



STRUCTURE	Silicon monolithic integrated circuits
PRODUCT SERIES	2-in-1 motor driver for VTR
TYPE	<b>BD6904FP</b>
FUNCTION	<ul style="list-style-type: none"><li>• VTR cylinder motor driver (Sensorless 3-phase full-wave soft switching drive system)</li><li>• VTR loading motor driver</li></ul>

○Absolute maximum ratings (Ta=25°C)

Parameter	Symbol	Limit	Unit
Supply voltage	VCC	7	V
	VM	15	V
	VG	20	V
Power dissipation	Pd	1450 <sup>*1</sup>	mW
Operating temperature range	Topr	-20~+75	°C
Storage temperature range	Tstg	-55~+150	°C
Maximum output current (cylinder block)	Iomax1	800 <sup>*2</sup>	mA
Maximum output current (loading block)	Iomax2	800 <sup>*2</sup>	mA
Junction temperature	Tjmax	+150	°C

<sup>\*1</sup> 90mm×90mm×1.6mm glass epoxy board. Derating in done at 11.6mW/°C for operating above Ta=25°C.

<sup>\*2</sup> Do not, however exceed Pd, ASO and Tjmax=150°C.

○Recommended operating conditions (Ta= -25~+75°C)

Parameter	Symbol	Min	Typ	Max	Unit
Supply voltage	VCC	4.5	5	5.5	V
	VM	9	12	14	V
	VG	VM+2	17	19	V
COM input in-phase voltage range	VCOMD	0	-	VM-2.5	V
PG amp in-phase input voltage range	VPD	1.5	-	3.7	V

This product described in this specification isn't judged whether it applies to COCOM regulations.

Please confirm in case of export.

This product isn't designed for protection against radioactive rays.

○Electrical characteristics (Unless otherwise specified, Ta=25°C, VCC=5V, VM1=VM2=12V, VG=17V)

Parameter	Symbol	Limit			Unit	Conditions
		Min.	Typ.	Max.		
Overall						
VCC total supply current	ICC	-	9	13	mA	
Output						
High-side output saturation voltage	VOH	-	0.4	0.7	V	Io=-300mA
Low-side output saturation voltage	VOL	-	0.55	0.85	V	Io=300mA
BEMF comparator						
BEMF comparator hysteresis width +	VHYSB+	+24	+36	+48	mV	
BEMF comparator hysteresis width -	VHYSB-	-59	-43	-27	mV	
Torque reference						
Torque reference start voltage	VECR	2.35	2.5	2.65	V	
Torque reference I/O gain	Gio	0.80	1.06	1.33	A/V	EC=2.3V-2.2V Gain output (HLM) RRNF=0.68Ω
Current limit voltage	VCL	239	295	345	mV	RRNF=0.68Ω
Soft switch						
CT1, CT2 charge current	ICTD	-53	-39	-25	μA	
CT1, CT2 discharge current	ICTI	29	45	61	μA	
High CT1, CT2 clamp voltage	VCTH	3.4	3.8	4.2	V	
Low CT1, CT2 clamp voltage	VCTL	0.85	1.05	1.25	V	
Startup control logic						
CST charge current	ICSTO	-20	-14	-8	μA	
CST discharge current	ICSTI	2	5.5	9	μA	
High CST clamp voltage	VCSTH	2.4	2.8	3.2	V	
Low CST clamp voltage	VCSTL	0.8	1.0	1.2	V	
CST off voltage	VCSTO	3.6	3.8	4.0	V	
PG amp						
Input bias current	IPG-	-	1	3	μA	PG=2.5V
Input offset voltage	VIOP	-8	-	+8	mV	
DC bias voltage	VBP	2.25	2.5	2.75	V	
Voltage gain 1	AV1	50	71	-	dB	f=1kHz
High output voltage	VOHP	3.4	3.75	-	V	IOH=-1mA
Low output voltage	VOLP	-	1.2	1.6	V	IOL=1mA
PFG output						
PG detection level	VPGTH	VBP-0.075	VBP-0.1	VBP-0.125	V	
High output voltage	VPFGH	3.5	-	-	V	IO=-30 μA
Middle output voltage	VPFGM	2.1	-	2.9	V	IO=± 10 μA
Low output voltage	VPFGL	-	-	0.9	V	IO=30 μA
Loading						
High-level FIN input	VFINH	3.5	-	-	V	
High-level RIN input	VRINH	3.5	-	-	V	
Low-level FIN input	VFINL	-	-	1.5	V	
Low-level RIN input	VRINL	-	-	1.5	V	
Output saturation voltage	VCE	-	0.3	0.6	V	IO=200mA, total of output transistor high-side and low-side voltage

※Source currents are treated as negative while sinking currents are treated as positive.



○Operation Notes

(1) Absolute maximum ratings

Use of the IC in excess of absolute maximum ratings such as the applied voltage or operating temperature range (Topr) may result in IC damage. Assumptions should not be made regarding the state of the IC (short mode or open mode) when such damage is suffered. The implementation of a physical safety measure such as a fuse should be considered when use of the IC in a special mode where the absolute maximum ratings may be exceeded is anticipated.

(2) Power supply lines

Regenerated current may flow as a result of the motor's back electromotive force. Insert capacitors between the power supply and ground pins to serve as a route for regenerated current. Determine the capacitance in full consideration of all the characteristics of the electrolytic capacitor, because the electrolytic capacitor may lose some capacitance at low temperatures. If the connected power supply does not have sufficient current absorption capacity, regenerative current will cause the voltage on the power supply line to rise, which combined with the product and its peripheral circuitry may exceed the absolute maximum ratings. It is recommended to implement a physical safety measure such as the insertion of a voltage clamp diode between the power supply and GND pins.

(3) Ground potential

Ensure a minimum GND pin potential in all operating conditions.

(4) Setting of heat

Use a thermal design that allows for a sufficient margin in light of the power dissipation (Pd) in actual operating conditions.

(5) Actions in strong magnetic field

Use caution when using the IC in the presence of a strong magnetic field as doing so may cause the IC to malfunction.

(6) ASO

When using the IC, set the output transistor for the motor so that it does not exceed absolute maximum ratings or ASO.

(7) Thermal shutdown circuit

This IC incorporates a TSD (thermal shutdown) circuit (TSD circuit). If the temperature of the chip reaches the following temperature, the motor coil output will be opened. The thermal shutdown circuit (TSD circuit) is designed only to shut the IC off to prevent runaway thermal operation. It is not designed to protect the IC or guarantee its operation. Do not continue to use the IC after operating this circuit or use the IC in an environment where the operation of this circuit is assumed.

TSD on temperature [°C] (typ.)	Hysteresis temperature [°C] (typ.)
170	20

(8) Ground Wiring Pattern

When using both small signal and large current GND patterns, it is recommended to isolate the two ground patterns, placing a single ground point at the application's reference point so that the pattern wiring resistance and voltage variations caused by large currents do not cause variations in the small signal ground voltage. Be careful not to change the GND wiring pattern of any external components, either.

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