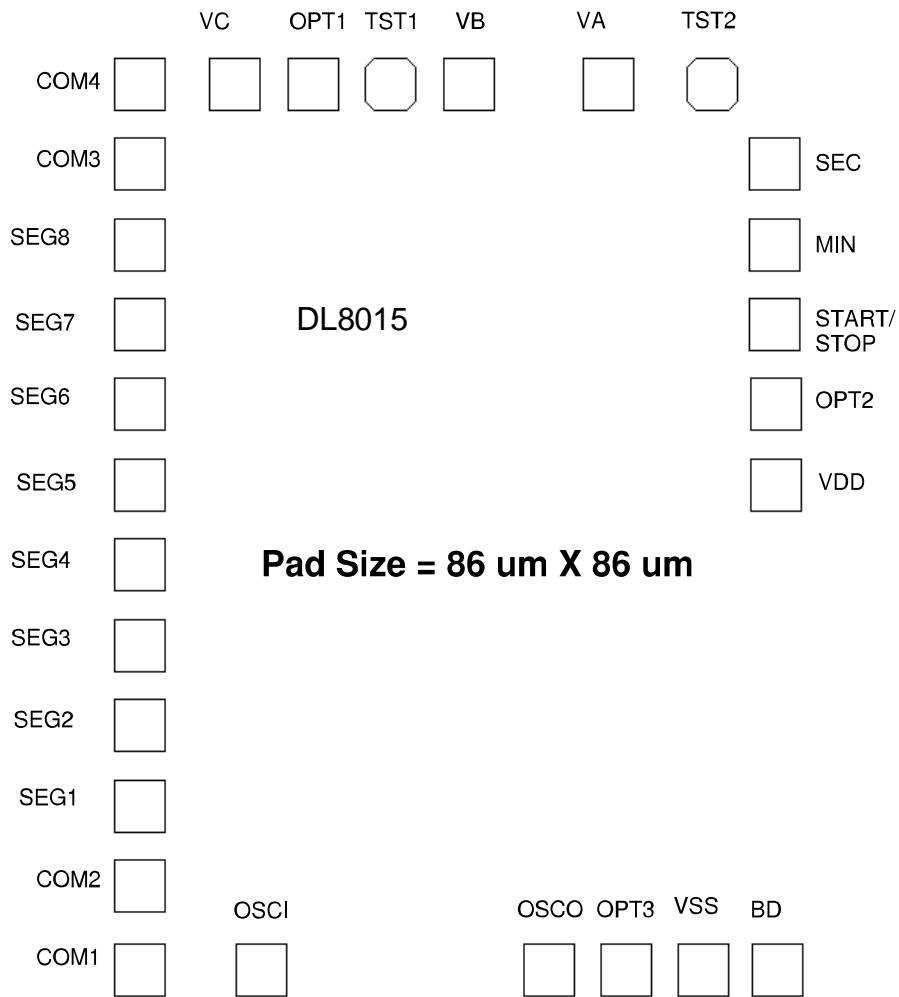
LCD FORMAT



	SEG1	SEG2	SEG3	SEG4	SEG5	SEG6	SEG7	SEG8
COM1	E1	C1	E2	C2	E3	C3	E4	C4
COM2	-	D1	-	D2	M,S	D3	-	D4
COM3	F1	G1	F2	G2	F3	G3	F4	G4
COM4	A1	B1	A2	B2	A3	B3	A4	B4

DL8015

PAD DIAGRAM



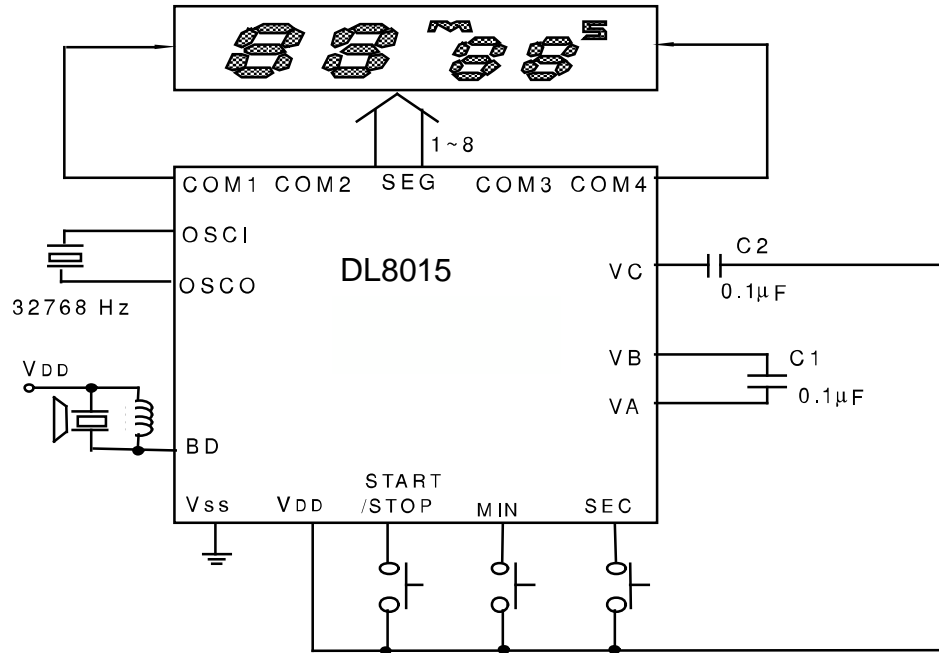
The Coordinate of Low Left Corner For Each Pad

COM1 (-613.5, -766.1)	BD (526.9, -766.1)	TST2 (471.9, 680.5)	SEG8 (-613.5, 418.5)
OSC1 (-408.5, -766.1)	VDD (527.0, 25.5)	VA (274.3, 680.4)	SEG7 (-613.5, 287.5)
OSCO (113.5, -766.1)	OPT2 (527.0, 156.5)	VB (-60.2, 680.5)	SEG6 (-613.5, 156.5)
OPT3 (264.5, -766)	START (526.9, 287.5)	TST1 (-175.9, 680.5)	SEG5 (-613.5, 25.5)
VSS (395.6, -766)	/STOP	OPT1 (-322.2, 680.5)	SEG4 (-613.5, -105.5)
	MIN (526.9, 418.5)	VC(-453.2, 680.5)	SEG3 (-613.5, -236.5)
	SEC (526.9, 549.5)	COM4 (-613.5, 680.5)	SEG2 (-613.5, -367.5)
		COM3 (-613.5, 549.5)	SEG1 (-613.5, -498.5)
			COM2 (-613.5, -629.5)

DL8015

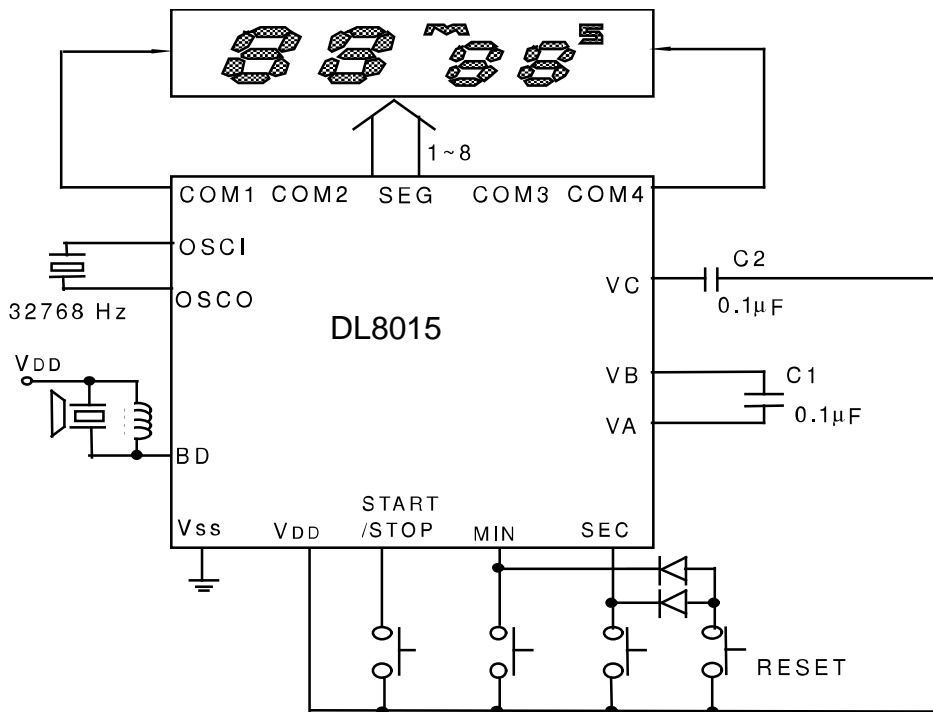
APPLICATION CIRCUIT

(1) Three Keys Application



Note: Substrate must be connected to VDD.

(2) Four Keys Application



Note: Substrate must be connected to VDD.