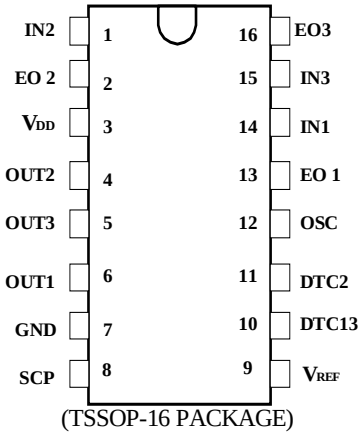
TRIPLE-CHANNEL PWM CONTROLLER

Features

- Complete PWM Power Control Circuitry
- Precision Reference：1.25V±1% (25°C)
- Low Operating Voltage：2.5V to 7V
- Under-voltage Lockout Protection
- Totem Pole Output
- Output Short Circuit Protection
- Low Dissipation Current：
  2.5mA (f=500kHz, Duty=50%)
- Separated On / Off Control for Ch-1,
  3 pair and Ch-2 (see function table)
- Dead Time Control：0 to 100%
- Wide Operating Frequency：50kHz to 1MHz
- Minimized External Components

Pin Configuration

TOP VIEW



(TSSOP-16 PACKAGE)

General Description

The AAT1100 provides an integrated triple-channel pulse-width-modulation (PWM) solution for the power supply of DC-DC system, this device offers the systems engineer the flexibility to tailor the power supply circuitry to a specific application. Each channel contains its own error amplifier, PWM comparator, dead–time control and output driver. The under-voltage protection, oscillator, short circuit protection and voltage reference circuit are common for the three channels.

The AAT1100 contains two boost exclusive circuits (Ch-1,3) and a buck-boost exclusive circuit (Ch-2). Dead-time control (DTC) can be set to provide 0% to 100% dead time by resistive divider network. Soft start can be implemented by paralleling the DTC resistor with a capacitor. Two dead time control inputs are assigned for Ch-1,3 pair and Ch-2 individually, and dead time control inputs can be used to control on / off operation.

With a minimum number of external components, the AAT1100 offers a simple and cost effective solution. And this device can operate from 2.5V to 7.0V supply voltages to achieve efficient operation in low power system.

*Spec is subject to change without notice in this document.

Function Table

Condition	Output		
	Ch-1	Ch-2	Ch-3
DTC13 > 0.3V, DTC2 > 0.3V	ON ”H”	ON ”L”	ON ”H”
DTC13 > 0.3V, DTC2 < 0.2V	ON ”H”	OFF ”H”	ON ”H”
DTC13 < 0.2V, DTC2 > 0.3V	OFF ”L”	ON ”L”	OFF ”L”
DTC13 < 0.2V, DTC2 < 0.2V	OFF ”L”	OFF ”H”	OFF ”L”

Pin Description

Pin #	Name	I/O	Description
1	IN2	I	Negative input of EA2 (Error Amplifier 2)
2	EO2	I/O	Feedback input of EA2
3	V_{DD}	I	Supply voltage
4	OUT2	O	Channel 2 output
5	OUT3	O	Channel 3 output
6	OUT1	O	Channel 1 output
7	GND		Ground
8	SCP	I	Short circuit protect
9	V_{REF}	O	Reference voltage output
10	DTC13	I	Dead time control of channel 1,3
11	DTC2	I	Dead time control of channel 2
12	OSC	I	Frequency setting capacitor & resistor input
13	EO1	I/O	Feedback input of EA1
14	IN1	I	Negative input of EA1
15	IN3	I	Negative input of EA3
16	EO3	I/O	Feedback input of EA3

Absolute Maximum Ratings

CHARACTERISTICS		SYMBOL	VALUE	UNIT
Supply voltage		V_{DD}	8	V
Input voltage (IN-, DTC)		V_I	V_{DD}	V
Output voltage		V_O	V_{DD} +0.3	V
Output current	Ch-1,3	I_O	-41/+21	mA
	Ch-2		-21/+41	mA
Output peak current	Sink ($t_w \leqq 2\mu s$, Duty$\leqq$10%)	I_{opeak}	+200	mA
	Source ($t_w \leqq 2\mu s$, Duty$\leqq$10%)		-200	
Operating free-air temperature range		T_{ope}	-20 to 85	°C
Storage temperature range		T_{stg}	-65 to 150	°C

Recommended Operating Conditions

	Symbol	Min	Max	Unit
Supply voltage, V_{DD}	V_{DD}	2.5	7	V
Input voltage, IN1, IN3	V_{I13}	0.95	1.55	V
Input voltage, IN2	V_{I2}	0.4	1.0	V
Output voltage	V_O	0	V_{DD}	V
OSC capacitor	C_T	10	1800	pF
OSC resistor (Note 1)	R_T	6	8	kΩ
Oscillator frequency	f_{OSC}	50	1000	kHz
Output current, Iout1, Iout3	I_{O13}		-40/+20	mA
Output current, Iout2	I_{O2}		-20/+40	mA
Output current of error amplifier	I_{FB}		60	µA
Operating free-air temperature	T_{ope}	-20	85	°C

Note 1: The rise and fall times of oscillator wave form will be equal at OSC resistor (R_T)=7kΩtheoretically.

Electrical Characteristics, V_{DD} = 3.3V (Unless Otherwise Specified) (See Note 2)

Oscillator

Parameter		Test Condition	Min	Typ	Max	Unit
Frequency	f_{OSC}	C_T = 130pF, R_T = 7kΩ	400	500	600	KHz
"H" level output voltage	V_{OSCH}	C_T = 130pF, R_T = 7kΩ	0.95	1.00	1.05	V
"L" level output voltage	V_{OSCL}	C_T = 130pF, R_T = 7kΩ	0.35	0.40	0.45	V
Frequency change with V_{DD}	f_{dV}	V_{DD} = 2.5V to 7V, T_A = 25°C C_T = 130pF, R_T = 7kΩ		1	2	%
Frequency change with T_A	f_{dT}			5	10	%
Output source current	I_{OSC}		-180	-200	-220	µA

Under-voltage Protection

Parameter		Test Condition	Min	Typ	Max	Unit
Upper threshold voltage	V_{UPH}	T_A = 25°C	2.2	2.3	2.4	V
Lower threshold voltage	V_{UPL}	T_A = 25°C	2.0	2.1	2.2	V
Hysteresis (V_{UPH} – V_{UPL})	V_{HYS}	T_A = 25°C	0.1	0.2	0.3	V

Short Circuit Protection Control

Parameter		Test Condition	Min	Typ	Max	Unit
Input threshold voltage	V_{r1}	Ch-1, 3	1.10	1.15	1.20	V
	V_{r2}	Ch-2	0.20	0.25	0.30	
Latch reset voltage	V_R	T_A = 25°C	0.8	1.5	1.8	V
Short-circuit detect threshold voltage	V_{r3}		1.20	1.25	1.30	V
SCP terminal source current	I_{SCP}		-1.4	-2.0	-2.6	µA

Note 2: Typical values of all parameters except for V_{REF} (dev) and f_{dT} are specified at T_A =25°C.

Electrical Characteristics, V_{DD} = 3.3V (Unless Otherwise Specified) (See Note 2) (continued)

Reference Voltage

Parameter		Test Conditions	Min	Typ	Max	Unit
Reference voltage	V_{REF}	$I_{REF} = -1mA$, $T_A = 25^oC$	1.237	1.250	1.263	V
Short-circuit output current	I_{os}	$V_{REF} = 0$	-2	-10	-30	mA
Input voltage regulation	V_{RI}	$I_{REF} = -1mA$, V_{DD} = 2.5V to 7V		2	5	mV
Output regulation	V_{RO}	$I_{REF} = -0.1mA$ to -1mA		1	5	mV
Reference voltage change with temperature	V_{RT}	$I_{REF} = -1mA$ (Note 3)		15	25	mV

EA (Error Amplifier)

Parameter		Test Condition	Min	Typ	Max	Unit
Input offset voltage	V_{IO}	Ch-1,3, A_V=1			15	mV
Input bias current	I_{IB}	Ch-1,3, V_1= 0.95V to 1.55V		±10	±20	nA
		Ch-2, V_1= 0.4V to 1.0V		±10	±20	
Input voltage range	V_{IR}	Ch-1,3	0.95		1.55	V
		Ch-2	0.4		1.0	
Open-loop voltage amplification	A_{VD}	$R_{FB} = 200k\Omega$		60		dB
Unity-gain bandwidth	B_1			1		MHz
Output voltage swing	V_{OM+}	$V_{ID} = 0.1V$, $I_O = -60\mu A$	1.2			V
	V_{OM-}	$V_{ID} = -0.1V$, $I_O = 0.2mA$			0.2	
Output sink current	I_{OM+}	$V_{ID} = -0.1V$, $V_O = 0.2V$	0.2	1.0		mA
Output source current	I_{OM-}	$V_{ID} = 0.1V$, $V_O = 1.2V$	-60	-100		µA
Input bias voltage	V_{r5}	Ch-2, A_V=1, T_A=25 °C	678	700	722	mV
		Ch-2, A_V=1	665	700	735	

Note 3: The deviation parameter V_{RT} (dev) is defined as the difference of the maximum and minimum values obtained over the recommended free-air temperature range (-20 °C to 85 °C).

Electrical Characteristics, V_{DD} = 3.3V (Unless Otherwise Specified) (See Note 2) (continued)

Dead Time Control

Parameter		Test Condition	Min	Typ	Max	Unit
Input bias current	$I_{BDT1/3}$	$V_{DTC1,3}$ = 0.35V to 1.05V			200	nA
	I_{BDT2}	V_{DTC2} = 0.35V to 1.05V		±2	±20	nA
Input threshold voltage (DTC 13)	V_{13d0}	Duty = 0%, f_{OSC} = 500kHz	0.3	0.4	0.5	V
	V_{13d100}	Duty = 100%, f_{OSC} = 500kHz	0.9	1.0	1.1	
Input threshold voltage (DTC2)	V_{2d0}	Duty = 0%, f_{OSC} = 500kHz	0.3	0.4	0.5	V
	V_{2d100}	Duty = 100%, f_{OSC} = 500kHz	0.9	1.0	1.1	
Channel On / Off threshold voltage	V_{r4}		0.2	0.25	0.3	V

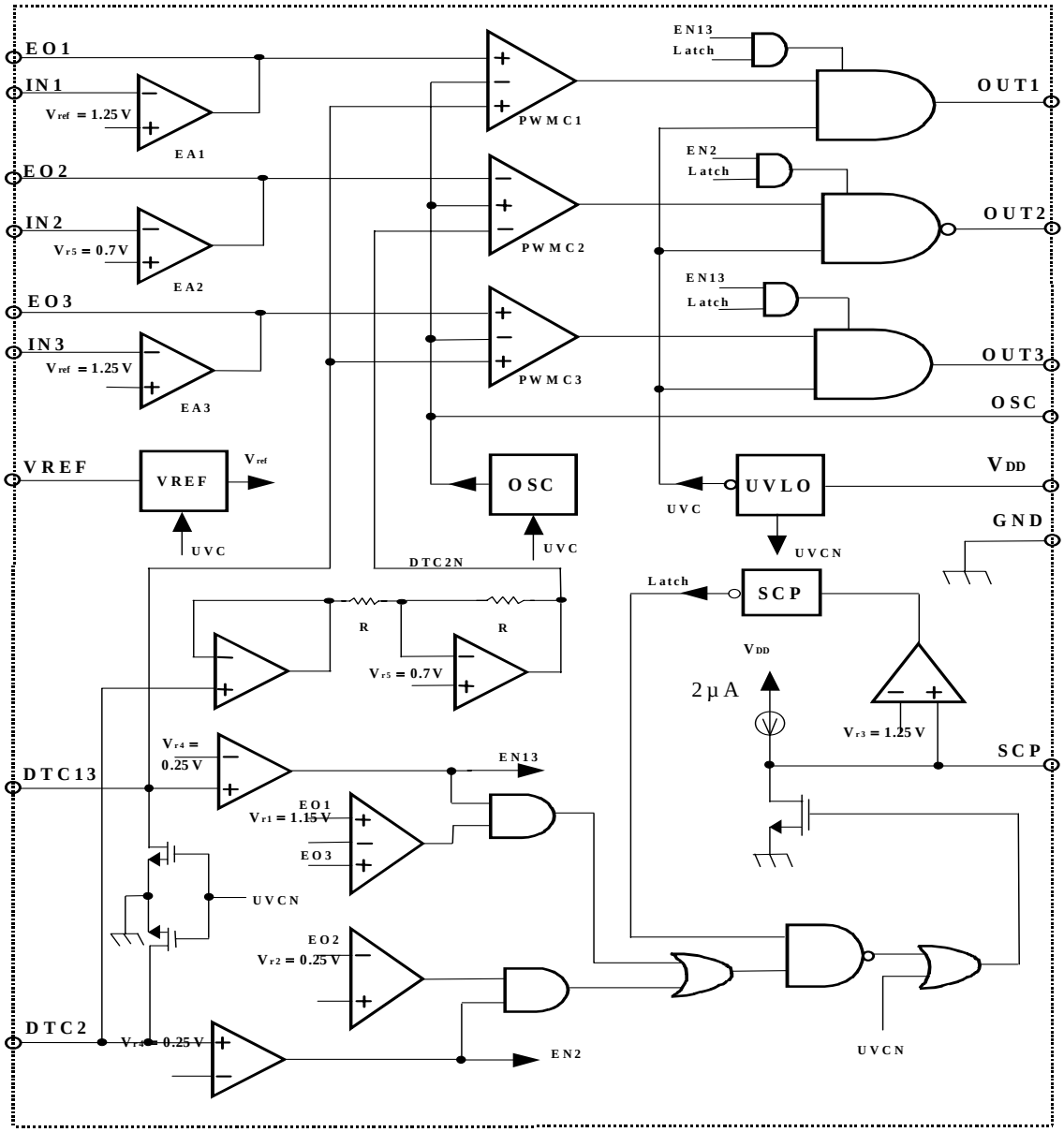
Output Stage

Parameter		Test Condition	Min	Typ	Max	Unit
High-level output voltage	V_{OH}	I_O = –20mA (Ch-2)	2.9	3.05		
		I_O = –40mA (Ch-1,3)	1.9	2.2		V
Low-level output voltage	V_{OL}	I_O = 20mA (Ch-1,3)		0.2	0.4	
		I_O = 40mA (Ch-2)		0.3	0.6	V
Rise time	T_{rise}	C_L = 1000pF		130		ns
Fall time	T_{fall}	C_L = 1000pF		50		ns

Operating Current

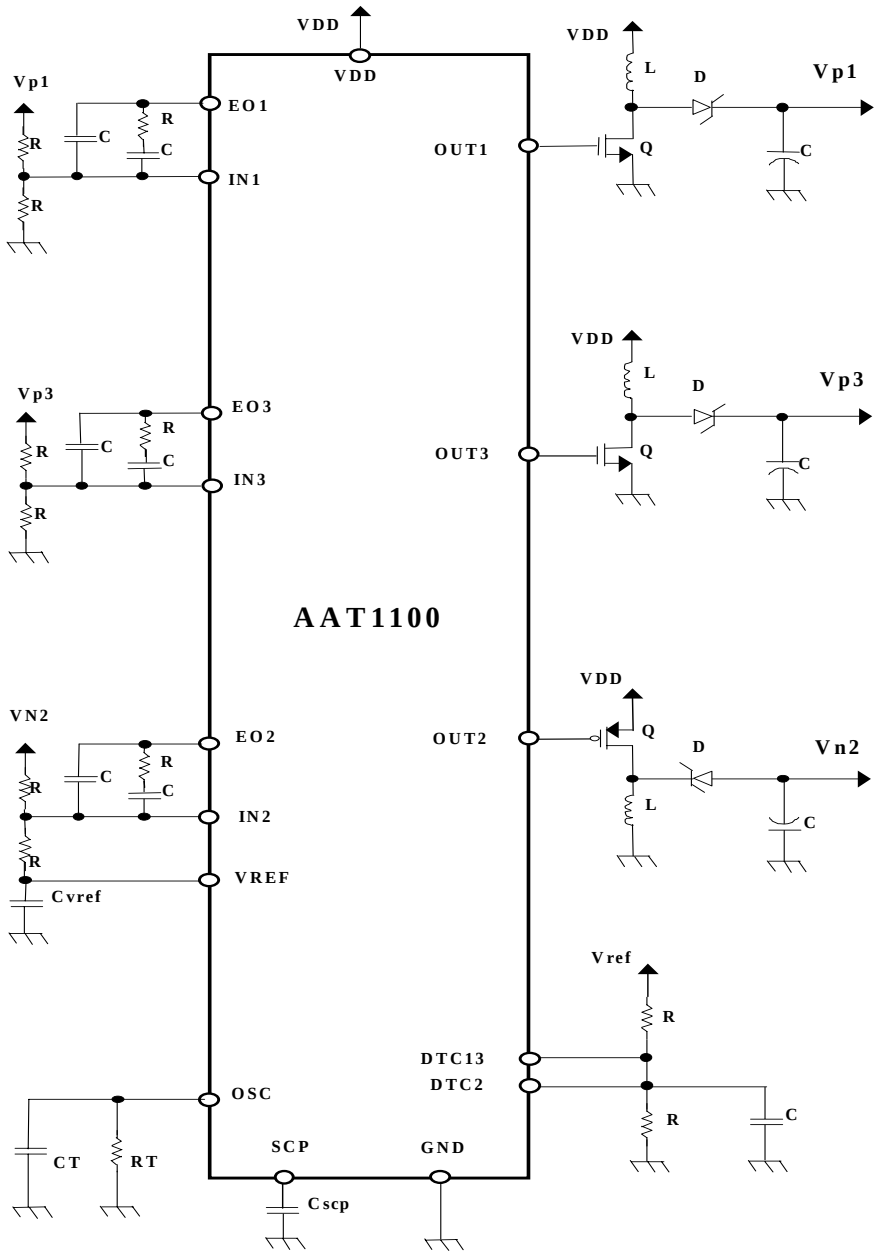
Parameter		Test Condition	Min	Typ	Max	Unit
Supply current	I_{DD-OFF}	Output ”OFF”state		2.5	4.0	mA
	I_{DD-ON}	f_{OSC} = 500kHz, Duty = 50%, No load		3.5	5.0	mA

Function Block Diagram

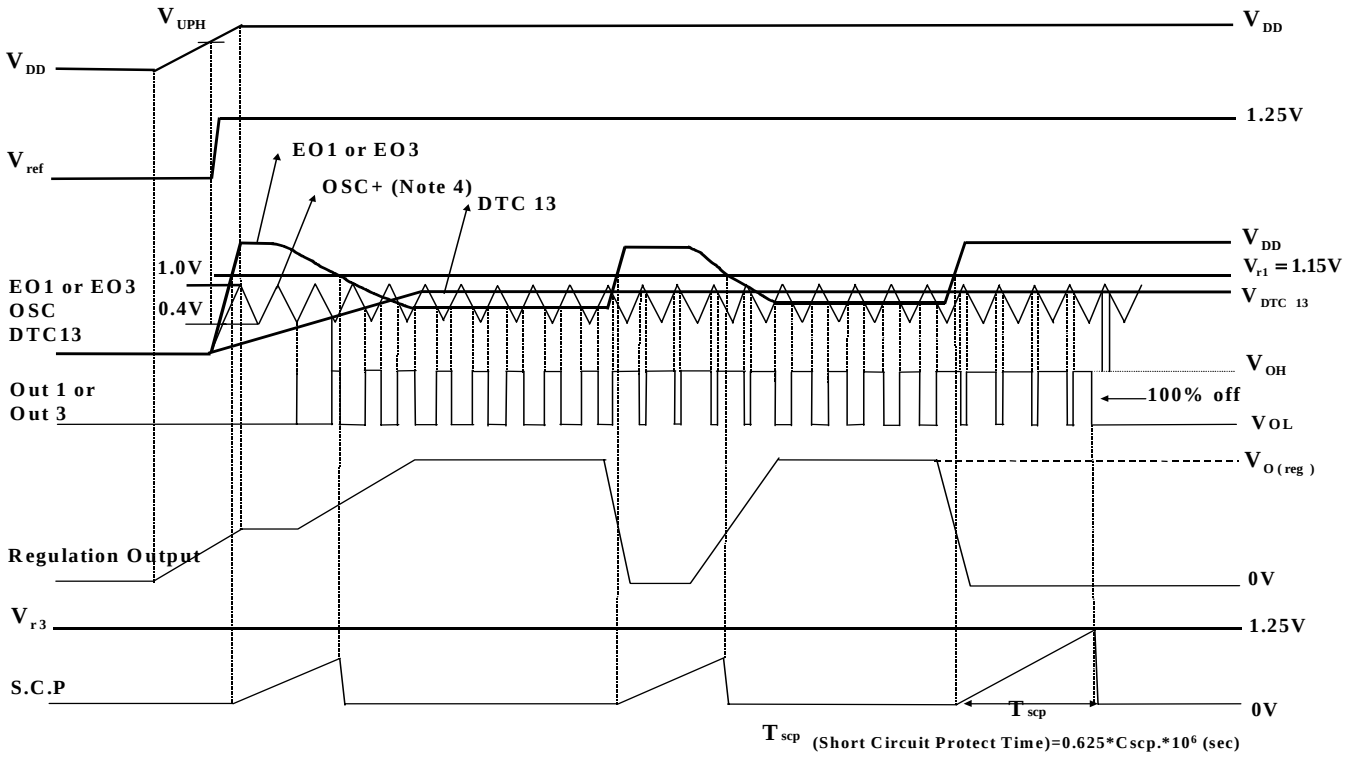


All voltage and current values in block diagram are nominal.

Application Circuit

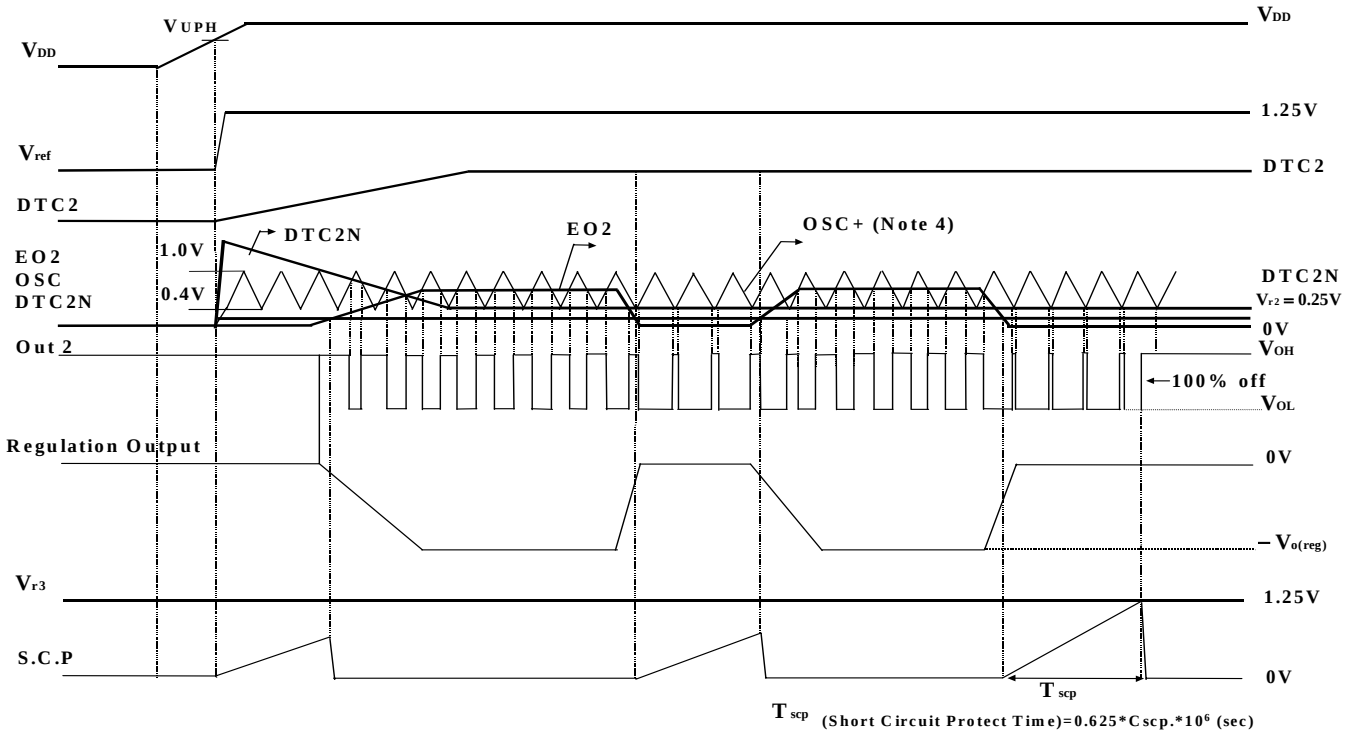


Timing Chart



Timing Chart for Ch-1 or Ch-3

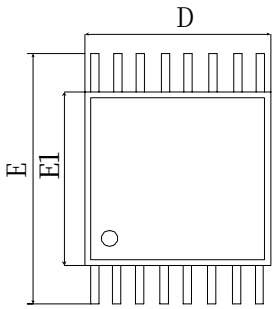
Timing Chart

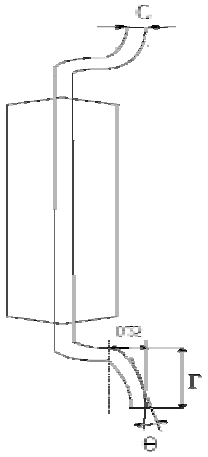


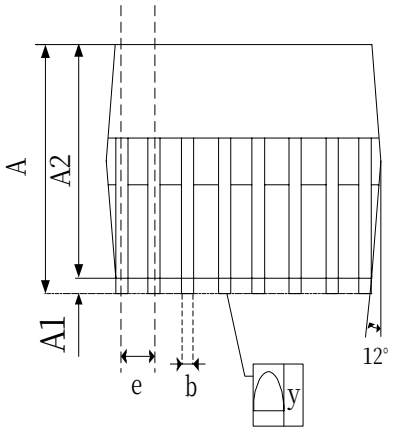
Timing Chart for Ch-2

Note 4 : + Oscillator wave form is illustrated as triangle wave form. But it is determined by time constant of timing resistor (RT) and capacitor (CT) connected to OSC terminal actually.

Package Dimension (Unit: Mil)







	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	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	4.90	5.075	5.10	0.193	0.1998	0.200
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	0.5	0.60	0.70	0.02	0.024	0.028
y	—	—	0.076	—	—	0.003
θ	0°	4°	8°	0°	4°	8°

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NOTE:

1. Controlling dimension : mm
2. Dimension "D" does not include mold flash, the bar burrs and gate burrs.
   Mold flush, the bar burrs and gate burrs shall not exceed 0.006"[0.15mm]
   per end.
   Dimension "E1" does not include interlead flash.
   interlead flash shall not exceed 0.010"[0.25mm] per side.
3. Dimension "b" does not include dambar protrusion.
   Allowable dambar protrusion shall be 0.003"[0.08mm] 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"[0.07mm]
4. Tolerance: ± 0.010"[0.25mm] unless otherwise specified.
5. Otherwise dimension follow acceptable spec.

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