

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°C to +125°C operation
- Fully isolated
- More than 100M Ω (500V DC) isolation
- Inhibit function and indefinite short circuit protection
- High Power Density: 28 W/in³
- Equivalent with Interpoint's MHF Series
- Hermetically sealed metal cases



Size (max)
 (non-flanged): (39.96x28.58x8.38 mm³)
 (flanged): (50.8 x 28.70 x 8.38 mm³)
 Weight: 31grams for non-flanged
 34grams for flanged

Figure 1 HHF28 Series DC/DC converters

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

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.

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°C ~ +125°C
- Inhibit voltage: $\leq 0.2V$
- Outside Sync. Signal:
 - Frequency Range: 450~600kHz
 - Duty Cycle:40%~60%
 - TTL: $0.8 \leq V \leq 4.5V$

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 Load_s, Unless Otherwise Specified)

Single output models			HHF28S5(F)		HHF28S12(F)		HHF28S15(F)	
Parameter	Conditions		Min	Max	Min	Max	Min	Max
Output Voltage (V)	I _o =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		have		have		have	
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 10 μs.
- ② The step line transition time should be greater than or equal to 10 μs.
- 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)	I _o =full load	Ambient temperature		3.20	3.40
		high and low temperature		3.10	3.50
Output Current(A)t	-	-	2.4	-	2.4
Output Power(W)	-	-	8	-	12
Output Ripple Voltage (mV)	BW=10 kHz to2 MHz(BW≤20MHz)I _o =full load	Ambient temperature		-	80
		high and low temperature		-	240
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-2MHz, I _o =full load	Ambient temperature			
		high and low temperature			
Efficiency (%)	I _o =full load	Ambient temperature		70	-
		high and low temperature		67	-
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	have		have	
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)	$V_{in}=16\sim 40V, I_o=full\ load$ $V_{in}=40\sim 16V, I_o=full\ load$	-800	800	-800	800
Step Line Response Recovery t_r (μs)	$V_{in}=16\sim 40V, I_o=full\ load$ $V_{in}=40\sim 16V, I_o=full\ load$	-	1200	-	1200
Load Fault Short Circuit recovery (ms)	short circuit to full load	-	30	-	30

Notes to Specifications:

- ① The step load transition time should be greater than or equal to $10\ \mu s$.
- ② The step line transition time should be greater than or equal to $10\ \mu s$.
- 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: ($T_{CASE} = -55^{\circ}C$ to $+125^{\circ}C$, $V_{IN} = +28V \pm 0.5V$, Full Load₅, Unless Otherwise Specified)

Single output models		HHF28S28(F)		HHF28S08F	
Parameter	Conditions	Min	Max	Min	Max
Output Voltage (V)	$I_o=full\ load$ Ambient temperature	27.72	28.28	7.9	8.1
				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 \leq 20MHz) $I_o=full\ load$	-	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 $I_o=full\ load$	-	-	-	-
				high and low temperature	-
Efficiency (%)	$I_o=full\ load$	78	-	75	-
				high and low temperature	75
Isolation ($M\Omega$)	Input to output or any pin to case (except case ground pin) at 500 VDC, $T_A = 25^{\circ}C$	100	-	100	-
Inhibit Function	$T_A = 25^{\circ}C$, Inhibit voltage, output disabled	have		have	
Protection Function	$T_A = 25^{\circ}C$	have		have	
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)	$T_A = 25^{\circ}C$, 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_r (μs)	50% load -- full load -50% load	-	-	-	-
Step Line Response Transient (mV pK)	$V_{in}=16\sim 40V, I_o=full\ load$ $V_{in}=40\sim 16V, I_o=full\ load$	-	-	-	-
				-	-
Step Line Response Recovery t_r (μs)	$V_{in}=16\sim 40V, I_o=full\ load$ $V_{in}=40\sim 16V, I_o=full\ load$	-	-	-	-
				-	-
Load Fault Short Circuit recovery (ms)	short circuit to full load	-	-	-	-

Notes to Specifications:

- ① The step load transition time should be greater than or equal to 10 μ s.
- ② The step line transition time should be greater than or equal to 10 μ s.
- 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: ($T_{CASE} = -55^{\circ}C$ to $+125^{\circ}C$, $V_{IN} = 28V \pm 0.5V$, Full Load_s, Unless Otherwise Specified)

Dual output models			HHF28D5(F)		HHF28D12(F)		HHF28D15(F)	
Parameter	Conditions		Min	Max	Min	Max	Min	Max
Output Voltage (V)	$I_{O1} = I_{O2} =$ 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 \leq 20M Hz) $I_{O1} = I_{O2} =$ 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, $I_{O1} = I_{O2} =$ full load	+ V_{out}	-	50	-	50	-	50
		- V_{out}	-	80	-	100	-	100
Load Regulation(mV)	$I_{O1} = I_{O2} =$ No load to full load	+ V_{out}	-	50	-	50	-	50
		- V_{out}	-	100	-	100	-	100
Efficiency (%)	$I_{O1} = I_{O2} =$ full load	Ambient temperature	77	-	76	-	76	-
		high and low temperature	75	-	74	-	74	-
Isolation (M Ω)	Input to output or any pin to case (except case ground pin) at 500 VDC, $T_A = 25^{\circ}C$		100	-	100	-	100	-
Inhibit Function	$T_A = 25^{\circ}C$, Inhibit voltage, output disabled		have		have		have	
Protection Function	$T_A = 25^{\circ}C$		have		have		have	
Start-up Overshoot mV pk	$V_{in} = 0$ to 28V, $I_{O1} = I_{O2} =$ 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)	$V_{in} = 0$ to 28V, $I_{O1} = I_{O2} =$ full load		-	20	-	25	-	25
Capacitive Load(μ F)	$T_A = 25^{\circ}C$, No effect on DC performance		-	47	-	10	-	10
Switching frequency(kHz)	$I_0 =$ 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 (μ s)	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, $I_{O1} = I_{O2} =$ full load		-800	800	-750	750	-750	750
Step Line Response Recovery t (μ s)	$V_{in} = 16$ ~40V, $I_{O1} = I_{O2} =$ full load		-	1200	-	1200	-	1200
Load Fault Short Circuit recovery (ms)	$I_{O1} = I_{O2}$ short circuit to full load		-	30	-	50	-	50

Notes to Specifications:

- ① The step load transition time should be greater than or equal to 10 μ s.
- ② The step line transition time should be greater than or equal to 10 μ s.
- 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: ($T_{CASE} = -55^{\circ}C$ to $+125^{\circ}C$, $V_{IN} = +28V \pm 0.5V$, Full Load_s, Unless Otherwise Specified)

Dual output models			HHF28D5N		HHF28D6N		HHF28D12N		HHF28D15N	
Parameter	Conditions		Min	Max	Min	Max	Min	Max	Min	Max
Output Voltage (V)	$I_{O1} = \text{full load}$	+ 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)	$I_{O} = \text{full load}$		-	40	-	40	-	40	-	40
Line Regulation(mV)	$I_{O} = \text{full load}$		-	20	-	20	-	20	-	20
Load Regulation(mV)	$I_{O} = \text{No load to full load}$		-	50	-	50	-	50	-	50
Efficiency (%)	$I_{O} = \text{full load}$		70	-	70	-	70	-	70	-
Isolation ($M\Omega$)	Input to output or any pin to case (except case ground pin) at 500 VDC, $T_A = 25^{\circ}C$		100	-	100	-	100	-	100	-
Inhibit Function	$T_A = 25^{\circ}C$, Inhibit voltage (0~0.2V), output disabled		have		have		have		have	
Protection Function	$T_A = 25^{\circ}C$									
Start-up Delay(ms)	$T_A = 25^{\circ}C$ $I_{O1} = I_{O2} = \text{full load}$		-	25	-	25	-	25	-	25

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

Series

(1) Single output model HHF28S15

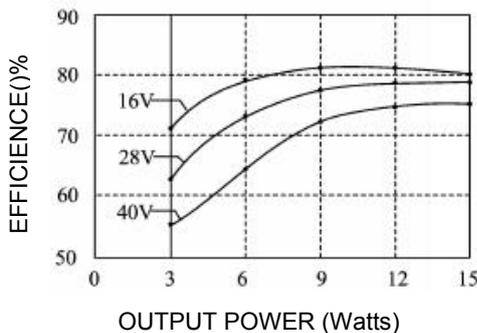


Figure 2 Efficiency (OUTPUT POWER)

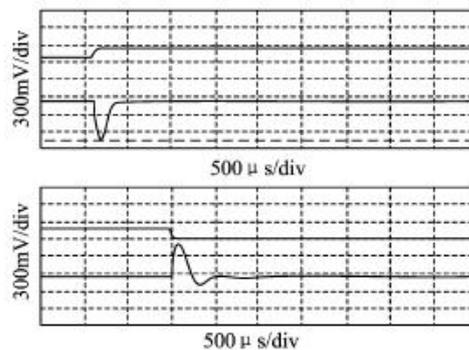


Figure 3 STEP LINE RESPONSE

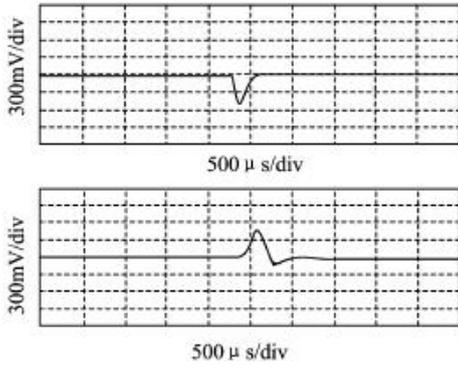


Figure 4 STEP LOAD RESPONSE

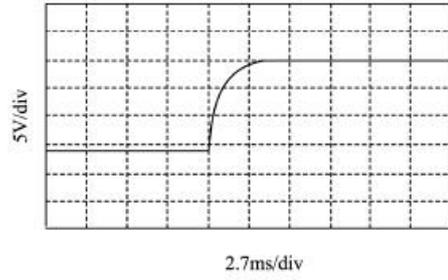


Figure 5 Start-up overshoot/ delay

(2) Dual output model HHF28D5

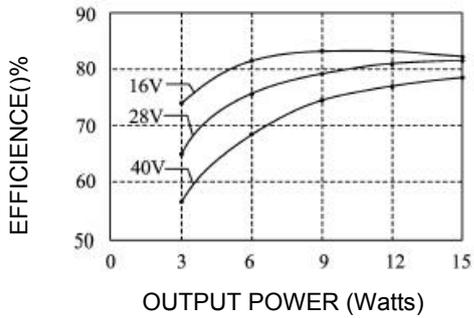


Figure 6 Efficiency (OUTPUT POWER)

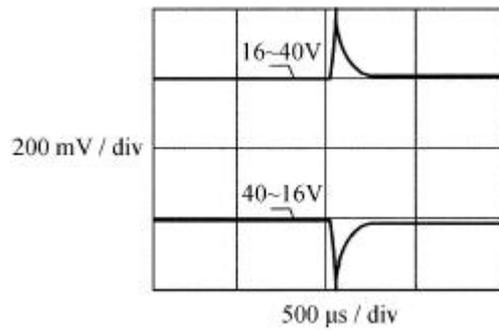


Figure 7 STEP LINE RESPONSE

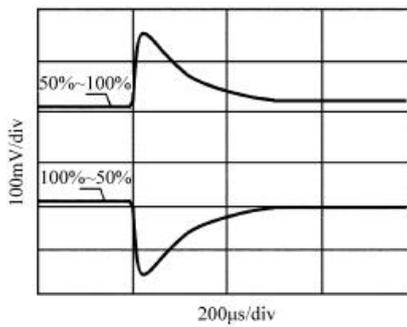


Figure 8 STEP LOAD RESPONSE

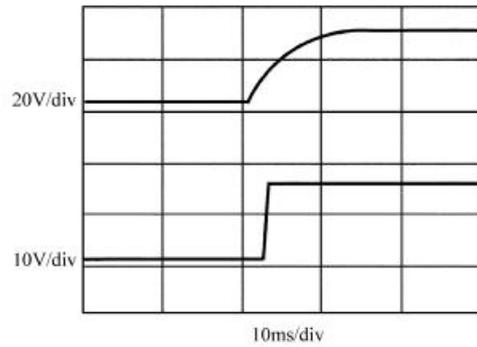


Figure 9 Start-up overshoot/ delay

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

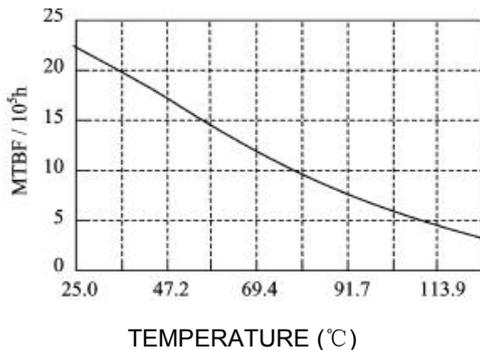


Figure10 Model HHF28S15

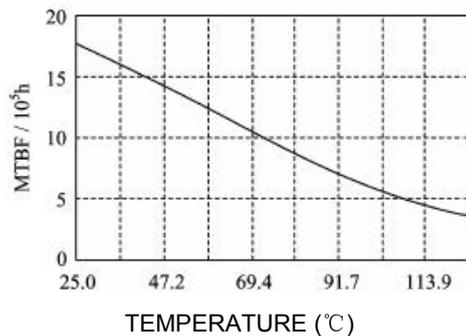


Figure 11 Model HHF28D15

6 Typical Connection Diagram of Mil Grade DC DC

converters--HHF28 Series

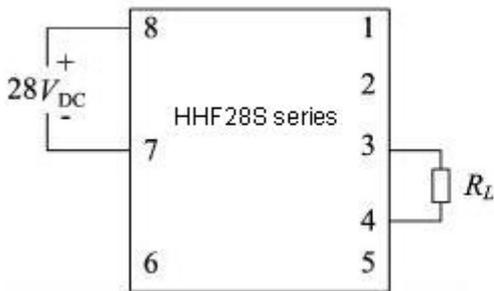


Figure12 Application Connection Diagram for Single output models

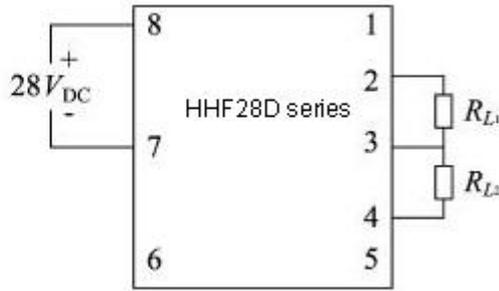


Figure13 Application Connection Diagram for Dual output models



Figure14 Inhibit Drive connection Diagram for Dual Output Models

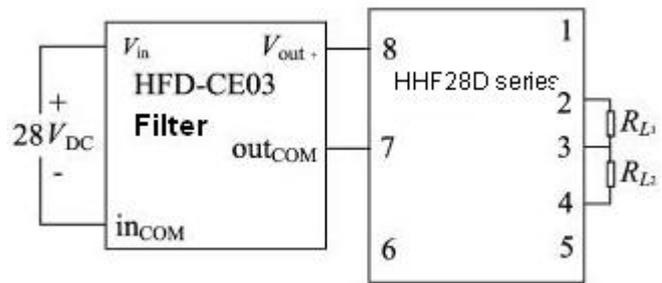


Figure15 Dual Output Converter with EMI Filter Connection Diagram

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

Series

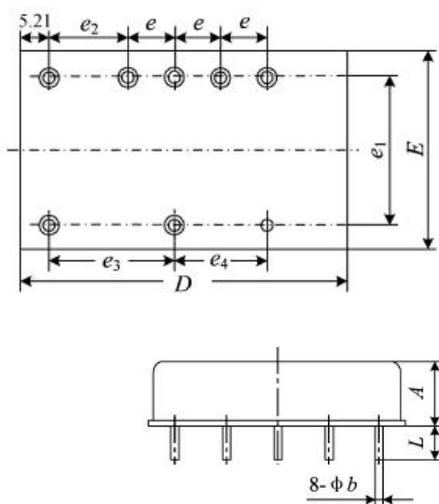


Figure16 Non-flanged outline

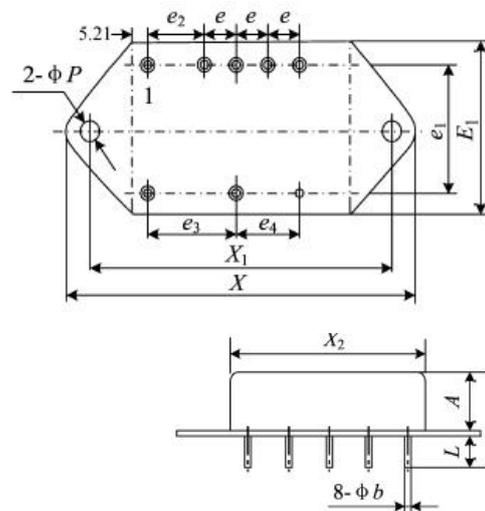


Figure17 Flanged outline

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

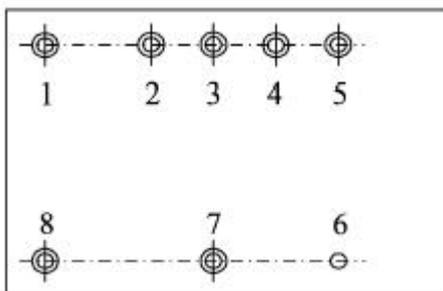


Figure18 Pin Out Bottom View of non-flanged outline

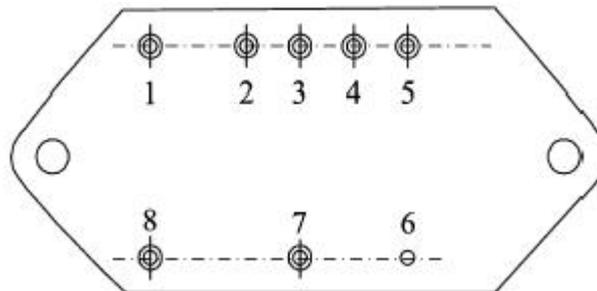


Figure19 Pin Out Bottom View of flanged outline

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 Pin 3 of HHF28S28 (F) can supply 14V output.
- ③ Pin 4 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

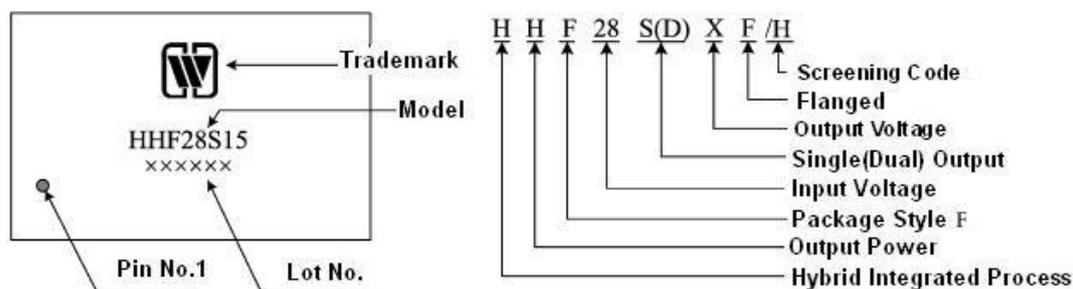


Figure 20 Part Numbering Key

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 °C , 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 °C , 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