

## Power Supply Application Evaluation Board Datasheet

The MB39A112 evaluation board is a surface mount circuit board with 3 channels of down conversion circuit. This evaluation board outputs voltage of 1.2 V, 3.3 V and 5.0 V from the output terminals of 3 systems, and supplying a current of Max 1.5 A. More ever, when the under voltage lockout protection circuit do operation or the short-circuit protection is detected by the protection function, the FET is turned off and the output is stopped. In addition, each channel can be controlled to be turned on and off, and can be set for a soft-start.

### Evaluation Board Specifications

(Ta = + 25 °C)

Parameter	Terminal	Value			Unit	
		Min	Typ	Max		
Input voltage	VIN	7	12	20	V	
Oscillation frequency	—	2115	2350	2585	kHz	
Output voltage	CH1	VO1	1.14	1.2	1.26	V
	CH2	VO2	3.13	3.3	3.47	V
	CH3	VO3	4.75	5.0	5.25	V
Ripple voltage	CH1	VO1	6	12	24	mV
	CH2	VO2	16	33	64	mV
	CH3	VO3	25	50	100	mV
Output current	CH1	VO1	800	1200	1500	mA
	CH2	VO2	150	500	1000	mA
	CH3	VO3	150	200	300	mA
Soft-start time	CH1	—	6.3	10	18.6	ms
	CH2	—	7.8	12	22.8	ms
	CH3	—	7.8	12	22.8	ms
Short-circuit detection time	—	430	720	1420	μs	

**Contents**

**Evaluation Board Specifications** ..... 1

**1. Terminal Description** ..... 3

**2. Switch Description** ..... 3

**3. Setup and Checkup** ..... 3

    3.1 Setup..... 3

    3.2 Checkup..... 3

**4. Component Layout** ..... 4

**5. Connection Diagram**..... 6

**6. Parts List** ..... 7

**7. Initial Settings** ..... 10

    7.1 Output voltage..... 10

    7.2 Oscillation frequency..... 10

    7.3 Soft-start time..... 10

    7.4 Short-circuit detection time ..... 10

**8. Reference Data**..... 11

    8.1 Conversion efficiency vs. Input voltage..... 11

    8.2 Load Regulation ( $V_{IN} = 12\text{ V}$ ) ..... 12

    8.3 Line regulation ..... 13

    8.4 Soft-start operation waveforms ..... 14

**9. Component Selection Methods** ..... 15

    9.1 CH1 1.2 V output ..... 16

    9.2 CH2 3.3 V output ..... 18

    9.3 CH3 5 V output ..... 20

**10. Ordering Information**..... 21

**Document History Page** ..... 22

**Sales, Solutions, and Legal Information** ..... 23

## 1. Terminal Description

Symbol	Description
VIN	Power supply terminal $V_{IN} = 7\text{ V to }25\text{ V (Typ }12\text{ V)}$
VOX	DC/DC converter output terminal
GND	GND terminal
GNDX	DC/DC converter GND terminal
ICGND	MB39A112 GND terminal

## 2. Switch Description

SW	Name	Function	OPEN	L
1	CS1	CH1 control	Output ON	Output OFF
2	CS2	CH2 control	Output ON	Output OFF
3	CS3	CH3 control	Output ON	Output OFF

## 3. Setup and Checkup

### 3.1 Setup

- Connect power-supply terminals side to the VIN and GND, and connect the VO side to required loading device or measuring instrument.
- Set SW1 to SW3 (CS1 to CS3) to OFF (output OFF) .

### 3.2 Checkup

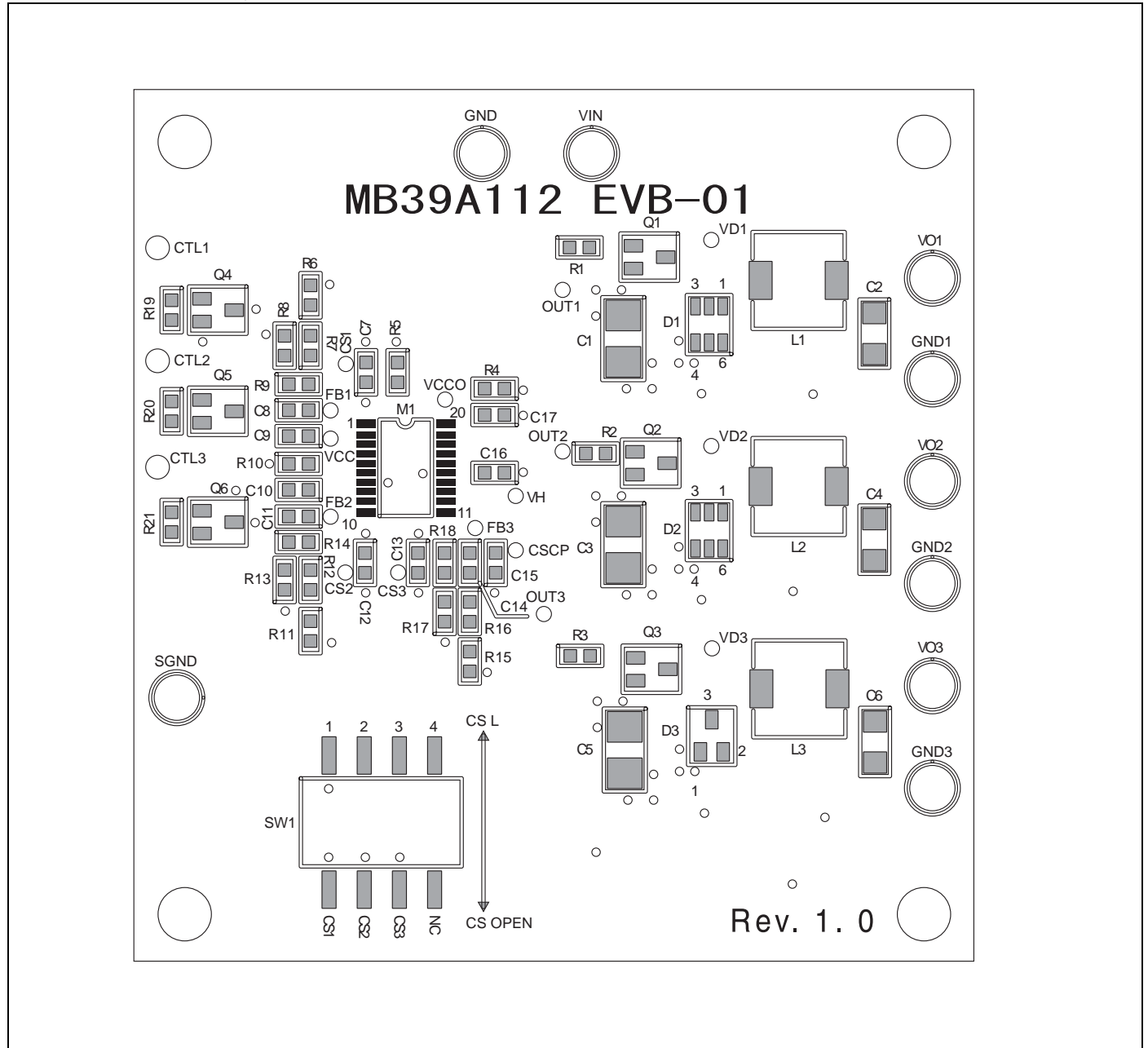
- Turn on VIN (power supply) , set SW1 to SW3 to ON (output ON) .

The IC works normally with the following outputs :

$V_{o1} = 1.2\text{ V (Typ)}$  ,  $V_{o2} = 3.3\text{ V (Typ)}$  ,  $V_{o3} = 5\text{ V (Typ)}$

## 4. Component Layout

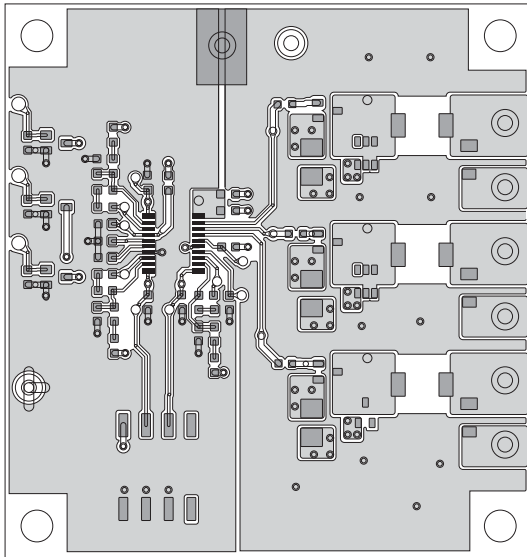
### ■ On-board Component Layout



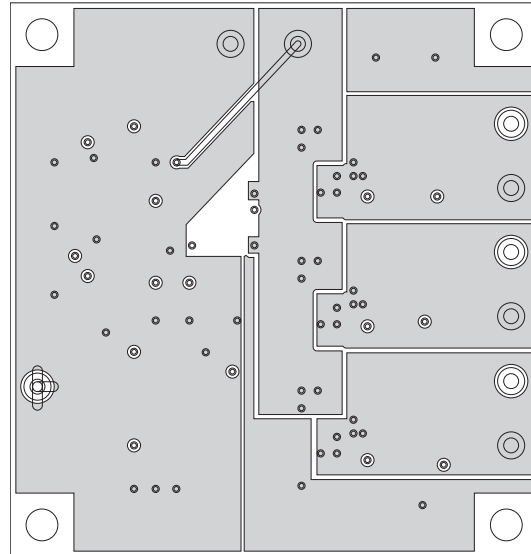
(Continued)

(Continued)

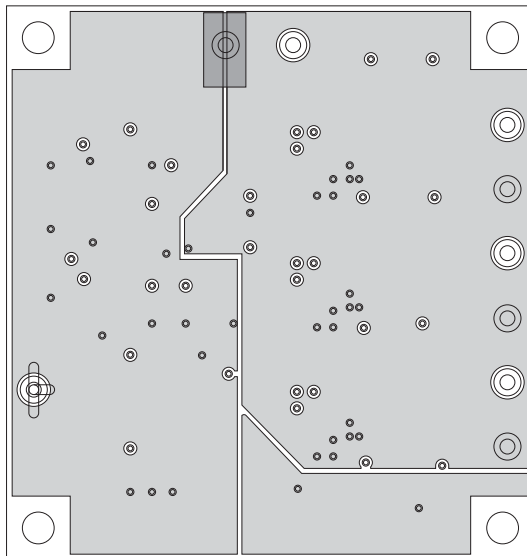
**Board Layout**



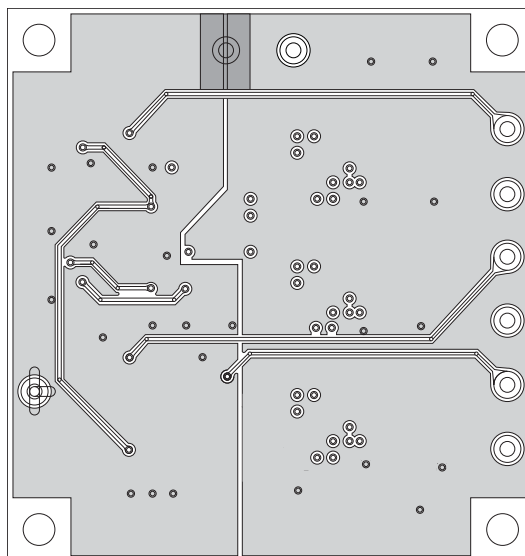
Top Side



Inside GND (Layer2)



Inside VIN (Layer3)



Bottom Side



**6. Parts List**

No.	Symbol (Circuit diagram mark)	Part name	Model name	Specification						Package	Manufacturer	Remarks
				Rating 1	Rating 2	Rating 3	Value	Deviation	Features			
1	M1	IC	MB39A112PFT	—	—	—	—	—	—	FPT-20P-M06	Cypress	
2	Q1	Pch FET	MCH3312	PD = 1 W	VGSS = 20 V	ID = 2.0 A	—	—	—	MCPH3	SANYO	
3	Q2	Pch FET	MCH3312	PD = 1 W	VGSS = 20 V	ID = 2.0 A	—	—	—	MCPH3	SANYO	
4	Q3	Pch FET	MCH3308	PD = 0.8 W	VGSS = 20 V	ID = 1.0 A	—	—	—	MCPH3	SANYO	
5	Q4	Nch FET	—	—	—	—	—	—	—	—	—	Not mounted
6	Q5	Nch FET	—	—	—	—	—	—	—	—	—	Not mounted
7	Q6	Nch FET	—	—	—	—	—	—	—	—	—	Not mounted
8	D1	SBD	SBE001	IF(AV) = 2 A	VRRM = 30 V	—	—	—	—	CPH6	SANYO	
9	D2	SBD	SBE001	IF(AV) = 2 A	VRRM = 30 V	—	—	—	—	CPH6	SANYO	
10	D3	SBD	SBS005	IF(AV) = 1 A	VRRM = 30 V	—	—	—	—	CPH3	SANYO	
11	L1	Coil	A916CY-2R0M	IDC1 = 3 A	IDC2 = 3.31A	—	2 $\mu$	$\pm 20\%$	RDC = 16 m $\Omega$	—	TOKO	
12	L2	Coil	A916CY-3R3M	IDC1 = 2.57 A	IDC2 = 2.81 A	—	3.3 $\mu$	$\pm 20\%$	RDC = 21.4 m $\Omega$	—	TOKO	
13	L3	Coil	A916CY-100M	IDC1 = 1.49 A	IDC2 = 1.97 A	—	10 $\mu$	$\pm 20\%$	RDC = 41.2 m $\Omega$	—	TOKO	
14	C1	Ceramic condenser	C3216-JB1E225 K	25 V	—	—	2.2 $\mu$	$\pm 10\%$	Temperature characteristics B	3216	TDK	
15	C2	Ceramic condenser	C3216-JB1C475 M	16 V	—	—	4.7 $\mu$	$\pm 20\%$	Temperature characteristics B	3216	TDK	
16	C3	Ceramic condenser	C3216-JB1E225 K	25 V	—	—	2.2 $\mu$	$\pm 10\%$	Temperature characteristics B	3216	TDK	
17	C4	Ceramic condenser	C3216-JB1C475 M	16 V	—	—	4.7 $\mu$	$\pm 20\%$	Temperature characteristics B	3216	TDK	
18	C5	Ceramic condenser	C3216-JB1E225 K	25 V	—	—	2.2 $\mu$	$\pm 10\%$	Temperature characteristics B	3216	TDK	

No.	Symbol (Circuit diagram mark)	Part name	Model name	Specification						Package	Manufacturer	Remarks
				Rating 1	Rating 2	Rating 3	Value	Deviation	Features			
19	C6	Ceramic condenser	C3216-JB1C475M	16 V	—	—	4.7 $\mu$	$\pm 20\%$	Temperature characteristics B	3216	TDK	
20	C7	Ceramic condenser	C1608-JB1H104K	50V	—	—	0.1 $\mu$	$\pm 10\%$	Temperature characteristics B	1608	TDK	
21	C8	Ceramic condenser	C1608-JB1H223K	50V	—	—	0.022 $\mu$	$\pm 10\%$	Temperature characteristics B	1608	TDK	
22	C9	Ceramic condenser	C1608-JB1H104K	50V	—	—	0.1 $\mu$	$\pm 10\%$	Temperature characteristics B	1608	TDK	
23	C10	Ceramic condenser	C1608CH1H101J	50V	—	—	100 p	$\pm 5\%$	Temperature characteristics CH	1608	TDK	
24	C11	Ceramic condenser	C1608-JB1H103K	50V	—	—	0.01 $\mu$	$\pm 10\%$	Temperature characteristics B	1608	TDK	
25	C12	Ceramic condenser	C1608-JB1H104K	50V	—	—	0.1 $\mu$	$\pm 10\%$	Temperature characteristics B	1608	TDK	
26	C13	Ceramic condenser	C1608-JB1H104K	50V	—	—	0.1 $\mu$	$\pm 10\%$	Temperature characteristics B	1608	TDK	
27	C14	Ceramic condenser	C1608-JB1H103K	50V	—	—	0.01 $\mu$	$\pm 10\%$	Temperature characteristics B	1608	TDK	
28	C15	Ceramic condenser	C1608-JB1H102K	50V	—	—	1000 p	$\pm 10\%$	Temperature characteristics B	1608	TDK	
29	C16	Ceramic condenser	C1608-JB1H104K	50V	—	—	0.1 $\mu$	$\pm 10\%$	Temperature characteristics B	1608	TDK	
30	C17	Ceramic condenser	C1608-JB1H104K	50V	—	—	0.1 $\mu$	$\pm 10\%$	Temperature characteristics B	1608	TDK	
31	R1	Jumper	RK73Z1J	1 A	—	—	0 $\Omega$	Max 50 m $\Omega$	—	1608	KOA	
32	R2	Jumper	RK73Z1J	1 A	—	—	0 $\Omega$	Max 50 m $\Omega$	—	1608	KOA	



No.	Symbol (Circuit diagram mark)	Part name	Model name	Specification						Package	Manufacturer	Remarks
				Rating 1	Rating 2	Rating 3	Value	Deviation	Features			
33	R3	Jumper	RK73Z1J	1 A	—	—	0 Ω	Max 50 mΩ	—	1608	KOA	
34	R4	Jumper	RK73Z1J	1 A	—	—	0 Ω	Max 50 mΩ	—	1608	KOA	
35	R5	Jumper	RK73Z1J	1 A	—	—	0 Ω	Max 50 mΩ	—	1608	KOA	
36	R6	Resistor	PR0816P-222-D	1/16 W	—	—	2.2 kΩ	±0.5 %	±25 ppm/ °C	1608	ssm	
37	R7	Resistor	PR0816P-183-D	1/16 W	—	—	18 kΩ	±0.5 %	±25 ppm/ °C	1608	ssm	
38	R8	Resistor	PR0816P-104-D	1/16 W	—	—	100 kΩ	±0.5 %	±25 ppm/ °C	1608	ssm	
39	R9	Resistor	PR0816P-821-D	1/16 W	—	—	820 Ω	±0.5 %	±25 ppm/ °C	1608	ssm	
40	R10	Resistor	PR0816P-512-D	1/16 W	—	—	5.1 kΩ	±0.5 %	±25 ppm/ °C	1608	ssm	
41	R11	Resistor	PR0816P-472-D	1/16 W	—	—	4.7 kΩ	±0.5 %	±25 ppm/ °C	1608	ssm	
42	R12	Resistor	PR0816P-563-D	1/16 W	—	—	56 kΩ	±0.5 %	±25 ppm/ °C	1608	ssm	
43	R13	Resistor	PR0816P-363-D	1/16 W	—	—	36 kΩ	±0.5 %	±25 ppm/ °C	1608	ssm	
44	R14	Resistor	PR0816P-821-D	1/16 W	—	—	820 Ω	±0.5 %	±25 ppm/ °C	1608	ssm	
45	R15	Resistor	PR0816P-681-D	1/16 W	—	—	680 Ω	±0.5 %	±25 ppm/ °C	1608	ssm	
46	R16	Resistor	PR0816P-303-D	1/16 W	—	—	30 kΩ	±0.5 %	±25 ppm/ °C	1608	ssm	
47	R17	Resistor	PR0816P-103-D	1/16 W	—	—	10 kΩ	±0.5 %	±25 ppm/ °C	1608	ssm	
48	R18	Resistor	PR0816P-102-D	1/16 W	—	—	1 kΩ	±0.5 %	±25 ppm/ °C	1608	ssm	
49	R19	Resistor	—	—	—	—	—	—	—	—	—	Not mounted
50	R20	Resistor	—	—	—	—	—	—	—	—	—	Not mounted
51	R21	Resistor	—	—	—	—	—	—	—	—	—	Not mounted
52	SW1	Switch	DMS-4H	—	—	—	—	—	—	—	MAT-SUKYU	

No.	Symbol (Circuit diagram mark)	Part name	Model name	Specification						Package	Manufacturer	Remarks
				Rating 1	Rating 2	Rating 3	Value	Deviation	Features			
53	—	Terminal pin	WT-2-1	—	—	—	—	—	—	—	MacEight	

SANYO            SANYO Electric Co., Ltd.  
 TOKO            TOKO, Inc.  
 TDK             TDK Corporation  
 KOA             KOA Corporation  
 ssm             SUSUMU CO., LTD.  
 MATSUKYU     Matsuky Co., Ltd.  
 MacEight       MacEight Co., Ltd.

## 7. Initial Settings

### 7.1 Output voltage

$$\text{CH1: } V_{o1} \text{ (V)} = \frac{R6 + R7 + R8}{R8} \times 1.0 \cong 1.2 \text{ V}$$

$$\text{CH2: } V_{o2} \text{ (V)} = \frac{R11 + R12 + R13}{R13} \times 1.23 \cong 3.3 \text{ V}$$

$$\text{CH3: } V_{o3} \text{ (V)} = \frac{R15 + R16 + R17}{R17} \times 1.23 \cong 5 \text{ V}$$

### 7.2 Oscillation frequency

$$f_{\text{osc}} \text{ (kHz)} = \frac{1200000}{C10 \text{ (pF)} \times R10 \text{ (k}\Omega\text{)}} \cong 2350 \text{ (kHz)}$$

### 7.3 Soft-start time

$$\text{CH1: } ts1 \text{ (s)} = 1.0 \times C7 \text{ (}\mu\text{F)} \cong 10 \text{ (ms)}$$

$$\text{CH2: } ts2 \text{ (s)} = 0.123 \times C12 \text{ (}\mu\text{F)} \cong 12 \text{ (ms)}$$

$$\text{CH3: } ts3 \text{ (s)} = 0.123 \times C13 \text{ (}\mu\text{F)} \cong 12 \text{ (ms)}$$

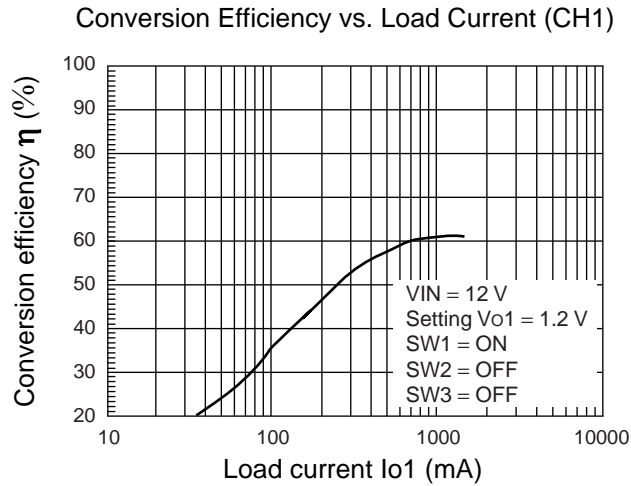
### 7.4 Short-circuit detection time

$$t_{\text{scp}} \text{ (s)} = 0.72 \times C15 \text{ (}\mu\text{F)} \cong 720 \text{ (}\mu\text{s)}$$

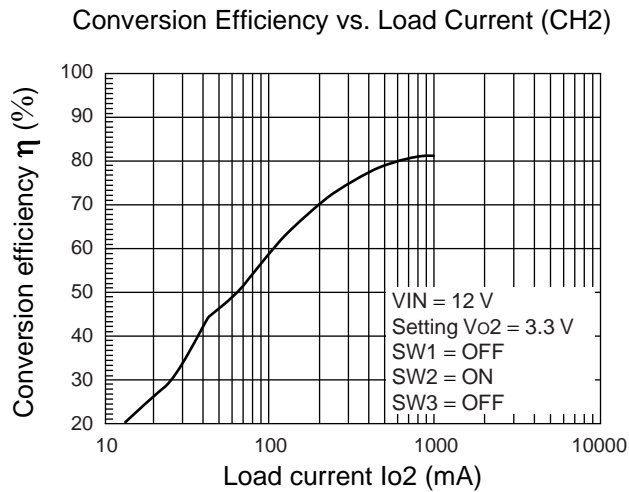
## 8. Reference Data

### 8.1 Conversion efficiency vs. Input voltage

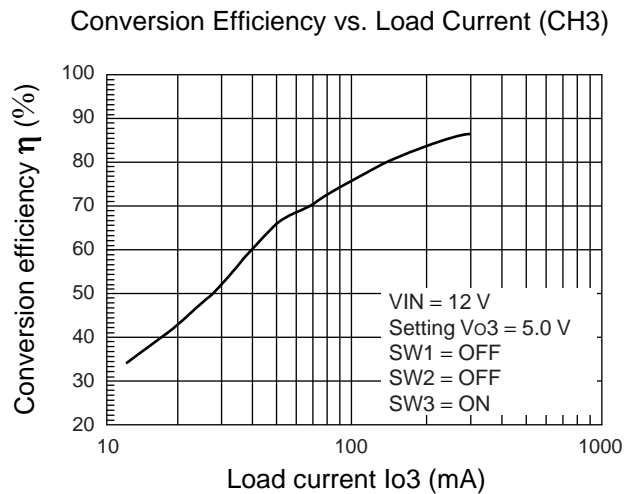
• CH1



• CH2

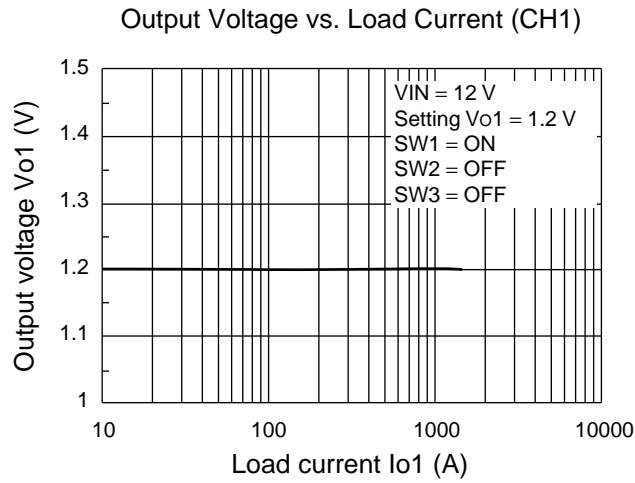


• CH3

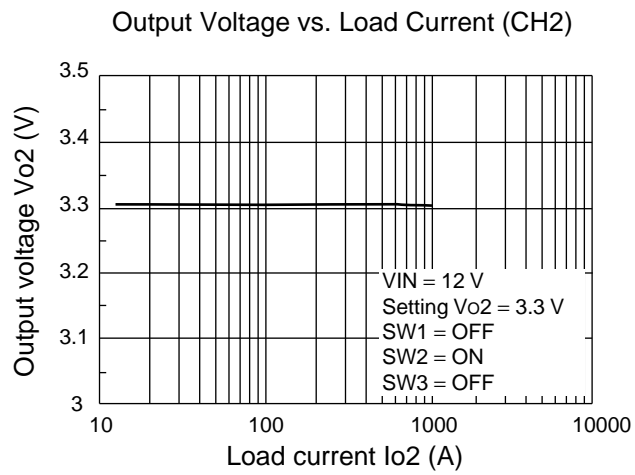


8.2 Load Regulation ( $V_{IN} = 12\text{ V}$ )

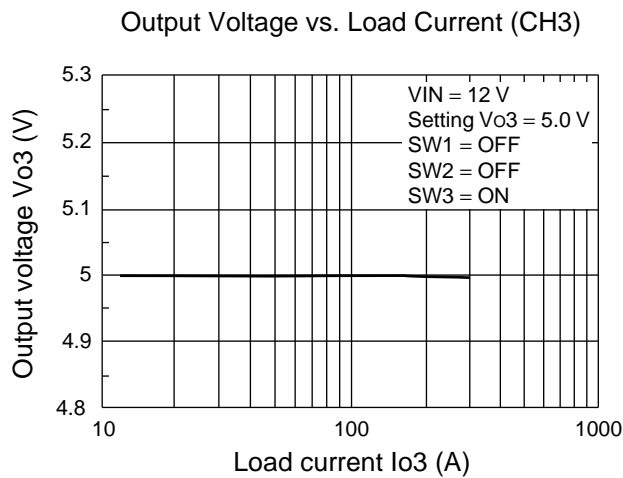
• CH1



• CH2

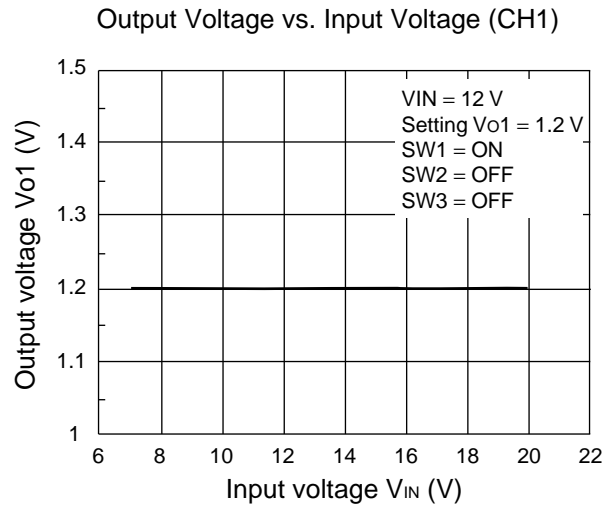


• CH3

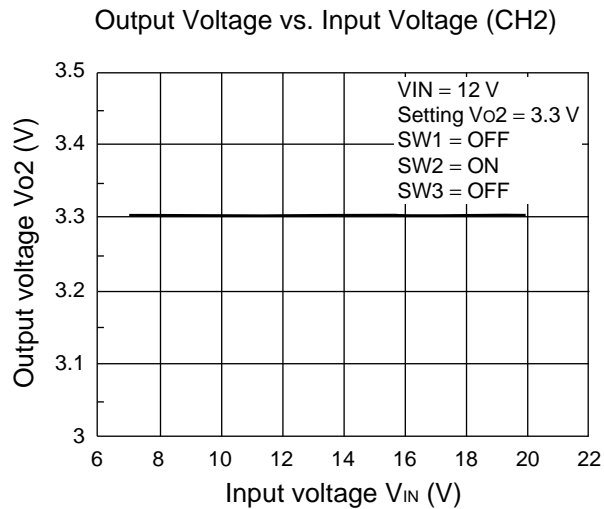


8.3 Line regulation

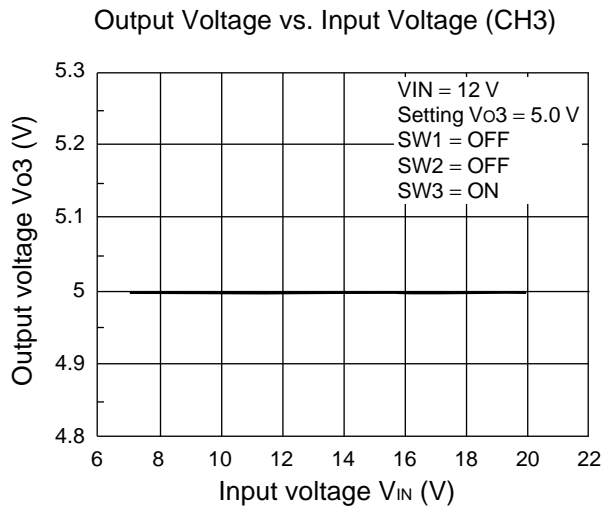
• CH1



• CH2

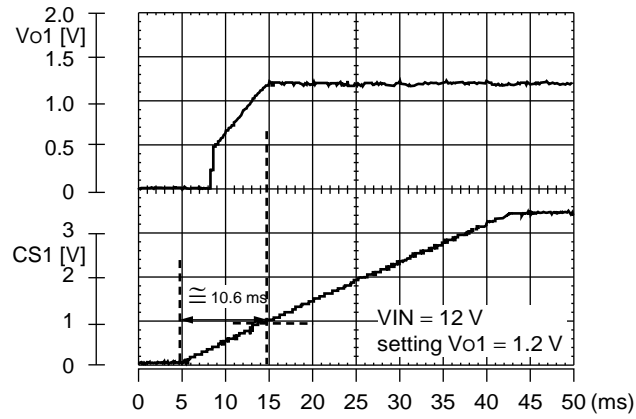


• CH3

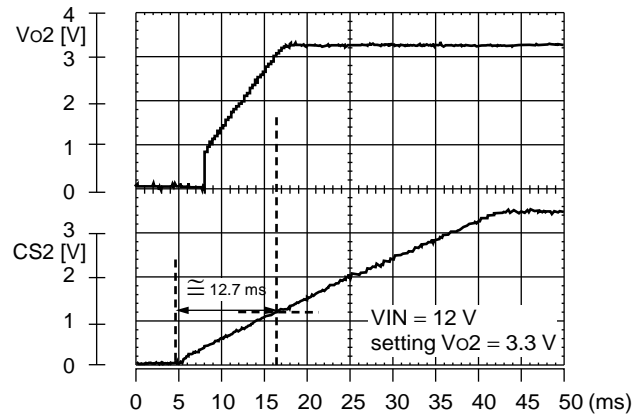


8.4 Soft-start operation waveforms

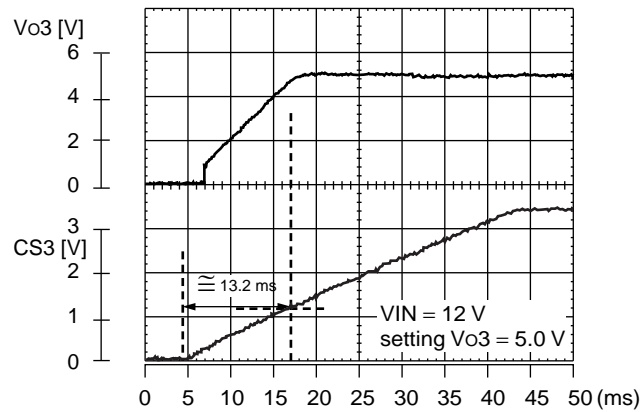
• CH1



• CH2

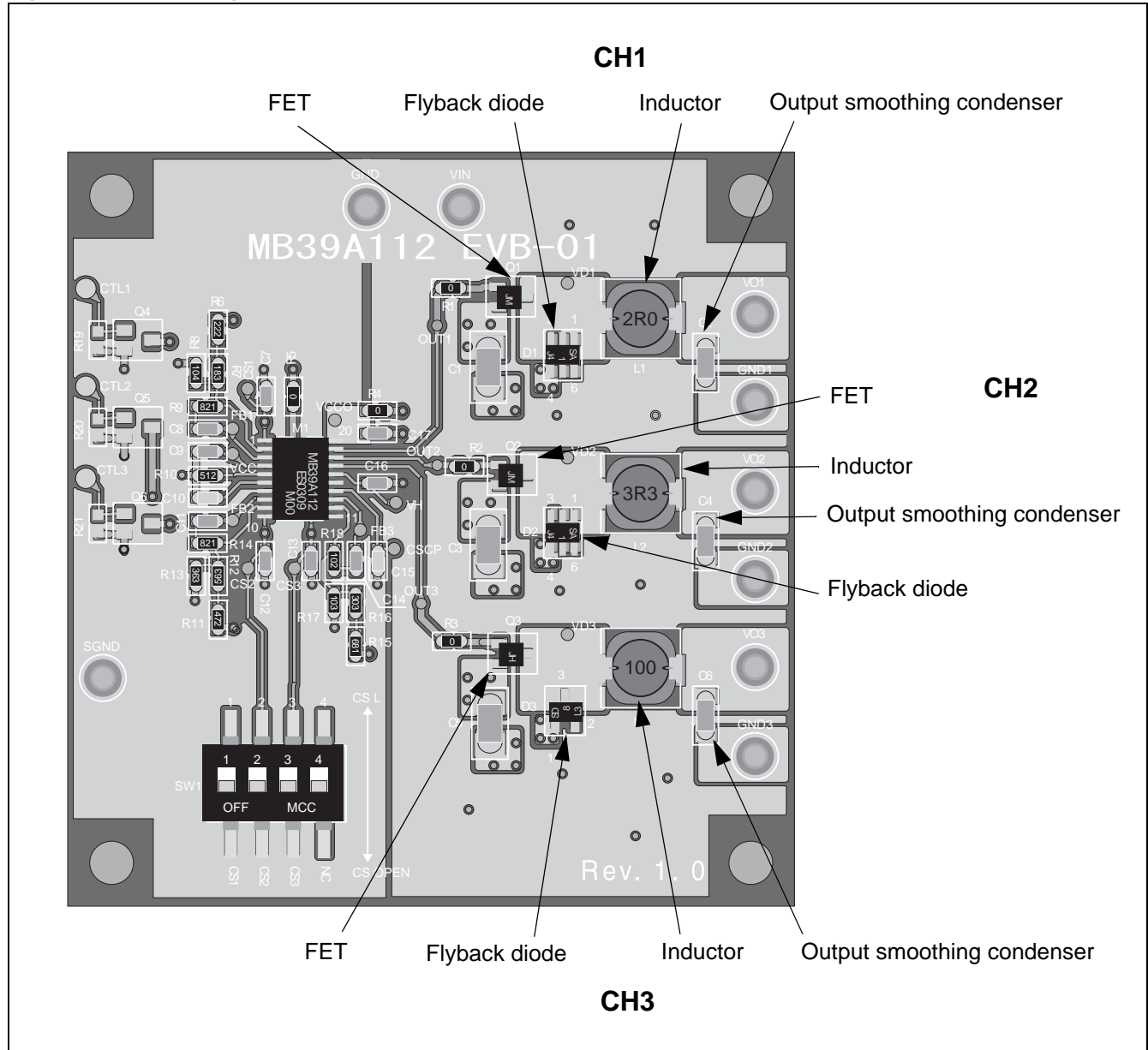


• CH3



### 9. Component Selection Methods

Figure 1. Board Photograph



## 9.1 CH1 1.2 V output

$V_{IN} = 12\text{ V (Typ)}$  ,  $V_{O1} = 1.2\text{ V}$  ,  $I_o = 1.5\text{ A}$  ,  $f_{osc} = 2300\text{ kHz}$

### 9.1.1 P-ch MOS FET (MCH3312 (SANYO product) )

$V_{DS} = -30\text{ V}$  ,  $V_{GS} = \pm 20\text{ V}$  ,  $I_D = -2\text{ A}$  ,  $R_{DS(ON)} = 205\text{ m}\Omega\text{ (Typ)}$  ,  $Q_g = 5.5\text{ nC (Typ)}$

#### Drain current : Peak value

The peak drain current of this FET must be within its rated current.

If the FET's peak drain current is  $I_D$ , it is obtained by the following formula.

$$\begin{aligned}
 I_D &\geq I_o + \frac{V_{IN} - V_{O1}}{2L} t_{ON} \\
 &\geq 1.5 + \frac{12 - 1.2}{2 \times 2 \times 10^{-6}} \times \frac{1}{2300 \times 10^3} \times 0.1 \\
 &\geq \underline{1.62\text{ A}}
 \end{aligned}$$

### 9.1.2 Inductor (A916CY-2R0M : TOKO product)

2.0  $\mu\text{H}$  (tolerance  $\pm 20\%$ ) , rated current = 3.0 A

#### The L value for all load current conditions

It is set so that the peak to peak value of the ripple current is 1/2 of the load current or less.

$$\begin{aligned}
 L &\geq \frac{2(V_{IN} - V_{O1})}{I_o} t_{ON} \\
 &\geq \frac{2 \times (12 - 1.2)}{1.5} \times \frac{1}{2300 \times 10^3} \times 0.1 \\
 &\geq \underline{0.63\ \mu\text{H}}
 \end{aligned}$$

#### The load current satisfying the continuous current condition

$$\begin{aligned}
 I_o &\geq \frac{V_{O1}}{2L} t_{OFF} \\
 &\geq \frac{1.2}{2 \times 2.0 \times 10^{-6}} \times \frac{1}{2300 \times 10^3} \times (1 - 0.1) \\
 &\geq \underline{0.12\text{ A}}
 \end{aligned}$$



**Ripple current : Peak value**

The peak ripple current must be within the rated current of the inductor.

If the peak ripple current is  $I_L$ , it is obtained by the following formula.

$$\begin{aligned}
 I_L &\geq I_o + \frac{V_{IN} - V_{o1}}{2L} t_{ON} \\
 &\geq 1.5 + \frac{12 - 1.2}{2 \times 2.0 \times 10^{-6}} \times \frac{1}{2300 \times 10^3} \times 0.1 \\
 &\geq \underline{1.62 \text{ A}}
 \end{aligned}$$

**Ripple current : peak-to-peak value**

If the peak-to-peak ripple current is  $\Delta I_L$ , it is obtained by the following formula.

$$\begin{aligned}
 \Delta I_L &= \frac{V_{IN} - V_{o1}}{L} t_{ON} \\
 &= \frac{12 - 1.2}{2.0 \times 10^{-6}} \times \frac{1}{2300 \times 10^3} \times 0.1 \\
 &\cong \underline{0.23 \text{ A}}
 \end{aligned}$$

**9.1.3 Flyback diode (SBE001 : SANYO product)**

$V_R$  (DC reverse voltage) = 30 V, average output current = 2.0 A, peak surge current = 20 A

$V_F$  (forward voltage) = 0.55 V, at  $I_F = 2.0 \text{ A}$

$V_R$  : The value enough to satisfy the input voltage → 30 V

On time of the diode is assumed to be  $t_D$  (Max) , the diode mean current  $I_{Di}$  is obtained by the following formula.

$$I_{Di} \geq I_o \times \left(1 - \frac{V_{o1}}{V_{IN}}\right) = 1.5 \times (1 - 0.1) \cong \underline{1.35 \text{ A}}$$

On time of the diode is assumed to be  $t_D$  (Max) , the diode peak current  $I_{Dip}$  is obtained by the following formula.

$$I_{Dip} \geq \left(I_o + \frac{V_{o1}}{2L} t_{OFF}\right) \cong \underline{1.62 \text{ A}}$$

## 9.2 CH2 3.3 V output

$$V_{IN} = 12 \text{ V (Typ)}, V_{O2} = 3.3 \text{ V}, I_o = 1.0 \text{ A}, f_{osc} = 2300 \text{ kHz}$$

### 9.2.1 P-ch MOS FET (MCH3312 (SANYO product))

$$V_{DS} = -30 \text{ V}, V_{GS} = \pm 20 \text{ V}, I_D = -2 \text{ A}, R_{DS(ON)} = 205 \text{ m}\Omega \text{ (Typ)}, Q_g = 5.5 \text{ nC (Typ)}$$

#### Drain current : Peak value

The peak drain current of this FET must be within its rated current.

If the FET's peak drain current is  $I_D$ , it is obtained by the following formula.

$$\begin{aligned} I_D &\geq I_o + \frac{V_{IN} - V_{O2}}{2L} t_{ON} \\ &\geq 1.0 + \frac{12 - 3.3}{2 \times 3.3 \times 10^{-6}} \times \frac{1}{2300 \times 10^3} \times 0.275 \\ &\geq \underline{1.16 \text{ A}} \end{aligned}$$

### 9.2.2 Inductor (A916CY-3R3M : TOKO product)

3.3  $\mu\text{H}$  (tolerance  $\pm 20\%$ ), rated current = 2.57 A

#### The L value for all load current conditions

It is set so that the peak to peak value of the ripple current is 1/2 of the load current or less.

$$\begin{aligned} L &\geq \frac{2(V_{IN} - V_{O2})}{I_o} t_{ON} \\ &\geq \frac{2 \times (12 - 3.3)}{1.0} \times \frac{1}{2300 \times 10^3} \times 0.275 \\ &\geq \underline{2.08 \mu\text{H}} \end{aligned}$$

#### The load current satisfying the continuous current condition

$$\begin{aligned} I_o &\geq \frac{V_{O2}}{2L} t_{OFF} \\ &\geq \frac{3.3}{2 \times 3.3 \times 10^{-6}} \times \frac{1}{2300 \times 10^3} \times (1 - 0.275) \\ &\geq \underline{0.16 \text{ A}} \end{aligned}$$

**Ripple current : Peak value**

The peak ripple current must be within the rated current of the inductor.

If the peak ripple current is  $I_L$ , it is obtained by the following formula.

$$\begin{aligned}
 I_L &\geq I_o + \frac{V_{IN} - V_{o2}}{2L} t_{ON} \\
 &\geq 1.0 + \frac{12 - 3.3}{2 \times 3.3 \times 10^{-6}} \times \frac{1}{2300 \times 10^3} \times 0.275 \\
 &\geq \underline{1.16 \text{ A}}
 \end{aligned}$$

**Ripple current : peak-to-peak value**

If the peak-to-peak ripple current is  $\Delta I_L$ , it is obtained by the following formula.

$$\begin{aligned}
 \Delta I_L &= \frac{V_{IN} - V_{o2}}{L} t_{ON} \\
 &= \frac{12 - 3.3}{3.3 \times 10^{-6}} \times \frac{1}{2300 \times 10^3} \times 0.275 \\
 &\cong \underline{0.315 \text{ A}}
 \end{aligned}$$

**9.2.3 Flyback diode (SBE001 : SANYO product)**

$V_R$  (DC reverse voltage) = 30 V, average output current = 2.0 A, peak surge current = 20 A

$V_F$  (forward voltage) = 0.55 V, at  $I_F = 2.0 \text{ A}$

$V_R$  : The value enough to satisfy the input voltage  $\rightarrow 30 \text{ V}$

On time of the diode is assumed to be  $t_D$  (Max) , the diode mean current  $I_{Di}$  is obtained by the following formula.

$$I_{Di} \geq I_o \times \left(1 - \frac{V_{o2}}{V_{IN}}\right) = 1.0 \times (1 - 0.275) \cong \underline{0.725 \text{ A}}$$

On time of the diode is assumed to be  $t_D$  (Max) , the diode peak current  $I_{Dip}$  is obtained by the following formula.

$$I_{Dip} \geq \left(I_o + \frac{V_{o2}}{2L} t_{OFF}\right) \cong \underline{1.16 \text{ A}}$$

### 9.3 CH3 5 V output

$V_{IN} = 12 \text{ V (Typ)}$  ,  $V_{O3} = 5 \text{ V}$  ,  $I_o = 0.3 \text{ A}$  ,  $f_{osc} = 2300 \text{ kHz}$

#### 9.3.1 P-ch MOS FET (MCH3308 (SANYO product) )

$V_{DS} = -30 \text{ V}$  ,  $V_{GS} = \pm 20 \text{ V}$  ,  $I_D = -1 \text{ A}$  ,  $R_{DS(ON)} = 720 \text{ m}\Omega \text{ (Typ)}$  ,  $Q_g = 2.6 \text{ nC (Typ)}$

#### Drain current : Peak value

The peak drain current of this FET must be within its rated current.

If the FET's peak drain current is  $I_D$ , it is obtained by the following formula.

$$\begin{aligned}
 I_D &\geq I_o + \frac{V_{IN} - V_{O3}}{2L} t_{ON} \\
 &\geq 0.3 + \frac{12 - 5}{2 \times 10 \times 10^{-6}} \times \frac{1}{2300 \times 10^3} \times 0.417 \\
 &\geq \underline{0.36 \text{ A}}
 \end{aligned}$$

#### 9.3.2 Inductor (A916CY-100M : TOKO product)

10  $\mu\text{H}$  (tolerance  $\pm 20\%$ ) , rated current = 1.49 A

#### The L value for all load current conditions

It is set so that the peak to peak value of the ripple current is 1/2 of the load current or less.

$$\begin{aligned}
 L &\geq \frac{2 (V_{IN} - V_{O3})}{I_o} t_{ON} \\
 &\geq \frac{2 \times (12 - 5)}{0.3} \times \frac{1}{2300 \times 10^3} \times 0.417 \\
 &\geq \underline{8.46 \mu\text{H}}
 \end{aligned}$$

#### The load current satisfying the continuous current condition

$$\begin{aligned}
 I_o &\geq \frac{V_{O3}}{2L} t_{OFF} \\
 &\geq \frac{5}{2 \times 10 \times 10^{-6}} \times \frac{1}{2300 \times 10^3} \times (1 - 0.417) \\
 &\geq \underline{63.4 \text{ mA}}
 \end{aligned}$$

**Ripple current : Peak value**

The peak ripple current must be within the rated current of the inductor.

If the peak ripple current is  $I_L$ , it is obtained by the following formula.

$$\begin{aligned}
 I_L &\geq I_o + \frac{V_{IN} - V_{o3}}{2L} t_{ON} \\
 &\geq 0.3 + \frac{12 - 5}{2 \times 10 \times 10^{-6}} \times \frac{1}{2300 \times 10^3} \times 0.417 \\
 &\geq \underline{0.36 \text{ A}}
 \end{aligned}$$

**Ripple current:Peak-to-peak value**

If the peak-to-peak ripple current is  $\Delta I_L$ , it is obtained by the following formula.

$$\begin{aligned}
 \Delta I_L &= \frac{V_{IN} - V_{o3}}{L} t_{ON} \\
 &= \frac{12 - 5}{10 \times 10^{-6}} \times \frac{1}{2300 \times 10^3} \times 0.417 \\
 &\cong \underline{0.127 \text{ A}}
 \end{aligned}$$

**9.3.3 Flyback diode (SBS005 : SANYO product)**

$V_R$  (DC reverse voltage) = 30 V, average output current = 1.0 A, peak surge current = 10 A

$V_F$  (forward voltage) = 0.35 V, at  $I_F = 0.5 \text{ A}$

$V_R$  : The value enough to satisfy the input voltage  $\rightarrow 30 \text{ V}$

On time of the diode is assumed to be  $t_D$  (Max) , the diode mean current  $I_{Di}$  is obtained by the following formula.

$$I_{Di} \geq I_o \times \left(1 - \frac{V_{o3}}{V_{IN}}\right) = 0.3 \times (1 - 0.417) \cong \underline{0.175 \text{ A}}$$

On time of the diode is assumed to be  $t_D$  (Max) , the diode peak current  $I_{Dip}$  is obtained by the following formula.

$$I_{Dip} \geq \left(I_o + \frac{V_{o2}}{2L} t_{OFF}\right) \cong \underline{0.36 \text{ A}}$$

**10. Ordering Information**

EV board part No.	EV board version No.	Remarks
MB39A112EVB-01	MB39A112EV Board Rev 1.0	

## Document History Page

Spansion Publication Number: DS04-71109-1E

Document Title: MB39A112EVB-01, Power Supply Application Evaluation Board Datasheet Document Number: 002-08322				
Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	-	TAOA	05/26/2004	Migrated to Cypress and assigned document number 002-08322. No change to document contents or format.
*A	5522626	TAOA	11/22/2016	Updated to Cypress template

## Sales, Solutions, and Legal Information

### Worldwide Sales and Design Support

Cypress maintains a worldwide network of offices, solution centers, manufacturer's representatives, and distributors. To find the office closest to you, visit us at [Cypress Locations](#).

#### Products

ARM® Cortex® Microcontrollers	<a href="http://cypress.com/arm">cypress.com/arm</a>
Automotive	<a href="http://cypress.com/automotive">cypress.com/automotive</a>
Clocks & Buffers	<a href="http://cypress.com/clocks">cypress.com/clocks</a>
Interface	<a href="http://cypress.com/interface">cypress.com/interface</a>
Internet of Things	<a href="http://cypress.com/iot">cypress.com/iot</a>
Lighting & Power Control	<a href="http://cypress.com/powerpsoc">cypress.com/powerpsoc</a>
Memory	<a href="http://cypress.com/memory">cypress.com/memory</a>
PSoC	<a href="http://cypress.com/psoc">cypress.com/psoc</a>
Touch Sensing	<a href="http://cypress.com/touch">cypress.com/touch</a>
USB Controllers	<a href="http://cypress.com/usb">cypress.com/usb</a>
Wireless/RF	<a href="http://cypress.com/wireless">cypress.com/wireless</a>

#### PSoC®Solutions

[PSoC 1](#) | [PSoC 3](#) | [PSoC 4](#) | [PSoC 5LP](#)

#### Cypress Developer Community

[Forums](#) | [Projects](#) | [Video](#) | [Blogs](#) | [Training](#) | [Components](#)

#### Technical Support

[cypress.com/support](http://cypress.com/support)

© Cypress Semiconductor Corporation, 2004-2016. This document is the property of Cypress Semiconductor Corporation and its subsidiaries, including Spansion LLC ("Cypress"). This document, including any software or firmware included or referenced in this document ("Software"), is owned by Cypress under the intellectual property laws and treaties of the United States and other countries worldwide. Cypress reserves all rights under such laws and treaties and does not, except as specifically stated in this paragraph, grant any license under its patents, copyrights, trademarks, or other intellectual property rights. If the Software is not accompanied by a license agreement and you do not otherwise have a written agreement with Cypress governing the use of the Software, then Cypress hereby grants you a personal, non-exclusive, nontransferable license (without the right to sublicense) (1) under its copyright rights in the Software (a) for Software provided in source code form, to modify and reproduce the Software solely for use with Cypress hardware products, only internally within your organization, and (b) to distribute the Software in binary code form externally to end users (either directly or indirectly through resellers and distributors), solely for use on Cypress hardware product units, and (2) under those claims of Cypress's patents that are infringed by the Software (as provided by Cypress, unmodified) to make, use, distribute, and import the Software solely for use with Cypress hardware products. Any other use, reproduction, modification, translation, or compilation of the Software is prohibited.

TO THE EXTENT PERMITTED BY APPLICABLE LAW, CYPRESS MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARD TO THIS DOCUMENT OR ANY SOFTWARE OR ACCOMPANYING HARDWARE, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. To the extent permitted by applicable law, Cypress reserves the right to make changes to this document without further notice. Cypress does not assume any liability arising out of the application or use of any product or circuit described in this document. Any information provided in this document, including any sample design information or programming code, is provided only for reference purposes. It is the responsibility of the user of this document to properly design, program, and test the functionality and safety of any application made of this information and any resulting product. Cypress products are not designed, intended, or authorized for use as critical components in systems designed or intended for the operation of weapons, weapons systems, nuclear installations, life-support devices or systems, other medical devices or systems (including resuscitation equipment and surgical implants), pollution control or hazardous substances management, or other uses where the failure of the device or system could cause personal injury, death, or property damage ("Unintended Uses"). A critical component is any component of a device or system whose failure to perform can be reasonably expected to cause the failure of the device or system, or to affect its safety or effectiveness. Cypress is not liable, in whole or in part, and you shall and hereby do release Cypress from any claim, damage, or other liability arising from or related to all Unintended Uses of Cypress products. You shall indemnify and hold Cypress harmless from and against all claims, costs, damages, and other liabilities, including claims for personal injury or death, arising from or related to any Unintended Uses of Cypress products.

Cypress, the Cypress logo, Spansion, the Spansion logo, and combinations thereof, WICED, PSoC, CapSense, EZ-USB, F-RAM, and Traveo are trademarks or registered trademarks of Cypress in the United States and other countries. For a more complete list of Cypress trademarks, visit [cypress.com](http://cypress.com). Other names and brands may be claimed as property of their respective owners.