TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

TA8416F

LOW VOLTAGE USE 3 PHASE HALL MOTOR DRIVER

TA8416F is low voltage use 3 phase Hall Motor Driver IC with stand-by function designed especially for portable VCR, Head Phone Stereo and other battery operated electrical equipment motor drive applications.

FEATURES

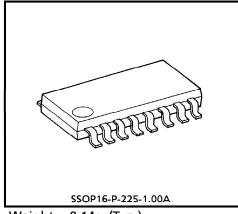
- 3 phase bipolar/unipolar Hall Motor Driver
- Low voltage use
- Voltage drive type
- Stand-by function for longer battery life
- MFP16 Flat package sealed
- 2 Hall Sensor drive available
- Operating supply voltage : $V_{CC} = 1.8 \sim 7.2 \text{V}$

 $V_S = 0.2 \sim 7.2 V$

• Output current : $I_{O(MAX.)} = 0.7A$ (AVE.)

= 1.3A (PEAK)

Built-in thermal shut down circuit



Weight: 0.14g (Typ.)

961001EBA

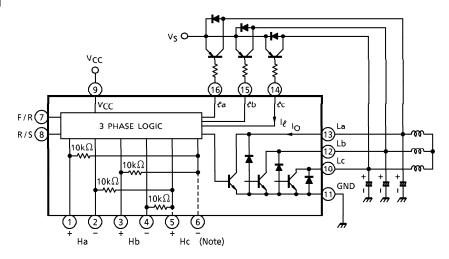
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BLOCK DIAGRAM



(Note) Refer to PIN FUNCTION 3.

PIN FUNCTION

PIN No.	SYMBOL	FUNCTIONAL DESCRIPTION	REMARK			
1	Ha+	a-phase Hall Amp. positive input terminal.	_			
2	Ha-	a-phase Hall Amp. negative input terminal.	_			
3	Hb+	b-phase Hall Amp. positive input terminal.	_			
4	Hb-	b-phase Hall Amp. negative input terminal.	_			
5	Hc+	c-phase Hall Amp. positive input terminal.	_			
6	Hc-	c-phase Hall Amp. negative input terminal.	_			
7	F/R	Rotation direction control input terminal.	H : Forward, L : Rererse			
8	R/S	Start/Stand by control Input terminal.	H : Start, L : Stand-by			
9	Vcc	Power supply input terminal.	$V_{CC (opr.)} = 1.8 \sim 7.2 V$			
10	Lc	c-phase drive output terminal.	_			
11	GND	GND terminal.	_			
12	Lb	b-phase drive output terminal.	_			
13	La	a-phase drive output terminal.	_			
14	ℓс	c-phase Pre-drive stage output terminal.	Connect to external PNP Transistor's Base			
15	ℓb	b-phase Pre-drive stage output terminal.	Connect to external PNP Transistor's Base			
16	lа	a-phase Pre-drive stage output terminal.	Connect to external PNP Transistor's Base			

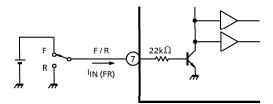
TERMINAL DESCRIPTION

1. Rotation direction control input (FR input, pin⑦)

Motor rotation direction is controlled by this terminal. More than 1V of control voltage becomes motor forward rotation and less than 0.4V of this voltage becomes motor reverse rotation. $22k\Omega$ of input resistance is equipped in series of this terminal. Therefore input current is calculated by following equation.

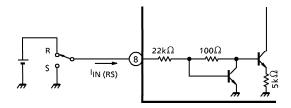
$$I_{\text{IN (FR)}} = \frac{V \odot - V_{\text{BE}}}{22 \times 10^3 \Omega} = \frac{3V - 0.7V}{22 \times 10^3 \Omega} \stackrel{=}{=} 100 \mu \text{A}$$
 $(V \odot = 3V)$

And the open mode of the terminal, there's no input current flow.



2. Start/stand-by control input (RS input, pin®)

Start (Run) and stand-by modes are controlled by this terminal. Operating voltage are more than 1V (Start or Run) and less than 0.5V (Stand-by). Supply current becomes less than 100μ A in Stand-by mode.



3. Hall sensor inputs (Ha+, -, Hb+, -, Hc+, -, pin①, ②, ③, ④, ⑤, ⑥)

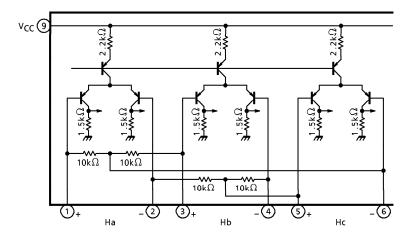
Hall Sensor Inputs for position sensing.

2 Hall Sensor Drive is also available by 4 pcs of $10k\Omega$ matrix resistors connect to Ha^{+, -} and Hb^{+, -} terminals.

But, in case of lower speed application, poor precision sensor positioning and good torque ripple and W/F characteristics required.

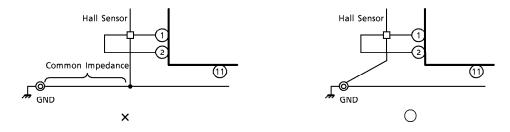
We recommend to use 3 Hall Sensors for stable operations. Input sensitivity is 20mV_{p-p} (Typ), but actual value is $2 \sim 3 \text{mV}$.

We recommend to input more than $20 \text{mV}_{\text{p-p}}$ to get good W/F characteristics.

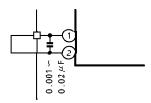


Wide DC operating range of $0 \sim V_{CC} - 1.2V$ is accomplished by PNP input circuit and also built in hysteresis restricts mis-function caused by external noise.

But care should be taken not to have a common impedance between Hall Sensor GND lines and the power GND line for stable operations.



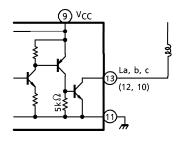
To decrease noise problems, we recommend to connect noise suppression capacitance $(0.001\sim0.02\mu\text{F})$ between each Hall Input Terminal.



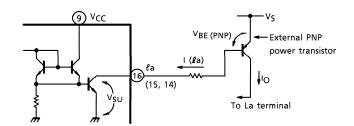
4. Output terminals (La, Lb, Lc, pin®, ®, ®)

This IC is designed for use 3 phase unipolar drive applications, but Bipolar drives also available with additional 3 transistors.

Care should be taken with back electron motive force generated by coil not to over the specified voltage.



Open collector type Pre-drive stage required current are calculated by following equation.



$$I(\ell a) = K_O \cdot \frac{I_O}{h_{fe}}$$

$$I (\ell a) = \frac{V_S - V_{BE} (PNP) - V_{SU}}{R}$$

$$K_{\mathbf{O}} \ge 2$$

h_{fe}: h_{fe} of PNP transistor IO: Output current

Summing that, V_{BE} (PNP) = 0.7V, V_{SU} = 0.2V

$$R = \frac{h_{fe} (V_S - 0.9)}{K_O \cdot I_O}$$

For Example, $V_S = 3V$, $h_{fe} = 100$, $I_O = 0.7A$, $K_O = 2$ $R = 150 \Omega$

FUNCTION

ROTATION CONTROL		POSITION SENSING INPUT			UPPER SIDE OUTPUT			LOWER SIDE OUTPUT			
F/R	R/S	На	Hb	Hc	ℓa	ℓb	ℓс	La	Lb	Lc	
н	н	Н	L	Н	1	0	0	0	1	0	
		Н	L	L	1	0	0	0	0	1	
		Н	Н	L	0	1	0	0	0	1	
		L	Н	L	0	1	0	1	0	0	
		L	Н	Н	0	0	1	1	0	0	
		L	L	Н	0	0	1	0	1	0	
	Н	Н	L	Н	0	1	0	1	0	0	
		Н	L	L	0	0	1	1	0	0	
ł ,		Н	Н	L	0	0	1	0	1	0	
L		L	Н	L	1	0	0	0	1	0	
		L	Н	Н	1	0	0	0	0	1	
		L	L	Н	0	1	0	0	0	1	
	L	Н	L	Н							
_		Н	L	L							
		Н	Н	L	High Impedance High Impedance				nco		
		L	Н	L	nigh impedance nigh impedanc			iiice			
		L	Н	Н							
		L	L	Н							

 $\begin{array}{lll} H \; : \; V_H{}^+ \! > \! V_H{}^- & 1 \; : \; ON \\ L \; : \; V_H{}^+ \! < \! V_H{}^- & 0 \; : \; OFF \end{array}$

MAXIMUM RATINGS (Ta = 25° C)

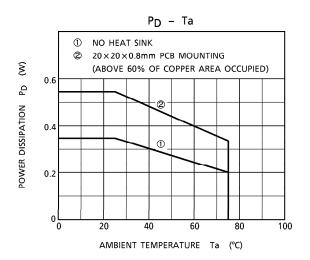
CHARACTERISTIC	SYMBOL	RATING	UNIT	
Supply Voltage	Vcc	8	V	
Supply Voltage	٧s	8		
Output Current	lo	0.7	Α	
Output Current	١ _ℓ	20.0	mA	
Power Dissination	PD	350 (Note 1)	mW	
Power Dissipation	יט	550 (Note 2)	11100	
Operating Temperature	T _{opr}	- 30~80	°C	
Storage Temperature	T _{stg}	- 55∼150	°C	

(Note 1) No heat sink

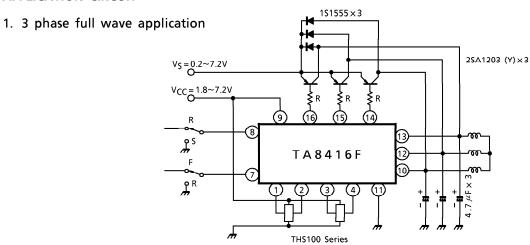
(Note 2) This rating is obtained by mounting on $20 \times 20 \times 0.8$ mm PCB that occupied above 60% of copper area.

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

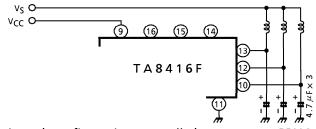
CHARACTERISTIC			SYMBOL	TEST CIR- CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	
Supply Current			l _{CC1}	_	$V_{CC} = 3V$, output "OPEN"	_	2.7	4.0	mΑ	
			lCC3		$V_{CC} = 6V$, output "OPEN"	-	3.0	5.0	mA	
					Stand-by mode output "OPEN" $V_{CC} = 3V$	-	0	100	μΑ	
Saturation	La, Lb, Lc Side		V _{SL-1}	_	I _O = 0.1A	_	0.2	_	V	
Voltage			V _{SL-2}	_	I _O = 0.6A	_	0.6	1.0		
Voltage	ℓa, ℓb, ℓc Side		V _{SU}	_	I _ℓ = 10mA	_	0.1	0.2		
Position	Sensitivity		٧ _H	_	_	_	20	_	mV _{p-p}	
Sensing Input	Operating DC Level		CMR	_	_	0	_	V _C C – 1.2	V	
Diode Forward Voltage		VF	_	I _F = 0.7A	_	1.2	_	V		
Rotation	Operating Voltage	Forward	V _{FWD}	_	_	1.0	_	_	v	
Control Input		Reverse	V _{RVS}	_	_	_	_	0.4	1 ' 	
Voltage	Operating Current		l _{IN} (FR)	_	V _{F / R} = 3V	_	100	200	μ A	
Start / Stand-by	Operating Voltage	Run	V _{RUN}	_	_	1.0	_	_	v	
Control		Stand-by	V _{ST}	_	_	_	_	0.5		
Input Voltage	Operating Current		lin (RS)	_	V _F / R = 3V		100	200	μ A	
Saturation Voltage Differential (La, Lb, Lc Side)			ΔVς	_	I _O = 200mA, La, Lb, Lc	_	20	_	mV	
Leakage Current			IL	_	V = 8V	_	0	100	μΑ	
Thermal Shut-down Circuit Operating Temperature			T _{SD}	_	Junction temperature	140	_	_	°C	



APPLICATION CIRCUIT



- (Note) \bullet V_S and V_{CC} terminals connecting application also available.
 - We recommend to use TOSHIBA Ga-As type Hall Sensor THS100 series.
 - Output capacitans (4.7 μ F \times 3) are for noise suppression use. It is required to increase the value if the vibration noise is so loud.
- 2. 3 phase half wave application

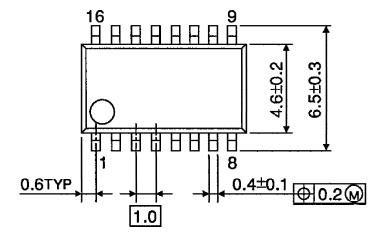


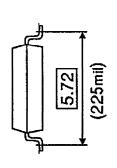
- (Note) Other circuit and configurations are all the same to APPLICATION CIRCUIT 1.
 - Care should be taken with BEMF value generated by coils that not increase specified value of output transistor withstand voltage.
 - Utmost care is necessary in the design of the output line, V_S and GND line since IC may be destroyed due to short-circuit between outputs, air contamination fault, or fault by improper grounding.

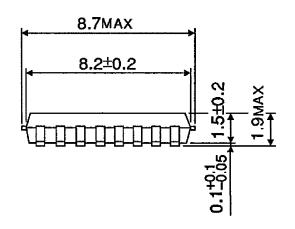
Unit: mm

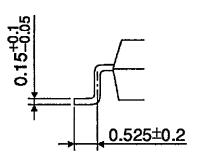
OUTLINE DRAWING

SSOP16-P-225-1.00A









Weight: 0.14g (Typ.)