Bellnix

Power IC BIC1422

<Summary>

BIC1422 is a high efficiency POWER-IC of MCM (multi chip module) with synchrounous rectification system chopper control, N channel MOSFET of main switch and low side MOSFET for synchronous rectification. Maximum output is 3A and the input voltage range is 8V-40V. The functions such as over-current protection, over-heat protection and ON/OFF control etc. are all put in the surface mount one-package IC, which makes it possible to achieve a small size and light DC-DC converter with very few external components.

< Features >

- Input voltage range: DC8-40V
- Output voltage: Output voltage adjustable using external resistances (2.5V-12V)
- Maximum output current: 3A (Derating is required for output higher than 8V)
- Main switch MOSFET and commutation MOSFET
- Overcurrent protection
- Heat protection
- Remote ON/ OFF control
- Lead-free correspondence

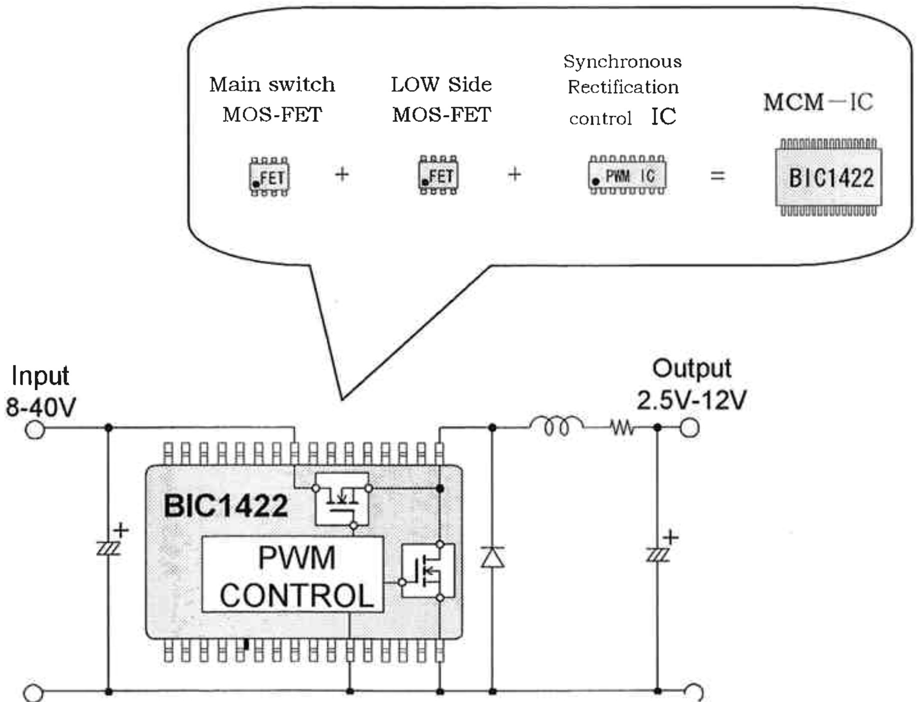
< Applications >

- Information distribution equipment
- Office automation equipment
- Electronic measuring instruments
- Home appliances
- Telecommunications equipment
- Factory automation equipment (Process control)
- Audio-Video devices

< Designation of product >

Model name: BIC1422

For packaging, only tape and reel is available.



This figure is different from actual wiring.

BDD20050412-030523

<Absolute maximum rating (Ta=25°C)>

Item	Symbol	Rating	Unit
Line voltage	Vin	42	V
Output MOS input voltage	Vdd	42	V
Output current (AVE)	Iout ave	3	A
Output current (PEAK)	Iout peak	4	A
OCL-, OCL+ terminal voltage	V_{OCL}	5.5	V
Remote control voltage	V_{RC}	5.5	V
Storage temperature	Tstg	-40 to 150	°C
Junction temperature	Tj	150	°C

<Electrical charateristics (Ta=25°C)>

Item	Symbol	Conditions	MIN	TYP	MAX	Unit
HighsideMOS Drain-source breakdown voltage	Vdss	Id=1mA,Vgs=0V	42	–	–	V
HighsideMOS Drain interruption current	Idss	Vds=40V,Vgs=0V	–	–	10	μA
HighsideMOS Drain-source ON resistance	Ron	Id=1.2A,Vgs=4.5V	–	33	70	mΩ
HighsideMOS Source-drain Di forward voltage	Vsd	Is=1.2A,Vgs=0V	–	–	1.5	V
LowSideMOS Drain-source breakdown voltage	Vdss	Id=1mA,Vgs=0V	42	–	–	V
LowSideMOS Drain interruption current	Idss	Vds=40V,Vgs=0V	–	–	10	μA
LowSideMOS Drain-source ON resistance	Ron	Id=1.2A,Vgs=4.5V	–	33	70	mΩ
LowSideMOS Source-drain breakdown voltge	Vsd	Is=1.2A,Vgs=0V	–	–	1.5	V
Start voltage	Vcc_start	–	6.5	7.2	7.9	V
Stop voltage	Vcc_stop	–	6	6.7	7.4	V
Start-stop voltage hysteresis	Vcc_hys	–	–	0.5	–	V
Current consumption	Icc	Vcc=8V-40V	–	10	13	mA
Current consumption with remote control OFF	Icc_off	Vcc=8V-40V	–	1.2	1.5	mA
Voltage with remote control terminal ON	Vrc_on	Vcc=8V-40V	-0.2	–	0.5	V
Voltage with remote control terminal OFF	Vrc_off	Vcc=8V-40V	2.5	–	5.3	V
Current with remote control terminals shorted	Irc	Vcc=8V-40V	–	–	250	μA
Boot terminal voltge	Vboot	Vcc=24V	5.4	6.5	7.6	V
Internal reference voltage	Vref	Vcc=8V-40V	4.75	5	5.25	V
Internal oscillation frequency	fosc	Vcc=24V	212.5	250	287.5	kHz
Overcurrent threshold voltage	Vth_OCL	Vcc=24V	0.162	0.19	0.218	V
SoftStart terminal current	Is/s	Vcc=24V	-20	-12.5	-5	μA
ErrorAmp reference voltage	Vamp	Vcc=8V-40V	2.4	2.45	2.5	V
Overcurrent protection operating temperature	T_TSD	–	–	150	–	°C

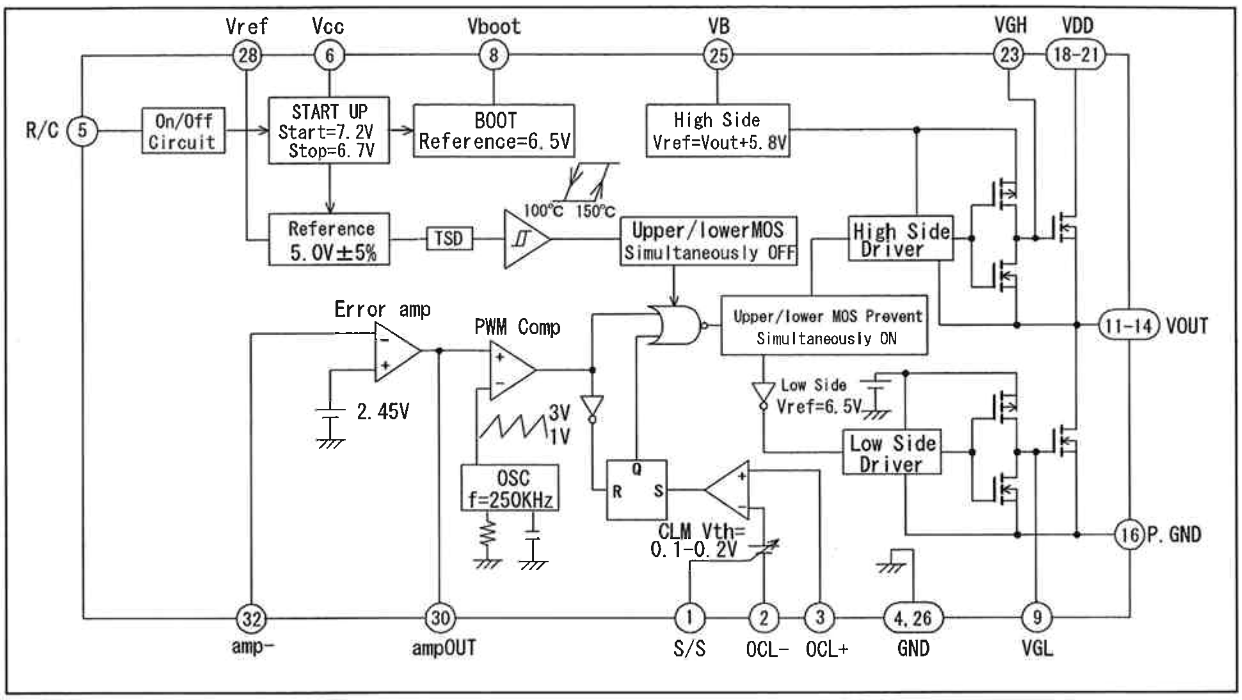
<Recommended operating conditions>

Item	Recomm.Value	Unit
Input voltage (Ta=-10 to +85 ° C)	8.0-40	V
Input voltage (Ta=-30 to -10 ° C)	8.5-40	V
Output voltage setting range	2.5-12	V
Operating temperature	-30 to 85	℃

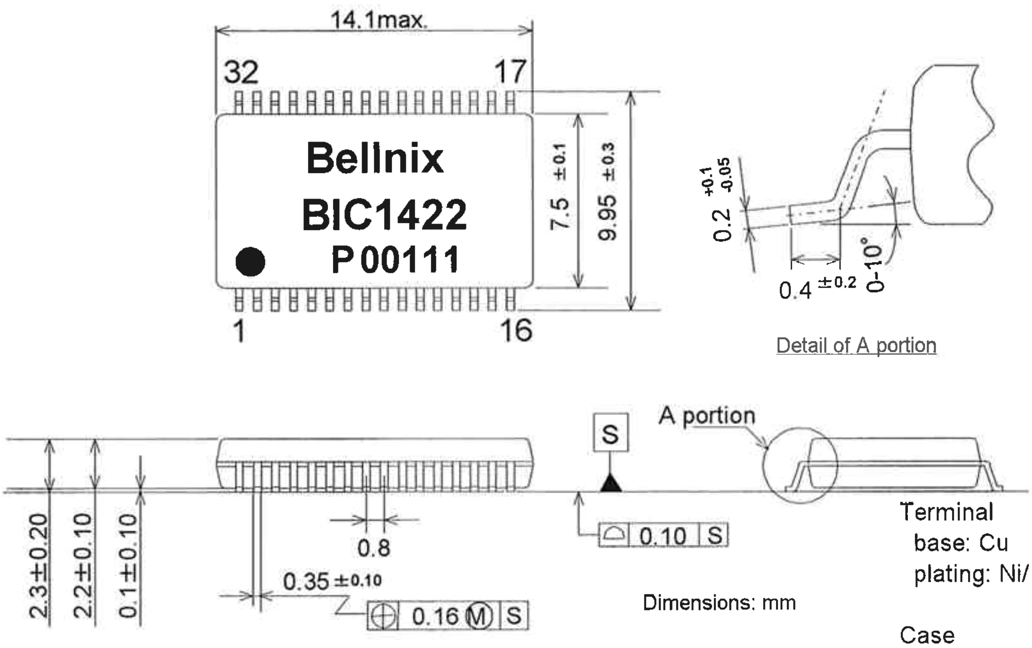
<Output current derating>

Output	
Set voltage	Current
2.5V - 8V	3A
≦12V	2.5A

<Block diagram>



<External dimensions>

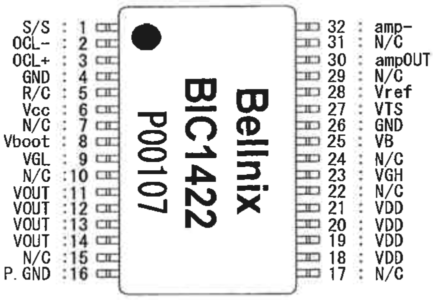


Dimensions: mm

Terminal
base: Cu
plating: Ni/ Pd/ Au

Case
Black epoxy resin (UL94 V-0)

< Terminal functions >



Terminal No.	Symbol	Function
1	S/S	Soft-start capacitor terminal
2	OCL-	Over-current detection terminal (-)
3	OCL+	Over-current detection terminal (+)
4,26	GND	Ground terminal
5	R/C	Remote ON/OFF control terminal
6	Vcc	Control circuit power supply terminal
8	Vboot	Main switch MOSFET control circuit power supply terminal
9	VGL	Low side MOSFET gate terminal for synchronous rectification
11～14	VOUT	Power supply output terminal
16	P.GND	Output circuit ground terminal
18～21	VDD	Main switch MOSFET power supply terminal
23	VGH	Main switch high side MOSFET gate terminal
25	VB	Output boot strap terminal. Used for connecting condensers across VB and VOUT terminals to boot strap IC internal main switch MOSFET control circuit.
27	VTS	Test terminal. Do not connect it to anything.
28	Vref	Internal reference voltage output terminal
30	ampOUT	Internal error amplifier output terminal
32	amp−	Internal error amplifier reversing input terminal
7,10,15,17 22,24,29,31	N/C	No connection terminal (N/C terminal)

<Peripheral functions>

1. Internal reference voltage (Vref)

IC internal circuitry reference voltage is provided by the temperature compensation reference voltage (5.0V). This reference voltage (Vref) provides a maximum external output current measured at the terminal of 1 mA.

2. Oscillation circuit (OSC)

The oscillation circuit is built into the device. No external oscillation capacitor nor resistor is required. The oscillation frequency (250KHz) is set internally and has a sawtooth wave pattern. The sawtooth wave pattern cannot be outputted externally.

3. Error amplifier (Error amp)

The error amplifier senses the DC to DC converter voltage and provides a PWM control signal output. Loop gain between the error amplifier ampOUT terminal and the negative amp terminal is determined by the connections between the feedback resistor and the capacitor.
This provides stable loop compensation throughout the system.

4. Over-current sensor (OCL)

The OCL is a pulse-by-pulse overcurrent sensor. The voltage drop across the external current sensing resistor is measured between the negative and positive terminals of the OCL. If the voltage drop exceeds ≒0.19V, the main switch (MOSFET) opens.

5. Remote ON/OFF (R/C)

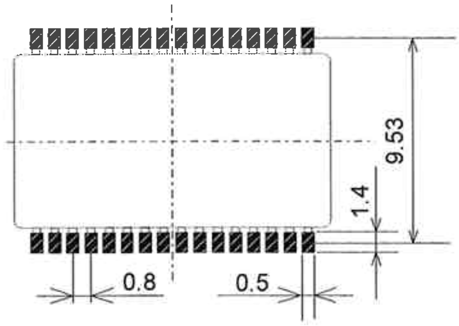
It is a remote terminal for output voltage ON/ OFF control.
Output On: 0-0.5V (Ground this terminal to GND)
Output Off: 2.5-5.3V (This terminal is open)

6. Soft-start (S/S)

It is a capacitor connection terminal for soft-start.
The start time is delayed by connecting a capacitor which is for soft-start to this terminal.
Connect a capacitor of approximately 0.1μF to this terminal.

<Mounting>

1. Soldering pattern reference (Reflow type)



2. Mounting cautions

Vibration and other mechanical disturbances can exert stress on the internal parts of the device. Carefully examine your equipment and place the device where vibration and other shock is minimal.

3. Soldering Conditions

The infrared reflow method is recommended. If the soldering time is too long or the soldering temperature is too high, it may damage the function of this IC, so be sure to use within the specified conditions.

1) Infrared reflow method

Temperature profile in the reflow method is as shown in the figure at the right.

2) Wave soldering conditions

- Pre-heating conditions

Center of the case temp.: 80-140°C

Pre-heating time: 30-60sec

- Heating conditions

Soldering temp.: 265±5°C

Heating time: 10±1sec

- Heating frequency: one time
- Notes

Solder bridge will be effected by the land, so give consideration when designing the printed board.

3) Storage conditions

After the dampproof package is opened, in an environment of temp. 30°C and relative temp. 70% or below: within 168Hrs.

4) Baking conditions

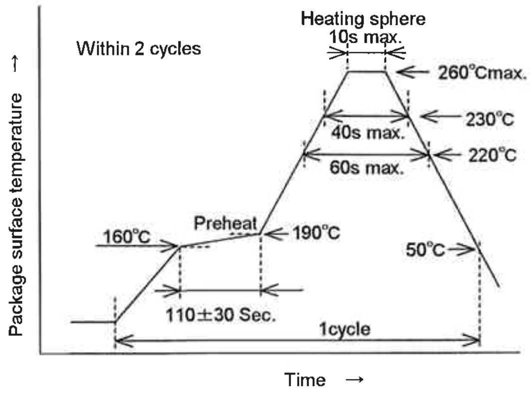
One time within 24Hrs. at 125°C

5) Soldering Iron

When using a soldering iron, execute under the following conditions.

- Soldering iron tip temp.: 380±10°C
- Heating time: 3±1sec
- Heating frequency: one time

Infrared and air reflow soldering conditions



4. Cleaning cautions

Carefully remove all flux. Allow time for the soldered areas to completely dry before using the device.

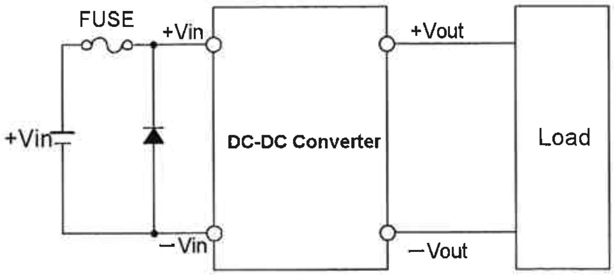
5. Resinous Coating

When remolding after mounting the device to the board, if the curing stress of the resinous is strong, it may give stress to the component. So be careful of choosing the resinous and calcify time.

<Usage>

1. Input protection element connection

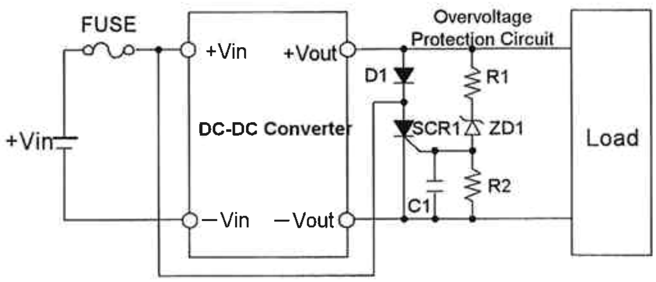
The BIC1422 device has an output current drop function. In the event of power IC device malfunction resulting in excessive input current flow, smoke and flame may be emitted from the equipment.
To prevent this, install fuse or protective circuitry to the power IC device input line. Install the fuse or protective circuitry to the positive side of the input line. Be sure that the fuse or protective circuitry is not too large to effectively protect the circuitry (the input line must be capable of carrying enough current to blow the fuse).



2. Overvoltage protection

The BIC1422 power IC device does not have an overvoltage (voltage surge) protection function. If a malfunction occurs in the device internal circuitry, there may be a voltage surge. Output will reflect this surge and damage to equipment may result. Smoke and flame may be emitted from the equipment. To prevent this, be sure to install voltage surge sensing and protection circuitry.
There are a number of ways to protect against voltage surge.
Figure shows a typical voltage surge protection set-up. The voltage surge sensing and protection circuit should be installed as close as possible to the load (away from the output smoothing capacitor)

Reference part example



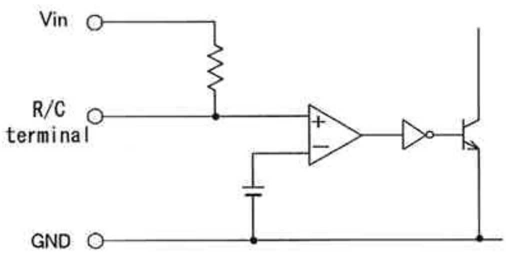
<Remote ON/OFF Control Function>

The remote ON/OFF control function can be used for turning output ON and OFF without making or breaking the input.

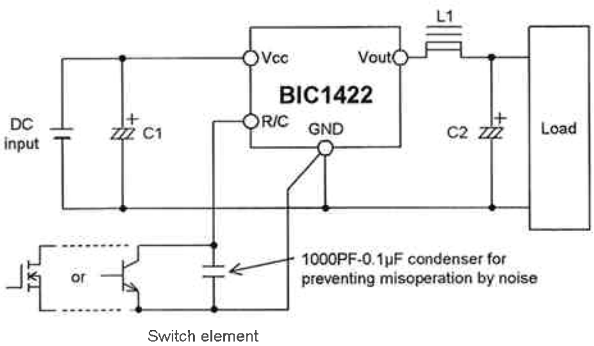
Output ON: 0-0.5V (This terminal is connected with GND)
Output Off: 2.5-5.3V (This terminal is opened)

- When the R/C function is not used, be sure to connect R/C terminal (5pin) and ground (4pin and 26pin).
- The R/C terminal can be turned ON and Off by a switch element such as a transistor or MOSFET. However, be sure to add a condenser (1000pF-0.1micro F) across the R/C terminal (5pin) and ground (4pin and 26pin) to prevent misoperation by noise.
- Since pull-up has been carried out in the module, there is no need of impressing the voltage from the outside.

1. R/C Functional Terminal Internal Equivalent Circuit



2. Method of Connecting R/C Functional Terminals



< Standard connections >

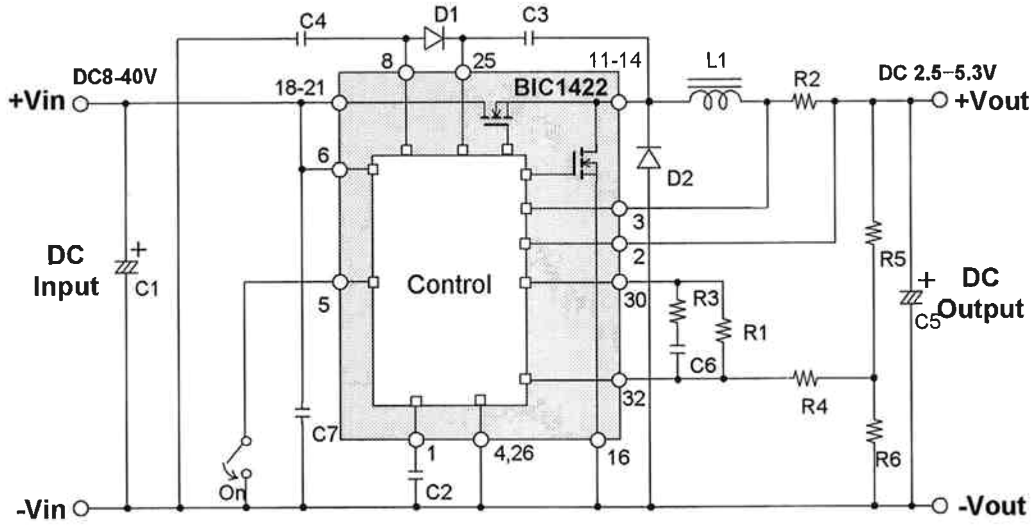
BIC1422 is a power IC developed for synchronous rectification type chopper method. This IC has built the major components of the controller IC part, high-side and low-side MOSFET for commutating etc. into one package. Accessories such as external choke and capacitor are required for this device. The characteristics of these external parts and the way they are packaged and connected will greatly affect the performance of the device and its circuits. Carefully select these external parts to provide optimum device perfoemance.
It is possible to adjust the output voltage between 2.5V-12V by external resistances. Connect as to the set output voltage.

1. For use with output voltage lower than 5.3V

1) Basic input and output terminal connections

- 9, 23, 27pins are the test terminals and must be left open.
- 7, 10, 15, 17, 22, 24, 29 and 31pins are N/C terminals (internally unconnected).
- Be sure to prepare and connect the external parts shown in the diagram below..
- The use of a low ESR product is recommended for the output smooth capacitor (C5).

2) Standard connections



3) Resistors for setting output voltage

Output voltage is adjusted using R5 and R6.
R6=2.2K ohm

$$R5 = \frac{R6 \times (Vout - 2.45)}{2.45} (\Omega)$$

- Setting output voltage examples (at R6=2.2K ohm)
  - Set at 2.5V, R5=47 ohm
  - Set at 3.3V, R5=770 ohm (300 ohm+470 ohm)
  - Set at 5.0V, R5=2.3K ohm (1K ohm+1.3K ohm)

For output voltage setting resistors (R5,R6), resistors with high temterapture characteristics and high accuracy are recommended.

4) Input voltage derating when output voltage is set to 3V or less.

The maximum input voltage within the usable input voltage range is determined as follows.

$$Vin(max) \leqq \frac{Vout}{0.075} (V)$$

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5) Reference parts

Reference parts for the standard circuit.

Due to conditions, the fixed numbers may change.

Parts No.	Component	Output voltage 2.5-5.0V Output current example 1A	3A	Type/ Manufacturer
IC 1	MCM−IC	BIC1422	BIC1422	Bellnix.co.ltd
L 1	Choke coil	68μH, 1.2A	22μH, 3.6A	
D 1	Diode	1SS300	1SS300	Toshiba
D 2	Schottky barrier diode	D1FS6	D1FS6	Shindengen
C 1	Electrolyte capacitor	50V, 100μF 724mA	50V, 270μF 1580mA	Rubycon
C 2	Ceramic capacitor	25V, 0.047μF	25V, 0.047μF	GRM39type or C1608type Murata or TDK
C 3	Ceramic capacitor	25V, 0.1μF	25V, 0.1μF	
C 4	Ceramic capacitor	25V, 1000PF	25V, 1000PF	
C 5	Electrolyte capacitor	10V, 470μF 72mohm	10V, 1200μF 23mohm	Rubycon
C 6	Ceramic capacitor	25V, 1000PF	25V, 1000PF	GRM39type or C1608type
C 7	Ceramic capacitor	25V, 0.01μF	25V, 0.01μF	
R 1	Resistance	0.1W, 1Mohm	0.1W, 1Mohm	
R 2	Resistance (parallel)	0.5W, 0.15ohm±5%	0.75W, 0.1ohm±5%×2	
R 3	Resistance	0.1W, 100Kohm	0.1W, 100Kohm	
R 4	Resistance	0.1W, 10Kohm	0.1W, 10Kohm	
R 5	Resistance	Calculation from output voltage set resistance		
R 6	Resistance	0.1W, 2.2Kohm±0.5ohm	0.1W, 2.2Kohm±0.5%	

6) Electrical characteristics (Ta=25°C)

Efficiency and ripple are measured according to external reference parts circuit configuration that is based on standard circuit configuration.

Unless otherwise specified, the efficiency and ripple voltage conditions are Vin=12V and Io=rated output current.

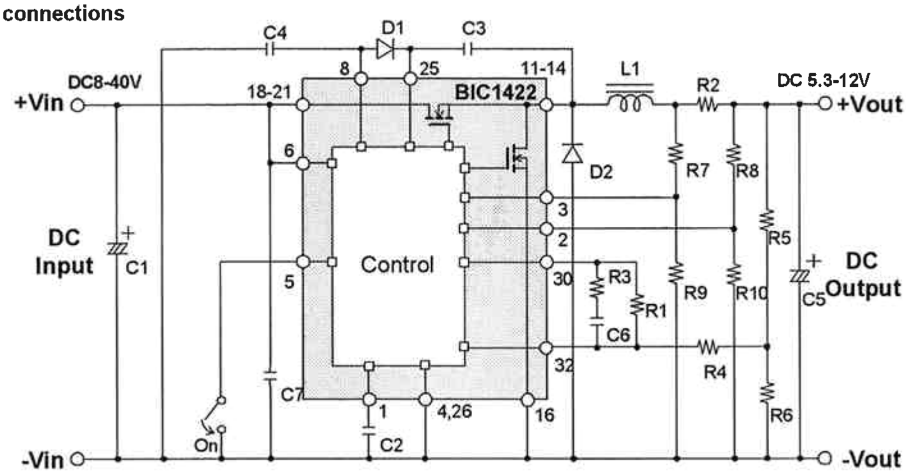
Item	Output current 1A			3A		
Output Voltage (V)	2.5	3.3	5.0	2.5	3.3	5.0
Input Voltage (V)	8-33	8-40		8-33	8-40	
Output current (A)	0 - 1			0 - 3		
Voltage regulation accuracy (%)	± 5					
Efficiency Typ. (%)	86	89	92	84	87	91
Oscillation frequency Typ. (kHz)	250					
Ripple voltage P-P Typ. (mV)	25					
Overcurrent protection (A)	Operation / auto-recovery at a current lower than rated current					
Operating temperature (°C)	- 10 to 85					

2. For use with output voltage higher than 5.3V

1) Basic connection of input/output terminals

- 9, 23 and 27pins are the test terminals and must be left open.
- 7, 10, 15, 17, 22, 24, 29 and 31pins are internal non-connecting pins (N/C terminals).
- Be sure to prepare and connect the external parts shown in the diagram below.
- The use of a low ESR product is recommeded for output smooth capacitor (C5).

2) Standard connections



3) Minimum required input voltage

The circuit method (step-down type) of this MCM-IC is set at maximum 70% on-duty, so difference between input voltage and output voltage is required. To set the output voltage at 5.6V or more, calculate the minimum input voltage by the equation below.

$$Vin(min) \geqq \frac{Vout}{0.7}$$

4) Terminal connection of OCL+, OCL-

When setting the output voltage higher than 5.3V, decide the resistances of R2, R7, R8, R9 and R10, so that the OCL-, OCL+ (2, 3pin) terminal voltage can become 5.3 or below.

R9 = R10 = 1k ohm

$$R7 = R8 \geqq \frac{(Vout + 0.2) - 5.3}{5.3} [Kohm] \qquad R2 = \frac{(1 + \frac{R7}{R9}) \times 0.19}{Iout\ (OCP)} [ohm]$$

When the output voltage exceeds 5.3V, a bridge circuit with R7, R8, R9 and R10 will be composed. The accuracy of the bridge circuit's resistance value will effect the operation of over-current protection. So be sure to choose a resistance with high accuracy (R7-R10 ±0.5% or below, R2±5% or below).

5) Output Voltage setting resistor

Output voltage is adjusted using R5 and R6.

R6=2.2K ohm

$$R5 = \frac{R6 \times (Vout - 2.45)}{2.45} (\Omega)$$

- Setting output voltage examples (at R6=2.2K ohm)
  - Set at 9V, R5=5.9k ohm (2K ohm+3.9K ohm)
  - Set at 12V, R5=8.6K ohm (5.6K ohm+3K ohm)

For output voltage setting resistors (R5, R6), resistors with high temperature characteristics and high accuracy are recommended.

6) Reference parts

Referenc parts for the standard circuit. Due to conditions, the fixed numbers may change.

Parts No.	Component	Output voltage 5.3V-8V		Output voltage 8V-12V	
		Output current example		Output current example	
		2A	3A	1A	2.5A
IC 1	MCM−IC	BIC1422	BIC1422	BIC1422	BIC1422
L 1	Choke	47μH, 2.4A	33μH, 3 .6A	120μH, 1.2A	47μH, 3A
D 1	Diode	1SS300	1SS300	1SS300	1SS300
D 2	Schottky Diode	D1FS6	D1FS6	D1FS6	D1FS6
C 1	Electrolyte capacitor	50V, 180μF 1190mA	50V, 270μF 1580mA	50V, 100μF 724mA	50V, 220μF 1370mA
C 2	Ceramic capacitor	25V, 0.047μF	25V, 0.047μF	25V, 0.047μF	25V, 0.047μF
C 3	Ceramic capacitor	25V, 0.1μF	25V, 0.1μF	25V, 0.1μF	25V, 0.1μF
C 4	Ceramic capacitor	25V, 1000PF	25V, 1000PF	25V, 1000PF	25V, 1000PF
C 5	Electrolyte capacitor	16V, 680μF 38mohm	16V,1000μF 23mohm	16V, 330μF 72mohm	16V, 680μF 38mohm
C 6	Ceramic capacitor	25V, 1000PF	25V, 1000PF	25V, 1000PF	25V, 1000PF
C 7	Ceramic capacitor	50V, 0.01μF	50V, 0.01μF	50V, 0.01μF	50V, 0.01μF
R 1	Resistance	0.1W, 1Mohm	0.1W, 1Mohm	0.1W, 1Mohm	0.1W, 1Mohm
R 2	Resistance	It is determined using the equation in 2. 4).			
R 3	Resistance	0.1W, 100Kohm	0.1W, 100Kohm	0.1W, 100Kohm	0.1W, 100Kohm
R 4	Resistance	0.1W, 10Kohm	0.1W, 10Kohm	0.1Wk 10Kohm	0.1W, 10Kohm
R 5	Resistance	It is determined using the equation in 2. 5).			
R 6	Resistance	0.1W, 2.2Kohm±0.5%	0.1W, 2.2Kohm±0.5%	0.1W, 2.2Kohm±0.5%	0.1W, 2.2Kohm±0.5%
R 7	Resistance	It is determined using the equation in 2. 4).			
R 8	Resistance				
R 9	Resistance	0.1W, 1Kohm±0.5%	0.1W, 1Kohm±0.5%	0.1W, 1Kohm±0.5%	0.1W, 1Kohm±0.5%
R 10	Resistance	0.1W, 1Kohm±0.5%	0.1W, 1Kohm±0.5%	0.1W, 1Kohm±0.5%	0.1W, 1Kohm±0.5%

7) Electrical characteristics (Ta=25°C)

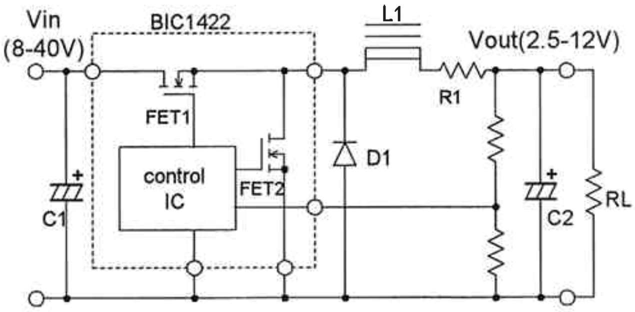
Efficiency and ripple are measured according to external reference parts circuit configuration that is based on standard circuit configuration.
Unless otherwise specified, the efficiency and ripple voltage conditions are Vin=12V and Io=rated output current.

Item	Output current example			
	1A		2.5A	
Output voltage (V)	9	12	9	12
Input voltage (V)	13 - 40	17.5 - 40	13 - 40	17.5 - 40
Output current (A)	0 - 1		0 - 2.5	
Voltage regulation accuracy (%)	± 5			
Efficiency Typ. (%)	93	94	94	95
Oscillation frequency Typ.(kHz typ.)	250			
Ripple voltage P-P Typ. (mVp-p typ.)	25			
Over-current protection (A)	Operation/auto-recovery at a current lower than rated current			
Operating temperature (°C)	- 30 to + 85			

< Basic operation explanation >

This Power IC BIC1422 adopts the synchronous rectification method. With this method, the DC-DC converter has high efficiency and ca supply large current.

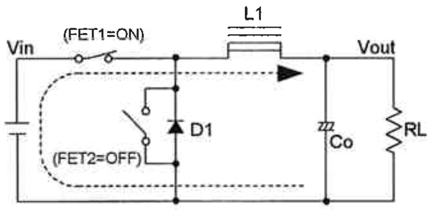
1. Basic circuit



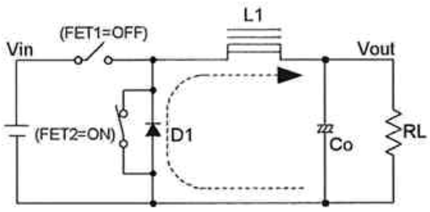
FET1 : Main switch MOSFET
FET2 : Bottom MOSFET
D1 : Free Wheeling Diode
R1 : Current detection resistance
C1 : Input Capacitor
C2 : Output Capacitor

In general step-down chopper converters, the commutation circuit part is composed of diode D1 alone. In synchronous rectification type, FET2 is connected parallel to this commutation diode and the efficiency is improved. Moreover it was general to adopt a P-channel when using a FET as a main switch, however with this Power IC BIC1422 a boost circuit is built-in and the main switching is done at the N-channel of MOSFET, thereby the efficiency can also be improved.

2. Flow of the main current



(a) At ton Current

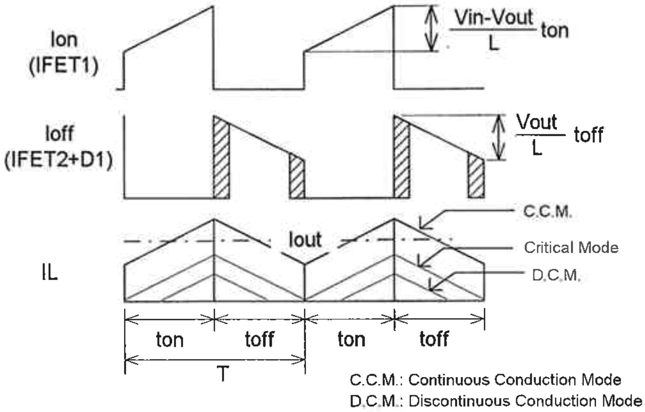


(b) At toff Current

At ton: Passes FET1 and current flows into L1.
At toff: Excitation current that has been saved at L1 go through FET2 (D1) and commutates.

3. Main current wave

Main Current Wave is shown in the figure below.



At toff, the excitation current of the choke goes through D1, FET2 and commutates. But at the oblique parts it goes through D1 and the middle part goes through FET2.

There are three current modes that flow into the choke. The superposed mode of direct current at rating load etc. is called C.C.M. The mode when current that flows into the choke is intermittent at light load is called D.C.M. The boundary between the C.C.M. and D.C.M. is called the critical mode.

At C.C.M., the voltage applied to the choke during ton period becomes Vin-Vo, therefore the current inclination ⊿IL will be

$$\Delta IL(ton) = \frac{Vin - Vo}{L} \times ton$$

When the FET1 goes off next, the current that has been flowing into the inductance will try to keep flowing into the same direction. So, it will go through D1, FET2 and start commutation. For the commutating current, the same current value of the value right before FET1 went off will flow, and the same voltage as the output voltage will be added to the both ends of L1. Therefore the current inclination ⊿IL when off will be

$$\Delta IL\ (toff) = \frac{Vo}{L} \times toff$$

And for C.C.M. the current inclination ⊿IL is the same, so it will be

$$Vo = \frac{ton}{ton + toff} \times Vin = \frac{ton}{T} \times Vin$$

To calculate the smooth choke inductance, design it so that the critical operation can be 15-20% of the rating current. Therefore, the inductance can be calculated with the equation below.

$$L = \frac{Vin - Vo}{\Delta IL} \times ton = \frac{Vin - Vo}{(0.15\ \text{to}\ 0.2) \times Io \times 2} \times \frac{Vo}{Vin \times f}$$

<Basic device set-up standards>

In the following order, the addition parts are designed.

1. Over-current detecting resistor (R1) selection
2. Inductance (L1) selection
3. Output capacitor (C2) selection
4. Input capacitor (C1) selection

1. Over-current detecting resistor (R1) selection method (Output voltage 5.3V or below)

The output current is detected by the drop voltage of resistor R1.
The over-current protection circuit of pulse by pulse method operates when the voltage generated at the resistance is 0.19V±15%.

$$R1 = \frac{Vth}{Iocp} [ohm]$$

Vth: Over-current detecting voltage (0.19V±15%)
Iocp: Over-current operating point

At the over-current operating point, the maximum output current will be set at 110-120%. At the over-current operating point, switching noise and other factors may cause some variation in the calculated value. Check your own equipment and calculate the value accordingly.

2. Inductance (L1) selection

Inductance is determined so that ⊿IL is 15 to 20% of the rating output current at the maximum input voltage.

$$L1 = \frac{(Vin(max) - Vo) \times Vo}{\Delta IL \times Vin(max) \times f} [H]$$

Vin (max): Maximum input voltage
Vo: Output voltage
⊿IL: 15-20% of output current (0.15 to 0.2 × Io)
f: Oscillation frequency (250kHz)

Regarding choke coil selection, be careful of direct superposition characteristics, not to saturate the choke coil even in the over-current area.

3. Output capacitor (C2) selection

If an electrolytic capacitor is used, output ripple is determined by⊿IL and capacitor impedance. Use the equation below to calculate the value. Select a device providing an impedance (Zc) lower than the calculated value.

$$Zc = \frac{Vrip}{\Delta IL}$$

Vrip: Output ripple voltage (Ex. 30mVp-p)
⊿IL: 15-20% of output current

4. Input capacitor (C1) selection

A large ripple current flows through the input capacitor. Use the equation below to calculate the value. Select a device providing a higher ripple current capacity (Irip) than the calculate value.

$$D = \frac{Vo}{Vi(min)}$$

$$Irip = \sqrt{D(1-D)} \times Io$$

D: Duty (Ton/T)
Vo: Output voltage
Vin (min): Minimum input voltage
Io: Output current

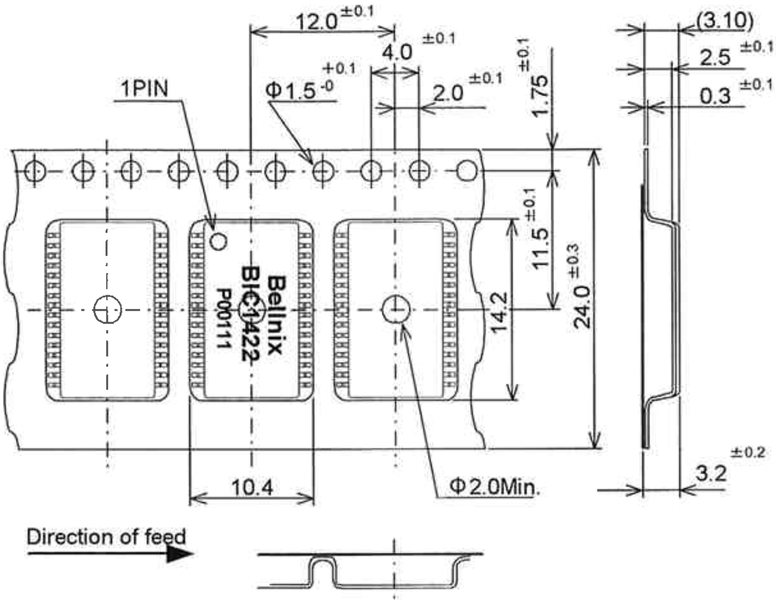
5. Thermal management

Temperature increase varies with input voltage, output voltage and output current. Case surface temperatures should no exceed 105°C. Set up your equipment accordingly.

<Packing>

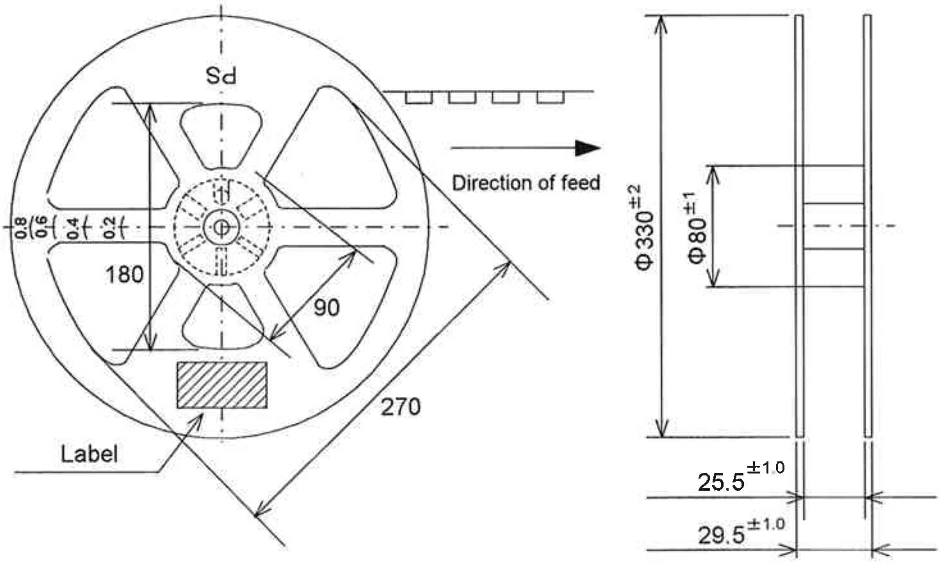
1. Tape & Reel

Dimensions comply with JIS, C-0806-3

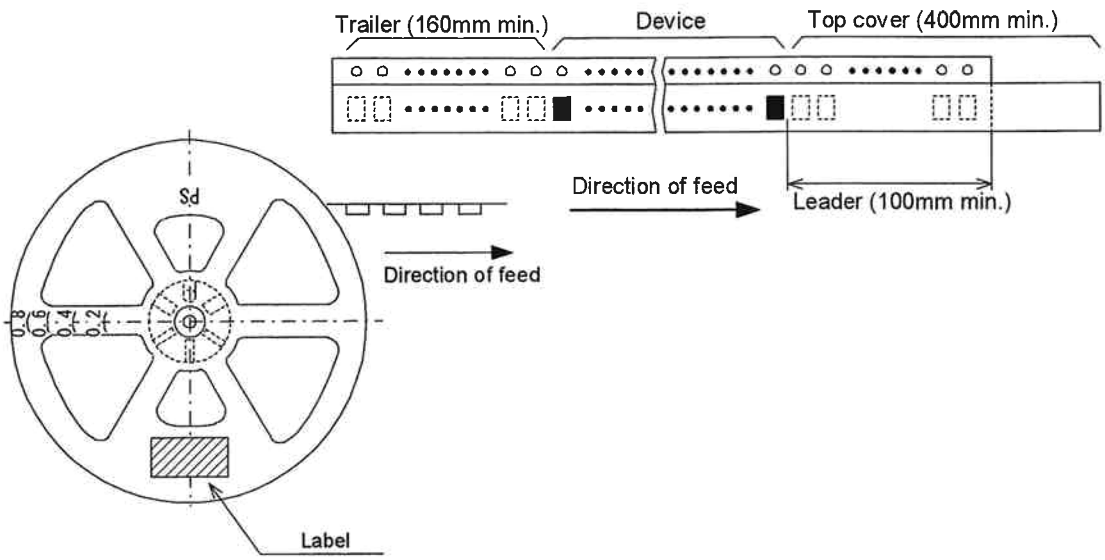


2. Reel

Materials: Polystyrene+Carbon



3. Leader and Trailer



<Precautions>

- This product is for being used in general electric equipments (business equipments, telecommunication equipments and measurement equipments). May not be used in medical equipments, nuclear equipments and trains which would affect lives or properties directly by the failure of this product.
- Do not remodel, process or use in a non-standard, it may cause serious accidents. We can not take responsibility for those products used in a wrong way or in a non-standard.
- When there is a problem, an excessive voltage may occur to the output and cause voltage decrease. Built-in a protection circuit (over-voltage protection, over-current protection etc.) assuming to have problems of malfunction and damage of equipments.
- Always keep the standards (input voltage, operating temperature and so on), without fail and be sure to insert a protection element to the input line. Also, always confirm each polarity (input and output) that there is no miss wiring before energizing. <<Wrong way of using will cause smoke fire.>>
- This product does not have a built-in over-voltage protection. When over-voltage occurs due to the abnormality in the module, there is a mode that input voltage comes out at it is, and may cause smoke and ignition. To prevent this, be sure to add over-voltage protection. <<When over-voltage occurs, the remote ON/ OFF pin of this IC do not function .>>
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Dream and Creation

*All specification are subjected to change without notice.

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