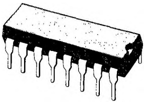
SGS-THOMSON
MICROELECTRONICS

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

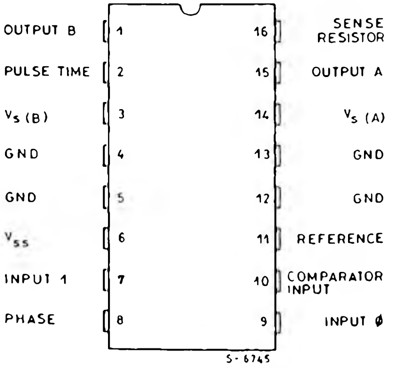


ORDER CODE : TEA3717DP

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.

CONNECTION DIAGRAM (top view)



ABSOLUTE MAXIMUM RATINGS

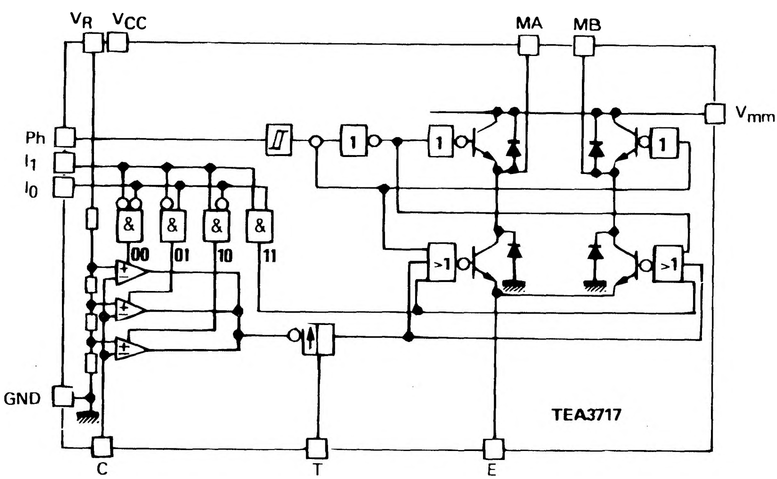
Symbol	Parameter	Value	Unit
V_{mm}	Power Supply Voltage (pins 14, 3)	45	V
V_{CC}	Logic Supply Voltage (pin 6)	7	V
 V_{in} V_{in} V_V	Input Voltage Logic Inputs Analog Inputs Reference Input	 – 0.5 to 6 V_{CC} 15	V
 I_{in} I_{in}	Input Current Logic Inputs Analog Inputs	 – 10 – 10	mA
I_O	Output Current	± 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

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

* Soldered on a 35 mm thick 20 cm^3 PC board copper area

SCHEMATIC DIAGRAM



RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Value			Unit
		Min.	Typ.	Max.	
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	–	–	2	µs
t_f	Fall Time, Logic Inputs	–	–	2	µs

ELECTRICAL CHARACTERISTICS, V_{CC} = 5 V, ± 5 %, V_{mm} = + 10 V to + 40 V, 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 = + 2.4 V)	–	–	20	µA
I_{IL}	Low Level Input Current - Logic Inputs (V_I = + 0.4 V)	– 0.4	–	–	mA
V_{CH} V_{CM} V_{CL}	Comparator Threshold Voltage (V_R = + 5.0 V), 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	µA
I_{off}	Output Leakage Current (I_0 = 1, I_1 = 1) T_{amb} = + 25 °C T_{amb} = + 70 °C, V_S = 40 V, V_{SS} = 5 V	 – –	 – 100	 100 200	µA
V_{sat}	Total Saturation Voltage Drop (I_o = 500 mA)	–	–	4.0	V
P_{tot}	Total Power Dissipation I_o = 500 mA, f_s = 30 kHz I_o = 800 mA, f_s = 30 kHz	 – –	 1.8 3.7	 2.3 –	W
t_{off}	Cut off Time (see figure 1 and 2, V_{mm} = + 10 V, t_{on} ≥ 5 µs)	25	30	35	µs
t_d	Turn off Delay (see figure 1 and 2, T_{amb} = + 25 °C, dVC/dt ≥ 50 mV/µs)	–	1.6		µs

Figure 1 (see note).

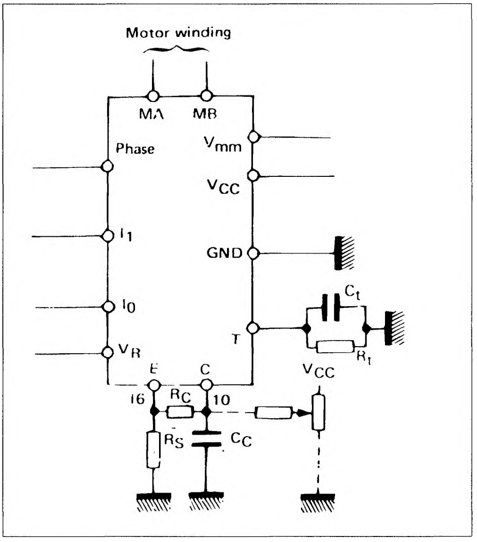
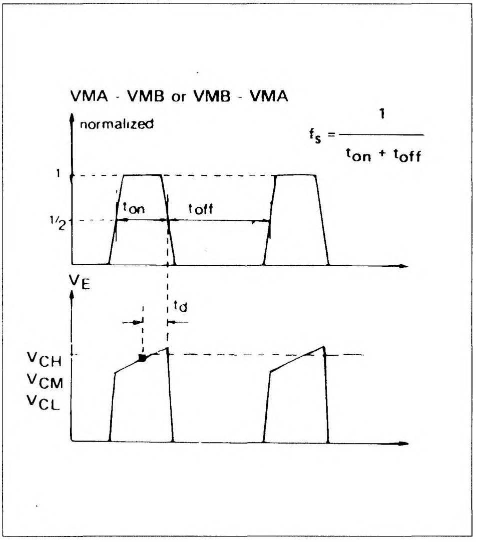


Figure 2.



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.

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

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}.

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.

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

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

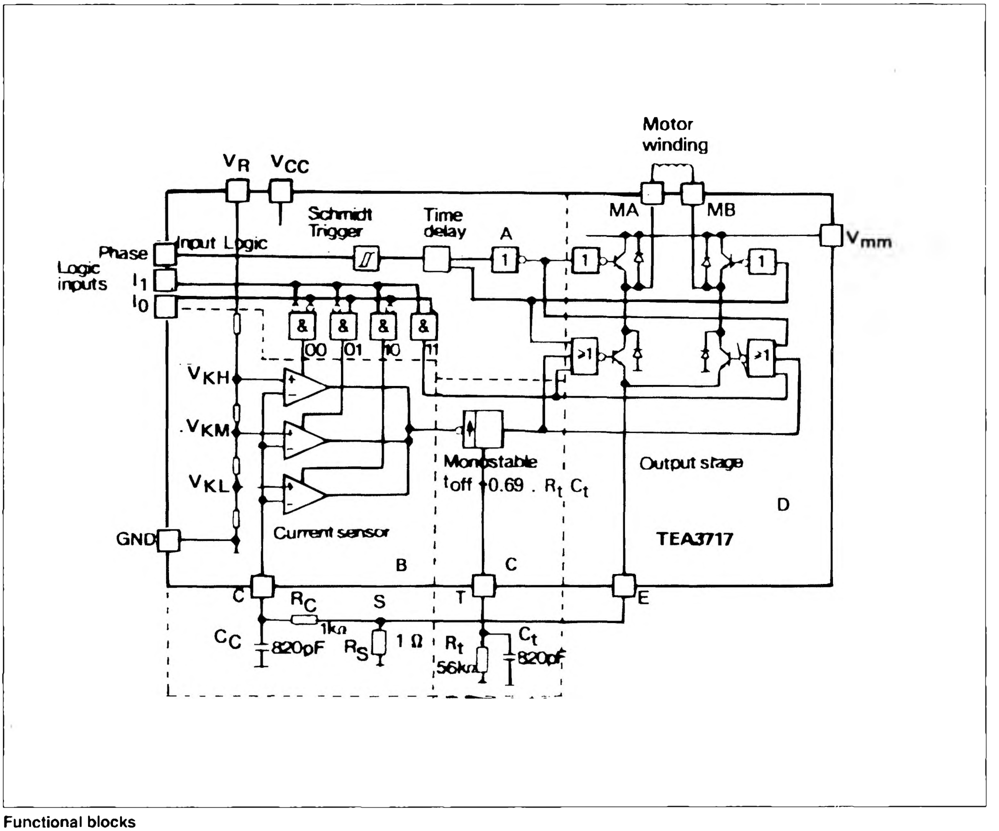
The circuit will stand any order of turn-on or turn-off of the supply voltages V_{SS} and V_S. Normal dV/dt values are then assumed.

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.



Functional blocks

A. TTL compatible input logic
B. Current sensor
C. Single-pulse generator (monostable)
D. Output stage with protection diodes.

Figure 4 : Typical Sink Saturation Voltage vs Output Current.

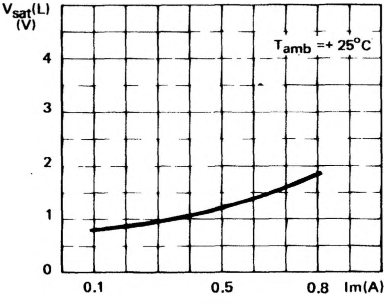


Figure 5 : Typical Source Saturation Voltage vs Output Current.

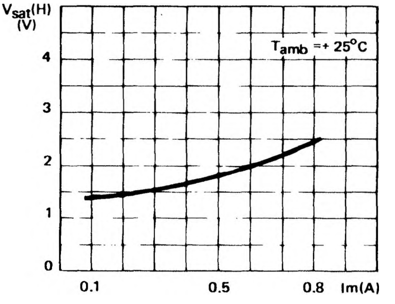
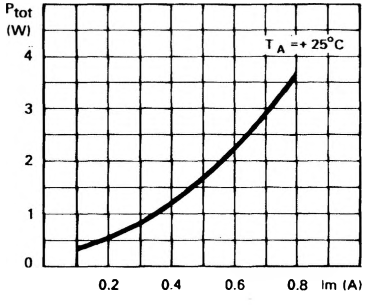


Figure 6 : Typical Power Losses vs Output Current.



TYPICAL APPLICATION

Figure 7 : Serial Printer Carriage Drive.

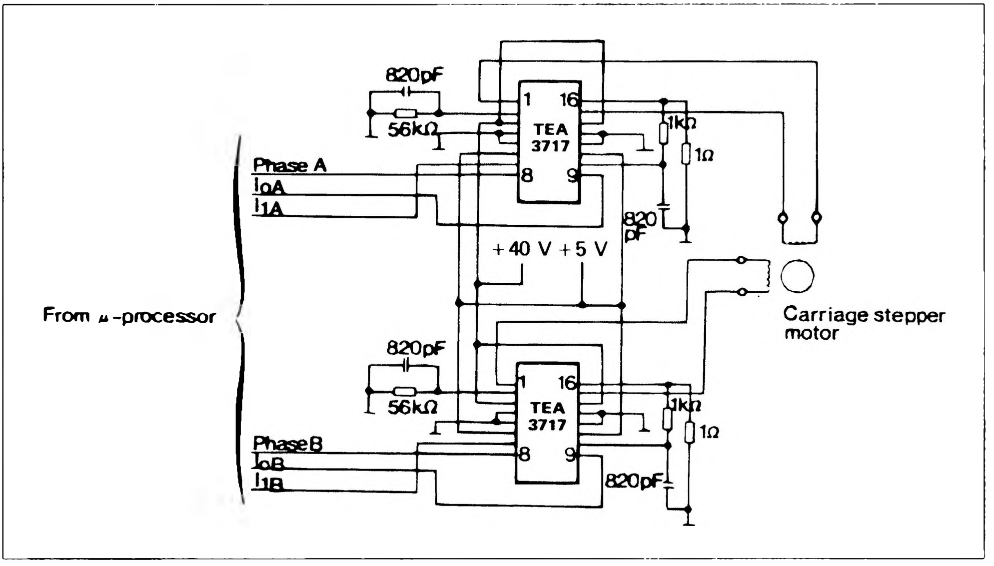


Figure 8 : Principal Operating Sequence.