SC1517-5
Micropower, Regulated 5V Charge Pump

Description

The SC1517-5 is pin compatible with LTC1517-5. This versatile charge pump produces a regulated 5V output from an input voltage ranging from 2.7V to 5V, making it ideal for Li-Ion battery applications. The extremely low operating current (typically 10µA with no load) prolongs battery usage time.The small device footprint and the low external parts count (one 0.1µF flying capacitor and two small bypass capacitors at V_{IN} and V_{OUT}) make the part ideally suited for compact circuit design.

The SC1517-5 charge pump can be used for applications that require up to 20mA ($3V \leq V_{IN} \leq 5V$) of output current, while providing a regulated 5V output voltage. During short circuit a current limit circuitry provides protection, while the thermal shutdown capability cycles V_{OUT} to prevent device failure. The SC1517-5 is available in a 5 lead SOT-23 package.

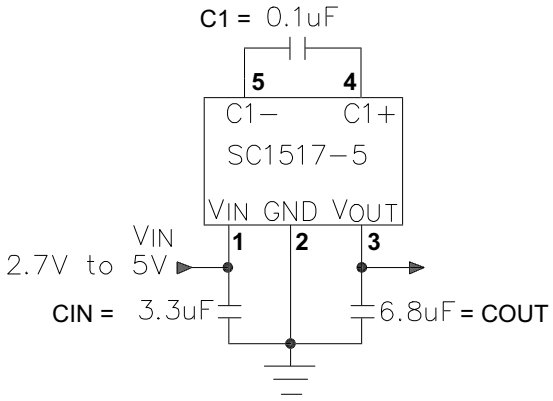
Features

- Ultra low power: I_{CC} = 10µA typ
- Soft start / Short circuit Current limit
- Thermal protection
- 5V±4% Regulated output
- V_{IN} Range: 2.7V to 5V
- Output current:
  10mA ($V_{IN} \geq 2.7V$)
  20mA ($V_{IN} \geq 3V$)
- No inductors
- Ultra small application circuit
- 800kHz switching frequency
- Surface mount packaging (5 pin SOT-23)
- All specifications rated over full temperature range (-40°C to 85°C)

Applications

- Desktop Computers
- Network Interface Cards (NICs)
- PCMCIA/PCI Interface Cards
- Cardbus™ Technology
- Power supplies with multiple input sources
- Cellular telephones
- PDA DCMCIA supplies
- Local power supplies
- Handheld instruments

Typical Application Schematic



Note : Ceramic capacitors used for improved performance, Low ESR Tantalum with ESR < 0.5 Ohms could also be used.

V_{OUT} = 5V±4%
I_{OUT} = 10mA ($V_{IN} \geq 2.7V$)
I_{OUT} = 20mA ($V_{IN} \geq 3V$)

Absolute Maximum Rating

Parameter	Symbol	Maximum	Units
Input Supply Voltage	V_{IN}	-0.3 to 6	V
Output Supply Voltage	V_{OUT}	-0.3 to 6	V
Power Dissipation	P_D	391	mW
Thermal Resistance	θ_{JA}	256	°C/W
Operating Ambient Temperature Range	T_A	-40 to +85	°C
Operating Junction Temperature Range	T_J	-40 to +125	°C
Storage Temperature Range	T_{STG}	-65 to +150	°C
Lead Temperature (Soldeirng) 10 Seconds	T_L	+300	°C
ESD Rating (Human Body Model)	ESD	2	kV

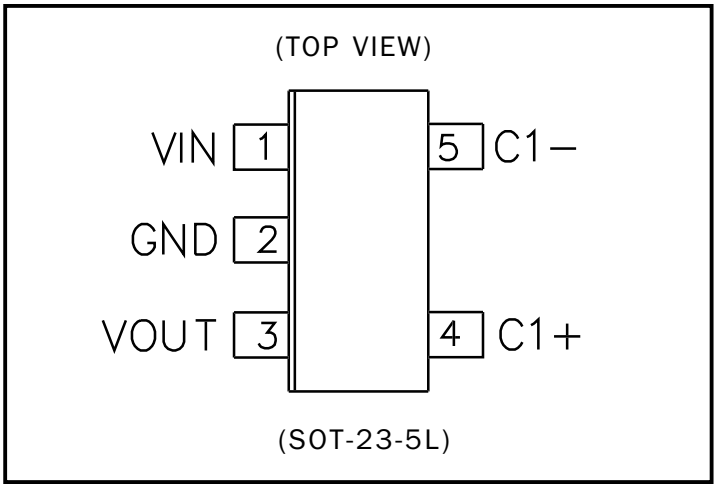
Electrical Characteristics

Unless specified: T_A = -40°C to 85°C, V_{IN} = 2.7V to 5V, C1 = 0.1µF, C_{IN} = 3.3µF, C_{OUT} = 6.8µF.

Parameter	Symbol	Conditions	MIN	TYP	MAX	UNITS
Operating Input Voltage	V_{IN}		2.7		5	V
Output Voltage	V_{OUT}	$2.7V \le V_{IN} \le 5V$, $I_{OUT} \le 10mA$	4.8	5.0	5.2	V
		$3V \le V_{IN} \le 5V$, $I_{OUT} \le 20mA$	4.8	5.0	5.2	V
Input Supply Current	I_{CC}	$2.7V \le V_{IN} \le 5V$, I_{OUT} = 0		10	15	µA
V_{OUT} Ripple (pk-pk)(1)(2)	V_R	V_{IN} = 3V, I_{OUT} = 20mA, C_{OUT} = 6.8µF		75		mV_{P-P}
Oscillator Frequency(1)(2)	f_{OSC}			800		kHz
V_{OUT} Turn-On Time(1)(2)	t_{ON}	V_{IN} = 3V, I_{OUT} = 0mA		1		ms
Soft start / Short circuit Current limit(1)(2)(3)	I_{limit}	Short circuit applied at Vout to GND	35	65		mA

NOTES:
(1) All electrical characteristics are for the application circuit on page 1.
(2) Guaranteed by design.
(3) Indefinite duration.

Pin Configurations



Ordering Information

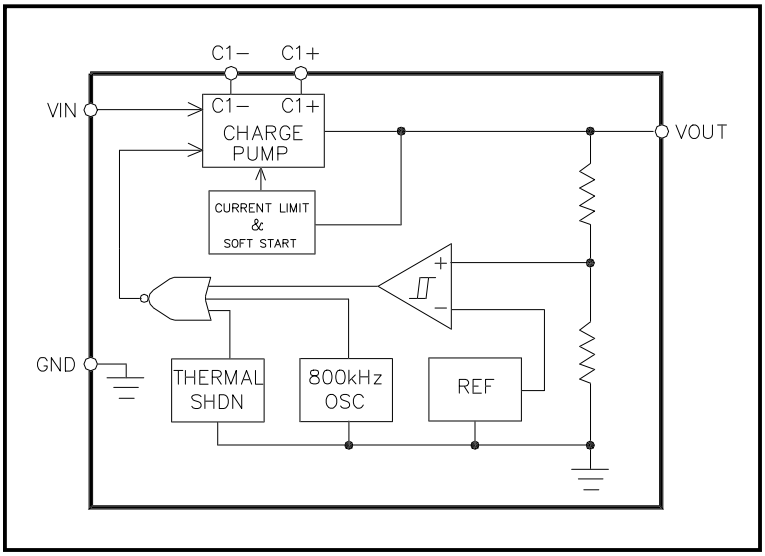
Part Number(1)	Package	Temp. Range (T_J)
SC1517ISK-5TR	SOT-23-5	-40° to 85°C

Note:
(1) Only available in tape and reel packaging. A reel contains 3,000 devices.

Pin Descriptions

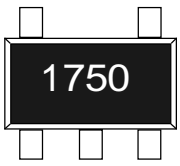
Pin	Pin Name	Pin Function
1	VIN	Charge pump input voltage. May be between 2.7V and 5V. V_{IN} should be bypassed with a low ESR capacitor ≥ 3.3uF as close as possible to the pin for best performance.
2	GND	Ground pin.
3	VOUT	Regulated output voltage. V_{OUT} should be bypassed with a low ESR capacitor ≥ 6.8uF as close as possible to the pin for best performance.
4	C1+	Charge pump flying capacitor positive terminal.
5	C1-	Charge pump flying capacitor negative terminal.

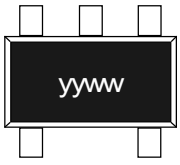
Block Diagram



Marking Information

Top Mark





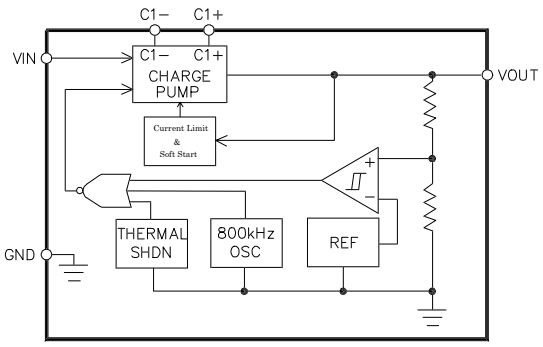
Bottom Mark

yyww = Datecode (Example : 9908)

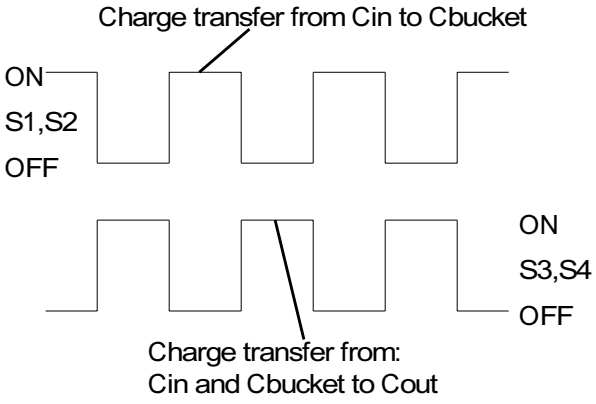
Applications Information

THEORY OF OPERATION

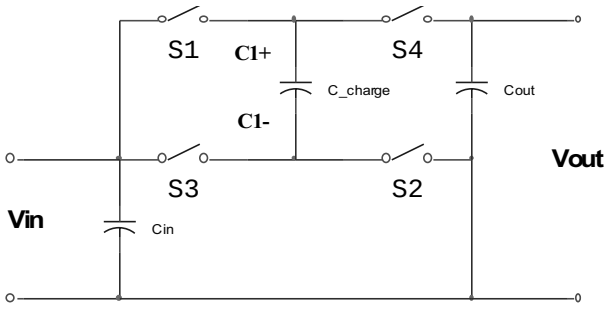
The SC1517-5 utilizes a switched capacitor charge pump, to generate an output voltage regulated to 5V+/-4%.



An internal oscillator generates two out of phase clock signals which turn on and off internal MOSFET switches. During phase1 of clock, the flying charge pump capacitor is



charged to Vin through switches S1, and S2. During phase2 the flying charge pump capacitor is connected in series with the input voltage via S3, and S4, producing an output voltage.



An integrated comparator senses the output voltage and disable the charge pump once an upper threshold is reached. As the output voltage drops below the lower threshold, the comparator enables the charge pump and hence regulation is achieved.

SHORT CIRCUIT / SOFT START

An internal current limit and soft start circuit provides protection against output short circuit and limits large current spikes generated during the initial start up to charge output capacitor.

As the over current condition is applied at the output, a comparator senses the output voltage and compares it to a signal approximating V_{IN} - 500mV.

If $V_{OUT} < V_{IN}$ - 500mV, the comparator enables a 65mA typical limited current source and the charge pump is disabled. Once the over current is removed and $V_{OUT} > V_{IN}$ - 500mV, the current source is disconnected from output and the charge pump circuitry is enabled again.

THERMAL SHUTDOWN

The thermal shutdown circuit provides added protection to the SC1517-5. During a V_{OUT} short circuit condition or if the load is excessive (I_{OUT} > 20mA), the thermal shut down circuit is active and if the junction temperature exceeds approximately 160°C, the charge pump is disabled. The charge pump is enabled only if the junction temperature drops to approximately 145°C. The SC1517-5 will cycle in and out of thermal shut down until the short circuit or the excessive load condition on V_{OUT} is removed, thereby improving device reliability.

CAPACITOR SELECTION

The peak to peak output ripple voltage is dependent on the following factors:

1- Oscillator Frequency
2- ESR of C_{OUT}
3- Capacitance value of C_{out}

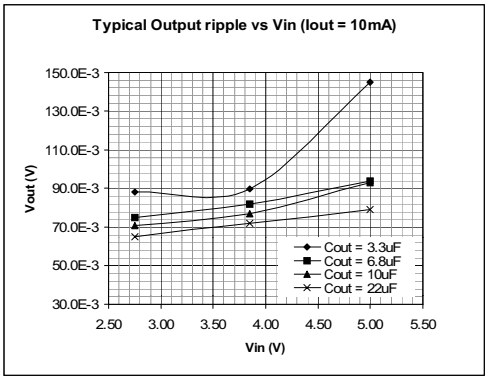
Item 1 is fixed and depend on the charge pump device used. Item 2, and 3 can be optimized for best performance and reduction of the output ripple.

Applications Infomation (Cont.)

The following formula could be used for an approximation for V_{out_ripple}.

$$V_{out\_ripple} = \frac{I_{out}}{2 \times F_{osc} \times C_{out}} + 2 \times I_{out} \times ESR\_ C_{out}$$

Figure below shows the effect of output capacitance value on the ripple voltage. Capacitors used were multilayer ceramic with low ESR < 0.1 Ohms .



Following tables show typical capacitor characteristics, and capacitor manufactures.

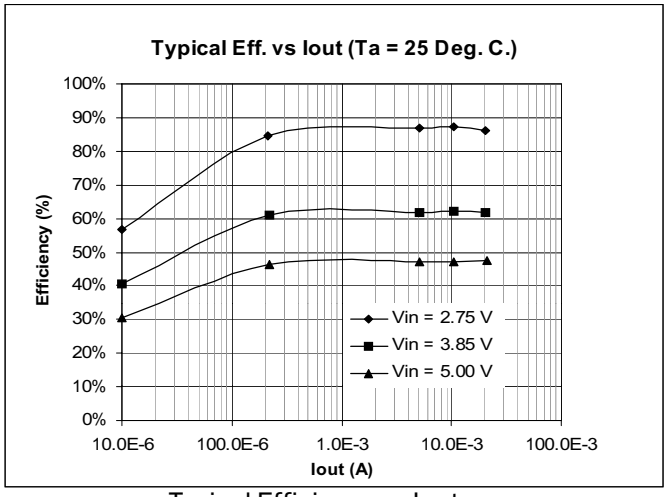
Component	ESR(Ω)	ESL(nH)
0.1uF Ceramic 0603 Package	0.050	1.60
1.0uF Ceramic 1206 Package	0.040	0.47
10uF Ceramic 1206 Package	0.075	0.50
47uF,16V Tantalum D case	0.100	0.60
330uF,6.3V "OSCON"	0.025	2.50
330uF,16V Al. Electrolytic	0.143	2.37
820uF,4V "OSCON"	0.012	2.50
1000uF,10V Al. Electrolytic	0.053	5.00

Capacitor Manufacturers	Phone
AVX Corp.	(803) 448-9411
VISHAY	(207) 324-4140
Nichicon Corp.	(708) 843-7500
muRata	(800) 831-9172
TOKIN	(408) 432-8020
Taiyo Yuden	(800) 348-2496
Sanyo	(619) 661-6835

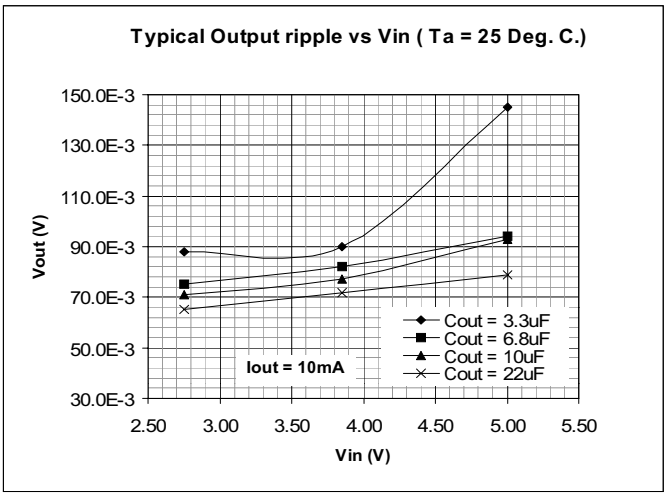
LAYOUT CONSIDERATION

Standard power board layout should be followed to ensure proper operation. Any stray inductance should be minimized, this can be achieved by using large power planes or traces, and reducing the distances between input, output and the load. All components should be placed as close as possible to the SC1517-5.

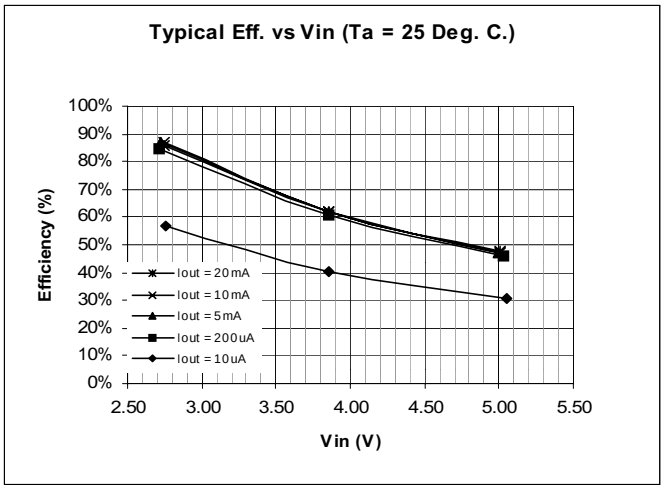
Typical Characteristics



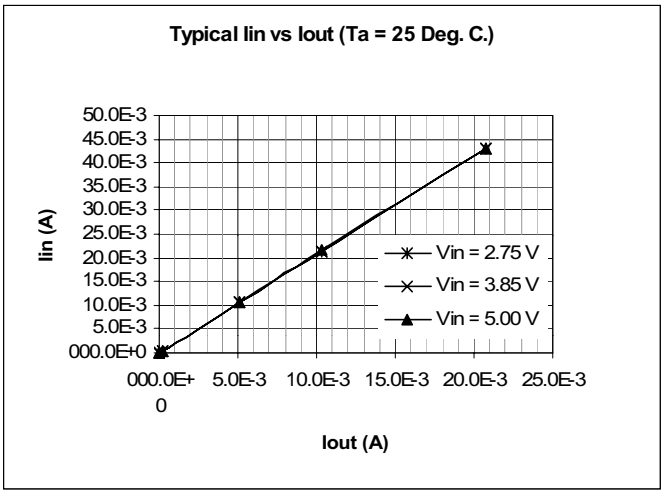
Typical Efficiency vs Iout



Typical Ripple vs Vout

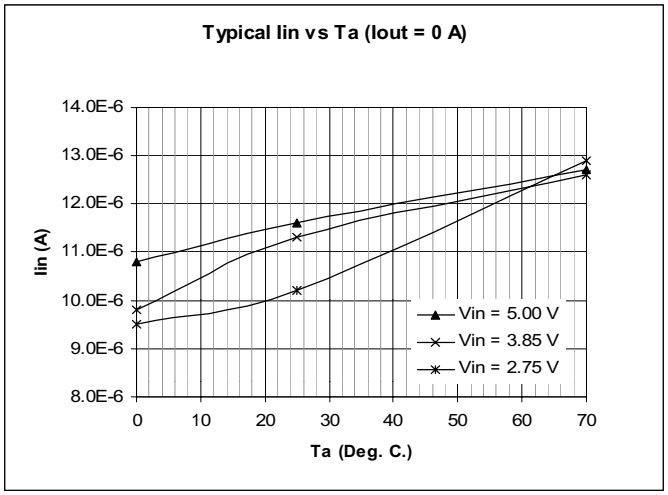


Typical Efficiency vs Vin

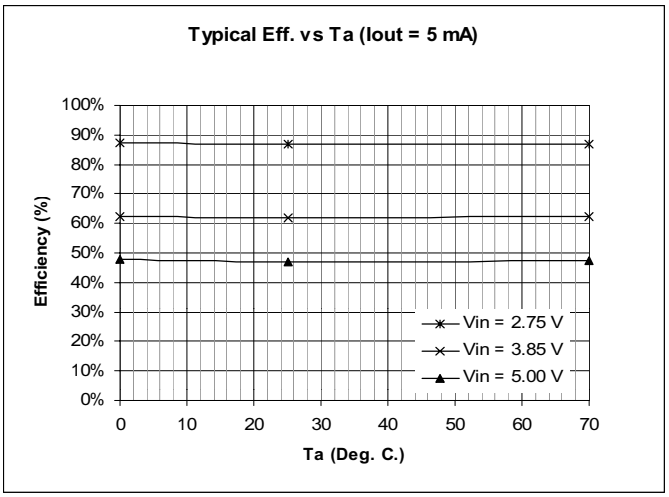


Typical Iin vs Iout

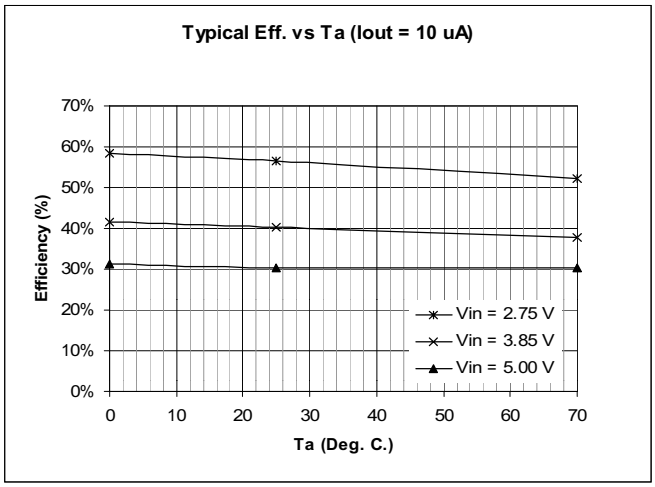
Typical Characteristics (Cont.)



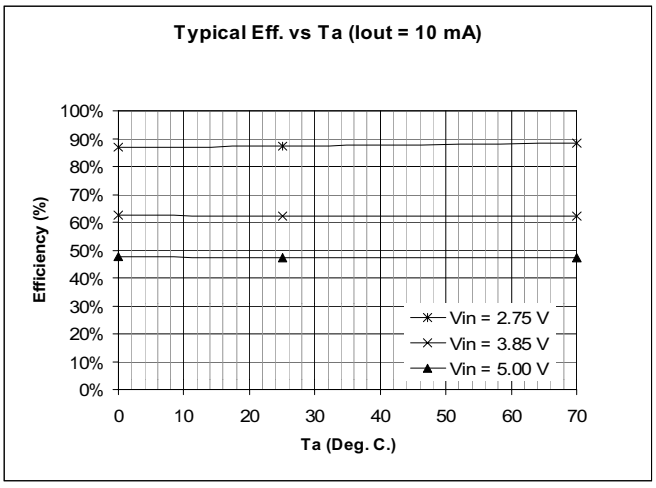
Typical Iin vs Ta Iout = 0



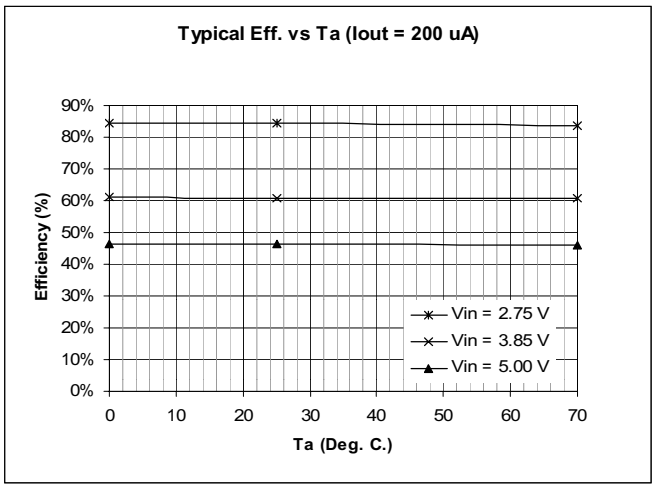
Typical Efficiency vs Ta Iout = 5mA



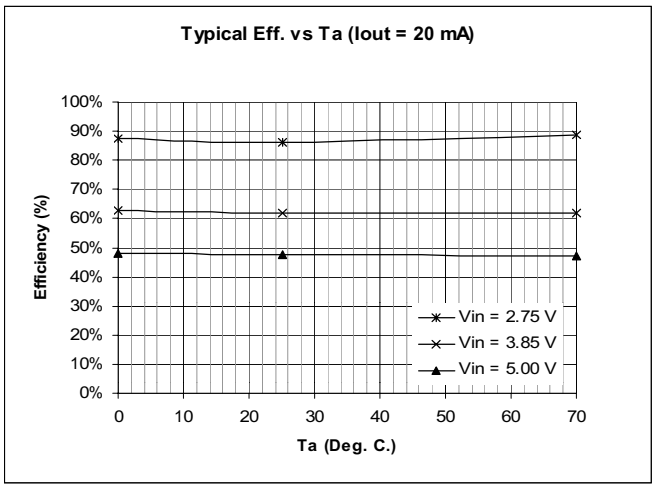
Typical Efficiency vs Ta Iout = 10uA



Typical Efficiency vs Ta Iout = 10mA

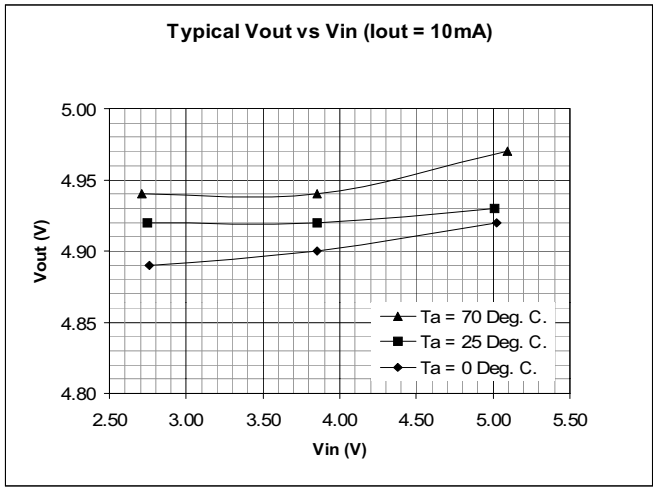


Typical Efficiency vs Ta Iout = 200uA

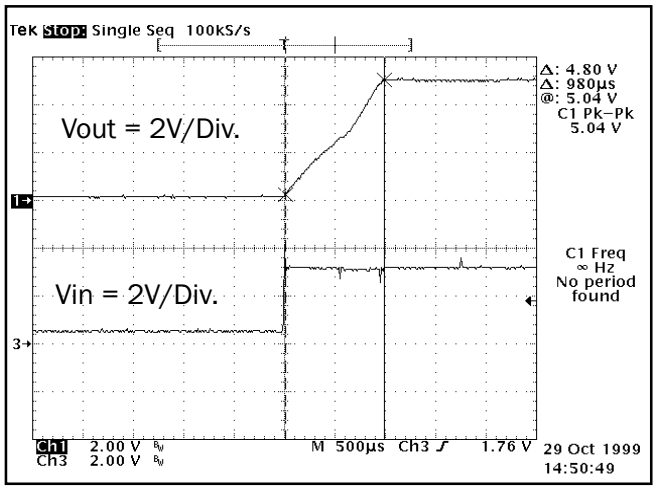


Typical Efficiency vs Ta Iout = 20mA

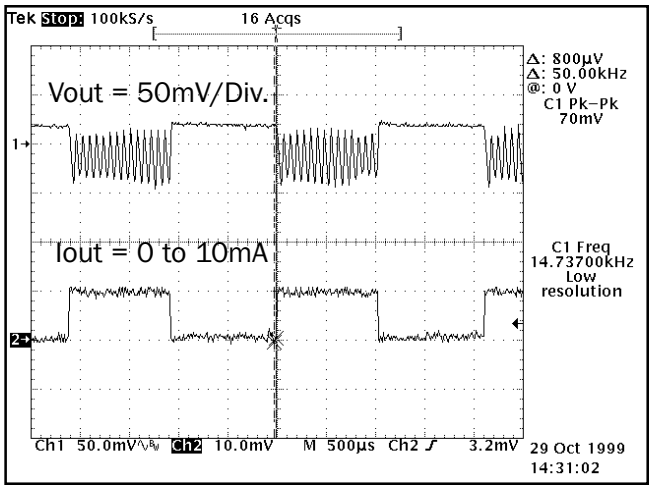
Typical Characteristics (Cont.)



Typical Vout vs Vin

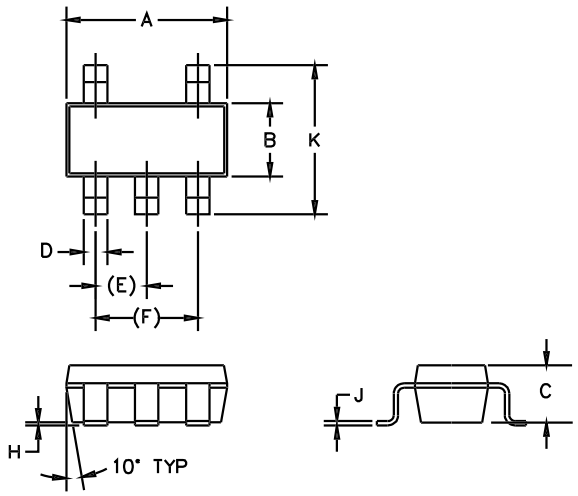


Turn on regulation time, Vin = 3V (Ta = 25°C.)



Transient Load responce, Vin = 3V (Ta =25°C.)

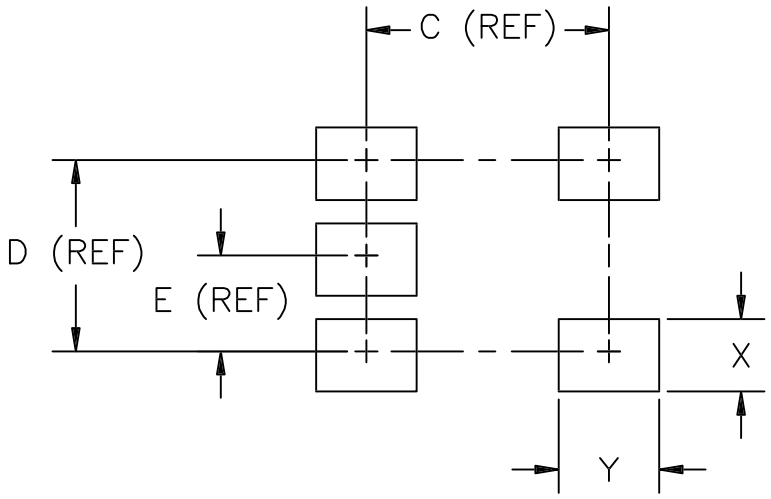
Outline Drawing - SOT-23-5L



DIMENSIONS					
DIM	INCHES		MM [1]		NOTE
	MIN	MAX	MIN	MAX	
A	.110	.120	2.80	3.05	–
B	.059	.070	1.50	1.75	–
C	.036	.051	.90	1.30	–
D	.014	.020	.35	.50	–
E	–	.037	–	0.95	REF
F	–	.075	–	1.90	REF
H	–	.006	–	.150	–
J	.0035	.008	.090	.20	–
K	.102	.118	2.6	3.00	–

[1] CONTROLLING DIMENSIONS: MILLIMETERS.

Land Pattern - SOT-23-5L



DIMENSIONS			
DIM	INCHES	MM	NOTE
C	.094	2.4	–
D	.074	1.9	–
E	.037	.95	–
X	.028	.7	–
Y	.039	1.0	–

Contact Information

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