



SANYO Semiconductors

DATA SHEET

LV5655VB — Bi-CMOS LSI 3-channel Switching Regulator Controller

Overview

The LV5655VB is a 3-channel switching regulator controller.

Features

- Low-voltage (3V) operation
- Reference voltage precision : $\pm 1\%$
- Standby circuit (CTL : Controls operation of all channels)
- Synchronous rectification: channel 1 and channel 2 (selected by SYN voltage)
- Independent soft start function for each channel

Specifications

Maximum Ratings at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	$V_{CC\ max}$		-0.3 to 16	V
Allowable power dissipation	$P_d\ max$	Mounted on a specified board*	0.72	W
Operating temperature	T_{opr}		-30 to +85	$^\circ\text{C}$
Storage temperature	T_{stg}		-55 to +125	$^\circ\text{C}$

* Specified board: 114.3mm \times 76.1mm \times 1.6mm, glass epoxy board.

Recommended Operating Conditions at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V_{CC}		3 to 15	V
Supply voltage	V_{BIAS}		3 to 15	V
Oscillation frequency	f_{OSC}		0.2 to 1.3	MHz

■ Any and all SANYO Semiconductor Co.,Ltd. products described or contained herein are, with regard to "standard application", intended for the use as general electronics equipment (home appliances, AV equipment, communication device, office equipment, industrial equipment etc.). The products mentioned herein shall not be intended for use for any "special application" (medical equipment whose purpose is to sustain life, aerospace instrument, nuclear control device, burning appliances, transportation machine, traffic signal system, safety equipment etc.) that shall require extremely high level of reliability and can directly threaten human lives in case of failure or malfunction of the product or may cause harm to human bodies, nor shall they grant any guarantee thereof. If you should intend to use our products for applications outside the standard applications of our customer who is considering such use and/or outside the scope of our intended standard applications, please consult with us prior to the intended use. If there is no consultation or inquiry before the intended use, our customer shall be solely responsible for the use.

■ Specifications of any and all SANYO Semiconductor Co.,Ltd. products described or contained herein stipulate the performance, characteristics, and functions of the described products in the independent state, and are not guarantees of the performance, characteristics, and functions of the described products as mounted in the customer's products or equipment. To verify symptoms and states that cannot be evaluated in an independent device, the customer should always evaluate and test devices mounted in the customer's products or equipment.

LV5655VB

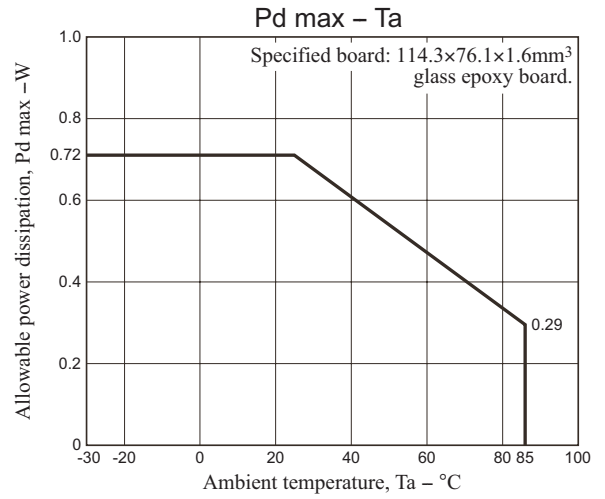
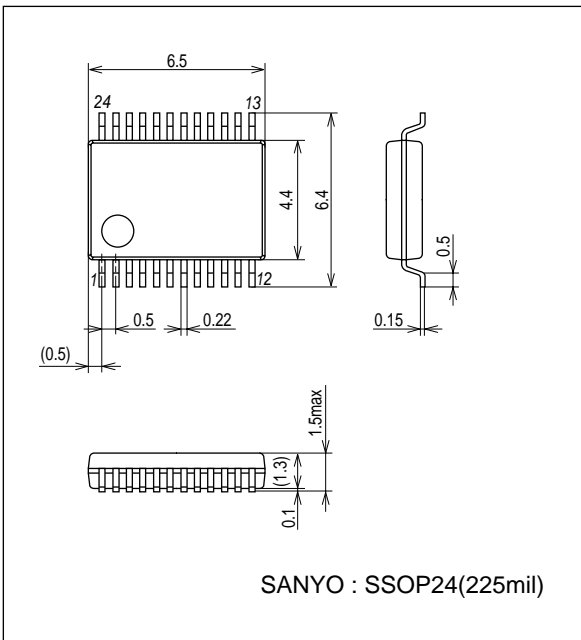
Electrical Characteristics at $T_a = 25^\circ\text{C}$, $V_{CC} = V_{BIAS} = 3.6\text{V}$, $SCP = 0\text{V}$

Parameter		Symbol	Conditions	Ratings			Unit
				min	typ	max	
Error amplifier 1							
IN ⁺ pin internal bias voltage		VB	Value added to the error amplifier offset at the error amplifier + side voltage	0.504	0.51	0.516	V
Output low voltage	ch1 to ch3	V _{LOW FB}	IN ⁻ = 2.0V, IFB = 20 μ A			0.2	V
Output high voltage	ch1 to ch3	V _{HI FB}	IN ⁻ = 0V, IFB1 = -20 μ A	2.0			V
Protection circuit							
Threshold voltage		V _{SCP}		1.1	1.25	1.4	V
SCP pin current		I _{SCP}			4		μ A
Software start block							
Soft start current	ch1 to ch3	I _{SF}	CSOFT* = 0V	3.2	4	4.8	μ A
Soft start resistance	ch1 to ch3	R _{SF}		160	200	240	k Ω
Fixed duty							
Maximum on duty 1	ch1	Duty MAX 1	IN ⁻ = 0V	100			%
Maximum on duty 2	ch2	Duty MAX 2	IN ⁻ = 0V	100			%
Maximum on duty 3	ch3	Duty MAX 3	IN ⁻ = 0V	80	85	90	%
Output block							
OUT pin high side on resistance		R _{OUT SOUR}	I _O = -10mA		28	50	Ω
OUT pin low side on resistance		R _{OUT SINK}	I _O = 10mA		18	35	Ω
Triangle wave oscillator block							
Current setting pin voltage		VT RT	RT = 20k Ω		0.56		V
Oscillation frequency		f _{OSC}	RT = 20k Ω	460	600	730	kHz
Reference voltage block							
Reference voltage		VREF			1.240		V
Line regulation		V _{LN REF}	V _{CC} = 3V to 15V			10	mV
SYN circuit							
On state voltage		V _{ON SYN}		2.0			V
OFF state voltage		V _{OFF SYN}				0.6	V
Pin input current		I _{IN SYN}	SYN* = 2V			60	μ A
Control circuit							
On state voltage		V _{ON CTL}		2.0			V
OFF state voltage		V _{OFF CTL}				0.6	V
Pin input current		I _{IN STBY}	CTL = 2V			60	μ A
All circuits							
V _{CC} current consumption		I _{CC}	IN1 ⁻ to IN3 ⁻ = 1V		4.5	6	mA
Standby mode current consumption		I _{OFF}	CTL = 0V, I _{OFF} = I _{CC} + I _{BIAS}			1	μ A

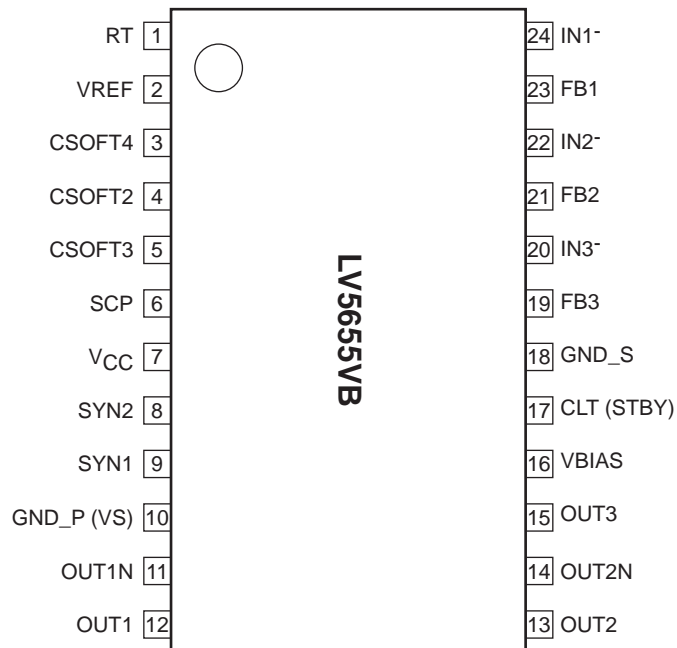
LV5655VB

Package Dimensions

unit : mm (typ)
3287



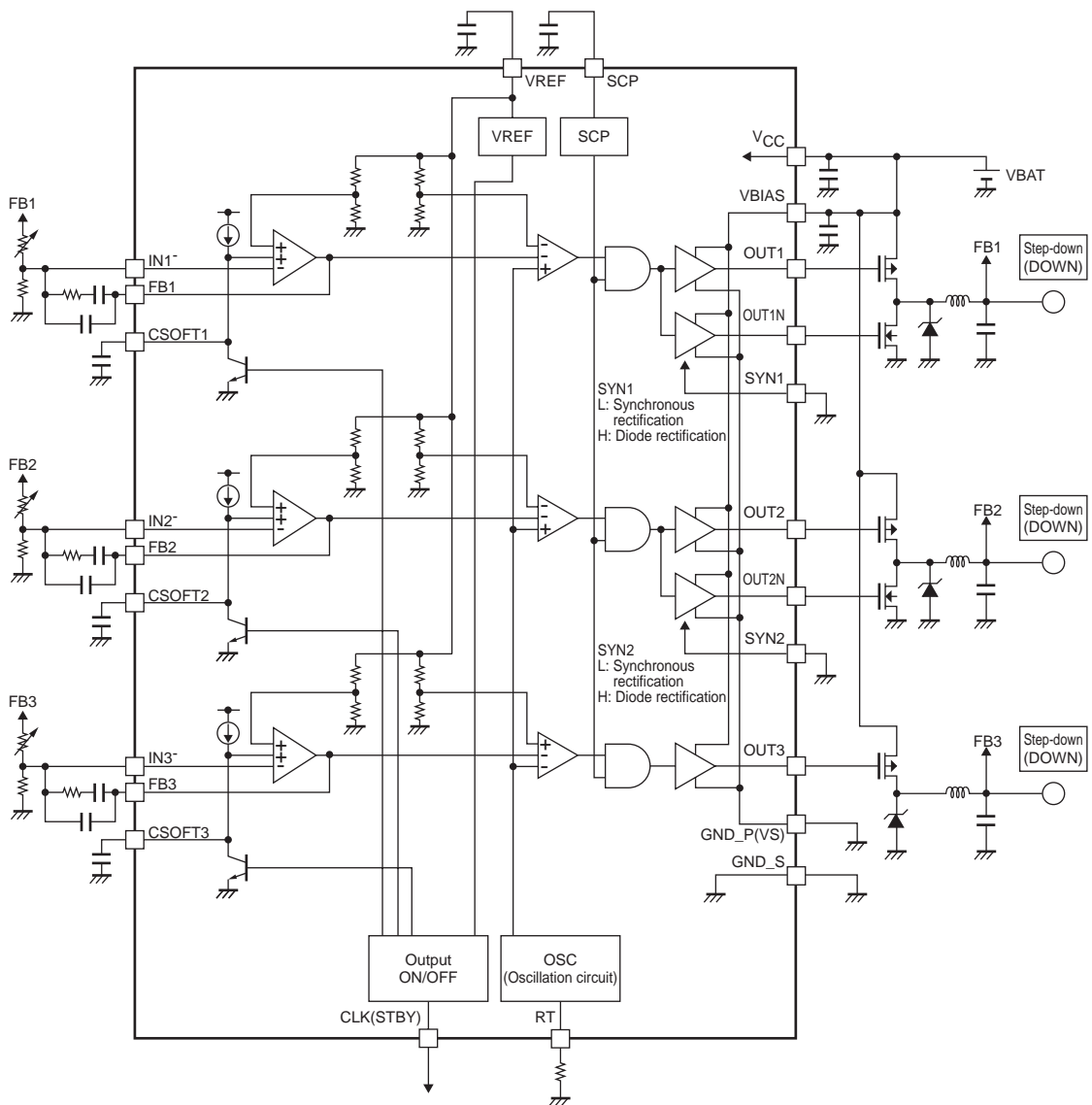
Pin Assignment



Top view

LV5655VB

Block Diagram and Sample Application Circuit



LV5655VB

Pin Function

Block	Pin No.	Pin Name	Functions
ch1 (Step-down)	24	IN1 ⁻	Error amplifier, - (Inverting) input.
	23	FB1	Error amplifier output.
	3	CSOFT1	Soft start setting capacitor connection. Connect to GND through a capacitor.
	12	OUT1	Output. External transistor P-channel gate connect.
	11	OUT1N	Output. External transistor N-channel gate connection.
	9	SYN1	Synchronous rectification/diode rectification switching, L : synchronous rectification H : diode rectification.
ch2 (Step-down)	22	IN2 ⁻	Error amplifier, - (Inverting) input.
	21	FB2	Error amplifier output.
	4	CSOFT2	Soft start setting capacitor connection. Connect to GND through a capacitor.
	13	OUT2	Output. External transistor P-channel gate connect.
	14	OUT2N	Output. External transistor N-channel gate connection.
	8	SYN2	Synchronous rectification/diode rectification switching, L : synchronous rectification H : diode rectification.
ch3 (Step-down)	20	IN3 ⁻	Error amplifier, - (Inverting) input.
	19	FB3	Error amplifier output.
	5	CSOFT3	Soft start setting capacitor connection. Connect to GND through a capacitor.
	15	OUT3	Output. External transistor P-channel gate connect.
POWER	7	V _{CC}	Power supply input (signal system).
	16	VBIAS	Power supply input (pre-output stage).
	18	GND_S	Ground (signal system).
	10	GND_P (VS)	Ground (pre-output stage).
CONTROL	2	VREF	Reference voltage output. Connect to GND through a capacitor.
	17	CTL (STBY)	Output control, H : all outputs ON, L : all outputs off.
	6	SCP	Connection pin for the delay time setting capacitor of short-circuit detection circuit (connect to GND).
OSC	1	RT	Oscillation frequency setting resistor connection (connect to GND).

LV5655VB

Equivalent Circuits

Pin No.	Pin Name	Description	Equivalent Circuit
17	CTL	CTL: Controls operation of all circuits. Controls operation of all channels. High : ON Low : OFF	
24 22 20	IN1 ⁻ IN2 ⁻ IN3 ⁻	Error amplifier inverting input. The regulator output is divided by a resistor and connected to IN ⁻	
23 21 19	FB1 FB2 FB3	Error amplifier output. These pins, in combination with IN ⁻ , configure the error amplifier filters	
3 4 5	CSoft1 CSoft2 CSoft3	Soft start. Connect to GND via a capacitor to set the soft start time.	
12 13 15	OUT1 OUT2 OUT3	Output. Connect external PchFET.	
11 14	OUT1N OUT2N	Output. Connect external NchFET.	

Continued on next page.

LV5655VB

Continued from preceding page.

Pin No.	Pin Name	Description	Equivalent Circuit
1	RT	Sets the oscillation frequency. Connect to GND through a resistor. Constant voltage output (0.56V typ.)	
6	SCP	Connect to GND via a capacitor to set the short circuit detection circuit delay time.	
9 8	SYN1 SYN2	Channel 1 and channel 2 synchronous/diode rectification switching. Low : Synchronous rectification High : Diode rectification Switching operates independently for the corresponding channel.	<p>SYN* L : Synchronous rectification H : Diode rectification</p>
23	VREF	Internal constant voltage circuit output. Connect a stabilizing capacitor.	
7	V _{CC}	Signal system power supply	V _{CC} ○ ———
16	VBIAS	Power system power supply (Output stage)	VBIAS ○ ———
18	GND _S	Signal system GND	GND _S ○ ———
10	GND _P (VS1)	Output stage GND (pre-stage)	GND _P (VS) ○ ———

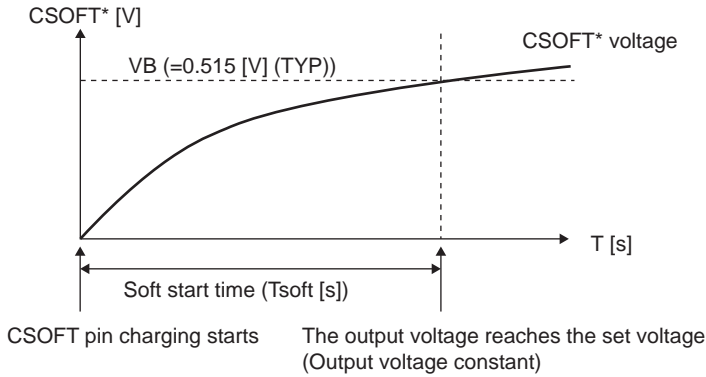
Notes

(1) Soft start time setting method

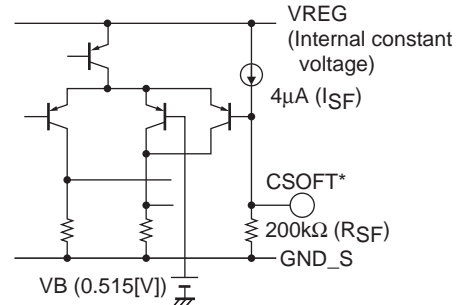
The soft start time is set with the capacitor connected between CSOFT* and GND_S.

This IC has an independent soft start function for each channel, so a capacitor must be connected for each CSOFT to set the soft start time.

(Description of soft start operation)



(Outline of soft start pin)



$$T_{SOFT} = C_{SOFT} \times R_{SF} \ln \left(\frac{V_B}{R_{SF} \times I_{SF}} \right)$$

$$= 0.206 \times 10^6 \times C_{SOFT} \text{ [s]}$$

(2) Setting the oscillation frequency

The oscillation frequency is set by the resistor (RT resistor) connected to the RT pin.

The RT pin is a constant voltage (0.56 [V] typ.) output, and the oscillation frequency is determined by the current run through the RT resistor and charging/discharging of the internal capacitor.

$$f_{OSC} \text{ [kHz]} = \frac{12 \times 1E3}{RT \text{ [k}\Omega\text{]}} \quad (\text{Reference calculation formula})$$

The internal oscillation frequency deviates from the calculated value due to overshoot, undershoot and other factors, so the frequency should be confirmed in an actual set.

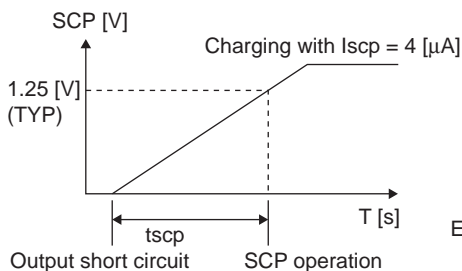
(3) SCP (short circuit protection) function

• Description of operation

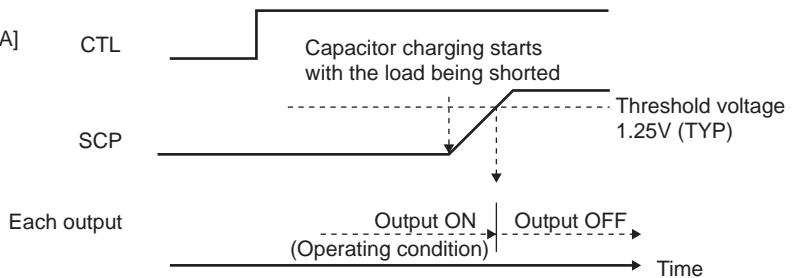
When any one of FB1 to FB4 goes High due to the load being shorted or other reason, charging to the SCP pin starts. If output does not recover during the set time T_{scp} and SCP pin voltage exceeds the threshold voltage, the protective circuit (SCP) operates and all channel outputs are turned OFF. All outputs are latched off by the protection circuit (SCP). This latched state (output OFF) is canceled by setting the CTL pin Low or by turning the power supply OFF. When not using the protection function (SCP), the SCP pin must be shorted to GND_S with a line that is as short as possible.

The SCP operation time is set by the capacitor connected to the SCP pin.

(SCP charging operation)



(SCP function)



- SANYO Semiconductor Co.,Ltd. assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all SANYO Semiconductor Co.,Ltd. products described or contained herein.
- SANYO Semiconductor Co.,Ltd. strives to supply high-quality high-reliability products, however, any and all semiconductor products fail or malfunction with some probability. It is possible that these probabilistic failures or malfunction could give rise to accidents or events that could endanger human lives, trouble that could give rise to smoke or fire, or accidents that could cause damage to other property. When designing equipment, adopt safety measures so that these kinds of accidents or events cannot occur. Such measures include but are not limited to protective circuits and error prevention circuits for safe design, redundant design, and structural design.
- In the event that any or all SANYO Semiconductor Co.,Ltd. products described or contained herein are controlled under any of applicable local export control laws and regulations, such products may require the export license from the authorities concerned in accordance with the above law.
- No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or any information storage or retrieval system, or otherwise, without the prior written consent of SANYO Semiconductor Co.,Ltd.
- Any and all information described or contained herein are subject to change without notice due to product/technology improvement, etc. When designing equipment, refer to the "Delivery Specification" for the SANYO Semiconductor Co.,Ltd. product that you intend to use.
- Information (including circuit diagrams and circuit parameters) herein is for example only; it is not guaranteed for volume production.
- Upon using the technical information or products described herein, neither warranty nor license shall be granted with regard to intellectual property rights or any other rights of SANYO Semiconductor Co.,Ltd. or any third party. SANYO Semiconductor Co.,Ltd. shall not be liable for any claim or suits with regard to a third party's intellectual property rights which has resulted from the use of the technical information and products mentioned above.

This catalog provides information as of April, 2009. Specifications and information herein are subject to change without notice.