

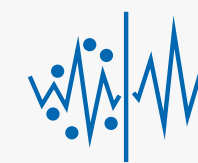


The Kepler series is designed for demanding applications requiring high linearity and a very low output current ripple. This used to be the exclusive domain of linear amplifiers, but Prodrive Technologies uses its extensive experience in amplifier technology to introduce a PWM drive with negligible switching noise that matches linear drive performance. The Kepler motor drives offer world-class linearity and switching noise. Due to internal output filtering and EMI protections, the drive can operate with a minimal number of external components.

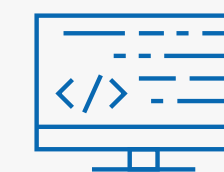
Kepler drives have an integrated Prodrive Motion Platform (PMP) motion controller. PMP is a highly flexible platform that is being used in many applications, ranging from personal transportation solutions to semiconductor industry. The PMP tooling ensures fast and effortless commissioning, while motion applications benefit from a powerful API and real-time control.

## Kepler D3-200/4-S

- Internal (S) / external (-) auxiliary power supply
- Rated phase current (continuous)
- Rated supply voltage
- Number of output phases
- Number of outputs (Single/Dual)
- Drive series



Integrated filtering



Programmable PMP motion controller via MATLAB Simulink integration



High precision Low Noise



Wide range of connectivity options

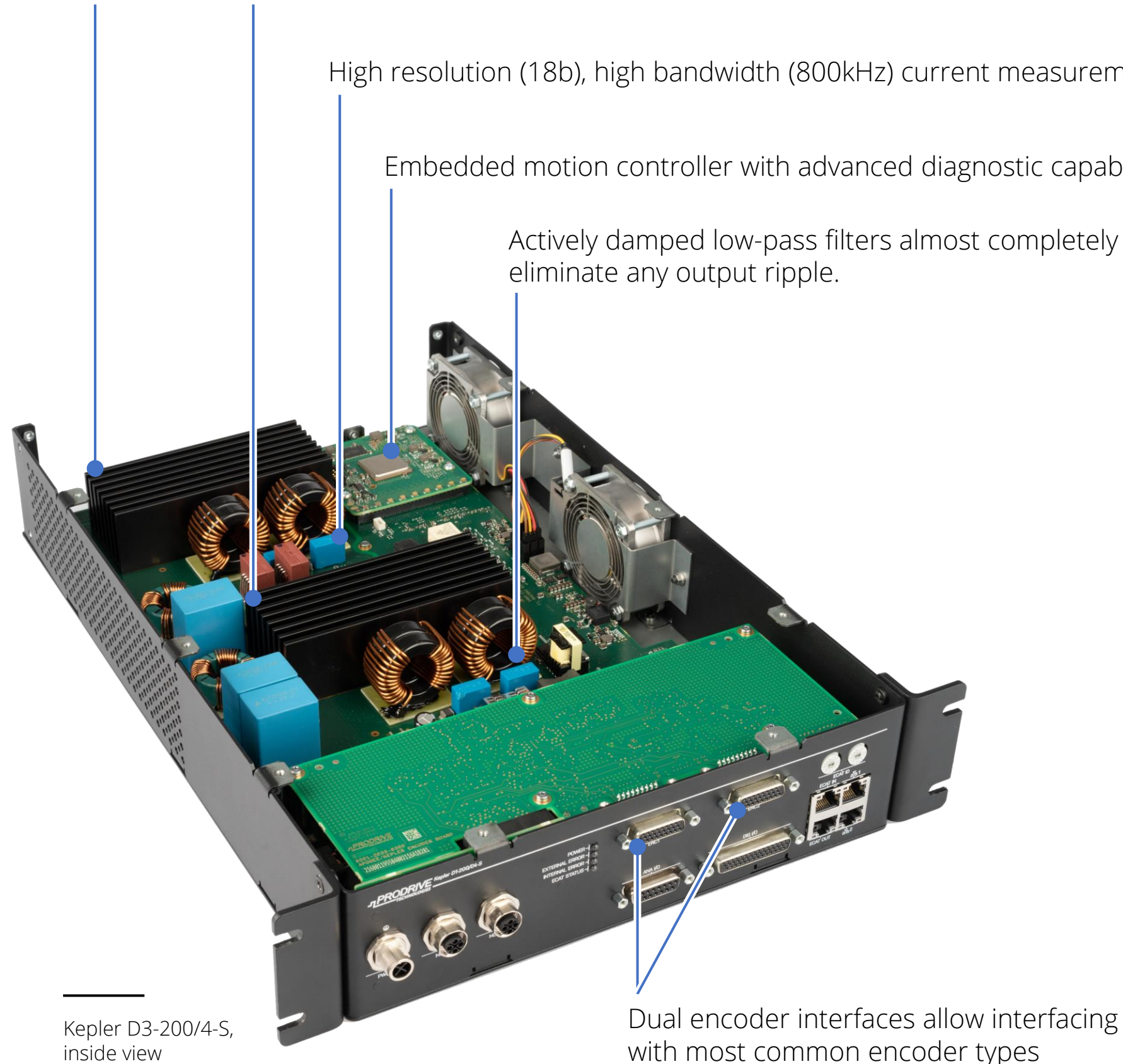
# KEPLER LINE – FEATURES

Dual, high-performance 200kHz power stages with Integrated thermal solution

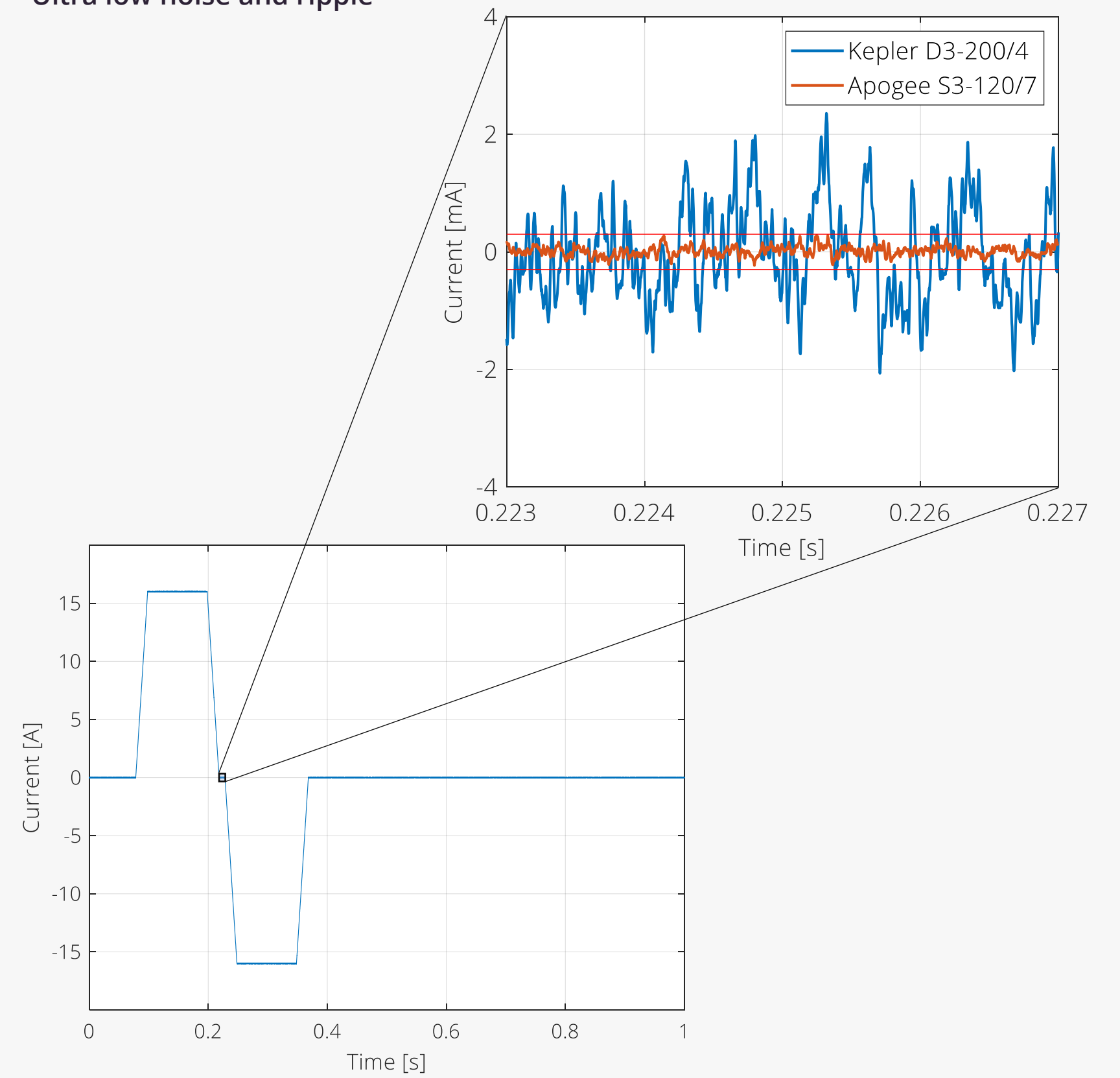
High resolution (18b), high bandwidth (800kHz) current measurement circuit

Embedded motion controller with advanced diagnostic capabilities

Actively damped low-pass filters almost completely eliminate any output ripple.

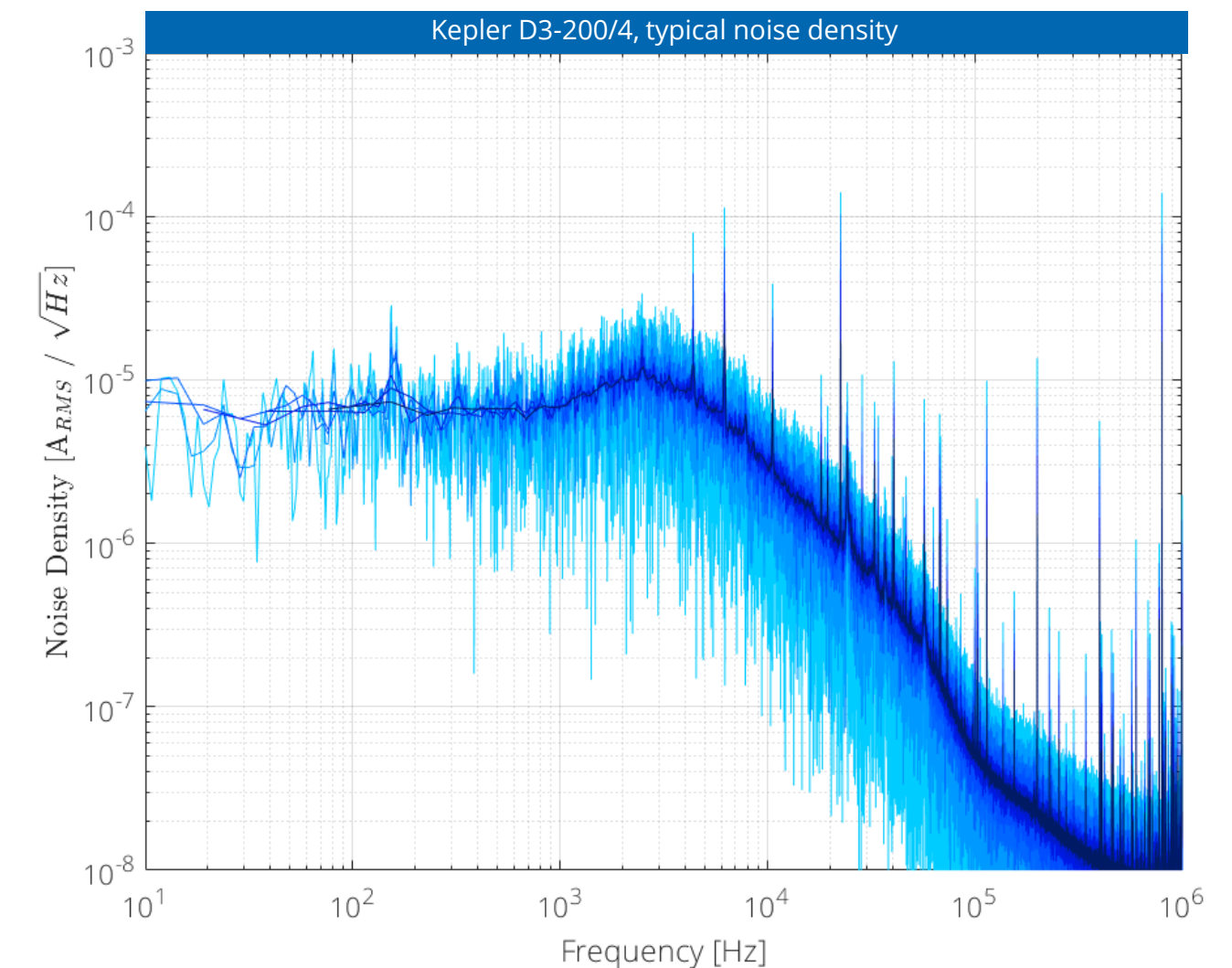


## Ultra low noise and ripple



# KEPLER LINE – PERFORMANCE SPECIFICATIONS

	Parameter	Symbol	Unit	D1-200/4	D3-200/4	Remark
Input	Supply input voltage	$V_{SUPPLY}$	V	2x30 to 2x100		Balanced supply
	Supply input voltage, abs. max	$V_{SUPPLY\_ABS\_MAX}$	$V_{DC}$	2x110		
	Peak input current	$I_{SUPPLY\_PEAK}$	$A_{PK}$	max 21		
	Continuous input current	$I_{SUPPLY\_CONT}$	$A_{RMS}$	max 9		
	Auxiliary input voltage	$V_{SUPPLY\_AUX}$	V	22 - 26		for version without -S suffix
	Auxiliary input current	$I_{AUX\_RMS}$	$A_{RMS}$	2		
Output	Number of motor outputs	$n_{MOT}$	-	2	2	
	Supported motor types		-	voice coil	3-phase PMSM/BLDC	
	Peak phase current	$I_{PH\_PK}$	$A_{PK}$	20		
	Continuous phase current	$I_{PH\_CONT}$	$A_{RMS}$	4,0		
	Peak phase-phase voltage range	$V_{PHPH\_PEAK}$	$V_{PK}$	0 - 180		$V_{SUPPLY} = 2x60VDC$
			$V_{RMS}$	0 - 120		
	Current loop, small signal bandwidth	$f_{-3dB}$	kHz	2 - 4		-3dB, typical value
	Rated switching frequency	$f_{PWM}$	kHz	200		
	Output frequency	$f_{MOT}$	Hz	0 - 595		dual use limited, see note
	Electrical braking function		-	Yes		shorts motor phases together
	External brake resistor		-	No		
	Internal brake resistor		-	No	Yes	
	Accuracy	Offset	$E_{MOT\_OFFSET}$	% of $I_{PH\_PK}$	<0,25	
Offset drift		$E_{MOT\_OFFSET\_DRIFT}$	% of $I_{PH\_PK}$	<0,07		
Gain error		$E_{MOT\_GAIN}$	% of $I_{PH\_PK}$	<0,82		
Gain error drift		$E_{MOT\_GAIN\_DRIFT}$	ppm of $I_{PK}$	<1500		
Non-linearity		$E_{MOT\_NONL}$	ppm of $I_{PK}$	<550		
Noise	Noise (spectral density @100Hz)	$I_{NOISE\_LF}$	$\mu A/Hz$	max 20		
	Noise (rms, 1Hz-10kHz)	$I_{NOISE\_100kHz}$	$\mu A_{RMS}$	max 600		
	Ripple	$I_{MOT\_RIPPLE}$	$\mu A_{RMS}$	350		2mH phase inductance, $\pm 48V$
Control	Interface type		-	GbE		
				EtherCAT		
				RS422		50Mbps max
	Update rate	$f_{ECAT}$	-	100Hz - 20kHz		
Diagnostic interface		-	GbE			



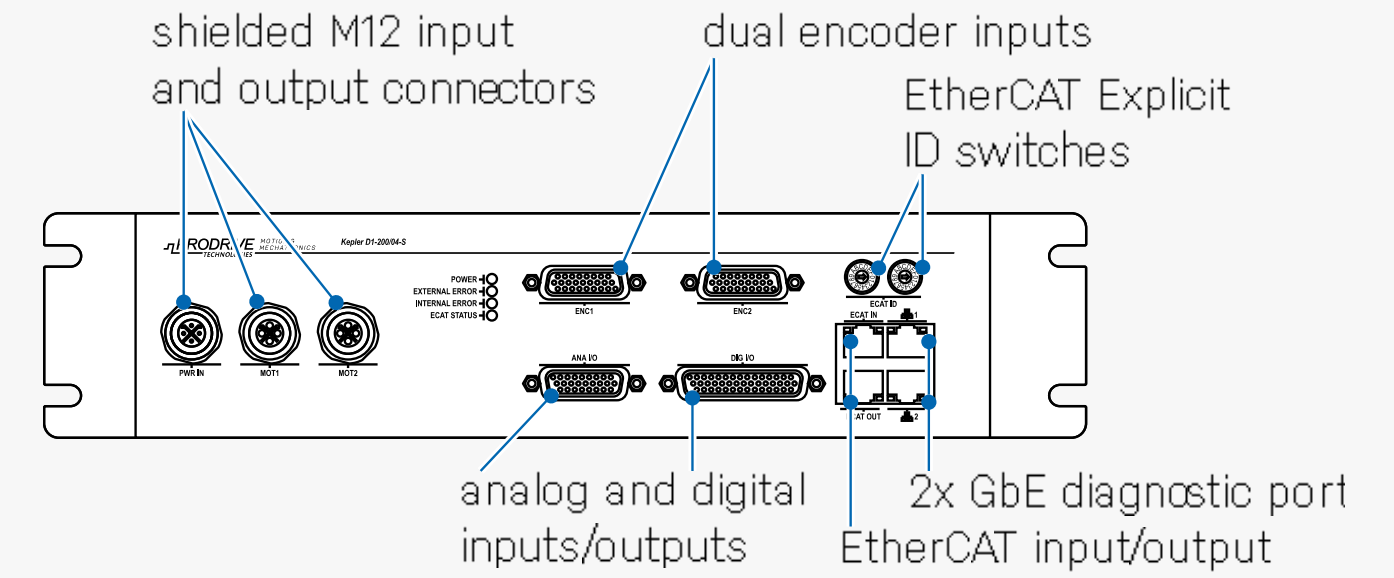
	Parameter	Symbol	Unit	D1-200/4	D3-200/4	Remark
Safety	Applicable standard		-	IEC/UL61800-5-1		TüV certified
	Pollution degree	PD	-	2		
	Overtoltage category	OVC	-	I		
	IP-protection class / enclosure type		-	IP20 / open type		
	Max operating altitude	$h_{OP\_max}$	m	2000		above mean sea level
	STO / SBC outputs		-			
EMC	Applicable standard		-	IEC61800-3		
	Input filtering		-	Cat C2, 2nd env		
	Output filtering		-	Actively damped LC		

## Notes:

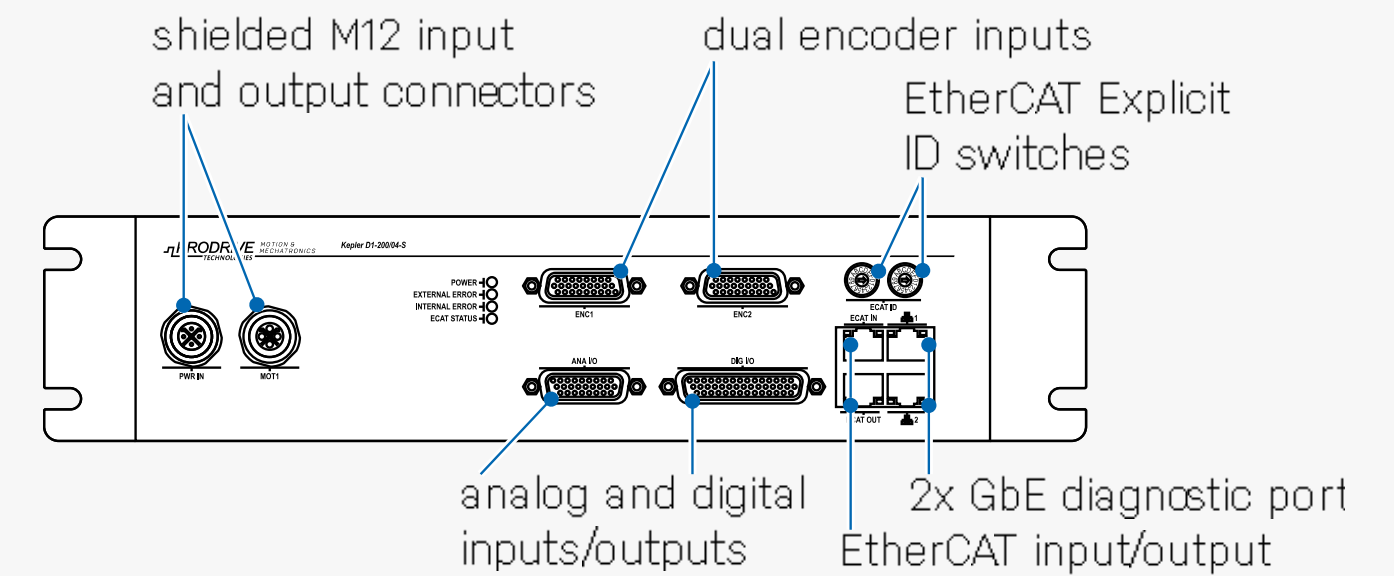
- All performance specifications are validated at an input voltage of 2 x 48V
- Dual use limited: output frequencies above 600Hz are subject to export control and require an export permit (EU 2021/821, 3A225)

	Parameter	Symbol	Unit	D1-200/4	D3-200/4	Remark
Encoder inputs	Number of encoder inputs	$n_{ENC}$	-	2		
	Supported types		-	Quadrature Analog Sin/Cos Digital hall Endat 2.1/2.2 Hiperface DSL (2W/4W) SSI / BiSS C		
	Max signal frequency	$f_{sincos\_max}$	MHz	1MHz - 4M counts/s		No missing pulses
	Maximum baudrate (digital encoders)	$f_{rs422\_max}$	MHz	32		
	Encoder supply voltage	$V_{ENC SUP}$	V	5 / 10		software selectable
	Encoder supply current	$I_{ENC SUP}$	mA	max 500		
General purpose I/O	Isolated digital inputs		-	4 x 24V		( $V_{IH} \geq 11V, V_{IL} \leq 5V, I_{IN} < 15mA$ )
	Isolated digital outputs		-	4 x 30V / 500mA		
	Non-isolated digital inputs		-	4 x TTL		
	Non-isolated digital outputs		-	2 x 24V - 1A 2x 24V - 200mA 4x TTL output		
	Analog inputs		-	2 x $\pm 10V$ diff		14bit resolution
	Analog output		-	2 x $\pm 10V$ diff		16bit resolution
	Brake outputs		-	-		

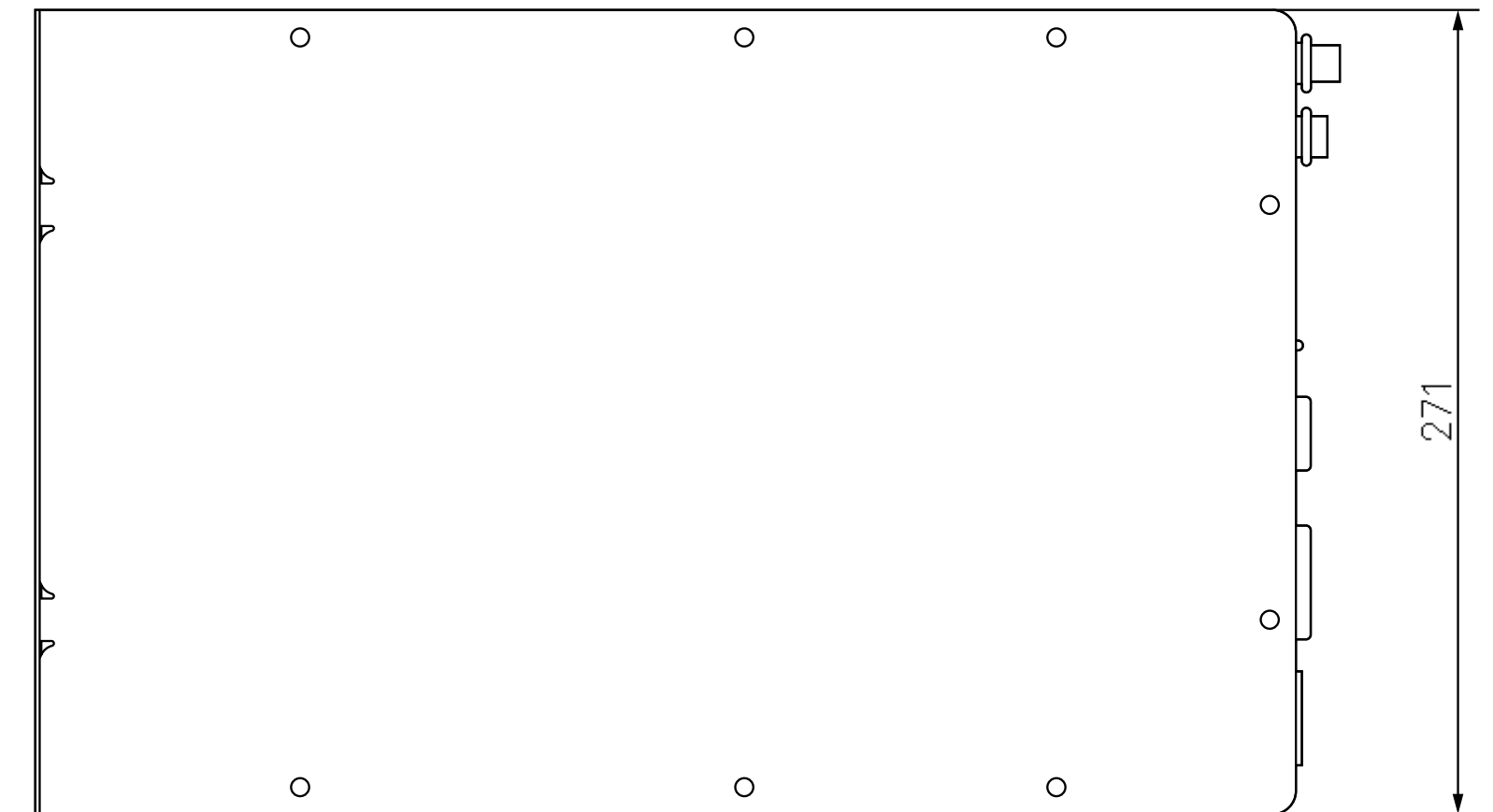
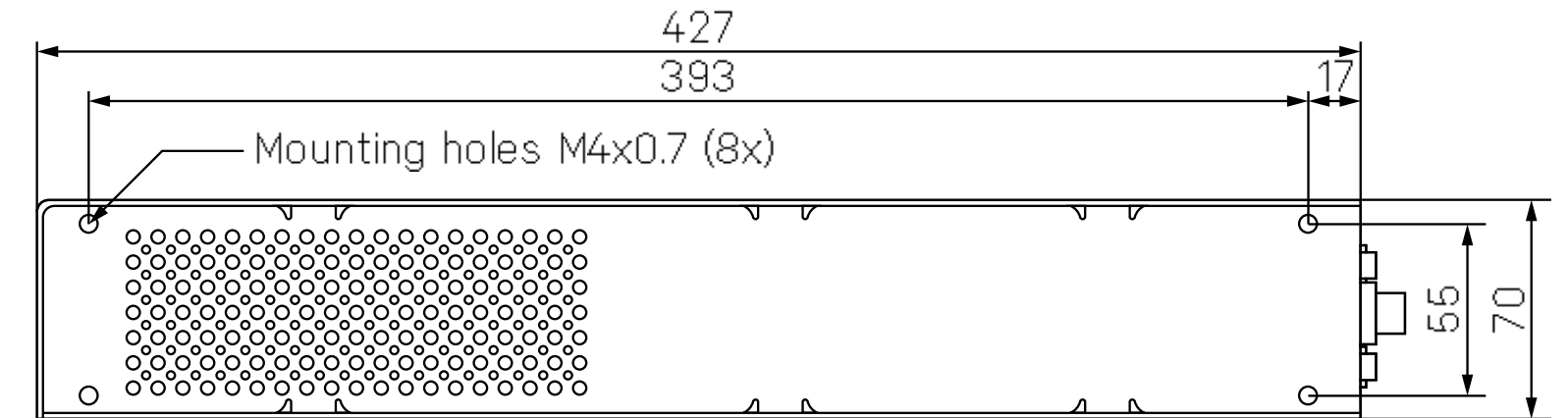
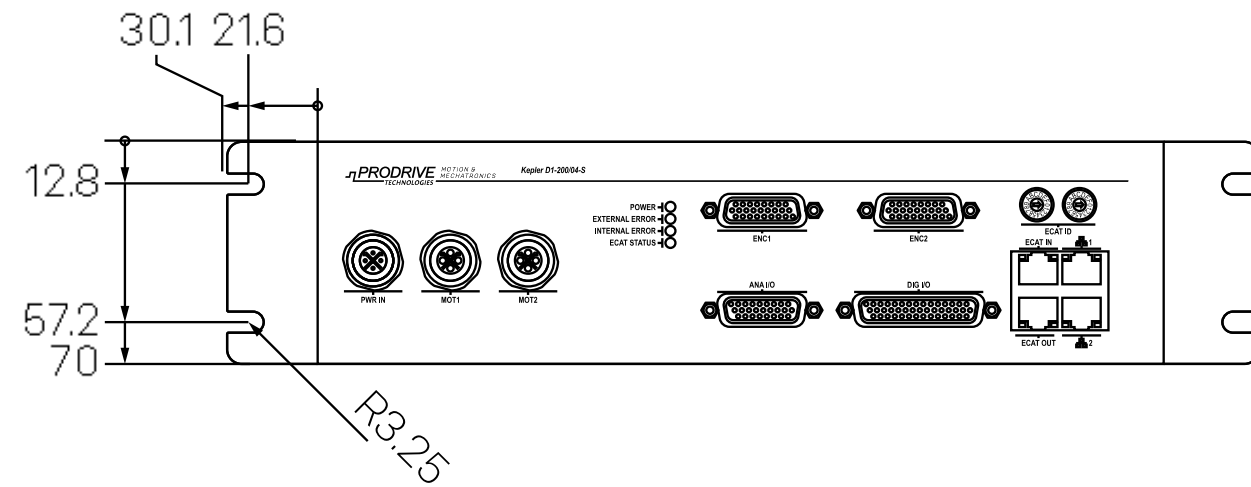
## S3-120/7



## D1-120/7



# KEPLER LINE – MECHANICAL SPECIFICATIONS



Mechanical	Parameter	Symbol	Unit	D1-200/4	D3-200/4	Remark
	Width	$d_W$	mm	271		
	Depth	$d_D$	mm	442		including connectors
	Height	$d_H$	mm	70		
	Operating temperature range	$T_{OP}$	°C	10 - 40		
	Operating humidity range	$h_{OP}$	%	20 - 80		non-condensing
	Shock & Vibration		-	IEC60068-2-6 (Fc)		
	Lifetime		-	>10 years		
	Mass	mass	kg	7,0		typical value



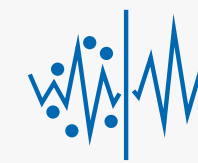
Apogee drives are especially designed for high-end applications that demand ultra-low output ripple and a highly linear response. This used to be the exclusive domain of linear amplifiers, but Prodrive Technologies uses its extensive experience in amplifier technology to introduce a PWM drive with negligible switching noise that matches linear drive performance.

Using proprietary end stage technology and a filtered output stage, the Apogee motor drives offer world-class linearity and switching noise. Due to internal output filtering and EMI protections, the drive can operate with a minimal number of external components.

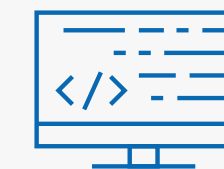
Compared with traditional analog drives, the Apogee line offers an increased system efficiency, significantly reducing the thermal load on the system.

## Apogee S3-120/7-S

- Internal (S) / external (-) auxiliary power supply
- Rated phase current (continuous)
- Rated supply voltage
- Number of output phases
- Number of outputs (Single/Dual)
- Drive series



Integrated filtering



Programmable PMP  
motion controller via  
MATLAB Simulink  
integration



High precision  
Low Noise



Wide range of  
connectivity options

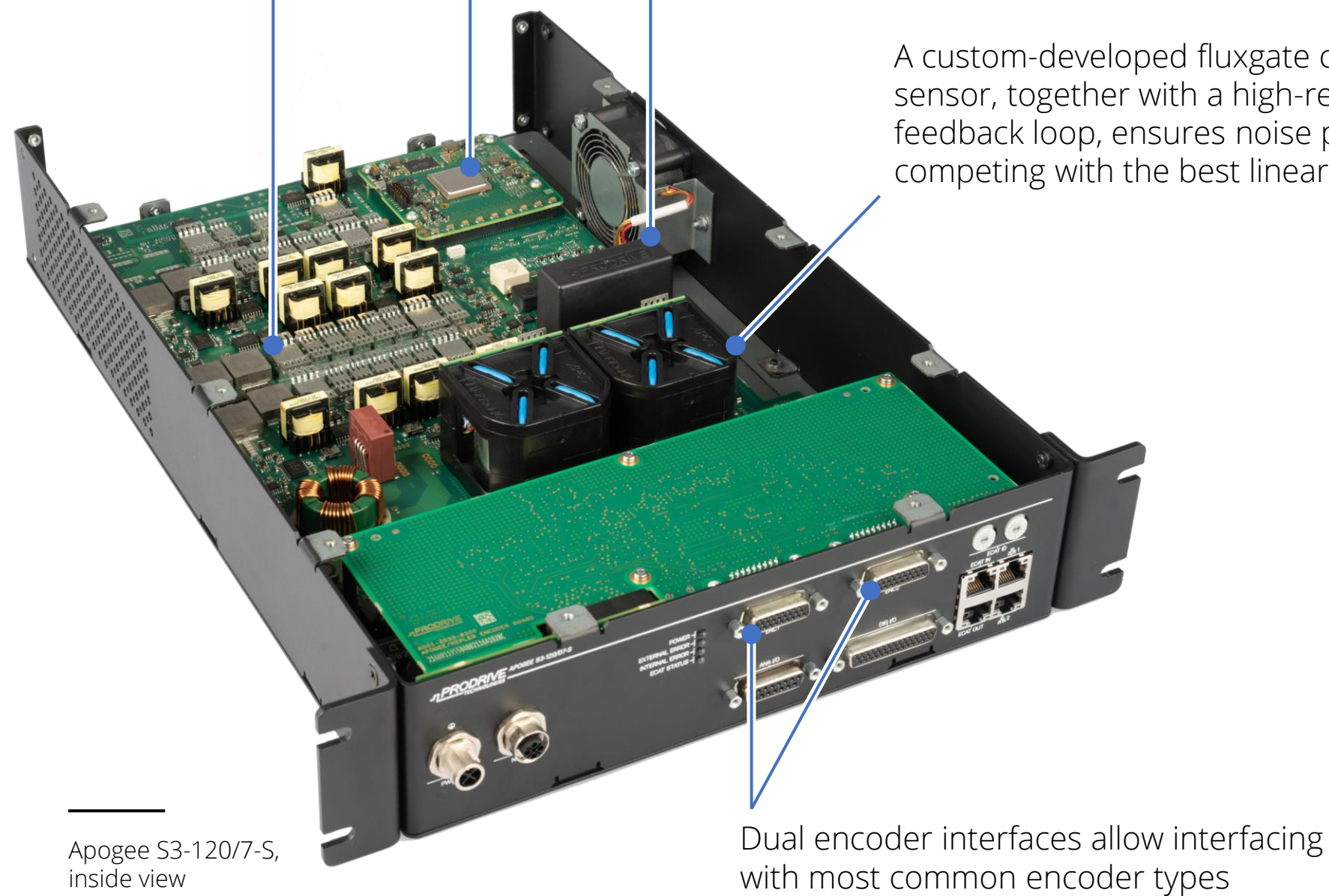
# APOGEE LINE – FEATURES

Internal low-pass filtering, combined with a multilevel output stage almost completely eliminates any output ripple.

Embedded motion controller with advanced diagnostic capabilities

The Apogee line uses high-stability metal foil resistors in combination with a temperature-controlled voltage reference to guarantee drift levels in the ppm range, significantly extending system level calibration intervals.

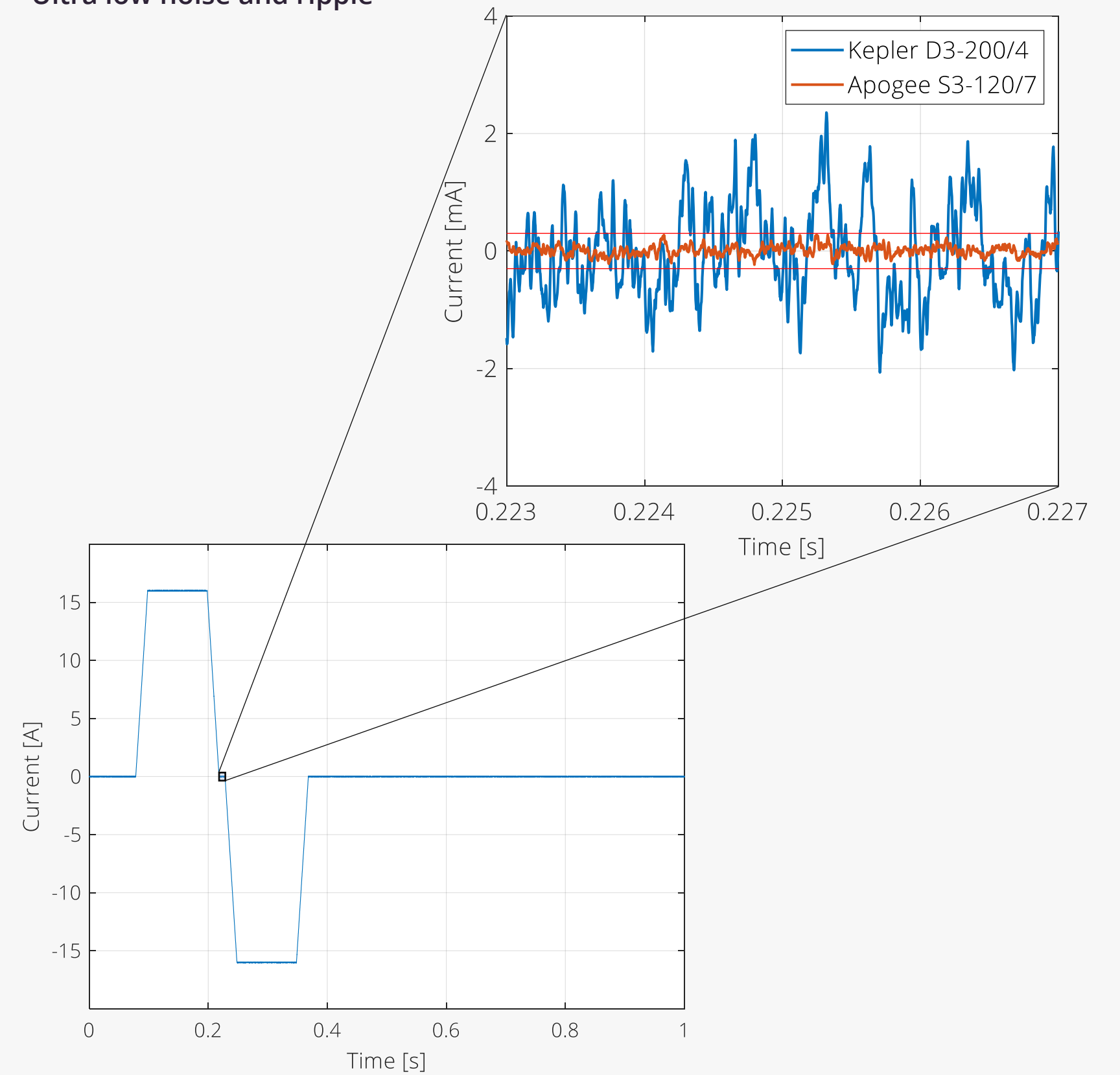
A custom-developed fluxgate current sensor, together with a high-resolution feedback loop, ensures noise performances competing with the best linear amplifiers.



Apogee S3-120/7-S, inside view

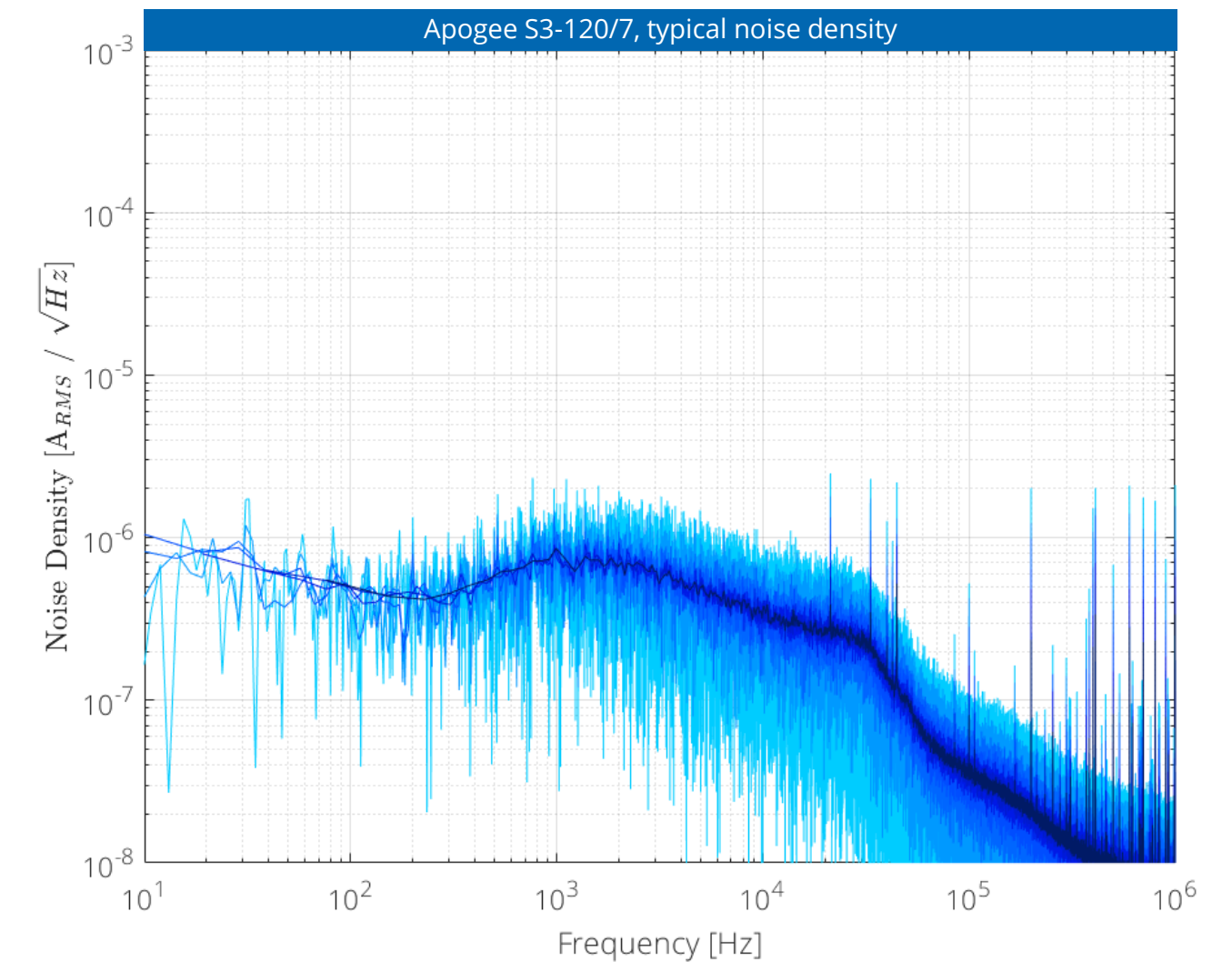
Dual encoder interfaces allow interfacing with most common encoder types

## Ultra low noise and ripple



# APOGEE LINE – PERFORMANCE SPECIFICATIONS

	Parameter	Symbol	Unit	S3-120/7	D1-120/7	Remark
Input	Supply input voltage	$V_{SUPPLY}$	V	2x30 to 2x60		Balanced supply
	Supply input voltage, abs. max	$V_{SUPPLY\_ABS\_MAX}$	$V_{DC}$	2x70		
	Peak input current	$I_{SUPPLY\_PEAK}$	$A_{PK}$	max 12		
	Continuous input current	$I_{SUPPLY\_CONT}$	$A_{RMS}$	max 7		
	Auxiliary input voltage	$V_{SUPPLY\_AUX}$	V	22 - 26		for version without -S suffix
	Auxiliary input current	$I_{AUX\_RMS}$	$A_{RMS}$	2		
Output	Number of motor outputs	$n_{MOT}$	-	1	2	
	Supported motor types		-	3-phase PMSM/BLDC	voice coil	
	Peak phase current	$I_{PH\_PK}$	$A_{PK}$	16,5		
	Continuous phase current	$I_{PH\_CONT}$	$A_{RMS}$	6,5		
	Peak phase-phase voltage range	$V_{PHPH\_PEAK}$	$V_{PK}$	0 - 100		$V_{SUPPLY} = 2x60VDC$
			$V_{RMS}$	0 - 70		
	Current loop, small signal bandwidth	$f_{-3dB}$	kHz	6 - 7		-3dB, typical value
	Rated switching frequency	$f_{PWM}$	kHz	200		
	Output frequency	$f_{MOT}$	Hz	0 - 595		dual use limited, see note
	Electrical braking function		-	Yes		shorts motor phases together
	External brake resistor		-	No		
	Internal brake resistor		-	Yes	No	
	Accuracy	Offset	$E_{MOT\_OFFSET}$	% of $I_{PH\_PK}$	<0,4	
Offset drift		$E_{MOT\_OFFSET\_DRIFT}$	% of $I_{PH\_PK}$	<0,1		
Gain error		$E_{MOT\_GAIN}$	% of $I_{PH\_PK}$	<0,7		
Gain error drift		$E_{MOT\_GAIN\_DRIFT}$	ppm of $I_{PK}$	<150		
Non-linearity		$E_{MOT\_NONL}$	ppm of $I_{PK}$	<50		
Noise	Noise (spectral density @100Hz)	$I_{NOISE\_LF}$	$\mu A/\sqrt{Hz}$	max 1		
	Noise (rms, 1Hz-10kHz)	$I_{NOISE\_10kHz}$	$\mu A_{RMS}$	max 110		
	Ripple	$I_{MOT\_RIPPLE}$	$\mu A_{RMS}$	100		2mH phase inductance, $\pm 48V$
Control	Interface type		-	GbE		
				EtherCAT		
				RS422		50Mbps max
	Update rate	$f_{ECAT}$	-	100Hz - 20kHz		
Diagnostic interface		-	GbE			



	Parameter	Symbol	Unit	S3-120/7	D1-120/7	Remark
Safety	Applicable standard		-	IEC/UL61800-5-1		TüV certified
	Pollution degree	PD	-	2		
	Overtoltage category	OVC	-	I		
	IP-protection class / enclosure type		-	IP20 / open type		
	Max operating altitude	$h_{OP\_max}$	m	2000		above mean sea level
	STO / SBC outputs		-			
EMC	Applicable standard		-	IEC61800-3		
	Input filtering		-	Cat C2, 2nd env		
	Output filtering		-	Actively damped LC		

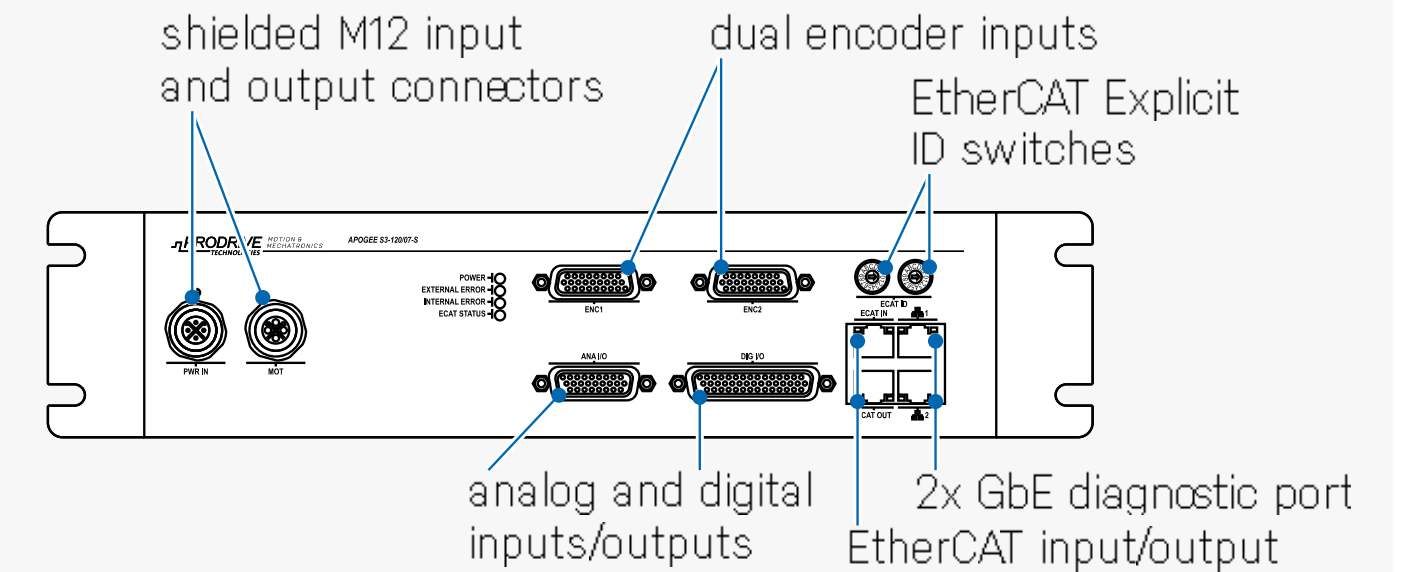
## Notes:

- All performance specifications are validated at an input voltage of 2 x 48V
- Dual use limited: output frequencies above 600Hz are subject to export control and require an export permit (EU 2021/821, 3A225)

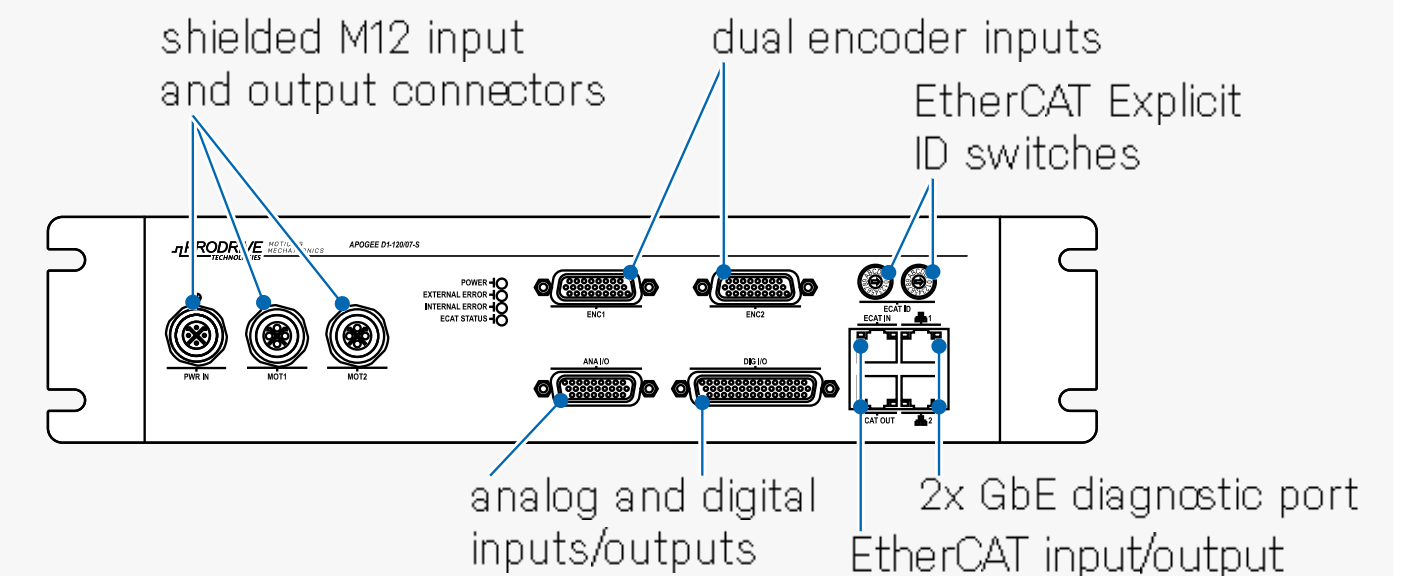


	Parameter	Symbol	Unit	S3-120/7	D1-120/7	Remark
Encoder inputs	Number of encoder inputs	$n_{ENC}$	-	2		
	Supported types			Quadrature Analog Sin/Cos Digital hall Endat 2.1/2.2 Hiperface DSL (2W/4W) SSI / BiSS C		
	Max signal frequency	$f_{sincos\_max}$	-	1MHz - 4M counts/s		No missing pulses
	Maximum baudrate (digital encoders)	$f_{rs422\_max}$	MHz	32		
	Encoder supply voltage	$V_{ENC SUP}$	V	5 / 10		software selectable
	Encoder supply current	$I_{ENC SUP}$	mA	max 500		
General purpose I/O	Isolated digital inputs		-	4 x 24V		( $V_{IH} \geq 11V, V_{IL} \leq 5V, I_{IN} < 15mA$ )
	Isolated digital outputs		-	4 x 30V / 500mA		
	Non-isolated digital inputs		-	4 x TTL		
	Non-isolated digital outputs		-	2 x 24V - 1A 2x 24V - 200mA 4x TTL output		
	Analog inputs		-	2 x $\pm 10V$ diff		14bit resolution
	Analog output		-	2 x $\pm 10V$ diff		16bit resolution
	Brake outputs		-	-		

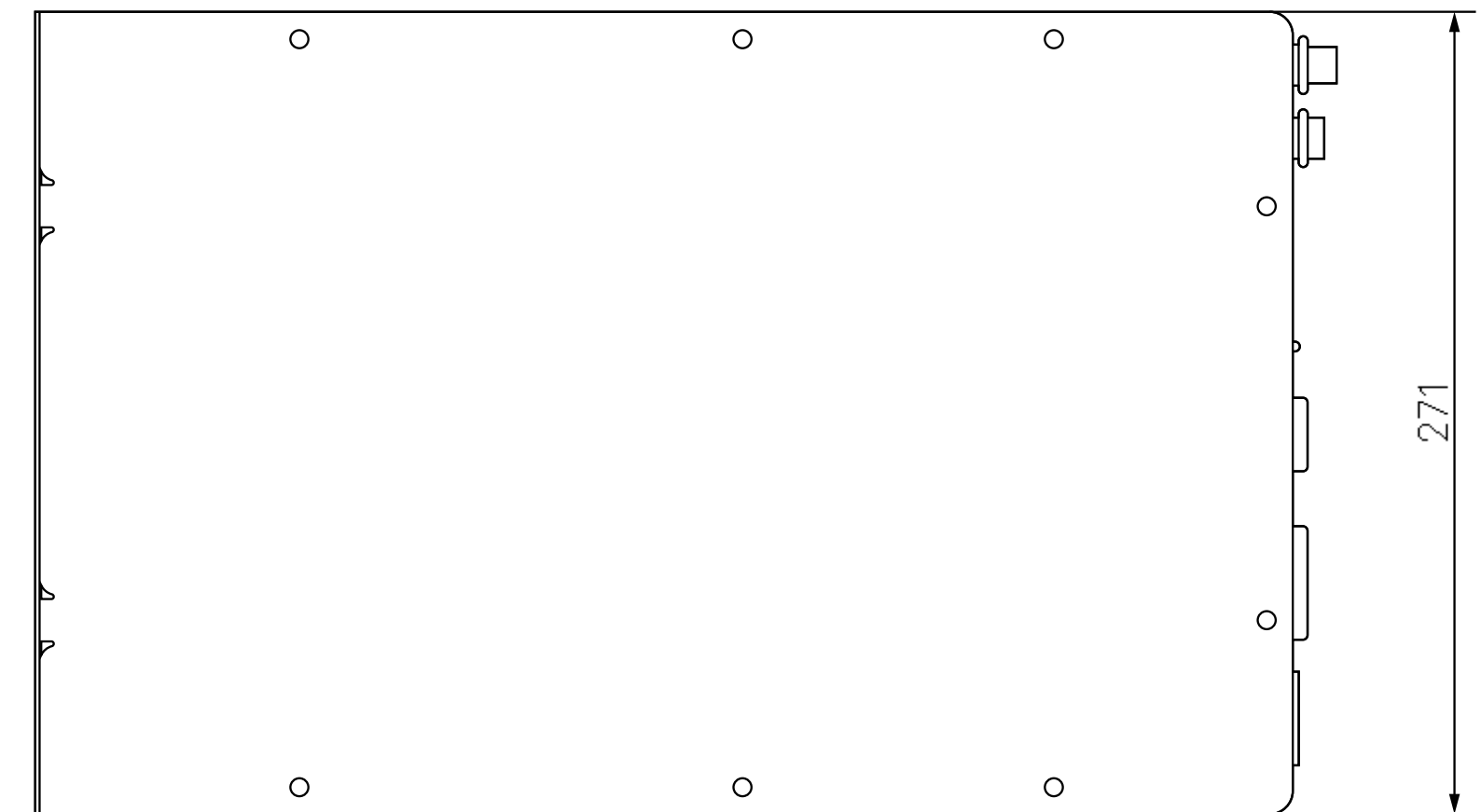
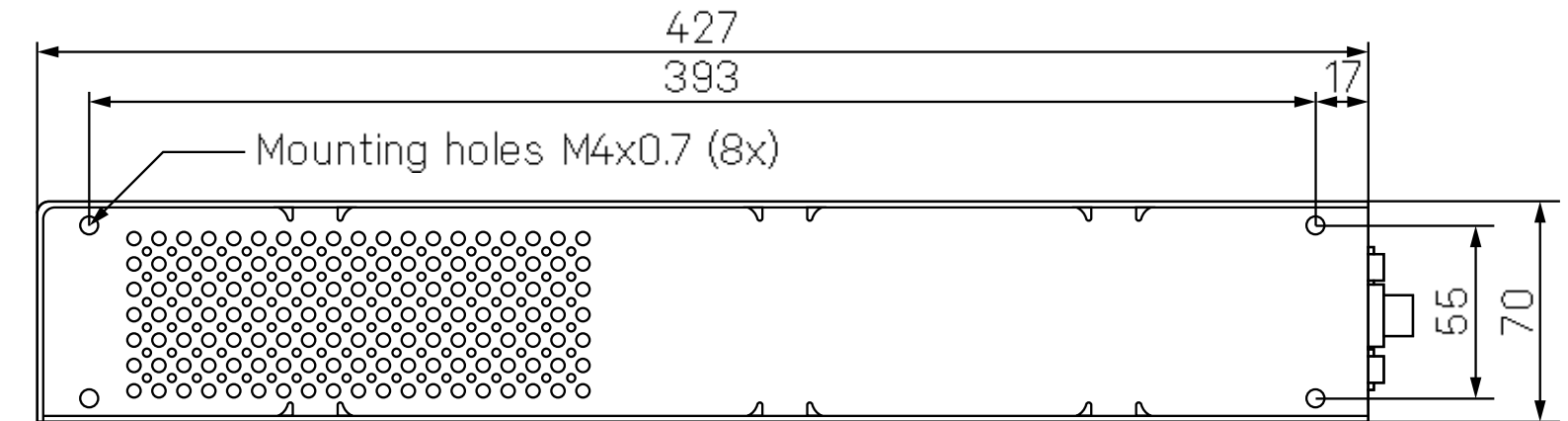
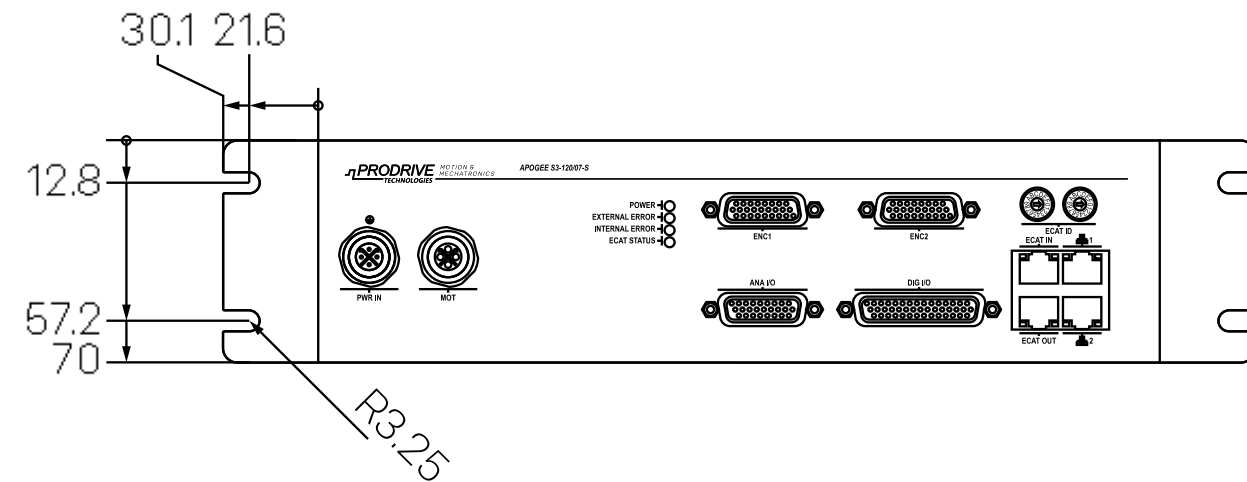
## S3-120/7



## D1-120/7



# APOGEE LINE –MECHANICAL SPECIFICATIONS



Mechanical	Parameter	Symbol	Unit	S3-120/7	D1-120/7	Remark
	Width	$d_W$	mm	271		
	Depth	$d_D$	mm	442		including connectors
	Height	$d_H$	mm	70		
	Operating temperature range	$T_{OP}$	°C	10 - 40		
	Operating humidity range	$h_{OP}$	%	20 - 80		non-condensing
	Shock & Vibration		-	IEC60068-2-6 (Fc)		
	Lifetime		-	>10 years		
	Mass	mass	kg	6,0		typical value