

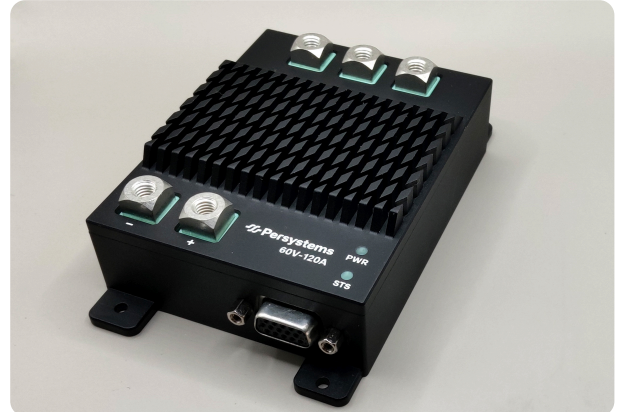
INV-60V-120A

7.5 kW air-cooled inverter for PMSM and BLDC drives · 17 – 60 V · 120 A continuous

The INV-60V-120A is a compact low-voltage three-phase inverter for sensorless field-oriented control of PMSM and BLDC motors. It combines a low-loss 80 V MOSFET power stage with a hybrid polymer/ceramic DC link and an anodized aluminium heat-sink housing. Designed for high continuous current under restricted cooling, it is used in UAV propulsion, robotics, light electric vehicles and industrial drives.

Key features

- **7.5 kW continuous, 10 kW boost** (180 s) at 60 V
- **120 A rms continuous phase current**, 163 A rms in boost mode (180 s)
- **Wide DC input 17 – 60 V**, absolute maximum 60 V
- **Sensorless FOC** with torque and speed control, field weakening and MTPA
- **50 kHz PWM** for low-inductance motors, reducing motor losses by up to 5 %
- **Isolated CAN** (1 Mbit/s) with DroneCAN and Persystems protocol, isolated PWM / PPM throttle input
- **Full protection suite**: overcurrent, short circuit, overtemperature, undervoltage, sensor fault
- **Real-time telemetry and logging** over CAN, configuration tool for commissioning
- **Three variants**: case (337 g), embedded board (154 g), Aero board (108 g)



INV-60V-120A, case variant with M6 terminals and D-SUB 15 HD signal connector

7.5 kW

continuous electrical power at 60 V

120 A rms

continuous phase current

17 – 60 V

DC bus voltage range

50 kHz

PWM switching frequency

1. General data

Parameter	Value	Notes
Product name	INV-60V-120A	-C case · -E embedded board · -A Aero board
Product type	3-phase voltage-source inverter	PMSM / BLDC (BLAC) motors
DC-link capacitance	1.8 mF polymer hybrid + 150 µF ceramic	10 × 180 µF hybrid, 15 × 10 µF MLCC
Control interfaces	CAN (isolated), PWM / PPM	see section 7
Cooling concept	Air cooled	heat-sink fins (case) or cooling plate / heat sink (board variants)
Status indication	2 LEDs (PWR, STS)	case and embedded variants

2. Electrical ratings

Parameter	Symbol	Value	Unit	Notes
Nominal DC bus voltage	$U_{DC,nom}$	48	V	nominal system voltage
Operating DC bus voltage range	U_{DC}	17 – 60	V	
Absolute maximum DC bus voltage	$U_{DC,max}$	60	V	hard limit incl. transients; components not rated above
Continuous phase current (rms)	$I_{ph,cont}$	120	A	≈ 170 A phase peak
Boost phase current (rms)	$I_{ph,boost}$	163	A	230 A phase peak, boost mode, for t = 180 s
Continuous electrical power	P_{cont}	7.5	kW	at 60 V; 6 kW at 48 V
Boost electrical power	P_{boost}	10	kW	at 60 V, for t = 180 s; 8 kW at 48 V
PWM switching frequency	f_{PWM}	50	kHz	standard setting; other settings on request
Maximum electrical output frequency	$f_{el,max}$	2 500	Hz	≈ 150 000 eRPM; 20 PWM periods per electrical revolution
Switching topology		3-phase bridge		6 × MOSFET, hard switched
Supported motor types		PMSM / BLDC		sinusoidal or trapezoidal back-EMF

3. Control and motor compatibility

Parameter	Value	Notes
Control modes	Torque control, speed control	setpoint via CAN or PWM / PPM
Commutation	FOC (field-oriented control)	sinusoidal currents, MTPA trajectory
Rotor position sensing	Sensorless	no position sensor required; D-SUB sensor inputs reserved
Motor temperature input	NTC, PTC or other analog sensor	any analog temperature sensor; configurable evaluation, monitoring and derating
Field weakening	Yes	automatic above base speed
Maximum speed limit	Configurable	set internally, reported as RPM_max on CAN
Parameter configuration	CAN / configuration tool	setup, commissioning, firmware update over CAN
Data logging	Real-time current / voltage logging	via configuration tool; error log over CAN

4. Protection and safety functions

Function	Value	Notes
Overcurrent protection	Yes	hardware and software protection, error log entry on trip
Short-circuit protection	Yes	inverter output short-circuit protection
Overtemperature protection	Yes	inverter (MOSFET-near sensor) and motor temperature, with derating
Undervoltage protection	Yes	undervoltage condition is detected and handled
Sensor fault detection	Yes	motor temperature sensor monitoring
Throttle signal monitoring	Yes	PPM invalid, timeout, inversion fault and noisy-signal detection
Safe shutdown behaviour	Yes	Safe Torque Off (freewheeling) or Active Short Circuit, selectable
Arming logic	Yes	arm / disarm via CAN broadcast; optional auto-arm on valid input

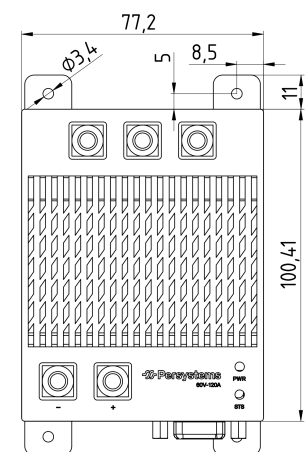
5. Thermal and environmental data

Parameter	Symbol	Value	Unit	Notes
Cooling type		Air cooled		rated values measured without forced airflow, mounted on a cooling plate
Operating ambient temperature	T_{amb}	-20 – 50	°C	
Storage temperature range	T_{stg}	-20 – 60	°C	preliminary
Maximum heat-sink temperature	$T_{HS,max}$	65	°C	preliminary
Maximum internal temperature	$T_{int,max}$	90	°C	measured near the transistors; protective derating above
Thermal derating		Yes		output current reduced automatically above the thermal limit
Ingress protection		on request		IP-rated housing available for the case variant

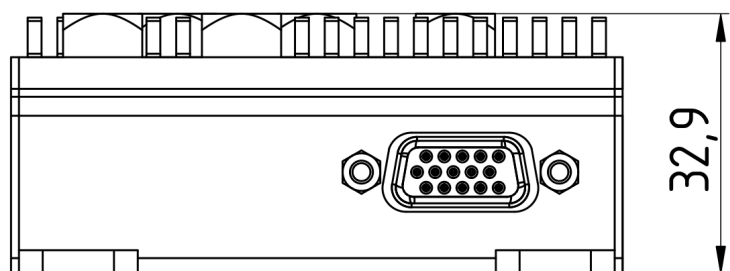
6. Mechanical data

Parameter	Case (-C)	Embedded (-E)	Aero (-A)	Notes
Dimensions L × W × H	100.4 × 77.2 × 32.9 mm	77 × 65 mm footprint	77 × 65 × 33.5 mm	case incl. mounting tabs; Aero incl. capacitors
Weight	337 g	154 g	108 g	measured; optional Aero heat sink ≈ 90 g
Housing	anodized aluminium, fins	none	none	boards mount on a cooling plate or the optional heat sink
Power connection	M6 studs	M6 studs	AWG 10 leads	see section 7
Mounting	4 × Ø 3.4 mm	4 × through holes	4 × through holes	conductive base plate recommended

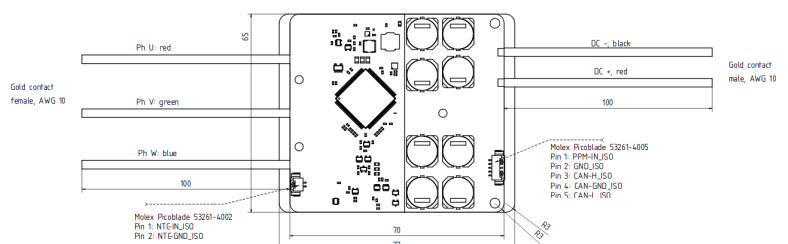
6.1 Dimensional drawings



Case variant, top view (mm)



Case variant, connector side (mm)



Aero variant, top view with lead and connector assignment (mm)

7. Interfaces

7.1 Power connections

Terminal	Signal	Case variant	Embedded variant	Aero variant
DC+	DC bus positive	M6 stud terminal	M6 stud terminal	lead, AWG 10, red, 100 mm, gold contact male
DC-	DC bus negative	M6 stud terminal	M6 stud terminal	lead, AWG 10, black, 100 mm, gold contact male
U · V · W	Motor phases	M6 stud terminals	M6 stud terminals	leads, AWG 10, red / green / blue, 100 mm, gold contact female

7.2 Signal connector, case and embedded variants (D-SUB 15 HD female)

Pin	Signal	Function	Pin	Signal	Function
1	CAN_H	CAN high (isolated)	9	CAN_GND	CAN reference ground
2	CAN_L	CAN low (isolated)	10	ENABLE	Enable input
3	PWM_IN	PWM / PPM throttle input	11	BAT-	Battery minus, case ground
4	TMP_M	Motor temperature sensor (NTC, PTC or other analog sensor)	12	HALL_W	Hall sensor W ¹
5	HALL_V	Hall sensor V ¹	13	HALL_U	Hall sensor U ¹
6	UV_EXT	Sensor supply 3.3 V / 5.0 V, 100 mA	14	AGND	Analog ground, Hall ground
7	POS_COS	Position sensor cosine (ADC) ¹	15	POS_SIN	Position sensor sine (ADC) ¹
8	AUX	Auxiliary digital input			

¹ Sensor inputs are present on the connector; sensor-based control modes are available as a firmware variant on request. Standard firmware runs sensorless.

7.3 Communication connector, Aero variant

Molex PicoBlade 53261-4005, 1.25 mm pitch

Pin	Signal	Description
1	PPM_IN_ISO	Isolated PPM / PWM input
2	GND_ISO	Isolated signal ground
3	CAN_H_ISO	Isolated CAN high
4	CAN_GND_ISO	Isolated CAN reference ground
5	CAN_L_ISO	Isolated CAN low

7.4 Sensor connector, Aero variant

Molex PicoBlade 53261-4002, 1.25 mm pitch

Pin	Signal	Description
1	NTC_IN_ISO	Motor temperature sensor input (NTC, PTC or other analog sensor)
2	NTC_GND_ISO	Temperature sensor ground

7.5 Auxiliary I/O, case and embedded variants

Resource	Specification
Analog inputs	3 × ADC, 0 – 5 V
Digital inputs	5 × GPIO, 3.3 V or 5 V
Sensor supply	3.3 V / 5.0 V, 100 mA, configurable
Extension header	SPI, PWM, GPIO, 3.3 V, AGND (internal)

7. Interfaces (continued)

7.6 Interface characteristics

Parameter	Specification
CAN protocols	DroneCAN, Persystems CAN protocol
CAN bit rate	1 Mbit/s standard, other rates on request
CAN termination	on-board 120 Ω , switchable
CAN isolation	galvanically isolated transceiver
CAN bus protection	ESD diodes PESD2CANFD24VQB-Q
PWM / PPM input	galvanically isolated

8. CAN interface

The inverter supports two CAN protocols, selectable by configuration:

- **DroneCAN** for direct integration with flight controllers such as ArduPilot.
- **Persystems CAN protocol** with full access to setpoints, parameters, telemetry and firmware update, summarised below.

8.1 Persystems CAN protocol

CAN 2.0B with 29-bit extended identifiers at 1 Mbit/s. The device address n is set in the identifier; the default device ID is 0x0A000000. Broadcast commands on 0x01000000 reach all devices on the bus. The full protocol description, including parameter access and firmware update, is available in the CAN protocol document.

Identifier	Cycle	Content (4 × 16-bit values unless noted)
0x0n000000	command	Setpoint and parameter write, e.g. speed setpoint in rpm or AutoArmOnInput
0x01000000	command	Broadcast: disarm, arm, trigger error log
0x1n000003	100 ms	Phase current rms, filtered DC current, DC voltage ($\times 0.1$), MOSFET temperature ($\times 0.01$)
0x1n000005	10 ms	Armed, inverted, throttle state, valid flag, raw and processed PPM signal
0x1n000006 / 07	100 ms	I_d , I_q actual and target · U_d , U_q and controller integrals
0x1n000008	100 ms	Motion-control state (STO, waiting for setpoint, control active, hard fault), error state, cycle-time quality, firmware version
0x1n00000C	100 ms	Speed actual, target and maximum (rpm), torque actual ($\times 0.001$)
0x1n00000F	on request	Error log (also sent automatically on overcurrent)
0x1n000013	100 ms	Motor temperature ($\times 0.01$)

9. Test conditions

Parameter	Value
Ambient temperature	25 °C
DC bus voltage	48 V and 60 V
Cooling condition	no forced airflow, natural convection
Validation motor	sensorless PMSM / BLDC test motor
PWM frequency	50 kHz
Mounting condition	mounted to thermally conductive base plate
Power measurement	Yokogawa WT3000 power analyzer, DC input and motor phases

10. Notes

- Values are subject to change without notice. Values marked preliminary are under qualification.
- Continuous ratings depend on thermal boundary conditions and mounting configuration.
- Peak ratings are valid only for the specified duration starting from thermal steady state at the continuous rating.
- Interface behaviour and limits are defined in the integration manual and the CAN protocol document.
- Customer-specific variants may differ from the standard version.
- The customer is responsible for the safety of the overall system; see the General Terms and Conditions, § 8.

11. Firmware security

The inverter only runs firmware that verifiably originates from Persystems. Firmware images cannot be read or modified in transit. The security concept is aligned with the EU Cyber Resilience Act and is currently being implemented; details on request.

Feature	Implementation
Signature	ECDSA P-256 with SHA-256, verified on the device before every activation
Encryption	AES-128, individual key per firmware image
Rollback protection	Security version in every image; older images are rejected even with a valid signature
Device groups	Separate keys per customer and country. On request we set up additional groups, e.g. per project, fleet or site, so that a security incident stays confined to one group. Group keys can be replaced without touching the devices.
Key management	Hardware security modules, offline root key, tamper-evident signing log
Update safety	Staging area, full verification before activation, power-fail safe
Production	Programming and key provisioning exclusively at Persystems; complete device register
Verification	Status query over CAN: serial number, device group, lock state and versions
Regulation	Aligned with the EU Cyber Resilience Act, Regulation (EU) 2024/2847