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ILI4003

A Single Chip Charge Pump for TFT-LCD Panel Power

Preliminary
Specification

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Content

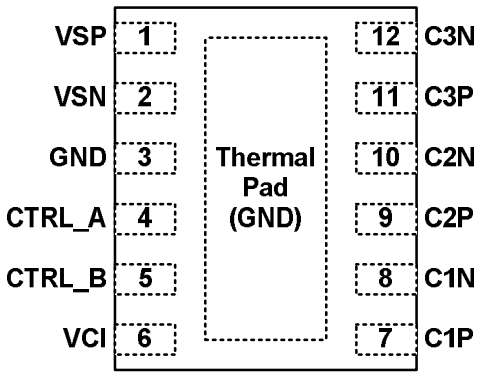
Introduction

The ILI4003 is a single chip charge pump solution designed for mobile and tablet TFT-LCD panel power. It integrates positive voltage charge pump and negative voltage charge pump with Soft-Start and input current limit protection. The positive voltage charge pump also has x1.5/x2/x3 pump mode can be selected by host controller which make TFT-LCD panel system design more flexible. The ILI4003 use a compact TDFN package (12-pin, 3mm*1.5mm*0.45mm) which reduce board size and make FPC or PCB layout design easier.

Features

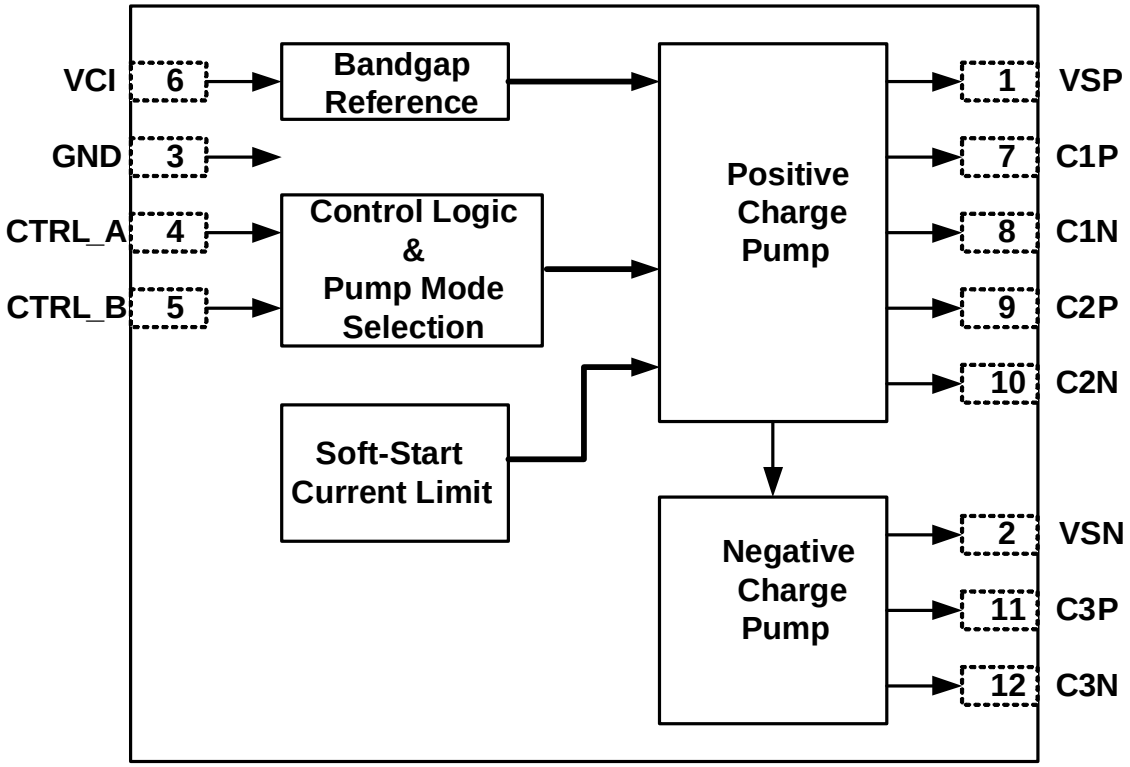
- 2.3V to 4.0V input supply voltage range
- Up to 20mA output current capability in x2 pump mode both positive and negative output voltage
- Up to 90% power conversion efficiency in x2 pump mode
- Support x1.5/x2/x3 pump mode selection for positive voltage charge pump
- Negative voltage charge pump follow x(-1) positive output voltage
- Positive output voltage range 4.5V to 6V
- Negative output voltage range -4.5V to -6V
- Build-in Soft-Start to reduce power on in-rush current
- Cycle by cycle input current limit protection
- 2.3V to 4.0V input voltage tolerance for control signals
- 12-pin 3mm*1.5mm*0.45mm TDFN package
- RoHS Compliant and Halogen Free

Pin Assignment



Top View

Functional Block Diagram



Pin Definition

Pin Name	PIN No.	Description
VSP	1	Positive output voltage. Connect a capacitor to GND. (2.2uF/10V typ.)
VSN	2	Negative output voltage. Connect a capacitor to GND. (2.2uF/10V typ.)
GND	3	Connect to GND.
CTRL_A	4	Control signal A, this signal should be low when no pumping.
CTRL_B	5	Control signal B, this signal should be low when no pumping.
VCI	6	Input supply voltage. Connect a capacitor to GND. (2.2uF/6.3V typ.)
C1P	7	Positive of the charge transfer capacitor 1.
C1N	8	Negative of the charge transfer capacitor 1. (1uF/10V typ.)
C2P	9	Positive of the charge transfer capacitor 2.
C2N	10	Negative of the charge transfer capacitor 2. (1uF/10V typ.)
C3P	11	Positive of the charge transfer capacitor 3.
C3N	12	Negative of the charge transfer capacitor 3. (1uF/10V typ.)
Thermal Pad	13	Exposed pad should be soldered to PCB or FPC board and connected to GND.

Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Value	Unit
Input Supply Voltage	V_{IN}	-0.3 ~ +6.5	V
Control Signals Input Voltage Range	V_{CTRL}	-0.3 ~ +6.5	V
Positive Output Voltage	VSP	+0.3 ~ +6.5	V
negative Output Voltage	VSN	-0.3 ~ -6.5	V
ESD Susceptibility in Human Body Model **(Note 2)**	HBM	2000	V
ESD Susceptibility in Machine Model	MM	200	V
Operating Ambient Temperature Range	T_A	-40 ~ +85	℃
Operating Junction Temperature Range	T_J	-40 to +125	℃
Storage Ambient Temperature Range	T_{ST}	-55 ~ +150	℃

Note 1: Stresses listed as the above “Absolute Maximum Ratings” may cause permanent damage to the device. These are for stress ratings. 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 remain possibility to affect device reliability.

Note 2: Devices are ESD sensitive. Handling precaution is recommended.

Recommended Operating Conditions (Note 3)

Parameter	Symbol	Value	Unit
Input Supply Voltage	V_{IN}	+2.3 ~ +4.0	V
Positive Output Voltage	VSP	+4.5 ~ +6.0	V
negative Output Voltage	VSN	-6.0 ~ -4.5	V
Input Supply Voltage for x1.5 Pump Mode		+3 ~ +4.0	V
Input Supply Voltage for x2 Pump Mode		+2.3 ~ +3.3	V
Input Supply Voltage for x3 Pump Mode		+2.3	V
Control Signals Input Voltage Range	V_{CTRL}	+2.3 ~ +4.0	V
Control Signals Pumping Clock Range	F_{OSC}	100 ~ 200	kHz
Operating Ambient Temperature Range	T_A	-40 to +85	℃
Operating Junction Temperature Range	T_J	-40 to +125	℃

Note 3: The device is not guaranteed to function outside its operating conditions.

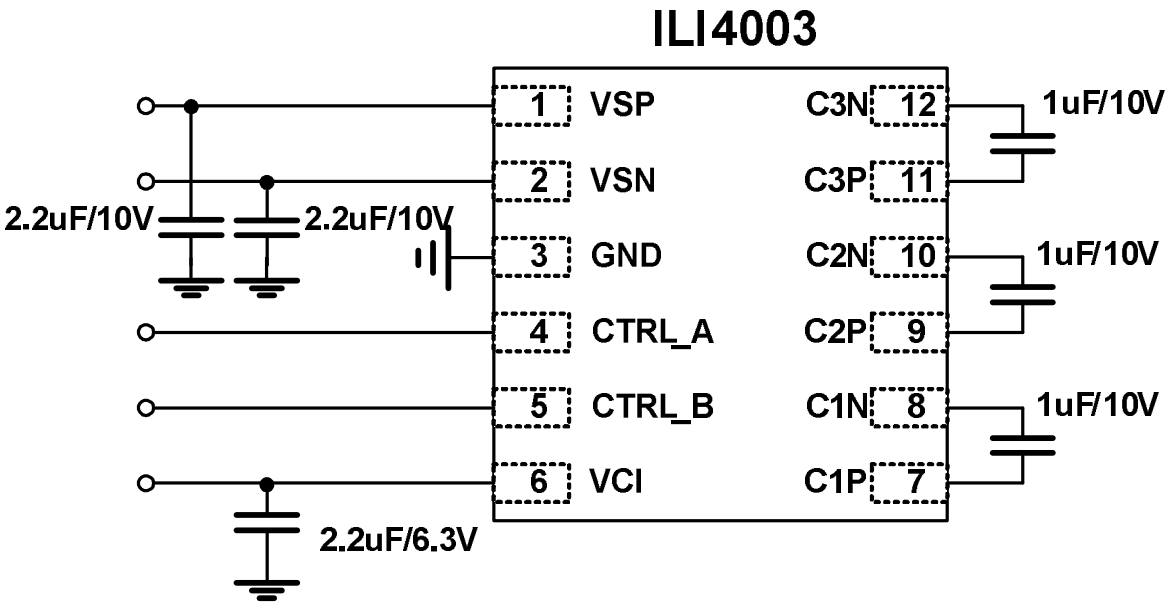
Electrical Characteristics

VCI=2.8V, x2 pump mode, VSP=5.4V, VSN=-5.2V, Ivsp=Ivsn=10mA, Fosc=200kHz, duty cycle=50%, T_A=25°C, unless otherwise specified. Please refer to typical application circuit.

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Input Power Supply						
Input Voltage Range	V_{IN}		2.3	2.8	4.0	V
Input Quiescent Current	I_Q	VCI=2.3V, sleep mode CTRL_A=Low, CTRL_B=Low	--	--	1	uA
		VCI=2.8V, sleep mode CTRL_A=Low, CTRL_B=Low	--	--	1	uA
		VCI=3.8V, sleep mode CTRL_A=Low, CTRL_B=Low	--	--	1	uA
		VCI=2.3V, x3 mode, no load CTRL_A=Fosc, CTRL_B=High	--	--	1	mA
		VCI=2.8V, x2 mode, no load CTRL_A=High, CTRL_B=Fosc	--	--	1	mA
		VCI=3.8V, x1.5 mode, no load CTRL_A=Fosc, CTRL_B=Fosc	--	--	1	mA
Positive Charge Pump						
Positive Output Voltage Range and Input Voltage Range in x1.5/x2/x3 Pump Mode	VSP	VCI=2.3V,x3 mode, Ivsp=0mA,Ivsn=0mA, CTRL_A=pumping clock, CTRL_B=High	4.5	--	6.0	V
		VCI=2.3V to 3.3V,x2 mode, Ivsp=0mA,Ivsn=0mA, CTRL_A=High, CTRL_B=pumping clock	4.5	--	6.0	V
		VCI=3V to 4.0V,x1.5 mode, Ivsp=0mA,Ivsn=0mA, CTRL_A=pumping clock, CTRL_B=pumping clock	4.5	--	6.0	V

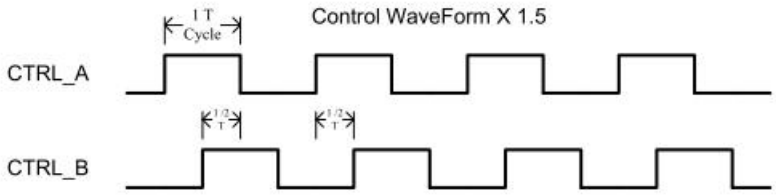
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Negative Charge Pump						
Negative Output Voltage Range and Input Voltage Range in x1.5/x2/x3 Pump Mode	VSN	VCI=2.3V,x3 mode, Ivsp=0mA,Ivsn=0mA, CTRL_A=pumping clock, CTRL_B=High	-6.0	--	-4.5	V
		VCI=2.3V to 3.3V,x2 mode, Ivsp=0mA,Ivsn=0mA, CTRL_A=High, CTRL_B=pumping clock	-6.0	--	-4.5	V
		VCI=3V to 4.0V,x1.5 mode, Ivsp=0mA,Ivsn=0mA, CTRL_A=pumping clock, CTRL_B=pumping clock	-6.0	--	-4.5	V
Control and Protection						
CTRL_A and CTRL_B input Threshold	V_{IH}	VCI=2.3V to 4.0V	0.8 *VCI	--	--	V
	V_{IL}	VCI=2.3V to 4.0V	--	--	0.2 *VCI	V
Soft-Start Period	T_{SS}	VCI=2.8V,x2 mode, Ivsp=0mA,Ivsn=0mA, CTRL_A=High, CTRL_B=pumping clock	--	1.28	--	ms
Input Current Limit	I_{LIMIT}	VCI=2.8V,x2 mode, CTRL_A=High, CTRL_B=pumping clock	--	1	--	A

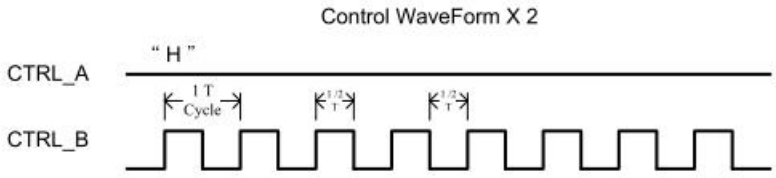
Typical Application Circuit

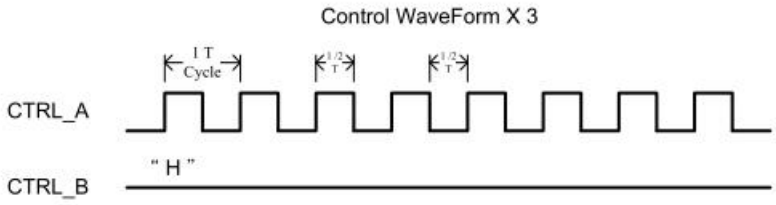


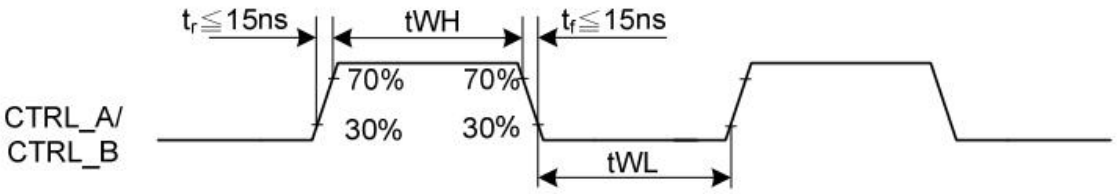
Application Information

Control Signal Timing Definition for Pump Mode Selection





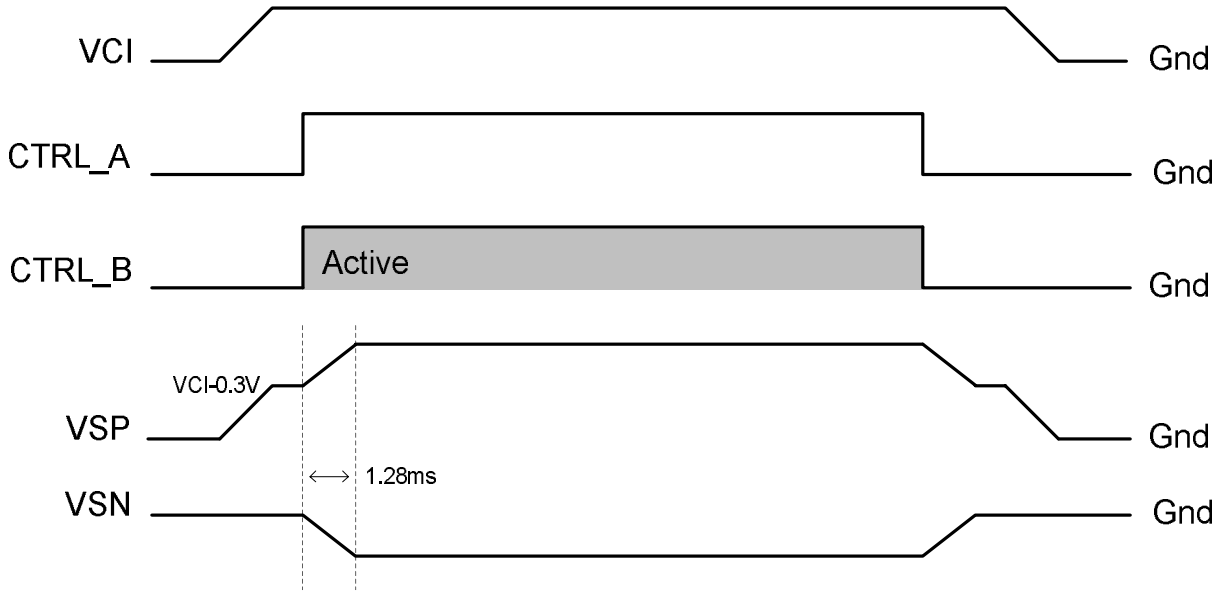




Parameter	Symbol	Specification			Unit
		Min.	Typ.	Max.	
Rising time	t_r	-	-	15	ns
Falling time	t_f	-	-	15	ns
High pulse width	t_{WH}	0.5	-	5	μs
Low pulse width	t_{WL}	0.5	-	5	μs

Note: VIN = 2.8V, T_A = -30 ~ +70℃

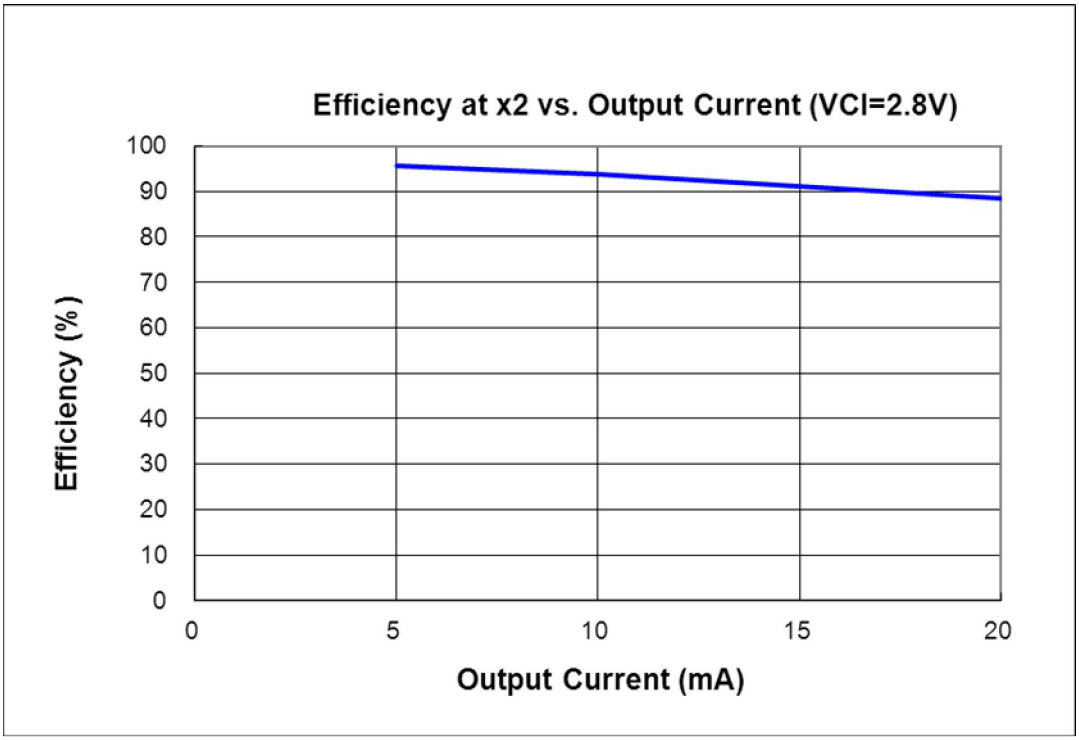
Timing Diagram



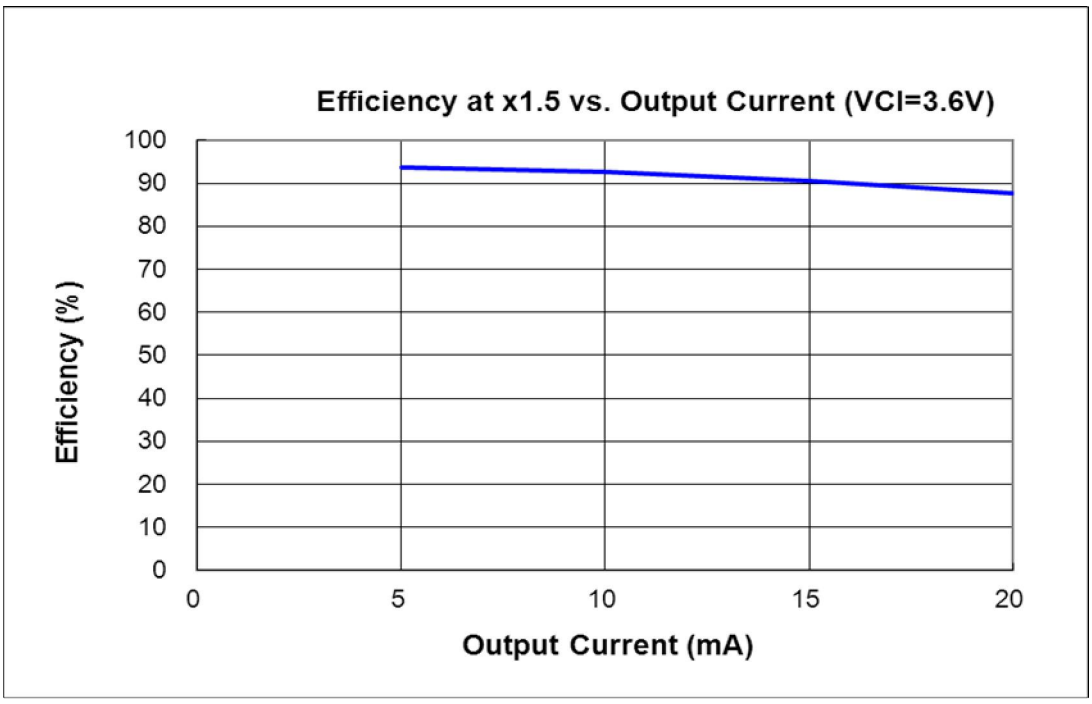
Typical Operating Characteristic

Power Conversion Efficiency

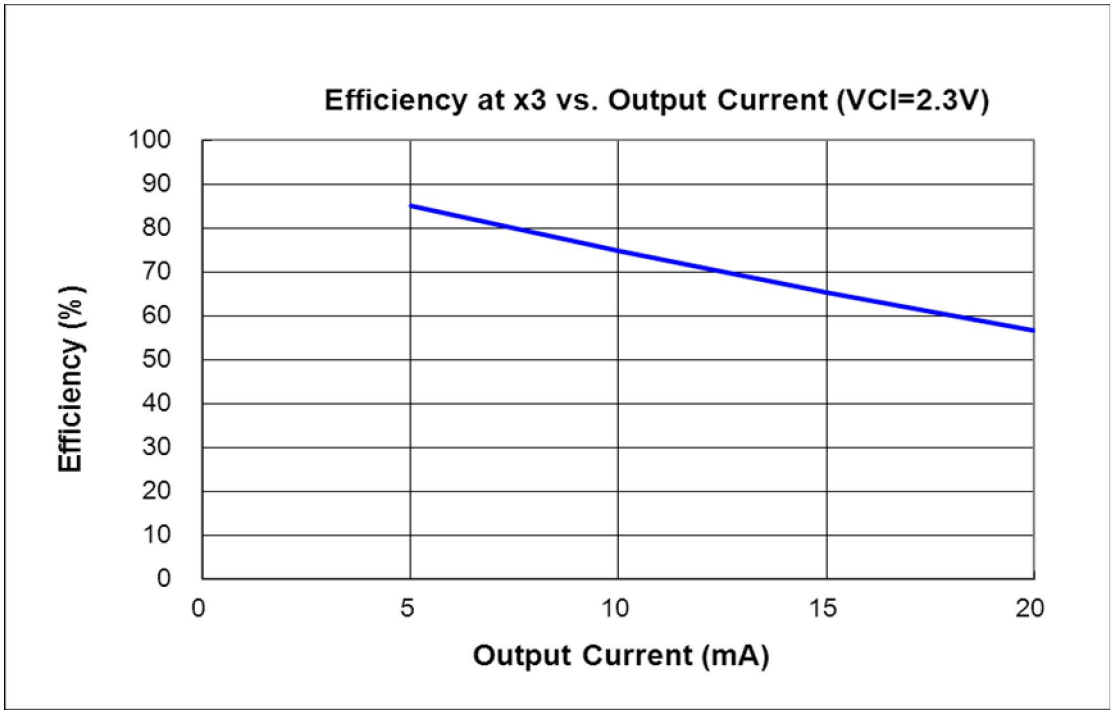
Note: VCI=2.8V,x2 mode, Ivsp=Ivsn=5mA to 20mA, CTRL_A=High, CTRL_B=pumping clock



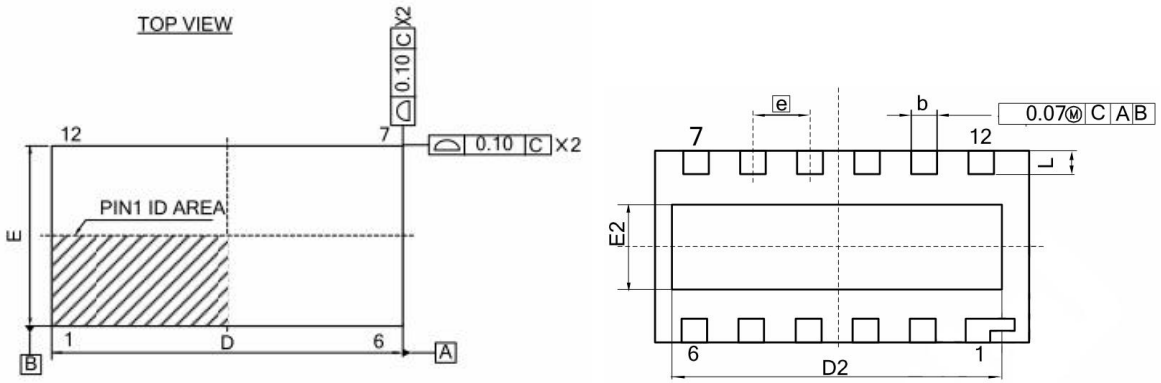
Note: VCI=3.6V,x1.5 mode, Ivsp= Ivsn=5mA to 20mA, CTRL_A=pumping clock, CTRL_B=pumping clock

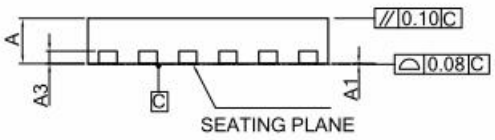


Note: VCI=2.3V,x3 mode, Ivsp=Ivsn=5mA to 20mA, CTRL_A=pumping clock, CTRL_B=High



Outline Dimension





NOTES:
1.CONTROLLING DIMENSION : MILLIMETERS.

SYMBOL	DIMENSION(MM)			DIMENSION(MIL)		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.40	0.45	0.50	15.7	17.7	19.7
A1	0.00	0.02	0.05	0	0.8	2
A3		0.203 REF			8 REF	
b	0.15	0.20	0.25	5.9	7.8	9.8
D	2.90	3.00	3.10	114.2	118.1	122.0
D2	2.75	2.80	2.85	108.3	110.2	112.2
E	1.40	1.50	1.60	55.1	59.0	63.0
E2	0.65	0.70	0.75	25.6	27.5	29.5
e		0.45 BSC			17.7 BSC	
L	0.15	0.20	0.25	5.9	7.9	9.8

Revision History

Version No.	Date	Page	Description
090	2012/11/01		New Format Create
091	2012/12/24		1. Modify VCI voltage from 4.8V to 4V. 2. Modify Electrical Characteristics. 3. Add Typical Operating Characteristic for power conversion efficiency. 4. Modify pin assignment.