

## FEATURES

- **-40°C to +85°C operation**
- **16 to 32 VDC input voltage**
- Fully isolated
- Opto-coupler feedback
- Switching frequency
  - Single and dual outputs  
typical 80 kHz, variable freq.
  - Triple output 200 kHz, fixed
- Topology – Flyback
- Inhibit function
- Indefinite short circuit protection
- Up to 75% efficiency
- **Requires external capacitors**

# DC/DC CONVERTERS 28 VOLT INPUT



## HR40 SERIES 4 WATT

MODELS		
VDC OUTPUT		
SINGLE	DUAL	TRIPLE
5	±12 ±15	+5 & ±12 +5 & ±15

Size (max.): 1.075 x 1.075 x 0.370 inches (27.31 x 27.31 x 9.40 mm)

See Section B8, case C2, for dimensions.

Weight: 20 grams maximum

Screening: Standard only. See Section C2 for screening description.

## DESCRIPTION

The HR40 Series™ DC/DC converters offer the high efficiencies associated with switching regulators, yet have full isolation of input and output grounds. The units are built using thick-film hybrid technology and are sealed in metal packages for high-reliability applications. All models are guaranteed to pass a gross leak test (maximum leak rate of  $1 \times 10^{-3}$  atm-cc/sec).

The HR40 Series devices are flyback energy storage switching regulators which require a minimum of components resulting in small package size. Single and dual models self-oscillate at an operating frequency which is an approximate inverse function of the load. At full load, the frequency is typically 80 kHz for single and dual output models. Triple output models operate at a fixed frequency of approximately 200 kHz. A transformer in the forward power circuit and an opto-coupler in the feedback/control loop maintain input to output isolation.

Models are available with single 5 volt, dual 12 or 15 volt, or triple (+5 and either ±12 or ±15) outputs with an input voltage range of 16 to 32 VDC. Output power of up to 4 watts is available from the dual output models for either balanced or unbalanced loads; however, at least 25% of the total load should be on the positive output. The single output device can provide 3.5 watts, and the triple output can supply up to 3.2 watts. The high efficiency is almost constant over the entire input voltage range and from approximately 25% of full load to full load. This makes the unit ideal for battery applications.

An open collector TTL inhibit is provided to allow power shutdown and startup from a logic input. An open circuit on the inhibit terminal (pin 15) gives normal operation, and a TTL low level shuts down the converter. The inhibit pin has an open circuit voltage of 12 to 28 V. Input current in the shutdown mode will be less than 15 mA. Current limiting is provided on each output for indefinite short circuit protection.

Due to the high efficiency, heat sinking requirements are minimized, but consideration should be given to removing self-generated heat when operating these devices at maximum ratings. To increase dissipation, heat conducting material (PCB, copper sheet, heat sink, etc.) should be brought into contact with the converter's baseplate. The converter can be operated at full load at a case temperature of 85°C, with the output power derated linearly to zero at 105°C.

### WARNING: EXTERNAL CAPACITORS REQUIRED

External capacitors are required on the outputs. **Operating the unit without external capacitors will result in damage to the internal circuitry.** Minimum recommended capacitor values are given in Tables 1 and 2. For optimum performance, low ESR (Equivalent Series Resistance) solid tantalum capacitors are required. The specifications on the following pages are based on the use of high-quality solid tantalums. Operation with different types of capacitors will seriously affect performance.

# HR40 SERIES 4 WATT

# DC/DC CONVERTERS

**ABSOLUTE MAXIMUM RATINGS**

**Input Voltage**

- 16 to 32 VDC

**Output Power**

- 3.2 to 4 watts depending on model

**Lead Soldering Temperature (10 sec)**

- 300°C

**Storage Temperature Range (Case)**

- -40°C to +125°C

**INHIBIT**

**Inhibit TTL Open Collector**

- Logic low (output disabled)  $\leq 0.8$  V
- Referenced to input common
- Logic high (output enabled)  $\geq 12$  V

**RECOMMENDED OPERATING CONDITIONS**

**Input Voltage Range**

- 16 to 32 VDC continuous
- 40 V for 50 ms transient

**Case Operating Temperature (Tc)**

- -40°C to +85°C full power
- -40°C to +105°C absolute

**Derating Output Power/Current**

- Linearly from 100% at 85°C to 0% at 105°C

**TYPICAL CHARACTERISTICS**

**Output Voltage Temperature Coefficient**

- HR41-2805 100 ppm/°C typ, 200 max.
- HR42-28XX 50 ppm/°C typ.
- HR43-28XX 100 ppm/°C typ.

**Input to Output Capacitance**

- 60 pF typical

**Isolation**

- 100 megohm minimum at 500 V

**Conversion Frequency**

- Single and dual output models, 80 kHz at full load typical, variable frequency
- Triple output models, 200 kHz typical fixed frequency

**Inhibit Pin Voltage (unit enabled)**

- 12 to 28 V

**WARNING: EXTERNAL CAPACITORS REQUIRED**

**Electrical Characteristics: 25°C Tc, 28 VDC Vin, 100% load, unless otherwise specified.**

SINGLE AND DUAL OUTPUT MODELS		HR41-2805			HR42-2812			HR42-2815			UNITS
PARAMETER <sup>1</sup>	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	P <sub>OUT</sub> = 2 W	4.90	5.0	5.10	±11.88	±12	±12.12	±14.85	±15	±15.15	VDC
OUTPUT CURRENT	18 TO 32 V <sub>IN</sub>	—	—	700	—	—	±167	—	—	±133	mA
OUTPUT POWER <sup>2</sup>	Tc = -40°C TO +85°C	—	—	3.5	—	—	4.0	—	—	4.0	W
OUTPUT RIPPLE	BW = 1 MHz	—	75	150	—	75	150	—	75	150	mV p-p
LINE REGULATION	18 - 32 V <sub>IN</sub> , P <sub>OUT</sub> = 2 W	—	5	10	—	10	20	—	10	20	mV
LOAD REGULATION	NO LOAD TO FULL	—	25	50	—	12	24	—	12	24	mV
INPUT VOLTAGE	Tc = -40°C TO +85°C	16	28	32	16	28	32	16	28	32	VDC
	TRANSIENT 50 ms	—	—	40	—	—	40	—	—	40	V
INPUT CURRENT	NO LOAD	—	7	10	—	10	15	—	10	15	mA
	FULL LOAD	—	—	192	—	—	213	—	—	213	
	INHIBITED	—	—	15	—	—	15	—	—	15	
EFFICIENCY	FULL LOAD	68	72	—	70	75	—	70	75	—	%

**Notes**

- External capacitors required to prevent damage to internal circuitry (see Table 1 for specifications).
- Dual output models deliver up to 4 watts total for balanced or unbalanced loads, however, the positive output should carry at least 25% of the total load.

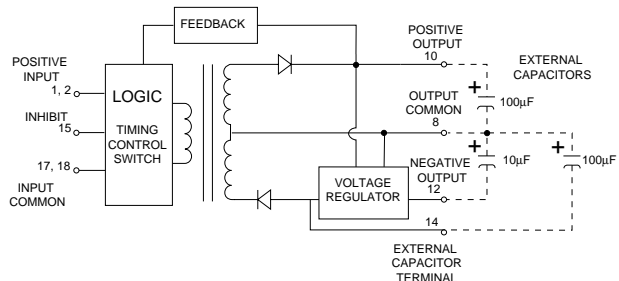
**SINGLE AND DUAL OUTPUT EXTERNAL CAPACITORS**  
OPERATION WITHOUT EXTERNAL CAPACITORS WILL RESULT IN DAMAGE TO THE INTERNAL CIRCUITRY.

**TABLE 1: EXTERNAL CAPACITOR REQUIREMENTS**

Model	Required Connection	Minimum Capacitor Value <sup>1</sup>
Single Output HR41-2805	Positive Output (12 & 13) to Output Common (8 & 9)	220 µF, 10 V
Dual Outputs <sup>2</sup> HR42-2812 and HR42-2815	Positive Output (10) to Output Common (8)	100 µF, 25 V
	External Capacitor (14) to Output Common (8) <sup>3</sup>	100 µF, 25 V
	Negative Output (12) to Output Common (8)	10 µF, 25 V

**Table 1 Notes**

- Capacitors should be high quality, low ESR components — solid tantalum is recommended.
- See Figure 1 for connection diagram
- Place positive side of capacitor toward pin 8.



**FIGURE 1: DUAL OUTPUT EXTERNAL CAPACITOR CONNECTIONS**

# DC/DC CONVERTERS

# HR40 SERIES 4 WATT

**WARNING: EXTERNAL CAPACITORS REQUIRED**

**Electrical Characteristics: 25°C Tc, 28 VDC Vin, 100% load, unless otherwise specified.**

TRIPLE OUTPUT MODELS			HR43-2812			HR43-2815			UNITS
PARAMETER <sup>1</sup>	CONDITIONS		MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	P <sub>OUT</sub> = 2 W BALANCED LOAD	MAIN	4.9	5.0	5.1	4.9	5.0	5.1	VDC
		AUX	±11.5	±12.0	±12.5	±14.5	±15.0	±15.5	
OUTPUT CURRENT <sup>2</sup>	18 TO 32 V <sub>IN</sub>	MAIN	10.0	—	400	10.0	—	400	mA
		AUX	—	—	±50.0	—	—	±40.0	
OUTPUT POWER	Tc = -40°C TO +85°C		—	—	3.2	—	—	3.2	W
OUTPUT RIPPLE	BW DC TO 1 MHz	MAIN	—	50	100	—	50	100	mV p-p
		±AUX	—	50	100	—	50	100	
LINE REGULATION	P <sub>OUT</sub> = 2 W 18 TO 32 V <sub>IN</sub>	MAIN	—	5	10	—	5	10	mV
		±AUX	—	3	6	—	3	7.5	
LOAD REGULATION	NO LOAD TO FULL	MAIN	—	15	30	—	15	30	mV
		±AUX	—	15	30	—	12	24	
INPUT VOLTAGE	Tc = -40°C TO +85°C		16	28	32	16	28	32	VDC
	TRANSIENT 50 ms		—	—	40	—	—	40	V
INPUT CURRENT	NO LOAD		—	10	20	—	10	20	mA
	FULL LOAD		—	—	176	—	—	176	
	INHIBITED		—	—	15	—	—	15	
EFFICIENCY	FULL LOAD		68	70	—	68	70	—	%

**Notes**

- External capacitors required to prevent damage to internal circuitry
- Minimum load required on main output for full power auxiliary operation. (see Table 2 for specifications).

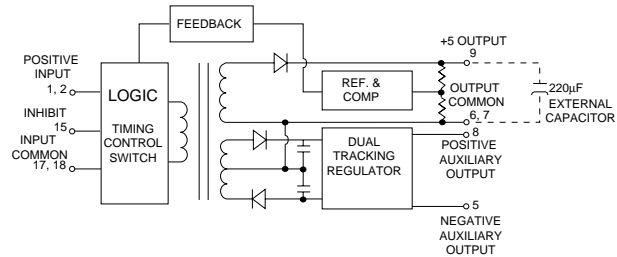
**TRIPLE OUTPUT EXTERNAL CAPACITOR  
OPERATION WITHOUT EXTERNAL CAPACITORS WILL RESULT IN DAMAGE TO THE INTERNAL CIRCUITRY.**

**TABLE 2: EXTERNAL CAPACITOR REQUIREMENTS**

Model	Required Connection <sup>1</sup>	Minimum Capacitor Value <sup>2</sup>
HR43-2812 and HR43-2815	Positive 5 VDC Output (9) to Output Common (6 or 7)	220 µF, 10 V

**Table 2 Notes**

- See Figure 2 for connection diagram.
- Capacitors should be high quality, low ESR components — solid tantalum is recommended.



**FIGURE 2:  
TRIPLE OUTPUT EXTERNAL CAPACITOR CONNECTIONS**

# HR40 SERIES 4 WATT

# DC/DC CONVERTERS

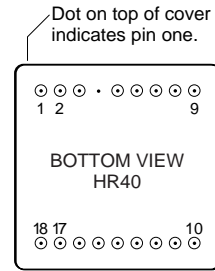
**WARNING: EXTERNAL CAPACITORS REQUIRED**  
OPERATION WITHOUT EXTERNAL CAPACITORS WILL RESULT IN DAMAGE TO THE INTERNAL CIRCUITRY.

PIN OUT			
Pin	Single Output	Dual Output	Triple Output
1, 2 <sup>1</sup>	Positive Input	Positive Input	Positive Input
3	No connection	No connection	No connection
4	Case	Case	Case
5	No connection	No connection	Negative Aux. Output
6	No connection	No Connection	Output Common Main <sup>2</sup>
7	No connection	No connection	Output Common Aux. <sup>2</sup>
8	Output Common <sup>3</sup>	Output Common	Positive Aux. Output
9	Output Common <sup>3</sup>	No connection	+5 VDC Output
10	No connection	Positive Output	No connection
11	No connection	No connection	No connection
12	Positive Output <sup>3</sup>	Negative Output	No connection
13	Positive Output <sup>3</sup>	No connection	No connection
14	No connection	Ext. Capacitor	No connection
15	Inhibit	Inhibit	Inhibit
16	No connection	No connection	No connection
17, 18 <sup>1</sup>	Input Common	Input Common	Input Common

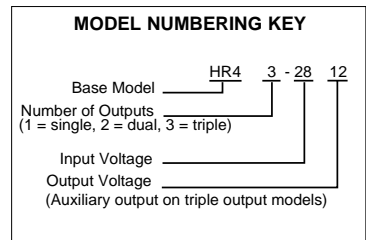
Pin Out Notes

- Make external connection to both pins on all models.  
Pins 1 and 2 positive input  
Pins 17 and 18 input common
- Pins 6 and 7 on triple output models are connected internally.
- On the HR41-2805:  
Make external connections to both output common pins (8 and 9).  
Make external connections to both positive output pins (12 and 13).



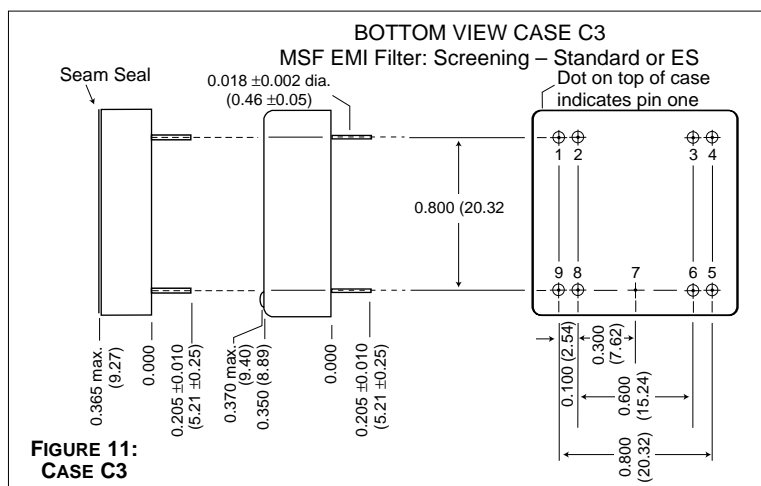
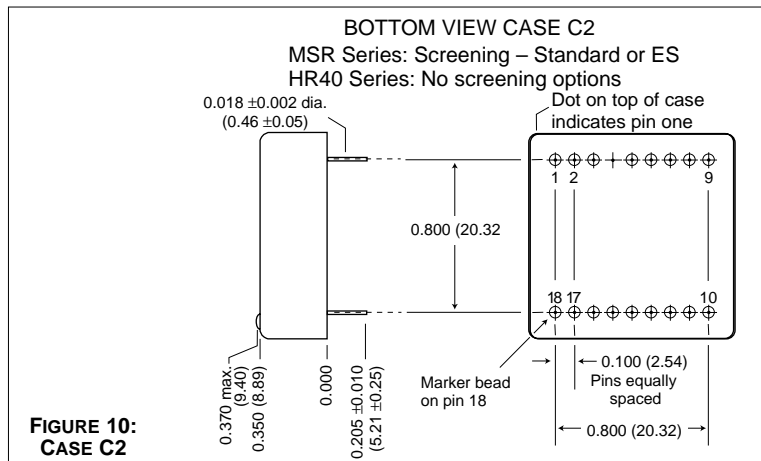
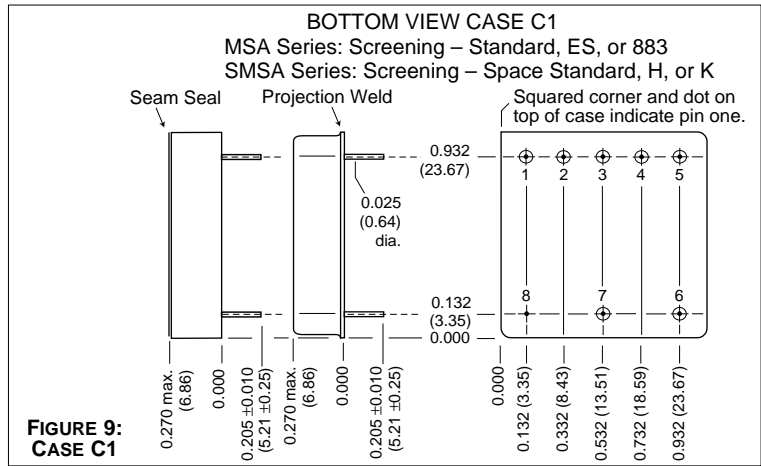
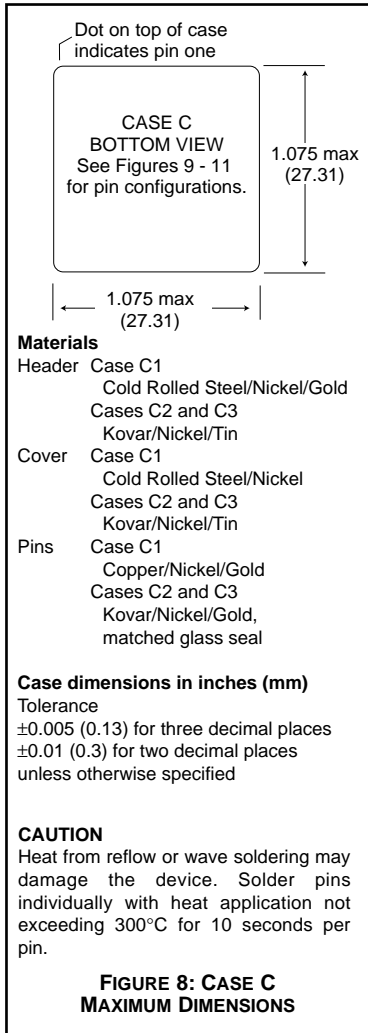
See Section B8. case C2, for dimensions

**FIGURE 3: PIN OUT**



# CASE C

# CASES



Note: Although every effort has been made to render the case drawings at actual size, variations in the printing process may cause some distortion. Please refer to the numerical dimensions for accuracy.

## **HR PRODUCTS**

<b>TEST (HR products)</b>	<b>STANDARD</b>
PRE-CAP INSPECTION Method 2017	yes
FINAL ELECTRICAL TEST MIL-PRF-38534, Group A Subgroups 1 and 4: +25°C case	yes
HERMETICITY TESTING Gross Leak, Dip ( $1 \times 10^{-3}$ )	yes
FINAL VISUAL INSPECTION Method 2009	yes

Test methods are referenced to MIL-STD-883 as determined by MIL-PRF-38534.

Applies to the following products:

HR700 Series  
HR300 Series  
HR150 Series  
HR120 Series  
HR40 Series