

## 1A Low Dropout, Fast Response Fixed Voltage Regulator

### Features

- Guaranteed Output Voltage Accuracy within 2%
- Fast Transient Response
- Load Regulation : 1mV Typ.
- Line Regulation : 4mV Typ.
- Low Dropout Voltage : 210mV at  $I_{OUT}=1A$
- Current Limit : 1A Typ. at  $T_j=125\text{ }^\circ\text{C}$
- On-Chip Thermal Limiting : 150  $^\circ\text{C}$  Typ.
- Standard 8-pin SO Power Package
- Very Low Shutdown Current : < 0.5 $\mu\text{A}$
- Fixed Output Voltage : 2.5V, 2.8V and 3.3V

### General Description

The APL1565A is a low dropout regulators operate from 2.7V to 6V input voltage and deliver up to 1A current capability. In order to obtain lower dropout voltage and faster transient response, which is critical for low voltage applications, the APL1565/A has been optimized.

The device is available in fixed output voltages of 2.5V, 2.8V and 3.3V. APL1565A Dropout voltage is guaranteed at a maximum of 210mV at 1A load.

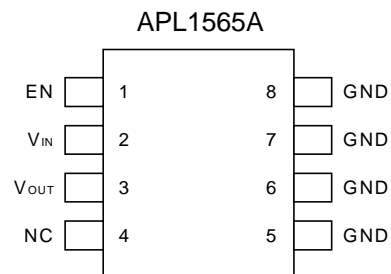
Current limit is trimmed to ensure specified output current and controlled short-circuit current. On-chip thermal limiting provides protection against any combination of overload that would create excessive junction temperatures.

The APL1565A is available in the industry standard 8-pin SO power package which can be used in applications where space is limited.

### Applications

- Peripheral Cards
- Active SCSI Terminators
- Low Voltage Logic Supplies
- Post Regulator for Switching Power Supply

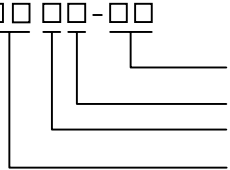
### Pin Configuration



Front View for SO - 8

ANPEC reserves the right to make changes to improve reliability or manufacturability without notice, and advise customers to obtain the latest version of relevant information to verify before placing orders.

## Ordering and Marking Information

<p>APL1565A - □□□□-□□</p>  <p>Handling Code Temp. Range Package Code Voltage Code</p>	<p>Package Code K : SOP-8 Temp. Range C : 0 to 70 °C Handling Code TU : Tube    TR : Tape &amp; Reel Voltage Code 25 : 2.5V    28 : 2.8V    33 : 3.3V</p>
APL1565A-25K : <span style="border: 1px solid black; padding: 2px;">APL1565A XXXXX25</span>	XXXXX - Date Code
APL1565A-28K : <span style="border: 1px solid black; padding: 2px;">APL1565A XXXXX28</span>	XXXXX - Date Code
APL1565A-33K : <span style="border: 1px solid black; padding: 2px;">APL1565A XXXXX33</span>	XXXXX - Date Code

## Pin Description

PIN		I/O	Description
No.	Name		
(1) <sup>Note1</sup>	EN	I	Enable control pin, low = off , high = normal .
2	V <sub>IN</sub>	I	Supply voltage input.
3	V <sub>OUT</sub>	O	Output pin of the regulator.
5(6,7,8) <sup>Note1</sup>	GND		Ground pins of the circuitry, and all ground pins must be soldered to PCB with proper power dissipation.

## Absolute Maximum Ratings

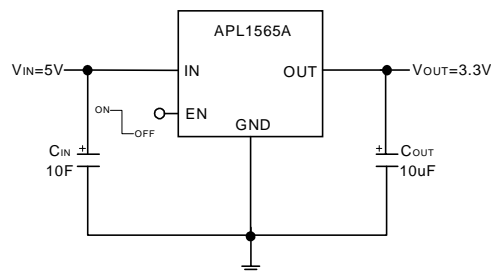
Symbol	Parameter	Rating	Unit
V <sub>IN</sub> , V <sub>OUT</sub>	Input Voltage or Out Voltage	6	V
EN	Enable Control Pin	6	V
R <sub>TH,JA</sub>	Thermal Resistance – Junction to Ambient	210	°C/W
P <sub>D</sub>	Power Dissipation	Internally Limited	W
T <sub>J</sub>	Operating Junction Temperature		°C
	Control Section	0 to 125	
	Power Transistor	0 to 150	
T <sub>STG</sub>	Storage Temperature Range	-65 to +150	°C
T <sub>L</sub>	Lead Temperature (Soldering, 10 second)	260	°C

## Electrical Characteristics

Unless otherwise noted these specifications apply over full temperature,  $V_{IN}=3.6V$ ,  $C_{IN}=C_{OUT}=4.7\mu F$ ,  $EN=V_{IN}$ ,  $T_j=0$  to  $125^\circ C$ . Typical values refer to  $T_j=25^\circ C$ .

Symbol	Parameter	Test Conditions	APL1565A			Unit
			Min.	Typ.	Max.	
$V_{IN}$	Input Voltage		2.7		6	V
$V_{OUT}$	Output Voltage	$V_{OUT}+1.0V < V_{CC} < 6.0V$ , $0mA < I_{OUT} < I_{MAX}$	$V_{OUT}-2\%$	$V_{OUT}$	$V_{OUT}+2\%$	V
$I_{LIMIT}$	Circuit Current Limit		1.0	1.2		A
$REG_{LINE}$	Line Regulation	$V_{OUT}+0.5V < V_{CC} < 6.0V$ , $0mA < I_{OUT} < I_{MAX}$		4	10	mV
$REG_{LOAD}$	Load Regulation	$V_{IN} = V_{OUT}+1.0V$ , $0mA < I_{OUT} < I_{MAX}$		1	6	mV
$V_{DROP}$	Dropout Voltage	$I_{OUT} = 1A$ , $T_j = 0\sim 125^\circ C$		210	400	mV
PSRR	Ripple Rejection	$F \leq 1kHz$ , $1V_{pp}$ at $V_{IN} = V_{OUT}+1.0V$	55	65		dB
$I_Q$	Quiescent Current	No load		50	100	$\mu A$
		$I_{OUT}=1A$		370	300	
	Shutdown Supply Current	$EN = low$ $I_{OUT}=0$ , $V_{CC} = 6.0V$		0.01	1	$\mu A$
$V_{IH}$	Enable Pin	$V_{IN}=3.3V$	1.8		0.4	V
$V_{IL}$	Threshold					
OTS	Over Temperature			150		$^\circ C$
		Hysteresis		10		$^\circ C$
TC	Output Voltage Temperature Coefficient			50		ppm/ $^\circ C$

## Application Circuit



5V to 3.3V Regulation with Enable Function

## Application Information

### Capacitor Selection and Regulator Stability

The APL1565A use at least a 4.7 $\mu$ F capacitor on the input. This capacitor can use Aluminum, Tantalum or Ceramic capacitors. Input capacitor with large values and low ESR provide better PSRR and line-transient response. The output capacitor also can use Aluminum, Tantalum or Ceramic capacitors, and a minimum value of 10 $\mu$ F and ESR above 0.06 $\Omega$  is recommended. A larger output capacitor can reduce noise and improve load-transient response, stability and PSRR.

### Load-Transient Considerations

The APL1565A load-transient response graphs in typical characteristics show the transient response. A step change in the load current from 0mA to 1A at 1 $\mu$ s will cause a 100mV transient spike. Larger output capacitor and lower ESR can reduce transient spike.

### Input-Output (Dropout)Voltage

The minimum input-output voltage difference (dropout) determines the lowest usable supply voltage. In battery-powered systems, this will determine the useful end-of-life battery voltage. Because the APL1565A use a p-channel MOSFET pass transistor, the dropout voltage is a function of drain-to-source on-resistance ( $R_{DS(ON)}$ ) multiplied by the load current.

### Reverse Current Protection

The APL1565A have an internal reverse protection, it does not need an external schottky diode to connect the regulator input and output. If the output voltage is forced above the input voltage by more than 11mV, the IC will be shutdown and the ground pin current is below 0.1 $\mu$ A.

### Current Limit

The APL1565A have a current limit protection. The output voltage will drop close to zero volt, when load current reaches the limit, and then the load current will be limited at 150mA after output voltage is below 0.7V. When the load current back to the value where limiting started, the output voltage and current will return to normal value. When output is shorted to ground, the APL1565/A will keep short circuit current at 150mA .

### Thermal Protection

Thermal protection limits total power dissipation in the device. When the junction temperature exceeds  $T_J=+150^{\circ}\text{C}$ , the thermal sensor generates a logic signal to turn off the pass transistor and allows IC to cool. When the IC's junction temperature is down by 10 $^{\circ}\text{C}$ , the thermal sensor will turn the pass transistor on again, resulting in a pulsed output during continuous thermal protection. Thermal protection is designed to protect it in the event of fault conditions. For continuous operation, do not exceed the absolute maximum junction temperature of  $T_J=+150^{\circ}\text{C}$ .

## Application Information (Cont.)

### Operating Region and Power Dissipation

The thermal resistance of the case to circuit board, and the rate of air flow all control the APL1565A's maximum power dissipation. The power dissipation across the device is  $P_D = I_{OUT}(V_{IN}-V_{OUT})$  and the maximum power dissipation is:

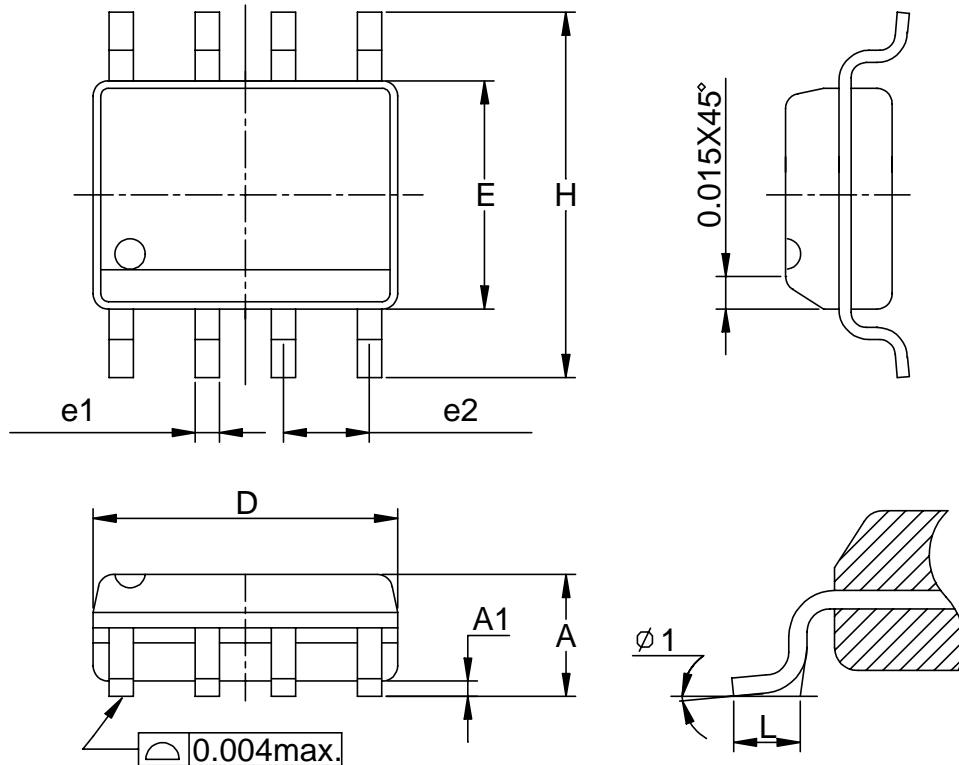
$$P_{D_{MAX}} = (T_J - T_A) / (\theta_{JC} + \theta_{CA})$$

where  $T_J - T_A$  is the temperature difference between the junction and ambient air,  $\theta_{JC}$  is the thermal resistance of the package, and  $\theta_{CA}$  is the thermal resistance through the printed circuit board, copper traces, and other materials to the ambient air.

The GND pin of the APL1565A provide an electrical connection to ground and channeling heat away. If power dissipation is large, connect the GND pin to ground using a large pad or ground plane, can improve the problem of over heat of IC.

## Package Information

SOP-8 pin ( Reference JEDEC Registration MS-012)



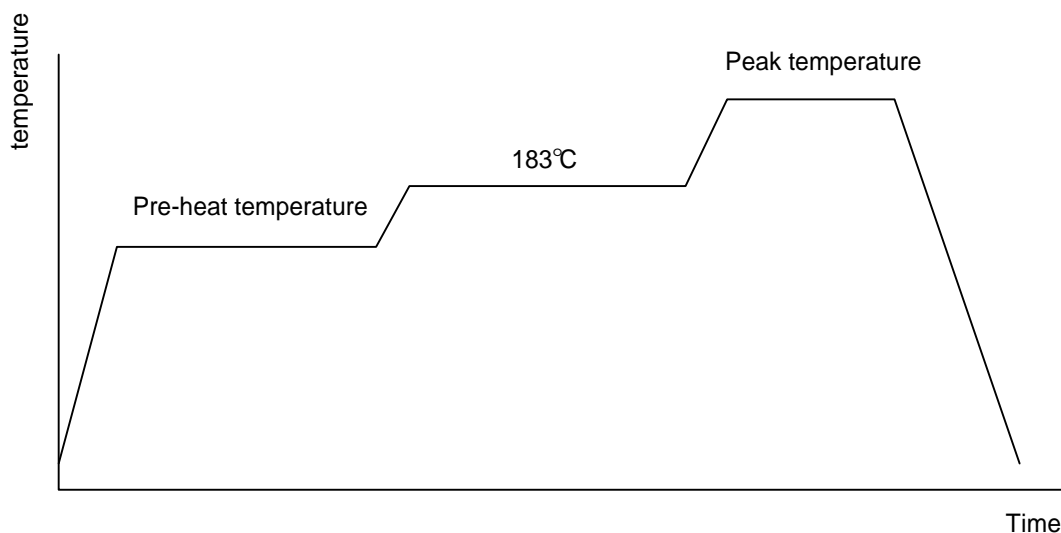
Dim	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
D	4.80	5.00	0.189	0.197
E	3.80	4.00	0.150	0.157
H	5.80	6.20	0.228	0.244
L	0.40	1.27	0.016	0.050
e1	0.33	0.51	0.013	0.020
e2	1.27BSC		0.50BSC	
φ 1	8°		8°	

## Physical Specifications

Terminal Material	Solder-Plated Copper (Solder Material : 90/10 or 63/37 SnPb)
Lead Solderability	Meets EIA Specification RSI86-91, ANSI/J-STD-002 Category 3.

## Reflow Condition (IR/Convection or VPR Reflow)

Reference JEDEC Standard J-STD-020A APRIL 1999



## Classification Reflow Profiles

	Convection or IR/ Convection	VPR
Average ramp-up rate(183°C to Peak)	3°C/second max.	10 °C /second max.
Preheat temperature 125 ± 25°C)	120 seconds max	
Temperature maintained above 183°C	60 – 150 seconds	
Time within 5°C of actual peak temperature	10 –20 seconds	60 seconds
Peak temperature range	220 +5/-0°C or 235 +5/-0°C	215-219°C or 235 +5/-0°C
Ramp-down rate	6 °C /second max.	10 °C /second max.
Time 25°C to peak temperature	6 minutes max.	

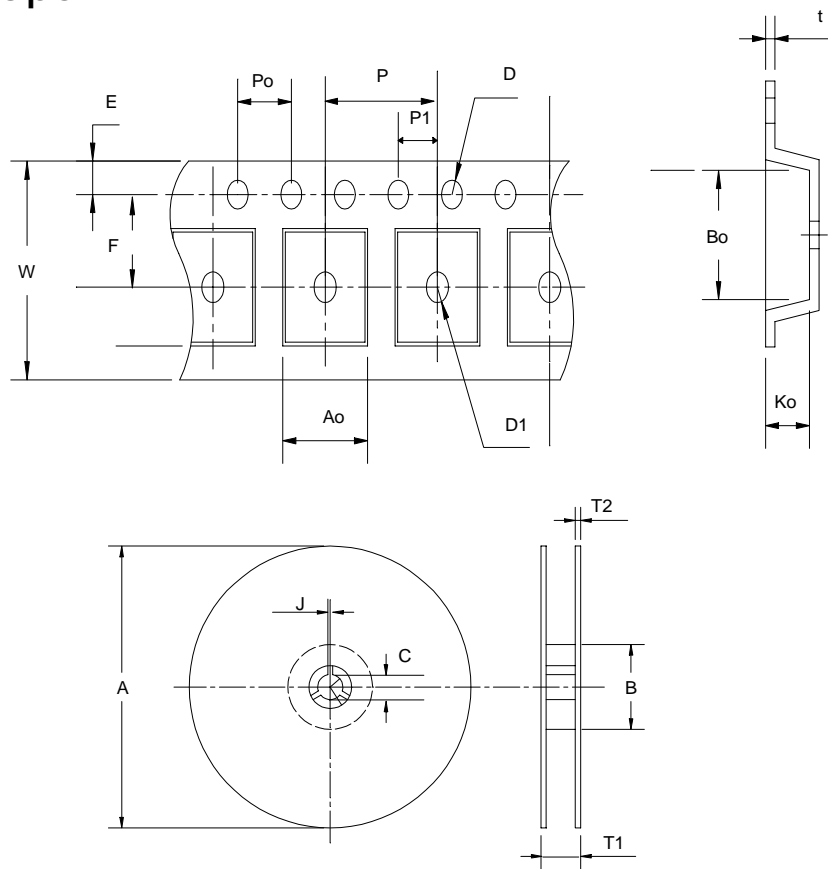
## Package Reflow Conditions

pkg. thickness ≥ 2.5mm and all bgas	pkg. thickness < 2.5mm and pkg. volume ≥ 350 mm <sup>3</sup>	pkg. thickness < 2.5mm and pkg. volume < 350mm <sup>3</sup>
Convection 220 +5/-0 °C		Convection 235 +5/-0 °C
VPR 215-219 °C		VPR 235 +5/-0 °C
IR/Convection 220 +5/-0 °C		IR/Convection 235 +5/-0 °C

## Reliability test program

Test item	Method	Description
SOLDERABILITY	MIL-STD-883D-2003	245°C , 5 SEC
HOLT	MIL-STD-883D-1005.7	1000 Hrs Bias @ 125 °C
PCT	JESD-22-B, A102	168 Hrs, 100 % RH , 121°C
TST	MIL-STD-883D-1011.9	-65°C ~ 150°C, 200 Cycles
ESD	MIL-STD-883D-3015.7	VHBM > 2KV, VMM > 200V
Latch-Up	JESD 78	10ms , $I_{tr} > 100mA$

## Carrier Tape



Application	A	B	C	J	T1	T2	W	P	E
SOP- 8	$330 \pm 1$	$62 +1.5$	$12.75+0.15$	$2 \pm 0.5$	$12.4 \pm 0.2$	$2 \pm 0.2$	$12 \pm 0.3$	$8 \pm 0.1$	$1.75 \pm 0.1$
	F	D	D1	$P_0$	$P_1$	$A_0$	$B_0$	$K_0$	t
	$5.5 \pm 1$	$1.55 +0.1$	$1.55 + 0.25$	$4.0 \pm 0.1$	$2.0 \pm 0.1$	$6.4 \pm 0.1$	$5.2 \pm 0.1$	$2.1 \pm 0.1$	$0.3 \pm 0.013$



## Cover Tape Dimensions

Application	Carrier Width	Cover Tape Width	Devices Per Reel
SOP- 8	12	9.3	2500

## Customer Service

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