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LV8413GP



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Bi-CMOS LSI

For DSC, and Cell Phone Camera Modules

H-Bridge × 2-channel Motor Driver

Application Note

Overview

The LV8413GP is an H-bridge, 2-channel motor driver IC and is able to control 4 modes of forward, reverse, brake, and standby.

This IC housed in a miniature package is optimum for use in a stepping motor driving system for DSC or a camera module of cell phones.

Function

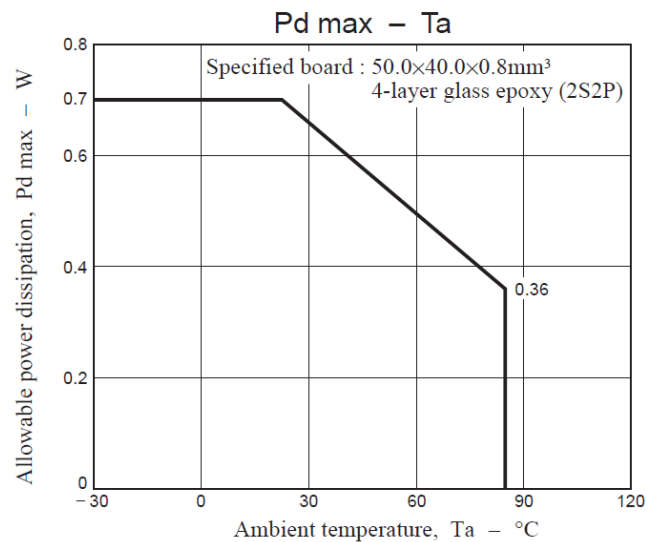
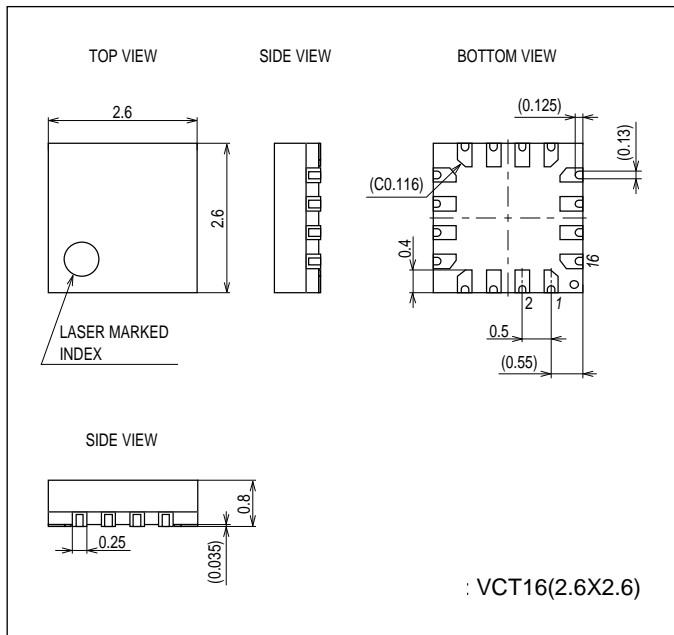
- Saturation drive H-bridge : 2-channels
- Built-in thermal protection circuit
- Built-in low voltage malfunction prevention circuit
- Incorporates a transistor for driving photosensors

Typical Applications

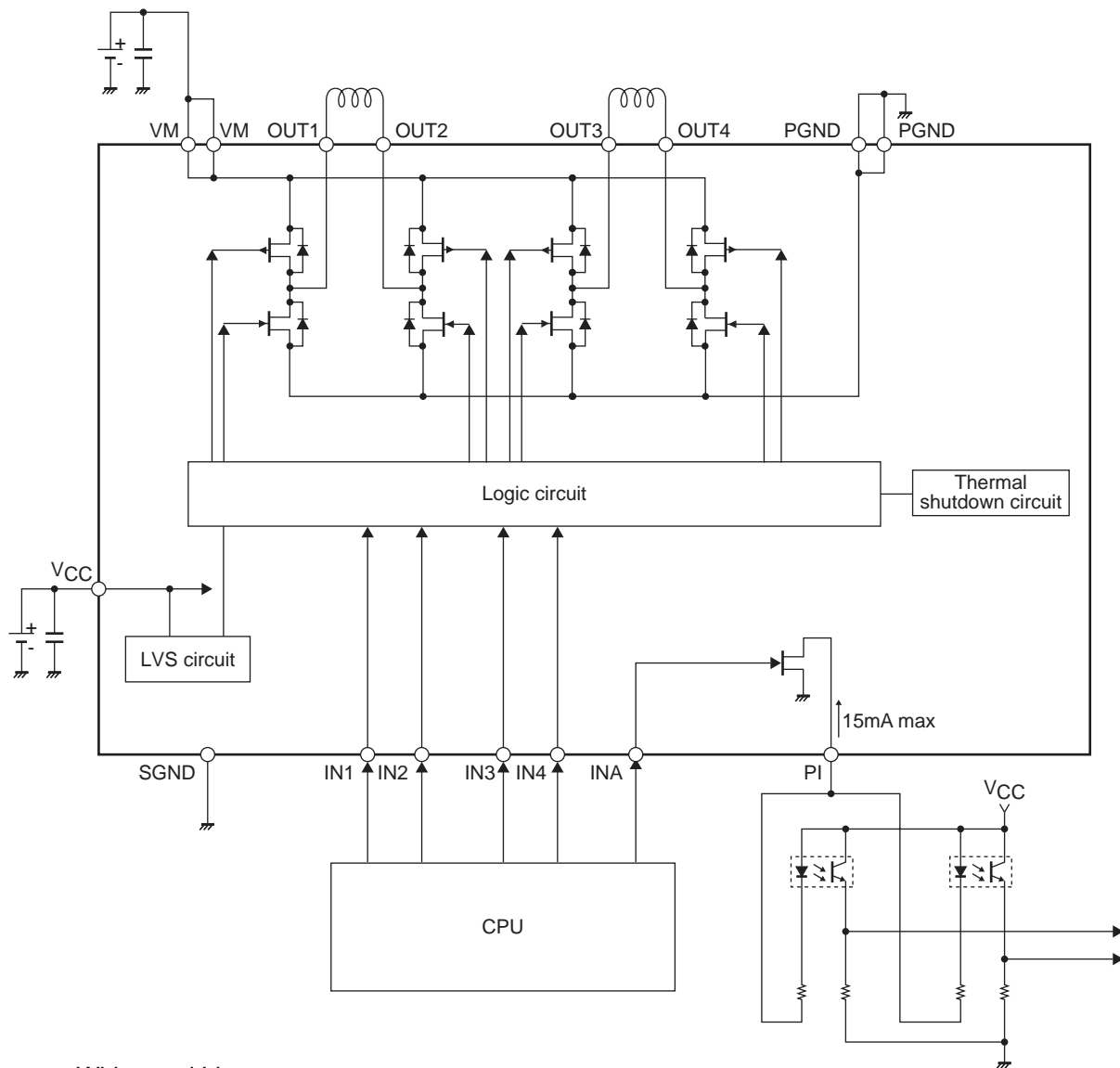
- DSC
- Security camera
- CCTV

Package Dimensions

unit : mm (typ)



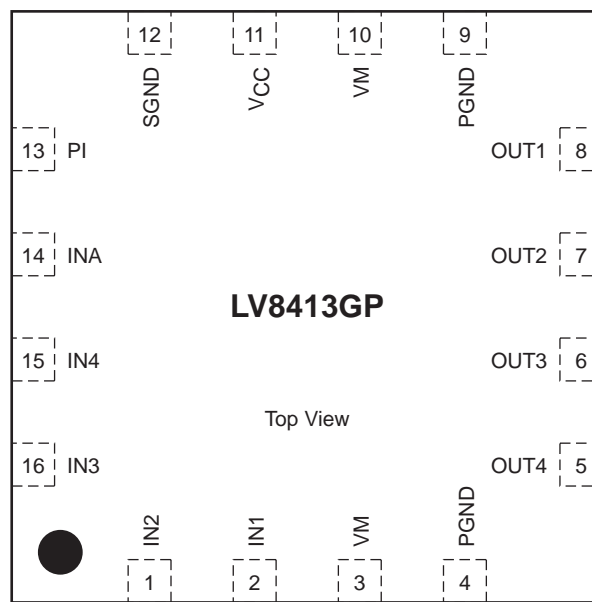
Block Diagram



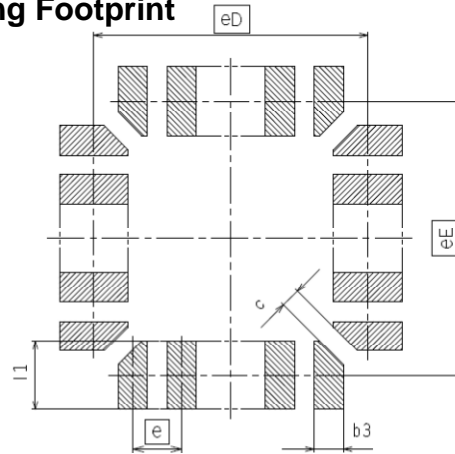
Notes on Wiring and Lines

1. Connect both the PGND pins and both the VM pins. Although both the PGND and VM lines are connected internally, both must be connected to provide even lower on-resistance output.
2. Since large currents flow in the VM and PGND lines, these lines should be made thicker, and line impedance reducing capacitors should be inserted in the vicinity of the IC.
3. Since SGND is the ground for the control system, rather than using the same wiring as the PGND line, it is preferable to connect this pin to the CPU ground line.
4. No restriction on priority among applied voltages of VM and VCC.

Pin Assignment



Recommended Soldering Footprint



(Unit:mm)

Reference symbol	Packages name				
	VCT/UCT16 (2, 6X2, 6)	VCT/UCT20 (2, 6X2, 6)	VCT/UCT20 (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

Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Power supply voltage 1	VM max		6	V
Power supply voltage 2	VCC max		6	V
Output peak current	IO peak	Outs 1 to 4, t ≤ 10msec, ON-duty ≤ 20%	600	mA
Output continuous current 1	IO max1	Outs 1 to 4	400	mA
Output continuous current 2	IO max2	PI	15	mA
Allowable power dissipation	Pd max	Mounted on a circuit board*	0.7	W
Operating temperature	Topr		-30 to +85	°C
Storage temperature	Tstg		-55 to +150	°C

* Specified circuit board : 50.0mm × 40.0mm × 0.8mm : glass epoxy four-layer board (2S2P)

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.

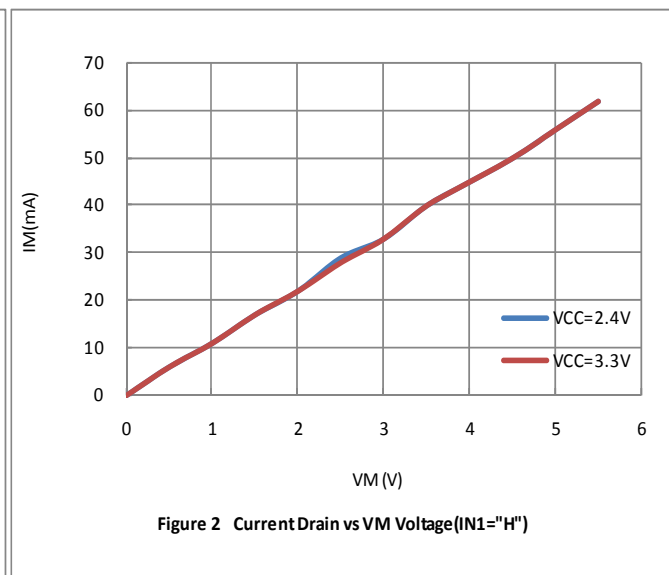
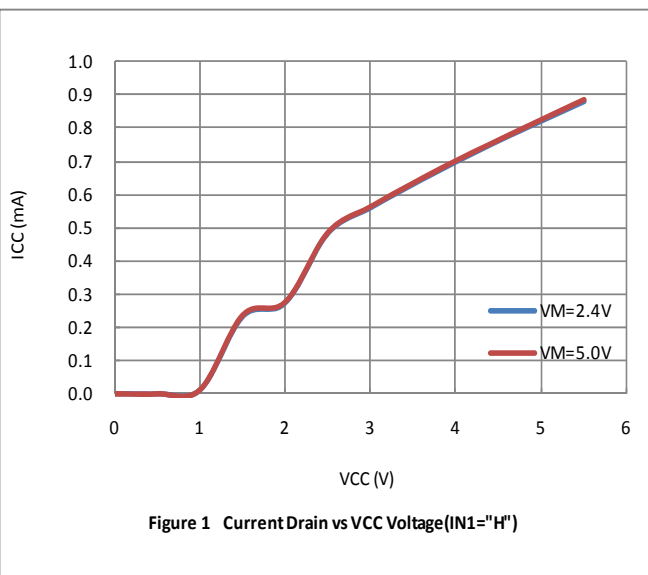
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

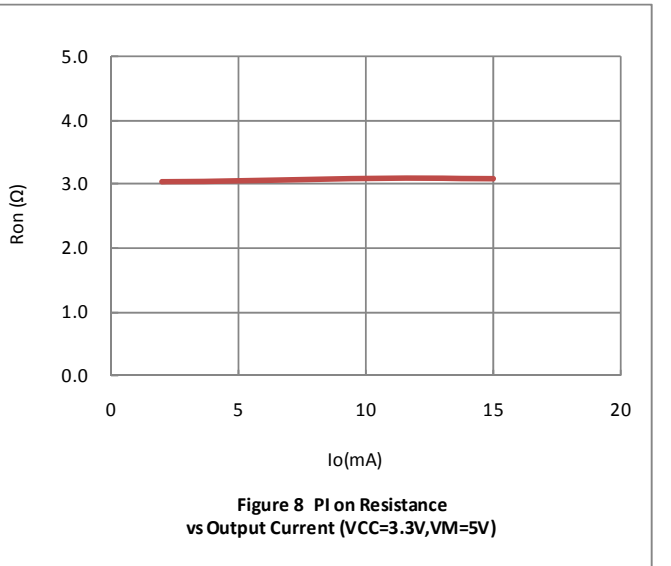
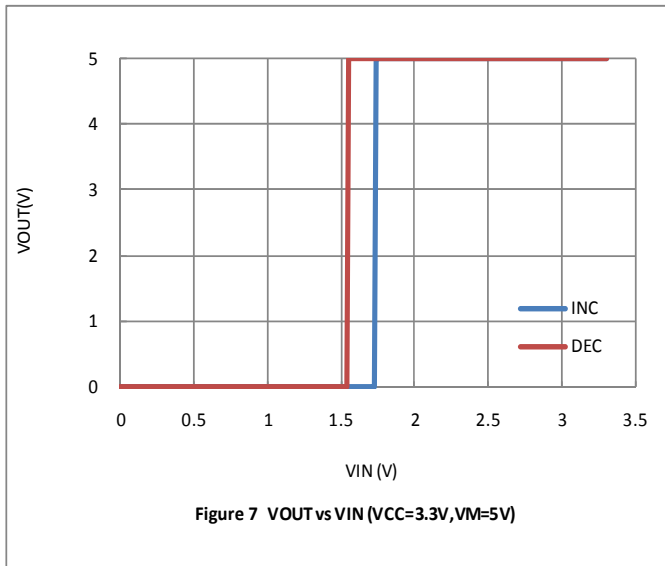
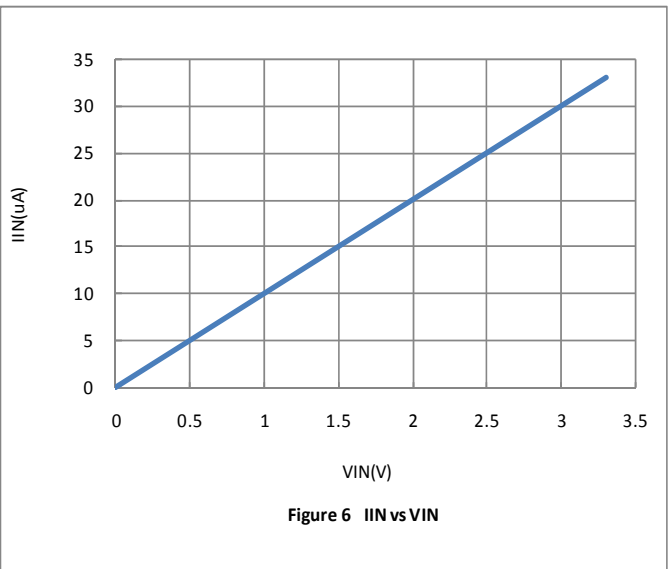
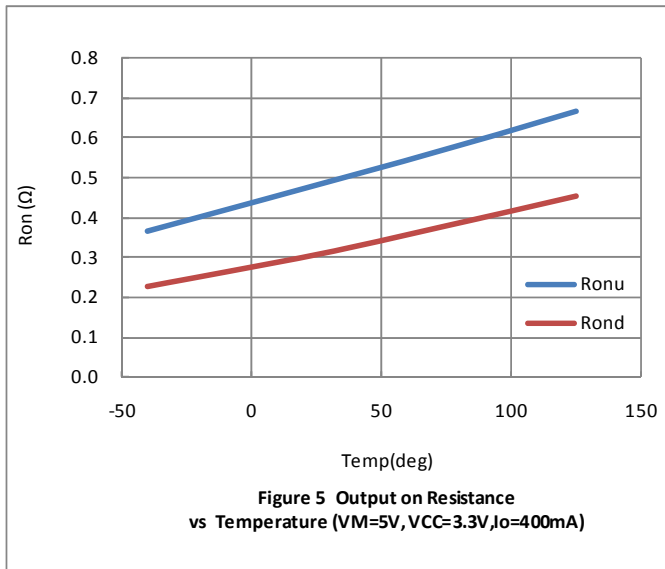
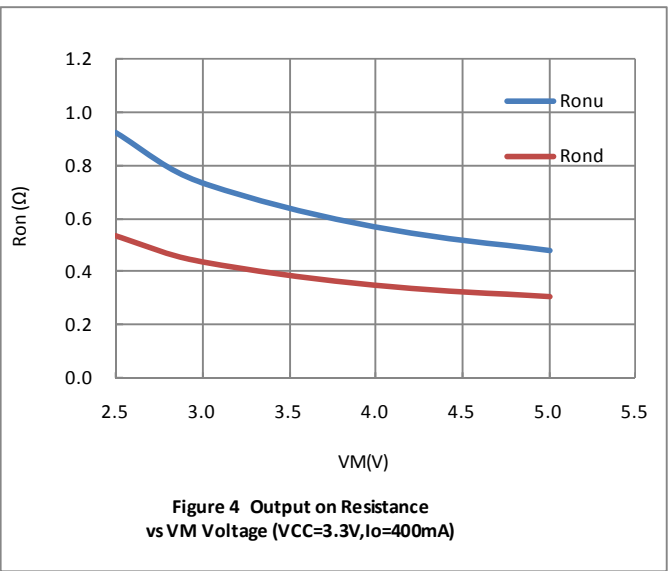
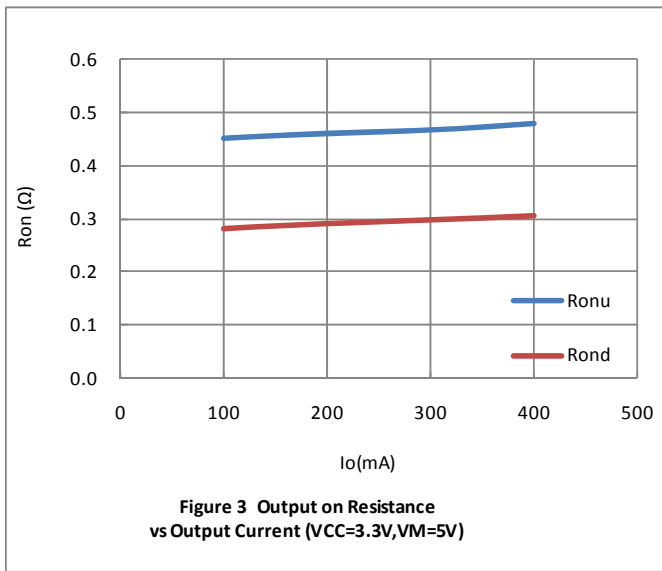
Recommended Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Power supply voltage range 1	VM		2.5		5.5	V
Power supply voltage range 2	V _{CC}		2.5		5.5	V
Logic input voltage range	V _{IN}		0		V _{CC} +0.3	V
Input frequency	f _{IN}	IN1 to 4, INA			100	kHz

Electrical Characteristics at Ta = 25°C, VM = 5V, V_{CC} = 3.3V, unless otherwise specified.

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Standby mode current drain	I _{stn}	IN1 to 4 = "L"			1.0	μA
VM current drain	I _M	Any one of IN1 to 4 = "H", with no load		70	150	μA
V _{CC} current drain	I _{CC}	Any one of IN1 to 4 = "H"		0.6	1.2	mA
V _{CC} low-voltage cutoff voltage	V _{th} V _{CC}		1.85	2.10	2.35	V
Low-voltage hysteresis voltage	V _{th} HYS		100	150	200	mV
Thermal shutdown temperature	TSD	Design guarantee value *	160	180	200	°C
Thermal hysteresis width	ΔTSD	Design guarantee value *	10	30	50	°C
OUT1 to 4						
Logic pin internal pull-down resistance	R _{in}	IN1 to 4	50	100	200	kΩ
Logic pin input current	I _{inL}	V _{IN} = 0, IN1 to 4			1.0	μA
	I _{inH}	V _{IN} = 3.3V, IN1 to 4	20	33	60	μA
Logic input high-level voltage	V _{inH}	IN1 to 4	2.5			V
Logic input low-level voltage	V _{inL}	IN1 to 4			1.0	V
Output on-resistance	R _{onu}	I _O = 400mA, upper ON resistance		0.5	0.8	Ω
	R _{ond}	I _O = 400mA, lower ON resistance		0.3	0.5	Ω
Output leakage current	I _{Oleak}				1	μA
Diode forward voltage	V _D	I _D = -400mA		1.0		V
PI						
Logic pin internal pull-down resistance	R _{in}	INA	50	100	200	kΩ
Logic pin input current	I _{inL}	V _{IN} = 0, INA			1.0	μA
	I _{inH}	V _{IN} = 3.3V, INA	20	33	50	μA
Logic input high-level voltage	V _{inH}	INA	2.5			V
Logic input low-level voltage	V _{inL}	INA			1.0	V
Output on-resistance	R _{on}	I _O = 10mA		4	6	Ω
Output leakage current	I _{Oleak}				1	μA





Pin Functions

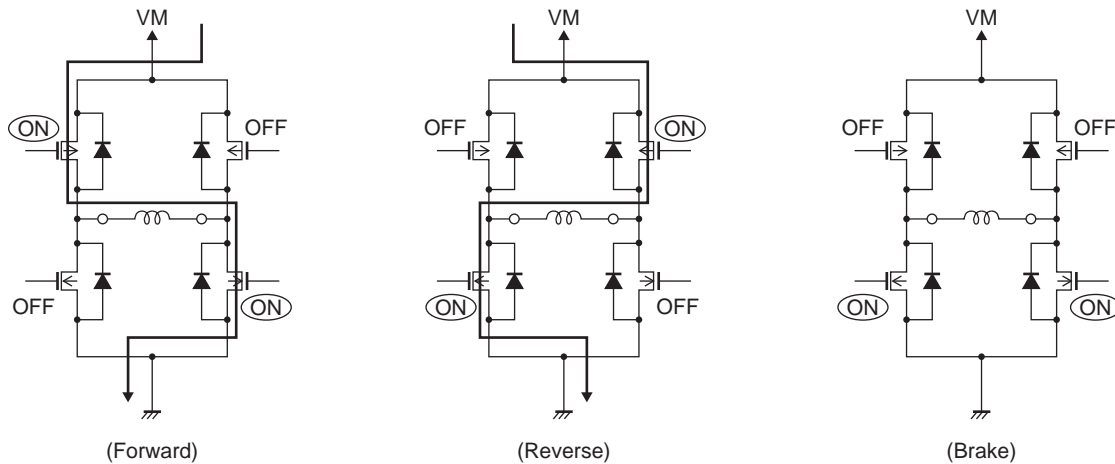
Pin No.	Pin name	Pin Function	Equivalent Circuit
2 1 16 15 14	IN1 IN2 IN3 IN4 INA	Control signal input pin Control signal input pin Control signal input pin Control signal input pin Control signal input pin	
8 7 6 5	OUT1 OUT2 OUT3 OUT4	Outpin Outpin Outpin Outpin	
13	PI	Outpin	
11	VCC	Logic system power supply connection pin	
3 10	VM VM	Motor power supply connection pin Motor power supply connection pin	
12	SGND	Signal ground	
4 9	PGND PGND	Power ground Power ground	

Operation explanation

- Common channels 1 to 2
- ch1 : IN1 to IN2, OUT1 to OUT2
- ch2 : IN3 to IN4, OUT3 to OUT4

Input		Output		Operation mode
IN1	IN2	OUT1	OUT2	
L	L	OFF	OFF	Standby
H	L	H	L	CW (forward)
L	H	L	H	CCW (reverse)
H	H	L	L	Brake

- Current limit control timing chart



- Photo sensor driving transistor

By setting the INA pin to "H", the photosensor driving transistor is activated.

The photosensor current is decided by an external resistance value.

Input INA	Photo sensor driving PI
L	OFF
H	ON

- Overheating protection function (Thermal Shutdown circuit)

The overheating protection circuit is built into. OUT1 through OUT4 are turned off when junction temperature T_j exceeds 180°C . The value of hysteresis and when it falls, the temperature drives the output again (automatic restoration).

The overheating protection circuit doesn't secure protection and the destruction prevention of the set because it becomes operation by the area where ratings $T_{j\text{max}} = 150^\circ\text{C}$ of the junction temperature was exceeded.

$$TSD = 180^\circ\text{C (typ)}$$

$$\Delta TSD = 30^\circ\text{C (typ)}$$

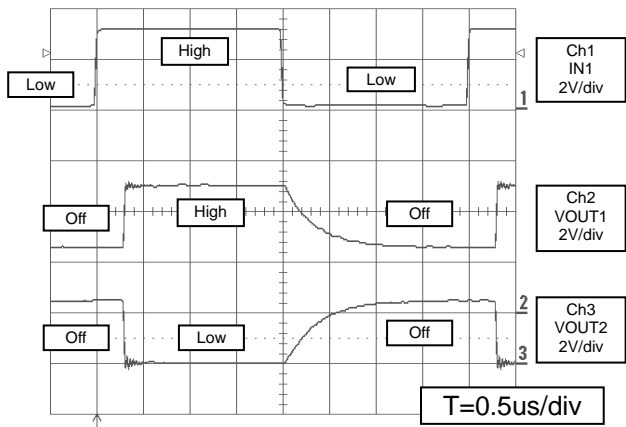
- Low voltage protection function (Low voltage malfunction prevention circuit)

When the VCC voltage is as below typical 2.1V in LV8413GP, OUT1 through OUT4 are turned off.

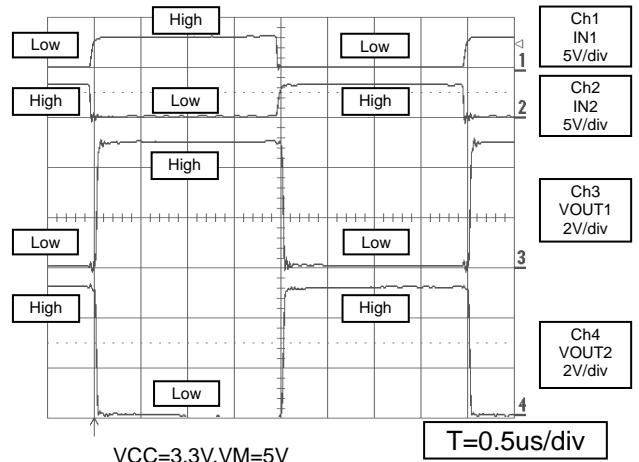
When the VCC voltage is as above typical 2.25V, OUT1 through OUT4 are turned on.

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

- PWM switching waveform example
- *Please refer to the following test circuit diagram1.

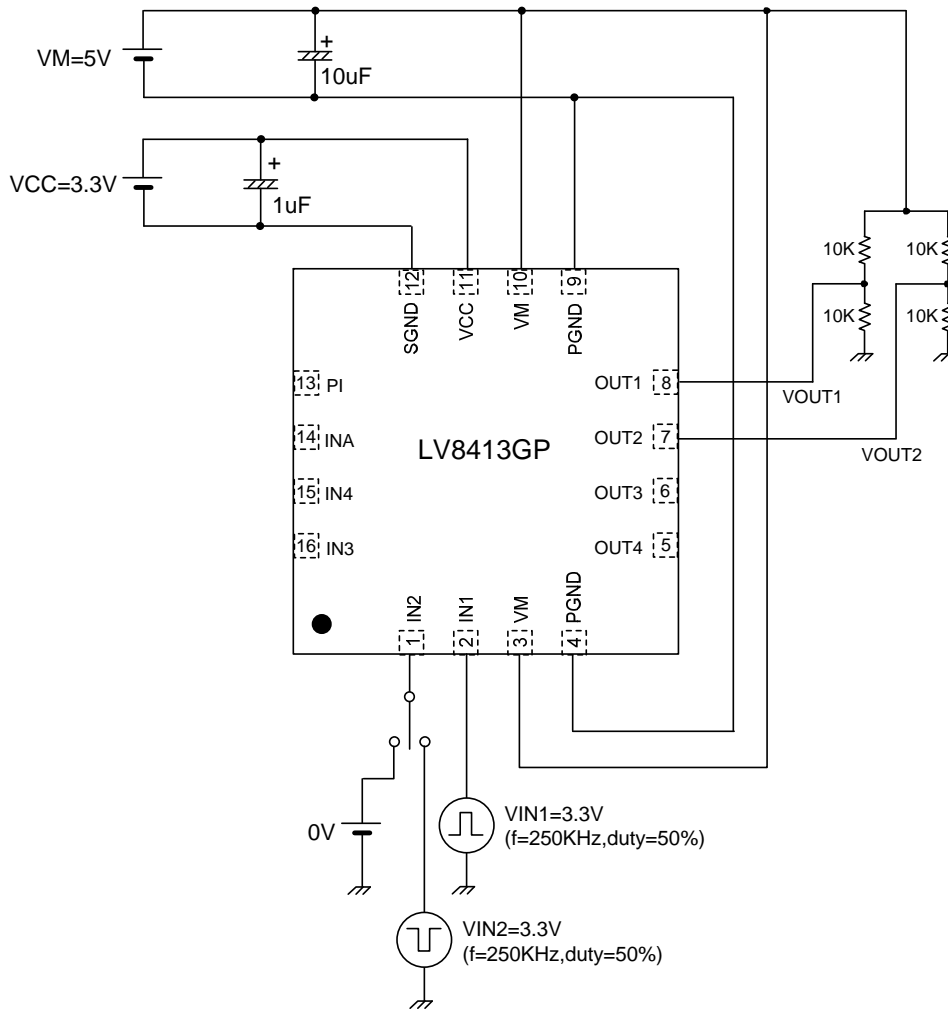


VCC=3.3V,VM=5V,IN2=0V
 VIN1=3.3V(f=250KHz,duty=50%)
 OUT1,2=Pull-up&down(10Kohm)



VCC=3.3V,VM=5V
 VIN1,2=3.3V(f=250KHz,duty=50%)
 OUT1,2=Pull-up&down(10Kohm)

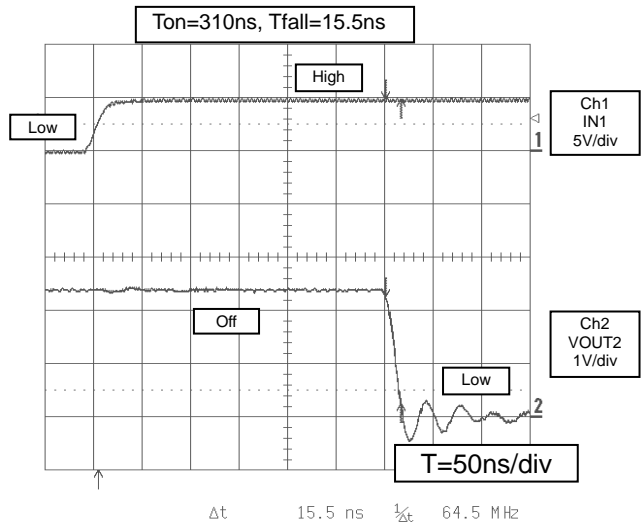
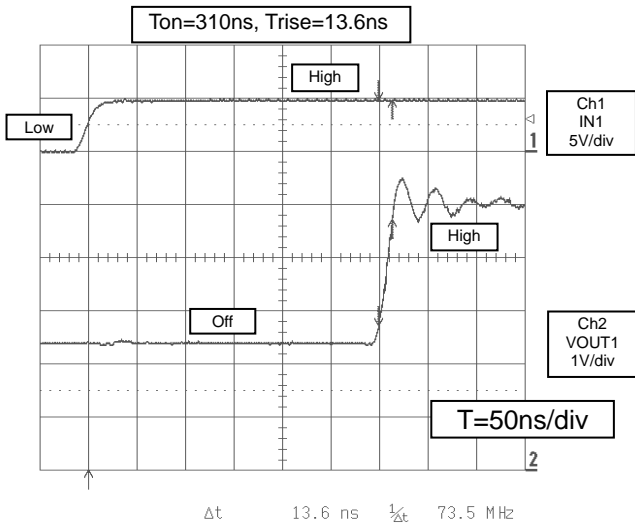
(Test Circuit Diagram1)



- Macrograph of the PWM switching waveform example
- *Please refer to the following Test Circuit diagram2.

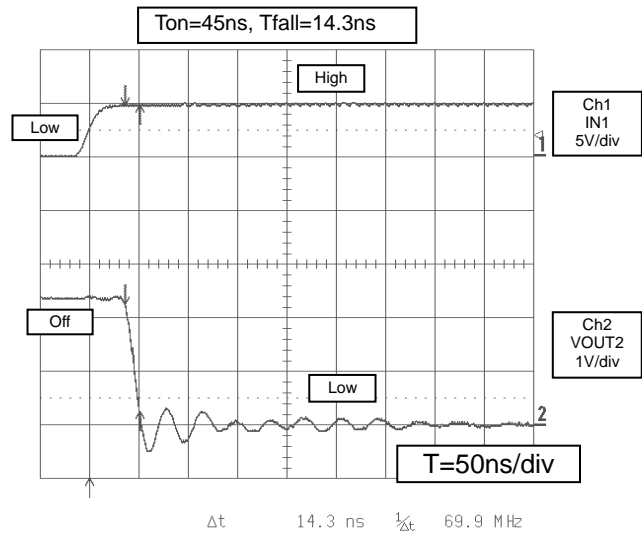
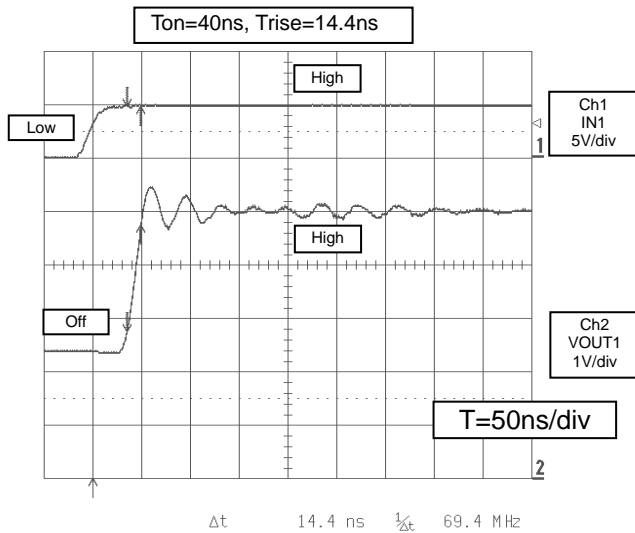
[Fast Decay_1]

VCC=5V, VM=5V, IN2=IN3=IN4=0V
 VIN1=5V (f=250KHz, duty=50%)
 OUT1, 2=Pull-up&down (10Kohm)



[Fast Decay_2]

VCC=5V, VM=5V, IN2=IN4=0V, IN3=5V
 VIN1=5V (f=250KHz, duty=50%)
 OUT1, 2=Pull-up&down (10Kohm)

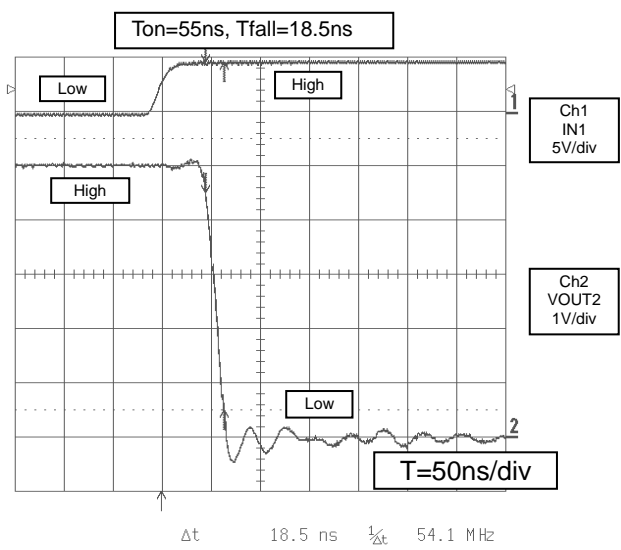
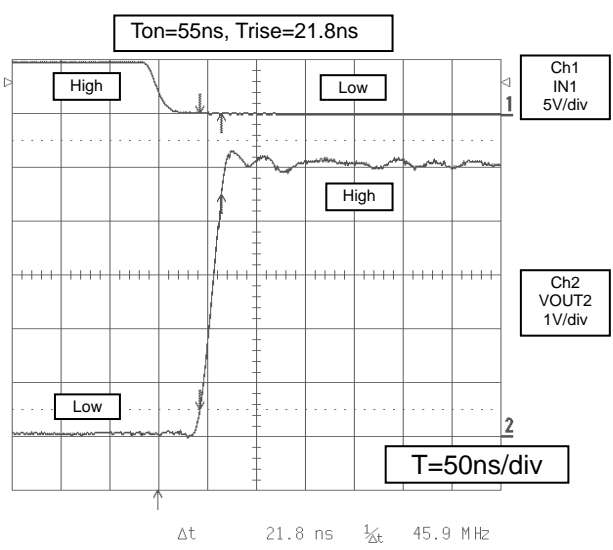


[Slow Decay]

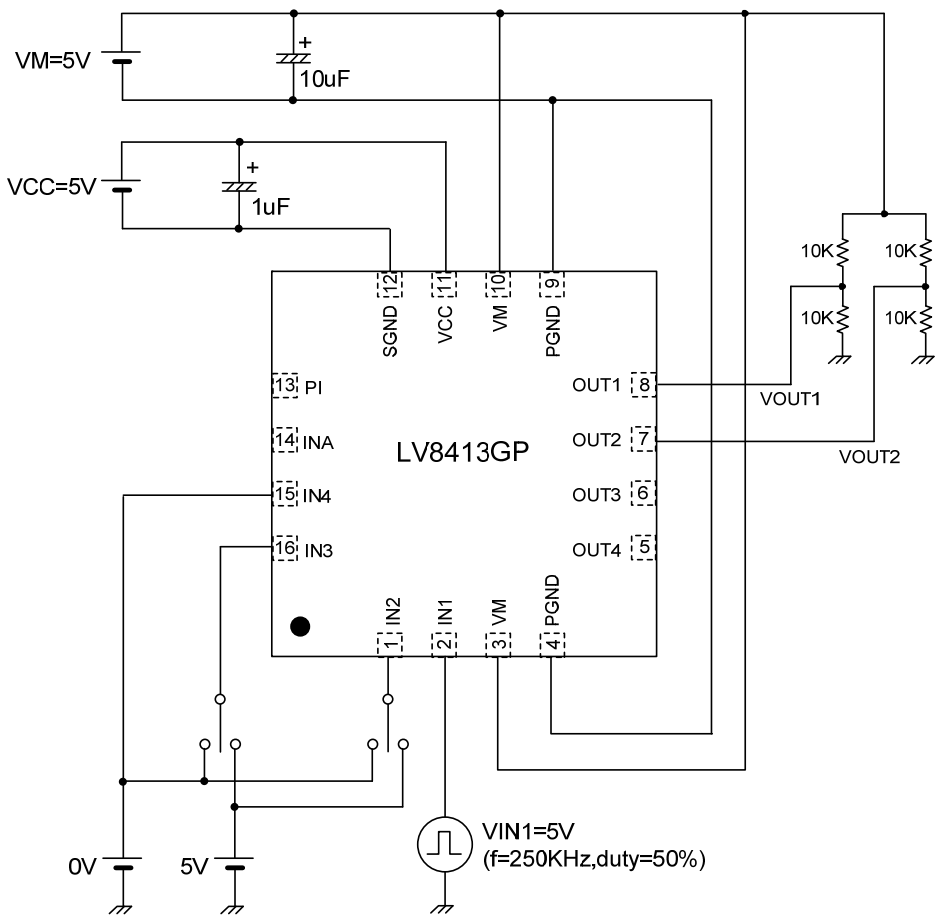
VCC=5V, VM=5V, IN2=5V, IN3=IN4=0V

VIN1=5V (f=250KHz, duty=50%)

OUT1, 2=Pull-up&down (10Kohm)

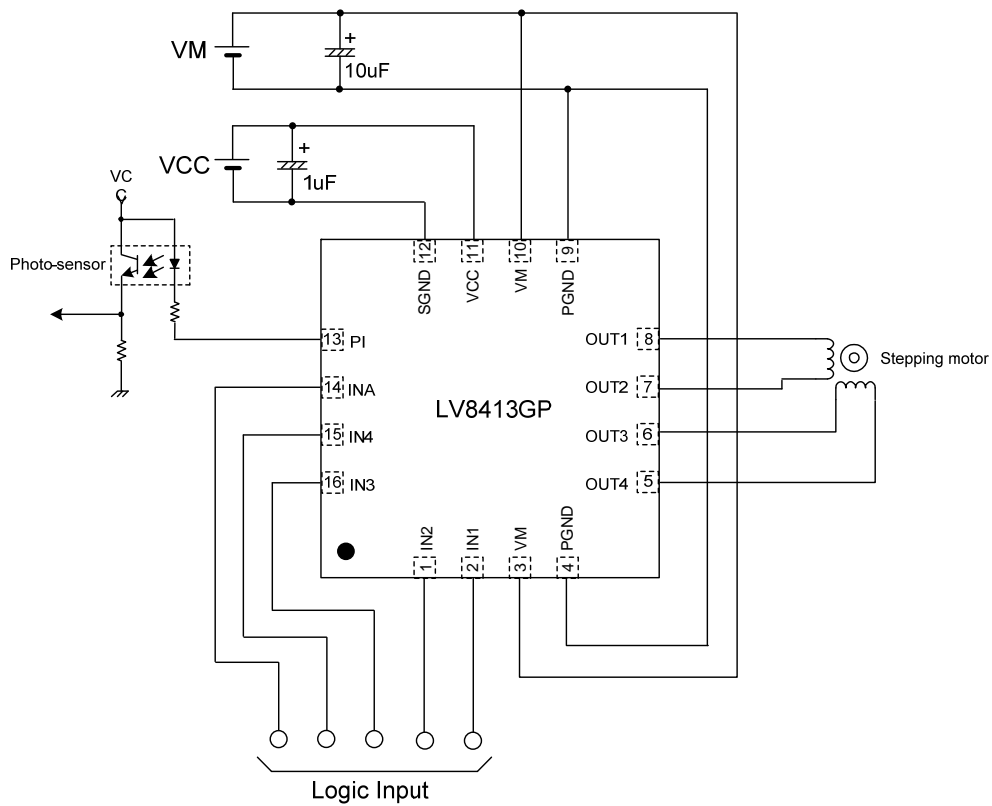


(Test Circuit Diagram2)

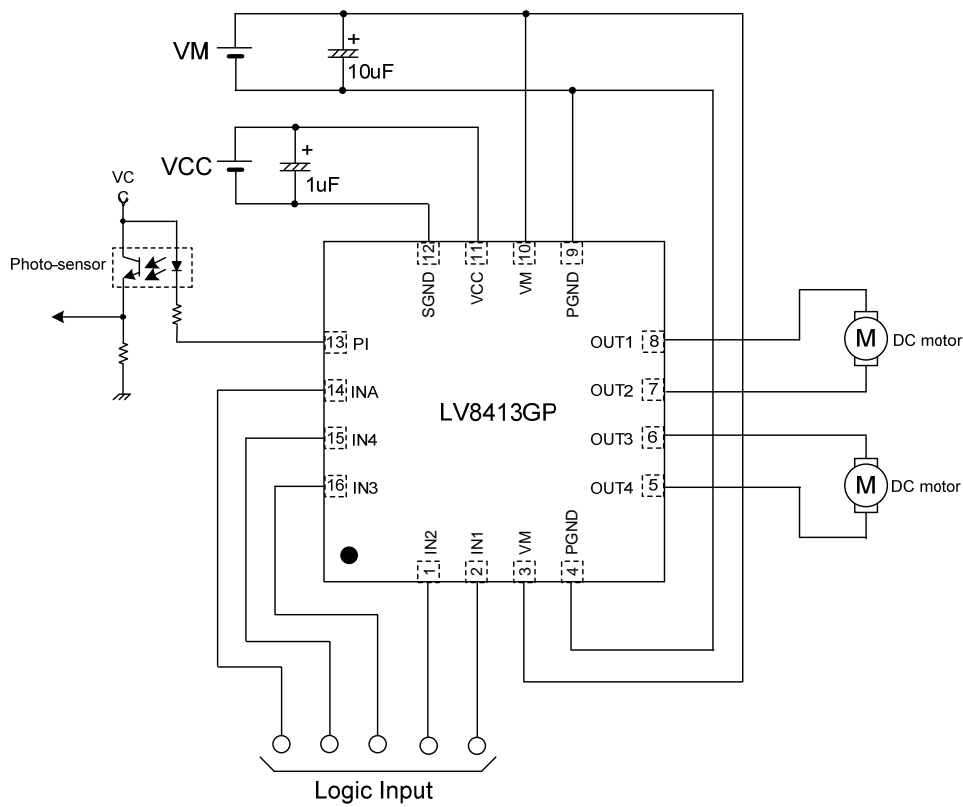


Application Circuit Example

- Example of application circuit with one stepping motor driving

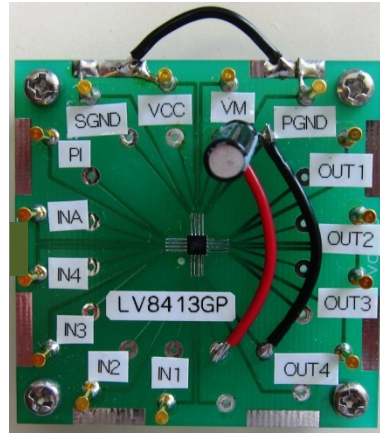


- Example of application circuit with two DC motors driving

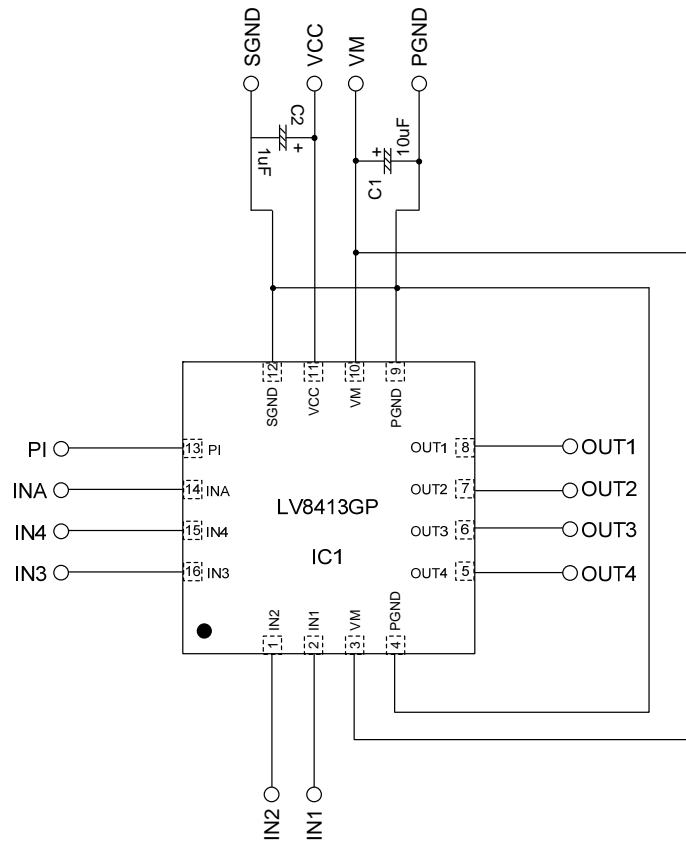


Evaluation board manual

- Overview



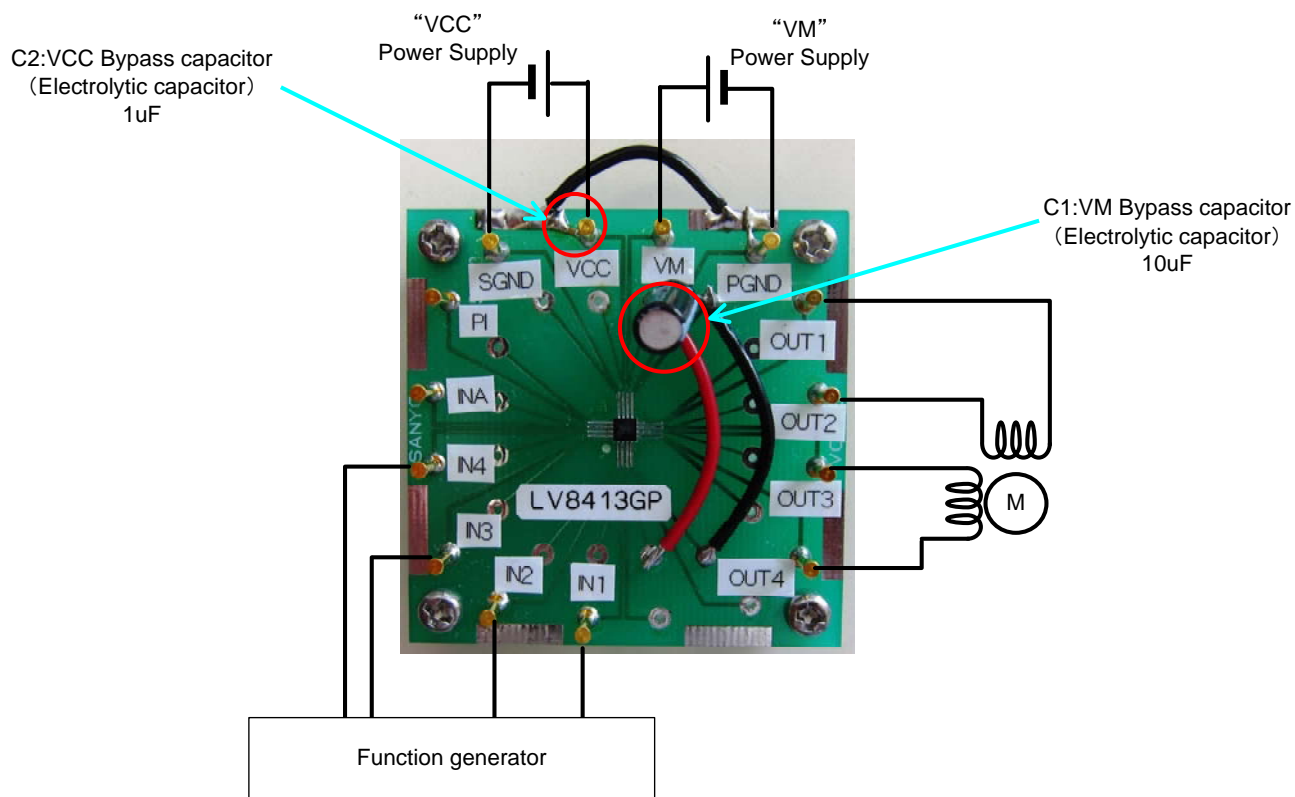
- Circuit diagram



Bill of Materials for LV8413GP Evaluation Board

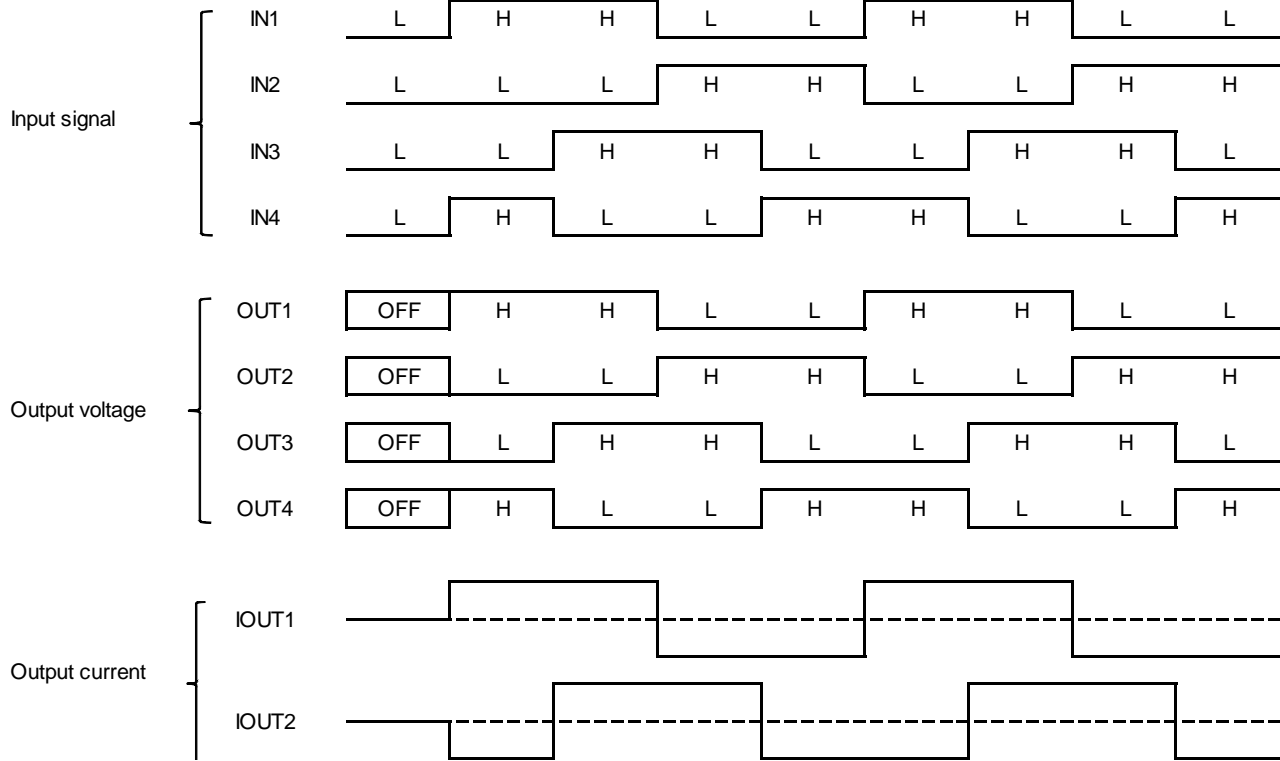
Designator	Qty	Description	Value	Tol	Footprint	Manufacturer	Manufacturer Part Number	Substitution Allowed	Lead Free
IC1	1	Motor Driver			VCT16 (2.6X2.6)	ON Semiconductor	LV8413GP	No	Yes
C1	1	VM Bypass capacitor	10µF 50V	±20%		SUN Electronic Industries	50ME10HC	Yes	Yes
C2	1	VCC Bypass Capacitor	0.1µF 100V			Murata	GRM188R72A10 4KA35D	Yes	Yes
TP1-TP14	14	Test points				MAC8	ST-1-3	Yes	Yes

•Stepping motor driving method

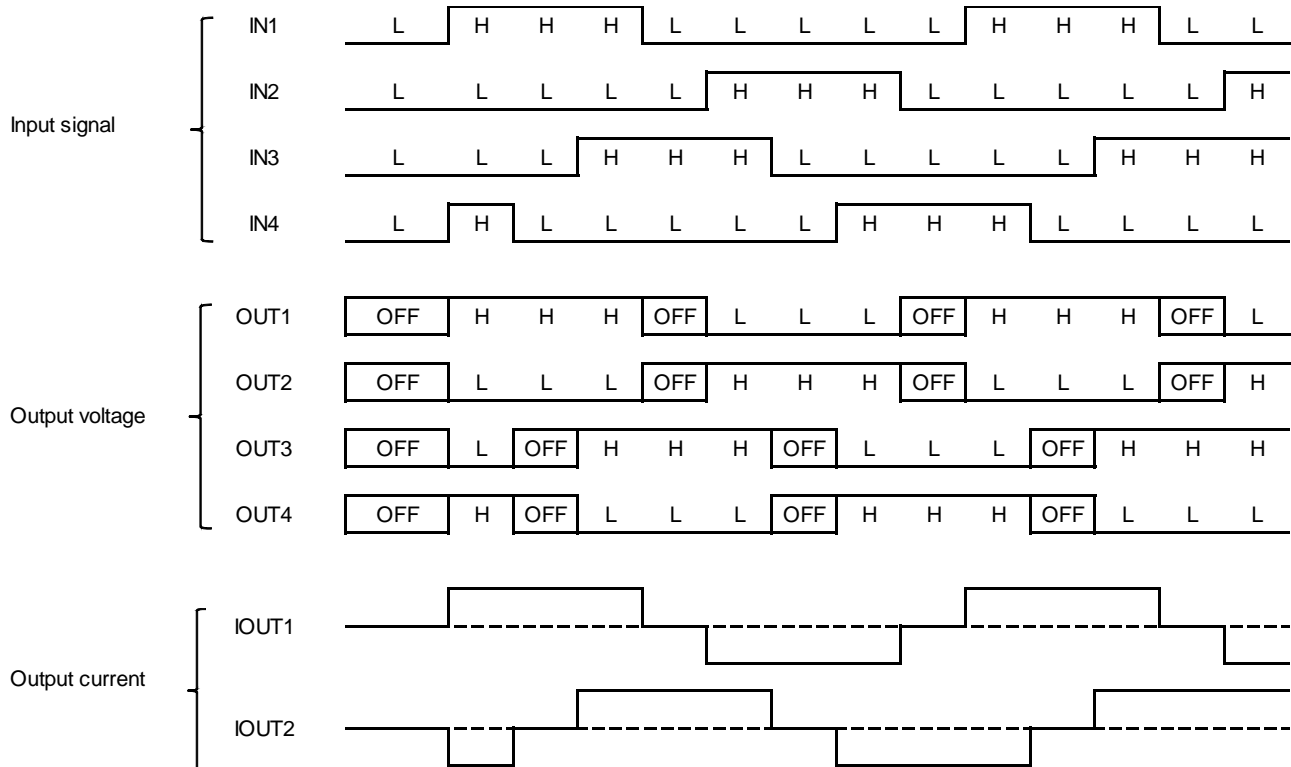


- Connect a stepping motor with OUT1, OUT2, OUT3 and OUT4.
- Connect the motor power supply with the terminal VM, the control power supply with the terminal VCC. Connect the GND line with the terminal PGND and SGND.
- Stepping motor drives it in 2-phase excitation or 1-2phase excitation by inputting a signal such as follows into IN1, IN2, IN3 and IN4.
- Check the stepping motor if rotating.
- Check the waveform of the output voltage and current.(Please refer to the following waveform example.)

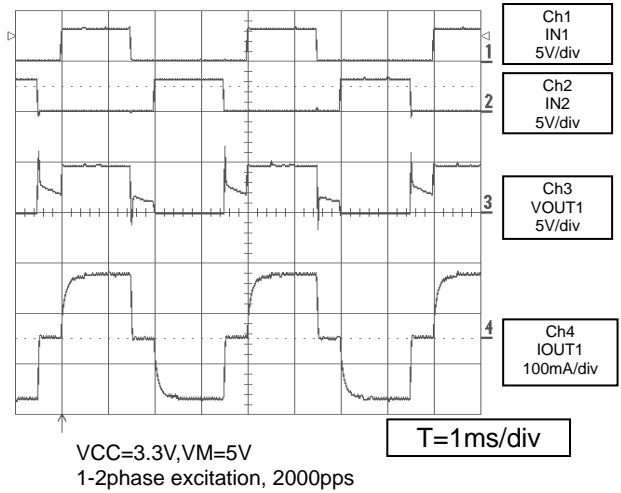
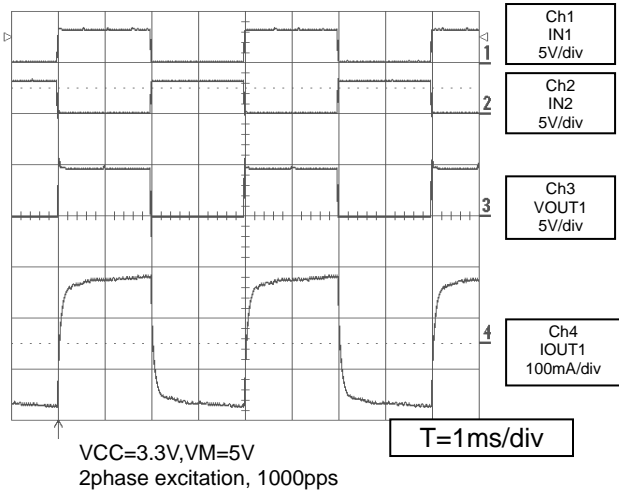
(2phase excitation)



(1-2phase excitation)



•Stepping motor driving waveform example



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