



Advanced Analog Technology, Inc.

AAT1105A

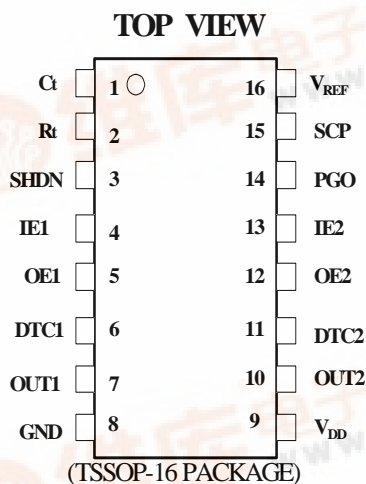
Details are subject to change without notice.

## BUCK BOOST & BOOST PWM CONTROLLER

### Features

- Complete PWM Power Control Circuitry  
CH1: Buck\_Boost, CH2: Boost
- Under-Voltage Lockout (UVLO) Protection
- Totem Pole Output
- Output Short Circuit Protection
- Dead-Time Control : 0% to 100%
- Wide Operating Frequency :  
10kHz to 800kHz
- Shutdown Control
- Power Good Protection
- $V_{DD}$  Range: 2.6V~6.5V

### Pin Configuration



### General Description

The AAT1105A provides an integrated two-channel pulse-width-modulation (PWM) solution for the power supply of DC-DC system. This device offers system engineers the 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 (SCP) and voltage reference circuit are the common features for the two channels.

The AAT1105A contains one step-up (boost) circuit at channel two (CH2) and one inverting (buck\_boost) circuit at channel one (CH1). 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 CH1 and CH2 individually, and dead-time control inputs can be used to control on / off operation.

The compact design and optimized external parts of AAT1105A offers a simple and effective solution.





**Pin Description**

Pin No	Name	I/O	Description
1	$C_t$	-	External Timing Capacitance
2	$R_t$	-	External Timing Resistance
3	SHDN	I	Shutdown Input Pin ( Internal Pull "H" )
4	IE1	I	Inverting Input of Error Amplifier 1
5	OE1	O	Output for Error Amplifier 1
6	DTC1	I	Output 1 Dead-Time / Soft-Start Setting
7	OUT1	O	Output 1
8	GND	-	Ground
9	$V_{DD}$	-	Power Supply
10	OUT2	O	Output 2
11	DTC2	I	Output 2 Dead-Time / Soft-Start Setting
12	OE2	O	Output of Error Amplifier 2
13	IE2	I	Inverting Input of Error Amplifier 2
14	PGO	O	Power Good Output Pin
15	SCP	-	Timer Latch Setting
16	$V_{REF}$	O	Reference Voltage (1.293V) Output

**Absolute Maximum Ratings**

CHARACTERISTICS	SYMBOL	VALUE	UNIT
Supply Voltage	$V_{DD}$	7	V
Input Voltage (IE -, DTC, SHDN)	$V_I$	$V_{DD}$	V
Output Voltage	$V_O$	$V_{DD}+0.3$	V
Output Current	$I_O$	-120/+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, $V_{DD}$	$V_{DD}$	2.6	6.5	V
Input Voltage, IE1, IE2	$V_{cm}$	0.3	1.5	V
Output Voltage	$V_O$	0	$V_{DD}$	V
Oscillator (OSC) Capacitance	$C_{OSC}$	100	15,000	pF
Oscillator (OSC) Resistance	$R_{OSC}$	3	50	k
Oscillator (OSC) Frequency	$f_{OSC}$	10	800	kHz
Output Current, $I_{out1}$ , $I_{out2}$	$I_O$		+50/-50	mA
Operating Free-Air Temperature	$T_C$	-20	85	°C



**Electrical Characteristics,  $V_{DD} = 3.3V$  (Unless Otherwise Specified) (See Note 1)**

**Oscillator**

Parameter		Test Condition	Min	Typ	Max	Unit
Frequency	$f_{OSC}$	$C_{OSC} = 220pF, R_{OSC} = 5.6k$	320	400	480	kHz
Frequency Changes with $V_{DD}$	$f_{\Delta V}$	$V_{DD} = 2.6V \text{ to } 6.0V,$ $T_C = 25^\circ C$ $C_{OSC} = 220pF,$ $R_{OSC} = 5.6k$	-	1	-	%

**Under-Voltage Protection**

Parameter		Test Condition	Min	Typ	Max	Unit
Upper Threshold Voltage	$V_{UPH}$	$T_C = 25^\circ C$	1.81	2.03	2.25	V
Lower Threshold Voltage	$V_{UPL}$	$T_C = 25^\circ C$	1.57	1.79	2.01	V
Hysteresis ( $V_{UPH} - V_{UPL}$ )	$V_{HYS}$	$T_C = 25^\circ C$	-	0.24	-	V

**Short Circuit Protection Control**

Parameter		Test Condition	Min	Typ	Max	Unit
Input Threshold Voltage	$V_{r2}$	CH2	1.81	1.29	1.40	V
Input Threshold Voltage	$V_{r1}$	CH1	0.30	0.37	0.44	V
Short-Circuit Detect Threshold Voltage	$V_{tscd}$		0.76	0.85	0.94	V
SCP Terminal Source Current	$I_{SCP}$		-3.8	-2.6	-1.4	$\mu A$
Stand-by Voltage	$V_{STB}$			50	100	mV
Latch Voltage	$V_{LT}$			30	100	mV

**Shutdown Control**

Parameter		Test Condition	Min	Typ	Max	Unit
Shutdown Enable Voltage	$V_{SE}$	$T_C = 25^\circ C$	-	-	0.5	V
Shutdown Release Voltage	$V_{SR}$	$T_C = 25^\circ C$	2.0	-	-	V

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



**Electrical Characteristics,  $V_{DD} = 3.3V$  (Unless Otherwise Specified) (See Note 1) (Cont.)**

**Reference Voltage**

Parameter		Test Conditions	Min	Typ	Max	Unit
Internal Reference Voltage	$V_{REFi}$	$I_{REF} = -1mA, T_C = 25^\circ C$	0.622	0.641	0.660	V
Reference Voltage	$V_{REF}$	$I_{REF} = -1mA, T_C = 25^\circ C$	1.280	1.293	1.306	
Input Voltage Regulation	$V_{RI}$	$I_{REF} = -1mA,$ $V_{DD} = 2.6V$ to $6.0V$	-	1	10	mV
Output Regulation	$V_{RO}$	$I_{REF} = -0.1mA$ to $-1mA$	-	1	6	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	-	1.5	V
Open-Loop Voltage Amplification	$A_{VO}$		70	85	-	dB
Output Voltage Swing	$V_{OS+}$		1.7	2.0	-	V
	$V_{OS-}$		-	0.2	0.4	
Output Sink Current	$I_{OS+}$	OE=0.65V	3	10	-	mA
Output Source Current	$I_{OS-}$	OE=0.65V	-	-65	-45	$\mu A$
Common-Mode Rejection Ratio	CMRR		60	80	-	dB

**PRDB (Power Good Protection)**

Parameter		Test Condition	Min	Typ	Max	Unit
Low Level Output Voltage	$V_{dbl}$	Pull-High $R_{20} = 100k\Omega$	-	0.2	0.4	V



Electrical Characteristics,  $V_{DD} = 3.3V$  (Unless Otherwise Specified) (See Note 1) (Cont.)

Dead Time Control & PWM

Parameter		Test Condition	Min	Typ	Max	Unit
Input Bias Current	$I_{IB}$	$V_{DTC} = 1.0V$	-	0.1	1.0	$\mu A$
Input Threshold Voltage (DTC1)	$V_{1d0}$	Duty = 0%, $f_{OSC} = 10kHz$	0.92	1.00	1.08	V
	$V_{1d100}$	Duty = 100%, $f_{OSC} = 10kHz$	0.48	0.56	0.64	
Input Threshold Voltage (DTC2)	$V_{2d0}$	Duty = 0%, $f_{OSC} = 10kHz$	0.48	0.56	0.64	V
	$V_{2d100}$	Duty = 100%, $f_{OSC} = 10kHz$	0.92	1.00	1.08	
Latch Input Voltage (DTC1)	$V_{1DTC}$	$I_{DTC} = 20\mu A$	1.15	1.20	-	V
Latch Input Voltage (DTC2)	$V_{2DTC}$	$I_{DTC} = 50\mu A$	-	0.2	0.4	V
Latch Mode Source Current (DTC1)	$I_{1DTC}$	DTC1=1.08V	-	-45	-30	$\mu A$
Latch Mode Source Current (DTC2)	$I_{2DTC}$	DTC2=0.48V	150	200	-	$\mu A$

Output Stage

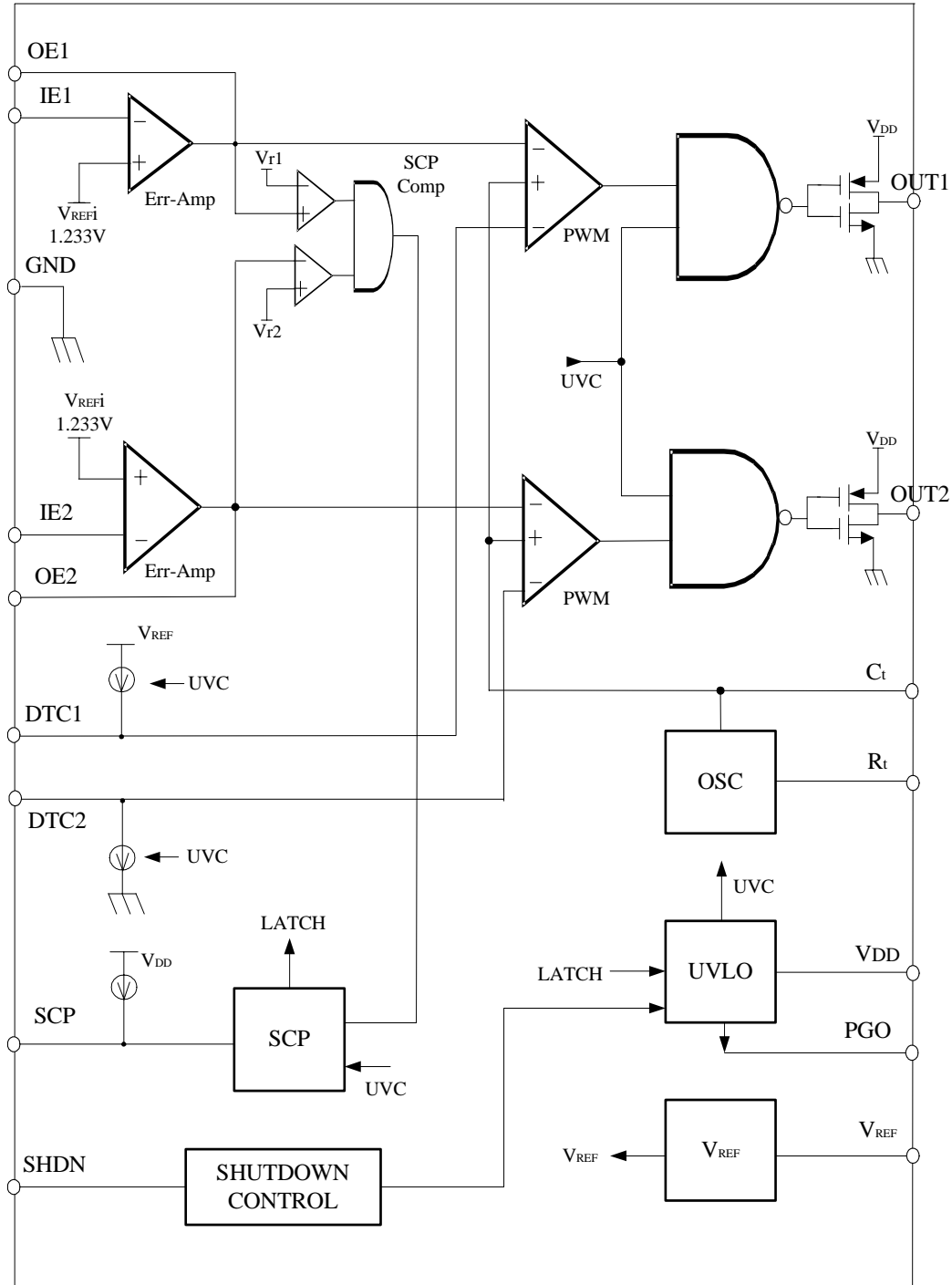
Parameter		Test Condition	Min	Typ	Max	Unit
High-Level Output Voltage	$V_{OH}$	$I_O = -50mA$	1.8	2.2	-	V
Low-Level Output Voltage	$V_{OL}$	$I_O = +50mA$	-	0.8	1.2	V
Rise Time	$t_{RISE}$	$C_L = 1,000pF$	-	100	-	ns
Fail Time	$t_{FALL}$	$C_L = 1,000pF$	-	100	-	ns
Leakage Current	$I_{LEAK}$	$V_O = 6.0V$	-	-	5	$\mu A$
Capacitance at the Output Pin	$C_L$					

Operating Current

Parameter		Test Condition	Min	Typ	Max	Unit
Supply Current	$I_{DD-OFF}$	Output "OFF" State	-	1.8	-	mA
	$I_{DD-ON}$	$R_{OSC} = 10k\Omega$	-	2.0	-	mA

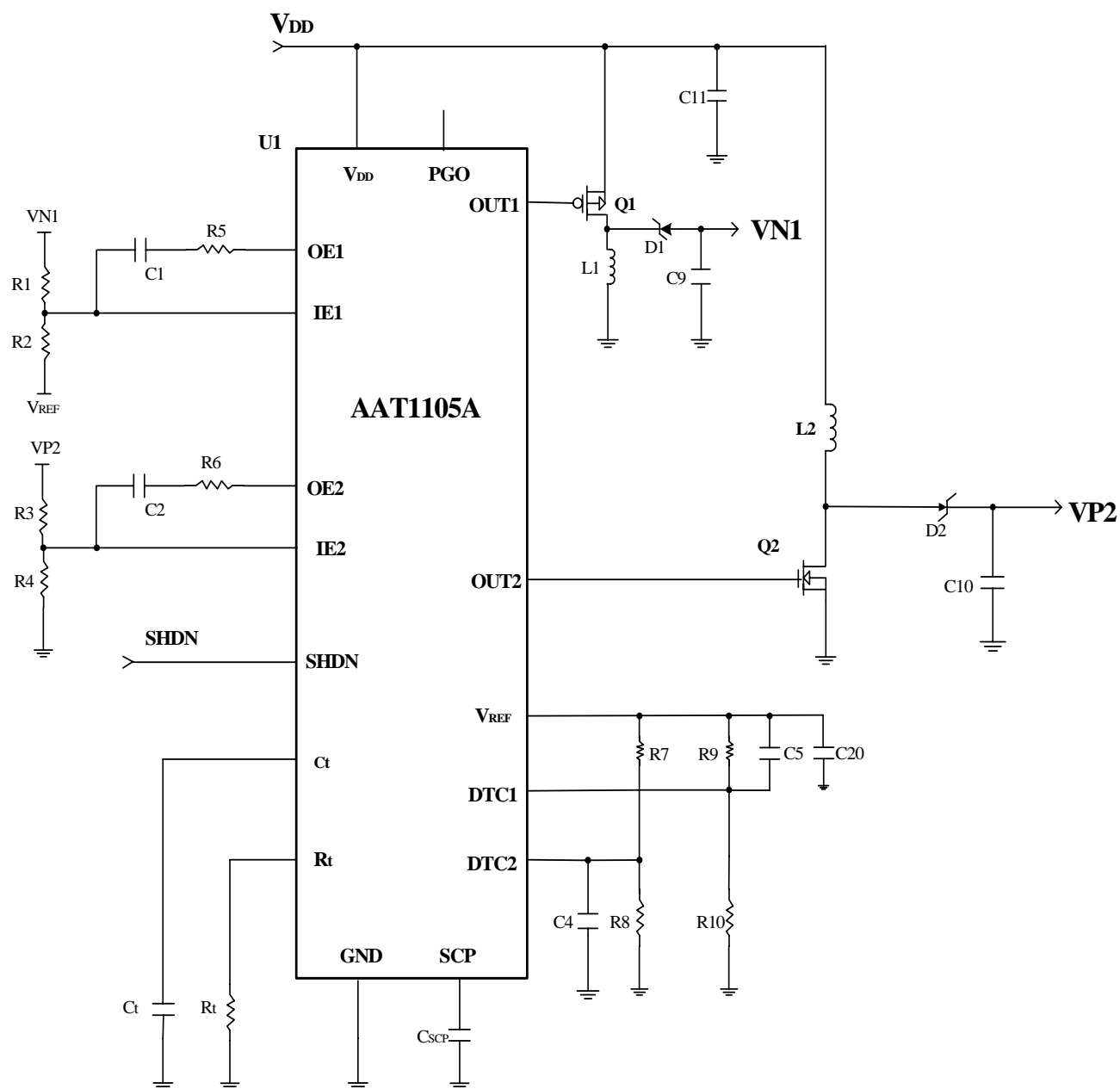


**Block Diagram**





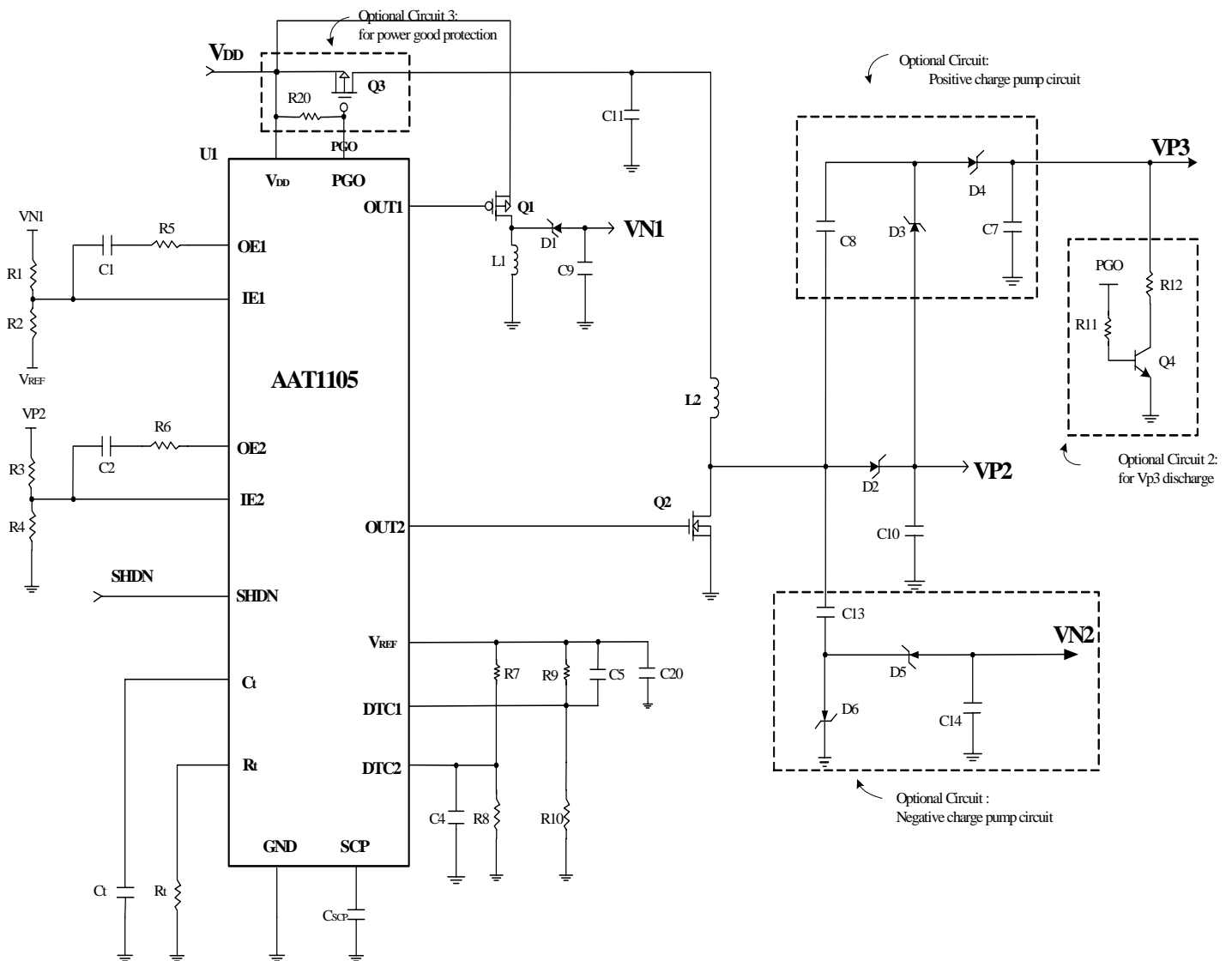
Application Circuit 1





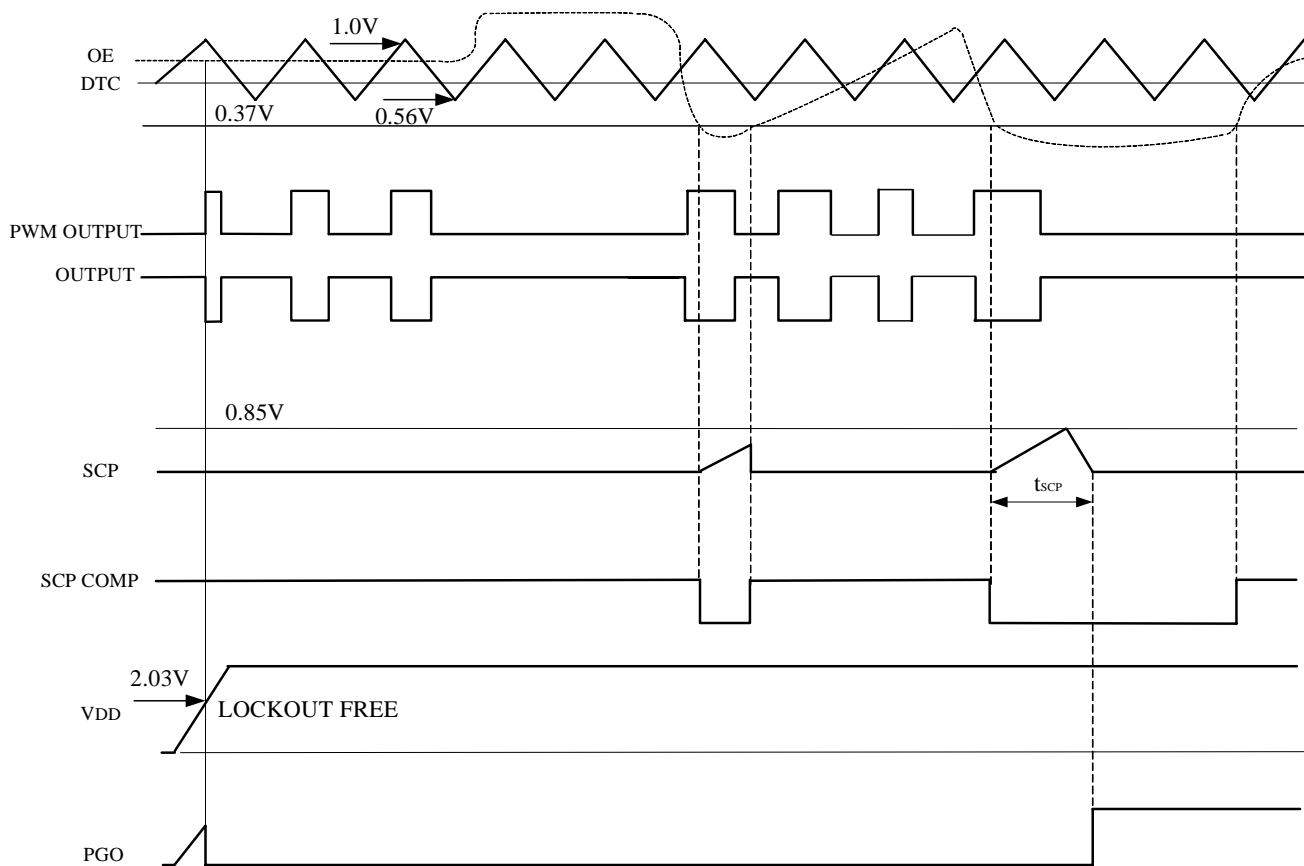


Application Circuit 2





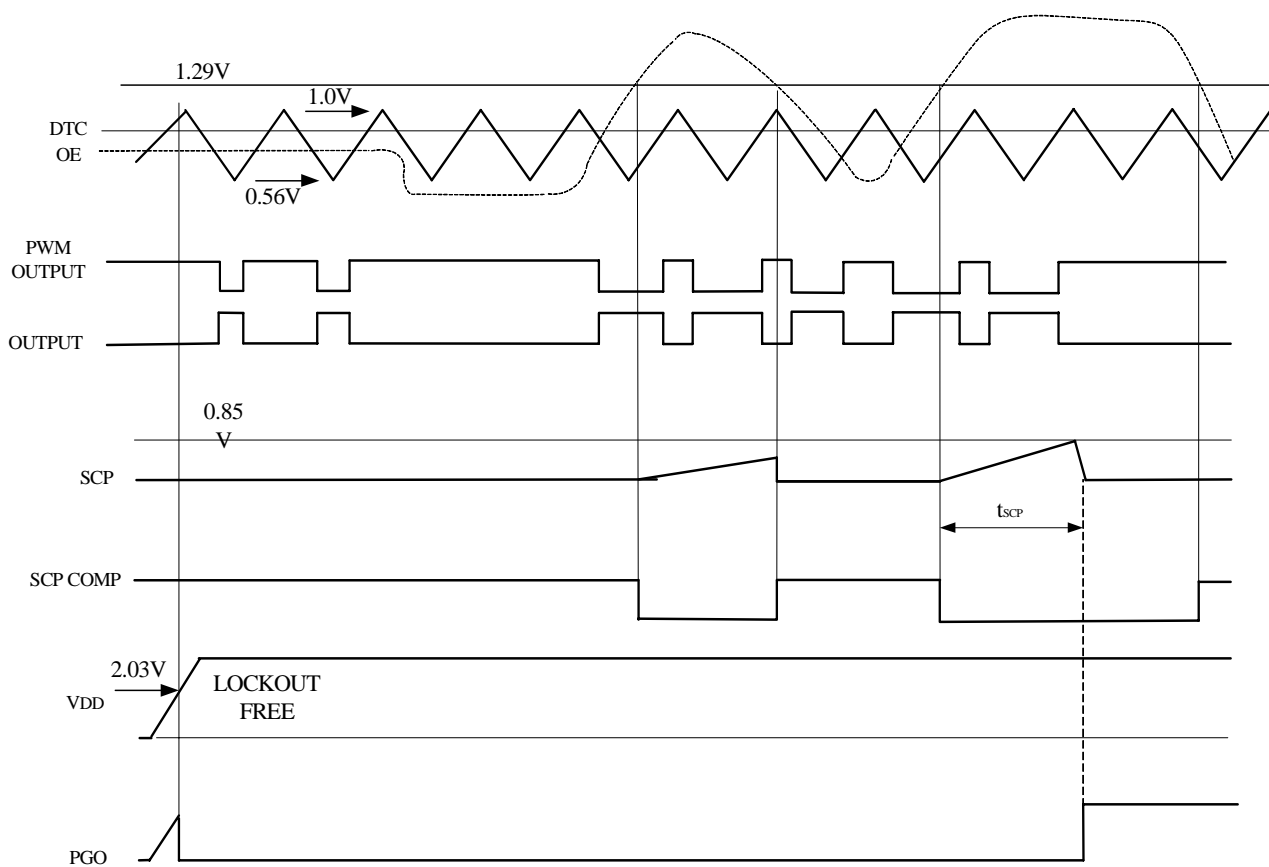
**Buck-Boost ( Inverting ) Timing Chart ( CH1 )**



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



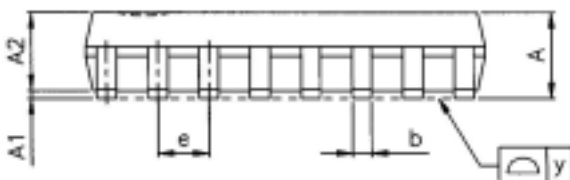
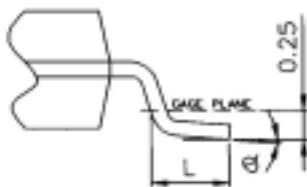
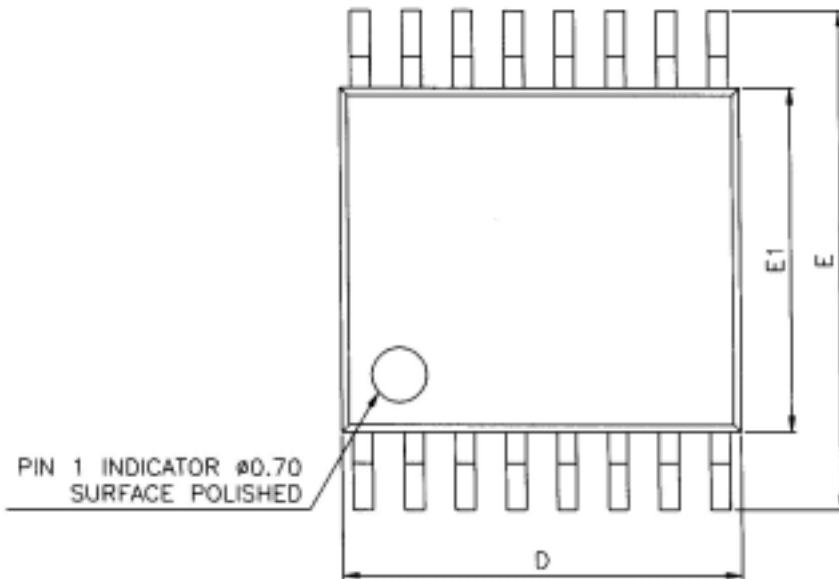
Boost (Step-up) Timing Chart (CH-2)



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

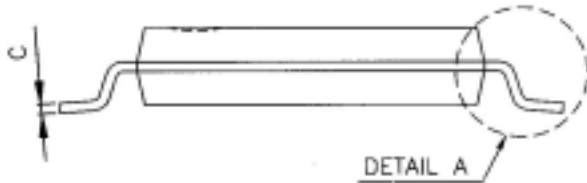


**Package Dimension**  
**16-Pin TSSOP**





Package Dimension (Cont.)



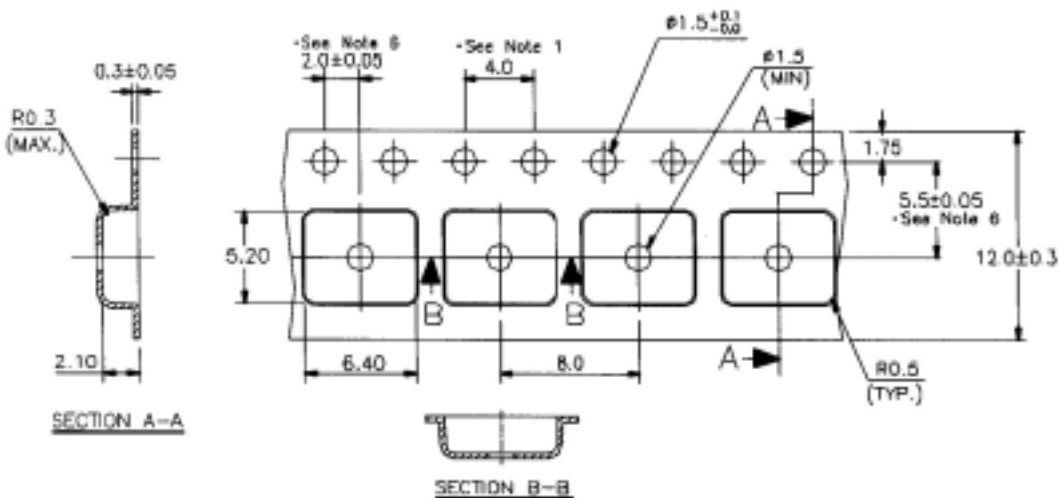
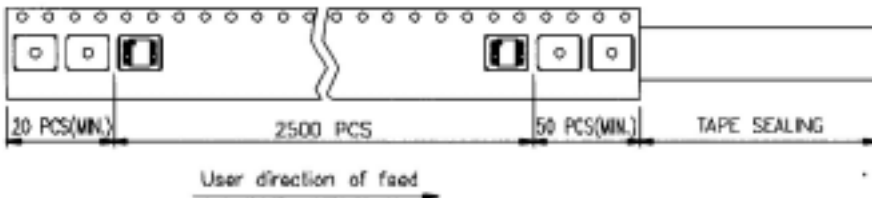
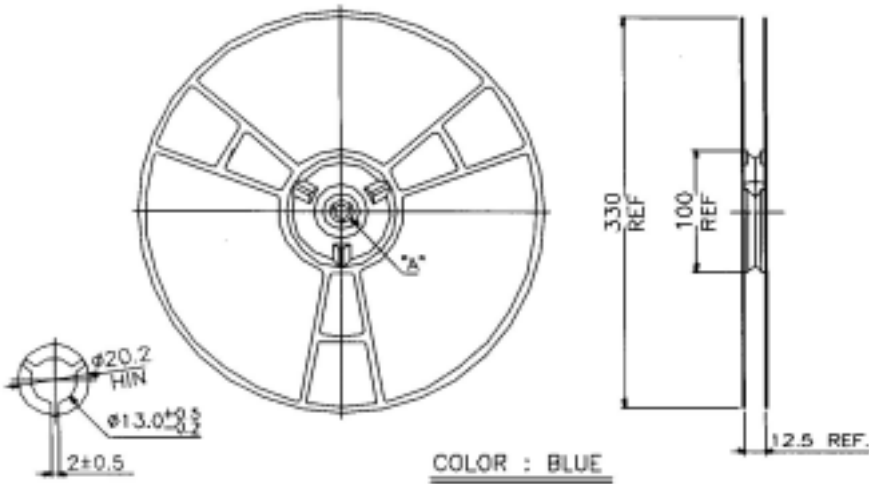
SYMBOLS	DIMENSIONS IN MILLIMETERS			DEMINSIONS IN INCHES		
	MIN	TYP	MAX	MIN	TYP	MAX
A	1.05	1.10	1.20	0.041	0.043	0.047
A1	0.05	0.10	0.15	0.002	0.004	0.006
A2	-----	1.00	1.05	-----	0.039	0.041
b	0.20	0.25	0.28	0.008	0.010	0.011
C	-----	0.127	-----	-----	0.005	-----
D	4.900	5.075	5.100	0.1930	0.1998	0.2000
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.

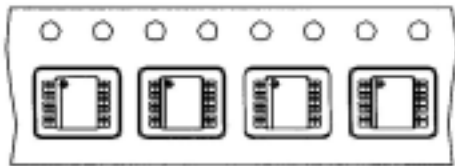


Tape and Reel





## Tape and Reel (Cont.)



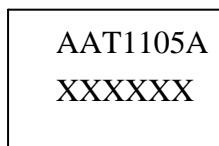
TSSOP 14L / 16L

### NOTE:

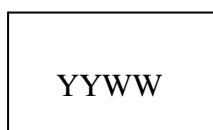
1. 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE  $\pm 0.2$  MILLIMETERS.
2. CAMBER NOT TO EXCEED 1 MILLIMETER IN 100 MILLIMETERS.
3. MATERIAL: ANTI-STATIC BLACK ADVANTEK POLYSTYRENE.
4.  $A_0$  AND  $B_0$  MEASURED ON A PLANE 0.3 MILLIMETERS ABOVE THE BOTTOM OF THE POCKET.
5.  $K_0$  MEASURED FROM A PLANE 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



### TSSOP16 Back Marking





**Ordering Information**

**AAT xxxxx-xx-x**

AAT Part Number

Package Code 1  
Tssop16: T1

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

**Remark:**  
**T=Taping Reel**  
PS.  
Tssop16→3,000pcs/reel  
**Blank=Tube**  
PS.  
Tssop16→56pcs/tube