LXY28162 USER'S MANUAL

JULY 2008
V1.0

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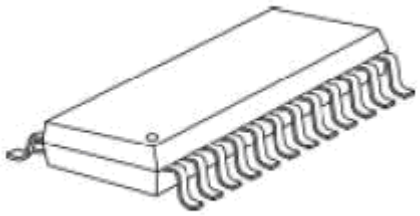
1 Product Description

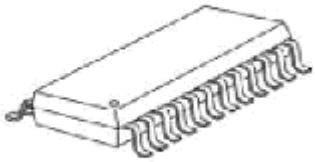
LXY28162, the 16-channel constant current LED Driver, is designed for LED video applications using internal Wise Pulse Width Modulation (W-PWM) control with selectable 16-bit color depth. LXY28162 features a 16-bit shift register which converts serial input data into each pixel gray scale of output port. At LXY28162 output port, sixteen regulated current ports are designed to provide uniform and constant current sinks for driving LEDs with a wide range of Vf variations. The output current can be preset through an external resistor. Moreover the preset current of LXY28162 can be further programmed to 1024 gain steps for LED global brightness adjustment.

Small OutLine Package



L:SOP24-300-1.0

Thin Shrink Package



S:SSOP24-150-0.635

LXY28162 offloads the signal timing generation of the host controller which just needs to feed data into drivers. LXY28162 drives the corresponding LEDs to the brightness specified by image data. With LXY28162, all output channels can be built with 16-bit color depth (65536 gray scales). Each LED's brightness can be calibrated enough from minimum to maximum brightness with compensated gamma correction or LED deviation information inside the 10-bit D/A.

1.1 Features

- Backward compatible with main trend 16-channel constant current IC in package
- 16 constant-current output channels
- 8-bit programmable output current gain to individual channel (pixel correction)
- 7-bit programmable output current gain to all channels (led display brightness adjustment)
- Open/Short-Circuit Detection to detect individual LED errors (real time online feedback)

- 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, 5~80mA
- Output current accuracy: between channels: ±1.5%, between ICs: ±3%
- Maximum data clock frequency: 25MHz
- 3.3-5V supply voltage

1.2 Applied field

- LED video applications

1.3 Basic Structure Description

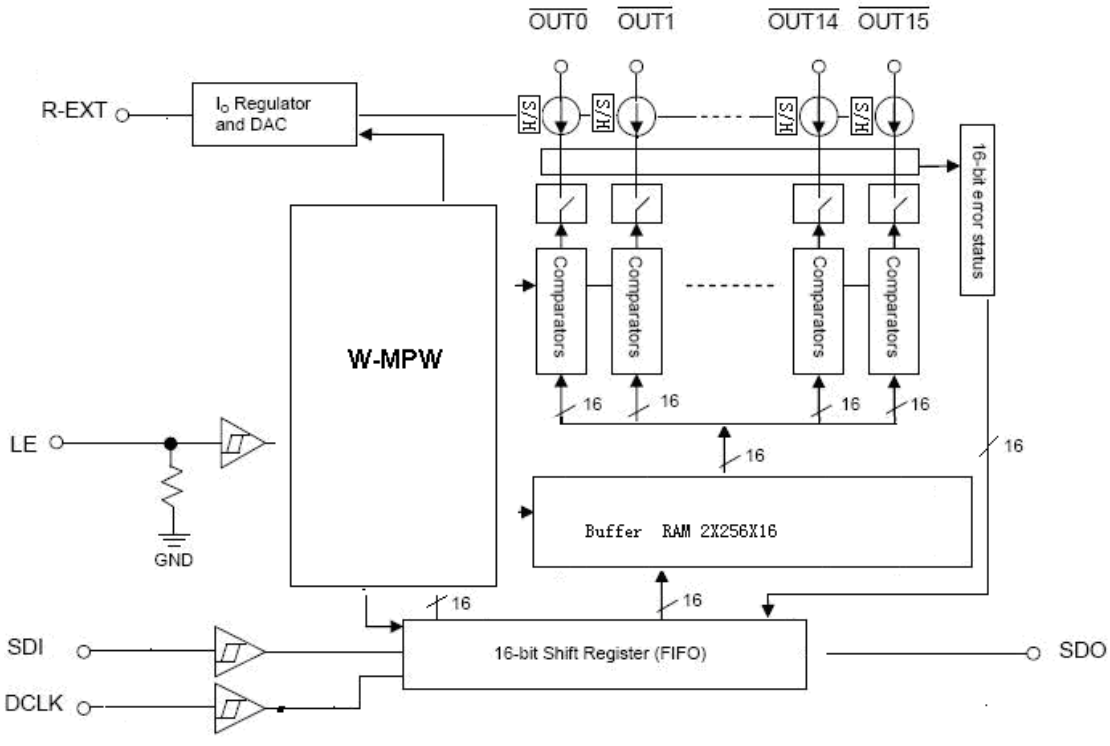
LXY28162 mainly includes serial-data input, Wise Pulse Width Modulation, constant current controlling circuit (8-bit each channel and 7-bit all channels), constant current output.

2 LXY28162 Specification

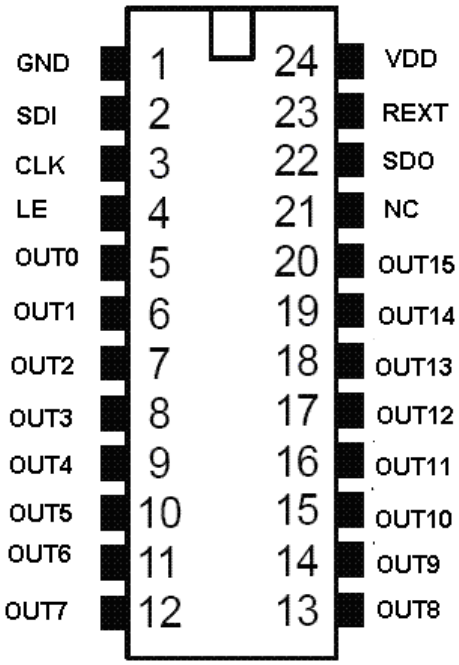
2.1 Block Diagram and Pin Configuration

LXY28162 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}	+80	mA
Sustaining Voltage at OUT Port	V_{DS}	7	V

Characteristic		Symbol	Rating	Unit
Data Clock Frequency		DCLK	+25	MHz
GND Terminal Current		I_{GND}	+1300	mA
Power Dissipation (On PCB, Ta=25° C)	L Type	P_D	2.39	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		72.4	
Operating Temperature		T_{opr}	-40～+85	° C
Storage Temperature		T_{stg}	-55～+150	° C

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

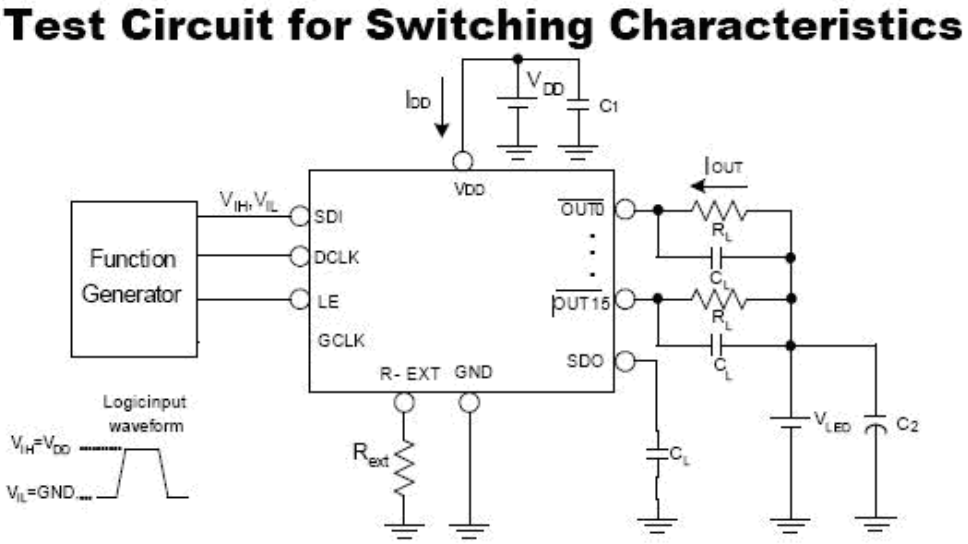
Characteristics		Symbol	Condition		Min.	Typ.	Max.	Unit
Supply Voltage		V_{DD}	-		3.3	5.0	5.5	V
Sustaining Voltage at OUT Ports		V_{DS}	OUT0 ~ OUT15		-	-	VDD+0.4	V
Output Current		I_{OUT}	Refer to "Test Circuit for Electrical Characteristics"		5	-	80	mA
		I_{OH}	SDO		-	-	-6.0	mA
		I_{OL}	SDO		-	-	6.0	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		%/ΔV_{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
LED Error Detection Threshold		$V_{DS,TH}$	-		-	0.15	0.20	% / 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	

Characteristics	Symbol	Condition	Min.	Typ.	Max.	Unit
Thermal Flag Temperature	TTF	Junction Temperature	135	150	165	° C

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

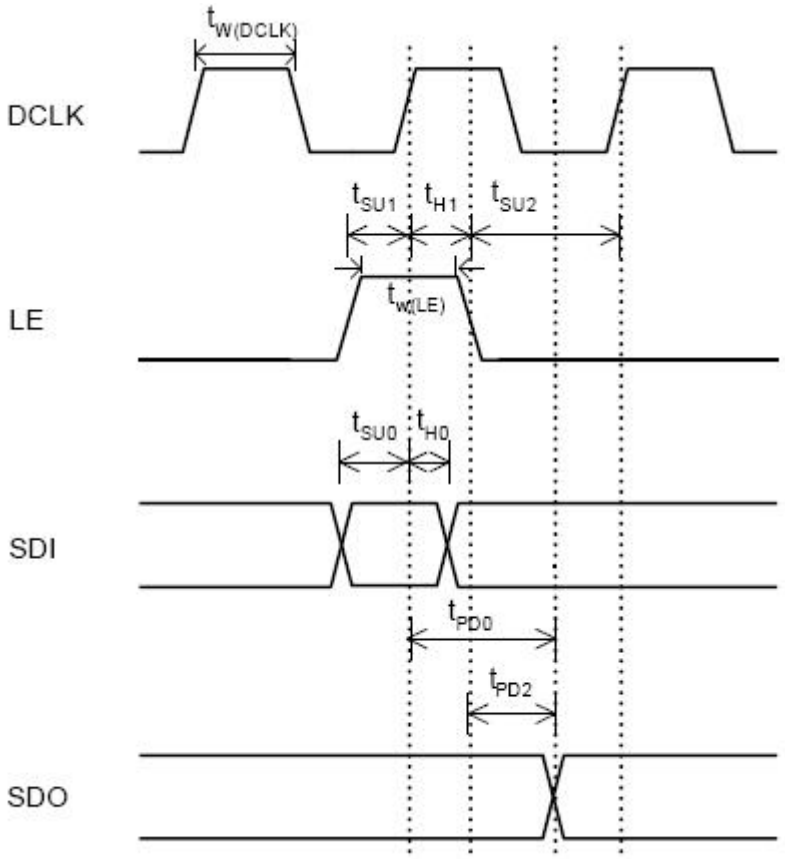
Characteristics		Symbol	Condition	Min.	Typ.	Max	Unit
Setup Time	SDI - DCLK↑	t_{SU0}		1	-	-	ns
	LE↑ – DCLK↑	t_{SU1}		1	-	-	ns
	LE↓ – DCLK↑	t_{SU2}		5	-	-	ns
Hold Time	DCLK↑ - SDI	t_{H0}		3	-	-	ns
	DCLK↑ - LE↓	t_{H1}		7	-	-	ns
Propagation Delay Time	DCLK -SDO (adjustable)	t_{PD0}	VDD=5.0V VIH=VDD VIL=GND	5	10	20	ns
				15	20	30	ns
				25	30	40	ns
				DCLK output to the receiver-end SDI of next driver IC			-
	GCLK – OUT8n	t_{PD1}		*	75	-	ns
Stagger Delay Time	OUT8n + 1*	t_{DL1}	RL=152Ω CL=10pF C1=100nF C2=10μF	-	25	-	ns
	OUT8n + 2 *	t_{DL2}		-	50	-	ns
	OUT8n + 3 *	t_{DL3}		-	75	-	ns
	OUT8n + 4 *	t_{DL4}			100		
	OUT8n + 5 *	t_{DL5}			125		
	OUT8n + 6 *	t_{DL6}			150		
	OUT8n + 7 *	t_{DL7}			175		
Pulse Width	LE	t_w(L)		5	-	-	ns
	DCLK	t_w(DCLK)		20	-	-	ns
	GCLK	t_w(GCLK)		20			ns
Output Rise Time of Output Ports		t_{OR}		-	10	20	ns
Output Fall Time of Output Ports		t_{OF}		-	10	20	ns
Error Detection Minimum. Duration		tEDD ***		1			μs
* Refer to the Timing Waveform, when n=0, 1, 2, 3.							

2.5 Test Circuit for Switching Characteristics

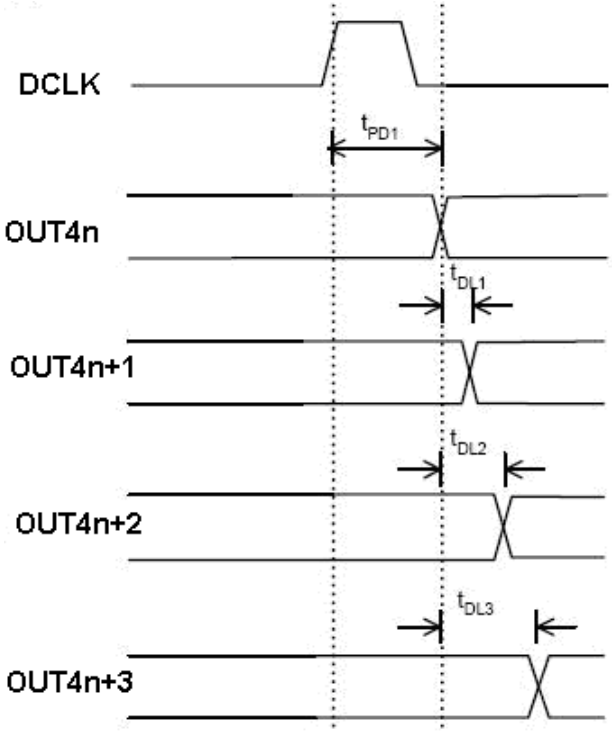


2.6 Timing Waveform

2.6.1 Serial-Port Timing Waveform



2.6.2 Output-Current Channel Timing Waveform



2.7 Open-Circuit Detection Principle

The principle of LXY28162 LED Open-Circuit Detection is based on the LED loading status.

2.8 Short-Circuit Detection Principle

The principle of LXY28162 LED Short-Circuit Detection is based on the LED loading status.

2.9 Thermal Error Flag

The thermal error flag indicates an overheating condition. when IC's junction temperature is over 150℃, the bit E is set to 1. The bit E can be read out through Read Configuration command.

2.10 Constant Current

In LED display application, LXY28162 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 ±1.5%, and that between IC is less than ±3%.

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.

2.11 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:

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

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

$$Iout = Imax \times SGreyScale/255 \times GGreyScale/127$$

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

VR—EXT is its voltage

SGreyScale Single channel grey scale control data (0-255)

GGreyScale Global grey scale control data (0-127)

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

2.12 Delay Time of Staggered Output

LXY28162 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.

2.13 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

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

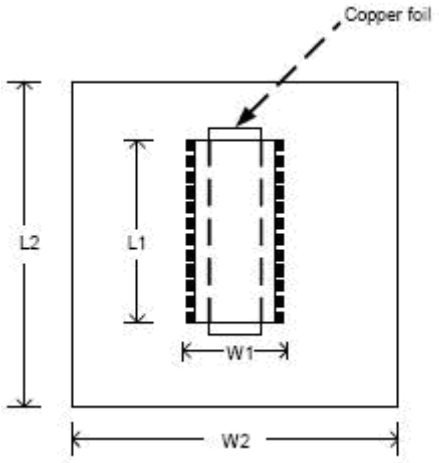
Therefore, to keep P_D (act)≤P_D (max), the allowable maximum output current as a function of duty cycle is:

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

The maximum power dissipation, PD(max)=(Tj－Ta)/Rth(j-a), decreases as the ambient temperature increases. So the LXY28162 must work in Safe Operation Area.

2.14 Usage of Thermal Pad

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

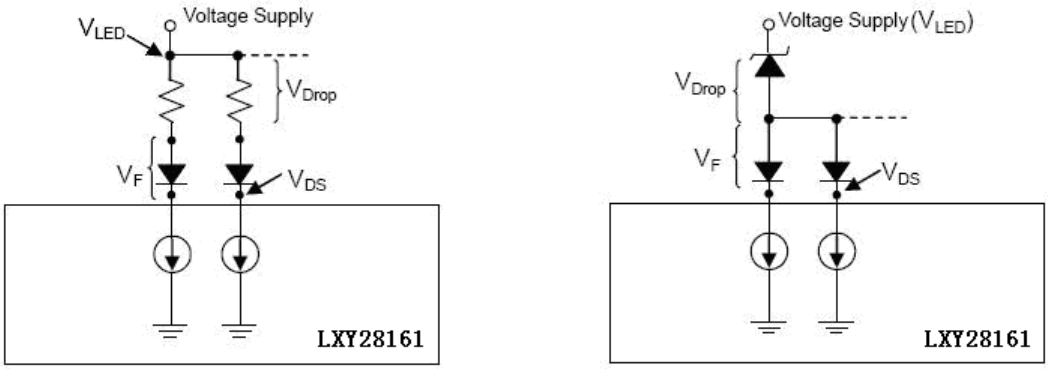


2.15 Thermal Protection Function

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.

2.16 LED Supply Voltage

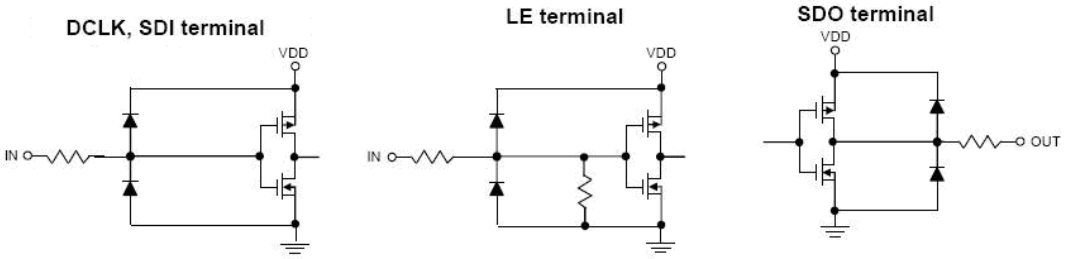
LXY28162 are designed to operate with VDS ranging from 0.4V to 0.8V (depending on IOUT=5～80mA), considering the package power dissipating limits. VDS may be higher enough to make when VLED＝5V, $PD_{(act)} < PD_{(max)}$ when VLED=5V and VDS=VLED－VF, in which VLED is the load supply voltage. In this case, 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.



2.17 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.

2.18 Equivalent Circuits of Inputs and Outputs



Equivalent circuits of Inputs and Outputs

3 Package Outline

LXY28162 applies SOP-8 package outline: