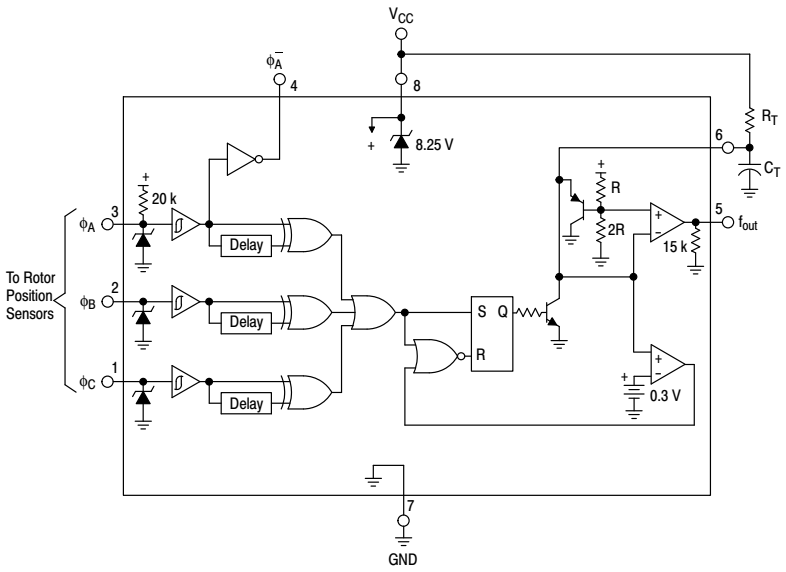
MC33039, NCV33039

Closed Loop Brushless Motor Adapter

The MC33039 is a high performance closed−loop speed control adapter specifically designed for use in brushless DC motor control systems. Implementation will allow precise speed regulation without the need for a magnetic or optical tachometer. This device contains three input buffers each with hysteresis for noise immunity, three digital edge detectors, a programmable monostable, and an internal shunt regulator. Also included is an inverter output for use in systems that require conversion of sensor phasing. Although this device is primarily intended for use with the MC33035 brushless motor controller, it can be used cost effectively in many other closed−loop speed control applications.

Features

- Digital Detection of Each Input Transition for Improved Low Speed Motor Operation
- TTL Compatible Inputs With Hysteresis
- Operation Down to 5.5 V for Direct Powering from MC33035 Reference
- Internal Shunt Regulator Allows Operation from a Non−Regulated Voltage Source
- Inverter Output for Easy Conversion between 60°/300° and 120°/240° Sensor Phasing Conventions
- Pb−Free Packages are Available

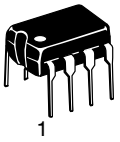


Representative Block Diagram

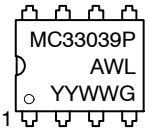
ON Semiconductor®

http://onsemi.com

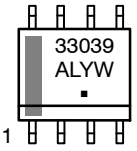
MARKING DIAGRAMS



PDIP−8
P SUFFIX
CASE 626

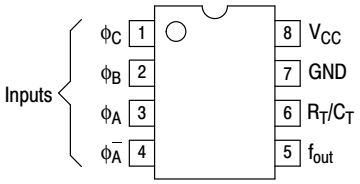


SOIC−8
D SUFFIX
CASE 751



A = Assembly Location
WL, L = Wafer Lot
YY, Y = Year
WW, W = Work Week
G or ▪ = Pb−Free Package

PIN CONNECTIONS



ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
V_{CC} Zener Current	$I_{Z(V_{CC})}$	30	mA
Logic Input Current (Pins 1, 2, 3)	I_{IH}	5.0	mA
Output Current (Pins 4, 5), Sink or Source	I_{DRV}	20	mA
Power Dissipation and Thermal Characteristics Maximum Power Dissipation @ T_A = + 85°C Thermal Resistance, Junction−to−Air	 P_D $R_{\theta JA}$	 650 100	 mW °C/W
Operating Junction Temperature	T_J	+150	°C
Operating Ambient Temperature Range MC33039 NCV33039	T_A	 −40 to +85 −40 to +125	°C
Storage Temperature Range	T_{stg}	−65 to +150	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

ELECTRICAL CHARACTERISTICS (V_{CC} = 6.25 V, R_T = 10 k, C_T = 22 nF, T_A = 25°C, unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
LOGIC INPUTS					
Input Threshold Voltage					V
High State	V_{IH}	2.4	2.1	–	
Low State	V_{IL}	–	1.4	1.0	
Hysteresis	V_H	0.4	0.7	0.9	
Input Current	I_{IH}				μA
High State (V_{IH} = 5.0 V)					
ϕ_A		− 40	− 60	− 80	
ϕ_B, ϕ_C		–	− 0.3	− 5.0	
Low State (V_{IL} = 0 V)	I_{IL}				
ϕ_A		− 190	− 300	− 380	
ϕ_B, ϕ_C		–	− 0.3	− 5.0	
MONOSTABLE AND OUTPUT SECTIONS					
Output Voltage	V_{OH}				V
High State					
f_{out} (I_{source} = 5.0 mA)		3.60	3.95	4.20	
$\overline{\phi_A}$ (I_{source} = 2.0 mA)		4.20	4.75	–	
Low State	V_{OL}				
f_{out} (I_{sink} = 10 mA)		–	0.25	0.50	
$\overline{\phi_A}$ (I_{sink} = 10 mA)		–	0.25	0.50	
Capacitor C_T Discharge Current	I_{dischg}	20	35	60	mA
Output Pulse Width (Pin 5)	t_{PW}	205	225	245	μs
POWER SUPPLY SECTION					
Power Supply Operating Voltage Range MC33039 (T_A = −40° to +85°C) NCV33039 (T_A = −40° to +125°C)	V_{CC}	5.5	–	V_Z	V
Power Supply Current	I_{CC}	1.8	3.9	5.0	mA
Zener Voltage (I_Z = 10 mA)	V_Z	7.5	8.25	9.0	V
Zener Dynamic Impedance (ΔI_Z = 10 mA to 20 mA, f ≤ 1.0 kHz)	$\lvert Z_{ka} \rvert$	–	2.0	5.0	Ω

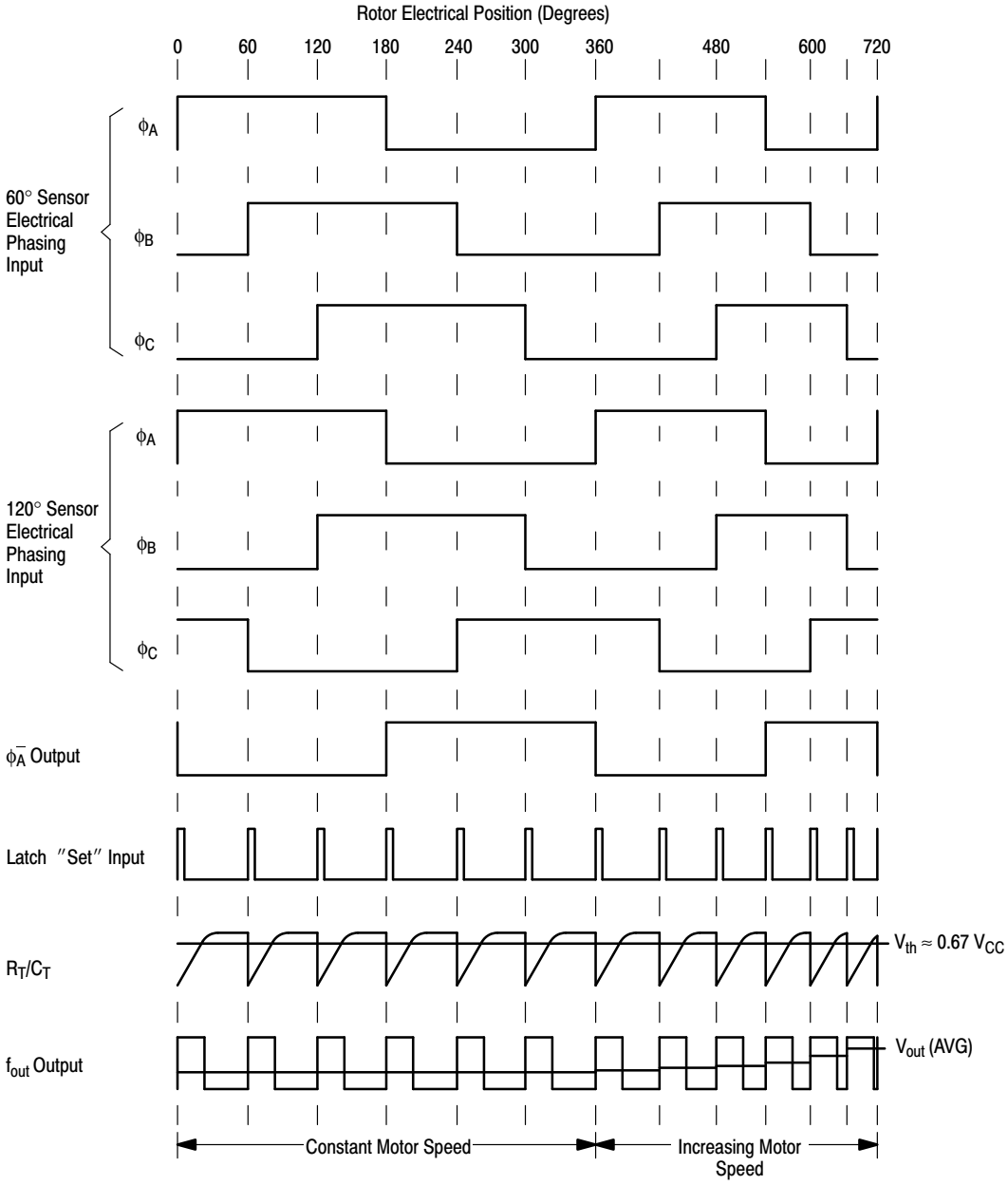


Figure 1. Typical Three Phase, Six Step Motor Application

OPERATING DESCRIPTION

The MC33039 provides an economical method of implementing closed−loop speed control of brushless DC motors by eliminating the need for a magnetic or optical tachometer. Shown in the timing diagram of Figure 1, the three inputs (Pins 1, 2, 3) monitor the brushless motor rotor position sensors. Each sensor signal transition is digitally detected, OR′ed at the Latch ′Set′ Input, and causes C_T to discharge. A corresponding output pulse is generated at f_{out} (Pin 5) of a defined amplitude, and programmable width determined by the values selected for R_T and C_T (Pin 6). The average voltage of the output pulse train increases with motor speed. When fed through a low pass filter or integrator, a DC voltage proportional to speed is generated. Figure 2 shows the proper connections for a typical closed loop application using the MC33035 brushless motor controller. Constant speed operation down to 100 RPM is possible with economical three phase four pole motors.

The ϕ_A inverter output (Pin 4) is used in systems where the controller and motor sensor phasing conventions are not compatible. A method of converting from either convention to the other is shown in Figure 3. For a more detailed explanation of this subject, refer to the text above Figure 39 on the MC33035 data sheet.

The output pulse amplitude V_{OH} is constant with temperature and controlled by the supply voltage on V_{CC} (Pin 8). Operation down to 5.5 V is guaranteed over temperature. For systems without a regulated power supply, an internal 8.25 V shunt regulator is provided.

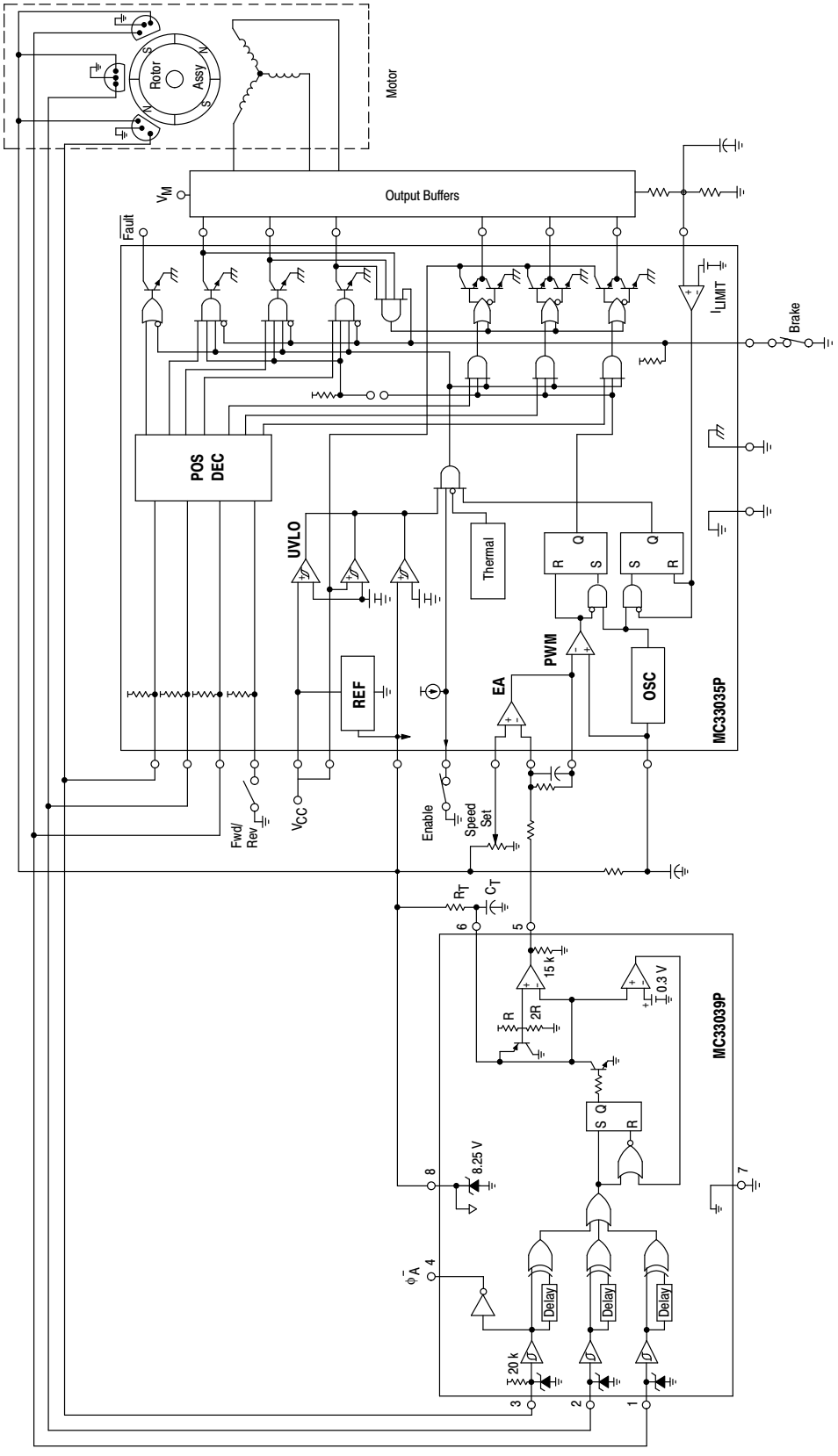


Figure 2. Typical Closed Loop Speed Control Application

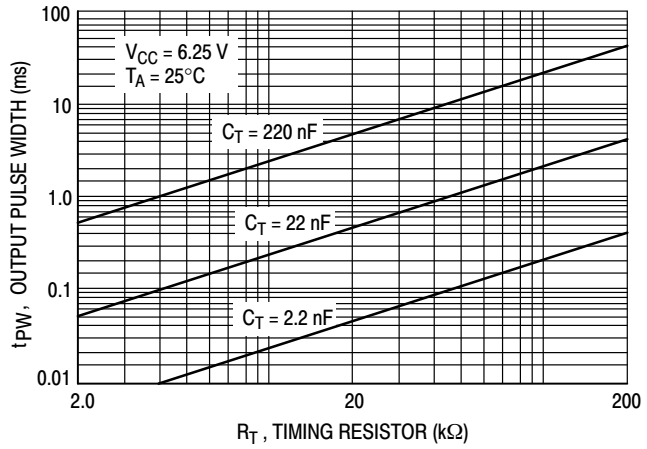


Figure 3. f_{out}, Pulse Width versus Timing Resistor

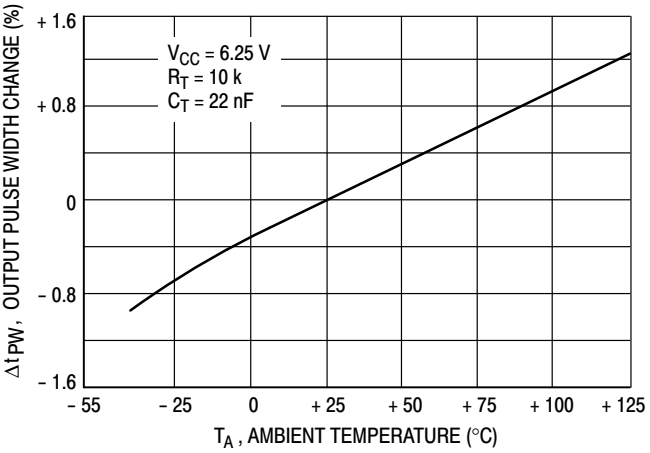


Figure 4. f_{out}, Pulse Width Change versus Temperature

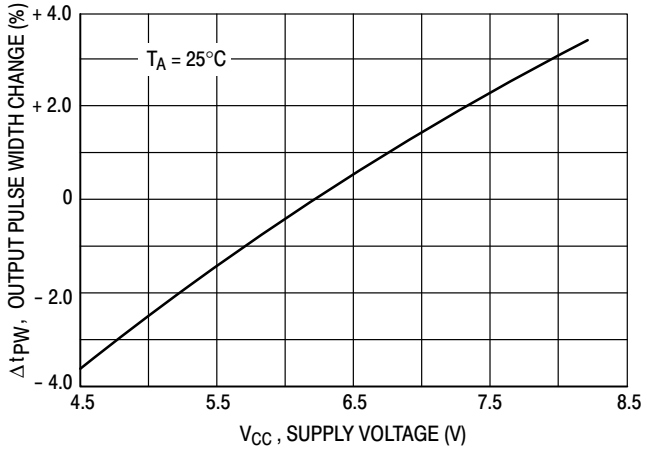


Figure 5. f_{out}, Pulse Width Change versus Supply Voltage

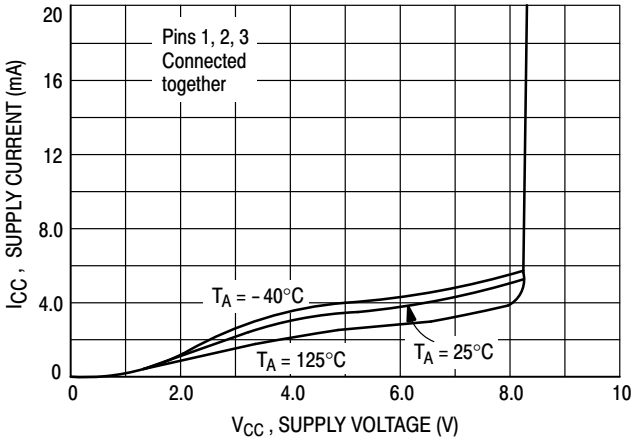


Figure 6. Supply Current versus Supply Voltage

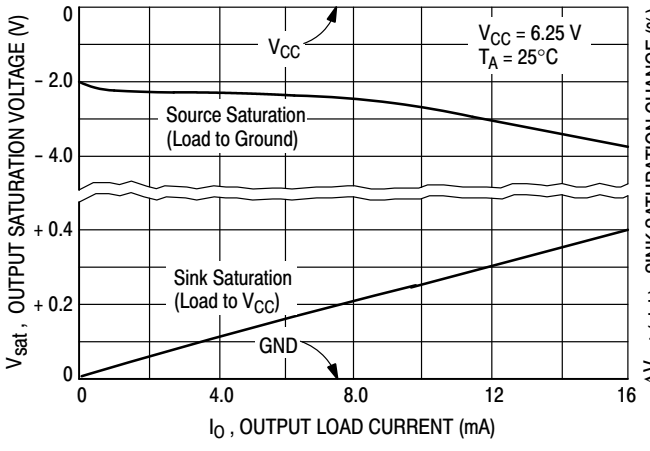


Figure 7. f_{out}, Saturation versus Load Current

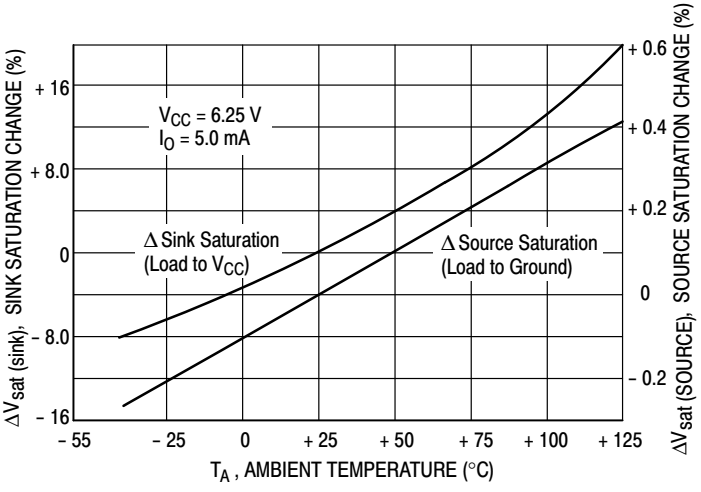


Figure 8. f_{out}, Saturation Change versus Temperature

ORDERING INFORMATION

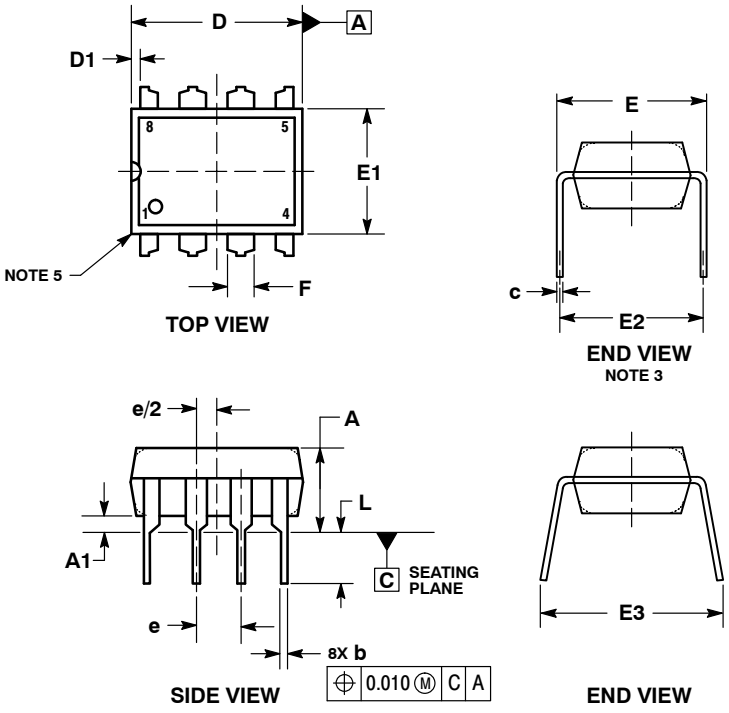
Device	Operating Temperature Range	Package	Shipping†
MC33039D	T_A = −40°C to +85°C	SOIC−8	98 Units / Rail
MC33039DG			
MC33039DR2			2500 / Tape & Reel
MC33039DR2G			
MC33039P		PDIP−8	50 Units / Rail
MC33039PG			
NCV33039DR2*	T_A = −40°C to +125°C	SOIC−8	2500 / Tape & Reel
NCV33039DR2G*			

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

*NCV33039: T_{low} = −40C, T_{high} = +125C. Guaranteed by design. NCV prefix is for automotive and other applications requiring site and change control.

PACKAGE DIMENSIONS

P SUFFIX
CASE 626−05
ISSUE M

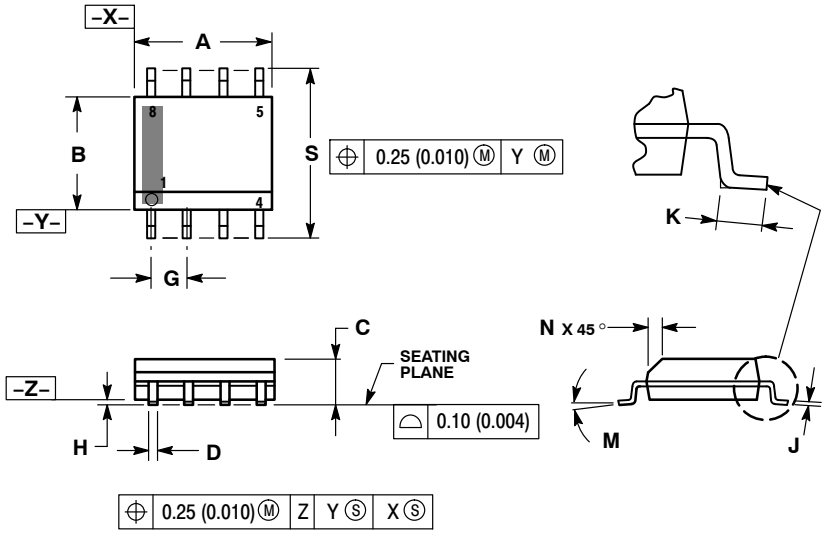


NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. DIMENSION E IS MEASURED WITH THE LEADS RESTRAINED PARALLEL AT WIDTH E2.
4. DIMENSION E1 DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

	INCHES			MILLIMETERS		
DIM	MIN	NOM	MAX	MIN	NOM	MAX
A	–––	–––	0.210	–––	–––	5.33
A1	0.015	–––	–––	0.38	–––	–––
b	0.014	0.018	0.022	0.35	0.46	0.56
C	0.008	0.010	0.014	0.20	0.25	0.36
D	0.355	0.365	0.400	9.02	9.27	10.02
D1	0.005	–––	–––	0.13	–––	–––
E	0.300	0.310	0.325	7.62	7.87	8.26
E1	0.240	0.250	0.280	6.10	6.35	7.11
E2	0.300 BSC			7.62 BSC		
E3	–––	–––	0.430	–––	–––	10.92
e	0.100 BSC			2.54 BSC		
L	0.115	0.130	0.150	2.92	3.30	3.81

PACKAGE DIMENSIONS

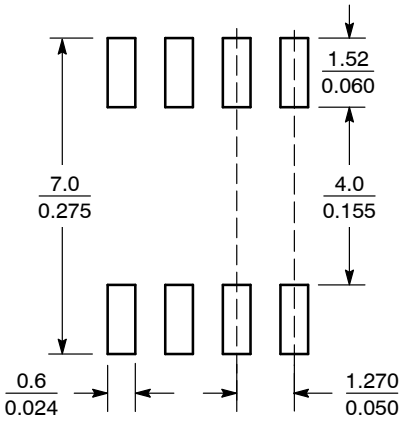
SOIC−8 NB
CASE 751−07
ISSUE AK



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751−01 THRU 751−06 ARE OBSOLETE. NEW STANDARD IS 751−07.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.197
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.020
G	1.27 BSC		0.050 BSC	
H	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
K	0.40	1.27	0.016	0.050
M	0 °	8 °	0 °	8 °
N	0.25	0.50	0.010	0.020
S	5.80	6.20	0.228	0.244

SOLDERING FOOTPRINT*



SCALE 6:1 (mm / inches)

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303−675−2175 or 800−344−3860 Toll Free USA/Canada
Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800−282−9855 Toll Free USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81−3−5817−1050

ON Semiconductor Website: **www.onsemi.com**

Order Literature: http://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative