

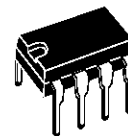
## CONTROL CIRCUIT FOR SWITCH MODE POWER SUPPLIES USING MOS TRANSISTORS

- FOLD-BACK CHARACTERISTIC PROVIDES OVERLOAD PROTECTION FOR EXTERNAL DIODES
- BURST OPERATION UNDER SHORT-CIRCUIT AND NO LOAD CONDITIONS
- LOOP ERROR PROTECTION
- SWITCH-OFF IN CASE OF TOO LOW LINE VOLTAGE (under voltage switch-off)
- LINE VOLTAGE COMPENSATION OF OVERLOAD POINT
- SOFT-START FOR SMOOTH START-UP
- CHIP OVER-TEMPERATURE PROTECTION (thermal shutdown)
- ON-CHIP PARASITIC TRANSFORMER OSCILLATION SUPPRESSION CIRCUITRY
- DECREASE OF REGULATED VOLTAGE FOR LOW POWER CONSUMPTION

### DESCRIPTION

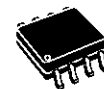
The IC TDA4605 controls the MOS Power Transistor and performs all necessary regulation and monitoring functions in free running flyback converters. Since good load regulation over a wide load range is attained, this IC is particularly suitable for Consumer as well as Industrial Power Supplies.

Alternative source of the TDA4605 is also available from SIEMENS Semiconductors Consumer Electronics A.G.



**DIP8**  
(Plastic Package)

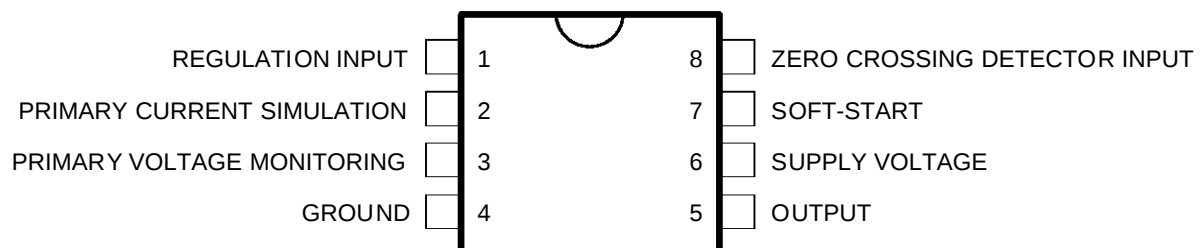
**ORDER CODE : TDA4605**



**SO8**  
(Plastic Micropackage)

**ORDER CODE : TDA4605D**

### PIN CONNECTIONS

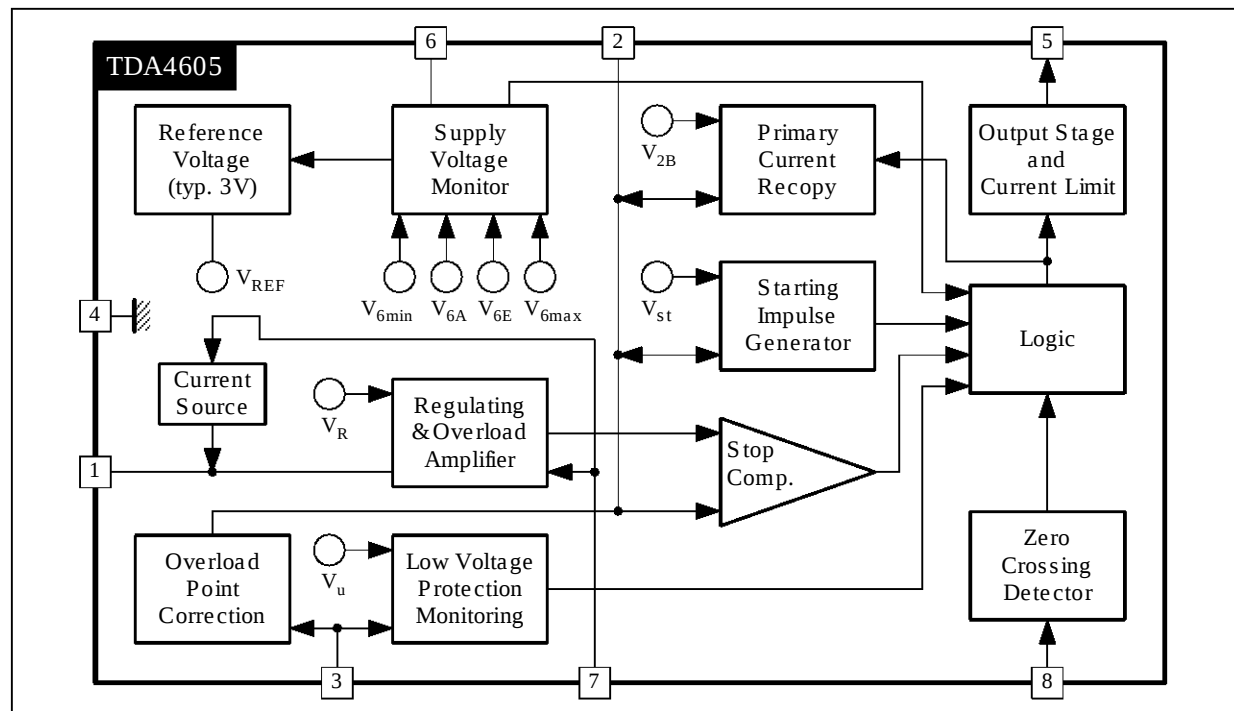


## PIN CONFIGURATION

| Pin Number | Description                                                                                                                                                                                                                                                                                                                                                                                         |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1          | Regulating voltage : information input concerning secondary voltage.<br>By comparing the regulating voltage obtained from the regulating winding of the transformer with the internal reference voltage, the output pulse width on Pin 5 is adapted to the load of the secondary side (normal, overload, short circuit, no load)                                                                    |
| 2          | Primary current simulation : information input regarding the primary current. The primary current rise in the primary winding is simulated at Pin 2 as a voltage rise by means of external RC element. When a value is reached that is derived from the regulating voltage at Pin 1, the output pulse at Pin 5 is terminated. The RC element serves to set the maximum power at the overload point. |
| 3          | Primary voltage detector : input for primary voltage monitoring. When the line voltage is too low the IC is switched-off by comparing $V_3$ with an internal reference. Voltage at Pin 3 is used for overload point compensation.                                                                                                                                                                   |
| 4          | Ground                                                                                                                                                                                                                                                                                                                                                                                              |
| 5          | Output : push-pull output for charge and discharge of the gate capacitance of the power MOS transistor.                                                                                                                                                                                                                                                                                             |
| 6          | Supply voltage : Supply voltage input. From it are derived a stable internal reference voltage ( $V_{REF}$ ) and the switching threshold $V_{6A}$ , $V_{6E}$ , $V_{6\max}$ and $V_{6\min}$ for the supply voltage detector.<br>if $V_6 > V_{6E}$ the $V_{REF}$ is switched on and switched off when $V_6 < V_{6A}$ . In addition the logic is only enable for $V_{6\min} < V_6 < V_{6\max}$ .       |
| 7          | Soft-start : input for soft-start and integration network. Start-up will begin with short pulses by connecting a capacitor between Pin 7 to ground. This capacitor together with a resistor connected between Pin 7 and error amplifier output also as acts an integrator network for regulation.                                                                                                   |
| 8          | Zero detector : Input for the oscillator feedback. After starting oscillator, every zero transit of the feedback voltage (falling edge) triggers an output pulse at Pin 5. The trigger threshold is at typically - 50mV                                                                                                                                                                             |

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## BLOCK DIAGRAM



4605-02.EPS

## ABSOLUTE MAXIMUM RATINGS

| Symbol           | Parameter                                         | Pin | Value      | Unit |
|------------------|---------------------------------------------------|-----|------------|------|
| V <sub>1</sub>   | Supply Voltage                                    | 1   | -0.3, +3   | V    |
| V <sub>2</sub>   |                                                   | 2   | -0.3       | V    |
| V <sub>3</sub>   |                                                   | 3   | -0.3       | V    |
| V <sub>4</sub>   |                                                   | 4   | -0.3       | V    |
| V <sub>6</sub>   |                                                   | 6   | -0.3, +20  | V    |
| V <sub>7</sub>   |                                                   | 7   | -0.3       | V    |
| I <sub>1</sub>   | Supply Current                                    | 1   | 3          | mA   |
| I <sub>2</sub>   |                                                   | 2   | 3          | mA   |
| I <sub>3</sub>   |                                                   | 3   | 3          | mA   |
| I <sub>4</sub>   |                                                   | 4   | -1.5       | A    |
| I <sub>5</sub>   |                                                   | 5   | -0.5, +1.5 | A    |
| I <sub>6</sub>   |                                                   | 6   | 0.5        | A    |
| I <sub>7</sub>   |                                                   | 7   | 3          | mA   |
| I <sub>8</sub>   |                                                   | 8   | -3, +3     | mA   |
| T <sub>j</sub>   | Junction Temperature (autom. thermal disjunction) |     | +125       | °C   |
| T <sub>stg</sub> | Storage Temperature                               |     | -40, +125  | °C   |

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## THERMAL DATA

| Symbol               | Parameter                           | Value    | Unit |
|----------------------|-------------------------------------|----------|------|
| R <sub>th(j-a)</sub> | Junction-ambient Thermal Resistance | 80       | °C/W |
| R <sub>th(j-c)</sub> | Junction-case Thermal Resistance    | 45       | °C/W |
| T <sub>amb</sub>     | Ambient Temperature                 | -20, +85 | °C   |

4605-03.TBL

ELECTRICAL CHARACTERISTICS (V<sub>CC</sub> = 10V, T<sub>amb</sub> = 25°C, unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------|-----------|-----------------|------|------|------|------|
|--------|-----------|-----------------|------|------|------|------|

## START-UP HYSTERESIS

|                  |                        |                                  |     |     |     |    |
|------------------|------------------------|----------------------------------|-----|-----|-----|----|
| I <sub>6E0</sub> | Start-up Current Drain | V <sub>6</sub> = V <sub>6E</sub> |     | 0.6 | 0.8 | mA |
| V <sub>6E</sub>  | Switch-on Voltage      |                                  | 11  | 12  | 13  | V  |
| V <sub>6A</sub>  | Switch-off Voltage     |                                  | 4.5 | 5   | 5.5 | V  |
| I <sub>6E1</sub> | Switch-on Current      | V <sub>6</sub> = V <sub>6E</sub> |     | 11  |     | mA |
| I <sub>6A1</sub> | Switch-off Current     | V <sub>6</sub> = V <sub>6A</sub> |     | 10  |     | mA |

VOLTAGE CLAMP (V<sub>6</sub> = 10V, IC Switched off)

|                      |                                              |                      |     |     |   |   |
|----------------------|----------------------------------------------|----------------------|-----|-----|---|---|
| V <sub>2(Max.)</sub> | At Pin 2 (V <sub>6</sub> < V <sub>6E</sub> ) | I <sub>2</sub> = 1mA | 5.6 | 6.6 | 9 | V |
| V <sub>3(Max.)</sub> | At Pin 3 (V <sub>6</sub> < V <sub>6E</sub> ) | I <sub>3</sub> = 1mA | 5.6 | 6.6 | 9 | V |

## CONTROL RANGE

|                 |                                                          |                                                                                    |     |     |     |    |
|-----------------|----------------------------------------------------------|------------------------------------------------------------------------------------|-----|-----|-----|----|
| V <sub>1R</sub> | Control Input Voltage                                    |                                                                                    | 400 | 410 | 420 | mV |
| -V <sub>R</sub> | Voltage Gain of the Control Circuit in the Control Range | V <sub>R</sub> = d(V <sub>2S</sub> - V <sub>2B</sub> )/dV <sub>1</sub><br>f = 1kHz |     | 43  |     | dB |

## PRIMARY CURRENT SIMULATION VOLTAGE

|                 |             |  |       |      |      |   |
|-----------------|-------------|--|-------|------|------|---|
| V <sub>2B</sub> | Basic Value |  | 0.955 | 1.00 | 1.03 | V |
|-----------------|-------------|--|-------|------|------|---|

## OVERLOAD RANGE AND SHORT CIRCUIT OPERATION

|                 |                                                              |                                         |      |      |      |   |
|-----------------|--------------------------------------------------------------|-----------------------------------------|------|------|------|---|
| V <sub>20</sub> | Peak Value in the Range of Secondary Overload                | V <sub>1</sub> = V <sub>1R</sub> - 10mV | 2.8  | 2.95 | 3.1  | V |
| DV <sub>2</sub> | Maximum Ramp Amplitude                                       | V <sub>20</sub> - V <sub>2B</sub>       | 1.82 | 1.95 | 2.08 | V |
| V <sub>2S</sub> | Peak Value in the Range of Secondary Short Circuit Operation | V <sub>1</sub> = 0                      | 2.3  | 2.5  | 2.7  | V |

## FOLDBACK POINT CORRECTION

|                 |                                   |                       |     |     |     |    |
|-----------------|-----------------------------------|-----------------------|-----|-----|-----|----|
| -I <sub>2</sub> | Foldback Point Correction Current | V <sub>3</sub> = 3.7V | 300 | 500 | 650 | μA |
|-----------------|-----------------------------------|-----------------------|-----|-----|-----|----|

4605-04.TBL

**ELECTRICAL CHARACTERISTICS** ( $V_{CC} = 10V$ ,  $T_{amb} = 25^{\circ}C$ , unless otherwise specified) (continued)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------|-----------|-----------------|------|------|------|------|
|--------|-----------|-----------------|------|------|------|------|

GENERALLY VALID DATA ( $V_6 = 10V$ )  
VOLTAGE OF THE ZERO Transition DETECTOR

|          |                                    |              |    |      |     |         |
|----------|------------------------------------|--------------|----|------|-----|---------|
| $V_{8P}$ | Positive Clamping Voltage          | $I_8 = 1mA$  |    | 0.75 |     | V       |
| $V_{8N}$ | Negative Clamping Voltage          | $I_8 = -1mA$ |    | -0.2 |     | V       |
| $V_{8S}$ | Threshold Value                    |              | 40 | 50   |     | mV      |
| TUL      | Suppression of Transformer Ringing |              | 3  | 3.8  | 4.5 | $\mu s$ |
| $-I_8$   | Input Current                      | $V_8 = 0$    | 0  |      | 4   | $\mu V$ |

PUSH-PULL OUTPUT STAGE  
SATURATION VOLTAGES

|            |                |               |  |     |     |   |
|------------|----------------|---------------|--|-----|-----|---|
| $V_{SatU}$ | Pin 5 Sourcing | $I_5 = -0.1A$ |  | 1.5 | 2.0 | V |
| $V_{SatU}$ | Pin 5 Sinking  | $I_5 = +0.1A$ |  | 1.0 | 1.2 | V |
| $V_{SatU}$ | Pin 5 Sinking  | $I_5 = +0.5A$ |  | 1.4 | 1.8 | V |

OUTPUT SLOW RATE

|            |              |  |  |     |  |           |
|------------|--------------|--|--|-----|--|-----------|
| $+dV_5/dt$ | Rising Edge  |  |  | 70  |  | $V/\mu s$ |
| $-dV_5/dt$ | Falling Edge |  |  | 100 |  | $V/\mu s$ |

REDUCTION OF CONTROL VOLTAGE

|        |                                       |            |  |    |  |         |
|--------|---------------------------------------|------------|--|----|--|---------|
| $-I_1$ | Current to reduce the Control Voltage | $V_7 = 1V$ |  | 50 |  | $\mu A$ |
|--------|---------------------------------------|------------|--|----|--|---------|

PROTECTION CIRCUIT

|               |                                                                                                                    |                  |     |      |      |             |
|---------------|--------------------------------------------------------------------------------------------------------------------|------------------|-----|------|------|-------------|
| $V_{6(Min.)}$ | Undervoltage Protection for $V_6$ :<br>Voltage at Pin 5 = $V_{5(Min.)}$ if $V_6 < V_{6(Min.)}$                     |                  | 7.0 | 7.25 | 7.5  | V           |
| $V_{6(Max.)}$ | Overvoltage Protection for $V_6$ :<br>Voltage at Pin 5 = $V_{5(Min.)}$ if $V_6 > V_{6(Max.)}$                      |                  | 15  | 16   | 16.5 | V           |
| $V_{3A}$      | Undervoltage Protection for $V_{AC}$ :<br>Voltage at Pin 5 = $V_{5(Min.)}$ if $V_3 < V_{3A}$                       | $V_2 = 0V$       | 970 | 1005 | 1040 | mV          |
| Oj            | Over Temperature : at the given chip temperature the IC will switch $V_5$ to $V_{5(Min.)}$                         |                  |     | 150  |      | $^{\circ}C$ |
| $V_{3Sat}$    | Voltage at Pin 3 if one of the protection functions was triggered ; ( $V_3$ will be clamped until $V_6 < V_{6A}$ ) | $I_3 = 750\mu A$ |     | 0.4  | 0.8  | V           |
| $I_6$         | Current Drain during Burst Operation                                                                               | $V_3 = V_2 = 0V$ |     | 8    |      | mA          |

4605-05.TBL

**FUNCTIONAL DESCRIPTION**

In free running fly-back converters, the TDA4605 assumes control of a MOS power transistor and all necessary regulation and monitoring functions.

The serial circuit of power transistor and primary winding of the flyback transformer is connected to the input voltage. During the switch-on period of the transistor, energy is stored in the transformer and during the switch-off period it is fed to the load via the secondary winding. By varying the switch-on time of the power transistor, the IC controls each portion of energy transferred to the secondary side such that the output voltage remains nearly independent of load variations.

The required control information is taken from the input voltage during the switch-on period and from a regulation winding during the switch-off period. A new cycle begins as soon as the energy stored in the transformer has been totally delivered to the

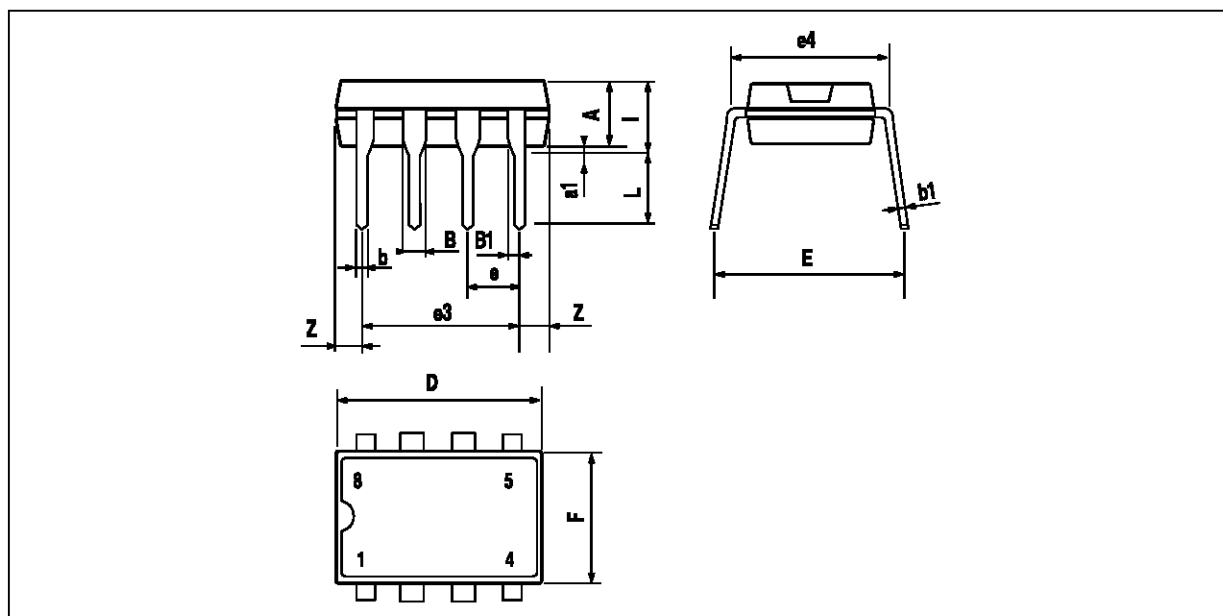
secondary side.

In different load ranges, the SMPS will behave as follows :

- **No-Load Operation** : The power supply unit oscillates in non continuous mode at a typical frequency of 20 to 40kHz. Depending upon the transformer winding and the regulated voltage divider, the output voltage can be slightly above the nominal value.
- **Normal Operation** : Starting from typ. 200kHz, the switching frequency falls with increasing load and decreasing AC voltage. The duty cycle depends primarily on the AC voltage. The output voltage is only slightly load-dependent.
- **Overload Point** : Maximum output power is available at this point of the output characteristics
- **Overload** : The energy transferred per operation cycle is limited at the top. Therefore, the output voltage will fall with secondary overloading.

## PACKAGE MECHANICAL DATA

8 PINS - PLASTIC DIP

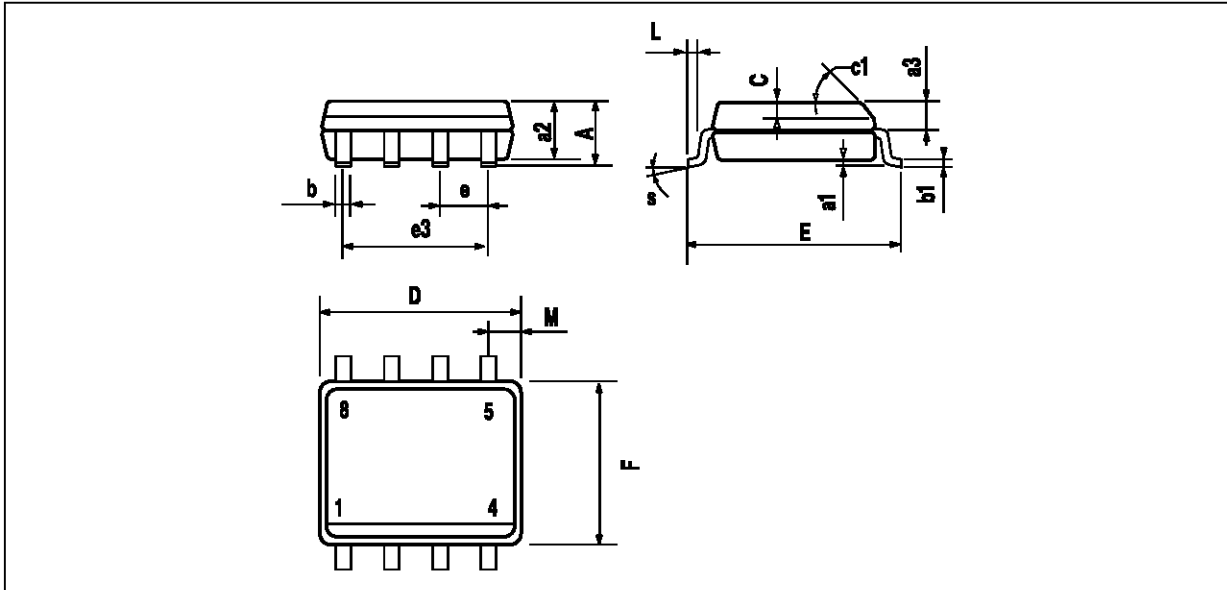


PM-DIP8.EPS

| Dimensions | Millimeters |      |       | Inches |       |       |
|------------|-------------|------|-------|--------|-------|-------|
|            | Min.        | Typ. | Max.  | Min.   | Typ.  | Max.  |
| A          |             | 3.32 |       |        | 0.131 |       |
| a1         | 0.51        |      |       | 0.020  |       |       |
| B          | 1.15        |      | 1.65  | 0.045  |       | 0.065 |
| b          | 0.356       |      | 0.55  | 0.014  |       | 0.022 |
| b1         | 0.204       |      | 0.304 | 0.008  |       | 0.012 |
| D          |             |      | 10.92 |        |       | 0.430 |
| E          | 7.95        |      | 9.75  | 0.313  |       | 0.384 |
| e          |             | 2.54 |       |        | 0.100 |       |
| e3         |             | 7.62 |       |        | 0.300 |       |
| e4         |             | 7.62 |       |        | 0.300 |       |
| F          |             |      | 6.6   |        |       | 0.260 |
| I          |             |      | 5.08  |        |       | 0.200 |
| L          | 3.18        |      | 3.81  | 0.125  |       | 0.150 |
| Z          |             |      | 1.52  |        |       | 0.060 |

DIP8.TBL

**PACKAGE MECHANICAL DATA**  
**8 PINS - PLASTIC MICROPACKAGE (SO)**



PM-S08.EPS

| Dimensions | Millimeters |      |      | Inches |       |       |
|------------|-------------|------|------|--------|-------|-------|
|            | Min.        | Typ. | Max. | Min.   | Typ.  | Max.  |
| A          |             |      | 1.75 |        |       | 0.069 |
| a1         | 0.1         |      | 0.25 | 0.004  |       | 0.010 |
| a2         |             |      | 1.65 |        |       | 0.065 |
| a3         | 0.65        |      | 0.85 | 0.026  |       | 0.033 |
| b          | 0.35        |      | 0.48 | 0.014  |       | 0.019 |
| b1         | 0.19        |      | 0.25 | 0.007  |       | 0.010 |
| C          | 0.25        |      | 0.5  | 0.010  |       | 0.020 |
| c1         | 45° (Typ.)  |      |      |        |       |       |
| D          | 4.8         |      | 5.0  | 0.189  |       | 0.197 |
| E          | 5.8         |      | 6.2  | 0.228  |       | 0.244 |
| e          |             | 1.27 |      |        | 0.050 |       |
| e3         |             | 3.81 |      |        | 0.150 |       |
| F          | 3.8         |      | 4.0  | 0.15   |       | 0.157 |
| L          | 0.4         |      | 1.27 | 0.016  |       | 0.050 |
| M          |             |      | 0.6  |        |       | 0.024 |
| S          | 8° (Max.)   |      |      |        |       |       |

SC8.TBL

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