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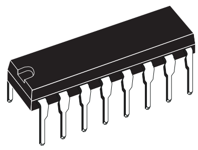
# TEA3717

## 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



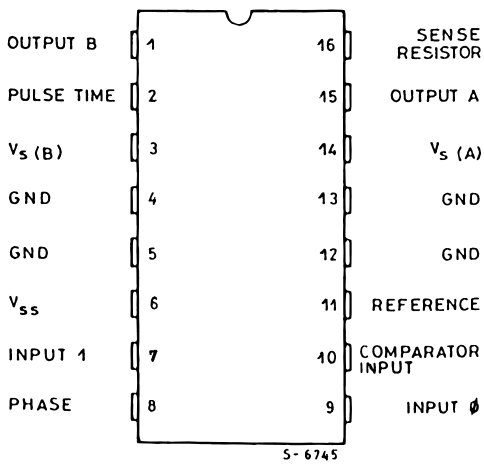
**POWERDIP 12 + 2 + 2**

**ORDERING NUMBER :** TEA3717DP

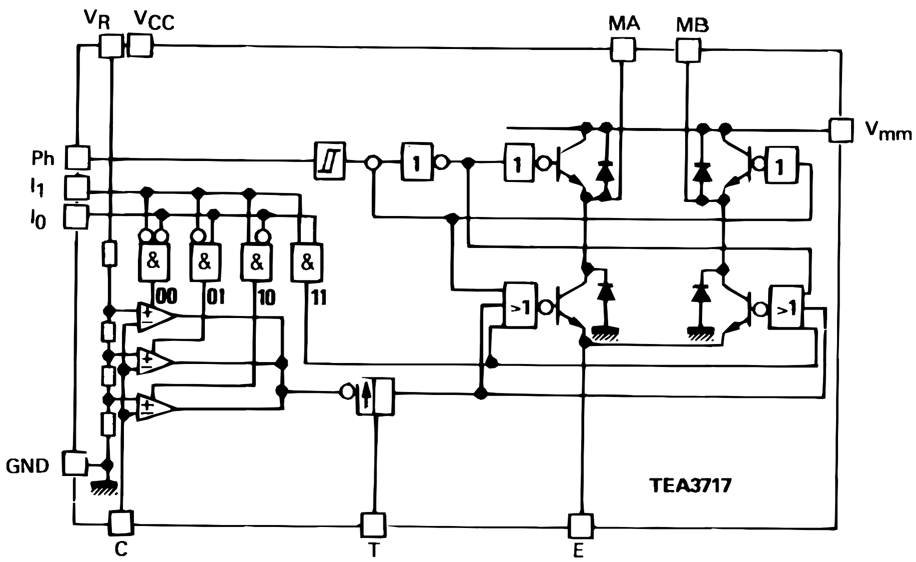
### DESCRIPTION

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 |
| | Input Voltage | | V |
| $V_{in}$ | Logic Inputs | – 0.5 to 6 | |
| $V_{in}$ | Analog Inputs | $V_{CC}$ | |
| $V_V$ | Reference Input | 15 | |
| | Input Current | | mA |
| $I_{in}$ | Logic Inputs | – 10 | |
| $I_{in}$ | Analog Inputs | – 10 | |
| $I_O$ | Output Current | ± 1 | A |
| $T_j$ | Junction Temperature | + 150 | °C |
| $T_{stg}$ | Storage Temperature Range | – 55 to + 150 | °C |
| $T_{oper}$ | Operating Ambiant Temperature Range | 0 to + 70 | °C |

## THERMAL DATA

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

* Soldered on a 35 mm thick 20 $cm^3$ 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 | °C |
| $t_r$ | Rise Time, Logic Inputs | – | – | 3 | µs |
| $t_f$ | Fall Time, Logic Inputs | – | – | 3 | µs |

## ELECTRICAL CHARACTERISTICS

$V_{CC}$ = 5V, ±5%, $V_{mm}$ = + 10V to + 40V, $T_{amb}$ = 0°C to + 70°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 | µA |
| $I_{IL}$ | Low Level Input Current - Logic Inputs ($V_I$ = + 0.4V) | – 0.4 | – | – | mA |
| $V_{CH}$<br>$V_{CM}$<br>$V_{CL}$ | Comparator Threshold Voltage ($V_R$ = + 5.0V), $I_0$ = 0, $I_1$ = 0<br>$I_0$ = 1, $I_1$ = 0<br>$I_0$ = 0, $I_1$ = 1 | 390<br>230<br>65 | 420<br>250<br>80 | 440<br>270<br>90 | mV |
| $I_{CO}$ | Comparator Input Current | – 20 | – | + 20 | µA |
| $I_{off}$ | Output Leakage Current ($I_0$ = 1, $I_1$ = 1)<br>$T_{amb}$ = + 25°C<br>$T_{amb}$ = + 70°C, $V_S$ = 40V, $V_{SS}$ = 5V | <br>–<br>– | <br>–<br>100 | <br>100<br>200 | µA |
| $V_{sat}$ | Total Saturation Voltage Drop ($I_o$ = 500mA) | – | – | 4.0 | V |
| $P_{tot}$ | Total Power Dissipation<br>$I_o$ = 500mA, $f_s$ = 30kHz<br>$I_o$ = 800mA, $f_s$ = 30kHz | <br>–<br>– | <br>1.8<br>3.7 | <br>2.3<br>– | W |
| $t_{off}$ | Cut off Time (see figure 1 and 2, $V_{mm}$ = + 10V, $t_{on} \geq 5\mu s$) | 25 | 30 | 35 | µs |
| $t_d$ | Turn off Delay (see figure 1 and 2, $T_{amb}$ = + 25°C, dVC/dt ≥ 50mV/µs) | – | 1.6 | | µs |

**Figure 1** (see note)

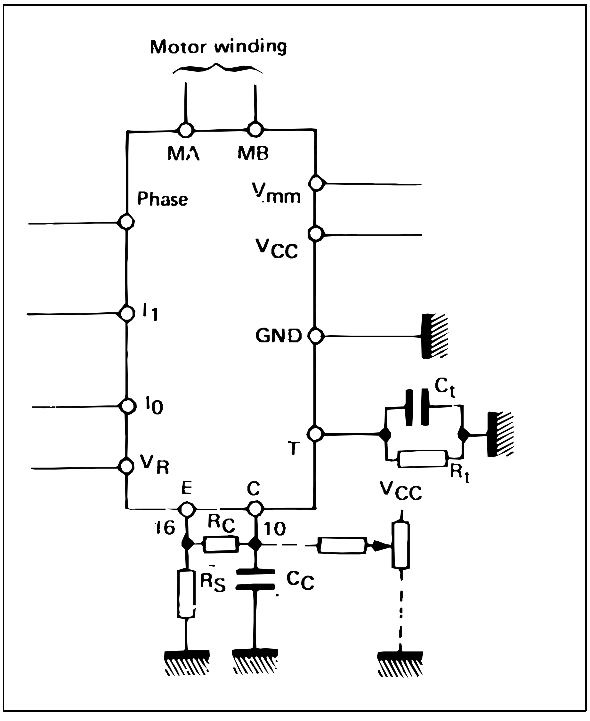
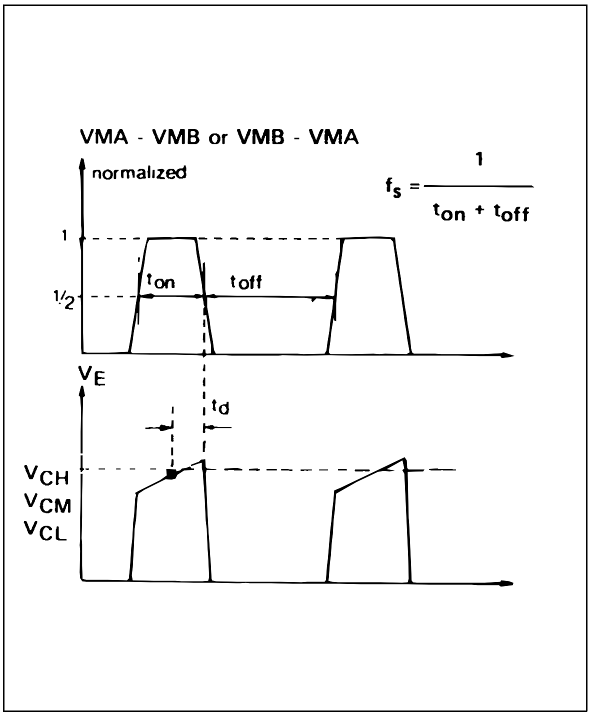



**Figure 2.**



## FUNCTIONAL DESCRIPTION

The circuit is intented 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 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 $t_{off}$.

**Note :** $R_S$ = 1 Ω, inductance free
$R_C$ = 1 kΩ
$C_C$ = 820 pF, ceramic
$R_t$ = 56 kΩ

## 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 $C_t$.

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

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 powersupplied 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

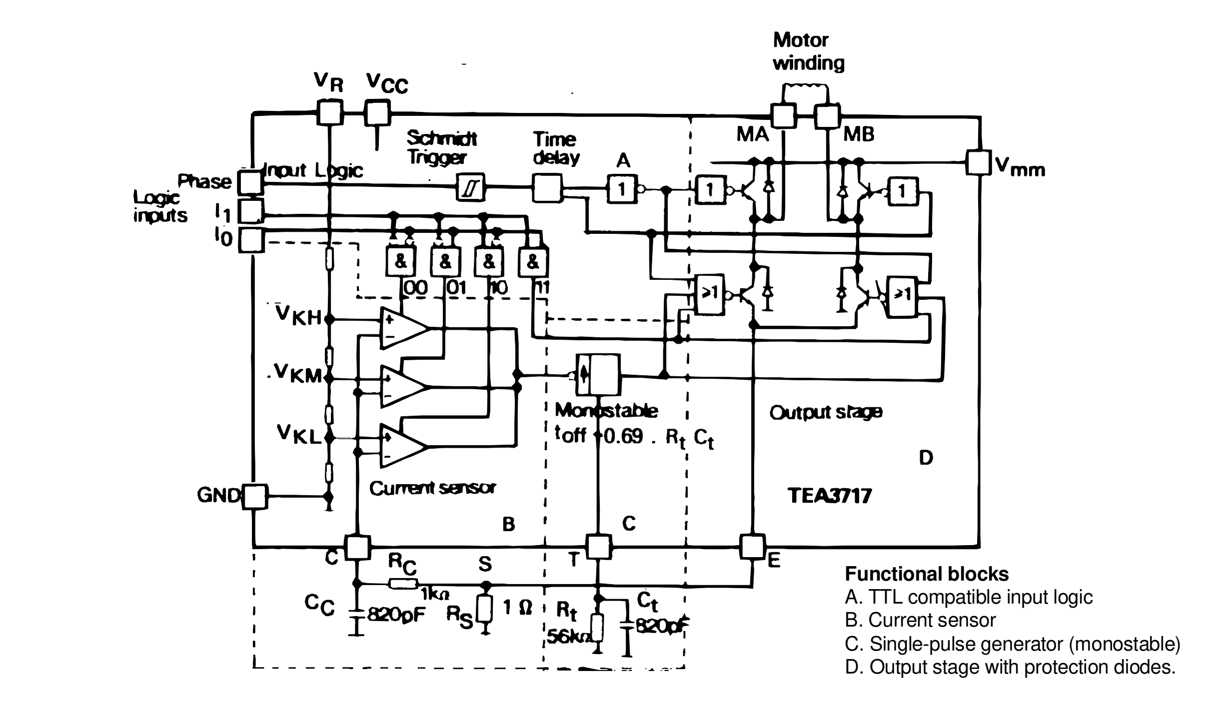



**Figure 4 :** Typical Sink Saturation Voltage versus Output Current

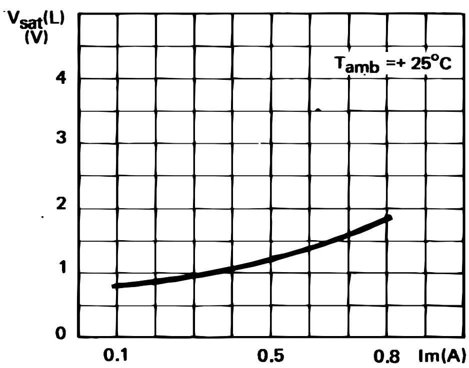



**Figure 5 :** Typical Source Saturation Voltage versus Output Current

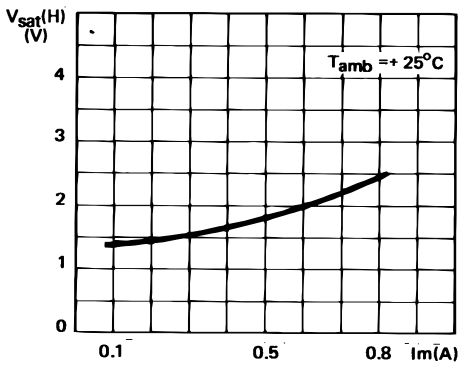
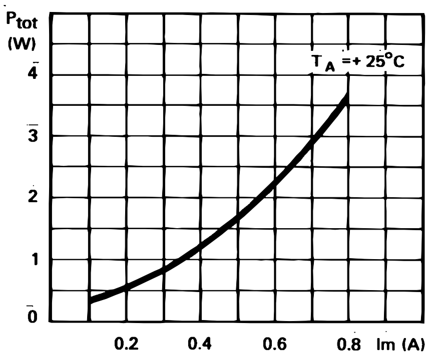



**Figure 6 :** Typical Power Losses versus Output Current



## TYPICAL APPLICATION

**Figure 7** : Serial Printer Carriage Drive.

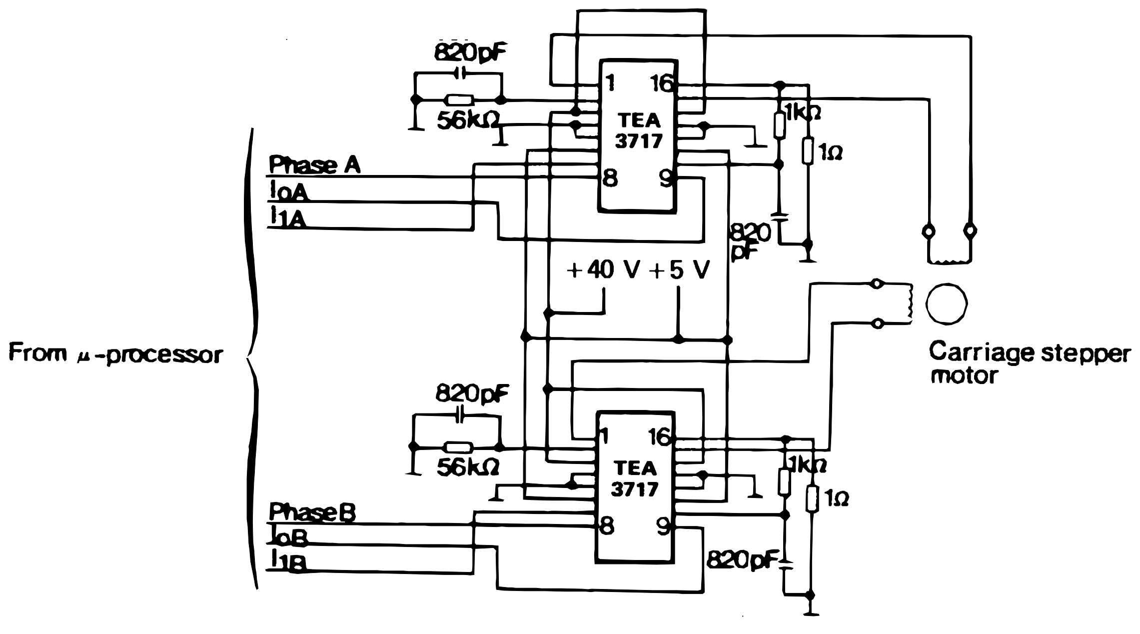
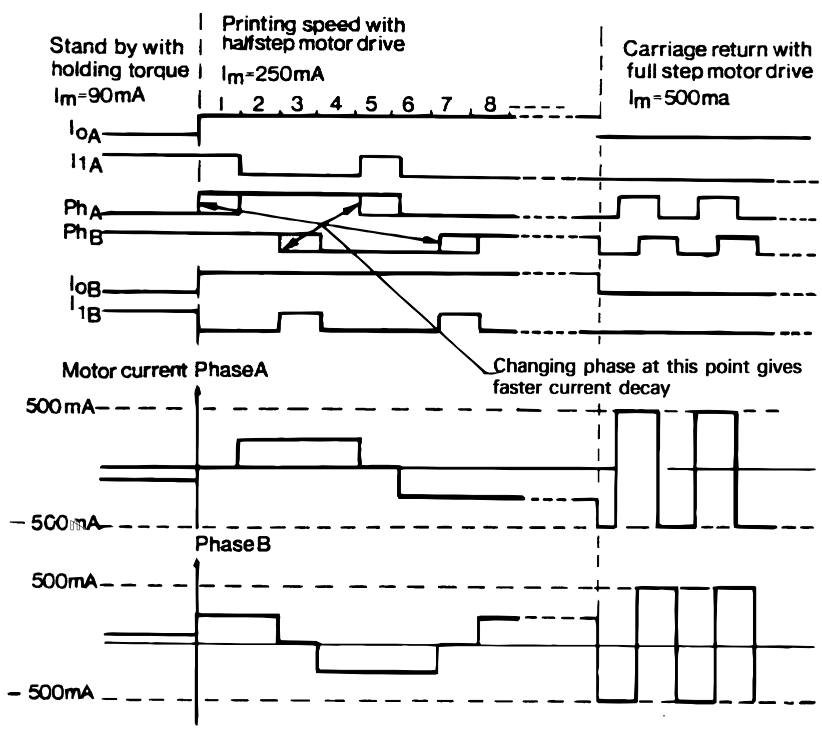
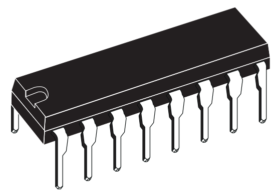



**Figure 8 :** Principal Operating Sequence.



| 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**