

# Thick Film Hybrid Large Power military DC-DC Converters (HOL28D Series)

## 1 Features of military DC-DC Converter HOL28D Series



- High reliability
- Input voltage range : 16V ~ 40V , Typical  
DC input voltage :28V
- Output power  $P_o$  : 100W ~ 150W
- Operating temperature range  $T_c$  : -55°C ~ +125°C
- Low Start-up current
- No output overshoot
- Inhibit function
- under-voltage and over-voltage lock
- Output short circuit and over-current protection
- Output voltage fine tunable
- Output sensing function
- Maximum power density : 100W/in<sup>3</sup>
- Efficiency 90%
- Hermetically sealed metal cases

Size :  
76.70\*38.60\*10.66mm<sup>3</sup>

Table1 Product models

HOL28D9R5
HOL28D12
HOL28D15

## 2 Scope of military DC-DC Converter HOL28D Series application

High-reliability electronic system for aviation and aerospace, weapon and ships etc.

## 3 Description of military DC-DC Converter HOL28D Series

This series products are high reliable hybrid thick film large power DC/DC converters. By using half-bridge circuit topology and pulse width modulation principle, the output sampling voltage isolated by optocoupler to modulate the pulse width and form the closed-loop control to make the product a stable voltage output. This series products are made by thick film hybrid integrated process, hermetically sealed metal cases. Product design and ma

nufacturing meets MIL-PRF-38534 requirements. Customers can connect the matching power EMI filters in the input port to improve the product's electromagnetic compatibility.

## 4 Electrical performance of military DC-DC Converter HOL28D Series

Tabel2 Rated conditions and recommended operating conditions

Absolute Max. Rated value	
Output voltage : 15.5V ~ 41V	Mechanical Shock : 1500g
Output power : 150W	Lead resistance to welding temperature : 300°C ( 15s )
Storage temperature : -65°C ~ 150°C	Weight : 100g
	ESD : 2000V

Table 3-1 Electric characteristics

No.	Parameter	Conditions ( Unless other wise , - 55°C≤T <sub>c</sub> ≤125°C , V <sub>IN</sub> =28V±5% )		HOL28D9R5		HOL28D12		HOL28D15	
				Min	Max	Min	Max	Min	Max
1	Input voltage/V	Low, High, Ambient Temperature		16	40	16	40	16	40
2.	Output voltage/V	Positive	Ambient, Full load	9.31	9.69	11.80	12.2	14.70	15.30
		Negative		-9.69	-9.31	-12.20	-11.80	-15.30	-14.70
		Positive	Low/high, Full load	9.31	9.69	11.80	12.20	14.70	15.30
		Negative		-9.69	-9.31	-12.20	-11.80	-15.30	-14.70
3	Output current/A	V <sub>IN</sub> =15V ~ 50V		—	6.3	—	5	—	5
4	Output Power/W			—	120	—	120	—	150
5	Output Ripple Voltage/mV	BW≤20MHz , Full load		—	100	—	120	—	150
6	Line	Positive	V <sub>IN</sub> =16V ~	—	95	—	120	—	150

	Regulation/mV	Negative	40V , Full load	—	95	—	120	—	150
7	Load Regulation/mV	Positive	No load to full	—	95	—	120	—	150
		Negative		—	95	—	120	—	150
8	Input current/mA	Inhibited		—	10	—	10	—	10
		I <sub>o</sub> =no load		—	100	—	100	—	100
9	Input Ripple current/mA	BW≤20MHz , Full load		—	200	—	200	—	200
10	Efficiency/%	Full load	Ambient	89	-	88	—	90	—
			Low/high	86	—	86	—	86	—
11	Isolation/MΩ	Input to output or any pin to case at 500V , T <sub>c</sub> =25°C		100	—	100	—	100	—
12	Inhibit voltage			—	0.3	—	0.3	—	0.3
13	Inhibit open circuit voltage/V	Full load		1.25	4	1.25	4	1.25	4
14	Under voltage turn-on voltage/V	Full load		14.5	15.5	14.5	15.5	14.5	15.5
15	Under voltage cut-off voltage/V	Full load		14	15	14	15	14	15
16	Short Circuit Protection power consumption			-	15	-	15	-	15
17	Capacitive load/μF	T <sub>c</sub> =25°C		—	500	—	500	—	500
18	Switching frequency/kHz	Full load		250	350	250	350	250	350
19	Cross regulation/mV	One side 30% load, the other from 30% to 70% load		—	380	—	480	—	600
20	Step Load Response Transient(mV pK)	50%load→full load or Full load →50% load		—	800	—	800	—	800
21	Step Load Response Recovery(μs)	50%load→full load or Full load →50% load		—	800	—	600	—	600
22	Step Line Response Transient(mV pK)	V <sub>IN</sub> : 16V→40V , V <sub>IN</sub> : 40V→16V , I <sub>o</sub> =Full		—	1200	—	1200	—	1200

		load						
23	Step Line Response Recovery( $\mu$ s)	$V_{IN} : 16V \rightarrow 40V$ , $V_{IN} : 40V \rightarrow 16V$ , $I_o = \text{Full load}$	—	1500	—	1500	—	1500
24	Start-up Overshoot(mV pK)	$V_{IN} : 0 \rightarrow 28V$ , $I_o = \text{Full load}$	—	25	—	25	—	25
25	Start-up Delay (ms)	$V_{IN} : 0 \rightarrow 28V$ , $I_o = \text{Full load}$	—	30	—	20	—	20

Table 3-2 Electric characteristics

No.	Parameter	Conditions ( Unless other wise , - $55^{\circ}\text{C} \leq T_c \leq 125^{\circ}\text{C}$ , $V_{IN} = 28V \pm 5\%$ )		HOL28D16R5		HOL28DXX		HOL28DXX	
				Min	Max	Min	Max	Min	Max
1	Input voltage/V	Low, High, Ambient Temperature		20	36				
2	Output voltage/V	Positive	16.25	16.25	16.25				
		Negative	-16.75	-16.75	-16.75				
		Positive	16.25	16.25	16.25				
		Negative	-16.75	-16.75	-16.75				
3	Output current/A			—	3.5				
4	Output Power/W			—	115				
5	Output Ripple Voltage/mV	BW $\leq$ 20MHz , Full load		—	150				
6	Line Regulation/mV	Positive	$V_{IN} = 16V \sim 40V$ , Full load	—	165				
		Negative		—	165				
7	Load Regulation/mV	Positive	No load to full	—	165				
		Negative		—	165				
8	Input current/mA	Inhibited		—	10				
		$I_o = \text{no load}$		—	100				
9	Input Ripple	BW $\leq$ 20MHz , Full		—	200				

	current/mA	load						
10	Efficiency/%	Full load	87	-				
			86	-				
11	Isolation/MΩ	Input to output or any pin to case at 500V , T <sub>c</sub> =25°C	100	-				
12	Inhibit voltage		0	0.7				
13	Inhibit open circuit voltage/V	Full load	1.25	4.0				
14	Under voltage open voltage/V	Full load	18	19.5				
15	Under voltage cut-off voltage/V	Full load	17	19				
16	Short Circuit Protection		—	15				
17	Capacitive load/μF	T <sub>c</sub> =25°C	—	330				
18	Switching frequency/kHz	Full load	250	350				
19	Cross regulation/mV	One side 30% load, the other from 30% to 70% load	—	800				
20	Step Load Response Transient(mV pK)	50%load→full load or Full load →50% load	—	800				
21	Step Load Response Recovery(μs)	50%load→full load or Full load →50% load	—	600				
22	Step Line Response Transient(mV pK)	V <sub>IN</sub> : 16V→40V , V <sub>IN</sub> : 40V→16V , I <sub>o</sub> =Full load	—	1200				
23	Step Line Response Recovery(μs)	V <sub>IN</sub> : 16V→40V , V <sub>IN</sub> : 40V→16V , I <sub>o</sub> =Full load	—	1500				
24	Start-up Overshoot(m)	V <sub>IN</sub> : 0→28V ,	—	150				

	V pK)	Io=Full load					
25	Start-up Delay (ms)	V <sub>IN</sub> : 0→28V , Io=Full load	—	50			

### 5 Circuit block diagram of military DC-DC Converter HOL28D Series

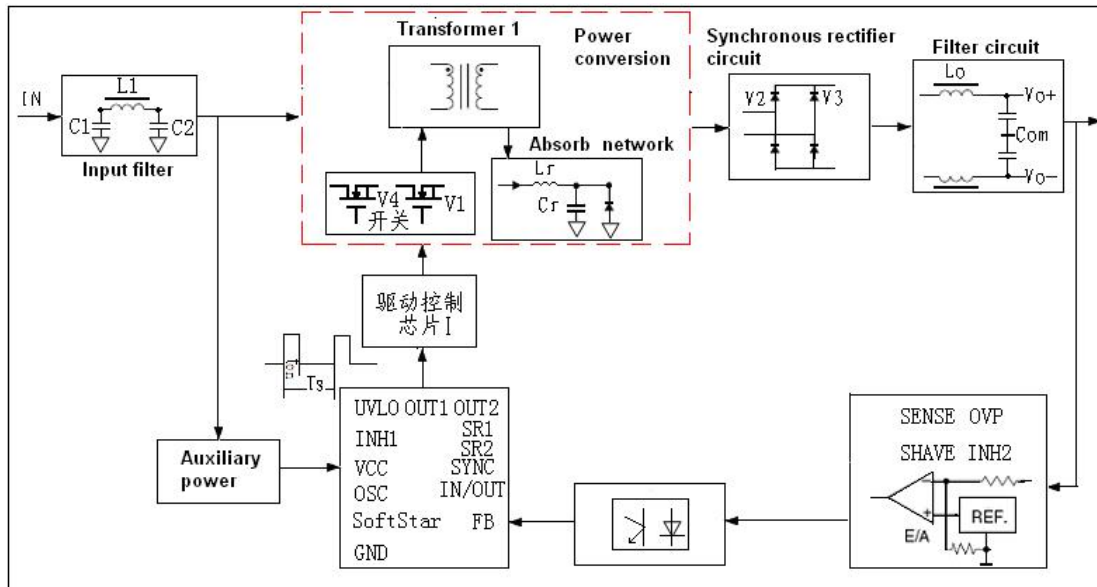


Fig 1 HOL28D Series circuit block diagram

### 6 Typical Performance Curves of military DC-DC Converter HOL28D Series

(Testing condition as per  $T_c=25^\circ\text{C}$  ,  $V_{IN}=28\text{V}\pm 5\%$ , Full load, unless otherwise specified)

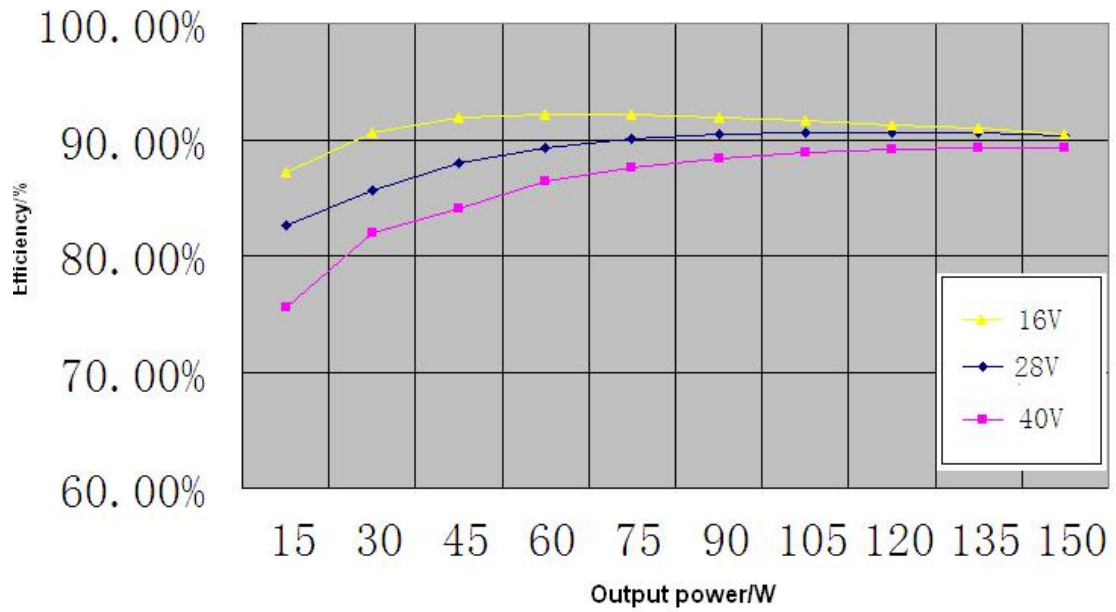


Fig 2 HOL28D15 Efficiency curves

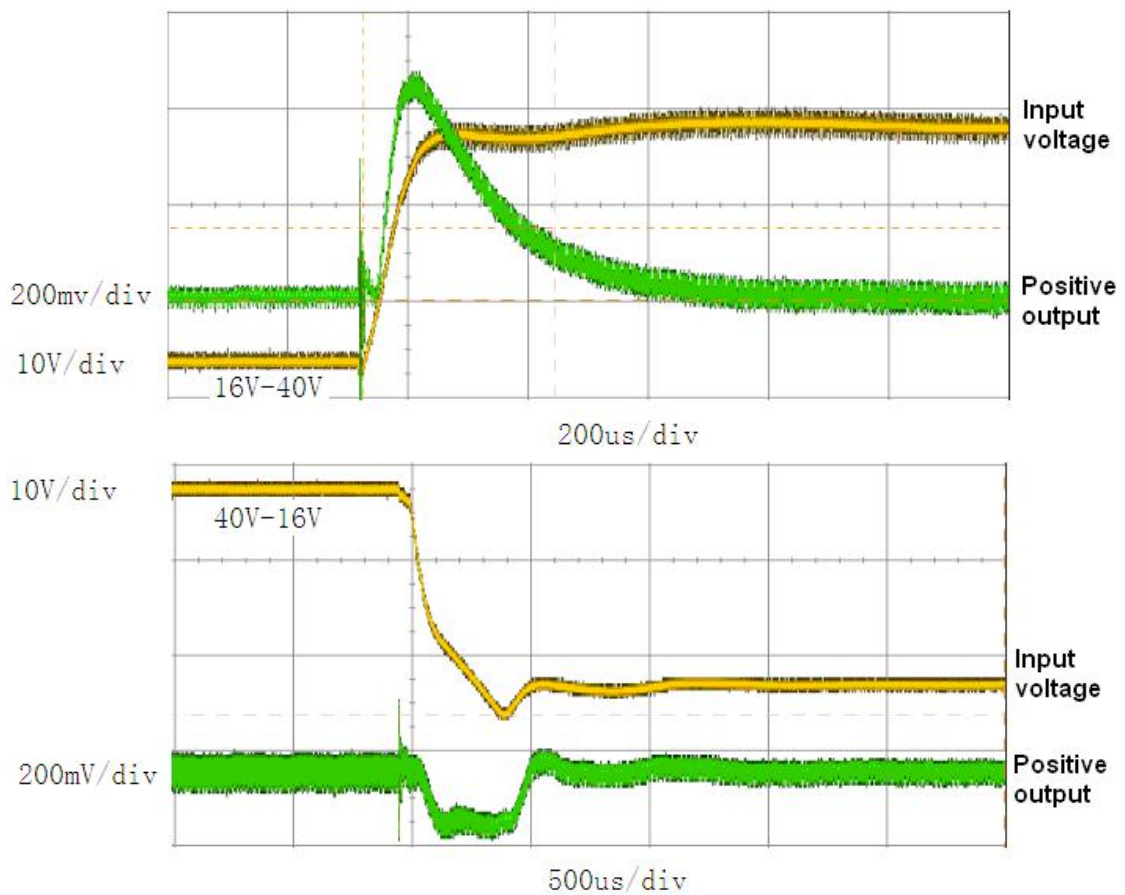


Fig 3 HOL28D15 Input Step Curve

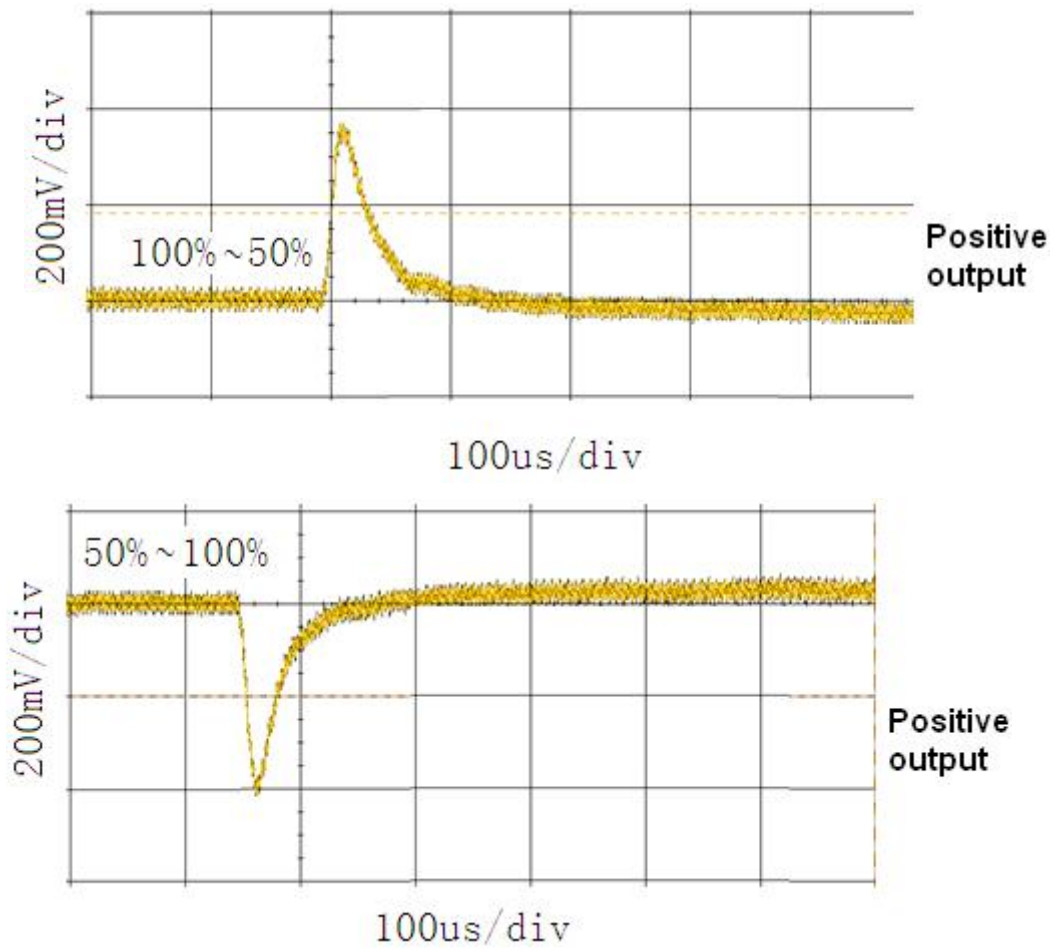


Fig 4 HOL28D15 Step Load Response (Positive output)



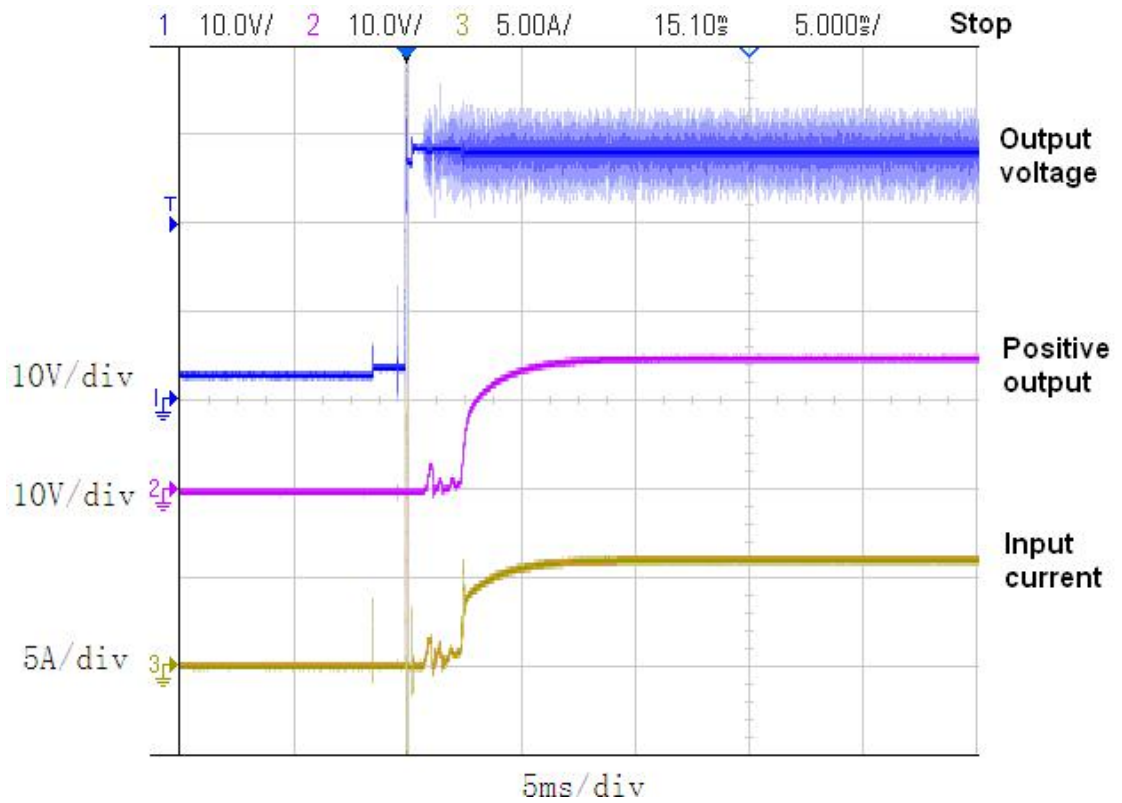


Fig 5 HOL28D15 Start-up Overshoot/Start-up Delay

## 7 MTBF Curves of military DC-DC Converter HOL28D Series

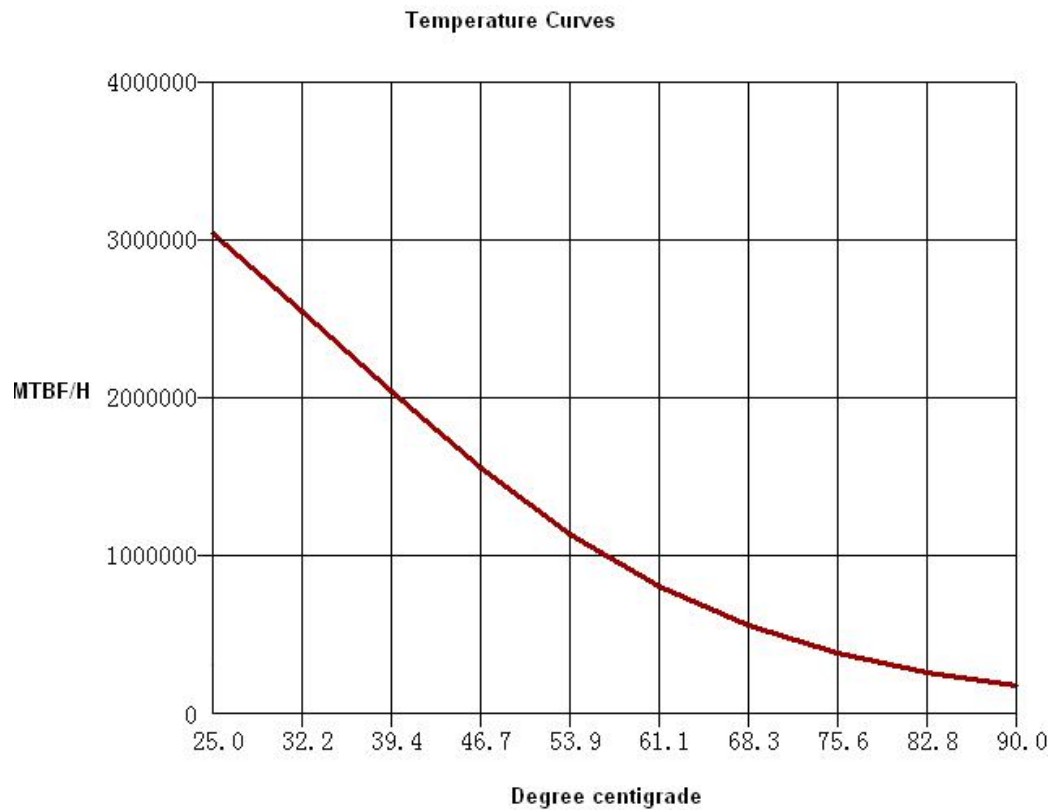


Fig 6 MTBF Temperature Curves (HOL28D15)

(Well ground condition)

### 8 Pin Designations of military DC-DC Converter HOL28D Series

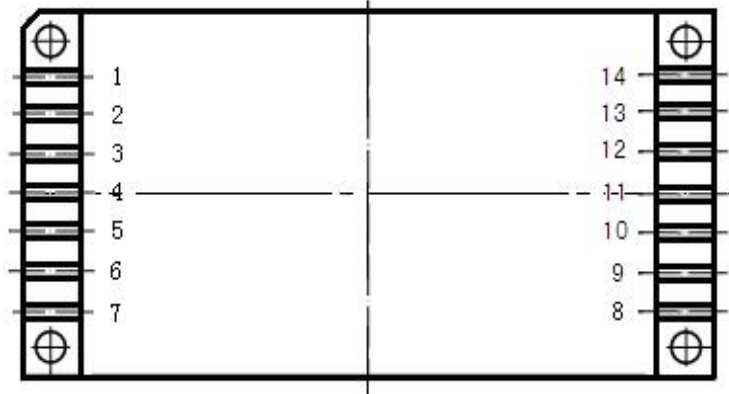


Fig 7 Pin Out Bottom View

#### Pin Designation

Pin	Symbol	Designation	Pin	Symbol	Designation
1	$V_{IN}$	Positive input	8	$V_{o+}$	Positive output
2	$GND_I$	Input ground	9	COM	Common
3	NC	NC	10	$V_{o-}$	Negative output
4	INH1	Primary Inhibit	11	Trim	Trimming
5	NC	NC	12	SHARE	Current flow control terminal
6	$SYN_I$	Synchronous input	13	NC	NC
7	NC	NC	14	NC	NC

Notes : HOL28D15、HOL28D16R5 ( This two models using this package type )

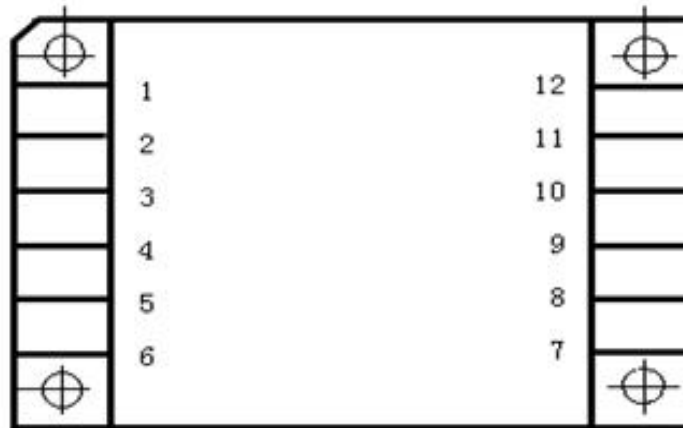


Fig 8 Pin out Bottom View

Pin Designation

Pin	Symbol	Designation	Pin	Symbol	Designation
1	$V_{IN}$	Positive input	7	$V_{o+}$	Positive output
2	$GND_I$	Input ground	8	COM	Common
3	NC	NC	9	$V_{o-}$	Negative output
4	INH1	Primary Inhibit	10	Trim	Trimming
5	NC	NC	11	SHARE	Current flow control terminal
6	$SYN_I$	Synchronous input	12	NC	NC

Notes: Subsequent series of products designed in the form of the package

## 9 Typical Connection Diagram of military DC-DC Converter HOL28D Series

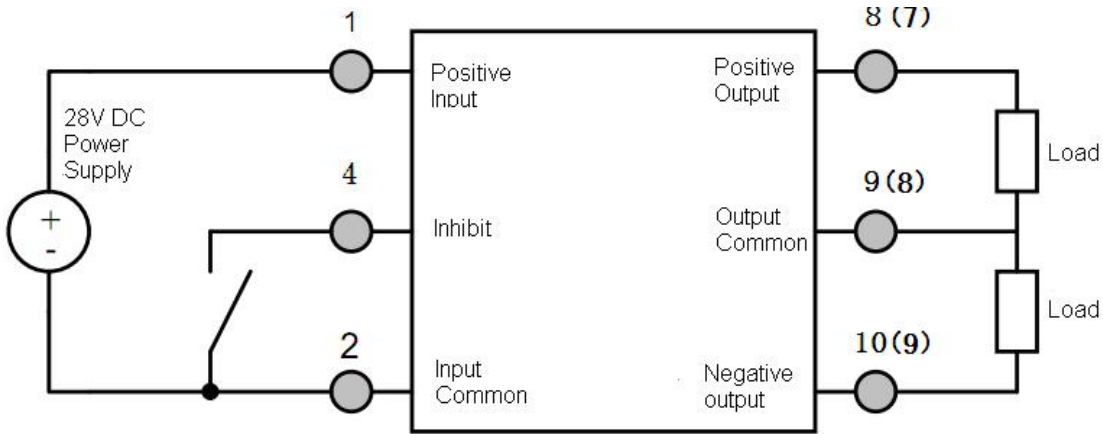


Fig 9 Products Using Connection Diagram

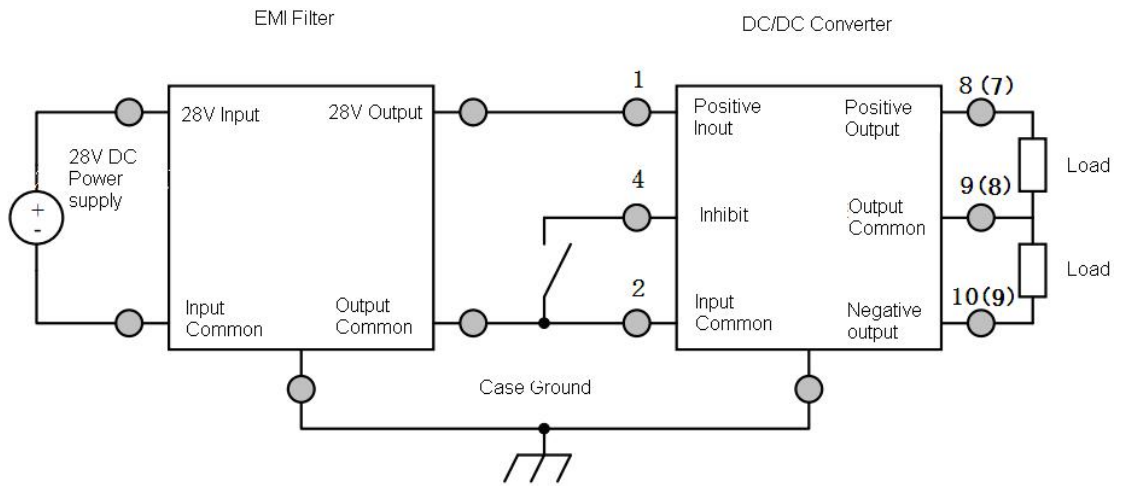


Fig 10 EMI Filter Connection Diagram

## 10 Package Specifications of military DC-DC Converter HOL28D Series

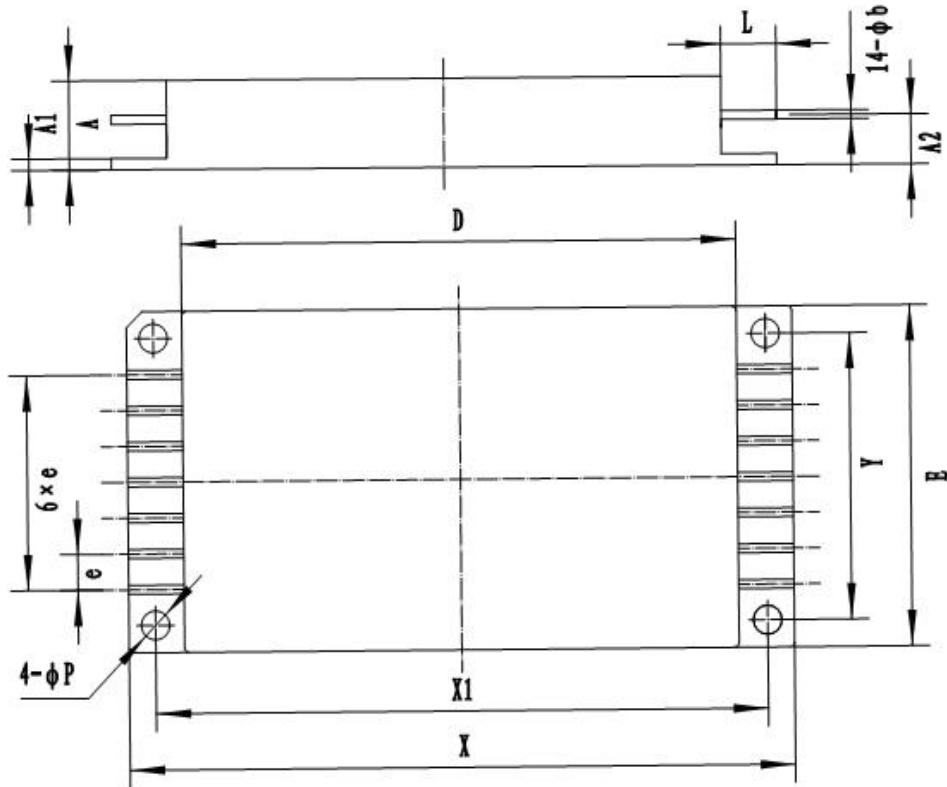


Fig 11 Bottom View

Table 4 Package Outline

Dimension Symbols	Unit/mm		
	Minimum	Nominal	Maximum
<i>A</i>	-	-	10.66
<i>A</i> <sub>1</sub>	0.97	-	1.57
<i>A</i> <sub>2</sub>	5.29	-	5.89
<i>φb</i>	0.87	-	1.13
<i>D</i>	-	-	64.00
<i>E</i>	-	-	38.60
<i>e</i>	-	4.00	-
<i>L</i>	5.35	-	-
<i>φP</i>	3.00	-	3.60
<i>Y</i>	31.50	-	32.50
<i>X</i> <sub>1</sub>	69.60	-	70.60
<i>X</i>	-	-	76.70

Notes: *e* is interchangeable size, made by the shell manufacturing and inspection, this specification does not do the assessment requirements.

Table 5 Case Materials

Case Model	Header	Header Plating	Cover	Cover Plating	Pin	Pin Plating	Sealing Style	Notes
fpp6438-14d	Cold Rolled Steel ( 10# )	Dau-2/Ni4Au1.0	Kovar (4J42)	Ni	Oxygen-free copper		Parallel seam welding	

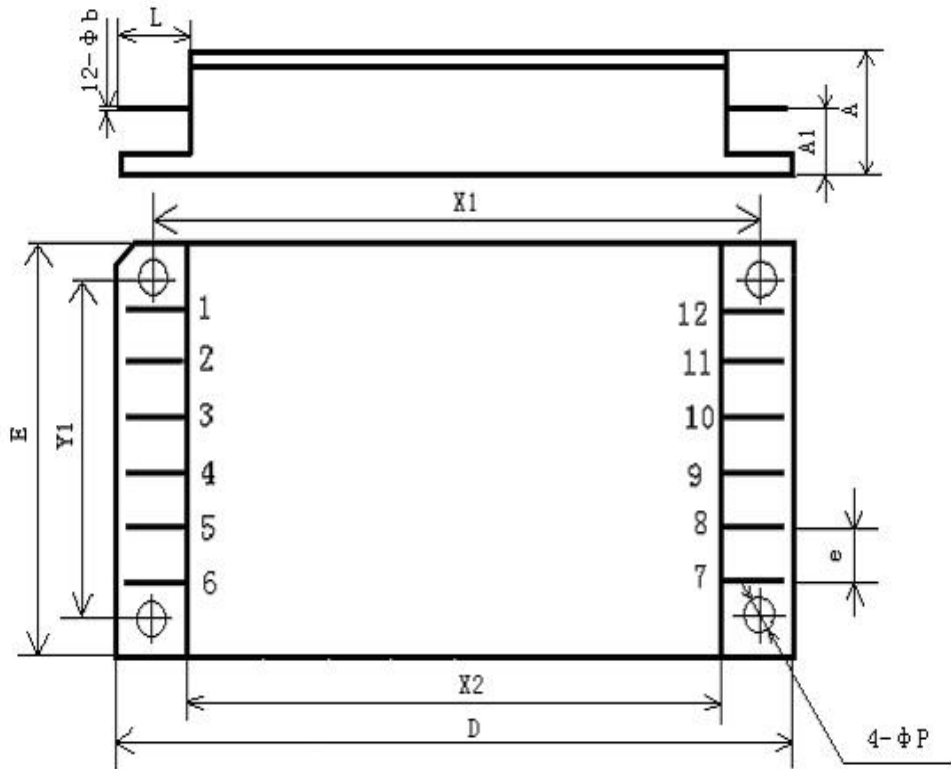


Fig 12 Bottom View

Table 6 Package Outline

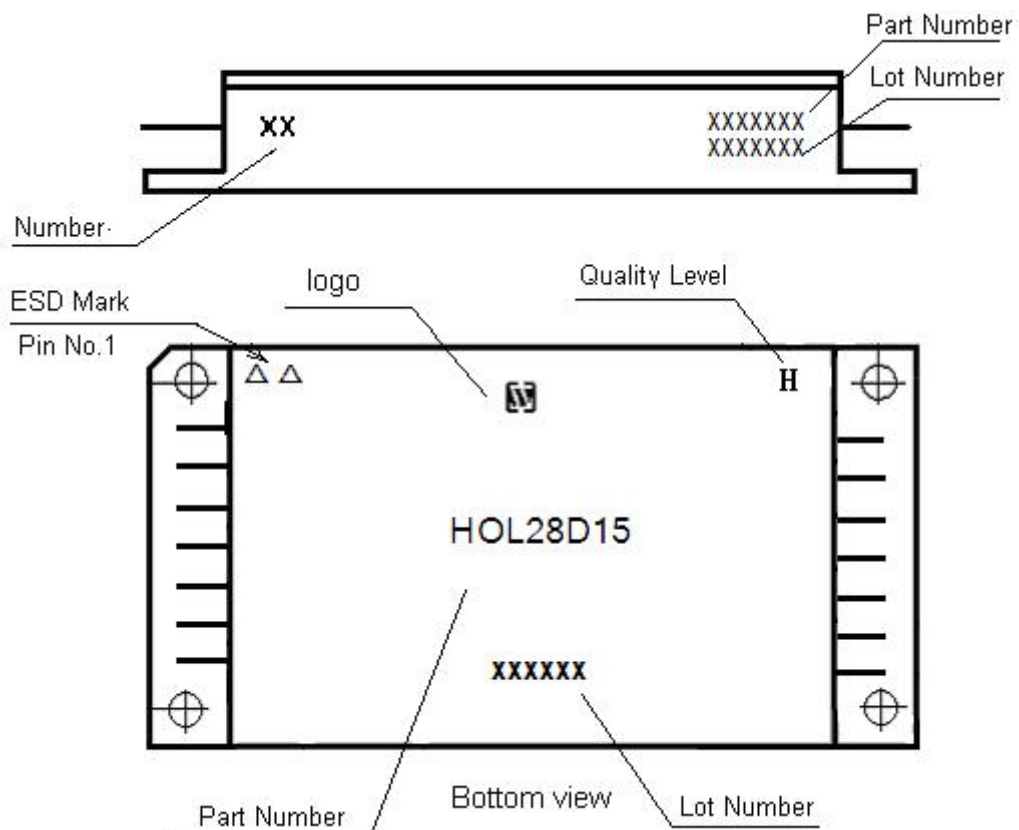
Dimension Symbols	Unit/mm		
	Minimum	Nominal	Maximum
A	-	-	10.66
A <sub>1</sub>	5.29	-	5.89
$\phi b$	0.87	-	1.13
D	-	-	76.70
E	-	-	38.60
e	-	5.08	-
L	5.35	-	-
$\phi P$	3.00	-	3.60
X <sub>1</sub>	69.90	70.1	70.3
X <sub>2</sub>	-	-	64.00
Y <sub>1</sub>	31.80	32	32.20

Notes: e is interchangeable size, made by the shell manufacturing and inspection, this specification does not do the assessment requirements.

Table 7 Package Outline

Case Model	Header	Header Plating	Cover	Cover Plating	Pin	Pin Plating	Sealing Style	Notes
fpp6438-12d	Cold Rolled Steel ( 10# )	Dau-2/Ni4Au1.0	Kovar (4J42)	Ni	Oxygen-free copper		Parallel seam welding	

### 11 Ordering information of military DC-DC Converter HOL28D Series



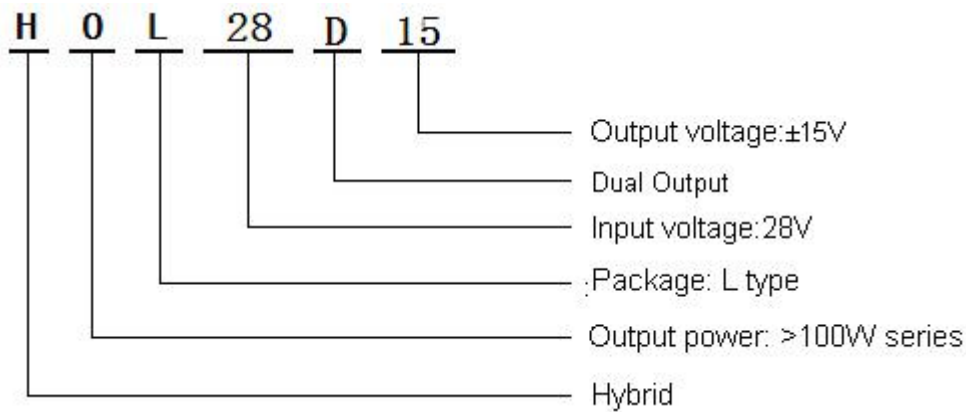


Fig 13 Part Numbering Key

## Application Notes

- ☆ Both positive and negative terminals for power supply shall be correctly connected when power is applied so as to avoid permanent damage to the device.
- ☆ Testing position shall be the root of the pin of the device when the electrical characteristic is measured.
- ☆ The baseplate of the device shall be closely attached to the circuit board during device mounting so as to avoid the damage on pins. The shockproof actions shall be adopted when necessary.
- ☆ Pins shall not be bended to avoid the glass insulator cracking and case leaking.
- ☆ Pins at inhibit terminal shall be hung in the air during no operation.
- ☆ When ordering this device , the detail electrical specification shall be based on relevant standards. While data offered in this document shall be for reference only.



