LV8080LP

ON Semiconductor®

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Bi-CMOS LSI

Two channels Constant-current H-bridge Driver Application Note

Overview

The LV8080LP is a two-channel constant-current driver that supports low-voltage operation. It is optimal for constant-current drive of stepping motors (AF and zoom) in portable equipment such as camera cell phones.

Function

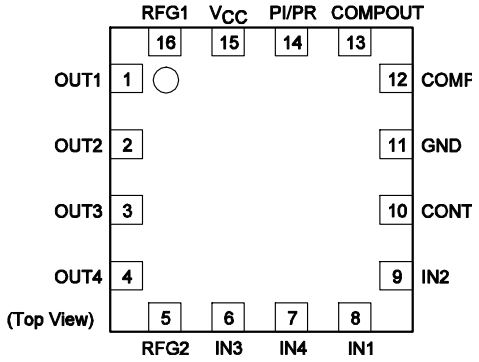
- Two channels constant-current H-bridge driver
- Built-in power supply switch and position detection comparator for use with a photoreflector
- Supports both 2-phase drive and 1-2 phase drive.
- Implemented in a low-power MOS IC process.
- Ultraminiature easy- to- solder VCT16 package (2.6 × 2.6mm)
- Built-in thermal protection and low-voltage sensing circuits

Typical Applications

- DSC
- Security Camera
- Pocket movie
- TOY
- POS, Card Reader
- Paintings and writings camera

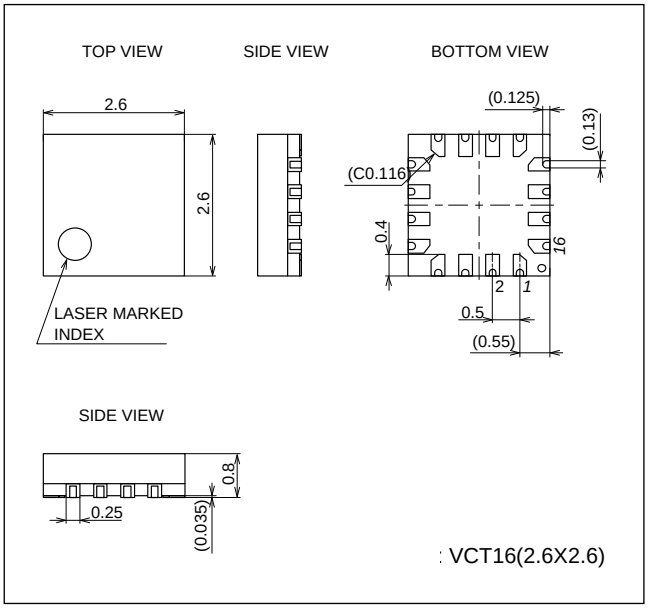
Pin Assignment

(VCT16)

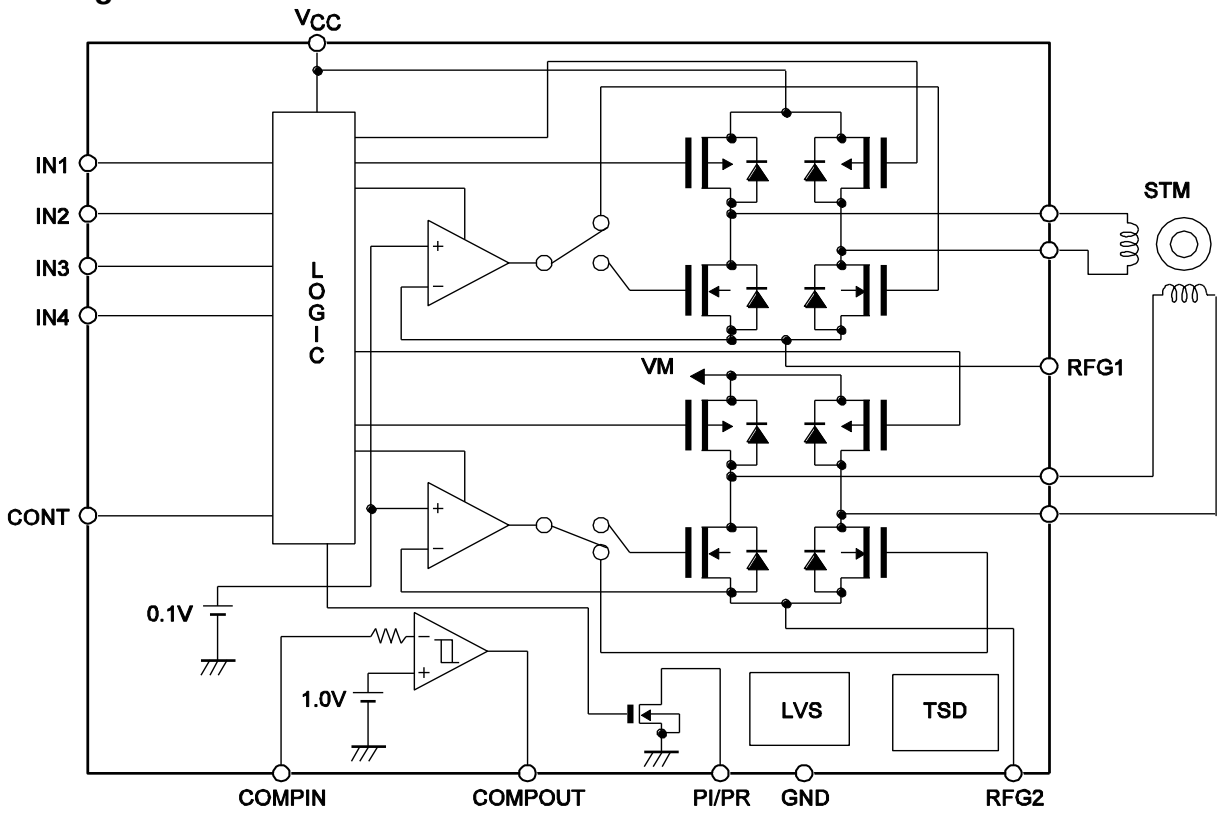


Package Dimensions

unit : mm (typ)



Block Diagram



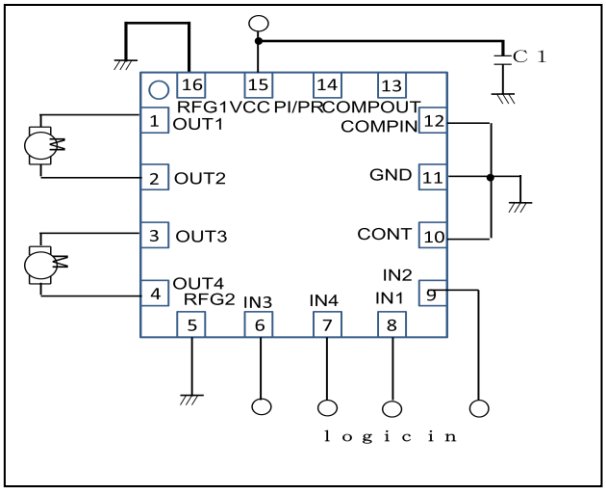
Constant-current calculation: I_{OUT} = 0.1 ÷ RF Example : When an I_{OUT} of 100mA is required, RF must be 1Ω.

Usage Notes

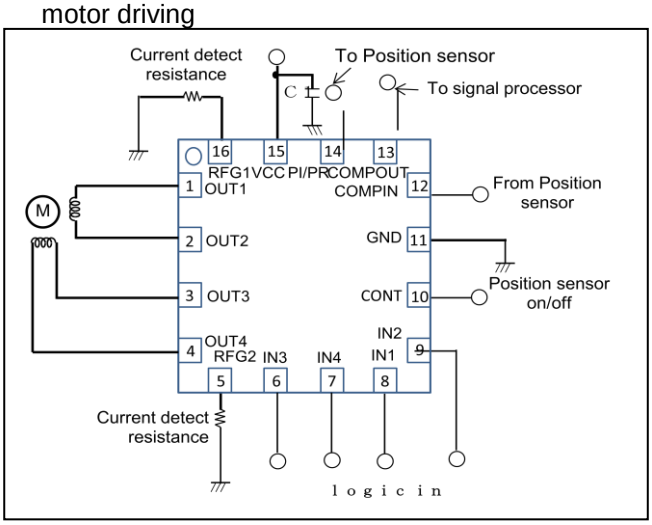
The constant current is set by the resource RF connected between RFG and ground according to the formula shown above.

Application Circuit Example

1. Example of applied circuit with two DC motor driving

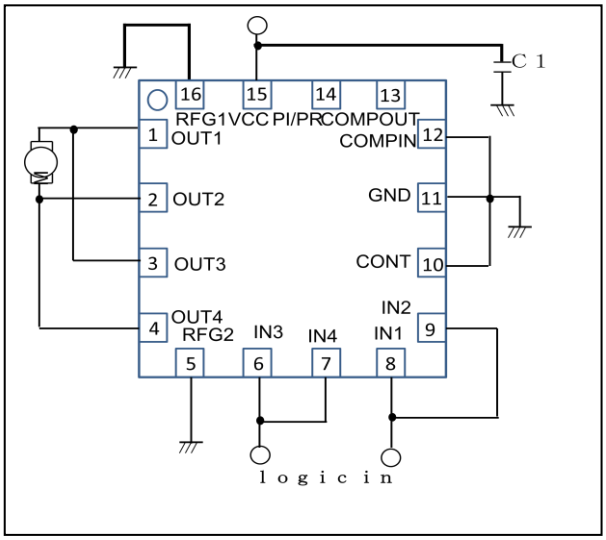


2. Example of applied circuit with one stepping motor driving



3. Example of applied circuit when connecting in parallel

The use likened to H bridge 1ch is shown possible in the figure below by connecting IN1 with IN3, IN2 with IN4, OUT1 with OUT3, OUT2, and OUT4. (I_O max = 0.8A, Upper and lower total R_{ON} = 1.35Ω)



Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC}, VM max		6.5	V
Output voltage	V_{OUT} max	OUT1, OUT2, OUT3, OUT4	6.5	V
Input voltage	V_{IN} max	CONT, IN	-0.3 to +6.5	V
Ground pin source current	IGND	Per channel	400	mA
Allowable power dissipation	Pd max	Mounted on a circuit board.*	700	mW
Operating temperature	Topr		-30 to +85	°C
Storage temperature	Tstg		-40 to +150	°C

* Specified circuit board : 40×50×0.8mm^3 : 4-layer (2S2P) glass epoxy printed circuit board

Caution 1) Absolute maximum ratings represent the value which cannot be exceeded for any length of time.

Caution 2) Even when the device is used within the range of absolute maximum ratings, as a result of continuous usage under high temperature, high current, high voltage, or drastic temperature change, the reliability of the IC may be degraded. Please contact us for the further details.

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

Recommended Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply voltage	V_{CC}		2.5		6.0	V
High-level input voltage	V_{IH}	CONT, IN	$0.6V_{CC}$		$0.6V_{CC}<$	V
Low-level input voltage	V_{IL}				$0.2V_{CC}$	V

Electrical Characteristics at Ta = 25°C, V_{CC} = 3.0V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Current drain	I_{CCO}	EN = 0V		0.1	1	μA
	$I_{CCO}1$	EN = 3V		0.7	1	mA
Output on resistance	Ron1	V_{CC} = 3.0V (High and low side total) EN = 3.0V, I_{OUT} = 100mA		2.0	3.0	Ω
	Ron2	V_{CC} = 5.0V (High and low side total) EN = 5.0V, I_{OUT} = 100mA		1.50	2.0	Ω
Constant-current output 1	$I_{OUT}1$	Between RFG and ground : 1Ω	95	100	105	mA
Constant-current output 2	$I_{OUT}2$	Between RFG and ground : 0.5Ω (Design specification)	190	200	210	mA
Output turn-on time	Traise	With RFG1 and RFG2 shorted to ground (Design specification)		1.3	3	μs
Output turn-off time	Tfall	With RFG1 and RFG2 shorted to ground (Design specification)		0.25	0.65	μs
Position detection voltage (high level)	V_H			1.0	1.06	V
Position detection voltage (low level)	V_L		0.74	0.8		V
Detection voltage hysteresis	HYS		0.165	0.18	0.195	V
PI/PR pin current	IPI/PR				20	mA
Input current	I_{IN}	V_{IN} = 3V		15	30	μA

Note : The design specification items are design guarantees and are not measured.

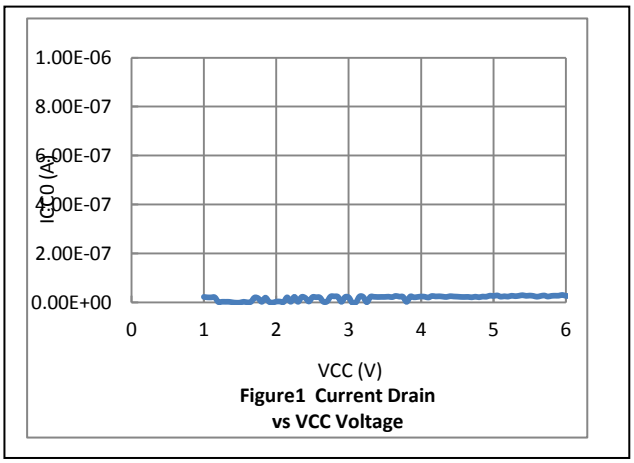


Figure1 Current Drain vs VCC Voltage

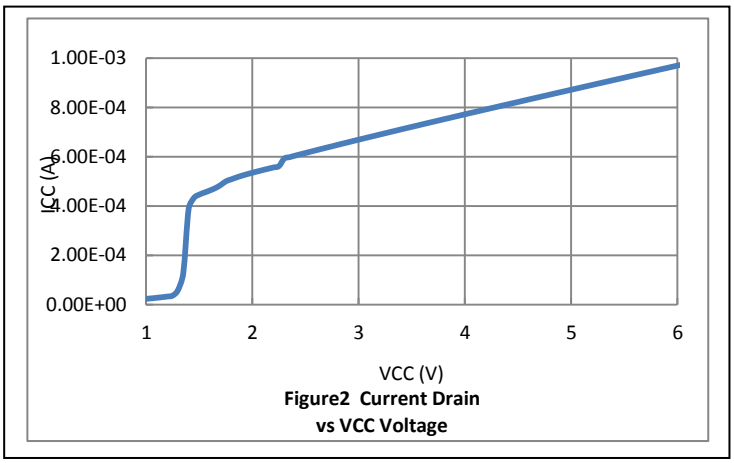


Figure2 Current Drain vs VCC Voltage

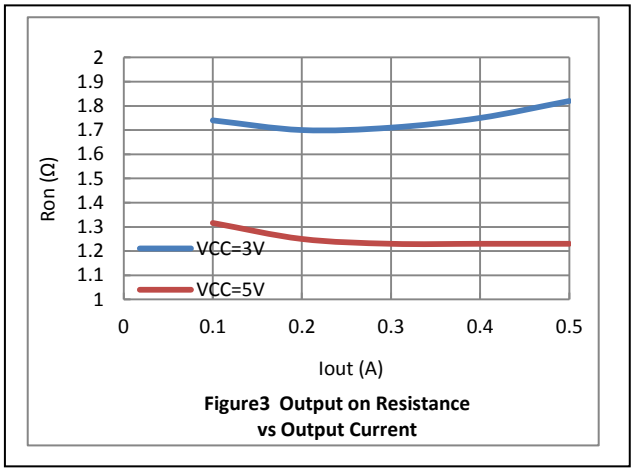


Figure3 Output on Resistance vs Output Current

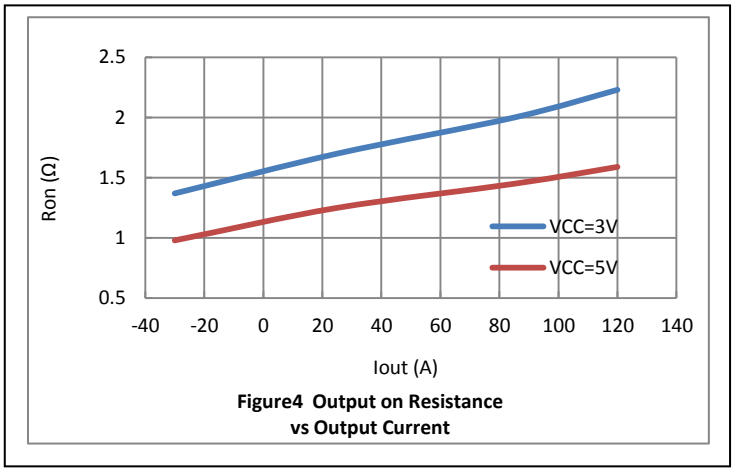


Figure4 Output on Resistance vs Output Current

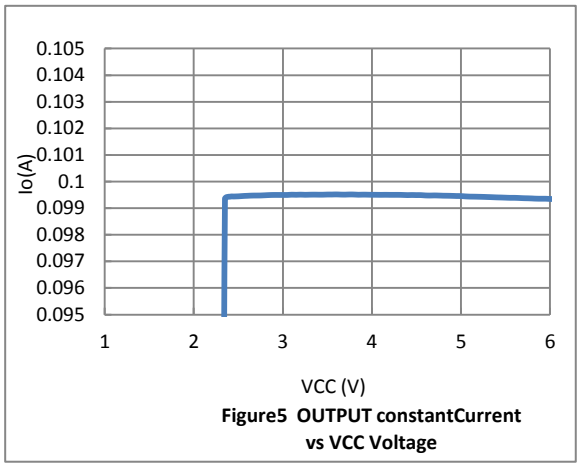


Figure5 OUTPUT constantCurrent vs VCC Voltage

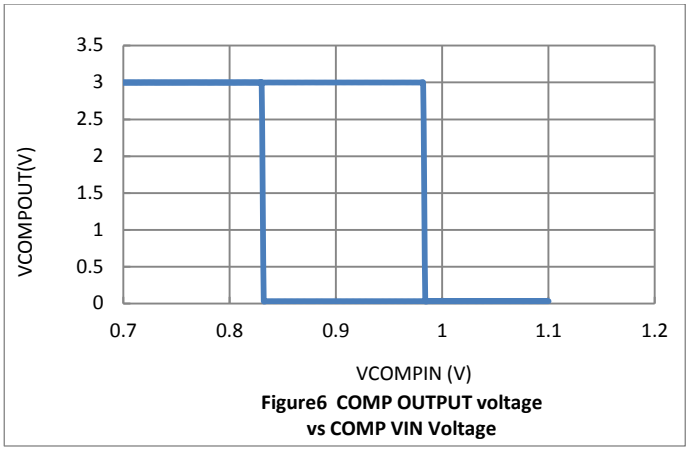


Figure6 COMP OUTPUT voltage vs COMP VIN Voltage

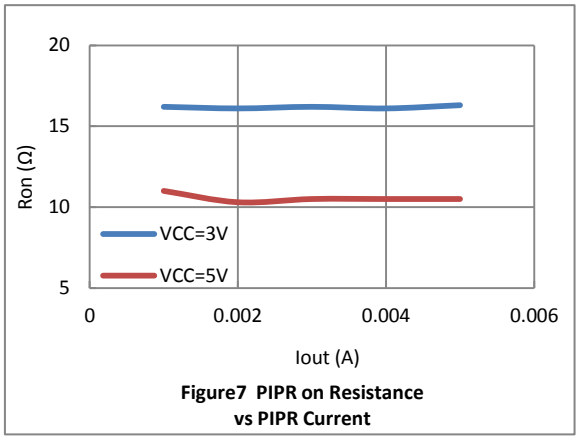


Figure7 PIPR on Resistance vs PIPR Current

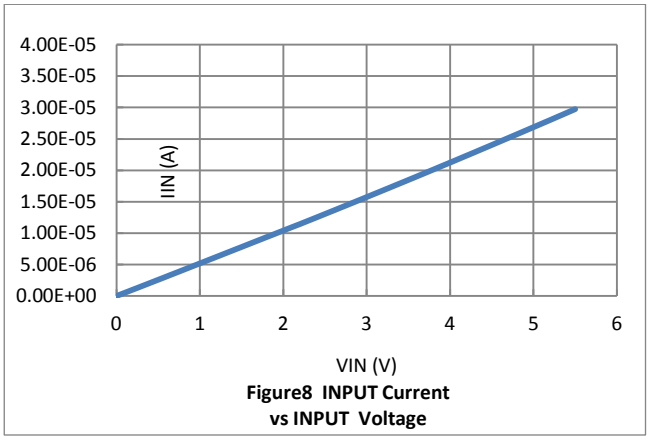


Figure8 INPUT Current vs INPUT Voltage

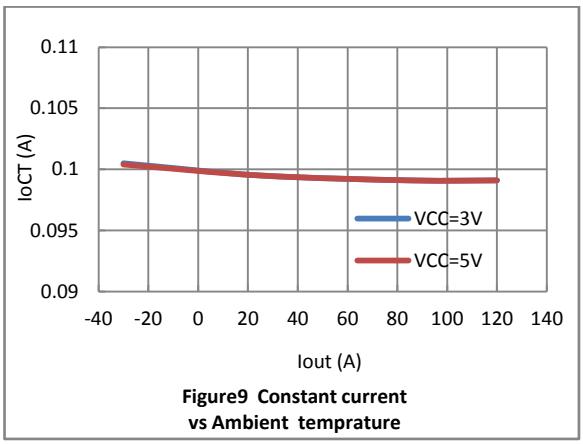


Figure9 Constant current vs Ambient temprature

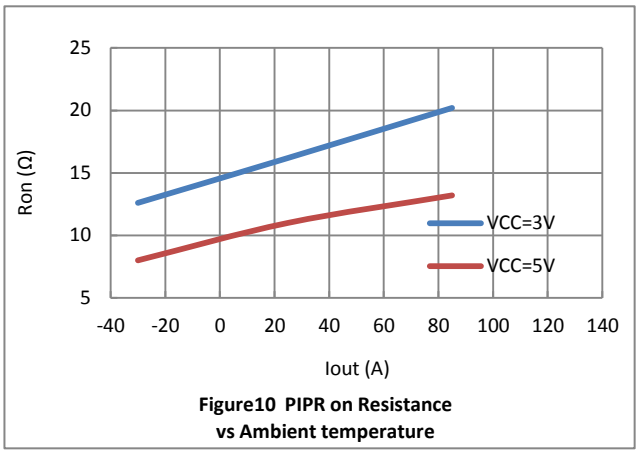
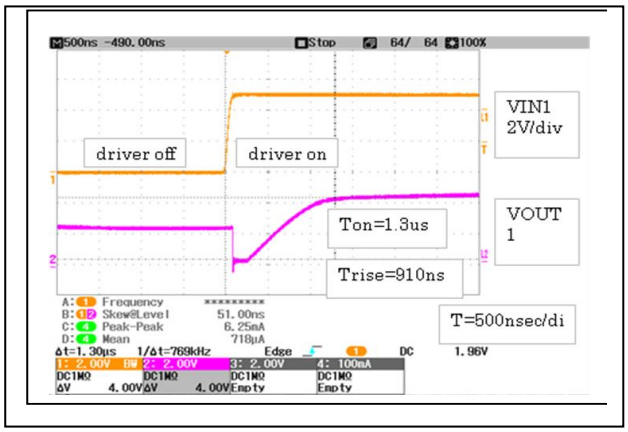


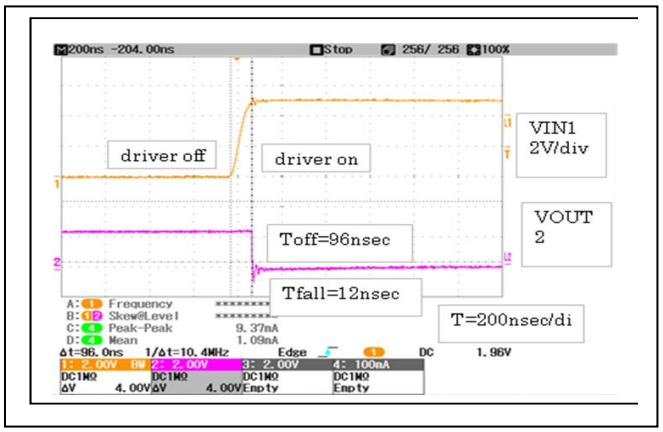
Figure10 PIPR on Resistance vs Ambient temperature

- Example of Turn-on and Turn-off output waveform

VCC = 5V, VIN1 = 100kHZ, 5V, duty50%, VIN2 = 0 input

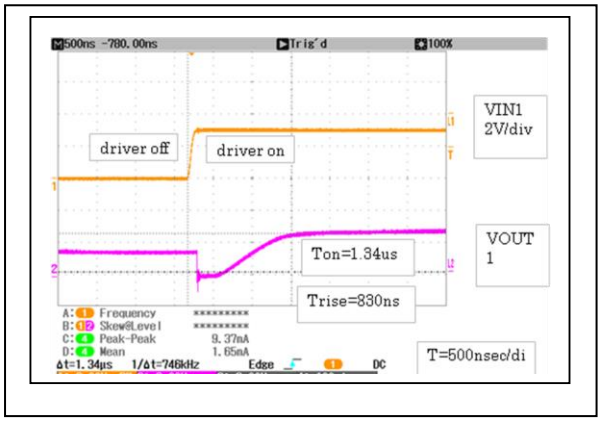
RFG-GND shorted load is 10kohm pullup & down (Fast decay)

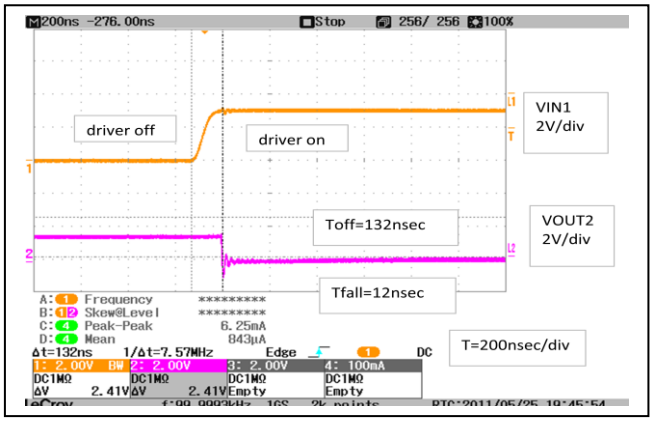




VCC = 3V, VIN1 = 100kHZ, 3V, duty50%, VIN2 = 0V input

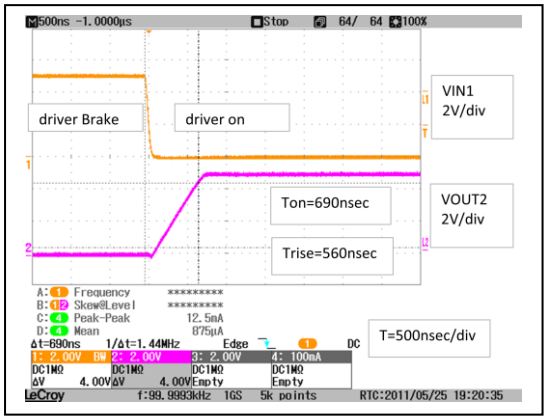
RFG-GND shorted load is 10kohm pullup & down (Fast decay)

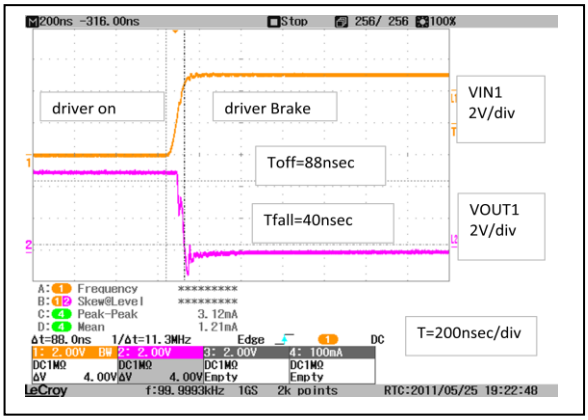




VCC = 5V, VIN1 = 100kHZ, 5V, duty50%,VIN2 = 5V input

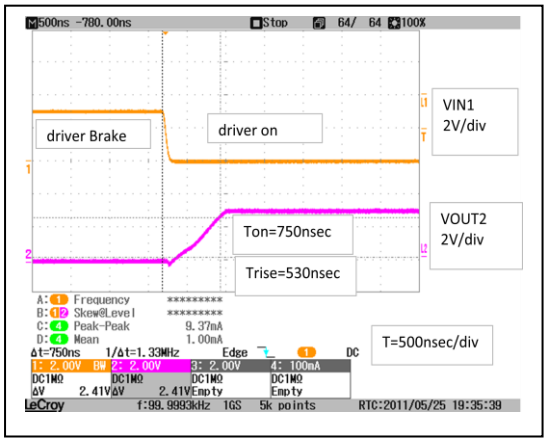
RFG-GND shorted load is 10kohm pullup & down (Slow decay)

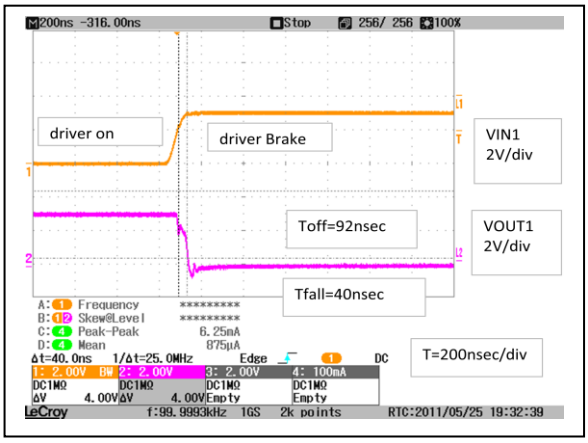




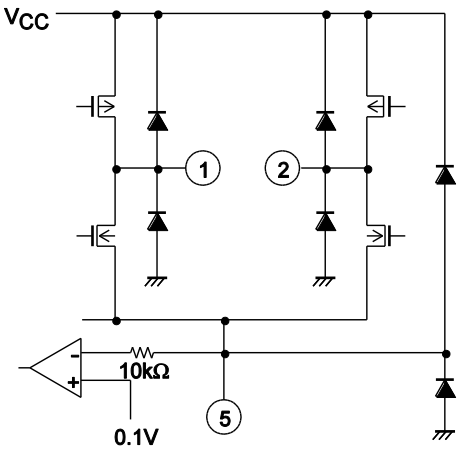
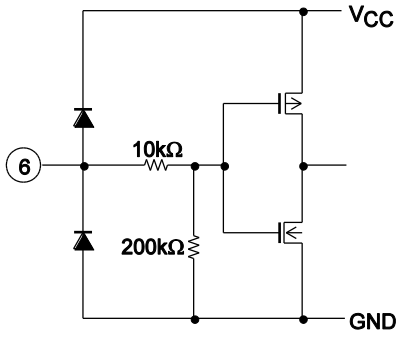
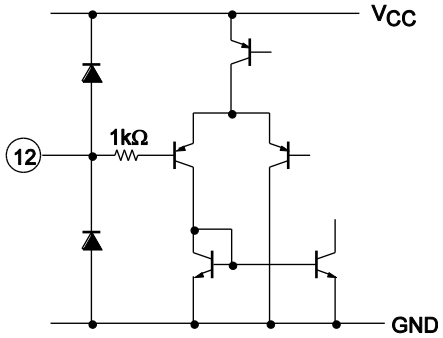
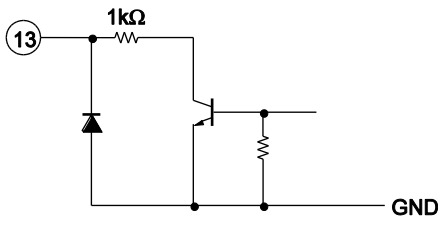
VCC = 3V, VIN1 = 100kHZ, 3V, duty50%, VIN2 = 3V input

RFG-GND shorted load is 10kohm pullup & down (Slow decay)





Pin Description

Pin No.	Pin Name	Description	Equivalent Circuit
1 2 3 4 5 16	OUT1 OUT2 OUT3 OUT4 RFG2 RFG1	1-4 : Output pins H-bridge type output pins Pins 1 and 2 are paired; and pins 3 and 4 are paired. 5, 16 : Current sensing resistor connection pins Connect the current sensing resistor between these pins and ground to detect the output currents for constant current control. Pin 16 corresponds to the output from pins 1 and 2 and pin 5 to the output from pins 1 and 2.	
6 7 8 9 10	IN3 IN4 IN1 IN2 CONT	Logic input pins	
11	GND	Ground	
12	COMPIN	Photo reflector position sensing comparator input	
13	COMPOUT	Photo reflector position sensing comparator output This pin serves as an open-collector output of the NPN transistor.	

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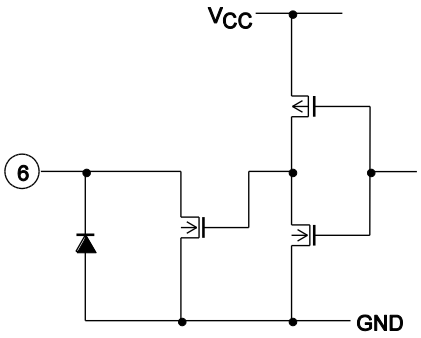
Pin No.	Pin Name	Description	Equivalent Circuit
14	PI/PR	A switch, with NMOS open-drain output, used to turn on/off the power supply of the position sensor unit. When using this switch, connect the position sensor unit between this pin and the V_{CC} pin. On/off control of this switch is accomplished by CONT pin. Setting the CONT pin high turns on the switch.	
15	V_{CC}	Power supply pin	

Operation explanation

1. LV8080LP Input-Output-Logic

Truth Table

Input				Output				Mode
IN1	IN2	IN3	IN4	OUT1	OUT2	OUT3	OUT4	
Low	Low	Low	Low	Off	Off	Off	Off	Standby mode
Low	High	-	-	Low	High	Off	Off	Channel 1, reverse
High	Low			High	Low			Channel 1, forward
High	High			Low	Low			Channel 1, brake mode
-	-	Low	High	Off	Off	Low	High	Channel 2, reverse
		High	Low			High	Low	Channel 2, forward
		High	High			Low	Low	Channel 2, brake mode

Note : The "-" input unstable state. When off, a high-impedance state.

- The ENA goes to the standby state with a low-level input, and to the operating state with a high-level input.
- The control input switches the forward/reverse mode.

2. DC motor operation sequence

- The following chart shows the DC-motor sequence from Standby, Forward, Reverse, Brake, and Forward. When IN1, IN2, IN3, IN4 are "L", the operation of LV8080 is stopped.
  Please set standby mode for 10usec between Forward and Reverse mode,
  Likewise, please set standby mode for 10usec between Forward and Brake mode, as well as Reverse and Brake mode.

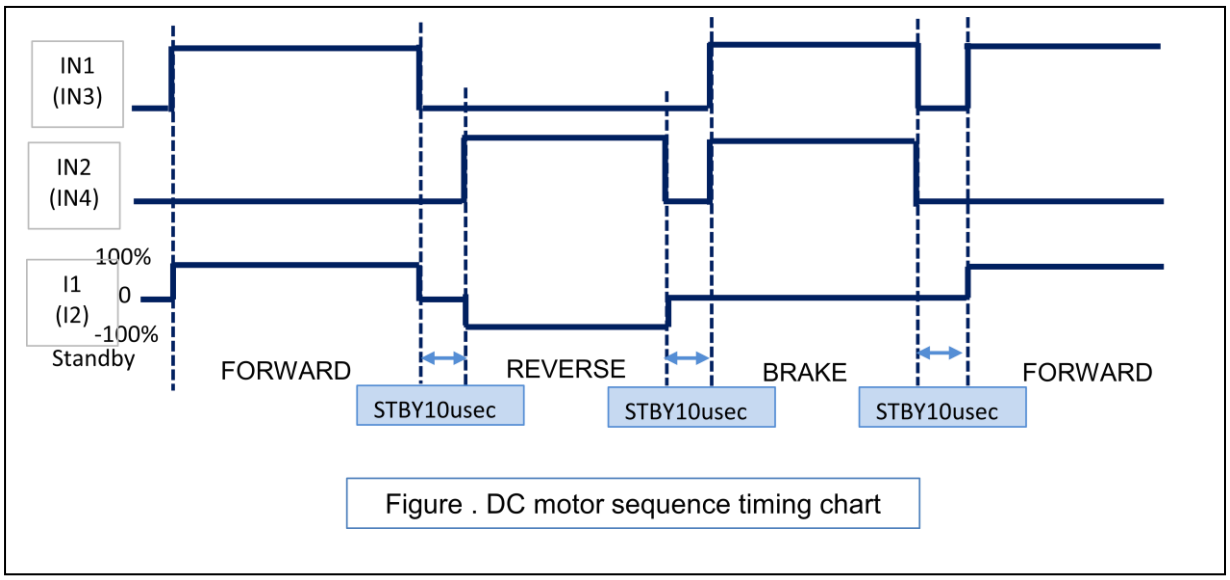
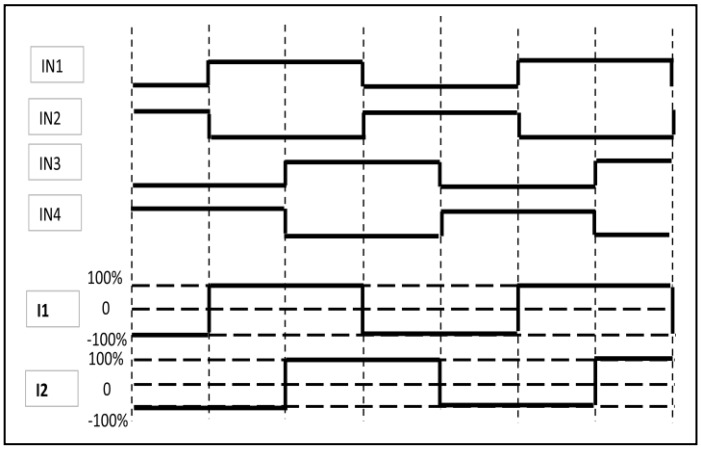


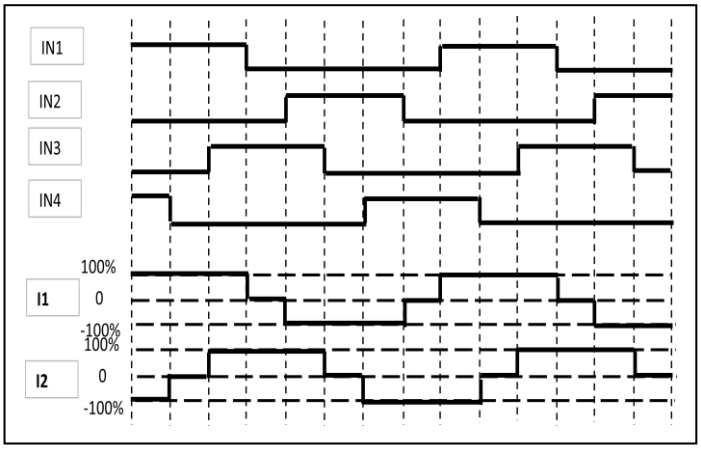
Figure . DC motor sequence timing chart

3. Stepping motor operation Sequence

Example of current wave type in each excitation mode when stepping motor parallel input is controlled.



2- phase excitation

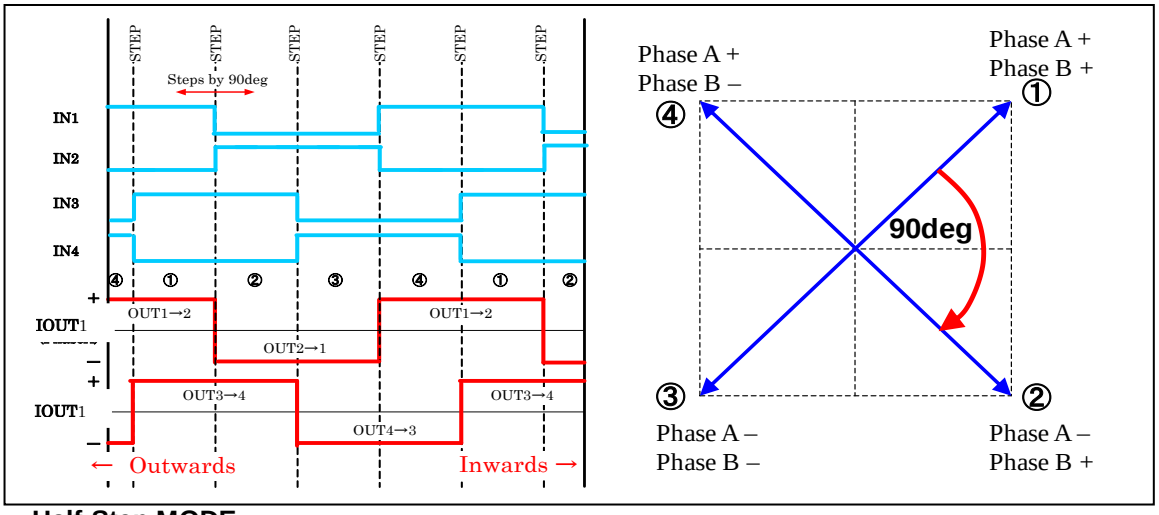


1-2 phase excitation

Theory

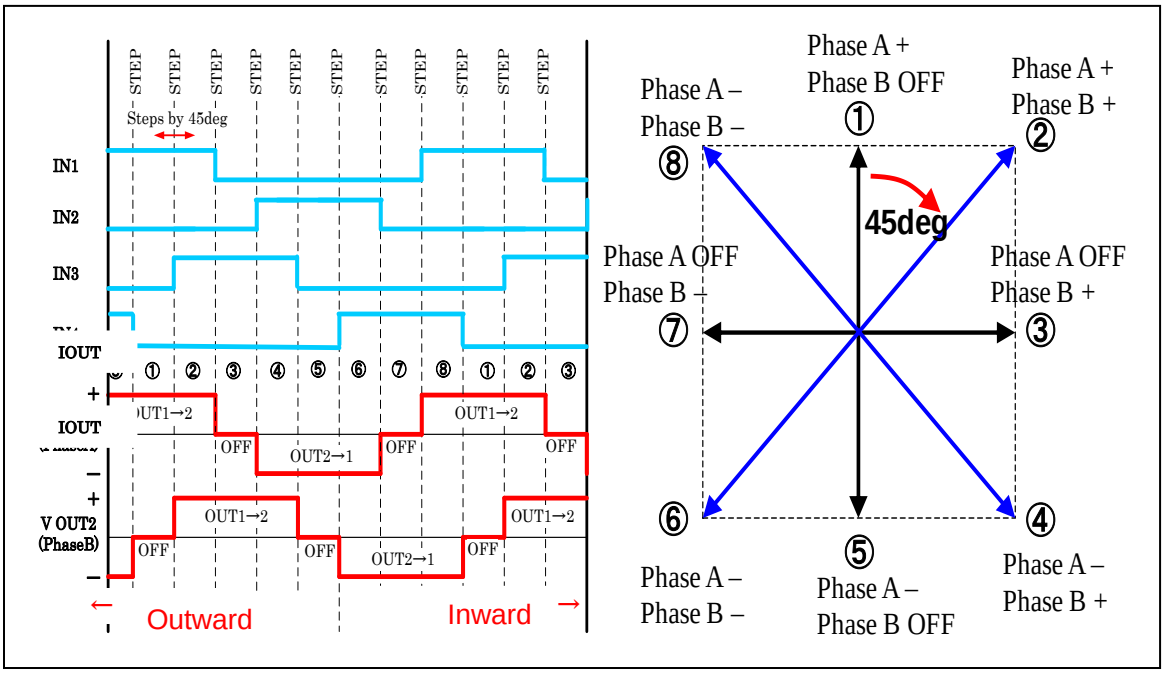
- **Full-Step MODE**

  The motor moves 90 degrees in an electric corner when I input 1Step.



- **Half-Step MODE**

  The motor moves 45 degrees in an electric corner when I input 1Step

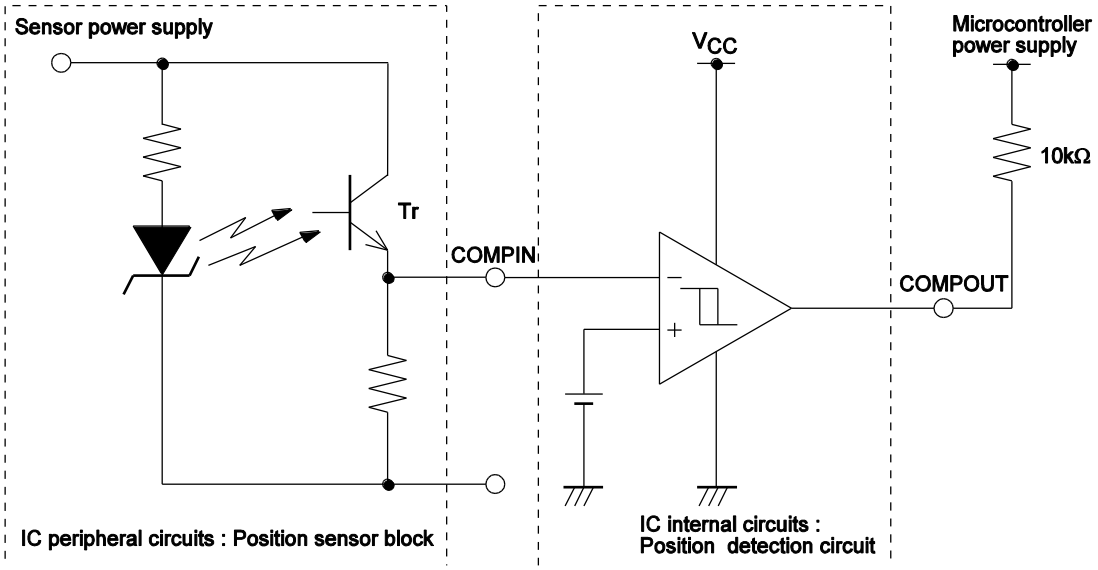


4. Constant current

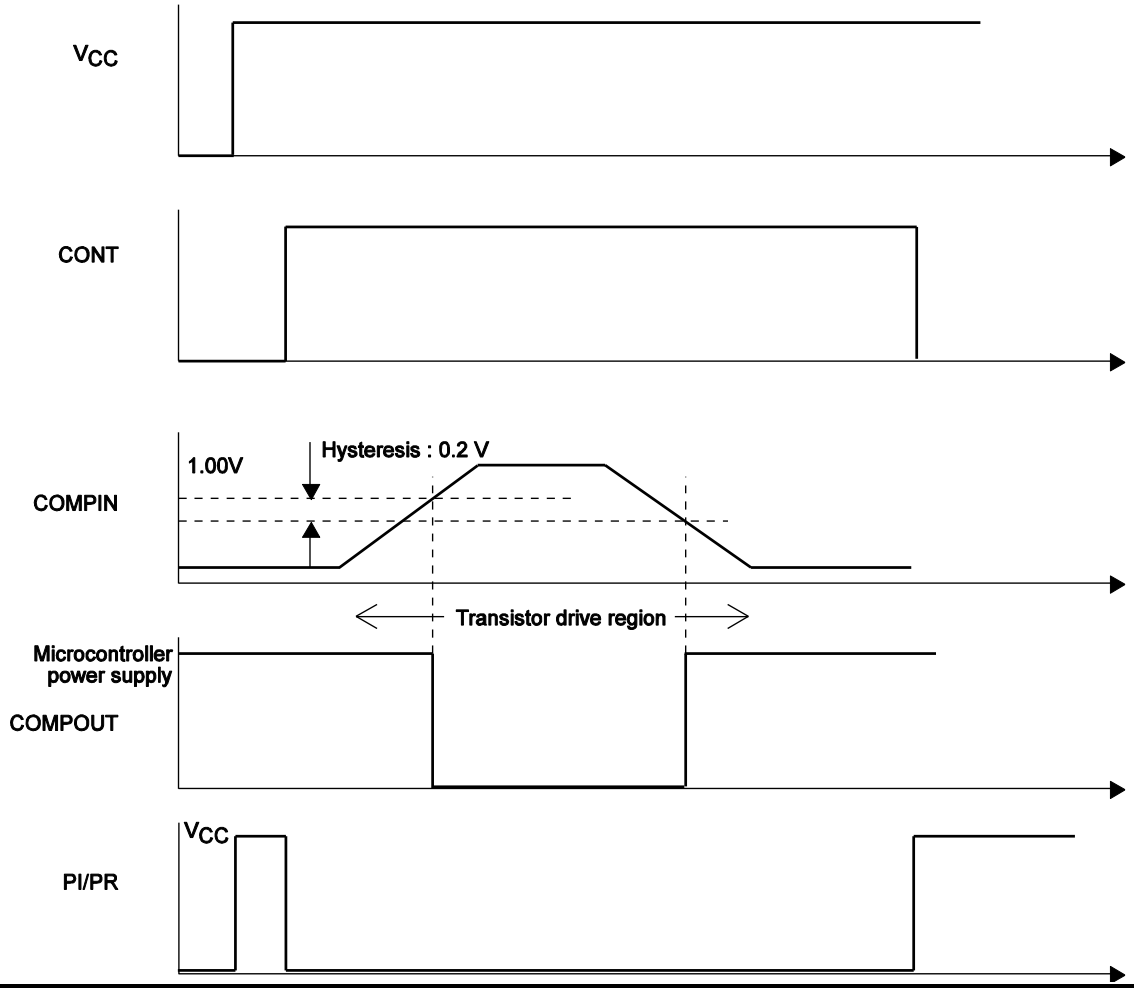
- Constant current is obtained as follows: I_{OUT} = 0.1 ÷ RF
  (Example: When I_{OUT} of 100mA is required, RF must be 1Ω. RF is the sense resistor as shown in p.3)
- The constant current is set by the resistor RF connected between RFG and ground.

5. Photosensor Position Detection Application Circuit Example

(a) Application circuit



(b) Timing chart



6. Thermal shutdown circuit

The thermal shutdown circuit in incorporated and the output is turned off when junction temperature Tj exceeds 175°C and
the abnormal state warning output is turned on. As the temperature falls by hysteresis, the output turned on again (automatic restoration).
The thermal shutdown circuit does not guarantee the protection of the final product because it operates when the temperature exceed the junction temperature of Tjmax=150°C.

TSD = 175°C (typ)
ΔTSD = 30°C (typ)

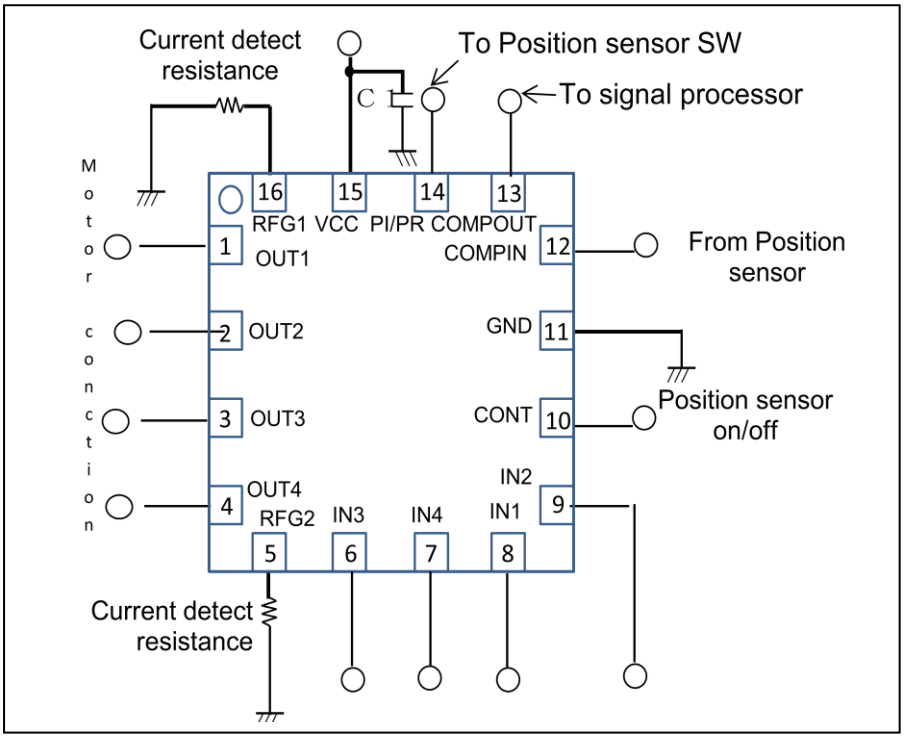
7. Low voltage protection function

When the VCC voltage is below the typical 2.4V in LV8080LP, OUT1 through OUT4 are turned off.
When the VCC voltage is above the typical 2.55V, OUT1 through OUT4 are turned on.

*When thermal shutdown function or low voltage protection function is activated, OUT1 through OUT4 are turned off under the control of the internal circuit. However, the output (PI) of photo sensor driving transistor continues operation.

Evaluation Board Manual

1. Eva-Board circuit diagram

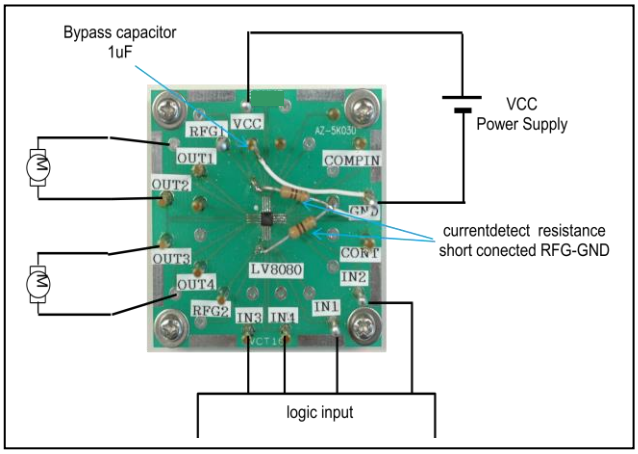


Bill of Materials for LV8080LP Evaluation Board

Designator	Qty	Description	Value	Tol	Footprint	Manufacturer	Manufacturer Part Number	Substitution Allowed	Lead Free
IC1	1	Motor Driver			VCT16 (2.6X2.6)	ON Semiconductor	LV8080LP	No	Yes
R1	2	Current detect resistance	Carbon 1Ω (1W/4)						
C2	1	VCC Bypass Capacitor	0.1μF 100V			Murata	GRM188R72A104KA35D	Yes	Yes
TP1-TP14	14	Test points				MAC8	ST-1-3	Yes	Yes

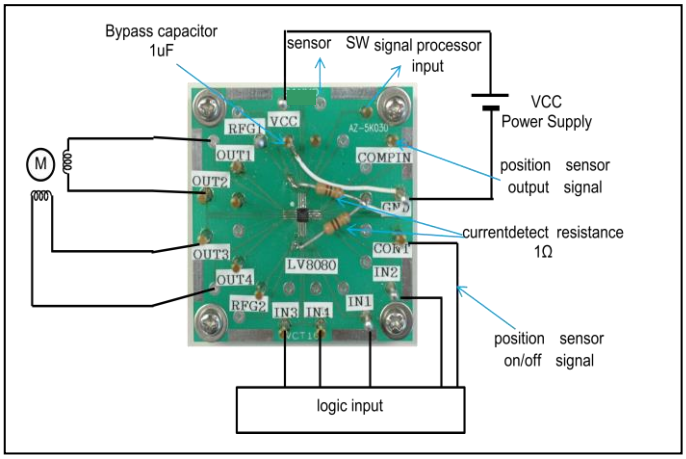
2-1. Eva-Board Photograph

(1) Two DC motor drive



- Connect OUT1 and OUT2, OUT3 and OUT4 to a DC motor each.
- Connect the motor power supply with the terminal VCC, the control power supply with the terminal VIN. Connect the GND line with the terminal GND.
- DC motor becomes the predetermined output state corresponding to the input state by inputting an input signal such as the following truth value table into IN1~IN4.

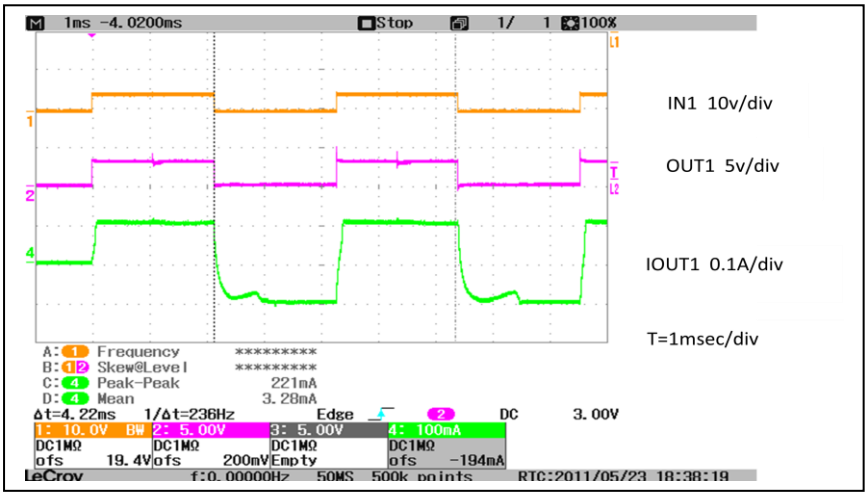
(2) One stepping motor drive



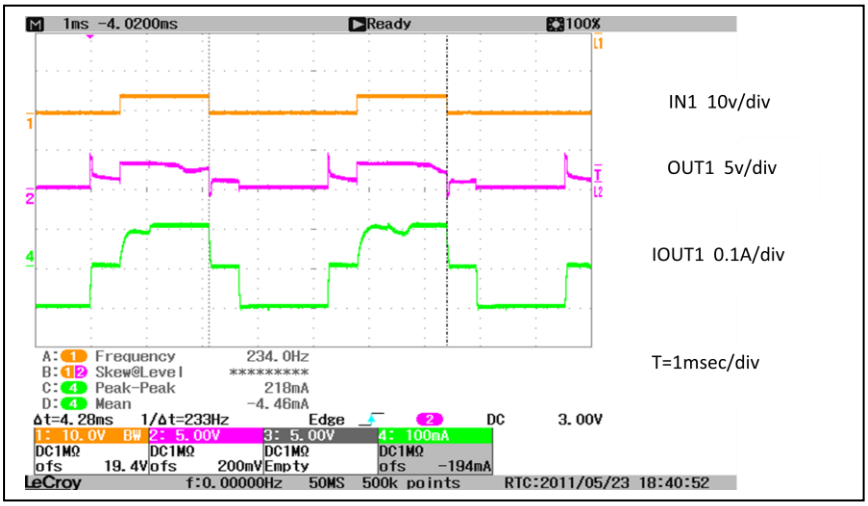
- Connect a stepping motor with OUT1, OUT2, OUT3 and OUT4.
- Connect the motor power supply with the terminal VCC, the control power supply with the terminal VIN. Connect the GND line with the terminal GND.
- STP motor drives it in a 2-phase excitation, 1-2 phase excitation by inputting an input signal such as follows into IN1~IN4.

Waveform of LV8080LP evaluation board when driving stepping motor

- Full-Step Drive VCC = 3.3V 1000pps

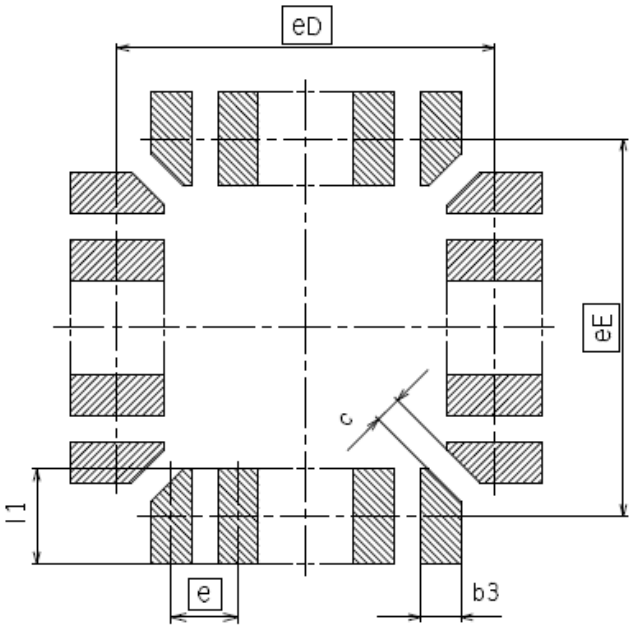


- Half-Step Drive　VCC = 3.3V　2000pps



Recommended Soldering Footprint

Mounting Pad Sketch　　VCT/UCT



(Unit:mm)

Reference symbol	Packages name				
	VCT/UCT16(2.6X2.6)	VCT/UCT20(2.6X2.6)	VCT/UCT20D(3.0X3.0)	VCT/UCT24(3.0X3.0)	VCT/UCT24(3.5X3.5)
eD	2.30	2.30	2.70	2.70	3.20
eE	2.30	2.30	2.70	2.70	3.20
e	0.50	0.40	0.50	0.40	0.50
b3	0.30	0.19	0.30	0.19	0.30
l1	0.70	0.70	0.70	0.70	0.70
c	0.20	0.20	0.20	0.20	0.20