

**HYBRID - HIGH RELIABILITY
RADIATION TOLERANT
DC/DC CONVERTER**

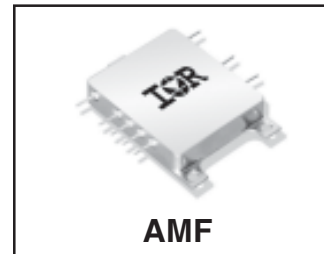
Description

The AMF28XXD series of DC/DC converter modules has been specifically designed for operation in moderate radiation environments supplementing the higher radiation performance available in the International Rectifier ART2815T converter series. Environments presented to space vehicles operating in low earth orbits, launch boosters, orbiting space stations and similar applications requiring a low power, high performance converter with moderate radiation hardness performance will be optimally served by the AMF28XXD series.

The physical configuration of the AMF28XXD series permits mounting directly to a heat conduction surface without the necessity of signal leads penetrating the heat sink surface. This package configuration permits greater independence in mounting and more mechanical security than traditional packages. International Rectifier's rugged ceramic seal pins are used exclusively in the package thereby assuring long term hermeticity.

The AMF28XXD has been designed for high density using chip and wire hybrid technology that complies with the class H requirements of MIL-PRF-38534. Manufactured in a facility fully qualified to MIL-PRF-38534, these converters are fabricated utilizing DSCC qualified processes. For available screening options, refer to device screening table in the data sheet. Applicable generic lot qualification test data including radiation performance can be made available on request. Consult IR Santa Clara for special requirements.

**AMF28XXD SERIES
28V Input, Dual Output**



Features

- 12W Output Power
- Available in $\pm 5V$, $\pm 12V$ and $\pm 15V$ Outputs
- 16 - 40VDC Input Range (28VDC Nominal)
- Low Input/Output Noise
- Total Ionizing Dose > 25KRads (Si)
- SEE Hardened to LET up to $60MeV.cm^2/mg$
- $-55^{\circ}C$ to $+125^{\circ}C$ Operating Range
- Indefinite Short Circuit Protection
- Flexible Mounting
- High Power Density
- Fully Isolated - Input to Output and to Case
- Complimentary EMI Filter Available
- Externally Synchronizable
- Electrical Performance Similar to AHF28XXD Series
- Standard Microcircuit Drawings Available

AMF28XXD Series

International
IRF Rectifier

Specifications

Absolute Maximum Ratings		Recommended Operating Conditions	
Input Voltage range	-0.5V to +50VDC	Input Voltage range	+16V to +40VDC
Soldering temperature	300°C for 10 seconds	Output Power	Less than or equal to 12W
Storage case temperature	-65°C to +135°C	Operating case temperature	-55°C to +125°C

Static Characteristics $-55^{\circ}\text{C} \leq T_{\text{CASE}} \leq +125^{\circ}\text{C}$, $V_{\text{IN}}=28\text{V}_{\text{DC}} \pm 5\%$, $C_L=0$, unless otherwise specified.

Parameter	Group A Subgroups	Test Conditions	Min	Nom	Max	Unit
Input Voltage			16	28	40	V
Output Voltage		$V_{\text{in}} = 28$ Volts, 10% load on both outputs				V
AMF2805D	1		± 4.95	± 5.00	± 5.05	
AMF2812D	1		± 11.88	± 12.00	± 12.12	
AMF2815D	1		± 14.85	± 15.00	± 15.15	
AMF2805D	2, 3		± 4.90		± 5.10	
AMF2812D	2, 3		± 11.76		± 12.24	
AMF2815D	2, 3		± 14.70		± 15.30	
Output Current ^{1, 2}		$V_{\text{in}} = 16, 28, 40$ Volts each output				mA
AMF2805D	1, 2, 3		240		2160	
AMF2812D	1, 2, 3		100		900	
AMF2815D	1, 2, 3		80		720	
Output Power ^{1, 2}		$V_{\text{in}} = 28$ Volts, 100% load				W
AMF2805D	1, 2, 3				12	
AMF2812D	1, 2, 3				12	
AMF2815D	1, 2, 3				12	
Output Ripple Voltage ^{1, 3}		$V_{\text{in}} = 16, 28, 40$ Volts, 100% load, BW = 20 Hz to 2 MHz				mV _{PP}
AMF2805D	1, 2, 3			25	60	
AMF2812D	1, 2, 3			25	60	
AMF2815D	1, 2, 3			25	60	
Output voltage Regulation ³		$V_{\text{in}} = 16, 28, 40$ Volts $I_{\text{out}} = 10, 50\%$, and 100% load				mV
Line						
AMF2805D	1, 2, 3			± 10	± 25	
AMF2812D	1, 2, 3			± 10	± 50	
AMF2815D	1, 2, 3			± 10	± 50	
Load						
AMF2805D	1, 2, 3			± 10	± 50	
AMF2805D	1, 2, 3			± 10	± 50	
AMF2805D	1, 2, 3			± 10	± 50	

For Notes to Specifications, refer to page 5

Static Characteristics (Continued) $-55^{\circ}\text{C} \leq T_{\text{CASE}} \leq +125^{\circ}\text{C}$, $V_{\text{IN}}=28\text{V}_{\text{DC}} \pm 5\%$, $C_L=0$, unless otherwise specified.

Parameter	Group A Subgroups	Test Conditions	Min	Nom	Max	Unit
Cross Regulation ⁵		Minimum 1.0 watt on both outputs 10%-90% load				
AMF2805D	1, 2, 3				10	%
AMF2812D	1, 2, 3				3.0	
AMF2815D	1, 2, 3				3.0	
Input Current						
No Load		$V_{\text{IN}}=28\text{V}$, $I_{\text{out}}=0$, Inhibit (pin 1)=open				
AMF2805D	1, 2, 3			35	60	mA
AMF2812D	1, 2, 3			35	60	
AMF2815D	1, 2, 3			35	60	
Inhibit		Inhibit (pin 1) shorted to input return (pin 7)				
AMF2805D	1, 2, 3			8.0	12	
AMF2812D	1, 2, 3			8.0	12	
AMF2815D	1, 2, 3			8.0	12	
Input Ripple Current ³		$V_{\text{IN}} = 16, 28, 40 \text{ Volts}$, 100% load, BW = 20 Hz to 2 MHz				
AMF2805D	1, 2, 3			20	50	mA _{pp}
AMF2812D	1, 2, 3			20	50	
AMF2815D	1, 2, 3			20	50	
Efficiency ³		100% load				
AMF2805D	1, 3		76			%
AMF2812D	1, 3		77			
AMF2815D	1, 3		78			
AMF2805D	2		72			
AMF2812D	2		74			
AMF2815D	2		74			
Isolation	1	Input to output or any pin to case (except pin 6) at 500Vdc	100			MΩ
Capacitive Load ^{5, 6}	4	No effect on dc performance, total for both outputs				
AMF2805D					500	μF
AMF2812D					200	
AMF2815D					200	
Short Circuit Power Dissipation	1, 2, 3				6.0	W
MTBF		MIL-HDBK-217F, SF @ $T_c=35^{\circ}\text{C}$	750			Khrs
Weight					36	g

For Notes to Specifications, refer to page 5

Dynamic Characteristics $-55^{\circ}\text{C} \leq T_{\text{CASE}} \leq +125^{\circ}\text{C}$, $V_{\text{IN}}=28\text{V}_{\text{DC}} \pm 5\%$, $C_L=0$, unless otherwise specified.

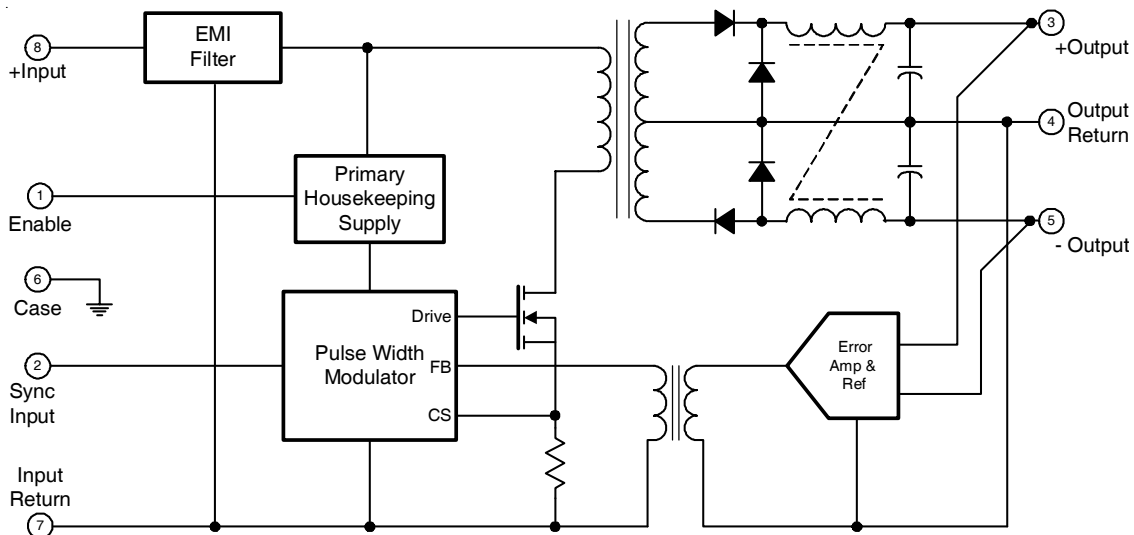
Parameter	Group A Subgroups	Test Conditions	Min	Nom	Max	Unit
Short Circuit Recovery ⁶		0% load to 100% Load				
AMF2805D	4, 5, 6				25	ms
AMF2812D	4, 5, 6				25	
AMF2815D	4, 5, 6				25	
Switching Frequency ³	4, 5, 6	100% load	500	550	600	KHz
Synchronization Input ³						
Frequency Range	4, 5, 6		500		700	KHz
Pulse Amplitude, Hi ⁶			2.5		10	V
Pulse Amplitude, Lo ⁶			-0.5		0.8	V
Pulse Rise time ⁶					100	ns
Pulse Duty Cycle ⁶			20		80	%
Output Response To Step Transient Load Changes ^{3,7}						
	4, 5, 6	Load step 50% $\rightleftharpoons$ 100%	-200		+200	mV _{pk}
	4, 5, 6	Load step 10% $\rightleftharpoons$ 50%	--800		+800	
Recovery Time, Step Transient Load Changes ^{3,7,8}						
	4, 5, 6	Load step 50% $\rightleftharpoons$ 100%			70	μs
	4, 5, 6	Load step 10% $\rightleftharpoons$ 50%			2000	
Output Response Transient Step Line Changes ^{3,6,9}		Input step 16 $\rightleftharpoons$ 40Vdc, 100% Load				
AMF2805D	4, 5, 6		-450		+450	mV _{pk}
AMF2812D	4, 5, 6		-750		+750	
AMF2815D	4, 5, 6		-750		+750	
Recovery Time Transient Step Line Changes ^{3,6,9}		Input step 16 $\rightleftharpoons$ 40Vdc, 100% load				
	4, 5, 6				1200	μs
Turn On Overshoot ^{3,10}						
All	4, 5, 6	0% load			600	mV _{pk}
AMF2805D	4, 5, 6	100% load			400	
AMF2812D	4, 5, 6				300	
AMF2815D	4, 5, 6				300	
Turn On Delay ^{3,10}						
	4, 5, 6	0% load to 100% load			25	ms

For Notes to Specifications, refer to page 5

Notes to Specifications

1. Applicable to positive and negative outputs.
2. Maximum combined output is 12W. 10.8W (max.) is available from either output (90%).
3. Load current split equally between $+V_{OUT}$ and $-V_{OUT}$.
4. 1.2W load on output under test, 1.2W to 10.8W load change on other output.
5. Capacitive value may be any value from 0 to the maximum limit without compromising DC performance. A capacitive load in excess of the maximum limit will not disturb loop stability but may interfere with the operation of the load fault detection circuitry, appearing as a short circuit during turn-on.
6. Parameter shall be tested as part of design characterization and after design or process changes. Thereafter, parameters shall be guaranteed to the limit specified.
7. Load step transition time between 2.0 μ s and 10 μ s.
8. Recovery time is measured from initiation of the transient to where V_{out} has returned to within $\pm 1\%$ of V_{out} at 50% load.
9. Input step transient time between 1.0 μ s and 10 μ s.
10. Turn-on delay time measurement is for either a step application of power at the input or the removal of a ground signal from the inhibit pin while power is applied to the input.

Block Diagram



Application Information

Inhibit Function (Enable)

Connecting the enable input (Pin 1) to input common (Pin 7) will cause the converter to shut down. It is recommended that the enable pin be driven by an open collector device capable of sinking at least 400 μ A of current. If the user chooses not to use the inhibit function, it may be left open and the converter will function normally. Because it is internally pulled up, the open circuit voltage of the inhibit input is 10 +1.0V_{DC}.

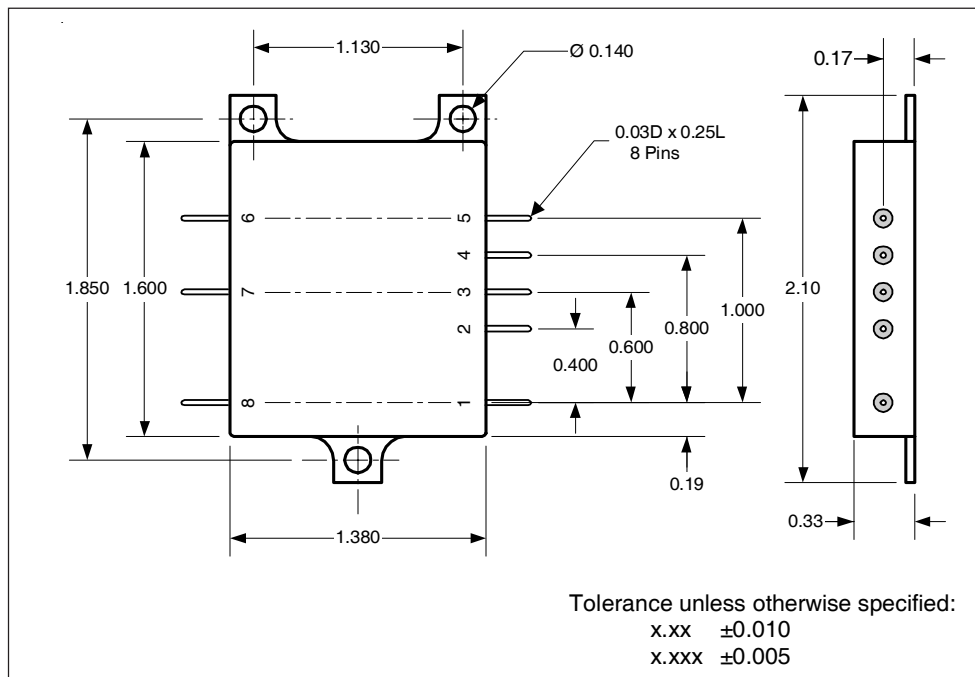
EMI Filter

An optional EMI filter is available (AFH461) that will reduce the input ripple current to levels below the limits imposed by MIL-STD-461 CE03.

Device Synchronization

When multiple DC/DC converters are utilized in a single system, significant low frequency noise may be generated due to a small difference in the switching frequency of the converters (beat frequency noise). Because of the low frequency nature of this noise (typically less than 10KHz), it is difficult to filter out and may interfere with proper operation of sensitive systems (communication, radar or telemetry). International Rectifier provides synchronization of multiple AMF type converters to match switching frequency of the converter to the frequency of the system clock, thus eliminating this type of noise.

Mechanical Outline



Pin Designation

Pin #	Designation
1	Enable
2	Sync Input
3	+ Output
4	Output Return
5	- Output
6	Case Ground
7	Input Return
8	+ Input

Radiation Specification

Parameter	Condition	Min	Typ	Max	Unit
Total Ionizing Dose	MIL-STD-883, Method 1019.4 Operating bias applied during exposure	30	—	—	KRads (Si)
Heavy Ion (Single event effects)	BNL Dual Van de Graf Generator	60	—	—	MeV •cm ² /mg

International Rectifier currently does not have a DSCC certified Radiation Hardness Assurance Program.

Device Screening

Requirement	MIL-STD-883 Method	No Suffix ②	CH ②	EM
Temperature Range	—	-55°C to +125°C	-55°C to +125°C	-55°C to +85°C
Element Evaluation	MIL-PRF-38534	Class H	Class H	N/A
Non-Destructive Bond Pull	2023	N/A	N/A	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 (2 x 160hrs)	320 hrs @ 125°C (2 x 160hrs)	48 hrs @ 125°C
Final Electrical (Group A)	MIL-PRF-38534 & Specification	-55°C, +25°C, +125°C	-55°C, +25°C, +125°C	-55°C, +25°C, +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.

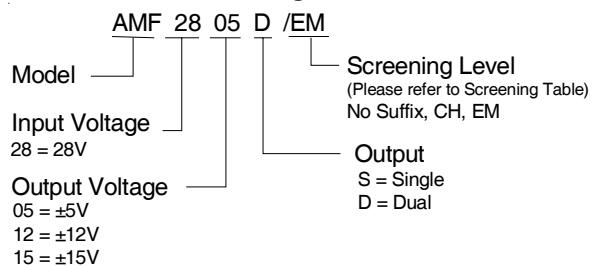
② Device with 'CH' suffix is a DSCC class H compliant without radiation performance. No suffix is a radiation rated device but not available as a DSCC qualified SMD per MIL-PRF-38534.

International Rectifier currently does not have a DSCC certified Radiation Hardness Assurance Program.

Standard Microcircuit Drawing Equivalence Table

Standard Microcircuit Drawing Number	IR Standard Part Number
5962-05222	AMF2812D
5962-05223	AMF2815D

Part Numbering



International
IR Rectifier

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Data and specifications subject to change without notice. 09/2008