

Introduction

The SA15-28 is an isolated DC-to-DC converter capable of delivering up to 15W of output power in a small size design. The SA family provides a radiation hardened option with top class TID and SEE performance for space and military applications. With a flyback converter topology, the SA15-28 is optimized for applications where isolated DC voltage conversion is required. The discrete surface mount design facilitates customization with reasonable lead time and modest NRE cost.

To achieve MIL-STD-461 EMI compliance, an external filter is required. Off-the-shelf filters, such as Microchip's SF100-28-28S, are available.

SA15-28 series excels in its robustness in applications with 39.6×10^6 hours of MTBF.

The SA15-28 is available in a 2.27" × 1.72" × 0.484" max package.

The SA15-28 Triple output supplies three isolated, semi-regulated outputs, and is designed to be a frontend for post regulators with outputs that can be setup in a series or parallel configurations.

Table of Contents

Introduction.....	1
1. Benefits and Features.....	3
2. Radiation Performance.....	4
3. Typical Applications Circuits.....	5
4. Absolute Maximum Ratings.....	7
5. Electrical Parameters.....	8
6. Radiation Specification (Note 1).....	10
7. Sample Electrical Waveforms (For Reference Only).....	11
8. Pin Configuration.....	14
9. Pin Description.....	15
10. Radiation Performance (-H) Hardened.....	16
11. Radiation Performance (-P) Prototype.....	17
12. Mechanical Outline (Radial Pins) Package.....	18
13. ATP Screening Test (-H) Hardened.....	20
14. ATP Screening Test (-P) Prototypes.....	21
15. Ordering Information.....	22
16. Revision History.....	23
Microchip Information.....	24
Trademarks.....	24
Legal Notice.....	24
Microchip Devices Code Protection Feature.....	24

1. Benefits and Features

- Up to 15W Output Power
- 22 VDC to 40 VDC Input Range

Main A	Aux B/C	Base Part Number
5V	5V	SA15-28-5-5T

- Triple Isolated 5V Outputs
- <1% Output Ripple
- Flyback Topology
- Inhibit Pin for Electrical ON/OFF
- Low Mass 55g
- Flight Proven Technology with $>39.6 \times 10^6$ Hours of MTBF
- Product is Classified as EAR99
- Customization of Input/Output Voltages Available Upon Request

2. Radiation Performance

- TID >100 krad (Si) and 30 krad (Si) ELDRS (<10 mrad/s) per MIL-STD-883 Method 1019
- SEE (SEGR, SEB, SET, SEL) immunity 82 MeV·cm²/mg

3. Typical Applications Circuits

Figure 3-1. SA15-5-5T Typical Application Circuit

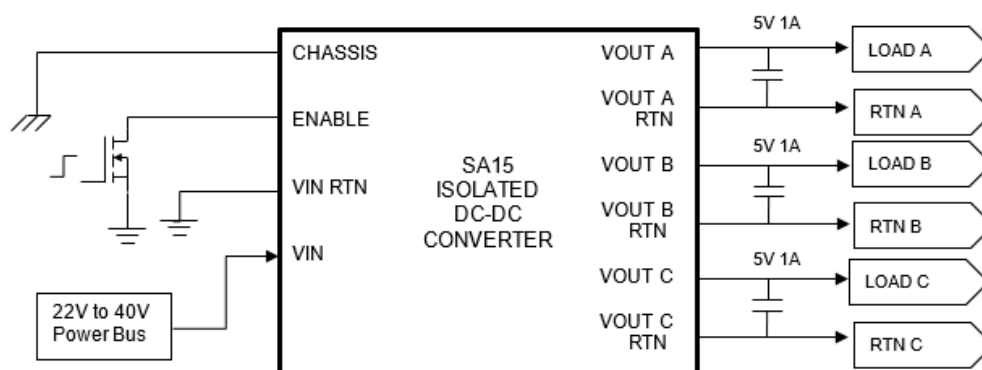


Figure 3-2. SA15-5-5T Parallel Outputs Application Circuit

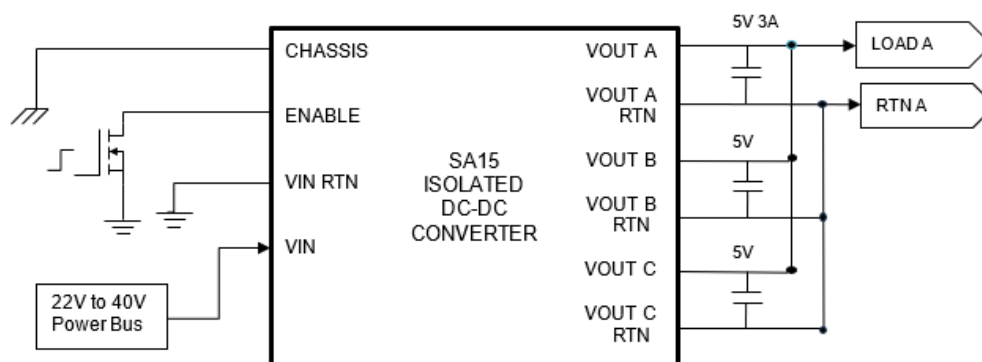


Figure 3-3. SA15-5-5T Split Outputs Application Circuit

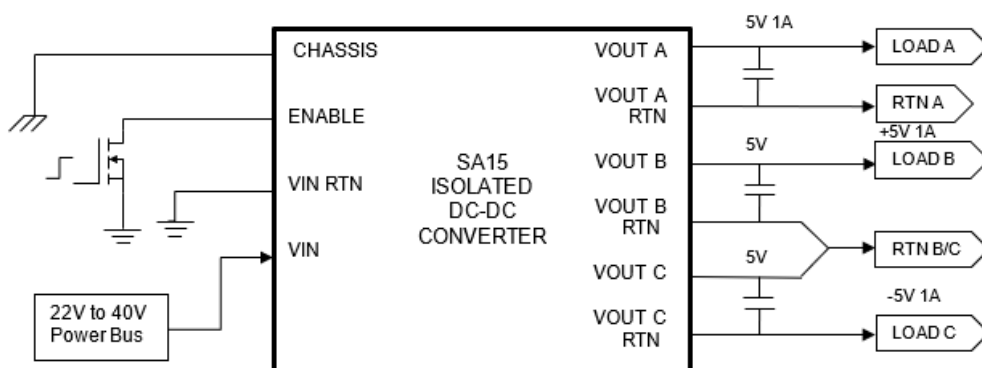
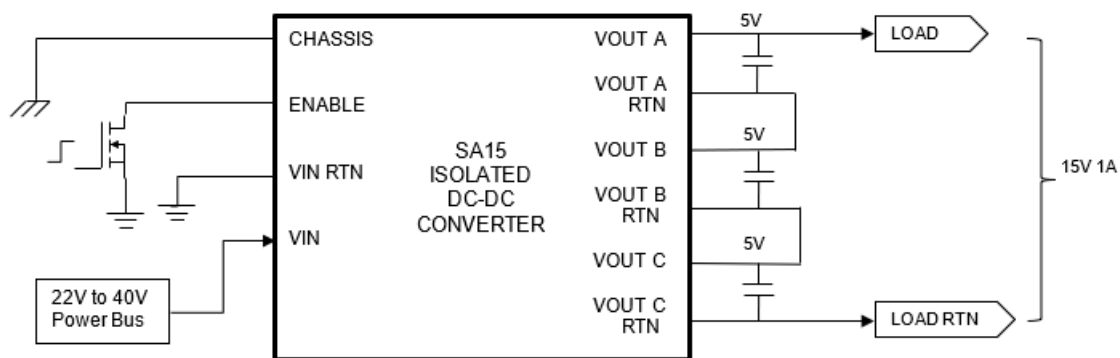


Figure 3-4. SA15-28-5-5T Series Outputs Application Circuit



Note: With each output of the SA15 isolated from each other, there are more possible connections. These are circuits that will be found in typical applications.

4. Absolute Maximum Ratings

Rating	Value
V_{IN} range	-0.5 VDC to 50 VDC
Output power	15 W
Lead temperature	300 °C for 10 s
Operating temperature	-55 °C to 125 °C
Storage temperature	-55 °C to 125 °C
Shock	1500 g_{pk} , 0.5 ms, ½ sine
Constant acceleration	50 g
Random vibration	24.06 g_{rms} , 50 Hz to 2000 Hz

5. Electrical Parameters

This section shows the electrical parameters of the SA15-28 Triple Series device under the following conditions unless otherwise specified:

Parameter	Output	Conditions	Min	Nom	Max	Units	
Input voltage all configurations							
(V _{in})	—	Note 2	22	28	40	V	
Output Voltages by configuration (V _{out})							
SA15-28-5-5T-x-x		I _{OUT} = 100% rated load				V	
Output A	5V		5.1	5.5	6.1		
Output B and C	5V		5.1	5.5	6.1		
Output Power by configuration (P _{out})							
SA15-28-5-5T-x-x		Note 13	1.5	—	15	W	
Output current by configuration (I _{out})							
SA15-28-5-5T-x-x		In all cases, output power must be kept within P _{out} rating. Note 13, 14, 15, 16					
Output A	5V		100	—	1000		mA
Output B and C	5V		100	—	1000		mA
Line regulation by configuration (VR _{LINE})							
SA15-28-5-5T-x-x		V _{IN} = 22V, 28V, 40V I _{OUT} = 10%, 50%, 100% rated Note 12					
Output A	5V		–50	—	50		mV
Output B and C	5V		–50	—	50		mV
Load regulation by configuration (VR _{LOAD})							
SA15-28-5-5T-x-x		V _{IN} = 22V, 28V, 40V I _{OUT} = 10%, 50%, 100% rated Note 11					
Output A	5V		–800	—	800		mV
Output B and C	5V		–800	—	800		mV
Cross regulation (VR _{cross})							
(Aux) B/C	—	V _{IN} = 22V, 28V, 40V I _{OUT} = 0.5A to 1A and on main, and ±half the rated current on the Aux outputs	–3.0	—	3.0	%	
Input current all configurations (I _{IN})							
(I _{in})	—	I _{OUT} =0, pin2 open	—	168	175	mA	
		Pin 2 short to pin 3	—	2	5	mA	
Output ripple all configurations (V _{RIP})							
(Main) A	—	V _{IN} = 22V, 28V, 40V I _{OUT} = 100% rated, Note 4	—	25	50	mVpp	
(Aux) B/C	—		—	25	50		
Efficiency by configuration (eff)							
SA15-28-5-5T-x-x		I _{OUT} = 100% rated load	69	72	—	%	
Inhibit input all configurations							
Inhibit input: ON Threshold		Note 1	4.5	—	—	V	
Inhibit input: OFF (sink)			1000	—	—	μA	
Inhibit input: OFF threshold			—	—	2	V	

Electrical Parameters (continued)						
Parameter	Output	Conditions	Min	Nom	Max	Units
Current limit all configurations						
Current limit point (% rated output)		When V _{OUT} = 90% of nominal set point	130	—	200	%
Power dissipation all conditions, load fault						
(P _D)	—	Short circuit, overload, Note 6	—	—	7	W
Output response to step load changes all configurations						
(V _{TLD})	—	(50% to/from 100%) rated load Note 7	−300	—	300	mVpk
Recovery time, step load changes all configurations						
(T _{TLD})	—	(50% to/from 100%) rated load Notes 7, 8	—	200	2000	μs
Output response to step line changes all configurations						
(V _{TLN})	—	22V to/from 40V I _{OUT} = 100% rated load Note 9	−100	—	100	mVpk
Recovery time, step line changes all configurations						
(T _{TLN})	—	22V to/from 40V I _{OUT} = 100% rated load Notes 8, 9	—	4	5	ms
Turn-on response: overshoot by configuration (V _{OS}) (main)						
SA15-28-5-5T-x-x		(0% to 100%) rated load Notes 3, 4, 10				
(MAIN) A	5V		—	—	500	mV
(AUX B/C)	5V		—	—	500	
Turn-on response: turn-on delay all configurations						
(T _{DLY})	—	Note 10	0.1	—	5	ms
Capacitive load by configuration (C _{LOAD})						
SA15-28-5-5T-x-x		Note 5				
(MAIN) A	5V		—	—	1000	μF
(AUX B/C)	5V		—	—	1000	
Line rejection						
—	—	DC to 50 kHz, I _{OUT} = 100% rated load	40	60	—	dB
Isolation						
—	—	50V @25 °C 1. Input (2–4) to All (1, 5–10) 2. Chassis (1) to All (2–10)	100	—	—	MΩ
Mass						
—	—	Standard case style B, D	—	55	—	g
MTBF						
—	—	MIL-HDBK-217F2, SF, 35 °C	—	39.6×10 ⁶	—	hrs

6. Radiation Specification (Note 1)

Environment	Conditions	Min	Unit
TID (gamma)	MIL-STD-883, method 1019 The operating bias applied during exposure	100	krad (Si)
SEE/SEU, SEL, SEGR, SEB	Heavy ions [LET] The operating bias applied during exposure	82	MeV•cm ² /mg

Notes:

- Parameter not 100% tested, and only assured by design.
- Parameter verified during line and load regulation tests. Regulation is specified for 10% to 100% loading on all outputs.
- The “-H” option incorporates FET technology providing a > 82 MeV•cm²/mg (gold ion) SEE capability to the design. The “-P” option is not rated for radiation.
- Tested and verified using a 20 kHz to 10 MHz bandwidth. Ripple is measured across a 50 Ohms termination with a 10 nF Cap in series. Results applicable for DC to 20 MHz bandwidth.
- The capacitive load may be any value from 0 to the maximum limit without compromising DC performance. A capacitive load exceeding the maximum limit may interfere with the proper operation of the converter's overload protection, potentially causing erratic behavior during turn-on.
- Overload power dissipation is defined as the device power dissipation with the load set such that $V_{OUT} = 90\%$ of nominal.
- The load step transition time is $\geq 10 \mu s$.
- 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.
- The line step transition time is $\geq 100 \mu s$.
- 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 2) to the point where $V_{OUT} = 90\%$ of nominal.
- Load regulation relative to the output voltage at 50% rated load.
- Line regulation relative to the output voltage at 28 VDC input.
- For operation at temperatures between 85 °C and 125 °C, de-rate power linearly from 15W (or rated maximum) to zero. Parameter limits are not guaranteed.
- Output regulation is not maintained if main output (A) load is less than 10% of maximum load.
- Output requires at least 10% loading for specified regulation. Voltage may increase at lighter loads and is limited by overvoltage Zener diodes.
- Unless otherwise specified, rated load means 15W total, 5W per output channel. Other load settings are acceptable provided the total of 15W is not exceeded and minimum output current limits are satisfied.

7. Sample Electrical Waveforms (For Reference Only)

Figure 7-1. SA15-28 Efficiency at 25 °C

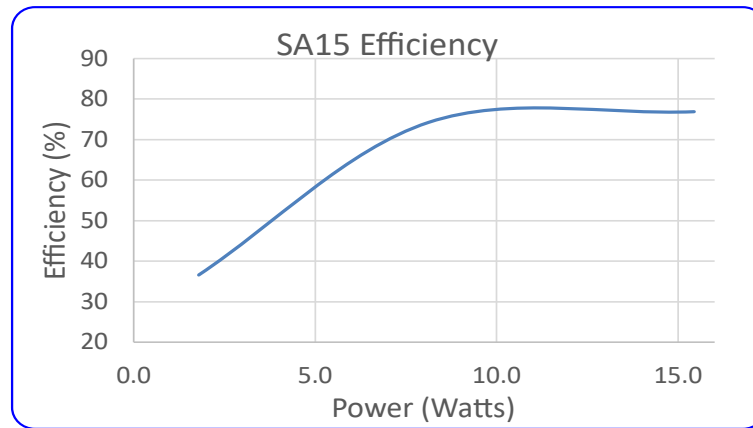


Figure 7-2. SA15-28 EMI Nominal Input Voltage, Nominal Load without EMI Filter

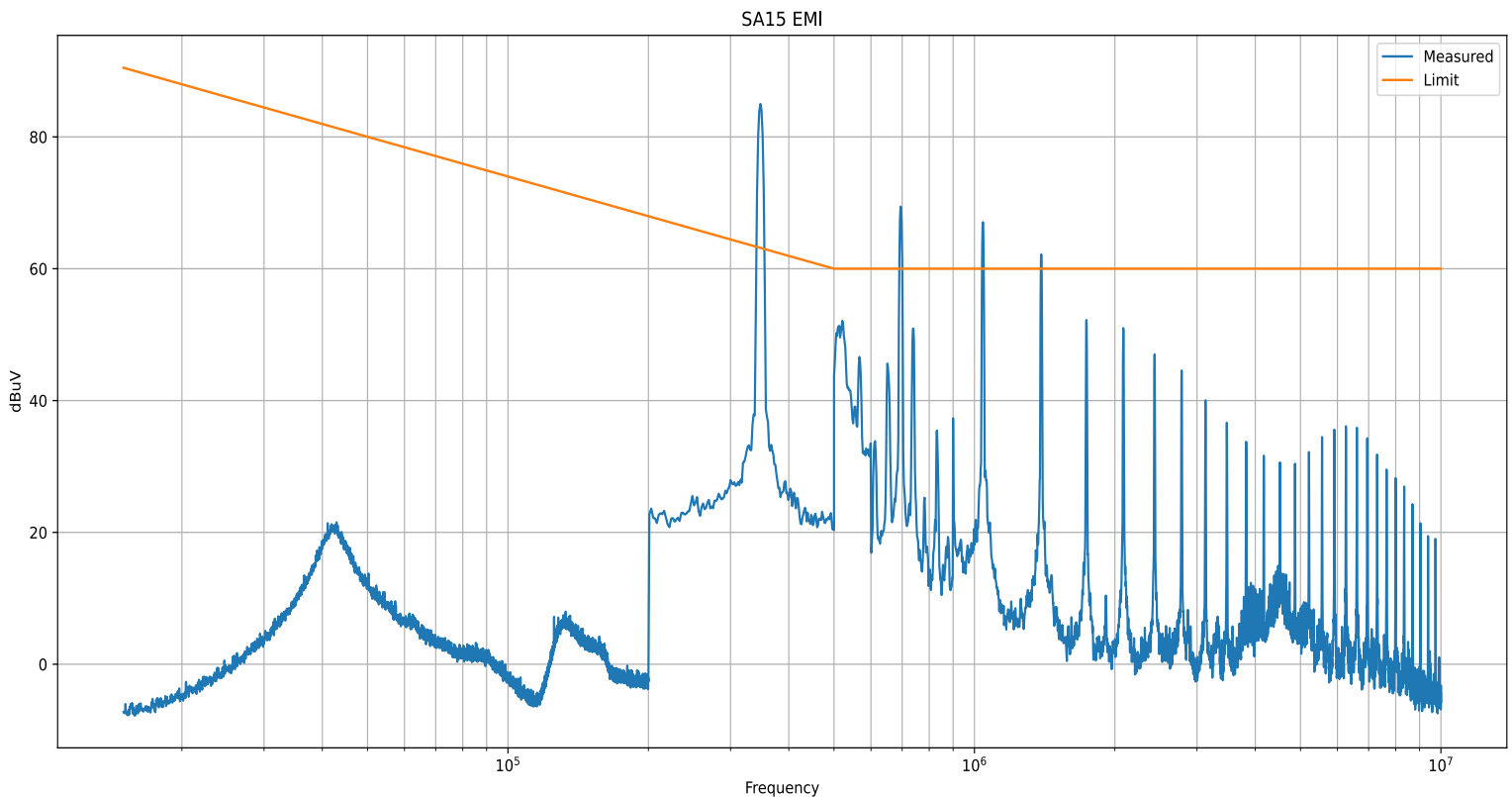


Figure 7-3. SA15-28 EMI Nominal Input Voltage, Nominal Load with SF100

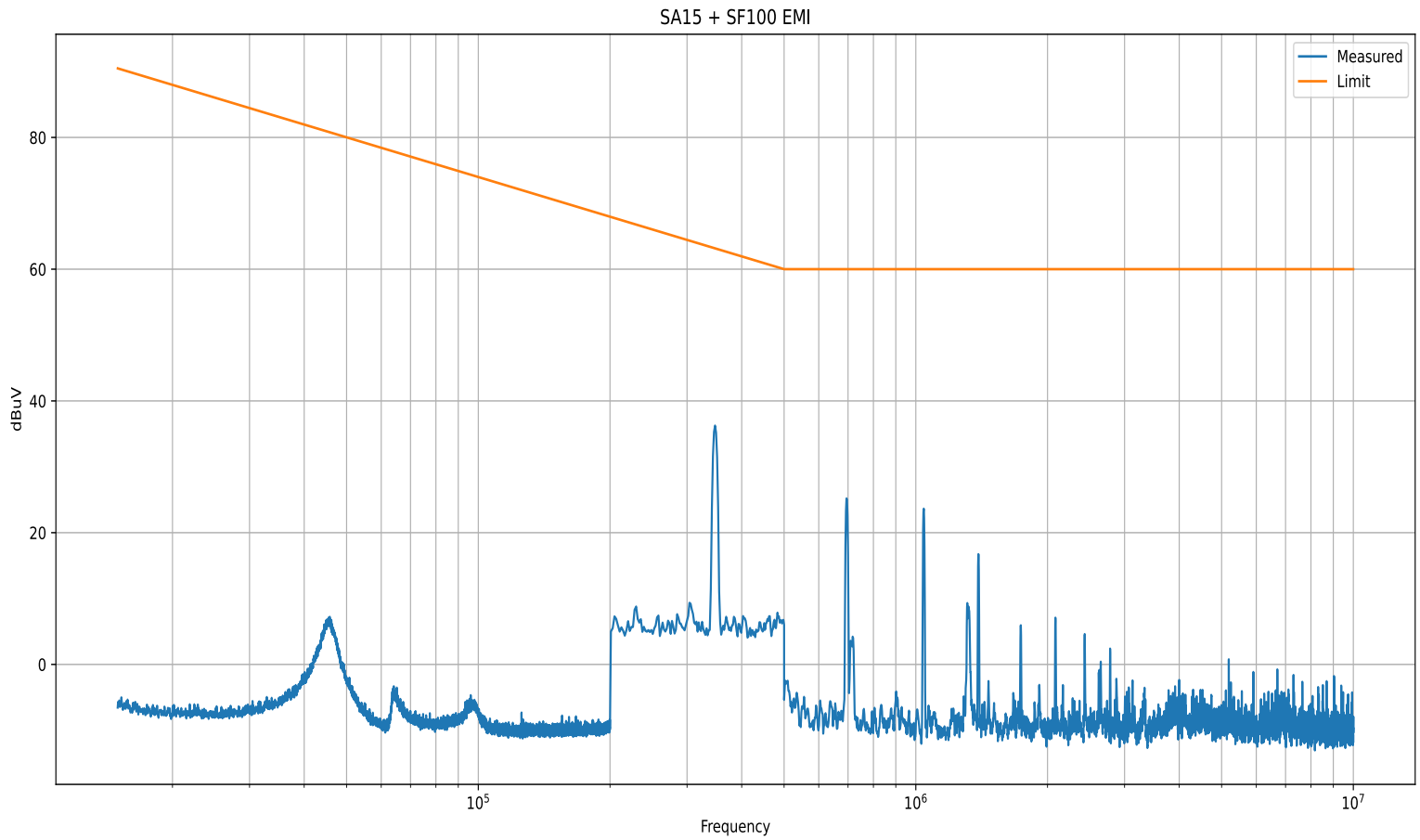


Figure 7-4. Typical Output Ripple at Full Load

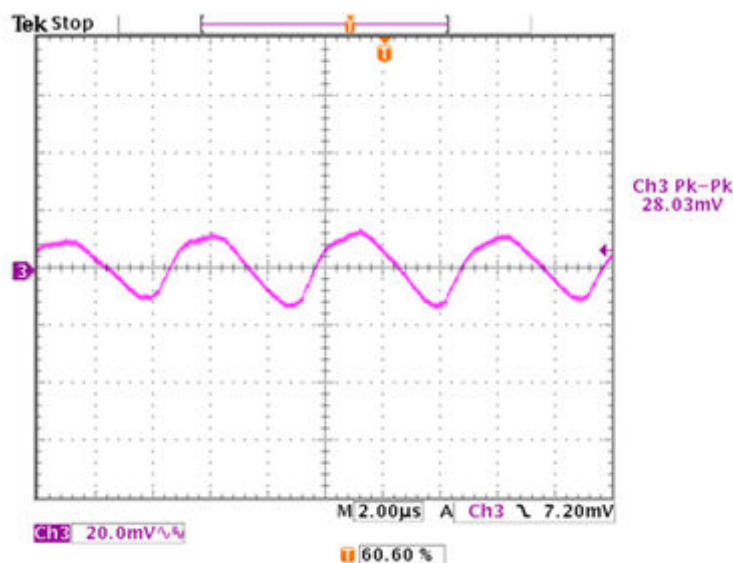
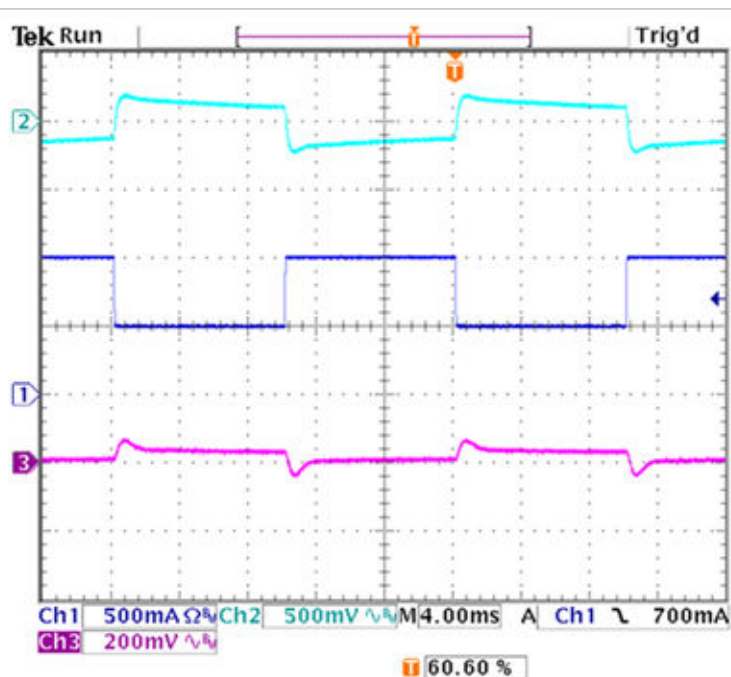


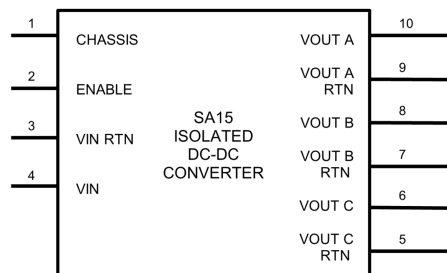
Figure 7-5. Typical 50% Load Step Transient Response



Main output transition from nominal to full load, rest of outputs loaded to nominal load.
 Sky-blue is AC couple probe to output with load transition from nominal to maximum load.
 Blue is current at the transition output.
 Purple is AC coupled to one of the nominal load outputs.

8. Pin Configuration

Figure 8-1. SA15-28 Triple Pin Configuration



9. Pin Description

PIN	Name	Description
1	CHASSIS	Chassis Pin
2	ENABLE	Power Supply ON/OFF, [ON (OPEN/HIGH), OFF (SHORT/LOW)]
3	28V RTN	Input Voltage Return/Ground
4	+28 VIN	Input Voltage
5	+5VC RTN	C Vout Return
6	+5VC	C Vout
7	+5VB RTN	B Vout Return
8	+5VB	B Vout
9	+5VA RTN	A Vout Return
10	+5VA	A Vout

10. Radiation Performance (-H) Hardened

- TID >100 krad (Si) and 30 krad (Si) ELDRS (<10 mrad/s) per MIL-STD-883 Method 1019
- SEE (SEGR, SEB, SET, SEL) immunity 82 MeV·cm²/mg (H-hardened)

11. Radiation Performance (-P) Prototype

Prototype units that are functionally the same except that components are not radiation hardened.
To be used for system checkout.

12. Mechanical Outline (Radial Pins) Package

Figure 12-1. Radial Pins and Thru-Hole Tabs Package (-D)

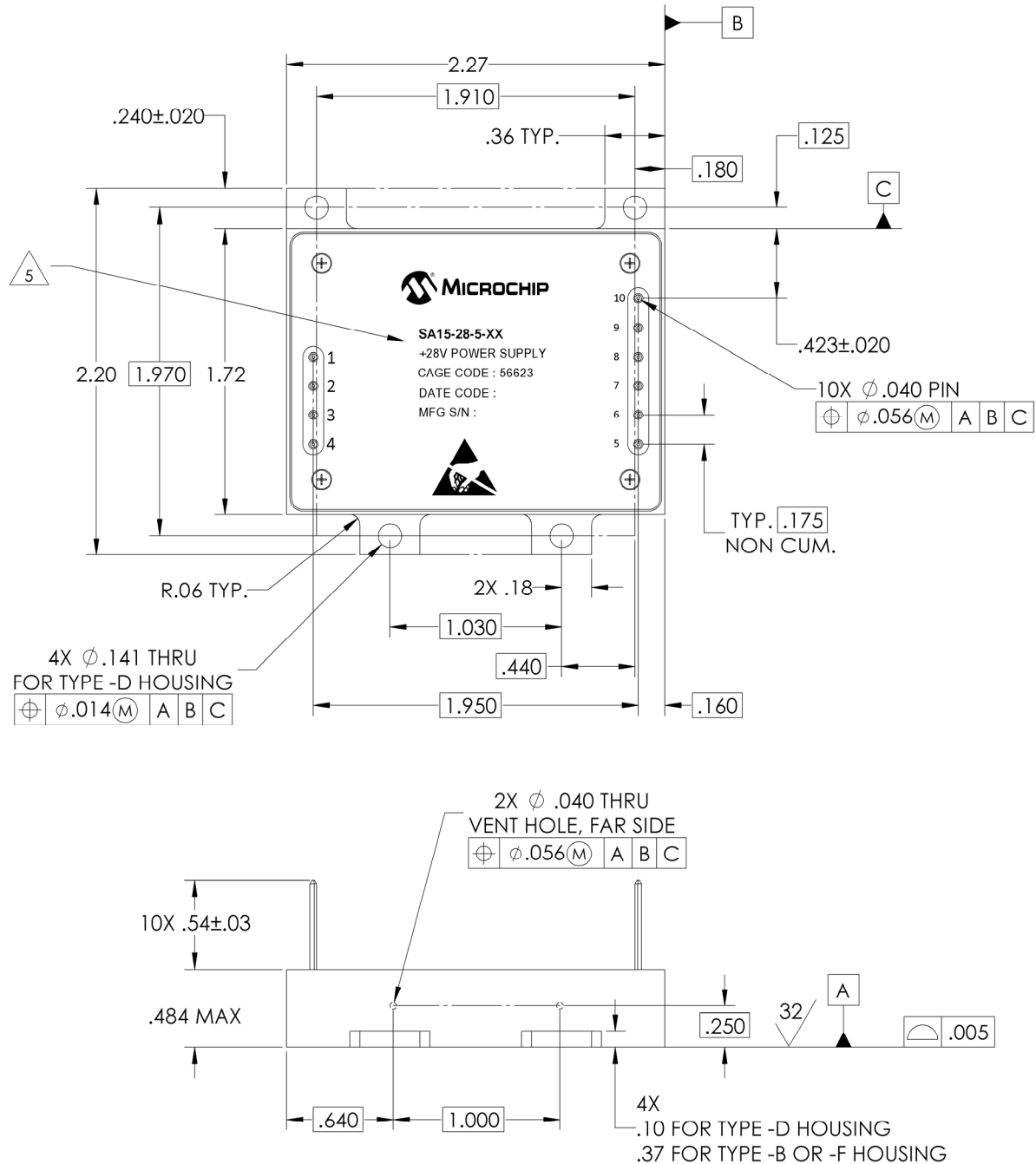
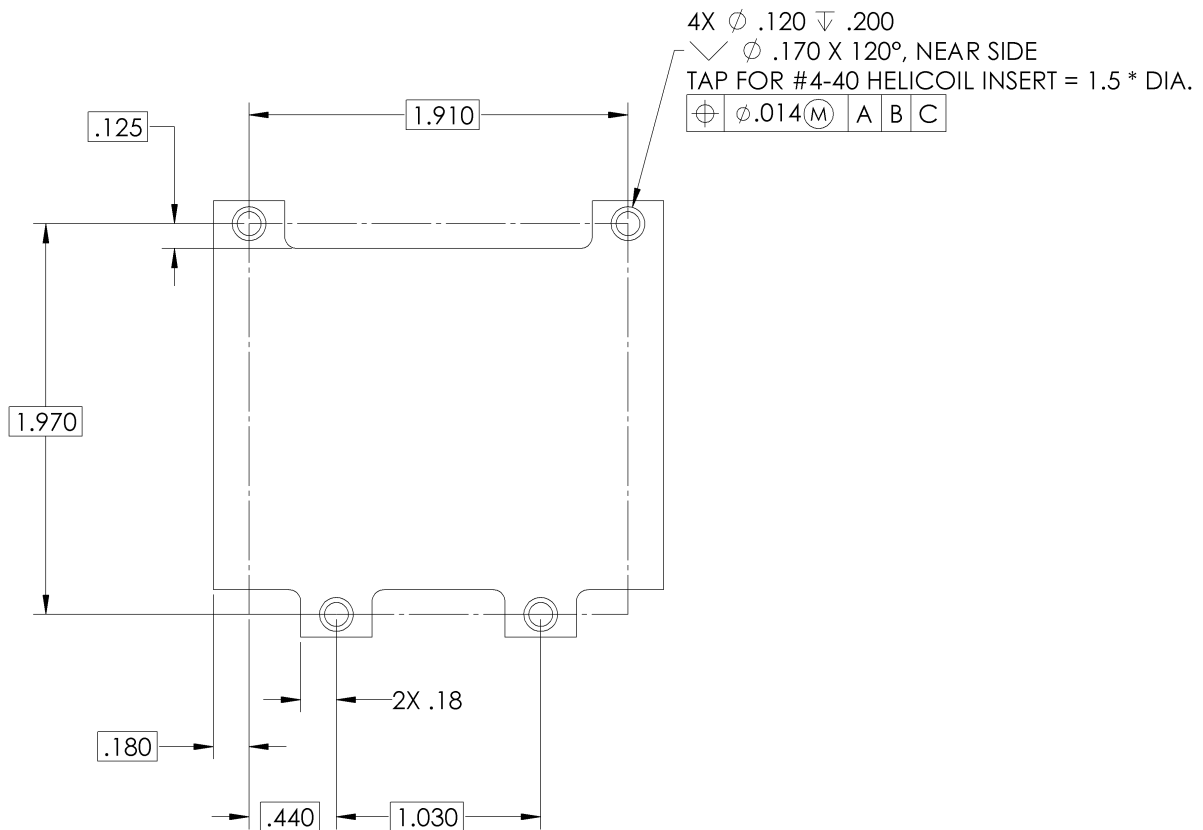


Figure 12-2. Radial Pins and Threaded Tabs Package Bottom View (-B or -F)



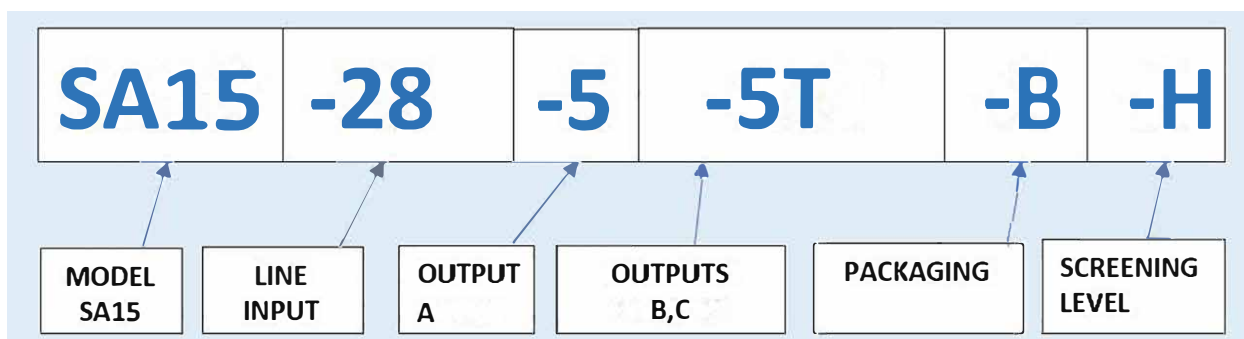
13. ATP Screening Test (-H) Hardened

Requirement	Test Method/Condition
External Visual	O&M – Dimensions and mass
Initial Electrical	Full performance at +25 °C
Vibration	Workmanship non-operating vibration MIL-STD-202, Method 214, Condition II-A, 6.21 grms random vibration, 50–2000 Hz, 1-minute perpendicular to the board
Post Vibration Electrical	Full performance at +25 °C
Temperature Cycle	MIL-STD-883, Method 1010, Condition A, 1 cycle, +85 °C to –55 °C, operating Outputs monitored during thermal cycles
Burn-in	40 Hrs @ 105 °C, 50% of rated load (outputs monitored)
Final Electrical	Full performance at +25 °C (deliverable data)
External Visual	No damage

14. ATP Screening Test (-P) Prototypes

Requirement	Test Method/Condition
External Visual	O&M – Dimensions and mass
Electrical	Full performance at +25 °C
Vibration	None
Temperature Cycle	None
Burn-in	None
External Visual	No damage

15. Ordering Information



Model	SA15	Standard Applications 15W, 28V input modules		
Line input	−28	28.0V	Line input voltage. Nominal input line	
Main A	−5	5.5V	Main output voltage	
Aux B/C	−5T	5.5V	Auxiliary output voltages (B and C outputs identical) (T is for triple)	
Mechanical Package	−B	Radial	4-40 thread	Mechanical packaging options. Electrical connections are either Radial or Axial. Mounting holes are drilled thru-hole or Threaded.
	−D	Radial	0.125 in thru-hole	
	−F	Radial	M3 thread	
Radiation Hardness	-H	Hardened	Microchip offers units with two levels of radiation screening.	
	-P	Prototype	Hardened and Prototype (non-hardened) units.	

Note: Other input voltage and output voltage combinations are available. Contact your local sales representative.

16. Revision History

Revision	Date	Description
A	06/2025	Initial version

Microchip Information

Trademarks

The “Microchip” name and logo, the “M” logo, and other names, logos, and brands are registered and unregistered trademarks of Microchip Technology Incorporated or its affiliates and/or subsidiaries in the United States and/or other countries (“Microchip Trademarks”). Information regarding Microchip Trademarks can be found at <https://www.microchip.com/en-us/about/legal-information/microchip-trademarks>.

ISBN: 979-8-3371-1417-0

Legal Notice

This publication and the information herein may be used only with Microchip products, including to design, test, and integrate Microchip products with your application. Use of this information in any other manner violates these terms. Information regarding device applications is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. Contact your local Microchip sales office for additional support or, obtain additional support at www.microchip.com/en-us/support/design-help/client-support-services.

THIS INFORMATION IS PROVIDED BY MICROCHIP “AS IS”. MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE, OR WARRANTIES RELATED TO ITS CONDITION, QUALITY, OR PERFORMANCE.

IN NO EVENT WILL MICROCHIP BE LIABLE FOR ANY INDIRECT, SPECIAL, PUNITIVE, INCIDENTAL, OR CONSEQUENTIAL LOSS, DAMAGE, COST, OR EXPENSE OF ANY KIND WHATSOEVER RELATED TO THE INFORMATION OR ITS USE, HOWEVER CAUSED, EVEN IF MICROCHIP HAS BEEN ADVISED OF THE POSSIBILITY OR THE DAMAGES ARE FORESEEABLE. TO THE FULLEST EXTENT ALLOWED BY LAW, MICROCHIP’S TOTAL LIABILITY ON ALL CLAIMS IN ANY WAY RELATED TO THE INFORMATION OR ITS USE WILL NOT EXCEED THE AMOUNT OF FEES, IF ANY, THAT YOU HAVE PAID DIRECTLY TO MICROCHIP FOR THE INFORMATION.

Use of Microchip devices in life support and/or safety applications is entirely at the buyer’s risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

Microchip Devices Code Protection Feature

Note the following details of the code protection feature on Microchip products:

- Microchip products meet the specifications contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is secure when used in the intended manner, within operating specifications, and under normal conditions.
- Microchip values and aggressively protects its intellectual property rights. Attempts to breach the code protection features of Microchip products are strictly prohibited and may violate the Digital Millennium Copyright Act.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is “unbreakable”. Code protection is constantly evolving. Microchip is committed to continuously improving the code protection features of our products.