

# DC/DC Converter (MV24C Series)

## 1 Features

- Input voltage range: 18~36V
- Typical input voltage: 24V
- Output voltage: 3.3V,5V,12V,15V,24V,28V
- Input under-voltage lockout
- Output over-voltage protection
- Fault alarm
- Output voltage regulation range: 10%~110%
- Logical shutdown function
- ZCS/ZVS power structure, PFM control
- Can parallel and expand current, Accept N+M fault-tolerance model
- 3000V voltage isolation



57.9×36.8×12.70mm<sup>3</sup>

weight: ≤30g

Table 1 product category

MV24C3V3M75B	MV24C5M100B	MV24C12M100B
MV24C15M100B	MV24C24M100B	MV24C28M100B

## 2 Scope of application

For military and civil high reliability electronic systems in aviation, aerospace, vessel, armament, radar, railway, etc.

## 3 Descriptions

MV24C series DC/DC converters use ZCS/ZVS soft switching structure with low noise PFM control. The operating frequency can reach 1MHz. The converters can replace the similar products of VICOR. These products isolated voltage reach 3000V. The efficiency are up to 88% and power density are 60W/in<sup>3</sup> above. The features of those products also include input over/under voltage lockout, output over-voltage protection and output over-current protection.

## 4 Technical Specifications

Table 2: Rated conditions and Operating conditions

Absolute maximum rating	Operating conditions
+In -In Voltage: -0.5V~53V; PC -In Voltage: -0.5V~7.0V; PR -In Voltage: -0.5V~7.0V; SC -Out Voltage: -0.5V~1.5V; Storage temperature: -65~125°C Welding temperature: (manual welding) (wave soldering)	Input voltage: 18~36V Working temperature (Tc) : -55~100°C

table 3(a) electrical characteristics

No.	Character		Symbol	Conditions ( Unless otherwise specified , -55°C≤Tc≤125°C, VIN=28V±5% )	MV24C3V3M7		MV24C5M100		MV24C12M10	
					5B		B		0B	
					Min	Max	Min	Max	Min	Max
1	Input transient voltage <sup>a</sup> /V		V <sub>IS</sub>	T <sub>A</sub> =25°C, less 100ms	-	50	-	50	-	50
2	Input under-voltage	turn-on voltage	V <sub>INL-ON</sub>		-	17.9	-	17.9	-	17.9
		Turn-off voltage	V <sub>INL-OFF</sub>		14.8	-	14.8	-	14.8	-
3	Input over turn-off/on voltage		V <sub>INL-ON/OFF</sub>		36.3	39.6	36.3	39.6	36.3	39.6
4	Inhibited input current/mA		I <sub>INH</sub>	T <sub>A</sub> =25°C	-	15.0	-	15.0	-	15.0
5	Bias voltage for PC port/V		V <sub>PC</sub>	T <sub>A</sub> =25°C, I <sub>PC</sub> =1.0mA	5.50	6.50	5.50	6.50	5.50	6.50
6	Current for PC port <sup>a</sup> /mA		I <sub>PC</sub>	T <sub>A</sub> =25°C, V <sub>PC</sub> =5.5V	1.5	3.0	1.5	3.0	1.5	3.0
7	Inhibited function for PC port/mV		V <sub>INH-PC</sub>	T <sub>A</sub> =25°C	2.3	2.9	2.3	2.9	2.3	2.9
8	Turn-on delay for PC port		T <sub>d(ON)</sub>	T <sub>A</sub> =25°C	-	7	-	7	-	7
9	alarm voltage for PC port <sup>a</sup> /V	peak/V	V <sub>A-PC</sub>	T <sub>A</sub> =25°C	-	6.5	—	6.5	—	6.5
		period/ms	T <sub>PC</sub>	Alarm will be turn on when input under-voltage or input over voltage	1	10	1	10	1	10
		pulse/μs	W <sub>PC</sub>		350	450	350	450	350	450
10	Resistance for PC port <sup>a</sup> /MΩ		R <sub>I-PC</sub>	T <sub>A</sub> =25°C	0.9	1.1	0.9	1.1	0.9	1.1
11	Output voltage amplitude for PR/V		V <sub>out-PR</sub>	T <sub>A</sub> =25°C, PR load over 30Ω, capacitance less 30pF	5.7	6.1	5.7	6.1	5.7	6.1
12	Output current for PR port		I <sub>out-PR</sub>	T <sub>A</sub> =25°C	150	-	150	-	150	-

13	Impedance for PR port input <sup>a</sup> /Ω	Z <sub>I-PR</sub>	T <sub>A</sub> =25℃		375	625	375	625	375	625
14	Input voltage threshold vale for PR port <sup>a</sup> /V	V <sub>I-PR</sub>	T <sub>A</sub> =25℃, Pulse width≥20ns		2.4	2.6	2.4	2.6	2.4	2.6
15	Drive capability <sup>a</sup> /pc	N	T <sub>A</sub> =25℃, no buffer amplifier circuit		-	3	-	3	-	3
16	Power distribution precision <sup>a</sup> /%	P <sub>E</sub>	T <sub>A</sub> =25℃, load≥10%		-	5	-	5	-	5
17	SC reference voltage/V	V <sub>b-SC</sub>	T <sub>A</sub> =25℃, relative negative output		1.21	1.25	1.21	1.25	1.21	1.25
18	SC alarm voltage <sup>a</sup> /V	V <sub>A-SC</sub>	T <sub>A</sub> =25℃, SC alarm will be turn on when input under-voltage or output over-voltage()		-	0.5	-	0.5	-	0.5
19	Induct offset voltage <sup>a</sup> /V	V <sub>SC</sub>	T <sub>A</sub> =25℃,each terminal<0.25V(induction terminal is closed)		-	0.5	—	0.5	—	0.5
20	Isolation voltage(Ac RMS)/V	V <sub>ISO</sub>	T <sub>A</sub> =25℃, 10s	Between input and output	3000	-	3000	-	3000	-
				Between input and baseboard	1500	-	1500	-	1500	-
				Between output and baseboard	500	-	500	-	500	-
21	Isolation resistance/MΩ	R <sub>ISO</sub>	T <sub>A</sub> =25℃, add 500V(DC)between input and output, add 500V(DC)between pin and baseboard		10	-	10	-	10	-
22	Output voltage/V	V <sub>out</sub>	T <sub>A</sub> =25℃, full-load		3.267	3.333	4.95	5.05	11.88	12.12
23	Output current/A	I <sub>out</sub>			0	22.72	0	20	0	8.33
24	Voltage regulation/%	S <sub>v</sub>	18 36, full-load		-	0.20	-	0.20	-	0.20
25	Load regulation/%	S <sub>in</sub>	No-load full-load		-	0.40	-	0.20	-	0.20
26	Temperature coefficient/(%/℃)	A <sub>v</sub>			-	0.005	-	0.005	-	0.005
27	Output voltage regulation range/%	V <sub>TR</sub>	T <sub>A</sub> =25℃, load≥10%		10	110	10	110	10	110
28	efficiency/%	η	T <sub>A</sub> =25℃, full-load		78	-	83	-	83.8	-
29	Ripple voltage and noise voltage (peak-peak value)/mV	V <sub>R</sub>	BW≤20MHz, full-load		-	175	-	175	-	175
30	Output over-voltage protection point/V	V <sub>ovp</sub>	T <sub>A</sub> =25℃		4.14	4.46	6.03	6.47	13.7	14.9
31	Static power/W	P <sub>D</sub>	No-load		-	6	-	4.80	-	6.1
32	Output protection current/A	I <sub>max</sub>	Output voltage decline to 95%		23.1	30.7	20.4	27.0	8.5	10.9
33	Short-circuit current <sup>a</sup> /A	I <sub>S</sub>	T <sub>A</sub> =25℃, V <sub>out</sub> <250mV		15.8	30.7	2.0	27.0	1.09	10.90

Continued table 3(b) electrical characteristics

No.	Character			Conditions ( Unless otherwise specified , $-55^{\circ}\text{C}\leq T_c\leq 125^{\circ}\text{C}$ , $V_{IN}=28\text{V}\pm 5\%$ )	MV24C15M40		MV24C24M40		MV24C28M40	
					0B		0B		0B	
					Min	Max	Min	Max	Min	Max
1	Input transient voltage <sup>a</sup> /V		$V_{IS}$	$T_A=25^{\circ}\text{C}$ , less 100ms	-	50	-	50	-	50
2	Input under-voltage /V	turn-on voltage	$V_{INL-O NT}$	-	17.9	-	17.9	-	17.9	17.9
		turn-off voltage	$V_{INL-O FF}$		14.8	-	14.8	-	-	-
3	Input over turn-off/on		$V_{INL-O N/OFF}$		36.3	39.6	36.3	39.6	36.3	39.6
4	Inhibited input current/mA		$I_{INH}$	$T_A=25^{\circ}\text{C}$	-	15.0	-	15.0	-	15.0
5	Bias voltage for PC port/V		$V_{PC}$	$T_A=25^{\circ}\text{C}$ , $I_{PC}=1.0\text{mA}$	5.50	6.50	5.50	6.50	5.50	6.50
6	Current for PC port <sup>a</sup> /mA		$I_{PC}$	$T_A=25^{\circ}\text{C}$ , $V_{PC}=5.5\text{V}$	1.5	3.0	1.5	3.0	1.5	3.0
7	Inhibited function for PC port/mV		$V_{INH-PC}$	$T_A=25^{\circ}\text{C}$	2.3	2.9	2.3	2.9	2.3	2.9
8	Turn-on delay for PC port <sup>a</sup> /ms		$T_{d(ON)}$	$T_A=25^{\circ}\text{C}$	-	7	-	7	-	7
9	alarm voltage for PC port <sup>a</sup> /V	peak/V	$V_{A-PC}$	-	6.5	—	6.5	—	6.5	6.5
		period/ms	$T_{PC}$	1	10	1	10	1	10	10
		pulse/ $\mu\text{s}$	$W_{PC}$	350	450	350	450	350	450	450
10	Resistance for PC port <sup>a</sup> /M $\Omega$		$R_{I-PC}$	$T_A=25^{\circ}\text{C}$	0.9	1.1	0.9	1.1	0.9	1.1
11	Output voltage amplitude for PR/V		$V_{out-PR}$	$T_A=25^{\circ}\text{C}$ , PR load over 30 $\Omega$ , capacitance less 30pF	5.7	6.1	5.7	6.1	5.7	6.1
12	Output current for PR port		$I_{out-PR}$	$T_A=25^{\circ}\text{C}$	150	-	150	-	150	-
13	Impedance for PR port input <sup>a</sup> / $\Omega$		$Z_{I-PR}$	$T_A=25^{\circ}\text{C}$	375	625	375	625	375	625
14	Input voltage threshold vale for PR port <sup>a</sup> /V		$V_{I-PR}$	$T_A=25^{\circ}\text{C}$ , Pulse width $\geq 20\text{ns}$	2.4	2.6	2.4	2.6	2.4	2.6
15	Drive capability <sup>a</sup> /pc		N	$T_A=25^{\circ}\text{C}$ , no buffer amplifier circuit	-	3	-	3	-	3
16	Power distribution precision <sup>a</sup> /%		$P_E$	$T_A=25^{\circ}\text{C}$ , load $\geq 10\%$	-	5	-	5	-	5
17	SC reference voltage/V		$V_{b-SC}$	$T_A=25^{\circ}\text{C}$ , relative negative output	1.21	1.25	1.21	1.25	1.21	1.25
18	SC alarm voltage <sup>a</sup> /V		$V_{A-SC}$	$T_A=25^{\circ}\text{C}$ , SC alarm will be turn on when input under-voltage or output over-voltage()	-	0.5	-	0.5	-	0.5
19	Induct offset voltage <sup>a</sup> /V		$V_{SC}$	$T_A=25^{\circ}\text{C}$ , each terminal $< 0.25\text{V}$ (induction terminal is	-	0.5	—	0.5	—	0.5

			closed)							
20	Isolation voltage(Ac RMS)/V	$V_{iso}$	$T_A=25^{\circ}C, 10s$	Between input and output	3000	-	3000	-	3000	-
				Between input and baseboard	1500	-	1500	-	1500	-
				Between output and baseboard	500	-	500	-	500	-
21	Isolation resistance/M $\Omega$	$R_{iso}$	$T_A=25^{\circ}C$ , add 500V(DC)between input and output, add 500V(DC)between pin and baseboard	10	-	10	-	10	-	
22	Output voltage	$V_{out}$	$T_A=25^{\circ}C$ , full-load	14.85	15.15	23.76	24.24	27.72	28.28	
23	Output current	$I_{out}$		0	6.67	0	4.17	0	3.57	
24	Voltage regulation/%	$S_v$	18 36, full-load	-	0.20	-	0.20	-	0.20	
25	Load regulation/%	$S_{in}$	No-load full-load	-	0.40	-	0.20	-	0.20	
26	Temperature coefficient/(%/ $^{\circ}C$ )	$A_v$		-	0.005	-	0.005	-	0.005	
27	Output voltage regulation range/%	$V_{TR}$	$T_A=25^{\circ}C$ , load $\geq 10\%$	10	110	10	110	10	110	
28	efficiency/%	$\eta$	$T_A=25^{\circ}C$ , full-load	88	-	87	-	88	-	
29	Ripple voltage and noise voltage (peak-peak value)/mV	$V_R$	$BW\leq 20MHz$ , full-load	-	125	-	88	-	107	
30	Output over-voltage protection point/V	$V_{ovp}$	$T_A=25^{\circ}C$	17.1	18.5	27.1	29.1	31.5	33.9	
31	Static power/W	$P_D$	No-load	-	7.0	-	5.4	-	5.0	
32	Output protection current/A	$I_{imax}$	Output voltage decline to 95%	6.80	8.67	4.25	5.67	3.64	5.0	
33	Short-circuit current <sup>2</sup> /A	$I_S$	$T_A=25^{\circ}C$ , $V_{out}<250mV$	4.66	8.67	2.91	5.42	0.50	5.00	

a design guarantee, test only be needed when identified inspection or parameters are effected by changing process

## 5 Circuit block diagram

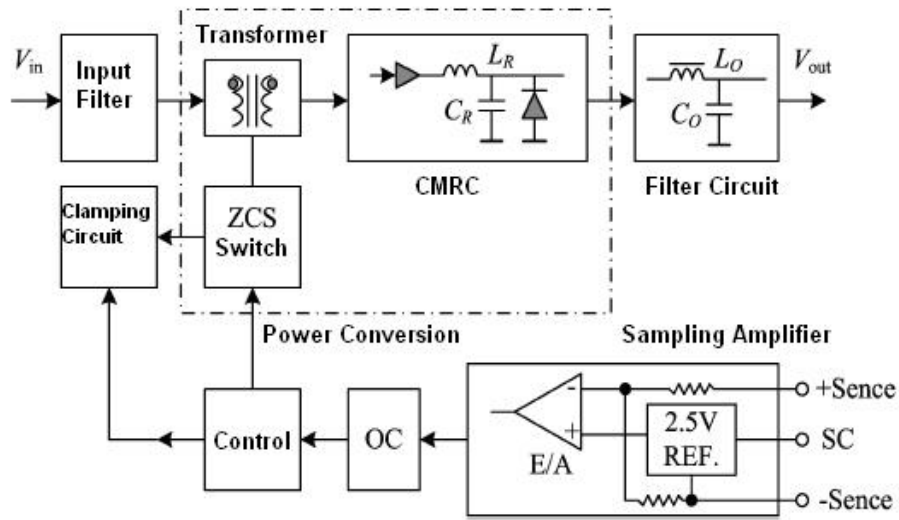


Diagram 2 Circuit block diagram

## 6 Typical Characteristic Curve

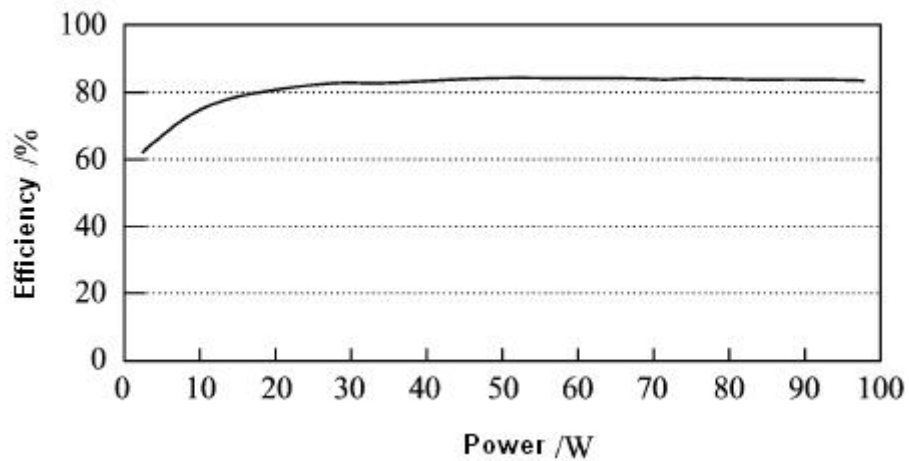


Diagram 3 Efficiency (Output power)

(MV24C5M100B model)

## 7 MTBF Curve

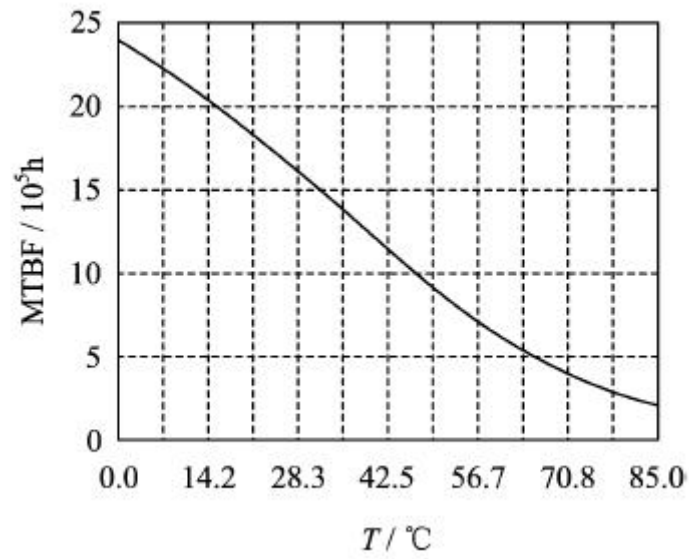


Diagram 4 MTBF Curve

(Predicting the ground is in good condition, this diagram correspond to MV24C5M100B model)

## 8 Pin Designation

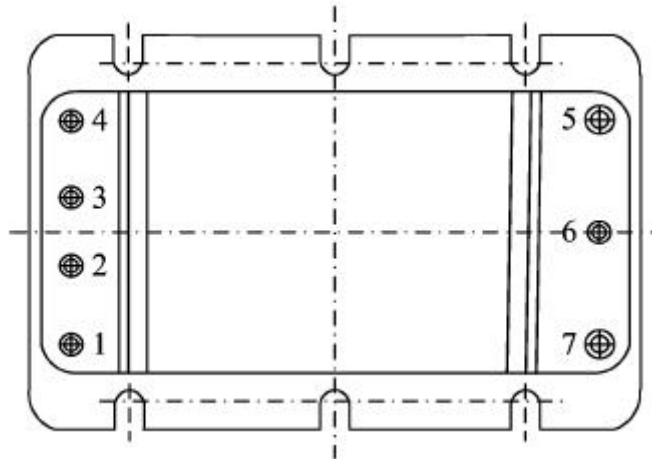


Figure 5 Pin Out Bottom View

Table 4 Pin Designation

Pin	Symbol	Designation
1	+In	Positive Input
2	PC	Prohibit/Alarm

3	PR	Parallel
4	- In	Negative Input
5	- Out	Negative Output
6	SC	Secondary Side Control
7	+Out	Positive Output

## 9 Typical Connection Diagram

(1) Electrical test circuit connection diagram (diagram 6)

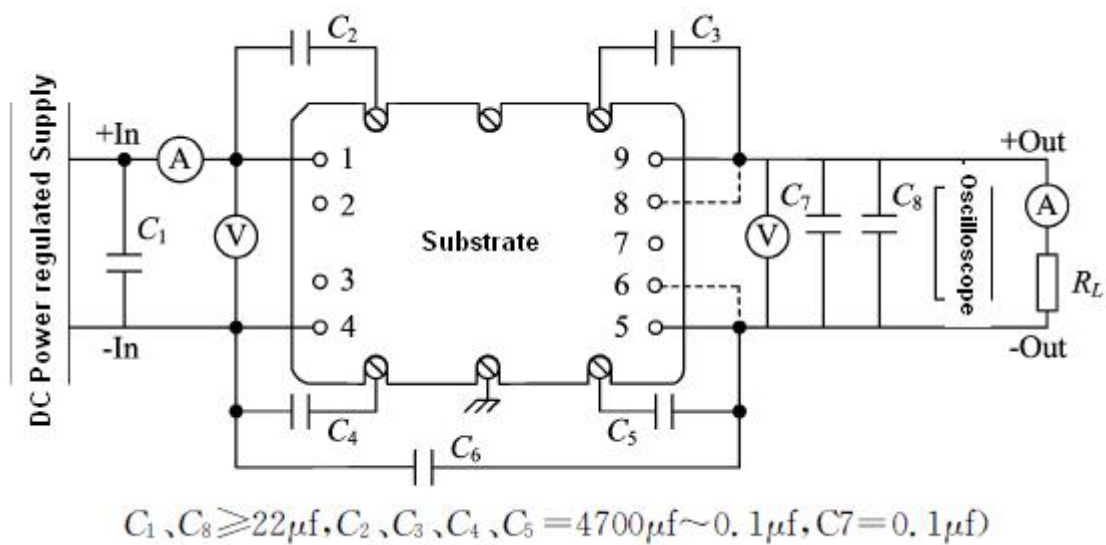
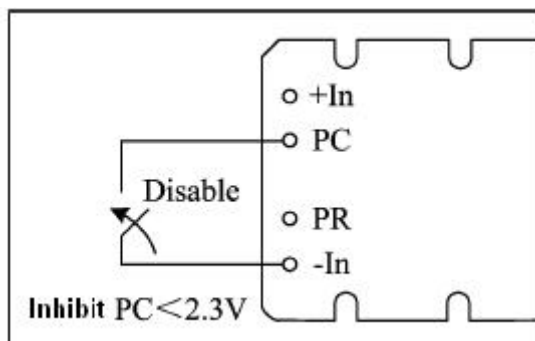


Diagram 6: Electrical test circuit connection diagram

(2) PC port is bi-directional port, which has module enabled function and Fault indicate



function.



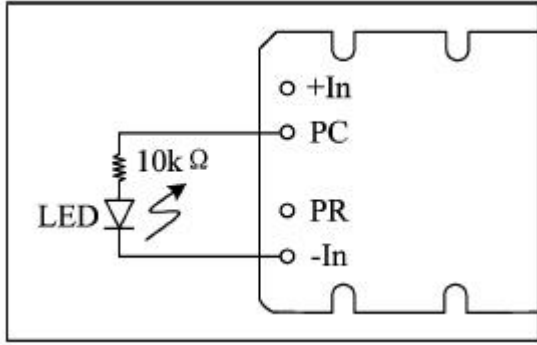


Diagram 7: module enabled

Diagram 8: Status indicate and Fault

indicate

The output will be inhibited when (-In) of PC port is less 2.3V, the repetition frequency of this pin should be more than 1s

LED indicator is lighted when the module is in normal operation; the indicator is flickering when over-voltage or under-voltage happened. PC port will be output signal as showed in diagram 9 when a failure happens.

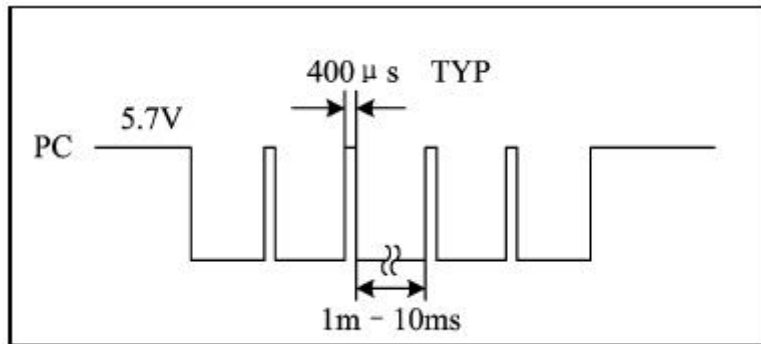


Diagram 9: Fault signal

### (3) Parallel function (N+M)

Realizing the paralleling and expanding current function by connecting with PR ports of modules, at the same time, the fault-tolerant function is also accepted. There are two methods to realize paralleling and expanding current function, one is the automatic master-slave mode (Diagram 10) and another one is the master-slave mode (diagram 11). Under master-slave mode, the output voltage of paralleling can be adjustable by SC port of master module in accept area. Even though both of these two methods can expand output power, the method of diagram 10 is better for system redundancy. The method of diagram 11 is better for the area in large electromagnetic interference. It must be pointed that, the cell array may be crushed by master module disabled.

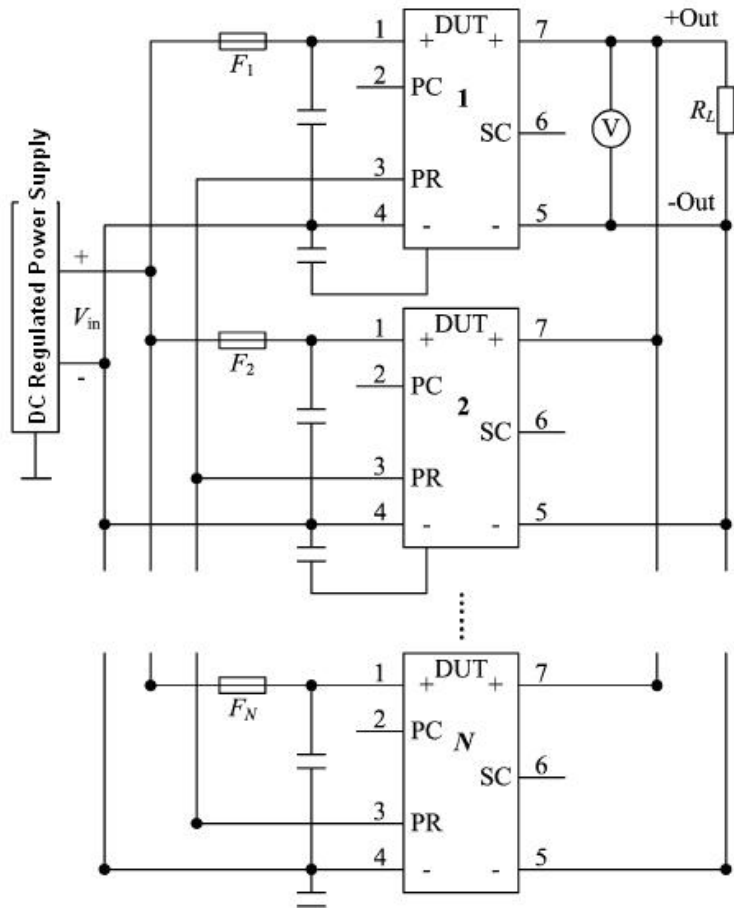


Diagram 10: Paralleling and expanding current

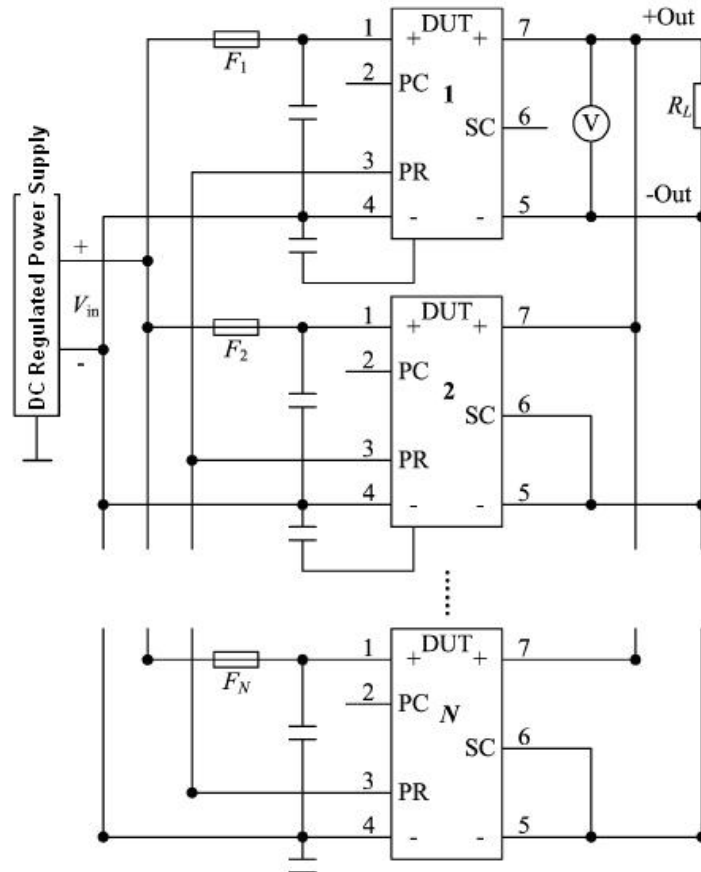


Diagram 11: Paralleling and expanding current (master-slave)

(4) Output Voltage Regulation

Connected as diagram 12, the value of output voltage and resistance RW1 are decided by the formula below

$$R_{w1} = \frac{1\,000(V_{out} - 1.23)V_{nom}}{1.23(V_{out} - V_{nom})} - 1\,000(\Omega)$$

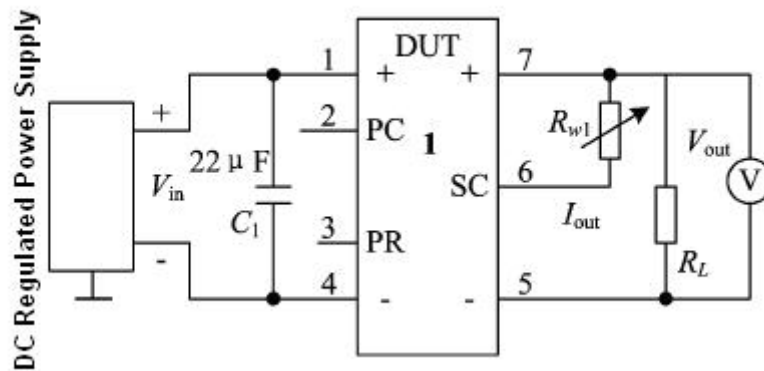


Diagram 12: Output voltage positive adjustment

Connected as diagram 13, the value of output voltage and resistance  $R_{w2}$  are decided by the formula below

$$R_{w2} = \frac{1\,000V_{out}}{V_{nom} - V_{out}} (\Omega)$$

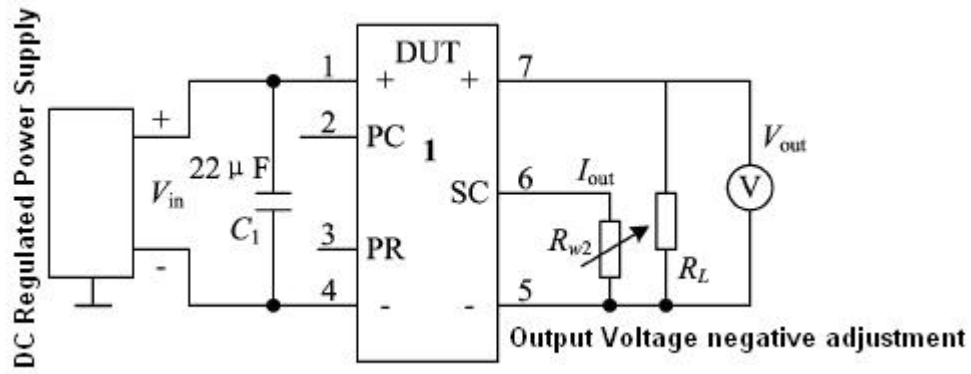


Diagram 13: Output voltage negative adjustment

## 10. Package Specifications

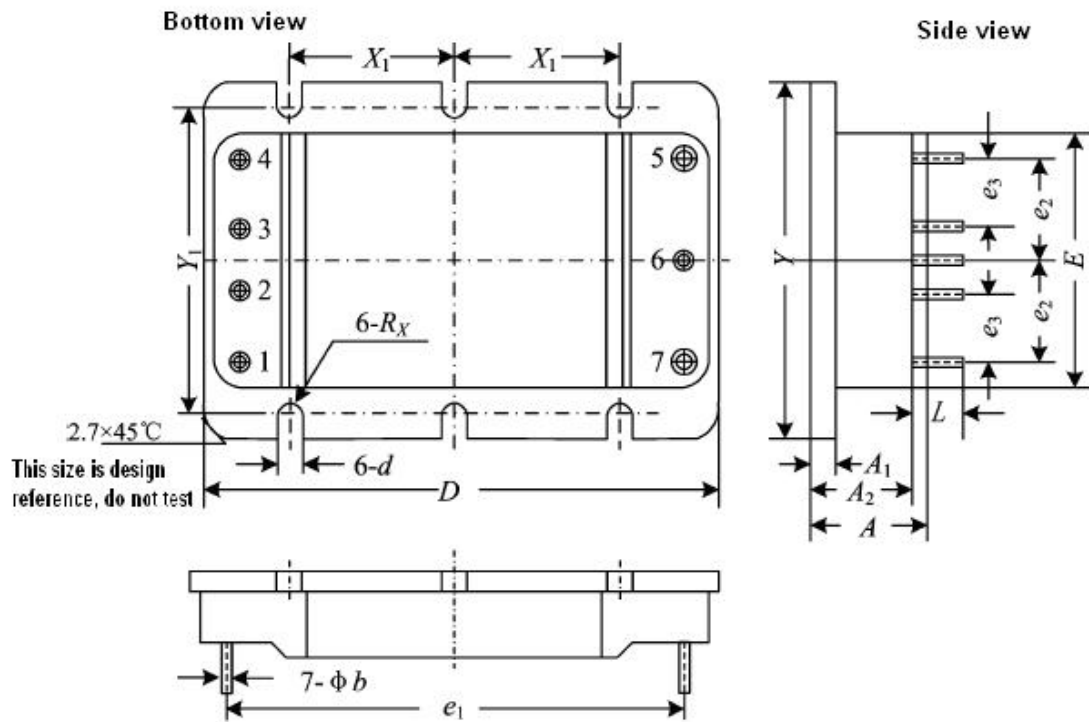


Diagram 14: Package outline drawing (upward view)

Table 5 Package Outline

Symbols	Unit/mm		
	Minimum	Typical	Maximum
A	12.20	-	13.50
A <sub>1</sub>	2.80	-	3.30
A <sub>2</sub>	10.65	-	11.40
Φb	1.90	-	2.16
D	57.52	-	58.28
E	26.42	-	27.42
e2	-	10.16	-
e3	-	6.99	-
e1	-	50.80	-
L	4.58	-	-
X1	16.26	-	16.76
Y1	32.01	-	32.51
d	3.17	-	3.55
Y	36.58	-	37.08

## 11 Ordering Information

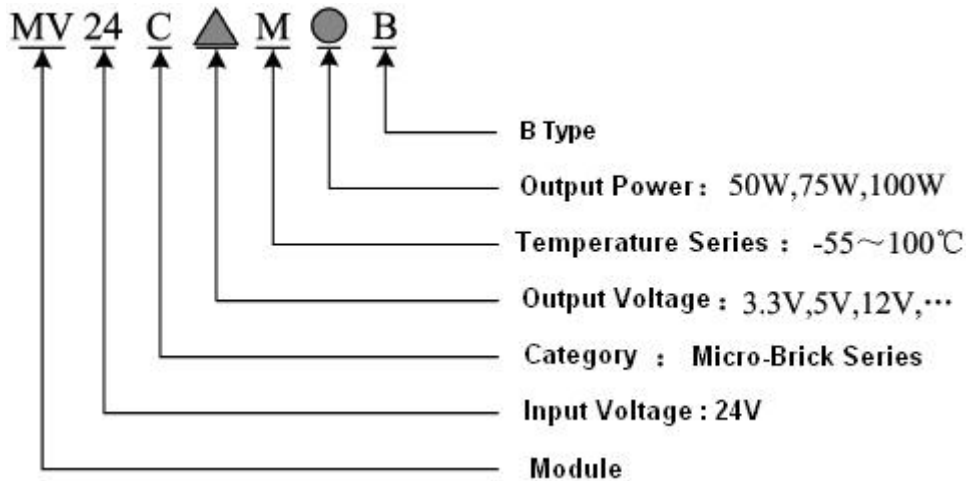


Diagram 15: Ordering Information

### Application Notes:

- ☆ The voltage detection point should be kept at the root of the pin of the testing product.
- ☆ Do not plug the product with electricity.
- ☆ Before power the testing product, you must confirm the polarity of the power supply to avoid damaging products by misconnection. At the same time, please ensure that the power supply voltage and load current does not exceed using limitation of the testing product.
- ☆ Unused pins shall be hung in the air during no operation.
- ☆ Pins at inhibit terminal shall be hung in the air during no operation.
- ☆ PC and PR can not be connected with +In and -In, SC can not be directly connected with +V<sub>out</sub>. Otherwise, the product may be damaged.
- ☆ When ordering this device, the detailed electrical specifications shall be based on relevant standards.