Data Sheet Of INK1003 IC Driver

Characteristics

- 3-Channel constant current LED driver.
- Output current won't vary with the driving output voltage.
- Wide operating voltage:3.3~5.4V
- High gray level, 256 gray levels.
- Polarity reverse function makes INK1003 suitable for high power full color LED lighting.
- Low output current deviation:
  Between channels in a single chip: ±1 %;
  Between chips: ±3%;
- Data frequency range wide: 400~800KHz
- Schmitt trigger input
- High reliability, ESD susceptibility high: HBM 8KV

Applications

- LED decorative lighting
- Digital Dream Color Led Strip Light
- Indoor/Outdoor LED video or massage display
- PWM signal generator
- All kinds of LED point light source
- LED strips operate between 5~12V

General Description

INK1003 is a constant current LED driver. It is a single line 3-Channel 256 Grey Level Driver.It is designed for indoor/ outdoor LED displays and decorative LED lighting system. It is suitable for LED cascading applications. The INK1003 owns 3 output channels, each channel can sink 18.6mA constant current. INK1003 contains single line data transceiver decoder, data latches, output registers, band gap reference voltage generator, internal oscillator, and low saturation constant current sinks. The data received by INK1003 is decoded and then the decoded data is transferred in to the gray level comparator. The output of the gray level comparator controls the constant output current.

The output polarity reverse function is designed for driving high power LED by adapting the application circuitry. The single line control scheme reduces the engineering troubles mostly, the special designed input and output staged of INK1003, make INK1003 survive during output and input pin short with power source or GND. When 800KHz, it can achieve 1024Pixels cascade connection.

INK1003 is available in both SOP-8 and DIP-8 packages, the operating temperature is -40~85℃.

PIN CONFIGURATION

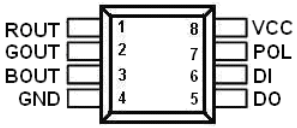
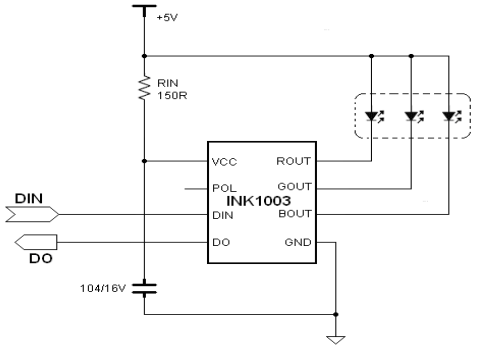


Fig1 SOP-8

TYPICAL APPLICATION CIRCUIT



Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
Power Supply Voltage	VCC	-0.3 to 6V	V
Input Voltage	V_{IN}	-0.3 to VCC+0.3V	V
Output Pin Voltage	V_{OUT}	-0.3 to VCC+0.3V	V
Driver PIN voltage	V_{XOUT}	-0.3 to 10V，I_{OUT} off	V
	V_{XOUT}	-0.3 to 5V，	V
Output current	I_{OUTCC}	18	mA
Output Current Deviation (Constant Current Driving Mode) Between output channels Between chips	 D_{IOI} D_{IOE}	 ±1 ±3	%
Input Clock Frequency	F_{CLK}	800	KHz
Maximum Power Dissipation	P_D	1200	mW
Operating Junction Temperature	Topr	-40 to + 150	℃
Storage Temperature Range	Tstg	-55 to + 150	
ESD susceptibility		8000	V

Note: If the voltage on the pins exceeds the maximum ratings may cause permanent damage to the device.

Electrical Parameters (VCC=5V, TA= 25℃, specified otherwise.)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
VCC range	V_{CC}		3	--	5	V
Output voltage	VOUT	IOUT=1uA	-0.3	--	10	V
Output Current	I_{outH}	V_{XOUT}=2V	17	--	19	mA
	I_{outL}	Output=“HIGH”, VOUT=10V	--	1	10	uA
	I_{SOURCE}	Other output	--	1	--	mA
	I_{SINK}	Other output	--	-1	--	mA
Quiescent Current	I_{STB}		--	1000	1600	μA
VCC clamp voltage	VCC_{CLAMP}	VIN=12V	5.3	5.4	5.6	V
Minimum constant current output time	I_{OH}	V_{IN}=V_{IH} or V_{IL},	--	2	--	uS
Input current	I_{IN}	PIN：CKI，SDI V_{IN}=VDD or GND	--	--	±1	uA
Input voltage level	V_{IH}	TA=-40～125℃	0.8*VDD	--	VDD	V
	V_{IL}		GND	--	0.2*VDD	V
Output current voltage regulation	$\%dV_{OUT}$		--	±1	--	%/V
Output current line regulation	$\%dV_{CC}$	V_{CC}=4～5.5V,V_{OUT} between 1.0V and 3.0V	--	±1	--	%/V
Pull down resistor	R_{INLOW}	R_{LIN},	--	300	--	KΩ

Function Block Diagram

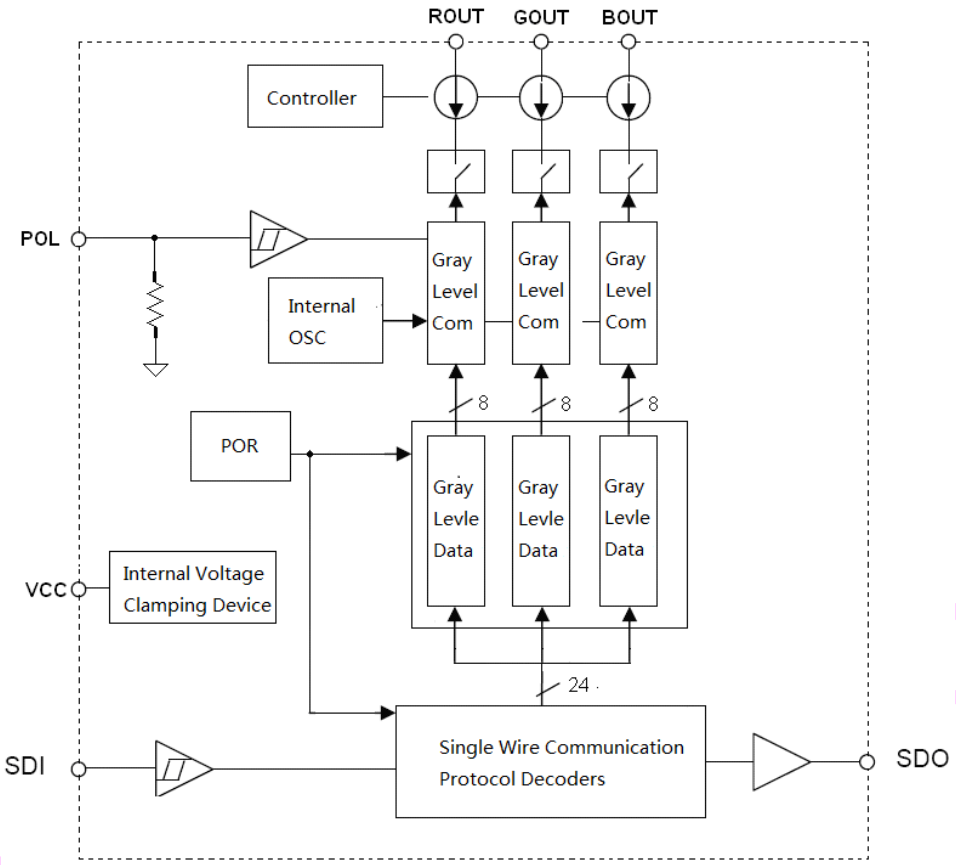


Fig2, Internal Function Block Diagram of INK1003

PIN Description

PIN	NAME	FUNCTION
1	ROUT	18mA low saturation constant current driver
2	GOUT	18mA low saturation constant current driver
3	BOUT	18mA low saturation constant current driver
4	GND	Ground
5	SDO	Buffered serial data output
6	SDI	Serial data input
7	POL	Output polarity reverse: POL="HIGH" output is reversed; POL="LOW", normal operation
8	VCC	Power supply

APPLICATIONS INFORMATION

Constant Current Output

In LED displays and decorative LED lighting system, INK 1003 can provide a constant output current varies precious little with output voltage, as several reasons bellow:

1) Advanced circuit construction results in Low output current deviation: ±1 % between channels in a single chip, ±3% between chips;
2) Advanced circuit construction results in constant current when output voltage is higher than saturation voltage. As the advantageous line regulation the I/V diagram of output current between voltage is nearly a horizontal straight line , which means output current is nearly independent with output voltage.

Power Dissipation of INK1003

The MAX power dissipation of INK1003 is determined by: PD(max)=(Tj-Ta)/Rth(j-a),when all 3 channel is on the power dissipation is : $P_D(act) = (I_{DD} \times V_{DD}) + (I_{OUT} \times Duty \times V_{DS} \times 3)$. In order to guarantee: PD(act)≤PD(MAX), the formula translation between output current and duty is :

$$I_{OUT} = (\frac{T_j - T_a}{R_{th(j-a)}} - I_{CC} \times V_{CC}) / V_{DS} / Duty / 3$$

When ambient temperature rises, the MAX power dissipation falls.

Load Voltage (V_{LED})

The design value of V_{DS} is 0.4~5V. Ensuring PD(ACT)>PD(MAX), the V_{DS} could be higher.. $V_{DS}=V_{LED}-V_F$ when V_{LED}=12V. V_{LED} is load voltage, which can be set lower, which is just higher than the lowest voltage allowed. A voltage divider can be used when necessary to produce a V_{DROP} for a lower power dissipation in IC, the formula can be described as: $V_{DS}=(V_{LED}-V_F)-V_{DROP}$

As the picture shows, resistors and zener diodes are suitable to reduce power dissipation of INK1003.

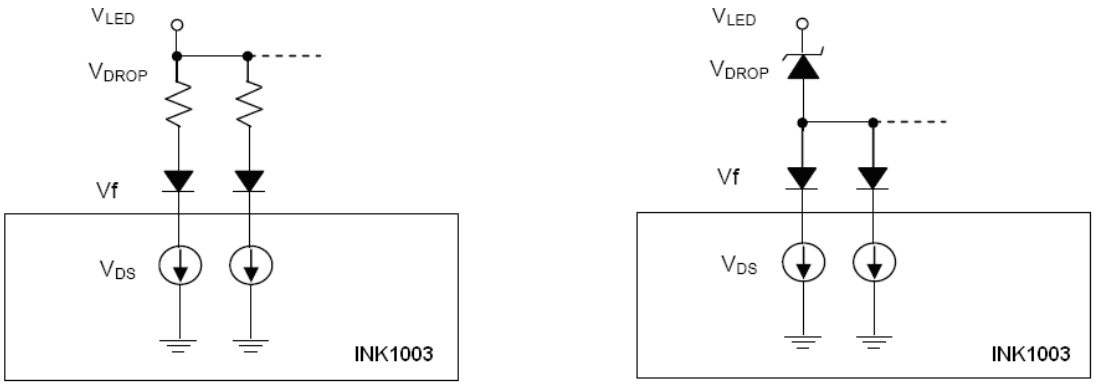


Fig 3, the voltage divider design of INK1003

Gray Scale Data Word Format

INK1003 uses the one-line communication mode, with return to zero code gray scale data transport. When the SDI node receives total 24 bit data, SDO node begins to send data to the next chip (set low before sending) . After that the IC no longer receives data, 3 PWM output named ROUT、GOUT、BOUT outputs signal with different duty according to the data received. The period of output signal is 3.2mS.The chip receives data again until RESET signal is sent to SDI node of the IC. Then the SDI node receives total 24 bit data, SDO node begins to send data to the next IC again. The output of ROUT、ROUT、BOUT will not change until receiving RESET signal. After the RESET signal(more than 24uS low signal) , 24 bit PWM data received newly will output to ROUT、GOUT、BOUT.

Automatic shaping forwarding technology is utilized, so the number of cascade is not affected by the signal transmission, but only affected by refresh speed. A n example of 1024 cascade, whose refresh time is 1024X0.4X2＝0.8192ms, There will be no flicker phenomenon.

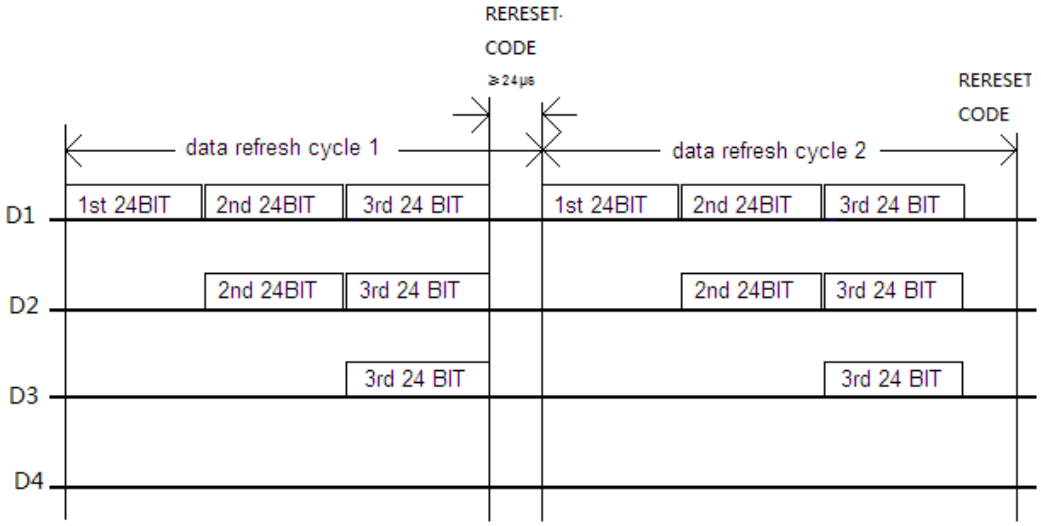
During data transfer, the first bit is the MSB of the ROUT channel, the last one transferred into the data shift register is the LSB of the BOUT channel.

The current duty of each channel of as bellow:

$$D_{XOUT} = \frac{L[7]*2^7 + L[6]*2^6 + L[5]*2^5 + L[4]*2^4 + L[3]*2^3 + L[2]*2^2 + L[1]*2^1 + L[0]}{256} \text{ ----- (7)}$$

Where L[x]=”0” or “1”, which is R、G、B[x], x=0,1,2……7 in the gray scale data. Gray scale data 0000 0000 is for the minimum 0 duty ratio, and 1111 1111 is for the maximum duty ratio.

INK1003 Communication Protocol

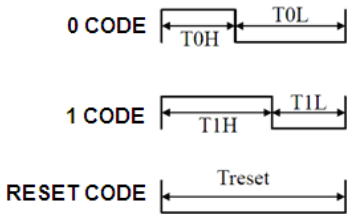


24 BIT DATA FORMATE

R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0

NOTE: MSB is sent first, LSB is sent last. In order to send data ROUT, GOUT, BOUT.

1) INPUT CODE



2) THE DATA SIGNAL LEVEL TIME

NAME	DISCRIPTION	TYPICAL	PERMISSIBLE ERROR
T0H	0 code of high level time	0.25 μs	± 75ns
T1H	1 code of high level time	1.0 μs	± 75ns
T0L	0 code of low level time	1.0 μs	± 75ns
T1L	1 code of low level time	0.2 5 μs	± 75ns

Fig 4， data of INK1003

5V APPLICATION

Inner power supply circuit clamps VCC at 5.4V .The clamp circuit will not work at 5V voltage supply, but at some abnormal condition of supply voltage such as the recovery time of short-circuit protection, the output voltage could be as high as 9V, which results in damage of IC. INK1003 could be permanent damaged if the Lamp power supply is reversely connected. In order to avoid such damage, bellow circuit is recommended:

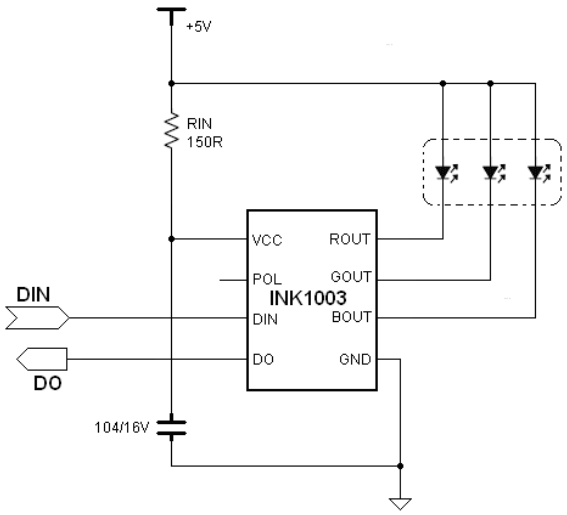


Fig5, *typical application circuit of 5V*

Such 5V typical application circuit can be widely used in 5V lamp strip, full color exposed lamp and all kinds of small video point light sources.

INK 1003 APPLICATION IN HIGH POWER PWM CONTROLLER.

Polarity reverse function is integrated in INK1003, when 7PIN is connected ground or none connect, IC will gray output normal. When 7PIN is connect VCC, the PWM signal of R/G/B channel reverses. The original 0 duty changes to 100%.With such function external power NPN switches or constant current driver can be used to driving the LED lamps in high voltage/power lighting application, and zero gray control can be easily realized. A capacitor connected between VIN and GND is necessary in high power LED lamps

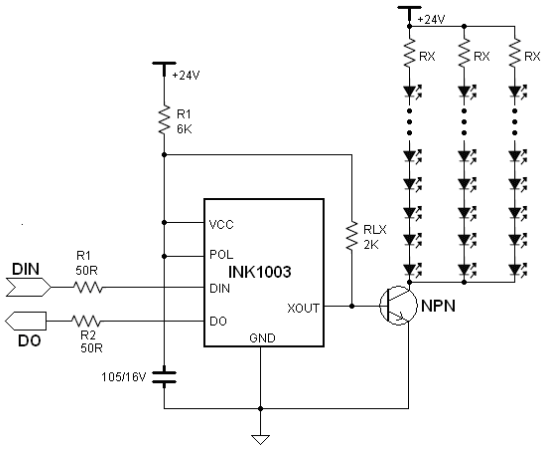


Fig6， *Typical high voltage application*

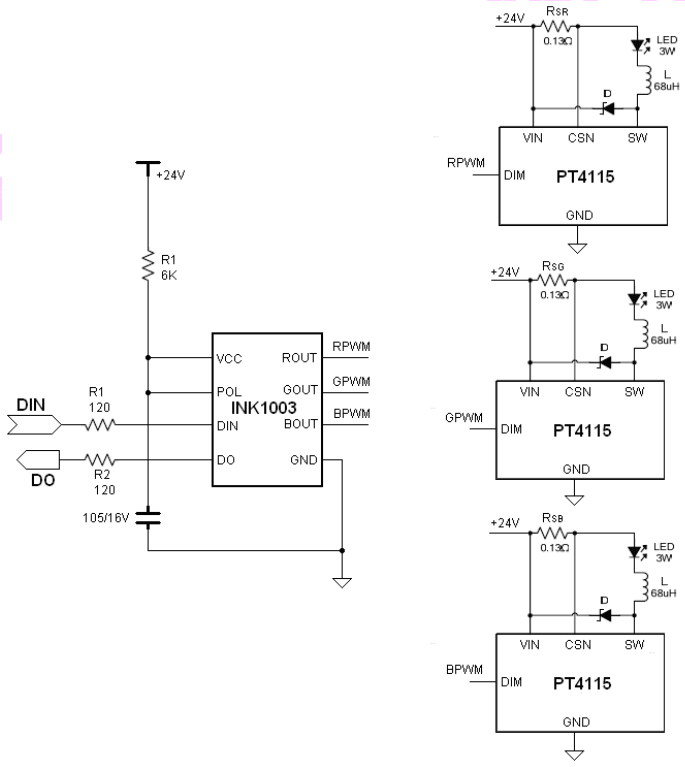


Fig7，*typical high power constant current application*

NOTE: A capacitor connected between VIN and GND is necessary

NOTE:

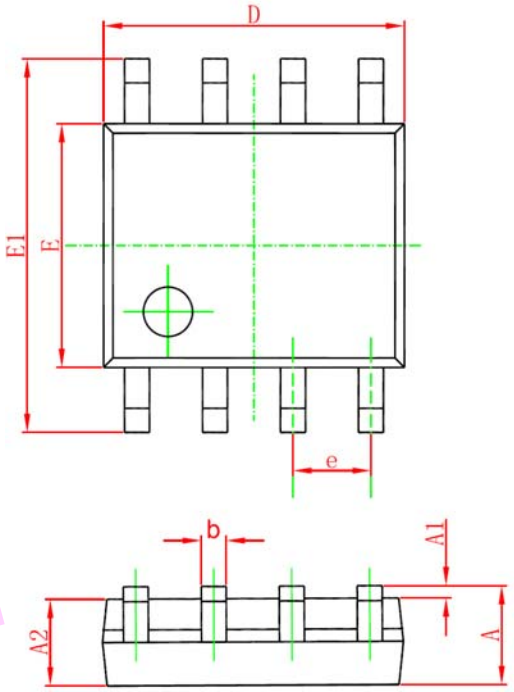
When POL is high as a PWM controller, do not set to “reverse output” in the controller software.

INK1003 Cascading Applications

Push-pull output stage is integrated in INK1003 to realize strong driving ability, signal can be transmit very long with cascade application. 20 meters can be realized at the 800 KHz clock frequency in laboratory. A series connected 50ohm resistor is needed to guarantee impedance matching and avoid signal reflection. Meanwhile, damage to the IC is avoid when signal line and power line is misconnected.

Package Information

SOP8



SIGN	mm	
	MIN	MAX
A	1.350	1.750
A1	0.100	0.250
A2	1.350	1.550
b	0.330	0.510
c	0.170	0.250
D	4.700	5.100
E	3.800	4.000
E1	5.800	6.200
e	1.270(BSC)	
L	0.400	1.270
θ	0°	8°