ZXGD3101T8

SYNCHRONOUS RECTIFIER CONTROLLER FOR FLYBACK CONVERTERS

Description

The ZXGD3101 is intended to drive MOSFETS configured as ideal diode replacements. The device is comprised of a differential amplifier detector stage and high current driver. The detector monitors the reverse voltage of the MOSFET such that if body diode conduction occurs a positive voltage is applied to the MOSFET's Gate pin.

Once the positive voltage is applied to the Gate the MOSFET switches on allowing reverse current flow. The detectors' output voltage is then proportional to the MOSFET Drain-Source reverse voltage drop and this is applied to the Gate via the driver. This action provides a rapid turn off as current decays.

Features

- Turn-off propagation delay 15ns and turn-off time 20ns
- Suitable for Discontinuous Mode (DCM), Critical Conduction Mode (CrCM) and Continuous conduction mode (CCM) operation
- Compliant with Energy Star V2.0 and European Code of Conduct V3
- Low component count
- Halogen free
- 5-15V V_{CC} range

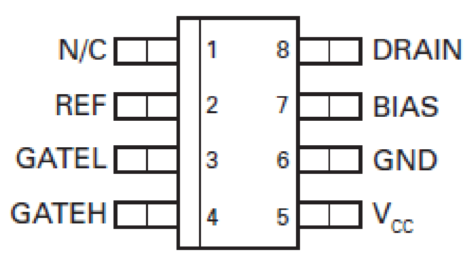
Applications

Flyback converters in:

- Adaptors
- LCD monitors
- Server PSU's
- Set top boxes

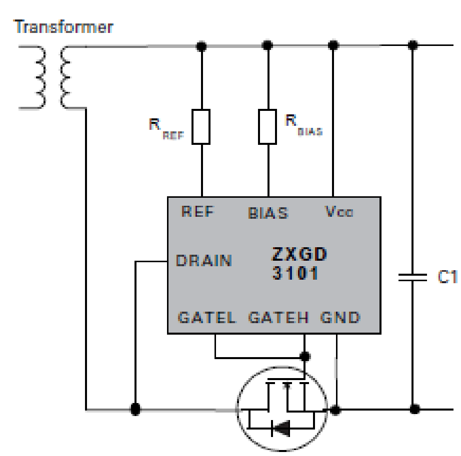
Refer to documents; AN54, DN90, DN91 and DN94 available from the website

Pin out detail



SM8

Typical configuration



Ordering information

Device	Status	Package	Part Mark	Reel size (inches)	Tape width (mm)	Quantity per reel
ZXGD3101T8TA	Active	SM8	ZXGD3101	7	12	1000

Absolute maximum ratings

Parameter	Symbol	Limit	Unit
Supply voltage[1]	V_{CC}	15	V
Continuous Drain pin voltage[1]	V_D	-3 to180	V
GATEH and GATEL output Voltage[1]	V_G	-3 to V_{CC} + 3	V
Driver peak source current	I_{SOURCE}	4	A
Driver peak sink current	I_{SINK}	7	A
Reference current	I_{REF}	25	mA
Bias voltage	V_{BIAS}	V_{CC}	V
Bias current	I_{BIAS}	100	mA
Power dissipation at T_A =25°C	P_D	500	mW
Operating junction temperature	T_j	-40 to +150	°C
Storage temperature	T_{stg}	-50 to +150	°C

NOTES:
1. All voltages are relative to GND pin

Thermal resistance

Parameter	Symbol	Value	Unit
Junction to ambient (*)	$R_{\theta JA}$	250	°C/W
Junction to lead (†)	$R_{\theta IA}$	54	°C/W

NOTES:
(*) Mounted on minimum 1oz copper on FR4 PCB in still air conditions
(†) Output Drivers - Junction to solder point at end of the lead 5 and 6

ESD Rating

Model	Rating	Unit
Human body	4,000	V
Machine	400	V

Electrical characteristics at $T_A = 25°C$;

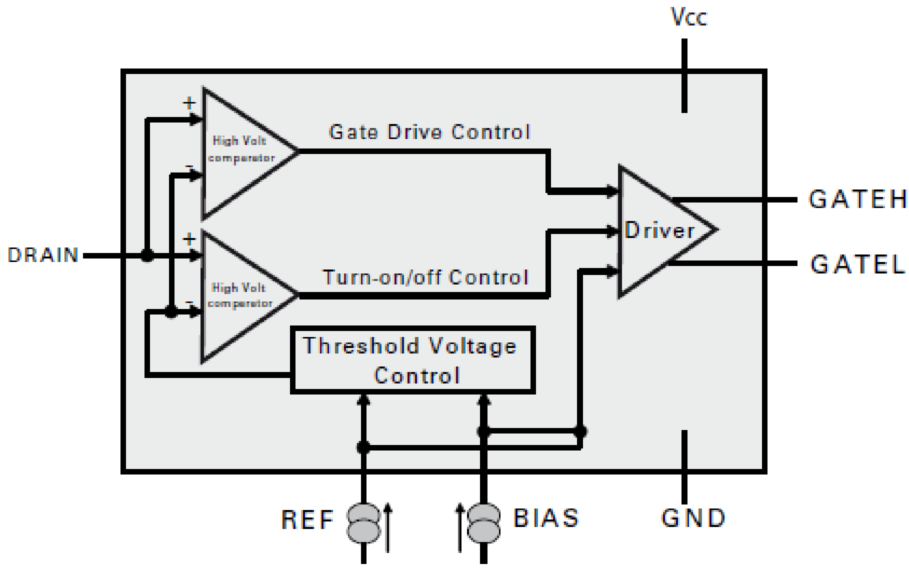
V_{CC} = 10V; R_{BIAS} = 1.8kΩ; R_{REF}=3kΩ

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input and supply characteristics						
Operating current	I_{OP}	$V_{DRAIN} \leq$ -200m V	-	3	-	mA
		$V_{DRAIN} \geq$ 0V	-	8	-	
Gate Driver						
Turn-off Threshold Voltage(**)	V_T	V_G = 1V, (*)	-45	-16	0	mV
GATE output voltage (**)	$V_{G(off)}$	$V_{DRAIN} \geq$ 0V, (*)	-	0.6	1	V
	V_G	V_{DRAIN} = -60mV, (†)	5.0	7.5	-	
		V_{DRAIN} = -80mV, (†)	7.0	8.5	-	
		V_{DRAIN} = -100mV, (†)	8.4	9	-	
		$V_{DRAIN} \leq$ -140mV, (†)	9.2	9.4	-	
		$V_{DRAIN} \leq$ -200mV, (†)	9.3	9.5	-	
GATEH peak source current	I_{SOURCE}	V_{GH} = 1V		2.5	-	A
GATEL peak sink current	I_{SINK}	V_{GL} = 5V		2.5	-	A
Turn on Propagation delay	t_{d1}	C_L = 2.2nF, (†) (a)		525		ns
Turn off Propagation delay	t_{d2}			15		ns
Gate rise time	t_r			305		ns
Gate fall time	t_f			20		ns

NOTES:

(**) GATEH connected to GATEL
(*) R_H = 100KΩ, R_L = 0/C
(†) R_L = 100KΩ, R_H = 0/C
(a) (Refer to Fig 4; Test circuit and Fig 5; Timing diagram on page 11

Schematic symbol and pin description



Pin No.	Symbol	Description and function
1	NC	**No connection** This pin can be connected to GND
2	REF	**Reference** This pin is connected to V_{CC} via resistor, R_{REF}. R_{REF} should be selected to source ~3mA into this pin. See note 1
3	GATEL	**Gate turn off** This pin sinks current, I_{SINK}, from the synchronous MOSFET Gate.
4	GATEH	**Gate turn on** This pin sources current, I_{SOURCE}, to the synchronous MOSFET Gate.
5	V_{CC}	**Power Supply** This is the supply pin. It is recommended to decouple this point to ground closely with a ceramic capacitor.
6	GND	**Ground** This is the ground reference point. Connect to the synchronous MOSFET Source terminal.
7	BIAS	**Bias** This pin is connected to V_{CC} via resistor, R_{BIAS}. R_{BIAS} should be selected to source 1.6 times I_{REF} into this pin. See note 1
8	DRAIN	**Drain connection** This pin connects directly to the synchronous MOSFET Drain terminal.

NOTES:

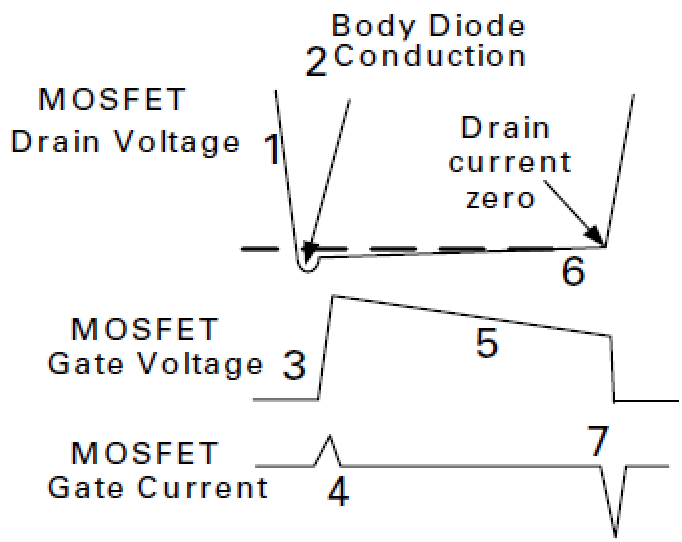
1. BIAS and REF pins should be assumed to be at GND+0.7V

Operation

Normal Operation

The operation of the device is described step-by-step with reference to the timing diagram below.

1. The detector monitors the MOSFET Drain-Source voltage.
2. When, due to transformer action, the MOSFET body diode is forced to conduct there is approximately -0.6V on the Drain pin.
3. The detector outputs a positive voltage with respect to ground, this voltage is then fed to the MOSFET driver stage and current is sourced out of the GATEH pin.
4. The current out of the GATEH pin is sourced into the synchronous MOSFET Gate to turn the device on.
5. The GATEH output voltage is now proportional to the Drain-Source voltage drop across the MOSFET due to the current flowing through the MOSFET.
6. MOSFET conduction continues until the drain current reaches zero.
7. At zero current the detector output voltage is zero and the synchronous MOSFET Gate voltage is pulled low by the GATEL, turning the device off.



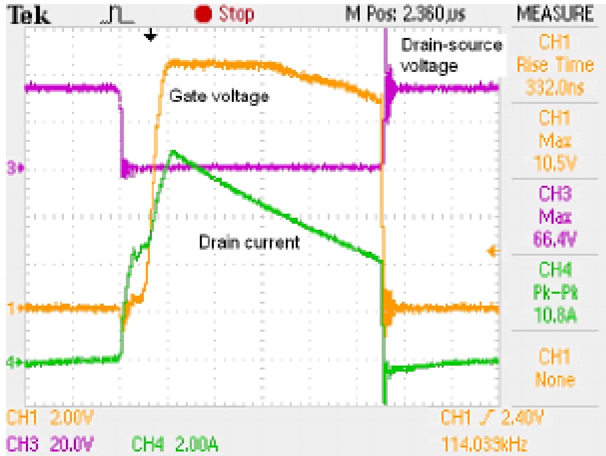


Fig 1a: Continuous Conduction Mode (CCM)

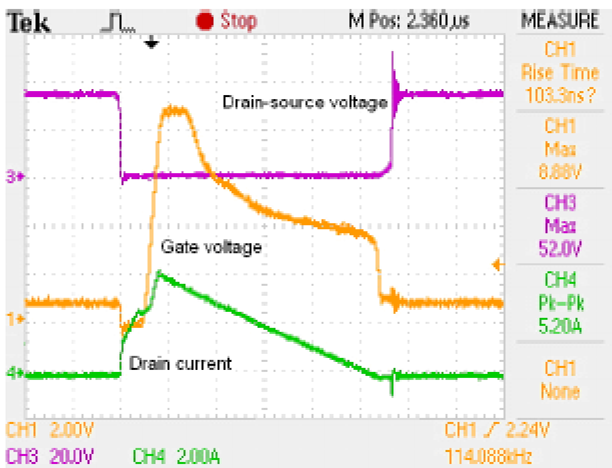


Fig 1b: Critical Conduction Mode (CrCM)

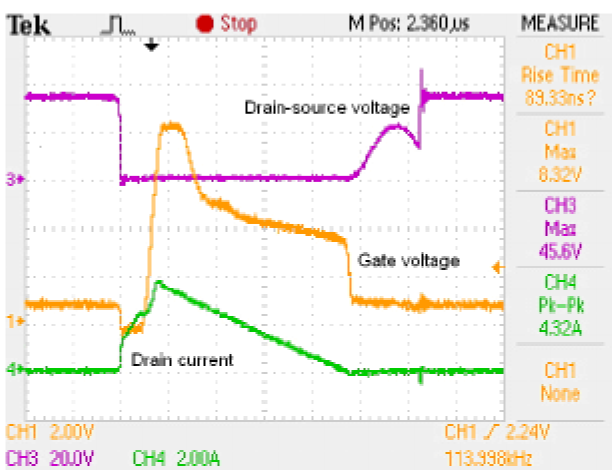
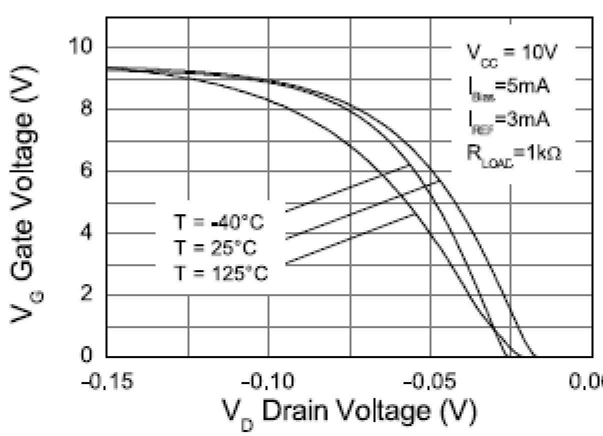


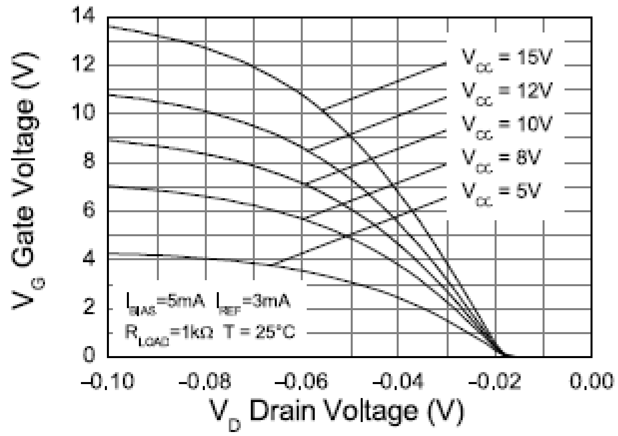
Fig 1c: Discontinuous Conduction Mode (DCM)

Figure 1. Typical waveforms

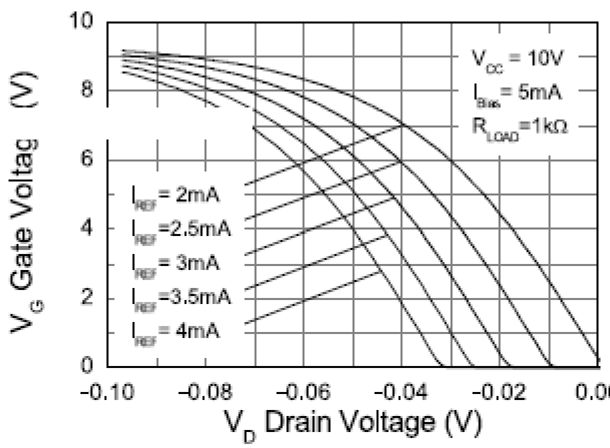
Typical characteristics



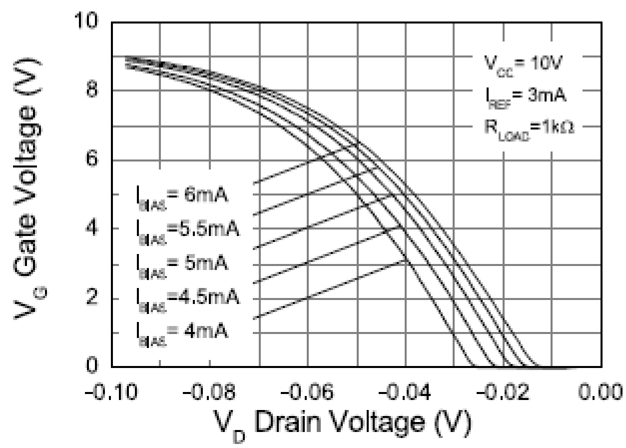
Transfer Characteristic



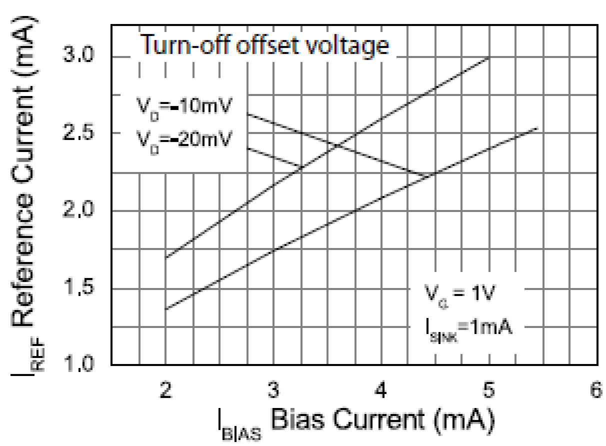
Transfer Characteristic



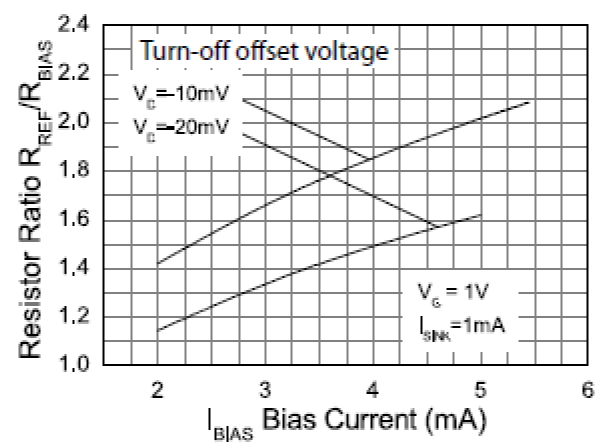
Transfer Characteristic



Transfer Characteristic

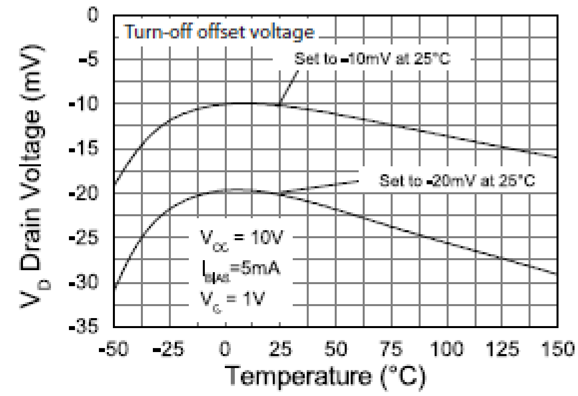


Bias Current vs Reference Current

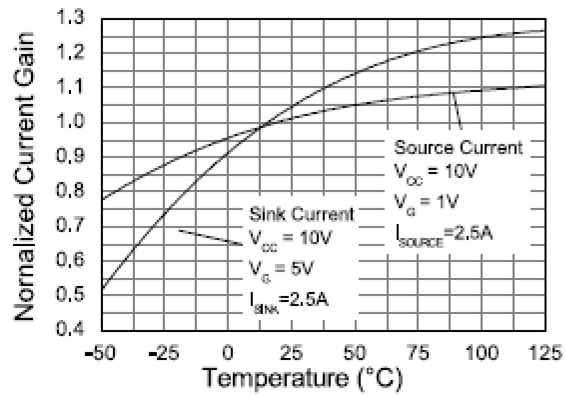


Bias Resistor vs Reference Resistor

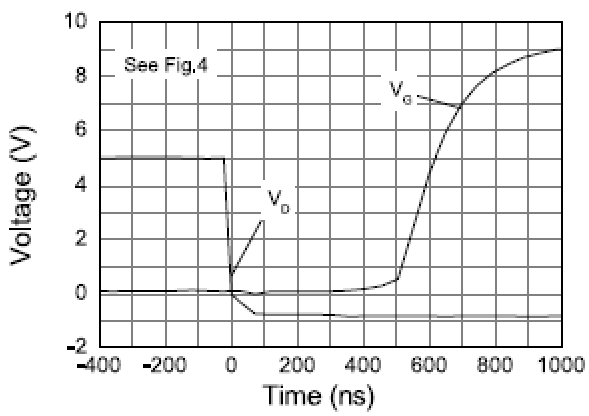
Typical characteristics



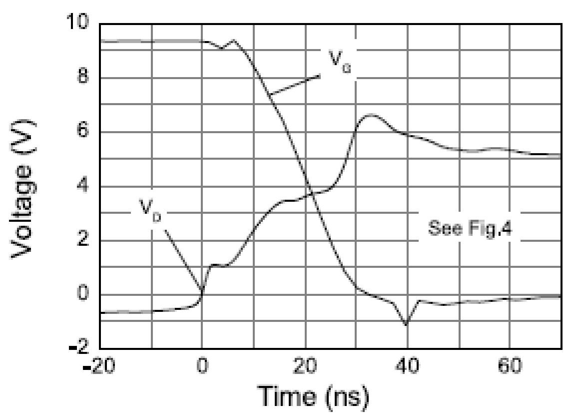
Drain Sense Voltage vs Temperature



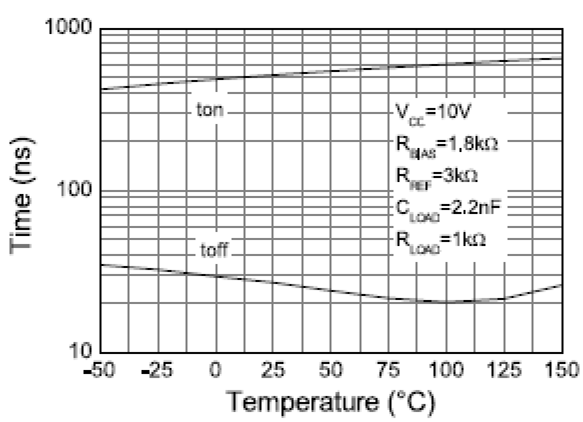
Output Current vs Temparature



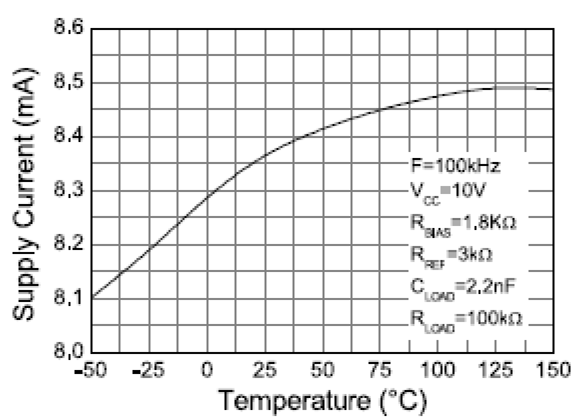
Switch On Speed



Switch Off Speed

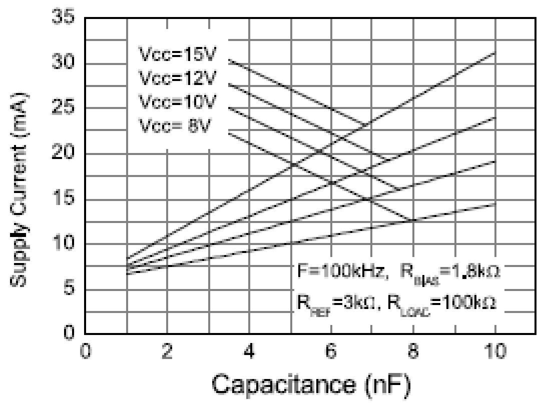


Switching vs Temperature

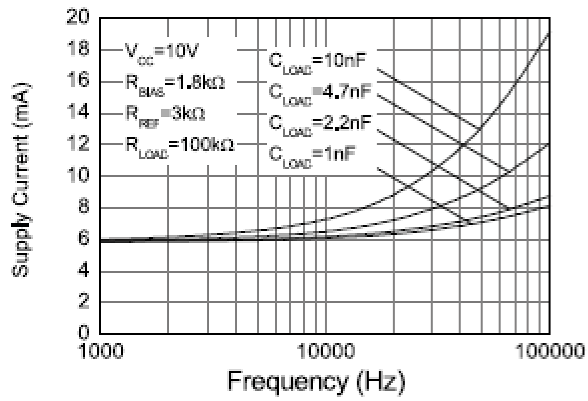


Supply Current vs Temperature

Typical characteristics



Supply Current vs Capacitive Load



Supply Current vs Frequency

Component selection

It is advisable to decouple the ZXGD3101 closely to V_{CC} and ground due to the possibility of high peak gate currents with C1 in Figure 2.

The proper selection of external resistors R_{REF} and R_{BIAS} is important to the optimum device operation. Select a value for resistor R_{REF} to give a reference current, I_{REF}, of ~3mA. The value of R_{BIAS} must then be 0.6 times the value of R_{REF} to give a bias current, I_{BIAS}, of 1.6 times I_{REF}. This provides a recommended typical offset voltage of -20mV.

External gate resistors are optional. They can be inserted to control the rise times which may help with EMI issues, power supply consumption issues or dissipation within the part.

$R_{REF} = (V_{CC} - 0.7V) / 0.003$

$R_{BIAS} = (V_{CC} - 0.7V) / 0.005$

Layout considerations

The Gate pins should be as close to the MOSFET Gate as possible. Also the ground return loop should be as short as possible. The decoupling capacitor should be close to the V_{CC} and Ground pin, and should be a X7R type.

For more detailed information refer to application note AN54.

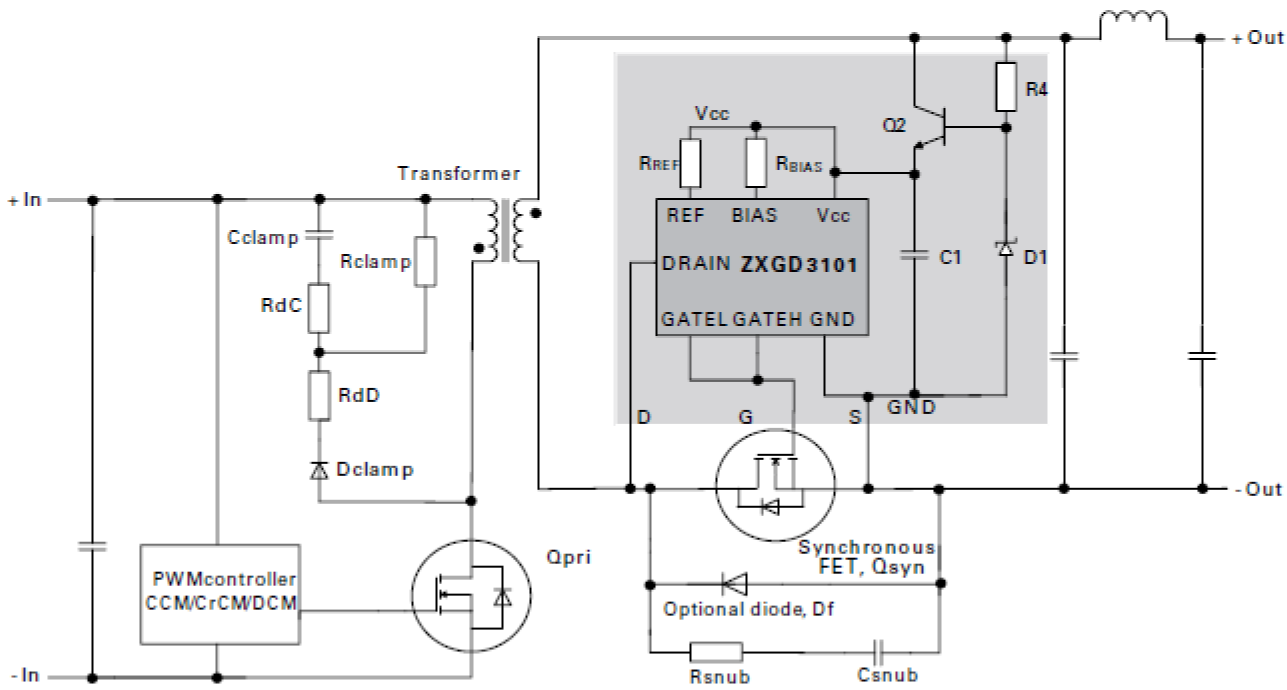


Figure 2 - Example connection for low side synchronous rectification

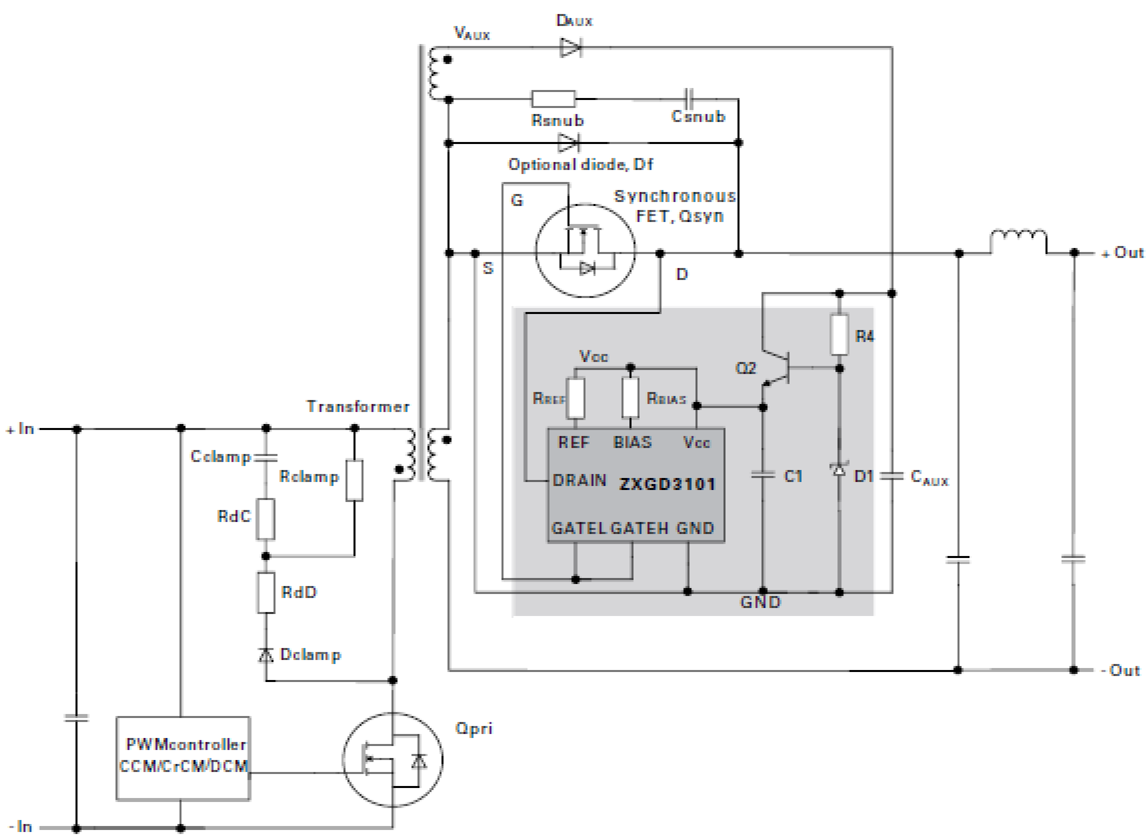


Figure 3 - Example connection for high side synchronous rectification

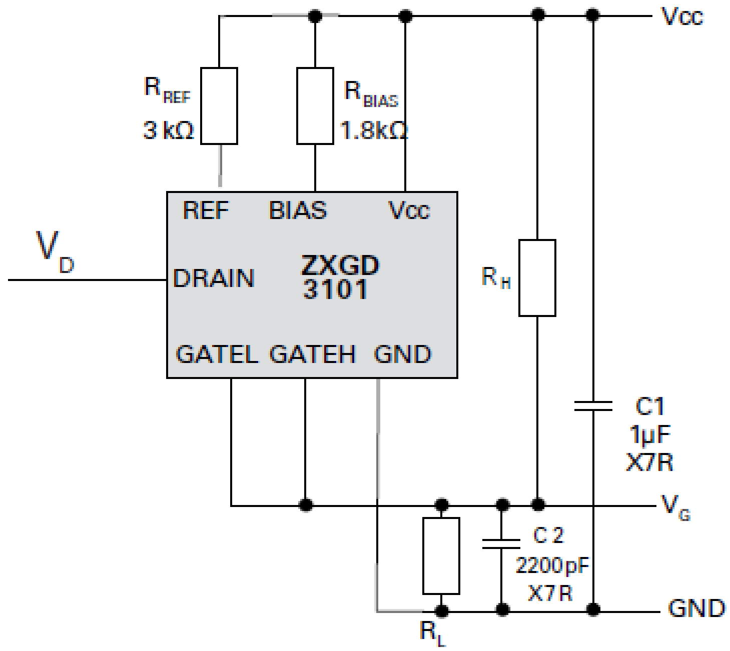


Figure 4: Test circuit

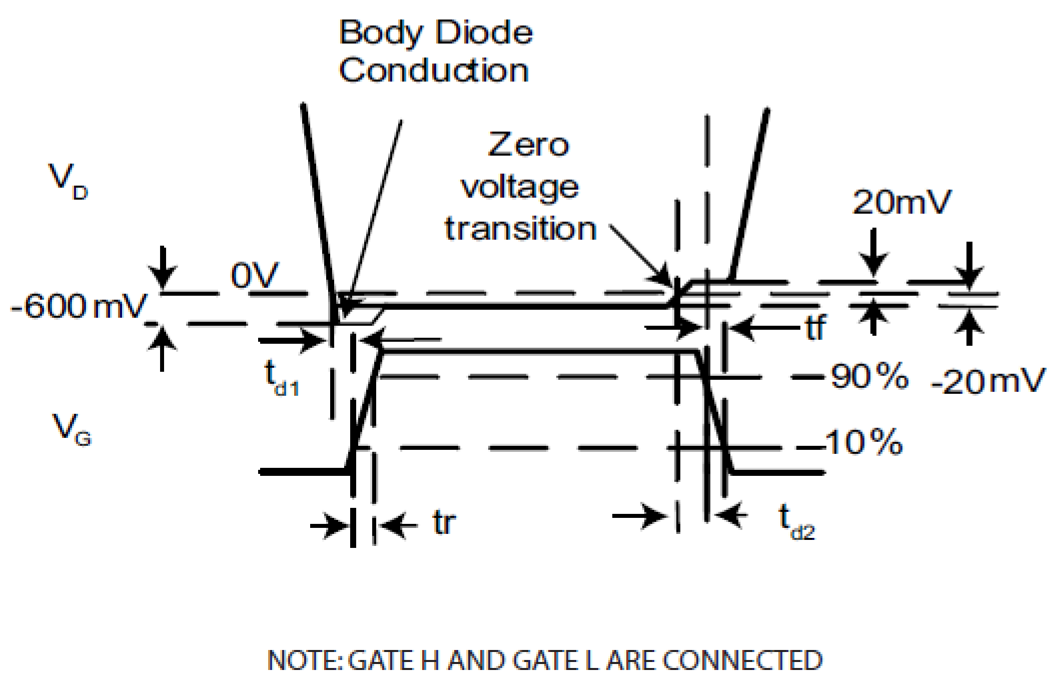
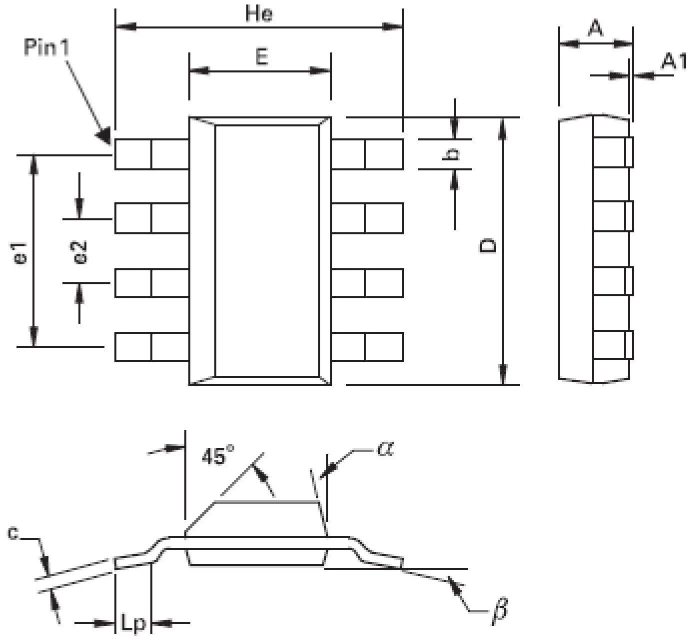


Figure 5: Timing diagram

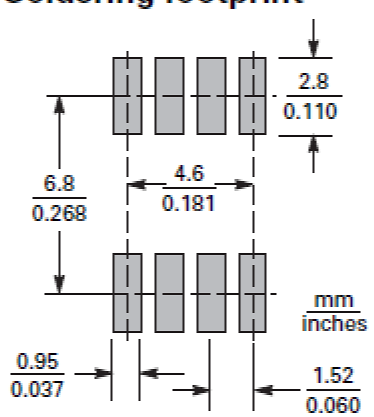
Package information - SM8 (Surface mounted, 8 pin package)



DIM	Millimeters			Inches			DIM	Millimeters			Inches		
	Min.	Max.	Typ.	Min.	Max.	Typ.		Min.	Max.	Typ.	Min.	Max.	Typ.
A	-	1.7	-	-	0.067	-	e1	-	-	4.59	-	-	0.1807
A1	0.02	0.1	-	0.0008	0.004	-	e2	-	-	1.53	-	-	0.0602
b	-	-	0.7	-	-	0.0275	He	6.7	7.3	-	0.264	0.287	-
c	0.24	0.32	-	0.009	0.013	-	Lp	0.9	-	-	0.035	-	-
D	6.3	6.7	-	0.248	0.264	-	α	-	15°	-	-	15°	-
E	3.3	3.7	-	0.130	0.145	-	β	-	-	10°	-	-	10°

Note: Controlling dimensions are in millimeters. Approximate dimensions are provided in inches

Soldering footprint



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