



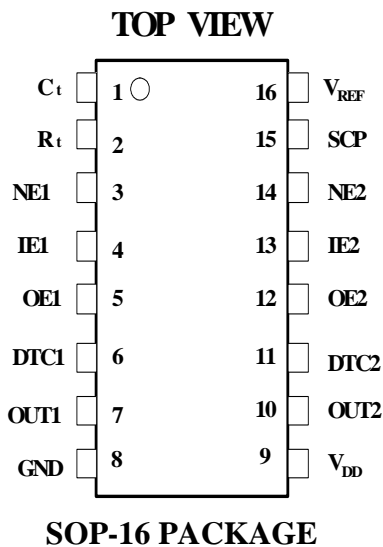
Details are subject to change without notice

## 2-CHANNEL SWITCHING REGULATOR

### FEATURES

- Complete PWM Power Control Circuitry
- 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 :  
10 kHz to 800 kHz
- $V_{DD}$  Range : 4.0V to 14.0V

### PIN CONFIGURATION



### GENERAL DESCRIPTION

The AAT1351 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 the two channels.

Both channels of AAT1351 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 minimum number of external components, the AAT1351 offers a simple and cost effective solution.

**PIN DESCRIPTION**

<b>PIN NO</b>	<b>NAME</b>	<b>I/O</b>	<b>DESCRIPTION</b>
1	$C_t$	I	External Timing Capacitance
2	$R_t$	I	External Timing Resistance
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**

	SYMBOL	MIN	MAX	UNIT
Supply Voltage, $V_{DD}$	$V_{DD}$	4.0	14.0	V
Input Voltage, IE1, IE2	$V_{cm}$	0.5	1.6	V
Output Voltage	$V_O$	0	$V_{DD}$	V
Oscillator (OSC) Capacitance	$C_{OSC}$	100	15,000	pF
Oscillator (OSC) Resistance	$R_{OSC}$	5.1	50.0	k $\Omega$
Oscillator (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		TEST CONDITION	MIN	TYP	MAX	UNIT
Frequency	$f_{OSC}$	$C_{OSC} = 330pF,$ $R_{OSC} = 10k\Omega$	160	200	240	kHz
Frequency Changes with $V_{DD}$	$f_{\Delta V}$	$V_{DD} = 4.0V$ to $14.0V,$ $T_C = 25^\circ C$ $C_{OSC} = 330pF,$ $R_{OSC} = 10k\Omega$	-	1	-	%

**UNDER VOLTAGE PROTECTION**

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
Upper Threshold Voltage	$V_{UPH}$	$T_C = 25^\circ C$	-	2.9	-	V
Lower Threshold Voltage	$V_{UPL}$	$T_C = 25^\circ C$	-	2.53	-	V
Hysteresis ( $V_{UPH} - V_{UPL}$ )	$V_{HYS}$	$T_C = 25^\circ C$	-	0.37	-	V

**SHORT CIRCUIT PROTECTION CONTROL**

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
Input Threshold Voltage	$V_{r1}$	CH1, CH2	-	1.18	-	V
Short Circuit Detect Threshold Voltage	$V_{r2}$		0.65	0.70	0.75	V
SCP Terminal Source Current	$I_{SCP}$		-20	-15	-10	$\mu A$
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  $T_C = 25^\circ C$ .



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

**REFERENCE VOLTAGE**

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
Reference Voltage	$V_{REF}$	$I_{REF} = -1mA, T_C = 25^\circ C$	2.4	2.5	2.6	V
Input Voltage Regulation	$V_{RI}$	$I_{REF} = -1mA,$ $V_{DD} = 4.0V$ to $14.0V$	-	1	5	mV
Output Regulation	$V_{RO}$	$I_{REF} = -0.1mA$ to $-3.0mA$	-	1	10	mV

**EA (ERROR AMPLIFIER)**

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
Input Offset Voltage	$V_{IO}$	CH1, CH2, Unity Gain	-	-	6	mV
Input Bias Current	$I_{IB}$	CH1, CH2	-	$\pm 15$	$\pm 100$	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	-	$\mu A$
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		TEST CONDITION	MIN	TYP	MAX	UNIT
Input Bias Current	$I_{IB}$	$V_{DTC} = 2V$	-	0.1	1.0	$\mu A$
Input Threshold Voltage (DTC)	$V_{d0}$	Duty = 0%, $f_{OSC} = 10kHz$	1.79	1.97	2.15	V
	$V_{d100}$	Duty = 100%, $f_{OSC} = 10kHz$	1.32	1.48	1.64	
Latch Input Voltage	$V_{DTC}$	$I_{DT} = 40\mu A$	2.28	2.48	-	V
Latch Mode Source Current	$I_{DTC}$	DTC1, DTC2=0V	-560	-200	-	$\mu A$

**OUTPUT STAGE**

PARAMETER		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	$\mu A$

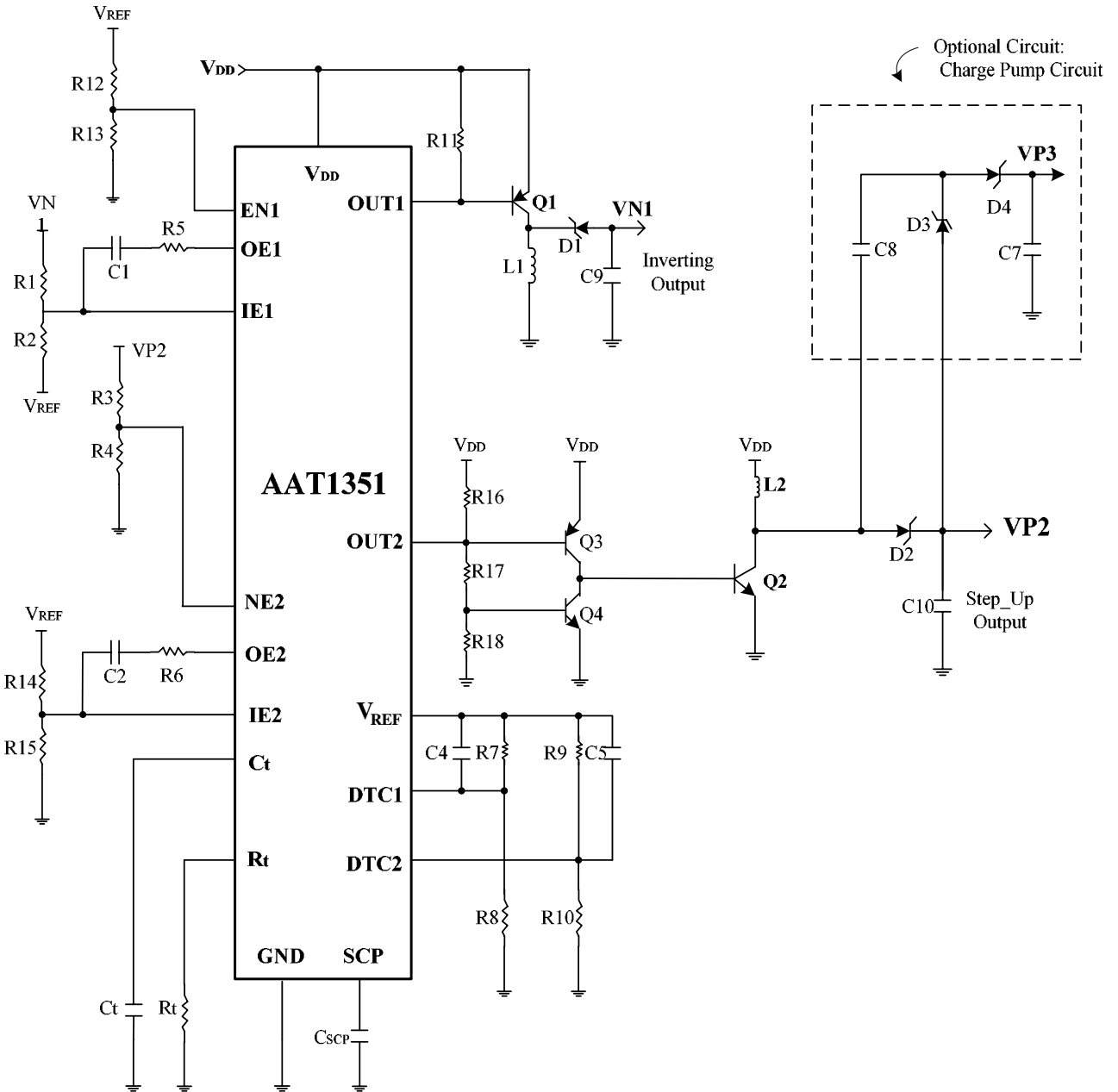
**OPERATING CURRENT**

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
Supply Current	$I_{DD-OFF}$	Output "OFF" State	-	1.3	1.8	mA
	$I_{DD-ON}$	$R_{OSC} = 10k\Omega$	-	1.6	2.4	mA





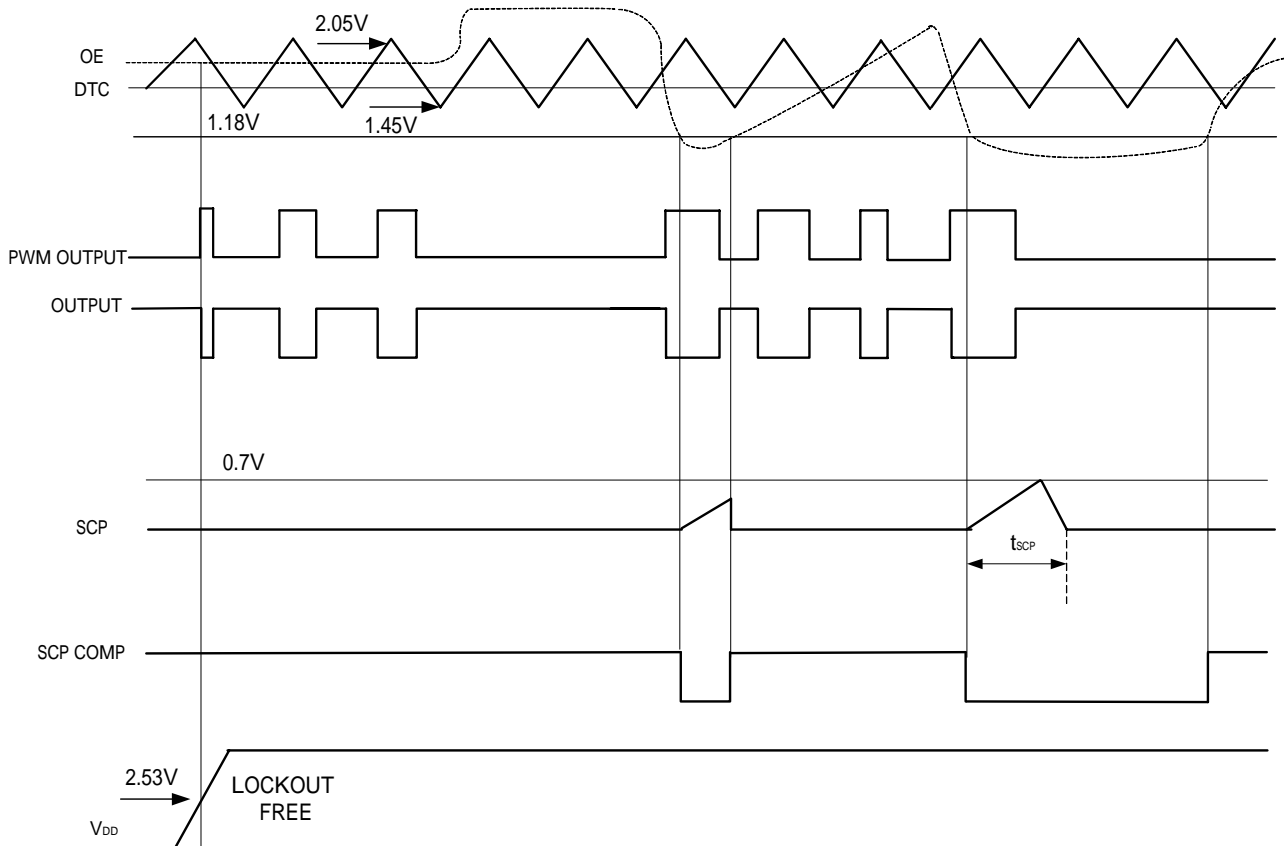
APPLICATION CIRCUIT







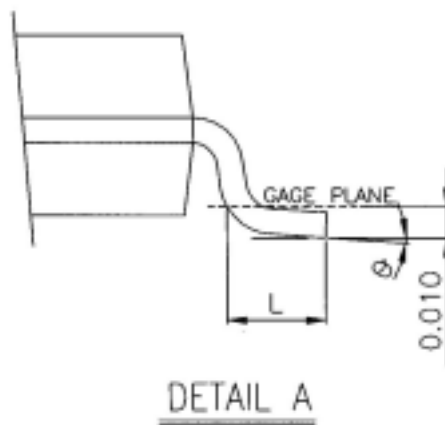
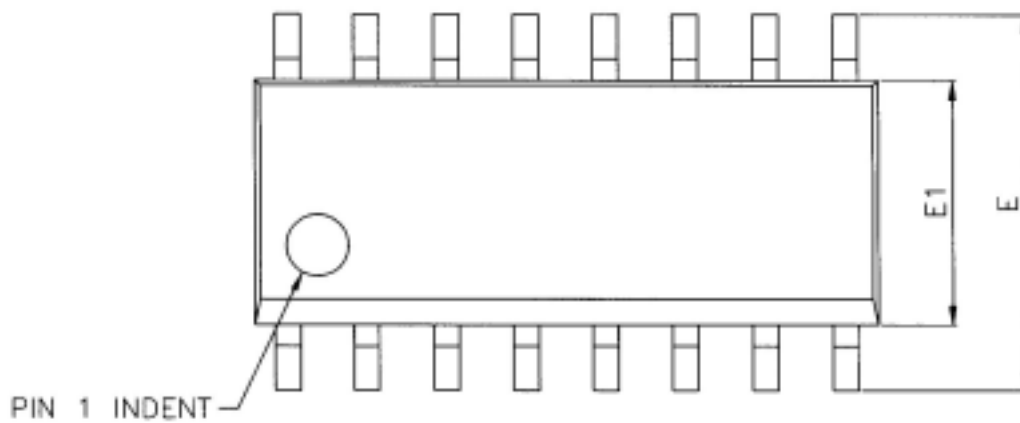
**TIMING CHART**



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

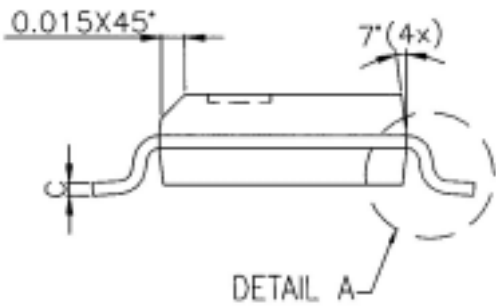
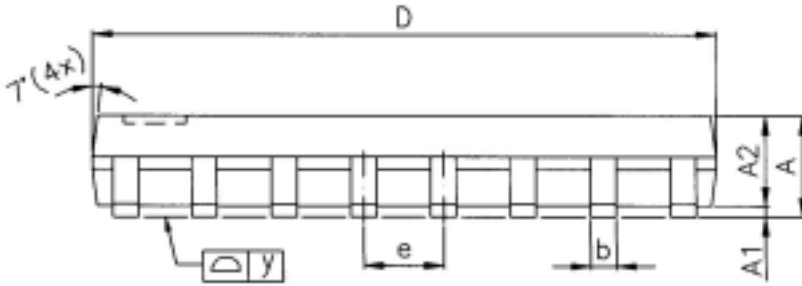


**PACKAGE DIMENSION**  
**16-PIN SOP**





PACKAGE DIMENSION (CONT.)





**PACKAGE DIMENSION (CONT.)**

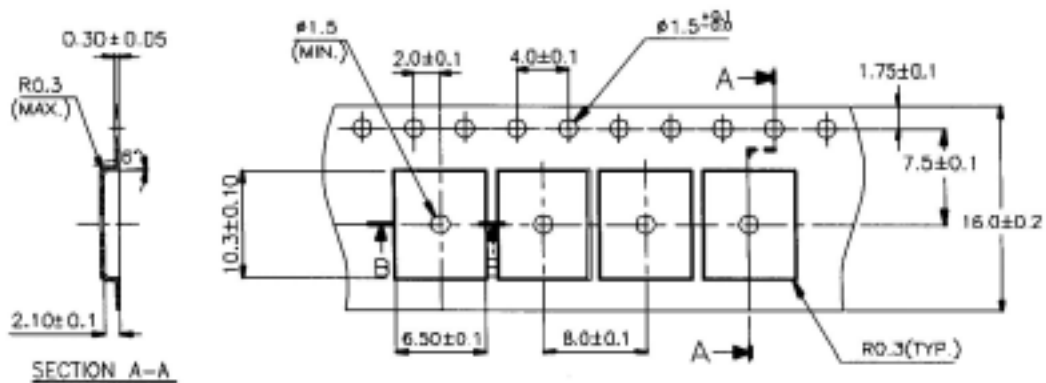
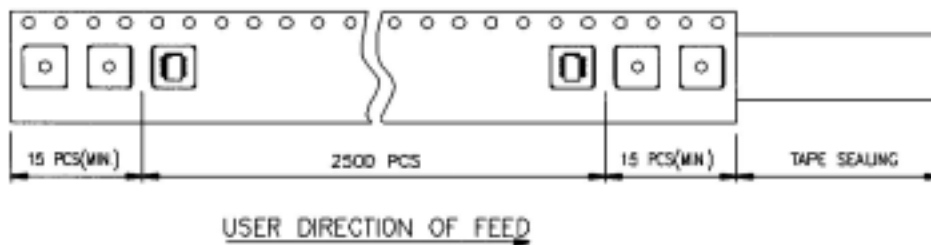
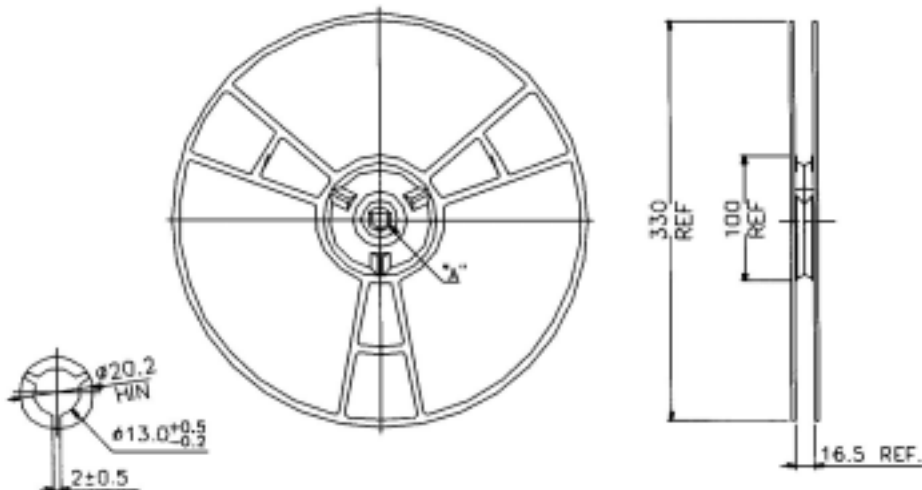
SYMBOLS	DIMENSIONS IN MILLIMETERS			DEMINSIONS IN INCHES		
	MIN	TYP	MAX	MIN	TYP	MAX
A	1.47	1.60	1.73	0.058	0.063	0.068
A1	0.10	-----	0.25	0.004	-----	0.010
A2	-----	1.45	-----	-----	0.057	-----
b	0.33	0.41	0.51	0.013	0.016	0.020
C	0.19	0.20	0.25	0.0075	0.0080	0.0098
D	9.80	9.91	10.01	0.386	0.390	0.394
E	5.79	5.99	6.20	0.228	0.236	0.244
E1	3.81	3.91	3.99	0.150	0.154	0.157
e	-----	1.27	-----	-----	0.050	-----
L	0.38	0.71	1.27	0.015	0.028	0.050
y	-----	-----	0.076	-----	-----	0.003
θ	0°	-----	8°	0°	-----	8°

NOTE:

1. CONTROLLING DIMENSION: INCH
2. LEAD FRAME MATERIAL: COPPER 194
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 SAHLL 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 MS-012

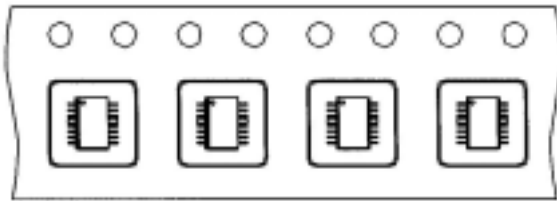


TAPE AND REEL

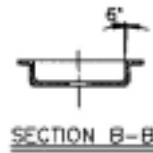




**TAPE AND REEL (CONT.)**



SOP 16L(150mil)



X.XXX X	± 0.0025
X.XXX	± 0.006
X.XX	± 0.025
X.X	± 0.10
X	± 0.25

UNIT: MILLIMETERS

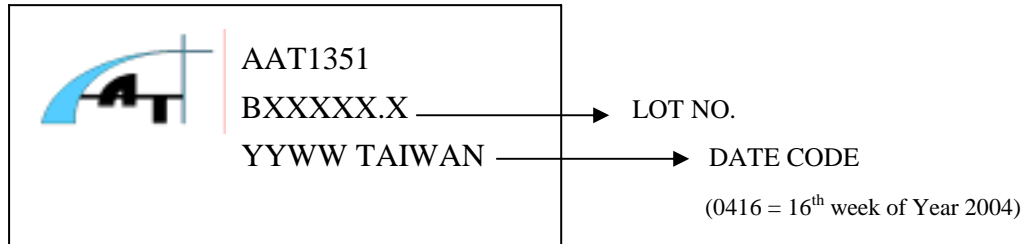
NOTE:

1. 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE  $\pm 0.2$ .
2. CHAMBER NOT TO EXCEED 1 MILLIMETER IN 100 MILLIMETERS.
3. MATERIAL: 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**

**SOP16 TOP MARKING**



NOTE: SOP16 HAS NO BACK MARKING.



**ORDERING INFORMATION**

**AAT xxxxx-xx-x**

AAT Part Number

Package Code 2  
T=Taping Reel  
Blank=Tube or Tray

**Remark:**  
**T=Taping Reel**  
PS.  
Sop16→ 3,000pcs/reel

**Blank=Tube**

Package Code 1  
Sop16: S1  
Sop16 (Batwing): S6  
Sop16 (Power Pad): S7