General Description

The GP9301BM is an analog signal to PWM signal converter which equivalent to a PWM output ADC. The chip can convert an analog voltage from 0V to VCC into a PWM signal with a duty cycle from 0% to 100%, the linear error of duty cycle is less than 0.5%, and compatible with 100K resistance and PWM signal input. The GP9301BM can provide capacity insulation application.

Features

- GP9131B, analog voltage input from 0V to VCC is linearly converted into PWM signal output with 0%-100% duty cycle.
- GP9131BM, after converter to PWM signal, the signal is modulated into high frequency PWM in order to provide capacitor insulation application.
- Analog Input signal compatible with 0-10V, PWM, 100KΩ resistor
- Input PWM signal high level: >2.7V
- Input signal VIN pin, built-in 100μA pull-up current
- Output PWM signal frequency range: 1Hz to 1MHz
- Ensure VCC rail discharge below 1.5V prior to subsequent power-up during rapid cycling tests
- Output PWM signal high level: 5V
- Maximum PWM duty cycle error: < 1%
- Linearity error of PWM duty <0.5%
- Power supply voltage: 10V-40V
- Power consumption: 5mA@typ.
- Startup time: <2ms
- Operating temperature: -40 °C to 125 °C

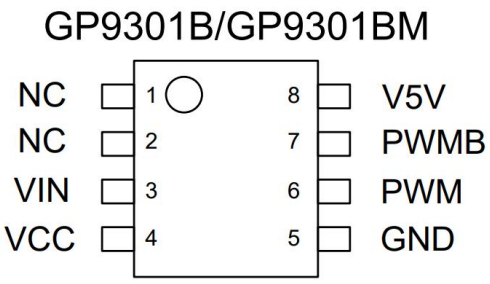
Applications

- DC motor speed regulation
- LED Dimming
- Industrial analog signal isolation
- Inverter
- Power supply

Pin Description

Pin. Name	Pin Description
VIN	Input analog voltage signal, compatible with PWM signal, 100K resistance
VCC	Power supply. This pin provides power supply for IC.
GND	Ground Pin.
V5V	Internal LDO, 5V output, a 1μF external capacitor is required. Ensure VCC rail discharge below 1.5V prior to subsequent power-up during rapid cycling tests
NC	No connect.
PWM	output signal of PWM

Table -A Pin. Name



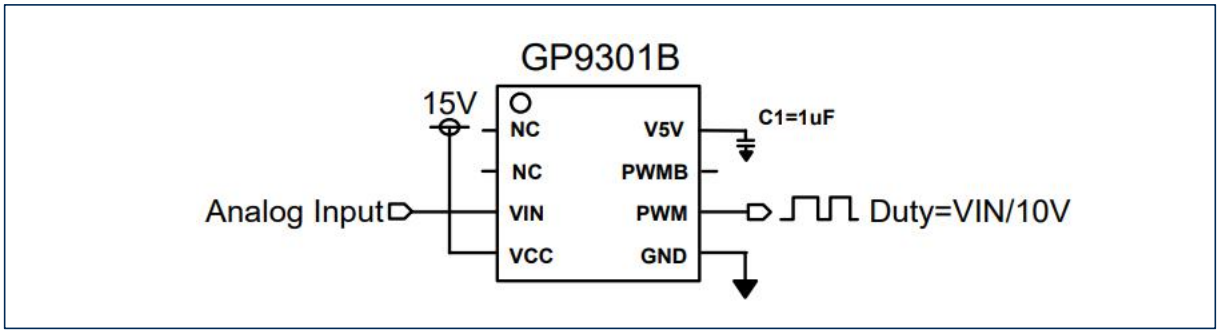
Absolute Maximum Ratings

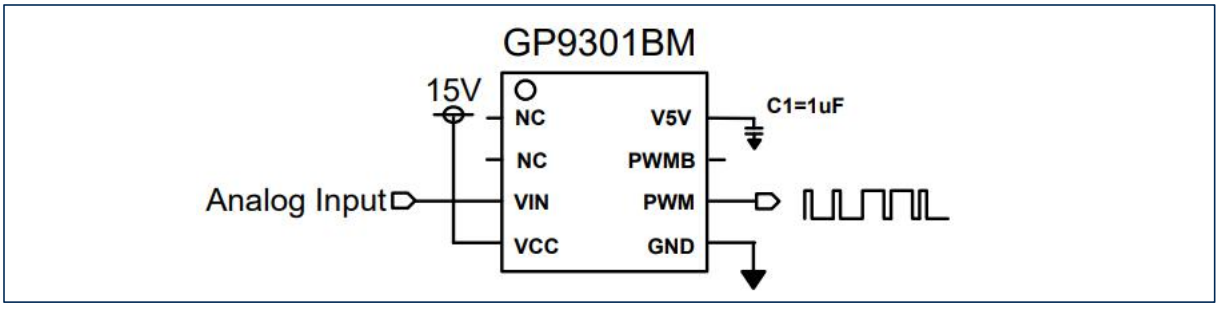
Operating Ambient Temperature Range	-40℃ to 125℃
Storage Temperature Range	-50℃ to 125℃
Input Voltage Range	-0.3 V to VCC + 0.3 V
Maximum voltage	40 V
ESD protection	> 2000 V

Note: Stresses exceeding those listed in the Maximum Rating stable may damage the device. Operation beyond the maximum Rating conditions or under harsh conditions may affect product reliability and function.

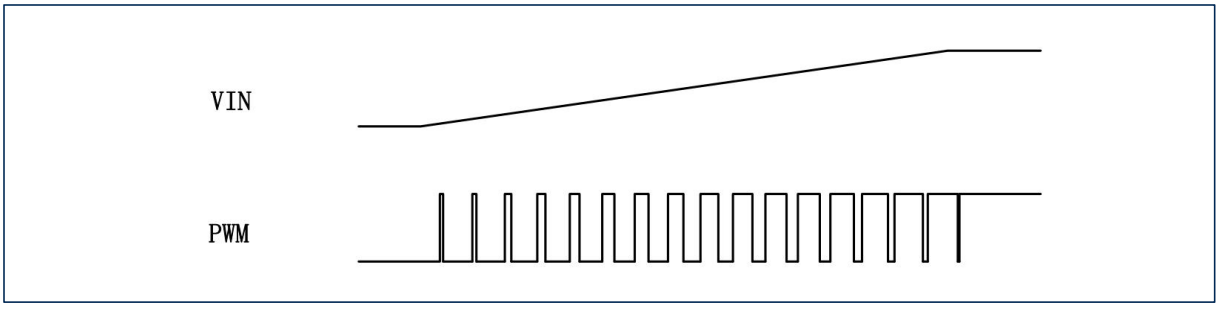
Typical Application

Typical Circuit

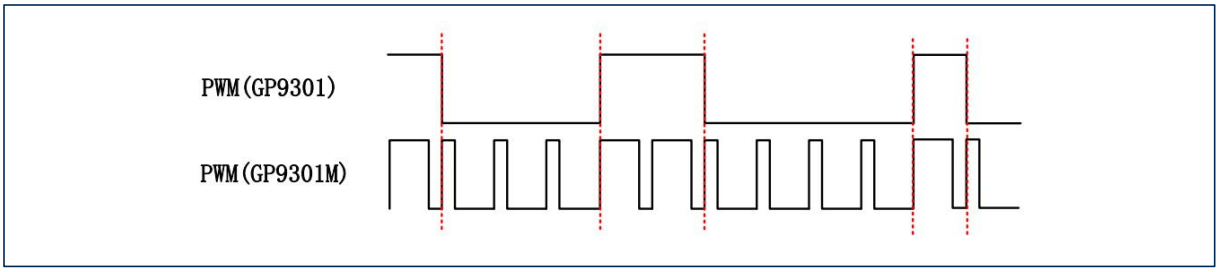




GP9301B analog voltage input and PWM output



GP9301BM and GP9301B output signals difference



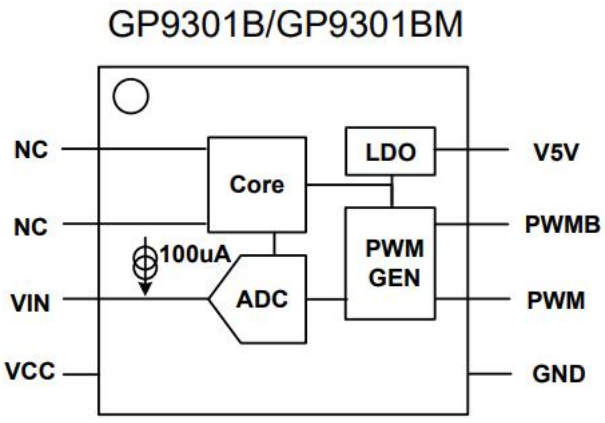
Operating mode

Typical function

The GP9301B is a high-performance APC chip (analog to PWM converter), whose outputs PWM signal frequency ranging from 1Hz to 1MHz. The analog input voltage range is from 0V to 10V, and the duty cycles of the output PWM and PWMB signals are from 0% to 100%. The duty cycle of the PWM signal is related to the input voltage as follows: D_{PWM} = VIN/10V. There is an internal 100uA pull up current source connected to the VIN pin, when connecting a 100K potentiometer, the VIN can be adjusted from 0V to 10V. The internal 100uA pull-up current source can be selected by different version. PWMB and PWM are a pair of complementary signals, which are opposite to each other.

The GP9301BM based on GP9301B output signal, modulates the output PWM signal into high frequency PWM signal, the high level output is modulated in of 75% duty cycle high frequency signal, low level output is modulated into 25% duty cycle high frequency signal, this modulation method can be used in capacitance isolation and transformer isolation application.

For the typical application circuits and application notes, please refer to Section 7.1.



Operating mode

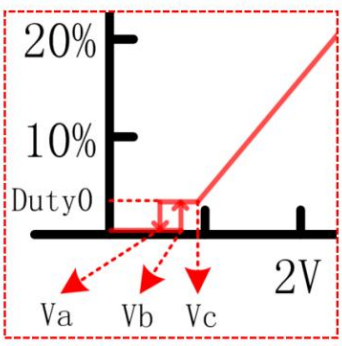
Typical conversion curve of voltage to PWM

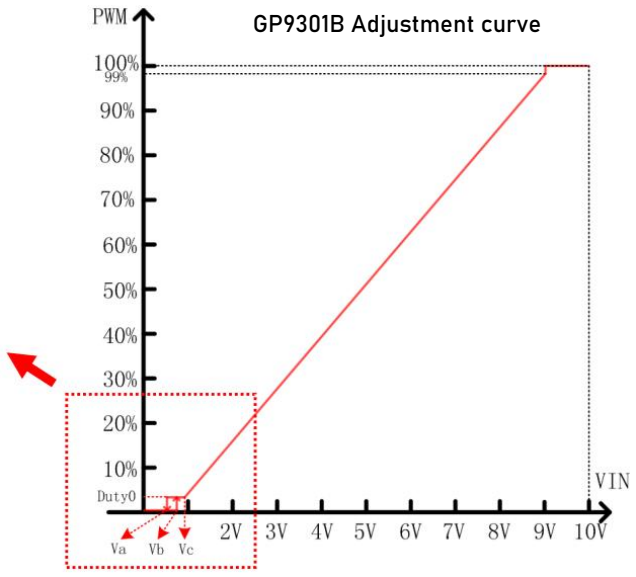
The GP9301B typical dimming curve description: (the voltage error range is less than 1%).

1. The start-up voltage of VIN is Va rising from 0V and the turn-off voltage is Vb falling from high voltage.
2. The output signal from input Va to Vc is constant value, and the output PWM duty cycle is 0%.
3. The output signal from input Vc to 9V is linear value, and the output PWM duty cycle is from 0 to 99%.
4. When VIN exceeds 9V, the output PWM duty cycle constant to 100%.

* the measured data of voltage of Va, Vb and Vc are as follows:

sample	Va	Vb	Vc	Duty0
#1	0.63V	0.78V	0.94V	0.9%
#2	0.61V	0.76V	0.95V	0.9%
#3	0.62V	0.77V	0.95V	1.0%
#4	0.67V	0.81V	1.00V	1.0%
#5	0.64V	0.78V	0.96V	1.0%





Take GP9301B-F1K-D1V9-SW as an example, F1K means the frequency is 1kHz, D1V9 means that when the input voltage drops to 1V, the output PWM duty cycle is 1%, when the input voltage rises to 9V, the output PWM duty cycle is 100% . The turn-off voltage is fixed at 0.6V. SW means SOP8 package and operating temperature of-40 ℃ to 85 ℃.

Likewise:

GP9301B-F4K-D5V9-SW means frequency 4KHz, dimming depth is 5%, input voltage rise to 9V then the output PWM duty cycle up to 100%.

GP9301B-F4K-D1V10-SW means frequency 4KHz, dimming depth is 1%, input voltage rise to 9V then the output PWM duty cycle up to 100%.

GP9301B-F1K-D5V10-SW means frequency 1KHz, dimming depth is 5%, input voltage rise to 10V then the output PWM duty cycle up to 100%.

AC Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit.
f_{pwm}	PWM signal frequency (Note 1)	1	1K	1M	Hz
Δf_{pwm}	Frequency error of PWM signal	-3	0	3	%
ΔD_{pwm}	Duty cycle error of PWM signal		0.5	1	%
D_{pwm}	Duty cycle of PWM signal (Note 2)	0		100	%
J_{pwm}	Jitter of PWM signal (Note 3)		0.1	0.2	$\%_{p-p}$
F_{BW}	Bandwidth		1K		Hz

Notes:

1, The PWM signal frequency can be adjusted into the range from 1Hz to 1MHz. The default value is 1KHz.

2, The PWM duty ratio is defined as the average duty ratio, each cycle may not fully equal due to cycle jitter.

3. Jitter is the ratio of the peak-to-peak deviation to the mean value in a period. The PWM jitter is measured at 1KHz frequency.

DC Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit.
VCC	Power supply voltage		10	12	40	V
ICC	Power consumption	VCC @ 15.0V		5		mA
VIN	Input voltage	*	0		10	V
IIL	Input leakage current	VIN = VCC or VSS			3	μA
VOL	Voltage output Low	VCC @ 15.0V, IOL = 10 mA			0.8	V
VOH	Voltage output High	VCC @ 15.0V, IOL = 10 mA			4.2	V
Tr	Output rise time	VCC @ 15.0V, C_{LOAD}=5pF		20	40	ns
Tf	Output fall time	VCC @ 15.0V, C_{LOAD}=5pF		20	40	ns
IV5V*	V5V drive capability	VCC @15.0V		10		mA

* the chip accuracy may be slightly affected by the load on V5V Pin.

Introduction of application and scheme

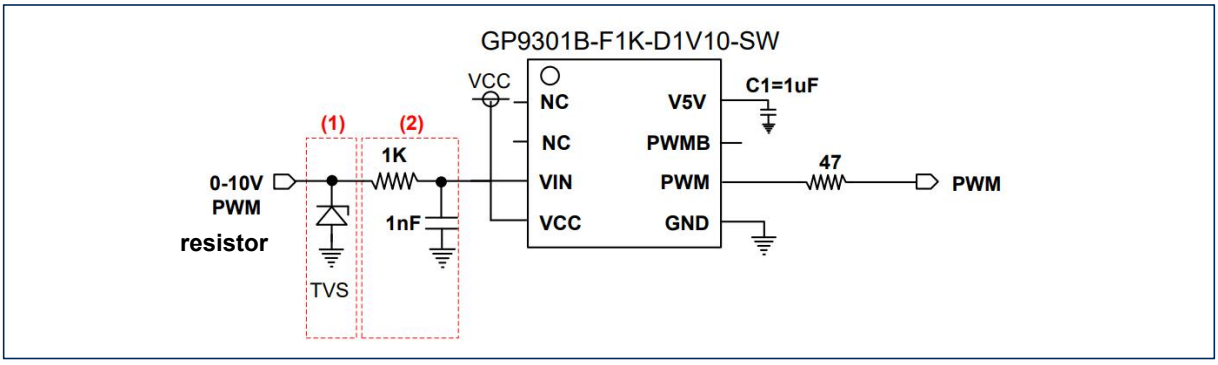
Typical GP9301B Circuits and points for attention

The 0-10V input of GP9301B is a diming interface, which need to be protected when the operation condition is harsh.

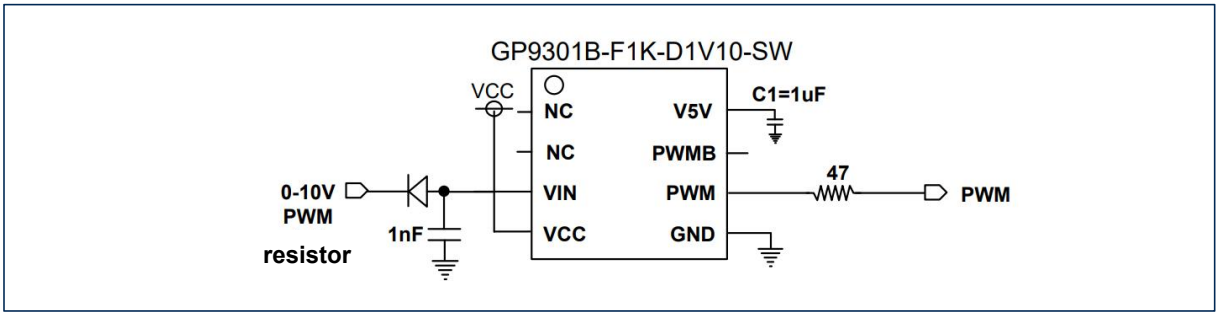
In the following figure, the input has two levels of protection:

1. TVS protects against input ESD and surge.
2. RC filter can filter high frequency noise.

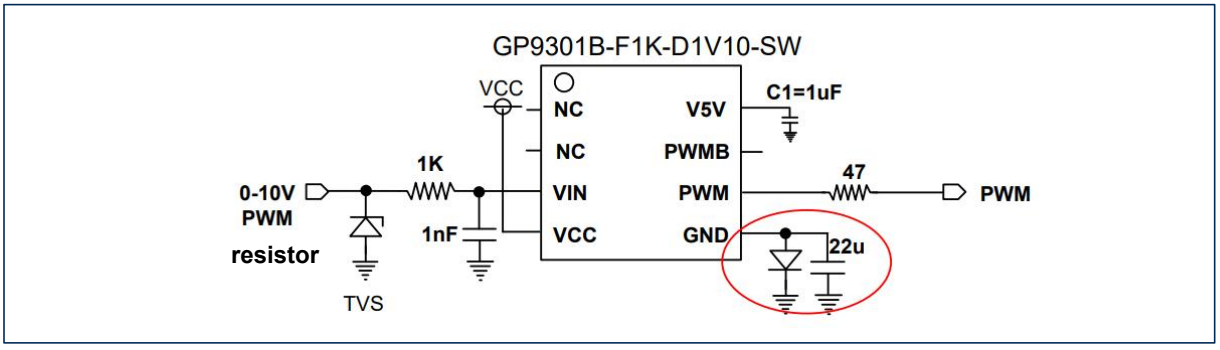
The resistance of the output is to prevent the irrigation from the load and provide anti-interference function.



Typical application circuit 1: turn-off when input voltage lower than 0.6V . Compatible with 10V PWM signal.



Typical application circuit 2: this circuit is compatible with the PWM signal of 2.7V-10V.



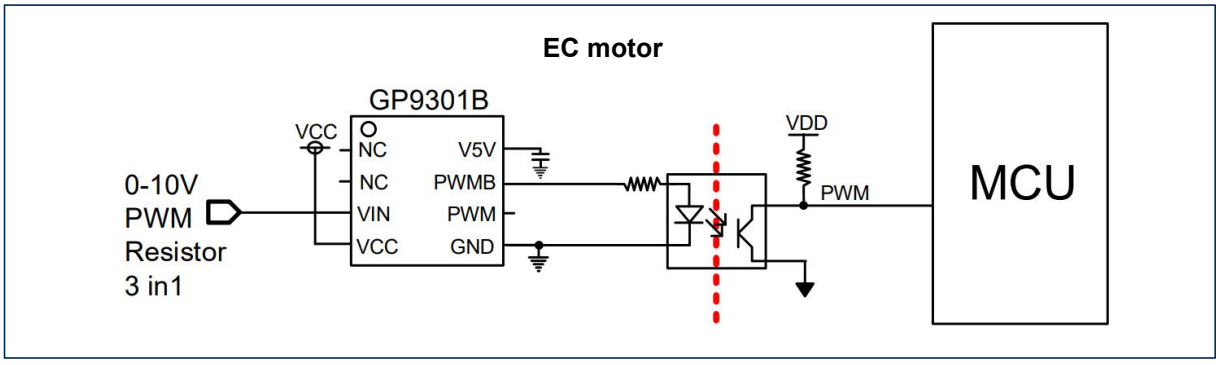
Typical application circuit 3: this circuit can raise the start-up voltage to more than 1V.

Introduction of application and scheme

0-10V/PWM/ Resistance three-in-one Motor driver

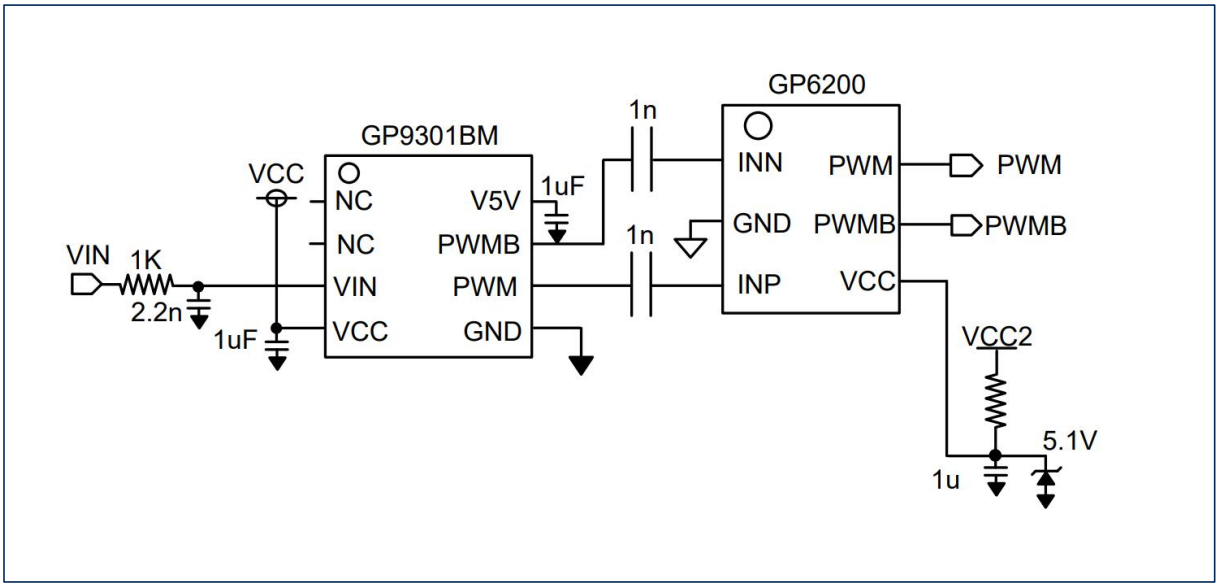
The motor speed signal is regulated by analog voltage (0-10V/0-5V) or PWM signal, for the EC motor, the motor's power supply is connect to 220V/110V/380V power distribution network, and the speed signal regulation connect to low-voltage, so the galvanic isolation is necessary. GP9301B converts the 0-10V analog voltage signal into PWM signal to drive isolation optocoupler for speed regulation.

The GP9301B not only supports 0-10V input, but also integrates the three-in-one input interface of PWM and 100K resistor, which optimizes the design of the interface circuit.



Capacitance isolation scheme from 0 to 10V to PWM

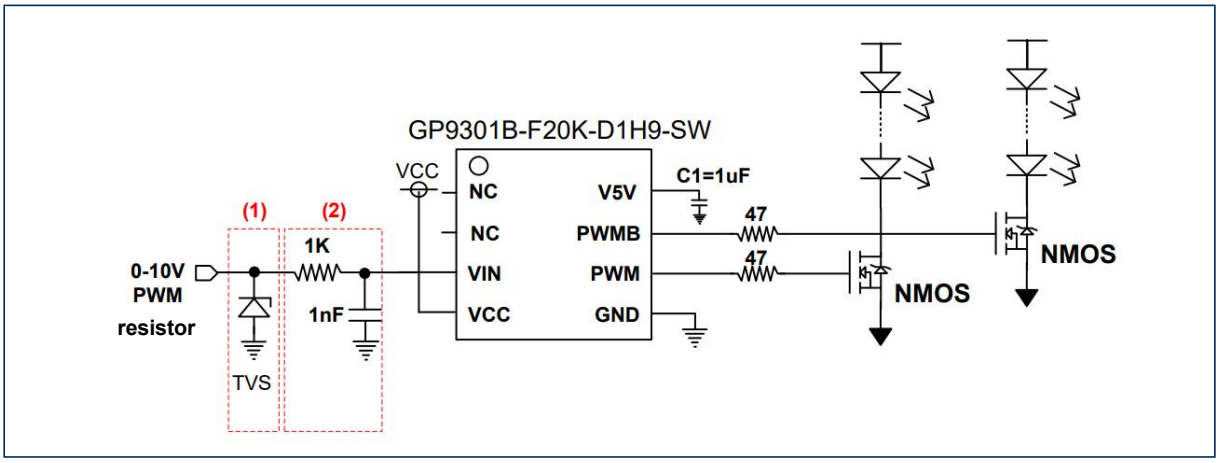
Analog signal modulation chip GP9301BM+ isolation capacitor + signal demodulation chip GP6200. Electrical isolation is realized by capacitors, and the isolation strength depends on the spec of capacitor, so this scheme can set the isolation voltage.



Introduction of application and scheme

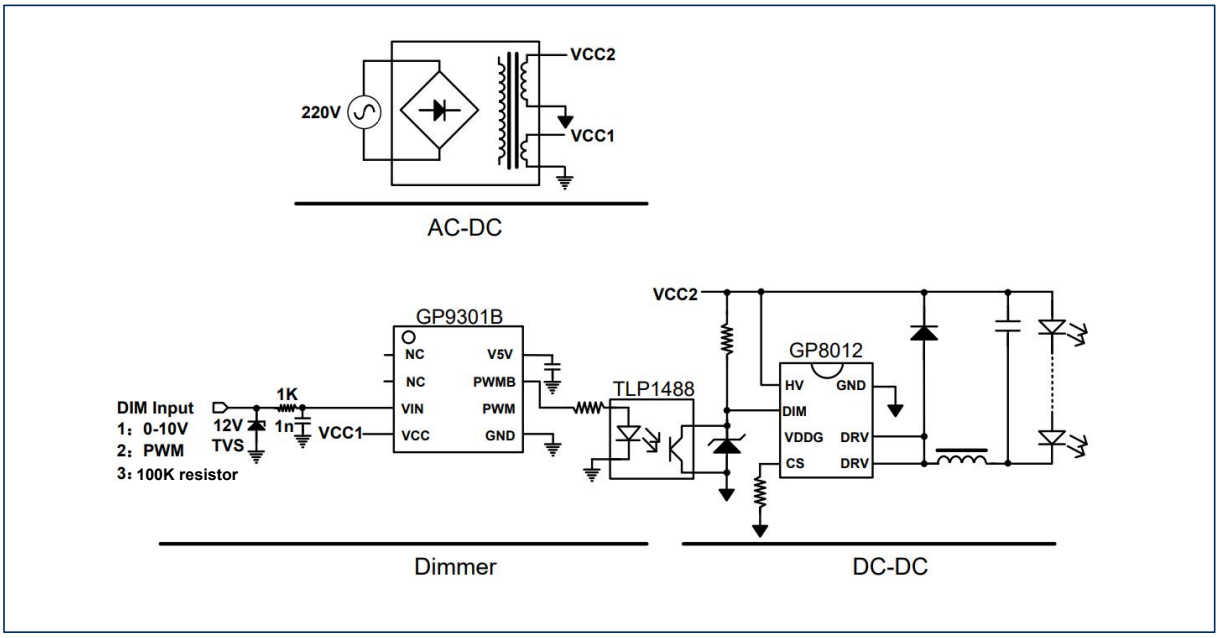
0-10V/PWM/Resistor three-in-one color temperature dimming scheme

0-10V analog signal input, GP9301B output a pair of complementary PWM signals of PWM and PWMB, driving the NMOS to control the two string LEDs color temperature, through changing PWM duty cycle to achieve LED color temperature diming.



0-10V three-in-one dimming scheme

This circuit is a dimming interface converter whose input signal can be a 0/1~10V dimming signal, resistor, or PWM signal. It recognizes the signal automatically, PWM generated by GP9301B according to the input voltage is: DPWM = VIN / 10V. The high level of PWM and PWMB signals is 5V. The PWMB signal is input signal of GP8012 for LED dimming through isolation optocoupler.



Ordering Information

GP 9 3 01B (X) - X - X - X

Product categories
8:PAC
9:APC

Power supply voltage
1:5V
3:40V

Series number

M:Modulated PWM output

XI: No pull-up current

The PWM frequency
F1K:Fixed 1Khz
F2K:Fixed 2Khz
F10K:Fixed 10Khz
F100K:Fixed 100Khz

terminal optimization
N:Normal
L*H*
C*H*
D*V*

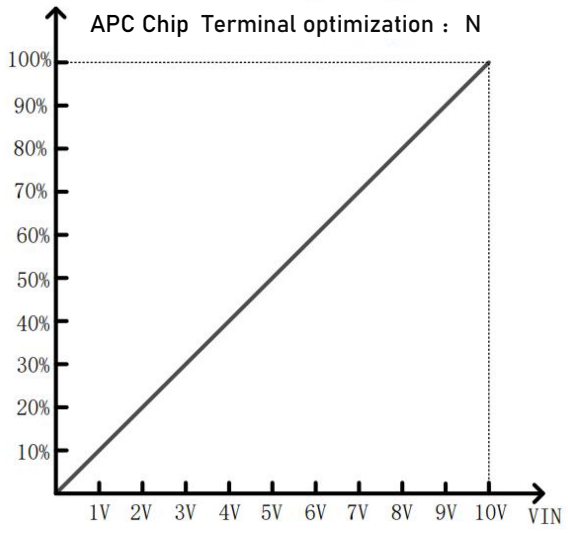
Package
S:SOP8

Temperature range
W:-40°C-85°C
H:-40°C-125°C

The GP9301B products not only converter the analogy voltage to PWM signal(terminal optimization is D1V9), but also customize different type by terminal optimization.

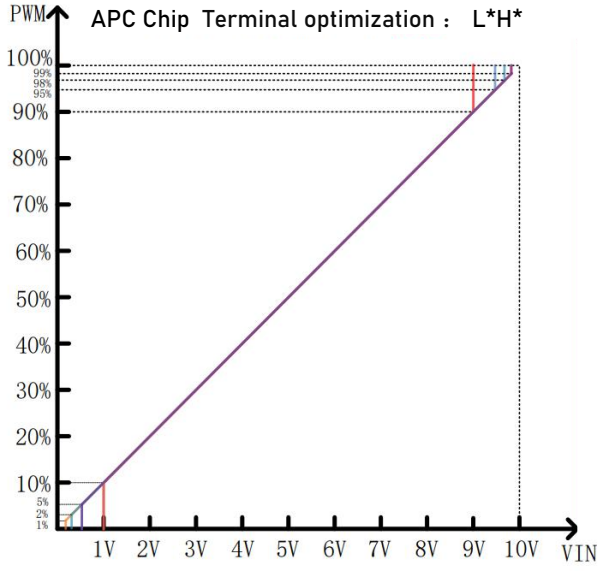
Terminal optimization： N

The end is without optimization, 0V-10V corresponds to PWM 0%-100%, because of offset voltage exist at zero, thus can not guarantee absolute 0V when PWM is 0%.



Terminal optimization： L*H*

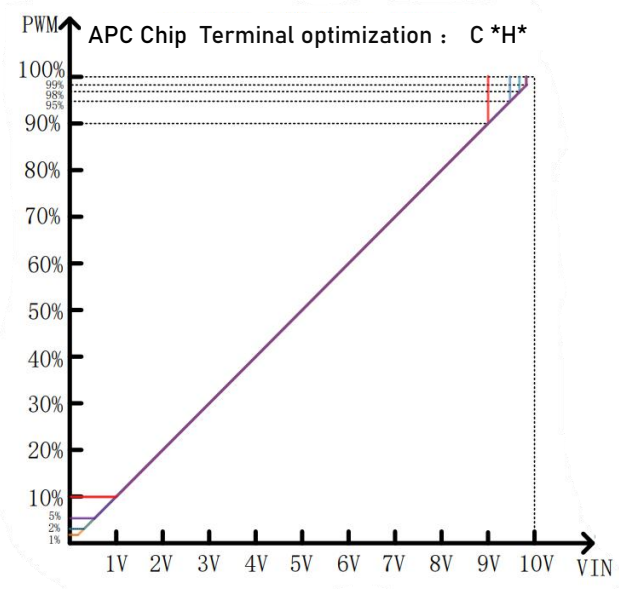
The output is setting 0 when it is lower than a certain duty cycle, and setting 100% when it is higher than a certain duty cycle. Low output has 4 grades to choose: 1%/2%/5%/10%; High output has 4 grades to choose: 90%/95%/98%/99%.



Common mode
GP9301-FXX-L1H1-SW
GP9301-FXX-L2H1-SW
GP9301-FXX-L5H1-SW
GP9301-FXX-LXH1-SW
Mode options
GP9301-FXX-L1H2-SW
GP9301-FXX-L2H2-SW
GP9301-FXX-L5H2-SW
GP9301-FXX-LXH2-SW
GP9301-FXX-L1H5-SW
GP9301-FXX-L2H5-SW
GP9301-FXX-L5H5-SW
GP9301-FXX-LXH5-SW
GP9301-FXX-L1HX-SW
GP9301-FXX-L2HX-SW
GP9301-FXX-L5HX-SW
GP9301-FXX-LXHX-SW

Terminal optimization: C *H*

When the output is lower than a certain duty cycle, the duty cycle keeping unchanged; when the output is higher than a certain duty cycle, the duty cycle is setting 100%. Low has 4 grades to choose 1%/2%/5%/10%; High has 4 grades to choose: 90%/95%/98%/99%.



Common mode
GP9301-FXX-C1H1-SW
GP9301-FXX-C2H1-SW
GP9301-FXX-C5H1-SW
GP9301-FXX-CXH1-SW
Mode options
GP9301-FXX-C1H2-SW
GP9301-FXX-C2H2-SW
GP9301-FXX-C5H2-SW
GP9301-FXX-CXH2-SW
GP9301-FXX-C1H5-SW
GP9301-FXX-C2H5-SW
GP9301-FXX-C5H5-SW
GP9301-FXX-CXH5-SW
GP9301-FXX-C1HX-SW
GP9301-FXX-C2HX-SW
GP9301-FXX-C5HX-SW
GP9301-FXX-CXHX-SW

* you can choose different frequencies and types of end treatment as needed.

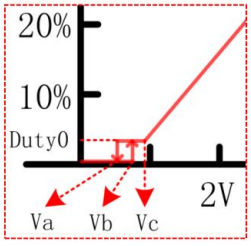
Terminal optimization： D*V*

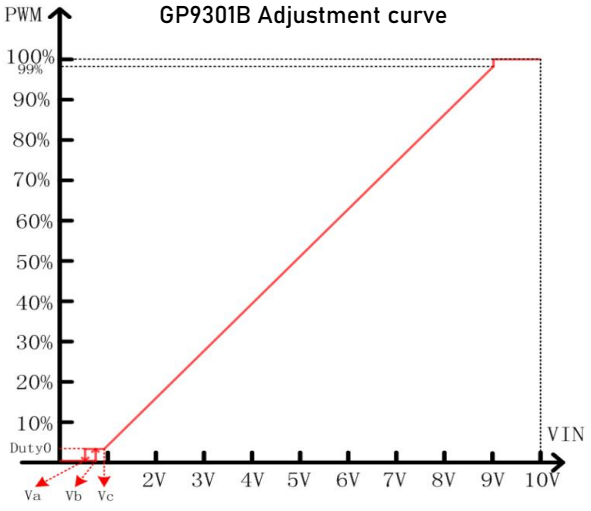
The typical dimming curve description: (the voltage error range is less than 1%).

1. The start-up voltage of VIN is Va rising from 0V and the turn-off voltage is Vb falling from high voltage.
2. The output signal from input Va to Vc is constant value, and the output PWM duty cycle is 0%.
3. The output signal from input Vc to 9V is linear value, and the output PWM duty cycle is from 0 to 99%.
4. When VIN exceeds 9V, the output PWM duty cycle constant to 100%.

* the measured data of voltage of Va, Vb and Vc are as follows:

Sample	Va	Vb	Vc	Duty0
#1	0.63V	0.78V	0.94V	0.9%
#2	0.61V	0.76V	0.95V	0.9%
#3	0.62V	0.77V	0.95V	1.0%
#4	0.67V	0.81V	1.00V	1.0%
#5	0.64V	0.78V	0.96V	1.0%





Take GP9301B-F1K-D1V9-SW as an example, F1K means the frequency is 1kHz, D1V9 means that when the input voltage drops to 1V, the output PWM duty cycle is 1%, when the input voltage rises to 9V, the output PWM duty cycle is 100% . The turn-off voltage is fixed at 0.6V. SW means SOP8 package and operating temperature of-40 ℃ to 85 ℃.

Likewise:

GP9301B-F4K-D5V9-SW means frequency 4KHz, dimming depth is 5%, input voltage rise to 9V then the output PWM duty cycle up to 100%.

GP9301B-F4K-D1V10-SW means frequency 4KHz, dimming depth is 1%, input voltage rise to 9V then the output PWM duty cycle up to 100%.

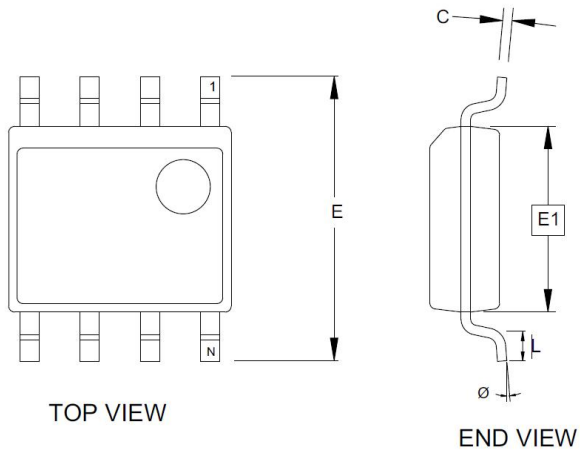
GP9301B-F1K-D5V10-SW means frequency 1KHz, dimming depth is 5%, input voltage rise to 10V then the output PWM duty cycle up to 100%.

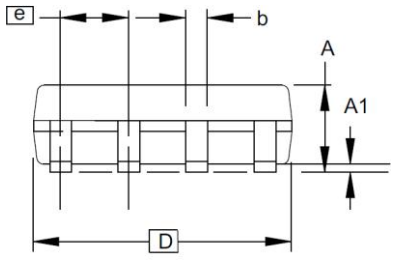
GP9301B series selection

Operating temperature	PWM frequency *1	terminal optimization*2	Ordering Number
-40℃-85℃	1KHz	D*V*	GP9301B-F1K-D*V*-SH
-40℃-85℃	1KHz	C*H*	GP9301B-F1K-C*H*-SH
-40℃-85℃	1KHz	L*H*	GP9301B-F1K-L*H*-SH
-40℃-85℃	1KHz	N	GP9301B-F1K-N-SH

* You can choose different frequencies and terminal optimization types as required

Package Dimension





(Unit: mm)

Symbol	Min.	Typ.	Max.
A1	0.10	–	0.25
A	1.35	–	1.75
b	0.31	–	0.51
C	0.17	–	0.25
D	4.80	–	5.05
E1	3.81	–	3.99
E	5.79	–	6.20
e	1.27 BSC		
L	0.40	–	1.27
Ø	0 °	–	8 °

Note:

- This figure is for general reference only. Refer to JEDEC drawing MS-012 for proper dimensions, tolerances, datum, etc.