

**HIGH RELIABILITY
DC-DC CONVERTER**

HMA423R409T/ES

+42V Input, Triple Output

Description

The HMA423R409T/ES is a 50W triple output, high reliability DC-DC converter designed for rugged environments and extended temperature operations such as those encountered in military, aerospace and industrial applications. The converter is in full compliance with the conducted emission, CE03 of MIL-STD-461C. Line rejection of greater than 40dB provides rejection of input noise. Features include small size, low weight and conservative component stress de-rating.

An external inhibit port is provided to enable a low power dissipation “stand-by” operation mode. A separate sync input is provided to allow the user to “pull” the switching frequency to a desired frequency.

The converter is enclosed in a hermetic 3.00” x 2.00” x 0.475” Aluminium-Silicon-Carbide, ALSiC, package and weighs less than 100 grams. The package utilizes rugged ceramic feed-thru copper core pins and is sealed using parallel seam welding.

Manufactured in a facility fully qualified to MIL-PRF-38534, this converter is fully screened to the requirements as described in the device screening table in this document.



Features

- 36.5 to 48V DC Input Range
- Up to 50W (peak) Output Power
- +3.4V Main Output, $\pm 9.2V$ Aux. Output
- Internal EMI Filter; Converter capable of meeting MIL-STD-461C CE03 and CS01
- Magnetically Coupled Feedback
- High Efficiency
- -55°C to +125°C Operating Temperature Range
- 100M Ω @ 500V DC Isolation
- Under-Voltage Lockout
- Short Circuit and Overload Protection
- Output Over voltage Limiter
- External Inhibit
- Sync Frequency Input
- Low Weight, < 100 grams

Applications

- Military Aircraft
- Commercial Aircraft
- Ground Equipment

Circuit Description

The HMA Series converter utilizes a single-ended forward topology with resonant reset. The nominal switching frequency is 650KHz. 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 and protection against output over voltage in the event of an internal control loop failure. This mechanism limits the maximum output voltage to approximately 20% over the nominal regardless of the line voltage.

An internal EMI filter allows the converter to meet the conducted emissions requirements of MIL-STD-461C on the input power leads. A single-stage output filter reduces the typical output ripple to less than 100mV peak-to-peak on the main output. Output current is limited under any load fault condition to approximately 130% 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. The current limit point exhibits a slightly negative temperature coefficient to reduce the possibility of thermal runaway. The current limit trip point is set approximately 130% above the nominal maximum to allow for short duration 60 watt peak output power.

An external inhibit port is provided to control converter operation. The converter's operation is inhibited when this pin is pulled low. It is designed to be driven by an open collector logic device. The pin may be left open for normal operation and has a nominal open circuit voltage of 10.5V with respect to the input return (pin 2).

| Absolute Maximum Ratings | | Recommended Operating Conditions | |
|--------------------------|----------------------|----------------------------------|-----------------------|
| Input voltage range | -0.5Vdc to +80Vdc | Input voltage range | +36.5Vdc to +48Vdc |
| Output power | Internally limited | Lead temperature | +300°C for 10 seconds |
| Output power | 0 to 120% Max. Rated | | |
| Operating temperature | -55°C to +125°C | | |
| Storage temperature | -55°C to +135°C | | |

Electrical Performance Characteristics

| Parameter | Group A Subgroup | Conditions -55°C ≤ T _C ≤ +125°C V _{IN} = 42V DC ± 5%, C _L = 0 unless otherwise specified | Limits | | | Unit |
|--|---------------------|--|------------------------|------------------------|------------------------|-------------------|
| | | | Min. | Nom. | Max. | |
| Input Voltage | 1,2,3 | Note 2 | 36.5 | 42 | 48 | V |
| Output Voltage (V _{OUT}) | 1,2,3 | I _{OUT} = 100% Rated Load, Note 5, 11 (main) (+aux.) (-aux.) | 3.35 +8.70 -9.70 | 3.40 +9.20 -9.20 | 3.45 +9.70 -8.70 | V |
| Output Power (P _{OUT}) | 1,2,3 | V _{IN} = 36.5, 42, 48 Volts, Note 2 | 0 | | 50 | W |
| Output Current (I _{OUT}) | 1,2,3 | V _{IN} = 36.5, 42, 48 Volts, Notes 2,3,4,5 (main) (+aux.) (-aux.) | 450 460 230 | | 4500 2300 1150 | mA |
| Line Regulation (V _{RLINE}) | 1,2,3 | V _{IN} = 36.5, 42, 48 Volts, Note 5 I _{OUT} = 10, 50, 100% Rated Load (main) (±aux.) | -10 -120 | | 10 120 | mV |
| Load Regulation (V _{RLOAD}) | 1,2,3 | V _{IN} = 36.5, 42, 48 Volts, Notes 5, 13 I _{OUT} = 10, 50, 100% Rated Load (main) (±aux.) | -50 -400 | | 50 400 | mV |
| Cross Regulation (V _{RCROSS}) | 1,2,3 | V _{IN} = 36.5, 42, 48 Volts I _{OUT} = 0.45A to 4.5A (main) and 1.15A (+aux), 575mA (-aux) | -6.0 | | 6.0 | % |
| Input Current (I _{IN}) | 1,2,3 | I _{OUT} = 0, Pin 3 open Pin 3 shorted to Pin 2 | | | 80 5.0 | mA |
| Output Ripple (V _{RIP}) | 1,2,3 | V _{IN} = 36.5, 42, 48 Volts, Notes 5, 6,14 I _{OUT} = 10, 50, 100% Rated Load (main) (±aux.) | | 25 50 | 100 200 | mV _{P-P} |

For Notes to Electrical Performance Characteristics, refer to page 5

Electrical Performance Characteristics (continued)

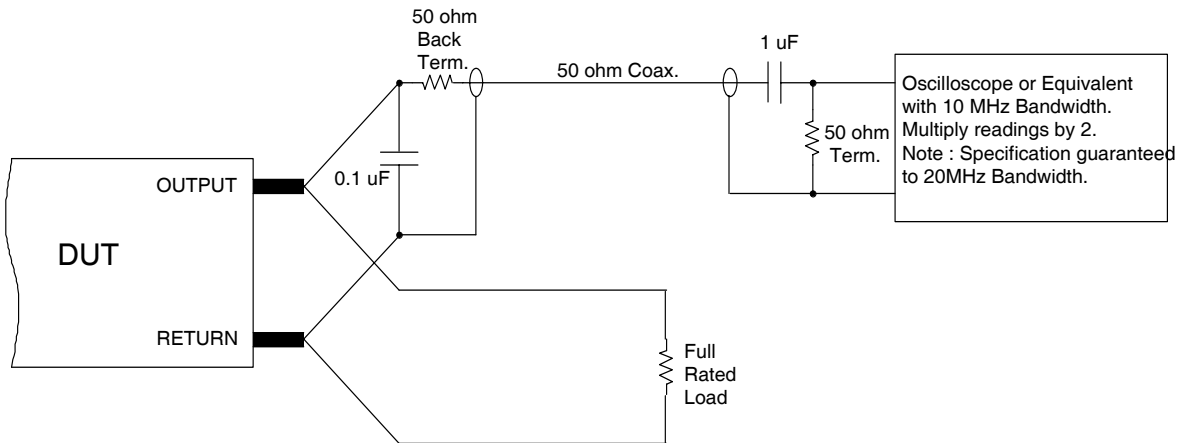
| Parameter | Group A Subgroup | Conditions -55°C ≤ T _C ≤ +125°C V _{IN} = 42V DC ± 5%, C _L = 0 unless otherwise specified | Limits | | | Unit |
|--|---------------------|--|------------|------|-------------|-------|
| | | | Min. | Nom. | Max. | |
| Switching Frequency (F _S) | 1 2,3 | Sync. Input (Pin 4) open | 600 500 | 650 | 700 700 | KHz |
| Efficiency (E _{FF}) | 1,2,3 | I _{OUT} = 100 % Rated Load , Note 5 | 74 | | | % |
| Inhibit Input | | | | | | |
| Open Circuit Voltage | | Note 1 | 3.0 | | 5.0 | V |
| Drive Current (Sink) | | | | | 100 | μA |
| Voltage Range | | | | -0.5 | 50 | V |
| Synchronization Input | | | | | | |
| Frequency Range | 1,2,3 | Ext. Clock on Sync. Input (Pin 4), Note 1 | 600 | | 700 | KHz |
| Pulse High Level | | | 4.0 | | 10 | V |
| Pulse Low Level | | | -0.5 | | 0.5 | V |
| Pulse Transition Time | | | 40 | | | V/μs |
| Pulse Duty Cycle | | | 20 | | 80 | % |
| Current Limit Point Expressed as a Percentage of Full Rated Output Power | 1 | V _{OUT} = 90% of Nominal, Note 5 | 130 | | | % |
| Output Response to Step Load Changes (V _{TLD}) | 4 | Half Load to/from Full Load, Notes 5, 9 | -300 | | 300 | mV pk |
| Recovery Time, Step Load Changes (T _{TLD}) | 4 | Half Load to/from Full Load, Notes 5, 9, 10 | | | 100 | μs |
| Turn-on Response | | No Load, Full Load, Notes 5, 12 | | | | |
| Overshoot (V _{OS}) | 4,5,6 | | | | 10 | % |
| Turn-on Delay (T _{DLY}) | | | 1.0 | | 15 | ms |
| Capacitive Load (C _L) | 1 | I _{OUT} = 100% Rated Load, No effect on DC Performance, Notes 1,5,7 (main) (Each aux.Output) | | | 1000 200 | μF |
| Line Rejection | 1 | I _{OUT} = 100% Rated Load, DC to 50KHz, Notes 1, 5 | 40 | 60 | | dB |
| Isolation | 1 | Input to Output or Any Pin to Case except Pin 10, test @ 500VDC | 100 | | | MΩ |
| Device Weight | | | | | 100 | g |

For Notes to Electrical Performance Characteristics, refer to page 5

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) Although operation with no load is permissible, **light** loading on the main (+3.4V) output may cause the output voltage of the auxiliary outputs ($\pm 9.2V$) to drop out of regulation. It is therefore recommended that at least 450 mA or 10 percent of the total output power, whichever is greater, be taken from the main (+3.4V) output.
- 4) Although operation with no load is permissible, **heavy** loading on the main (+3.4V) output may cause the output voltage of the auxiliary outputs ($\pm 9.2V$) to rise out of regulation. It is therefore recommended that at least 20 percent of the total output power, whichever is greater, be taken from the auxiliary ($\pm 9.2V$) outputs.
- 5) Unless otherwise specified, "Rated" load is 15.3W on the main (+3.4V) output, 21.16W on the +9.2V output and 10.58W on the -9.2V output. Load currents of up to 6.0A on the 3.4V output, 2.3A on the +9.2V and 1.15A on the -9.2V output are acceptable as long as the total output power does not to exceed 50W.
- 6) Guaranteed for a D.C. to 20MHz bandwidth. Tested using a 20KHz to 10MHz bandwidth using the circuit shown on next page.
- 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 $\leq 10 \mu\text{sec}$.
- 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) The worst case loading condition is min load on the main (+3.4V) output and max load on the auxiliary ($\pm 9.2V$) outputs. In this case, the $\pm 9.2V$ output can be drop down to 7.9V.
- 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 3) to the point where $V_{OUT} = 90\%$ of nominal.
- 13) Load is varied for output under test while the remaining outputs are loaded at 50% of rated. Regulation relative to output voltage at 50% rated load.

Circuit for Measuring Output Ripple Voltage



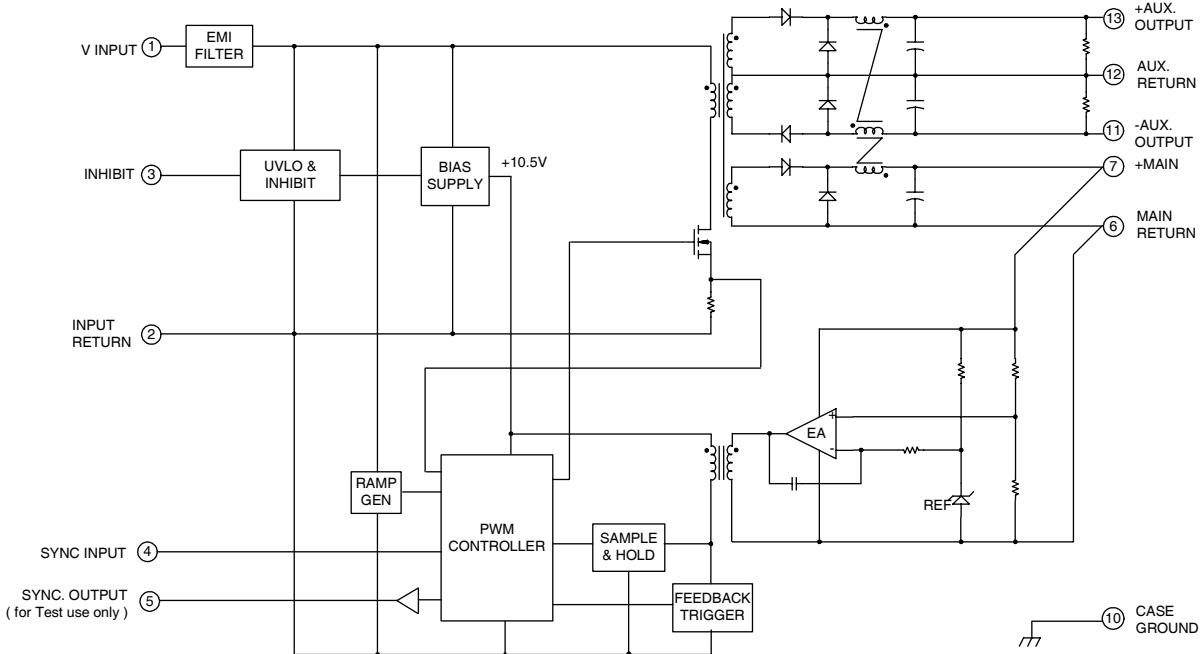
Device Screening

| Requirement | MIL-STD-883 Method | Test Conditions |
|------------------------------|----------------------------------|-----------------|
| Temperature Range | | -55°C to +125°C |
| Element Evaluation | | |
| Internal Visual | 2017 | Yes |
| Temperature Cycle | 1010 | Cond B |
| Constant Acceleration | 2001 | 500 Gs |
| Burn-In | 1015 | 48 hrs@ 125°C |
| Final Electrical (Group A) | MIL-PRF-38534 and Specifications | 25°C |
| Seal, Fine and Gross | 1014 | Cond A, C |
| External Visual | 2009 | Yes |

Notes:

- ① Best commercial practice

Block Diagram



Pin Designation

| Pin | Designation | Pin | Designation |
|-----|----------------------|-----|--------------------|
| 1 | +V Input | 8 | NC |
| 2 | Input Return | 9 | NC |
| 3 | Inhibit | 10 | Case Ground |
| 4 | Sync Input | 11 | -9.2V Output |
| 5 | Sync Output (T.P.) * | 12 | Aux. Output Return |
| 6 | Main Return | 13 | +9.2V Output |
| 7 | +3.4V Output | | |

* T.P. = Test Point

Mechanical Diagram

