CHIP FOUNTAIN

Built-in PMW 16-channel constant current LED driver

Overview

CFD435AQP9 is a high-end driver specially designed for LED display ,which is driven by 16-channel constant-current sink current.

CFD435AQP9 has built-in 16K SRAM to store display data, which effectively solves the problem of transmission bandwidth limitation. At the same time, the driver adopts PWM gray scattering scan mode, which greatly improves the gray level of the display and shooting refresh rate.

CFD435AQP9 has built-in dynamic low-power technology to eliminate useless power consumption,which can effectively reduce the overall display temperature .

CFD435AQP9 has a variety of gray compensation mechanisms and high-precision linear current gain to make the color restoration of the display more accurate.

CFD435AQP9 has current gray compensation technology, which can effectively improve the low gray refresh rate.

CFD435AQP9 has the function of open-circuit detection and protection, which can detect and eliminate the cross caused by open -circuit point in real time.

CFD435AQP9 is packaged in QSOP24 and the normal operating temperature range is -40°C to 85°C.

Characteristic parameter

- Operating voltage: 3v～5.5v
- Built-in PWM gray control, easy to achieve built-in high gray and high refresh rate
- 16K SRAM,up to 32 scan
- PWM refresh multiplier technology and GCLK multiplier technologe
- Current gray technologe
- Built-in dynamic energy saving technology, reducing useless power consumption
- Built-in column blanking function
- A variety of gray compensation methods to eliminate low gray and cross-board color deviation
- 64-level global current gain
- Four-level programmable constant-current knee point（0.2V/0.3V/0.4V/0.5V）
- Current output range:
  0.3～25mA @VDD=5V
  0.3～12mA @VDD=3.3V
- Current accuracy
  Between channels:
  ±1.2%(Typical) ±1.5%(Max)
  Between ICs:
  ±1.2%(Typical) ±1.5%(Max)
- SPI-like interface , up to 30Mhz
- Built-in ghosting elimination function
- Effectively preventing caterpillars through port voltage clamp technology
- Built-in open-circuit detection function to silently eliminate open -circuit cross in real time

Typical applications

- Outdoor or indoor LED display
- LED display on mobile phones or other handheld devices
- Keyboard or mouse backlight
- White goods
- Smart speaker

Function Block Diagram

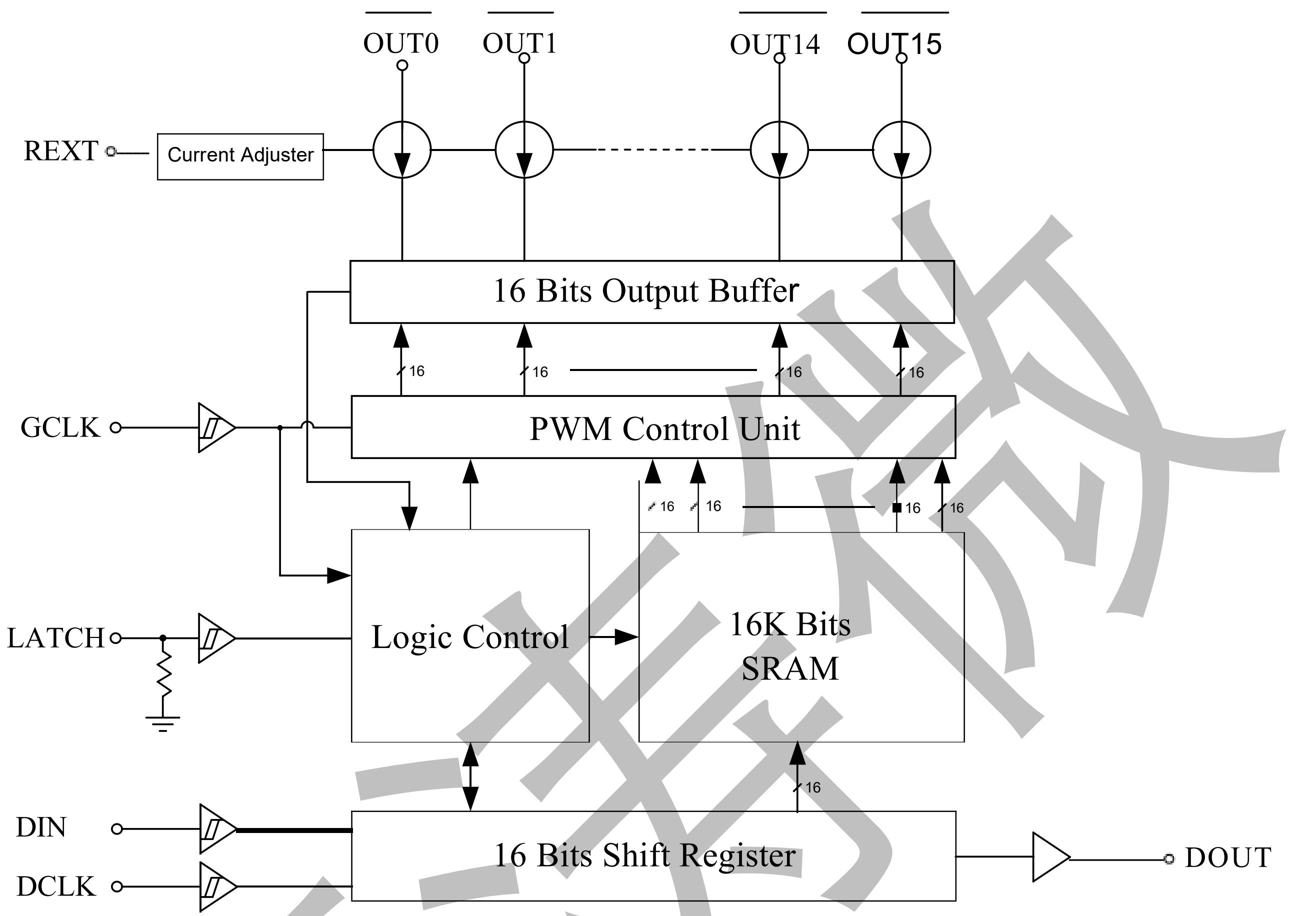
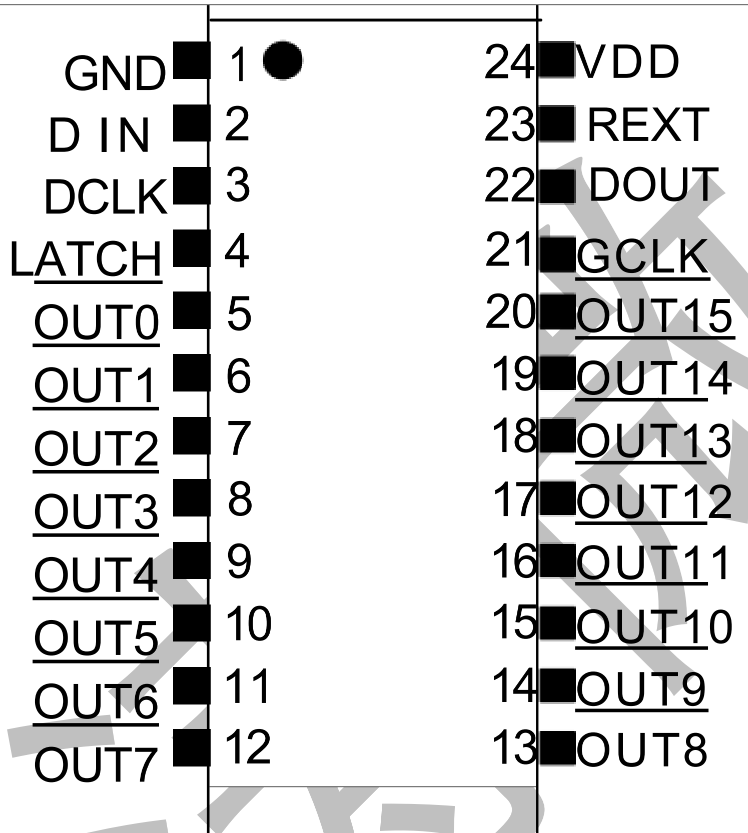


Figure 1 Function Block Diagram

Pin Diagram

Package	Pin Diagram (Top view)
QSOP24	

Pin Description

Sympol	Pin Number	Description
GND	1	Ground
DIN	2	Serial data input
DCLK	3	Clock signal,， positive edge sampling
LATCH	4	Internal data latch signal, different commands can be distinguished by identifying the length of LATCH
OUT0 ～OUT15	5～20	Constant current output driving channel
GCLK	21	PWM gray clock
DOUT	12	Serial data output , the next IC can be cascaded
REXT	23	The external reference resistance is connected to the pin, and the constant current of the channel can be adjusted by changing the resistance
VDD	24	Power

Order Information

Storage temperature： -65°C ~ +150°C

Part Number	Package	Packaging form	Quantity/Reel	Reel /Box
CFD435AQP9	QSOP24	Vacuum Tape	2500	8

I/O Equivalent Circuit

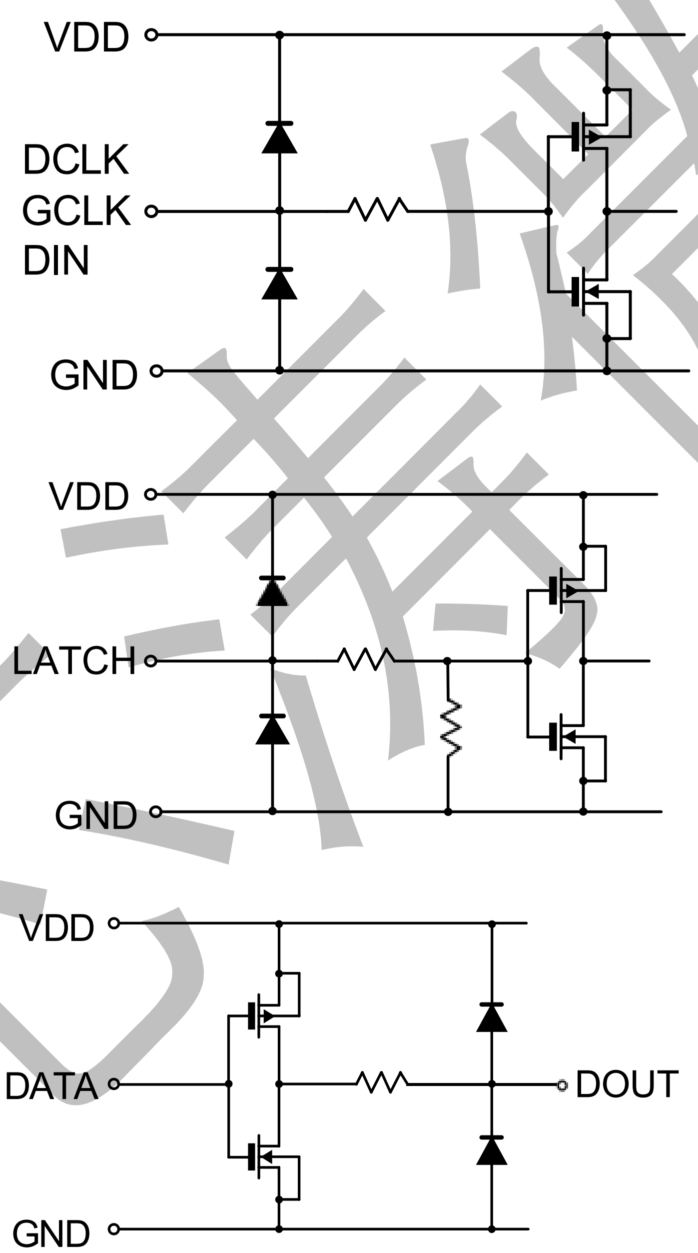


Figure 2 I/O Equivalent Circuit

Limit Parameter

VDD	-0.3v～+0.6v
Input voltage	-0.4v～VCC+0.4v
T_{JMAX}	+125°C
T_{STG}	-65°C~150°C
T_A	-40°C～+85°C
I_{OUT}	20mA
I_{GND}	360mA
F_{DCLK} / F_{GCLK}	30MHz
Rth	75°C/W
P_D	1600mw （T_A=25°C）
	750mw （T_A=80°C）
ESD （HBM）	±6KV

Electrical Parameter （VDD=5V， TA=25°C，current gain GCC is set to "111111"，PWM date=0xFFFF）

Sympol	Parameter	Condition	MIN	TYP	MAX	Unite
V_{DD}	Operating Voltage		3		5.5	V
I_{CC}	Static Operating Current	ALL INPUT=0 All output off REXT=2K		5	7	mA
I_{SG}	Output Constant Current &Error	V_{OUT}=0.55V REXT=2K		8.6		mA
					±1.5	%
V_{OUT}	Constant Current Output Voltage	I_{OUT}=15mA	550			mV
%/V_{DD}	Constant Current Output Change （VS VDD）	I_{OUT}=10mA		± 1.5		%/V
%/V_{OUT}	Constant Current Output Change （VS VOUT）	IOUT=10mA		±0.1		%/V
Logic Electrical Parameter （DIN 、DCLK 、 GCLK、 LATCH&DOUT）						
V_{IH}	High-Level Input Voltage	VCC=5V	3.5			V
V_{IL}	Low-Level Input Voltage	VCC=5V			1.5	V
I_{IL}	Low-Level Input Current	V_{INPUT}=0V （DCLK， GCLK， DIN， LATCH）			10	nA

I_{IH}	High-Level Input Current	V_{INPUT}=5V (DCLK, GCLK, DIN)			10	nA
		V_{INPUT}=5V (LATCH)		100		uA
V_{OL}	Low-Level Output Voltage	I_{OL}=1mA (DOUT)			0.4	V
V_{OH}	High-Level Output Voltage	I_{OH}=-1mA (DOUT)	4.6			

AC Parameter（VDD=5V， TA=25°C，current gain GCC is set to “111111”, PWM date=0xFFFF）

Sympol	Parameter	Condition	MIN	TYP	MAX	Unite
T_{pLH1}	**Low to high transmission delay** DCLK->DOUT	VIH=VDD VIL=GND REXT=750 Ω VL=4.5V RL=150Ω CL=10Pf		10	20	ns
T_{pLH2}	**Low to high transmission delay** GCLK->OUTn			20	40	ns
T_{pHL1}	**High to low transmission delay DCLK->DOUT**			10	20	ns
T_{pHL2}	**High to low transmission delay** GCLK->OUTn			20	40	ns
T_{SETUP1}	**LATCH setup time**		10			ns
T_{HLOD1}	**LATCH hold time**		10			ns
T_{SETUP2}	DIN setup time		3			ns
T_{HLOD2}	DIN hold time		5			ns
T_{WDCLK}	DCLK pulse width			15		ns
T_{WLATCH}	LATCH pulse width			15		ns
T_{WGCLK}	GCLK pulse width		30			ns
T_{or}	Output channel rise time		30			ns
T_{of}	Output channel fall time		15			ns

AC Sequence Diagram

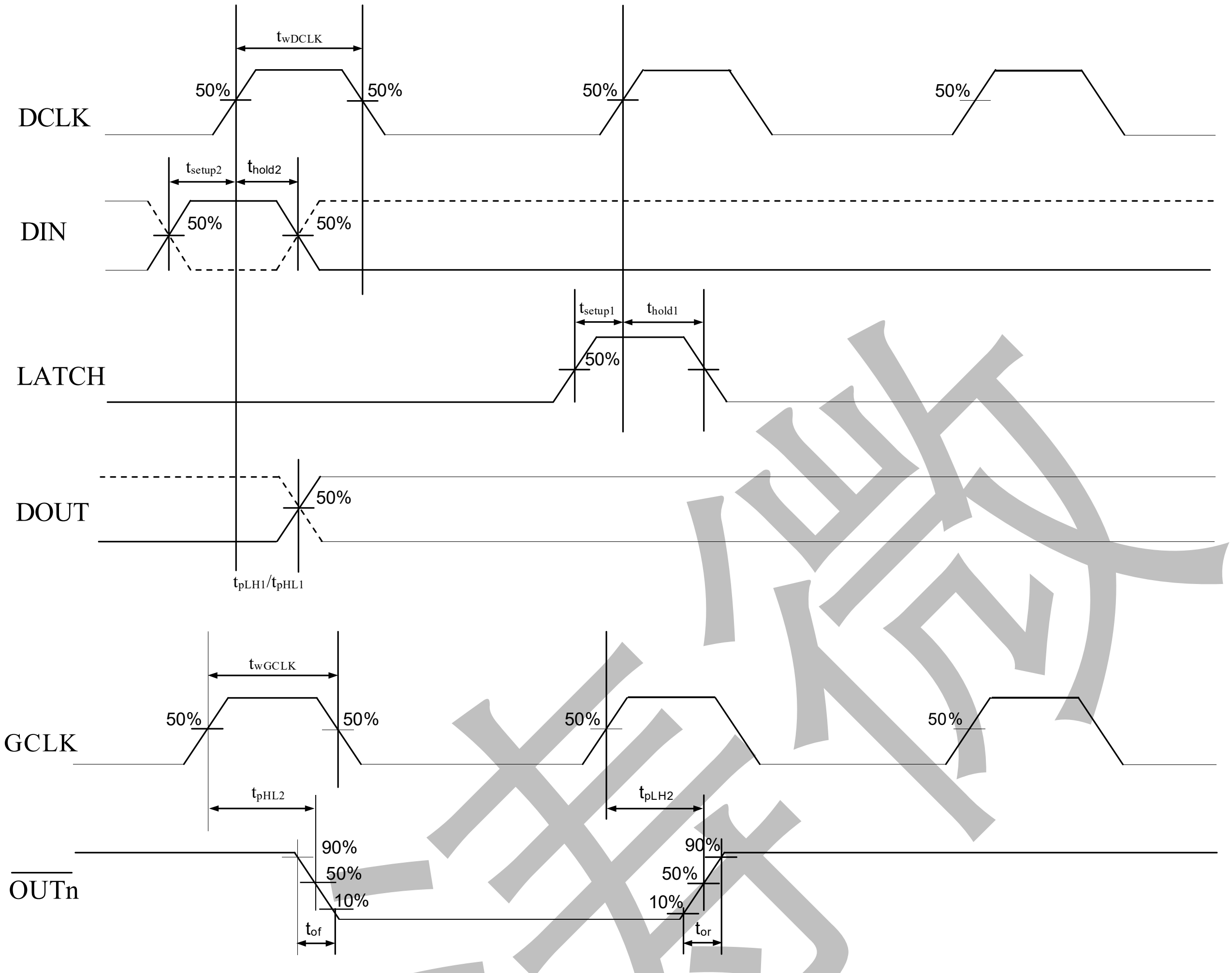


Figure 3 AC Sequence Diagram

Text Circuit

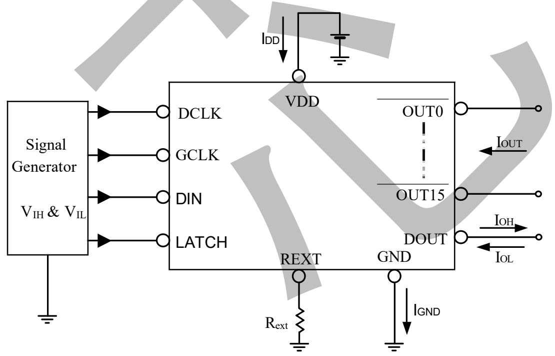


Figure 4-1 DC Characteristics Test

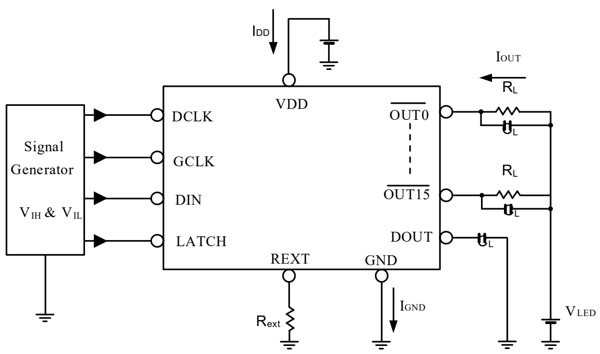
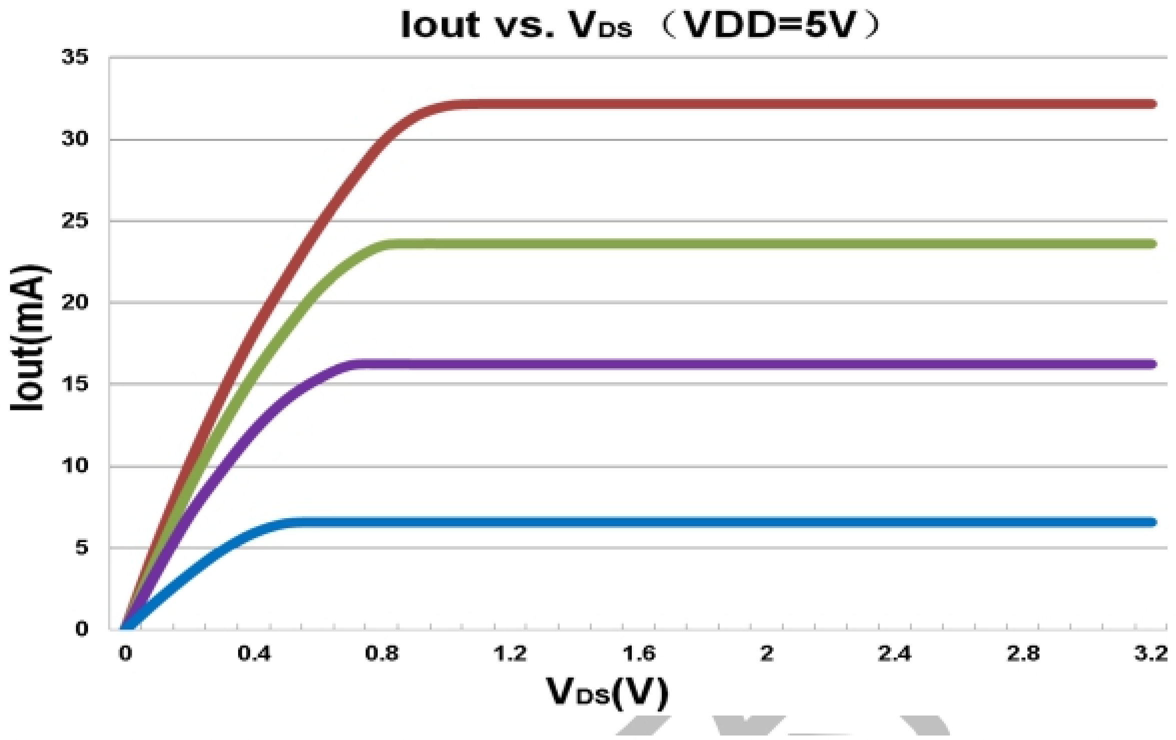


Figure 4-2 Dynamic Characteristics Test

Constant Current Characteristics

CFD435AQP9 adopts constant current driving mode. When the VDS voltage is greater than the output minimum breakover voltage, the channel driver enters the constant current state, and the channel current is no longer affected by the change of VDS. The current precision control technology is adopted inside the IC, which can maintain high consistency between channels and between ICs.



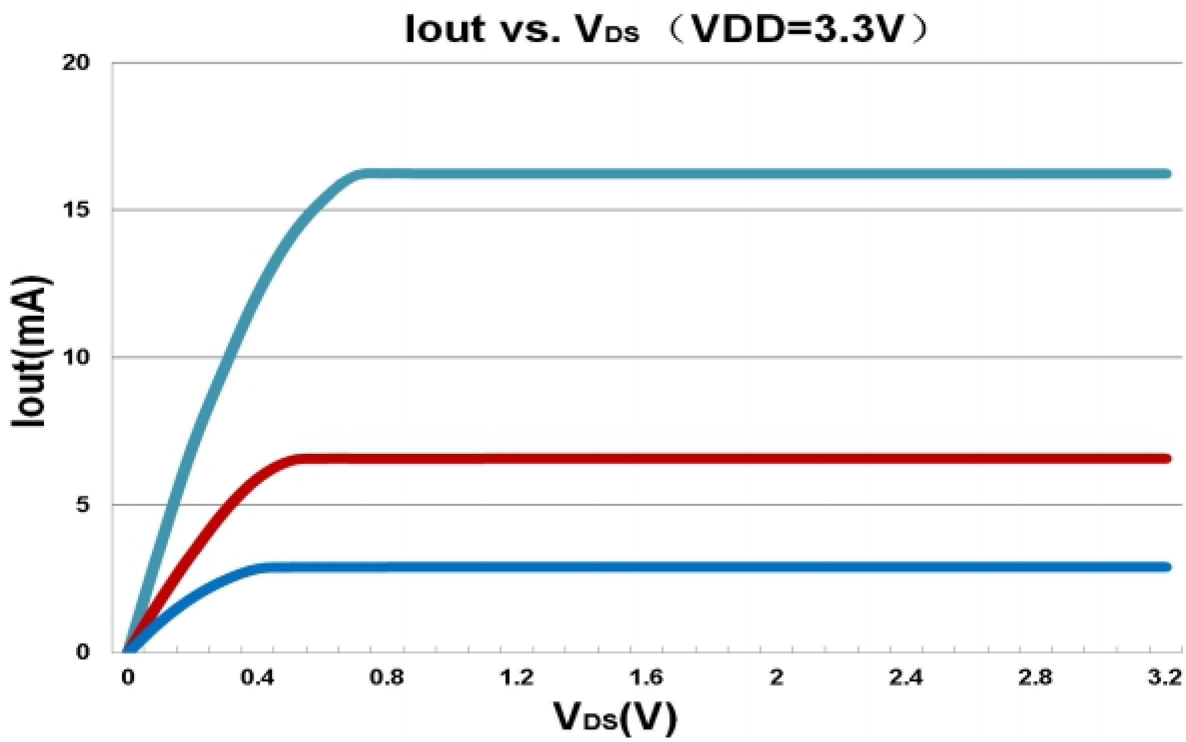


Figure 5 Constant Current Characteristic Curve

Constant current output calculation

GCC 6BIT global current gain value control the I_{OUT} of OUT0～OUT15

$$I_{OUT} = \frac{218}{Rext} \times (17 + GCC)$$

$$GCC = \sum_{n*0}^{5} B[n] \times 2^{n}$$

"n" corresponds to the position of GCC bit, B [n] represents the binary value (0 or 1)of the corresponding position of GCC.

Rext is the resistance for the external current, assuming Rext = 2000 ohms

After power on by default, B5:B0=000000,GCC=0,

$I_{OUT} = \frac{218}{2000} \times (17 + 0) = 1.853mA$;

Set the maximum current as B5: B0 = 111111, GCC=63；

$I_{OUT} = \frac{218}{2000} \times (17 + 63) = 8.72mA$

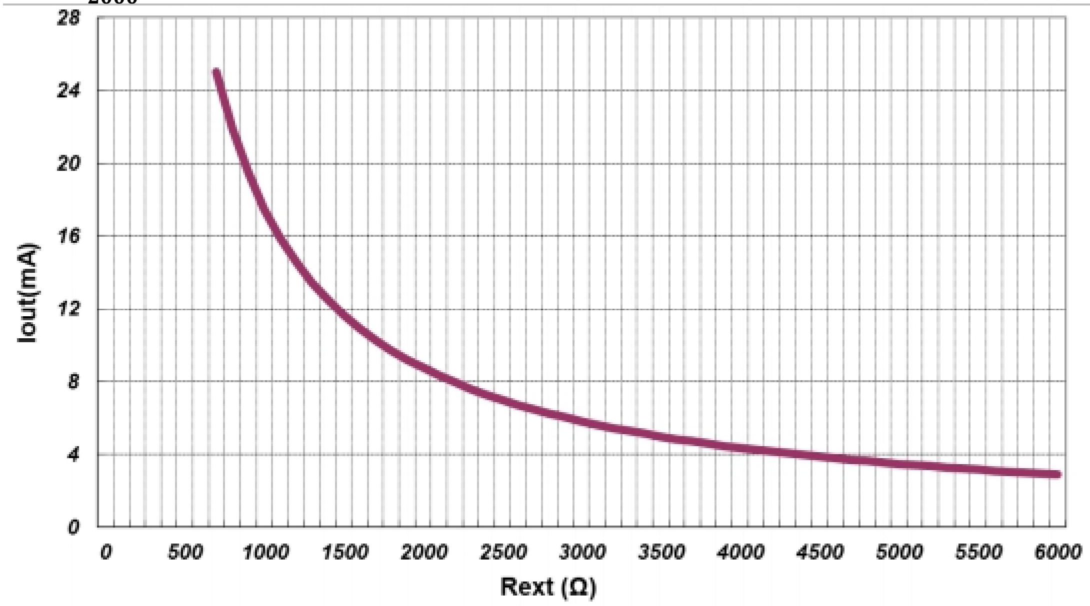


Figure 6 Corresponding relationship between output current and rext resistance (GCC = 111111)

This current I_{OUT} is the peak current and the actual output average current needs to be combined with PWM data and scan number.

Low-power application

The IC register provides two-level programmable constant current knee point. In practical applications, users can slect the suitable one according to the forward voltage(Vf) which the LED used. Then a lower voltage can be used to achieve the low-power application.Since the forward voltage of the red lights and green lights and blue lights are quite different, the application can be independently selected and set according to the actual situation.

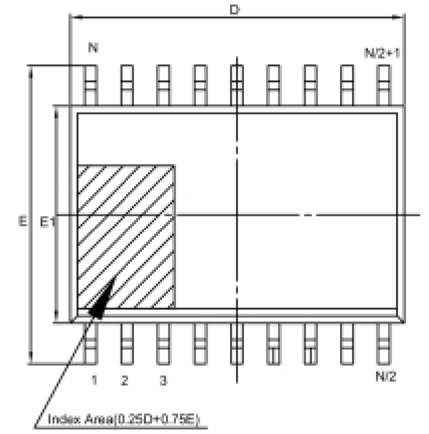
Package heat dissipation power PD

Each type of IC package form has a maximum limit power. IC products must run within the limit power to ensure product reliability. The maximum limit power PD(max) = (Tj,max-Tamb)/Rth(j-a). Among them, Tj,max is the maximum junction temperature of the IC and usually selects 150°C;Tamb is the ambience temperature, and Rth(j-a) is the thermal resistance of the package.

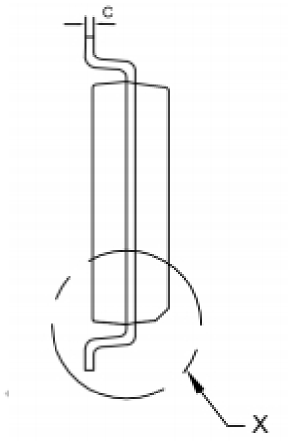
Welding instructions

The pin plating of this product complies with the RoHS standard and supports the usual tin-lead process and lead-free process. When the user uses the tin-lead process, the welding temperature range is 215°C to 245°C; when using the lead-free process, the temperature needs to comply with the J-STD-020 standard of 245°C to 260°C.

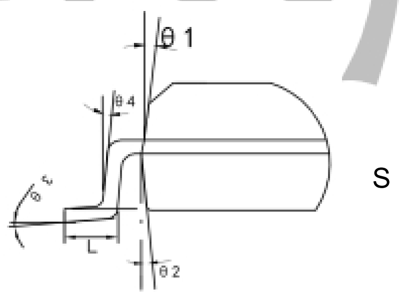
QSOP24 **Package Information**

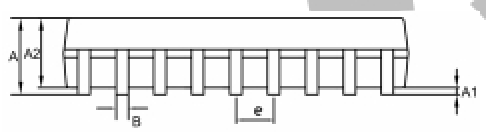


Top View



Side View





Detail "X"

Side View

Symbol	Min(mm)	Nom(mm)	Max(mm)
A	1.50		1.80
A1	0.102		0.249
A2	1.40		1.55
E	5.842		6.198
E1	3.861		3.998
D	8.585		8.738
L	0.406		0.889
e	0.635 TYP		
B	0.20		0.30
C	0.2 TYP		
θ1	8º TYP		
θ2	8º TYP		
θ3	0º		8º
θ4	4º TYP		