

**HYBRID-HIGH RELIABILITY  
RADIATION HARDENED  
LOW POWER  
DC-DC CONVERTER**

**S-SERIES**  
**28V Input, Single/Dual Output**

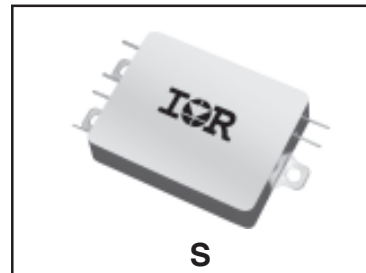
**Description**

The S-Series of DC-DC converters are low power radiation hardened, high reliability devices designed for hostile radiation environments such as those encountered by geostationary earth orbit satellites, deep space probes and communication systems. Features include small size, high efficiency, low weight and a high tolerance to total ionizing dose, single event effects, and environmental stresses such as temperature extremes, mechanical shock, and vibration. Extensive documentation including Radiation Susceptibility, Thermal Analysis, Stress Analysis and MTBF are available.

The converters incorporate a fixed frequency single ended forward topology with magnetic feedback and an internal EMI filter utilizing large multilayer ceramic capacitors processed per MIL-PRF-49470 for improved reliability. All models include an external inhibit port. They are encased in a hermetic 1.71" x 1.31" x 0.45" steel package and weigh less than 50 grams. The package utilizes rugged ceramic feed-through copper core pins and is hermetically sealed using parallel seam welding.

Manufactured in a facility fully qualified to MIL-PRF-38534, these converters are fabricated utilizing DLA Land and Maritime qualified processes. For available screening options, refer to device screening table in the data sheet.

Non-flight versions of the S-Series converters are available for system development purposes. Variations in electrical specifications and screening to meet custom requirements can be accommodated.



**Features**

- Total Dose >100K Rad(Si)
- SEE Hardened to LET up to 82 MeV.cm<sup>2</sup>/mg
- Low Weight < 50 grams
- Magnetically Coupled Feedback
- 18V to 40V DC Input Range
- Up to 10W Output Power
- Single and Dual Output Models Include 3.3, 5, 7, 12, 15,  $\pm 5$ ,  $\pm 12$  and  $\pm 15V$
- High Efficiency - to 82%
- -55°C to +125°C Operating Temperature Range
- 100M $\Omega$  @ 500VDC Isolation
- Under-Voltage Protection
- Short Circuit and Overload Protection
- Output Over Voltage Limiter
- External Inhibit
- Standard Microcircuit Drawings Available

**Applications**

- Geostationary or Low Earth Orbit Satellites
- Launch Vehicles
- Communication Systems

## **Circuit Description**

The S-Series converters utilize a single-ended forward topology with resonant reset. The nominal switching frequency is 525KHz. Electrical isolation and tight output regulation are achieved through the use of a magnetically coupled feedback. Voltage feed-forward with duty factor limiting provides high line rejection.

Output power is limited under any load fault condition to approximately 135% for singles and 145% for duals of rated. An overload condition causes the converter output to behave like a constant current source with the output voltage dropping below nominal. The converter will resume normal operation when the load current is reduced below the current limit point. This protects the converter from both overload and short circuit conditions. There are no latching elements included in the load fault protection circuits to eliminate the possibility of falsely triggering the protection circuits during single event radiation exposure.

An under-voltage protection circuit prohibits the converter from operating when the line voltage is too low for safe operation. The converter will not start until the line voltage rises to approximately 12V.

An external enable port is provided to control converter operation. This input is intended for operation with an open collector transistor drive or a relay closure to the input return. The pin may be left open for normal operation and has a nominal open circuit voltage of 10.5V.

## **Design Methodology**

The S-Series was developed using a proven conservative design methodology, which includes selecting radiation tolerant, and established reliability components and fully derating to the requirements of MIL-STD-975 and MIL-STD-1547 except for the CDR type of capacitors, a capacitor with 50V rating is used for in-circuit voltage stress of less than 10V. Heavy derating of the radiation-hardened power MOSFET virtually eliminates the possibility of SEGR and SEB. A magnetic feedback circuit is utilized instead of opto-couplers to minimize temperature, radiation and aging sensitivity. PSPICE was used extensively to predict and optimize circuit performance for both beginning and end-of-life. Thorough design analyses include Radiation Susceptibility (TREE), Worst Case, Stress, Thermal and Reliability (MTBF).

## Specifications

| Absolute Maximum Ratings |                       | Recommended Operating Conditions   |                  |
|--------------------------|-----------------------|------------------------------------|------------------|
| Input voltage range      | -0.5Vdc to +60Vdc     | Input voltage range                | +18Vdc to +40Vdc |
| Output power             | Internally limited    | Output power                       | 0 to Max. Rated  |
| Lead temperature         | +300°C for 10 seconds |                                    |                  |
| Operating temperature    | -55°C to +135°C       | Operating temperature              | -55°C to +125°C  |
| Storage temperature      | -55°C to +135°C       | Operating temperature <sup>1</sup> | -55°C to +70°C   |

<sup>1</sup> Meets derating per MIL-STD-975

## Electrical Performance Characteristics

| Parameter                                       | Group A Subgroup | Conditions<br>-55°C ≤ T <sub>C</sub> ≤ +85°C<br>V <sub>IN</sub> = 28V DC ± 5%, C <sub>L</sub> = 0<br>unless otherwise specified | Limits  |        |         | Unit |
|-------------------------------------------------|------------------|---------------------------------------------------------------------------------------------------------------------------------|---------|--------|---------|------|
|                                                 |                  |                                                                                                                                 | Min     | Nom    | Max     |      |
| Input Voltage                                   |                  |                                                                                                                                 | 18      | 28     | 40      | V    |
| Output Voltage ( V <sub>OUT</sub> )             |                  |                                                                                                                                 |         |        |         |      |
| S2803R3S                                        | 1                | I <sub>OUT</sub> = 100% rated load<br>Note 4                                                                                    | 3.27    | 3.30   | 3.33    | V    |
| S2805S                                          | 1                |                                                                                                                                 | 4.95    | 5.00   | 5.05    |      |
| S2807S                                          | 1                |                                                                                                                                 | 6.93    | 7.00   | 7.07    |      |
| S2812S                                          | 1                |                                                                                                                                 | 11.88   | 12.00  | 12.12   |      |
| S2815S                                          | 1                |                                                                                                                                 | 14.85   | 15.00  | 15.15   |      |
| S2805D                                          | 1                |                                                                                                                                 | ±4.95   | ±5.00  | ±5.05   |      |
| S2812D                                          | 1                |                                                                                                                                 | ±11.88  | ±12.00 | ±12.12  |      |
| S2815D                                          | 1                |                                                                                                                                 | ±14.85  | ±15.00 | ±15.15  |      |
| S2803R3S                                        | 2,3              |                                                                                                                                 | 3.230   |        | 3.370   |      |
| S2805S                                          | 2,3              |                                                                                                                                 | 4.900   |        | 5.100   |      |
| S2807S                                          | 2,3              |                                                                                                                                 | 6.895   |        | 7.105   |      |
| S2812S                                          | 2,3              | I <sub>OUT</sub> = 100% rated load<br>Note 4                                                                                    | 11.760  |        | 12.240  |      |
| S2815S                                          | 2,3              |                                                                                                                                 | 14.700  |        | 15.300  |      |
| S2805D                                          | 2,3              |                                                                                                                                 | ±4.900  |        | ±5.100  |      |
| S2812D                                          | 2,3              |                                                                                                                                 | ±11.760 |        | ±12.240 |      |
| S2815D                                          | 2,3              |                                                                                                                                 | ±14.700 |        | ±15.300 |      |
| Output power ( P <sub>OUT</sub> )<br>All models | 1,2,3            | V <sub>IN</sub> = 18, 28, 40 Volts, Note 2                                                                                      | 0       |        | 10      | W    |
| Output current ( I <sub>OUT</sub> )             |                  |                                                                                                                                 |         |        |         |      |
| S2803R3S                                        | 1,2,3            | V <sub>IN</sub> = 18, 28, 40 Volts, Note 2                                                                                      | 0       |        | 3.03    | A    |
| S2805S                                          |                  |                                                                                                                                 | 0       |        | 2.00    |      |
| S2807S                                          |                  |                                                                                                                                 | 0       |        | 1.43    |      |
| S2812S                                          |                  |                                                                                                                                 | 0       |        | 0.83    |      |
| S2815S                                          |                  |                                                                                                                                 | 0       |        | 0.67    |      |
| S2805D                                          |                  |                                                                                                                                 | 0.16    |        | 1.60    |      |
| S2812D                                          |                  | Either Output, Note 3                                                                                                           | 0.06    |        | 0.66    |      |
| S2815D                                          |                  | Either Output, Note 3                                                                                                           | 0.05    |        | 0.54    |      |
| Line regulation ( V <sub>RLINE</sub> )          |                  |                                                                                                                                 |         |        |         |      |
| S28XXS                                          | 1,2,3            | V <sub>IN</sub> = 18, 28, 40 Volts<br>I <sub>OUT</sub> = 0, 50%, 100% rated                                                     | -0.5    |        | 0.5     | %    |
| S28XXD                                          |                  | I <sub>OUT</sub> = 10%, 50%, 100% rated, Note 4                                                                                 | -0.5    |        | 0.5     |      |
| Load regulation ( V <sub>RLOAD</sub> )          |                  |                                                                                                                                 |         |        |         |      |
| S28XXS                                          | 1,2,3            | V <sub>IN</sub> = 18, 28, 40 Volts<br>I <sub>OUT</sub> = 0, 50%, 100% rated                                                     | -1.0    |        | 1.0     | %    |
| S28XXD                                          |                  | I <sub>OUT</sub> = 10%, 50%, 100% rated, Note 4                                                                                 | -1.0    |        | 1.0     |      |
| Cross regulation ( V <sub>RCROSS</sub> )        |                  |                                                                                                                                 |         |        |         |      |
| S2805D                                          | 1,2,3            | Duals only, Note 5                                                                                                              | -5.0    |        | 5.0     | %    |
| S2812D                                          |                  | V <sub>IN</sub> = 18, 28, 40 Volts                                                                                              | -3.0    |        | 3.0     |      |
| S2815D                                          |                  |                                                                                                                                 | -3.0    |        | 3.0     |      |

For Notes to Electrical Performance Characteristic Table, refer to page 6

**S-SERIES**  
**(28V Input, Single/Dual Output)**

International  
**IRF** Rectifier

**Electrical Performance Characteristics ( continued )**

| Parameter                                                                                                                                                        | Group A Subgroup | Conditions<br>-55°C ≤ T <sub>C</sub> ≤ +85°C<br>V <sub>IN</sub> = 28V DC ± 5%, C <sub>L</sub> = 0<br>unless otherwise specified                                                                           | Limits                                               |                                              |                                                      | Unit         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|----------------------------------------------|------------------------------------------------------|--------------|
|                                                                                                                                                                  |                  |                                                                                                                                                                                                           | Min                                                  | Nom                                          | Max                                                  |              |
| Total Regulation<br>S2803R3S<br>S2805S<br>S2807S<br>S2812S<br>S2815S<br>S2805D<br>S2812D<br>S2815D                                                               | 1,2,3            | V <sub>IN</sub> = 18, 28, 40 Volts<br><br>Single Output: I <sub>OUT</sub> = 0% ,50%,100%<br>of rated current Note 14<br><br>Dual Output: I <sub>OUT</sub> = 10% ,50%,100%<br>of rated current Notes 4, 14 | 2.0<br>2.0<br>2.0<br>2.0<br>2.0<br>5.0<br>3.0<br>3.0 |                                              | 2.0<br>2.0<br>2.0<br>2.0<br>2.0<br>5.0<br>3.0<br>3.0 | %            |
| Input current ( I <sub>IN</sub> )<br>S2803R3S<br>S2805S<br>S2807S<br>S2812S<br>S2815S<br>S2805D<br>S2812D<br>S2815D                                              | 1,2,3            | I <sub>OUT</sub> = 0, Pin 4 open                                                                                                                                                                          |                                                      |                                              | 60<br>70<br>70<br>70<br>70<br>70<br>70<br>70         | mA           |
|                                                                                                                                                                  |                  | Pin 4 shorted to pin 2                                                                                                                                                                                    |                                                      |                                              | 5.0                                                  | mA           |
| Switching frequency ( F <sub>S</sub> )                                                                                                                           | 1,2,3            |                                                                                                                                                                                                           | 475                                                  | 525                                          | 575                                                  | KHz          |
| Output ripple ( V <sub>RIP</sub> )<br>S2803R3S<br>S2805S<br>S2807S<br>S2812S<br>S2815S<br>S2805D<br>S2812D<br>S2815D                                             | 1,2,3            | V <sub>IN</sub> = 18, 28, 40 Volts<br>I <sub>OUT</sub> = 100% rated load<br>Notes 4, 6                                                                                                                    |                                                      |                                              | 50<br>50<br>45<br>50<br>60<br>80<br>80<br>80         | mV p-p       |
| Efficiency ( E <sub>FF</sub> )<br>S2803R3S<br>S2805S<br>S2807S<br>S2812S<br>S2815S<br>S2805D<br>S2812D<br>S2815D                                                 | 1,2,3            | I <sub>OUT</sub> = 100% rated load<br>Note 4                                                                                                                                                              | 68<br>75<br>76<br>78<br>77<br>76<br>76<br>76         | 73<br>80<br>81<br>81<br>82<br>80<br>81<br>82 |                                                      | %            |
| Enable Input ( Inhibit Function )<br>Open circuit voltage<br>Drive current ( sink )<br>Voltage range                                                             | 1,2,3            | Note 1                                                                                                                                                                                                    | 9.5<br>-0.5                                          |                                              | 11.5<br>500<br>50                                    | V<br>μA<br>V |
| Current Limit Point<br>Expressed as a percentage<br>of full rated load current<br>S2803R3S<br>S2805S<br>S2807S<br>S2812S<br>S2815S<br>S2805D<br>S2812D<br>S2815D | 1,2,3            | V <sub>OUT</sub> = 90% of Nominal, Note 4, 13                                                                                                                                                             | 105<br>105<br>110<br>105<br>110<br>105<br>105<br>105 |                                              | 140<br>140<br>144<br>145<br>146<br>150<br>160<br>167 | %            |

For Notes to Electrical Performance Characteristic Table, refer to page 6

**Electrical Performance Characteristics ( continued )**

| Parameter                                                                                                                                                                 | Group A Subgroup | Conditions<br>-55°C ≤ T <sub>C</sub> ≤ +85°C<br>V <sub>IN</sub> = 28V DC ± 5%, C <sub>L</sub> = 0<br>unless otherwise specified | Limits                |     |                                                                | Unit                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----|----------------------------------------------------------------|--------------------------------------|
|                                                                                                                                                                           |                  |                                                                                                                                 | Min                   | Nom | Max                                                            |                                      |
| Power dissipation, load fault (P <sub>D</sub> )                                                                                                                           | 1,2,3            | Short Circuit, Overload, Note 8                                                                                                 |                       |     | 9.0                                                            | W                                    |
| Output response to step load changes ( V <sub>TLD</sub> )                                                                                                                 | 4,5,6            | Half Load to/ from Full Load, Notes 4,9                                                                                         | -300                  |     | 300                                                            | mV pk                                |
| Recovery time, step load changes ( T <sub>TLD</sub> )                                                                                                                     | 4,5,6            | Half Load to/from Full Load, Notes 4,9,10                                                                                       |                       |     | 200                                                            | μs                                   |
| Output response to step line changes ( V <sub>TLN</sub> )                                                                                                                 | 4,5,6            | 18V to/from 40V<br>I <sub>OUT</sub> = 100% rated load, Notes 1,4,11                                                             | -300                  |     | 300                                                            | mV pk                                |
| Recovery time, step line changes ( T <sub>TLN</sub> )                                                                                                                     | 4,5,6            | 18V to/from 40V<br>I <sub>OUT</sub> = 100% rated load, Notes 1,4,10,11                                                          |                       |     | 200                                                            | μs                                   |
| Turn-on Response<br>Overshoot ( V <sub>OS</sub> )<br>S2803R3S<br>S2805S<br>S2807S<br>S2812S<br>S2815S<br>S2805D<br>S2812D<br>S2815D<br>Turn-on Delay ( T <sub>DLY</sub> ) | 4,5,6            | 10% Load, Full Load<br>Notes 4,12                                                                                               |                       |     | 500<br>600<br>750<br>1400<br>1650<br>600<br>1400<br>1500<br>10 | mV<br><br><br><br><br><br><br><br>ms |
| Capacitive Load ( C <sub>L</sub> )<br>S2803R3S<br>S2805S<br>S2807S<br>S2812S<br>S2815S<br>S2805D<br>S2812D<br>S2815D                                                      | 1                | I <sub>OUT</sub> = 100% rated load<br>No effect on DC performance<br>Notes 1, 4, 7<br><br>Each output on duals                  |                       |     | 2200<br>1000<br>750<br>180<br>120<br>500<br>90<br>60           | μF                                   |
| Line Rejection                                                                                                                                                            | 1                | I <sub>OUT</sub> = 100% rated load<br>DC to 50KHz, Notes 1, 4                                                                   |                       | 50  |                                                                | dB                                   |
| Isolation                                                                                                                                                                 | 1                | Input to Output or Any Pin to Case<br>except pin 3, test @ 500VDC                                                               | 100                   |     |                                                                | MΩ                                   |
| Device Weight                                                                                                                                                             |                  |                                                                                                                                 |                       |     | 50                                                             | g                                    |
| MTBF                                                                                                                                                                      |                  | MIL-HDBK-217F2, SF, 35°C                                                                                                        | 1.5 x 10 <sup>6</sup> |     |                                                                | Hours                                |

For Notes to Electrical Performance Characteristic Table, refer to page 6

## S-SERIES (28V Input, Single/Dual Output)

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### Notes: Electrical Performance Characteristics

1. Parameter is tested as part of design characterization or after design changes. Thereafter, parameter shall be guaranteed to the limits specified.
2. Parameter verified during line and load regulation tests.
3. Output load current must be distributed such that at least 20% of the total load current is being provided by one of the outputs.
4. Load currents split equally between outputs on dual output models. For dual output models, the output may not meet regulation limits but the converter will not be damaged under this condition.
5. Cross regulation is measured with 20% rated load on output under test while changing the load on the other output from 20% to 80% of rated.
6. Guaranteed for a D.C. to 20MHz bandwidth. Tested using a 20KHz to 10MHz bandwidth.
7. Capacitive load may be any value from 0 to the maximum limit without compromising dc performance. A capacitive load in excess of the maximum limit may interfere with the proper operation of the converter's overload protection, causing erratic behavior during turn-on.
8. Overload power dissipation is defined as the device power dissipation with the load set such that  $V_{OUT} = 90\%$  of nominal.
9. Load step transition time  $\geq 10 \mu s$ .
10. Recovery time is measured from the initiation of the transient to where  $V_{OUT}$  has returned to within  $\pm 1\%$  of its steady state value.
11. Line step transition time  $\geq 100 \mu s$ .
12. Turn-on delay time from either a step application of input power or a logic low to a logic high transition on the inhibit pin (pin 4) to the point where  $V_{OUT} = 90\%$  of nominal.
13. Current limit point expressed as a percentage of full rated load current.
14. Total Regulation includes all combinations of line and load compared to the nominal output voltage. For dual models all line, load, and cross regulation conditions are tested per Note 4 and Note 5.

### Radiation Performance Characteristics

| Test                                        | Conditions                                                                                                                                                                                      | Min | Typ | Unit                |
|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|---------------------|
| Total Ionizing Dose (Gamma)                 | MIL-PRF-883, Method 1019.5<br>Operating bias applied during exposure,<br>Half Rated Load, $V_{IN} = 28V$                                                                                        | 100 |     | Krads(Si)           |
| Single Event Effects<br>SEU, SEL, SEGR, SEB | Heavy Ions (LET)<br>Operating bias applied during exposure,<br>Full Rated Load, $V_{IN} = 18V, 28V \text{ \& } 40V$<br><br><b>Test lab: Cyclotron Institute,<br/>Texas A &amp; M University</b> | 82  |     | $MeV \cdot cm^2/mg$ |

International Rectifier currently does not have a DLA Land and Maritime certified Radiation Hardness Assurance Program.

The diagram shows a power supply system with the following components and connections:

- EMI Filter:** Connected to terminal 1 (+Input) and terminal 3 (Input Return).
- Primary Housekeeping Supply:** Connected to terminal 4 (Enable) and terminal 3. It provides a Drive signal to the Pulse Width Modulator.
- Pulse Width Modulator:** Receives the Drive signal and provides FB (Feedback) and CS (Current Sense) signals. It is connected to terminal 3 and the primary of a transformer.
- Transformer:** A two-winding transformer. The primary is connected to the Pulse Width Modulator and the EMI Filter. The secondary is connected to the Error Amp & Ref and the Output Return.
- Error Amp & Ref:** Receives a signal from the secondary of the transformer and provides a feedback signal to the Pulse Width Modulator.
- Output Stage:** Consists of a diode, an inductor, and a capacitor. The diode is connected to the secondary of the transformer. The inductor is connected to the diode and the Output Return. The capacitor is connected to the inductor and the Output Return.
- Terminals:**
  - 1: +Input
  - 2: Case (connected to ground)
  - 3: Input Return
  - 4: Enable
  - 6: +Vout
  - 7: Output Return

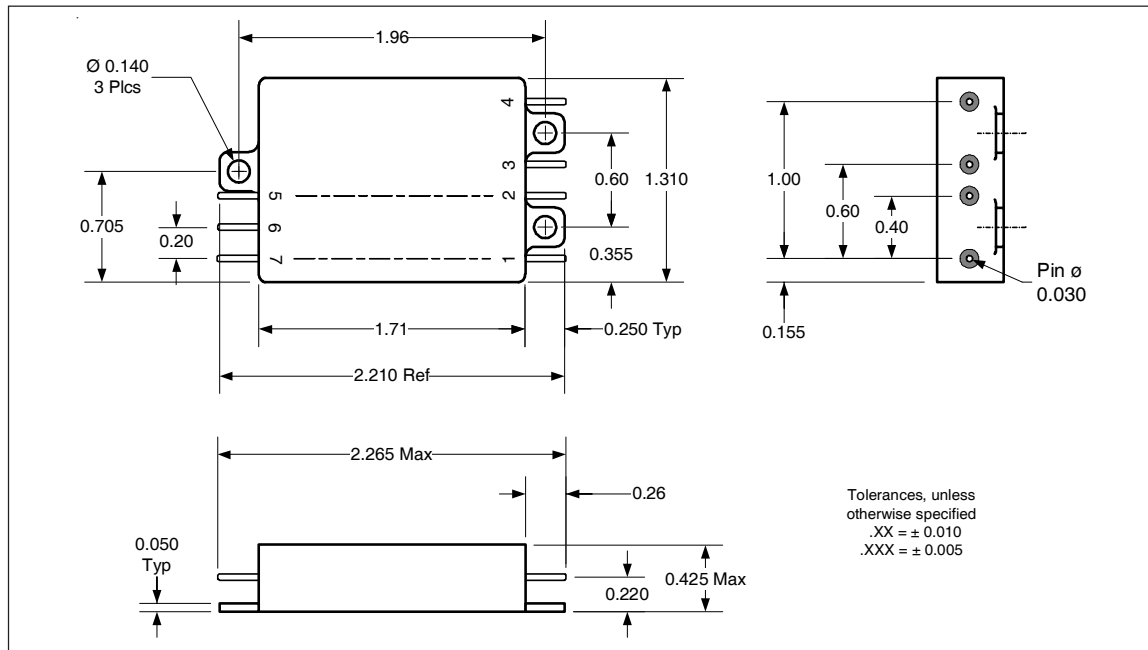
The diagram illustrates the electrical connections for a power supply system. The components and their connections are as follows:

- EMI Filter:** Receives the **+Input** (1) and **Input Return** (3). It is connected to the **Primary Housekeeping Supply** and the **Error Amp & Ref**.
- Primary Housekeeping Supply:** Provides power to the **Enable** (4) and the **Pulse Width Modulator**.
- Pulse Width Modulator:** Receives the **Enable** (4) and provides the **Drive** signal to the inverter. It also receives feedback signals **FB** and **CS** from the inverter.
- Error Amp & Ref:** Receives feedback from the output filter and provides a reference signal to the **Pulse Width Modulator**.
- Inverter:** A full-bridge inverter consisting of four MOSFETs and four diodes. It is driven by the **Drive** signal and provides the **Output** (7) and **Output Return** (6) to the **Output Filter**.
- Output Filter:** A filter consisting of an inductor and two capacitors. It receives the **Output** (7) and **Output Return** (6) and provides the **+Vout** (7) and **-Vout** (5) to the load.

**S-SERIES**  
(28V Input, Single/Dual Output)

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**Mechanical Outline**



**Pin Designation**

| Pin # | Single        | Pin # | Dual          |
|-------|---------------|-------|---------------|
| 1     | + Vin         | 1     | + Vin         |
| 2     | Case          | 2     | Case          |
| 3     | Input Return  | 3     | Input Return  |
| 4     | Enable        | 4     | Enable        |
| 5     | NC            | 5     | - Vout        |
| 6     | + Vout        | 6     | Output Return |
| 7     | Output Return | 7     | + Vout        |

**Standard Microcircuit Drawing Equivalence Table**

| Standard Microcircuit Drawing Number | IR Standard Part Number |
|--------------------------------------|-------------------------|
| 5962-04238                           | S2803R3S                |
| 5962-04239                           | S2805S                  |
| 5962-13216                           | S2807S                  |
| 5962-04240                           | S2812S                  |
| 5962-04241                           | S2815S                  |
| 5962-04242                           | S2805D                  |
| 5962-04243                           | S2812D                  |
| 5962-04244                           | S2815D                  |

**Device Screening**

| Requirement                     | MIL-STD-883 Method               | No Suffix ②                        | CK ②                               | EM                     |
|---------------------------------|----------------------------------|------------------------------------|------------------------------------|------------------------|
| Temperature Range               | —                                | -55°C to +85°C                     | -55°C to +85°C                     | -55°C to +85°C         |
| Element Evaluation              | MIL-PRF-38534                    | Class K                            | Class K                            | N/A                    |
| Non-Destructive Bond Pull       | 2023                             | Yes                                | Yes                                | N/A                    |
| Internal Visual                 | 2017                             | Yes                                | Yes                                | ①                      |
| Temperature Cycle               | 1010                             | Cond C                             | Cond C                             | Cond C                 |
| Constant Acceleration           | 2001, Y1 Axis                    | 3000 Gs                            | 3000 Gs                            | 3000 Gs                |
| PIND                            | 2020                             | Cond A                             | Cond A                             | N/A                    |
| Burn-In                         | 1015                             | 320 hrs @ 125°C<br>( 2 x 160 hrs ) | 320 hrs @ 125°C<br>( 2 x 160 hrs ) | 48 hrs @ 125°C         |
| Final Electrical<br>( Group A ) | MIL-PRF-38534<br>& Specification | -55°C, +25°C,<br>+85°C             | -55°C, +25°C,<br>+85°C             | -55°C, +25°C,<br>+85°C |
| PDA                             | MIL-PRF-38534                    | 2%                                 | 2%                                 | N/A                    |
| Seal, Fine and Gross            | 1014                             | Cond A, C                          | Cond A, C                          | Cond A                 |
| Radiographic                    | 2012                             | Yes                                | Yes                                | N/A                    |
| External Visual                 | 2009                             | Yes                                | Yes                                | ①                      |

**Notes:**

- ① Best commercial practice.
- ② CK is a DLA Land and Maritime (formerly DSCC) part marking used to designate a Class K compliant hybrid.  
The CK marking does not indicate the hybrid is radiation certified.  
No Suffix is a radiation rated device but not available as a DLA Land and Maritime qualified SMD per MIL-PRF-38534.  
International Rectifier currently does not have a DLA Land and Maritime certified Radiation Hardness Assurance Program.

**Part Numbering**

