



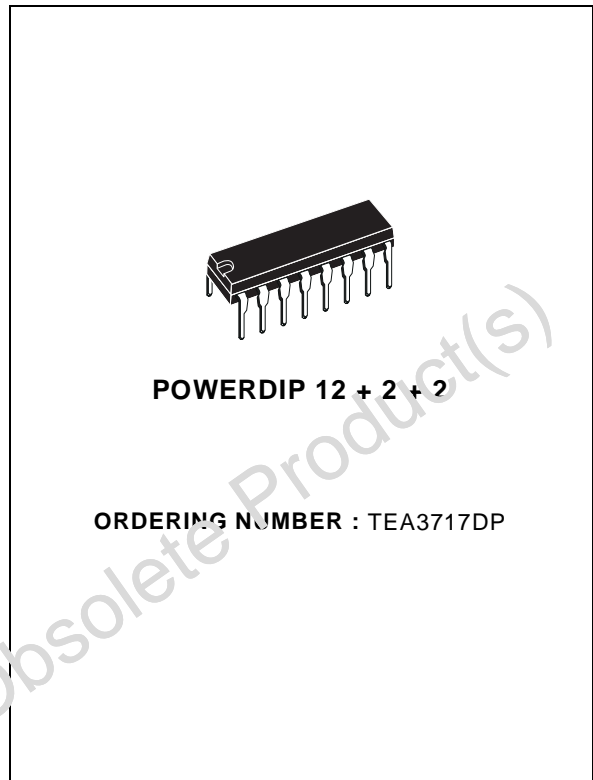
TEA3717

## STEPPER MOTOR DRIVER

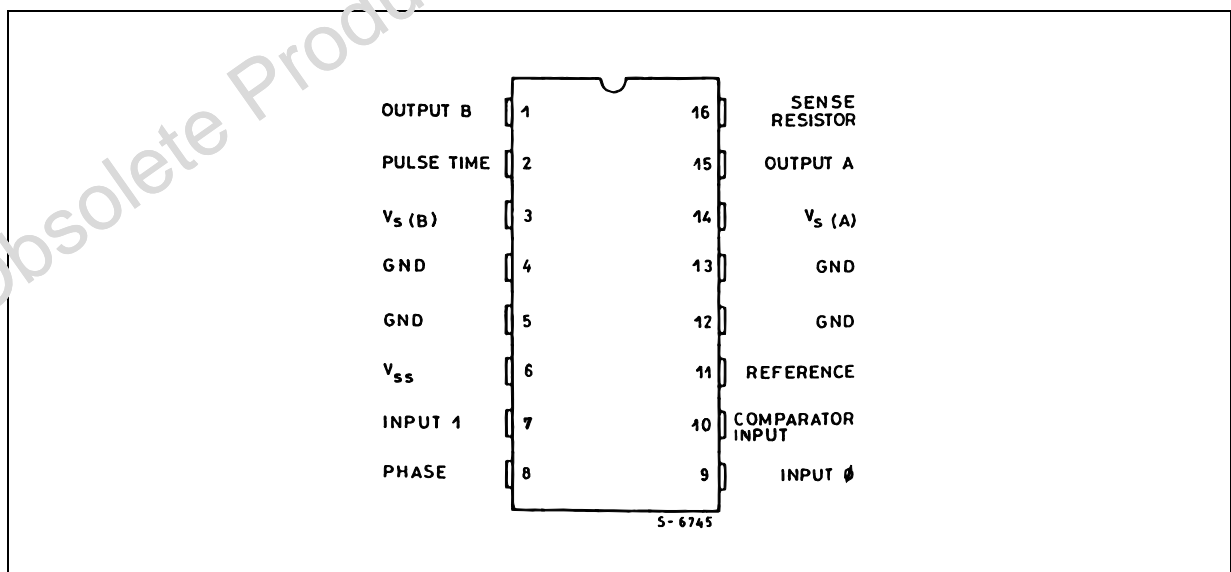
- HALF-STEP AND FULL-STEP MODE
- BIPOLAR DRIVE OF STEPPER MOTOR FOR MAXIMUM MOTOR PERFORMANCE
- BUILT-IN PROTECTION DIODES
- WIDE RANGE OF CURRENT CONTROL 5 TO 1000 mA
- WIDE VOLTAGE RANGE 10 TO 45 V
- DESIGNED FOR UNSTABILIZED MOTOR SUPPLY VOLTAGE
- CURRENT LEVELS CAN BE SELECTED IN STEPS OR VARIED CONTINUOUSLY

### DESCRIPTION

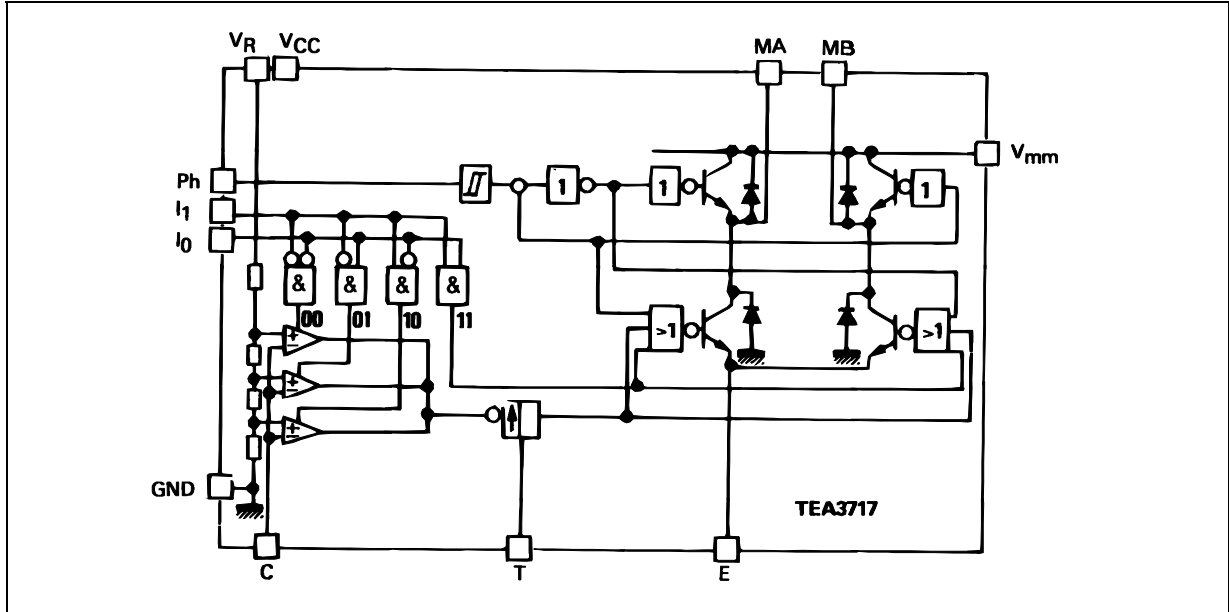
The TEA3717 is a bipolar monolithic integrated circuit intended to control and drive the current in one winding of a bipolar stepper motor. The circuit consists of an LS-TTL compatible logic input, a current sensor, a monostable and an output stage with built-in protection diodes. Two TEA3717 and a few external components form a complete control and drive unit for LS-TTL or microprocessor-controlled stepper motor systems.



### PIN CONNECTION (top view)



**SCHEMATIC DIAGRAM**



**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
$V_{mm}$	Power Supply Voltage (pins 14, 3)	45	V
$V_{CC}$	Logic Supply Voltage (pin 6)	7	V
$V_{in}$ $V_{in}$ $V_V$	Input Voltage Logic Inputs Analog Inputs Reference Input	- 0.5 to 6 $V_{CC}$ 15	V
$I_{in}$ $I_{in}$	Input Current Logic Inputs Analog Inputs	- 10 - 10	mA
$I_o$	Output Current	$\pm 1$	A
$T_j$	Junction Temperature	+ 150	$^{\circ}C$
$T_{stg}$	Storage Temperature Range	- 55 to + 150	$^{\circ}C$
$T_{oper}$	Operating Ambient Temperature Range	0 to + 70	$^{\circ}C$

**THERMAL DATA**

Symbol	Parameter	Value	Unit
$R_{th(j-c)}$	Maximum Junction-pins Thermal Resistance	11	$^{\circ}C/W$
$R_{th(j-a)}$	Maximum Junction-ambient Thermal Resistance	45*	$^{\circ}C/W$

\* Soldered on a 35 mm thick 20 cm<sup>3</sup> PC board copper area

**RECOMMENDED OPERATING CONDITIONS**

Symbol	Parameter	Min.	Typ.	Max.	Unit
$V_{CC}$	Supply Voltage	4.75	5	5.25	V
$V_{mm}$	Supply Voltage	10	-	40	V
$I_o$	Output Current	0.020	-	0.8	A
$T_{amb}$	Ambient Temperature	0	-	70	$^{\circ}C$
$t_r$	Rise Time, Logic Inputs	-	-	3	$\mu s$
$t_f$	Fall Time, Logic Inputs	-	-	3	$\mu s$

**ELECTRICAL CHARACTERISTICS**

$V_{CC} = 5V, \pm 5\%, V_{mm} = +10V \text{ to } +40V, T_{amb} = 0^{\circ}C \text{ to } +70^{\circ}C$  (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
$I_{CC}$	Supply Current	-	-	25	mA
$V_{IH}$	High Level Input Voltage - Logic Inputs	2.0	-	-	V
$V_{IL}$	Low Level Input Voltage - Logic Inputs	-	-	0.8	V
$I_{IH}$	High Level Input Current - Logic Input ( $V_I = +2.4V$ )	-	-	20	$\mu A$
$I_{IL}$	Low Level Input Current - Logic Inputs ( $V_I = +0.4V$ )	-0.4	-	-	mA
$V_{CH}$ $V_{CM}$ $V_{CL}$	Comparator Threshold Voltage ( $V_R = +5.0V$ ), $I_0 = 0, I_1 = 0$ $I_0 = 1, I_1 = 0$ $I_0 = 0, I_1 = 1$	390 230 65	420 250 80	440 270 90	mV
$I_{CO}$	Comparator Input Current	-20	-	+20	$\mu A$
$I_{off}$	Output Leakage Current ( $I_0 = 1, I_1 = 1$ ) $T_{amb} = +25^{\circ}C$ $T_{amb} = +70^{\circ}C, V_S = 40V, V_{SS} = 5V$	- -	- 100	100 200	$\mu A$
$V_{sat}$	Total Saturation Voltage Drop ( $I_0 = 500mA$ )	-	-	4.0	V
$P_{tot}$	Total Power Dissipation $I_0 = 500mA, f_s = 30kHz$ $I_0 = 800mA, f_s = 30kHz$	- -	1.8 3.7	2.3 -	W
$t_{off}$	Cut off Time (see figure 1 and 2, $V_{mm} = +10V, t_{on} \geq 5\mu s$ )	25	30	35	$\mu s$
$t_d$	Turn off Delay (see figure 1 and 2, $T_{amb} = +25^{\circ}C, dV_C/dt \geq 50mV/\mu s$ )	-	1.6		$\mu s$

Figure 1 (see note)

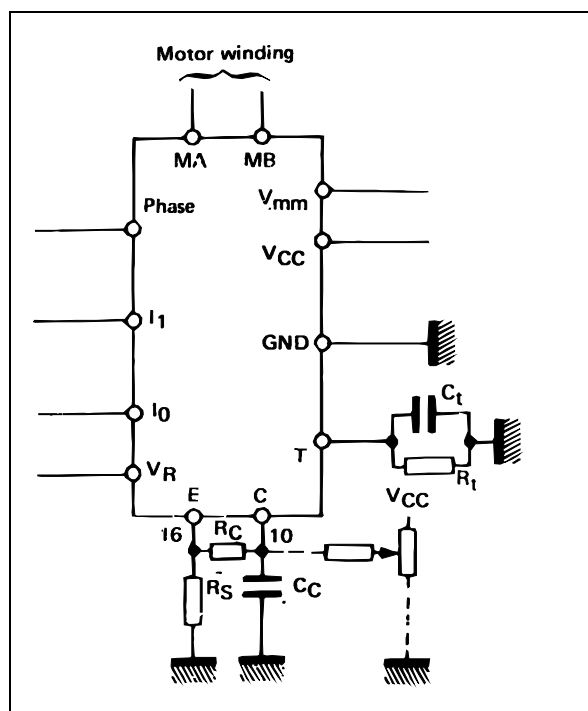
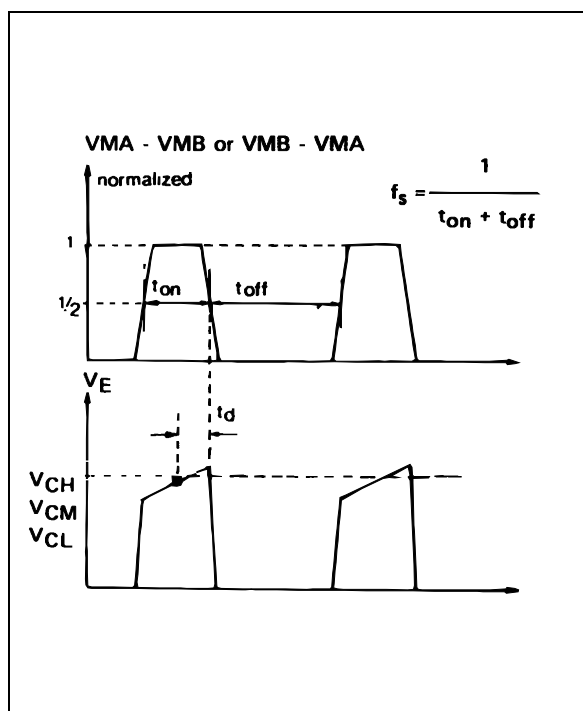


Figure 2.



## FUNCTIONAL DESCRIPTION

The circuit is intended to drive a bipolar constant current through one motor winding. The constant current is generated through switch mode regulation.

There is a choice of three different current levels with the two logic inputs  $I_0$  and  $I_1$ . The current can also be switched off completely.

## INPUT LOGIC

If any of the logic inputs is left open, the circuit will treat it as a high level input.

$I_0$	$I_1$	Current Level
H	H	No Current
L	H	Low Current
H	L	Medium Current
L	L	Maximum Current

**PHASE** – This input determines the direction of current flow in the winding, depending on the motor connections. The signal is fed through a Schmidt-trigger for noise immunity, and through a time delay in order to guarantee that no short-circuit occurs in the output stage during phase-shift. High level on the PHASE-input causes the motor current flow from  $M_A$  through the winding to  $M_B$ .

$I_0$  and  $I_1$  – The current level in the motor winding is selected with these inputs. The values of the different current levels are determined by the reference voltage  $V_R$  together with the value of the sensing resistor  $R_S$ .

## CURRENT SENSOR

This part contains a current sensing resistor ( $R_S$ ), a low pass filter ( $R_C$ ,  $C_C$ ) and three comparators. Only one comparator is active at a time. It is activated by the input logic according to the current level chosen with signals  $I_0$  and  $I_1$ . The motor current flows through the sensing resistor  $R_S$ . When the current has increased so that the voltage across  $R_S$  becomes higher than the reference voltage on the

**Note :**  $R_S = 1 \Omega$ , inductance free  
 $R_C = 1 \text{ k}\Omega$   
 $C_C = 820 \text{ pF}$ , ceramic  
 $R_t = 56 \text{ k}\Omega$

other comparator input, the comparator output goes high, which triggers the pulse generator and its output goes high during a fixed pulse time ( $t_{off}$ ), thus switching off the power feed to the motor winding, and causing the motor current to decrease during  $t_{off}$ .

## SINGLE-PULSE GENERATOR

The pulse generator is a monostable triggered on the positive going edge of the comparator output. The monostable output is high during the pulse time,  $t_{off}$ , which is determined by the timing components  $R_t$  and  $C_t$ .

$$t_{off} = 0.69 \cdot R_t \cdot C_t$$

The single pulse switches off the power feed to the motor winding, causing the winding current to decrease during  $t_{off}$ .

If a new trigger signal should occur during  $t_{off}$ , it is ignored.

## OUTPUT STAGE

The output stage contains four Darlington transistors and four diodes, connected in an H-bridge. The two sinking transistors are used to switch the power supplied to the motor winding, thus driving a constant current through the winding.

It should be noted however, that it is not permitted to short circuit the outputs.

$V_{CC}$ ,  $V_{mm}$ ,  $V_R$

The circuit will stand any order of turn-on or turn-off of the supply voltages  $V_{SS}$  and  $V_S$ . Normal  $dV/dt$  values are then assumed.

Preferably,  $V_R$  should be tracking  $V_{CC}$  during power-on and power-off.

## ANALOG CONTROL

The current levels can be varied continuously either if  $V_R$  is varied or with a circuit varying the voltage fed into the comparator terminal (see fig.1).

Figure 3

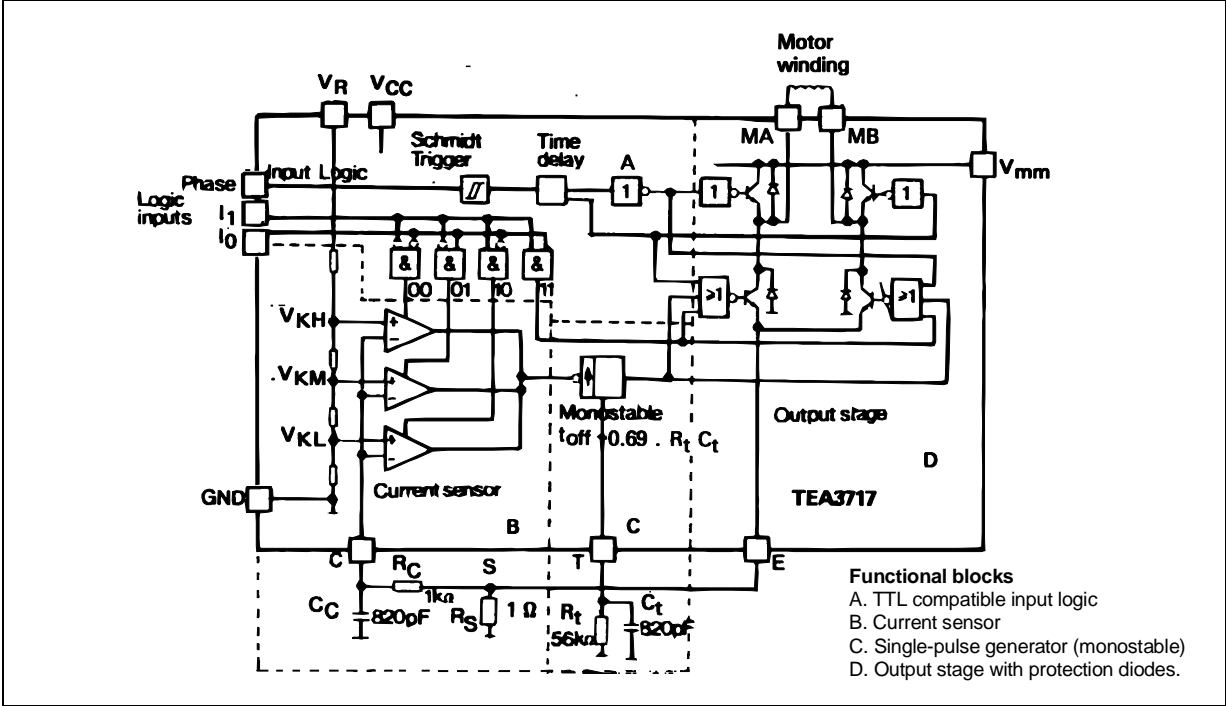


Figure 4 : Typical Sink Saturation Voltage versus Output Current

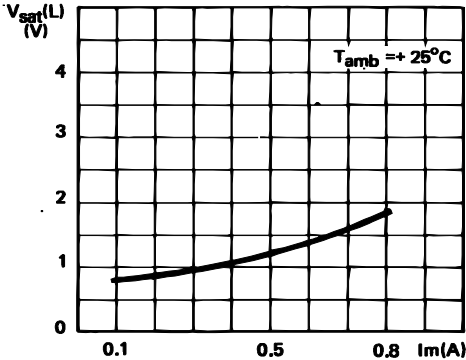


Figure 5 : Typical Source Saturation Voltage versus Output Current

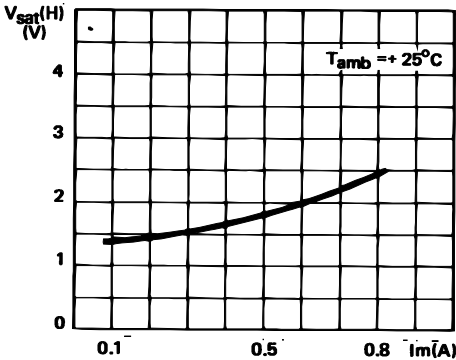
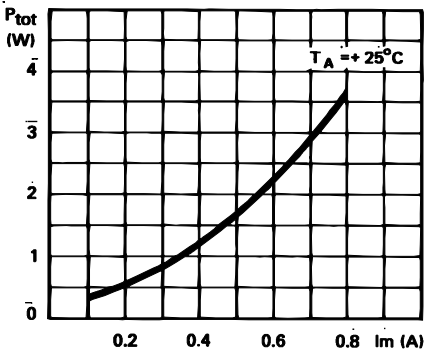


Figure 6 : Typical Power Losses versus Output Current



TYPICAL APPLICATION

Figure 7 : Serial Printer Carriage Drive.

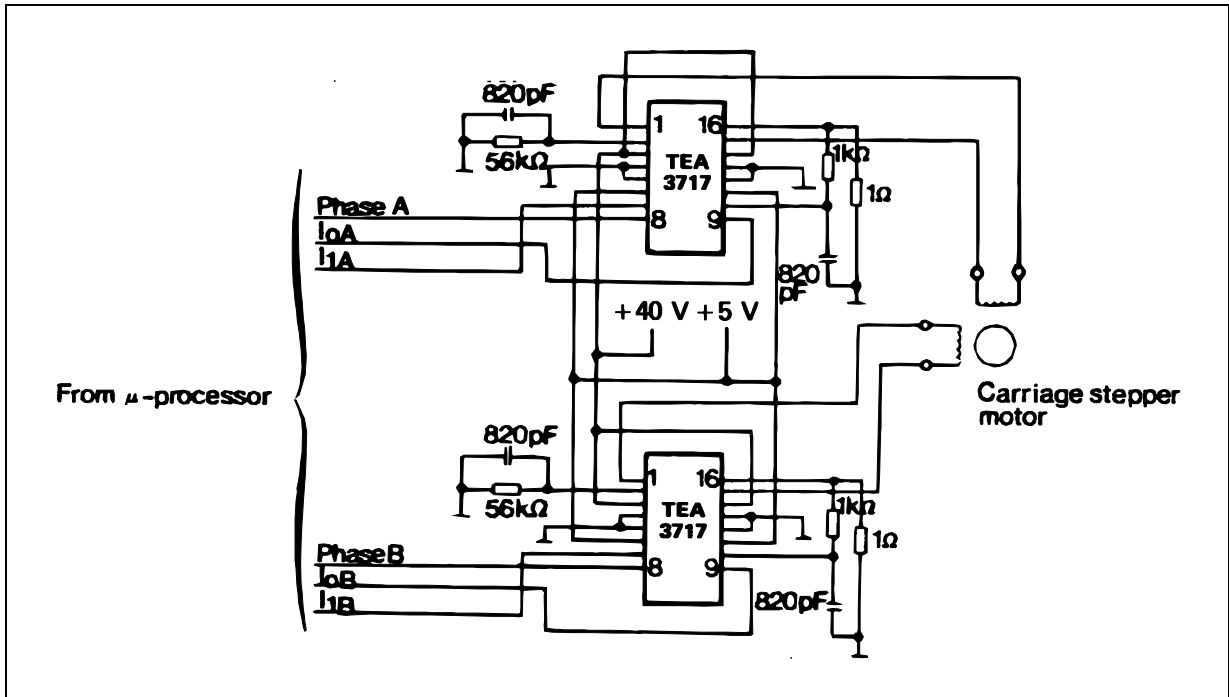
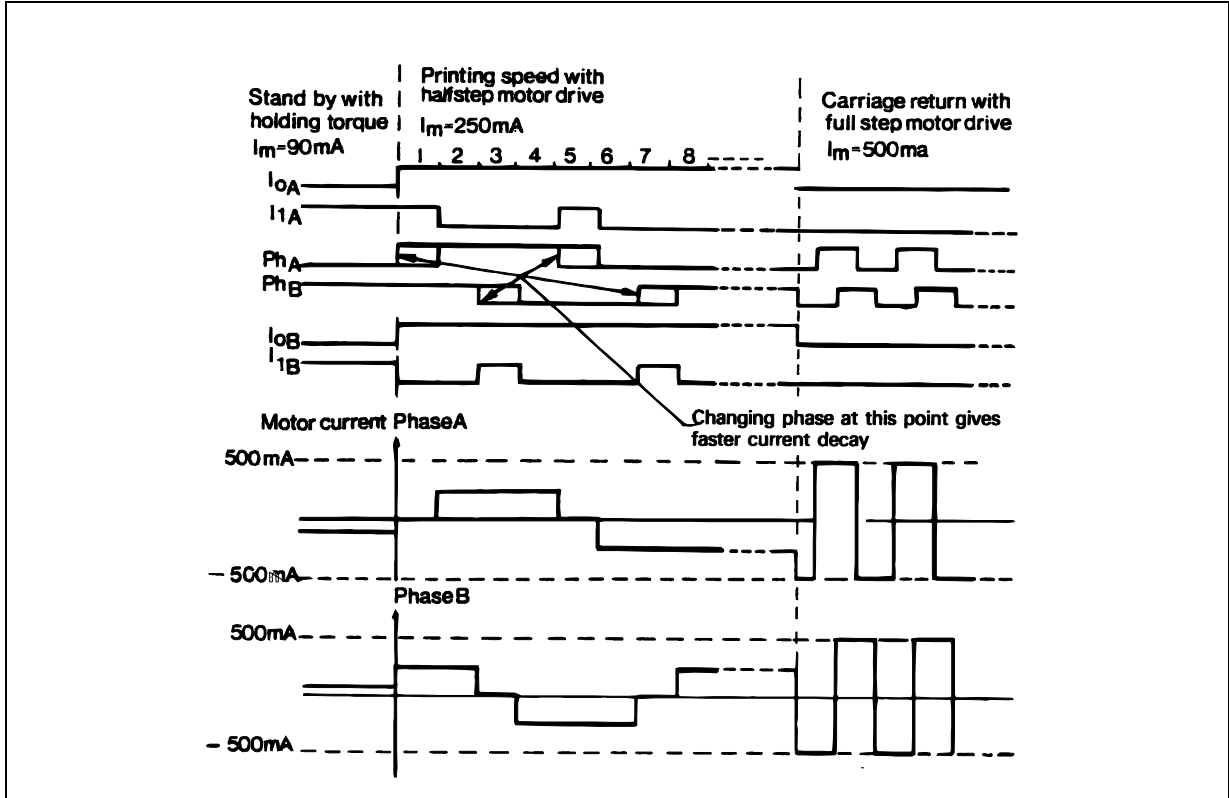
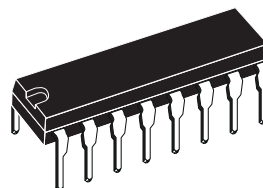


Figure 8 : Principal Operating Sequence.

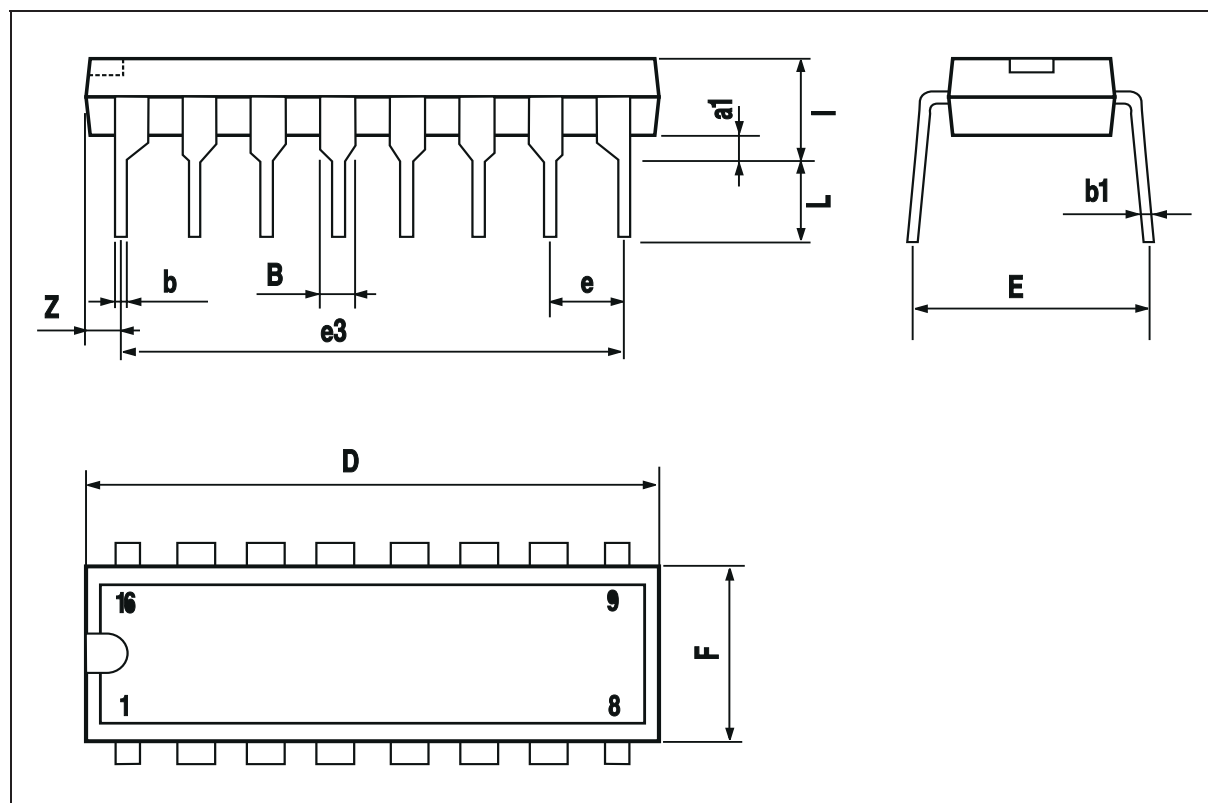


DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.85		1.40	0.033		0.055
b		0.50			0.020	
b1	0.38		0.50	0.015		0.020
D			20.0			0.787
E		8.80			0.346	
e		2.54			0.100	
e3		17.78			0.700	
F			7.10			0.280
I			5.10			0.201
L		3.30			0.130	
Z			1.27			0.050

## OUTLINE AND MECHANICAL DATA



**Powerdip 16**



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