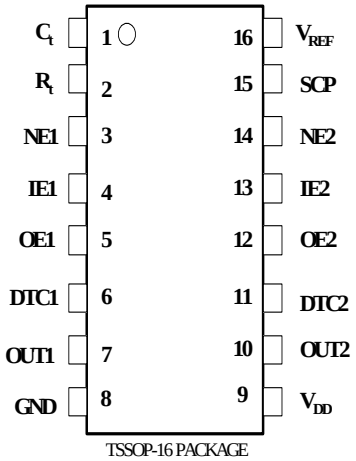
# 2-CHANNEL SWITCHING REGULATOR

## FEATURES

- Complete PWM Power Control Circuitry
- Precision Reference：2.5V ± 1% (25 °C)
- Under-Voltage Lockout (UVLO) Protection
- Open Drain Output
- Output Short Circuit Protection
- Low Dissipation Current：1.6mA
- Dead-Time Control：0 % to 100%
- Wide Operating Frequency：
  10kHz to 800kHz
- $V_{DD}$ Range：4.0V to 14.0V

## PIN CONFIGURATION

TOP VIEW




TSSOP-16 PACKAGE

## GENERAL DESCRIPTION

The AAT1343 provides an integrated two-channel pulse-width-modulation (PWM) solution for the power supply of DC-DC system; this device offers the systems engineer flexibility to tailor-make the power supply circuitry for specific applications. Each channel contains its own error amplifier, PWM comparator, dead–time control (DTC) and output driver. The under-voltage protection, oscillator, short circuit protection and voltage reference circuit are the common features for these two channels.

Both channels of AAT1343 can be used for DC-DC converter operations including step-up, step-down, and inverting. Dead-time control can be set to provide 0% to 100% dead-time through a resistive divider network. Soft-start can be implemented by paralleling the DTC resistor with a capacitor. Two dead-time control inputs are assigned for channel 1 (CH1) and channel 2 (CH2) individually, and dead-time control inputs can be used to control on / off operation.

With a minimal number of external components, the AAT1343 offers a simple and cost effective solution.

## PIN DESCRIPTION

| PIN NO. | NAME | I/O | DESCRIPTION |
|---|---|---|---|
| 1 | $C_t$ | I | External Timing Capacitor |
| 2 | $R_t$ | I | External Timing Resistor |
| 3 | NE1 | I | Noninverting Input of Error Amplifier 1 |
| 4 | IE1 | I | Inverting Input of Error Amplifier 1 |
| 5 | OE1 | I | Output of Error Amplifier 1 |
| 6 | DTC1 | I | Output 1 Dead-Time / Soft-Start Setting |
| 7 | OUT1 | O | Output 1 |
| 8 | GND | | Ground |
| 9 | $V_{DD}$ | I | Power Supply |
| 10 | OUT2 | O | Output 2 |
| 11 | DTC2 | I | Output 2 Dead-Time / Soft-Start Setting |
| 12 | OE2 | I | Output of Error Amplifier 2 |
| 13 | IE2 | I | Inverting Input of Error Amplifier 2 |
| 14 | NE2 | I | Noninverting Input of Error Amplifier 2 |
| 15 | SCP | I | Timer Latch Setting |
| 16 | $V_{REF}$ | O | Reference Voltage (2.5V) Output |

## ABSOLUTE MAXIMUM RATINGS

| CHARACTERISTICS | SYMBOL | VALUE | UNIT |
|---|---|---|---|
| Supply Voltage | $V_{DD}$ | 14.0 | V |
| Input Voltage ( IE – , DTC) | $V_I$ | $V_{DD}$ | V |
| Output Voltage | $V_O$ | $V_{DD}$ +0.3 | V |
| Output Current | $I_O$ | 120 | mA |
| Operating Free-Air Temperature Range | $T_C$ | – 20 to + 85 | °C |
| Storage Temperature Range | $T_{storage}$ | – 45 to + 125 | °C |
| Power Dissipation | $P_d$ | 500 | mW |

## RECOMMENDED OPERATING CONDITIONS

| CHARACTERISTICS | SYMBOL | MIN | MAX | UNIT |
|---|---|---|---|---|
| Supply Voltage, $V_{DD}$ | $V_{DD}$ | 4.0 | 14.0 | V |
| Input Voltage at IE1 and IE2 | $V_{cm}$ | 0.5 | 1.6 | V |
| Output Voltage | $V_O$ | 0 | $V_{DD}$ | V |
| Oscillation (OSC) Capacitance | $C_{OSC}$ | 100 | 15,000 | pF |
| Oscillation (OSC) Resistance | $R_{OSC}$ | 5.1 | 50.0 | kΩ |
| Oscillation (OSC) Frequency | $f_{OSC}$ | 10 | 800 | kHz |
| Output Current, $I_{OUT1}$, $I_{OUT2}$ | $I_O$ | - | 100 | mA |
| Operating Free-Air Temperature | $T_C$ | – 20 | 85 | °C |

## ELECTRICAL CHARACTERISTICS, $V_{DD}$ = 6.0V (UNLESS OTHERWISE SPECIFIED) (SEE NOTE 1)

### OSCILLATOR

| PARAMETER | SYMBOL | TEST CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Frequency | $f_{OSC}$ | $C_{OSC}$ = 220pF, $R_{OSC}$ = 10 kΩ | 320 | 400 | 480 | kHz |
| Frequency Changes with $V_{DD}$ | $f_{\Delta V}$ | $V_{DD}$ = 4.0V to 14.0V, $T_C$ = 25 °C, $C_{OSC}$ = 220pF, $R_{OSC}$ = 10 kΩ | - | 1 | - | % |

### UNDER VOLTAGE PROTECTION

| PARAMETER | SYMBOL | TEST CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Upper Threshold Voltage | $V_{UPH}$ | $T_C$ = 25 °C | 2.6 | 2.9 | 3.2 | V |
| Lower Threshold Voltage | $V_{UPL}$ | $T_C$ = 25 °C | 2.23 | 2.53 | 2.83 | V |
| Hysteresis ($V_{UPH}$ – $V_{UPL}$) | $V_{HYS}$ | $T_C$ = 25 °C | - | 0.37 | - | V |

### SHORT CIRCUIT PROTECTION CONTROL

| PARAMETER | SYMBOL | TEST CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Input Threshold Voltage | $V_{r1}$ | CH1, CH2 | 0.95 | 1.05 | 1.15 | V |
| Short-Circuit Detection Threshold Voltage | $V_{r2}$ | | 1.48 | 1.64 | 1.80 | V |
| SCP Terminal Source Current | $I_{SCP}$ | | – 3.5 | – 2.5 | – 1.5 | µA |
| Stand-by Voltage | $V_{STB}$ | | - | 50 | 100 | mV |
| Latch Voltage | $V_{LT}$ | | - | 30 | 100 | mV |

Note 1: Typical values of all parameters are specified at $T_C$ =25 °C.

## ELECTRICAL CHARACTERISTICS, $V_{DD}$ = 6.0V (UNLESS OTHERWISE SPECIFIED) (SEE NOTE 1) (CONT.)

### REFERENCE VOLTAGE

| PARAMETER | SYMBOL | TEST CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Reference Voltage | $V_{REF}$ | $I_{REF}$ = –1mA , $T_C$ = 25 °C | 2.480 | 2.505 | 2.530 | V |
| Input Voltage Regulation | $V_{RI}$ | $I_{REF}$ = –1mA , $V_{DD}$ = 4.0V to 14.0V | - | 1 | 5 | mV |
| Output Voltage Regulation | $V_{RO}$ | $I_{REF}$ = –0.1mA to – 3.0 mA | - | 1 | 10 | mV |

### EA (ERROR AMPLIFIER)

| PARAMETER | SYMBOL | TEST CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Input Offset Voltage | $V_{IO}$ | CH1, CH2, Unity Gain | - | - | 6 | mV |
| Input Bias Current | $I_{IB}$ | CH1, CH2 | - | ±15 | ±100 | nA |
| Input Voltage Range | $V_{IR}$ | CH1, CH2 | 0.5 | - | 1.6 | V |
| Open-Loop Voltage Gain | $A_{VO}$ | | 70 | 85 | - | dB |
| Output Voltage Swing | $V_{OS+}$ | | 2.3 | 2.5 | - | V |
| | $V_{OS–}$ | | - | 0.7 | 0.9 | |
| Output Sink Current | $I_{OS+}$ | OE=1.25V | 3 | 20 | - | mA |
| Output Source Current | $I_{OS–}$ | OE=1.25V | – 75 | – 45 | - | µA |
| Common-Mode Rejection Ratio | CMRR | | 60 | 80 | - | dB |

## ELECTRICAL CHARACTERISTICS, $V_{DD}$ = 6.0V (UNLESS OTHERWISE SPECIFIED) (SEE NOTE 1) (CONT.)

### DEAD-TIME CONTROL & PWM

| PARAMETER | SYMBOL | TEST CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Input Bias Current | $I_{IB}$ | $V_{DTC}$ = 2.0V | - | 0.1 | 1.0 | µA |
| Input Threshold Voltage (DTC) | $V_{d0}$ | Duty = 0%, $f_{OSC}$ = 10kHz | 1.87 | 1.97 | 2.07 | V |
| | $V_{d100}$ | Duty = 100%, $f_{OSC}$ = 10kHz | 1.38 | 1.48 | 1.58 | |
| Latch Input Voltage | $V_{DTC}$ | $I_{DTC}$ = 40µA | 2.28 | 2.48 | - | V |
| Latch Mode Source Current | $I_{DTC}$ | DTC1, DTC2 = 0V | – 560 | – 200 | - | µA |

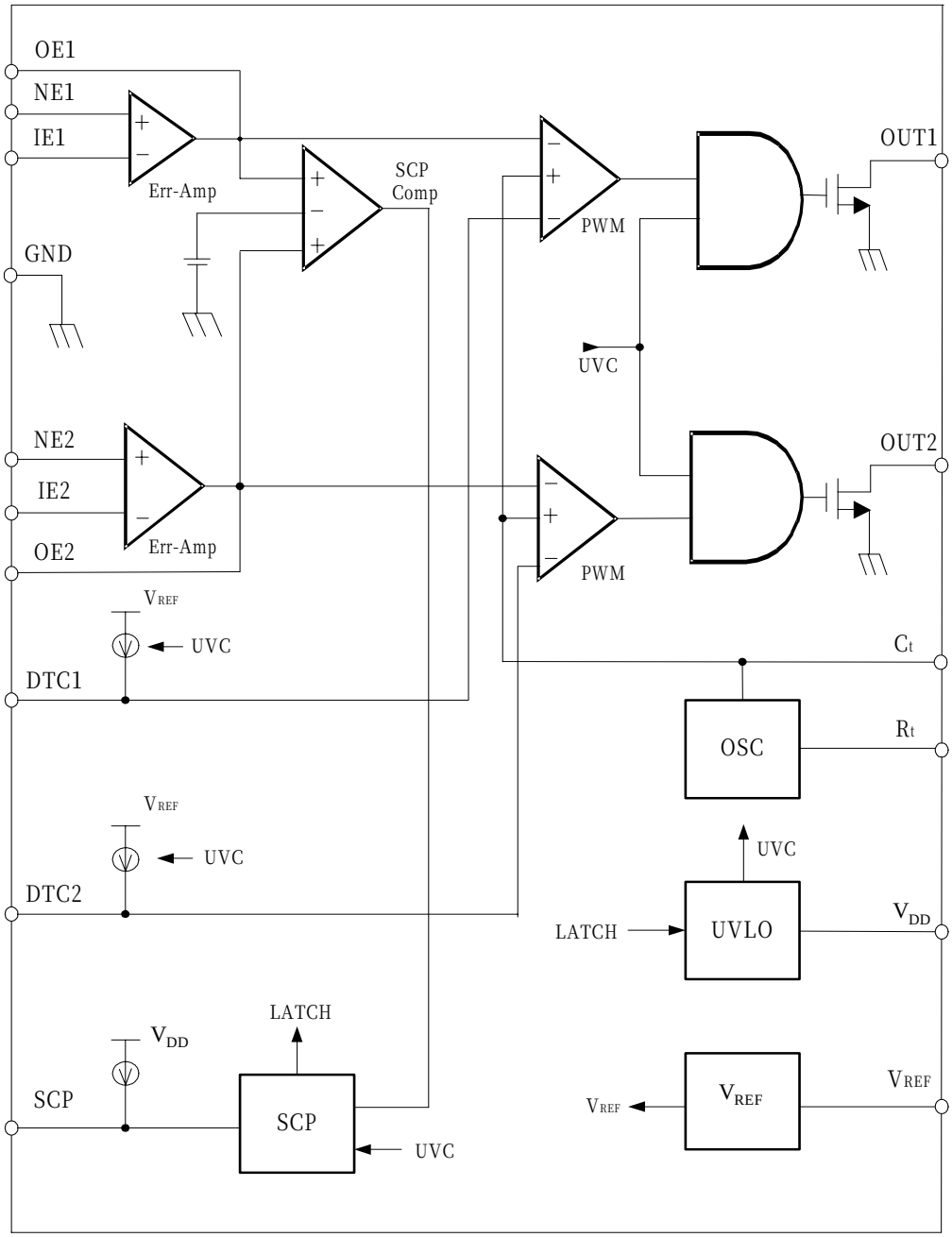
### OUTPUT STAGE

| PARAMETER | SYMBOL | TEST CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Saturation Voltage | $V_{SAT}$ | $I_O$ = 75mA（CH1, CH2） | - | 0.8 | 1.2 | V |
| Leakage Current | $I_{LEAK}$ | $V_O$ =14.0V | - | - | 5 | µA |

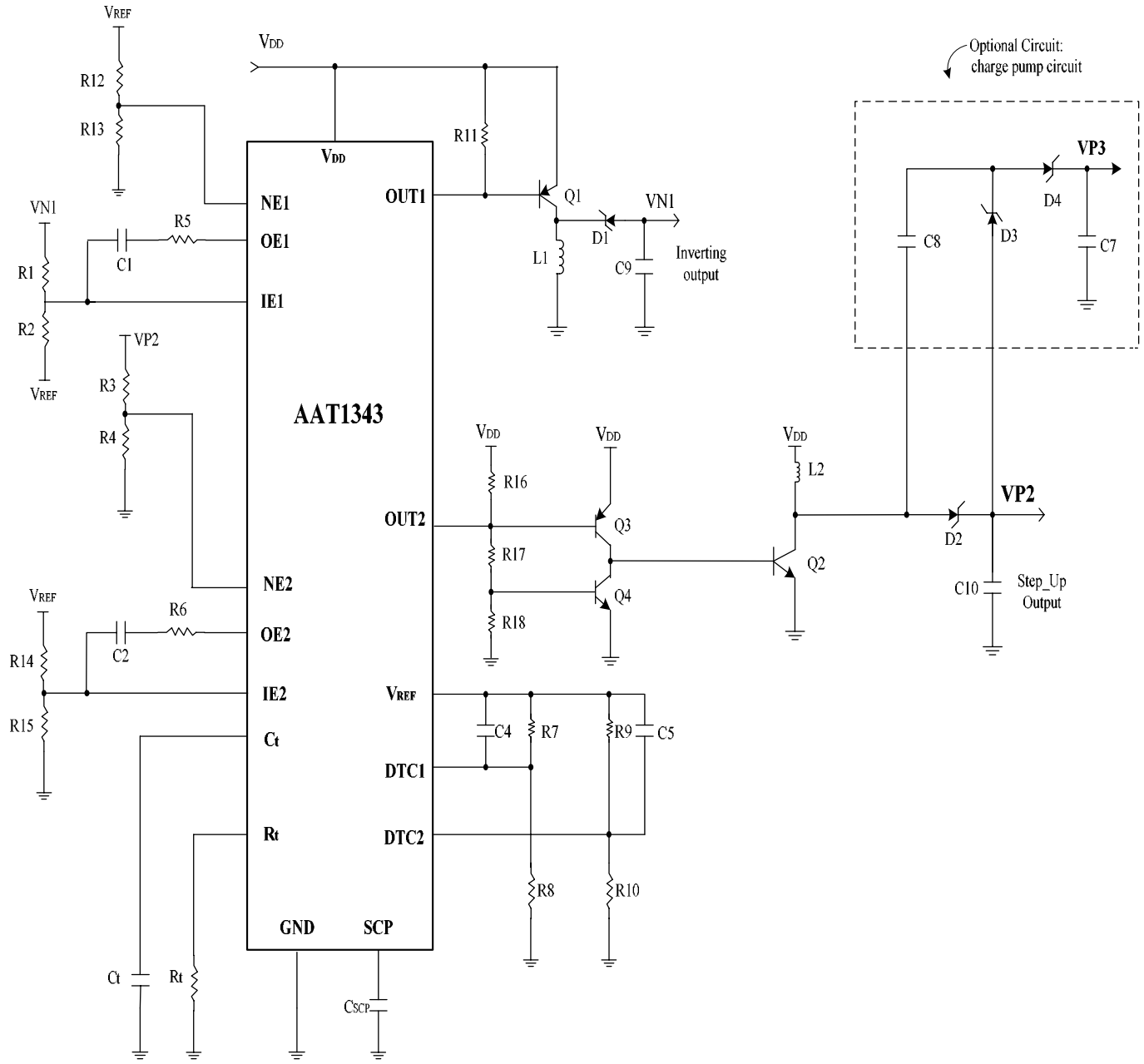
### OPERATING CURRENT

| PARAMETER | SYMBOL | TEST CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Supply Current | $I_{DD-OFF}$ | Output “OFF” State | - | 1.3 | 1.8 | mA |
| | $I_{DD-ON}$ | $R_{OSC}$ =10 kΩ | - | 1.6 | 2.3 | mA |

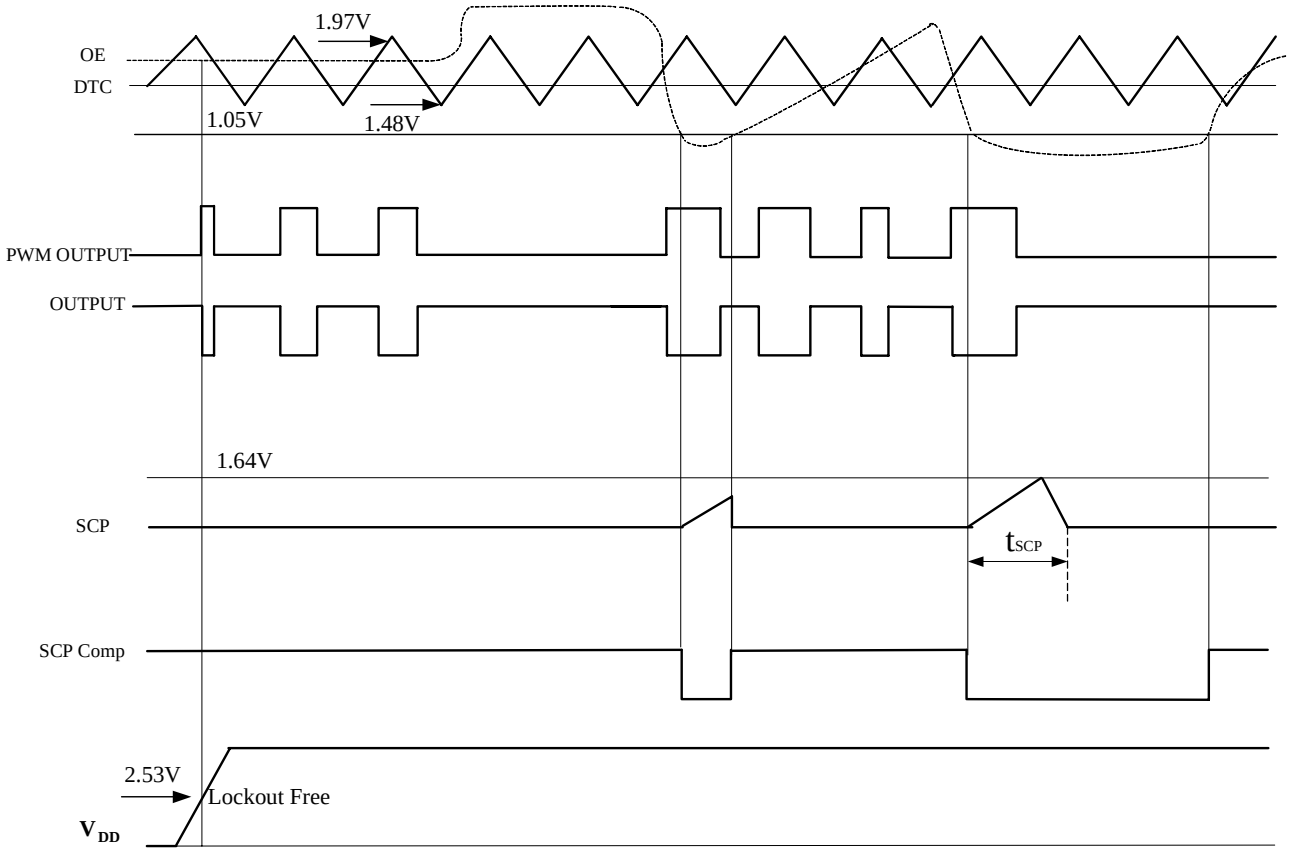
## BLOCK DIAGRAM



## APPLICATION CIRCUIT

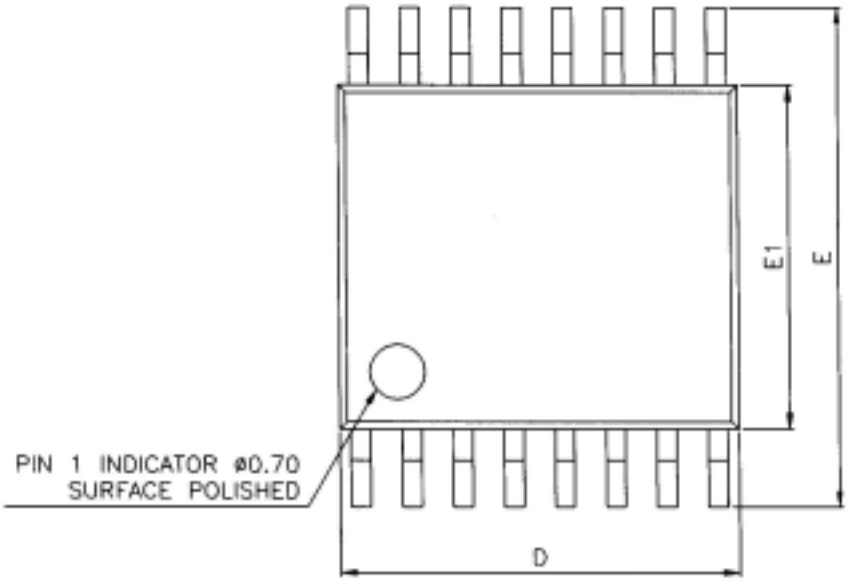


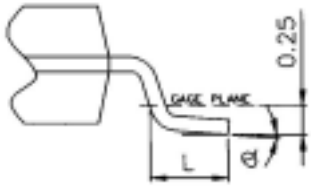
## TIMING CHART

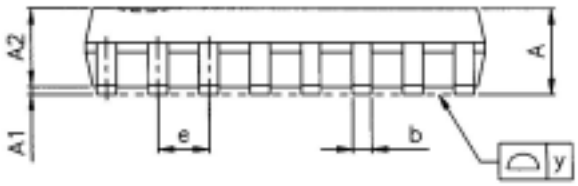



Note: $t_{SCP} \cong \frac{C_{SCP} V_{r2}}{I_{SCP}}$

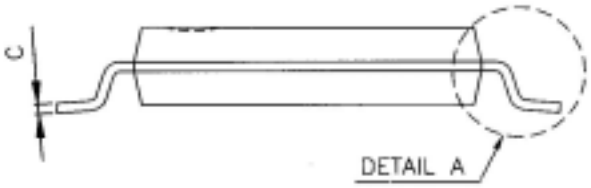
## PACKAGE DIMENSION
### 16-PIN TSSOP



## PACKAGE DIMENSION (CONT.)



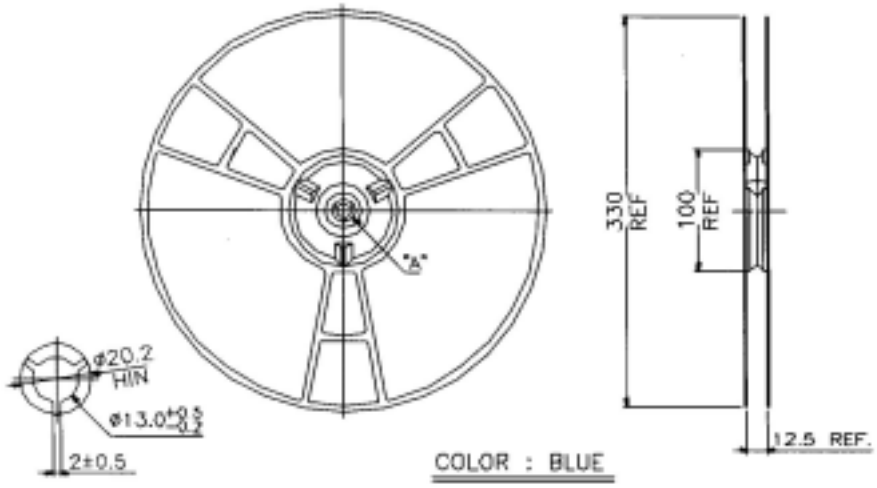

| SYMBOLS | DIMENSIONS IN MILLIMETERS | | | DEMINSIONS IN INCHES | | |
|---|---|---|---|---|---|---|
| | MIN | TYP | MAX | MIN | TYP | MAX |
| A | 1.05 | 1.10 | 1.20 | 0.041 | 0.043 | 0.047 |
| A1 | 0.05 | 0.10 | 0.15 | 0.002 | 0.004 | 0.006 |
| A2 | ------ | 1.00 | 1.05 | ------ | 0.039 | 0.041 |
| b | 0.20 | 0.25 | 0.28 | 0.008 | 0.010 | 0.011 |
| C | ------ | 0.127 | ------ | ------ | 0.005 | ------ |
| D | 4.900 | 5.075 | 5.100 | 0.1930 | 0.1998 | 0.2000 |
| E | 6.20 | 6.40 | 6.60 | 0.244 | 0.252 | 0.260 |
| E1 | 4.30 | 4.40 | 4.50 | 0.170 | 0.173 | 0.177 |
| e | ------ | 0.65 | ------ | ------ | 0.026 | ------ |
| L | 0.50 | 0.60 | 0.70 | 0.020 | 0.024 | 0.028 |
| y | ------ | ------ | 0.076 | ------ | ------ | 0.003 |
| θ | 0° | 4° | 8° | 0° | 4° | 8° |

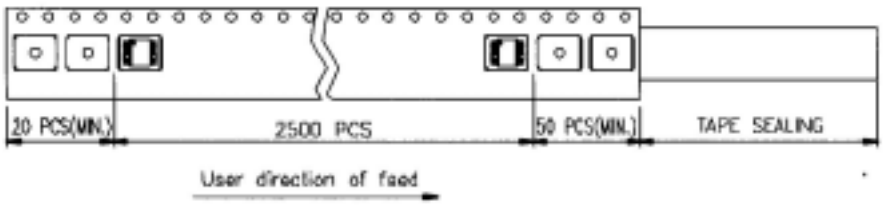
NOTE:

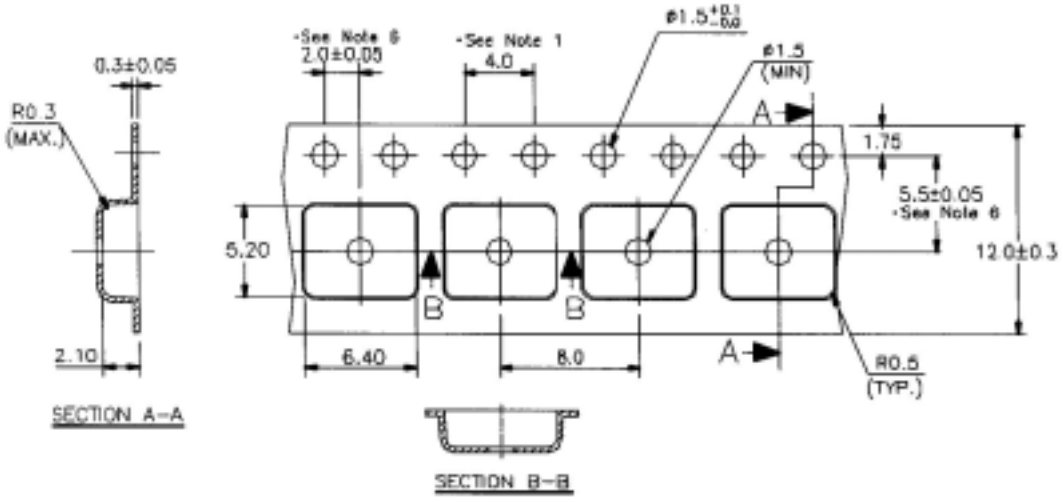
1. CONTROLLING DIMENSION: MILLIMETERS
2. LEAD FRAME MATERIAL: OLIN C7025/EFTEC 64T
3. DIMENSION “D” DOES NOT INCLUDE MOLD FLASH, TIE BAR BURRS AND GATE BURRS. MOLD FLASH, TIE BAR BURRS AND GATE BURRS SHALL NOT EXCEED 0.006” [0.15 MILLIMETERS] PER END. DIMENSION “E1” DOES NOT INCLUDE INTERLEAD FLASH. INTERLEAD FLASH SHALL NOT EXCEED 0.010” [0.25 MILLIMETERS] PER SIDE.
4. DIMENSION “b” DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.003” [0.08 MILLIMETERS] TOTAL IN EXCESS OF THE “b” DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSION AND AN ADJACENT LEAD TO BE 0.0028” [0.07 MILLIMETERS].
5. TOLERANCE: ± 0.010 [0.25 MILLIMETERS] UNLESS OTHERWISE SPECIFIED.
6. OTHERWISE DIMENSION FOLLOW ACCEPTABLE SPEC.
7. REFERENCE DOCUMENT: JEDEC SPEC MO-153.

## TAPE AND REEL

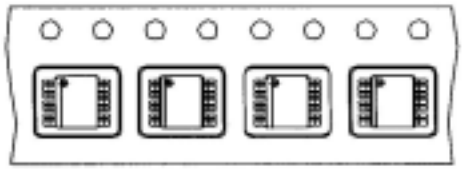
**PACKING METHOD: 2,500PCS/REEL, 1 REEL/BOX**



## TAPE AND REEL (CONT.)



TSSOP 14L / 16L

NOTE:

1. 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE ± 0.2 MILLIMETERS.
2. CAMBER NOT TO EXCEED 1 MILLIMETER IN 100 MILLIMETERS.
3. MATERIAL: ANTI-STATIC BLACK ADVANTEK POLYSTYRENE.
4. $A_0$ AND $B_0$ MEASURED ON A PLANE 0.3 MILLIMETERS ABOVE THE BOTTOM OF THE POCKET.
5. $K_0$ MEASURED FROM A PLANE ON THE INSIDE BOTTOM OF THE POCKET TO THE TOP SURFACE OF THE CARRIER.
6. POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED AS TRUE POSITION OF POCKET, NOT POCKET HOLE.

## PART MARKING

### TSSOP16 TOP MARKING

| |
|---|
| AAT1343<br>XXXXXX |

### TSSOP16 BACK MARKING

| |
|---|
| YYWW |

ORDERING INFORMATION