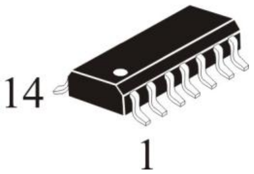
DC Motor Driver for Servo Driver Applications

IK8508

GENERAL DESCRIPTION

IK8508 is a fully protected H-bridge driver designed especially for automotive headlight beam control and industrial servo control applications. The device built using the high voltage BCDMOS process. IK8508 is a light position controller intended to use in passenger cars. This circuit adapts the elevation of the light beam of the head light of the car to a state defined by the car driver using a potentiometer on the dashboard. An internal window-comparator controls the input line. In the case of a fault condition, like short circuit to ground, short circuit to supply-voltage, and broken wire, the IK8508 stops the motor immediately. In addition, the device protected against temperatures above 160ºC and electrical transients. Furthermore, the built in features like under and over voltage protections, short circuit and broken wire detection, and over temperature protection will open a wide range of automotive and industrial applications.

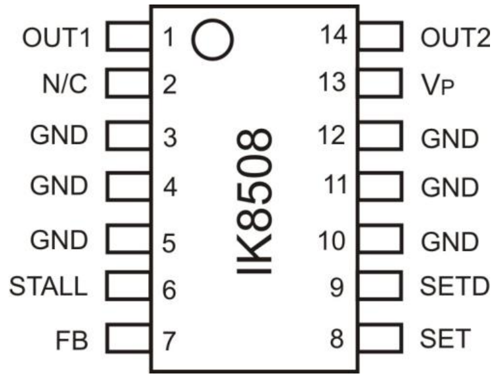
14-PDSOP



FEATURES

- ♦ Low positional error
- ♦ Low noise sensitivity due to hysteresis
- ♦ Low supply current
- ♦ Wide input voltage range (0.05Vp - 0.95Vp)
- ♦ Over temperature protection
- ♦ Over- and under voltage lockout
- ♦ Broken wire and short-circuit indication on SET input
- ♦ Stall function via temperature
- ♦ Stall function with external stall current control
- ♦ Full output protection
- ♦ No crossover current
- ♦ Hysteresis level set externally
- ♦ Internal clamp diodes
- ♦ Enhanced power packages

PIN ASSIGNMENT

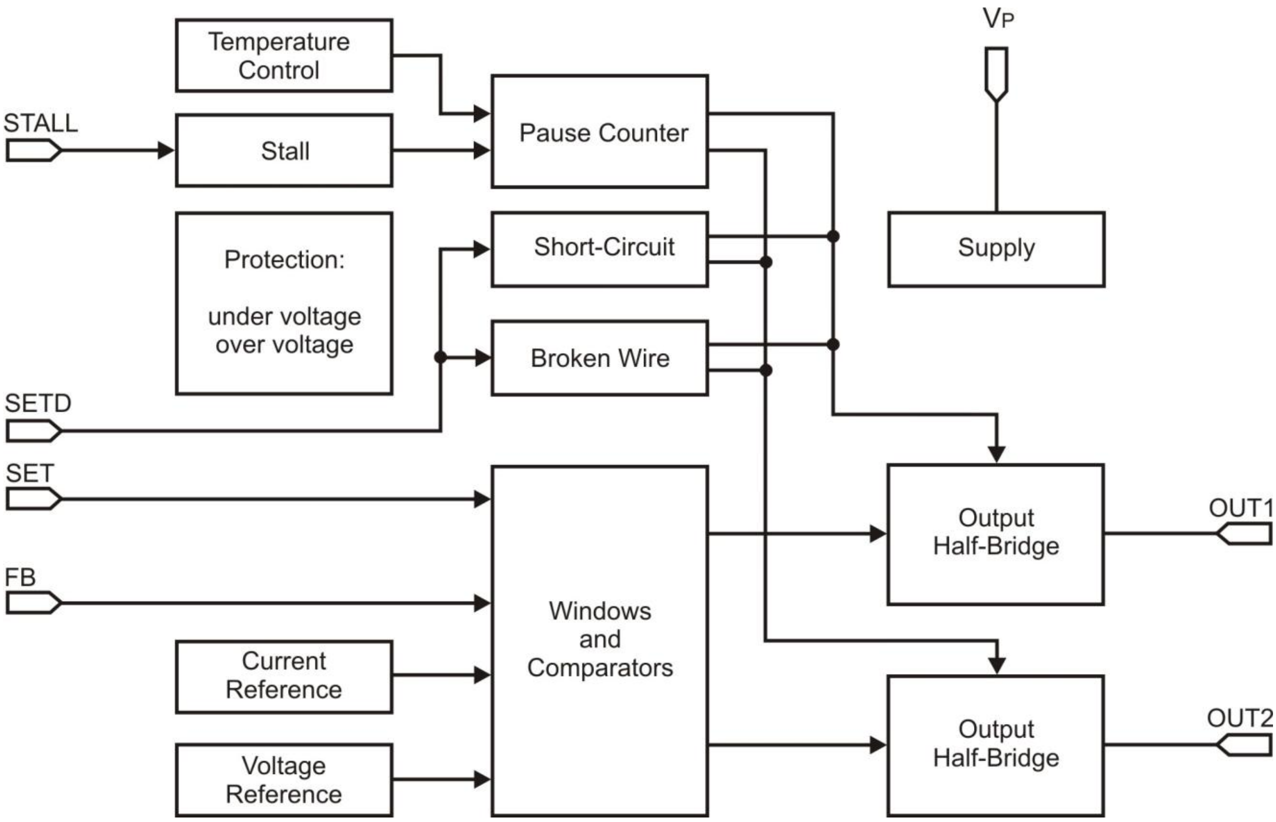


14-PDSOP

PIN LIST AND DESCRIPTIONS

Pin Name	I/O	Description	Pin №
OUT1	O	Output 1	1
N/C	-	Not connected	2
Stall	I	Stall input	6
FB	I	Feedback input	7
SET	I	Set input	8
SETD	I	Set input (over range control)	9
Vp	-	Supply voltage	13
OUT2	O	Output 2	14
GND	-	Ground	3,4,5,10,11,12

BLOCK DIAGRAM.



FUNCTIONAL DESCRIPTION.

The device is intended to control the elevation of the light beam of a head light of a passenger car. The driver can control the elevation of the light beam by rotating a potentiometer on the dashboard (the setting potentiometer). The device adapts the elevation of the light beam by activating the control motor. The elevation of the head light is fed back to the device by a second potentiometer (the feedback potentiometer). This feedback potentiometer is mechanically coupled to the motor.

The device operates only when the supply voltage is within certain limits. The device is switched off outside these boundaries. The under voltage detection detects whether the supply voltage is below the under voltage threshold. The motor will not be activated when this occurs, but it remains short-circuited by the output stages. The over voltage will switch off the total device when the supply voltage is higher than the over voltage threshold.

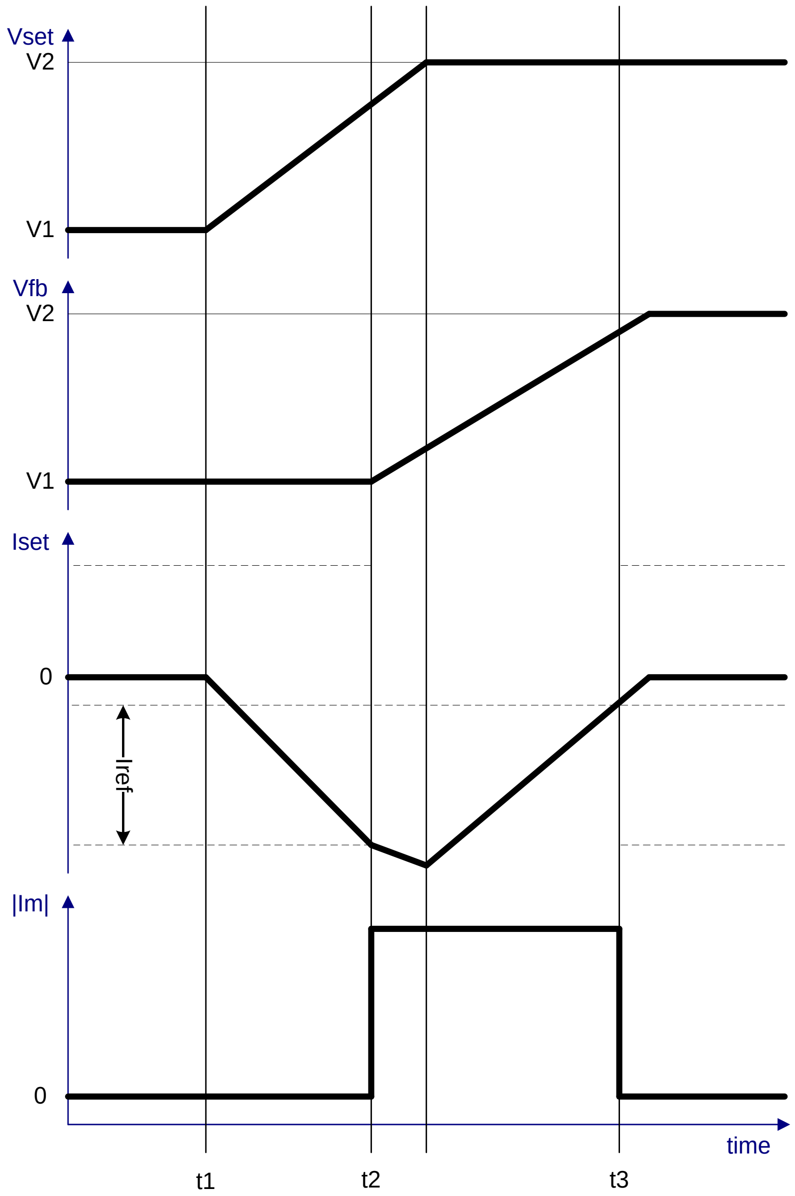
A thermal protection circuit becomes active if the junction temperature exceeds a value of approximately 160 °C. This circuit will reduce the motor current, which will result in a lower dissipation and hence a lower chip temperature. This condition will only occur when the motor is blocked at high ambient temperature.

A detection of a broken wire of the slider of the setting potentiometer is included on pin FB because it will be connected to the device by a wire several meters long. This detection circuit prevents the motor from rotating when the wire is broken. In this event the brake will remain active.

The protection of V_{SET} to V_P circuit prevents the motor from rotating when the voltage at the V_{SETD} input is above the threshold value. This can be used to detect whether the wire from the slider of the setting potentiometer is short-circuited to the battery line. A protection of V_{SET} short-circuited to ground is also present. The motor will be stopped if V_{SET} becomes lower than the threshold level.

The device is protected against electrical transients which may occur in an automotive environment. The device will shut off when positive transients on the battery line occur. The motor will not be short-circuited in this event. The fly back diodes located inside of outputs will remain present. The state of the output stages at the moment when the transient starts is preserved by internal flip-flops. Negative transients on the battery line will result in a set short-circuited to ground fault detection, because it will result in a voltage at the setting input which is below the short-circuited to ground threshold. The device however discharges the electrolytic capacitor during these transients. It will stop functioning when the resulting supply voltage becomes too low.

TIMING DIAGRAMM.



The timing diagram of IK8508 can divide into several parts starting from a steady state. In this case, (until t1) a large Iref is active, indicated by the dotted lines. When the setting potentiometer rotated and the input current Iset becomes higher than Iref (at time t2), the motor will start and the motor current will decrease. At the same time, the Iref switched to a low level. During rotation of the motor, the Iset will decrease until it becomes lower than this low reference current (t3). At this time, the motor will stop and the Iref set to the higher value. The polarity of the feedback potentiometer should be such that the voltage at the slider of the feedback potentiometer increases when OUT1 is high and OUT2 is low.

ABSOLUTE MAXIMUM RATINGS*

All voltages defined with respect to ground. Positive currents flow into the device.

Symbol	Parameter	Conditions	Min.	Max.	Unit
V_P	Supply Voltage	operating	8	18	V
		non-operating	-0.3	50	V
Vn	Voltage on any input pin		-0.3	V_P+0.3	V
Vesd	Electrostatic discharge (HBM)	note 1	-4	4	kV
	Electrostatic discharge (MM)		-200	200	V
Tstg	Storage Temperature		-55	150	°C
Tj	Junction Temperature		-40	150	°C
Tamb	Ambient Temperature		-40	105	°C
R_L	Load Resistance	note 2	10	-	Ω
I_L	Load Current	note 2	2	-	A

**Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

Notes

1. Human body model: equivalent to discharging a 100 pF capacitor through a 1.5 kΩ resistor.
   According JEDEC JESD22-A114.
   MM model: equivalent to discharging a 200 pF capacitor through a 0Ω resistor.
   According JEDEC JESD22-A115.
2. Vb = 13 V, Tamb = 25°C; duration 50 ms maximum; non-repetitive.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
Rth(j-a).	Thermal resistance from junction to ambient in free air for 14-pin PDSOP package	77	˚C/W
PDmax	Power Dissipation at T_A = 25^{o}C for 14-pin PDSOP package	1.6	W

ELECTRICAL CHARACTERISTICS

Vp = 12V, R_L = 14Ω, Rset = Rfb = 10kΩ. All voltages defined with respect to ground. Positive currents flow into the device. Unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Supply						
Vp(min)	under voltage threshold	Tamb = 25ºC	6	-	8	V
Vp(max)	over voltage threshold	Tamb = 25ºC	17.5	-	22	V
		Tamb = -40 to 105ºC	17	-	22.8	
Ip(ss)	supply current, steady state	note 1	-	-	6	mA
Ip-|Im|	supply current, motor active	|Im|<400mA; note 2	-	-	40	mA
		|Im|<900mA; note 2	-	-	80	
Setting input (SET)						
Vset	operating voltage		0.05Vp	-	0.95Vp	V
Iset	input current	Rset>10kΩ	-50	-	50	μA
Vset(sc)	wire short-circuited to ground threshold	output stages switched off	-	-	0.4	V
	wire short-circuited to battery threshold	output stages switched off	Vp	-	-	
ΔVset	broken ground set pull-up	note 3	-	-	160	mV
Feedback input (FB)						
Vfb	operating voltage		0.05Vp	-	0.95Vp	V
Ifb(max)	maximum input current	Rfb>10kΩ	-0.1	-	0.1	μA
Motor outputs						
|Vm|	output voltage	|Im|<700mA, Tamb = 25ºC, note 2	Vp-2.5	-	-	V
		|Im|<700mA, Tamb = -40 to 105ºC, note 2	Vp-2.9	-	-	
|Im|	output current	Vp≥12.3V, Tamb = 25ºC, note 2	700	-	-	mA
		Vp≥12.3V, Tamb = -40 to 105ºC, note 2	670	-	-	

ELECTRICAL CHARACTERISTICS (continue)

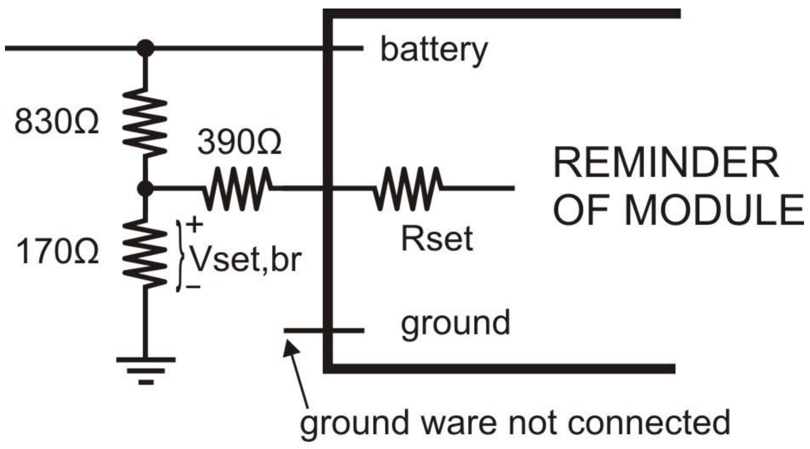
Vp = 12V, R_L = 14Ω, Rset = Rfb = 10kΩ. All voltages defined with respect to ground. Positive currents flow into the device. Unless otherwise specified.

Reference current						
|Iset|	motor switch-on level	Vp = 12V	6	9	12	μA
		Vp = 18V	9	13.5	18	
	motor switch-off level		-	2.5	-	μA
Thermal protection						
Tj(sd)	Thermal shutdown junction temperature	T increasing	-	160	-	˚C
Tj(so)	Thermal switch-on junction temperature	T decreasing	-	130	-	

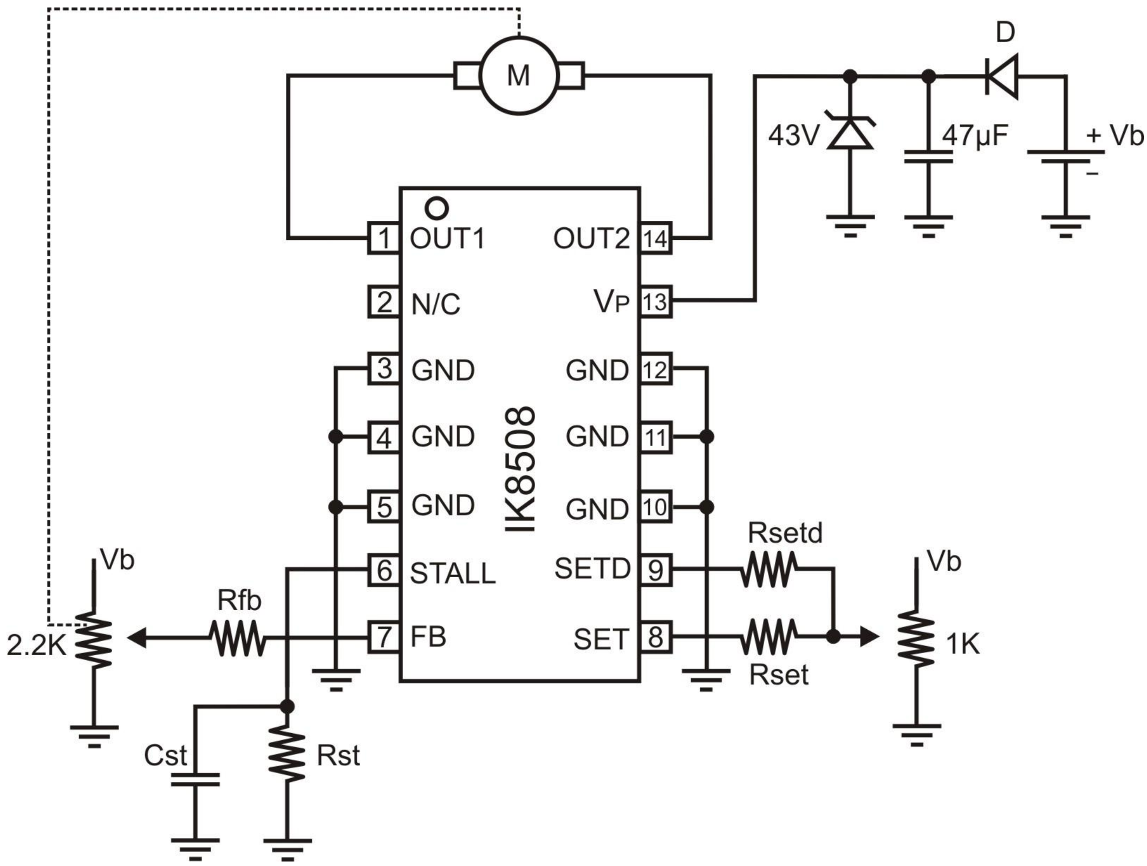
Notes:

1. Steady state implies that the motor is not running (Im = 0) Vset = Vfb = 0.5Vp.
2. This is only valid when the temperature protection is not active.
3. ∆Vset is the difference in voltage on the set potentiometer between the situation when the ground ware is interrupted (Vset,br) and voltage on the set potentiometer during normal operation (Vset = 0.17 Vb = 2.72 V).

The conditions for this test are Rset = 10kΩ, Vb = 16V, ∆Vset = Vset, br-2.72.



APPLICATION CIRCUIT



The resistor in the input line Rsetd is present to limit the current during the transients and should have a value near 2KΩ.

The resistor in the feedback input line Rfb is present to limit the current during the transients and should have a value lager than 2KΩ.

The resistor in the set input line Rset is present to set the voltage hysteresis and must be larger than 2KΩ.

A diode placed in series with the supply line to protect the device from reverse polarity switching.

STALL COUNTER

The stall counter can start from two events – over temperature ($T \geq 160°C$) or over load current (stall current). The resistor for setting the current threshold is:

$$Rst \cong 17000 \times (Vb-0.7) / Ist,$$

where:
Vb – battery voltage;
Ist – motor stall current.

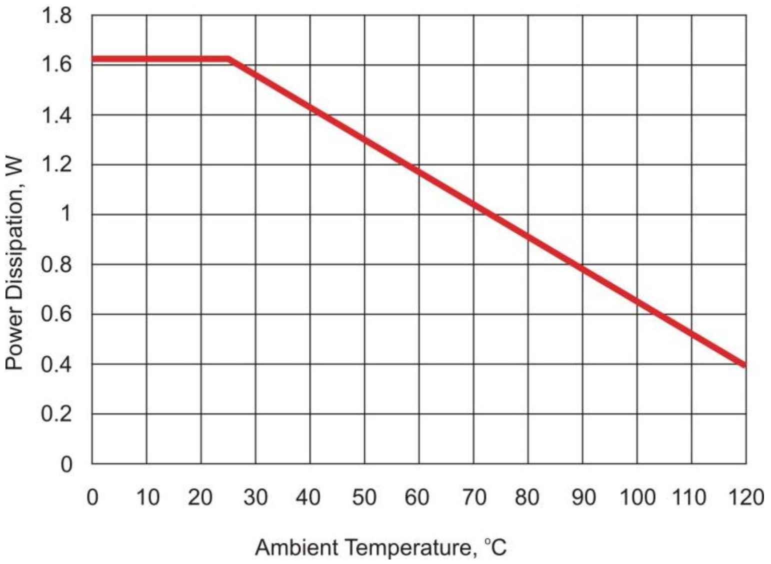
Example:

By the formula
$Rst \cong 17000 \times (Vb-0.7) / Ist$,
Components of the Demo board are:
Rst = 2M
Cst = 2.2uF

THERMAL ASPECTS

The maximum power dissipation is decreases as the ambient temperature increases.

PD(max) = (Tj,max – Ta) / Rth(j-a) (1)



The actual power dissipation of the device is the sum of two sources: the supply current ($I_P - |Im|$) times the supply voltage (V_P) plus the motor current ($|Im|$) times the output saturation voltage ($V_P - |Vm|$).

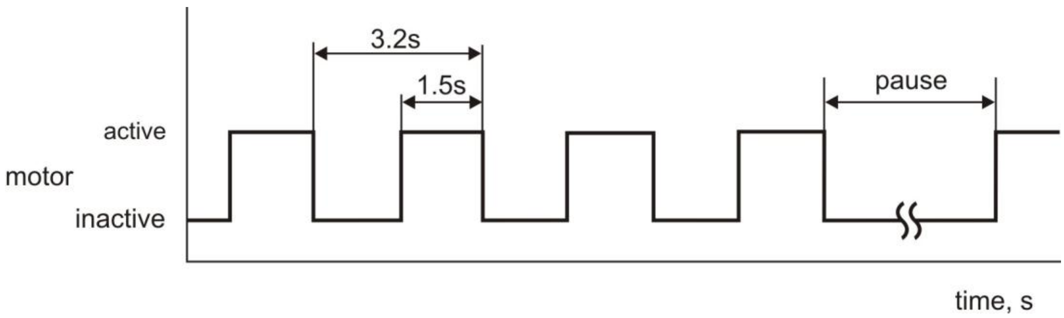
In formula:

PD = Vp × (Ip - |Im|) + |Im| × (Vp - |Vm|)   (2)

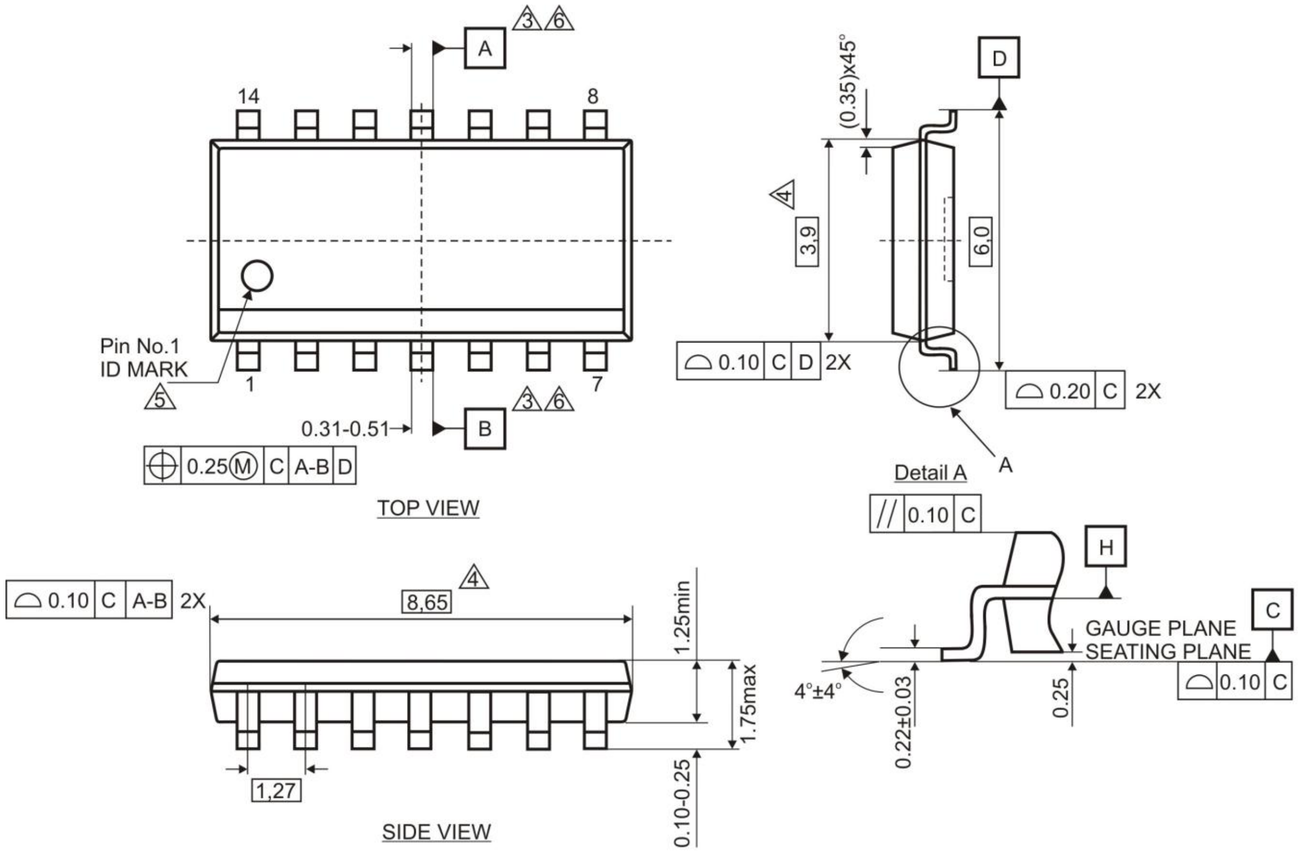
(Vp – |Vm|) = 2.5V do not allow at Tamb = 105°C.

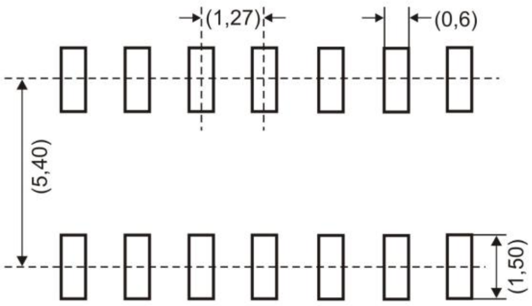
However, it is also improbable that the motor continuously driven, therefore the following assumptions have been made.

It is assumed that the device must be capable of moving the motor from one end to the other in four equal steps. After this excursion, a pause is needed before the same pulses are used to return to the original position. This operation is illustrated in the below Figure.



14 LEAD NARROW BODY SMALL OUTLINE PLASTIC PACKAGE





TYPICAL RECOMMENDED LAND PATTERN

NOTES:
1. Dimensions are in millimeters.
   Dimensions in ( ) for reference only.
2. Dimensioning and tolerancing per ASMEY14.5M-1994.
3. Datum A and B to be determined at Datum H.
4. Dimensions does not include interlead flash or protrusions. Interlead flash or protrusions shall not exceed 0.25 mm per side.
5. The Pin 1 identifier may be either a mold or a mark feature.
6. Does not include dambar protrusion. allowable dambar protrusion shall be 0.10mm total in excess of lead width at maximum conditions.
7. Reference to JEDEC MS-012-AB.