DD313

3-CHANNEL HIGH CONSTANT CURRENT LED DRIVER

with ERROR DETECTION

點晶科技股份有限公司
SILICON TOUCH TECHNOLOGY INC.
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3-CHANNEL HIGH CONSTANT CURRENT LED DRIVER
with ERROR DETECTION

General Description

DD313 is a high constant current driver designed   for power LED applications. It incorporates three-channel constant current circuitry with c urrent value set by three external resistors. The three enable pins are specifically designed for independent control over each of the three output terminals. The fast response of the output current can adap t to high dimming resolution and high refresh rate applications. Built-in LE D open detection, ov er te mperature, and over cu rrent protection function s ensure the system reliability.

Features

- Three channel with independent dimming control and current adjustment
- Maximum output current: 500mA determined by three external resistors
- Minimum output voltage: 1V (Iout = 500mA)
- Maximum output voltage: 18V
- Fast output current response
- Supply voltage range: 5V ~ 18V
- Over current protection
- LED open detection
- Thermal alarm (junction temperature > 110°C)
- Thermal shutdown (junction temperature > 180°C)
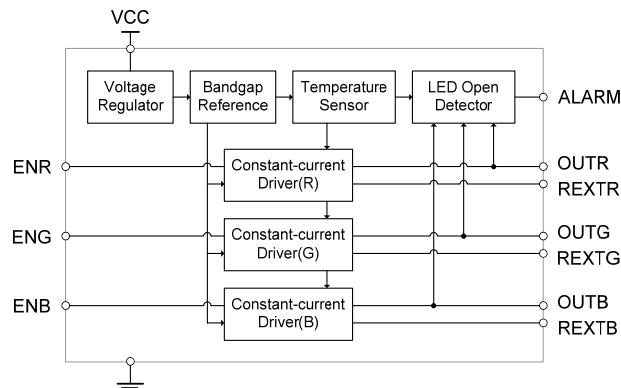
Applications

- LED architectural or entertainment lighting
- LED general or specialty illumination
- LED backlighting applications
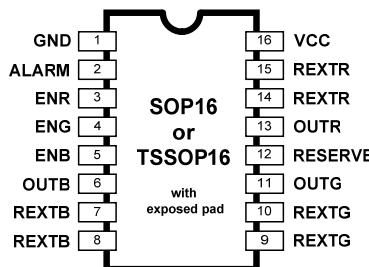
Package Types

- SOP16 (with exposed pad), TSSOP16 (with exposed pad)

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Block Diagram

Pin Connection

Pin Description

PIN No.	PIN NAME	FUNCTION
SOP16/TSSOP16: 1	GND	Ground terminal.
SOP16/TSSOP16: 2	ALARM	Output open drain terminal: (connected to a pull-high resistor) **'H'** means normal conditions, **'L'** means LED open or chip overheated.
SOP16/TSSOP16: 3,4,5	ENR,G,B	Output current enable terminal.
SOP16/TSSOP16: 6,11,13	OUTB,G,R	Sink constant current outputs (open-drain).
SOP16/TSSOP16: 7,8,9,10,14,15	REXTB[*1] REXTG[*1] REXTR[*1]	External resistors connected between REXT and GND for driver current value setting.
SOP16/TSSOP16: 12	RESERVE	Terminal for testing, user should leave this pin open.
SOP16/TSSOP16: 16	VCC	Power supply terminal.

[*1] Notice that both REXT pins (pin7 and 8, pin9 and 10, pin14 and 15) should be connected in PCB layout.

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Maximum Ratings (Ta=25°C, Tj(max) = 140°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	VCC	-0.3 ~ 18	V
Input Voltage	VIN	-0.3 ~ VCC	
Output Current	Iout	0.5	A
Output Voltage	Vout	-0.3 ~ 18	V
Enable Voltage	VEN	-0.3 ~ 18	
GND Terminal Current	IGND	1.5	A
Power Dissipation	Pd	3.3 (TSSOP16 with exposed pad) 2.7 (SOP16 with exposed pad)	W
Thermal Resistance (Junction to Air)	Rth(j-a) [*1]	38 (TSSOP16 with exposed pad) 46 (SOP16 with exposed pad)	°C/W
Operating Temperature	Top	-40 ~ 85	°C
Storage Temperature	Tstg	-55 ~ 150	

Recommended Operating Condition

CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	VCC	—	5.0	—	18	V
Output Voltage	Vout	Driver On [*2]	0.8	—	—	V
		Driver Off [*3]	—	—	18	
Output Current	Iout	OUT(R, G, B)	—	—	0.5	A
Input Enable Voltage [*4]	VIH	VCC = 5V ~ 18V	3.0	—	18	V
	VIL		-0.3	—	0.7	
Input Enable Frequency	FEN	Ven > 3.0V	DC	—	1	MHz

[*1] Base on JEDEC high conductivity test board (4-layer) simulation.
[*2] The power dissipation is limited to its package and ambient temperature.
[*3] The driver output voltage including any overshoot stress has to be compliant with the maximum voltage (18V).
[*4].To avoid destroying the ESD protection circuit, the input enable voltage should be lower than the supply voltage.

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Electrical Characteristics (Ta = 25°C unless otherwise noted)

CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Input Enable Voltage "H" Level	$V_{EN(IH)}$ 3.0	VCC = 5.0 V ~ 18 V		—	18	V
Input Enable Voltage "L" Level	$V_{EN(IL)}$		-0.3	—	1.0	
Output Leakage Current	I_{OL}	Vout = 18 V Ven (R,G,B) = 0 V	—	—	1.0	uA
Output Current Skew (Channel-to-Channel) [1]	I_{OL1}	Vout = 1.0 V Iout = 50mA ~ 0.5A	—	—	±3	%
Output Current Skew (Chip-to-Chip) [2]	I_{OL2}		—	—	±6	
Output Voltage Regulation	% / Vout	Vout = 1 V ~ 3 V REXT = 1 Ω	—	0.1	—	% / V
Supply Voltage Regulation [3]	% / VCC	REXT = 1 Ω	—	0.1	—	
LED Open Detection Threshold	V(od)	all outputs turn on	—	0.3	—	V
Alarm threshold temperature	Talm	REXT = 1 KΩ all outputs turn on	—	110	—	°C
Shutdown threshold temperature	Tstd		—	180	—	
Supply Current [4]	I_{DD1}	VCC = 5 V REXT = 1 Ω all outputs turn on	—	1.2	—	mA
	I_{DD2}	VCC = 12 V REXT = 1 Ω all outputs turn on	—	2.4	—	
	I_{DD3}	VCC = 18 V REXT = 1 Ω all outputs turn on	—	3.3	—	

[1] Channel-to-channel skew is defined as the ratio between (any Iout – average Iout) and average Iout, where average Iout = (Imax + Imin) / 2.
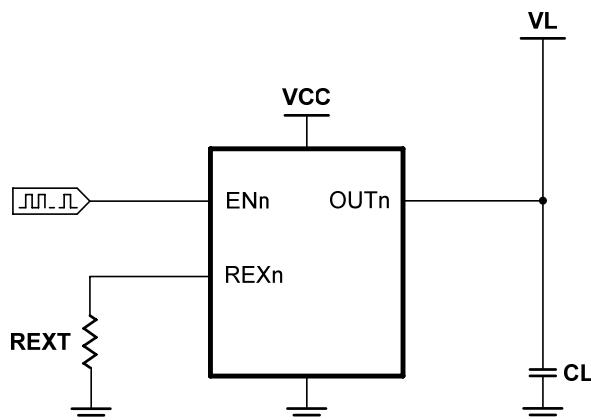
[2] Chip-to-Chip skew is defined as the range into which any output current of any IC falls.

[3] To operate driver within supply voltage 6.5V~8.5V may drop the output current due to semiconductor process variations.

[4] IO excluded.
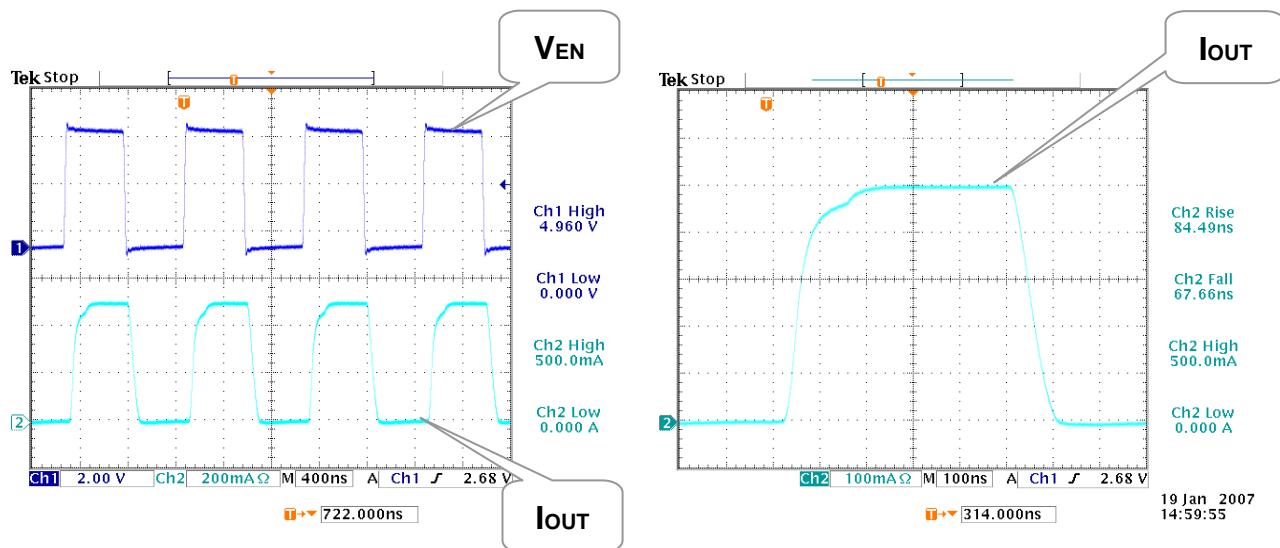
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Switching Characteristics (Ta = 25°C unless otherwise noted)

CHARACTERISTIC		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Delay ('L' to 'H')	EN-to-OUT (Driver On)	tpLH	VIH = 5 V	—	65	—	ns
Propagation Delay ('H' to 'L')	EN-to-OUT (Driver Off)	tpHL	VIL = 0 V REXT = 1 Ω	—	65	—	
Output Current Rise Time		tor	VCC = 12 V VL = 5 V	—	50	—	
Output Current Fall Time		tof	CL = 13 pF	—	60	—	

Switching Characteristics Test Circuit

Transient Characteristics

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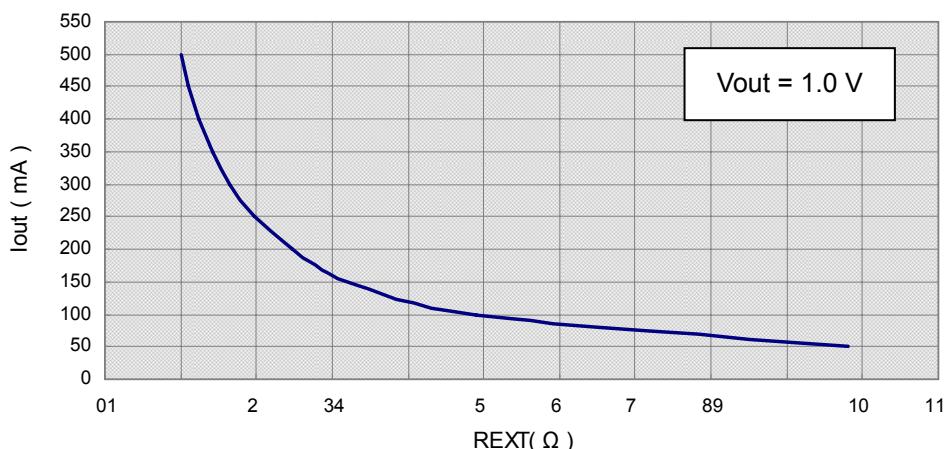
Constant-Current Output
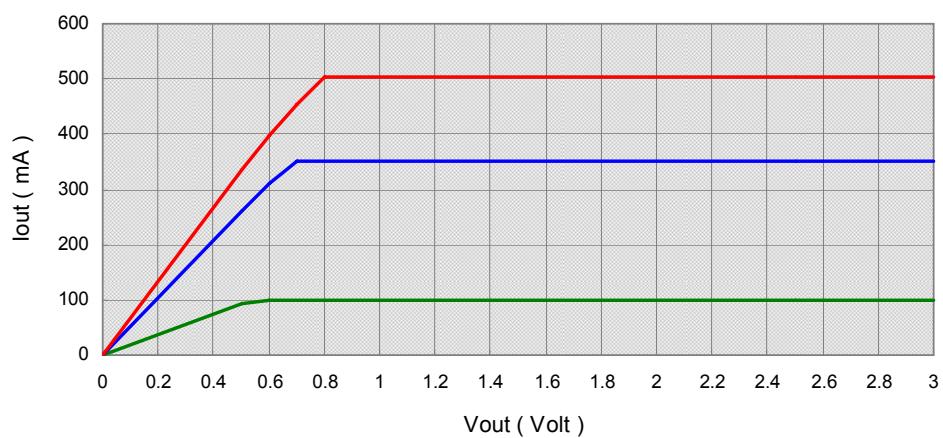
Constant-current value of each out put channel is set by an extern al resistor connected between the REXT(R, G, B) pin and GND individually. Varying the resistor value can adjust the current up to 500mA. Notice tha t th e outpu t c urrent is a   litt le increasing o r de creasing until the device temperature and am bient tem perature are bala nced. The m aximum power dissipation of the determined external resistor should be lar   ge enough than the actual power consum   ption: $0.5(V) \times Iout(A)$ need to be considered. Approxim   ate out put current va lue can be calculated by following equation:

$$\mathbf{IOUT_{(R,G,B)}(A) \simeq 0.5\ (V)\ /\ REXT_{(R,G,B)}(\Omega)}$$

Output Current as a Function of REXT value

Vout = 1.0 V

Output Current as a Function of Output Voltage

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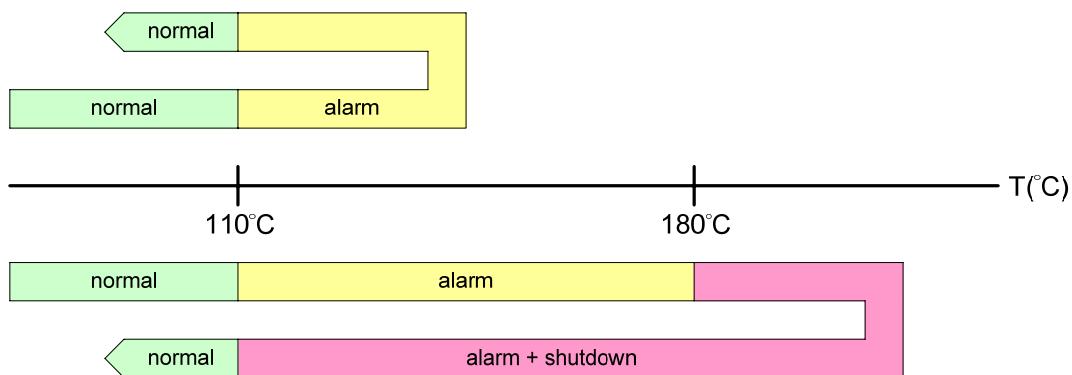
Alarm Function

It can detect the operating stat us by connecting a pul l-high resistor to the open-drain ALARM pin. The ALARM pin is kept 'H' for normal conditions, and shifted to 'L' if there is any failure like LED open, overheating or both occurrence. User can   determine the dif ferent sta tus f rom the truth table below:

ALARM	ENR	ENG	ENB	Status
H	don't care	don't care	don't care	Normal Operation
H→L	H	L	L	OUT**R** LED Open or Thermal issue
H→L	L	H	L	OUT**G** LED Open or Thermal issue
H→L	L	L	H	OUT**B** LED Open or Thermal issue
H→L	L	L	L	Thermal Alarm or Shutdown

Thermal Alarm and Shutdown

During operation, when the junction temperature of the IC will reach about 110℃, the ALARM pin will sh ift to low lev el and prod uce a warning si gnal. Suggested cooling measures is to start the fan, lower the output currents and etc. If no   cooling m easures were activated, the junction temperature m ight continue to rise.   Once it reaches approxim ately above 180 ℃, it will cause the driver to shutdown all the outputs. Basically, the IC will cool down and return to th e safe operating temperature which is ap proximately below 110℃. The ALARM pin will rese t to h igh level, disable the warning, and restart all the outputs at the same time. Operation in the thermal situation for a long time may cause chip damage permanently.


Relations between Alarm Function and Junction Temperature

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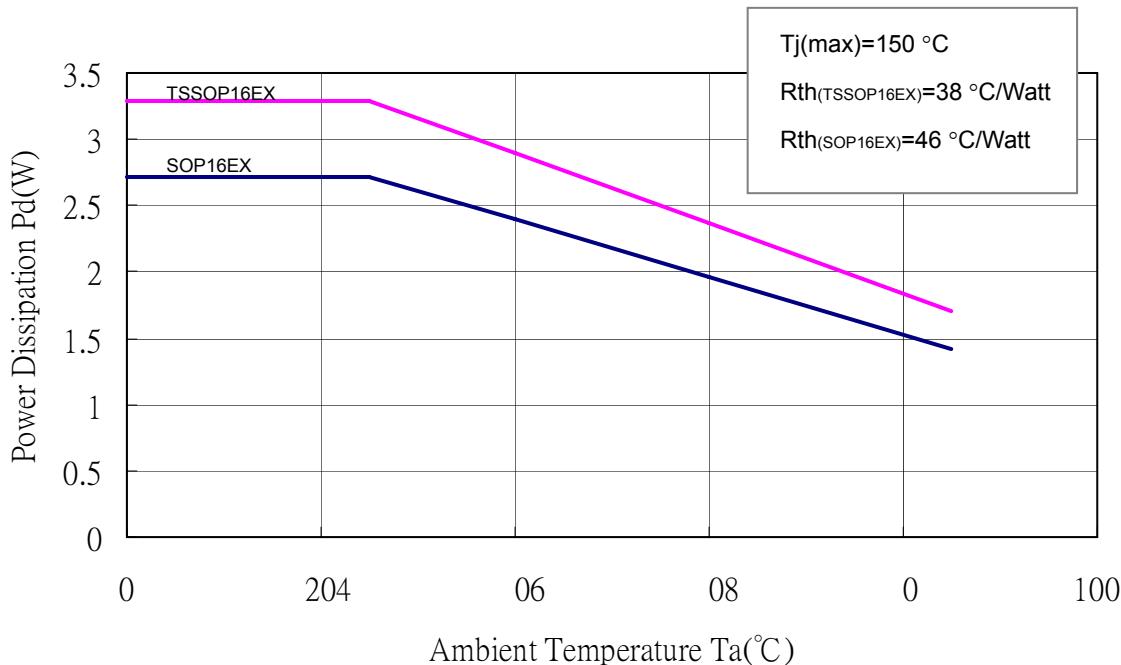
Power Dissipation

The power dissipation of a sem   iconductor chip is lim ited to its package and am   bient temperature, in which the device requires th   e maximum output current calculated for given operating conditions. The m   aximum allowable pow   er consum ption can be calculated by the following equation:

$$Pd(max)(Watt) = \frac{Tj(junction\ temperature)(max)(\,^{\circ}C) - Ta(ambient\ temperature)(\,^{\circ}C)}{Rth(junction\text{-}to\text{-}air\ thermal\ resistance)(\,^{\circ}C/Watt)}$$

The relationship between power dissipation and operating tem perature can be refer t o t he fi gure below:

Tj(max)=150 °C

Rth$_{(TSSOP16EX)}$=38 °C/Watt

Rth$_{(SOP16EX)}$=46 °C/Watt

Based on the Pd(max), the maximum allowable voltage of output term inal can be determined by the following equation:
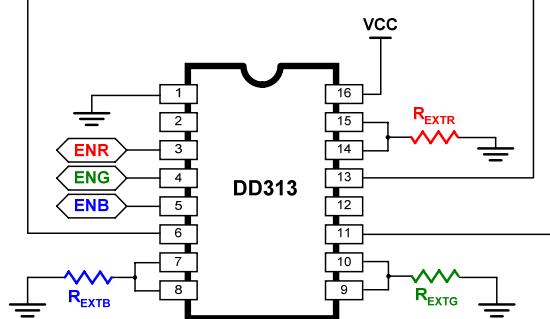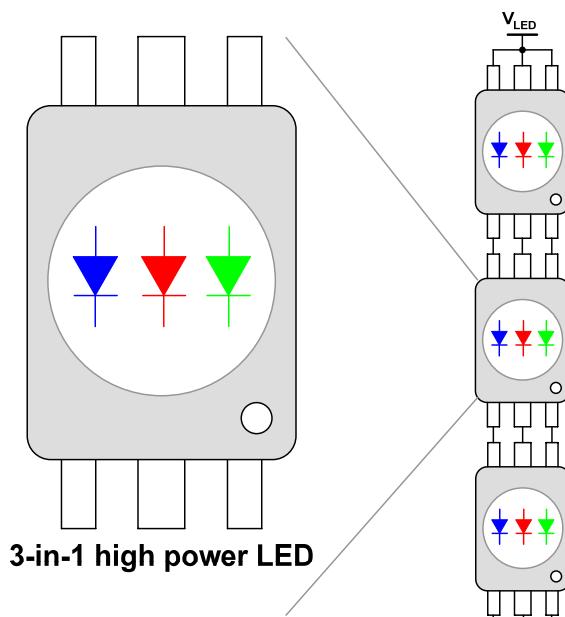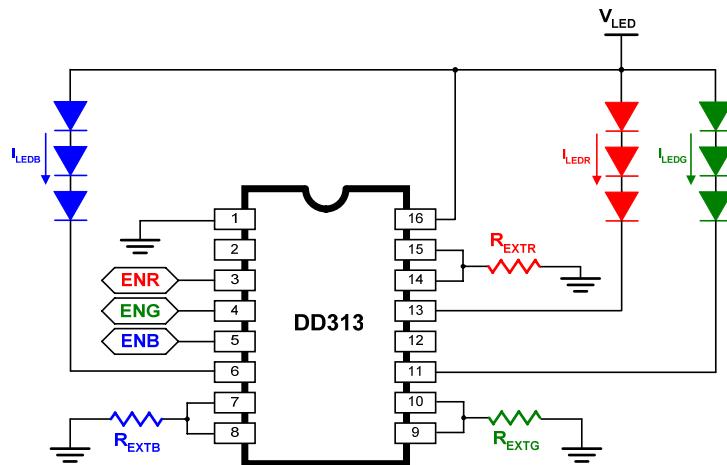
$$VoutR \times IoutR \times DutyR + VoutG \times IoutG \times DutyG + VoutB \times IoutB \times DutyB \leq Pd(max)(W) - Vcc(V) \times I_{DD}(A)$$

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Typical Application

3-in-1 high power LED

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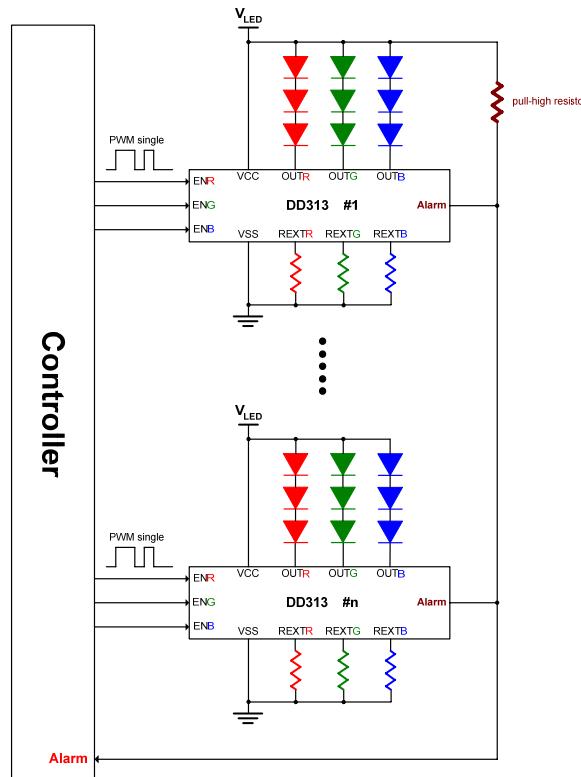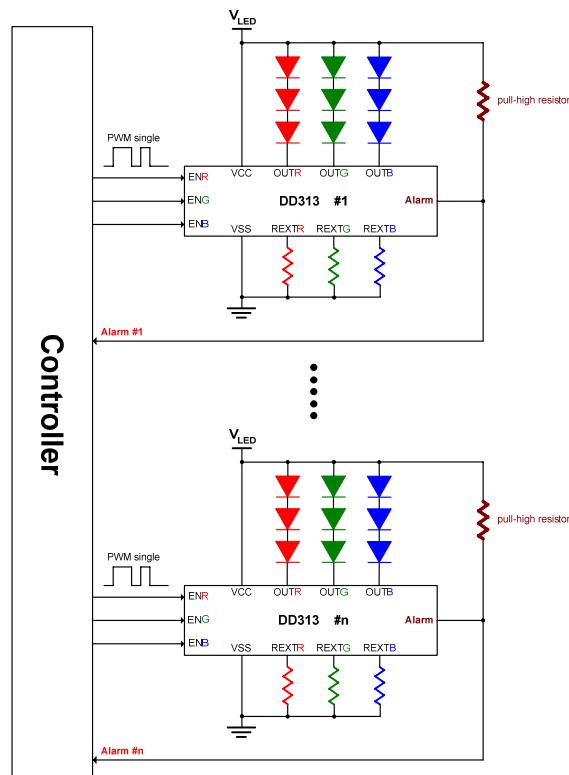
DD313

Typical Application
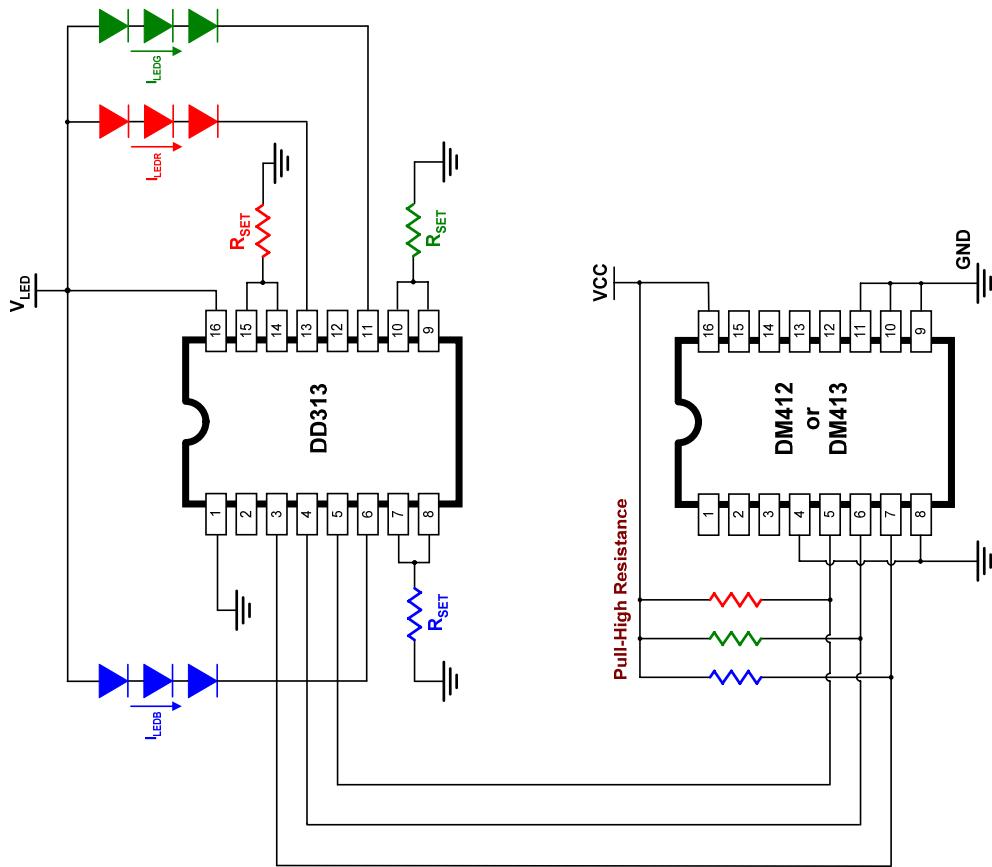
Feedback Alarm signal with only one pull-high resistor

Independent feedback Alarm signal

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Typical Application
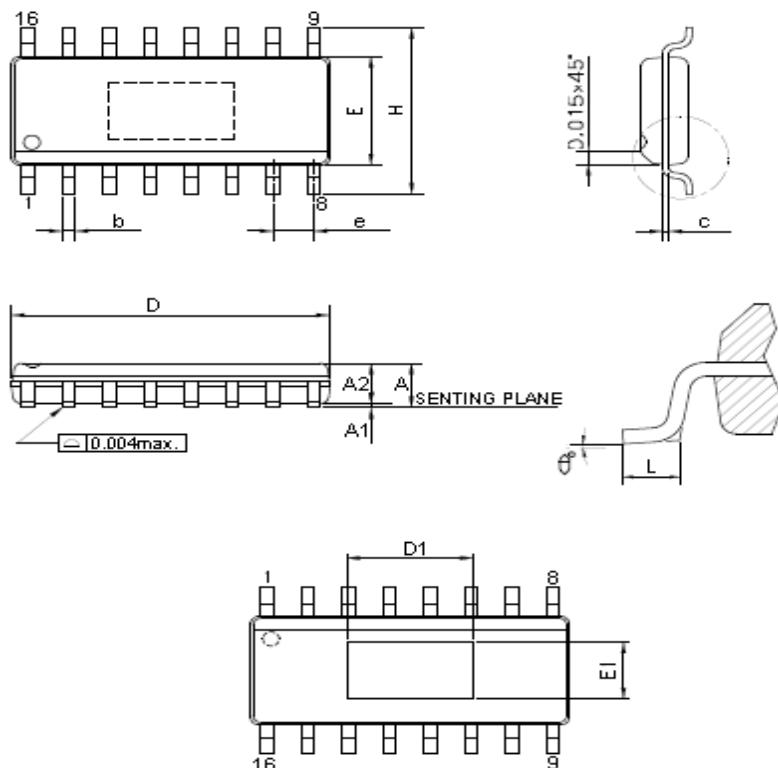
DD313 is specifically designed to withstand high frequency switching signal (1Mhz max) while providing high current driving capability. By connecting ENABLE pin to a PWM signal output, system will adapt to precise dimming control. In this display of a typical application, a PWM enabled RGB driver DM412/DM413 is configured to act as PWM signal generator. Through serial data input, DM412/DM413 can generate maximum of 16/14 bits RGB PWM grayscale signal to control the three channel of DD313. The combination of DD313 and DM412/DM413 offers an ideal solution for high end grayscale control and color manipulation.

DM412/DM413 is a three-channel constant current LED driver specifically designed for LED lighting or display applications. It incorporates shift registers, data latches, and built-in oscillator for PWM functioning. Data and clock buffer outputs are designed for cascading another chip. Additionally the Output Polarity Reverse function make DM412/DM413 can be a PWM signal generator.

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Package Outline Dimension

SOP16 (exposed pad)
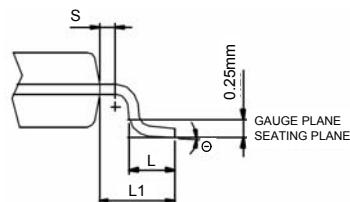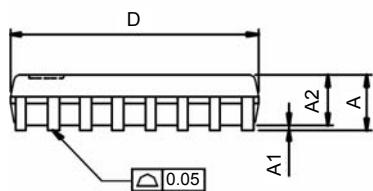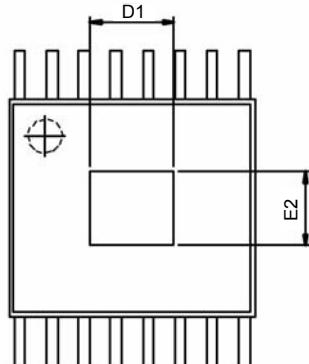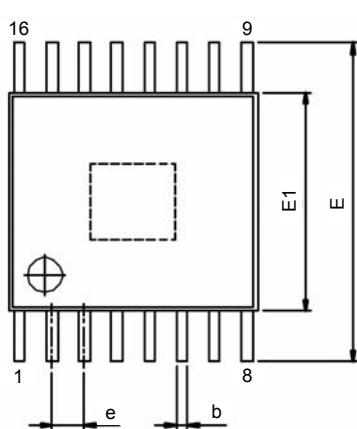
SOP16(EP)-150mil		mm	
SYMBOLS	MIN.	TYP.	MAX.
A	1.346	-	1.753
A1	0.051	-	0.152
A2	1.245	-	1.651
b	0.406 BSC		
c	0.203 BSC		
D	9.804	-	10.008
E	3.810	-	3.988
e	1.270 BSC		
H	5.791	-	6.198
L	0.406	-	1.270
θ°	0	-	8
PAD SIZE1　(95×18E)			
E1	1.930	-	2.413
D1	3.658	-	4.572

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Package Outline Dimension

TSSOP16 (exposed pad)

TSSOP16(EP)	mm		
SYMBOLS	MIN.	TYP.	MAX.
A	-	-	1.200
A1	0.000	-	0.150
A2	0.800	1.000	1.050
b	0.190	-	0.300
D	4.900	5.000	5.100
E1	4.300	4.400	4.500
E	6.400 TYP		
e	0.650 TYP		
L1	1.000 REF		
L	0.450	0.600	0.750
S	0.200	-	-
θ°	0	-	8
PAD SIZE　(118×11E)			
E2	2.400	-	3.000
D1	2.400	-	3.000

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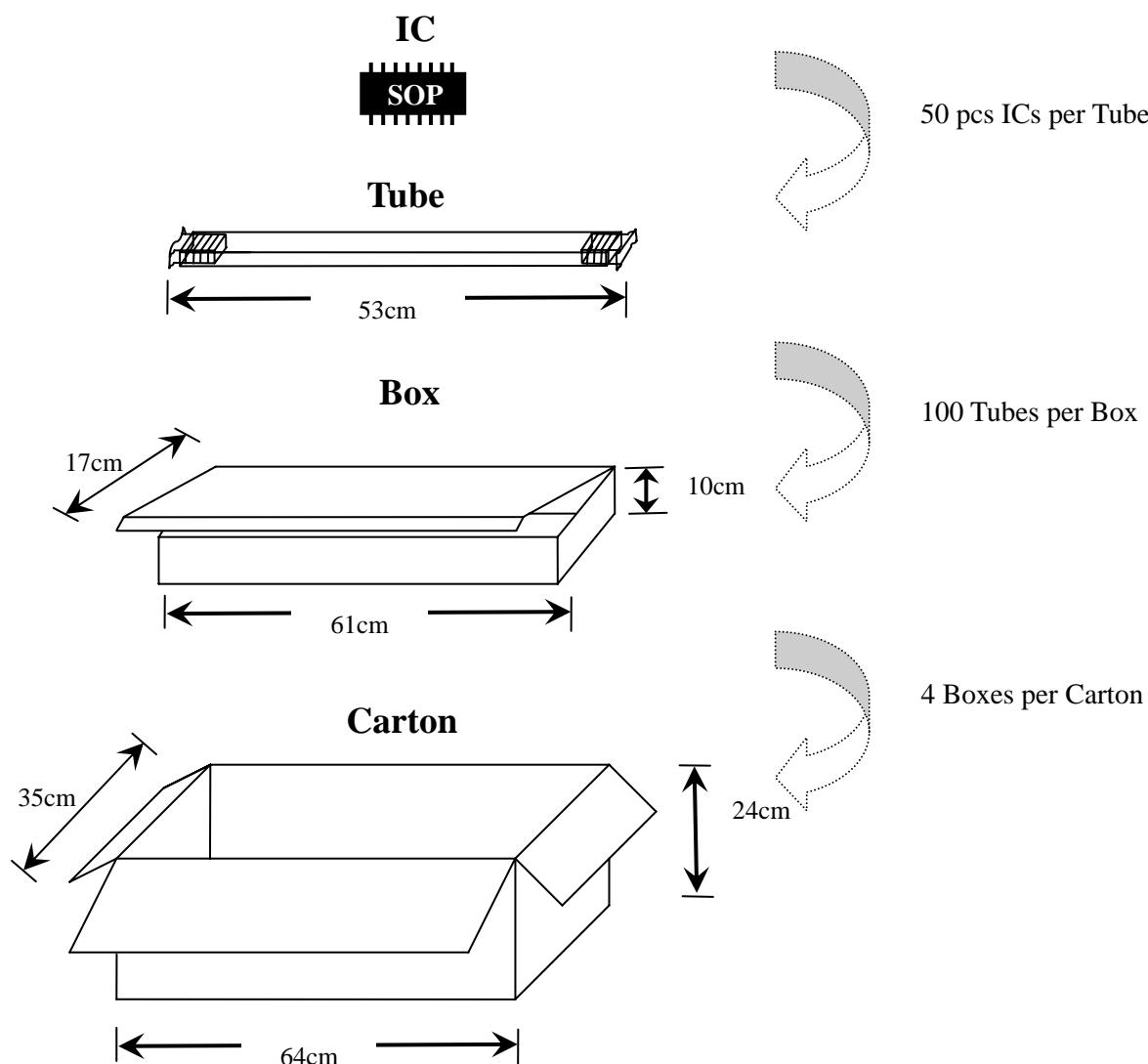
Product Ordering Information

Part Number	Package Type	Number / Weight (typ.)	
		Tube / Tray	**Reel (Box included)**
DD313-SOP	SOP16-150-0.05	50pcs / Tube 0.017kg ± 5%	2,500pcs / Reel 0.97kg ± 5%
DD313-TSSOP	TSSOP16-173-0.65	96pcs / Tube 0.014kg ± 5%	2,500pcs / Reel 0.74kg ± 5%

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DD313-SOP Package and Weight（4 Boxes Set）

SOP16 - 150 - 0.05
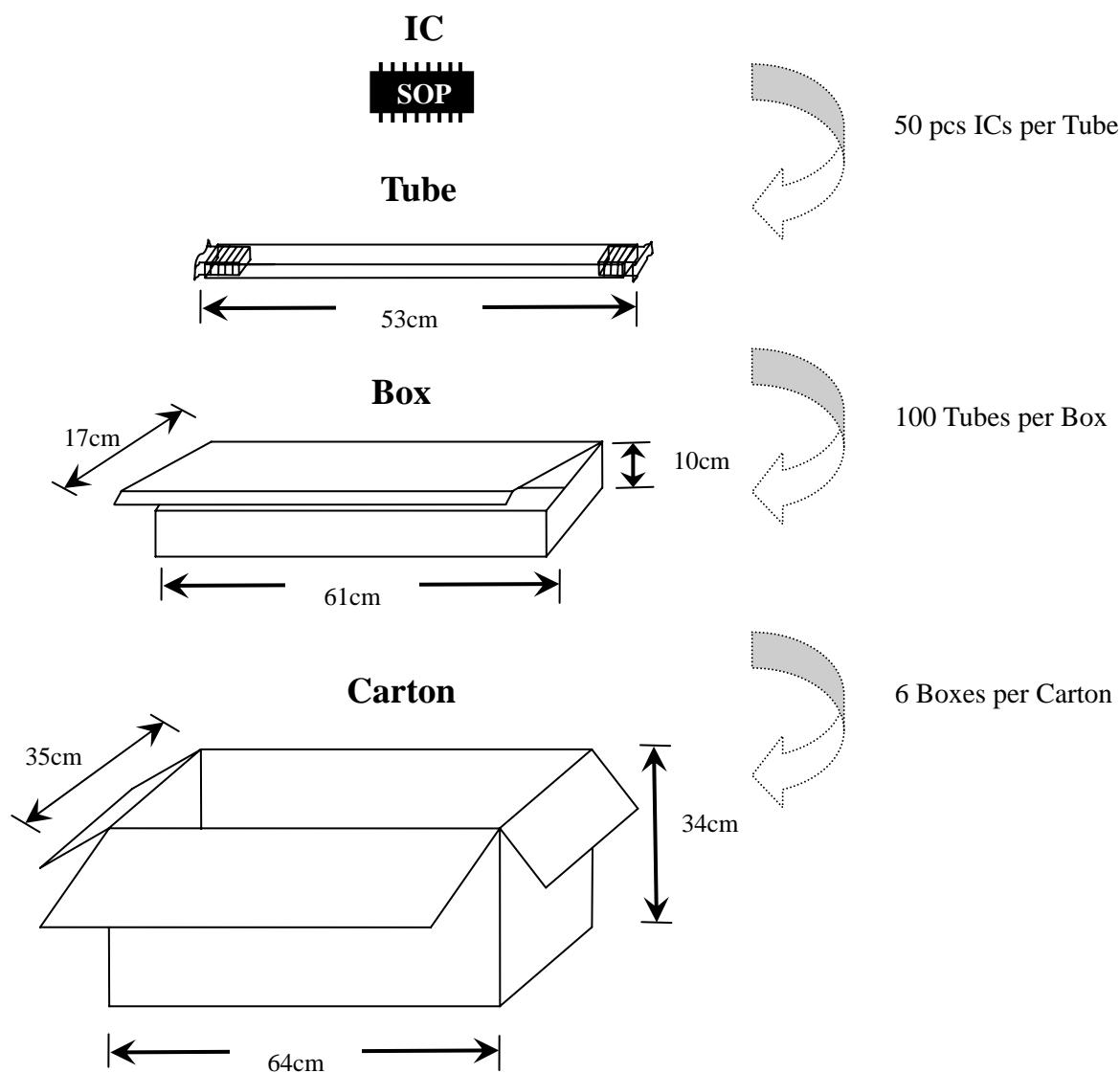
IC

SOP

50 pcs ICs per Tube

Tube

53cm

Box

100 Tubes per Box

17cm

10cm

61cm

Carton

4 Boxes per Carton

35cm

24cm

64cm

Weight

Item	Description	Weight（Kg）
1	50 pcs DD313-SOP per Tube	0.017±5%
2	Net Weight of one Box	0.40±5%
3	Net Weight of one Carton	1.24±5%
4	Per Carton Set（4 Boxes, 20,000 pcs）	9.64±5%

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DD313-SOP Package and Weight（6 Boxes Set）

SOP16 - 150 - 0.05
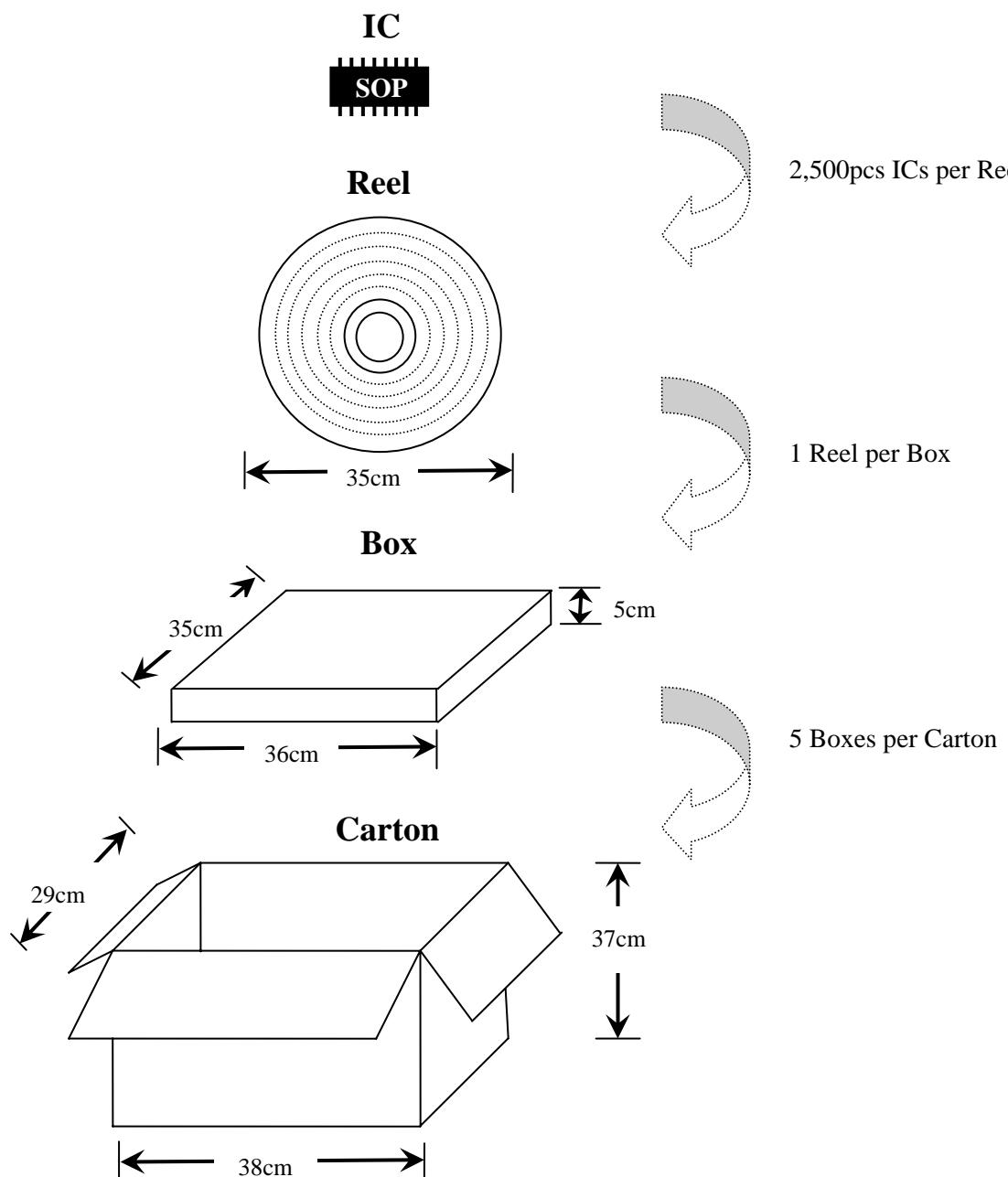
IC

SOP

50 pcs ICs per Tube

Tube

53cm

Box

17cm

10cm

61cm

100 Tubes per Box

Carton

35cm

34cm

64cm

6 Boxes per Carton

Weight

Item	Description	Weight（Kg）
1	50 pcs DD313-SOP per Tube	0.017±5%
2	Net Weight of one Box	0.40±5%
3	Net Weight of one Carton	1.44±5%
4	Per Carton Set（6 Boxes, 30,000 pcs）	14.04±5%

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DD313

DD313-SOP Package and Weight

SOP16 - 150 - 0.05

IC

SOP

Reel

35cm

2,500pcs ICs per Reel

1 Reel per Box

Box

35cm

5cm

36cm

5 Boxes per Carton

Carton

29cm

37cm

38cm
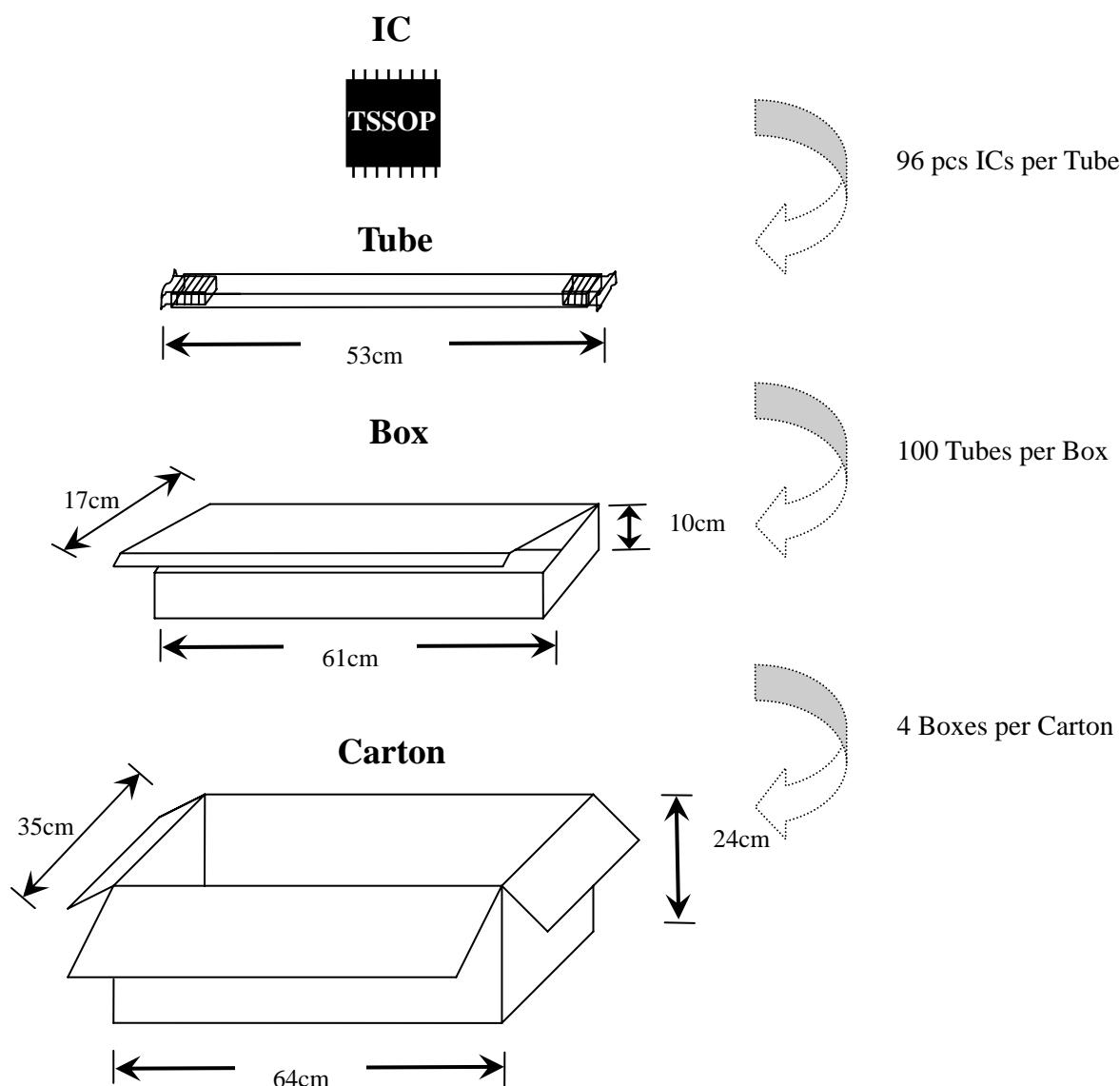
Weight

Item	Description	Weight (Kg)
1	2,500 pcs DD313-SOP per Reel	0.97±5%
2	Net Weight of one Box	0.24±5%
3	Net Weight of one Carton	0.90±5%
4	Per Carton Set (5 Boxes, 12,500 pcs)	6.95±5%

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SILICON TOUCH TECHNOLOGY INC.
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9-7F-1, Prosperity Road 1 , Hsin-Chu, Taiwan, R.O.C.
Tel：886-3-5645656　　F ax：886-3-5645626

DD313-TSSOP Package and Weight（4 Boxes Set）

TSSOP - 173 - 0.65

IC

TSSOP

96 pcs ICs per Tube

Tube

53cm

100 Tubes per Box

Box

17cm

10cm

61cm

4 Boxes per Carton

Carton

35cm

24cm

64cm

Weight

Item	Description	Weight（Kg）
1	96 pcs DD313-TSSOP per Tube	0.014±5%
2	Net Weight of one Box	0.40±5%
3	Net Weight of one Carton	1.24±5%
4	Per Carton Set（4 Boxes, 38,400 pcs）	8.44±5%

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DD313

DD313-TSSOP Package and Weight（6 Boxes Set）

TSSOP - 173 - 0.65

IC

TSSOP

96 pcs ICs per Tube

Tube

53cm

100 Tubes per Box

Box

17cm

10cm

61cm

6 Boxes per Carton

Carton

35cm

34cm

64cm
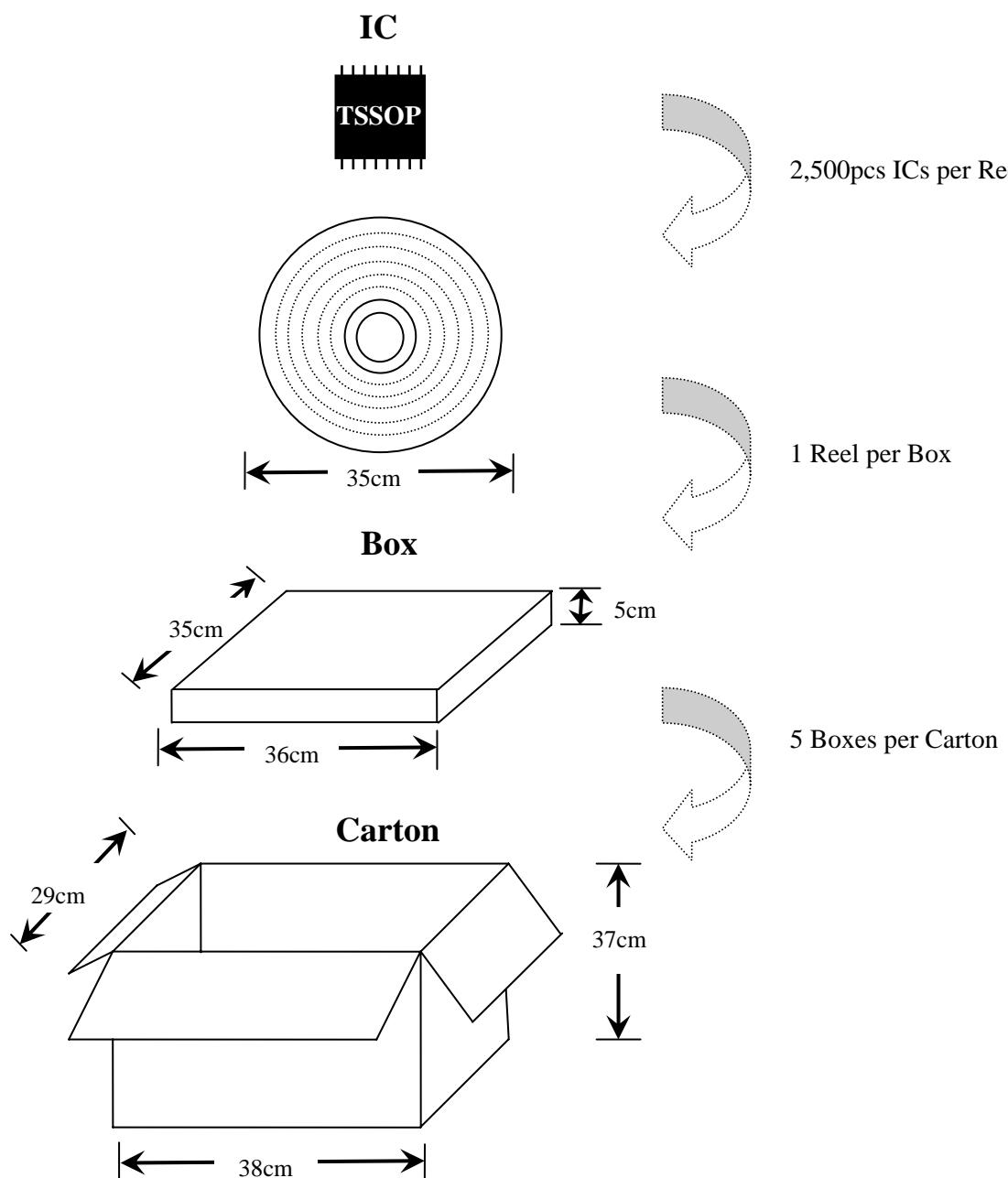
Weight

Item	Description	Weight（Kg）
1	96 pcs DD313-TSSOP per Tube	0.014±5%
2	Net Weight of one Box	0.40±5%
3	Net Weight of one Carton	1.44±5%
4	Per Carton Set（6 Boxes, 57,600 pcs）	12.24±5%

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DD313-TSSOP Package and Weight

TSSOP16 - 173 - 0.65

IC

TSSOP

2,500pcs ICs per Reel

35cm

1 Reel per Box

Box

35cm

5cm

36cm

5 Boxes per Carton

Carton

29cm

37cm

38cm

Weight

Item	Description	Weight (Kg)
1	2,500 pcs DD313-TSSOP per Reel	0.74±5%
2	Net Weight of one Box	0.24±5%
3	Net Weight of one Carton	0.90±5%
4	Per Carton Set (5 Boxes, 12,500 pcs)	5.80±5%

SILICON TOUCH TECHNOLOGY INC.
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DD313

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