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DS04-71112-1Ea

ASSP for Power Supply Applications

Evaluation Board

MB39A114

■ DESCRIPTION

The MB39A114 evaluation board is a surface mount circuit board of down conversion circuit.

The MB39A114 evaluation board is a high-precision and high-efficiency battery charger, that supports both 3 cells and 4 cells, of the charge voltage selectable with the SEL terminal. It controls the charge voltage and charge current based on the power-supply voltage of, for example, an AC adapter to supply a current of up to 3 A.

This IC can dynamically control secondary batteries' charge current, which detects voltage drop in an AC adapter in order to keep its power constant (Dynamically-controlled charging) .

■ EVALUATION BOARD SPECIFICATIONS

(Ta = +25 °C)

Parameter		Value			Unit
		Min	Typ	Max	
Input voltage	Setting 12.6 V	13.2*2	16	22	V
	Setting 16.8 V*1	17.4*2	19	25	V
Output voltage	Setting 12.6 V	12.537	12.6	12.663	V
	Setting 16.8 V*1	16.716	16.8	16.924	V
Ripple voltage	Setting 12.6 V	—	126	252	mV
	Setting 16.8 V*1	—	168	336	mV
UV Comp detection voltage (VCC = H→L)	Setting 12.6 V	12.6	12.8	13	V
	Setting 16.8 V*1	16.8	17	17.2	V
Output current	SW2 = ON	2.82	3.03	3.26	A
	SW2 = OFF	0.182	0.26	0.338	A
Dynamically-controlled charging detection voltage*2		17.6	18	18.4	V
Oscillation frequency		260	300	340	kHz
Soft-start time	Constant voltage mode	5.9	9.3	17	ms
	Constant current mode	2.8	4.4	8.2	ms

*1 : Initial setting value is for 4 cells (16.8 V) .

*2 : The actual minimum value is the dynamically-controlled charging detection voltage.

2004.6

FUJITSU

■ TERMINAL DESCRIPTION

Symbol	Function
VAC	AC adapter input terminal
VIN	IC power supply terminal
V_O	DC/DC converter output terminal VBATT = 16.8 V (Typ)
BATT	System output terminal
CTL	Power supply control terminal [at SW1 (switch1) = OFF] VCTL = 0 V to 0.8 V : Standby mode VCTL = 2.0 V to VIN : Operation mode
VREF	Reference voltage output terminal
MODE SW	Mode control terminal [at SW2 (switch2) = OFF] VMODE SW = 0 V to 1.0 V : Dead battery mode*1 VMODE SW = High-Z (or 2.5 V to VIN) : DCC mode*2
CVM	Constant-voltage control state detection output terminal (open drain form) At constant-voltage control state : "L" level
OVP	DC/DC converter output overvoltage detection terminal (open drain form) At overvoltage : "H" level
SEL*3	Output voltage setting 3/4-cell switch terminal VSEL = 0 V to 0.8 V : 3-cell setting VSEL = 2.0 V to VIN : 4-cell setting
GND	Battery charger system GND
SGND	IC control side GND

*1 : This mode is used to check whether the battery is normal. The dead battery mode charge current value is set to about 260 mA (Typ) .

*2 : Charging is performed in Dynamically-Controlled Charging (DCC) mode. The DCC mode charge current value is set to 3 A (Typ) .

*3 : Standard setting : SEL terminal = 0 Ω pull-up to VCC
At VBATT = 12.6 V : R28 = REMOVE

Note : The AC adapter detection voltage is set to 18.0 V to control a constant electric power. For normal operation, apply a voltage of at least 18.0 V to the VAC terminal.

■ SWITCH DESCRIPTION

SW	Name	Function	ON	OFF
1	CTL	Power supply control	Operation	Stand-by
2	mode SW	Charge current mode control	DCC mode	Dead battery mode

■ SETUP AND CHECKUP

- Setup
  - Connect power supply terminal side to VAC and GND. Connect the BATT terminal to required loading device or measuring instrument.
  - Set SW to OFF.

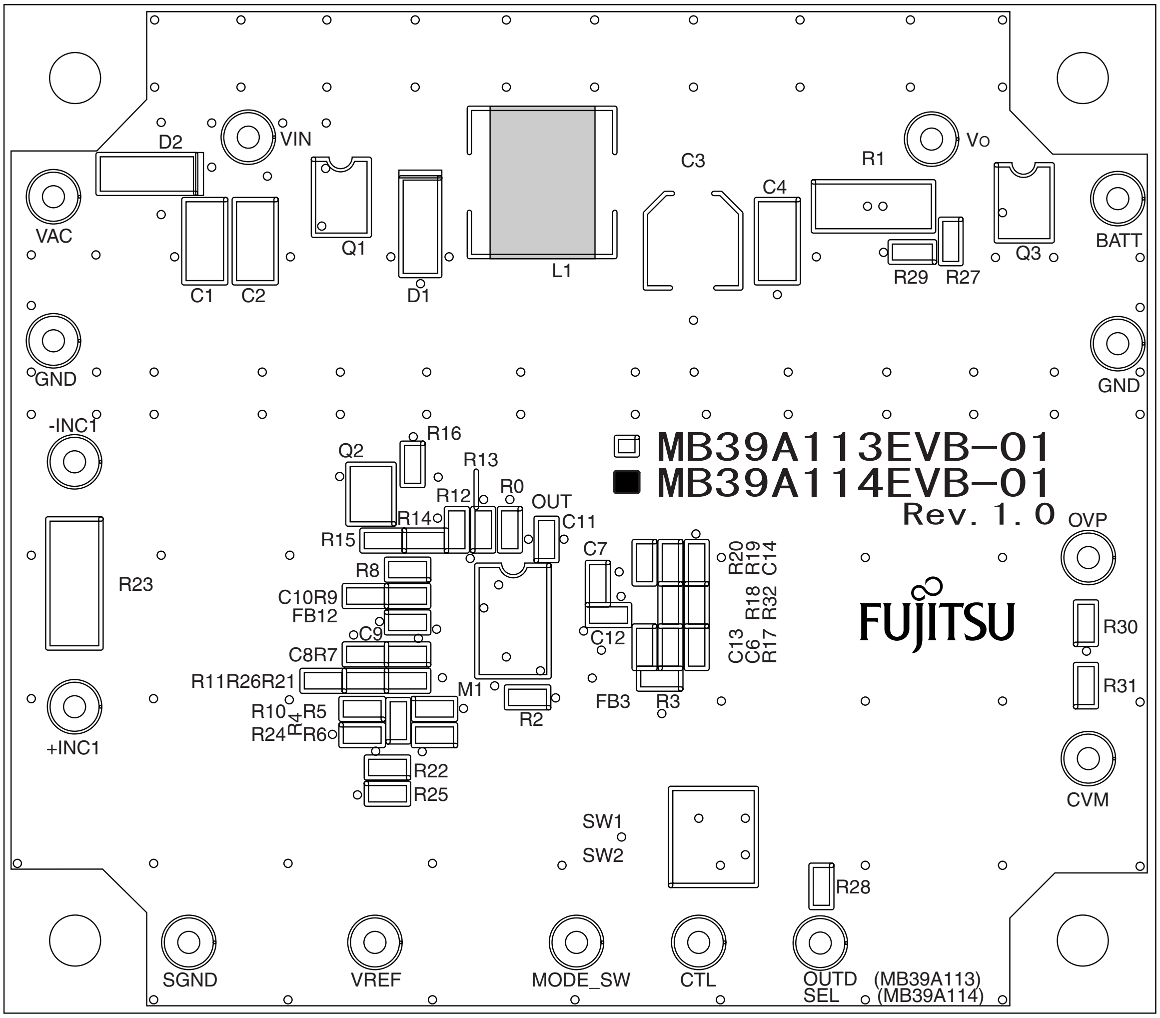
- Checkup

Turn on SW1 and turn on the power to the VAC (power supply) while turned on.

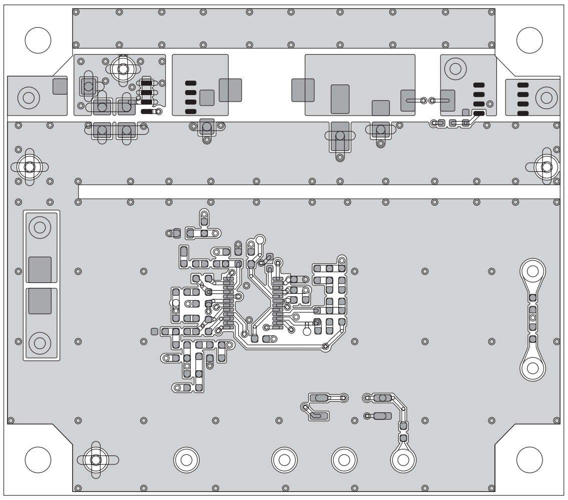
The IC works normally with the following outputs: BATT = 16.8 V (Typ) .

SW2 = ON : DCC mode
SW2 = OFF : Dead battery mode

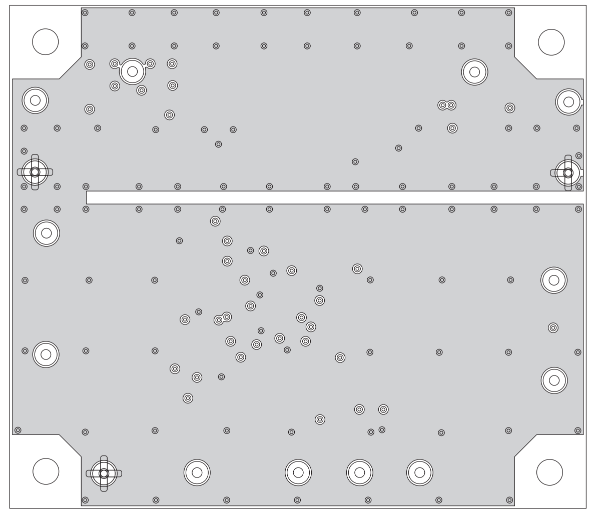
■ COMPONENT LAYOUT



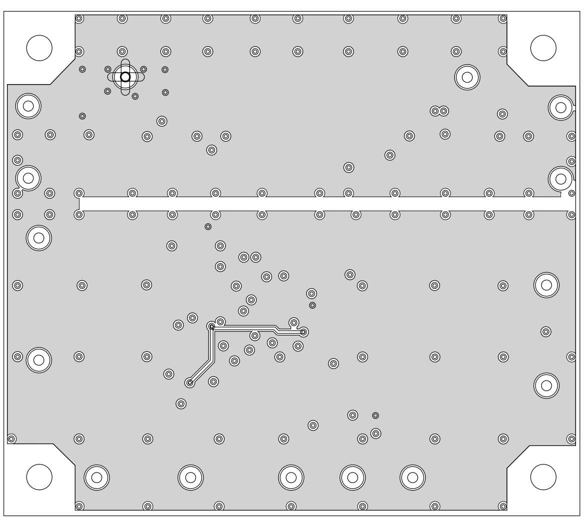
• Board layout



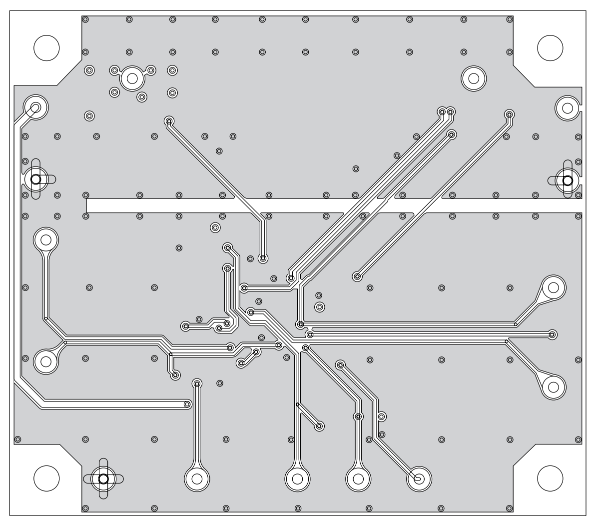
Top Side



Inside GND (Layer2)

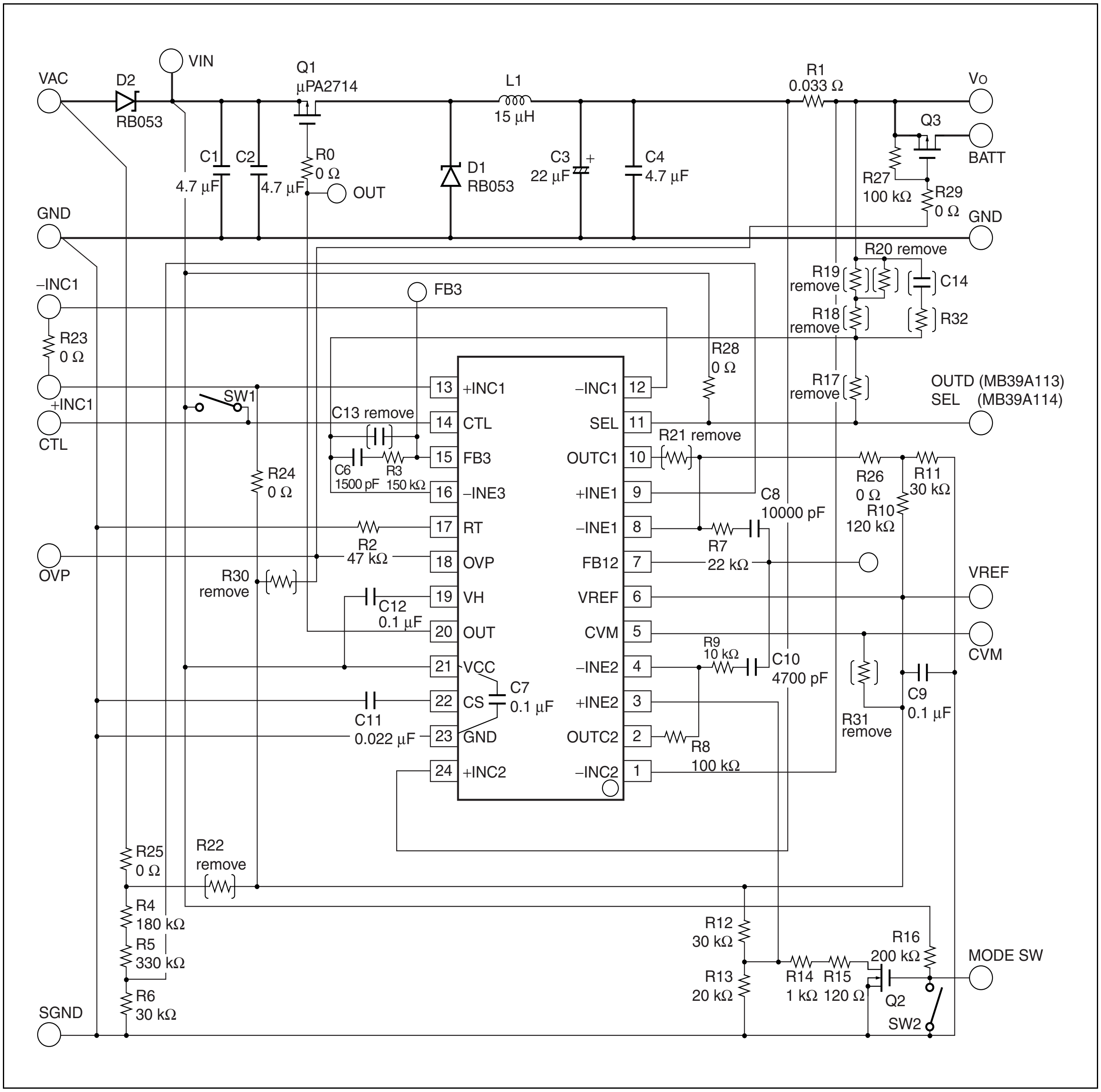


Inside VIN (Layer3)



Bottom Side

■ CONNECTION DIAGRAM



■ PARTS LIST

Symbol*	Part name	Model name	Specification						Package	Manu-facturer	Note
			Rating 1	Rating 2	Rating 3	Value	Devia-tion	Features			
M1	IC	MB39A114PFT	—	—	—	—	—	—	FPT-24P-M03	FUJITSU MICROELEC-TRONICS	
Q1	Pch FET	µPA2714GR	PD = 2 W	VGSS = – 30 V	ID = 7 A	—	—	—	SO-8	NEC	
Q2	Nch FET	MCH3405	PD = 0.8 W	VGSS = 20 V	ID = 1.8 A	—	—	—	MCPH3	SANYO	
Q3	Pch FET	µPA2714GR	PD = 2 W	VGSS = – 30 V	ID = 7 A	—	—	—	SO-8	NEC	
D1	SBD	RB053L-30	VF = 0.42 V at 3 A	VRRM = 30 V	—	—	—	—	PMDS	ROHM	
D2	SBD	RB053L-30	VF = 0.42 V at 3 A	VRRM = 30 V	—	—	—	—	PMDS	ROHM	
L1	Coil	CDRH104R150	RDC = 3.6 A	—	—	15 µH	± 30%	DCR = 50 mΩ	SMD	SUMIDA	
C1	Ceramic condenser	C3225JB1E475K	25 V	—	—	4.7 µF	± 10%	Temperature characteristics B	3225	TDK	
C2	Ceramic condenser	C3225JB1E475K	25 V	—	—	4.7 µF	± 10%	Temperature characteristics B	3225	TDK	
C3	OS-CON™	20SVP22M	20 V	1450 mArms	—	22 µF	—	ESR = 60 mΩ	SMD	SANYO	
C4	Ceramic condenser	C3225JB1E475K	25 V	—	—	4.7 µF	± 10%	Temperature characteristics B	3225	TDK	
C6	Ceramic condenser	C1608JB1H152K	50 V	—	—	1500 pF	± 10%	Temperature characteristics B	1608	TDK	
C7	Ceramic condenser	C1608JB1H104K	50 V	—	—	0.1 µF	± 10%	Temperature characteristics B	1608	TDK	
C8	Ceramic condenser	C1608JB1H103K	50 V	—	—	0.01 µF	± 10%	Temperature characteristics B	1608	TDK	
C9	Ceramic condenser	C1608JB1H104K	50 V	—	—	0.1 µF	± 10%	Temperature characteristics B	1608	TDK	
C10	Ceramic condenser	C1608JB1H472K	50 V	—	—	4700 pF	± 10%	Temperature characteristics B	1608	TDK	
C11	Ceramic condenser	C1608JB1H223K	50 V	—	—	0.022 µF	± 10%	Temperature characteristics B	1608	TDK	
C12	Ceramic condenser	C1608JB1H104K	50 V	—	—	0.1 µF	± 10%	Temperature characteristics B	1608	TDK	
C13	Ceramic condenser	C1608JB1H104K	50 V	—	—	0.1 µF	± 10%	Temperature characteristics B	1608	TDK	Not mounted
C14	Ceramic condenser	C1608JB1H104K	50 V	—	—	0.1 µF	± 10%	Temperature characteristics B	1608	TDK	Not mounted

* : Refer to "■ COMPONENT LAYOUT".

Note : OS - CON™ is a trademark of SANYO Electric Co., Ltd.

(Continued)

Symbol*	Part name	Model name	Specification						Package	Manu-facturer	Note
			Rating 1	Rating 2	Rating 3	Value	Devia-tion	Features			
R0	Jumper	RK73Z1J	1 A	—	—	0 Ω	Max 50 mΩ	—	1608	KOA	
R1	Resistor	SL1TTE33LOF	1 W	—	—	33 mΩ	± 1%	—	6.2 × 4.5 mm	KOA	
R2	Resistor	RR0816P-473-D	1/16 W	—	—	47 kΩ	± 0.5%	± 25 ppm/ °C	1608	ssm	
R3	Resistor	RR0816P-154-D	1/16 W	—	—	150 kΩ	± 0.5%	± 25 ppm/ °C	1608	ssm	
R4	Resistor	RR0816P-184-D	1/16 W	—	—	180 kΩ	± 0.5%	± 25 ppm/ °C	1608	ssm	
R5	Resistor	RR0816P-334-D	1/16 W	—	—	330 kΩ	± 0.5%	± 25 ppm/ °C	1608	ssm	
R6	Resistor	RR0816P-303-D	1/16 W	—	—	30 kΩ	± 0.5%	± 25 ppm/ °C	1608	ssm	
R7	Resistor	RR0816P-223-D	1/16 W	—	—	22 kΩ	± 0.5%	± 25 ppm/ °C	1608	ssm	
R8	Resistor	RR0816P-104-D	1/16 W	—	—	100 kΩ	± 0.5%	± 25 ppm/ °C	1608	ssm	
R9	Resistor	RR0816P-103-D	1/16 W	—	—	10 kΩ	± 0.5%	± 25 ppm/ °C	1608	ssm	
R10	Resistor	RR0816P-124-D	1/16 W	—	—	120 kΩ	± 0.5%	± 25 ppm/ °C	1608	ssm	
R11	Resistor	RR0816P-303-D	1/16 W	—	—	30 kΩ	± 0.5%	± 25 ppm/ °C	1608	ssm	
R12	Resistor	RR0816P-303-D	1/16 W	—	—	30 kΩ	± 0.5%	± 25 ppm/ °C	1608	ssm	
R13	Resistor	RR0816P-203-D	1/16 W	—	—	20 kΩ	± 0.5%	± 25 ppm/ °C	1608	ssm	
R14	Resistor	RR0816P-102-D	1/16 W	—	—	1 kΩ	± 0.5%	± 25 ppm/ °C	1608	ssm	
R15	Resistor	RR0816P-121-D	1/16 W	—	—	120 Ω	± 0.5%	± 25 ppm/ °C	1608	ssm	
R16	Resistor	RR0816P-204-D	1/16 W	—	—	200 kΩ	± 0.5%	± 25 ppm/ °C	1608	ssm	
R17	Resistor	RR0816P-104-D	1/16 W	—	—	100 kΩ	± 0.5%	± 25 ppm/ °C	1608	ssm	Not mounted
R18	Resistor	RR0816P-204-D	1/16 W	—	—	200 kΩ	± 0.5%	± 25 ppm/ °C	1608	ssm	Not mounted
R19	Resistor	RR0816P-104-D	1/16 W	—	—	100 kΩ	± 0.5%	± 25 ppm/ °C	1608	ssm	Not mounted
R20	Jumper	RK73Z1J	1 A	—	—	0 Ω	Max 50 mΩ	—	1608	KOA	Not mounted
R21	Resistor	RR0816P-104-D	1/16 W	—	—	100 kΩ	± 0.5%	± 25 ppm/ °C	1608	ssm	Not mounted
R22	Jumper	RK73Z1J	1 A	—	—	0 Ω	Max 50 mΩ	—	1608	KOA	Not mounted
R23	Jumper	RK73Z1J	1 A	—	—	0 Ω	Max 50 mΩ	—	1608	KOA	
R24	Jumper	RK73Z1J	1 A	—	—	0 Ω	Max 50 mΩ	—	1608	KOA	
R25	Jumper	RK73Z1J	1 A	—	—	0 Ω	Max 50 mΩ	—	1608	KOA	

* : Refer to “■ COMPONENT LAYOUT”.

(Continued)

(Continued)

Symbol*	Part name	Model name	Specification						Package	Manu-facturer	Note
			Rating 1	Rating 2	Rating 3	Value	Devia-tion	Features			
R26	Jumper	RK73Z1J	1 A	—	—	0 Ω	Max 50 mΩ	—	1608	KOA	
R27	Resistor	RR0816P-104-D	1/16 W	—	—	100 kΩ	± 0.5%	± 25 ppm/ °C	1608	ssm	
R28	Jumper	RK73Z1J	1 A	—	—	0 Ω	Max 50 mΩ	—	1608	KOA	
R29	Jumper	RK73Z1J	1 A	—	—	0 Ω	Max 50 mΩ	—	1608	KOA	
R30	Resistor	RR0816P-104-D	1/16 W	—	—	100 kΩ	± 0.5%	± 25 ppm/ °C	1608	ssm	Not mounted
R31	Resistor	RR0816P-104-D	1/16 W	—	—	100 kΩ	± 0.5%	± 25 ppm/ °C	1608	ssm	Not mounted
R32	Resistor	RR0816P-103-D	1/16 W	—	—	10 kΩ	± 0.5%	± 25 ppm/ °C	1608	ssm	Not mounted
SW1, SW2	Switch	DMS-2H	—	—	—	2 poles	—	—	—	MATSUKYU	
—	Terminal pins	WT-2-1	—	—	—	—	—	—	—	MacEight	

* : Refer to "■ COMPONENT LAYOUT".

NEC	NEC corporation
ROHM	ROHM CO., LTD
SUMIDA	Sumida Corporation
SANYO	SANYO Electric Co., Ltd
TDK	TDK Corporation
KOA	KOA Corporation
ssm	SUSUMU CO., LTD.
MATSUKYU	Matsukyu Co., Ltd.
MacEight	MacEight Co., Ltd

■ INITIAL SETTINGS

(1) Dynamically-controlled charging detection voltage (DCC mode)

$$Vth = \frac{R11}{R10 + R11} \times VREF \times \frac{R4 + R5 + R6}{R6} = 18.0\ (V)$$

Note : Change the setting when the product is used with a 16 V AC adapter.

(2) Maximum charge current (CC mode)

$$Io\ (Max)\ (A) = \frac{VREF \times R13}{(R12 + R13) \times 20 \times R1} = 3.03\ (A)$$

(3) Dead battery mode charge current

$$I_{DEAD}\ (A) = \frac{VREF \times R13 \times (R14 + R15)}{(R12 \times R13 + (R12 + R13) \times (R14 + R15)) \times 20 \times R1} = 0.25\ (A)$$

(4) Soft-start time

Constant-voltage mode soft-start time

$$ts\ (ms) = 0.42 \times C11\ (\mu F) = 9.2\ (ms)$$

Constant-current mode soft-start time

$$ts\ (ms) = \frac{R13}{(R12 + R13)} \times \frac{VREF}{10\ (\mu A)} \times C11\ (\mu F) = 4.4\ (ms)$$

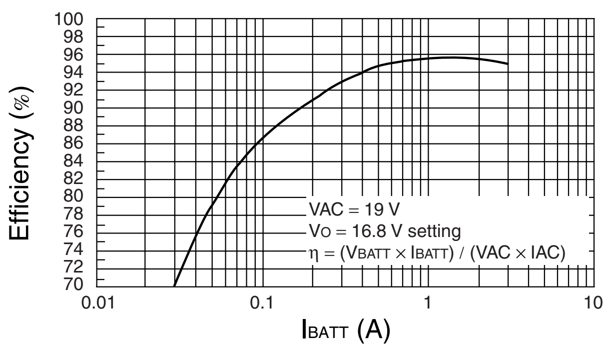
(5) Oscillation frequency

$$fosc\ (kHz) = \frac{14100}{R2\ (k\Omega)} = 300\ (kHz)$$

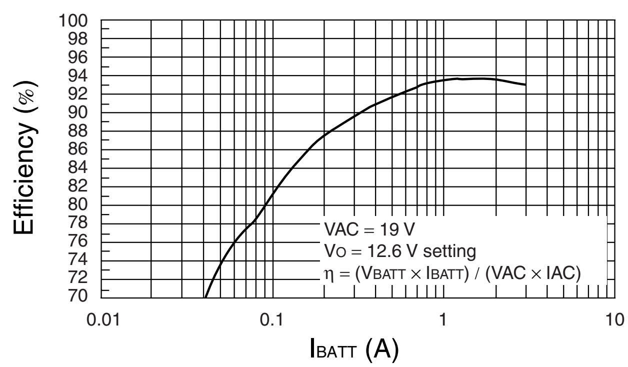
■ REFERENCE DATA

1. Conversion efficiency

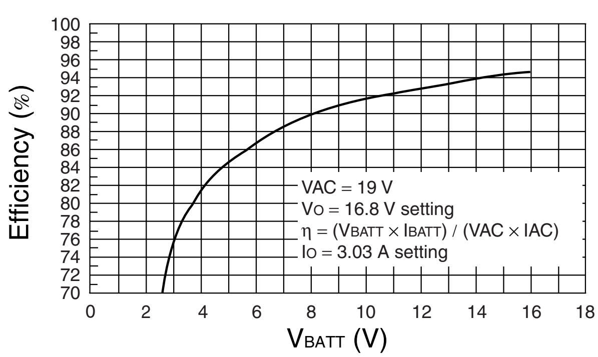
V_O = 16.8 V setting constant-voltage control
I_{BATT} vs. Efficiency (Constant Voltage mode)



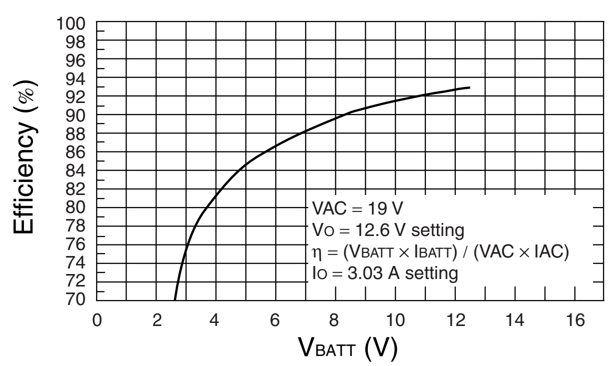
V_O = 12.6 V setting constant-voltage control
I_{BATT} vs. Efficiency (Constant Voltage mode)



V_O = 16.8 V setting constant-current control
V_{BATT} vs. Efficiency (Constant Current mode)

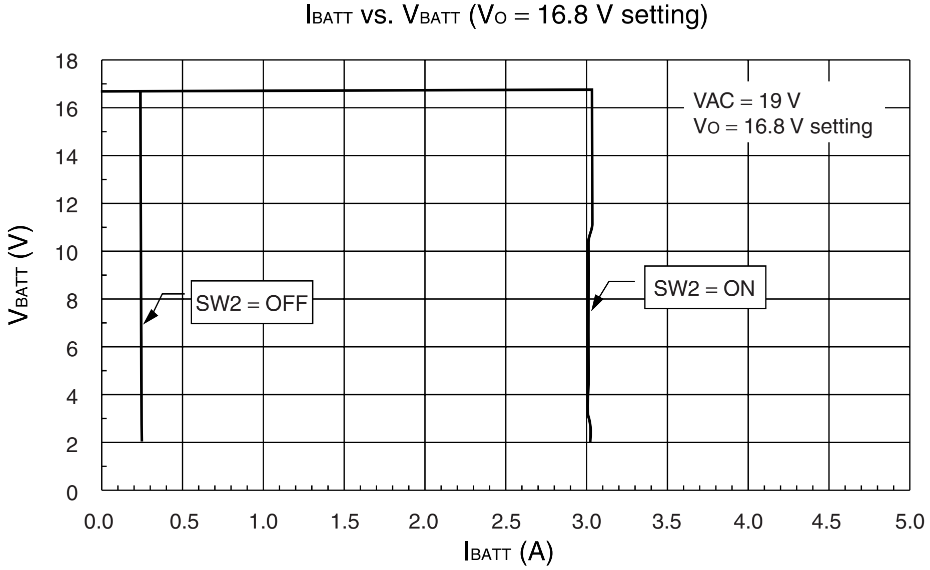


V_O = 12.6 V setting constant-current control
V_{BATT} vs. Efficiency (Constant Current mode)

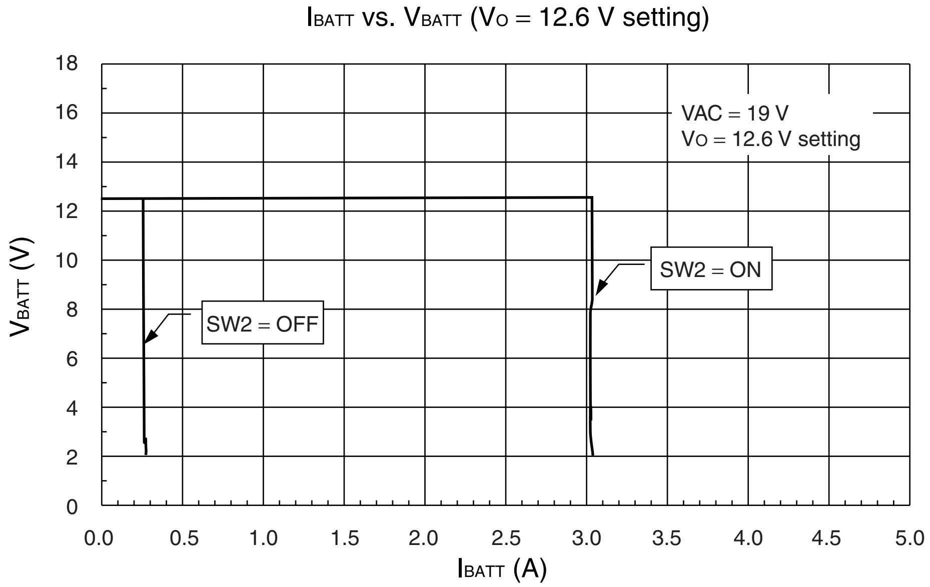


2. Dropping characteristic

V_O = 16.8 V setting

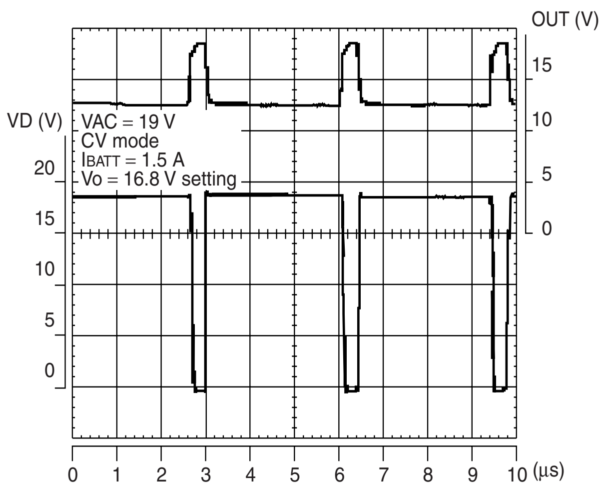


V_O = 12.6 V setting

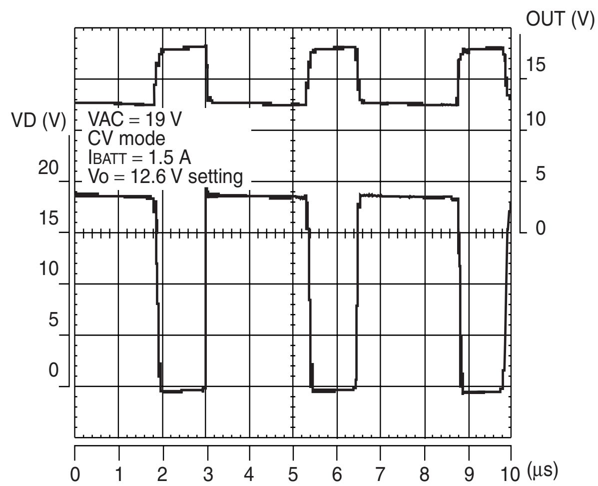


3. Switching waveform

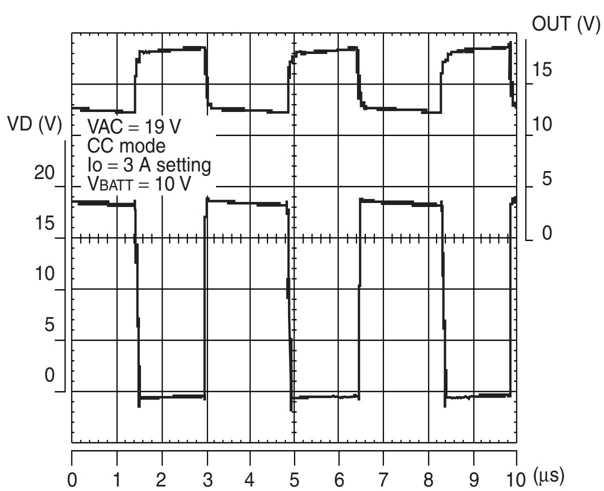
V_O = 16.8 V setting constant-voltage control



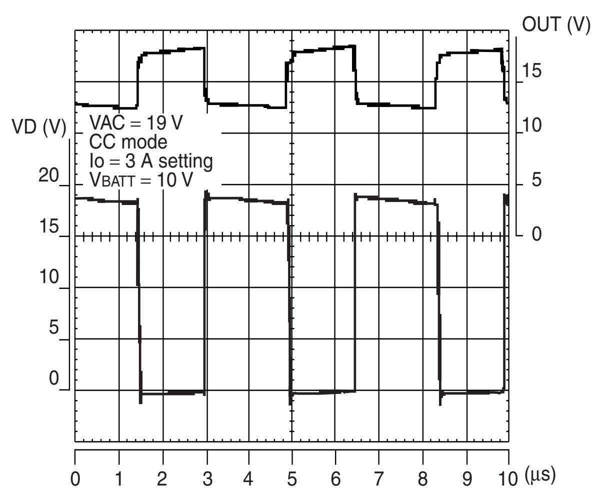
V_O = 12.6 V setting constant-voltage control



V_O = 16.8 V setting constant-current control

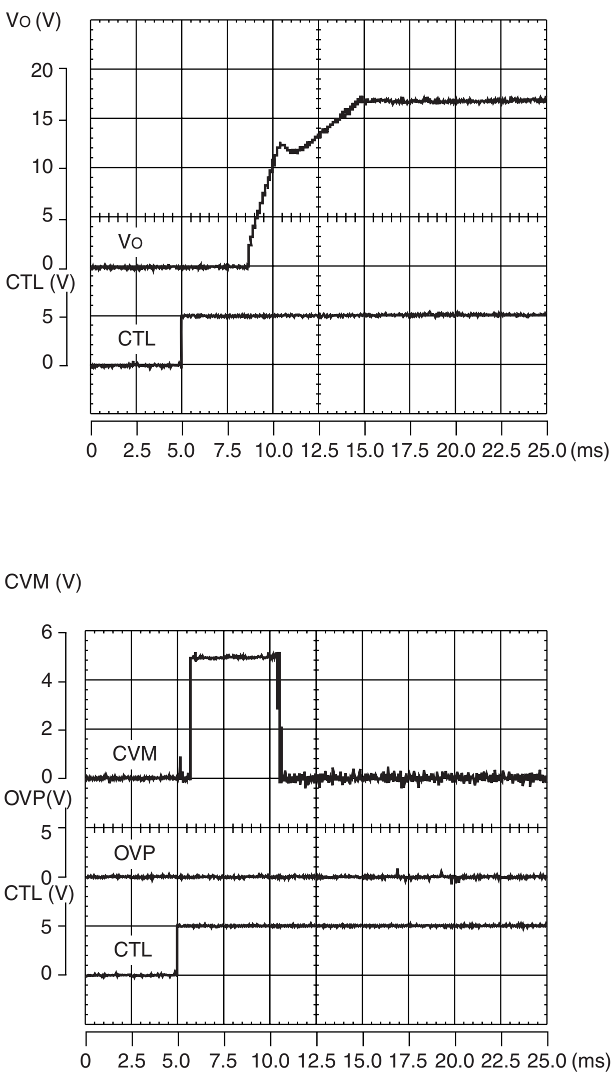


V_O = 12.6 V setting constant-current control

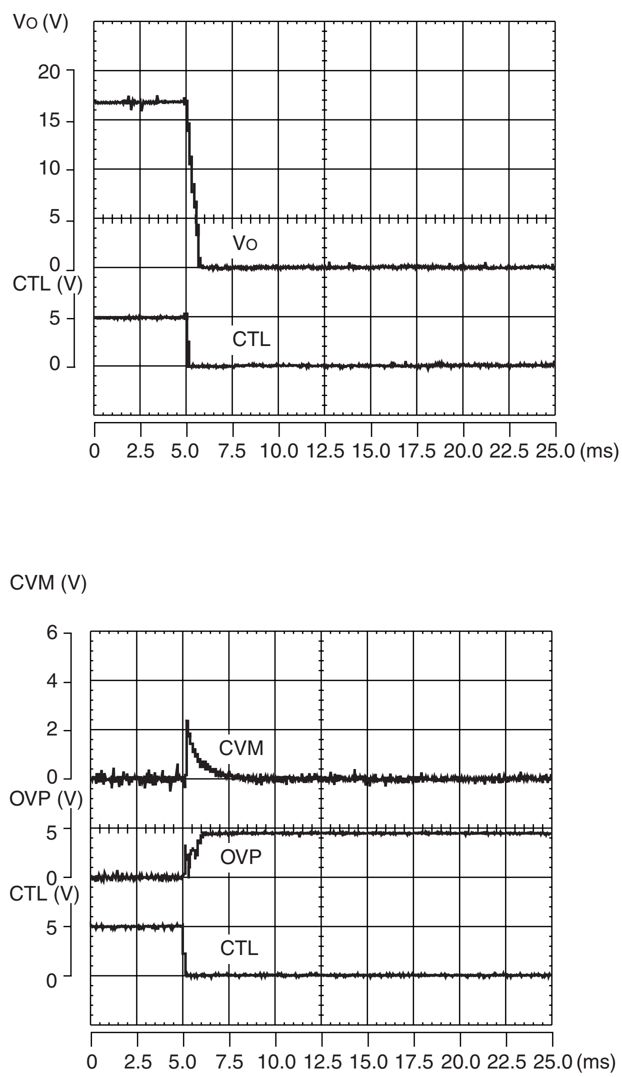


4. Soft-start/discharge operation waveform

Soft-start operation waveform

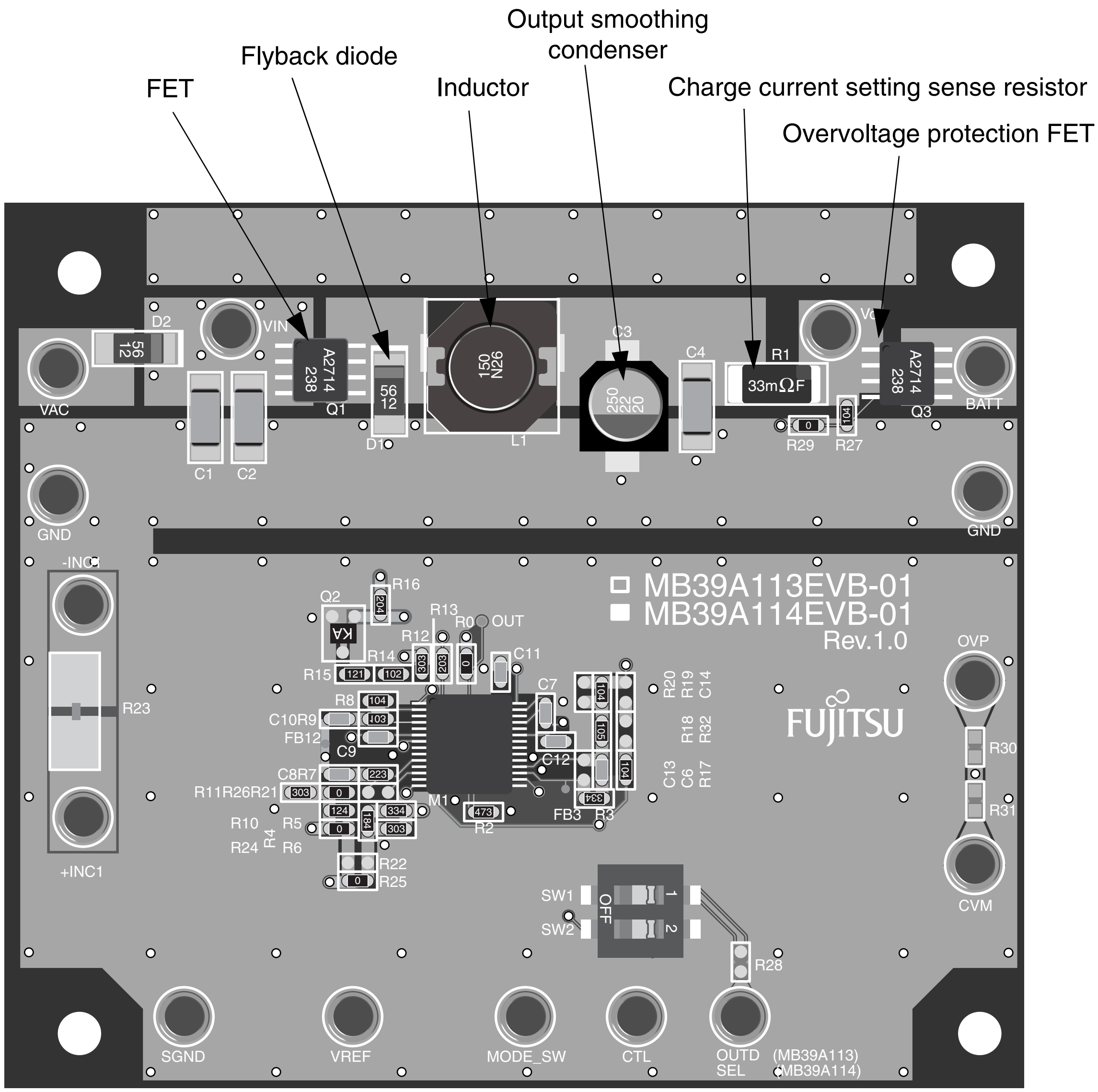


Discharge operation waveform



Note : Setting V_O = 16.8 V, BATT = 10 Ω

■ COMPONENT SELECTION METHODS



• 16.8 V output

V_{IN} = 25 V (Max) , Vo = 16.8 V, Io = 3 A, f_{OSC} = 300 kHz

1. P-ch MOS FET (μPA2714 (NEC product))

V_{DS} = – 30 V, V_{GS} = ± 20 V, I_D = 7 A, R_{DS} (ON) = 16 mΩ (Typ) , Qg = 31 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.
Main

$$I_D \geq I_O + \frac{V_{IN} - V_O}{2L} t_{ON}$$

$$\geq 3 + \frac{25 - 16.8}{2 \times 15 \times 10^{-6}} \times \frac{1}{300 \times 10^3} \times 0.672$$

$$\geq \underline{3.6\ A}$$

2. Inductor (CDRH104R-150 : SUMIDA product)

15 μH (tolerance ± 30%) , rated current = 3.6 A

L value at full load current condition:

Peak-to-peak value of ripple current should be set under half load current.

$$L \geq \frac{2\ (V_{IN} - V_O)}{I_O} t_{ON}$$

$$\geq \frac{2 \times (25 - 16.8)}{3} \times \frac{1}{300 \times 10^3} \times 0.672$$

$$\geq \underline{12.2\ \mu H}$$

The load current satisfying the continuous current condition

$$I_O \geq \frac{V_O}{2L} t_{OFF}$$

$$\geq \frac{16.8}{2 \times 15 \times 10^{-6}} \times \frac{1}{300 \times 10^3} \times (1 - 0.672)$$

$$\geq \underline{0.61\ A}$$

Ripple current : peak value

The peak ripple current must be within the rated current of the inductor
If the peak ripple current is IL, it is obtained by the following formula.

$$I_L \geq I_O + \frac{V_{IN} - V_O}{2L} t_{ON}$$

$$\geq 3 + \frac{25 - 16.8}{2 \times 15 \times 10^{-6}} \times \frac{1}{300 \times 10^3} \times 0.672$$

$$\geq \underline{3.6\ A}$$

Ripple current : peak-to-peak value

If the peak-to-peak ripple current is ΔI_L, it is obtained by the following formula.

$$\Delta I_L = \frac{V_{IN} - V_O}{L} t_{ON}$$

$$= \frac{25 - 16.8}{15 \times 10^{-6}} \times \frac{1}{300 \times 10^3} \times 0.672$$

$$\doteqdot \underline{1.22\ A}$$

3. Output smoothing condenser (20SVP22M : SANYO product)

22 μF, rated voltage = 20 V, ESR = 60 mΩ, maximum allowable ripple current = 1450 mArms

Assume the output ripple voltage as ΔV_O (1% of output voltage) , output smoothing condenser as C_L, ripple current as $I_{CL}rms$, series resistance as ESR.

Series resistance

$$ESR \leq \frac{\Delta V_O}{\Delta I_L} - \frac{1}{2\pi f C_L}$$

$$\leq \frac{0.168}{1.22} - \frac{1}{2\pi \times 300 \times 10^3 \times 22 \times 10^{-6}}$$

$$\leq \underline{114\ m\Omega}$$

Condenser

$$C_L \geq \frac{\Delta I_L}{2\pi f (\Delta V_O - \Delta I_L \times ESR)}$$

$$= \frac{1.22}{2\pi \times 300 \times 10^3 \times (0.168 - 1.22 \times 0.06)}$$

$$\fallingdotseq \underline{6.8\ \mu F}$$

Ripple current

$$I_{CL}rms \geq \frac{(V_{IN} - V_O)\ t_{ON}}{2\sqrt{3}L}$$

$$= \frac{(25 - 16.8) \times 0.672}{2\sqrt{3} \times 15 \times 10^{-6} \times 300 \times 10^3}$$

$$\fallingdotseq \underline{707\ mArms}$$

4. Flyback diode (RB053L-30 : ROHM product)

V_R (DC reverse voltage) = 30 V, mean output current = 3.0 A, peak surge current = 70 A
V_R = value enough to satisfy the input voltage → 30 V

With the diode conduction time assumed as t_D (Max) , the diode mean current I_{Di} is obtained by the following formula.

$$I_{Di} \geq I_O \times \left(1 - \frac{V_O}{V_{IN}}\right) = 3 \times (1 - 0.672) \fallingdotseq \underline{984\ mA}$$

With the diode conduction time assumed as t_D (Max) , the diode peak surge current I_{Dip} is obtained by the following formula.

$$I_{Dip} \geq \left(I_O + \frac{V_O}{2L} t_{OFF}\right) \fallingdotseq \underline{3.6\ A}$$

5. Charge current setting sense resistor (SL1TTE33LOF KOA product) 33 mΩ

Where the +INE2 terminal voltage is 2 V and the charge current is 3 A, R1 is obtained by the following formula.

$$R1 = \frac{+INE2}{20 \times I1}$$

$$= \frac{2}{20 \times 3}$$

$$\fallingdotseq \underline{33\ m\Omega}$$

• 12.6 V output

$V_{IN} = 22$ V (Max) , $V_O = 12.6$ V, $I_O = 3$ A, $f_{OSC} = 300$ kHz

1. P-ch MOS FET (μPA2714 (NEC product))

$V_{DS} = -30$ V, $V_{GS} = \pm 20$ V, $I_D = 7$ A, R_{DS} (ON) $= 16$ mΩ (Typ) , Qg = 31 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.

Main

$$I_D \geq I_O + \frac{V_{IN} - V_O}{2L} \quad t_{ON}$$

$$\geq 3 + \frac{25 - 12.6}{2 \times 15 \times 10^{-6}} \times \frac{1}{300 \times 10^3} \times 0.572$$

$$\geq \underline{3.6\ A}$$

2. Inductor (CDRH104R-150 : SUMIDA product)

15 μH (tolerance ± 30%) , rated current = 3.6 A

L value at full load current condition:

Peak-to-peak value of ripple current should be set under half load current.

$$L \geq \frac{2\,(V_{IN} - V_O)}{I_O} t_{ON}$$

$$\geq \frac{2 \times (22 - 12.6)}{3} \times \frac{1}{300 \times 10^3} \times 0.572$$

$$\geq \underline{12.0\ \mu H}$$

The load current satisfying the continuous current condition.

$$I_O \geq \frac{V_O}{2L} t_{OFF}$$

$$\geq \frac{12.6}{2 \times 15 \times 10^{-6}} \times \frac{1}{300 \times 10^3} \times (1 - 0.572)$$

$$\geq \underline{0.60\ A}$$

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.

$$I_L \geq I_O + \frac{V_{IN} - V_O}{2L} \quad t_{ON}$$

$$\geq 3 + \frac{22 - 12.6}{2 \times 15 \times 10^{-6}} \times \frac{1}{300 \times 10^3} \times 0.572$$

$$\geq \underline{3.6\ A}$$

Ripple current : peak-to-peak value

If the peak-to-peak ripple current is ΔI_L, it is obtained by the following formula.

$$\Delta I_L = \frac{V_{IN} - V_O}{L} t_{ON}$$

$$= \frac{22 - 12.6}{15 \times 10^{-6}} \times \frac{1}{300 \times 10^3} \times 0.572$$

$$\fallingdotseq \underline{1.2\ A}$$

3. Output smoothing condenser (20SVP22M : SANYO product)

22 µF, rated voltage = 20 V, ESR = 60 mΩ, maximum allowable ripple current = 1450 mArms

Assume the output ripple voltage as ΔV_O (1% of output voltage) , output smoothing condenser as C_L, ripple current as I_{CL}rms, series resistance as ESR.

Series resistance

$$ESR \leq \frac{\Delta V_O}{\Delta I_L} - \frac{1}{2\pi f C_L}$$

$$\leq \frac{0.126}{1.2} - \frac{1}{2\pi \times 300 \times 10^3 \times 22 \times 10^{-6}}$$

$$\leq \underline{80\ m\Omega}$$

Condenser

$$C_L \geq \frac{\Delta I_L}{2\pi f\,(\Delta V_O - \Delta I_L \times ESR)}$$

$$\geq \frac{1.2}{2\pi \times 300 \times 10^3 \times (0.126 - 1.2 \times 0.06)}$$

$$\geq \underline{11.8\ \mu F}$$

Ripple current

$$I_{CL}rms \geq \frac{(V_{IN} - V_O)\,t_{ON}}{2\sqrt{3}L}$$

$$\geq \frac{(22 - 12.6) \times 0.572}{2\sqrt{3} \times 15 \times 10^{-6} \times 300 \times 10^3}$$

$$\geq \underline{690\ mArms}$$

4. Flyback diode (RB053L-30 : ROHM product)

V_R (DC reverse voltage) = 30 V, mean output current = 3.0 A, peak surge current = 70 A
V_R = value enough to satisfy the input voltage → 30 V

With the diode conduction time assumed as t_D (Max) , the diode mean current I_{Di} is obtained by the following formula.

$$I_{Di} \geq I_O \times \left(1 - \frac{V_O}{V_{IN}}\right) = 3 \times (1 - 0.572) \doteqdot \underline{1284\ mA}$$

With the diode conduction time assumed as t_D (Max) , the diode peak surge current I_{Dip} is obtained by the following formula.

$$I_{Dip} \geq \left(I_O + \frac{V_O}{2L} t_{OFF}\right) \doteqdot \underline{3.6\ A}$$

5. Charge current setting sense resistor (SL1TTE33LOF KOA product) 33 mΩ

Where the +INE2 terminal voltage is 2 V and the charge current is 3 A, R1 is obtained by the following formula.

$$R1 = \frac{+INE2}{20 \times I1}$$

$$= \frac{2}{20 \times 3}$$

$$\doteqdot \underline{33\ m\Omega}$$

■ ORDERING INFORMATION

EV board part No.	EVboard version No.	Remarks
MB39A114EVB-01	MB39A114EVB-01 Rev 1.0	

FUJITSU MICROELECTRONICS LIMITED

Shinjuku Dai-Ichi Seimei Bldg. 7-1, Nishishinjuku 2-chome, Shinjuku-ku,
Tokyo 163-0722, Japan Tel: +81-3-5322-3347 Fax: +81-3-5322-3387
http://jp.fujitsu.com/fml/en/

For further information please contact:

North and South America
FUJITSU MICROELECTRONICS AMERICA, INC.
1250 E. Arques Avenue, M/S 333
Sunnyvale, CA 94085-5401, U.S.A.
Tel: +1-408-737-5600 Fax: +1-408-737-5999
http://www.fma.fujitsu.com/

Europe
FUJITSU MICROELECTRONICS EUROPE GmbH
Pittlerstrasse 47, 63225 Langen,
Germany
Tel: +49-6103-690-0 Fax: +49-6103-690-122
http://emea.fujitsu.com/microelectronics/

Korea
FUJITSU MICROELECTRONICS KOREA LTD.
206 KOSMO TOWER, 1002 Daechi-Dong,
Kangnam-Gu,Seoul 135-280
Korea
Tel: +82-2-3484-7100 Fax: +82-2-3484-7111
http://www.fmk.fujitsu.com/

Asia Pacific
FUJITSU MICROELECTRONICS ASIA PTE LTD.
151 Lorong Chuan, #05-08 New Tech Park,
Singapore 556741
Tel: +65-6281-0770 Fax: +65-6281-0220
http://www.fujitsu.com/sg/services/micro/semiconductor/

FUJITSU MICROELECTRONICS SHANGHAI CO., LTD.
Rm.3102, Bund Center, No.222 Yan An Road(E),
Shanghai 200002, China
Tel: +86-21-6335-1560 Fax: +86-21-6335-1605
http://cn.fujitsu.com/fmc/

FUJITSU MICROELECTRONICS PACIFIC ASIA LTD.
10/F., World Commerce Centre, 11 Canton Road
Tsimshatsui, Kowloon
Hong Kong
Tel: +852-2377-0226 Fax: +852-2376-3269
http://cn.fujitsu.com/fmc/tw

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