LXY28161 USER'S MANUAL

JULY 2008
V1.0

Pay attention to the last page

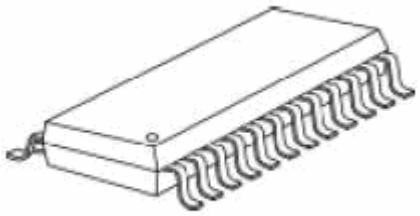
CONTENTS

1 Product Description

LXY28161, the 16-channel constant current LED Driver, is designed for LED video applications using internal Wise Pulse Width Modulation (W-PWM) control with selectable 16-bit color depth. LXY28161 saves the 60 Hz images input data in the 8K RAM, then converts into each pixel gray scale of output channel, all output channels can be built with 65536 gray scales and 4800 Hz refresh rate.

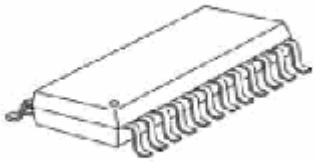
LXY28161 has 16 constant-current output channels. Constant output current is invariant to load voltage change. The output current can be preset through an external resistor. LXY28161 supports static and any scan mode (within 16) led displays. The gray scales and refresh rate is user adjustable.

Small OutLine Package



L:SOP24-300-1.0

Thin Shrink Package



S:SSOP24-150-0.635

1.1 Features

- Backward compatible with main trend 16-channel constant current IC in package
- 16 constant-current output channels
- 16-bit color depth W-PWM control
- Refresh rate up to 4800Hz
- Schmitt trigger input
- Staggered output delay (reduce EMI)
- Over temperature protection
- Constant output current range: 5V, 5~60mA
- Output current accuracy: between channels: ±3%, between ICs: ±6%
- Maximum data clock frequency: 25MHz
- 5V supply voltage

1.2 Applied field

- LED video applications

1.3 Basic Structure Description

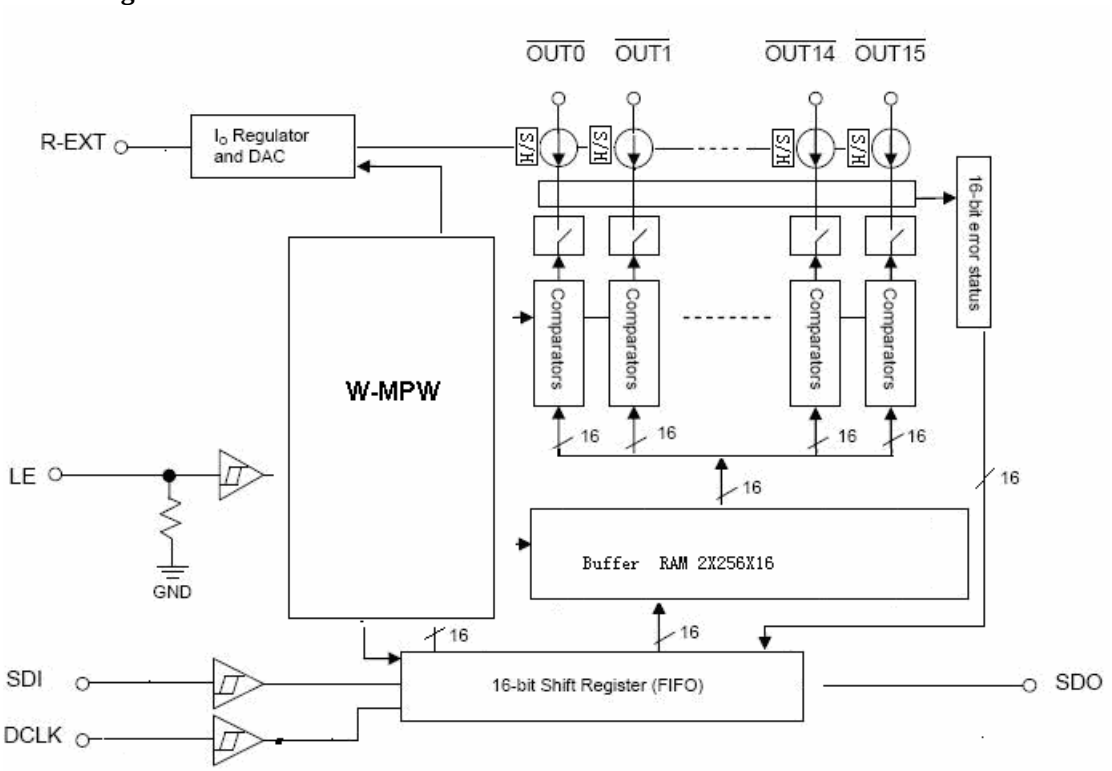
LXY28161 mainly includes serial-data input, Wise Pulse Width Modulation, constant current controlling circuit, constant current output.

2 LXY28161 Specification

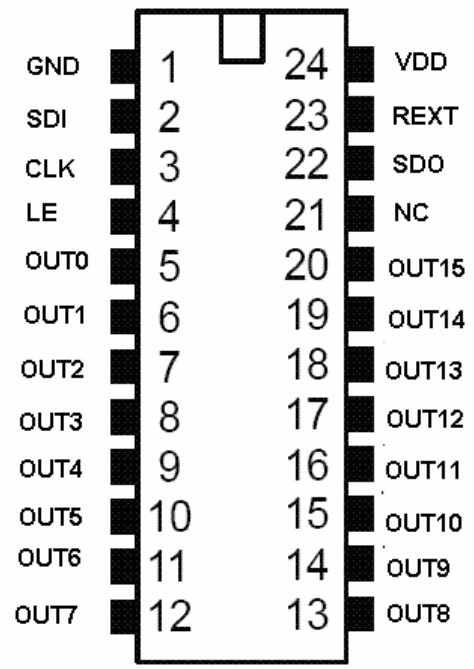
2.1 Block Diagram and Pin Configuration

LXY28161 applies SOP－24 and TSSOP-24 in package outline, Block Diagram and Pin Configuration are as following diagrams:

Block Diagram



Pin Configuration



Pin Name	Pin No.	Type	Function
GND	1	Power	Ground terminal for control logic and current sink
SDI	2	Schmitt trigger input	Serial-data input to the shift register
CLK	3	Schmitt trigger input	Clock input terminal for data shift on rising edge
LE	4	Schmitt trigger input	Data strobe terminal and controlling command with DCLK
OUT0～15	5～20	Output	Constant current output terminal, 5-60mA
NC	21	-	-
SDO	22	Controllable staggered output delay	10ns, 20ns, 30ns selectable. Serial-data output to the receiver-end SDI of next driver IC
R-EXT	23	Controlling	Input terminal used to connect an external resistor for setting up output current for all output channels
VDD	24	Power	5V supply voltage terminal

2.2 Maximum Rating

Characteristic		Symbol	Rating	Unit
Supply Voltage		V_{DD}	7	V
Input Pin Voltage (SDI)		V_{IN}	-0.4～VDD+0.4	V
Output Current		I_{OUT}	+60	mA
Sustaining Voltage at OUT Port		V_{DS}	7	V
Data Clock Frequency		DCLK	+25	MHz
GND Terminal Current		I_{GND}	+1000	mA
Power Dissipation (On PCB, Ta=25° C)	L Type	P_D	2.12	W
	S Type	P_D	1.73	W
Thermal Resistance (On PCB, Ta=25° C)	L Type	$R_{th(j-a)}$	59.1	° C/W
	S Type		72.43	
Operating Temperature		T_{opr}	-40～+85	° C
Storage Temperature		T_{stg}	-55～+150	° C

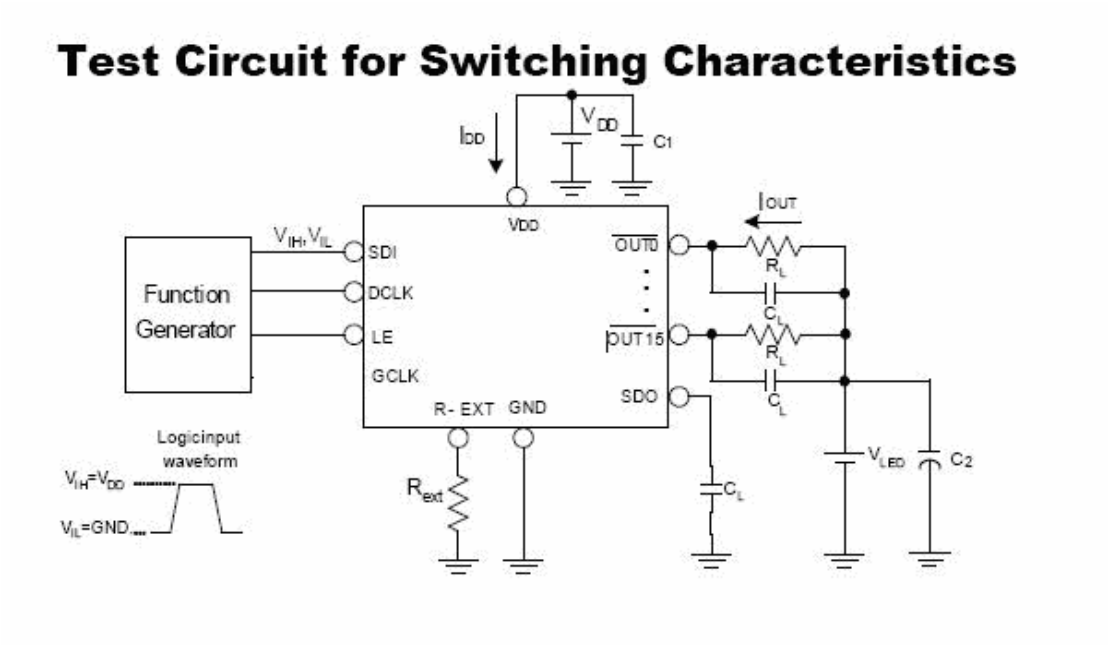
2.3 Electrical Characteristics (V_{DD}=5.0V)

Characteristics		Symbol	Condition		Min.	Typ.	Max.	Unit
Supply Voltage		V_{DD}	-		3.3	5.0	5.5	V
Sustaining Voltage at OUT Ports		V_{DS}	OUT0 ~ OUT15		-	-	VDD+0.4	V
Output Current		I_{OUT}	Refer to "Test Circuit for Electrical Characteristics"		5	-	60	mA
		I_{OH}	SDO		-	-	-6.0	mA
		I_{OL}	SDO		-	-	6.0	mA
Input Voltage	"H" level	V_{IH}	Ta=-40~85ºC		0.7*VDD	-	VDD	V
	"L" level	V_{IL}	Ta=-40~85ºC		GND	-	0.3*VDD	V
Output Leakage Current		I_{OH}	V_{DS}=7.0V		-	-	0.5	μA
Output Voltage	SDO	V_{OL}	I_{OL}=+6.0mA		-	-	0.4	V
		V_{OH}	I_{OH}=-6.0mA		4.6	-	-	V
Current Skew (Channel)		ΔI_{OUT1}	I_{OUT}=10.8mA V_{DS}=1.0V	R_{ext}=1800Ω	-	±1.5	±3.0	%
Current Skew (IC)		ΔI_{OUT2}	I_{OUT}=10.8mA V_{DS}=1.0V	R_{ext}=1800Ω	-	±3.0	±6.0	%
Output Current vs. Output Voltage Regulation		$\%/\Delta V_{DS}$	V_{DS} ＝ 1.0V and 3.0V, R_{ext}=910Ω@21mA		-	±0.1	±0.5	% / V
Output Current vs. Output Voltage Regulation		$\%/dV_{DD}$	V_{DD} ＝ 4.5V and 5.5V		-	±1.0	±5.0	% / V
Pull-down Resistor		R_{IN}(down)	LE		250	500	800	KΩ
Supply Current	"Off"	I_{DD}(off) 1	R_{ext}=Open	OUT0 ~ OUT15 =Off	-	11.4	12.5	mA
		I_{DD}(off) 2	R_{ext}=1800Ω	OUT0 ~ OUT15 =Off	-	12.3	13.5	
		I_{DD}(off) 3	R_{ext}=910Ω	OUT0 ~ OUT15 =Off	-	13.7	15.0	
	"On"	I_{DD}(on) 1	R_{ext}=1800Ω	OUT0 ~ OUT15 =On	-	14.2	15.7	
		I_{DD}(on) 2	R_{ext}=91Ω	OUT0 ~ OUT15 =On	-	16.3	18.5	
Thermal Flag Temperature		TTF	Junction Temperature		135	150	165	° C

2.4 Switching Characteristics（V_{DD}＝5V）

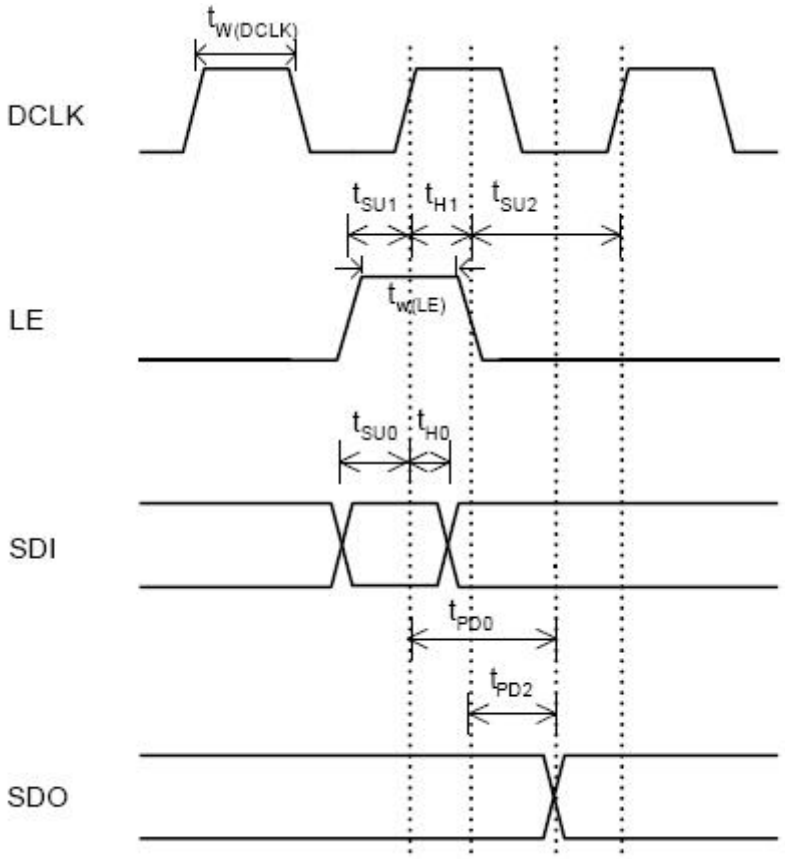
Characteristics		Symbol	Condition	Min.	Typ.	Max	Unit
Setup Time	SDI - DCLK↑	t_{SU0}		1	-	-	ns
	LE↑ – DCLK↑	t_{SU1}		1	-	-	ns
	LE↓ – DCLK↑	t_{SU2}		5	-	-	ns
Hold Time	DCLK↑ - SDI	t_{H0}		3	-	-	ns
	DCLK↑ - LE↓	t_{H1}		7	-	-	ns
Propagation Delay Time	DCLK -SDO (adjustable)	t_{PD0}	VDD=5.0V VIH=VDD VIL=GND	5	10	20	ns
				15	20	30	ns
				25	30	40	ns
				DCLK output to the receiver-end SDI of next driver IC			-
	GCLK – OUT4n	t_{PD1}		*	75	-	ns
Stagger Delay Time	OUT4n + 1*	t_{DL1}	RL=152Ω CL=10pF C1=100nF C2=10μF	-	25	-	ns
	OUT4n + 2 *	t_{DL2}		-	50	-	ns
	OUT4n + 3 *	t_{DL3}		-	75	-	ns
Pulse Width	LE	t_w(L)		5	-	-	ns
	DCLK	t_w(DCLK)		20	-	-	ns
Output Rise Time of Output Ports		t_{OR}		-	10	20	ns
Output Fall Time of Output Ports		t_{OF}		-	10	20	ns
* Refer to the Timing Waveform, when n=0, 1, 2, 3.							

2.5 Test Circuit for Switching Characteristics

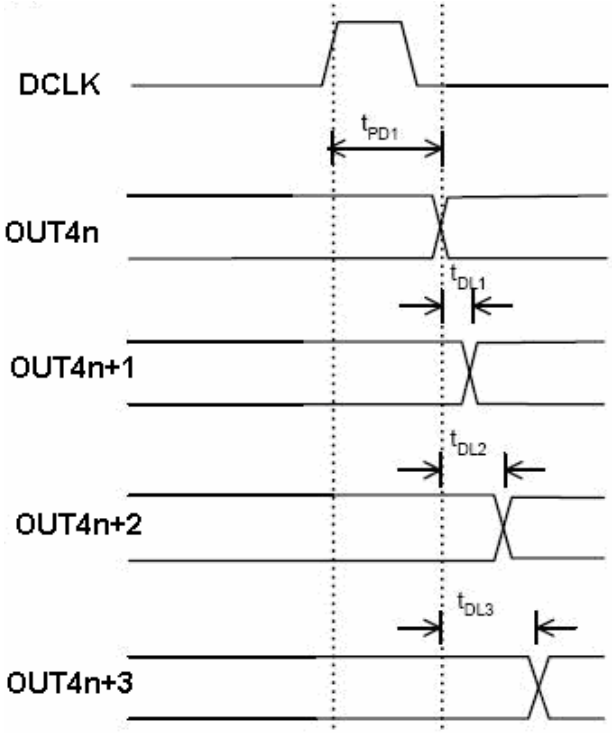


2.6 Timing Waveform

2.6.1 Serial-Port Timing Waveform



2.6.2 Output-Current Channel Timing Waveform



2.7 Constant Current

In LED display application, LXY28161 provides nearly no variation in current from channel to channel and from IC to IC. This can be achieved by:

1) The typical current variation between channels is less than ±3%, and that between IC is less than ±6%.

2) In addition, the output current can be kept constant regardless of LED forward voltages. This guarantees LED to be performed on the same brightness as user's specification.

2.8 Setting Output Current

The output current (I_{OUT}) is set by an external resistor, $R_{ext.}$ The default relationship between I_{OUT} and R_{ext} is:

$$V_{R-EXT}=1.26V \ ;$$

$$I_{OUT}=(V_{R-EXT}/R_{ext}) \ x \ 15.5$$

Rext is the resistance of the external connected to R-EXT terminal

VR—EXT is its voltage

The output current is about 21mA when Rext=910Ω and 10.8mA when Rext=1800Ω

2.9 Delay Time of Staggered Output

LXY28161 has a built-in staggered circuit to perform delay mechanism. 16 channels are divided to four groups. Each output port has 25nS delay time, so that the instant current from the power line will be lowered.

2.10 Package Power Dissipation

The maximum allowable package power dissipation is determined as

$$P_D(max)=(Tj-Ta)/R_{th}(j-a).$$

When 16 output channels are turned on simultaneously, the actual package power dissipation is

$$P_D(act)=(I_{DD}xV_{DD})+(I_{OUT}xDutyxV_{DS}x16).$$

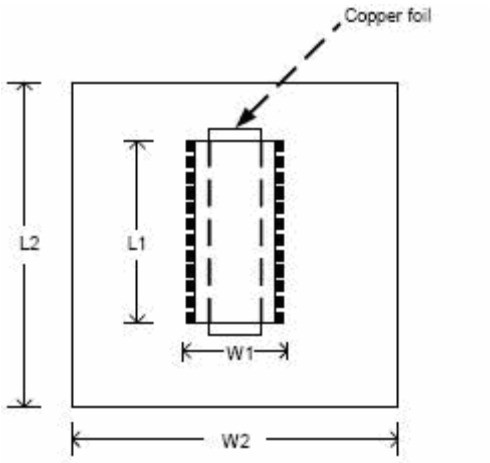
Therefore, to keep P_D (act)≤P_D (max), the allowable maximum output current as a function of duty cycle is:

$$I_{OUT}=\{[(Tj-Ta)/Rth(j-a)]-(I_{DD}xV_{DD})\}/(DutyxV_{DS}x16), \ (Tj=150°C)$$

The maximum power dissipation, PD(max)=(Tj-Ta)/Rth(j-a), decreases as the ambient temperature increases. So the LXY28161 must work in Safe Operation Area.

2.11 Usage of Thermal Pad

The PCB area L2xW2 is 4 times of the IC's area L1xW1.

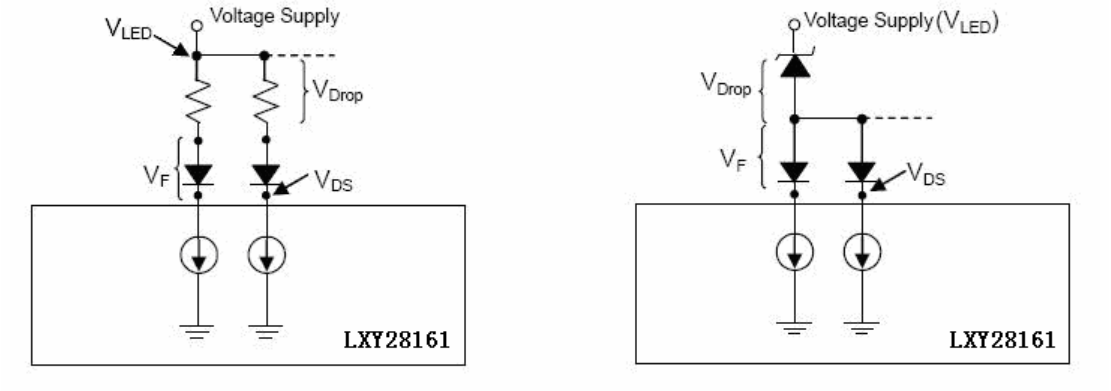


2.12 Thermal Protection Function

The thermal protection function is enabled by default. The output current will decrease to 25%. As soon as the temperature is below 110℃, the thermal error flag will return to 0 and the output current will recover from the 25% current.

2.13 LED Supply Voltage

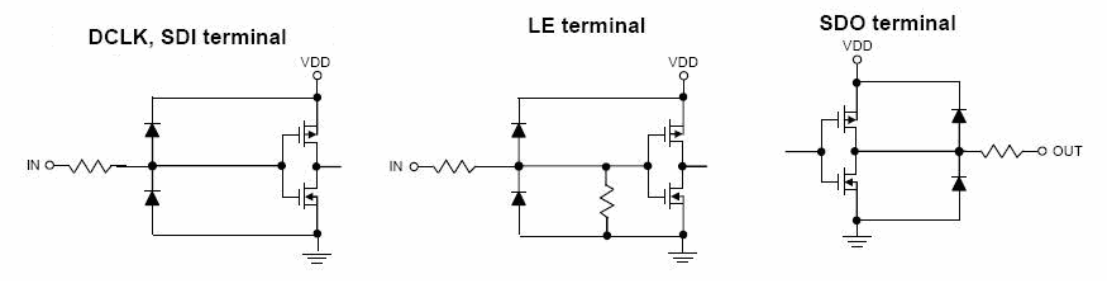
LXY28161 are designed to operate with VDS ranging from 0.4V to 0.8V (depending on IOUT=5 ～ 60mA), considering the package power dissipating limits. VDS may be higher enough to make when VLED＝5V, $PD_{(act)} < PD_{(max)}$ when VLED=5V and VDS=VLED－VF, in which VLED is the load supply voltage. In this case, it is recommended to use the lowest possible supply voltage or to set an external voltage reducer, VDROP. A voltage reducer lets VDS=(VLED－VF)－VDROP. Resistors or Zener diode can be used in the applications as shown in the following figures.



2.14 Switching Noise Reduction

LED drivers are frequently used in switch-mode applications which always behave with switching noise due to the parasitic inductance on PCB. To eliminate switching noise, refer to Application Note for 8-bit and 16-bit LED Drivers-Overshoot.

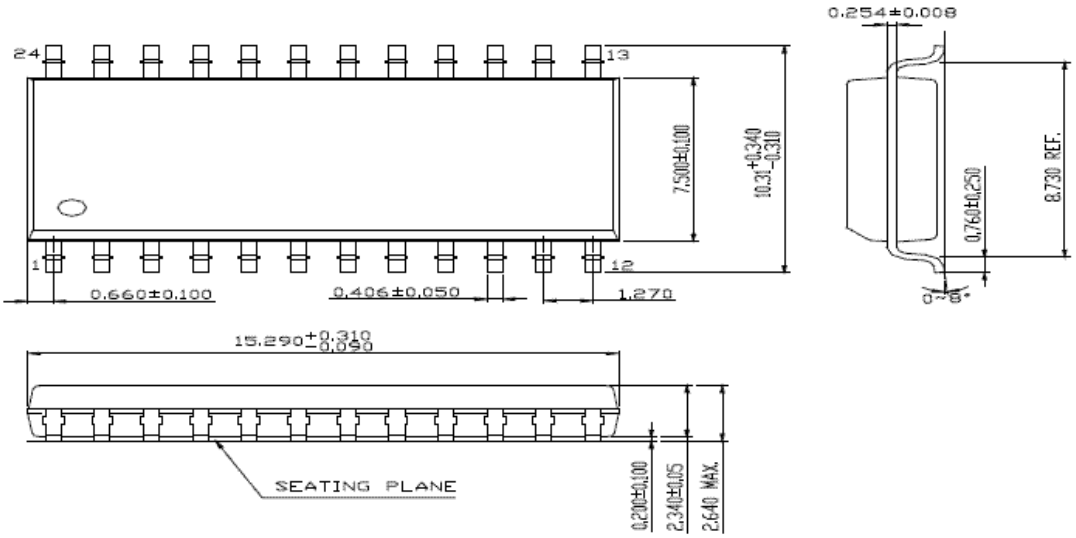
2.15 Equivalent Circuits of Inputs and Outputs



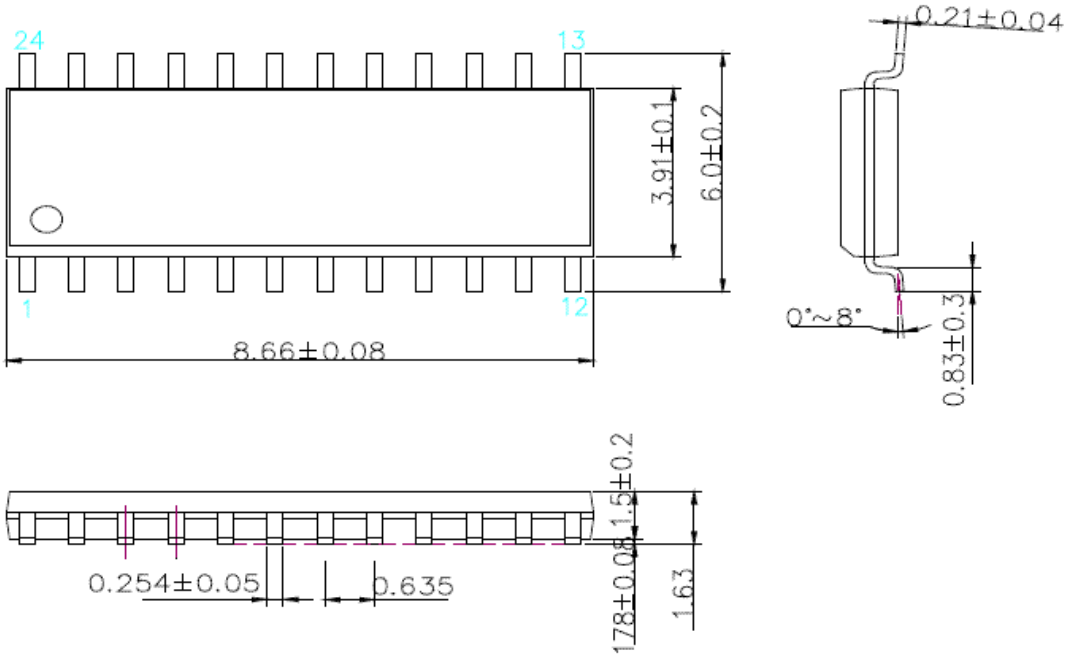
Equivalent circuits of Inputs and Outputs

3 Package Outline

LXY2816 applies SOP－24 and TSSOP-24 package outline:



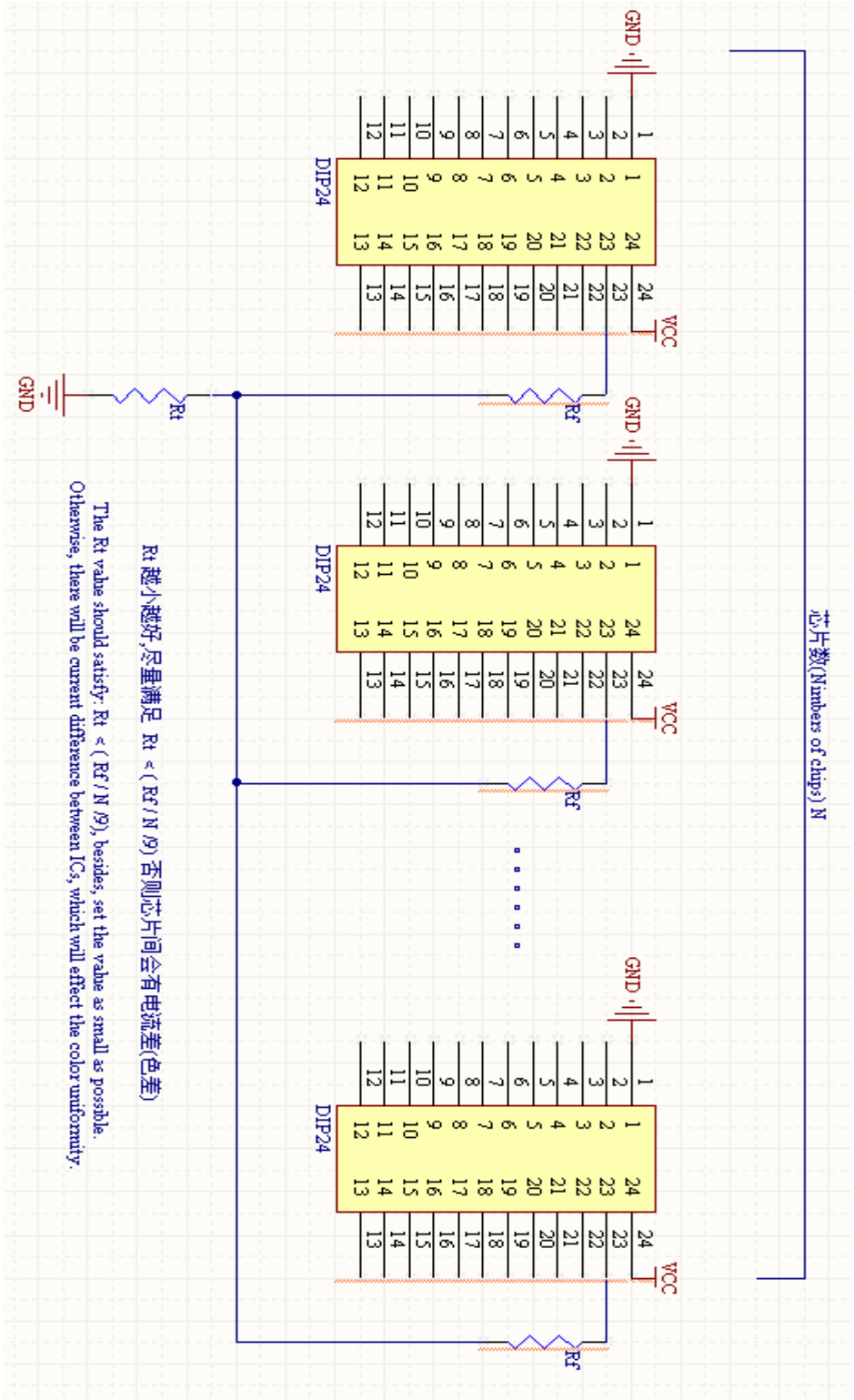
SOP-24 Outline Drawing



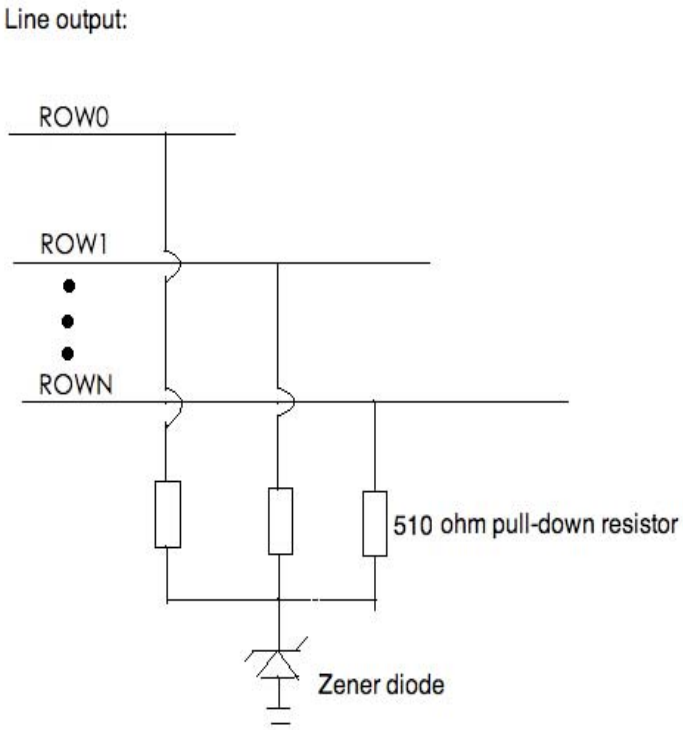
SSOP-24 Outline Drawing

4. Attention

4.1 The Rt value should satisfy: Rt ＜ (Rf / N /9), besides, set the value as small as possible. Otherwise, there will be current difference between ICs, which will effect the color uniformity.



4.2 In the Line-output, before connecting the GND, add a zener diode. The voltage of the zener diode is between 3.0V and 3.6V. Test and choose one that suit most. In out test, 3.3V is good.



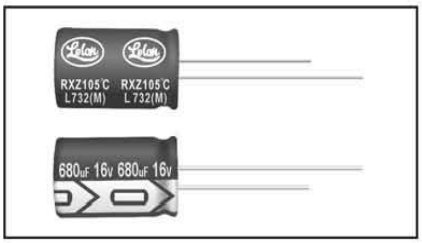
4.3 For Electronic capacitors, please use Taiwan Lelon's RXZ series high frequency capacitors, or some other brand which is similar in functions with the follow specifications:

http://www.lelon.com.tw/index.php?fn=search2&keyword=rxz

Aluminum Electrolytic Capacitors RXZ

Feature

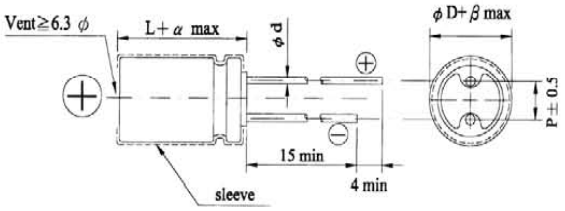
- 105℃, 2,000 hours assured, Low Impedance type
- Enabled high ripple current by a reduction of ESR high frequency range, suitable for computer motherboard
- RoHS Compliance



SPECIFICATIONS

Items	Performance
Operating Temperature Range	-40℃ ~+105℃
Capacitance Tolerance	±20% (at 120Hz, 20℃)
Leakage Current (at 20℃)	I = 0.01CV or 3 (μA) whichever is greater (after 2 minutes) Where, C = rated capacitance in μF V = rated DC working voltage in V
Dissipation Factor (Tan δ at 120Hz, 20℃)	Rated Voltage: 6.3 / 10 / 16 Tan δ (max): 0.22 / 0.19 / 0.16 When the capacitance exceeds 1,000 μF, 0.02 shall be added every 1,000 μF increase.
Low Temperature Characteristics (at 120Hz)	Impedance ratio shall not exceed the values given in the table below. Rated Voltage: 6.3 / 10 / 16 Impedance Ratio Z(-25℃)/Z(+20℃): 2 / 2 / 2 Impedance Ratio Z(-40℃)/Z(+20℃): 3 / 3 / 3
Load Life Test	Test Time: 2,000 Hrs Capacitance Change: Within ±25% of initial value Dissipation Factor: Less than 200% of specified value Leakage Current: Within specified value * The above specifications shall be satisfied when the capacitors are restored to 20℃ after the rated voltage applied with rated ripple current for 2,000 hrs at 105℃.
Shelf Life Test	Test time: 500 hrs; other items are the same as those for the load life test.
Ripple Current & Frequency Multipliers	Frequency (Hz): 120 / 1K / 10K / 100K up Multiplier: 0.5 / 0.8 / 0.9 / 1.0

DIAGRAM OF DIMENSIONS



LEAD SPACING AND DIAMETER Unit: mm

φD	8	10
P	3.5	5.0
φd	0.6	
α	1.0	1.5
β	0.5	

Dimension: φD×L(mm)
Ripple Current: mA/rms at 100KHz, 105℃
Impedance: Ω at 100KHz, 20℃

DIMENSION & PERMISSIBLE RIPPLE CURRENT

V. DC / φD×L / Item	6.3V (0J)			10V (1A)			16V (1C)		
	μF	Impedance	Ripple Current	μF	Impedance	Ripple Current	μF	Impedance	Ripple Current
8×11.5	820	0.040	1,140	680	0.040	1,140	470	0.040	1,140
8×16	1,200	0.028	1,490	1,000	0.028	1,490	680	0.028	1,490
8×20	1,800	0.019	1,870	1,500	0.019	1,870	1,000	0.019	1,870
10×12.5	1,500	0.026	1,540	1,000	0.026	1,540	680	0.026	1,540
10×16	1,800	0.019	2,000	1,500	0.019	2,000	1,000	0.019	2,000
10×20	2,200	0.013	2,550	1,800	0.013	2,550	1,500	0.013	2,550
10×23	3,300	0.012	2,800	2,200	0.012	2,800	1,800	0.012	2,800