Overview

Welcome to the Core Box datasheet. This document contains technical specifications that outline the product's features and capabilities, including details on dimensions, materials, performance, and electrical requirements. Additionally, it offers guidance on how to use the product correctly, including installation instructions.

This document aims to provide a comprehensive understanding of the product's functionalities and features, covering essential topics such as electrical and mechanical installation, certifications, connectors, and environmental specifications, including operating and storage temperatures, dimensions, and power supply. It will also discuss frequency output, signal input and output ports, communication ports, GNSS receiver, processing capabilities, as well as product variants and much more.

Summary

1. Introduction: Core Box and its features

The Core Box is an ECU designed to deliver modular automatic steering solutions for a diverse array of vehicles. Hexagon has tackled the challenges of a fragmented technology landscape, plagued by compatibility and integration issues. The Core Box offers a dependable and precise auto-steering solution seamlessly integrated into the machine's user interface.

This document covers the technical aspects of the product. For a comprehensive guide on how to understand, update, and effectively use the Core Box system, request Hexagon support for the Core Box Integrator Guide. It begins with an overview of Core Box and its main functions, followed by detailed descriptions of key features, including LED patterns, ignition system interactions, network status, and update instructions.

1.1 Product variants

The Core Box has two variants ready for ordering. These two variants were designed to cater to a wide range of user requirements and application scenarios, ensuring flexibility and compatibility with various setups and systems. It is possible to request the creation of a custom variant with only the requested functionalities, please consult Hexagon's sales at Sales enquiry | Hexagon for more information.

Functionality	Lite	Full
IMU	✓	✓
Ethernet 100BASE-TX	✓	✓
Serial RS-232	✓	✓
4x Digital inputs	✓	✓
1x Analog input	✓	✓
High side output	✓	✓
Power supply	✓	✓
3x CAN interface	✓	✓
Emulated Radar output	X	✓
Wi-Fi 2.4 GHz	X	✓
Buzzer (internal)	X	✓
USB C	X	✓
Automotive Ethernet - 100BASE-T1	X	✓
Power drive board	X	✓
Mobile connection modem	X	✓
GNSS OEM7500	X	X
GNSS OEM7700	X	X

2. Processing Capabilities

The Core Box is designed with advanced processing capabilities to ensure optimal performance and efficiency. Its architecture includes powerful processors and ample memory, enabling it to handle complex tasks and provide real-time data processing. Below, we delve into the specific components that contribute to the Core Box's functionality.

2.1 Processor

The Core Box is powered by a powerful quad-core ARM Cortex® A53 with a 1.6 GHz processing clock.

2.2. Application MCU

In addition to the main processor, the Core Box also features an ARM Cortex® M7 co-processor that provides real-time processing, enhancing the precision of IMU calculations.

2.3 Memory and Storage

Standard commercial versions come equipped with 1 GB of DDR4 RAM, with an upgrade option to 2 GB available upon request. The Core Box includes 8 GB of eMMC storage in standard versions, which can also be upgraded to 32 GB as needed

3. GNSS receiver

Core Box is compatible with NovAtel® receivers and is prepared to run with the main GNSS constellations providing high-precision positioning with terrain compensation and centimetre-level accuracy. Some of the key features are:

- NovAtel OEM7 series compatibility;
- GPS, GLONASS, BeiDou, Galileo, QZSS, NavIC Constellations;
- Single point multi-frequency, SBAS, DGPS, TerraStar-L, TerraStar-C PRO, RTK (Real Time Kinematic);
- Dual GNSS Antenna capability for enhanced heading estimation;
- Capable of operating with NovAtel's SMART7 and via NMEA input.

4. Communication Ports

This section explores the various communication ports available on the Core Box, highlighting their specifications.

4.1 USB

The device has two USB ports for the user interface with the possibility of charging devices such as smartphones and tablets.

USB 1	USB 2
• USB Type-A connector • USB Host 2.0 • Power up to 7W (1.4A)	• USB Type-C connector • USB Host 3.0 • Charging protocols: DCP, BC1.2, Apple Divider 3, Huawei FPC, QC3.0, Type-C (Standard), all up to 15W. (3A @5V)

4.2 Ethernet

The device has a great differential for having the ability to use three different ethernet communication protocols.
The Ethernet ports are used as Core Box interface, via its API.

Ethernet Port 1	Ethernet Port 2	Ethernet Port 3
• 10BASE-T/ 100BASE-TX protocol. • DIN M12 connector 4-pin Key D. • Can be used for connecting to a display interface. • Employs HTTP protocol and proprietary API.	• 100BASE-T1 protocol (single pair ethernet). • BroadR-Reach compatible. • Allows high-speed data transfer over a single twisted pair cable. • DIN M12 connector 4-pin key D with power output pins for driving external accessories up to 3A (same input voltage).	• 100BASE-T1 protocol (single pair ethernet). • BroadR-Reach compatible. • Daisy-chained interface allows connection with other devices with no need for an external switch. • Allows high-speed data transfer over a single twisted pair cable. • DIN M12 connector 4-pin key D with power output pins for driving external accessories up to 3A (same input voltage).

4.3 CAN Bus

Three CAN Buses are possible to be configured in Core Box to allow the client to connect different devices and accessories in different buses, using proprietary or third-party protocols. All cables with CAN Bus must have an external terminator to ensure proper signal integrity and communication reliability.

Primary CAN Bus	Secondary CAN Bus	Auxiliary CAN Bus
• CAN 2.0 FD (bitrate up to 1 Mbps). • Display and Vehicle Interface. • ISOBUS protocol.	• CAN 2.0 FD (bitrate up to 1 Mbps). • Proprietary CAN protocol (allows the user to connect Hexagon devices). • MDU Control. • CAN-Based Wheel Angle Sensor.	• CAN 2.0 FD (bitrate up to 1 Mbps).

4.4 Serial Port

A Serial Port can be configured to allow more options for integration with external devices.

- RS-232 (TX and RX)
- GNSS receiver support (TX and RX)
- Position output (TX line only)
- NMEA 0183/ NovAtel Protocol

4.5 Wireless Connectivity

Wireless communication can be configured in Core Box as an optional feature allowing integration with external resources and cloud services.

- Wi-Fi 2.4 GHz (IEE 802.11a/b/g/n/ac)
- Bluetooth 5.2 BR/EDR/LE
- Hexagon's Remote Access
- Cellular Gateway
- RP-SMA Connector for external antenna

4.5.1 Cellular Connectivity

Cellular connectivity in precision agriculture, coupled with Real-Time Kinematic (RTK) GNSS correction, provides real-time data access and precise positioning, enhancing crop management and yield optimization.

- PCIe modem interface
- Micro-SIM Card
- Worldwide coverage*
- 4G (3G/2G fallback)
- RTK Correction over the internet (optional)
- SMA Antenna Connector (main + div)

*Confirm with your sales representative the countries covered.

5. Signal Input/Output Ports

The Core Box has a considerable number of input/output pins capable of interfacing with external sensors and systems.

5.1 Digital Input

The device supports up to seven digital inputs including NPN and PNP, up to 36 VDC with voltage transient suppression protection.

DIGITAL INPUT		
Input name	**Input type**	**Application**
SNS IN BB	PNP (0 – 36V)	Remote ON-OFF switch
SNS IN BA *		Tachometer Input (capable of handling signals with frequencies up to 5 kHz)
SNS IN BP		Foot or Seat Switch
SNS IN BM	NPN (0 – 36V)	Remote Engage/Disengage
SNS IN PA *		Wheel angle sensor A
SNS IN PB *		Wheel angle sensor B
SNS IN PC *		Auxiliary input

* Features enabled with the Power Board.

5.2 Analog Input

The device supports up to four analogic inputs, up to five VDC with voltage transient suppression protection.

ANALOG INPUT		
Input name	**Input type**	**Application**
ANALOG IN P1 *	ANALOG 0.5V** to 5.5V	Wheel angle sensor A1
ANALOG IN P2 *		Wheel angle sensor A2
ANALOG IN P3 *		Pressure transducer or Flow Switch or SASA Sensor
ANALOG IN B1		Seat Switch (analog)

* Features enabled with the Power Board.
** Analog inputs lower than 0.5V can be read but accuracy is not guaranteed.

5.3 Power board - PWM Output

Core Box can be configured with PWM optional outputs that provide precise control over hydraulic steering valves, allowing for fine-tuned steering control and potentially other applications.

- Half-bridge output
- PWM/Proportional or bang-bang
- Up to 10 A continuous (maximum current shared among the outputs)

- Support of open and closed centre vehicle hydraulic steering systems

5.4 High-Side Switch

Optional high-side switch that can drive up to 120 mA for an external buzzer.

5.5 Frequency Output

Optional push-pull output can drive up to 145 mA as a digital frequency output for applications that need a radar output signal.

6. IMU (Inertial Measurement Unit) Sensor

Inertial measurement unit with enhanced terrain compensation.

- 6 axis IMU
- Accelerometer and gyroscope interfaces.

7. HMI Interface

The operation can be easily checked through the three bi-colour status LEDs and internal monotone buzzer present on the device, which provide information on the following statuses:

- Power status
- Connectivity status
- Alarms

Information: Click here to learn how to interpret the LEDs patterns.

8. Power Supply

This section details the power features of the Core Box, as well as its ability to power external devices such as sensors and actuators.

8.1 Supply Input

The Core Box has a wide range of operating voltage, enabling it to function with various applications and machinery. Additionally, it features reverse polarity protection, surge protection, and load dump protection in accordance with ISO 14982:1998 standards.

- 12 VDC.
- Up to 15 A.
- Leakage current < 100uA@12VDC.

8.2 ECUs power supply

- 12 VDC (equal to supply voltage).
- Up to 3 A.
- Power supply for other ECUs.
- Hot Swap capability.

8.3 Sensors power supply

- Regulated 5 or 12 VDC.
- Up to 0.5 A.
- Power supply for external sensors.

9. Environmental and Characteristics

Now, you will learn the environmental specifications and physical characteristics of the Core Box, ensuring it meets durability and performance standards.

- Operating Temperature: Wide operating temperature range: -40°C to +80°C
- Storage Temperature: Wide storage temperature range: -40°C to +85°C
- IP Rating: Waterproof enclosure: IP66, IP67
- Dimensions: Heavy-Duty aluminium enclosure with dimensions: 208.00 x 161.07 x 68.75 mm (W x H x D)

10. Connectors

In this section, we detail the connectors available in both the lite and full variants, including item descriptions, connector types, and their applications. Additionally, we provide pinouts that outline pin numbers, names, and corresponding functions for each connector.

10.1 Variant Lite

Item	Connector type	Applications
C1	M12 Male – 5-pin key L	Battery input, Primary CAN Bus, Remote ON-OFF switch
C2	M12 Male – 12-pin key A	Secondary CAN Bus, Serial Port, High-Side Switch, Foot/Seat Switch (digital and analog), Remote Engage/Disengage
C3	M12 Male – 8-pin key A	Auxiliary CAN Bus, Tachometer Input, Frequency Output
	M12 Female – 4-pin key D	Ethernet Port 1 – Employs HTTP protocol and proprietary API.
	USB Type-A	USB Port 1 Type-A 2.0 up to 1.5A

10.2 Variant Full

Item	Connector type	Applications
1	M12 Male – 5-pin key L	Battery input, Primary CAN Bus, Remote ON-OFF switch
2	M12 Male – 12-pin key A	Secondary CAN Bus, Serial Port, High-Side Switch, Foot/Seat Switch (digital and analog), Remote Engage/Disengage
3	M12 Male – 8-pin key A	Auxiliary CAN Bus, Tachometer Input, Frequency Output
4	M12 Female – 4-pin key D	Ethernet Port 1 – Employs HTTP protocol and proprietary API.
5	SMA	Cellular connectivity – Main antenna
6	SMA	Cellular connectivity – DIV antenna
7	RP-SMA	Wireless connectivity antenna
8	USB Type-A	USB Port 1 Type-A 2.0 up to 1.5A
9	USB Type-C	USB Port 2 Type-C 3.0 up to 3A
10	M12 Female – 4-pin key D	Ethernet Port 2 – BroadR-Reach compatible
11	M12 Female – 4-pin key D	Ethernet Port 3 – BroadR-Reach compatible
12	DT Male 12-pin key A	Power driver board (PWM output, Wheel Angle Sensor (digital H and L), Auxiliary Input, Wheel Angle Sensor (analog 1 and 2), Supply output up to 10A

10.3 Pinouts

CONNECTOR C1 (M12 Male 5-pin key L)		
Pin	**Pin name**	**Pin function**
1	BATT+	Battery + (up to 16A)
2	CAN2 L	Low
3	CAN2 H	Primary CAN Bus High
4	SNS IN BB	Remote ON-OFF switch
FE	BATT-	Battery ground (up to 16A)

Mating connector: M12 Female 5-pin key L
For CAN Bus, an external 120 Ohm terminator resistor must be placed between CAN Low and CAN High to ensure proper functionality. Terminator part number suggestion: DTM06-2S-P006

CONNECTOR C2 (M12 Male 12-pin key A)		
Pin	**Pin name**	**Pin function**
1	CAN1 L	Secondary CAN Bus Low
2	CAN1 H	Secondary CAN Bus High
3	VCC OUT	Supply Output up to 3A
4	GND	Ground
5	RS-232 TX	RS-232 Serial Port TX
6	RS-232 RX	RS-232 Serial Port RX
7	EX. BUZZER OUT	High-Side Switch up to 120 mA for external buzzer.
8	SNS IN BP	Seat Switch (Sensor P)
9	SNS IN BM	Remote Engage/Disengage (Sensor M)
10	5/12V OUT	Supply Output (5V or 12V) up to 0.5 A
11	ANALOG IN B1	Seat Switch (analog 1)
12	GND	Ground

Mating connector: M12 Female 12-pin key A
For CAN Bus, an external 120 Ohm terminator resistor must be placed between CAN Low and CAN High to ensure proper functionality. Terminator part number suggestion: DTM06-2S-P006

CONNECTOR C3 (M12 Male 8-pin key A)		
Pin	**Pin name**	**Pin function**
1	NC	Not Connected
2	SNS IN BA	Tachometer Input (Sensor A)
3	VCC OUT	Supply Output up to 3A
4	GND	Ground
5	CAN3 L	Auxiliary CAN Bus Low
6	CAN3 H	Auxiliary CAN Bus High
7	NC	Not Connected
8	FREQ. OUTPUT	Frequency Output up to 145 mA

Mating connector: M12 Female 8-pin key A
For CAN Bus, an external 120 Ohm terminator resistor must be placed between CAN Low and CAN High to ensure proper functionality. Terminator part number suggestion: DTM06-2S-P006

CONNECTOR ETHERNET 100BASE-TX (M12 Female 4-pin key D)		
Pin	**Pin name**	**Pin function**
1	TX+	TX+
2	RX+	RX+
3	TX-	TX-
4	RX-	RX-

Mating connector: M12 Male 4-pin key D

CONNECTOR ETHERNET 100BASE-T1 (2x M12 Female – 4-pin key D)		
Pin	**Pin name**	**Pin function**
1	SPETH 1,2 DA P	Single-Pair Ethernet Data +
2	SPETH 1,2 DA N	Single-Pair Ethernet Data -
3	VCC OUT	Supply Output up to 3A
4	GND	Ground

Mating connector: M12 Male 4-pin key D

CONNECTOR A (Deutsch DT Male – 12-pin key A)	
Pin	**Pin function**
1	PWM Output A: Max 10A (shared with B and C)
2	PWM Output B: Max 10A (shared with A and C)
3	PWM Output C: Max 10A (shared with A and B)
4	Supply Output (5V or 12V)
5	Auxiliary Input C
6	Wheel Angle Sensor B
7	Wheel Angle Sensor A
8	Wheel Angle Sensor (Analog 1)
9	Ground
10	Wheel Angle Sensor (Analog 2)
11	Pressure Transducer or Flow Switch or SASA Sensor (Analog 3)
12	Supply Output
Mating connector: Deutsch DT06-12SA	

11. Electrical Installation

The circular connectors must be tightened with the recommended torque listed below.

Warning: Over-tightening or under tightening can lead an improper sealing, potential damage, or unreliable connections. The equipment's power harness must include a 15A blade fuse. We recommend the part number: 0287015.PXCN. Use 12 AWG wires for the battery connection and 16 AWG wires for all other connections.

Connector	Functions	Recommended torque
M12	C1, C2, C3 and Ethernet	0.6 to 1.0 Nm
SMA	Wireless and Cellular connectivity	0.3 to 0.6 Nm
TNC	GNSS	1.4 to 1.7 Nm

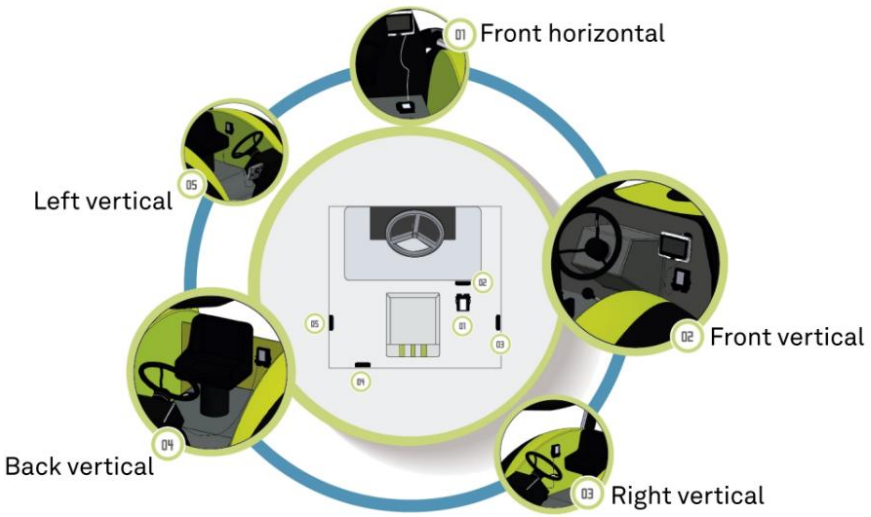
Handle the cable near the connector carefully to prevent the application of external force, which may cause damage.
It is recommended that a 15A fuse be used in the power cable (C1 connector). The battery connection should be made with 12 AWG wires, and all other connections should be made with 16 AWG wires.

12. Mechanical Installation

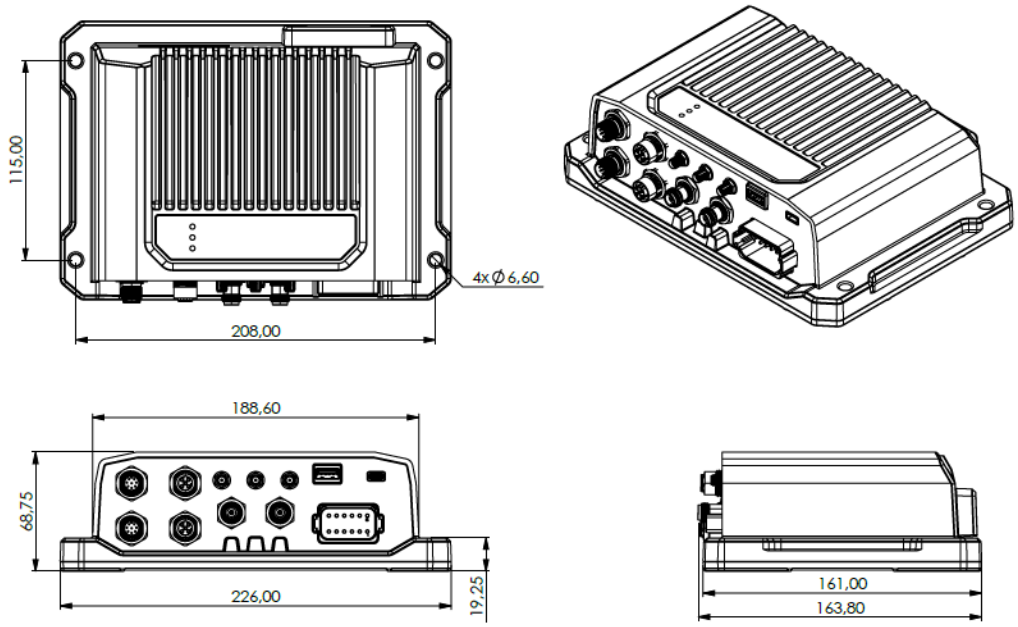
To mount the Core Box on the vehicle, use the four 6.6 mm holes provided. We recommend using M6 screws with a minimum length of 35 mm. For secure fastening, please include both plain and spring washers. Tighten the screws to a torque of 8 to 10 Nm.

Warning: The equipment must be mounted on a flat surface that is not made of combustible material due to its potential fire hazard. This surface must cover the entire bottom part of the product.

Select the proper installation position on a flat surface for the Core Box based on the following guidelines:



12.1 Mechanical drawing



13. Certifications

Certification group	Test description	Test standard
EMC conformity	Electrical transient	ISO 14982:2009, ISO 7637-2:2011
	Electrostatic discharge (ESD)	ISO 14982:2009, ISO 10605:2008
	Radiated immunity	ISO 14982:2009, ISO 11452-2:2004
	BCI immunity	ISO 14982:2009, ISO 11452-4:2005
	Radiated RF emission	ISO 14982:1998, CISPR 25 FCC Part 15 B
	Conducted immunity	ETSI EN 301 489-1:2019, EN 61000-4-6:2014
	Radiated immunity	ETSI EN 301 489-1:2019, EN 61000-4-3:2006+A2:2010
	Electrical transient	ETSI EN 301 489-1:2019, ISO 7637-2:2011
	Radiated spurious emissions	ETSI EN 301 511:2017 (2G), ETSI EN 301 908-2:2017 (3G) ETSI EN 301 908-13:2019 (4G), ETSI EN 300 328:2019 (Wi-Fi), ETSI EN 303 413:2020 (GNSS), ETSI EG 203 367:2016 (Multi-Radio)
Environmental	Vibration	MIL-STD-810G, METHOD 514.6, CATEGORY 24
	Vibration	IEC 60068-2-6, 5G 10Hz-2000Hz
	Shock	MIL-STD-810G, METHOD 516.6, PROCEDURE 1
	Ingress Protection	IP66, IP67, IEC 60529:2017
Safety	Safety	IEC 62368-1:2018
Network	ANATEL	Approval Certificate
Other	WEEE RoHS	

This equipment is not entitled to protection against harmful interference and must not cause interference to properly authorized systems. For more information, please visit ANATEL's website at (www.anatel.gov.br).

14. Future releases

Stay informed about what's coming next as we work to deliver even more value and innovation in future updates and enhancements.

14.1 M.2 Key B Interface

The Core Box is upgradeable with an M.2 Key B interface. An M.2 Key B interface offers several advantages, including compactness and versatility. This interface is primarily used for wireless connectivity and storage expansion in various devices. Its benefits include:

- **Compact form factor:** M.2 Key B is smaller and more space-efficient than traditional connectors, making it ideal for ultra-slim and compact devices.
- **High-speed data transfer:** It supports high-speed data transfer through PCIe and SATA interfaces, allowing for fast storage expansion and improved system performance.
- **Wireless connectivity:** M.2 Key B slots are commonly used for 4G and 5G modules, enabling wireless connectivity in portable devices.
- **Versatile applications:** Beyond wireless modules, M.2 Key B slots can accommodate other peripherals like cellular modems, GNSS receivers, adding functionality to a wide range of devices.

Contact support for more information.

15. Revision

Version	Date	Author	Description
R001	08-Aug-2022	Jonatan Vieira	First version based on first requirements
R002	10-Oct-2022	Jonatan Vieira	First complete version
R003	06-Aug-2023	Gabriel Lorenzetti	Updated document with final product versions
R004	29-Feb-2024	Jonatan Vieira	Review and approval
R005	25-Apr-2024	Jonatan Vieira	Update CAN ports in Product Version table
R006	07-Jul-2024	Daniel Melo	General review
R007	13-Ago-2024	Hugo Fagundes	Available variants update and general formatting
R008	30-Ago-2024	Daniel Melo	Added CAN bus terminator info
R009	26-Set-2024	Hugo Fagundes	Updates variants info and general formatting
R009	02-Oct-2024	Amanda Arrais	Enhanced readability and improved formatting
R010	19-Nov-2024	Flávio Oliveira	Improved USB information. Adjusted analog input, maximum and minimum voltage.
R011	16-Dec-2024	Amanda Arrais	Added the “Future releases” section
R012	21-Feb-2025	Gabriel Lorenzetti	Updated Information regarding Safety Compliance
R013	27-Mar-2025	Caroline Sander	Updated layout