

Step Down Voltage-Regulator with Reset

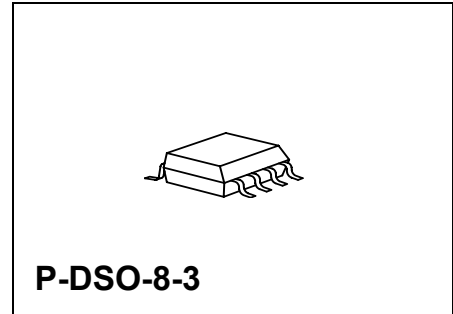
TLE 6365

Datasheet

1 Overview

1.1 Features

- Step down converter
- Supply Over- and Under-Voltage-Lockout
- Low Output voltage tolerance
- Output Overvoltage Lockout
- Output Under-Voltage-Reset with delay
- Overtemperature Shutdown
- Wide Ambient operation range -40°C to 125°C
- Wide Supply voltage operation range
- Very low current consumption
- Very small P-DSO-8 SMD package



Type	Ordering Code	Package
TLE 6365 G	Q67006-A9515	P-DSO-8-3

Functional description

General

The **TLE 6365 G** is a power supply circuit especially designed for automotive applications.

The device is based on Infineon's power technology SPT® which allows bipolar and CMOS control circuitry to be integrated with DMOS power devices on the same monolithic circuitry.

The **TLE 6365 G** contains a buck converter and a power on reset feature to start up the system.

The very small **P-DSO-8-3** SMD package meets the application requirements.

It delivers a precise 5V fully short circuit protected output voltage.

Furthermore, the build-in features like under- and overvoltage lockout for supply- and output-voltage and the overtemperature shutdown feature increase the reliability of the **TLE 6365 G** supply system.

1.2 Pin Definitions and Functions

Pin No	Symbol	Function
1	R	Reference Input ; an external resistor from this pin to GND determines the reference current and so the oscillator / switching frequency
2	RO	Reset Output ; open drain output from reset comparator with an internal pull up resistor
3	BUC	Buck-Converter Compensation Input ; output of internal error amplifier; for loop-compensation and therefore stability connect an external R-C-series combination to GND.
4	GND	Ground ; analog signal ground
5	V_{CC}	Output Voltage Input ; feedback input (with integrated resistor divider) and logic supply input; external blocking capacitor necessary
7	BUO	Buck Converter Output ; source of the integrated power-DMOS
6	BDS	Buck Driver Supply Input ; voltage to drive the buck converter powerstage
8	V_S	Supply Voltage Input ; buck converter input voltage; external blocking capacitor necessary.

Pin Configuration

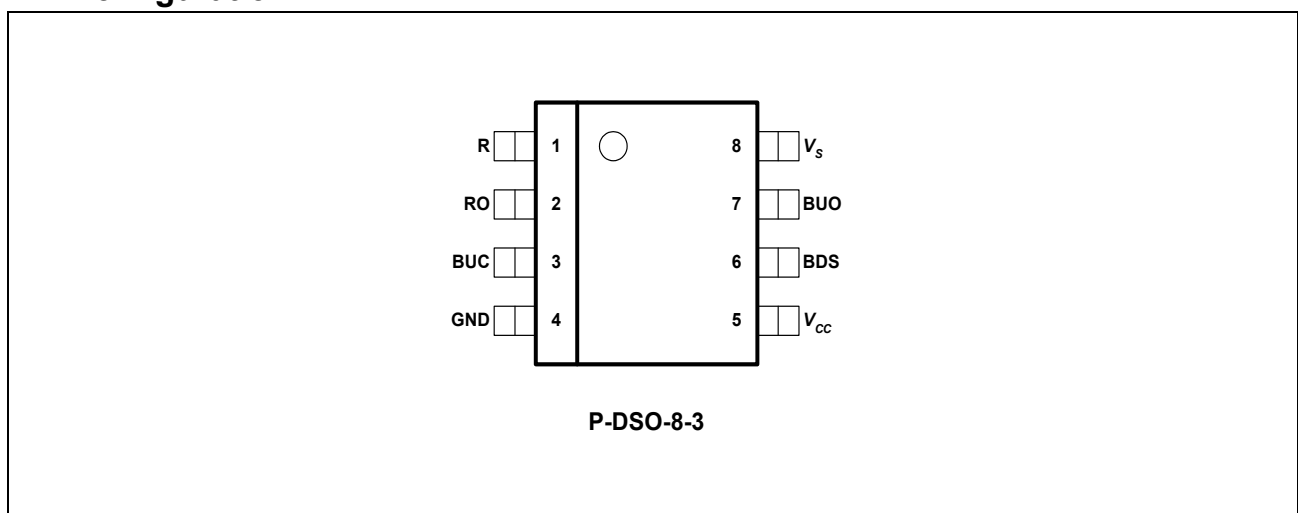


Figure 1 Pin Configuration (top view)

1.3 Block Diagram

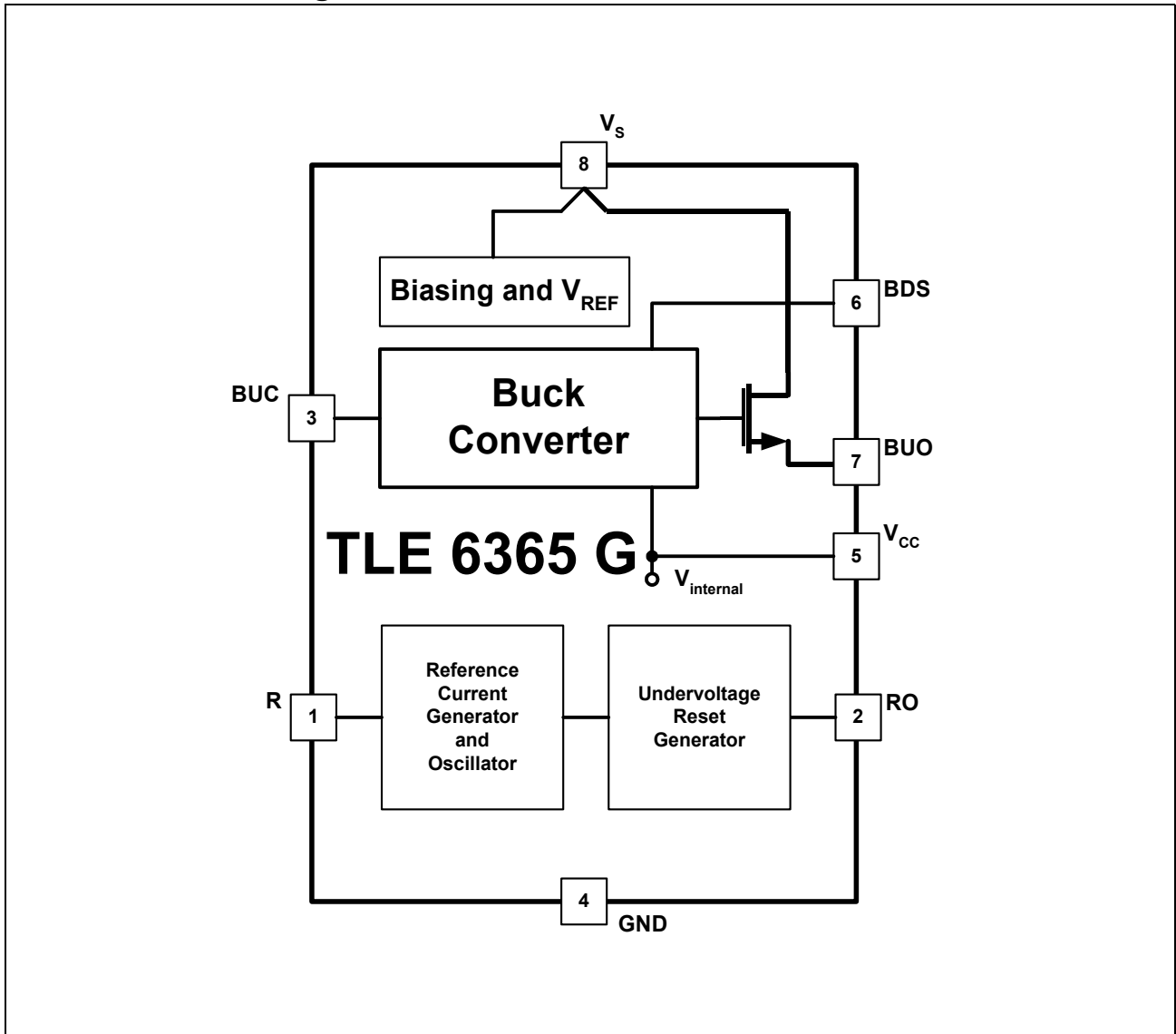


Figure 2 Block Diagram

1.4 Absolute Maximum Ratings

Parameter	Symbol	Limit Values		Unit	Remarks
		min.	max.		

Voltages

Supply voltage	V_S	– 0.3	46	V	
Buck output voltage	V_{BUO}	– 1	46	V	
Buck driver supply voltage	V_{BDS}	– 0.3	55	V	
Buck compensation input voltage	V_{BUC}	– 0.3	6.8	V	
Logic supply voltage	V_{CC}	– 0.3	6.8	V	
Reset output voltage	V_{RO}	– 0.3	6.8	V	
Current reference voltage	V_R	– 0.3	6.8	V	

ESD-Protection (Human Body Model; R=1,5k Ω ; C=100pF)

all pins to GND	V_{HBM}	–2	2	kV	
-----------------	-----------	----	---	----	--

Temperatures

Junction temperature	T_j	– 40	150	°C	–
Storage temperature	T_{stg}	– 50	150	°C	–

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

1.5 Operating Range

Parameter	Symbol	Limit Values		Unit	Remarks
		min.	max.		
Supply voltage	V_S	– 0.3	40	V	
Supply voltage	V_S	5	35	V	V_S increasing
Supply voltage	V_S	4.5	36	V	V_S decreasing
Supply voltage	V_S	– 0.3	4.5	V	Buck-Converter OFF
Buck output voltage	V_{BUO}	– 0.6	40	V	
Buck driver supply voltage	V_{BDS}	– 0.3	50	V	
Buck compensation input voltage	V_{BUC}	0	3.0	V	
Logic supply voltage	V_{CC}	4.0	6.2	V	
Reset output voltage	V_{RO}	– 0.3	$V_{CC} + 0.3$	V	
Current reference voltage	V_{CREF}	0	1.23	V	
Junction temperature	T_j	– 40	150	°C	

Thermal Resistance

Junction ambient	R_{thj-a}		180	K/W	–
------------------	-------------	--	-----	-----	---

1.6 Electrical Characteristics

$8V < V_S < 35V$; $4.75V < V_{CC} < 5.25V$; $-40^{\circ}C < T_j < 150^{\circ}C$; $R_R = 47k\Omega$;

all voltages with respect to ground; positive current defined flowing into the pin; unless otherwise specified

No.	Parameter	Symbol	Limit Values			Unit	Test Condition
			min.	typ.	max		
1.6.1	Current Consumption						
1.6.1.1	Current consumption; see applicatiopn circuit	I _S		1.5	4	mA	I _{CC} =0mA
1.6.1.2	Current consumption; see applicatiopn circuit	I _S		5	10	mA	I _{CC} =400mA
1.6.2	Under- and Over-Voltage Lockout at V _S						
1.6.2.1	UV ON voltage; buck conv. ON	V _{SUVON}	4.0	4.5	5.0	V	V _S increasing;
1.6.2.2	UV OFF voltage; buck conv. OFF	V _{SUVOFF}	3.5	4.0	4.5	V	V _S decreasing
1.6.2.3	UV Hysteresis voltage	V _{SUVHY}	0.2	0.5	1.0	V	HY = ON - OFF
1.6.2.4	OV OFF voltage; buck conv. OFF	V _{SOVOFF}	34	37	40	V	V _S increasing
1.6.2.5	OV ON voltage; buck conv. ON	V _{SOVON}	30	33	36	V	V _S decreasing
1.6.2.6	OV Hysteresis voltage	V _{SUVHY}	1.5	4	10	V	HY = OFF - ON
1.6.3	Over-Voltage Lockout at V _{CC}						
1.6.3.1	OV OFF voltage; buck conv. OFF	V _{CCOVOFF}	5.5	6.0	6.5	V	V _{CC} increasing
1.6.3.2	OV ON voltage; buck conv. ON	V _{CCOVON}	5.25	5.75	6.25	V	V _{CC} decreasing
1.6.3.3	OV Hysteresis voltage	V _{CCOVHY}	0.10	0.25	0.50	V	HY = OFF - ON

1.6 Electrical Characteristics (cont'd)

$8V < V_S < 35V$; $4.75V < V_{CC} < 5.25V$; $-40^{\circ}C < T_j < 150^{\circ}C$; $R_R = 47k\Omega$

all voltages with respect to ground; positive current defined flowing into the pin; unless otherwise specified

No.	Parameter	Symbol	Limit Values			Unit	Test Condition
			min.	typ.	max		
1.6.4	Buck-Converter; BUO, BDS, BUC and V_{CC}						
1.6.4.1	Logic supply voltage	V_{CC}	4.9		5.1	V	$1mA < I_{CC} < 400mA$; see. appl. circuit
1.6.4.2	Efficiency; see. appl. circuit	η		85		%	$I_{CC} = 400mA$; $V_S = 14V$
1.6.4.3	Power-Stage ON resistance	R_{BUON}		0.38	0.5	Ω	$T_j = 25^{\circ}C$; $I_{BUO} = 0.6A$
1.6.4.4	Power-Stage ON resistance	R_{BUON}			1.0	Ω	$I_{BUO} = 0.6A$
1.6.4.5	Buck overcurrent threshold	I_{BUOC}	0.7	0.9	1.2	A	
1.6.4.6	Input current on pin V_{CC}	I_{CC}			500	μA	$V_{CC} = 5V$
1.6.4.7	Buck Gate supply voltage; $V_{BGS} = V_S - V_{BDS}$	V_{BGS}	5	7.2	10	V	
1.6.5	Reference Input ; R (Oscillator; Timebase for Buck-Converter and Reset)						
1.6.5.1	Voltage on pin R	V_R		1.4		V	$R_R = 100k\Omega$
1.6.5.2	Oscillator frequency	f_{OSC}	85	95	105	kHz	$T_j = 25^{\circ}C$
1.6.5.3	Oscillator frequency	f_{OSC}	75		115	kHz	
1.6.5.4	Cycle time for reset timing	t_{CYL}		1		ms	$t_{CYL} = 100 / f_{OSC}$

1.6 Electrical Characteristics (cont'd)

$8V < V_S < 35V$; $4.75V < V_{CC} < 5.25V$; $-40^{\circ}C < T_j < 150^{\circ}C$; $R_R = 47k\Omega$

all voltages with respect to ground; positive current defined flowing into the pin; unless otherwise specified

No.	Parameter	Symbol	Limit Values			Unit	Test Condition
			min.	typ.	max		
1.6.6	Reset Generator; RO						
1.6.6.1	Reset threshold; V_{CC} decreasing	V_{RT}	4.50	4.65	4.75	V	V_{RO} H to L or L to H transition; V_{RO} remains low down to $V_{CC}>1V$
1.6.6.2	Reset low voltage	V_{ROL}	-	0.2	0.4	V	$I_{ROL}=1mA$; $2.5V < V_{CC}$ $< V_{RT}$
1.6.6.3	Reset low voltage	V_{ROL}	-	0.2	0.4	V	$I_{ROL}=0.2mA$; $1V < V_{CC} <$ V_{RT}
1.6.6.4	Reset high voltage	V_{ROH}	V_{CC} -0.1		V_{CC} +0.1	V	$I_{ROH} = 0mA$
1.6.6.5	Reset pull up curent	I_{RO}		240		μA	$0V < V_{RO} <$ $4V$
1.6.6.6	Reset Reaction time	t_{RR}	10	40	90	μs	$V_{CC} < V_{RT}$
1.6.6.7	Power-up reset delay time	t_{RD}		128		t_{CYL}	$V_{CC} \geq 4.8 V$
1.6.7	Thermal Shutdown (Boost and Buck-Converter OFF)						
1.6.7.1	Thermal shutdown junction temperature	T_{jSD}	150	175	200	$^{\circ}C$	
1.6.7.2	Thermal switch-on junction temperature	T_{jSO}	120		170	$^{\circ}C$	
1.6.7.3	Temperature hysteresis	ΔT		30		K	

2 Circuit Description

Below some important sections of the **TLE 6365** are described in more detail.

Power On Reset

In order to avoid any system failure, a sequence of several conditions has to be passed. In case of V_{CC} power down ($V_{CC} < V_{RT}$ for $t > t_{RR}$) a logic LOW signal is generated at the pin RO to reset an external microcontroller. When the level of V_{CC} reaches the reset threshold V_{RT} , the signal at RO remains LOW for the Power-up reset delay time t_{RD} before switching to HIGH. If V_{CC} drops below the reset threshold V_{RT} for a time extending the reset reaction time t_{RR} , the reset circuit is activated and a power down sequence of period t_{RD} is initiated. The reset reaction time t_{RR} avoids wrong triggering caused by short “glitches” on the V_{CC} -line.

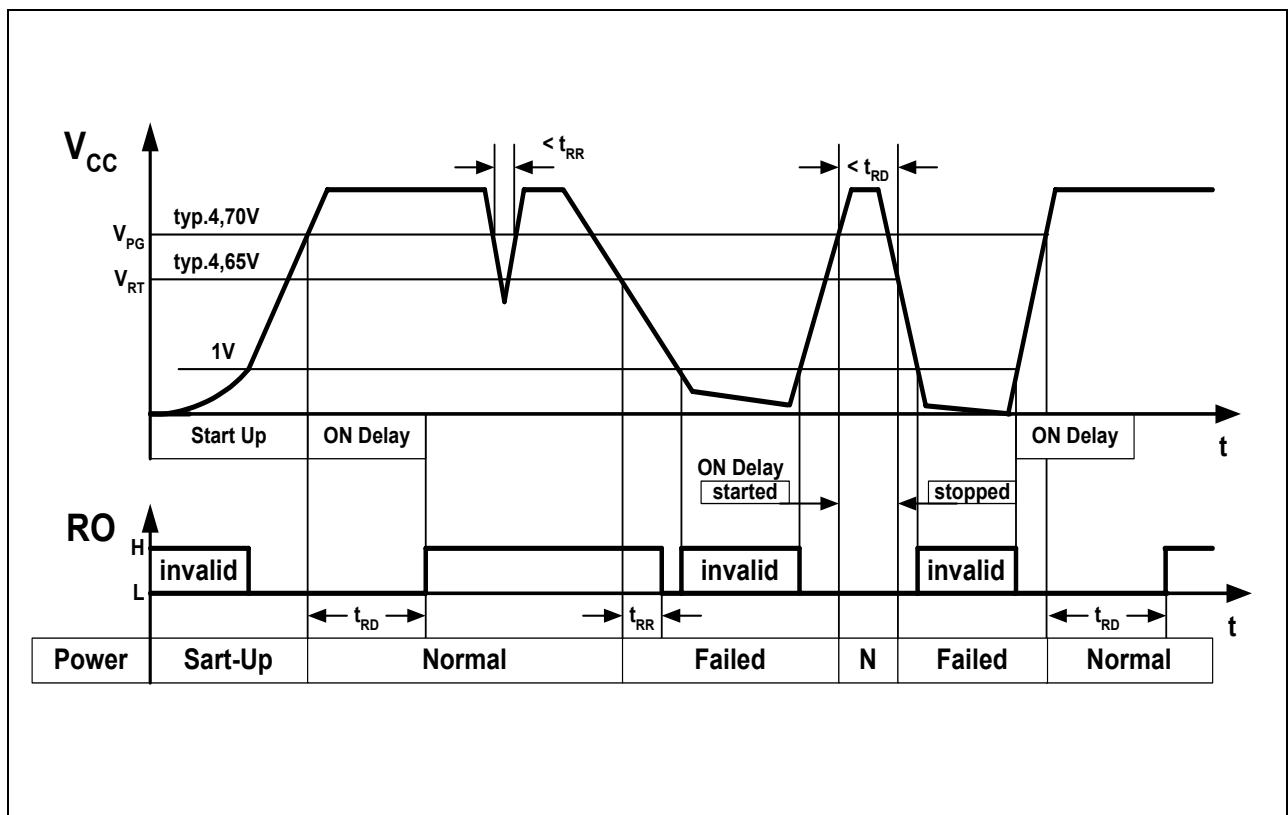


Figure 3 Reset Function

Buck Converter

A stabilized logic supply voltage (typ. 5 V) for general purpose is realized in the system by a buck converter. An external buck-inductance L_{BU} is PWM switched by a high side DMOS power transistor with the programmed frequency (pin R).

The buck converter uses the temperature compensated bandgap reference voltage (typ. 2.8 V) for its regulation loop.

This reference voltage is connected to the non-inverting input of the error amplifier and an internal voltage divider supplies the inverting input. Therefore the output voltage V_{CC} is fixed due to the internal resistor ratio to typ. 5.0 V.

The output of the error amplifier goes to the inverting input of the PWM comparator as well as to the buck compensation output BUC.

When the error amplifier output voltage exceeds the sawtooth voltage the output power MOS-transistor is switched on. So the duration of the output transistor conduction phase depends on the V_{CC} level. A logic signal PWM with variable pulse width is generated.

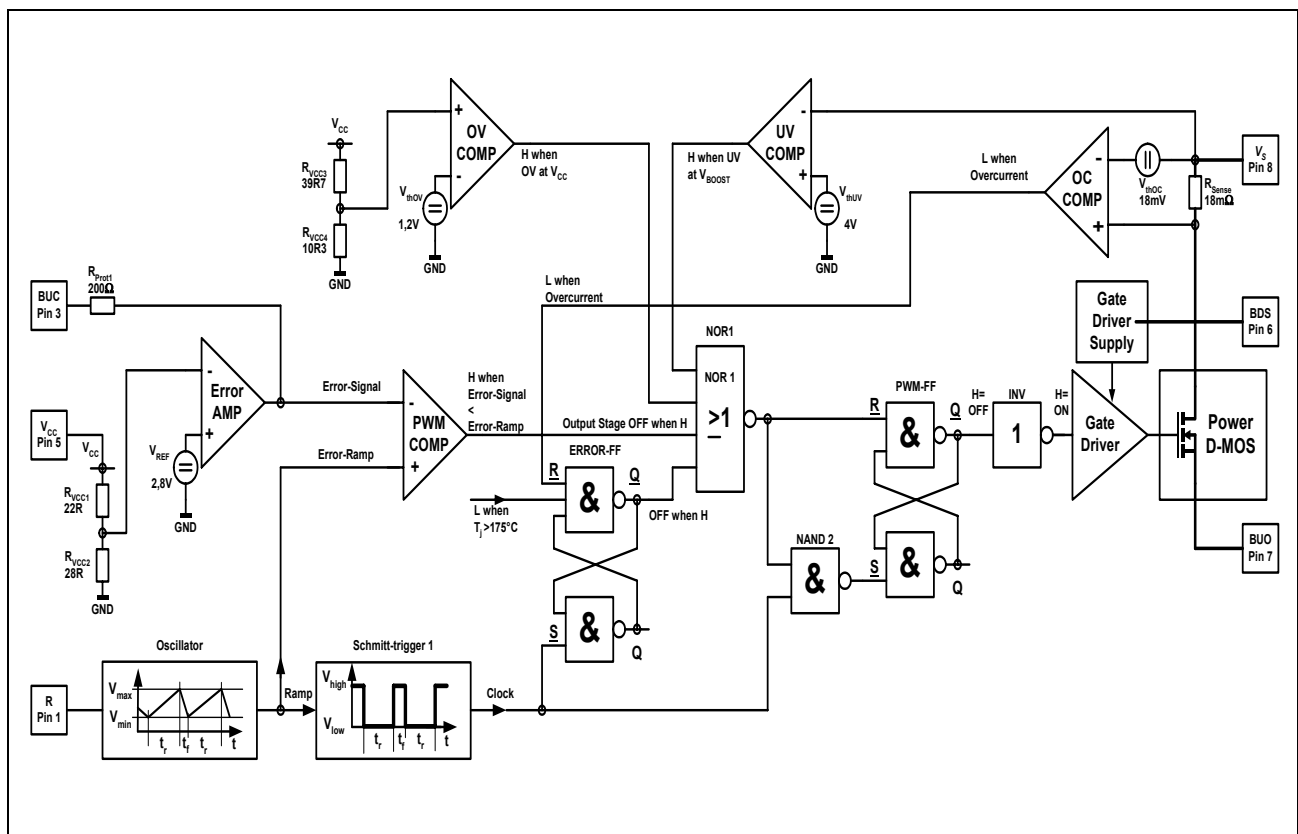


Figure 4 Buck Converter Block Diagram

External loop compensation is required for converter stability, and is formed by connecting a compensation resistor-capacitor series-network (R_{BUC} , C_{BUC}) between pin BUC and GND.

In the case of overload or short-circuit at V_{CC} (the output current exceeds the buck overcurrent threshold I_{BUOC}) the DMOS output transistor is switched off by the overcurrent comparator immediately.

In order to protect the V_{CC} input as well as the external load against catastrophic failures, an overvoltage protection is provided which switches off the output transistor as soon as the voltage at pin V_{CC} exceeds the internal fixed overvoltage threshold

$V_{CCOV\ OFF} = \text{typ. } 6.0 \text{ V}$.

Also a battery undervoltage protection is implemented in the **TLE 6365** to avoid wrong operation of the following supplied devices, the typical threshold when decreasing the battery voltage is at $V_{SU\ OFF} = \text{typ. } 4.0 \text{ V}$.

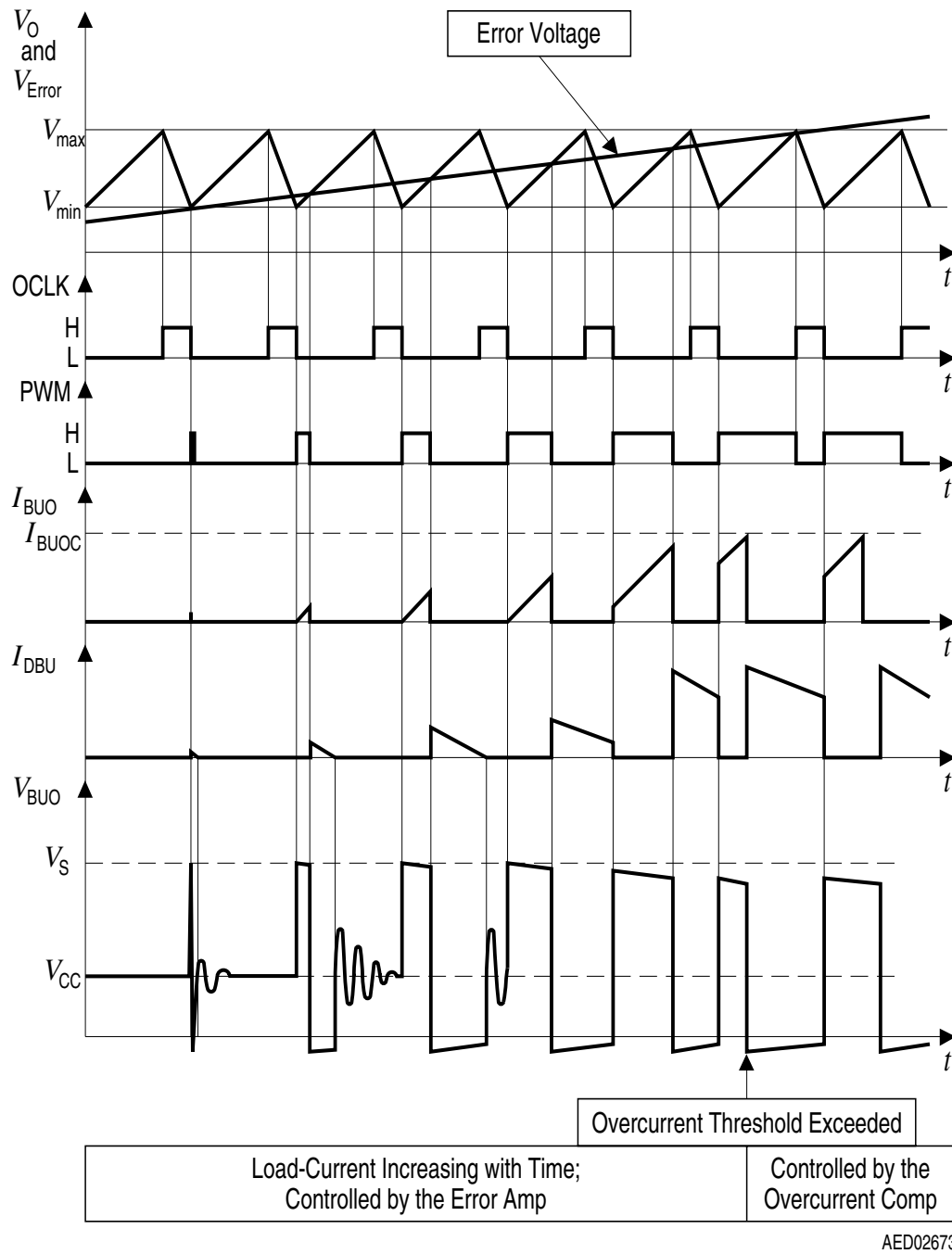


Figure 5 Most Important Waveforms of the Buck Converter Circuit

t

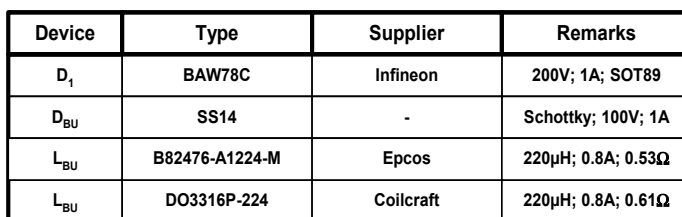
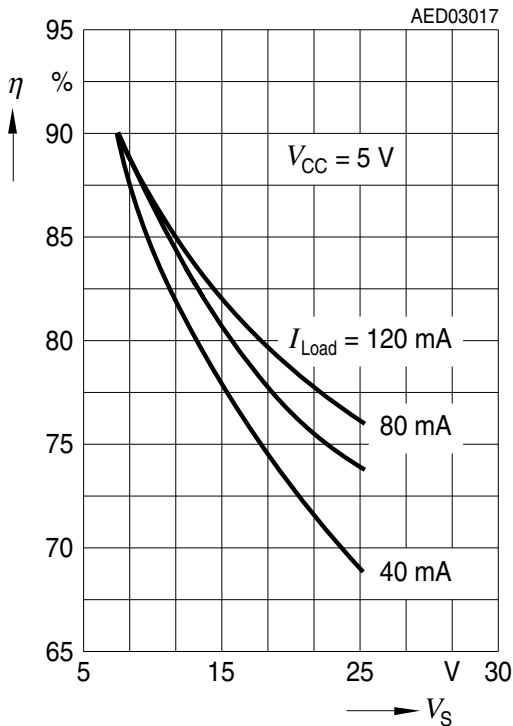


Figure 6 Application Circuit

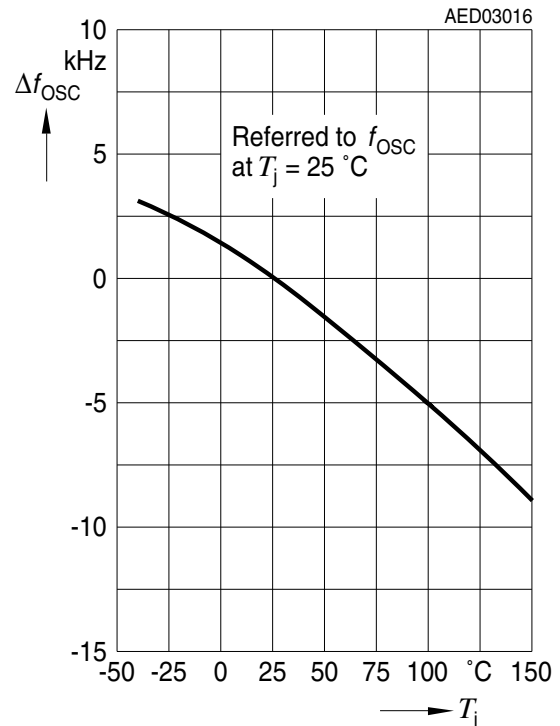
4 Diagrams: Oscillator and Boost/Buck-Converter Performance

In the following the behaviour of the Boost/Buck-converter and the oscillator is shown.

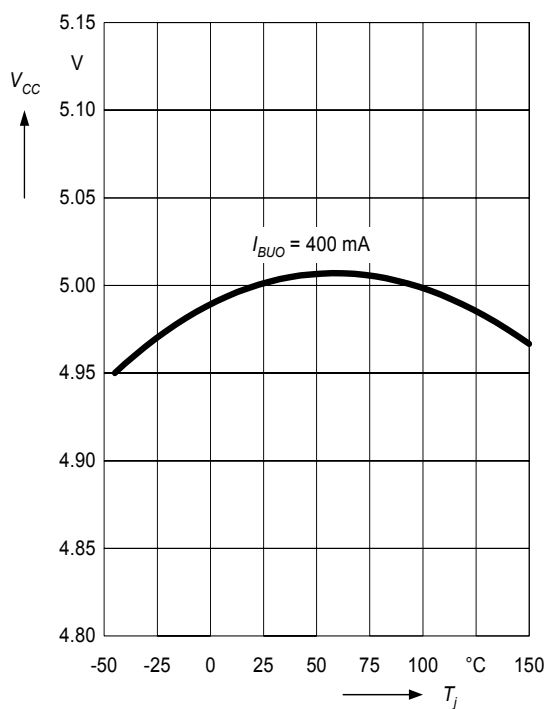
Efficiency Buck vs. Boost Voltage



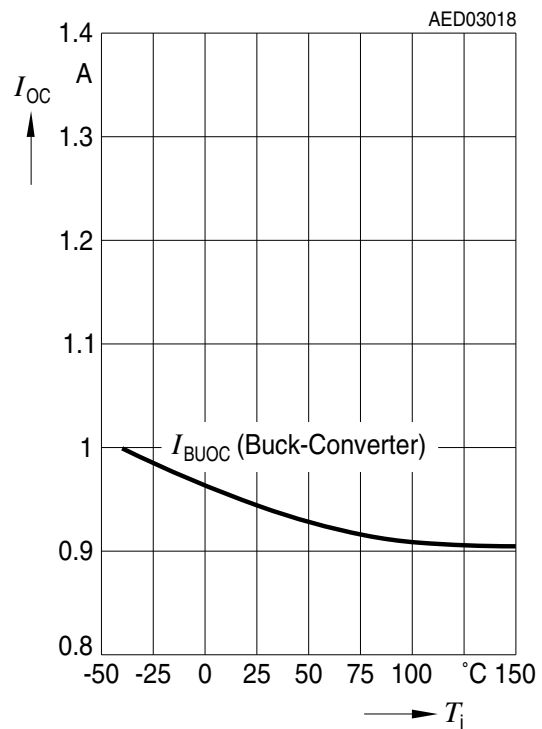
Oscillator Frequency Deviation vs. Junction Temperature



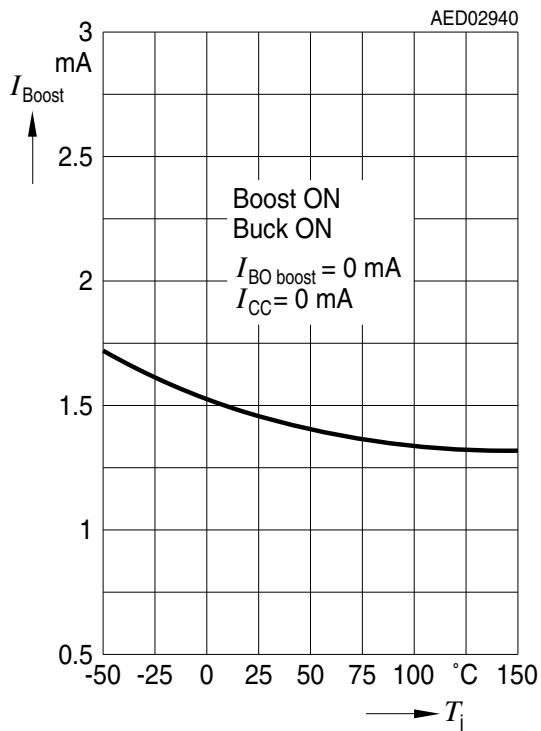
Feedback Voltage vs. Junction Temperature



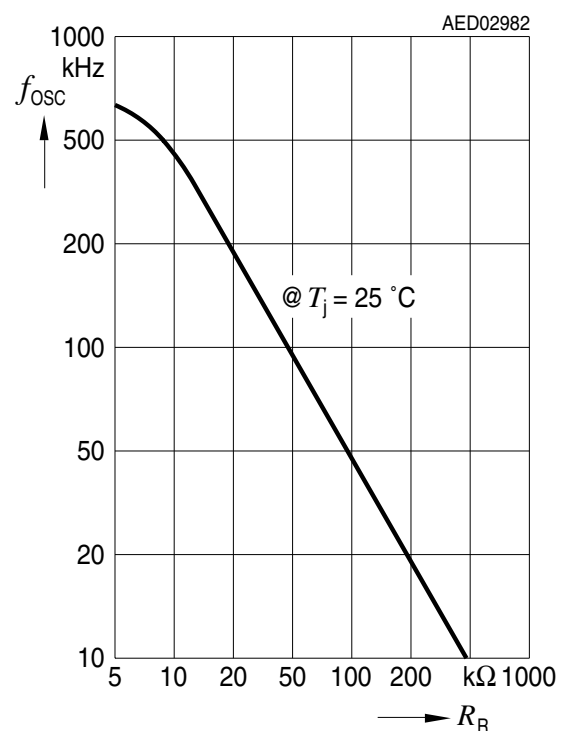
Buck Overcurrent Threshold vs. Junction Temperature



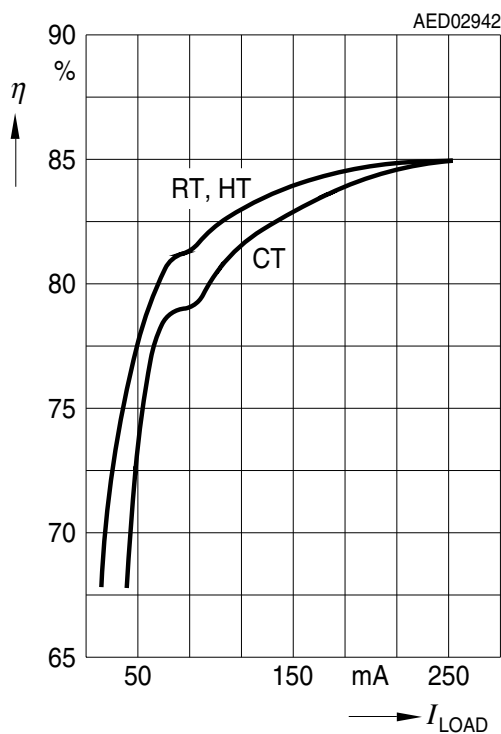
Current Consumption vs. Junction Temperature



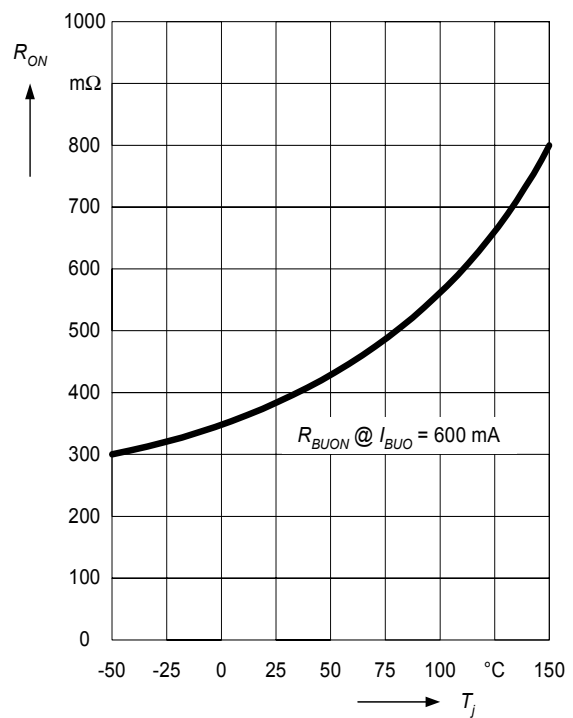
Oscillator Frequency vs. Resistor between R and GNDr



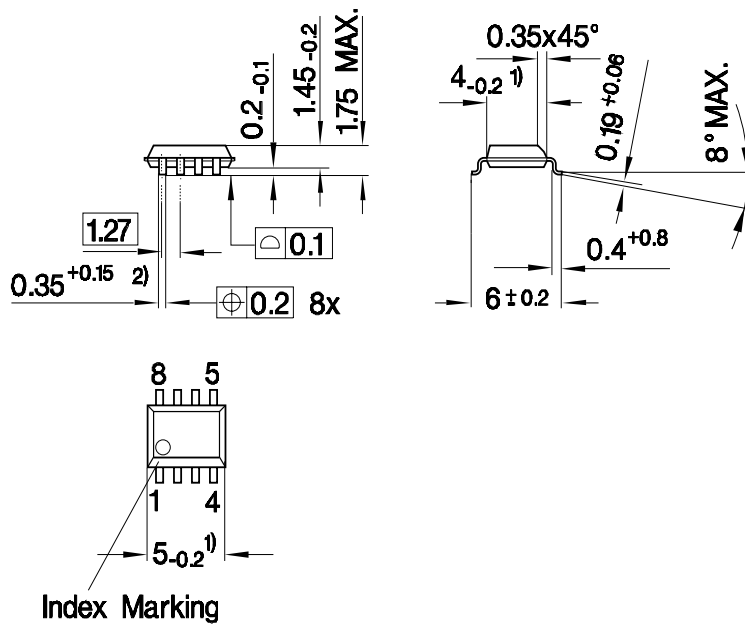
Efficiency Buck vs. Load



Buck ON Resistance vs. Junction Temperature



5 Package Outlines



- 1) Does not include plastic or metal protrusion of 0.15 max. per side
- 2) Lead width can be 0.61 max. in dambar area

**Published by Infineon Technologies AG i. Gr.,
Bereichs Kommunikation, St.-Martin-Strasse 53
D-81541 München**

**© Infineon Technologies AG1999
All Rights Reserved.**

Attention please!

The information herein is given to describe certain components and shall not be considered as warranted characteristics.

Terms of delivery and rights to technical change reserved.

We hereby disclaim any and all warranties, including but not limited to warranties of non-infringement, regarding circuits, descriptions and charts stated herein.

Infineon Technologies is an approved CECC manufacturer.

Information

For further information on technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies Office in Germany or our Infineon Technologies Representatives worldwide (see address list).

Warnings

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

Infineon Technologies Components may only be used in life-support devices or systems 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 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.