MB39C326

ASSP for Power Supply Applications
6MHz Synchronous Rectification
Buck-Boost DC/DC Converter IC

Data Sheet (Full Production)

Publication Number MB39C326_ DS405-00001 Revision 2.1 Issue Date January 31, 2014

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■ DESCRIPTION

The MB39C326 is a high efficiency, low noise synchronous, Buck-boost DC/DC converter designed for powering the radio frequency power amplifiers (RFPA) in 3G/GSM mobile handsets and other mobile applications.

■ FEATURES

- High efficiency : Up to 93%
- Input voltage range : 2.5 V to 5.5 V
- Adjustable output voltage range : 0.8 V to 5.0 V
- Over current limit value (peak) : 3.1A/1.3A/0.49A
- Maximum output current
  - (Buck, PWM mode) : 1200mA (V_{IN}=5.0V to 5.5V, at Vo=5.0V)
    : 1200mA (V_{IN}=3.6V to 5.5V, at Vo=3.6V)
    : 1200mA (V_{IN}=3.3V to 5.5V, at Vo=3.3V)
  - (Boost, PWM mode) : 900mA (V_{IN}=3.7V to 5.0V, at Vo=5.0V)
    : 700mA (V_{IN}=2.5V to 3.6V, at Vo=3.6V)
    : 800mA (V_{IN}=2.5V to 3.3V, at Vo=3.3V)
  - (Buck, PowerSave mode) : 600mA (V_{IN}=5.0V to 5.5V, at Vo=5.0V)
    : 600mA (V_{IN}=3.6V to 5.5V, at Vo=3.6V)
    : 600mA (V_{IN}=3.3V to 5.5V, at Vo=3.3V)
  - (Boost, PowerSave mode) : 500mA (V_{IN}=3.7V to 5.0V, at Vo=5.0V)
    : 400mA (V_{IN}=2.5V to 3.6V, at Vo=3.6V)
    : 500mA (V_{IN}=2.5V to 3.3V, at Vo=3.3V)
- Quiescent current : 50µA
- 6MHz PWM operation allows 0.5µH small form inductor
- Automatic Transition between Buck mode and boost mode
- Power-Save Mode for improved efficiency at light load current

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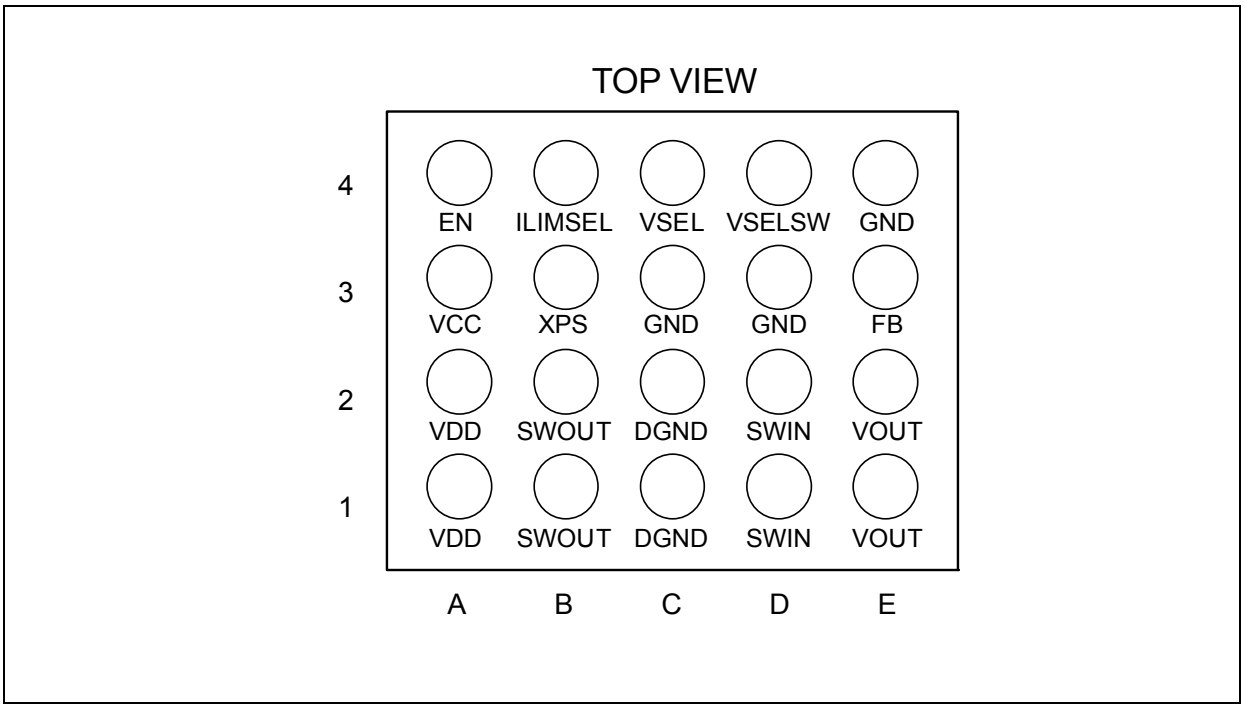
- Selectable output voltage with external resistor
- Built-in Over temperature protection circuit
- Built-in Under voltage lockout protection circuit
- Package : WL-CSP (20pin 0.4 mm-ball-pitch 2.15×1.94 mm)

■ APPLICATIONS

- Products that use 1-cell lithium batteries for the power supply
- RF power amplifier
- Cell-phone
- RF-PC card and PDA

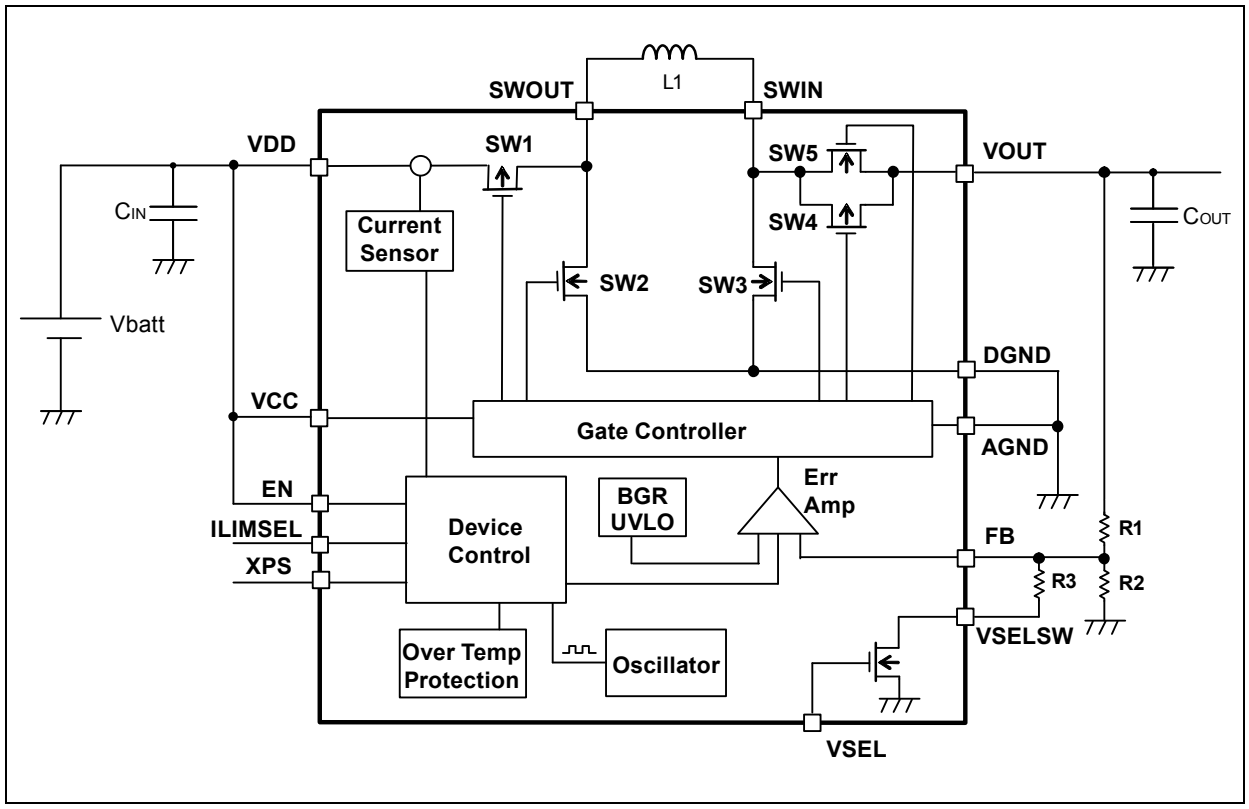
■ PIN ASSIGNMENTS



■ PIN DISCRIPTIONS

Pin No.	Pin Name	I/O	Description
A4	EN	I	IC Enable input pin (H: Enable, L: Shutdown)
E3	FB	I	Voltage feedback pin
C3,D3,E4	GND		Control / Logic ground pins
B4	ILIMSEL	I	Current limit mode pin
B1,B2	SWOUT	I	Connection pins for Inductor
D1,D2	SWIN	I	Connection pins for Inductor
C1,C2	DGND		Power ground pins
C4	VSEL	I	Output voltage select pin (H:Using R3 L:No using R3)
D4	VSELSW		Connection pin for output voltage setting resistor R3
A1,A2	VDD	I	Electric power input pin for DCDC converter output voltage
A3	VCC	I	Electric power input pin for IC control block
B3	XPS	I	Power save mode pin (H: Normal mode, L: Power save mode)
E1,E2	VOUT	O	Buck-boost converter output pins

■ BLOCK DIAGRAM



■ FUNCTION

(1) Gate Controller

It is controlled the synchronous rectification operation of built-in 2-P-ch MOS FETs and 2-N-ch MOS FETs according to frequency (6 MHz) set with a oscillator at the normal operation.

(2) Error Amp & phase compensation circuit

This compares the feedback voltage and the reference voltage (VREF). This IC contains the phase compensation circuit which optimizes the IC operation. Therefore, it is unnecessary to consideration of the phase compensation circuit, and external parts for the phase compensation.

(3) Band gap reference circuit

A high accuracy reference voltage is generated with BGR (band gap reference) circuit.

(4) Oscillator

The internal oscillator output a 6 MHz clock signal to set a switching frequency.

(5) Over temperature protection circuit

The over temperature protection circuit is built-in as a protection circuit. When junction temperature reaches +125°C, the over temperature protection circuit turns off all N-ch MOS FETs and P-ch MOS FETs. Also, when the junction temperature falls to +110°C, this IC operates normally.

(6) Over current protection circuit (Current Sensor + Device Control)

The over current protection circuit detects the current (I_{LX}) which flows from built-in P-ch MOS FET connected to VDD into an external inductor. The over current protection circuit controls the peak value of current (I_{PK}).

(7) Power save mode operation

Power save mode is used to improve efficiency at the light load. By setting the XPS pin to "L" level, power save mode is set and the operation is performed in PWM mode or PFM mode depending on the load current. At this time, if the load current is low, this IC operates with PFM (PulseFrequency Modulation). It should be used above V_{OUT} = 0.8V. If the output voltage becomes lower than the setting value at the light load, switching is performed several times and the output voltage rises. If the output voltage reaches the setting value, it changes to the stop state, all of the four FETs are turned off, and the switching loss and the dissipation power for the circuit are suppressed.
Consumption current in stop state at the power-save-mode becomes about 50µA.

• Function Table

Mode	XPS	ILIMSEL	Input voltage range[V]		Output voltage range[V]		Over current limit (I_{PK}) [A]
			Min	Max	Min	Max	
PWM mode	H	L	2.5	5.5	0.8	5.0	3.1
Power save mode	L	H					1.3
		L					0.49

Note: Input of (XPS, ILIMSEL=H, H) is prohibited.

(8) EN pin

When the EN pin is set to "H" level, the device operation is enabled. When the EN pin is set to GND, the device is switched to shutdown mode.

When the EN pin is set to "L" level, the device is switched to shutdown mode.
In shutdown mode, the regulator stops switching, all FET switches are turned off, and the load is disconnected from the input.

(9) VSEL pin

MB39C326 has a function to change the output voltage with the VSEL pin and additional resistance.
For details of the output voltage settings, see the section (2) of "Programming the Output Voltage" in ■ APPLICATION NOTES.

(10) Buck-Boost operations

MB39C326 operates in Buck or Boost mode by monitoring the VCC/VOUT voltage with a newly developed PWM controller.
The transition between buck and boost mode is smooth and the efficiency is high.

During Buck mode (VCC>VOUT), SW1 and SW2 perform switching while SW3 is fixed to OFF and SW4 and 5 are fixed to ON.
During Boost mode (VCC<VOUT), SW3, SW4 and SW5 perform switching while SW1 is fixed to ON and SW2 is fixed to OFF.

The voltage values of VCC and VDD at the switching between buck and boost vary depending on the load current, the environmental temperature and the process variations.

(11) Startup circuit

MB39C326 has the soft-start function to prevent rush current upon turning on of the power.
The startup time is approximately 100µ seconds.

■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Condition	Rating		Unit
			Min	Max	
Power supply voltage	V_{MAX}	VDD, VCC	-0.3	+7.0	V
Signal input voltage	V_{INMAX}	EN, XPS, VSEL, ILIMSEL	-0.3	V_{DD}+0.3	V
Power dissipation	P_D	Ta ≤ +25°C	-	1080	mW
Storage temperature	T_{STG}	-	-65	+150	°C
ESD Voltage	V_{ESDH}	Human Body Model (100 pF, 1.5 kΩ)	-2000	+2000	V
	V_{ESDM}	Machine Model (200 pF, 0Ω)	-200	+200	V
	V_{ESDC}	Charged device model	-1000	+1000	V
Maximum junction temperature	Tj_{-MAX}	-	-	+95	°C

WARNING: Semiconductor devices may be permanently damaged by application of stress (including, without limitation, voltage, current or temperature) in excess of absolute maximum ratings.
Do not exceed any of these ratings.

■ RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Condition	Value			Unit
			Min	Typ	Max	
Power supply voltage	V_{DD}	VDD, VCC	2.5*	3.7	5.5*	V
Signal input voltage	V_{IDD}	EN, XPS, VSEL, ILIMSEL	0.0	-	V_{DD}	V
Output current (Buck) PWM mode	Io (Max1)	V_{IN}=5.5, Vo=5.0V, XPS=H, ILIMSEL=L	-	-	1200	mA
	Io (Max2)	V_{IN}=5.5, Vo=4.4V, XPS=H, ILIMSEL=L	-	-	1200	mA
	Io (Max3)	V_{IN}=5.5, Vo=3.6V, XPS=H, ILIMSEL=L	-	-	1200	mA
		V_{IN}=4.2, Vo=3.6V, XPS=H, ILIMSEL=L	-	-	1200	mA
	Io (Max4)	V_{IN}=5.5, Vo=3.3V, XPS=H, ILIMSEL=L	-	-	1200	mA
		V_{IN}=3.7, Vo=3.3V, XPS=H, ILIMSEL=L	-	-	1200	mA
	Io (Max5)	V_{IN}=5.5, Vo=2.0V, XPS=H, ILIMSEL=L	-	-	1200	mA
		V_{IN}=3.7, Vo=2.0V, XPS=H, ILIMSEL=L	-	-	1200	mA
		V_{IN}=2.5, Vo=2.0V, XPS=H, ILIMSEL=L	-	-	1200	mA
	Io (Max6)	V_{IN}=5.5, Vo=1.2V, XPS=H, ILIMSEL=L	-	-	700	mA
		V_{IN}=3.7, Vo=1.2V, XPS=H, ILIMSEL=L	-	-	600	mA
		V_{IN}=2.5, Vo=1.2V, XPS=H, ILIMSEL=L	-	-	600	mA
	Io (Max7)	V_{IN}=5.5, Vo=0.8V, XPS=H, ILIMSEL=L	-	-	600	mA
		V_{IN}=3.7, Vo=0.8V, XPS=H, ILIMSEL=L	-	-	500	mA
		V_{IN}=2.5, Vo=0.8V, XPS=H, ILIMSEL=L	-	-	250	mA
Output current (Boost) PWM mode	Io (Max8)	V_{IN}=2.5V, Vo=3.3V, XPS=H, ILIMSEL=L	-	-	800	mA
	Io (Max9)	V_{IN}=2.5V, Vo=3.6V, XPS=H, ILIMSEL=L	-	-	700	mA
	Io (Max10)	V_{IN}=3.7V, Vo=4.4V, XPS=H, ILIMSEL=L	-	-	1000	mA
		V_{IN}=2.5V, Vo=4.4V, XPS=H, ILIMSEL=L	-	-	700	mA
	Io (Max11)	V_{IN}=3.7V, Vo=5V, XPS=H, ILIMSEL=L	-	-	900	mA
		V_{IN}=2.5V, Vo=5V, XPS=H, ILIMSEL=L	-	-	600	mA
Output current (Buck) PowerSave mode	Io (Max12)	V_{IN}=5.5, Vo=5.0V, XPS=L, ILIMSEL=H	-	-	600	mA
	Io (Max13)	V_{IN}=5.5, Vo=4.4V, XPS=L, ILIMSEL=H	-	-	600	mA
	Io (Max14)	V_{IN}=5.5, Vo=3.6V, XPS=L, ILIMSEL=H	-	-	600	mA
		V_{IN}=4.2, Vo=3.6V, XPS=L, ILIMSEL=H	-	-	600	mA
	Io (Max15)	V_{IN}=5.5, Vo=3.3V, XPS=L, ILIMSEL=H	-	-	600	mA
		V_{IN}=3.7, Vo=3.3V, XPS=L, ILIMSEL=H	-	-	600	mA
	Io (Max16)	V_{IN}=5.5, Vo=2.0V, XPS=L, ILIMSEL=H	-	-	600	mA
		V_{IN}=3.7, Vo=2.0V, XPS=L, ILIMSEL=H	-	-	500	mA
		V_{IN}=2.5, Vo=2.0V, XPS=L, ILIMSEL=H	-	-	500	mA
	Io (Max17)	V_{IN}=5.5, Vo=1.2V, XPS=L, ILIMSEL=H	-	-	400	mA
		V_{IN}=3.7, Vo=1.2V, XPS=L, ILIMSEL=H	-	-	300	mA
		V_{IN}=2.5, Vo=1.2V, XPS=L, ILIMSEL=H	-	-	300	mA
	Io (Max18)	V_{IN}=5.5, Vo=0.8V, XPS=L, ILIMSEL=H	-	-	400	mA
		V_{IN}=3.7, Vo=0.8V, XPS=L, ILIMSEL=H	-	-	200	mA
		V_{IN}=2.5, Vo=0.8V, XPS=L, ILIMSEL=H	-	-	200	mA
Output current (Boost) PowerSave mode	Io (Max19)	V_{IN}=2.5V, Vo=3.3V, XPS=L, ILIMSEL=H	-	-	500	mA
	Io (Max20)	V_{IN}=2.5V, Vo=3.6V, XPS=L, ILIMSEL=H	-	-	400	mA
	Io (Max21)	V_{IN}=3.7V, Vo=4.4V, XPS=L, ILIMSEL=H	-	-	600	mA
		V_{IN}=2.5V, Vo=4.4V, XPS=L, ILIMSEL=H	-	-	350	mA
	Io (Max22)	V_{IN}=3.7V, Vo=5V, XPS=L, ILIMSEL=H	-	-	500	mA
		V_{IN}=2.5V, Vo=5V, XPS=L, ILIMSEL=H	-	-	300	mA

Parameter	Symbol	Condition	Value			Unit
			Min	Typ	Max	
Operating Ambient temperature	Ta	-	-40	-	+85	°C
Junction temperature range	Tj	-	-40	-	+95	°C
Inductor value	L	-	-	0.5	-	µH

* : Depending on the setting condition. See "•Function Table" in "■FUNCTION (7) Power save mode operation".

WARNING: The recommended operating conditions are required in order to ensure the normal operation of the semiconductor device. All of the device's electrical characteristics are warranted when the device is operated under these conditions.
Any use of semiconductor devices will be under their recommended operating condition.
Operation under any conditions other than these conditions may adversely affect reliability of device and could result in device failure.
No warranty is made with respect to any use, operating conditions or combinations not represented on this data sheet. If you are considering application under any conditions other than listed herein, please contact sales representatives beforehand.

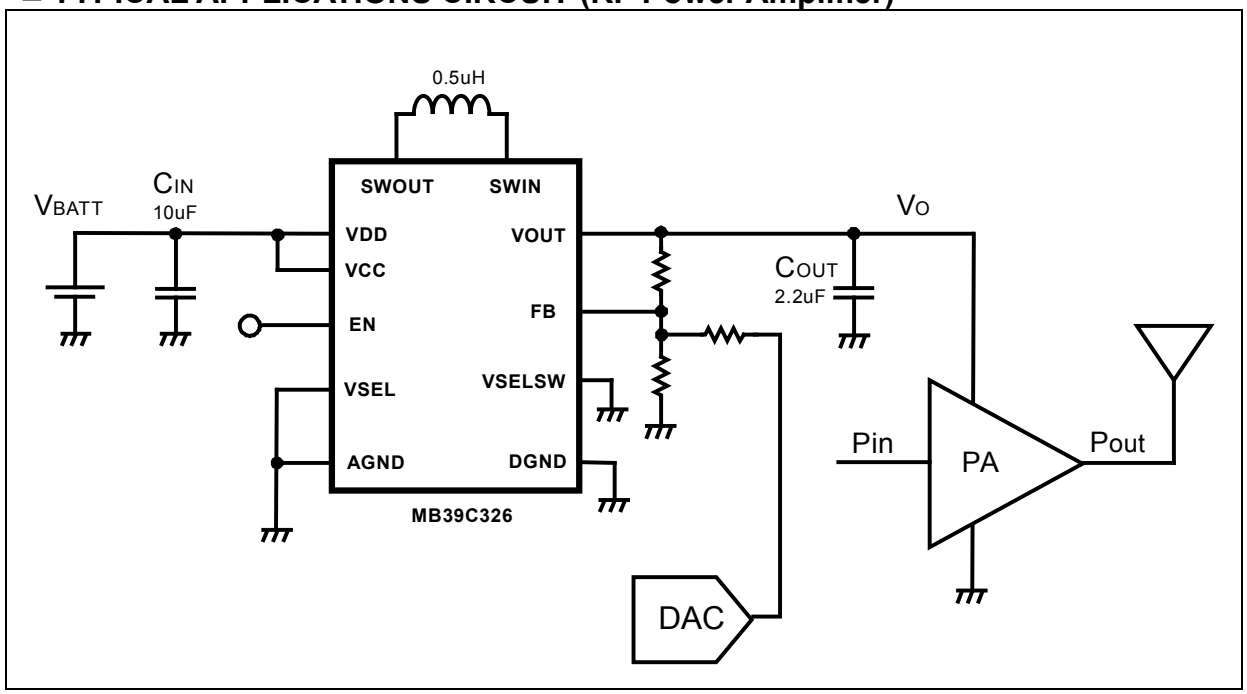
■ ELECTRICAL CHARACTERISTICS

The specifications apply under the recommended operating condition.

Parameter		Symbol	Condition	Value			Unit
				Min	Typ	Max	
Output voltage range		V_O	XPS = L/XPS = H, ILIMSEL = L	0.8	-	5.0	V
Feedback voltage		V_{FB}	-	490	500	510	mV
Maximum output current		I_O	V_{IN} = 3.1 V, V_O = 4.5 V XPS = H, ILIMSEL = L	800	-	-	mA
Line Regulation		V_{LINE}	I_O = 0 to 800mA	-	0.2	-	%
Load Regulation		V_{LOAD}	I_O = 0 to 800mA	-	0.3	-	%
Over current limit		I_{PK}	XPS= H, ILIMSEL = L	2.50	3.10	3.75	A
			XPS=L, ILIMSEL = H	1.05	1.30	1.60	A
			XPS=L, ILIMSEL = L	0.36	0.49	0.60	A
Oscillation frequency		f_{OSC}	-	5.2	5.8	6.4	MHz
Shutdown current		I_{SD}	EN = L	-	-	2	µA
Quiescent current		I_Q	EN = H, XPS = L, V_{IN} = 3.7 V, V_O = 3.3 V, I_O = 0 mA	-	50	-	µA
SW FET ON resistance	SW1	Rdson	V_{DD}= 3.7 V, V_O=3.3V, Ta=+25°C	-	63.5	84	mΩ
	SW2			-	124	175	
	SW3			-	82	116	
	SW4			-	123	164	
	SW5			-	51	72	
Over temperature protection		T_{OTPH}	-	-	135*	-	°C
		T_{OTPL}	-	-	110*	-	°C
UVLO Threshold voltage		V_{UVLOH}	-	1.9	2.0	2.1	V
		V_{UVLOL}	-	1.8	1.9	2.0	V
Signal input threshold voltage		V_{IL}	EN, XPS, VSEL, ILIMSEL	0.0	-	0.25	V
		V_{IH}	EN, XPS, VSEL, ILIMSEL	1.5	-	V_{DD}	V
Signal input current		I_{CTL}	EN, XPS, VSEL, ILIMSEL	-	-	0.1	µA

*: This parameter is not be specified. This should be used as a reference to support designing the circuits.

■ TYPICAL APPLICATIONS CIRCUIT (RF Power Amplifier)



■ APPLICATION NOTES

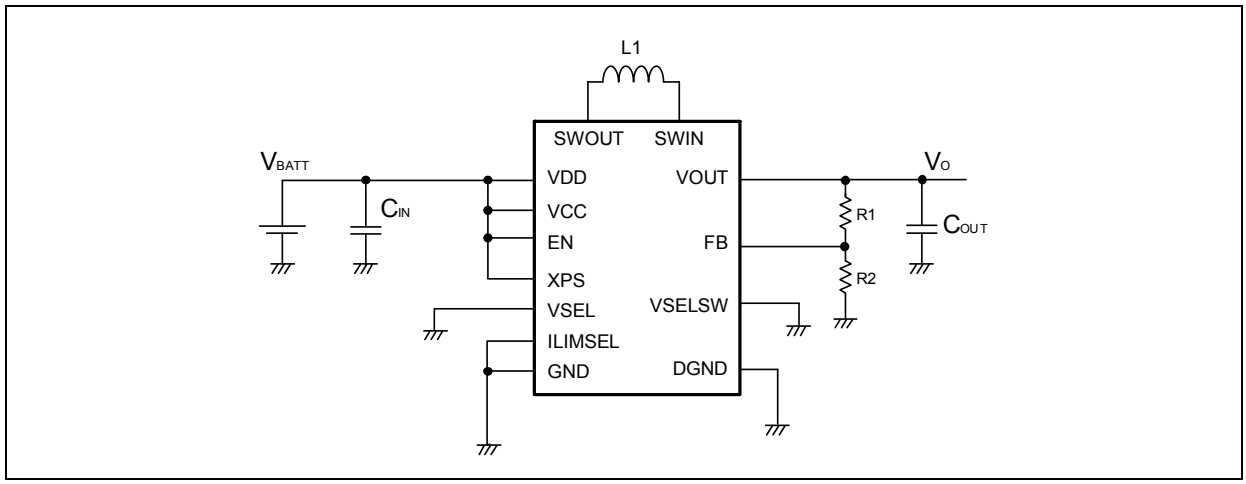
● Programming the Output Voltage

Output voltage is calculated using the equation (1) below.
Use R1 resistor value of 620 kΩ. Built-in phase compensation circuit is generated according to this resistor value.

(1) Not using a selectable voltage option

$$V_O = V_{FB} \times \frac{R_1+R_2}{R_2}$$

(V_{FB} = 500 mV)



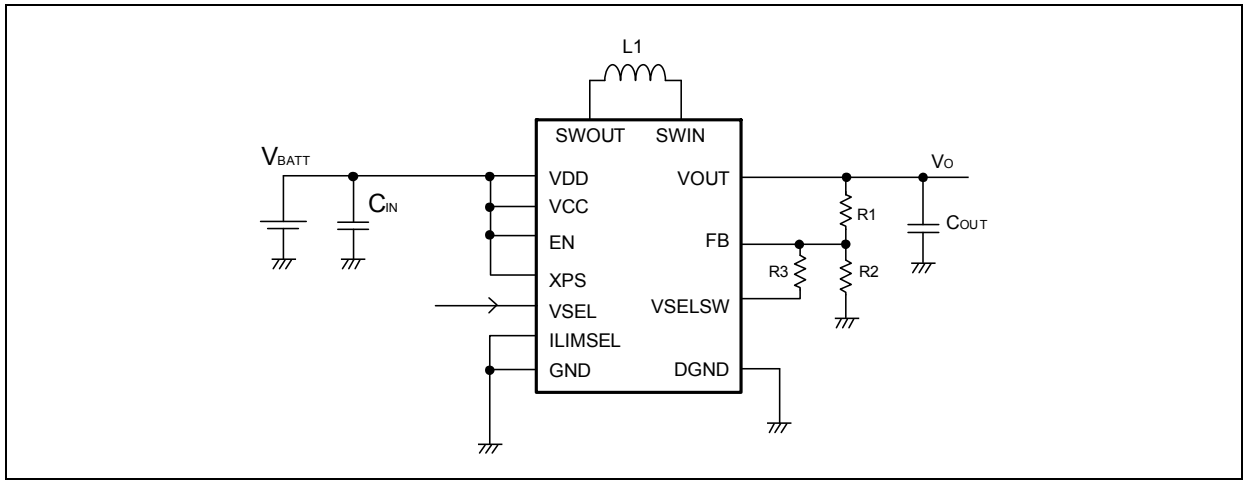
(2) Using a selectable voltage option

When VSEL=L

$$V_O = V_{FB} \times \frac{R_1+R_2}{R_2}$$

When VSEL=H

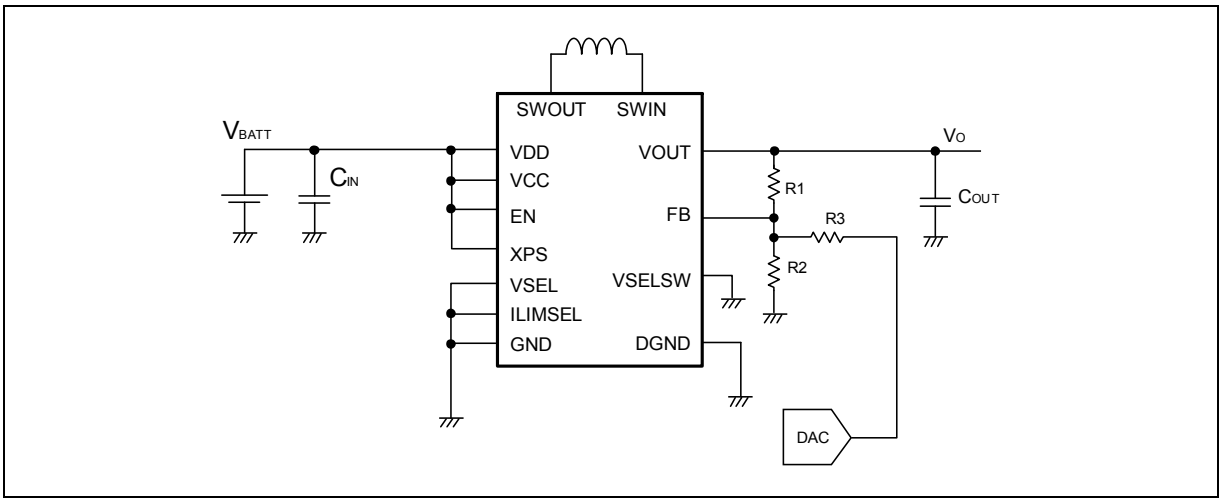
$$V_O = V_{FB} \times \frac{R_1+(R_2//R_3)}{R_2//R_3}$$



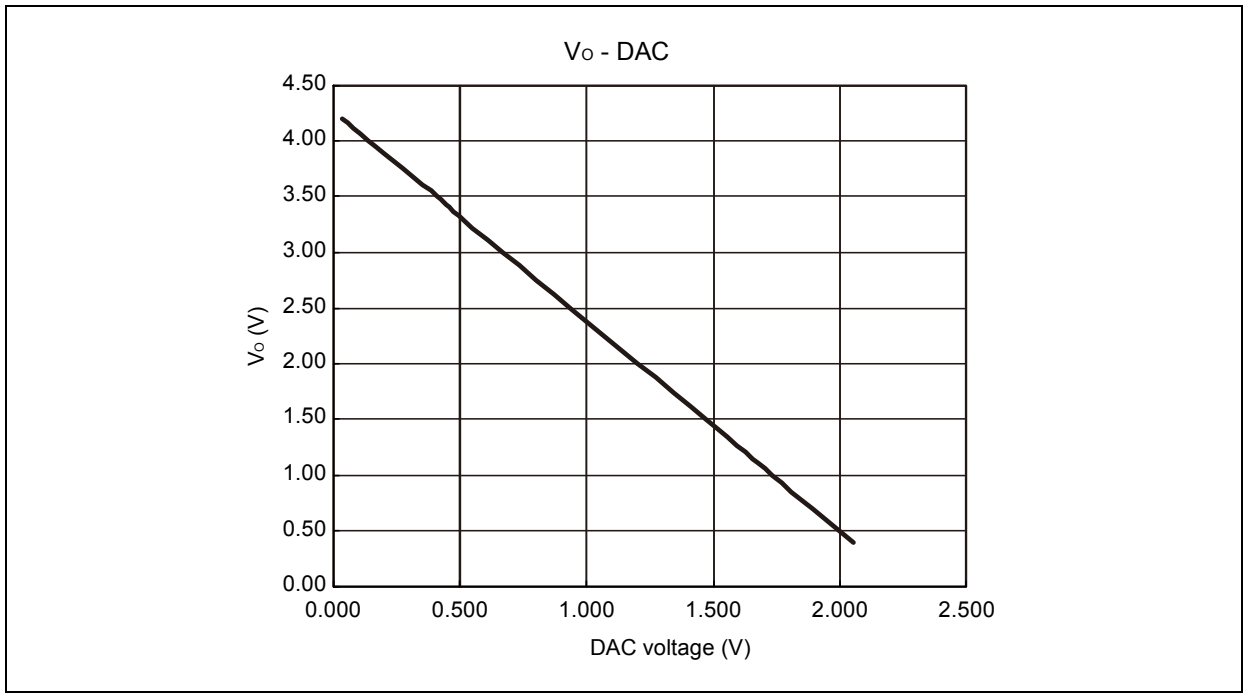
(3) When the output variable is dynamically performed

$$V_O = -\frac{R_1}{R_3} \times V_{DAC} + V_{FB} \times \left(\frac{R_1}{R_3} + \frac{R_1}{R_2} + 1 \right)$$

(V_{FB} = 500mV)



- **Relationship between DAC and output when setting to R1=620kΩ, R2=110kΩ and R3=330kΩ**



■ INDUCTOR SELECTION

The recommended inductor is 0.5µH (0.47µH).
To acquire a high-efficiency, select an inductor with low ESR.
Confirm in use conditions that the coil current does not exceed the rated saturation current.
It is recommended that the switch current limit value is considered.
Note that the permissible current value might be low about some products with high ESR.

The following table shows the recommended inductor.

Vendor	Part #	Size			DCR[Ω] (max)	Isat[A] (-30%)
		L[mm]	W[mm]	H[mm]		
Coilcraft	XPL2010-501ML	1.9	2.0	1.0	0.045	2.64

■ INPUT CAPACITOR SELECTION

It is recommended to place a low ESR ceramic bypass capacitor at least 10uF close to VDD and GND because the input capacitor is the power-supply voltage.

The execution capacity of some ceramic capacitors greatly decreases when adding bias.
Select a product by checking the part characteristics of manufacturer because small size parts or low voltage rating parts tend to have that characteristic.

■ OUTPUT CAPACITOR SELECTION

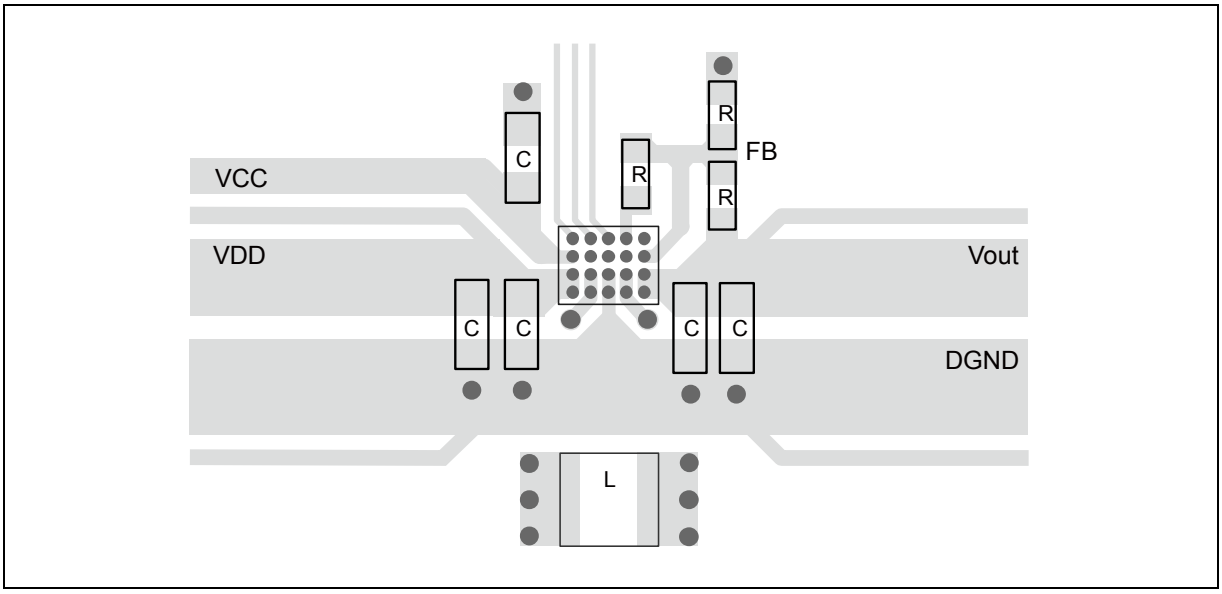
The recommended standard capacity of the output capacitor is 2.2uF in PWM mode.
When using in PFM mode, the capacitor with larger capacity (around 22µF) is recommended to reduce the ripple voltage.
To suppress the decrease of output voltage during the load change, adjust with a larger capacitor.
Larger capacitors and low ESR capacitors is useful to reduce the ripple.

■ THERMAL INFORMATION

Power dissipation is 1080mW Max.
Thermal resistance is 65°C /W (JEDEC). This value can be used to calculate the chip temperature.
Thermal resistance is calculated based on the usage of JEDEC standard boards. It is recommended to consider for the thermal design that the value may vary depending on the area of the board and the positions of the vias.
See "Power dissipation vs. Operation ambient temperature" in "■EXAMPLE OF STANDARD OPERATION CHARACTERISTICS".

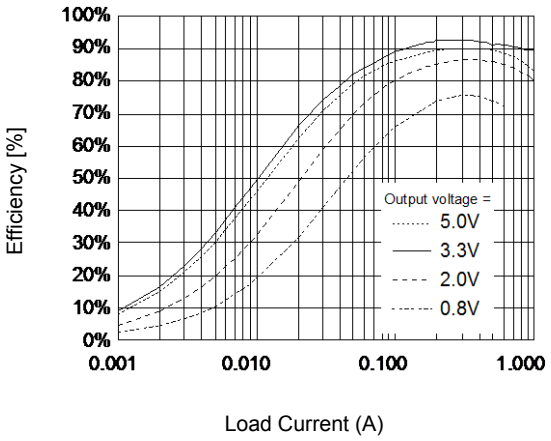
■ NOTES ON BOARD LAYOUT

A suitable board layout is required for stable operations of this IC.
Place the peripheral component, input capacitance C_{IN} and the output capacitance C_{OUT} close to this IC as much as possible, and connect them with the shortest routes.
The routes with large current, in particular, the routes with variable current must be placed on the front surface with the shortest routes.
Separate DGND from GND and connect GND at one point close to C_{OUT}.
Provide the ground plane as much as possible on the IC mounted face. It is useful for heat dissipation.

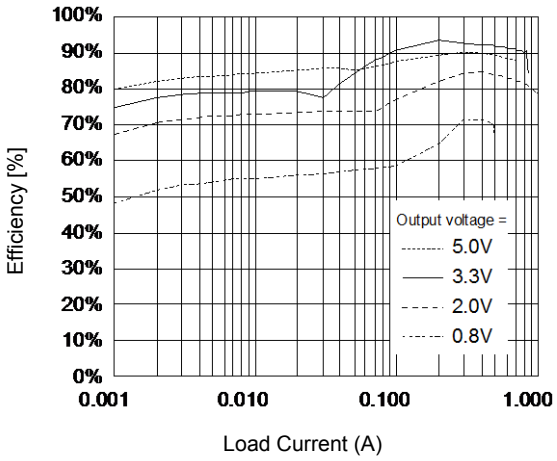


■ EXAMPLE OF STANDARD OPERATION CHARACTERISTICS

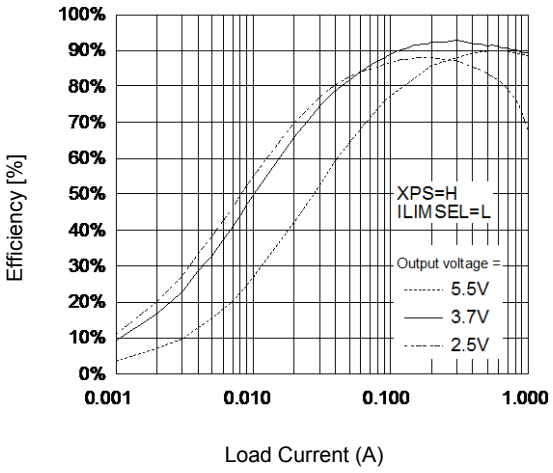
Efficiency vs. Load Current (V_{IN}=3.7V, PWM mode)



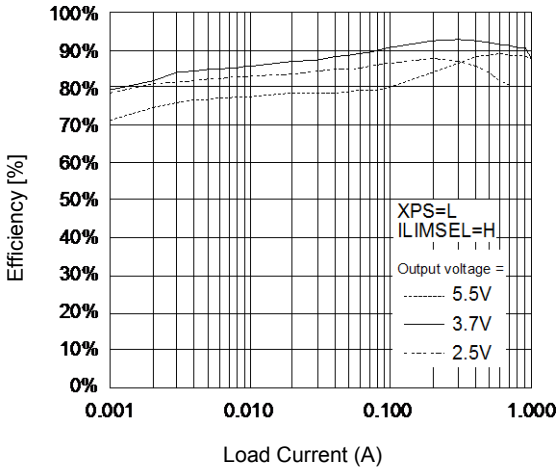
Efficiency vs. Load Current
(V_{IN} =3.7V, PowerSave mode)



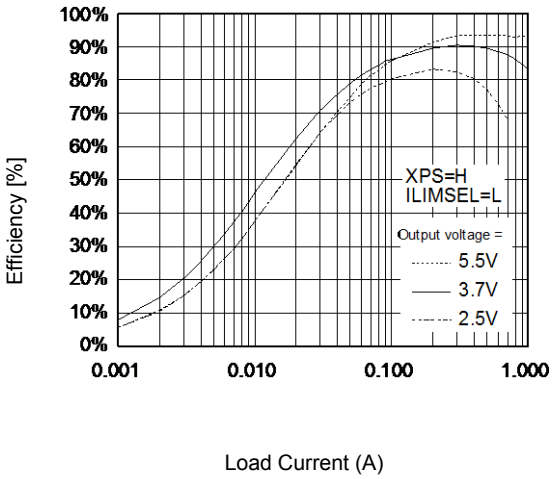
Efficiency vs. Load Current (V_O=3.3V, PWM mode)



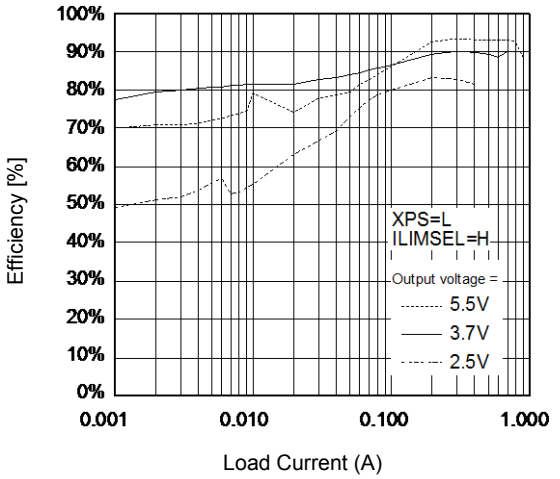
Efficiency vs. Load Current
(V_O=3.3V, PowerSave mode)



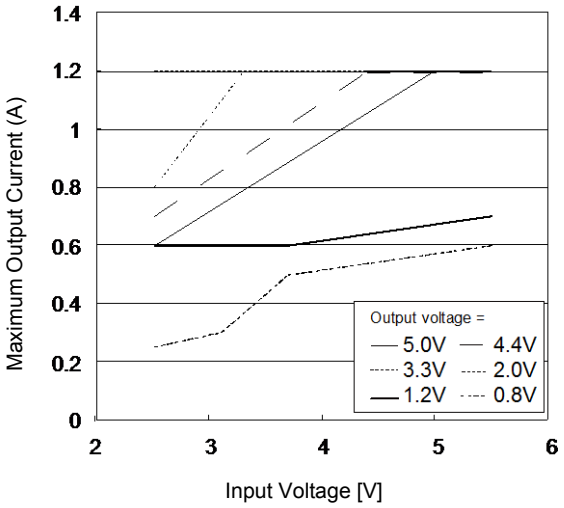
Efficiency vs. Load Current (V_O=5.0V, PWM mode)



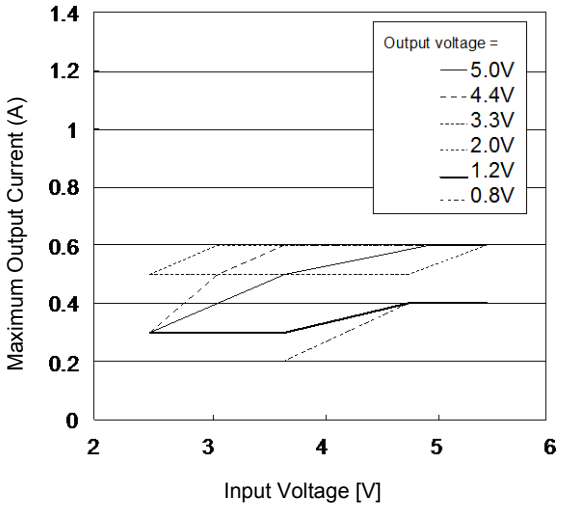
Efficiency vs. Load Current
(V_O=5.0V, PowerSave mode)



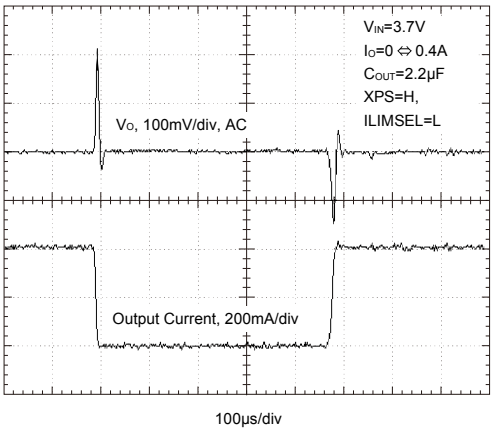
Maximum Output Current vs. Input Voltage
(PWM mode)



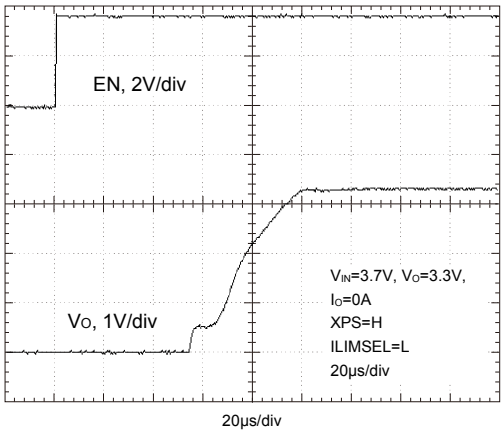
Maximum Output Current vs. Input Voltage
(Power save mode)



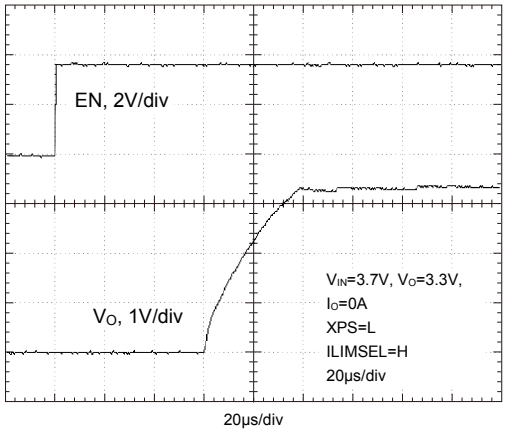
Load sudden change waveform



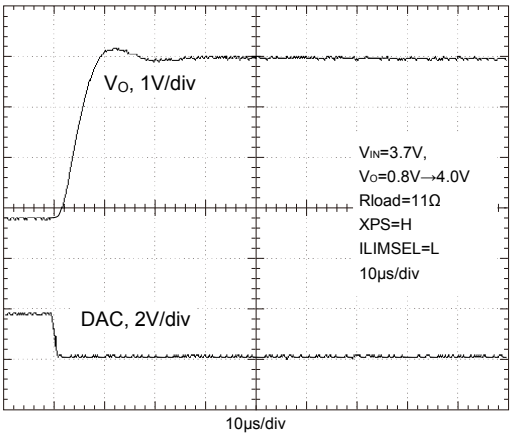
Startup (PWM mode)



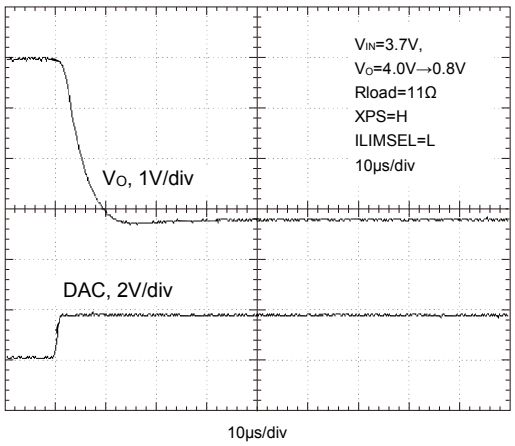
Startup (PowerSave mode)



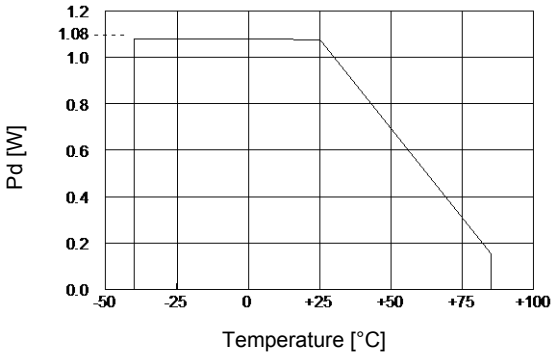
V_O step response (Rise)



V_O step response (Fall)



Power consumption vs.
Operating ambient temperature



■ USAGE PRECAUTION

1. Do not configure the IC over the maximum ratings.
   If the IC is used over the maximum ratings, the LSI may be permanently damaged.

   It is preferable for the device to be normally operated within the recommended usage conditions. Usage outside of these conditions can have a bad effect on the reliability of the LSI.

2. Use the devices within recommended operating conditions.
   The recommended operating conditions are the recommended values that guarantee the normal operations of LSI.

   The electrical ratings are guaranteed when the device is used within the recommended operating conditions and under the conditions stated for each item.

3. Printed circuit board ground lines should be set up with consideration for common impedance.

4. Take appropriate measures against static electricity.
   - Containers for semiconductor materials should have anti-static protection or be made of conductive material.
   - After mounting, printed circuit boards should be stored and shipped in conductive bags or containers.
   - Work platforms, tools, and instruments should be properly grounded.
   - Working personnel should be grounded with resistance of 250 kΩ to 1 MΩ in series between body and ground.

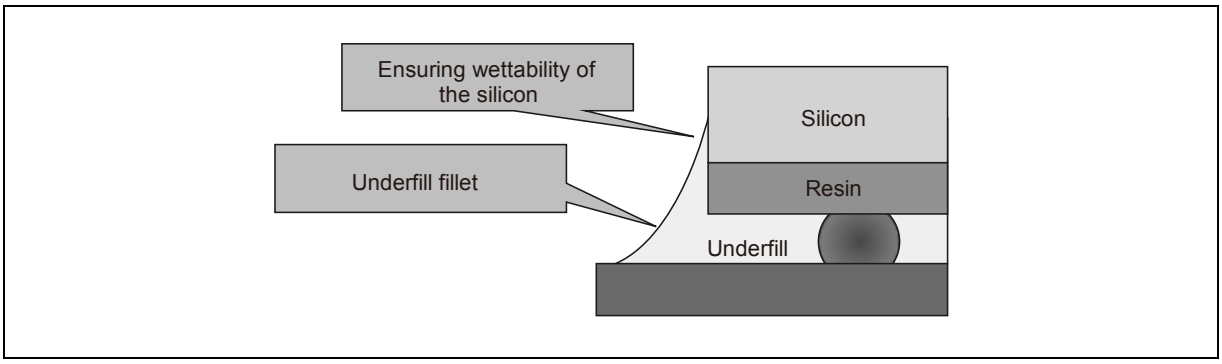
5. Do not apply negative voltages.
   The use of negative voltages below -0.3 V may cause the parasitic transistor to be activated on LSI lines, which can cause malfunctions.

■ NOTES ON MOUNTING

In general, the underfill material and sealing method affect the reliability of mounting.
Spansion does not evaluate the mounting using the underfill material.
It is advisable for each customer to evaluate the mounting enough.

WL-CSP has a surface boundary between silicon and resin at the side of the package.
Resin may be pulled by the board because of the underfill material and its shape and the state, and stress may occur at the surface boundary.
The result may vary depending on the board and the underfill material used by each customer; therefore, it is advisable for each customer to evaluate the mounting enough in order to apply to the products.

When using the underfill materials, be sure to apply the underfill to the silicon side surface as shown below (fillet formation).



■ ORDERING INFORMATION

Part number	Package	Remarks
MB39C326PW	20-pin plastic WLP (WLP-20P-M01)	

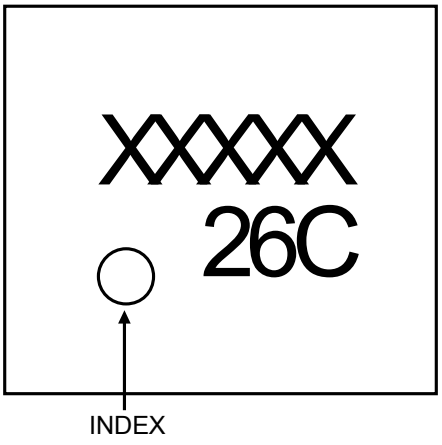
■ EV BOARD ORDERING INFORMATION

EV board number	EV board version No.	Remarks
MB39C326-EVB-01	MB39C326-EVB-01 REV5.0	20pin-WL-CSP

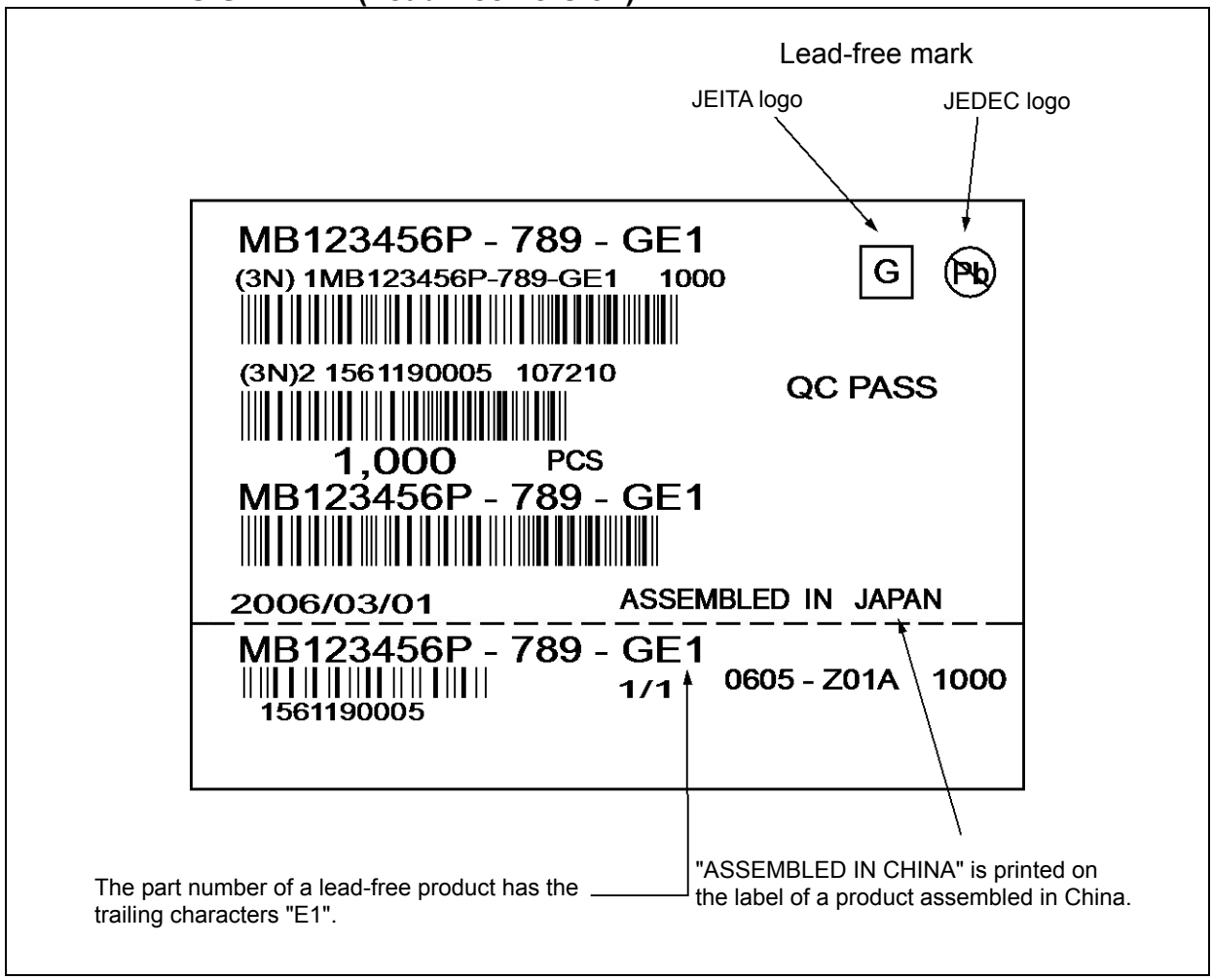
■ RoHS COMPLIANCE INFORMATION OF LEAD (Pb) FREE VERSION

The LSI products of Spansion with "E1" are compliant with RoHS Directive, and has observed the standard of lead, cadmium, mercury, Hexavalent chromium, polybrominated biphenyls (PBB), and polybrominated diphenyl ethers (PBDE). A product whose part number has trailing characters "E1" is RoHS compliant.

■ MARKING



■ LABELING SAMPLE (Lead free version)



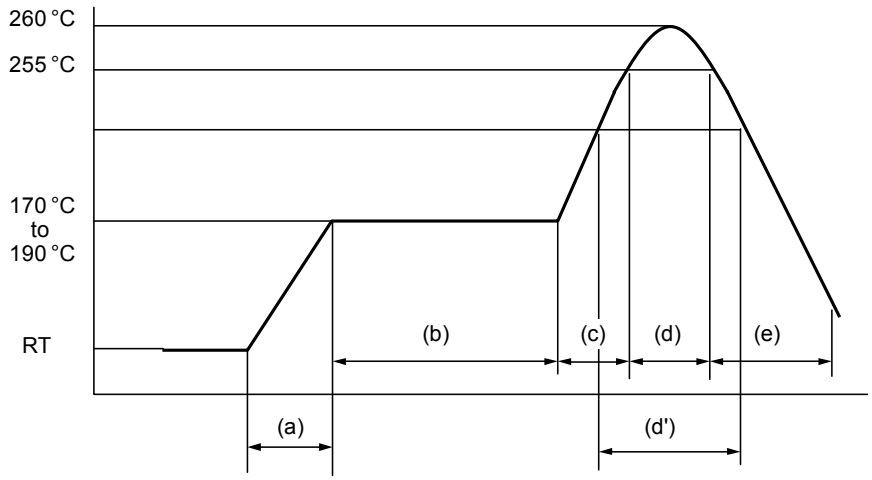
■ MB39C326PW RECOMMENDED CONDITIONS OF MOISTURE SENSITIVITY LEVEL

[Spansion Recommended Mounting Conditions]

Item	Condition	
Mounting Method	IR (infrared reflow), warm air reflow	
Mounting times	2 times	
Storage period	Before opening	Please use it within two years after manufacture.
	From opening to the 2nd reflow	
Storage conditions	5°C to 30°C, 70% RH or less (the lowest possible humidity)	

[Parameters for Each Mounting Method]

IR (infrared reflow)



H rank: 260°C Max

(a) Temperature Increase gradient : Average 1°C/s to 4°C/s

(b) Preliminary heating : Temperature 170°C to 190°C, 60s to 180s

(c) Temperature Increase gradient : Average 1°C/s to 4°C/s

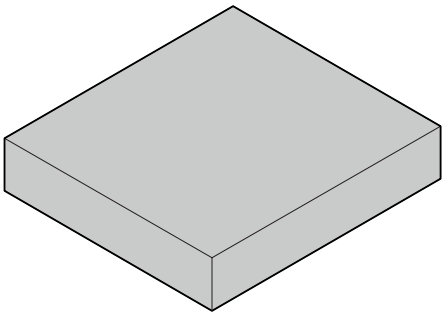
(d) Actual heating : Temperature 260°C Max; 255°C or more, 10s or less

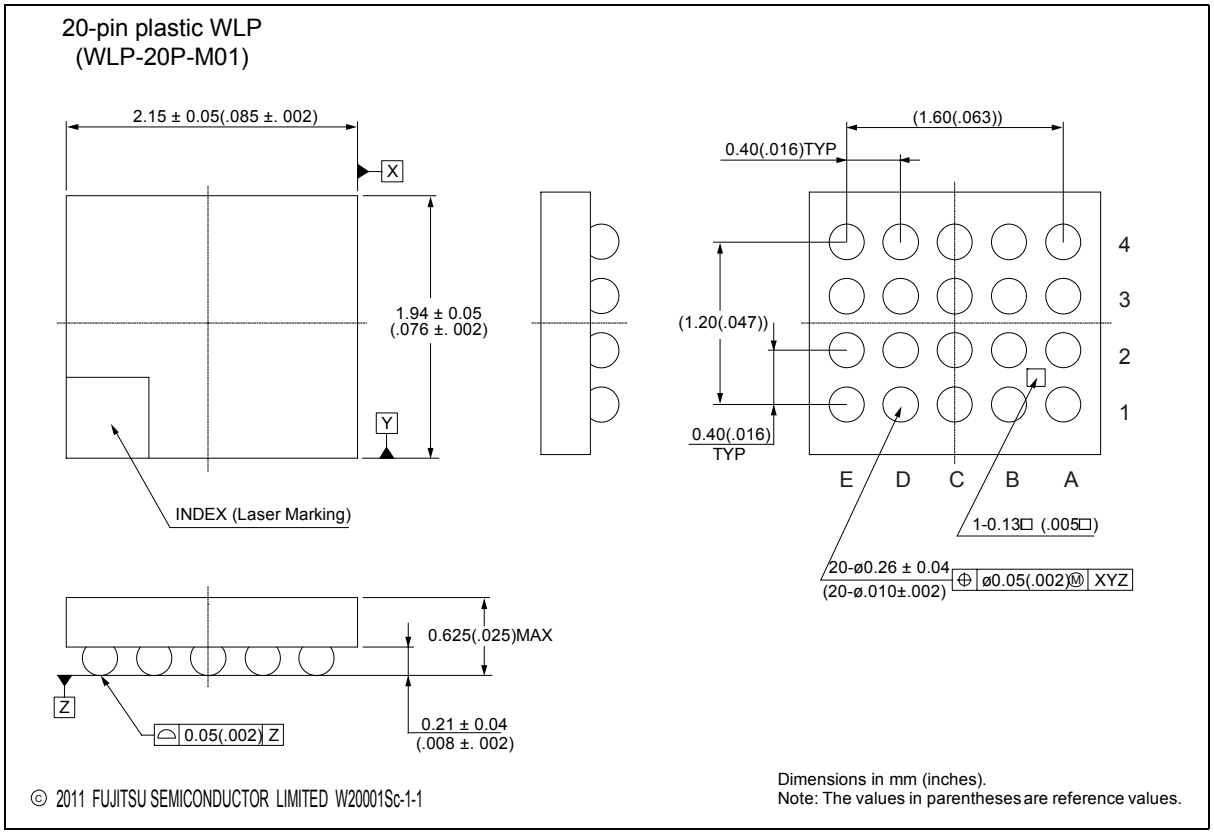
(d') : Temperature 230°C or more, 40s or less
or
Temperature 225°C or more, 60s or less
or
Temperature 220°C or more, 80s or less

(e) Cooling : Natural cooling or forced cooling

Note : Temperature : the top of the package body

■ PACKAGE DIMENSIONS

20-pin plastic WLP		
	Lead pitch	0.4 mm
	Package width × package length	2.15 mm × 1.94
	Lead shape	Soldering ball
	Sealing method	Print
	Mounting height	0.625 mm Max.
	Weight	0.005 g
(WLP-20P-M01)	Code (Reference)	S-WF BGA20-2.15 × 1.94-0.40



Please check the latest package dimension at the following URL.
http://edevice.fujitsu.com/package/en-search/

■ Major Changes

Page	Section	Change Results
Revision 2.0		
9	■ ELECTRICAL CHARACTERISTICS	Revised the values.
Revision 2.1		
-	-	Company name and layout design change

Colophon

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