

TENTATIVE

TOSHIBA BI-CMOS INTEGRATED CIRCUIT SILICON MONOLITHIC

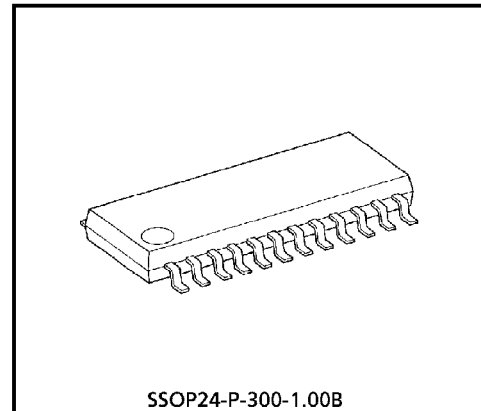
T B 6 5 2 6 F**CHOPPER-TYPE BIPOLAR STEPPING MOTOR CONTROL DRIVER IC**

The TB6526F is a PWM chopper-type sinusoidal micro-step bipolar stepping motor driver IC.

It is capable of 1-2 and 2W1-2 phase excitation modes and forward and reverse rotation modes, low-vibration, low-torque ripple, and high-efficiency driving.

FEATURES

- Forward and reverse rotations are available.
- 1-2, 2W1-2 phase driving is available.
- Structured by high breakdown voltage Bi-CMOS process.
- Package: SSOP24-P-300-1.00B
- Externally equipped with PNP output transistor.
- Reset and enable pins are attached.

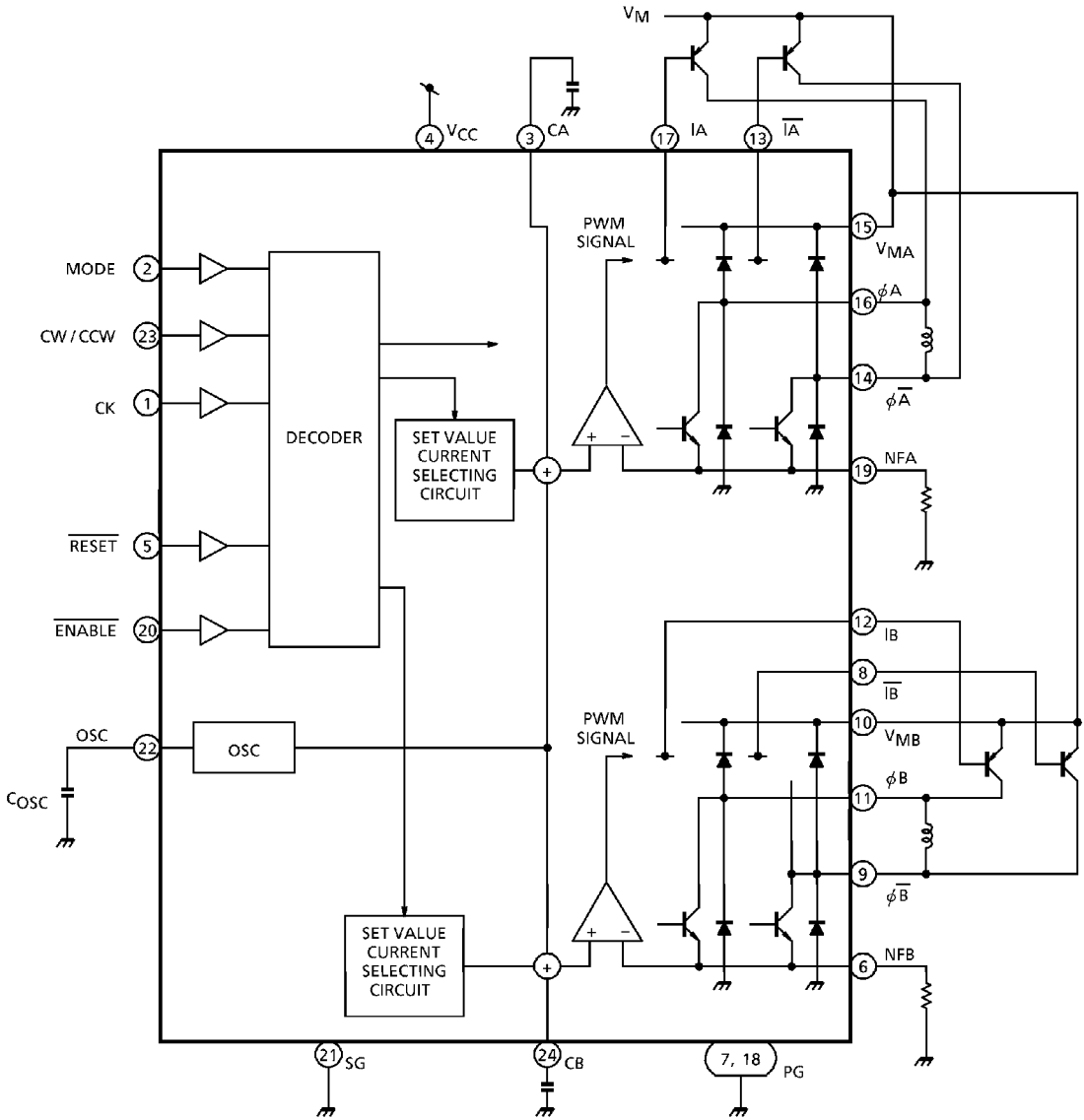


Weight : 0.27g (Typ.)

961001EBA1

- TOSHIBA is continually working to improve the quality and the reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to observe standards of safety, and to avoid situations in which a malfunction or failure of a TOSHIBA product could cause loss of human life, bodily injury or damage to property. In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent products specifications. Also, please keep in mind the precautions and conditions set forth in the TOSHIBA Semiconductor Reliability Handbook.
- The products described in this document are subject to foreign exchange and foreign trade control laws.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.

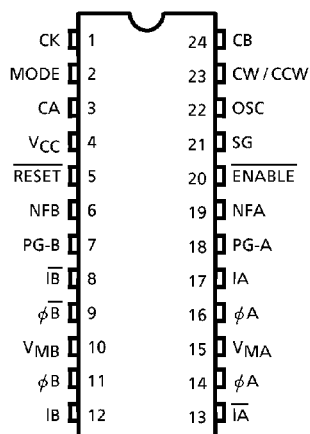
BLOCK DIAGRAM





PIN FUNCTION

PIN No.	SYMBOL	FUNCTIONAL DESCRIPTION	
1	CK	CLOCK Signal Input	Truth table A
2	MODE	Excitation Mode Setting terminal	Truth table B
3	CA	Noise reduction condenser outer terminal	
4	V _{CC}	Power voltage supply terminal for Logic	
5	RESET	RESET Signal Input terminal	Truth table A
6	NFB	B Channel current detective terminal	
7	PG-B	Power GND B terminal	
8	I _B	Upper PNP Transistor Base terminal (\bar{B} phase)	
9	ϕB	B output	
10	V _{MB}	Power voltage supply terminal for Motor B	
11	ϕB	Output B terminal	
12	I _B	Upper PNP Transistor Base terminal (B phase)	
13	I _A	Upper PNP Transistor Base terminal (\bar{A} phase)	
14	ϕA	Output \bar{A} terminal	
15	V _{MA}	Power voltage supply terminal for Motor A	
16	ϕA	Output A terminal	
17	I _A	Upper side PNP transistor Base terminal (A phase)	
18	PG-A	Power GND A terminal	
19	NFA	A Channel current detection terminal	
20	ENABLE	ENABLE Signal input terminal	Truth table A
21	SG	Signal GND terminal	
22	OSC	Internal Oscillation frequency detective terminal with external condenser	
23	CW/CCW	Forward rotation / Reverse rotation signal input	Truth table A
24	CB	Noise reduction condenser outside terminal	

PIN CONNECTION



TRUTH TABLE A

INPUT				MODE
CK1	CW/CCW	RESET	ENABLE	
	L	H	L	CW
	H	H	L	CCW
X	X	L	L	INITIAL MODE
X	X	X	H	Z

Z : High Impedance
 X : Don't Care

(Note) Do not use INHIBIT MODE.

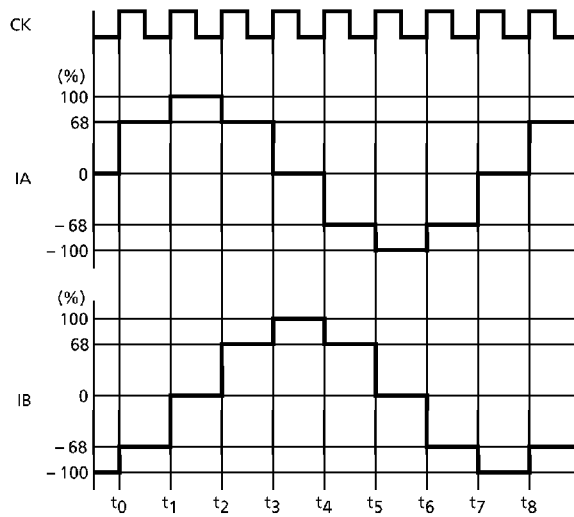
TRUTH TABLE B

INPUT MODE	MODE (EXCITATION)
L	1-2 phase
H	2W1-2 phase

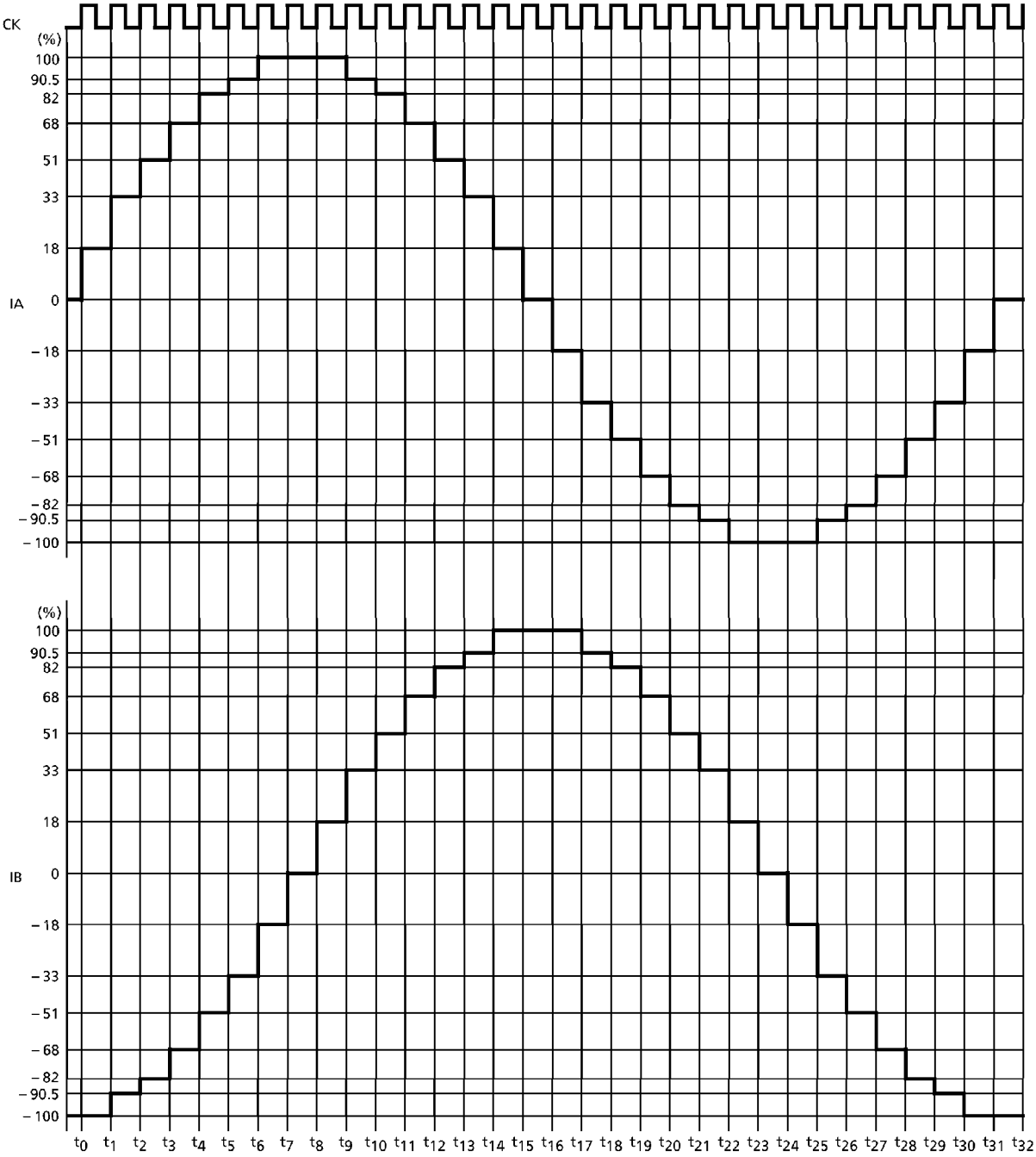
INITIAL MODE

MODE EXCITATION	A-PHASE CURRENT	B-PHASE CURRENT
1-2 phase	100%	0%
2W1-2 phase	100%	0%

1-2 PHASE EXCITATION (MODE : L, CW mode)



2W1-2 EXCITATION (MODE : H, CW mode)



MAXIMUM RATING (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V _{CC}	5.5	V
Output Voltage	V _{M (opr.)}	4.0~8.0	V
	V _{M (MAX.)}	10.0	
Output Current	I _{O (MAX.)}	120	mA
Input Voltage	V _{IN}	~V _{CC}	V
Power Dissipation	P _D	0.83 (Note 1)	W
		1.04 (Note 2)	
Operating Temperature	T _{opr}	- 30~85	°C
Storage Temperature	T _{stg}	- 55~150	°C
Feed Back Voltage	V _I	1.0	V

(Note 1) No heat sink

(Note 2) When mounted on substrate (50×50×1.6mm Cu 10%)

RECOMMENDED OPERATING CONDITIONS (Ta = - 30~85°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN	TYP.	MAX	UNIT
Control Power Supply Voltage	V _{CC (opr.)}		2.7	3.0	5.5	V
Motor Power Supply Voltage	V _{M (opr.)}		4.0	—	8.0	V
Output Current	I _{OUT}		—	—	100	mA
Input Voltage	V _{IN}		—	—	V _{CC}	V
Clock Frequency	f _{CLOCK}		—	—	5	kHz
OSC Frequency	f _{OSC}		15	—	80	kHz

ELECTRICAL CHARACTERISTICS

Unless otherwise specified ($T_a = 25^\circ\text{C}$, $V_{CC} = 3\text{V}$, $V_M = 5\text{V}$, load inductance : $L = 8\text{mH} / R = 50\Omega$,
with outer PNP)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN	TYP.	MAX	UNIT
Input Voltage	High	$V_{IN(H)}$	1	MODE, CW / CCW, $\overline{\text{ENABLE}}$ CK, $\overline{\text{RESET}}$	$V_{CC} \times 0.7$	—	$V_{CC} + 0.4$	V
	Low	$V_{IN(L)}$			GND -0.4	—	$V_{CC} \times 0.3$	
Input Current		$I_{IN(H)}$	2	$V_{IN} = 3.0\text{V}$	—	—	100	nA
		$I_{IN(L)}$		$V_{IN} = 0\text{V}$	—	—	100	
Current Consumption V_{CC} Pin		I_{CC1}	3	Output open, $\overline{\text{RESET}} : \text{H}$, $\overline{\text{ENABLE}} : \text{L}$, (1-2 phase excitation)	—	7	9	mA
		I_{CC2}		Output open, $\overline{\text{RESET}} : \text{H}$, $\overline{\text{ENABLE}} : \text{L}$, (2W1-2 phase excitation)	—	7	9	
		I_{CC3}		$\overline{\text{RESET}} : \text{L}$, $\overline{\text{ENABLE}} : \text{H}$	—	1.3	—	
		I_{CC4}		$\overline{\text{RESET}} : \text{H}$, $\overline{\text{ENABLE}} : \text{H}$	—	1.3	—	
Comparator Reference Voltage Level		V_{NF1}	9	C_A, C_B	0.24	0.27	0.30	V
		V_{NF2}	4	$R_{NF} = 3.3\Omega$, $C_{OSC} = 3300\text{pF}$	1.65	190	215	mV
		V_{NF3}	4	$R_{NF} = 2.2\Omega$, $C_{OSC} = 3300\text{pF}$	145	167	185	mV
Output Inter-channel Differential		ΔV_O	4	$(V_{NFA} - V_{NFB}) / V_{NFA}$, $C_{OSC} = 3300\text{pF}$, $R_{NF} = 3.3\Omega$	-10	—	10	%
Maximum OSC Frequency		$f_{OSC(MAX.)}$	—		100	—	—	kHz
Minimum OSC Frequency		$f_{OSC(MIN.)}$	—		—	—	10	kHz
OSC Frequency		f_{OSC}	5	$C_{OSC} = 3300\text{pF}$	31	44	70	kHz

ELECTRICAL CHARACTERISTICS

Unless otherwise specified (Ta = 25°C, VCC = 3V, VM = 5V, load inductance : L = 8mH / R = 50Ω, with outer PNP)

OUTPUT SECTION

CHARACTERISTIC			SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN	TYP.	MAX	UNIT
Upper Side Driving Current			I _U	6	V _C = 3V	—	1.5	1.6	mA
Lower Side Saturation Voltage			V _{SAT L1}	7	I _{OUT} = 0.06A	—	0.10	—	V
			V _{SAT L2}			—	0.16	0.43	
Diode Forward Voltage	Upper Side	V _{F U}	8	I _{OUT} = 0.12A	—	1.24	1.8	V	
	Lower Side	V _{F L}			—	0.95	1.6		
Output Dark Current (A + B channel)			I _{M1}	3	ENABLE : "H" level RESET : "L" level Output open	—	—	50	μA
			I _{M2}		ENABLE : "L" level RESET : "H" level Output open	—	17	28	
NF Dark Current (1 channel)			I _{NF}		ENABLE : "L" level RESET : "H" level Output open	1	2.5	7	mA
A·B Chopper Current (Note)	2W1-2 phase excitation	1-2 phase excitation	Vector	4	R _{NF} = 3.3Ω C _{OSC} = 3300pF V _{NF}	θ = 0	—	100	—
	2W1-2 phase excitation	—				θ = 1/8	—	100	—
	2W1-2 phase excitation	—				θ = 2/8	85.5	90.5	95.5
	2W1-2 phase excitation	—				θ = 3/8	77	82	87
	2W1-2 phase excitation	1-2 phase excitation				θ = 4/8	64	69	74
	2W1-2 phase excitation	—				θ = 5/8	48	53	58
	2W1-2 phase excitation	—				θ = 6/8	31	36	41
	2W1-2 phase excitation	—				θ = 7/8	16	21	26

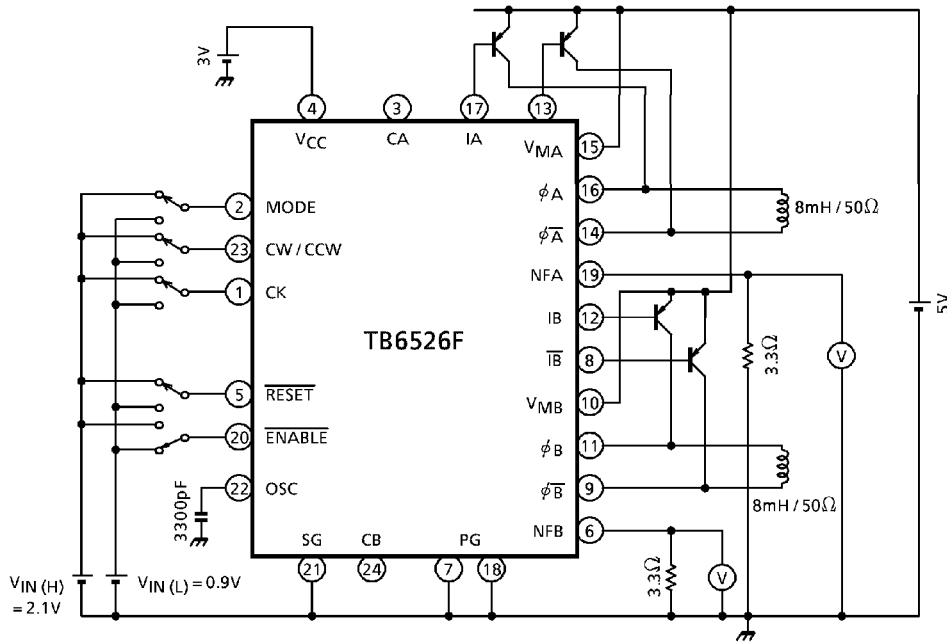
(Note) Maximum current θ = 0 is set at 100.

ELECTRICAL CHARACTERISTICS

Unless otherwise specified (Ta = 25°C, VCC = 3V, VM = 5V, load inductance : L = 8mH / R = 50Ω, with outer PNP)

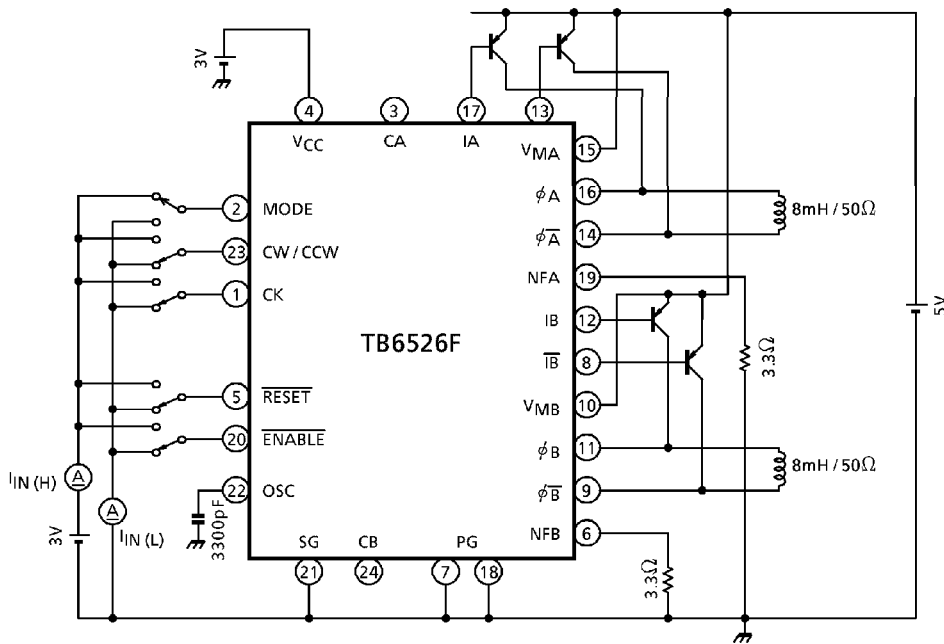
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN	TYP.	MAX	UNIT	
Reference Voltage	ΔV_{NF}	9	$\Delta\theta = 0/8 - 1/8$	Measured by CA and CB	—	0	—	mV
			$\Delta\theta = 1/8 - 2/8$		10	17	35	
			$\Delta\theta = 2/8 - 3/8$		5	16	30	
			$\Delta\theta = 3/8 - 4/8$		16.25	21	41.25	
			$\Delta\theta = 4/8 - 5/8$		25	32	50	
			$\Delta\theta = 5/8 - 6/8$		26.25	31	51.25	
			$\Delta\theta = 6/8 - 7/8$		15	28	45	
Output Tr Switching	t_r	12	$R_L = 2\Omega, V_{NF} = 0V, C_L = 15pF$	—	0.3	—	μs	
	t_f			—	2.2	—		
	t_{pLH}			CK~output	—	1.5		—
	t_{pHL}				—	2.7		—
	t_{pLH}			OSC~output	—	5.4		—
	t_{pHL}				—	6.3		—
	t_{pLH}			RESET~output	—	2.0		—
	t_{pHL}				—	2.5		—
	t_{pLH}			ENABLE~output	—	5.0		—
	t_{pHL}				—	6.0		—
Output Leakage Current	I_{OL}	10	$V_M = 10V$	—	—	50	μA	
V_{MA} / V_{MB} Off Current	I_{off}	11	$V_{CC} = 0, V_M = 5V$	—	—	1	μA	

TEST CIRCUIT 1 : $V_{IN(H)}$, $V_{IN(L)}$

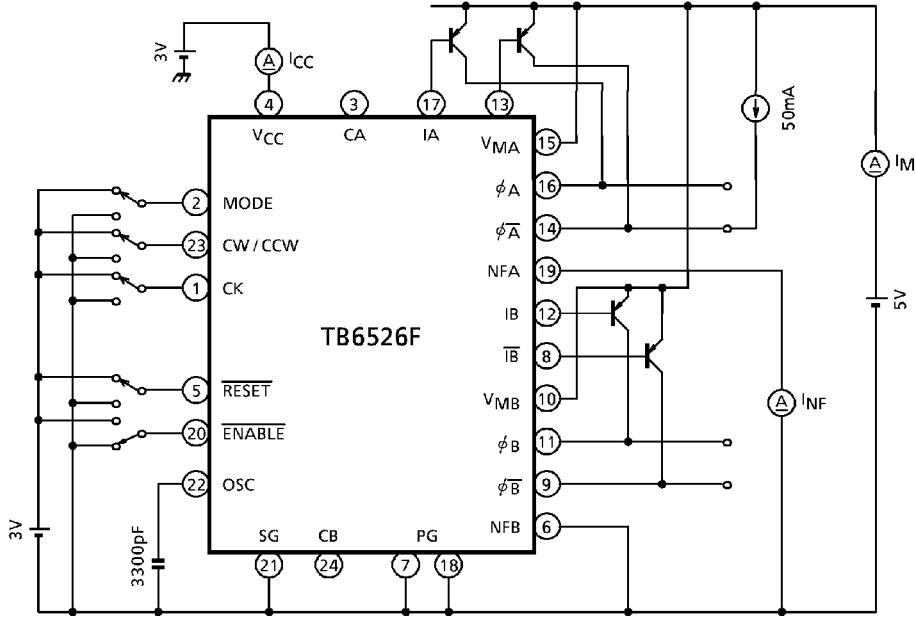


(Note) When input voltage $V_{IN(H)}$, $V_{IN(L)}$ is applied, verify the output function (NF voltage measurement).

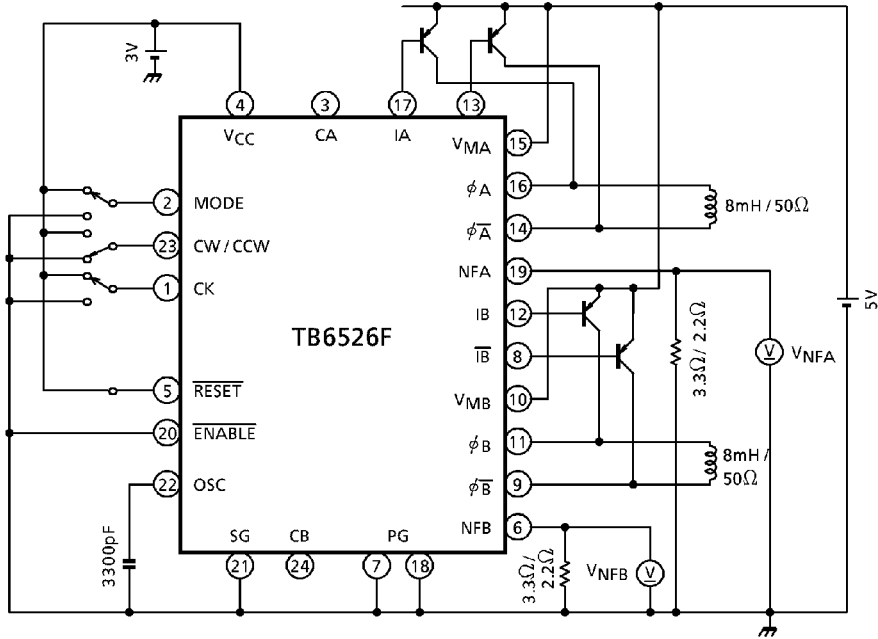
TEST CIRCUIT 2 : $I_{IN(H)}$, $I_{IN(L)}$



TEST CIRCUIT 3 : I_{CC} , I_M , I_{NF}

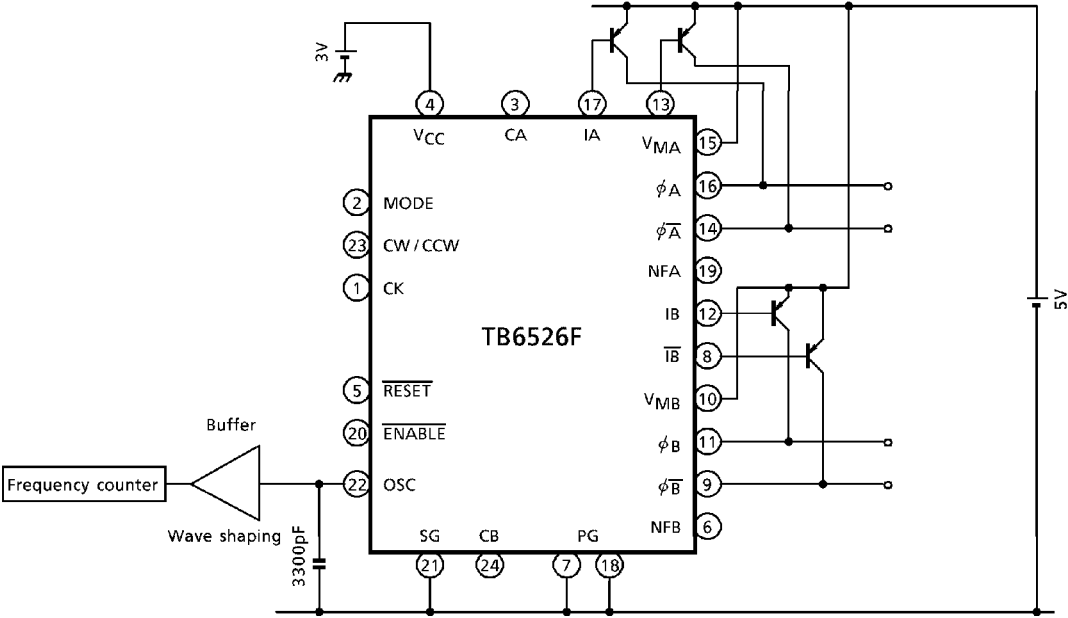


TEST CIRCUIT 4 : V_{NF2} , V_{NF3} , ΔV_O

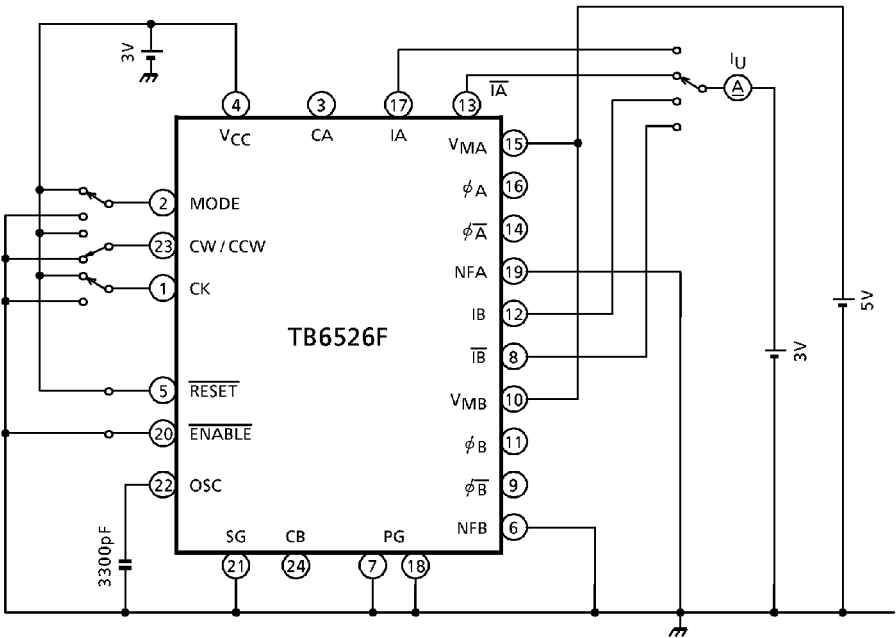


(Note) V_{NF2} : V_{NFA} (100%), V_{NFB} (100%) when $R_{NF} = 3.3\Omega$
 V_{NF3} : V_{NFA} (100%), V_{NFB} (100%) when $R_{NF} = 2.2\Omega$

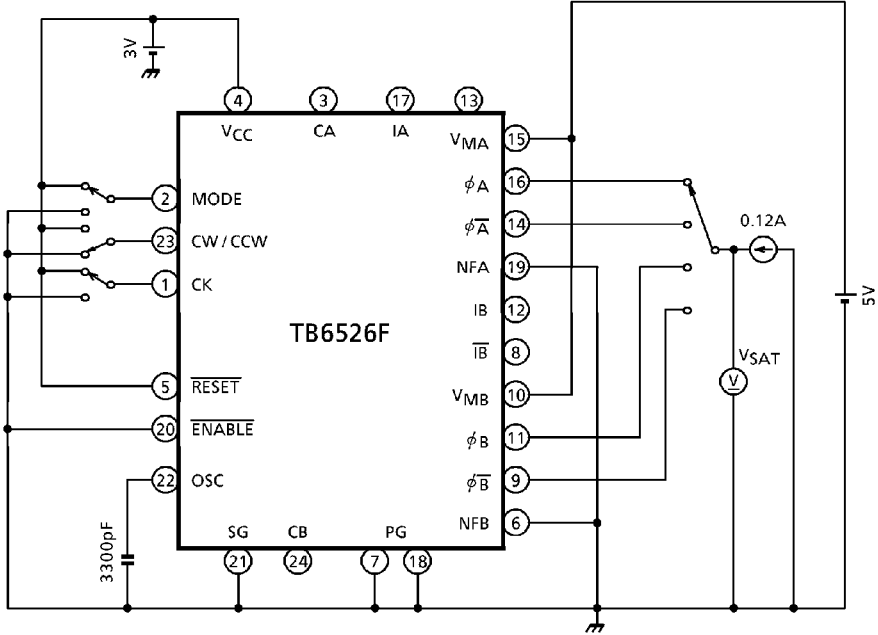
TEST CIRCUIT 5 : f_{OSC}



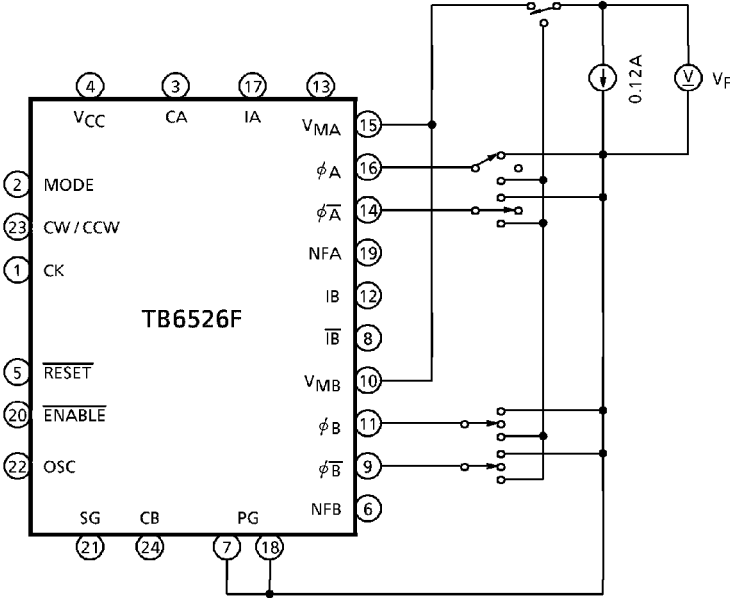
TEST CIRCUIT 6 : I_U



TEST CIRCUIT 7 : V_{SAT}

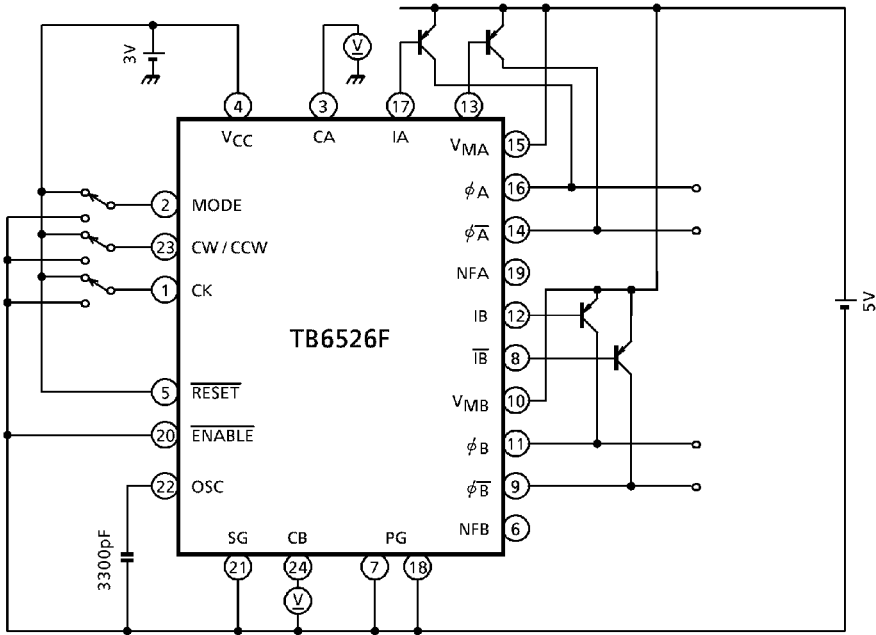


TEST CIRCUIT 8 : V_{F-U} , V_{F-L}

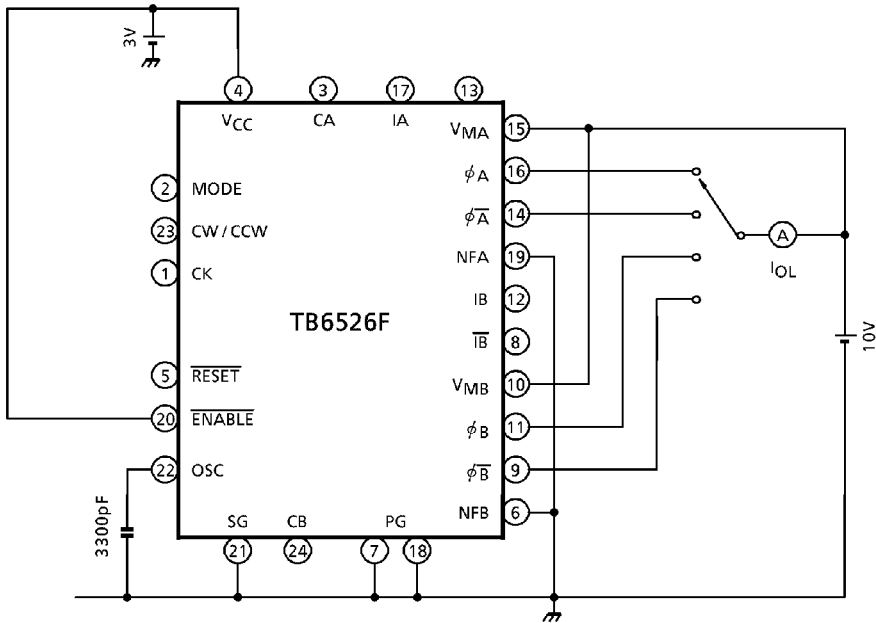


(Note) Not to take GND with any non-connecting pins.

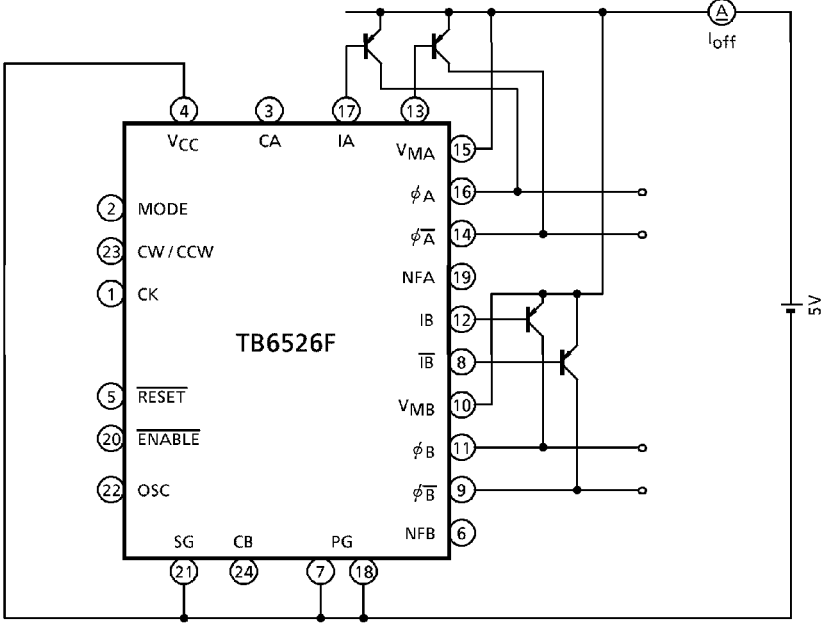
TEST CIRCUIT 9 : V_{NF1} , ΔV_{NF}



TEST CIRCUIT 10 : I_{OL}

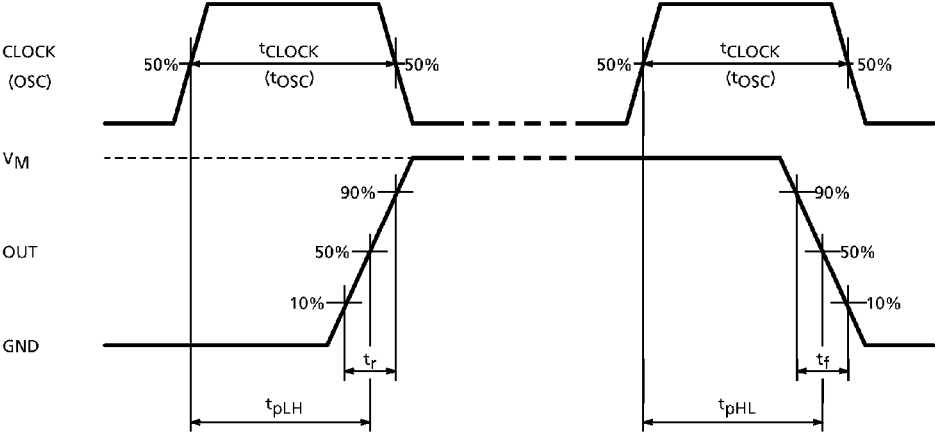


TEST CIRCUIT 11



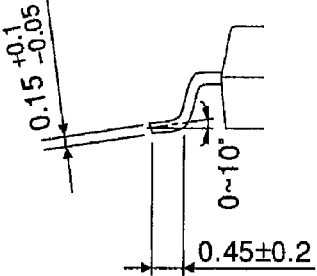
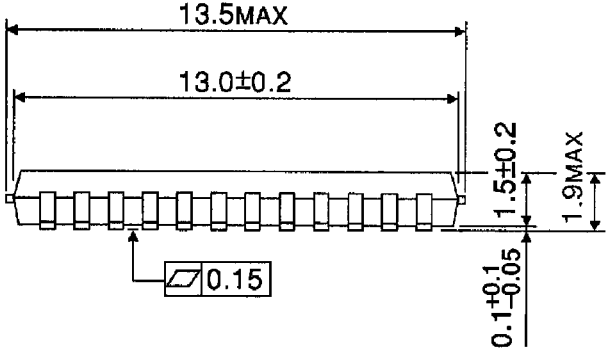
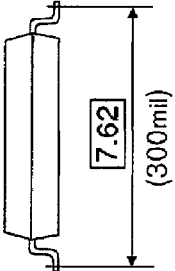
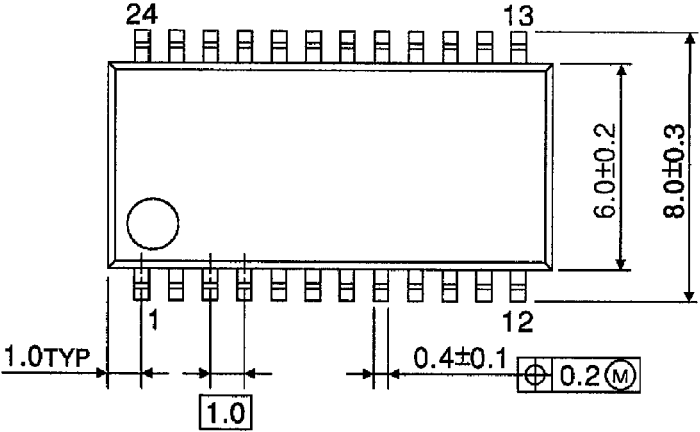
AC ELECTRICAL CHARACTERISTICS, TEST CIRCUIT 12

CK (OSC) - OUT



OUTLINE DRAWING
SSOP24-P-300-1.00B

Unit : mm



Weight : 0.27g (Typ.)