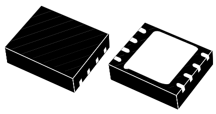
STOD2540

PMOLED display power supply

Feature summary

- Inductor switcher boost controller.
- PFM mode control.
- High efficiency over wide range of load (1mA to 40mA).
- Integrated Load disconnect switch.
- Over voltage protection with automatic restart
- Soft start with adjustable peak current limit
- Enable pin
- Low shutdown current.
- Small external inductor.
- Supply voltage from 3.0V to 5.5V



QFN8 (3mm x 3mm)

Application

- PMOLED display driver

Description

STOD2540 is dedicated to Passive Matrix OLED (PMOLED) display for portable handset and is used to provide the precharge and biasing voltage of the column matrix driver as shown on the Fig.3.

The current capability of STOD2540 allows feeding a 1", 1.3" or 1.5" color PMOLED.

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STOD2540 is a boost converter that operates from 3.0V to 5.5V and can provide an output voltage as high as 25V. The output current capability is maximum 40mA up to 25V output voltage. The regulation is done by sensing the output voltage through a resistor divider network as shown on the *Figure 3.*

In state of the art boost converter, a DC current path exists between the battery source and the load. In order to reduce the consumption in shutdown mode a high side load isolation switch is necessary to cut this DC current path in stand by mode. The Load Disconnect Switch (LDS) acts as an isolation switch in shutdown mode.

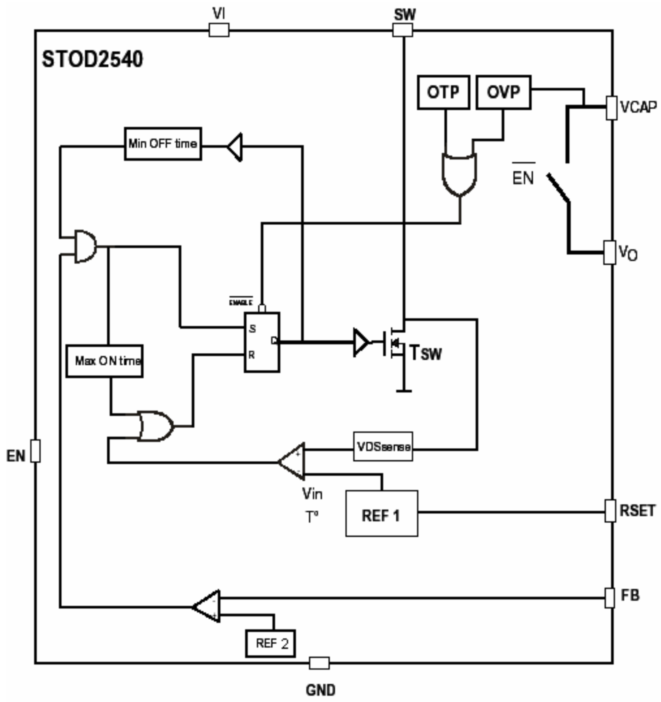
Order codes

Part number	Package	Comments
STOD2540PMR	QFN8 (3mm x 3mm)	4500 parts per reel

Contents

1 Schematic diagram

Figure 1. Block diagram



2 Pin configuration

Figure 2. Pin connections (top view)

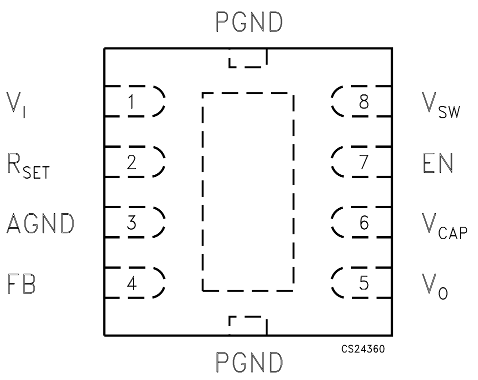


Table 1. Pin description

PIN N°	SYMBOL	NOTE
1	V_I	Supply voltage
2	RSET	Peak inductor current adjust
3	AGND	Analog Ground
4	FB	Feedback for the LED current regulation
5	V_O	Output voltage for LED supply
6	VCAP	Load Disconnect Switch input
7	ENABLE	IC enable signal
8	VSW	Boost switch drain
9	PGND	Power Ground

3 Maximum ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
VB_{SW}, VB_O	Breakdown voltage at OUT and SW pin	40	V
V_I	Supply voltage range	6	V
R_{SET}	R_{SET} pin	V_I + 0.3	V
EN	Enable pin	V_I + 0.3	V
V_{ESD}	ESD ratings, HBM MIL STD 883C	2	kV
T_{STG}	Storage Temperature Range	-65 to 150	°C
T_{OP}	Operating Junction Temperature Range	-40 to 85	°C

Table 3. Thermal Data

Symbol	Parameter	Value	Unit
R_{thJA}	Thermal Resistance Junction-Ambient	52	°C/W

4 Electrical characteristics

Table 4. Electrical characteristics
(T_J = 40°C to 85°C, V_I = 3.6V, V_{EN} = 3V, C_I = C_O = 4.7µF, L = 4.7µH, R_1 = 180kΩ, R_2 = 10kΩ, V_O = 24V, Typ. values @ 25°C, unless otherwise specified).

Symbol	Parameter	Test	Min.	Typ.	Max.	Unit
V_I	Input voltage range		3.0		5.5	V
V_O	Regulated output voltage	V_I = 3V to 5.5V	V_I + 0.5	25	35	V
V_{OVP}	Over voltage protection on output		35			V
I_O	Continuous output current	V_O = 25V	1		40	mA
I_{SD}	Stand-by current	V_{EN} = Low, V_I = 3.6V			3	µA
		V_{EN} = Low, V_I = 3V to 4.2V			10	
I_Q	Quiescent current consumption	V_I = 3V to 4.2V @ 25°C		0.4	0.8	mA
		V_I = 5.5V @ 25°C		0.8	1.2	
$R_{DSON\text{-}SW}$	Boost switch R_{DSON} Note: 1	V_I = 4.2V, I_{SW} = 100mA		0.4		Ω
	BVDS Breakdown voltage		40			V
R_{DSON}-LDS	R_{DSON} Note: 1	V_O = 25V, I_O = 30mA		2		Ω
	BVDS Breakdown voltage		40			V
$I_{LIM\text{-}ADJ}$	Peak inductor limit range Note: 1	R_{SET} = 2kΩ to 100kΩ	0.1		1.5	A
$I_{LIM\text{-}MAX}$	Maximum peak inductor current Note: 1	V_I = 3V to 5.5V, R_{SET} = V_I	0.75		1.2	A
FB	Feedback voltage	5% @ 25°C	1.18	1.24	1.30	V
T_{ON_MAX}	Maximum ON Time	V_I = 4.2V		5.5		µs
T_{OFF_MIN}	Minimum OFF Time	V_I = 4.2V		300		ns
Eff	Efficiency, V_I = 3.6V Note: 1	I_O = 1 mA to 5mA	65			%
		I_O = 5 mA to 40mA	70			
	Efficiency, V_I =4.2V Note: 1	I_O = 1 mA to 5mA	65			
		I_O = 5 mA to 40mA	70			
Ripple	Output ripple and noise	V_I = 3.6V, I_O = 5 mA, V_O = 24V		1.3		%
		V_I = 3.6V, I_O = 30 mA, V_O = 24V		1.3		
		V_I = 3.6V, I_O = 5 mA, V_O = 24V		1.3		
		V_I = 3.6V, I_O = 30 mA, V_O = 24V		1.3		
OV_{HYST}	Overvoltage hysteresis			2		V

Table 4. Electrical characteristics
(T_J = 40°C to 85°C, V_I = 3.6V, V_{EN} = 3V, C_I = C_O = 4.7µF, L = 4.7µH, R_1 = 180kΩ, R_2 = 10kΩ, V_O = 24V, Typ. values @ 25°C, unless otherwise specified).

Symbol	Parameter	Test	Min.	Typ.	Max.	Unit
V_{EN}	Enable input logic low	Disable Low V_{IL}			0.3	V
	Enable input logic high	Enable High V_{IH}	1.2			
Line_V_{FB}	Line regulation V_{FB}	V_I = 3V to 5.5V, I_O = 5 mA		5	35	mV
Load_V_{FB}	Line regulation V_{FB}	V_I = 3V to 5.5V, I_O = 5 mA		5	35	mV

Note: 1 Guaranteed by design.

5 Functional description

5.1 Boost controller

STOD2540 is a Boost converter operating in PFM (pulsed frequency modulation) mode. The converter monitors the output voltage through the bridge resistor divider R_1 and R_2 and when the feedback voltage falls below the reference voltage, REF2, the boost switch T_{SW} turns ON and the current ramps up. The inductor current is measured by sensing the temperature compensated drain voltage of the boost MOSFET. The boost turns off when its drain voltage reaches the internally reference REF1, the main switch remains off until the minimum off time (300ns typical) has passed and the feedback voltage is below the reference again. A maximum ON time of 4µs prevent the switch T_{SW} to stay ON during a too long period of time.

In order to well calculate the bridge resistors values with a fixed V_O, the following formula can be used:

$$\frac{Vout}{1{,}24} - 1 = \frac{R_1}{R_2}$$

5.2 Adjustable peak inductor current limit

The peak inductor current is monitored by sensing the drain voltage of the switch T_{SW}.

Since it exceeds the temperature compensated and supply voltage compensated reference REF1, the RS Flip flop is reset and T_{SW} is turned OFF.

By connecting a resistance between the pin RSET and GND, the peak current limit can be adjusted from 200mA to 1.5A (R_{SET} from 2kΩ to 100kΩ). When the pin R_{SET} is directly connected to V_I, the default value is 1A.

5.3 Enable

The ENABLE pin is a high logic input signal and allows turning on/off the controller without cutting the input voltage from the boost regulator circuit. With a high input voltage (1.2V $<V_{EN}< V_I+0.3V$) on this pin, the device is allowed to work normally. No pull-up or pull down is present on this pin.

5.4 OVP

If the regulation loop is cut, there is no signal at the feedback pin, the PFM controller will then continue to switch without control and generate an output voltage at the SW, V_{CAP} and V_O pin exceeding the breakdown value V_{BSW}, V_{BCAP} and V_{BO}.

The Over Voltage Protection (OVP) senses the voltage at the V_{CAP} pin.When the voltage exceed the breakdown voltage of the device the controller is automatically turned Off.

A hysteresis control allows the device restarting automatically since the output voltage drops down below a 2V typical value.

5.5 Load isolation switch

When the device is in shutdown mode it exists always a DC current path from the power source to the load that contributes to increase the stand by consumption. A high side switch LDS isolates the load from the source when the STOD2540 is disabled.

5.6 Efficiency

The total consumption of some PMOLED display can be as low as 1mA. In order to increase the battery run time of the device, STOD2540 offers a high efficiency over a wide range of load and input voltage range.

6 Typical application

Figure 3. Basic Connection

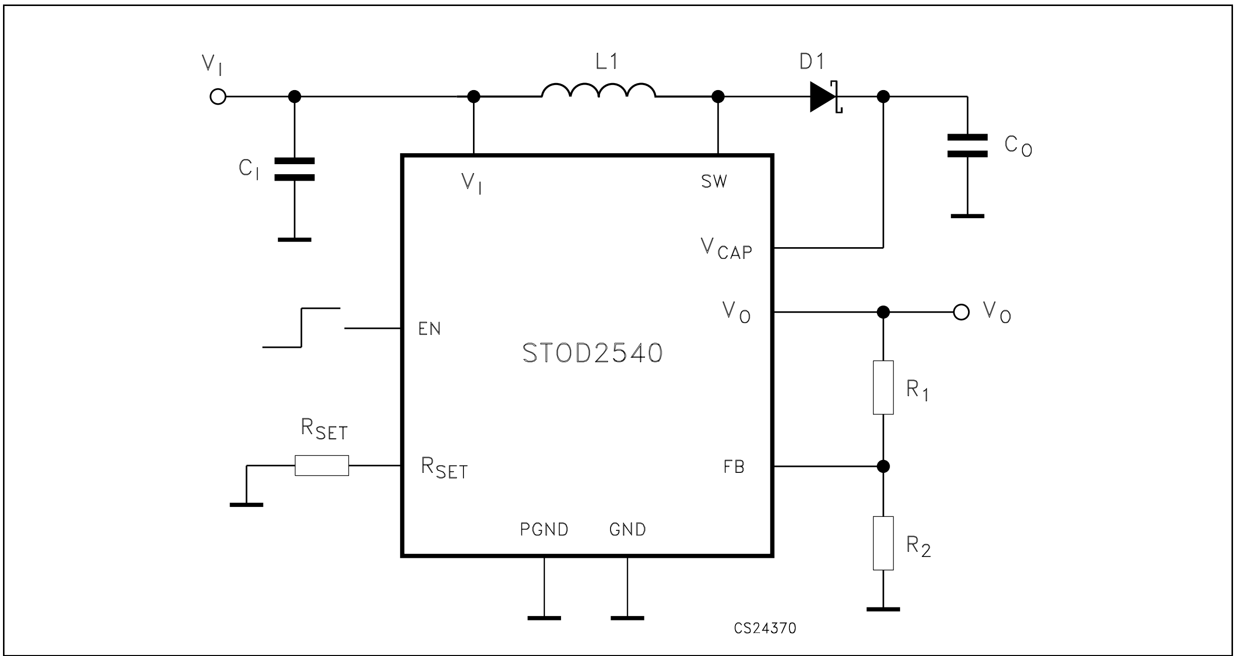


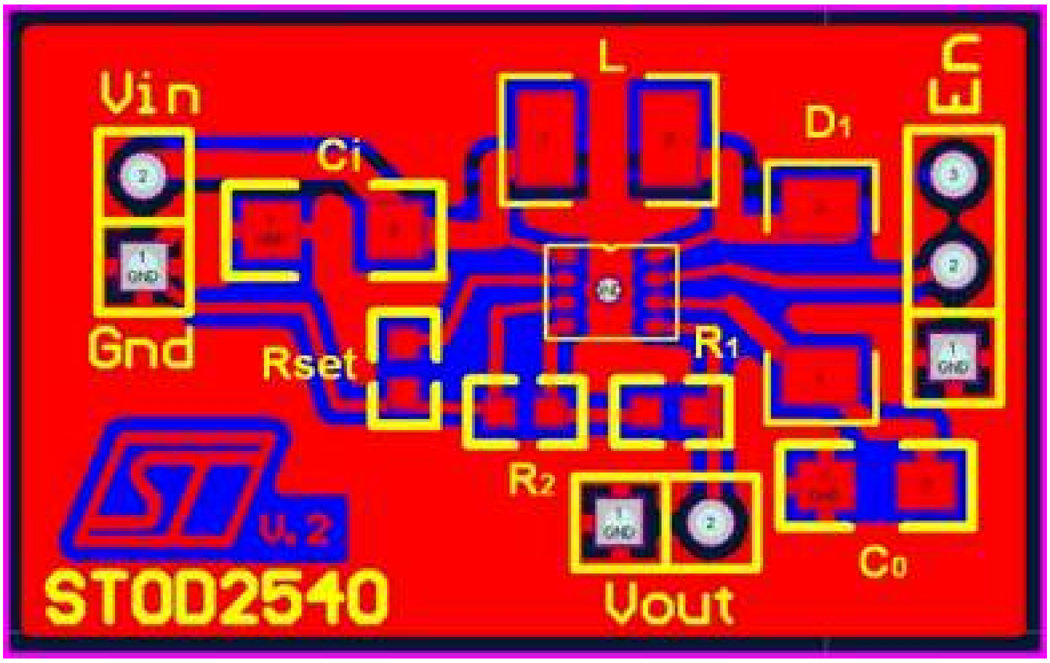
Table 5. External components (see fig. 3 and note)

Symbol	Parameter	Test	Min.	Typ.	Max.	Unit
D	Boost schottky diode	VRRM	30			V
		V_F at I_F = 300mA, T_J = 25°C			0.5	V
		I_R at V_R = 10V, T_J = 25°C			30	µA
R_1	Feedback resistor			180		kΩ
R_2	Feedback resistor			10		
R_{SET}	Peak current limit adjust	I_{PK} = 100mA to 1.5A	2		100	
C_I	Input ceramic type low ESR	Ceramic Type		4.7		µF
C_O	Output capacitance: ceramic low ESR	Capacitance	4.7			µF
		Voltage	42			V
		ESR			1.6	Ω
L	Boost inductor (height < 2mm)	Inductance			4.7	µH
		I_{SAT}, R_{SET} pin to V_I			1	A

Note: The external components proposal should be considered as a design reference guide. The performances mentioned in the electrical characteristics table are not guaranteed for all the possible electrical parameters of the components included in this list. On other hand the operation of STOD2540 is not limited with the use of components included in this list.

6.1 Demoboard

Figure 4. Suggested demoboard schematic (Top layer view)



7 Typical performance characteristics

(T_J = 40°C to 85°C, V_I = 3.6V, V_{EN} = 3V, C_I = C_O = 4.7µF, L = 4.7µH, R_1 = 180kΩ, R_2 = 10kΩ, V_O = 24V, Typ. values @ 25°C, unless otherwise specified)

Figure 5. Efficiency vs output current

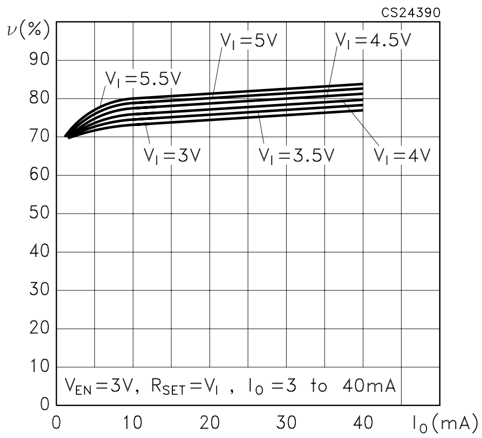


Figure 6. Efficiency vs input voltage

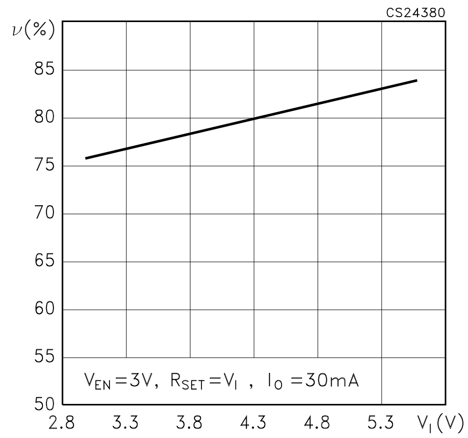


Figure 7. V_{EN} vs temperature

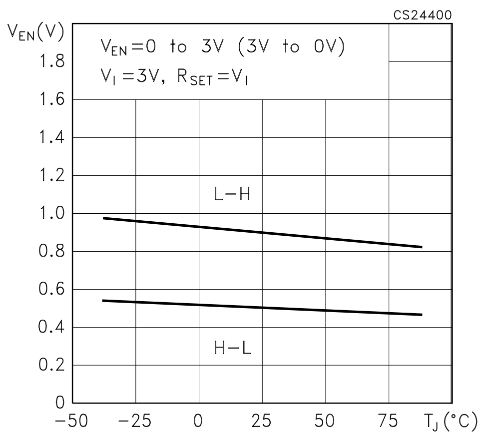


Figure 8. V_{FB} vs input voltage

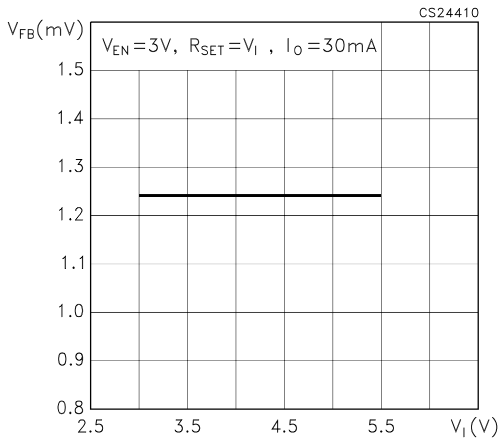


Figure 9. V_{FB} vs output current

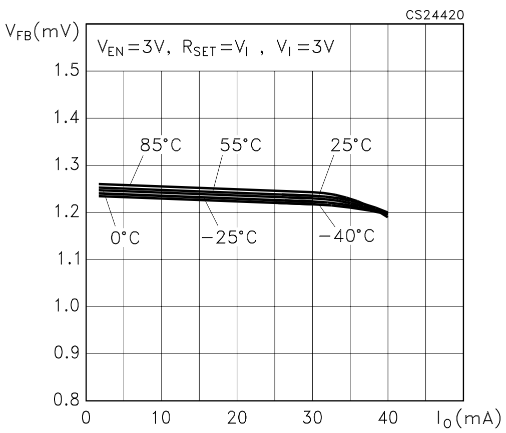


Figure 10. V_{FB} vs output current

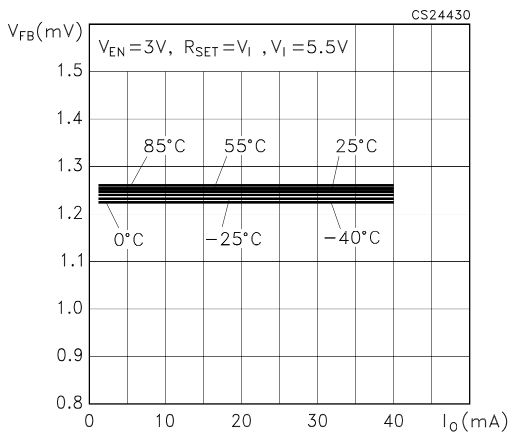


Figure 11. V_{OVP} vs temperature

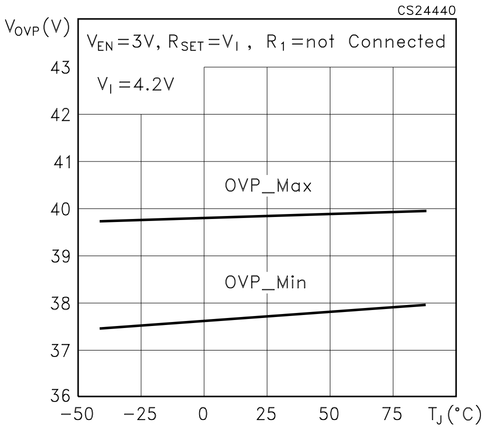


Figure 12. V_{RIPPLE} vs input voltage

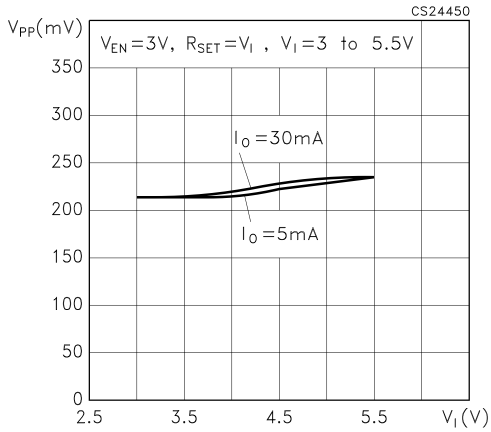


Figure 13. I_{LIM_MAX} vs input voltage

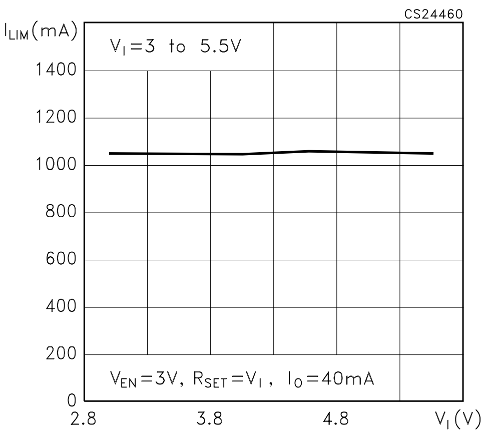


Figure 14. I_{LIM_MAX} vs temperature

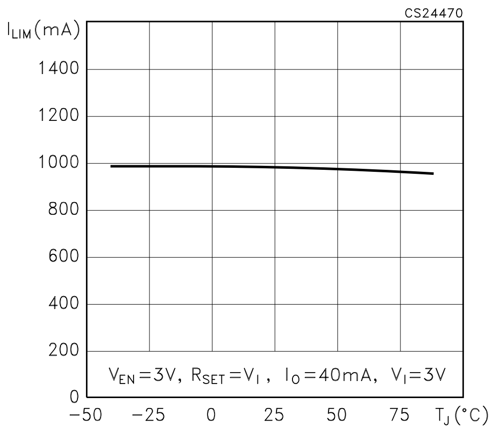


Figure 15. I_{LIM_MAX} vs R_{SET}

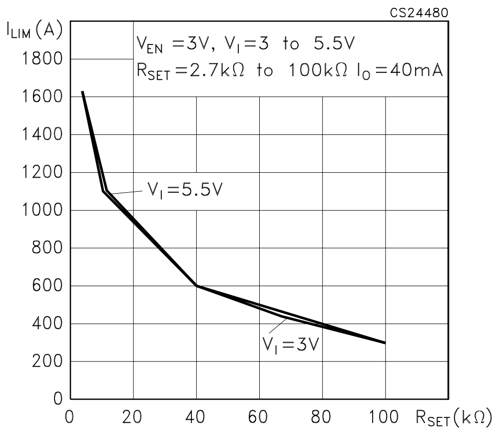


Figure 16. I_Q vs temperature

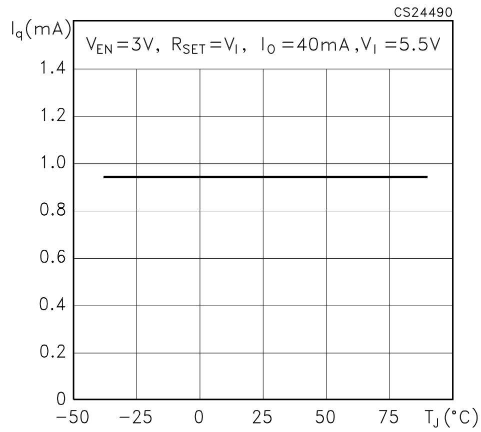


Figure 17. T_{ON_MAX} vs temperature

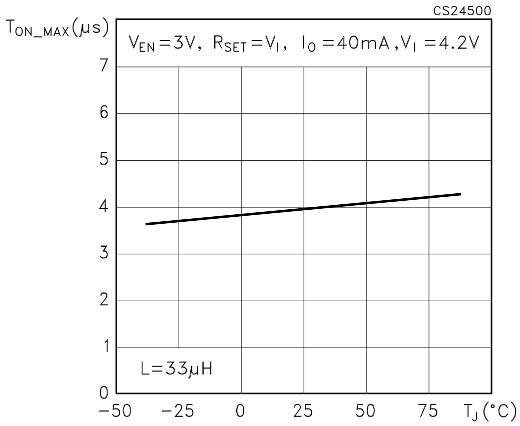


Figure 18. T_{OFF_MIN} vs temperature

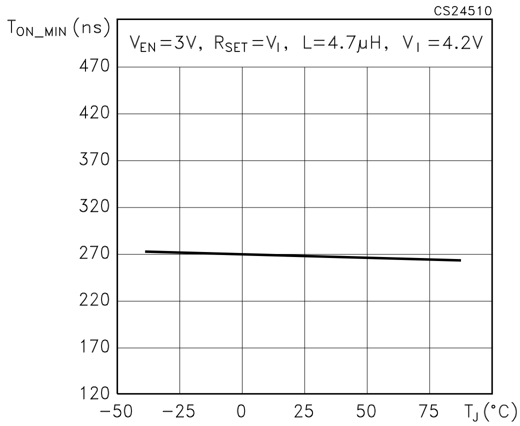


Figure 19. Line V_{FB} vs temperature

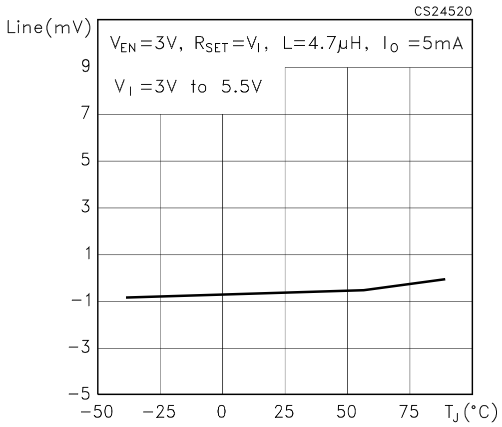
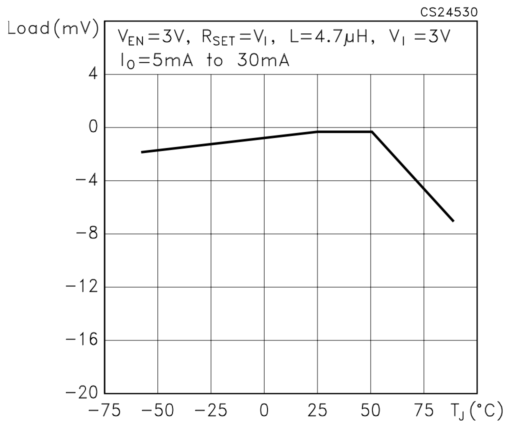


Figure 20. Load V_{FB} vs temperature

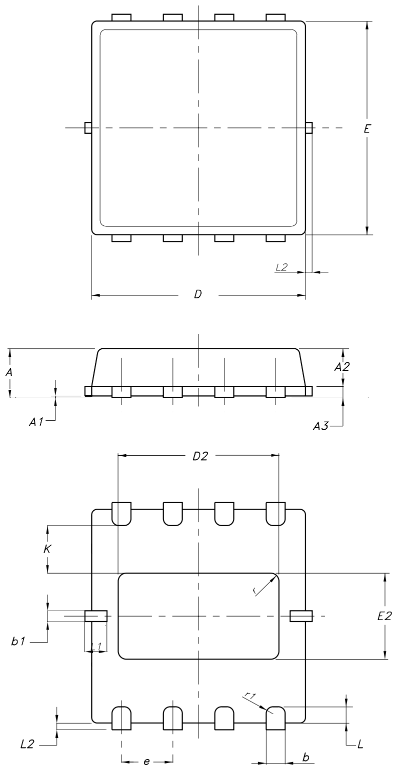


8 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second Level Interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com.

QFN8 (3x3) MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	0.80	0.90	1.00	0.032	0.035	0.039
A1		0.03	0.05		0.001	0.002
A2	0.65	0.70	0.75	0.026	0.028	0.030
A3	0.15	0.20	0.25	0.006	0.008	0.010
b	0.29	0.31	0.39	0.011	0.012	0.015
b1	0.17		0.30	0.007		0.012
D		3.00			0.118	
D2	1.92	2.02	2.12	0.076	0.080	0.084
E		3.00			0.118	
E2	1.11	1.21	1.31	0.044	0.048	0.052
e		0.65			0.026	
K	0.20			0.008		
L	0.20	0.29	0.45	0.008	0.011	0.018
L1	0.16	0.24	0.40	0.006	0.009	0.016
L2			0.13			0.005
r		0.15			0.006	
r1		0.15			0.006	



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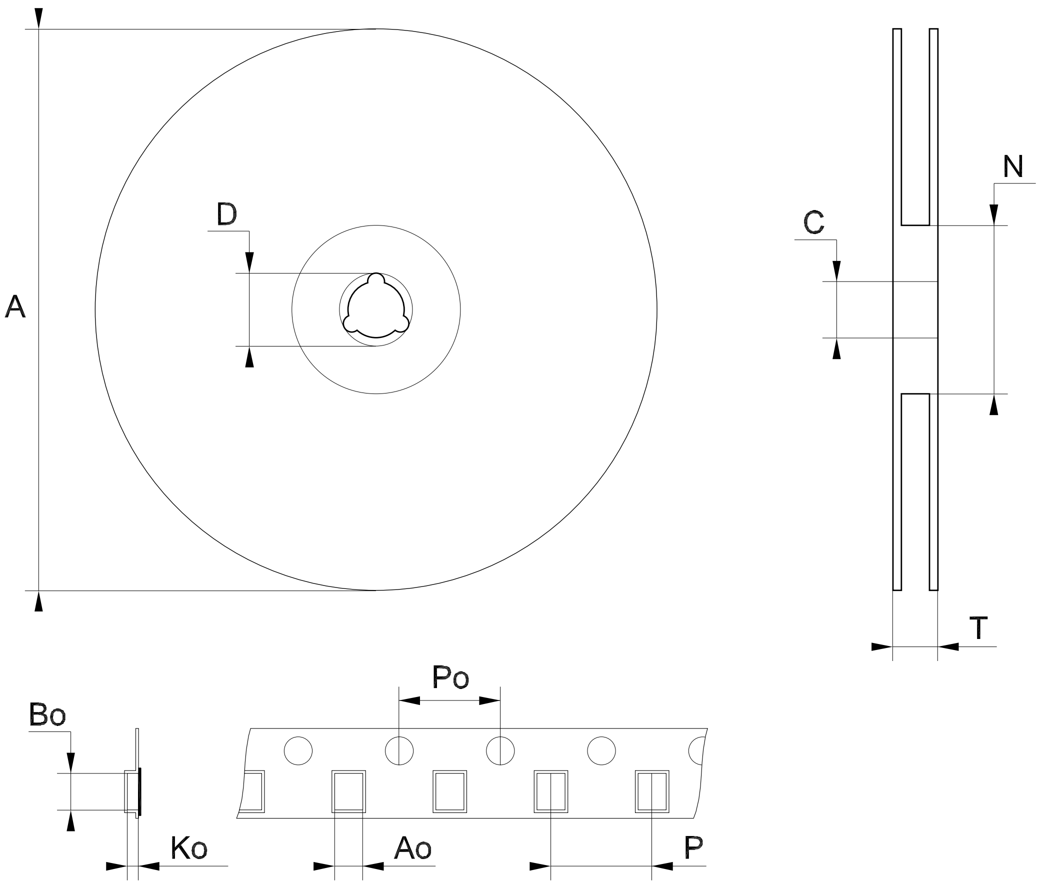
Tape & Reel QFNxx/DFNxx (3x3) MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			18.4			0.724
Ao		3.3			0.130	
Bo		3.3			0.130	
Ko		1.1			0.043	
Po		4			0.157	
P		8			0.315	



Note: Drawing not in scale

9 Revision history

Table 6. Document revision history

Date	Revision	Changes
22-Mar-2006	1	Initial release.
03-Apr-2006	2	Add fig. 2 demoboard on page 3.

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