CHIPONE

集创北方

ICND2112

(6-Channel and 8-Line PWM Constant Current LED Driver)

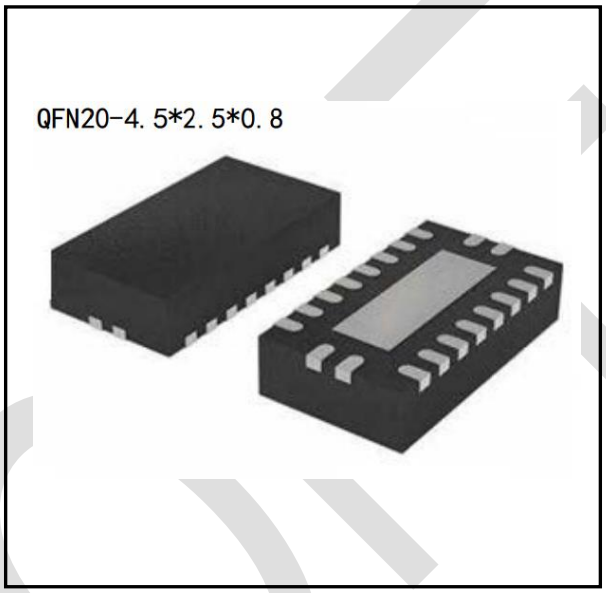
Description

The ICND2112 is 6-Channel and 8-line PWM Constant Current LED Driver. All 6-channels constant current can be set by a single external resistor, which provides users flexibility in controlling the light intensity of LEDs.

ICND2112 is designed for dual line concatenated transmission. SDI, CLK double line data and control instruction serial transmission, the number of cascades is 150.

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



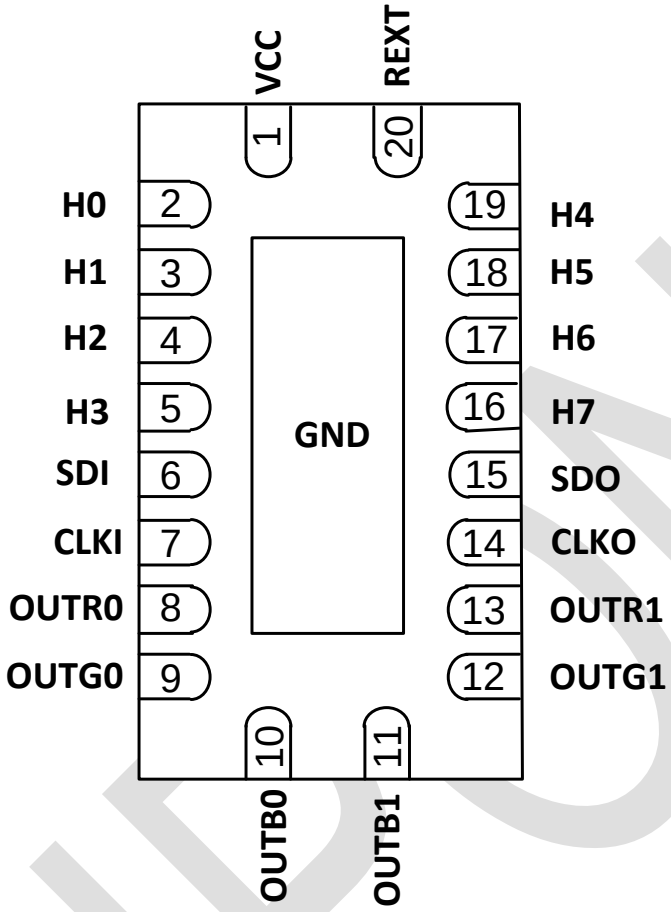
ICND2112

Features

- 6-channel constant current output
- Output current setting range:
  2~30mA×16@V_{DD}=5V constant current output
  2~15mA×16@V_{DD}=3.3Vconstant 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_{MAX}=12.5MHz(Max)
- Power supply voltage: V_{DD} =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



ICND2112 BN (QFN20)		
Pin No.	**Pin Name**	**Function**
1	VCC	Power-supply voltage
2-5	H0-H3	Power switch output
6	SDI	Serial-data or command input
7	CLKI	Clock input terminal for data shift on rising edge
8-13	OUTR0-OUTB1	Constant current output
14	CLKO	Clock output to the following IC
15	SDO	Serial-data or command output to the following IC
16-19	H7-H4	Power switch output
20	REXT	Constant-current value setting .Connection to an external resistor to GND
EPad	GND	Power ground

Maximum Ratings (T_a =25℃)

Characteristics	Symbol	Rating	Unit
Supply Voltage	V_{DD}	0~5.5	V
Output Current	I_O	30	mA
Input Voltage	V_{IN}	-0.4~V_{DD}+0.4	V
Output voltage	V_{OUT}	10V	
Clock Frequency	F_{CLK}	12.5	MHz
Operating Temperature	T_{opr}	-40 ~ 85	℃
Storage Temperature	T_{stg}	-55 ~ 150	℃

Electrical Characteristics (Unless otherwise specified, V_{DD} =4.5~5.5V，T_a =25℃)

Characteristics	Symbol	Test circuit	Test Conditions	Min	Typ	Max	Unit
Power supply current	I_{DD1}	4	Rext=Open，OUT off	-	2.8		mA
	I_{DD2}	4	Rext=2KΩ，OUT off	-	7.2		mA
	I_{DD3}	4	Rext=10KΩ，OUT off	-	4.2		mA
	I_{DD4}	4	Rext=2KΩ，OUT on	-	7.3		mA
	I_{DD5}	4	Rext=10KΩ，OUT on	-	4.3		mA
Constant current output	I_{O1}	5	V_{DD}=5.0V, V_O=1.0V, R_{EXT}=1.23kΩ	-	15	-	mA
	I_{O2}	5	V_{DD}=5.0V, V_O=1.0V, R_{EXT}=12KΩ	-	1.54	-	mA
Constant current error	ΔI_O	5	V_{DD}=5.0V, V_O=1.0V, R_{EXT}=1.23kΩ, OUTR0~OUTB1	-	±0.23	±0.45	mA
Constant current power supply voltage regulation	$\%V_{DD}$	5	V_{DD}=4.5~5.5V, V_O=1.0V, R_{EXT}=1.24kΩ, OUTR0~OUTB1	-	±0.2	-	%/V
Constant current output voltage regulation	$\%V_{OUT}$	5	V_{DD}=5.0V, V_O=1.0~3.0V, R_{EXT}=1.24kΩ, OUTR0~OUTB1	-	±0.1		%/V

DC Items (Unless otherwise specified, T_a =-40℃~85℃)

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*V_{DD}	-	V_{DD}	V
Low level logic input voltage	V_{IL}	-	GND	-	0.3*V_{DD}	V
Constant current output	I_O	OUTn	2	-	30	mA

Application Information

ICND2112 exploits current precision controlling technology，and provides nearly no current variations from channel to channel and from IC to IC.

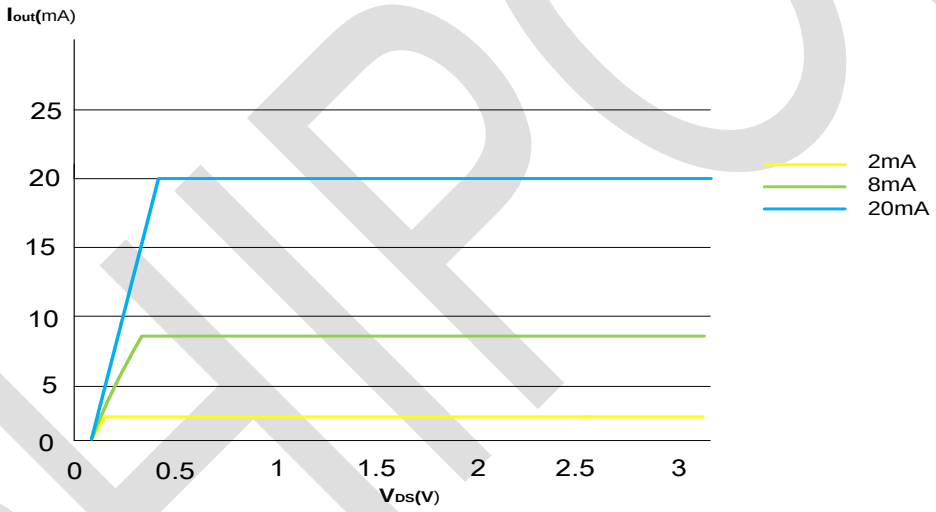
1) The maximum current variation between channels is less than ±1.5%，and that between ICs<±3.0%.

2) The current characteristic of output stage is flat, and can be kept constant regardless of the variations of LED forward voltage.

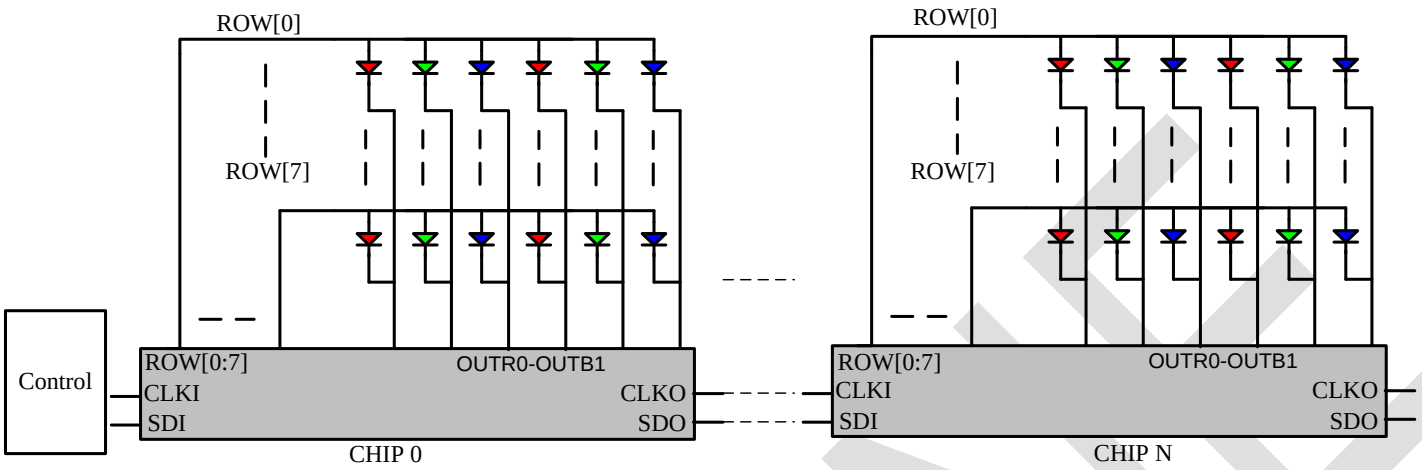
Setting Output Current

The output current (I_{out}) of ICND2112 is set by an external resistor, R_{ext}. The relationship between I_{out} and R_{ext} is

$$Iout=(V_{R\text{-}EXT}/ R_{ext})*15 \quad V_{R\text{-}EXT}=1.24V; \quad Igain=100\%$$



Application Circuit



The above is a display driver circuit using ICND2112. Each chip drives 8 line and 2 sets of RGB, a total of 16 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.

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:

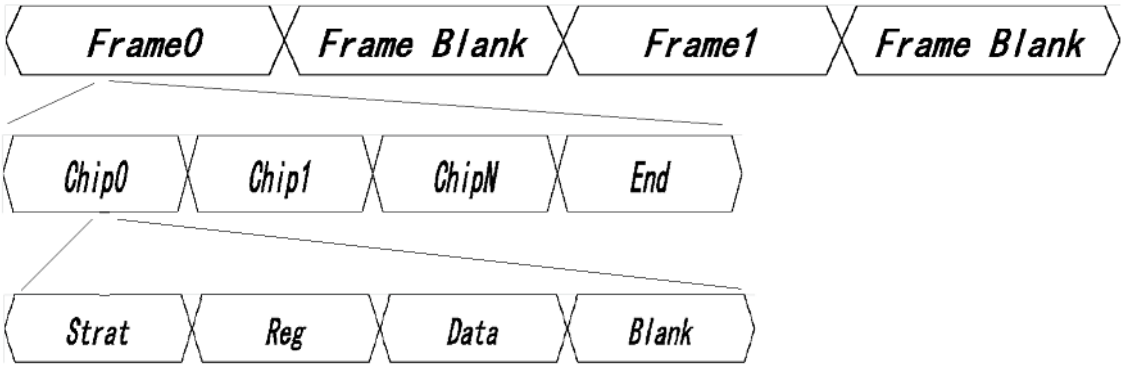
Name	Command	Description
Start	Frame start	32bit date=1
End	Frame end	60bit date=1
Blank	Blank signal	16bit data=0
Reg	Reg input	48bit Register, Send Reg0 first, then send Reg1,high bit in front The bit[0] and bit[15] of Reg0,Reg1 and Reg2 must be 0, that is, REG0[14:1] and REG1[14:1] are valid register bits
Data	Date input	96bit data for each line, 8lines of 768bit. first send ROW0~ROW7 of CH0, then send ROW0~ROW7 of CH1,untill ROW0~ROW7 of CH5,high bit in front chip0ch0row0-chip0ch0row1-chip0ch0row2-chip0ch0row3…chip0ch0row7 chip0ch1row0-chip0ch1row1-chip0ch1row2-chip0ch1row3…chip0ch1row7 **…** -chip0ch5row0-chip0ch5row1-chip0ch5row2-chip0ch5row3…chip0ch5row7
Frame Blank	Blank between frame	The ***End*** of each frame needs at least 2176 bit0 intervals between the next ***Start*** , (256+16)*8=2176

Waveform of Display

Between frames and frames, it is necessary to add ***Frame Blank*** at least 2176 bit0.

The chip sequence of input data is: chip0,chip1…chip N, ending with the End instruction, indicating the end of the frame transmission.

The sending order of each chip is: ***Start, Reg, Data, Blank***



Reg：48bit Register, Send Reg0 first, and then send Reg1,Reg2 high bit in front

The bit [0] and bit [15] of Reg0 ,Reg1 and Reg2 must be 0, that is, REG0 [14:1] , REG1 [14:1]and REG2 [14:1] are valid register bits

Data: first send ROW0~ROW7 of CH0, then send ROW0~ROW7 of CH1, until ROW0~ROW7 of CH5,high bit in front

chip0ch0row0-chip0ch0row1-chip0ch0row2-chip0ch0row3…chip0ch0row7

Chip0ch1row0-chip0ch1row1-chip0ch1row2-chip0ch1row3…chip0ch1row7

…

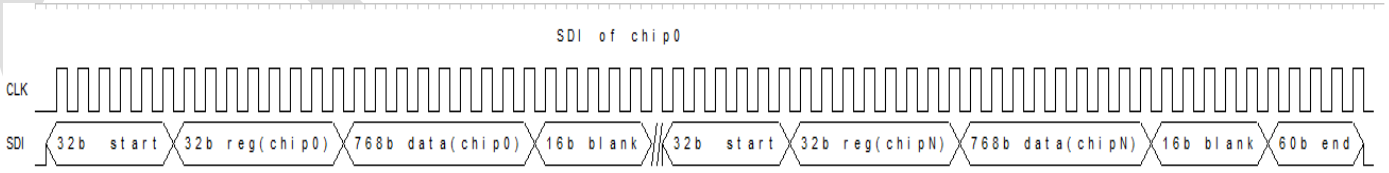
-chip0ch5row0-chip0ch5row1-chip0ch5row2-chip0ch5row3…chip0ch5row7`

NOTE:

1 Data is16bit，The maximum value of data is 65534 (i.e. 1111111111111110, not 16bit is 1).

2 When the number of scans is less than 8, 8 lines of data still need to be transmitted. If the effective data is insufficient, blank data can be added to fill in.

3 The CLK signal is transmitted at a fixed frequency and needs continuous transmission.



Register

Reg0

Reg	Name	Default	Description
[15]	Reserved	1b'0	
[14:13]	R_WID	2b'11	Data bit select (low data is valid, data high is 0). Group number is fixed 256,CLK for each group: 00: 13bit(32CLK/GROUP) 01: 14bit(64CLK/GROUP) 10: 15bit(128CLK/GROUP) 11: 16bit (256CLK/GROUP)
[12:9]	R_DUM	4b'1111	Line free time =(R_DUM<3:0>+1)*TCLK
[8:5]	R_AG	4b'1000	Upper ghosting elimination time=(R_AG<3:0>+1)*TCLK
[4]	PWM-wider	1'h0	Enhancement for low gray 1:Enable 0:Disable
[3:0]	TEST	4b'0000	Test Only

Reg1

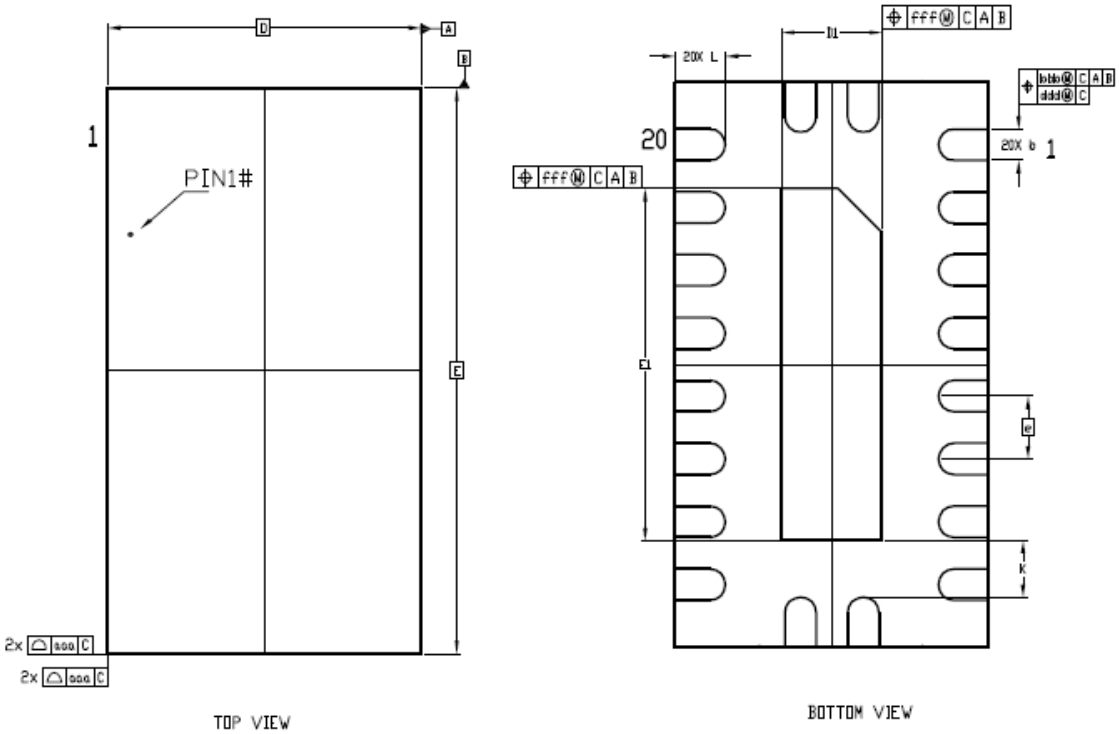
Reg	Name	Default	Description
[15]	Reserved	1b'0	
[14]	R_ROWOFF	1b'0	Line output 1: Disable 0: Enable
[13:11]	R_ROWSEL	3b'111	Scan line number 111:8 110:7, … 010:3 001&000:2
[10:9]	R_ROWDNV	2b'11	Upper ghosting elimination level adjust
[8:6]	R_V0P3	3b'100	Test Only
[5]	R_REG2EN	1b'1	Reg2 0:Disable 1:Enable
[4]	R_BREAK	1b'0	Enhancement for low gray 0:Disable 1:Enable

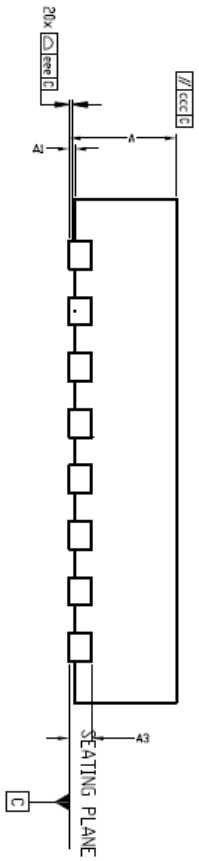
[3:2]	Reserved	2b'0	
[1]	R_UP	1b'0	Lower ghosting elimination 0:Disable 1:Enable
[0]	Reserved	1b'0	

Reg2

Reg	Name	Default	Description
[15]	Reserved	1b'0	
[14：10]	R_G2R	5b'11111	Green Current adjust(Red is 100%) Igain_Green=R_G2R*1.61%+50%
[9:5]	R_B2R	5b'11111	Blue Current adjust(Red is 100%) Igain_Blue=R_B2R*2.41%+25%
[4:1]	R_VUP	4b'1000	Lower ghosting elimination level adjust
[0]	Reserved	1b'0	

Package Outline





DIM / SYMBOL	MIN.	NOM.	MAX.
	0.70	0.75	0.80
A	0.80	0.85	0.90
A1	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）
ICND2112BN	QFN20-4.5*2.5*0.85	25.9

Important information

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