FUJITSU SEMICONDUCTOR
DATA SHEET

DS405-00001-0v02-E

ASSP for Power Supply Applications

6MHz Synchronous Rectification Buck-Boost DC/DC Converter IC

MB39C326

■ 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. It provides up to 800 mA of output current over an input voltage range of 2.5 V to 5.5 V. The maximum average current in the switches is limited to a typical value of 2000 mA.

■ FEATURES

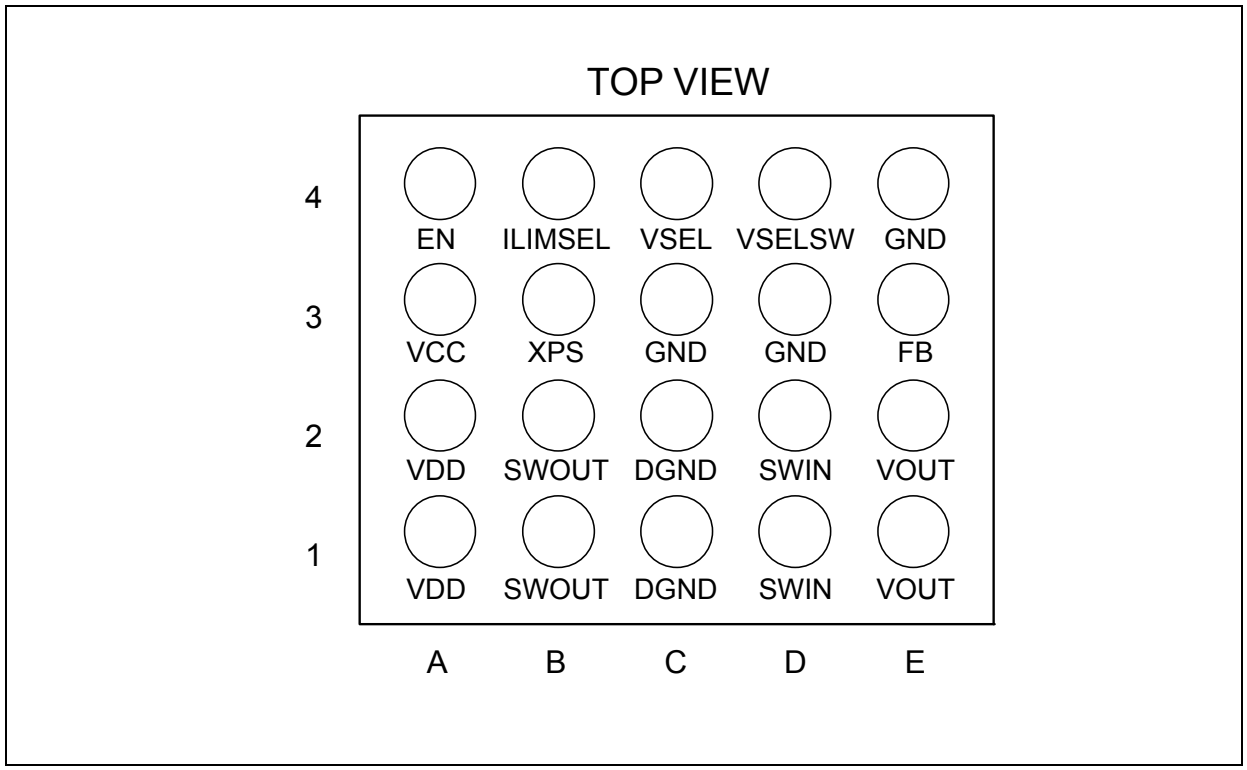
- High efficiency : Up to 95%
- Input voltage range : 2.5 V to 5.5 V
- Adjustable output voltage range : 0.4 V to 5.0 V
- Input current limit value : 2A/1A/0.5A
- Output current : 1200mA (Buck, output at 3.3V)
  : 800mA (Boost, output at 3.3V)
- Quiescent current : 50µA
- 6MHz PWM operation allows 0.5µH small form inductor
- Less than 20µs step response for 3G
- Automatic Transition between Buck mode and boost mode
- Power-Save Mode for improved efficiency at light load current
- 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

2011.12

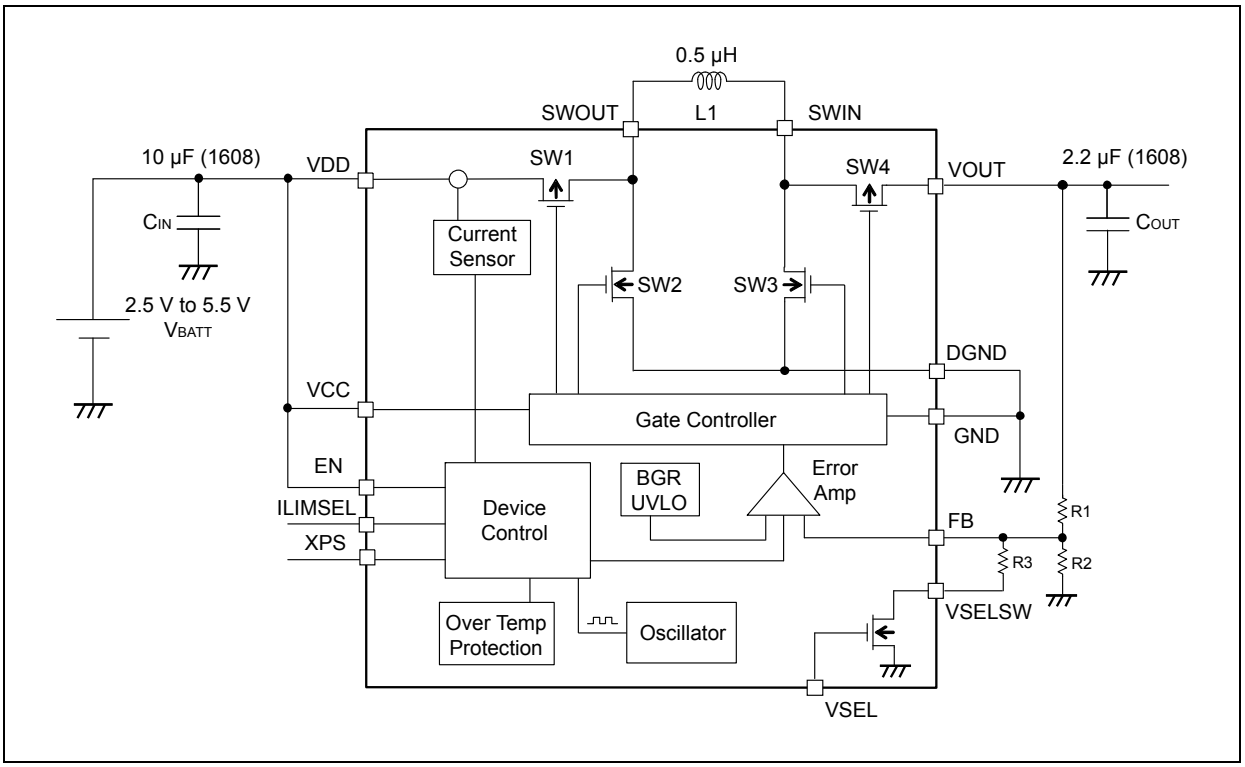
■ PIN ASSIGNMENTS



■ 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.

(7) Power save mode operation

Power Save mode is used to improve efficiency at the light load. The XPS pin should be set at low to enable power save mode. When the load current is lower than 300 mA, this IC operates with PFM (Pulse Frequency Modulation). It should be used above V_{OUT} =0.8 V. 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 consumption power for the circuit are suppressed.

• Function Table

Mode	XPS	ILIMSEL	Input voltage range[V]		Output voltage range[V]		Current limit [A]
			Min	Max	Min	Max	
PWM mode	H	H	3.1	4.8	0.4	4.2	2.0
		L	2.5	5.5	0.8	5.0	
Power save mode	L	H					1.0
		L					0.5

■ 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	-	-	1080	mW
Storage temperature	T_{STG}	-	-65	+150	°C
ESD Voltage	V_{ESDH}	Human Body Model (100 pF, 1.5 kΩ)	-1000	+1000	V
	V_{ESDM}	Machine Model (200 pF, 0Ω)	-200	+200	V
	V_{ESDC}	Charged device model	-1	+1	kV

WARNING: Semiconductor devices can be permanently damaged by application of stress (voltage, current, temperature, etc.) in excess of absolute maximum ratings. Do not exceed 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
Operating Ambient temperature	Ta	-	-40	-	+85	°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 within these ranges.
Always use semiconductor devices within their recommended operating condition ranges.
Operation outside these ranges may adversely affect reliability and could result in device failure.
No warranty is made with respect to uses, operating conditions, or combinations not represented on the data sheet. Users considering application outside the listed conditions are advised to contact their representatives beforehand.

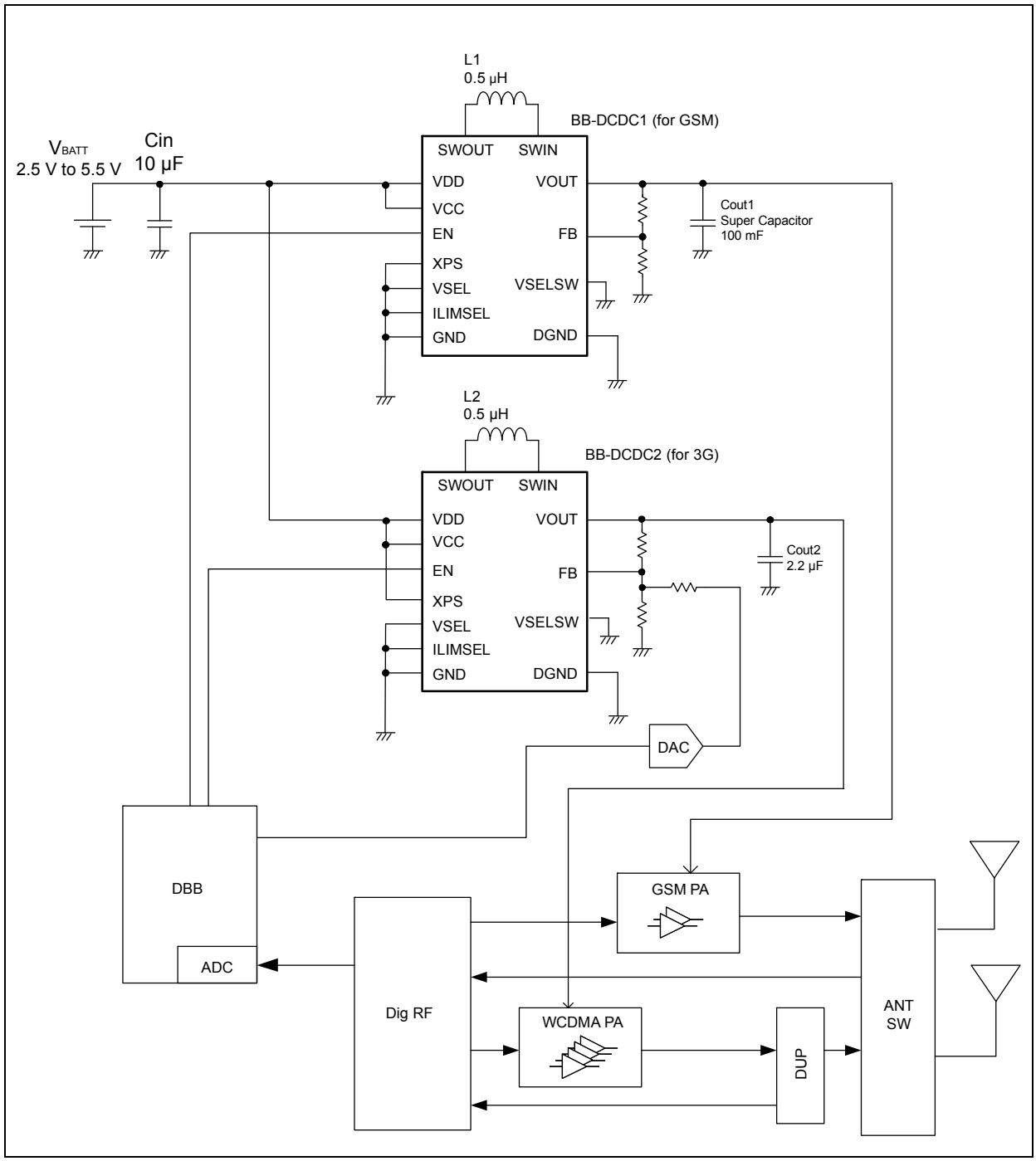
■ ELECTRICAL CHARACTERISTICS

The specifications apply under the recommended operating condition.

Parameter	Symbol	Condition	Value			Unit
			Min	Typ	Max	
Input voltage	V_{IN}	XPS=L/XPS = H, ILIMSEL = L	2.5	3.7	5.5	V
		XPS = H, ILIMSEL = H	3.1	-	4.8	
Output voltage	V_{OUT}	XPS = L/XPS = H, ILIMSEL = L	0.8	-	5.0	V
		XPS = H, ILIMSEL = H	0.4	-	4.2	
Feedback voltage	V_{FB}	-	-	500*	-	mV
Maximum output current	I_{OUT}	V_{IN} = 2.5 V, V_{OUT} = 4.5 V	800	-	-	mA
Line Regulation	V_{LINE}	I_{OUT} = 0 to I_{OMAX}	-	-	10	mV
Load Regulation	V_{LOAD}	I_{OUT} = 0 to I_{OMAX}	-	-	20	mV
Output current limit	I_{PK}	SWOUT	2.0	2.5	3.0	A
Input current limit	I_{LIMIT}	XPS=H	-	2.0*	-	A
		XPS=L, ILIMSEL = H	-	1.0*	-	A
		XPS=L, ILIMSEL = L	-	0.5*	-	A
Oscillation frequency	f_{OSC}	-	-	6*	-	MHz
Shutdown current	I_{SD}	EN = L	-	-	2	µA
Quiescent current	I_Q	EN = H, XPS = L, V_{IN} = 3.7 V, V_{OUT} = 3.4 V, I_{OUT} = 0 mA	-	50	-	µA
Over temperature protection	T_{OTPH}	-	-	135*	-	°C
	T_{OTPL}	-	-	110*	-	°C
UVLO Threshold voltage	V_{UVLOH}	-	-	2.0*	-	V
	V_{UVLOL}	-	-	1.9*	-	V
Signal input threshold voltage	V_{IL}	EN, XPS, VSEL, ILIMSEL	0.0	-	V_{DD}×0.3	V
	V_{IH}	EN, XPS, VSEL, ILIMSEL	V_{DD}×0.7	-	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



■ APPLICATION NOTES

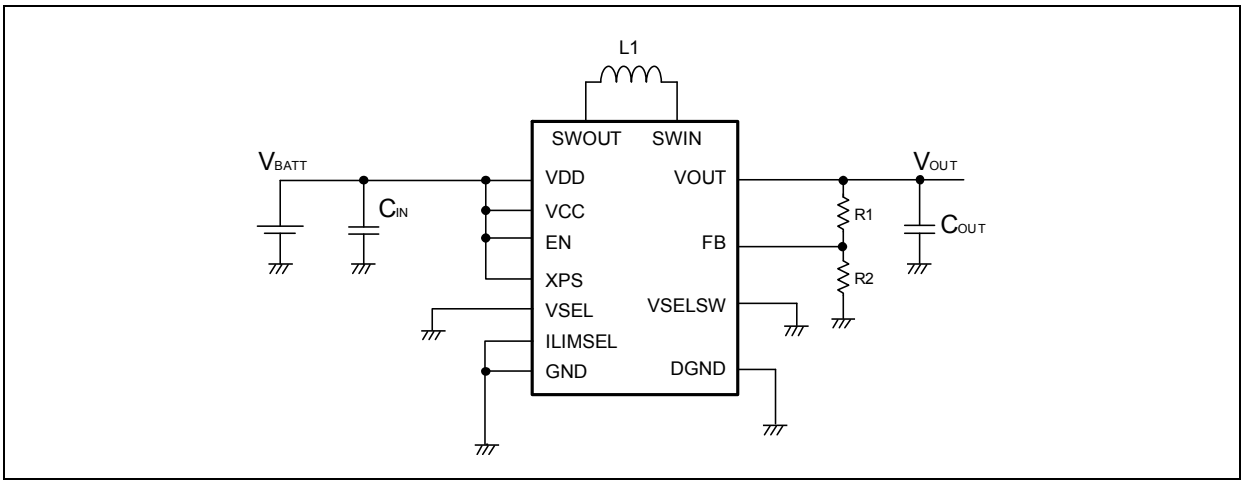
● Programming the Output Voltage

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

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

(V_{FB} = 500 mV)



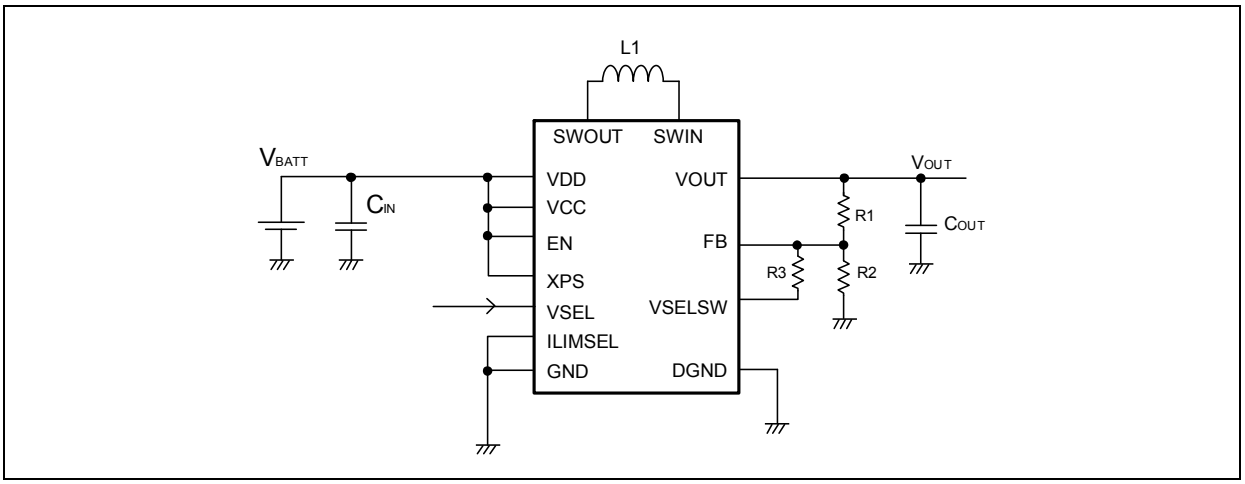
(2) Using a selectable voltage option

When VSEL=L

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

When VSEL=H

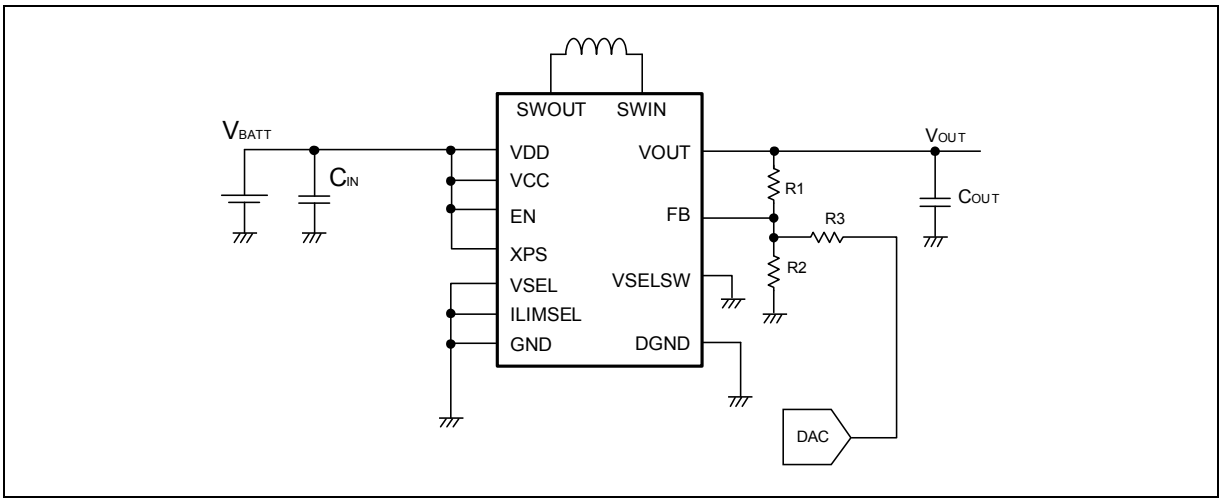
$$V_{OUT} = V_{FB} \times \frac{R_1 + (R_2 \| R_3)}{R_2 \| R_3}$$



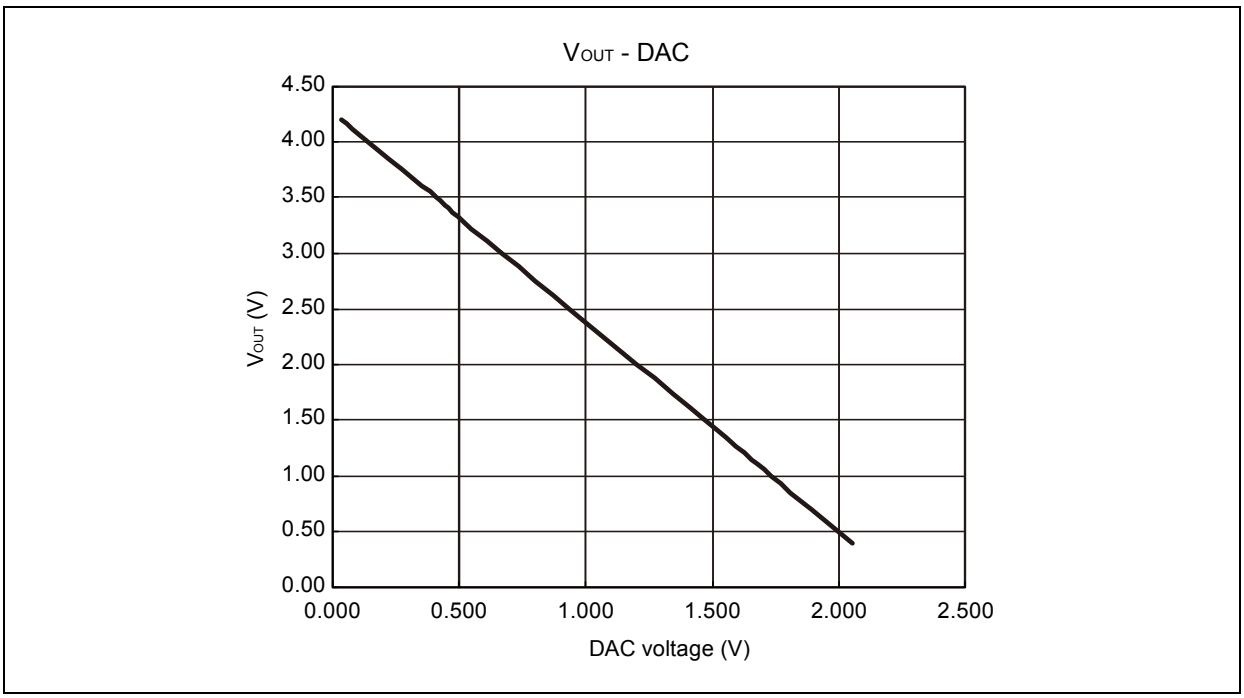
(3) When the output variable is dynamically performed

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

(V_{FB} = 500mV)

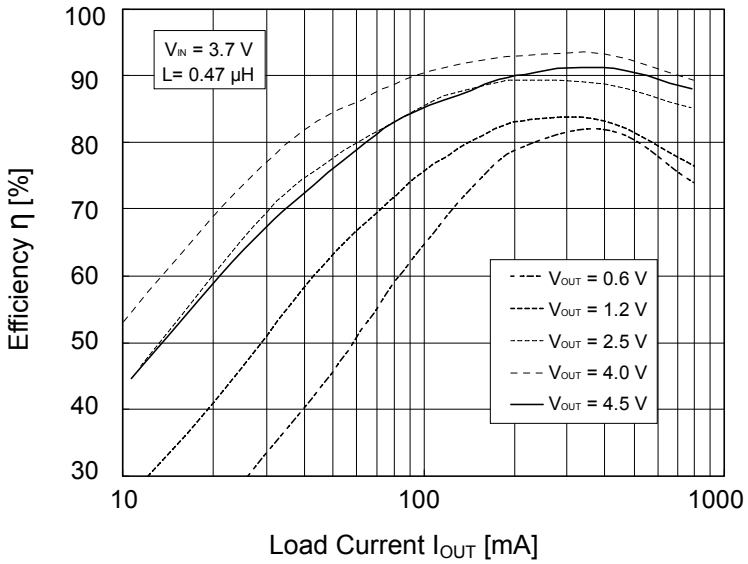


● **Relationship between DAC and output when setting to R1=620kΩ, R2=110kΩ and R3=330kΩ**

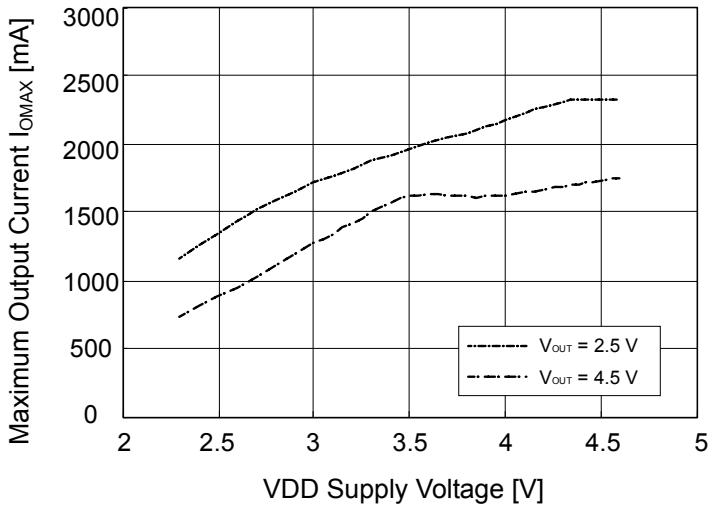


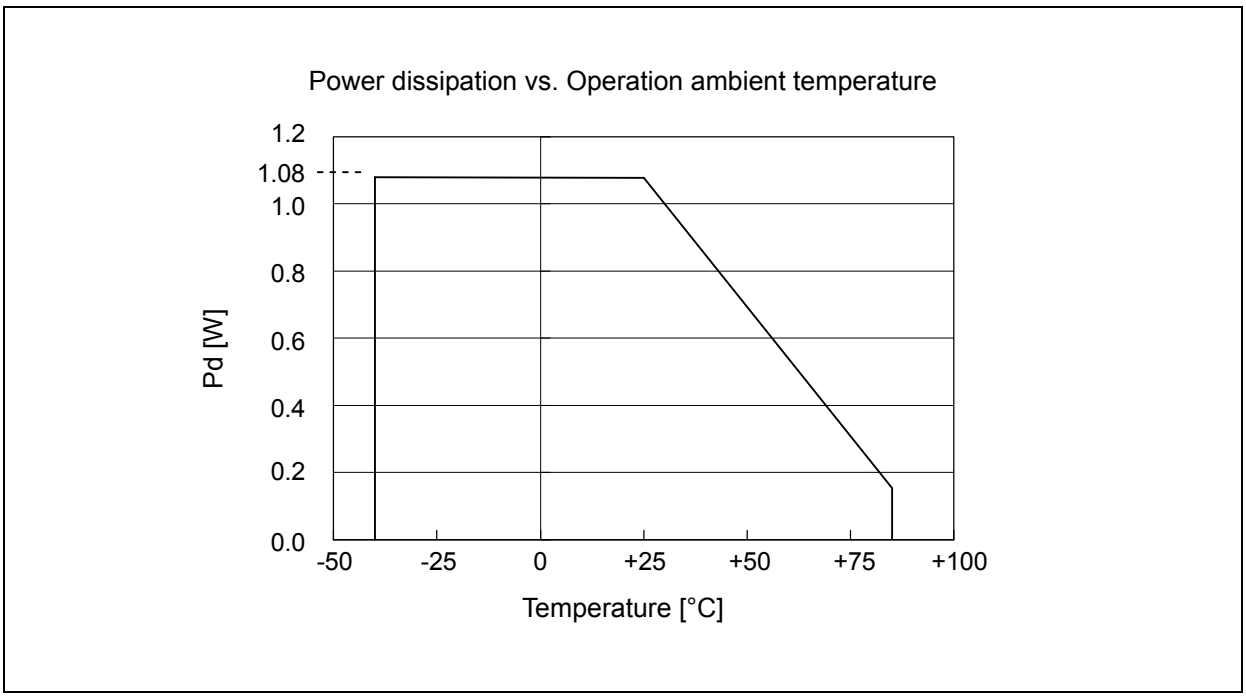
■ EXAMPLE OF STANDARD OPERATION CHARACTERISTICS

Efficiency vs. Load Current



Maximum Output Current vs. Input Voltage




Power dissipation vs. Operation ambient temperature
Pd [W]
1.2
1.08
1.0
0.8
0.6
0.4
0.2
0.0
-50
-25
0
+25
+50
+75
+100
Temperature [°C]

■ 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.

■ ORDERING INFORMATION

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

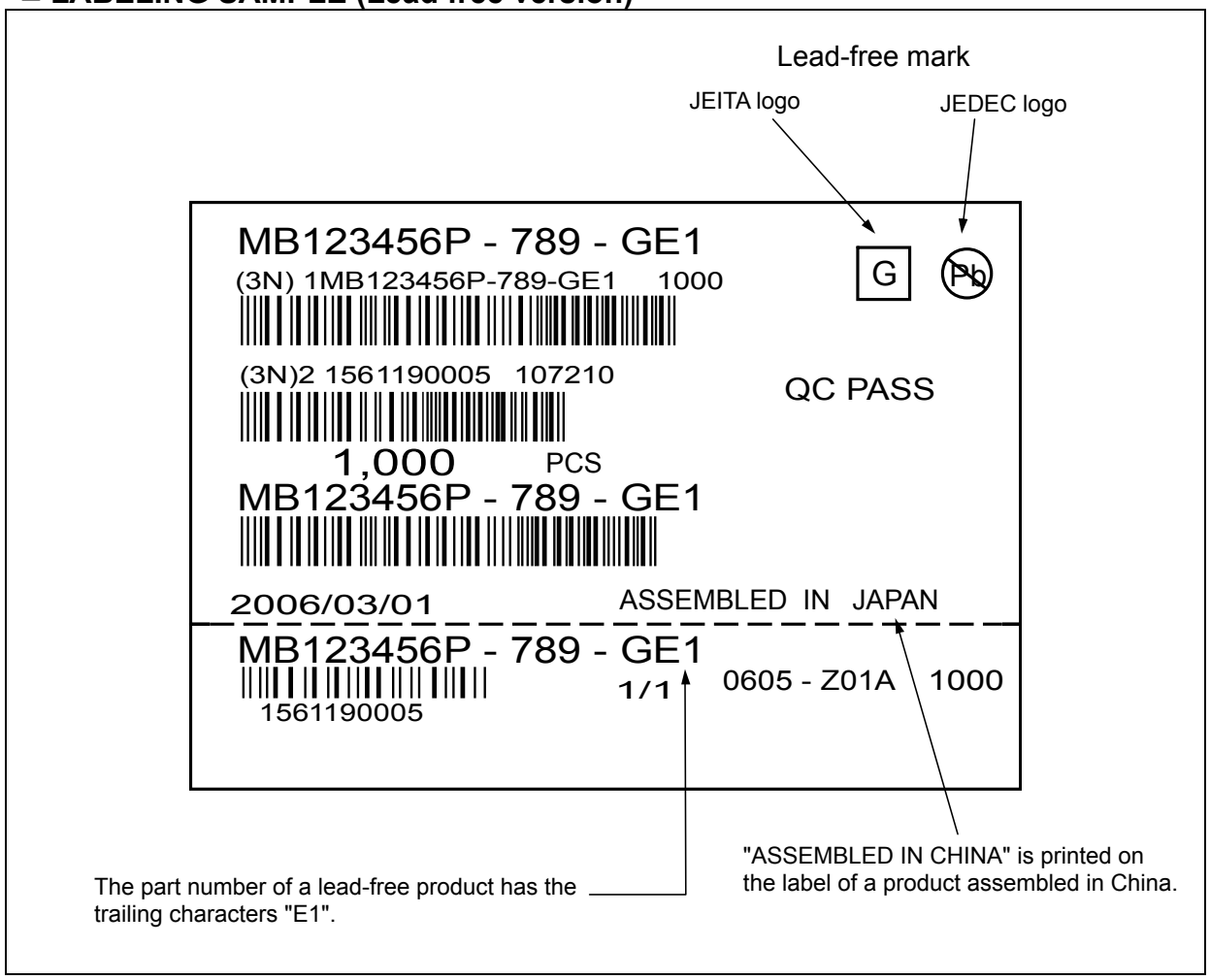
■ EV BOARD ORDERING INFORMATION

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 FUJITSU SEMICONDUCTOR 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.

■ LABELING SAMPLE (Lead free version)



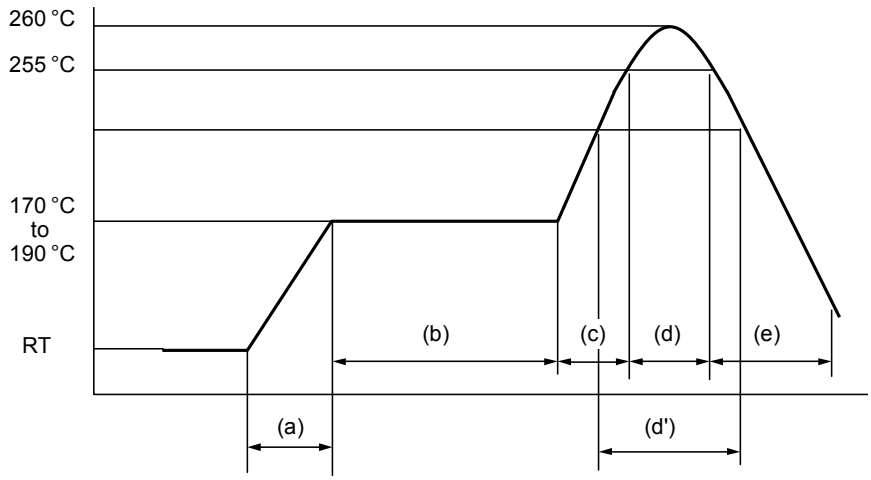
■ MB39C326PW RECOMMENDED CONDITIONS OF MOISTURE SENSITIVITY LEVEL

[FUJITSU SEMICONDUCTOR 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

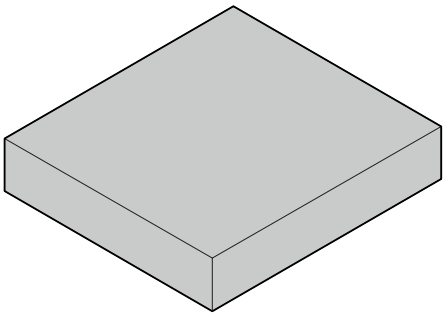
(d) Actual heating : Temperature 260°C Max; 255°C or more, 10s or less

(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

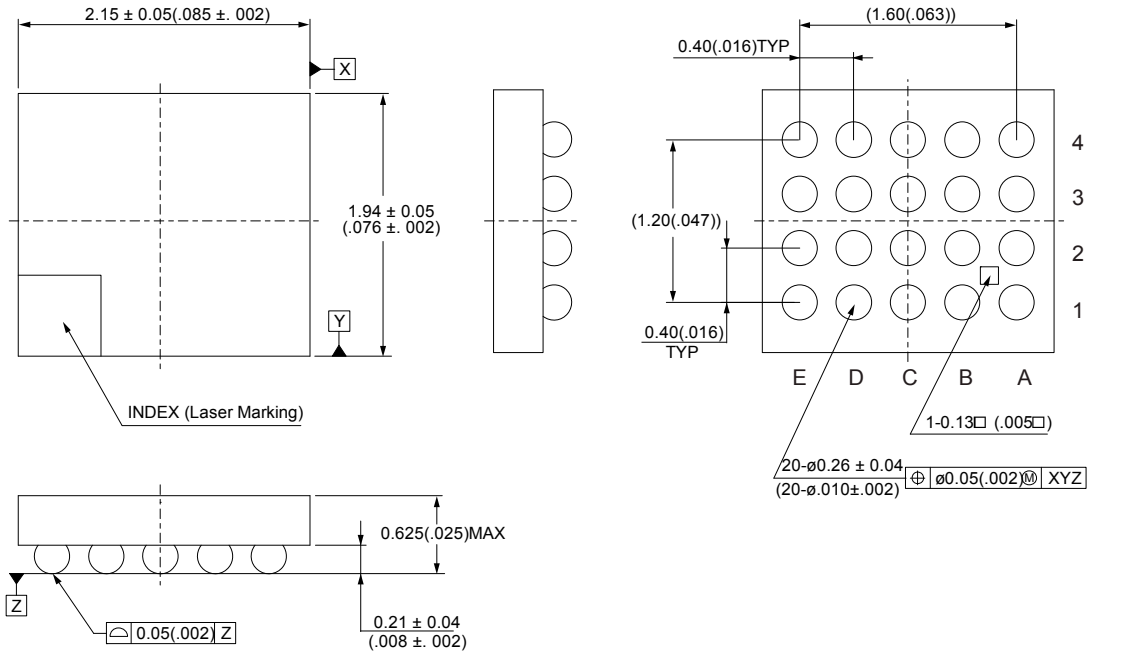
(e) Cooling : Natural cooling or forced cooling

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

20-pin plastic WLP
(WLP-20P-M01)



Dimensions in mm (inches).
Note: The values in parentheses are reference values.

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

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MEMO

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FUJITSU SEMICONDUCTOR LIMITED

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