



SANYO Semiconductors

# DATA SHEET

An ON Semiconductor Company

## LV5813TT — Bi-CMOS IC Step-down Switching Regulator

### Overview

LV5813TT is 1ch step down switching regulator. 0.25Ω FET is incorporated on the upper side to achieve high-efficiency operation for large output current. Compact-package MSOP8 (150mil) employed. Current mode control type, with superior load current response and easy phase compensation. ON/OFF pin, allowing the standby mode with the current drain of 90μA or less. Pulse-by-pulse over-current protection and overheat protection available for protection of load devices. Soft start pin to be provided with a capacitance for soft start.

### Functions

- 1.5A 1ch step-down switching regulator
- Wide input dynamic range (4.75V to 18V)
- High efficiency : 90% ( $V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{OUT} = 1A$ )
- Compact package : MSOP8 (150mil)
- Standby mode
- Over-current protection
- Thermal shutdown
- Fixed frequency : 370kHz
- Soft start
- Reference voltage : 0.8V

### Applications

- LCD TV
- Blu-ray Disc Player/Recorder
- Pre regulator
- PDP TV
- For χDSL power supply
- Amusement

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# LV5813TT

## Specifications

### Absolute Maximum Ratings at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Maximum input $V_{IN}$ voltage	$V_{IN\ max}$		20	V
BOOT pin maximum voltage	$V_{BT\ max}$		25	V
SW pin maximum voltage	$V_{SW\ max}$		$V_{IN\ max}$	V
BOOT pin-SW pin maximum voltage	$V_{BS-SW\ max}$		7	V
EN pin maximum voltage	$V_{EN\ max}$	*1	$V_{IN}+0.3$	V
FB, COMP, SS pin maximum voltage	$V_{fs\ max}$		7	V
Allowable power dissipation	$P_d\ max$	With specified substrate *2	0.85	W
Junction temperature	$T_J\ max$		150	$^\circ\text{C}$
Operating temperature	$T_{opr}$		-20 to +80	$^\circ\text{C}$
Storage temperature	$T_{stg}$		-40 to +150	$^\circ\text{C}$

Note : Plan the maximum voltage while including coil and surge voltages, so that the maximum voltage is not exceeded even for an instant.

\*1 :  $V_{IN} + 0.3 < V_{IN\ max}$

\*2 : Specified substrate : 46.4mm × 31.8mm × 1.7mm, glass epoxy substrate

### Recommended Operating Conditions at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
$V_{IN}$ pin voltage	$V_{IN}$		4.75 to 18	V
BOOT pin voltage	$V_{BT}$		-0.3 to 23	V
SW pin voltage	$V_{SW}$		-0.4 to $V_{IN}$	V
BOOT pin-SW pin maximum voltage	$V_{BS-SW}$		6.5	V
EN pin maximum voltage	$V_{EN}$		$V_{IN} + 0.3$	V
FB, COMP, SS pin voltage	$V_{FSO}$		6	V

### Electrical Characteristics at $T_a = 25^\circ\text{C}$ , $V_{IN} = 12\text{V}$ , unless otherwise specified.

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
IC current drain at standby	$I_{CC1}$	EN = 0V		90		$\mu\text{A}$
IC current drain in operation	$I_{CC2}$	EN = 5V, FB = 1V		2		mA
Efficiency	Effcy	$V_{IN} = 12\text{V}$ , $I_{OUT} = 1\text{A}$ , $V_O = 5\text{V}$ , Design target *3		90		%
Reference voltage	$V_{ref}$	$V_{IN} = 4.75\text{V}$ to 18V	-2%	0.8	+2%	V
FB pin bias current	$I_{ref}$	FB = 0.8V		20	200	nA
High-side ON resistance	$R_{onH}$	BOOT = 5V		0.25		$\Omega$
Oscillation frequency	$F_{OSC}$		296	370	444	kHz
Oscillation frequency during short-circuit protection	$F_{OSCS}$		85	115	145	kHz
EN high-threshold voltage	$V_{enh}$		0.9	1.8	2.7	V
EN low-threshold voltage	$V_{enl}$		0.7	1.35	2.0	V
Maximum ON DUTY	$D\ max$			85		%
Current limit peak value 1	$I_{cl1}$	$V_{IN} = 12\text{V}$ , $V_{OUT} = 1.2\text{V}$ , $L = 10\mu\text{H}$	3.1		5.7	A
Current limit peak value 2	$I_{cl2}$	$V_{IN} = 12\text{V}$ , $V_{OUT} = 3.3\text{V}$ , $L = 10\mu\text{H}$	2.8		5.4	A
Current limit peak value 3	$I_{cl3}$	$V_{IN} = 12\text{V}$ , $V_{OUT} = 5\text{V}$ , $L = 10\mu\text{H}$	2.5		5.1	A
Thermal shutdown temperature	$T_{tsd}$	Design guarantee *4		160		$^\circ\text{C}$
Thermal shutdown temperature hysteresis	$D_{tsd}$	Design guarantee *4		40		$^\circ\text{C}$
Soft start current	$I_{SS}$	SS = 0V	3	5	7	$\mu\text{A}$

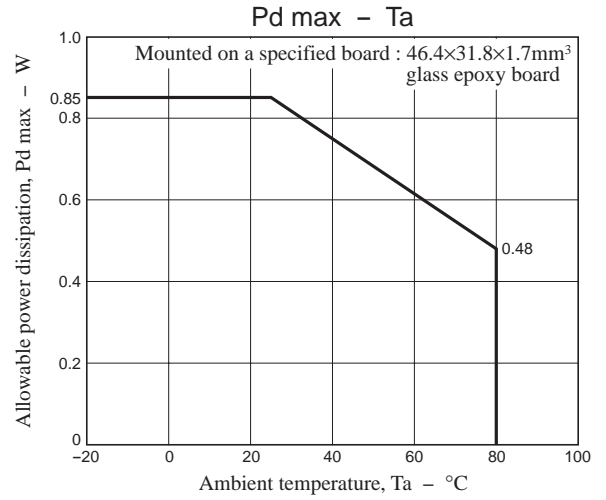
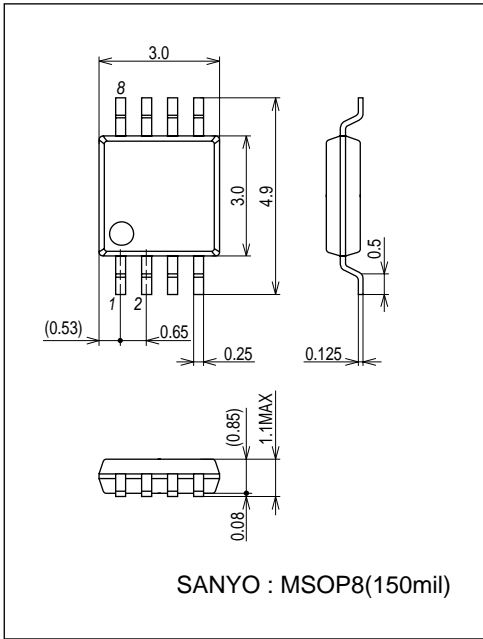
\*3 : Reference value (not tested before shipment)

\*4 : Design guarantee (value guaranteed by design and not tested before shipment)

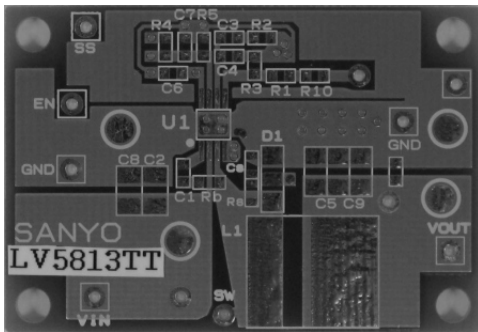
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## Package Dimensions

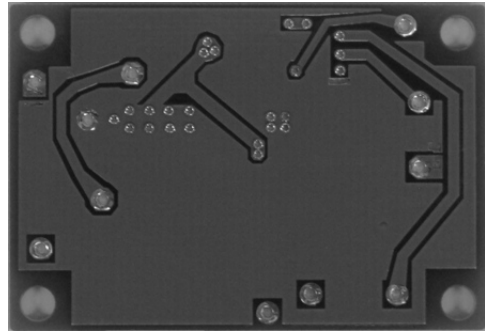
unit : mm (typ)  
3245B



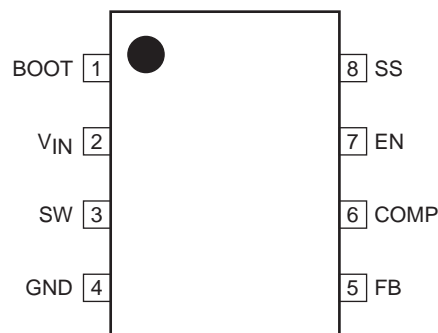
Specified Board (Top side)



Specified Board (Bottom side)



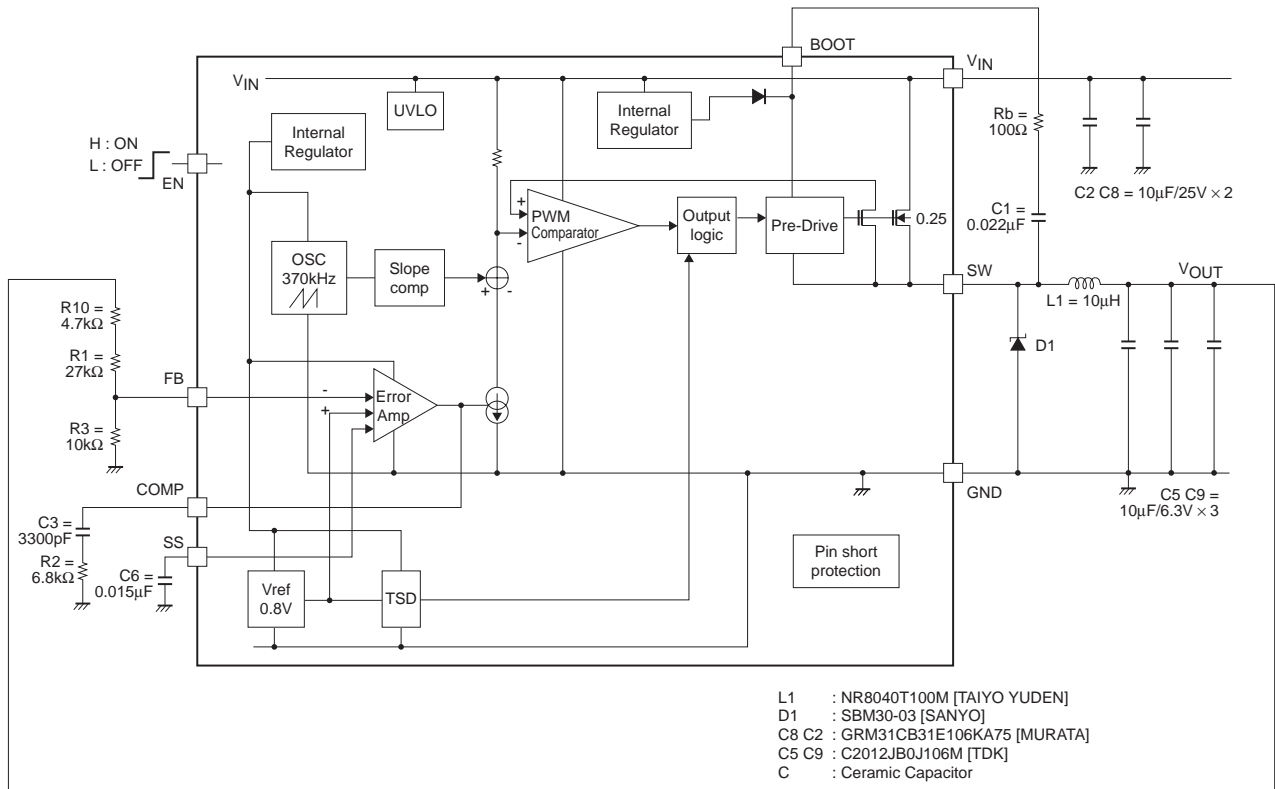
## Pin Assignment



Top view

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## Block Diagram and Sample Application Circuit (3.3V output)



### Pin Function

Pin No.	Pin name	Description	Equivalent Circuit
1	BOOT	Upper MOS transistor boot strap capacitance connection pin Connect the boot capacitance of about 0.022μF between SW pins To protect the SW pin's absolute maximum rating, to ensure stable operation, and to eliminate noise, the boot capacitance serial resistance (about 100Ω) Rb proves effective.	
2	V <sub>IN</sub>	Input voltage pin. Connect substantially large (10μF 2 parameters or more) capacitance between this pin and GND.	See BOOT
3	SW	Power switch pin. Connect the output LC filter. Connect the above capacitance between this pin and BOOT pin.	See BOOT
4	GND	Ground pin.	-

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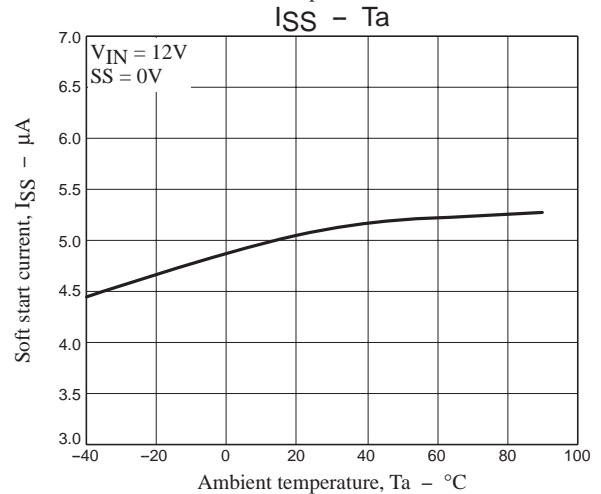
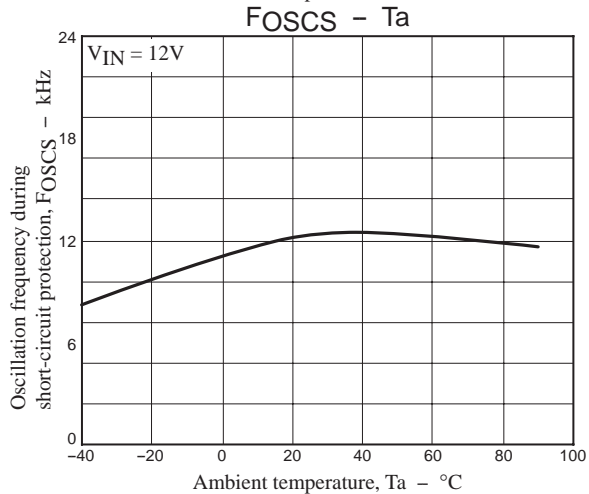
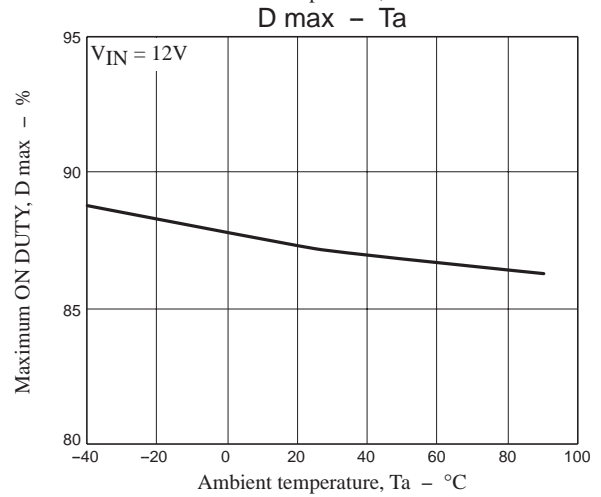
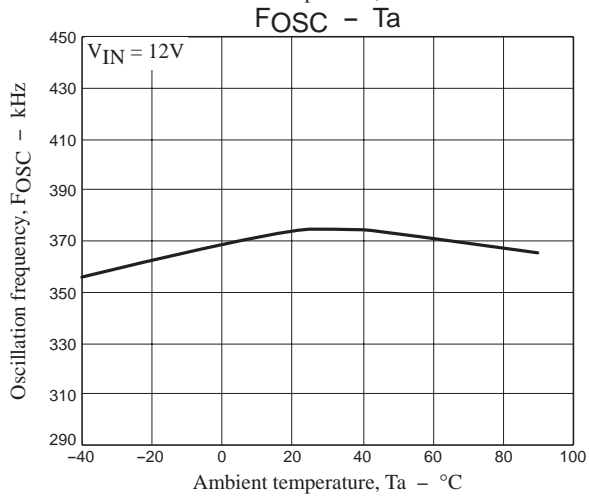
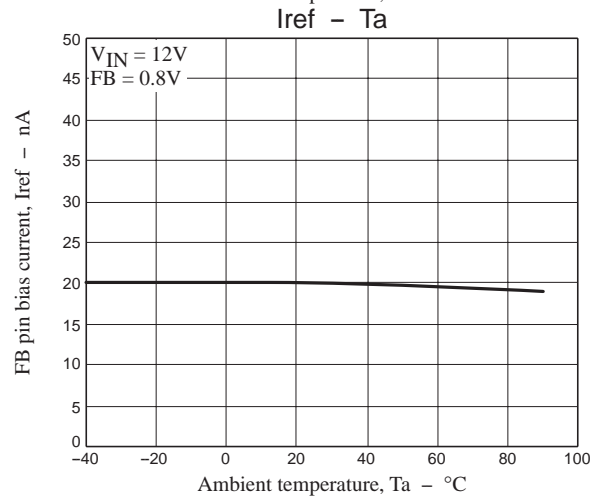
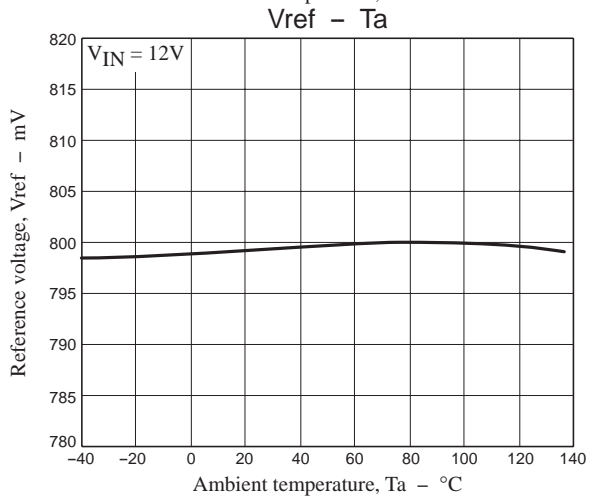
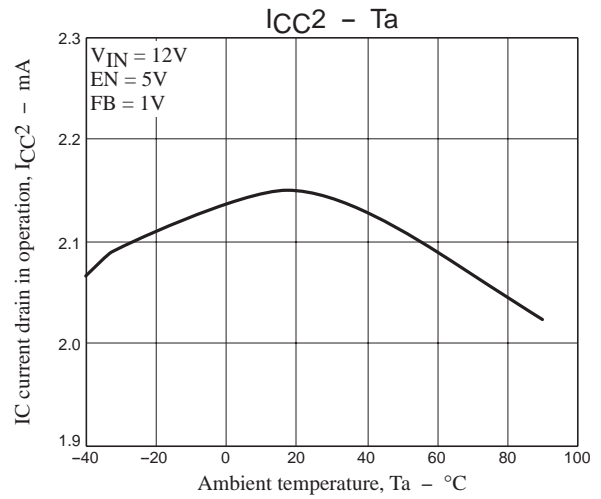
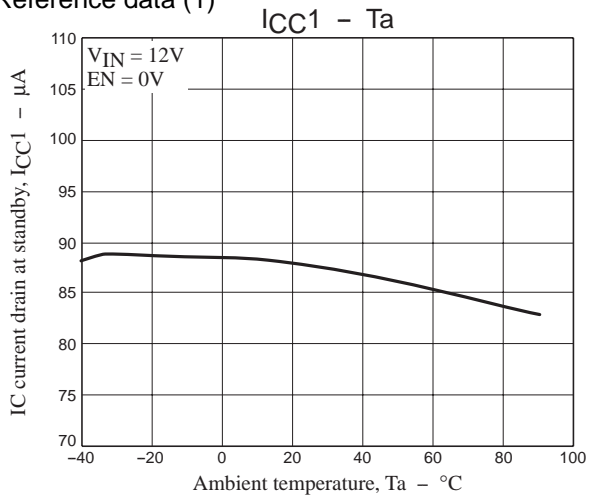
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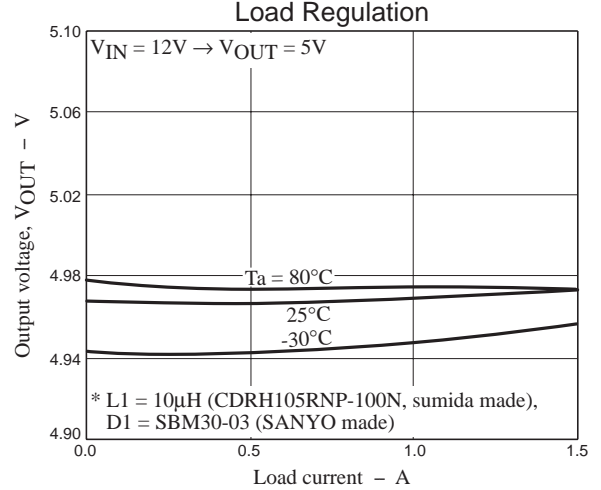
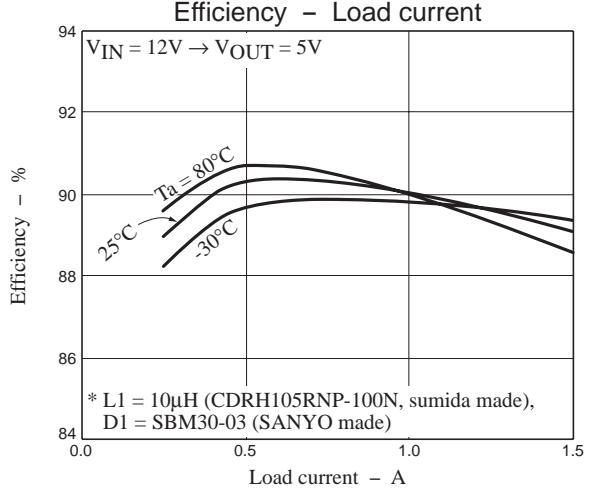
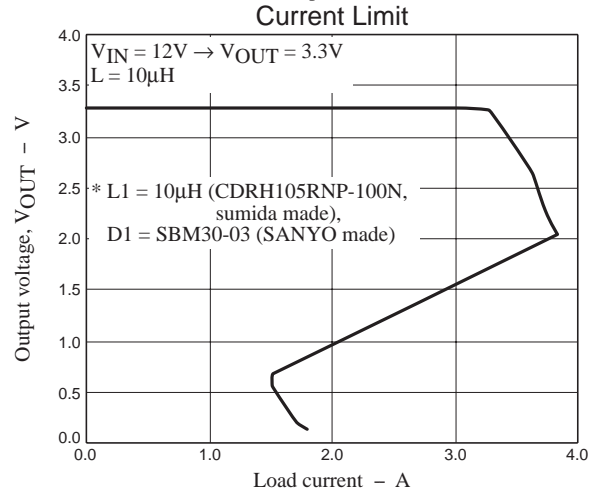
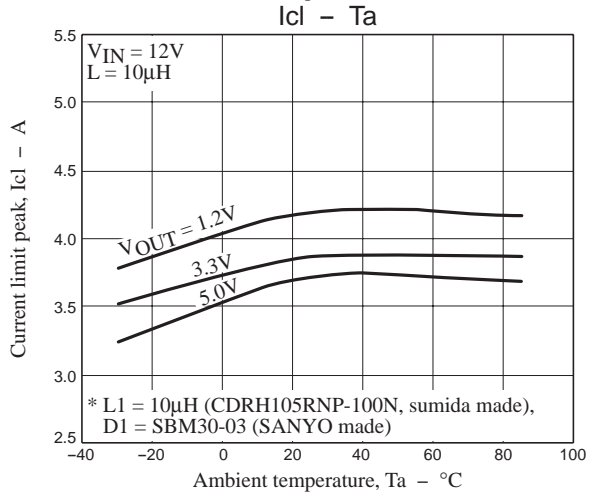
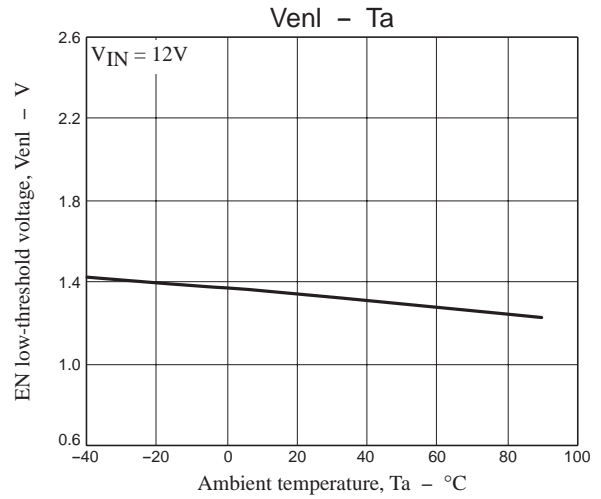
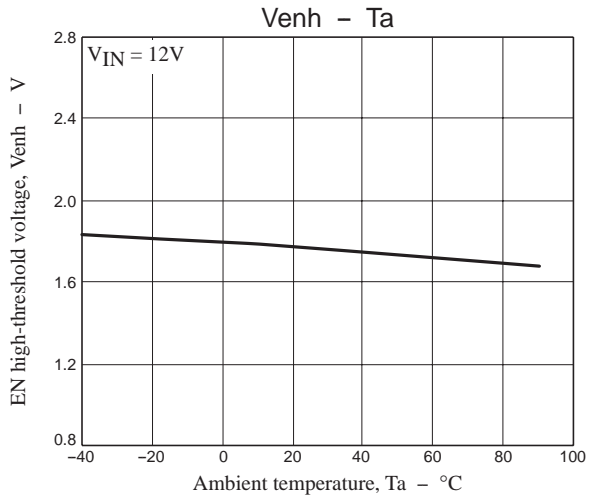
Pin No.	Pin name	Description	Equivalent Circuit
5	FB	<p>Feedback pin</p> <p>Sets the output voltage by means of split resistor in the section of the output voltage <math>V_{OUT}</math> - FB - GND. <math>V_{OUT}</math> setting is made as calculated below :</p> $V_{OUT} = V_{ref} \times \left\{ 1 + \frac{(R1 + R10)}{R3} \right\}$ <p style="text-align: center;"><math>V_{ref} = 0.8V</math></p> <p>Example : 3.3V output voltage (See block diagram and sample application circuit)</p> $V_{OUT} = 0.8 \times \left\{ 1 + \frac{(27k + 4.3k)}{10k} \right\}$ <p style="text-align: center;"><math>= 3.304V</math></p>	
6	COMP	<p>Phase compensation pin</p> <p>Connects with the phase compensation external capacitance and resistance of DC/DC converter close loop.</p>	
7	EN	<p>Enable pin</p> <p>Converter enabled when set to the HIGH voltage and disabled when connected to GND.</p>	
8	SS	<p>Soft start pin</p> <p>Set the soft start time by means of the built-in 5µA source voltage and external soft start capacity</p> <p><math>C_{ss}</math> can be set as follows :</p> $C6 = 5\mu A \times \frac{T_{ss}}{V_{ref}}$ <p>Where, <math>T_{ss}</math> is soft start time and <math>V_{ref}</math> is the reference voltage.</p> <p>Example : 2.4ms soft start time achieved</p> $C_{ss} = 5\mu A \times \frac{2.4ms}{0.8V} = 0.015\mu F$	

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## Reference data (1)



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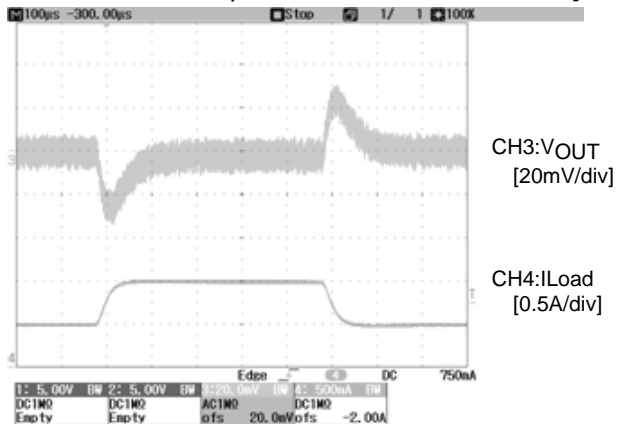


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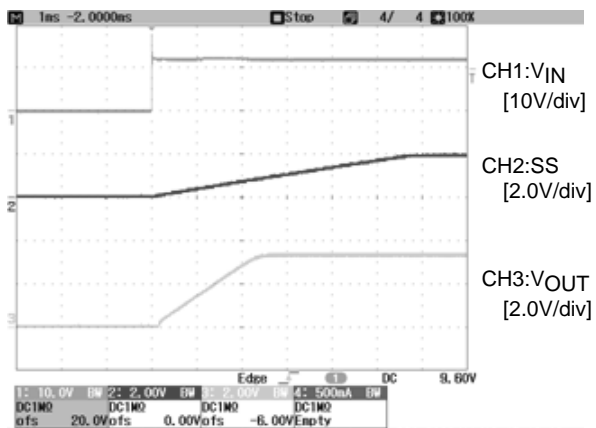
## Reference data (2)

(\* measurement circuit is shown in “8. Sample Application circuit”,  $V_{IN} = 12V \Rightarrow V_{OUT} = 3.3V$ )

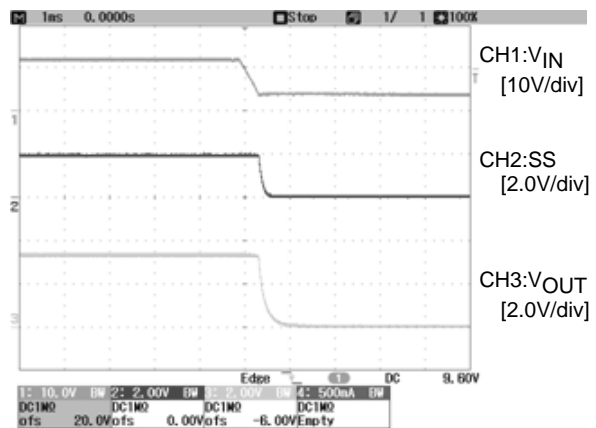
### •Load transient response $I_{Load} = 0.5A \leftrightarrow 1.0A$ [100 $\mu$ sec/div]



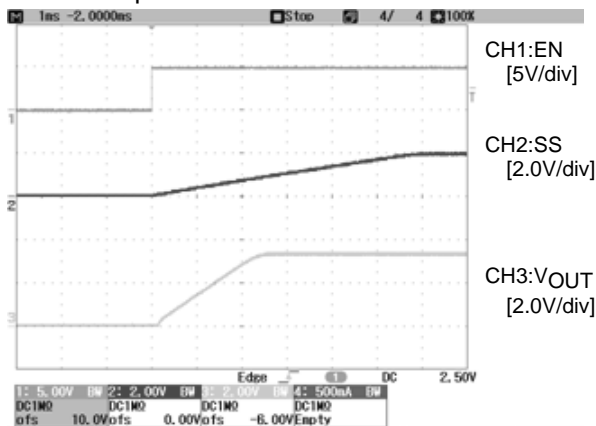
### • $V_{IN}$ start up waveform $I_{Load} = 0.5A$



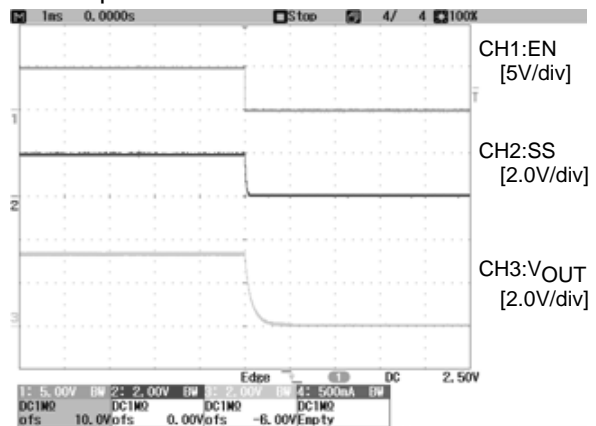
### • $V_{IN}$ stop waveform $I_{Load} = 0.5A$



### •EN start up waveform $I_{Load} = 0.5A$



### •EN stop waveform $I_{Load} = 0.5A$



## Considerations for the design

- During use with  $V_{IN} = 12V$  or less, the boot strap voltage may become deficient due to intermittent operation at no load, resulting in failure of normal operation. In this case, insert a resistance of about  $500\Omega$  between  $V_{OUT}$  and GND and avoid the intermittent operation mode during use.
- Insertion of serial beads in the Schottky diode for removal of noise may cause generation of the negative voltage deviating from the absolute maximum rating at the SW pin, resulting in failure of normal operation. In such an event, do not insert beads as above described and, instead, remove noise by means of the BOOT resistance  $R_b$ .



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