

TOSHIBA Bi-CMOS INTEGRATED CIRCUIT SILICON MONOLITHIC

T B 6 5 0 8 F**CYLINDER MOTOR CONTROL DRIVER IC FOR VTR MOVIE**

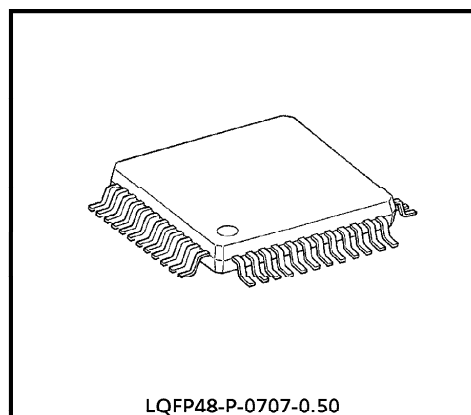
The TB6508F is a 3 Phase, Low Noise, Low Voltage, Sensorless Motor Control IC for VTR Movie.

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.

FEATURES

- Operating Supply Voltage : $V_{CC} = 3.2 \sim 5.5V$
- Motor Supply Voltage : $V_M = 3.0 \sim 12V$
- 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.



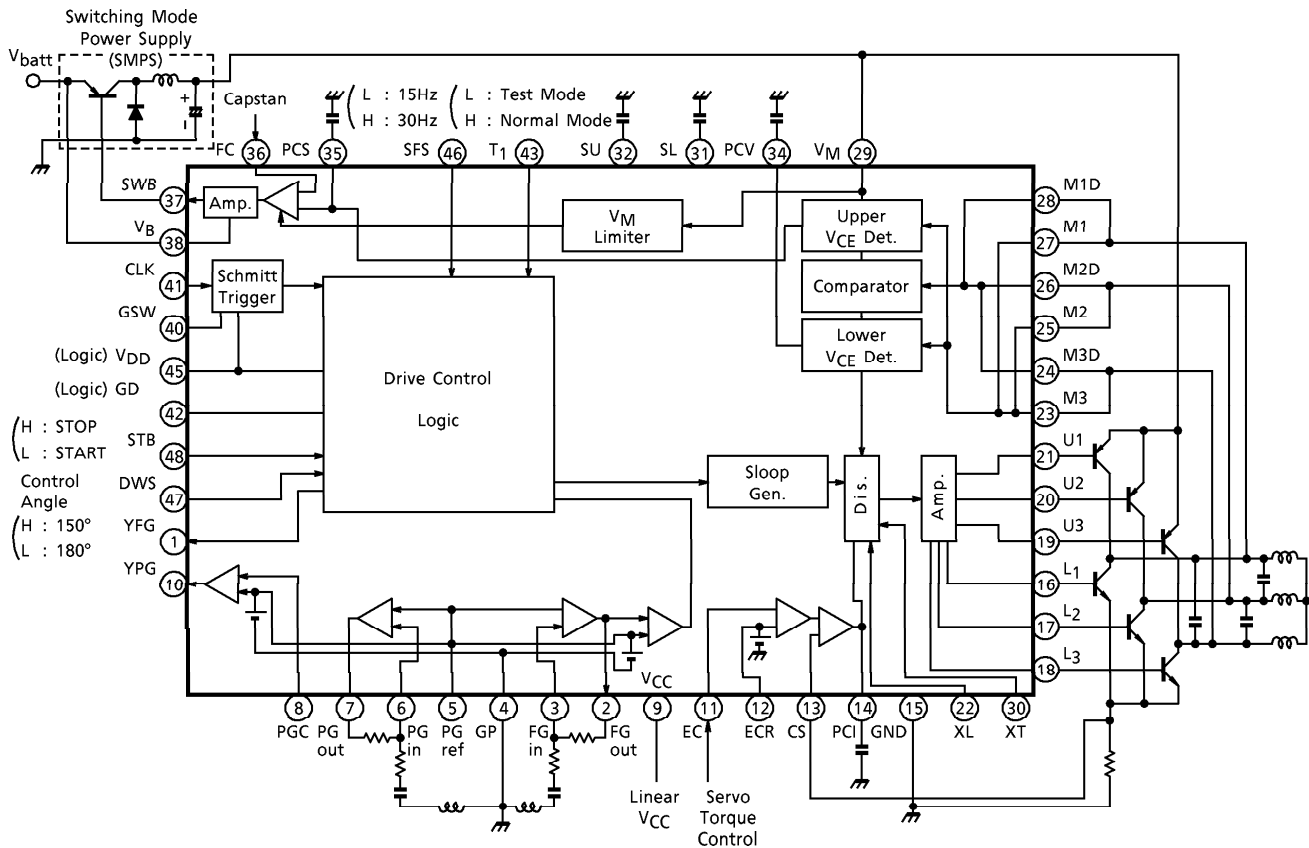
LQFP48-P-0707-0.50

Weight : 0.17g (Typ.)

961001EBA2

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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~V _{CC} + 0.3 (Note 2)	V
Power Dissipation	P _D	300 (Note 3)	mW
Operating Temperature	T _{opr}	- 20~75	°C
Storage Temperature	T _{stg}	- 55~125	°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.

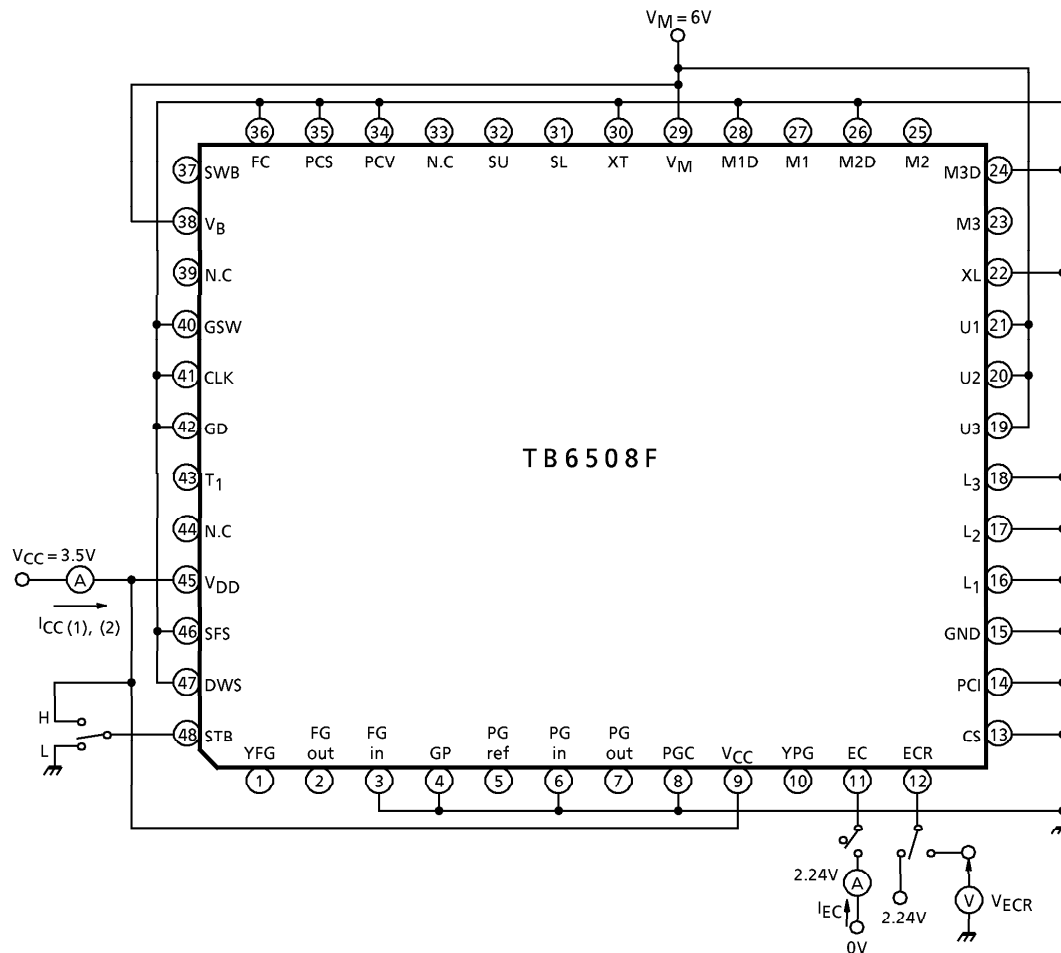
ELECTRICAL CHARACTERISTICS (Unless otherwise specified, Ta = 25°C, V_{CC} = 3.5V)

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	C _S max	2	R _{CS} = 0.27Ω	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 CIRCUIT	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	$V_{p-p} = 1.5mV$ $f = 1kHz$	45	—	—	dB
21	YFG High Level	YFG (H)	7	$I_{YFG} = - 100\mu A$	2.0	—	—	V
22	YFG Low Level	YFG (L)	7	$I_{YFG} = 100\mu A$	—	—	1.5	V
23	PG Amp. Gain	G_{PG}	6	$V_{p-p} = 1.5mV$, $f = 1kHz$	45	—	—	dB
24	PG Amp. Offset Voltage	ΔPG_{in}	7	—	0.45	0.5	0.6	V
25	YPG High Level	YPG (H)	7	$I_{YPG} = - 10\mu A$	2.0	—	—	V
26	YPG Low Level	YPG (L)	7	$I_{YPG} = 100\mu A$	—	—	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.

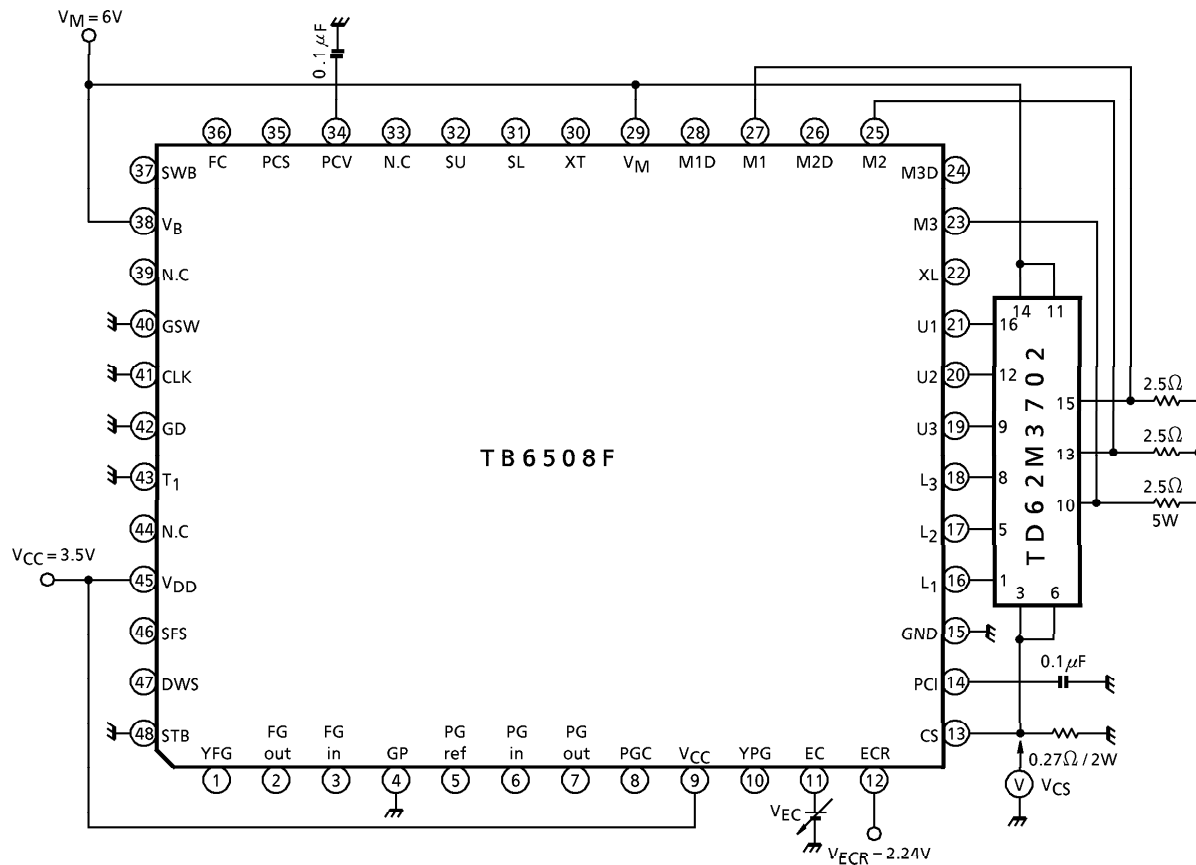
No.3

Measure the voltage potential of pin⑫.

No.4

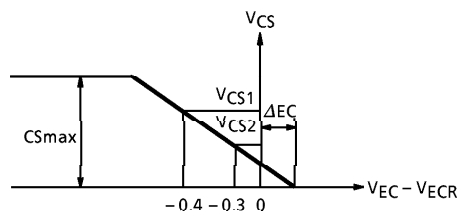
Set EC = 0V, ECR = 2.24V, then measure the current to pin⑪.

TEST CIRCUIT 2



No.5, 6, 7

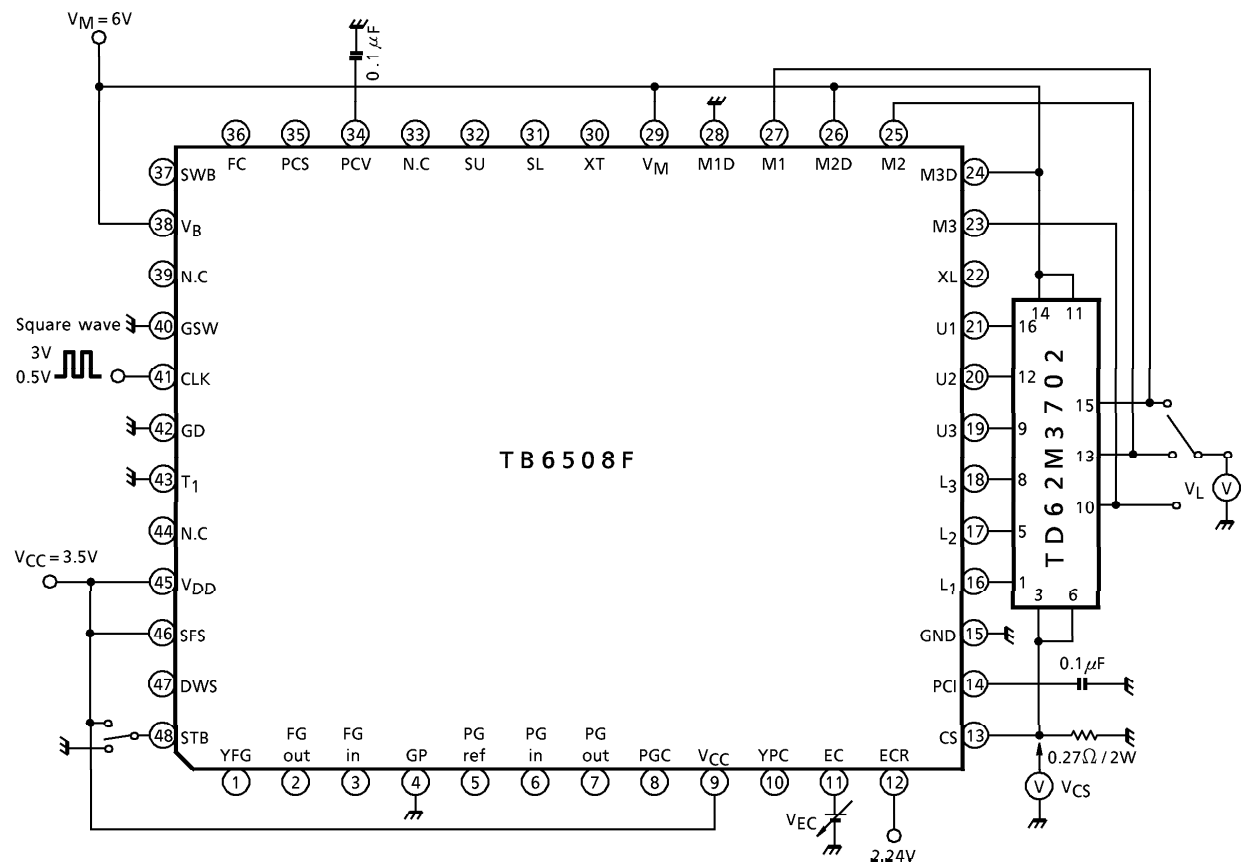
Set $V_{ECR} = 2.24V$, change V_{EC} from 0V to 3V, then measure the voltage potential of V_{CS} .



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

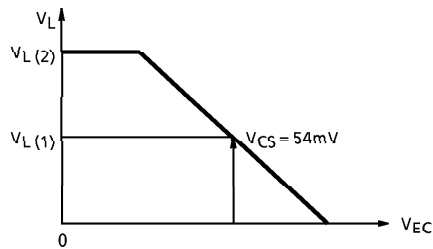
$$G_{io} = \frac{V_{CS1} - V_{CS2}}{0.1V}$$

TEST CIRCUIT 3



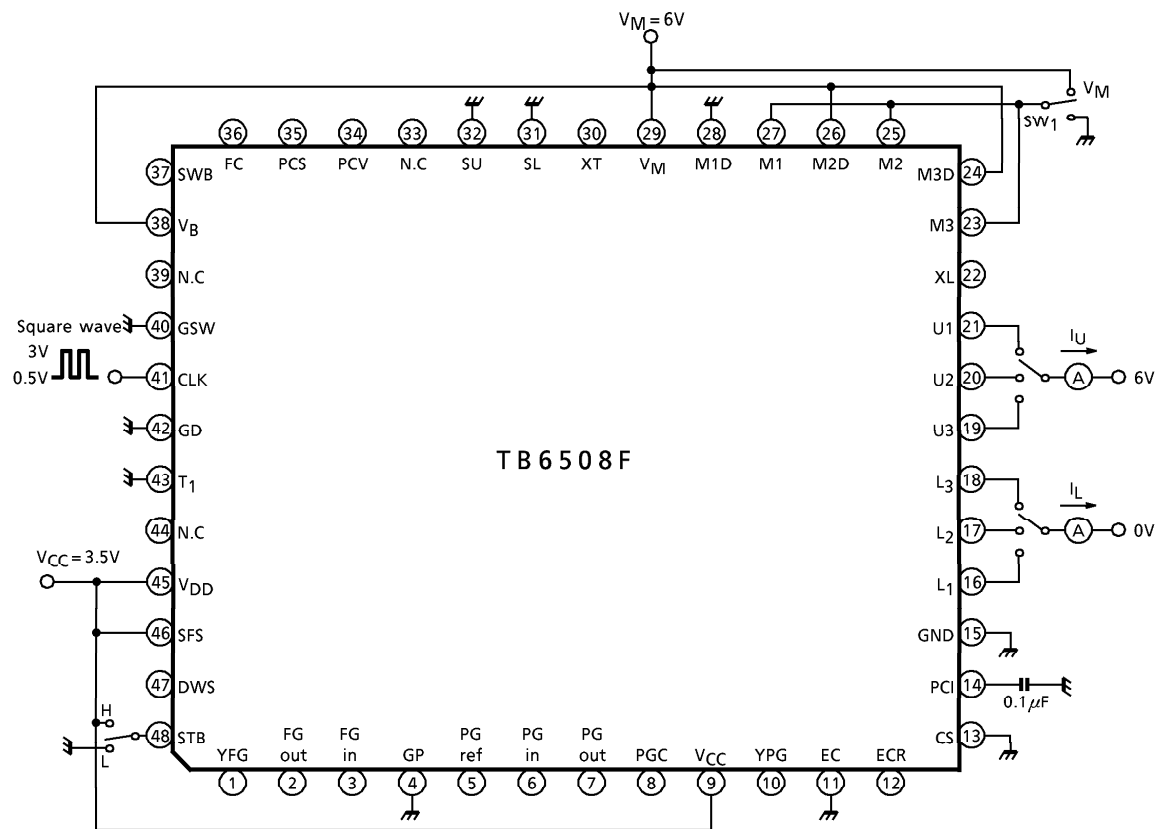
No.8, 9

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

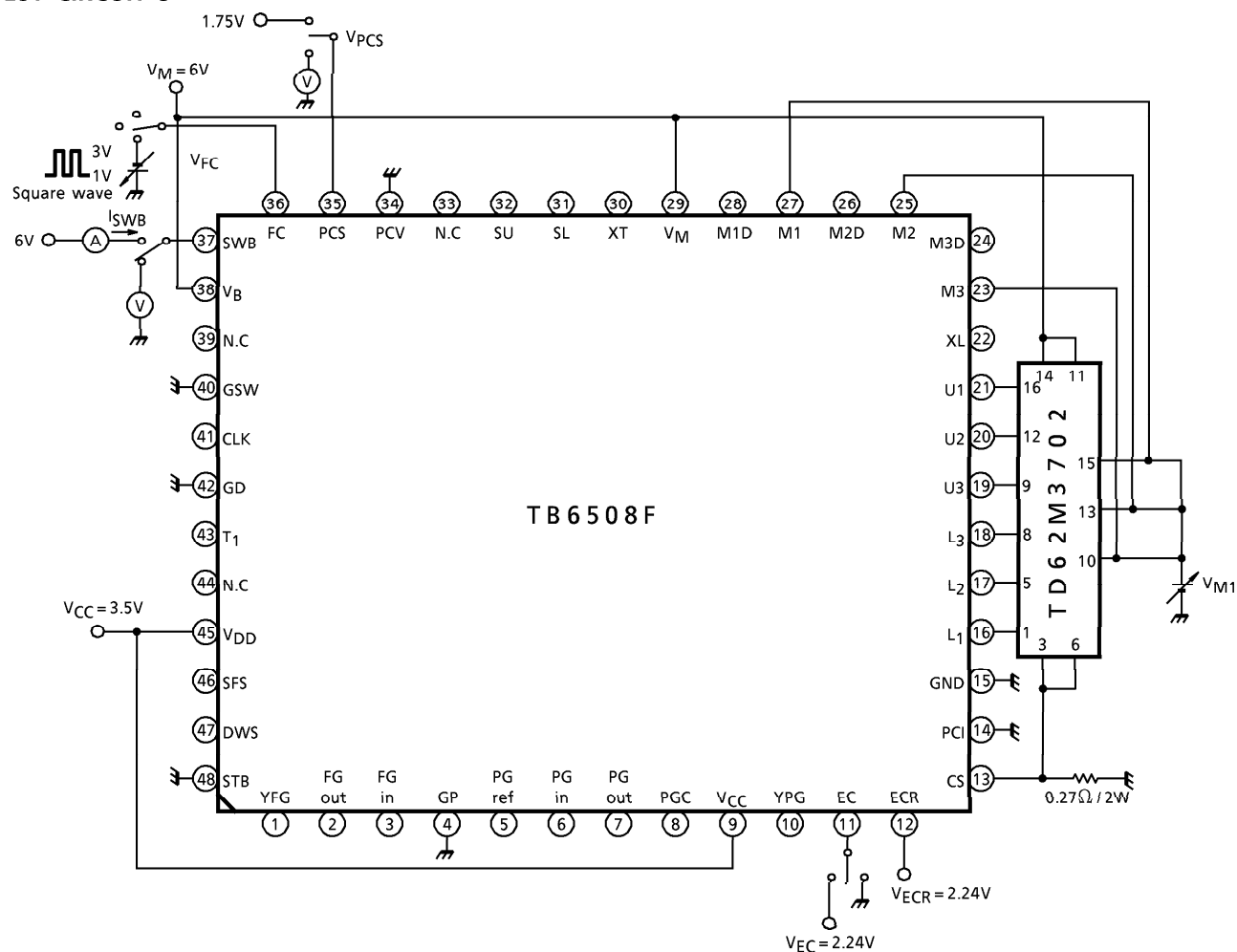


No.10, 11

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 $V_{PCS} = 1.75V$.

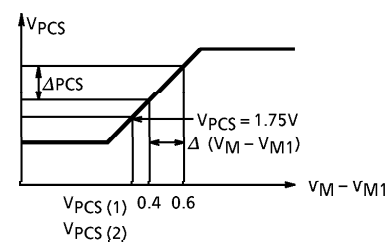
No.13

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 $V_{FC} = 3V$, $V_{EC} = 2.24V$, and $V_{ECR} = 2.24V$, then measure the current to 37.

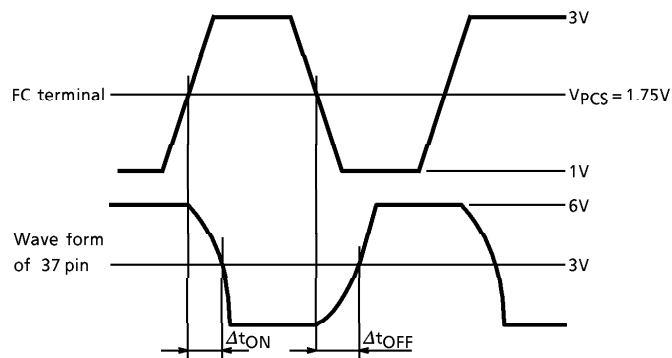
No.16

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

No.17, 18

Input a square wave from FC terminal.

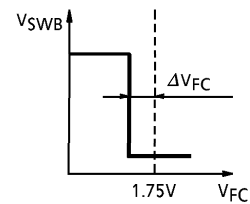
Set $V_{PCS} = 1.75V$



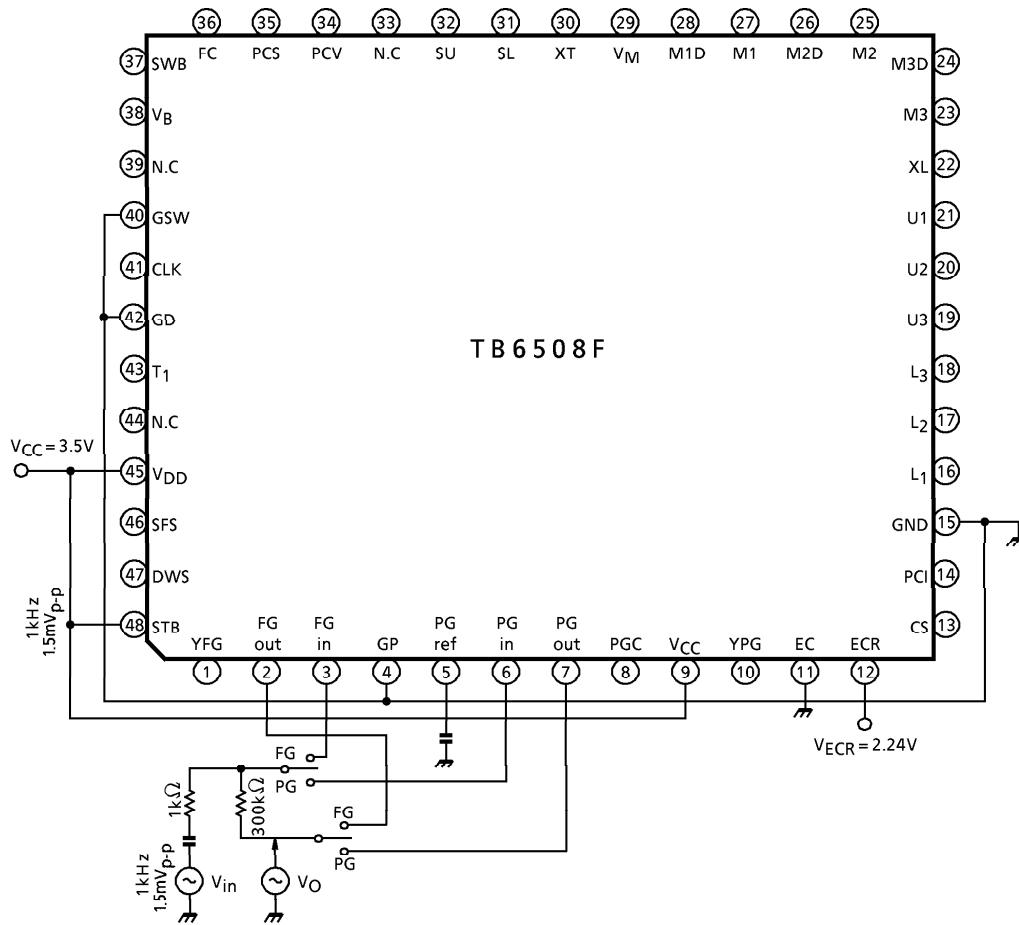
No.19

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

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



TEST CIRCUIT 6



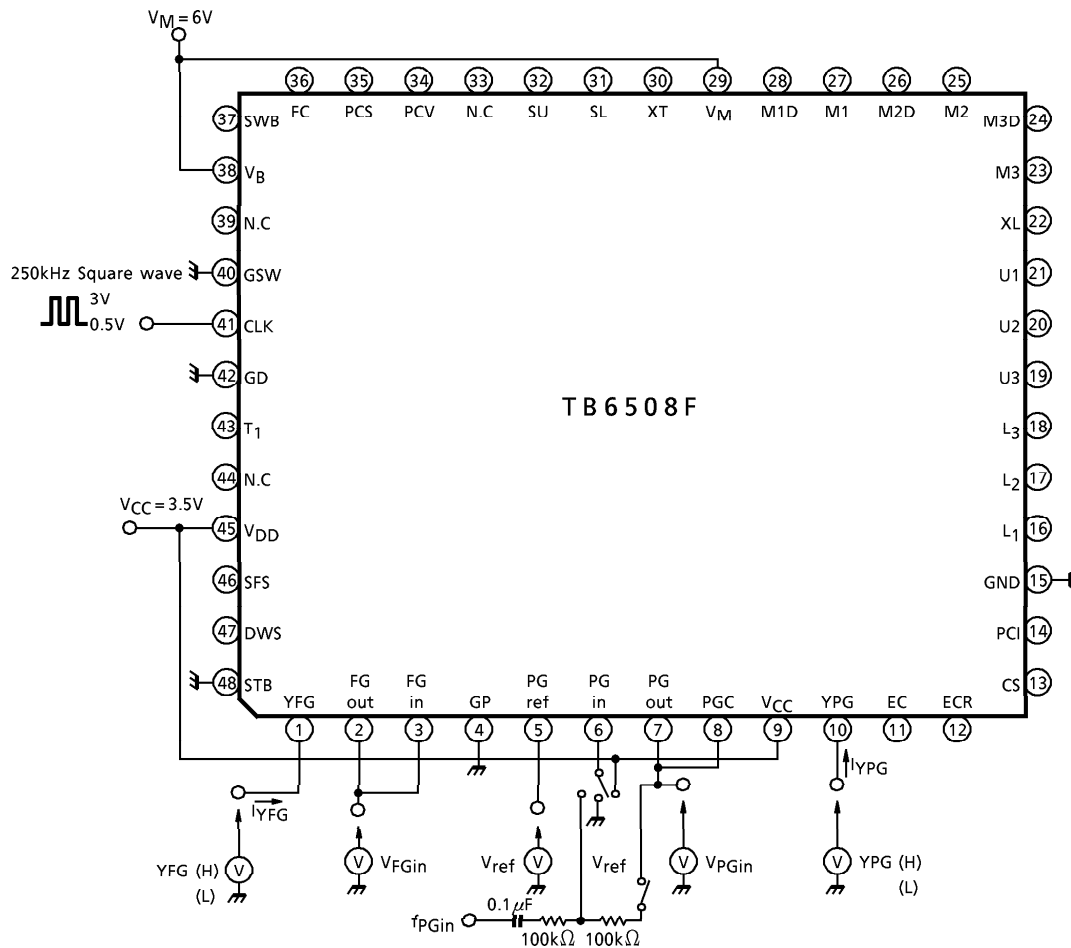
No.20

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

No.23

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

TEST CIRCUIT 7



No.24

Input a 10kHz square wave from f_{PGin} . Set f_{PGin} to 1.2V_{p-p} ($\Delta PG_{in} = 0.6V$) and check that ⑩ is active.

Also, set V_{p-p} to 0.9V ($\Delta PG_{in} = 0.45V$) and check that pin is not active.

No.21

Set YFG to high then measure the YFG voltage potential when a current of $I_{YFG} = -100\mu A$ is obtained.

No.22

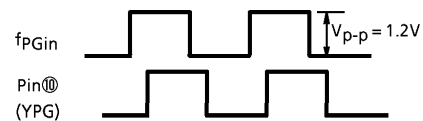
Set YFG to low then measure the YFG voltage potential when measure a current of $I_{YFG} = -100\mu A$.

No.25

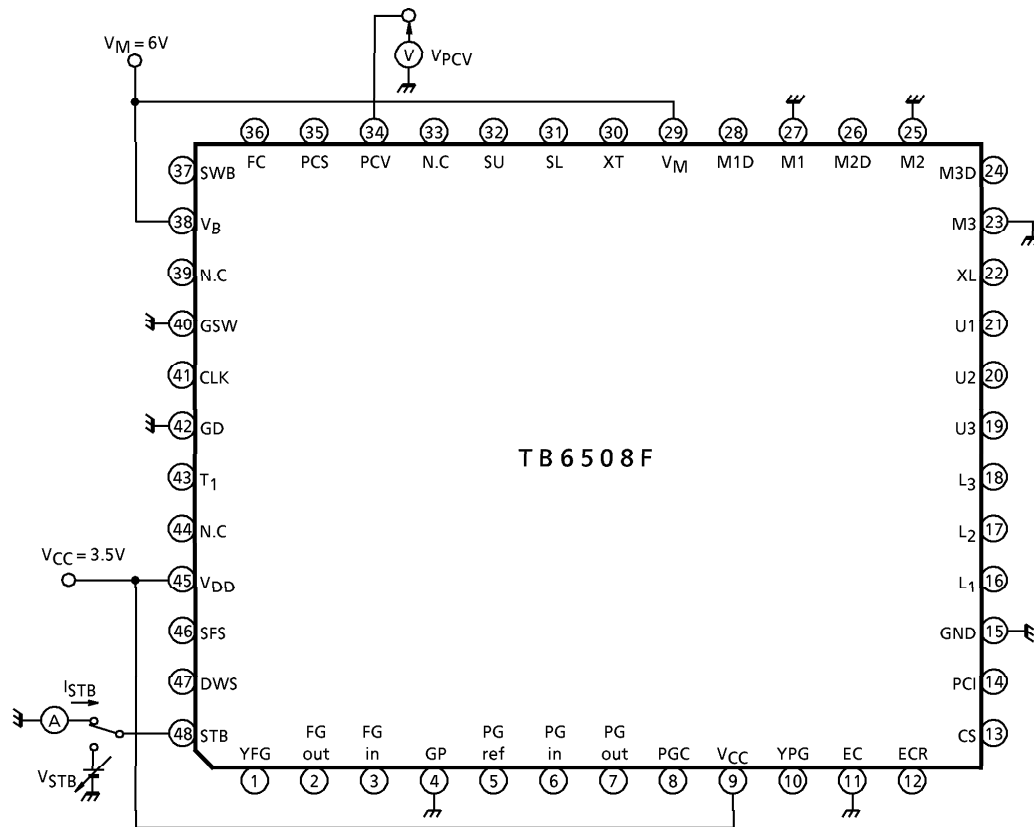
Set PG into Low and set YPG to High, then measure the YFG voltage potential when a current of $I_{YFG} = 100\mu A$ is obtained.

No.26

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



TEST CIRCUIT 8

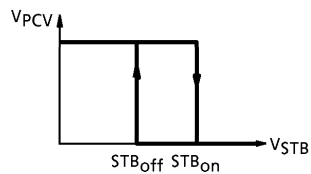


No.27, 28

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.

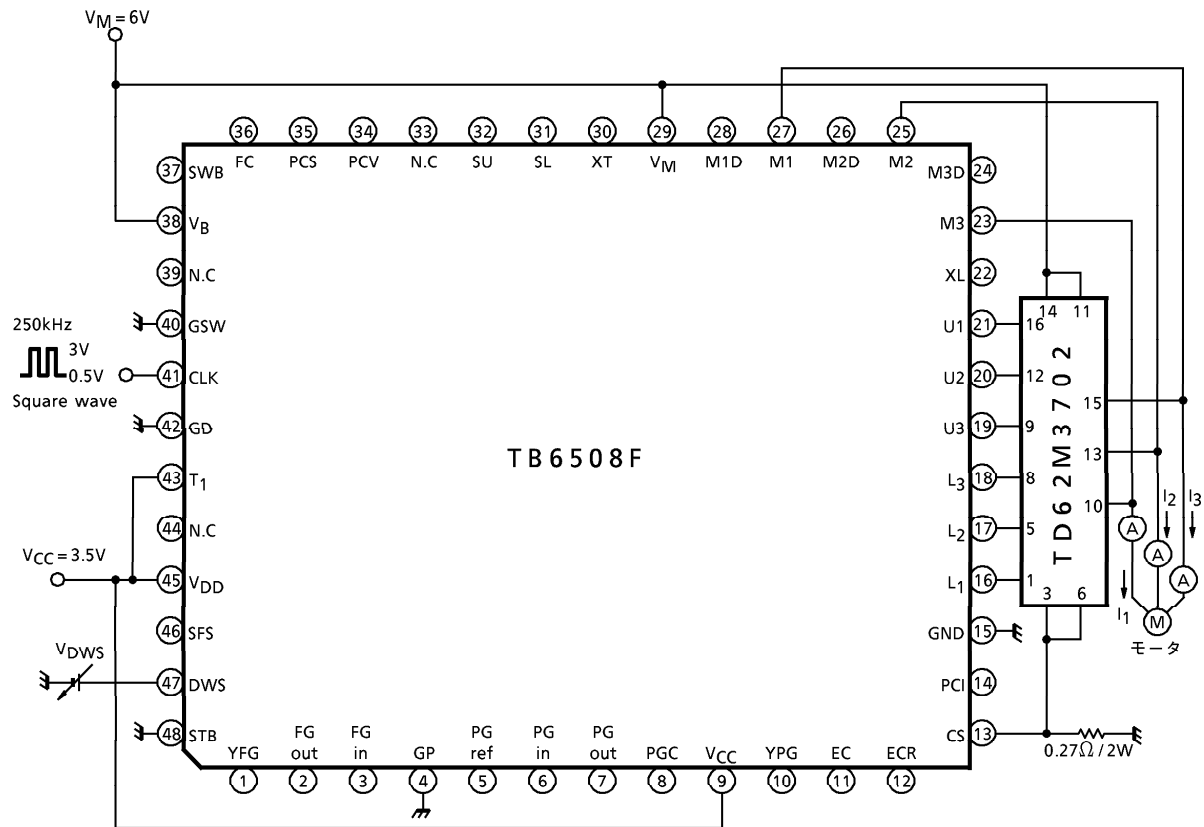
V_{STB} is STB_{on}, when change V_{PCV} from high to low.



No.29

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

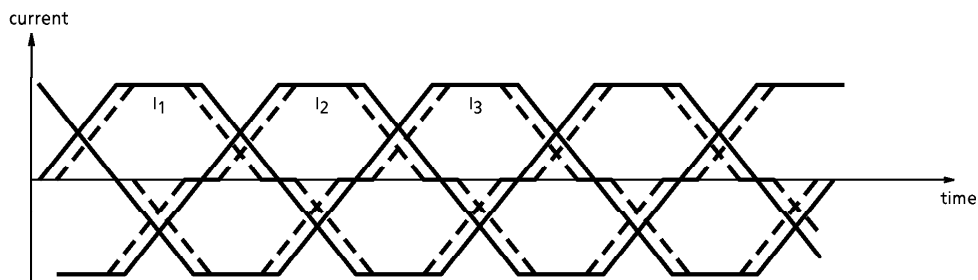
TEST CIRCUIT 9



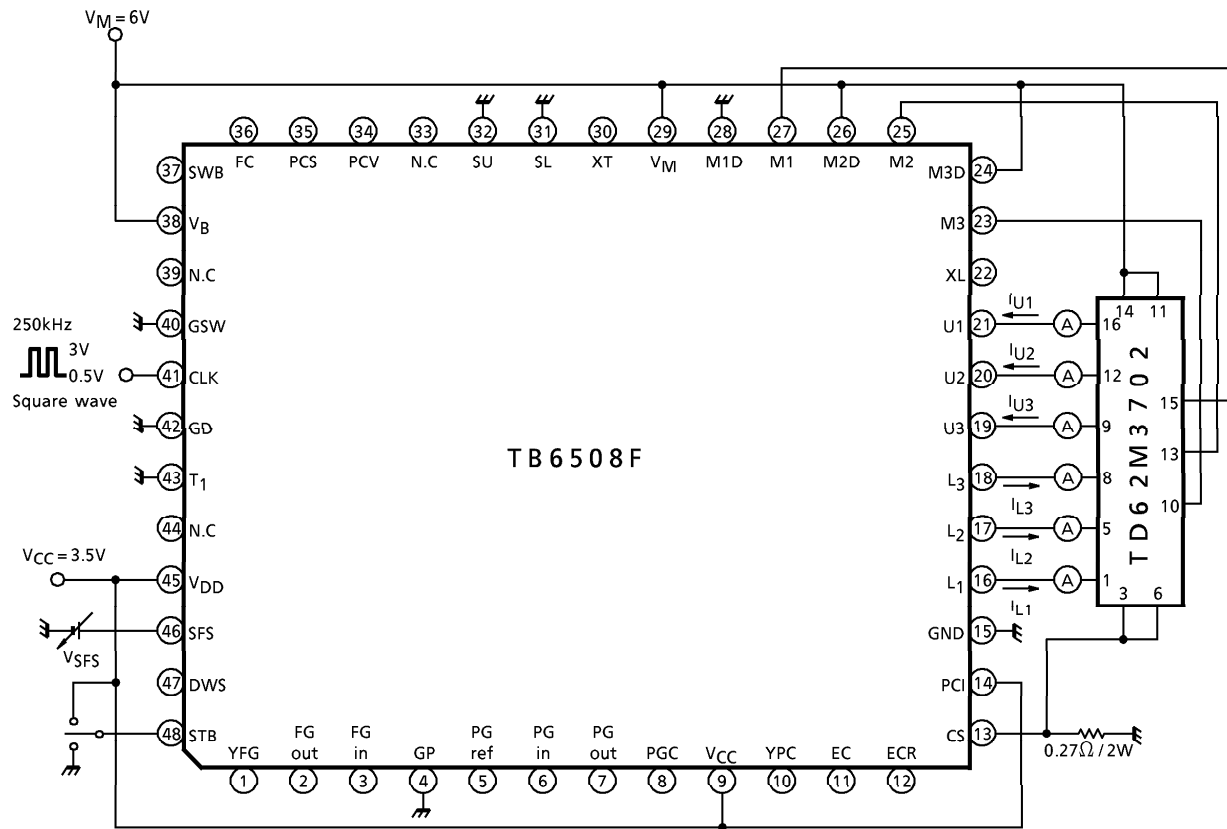
No.30, 31

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 current 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)

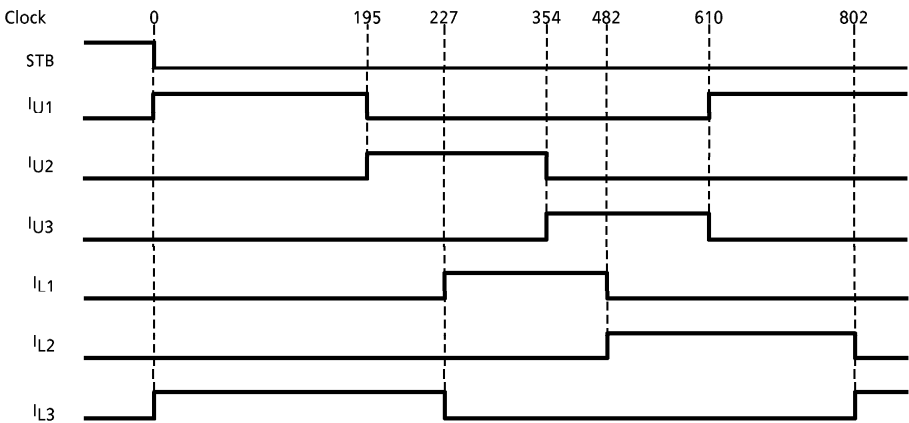


Fig.1 SFS (L)

SFS-H (30Hz)

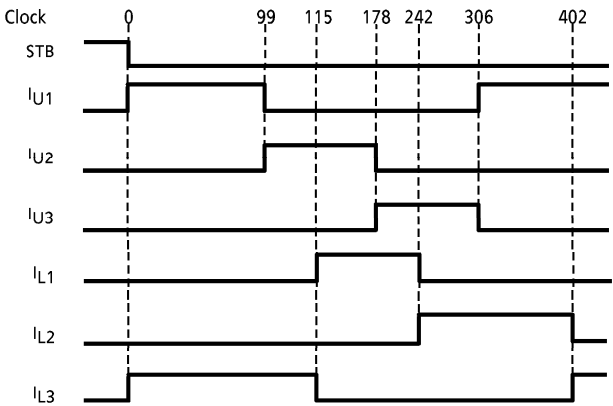
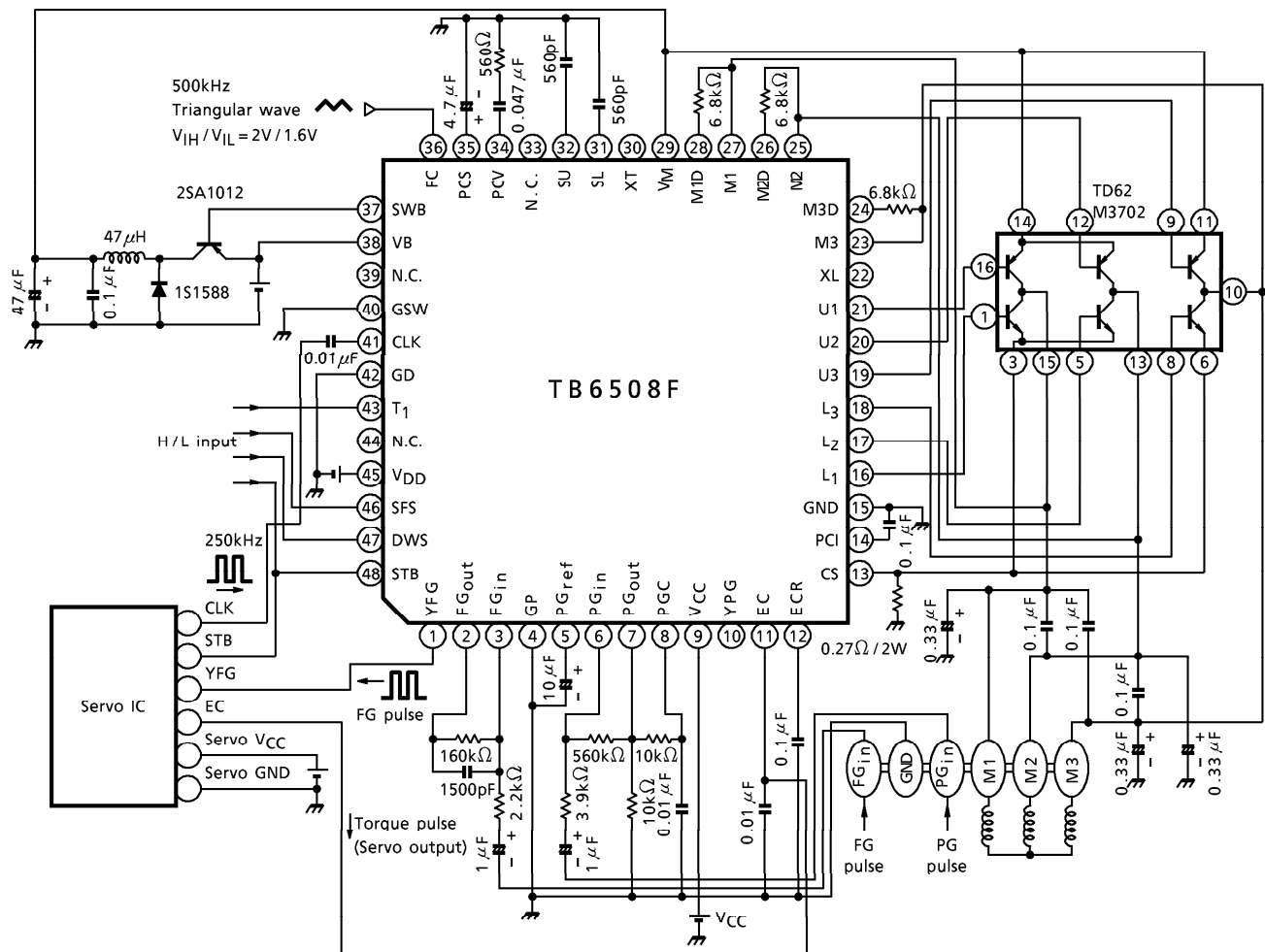


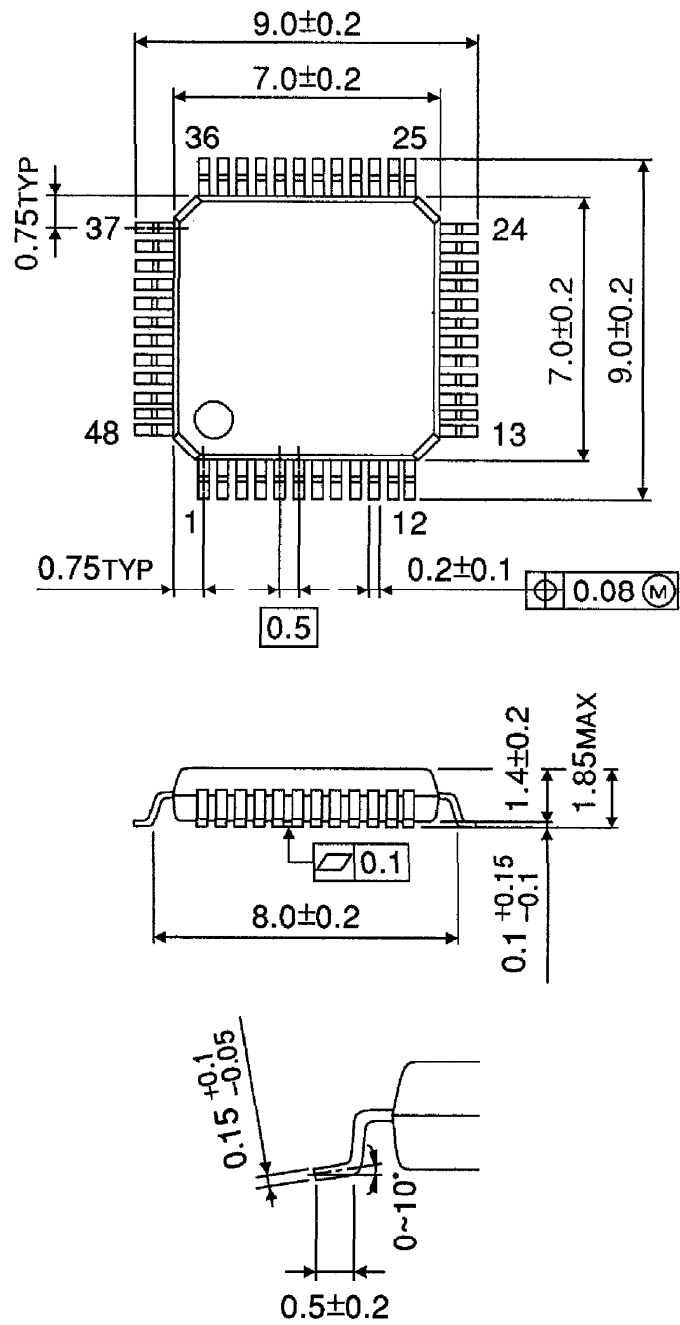
Fig.2 SFS (H)

APPLICATION CIRCUIT



OUTLINE DRAWING
LQFP48-P-0707-0.50

Unit : mm



Weight : 0.17g (Typ.)