



**ICND2110**

**(12-Channel PWM Constant Current LED Sink Driver)**

## Description

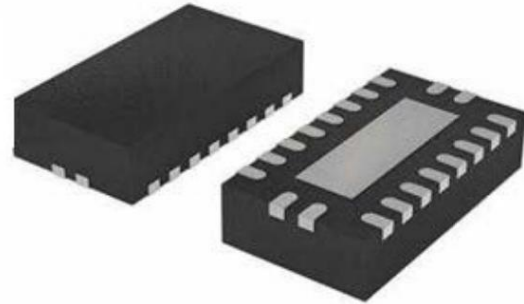
The ICND2110 is 12-channel PWM constant current sink LED driver. All 12-channels constant current can be set by a single external resistor, which provides users flexibility in controlling the light intensity of LEDs.

ICND2110 is designed for dual line concatenated transmission. SDI, CLK double line data and control instruction serial transmission, the number of cascades is greater than 512.

The use of dual line protocol transmission can simplify the design, and the application of QFN20 super small package to more design occasions. Using the PWM design of 16bit, the super high refresh rate of 3840Hz can be easily reached.

## Package

QFN20-4. 5\*2. 5\*0. 8



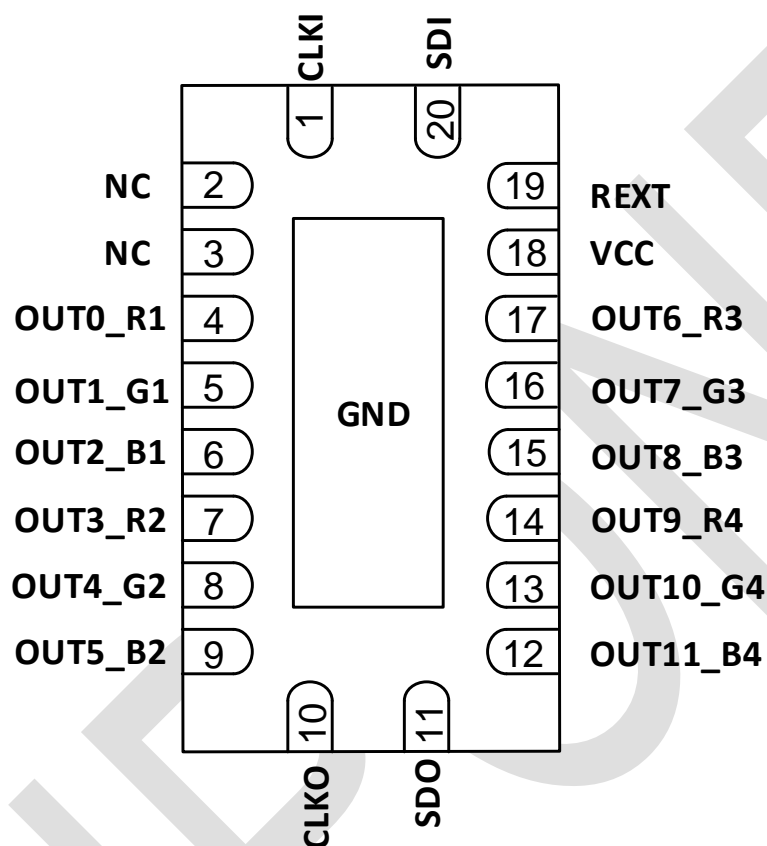
**ICND2110**

## Features

- ✧ 12-channel constant current output
- ✧ Output current setting range:  
0.5~25mA×16@V<sub>DD</sub>=5V constant current output  
0.5~15mA×16@V<sub>DD</sub>=3.3V constant current output
- ✧ Current accuracy  
Between channel :< ±1.5%  
Between ICs :< ± 3.0%
- ✧ Fast response of output current
- ✧ I/O: Schmitt trigger input
- ✧ 16 bit PWM gray scale
- ✧ Data transfer frequency: f<sub>MAX</sub>=30MHz(Max)
- ✧ Power supply voltage: V<sub>DD</sub> =3.3 ~ 5V
- ✧ Operating Temperature: -40°C to +85°C
- ✧ Pre-Charge for Ghosting Reduction
- ✧ LED Protection Circuit

## Pin Configuration

QFN20-4. 5\*2. 5\*0. 8



ICND2110 (QFN20)		
Pin No.	Pin Name	Function
1	CLKI	Clock input terminal for data shift on rising edge
2,3	NC	NC
4~9,17~12	OUT	Constant current output
10	CLKO	Clock output to the following IC
11	SDO	Serial-data or command output to the following IC
18	VCC	Power-supply voltage
19	REXT	Constant-current value setting .Connection to an external resistor to GND.
20	SDI	Serial-data or command input
Thermal-Pad	GND	Power ground

**Maximum Ratings** ( $T_a = 25^\circ\text{C}$ )

Characteristics	Symbol	Rating	Unit
Supply Voltage	$V_{DD}$	0~5.5	V
Output Current	$I_o$	25	mA
Input Voltage	$V_{IN}$	-0.4~ $V_{DD}+0.4$	V
Output voltage	$V_{OUT}$	10V	
Clock Frequency	$F_{CLK}$	30	MHz
Operating Temperature	$T_{opr}$	-40 ~ 85	$^\circ\text{C}$
Storage Temperature	$T_{stg}$	-55 ~ 150	$^\circ\text{C}$

**Electrical Characteristics** (Unless otherwise specified,  $V_{DD} = 4.5\sim 5.5\text{V}$ ,  $T_a = 25^\circ\text{C}$ )

Characteristics	Symbol	Test circuit	Test Conditions	Min	Typ	Max	Unit
Power supply current	$I_{DD1}$	4	$R_{EXT}=0\text{Open}$ , OUT off	—	2.7		mA
	$I_{DD2}$	4	$R_{EXT}=1.24\text{k}\Omega$ , OUT off	—	4.8		mA
	$I_{DD3}$	4	$R_{EXT}=8.8\text{k}\Omega$ , OUT off	—	3.2		mA
	$I_{DD4}$	4	$R_{EXT}=1.24\text{k}\Omega$ , OUT on	—	5.5		mA
	$I_{DD5}$	4	$R_{EXT}=8.8\text{k}\Omega$ , OUT on	—	3.9		mA
Constant current output	$I_{O1}$	5	$V_{DD}=5.0\text{V}$ , $V_o=1.0\text{V}$ , $R_{EXT}=1.23\text{k}\Omega$	—	15	—	mA
	$I_{O2}$	5	$V_{DD}=5.0\text{V}$ , $V_o=1.0\text{V}$ , $R_{EXT}=12\text{k}\Omega$	—	1.54	—	mA
Constant current error	$\Delta I_o$	5	$V_{DD}=5.0\text{V}$ , $V_o=1.0\text{V}$ , $R_{EXT}=1.23\text{k}\Omega$ , OUT0~OUT11	—	$\pm 0.23$	$\pm 0.45$	mA
Constant current power supply voltage regulation	$\%V_{DD}$	5	$V_{DD}=4.5\sim 5.5\text{V}$ , $V_o=1.0\text{V}$ , $R_{EXT}=1.24\text{k}\Omega$ , OUT0~OUT11	—	$\pm 0.2$	—	%/V
Constant current output voltage regulation	$\%V_{OUT}$	5	$V_{DD}=5.0\text{V}$ , $V_o=1.0\sim 3.0\text{V}$ , $R_{EXT}=1.24\text{k}\Omega$ , OUT0~OUT11	—	$\pm 0.1$		%/V

**DC Items** (Unless otherwise specified,  $T_a = -40^{\circ}\text{C} \sim 85^{\circ}\text{C}$ )

Characteristics	Symbol	Test Conditions	Min	Typ	Max	Unit
Power Supply Voltage	$V_{DD}$	—	3.3	5	5.5	V
Output Voltage when ON	$V_{O(ON)}$	OUTn	0.6	—	5	V
High level logic input voltage	$V_{IH}$	—	$0.7 \cdot V_{DD}$	—	$V_{DD}$	V
Low level logic input voltage	$V_{IL}$	—	GND	—	$0.3 \cdot V_{DD}$	V
Constant current output	$I_o$	OUTn	0.5	—	25	mA

## Application Information

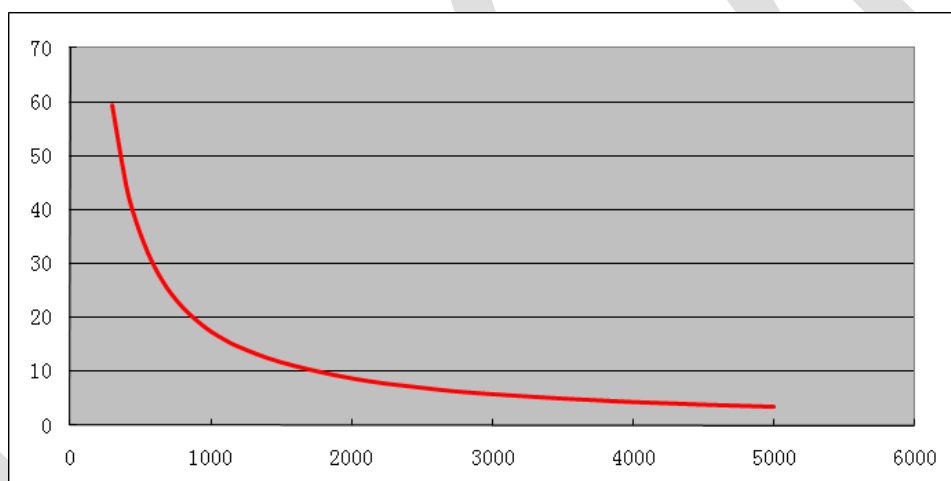
ICND2110 exploits current precision controlling technology, and provides nearly no current variations from channel to channel and from IC to IC.

- 1) The maximum current variation between channels is less than  $\pm 1.5\%$ , and that between ICs  $< \pm 3.0\%$ .
- 2) The current characteristic of output stage is flat, and can be kept constant regardless of the variations of LED forward voltage.

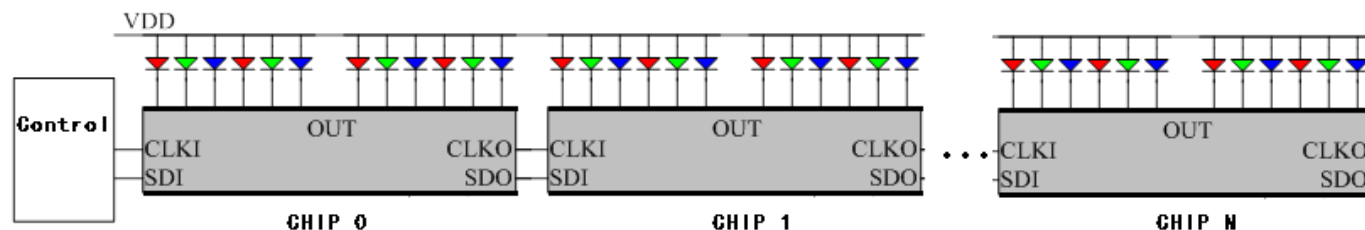
## Setting Output Current

The output current ( $I_{out}$ ) of ICND2110 is set by an external resistor,  $R_{ext}$ . The relationship between  $I_{out}$  and  $R_{ext}$  is

$$I_{out} = (V_{R-EXT} / R_{ext}) * 15 \quad V_{R-EXT} = 1.24V;$$



## Application Circuit



The above is a display driver circuit using ICND2110. Each chip drives 4 sets of RGB, a total of 4 RGB-LED lights. The data is transferred and configured by dual line serial concatenation. The data of chip0 is sent first, and the data of chip N is sent at last. It shows that the static mode is used only to send instructions and data at each frame.

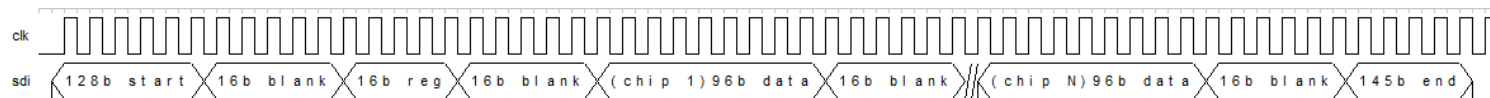
## Control and Data

Using dual line transmission mode, the CLK signal is transmitted at a fixed frequency and needs to be sent continuously, without interruption. The SDI signal is transmitted for the data and instruction, and is collected and written when the CLK signal is on the rising edge.

Command and descriptions are as follows:

Name	Command	Description
<b>Start</b>	Frame start	128bit data=1
<b>End</b>	Frame end	145bit data=1
<b>Blank</b>	Blank signal	16bit data=0, <b>Blank</b> should be send between <b>Start,Reg,Data</b> of each chip, <b>End</b>
<b>Reg</b>	Reg input	16bit Register
<b>Data</b>	Date input	96bit data,Corresponding to OUT5~OUT0 and OUT11~OUT6 output channel 16bit data, first send OUT5 or OUT11, high bit in front, low bit in the rear

## Waveform of Display



1. Send **Start** at the begin of each frame;
2. Send **Blank**;
3. Send **Reg**, input 16bit register;
4. Send **Blank**;
5. Send **Date** of chip1- OUT5~OUT0;
6. Send **Blank**;
7. Send **Date** of chip1- OUT11~OUT6;
8. Send **Blank**;
9. Repeat step 5~8, in turn, write chip 1, chip 2, until chip N;
10. Send **End**, frame data transmission end;
11. SDI pulls down until the next frame begins.

### Note:

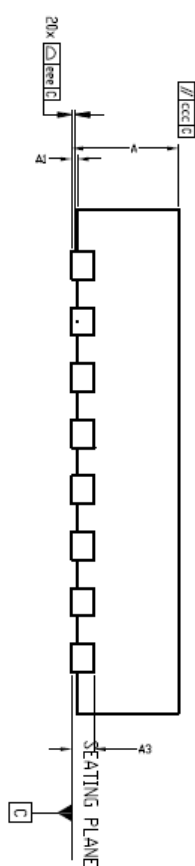
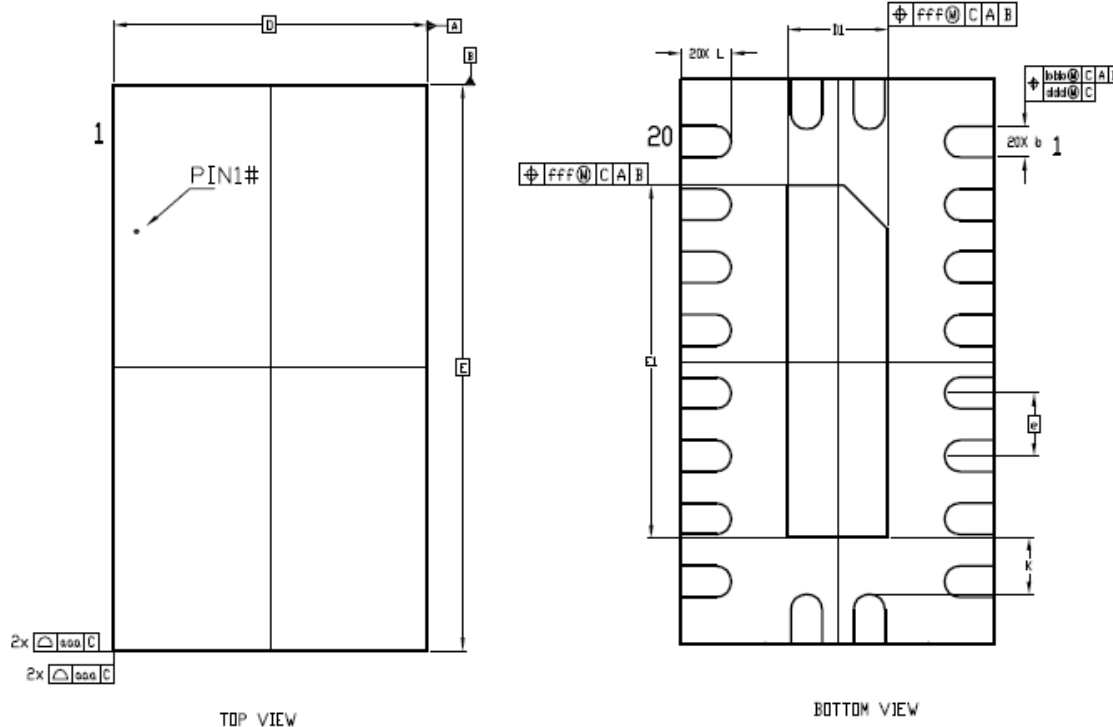
1. Data 0 is sent when no data or instruction is sent;
2. CLK needs to be sent continuously, without interruption.

## Register

Reg	Name	Default	Description
15:5	Reserved	0	
4	PWM-wider	1'h0	Enhancement for low gray 1:enable 0:disable
3	UP	1'h0	Ghosting reduction : 1:enable 0:disable
2:0	Test	3'h7	Test Only



## Package Outline



DIM SYMBOL	MIN.	NOM.	MAX.
A	0.70	0.75	0.80
A1	0.80	0.85	0.90
A3	0	0.02	0.05
A3	-	0.20 REF	-
b	0.20	0.25	0.30
D	2.50BSC		
E	4.50BSC		
D1	0.70	0.80	0.90
E1	2.70	2.80	2.95
e	0.50BSC		
L	0.35	0.40	0.45
K	0.20	-	-
aaa	0.15		
bbb	0.10		
ccc	0.10		
ddd	0.05		
eee	0.08		
fff	0.10		

## Product Ordering Information

Product number	Package (Pb-Free)	Weight (mg)
ICND2110	QFN20-4.5*2.5*0.85	25.9

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