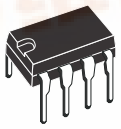
ST735S
ST735T

300kHz, -5V/ADJ INVERTING, NEGATIVE OUTPUT CURRENT-MODE PWM REGULATOR

- CONVERTS +4.0V TO + 6.2V INPUT TO -5V OUTPUT (735S) OR +3.5V TO + 9.0V TO A NEGATIVE ADJUSTABLE OUTPUT (735T)
- 1W GUARANTEED OUTPUT POWER
- 72% TYPICAL EFFICIENCY
- 0.8mA QUIESCENT CURRENT
- 1µA SHUTDOWN MODE
- 300KHZ FIXED FREQUENCY OSCILLATOR
- CURRENT MODE PWM CONVERTER
- LOW NOISE AND JITTER
- SOFT START
- SIMPLE APPLICATION CIRCUIT
- UNDERVOLTAGE LOCKOUT (735S)



DIP-8

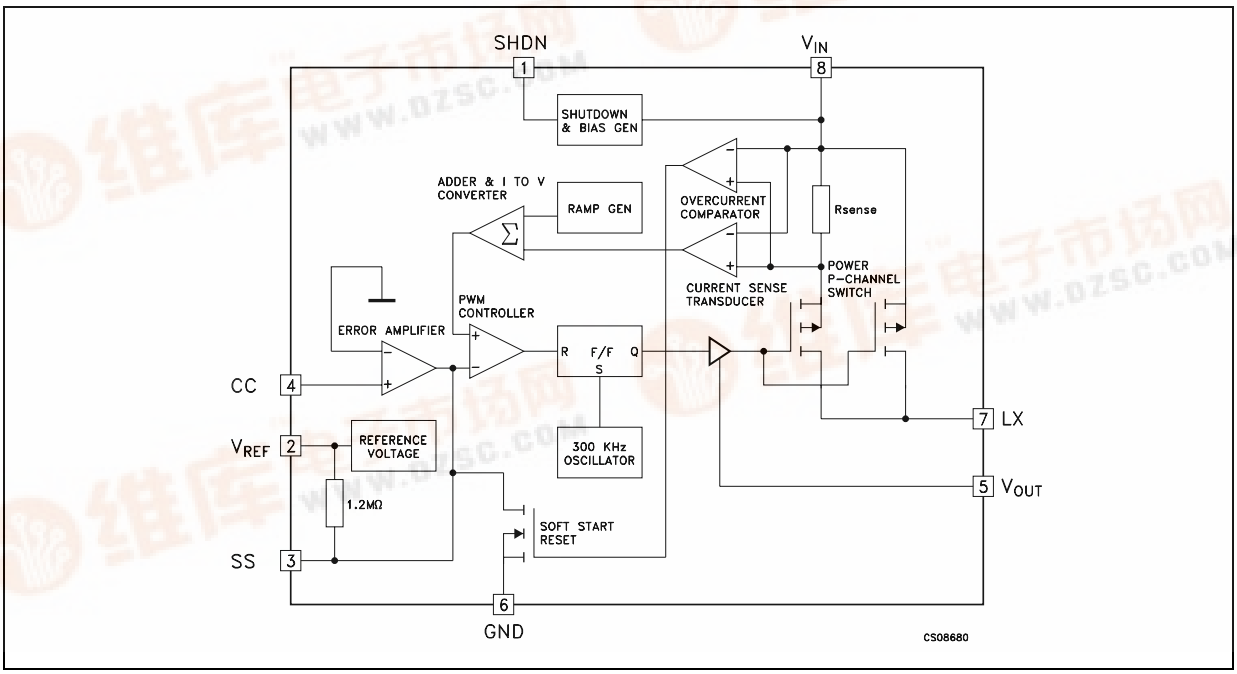
SO-8

DESCRIPTION

The ST735S/ST735T is a Bi-CMOS, inverting switch mode DC-DC regulator with internal Power MOSFET that generates a fixed -5V (S version) or a negative adjustable (T version) output voltage from a 4V (3.5V for the 735T) to 6.2V input voltage (9V for the 735T); is guaranteed an output current of 200mA for inputs greater than 4.5V. The quiescent current for this device is typically of 0.8mA and, in shutdown mode it is reduced to 1µA.

These power-conserving features, along with high efficiency and applications circuits, thaT lend itself to minaturization, make the ST735S/ST735T excellent in a broad range of on-card, HDD and portable equipment applications. These device employ a high performance current mode pulse with modulation (PWM) control scheme to provide tight output voltage regulation and low noise. The fixed frequency oscillator is factory trimmed to 300KHz, allowing for easy noise filtering. The regulator in production is tested to guarantee an output accuracy within ±5% over all specified conditions.

SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

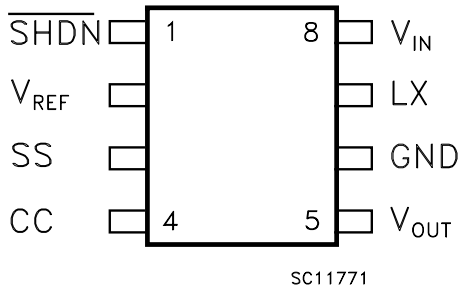
Symbol	Parameter		Value	Unit
V_{IN}	DC Input Voltage (V_{IN} to GND) for ST735S		-0.3 to +7	V
V_{IN}	DC Input Voltage (V_{IN} to GND) for ST735T (Note 1)		-0.3 to +11	V
SHDN	Shutdown Voltage (SHDN to GND)		-0.3 to V_{IN}+0.3	V
V_{LX}	Switch Voltage (Lx to V_{IN})		-12.5 to +0.3	V
V_{FB}	Feedback Voltage (V_{OUT} to GND)		-11 to +0.3	V
V_{OUT}	Output Voltage (V_{OUT} to GND)		-11 to +0.3	V
	Other Input Voltage (SS, CC to GND)		-0.3 to V_++0.3	V
I_{LX}	Peack Switch Current		2	A
P_{tot}	Power Dissipation at T_j = 70°C	DIP-8	725	mW
		SO-8	470	
T_{stg}	Storage Temperature Range		-55 to +150	°C
T_{op}	Operating Junction Temperature Range		-40 to +125	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.
Note 1: The input to output differential voltage is limited to $V_{IN}+|V_{OUT}|<12.7V$

THERMAL DATA

Symbol	Parameter	DIP-8	SO-8	Unit
$R_{thj\text{-}case}$	Thermal Resistance Junction-case	2	8	°C/W

CONNECTION DIAGRAM (top view)



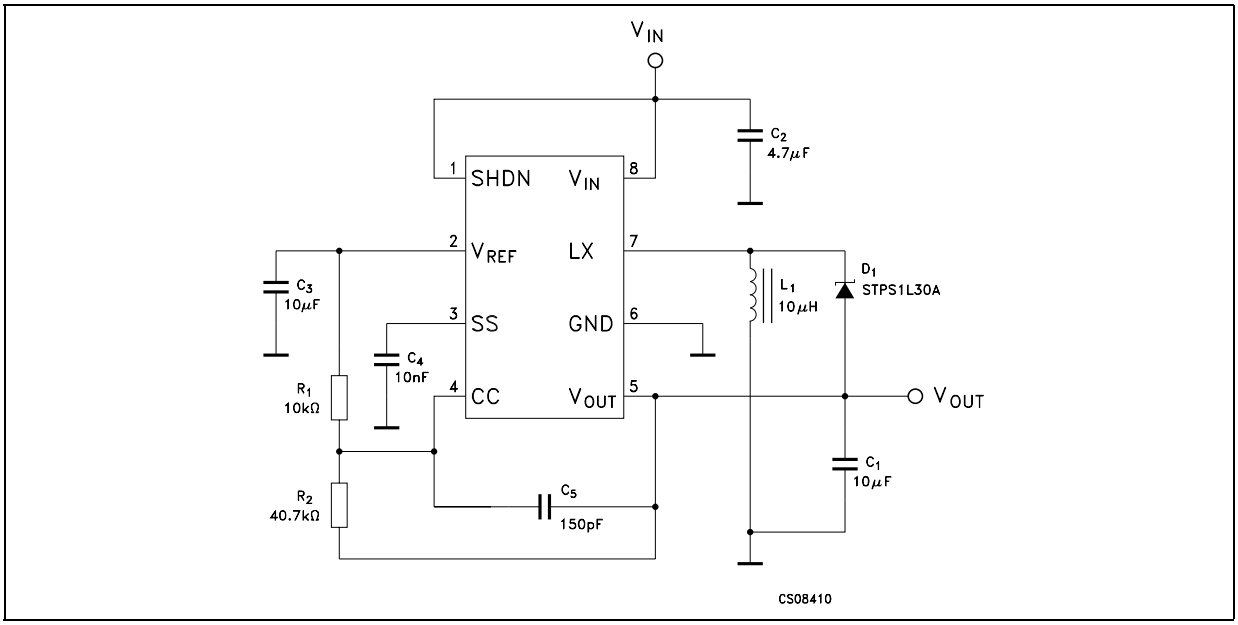
PIN DESCRIPTION

Pin N°	Symbol	Name and Function
1	SHDN	SHUT-DOWN Control (V_{CC}=ON GND=Shutdown
2	V_{REF}	Reference Output Voltage
3	SS	Soft Start
4	CC	Compensation Input
5	V_{OUT}	Negative Output Voltage
6	GND	Ground
7	LX	Switch Output
8	V_{IN}	Positive Supply - Voltage Input

ORDERING CODES

TYPE	DIP-8	SO-8	SO-8 (T&R)
ST735S	ST735SCN	ST735SCD	ST735SCD-TR
ST735T	ST735TCN	ST735TCD	ST735TCD-TR

TYPICAL APPLICATION CIRCUIT

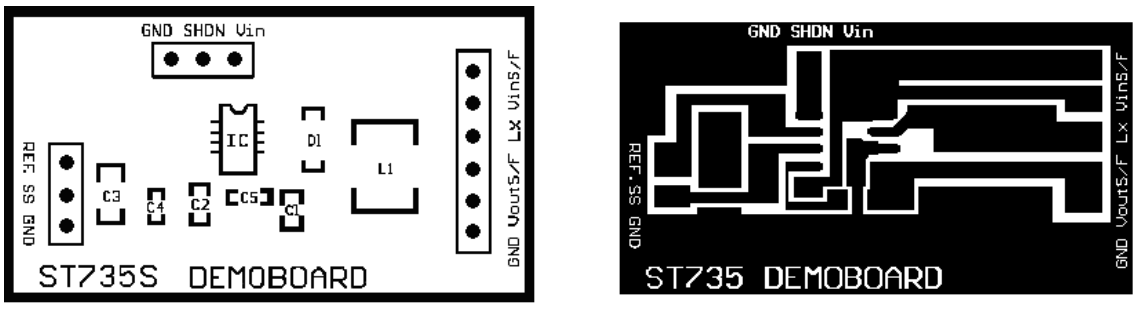


NOTE:
1) All capacitors are X7R ceramic
2) C_5 can be omitted if are used higher values for the input and output capacitors (suggested C_2=47µF, C_1=100µF).
3) R_1 and R_2 must be placed is ST735T applications only. Their values are calculated by the following formula $R_2=(|V_{OUT}|/V_{REF})xR_1$. For R_1 can be chosen any value between 2kΩ and 20kΩ

APPLICATION CIRCUIT

To achieve the best performances from switching power supply topology, particular care to layout drawing is needed, in order to minimize EMI and obtain low noise. Moreover, jitter free operation ensures the full device functionality. Layout design proposed on demoboard helps to lower the developing time. Wire lengths must be minimized, filter and bypass capacitors must be low ESR type, placed as close as possible to the integrated circuit. The 4.7µF (or 6.8µF) inductor must be chosen built on a core, taking care that saturation current should be higher than the peak LX switch current. See the Peak Inductor Current vs Output Current graph.

PRINTED DEMOBOARD (not in scale)



ELECTRICAL CHARACTERISTICS OF ST735S (Refer to test circuit, V_{IN}=5V, C_{IN} = 4.7µF, C_{OUT} = 10µF all X7R ceramic, L = 4.7µH (Note1) , I_{OUT}=0mA, T_{amb} = -40 to 125°C, unless otherwise specified. Typical value are referred at T_{amb}= 25°C)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Input Voltage		4		6.2	V
V_{OUT}	Output Voltage	V_{IN} = 4.5V to 6.2V I_{OUT} = 0 to 200mA T_{amb}= -40 to 125°C	-5.25	-5	-4.75	V
		V_{IN} = 4.0V to 6.2V I_{OUT} = 0 to 175mA T_{amb}= -40 to 125°C	-5.25	-5	-4.75	V
I_{OUT}	Output Current	V_{IN} = 4.5V to 6.2V T_J= 0 to 125°C	200	275		mA
		V_{IN} = 4.5V to 6.2V I_{OUT} = 0 to 175mA T_{amb}= -40 to 125°C	175			mA
		V_{IN} = 4.0V V_{OUT} = -5V		175		mA
I_{SUPPLY}	Supply Current	Includes Switch Current		0.8	1.6	mA
$I_{STANDBY}$	Standby Current	V_{SHDN} = 0V		1	10	µA
I_{SC}	Short Circuit Current	V_{IN} = 5V		0.9		A
I_{PEAK}	LX Max Peak Current	(Note 2)		1.5		A
V_{LO}	Undervoltage Lock-out			3.5	4	V
ΔV_{OUT}	Line Regulation	V_{IN} = 4.0V to 6.2V		0.1		%/V
ΔV_{OUT}	Load Regulation	I_{OUT} = 0 to 200mA		0.003		%/mA
V_{REF}	Reference Voltage	T_{amb}= 25°C (Note 3)		1.225		V
ΔV_{REF}	Reference Drift	T_{amb}= -40 to 125°C		50		ppm/°C
R_{DSON}	LX ON Voltage			0.5		Ω
I_{LEAK}	LX Leakage Current	V_{DS} = 10V		1		µA
I_{SH}	Shutdown Pin Current				1	µA
V_{IL}	Shutdown Input Low Threshold				0.25	V
V_{IH}	Shutdown Input High Threshold		2			V
f_{OSC}	Maximum Oscillator Frequency			300		KHz
ν	Efficency	I_{OUT} = 100mA		72		%
R_{CC}	Compensation Pin Impedance on CC Pin			7.5		KΩ

Note 1: Utilize of 6.8µH permits to reach higher current capability at the same operating conditions
Note2: Guaranteed by design, but not tested in production
Note3 : Tested at I_{VREF} = 125µA

ELECTRICAL CHARACTERISTICS OF ST735T (Refer to test circuit, V_{IN}=5V, C_{IN} = 4.7µF, C_{OUT} = 10µF all X7R ceramic, L = 4.7µH (Note1) , I_{OUT}=0mA, V_O adjusted to -5V, T_{amb} = -40 to 125°C, unless otherwise specified. Typical value are referred at Tamb= 25°C)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Input Voltage		3.5		9	V
V_O	Output Voltage	V_{IN} = 4.5V to 6.2V I_{OUT} = 0 to 200mA T_{amb}= -40 to 125°C	-5.25	-5	-4.75	V
		V_{IN} = 4.0V to 6.2V I_{OUT} = 0 to 175mA T_{amb}= -40 to 125°C	-5.25	-5	-4.75	V
I_O	Output Current	V_{IN} = 4.5V to 6.2V T_{amb}= 0 to 125°C	200	275		mA
		V_{IN} = 4.5V to 6.2V I_{OUT} = 0 to 175mA T_{amb}= -40 to 125°C	175			mA
		V_{IN} = 4.0V V_{OUT} = -5V		175		mA
I_{SUPPLY}	Supply Current	Includes Switch Current		0.8	1.6	mA
$I_{STANDBY}$	Standby Current	V_{SHDN} = 0V		1	10	µA
I_{SC}	Short Circuit Current	V_{IN} = 5V		0.9		A
I_{PEAK}	LX Max Peak Current	(Note 2)		1.5		A
V_{LO}	Undervoltage Lock-out			3.5	4	V
ΔV_{OUT}	Line Regulation	V_{IN} = 4.0V to 6.2V		0.1		%/V
ΔV_{OUT}	Load Regulation	I_{OUT} = 0 to 200mA		0.003		%/mA
V_{REF}	Reference Voltage	T_{amb}= 25°C (Note 3)		1.225		V
ΔV_{REF}	Reference Drift	T_{amb}= -40 to 125°C		50		ppm/°C
R_{DSON}	LX ON Voltage			0.5		Ω
I_{LEAK}	LX Leakage Current	V_{DS} = 10V		1		µA
I_{SH}	Shutdown Pin Current				1	µA
V_{IL}	Shutdown Input Low Threshold				0.25	V
V_{IH}	Shutdown Input High Threshold		2			V
f_{OSC}	Maximum Oscillator Frequency			300		KHz
ν	Efficency	I_{OUT} = 100mA		72		%
R_{CC}	Compensation Pin Impedance on CC Pin			7.5		KΩ

Note 1: Utilize of 6.8µH permits to reach higher current capability at the same operating conditions
Note2: Guaranteed by design, but not tested in production
Note3 : Tested at I_{VREF} = 125µA

TYPICAL CHARACTERISTICS (Referred to typical application circuit, T_{amb}=25°C unless otherwise specified)

Figure 1 : Output Voltage vs Temperature

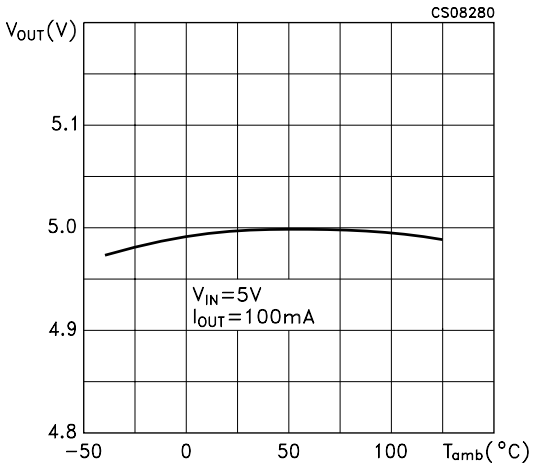


Figure 2 : Reference Voltage vs Temperature

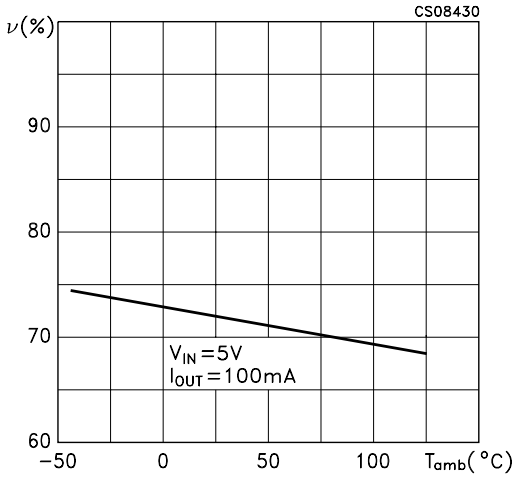


Figure 3 : Efficency vs Temperature

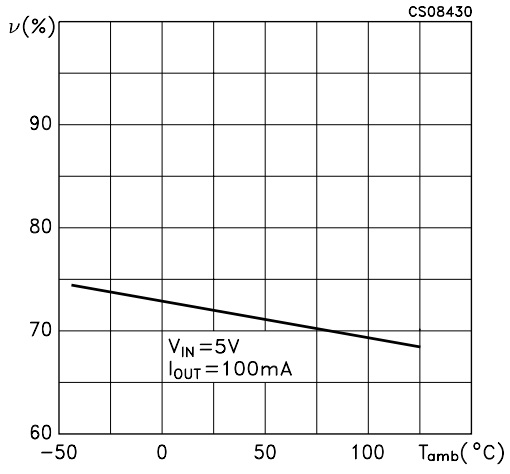


Figure 4 : Efficency vs Ouput Current

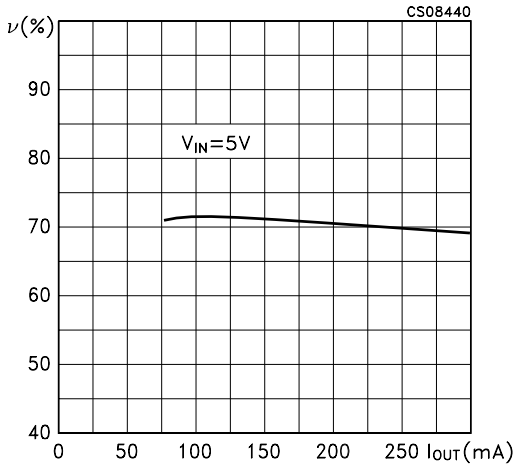


Figure 5 : Efficency vs Low Ouput Current

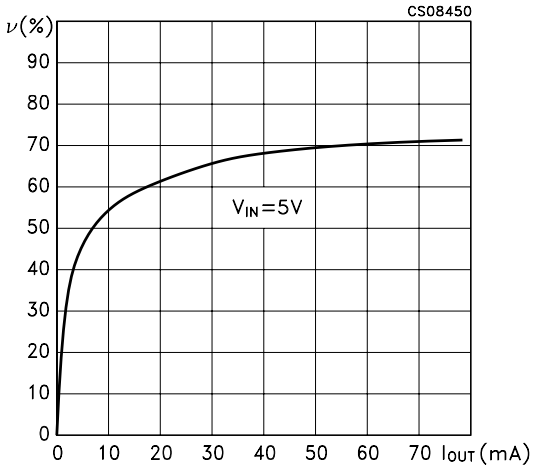


Figure 6 : Supply Current vs Temperature

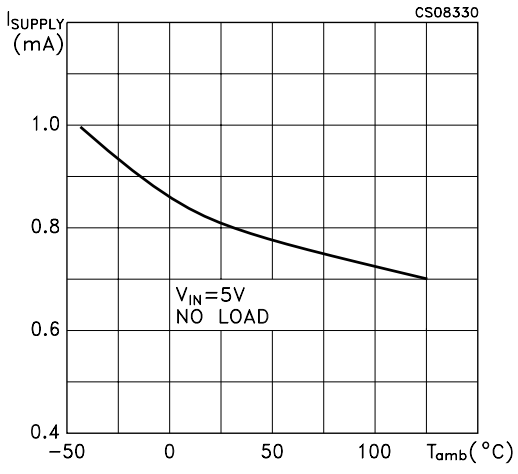


Figure 7 : Supply Current vs Input Voltage for ST735S

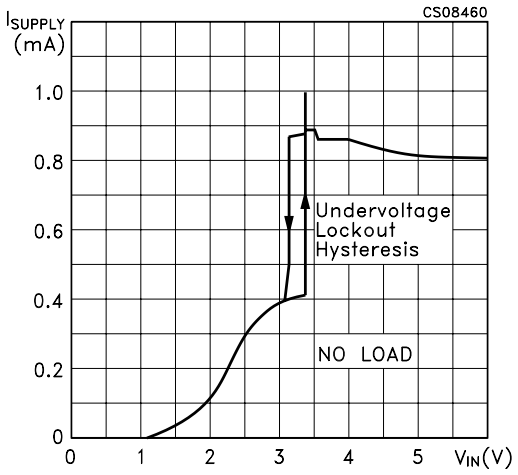


Figure 8 : Supply Current vs Input Voltage for ST734T

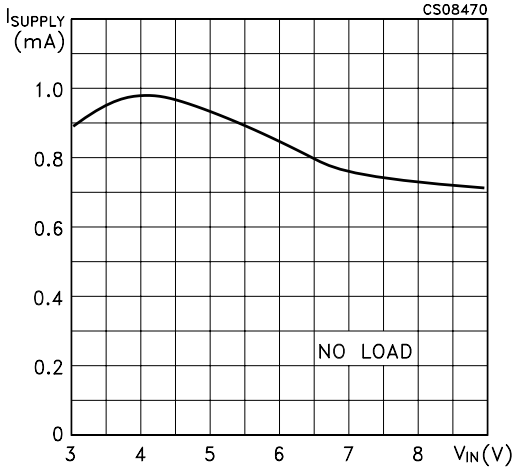


Figure 9 : Shutdown Threshold vs Temperature

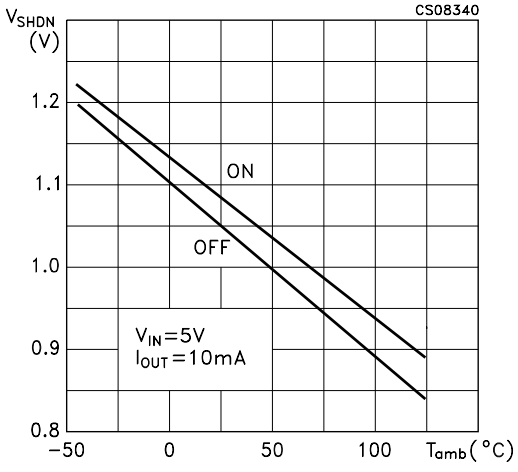


Figure 10 : Peack Inductor vs Output Current

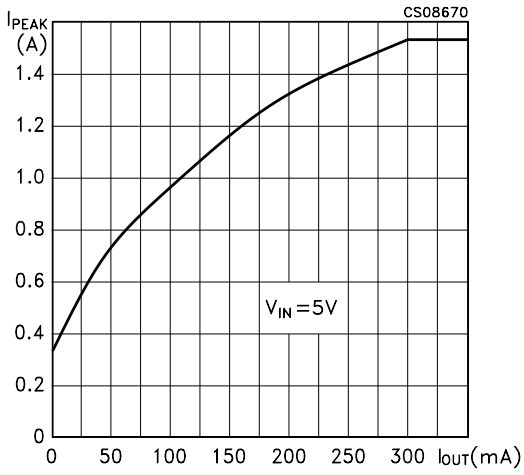


Figure 11 : Switch Current Limit vs Soft Start Voltage

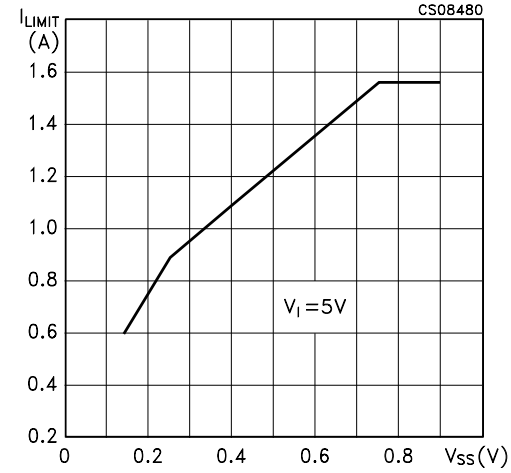


Figure 12 : Oscillator Frequency Vs Temperature

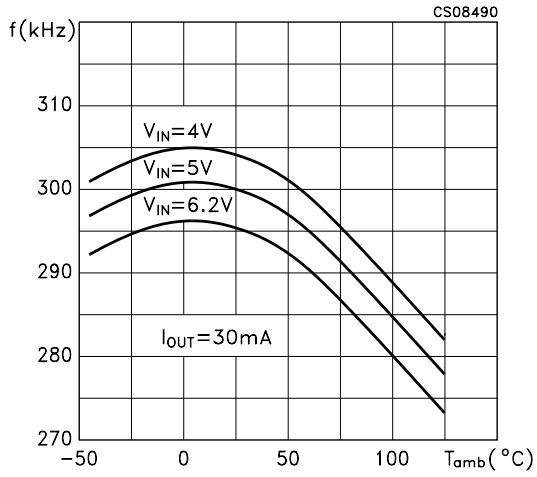


Figure 13 : LX On Resistance vs Temperature

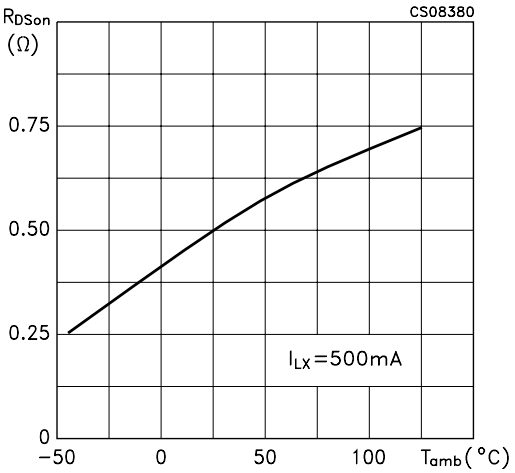


Figure 14 : LX On Resistance vs Input Voltage

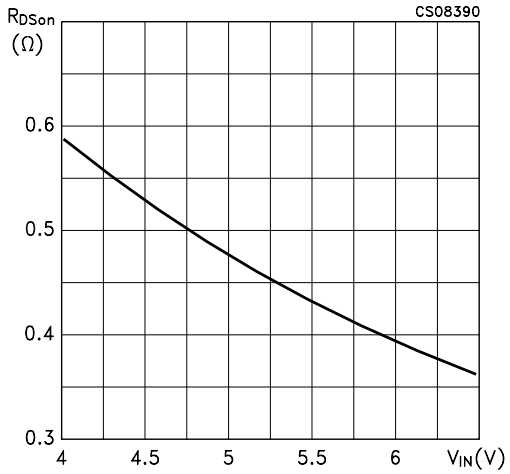
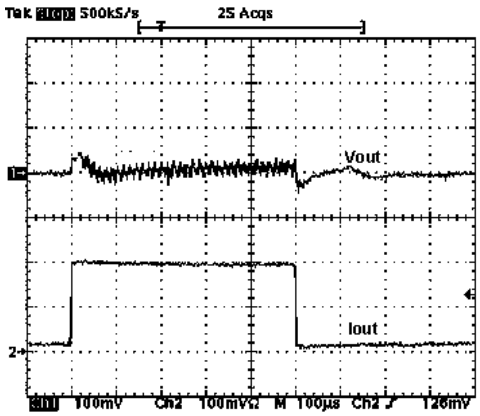
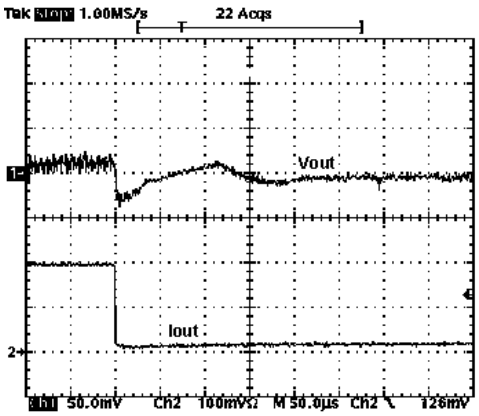


Figure 15 : Load Transient



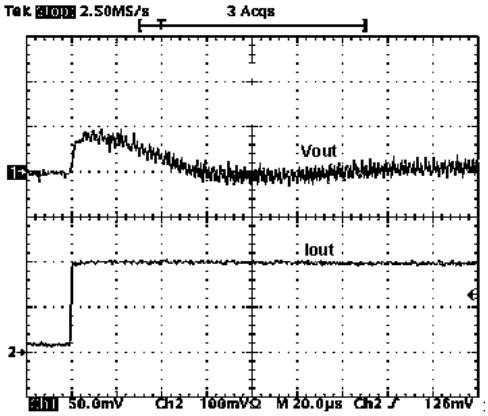
V_I=5V, I_O=20mA to 200mA, C_I = 4.7µF, C_O=100µF, t_r=t_f=1µs

Figure 16 : Load Transient



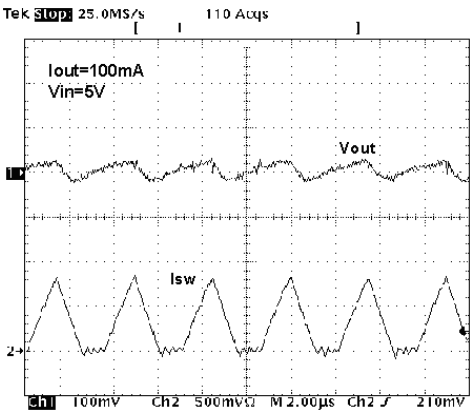
V_I=5V, I_O=20mA to 200mA, C_I = 4.7µF, C_O=100µF, t_f=1µs

Figure 17 : Load Transient



V_I=5V, I_O=20mA to 200mA, C_I = 4.7µF, C_O=100µF, t_r=1µs

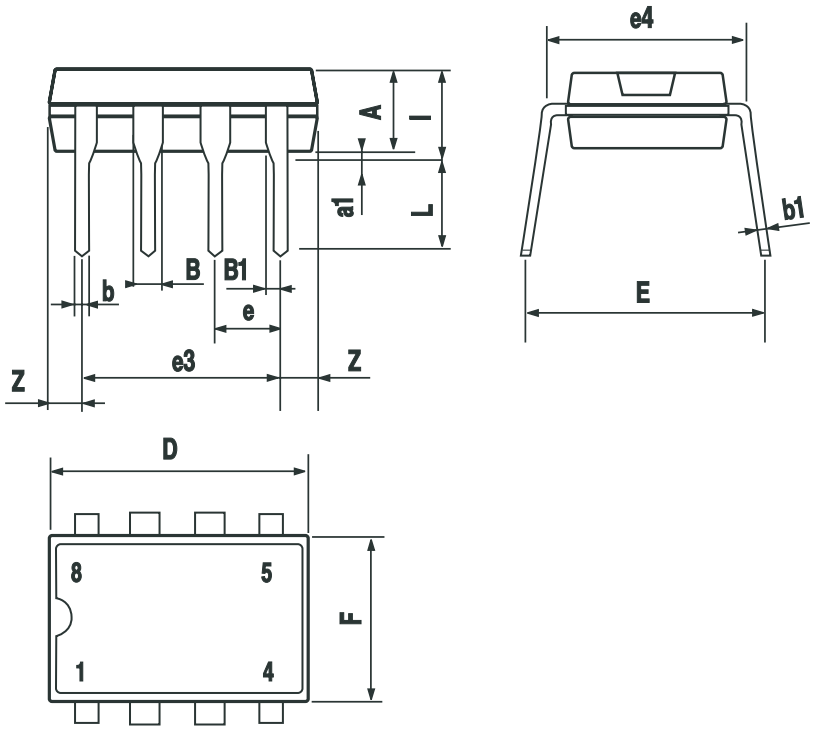
Figure 18 : Switching Waveform



V_I=5V, I_O=100mA

Plastic DIP-8 MECHANICAL DATA

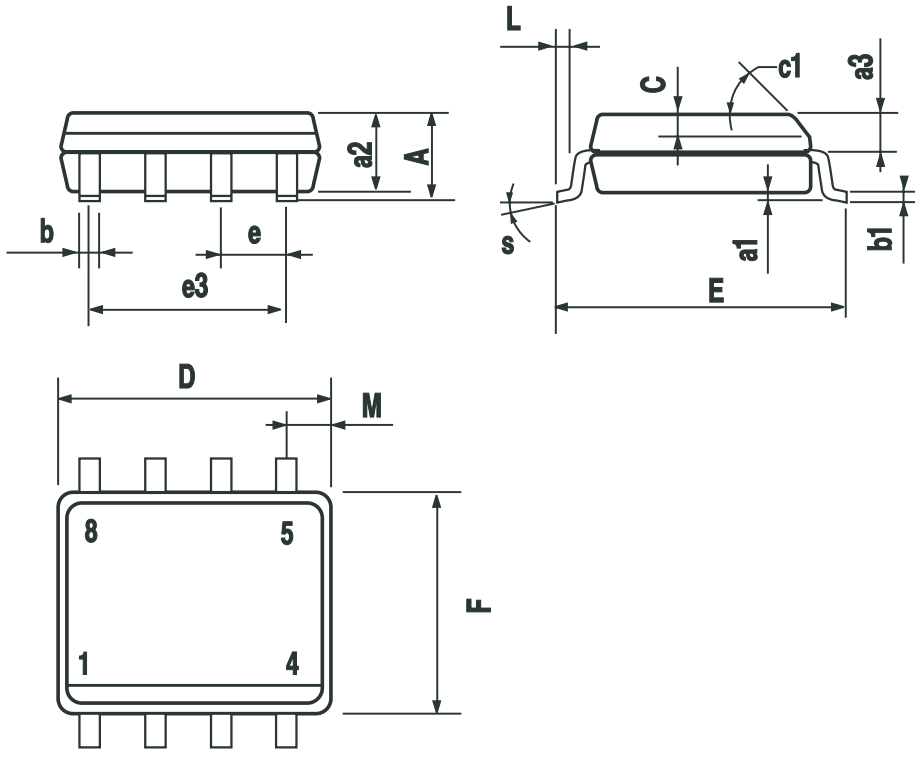
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A		3.3			0.130	
a1	0.7			0.028		
B	1.39		1.65	0.055		0.065
B1	0.91		1.04	0.036		0.041
b		0.5			0.020	
b1	0.38		0.5	0.015		0.020
D			9.8			0.386
E		8.8			0.346	
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			7.1			0.280
I			4.8			0.189
L		3.3			0.130	
Z	0.44		1.6	0.017		0.063



P001F

SO-8 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.25	0.003		0.009
a2			1.65			0.064
a3	0.65		0.85	0.025		0.033
b	0.35		0.48	0.013		0.018
b1	0.19		0.25	0.007		0.010
C	0.25		0.5	0.010		0.019
c1	45° (typ.)					
D	4.8		5.0	0.189		0.196
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		3.81			0.150	
F	3.8		4.0	0.149		0.157
L	0.4		1.27	0.015		0.050
M			0.6			0.023
S	8° (max.)					



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