IFX54211MB V33

High PSRR Low Dropout Linear Voltage Regulator

Data Sheet

Rev. 1.0, 2015-08-26

Standard Power

RoHS

1   Overview

Features

- Output Voltage: 3.3 V
- Output Voltage Accuracy of ±3 %
- Output Currents up to 150 mA
- Extended Input Voltage Operating Range of 2.7 V to 18 V
- Enable Functionality
- Low Dropout Voltage: typ. 290mV
- Very Low Quiescent Current: typ. 50 µA
- Very Low Shutdown Current: typ. 0.01 µA
- Very High PSRR: typ. 63dB at 10 kHz
- Output Current Limitation
- Short Circuit protected
- Overtemperature Shutdown
- Wide Temperature Range From -40 °C up to 125 °C
- Green Product (RoHS compliant)
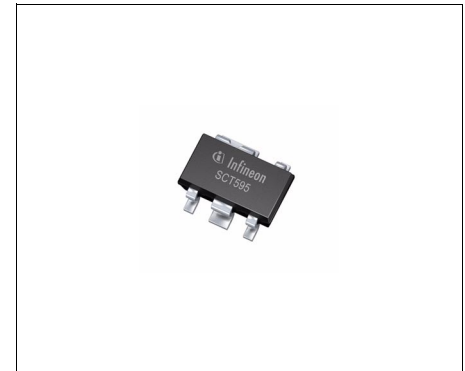
PG-SCT595

Functional Description

The IFX54211MB V33 is a monolithic integrated fixed linear voltage regulator for load currents up to 150 mA. The IC regulates an input voltage V_{IN} up to 18 V to a fixed output voltage of 3.3 V with a precision of ±3 %. The IFX54211MB V33 is especially designed for applications requiring very low standby currents, e.g. with a permanent connection to a power supply, e.g. like a preregulating DCDC converter. Besides the very low quiescent current the current consumption of the device remains low also for higher load currents thanks to its PMOS powerstage. The IFX54211MB V33 combines in an ideal way a 150 mA current capability with extremely small package outlines, low dropout capability and high Power Supply Ripple Rejection PSRR over a wide frequency range. The component can be enabled/disabled via the Enable input. The device is available in a very small surface mounted PG-SCT595 package and is designed for the harsh environment of industrial applications. Therefore it is protected against overload, short circuit and overtemperature conditions by the implemented output current limitation and the overtemperature shutdown circuit. The IFX54211MB V33 can be also used in all other applications requiring a stabilized 3.3 V voltage.

Choosing External Components

The input capacitor C_{IN} is recommended for compensating line influences. An output capacitor C_{OUT} is necessary for the stability of the regulating circuit. One strength of the device is that stability is guaranteed already for very

Type	Package	Marking
IFX54211MB V33	PG-SCT595	51

Data Sheet   2   Rev. 1.0, 2015-08-26

small output capacitors down to just 1 µF and at the same time for a wide ESR range from ≤ 10 Ω down to ceramic values within the whole operating temperature range and thus allowing the user a maximized flexibility in the choice of an output capacitor C_{OUT}. For details please refer to **"Functional Range" on Page 7**.

The qualification of this product is based on JEDEC JESD47 and may reference existing qualification results of similar products. Such referring is justified by the structural similarity of the products. The product is not qualified and manufactured according to the requirements of Infineon Technologies with regard to automotive and/or transportation applications. Infineon Technologies administrates a comprehensive qualify management system according to the latest version of the ISO9001 and ISO/TS 16949

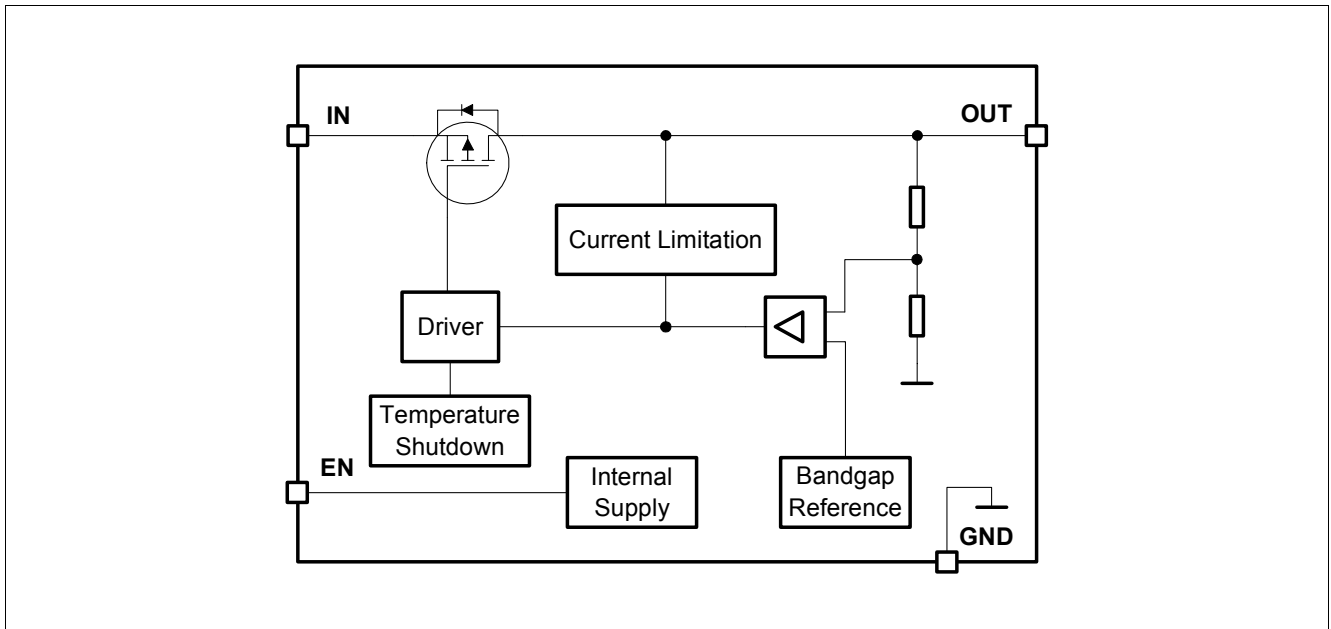The most updated certificates of the aforesaid ISO9001 and ISOTS 16949 are available on the Infineon Technologies webpage **http://www.infineon.com/cms/en/product/technology/quality/**

2   Block Diagram

Figure 1   Block Diagram

3 Pin Configuration

3.1 Pin Assignment PG-SCT595

SCT595.vsd
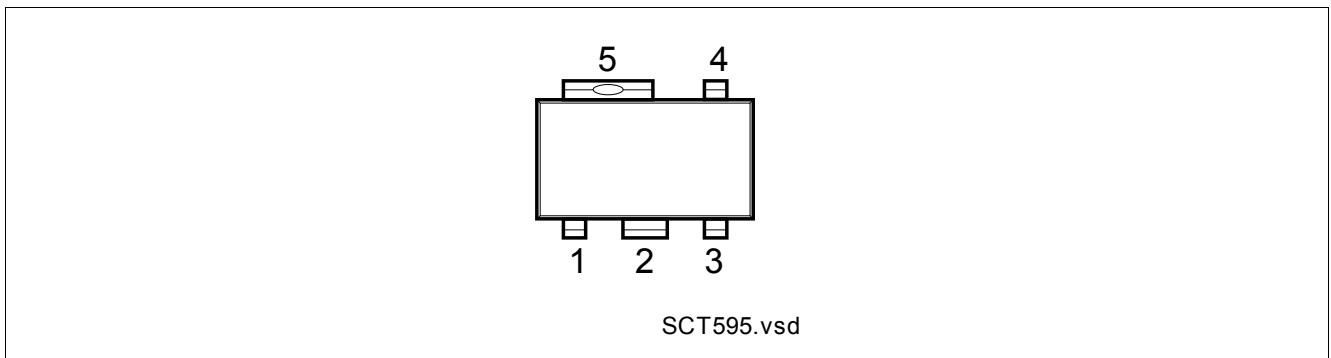
Figure 2   Pin Configuration Package PG-SCT595-5

3.2 Pin Definitions and Functions

Pin	Symbol	Function
1	IN	**Input.** **IC supply.** For compensating line influences, a capacitor of 220 nF close to the IC pin is recommended.
2	GND	**Ground Reference.** Internally connected to Pin 5. Connect to heatsink area. For thermal reasons both ground Pins 2 and 5 have to be soldered.
3	OUT	**Output.** Block to GND with a capacitor close to the IC terminals, respecting capacitance and ESR requirements given in the **"Functional Range" on Page 7**.
4	EN	**Enable.** A low signal disables the IC. A high signal switches it on. Connect to the input I, if the enable functionality is not required.
5	GND	**Ground Reference.** Internally connected to Pin 2. Connect to heatsink area. For thermal reasons both ground Pins 2 and 5 have to be soldered.

4 General Product Characteristics

4.1 Absolute Maximum Ratings

Table 1 Absolute Maximum Ratings [1)] T_j = -40 °C to +125 °C; all voltages with respect to ground, (unless otherwise specified)

Parameter	Symbol	Values			Unit	Note / Test Condition	Number
		Min.	Typ.	Max.			
Input IN							
Voltage	V_{IN}	-0.3	–	20	V	–	P_4.1.1
Output OUT							
Voltage	V_{OUT}	-0.3	–	5.5	V	–	P_4.1.2
Enable EN							
Voltage	V_{EN}	-0.3	–	20	V	–	P_4.1.3
Temperature							
Junction temperature	T_j	-40	–	150	°C	–	P_4.1.4
Storage temperature	T_{stg}	-55	–	150	°C	–	P_4.1.5
ESD Susceptibility							
ESD Absorption	$V_{ESD,HBM}$	-4	–	4	kV	Human Body Model (HBM) [2)]	P_4.1.6
ESD Absorption	$V_{ESD,CDM}$	-750	–	750	V	Charge Device Model (CDM) [3)] at all pins	P_4.1.7

1) not subject to production test, specified by design

2) ESD susceptibility, HBM according to ANSI/ESDA/JEDEC JS001 (1.5 kΩ, 100 pF)

3) ESD susceptibility, Charged Device Model "CDM" ESDA STM5.3.1 or ANSI/ESD S.5.3.1

Note: Stresses above the ones listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

1. Integrated protection functions are designed to prevent IC destruction under fault conditions described in the data sheet. Fault conditions are considered as "outside" normal operating range. Protection functions are not designed for continuous repetitive operation.

4.2 Functional Range

Table 2

Parameter	Symbol	Values			Unit	Note / Test Condition	Number
		Min.	Typ.	Max.			
Input voltage	V_{IN}	2.7		18	V	–	P_4.2.1
Output Capacitor Requirements for Stability	C_{OUT}	1		–	µF	[1]	P_4.2.2
Output Capacitor Requirements for Stability	ESR(C_{OUT})	–		10	Ω	[2]	P_4.2.3
Junction temperature	T_j	-40		125	°C	–	P_4.2.4

1) The minimum output capacitance requirement is applicable for a worst case capacitance tolerance of 30%
2) relevant ESR value at f = 10 kHz

Note: Within the functional or operating range, the IC operates as described in the circuit description. The electrical characteristics are specified within the conditions given in the Electrical Characteristics table.

4.3 Thermal Resistance

*Note: This thermal data was generated in accordance with JEDEC JESD51 standards. For more information, go to **www.jedec.org**.*

Table 3

Parameter	Symbol	Values			Unit	Note / Test Condition	Number
		Min.	Typ.	Max.			
Junction to Ambient	R_{thJA}	–	81	–	K/W	2s2p board [1]	P_4.3.1
Junction to Ambient	R_{thJA}	–	217	–	K/W	Footprint only [2]	P_4.3.2
Junction to Ambient	R_{thJA}	–	117	–	K/W	300 mm^2 PCB heatsink area [2]	P_4.3.3
Junction to Ambient	R_{thJA}	–	103	–	K/W	600 mm^2 PCB heatsink area [2]	P_4.3.4
Junction to Soldering Point	R_{thJSP}	–	30	–	K/W	Pins 2, 5 fixed to T_A	P_4.3.5

1) Specified R_{thJA} value is according to JESD51-2,-5,-7 at natural convection on FR4 2s2p board; The product (chip+package) was simulated on a 76.2 x 114.3 x 1.5 mm board with 2 inner copper layers (2 x 70µm Cu, 2 x 35µm Cu). Where applicable a thermal via array next to the package contacted to the first inner copper layer.
2) Package mounted on PCB FR4; 80 x 80 x 1.5 mm; 35 µm Cu, 5 µm Sn; horizontal position; zero airflow. Not subject to production test; specified by design.

5 Voltage Regulator

5.1 Description Voltage Regulator

The output voltage V_{OUT} is controlled as follows: It is divided by an internal resistor divider. This fraction is then compared to an internal reference and drives the pass transistor accordingly.

The control loop stability depends on the output capacitor C_{OUT}, the load current, the chip temperature and the circuit design. To ensure stable operation, the requirements for output capacitance and equivalent series resistance ESR, given in **"Functional Range" on Page 7**, have to be maintained. For details see also the typical performance graph **"Output Capacitor Series Resistance ESR(C_{OUT}) vs. Output Current I$_{OUT}$" on Page 11**. As the output capacitor also has to buffer load steps it should be sized according to the needs of the application.

An input capacitor C_{IN} is recommended to compensate line influences. Connect the capacitors close to the terminals of the component.

In case the load current is above the specified limit, e.g. in case of a short circuit, the output current limitation limits the current. The output voltage is therefore decreasing at the same time.

The overtemperature shutdown circuit prevents the IC from immediate destruction under fault conditions (e.g. output continuously short-circuited) by switching off the power stage. After the chip has cooled down, the regulator restarts. This leads to an oscillatory behavior of the output voltage until the fault is removed. However, entering thermal shutdown during operation implies that the junction temperature Tj of the device has reached values outside the maximum ratings. It needs to be kept in mind that operation outside the maximum ratings may cause a significant reduction of the IC's lifetime and that protection functions like overtemperature shutdown are not designed for continuous repetitive operation.
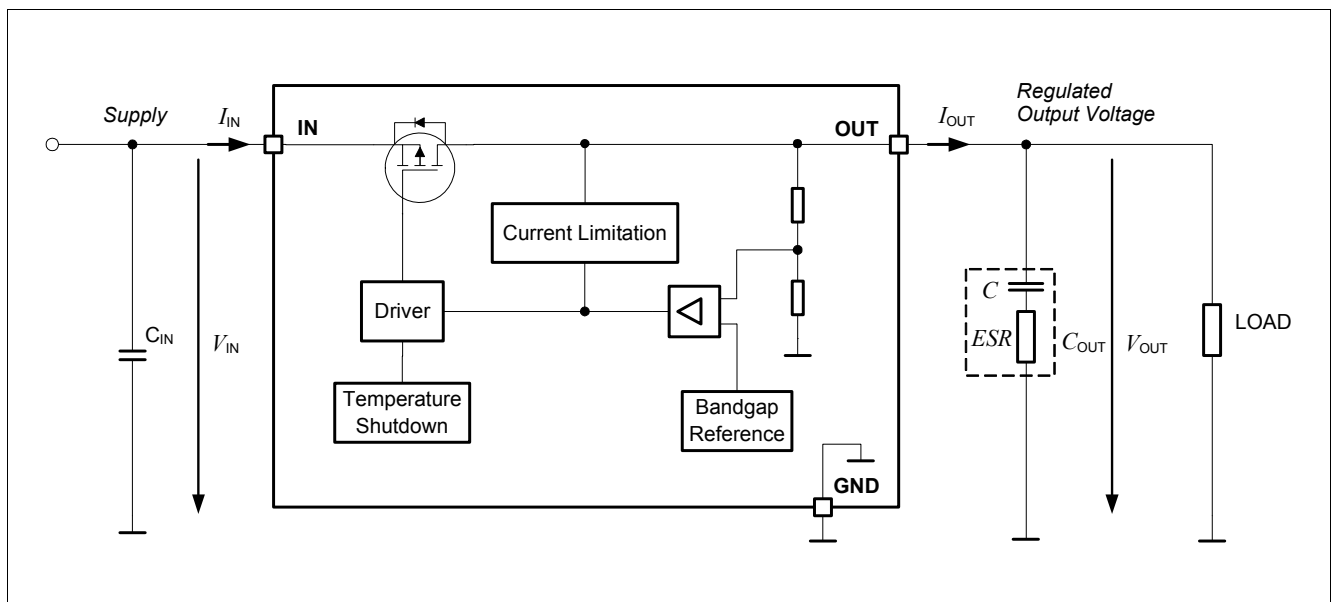

Figure 3   Block Diagram Voltage Regulator Circuit

5.2 Electrical Characteristics Voltage Regulator

Table 4 Electrical Characteristics V_{IN} = 4.3 V; T_j = -40 °C to +125 °C; all voltages with respect to ground (unless otherwise specified)

Parameter	Symbol	Values			Unit	Note / Test Condition	Number
		Min.	Typ.	Max.			
Output Voltage	V_{OUT}	3.2	3.3	3.4	V	I_{OUT} = 10 mA ; T_j = 25 °C	**P_5.2.1**
Output Voltage	V_{OUT}	3.17	3.3	3.43	V	I_{OUT} = 10 mA	**P_5.2.2**
Dropout Voltage [1]	V_{dr}	–	290	570	mV	I_{OUT} = 150 mA	**P_5.2.3**
Load Regulation	ΔV_{OUT}	-80	-25	–	mV	I_{OUT} = 1 mA to 150 mA	**P_5.2.4**
Line Regulation	ΔV_{OUT}	–	1.88	37.6	mV	V_{IN} = 4.3 V to 10 V ; I_{OUT} = 1 mA	**P_5.2.5**
Output Current Limitation	I_{OUT}	151	300	–	mA	0 V ≤ V_{OUT} ≤ 3.0 V	**P_5.2.6**
Power Supply Ripple Rejection [2]	PSRR	–	63	–	dB	f_f = 10 kHz ; I_{OUT} = 50 mA ; T_j = 25 °C ; V_{IN} = 4.3 V ; ΔV_{IN} = 1 V_{pp} ; C_{OUT}= 1 µF (Ceramic Capacitor)	**P_5.2.7**
Overtemperature Shutdown Threshold [2]	$T_{j,sd}$	151	170	190	°C	–	**P_5.2.8**

1) Dropout voltage is defined as the difference between input and output voltage when the output voltage decreases 100 mV from output voltage measured at V_{IN} = $V_{OUT,nom}$ + 1 V, I_{OUT} = 150mA.

2) Parameter is not subject to production test, specified by design

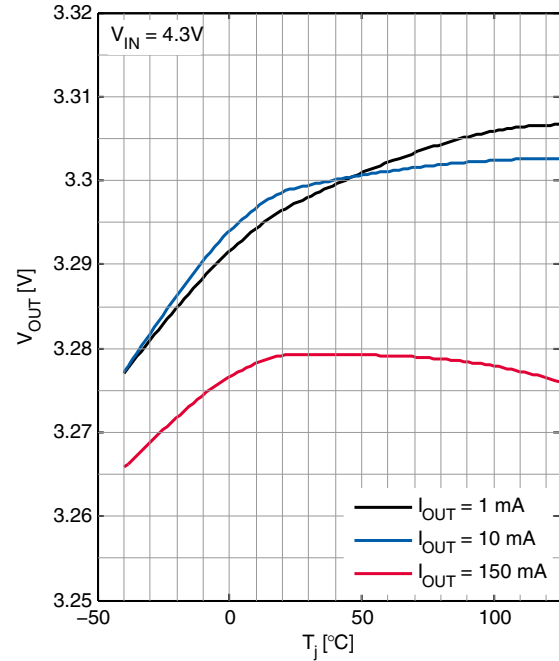## 5.3 Typical Performance Characteristics Voltage Regulator
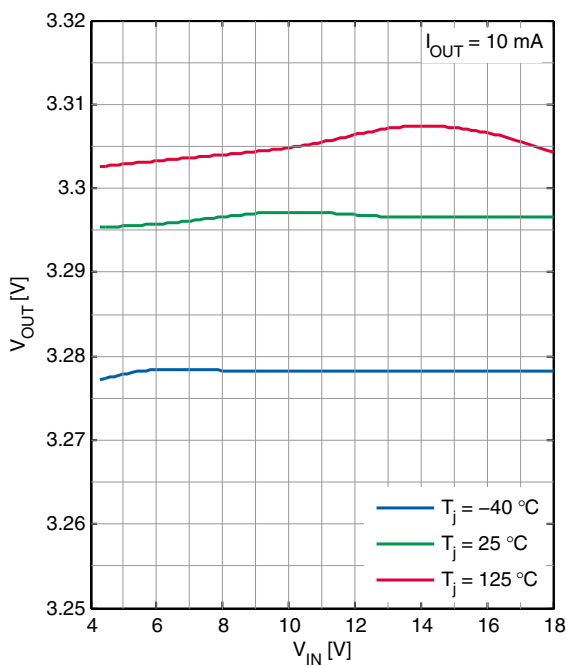
V_{EN} = 5 V (unless otherwise noted)
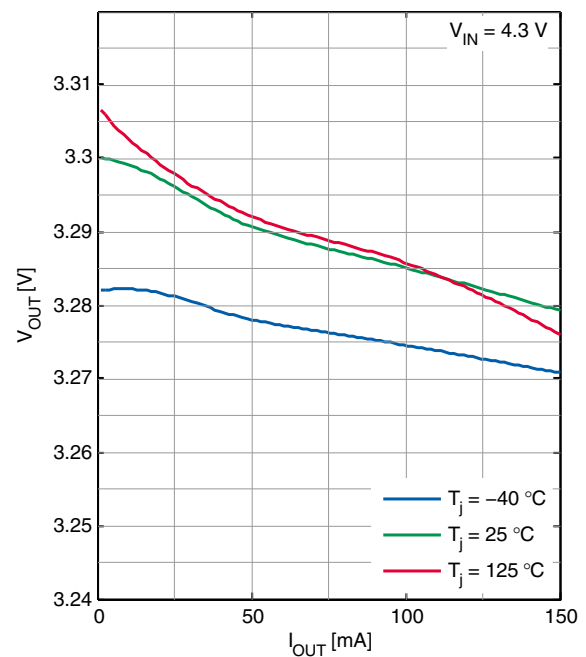
Output Voltage V_{OUT} vs. Input Voltage V_{IN}
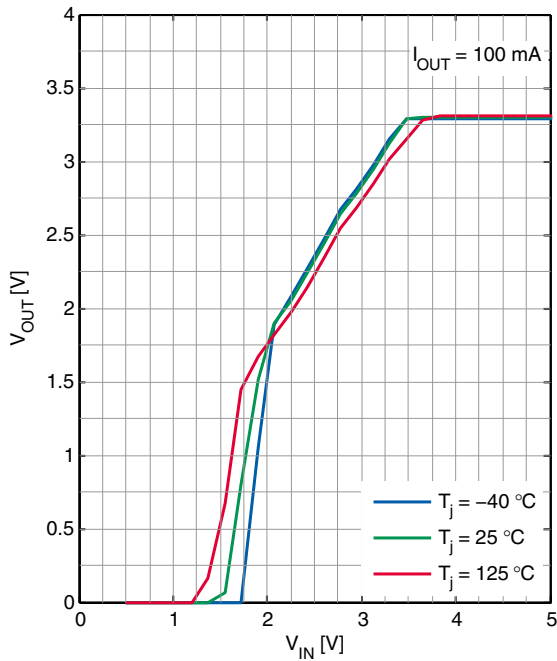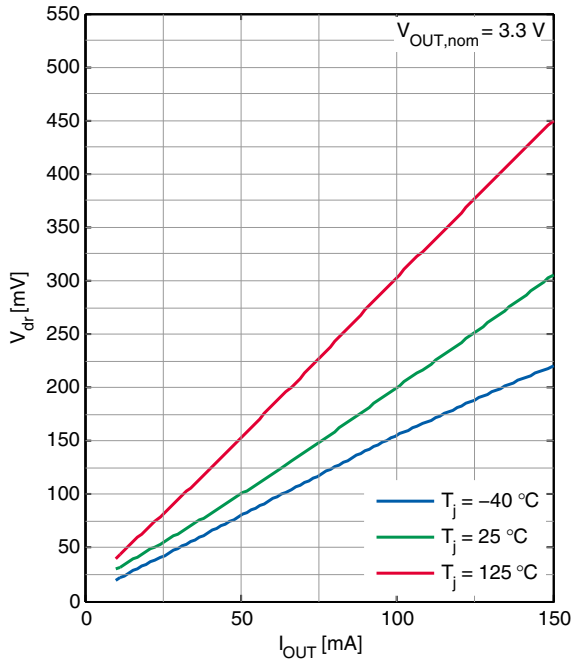

Output Voltage V_{OUT} vs. Junction Temperature T_j

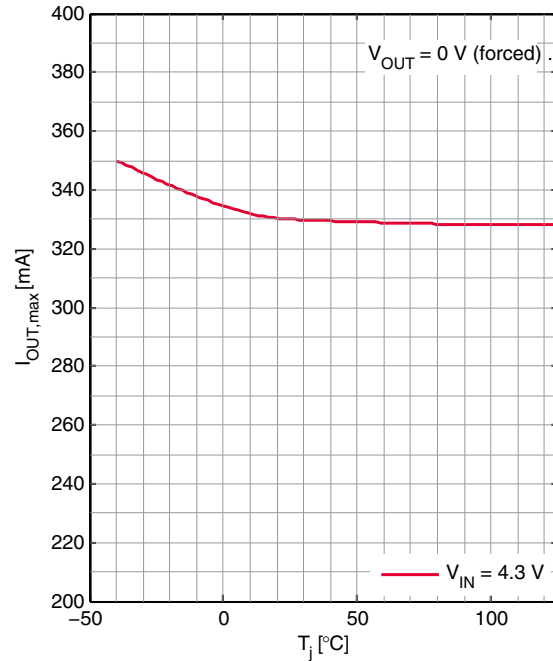**Line Regulation: Output Voltage V_{OUT} vs. Input Voltage V_{IN}**

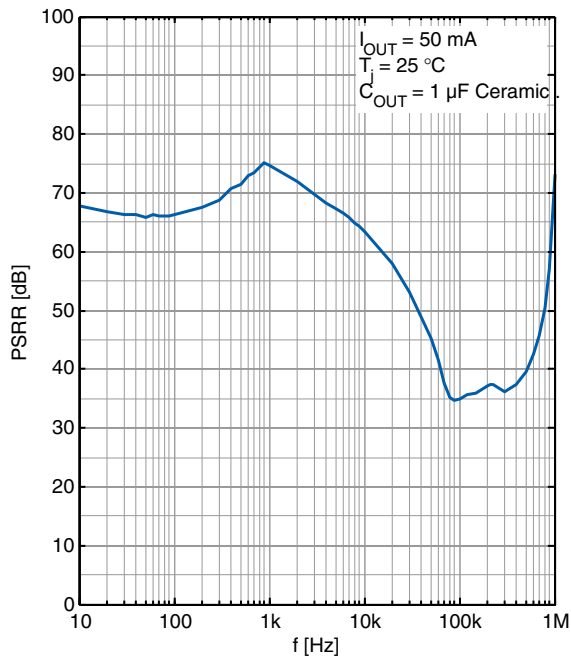**Load Regulation: Output Voltage V_{OUT} vs. Load Current I_{OUT}**

Dropout Voltage V_{dr} vs. Load Current I_{OUT}
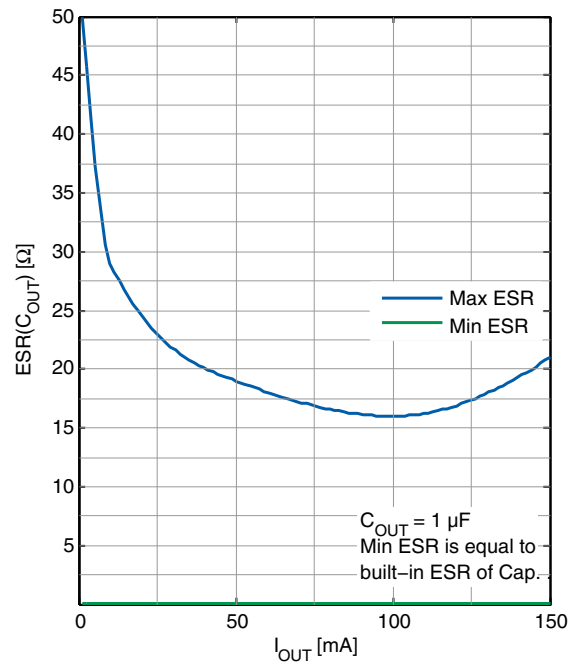

Output Current Limitation $I_{Q,max}$ vs. Junction Temperature T_j

PSRR vs. Frequency f

Output Capacitor Series Resistance ESR(C_{OUT}) vs. Output Current I_{OUT}

6 Current Consumption

6.1 Description Current Consumption

The Current Consumption of the device is characterizing the current the device needs to operate. The Quiescent Current is describing the Current Consumption in a very low load condition (e.g. the supplied microcontroller is in sleep mode). The IFX54211MB V33 has an Enable functionality to shutdown the device, in case it is not needed. During shutdown the device has a very low Current Consumption. The Current Consumption of the device is defined as the delta between I_{IN} and I_{OUT} and thus can be determined by measuring the current flowing out of the GND Pin when subtracting I_{EN}.
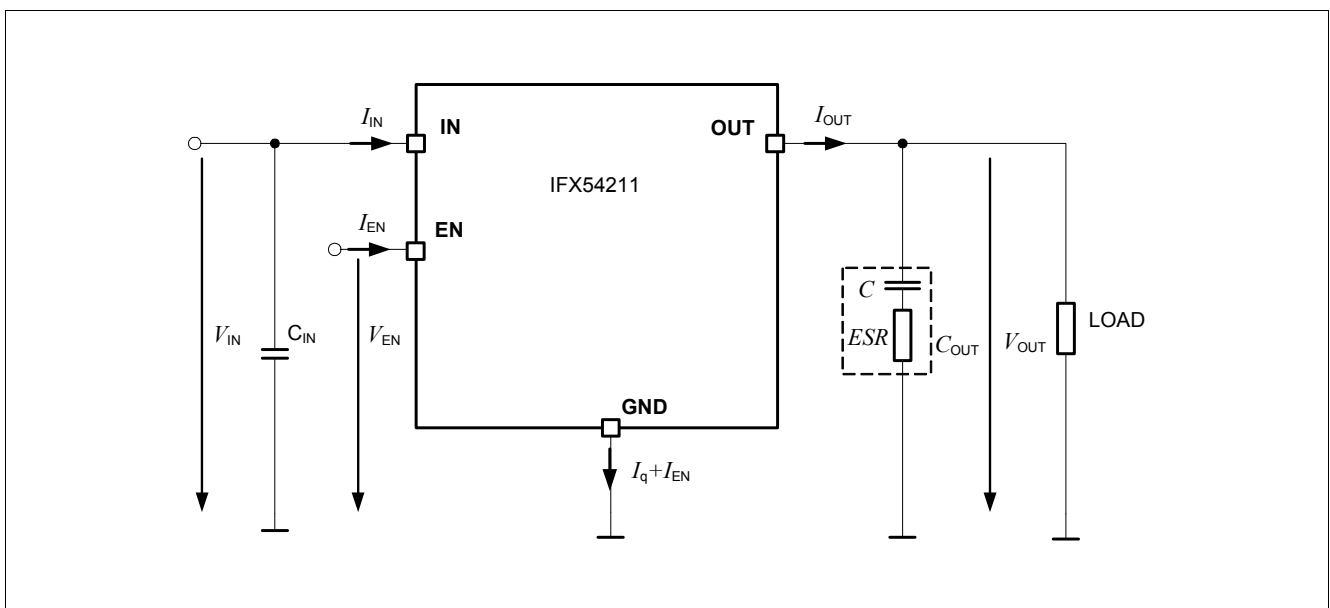

Figure 4   Parameter Definition Current Consumption

6.2 Electrical Characteristics Current Consumption

Table 5   Electrical Characteristics V_{IN} = 4.3 V; T_j = -40 °C to +125 °C; all voltages with respect to ground (unless otherwise specified)

| Parameter	Symbol	Values			Unit	Note / Test Condition	Number
		Min.	Typ.	Max.			
Quiescent Current $I_q = I_{IN} - I_{OUT}$	I_q	–	50	75	µA	I_{OUT} = 10 µA ; T_j = 25 °C	**P_6.2.1**
Quiescent Current $I_q = I_{IN} - I_{OUT}$	I_q	–	–	100	µA	I_{OUT} = 10 µA ; T_j ≤ 125 °C	**P_6.2.2**
Current Consumption $I_q = I_{IN} - I_{OUT}$	I_q	–	150	200	µA	I_{OUT} = 50 mA	**P_6.2.3**
Quiescent Current in Shutdown	$I_{q,off}$	–	0.01	1	µA	V_{IN} = 6 V ; V_{EN} = 0 V ; T_j ≤ 125 °C ; V_{OUT} = 0 V	**P_6.2.4**

6.3   Typical Performance Characteristics Current Consumption
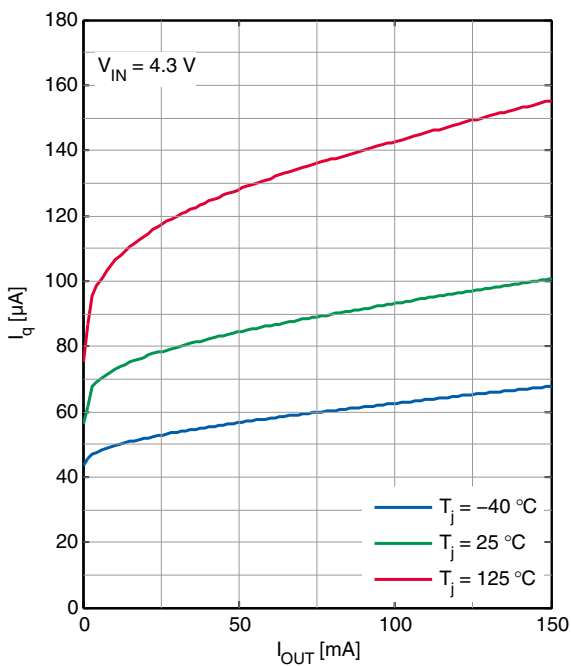
V_{EN} = 5 V (unless otherwise noted)

Quiescent Current I_q vs.
Input Voltage V_{IN}
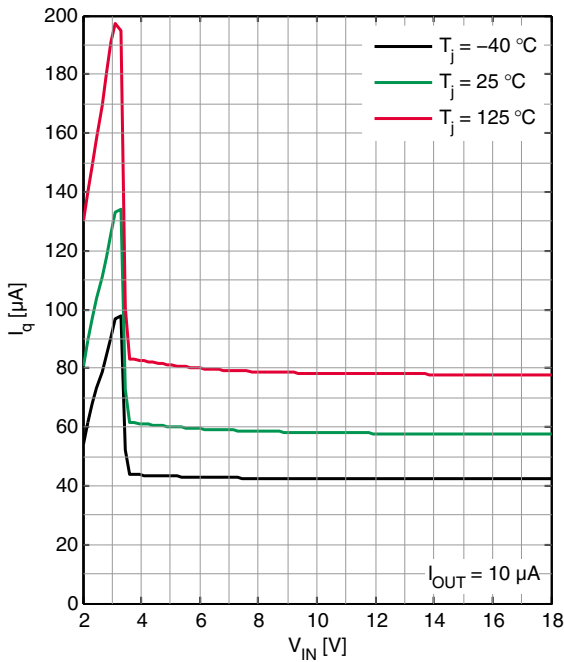
Current Consumption (GND Current) I_q vs.
Junction Temperature T_j
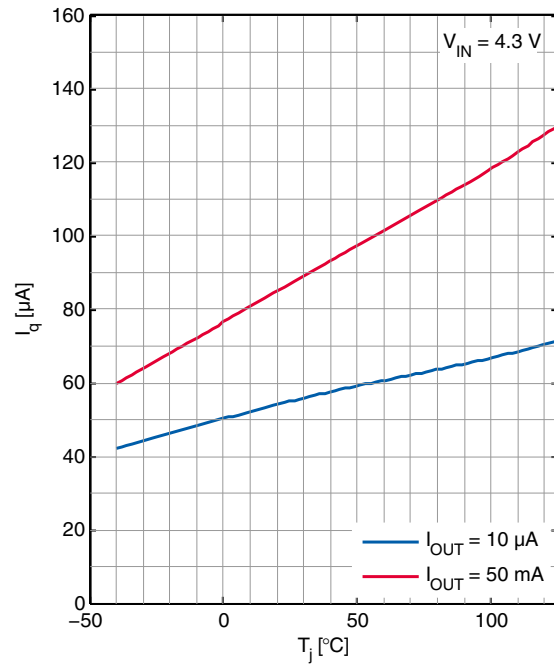
Current Consumption (GND Current) I_q vs.
Load Current I_{OUT}

7 Enable Function

7.1 Description Enable Function

The IFX54211MB V33 can be turned on or turned off by the EN Input. The parameter V_{EN} is the voltage provided to the EN Pin as shown in **Figure 4 "Parameter Definition Current Consumption" on Page 12**.

With voltage levels lower than $V_{EN,Lo}$ applied to the EN Input the device will be turned off. During this state the device is in shutdown with a very low current consumption $I_{q,off}$.

Changing the voltage at the EN Input from $V_{EN,Lo}$ to $V_{EN,Hi}$ will trigger the start-up of the device. For voltages higher than $V_{EN,Hi}$ the device will regulate the output voltage to the nominal value as described in **Chapter 5 Voltage Regulator**.

7.2 Electrical Characteristics Enable Function

Table 6   Electrical Characteristics V_{IN} = 4.3 V; T_j = -40 °C to +125 °C; all voltages with respect to ground (unless otherwise specified)

| Parameter	Symbol	Values			Unit	Note / Test Condition	Number
		Min.	Typ.	Max.			
Enable High Voltage Level	$V_{EN,Hi}$	2	–	–	V	$V_{OUT,on} \geq 3.135$ V	**P_7.2.1**
Enable Low Voltage Level	$V_{EN,Lo}$	–	–	0.4	V	$V_{OUT,off} \leq 200$ mV	**P_7.2.2**
Enable Pin Current [1]	I_{EN}	–	–	5	µA	$V_{EN} = 5$ V	**P_7.2.3**

1) Enable pin current flows into the EN pin.

7.3 Typical Performance Characteristics Enable Function

Power Up Timing
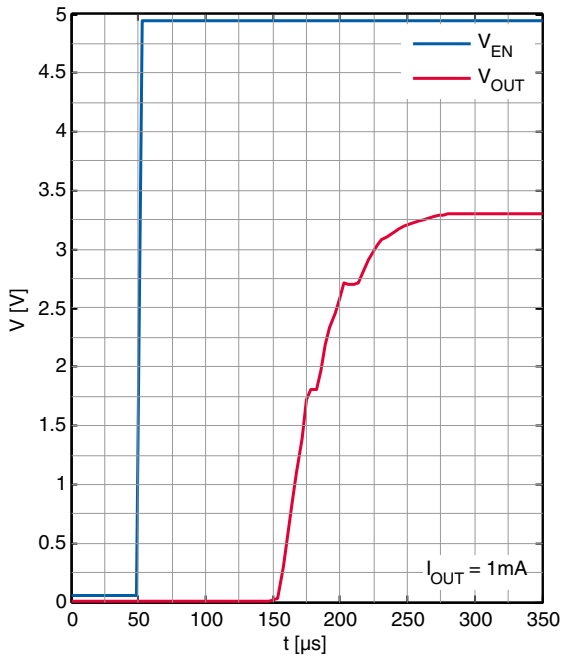
**Enable Thresholds V_{EN} vs.
Junction Temperature T_j**
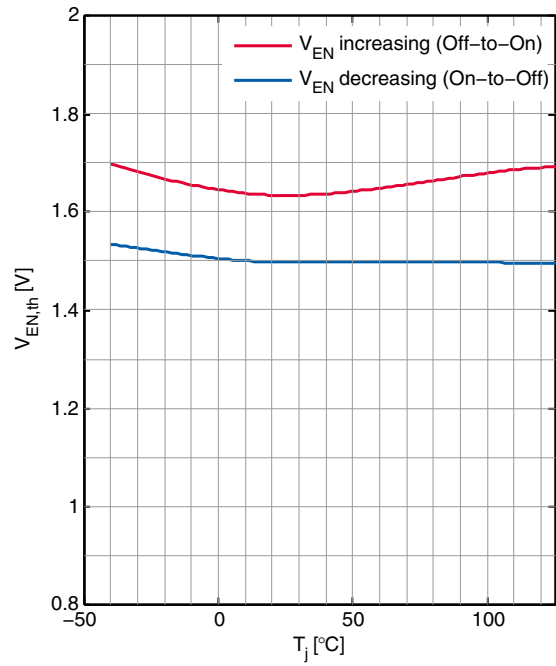
8 Application Information

Note: The following information is given as a hint for the implementation of the device only and shall not be regarded as a description or warranty of a certain functionality, condition or quality of the device.
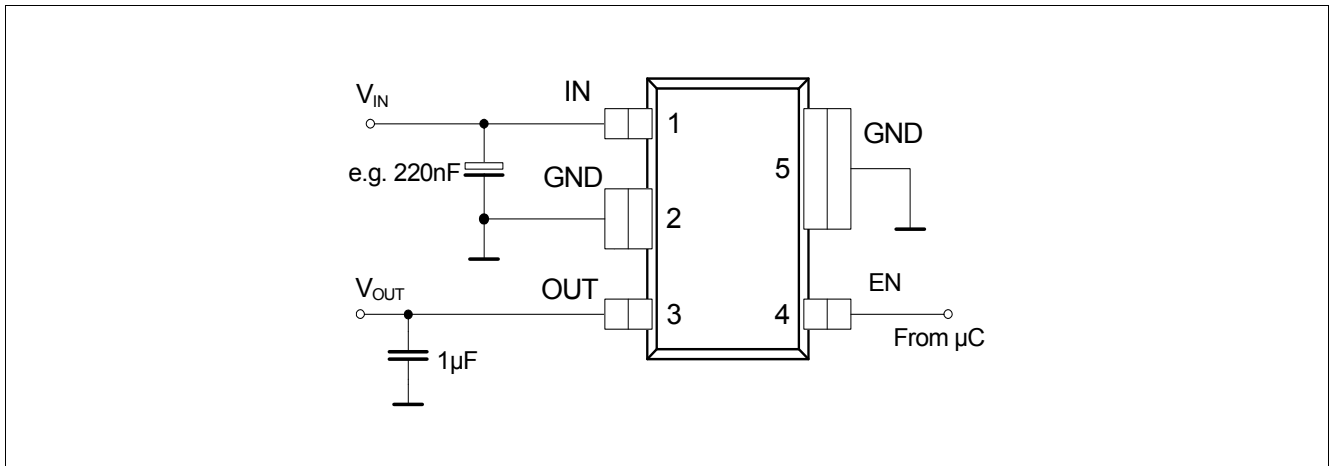

Figure 5   Application Diagram

Note: This is a very simplified example of an application circuit. The function must be verified in the real application.

A typical application circuit of the IFX54211MB V33 is shown in **Figure 5**. It shows a generic configuration of the voltage regulator, with the recommended minimum number of components one should use. Theoretically, if there is no risk of high frequency noise at all, even the small input filter capacitor can be omitted. For many typical application cases only an output capacitor and a small ceramic input capacitor are needed. Depending on the application's environment, additional components like an input buffer capacitor or a reverse polarity protection diode can be considered as well.

Input Filter Capacitor C_{IN}

A small ceramic capacitor (e.g. 220nF in **Figure 5**) at the device input helps filtering high frequency noise. To reach the best filter effect, this capacitor should be placed as close as possible to the input pin. The input filter capacitor does not have an influence on the stability of the regulation loop of the device, but in case of fast load changes an input capacitor can buffer the input voltage. Otherwise the parasitic inductance of the input line length can drop the input voltage at the IC terminals and influence the output voltage.

Output Capacitor C_{OUT}

The output capacitor is the external component that is required in any case as it is a part of the device's regulation loop. To maintain stability of this loop, the IFX54211MB V33 requires at least an output capacitor respecting the values given in **"Functional Range" on Page 7**. The given parameters ensure a stable regulation loop in general, in case of fast load changes in the application the output capacitance may have to be increased according to the requirements for load responses.
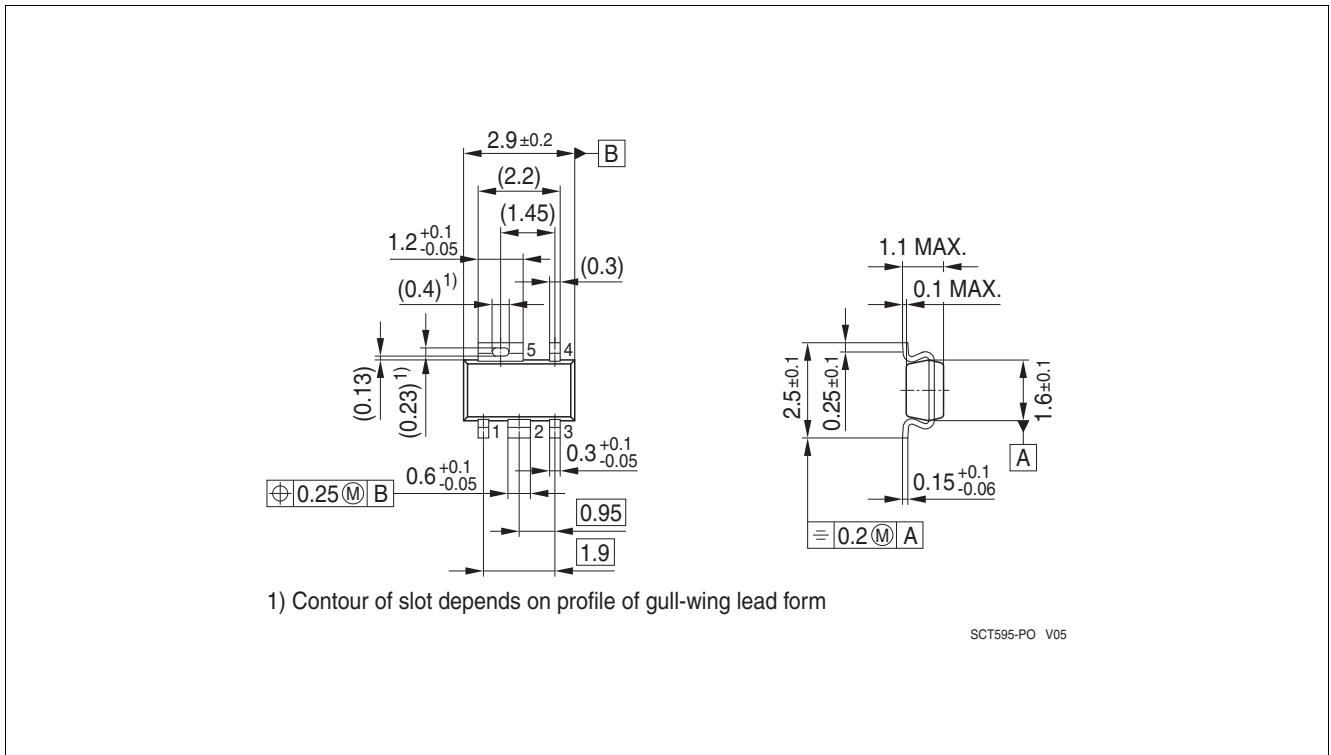
9 Package Outlines

1) Contour of slot depends on profile of gull-wing lead form

SCT595-PO V05

Figure 6   PG-SCT595

Green Product (RoHS compliant)

To meet the world-wide customer requirements for environmentally friendly products and to be compliant with government regulations the device is available as a green product. Green products are RoHS-Compliant (i.e Pb-free finish on leads and suitable for Pb-free soldering according to IPC/JEDEC J-STD-020).

For further information on alternative packages, please visit our website:
http://www.infineon.com/packages.

Dimensions in mm

10 Revision History

Revision	Date	Changes
1.0	2015-08-26	Data Sheet – Initial Release

Legal Disclaimer

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation, warranties of non-infringement of intellectual property rights of any third party.

Information

For further information on technology, delivery terms and conditions and prices, please contact the nearest Infineon Technologies Office (**www.infineon.com**).

Warnings

Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.

The Infineon Technologies component described in this Data Sheet may be used in life-support devices or systems and/or automotive, aviation and aerospace applications or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support automotive, aviation and aerospace device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.