CDM10VD

Flexible 0-10V Dimming Solution

CDM10VD
CDM10VD-2
CDM10VD-3
CDM10VD-4
Quality Requirement Category: Standard

Features

- Simplest 0-10 V design on the market. CDM10VD-Series comes with the following default settings:
  - Minimum duty cycle 5% or 10% @1V
  - 1kHz PWM frequency
  - 120µA Dimmer/Resistor Bias current
  - 9.4 V dimming voltage for 100%
  - 1mA or 5mA output current for driving an optocoupler
- Wide input V_{cc} range from 11 to 25 V plus extended range down to 6V
- Minimum 200mV dimming hysteresis between dimming to OFF and to ON
- Variable Frequency PWM Input Mode
- Replaces many external components with a single chip reducing BOM and PCB space
- Minimum variation from device to device

Applications

- LED Drivers needing 0-10 V Dimming Circuits
- Industrial and Commercial Dimmable Applications: Luminaires, Troffers, Downlights, Sconces, Undercabinet, Office Lighting, Signage applications, Dali-applications

Product Type	Output current / min. Duty Cycle	Package
CDM10VD	5 mA / 5 %	SOT23-6
CDM10VD-2	5 mA / 10 %	SOT23-6
CDM10VD-3	1 mA / 5 %	SOT23-6
CDM10VD-4	1 mA / 10 %	SOT23-6

Description

CDM10V is a fully integrated 0-10 V dimming interface IC and comes in a SOT23-6 package to cover space requirements on small PCB designs.

The device is targeted for various dimming applications in lighting. The IC can be used to transmit analog voltage based signals from a 0-10 V dimmer or a potentiometer or a PWM input of a lighting controller IC, transformed to a 5 mA/1 mA current based fixed frequency PWM signal, to directly drive an external optocoupler. To avoid flickering when dimming, the light up and the light down threshold has a minimum implemented hysteresis of 200mV.

It replaces many components in a traditional solution and reduces BOM and PCB space significantly.

The CDM10VD-Series ICs outputs a 0 - 100% PWM current signal at a frequency of 1 kHz with an amplitude value of 1mA or 5 mA.

Description

The duty cycle of the PWM signal can be selected to be either 5% or 10%. Dim-to-off feature is fully supported with a minimum hysteresis of 200 mV between dim-to-dark and dim-to-light.

Embedded digital signal processing maintains minimum variations from device to device.

Table of contents

1 Block Diagram

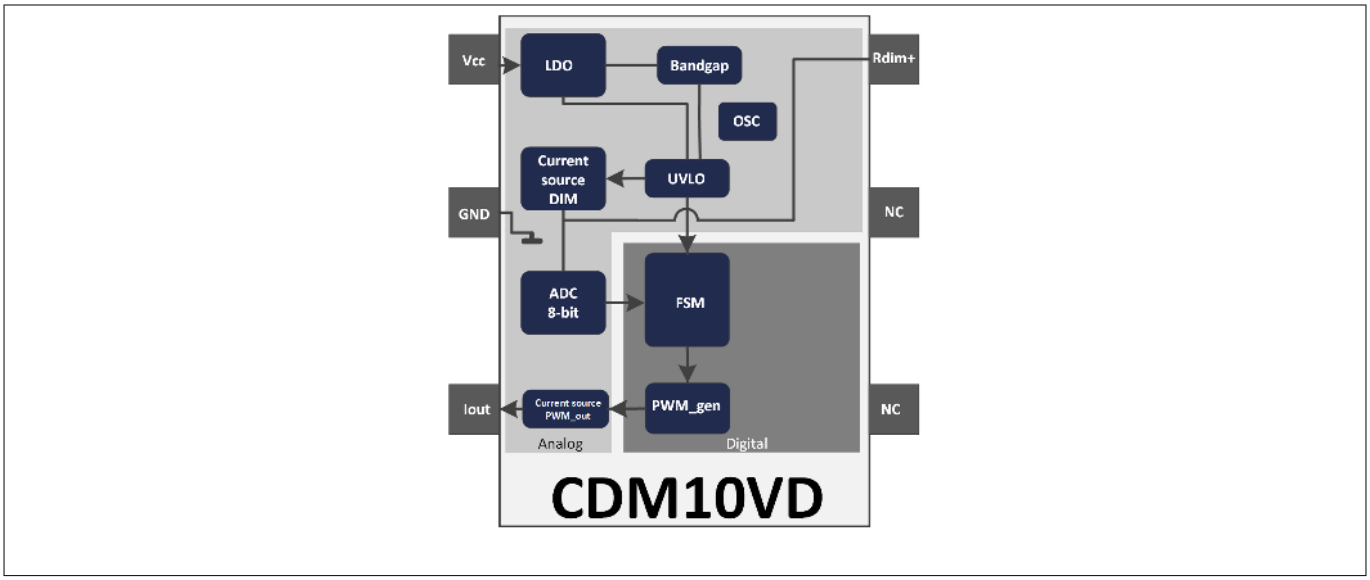

Figure 1 Block Diagram of the CDM10VD

2 Pin Configuration

Table 1 Pin configutation

Pin	Name	Function
1	V_{CC}	Input supply voltage
2	GND	GND
3	I_{out}	PWM output current
4	NC	GND
5	NC	GND
6	R_{dim+}	Dimmer current output /Voltage sense

3 Functional Description

Typical Application Circuit

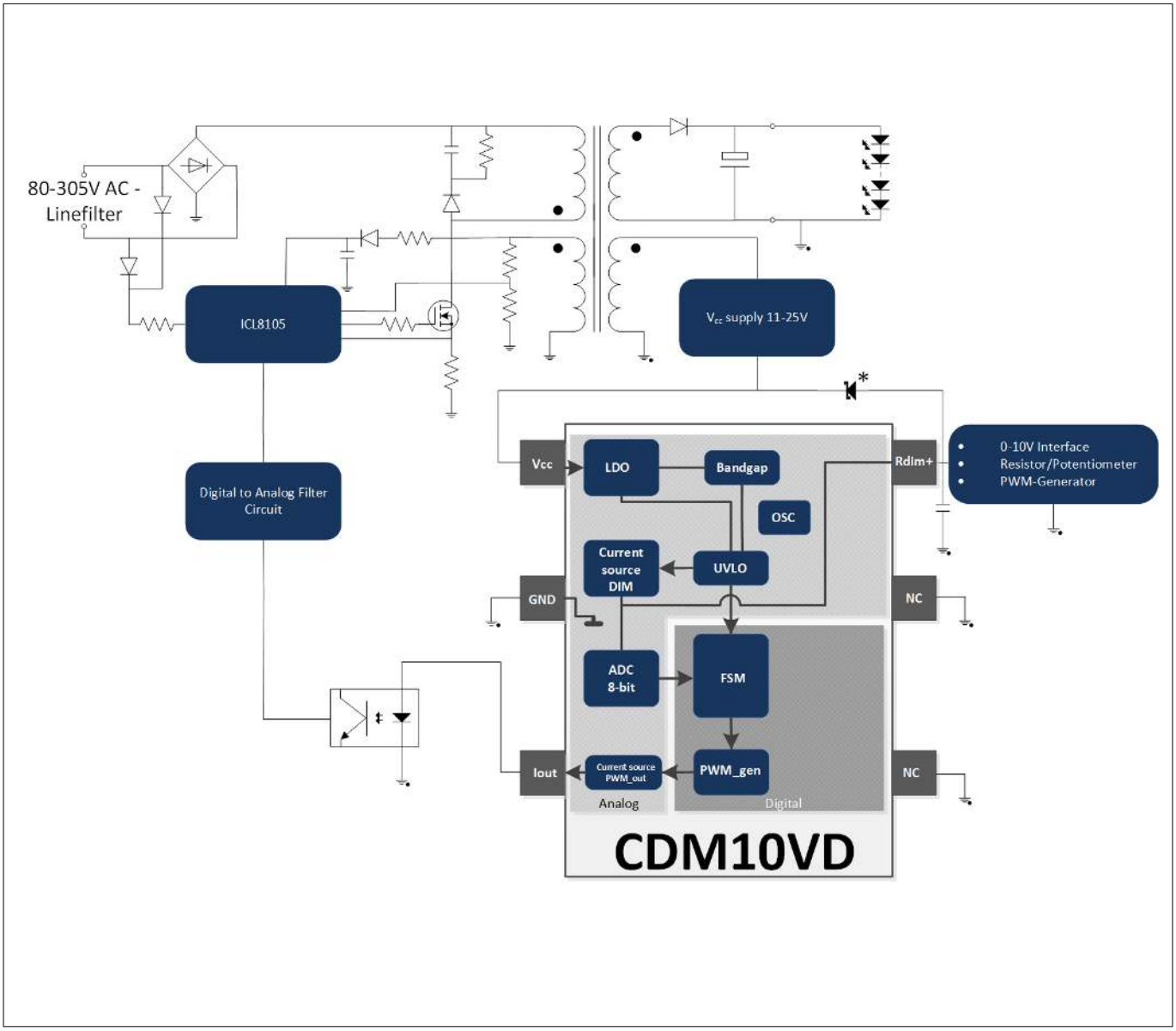

Figure 2 Typical Application Circuit

*Note: The Diode marked with * is for the protection of the R_{dim+}-Pin when active dimming is used. This is because the voltage on this Pin is not allowed to be higher than V_{CC}+0.5V. It is advised to use a low leakage, low reverse current Schottky-Diode in order to not influence the dimming performance (e.g. MMSD301T1G).*

Note: The capacitor connected to the R_{dim+}-Pin reduces the amount of coupled noise to the dimming signal. The size of this capacitance should be in the range of 2.2 - 10 nF (typ. 4.7 nF), where a small capacitor allows steeper edges of the dimming signal, a larger capacitor enhances the noise reduction.

Recommended cooling area

In order to guarantee the full functionality of the CDM10VD device, the required cooling area has to be selected according to the graph in ***Figure 3***.

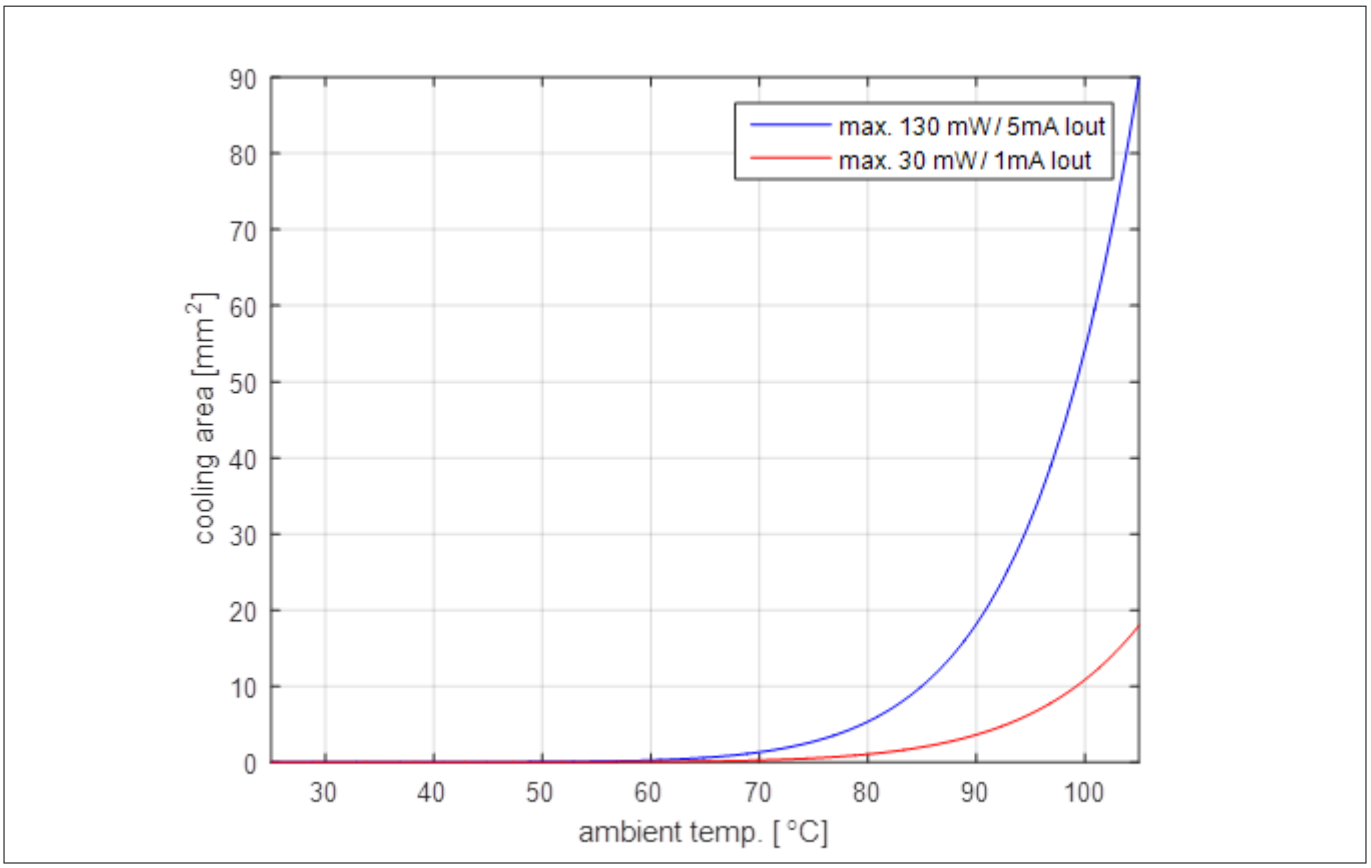

Figure 3 Cooling area over ambient temperature CDM10VD

Dimming Characteristic

Table 2 PWM Output current referring to R_{dim+}-Pin nominal Voltage

R_{dim+}	I_{out}
<0.5V (dim-to-dark)	OFF (0%)
0.5V…1V (dim-to-dark)	Min duty cycle 5%/10%
<0.7V (dim-to-bright)	OFF (0%)
0.7V…1V (dim-to-bright)	Min duty cycle 5%/10%
1V….9.4V	Min duty cycle (@ 1V)...100% (@ 9.4V)
>9.4V	Always active (100%)

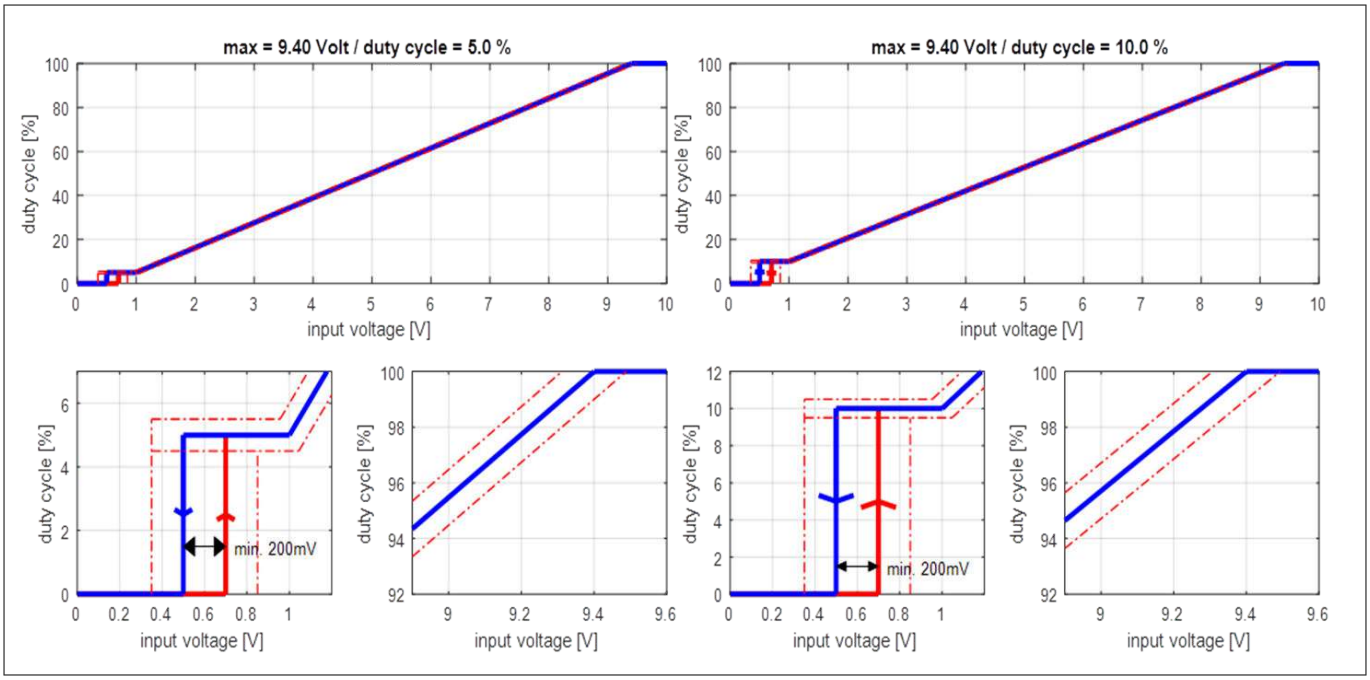

Figure 4 Dimming Characteristic with +-1% error for start- & endpoint for 5% and 10% Min Duty Cycle

Table 3 Dim2bright and dim2off thresholds

Dim2off				Dim2bright				Hysteresis
min	nom	max		min	nom	max		min
0,35	0,5	0,65		0,55	0,7	0,85		200mV

The CDM10VD device has two operating ranges, as seen in ***Figure 5***, in regards of the supply voltage V_{CC}.
The following conditions must be taken into consideration:

- between 11 and 25V the device is fully operable and all parameters are in specification
- between 6 and 11V the device is functional but the parameters might be out of specification

The purpose of the extended V_{CC} range is to use it during the off state of the LED. Here the secondary side supply voltage can be lowered down to 6V, which is sufficient to keep the CDM10VD device functional. The System has to be designed in an way that the remaining power, which is transferred to the output, is low enough so the LEDs' doesn't emit any visible light, but sufficient to keep the CDM10VD in this extended V_{CC} range. If a voltage on the R_{dim+}-pin is sensed, which is higher than the dim2bright threshold, the system powers

the output to the normal operating voltage. This should also bring the V_{CC} supply voltage to the normal operating area of the CDM10VD device where all parameters are in specification again.

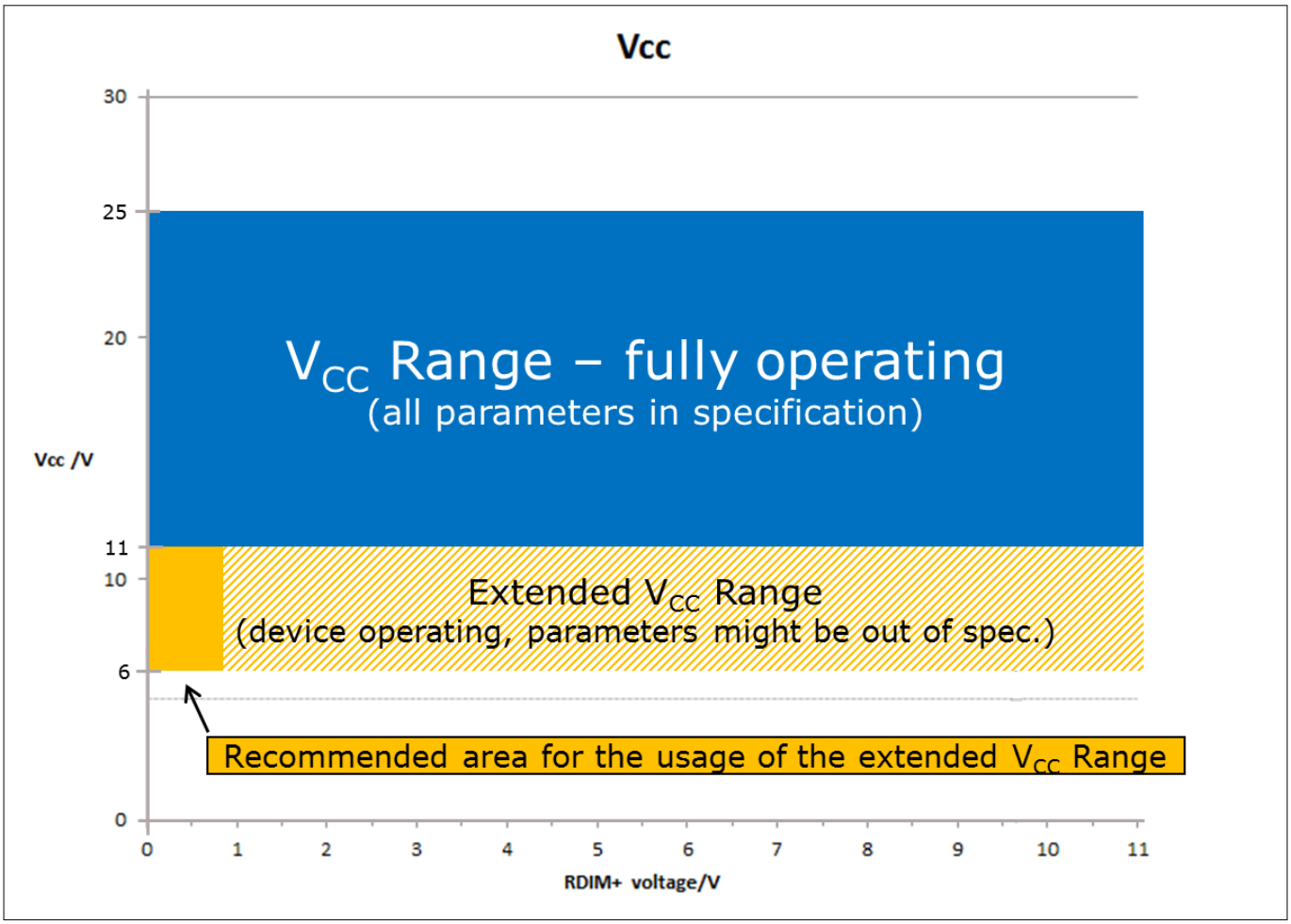

Figure 5 Extended V_{CC} range

Variable Frequency PWM Input Mode

CDM10VD device can be operated in a 'frequency conversion input mode'. In this mode the PWM input signal on R_{dim+} with frequencies between 100 Hz and 3 kHz will be converted to 1 kHz signal on I_{out}. The duty cycle between input and output signals remain at the same level. The configuration and conditions are described below.

Variable frequency mode conditions

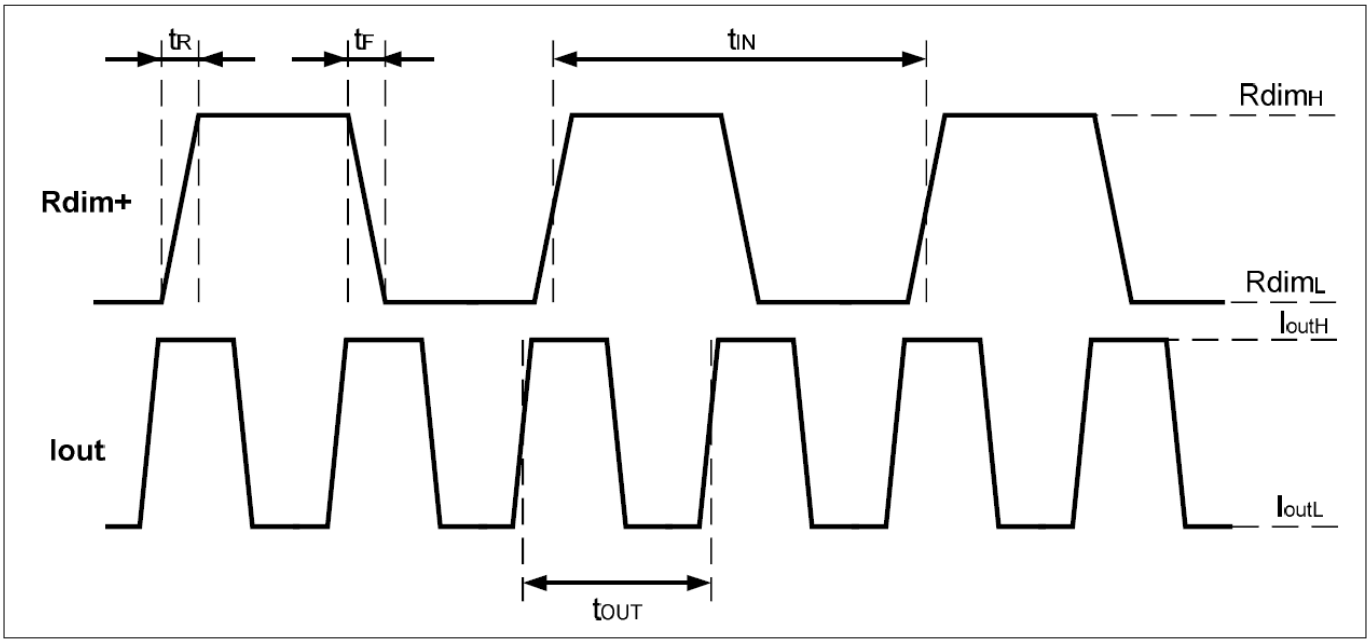

Figure 6 Timing for the Variable Frequency PWM Input Mode

Table 4 Conditions for the Variable Frequency PWM Input Mode

Condition	Name	Min	Nom	Max
R_{dimH}	R_{dim+}High Value	9.6 V		V_{CC}+0,5V
R_{dimL}	R_{dim+}Low Value	-0.5 V	0.0 V	0.5 V
I_{outH}	I_{out}High Value		R_{Iout} * I_{Iout}[1]	
I_{outL}	I_{out}Low Value		0.0 V	
t_{IN}	Period input signal	0.33 ms	1.0 ms	10.0 ms
t_{OUT}	Period ouput signal	1.0 ms - 5 %	1.0 ms	1.0ms + 5 %
t_R	Rising edge time			1.8 µs
t_F	Falling edge time			1.8 µs

Note: [1] *R_{Iout} is the resistance connected between the I_{out} and the GND-PIN. I_{out} is 1 mA or 5 mA dependent on the CDM10VD version.*

Once the CDM10VD detects the frequency in the range 100 Hz and 3 kHz on the R_{dim+} input the internal FSM will lock after min eight input signal periods. In this time the input R_{dim+} signal is provided to the I_{out} directly, see ***Figure 7***.

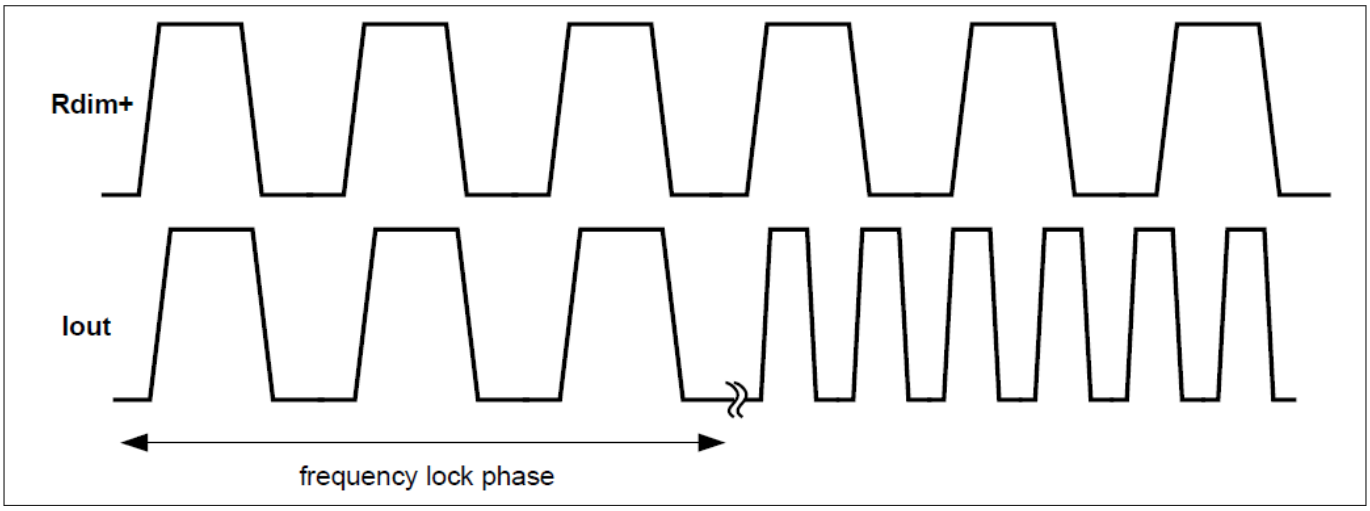

Figure 7 Lock phase default mode

Backup mode

To avoid the I_{out} behavior during lock phase in default mode, there is an additional option described below. In normal operation Pin 5 has to be connected to the GND level. In this mode the CDM10VD selects automatically between the standard hysteresis mode and the frequency conversion mode depending on the input signal on R_{dim+}. Leaving the Pin 5 unconnected, the CMD10VD device will switch directly to the frequency conversion mode and the I_{out} pin will be tied to GND during the frequency lock phase, see ***Figure 8***. In this mode the standard hysteresis mode cannot be used.

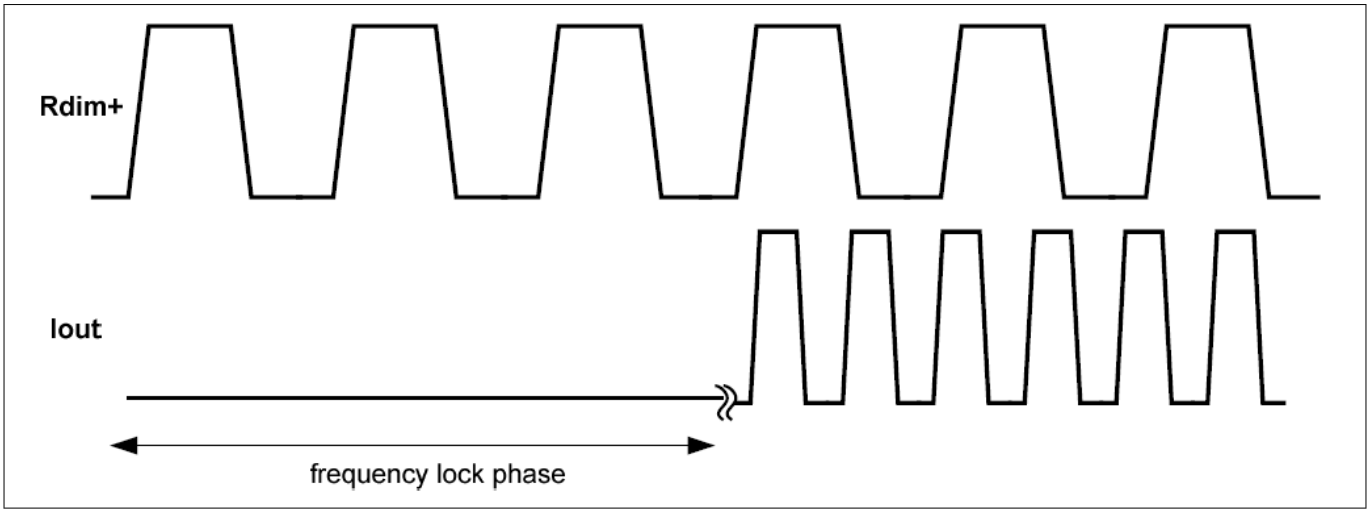

Figure 8 Lock phase backup mode

4 Electrial Characteristics and Parameters

Table 5 Absolute Maximum Ratings

Pin	Name	Values		Unit	Note or Test Condition
		Min.	Max.		
1	V_{cc}	0	26	V	
2	GND	0	0	V	Point of reference
3	I_{out}	-0.5	3.63	V	Depending on the optocupler voltage @ 5mA or 1mA
4	NC	-0.25	0.1	V	Connect to GND during operation
5	NC	-0.25	0.1	V	During operation Connect to GND
6	R_{dim+}	-0.5	V_{CC} + 0.5	V	An applied voltage above max value leads to the destruction of the device. Also valid if V_{CC} is 0 V.

Absolute maximum ratings (***Table 5***) are defined as ratings which when being exceeded may lead to destruction of the integrated circuit. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the integrated circuit. These values are not tested during production test.

Table 6 Electrical Characteristics

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Input Voltage	V_{in}	11		25	V	Operating Voltage
Extended Input Voltage	V_{ext}	6		10.9	V	Parameters might be out of spec.
Junction Temperature Range	T_J	-40		135	°C	
Ambient Temperature Range	T_A	-40		105	°C	All limits guaranteed
Startup Ambient Temperature Range	T_A	-55		105	°C	IC startup guaranteed
Current Consumption	I_{CC}			1	mA	Current Consumption of the IC for self supply
Output Current for Dimmer	I_{dim}	-5%	120	+5%	µA	Current flow out of R_{dim+}-Pin
PWM frequency	f_{PWM}	-5%	1000	+5%	Hz	
Dimming accuracy		-1		+1	%	With active dimming incl. all variations

Table 6 Electrical Characteristics (continued)

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Wake-up Time	t_w			40	µs	Time from V_{CC} = 6 V to first output current
ESD capability HBM	V_{HAB}			1500	V	according to ANSI/ESDA/JEDEC JS-001
ESD capability CDM	V_{CDM}			500		according to JESD22 C101

Table 7 Electrical Characteristics for CDM10VD

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Output Current for Optocoupler	I_{out}	4.5	5	5.5	mA	
Min. duty cycle	PW_{PWM}	-0.5	5	+0.5	%	Percentage of the pulse width
Power Dissipation	P_{tot}	8.25 @ 5% duty cycle;	130 @ 100% duty cycle 83.2 @ 70% duty cycle 54 @ 50% duty cycle 30.4 @ 30% duty cycle	160 @ 100% PWM & 25 V_{in}	mW	Dimmer current included

Table 8 Electrical Characteristics for CDM10VD-2

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Output Current for Optocoupler	I_{out}	4.5	5	5.5	mA	
Min. duty cycle	PW_{PWM}	-0.5	10	+0.5	%	Percentage of the pulse width
Power Dissipation	P_{tot}	11 @ 10% duty cycle	130 @ 100% duty cycle 83.2 @ 70% duty cycle 54 @ 50% duty cycle 30.4 @ 30% duty cycle	160 @ 100% PWM & 25 V_{in}	mW	Dimmer current included

Table 9 Electrical Characteristics for CDM10VD-3

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Output Current for Optocoupler	I_{out}	0.9	1	1.1	mA	
Min. duty cycle	PW_{PWM}	-0.5	5	+0.5	%	Percentage of the pulse width
Power Dissipation	P_{tot}	2.3 @ 5% duty cycle	30 @ 100% duty cycle 21 @ 70% duty cycle 15 @ 50% duty cycle 9 @ 30% duty cycle	53 @ 100% PWM & 25 V_{in}	mW	Dimmer current included

Table 10 Electrical Characteristics for CDM10VD-4

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Output Current for Optocoupler	I_{out}	0.9	1	1.1	mA	
Min. duty cycle	PW_{PWM}	-0.5	10	+0.5	%	Percentage of the pulse width
Power Dissipation	P_{tot}	2.6 @ 10% duty cycle	30 @ 100% duty cycle 21 @ 70% duty cycle 15 @ 50% duty cycle 9 @ 30% duty cycle	53 @ 100% PWM & 25 V_{in}	mW	Dimmer current included

Note: *Please contact Infineon if you are in need of an inverted output current.*

5 Package Dimensions

Package Drawings

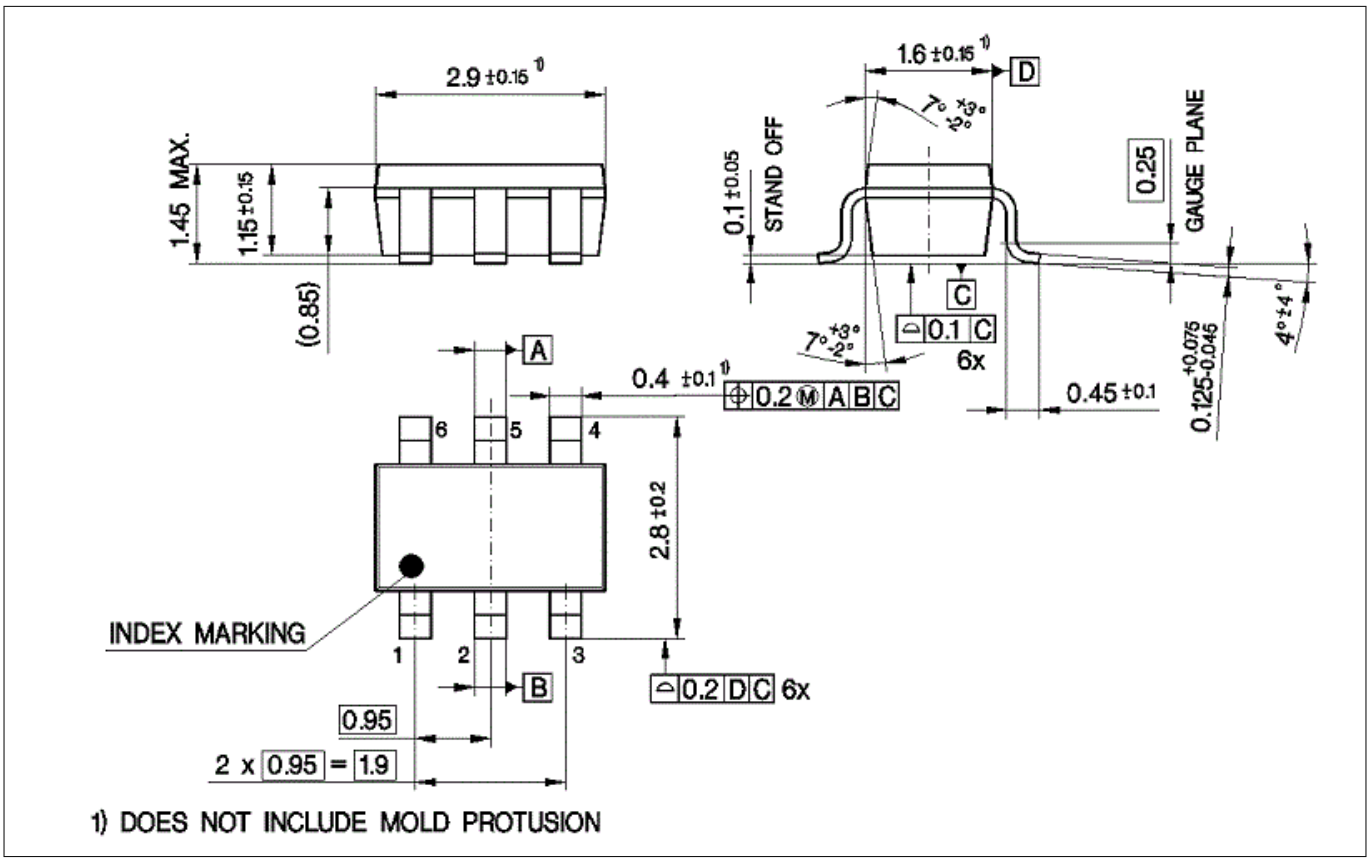

Figure 9 Package Drawings

Package Dimensions

Footprint

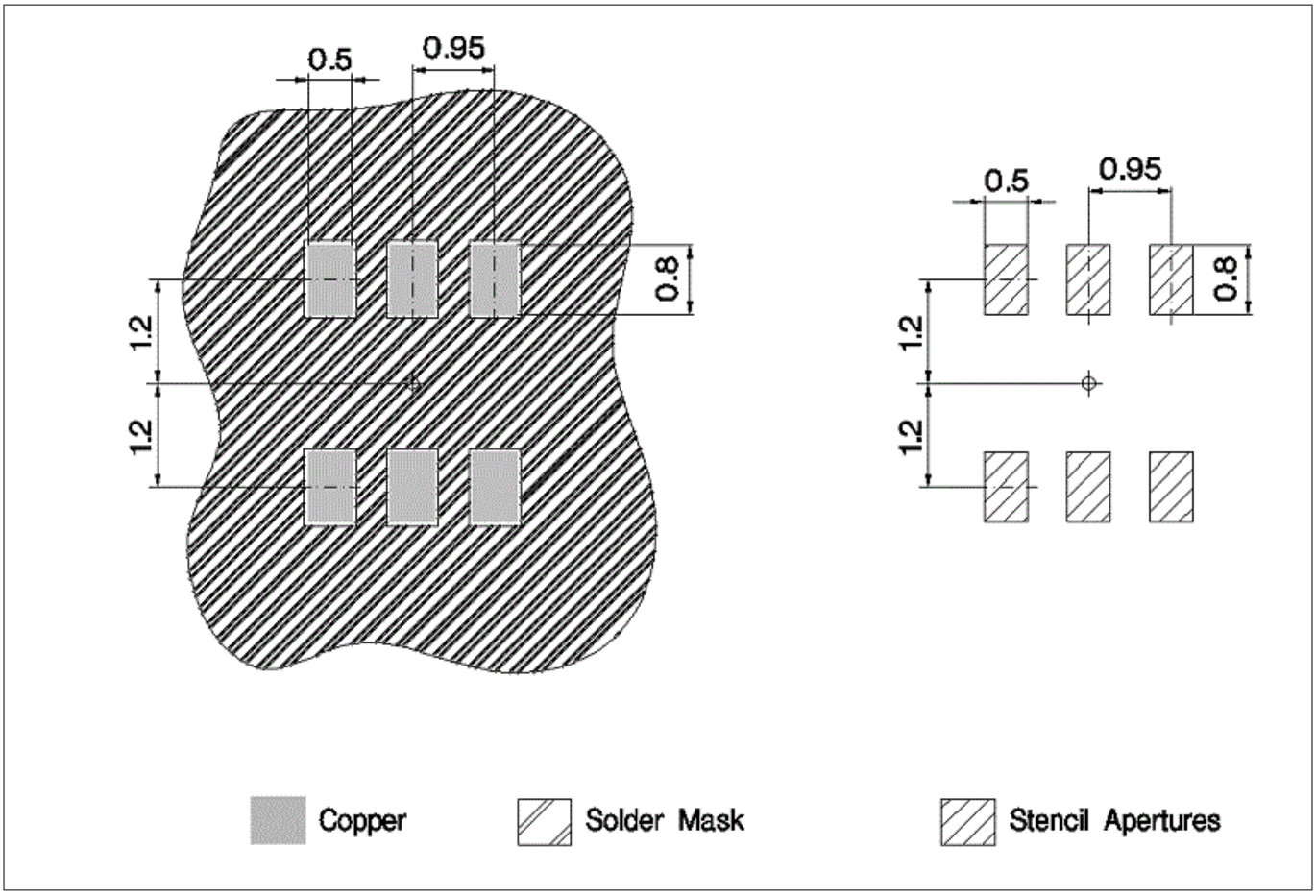

Figure 10 Footprint

Packing Description

Packing Type
Tape and Reel
∅ Reel: 180
Pieces / Reel: 3000
Reels / Box: 1

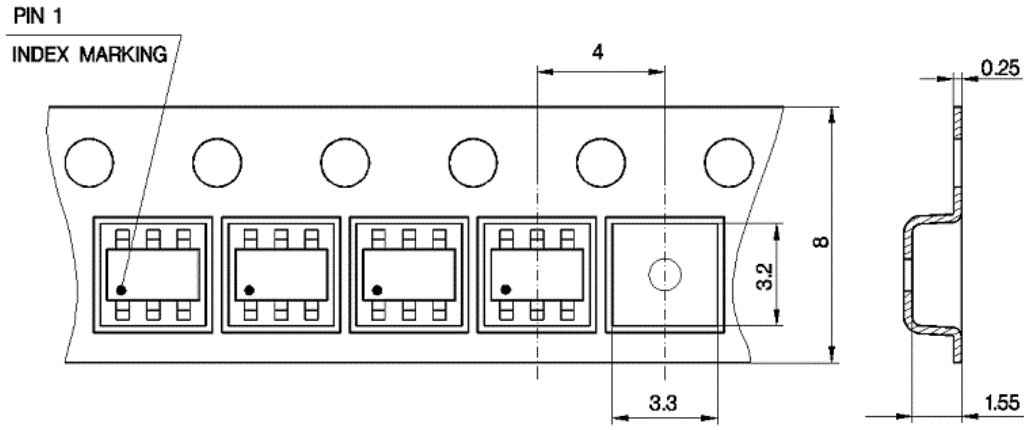

Figure 11 Packing

6 References

Related information

Please refer to the Datasheet of the CDM10V for further application related information.

Revision History

Major changes since previous revision

Revision History

Reference	Description
v1.0	First release
v1.1	Corrected value for min power dissipation in table 10.

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