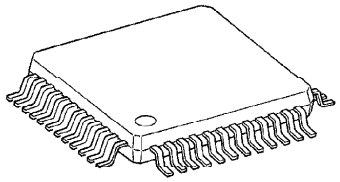
TOSHIBA Bi-CMOS INTEGRATED CIRCUIT SILICON MONOLITHIC

TB6508F

CYLINDER MOTOR CONTROL DRIVER IC FOR VTR MOVIE

The TB6508F is a 3 Phase, Low Noise, Low Voltage, Sensorless Motor Control IC for VTR Movie.
The Outputs (10mA Max.) drive external PNP / NPN Power transistors.
Small outline (QFP-48) surface mount package enables to design a compact cylinder drive system.



LQFP48-P-0707-0.50

Weight : 0.17g (Typ.)

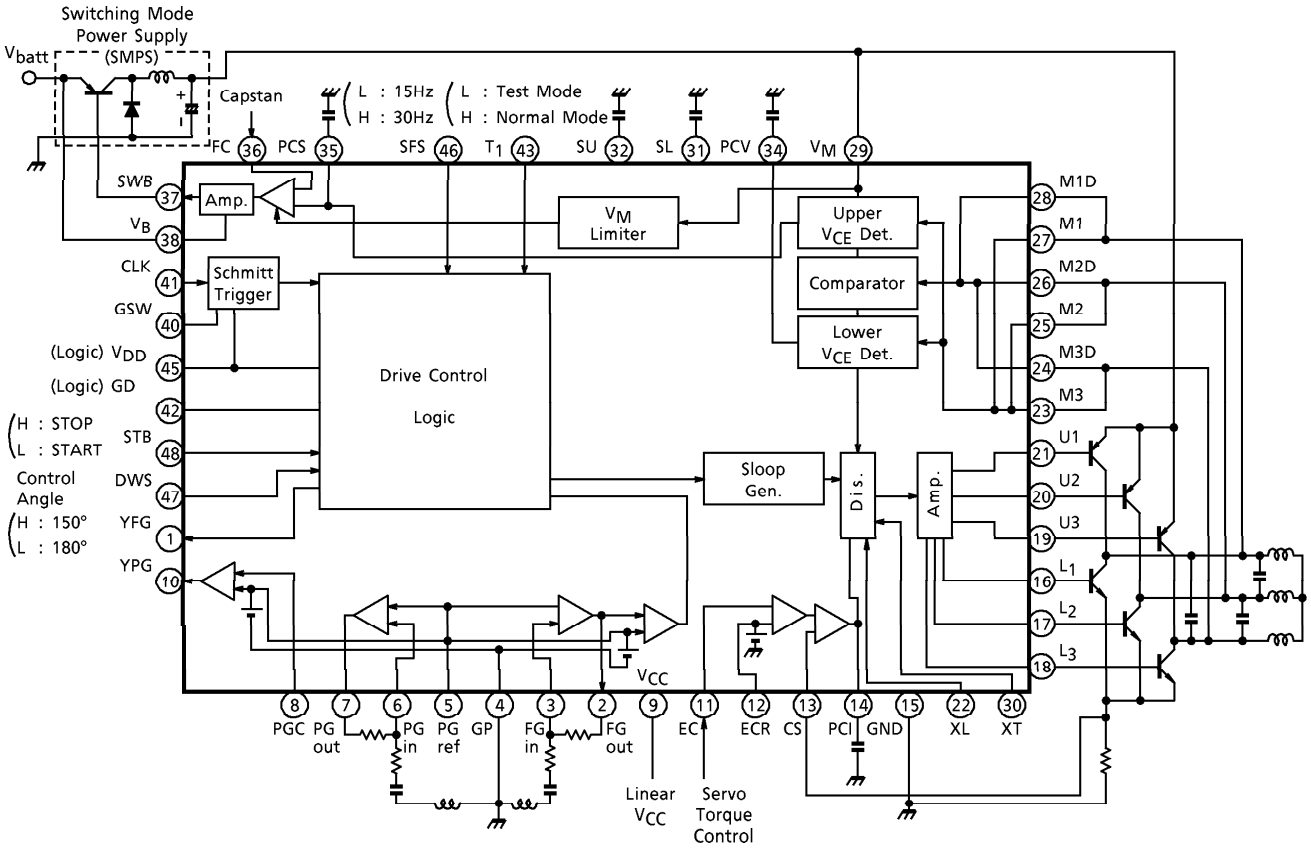
FEATURES

- Operating Supply Voltage : V_{CC} = 3.2~5.5V
- Motor Supply Voltage : V_M = 3.0~12V
- Low Noise Type. : Soft Switching Drive
  : Quasi-Linear Driving
  Wave form generator
- Internal Functions
- Switching Mode Power Supply Control Circuit
- Torque Signal Input
- FG Amp.
- PG Amp.

961001EBA2

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- The products described in this document are subject to foreign exchange and foreign trade control laws.
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BLOCK DIAGRAM



PIN FUNCTION

PIN No.	SYMBOL	FUNCTIONAL DESCRIPTION	PIN No.	SYMBOL	FUNCTIONAL DESCRIPTION
1	YFG	FG Processed Output	15	GND	GND Terminal
2	FG_{out}	FG Amp. Output	16	L_1	Lower Side Pre Drive Output 1
3	FG_{in}	FG Input	17	L_2	Lower Side Pre Drive Output 2
4	GP	PG GND	18	L_3	Lower Side Pre Drive Output 3
5	PG_{ref}	FG·PG Reference Voltage	19	U3	Upper Side Pre Drive Output 3
6	PG_{in}	PG Input	20	U2	Upper Side Pre Drive Output 2
7	PG_{out}	PG Amp. Output	21	U1	Upper Side Pre Drive Output 1
8	PGC	PG Comparator Input	22	XL	Conduction Angle Fine Adj. (1)
9	V_{CC}	Linear Power Supply	23	M3	Motor Coil Terminal 3
10	YPG	PG Waveform Output	24	M3D	Motor Back Electromotive Force In
11	EC	Torque Control Input	25	M2	Motor Coil Terminal 2
12	ECR	Torque Control Reference Input	26	M2D	Motor Back Electromotive Force In
13	CS	Current Detection Terminal	27	M1	Motor Coil Terminal 1
14	PCI	Current Feed Back Phase Comp.	28	M1D	Motor Back Electromotive Force In

PIN No.	SYMBOL	FUNCTIONAL DESCRIPTION	PIN No.	SYMBOL	FUNCTIONAL DESCRIPTION
29	V_M	Motor Supply Terminal	39	N.C.	Non Connection
30	XT	Conduction Angle Fine Adj. (2)	40	GSW	SMPS Supply GND
31	SL	Upper Side Slope Voltage	41	CLK	Clock Input
32	SU	Lower Side Slope Voltage	42	GD	Logic GND
33	N.C.	Non Connection	43	T_1	Test Mode Switch
34	PCV	Voltage Feed Back Compensation	44	N.C.	Non Connection
35	PCS	SENSE Compensation	45	V_{DD}	Logic Power Supply
36	FC	Reference Slope Input	46	SFS	Start Frequency Selector
37	SWB	SMPS Drive Output	47	DWS	Conduction Angle Selection
38	V_B	Unregulated Supply Voltage	48	STB	Stand-by Switch Input

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	6	V
Motor Supply Voltage	V_M	14	V
Switching Supply Voltage	V_B	14	
Supply Input / Output Voltage	V_{SWB}	14	
Output Terminal Voltage	V_N	14 (Note 1)	V
Input Terminal Voltage	V_I	$-0.3 \sim V_{CC} + 0.3$ (Note 2)	V
Power Dissipation	P_D	300 (Note 3)	mW
Operating Temperature	T_{opr}	$-20 \sim 75$	°C
Storage Temperature	T_{stg}	$-55 \sim 125$	°C

Recommended Supply Voltage
V_{CC} = 5V

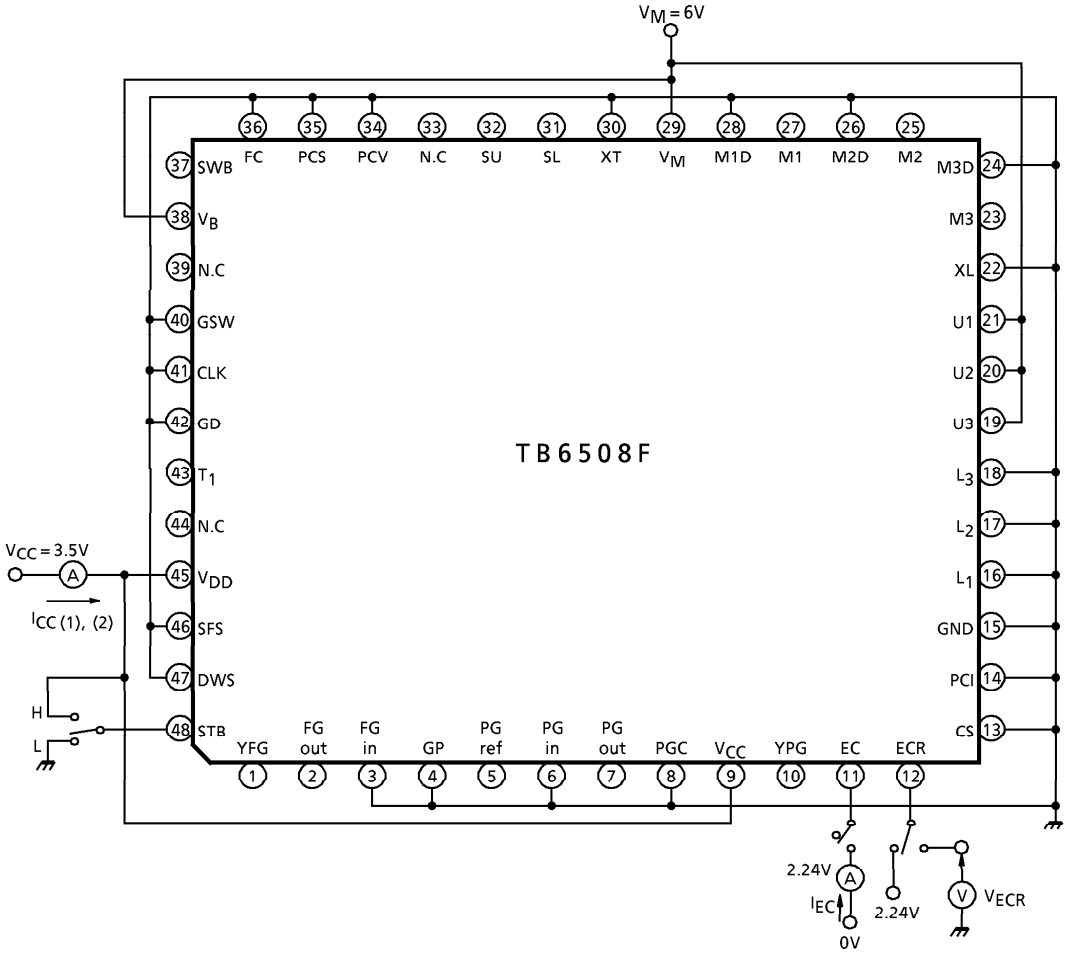
(Note 1) N = 19, 20, 21, 23, 24, 25, 27 and 28.
(Note 2) I = 3, 5, 6, 10, 11, 12, 13, 22, 30, 33, 36, 41, 43, 46, 47 and 48.
(Note 3) Mounted on a 50mm × 50mm × 1.6mm PCB with 50% Copper area coverage.

ELECTRICAL CHARACTERISTICS (Unless otherwise specified, Ta = 25°C, V_{CC} = 3.5V)
Recommended nominal supply voltage V_{CC} is 5V. Following electrical characteristics is to assure low voltage operation.

No.	CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
1	Supply Current (1)	$I_{CC\,(1)}$	1	Operational	—	—	20	mA
2	Supply Current (2)	$I_{CC\,(2)}$	1	STB mode	—	—	6	mA
3	ETR Voltage	V_{ECR}	1	—	2.14	2.24	2.54	V
4	Torque Control Input Current	I_{EC}	1	EC = 0V	−5	—	—	μA
5	Torque Cont. Input Offset Vol	ΔEC	2	—	−100	—	100	mV
6	Input / Output Gain	G_{io}	2	—	−17.72	−16.48	−15.39	dB
7	Max. Output Voltage	CSmax	2	$R_{CS} = 0.27\Omega$	136	151	174	mV
8	Low Side Output Voltage (1)	$V_{L\,(1)}$	3	V_{CS} = 54mV	0.2	—	0.6	V

No.	CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
9	Low Side Output Voltage (2)	$V_{L\,(2)}$	3	ECR = 2.24V, EC = 0V	0.45	—	0.85	V
10	Upper Side Drive Current	I_U	4	—	—	—	− 10	mA
11	Low Side Drive Current	I_L	4	—	10	—	—	mA
12	PCS Operation Point	$V_{PCS\,(1)}$	5	EC = ECR = 2.24V V_{PCS} = 1.75V	0.26	0.37	0.48	V
13	PCS Operation Point	$V_{PCS\,(2)}$	5	EC = 0V, ECR = 2.24V V_{PCS} = 1.75V	0.43	0.62	0.81	V
14	PCS Gain	G_{PCS}	5	—	13.06	16.26	18.59	dB
15	SMPS Drive Current (1)	$I_{SW\,(1)}$	5	VM1 = 6V EC = ECR = 2.24V	3	—	—	mA
16	SMPS Drive Current (2)	$I_{SW\,(2)}$	5	VM1 = 6V EC = 0V, ECR = 2.24V	11	—	—	mA
17	SMPS Comparator ON Time	t_{ON}	5	—	—	—	1.0	μs
18	SMPS Comparator OFF Time	t_{OFF}	5	—	—	—	1.0	μs
19	SMPS Comparator Offset Voltage	ΔV_{FC}	5	—	− 5	—	25	mV
20	FG Amp. Gain	G_{FG}	6	$V_{p\text{-}p}$ = 1.5mV f = 1kHz	45	—	—	dB
21	YFG High Level	YFG (H)	7	I_{YFG} = − 100μA	2.0	—	—	V
22	YFG Low Level	YFG (L)	7	I_{YFG} = 100μA	—	—	1.5	V
23	PG Amp. Gain	G_{PG}	6	$V_{p\text{-}p}$ = 1.5mV, f = 1kHz	45	—	—	dB
24	PG Amp. Offset Voltage	ΔPG_{in}	7	—	0.45	0.5	0.6	V
25	YPG High Level	YPG (H)	7	I_{YPG} = − 10μA	2.0	—	—	V
26	YPG Low Level	YPG (L)	7	I_{YPG} = 100μA	—	—	1.0	V
27	Stand-by Voltage	STB_{on}	8	—	2.15	—	—	V
28	Stand-by Release Voltage	STB_{off}	8	—	—	—	1.0	V
29	Stand-by Input Current	I_{STB}	8	V_{STB} = 0V	− 100	—	—	μA
30	Conduction Angle Selector Control Voltage Q = 180°	DWS (L)	9	—	—	—	1.05	V
31	Conduction Angle Selector Control Voltage Q = 150°	DWS (H)	9	—	2.45	—	—	V
32	Starting Frequency Selector Control Voltage f = 15Hz	SFS (L)	10	—	—	—	1.05	V
33	Starting Frequency Selector Control Voltage f = 30Hz	SFS (H)	10	—	2.45	—	—	V

TEST CIRCUIT 1



No.1

Set STB = 0V, EC = 2.24V, and ECR = 2.24V, then measure the current to the V_{CC} pin.

No.2

Set STB = 3.5V, EC = 2.24V, and ECR = 2.24V, then measure the current to the V_{CC} pin.

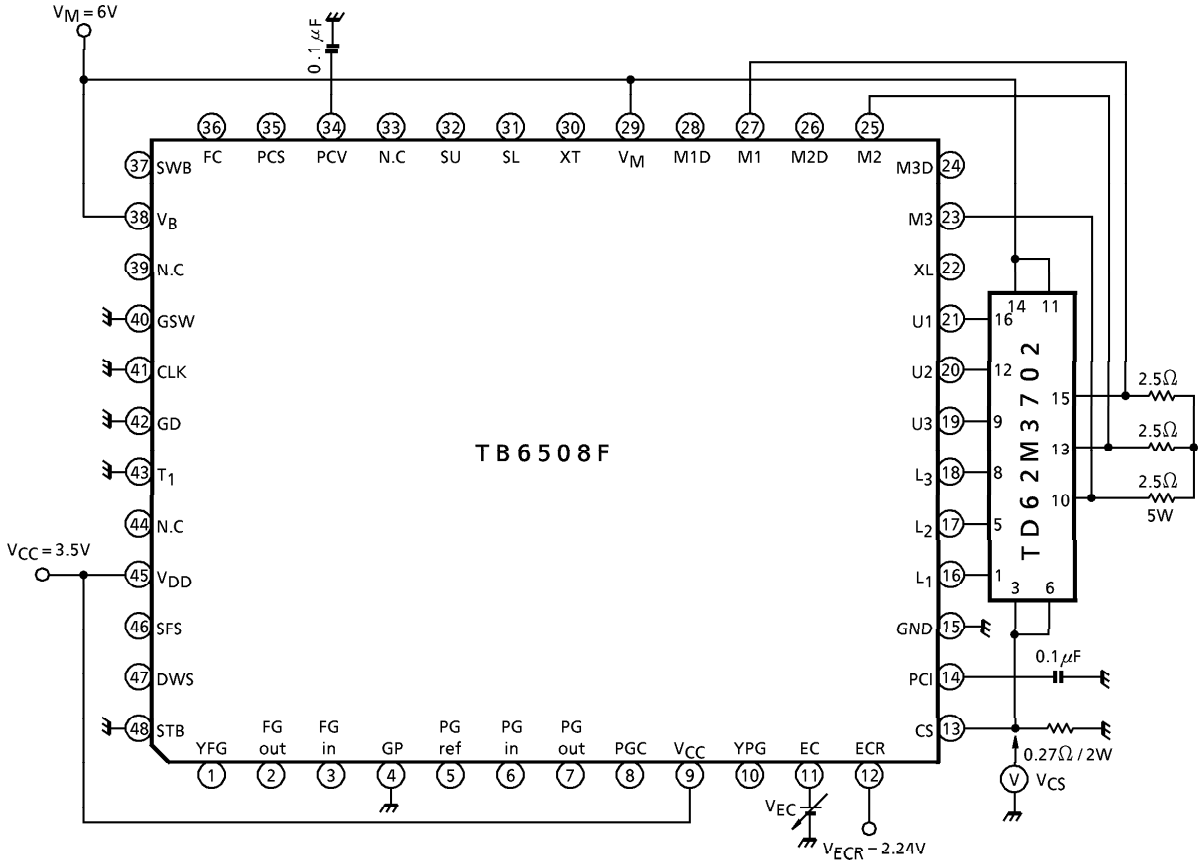
No.3

Measure the voltage potential of pin⑫.

No.4

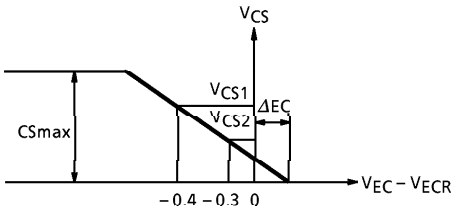
Set EC = 0V, ECR = 2.24V, then measure the current to pin⑪.

TEST CIRCUIT 2



No.5, 6, 7

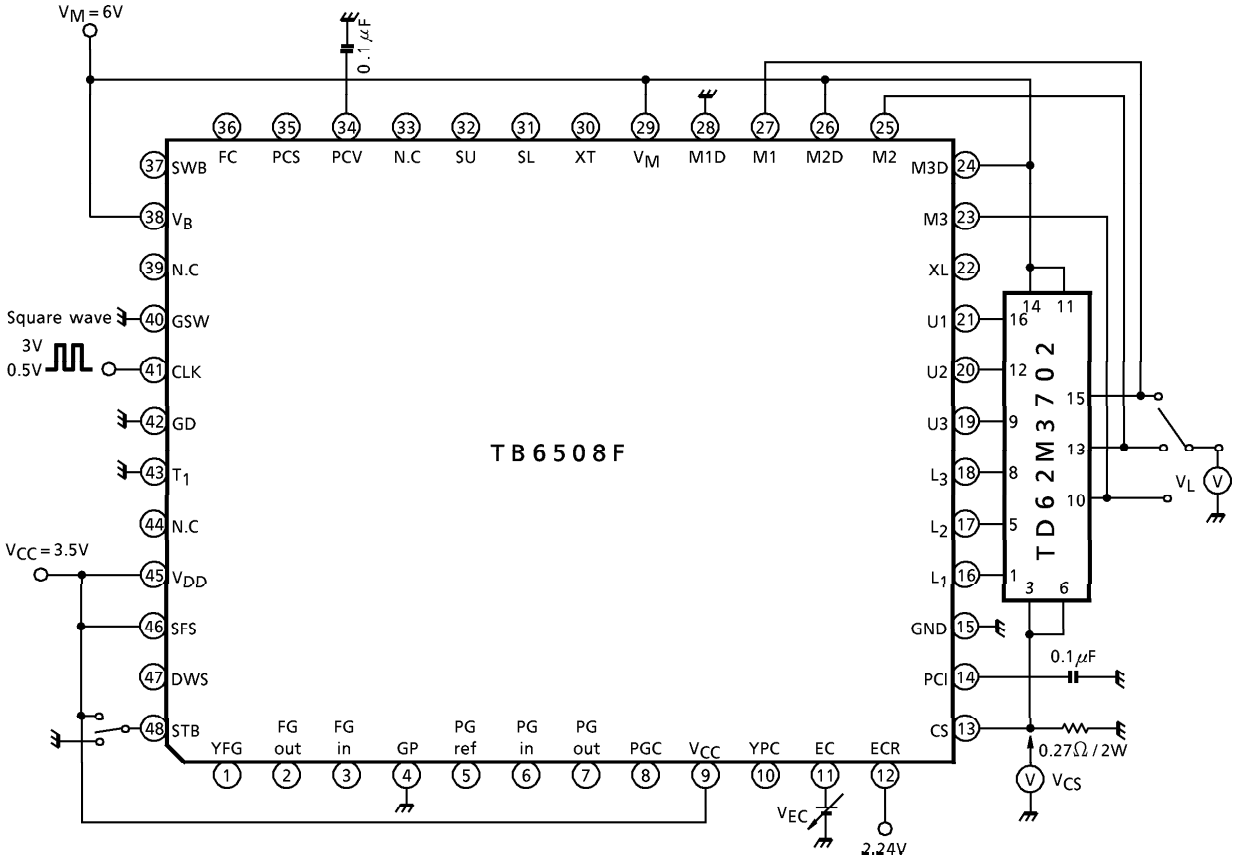
Set $V_{ECR} = 2.24V$, change V_{EC} from 0V to 3V, then measure the voltage potential of V_{CS}.



$$\Delta EC = V_{EC} - V_{ECR} \quad (V_{CS} = 0V)$$

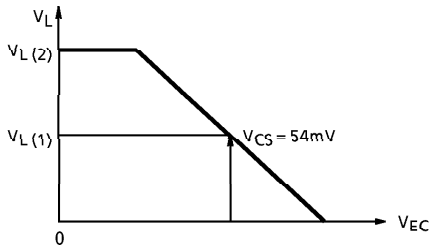
$$G_{io} = \frac{V_{CS1} - V_{CS2}}{0.1V}$$

TEST CIRCUIT 3



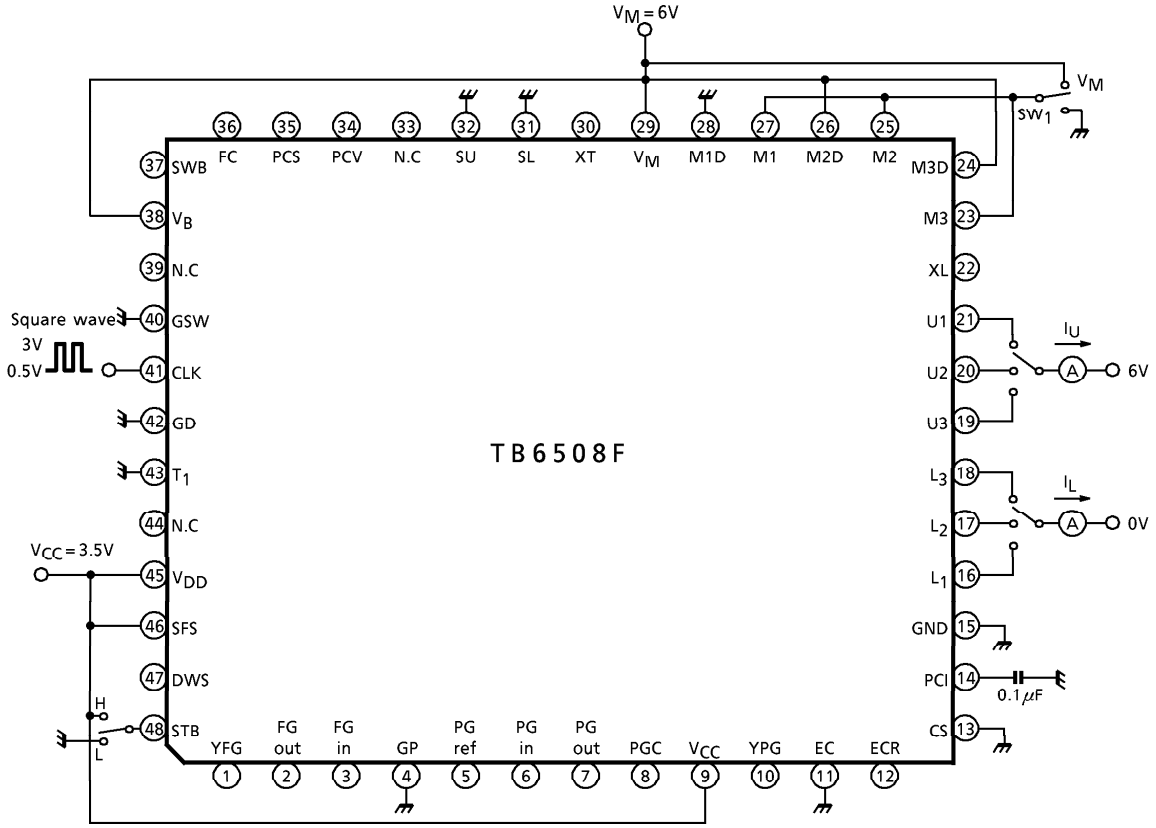
No.8, 9

To set the drive angle, change the STB terminal (pin 48) from high to low.
Then input the number of clocks indicated below to the CLK terminal (pin 41).



CLOCK	50	200	300
Terminal	M3	M1	M2

TEST CIRCUIT 4

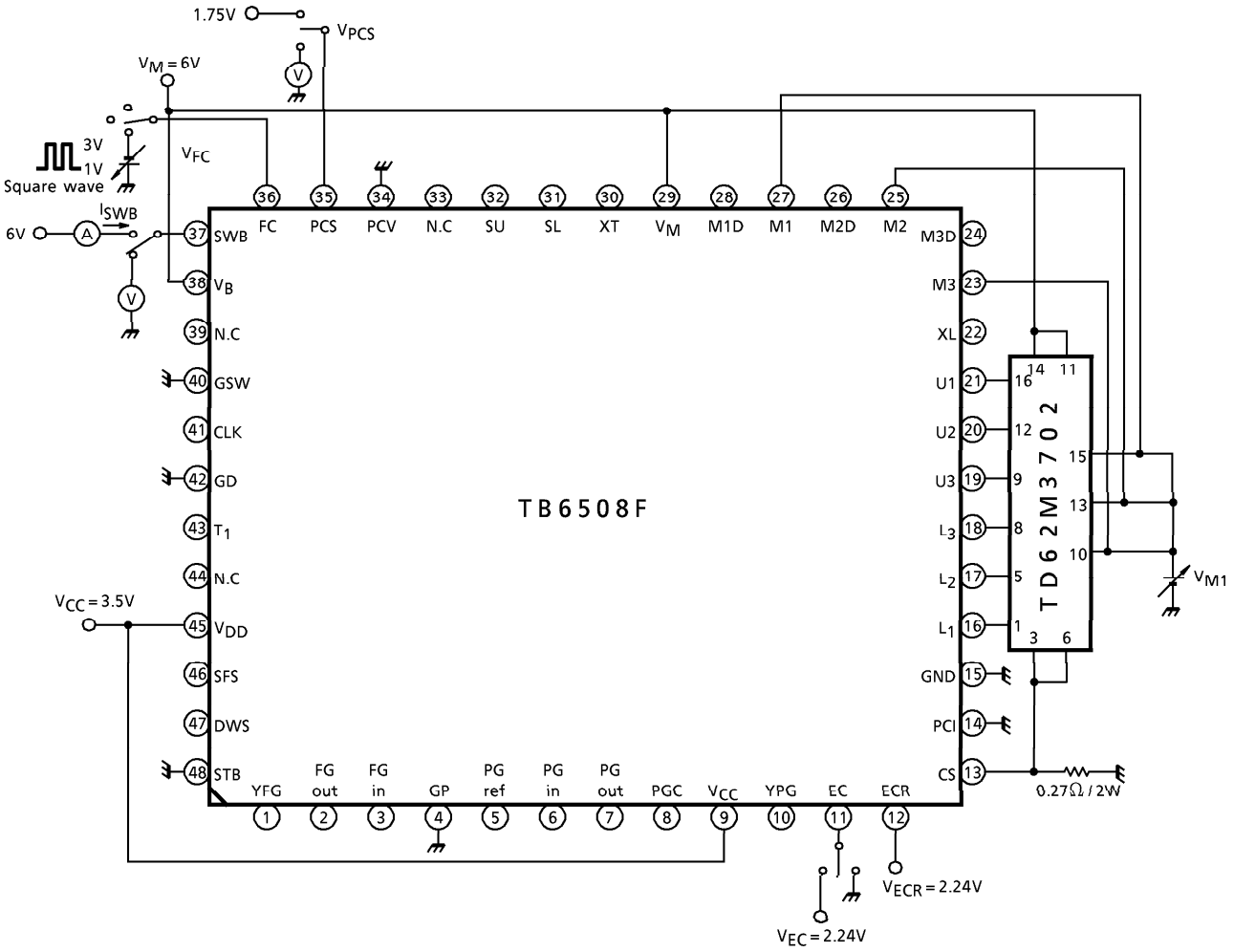


No.10, 11

To set the drive angle, change the STB terminal (pin 48) from high to low.
Then input the number of clocks indicated below to the CLK terminal (pin 41).

CLOCK	50		150		280	
Terminal	I_{U1}	I_{L3}	I_{U2}	I_{L1}	I_{U3}	I_{L2}
SW1	0V	V_M	0V	V_M	0V	V_M

TEST CIRCUIT 5



No.12

Set $V_{EC} = 2.24V$, then measure V_{M1} when $V_{PCS} = 1.75V$.

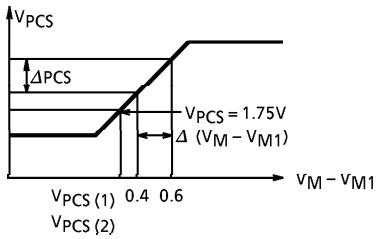
No.13

Set $V_{EC} = 0V$ then measure V_{M1} when $V_{PCS} = 1.75V$.

No.14

Set $V_{EC} = 2.24V$, $V_{ECR} = 2.24V$ and $V_M = 6V$, then determine G_{PCS} from the amount V_{PCS} voltage varies when (V_M-V_{M1}) changes from 0.4V to 0.6V.

$$G_{PCS} = \frac{\Delta PCS}{\Delta\ (V_M - V_{M1})}$$



No.15

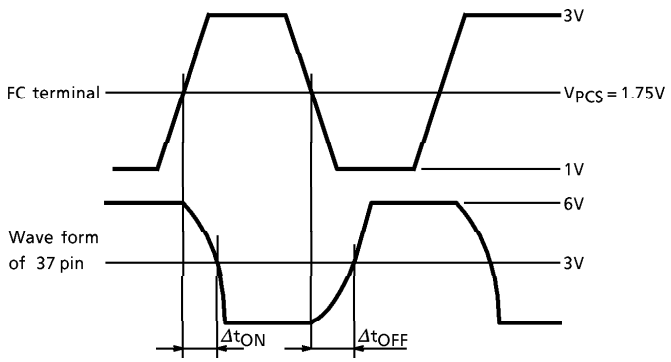
Set FC = 3V, EC = 2.24V, and ECR = 2.24, then measure the current to 37.

No.16

Set FC = 3V, EC = 0V, and ECR = 2.24V, then measure the current to 37.

No.17, 18

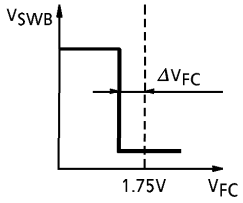
Input a square wave from FC terminal.
Set V_{PCS} = 1.75V



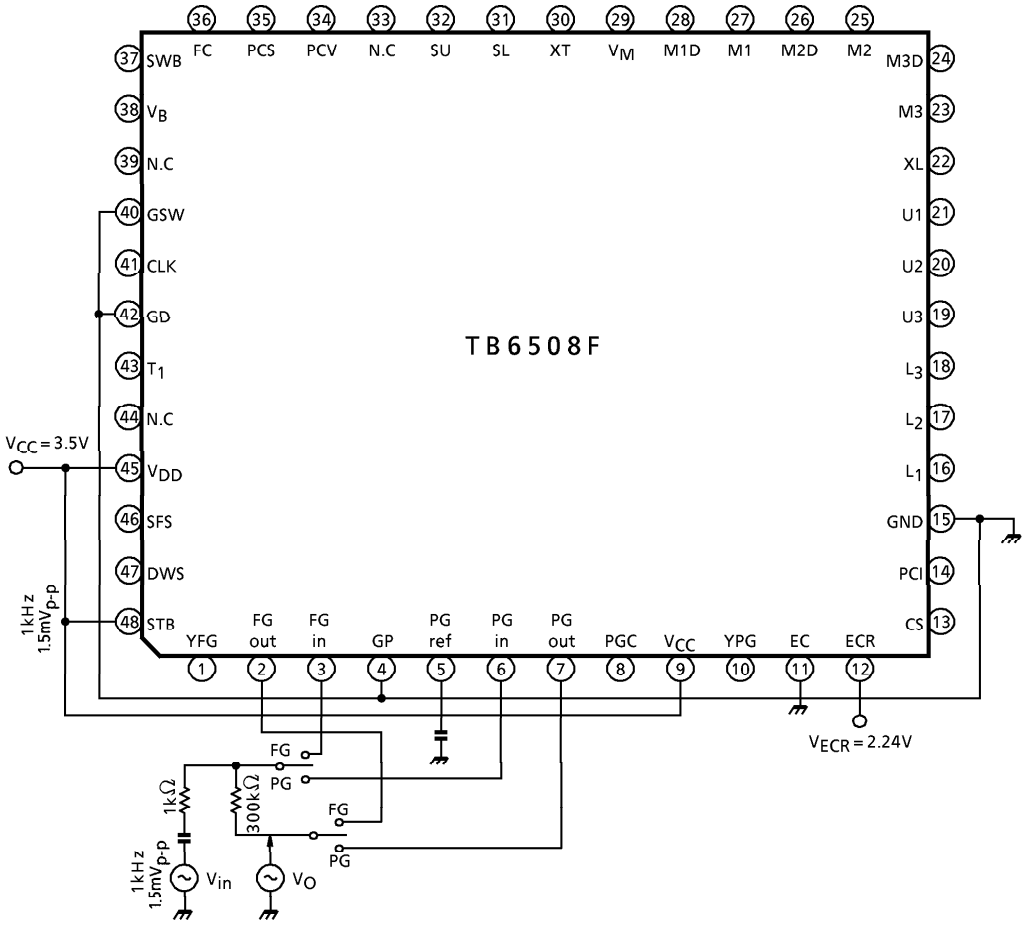
No.19

Set V_{PCS} = 1.75V, change V_{FC}

$\Delta V_{FC} = V_{PCS} - V_{FC}$



TEST CIRCUIT 6



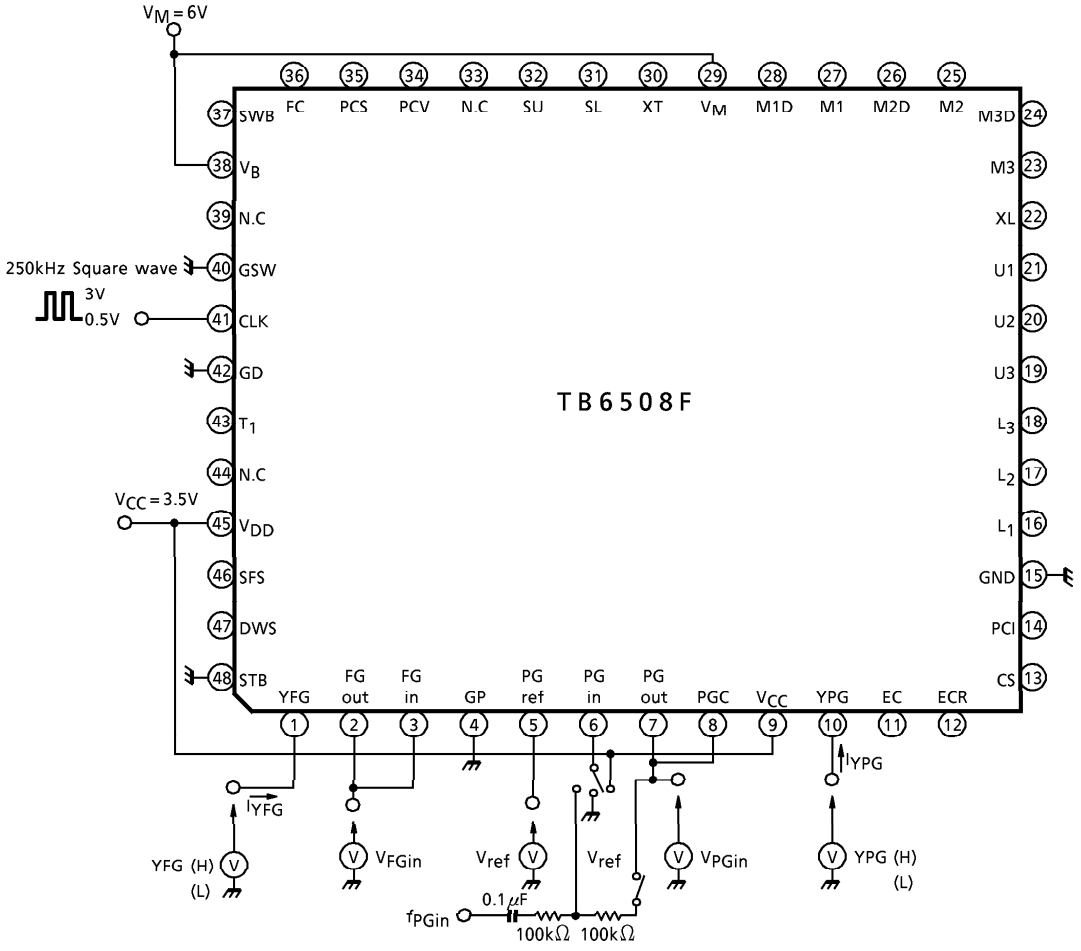
No.20

Set SW to FG, then determine $G_{FG} = 20\ell og\ (V_O / V_{IN})$ by measuring.
V_O when $V_{IN} = 1.5mV_{p-p}$, 1kHz.

No.23

Set SW to PG, then determine $G_{PG} = 20\ell og\ (V_O / V_{IN})$ by measuring V_O when $V_{IN} = 1.5mV_{p-p}$, 1kHz.

TEST CIRCUIT 7

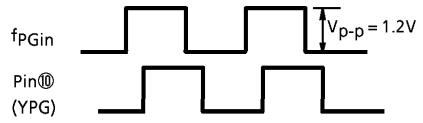


No.24

Input a 10kHz square wave from f_{PGin}, Set f_{PGin} to $1.2V_{p-p}$ (ΔPG_{in} = 0.6V) and check that ⑩ is active.
Also, set V_{p-p} to 0.9V (ΔPG_{in} = 0.45V) and check that pin is not active.

No.21

Set YFG to high then measure the YFG voltage potention when a current of I_{YFG} = – 100μA is obtained.



No.22

Set YFG to low then measure the YFG voltage potential when measure a current of I_{YFG} = – 100μA.

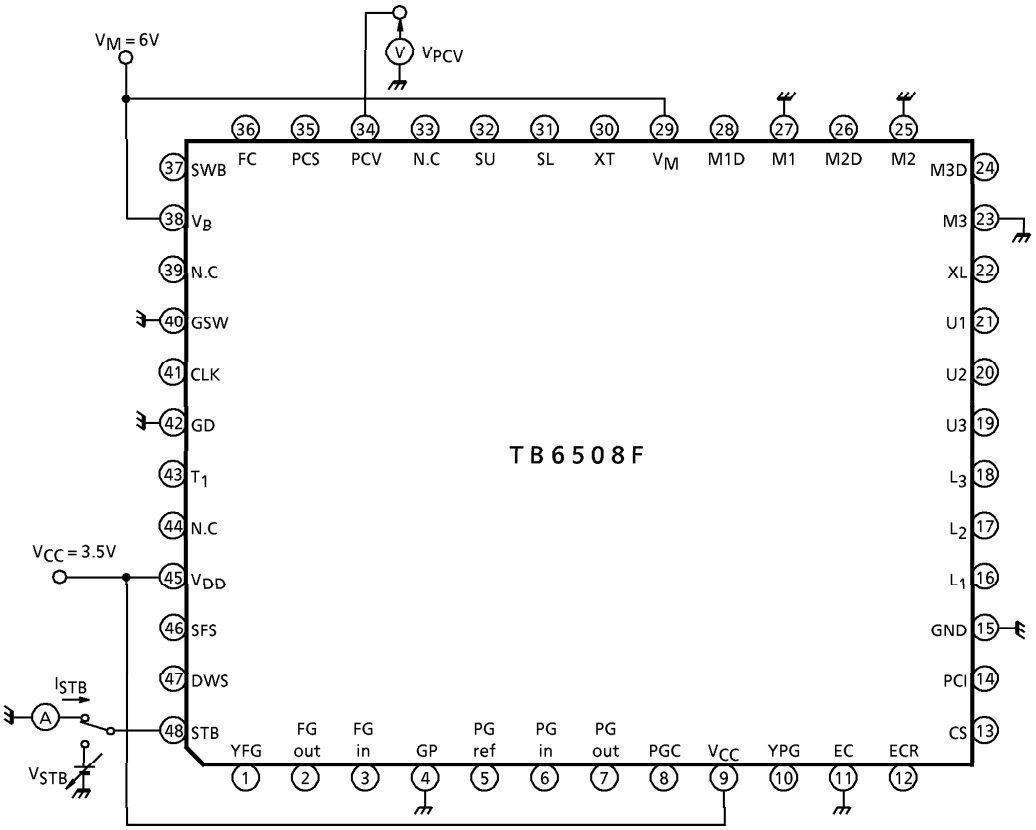
No.25

Set PG into Low and set YPG to High, then measure the YFG voltage potential when a current of I_{YFG} = 100μA is obtained.

No.26

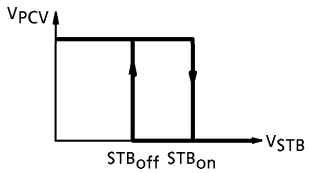
Set PG into high and set YPG to low then measure the YPG voltage potential when a current of I_{YPG} = 100μA is obtained.

TEST CIRCUIT 8



No.27, 28

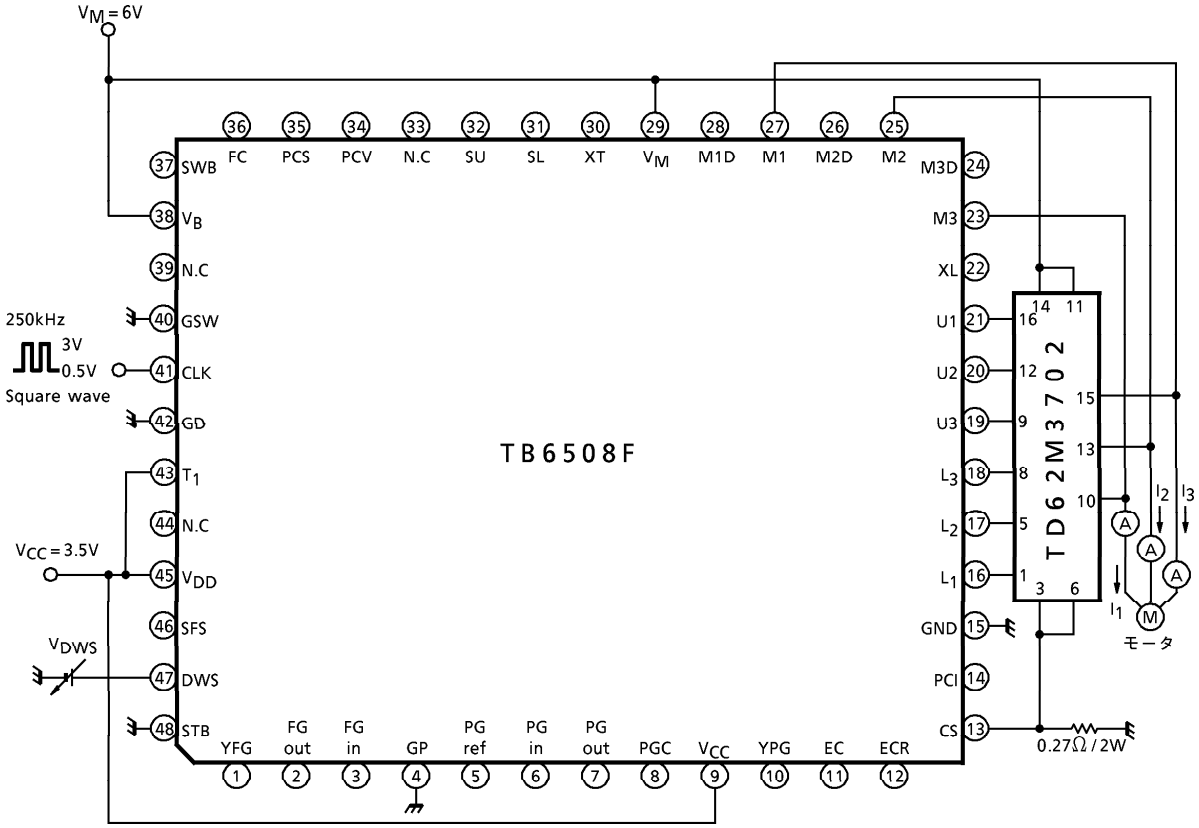
Change V_{STB} from 0V to 3.5V, and from 3.5V to 0V, then measure the V_{PCV}.
V_{STB} is STB_{on}, when change V_{PCV} from high to Low.
V_{STB} is STB_{on}, when change V_{PCV} from high to low.



No.29

Measure the I_{STB} when $V_{STB} = 0V$

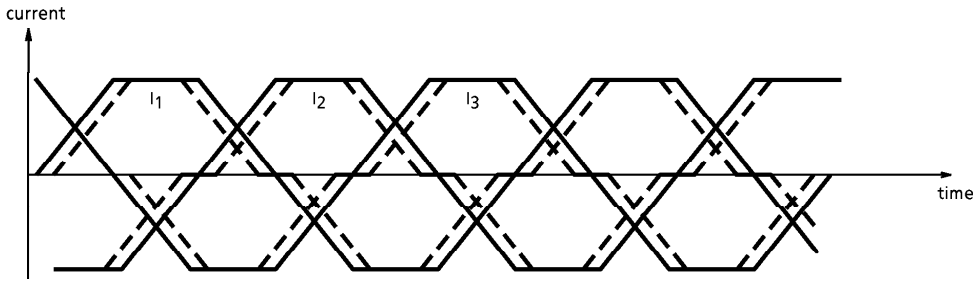
TEST CIRCUIT 9



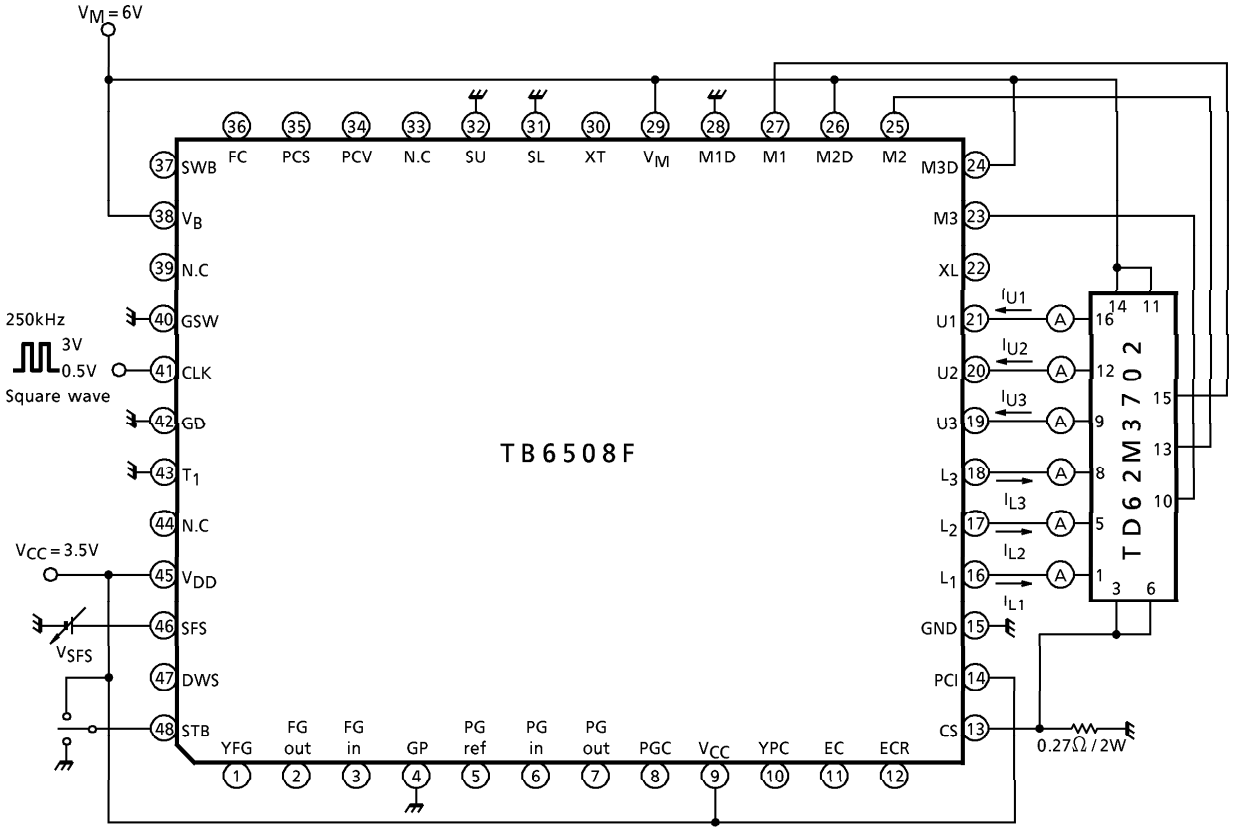
No.30, 31

Changes V_{DWS} from 0V to 3.5V while the motor is running, and measures the changes of I_1, I_2, and I_3.

The continuous lines in the diagram are DWS (L) at 180° or, while the dotted lines are DWS (H) at 150° on.



TEST CIRCUIT 10



No.32, 33

Change V_{SFS} to 0V and to 3.5V, then measure the carrent of $I_{U1\sim3}$ and $I_{L1\sim3}$.

Fig.1 Case of SFS (L)-15Hz.

Fig.2 Case of SFS (H)-30Hz.

SFS-L (15Hz)

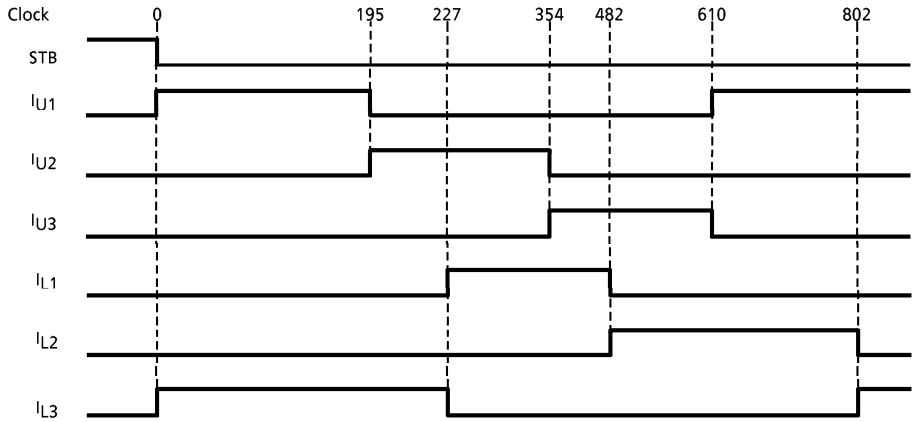


Fig.1 SFS (L)

SFS-H (30Hz)

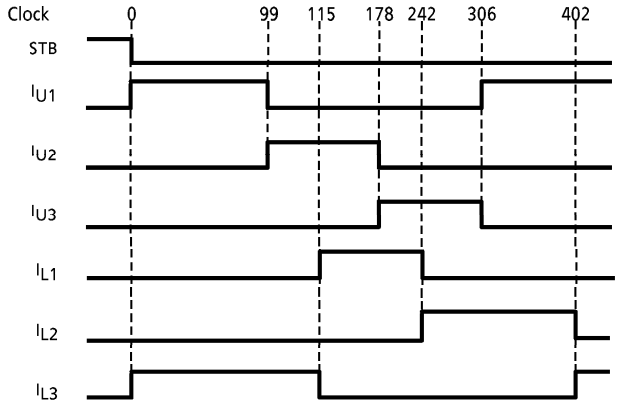
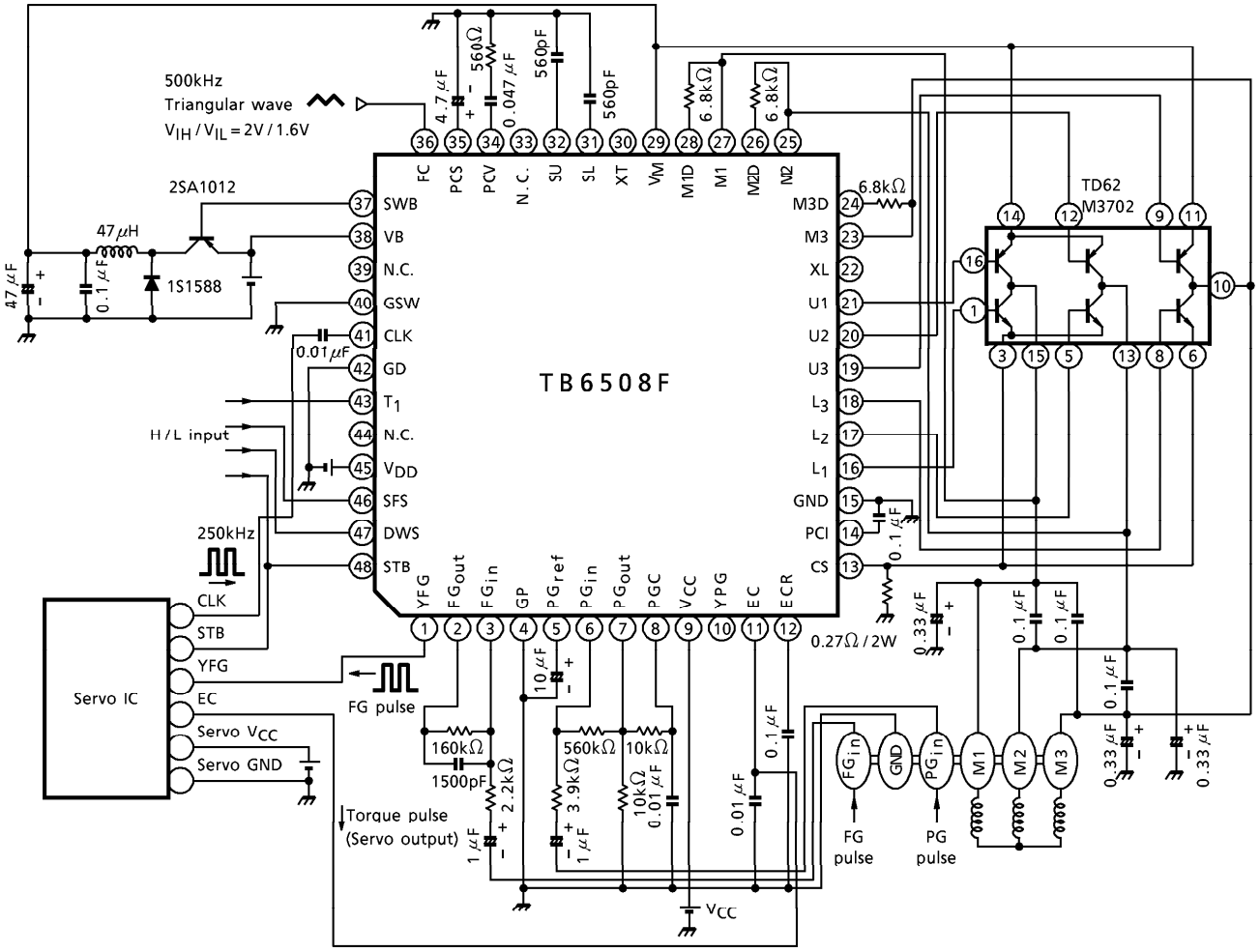


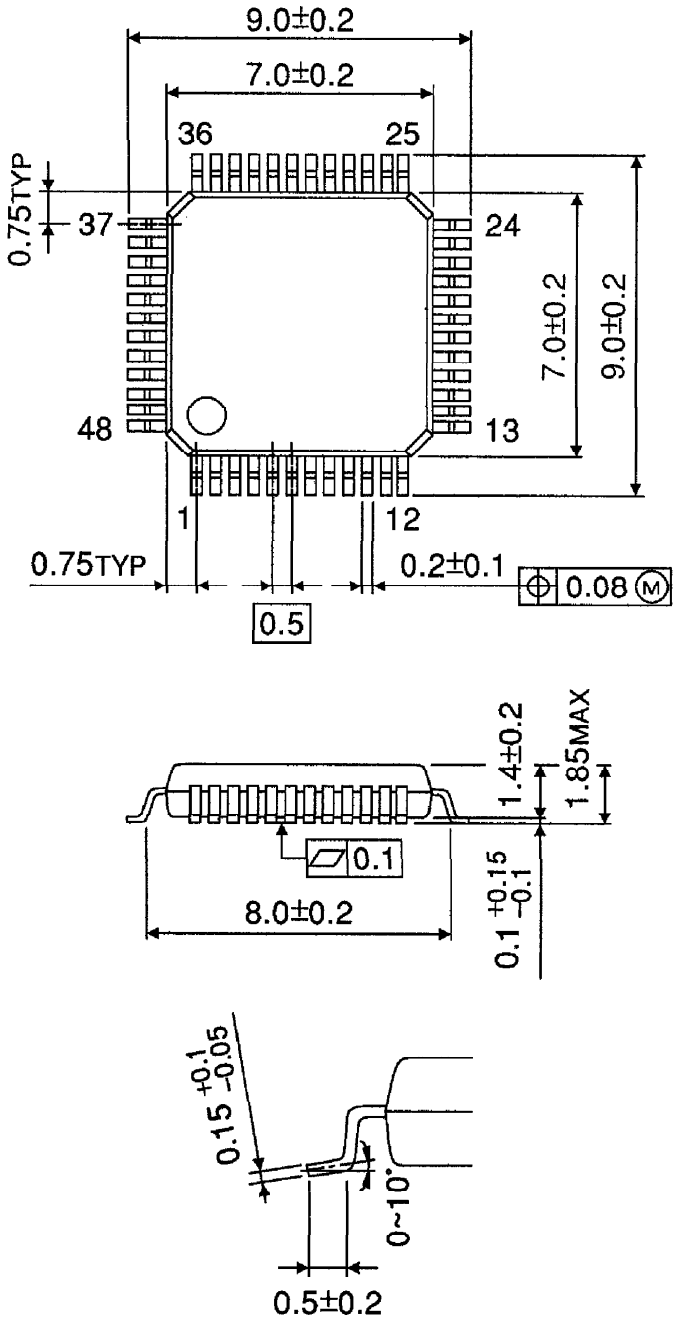
Fig.2 SFS (H)

APPLICATION CIRCUIT



OUTLINE DRAWING

LQFP48-P-0707-0.50 Unit : mm



Weight : 0.17g (Typ.)