



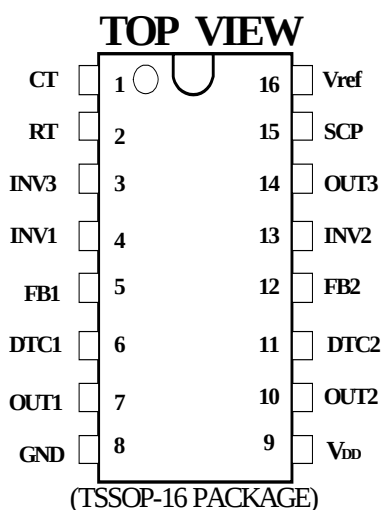
Preliminary and Provisional

## 2-CHANNEL STEP-UP PWM CONTROLLERS WITH ADJUSTABLE LDO

### Features

- Complete PWM Power Control Circuitry
- Adjustable LDO Regulator
- Under-voltage Lockout Protection
- Totem pole Output
- Output Short Circuit Protection
- Dead Time Control : 0 to 100%
- Wide Operating Frequency :  
10kHz to 800kHz

### Pin Configuration



### General Description

The AAT1108 series provides an integrated two-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 two channels.

The AAT1108 contains two boost (step-up) exclusive circuits. 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 and Ch-2 individually, and dead time control inputs can be used to control on / off operation.

The maximum output currents of LDO regulator can be enlarged by connect a N\_MOS FET (or NPN bipolar) as a source follow stage at out3 pin.

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



**Pin Description**

| Pin # | Name             | I/O | Description                             |
|-------|------------------|-----|-----------------------------------------|
| 1     | CT               | I   | External timing capacitance             |
| 2     | RT               | I   | External timing resistance              |
| 3     | INV3             | I   | Negative input for LDO amplifier        |
| 4     | INV1             | I   | Negative input for error amplifier 1    |
| 5     | FB1              | I   | 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 <sub>DD</sub>  | I   | Power supply                            |
| 10    | OUT2             | O   | Output 2                                |
| 11    | DTC2             | I   | Output 2 dead time / soft start setting |
| 12    | FB2              | I   | Output for error amplifier 2            |
| 13    | INV2             | I   | Negative input for error amplifier 2    |
| 14    | OUT3             | I   | LDO output                              |
| 15    | SCP              | I   | Timer latch setting                     |
| 16    | V <sub>ref</sub> | O   | Reference voltage (2.505V) output       |



#### Absolute Maximum Ratings

| CHARACTERISTICS                      | SYMBOL    | VALUE          | UNIT |
|--------------------------------------|-----------|----------------|------|
| Supply voltage                       | $V_{DD}$  | 7              | V    |
| Input voltage (IN-, DTC)             | $V_I$     | $V_{DD}$       | V    |
| Output voltage                       | $V_O$     | $V_{DD} + 0.3$ | V    |
| Output current                       | $I_O$     | -120/+120      | mA   |
| Operating free-air temperature range | $T_{ope}$ | -20 to 85      | °C   |
| Storage temperature range            | $T_{stg}$ | -65 to 150     | °C   |
| Power dissipation                    | $P_d$     | 500            | mW   |

#### Recommended Operating Conditions

|                                       | Symbol    | Min | Max      | Unit       |
|---------------------------------------|-----------|-----|----------|------------|
| Supply voltage, $V_{DD}$              | $V_{DD}$  | 4.0 | 6.5      | V          |
| Input voltage, INV1, INV2, INV3       | $V_{cm}$  | 0.5 | 1.6      | V          |
| Output voltage                        | $V_O$     | 0   | $V_{DD}$ | V          |
| OSC capacitor                         | $C_T$     | 100 | 15000    | pF         |
| OSC resistor (Note 1)                 | $R_T$     | 5.1 | 50       | k $\Omega$ |
| Oscillator frequency                  | $f_{OSC}$ | 10  | 800      | kHz        |
| Output current, Iout1, Iout2          | $I_{O2}$  |     | +50/-50  | mA         |
| Out put current, Iout3 (Vout3 = 3.3v) | $I_{O3}$  |     | +30      | mA         |
| Operating free-air temperature        | $T_{ope}$ | -20 | 85       | °C         |



Electrical Characteristics,  $V_{DD} = 5.0V$  (Unless Otherwise Specified) (See Note 1)

#### Oscillator

| Parameter                      |           | Test Condition                                                                      | Min | Typ | Max | Unit |
|--------------------------------|-----------|-------------------------------------------------------------------------------------|-----|-----|-----|------|
| Frequency                      | $f_{OSC}$ | $C_T = 220pF, R_T = 10k\Omega$                                                      | 320 | 400 | 480 | KHz  |
| Frequency change with $V_{DD}$ | $f_{dV}$  | $V_{DD} = 4.0V$ to $6.0V$ ,<br>$T_A = 25^\circ C$<br>$C_T = 220pF, R_T = 10k\Omega$ |     | 1   |     | %    |

#### Under-voltage Protection

| Parameter                          |           | Test Condition     | Min  | Typ  | Max  | Unit |
|------------------------------------|-----------|--------------------|------|------|------|------|
| Upper threshold voltage            | $V_{UPH}$ | $T_A = 25^\circ C$ | 2.6  | 2.9  | 3.2  | V    |
| Lower threshold voltage            | $V_{UPL}$ | $T_A = 25^\circ C$ | 2.23 | 2.53 | 2.83 | V    |
| Hysteresis ( $V_{UPH} - V_{UPL}$ ) | $V_{HYS}$ | $T_A = 25^\circ C$ |      | 0.37 |      | V    |

#### Short Circuit Protection Control

| Parameter                              |           | Test Condition | Min  | Typ  | Max  | Unit    |
|----------------------------------------|-----------|----------------|------|------|------|---------|
| Input threshold voltage                | $V_{r1}$  | Ch-1, 2        | 2.1  | 2.4  | 2.65 | V       |
| Short-circuit detect threshold voltage | $V_{r2}$  |                | 1.48 | 1.64 | 1.8  | V       |
| SCP terminal source current            | $I_{SCP}$ |                | -1.5 | -2.5 | -3.5 | $\mu A$ |
| Standby Voltage                        | $V_{STB}$ |                |      | 50   | 100  | mV      |
| Latch Voltage                          | $V_{LT}$  |                |      | 30   | 100  | mV      |

Note1: Typical values of all parameters are specified at  $T_A = 25^\circ C$ .



**Electrical Characteristics,  $V_{DD} = 5.0V$  (Unless Otherwise Specified) (See Note 1) (continued)**  
**Reference Voltage**

| Parameter                  |            | Test Conditions                                       | Min   | Typ   | Max   | Unit |
|----------------------------|------------|-------------------------------------------------------|-------|-------|-------|------|
| Internal reference Voltage | $V_{refi}$ | $I_{REF} = -1mA, T_A = 25^\circ C$                    | 1.220 | 1.233 | 1.246 | V    |
| Reference voltage          | $V_{REF}$  | $I_{REF} = -1mA, T_A = 25^\circ C$                    | 2.430 | 2.505 | 2.580 |      |
| Input voltage regulation   | $V_{RI}$   | $I_{REF} = -1mA,$<br>$V_{DD} = 4.0V \text{ to } 6.0V$ |       | 1     | 5     | mV   |
| Output regulation          | $V_{RO}$   | $I_{REF} = -0.1mA \text{ to } -1mA$                   |       | 1     |       | mV   |

**EA (Error Amplifier)**

| Parameter                       |           | Test Condition  | Min | Typ      | Max       | Unit    |
|---------------------------------|-----------|-----------------|-----|----------|-----------|---------|
| Input offset voltage            | $V_{IO}$  | Ch-1,2, $A_v=1$ |     |          | 6         | mV      |
| Input bias current              | $I_{IB}$  | Ch-1,2          |     | $\pm 15$ | $\pm 100$ | nA      |
| Input voltage range             | $V_{IR}$  | Ch-1,2          | 0.5 |          | 1.6       | V       |
| Open-loop voltage amplification | $A_{VD}$  |                 | 70  | 85       |           | dB      |
| Output voltage swing            | $V_{OM+}$ |                 | 2.3 | 2.5      |           | V       |
|                                 | $V_{OM-}$ |                 |     | 0.7      | 0.9       |         |
| Output sink current             | $I_{OM+}$ | FB=1.25V        | 3   | 20       |           | mA      |
| Output source current           | $I_{OM-}$ | FB=1.25V        | -45 | -75      |           | $\mu A$ |
| Common-mode rejection ratio     | CMRR      |                 | 60  | 80       |           | dB      |



**Electrical Characteristics,  $V_{DD} = 5.0V$  (Unless Otherwise Specified) (See Note 1) (continued)**

**Dead Time Control & PWM**

| Parameter                     |            | Test Condition                    | Min  | Typ  | Max  | Unit    |
|-------------------------------|------------|-----------------------------------|------|------|------|---------|
| Input bias current            | $I_{BDT}$  | $V_{DTC} = 2V$                    |      | 0.1  | 1    | $\mu A$ |
| Input threshold voltage (DTC) | $V_{d0}$   | Duty = 0%, $f_{OSC} = 10kHz$      | 1.38 | 1.48 | 1.58 | V       |
|                               | $V_{d100}$ | Duty = 100%,<br>$f_{OSC} = 10kHz$ | 1.87 | 1.97 | 2.07 |         |
| Latch input voltage           | $V_{DT}$   | $I_{DT} = 100\mu A$               |      | 0.1  | 0.3  | V       |
| Latch mode source current     | $I_{DT}$   | DTC1,2=2.0V                       | 200  | 500  |      | $\mu A$ |

**Output Stage**

| Parameter                 |            | Test Condition | Min | Typ | Max | Unit    |
|---------------------------|------------|----------------|-----|-----|-----|---------|
| High-level output voltage | $V_{OH}$   | $I_O = -50mA$  | 3.6 | 4.0 |     | V       |
| Low-level output voltage  | $V_{OL}$   | $I_O = +50mA$  |     | 0.8 | 1.2 | V       |
| Rise time                 | $T_{rise}$ | $C_L = 1000pF$ |     | 100 |     | nS      |
| Fail time                 | $T_{fail}$ | $C_L = 1000pF$ |     | 100 |     | nS      |
| Leakage current           | $I_{peak}$ | $V_o = 6.0V$   |     |     | 5   | $\mu A$ |

**Operating Current**

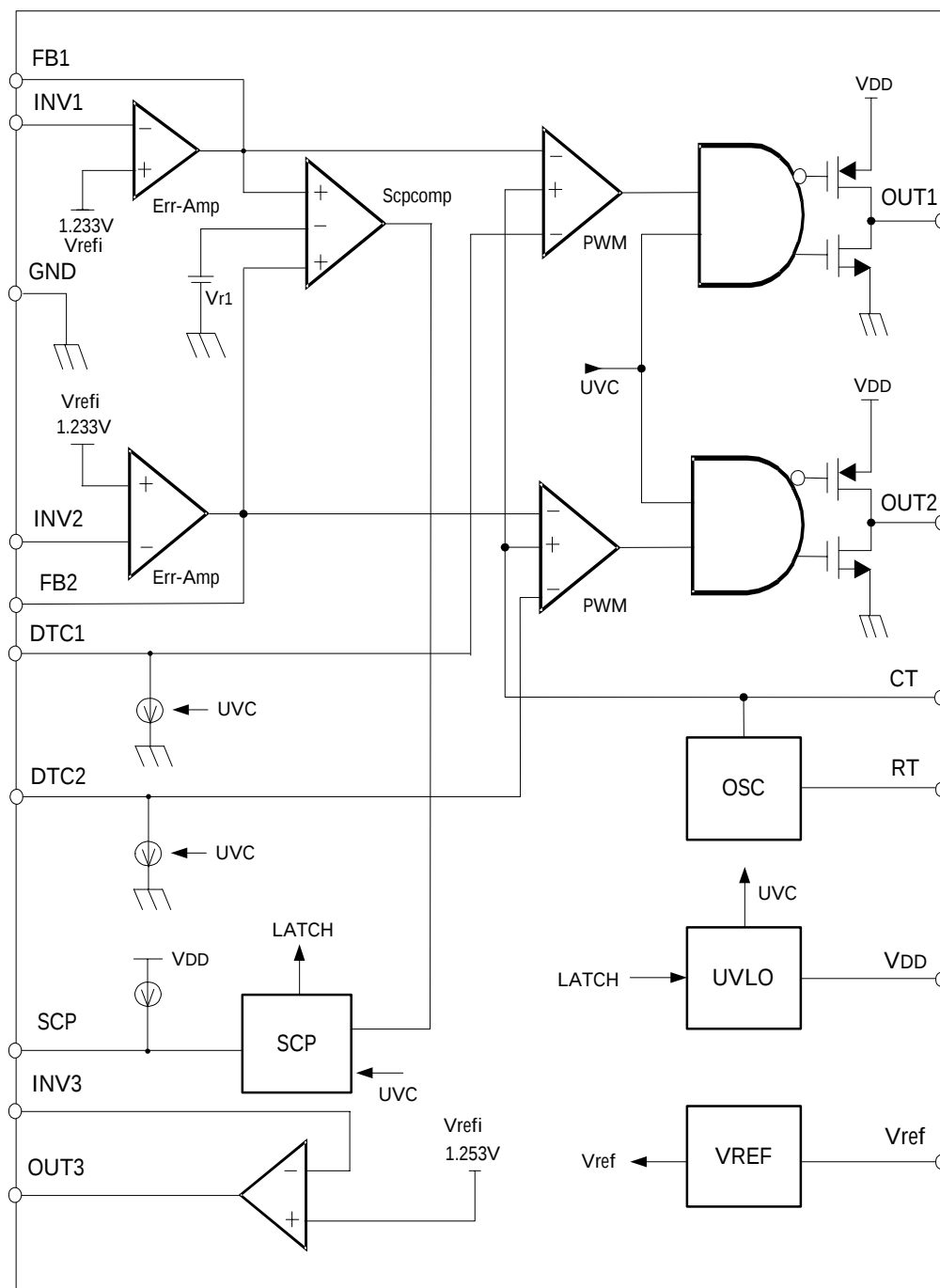
| Parameter      |              | Test Condition     | Min | Typ | Max | Unit |
|----------------|--------------|--------------------|-----|-----|-----|------|
| Supply current | $I_{DD-OFF}$ | Output "OFF" state |     | 1.8 |     | mA   |
|                | $I_{DD-ON}$  | $P_{RT} = 10k$     |     | 2.0 |     | mA   |

**LDO ( $V_{out3} = 3.3V$ )**

| Parameter       |          | Test Condition                                | Min  | Typ  | Max  | Unit |
|-----------------|----------|-----------------------------------------------|------|------|------|------|
| Output voltage  | $V_{rd}$ | $V_{DD} = 5V, V_{out3} = 3.3V$                | 3.17 | 3.3  | 3.43 | V    |
| Line Regulation | $LR_I$   | $V_{DD} = 4V \sim 6.5V,$<br>$I_{out3} = 10mA$ |      | 0.08 | 0.3  | %    |
| Load Regulation | $LR_O$   | $I_{out3} = 1mA \sim 30mA$                    |      | 0.1  |      | %    |

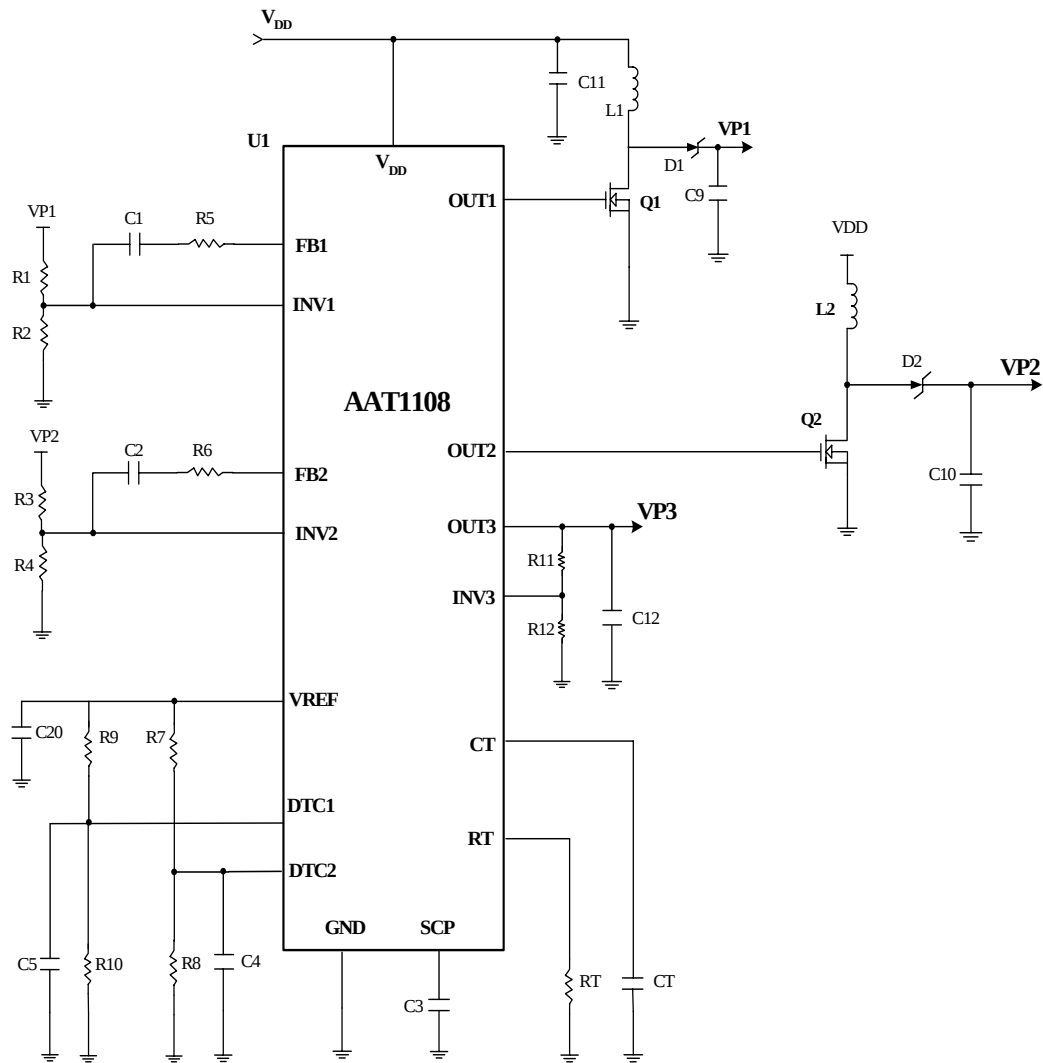


Function Block Diagram



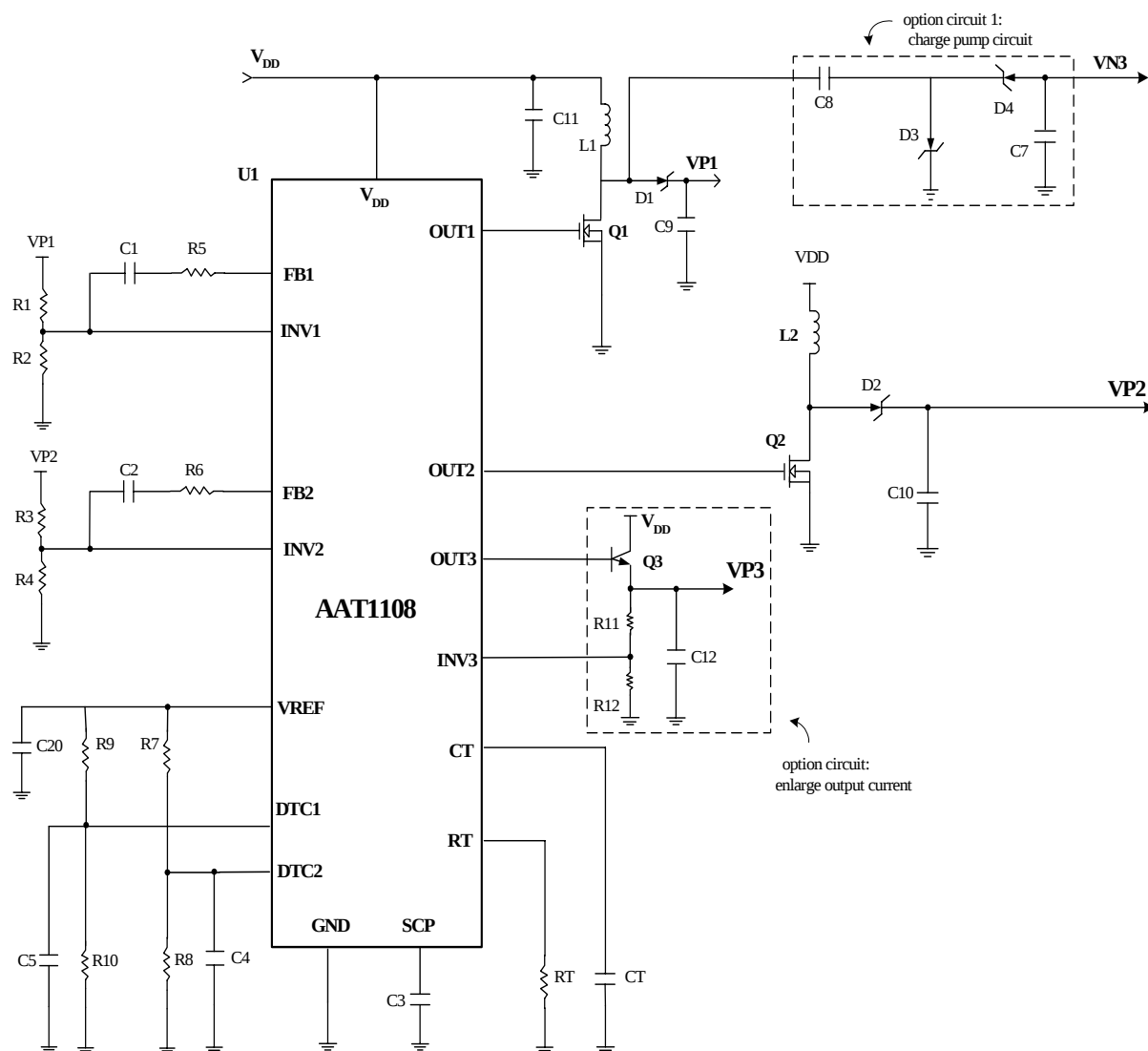


Application Circuit 1



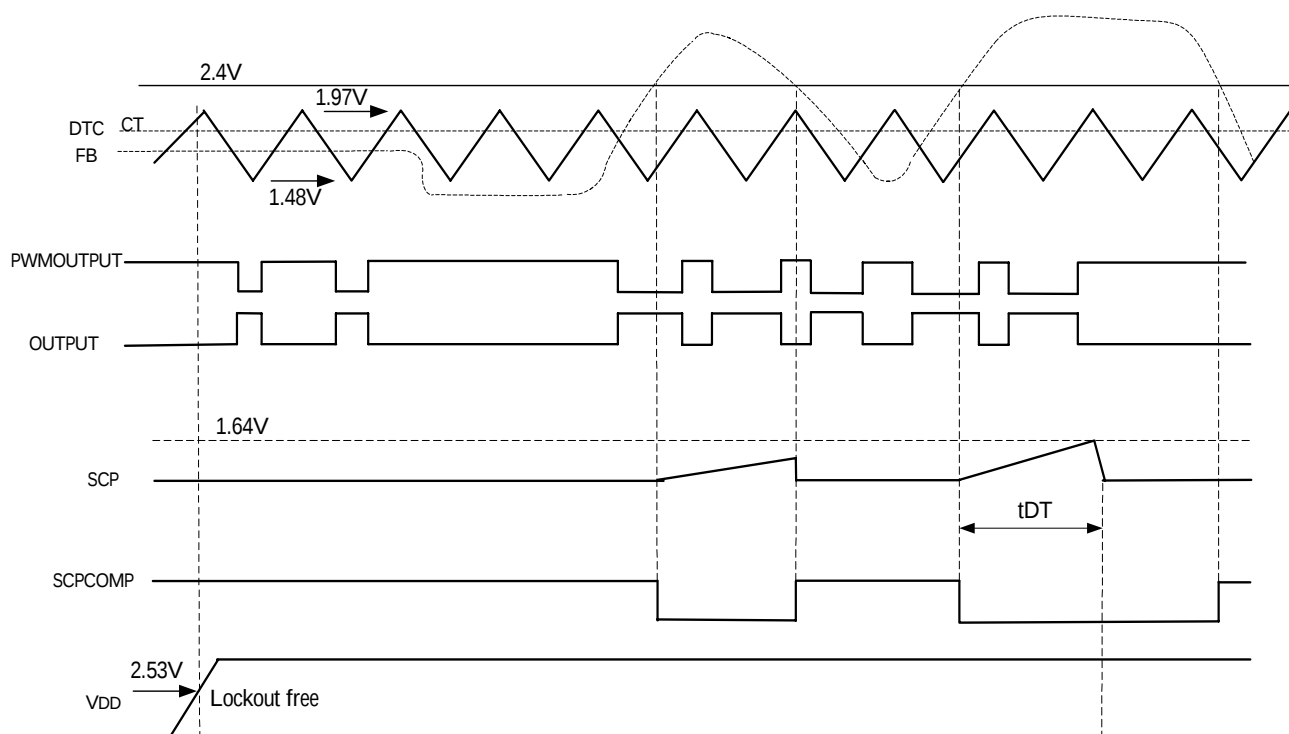


## Application Circuit 2



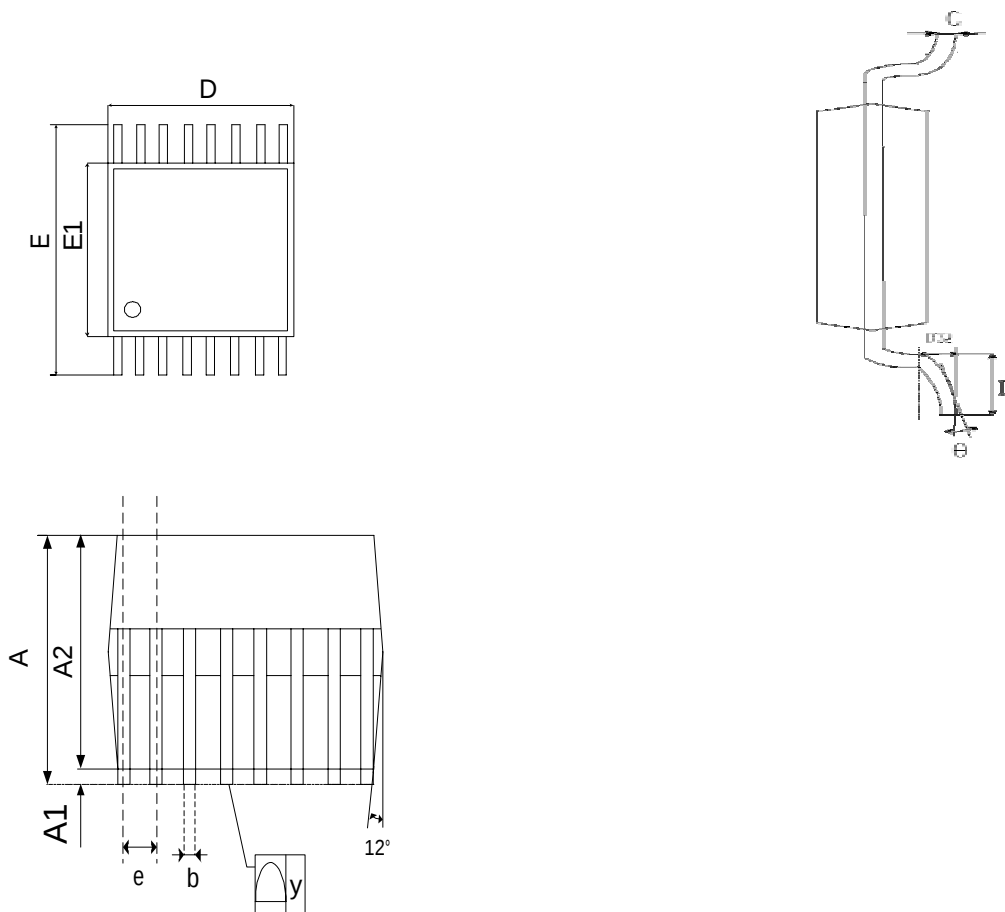


## Boost (Step-up) Timing Chart





Package Dimension (Unit: Mil)



|     | DIMENSIONS IN MILLIMETERS |       |       | DIMENSIONS IN INCHES |        |       |
|-----|---------------------------|-------|-------|----------------------|--------|-------|
|     | M I N                     | N O M | M A X | M I N                | N O M  | M A X |
| A   | 1.05                      | 1.10  | 1.20  | 0.041                | 0.043  | 0.047 |
| A 1 | 0.05                      | 0.10  | 0.15  | 0.002                | 0.004  | 0.006 |
| A 2 | —                         | 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 |
| E 1 | 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°    |
|     |                           |       |       |                      |        |       |