GEC PLESSEY
SEMICONDUCTORS

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TDA1085C

PHASE CONTROL INTEGRATED CIRCUIT

The TDA1085C is a silicon integrated circuit designed for use in phase control systems of AC mains with resistive and inductive loads The circuit may form the basis of closed loop control systems utilizing tacho frequency or analog voltage feedback.

The circuit was primarily designed for motor speed control in automatic washing machines and hence includes a programmable multiple ramp generator to control acceleration rates.

DP16

Fig.1 Pin Connections (top view)

FEATURES

- **Powered direct from AC mains or DC line.**
- **Flexible ramp generator to provide controlled acceleration and distribution period.**
- **Actual speed derived from tachogenerator frequency or magnitude.**
- **Control amplifier allowing loop gain control.**
- **Symmetrical positive and negative wave firing of the triac.**
- **Motor current limiting.**
- **Fail safe in case of open circuit tachogenerator.**
- **Repeated triac pulses provided if triac unlatches.**

BLOCK DIAGRAM

Fig. 2 Block Diagram of TDA1085C

ELECTRICAL CHARACTERISTICS

TEST CONDITIONS (unless otherwise stated)

T_{amb} = +25°C
All potentials measured with respect to common (Pin 8)

Characteristic	Value			Units	Conditions
	Min.	Typ.	Max.		
CURRENT CONSUMPTION					
Pin 9					
IC operating current		7.4	8.9	mA	Total current required is dependent on external circuitry.
VOLTAGE REGULATOR					
Pin 9					
Shunt regulating voltage		15.5	16	V	$I_9 + I_{10}$= 10mA
Monitor enable level		15.1		V	
Monitor disable level		14.5		V	
RAMP GENERATOR (See Fig.3)					
Pin 7					
Fast ramp current		1.2		mA	
Residual charging current		5		µA	During slow ramp period
Pin 5					
Speed program voltage range	0.08		13.5	V	
Bias current			-20	µA	
Pin 6					
Program distribute level	0		4	V	
Bias current			-20	µA	
Internal					
Low distribute level V_{RA}		V_6	1.2	V	Distribute levels referred to ramp generator.
High distribute level V_{RB}	$1.9V_6$	$2V_6$	$2.1V_6$	V	
FREQUENCY-ANALOG CONVERTER					
Pin 12					
Positive tacho input voltage			6	V	
Negative tacho input voltage			-3	V	
Minimum tacho input voltage	200			mV	Peak-Peak
Internal bias current		25		µA	
Pin 12 to Pin 11					
Conversion factor (typical)		7.5		mV/Hz	C pin 6 = 390pF,R pin 4 = 150kΩ
		15		mV/Hz	C pin 6 = 820pF,R pin 4 = 150kΩ
Conversion gain		10			
Linearity	±4		%		
CONTROL AMPLIFIER					
Pin 4					
Actual speed voltage limits	0		13.5	V	
Analog input bias current			-350	nA	
Pin 4, 5 & 16					
Diffenential offset voltage	-60		+20	mV	$V_5 - V_4$ to give $V_{16} = 0$
Transconductance		300		µA/V	
Pin 16					
Output current drive		±100		µA	

(continued)

ELECTRICAL CHARACTERISTICS (continued)

Characteristic	Value Min.	Value Typ.	Value Max.	Units	Conditions
FIRING PULSE TIMING					
Pin 2					
Voltage sync trip level		±50		µA	
Pin 1					
Current sync trip level		±50		µA	
Pin 16					
Phase control voltage swing		11.7		V	
Pin 13					
Firing pulse width		55		µs	R pin 15 = 300kΩ
Pulse repetition time		200		µs	C pin 14 = 47nF
Pin 14					
Ramp recharge current (I_R)		150		µA	
FIRING PULSE OPUTPUT DRIVE					
Pin 13					
High output level		V_{CC} - 4		V	At 150mA drive current
Leakage current			30	µA	
LOAD CURRENT LIMITER					
Pin 3 & Pin 7					
Current gain		170	-		Reset of ramp generator
Pin 7					
Discharge current		35		mA	

CIRCUIT DESCRIPTION

The TDA1085C incorporates a shunt type voltage regulator which enables it to be powered direct from the mains or from a DC supply. It can provide adequate current to drive external speed reference potential dividers that may be switched by contacts on mechanical timers. A supply monitor circuit resets timing functions and inhibits triac firing pulses when the circuit is being powered up at 'switch on'.

A ramp generator is provided to control the acceleration of the motor, to a speed as programmed on the speed program input, pin 5. If this pin becomes grounded a general reset and inhibit of triac pulses will take effect. A programmable period of slow acceleration may be used to give a 'distribution' period for automatic washing machines. Charging currents for the ramp generator are determined by an external resistor for the slow ramp period and internally during the fast ramp.

A frequency to analog (F-A) converter is provided on this device enabling advantage to be taken of tachogenerator frequency to be used for motor speed sensing. The conversion is carried out by transferring a pulse of charge (defined by the F-A converter capacitor) into an RC filter when the tacho input goes positive. An internal bias current is provided to the input pin; this serves two purposes: it senses the continuity of the tacho, causing a general reset and inhibit of output pulses if it goes open circuit; secondly it enables the input to be easily biased such that tacho noise causes no additional triggering of the F-A converter.

The control amplifier has differential inputs that compare the ramp generator voltage (internal) against the actual speed voltage. The output of this amplifier is a bidirectional current of limited amplitude which is integrated to limit the maximum rate of change of triac firing pulse phase angle. The actual speed voltage may be derived directly from a tacho (for analog sensing) or via the F-A converter circuit (for digital sensing). Digital sensing has the advantage that no tacho calibration is required, plus stability against temperature variations and ageing effects.

Synchronisation of the triac pulse is achieved by delaying the pulse with reference to the zero voltage points of the mains cycles. These points are determined by the voltage synchronisation input to the device. Inductive motors give rise to phase lag of the load current. Under high speed or heavy load conditions it is essential that the triac is fired after the load current from the previous half cycle has ceased The current synchronisation pin (1) performs this

Fig. 4 TDA1085C Circuit Diagram

task by ensuring that there is a voltage across the triac before a trigger pulse is supplied (when the triac is conducting current only a small voltage drop appears across it). The triac pulse width is dependent on the capacitor which also delays the pulse from the zero voltage point If the triac fails to latch, repeated pulses will be supplied.

The current limitation pin (3) may be used to monitor the peak negative load current This may be necessary to protect the triac and or motor under stall conditions. The trip point is determined by external resistors which when exceeded will cause the ramp generator to discharge to a safe working voltage.

RAMP GENERATOR CHARACTERISTIC

V_{RA} and V_{RB} are determined by the voltage programmed on pin 6 (V_6). Under all conditions $V_{RB} = 2V_6$, whereas $V_{RA} = V_6$ for $V_6 \leq 1.2V$ but is clamped at 1 .2V for $V_6 \geq 1.2V$.

The ramp generator output voltage only rises to the desired speed voltage as defined on pin 5.

ABSOLUTE MAXIMUM RATINGS

Electrical

Peak input current (I sync), pin 1:	±2mA
Peak input current (V sync), pin 2:	±2mA
Current drain, pin 3:	5mA
Positive input voltage, pin 3:	6V
Analog voltage drive, pin 4:	V_{CC}
Speed reference voltage, pin 5:	V_{CC}
Distribute level, pin 6:	V_{CC}
IC Circuit current (pin 10 disconnected), pin 9:	10mA
Supply shunt regulating current, pin 10:	30mA
Tachogenerator(digital)drive input, pin 12:	-3, +0.1 mA
Triac gate current, pin 13:	200mA
Phase timing current, pin 15:	1 mA

Thermal

Operating ambient temperature:	0°C to +70°C
Storage temperature:	-55°C to +125°C

Fig. 3 Ramp Generator Characteristic

Fig. 5 Power Dissipation

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