Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!

Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832
Email & Skype: info@chipsmall.com Web: www.chipsmall.com
Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

Hi-performance Regulator IC Series for PCs

Nch FET Ultra LDOs for Desktop PCs

BD3523HFN, BD35230HFN, BD35231HFN

No.09030EBT01

●Description

The BD3523HFN, BD35230HFN, BD35231HFN ultra low-dropout linear chipset regulator operates from a very low input supply, and offers ideal performance in low input voltage to low output voltage applications. It incorporates a built-in N-MOSFET power transistor to minimize the input-to-output voltage differential to the ON resistance (R_{ON}=150mΩ) level. By lowering the dropout voltage in this way, the regulator realizes high current output (Iomax=2.0A) with reduced conversion loss, and thereby obviates the switching regulator and its power transistor, choke coil, and rectifier diode. Thus, the BD3523HFN, BD35230HFN, BD35231HFN designed to enable significant package profile downsizing and cost reduction. In BD3523HFN, an external resistor allows the entire range of output voltage configurations between 0.65 and 2.7V, while the NRCS (soft start) function enables a controlled output voltage ramp-up, which can be programmed to whatever power supply sequence is required.

●Features

1) Internal high-precision reference voltage circuit(0.65V±1%)
2) Internal high-precision output voltage circuit <BD35230HFN/BD35231HFN>
3) Built-in VCC undervoltage lockout circuit (VCC=3.80V)
4) NRCS (soft start) function reduces the magnitude of in-rush current
5) Internal Nch MOSFET driver offers low ON resistance (100mΩ typ)
6) Built-in short circuit protection (SCP)
7) Built-in current limit circuit (2.0A min)
8) Built-in thermal shutdown (TSD) circuit
9) Variable output (0.65～2.7V) <BD3523HFN>
10) High-power package HSON8 : 2.9mm×3.0mm×0.6mm
11) Tracking function

●Applications

Notebook computers, Desktop computers, LCD-TV, DVD, Digital appliances

●Line-up

Maximum Output Voltage	Package	Product name
Adjustable (0.65～2.7V)	HSON8	BD3523HFN
1.0V (fixed)		BD35230HFN
1.2V (fixed)		BD35231HFN

●Absolute maximum ratings

Parameter	Symbol	Limit			Unit
		BD3523HFN	BD35230HFN	BD35231HFN	
Input Voltage 1	V_{CC}	+6.0 *1			V
Input Voltage 2	V_{IN}	+6.0 *1			V
Maximum Output Current	I_O	2*1			A
Enable Input Voltage	V_{EN}	-0.3～+6.0			V
Power Dissipation 1	Pd1	0.63 *2			W
Power Dissipation 2	Pd2	1.35 *3			W
Power Dissipation 3	Pd3	1.75*4			W
Operating Temperature Range	Topr	-10～+100			℃
Storage Temperature Range	Tstg	-55～+125			℃
Maximum Junction Temperature	Tjmax	+150			℃

*1 Should not exceed Pd.
*2 Reduced by 5.04mW/℃ for each increase in Ta≧25℃ (when mounted on a 70mm×70mm×1.6mm glass-epoxy board, 1-layer, copper foil area : less than 0.2%)
*3 Reduced by 10.8mW/℃ for each increase in Ta≧25℃ (when mounted on a 70mm×70mm×1.6mm glass-epoxy board, 1-layer, copper foil area : less than 7.0%)
*4 Reduced by 14.0mW/℃ for each increase in Ta≧25℃ (when mounted on a 70mm×70mm×1.6mm glass-epoxy board, 1-layer, copper foil area : less than 65.0%)

●Operating Voltage(Ta=25℃)

Parameter	Symbol	BD3522EFV		BD35221EFV		BD35222EFV		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
Input Voltage 1	V_{CC}	4.3	5.5	4.3	5.5	4.3	5.5	V
Input Voltage 2	V_{IN}	0.95	VCC-1 *5	1.3	VCC-1 *5	1.5	VCC-1 *5	V
Output Voltage Setting Range	I_O	VFB	2.7	1.0 (fixed)		1.2 (fixed)		V
Enable Input Voltage	V_{EN}	-0.3	5.5	-0.3	5.5	-0.3	5.5	V
NRCS Capacity	CNRCS	0.001	1	0.001	1	0.001	1	μF

*5 VCC and VIN do not have to be implemented in the order listed.
*This product is not designed for use in radioactive environments.

●Electrical Characteristics

BD3523HFN (Unless otherwise specified, Ta=25℃, V_{CC}=5V, V_{EN}=3V, V_{IN}=1.7V, R1=3.9kΩ, R2=3.3kΩ)

Parameter	Symbol	Limit			Unit	Condition
		Min.	Typ.	Max.		
Bias Current	I_{CC}	-	0.7	1.2	mA	
VCC Shutdown Mode Current	I_{ST}	-	0	10	μA	V_{EN}=0V
Output Voltage	I_O	2.0	-	-	A	
Feedback Voltage 1	$V_{FB}1$	0.643	0.650	0.657	V	
Feedback Voltage 2	$V_{FB}2$	0.637	0.650	0.663	V	Tj=-10 to 100℃
Line Regulation 1	Reg.l1	-	0.1	0.5	%/V	V_{CC}=4.3V to 5.5V
Line Regulation 2	Reg.l2	-	0.1	0.5	%/V	V_{IN}=1.2V to 3.3V
Load Regulation	Reg.L	-	0.5	10	mV	I_O=0 to 2A
Output ON Resistance	R_{ON}	-	100	150	mΩ	I_O=2A,V_{IN}=1.2V, Tj=-10 to 100℃
Standby Discharge Current	I_{DEN}	1	-	-	mA	V_{EN}=0V, V_O=1V
[ENABLE]						
Enable Pin Input Voltage High	EN_{HIGH}	2	-	-	V	
Enable Pin Input Voltage Low	EN_{LOW}	0	-	0.8	V	
Enable Input Bias Current	I_{EN}	-	7	10	μA	V_{EN}=3V
[FEEDBACK]						
Feedback Pin Bias Current	I_{FB}	-100	0	100	nA	
[NRCS]						
NRCS Charge Current	I_{NRCS}	12	20	28	μA	
NRCS Standby Voltage	V_{STB}	-	0	50	mV	V_{EN}=0V
[UVLO]						
VCC Undervoltage Lockout Threshold Voltage	V_{CC}UVLO	3.5	3.8	4.1	V	V_{CC}:Sweep-up
VCC Undervoltage Lockout Hysteresis Voltage	V_{CC}hys	100	160	220	mV	V_{CC}:Sweep-down
V_{IN}Undervoltage Lockout Threshold Voltage	V_{IN}UVLO	0.55	0.65	0.75	V	V_{IN}:Sweep-up
[SCP]						
SCP Start up Voltage	V_{OSCP}	$V_O \times 0.3$	$V_O \times 0.4$	$V_O \times 0.5$	V	
SCP Threshold Voltage	T_{SCP}	45	90	200	μsec	

●Electrical Characteristics

BD35230HFN (Unless otherwise specified, Ta=25℃, V_{CC}=5V, V_{EN}=3V, V_{IN}=1.7V)

Parameter	Symbol	Limit			Unit	Condition
		Min.	Typ.	Max.		
Bias Current	I_{CC}	-	0.7	1.2	mA	
VCC Shutdown Mode Current	I_{ST}	-	0	10	μA	V_{EN}=0V
Output Voltage	I_O	2.0	-	-	A	
Feedback Voltage 1	V_{OS}1	0.990	1.000	1.010	V	
Feedback Voltage 2	V_{OS}2	0.980	1.000	1.020	V	Tj=-10 to 100℃
Line Regulation 1	Reg.l1	-	0.1	0.5	%/V	V_{CC}=4.3V to 5.5V
Line Regulation 2	Reg.l2	-	0.1	0.5	%/V	V_{IN}=1.3V to 3.3V
Load Regulation	Reg.L	-	0.5	10	mV	I_O=0 to 2A
Output ON Resistance	R_{ON}	-	100	150	mΩ	I_O=2A,V_{IN}=1.0V, Tj=-10 to 100℃
Standby Discharge Current	I_{DEN}	1	-	-	mA	V_{EN}=0V, V_O=1V
[ENABLE]						
Enable Pin Input Voltage High	EN_{HIGH}	2	-	-	V	
Enable Pin Input Voltage Low	EN_{LOW}	0	-	0.8	V	
Enable Input Bias Current	I_{EN}	-	7	10	μA	V_{EN}=3V
[NRCS]						
NRCS Charge Current	I_{NRCS}	12	20	28	μA	
NRCS Standby Voltage	V_{STB}	-	0	50	mV	V_{EN}=0V
[UVLO]						
VCC Undervoltage Lockout Threshold Voltage	V_{CC}UVLO	3.5	3.8	4.1	V	V_{CC}:Sweep-up
VCC Undervoltage Lockout Hysteresis Voltage	V_{CC}HYS	100	160	220	mV	V_{CC}:Sweep-down
V_{IN} Undervoltage Lockout Threshold Voltage	V_{IN}UVLO	0.60	0.70	0.80	V	V_{IN}:Sweep-up
[SCP]						
SCP Start up Voltage	V_{OSCP}	V_O×0.3	V_O×0.4	V_O×0.5	V	
SCP Threshold Voltage	T_{SCP}	45	90	200	μsec	

●Electrical Characteristics

BD35231HFN(Unless otherwise specified, Ta=25℃, V_{CC}=5V, V_{EN}=3V, V_{IN}=1.7V)

Parameter	Symbol	Limit			Unit	Condition
		Min.	Typ.	Max.		
Bias Current	I_{CC}	-	0.7	1.2	mA	
VCC Shutdown Mode Current	I_{ST}	-	0	10	μA	V_{EN}=0V
Output Voltage	I_O	2.0	-	-	A	
Feedback Voltage 1	V_{OS}1	1.188	1.200	1.212	V	
Feedback Voltage 2	V_{OS}2	1.176	1.200	1.224	V	Tj=-10 to 100℃
Line Regulation 1	Reg.l1	-	0.1	0.5	%/V	V_{CC}=4.3V to 5.5V
Line Regulation 2	Reg.l2	-	0.1	0.5	%/V	V_{IN}=1.5V to 3.3V
Load Regulation	Reg.L	-	0.5	10	mV	I_O=0 to 2A
Output ON Resistance	R_{ON}	-	100	150	mΩ	I_O=2A,V_{IN}=1.2V, Tj=-10 to 100℃
Standby Discharge Current	I_{DEN}	1	-	-	mA	V_{EN}=0V, V_O=1V
[ENABLE]						
Enable PinInput Voltage High	EN_{HIGH}	2	-	-	V	
Enable PinInput Voltage Low	EN_{LOW}	0	-	0.8	V	
Enable Input Bias Current	I_{EN}	-	7	10	μA	V_{EN}=3V
[NRCS]						
NRCS Charge Current	I_{NRCS}	12	20	28	μA	
NRCS Standby Voltage	V_{STB}	-	0	50	mV	V_{EN}=0V
[UVLO]						
VCC Undervoltage Lockout Threshold Voltage	V_{CC}UVLO	3.5	3.8	4.1	V	V_{CC}:Sweep-up
VCC Undervoltage Lockout Hysteresis Voltage	V_{CC}HYS	100	160	220	mV	V_{CC}:Sweep-down
V_{IN} Undervoltage Lockout Threshold Voltage	V_{IN}UVLO	0.72	0.84	0.96	V	V_{IN}:Sweep-up
[SCP]						
SCP Start up Voltage	V_{OSCP}	V_O×0.3	V_O×0.4	V_O×0.5	V	
SCP Threshold Voltage	T_{SCP}	45	90	200	μsec	

●Reference Data
BD35231HFN

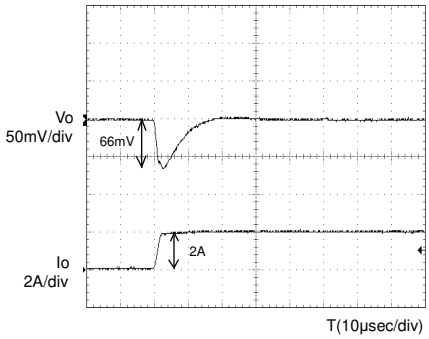


Fig.1 Transient Response
(0A→2A)
Co=100µF
Cfb=1000pF

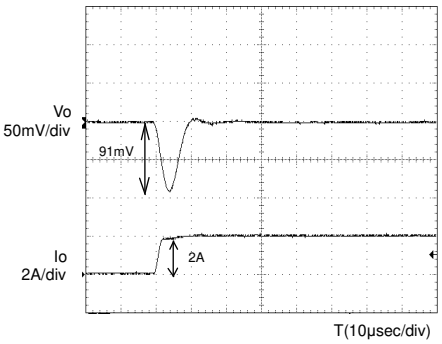


Fig.2 Transient Response
(0A→2A)
Co=47µF
Cfb=1000pF

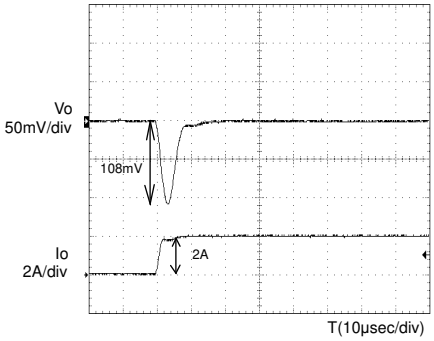


Fig.3 Transient Response
(0A→2A)
Co=22µF
Cfb=1000pF

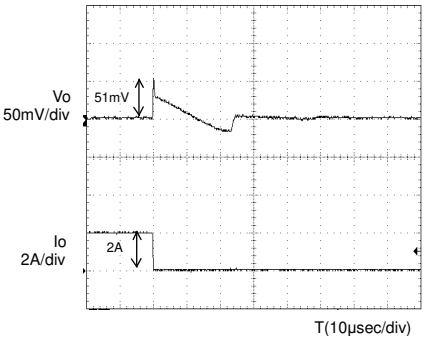


Fig.4 Transient Response
(2A→0A)
Co=100µF
Cfb=1000pF

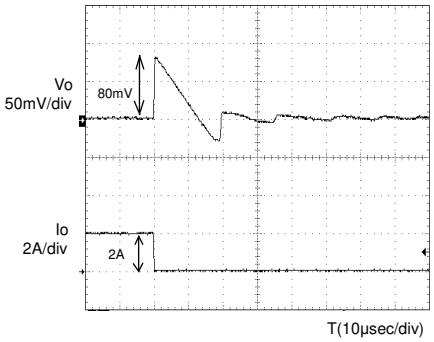


Fig.5 Transient Response
(2A→0A)
Co=47
Cfb=1000pF

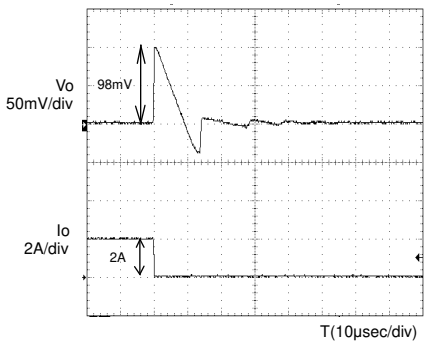


Fig.6 Transient Response
(2A→0A)
Co=22
Cfb=1000pF

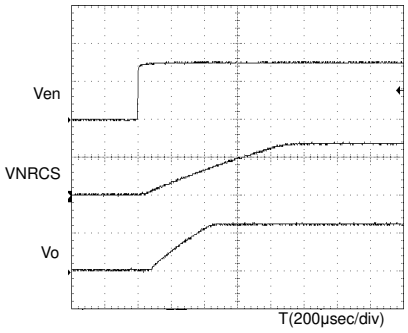


Fig.7 Waveform at output start

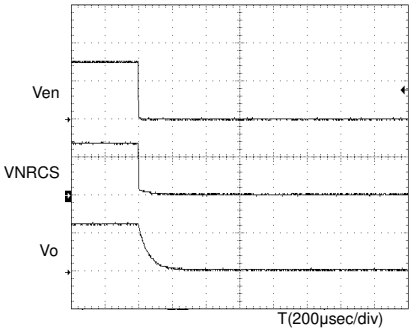


Fig.8 Waveform at output OFF

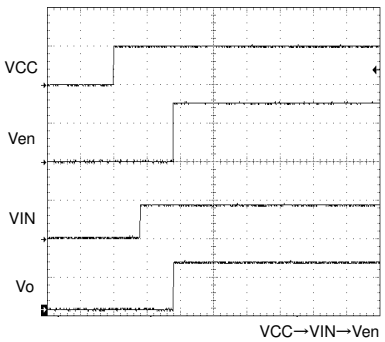


Fig.9 Input sequence

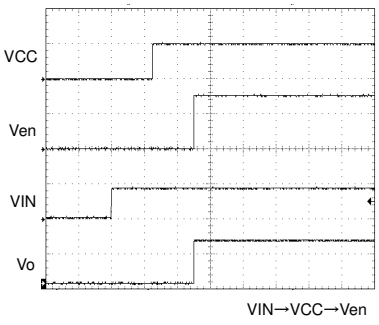


Fig.10 Input sequence

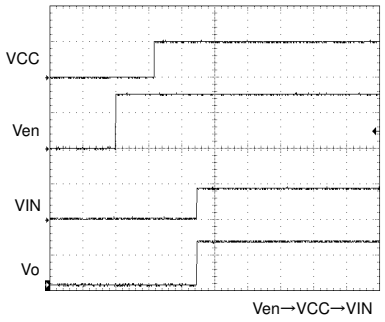


Fig.11 Input sequence

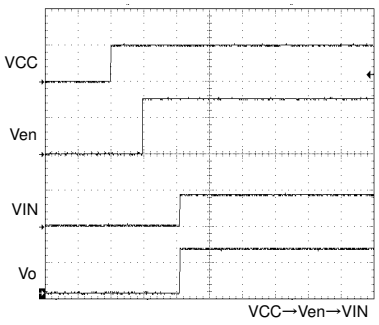


Fig.12 Input sequence

●Reference Data

BD35231HFN

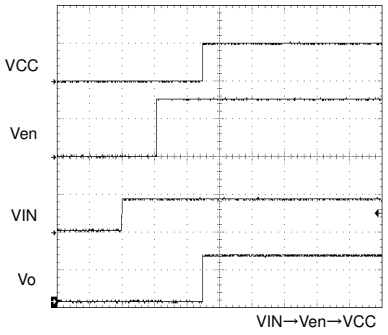


Fig.13 Input sequence

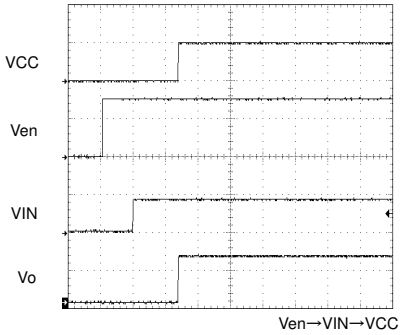


Fig.14 Input sequence

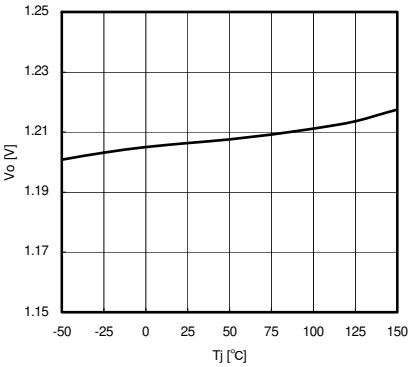


Fig.15 Tj-Vo (Io=0mA)

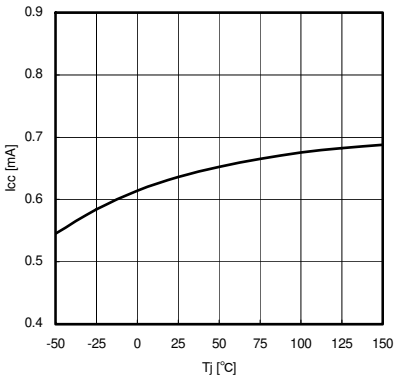


Fig.16 Tj-ICC

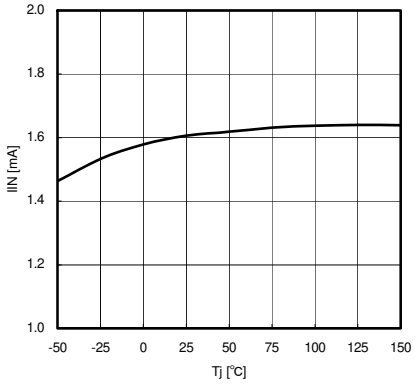


Fig.17 Tj-IIN

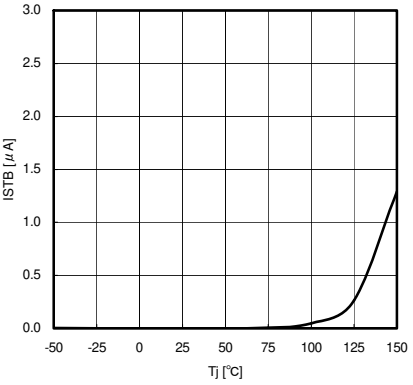


Fig.18 Tj-ICCSTB

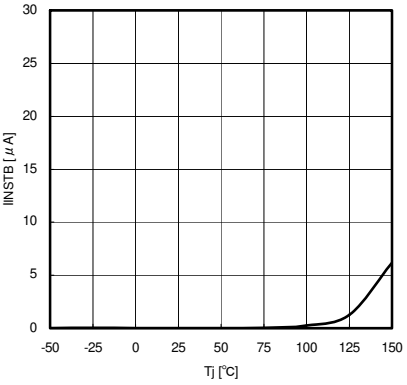


Fig.19 Tj-IINSTB

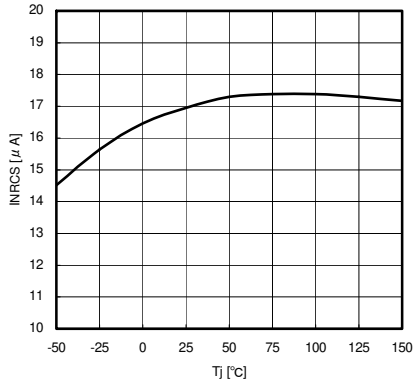


Fig.20 Tj-NRSC

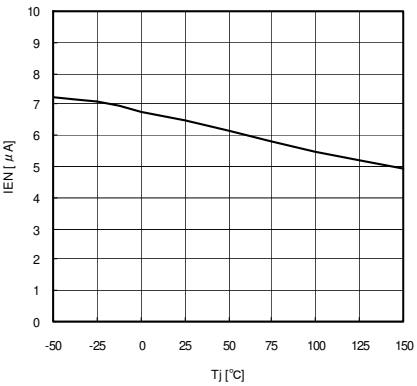


Fig.21 Tj-IEN

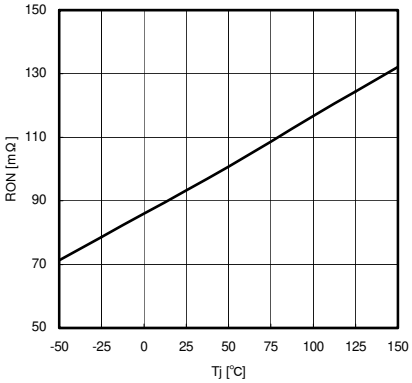


Fig.22 Tj-RON
(Vcc=5V/Vo=1.2V)

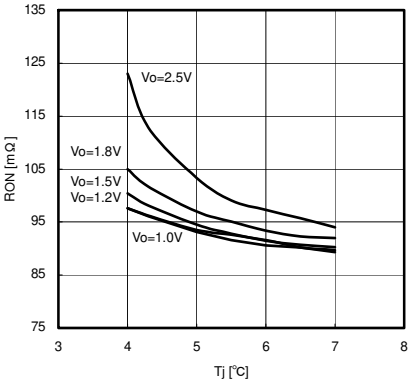
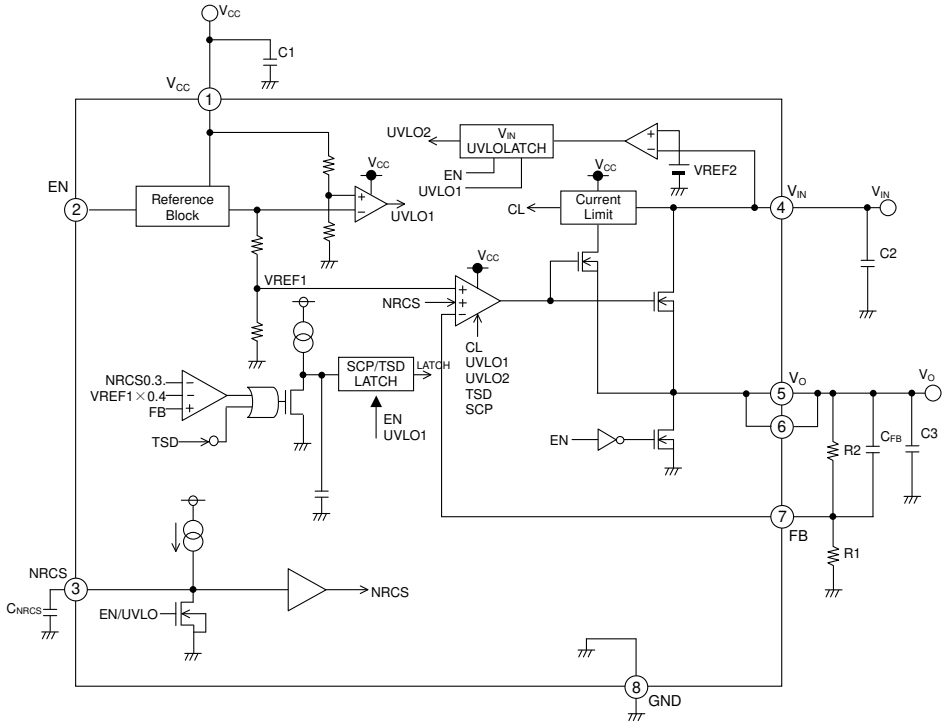


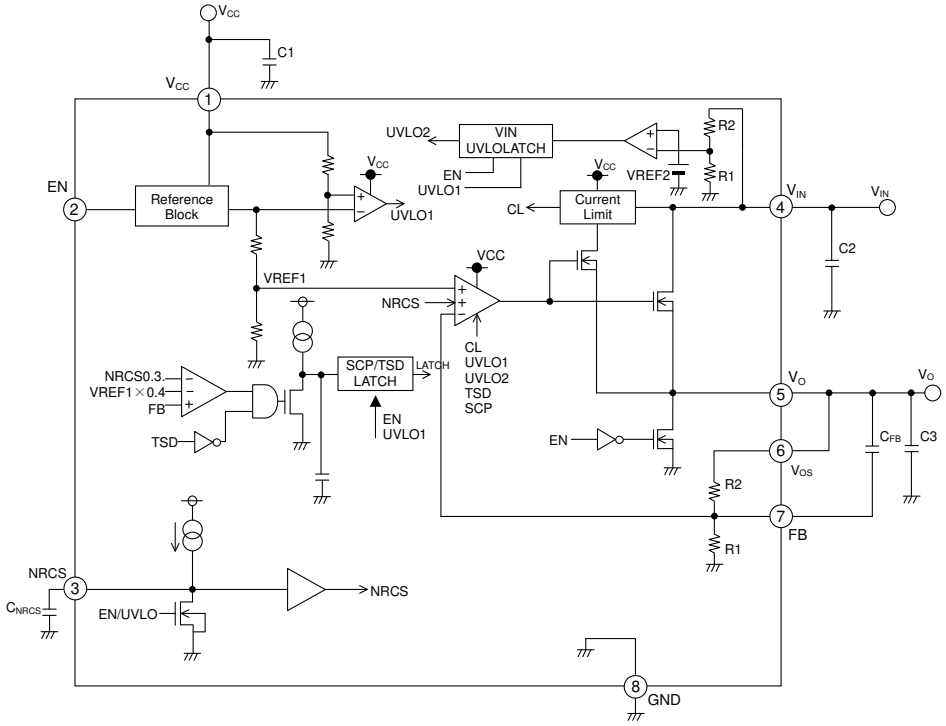
Fig.23 Vcc- RON

●Block Diagram

BD3523HFN

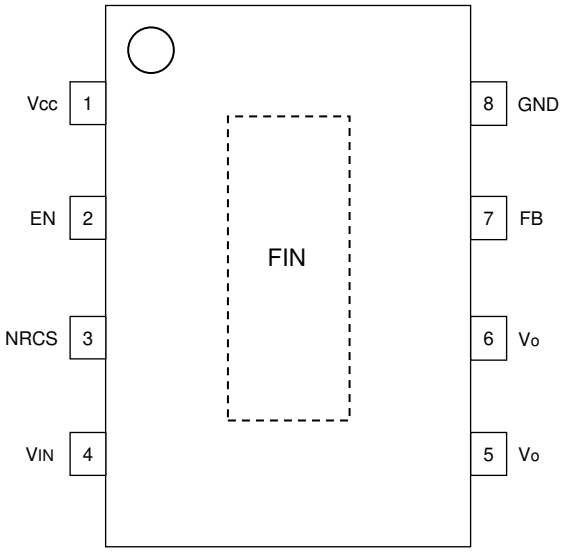


BD35230HFN/BD35231HFN

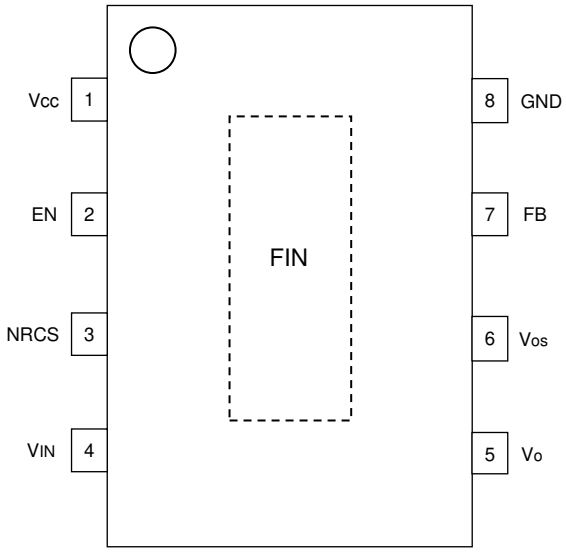


●Pin Layout

BD3523HFN



BD35230HFN/BD35231HFN



●Pin Function Table

BD3523HFN

PIN No.	PIN name	PIN Function
1	VCC	Power Supply Pin
2	EN	Enable Input Pin
3	NRCS	In-rush Current Protection (NRCS) Capacitor Connection Pin
4	VIN	Input Voltage Pin
5	VO	Output Voltage Pin
6	VO	Output Voltage Pin
7	FB	Reference Voltage Feedback Pin
8	GND	Ground Pin
-	FIN	Connected to heatsink and GND

BD35230HFN/BD35231HFN

PIN No.	PIN name	PIN Function
1	VCC	Power Supply Pin
2	EN	Enable Input Pin
3	NRCS	In-rush Current Protection (NRCS) Capacitor Connection Pin
4	VIN	Input Voltage Pin
5	VO	Output Voltage Pin
6	VOS	Output Voltage Control Pin
7	FB	Reference Voltage Feedback Pin
8	GND	Ground Pin
-	FIN	Connected to heatsink and GND

●Operation of Each Block

・AMP

This is an error amp that compares the reference voltage (0.65V) with VO to drive the output Nch FET (Ron=150mΩ). Frequency optimization helps to realize rapid transient response, and to support the use of ceramic capacitors on the output capacitors. AMP input voltage ranges from GND to 2.7V, while the AMP output ranges from GND to VCC. When EN is OFF, or when UVLO is active, output goes LOW and the output of the NchFET switches OFF.

・EN

The EN block controls the regulator's ON/OFF state via the EN logic input pin. In the OFF position, circuit voltage is maintained at 0μA, thus minimizing current consumption at standby. The FET is switched ON to enable discharge of the NRCS pin VO, thereby draining the excess charge and preventing the IC on the load side from malfunctioning. Since no electrical connection is required (e.g. between the VCC pin and the ESD prevention diode), module operation is independent of the input sequence.

・VCCUVLO

To prevent malfunctions that can occur during a momentary decrease in VCC, the UVLO circuit switches the output OFF, and (like the EN block) discharges NRCS and VO. Once the UVLO threshold voltage (TYP3.80V) is reached, the power-on reset is triggered and output continues.

・VINUVLO

When VD voltage exceeds the threshold voltage, VDUVLO becomes active. Once active, the status of output voltage remains ON even if VD voltage drops. (When VIN voltage drops, SCP engages and output switches OFF.)
Unlike EN and VCC, it is effective at output startup. VDUVLO can be restored either by reconnecting the EN pin or VCC pin.

・CURRENT LIMIT

When output is ON, the current limit function monitors the internal IC output current against the parameter value. When current exceeds this level, the current limit module lowers the output current to protect the load IC. When the overcurrent state is eliminated, output voltage is restored to the parameter value. However, when output voltage falls to or below the SCP startup voltage, the SCP function becomes active and the output switches OFF.

・NRCS (Non Rush Current on Start-up)

The soft start function enabled by connecting an external capacitor between the NRCS pin and ground. Output ramp-up can be set for any period up to the time the NRCS pin reaches VFB (0.65V). During startup, the NRCS pin serves as a 20μA (TYP) constant current source to charge the external capacitor. Output start time is calculated via the formula below.

$$T_{NRCS}\ (typ.) = \frac{C_{NRCS} \times V_{FB}}{I_{NRCS}}$$

・TSD (Thermal Shut down)

The shutdown (TSD) circuit automatically is latched OFF when the chip temperature exceeds the threshold temperature after the programmed time period elapses, thus serving to protect the IC against "thermal runaway" and heat damage. Because the TSD circuit is intended to shut down the IC only in the presence of extreme heat, it is crucial that the Tj (max) parameter not be exceeded in the thermal design ,in order to avoid potential problems with the TSD.

$$T_{TSD}\ (typ.) = \frac{C_{SCP} \times V_{SCPTH}}{20uA}$$

・VIN

The VIN line acts as the major current supply line, and is connected to the output NchFET drain. Since no electrical connection (such as between the VCC pin and the ESD protection diode) is necessary, VIN operates independent of the input sequence. However, since an output NchFET body diode exists between VIN and VO, a VIN-VO electric (diode) connection is present. Note, therefore, that when output is switched ON or OFF, reverse current may flow to VIN from VO.

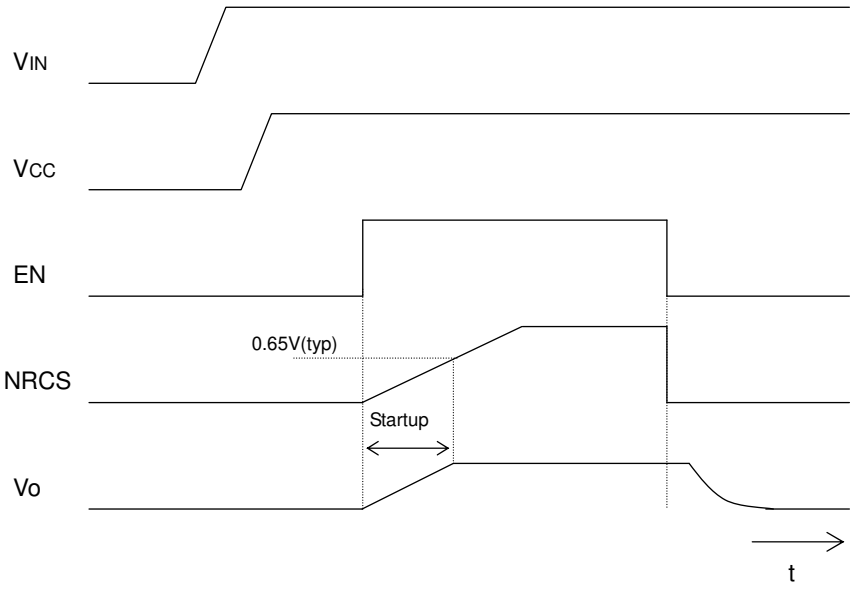
・SCP

When output voltage (Vo) drops, the IC assumes that VO pin is shorted to GND and switches the output voltage OFF. After the GND short has been detected and the programmed delay time has elapsed, output is latched OFF. It is also effective during output startup. SCP can be cleared either by reconnecting the EN pin or VCC pin. Delay time is calculated via the formula below.

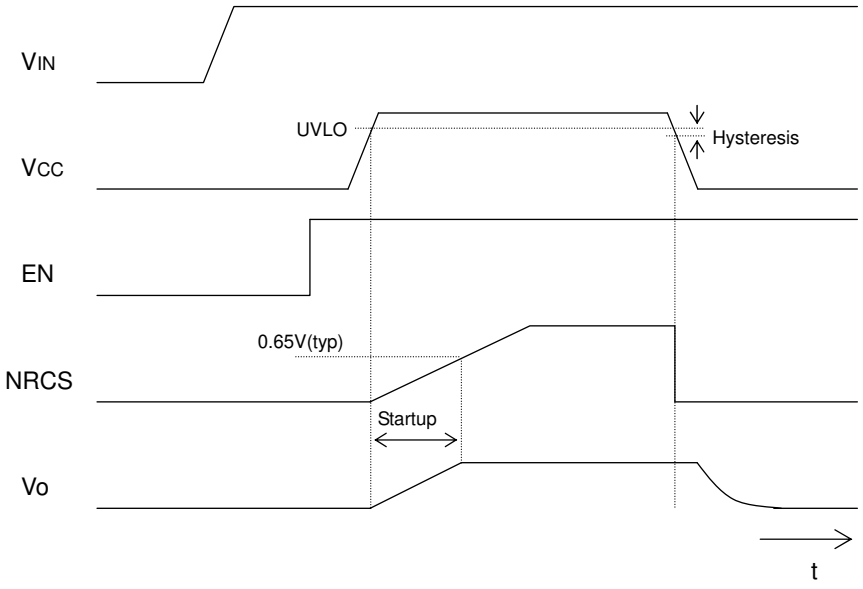
$$T_{SCP}\ (typ.) = \frac{C_{SCP} \times V_{SCPTH}}{I_{SCP}}$$

●Timing Chart

EN ON/OFF

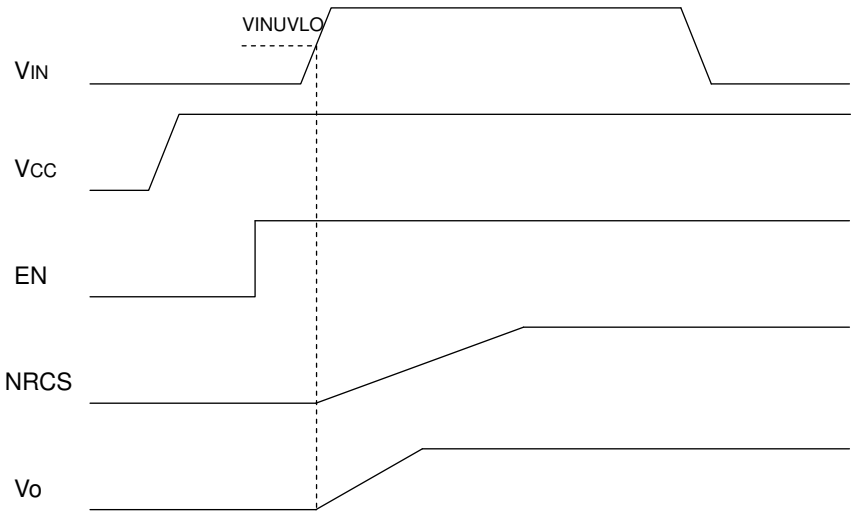


VCC ON/OFF

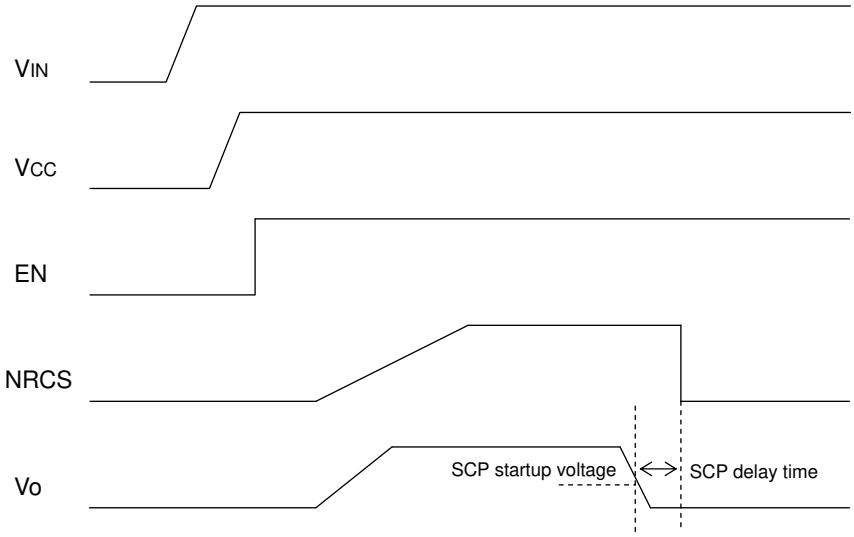


●Timing Chart

VIN ON

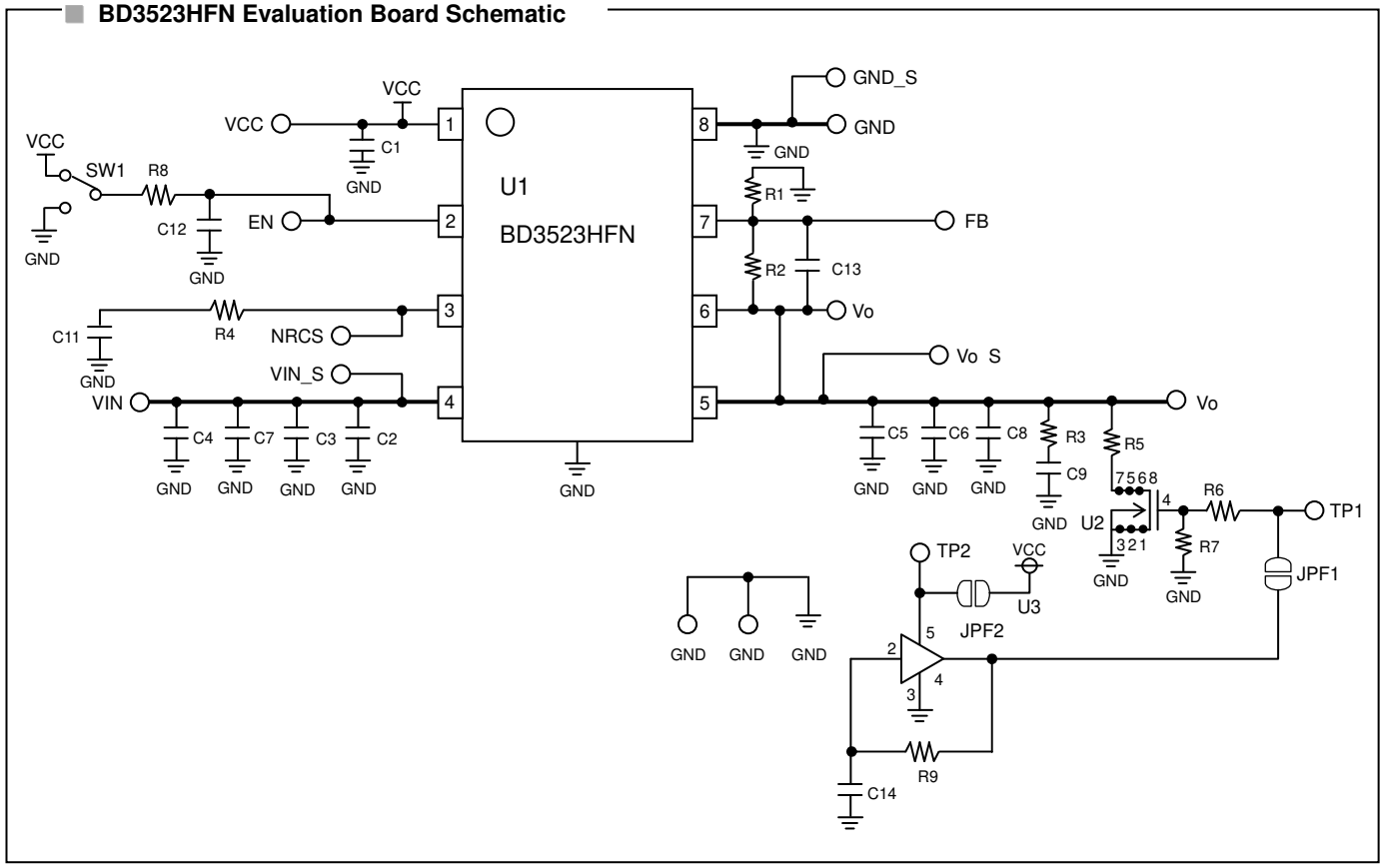


SCP OFF



●Evaluation Board

■ **BD3523HFN Evaluation Board Schematic**



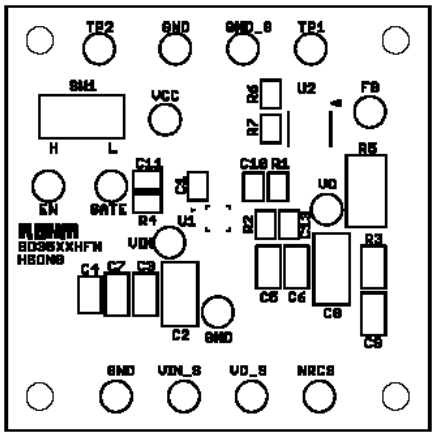
■ BD3523HFN Evaluation Board List

Component	Rating	Manufacturer	Product Name
U1	-	ROHM	BD3523XHFN
C1	1μF	MURATA	GRM188B11A105KD
C3	10μF	KYOCERA	CM32X5R226M10A
C5	22μF	KYOCERA	CM32X5R226M10A
C11	0.01μF	MURATA	GRM188B11H103KD

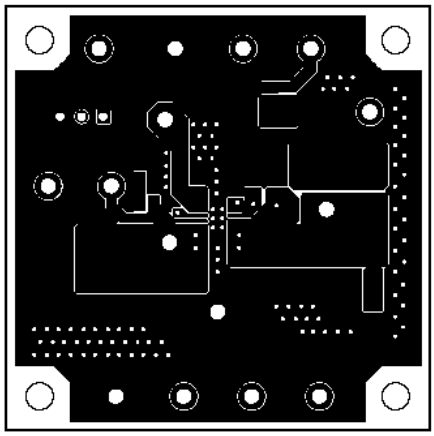
Component	Rating	Manufacturer	Product Name
C13	1000pF	MURATA	GRM188B11H102KD
R1	3.9kΩ	ROHM	MCR03EZPF3301
R2	3.3kΩ	ROHM	MCR03EAPF3901
R4	0Ω	-	Jumper
R8	0Ω	-	Jumper

■ BD3523HFN Evaluation Board Layout
(2nd layer and 3rd layer are GND line.)

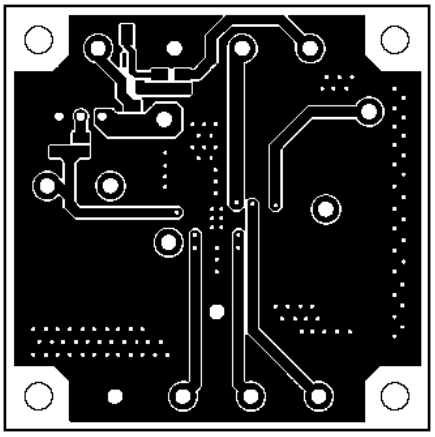
Silk Screen



TOP Layer

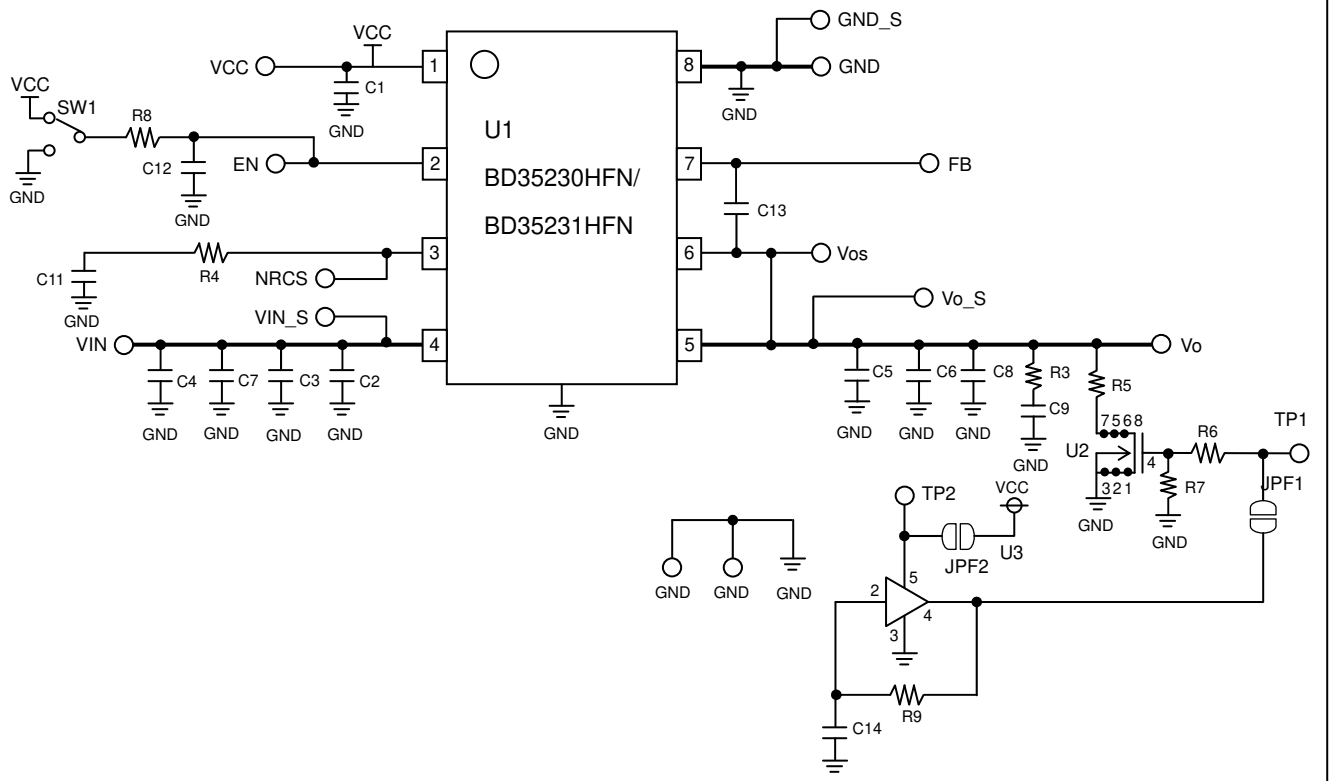


Bottom Layer



●Evaluation Board

■ BD35230HFN / BD35231HFN Evaluation Board Schematic



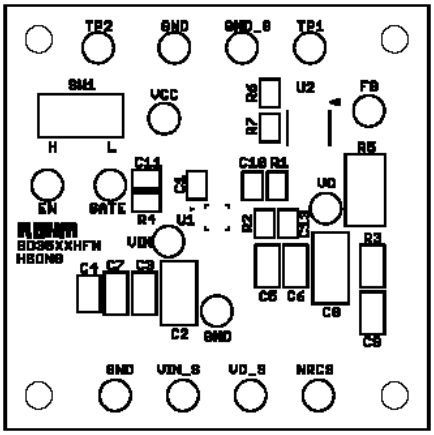
■ BD35230HFN / BD35231HFN Evaluation Board List

Component	Rating	Manufacturer	Product Name
U1	-	ROHM	BD3523XHFN
C1	1μF	MURATA	GRM188B11A105KD
C3	10μF	KYOCERA	CM32X5R226M10A
C5	22μF	KYOCERA	CM32X5R226M10A

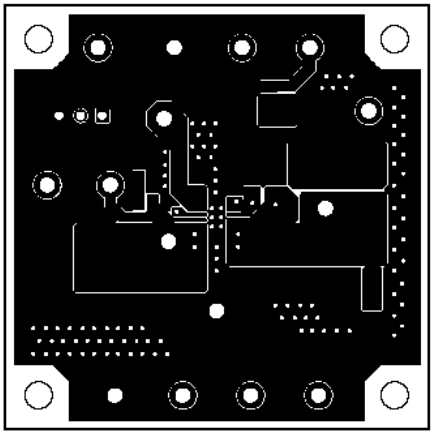
Component	Rating	Manufacturer	Product Name
C13	1000pF	MURATA	GRM188B11H102KD
R1	3.9kΩ	ROHM	MCR03EZPF3301
R2	3.3kΩ	ROHM	MCR03EAPF3901
R4	0Ω	-	Jumper

■ BD35230HFN / BD35231HFN Evaluation Board Layout
(2nd layer and 3rd layer are GND line.)

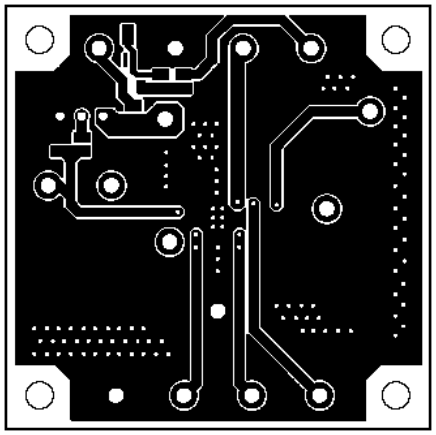
Silk Screen



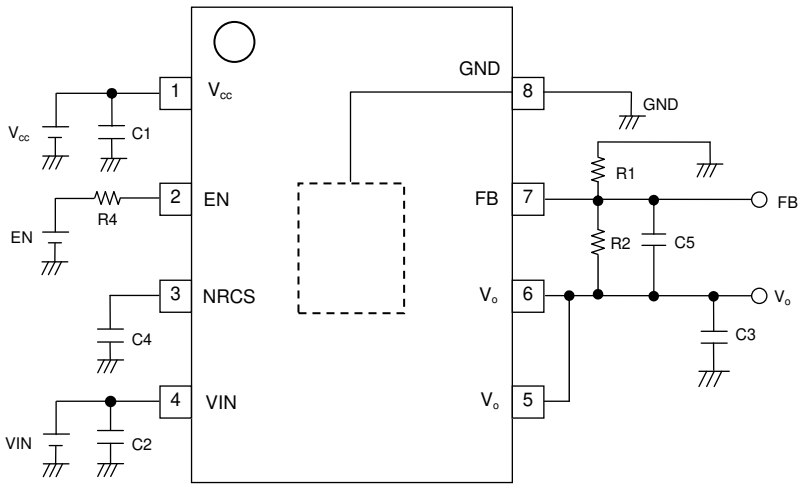
TOP Layer



Bottom Layer

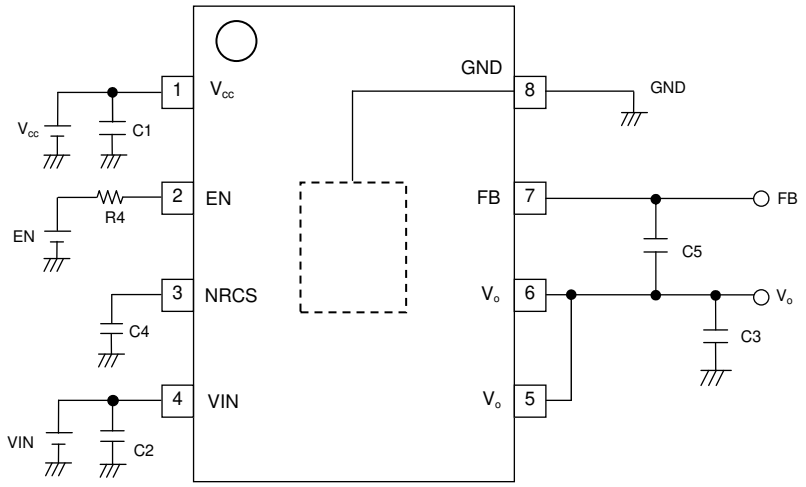


●Recommended Circuit Example (BD3523HFN)



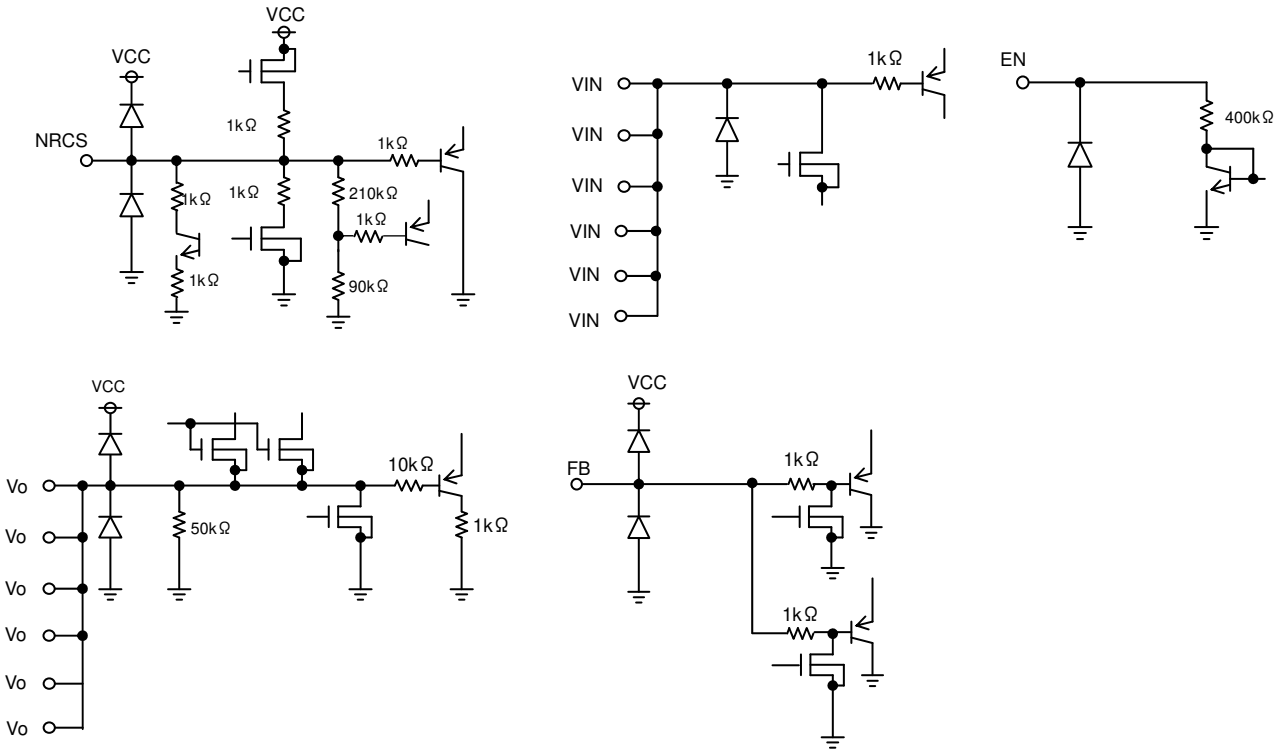
Component	Recommended Value	Programming Notes and Precautions
R1/R2	3.3k /3.9k	IC output voltage can be set with a configuration formula $V_{FB} \times (R1+R2)/R7$ using the values for the internal reference output voltage (V_{FB}) and the output voltage resistors (R6, R7). Select resistance values that will avoid the impact of the FB bias current (±100nA). The recommended total resistance value is 10kΩ.
C3	22μF	To assure output voltage stability, please be certain the output capacitors are connected between Vo1, Vo2, Vo3 pin and GND. Output capacitors play a role in loop gain phase compensation and in mitigating output fluctuation during rapid changes in load level. Insufficient capacitance may cause oscillation, while high equivalent series reisistance (ESR) will exacerbate output voltage fluctuation under rapid load change conditions. While a 47μF ceramic capacitor is recomended, actual stability is highly dependent on temperature and load conditions. Also, note that connecting different types of capacitors in series may result in insufficient total phase compensation, thus causing oscillation. In light of this information, please confirm operation across a variety of temperature and load conditions.
C1/ C2	1μF/22μF	Input capacitors reduce the output impedance of the voltage supply source connected to the input pin (V_{CC},). If the impedance of this power supply were to increase, input voltage (V_{CC}) could become unstable, leading to oscillation or lowered ripple rejection function. While a low-ESR 1μF capacitor with minimal susceptibility to temperature is recommended, stability is highly dependent on the input power supply characteristics and the substrate wiring pattern. In light of this information, please confirm operation across a variety of temperature and load conditions.
C4	0.01μF	The Non Rush Current on Startup (NRCS) function is built into the IC to prevent rush current from going through the load (VIN to VO) and impacting output capacitors at power supply start-up. Constant current comes from the NRCS pin when EN is HIGH or the UVLO function is deactivated. The temporary reference voltage is proportionate to time, due to the current charge of the NRCS pin capacitor, and output voltage start-up is proportionate to this reference voltage. Capacitors with low susceptibility to temperature are recommended, in order to assure a stable soft-start time.
C5	-	This component is employed when the C3 capacitor causes, or may cause, oscillation. It provides more precise internal phase correction.
R4	Several kΩ ～several 10kΩ	It is recommended that a resistance (several kΩ to several 10kΩ) be put in R4, in case negative voltage is applied in EN pin.

●Recommended Circuit Example (BD35230HFN/BD35231HFN)



Component	Recommended Value	Programming Notes and Precautions
C3	22µF	To assure output voltage stability, please be certain the output capacitors are connected between Vo pin and GND. Output capacitors play a role in loop gain phase compensation and in mitigating output fluctuation during rapid changes in load level. Insufficient capacitance may cause oscillation, while high equivalent series reisistance (ESR) will exacerbate output voltage fluctuation under rapid load change conditions. While a 22µF ceramic capacitor is recomended, actual stability is highly dependent on temperature and load conditions. Also, note that connecting different types of capacitors in series may result in insufficient total phase compensation, thus causing oscillation. In light of this information, please confirm operation across a variety of temperature and load conditions.
C1/C2	1µF/10µF	Input capacitors reduce the output impedance of the voltage supply source connected to the (VCC, VIN) input pins. If the impedance of this power supply were to increase, input voltage (VCC, VIN) could become unstable, leading to oscillation or lowered ripple rejection function. While a low-ESR 1µF/10µF capacitor with minimal susceptibility to temperature is recommended, stability is highly dependent on the input power supply characteristics and the substrate wiring pattern. In light of this information, please confirm operation across a variety of temperature and load conditions.
C4	0.01µF	The Non Rush Current on Startup (NRCS) function is built into the IC to prevent rush current from going through the load (VIN to VO) and impacting output capacitors at power supply start-up. Constant current comes from the NRCS pin when EN is HIGH or the UVLO function is deactivated. The temporary reference voltage is proportionate to time, due to the current charge of the NRCS pin capacitor, and output voltage start-up is proportionate to this reference voltage. Capacitors with low susceptibility to temperature are recommended, in order to assure a stable soft-start time.
C5	1000pF	This component is employed when the C16 capacitor causes, or may cause, oscillation. It provides more precise internal phase correction.

●**Input-Output Equivalent Circuit Diagram** (BD3523HFN)



●**Operation Notes**

1. Absolute maximum ratings
   An excess in the absolute maximum ratings, such as supply voltage, temperature range of operating conditions, etc., can break down the devices, thus making impossible to identify breaking mode, such as a short circuit or an open circuit. If any over rated values will expect to exceed the absolute maximum ratings, consider adding circuit protection devices, such as fuses.

2. Connecting the power supply connector backward
   Connecting of the power supply in reverse polarity can damage IC. Take precautions when connecting the power supply lines. An external direction diode can be added.

3. Power supply lines
   Design PCB layout pattern to provide low impedance GND and supply lines. To obtain a low noise ground and supply line, separate the ground section and supply lines of the digital and analog blocks. Furthermore, for all power supply terminals to ICs, connect a capacitor between the power supply and the GND terminal. When applying electrolytic capacitors in the circuit, not that capacitance characteristic values are reduced at low temperatures.

4. GND voltage
   The potential of GND pin must be minimum potential in all operating conditions.

5. Thermal design
   Use a thermal design that allows for a sufficient margin in light of the power dissipation (Pd) in actual operating conditions.

6. Inter-pin shorts and mounting errors
   Use caution when positioning the IC for mounting on printed circuit boards. The IC may be damaged if there is any connection error or if pins are shorted together.

7. Actions in strong electromagnetic field
   Use caution when using the IC in the presence of a strong electromagnetic field as doing so may cause the IC to malfunction.

8. ASO

When using the IC, set the output transistor so that it does not exceed absolute maximum ratings or ASO.

9. Thermal shutdown circuit

The IC incorporates a built-in thermal shutdown circuit (TSD circuit). The thermal shutdown circuit (TSD circuit) is designed only to shut the IC off to prevent thermal runaway. It is not designed to protect the IC or guarantee its operation. Do not continue to use the IC after operating this circuit or use the IC in an environment where the operation of this circuit is assumed.

	TSD on temperature [°C] (typ.)
BD3523HFN/BD35230HFN/BD35231HFN	175

10. Testing on application boards

When testing the IC on an application board, connecting a capacitor to a pin with low impedance subjects the IC to stress. Always discharge capacitors after each process or step. Always turn the IC's power supply off before connecting it to or removing it from a jig or fixture during the inspection process. Ground the IC during assembly steps as an antistatic measure. Use similar precaution when transporting or storing the IC.

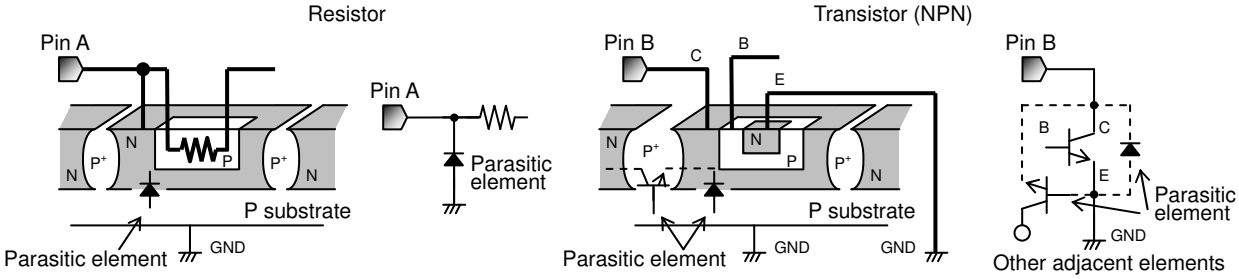
11. Regarding input pin of the IC

This monolithic IC contains P+ isolation and P substrate layers between adjacent elements in order to keep them isolated. P-N junctions are formed at the intersection of these P layers with the N layers of other elements, creating a parasitic diode or transistor. For example, the relation between each potential is as follows:

When GND > Pin A and GND > Pin B, the P-N junction operates as a parasitic diode.

When GND > Pin B, the P-N junction operates as a parasitic transistor.

Parasitic diodes can occur inevitable in the structure of the IC. The operation of parasitic diodes can result in mutual interference among circuits, operational faults, or physical damage. Accordingly, methods by which parasitic diodes operate, such as applying a voltage that is lower than the GND (P substrate) voltage to an input pin, should not be used.



Example of IC structure

12. Ground Wiring Pattern.

When using both small signal and large current GND patterns, it is recommended to isolate the two ground patterns, placing a single ground point at the ground potential of application so that the pattern wiring resistance and voltage variations caused by large currents do not cause variations in the small signal ground voltage. Be careful not to change the GND wiring pattern of any external components, either.

●Heat Loss

Thermal design should allow operation within the following conditions. Note that the temperatures listed are the allowed temperature limits, and thermal design should allow sufficient margin from the limits.

1. Ambient temperature Ta can be no higher than 100℃.
2. Chip junction temperature (Tj) can be no higher than 150℃.

Chip junction temperature can be determined as follows:

① Calculation based on ambient temperature (Ta)

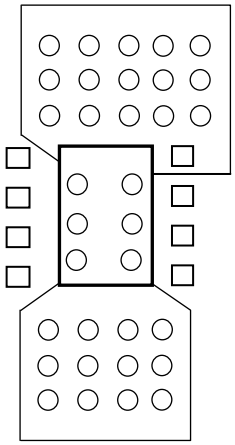
$Tj=Ta+\theta j\text{-}a\times W$

＜Reference values＞

θj-a: HSON8	198.4℃/W	1-layer substrate (copper foil area : below 0.2%)
	92.4℃/W	1-layer substrate (copper foil area : 7%)
	71.4℃/W	2-layer substrate (copper foil area : 65%)

Substrate size: $70\times70\times1.6mm^3$ (substrate with thermal via)

It is recommended to layout the VIA for heat radiation in the GND pattern of reverse (of IC) when there is the GND pattern in the inner layer (in using multiplayer substrate). This package is so small (size: 2.9mm×3.0mm) that it is not available to layout the VIA in the bottom of IC. Spreading the pattern and being increased the number of VIA like the figure below enable to get the superior heat radiation characteristic. (This figure is the image. It is recommended that the VIA size and the number is designed suitable for the actual situation.).



Most of the heat loss that occurs in the BD3523XHFN is generated from the output Nch FET. Power loss is determined by the total VIN-Vo voltage and output current. Be sure to confirm the system input and output voltage and the output current conditions in relation to the heat dissipation characteristics of the VIN and Vo in the design. Bearing in mind that heat dissipation may vary substantially depending on the substrate employed (due to the power package incorporated in the BD3523XHFN) make certain to factor conditions such as substrate size into the thermal design.

$$\text{Power consumption (W)} = \left\{\text{Input voltage (VIN)- Output voltage (Vo)}\right\}\times \text{Io(Ave)}$$

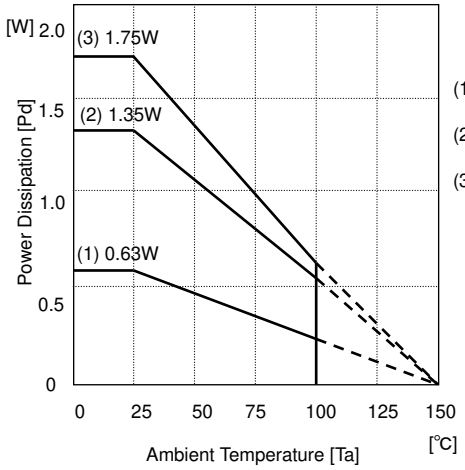
Example) Where VIN=1.7V, Vo=1.2V, Io(Ave) = 2A,

$$\text{Power consumption (W)} = \left\{1.7(V)-1.2(V)\right\}\times 2.0(A)$$

$$= 1.0(W)$$

●Heat Dissipation Characteristics

◎HSON8



(1) 1 layer substrate (substrate surface copper foil area: below 0.2%)
θj-a=198.4℃/W
(2) 2 layer substrate (substrate surface copper foil area:7%)
θj-a=92.4℃/W
(3) 2 layer substrate (substrate surface copper foil area:65%)
θj-a=71.4℃/W

●Ordering part number

B	D	3	5	2	3	H	F	N	-	T	R

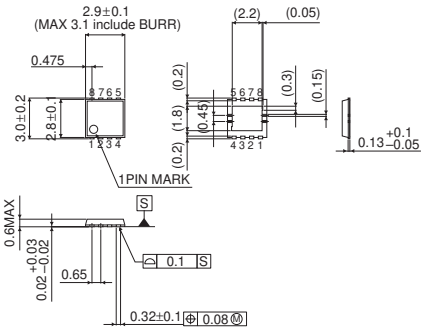
Part No.

Part No.
3523
35230
35231

Package
HFN : HSON8

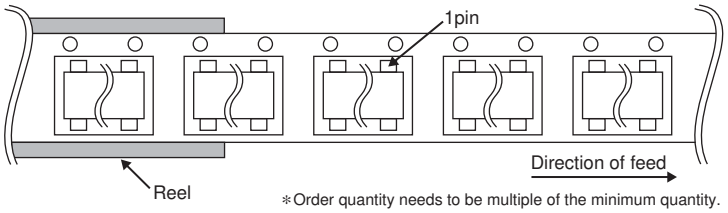
Packaging and forming specification
TR: Embossed tape and reel

HSON8



<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	3000pcs
Direction of feed	TR (The direction is the 1pin of product is at the upper right when you hold reel on the left hand and you pull out the tape on the right hand)



∗Order quantity needs to be multiple of the minimum quantity.

Notes

No copying or reproduction of this document, in part or in whole, is permitted without the consent of ROHM Co.,Ltd.

The content specified herein is subject to change for improvement without notice.

The content specified herein is for the purpose of introducing ROHM's products (hereinafter "Products"). If you wish to use any such Product, please be sure to refer to the specifications, which can be obtained from ROHM upon request.

Examples of application circuits, circuit constants and any other information contained herein illustrate the standard usage and operations of the Products. The peripheral conditions must be taken into account when designing circuits for mass production.

Great care was taken in ensuring the accuracy of the information specified in this document. However, should you incur any damage arising from any inaccuracy or misprint of such information, ROHM shall bear no responsibility for such damage.

The technical information specified herein is intended only to show the typical functions of and examples of application circuits for the Products. ROHM does not grant you, explicitly or implicitly, any license to use or exercise intellectual property or other rights held by ROHM and other parties. ROHM shall bear no responsibility whatsoever for any dispute arising from the use of such technical information.

The Products specified in this document are intended to be used with general-use electronic equipment or devices (such as audio visual equipment, office-automation equipment, communication devices, electronic appliances and amusement devices).

The Products specified in this document are not designed to be radiation tolerant.

While ROHM always makes efforts to enhance the quality and reliability of its Products, a Product may fail or malfunction for a variety of reasons.

Please be sure to implement in your equipment using the Products safety measures to guard against the possibility of physical injury, fire or any other damage caused in the event of the failure of any Product, such as derating, redundancy, fire control and fail-safe designs. ROHM shall bear no responsibility whatsoever for your use of any Product outside of the prescribed scope or not in accordance with the instruction manual.

The Products are not designed or manufactured to be used with any equipment, device or system which requires an extremely high level of reliability the failure or malfunction of which may result in a direct threat to human life or create a risk of human injury (such as a medical instrument, transportation equipment, aerospace machinery, nuclear-reactor controller, fuel-controller or other safety device). ROHM shall bear no responsibility in any way for use of any of the Products for the above special purposes. If a Product is intended to be used for any such special purpose, please contact a ROHM sales representative before purchasing.

If you intend to export or ship overseas any Product or technology specified herein that may be controlled under the Foreign Exchange and the Foreign Trade Law, you will be required to obtain a license or permit under the Law.

ROHM SEMICONDUCTOR

Thank you for your accessing to ROHM product informations.
More detail product informations and catalogs are available, please contact us.

ROHM Customer Support System

http://www.rohm.com/contact/