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SANYO Semiconductors
DATA SHEET

Monolithic Digital IC

LB11948T — PWM Constant Current Control 1-2 Phase Excitation Stepping Motor Driver

Overview

The LB11948T is a low saturation voltage output PWM current control bipolar drive stepping motor driver. It is optimal for use as the driver for the miniature low-voltage stepping motors used in portable electronic equipment such as portable thermal printers.

Features

- PWM current control (external excitation)
- Simultaneous on state prevention function (through current prevention)
- Thermal shutdown circuit
- Noise canceller function
- Low-power mode control pin

Specifications

Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
VS supply voltage	VS		–0.3 to +18	V
Logic system supply voltage	V_{CC}		–0.3 to +18	V
Peak output current	$I_O$peak	tW ≤ 20 μS	0.5	A
Continuous output current	$I_O$max		0.4	A
Emitter output voltage	VE		1.0	V
Input voltage	VIN		–0.3 to V_{CC}	V
Allowable power dissipation	Pdmax	Mounted on the specified PCB*	1.2	W
Operating temperature	Topg		–20 to +85	°C
Storage temperature	Tstg		–40 to +150	°C

Note *: Specified PCB: 114.3 × 76.1 × 1.6 mm

Recommended Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
VS supply voltage	VS		3.0 to 15	V
V_{CC} supply voltage	V_{CC}		3.0 to 15	V
Reference voltage	V_{REF}		0.0 to 0.5	V

Electrical Characteristics at Ta = 25°C, V_S = V_{CC} = 5 V, V_{REF} = 0.3 V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
[Output Block]						
V_S system supply current	I_{VS} OFF	PH1 = PH2 = 0 V, EN1 = EN2 = 3.0 V ST = 3.0 V			5	μA
	I_{VS} ON	PH1 = PH2 = EN1 = EN2 = 0 V ST = 3.0 V	28	40	52	mA
	I_{VS} wt	PH1 = PH2 = EN1 = EN2 = ST = 0 V			1	μA
Output saturation voltage 1	V_O(sat) 1	I_O = +0.2A (source)		0.2	0.4	V
Output saturation voltage 2	V_O(sat) 2	I_O = +0.4A (source)		0.3	0.5	V
Output saturation voltage 3	V_O(sat) 3	I_O = –0.2A (sink)		0.2	0.4	V
Output saturation voltage 4	V_O(sat) 4	I_O = –0.4A (sink)		0.3	0.5	V
Output leakage current	I_O1 (leak)	V_O = V_{BB} (sink)			50	μA
	I_O2 (leak)	V_O = 0 V (source)	–50			μA
Upper and lower side output diodes						
Forward voltage 1 (upper side)	VF1	I = 400 mA	0.9	1.1	1.3	V
Forward voltage 2 (lower side)	VF2	I = 400 mA	0.9	1.1	1.3	V
[Logic Block]						
V_{CC} system supply current	I_{CC} OFF	PH1 = PH2 = 0 V, EN1 = EN2 = 3.0 V ST = 3.0 V	6.5	10	13.5	mA
	I_{CC} ON	PH1 = PH2 = EN1 = EN2 = 0 V ST = 3.0 V	7	11	15	mA
	I_{CC} wt	PH1 = PH2 = EN1 = EN2 = ST = 0 V			1	μA
Input voltage	VI on		2.0			V
	VI off				0.8	V
Input current	I_{IN}	VIN = 5 V	70	100	130	μA
Reference voltage: 1 V	V1V	I_O = 1 mA	0.95	1	1.05	V
Current setting reactive current	IE		–22	–17	–10.5	mA
Reference current	IREF	V_{REF} = 0.3 V, VE = 0.3 V	–1			μA
CR pin current 1	ICR1	CR = 0.5 V	–2			μA
CR pin current 2	ICR2	CR = 3 V	1.65	2.2	2.75	mA
Sense voltage 1	VSEN1	V_{REF} = 0.5 V	0.475	0.5	0.525	V
Thermal shutdown temperature *	TS	*		170		°C

Note *: Design guarantee value

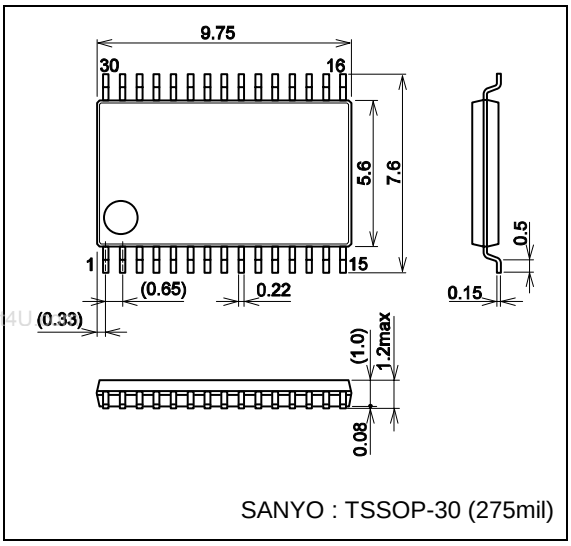
Truth Table

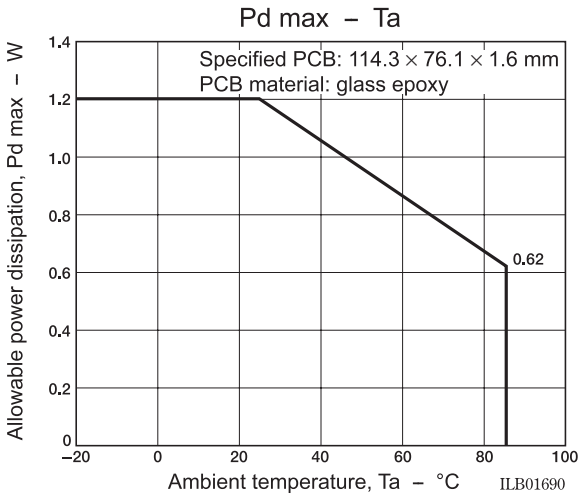
	Channel 1				Channel 2			
Input	Input		Output		Input		Output	
ST	PHASE1	ENABLE1	OUTA–	OUTA	PHASE2	ENABLE2	OUTB–	OUTB
H	L	L	H	L	L	L	H	L
H	H	L	L	H	H	L	L	H
H	*	H	OFF	OFF	*	H	OFF	OFF
L	*	*	OFF	OFF	*	*	OFF	OFF

Note *: Levels shown as an asterisk (*) can be set to be either high or low.

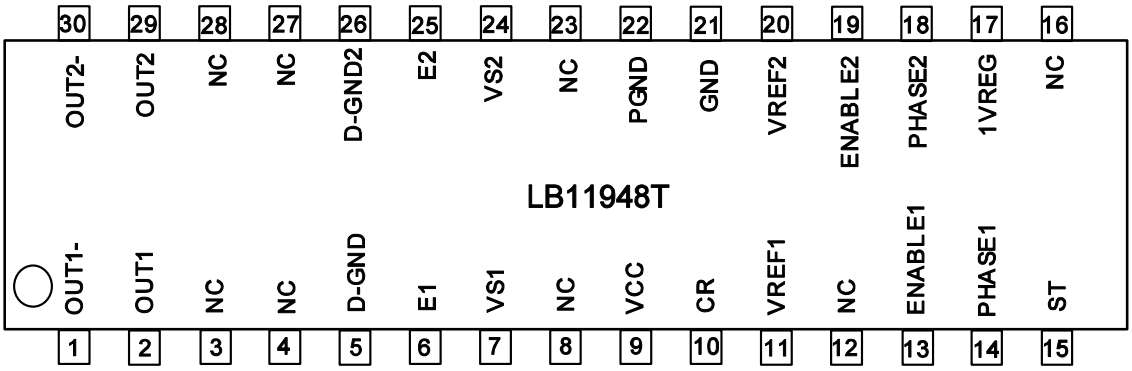
Package Dimensions

unit: mm
3259





Pin Assignment

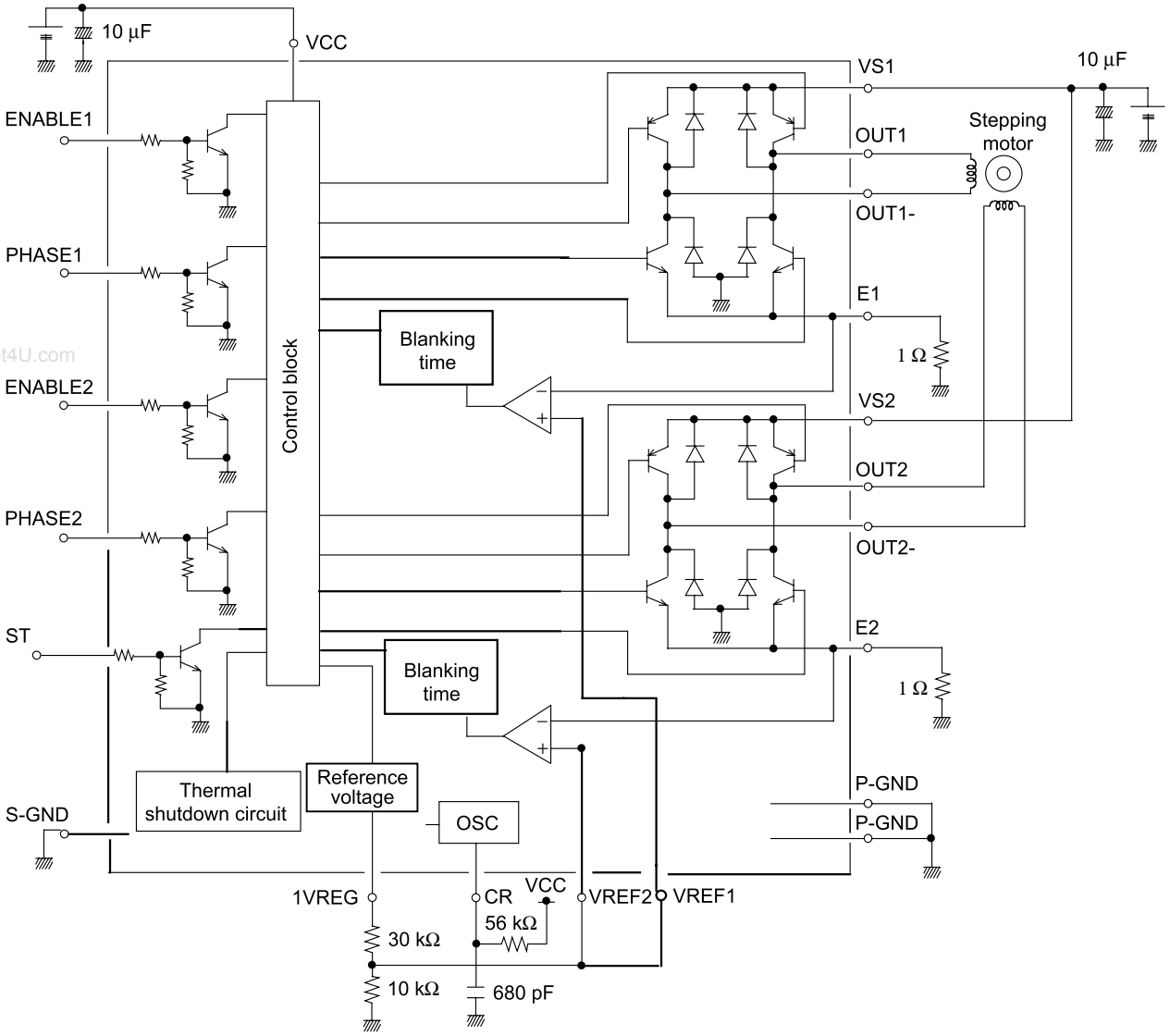


Top view

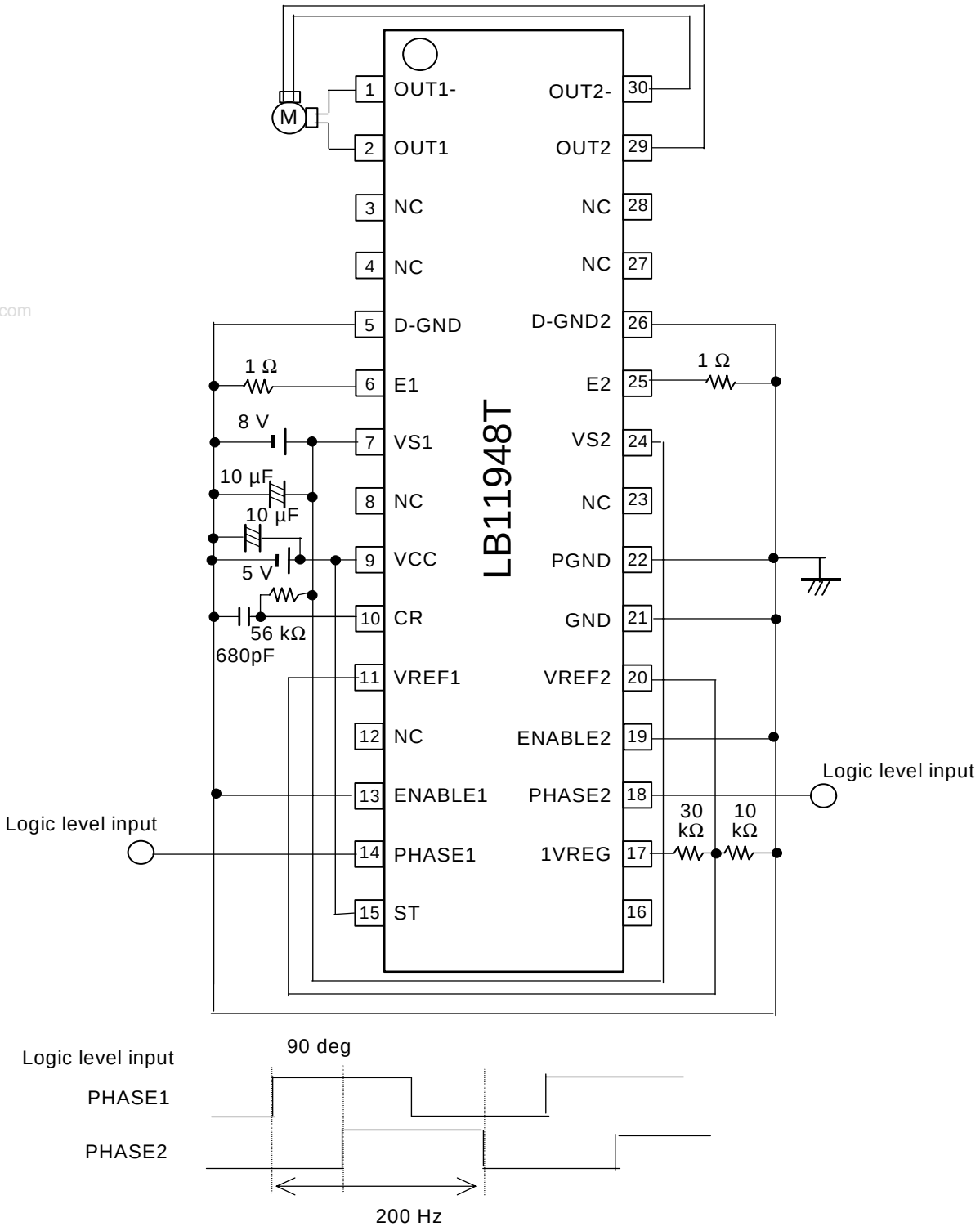
Pin Functions

Pin No.	Symbol	Functional descriptions
1	OUT1–	Output
2	OUT1	Output
3	NC	Unused
4	NC	Unused
5	D–GND	Lower side internal diode anode connection
6	E1	Constant current control sensing The motor current is set by the value of the sensing resistor Re connected between the E1 pin and ground. The current is set according to the following equation: I_O = VREF/Re (A)
7	VS1	VS power supply
8	NC	Unused
9	V_{CC}	V_{CC} power supply
10	CR	RC oscillator connection
11	VREF1	Current setting system reference voltage input VREF1 voltage range: 0 to 0.5 V
12	NC	Unused
13	ENABLE1	Logic level input The output is turned off when ENABLE1 is low, and the outputs are turned on (operating state) when ENABLE2 is high.
14	PHASE1	Logic level input: phase switching When PHASE1 = high: Output pin states: OUTA: high, OUTA-: low. When PHASE1 = low: Output pin states: OUTA: low, OUTA-: high.
15	ST	Standby mode setting When ST = high: the IC operates in normal operating mode. When ST = low: the IC operates in standby mode. The V_S and V_{CC} current drain levels are under 1 μA in this mode.
16	NC	Unused
17	1VREG	1 V regulator circuit output The LB11948 includes an internal 1 V regulator circuit, and this pin is the output from that circuit. The VREF1 and VREF2 reference voltages can be set by voltage dividing the 1 V regulator output.
18	PHASE2	Logic level input: phase switching When PHASE2 = high: Output pin states: OUTA: high, OUTA-: low. When PHASE2 = low: Output pin states: OUTA: low, OUTA-: high.
19	ENABLE2	Logic level input The output is turned off when ENABLE1 is low, and the outputs are turned on (operating state) when ENABLE2 is high.
20	VREF2	Current setting reference voltage input VREF2 voltage range: 0 to 0.5 V
21	GND	Ground (small signal circuit system ground)
22	PGND	Power system ground (high current circuit system ground)
23	NC	Unused
24	VS2	VS power supply
25	E2	Constant current control sensing The motor current is set by the value of the sensing resistor Re connected between the E2 pin and ground. The current is set according to the following equation: I_O = VREF/Re (A)
26	D–GND	Lower side internal diode anode connection
27	NC	Unused
28	NC	Unused
29	OUT2	Output
30	OUT2–	Output

Block Diagram



Sample Application Circuit



Drive Sequence Table

2 Phase Excitation Drive Sequence

Table 1 Clockwise drive

No.	PHASE1	ENABLE1	OUT1	OUT1–	PHASE2	ENABLE2	OUT2	OUT2–
0	0	0	0	1	0	0	0	1
1	1	0	1	0	0	0	0	1
2	1	0	1	0	1	0	1	0
3	0	0	0	1	1	0	1	0

Table 2 Counterclockwise drive

No.	PHASE1	ENABLE1	OUT1	OUT1–	PHASE2	ENABLE2	OUT2	OUT2–
0	0	0	0	1	1	0	1	0
1	1	0	1	0	1	0	1	0
2	1	0	1	0	0	0	0	1
3	0	0	0	1	0	0	0	1

1-2 Phase Excitation Drive Sequence

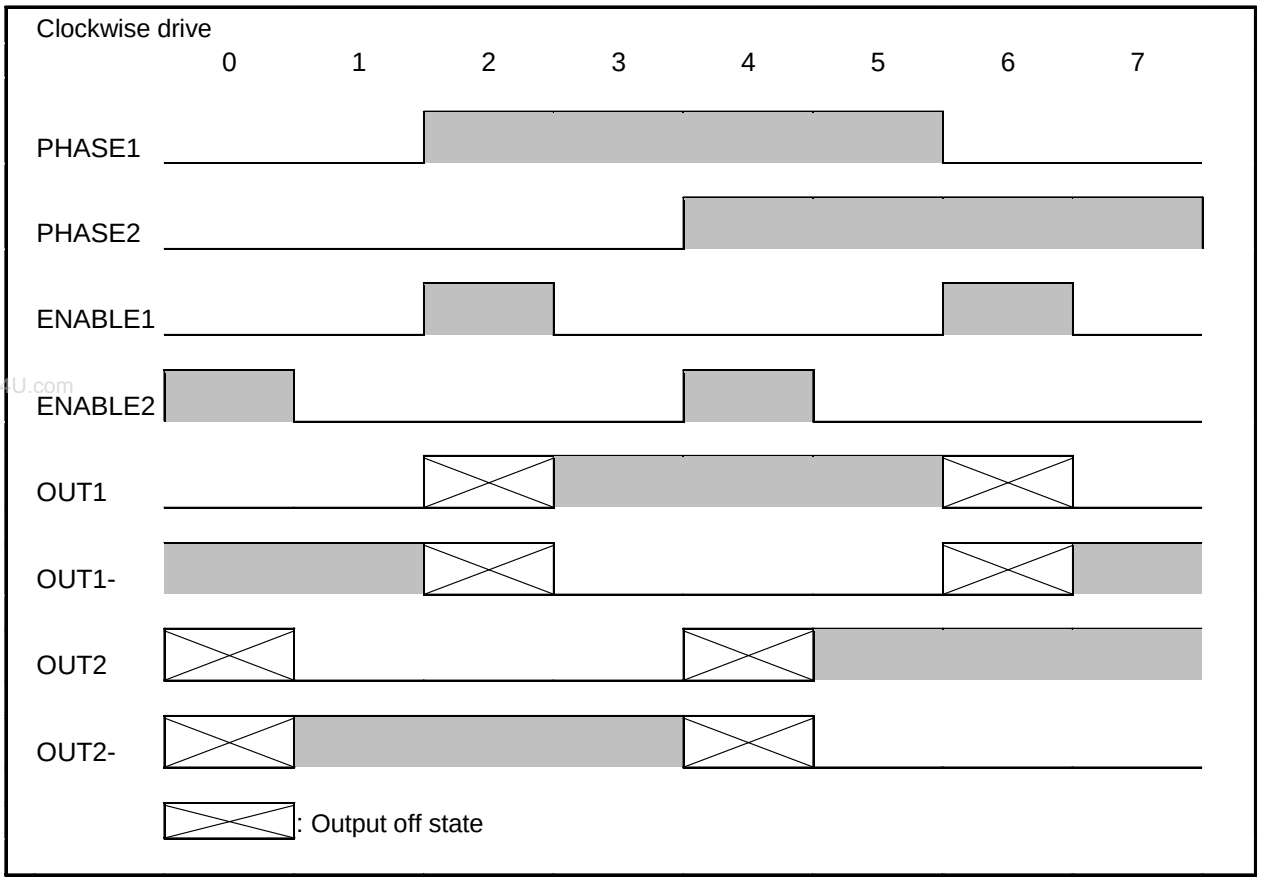
Table 3 Clockwise drive

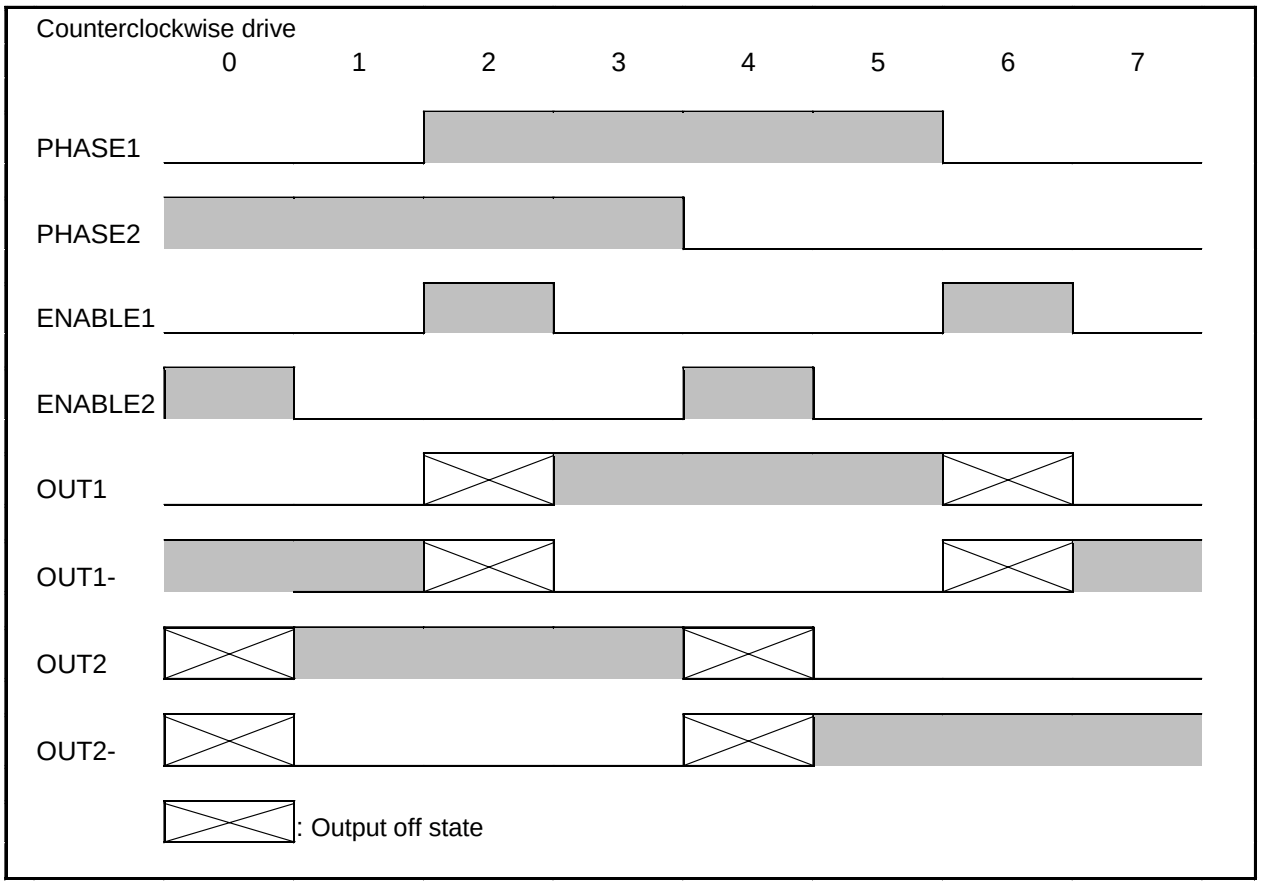
No.	PHASE1	ENABLE1	OUT1	OUT1–	PHASE2	ENABLE2	OUT2	OUT2–
0	0	0	0	1	0	1	OFF	OFF
1	0	0	0	1	0	0	0	1
2	1	1	OFF	OFF	0	0	0	1
3	1	0	1	0	0	0	0	1
4	1	0	1	0	1	1	OFF	OFF
5	1	0	1	0	1	0	1	0
6	0	1	OFF	OFF	1	0	1	0
7	0	0	0	1	1	0	1	0

Table 4 Counterclockwise drive

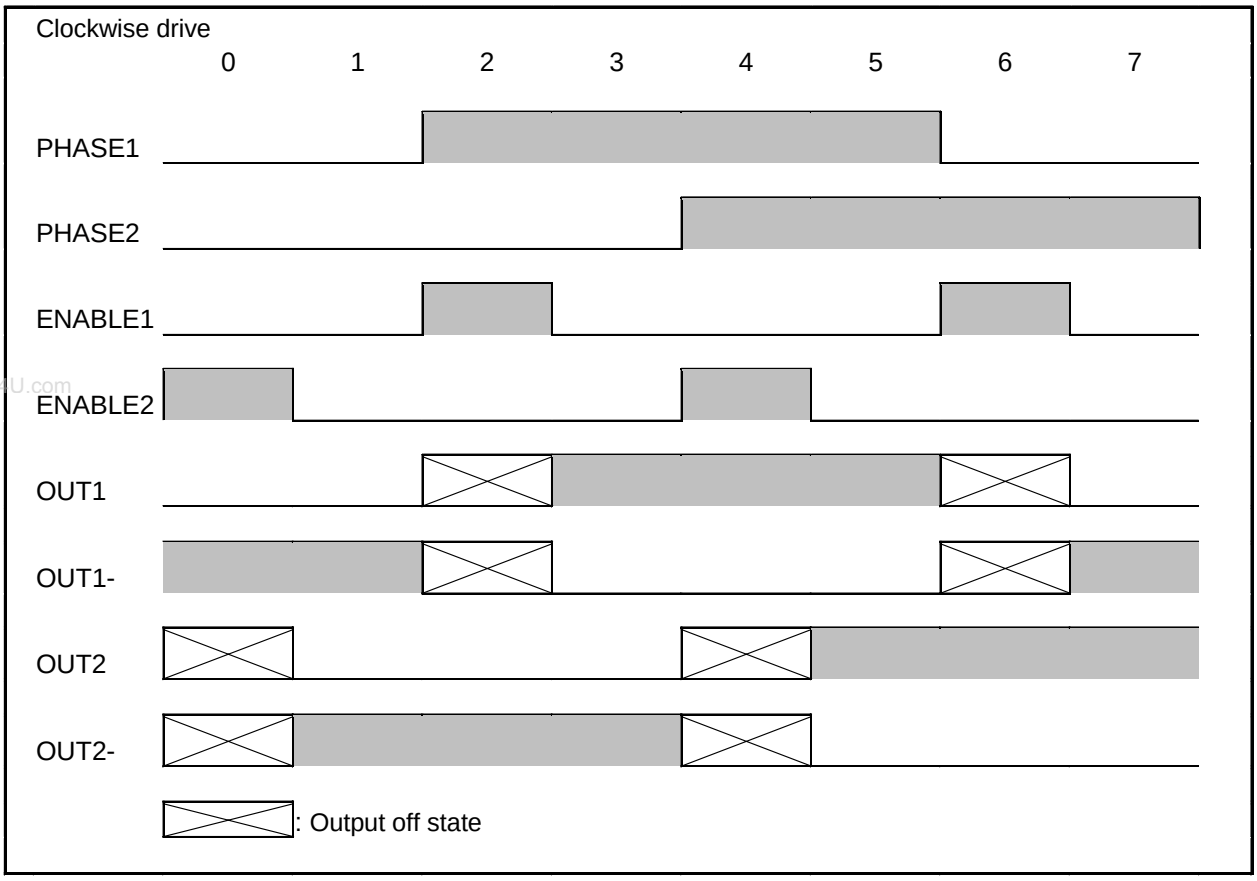
No.	PHASE1	ENABLE1	OUT1	OUT1–	PHASE2	ENABLE2	OUT2	OUT2–
0	0	0	0	1	1	1	OFF	OFF
1	0	0	0	1	1	0	1	0
2	1	1	OFF	OFF	1	0	1	0
3	1	0	1	0	1	0	1	0
4	1	0	1	0	0	1	OFF	OFF
5	1	0	1	0	0	0	0	1
6	0	1	OFF	OFF	0	0	0	1
7	0	0	0	1	0	0	0	1

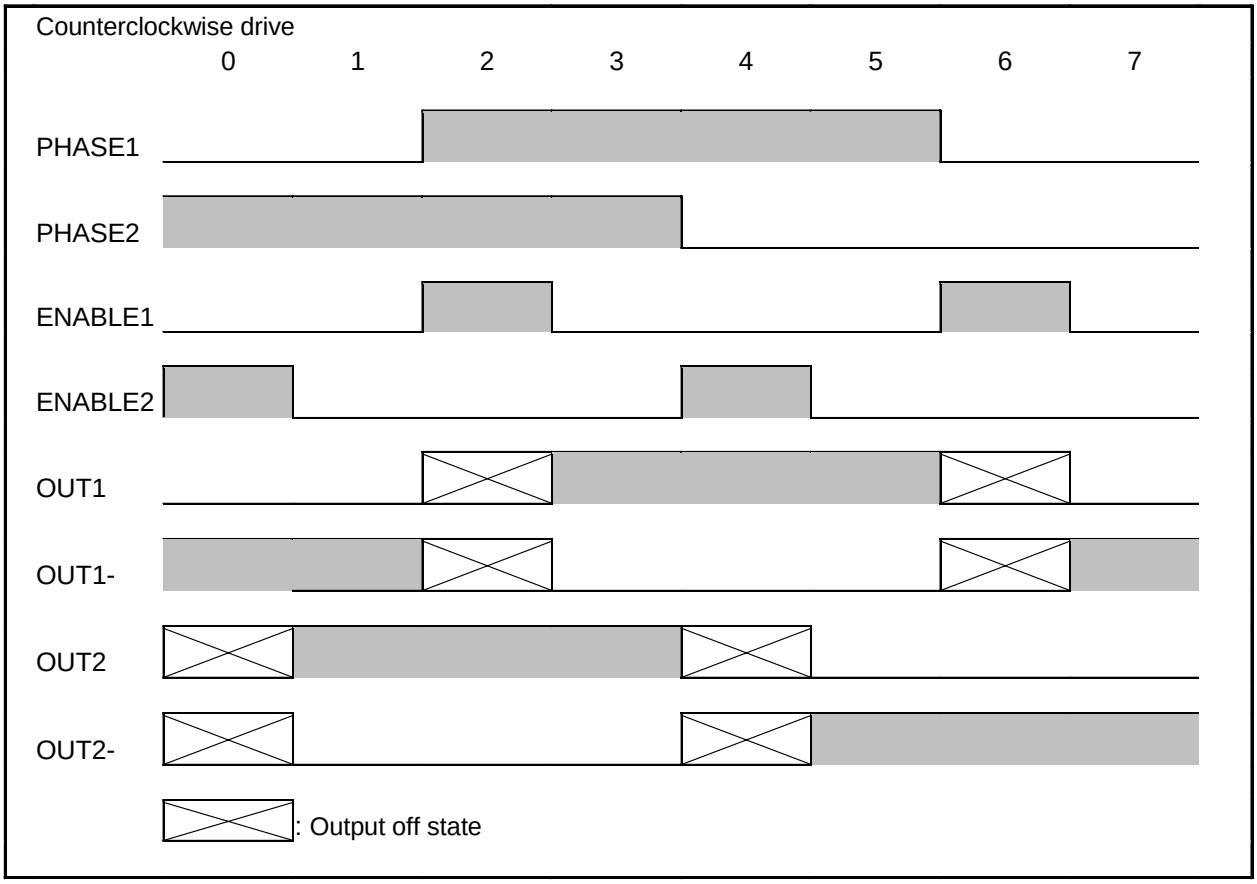
2 Phase Excitation Drive Sequence



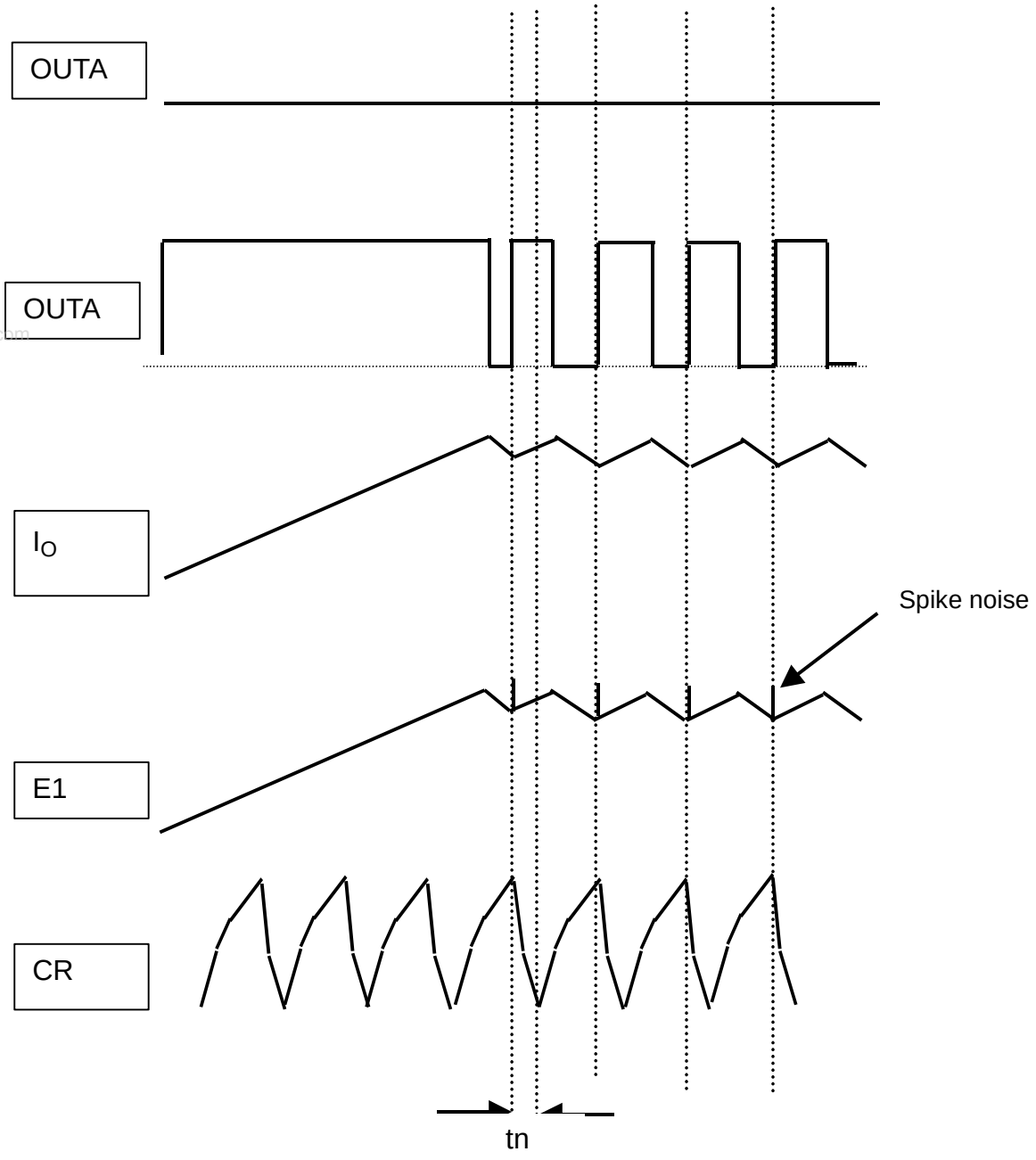


1-2 Phase Excitation Drive Sequence





Switching Operation Timing Chart



tn: The noise canceller operating time

Usage Notes

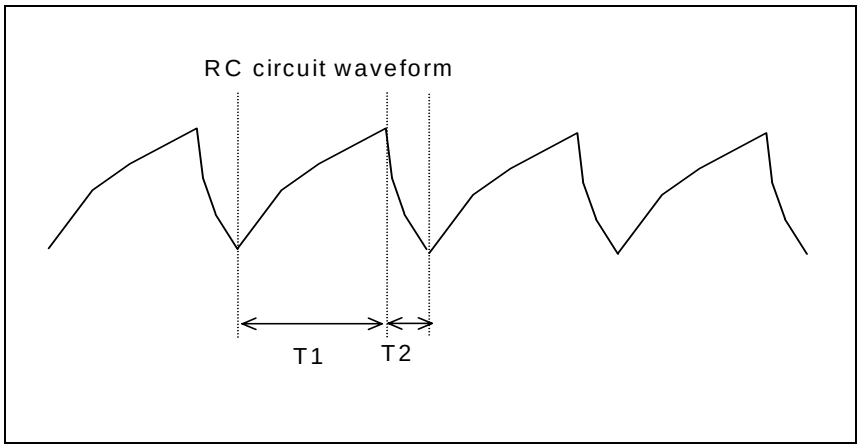
Simplified Formulas for Determining Resistor and Capacitor Values

The formulas for setting the rise time (T1) and the fall time (T2) for the RC oscillator are shown below.

$T1 \approx 0.44C \cdot R$ (s)

$T2 \approx 0.72 \cdot (C \cdot R \cdot 100)/(R + 1000)$ (s)

Set the oscillator frequency using the simplified formulas shown above.
Note that the T2 triangle wave fall time is the noise canceller circuit operating time.



Setting the Constant Current Level

The reference voltage VREF1 and VREF2 can be set by voltage dividing the 1 V regulator output.
The output current is set by the voltage applied to the VREF pins and the resistors RE connected between the E1 and E2 pins and ground.

The output current is set according to the following equation: $I_O = VREF/Re$ (A)

VREF voltage operating range: 0 to 1 V
E1 pin voltage range: 0 to 1 V

Notes on the VREF Pins

- Since the VREF pins are the input pins for the reference voltage used to set the current, applications must be designed so that noise that could influence circuit operation does not occur at these pins.

Notes on the Ground Pins

Since this IC switches large currents, the following notes on ground lines must be observed.

- The PCB pattern lines in areas that handle large currents must be as wide as possible so as to have low impedances, and must be kept as far as possible from the small signal systems.
- The ground terminals on the sensing resistors Re connected to the E pins (E1 and E2) must be connected as close as possible to the IC GND (pin 21), PGND (pin 22), or DGND (pins 5 and 26) pins as possible.
- The capacitors between V_{CC} and ground and between V_{BB} and ground must be as close as possible to the corresponding V_{CC} and V_{BB} pin in the pattern.

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