FEELING Technology

FP38G43

BURST/CURRENT MODE PWM IC

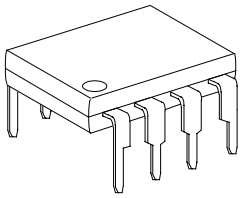
GENERAL DESCRIPTION

The **FP38G43** is a burst/current mode PWM IC, composed of NMOS driver capability with a PWM control latch, burst/current mode current sense comparator and an error amplifier, the **FP38G43** contains a 5V precision voltage reference regulator, under-voltage lockout circuit (UVLO), oscillator circuit, applied to offer space and low cost in many applications such as the AC/DC converter and off-line switching power supply.

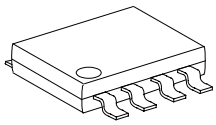
The **FP38G43**, a high performance integrated IC, is designed for the typical application examples are shown as below.

FEATURES

- Precision Reference Voltage: 5.0V (±1%)
- Low start-up current: typ. 60uA
- Low operating current: typ. 6mA
- High current NMOS driver: 100mA
- Internal temperature compensated oscillator
- Double pulse suppression
- UVLO with Hysteresis function
- Burst/Current Mode Swapping function
- Oscillator Frequency: Max. 500KHz
- Package: PDIP8 / SOP8



PDIP8

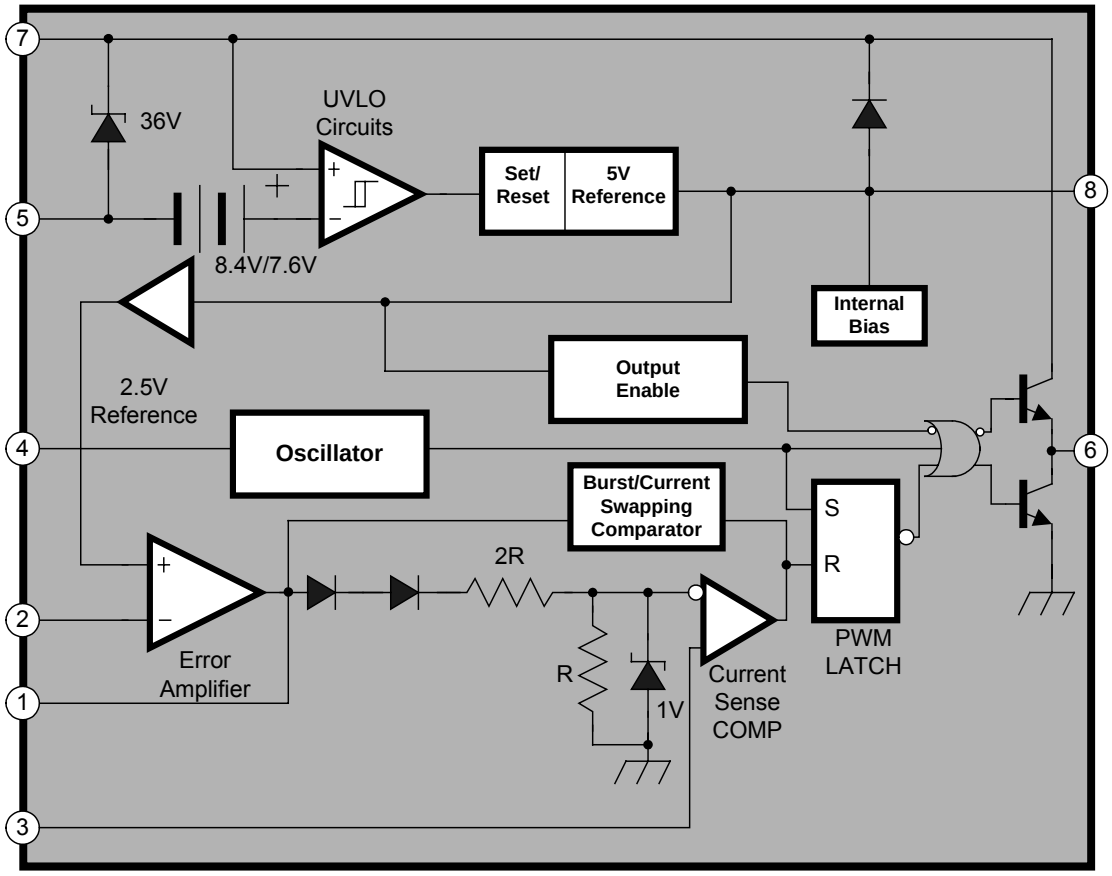


SOP8

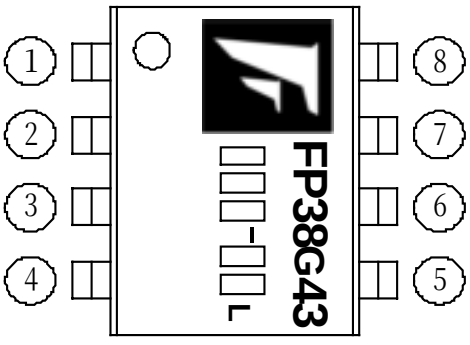
TYPICAL APPLICATION

- AC-DC Converter
- SMPS
- AC Adaptor

FUNCTIONAL BLOCK DIAGRAM



MARK VIEW



PIN DESCRIPTION

NAME	NO.	STATUS	DESCRIPTION
COMP	1	O	Error Amplifier Feedback Output
VFB	2	I	Error Amplifier Inverting Input
IS	3	I	Current Sense Input
OSC	4	I	RC Circuit for Oscillator
GND	5	P	IC Ground
OUT	6	O	Totem Pole Output
VCC	7	P	IC Power Supply
VREF	8	P	5.0V Reference Output

ABSOLUTE MAXIMUM RATINGS

Supply Voltage (Vz) ---------- 36V

Output Current (I_O) ---------- ±0.8A

Analog Input (V_{FB}, V_{SENSE}) ---------- -0.3V ~ +5.5V

Maximum Junction Temperature (T_j) ---------- +150℃

Thermal Resistance Junction to Ambient (PDIP8 package) ---------- 100℃/W

(SOP8 package) ---------- 175℃/W

Power Dissipation

PDIP8

T_A=25℃ ---------- 1250mW

T_A=70℃ ---------- 750mW

SOP8

T_A=25℃ ---------- 650mW

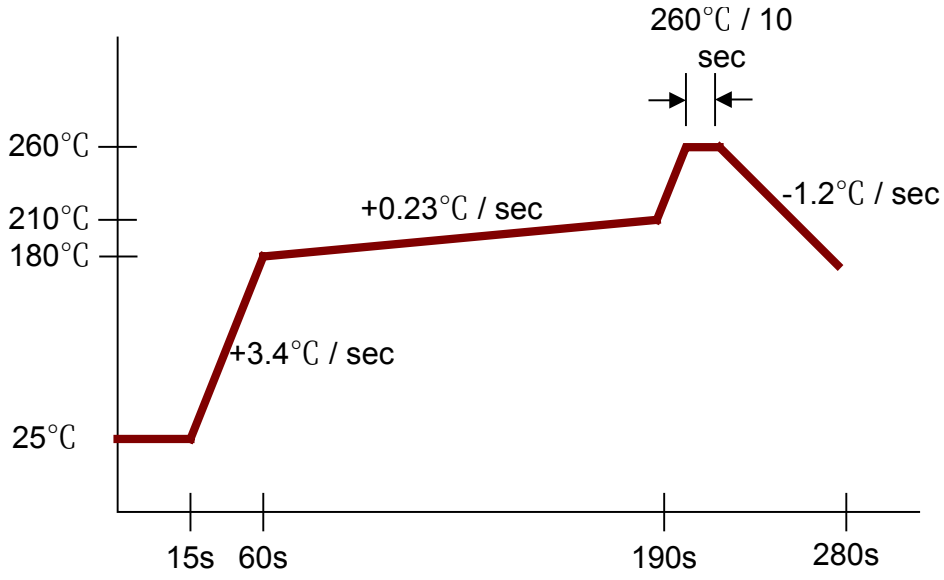
T_A=70℃ ---------- 550mW

Operating Temperature Range (T_{OPR}) ---------- -20℃ ~ 85℃

Storage Temperature Range (T_{STG}) ---------- -65℃ ~ 150℃

PDIP8 Lead Temperature (soldering, 10 sec) ---------- +260℃

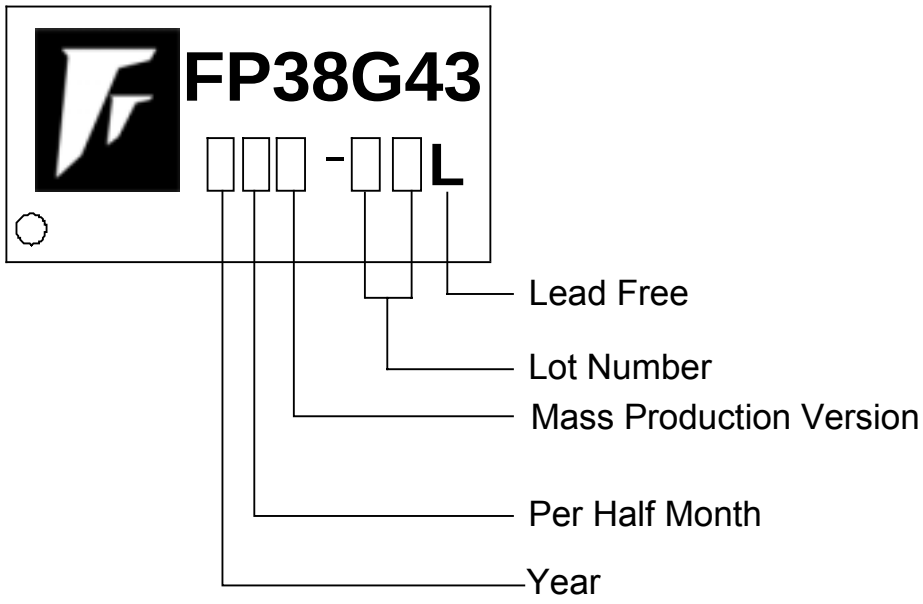
SOP8 Lead Temperature (soldering, 10 sec) ---------- +260℃



ORDER INFORMATION

Part Number	Operating Temperature	Package	Description
FP38G43P-LF	-20℃ ~ +85℃	PDIP8	Tube
FP38G43D-LF	-20℃ ~ +85℃	SOP8	Tube
FP38G43DR-LF	-20℃ ~ +85℃	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

The INK Lot Number is the last two numbers of wafer lot number.

For Example:

A3311C62

→ Lot Number

DC Electrical Characteristics

(V_{CC}=15V, R_T=10K,C_T=3.3nF,0℃≦ T_A≦ 70℃, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Reference Section						
Output Voltage	V_{REF}	T_j=25℃, I_{REF}=1mA	4.9	5.0	5.1	V
Line Regulation	Δ V_{REF}	12V≦ V_{CC}≦ 25V		2.0	20	mV
Load Regulation	Δ V_{REF}	1mA≦ I_{REF}≦ 20mA		3.0	25	
Output Short Circuit	I_{SC}	T_A=25℃		-100	-180	mA
Oscillator Section						
Oscillation Frequency	f	T_j=25℃	49	52	55	KHz
Voltage Stability	Δ f/Δ V_{CC}	12V≦ V_{CC}≦ 25V		0.2	1.0	%
Temperature Stability	Δ f/Δ T_A	T_{MIN}≦ T_A≦ T_{MAX}		0.5		%
Ampiltude	V_{OSC}	V_{P-P} of OSC pin		1.6		V
Error Amplifier Section						
Input Bias Current	I_{BIAS}	V_{FB}=5V		-0.1	-2.0	μA
Input Voltage	$V_{I(EA)}$	V_{COMP}=2.5V	2.42	2.5	2.58	V
Open Loop Gain	A_{VOL}	2V≦ V_{OUT}≦ 4V	65	90		dB
Unity Gain Bandwidth	BW_U	Note 3	0.7	1.0		MHz
Power Supply Rejection Ratio	PSRR	12V≦ V_{CC}≦ 25V	60	70		dB
Output Sink Current	I_{SINK}	V_{FB}=2.7V,V_{COMP}=1.1V	2	7		mA
Output Source Current	I_{SOURCE}	V_{FB}=2.3V,V_{COMP}=5V	-0.5	-1.0		
V_{COMP} High Voltage	V_{OH}	V_{FB}=2.3V, R_L=15KΩ to GND	5.0	6.0		V
V_{COMP} Low Voltage	V_{OL}	V_{FB}=2.7V, R_L=15KΩ to V_{REF}		0.8	1.1	
Current Sense Section						
Gain	G_V	(Note 1 & 2)	2.85	3.0	3.15	V/V
Maximum Input Signal	$V_{I\ (MAX)}$	V_{COMP}=5V(Note 1)	0.9	1.0	1.1	V
Supply Voltage Rejection	SVR	12V ≦ V_{CC} ≦ 25V (Note 1)		70		dB
Input Bias Current	I_{BIAS}			-2	-10	μA
Delay to Output	t_{DO}			150	300	ns
Burst/Current Mode Section						
Burst/Current Mode Swapping Voltage	V_{BCS}	V_{COMP} Voltage	2.5	2.6	2.7	V

DC ELECTRICAL CHARACTERISTICS (Cont.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output Section						
V_{OUT} Low Voltage	V_{OL}	I_{SINK}=20mA		0.1	0.4	V
		I_{SINK}=200mA		1.6	2.2	
V_{OUT} High Voltage	V_{OH}	I_{SOURCE}=20mA	13	13.5		V
		I_{SOURCE}=200mA	12	13.0		
Rise Time	t_R	T_J=25℃,C_L=1nF (Note 3)		50	150	nS
Fall Time	t_F	T_J=25℃,C_L=1nF (Note 3)		50	150	
Under-Voltage Lockout Section						
Start Threshold	$V_{TH\ (ST)}$		7.8	8.4	9.0	V
Minimum Operating Voltage	$V_{OPR\ (MIN)}$	After Turn On	7.0	7.6	8.2	V
PWM Section						
Maximum Duty Cycle	$D_{(MAX)}$		94	96	100	%
Minimum Duty Cycle	$D_{(MIN)}$				0	
Total Standby Current						
Start-Up Current	I_{ST}			0.06	0.08	mA
Operating Supply Current	$I_{CC(OPR)}$	V_{FB}=0V V_{SENSE}=0V	5	6	8	
V_{CC} Zener Voltage	V_Z	I_{CC}=25mA		36		V

Notes
1. Parameter measured at trip point of latch with V_{FB}=0V.
2. Gain defined as A= ΔV_{COMP} / Δ_{VSENSE}; 0≦ V_{SENSE} ≦ 0.8V
3. These parameters, although guaranteed, are not 100% tested in production.

TYPICAL CHARACTERISTICS

Timing Resistor
VS
Oscillator Frequence

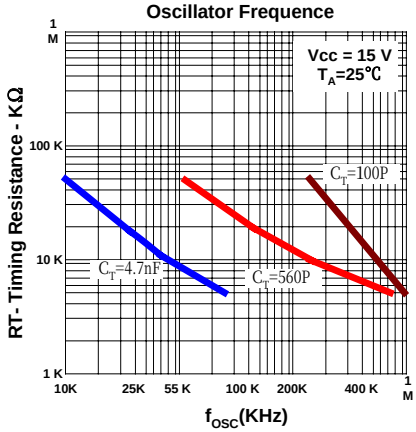


Figure 1

Maximum Output Duty Cycle
VS
Timing Resisror

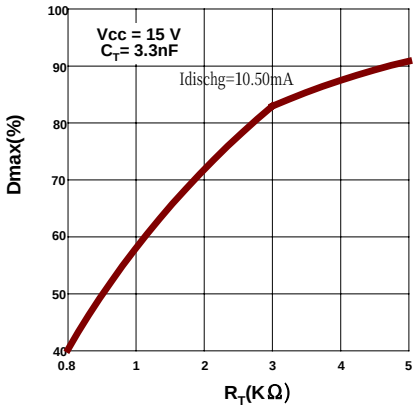


Figure 2

Oscillator Discharge Current
VS
Temperature

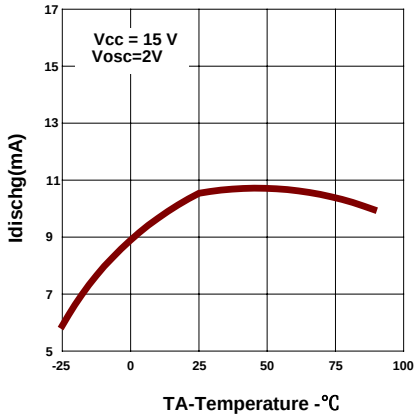


Figure 3

Reference Voltage Change
VS
Source Current

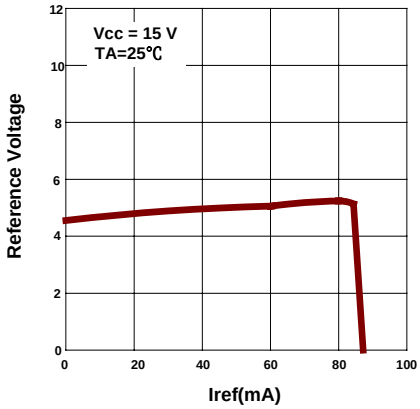


Figure 4

Reference Short Circuit Current
VS
Temperature

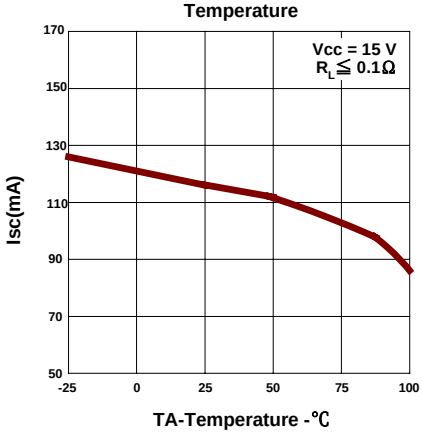


Figure 5

Current Sense Input Threshold
VS
Error Amp Output Voltage

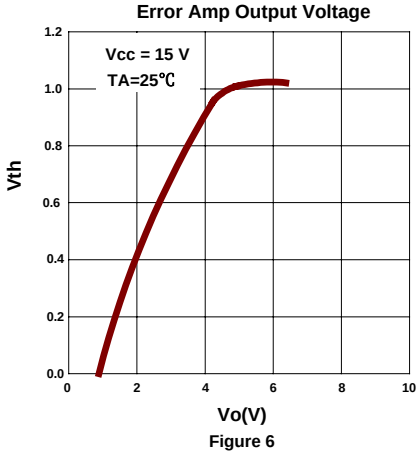


Figure 6

TYPICAL CHARACTERISTICS (continued)

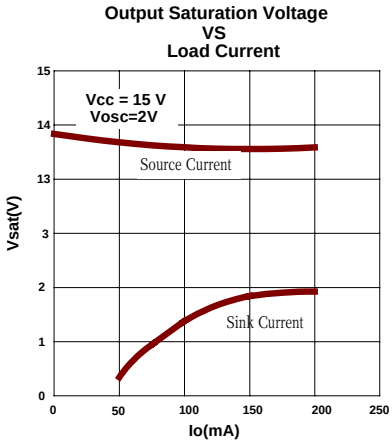


Figure 7

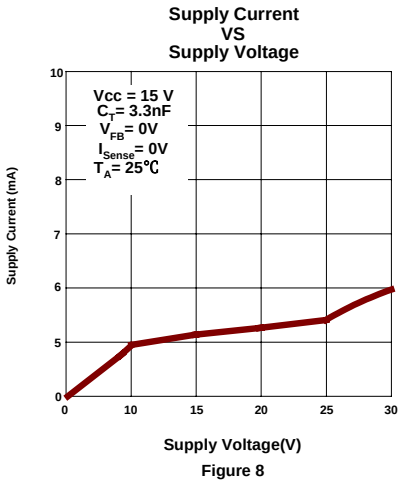


Figure 8

Output Waveform

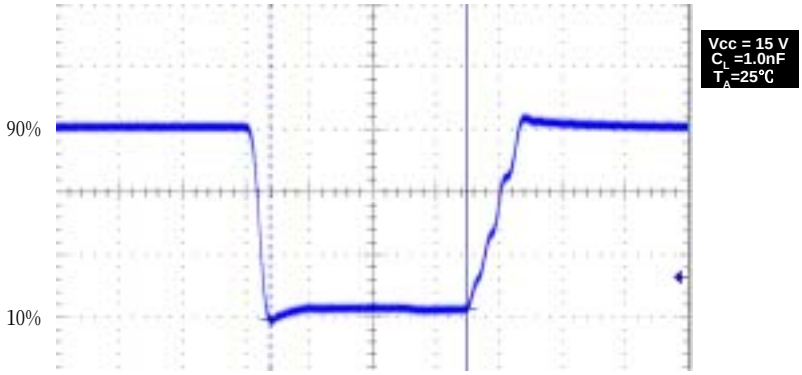


Figure 9

Output Cross Conduction

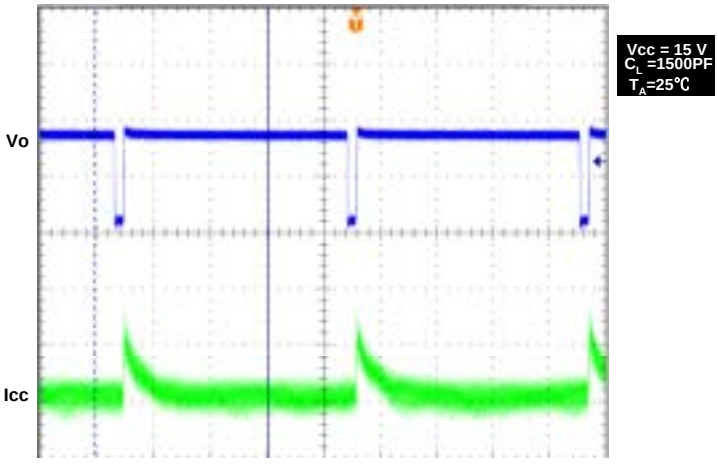
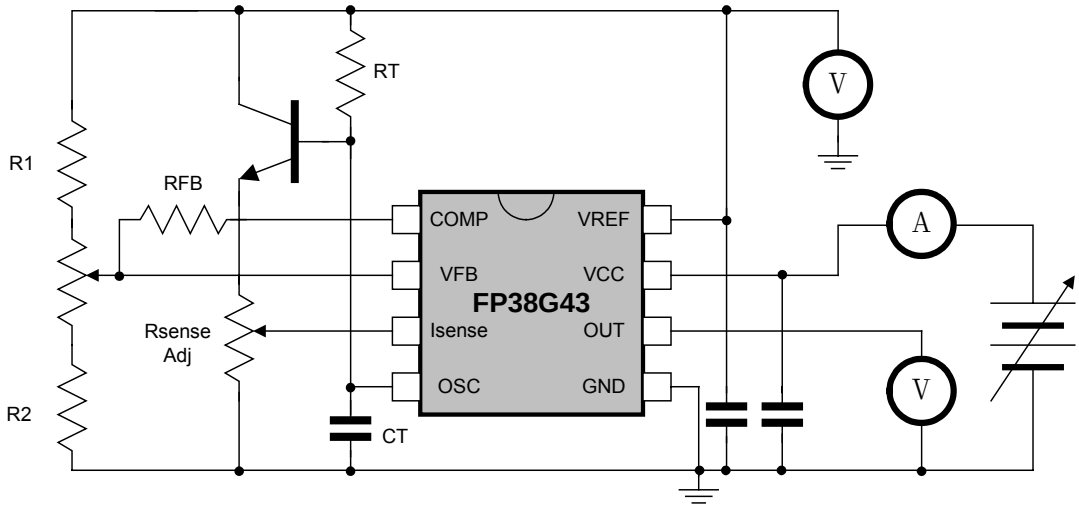


Figure 10

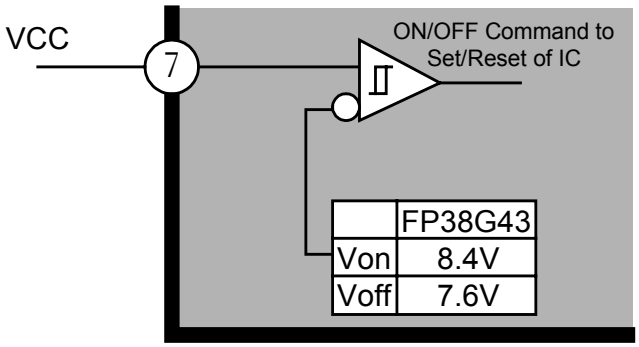
Test Circuits

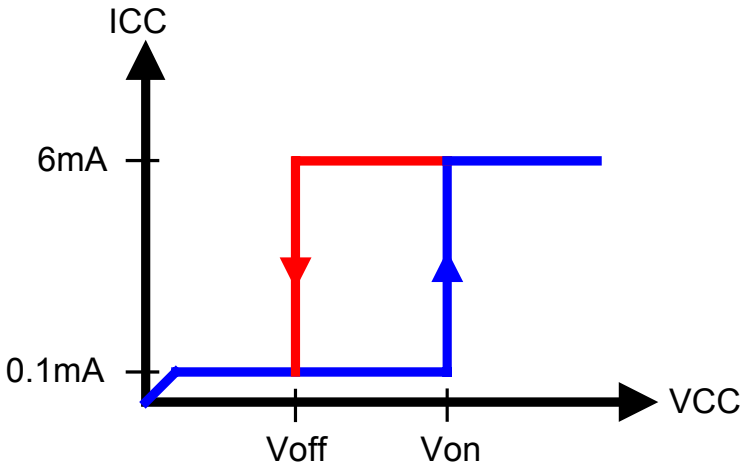


Function Descriptions

Under Voltage Lockout

The **FP38G43** has a lockout function such as below figure. The output of pin6 is low state during the range of under-voltage lockout (UVLO). V_{ON} is a threshold voltage for IC operation until VCC is more than this voltage point, and the V_{OFF} is a minimum operating voltage to keep **FP38G43** working continuously.

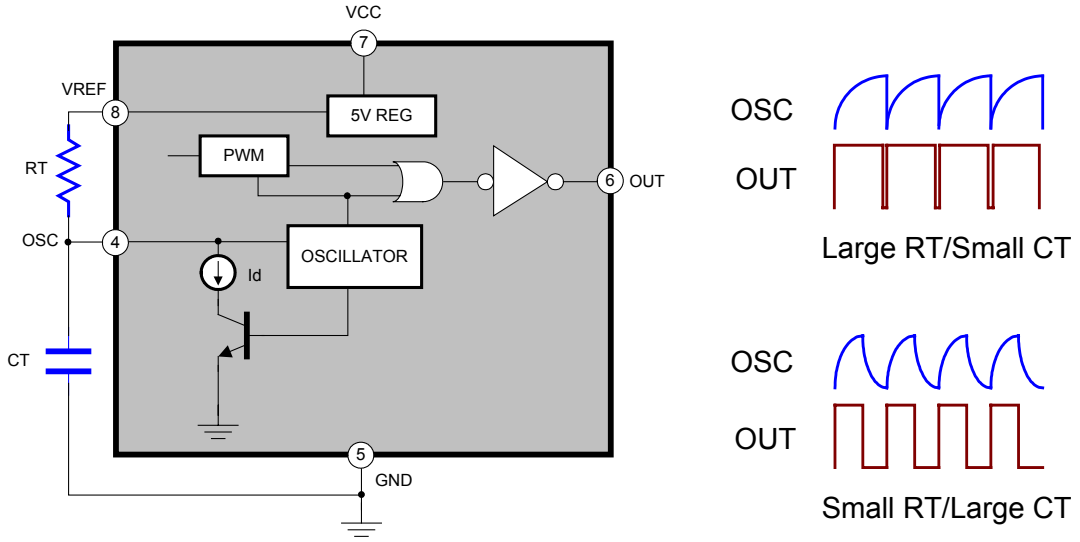




During UVLO, the Output is low

Oscillator and Output Waveforms

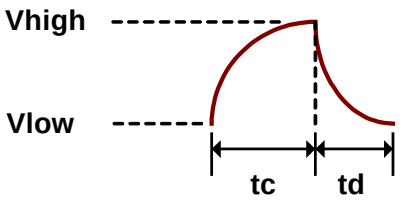
It uses an external RC circuit for oscillation of **FP38G43**, C_T is charged from V_{REF} and through R_T and discharged to the internal circuits including a source current I_D and a NPN transistor. The waveforms of different R_T/C_T are also shown as below.



The charge and discharge time could be calculated by these formulas:

$$t_c = Rt \cdot Ct \ln\left(\frac{V_{ref} - V_{low}}{V_{ref} - V_{high}}\right)$$

$$t_d = Rt \cdot Ct \ln\left(\frac{V_{ref} - I_d R_t - V_{low}}{V_{ref} - I_d R_t - V_{high}}\right)$$



For example:

FP38G43 V_{REF}=5.0V, V_{HIGH}=2.7V, V_{LOW}=1.0V, I_D=8.3mA (IC specification)

And external R_T= 10KΩ, C_T= 3.3nF

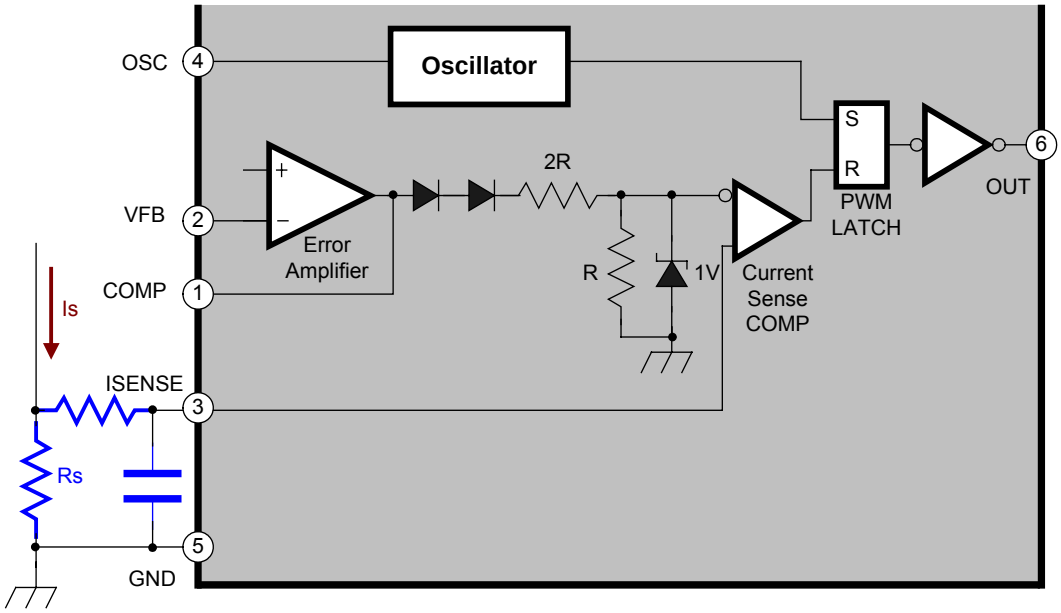
t_C = 10000 * 3.3e-9 * ln (4/2.3) = 0.000033 * 0.5534 = 18.26μs

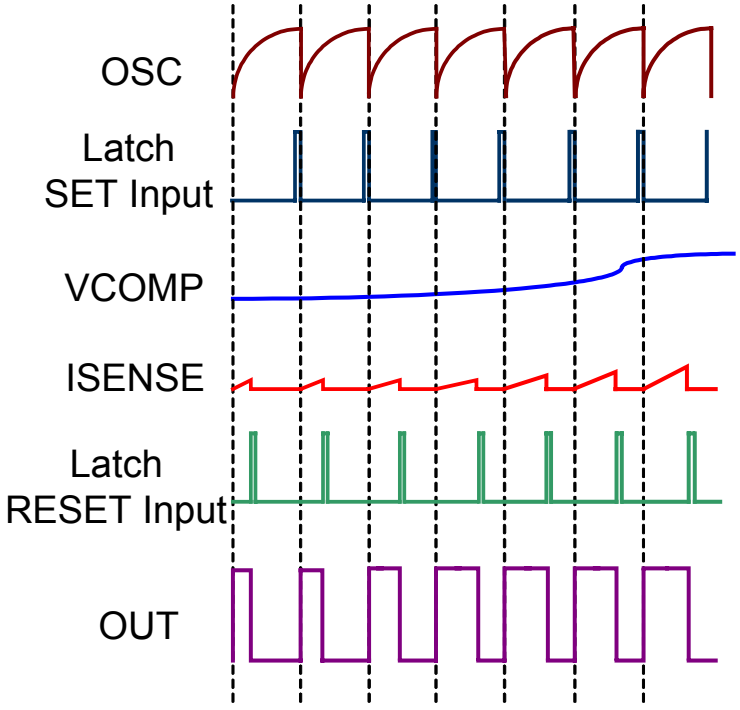
t_D = 10000 * 3.3e-9 * ln (1.02) = 0.000033 * 0.021 = 0.7μs

f_{OSC}= 1 / (t_C + t_D) = 52.74KHz

Error Amplifier, Current Sense and Output PWM Waveforms (Current Mode Condition)

The duty cycle of PWM waveform is depended on the error amplifier and current sense signal, which are compared together by PWM Latch.

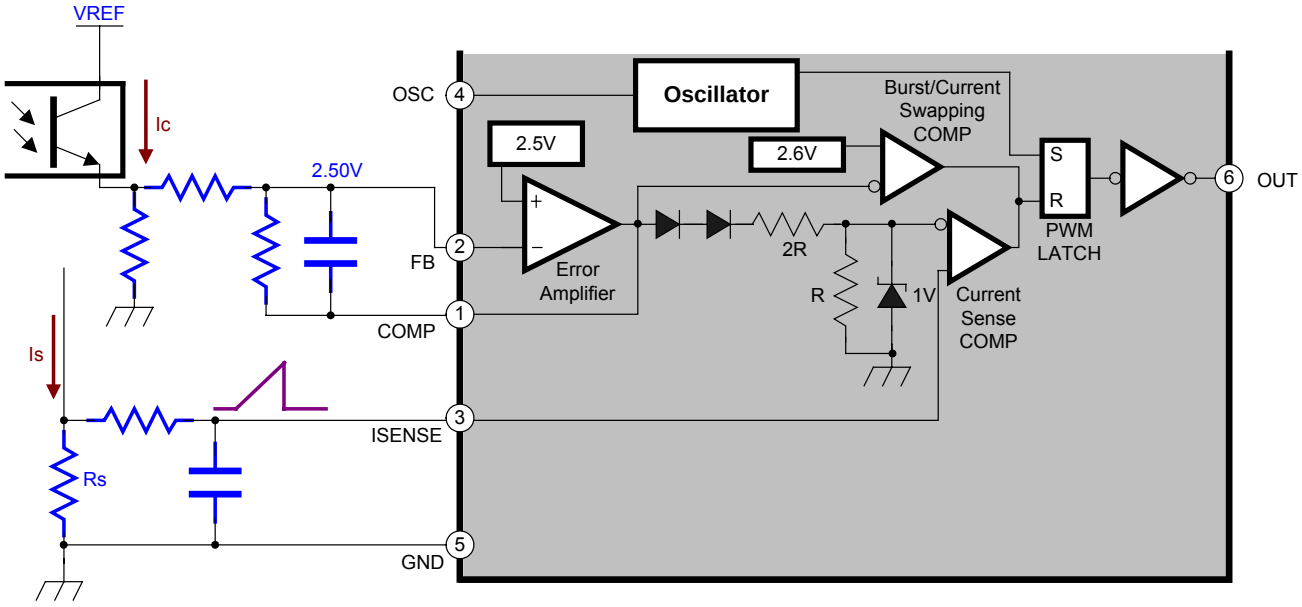


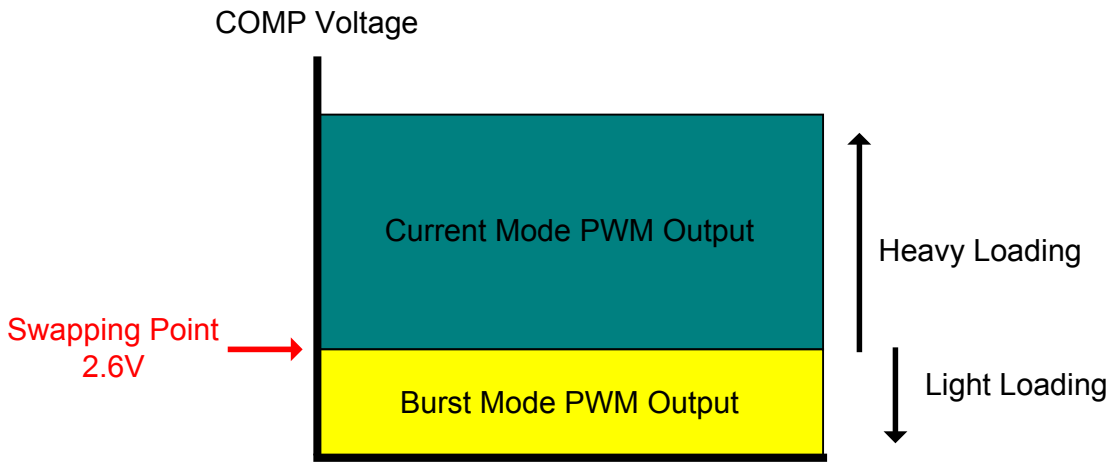


Large RT/Small CT

Burst/Current Mode Comparator and Swapping Function

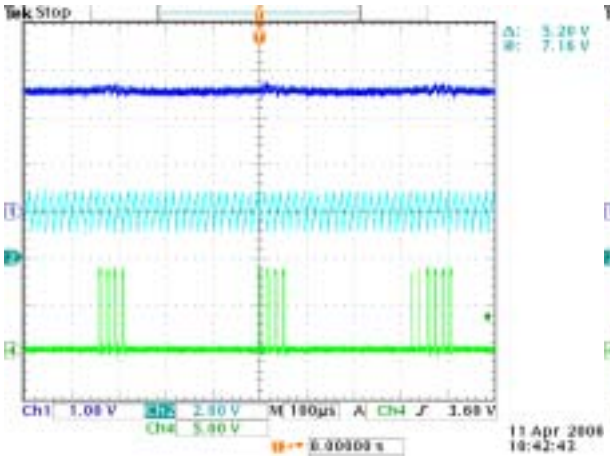
The swapping comparator controls the burst mode and current mode swapping function, the output voltage of error amplifier is compared with 2.6V internal reference that is a voltage which determine the **FP38G43** is operation in burst mode or current mode such as the below relationship of heavy loading and light loading.



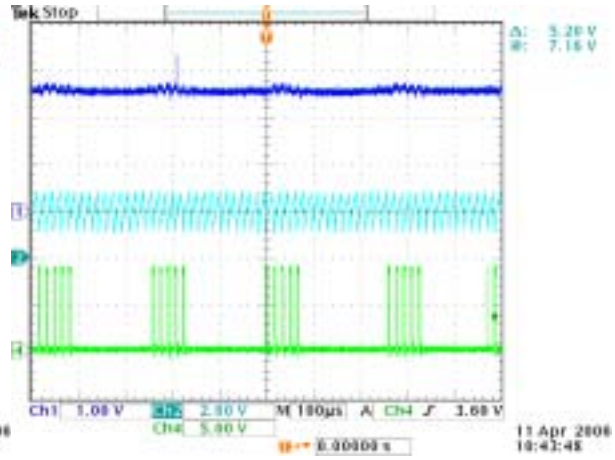


Burst Mode Function Testing Waveforms

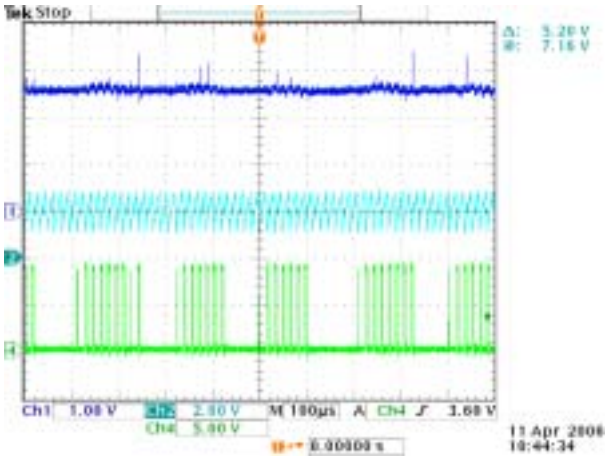
Under light loading, the burst waveform of **FP38G43** is decided by different loading current of VOUT.



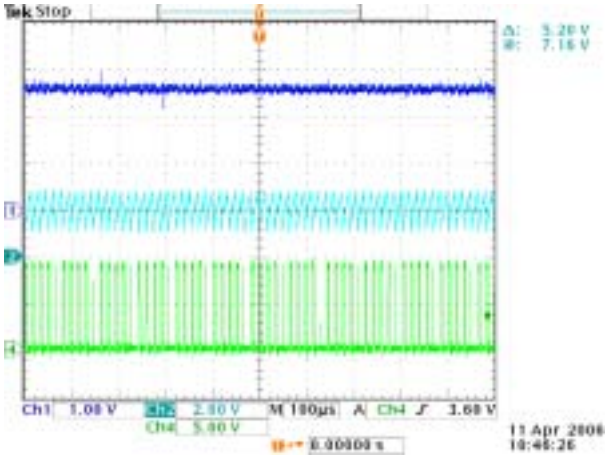
I_{OUT}=170mA



I_{OUT}=300mA



I_{OUT}=500mA



I_{OUT}=750mA

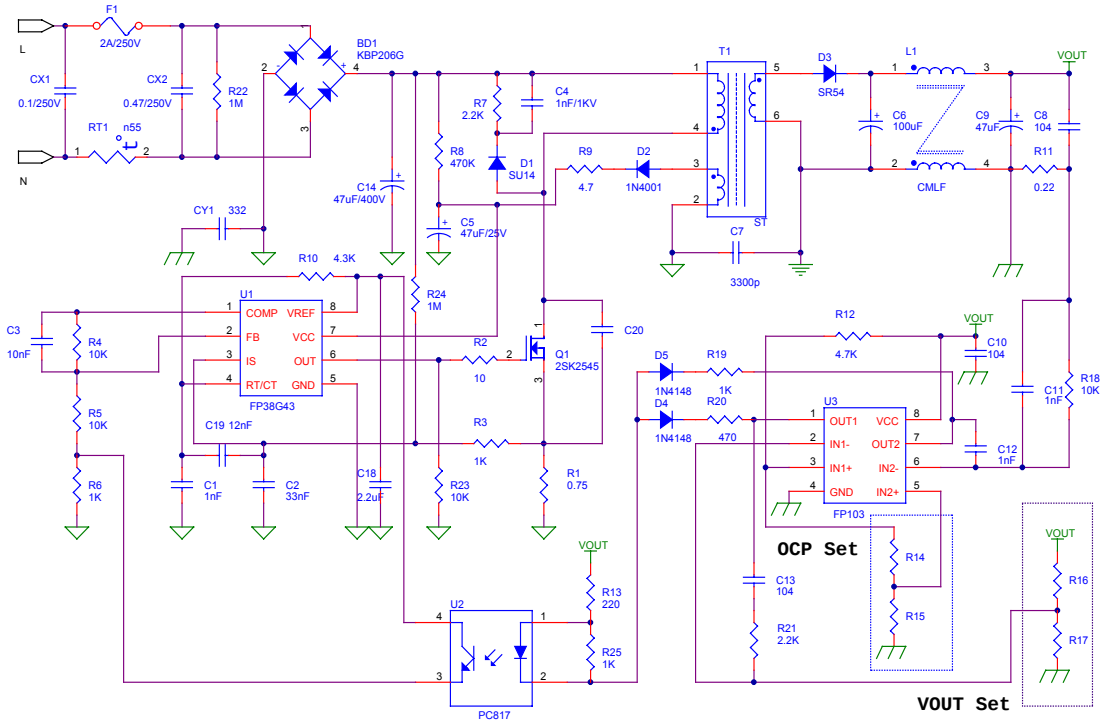
Application Example

This is a simple application circuit for **60W** AC Adaptor example. The gate of MOSFET is connected to pin6 of **FP38G43**, and PWM duty is determined by EA feedback signal from the photo coupler and **R1** sense voltage.

The initial start-up voltage of **FP38G43** comes from AC line and through **R8**, and normal supply voltage is available until the T1 transformer converted the store energy to T1 primary side output through **D2** and **R9** to **FP38G43**.

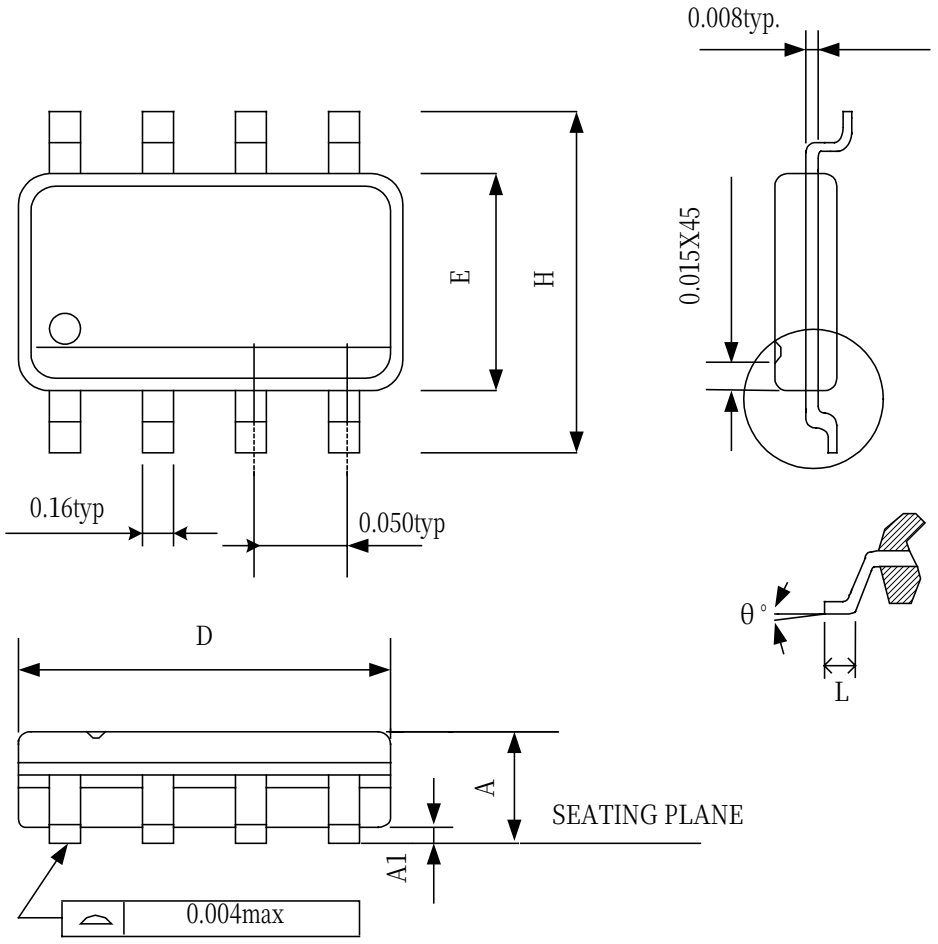
The V_{REF} voltage of **FP103** with **R16** and **R17** determine the output voltage of VOUT.

The V_{REF} voltage of **FP103** with **R11**, **R14** and **R15** determine the over current value.



PACKAGE OUTLINE

SOP8

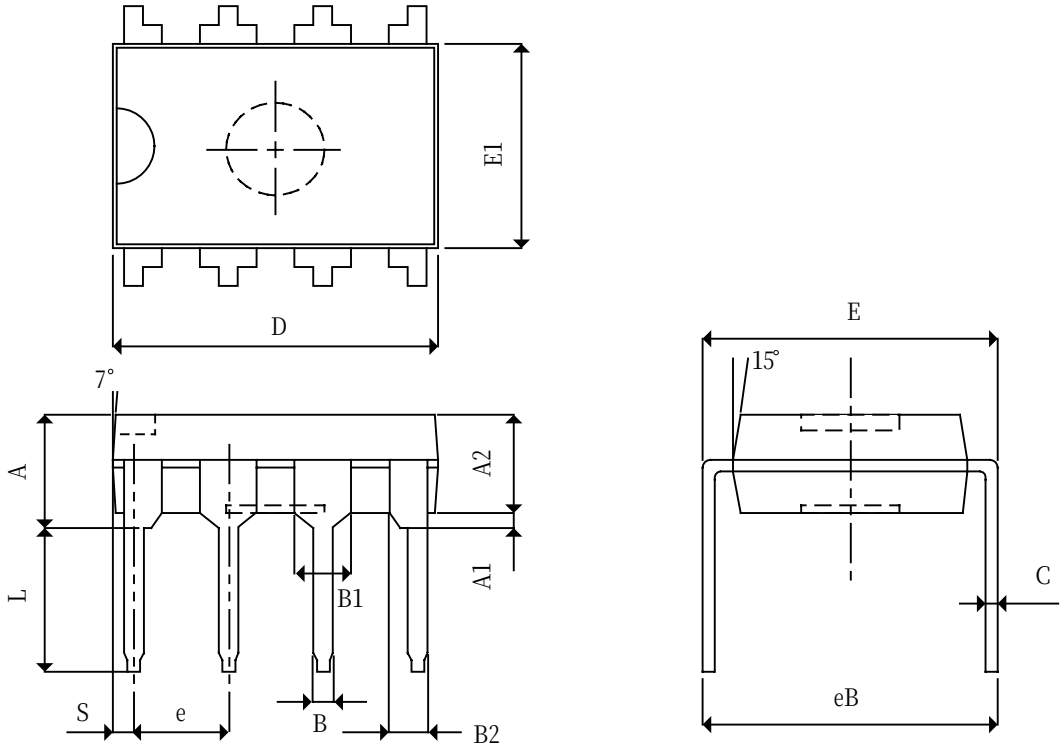


SYMBOLS	MIN	MAX
A	0.053	0.069
A1	0.004	0.010
D	0.189	0.196
E	0.150	0.157
H	0.228	0.244
L	0.016	0.050
θ °	0	8

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.

PDIP8



SYMBOLS	MIN	MAX
A	0.142	0.165
A1	0.015	----
A2	0.128	0.136
B	0.014	0.022
B1	0.055	0.065
B2	0.032	0.046
C	0.008	0.013
D	0.359	0.375
E	0.300	0.325
E1	0.244	0.260
e	0.095	0.110
L	0.125	
eB	0.330	0.370
S	0.028	0.038

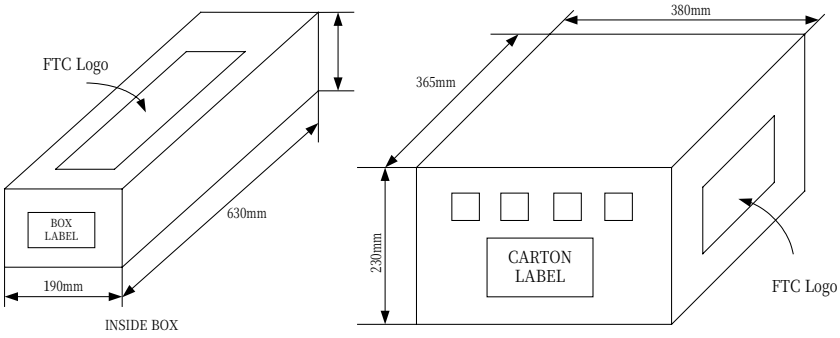
NOTE:

1. CONTROLLING DIMENSION: INCH
2. TOLERANCE: 0.010” UNLESS OTHERWISE SPECIFIED.
3. PACKAGE DIMENSION EXCLUDE MOLDING FLASH.
4. PACKAGE DIMENSIONS ARE IN COMPLIANCE WITH JEDEC STANDARD MS-001 AB JUL85’ ISSUE B.

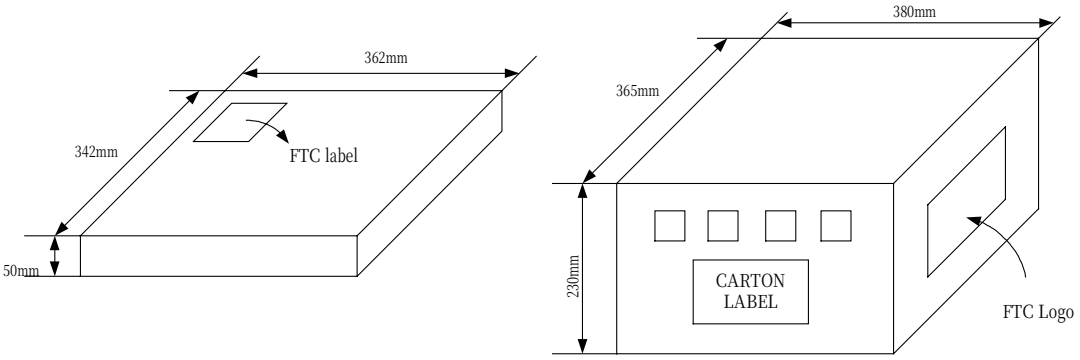
PACKING SPECIFICATIONS

BOX DIMENSION

TUBE INSIDE BOX AND CARTON



TAPE & REEL INSIDE BOX AND CARTON



PACKING QUANTITY SPECIFICATIONS

100 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 : FP38G43DR-LF
Lot No : A3311C62
D/C : 6Xx-XXL
Q'ty : ◎ ◎

無鉛
Lead Free

CARTON

Feeling Technology Corp.

Product Type: FP38G43DR-LF

Lot No: A3311C62

Date Code: 6Xx-XXL

Package Type: SOP-8L

Marking Type: Laser

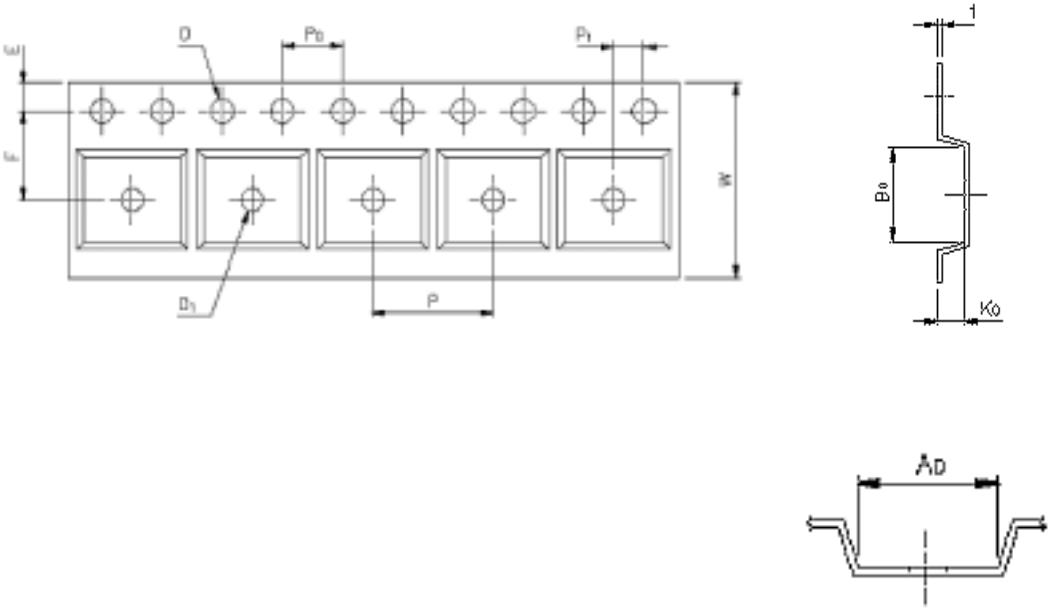
Total Q'ty: 10,000

無鉛
Lead Free

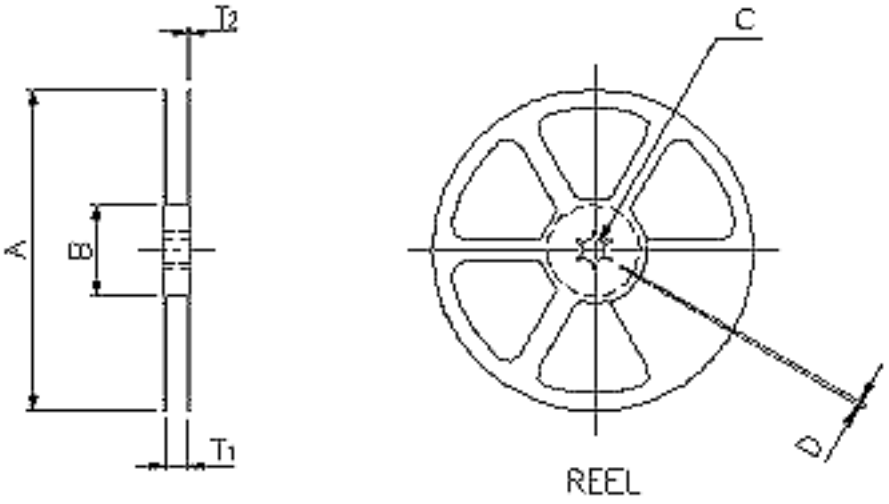
CARRIER TAPE DIMENSIONS

APPLICATION	W	P	E	F	D	D_1
SOP8	$12.0^{+0.3}_{-0.1}$	8.0±0.1	1.75±0.1	5.5±0.1	1.55±0.1	$1.5^{+0.25}$

APPLICATION	P_0	P_1	A_0	B_0	K_0	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 DIMENISIONS



APPLICATION	MATERIAL	A	B	C	D	T_1	T_2
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