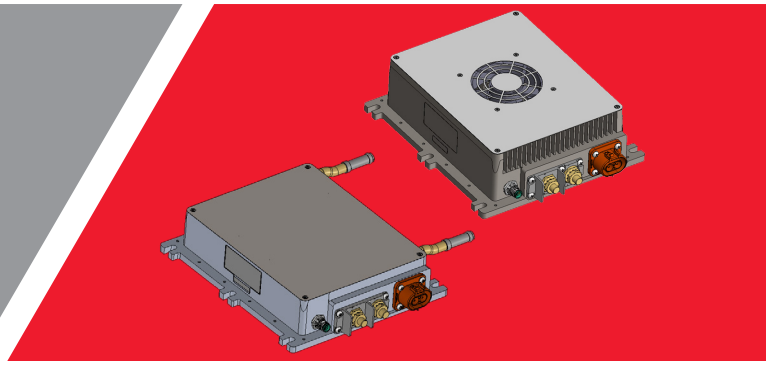
PRELIMINARY DEVELOPMENT SPECIFICATIONS

-SUBJECT TO CHANGE

sales@calex.com +1 (925) 687-4411

HVC Series

3kW DC-DC APM (Auxiliary Power Module)



Product Overview.

HVC series of 3 kW auxiliary power modules (APM) provide high performance under extreme conditions. The APM accepts input voltage from 230Vdc to 420Vdc and provides a single isolated 12Vdc output for powering auxilliary equipment.

The fully isolated low voltage supports positive or negative output polarity and associated grounding configurations.

HVC series are available in fan-cooled or liquid cooled rugged, fully IP rated, vibration resistant, thermally optimized enclosures. Threaded through holes to allow easy mounting or for the addition of a heatsink for extended temperature operation for further flexibility.

A comprehensive CAN 2.0B digital interface is provided.

The high efficiency and impressive power density are achieved by use of advanced circuit design including low-loss synchronous rectification technology, resulting in a highly reliable product for Industrial and e-mobility applications.

Features

- Wide 230-420 VDC High Side Voltage Input
- Supports 12Vdc battery configurations
- Efficiency >94%
- Liquid Cooled and Fan cooled configurations
- IP6K9K Ingress protection
- Excellent shock and vibration damping
- High power density
- Fully protected and recoverable from Over-Current, Short Circuit and Over-Temperature faults
- Highly Reliable
- SAE J1939 Protocol Via CAN Bus interface
- Dual Can bus digital interface

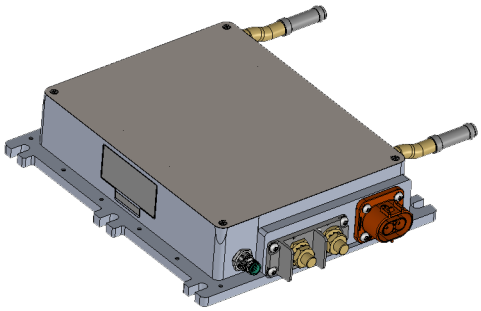
Table of Contents

HVC Series

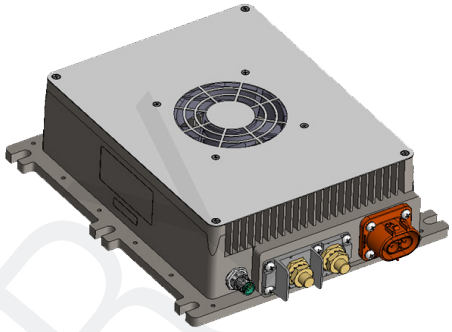
3kW DC/DC Auxiliary Power Module

ORDERING GUIDE

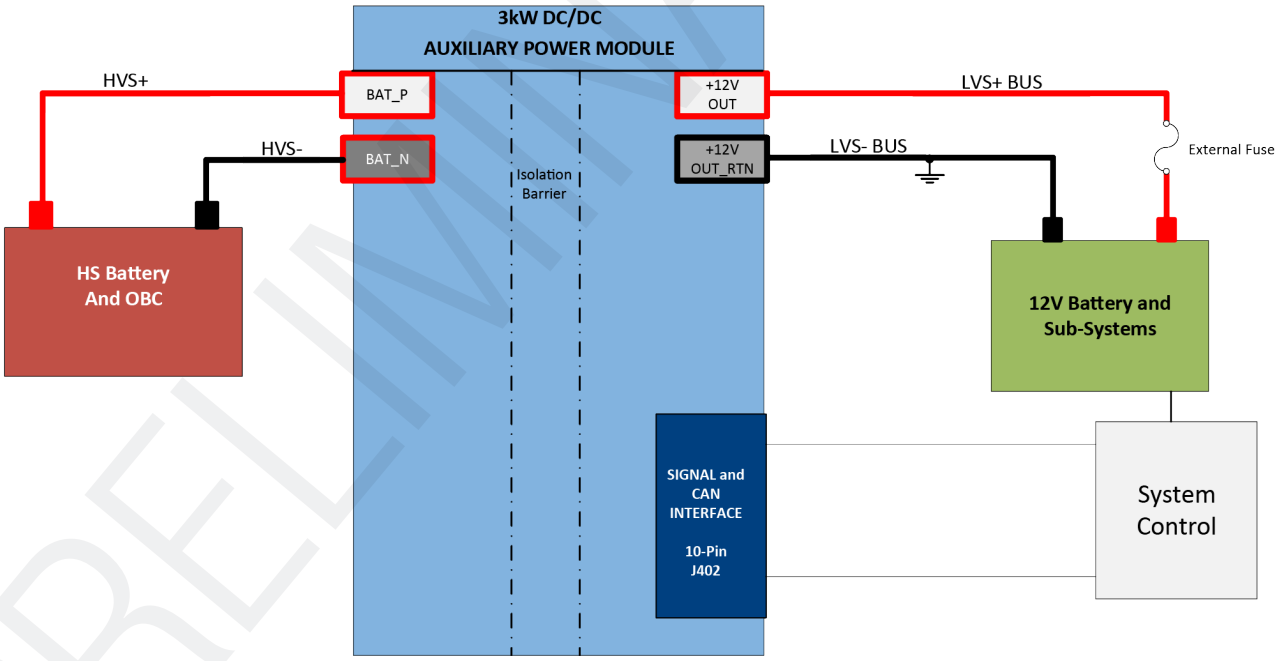
Model	Input Voltage	Output Voltage (Nom.)	Output Current	Configuration	Max. Output Power	Toronto Project#
400S12.3K0HVC-L	230-420	9-16VDC	250A	Liquid Cooled	3KW	M2101
400S12.3K0HVC-H	230-420	9-16VDC	250A	Fan Cooled	3KW	M2102



Liquid Cooled Model



Fan Cooled Model



Link to Application Wiring Configurations

Electrical Specifications

Note: All specifications are based on 25°C Ambient, Vin = 320Vdc Vout nominal load, unless otherwise specified

Parameter	Conditions		Min.	Typ.	Max.	Units
Input Characteristics						
Voltage Range			230		420	Vdc
Turn-on threshold	Default, ramping up		210		220	
Turn-off voltage	Default, ramping down		205		215	
Overvoltage Protection	Self Recoverable		421		437	Vdc
Input Current	(TBD) 100% full load; 220Vdc input			14.2		Adc
Peak Inrush Current	420Vdc input; cold start;excludes inrush due to EMI filter x-cap.) <200ms			20	50	Adc
Input Fuse	20A, 420V fast-acting, non-resettable					
Efficiency	Steady state operation, 25°C; Liquid Cooling Model; 50% max. load, Vin: Nominal (refer to Plot for typical performance example)			94		%
Output Characteristics						
Initial Voltage Set-Point	Vin=350Vdc; Iout 50% full load, constant current load.		11.7	12.0	12.4	Vdc
Voltage Range	Refer to Output Voltage vs Current curve for Voltage/Load characteristics (CAN programmable)		9	12	16	Vdc
Voltage Regulation[1]	% of Vout Set-Point		-2		+2	%
Output Ripple & Noise[1]	20MHz Bandwidth; Full load; Ripple and noise are measured with 0.1 µF of ceramic capacitance and 10 µF of tantalum capacitance on each of the power supply outputs. A short coaxial cable to the scope termination is used.				±120	mV p-p
Output Current range[1]			3		250	Adc
External Load Capacitance	Full load (resistive); -40 °C < Ta <+105 °C	CEXT	470		4700	µF
		ESR	10		100	mΩ
Over Current Protection (TBD)	Continuous retry = up to 6 times; vout UV (8.5V) brickwall and then latches-off		251		300	Adc
	CC Inception starting from ≥12V to 16V from 250A to 187.5A respectively. For vout < 12V down to 9V CC inception is 250A.					
	Brick wall Limit --> the greater of 3kW or 250A					
Short Circuit Protection	Refer to Output Voltage vs Current curve for Voltage/Load characteristics; (latch/retry configuration is can configurable)				560	Apk
Overvoltage Protection	Latching, requires input voltage recycle to clear latch		16		19	Vdc
Stand-by leakage current	HV input side, "command off" condition (Converter is disabled and in hibernation) 220Vin			1.3		ma
	LV input side, "command off" condition (Converter is disabled and in hibernation) 12V			4.4		
Output Turn-on delay	Output turn on time from application of input power			3164	5000	

Note: All specifications are based on 25°C Ambient, VIN = 320Vdc Vout nominal load, unless otherwise specified

[1] Operates safely under "no load" without shutting down, however a minimum load is required to meet output regulation and ripple specifications.

Isolation Characteristics

Parameter	Min.	Typ.	Max.	Units
Input to Output - Reinforced	4242			Vdc
Input to Chassis - Basic	2121			
Low Voltage Side Output return internally connected to Chassis	0			Vdc
Isolation Resistance; Test voltage (Class 0)	500			OHM/V

Environmental Characteristics

Parameter	Note	Min	Typ	Max	Units
Operating Temperature (Ambient)	Liquid Cooled	-40		+85	°C
	Fan Cooled	-40		+65	°C
Storage Temperature		-40		+85	°C
Over Temperature Shutdown	Liquid Cooled		90		°C
	Fan Cooled		69		°C
Coolant Temperature Range		-40		+65	°C
Liquid Cooling	50% water, 50% ethylene glycol			+65	°C
Coolant Flow Rate	Pressure drop <100mbar		6		L/min
Coolant Max Volume			6		L
Ingress Protection			IPC6K9K		
Product Life	Telcordia SR-332, Method I Case 1 50% electrical stress,40°C components; 27°C coolant, full load		10		Years
EMC requirements for electrical and electronic components/aggregates	The APM is designed to comply with the following sections of UN-ECE Regulation No. 10 Revision 4, as a component (Including Corr. 1, Amend 1 & 2 - July 2013): Section 6.5 - Broadband Electromagnetic Interference Generated by ESA's; CISPR 25, ALSE Method, 30MHz-1GHz Section 6.6 - Narrowband Electromagnetic Interference Generated by ESA's; CISPR 25, ALSE Method, 30MHz-1GHz Section 6.7 - Immunity of ESA's to Electromagnetic Radiation; ISO 11452-2, Absorber-lined shielded enclosure 200MHz-2GHz; ISO 11452-4; Bulk current injection 20-200MHz CISPR 25 - Conducted Emissions; 400VDC/7.5A Input test conditions Section 4.5 - Broadband Electromagnetic Emissions Radiated (ESA's): CISPR 12:2007 Method, 300MHz-1GHz, test limits per Section 4.5.2 (ESA Broadband reference limits) Section 4.6 - Narrowband Electromagnetic Emissions Radiated (ESA's): CISPR 12:2007 Method, 300MHz-1GHz, test limits per Section 4.6.2 (ESA Nroadband reference limits) Section 4.7 - Radiated Electromagnetic Field Method; Absorber-lined Chamber test method according to ISO 11451-2:2015: 30V/m test level; frequency range 20MHz-2GHz; (Horizontal & Vertical Polarity) Section 4.8 - Electrostatic Discharge (ESD); +/-6kV test level				

(CONTINUED):
Environmental Characteristics

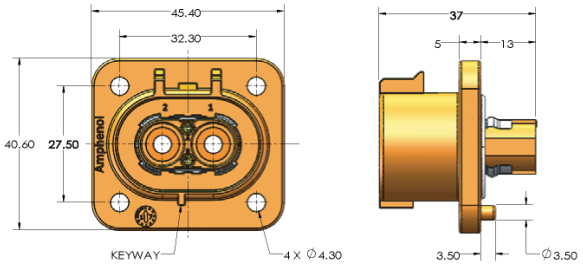
Parameter	Compliance
Shock and Vibration, Ingress	The APM is designed to meet the following environmental standards and test requirements applicable to body mounted (sprung masses) in passenger and commercial vehicles: ISO 16750-3 SECTION 4.1.3.2.3 - Random Vibration; 32 hours/axis in 3 axes ISO 16750-3 SECTION 4.2.2 - Mechanical Shock; 500 m/s^2, 6ms half-sine, 10 shocks per direction ISO 16750-3 SECTION 4.3 - Free Fall; 2 falls, steel plate from 1m ISO 16750-4 SECTION 5.1.1 - Low Temperature; -40°C for 24 hours ISO 16750-4 SECTION 5.1.2 - High Temperature; +85°C for 48 hours ISO 16750-4 SECTION 5.2 - Temperature Steps; -40°C to +70°C ISO 16750-4 SECTION 5.3.1 - Temperature Cycle; 30 cycles (240 hours) ISO 16750-4 SECTION 5.3.2- Rapid Change of Temperature; 300 cycles, 60 minutes at each extreme ISO 16750-4 SECTION 5.5.1 - Salt Spray, Corrosion; severity 4 ISO 16750-4 SECTION 5.5.2 - Salt Spray, Leakage and Function; severity 4 ISO 16750-4 SECTION 5.6 - Humid Heat, Cyclic; test No. 2, 10 cycles ISO 16750-4 SECTION 5.7 - Damp Heat; severity 1 ISO 16750-4 SECTION 5.8 - Mixed Flow Gas; Method 4, 21 days; non-operational ISO 20653 IP6KX - Dust Tight ISO 20653 IPX9K - High pressure/Steam-jet Cleaning
Regulatory Compliance	
Safety Agency Approvals	
Note: This product is not IATF/AECQ certified, contact Calex for additional details.	

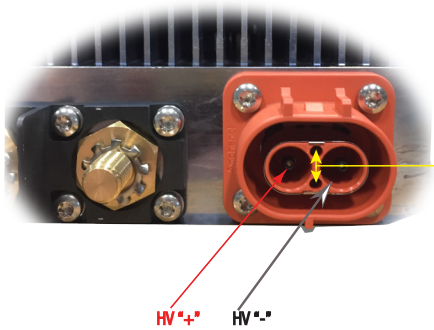
CAN Signal Reporting Accuracy					
Voltage, Input / Output	% Full-scale	-2		+2	%
Current, Input / Output t		-5		+5	%
Power, Input / Output		-10		+10	

Mechanical					
Weight	Liquid Cooled Model, excluding		4.9		kG
	Fan Cooled model		4.7		kG
Case Dimension	Liquid Cooled Model		267 x 240 x 59.2		mm
	Fan Cooled Model		267 x 240 x 70		

Connectors

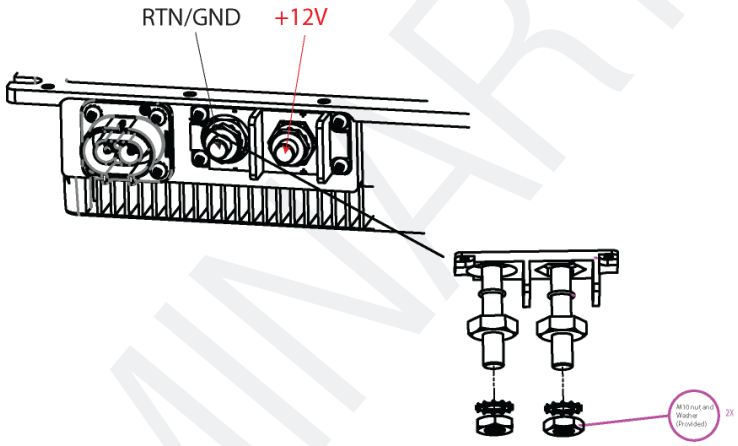
HS input (APM side) Amphenol ePOWER LITE P/N: C10-738025-2AP3; Mating connector: Amphenol ELP02A03





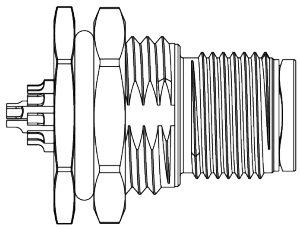
NOTE:
These HVIL pins must be connected / shorted together externally to enable operation of APM. The recommended Plug/Connector provides this short / connection interanlly.

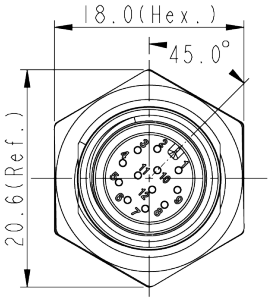
LS Output

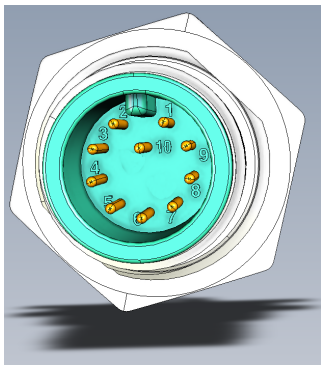


COMMUNICATIONS DETAILS

APM Side Signal Connector: AMPHENOL M12A-10PMMS-SF8001







Mating Signal Connector: Amphenol M12A-10BFFA-SL8001 (not shown)

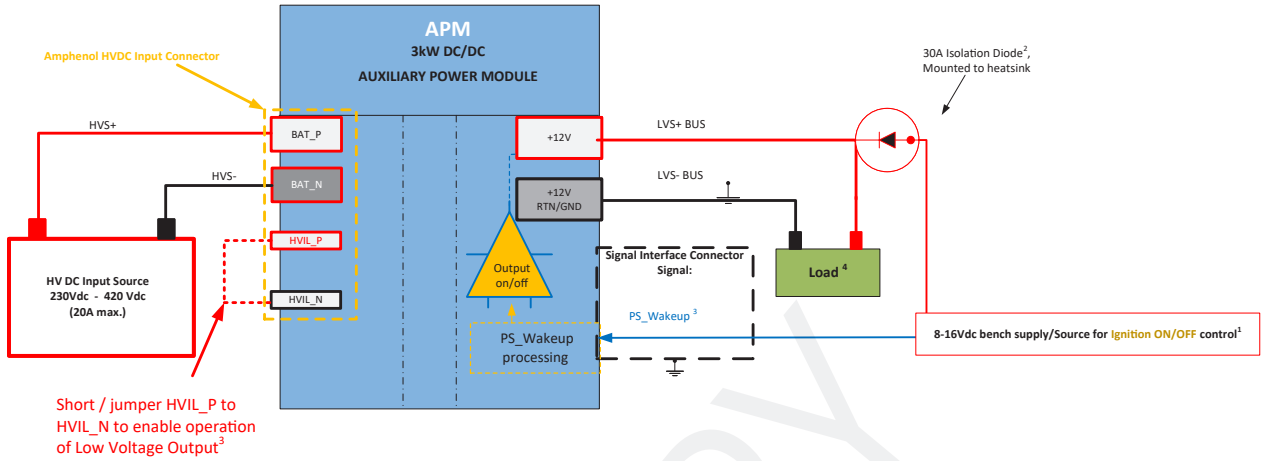
SIGNAL CHARACTERISTICS

Pin #	Signal Name	Input/Output	Description	Interface Details
1	PS_WAKEUP	Input	This signal is ground referenced and provides a method to enable/disable the APM 12V output. The auxiliary battery 8-16Vdc positive output must be applied this pin to enable the output.	Internally 3.3K Pull-down
2	+12V_OUT	Input	8-16V (from auxiliary battery)	
3	GND	Input	GND, internally connected to 12V Output RTN/GND	
4	CAN_SPEED	Input	CAN Bus speed selector: 0=250kbps, 1= 500kbps	Internally pulled up 100K to 3.3V
5	CAN_H	Bi-Directional	CAN A differential High line I/O – "High" in dominant state	
6	CAN_L	Bi-Directional	CAN A differential Low line I/O – "Low" in a dominant state	
7	CAN_H_B	Bi-Directional	CAN B differential High line I/O – "High" in dominant state	
8	CAN_L_B	Bi-Directional	CAN B differential Low line I/O – "Low" in a dominant state	
9	HVIL_P	Input	The High Voltage Interlock provide a method for the system/host to detect when the APM is connected or disconnected. The APM provides a passive 0 OHM pass-through between HVIL_P and HVIL_N pins. Refer to wiring diagram for application details	0 OHM link from HVIL_P to HVIL_N pins; maximum current: 30mA (exceeding this current may damage the OBC internal jumper/link)
10	HVIL_N	Output		

[1] a 250A external fuse must be connected between the 12V main output of the APM and battery connection

Wiring Diagrams

Basic Configuration, Operation without Auxiliary Battery



Connection Notes:

This configuration is useful to operate the APM without the Aux. Battery and provides the constant current HVIL source, PS_Wa keup signal and also provide the minimum load required to enable operation of the APM's output.

1) External DC power supply (8-16Vdc @ 3-5A, should also have adjustable current limit as a precaution):

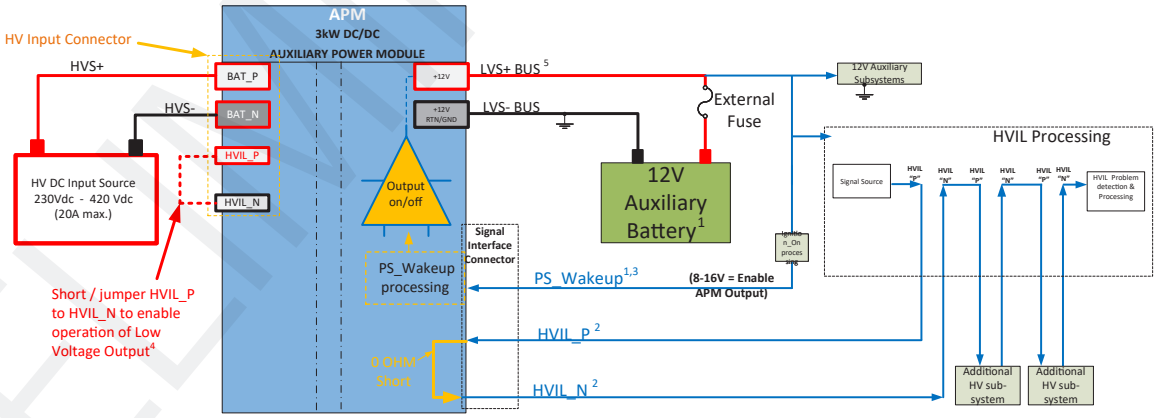
- Provides a voltage source at the output of the APM to start-up internal housekeeping circuits that would normally be supplied by the auxiliary battery
- Provides the 8-16Vdc input voltage for the "PS_WAKEUP" signal
- Provides a current source, required by the HVIL via two external resistors. This circuit mimics the 10-20ma constant current source typically provided by the vehicle's HVIL watchdog circuitry

2) The output Isolation diode protects the DC bench power supply from the harmful effects of reverse voltage. Since the diode is for ward biased (provides 2A minimum load to the APM), it should be mounted to a heatsink. A 20A diode is recommended.

3) PS_WAKEUP requires 8-16Vdc input to enable output operation, sourced by the same DC bench power supply

4) APM output load current should be ≥ 2A to For jitter-free output voltage. The APM will start-up and operate safely at lower load current however the output voltage may vary up and down slightly

Basic Configuration with Auxiliary Battery



Connection Notes:

This configuration illustrates the APM Configuration in typical applications, auxiliary battery / typical application system

1) Auxiliary battery:

- Provides The low voltage power source necessary to operate the low voltage system side and internal APM circuits, with or without presence of the HV / Motive battery
- Provides the voltage for the "PS_WAKEUP" signal, to enable APM operation either directly or via system / ECU processing such as Ignition sensing/processing

2) APM HVIL is a 0-OHM passthrough from HVIL_P to HVIL_N and provides a passive indication of APM connection within the HVIL system. There is no active processing of HVIL with APM

3) PS_WAKEUP requires 8-16Vdc input to enable output operation

4) The datasheet recommended input plug features a built in jumper across the HVIL pins therefore no further accommodations are needed for HVIL in that case

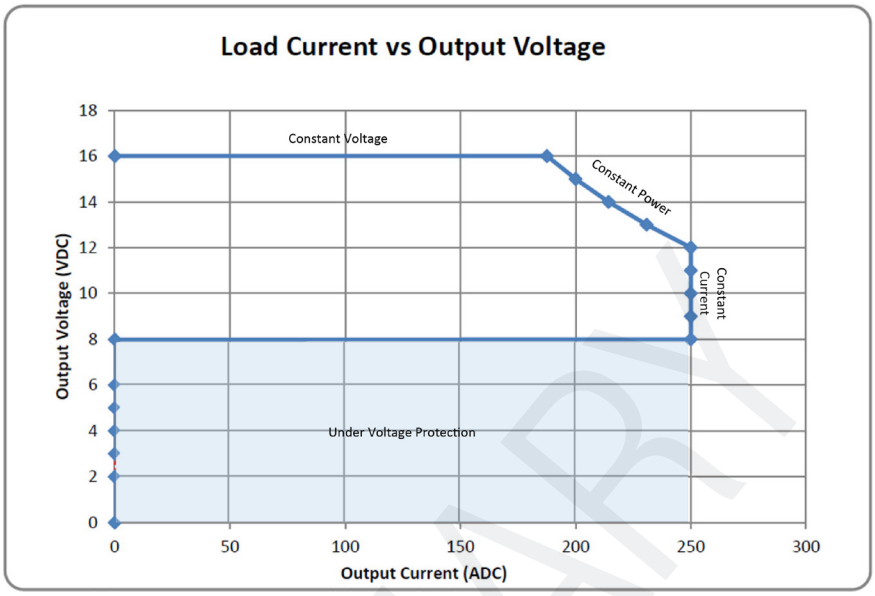
5) APM output load current should be ≥ 2A to For jitter-free output voltage. The APM will start-up and operate safely at lower load current however the output voltage may vary up and down slightly

Link Back to Page 2

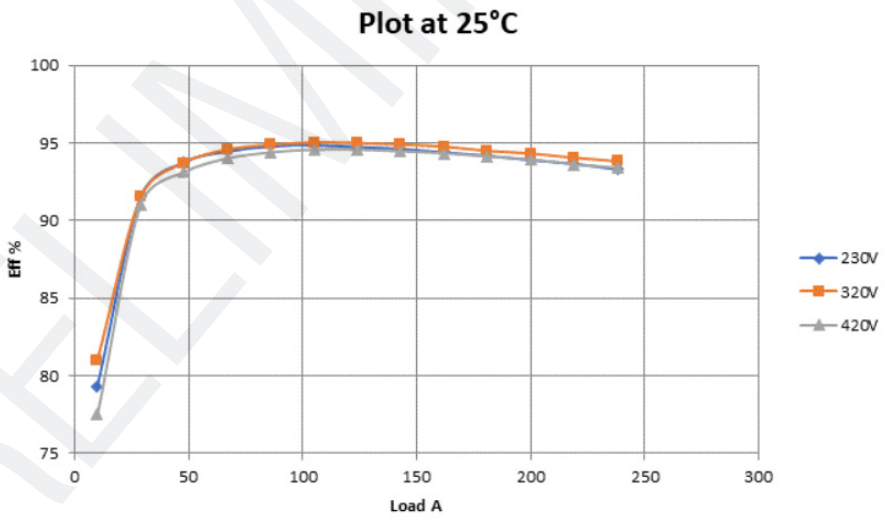
Typical Performance Characteristics

Output Voltage vs Load Current Operating Area

Link back to "Output Voltage"

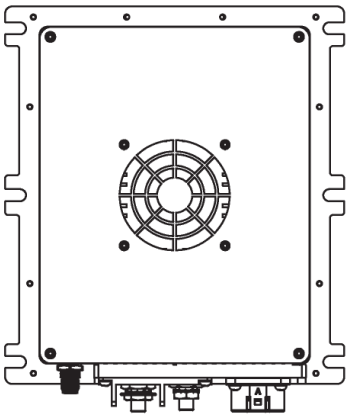


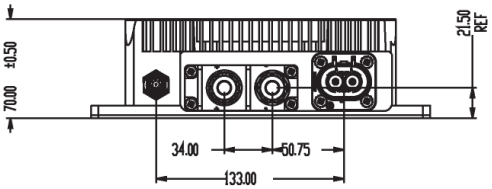
Efficiency vs Load Current Plot

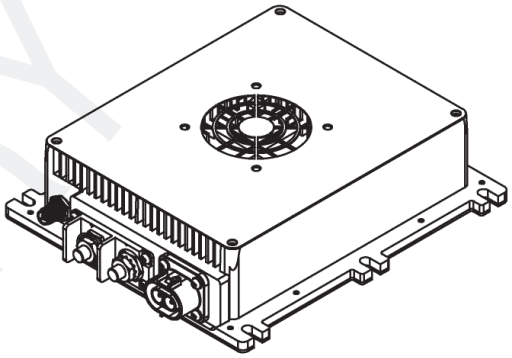


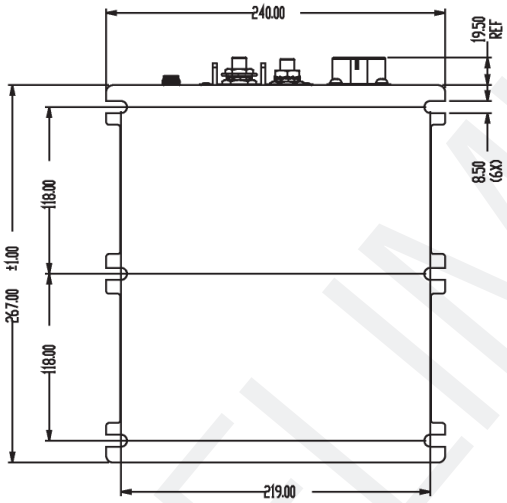
MECHANICAL SPECIFICATIONS

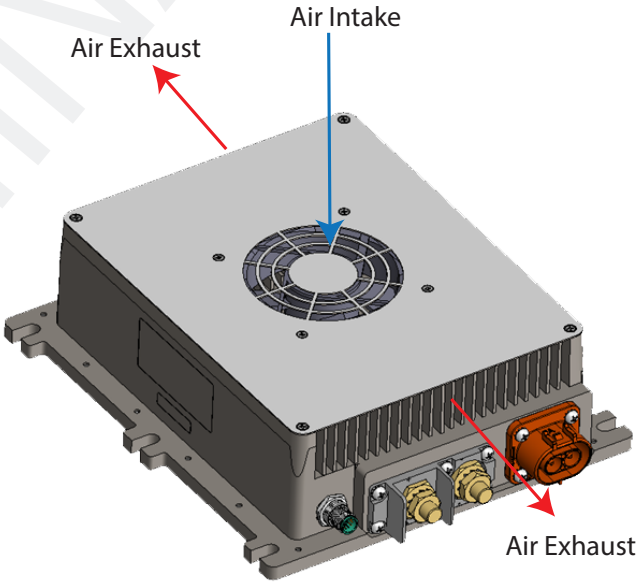
FAN COOLED MODEL: 400S12.3K0HVC-H







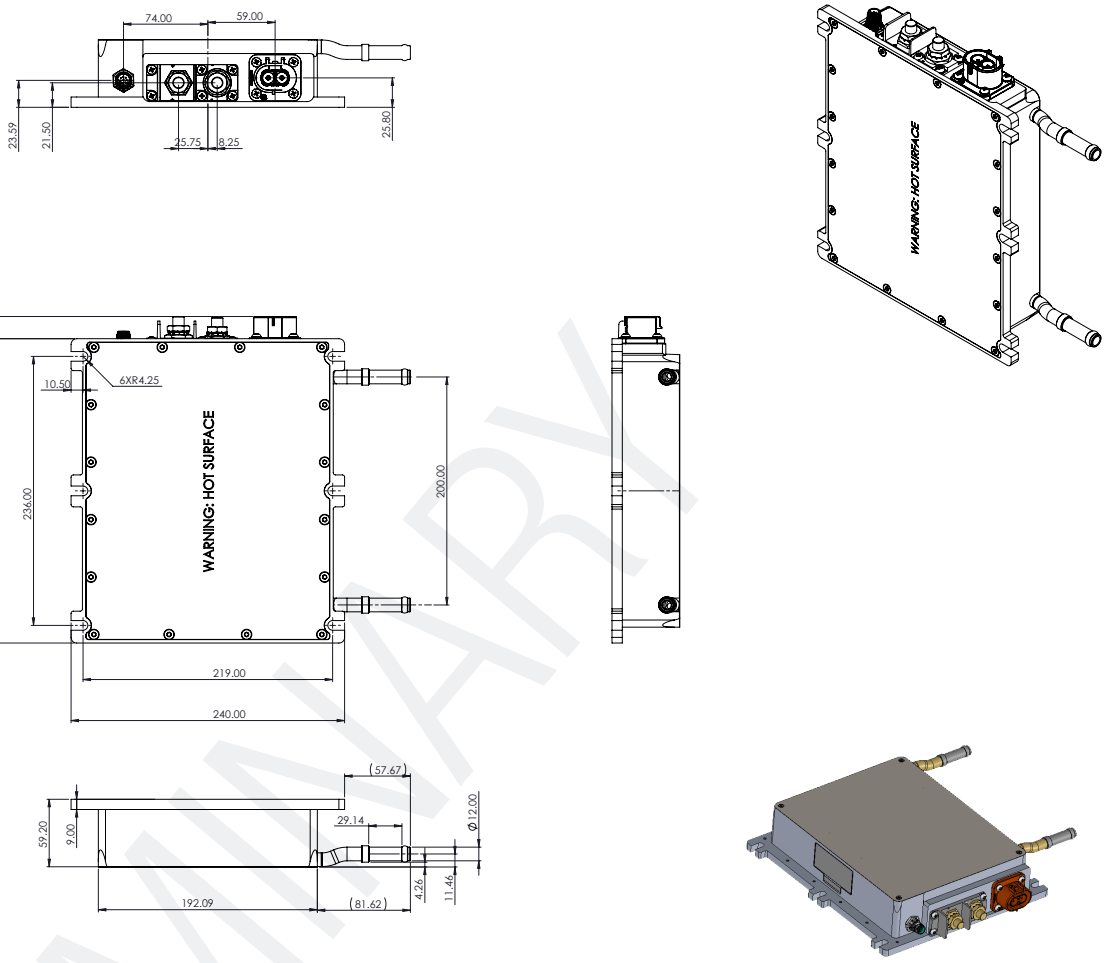




1. Reference file:750-000-2102-1 Rev R1
2. This drawing is a graphical representation of the product and may not show all fine details. Please contact Murata for 3D model for details
3. May be mounting Horizontally or Vertically provided airflow is not obstructed. Minimum clearance between surface and any obstruction for airflow cooling:
   - ≥30mm air intake surface
   - ≥100mmair exhaust surfaces.

MECHANICAL SPECIFICATIONS

LIQUID COOLED MODEL: 400S12.3K0HVC-L



1. Reference file:750-000-2101-2 Rev R
2. This drawing is a graphical representation of the product and may not show all fine details. Please contact Murata for 3D model for details
3. Fits 12mm Coolant hose
4. May be mounted in any vertical or horizontal orientation