CHERRY SEMICONDUCTOR

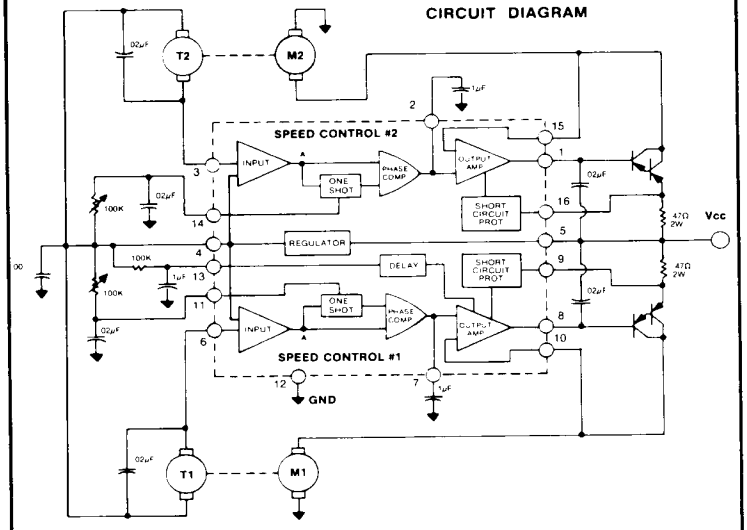
CS-140

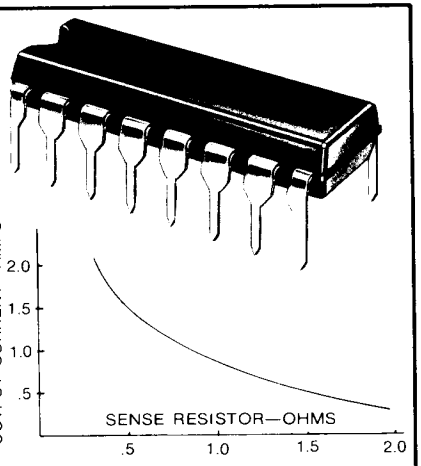
DUAL MOTOR SPEED CONTROL IC

DESCRIPTION

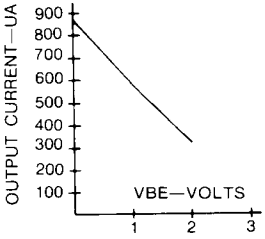
The CS-140 is a dual monolithic integrated circuit motor speed control. The circuit is a closed loop feedback system using a sinewave or optical tachometer. Use of an external output transistor allows this IC to control a variety of motors.

CIRCUIT DIAGRAM





SHORT CIRCUIT CURRENT LIMITING



OUTPUT TRANSISTOR
DRIVE CURRENT VERSUS VBE

ELECTRICAL CHARACTERISTICS Vcc = 12V (unless otherwise noted)

		MIN	TYP	MAX	UNITS
Input Circuit Threshold	V3-4, V6-4	+1	+18	+36	mV
Input Current	I3, I6		2	10	uA
Input Impedance	Z3, Z6		300		K ohm
Ratio of One Shot Trip Point to Regulator Volt.	V14-12/V4-12 V11-12/V4-12	0.54	0.6	0.66	
One Shot Time		0.5			mS
One Shot Resistor	RT	10		125	K ohm
Current Limit Threshold	V5-16, V5-9		0.7		V
Output Transistor Drive	I1, I8	200	500		uA
Input Current	I9, I16		0.1	2	mA
Ratio of Delay Trip Point to Regulator Volt.	V13-12/V4-12	0.6	0.67	0.74	
Delay Input Current	I13		2	10	uA
Supply Operating Range	V5-12	7		15	V
One Shot Δ T vs Supply			0.1		%
One Shot Δ T vs Temp			0.1		%
Voltage Regulator	V4-12	3.6	4.0	4.4	V
Supply Current	I5		12	15	mA

ABSOLUTE MAXIMUM RATINGS

Power Supply Voltage ..... V_{5-12} 15V
Output Current ..... (Determined by External Output Transistor)
Input Voltage ..... V_{3-12}, V_{6-12} ..... V_{5-12}
Input Voltage ..... V_{11-12}, V_{14-12} ..... V_{4-12}
Storage Temp ..... T_S ... -40°C to +150°C
Operating Temp ..... T_A .... -20°C to +70°C

TYPICAL OPERATION WITH SINEWAVE TAC

Motor 200 mA @ 4V @ 3000 RPM
Tac 2V P-P, 300 HZ @ 3000 RPM

	Min	Typ	Max
Speed Regulation VCC = 7 to 12V, TA = 25°C		±0.1%	±1%
Speed Regulation VCC = 12V, TA = -20°C to +70°C		±0.1%	±1%
TAC Signal Required	1V P-P		

CS-140 CIRCUIT OPERATION

The CS-140 contains two identical Motor Speed Control circuits each of which contains a high gain input comparator, one shot multivibrator (OSMV), phase comparator, output amplifier and short circuit protection. Speed Control circuit #1 also has provision for delaying its start up.

In a typical application, the tachometer output voltage is connected to the high gain input comparator. For proper operation, the tachometer output voltage must be a minimum of $1V_{p\text{-}p}$. During start up (no signal at the comparator input), the comparator output goes to a high state.

For sake of accuracy, it is desirable for the comparator to trigger at zero-crossing since changes in tachometer input frequency are more easily detected near zero crossing than on sharp slope of tachometer sine wave. Note that the comparator input threshold is typically offset 18mv above the voltage at pin 4. This built-in offset insures that during turn-on, there will be a positive start-up. In cases where the tachometer input is lost, the motor will continue to run without regulation and will be limited by motor characteristics or current limiting.

The input comparator's transition to a high state triggers the OSMV which has a programed pulse width given by: $t_{os} = 0.92$ RC. The resulting regulated motor speed is:

$$f_m = \frac{1}{2\,t_{os}} = \frac{1}{1.84RC}, \text{ where R}$$

is an external resistance between pins 4 and 14, and pins 4 and 11, and C is an external capacitance from pins 14 and 11 to ground.

The phase comparator now compares the length of the comparator output pulse, which corresponds to the negative half cycle of the tachometer sine wave, to the length of the OSMV pulse. If the OSMV pulse is shorter than comparator output, (i.e. tachometer and motor slower than the selected speed), the phase comparator output begins to source current into capacitor (Pin 2 or Pin 7) and correspondingly increases the drive to the output transistor and motor.

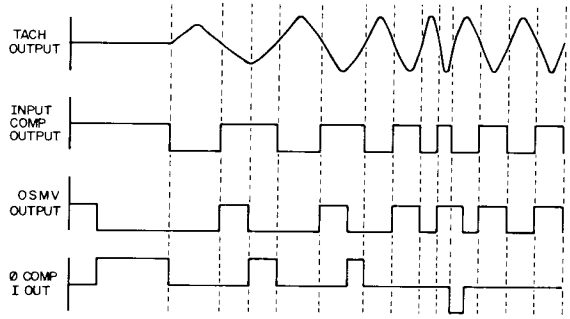
When the positive signal at the comparator output is shorter than the pulse from the one-shot, the phase comparator is sinking current and is reducing the drive capability and thereby slowing down the motor. When both pulses are equal, the system will be in a phase and frequency lock and the output drive will be driving the motor at the selected speed.

An additional optional feature of the CS-140 is the programmable delay provided at Pin 13. This delay provides the capability to delay the start of Motor 1 for a predetermined time after starting Motor 2. The delay circuit is essentially a comparator which locks out the output amplifier until the input of pin 13 exceeds the trip point. Since the comparator input trip point is set at .67 (Vreg), the delay time is aproximately:

$$t_d = RC \log_n \frac{1}{1\text{-}0.67} = RC\ (1.1).$$

The CS-140 also provides short circuit protection by means of current limiting. The current limiting is programed by resistors between pin 5 and pin 16 (pin 9). The current limit threshold is 0.7V and the output current limit is approximately:

$$I_{limit} = \frac{0.7}{Rext}, \text{ where Rext is an external resistor between pins 5 an d16 and pins 5 and 9.}$$



CS-140 WAVEFORMS