

TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT MULTI-CHIP

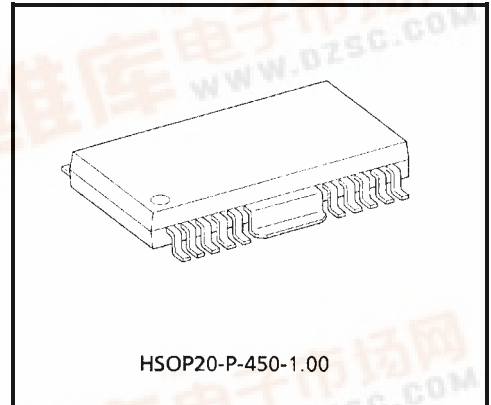
TA84002F

PWM CHOPPER TYPE 2-PHASE BIPOLAR STEPPING MOTOR DRIVER

The TA84002F is designed to drive both windings of a two-phase bipolar stepping motor.

FEATURES

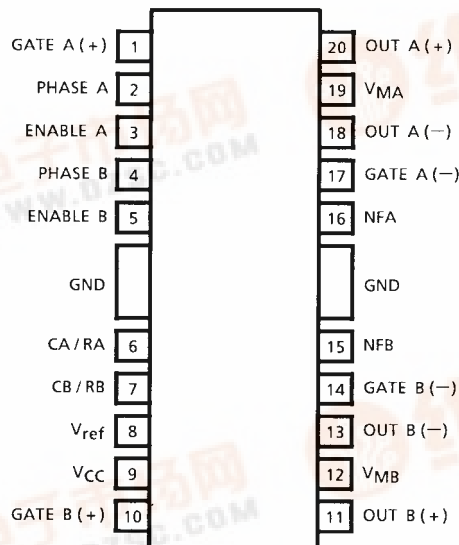
- Internal PWM current control
- Wide range of operating supply voltage
 VM (motor) : 10 V to 30 V
 VCC (control) : 4.5 V to 5.5 V
- Output current : 1.0 A (peak)
- Multichip IC consisting of four P-channel MOSFETs and one main chip.
- Full-step and half-step are available
- Internal thermal-shutdown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



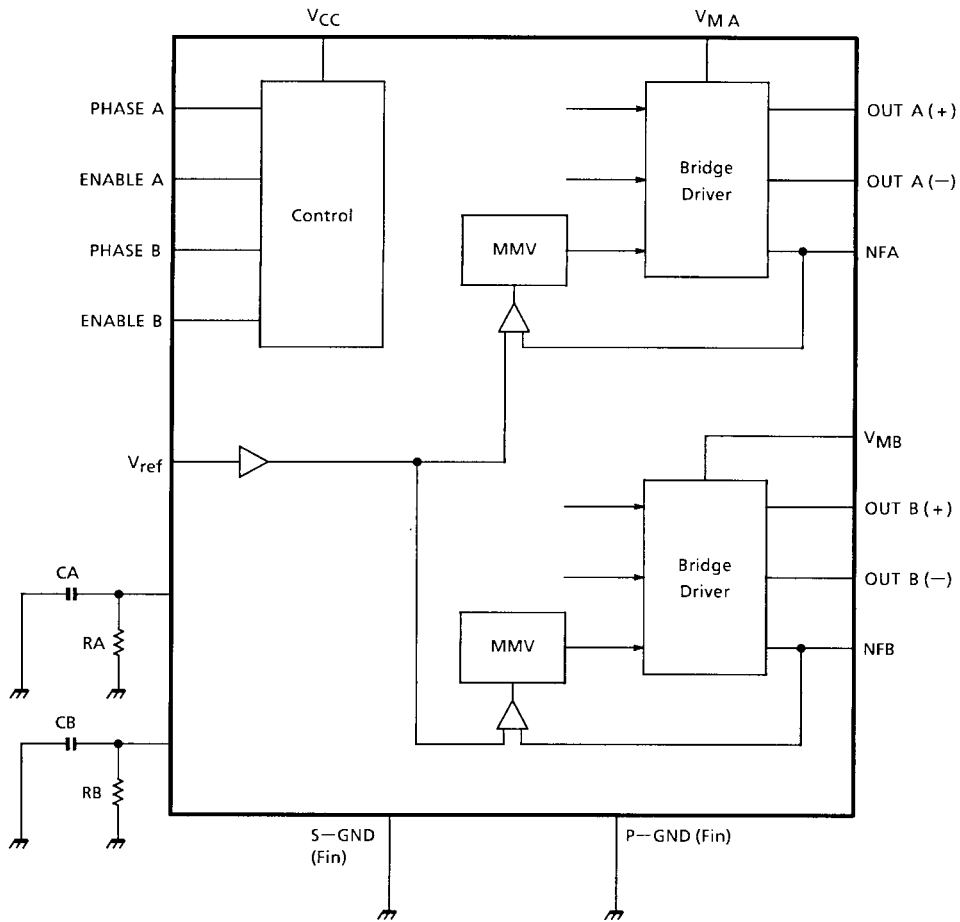
Weight : 0.79 g (Typ.)

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



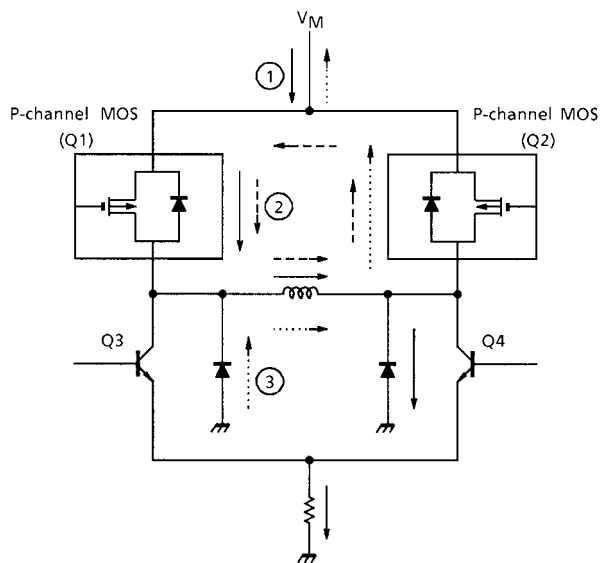
TRUTH TABLE

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 MOSFETs are used as upper-side power transistors.
- Output current is controlled by switching lower-side transistor.
- During 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

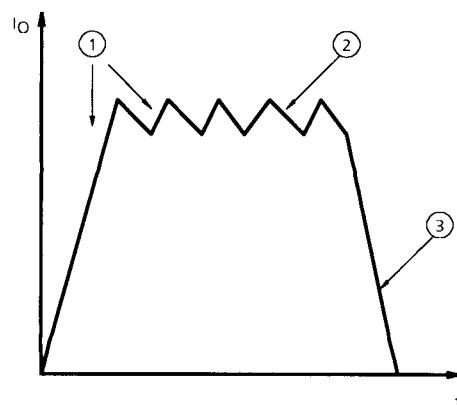
(Slow Decay)

Q1: ON, Q2: OFF

Q3: OFF, Q4: OFF

.....→ : (3) ALL OFF

(Fast Decay)



PWM CURRENT CONTROL

Output current is sensed and controlled independently in each bridge by an external sense resistor (RNF), 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: $V_{ref} / 5$

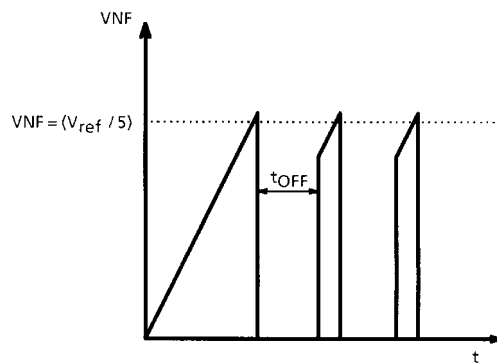
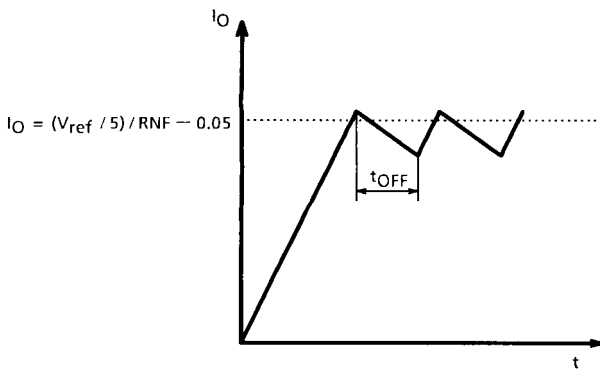
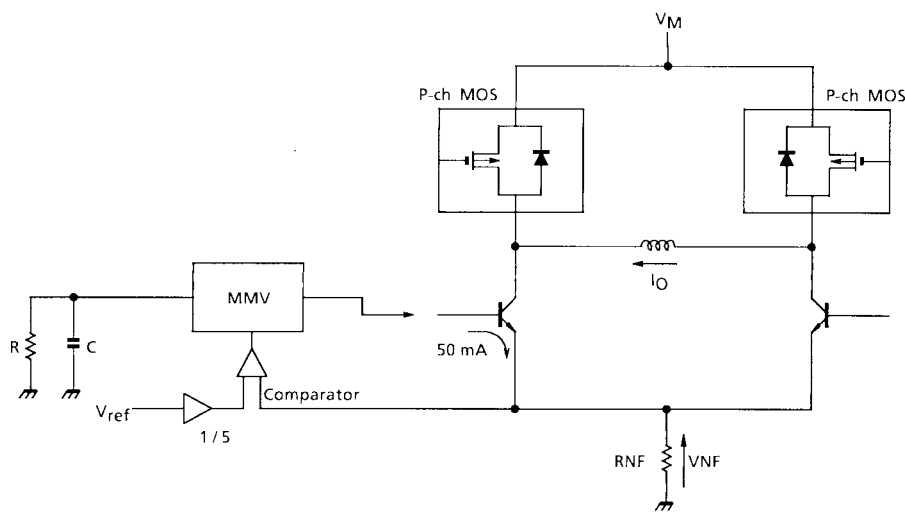
The comparator then triggers the mono-stable, which turn OFF the lower transistor of the bridge.

The OFF time is determined by the mono-stable's external RC timing components.

$$t_{OFF} \approx 1.1 CR$$

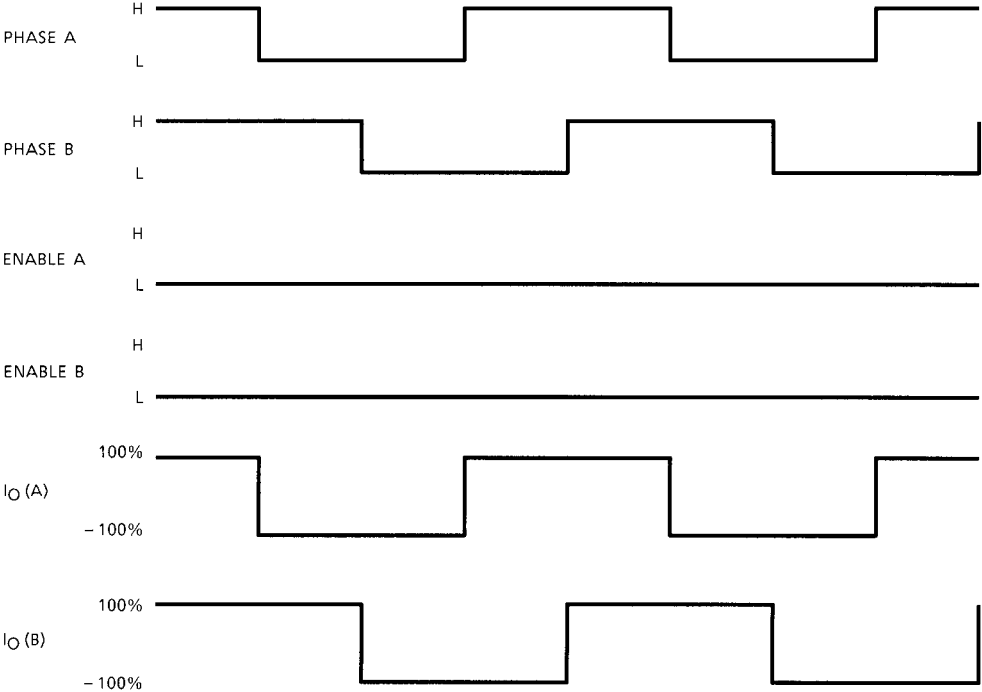
The value of the current limiting (I_O) is approximated by

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

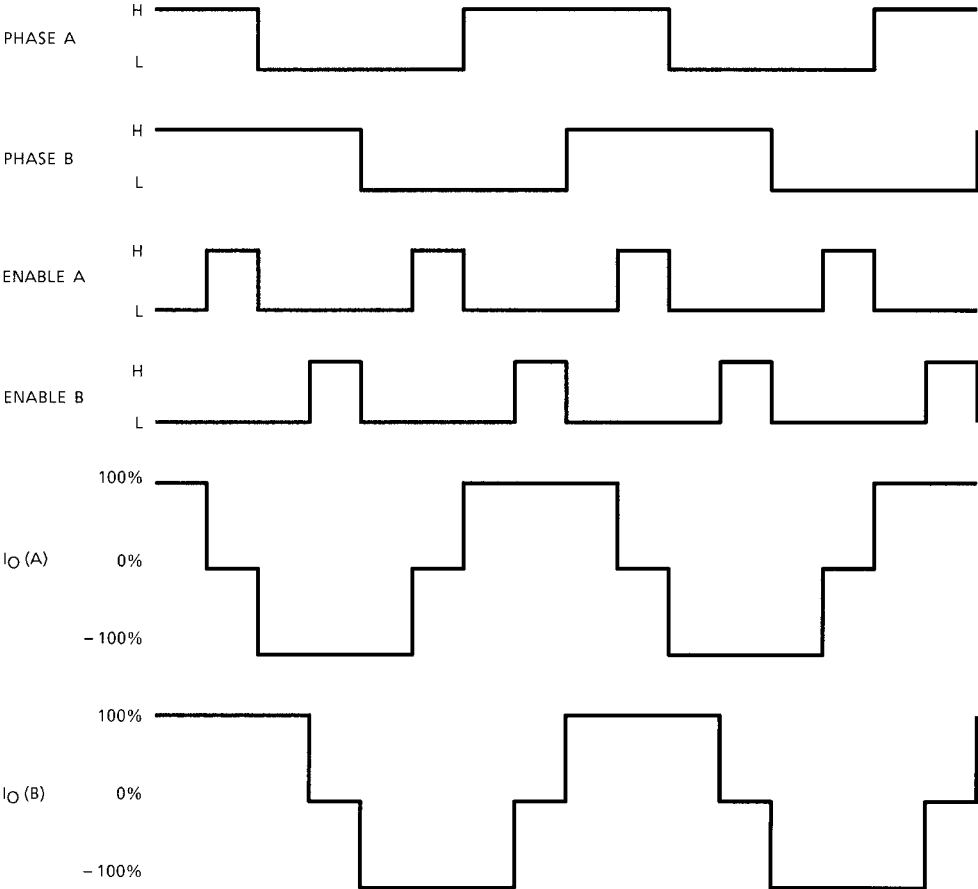


TIMING CHART

(1) Full Step



(2) Half Step



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)

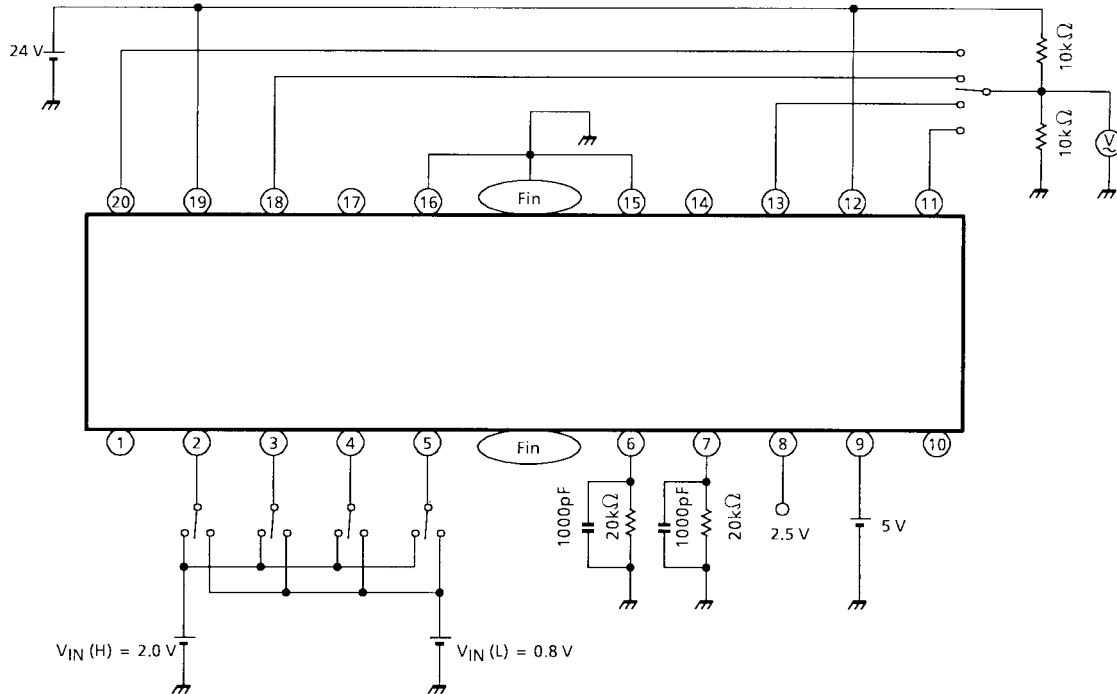
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN	TYP.	MAX	UNIT
Supply Voltage (Control)	V _{CC}	—		4.5	5.0	5.5	V
Supply Voltage (Motor)	V _M	—		10	24	30	V
Output Current	I _O	—		—	—	0.8	A / ch
Input Voltage	V _{IN}	—	PHASE, ENABLE	GND	—	V _{CC}	V
Reference Voltage	V _{ref}	—		1.2	2.5	V _{CC} -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

ELECTRICAL CHARACTERISTICS (Ta = 25°C, VCC = 5 V, VM = 24 V)

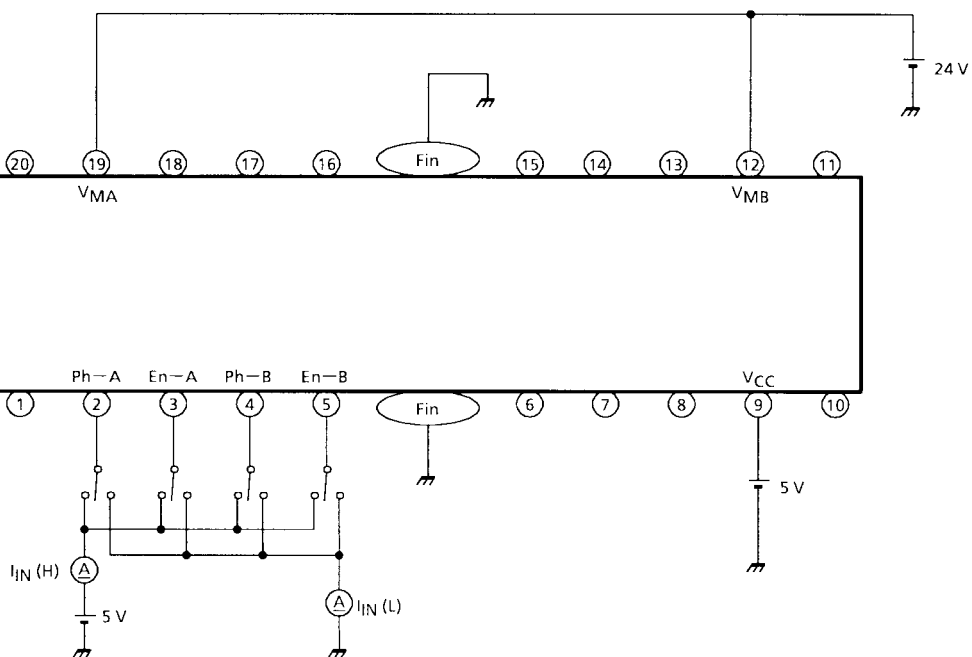
CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN	TYP.	MAX	UNIT
Input Voltage	V _{IN(H)}	1	PHASE, ENABLE	2.0	—	V _{CC} + 0.3 V	V
	V _{IN(L)}			GND - 0.3 V	—	0.8	
Input Current	I _{IN(H)}	2	PHASE, ENABLE, V _{IN} = 5 V	—	2	20	μA
	I _{IN(L)}		PHASE, V _{IN} = GND	—	0	1	
	I _{IN(L)}		ENABLE, V _{IN} = 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	
	I _{M1}	5	ENABLE A / B = Low 2-Phase ON	—	5	13	
	I _{M2}		ENABLE A = Low, B = High 1-Phase ON	—	4.5	11	
I _{M3}	ENABLE A / B = High 2-Phase OFF		—	4	9		
Output Saturation Voltage (Lower-side)	V _{SAT1}	6	I _O = 0.5 A	—	0.35	0.8	V
	V _{SAT2}		I _O = 1.0 A	—	0.65	2.0	
ON Resistor (Upper-side)	R _{on1}	7	I _O = 0.5 A	—	0.6	1.0	Ω
Diode Forward Voltage (Lower-side)	V _{F(L)}	8	I _F = 1.0 A	—	1.4	2.0	V
Diode Forward Voltage (Upper-side)	V _{F(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	V _{NF} / V _{ref}	0.17	0.2	0.23	
Setting Current	I _{set}	—	V _{ref} = 2.5 V, R _{NF} = 1 Ω	0.35	0.45	0.55	A
Thermal Shutdown Temperature	TSD	—	T _j	—	165	—	°C
Thermal Shutdown Hysteresis	ΔT	—		—	15	—	°C
Output Leakage Current	I _{L (H)}	12	P-channel MOS	—	0	100	μA
	I _{L (L)}			—	0	50	
Pch MOS Drive Current	I _G	13		330	530	730	μA

TEST CIRCUIT

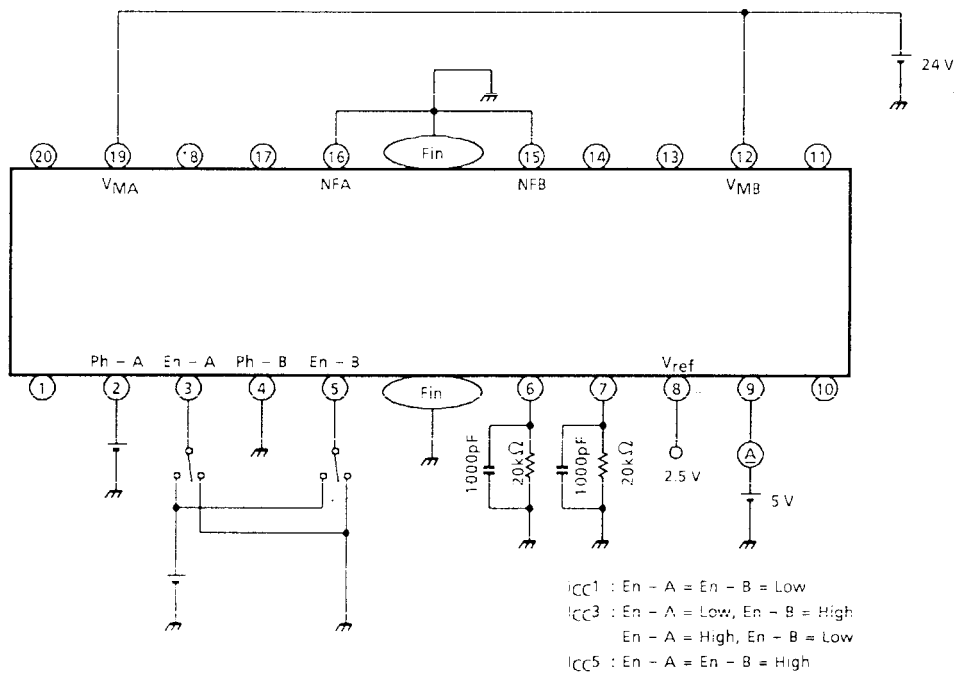
1. $V_{IN} (H), V_{IN} (L)$



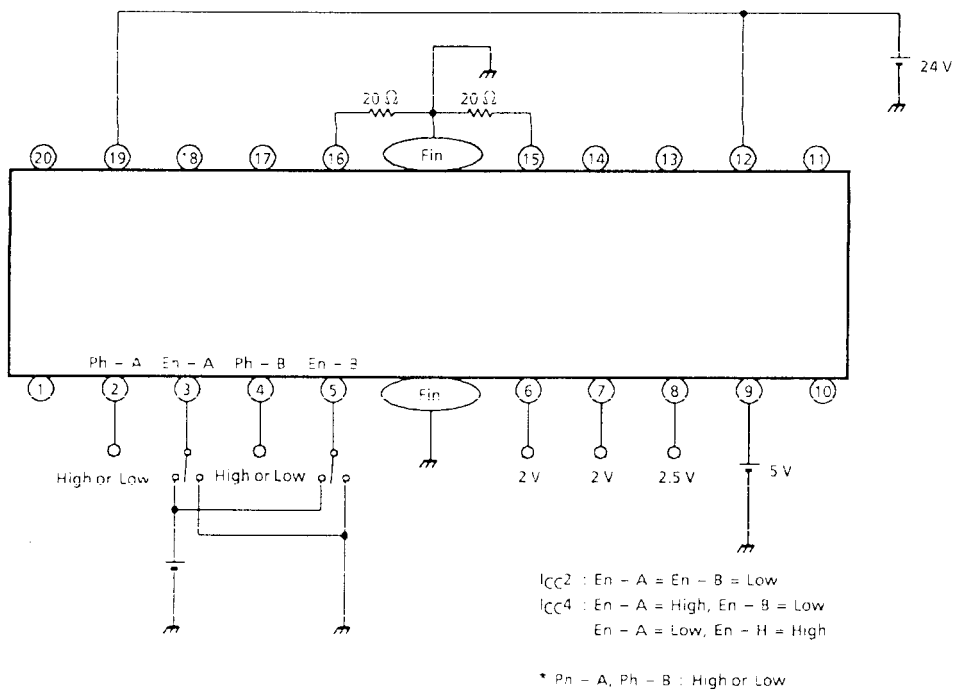
2. $I_{IN} (H), I_{IN} (L)$



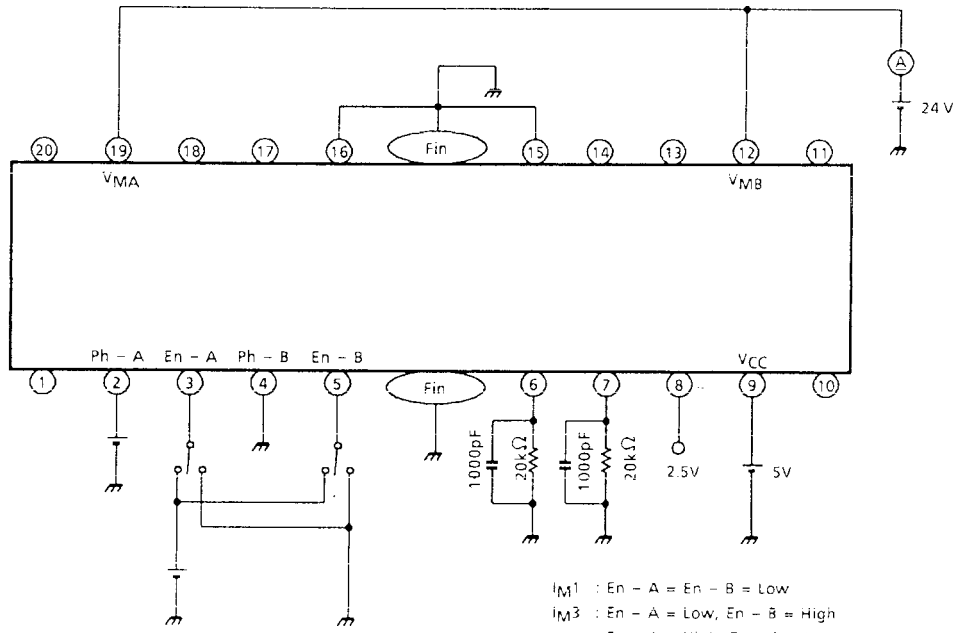
3. Icc1, Icc3, Icc5



4. Icc2, Icc4

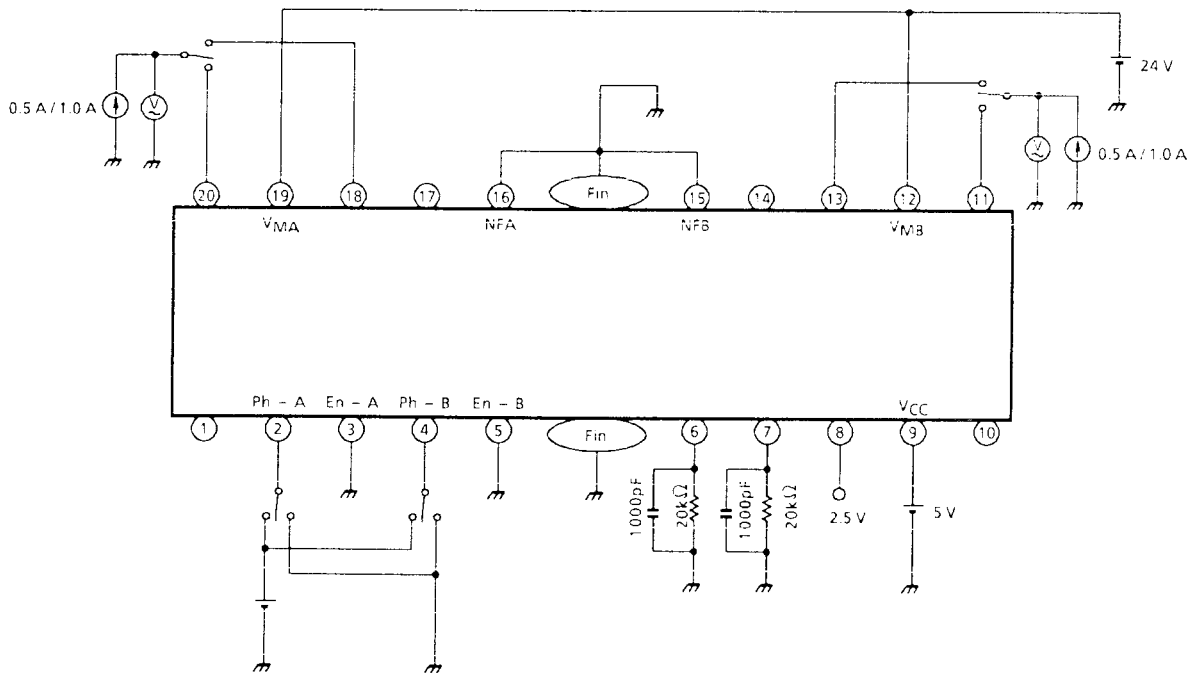


5. I_{M1}, I_{M2}, I_{M3}

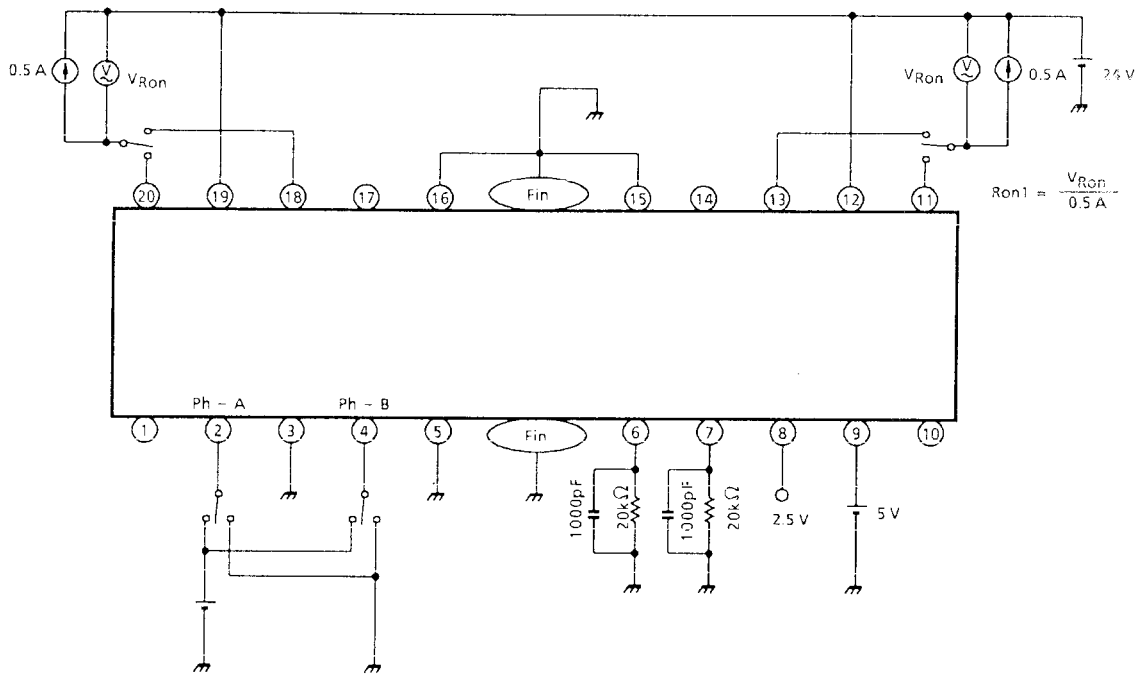


* Ph - A, Ph - B : High or Low

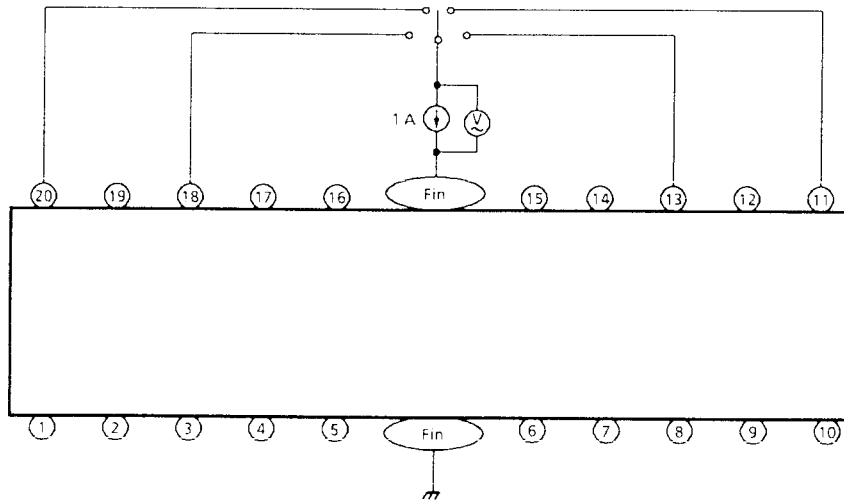
6. V_{SAT1}, V_{SAT2}



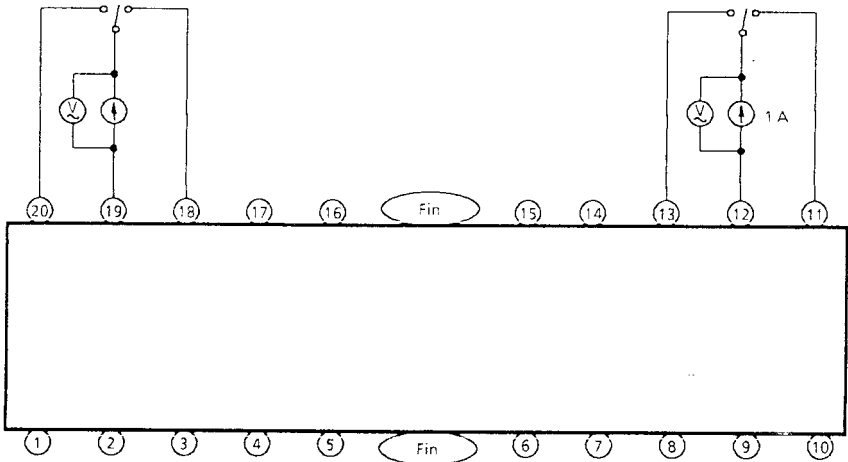
7. Ron1



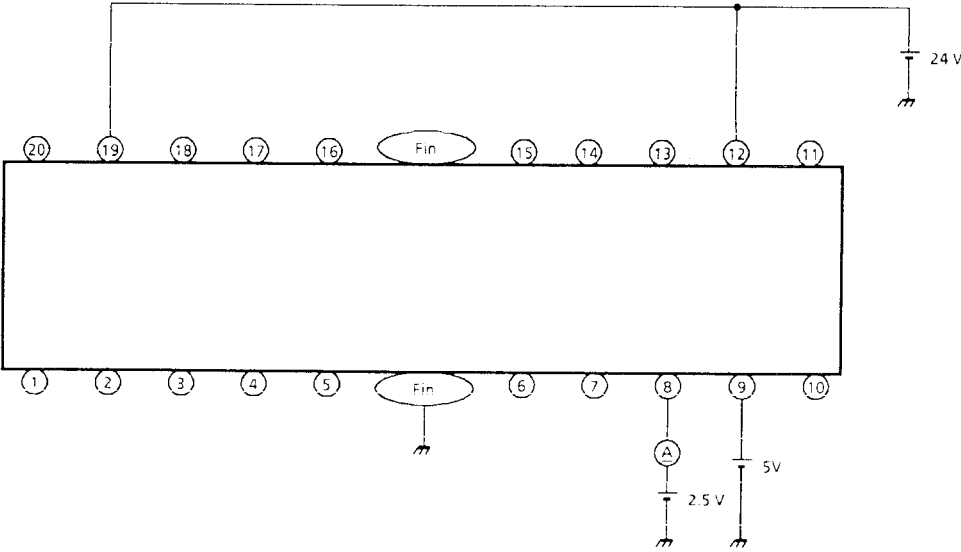
8. VF (L)



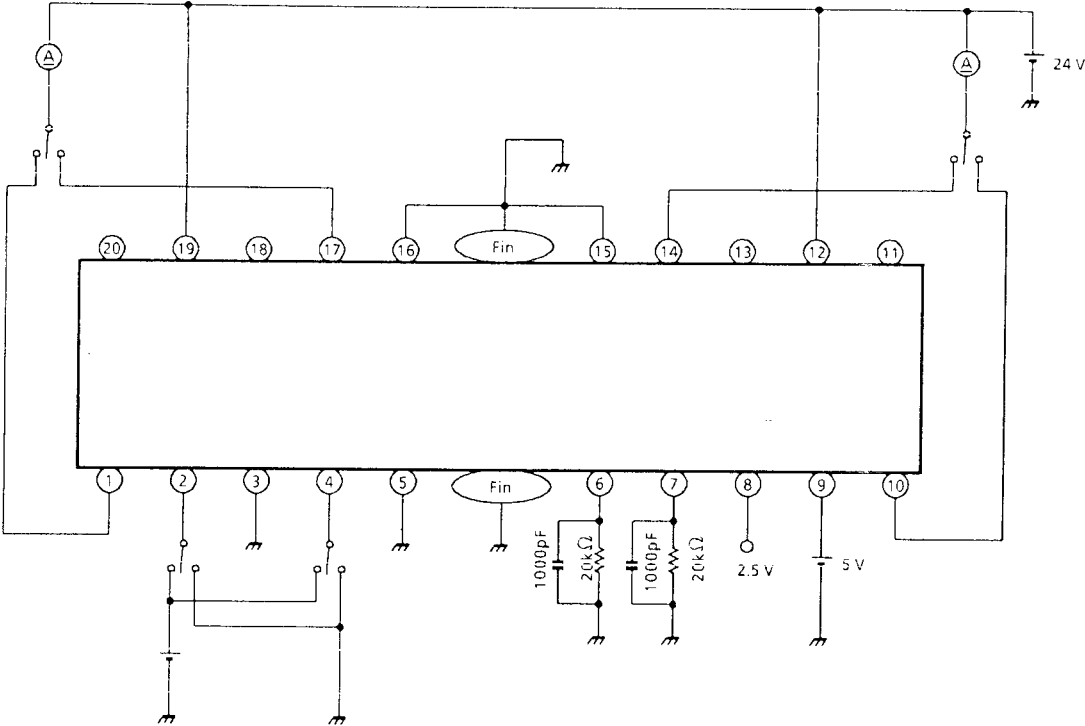
9. VF (H)



10. I_{ref}

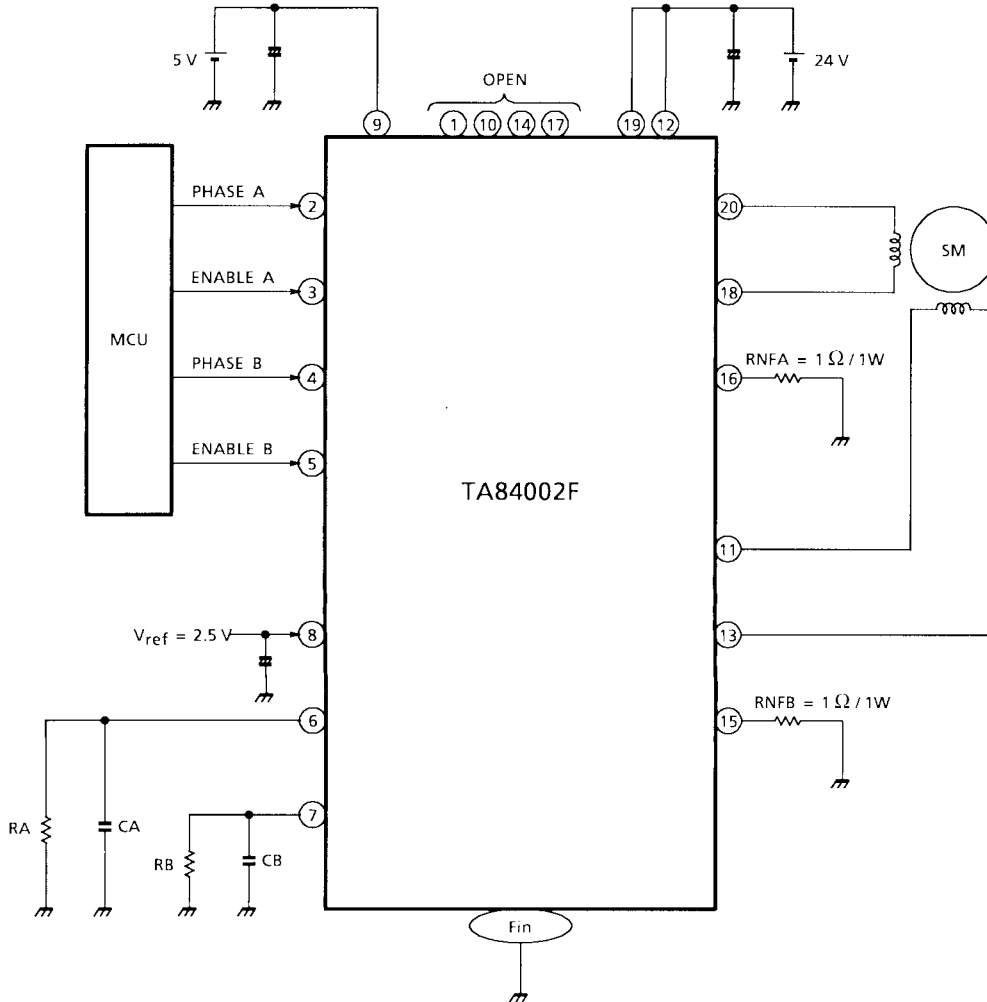


13. I_G



APPLICATION CIRCUIT

In case of $I_{OUT} = 0.5\text{ A}$



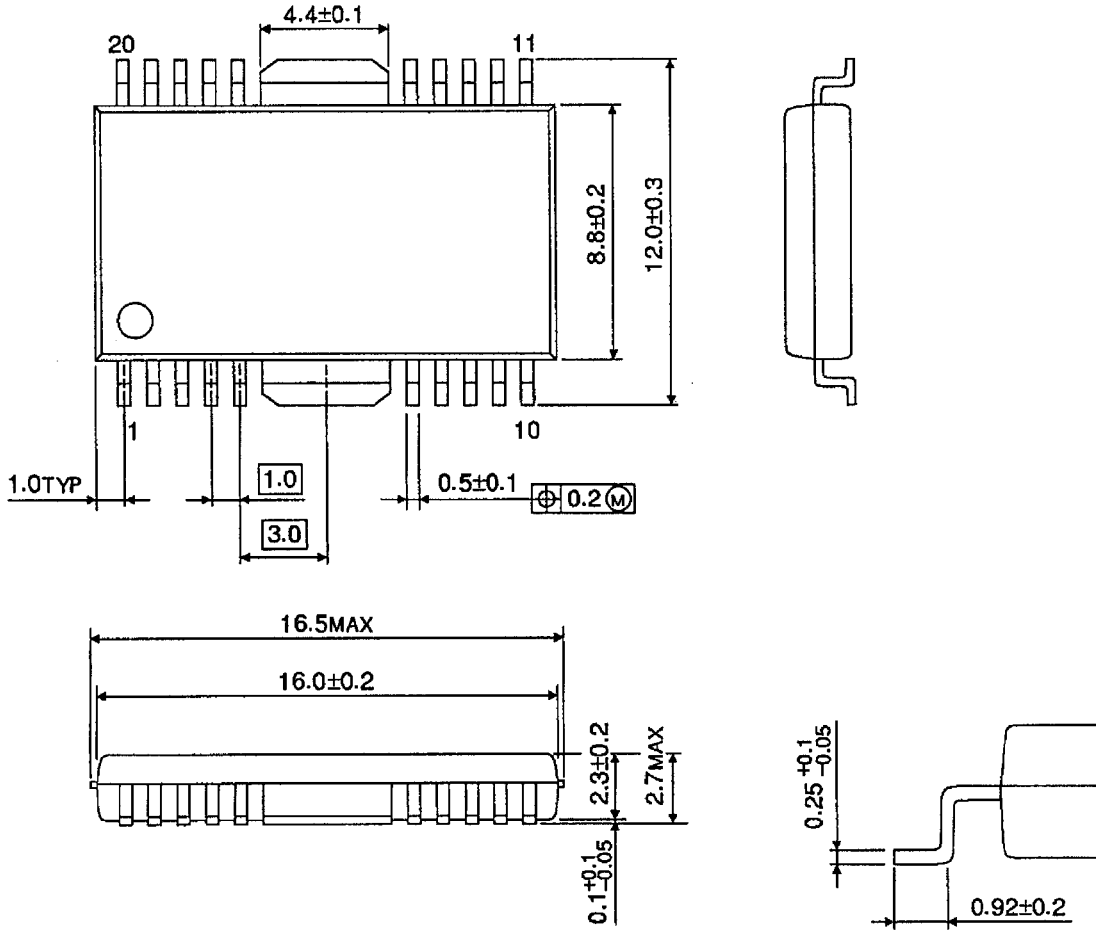
Note 1: Capacitor for noise suppression to be connected between the Power Supply (V_{CC} , V_M , V_{ref}) and GND to stabilize the operation.

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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