

TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

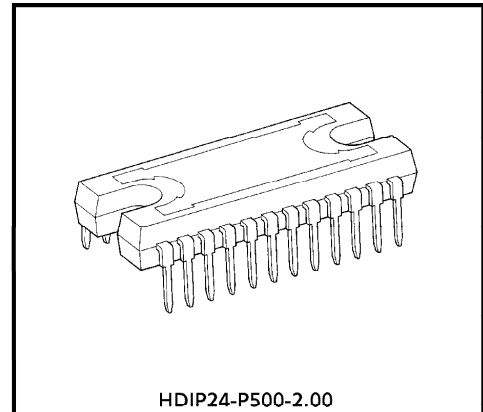
TA8411L

STEPPING MOTOR SYSTEM DRIVER

The TA8411L is Stepping Motor System Driver IC incorporates Dual Bipolar Stepping Motor Drivers, DC Motor Driver and Serial to Parallel Signal Conversion Circuit (12 bit Serial to Parallel Shift Resistor with Latch) which control the 3 Output Drivers states by means of Input Serial Signal trains.

FEATURES

- 2 Bipolar Stepping Motors and 1 Brush DC Motor (or Solenoid) are controlled by input serial signal trains and latch signals.
- Output Current up to 0.8A (for Stepper) and 0.6A (for DC Motor).
- PWM Chopper type Stepping Motor Drivers.
- All C-MOS Compatible Inputs.
- Operating Supply Voltage : $V_{M1, 2} = 0 \sim 27V$
 $V_{CC} = 4.5 \sim 5.5V$

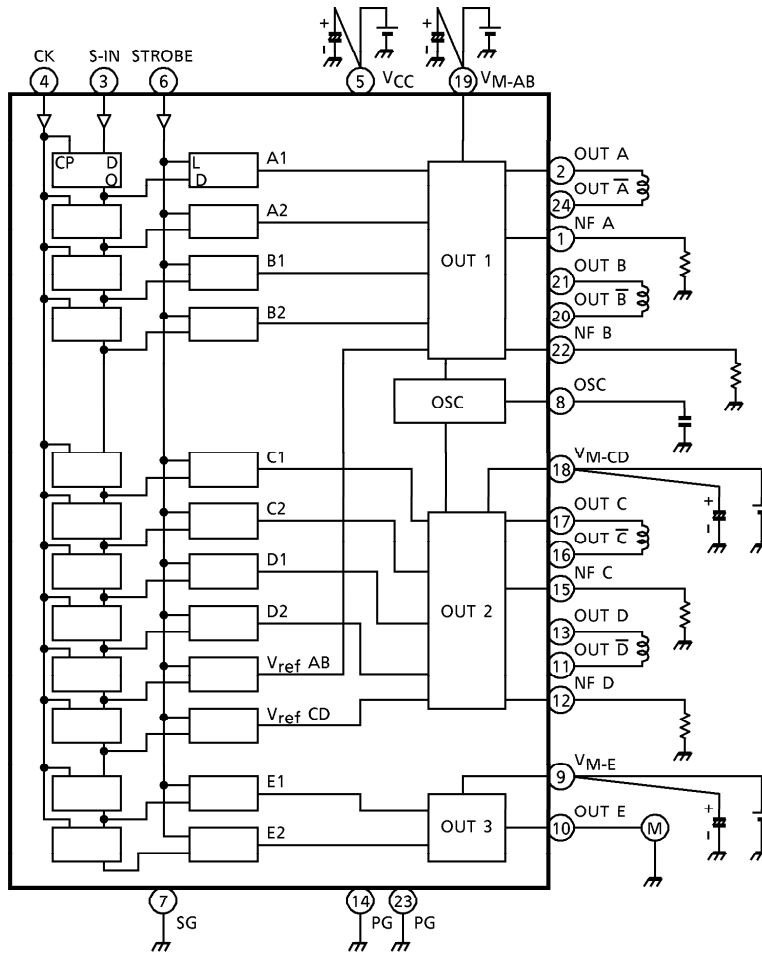


Weight : 4.30g (Typ.)

961001EBA1

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BLOCK DIAGRAM



(Note 1) Capacitance connect to each Power Supply Terminal is required to change to optimum value for noise elimination and also required to connect directly to each Power Supply Terminal (V_{CC} , V_{M1} , 2) and the corresponding GND Terminal (See Table 1) for stable operations.

Table 1

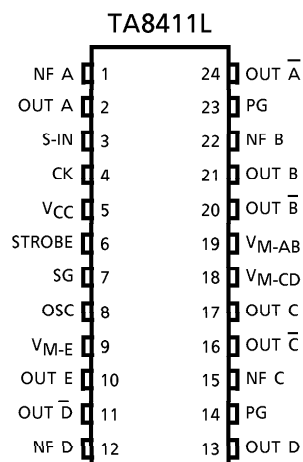
GND	POWER SUPPLY
Pin⑦ (SG)	Pin⑤ (V_{CC})
Pin⑬ (PG)	Pin⑱ (V_{M-AB})
Pin⑭ (PG)	Pin⑱ (V_{M-AB}), Pin⑨ (V_{M-E})

(Note 2) Heat Fin is connect to GND terminal with Low Impedance.

PIN FUNCTION

PIN No.	SYMBOL	FUNCTIONAL DESCRIPTION
1	NF A	A channel current detection output terminal.
2	OUT A	OUTPUT A
3	S-IN	Serial signal input terminal.
4	CK	Clock signal input terminal.
5	V _{CC}	Supply voltage terminal for control circuit.
6	STROBE	STROBE signal input terminal.
7	SG	Signal GND terminal.
8	OSC	Internal osc frequency setting terminal.
9	V _{M-E}	E channel power supply input terminal.
10	OUT E	E channel output terminal. (pushpull output)
11	OUT \bar{D}	OUTPUT \bar{D}
12	NF D	D channel current detection output terminal.
13	OUT D	OUTPUT D
14	PG	Power GND terminal.
15	NF C	C channel current detection output terminal.
16	OUT \bar{C}	OUTPUT \bar{C}
17	OUT C	OUTPUT C
18	V _{M-CD}	Supply voltage terminal for C channel D channel.
19	V _{M-AB}	Supply voltage terminal for A channel B channel.
20	OUT \bar{B}	OUTPUT \bar{B}
21	OUT B	OUTPUT B
22	NF B	B channel current detection output terminal.
23	PG	Power GND terminal.
24	OUT \bar{A}	OUTPUT \bar{A}

PIN CONNECTION

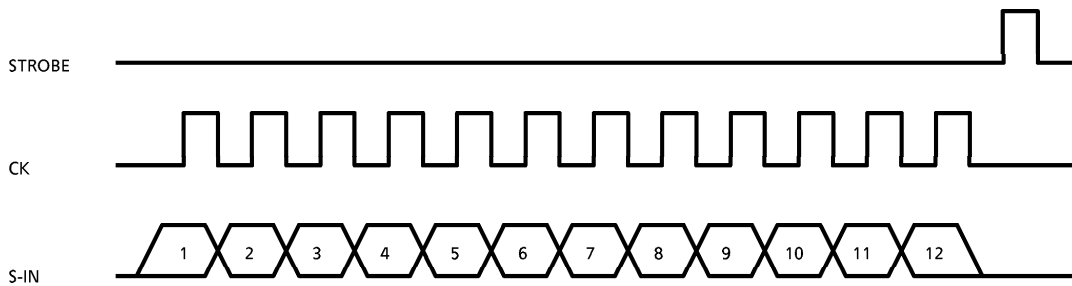


INPUT SERIAL PULSE TRAIN (PIN③) AND POWER OUTPUT STATES

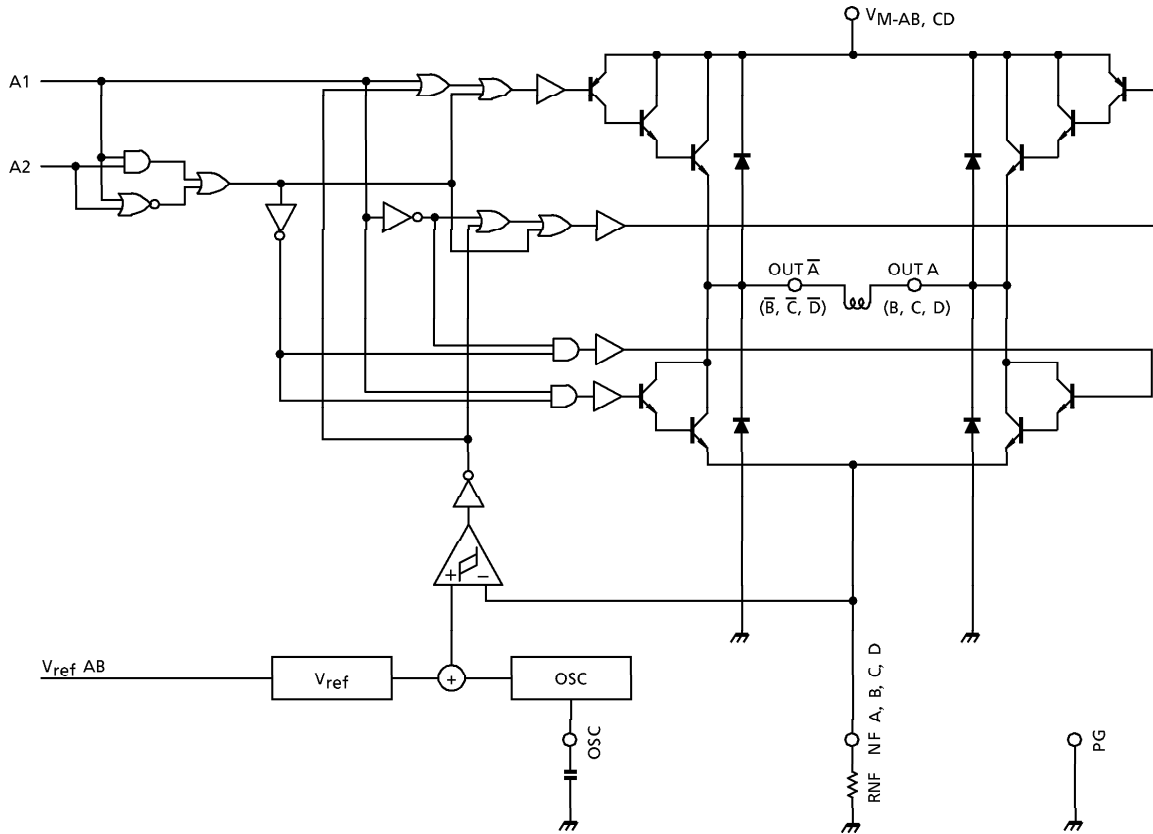
SERIAL INPUT SIGNAL TRAIN		CONTROL	OPERATION																														
↑	1	E2	<table border="1"> <thead> <tr> <th colspan="2">INPUT</th> <th>OUTPUT</th> <th rowspan="2">MODE</th> </tr> <tr> <th>E1</th> <th>E2</th> <th>E</th> </tr> </thead> <tbody> <tr> <td>L</td> <td>L</td> <td>∞</td> <td>STOP</td> </tr> <tr> <td>H</td> <td>L</td> <td>H</td> <td>CW/CCW</td> </tr> <tr> <td>L</td> <td>H</td> <td>L</td> <td>Brake</td> </tr> <tr> <td>H</td> <td>H</td> <td>∞</td> <td>STOP</td> </tr> </tbody> </table>	INPUT		OUTPUT	MODE	E1	E2	E	L	L	∞	STOP	H	L	H	CW/CCW	L	H	L	Brake	H	H	∞	STOP							
	INPUT			OUTPUT	MODE																												
	E1	E2		E																													
	L	L		∞	STOP																												
	H	L	H	CW/CCW																													
	L	H	L	Brake																													
	H	H	∞	STOP																													
	2	E1	DC Motor Control																														
	3	V _{ref} CD	Stepping Motor 2 Chopping Rate Control (V _{ref} CD)	V _{ref} = 0.7V Typ. (at "H" Mode) = 0.55V Typ. (at "L" Mode)																													
	4	V _{ref} AB	Stepping Motor 1 Chopping Rate Control (V _{ref} AB)																														
	5	D2	Stepping Motor 2 Control (OUT C, D)	<table border="1"> <thead> <tr> <th colspan="2">INPUT</th> <th colspan="2">OUTPUT</th> <th rowspan="2">MODE</th> </tr> <tr> <th>A1</th> <th>A2</th> <th>A</th> <th>\bar{A}</th> </tr> </thead> <tbody> <tr> <td>L</td> <td>L</td> <td>∞</td> <td>∞</td> <td>STOP</td> </tr> <tr> <td>H</td> <td>L</td> <td>H</td> <td>L</td> <td>CW/CCW</td> </tr> <tr> <td>L</td> <td>H</td> <td>L</td> <td>H</td> <td>CCW/CW</td> </tr> <tr> <td>H</td> <td>H</td> <td>∞</td> <td>∞</td> <td>STOP</td> </tr> </tbody> </table>	INPUT		OUTPUT		MODE	A1	A2	A	\bar{A}	L	L	∞	∞	STOP	H	L	H	L	CW/CCW	L	H	L	H	CCW/CW	H	H	∞	∞	STOP
	INPUT				OUTPUT		MODE																										
A1	A2	A			\bar{A}																												
L	L	∞			∞	STOP																											
H	L	H	L	CW/CCW																													
L	H	L	H	CCW/CW																													
H	H	∞	∞	STOP																													
6	D1																																
7	C2																																
8	C1	Stepping Motor 1 Control (OUT A, B)	B1, B2 → B, \bar{B} C1, C2 → C, \bar{C} D1, D2 → D, \bar{D} are all the same.																														
9	B2																																
10	B1																																
11	A2																																
12	A1																																

∞ : High impedance

INPUT SERIAL PULSE TRAIN TIMING CHART



OUTPUT STAGE 1, 2 1/2 CIRCUIT



FUNCTION (Comp.+ > Comp.-)

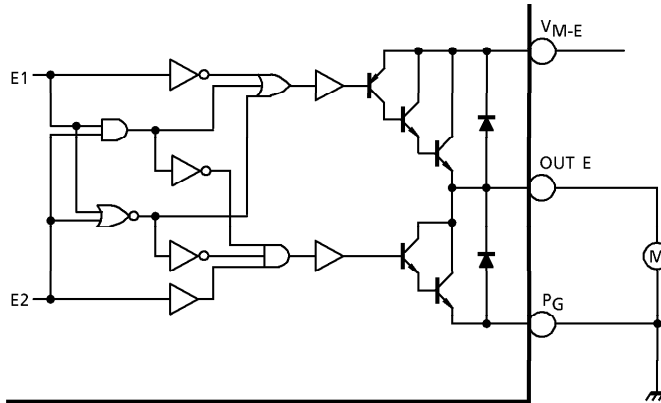
A1	A2	A	Ā	MODE
L	L	∞	∞	STOP
H	L	H	L	CW / CCW
L	H	L	H	CCW / CW
H	H	∞	∞	STOP

∞ : High impedance

(Note 1) In case of Comp.+ < Comp.-, Upper side Power Transistor turned off.

(Note 2) Free wheeling diode connects between Output A terminal and GND is required for stable operations. And also recommend to connect free wheeling diodes other Output terminals for reliable operations.

OUTPUT STAGE 3

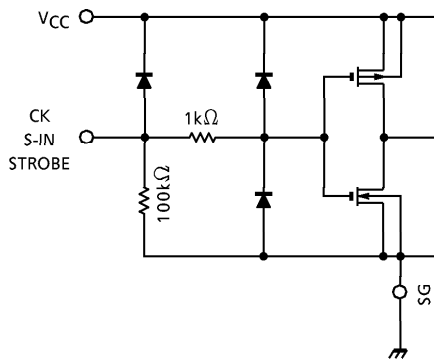


FUNCTION

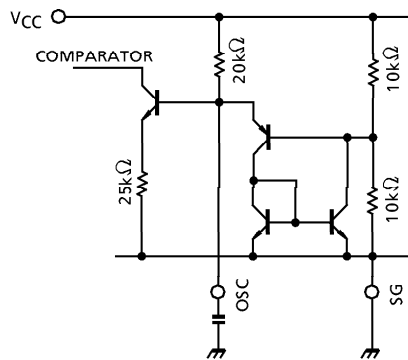
E1	E2	E	MODE
L	L	∞	STOP
H	L	H	CW
L	H	L	BRAKE
H	H	∞	STOP

∞ : High impedance

INPUT STAGE (CK, S-IN, STROBE)



OSC STAGE (OSC)



$$f_{osc} = \frac{1}{21.4 C_{OSC}} \text{ (kHz)}$$

C_{OSC} : μF

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage (Motor)	V _M	30	V
Supply Voltage (Control)	V _{CC}	5.5	V
Input Voltage	V _{IN}	5.5	V
Output Current	I _{O1} , I _{O2}	0.8	A
	I _{O3}	0.6	
Power Dissipation	P _D	16.2 (Note 1)	W
		2.5 (Note 2)	
Operating Temperature	T _{opr}	-40~85	°C
Storage Temperature	T _{stg}	-55~150	°C

(Note 1) T_c = 85°C

(Note 2) No heat sink

RECOMMENDED OPERATION CONDITION

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage (Control)		V _{CC}	—	4.5	5.0	5.5	V
Supply Voltage (Motor)		V _M	—	21.6	24	26.4	V
Input Voltage		V _{IN}	—	0	—	V _{CC}	V
Output Current	I _{OUT} A, B, C, D	I _{OUT}	Ta = 0~70°C V _{CC} = 5V V _M = 24V	—	—	0.7	A
	I _{OUT} E			—	—	0.4	
Clock Frequency		f _{CK}		—	—	1.0	MHz
		f _{STROBE}		—	—	1.0	
Clock Pulse Width		t _w CK		500	—	—	ns
		t _w STROBE		500	—	—	
Data Set Up Time		t _{su}		250	—	—	ns
Data Hold Time		t _H		250	—	—	ns
PWM Oscillation Frequency		f _{PWM}		20	—	100	kHz

ELECTRICAL CHARACTERISTICS

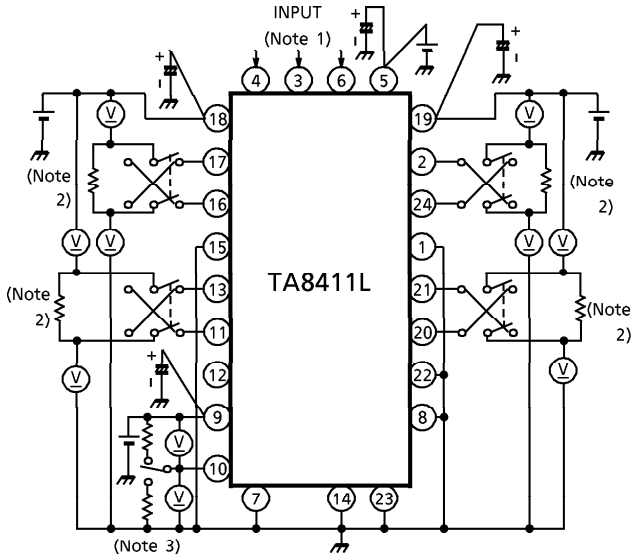
Output stage (Ta = 25°C, V_{CC} = 5V, V_M = 24V)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	
Operation Power Supply Voltage		V _{M(opr)}	—	—	0	—	27	V	
Saturation Voltage	AB DC	V _{CE} (SAT) Upper	1	I _{OUT} = 0.7A	Output - V _{CC}	—	2.0	2.5	V
				I _{OUT} = 0.5A		—	1.8	2.3	
	AB CD	V _{CE} (SAT) Lower	1	I _{OUT} = 0.7A	Output - NF	—	1.5	2.0	
				I _{OUT} = 0.5A		—	1.3	1.8	
	E	V _{CE} (SAT) Upper	1	I _{OUT} = 0.5A	Output - V _{CC}	—	1.8	2.3	
				I _{OUT} = 0.3A		—	1.7	2.2	
	E	V _{CE} (SAT) Lower	1	I _{OUT} = 0.5A	Output - NF	—	1.5	2.0	
				I _{OUT} = 0.3A		—	1.2	1.7	
Output Leak Current		I _{OL-H}	2	V _{CE} = 30V	—	—	50	μA	
		I _{OL-L}			—	—	50		
Clamp Diode Forward Voltage	AB CD	V _{F-U}	3	I _F = 700mA	Output A~D	—	1.6	2.0	V
		V _{F-L}				—	1.6	2.0	
	E	V _{F-U}	3	I _F = 500mA	Output E	—	1.5	1.9	
		V _{F-L}				—	1.7	2.1	
Propagation Delay Time (ST-OUT)		t _p	7	—	—	600	—	ns	

Small signal stage ($T_a = 25^\circ\text{C}$, $V_{CC} = 5\text{V}$, $V_M = 24\text{V}$)

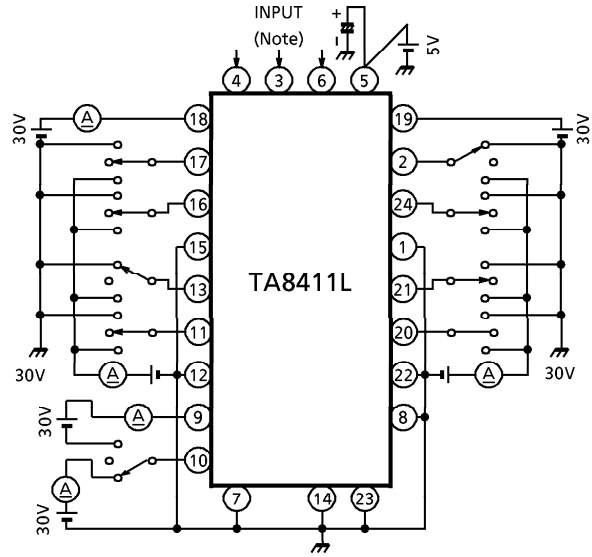
CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	
Operating Supply Voltage		$V_{CC(\text{opr})}$	—	—	4.5	—	5.5	V	
Quiescent Current		I_{CC1}	4	$V_{CC} = 5\text{V}$ Output Open	Output off mode	—	26.0	40	mA
		I_{CC2}			Output on mode : output stage 1 or 2	—	26.0	40	
		I_{CC3}			Output on mode : output stage 1 and 2	—	24.0	37	
		I_{CC4}			Output on mode : output stage 3	—	25.0	38	
Input Voltage	"H" Level	$V_{IN\ H}$	—	$V_{CC} = 5.0\text{V}$	CK, S-IN STROBE	3.5	—	V_{CC}	V
	"L" Level	$V_{IN\ L}$				-0.4	—	1.5	
Input Current	"H" Level	$I_{IN\ H}$	5	$V_{CC} = 5.0\text{V}$	$V_{IN\ H} = 5.5\text{V}$	—	55	150	μA
					$V_{IN\ H} = 3.5\text{V}$	—	35	100	
					$V_{IN\ L} = 1.5\text{V}$	—	15	50	
V_{ref}	"H" Level	$V_{\text{ref}\ H}$	6	$T_j = -40 \sim 125^\circ\text{C}$ $C_{\text{OSC}} = 3300\text{pF}$ $R_{\text{NF}} = 3.3\Omega$ $L = 19.5\text{mH}$	$V_{\text{ref}\ IN} = \text{"H"}$	0.6	0.7	0.8	V
	"L" Level	$V_{\text{ref}\ L}$			$V_{\text{ref}\ IN} = \text{"L"}$	0.45	0.55	0.65	
V_{ref} Level Differential Voltage		ΔV_{ref}	6	$V_{\text{ref}\ (H)} - V_{\text{ref}\ (L)}$		—	0.15	—	V
Reset Voltage		V_{CCR}	—	—	3.4	3.9	4.4	V	
PWM Oscillation Frequency		f_{PWM}	—	—	10	—	200	kHz	
Clock Frequency		f_{CK}	7	—	—	—	1.5	MHz	
		f_{STROBE}	7	—	—	—	1.5		
Min. Clock Width		t_{CK}	7	—	340	—	—	ns	
		t_{STROBE}	7	—	340	—	—		
Data Set Up Time		t_{SU}	7	—	170	—	—	ns	
Data Hold Up Time		t_{H}	7	—	170	—	—	ns	

TEST CIRCUIT 1. $V_{CE(SAT)}$ Upper, Lower



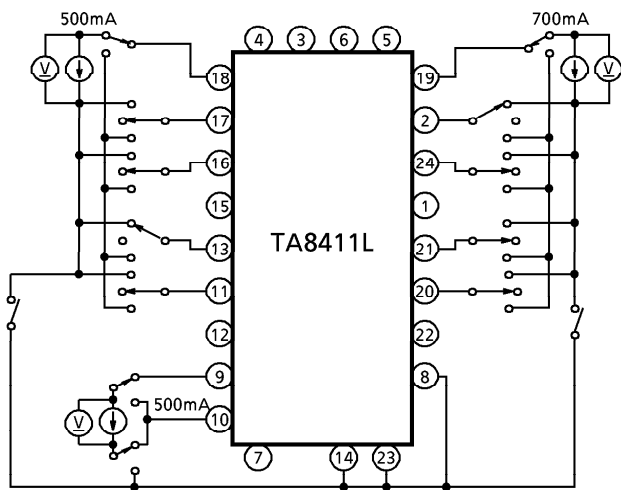
- (Note 1) Sets Output Transistor active with Input mode select.
- (Note 2) Calibrate Output Current becomes 0.5A (or 0.7A) with this resistor.
- (Note 3) Calibrate Output Current becomes 0.3A (or 0.5A) with this resistor.

TEST CIRCUIT 2. I_{OL-H} , I_{OL-L}



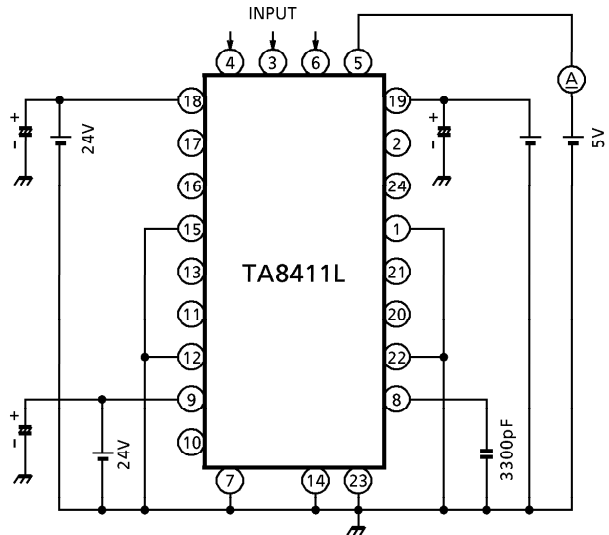
- (Note) All "L" level S-IN signal, normal CK and Strobe signals are required to measure.

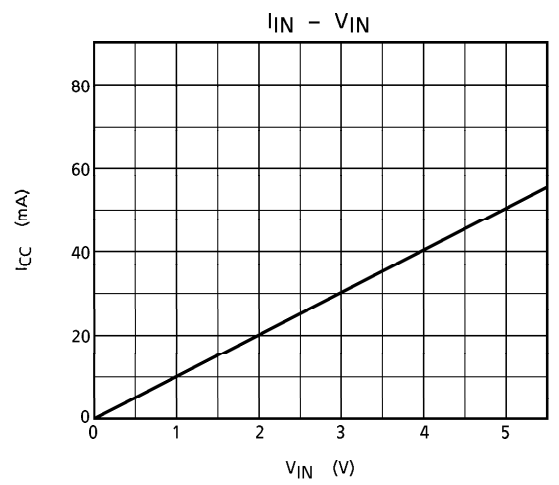
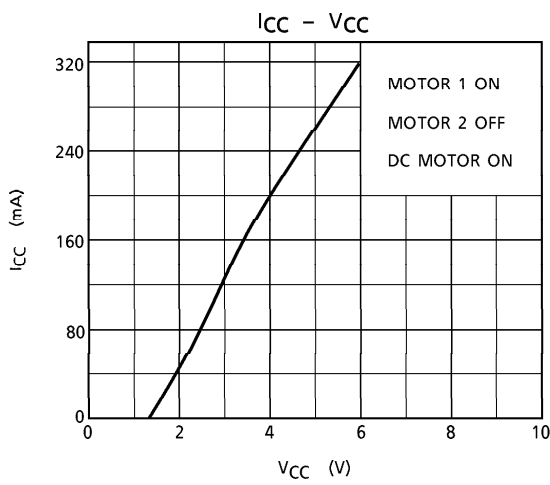
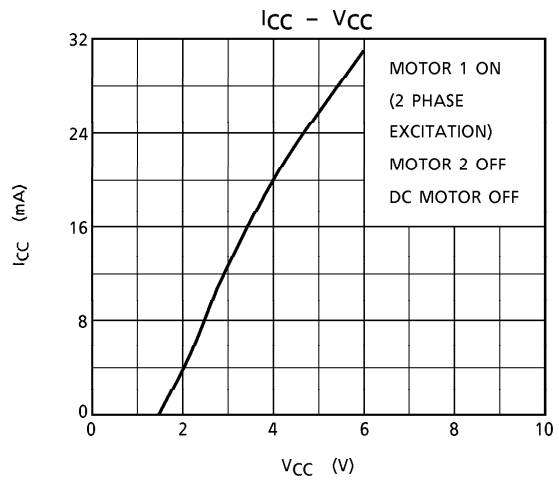
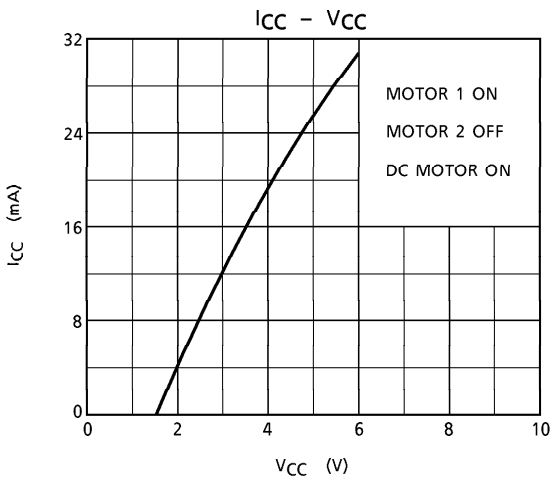
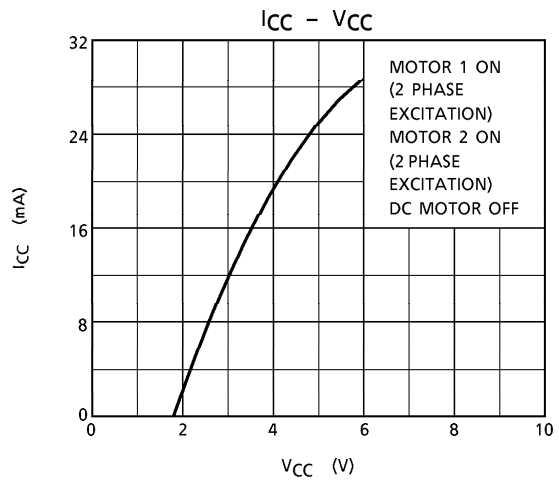
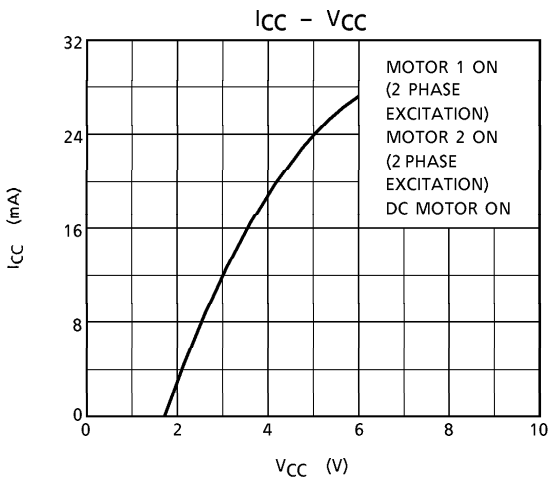
TEST CIRCUIT 3. V_{F-U} , V_{F-L}

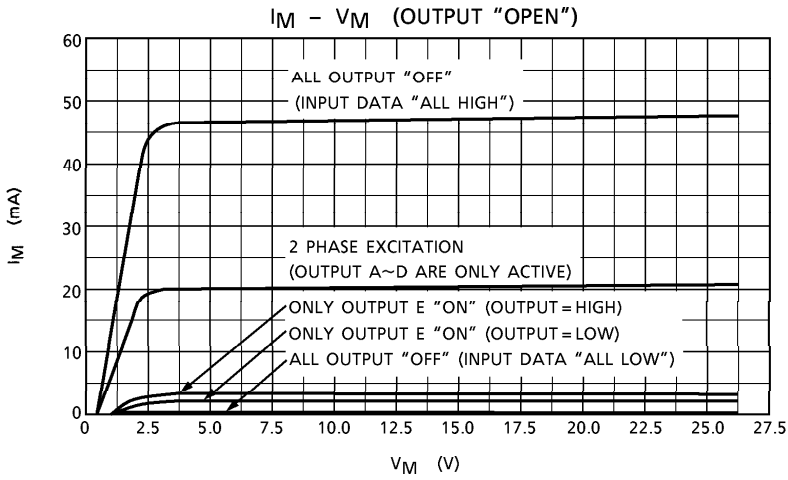


- (Note) Not to take a GND with any non-connecting Pins.

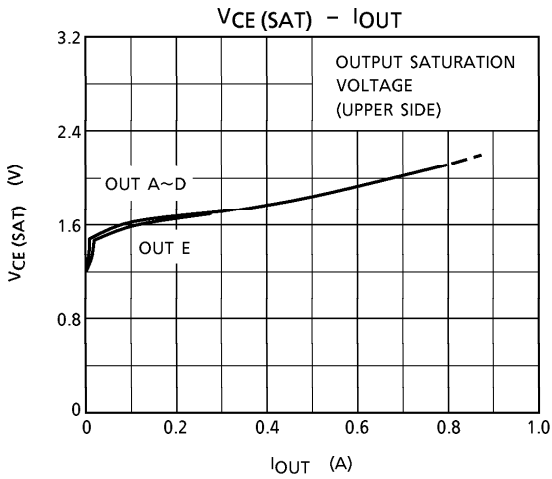
TEST CIRCUIT 4. $I_{CC1, 2, 3, 4}$



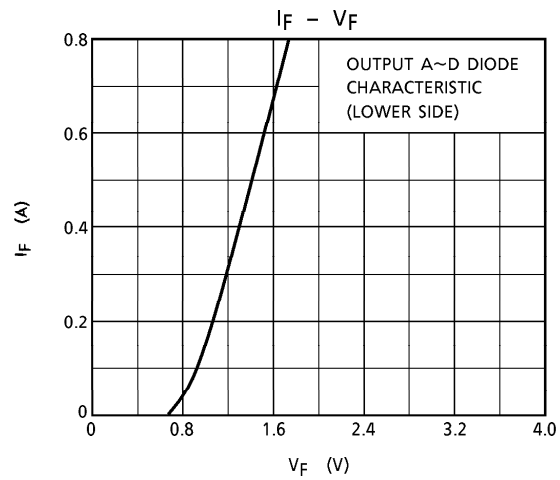
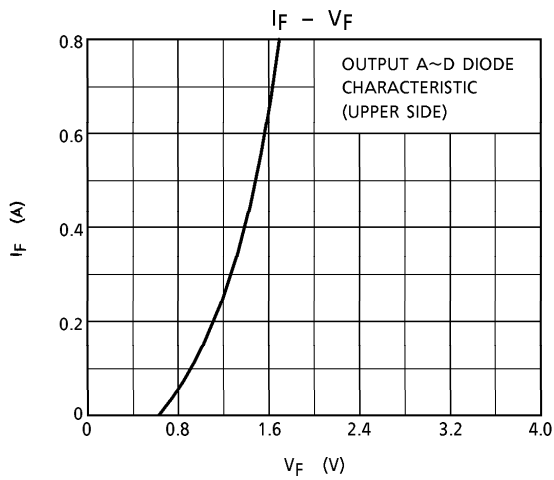
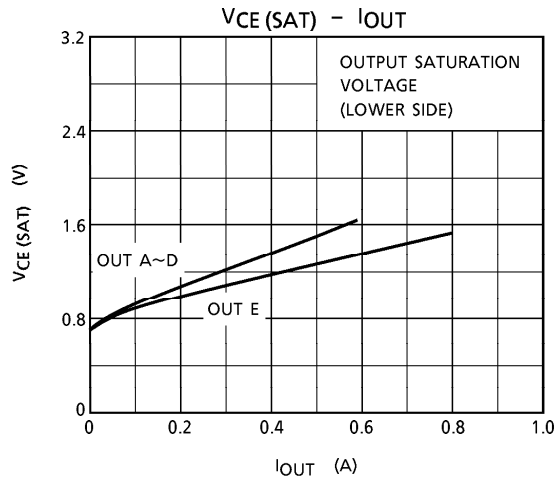


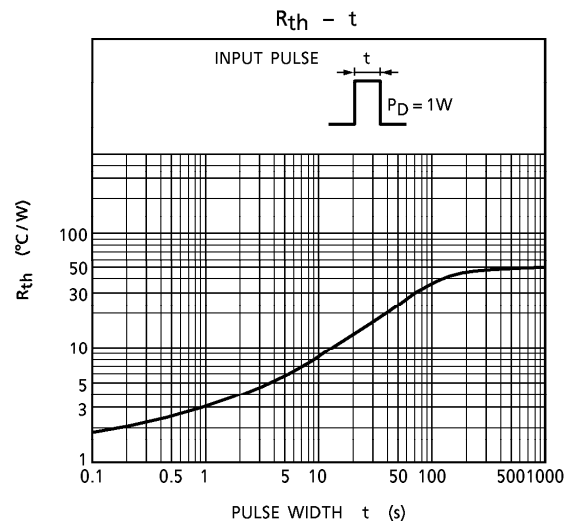
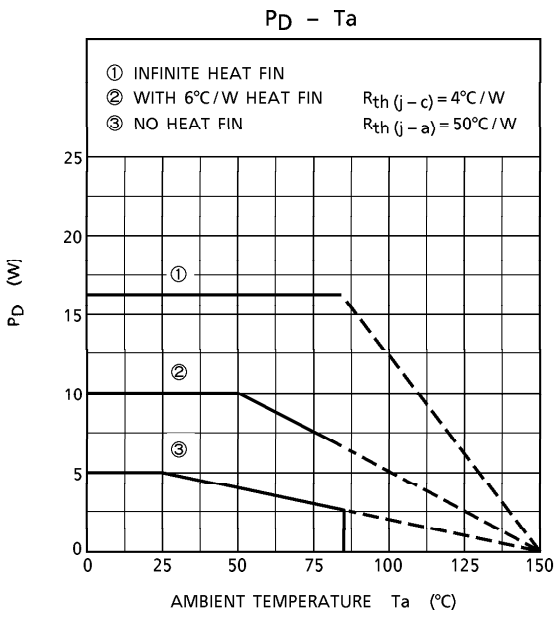
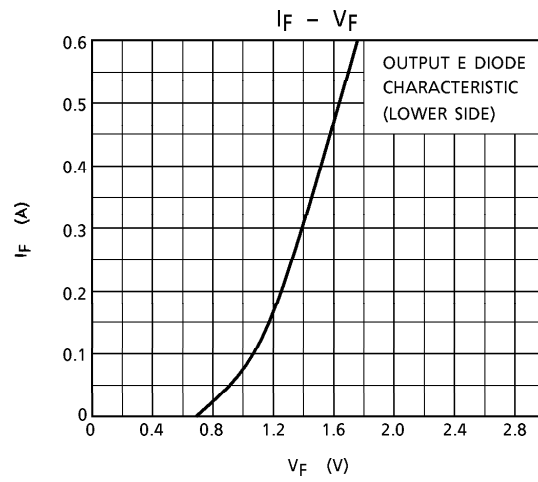
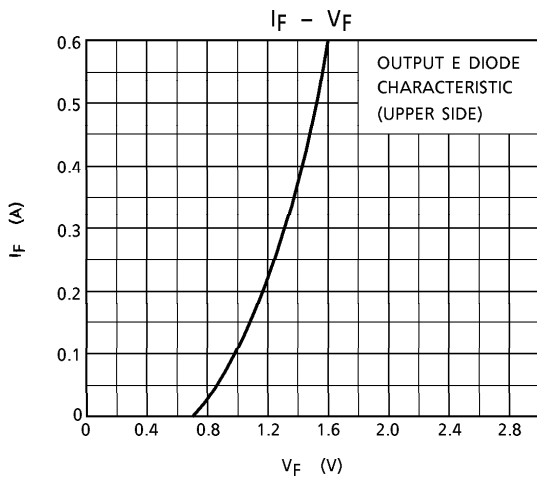


(Note) $I_M = I_M - AB + I_M - CD + I_M - E$

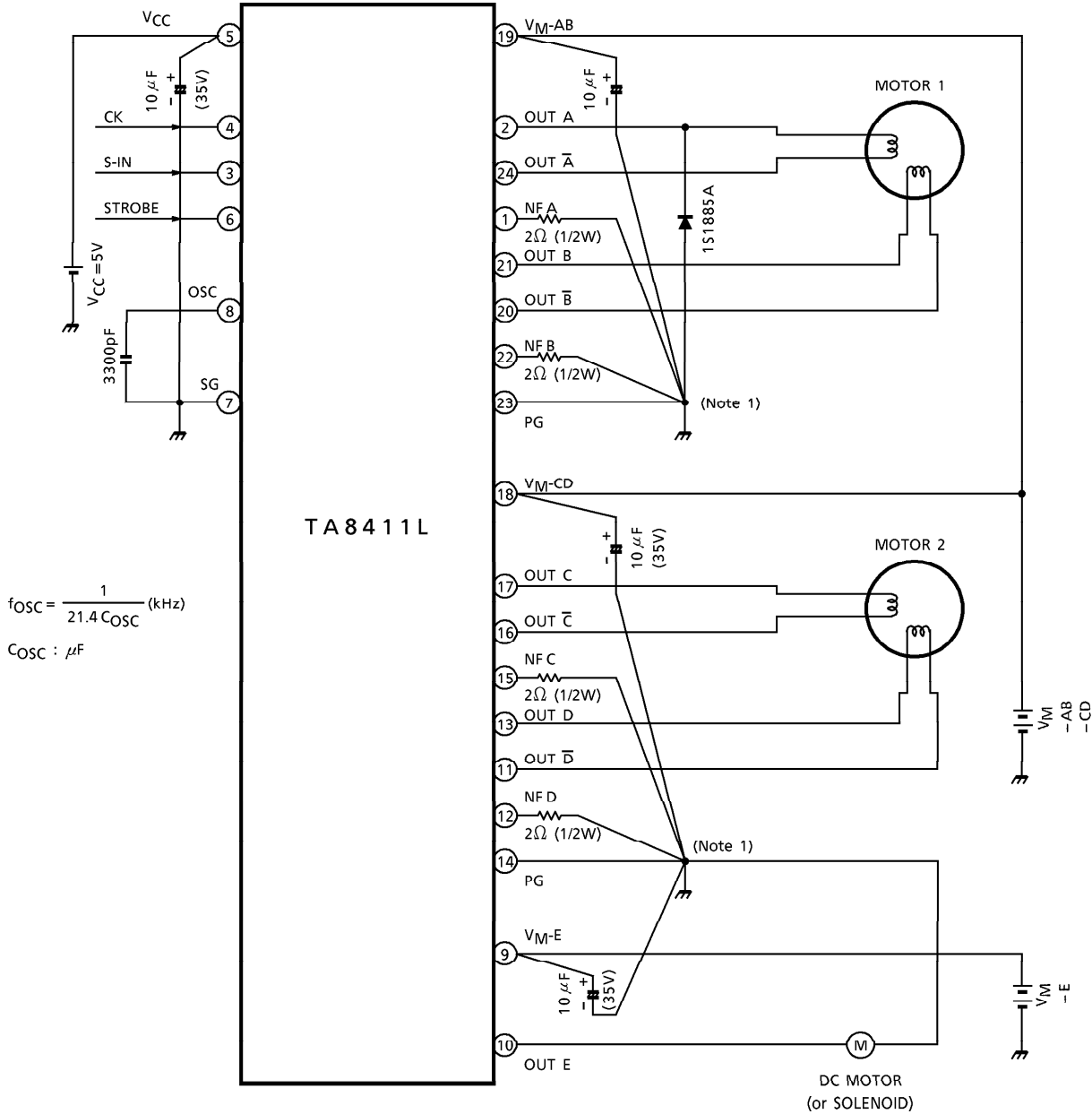


OUT E





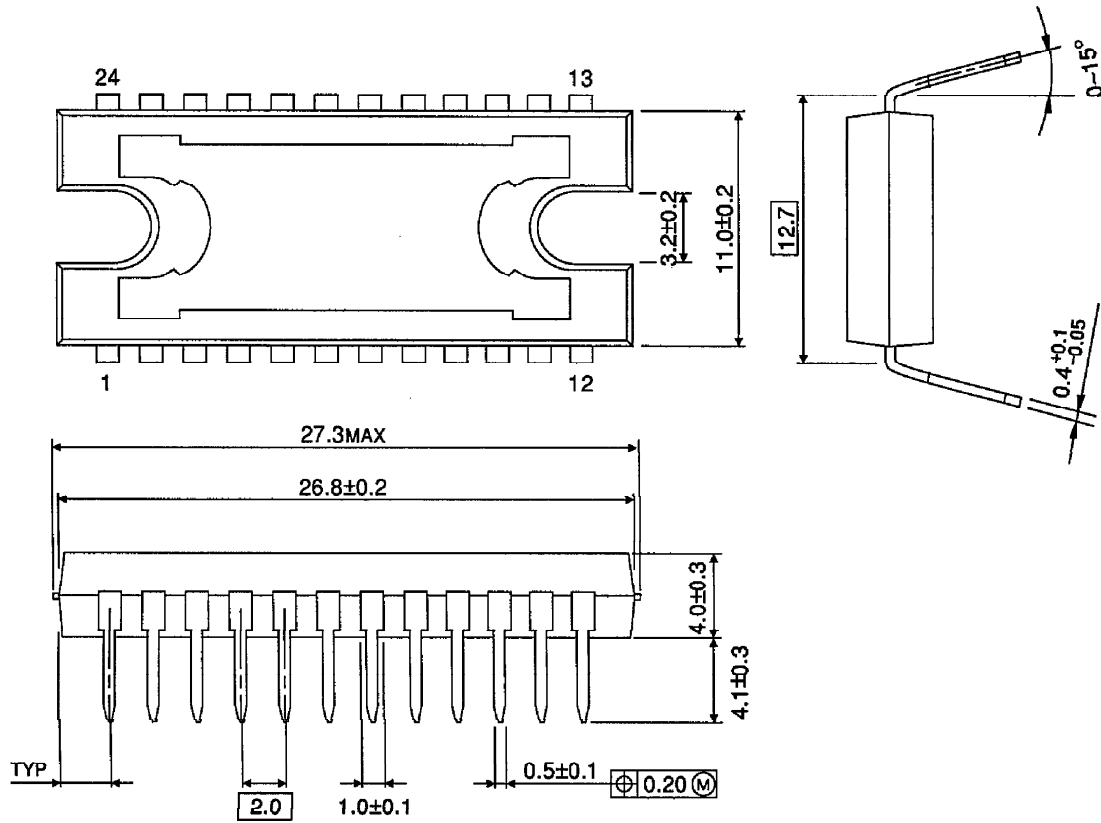
APPLICATION CIRCUIT



- (Note 1) Care should be taken not to have a common impedance with Output Current pass of each Motor (NF A, NF B for Motor 1, NF C, NF D for Motor 2 and PG for DC Motor) and any other signal lines. And recommend to take One Point GND with each Output Current pass and corresponding PG terminal. (See Table 1 of Block Diagram.)
- (Note 2) Utmost care is necessary in the design of the output line, V_M and GND line since IC may be destroyed due to short-circuit between outputs, air contamination fault, or fault by improper grounding.

OUTLINE DRAWING
HDIP24-P500-2.00

Unit : mm



Weight : 4.30g (Typ.)