

# MC145583

## Product Preview

### 3.3 Volt Only

### Driver/Receiver with an

### Integrated Standby Mode

### EIA-232-E and CCITT V.28

The MC145583 is a CMOS transceiver composed of three drivers and five receivers that fulfills the electrical specifications of EIA-232-E, EIA-562, and CCITT V.28 while operating from a single + 3.3 or + 5.0 V power supply. This transceiver is a high-performance, low-power consumption device that is equipped with a standby function.

A voltage tripler and inverter converts the + 3.3 V to  $\pm 8.8$  V, or a voltage doubler and inverter converts the + 5.0 V to  $\pm 8.8$  V. This is accomplished through an on-chip 40 kHz oscillator and five inexpensive external capacitors.

#### Drivers:

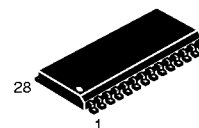
- $\pm 5$  V Minimum Output Swing at 3.3 or 5.0 V Power Supply
- 300  $\Omega$  Power-Off Impedance
- Output Current Limiting
- Three-State Outputs During Standby Mode

#### Receivers:

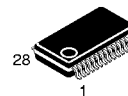
- $\pm 25$  V Input Range
- 3 to 7 k $\Omega$  Input Impedance
- 0.8 V Hysteresis for Enhanced Noise Immunity
- Three-State Outputs During Standby Mode

#### Ring Monitor Circuit:

- Invert the Input Level on Rx1 to Logic Output Level on RIMON at Standby Mode



**DW SUFFIX**  
SOG PACKAGE  
CASE 751F

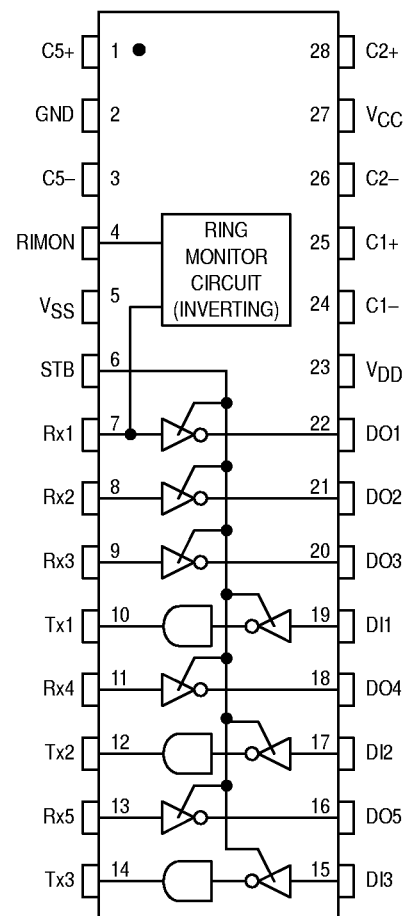


**VF SUFFIX**  
SSOP  
CASE 940J

#### ORDERING INFORMATION

MC145583DW SOG Package  
MC145583VF SSOP

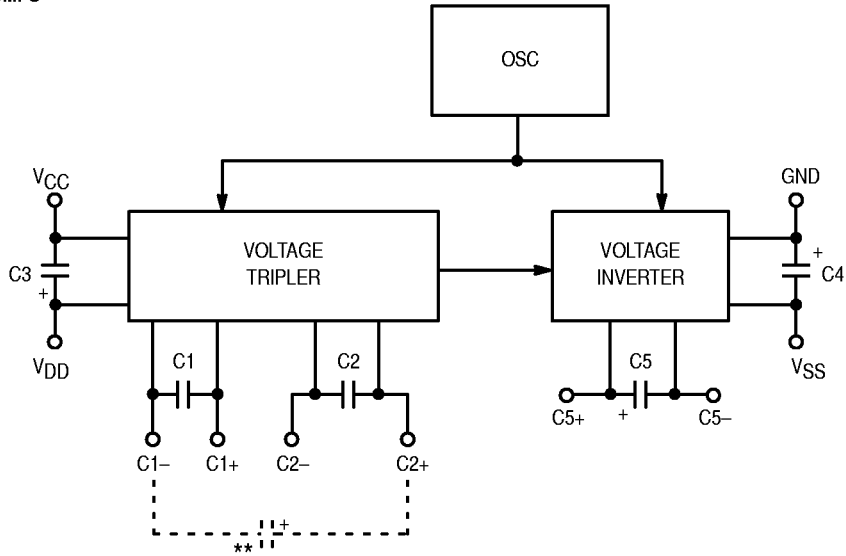
#### PIN ASSIGNMENT



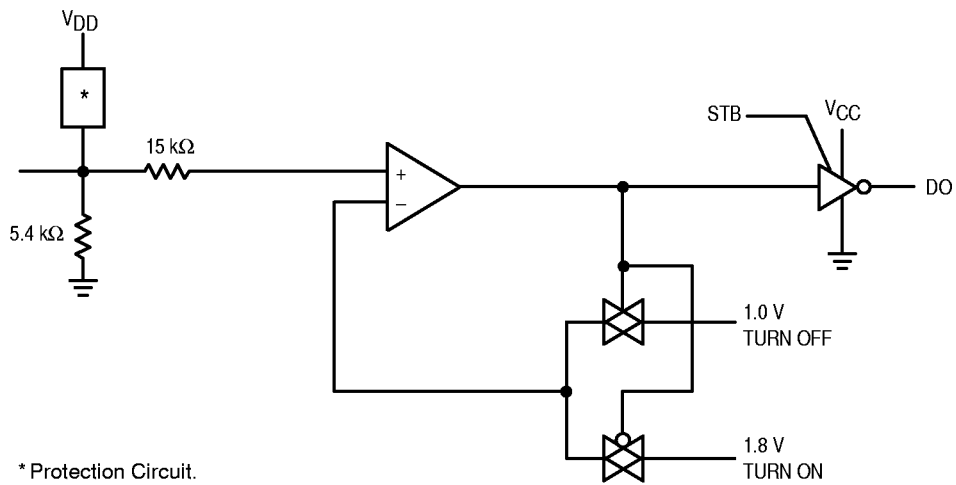
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## FUNCTION DIAGRAM

### CHARGE PUMPS

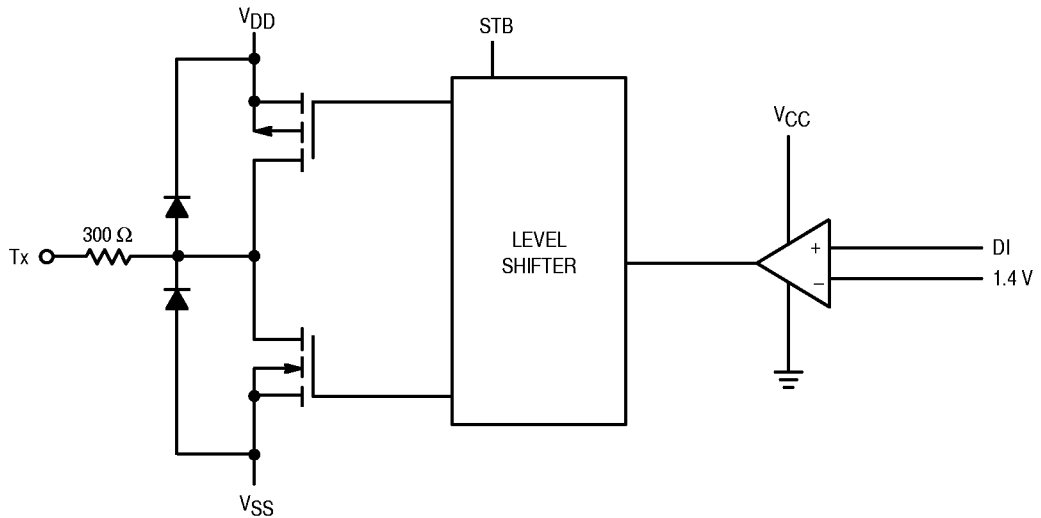


### RECEIVER



\* Protection Circuit.  
 \*\* Capacitors C1 and C2 are replaced by a 1  $\mu$ F capacitor at  $V_{CC} = 5.0$  V supply.

### DRIVER



**MAXIMUM RATINGS** (Voltage polarities referenced to GND)

Rating	Symbol	Value	Unit
DC Supply Voltage	$V_{CC}$	- 0.5 to + 6.0	V
Input Voltage Rx1 – Rx5 Inputs DI1 – DI3 Inputs	$V_{IR}$	$V_{SS} - 15$ to $V_{DD} + 15$ - 0.5 to $V_{CC} + 0.5$	V
DC Current per Pin	I	± 100	mA
Power Dissipation	$P_D$	1	W
Operating Temperature Range	$T_A$	- 40 to + 85	°C
Storage Temperature Range	$T_{stg}$	- 85 to + 150	°C

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation, it is recommended that the voltage at the DI and DO pins be constrained to the range  $GND \leq V_{DI} \leq V_{CC}$  and  $GND \leq V_{DO} \leq V_{CC}$ . Also, the voltage at the Rx pin should be constrained to  $(V_{SS} - 15 V) \leq V_{Rx1} - Rx5 \leq (V_{DD} + 15 V)$ , and Tx should be constrained to  $V_{SS} \leq V_{Tx1} - Tx3 \leq V_{DD}$ .

Unused inputs must always be tied to an appropriate logic voltage level (e.g., GND or  $V_{CC}$  for DI, and GND for Rx).

**RECOMMENDED OPERATING LIMITS**

Parameter	Symbol	Min	Typ	Max	Unit
Power Supply	$V_{CC}$ $V_{CC}^*$	3.0 4.5	3.3 5.0	3.6 5.5	V
Operating Temperature Range	$T_A$	- 40	—	85	°C

\* Capacitors C1 and C2 are replaced by a 1  $\mu$ F capacitor at  $V_{CC} = 5$  V.

**DC ELECTRICAL CHARACTERISTICS** (Voltage polarities referenced to GND = 0 V; C1 – C5 = 1  $\mu$ F;  $T_A = 25^\circ\text{C}$ )

Parameter	Symbol	Min	Typ	Max	Unit
DC Power Supply	$V_{CC}$	3.0	3.3	3.6	V
Quiescent Supply Current (Output Unloaded, Input Low)	$I_{CC}$	—	2.8	6.0	mA
Quiescent Supply Current (Standby Mode; STB = 1, Output Unloaded)	$I_{CC(STB)}$	—	< 5	10	$\mu$ A
Control Signal Input Voltage (STB)	$V_{IL}$ $V_{IH}$	— $V_{CC} - 0.5$	— —	0.5 —	V
Control Signal Input Current (STB)	$I_{IL}$ $I_{IH}$	— —	— —	10 10	$\mu$ A
Charge Pumps Output Voltage ( $V_{CC} = 3$ V; C1, C2, C3, C4, C5 = 1 $\mu$ F) Output Voltage ( $V_{DD}$ ) $I_{load} = 0$ mA $I_{load} = 6$ mA	$V_{DD}$	8.5 7.5	8.8 7.9	— —	V
Output Voltage ( $V_{SS}$ ) $I_{load} = 0$ mA $I_{load} = 6$ mA	$V_{SS}$	— —	- 8.8 - 7.8	- 8.5 - 7.0	V

**RECEIVER ELECTRICAL SPECIFICATIONS**

(Voltage polarities referenced to GND = 0 V;  $V_{CC} = + 3.3$  V  $\pm$  10%; C1 – C5 = 1  $\mu$ F;  $T_A = 25^\circ\text{C}$ )

Parameter	Symbol	Min	Typ	Max	Unit
Input Turn-On Threshold ( $V_{DO1} - DO5 = V_{OL}$ ; Rx1 – Rx5) 3.3 V 5.0 V	$V_{on}$	1.35 2.00	1.8 2.5	2.35 3.10	V
Input Turn-Off Threshold ( $V_{DO1} - DO5 = V_{OH}$ ; Rx1 – Rx5) 3.3 V 5.0 V	$V_{off}$	0.75 1.20	1.0 1.5	1.25 1.80	V
Input Resistance	$R_{in}$	3	5.4	7	k $\Omega$
High-Level Output Voltage (DO1 – DO5) $V_{Rx1} - Rx5 = - 3$ to - 25 V $I_{out} = - 20$ $\mu$ A $I_{out} = - 1$ mA	$V_{OH}$	$V_{CC} - 0.1$ $V_{CC} - 0.6$	— 2.7	— —	V
Low-Level Output Voltage (DO1 – DO5) $V_{Rx1} - Rx5 = + 3$ to + 25 V $I_{out} = + 20$ $\mu$ A $I_{out} = + 1.6$ mA	$V_{OL}$	— —	0.01 0.5	0.1 0.7	V
Ring Monitor Circuit (Input Threshold)	$V_{TH}$	—	1.1	—	V
High-Level Output Voltage (RIMON) $I_{out} = - 20$ $\mu$ A $I_{out} = - 1$ mA	$V_{OH}$	$V_{CC} - 0.1$ $V_{CC} - 0.6$	— 2.7	— —	V
Low-Level Output Voltage (RIMON) $I_{out} = + 20$ $\mu$ A $I_{out} = + 1.6$ mA	$V_{OL}$	— —	0.01 0.5	0.1 0.7	V

## DRIVER ELECTRICAL SPECIFICATIONS

(Voltage polarities referenced to GND = 0 V;  $V_{CC} = +3.3\text{ V}$  or  $+5.0\text{ V} \pm 10\%$ ;  $C_1 - C_5 = 1\ \mu\text{F}$ ;  $T_A = 25^\circ\text{C}$ )

Parameter	Symbol	Min	Typ	Max	Unit
Digital Input Voltage Logic Low Logic High	$V_{IL}$ $V_{IH}$	— 1.8	— —	0.7 —	V
Digital Input Current $V_{DI} = \text{GND}$ $V_{DI} = V_{CC}$	$I_{IL}$ $I_{IH}$	— —	7 —	— $\pm 1.0$	$\mu\text{A}$
Output High Voltage Load on All Tx1 – Tx3, $R_L = 3\ \text{k}\Omega$ ; $C_P = 2500\ \text{pF}$ , $V_{DI1} - DI3 = \text{Logic Low}$ No Load	$V_{OH}$	5.0 8.5	7.0 8.8	— —	V
Output Low Voltage Load on All Tx1 – Tx3, $R_L = 3\ \text{k}\Omega$ ; $C_P = 2500\ \text{pF}$ , $V_{DI1} - DI3 = \text{Logic High}$ No Load	$V_{OL}$	— —	-7.0 -8.8	-5.0 -8.5	V
Ripple (Refer to $V_{DD} - V_{SS}$ Value) ***	$V_{RF}$	—	—	$\pm 5\%$	
Off Source Impedance Tx1 – Tx3	$Z_{off}$	300	—	—	$\Omega$
Output Short Circuit Current ( $V_{CC} = 3.3\text{ V}$ or $5.5\text{ V}$ ) Tx1 – Tx3 Shorted to GND* Tx1 – Tx3 Shorted to $\pm 15\text{ V}$ **	$I_{SC}$	— —	— —	$\pm 60$ $\pm 100$	$\text{mA}$

\* Specification is for one Tx output to be shorted at a time. Should all three driver outputs be shorted simultaneously, device power dissipation limits could be exceeded.

\*\* This condition could exceed package limitations.

\*\*\* Ripple  $V_{RF}$  would not exceed  $\pm 5\%$  of  $(V_{DD} - V_{SS})$ .

## SWITCHING CHARACTERISTICS ( $V_{CC} = +3.3\text{ V}$ or $+5\text{ V}$ , $\pm 10\%$ ; $C_1 - C_5 = 1\ \mu\text{F}$ ; $T_A = 25^\circ\text{C}$ )

Parameter	Symbol	Min	Typ	Max	Unit
<b>Drivers</b>					
Propagation Delay Time Low-to-High ( $R_L = 3\ \text{k}\Omega$ , $C_L = 50\ \text{pF}$ or $2500\ \text{pF}$ )	$t_{DPLH}$	—	0.5	1	$\mu\text{s}$
High-to-Low ( $R_L = 3\ \text{k}\Omega$ , $C_L = 50\ \text{pF}$ or $2500\ \text{pF}$ )	$t_{DPHL}$	—	0.5	1	
Output Slew Rate (Source $R = 300\ \Omega$ ) Loading: $R_L = 3 - 7\ \text{k}\Omega$ ; $C_L = 2500\ \text{pF}$	SR	$\pm 4$	—	$\pm 30$	$\text{V}/\mu\text{s}$
Output Disable Time*	$t_{DAZ}$	—	4	10	$\mu\text{s}$
Output Enable Time*	$t_{DZA}$	—	25	50	ms

## Receivers

Propagation Delay Time Low-to-High	$t_{RPLH}$	—	—	1	$\mu\text{s}$
High-to-Low	$t_{RPHL}$	—	—	1	
Output Rise Time	$t_r$	—	120	200	ns
Output Fall Time	$t_f$	—	40	100	ns
Output Disable Time*	$t_{RAZ}$	—	4	10	$\mu\text{s}$
Output Enable Time*	$t_{RZA}$	—	25	50	ms

\* Including the charge pump setup time.

## TRUTH TABLES

### Drivers

DI	STB	Tx
X	H	Z*
H	L	L
L	L	H

\*  $V_{SS} \leq V_{Tx} \leq V_{DD}$  X = Don't Care

### Receivers

Rx	STB	DO
X	H	Z*
H	L	L
L	L	H

\*  $\text{GND} \leq V_{DO} \leq V_{CC}$  X = Don't Care

## PIN DESCRIPTIONS

### V<sub>CC</sub>

#### Digital Power Supply (Pin 27)

This digital supply pin is connected to the logic power supply. This pin should have a not less than 0.33  $\mu\text{F}$  capacitor GND.

### GND

#### Ground (Pin 2)

Ground return pin is typically connected to the signal ground pin of the EIA-232-E connector (Pin 7) as well as to the logic power supply ground.

### V<sub>DD</sub>

#### Positive Power Supply (Pin 23)

This is the positive output of the on-chip voltage tripler and the positive power supply input of the driver/receiver sections of the device. This pin requires an external storage capacitor to filter the 50% duty cycle voltage generated by the charge pump.

### V<sub>SS</sub>

#### Negative Power Supply (Pin 5)

This is the negative output of the on-chip voltage tripler/inverter and the negative power supply input of the driver/receiver sections of the device. This pin requires an external storage capacitor to filter the 50% duty cycle voltage generated by the charge pump.

### RIMON

#### Ring Monitor Circuit (Pin 4)

The Ring Monitor Circuit will convert the input level on Rx1 pin at standby mode and output on the RIMON pin.

### STB

#### Standby Mode (Pin 6)

The device enters the standby mode while this pin is connected to the logic high level. During the standby mode,

driver and receiver output pins become high-impedance state. In this condition, supply current  $I_{CC}$  is below 5  $\mu\text{A}$  (typ).

### C5+, C5-, C2+, C2-, C1+, C1-

#### Voltage Tripler and Inverter (Pins 1, 3, 28, 26, 25, 24)

These are the connections to the internal voltage tripler and inverter, which generate the V<sub>DD</sub> and V<sub>SS</sub> voltages.

### Rx1, Rx2, Rx3, Rx4, Rx5

#### Receive Data Inputs (Pins 7, 8, 9, 11, 13)

These are the EIA-232-E receive signal inputs. A voltage between +3 and +25 V is decoded as a space, and causes the corresponding DO pin to swing to GND (0 V). A voltage between -3 and -25 V is decoded as a mark, and causes the DO pin to swing up to V<sub>CC</sub>.

### DO1, DO2, DO3, DO4, DO5

#### Data Outputs (Pins 22, 21, 20, 18, 16)

These are the receiver digital output pins, which swing from V<sub>CC</sub> to GND. Output level of these pins is high impedance while in standby mode.

### DI1, DI2, DI3

#### Data Inputs (Pins 19, 17, 15)

These are the high impedance digital input pins to the drivers. Input voltage levels on these pins must be between V<sub>CC</sub> and GND.

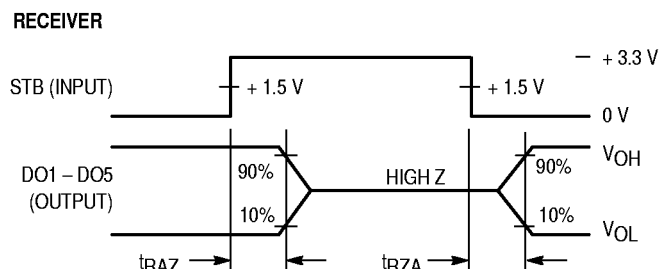
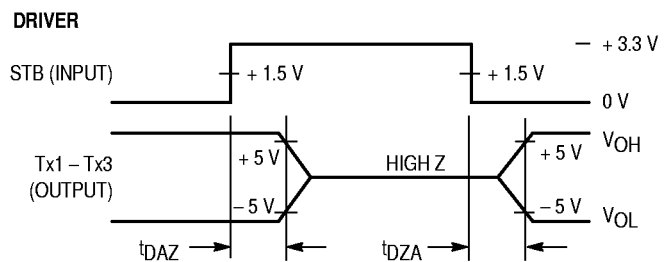
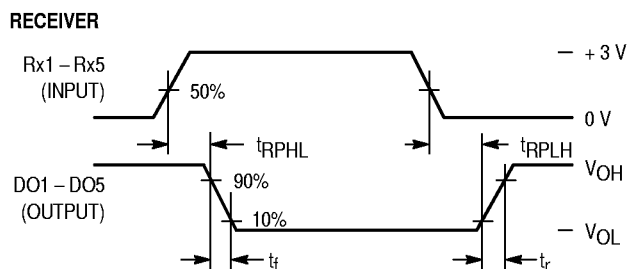
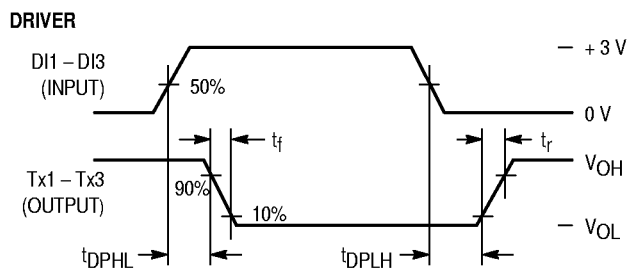
### Tx1, Tx2, Tx3

#### Transmit Data Output (Pins 10, 12, 14)

These are the EIA-232-E transmit signal output pins, which swing toward V<sub>DD</sub> and V<sub>SS</sub>. A logic 1 at a DI input causes the corresponding Tx output to swing toward V<sub>SS</sub>. The actual levels and slew rate achieved will depend on the output loading ( $R_L/C_L$ ).

The minimum output impedance is 300  $\Omega$  when turned off.

## SWITCHING CHARACTERISTICS



## ESD PROTECTION

ESD protection on IC devices that have their pins accessible to the outside world is essential. High static voltages applied to the pins when someone touches them either directly or indirectly can cause damage to gate oxides and transistor junctions by coupling a portion of the energy from the I/O pin to the power supply buses of the IC. This coupling

will usually occur through the internal ESD protection diodes which are designed to do just that. The key to protecting the IC is to shunt as much of the energy to ground as possible before it enters the IC. Figure 1 shows a technique which will clamp the ESD voltage at approximately  $\pm 15$  V using the MMBZ15VDLT1. Any residual voltage which appears on the supply pins is shunted to ground through the capacitors C1 and C2.

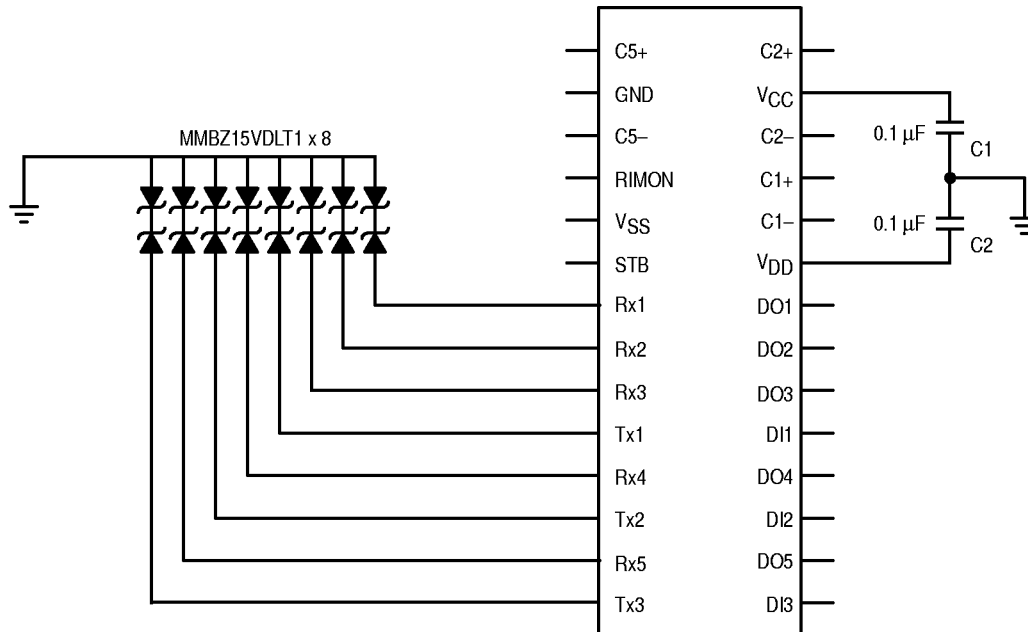
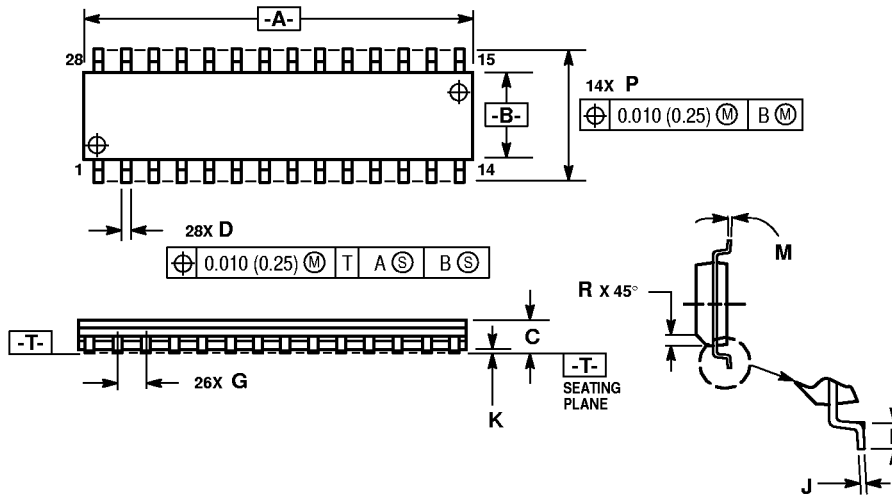


Figure 1. ESD Protection Scheme

# PACKAGE DIMENSIONS

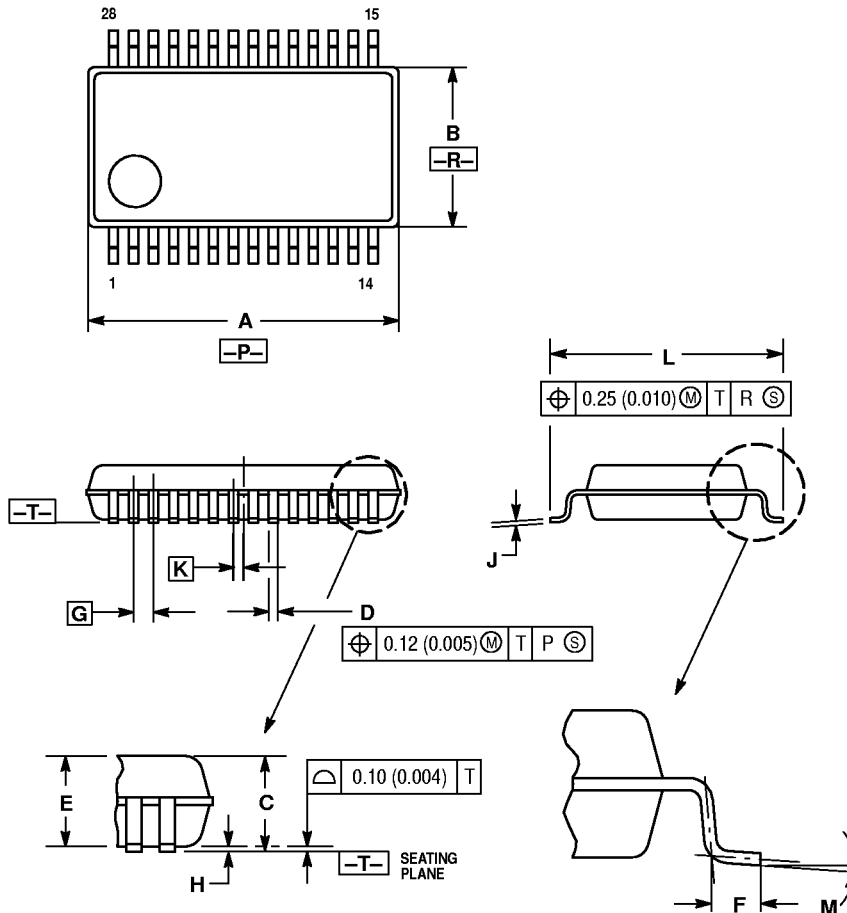
## DW SUFFIX SOG PACKAGE CASE 751F-04



- 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 0.13 (0.005) TOTAL IN EXCESS OF D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	17.80	18.05	0.701	0.711
B	7.40	7.60	0.292	0.299
C	2.35	2.65	0.093	0.104
D	0.35	0.49	0.014	0.019
F	0.41	0.90	0.016	0.035
G	1.27 BSC		0.050 BSC	
J	0.23	0.32	0.009	0.013
K	0.13	0.29	0.005	0.011
M	0°	8°	0°	8°
P	10.05	10.55	0.395	0.415
R	0.25	0.75	0.010	0.029

## VF SUFFIX SSOP CASE 940J-01



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION. MOLD PROTRUSION IS 0.15 (0.006) MAX PER SIDE.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	10.10	10.20	0.398	0.402
B	5.20	5.30	0.205	0.209
C	—	2.00	—	0.079
D	0.20	0.40	0.008	0.016
E	1.75	1.85	0.069	0.073
F	0.45	0.75	0.018	0.030
G	0.65 BSC		0.0256 BSC	
H	0.00	0.15	0.000	0.006
J	0.10	0.20	0.004	0.008
K	0.325 BSC		0.0128 BSC	
L	7.50	7.90	0.295	0.311
M	1°	7°	1°	7°