# MSK

## M.S. KENNEDY CORP.

**6W DUAL DC-DC CONVERTERS**

# DAC2800D SERIES

4707 Dey Road  Liverpool, N.Y. 13088

(315) 701-6751

HI-REL  DESIGN
- WAVE  SOLDERABLE  PACKAGE
- ALL  CERAMIC  CAPACITORS
- SURFACE  MOUNT  MAGNETICS

FEATURES — DUAL  OUTPUT
- REPLACES  APEX  DHC2812D & DHC2815D
- BOTH  OUTPUTS  FULLY  REGULATED
- NO  DERATING — –55°C  TO  +125°C
- HIGH  ISOLATION — 500V
- TRACKING  OUPUT  V  ADJUSTMENT — STANDARD
- REMOTE  SHUTDOWN
- 11 TO 50V  INPUT  WITH  5  WATT  OUTPUT
- AVAILABLE  WITH  ±12V OR  ±15V  OUTPUTS

## DESCRIPTION

The DAC2800D series of DC-DC converters provides the ruggedness reliability and features required to meet the advanced design challenges of today's hi-rel market. This has been accomplished while retaining a power density of 15 W/in$^3$ and 375 mW/gram of power/package performance. The use of advanced substrate and reflow soldering techniques during construction results in a rugged, cost-effective, and completely solderable package.

The DAC2800D hybrid converter series utilizes all ceramic capacitors, surface mount magnetics, and ultrasonically bonded wires to provide reliable operation at all operating temperatures while surviving G forces of up to 500 G.

The DAC2800D series has two fully regulated tracking outputs. Standard features include output fault monitoring and/or turn on voltage point programming via the shutdown pin. All three functions may be implemented simultaneously with a minimum of external components. An output voltage adjustment / load compensation pin which adjusts both outputs simultaneously is also standard.

Fault tolerant design protects these converters from most external circuit faults. The +output and output adjust pins will withstand +25 V while the shutdown pin will withstand +50 V, protecting the converters from a variety of system or board faults e.g. solder bridges etc. Unique load fault protection circuitry allows this converter to pull up loads having difficult static load line characteristics and allows short term load excursions significantly beyond ratings in most applications.

A transformer isolated flyback converter topology operating at a switching frequency of 400 kHz allows operation over a wide input voltage range. Internal filtering of outputs eliminates the need for external capacitors in many applications.
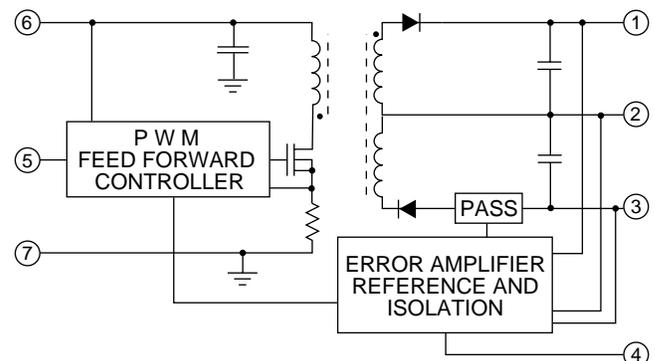
The 8-pin DIP package is hermetically sealed and isolated from the internal circuits. Heat sinking is recommended for full power operation at elevated ambient temperatures.
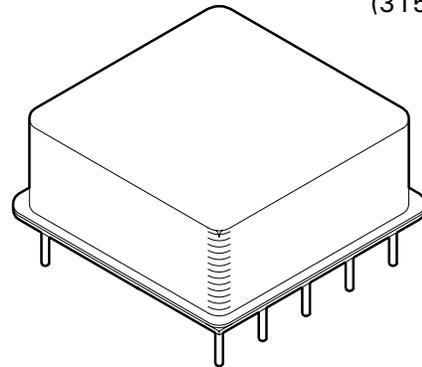
## TYPICAL APPLICATION
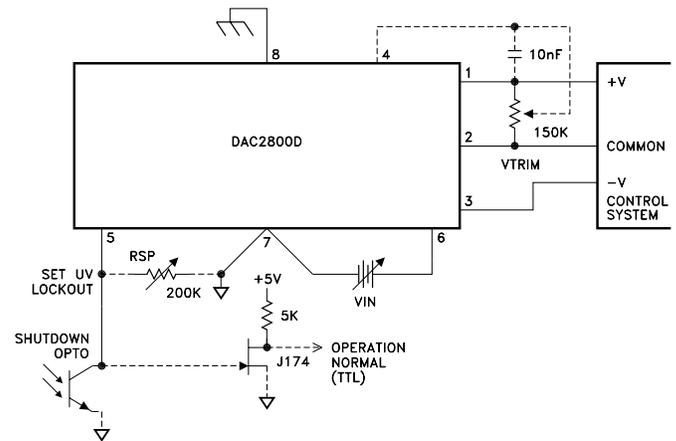


## BLOCK DIAGRAM



## EXTERNAL CONNECTIONS

| | | | |
|---|---|---|---|
| 1 | +OUTPUT | 8 | CASE |
| 2 | OUTPUT COMMON | | |
| 3 | -OUTPUT | 7 | -INPUT |
| 4 | ADJUST/COMP | | |
| 5 | SHUTDOWN PLUS | 6 | +INPUT |

Rev. A  3/01

# DAC2812D • DAC2815D

## ABSOLUTE MAXIMUM RATINGS

| | DAC2812D | DAC2815D |
|---|---|---|
| INPUT VOLTAGE RANGE (Pin 7 to 6 or 5) | 50Vdc | 50Vdc |
| INPUT TRANSIENT (Pin 7 to 6) | 80V @ 50ms | 80V @ 50ms |
| OUTPUT CURRENT (Continuous) | 360mA[4] | 288mA[4] |
| TEMPERATURE, Storage | −65°C, 150°C | −65°C, 150°C |
| TEMPERATURE, Pin Soldering 10s | 300°C | 300°C |

## SPECIFICATIONS

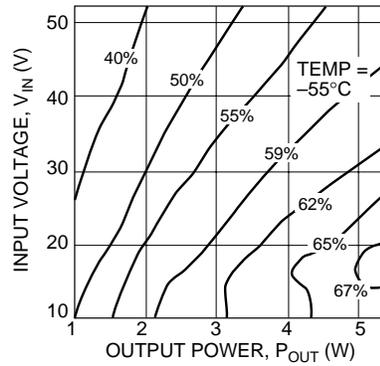| PARAMETER | TEST CONDITIONS[1] | DAC2812D MIN | DAC2812D TYP | DAC2812D MAX | DAC2815D MIN | DAC2815D TYP | DAC2815D MAX | UNITS |
|---|---|---|---|---|---|---|---|---|
| **STEADY STATE CHARACTERISTICS** | | | | | | | | |
| INPUT VOLTAGE RANGE | −55°C ↔ 125°C | 11 | 28 | 50 | 11 | 28 | 50 | Vdc |
| OUTPUT VOLTAGE (+/−) | $+I_o = -I_o$ = 10% | 11.9 | 12 | 12.1 | 14.9 | 15 | 15.1 | Vdc |
| OUTPUT CURRENT −55°C × 125°C | $V_{IN}$ = 16 ↔ 40 | | ±225 | 360[4] | | ±180 | 288[4] | mAdc |
| | $V_{IN}$ = 11 ↔ 50 | | ±208 | 333[4] | | ±167 | 267[4] | mAdc |
| OUTPUT POWER −55°C × 125°C | $V_{IN}$ = 16 ↔ 40 | | | 5.4 | | | 5.4 | W |
| | $V_{IN}$ = 11 ↔ 50 | | | 5 | | | 5 | W |
| EFFICIENCY | $+I_o = -I_o$ = 100% | 60 | 64 | | 61 | 65 | | % |
| LINE REGULATION | $V_{IN}$ = 11 ↔ 50; $+I_o = -I_o$ = 100% | | 5 | | | 5 | | mV |
| LOAD REGULATION | | | | | | | | |
| + ($+I_o$ = 0 − 160%) | $-I_o$ = 40%[2] | | 5 | | | 5 | | mV |
| − ($-I_o$ = 0 − 160%) | $+I_o$ = 40%[2] | | 20 | | | 15 | | mV |
| OPERATING TEMPERATURE, CASE | | −55 | | 125 | −55 | | 125 | °C |
| TEMPERATURE COEFFICIENT | | | | | | | | |
| (Vout +/−) | | | 0.006 | | | 0.006 | | %/°C |
| INPUT RIPPLE CURRENT | Bandwidth = 10kHz → 1MHz | | 340 | | | 340 | | mArms |
| WITH 1µH SERIES INDUCTANCE | Bandwidth = 10kHz → 1MHz | | 45 | | | 45 | | mArms |
| OUTPUT RIPPLE VOLTAGE | Bandwidth = 10kHz → 1MHz | | 15 | 60 | | 15 | 60 | mVrms |
| LOAD CAPACITANCE[3] (PER OUTPUT | $V_{IN}$ = 16 ↔ 40 | | | 100 | | | 100 | µF |
| OVER −55°C × 125°C) | $V_{IN}$ = 11 ↔ 50 | | | 50 | | | 50 | µF |
| SHORT CIRCUIT DISSIPATION | | | 0.5 | | | 0.5 | | W |
| QUIESCENT INPUT CURRENT | | | 50 | 70 | | 50 | 70 | mA |
| INHIBITED | | 0.9 | 1.25 | 2.5 | 0.09 | 1.25 | 2.5 | mA |
| **ISOLATION CHARACTERISTICS (INPUT/OUTPUT/CASE)** | | | | | | | | |
| LEAKAGE RESISTANCE | 500 Vdc | 100 | | | 100 | | | MΩ |
| LEAKAGE CAPACITANCE | 10kHz | | 400 | 500 | | 400 | 500 | pF |
| **DYNAMIC CHARACTERISTICS** | | | | | | | | |
| LINE STEP RESPONSE | $V_{IN}$ = 16 ↔ 40 Vdc | | | | | | | |
| VOLTAGE CHANGE | | | 200 | | | 200 | | mV |
| RECOVERY TIME (99%) | | | 250 | | | 250 | | µS |
| WITH 50 µF OUTPUT CAPACITORS[3] | | | | | | | | |
| VOLTAGE CHANGE | | | 150 | | | 150 | | mV |
| RECOVERY TIME (99%) | | | 400 | | | 400 | | µS |
| LOAD STEP RESPONSE | $+I_o = -I_o$ = 50 ↔ 100% | | | | | | | |
| VOLTAGE CHANGE | | | 400 | | | 400 | | mV |
| RECOVERY TIME (99%) | | | 200 | | | 200 | | µS |
| WITH 50 µF OUTPUT CAPACITORS[3] | | | | | | | | |
| VOLTAGE CHANGE | | | 300 | | | 300 | | mV |
| RECOVERY TIME (99%) | | | 300 | | | 300 | | µS |
| START-UP OVERSHOOT | $V_{IN}$ = 0 → 28 Vdc | | 0 | | | 0 | | mV |
| SHUTDOWN DELAY | Pin 5 = >10 ↔ <8 Vdc | | 250 | 500 | | 250 | 500 | µS |
| SHUTDOWN RECOVERY | Pin 5 = > 8 ↔ <10Vdc | | 40 | 60 | | 40 | 60 | mS |

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NOTES: 1. Unless otherwise stated $T_C$ = 25°, $V_{IN}$ = 28V, $-I_o$= $+I_o$= 100%,
2. Regulation measured on output pins 1/16" from case. $I_o$= 100% means 2.5 or 2.7 watts.
3. Capacitors should be connected from + to common and – to common only.
   Capacitance value imbalance should not be more than 4:1.
4. Up to 80% of total load may be drawn from either output.

| PACKAGE & THERMAL SPECIFICATIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|
| WEIGHT | | 14 | | GRAMS |
| TEMPERATURE RISE, junction to case | | 17 | 25 | °C |
| TEMPERATURE RISE, ambient | | 30 | | °C/W |

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### EFFICIENCY CONTOURS

TEMP = 25°C

INPUT VOLTAGE, $V_{IN}$ (V)

40%
50%
55%
60%
63%
65%
66%

OUTPUT POWER, $P_{OUT}$ (W)

### EFFICIENCY CONTOURS

TEMP = −55°C

INPUT VOLTAGE, $V_{IN}$ (V)

40%
50%
55%
59%
62%
65%
67%

OUTPUT POWER, $P_{OUT}$ (W)

### EFFICIENCY CONTOURS

TEMP = 125°C

INPUT VOLTAGE, $V_{IN}$ (V)

40%
50%
55%
58%
60%
62%
63%

OUTPUT CURRENT, $P_{OUT}$ (W)

### LOW LINE DROP OUT

INPUT VOLTAGE, $V_{IN}$ (V)

OUTPUT DC CURRENT RATING

OUTPUT CURRENT, $P_{OUT}$ (W)

### + LOAD TRANSIENT RESPONSE

OUTPUT RESPONSE, X (UNITS/DIV)

$+V_{OUT}$
−LOAD = 90mA
$−V_{OUT}$
360mA
+LOAD
90mA   NO OUTPUT BUS CAPCITANCE

1 V

2 A

TIME, t (100μsec/DIV)

### − LOAD TRANSIENT RESPONSE

OUTPUT RESPONSE, X (UNITS/DIV)

$+V_{OUT}$   +LOAD = 90mA
$−V_{OUT}$
360mA
−LOAD
90mA   NO OUTPUT BUS CAPACITANCE

1 V

1 V

100mA

TIME, t (100μsec/DIV)

### TURN ON THRESHOLD

TURN ON VOLTAGE, $E_{TO}$ (V)

SET POINT RESISTOR, $R_{SP}$ (Ω)

### LINE TRANSIENT RESPONSE

OUTPUT RESPONSE, X (UNITS/DIV)

OUTPUT LOAD = 225mA
$+V_{OUT}$
$−V_{OUT}$
$V_{IN}$
40V   16V
NO OUTPUT CAPACITANCE

500mV
500mV
20V

TIME, t (100μsec/DIV)

### TURN ON RESPONSE

RESPONSE, X (UNITS/DIV)

$+V_{OUT}$   +12V
OUTPUT LOAD = 225mA
−12V
$+V_{OUT}$
$V_{IN}$
28V   INCLUDES 50μF ON
EACH OUTPUT

2 V

10 V

0V

TIME, t (10msec/DIV)

### AUDIO REJECTION

AUDIO REJECTION, $A_V$ (dB)

$V_{IN}$ = 28V
$I_{OUT}$ = 225 mA

FREQUENCY, f (Hz)

### EFFICIENCY CONTOURS



### EFFICIENCY CONTOURS



### EFFICIENCY CONTOURS



### LOW LINE DROP OUT
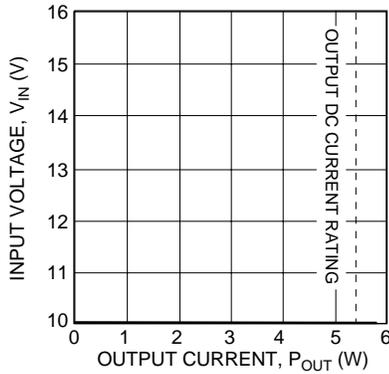


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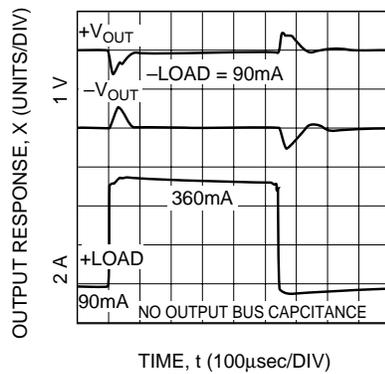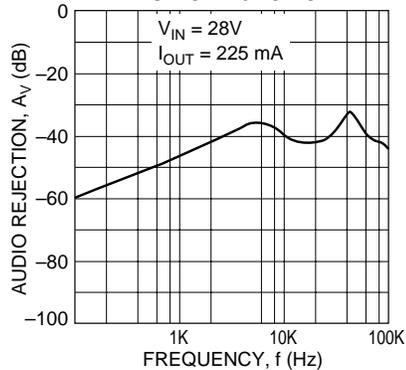


### – LOAD TRANSIENT RESPONSE
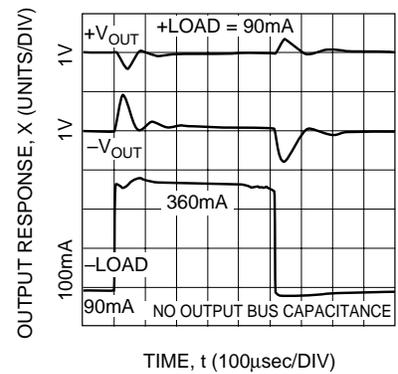


### TURN ON THRESHOLD
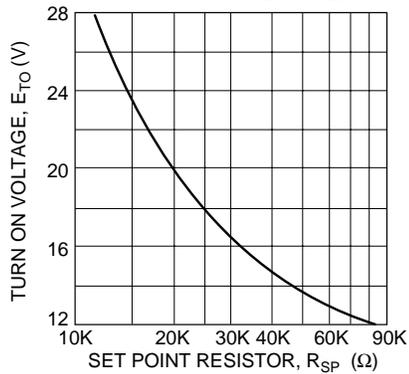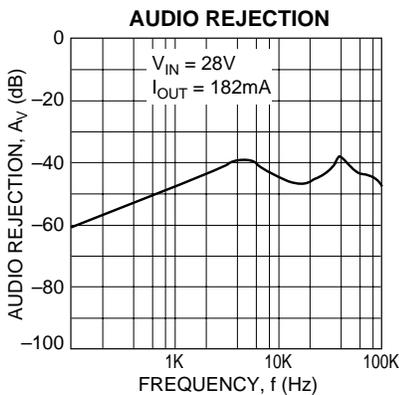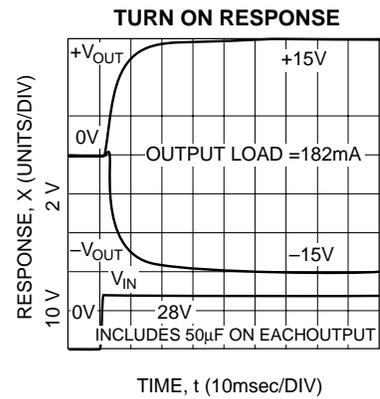


### LINE TRANSIENT RESPONSE
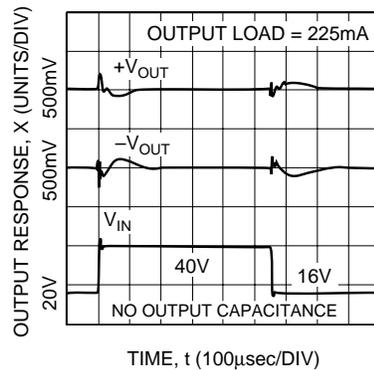


### TURN ON RESPONSE
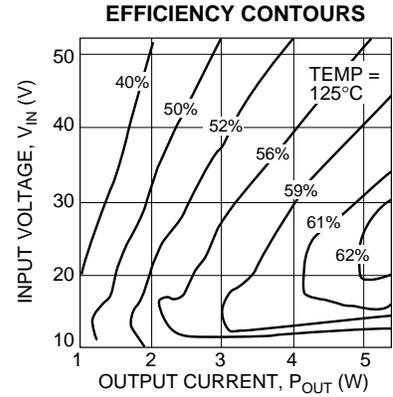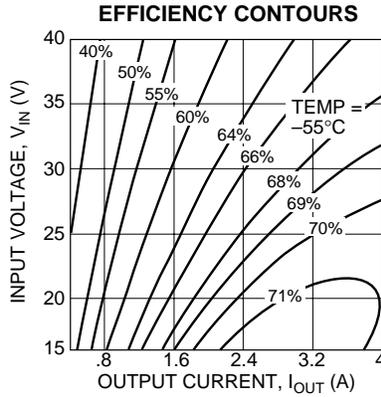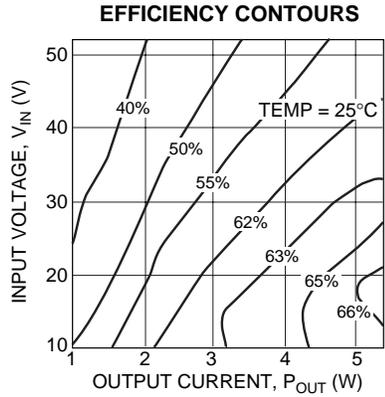


### AUDIO REJECTION



5
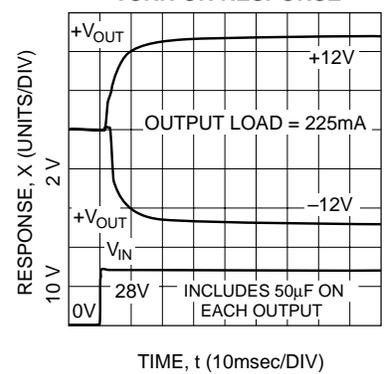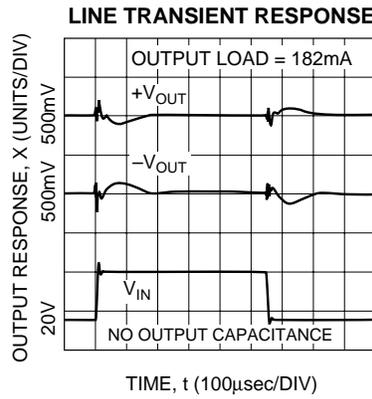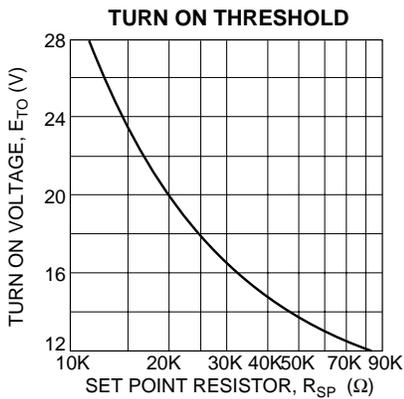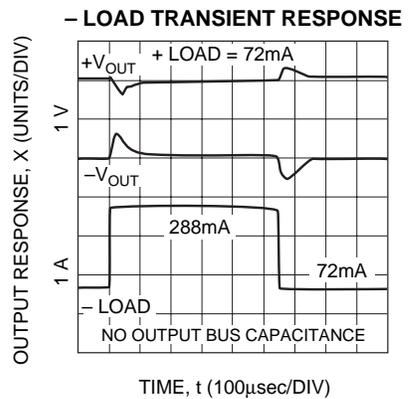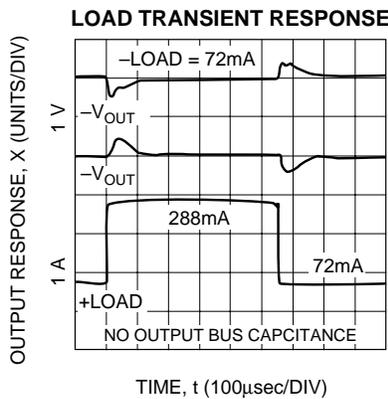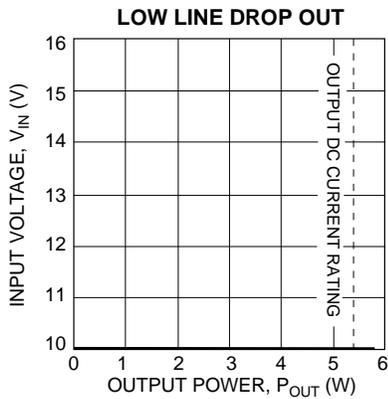
## OUTPUT ADJUST / COMP

The output voltage of the DAC2800D may be adjusted from 90% to 110% of nominal value by the use of a 150K( potentiometer as shown. Adjustment beyond this range is possible, however certain characteristics of the converter such as but not limited to input voltage range, efficiency, ripple and temperature performance will change. Characterization by the user is recommended in such applications.
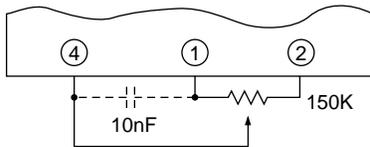


Adjust/comp (pin 4) may be driven by external circuitry referenced to pin 2 (-output) if desired. Grounding pin 4 causes voltage to increase (25% typically) while driving pin 4 above 1.3 V causes output voltage to decrease. Pin 4 may be driven negative without damage, however the resultant increase in converter output voltage should be considered. Pin 4 may be driven through 10K( or more if connection of the comp function is also required.

The comp function of pin 4 allows load transient response to be tailored to suit specific application requirements. This feature may be utilized by connecting a 10nF or less capacitor between pins 4 and 1.

## SHUTDOWN PLUS

Pin 5 is used for remote shutdown, output fault detection, and/or setting the input voltage point at which the converter will turn on as shown in the typical application diagram. No connection to pin 5 is necessary for normal operation of the converter. Pin 5 is referenced to pin 7 (-input).

Shutdown may be implemented by simply connecting pin 5 to an open collector logic output or switch rated at 2.5 mA, 25 Vdc or higher.

Input voltage turn on point is programmed with a single resistor from pin 5 to 7. An input turn on/off hysteresis (typically 3.5% of Vin) will be observed. This should be considered when making or verifying set point adjustment. The value of the setpoint resistor may be determined by the following:

$$R = \frac{210 * 10^3}{E_{TO} - 9.5}$$ (+/– 10% accuracy at $25^O$C)

Set point temperature coefficient is typically + 400ppm/$^O$C

Output fault monitoring is accomplished by observing pin 5 with a high impedance monitoring circuit. Pin 5 voltage drops from over 10 V to below 1 V when a load fault causes the converter's fault protection circuitry to activate. It will remain low for at least 100 mS and return high. If the load fault is still present pin 5 will return low and the cycle will repeat. A resistor > 400K( from pin 5 to 7 provides pull down for pin 5 if there is no input setpoint programming resistor already in place.

## LOAD FAULT RESPONSE

The DAC2800D series of DC-DC converters share load fault philosophies. Load fault conditions include short-circuit and severe overload conditions. The DAC2800D converter series responds to load faults by turning off all power conversion circuits for 250 mS and then attempting to restart for 10 mS (typical). The net "on" duty factor during a fault is very low resulting in low converter dissipation and immunity from overheating at 125°C. Current beyond rated can flow into the load at startup time. This allows the converter to bring up capacitive and other difficult load types more reliably than competing converters.
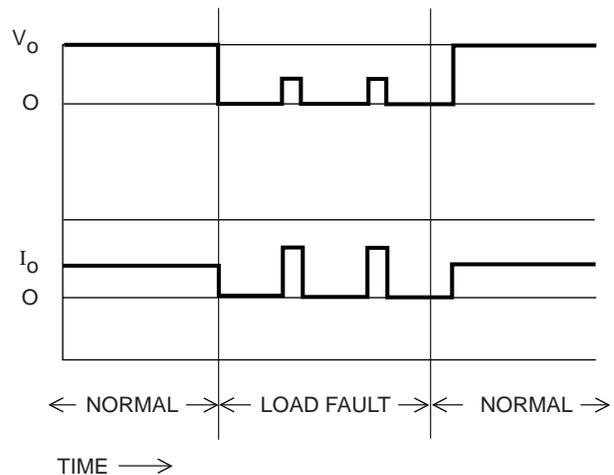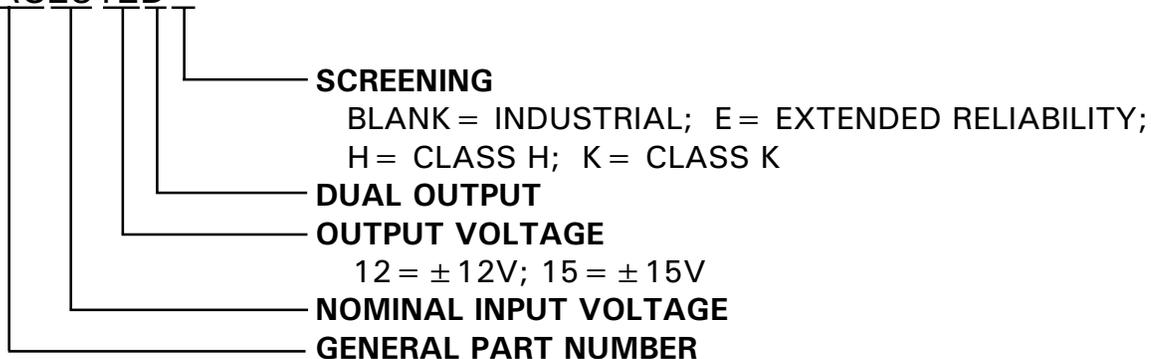
MECHANICAL SPECIFICATIONS
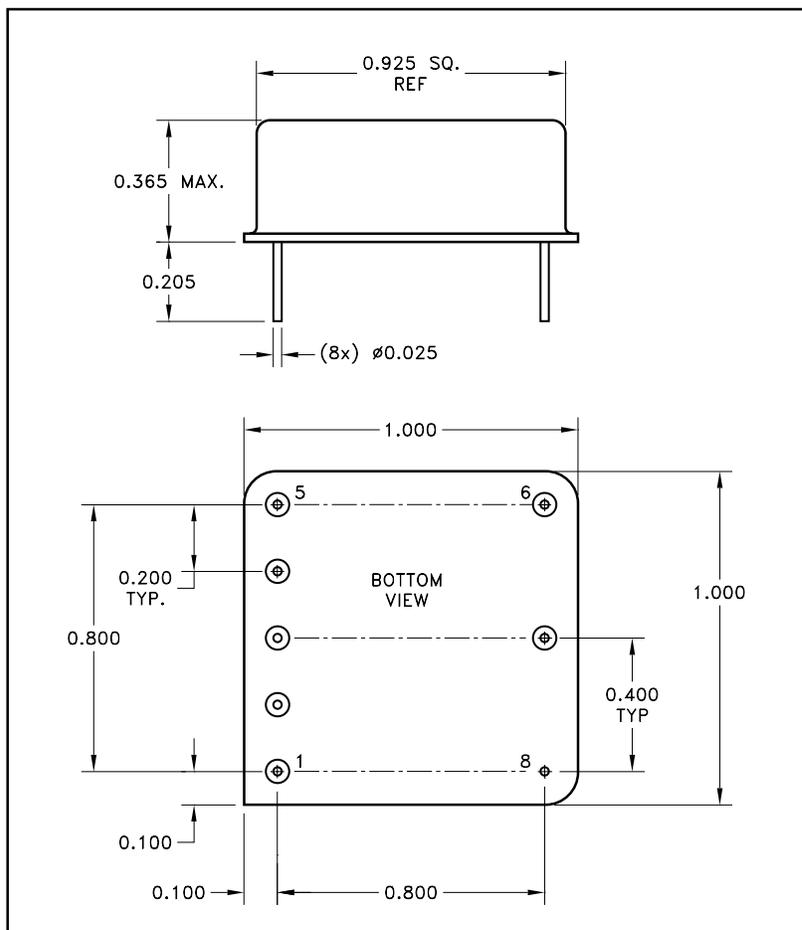


NOTE:  ALL DIMENSIONS ARE ±0.010 INCHES UNLESS OTHERWISE LABELED.
ESD Triangle indicates Pin 1.

# *ORDERING INFORMATION*

DAC2812D

**SCREENING**
BLANK = INDUSTRIAL;  E = EXTENDED RELIABILITY;
H = CLASS H;  K = CLASS K
**DUAL OUTPUT**
**OUTPUT VOLTAGE**
12 = ±12V; 15 = ±15V
**NOMINAL INPUT VOLTAGE**
**GENERAL PART NUMBER**

The above example is an industrial grade ±12V dual output converter

## M.S. Kennedy Corp.
4707 Dey Road, Liverpool, New York 13088
Phone (315) 701-6751
FAX (315) 701-6752
www.mskennedy.com

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