

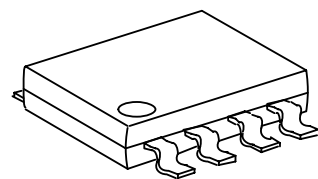
## 1 CHANNEL SYNCHRONOUS PWM CONTROL IC

### GENERAL DESCRIPTION

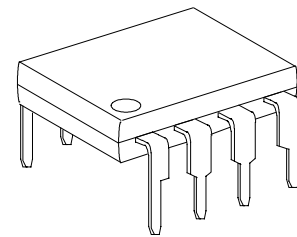
The **FP5137A** is a synchronous buck switching regulator control IC for DC-DC applications field. The **FP5137A** includes a totem-pole high/low side stage for driving NMOS, high precision reference (0.8V) for comparing output voltage with feedback amplifier, an internal **400KHz** oscillator and programmable soft start function.

### FEATURES

- Feedback Reference Voltage: 0.8V (2%)
- Peak Output Source/Drive Capability: 500mA
- Internal 400KHz Oscillator
- Programmable Soft Start function (SS)
- Short Circuit Protection function(SCP)
- Internal UVLO function
- Package: PDIP8/SOP8/SOP8(EP)



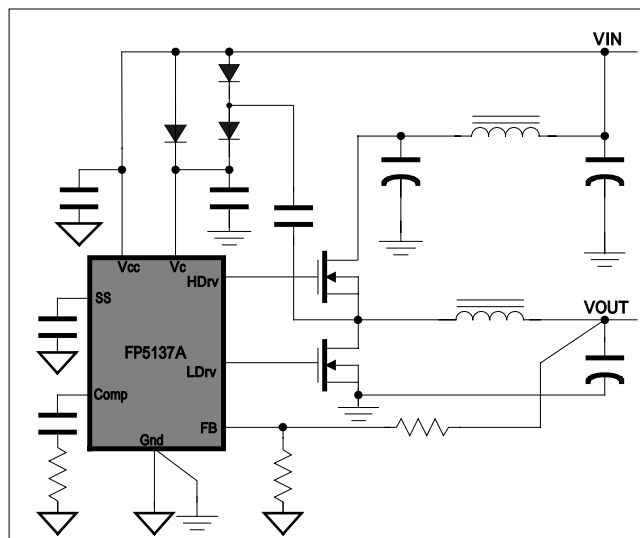
SOP8



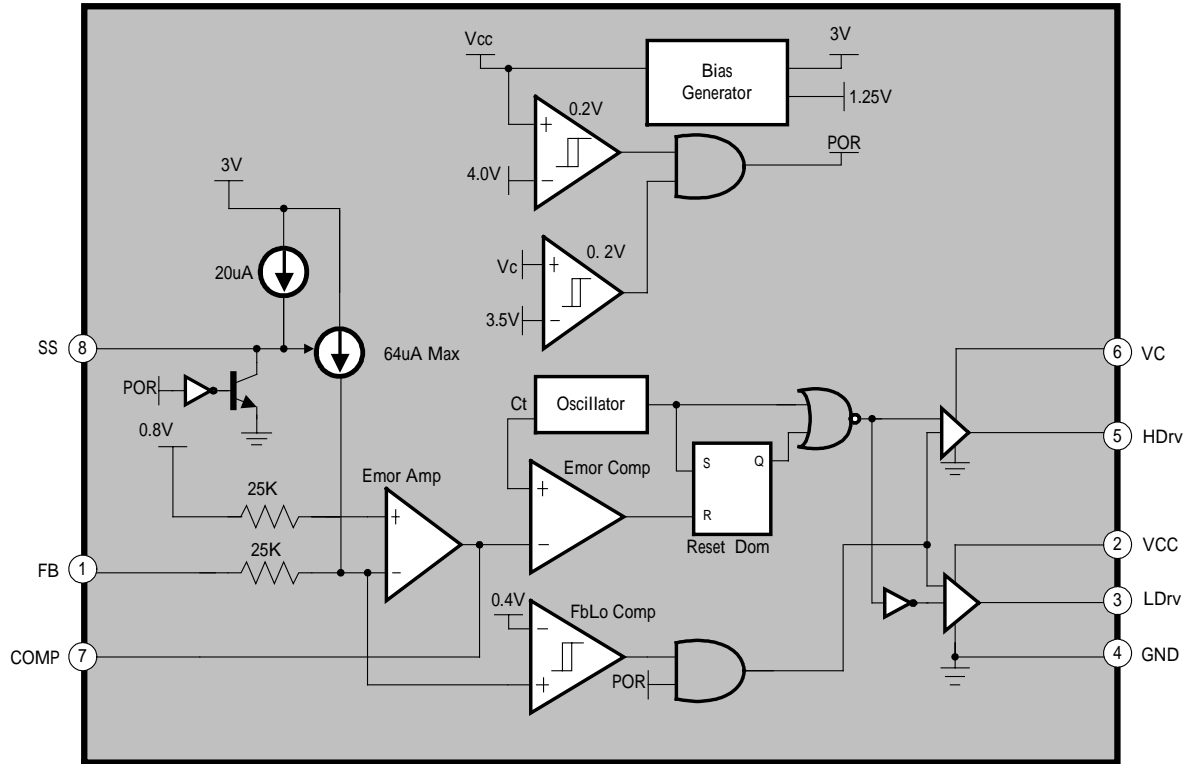
PDIP8

### TYPICAL APPLICATION

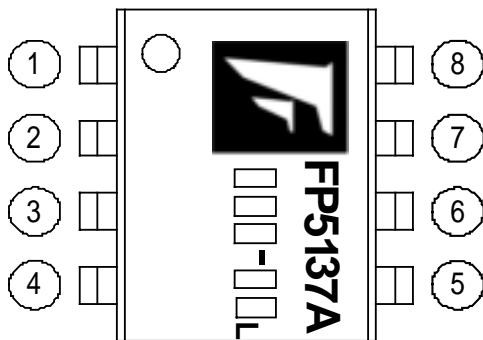
- VGA Card
- High Efficiency DC-DC Converter
- Battery Charger



## FUNCTIONAL BLOCK DIAGRAM



### MARK VIEW



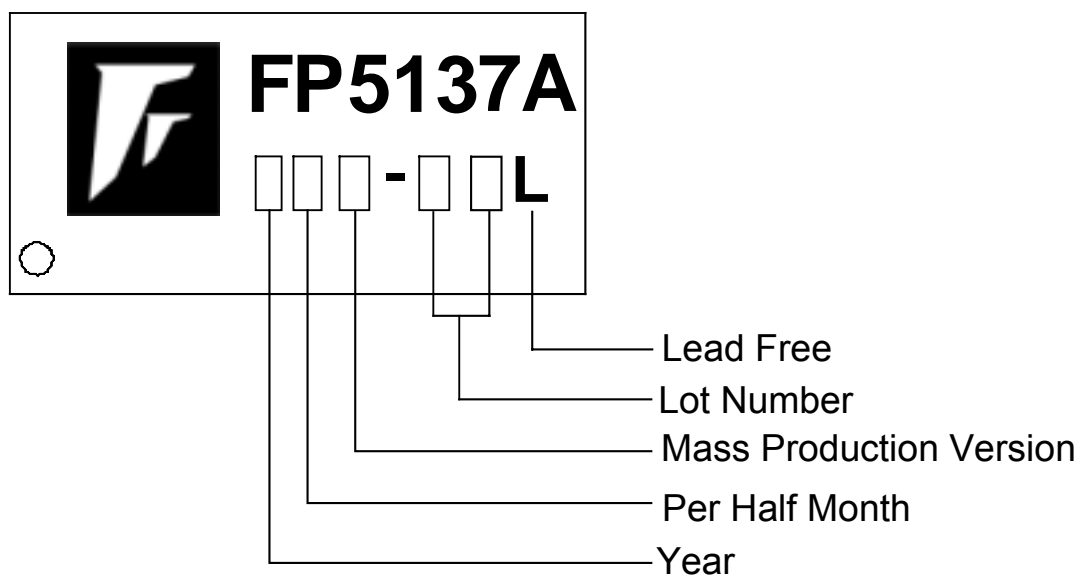
### PIN DESCRIPTION

Name	No.	I/O	Description
FB	1	I	Error amplifier inverting input pin
V <sub>CC</sub>	2	P	IC power supply
LDRV	3	O	Low Side NMOS Driver
GND	4	P	IC ground
HDRV	5	O	High Side NMOS Driver
V <sub>C</sub>	6	P	A supply voltage for High Side Driver
COMP	7	O	Error amplifier compensation output
SS	8	I	To connect a capacitor for Soft-start

## ORDER INFORMATION

Part Number	Operating Temperature	Package	Description
FP5137AP-LF	-10°C ~ +85°C	PDIP8	Tube
FP5137AD-LF	-10°C ~ +85°C	SOP8	Tube
FP5137ADR-LF	-10°C ~ +85°C	SOP8	Tape & Reel
FP5137AX-LF	-10°C ~ +85°C	SOP8	Tube
FP5137AXR-LF	-10°C ~ +85°C	SOP8	Tape & Reel

## IC DATE CODE DISTINGUISH



### FOR EXAMPLE:

January            A (Front Half Month), B (Last Half Month)  
 February         C, D  
 March             E, F            -----And so on

Lot Number is the last two numbers

### For Example:

A3311C<sup>62</sup>  
 ↳ Lot Number

## ABSOLUTE MAXIMUM RATINGS

Power supply voltage ( $V_{CC}$ )	-----	+25V
Power supply voltage ( $V_C$ )	-----	+30V
Output source current	-----	500mA
Output sink current	-----	+500mA
Junction Temperature ( $T_j$ )	-----	+150
Allowable dissipation		
PDIP8 Ta +25	-----	800mW
SOP8 Ta +25	-----	650mW
SOP8-EXPOSED PAD Ta +25	-----	600mW

## Thermal Resistance

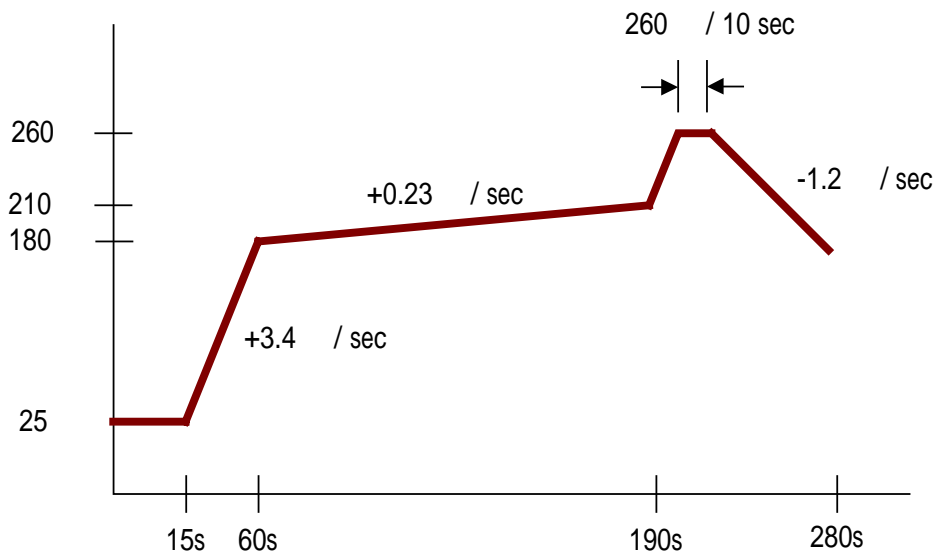
### SOP8

$T_{JA}$	-----	130 $^{\circ}C/W$
$T_{JC}$	-----	38.8 $^{\circ}C/W$

### SOP8(EP)

$T_{JA}$	-----	120 $^{\circ}C/W$
$T_{JC}$	-----	38.8 $^{\circ}C/W$

Operating temperature	-----	-10    +85
Storage temperature	-----	-55    +125
Operating Junction Temperature Range	-----	+0 $^{\circ}C$ 125 $^{\circ}C$
PDIP8 Lead Temperature (soldering, 20 sec)	-----	+260
SOP8 Lead Temperature (soldering, 10 sec)	-----	+260



**Lead Free Soldering Curve**

**DC ELECTRICAL CHARACTERISTICS**( $T_a=25$  , $V_{CC}=+5V$ ,  $V_C=+12V$ , unless otherwise noted)

**Under Voltage Lock-Out section (U.V.L.O.)**

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
UVLO threshold voltage	$V_{CC(UVLO)}$	Sweep up $V_{CC}$	4.0	4.2	4.4	V
Hysteresis voltage	$V_{CC(HYS)}$			0.25		V
UVLO threshold voltage	$V_C(UVLO)$	Sweep up $V_C$	3.1	3.3	3.5	V
Hysteresis voltage	$V_C(HYS)$			0.25		V
UVLO threshold voltage	$V_{FB(UVLO)}$	Sweep down FB	0.3	0.4	0.5	V
Hysteresis voltage	$V_{FB(HYS)}$			0.1		V

**Soft Start section (S.S.)**

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input source current	$I_{SS}$	$V_{SS}=0V$	-10	-20	-30	$\mu A$

**Oscillator section**

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Oscillation frequency	f			400		KHz
Frequency change with voltage	$\Delta f / \Delta V$	$V_{CC}=5V$ to $25V$		2	10	%
Frequency change with temperature	$\Delta f / \Delta T$	$T_a = -10$ to $85$		5		%

**Period Adjustment section**

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Maximum duty cycle	$T_{DUTY(ON)}$	$V_{FB}=1.0V$	85	90	95	%
Minimum duty cycle	$T_{DUTY(OFF)}$	$V_{FB}=1.5V$	0	0		%

## DC ELECTRICAL CHARACTERISTICS (Cont.)

### Total Device section

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Dynamic $V_{CC}$ supply current	$I_{CC(DYN)}$	$C_L=1500pF$	2	5	8	mA
Static $V_{CC}$ supply current	$I_{CCQ}$	$V_{SS}=0V$	1	3.3	6	mA
Dynamic $V_C$ supply current	$I_{C(DYN)}$	$C_L=1500pF$	2	7	10	mA
Static $V_C$ supply current	$I_{CQ}$	$V_{SS}=0V$	0.5	1	4.5	mA

### Error Amplifier section

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input threshold voltage	$V_{FB}$		0.784	0.8	0.816	V
$V_{FB}$ change with voltage	$\Delta V_{FB} / \Delta V$	$V_{CC}=5V$ to 25V		5	20	mV
$V_T$ change with temperature	$\Delta V_{FB} / \Delta T$	$T_a = -10$ to 85		1		%
Input bias current	$I_{FB1}$	$V_{SS}=3V, V_{FB}=1V$		-0.1		$\mu A$
	$I_{FB2}$	$V_{SS}=0V, V_{FB}=1V$		-64		$\mu A$
Transconductance	gm	--	450	600	750	$\mu mho$

### Output section

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
HDrv output high voltage	$V_{OH1}$	$V_{FB}=0.6V, I_O=-200mA$		2		V
LDrv output high voltage	$V_{OH2}$	$V_{FB}=1.0V, I_O=-200mA$		2		V
HDrv output low voltage	$V_{OL1}$	$V_{FB}=1.0V, I_O=200mA$		1.8		V
LDrv output low voltage	$V_{OL2}$	$V_{FB}=0.6V, I_O=200mA$		1.8		V
Rise time	$T_r$	$C_L=1500pF$		50	100	ns
Fall time	$T_f$	$C_L=1500pF$		50	100	ns
Dead band time	$T_{db}$		50	100	150	ns

## TYPICAL CHARACTERISTICS

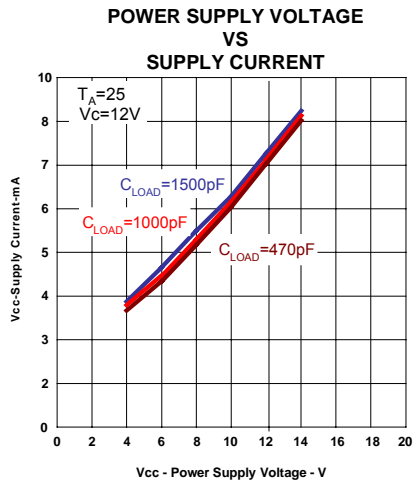


Figure 1

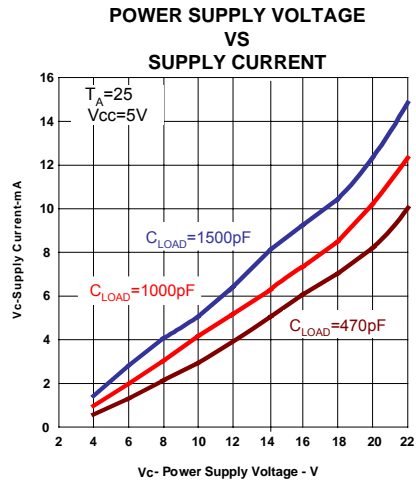


Figure 2

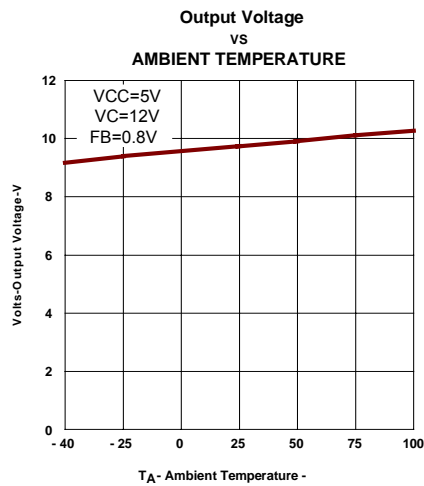


Figure 3

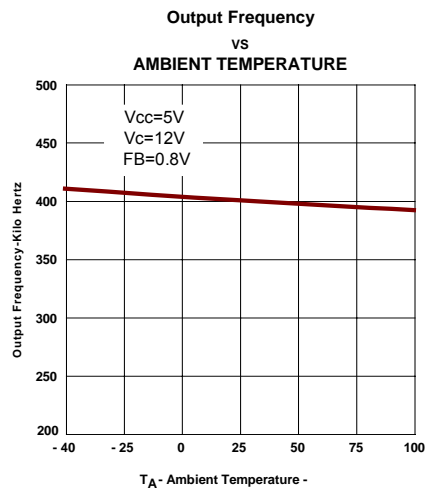


Figure 4

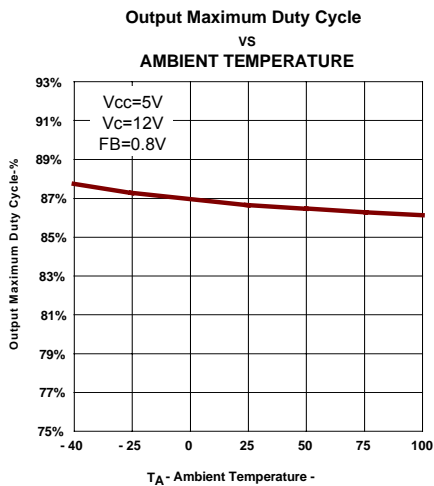


Figure 5

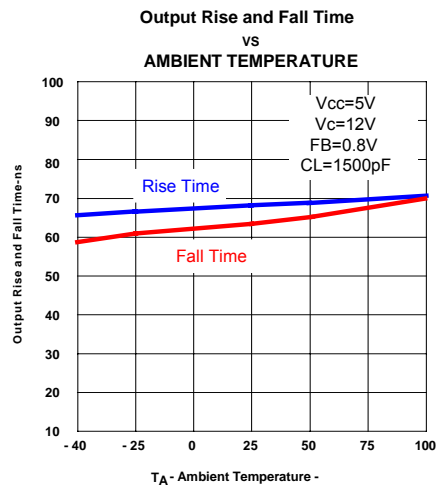


Figure 6

## DETAILED DESCRIPTION

### Voltage reference

A 3.0V regulator operating from VCC is used to power the internal circuitry of the **FP5137A**. An internal resistive divider provides **0.8V** reference for the error amplifier, Soft-start (**typ. 1.5V**) and SCP (**typ. 0.5V**) circuits.

### Error amplifier

The error amplifier compares a sample of the dc-dc converter output voltage to the **0.8V** reference and generates an error signal for the error comparator. Output voltage of dc-dc converter is setting with the resistor divider using the following expression (see figure 7):

$$V_{out} = \left(1 + \frac{R1}{R2}\right) * 0.8$$

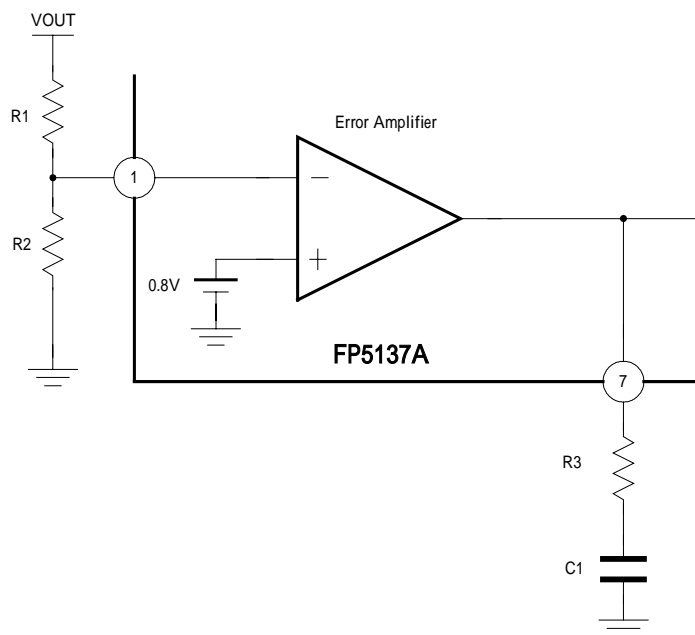


Figure 7. Error Amplifier with Feedback resistance divider

### Oscillator

The fixed frequency generates from an internal RC oscillator, and the typical value is **400KHz**.

### Under voltage lockout (UVLO)

**FP5137A** has a different under voltage lockout point for VCC (**typ. 4.2V**) and VC (**typ. 3.3V**).

The converter is normal operation when supply voltage rises above the point of lockout; otherwise the output drivers of **FP5137A** are off.



### Soft Start

When the VCC and VC of **FP5137A** are ready, the power on reset (POR) signal is enable. The internal current source (**typ. 20μA**) will charge the external capacitor connected soft-start pin and another internal current source (**max. 64μA**) will control feedback voltage of error amplifier and enable output driver for soft-start function. The soft-start timing can be decided by following expression:

$$t_{ss} = 75 * C_{ss}(ms)$$

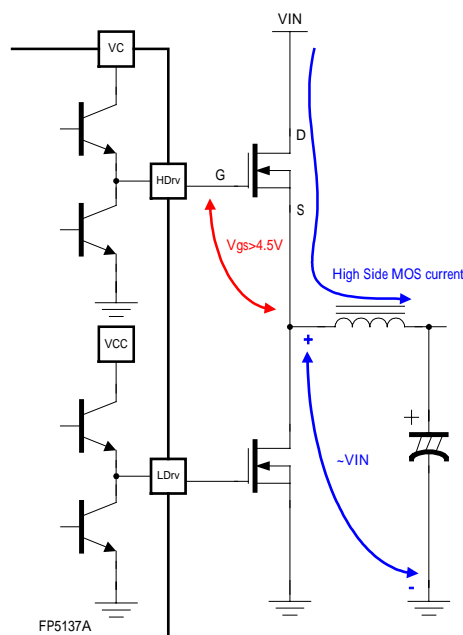
**FP5137A** should be shutdown whenever it is forced a voltage under **0.5V** at soft-start pin.

### Short-circuit protection

**FP5137A** should be shutdown immediately whenever output voltage under **0.4V**, the mean is hard to maintain the output voltage during maximum duty cycle under short-circuit, and the PWM output are off until short circuit problem is release.

### Output transistor and boost voltage V<sub>C</sub>

**FP5137A** uses two NMOS and their turn-on VGS voltage near 4.5V, the source voltage of high side NMOS is near VIN, and it is necessary to supply a boost voltage higher than VIN for high side NMOS gate drive, the following figure explains the relation of MOS gate to source voltage. Application circuits can use different method to solve the boost power supply VC for high side driver. (**Recommend boost voltage VC is sum of VIN and VGS**)



**Figure 8. IC Output Stage with NMOS**

## BASIC APPLICATION NOTE (Dual Power Supply)

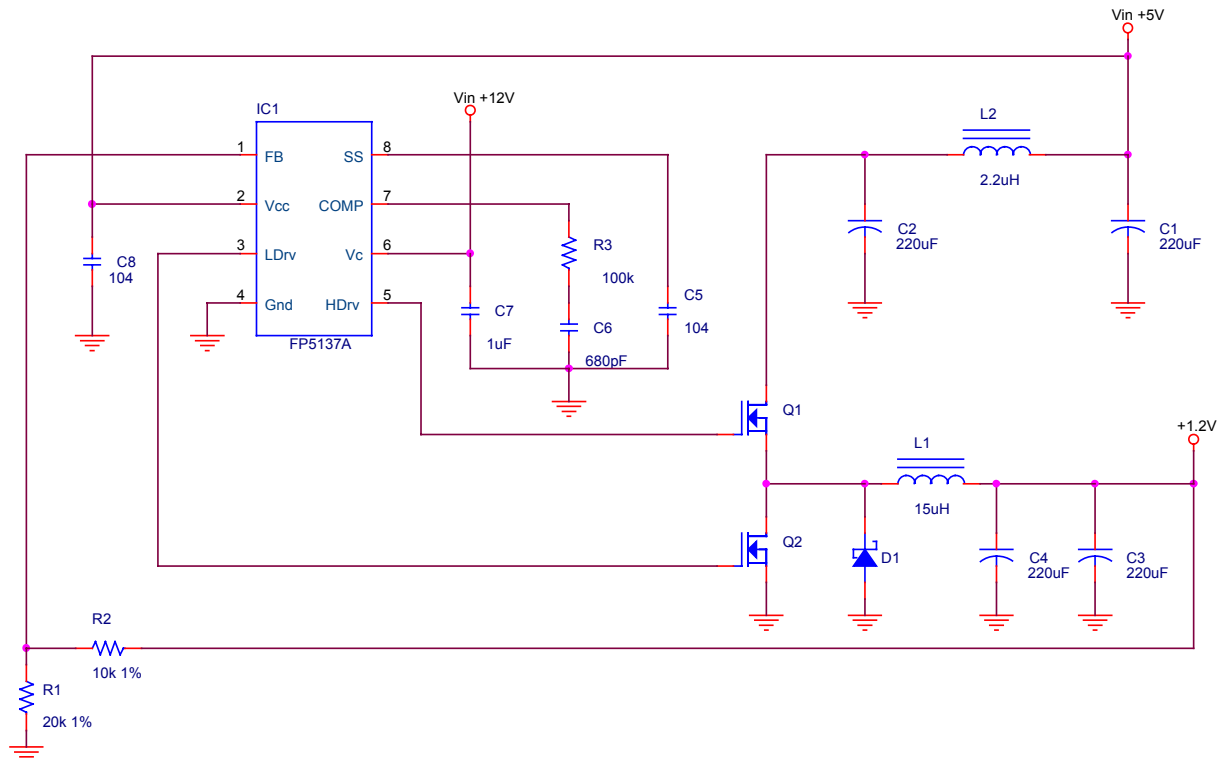


Figure 9. FP5137A DC/DC Converter circuit using dual power supply

### Application Description

This is a simple application circuit using dual power supply (+5V and +12V), the converting voltage is from +5V to +1.2V, and +12V connects with VC pin makes sure the high side NMOS can be turn-on.

The output voltage determines from the following formula:

$$V_{out} = \left(1 + \frac{R2}{R1}\right) * VREF = \left(1 + \frac{10K}{20K}\right) * 0.8V = 1.20V$$

The soft-start time determines from the following formula:

$$T_{SS} = 75 * C5 = 75 * 0.1(ms) = 7.5ms$$

## BASIC APPLICATION NOTE (Single Power Supply)

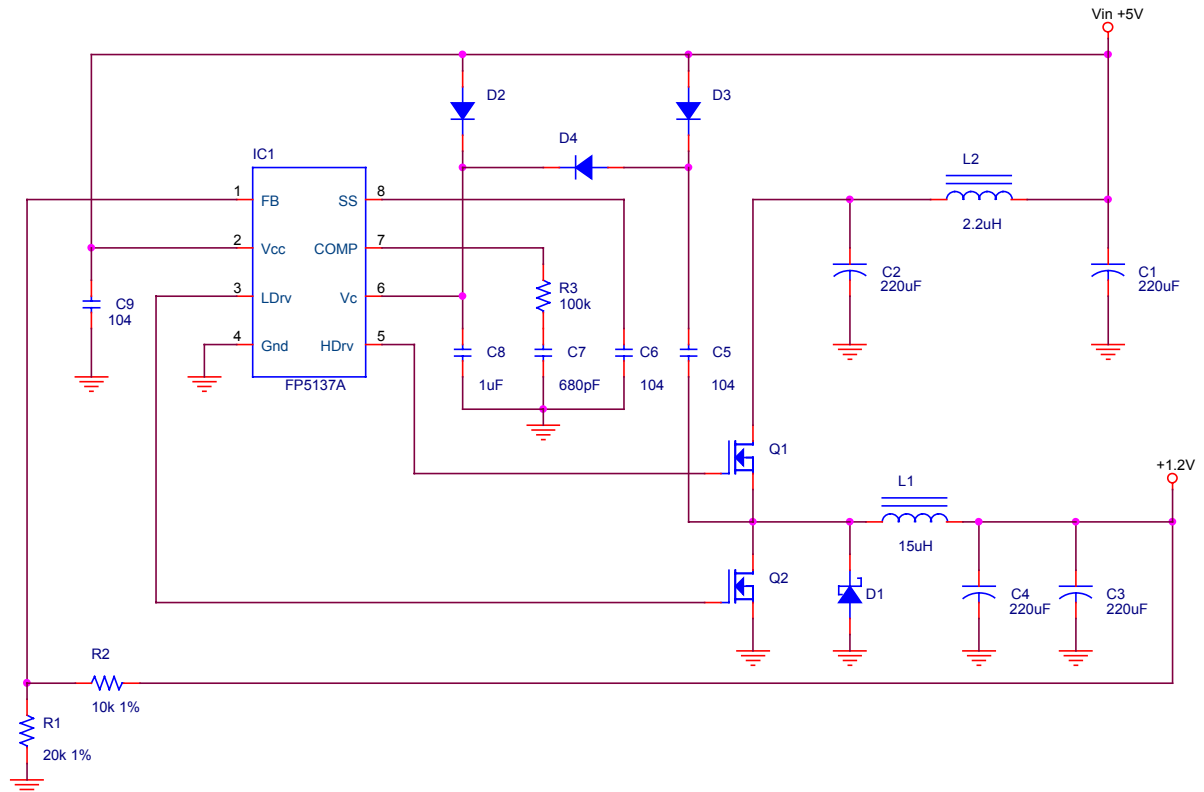


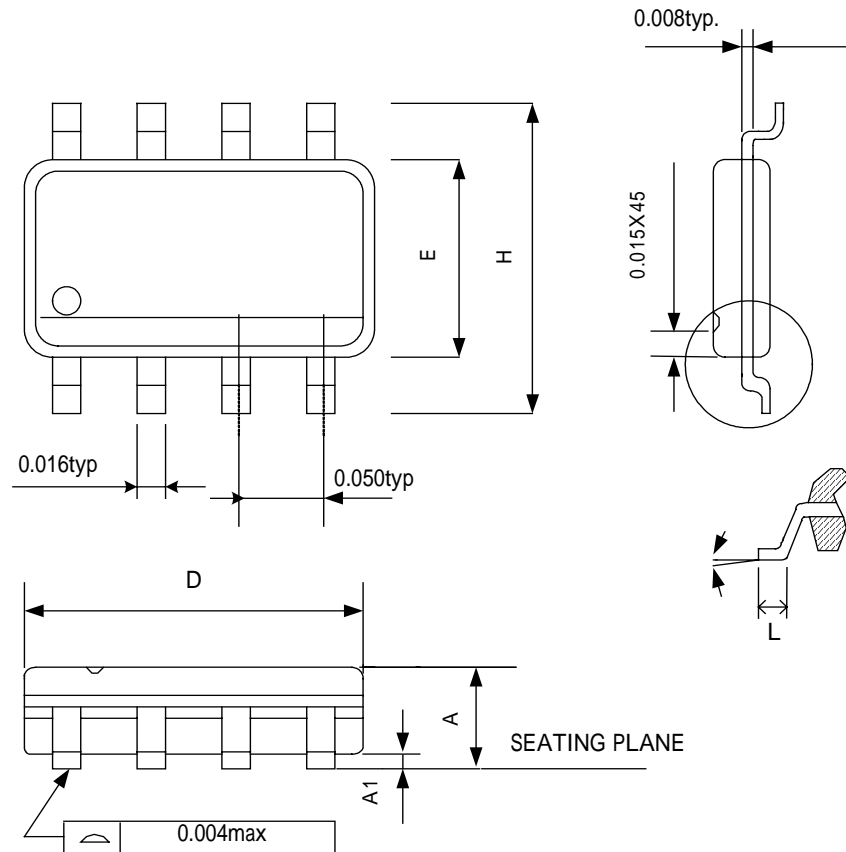
Figure 10. FP5137A DC/DC Converter circuit using single power supply

### Application Description

This application circuit is same as dual power supply but VC pin uses a charge-pump circuit with D2~D4 and C5, C8.

The C5 capacitor would charge near +5V through D3 when +5V power supply is turn-on, the voltage of VC is a sum of C5 voltage and  $V_{IN}-V_{DIODE}$  voltage, is higher than Q1 source terminal during Q1 turns on.

## PACKAGE OUTLINE SOP8

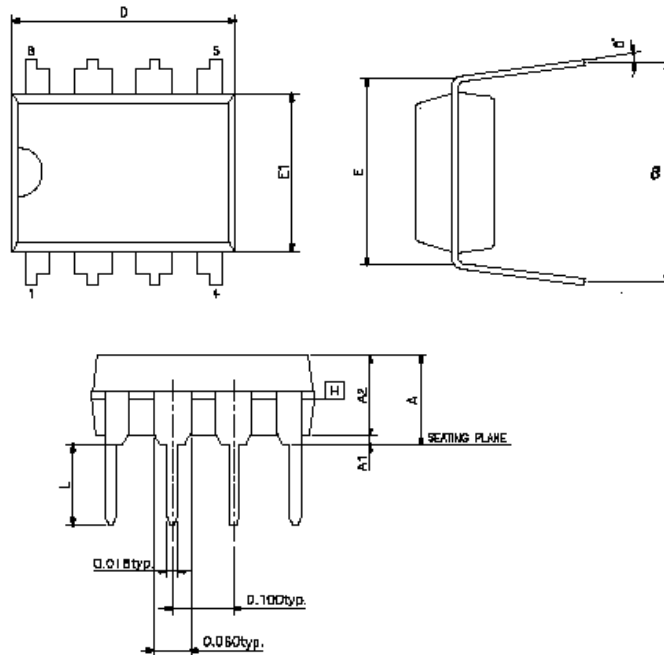


SYMBOLS	MIN	MAX
	0.053	0.069
A1	0.004	0.010
D	0.189	0.196
E	0.150	0.157
H	0.228	0.244
L	0.016	0.050
°	0	8

**NOTE:**

1. JEDEC OUTLINE:MS-012 AA
2. DIMENSIONS "D" DOES NOT INCLUDE MOLD FLASH,PROTRUSIONS OR GATE BURRS.MOLD FLASH,PROTRUSIONS AND GATE BURRS SHALL NOT EXCEED .15mm (.0.06in) PER SIDE
3. DIMENSIONS "E" DOES NOT INCLUDE INTER-LEAD FLASH,OR PROTRUSIONS. INTER-LEAD FLASH AND PROTRUSIONS SHALL NOT EXCEED .25mm (.0.10in) PER SIDE.

## PDIP 8



SYMBOLS	MIN	NOR	MAX
A	-	-	0.210
A1	0.015	-	-
A2	0.125	0.130	0.135
D	0.355	0.365	0.400
E	0.300BSC		
E1	0.245	0.250	0.255
L	0.115	0.130	0.150
e	0.335	0.355	0.375
°	0	7	15

### NOTE:

0. JEDEC OUTLINE: MS-001 BA

1. "D" "E1" DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .010 INCH

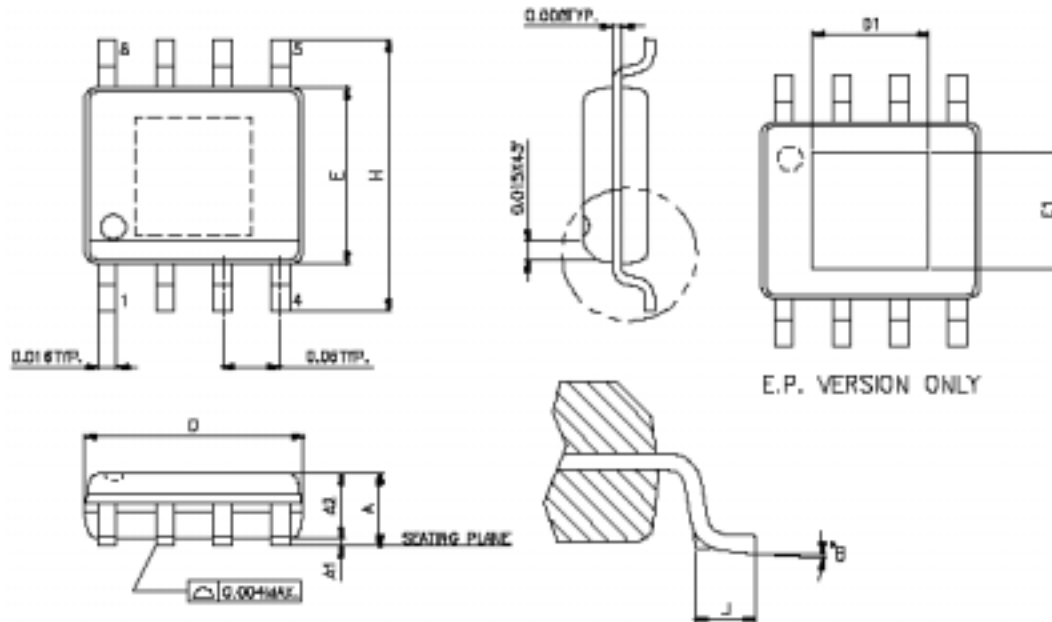
2. eB IS MEASURED AT THE LEAD TIPS WITH THE LEADS UNCONSTRAINED

3. POINTED OR ROUNDED LEAD TIPS ARE PREFERRED TO EASE INSERTION

4. DISTANCE BETWEEN LEADS INCLUDING DAM BAR PROTRUSIONS TO BE .005 INCH MINIMUM

5. DATUM PLANE H COINCIDENT WITH THE BOTTOM OF LEAD, WHERE LEAD EXITS BODY.

## SOP8-EXPOSED PAD



SYMBOLS	MIN	MAX
A	1.346	1.752
A1	0.101	0.254
D	4.800	4.978
E	3.810	3.987
H	5.791	6.197
L	0.406	1.270
°	0	8

### THERMALLY ENHANCED DIMENSIONS

PAD SIZE	E1	D1
A	2.057 REF	2.057 REF
A1	2.184 REF	2.971 REF

UNIT:MM

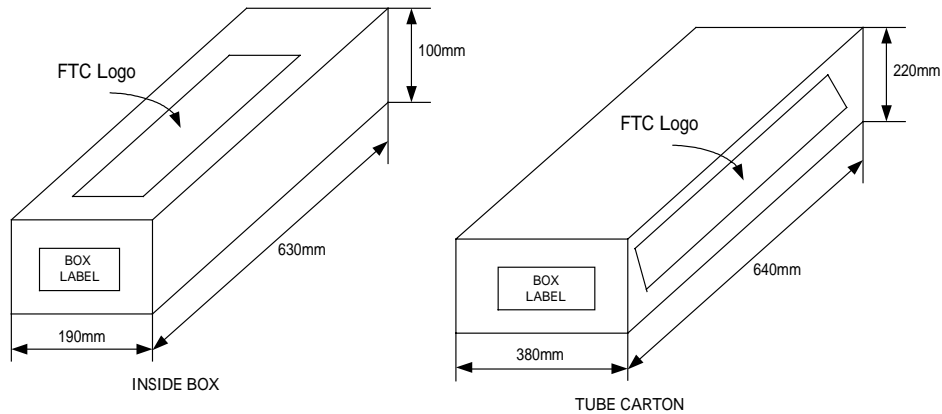
#### NOTE:

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- 2.DIMENSIONS "E" DOES NOT INCLUDE INTER-LEAD FLASH,OR PROTRUSIONS. INTER-LEAD FLASH AND PROTRUSIONS SHALL NOT EXCEED .25mm (.0.10in) PER SIDE.

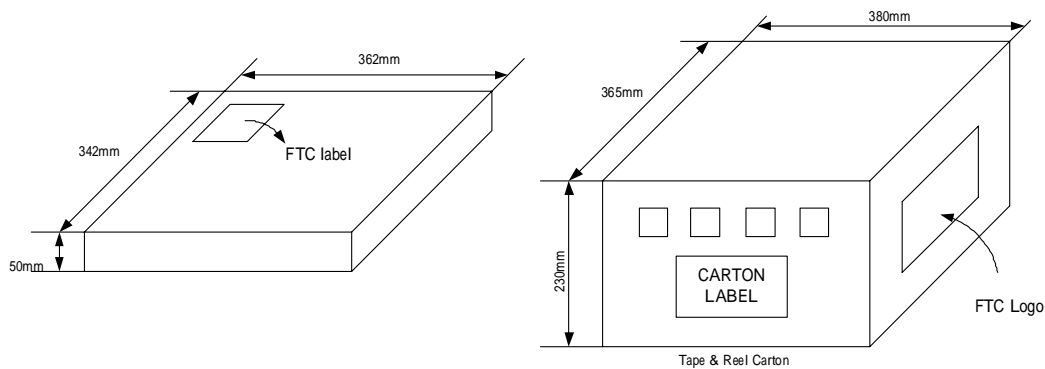
## PACKING SPECIFICATIONS

### BOX DIMENSION

#### TUBE INSIDE BOX AND CARTON



#### TAPE AND REEL INSIDE BOX AND CARTON



## PACKING QUANTITY SPECIFICATIONS

SOP8	SOP8-EXPOSED PAD	PDIP8	SOP8
	100 EA/TUBE	50 EA/TUBE	2500 EA / REEL
	100 TUBES / INSIDE BOX		4 INSIDE BOXES / CARTON
	4 INSIDE BOXES / CARTON		

## LABEL SPECIFICATIONS

### Tapping & Reel

Feeling Technology Corp.
Product FP5137ADR-LF
Lot No A3311C62-L
D/C 4Xx-XXL
Q'ty
<div style="border: 1px solid black; padding: 2px; display: inline-block;">           無鉛 Lead Free         </div>

## CARTON

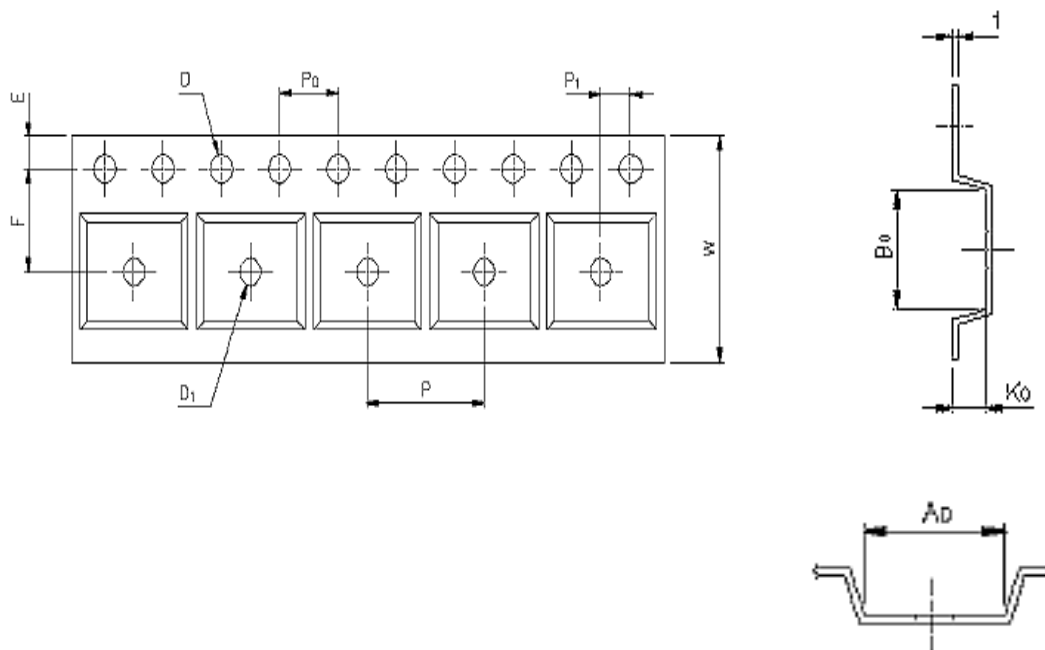
Feeling Technology Corp.	
Product Type: FP5137ADR-LF	
Lot No: A3311C62-L	
Date Code: 4Xx-XXL	
Package Type: SOP-8L	
Marking Type: Laser	無鉛 Lead Free
Total Q'ty: 10,000	

## SOP8

### CARRIER TAPE DIMENSIONS

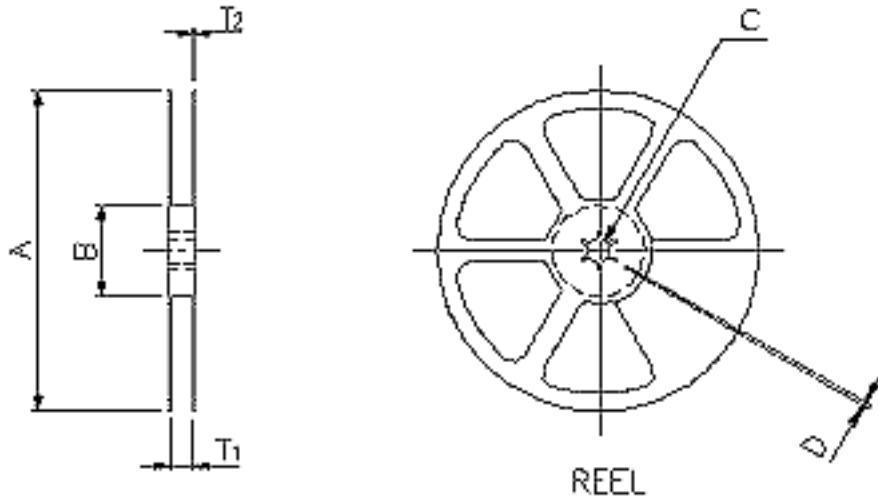
APPLICATION	W	P	E	F	D	D <sub>1</sub>
SOP8	12.0 <sup>+0.3</sup> <sub>-0.1</sub>	8.0±0.1	1.75±0.1	5.5±0.1	1.55±0.1	1.5 <sup>+0.25</sup>

APPLICATION	P <sub>0</sub>	P <sub>1</sub>	A <sub>D</sub>	B <sub>0</sub>	K <sub>0</sub>	t
SOP8	4.0±0.1	2.0±0.1	6.4±0.1	5.20±0.1	2.1±0.10	0.30±0.013





## REEL DIMENSIONS

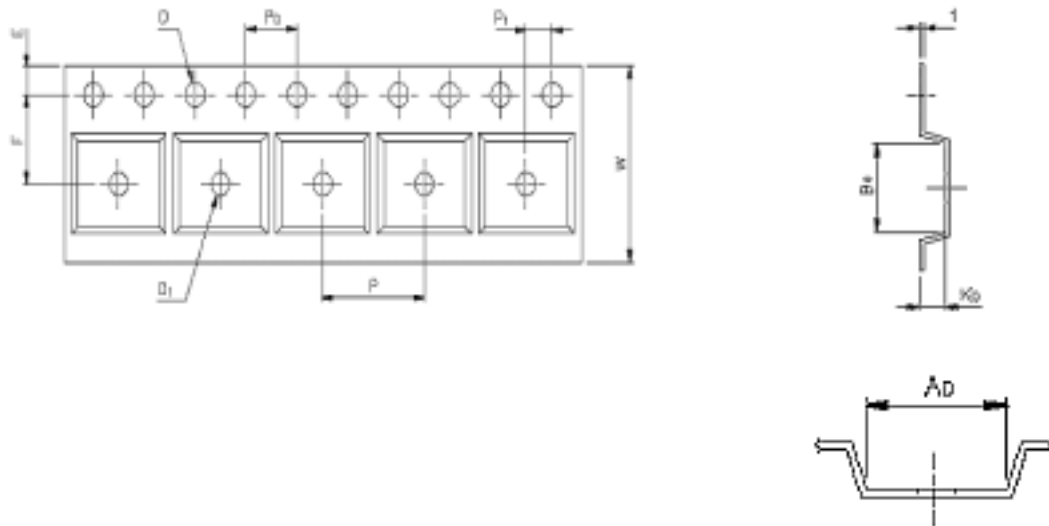


APPLICATION	MATERIAL	A	B	C	D	T <sub>1</sub>	T <sub>2</sub>
SOP8	PLASTIC REEL (WHILE)	330±0.1	62±1.5	12.75+0.15	2+0.6	12.4+0.2	2.0+0.2

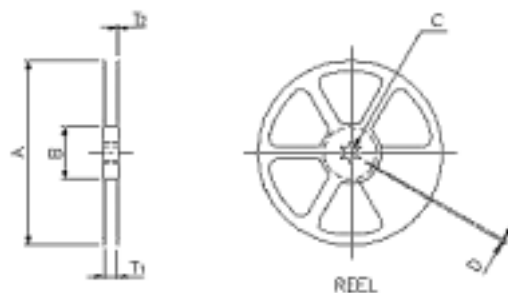
**SOP8-EXPOSED PAD  
CARRIER TAPE DIMENSIONS**

APPLICATION	W	P	E	F	D	D <sub>1</sub>
SOP8	12.0 <sup>+0.3</sup> <sub>-0.1</sub>	8.0±0.1	1.75±0.1	5.5±0.1	1.55±0.1	1.5 <sup>+0.25</sup>

APPLICATION	P <sub>0</sub>	P <sub>1</sub>	A <sub>D</sub>	B <sub>0</sub>	K <sub>0</sub>	t
SOP8	4.0±0.1	2.0±0.1	6.4±0.1	5.20±0.1	2.1±0.10	0.30±0.013



**REEL DIMENSIONS**



APPLICATION	MATERIAL	A	B	C	D	T <sub>1</sub>	T <sub>2</sub>
SOP8	PLASTIC REEL (WHILE)	330±0.1	62±1.5	12.75±0.15	2±0.6	12.4±0.2	2.0±0.2