
Timer/Dimmer with Gate Driver, Zero Detection & Protection

1. Functional Description

The AMG-LI080 is a timer IC with a gate driver output for MOSFETs. The timer is set by a zero crossing detector and reset by external RC. This IC features protection against over-current, over-voltage and over-temperature. This IC is well suited for several kinds of dimmer and timer applications.

2. Features

- Supply voltage: 10VDC...12VDC
- Power-on start schematic
- Load power between 20W...1000W (depends on external MOSFETs)
- Flexible soft start function
- Zero-crossing detection
- Inputs for protection functions (over-current, over-voltage and over-temperature)
- Low bias current
- Protective shut down function
- LED status indication for output status at all times
- Ambient temperature range: 0°C...85°C
- Package: SOP14 – Body size: 8.65mm x 3.90mm x 1.45mm
- RoHS compliant

3. Application

The AMG-LI080 is suitable for timing, PWM and dimmer applications. It is most suitable for incandescent and halogen lamp dimmers.

Timer/Dimmer with Gate Driver, Zero Detection & Protection

3.1. Application Circuit Example

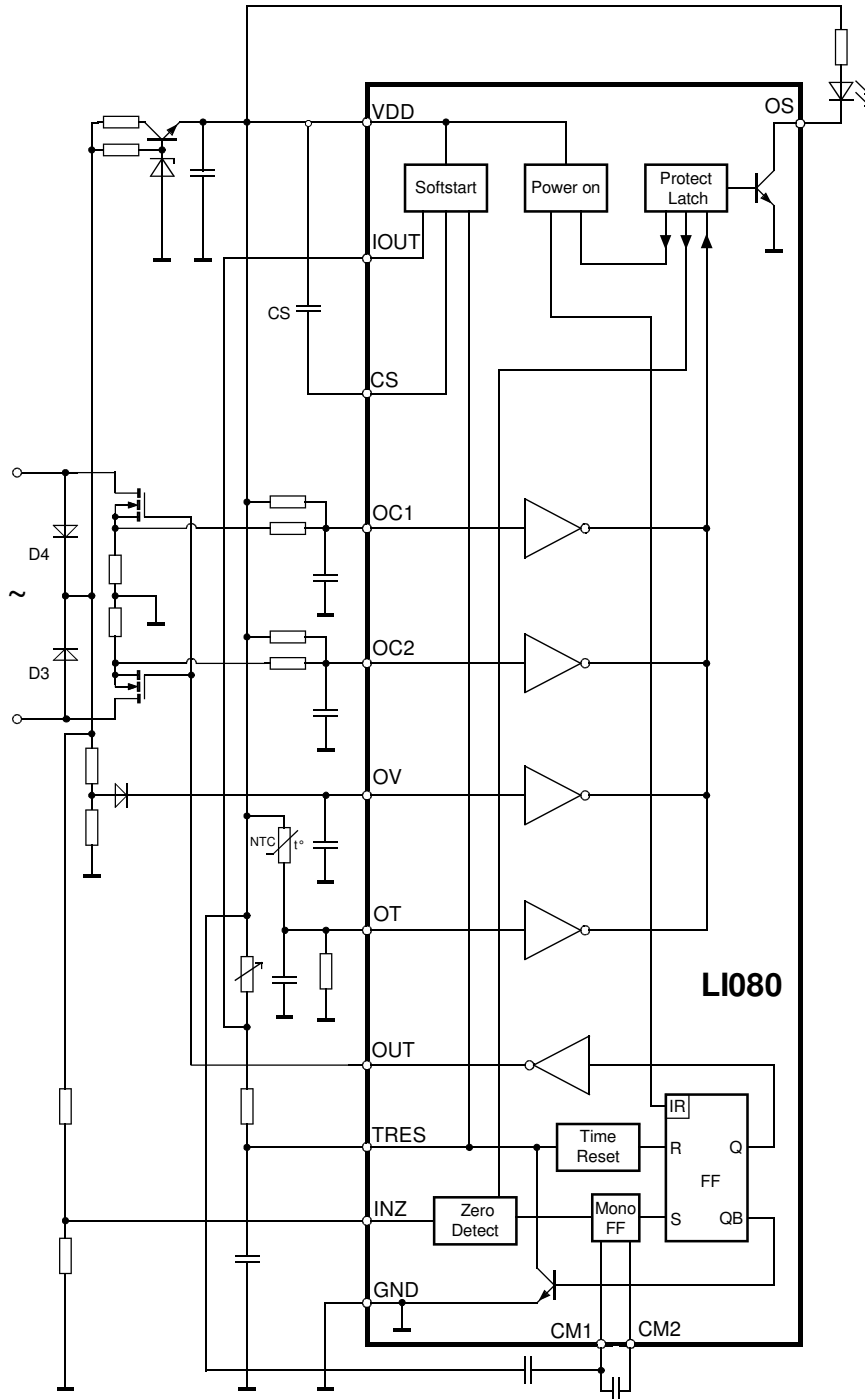


Figure 1: Example application circuit

Timer/Dimmer with Gate Driver, Zero Detection & Protection

Table of Contents

1.Functional Description.....	1
2.Features.....	1
3.Application.....	1
3.1.Application Circuit Example.....	2
4.Block Diagram.....	4
5.Block Descriptions.....	5
5.1.Zero Crossing	5
5.2.Time Reset.....	5
5.3.Gate Driver + Output Latch.....	5
5.4.Protection Logic.....	5
5.5.Soft Start.....	5
6.Pinning.....	6
7.Pin description.....	7
8.Function Table.....	8
9.Absolute Maximum Ratings.....	8
10.Electrical Characteristics.....	9
10.1.Operational Range.....	9
10.2.DC Characteristics.....	9
10.3.AC Characteristics.....	10
11.Diagrams.....	11
11.1.Electrical Diagrams.....	11
11.2.Pulse Diagrams.....	18
11.3.Start Up Diagrams.....	19
11.4.Soft Start Diagrams.....	20
11.5.Error Function Diagrams.....	21
12.IC-Package.....	22
13.IC-Marking.....	22
14.Ordering Information.....	22
15.Notes and Cautions.....	23
15.1.ESD Protection.....	23
15.2.Storage conditions.....	23
16.Disclaimer.....	23
17.Contact Information.....	24

Timer/Dimmer with Gate Driver, Zero Detection & Protection

4. Block Diagram

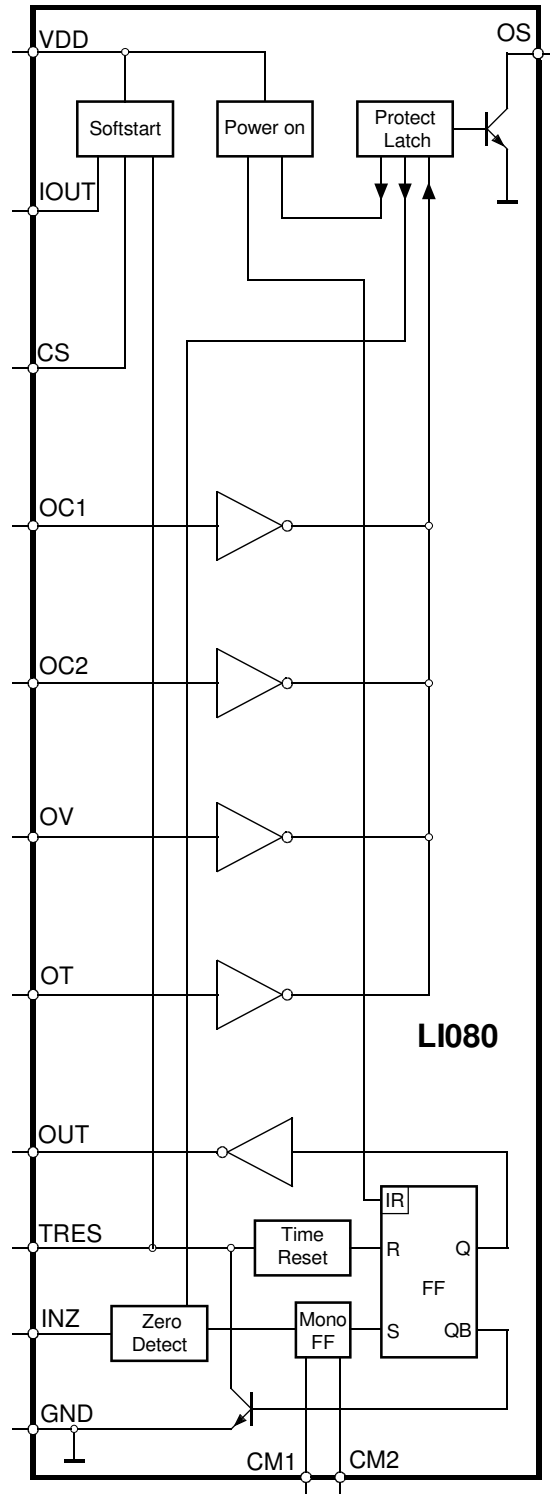


Figure 2: LI080 Block Diagram

Timer/Dimmer with Gate Driver, Zero Detection & Protection

5. Block Descriptions

5.1. Zero Crossing

Detects the Zero Crossing of the AC sine wave. The INZ input is connected to the rectified mains with a resistor divider. For noise suppression, the INZ input should also be connected to GND with a capacitor. This capacitor will cause a time delay between the actual zero crossing and the detection. Bigger capacitors will cause a longer time delay than smaller ones. This time delay may or may not affect the function.

5.2. Time Reset

Determines the on time of the output, thus the duty cycle, or the time of the reverse phase cut. The Time Reset is triggered by the zero crossing. The Time Reset is reset by an external R and C, which determines the time to reset.

5.3. Gate Driver + Output Latch

Supplies the gate charge for the external MOSFETs. Continuous current capability is around 10mA. The output latch is set by the Zero Crossing and reset by the Time Reset.

5.4. Protection Logic

The IC has 3 sense inputs for over voltage, over current and over temperature protection.

OVP: Over Voltage Protection

OTP: Over Temperature Protection

OCP: Over Current Protection

These sense inputs have an internal pull up and are connected to a comparator. The comparator thresholds are set according to their dedicated protection function, but nevertheless, they can be used for something else. The sense inputs all need some additional external circuitry to enable the protection. Please refer to the example application diagram or the application note. If a specific protection function is not needed, the corresponding sense input should be connected to GND. All 3 protection comparators individually set a latch when the threshold is reached. When set, the latch will inhibit the Zero Crossing and thus the output of the device and activate the LED driver. The protective latch is reset at power up. As such the protection functions work like a recoverable fuse.

5.5. Soft Start

Soft Start is in essence adjustable current source. With an external C, the time to reach max. current can be adjusted. In that way, a soft start function can be built. Please refer to the example application diagram or the application note. In case, a 1-10V analog signal shall control the dimmer, it can be connected to the CS pin.

Timer/Dimmer with Gate Driver, Zero Detection & Protection

6. Pinning

PIN#	Symbol	Description
1	VDD	Supply voltage
2	CS	Capacitor soft start
3	IOUT	Current source soft start
4	TRES	Input dimming time reset
5	INZ	Input detection zero crossing
6	CM1	Connection 1 capacitor mono-flop zero detect
7	GND	Signal ground
8	CM2	Connection 2 capacitor mono-flop zero detect
9	OT	Input over temperature
10	OV	Input over voltage
11	OC2	Input 2 over current
12	OC1	Input 1 over current
13	OUT	Output gate driver
14	OS	Output status

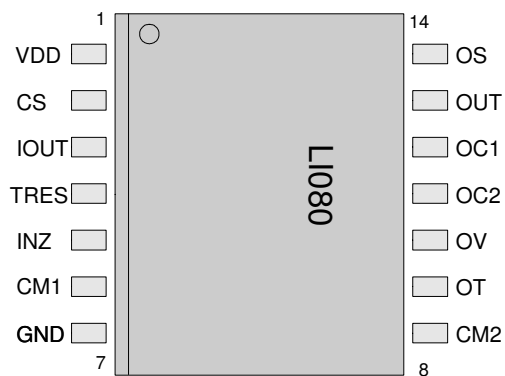


Figure 3: SOP14 Pinout

Timer/Dimmer with Gate Driver, Zero Detection & Protection

7. Pin description

VDD

- Power supply voltage, supply voltage for all internal circuits
- external block capacitor to be connected between this pin and ground

GND

- Supply voltage ground, ground reference point for all thresholds

OUT

- Gate Driver output

TRES

- Threshold input, to be connected with a cap and source resistance to set the reset time

INZ

- Zero crossing detection input
- Set the duty cycle when the voltage goes through zero

IOUT

- Current source output for soft start

CS

- Input, connected to a capacitor setting the soft start time

CM1, CM2

- Input, connection 1 and 2 for a cap, setting the pulse width via internal monoflop

OC1, OC2

- Current sense input for OCP, connection to external shunt resistors
- On over current conditions, the output OUT and status OS are both pulled low

OV

- Over voltage protection input, connected to an external diode with voltage divider
- On over voltage conditions, the output OUT and status OS are pulled low

OT

- Over temperature protection input, connected to an external NTC with voltage divider
- On over temperature conditions, the output OUT and status OS are pulled low

OS

- Output status indicator
- On over current, voltage and temperature conditions this output is pulled low

Timer/Dimmer with Gate Driver, Zero Detection & Protection

8. Function Table

#	Function	Inputs				Outputs	
		OC1	OC2	OV	OT	OUT	OS
1							
2	Normal	L	L	L	L	High Gate Voltage	H
3	Error Detection OC1	H	X	X	X	Low Gate Voltage	L
4	Error Detection OC2	X	H	X	X	Low Gate Voltage	L
5	Error Detection OV	X	X	H	X	Low Gate Voltage	L
6	Error Detection OT	X	X	X	H	Low Gate Voltage	L

H – High, L – Low, X – any input state

9. Absolute Maximum Ratings

The Absolute Maximum Ratings may not be exceeded under any circumstances.

#	Symbol	Parameter	Min	Max	Unit
1	V _{DD}	Supply Voltage	-0.3	15	V
2	V _{OUT}	Output Voltage OUT (I _{OUTmax} =±10mA)	-0.3	VDD	V
3	V _{OS}	Output Status OS (I _{OSmax} =3mA)	-0.3	VDD	V
4	V _{TRES}	Input Voltage TRES (I _{TRESmax} =10mA)	-0.3	VDD	V
5	V _{IOUT}	Input Voltage IOUT (I _{IOUTmax} =-1mA)	-0.3	VDD	V
6	V _{CS}	Input Voltage CS	-13.5	VDD	V
7.1	V _{INCM1}	Input Voltage CM1 (I _{CM1min} =-1mA)	-0.3	VDD	V
7.2	V _{INCM2}	Input Voltage CM2 (I _{CM2min} =1mA)	-0.3	VDD	V
8	V _{OC, OV, OT}	Input Voltage OC1, OC2, OV, OT	-0.3	1	V
9	V _{INZ}	Input Voltage INZ (I _{INZmax} =2mA)	-0.3	6	V
10	I _{OUT}	Current Output OUT	-10	10	mA
11	IO+	Output H short circuit pulsed current (V _{out} =0V, PW<1us)	-150	0	mA
12	IO-	Output L short circuit pulsed current (V _{out} =12V, PW<1us)	0	150	mA
13	I _{TRES}	Input Current TRES	0	10	mA
14	I _{CM1}	Input Current ICM1	-1	0	mA
15	I _{CM2}	Input Current ICM2	0	1	mA
16	I _{OS}	Output Current Status OS	0	3	mA
17	I _{INZ}	Input Current INZ		2	mA
18	I _{IOUT}	Output Current IOUT	-1	0	mA

Timer/Dimmer with Gate Driver, Zero Detection & Protection

#	Symbol	Parameter	Min	Max	Unit
19	P_{tot}	Total Power Dissipation		250	mW
20	P_{TOTG}	Total Power Dissipation Gate Control		100	mW
21	$V_{ESD}^{1)}$	ESD – Input Protection Voltage VDD, TRES, INZ, CH, CM1, CM2	-2000	2000	V
22	T_{stg}	ESD – Input Protection Voltage OC1, OC2, OV, OT,	-900	900	V
23	T_j	ESD – Output Protection Voltage OUT, OS,CS	-900	900	V

Notes:

¹⁾ V_{ESD} according to Human Body Model, MIL-STD-883D, Method 3015.7, Class 2

²⁾ $T_j = R_{thjc} * P_{tot} + T_{amb}$

10. Electrical Characteristics

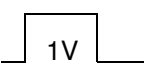
10.1. Operational Range

#	Symbol	Parameter	Min	Max	Unit
1	V_{DD}	Supply Voltage	10	12	V
2	T_{amb}	Ambient Temperature Range	0	70	°C

10.2. DC Characteristics

DC characteristics contain the spread of values guaranteed within the specified supply voltage and temperature range and the technology process parameter range unless otherwise specified.

$T_j = 25^\circ\text{C}$ for typical values

#	Symbol	Parameter	Conditions	Min	Typ	Max	Unit
1	I_{DDL}	Current Consumption	$V_{OUT} = \text{Low}$ $V_{DD} = 12\text{V}$ $V_{INZ} = 1\text{V}$	-	0.8	1.0	mA
2	I_{DDH}	Current Consumption	$V_{OUT} = \text{High}$ $V_{DD} = 12\text{V}$ $V_{INZ} = 1\text{V}$	-	0.5	0.8	mA
3	I_{DDL_Error}	Current Consumption Error-Mode	$V_{OUT} = \text{Low}$ $V_{DD} = 12\text{V}$ $V_{INZ} = 1\text{V}$ V_{OT} 	-	1.4	1.9	mA
4	V_{TRES}	Threshold Voltage Input TRES	$V_{DD} = 12\text{V}$	6.5	7.5	8.5	V
5	V_{PON}	Threshold Voltage Power on	$V_{DD} = 12\text{V}$	8.0	9.1	9.9	V
6	$V_{TH\ OC1, 2}$	Threshold Voltage OC1, 2	$V_{DD} = 12\text{V}$	0.55	0.75	0.85	V
7	$V_{TH\ OV}$	Threshold Voltage OV	$V_{DD} = 12\text{V}$	0.55	0.75	0.85	V
8	$V_{TH\ OT}$	Threshold Voltage OT	$V_{DD} = 12\text{V}$	0.55	0.75	0.85	V

Timer/Dimmer with Gate Driver, Zero Detection & Protection

#	Symbol	Parameter	Conditions	Min	Typ	Max	Unit
9	V _{OUTH}	Output Voltage High OUT	-I _{OUT} = 6mA V _{DD} = 12V	7.5	9.2	-	V
10	V _{OUTH}	Output Voltage High OUT	-I _{OUT} = 10μA V _{DD} = 12V	7.5	10.6	-	V
11	V _{OUTL}	Output Voltage Low OUT	I _{OUT} = 6mA V _{DD} = 12V	-	0.2	0.55	V
12	V _{OUTL}	Output Voltage Low OUT	I _{OUT} = 10μA V _{DD} = 12V	-	0.1	0.55	V
13	V _{OSL}	Output Voltage Low Error-Mode OS	I _{OS} = 2mA V _{DD} = 12V	-	0.2	0.55	V

10.3. AC Characteristics

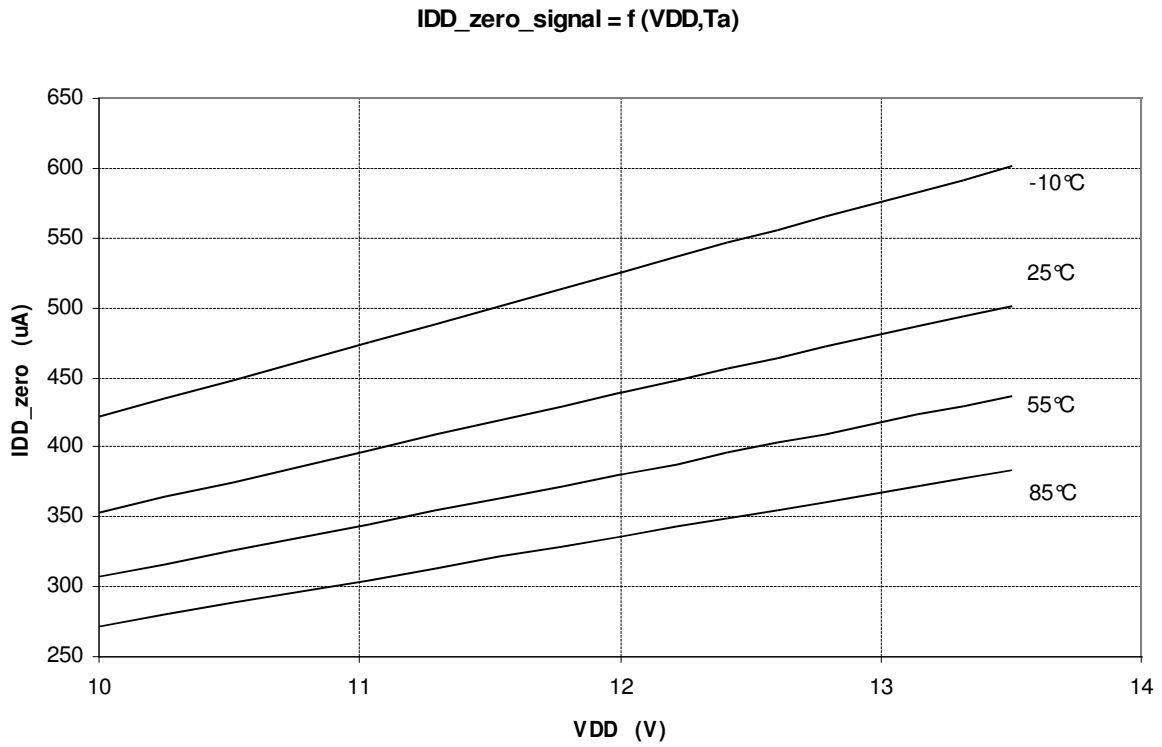
AC characteristics contain the spread of values guaranteed within the specified supply voltage and temperature range and the technology process parameter range unless otherwise specified.

T_j = 25°C for typical values

Symbol	Parameter	Conditions	Typ	Max	Unit
t _{r OUT}	Turn-on rise time	C _L = 1.5nF V _{DD} = 12V	200	500	ns
T _{f OUT}	Turn-off fall time	C _L = 1.5nF V _{DD} = 12V	200	500	ns
t _{Soft c}	Soft Start Time cold	C _{CS} = 4.7μF, max. Full Power PF = 0.95 V _{DD} = 12V	1.9		s

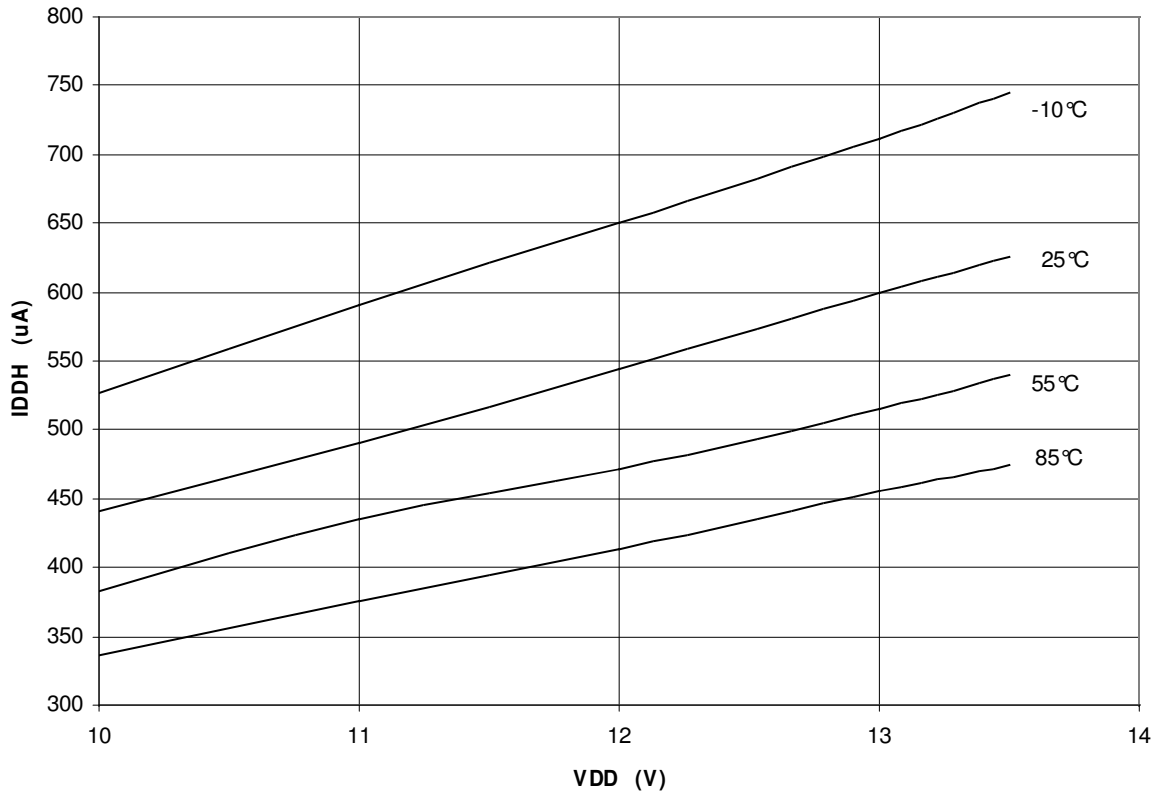
11. Diagrams

11.1. Electrical Diagrams

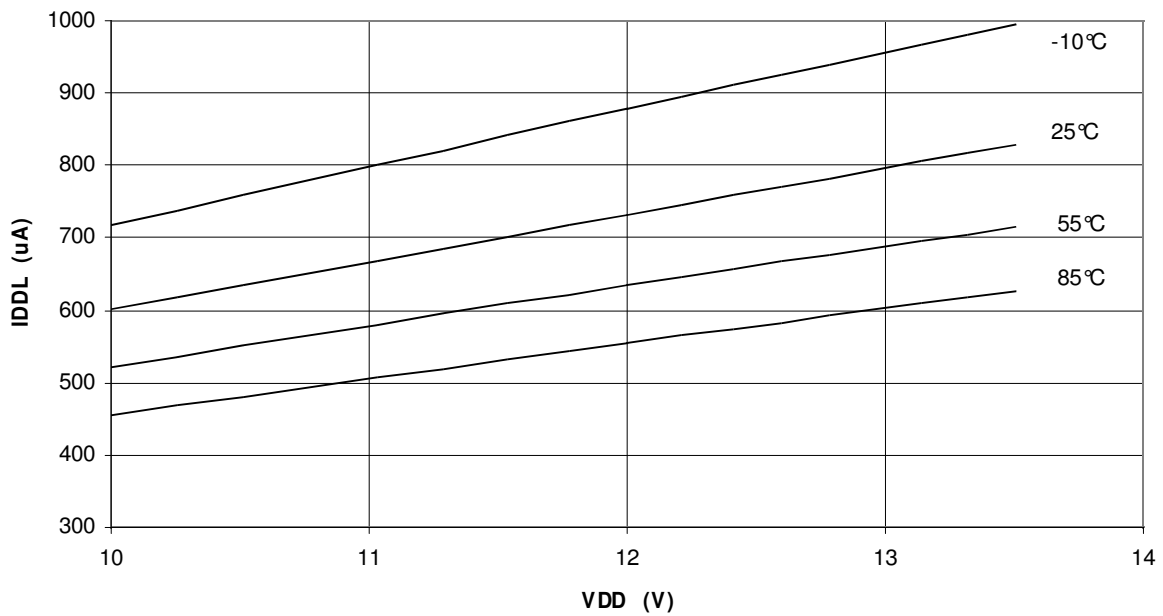


Timer/Dimmer with Gate Driver, Zero Detection & Protection

$IDDH = f(VDD, Ta)$

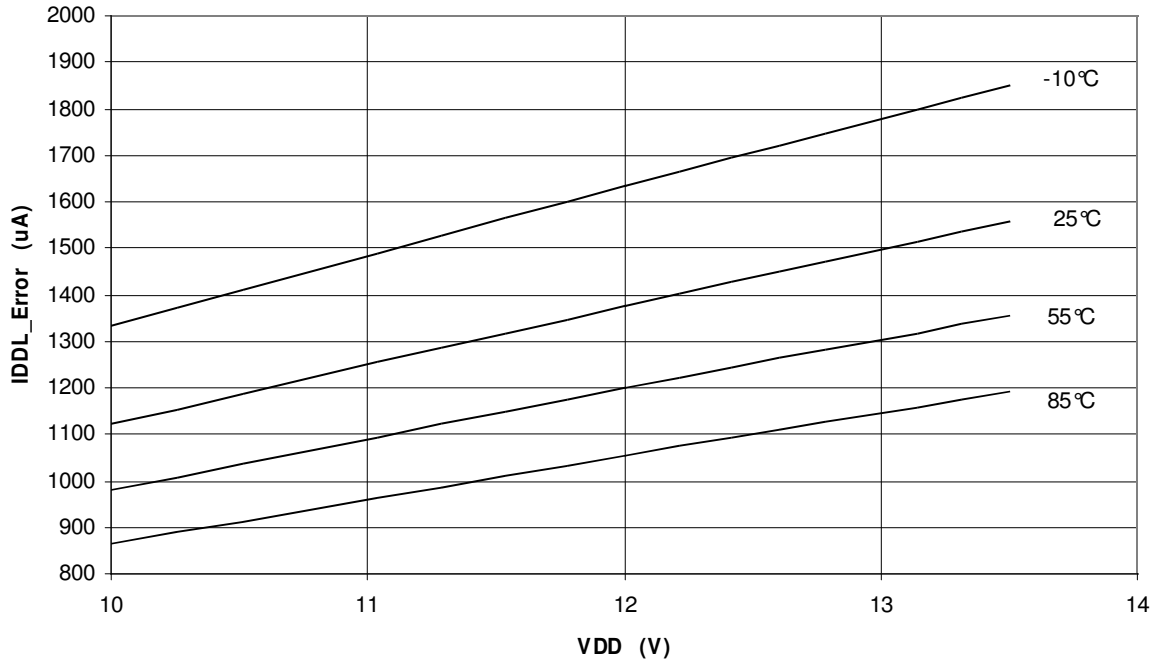


$IDDL = f(VDD, Ta)$

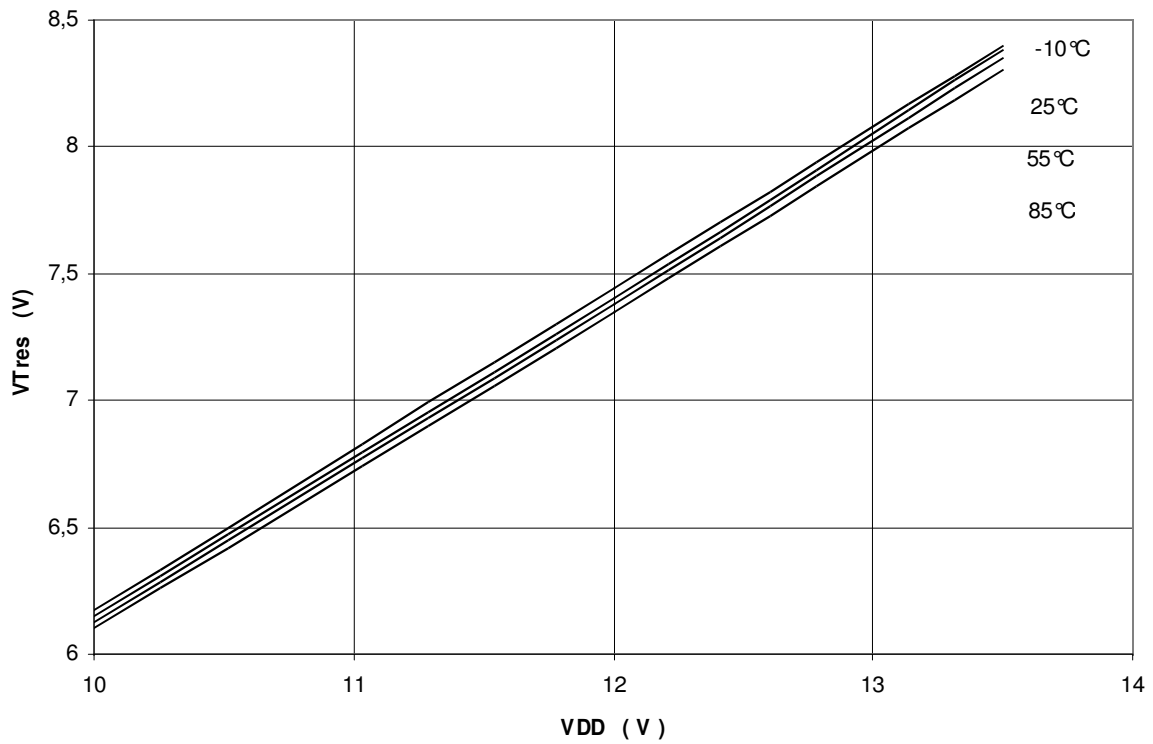


Timer/Dimmer with Gate Driver, Zero Detection & Protection

IDDL_Error f (VDD,Ta)

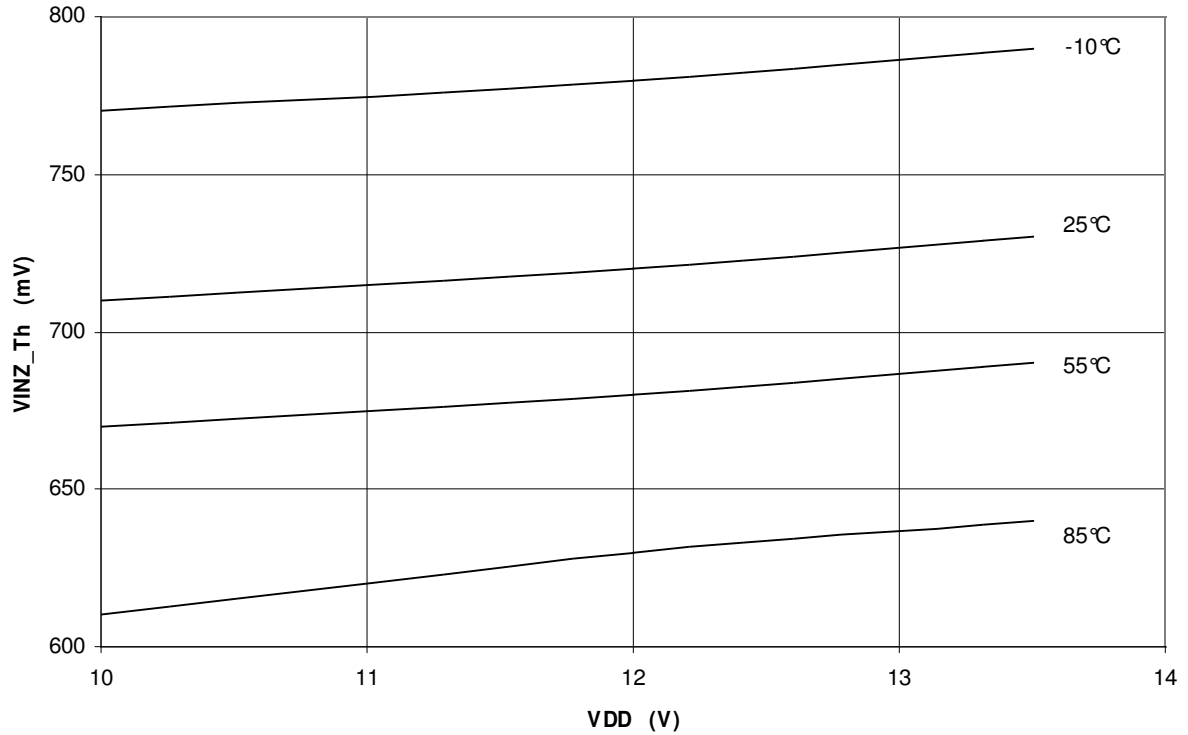


VTres = f (VDD,Ta)

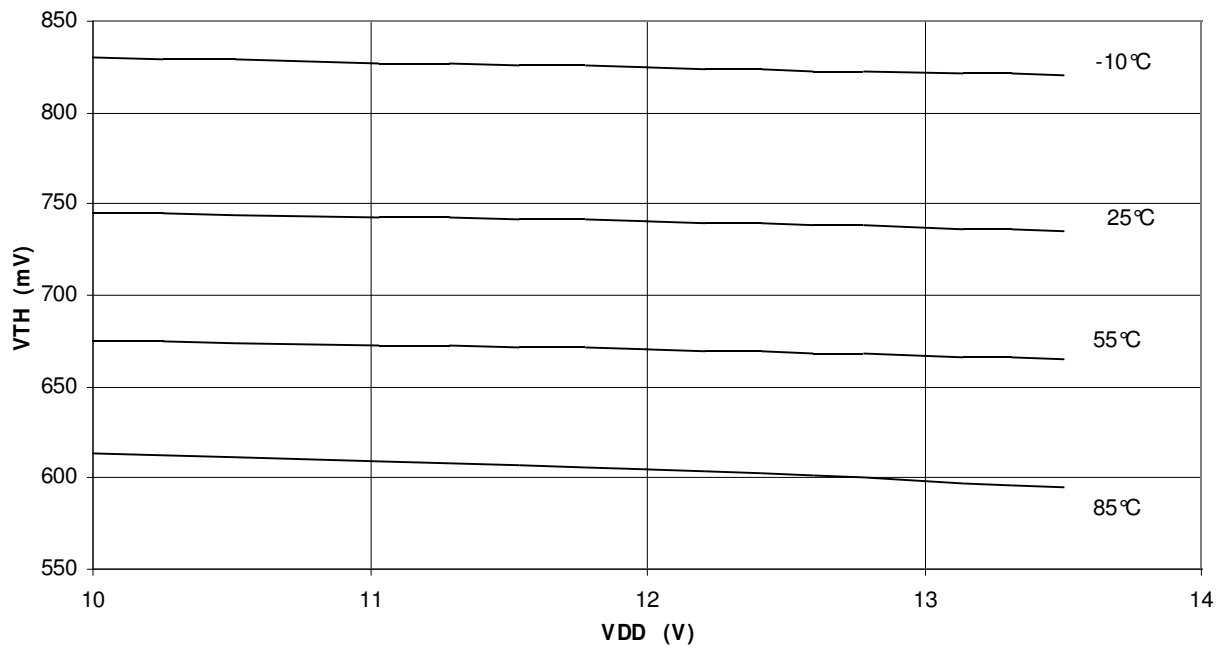


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$$\text{VINZ_Threshold} = f(\text{VDD}, \text{Ta})$$

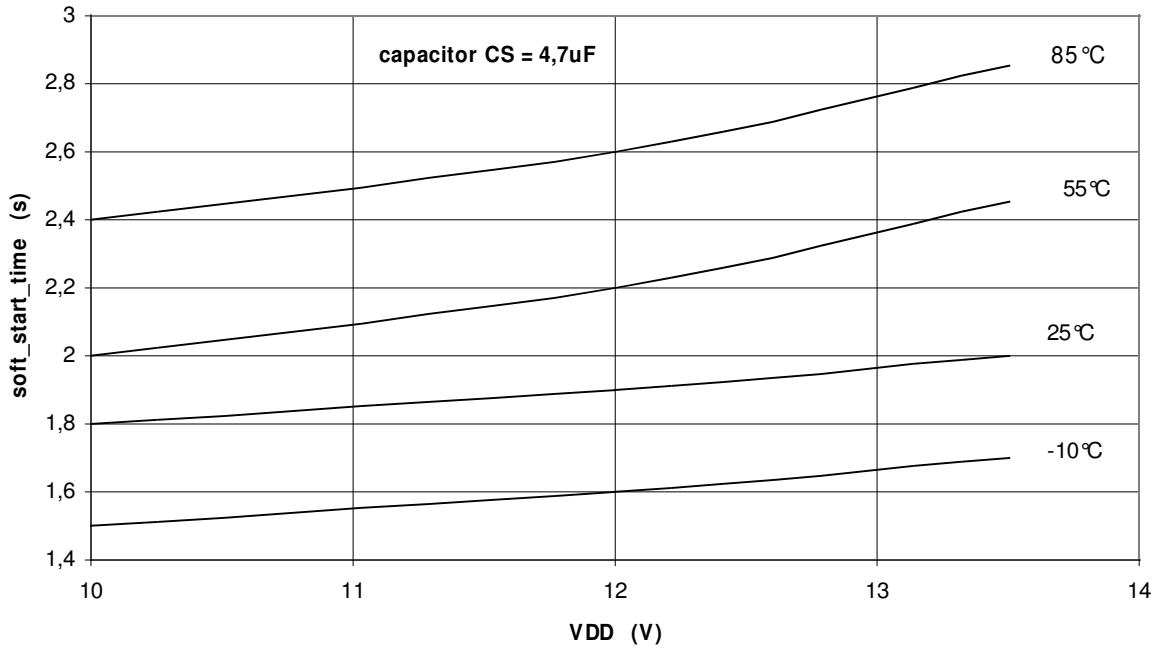


VTH

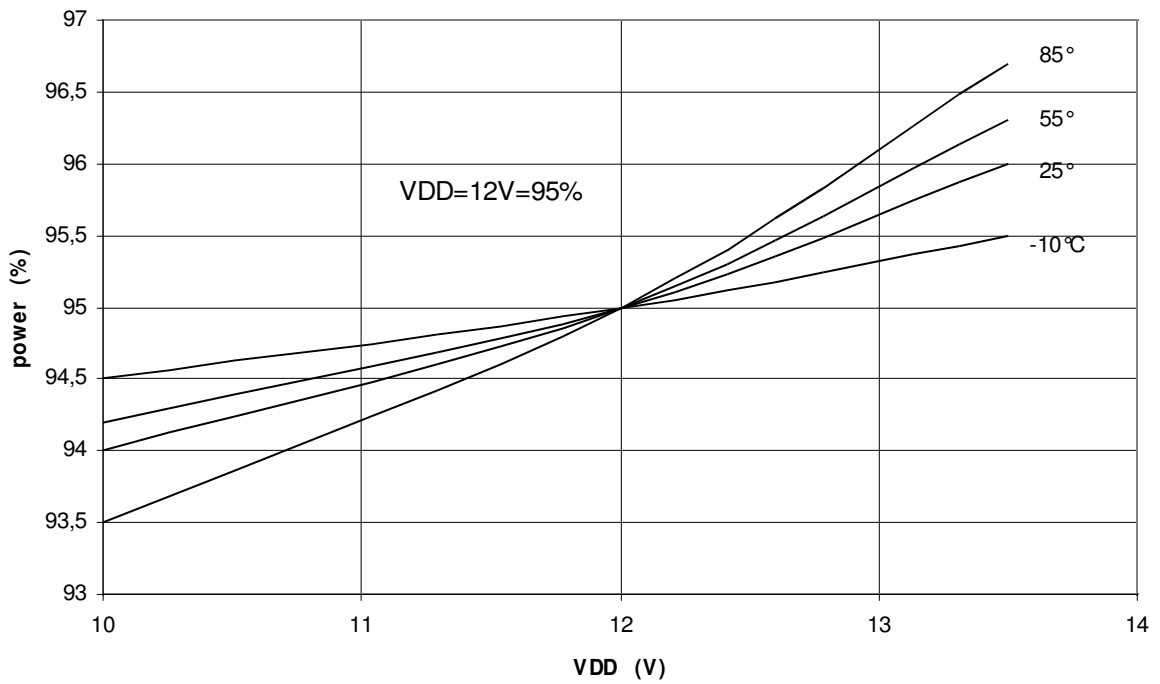


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soft_start_time_cold = f(VDD, Ta)

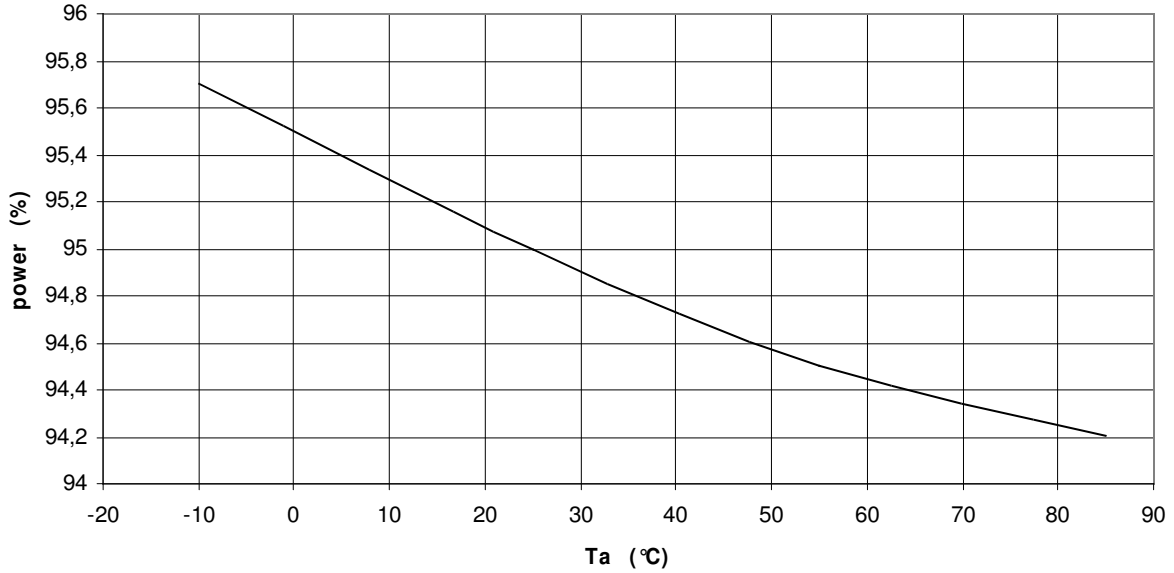


power = f(VDD, Ta)

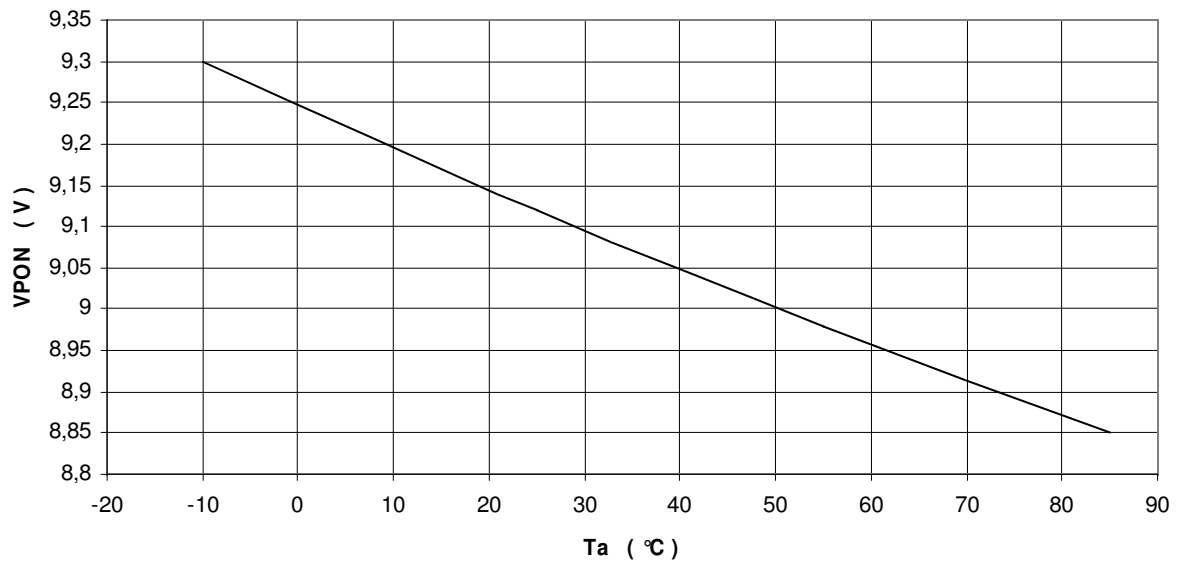


Timer/Dimmer with Gate Driver, Zero Detection & Protection

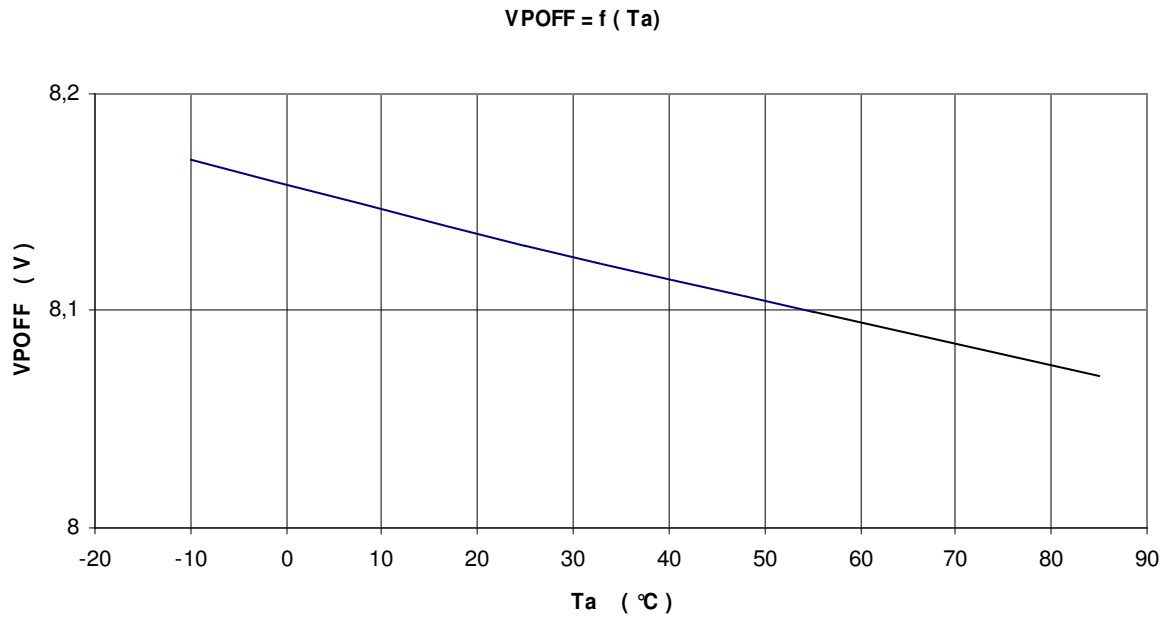
power f = (Ta) VDD=12V



VPON = f (Ta)

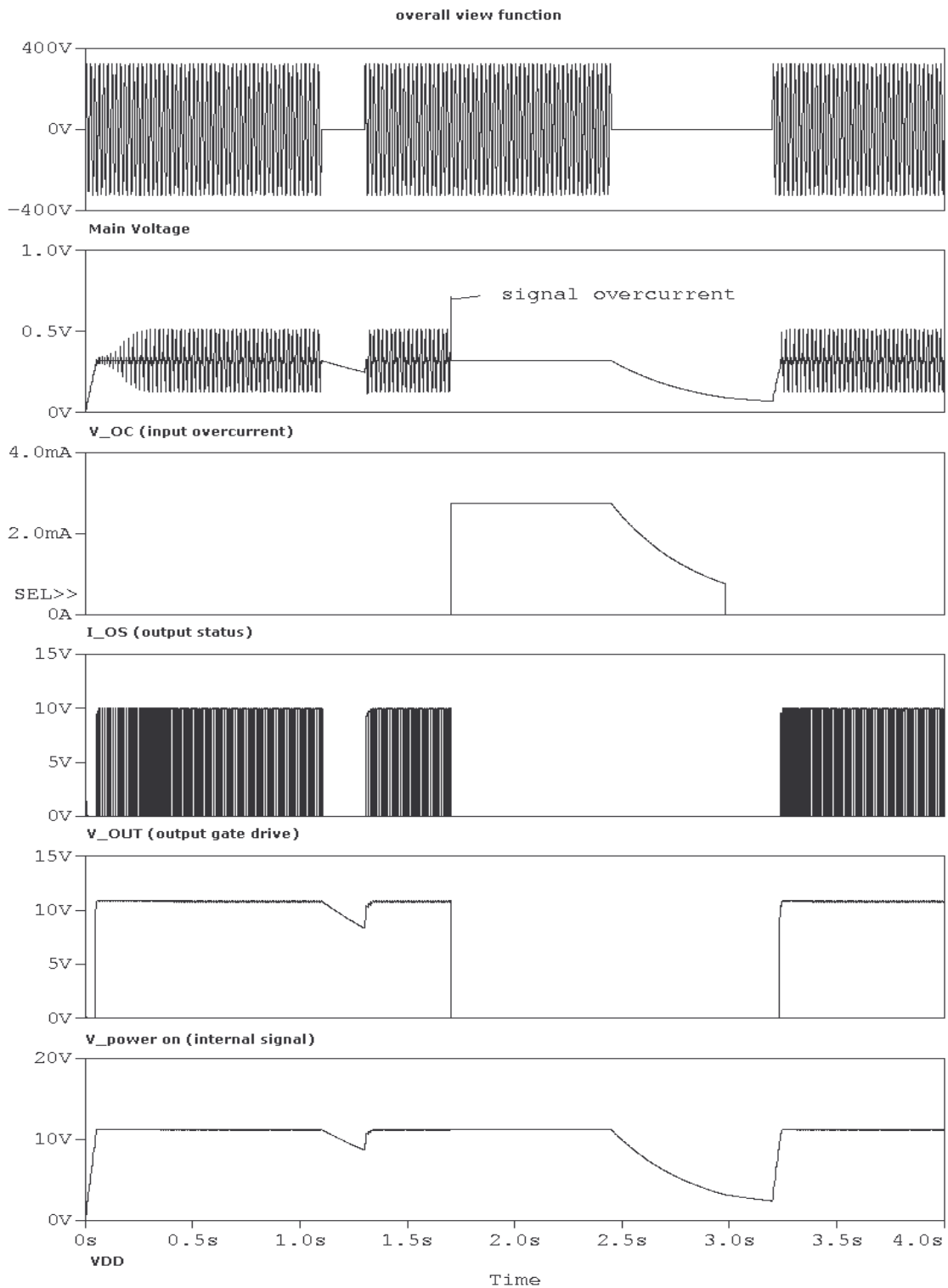


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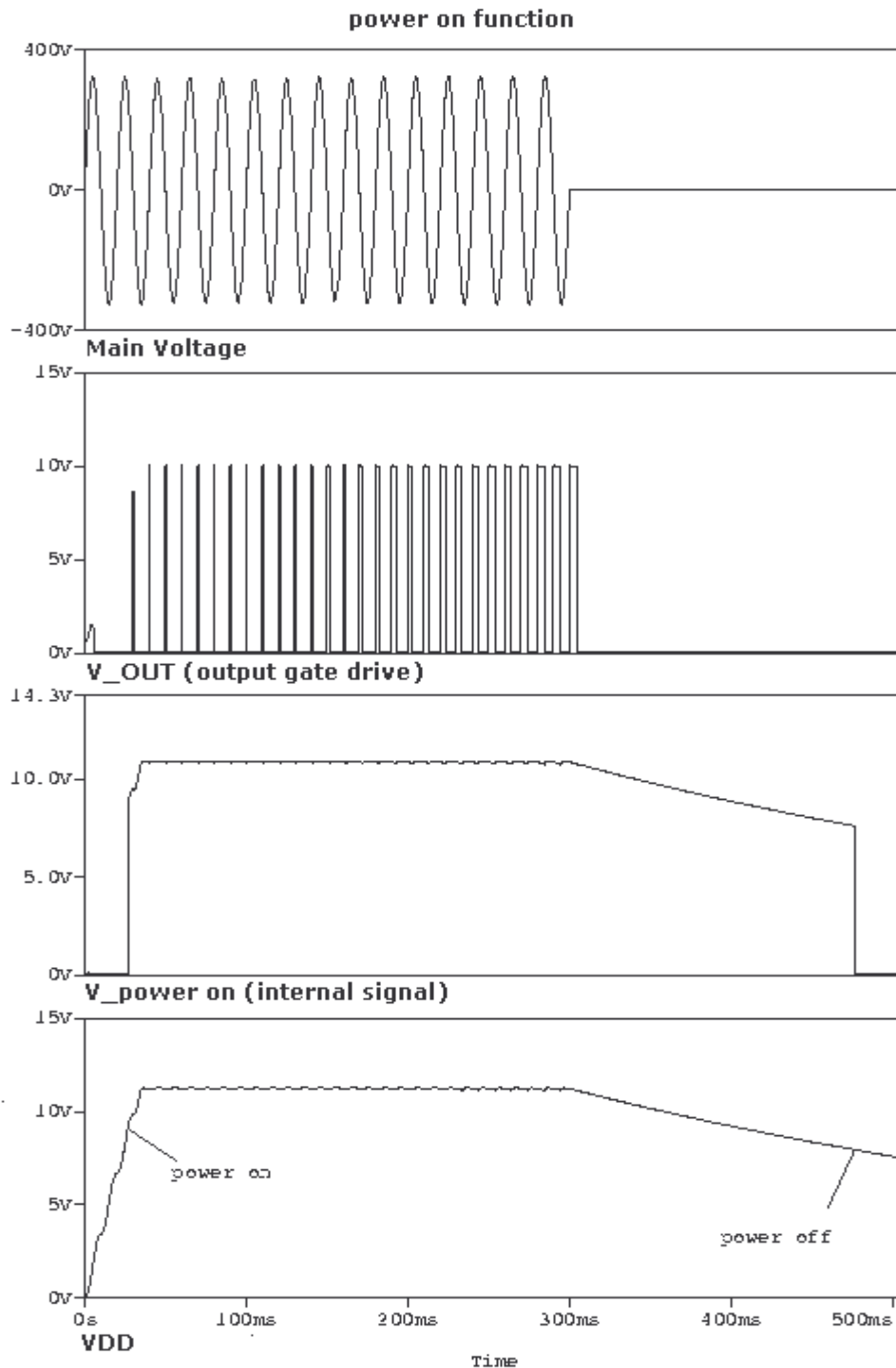
Timer/Dimmer with Gate Driver, Zero Detection & Protection

11.2. Pulse Diagrams



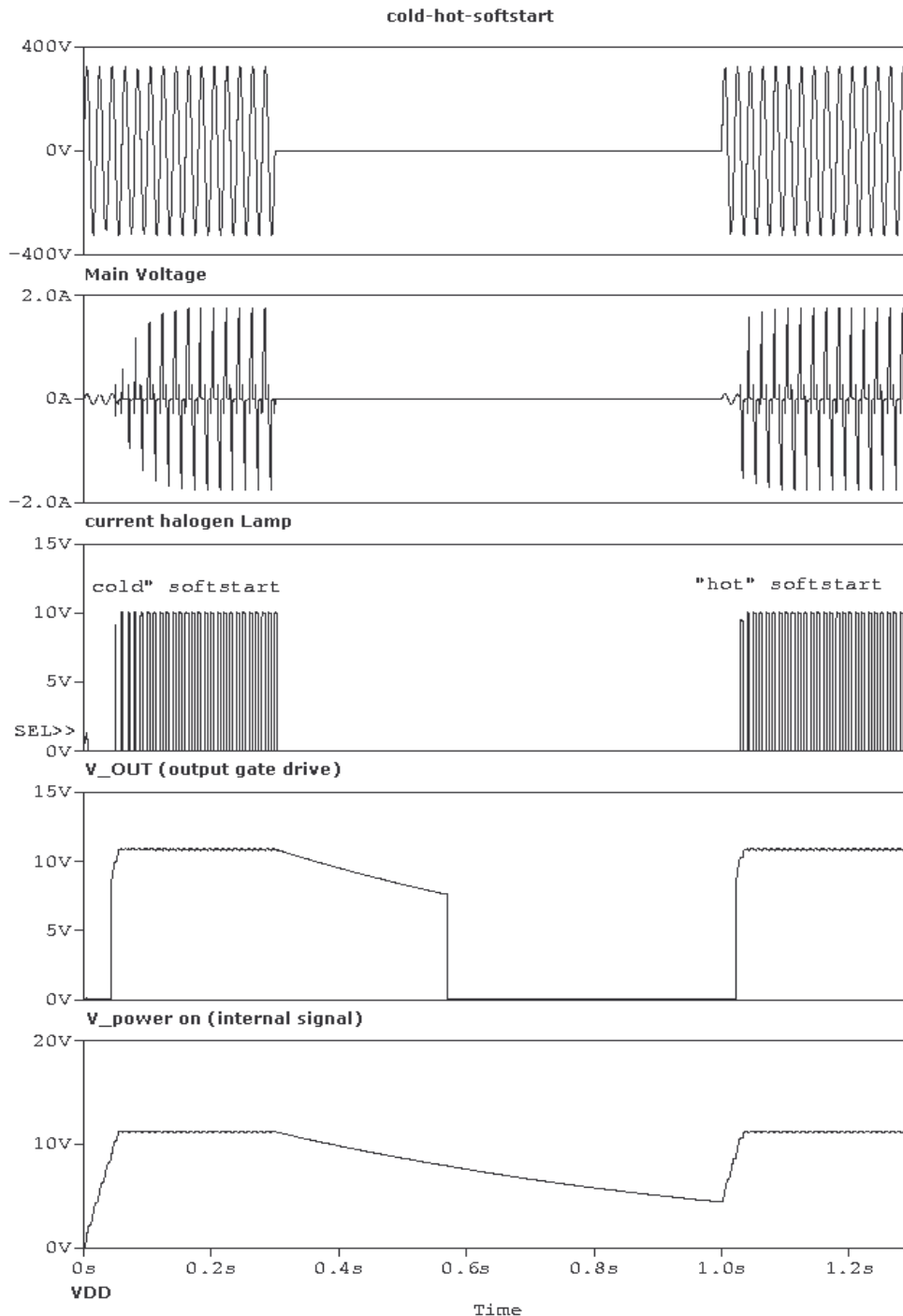
Timer/Dimmer with Gate Driver, Zero Detection & Protection

11.3. Start Up Diagrams



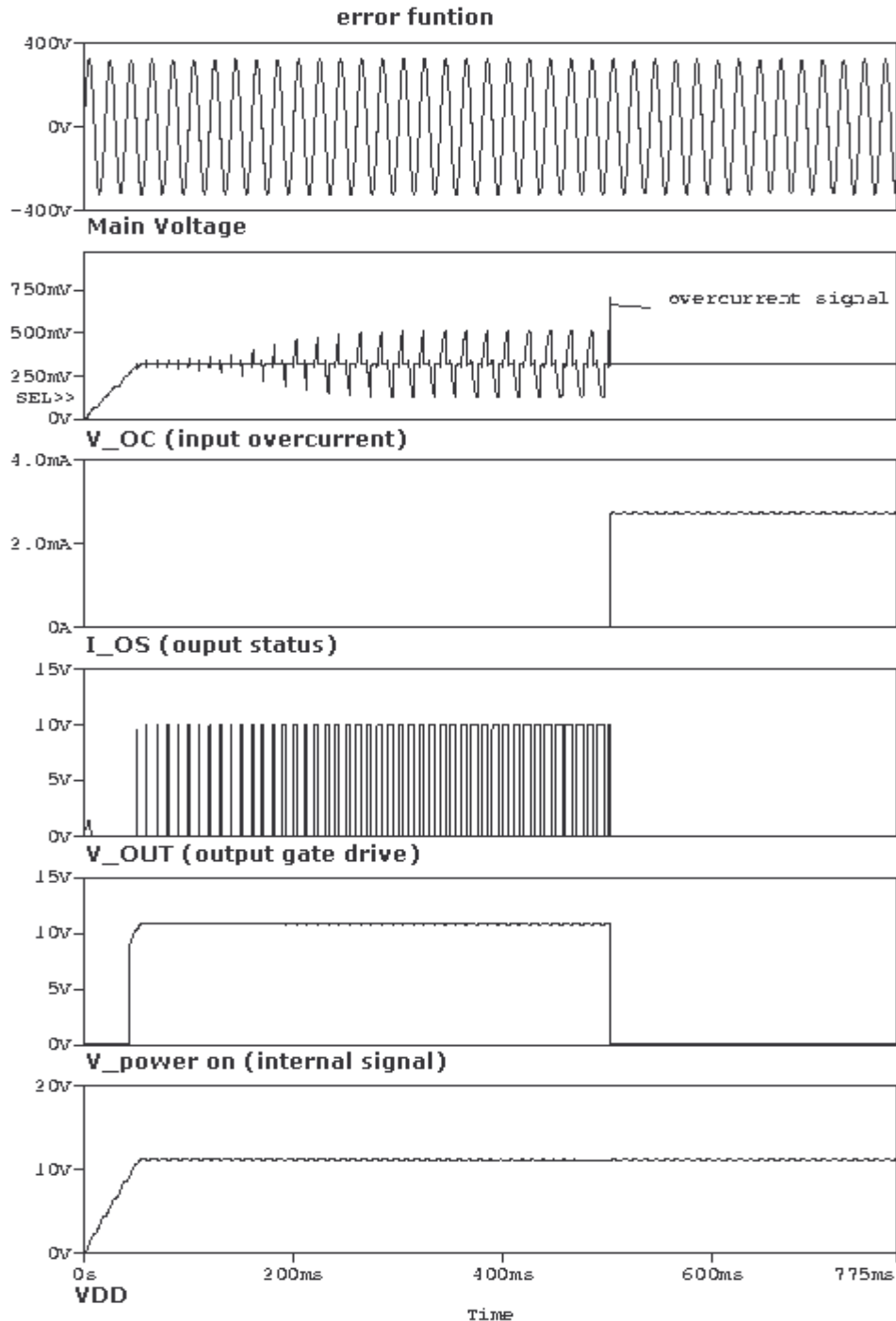
Timer/Dimmer with Gate Driver, Zero Detection & Protection

11.4. Soft Start Diagrams



Timer/Dimmer with Gate Driver, Zero Detection & Protection

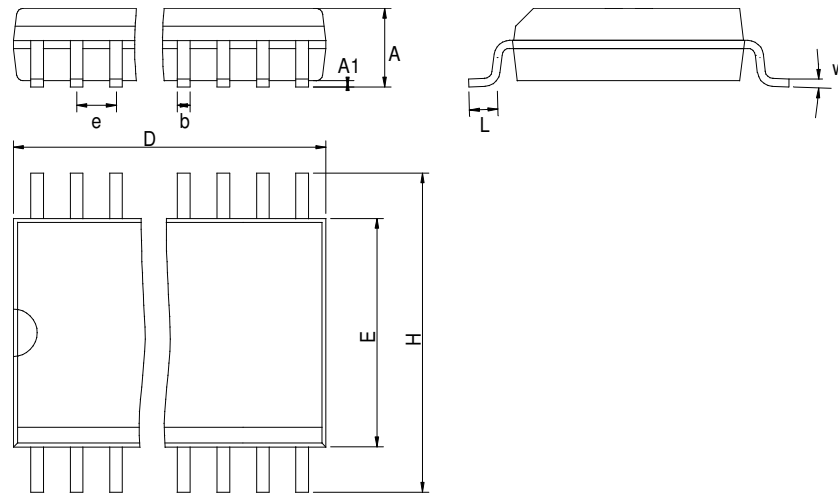
11.5. Error Function Diagrams



Timer/Dimmer with Gate Driver, Zero Detection & Protection

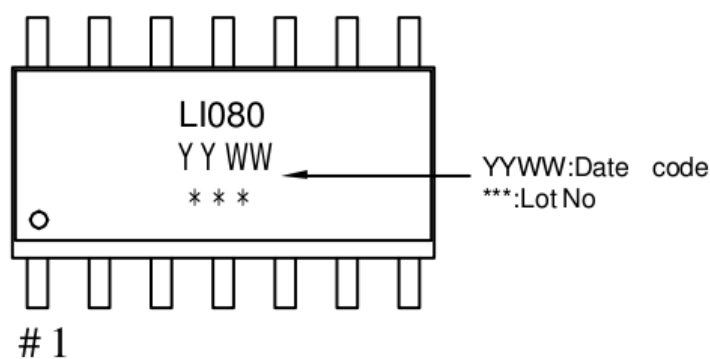
12. IC-Package

12.1. SOP14 – Small Outline Package, 14 leads, RoHS compliant



Small Outline Package (SOP)											
Package		D	E	H	A	A1	e	b	L	w	
SOP 14	nom	8,65	3,90	6,00	1,75	0,15	1,27	0,41	0,72	4°	
Dimension : mm											

13. IC-Marking



14. Ordering Information

AMG-LI080-ISP14U shipment in tubes
 AMG-LI080-ISP14R shipment in Tape & Reel

Timer/Dimmer with Gate Driver, Zero Detection & Protection

15. Notes and Cautions

15.1. ESD Protection

The Requirements for Handling Electrostatic Discharge Sensitive Devices are described in the JEDEC standard JESD625-A. Please note the following recommendations:

- When handling the device, operators must be grounded by wearing a for the purpose designed grounded wrist strap with at least 1M Ω resistance and direct skin contact.
- Operators must at all times wear ESD protective shoes or the area should be surrounded by for ESD protection intended floor mats.
- Opening of the protective ESD package that the device is delivered in must only occur at a properly equipped ESD workbench. The tape with which the package is held together must be cut with a sharp cutting tool, never pulled or ripped off.
- Any unnecessary contact with the device or any unprotected conductive points should be avoided.
- Work only with qualified and grounded tools, measuring equipment, casing and workbenches.
- Outside properly protected ESD-areas the device or any electronic assembly that it may be part of should always be transported in EGB/ESD shielded packaging.

15.2. Storage conditions

The AMG-LI080 corresponds to moisture sensitivity classification ML2 , according to JEDEC standard J-STD-020, and should be handled and stored according to J-STD-033.

16. Disclaimer

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17. Contact Information

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