SGS-THOMSON
MICROELECTRONICS

L6506

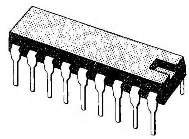
CURRENT CONTROLLER FOR STEPPING MOTORS

PRELIMINARY DATA

DESCRIPTION

The L6506 is a linear integrated circuit designed to sense and control the current in stepping motors and similar devices. When used in conjunction with the L293, L298, L7150, or L7180, the chip set forms a constant current drive for and inductive load and performs all the interface function from the control logic thru the power stage.

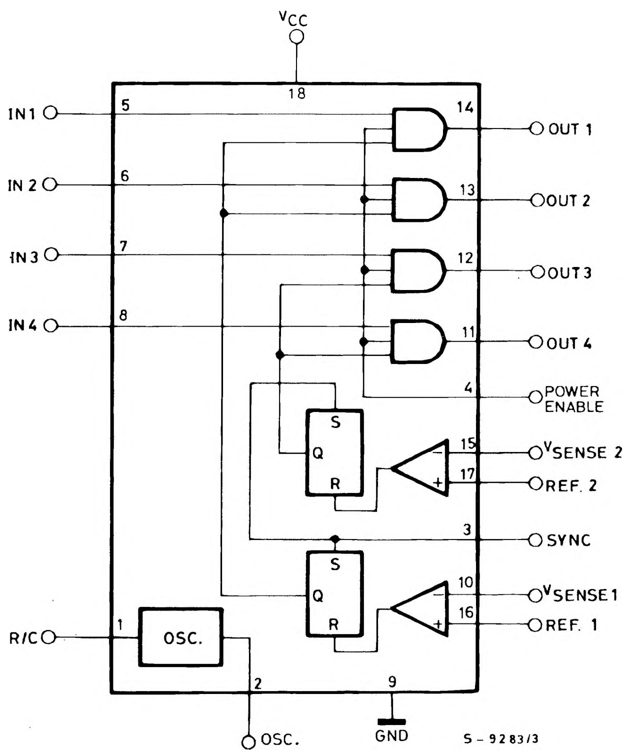
Two or more devices may be synchronized using the sync pin. In this mode of operation the oscillator in the master chip sets the operating frequency in all chips.



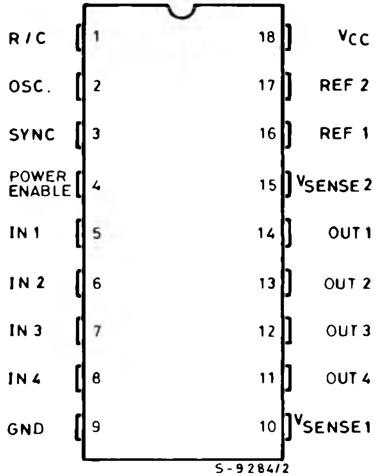
DIP-18 Plastic

ORDER CODE : L6506

BLOCK DIAGRAM



CONNECTION DIAGRAM (top view)



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	10	V
V_I	Input Signals	7	V
P_{tot}	Total Power Dissipation (T_{amb} = 70 °C)	1	W
T_j	Junction Temperature	150	°C
T_{stg}	Storage Temperature	– 40 to 150	°C

THERMAL DATA

$R_{th\ j\text{-}amb}$	Thermal Resistance Junction-ambient	Max	80	°C/W

ELECTRICAL CHARACTERISTICS (V_{CC} = 5.0 V, T_{amb} = 25 °C ; unless otherwise noted)

Symbol	Parameter	Test Condtions	Min.	Typ.	Max.	Unit
V_{CC}	Supply Voltage		4.5		7	V
I_{CC}	Quiescent Supply Current	V_{CC} = 7 V			25	mA

COMPARATOR SECTION

V_{IN}	Input Voltage Range	V_{sense} Inputs	– 0.3		3	V
V_{IO}	Input Offset Voltage	V_{IN} = 1.4 V			± 5.0	mV
I_{IO}	Input Offset Current				± 200	nA
I_{IB}	Input Bias Current				1	µA
	Response Time	V_{REF} = 1.4 V V_{SENS} = 0 to 5 V		0.8	1.5	µs

ELECTRICAL CHARACTERISTICS (Continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
COMPARATOR SECTION PERFORMANCE (over operating temperature range)						
V_{IO}	Input Offset Voltage	V_{IN} = 1.4 V			± 20	mV
I_{IO}	Input Offset Current				± 500	nA
LOGIC SECTION(over operating temperature range) - (TTL compatible inputs & outputs)						
V_{IH}	Input High Voltage		2.0		V_s	V
V_{IL}	Input Low Voltage				0.8	V
V_{OH}	Output High Voltage	V_{CC} = 4.75 V I_{OH} = 400 μA	2	3.5		V
V_{OL}	Ouptut Low Voltage	V_{CC} = 4.75 V I_{OH} = 4.0 mA		0.25	0.4	V
I_{OH}	Ouput Source Current Outputs 1 - 4	V_{CC} = 4.75 V	2.75			mA
OSCILLATOR						
f_{osc}	Frequency Range		5		70	KHz
V_{thL}	Lower Threshold Voltage			0.33 V_{CC}		V
V_{thH}	Higher Threshold Voltage			0.66 V_{CC}		V
R_i	Internal Discharge Resistor		0.7	1	1.3	KΩ

CIRCUIT OPERATION

The L6506 is intended for use with dual bridge drivers, such as the L298, quad darlington arrays, such as the L7180, or discrete power transistors to drive stepper motors and other similar loads. The main function of the device is to sense and control the current in each of the load windings.

A common on-chip oscillator drives the dual chopper and sets the operating frequency for the pulse width modulated drive. The RC network on pin 1 sets the operating frequency which is given by the equation :

$$f = \frac{1}{0.69\,RC} \quad \text{for } R > 10\text{ K}$$

The oscillator provides pulses to set the two flip-flops which in turn cause the outputs to activate the drive. When the current in the load winding reaches the programmed peak value, the voltage across the sense resistor (R_{sense}) is equal to V_{ref} and the corresponding comparator resets its flip-flop interrupting the drive current until the next oscillator pulse occurs. The peak current in each winding is programmed by selecting the value of the sense resistor and V_{ref}. Since separate inputs are provided for each chopper, each of the loads may be programmed independently allowing the device to be used to implement microstepping of the motor. Lower threshold of L6506's oscillator is 1/3 V_{CC}. Upper threshold is 2/3 V_{CC} and internal discharge resistor is 1 KΩ ±30 %.

Ground noise problems in multiple configurations can be avoided by synchronizing the oscillators. This may be done by connecting the sync pins of each of the devices with the oscillator output of the master device and connecting the R/C pin of the unused oscillators to ground.

The equations for the active time of the sync pulse (T2), the inactive time of the sync signal (T1) and the duty cycle can be found by looking at the figure 1 and are :

$$T2 = 0.69\,C1\,\frac{R1\,R_{IN}}{R1 + R_{IN}} \qquad (1)$$

$$T1 = 0.69\,R1\,C1 \qquad (2)$$

$$DC = \frac{T2}{T1 + T2} \qquad (3)$$

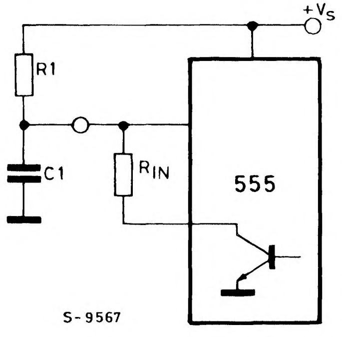
By substituting equations 1 and 2 into equation 3 and solving for the value of R1 the following equations for the external components can be derived :

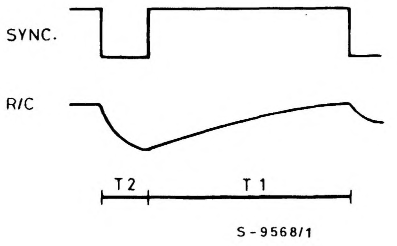
$$R1 = \left(\frac{1}{DC} - 2\right) R_{IN} \qquad (4)$$

$$C1 = \frac{T1}{0.69\ R1} \qquad (5)$$

Looking at equation 1 it can easily be seen that the minimum pulse width of T2 will occur when the value of R1 is at its minimum and the value of R1 at its maximum. Therefore, when evaluating equation 4 the minimum value for R1 of 700Ω (1 KΩ – 30 %) should be used to guarantee the required pulse width.

Figure 1 : Oscillator Circuit and Waveforms.





APPLICATIONS INFORMATION

The circuits shown in figures 2 and 3 use the L6506 to implement constant current drives for stepper motors. Figure 2 shows the L6506 used with the L298 to drive a 2 phase bipolar motor. Figure 3 shows the L6506 used with the L7180 to drive a 4 phase unipolar motor. The peak current can be calculated using the equation :

$$I_{peak} = \frac{V_{ref}}{R_{sense}}$$

The circuit of Fig.2 can be used in applications requiring different peak and hold current values by modifying in the reference voltage.

The L6506 may be used to implement either full step or half step drives. In the case of 2 phase bipolar stepper motor applications, if a half step drive is used, the bridge requires an additional input to disable the power stage during the half step. If used in conjunction with the L298 the enable inputs may be used for this purpose.

For quad darlington array in 4 phase unipolar motor applications half step may be implemented using the 4 phase inputs.

The L6506 may also be used to implement microstepping of either bipolar or unipolar motors.

Figure 2 : Application Circuit Bipolar Stepper Motor Driver.

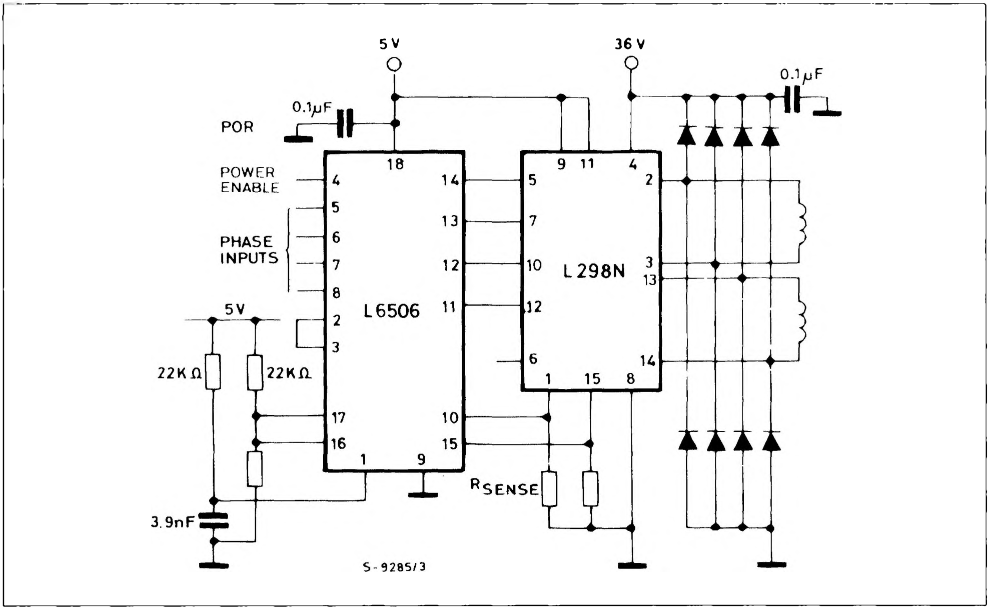


Figure 3 : Application Circuit Unipolar Stepper Motor.