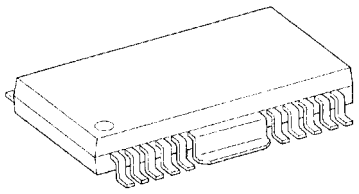
TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT MULTI-CHIP

TA84002F

PWM CHOPPER TYPE 2−PHASE BIPOLAR STEPPING MOTOR DRIVER

The TA84002F is designed to drive both windings of a two−phase bipolar setpping motor.



HSOP20-P-450-1.00

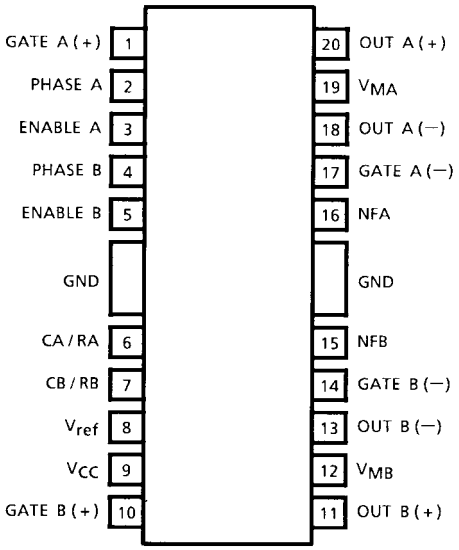
Weight : 0.79 g (Typ.)

FEATURES

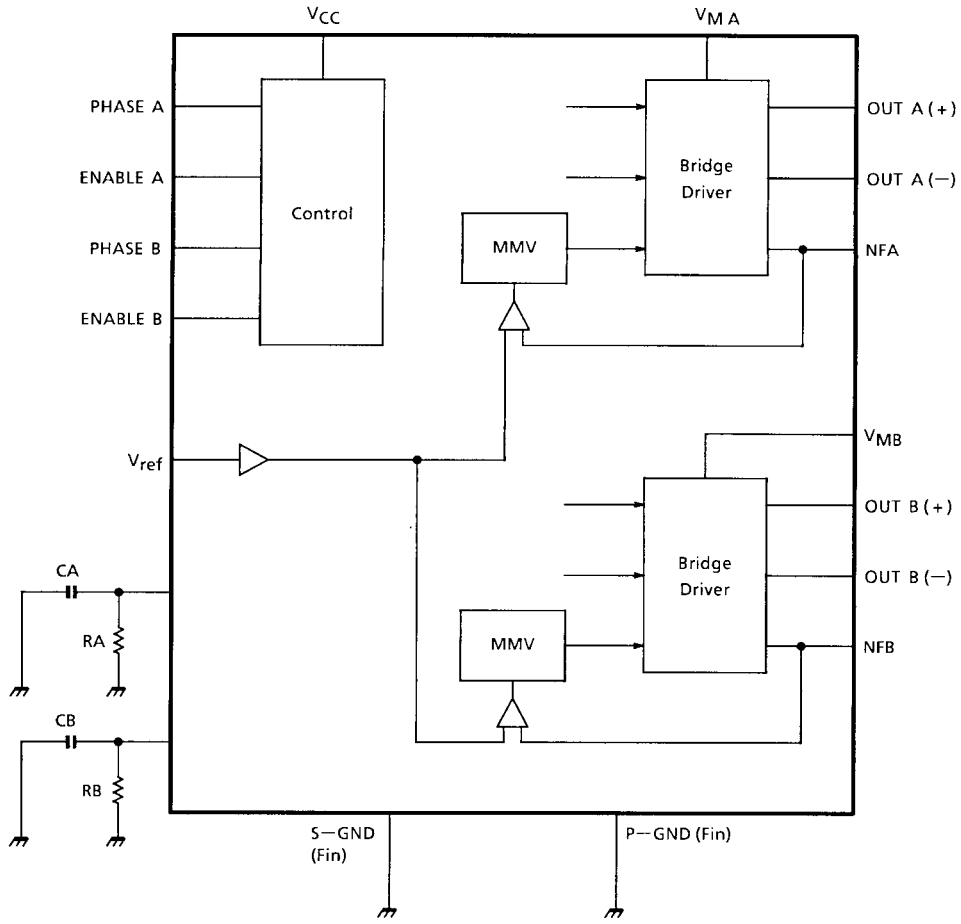
- Internal PWM current control
- Wide range of operating supply voltage
  V_M (motor) : 10 V to 30 V
  V_{CC} (control) : 4.5 V to 5.5 V
- Output current : 1.0 A (peak)
- Multichip IC consisting of four P−channel MOSFETs and one main chip.
- Full−step and half−step are available
- Internal thermal−shutdown circuit
- Package : HSOP20−P−450−1.00

Note1: This product has a multichip (MCP) structure utilizing Pch MOS technology. Take care when handling because Pch MOS has low electrostatic resistance.

PIN ASSIGNMENT



BLOCK DIAGRAM



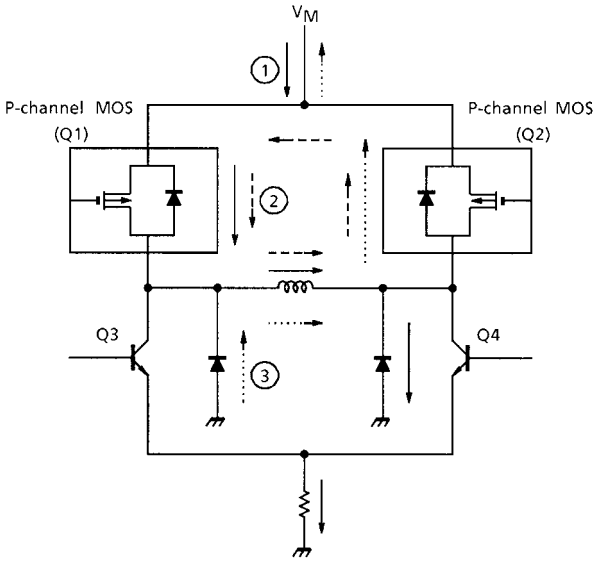
TRUTH TABLE

PHASE	ENABLE	OUT (+)	OUT (−)
X	H	OFF	OFF
H	L	H	L
L	L	L	H

X: Don't care

OUTPUT STAGE

- The TA84002F is Multichip IC consisting of four P−channel MOSFETs and one main chip.
- Four P−channel MOSETs are used as upper−side power transistors.
- Output current is controlled by swiching lower−side transistor.
- Durin CHOP ON, the current flows through P−channel MOS, The motor winding, sink transistor and sense resistor.
- During CHOP OFF, the current circulates the motor winding, P−channel MOS and the diode of P−channel MOS.
- Power dissipation is divided by the five chips.



⟶ : (1) CHOP ON

(Drive Mode)

Q1: ON, Q2: OFF

Q3: OFF, Q4: ON

- - → : (2) CHOP OFF

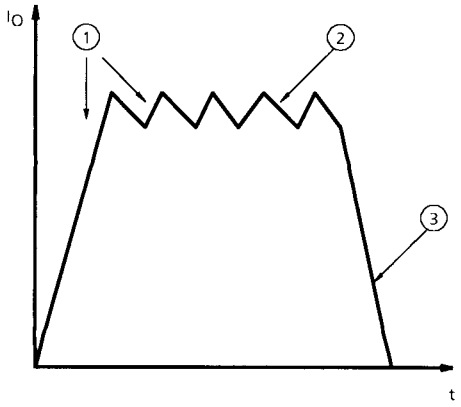
(Slow Decay)

Q1: ON, Q2: OFF

Q3: OFF, Q4: OFF

⋯→ : (3) ALL OFF

(Fast Decay)



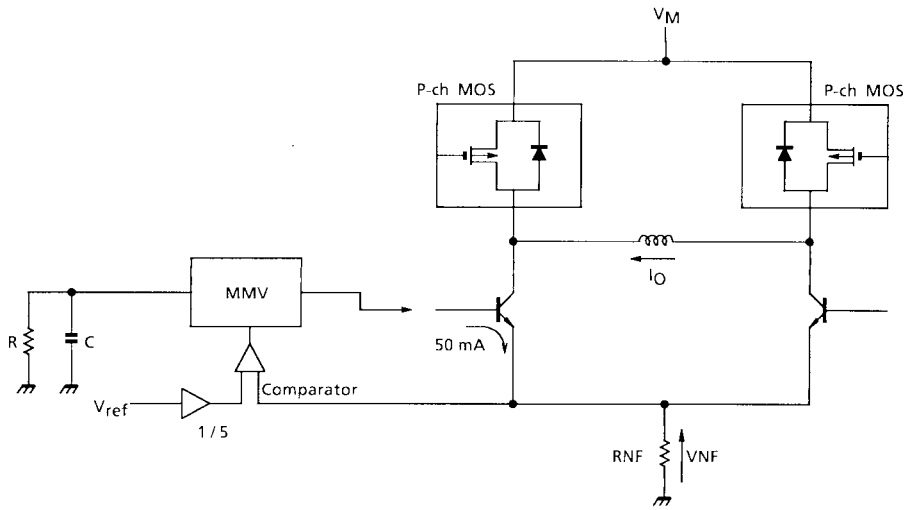
PWM CURRENT CONTROL

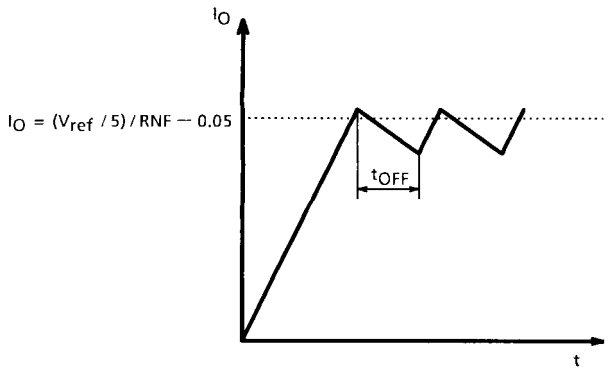
Output current is sensed and cotrolled independently in each bridge by an external sense resistor (RFN), internal comparator, and mono−stable multi−vibrator.
When the bridge is turn ON, current increases in the motor winding and flows through the external sense resistor until the sense voltage (VNF) reaches the level set at the comparator' s input: V_{ref} / 5
The comparator then triggers the mono−stable, which turn OFF the lower transistor of the bridge.
The OFF time is determined by the mono−stable' s external RC timing components.

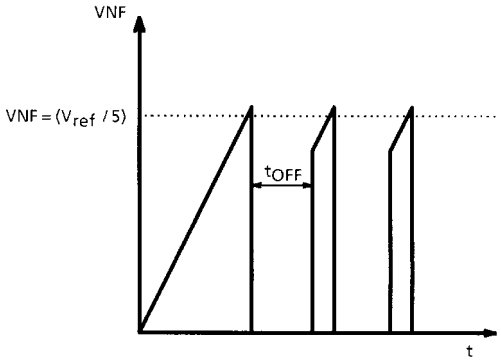
$t_{OFF} \approx 1.1$ CR

The value of the current limiting (I_O) is approximated by

$I_O = (V_{ref} / 5) / RNF - 0.05$

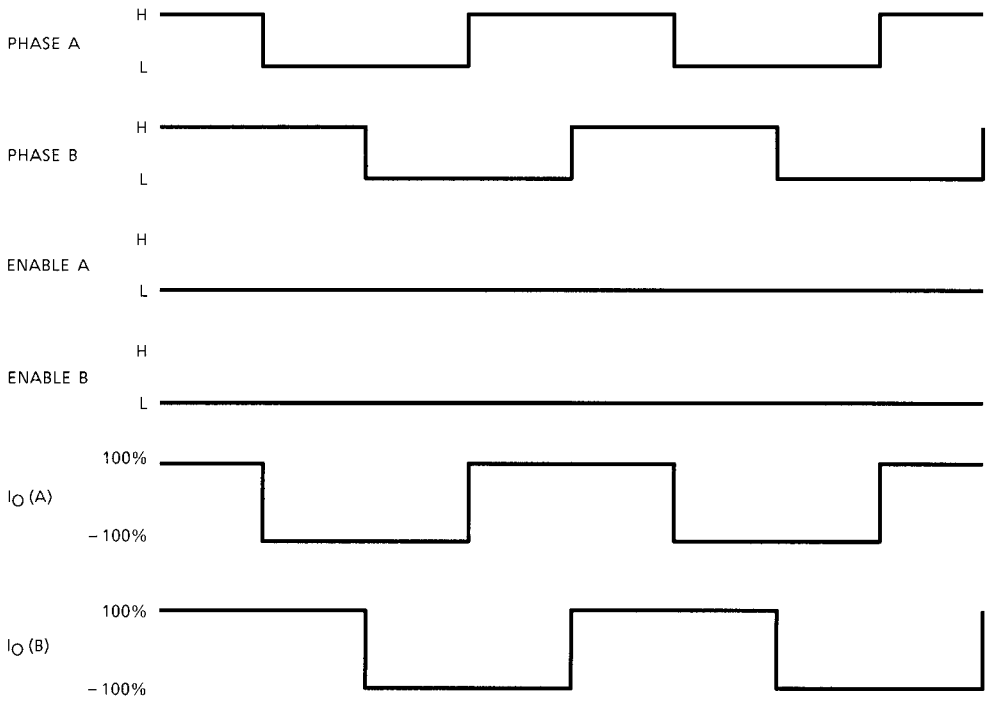




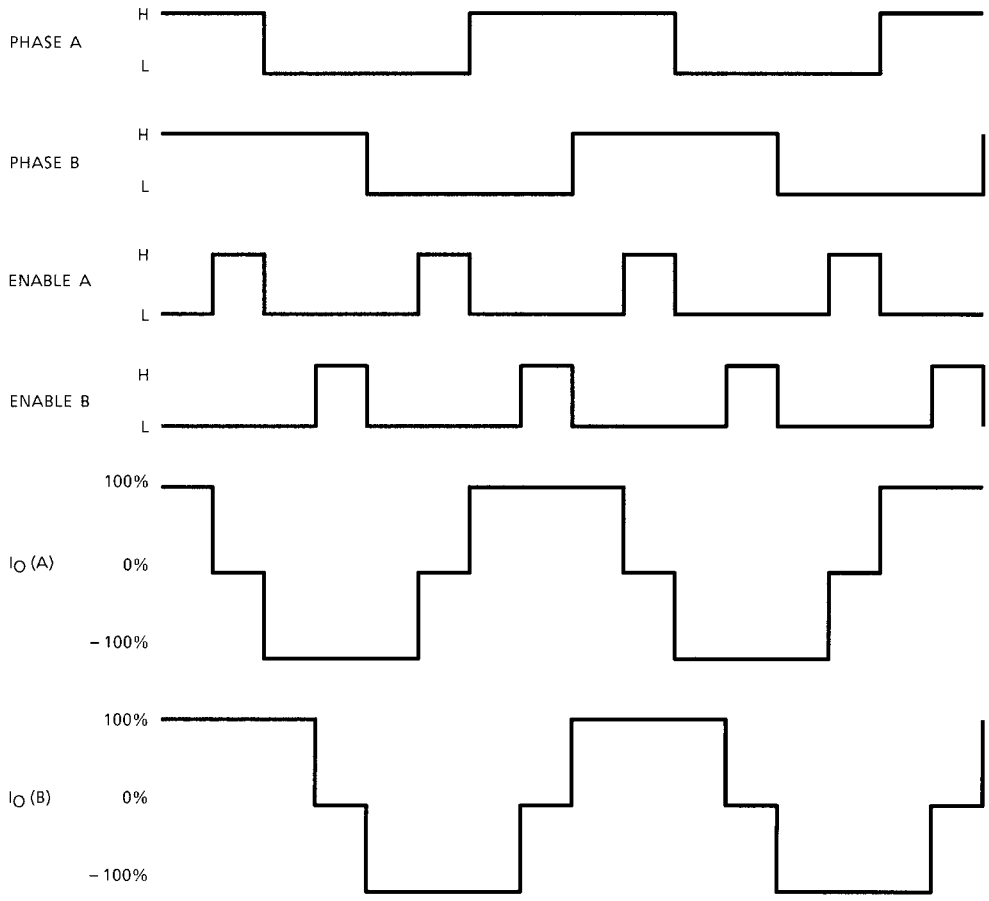


TIMING CHART

(1) Full Step



(2) Half Step


PHASE A
H
L
PHASE B
H
L
ENABLE A
H
L
ENABLE B
H
L
100%
I_O (A)
0%
– 100%
100%
I_O (B)
0%
– 100%

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage (Motor)	V_M	35	V
Supply Voltage (Control)	V_{CC}	7	V
Output Current	I_O	1.0	A / ch
Input Voltage	V_{IN}	GND − 0.4 to V_{CC} + 0.4 V	V
Power Dissipation	P_D	2.5 (Note)	W
Operating Temperature	T_{opr}	−30 to 85	°C
Storage Temperature	T_{stg}	−55 to 150	°C

Note: This rating is obtained by mounting on 50 × 50 × 1.6 mm PCB that occupied above 60% of copper.

RECOMMENDED OPERATION CONDITION (Ta = −30 to 85°C)

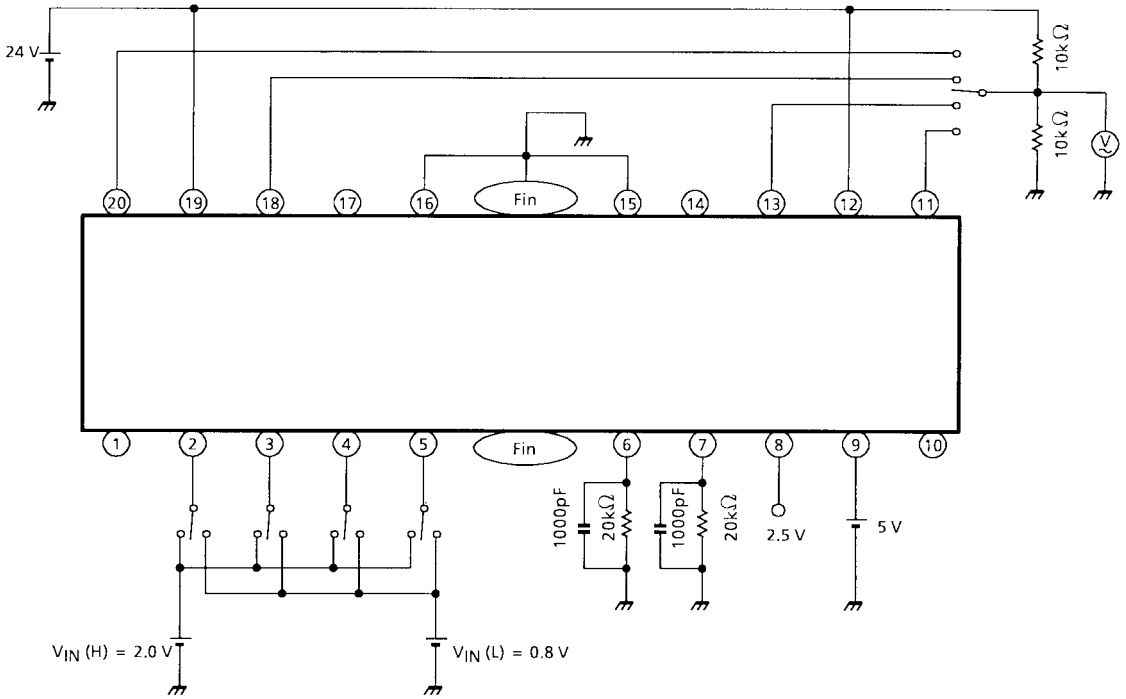
CHARACTERISTIC	SYMBOL	TEST CIR−CUIT	TEST CONDITION	MIN	TYP.	MAX	UNIT
Supply Voltage (Control)	V_{CC}	—		4.5	5.0	5.5	V
Supply Voltage (Motor)	V_M	—		10	24	30	V
Output Current	I_O	—		—	—	0.8	A / ch
Input Voltage	V_{IN}	—	PHASE, ENABLE	GND	—	V_{CC}	V
Reference Voltage	V_{ref}	—		1.2	2.5	V_{CC} − 0.5	V
PWM Frequency	f_{PWM}	—		15	30	50	kHz

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

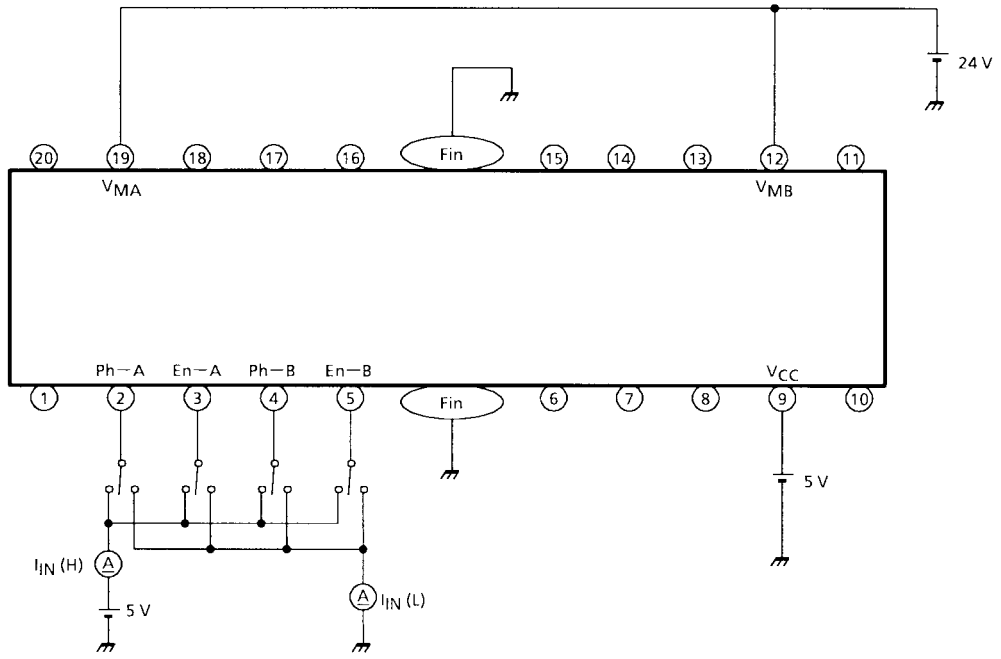
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN	TYP.	MAX	UNIT
Input Voltage	V_{IN}(H)	1	PHASE, ENABLE	2.0	—	V_{CC} + 0.3 V	V
	V_{IN}(L)			GND − 0.3 V	—	0.8	
Input Current	I_{IN}(H)	2	PHASE, ENABLE, V_{IN} = 5 V	—	2	20	μA
	I_{IN}(L)		PHASE, V_{IN} = GND	—	0	1	
	I_{IN}(L)		ENABLE, V_{IN} = GND	—	55	100	
Supply Current	I_{CC1}	3	ENABLE A / B = Low 2−Phase 100% ON	—	110	180	mA
	I_{CC2}	4	ENABLE A / B = Low 2−Phase 100% OFF	—	6	14	
	I_{CC3}	3	ENABLE A = Low, B = High 1−Phase 100% ON	—	55	90	
	I_{CC4}	4	ENABLE A = Low, B = High 1−Phase 100% OFF	—	6	14	
	I_{CC5}	3	ENABLE A / B = High 2−Phase OFF	—	6	14	
	IM1	5	ENABLE A / B = Low 2−Phase ON	—	5	13	
	IM2		ENABLE A = Low, B = High 1−Phase ON	—	4.5	11	
	IM3		ENABLE A / B = High 2−Phase OFF	—	4	9	
Output Saturation Voltage (Lower−side)	V_{SAT}1	6	I_O = 0.5 A	—	0.35	0.8	V
	V_{SAT}2		I_O = 1.0 A	—	0.65	2.0	
ON Resistor (Upper−side)	Ron1	7	I_O = 0.5 A	—	0.6	1.0	Ω
Diode Forward Voltage (Lower−side)	VF(L)	8	I_F = 1.0 A	—	1.4	2.0	V
Diode Forward Voltage (Upper−side)	VF(H)	9	I_F = 1.0 A	—	0.95	1.8	V
Reference Voltage Range	V_{ref}	—		1.0	2.5	V_{CC} − 0.5	V
Reference Current	I_{ref}	10	V_{ref} = 2.5 V	—	0.2	5	μA
Reference Divider Ratio	GAIN	11	VNF / Vref	0.17	0.2	0.23	
Setting Current	I_{set}	—	V_{ref} = 2.5 V, RNF = 1 Ω	0.35	0.45	0.55	A
Thermal Shutdown Temperature	TSD	—	T_j	—	165	—	°C
Thermal Shutdown Hysteriesis	ΔT	—		—	15	—	°C
Output Leakage Current	IL (H)	12	P−channel MOS	—	0	100	μA
	IL (L)			—	0	50	
Pch MOS Drive Current	I_G	13		330	530	730	μA

TEST CIRCUIT

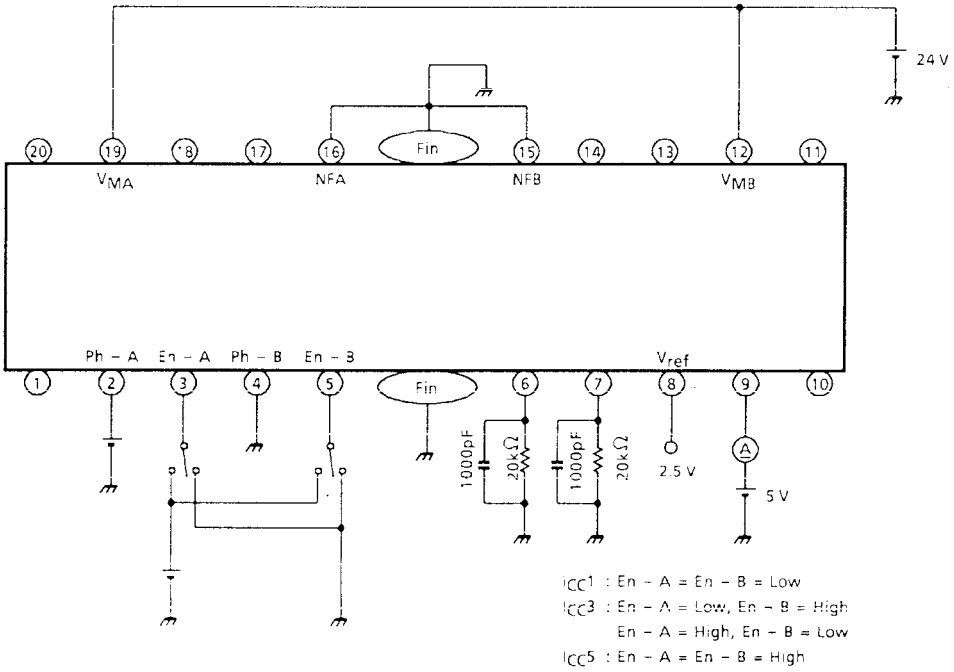
1. V_{IN} (H), V_{IN} (L)



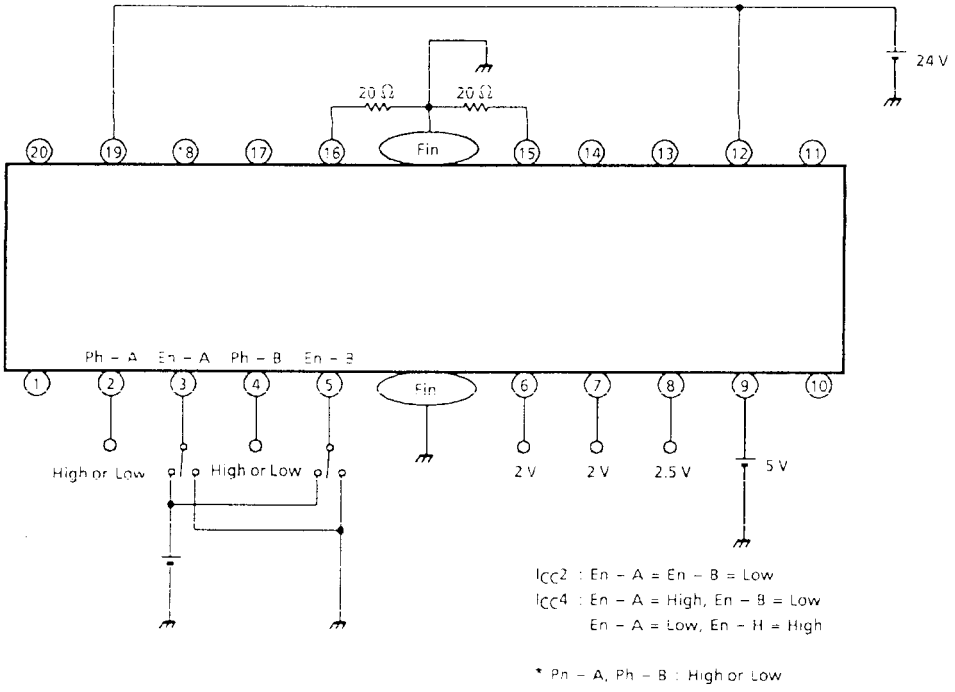
2. I_{IN} (H), I_{IN} (L)



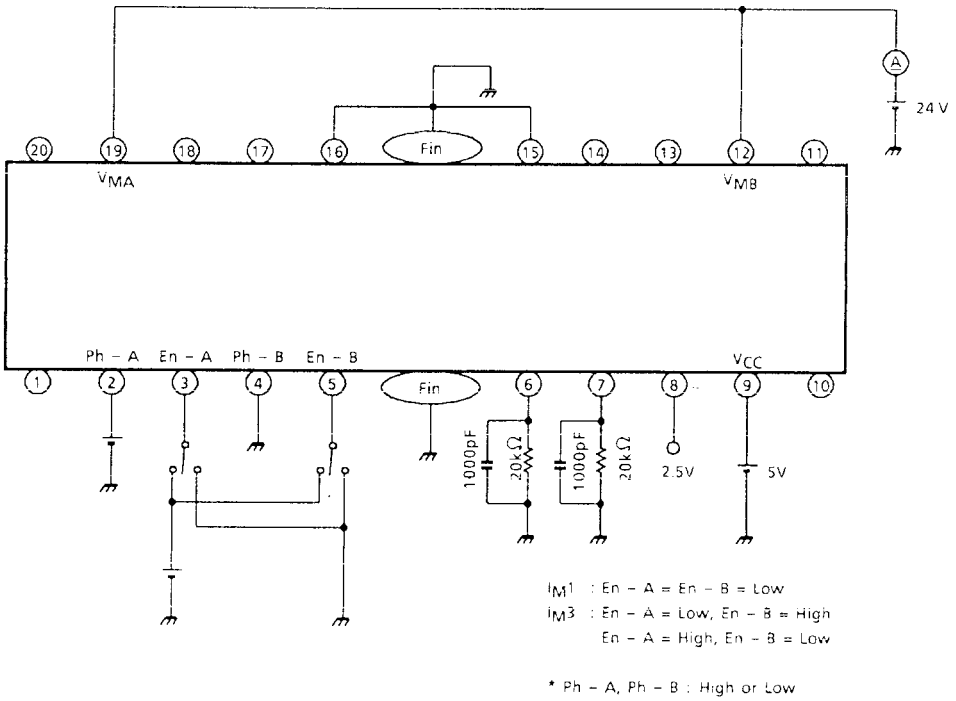
3. $I_{CC}1$, $I_{CC}3$, $I_{CC}5$



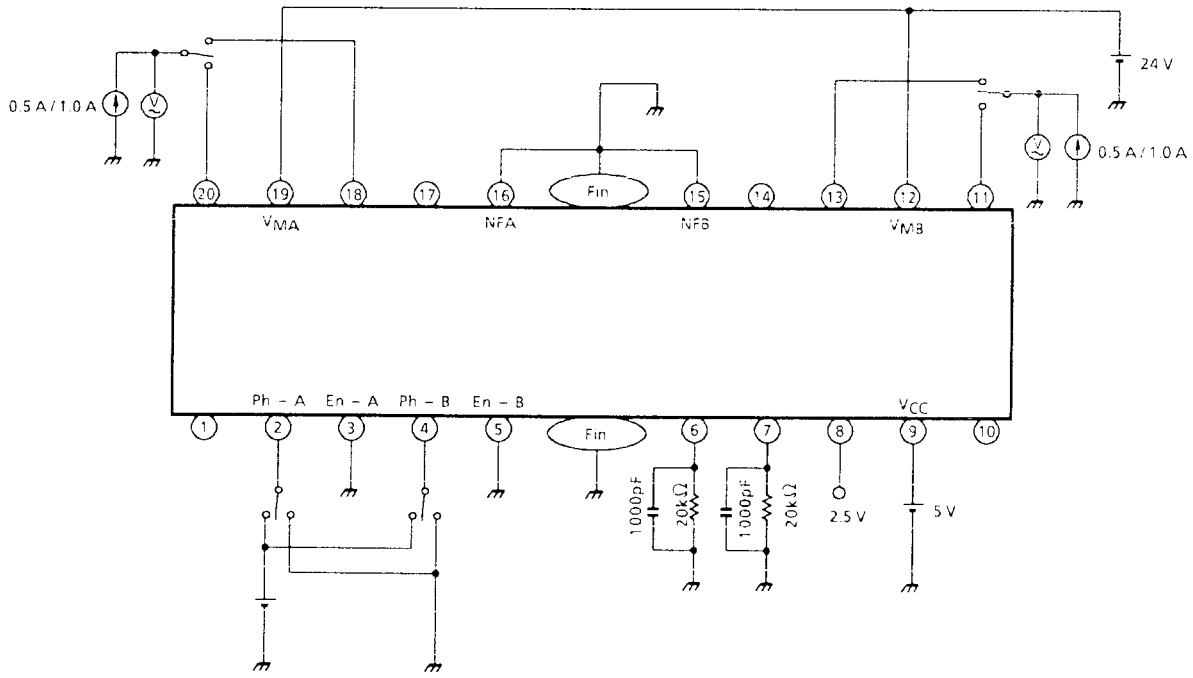
4. $I_{CC}2$, $I_{CC}4$



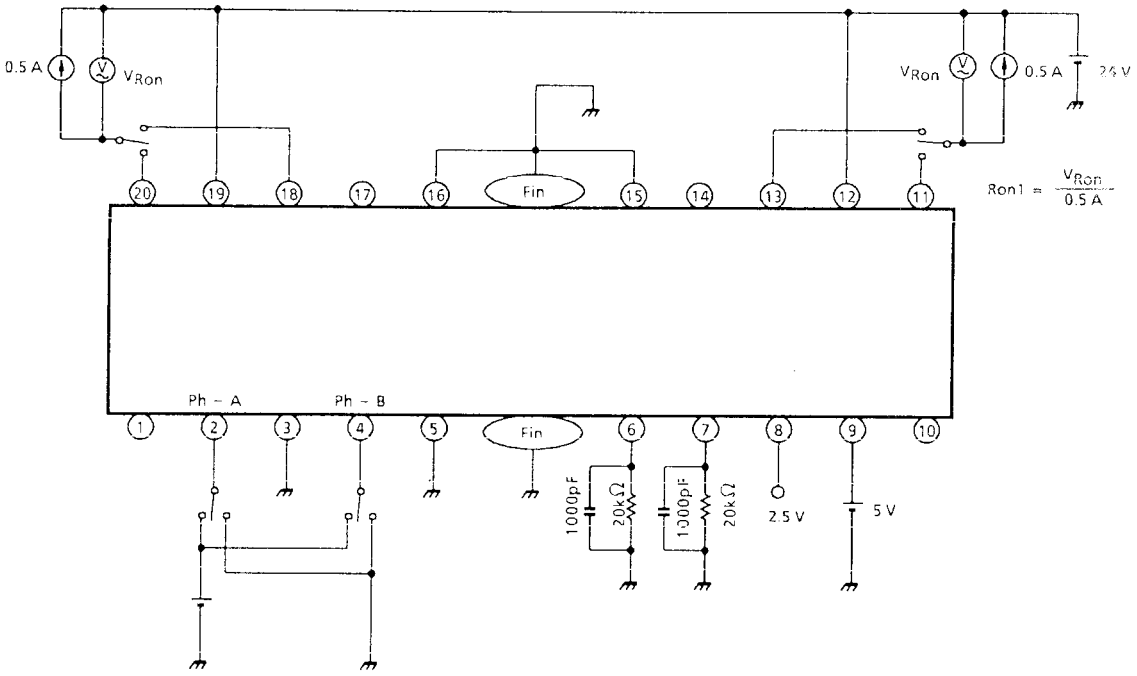
5. I_M1, I_M2, I_M3



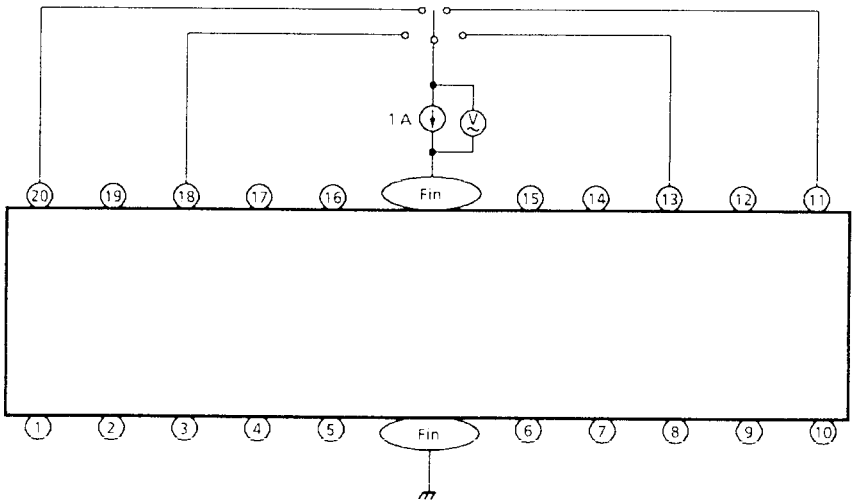
6. $V_{SAT}1$, $V_{SAT}2$



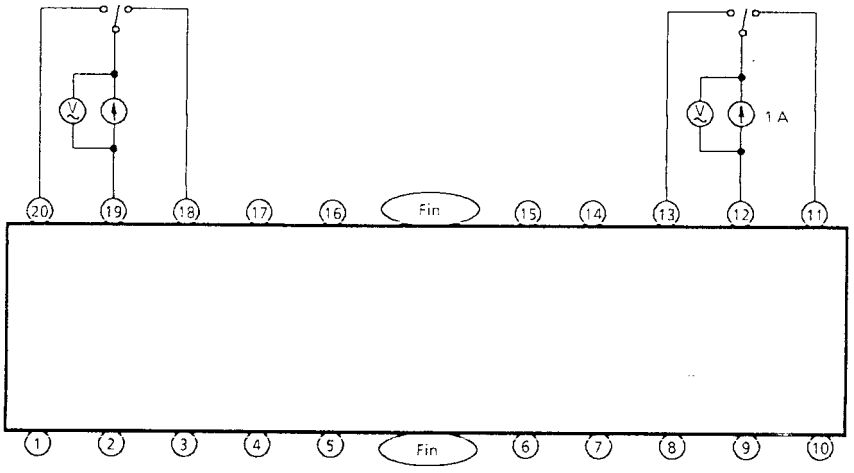
7. $R_{on}1$


0.5 A
VRon
VRon
0.5 A
24 V
Ron1 = VRon / 0.5 A
Fin
Ph – A
Ph – B
Fin
1000pF
20kΩ
1000pF
20kΩ
2.5 V
5 V

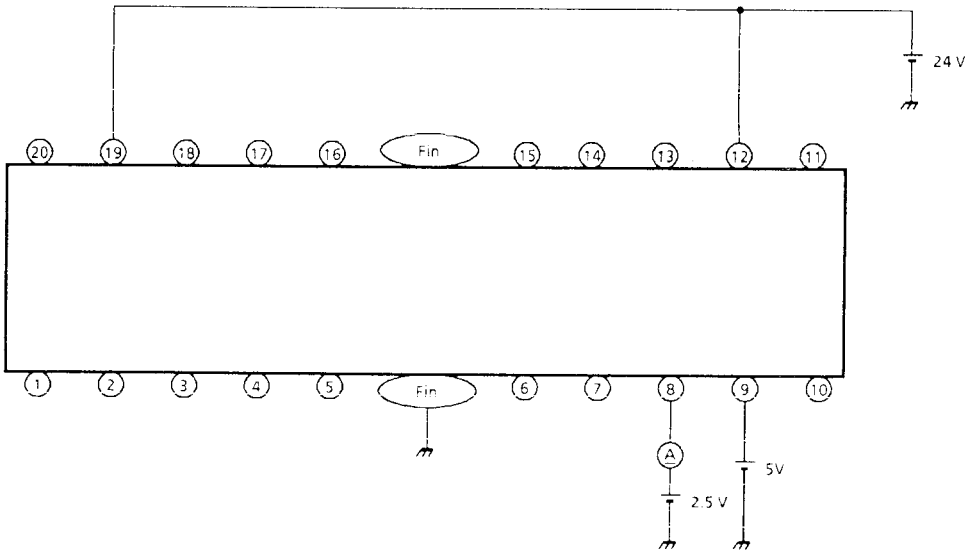
8. VF (L)


1 A
Fin
Fin

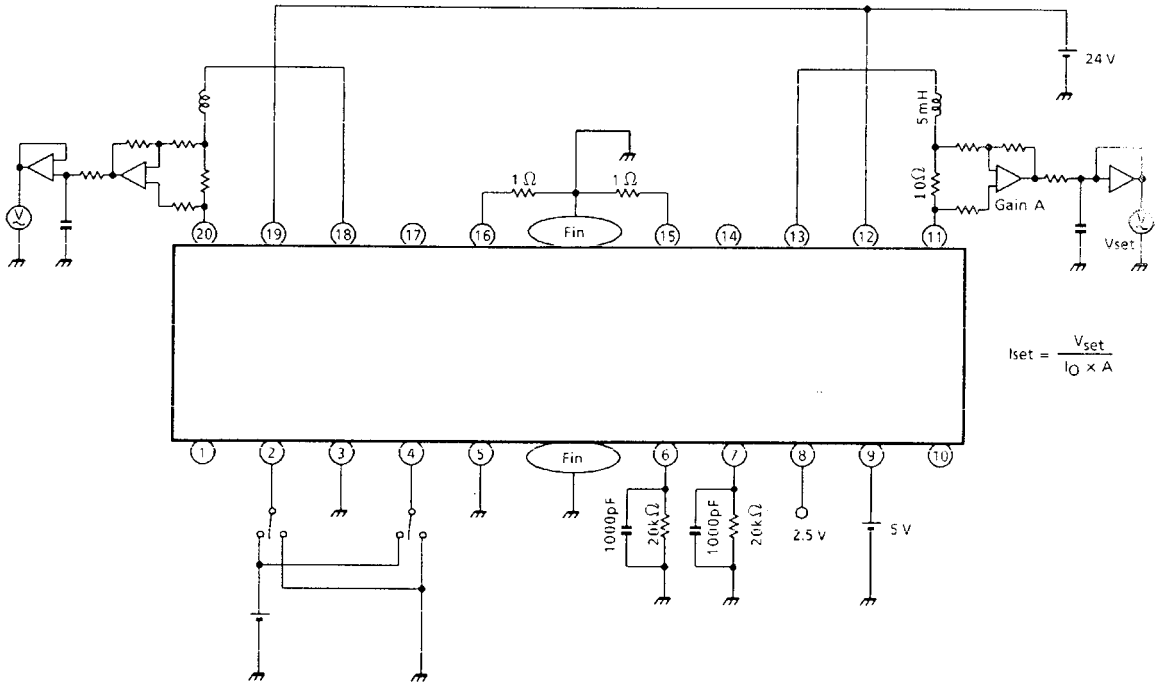
9. VF (H)



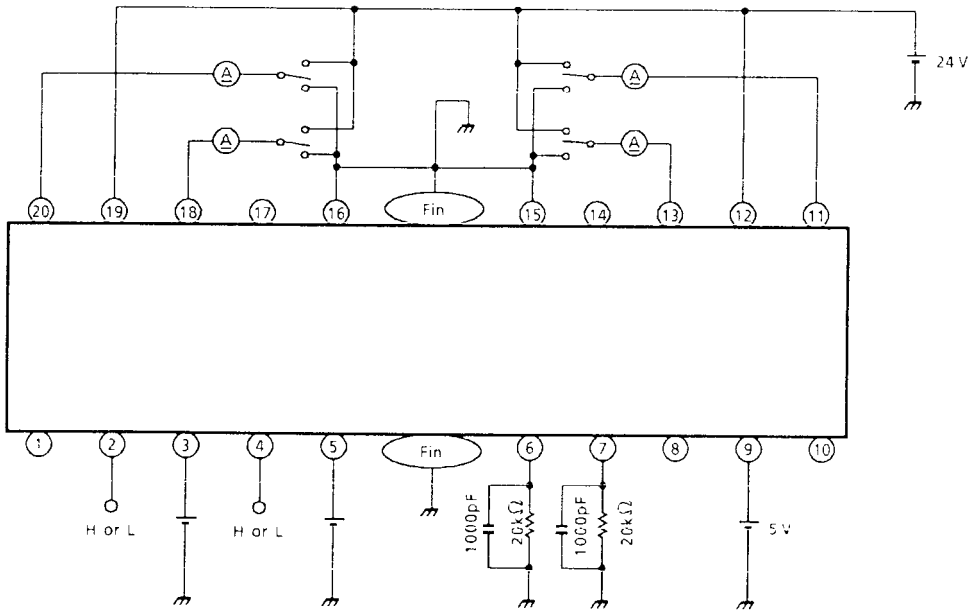
10. I_{ref}



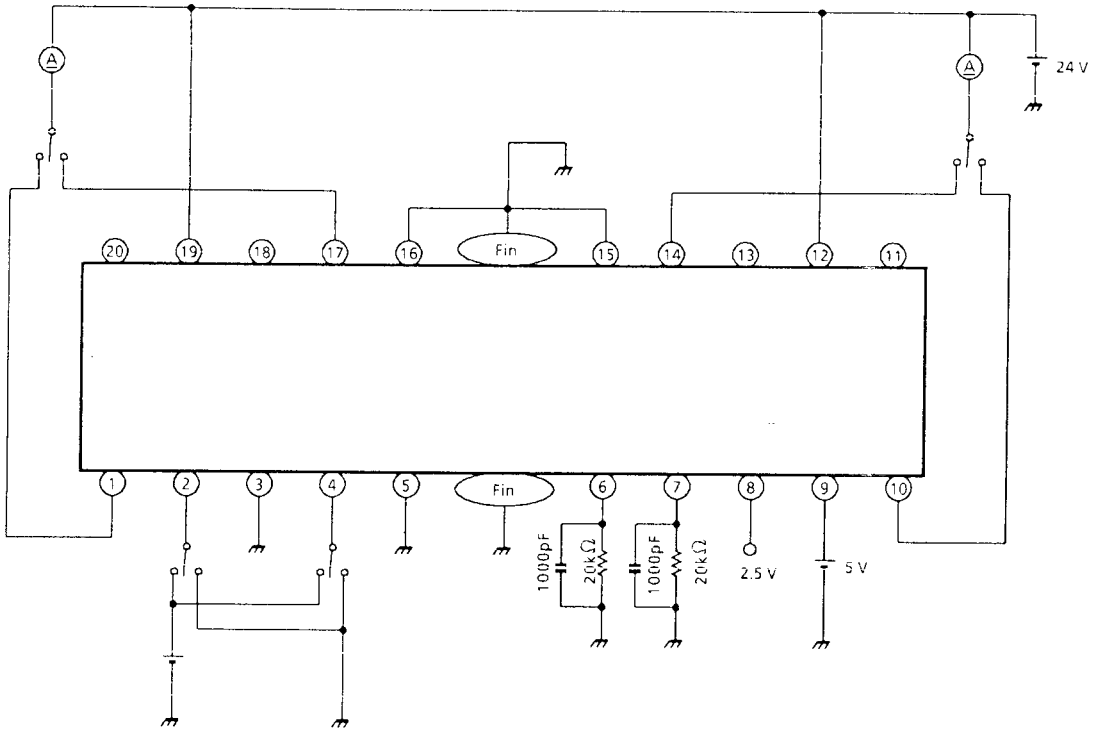
11. I_{set}



12. I_L (H), I_L (L)

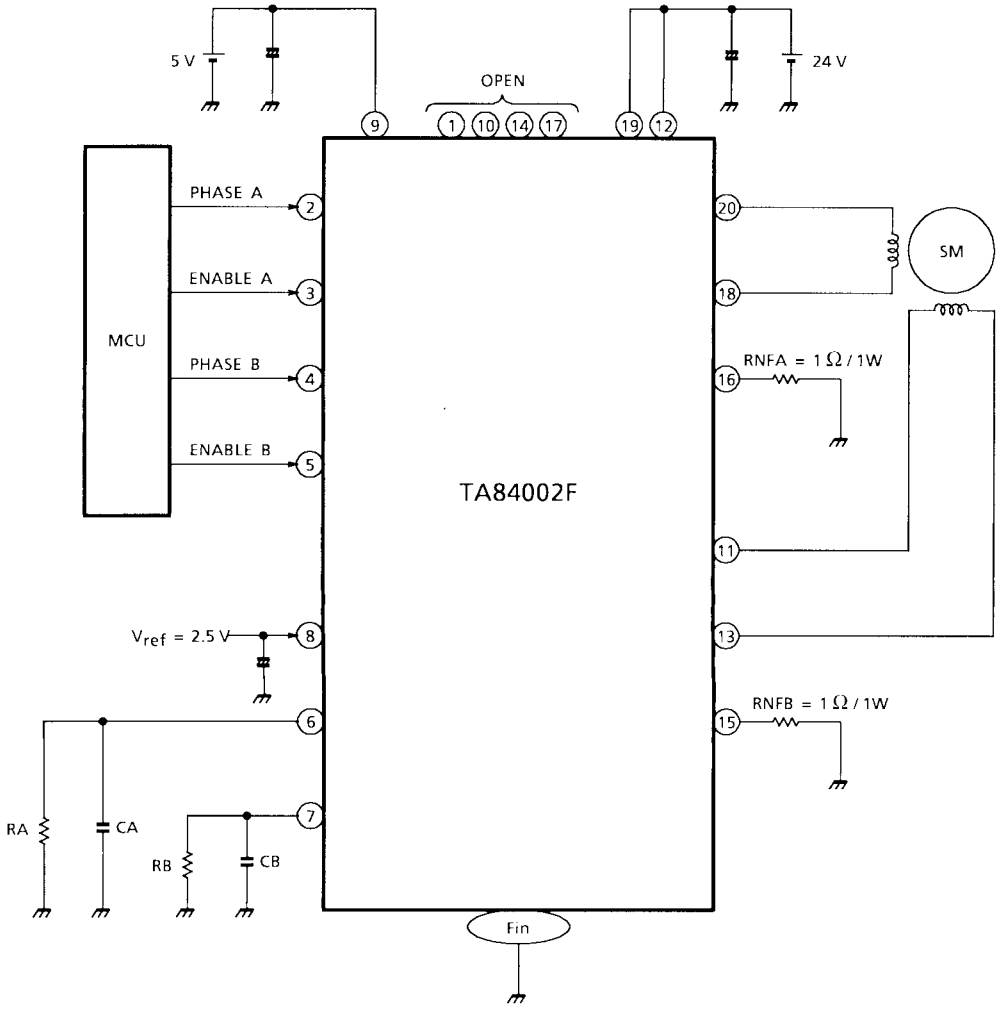


13. I_G


A
A
24 V
20
19
18
17
16
Fin
15
14
13
12
11
1
2
3
4
5
Fin
6
7
8
9
10
1000pF
20kΩ
1000pF
20kΩ
2.5 V
5 V

APPLICATION CIRCUIT

In case of I_{OUT} = 0.5 A

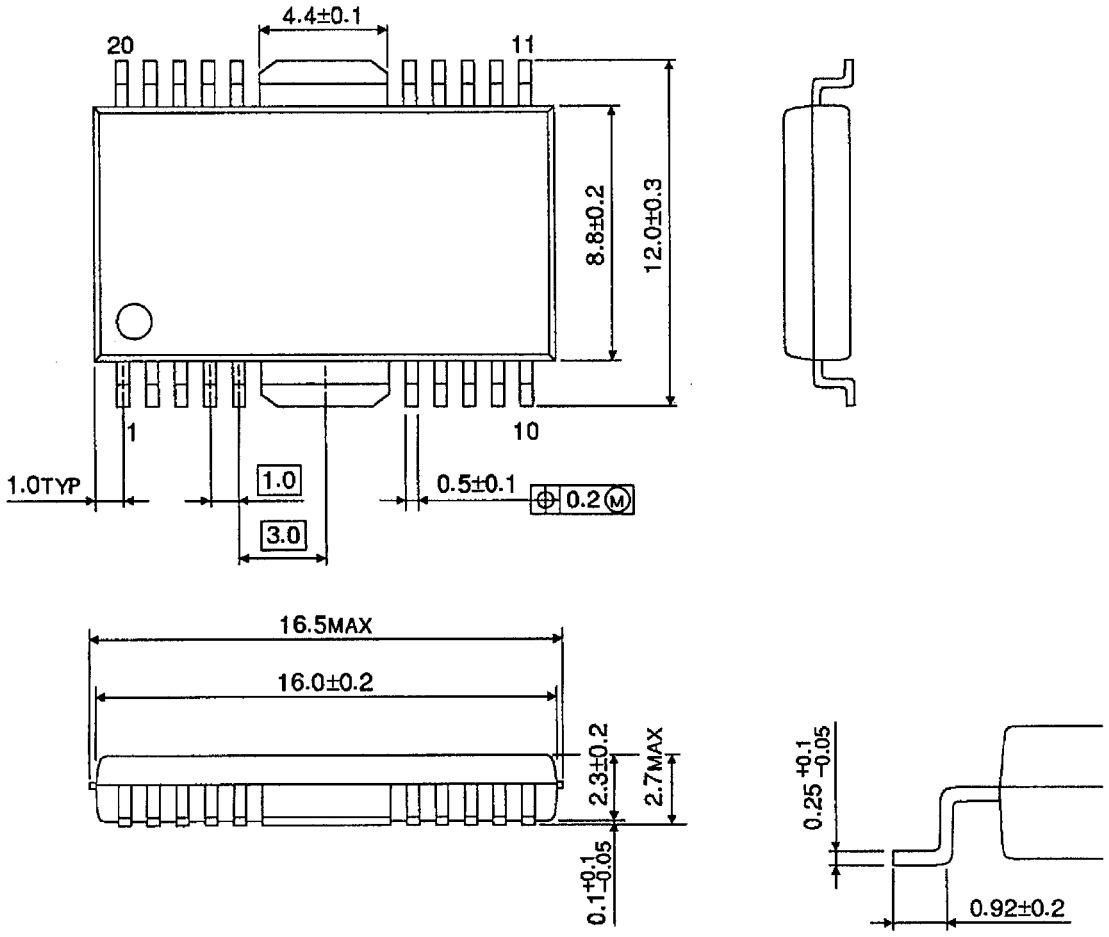


Note 1: Capacitor for noise suppression to be connected between the Power Supply (V_{CC}, V_M, V_{ref}) and GND to stabilize the operation.

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.

PACKAGE DIMENSIONS

HSOP20−P−450−1.00 Unit : mm



Weight : 0.79 g (Typ.)

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000707EBA

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