Mil Grade DC DC converters--HHF28 Series

1 Features of Mil Grade DC DC converters--HHF28 Series

- 16 to 40 VDC input, typical 28V
- 15W output power
- -55℃ to＋125℃ operation
- Fully isolated
- More than100MΩ(500V DC) isolation
- Inhibit function and indefinite short circuit protection
- High Power Density: 28 W/in^3
- Equivalent with Interpoint's MHF Series
- Hermetically sealed metal cases

Size (max)
(non-flanged): (39.96x28.58x8.38 mm^3)
(flanged): (50.8 x 28.70 x 8..38 mm^3)
Weight: 31grams for non-flanged
34grams for flanged

Figure 1 HHF28 Series DC/DC converters

2 Description of Mil Grade DC DC converters--HHF28 Series

The HHF28 Series of DC/DC converters offer up to 15 watts of output power with high reliability. The HHF28 series' small size, light weight, and hermetically sealed metal packages make them ideal for use in aviation aerospace and other high reliability applications.

Table 1 Product models

MODELS	
SINGLE	DUAL
HHF28S3R3(F)	HHF28D5(F)
HHF28S5(F)	HHF28D12(F)
HHF28S5R2(F)	HHF28D15(F)
HHF28S12(F)	HHF28D5N
HHF28S15(F)	HHF28D6N
HHF28S28(F)	HHF28D12N
HHF28S08(F)	HHF28D15N

The HHF 28 series of converters use forward pulse width modulated topology design. The operating principle is that the sampling signal of output voltage, coupled by the opto-coupler, works together with the sampling signal of input loop current to regulate the pulse width of the controller. The double close loop control can create constant voltage output and short circuit protection. The magnetic feedback technology can effectively prevent the magnetic saturation of transformer and also products reliability can be improved.

Thick film hybrid techniques provide the HHF28 Series of converters with reliability levels and optimum miniaturization. The design and manufacturing process of HHF28 Series of converters are in compliance with General Standards of Hybrid Integrated Circuits and detailed standards of

manufacturing. Connected to a HFD-CE03 filter, the HHF Series of converters can achieve better electromagnetic compatibility (EMC) performance.

3 Electrical Performance of Mil Grade DC DC converters--HHF28 Series

ABSOLUTE MAXIMUM RATINGS

- Input Voltage: 16~44
- Power dissipation: 6W
- Lead Soldering Temperature : 300°C (10 sec per lead)
- Storage Temperature Range (Case): -55℃ ~ +125℃
- Inhibit voltage: ≤0.2V
- Outside Sync. Signal:
  Frequency Range: 450~600kHz
  Duty Cycle:40%~60%
  TTL: 0.8≤V≤4.5V

RECOMMENDED OPERATING CONDITIONS

- DC Input voltage range :16~ 40V
- Case Operating Temperature (Tc): –55°C to +125°C

HHF28S5(F) HHF28S12(F) HHF28S15(F)

Table 2 Electrical Characteristics: (T_{CASE} = -55°C to +125°C, V_{IN} = +28V ± 0.5V, Full Load5, Unless Otherwise Specified**)**

Single output models			HHF28S5(F)		HHF28S12(F)		HHF28S15(F)	
Parameter	**Conditions**		**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Output Voltage (V)	Io=full load	Ambient temperature	4.95	5.05	11.88	12.12	14.85	15.15
		high and low temperature	4.85	5.15	11.76	12.24	14.70	15.30
Output Current(A)t	V_{IN} = 16 TO 40 VDC		-	2.4	-	1.25	-	1
Output Power(W)	-		-	12	-	15	-	15
Output Ripple Voltage (mV)	BW=10 kHz to 2 MHz I_o=full load	Ambient temperature	-	80	-	80	-	80
		high and low temperature	-	100	-	120	-	120
Line Regulation(mV)	V_{IN} = 16 TO 40 VDC,I_o=full load		-	50	-	50	-	50
Load Regulation(mV)	I_o=No load to load		-	50	-	50	-	50
Input Ripple Current(mA)	BW=10kHz-2M Hz I_o=full load	Ambient temperature	-	80	-	80	-	80
		high and low temperature	-	100	-	120	-	120
Efficiency (%)	I_o=full load	Ambient temperature	75	-	76	-	78	-
		high and low temperature	72	-	74	-	74	-
Isolation (MΩ)	Input to output or any pin to case (except case ground pin) at 500 VDC, T_A = 25° C		100	-	100	-	100	-
Inhibit Function	T_A = 25° C，Inhibit voltage, output disabled		have		have		have	
Protection Function	T_A = 25° C							
Start-up Overshoot mV pk	V_{in}=0 to 28V, I_o=full load		-	600	-	1200	-	1500
Start-up Delay(ms)	V_{in}=0 to 28V, I_o=full load		-	25	-	25	-	25
Capacitive Load(μF)	T_A = 25° C, No effect on DC performance		-	300	-	100	-	100
Switching Frequency(kHz)	I_o=full load		400	600	400	600	400	600
Step Load Response Transient(mV pK)	50% load -- full load -50% load		-400	400	-500	500	-600	600

Step Load Response Recovery t (μs)	50% load -- full load -50% load	-	300	-	300	-	300
Step Line Response Transient (mV pK)	V_{in}=16~40V, I_o=full load V_{in}=40~16V, I_o=full load	-800	800	-800	800	-800	800
Step Line Response Recovery t (μs)	V_{in}=16~40V, I_o=full load V_{in}=40~16V, I_o=full load	-	1200	-	1200	-	1200
Load Fault Short Circuit recovery (ms)	short circuit to full load	-	30	-	30	-	30

Notes to Specifications:

① The step load transition time should be greater than or equal to 10μs.

② The step line transition time should be greater than or equal to 10μs.

③ Recovery time is measured from application of the transient to point at which V_{OUT} is within 1% of V_{OUT} at final value.

HHF28S3R3(F) , HHF28S5R2(F)

Table 3 Electrical Characteristics: (T_{CASE} = -55°C to +125°C, V_{IN} = +28V ± 0.5V, Full Load5, Unless Otherwise Specified**)**

Single output models			**HHF28S3R3(F)**		**HHF28S5R2(F)**	
Parameter	**Conditions**		**Min**	**Max**	**Min**	**Max**
Output Voltage (V)	Io=full load	Ambient temperature	3.20	3.40	5.15	5.25
		high and low temperature	3.10	3.50	5.04	5.36
Output Current(A)t	-		-	2.4	-	2.4
Output Power(W)	-		-	8	-	12
Output Ripple Voltage (mV)	BW=10 kHz to2 MHz(BW≤20M Hz)I_o=full load	Ambient temperature	-	80	-	50
		high and low temperature	-	240	-	100
Line Regulation (mV)	V_{IN} = 16 TO 40 VDC,(V_{IN} = 10 TO 20 VDC) I_o=full load		-	100	-	50
Load Regulation(mV)	I_o=No load to load		-	50	-	50
Input Ripple Current (mA)	BW=10kHz-2M Hz, I_o=full load	Ambient temperature				
		high and low temperature				
Efficiency (%)	I_o=full load	Ambient temperature	70	-	75	-
		high and low temperature	67	-	72	-
Isolation (MΩ)	Input to output or any pin to case (except case ground pin) at 500 VDC, T_A = 25° C		100	-	100	-
Inhibit Function	T_A = 25° C， Inhibit voltage, output disabled		have		have	
Protection Function	T_A = 25° C					
Start-up Overshoot mV pk	V_{in}=16 to 40V, I_o=full load		-	300	-	600
Start-up Delay (ms)	V_{in}=16 to 40V, I_o=full load		-	25	-	25
Capacitive Load(μF)	T_A = 25° C, No effect on DC performance		-	300	-	300
Switching Frequency(kHz)	I_o=full load		400	600	400	600
Step Load Response Transient(mV pK)	50% load -- full load -50% load		-400	400	-400	400
Step Load Response Recovery t (μs)	50% load -- full load -50% load		-	300	-	300

Step Line Response Transient (mV pK)	V_{in}=16~40V, I_o=full load V_{in}=40~16V, I_o=full load	-800	800	-800	800
Step Line Response Recovery t (μs)	V_{in}=16~40V, I_o=full load V_{in}=40~16V, I_o=full load	-	1200	-	1200
Load Fault Short Circuit recovery (ms)	short circuit to full load	-	30	-	30

Notes to Specifications:

①The step load transition time should be greater than or equal to 10μs.

②The step line transition time should be greater than or equal to 10μs.

③ Recovery time is measured from application of the transient to point at which V_{OUT} is within 1% of V_{OUT} at final value

HHF28S28(F), HHF28S08F

Table4 Electrical Characteristics: (T_{CASE} = -55°C to +125°C, V_{IN} = +28V ± 0.5V, Full Load5, Unless Otherwise Specified**)**

Single output models			**HHF28S28(F)**		**HHF28S08F**	
Parameter	**Conditions**		**Min**	**Max**	**Min**	**Max**
Output Voltage (V)	Io=full load	Ambient temperature	27.72	28.28	7.9	8.1
		high and low temperature			7.8	8.2
Output Current(A)t	-		0	0.54	-	2
Output Power(W)	-		-	15	-	-
Output Ripple Voltage (mV)	BW=10 kHz to2 MHz(BW≤20M Hz)I_o=full load	Ambient temperature	-	120	-	30
		high and low temperature				
Line Regulation (mV)	V_{IN} = 16 TO 40 VDC,(V_{IN} = 10 TO 20 VDC) I_o=full load		-	180	-	0.2(%)
Load Regulation(mV)	I_o=No load to load		-	180	-	0.5(%)
Input Ripple Current (mA)	BW=10kHz-2MHz I_o=full load	Ambient temperature	-	-	-	-
		high and low temperature				
Efficiency (%)	I_o=full load	Ambient temperature	78	-	75	-
		high and low temperature				
Isolation (MΩ)	Input to output or any pin to case (except case ground pin) at 500 VDC, T_A = 25° C		100	-	100	-
Inhibit Function	T_A = 25° C， Inhibit voltage, output disabled		have		have	
Protection Function	T_A = 25° C					
Start-up Overshoot mV pk	V_{in}=16 to 40V, I_o=full load		-	1200	-	1200
Start-up Delay (ms)	V_{in}=16 to 40V, I_o=full load		-	25	-	100
Capacitive Load(μF)	T_A = 25° C, No effect on DC performance		-	470	-	-
Switching Frequency(kHz)	I_o=full load		375	525	-	-
Step Load Response Transient(mV pK)	50% load -- full load -50% load		-	-	-	-
Step Load Response Recovery t (μs)	50% load -- full load -50% load		-	-	-	-
Step Line Response Transient (mV pK)	V_{in}=16~40V, I_o=full load V_{in}=40~16V, I_o=full load		-	-	-	-
Step Line Response Recovery t (μs)	V_{in}=16~40V, I_o=full load V_{in}=40~16V, I_o=full load		-	-	-	-
Load Fault Short Circuit recovery (ms)	short circuit to full load		-	-	-	-

Notes to Specifications:

①The step load transition time should be greater than or equal to 10μs.

②The step line transition time should be greater than or equal to 10μs.

③ Recovery time is measured from application of the transient to point at which V_{OUT} is within 1% of V_{OUT} at final value

HHF28D5(F), HHF28D12(F), HHF28D15(F)

Table 5 Electrical Characteristics: (T_{CASE} = -55°C to +125°C, V_{IN} = 28V ± 0.5V,Full Load5, Unless Otherwise Specified)

Dual output models				**HHF28D5(F)**		**HHF28D12(F)**		**HHF28D15(F)**	
Parameter	**Conditions**			**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Output Voltage (V)	Io_1= Io_2= full load	Ambient temperature		4.95	5.05	11.88	12.12	14.85	15.15
		high and low temperature		4.85	5.15	11.76	12.24	14.70	15.30
		Ambient temperature		-5.08	-4.92	-12.18	-11.82	-15.23	-14.78
		high and low temperature		-5.18	-4.82	-12.30	-11.70	-15.38	-14.63
Output Current(A)t	V_{IN} = 16 TO 40 VDC			-	1.2	-	0.625	-	0.5
Output Power(W)	-			-	12	-	15	-	15
Output Ripple Voltage (mV)	BW=10kHz to 2 MHz(BW≤20M Hz) Io_1= Io_2= full load	Ambient temperature		-	80	-	80	-	80
		high and low temperature		-	120	-	120	-	120
		Ambient temperature		-	80	-	80	-	80
		high and low temperature		-	120	-	120	-	120
Line Regulation(mV)	V_{IN} = 16 TO 40 VDC, Io_1= Io_2= full load		+V_{out}	-	50	-	50	-	50
			-V_{out}	-	80	-	100	-	100
Load Regulation(mV)	Io_1= Io_2=No load to full load		+V_{out}	-	50	-	50	-	50
			-V_{out}	-	100	-	100	-	100
Efficiency (%)	Io_1= Io_2=full load	Ambient temperature		77	-	76	-	76	-
		high and low temperature		75	-	74	-	74	-
Isolation (MΩ)	Input to output or any pin to case (except case ground pin) at 500 VDC, T_A = 25° C			100	-	100	-	100	-
Inhibit Function	T_A = 25° C，Inhibit voltage, output disabled			have		have		have	
Protection Function	T_A = 25° C								
Start-up Overshoot mV pk	V_{in}=0 to 28V, Io_1=Io_2=full load	Ambient temperature		-	100	-	500	-	500
		high and low temperature		-	250	-	750	-	750
		Ambient temperature		-	100	-	500	-	500
		high and low temperature		-	250	-	750	-	750
Start-up Delay(ms)	V_{in}=0 to28V, Io_1=Io_2=full load			-	20	-	25	-	25
Capacitive Load(μF)	T_A = 25° C, No effect on DC performance			-	47	-	10	-	10
Switchingfrequency(kHz)	Io=full load			400	600	400	600	400	600
Step Load Response Transient(mV pK)	50% load to full load or full load to 50% load, Each V_{out} has balanced load	Ambient temperature		-600	600	-600	600	-600	600
		high and low temperature				-700	700	-700	700
		Ambient temperature				-600	600	-600	600
		high and low temperature				-700	700	-700	700
Step Load Response Recovery t (μs)	50% load to full load or full load to 50% load,Each V_{out} has balanced load			-	500	-	500	-	500
Step Line Response Transient (mV pK)	V_{in}=16~40V, Io_1= Io_2=full load			-800	800	-750	750	-750	750
Step Line Response Recovery t (μs)	V_{in}=16~40V, Io_1= Io_2=full load			-	1200	-	1200	-	1200
Load Fault Short Circuit recovery (ms)	Io_1= Io_2 short circuit to full load			-	30	-	50	-	50

Notes to Specifications:

①The step load transition time should be greater than or equal to 10μs.

②The step line transition time should be greater than or equal to 10μs.

③ Recovery time is measured from application of the transient to point at which V_{OUT} is within 1% of V_{OUT} at final value.

HHF28D5N, HHF28D6N, HHF28D15N

Table 6 Electrical Characteristics: (T_{CASE} = -55°C to +125°C, V_{IN} = +28V ± 0.5V, Full Load[5], Unless Otherwise Specified**)**

Dual output models			HHF28D5N		HHF28D6N		HHF28D12N		HHF28D15N	
Parameter	**Conditions**		**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Output Voltage (V)	Io_1 = full load	$+V_{out}$	4.8	5.2	5.8	6.2	11.8	12.2	14.8	15.2
		$-V_{out}$	-5.2	-4.8	-6.2	-5.8	-12.2	-11.8	-15.2	-14.8
Output Current(A)	-		-	2	-	2	-	1	-	0.8
			-	0.2	-	0.2	-	0.2	-	0.2
Output Power(W)	-		-	11	-	13	-	14	-	15
Output Ripple Voltage(mV)	Io= full load		-	40	-	40	-	40	-	40
Line Regulation(mV)	Io= full load		-	20	-	20	-	20	-	20
Load Regulation(mV)	Io=No load to full load		-	50	-	50	-	50	-	50
Efficiency (%)	Io= full load		70	-	70	-	70	-	70	-
Isolation (MΩ)	Input to output or any pin to case (except case ground pin) at 500 VDC, T_A = 25° C		100	-	100	-	100	-	100	-
Inhibit Function	T_A = 25° C, Inhibit voltage (0~0.2V), output disabled		have		have		have		have	
Protection Function	T_A = 25° C									
Start-up Delay(ms)	T_A = 25° C Io_1=Io_2=full load		-	25	-	25	-	25	-	25

4 Typical Performance Curves of Mil Grade DC DC converters--HHF28 Series

(1) Single output model HHF28S15

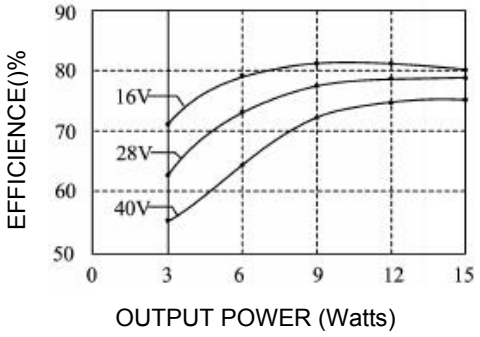

Figure 2 Efficiency (OUTPUT POWER)

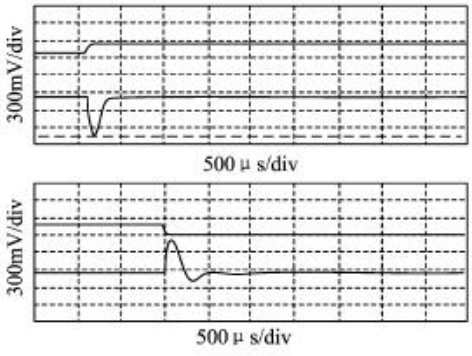

Figure 3 STEP LINE RESPONSE

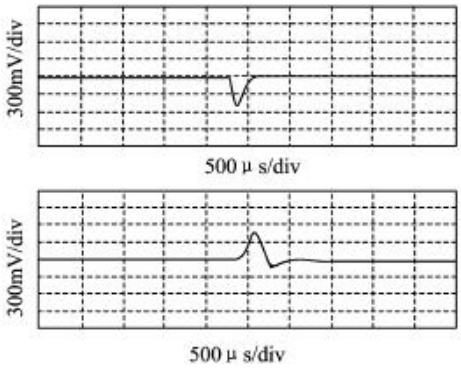

Figure 4 STEP LOAD RESPONSE

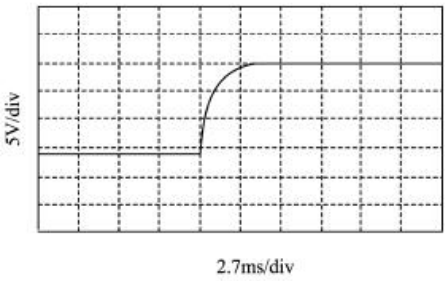

Figure 5 Start-up overshoot/ delay

(2) Dual output model HHF28D5

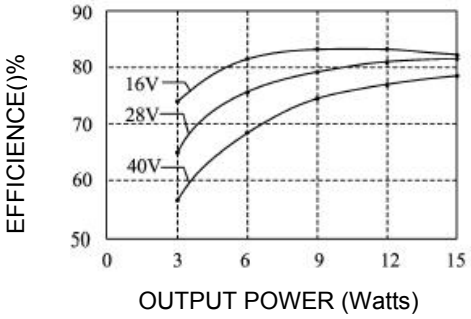

Figure 6 Efficiency (OUTPUT POWER)

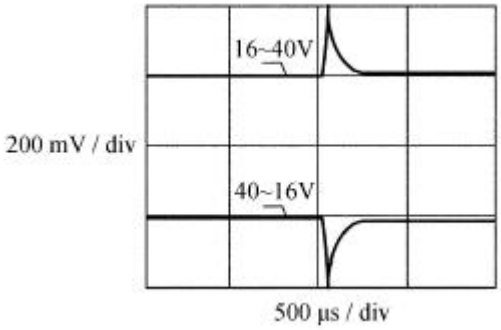

Figure 7 STEP LINE RESPONSE

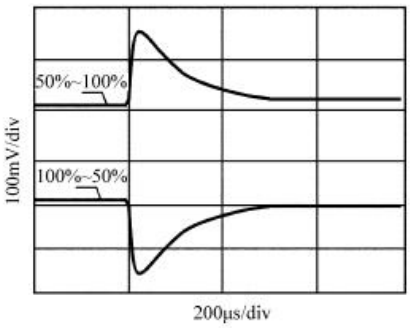

Figure 8 STEP LOAD RESPONSE

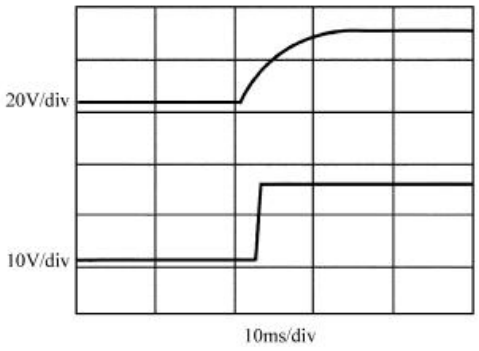

Figure 9 Start-up overshoot/ delay

5 Typical MTBF Curves of Mil Grade DC DC converters--HHF28 Series

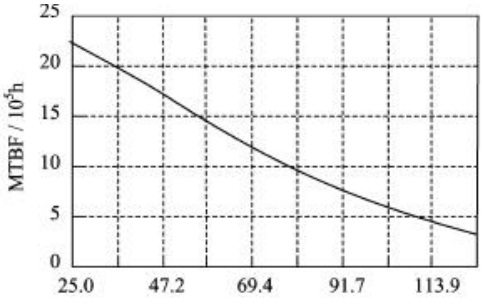

Figure10 Model HHF28S15

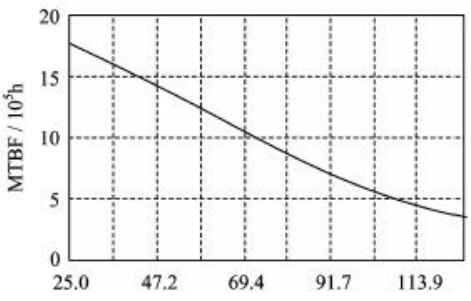

Figure 11 Model HHF28D15

6 Typical Connection Diagram of Mil Grade DC DC converters--HHF28 Series

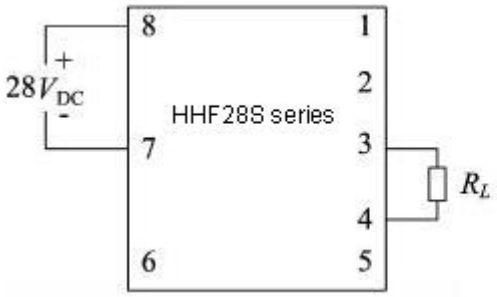

Figure12 Application Connection Diagram for Single output models

Figure13 Application Connection Diagram for Dual output models

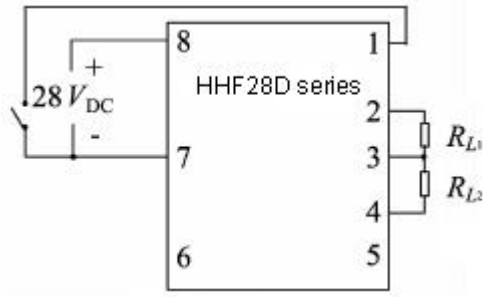

Figure14 Inhibit Drive connection Diagram for Dual Output Models

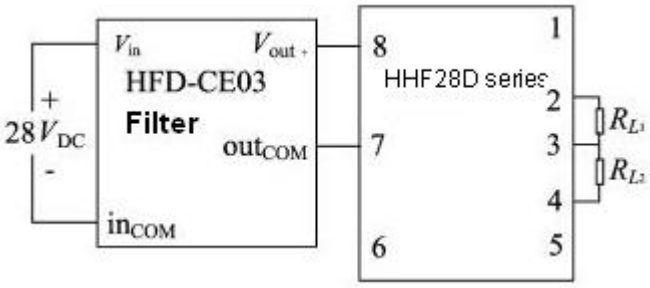

Figure15 Dual Output Converter with EMI Filter Connection Diagram

7 Package Specifications of Mil Grade DC DC converters--HHF28 Series

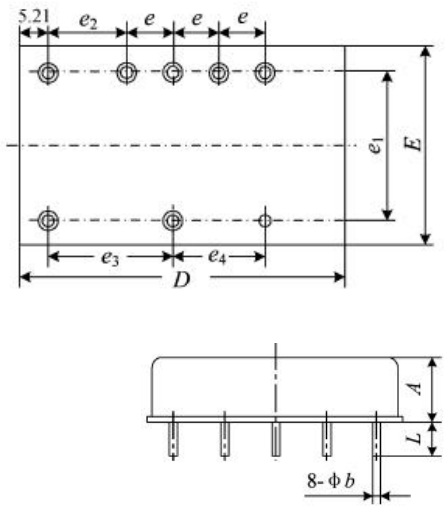

Figure16 Non-flanged outline

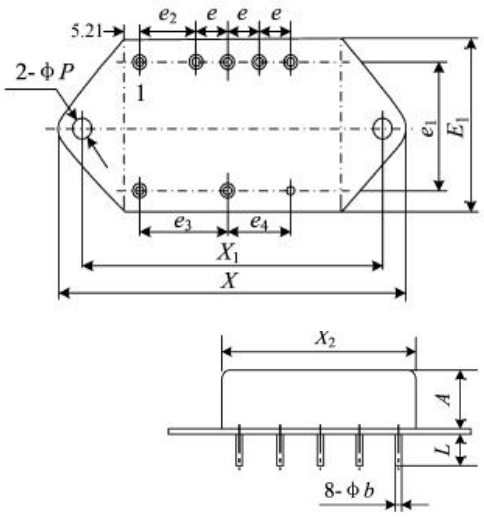

Figure17 Flanged outline

Table 7 Package Outline

Dimension Symbols		Units/mm		
		Min	Typ	Max
A		—	—	8.38
ϕb	A	0.64	—	0.89
	B	0.9	—	1.1
D		36.70	—	36.96
e		—	5.08	—
e_1		—	20.32	—
e_2		—	7.62	—
e_3		—	12.70	—
e_4		—	10.16	—
E		28.32	—	28.58
E_1		—	—	28.70
L		6.09	—	6.60
ϕP		3.17	—	3.43
X		—	—	50.80
X_1		43.82	—	44.07
X_2		—	—	36.83

Notes:

① **Character "A" is 8.6 mm for HHF15S5, HHF28S3R3 and HHF28S2R5.**

② **Character "A" is 10 mm for HHF28S5 and HHF28S2R5-A**

Table 8 Case Materials

Case Model	Header	Header Plating	Cover	Cover Plating	Pin	Pin Plating	Sealing Style	Notes
UPP32727-08f	Cold Rolled Steel （10#）	Nickel	Iron/Nickel Alloy （4J42）	Nickel	Copper Compound	Nickel/Gold	Compression Seal	Nickel plating is for pin6.

Notes:

Solder pins individually with heat application not exceeding 300° C for 10 seconds per pin.

8 Pin Designation of Mil Grade DC DC converters--HHF28 Series

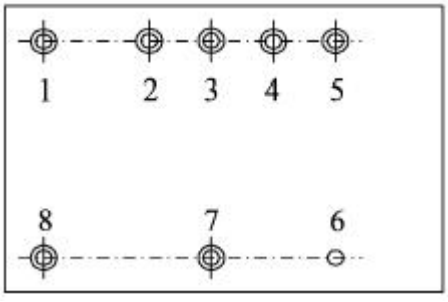

Figure18 Pin Out Bottom View of non-flanged outline

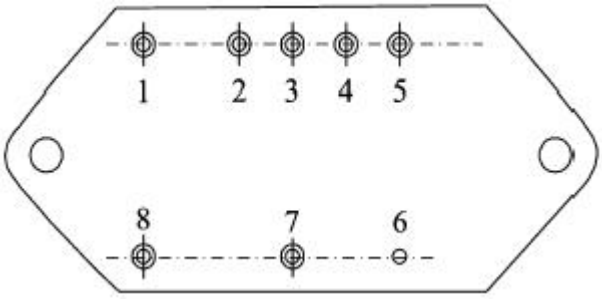

Figure19 Pin Out Bottom View of flanged outline

Pin	Single Output	Dual Output
1	Inhibit	Inhibit
2	No connection ①	Positive Output
3	Output Common ②	Output Common
4	Positive Output ③	Negative Output
5	Sync ④	Sync
6	Case Ground	Case Ground
7	Input Common	Input Common
8	Positive Input	Positive Input

Notes:

① Pin 2 of HHF28S28(F)is for output.

② Pin3 of HHF28S28 (F) can supply 14V output.

③ Pin4 of HHF28S28 (F) is for output common.

④ Pin 5 of HHF28S08 (F) is for no connection.

9 Ordering information of Mil Grade DC DC converters--HHF28 Series

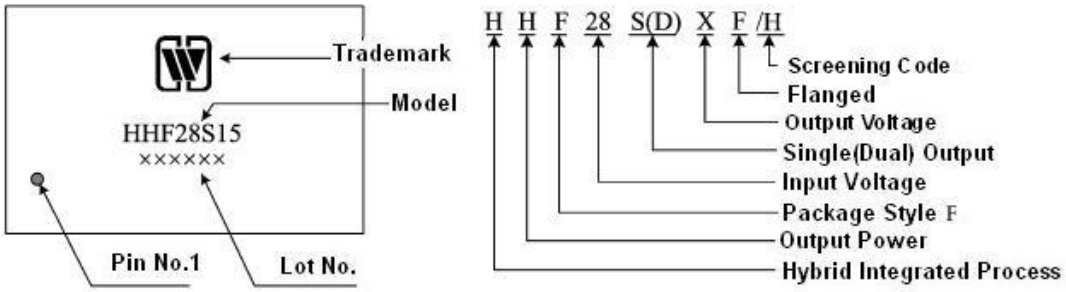

Figure 20 Part Numbering Key

Application Notes:

- The correct power supply is to be ensured that may not cause permanent damage to the device.
- When the electrical performance is tested, the testing position should be pin of the device.
- When the device is mounted, the bottom of the device should be closely attached to the circuit board. So as to avoid the damage of the pins, the shockproof should be increased when it is required
- When the case temperature is at 105℃, it is suggested that thickness of the thermal sinking plate is 5mm, the dimension is greater than 120mm×100mm.
- When the case temperature is at 125℃, it is suggested that thickness of the thermal sinking plate is 5mm, the dimension is greater than 120mm×100mm.
- The pin should not be bending to avoid the glass insulator broken and cause the leakage.

To request a quotation or place orders please contact our sales representative or the ECRIM Sales Department at:

Sales Phone: (086) 0551-3667943 **Sales Fax**: (086) 0551-3638101

E-mail: sales@ecrim.cn