

TENTATIVE

TOSHIBA Bi-CMOS INTEGRATED CIRCUIT SILICON MONOLITHIC

# T B 6 5 2 6 F

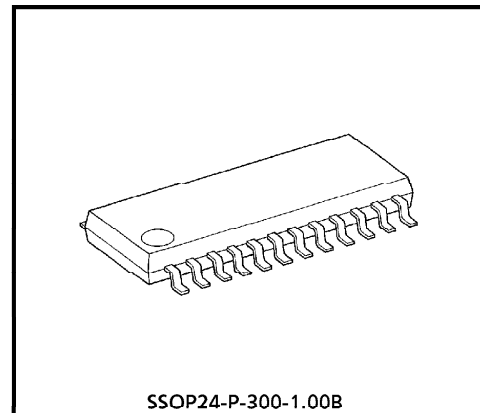
## CHOPPER-TYPE BIPOLAR STEPPING MOTOR CONTROL DRIVER IC

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.

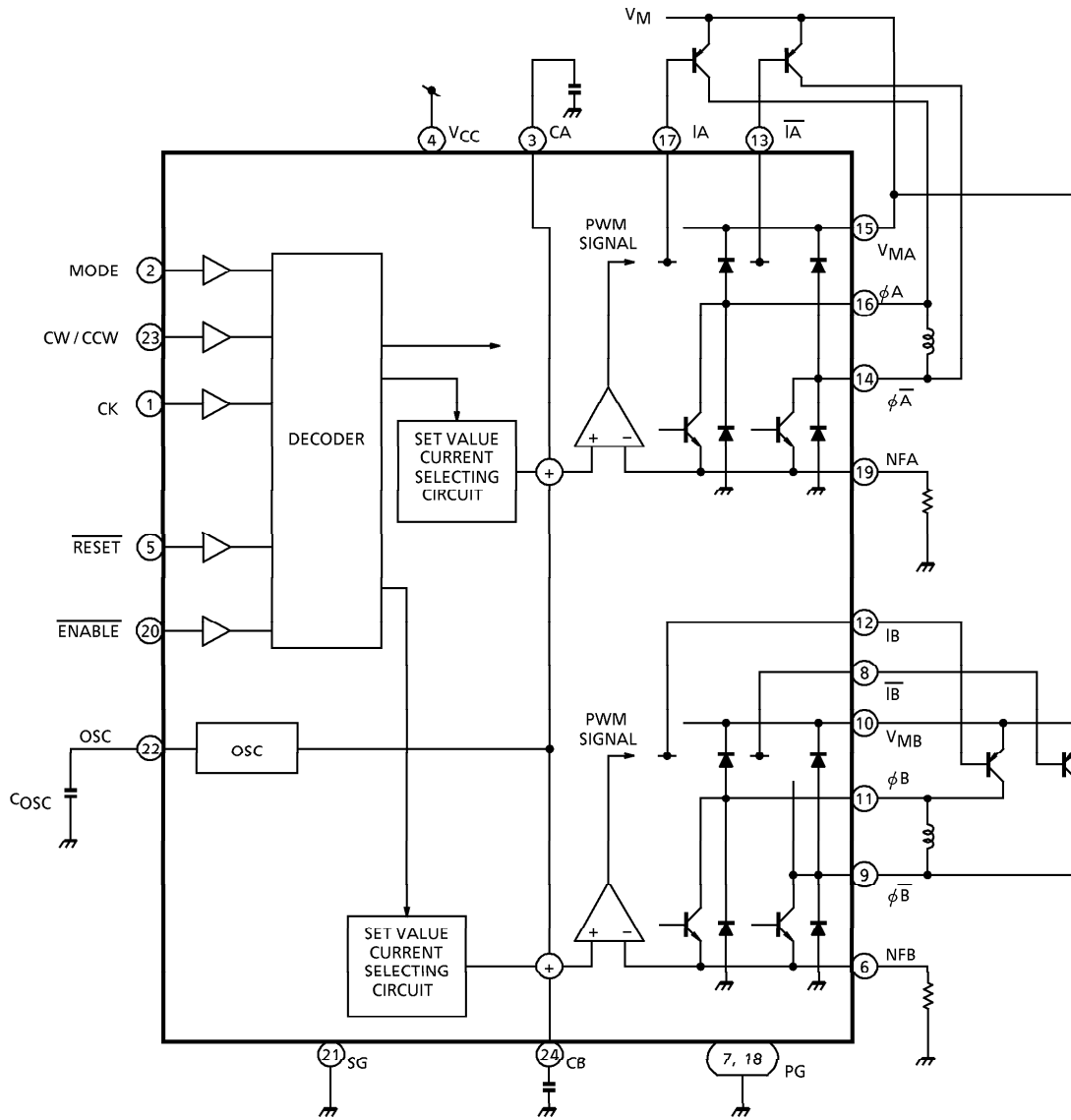


Weight : 0.27g (Typ.)

961001EBA1

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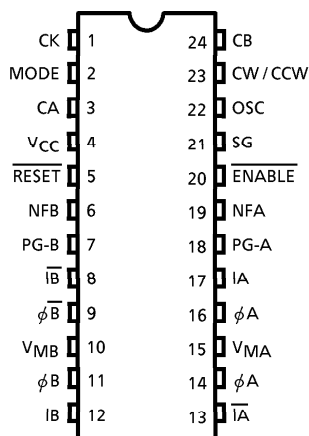
BLOCK DIAGRAM





**PIN FUNCTION**

PIN No.	SYMBOL	FUNCTIONAL DESCRIPTION
1	CK	CLOCK Signal Input <span style="float:right">Truth table A</span>
2	MODE	Excitation Mode Setting terminal <span style="float:right">Truth table B</span>
3	CA	Noise reduction condenser outer terminal
4	V <sub>CC</sub>	Power voltage supply terminal for Logic
5	RESET	RESET Signal Input terminal <span style="float:right">Truth table A</span>
6	NFB	B Channel current detective terminal
7	PG-B	Power GND B terminal
8	IB	Upper PNP Transistor Base terminal ( $\bar{B}$ phase)
9	$\phi\bar{B}$	$\bar{B}$ output
10	V <sub>MB</sub>	Power voltage supply terminal for Motor B
11	$\phi B$	Output B terminal
12	IB	Upper PNP Transistor Base terminal (B phase)
13	$\bar{I}A$	Upper PNP Transistor Base terminal ( $\bar{A}$ phase)
14	$\phi\bar{A}$	Output $\bar{A}$ terminal
15	V <sub>MA</sub>	Power voltage supply terminal for Motor A
16	$\phi A$	Output A terminal
17	IA	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 <span style="float:right">Truth table A</span>
21	SG	Signal GND terminal
22	OSC	Internal Oscillation frequency detective terminal with external condenser
23	CW / CCW	Forward rotation / Reverse rotation signal input <span style="float:right">Truth table A</span>
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.

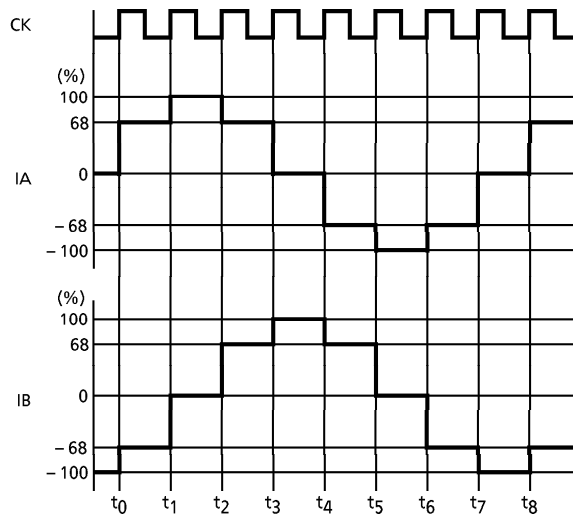
TRUTH TABLE B

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

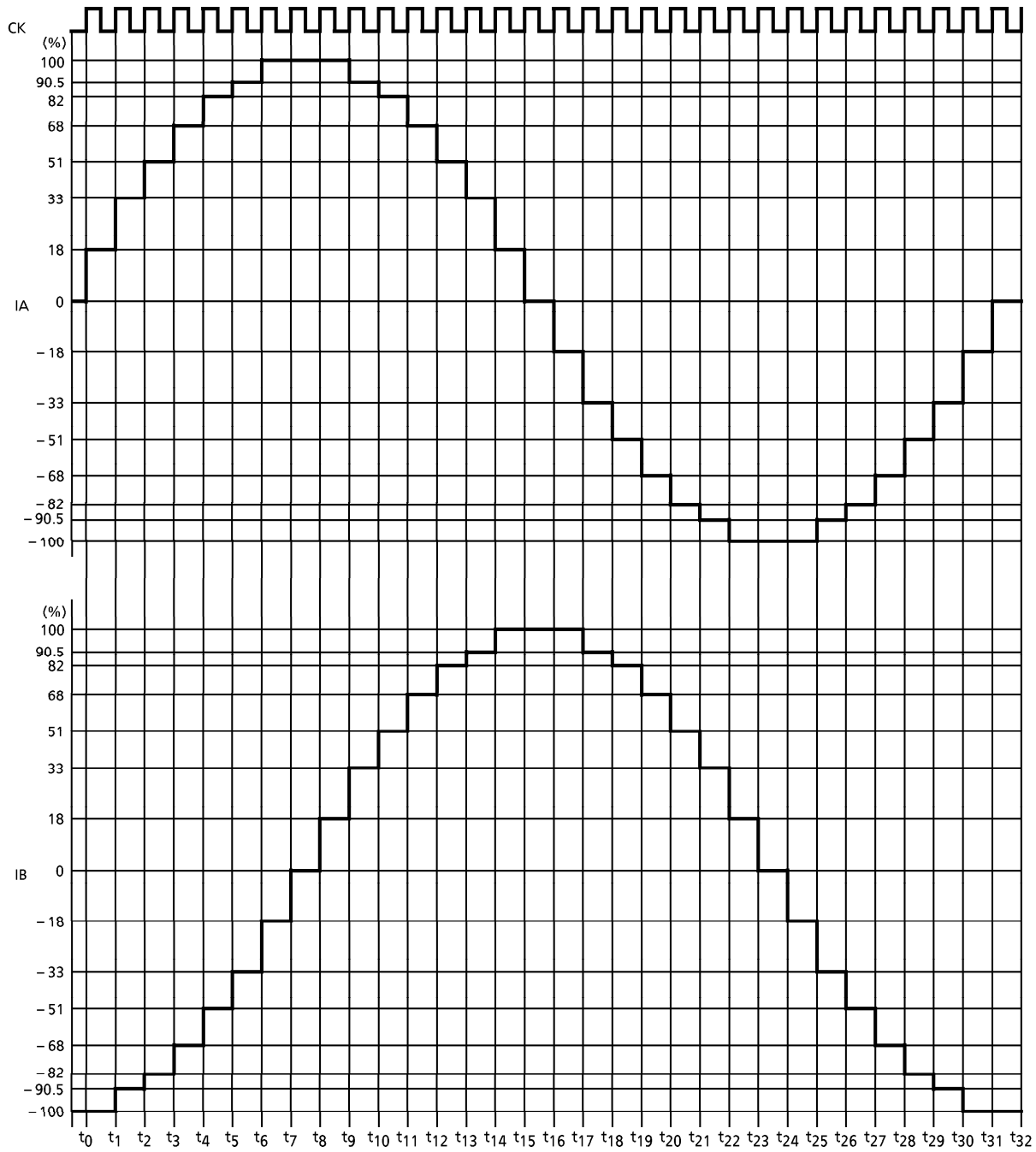
INITIAL MODE

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 <sub>CC</sub>	5.5	V
Output Voltage	V <sub>M (opr.)</sub>	4.0~8.0	V
	V <sub>M (MAX.)</sub>	10.0	
Output Current	I <sub>O (MAX.)</sub>	120	mA
Input Voltage	V <sub>IN</sub>	~V <sub>CC</sub>	V
Power Dissipation	P <sub>D</sub>	0.83 (Note 1)	W
		1.04 (Note 2)	
Operating Temperature	T <sub>opr</sub>	-30~85	°C
Storage Temperature	T <sub>stg</sub>	-55~150	°C
Feed Back Voltage	V <sub>I</sub>	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 <sub>CC (opr.)</sub>		2.7	3.0	5.5	V
Motor Power Supply Voltage	V <sub>M (opr.)</sub>		4.0	—	8.0	V
Output Current	I <sub>OUT</sub>		—	—	100	mA
Input Voltage	V <sub>IN</sub>		—	—	V <sub>CC</sub>	V
Clock Frequency	f <sub>CLOCK</sub>		—	—	5	kHz
OSC Frequency	f <sub>OSC</sub>		15	—	80	kHz

**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
Input Voltage	High	VIN (H)	1	MODE, CW / CCW, $\overline{\text{ENABLE}}$ CK, RESET	VCC × 0.7	—	VCC + 0.4	V
	Low	VIN (L)			GND - 0.4	—	VCC × 0.3	
Input Current		IIN (H)	2	VIN = 3.0V	—	—	100	nA
		IIN (L)		VIN = 0V	—	—	100	
Current Consumption  VCC Pin		I <sub>CC1</sub>	3	Output open, RESET : H, $\overline{\text{ENABLE}}$ : L, (1-2 phase excitation)	—	7	9	mA
		I <sub>CC2</sub>		Output open, RESET : H, $\overline{\text{ENABLE}}$ : L, (2W1-2 phase excitation)	—	7	9	
		I <sub>CC3</sub>		RESET : L, $\overline{\text{ENABLE}}$ : H	—	1.3	—	
		I <sub>CC4</sub>		RESET : H, $\overline{\text{ENABLE}}$ : H	—	1.3	—	
Comparator Reference Voltage Level		VNF1	9	CA, CB	0.24	0.27	0.30	V
		VNF2	4	RNF = 3.3Ω, C <sub>OSC</sub> = 3300pF	1.65	190	215	mV
		VNF3	4	RNF = 2.2Ω, C <sub>OSC</sub> = 3300pF	145	167	185	mV
Output Inter-channel Differential		ΔVO	4	(VNFA - VNFB) / VNFA, C <sub>OSC</sub> = 3300pF, RNF = 3.3Ω	- 10	—	10	%
Maximum OSC Frequency		f <sub>OSC</sub> (MAX.)	—		100	—	—	kHz
Minimum OSC Frequency		f <sub>OSC</sub> (MIN.)	—		—	—	10	kHz
OSC Frequency		f <sub>OSC</sub>	5	C <sub>OSC</sub> = 3300pF	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 <sub>U</sub>	6	V <sub>C</sub> = 3V	—	1.5	1.6	mA	
Lower Side Saturation Voltage			V <sub>SAT L1</sub>	7	I <sub>OUT</sub> = 0.06A	—	0.10	—	V	
			V <sub>SAT L2</sub>		I <sub>OUT</sub> = 0.12A	—	0.16	0.43		
Diode Forward Voltage	Upper Side	V <sub>F U</sub>	8	I <sub>OUT</sub> = 0.12A	—	1.24	1.8	V		
	Lower Side	V <sub>F L</sub>			—	0.95	1.6			
Output Dark Current (A + B channel)			I <sub>M1</sub>	3	ENABLE : "H" level RESET : "L" level Output open	—	—	50	μA	
			I <sub>M2</sub>		ENABLE : "L" level RESET : "H" level Output open	—	17	28	mA	
NF Dark Current (1 channel)			I <sub>NF</sub>		ENABLE : "L" level RESET : "H" level Output open	1	2.5	7		
A·B Chopper Current (Note)	2W1-2 phase excitation	1-2 phase excitation	Vector	4	θ = 0	R <sub>NF</sub> = 3.3Ω C <sub>OSC</sub> = 3300pF V <sub>NF</sub>	—	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.

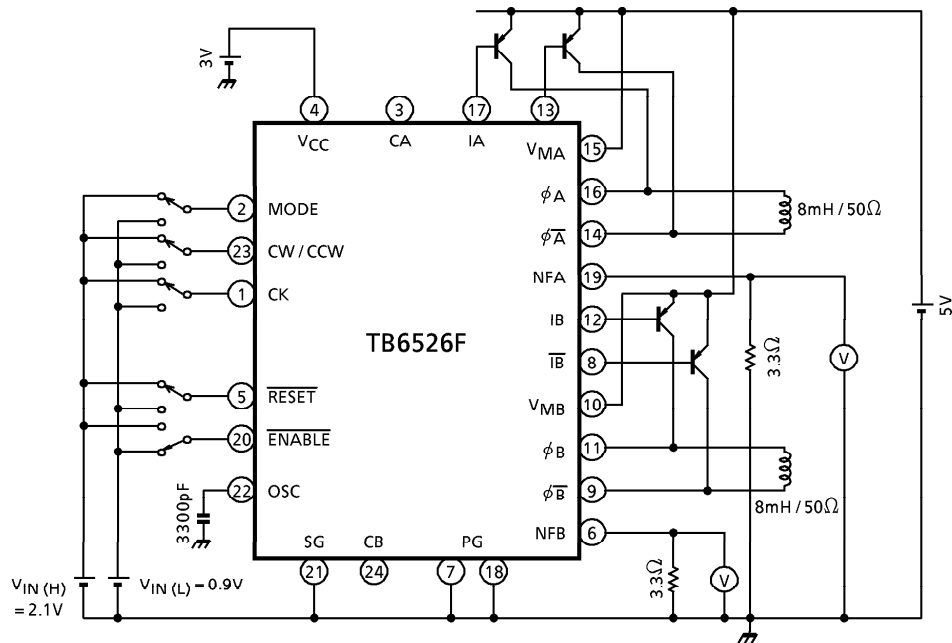


**ELECTRICAL CHARACTERISTICS**

Unless otherwise specified (Ta = 25°C, V<sub>CC</sub> = 3V, V<sub>M</sub> = 5V, load inductance : L = 8mH / R = 50Ω, with outer PNP)

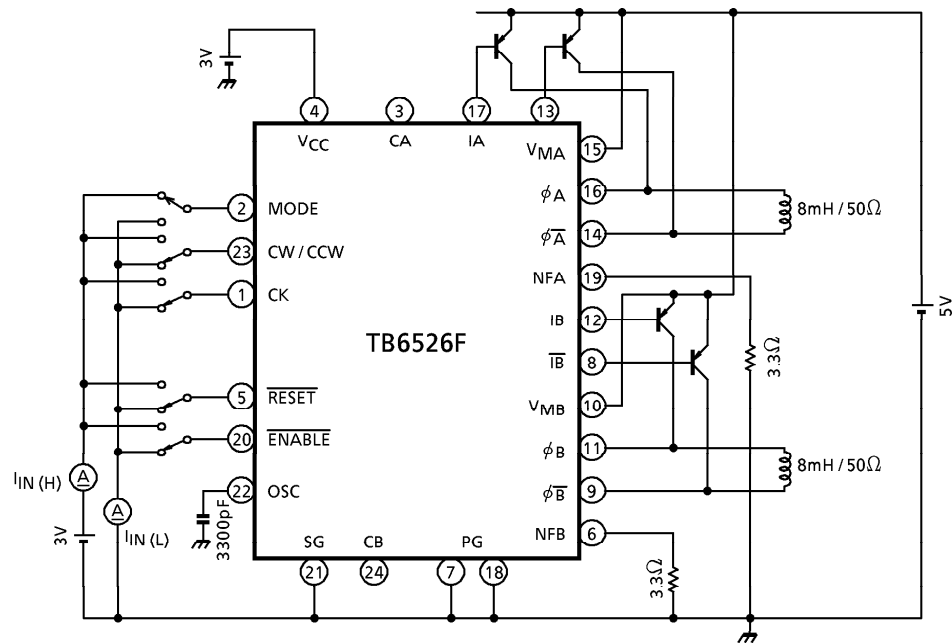
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN	TYP.	MAX	UNIT	
Reference Voltage	$\Delta V_{NF}$	9	$\Delta\theta = 0/8 - 1/8$	Measured by CA and CB	—	0	—	mV
			$\Delta\theta = 1/8 - 2/8$		10	17	35	
			$\Delta\theta = 2/8 - 3/8$		5	16	30	
			$\Delta\theta = 3/8 - 4/8$		16.25	21	41.25	
			$\Delta\theta = 4/8 - 5/8$		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	—	$\mu s$	
	$t_f$			—	2.2	—		
	$t_{pLH}$			CK~output	—	1.5		—
	$t_{pHL}$				—	2.7		—
	$t_{pLH}$			OSC~output	—	5.4		—
	$t_{pHL}$				—	6.3		—
	$t_{pLH}$			$\overline{RESET}$ ~output	—	2.0		—
	$t_{pHL}$				—	2.5		—
	$t_{pLH}$			$\overline{ENABLE}$ ~output	—	5.0		—
	$t_{pHL}$				—	6.0		—
Output Leakage Current	$I_{OL}$	10	$V_M = 10V$	—	—	50	$\mu A$	
V <sub>MA</sub> / V <sub>MB</sub> Off Current	$I_{off}$	11	$V_{CC} = 0, V_M = 5V$	—	—	1	$\mu A$	

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

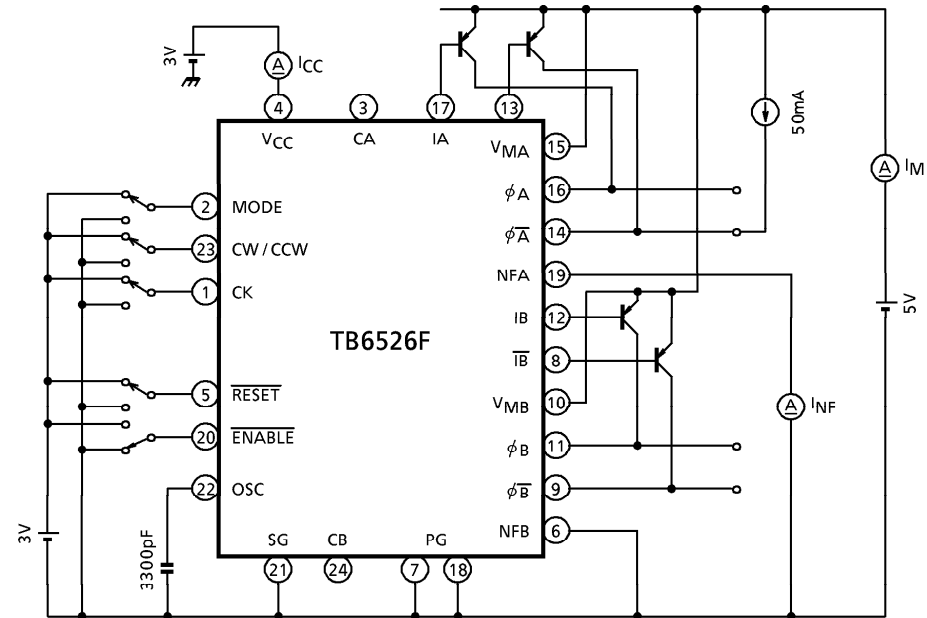


(Note) When input voltage  $V_{IN(H)}$ ,  $V_{IN(L)}$  is applied, verify the output function (NF voltage measurement).

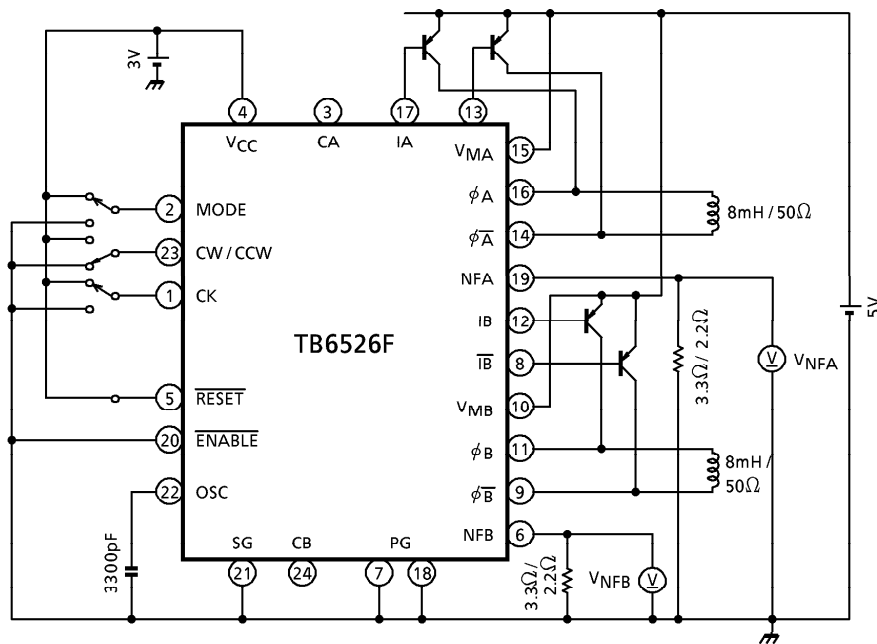
TEST CIRCUIT 2 :  $I_{IN(H)}$ ,  $I_{IN(L)}$



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

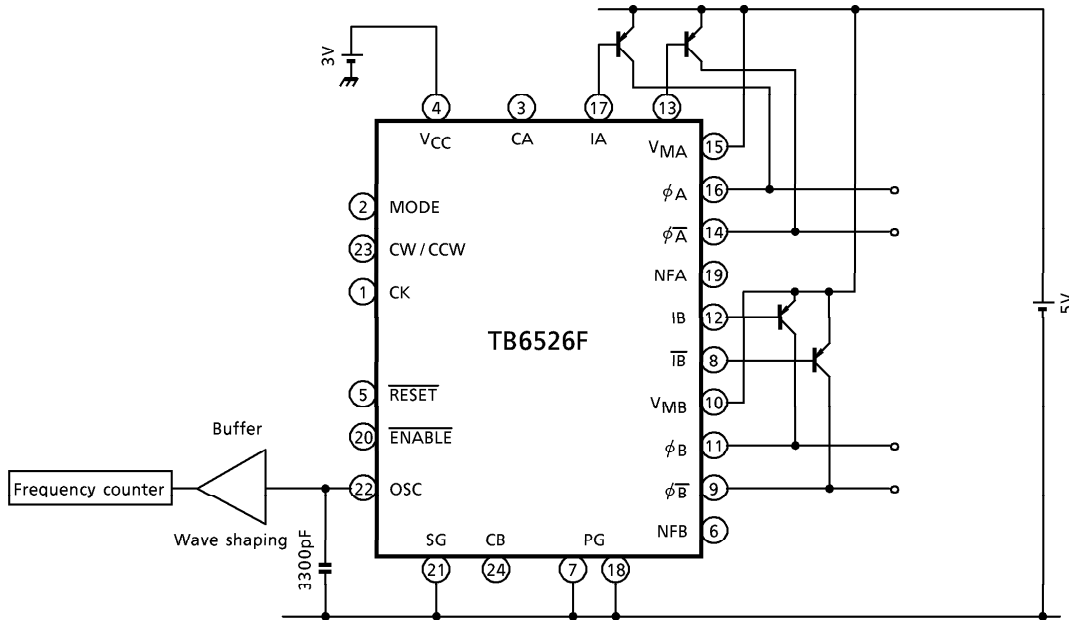


TEST CIRCUIT 4 :  $V_{NF2}$ ,  $V_{NF3}$ ,  $\Delta V_O$

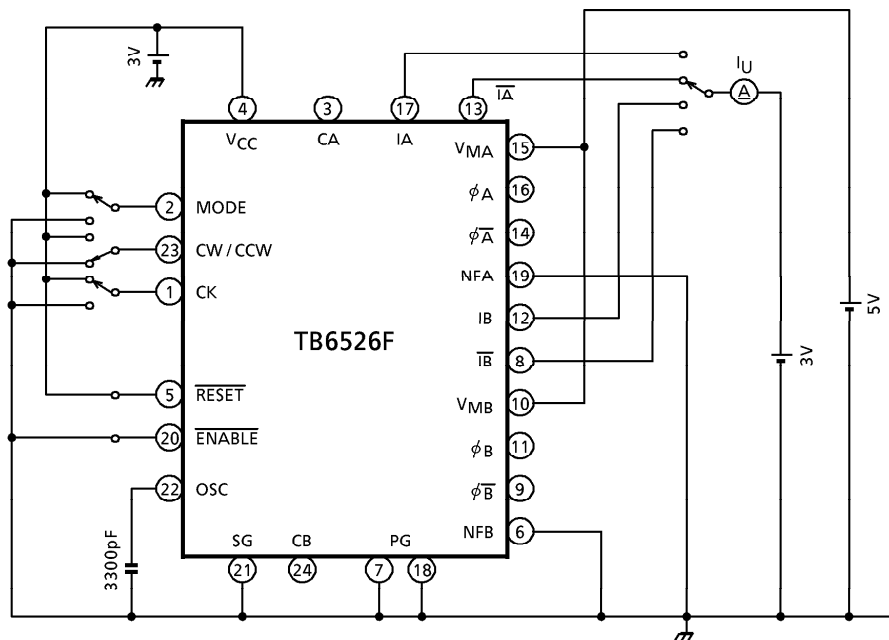


(Note)  $V_{NF2}$  :  $V_{NFA}$  (100%),  $V_{NFB}$  (100%) when  $R_{NF} = 3.3\Omega$   
 $V_{NF3}$  :  $V_{NFA}$  (100%),  $V_{NFB}$  (100%) when  $R_{NF} = 2.2\Omega$

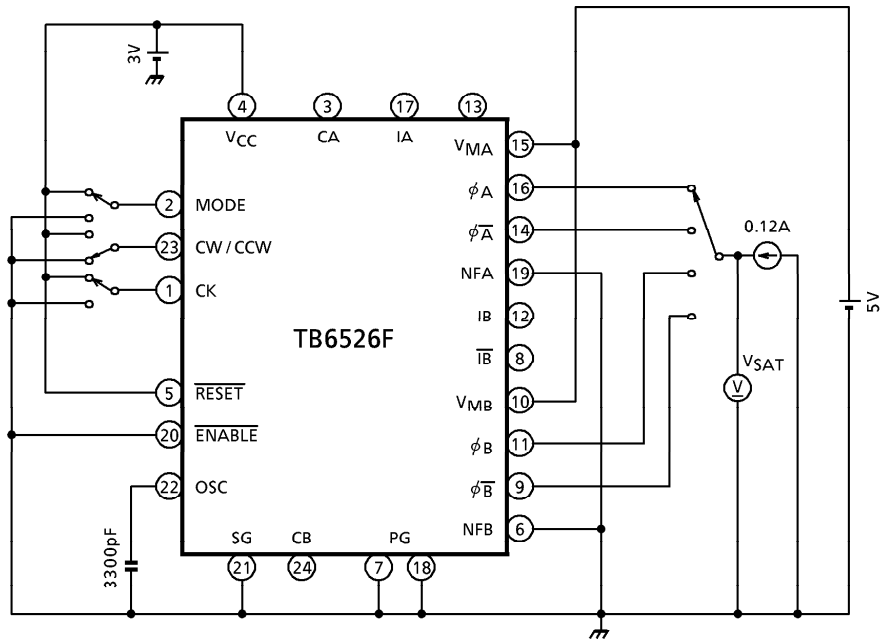
TEST CIRCUIT 5 :  $f_{OSC}$



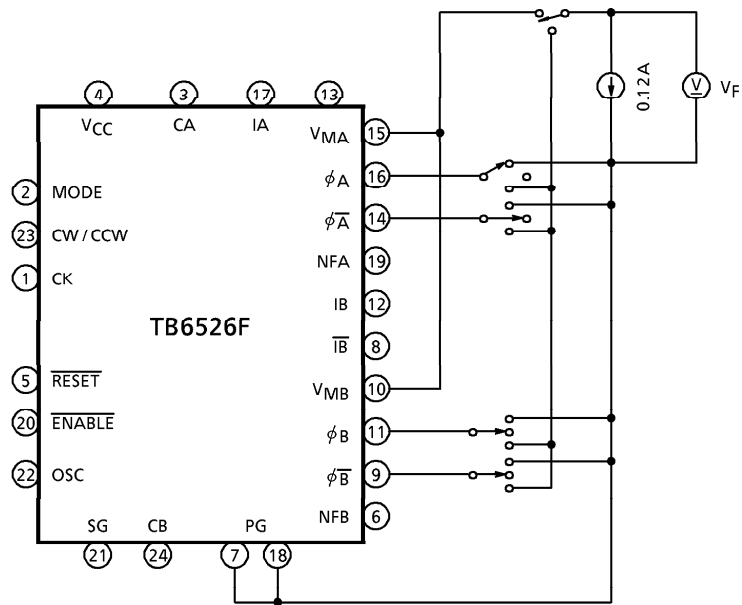
TEST CIRCUIT 6 :  $I_U$



TEST CIRCUIT 7 :  $V_{SAT}$

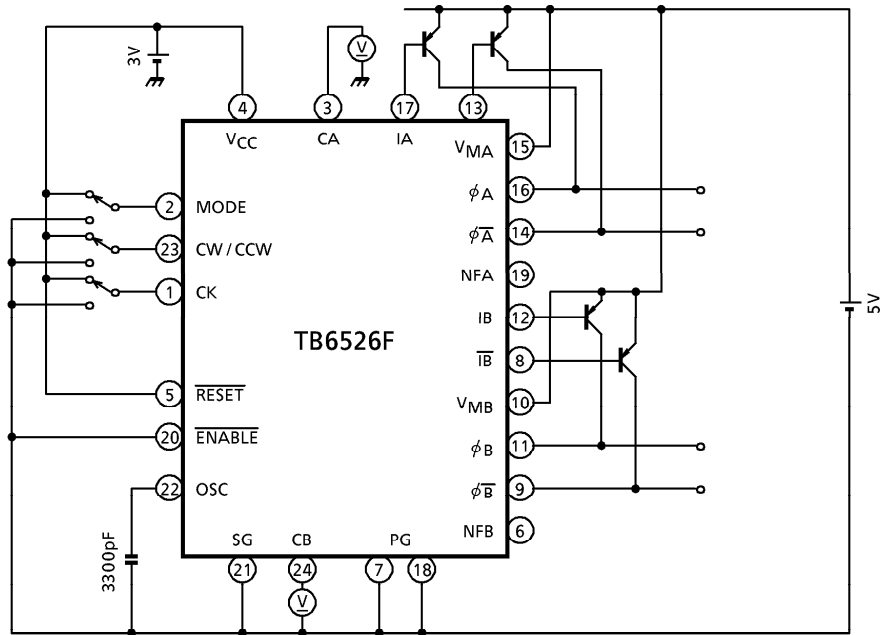


TEST CIRCUIT 8 :  $V_{F-U}$ ,  $V_{F-L}$

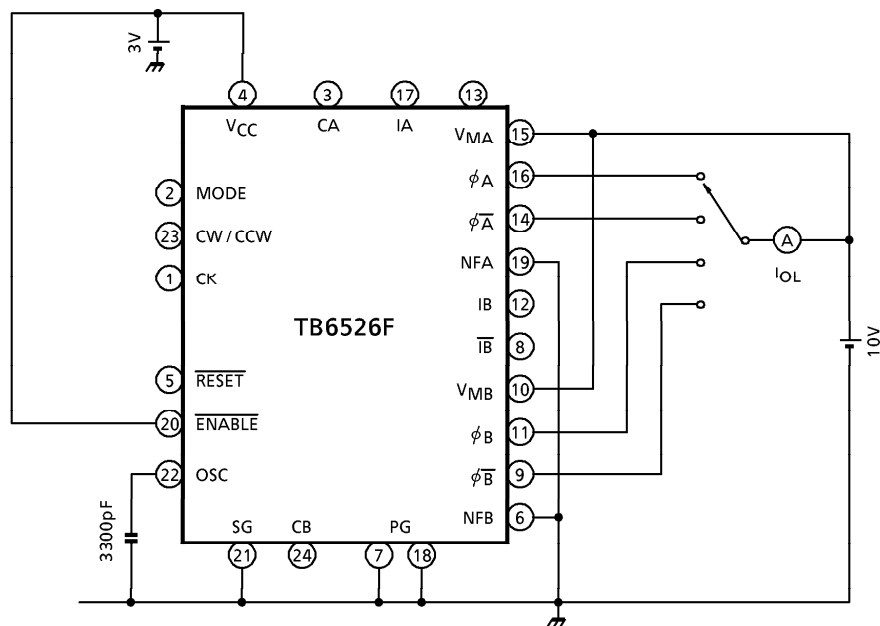


(Note) Not to take GND with any non-connecting pins.

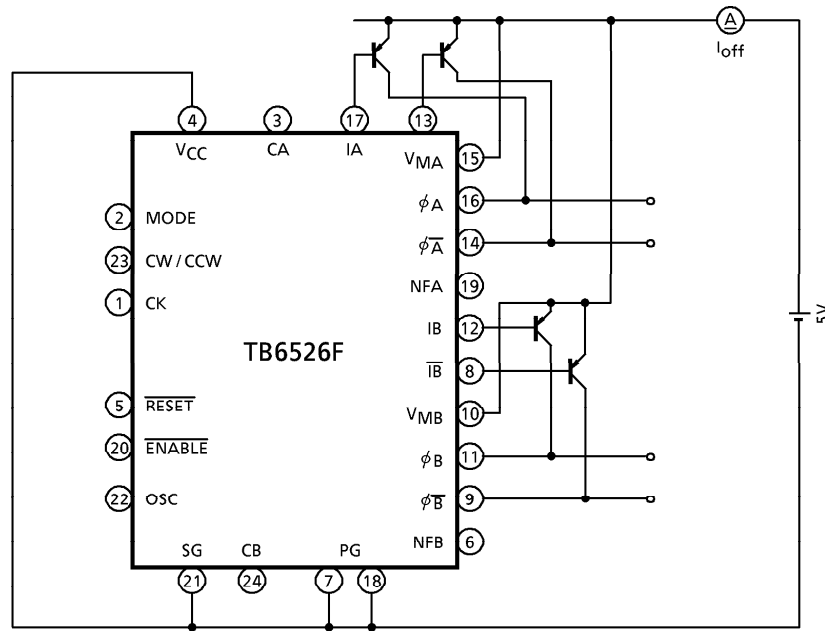
TEST CIRCUIT 9 :  $V_{NF1}$ ,  $\Delta V_{NF}$



TEST CIRCUIT 10 :  $I_{OL}$

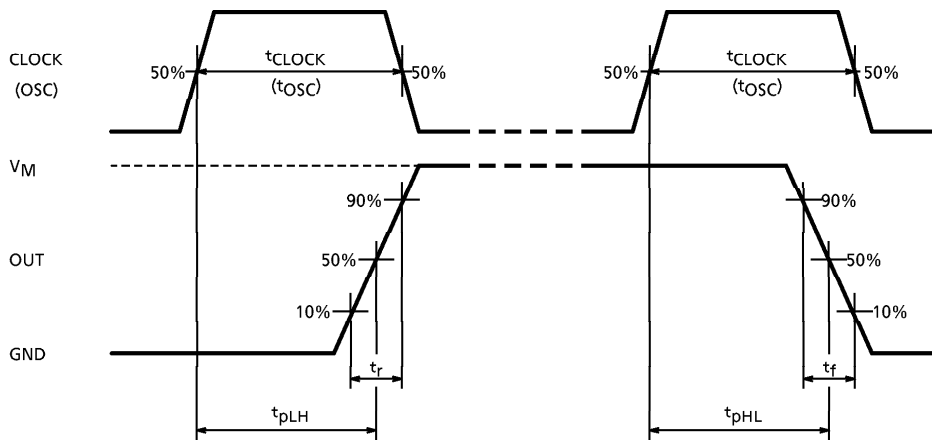


TEST CIRCUIT 11



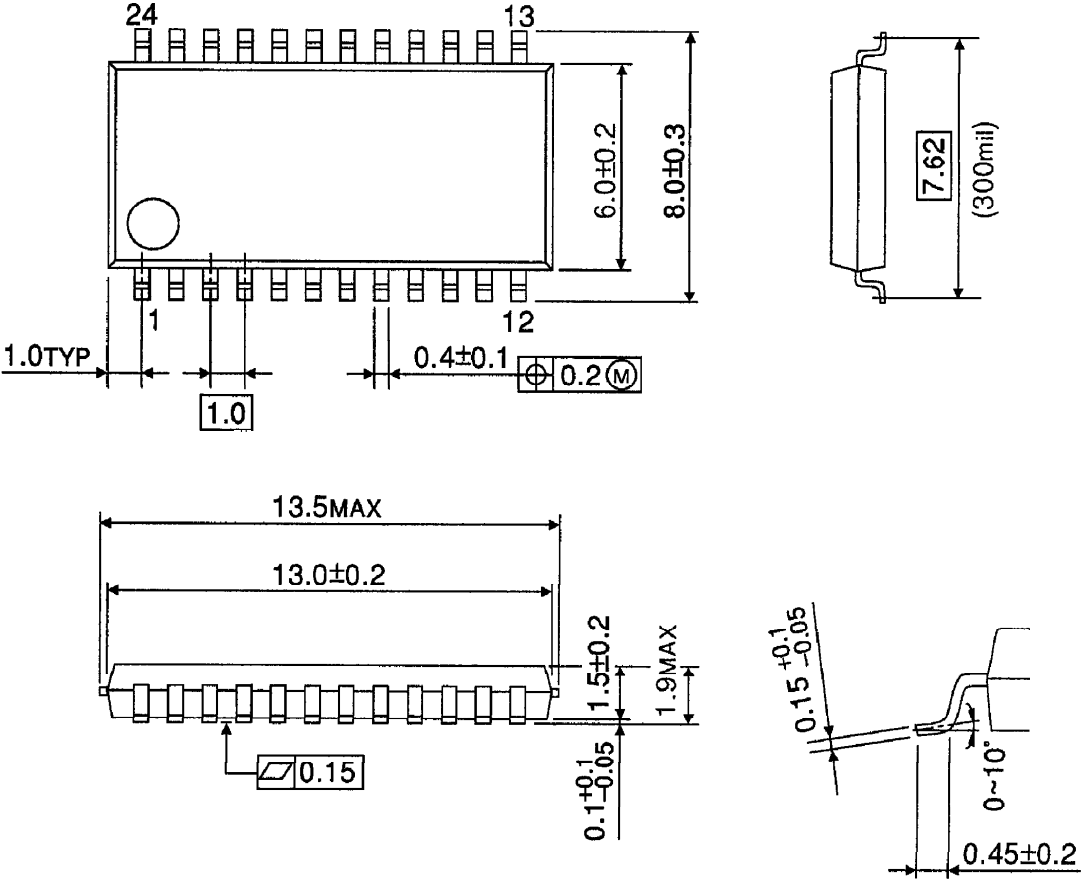
AC ELECTRICAL CHARACTERISTICS, TEST CIRCUIT 12

CK (OSC) - OUT



OUTLINE DRAWING  
SSOP24-P-300-1.00B

Unit : mm



Weight : 0.27g (Typ.)