

Features

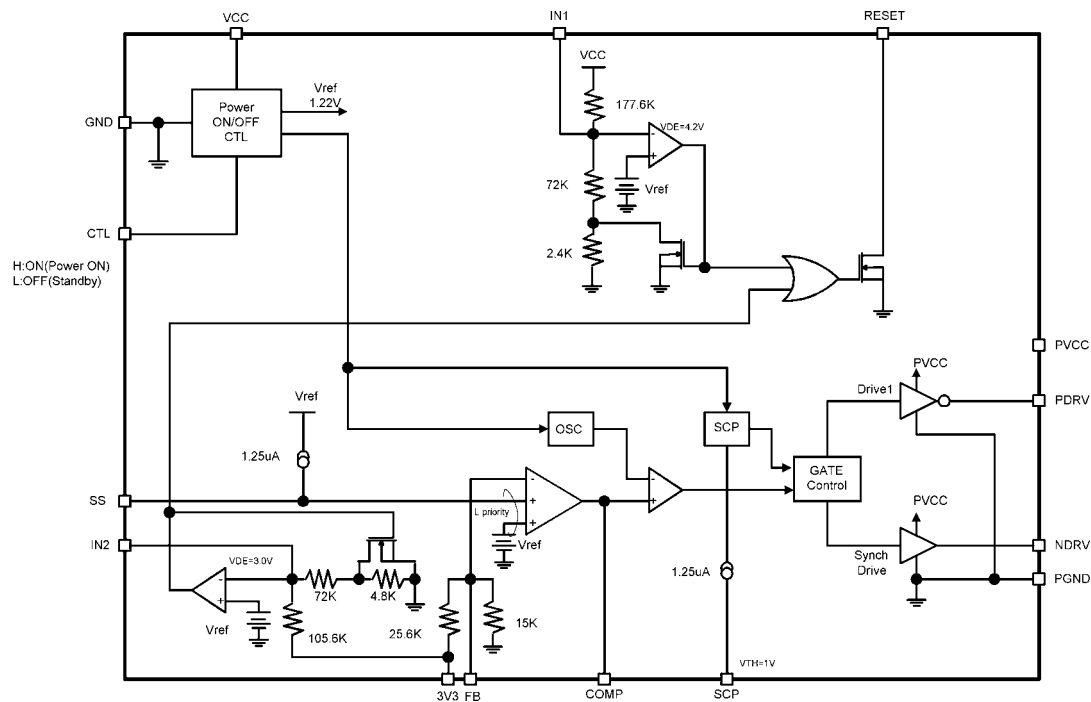
- High efficiency (min. 90% On $I_O=300\text{mA}$ ~600mA)
- Using external P and N channel MOSFET
- Supports for down and up/down Zeta conversion
- Maximum Duty 100%
- Oscillation frequency 300KHz or 600KHz
- Soft Start by an external capacity
- Output voltage accuracy $\pm 2\%$
- Built-in ON/OFF Function
- Built-in Short-circuit Protection
- Stand-by current max. $10\mu\text{A}$
- Quiescent Current 1mA
- Monitor the input voltage and 3V3 output
- Input voltage: $2.5\text{V} \sim 7.0\text{V}$

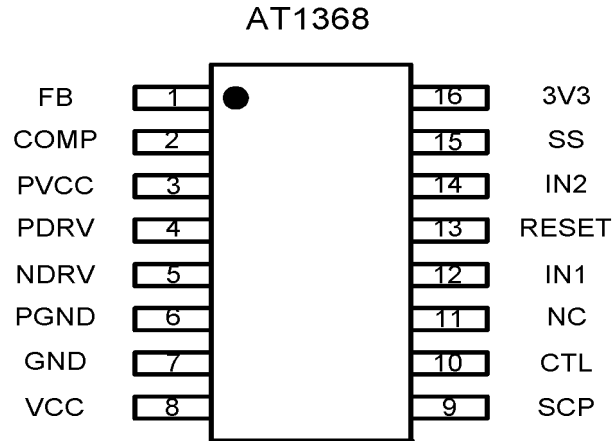
Applications

- Slim-Type CD-ROM/DVD-ROM/CD-RW
- Power Supply for portable devices
- Main or Sub Power source for notebook computers and peripherals.

General Description

The AT1368 provides complete control and protection for a DC/DC converter optimized for high-performance microprocessor applications. It is designed to drive one P-Channel and one N-Channel MOSFETs in a synchronous-rectified buck topology. The AT1368 integrates all of the control, output adjustment, monitoring and protection functions into a single package. The output voltage of the converter can be precisely regulated with a maximum tolerance of $\pm 2\%$ over temperature and line voltage variations. The AT1368 is a family of low-noise synchronous step-down DC/DC converters that is ideally suited for systems powered from a 1-cell Li-ion battery or from a 3-cell to 4-cell NiCd, NiMH, or alkaline battery. It can also be used to USB-Based power system.

Block Diagram


Pin Configuration

Ordering Information

| Part number | Package | Marking |
|-------------|---------|----------|
| AT1368A | SSOP16 | AT1368AR |
| AT1368B | SSOP16 | AT1368BR |
| AT1368B | TSSOP16 | AT1368BP |

A: fosc =300KHz B: fosc =600KHz

Pin Description

| Symbol | Pin No. | Descript | Symbol | Pin No.(A/B) | Descript |
|-------------|---------|------------------------------------|--------------|--------------|------------------------------------------|
| FB | 1 | Inverting input to error amplifier | SCP | 9 | Short-Circuit protection |
| COMP | 2 | Error amplifier output | CTL | 10 | Chip enable, high active |
| PVCC | 3 | Power blocks power supply | NC | 11 | - |
| PDRV | 4 | Output for Pch-MOSFET | IN1 | 12 | VCC monitor voltage adjustable input pin |
| NDRV | 5 | Output for Nch-MOSFET | RESET | 13 | Power Good indicator |
| PGND | 6 | Power blocks ground | IN2 | 14 | 3V3 output monitor adjustable input pin |
| GND | 7 | Control blocks ground | SS | 15 | Soft-start |
| VCC | 8 | Control blocks power supply | 3V3 | 16 | Output voltage 3.3V |

Absolute Maximum Ratings

| Parameter | Condition | Rated Value | | Unit |
|-----------------------------------------|--------------------------------------|-------------|------|--------------------|
| | | Min. | Max. | |
| Power Supply Voltage | — | - | +8 | V |
| Source Average Current of PDRV, NDRV | — | - | -50 | mA |
| Sink Average Current of PDRV, NDRV | — | - | 50 | mA |
| Source Peak Current of PDRV, NDRV | — | - | -200 | mA |
| Sink Peak Current of PDRV, NDRV | — | - | 200 | mA |
| Input Voltage to Error Amplifier | — | - | 6.5 | V |
| Continuous power dissipation | SSOP16 ($T_a=+25^{\circ}\text{C}$) | - | 560 | mW |
| Operating temperature | — | -30 | +85 | $^{\circ}\text{C}$ |
| Storage temperature | — | -55 | +125 | $^{\circ}\text{C}$ |

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Recommended Operating Conditions

 ($T_a=+25^{\circ}\text{C}$)

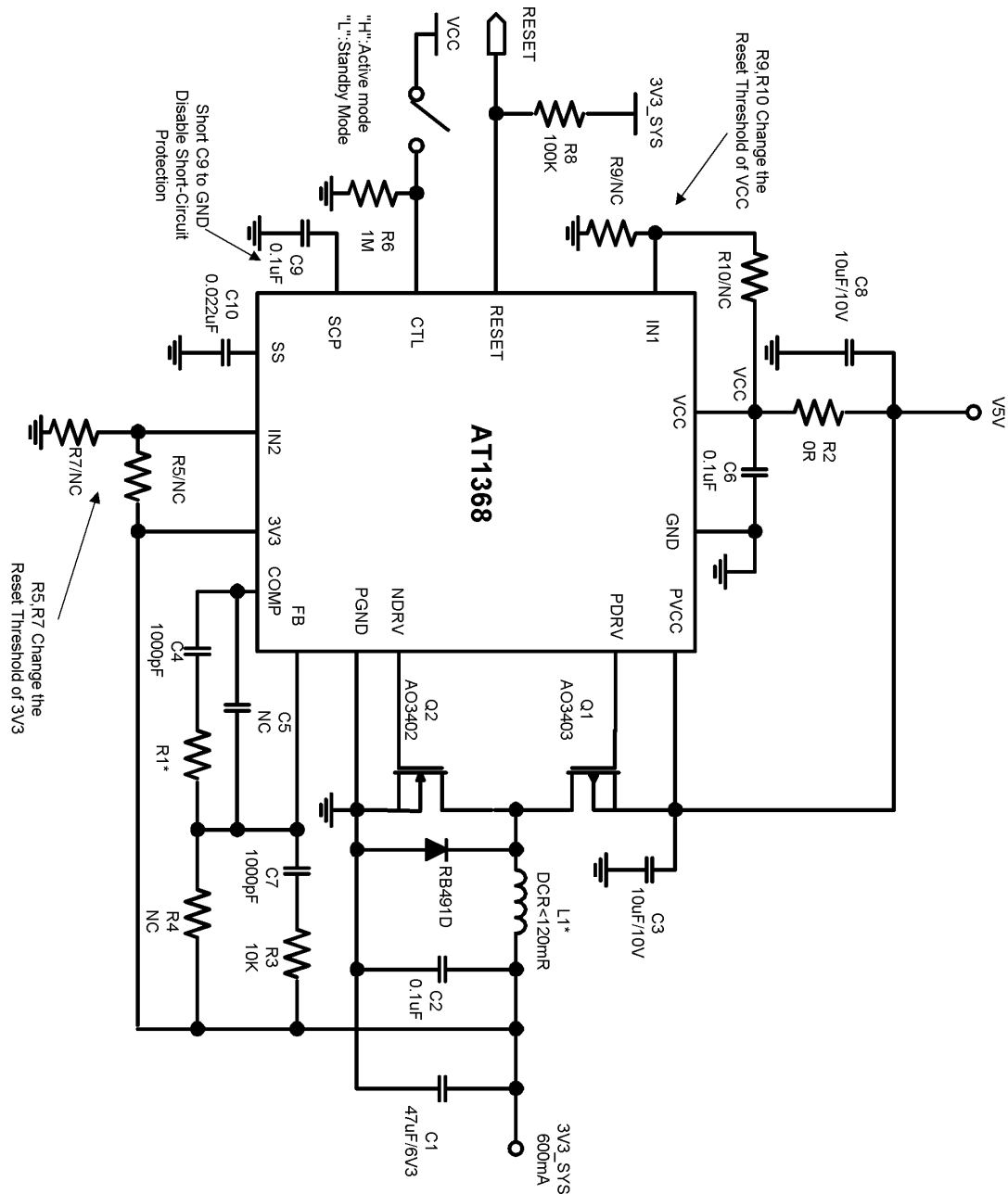
| Parameter | Symbol | Values | | | Unit |
|-----------------------|-----------|--------|------|------|--------------------|
| | | Min. | Typ. | Max. | |
| Power supply voltage | V_{CC} | 2.5 | -- | 7 | V |
| Control input voltage | V_{CTL} | 0 | -- | 7 | V |
| Operating temperature | T_{OP} | -20 | +25 | +85 | $^{\circ}\text{C}$ |

Electrical Characteristics

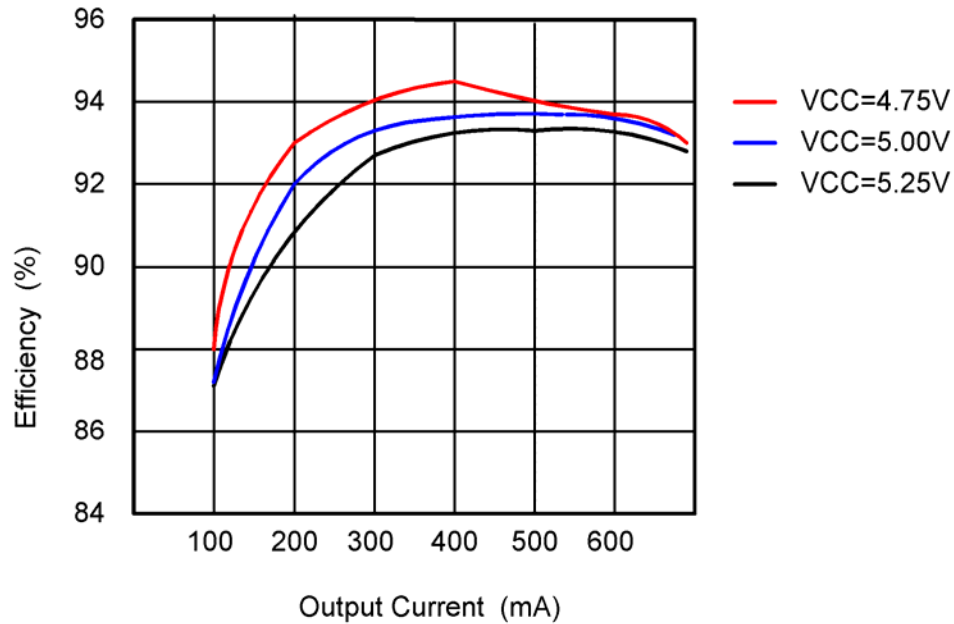
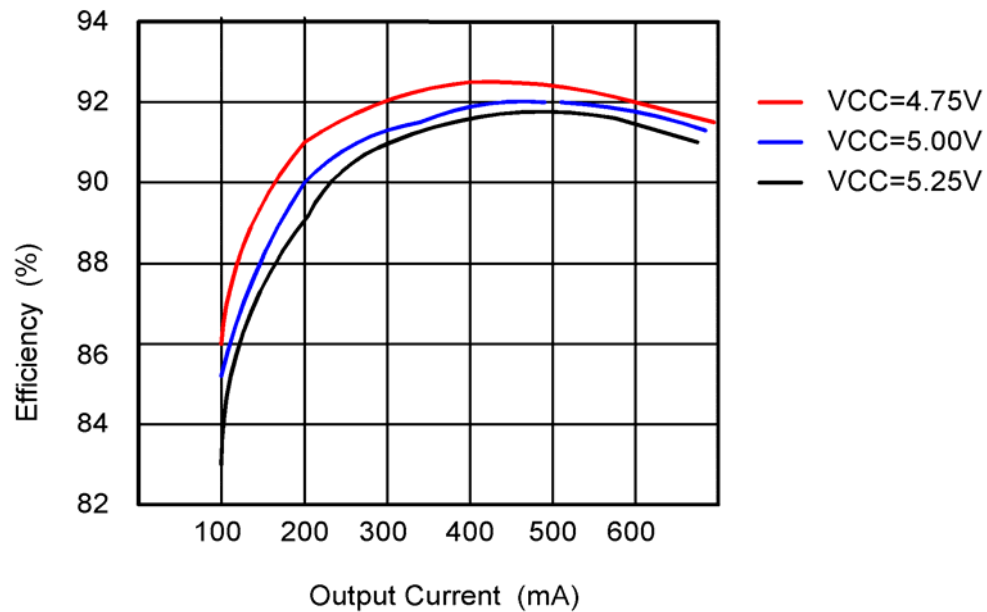
 (VCC = 5V, T_a = +25°C, unless otherwise noted.)

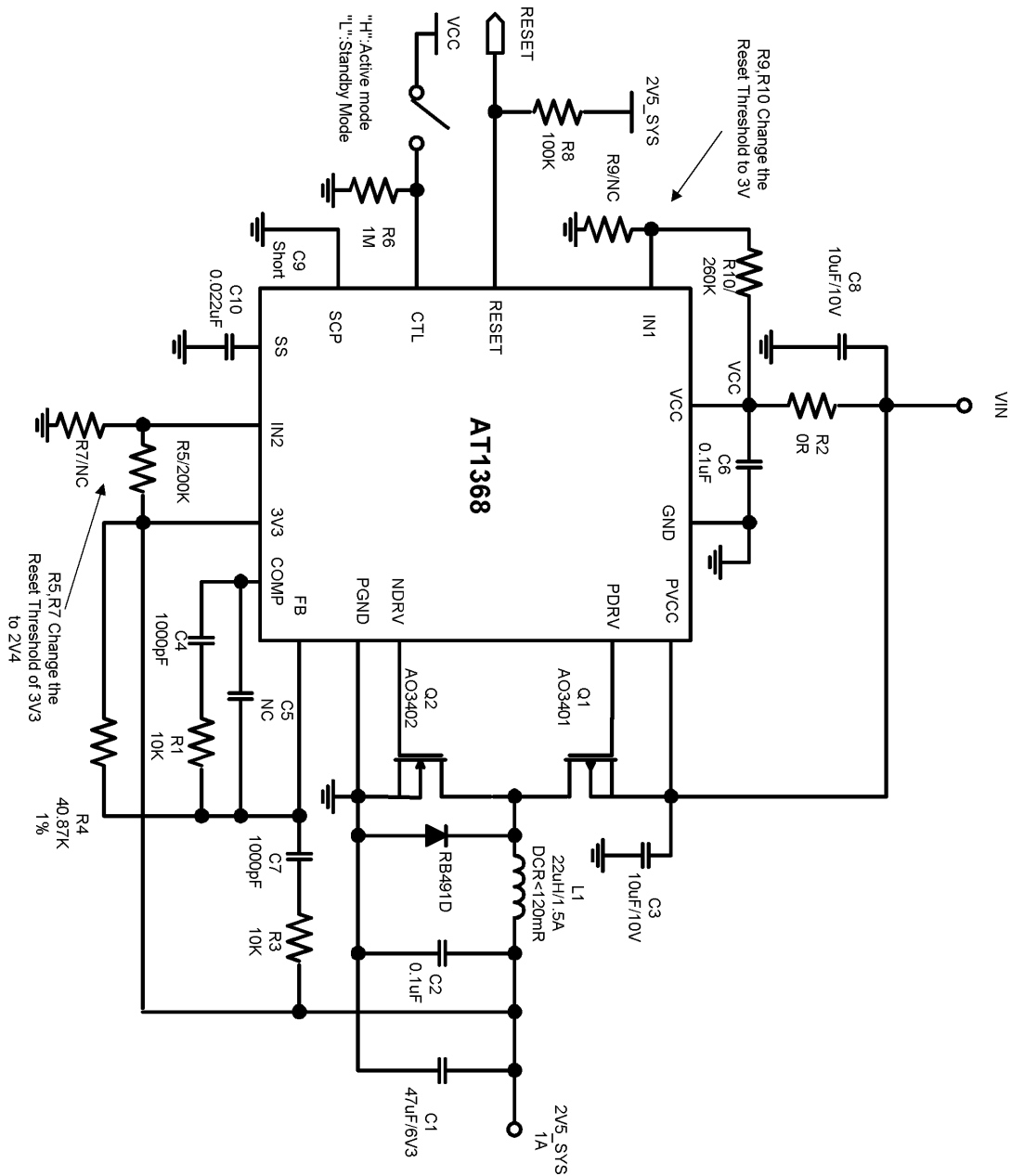
| Parameter | Symbol | Condition | Values | | | Unit | |
|--------------------------------|-------------------------------------------|-----------------------|------------------------------------------------------------|------|-------|------|-----|
| | | | Min. | Typ. | Max. | | |
| Entire device | Input Supply Range | V _{CC} | | 2.5 | -- | 7.0 | V |
| | Quiescent Current | I _{CC} | Duty=50%, f _{OSC} =600KHz PDRV/NDRV No Load | | 1.0 | 1.5 | mA |
| | Current in standby mode | I _{ST} | CTL=0V | | | 10 | μA |
| | Reference Voltage | V _{REF} | T _a = -20°C to +85°C | 1.20 | 1.22 | 1.24 | V |
| | Reference Voltage line-regulation | V _{REF-Line} | VCC=2.5V to 7.0V | | 1 | 5 | mV |
| | Reference Variation with Temperature | | T _a = -20°C to +85°C | | 0.5 | 1.5 | % |
| Error amplifier | Input Offset Voltage | V _{IO} | | | | 10 | mV |
| | Source Current | I _{OH} | V _{COMP} = V _{REF} - 0.5V | 1.0 | 1.5 | 2.0 | mA |
| | Sink Current | I _{OL} | V _{COMP} = 0.5V | -160 | -120 | -80 | μA |
| | Source current Variation with temperature | | T _a = -20°C to +85°C | | | 20 | % |
| | Sink current Variation with temperature | | T _a = -20°C to +85°C | | | 20 | % |
| | Unity Gain Bandwidth | f _T | | | 10.0 | | MHz |
| | Common Mode Input Voltage Range | V _{COM} | | 0.2 | | 1.5 | V |
| | DC Open Loop Gain | A _V | | | 110 | | dB |
| Sawtooth wave oscillator (OSC) | Frequency | f _{osc} | AT1368A | 250 | 300 | 350 | KHz |
| | | f _{osc} | AT1368B | 500 | 600 | 700 | KHz |
| | High Level Voltage | | | | 1.0 | | V |
| | Low Level Voltage | | | | 0.5 | | V |
| | Variation with Power Supply | | Vcc=2.5V to 7V | | | 2 | % |
| | Variation with temperature | | T _a = -20°C to +85°C | | | 7 | % |
| Soft-Start | Charge Current of SS | I _{CSS} | | | -1.0 | | μA |
| | Invalid threshold voltage of SS | | | | 1.0 | | V |
| Short-Circuit | Charge Current of SS | I _{CSS} | | | -1.25 | | μA |
| | Threshold Voltage of SCP | | | | 1.0 | | V |

| | | | | | | | |
|---------------------|-----------------------|-------------------|-------------------------|------|------|------|----------|
| PDRV Output Block | Output source current | I_{source} | Duty \geq 95% PDRV=0V | - | -130 | -80 | mA |
| | Output sink current | I_{sink} | Duty \leq 5% PDRV=5V | 65 | 100 | | mA |
| | Output ON resistor | R_{OH} | PDRV=-15mA | | 18 | 30 | Ω |
| | | R_{OL} | PDRV=15mA | | 16 | 25 | Ω |
| NDRV Output Block | Output source current | I_{source} | Duty \geq 95% NDRV=0V | - | -130 | -80 | mA |
| | Output sink current | I_{sink} | Duty \leq 5% NDRV=5V | 65 | 100 | | mA |
| | Output ON resistor | R_{OH} | NDRV=-15mA | | 18 | 30 | Ω |
| | | R_{OL} | NDRV=15mA | | 16 | 25 | Ω |
| Control Block | CTL input voltage | V_{IH} | Active mode | 1.5 | | VCC | V |
| | | V_{IL} | Standby mode | 0 | | 0.8 | V |
| | CTL input Current | I_{CTL} | CTL=5.0V | | | 20 | μ A |
| RESET Monitor Block | VCC reset ON voltage | V_{RSTON1} | VCC rising | 4.10 | 4.20 | 4.30 | V |
| | VCC reset hysteresis | $V_{RSTON1\ hvs}$ | VCC falling | | | 100 | mV |
| | 3V3 reset ON voltage | V_{RSTON2} | 3V3 rising | 2.94 | 3.0 | 3.06 | V |
| | 3V3 reset hysteresis | $V_{RSTON2\ hvs}$ | 3V3 falling | | | 100 | mV |
| | Reset output voltage | V_{OL} | $I_L = 1mA$ | | | 0.4 | V |
| | Reset leakage current | I_{Leak} | | | | 2.0 | μ A |

Typical Application Circuit: 3V3 Output


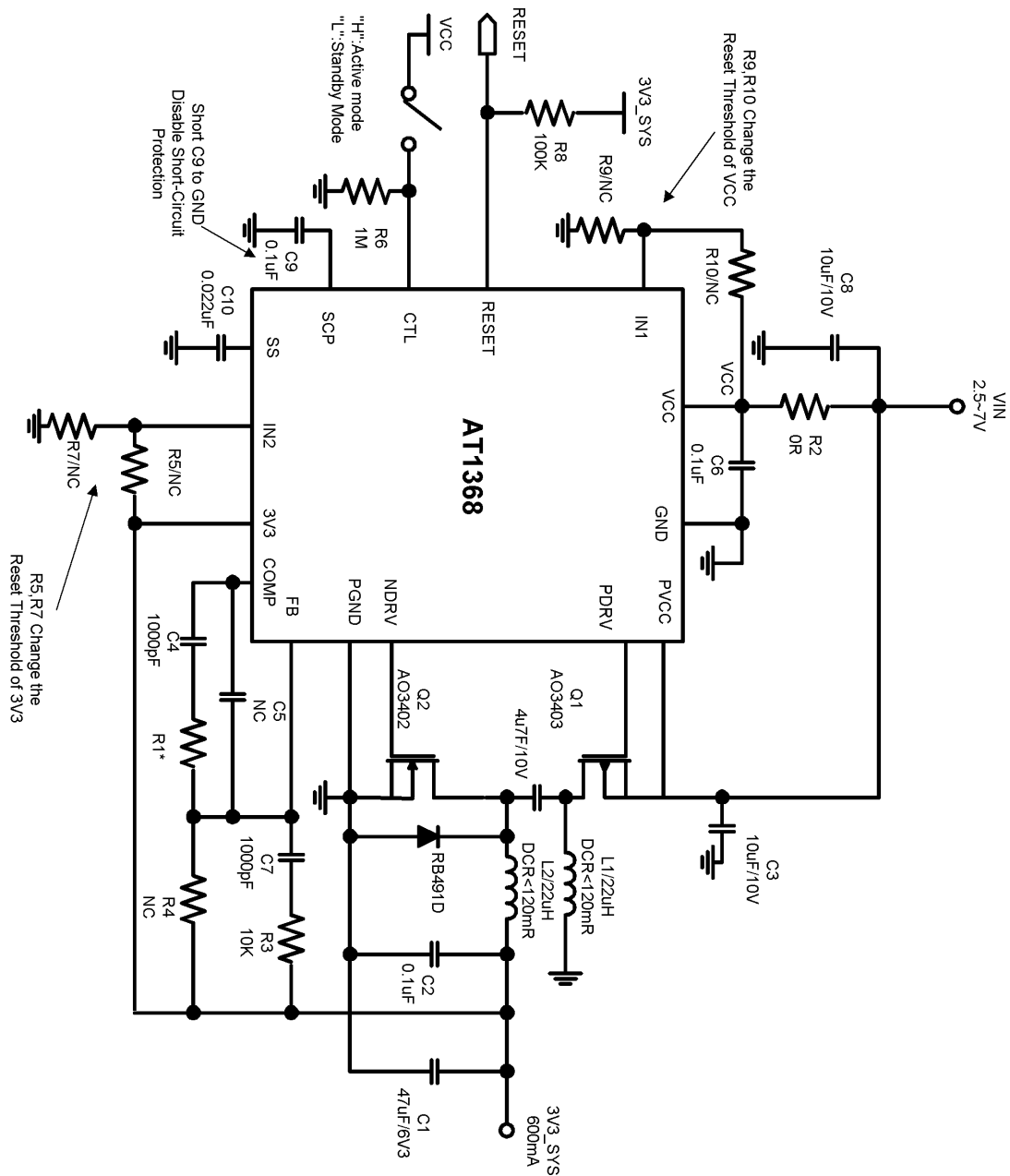
- L1:** AT1368A: 22µH/0.77A/104mΩ TDK-SLF6028T-220MR77
 AT1368B: 10µH/1A/74.5mΩ TDK-SLF6028T-100M1R0
R1: AT1368A: 100K
 AT1368B: 10K

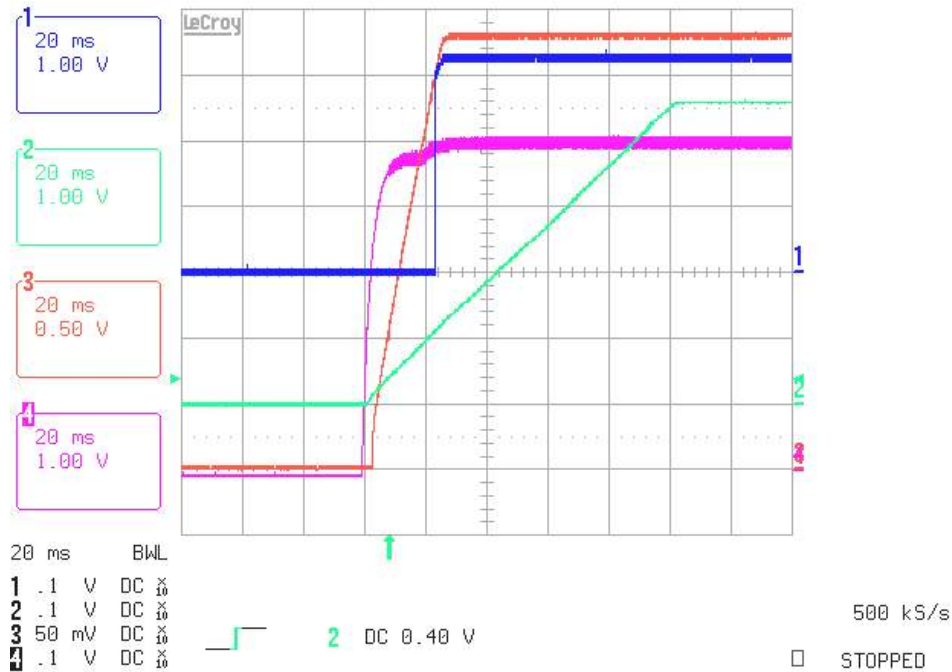
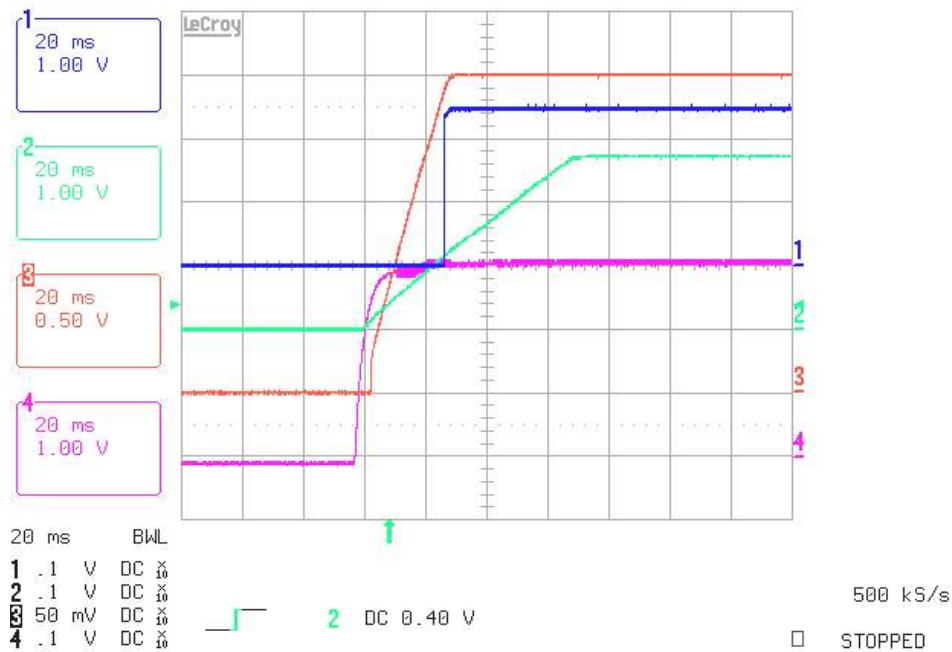
AT1368A Efficiency

AT1368B Efficiency


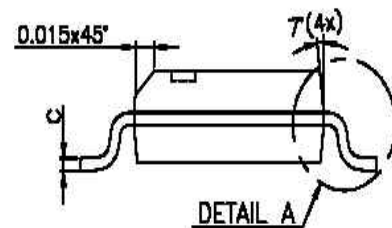
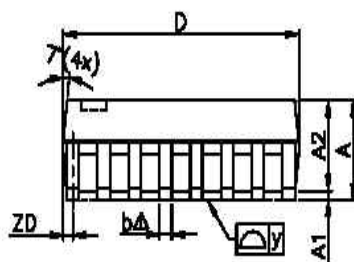
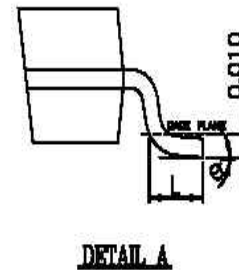
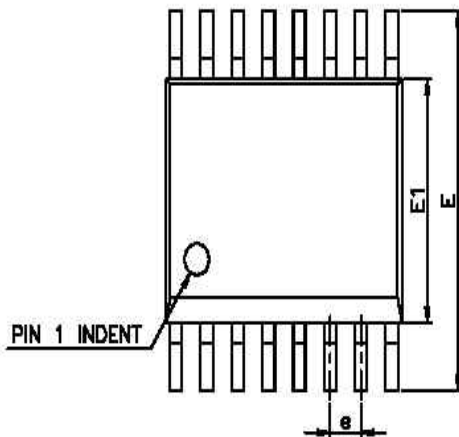
Typical Application Circuit: 2V5 Output


*1V8 Output: R4:9.8KΩ R5:38.7KΩ

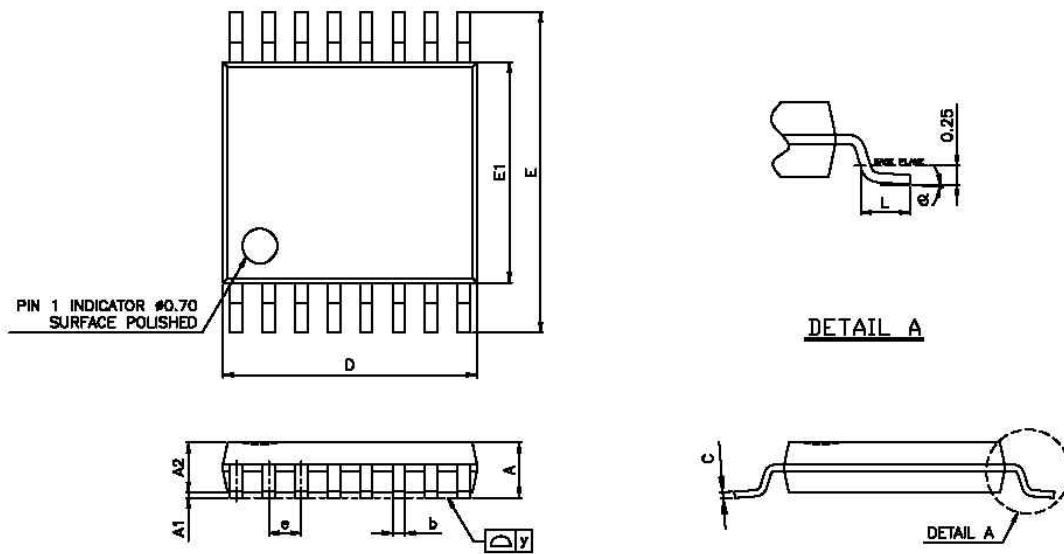
*Vin from 2.5V to 7V, disable SCP function

Typical Application Circuit: Zeta converter 3V3 Output


CH1:Reset CH2:SS CH3:Vout CH4:Vin

Fig.1 Vout:3.3V/1A Vin:5V Start-Up Waveform

Fig.2 Vout:2.5V/1A Vin:3.1V Start-Up Waveform

Package Outline 16-pin SSOP


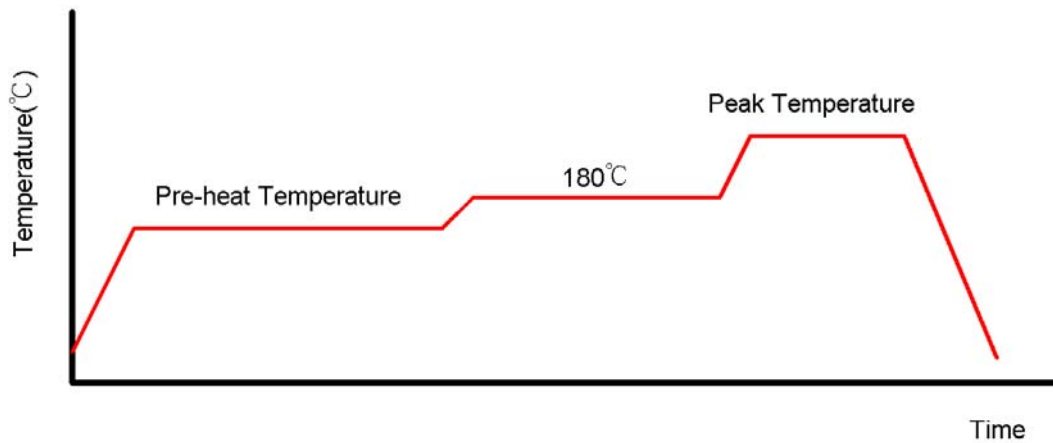
| SYMBOL | MILLIMETERS | | | INCHES | | |
|--------|-------------|------|-------|--------|-------|-------|
| | MIN | TYP | MAX | MIN | TYP | MAX |
| A | 1.35 | 1.60 | 1.75 | 0.053 | 0.063 | 0.069 |
| A1 | 0.10 | 0.15 | 0.25 | 0.004 | 0.006 | 0.010 |
| A2 | - | - | 1.50 | - | - | 0.059 |
| b | 0.20 | - | 0.30 | 0.008 | - | 0.012 |
| C | 0.18 | - | 0.25 | 0.007 | - | 0.010 |
| D | 4.80 | 4.85 | 5.00 | 0.189 | 0.191 | 0.197 |
| ZD | - | 0.20 | - | - | 0.008 | - |
| 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 |
| L | 0.41 | 0.71 | 1.27 | 0.016 | 0.028 | 0.050 |
| e | - | 0.64 | - | - | 0.025 | - |
| y | - | - | 0.076 | - | - | 0.003 |
| θ | 0° | - | 8° | 0° | - | 8° |

Package Outline 16-pin TSSOP


| SYMBOL | MILLIMETERS | | | 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 | 4.90 | 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 |
| L | 0.50 | 0.60 | 0.70 | 0.020 | 0.024 | 0.028 |
| e | - | 0.65 | - | - | 0.026 | - |
| y | - | - | 0.076 | - | - | 0.003 |
| θ | 0° | | 8° | 0° | | 8° |

Reflow Condition (IR/Convection or VPR Reflow)

Reference JEDEC Standard J-STD-020A


Classification Reflow Profiles

| | Convection or IR/Convection | VPR |
|--------------------------------------------|-----------------------------|------------------------|
| Average Heating Rate(180°C to peak) | 5°C/second max. | 10°C/second max. |
| Preheat Temperature(125±20°C) | 120 seconds max. | |
| Temperature maintained above 180°C | 10~150 seconds | |
| Time within 5°C of actual Peak Temperature | 10~20 seconds | 60 seconds |
| Peak Temperature Range(Note 1) | 219~225°C or 235~240°C | 219~225°C or 235~240°C |
| Cooling Rate | 6°C /second max. | 10°C/second max. |
| Time 25°C to Peak Temperature | 6 minutes max. | |

*1 The maximum peak temperatures for IR and VP reflow are depending on package dimensions.

Package Reflow Conditions

| Pkg. Thickness ≥2.5mm and all bags | Pkg. Thickness <2.5mm and Pkg. Volume ≥350 mm ³ | Pkg. Thickness <2.5mm and Pkg. Volume <350 mm ³ |
|------------------------------------|------------------------------------------------------------|------------------------------------------------------------|
| Convection 219~225°C | | Convection 235~240°C |
| VPR 219~225°C | | VPR 235~240°C |
| IR/Convection 219~225°C | | IR/Convection 235~240°C |