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S-8355/56/57/58 Series

STEP-UP, SUPER-SMALL PACKAGE, 600 kHz, PWM CONTROL or PWM/PFM SWITCHABLE SWITCHING REGULATOR CONTROLLER

www.sii-ic.com

Rev.7.0_00

The S-8355/56/57/58 Series is a CMOS step-up switching regulator controller which mainly consists of a reference voltage source, an oscillation circuit, an error amplifier, a phase compensation circuit, a PWM control circuit (S-8355/57 Series) and a PWM/PFM switching control circuit (S-8356/58 Series).
With an external low-ON-resistance Nch Power MOS, this product is ideal for applications requiring high efficiency and a high output current.
The S-8355/57 Series realizes low ripple, high efficiency, and excellent transient characteristics due to its PWM control circuit whose duty ratio can be varied linearly from 0 to 83% (from 0 to 78% for 250 kHz, 300 kHz, and 600 kHz models), an excellently designed error amplifier and a phase compensation circuits.
S-8356/58 Series features a PWM/PFM switching controller that can switch the operation to a PFM controller with a duty ratio is 15% under a light load to prevent a decline in the efficiency due to the IC operating current.

■ Features

- Low voltage operation : Startup at 0.9 V min. (I_{OUT} = 1 mA) guaranteed
- Low current consumption : During operation 25.9 μA (3.3 V, 100 kHz, typ.)
  During shutdown 0.5 μA (max.)
- Duty ratio : Built-in PWM/PFM switching control circuit (S-8356/58 Series)
  15 to 83% (100 kHz models)
  15 to 78% (250 kHz, 300 kHz, and 600 kHz models)
- External parts : Coil, diode, capacitor, and transistor
- Output voltage : Selectable in 0.1 V steps between 1.5 and 6.5 V (for V_{DD} / V_{OUT} separate types)
  Selectable in 0.1 V steps between 2.0 and 6.5 V (for other than V_{DD} / V_{OUT} separate types)
- Output voltage accuracy : ±2.4%
- Oscillation frequency : 100 kHz, 250 kHz, 300 kHz, 600 kHz selectable

- Soft start function : 6 ms (100 kHz, typ.)
- Shutdown function
- Lead-free, Sn 100%, halogen-free[*1]

***1.** Refer to "■ **Product Name Structure**" for details.

■ Applications

- Power supplies for portable equipment such as digital cameras, electronic notebooks, and PDAs
- Power supplies for audio equipment such as portable CD / MD players
- Constant voltage power supplies for cameras, VCRs, and communications devices
- Power supplies for microcomputers

■ Packages

- SOT-23-3
- SOT-23-5
- SOT-89-3
- 6-Pin SNB(B)

■ Block Diagrams

(1) S-8357/58 Series B, H and F Types (Without Shutdown Function)

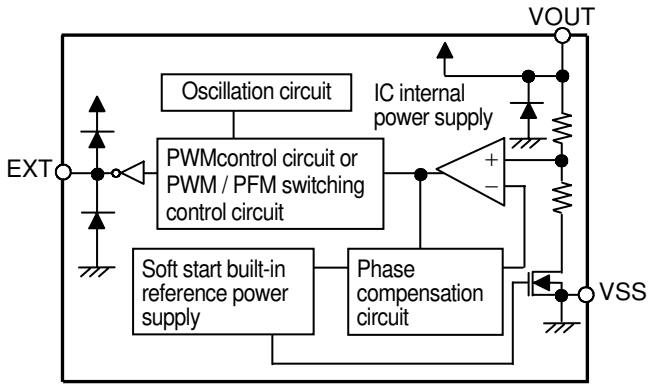


Figure 1

(2) S-8357/58 Series B, H, F and N Types (With Shutdown Function)

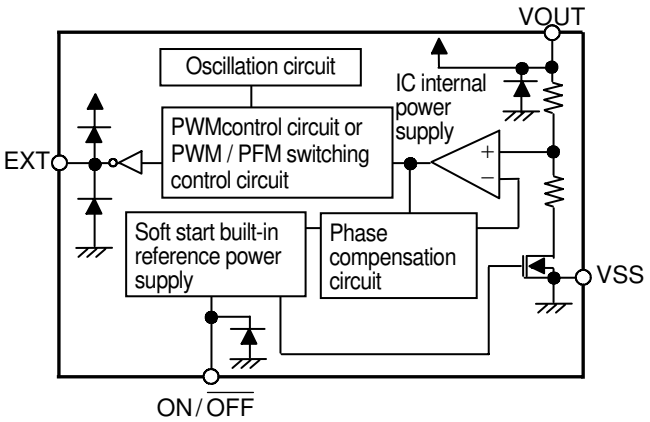


Figure 2

(3) S-8357/58 Series E, J, G and P Types (V_{DD} / V_{OUT} Separate Type)

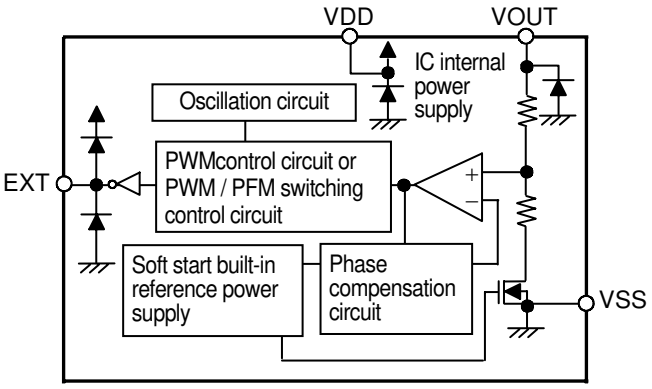


Figure 3

(4) S-8355/56 Series K, L, M and Q Types (With Shutdown Function, V_{DD} / V_{OUT} Separate Type)

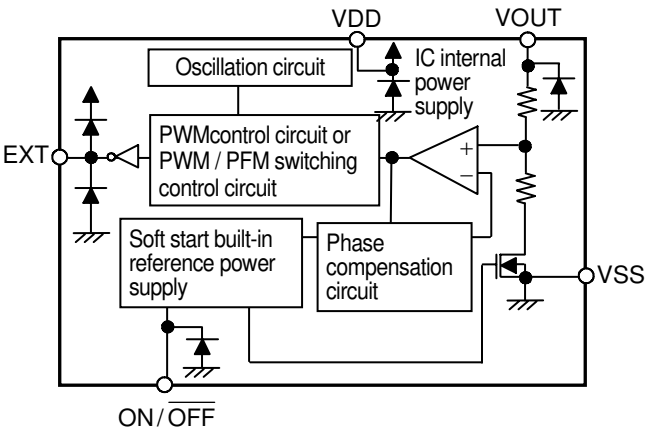


Figure 4

■ Product Name Structure

The control system, product types, output voltage, and packages for the S-8355/56/57/58 Series can be selected at the user's request. Please refer to the "**3. Product Name**" for the definition of the product name, "**4. Package**" regarding the package drawings and "**5. Product Name List**" for the full product names.

1. Function List

(1) PWM Control Products

Table 1

Product Name	Switching Frequency kHz	Shutdown Function	V_{DD} / V_{OUT} Separate Type	Package	Application
S-8355KxxMC	100	Yes	Yes	SOT-23-5	Applications requiring variable output voltage and a shutdown function
S-8355LxxMC, S-8355LxxBD	250	Yes	Yes	SOT-23-5, 6-Pin SNB(B)	Applications requiring variable output voltage, a shutdown function, and a thin coil
S-8355MxxMC, S-8355MxxBD	300	Yes	Yes	SOT-23-5, 6-Pin SNB(B)	Applications requiring variable output voltage, a shutdown function, and a thin coil
S-8355QxxMC, S-8355QxxBD	600	Yes	Yes	SOT-23-5, 6-Pin SNB(B)	Applications requiring variable output voltage, a shutdown function, and a thin coil
S-8357BxxMC	100	Yes	–	SOT-23-5	Applications requiring a shutdown function
S-8357BxxMA	100	–	–	SOT-23-3	Applications not requiring a shutdown function
S-8357BxxUA	100	–	–	SOT-89-3	Applications not requiring a shutdown function
S-8357ExxMC	100	–	Yes	SOT-23-5	Applications in which output voltage is adjusted by external resistor
S-8357FxxMC, S-8357FxxBD	300	Yes	–	SOT-23-5, 6-Pin SNB(B)	Applications requiring a shutdown function and a thin coil
S-8357GxxMC, S-8357GxxBD	300	–	Yes	SOT-23-5, 6-Pin SNB(B)	Applications requiring variable output voltage and a thin coil
S-8357HxxMC, S-8357HxxBD	250	Yes	–	SOT-23-5, 6-Pin SNB(B)	Applications requiring a shutdown function and a thin coil
S-8357JxxMC, S-8357JxxBD	250	–	Yes	SOT-23-5, 6-Pin SNB(B)	Applications requiring variable output voltage with an external resistor and a thin coil
S-8357NxxMC, S-8357NxxBD	600	Yes	–	SOT-23-5, 6-Pin SNB(B)	Applications requiring a shutdown function and a thin coil
S-8357PxxMC, S-8357PxxBD	600	–	Yes	SOT-23-5, 6-Pin SNB(B)	Applications requiring variable output voltage with an external resistor and a thin coil

(2) PWM / PFM Switching Control Products

Table 2

Product Name	Switching Frequency kHz	Shutdown Function	V_{DD} / V_{OUT} Separate Type	Package	Application
S-8356KxxMC	100	Yes	Yes	SOT-23-5	Applications requiring variable output voltage and a shutdown function
S-8356LxxMC, S-8356LxxBD	250	Yes	Yes	SOT-23-5, 6-Pin SNB(B)	Applications requiring variable output voltage, a shutdown function, and a thin coil
S-8356MxxMC, S-8356MxxBD	300	Yes	Yes	SOT-23-5, 6-Pin SNB(B)	Applications requiring variable output voltage, a shutdown function, and a thin coil
S-8356QxxMC, S-8356QxxBD	600	Yes	Yes	SOT-23-5, 6-Pin SNB(B)	Applications requiring variable output voltage, a shutdown function, and a thin coil
S-8358BxxMC	100	Yes	–	SOT-23-5	Applications requiring a shutdown function
S-8358BxxMA	100	–	–	SOT-23-3	Applications not requiring a shutdown function
S-8358BxxUA	100	–	–	SOT-89-3	Applications not requiring a shutdown function
S-8358ExxMC	100	–	Yes	SOT-23-5	Applications in which output voltage is adjusted by external resistor
S-8358FxxMC, S-8358FxxBD	300	Yes	–	SOT-23-5, 6-Pin SNB(B)	Applications requiring a shutdown function and a thin coil
S-8358GxxMC, S-8358GxxBD	300	–	Yes	SOT-23-5, 6-Pin SNB(B)	Applications requiring variable output voltage and a thin coil
S-8358HxxMC, S-8358HxxBD	250	Yes	–	SOT-23-5, 6-Pin SNB(B)	Applications requiring a shutdown function and a thin coil
S-8358JxxMC, S-8358JxxBD	250	–	Yes	SOT-23-5, 6-Pin SNB(B)	Applications requiring variable output voltage with an external resistor and a thin coil
S-8358NxxMC, S-8358NxxBD	600	Yes	–	SOT-23-5, 6-Pin SNB(B)	Applications requiring a shutdown function and a thin coil
S-8358PxxMC, S-8358PxxBD	600	–	Yes	SOT-23-5, 6-Pin SNB(B)	Applications requiring variable output voltage with an external resistor and a thin coil

2. Package and Function List by Product Type

Table 3

Series Name	Type	Package Name (Abbreviation)	Shutdown Function Yes / No	V_{DD} / V_{OUT} Separate Type Yes / No
S-8355 Series, S-8356 Series	K, L, M, Q (Shutdown function + V_{DD} / V_{OUT} separate type) K = 100 kHz, L = 250 kHz, M = 300 kHz, Q = 600 kHz	MC / BD	Yes	Yes
S-8357 Series	B, H, F (Normal product) B = 100 kHz, H = 250 kHz, F = 300 kHz	MA / UA	No	No
		MC / BD	Yes	
	N (Normal product) N = 600 kHz	MC / BD	Yes	No
	E, J, G, P (V_{DD} / V_{OUT} separate type) E = 100 kHz, J = 250 kHz, G = 300 kHz, P = 600 kHz	MC / BD	No	Yes
S-8358 Series	B, H, F (Normal product) B = 100 kHz, H = 250 kHz, F = 300 kHz	MA / UA	No	No
		MC / BD	Yes	
	N (Normal product) N = 600 kHz	MC/BD	Yes	No
	E, J, G, P (V_{DD} / V_{OUT} separate type) E = 100 kHz, J = 250 kHz, G = 300 kHz, P = 600 kHz	MC / BD	No	Yes

3. Product Name

(1) SOT-23-3 Packages

S-835 x x xx MA - xxx T2 G

- Environmental code
  - G : Lead-free (for details, please contact our sales office)
- IC direction in tape specifications *1
  - T2 : SOT-23-3
- Product name (abbreviation) *2
- Package name (abbreviation)
  - MA : SOT-23-3
- Output voltage
  - 15 to 65
  - (e.g. When the output voltage is 1.5 V, it is expressed as 15.)
- Product type
  - B : Normal product, (S-8357/58 Series) f_{OSC} = 100 kHz
  - H : Normal product, (S-8357/58 Series) f_{OSC} = 250 kHz
  - F : Normal product, (S-8357/58 Series) f_{OSC} = 300 kHz
  - N : Normal product, (S-8357/58 Series) f_{OSC} = 600 kHz
  - E : V_{DD} / V_{OUT} separate type, (S-8357/58 Series) f_{OSC} = 100 kHz
  - J : V_{DD} / V_{OUT} separate type, (S-8357/58 Series) f_{OSC} = 250 kHz
  - G : V_{DD} / V_{OUT} separate type, (S-8357/58 Series) f_{OSC} = 300 kHz
  - P : V_{DD} / V_{OUT} separate type, (S-8357/58 Series) f_{OSC} = 600 kHz
  - K : With shutdown function + V_{DD} / V_{OUT} separate type, (S-8355/56 Series) f_{OSC} = 100 kHz
  - L : With shutdown function + V_{DD} / V_{OUT} separate type, (S-8355/56 Series) f_{OSC} = 250 kHz
  - M : With shutdown function + V_{DD} / V_{OUT} separate type, (S-8355/56 Series) f_{OSC} = 300 kHz
  - Q : With shutdown function + V_{DD} / V_{OUT} separate type, (S-8355/56 Series) f_{OSC} = 600 kHz
- Control system
  - 5 or 7 : PWM control
  - 6 or 8 : PWM / PFM switching control

***1.** Refer to the tape specifications.
***2.** Refer to the **Table 4** to **Table 13** in the "**5. Product Name List**".

(2) SOT-23-5, SOT-89-3 Packages

S-835 x x xx xx - xxx T2 x

- Environmental code
  - U : Lead-free (Sn 100%), halogen-free
  - G : Lead-free (for details, please contact our sales office)
- IC direction in tape specifications *1
  - T2 : SOT-23-5, SOT-89-3
- Product name (abbreviation) *2
- Package name (abbreviation)
  - MC : SOT-23-5
  - UA : SOT-89-3
- Output voltage
  - 15 to 65
  - (e.g. When the output voltage is 1.5 V, it is expressed as 15.)
- Product type
  - B : Normal product, (S-8357/58 Series) f_{OSC} = 100 kHz
  - H : Normal product, (S-8357/58 Series) f_{OSC} = 250 kHz
  - F : Normal product, (S-8357/58 Series) f_{OSC} = 300 kHz
  - N : Normal product, (S-8357/58 Series) f_{OSC} = 600 kHz
  - E : V_{DD} / V_{OUT} separate type, (S-8357/58 Series) f_{OSC} = 100 kHz
  - J : V_{DD} / V_{OUT} separate type, (S-8357/58 Series) f_{OSC} = 250 kHz
  - G : V_{DD} / V_{OUT} separate type, (S-8357/58 Series) f_{OSC} = 300 kHz
  - P : V_{DD} / V_{OUT} separate type, (S-8357/58 Series) f_{OSC} = 600 kHz
  - K : With shutdown function + V_{DD} / V_{OUT} separate type, (S-8355/56 Series) f_{OSC} = 100 kHz
  - L : With shutdown function + V_{DD} / V_{OUT} separate type, (S-8355/56 Series) f_{OSC} = 250 kHz
  - M : With shutdown function + V_{DD} / V_{OUT} separate type, (S-8355/56 Series) f_{OSC} = 300 kHz
  - Q : With shutdown function + V_{DD} / V_{OUT} separate type, (S-8355/56 Series) f_{OSC} = 600 kHz
- Control system
  - 5 or 7 : PWM control
  - 6 or 8 : PWM / PFM switching control

***1.** Refer to the tape specifications.
***2.** Refer to the **Table 4** to **Table 13** in the "**5. Product Name List**".

(3) 6-Pin SNB(B) Package

S-835 x x xx BD - xxx - TF

- IC direction in tape specifications *1
  - TF : 6-Pin SNB(B)
- Product name (abbreviation) *2
- Package name (abbreviation)
  - BD : 6-Pin SNB(B)
- Output voltage
  - 15 to 65
  - (e.g. When the output voltage is 1.5 V, it is expressed as 15.)
- Product type
  - B : Normal product, (S-8357/58 Series) f_{OSC} = 100 kHz
  - H : Normal product, (S-8357/58 Series) f_{OSC} = 250 kHz
  - F : Normal product, (S-8357/58 Series) f_{OSC} = 300 kHz
  - N : Normal product, (S-8357/58 Series) f_{OSC} = 600 kHz
  - E : V_{DD} / V_{OUT} separate type, (S-8357/58 Series) f_{OSC} = 100 kHz
  - J : V_{DD} / V_{OUT} separate type, (S-8357/58 Series) f_{OSC} = 250 kHz
  - G : V_{DD} / V_{OUT} separate type, (S-8357/58 Series) f_{OSC} = 300 kHz
  - P : V_{DD} / V_{OUT} separate type, (S-8357/58 Series) f_{OSC} = 600 kHz
  - K : With shutdown function + V_{DD} / V_{OUT} separate type, (S-8355/56 Series) f_{OSC} = 100 kHz
  - L : With shutdown function + V_{DD} / V_{OUT} separate type, (S-8355/56 Series) f_{OSC} = 250 kHz
  - M : With shutdown function + V_{DD} / V_{OUT} separate type, (S-8355/56 Series) f_{OSC} = 300 kHz
  - Q : With shutdown function + V_{DD} / V_{OUT} separate type, (S-8355/56 Series) f_{OSC} = 600 kHz
- Control system
  - 5 or 7 : PWM control
  - 6 or 8 : PWM / PFM switching control

***1.** Refer to the tape specifications.
***2.** Refer to the **Table 4** to **Table 13** in the "**5. Product Name List**".

4. Package

Package Name	Drawing Code		
	Package	Tape	Reel
SOT-23-3	MP003-A-P-SD	MP003-A-C-SD	MP003-A-R-SD
SOT-23-5	MP005-A-P-SD	MP005-A-C-SD	MP005-A-R-SD
SOT-89-3	UP003-A-P-SD	UP003-A-C-SD	UP003-A-R-SD
6-Pin SNB(B)	BD006-A-P-SD	BD006-A-C-SD	BD006-A-R-SD

5. Product Name List

(1) S-8355 Series

Table 4

Output voltage	S-8355KxxMC Series	S-8355LxxMC Series	S-8355MxxMC Series	S-8355MxxBD Series
1.5 V	–	S-8355L15MC-NCAT2x	–	–
1.8 V	S-8355K18MC-NADT2x	–	S-8355M18MC-MCDT2x	S-8355M18BD-MCD-TF
2.0 V	S-8355K20MC-NAFT2x	S-8355L20MC-NCFT2x	S-8355M20MC-MCFT2x	–
2.4 V	S-8355K24MC-NAJT2x	–	–	–
3.0 V	S-8355K30MC-NAPT2x	–	S-8355M30MC-MCPT2x	–
3.1 V	S-8355K31MC-NAQT2x	–	S-8355M31MC-MCQT2x	–
3.2 V	–	–	S-8355M32MC-MCRT2x	–
3.3 V	S-8355K33MC-NAST2x	–	–	–
3.4 V	–	–	S-8355M34MC-MCTT2x	S-8355M34BD-MCT-TF
5.0 V	S-8355K50MC-NBJT2x	–	S-8355M50MC-MDJT2x	–
5.5 V	–	–	S-8355M55MC-MDOT2x	–
6.0 V	–	–	S-8355M60MC-MDTT2x	–
6.5 V	–	–	S-8355M65MC-MDYT2x	–

Table 5

Output voltage	S-8355QxxMC Series	S-8355QxxBD Series
1.5 V	S-8355Q15MC-OWAT2x	S-8355Q15BD-OWA-TF
1.8 V	S-8355Q18MC-OWDT2x	–
2.0 V	S-8355Q20MC-OWFT2x	–
2.4 V	S-8355Q24MC-OWJT2x	–
2.8 V	S-8355Q28MC-OWNT2x	S-8355Q28BD-OWN-TF
3.0 V	S-8355Q30MC-OWPT2x	–
3.1 V	S-8355Q31MC-OWQT2x	S-8355Q31BD-OWQ-TF
3.3 V	S-8355Q33MC-OWST2x	–
3.4 V	S-8355Q34MC-OWTT2x	S-8355Q34BD-OWT-TF
4.5 V	S-8355Q45MC-OXET2x	–
5.0 V	S-8355Q50MC-OXJT2x	S-8355Q50BD-OXJ-TF
5.1 V	S-8355Q51MC-OXKT2x	–
6.0 V	S-8355Q60MC-OXTT2x	–

Remark 1. Please contact the SII marketing department for products with an output voltage other than those specified above.
2. x: G or U
3. Please select products of environmental code = U for Sn 100%, halogen-free products.

(2) S-8356 Series

Table 6

Output voltage	S-8356KxxMC Series	S-8356LxxMC Series	S-8356MxxMC Series	S-8356MxxBD Series
1.5 V	–	–	S-8356M15MC-MEAT2x	–
1.8 V	S-8356K18MC-NEDT2x	–	S-8356M18MC-MEDT2x	S-8356M18BD-MED-TF
3.0 V	S-8356K30MC-NEPT2x	S-8356L30MC-NGPT2x	S-8356M30MC-MEPT2x	–
3.1 V	–	–	S-8356M31MC-MEQT2x	–
3.3 V	S-8356K33MC-NEST2x	–	S-8356M33MC-MEST2x	–
3.5 V	–	–	S-8356M35MC-MEUT2x	–
3.6 V	S-8356K36MC-NEVT2x	–	S-8356M36MC-MEVT2x	–
4.0 V	S-8356K40MC-NEZT2x	–	–	–
5.0 V	S-8356K50MC-NFJT2x	–	S-8356M50MC-MFJT2x	S-8356M50BD-MFJ-TF

Table 7

Output voltage	S-8356QxxMC Series	S-8356QxxBD Series
1.8 V	S-8356Q18MC-OYDT2x	S-8356Q18BD-OYD-TF
2.8 V	S-8356Q28MC-OYNT2x	–
3.0 V	S-8356Q30MC-OYPT2x	–
3.1 V	S-8356Q31MC-OYQT2x	–
3.3 V	S-8356Q33MC-OYST2x	S-8356Q33BD-OYS-TF
3.5 V	S-8356Q35MC-OYUT2x	–
3.7 V	–	S-8356Q37BD-OYW-TF
4.0 V	S-8356Q40MC-OYZT2x	–
5.0 V	S-8356Q50MC-OVJT2x	S-8356Q50BD-OVJ-TF
5.3 V	S-8356Q53MC-OVMT2x	–

Remark 1. Please contact the SII marketing department for products with an output voltage other than those specified above.
2. x: G or U
3. Please select products of environmental code = U for Sn 100%, halogen-free products.

(3) S-8357 Series

Table 8

Output voltage	S-8357BxxMC Series	S-8357BxxMA Series	S-8357BxxUA Series	S-8357ExxMC Series
1.5 V	–	–	–	S-8357E15MC-NKAT2x
2.0 V	–	–	–	S-8357E20MC-NKFT2x
2.5 V	S-8357B25MC-NIKT2x	–	–	–
2.6 V	S-8357B26MC-NILT2x	–	–	–
2.7 V	S-8357B27MC-NIMT2x	–	–	–
2.8 V	S-8357B28MC-NINT2x	–	–	–
3.0 V	S-8357B30MC-NIPT2x	S-8357B30MA-NIPT2G	–	S-8357E30MC-NKPT2x
3.3 V	S-8357B33MC-NIST2x	S-8357B33MA-NIST2G	S-8357B33UA-NIST2x	–
3.6 V	S-8357B36MC-NIVT2x	–	–	–
3.8 V	–	–	S-8357B38UA-NIXT2x	–
4.0 V	S-8357B40MC-NIZT2x	–	–	–
4.8 V	S-8357B48MC-NJHT2x	–	S-8357B48UA-NJHT2x	–
5.0 V	S-8357B50MC-NJJT2x	S-8357B50MA-NJJT2G	S-8357B50UA-NJJT2x	S-8357E50MC-NLJT2x
5.2 V	S-8357B52MC-NJLT2x	–	–	–
5.4 V	S-8357B54MC-NJNT2x	–	–	–
6.0 V	S-8357B60MC-NJTT2x	–	–	–

Table 9

Output voltage	S-8357FxxMC Series	S-8357GxxMC Series	S-8357HxxMC Series	S-8357JxxMC Series
2.0 V	–	–	–	S-8357J20MC-NOFT2x
2.5 V	–	–	–	S-8357J25MC-NOKT2x
3.0 V	S-8357F30MC-MGPT2x	–	S-8357H30MC-NMPT2G	–
3.1 V	–	–	S-8357H31MC-NMQT2G	–
3.2 V	S-8357F32MC-MGRT2x	S-8357G32MC-MIRT2x	–	–
3.3 V	S-8357F33MC-MGST2x	S-8357G33MC-MIST2x	–	–
3.5 V	–	–	S-8357H35MC-NMUT2x	–
3.6 V	S-8357F36MC-MGVT2x	–	S-8357H36MC-NMVT2x	–
4.2 V	–	–	S-8357H42MC-NNBT2x	–
5.0 V	S-8357F50MC-MHJT2x	S-8357G50MC-MJJT2x	S-8357H50MC-NNJT2x	S-8357J50MC-NPJT2x
5.2 V	S-8357F52MC-MHLT2x	–	S-8357H52MC-NNLT2x	–
6.5 V	S-8357F65MC-MHYT2x	–	–	–

Table 10

Output voltage	S-8357JxxBD Series	S-8357NxxMC Series
3.0 V	–	S-8357N30MC-O2PT2x
3.3 V	–	S-8357N33MC-O2ST2x
5.0 V	S-8357J50BD-NPJ-TF	S-8357N50MC-O3JT2x
5.3 V	–	S-8357N53MC-O3MT2x

Remark 1. Please contact the SII marketing department for products with an output voltage other than those specified above.
2. x: G or U
3. Please select products of environmental code = U for Sn 100%, halogen-free products.

(4) S-8358 Series

Table 11

Output voltage	S-8358BxxMC Series	S-8358BxxMA Series	S-8358BxxUA Series	S-8358ExxMC Series
2.0 V	–	–	–	S-8358E20MC-NSFT2x
2.3 V	S-8358B23MC-NQIT2x	–	–	–
2.5 V	S-8358B25MC-NQKT2x	–	–	–
2.6 V	S-8358B26MC-NQLT2x	–	–	–
2.7 V	S-8358B27MC-NQMT2x	–	–	–
2.8 V	S-8358B28MC-NQNT2x	–	–	–
3.0 V	S-8358B30MC-NQPT2x	S-8358B30MA-NQPT2G	–	–
3.1 V	S-8358B31MC-NQQT2x	–	–	–
3.2 V	S-8358B32MC-NQRT2x	–	–	–
3.3 V	S-8358B33MC-NQST2x	–	S-8358B33UA-NQST2x	–
3.5 V	S-8358B35MC-NQUT2x	–	–	–
3.6 V	S-8358B36MC-NQVT2x	–	–	–
3.8 V	S-8358B38MC-NQXT2x	–	–	–
4.0 V	S-8358B40MC-NQZT2x	–	–	–
5.0 V	S-8358B50MC-NRJT2x	S-8358B50MA-NRJT2G	S-8358B50UA-NRJT2x	S-8358E50MC-NTJT2x
5.3 V	S-8358B53MC-NRMT2x	–	–	–
6.0 V	S-8358B60MC-NRTT2x	–	S-8358B60UA-NRTT2x	–

Table 12

Output voltage	S-8358FxxMC Series	S-8358GxxMC Series	S-8358HxxMC Series	S-8358JxxMC Series
2.3 V	–	–	S-8358H23MC-NUIT2x	–
2.6 V	S-8358F26MC-MKLT2x	–	–	–
2.7 V	S-8358F27MC-MKMT2x	–	–	–
3.0 V	S-8358F30MC-MKPT2x	–	S-8358H30MC-NUPT2x	–
3.2 V	—	–	S-8358H32MC-NURT2x	–
3.3 V	S-8358F33MC-MKST2x	–	S-8358H33MC-NUST2x	S-8358J33MC-NWST2x
3.6 V	S-8358F36MC-MKVT2x	–	–	–
4.0 V	—	–	S-8358H40MC-NUZT2x	–
5.0 V	S-8358F50MC-MLJT2x	S-8358G50MC-MNJT2x	S-8358H50MC-NVJT2x	S-8358J50MC-NXJT2x
5.3 V	S-8358F53MC-MLMT2x	–	–	–
5.7 V	S-8358F57MC-MLQT2x	–	–	–
6.0 V	S-8358F60MC-MLTT2x	–	–	–

Table 13

Output voltage	S-8358NxxMC Series	S-8358PxxMC Series
2.0 V	–	S-8358P20MC-O8FT2x
3.0 V	S-8358N30MC-O6PT2x	–
3.3 V	S-8358N33MC-O6ST2x	–
5.0 V	S-8358N50MC-O7JT2x	–
5.2 V	–	S-8358P52MC-O9LT2x
5.3 V	S-8358N53MC-O7MT2x	–

Remark 1. Please contact the SII marketing department for products with an output voltage other than those specified above.
2. x: G or U
3. Please select products of environmental code = U for Sn 100%, halogen-free products.

■ Pin Configurations

SOT-23-3
Top view

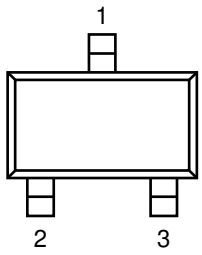


Figure 5

SOT-23-5
Top view

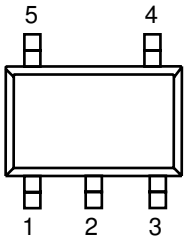


Figure 6

Table 14 S-8357/58 Series B, H and F Types
(Without shutdown function, V_{DD} / V_{OUT} non-separate type)

Pin No.	Symbol	Pin Description
1	VOUT	Output voltage pin and IC power supply pin
2	VSS	GND pin
3	EXT	External transistor connection pin

Table 15 S-8355/56 Series K, L, M and Q Types
(With shutdown function, V_{DD} / V_{OUT} separate type)

Pin No.	Symbol	Pin Description
1	VOUT	Output voltage
2	VDD	IC power supply pin
3	ON / $\overline{\text{OFF}}$	Shutdown pin "H": Normal operation (Step-up operating) "L": Step-up stopped (Entire circuit stopped)
4	VSS	GND pin
5	EXT	External transistor connection pin

Table 16 S-8357/58 Series B, H, F and N Types
(With shutdown function, V_{DD} / V_{OUT} non-separate type)

Pin No.	Symbol	Pin Description
1	ON / $\overline{\text{OFF}}$	Shutdown pin "H": Normal operation (Step-up operating) "L": Step-up stopped (Entire circuit stopped)
2	VOUT	Output voltage pin and IC power supply pin
3	NC*1	No connection
4	VSS	GND pin
5	EXT	External transistor connection pin

***1.** The NC pin indicates electrically open.

Table 17 S-8357/58 Series E, J, G and P Types
(Without shutdown function, V_{DD} / V_{OUT} separate type)

Pin No.	Symbol	Pin Description
1	VOUT	Output voltage pin
2	VDD	IC power supply pin
3	NC*1	No connection
4	VSS	GND pin
5	EXT	External transistor connection pin

***1.** The NC pin indicates electrically open.

SOT-89-3
Top view

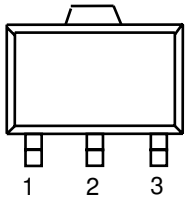
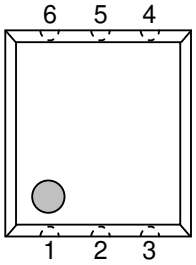
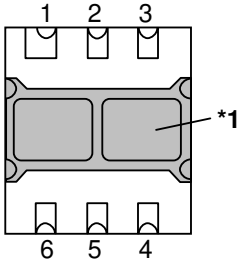


Figure 7

6-Pin SNB(B)
Top view



Bottom view



***1.** Connect the heatsink of back side at shadowed area to the board, and set electric potential open or VDD.
However, do not use it as the function of electrode.

Figure 8

Table 18 S-8357/58 Series B, H and F Types
(Without shutdown function, V_{DD} / V_{OUT} non-separate type)

Pin No.	Symbol	Pin Description
1	VSS	GND pin
2	VOUT	Output voltage pin and IC power supply pin
3	EXT	External transistor connection pin

Table 19 S-8355/56 Series K, L, M and Q Types
(With shutdown function, V_{DD} / V_{OUT} separate type)

Pin No.	Symbol	Pin Description
1	ON / $\overline{OFF}$	Shutdown pin "H": Normal operation (Step-up operating) "L": Step-up stopped (Entire circuit stopped)
2	VOUT	Output voltage pin
3	VDD	IC power supply pin
4	EXT	External transistor connection pin
5	NC*1	No connection
6	VSS	GND pin

***1.** The NC pin indicates electrically open.

Table 20 S-8357/58 Series B, H, F and N Types
(With shutdown function, V_{DD} / V_{OUT} non-separate type)

Pin No.	Symbol	Pin Description
1	NC*1	No connection
2	ON / $\overline{OFF}$	Shutdown pin "H": Normal operation (Step-up operating) "L": Step-up stopped (Entire circuit stopped)
3	VOUT	Output voltage pin and IC power supply pin
4	EXT	External transistor connection pin
5	NC*1	No connection
6	VSS	GND pin

***1.** The NC pin indicates electrically open.

Table 21 S-8357/58 Series E, J, G and P Types
(Without shutdown function, V_{DD} / V_{OUT} separate type)

Pin No.	Symbol	Pin Description
1	NC*1	No connection
2	VOUT	Output voltage pin
3	VDD	IC power supply pin
4	EXT	External transistor connection pin
5	NC*1	No connection
6	VSS	GND pin

***1.** The NC pin indicates electrically open.

■ Absolute Maximum Ratings

Table 22

(Ta = 25°C unless otherwise specified)

Item		Symbol	Absolute maximum rating	Unit
VOUT pin voltage		V_{OUT}	V_{SS} − 0.3 to V_{SS} + 12	V
ON/$\overline{\text{OFF}}$ pin voltage *1		$V_{ON/\overline{OFF}}$	V_{SS} − 0.3 to V_{SS} + 12	V
VDD pin voltage *2		V_{DD}	V_{SS} − 0.3 to V_{SS} + 12	V
EXT pin voltage	B, H, F, N type	V_{EXT}	V_{SS} − 0.3 to V_{OUT} + 0.3	V
	Others		V_{SS} − 0.3 to V_{DD} + 0.3	V
EXT pin current		I_{EXT}	±80	mA
Power dissipation	SOT-23-3	P_D	150 (When not mounted on board)	mW
			430*3	mW
	SOT-23-5		250 (When not mounted on board)	mW
			600*3	mW
	SOT-89-3		500 (When not mounted on board)	mW
			1000*3	mW
	6-Pin SNB(B)		90 (When not mounted on board)	mW
			450*3	mW
Operating ambient temperature		T_{opr}	− 40 to + 85	°C
Storage temperature		T_{stg}	− 40 to + 125	°C

***1.** With shutdown function

***2.** For V_{DD} / V_{OUT} separate type

***3.** When mounted on board

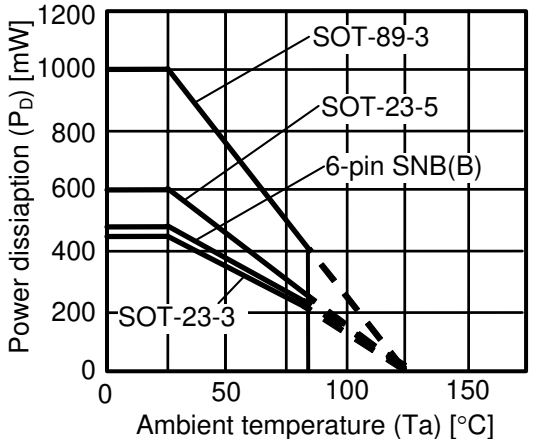
[Mounted board]

(1) Board size : 114.3 mm × 76.2 mm × t1.6 mm

(2) Name : JEDEC STANDARD51-7

Caution The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded under any conditions.

(1) When mounted on board



(2) When not mounted on board

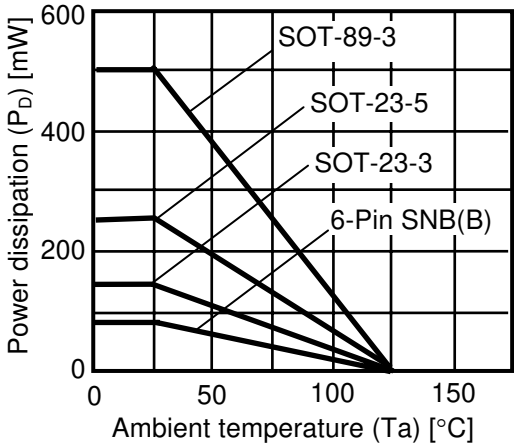


Figure 9 Power Dissipation of The Package

■ Electrical Characteristics

(1) 100 kHz Product (B, E and K Types)

Table 23 (1 / 2)

(Ta = 25°C unless otherwise specified)

Item	Symbol	Condition		Min.	Typ.	Max.	Unit	Measurement circuit
Output voltage	V_{OUT}	–		$V_{OUT(S)} \times 0.976$	$V_{OUT(S)}$	$V_{OUT(S)} \times 1.024$	V	2
Input voltage	V_{IN}	–		–	–	10	V	2
Operation start voltage	V_{ST1}	I_{OUT} = 1 mA		–	–	0.9	V	2
Oscillation start voltage	V_{ST2}	No external parts, Voltage applied to V_{OUT}		–	–	0.8	V	1
Operation holding voltage	V_{HLD}	I_{OUT} = 1 mA, Judged by decreasing V_{IN} voltage gradually		0.7	–	–	V	2
Current consumption 1	I_{SS1}	$V_{OUT} = V_{OUT(S)} \times 0.95$	S-835xx15 to 19	–	14.0	23.4	μA	1
			S-835xx20 to 29	–	19.7	32.9	μA	1
			S-835xx30 to 39	–	25.9	43.2	μA	1
			S-835xx40 to 49	–	32.6	54.4	μA	1
			S-835xx50 to 59	–	39.8	66.4	μA	1
			S-835xx60 to 65	–	47.3	78.9	μA	1
Current consumption 2	I_{SS2}	$V_{OUT} = V_{OUT(S)} + 0.5$ V	S-835xx15 to 19	–	5.6	11.1	μA	1
			S-835xx20 to 29	–	5.8	11.5	μA	1
			S-835xx30 to 39	–	5.9	11.8	μA	1
			S-835xx40 to 49	–	6.1	12.1	μA	1
			S-835xx50 to 59	–	6.3	12.5	μA	1
			S-835xx60 to 65	–	6.4	12.8	μA	1
Current consumption during shutdown (With shutdown function)	I_{SSS}	$V_{ON/\overline{OFF}}$ = 0 V		–	–	0.5	μA	1
EXT pin output current	I_{EXTH}	$V_{EXT} = V_{OUT} - 0.4$ V	S-835xx15 to 19	– 4.5	– 8.9	–	mA	1
			S-835xx20 to 24	– 6.2	– 12.3	–	mA	1
			S-835xx25 to 29	– 7.8	– 15.7	–	mA	1
			S-835xx30 to 39	– 10.3	– 20.7	–	mA	1
			S-835xx40 to 49	– 13.3	– 26.7	–	mA	1
			S-835xx50 to 59	– 16.1	– 32.3	–	mA	1
			S-835xx60 to 65	– 18.9	– 37.7	–	mA	1
	I_{EXTL}	V_{EXT} = 0.4 V	S-835xx15 to 19	9.5	19.0	–	mA	1
			S-835xx20 to 24	12.6	25.2	–	mA	1
			S-835xx25 to 29	15.5	31.0	–	mA	1
			S-835xx30 to 39	19.2	38.5	–	mA	1
			S-835xx40 to 49	23.8	47.6	–	mA	1
			S-835xx50 to 59	27.4	54.8	–	mA	1
			S-835xx60 to 65	30.3	60.6	–	mA	1
Line regulation	ΔV_{OUT1}	$V_{IN} = V_{OUT(S)} \times 0.4$ to $\times 0.6$		–	30	60	mV	2
Load regulation	ΔV_{OUT2}	I_{OUT} = 10 μA to $V_{OUT(S)} / 50 \times 1.25$		–	30	60	mV	2
Output voltage temperature coefficient	$\frac{\Delta V_{OUT}}{\Delta Ta \bullet V_{OUT}}$	Ta = –40 to +85°C		–	±50	–	ppm / °C	2
Oscillation frequency	f_{OSC}	$V_{OUT} = V_{OUT(S)} \times 0.95$		85	100	115	kHz	1
Maximum duty ratio	MaxDuty	$V_{OUT} = V_{OUT(S)} \times 0.95$		75	83	90	%	1
PWM / PFM switching duty ratio (For S-8356/58 Series)	PFMDuty	$V_{IN} = V_{OUT(S)} - 0.1$ V, No-load		10	15	24	%	1
$ON/\overline{OFF}$ pin input voltage (With shutdown function)	V_{SH}	Measured oscillation at EXT pin		0.75	–	–	V	1
	V_{SL1}	Judged oscillation stop at EXT pin	At $V_{OUT} \geq 1.5$ V	–	–	0.3	V	1
	V_{SL2}		At $V_{OUT} < 1.5$ V	–	–	0.2	V	1

Table 23 (2 / 2)

(Ta = 25°C unless otherwise specified)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Measurement circuit
ON / $\overline{\text{OFF}}$ pin input current (For with shutdown function)	I_{SH}	$V_{ON/\overline{OFF}} = V_{OUT(S)} \times 0.95$	– 0.1	–	0.1	μA	1
	I_{SL}	$V_{ON/\overline{OFF}} = 0$ V	– 0.1	–	0.1	μA	1
Soft start time	t_{SS}	–	3.0	6.0	12.0	ms	2
Efficiency	EFFI	–	–	85	–	%	2

External parts

Coil: CDRH6D28-470 of Sumida Corporation
Diode: RB461F (Schottky type) of Rohm Co., Ltd.
Capacitor: F93 (16 V, 47 μF tantalum type) of Nichicon Corporation
Transistor: CPH3210 of Sanyo Electric Co., Ltd.
Base resistor (R_b): 1.0 kΩ
Base capacitor (C_b): 2200 pF (ceramic type)

$V_{IN} = V_{OUT(S)} \times 0.6$ applied, $I_{OUT} = V_{OUT(S)} / 50\ \Omega$

With shutdown function : ON / $\overline{\text{OFF}}$ pin is connected to V_{OUT}

For V_{DD} / V_{OUT} separate type : VDD pin is connected to VOUT pin

Remark **1.** $V_{OUT(S)}$ specified above is the set output voltage value, and V_{OUT} is the typical value of the actual output voltage.

2. V_{DD} / V_{OUT} separate type

A step-up operation is performed from V_{DD} = 0.8 V. However, 1.8 V ≤ V_{DD} ≤ 10 V is recommended stabilizing the output voltage and oscillation frequency. (V_{DD} ≥ 1.8 V must be applied for products with a set value of less than 1.9 V.)

(2) 250 kHz Product (H, J and L Types)

Table 24

(Ta = 25°C unless otherwise specified)

Item	Symbol	Condition		Min.	Typ.	Max.	Unit	Measurement circuit
Output voltage	V_{OUT}	–		$V_{OUT(S)} \times 0.976$	$V_{OUT(S)}$	$V_{OUT(S)} \times 1.024$	V	2
Input voltage	V_{IN}	–		–	–	10	V	2
Operation start voltage	V_{ST1}	I_{OUT} = 1 mA		–	–	0.9	V	2
Oscillation start voltage	V_{ST2}	No external parts, Voltage applied to V_{OUT}		–	–	0.8	V	1
Operation holding voltage	V_{HLD}	I_{OUT} = 1 mA, Judged by decreasing V_{IN} voltage gradually		0.7	–	–	V	2
Current consumption 1	I_{SS1}	$V_{OUT} = V_{OUT(S)} \times 0.95$	S-835xx15 to 19	–	28.9	48.2	μA	1
			S-835xx20 to 29	–	42.7	71.1	μA	1
			S-835xx30 to 39	–	58.0	96.7	μA	1
			S-835xx40 to 49	–	74.5	124.1	μA	1
			S-835xx50 to 59	–	92.0	153.4	μA	1
			S-835xx60 to 65	–	110.5	184.2	μA	1
Current consumption 2	I_{SS2}	$V_{OUT} = V_{OUT(S)} + 0.5$ V	S-835xx15 to 19	–	8.7	17.3	μA	1
			S-835xx20 to 29	–	8.8	17.6	μA	1
			S-835xx30 to 39	–	9.0	18.0	μA	1
			S-835xx40 to 49	–	9.2	18.3	μA	1
			S-835xx50 to 59	–	9.3	18.6	μA	1
			S-835xx60 to 65	–	9.5	19.0	μA	1
Current consumption during shutdown (With shutdown function)	I_{SSS}	$V_{ON/\overline{OFF}}$ = 0 V		–	–	0.5	μA	1
EXT pin output current	I_{EXTH}	$V_{EXT} = V_{OUT} - 0.4$ V	S-835xx15 to 19	– 4.5	– 8.9	–	mA	1
			S-835xx20 to 24	– 6.2	– 12.3	–	mA	1
			S-835xx25 to 29	– 7.8	– 15.7	–	mA	1
			S-835xx30 to 39	– 10.3	– 20.7	–	mA	1
			S-835xx40 to 49	– 13.3	– 26.7	–	mA	1
			S-835xx50 to 59	– 16.1	– 32.3	–	mA	1
			S-835xx60 to 65	– 18.9	– 37.7	–	mA	1
	I_{EXTL}	V_{EXT} = 0.4 V	S-835xx15 to 19	9.5	19.0	–	mA	1
			S-835xx20 to 24	12.6	25.2	–	mA	1
			S-835xx25 to 29	15.5	31.0	–	mA	1
			S-835xx30 to 39	19.2	38.5	–	mA	1
			S-835xx40 to 49	23.8	47.6	–	mA	1
			S-835xx50 to 59	27.4	54.8	–	mA	1
			S-835xx60 to 65	30.3	60.6	–	mA	1
Line regulation	ΔV_{OUT1}	$V_{IN} = V_{OUT(S)} \times 0.4$ to $\times 0.6$		–	30	60	mV	2
Load regulation	ΔV_{OUT2}	I_{OUT} = 10 μA to $V_{OUT(S)} / 50 \times 1.25$		–	30	60	mV	2
Output voltage temperature coefficient	$\frac{\Delta V_{OUT}}{\Delta Ta \bullet V_{OUT}}$	Ta = –40 to +85°C		–	±50	–	ppm / °C	2
Oscillation frequency	f_{OSC}	$V_{OUT} = V_{OUT(S)} \times 0.95$		212.5	250	287.5	kHz	1
Maximum duty ratio	MaxDuty	$V_{OUT} = V_{OUT(S)} \times 0.95$		70	78	85	%	1
PWM / PFM switching duty ratio (For S-8356/58 Series)	PFMDuty	$V_{IN} = V_{OUT(S)} - 0.1$ V, No-load		10	15	24	%	1
$ON/\overline{OFF}$ pin input voltage (With shutdown function)	V_{SH}	Measured oscillation at EXT pin		0.75	–	–	V	1
	V_{SL1}	Judged oscillation stop at EXT pin	At $V_{OUT} \geq 1.5$ V	–	–	0.3	V	1
	V_{SL2}		At $V_{OUT} < 1.5$ V	–	–	0.2	V	1
$ON/\overline{OFF}$ pin input current (With shutdown function)	I_{SH}	$V_{ON/\overline{OFF}} = V_{OUT(S)} \times 0.95$		– 0.1	–	0.1	μA	1
	I_{SL}	$V_{ON/\overline{OFF}}$ = 0 V		– 0.1	–	0.1	μA	1
Soft start time	t_{SS}	–		1.5	3.0	6.0	ms	2
Efficiency	EFFI	–		–	85	–	%	2

External parts

Coil:	CDRH6D28-220 of Sumida Corporation
Diode:	RB461F (Schottky type) of Rohm Co., Ltd.
Capacitor:	F93 (16 V, 47 μF tantalum type) of Nichicon Corporation
Transistor:	CPH3210 of Sanyo Electric Co., Ltd.
Base resistor (R_b):	1.0 kΩ
Base capacitor (C_b):	2200 pF (ceramic type)

$V_{IN} = V_{OUT(S)} \times 0.6$ applied, $I_{OUT} = V_{OUT(S)} / 50\ \Omega$

With shutdown function : $\overline{ON}/OFF$ pin is connected to V_{OUT}

For V_{DD} / V_{OUT} separate type : VDD pin is connected to VOUT pin

Remark **1.** $V_{OUT(S)}$ specified above is the set output voltage value, and V_{OUT} is the typical value of the actual output voltage.

2. V_{DD} / V_{OUT} separate type

A step-up operation is performed from V_{DD} = 0.8 V. However, 1.8 V ≤ V_{DD} ≤ 10 V is recommended stabilizing the output voltage and oscillation frequency. (V_{DD} ≥ 1.8 V must be applied for products with a set value of less than 1.9 V.)

(3) 300 kHz Product (F, G and M Types)

Table 25

(Ta = 25°C unless otherwise specified)

Item	Symbol	Condition		Min.	Typ.	Max.	Unit	Measurement circuit
Output voltage	V_{OUT}	–		$V_{OUT(S)} \times 0.976$	$V_{OUT(S)}$	$V_{OUT(S)} \times 1.024$	V	2
Input voltage	V_{IN}	–		–	–	10	V	2
Operation start voltage	V_{ST1}	I_{OUT} = 1 mA		–	–	0.9	V	2
Oscillation start voltage	V_{ST2}	No external parts, Voltage applied to V_{OUT}		–	–	0.8	V	1
Operation holding voltage	V_{HLD}	I_{OUT} = 1 mA, Judged by decreasing V_{IN} voltage gradually		0.7	–	–	V	2
Current consumption 1	I_{SS1}	$V_{OUT} = V_{OUT(S)} \times 0.95$	S-835xx15 to 19	–	33.8	56.4	μA	1
			S-835xx20 to 29	–	50.3	83.9	μA	1
			S-835xx30 to 39	–	68.6	114.4	μA	1
			S-835xx40 to 49	–	88.4	147.4	μA	1
			S-835xx50 to 59	–	109.4	182.4	μA	1
			S-835xx60 to 65	–	131.6	219.3	μA	1
Current consumption 2	I_{SS2}	$V_{OUT} = V_{OUT(S)} + 0.5$ V	S-835xx15 to 19	–	9.7	19.4	μA	1
			S-835xx20 to 29	–	9.9	19.7	μA	1
			S-835xx30 to 39	–	10.0	20.0	μA	1
			S-835xx40 to 49	–	10.2	20.4	μA	1
			S-835xx50 to 59	–	10.4	20.7	μA	1
			S-835xx60 to 65	–	10.5	21.0	μA	1
Current consumption during shutdown (With shutdown function)	I_{SSS}	$V_{ON/\overline{OFF}}$ = 0 V		–	–	0.5	μA	1
EXT pin output current	I_{EXTH}	$V_{EXT} = V_{OUT} - 0.4$ V	S-835xx15 to 19	– 4.5	– 8.9	–	mA	1
			S-835xx20 to 24	– 6.2	– 12.3	–	mA	1
			S-835xx25 to 29	– 7.8	– 15.7	–	mA	1
			S-835xx30 to 39	– 10.3	– 20.7	–	mA	1
			S-835xx40 to 49	– 13.3	– 26.7	–	mA	1
			S-835xx50 to 59	– 16.1	– 32.3	–	mA	1
			S-835xx60 to 65	– 18.9	– 37.7	–	mA	1
	I_{EXTL}	V_{EXT} = 0.4 V	S-835xx15 to 19	9.5	19.0	–	mA	1
			S-835xx20 to 24	12.6	25.2	–	mA	1
			S-835xx25 to 29	15.5	31.0	–	mA	1
			S-835xx30 to 39	19.2	38.5	–	mA	1
			S-835xx40 to 49	23.8	47.6	–	mA	1
			S-835xx50 to 59	27.4	54.8	–	mA	1
			S-835xx60 to 65	30.3	60.6	–	mA	1
Line regulation	ΔV_{OUT1}	$V_{IN} = V_{OUT(S)} \times 0.4$ to $\times 0.6$		–	30	60	mV	2
Load regulation	ΔV_{OUT2}	I_{OUT} = 10 μA to $V_{OUT(S)} / 50 \times 1.25$		–	30	60	mV	2
Output voltage temperature coefficient	$\frac{\Delta V_{OUT}}{\Delta Ta \bullet V_{OUT}}$	Ta = –40 to +85°C		–	±50	–	ppm / °C	2
Oscillation frequency	f_{OSC}	$V_{OUT} = V_{OUT(S)} \times 0.95$		255	300	345	kHz	1
Maximum duty ratio	MaxDuty	$V_{OUT} = V_{OUT(S)} \times 0.95$		70	78	85	%	1
PWM / PFM switching duty ratio (For S-8356/58 Series)	PFMDuty	$V_{IN} = V_{OUT(S)} - 0.1$ V, No-load		10	15	24	%	1
$ON/\overline{OFF}$ pin input voltage (With shutdown function)	V_{SH}	Measured oscillation at EXT pin		0.75	–	–	V	1
	V_{SL1}	Judged oscillation stop at EXT pin	At $V_{OUT} \geq 1.5$ V	–	–	0.3	V	1
	V_{SL2}		At $V_{OUT} < 1.5$ V	–	–	0.2	V	1
$ON/\overline{OFF}$ pin input current (With shutdown function)	I_{SH}	$V_{ON/\overline{OFF}} = V_{OUT(S)} \times 0.95$		– 0.1	–	0.1	μA	1
	I_{SL}	$V_{ON/\overline{OFF}}$ = 0 V		– 0.1	–	0.1	μA	1
Soft start time	t_{SS}	–		1.5	3.0	6.0	ms	2
Efficiency	EFFI	–		–	85	–	%	2

External parts

Coil:	CDRH6D28-220 of Sumida Corporation
Diode:	RB461F (Schottky type) of Rohm Co., Ltd.
Capacitor:	F93 (16 V, 47 μF tantalum type) of Nichicon Corporation
Transistor:	CPH3210 of Sanyo Electric Co., Ltd.
Base resistor (R_b):	1.0 kΩ
Base capacitor (C_b):	2200 pF (ceramic type)

$V_{IN} = V_{OUT(S)} \times 0.6$ applied, $I_{OUT} = V_{OUT(S)} / 50\ \Omega$

With shutdown function : ON/$\overline{\text{OFF}}$ pin is connected to V_{OUT}

For V_{DD} / V_{OUT} separate type : VDD pin is connected to VOUT pin

Remark **1.** $V_{OUT(S)}$ specified above is the set output voltage value, and V_{OUT} is the typical value of the actual output voltage.

2. V_{DD} / V_{OUT} separate type

A step-up operation is performed from V_{DD} = 0.8 V. However, 1.8 V ≤ V_{DD} ≤ 10 V is recommended stabilizing the output voltage and oscillation frequency. (V_{DD} ≥ 1.8 V must be applied for products with a set value of less than 1.9 V.)

(4) 600 kHz Product (N Type)

Table 26

(Ta = 25°C unless otherwise specified)

Item	Symbol	Condition		Min.	Typ.	Max.	Unit	Measurement circuit
Output voltage	V_{OUT}	–		$V_{OUT(S)} \times 0.976$	$V_{OUT(S)}$	$V_{OUT(S)} \times 1.024$	V	2
Input voltage	V_{IN}	–		–	–	10	V	2
Operation start voltage	V_{ST1}	I_{OUT} = 1 mA		–	–	0.9	V	2
Oscillation start voltage	V_{ST2}	No external parts, Voltage applied to V_{OUT}		–	–	0.8	V	1
Operation holding voltage	V_{HLD}	I_{OUT} = 1 mA, Judged by decreasing V_{IN} voltage gradually		0.7	–	–	V	2
Current consumption 1	I_{SS1}	$V_{OUT} = V_{OUT(S)} \times 0.95$	S-835xx15 to 19	–	63.6	105.9	μA	1
			S-835xx20 to 29	–	96.4	160.6	μA	1
			S-835xx30 to 39	–	132.8	221.3	μA	1
			S-835xx40 to 49	–	172.2	286.9	μA	1
			S-835xx50 to 59	–	214.0	356.7	μA	1
			S-835xx60 to 65	–	240.2	400.3	μA	1
Current consumption 2	I_{SS2}	$V_{OUT} = V_{OUT(S)} + 0.5$ V	S-835xx15 to 19	–	15.9	31.8	μA	1
			S-835xx20 to 29	–	16.1	32.1	μA	1
			S-835xx30 to 39	–	16.2	32.4	μA	1
			S-835xx40 to 49	–	16.4	32.8	μA	1
			S-835xx50 to 59	–	16.6	33.1	μA	1
			S-835xx60 to 65	–	16.7	33.3	μA	1
Current consumption during shutdown	I_{SSS}	$V_{ON/\overline{OFF}}$ = 0 V		–	–	0.5	μA	1
EXT pin output current	I_{EXTH}	$V_{EXT} = V_{OUT} - 0.4$ V	S-835xx15 to 19	– 4.5	– 8.9	–	mA	1
			S-835xx20 to 24	– 6.2	– 12.3	–	mA	1
			S-835xx25 to 29	– 7.8	– 15.7	–	mA	1
			S-835xx30 to 39	– 10.3	– 20.7	–	mA	1
			S-835xx40 to 49	– 13.3	– 26.7	–	mA	1
			S-835xx50 to 59	– 16.1	– 32.3	–	mA	1
			S-835xx60 to 65	– 18.9	– 37.7	–	mA	1
	I_{EXTL}	V_{EXT} = 0.4 V	S-835xx15 to 19	9.5	19.0	–	mA	1
			S-835xx20 to 24	12.6	25.2	–	mA	1
			S-835xx25 to 29	15.5	31.0	–	mA	1
			S-835xx30 to 39	19.2	38.5	–	mA	1
			S-835xx40 to 49	23.8	47.6	–	mA	1
			S-835xx50 to 59	27.4	54.8	–	mA	1
			S-835xx60 to 65	30.3	60.6	–	mA	1
Line regulation	ΔV_{OUT1}	$V_{IN} = V_{OUT(S)} \times 0.4$ to $\times 0.6$		–	30	60	mV	2
Load regulation	ΔV_{OUT2}	I_{OUT} = 10 μA to $V_{OUT(S)}$ / 50 × 1.25		–	30	60	mV	2
Output voltage temperature coefficient	$\frac{\Delta V_{OUT}}{\Delta Ta \bullet V_{OUT}}$	Ta = –40 to +85°C		–	±50	–	ppm / °C	2
Oscillation frequency	f_{OSC}	$V_{OUT} = V_{OUT(S)} \times 0.95$		510	600	690	kHz	1
Maximum duty ratio	MaxDuty	$V_{OUT} = V_{OUT(S)} \times 0.95$		65	78	85	%	1
PWM / PFM switching duty ratio (For S-8356/58 Series)	PFMDuty	$V_{IN} = V_{OUT(S)} - 0.1$ V, No-load		10	15	24	%	1
$ON/\overline{OFF}$ pin input voltage	V_{SH}	Measured oscillation at EXT pin		0.75	–	–	V	1
	V_{SL1}	Judged oscillation stop at EXT pin	At $V_{OUT} \geq 1.5$ V	–	–	0.3	V	1
	V_{SL2}		At $V_{OUT} < 1.5$ V	–	–	0.2	V	1
$ON/\overline{OFF}$ pin input current	I_{SH}	$V_{ON/\overline{OFF}} = V_{OUT(S)} \times 0.95$		– 0.1	–	0.1	μA	1
	I_{SL}	$V_{ON/\overline{OFF}}$ = 0 V		– 0.1	–	0.1	μA	1
Soft start time	t_{SS}	–		1.5	3.0	6.0	ms	2
Efficiency	EFFI	–		–	85	–	%	2

External parts

Coil:	CDRH6D28-100 of Sumida Corporation
Diode:	RB461F (Schottky type) of Rohm Co., Ltd.
Capacitor:	F93 (16 V, 47 μF tantalum type) of Nichicon Corporation
Transistor:	CPH3210 of Sanyo Electric Co., Ltd.
Base resistor (R_b):	1.0 kΩ
Base capacitor (C_b):	2200 pF (ceramic type)

$V_{IN} = V_{OUT(S)} \times 0.6$ applied, $I_{OUT} = V_{OUT(S)} / 50\ \Omega$, ON / $\overline{\text{OFF}}$ = V_{OUT}

Remark $V_{OUT(S)}$ specified above is the set output voltage value, and V_{OUT} is the typical value of the actual output voltage.

(5) 600 kHz Product (P and Q types)

Table 27

(Ta = 25°C unless otherwise specified)

Item	Symbol	Condition		Min.	Typ.	Max.	Unit	Measurement circuit
Output voltage	V_{OUT}	–		$V_{OUT(S)} \times 0.976$	$V_{OUT(S)}$	$V_{OUT(S)} \times 1.024$	V	4
Input voltage	V_{IN}	–		–	–	10	V	4
Operation start voltage	V_{ST1}	I_{OUT} = 1 mA		–	–	0.9	V	4
Oscillation start voltage	V_{ST2}	No external parts, Voltage applied to V_{DD}		–	–	0.8	V	3
Operation holding voltage	V_{HLD}	I_{OUT} = 1 mA, Judged by decreasing V_{IN} voltage gradually		0.7	–	–	V	4
Current consumption 1	I_{SS1}	V_{DD} = 3.3 V		–	132.8	221.3	μA	3
Current consumption 2	I_{SS2}	V_{DD} = 3.3 V		–	16.2	32.4	μA	3
Current consumption during shutdown (With shutdown function)	I_{SSS}	$V_{ON/\overline{OFF}}$ = 0 V		–	–	0.5	μA	3
EXT pin output current	I_{EXTH}	V_{DD} = 3.3 V		– 10.3	– 20.7	–	mA	3
	I_{EXTL}	V_{DD} = 3.3 V		19.2	38.5	–	mA	3
Line regulation	ΔV_{OUT1}	$V_{IN} = V_{OUT(S)} \times 0.4$ to $\times 0.6$		–	30	60	mV	4
Load regulation	ΔV_{OUT2}	I_{OUT} = 10 μA to $V_{OUT(S)} / 50 \times 1.25$		–	30	60	mV	4
Output voltage temperature coefficient	$\frac{\Delta V_{OUT}}{\Delta Ta \bullet V_{OUT}}$	Ta = –40 to +85°C		–	±50	–	ppm / °C	4
Oscillation frequency	f_{OSC}	V_{DD} = 3.3 V		510	600	690	kHz	3
Maximum duty ratio	MaxDuty	V_{DD} = 3.3 V		65	78	85	%	3
PWM / PFM switching duty ratio (For S-8356/58 Series)	PFMDuty	$V_{IN} = V_{OUT(S)} - 0.1$ V, No-load		10	15	24	%	3
$ON/\overline{OFF}$ pin input voltage (With shutdown function)	V_{SH}	Measured oscillation at EXT pin		0.75	–	–	V	3
	V_{SL1}	Judged oscillation stop at EXT pin	At $V_{OUT} \geq 1.5$ V	–	–	0.3	V	3
	V_{SL2}		At $V_{OUT} < 1.5$ V	–	–	0.2	V	3
$ON/\overline{OFF}$ pin input current (With shutdown function)	I_{SH}	$V_{ON/\overline{OFF}} = V_{OUT(S)} \times 0.95$		– 0.1	–	0.1	μA	3
	I_{SL}	$V_{ON/\overline{OFF}}$ = 0 V		– 0.1	–	0.1	μA	3
Soft start time	t_{SS}	–		1.5	3.0	6.0	ms	4
Efficiency	EFFI	–		–	85	–	%	4

External parts

Coil: CDRH6D28-100 of Sumida Corporation
Diode: RB461F (Schottky type) of Rohm Co., Ltd.
Capacitor: F93 (16 V, 47 μF tantalum type) of Nichicon Corporation
Transistor: CPH3210 of Sanyo Electric Co., Ltd.
Base resistor (R_b): 1.0 kΩ
Base capacitor (C_b): 2200 pF (ceramic type)

$V_{IN} = V_{OUT(S)} \times 0.6$ applied, $I_{OUT} = V_{OUT(S)} / 50\ \Omega$, $ON/\overline{OFF} = V_{OUT}$

Remark **1.** $V_{OUT(S)}$ specified above is the set output voltage value, and V_{OUT} is the typical value of the actual output voltage.
2. V_{DD} / V_{OUT} separate type
A step-up operation is performed from V_{DD} = 0.8 V. However, 1.8 V ≤ V_{DD} ≤ 10 V is recommended stabilizing the output voltage and oscillation frequency. ($V_{DD} \geq 1.8$ V must be applied for products with a set value of less than 1.9 V.)

■ Measurement Circuits

1.

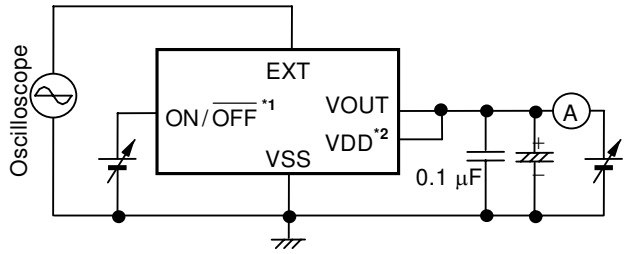


Figure 10

2.

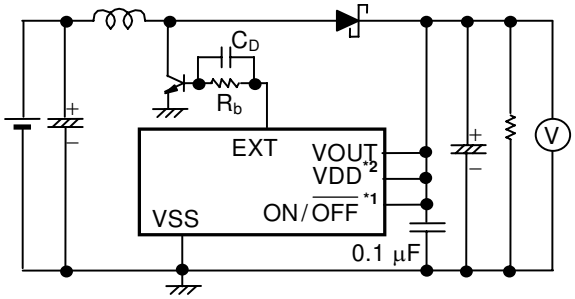


Figure 11

3.

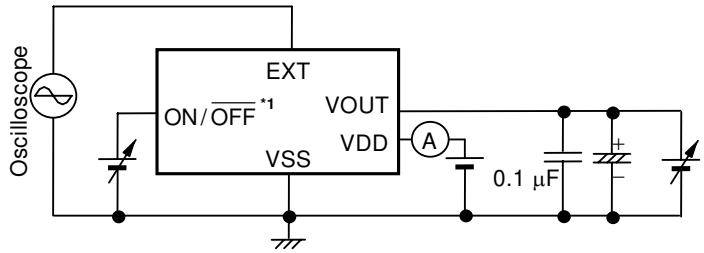


Figure 12

4.

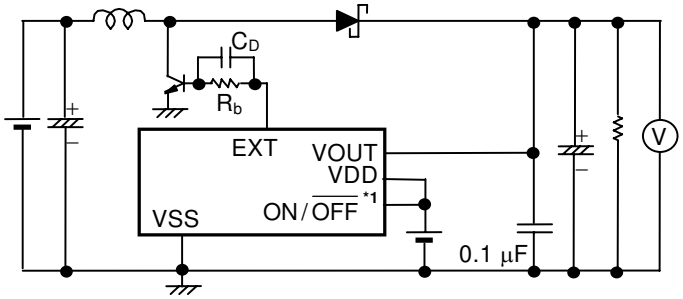


Figure 13

***1.** With shutdown function
***2.** For V_{DD} / V_{OUT} separate type

■ Operation

1. Switching Control Types

1.1 PWM Control (S-8355/57 Series)

The S-8355/57 Series is a DC-DC converter using a pulse width modulation method (PWM) and features a low current consumption.
In conventional PFM DC-DC converters, pulses are skipped when the output load current is low, causing a fluctuation in the ripple frequency of the output voltage, resulting in an increase in the ripple voltage. The switching frequency does not change, although the pulse width changes from 0 to 83% (78% for F, G, H, J, L, M, N, P and Q types) corresponding to each load current. The ripple voltage generated from switching can thus be removed easily through a filter because the switching frequency is constant.

1.2 PWM/PFM Switching Control (S-8356/58 Series)

S-8356/58 Series is a DC-DC converter that automatically switches between a pulse width modulation method (PWM) and a pulse frequency modulation method (PFM), depending on the load current, and features low current consumption.
The S-8356/58 Series operates under PWM control with the pulse width duty changing from 15 to 83% (78% for F, G, H, J, L, M, N, P and Q types) in a high output load current area.
The S-8356/58 Series operates under PFM control with the pulse width duty fixed at 15%, and pulses are skipped according to the load current. The oscillation circuit thus oscillates intermittently so that the resultant lower self current consumption prevents a reduction in the efficiency at a low load current. The switching point from PWM control to PFM control depends on the external devices (coil, diode, etc.), input voltage and output voltage. This series are an especially highly efficient DC-DC converter at an output current around 100 μA.

2. Soft Start Function

For this IC, the built-in soft start circuit controls the rush current and overshoot of the output voltage when powering on or when the ON/$\overline{\text{OFF}}$ pin is switched to the “H” level.