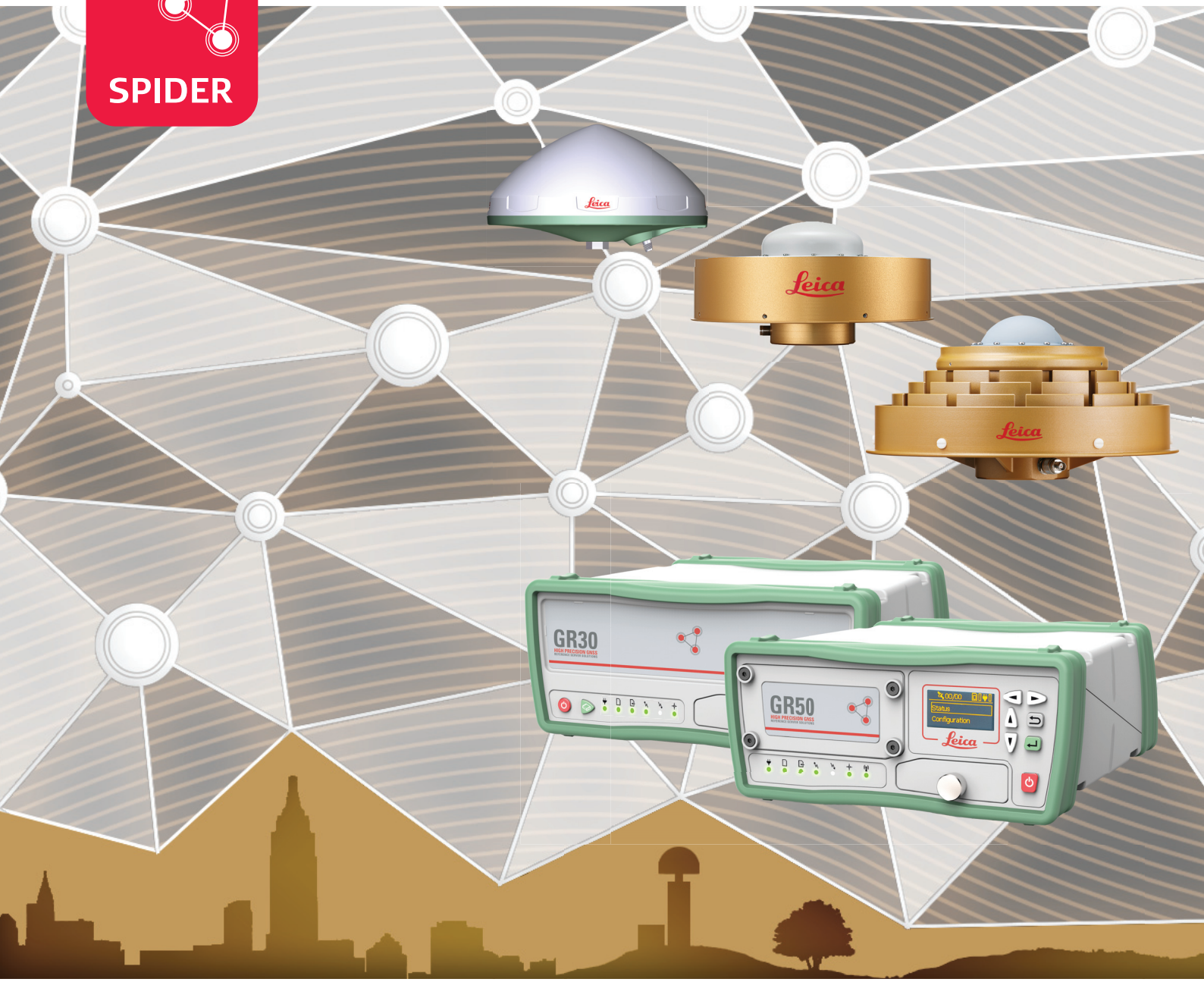
Leica Spider Hardware



Technical data
Version 4.4
English

- when it has to be **right**

Leica Geosystems

PART OF HEXAGON

Introduction

This brochure contains important technical data regarding Leica GNSS reference servers (receiver), Leica RefWorx onboard web server firmware and antennas.

Read carefully through the Technical Data.

Trademarks

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Validity of this brochure

This brochure applies to the following products:

- Leica GR30/GR50 Reference Servers
- Leica RefWorx Firmware (current version at publication date)
- Leica AR10/AR20/AR25 Antennas

myWorld

https://myworld-portal.leica-geosystems.com/ offers a wide range of services, information and training material.

With direct access to myWorld, you are able to access all relevant services whenever it is convenient for you.

The availability of services depends on the instrument model.

Service	Description
My Products	Register all products that you and your company own and explore your world of Leica Geosystems: View detailed information on your products and update your products with the latest software and keep up-to-date with the latest documentation.
My Service	View the current service status and full service history of your products in Leica Geosystems service centres. Access detailed information on the services performed and download your latest calibration certificates and service reports.
My Support	Create new support requests for your products that will be answered by your local Leica Geosystems support team. View your complete support history and view detailed information on all your support requests.
Knowledge	Enter key words and start searching in our knowledge base. You can find FAQs (Frequently asked questions) as well as Knowledge articles for Leica Geosystems products.
Downloads	Downloads of software, manuals, tools, training material and news for Leica Geosystems products. Download the latest documentation and software to keep yourself and your products up-to-date. You can access downloads of software, manuals, tools, and training material.

Service	Description
Online Learning	Welcome to the home of Leica Geosystems online learning! There are numerous online courses – available to all customers with products that have valid CCPs (Customer Care Packages).
My SmartNet	Add and view your HxGN SmartNet subscriptions and user information. HxGN SmartNet delivers high-precision and high-availability GNSS network correction services in real-time and around the globe. The HxGN SmartNet Global family offers Network RTK with RTK bridging and Precise Point Positioning (PPP) services. These services work exclusively with Leica Geosystems GS smart antennas and receivers, providing the highest accuracy. Combined, they ensure HxGN SmartNet coverage everywhere.
My Trusted Services	Leica Geosystems Trusted Services offer you increased productivity while at the same time providing maximum security. New software services and state-of-the-art IT infrastructure offer a vast potential to optimise your workflow and increase your efficiency and productivity, both now and in the future.
My Security	Leica Geosystems Security delivers you total peace-of-mind in knowing that if your instrument is ever stolen, a locking mechanism is available to ensure that the instrument is disabled and can no longer be used.

Table of Contents

1 GNSS Reference Servers and Receivers

1.1 Overview

Sales variants

	GR30 Baseline (841 150)	GR30 Highline (841 151)	GR50 Bluetooth Baseline (841 152)	GR50 Bluetooth Highline (841 153)	GR50 WLAN Baseline (841 154)	GR50 WLAN Highline (841 155)
GNSS & Tracking						
GPS	●	●	●	●	●	●
GLONASS	●	●	●	●	●	●
Galileo	❍	●	❍	●	❍	●
BeiDou	❍	●	❍	●	❍	●
QZSS	❍	●	❍	●	❍	●
NavIC	❍	❍	❍	❍	❍	❍
SmatTrack+ Interference Mitigation	❍	❍	❍	❍	❍	❍
Radio Frequency Power Spectrum output	●	●	●	●	●	●
Detect & notify interference	●	●	●	●	●	●
Position Update & Data Recording						
1 Hz logging and streaming	●	●	●	●	●	●
2-20 Hz logging and streaming	❍	❍	❍	❍	❍	❍
50 Hz logging and streaming[1)]	❍	❍	❍	❍	❍	❍
Additional RefWorx Features						
LeicaRefWorx Web Server	●	●	●	●	●	●
User Access Management	●	●	●	●	●	●
System Configuration Backup & Restore	●	●	●	●	●	●
RINEX logging	❍	●	❍	●	❍	●
FTP/SFTP Push	❍	●	❍	●	❍	●
Extended Formats	❍	❍	❍	❍	❍	❍
Multi-Clients/Ntrip Caster	❍	●	❍	●	❍	●
Wake-Up	❍	❍	❍	❍	❍	❍
Campaign Use	●	●	●	●	●	●

[1)] 100 Hz ready. Can be provided through future firmware upgrade.

	GR30 Baseline (841 150)	GR30 Highline (841 151)	GR50 Bluetooth Baseline (841 152)	GR50 Bluetooth Highline (841 153)	GR50 WLAN Baseline (841 154)	GR50 WLAN Highline (841 155)
Extended OWI[2)]	❍	❍	❍	❍	❍	❍
WLAN	–	–	–	–	❍	❍
Site Monitor (DGNSS/RTK positioning)	❍	❍	❍	❍	❍	❍
Velocity & Displacement Engine	❍	❍	❍	❍	❍	❍

● Standard ❍ Optional – Not Available

Options

For GR30/GR50

842 486	**GRL202**	Galileo
842 488	**GRL203**	BeiDou
842 489	**GRL204**	QZSS
865 276	**GRL205**	NavIC
	☞	Requires "Highline" variant or "Baseline" variant plus GRL202 & GRL203 GNSS options.
865 277	**GRL206**	SmartTrack+ Interference mitigation
774 428	**GRL107**	RINEX option
774 432	**GRL111**	FTP/SFTP Push option
774 429	**GRL108**	Extended Formats option. Includes BINEX/CMR/CMR+
774 430	**GRL109**	2-20 Hz logging and streaming
842 490	**GRL210**	50 Hz logging and streaming
	☞	Requires GRL109
774 436	**GRL115**	Multi-Client and Ntrip Caster
778 851	**GRL116**	Wake-Up
778 852	**GRL117**	Extended OWI for third party software[2)]
774 435	**GRL114**	Site Monitor[3)]

[2)] Not required for use with Leica GNSS Spider.

[3)] Calculates fixed positions for structural monitoring and reference station integrity applications. Supports application specific processing modes according to the section Accuracy in differential phase mode.

805 687	**GRL120**	GR50W WLAN activation (For GR50W WLAN ready units only)
835 566	**GRL124**	Velocity & Displacement Engine[4)]

Hardware and Software

	GR30	GR50
Position & data recording		
1 Hz logging and streaming	●	●
2-20 Hz logging and streaming	❍	❍
50 Hz logging and streaming[5)]	❍	❍
Connectors/Ports		
Power Input Pins (Lemo)	2	2
Ethernet RJ45 ruggedized	●	●
Serial (Lemo)	1	2
PPS	–	●
External Oscillator	●	●
Event Input	–	●
USB Client	●	●
USB Host	–	●
Bluetooth	–	●
WLAN	–	●
Slot-in communication port	●	●
User Interface		
Screen	–	●
Keypad	–	●
Power Button	●	●
Function Button	1	6
LEDs	6	7
RefWorx Web Interface	●	●
GNSS Spider Support	●	●
Data Storage/Logging (internal)		
Memory Type	SD/SDHC	SD/SDHC
Memory Size (max) [GB]	32	32
Maximum Data Rate [Hz]	50	50
Proprietary (MDB)	●	●
RINEX v2.11, v3.03 RINEX Hatanaka	❍	❍

[4)] Velocity & Displacement Engine: Leica VADASE allows the detection of fast movements without any external correction data. It provides precise velocity and displacement information, according to the section Accuracy (rms) single receiver navigation mode.

[5)] 100 Hz ready. Can be provided through future firmware upgrade.

	GR30	GR50
Zip File Compression	●	●
Data Streaming		
Maximum Data Rate [Hz]	50	50
TCP/IP ports	20	20
Services		
HTTP / HTTPS	●	●
FTP Server	●	●
DHCP / DNS	●	●
DynDNS	●	●
SNMP	●	●
Active Assist[6)]	●	●
SSL/TLS	●	●
Internet connection sharing	●	●
Power Consumption, Supply, Management		
Power Consumption [W]	3.5	3.1
External Power Sources (number)	2	2[7)]
Power Over Ethernet	–	●
Internal Battery	–	●
Internal Charger	–	●
Battery Tpye	–	GEB242
Power Fail Recovery	●	●
Power Management[8)]	–	●
Power Wake-Up	●	●
Physical specifications		
Size [mm]	210 × 190 × 78	210 × 190 × 78
Weight [kg]	1.67[9)]	2.01[9)]

● Standard ❍ Optional – Not Available

[6)] Requires a valid Customer Care Package (CCP) contract for firmware maintenance and support.

[7)] Two fully independent, priority-managed power sources.

[8)] Comprehensive power management to define minimum or maximum power up/down levels, primary supply and recovery after power fail behaviour.

[9)] Weight with bumpers.

1.2 Tracking Characteristics

1.2.1 Overview

Instrument technology

Leica patented SmartTrack+ technology

- Advanced measurement engine generation 7 (555 universal tracking channels, flexible number of signals per satellite, more than 140 satellites multifrequency)
- Resilient signal tracking and interference mitigation technology ensuring consistent, accurate and reliable GNSS multi-frequency measurements even in challenging environments
- Automatically detects and notifies about relevant signal interference
- Industry leading Pulse Aperture Correlator (PAC) multipath mitigation technology for superior quality measurements
- Excellent low elevation tracking
- Very low noise GNSS carrier phase measurements with < 0.5 mm precision
- Minimum acquisition time

Tracking satellite signals

The following satellite signals are tracked[10]:

- GPS[11]: L1 C/A, L1C, L2P(Y), L2C, L5
- GLONASS[11]: L1, L2P, L2C, L3
- Galileo: E1, E5a, E5b, E5ab (AltBOC), E6
- BeiDou: B1I, B1C, B2I, B2a, B2b, B3I
- QZSS[11]: L1 C/A, L1C, L2C, L5
- NavIC: L5
- SBAS: L1[11] from WAAS, EGNOS, GAGAN, MSAS

Time for initial acquisition of signals

Cold start[12] < 39 s (typical)

Hot start[13] < 20 s (typical)

Time for reacquisition of signals

L1 < 0.5 s (typical)

L2 < 1.0 s (typical)

[10] The hardware is prepared for new signals and is designed for BeiDou Phase 2, Phase 3, B1, B2, B3 and Galileo commercial service compatibility. The firmware will be enhanced to support new signals as soon as the officially published signal interface control documentation (ICD) becomes available and the systems operational constellation allows for commercial practical use. Generally, the tracking capability for a specific satellite system is based on publicly available information. For cases where public information is subject to change or not yet available, Leica Geosystems cannot guarantee that these receivers will be fully compatible with a future generation of satellites or signals.

[11] GPS L1P(Y), GLONASS L1P, L5 CDMA, QZSS L6 and SBAS L5 can be provided through future firmware upgrade.

[12] Typical value. No almanac or ephemerides and no approximate position or time.

[13] Typical value. Almanac and recent ephemerides saved and approximate position and time entered.

Sensitivity

Initial acquisition (cold): 35[14)] dB-Hz

Initial acquisition (hot): 35[15)] dB-Hz

Reacquisition: 31 dB-Hz

Tracking GNSS: 28[16)] dB-Hz

GPS Carrier tracking

Condition	GR30/GR50
L1, AS off or on	Reconstructed carrier phase via C/A-code.
L2, AS off	Reconstructed carrier phase via P2-code.
L2, AS on	Switches automatically to patented P-code aided technique providing full L2 reconstructed carrier phase.

GPS code measurements

Condition	GR30/GR50
L1, AS off L1, AS on	Code measurements: C/A-code.
L2, AS off	Code measurements: P2-code and/or L2C code.
L2, AS on	Code measurements: Patented P-code aided code and/or L2C code.

Code smoothing using carrier phase measurements is optional.

Interference monitoring and mitigation

The receiver continuously measures and monitors the relevant frequency spectrum for unwanted interference at user definable sensitivity. The automatic detection and notification about potential interference assist the administrator to take informed decisions.

The SmartTrack+ Advanced Interference Mitigation option offers resilient signal tracking ensuring reliable GNSS multi-frequency operation even in challenging environments.

The radio frequency power spectrum levels can be measured and output at configurable density and update rate for all GNSS bands.

Leica Interference Toolbox desktop software allows to easily monitor, quantify and enable mitigation options on the receiver to remove interference sources impacting the receiver performance.

1.2.2 Measurement Precision and Position Accuracy

☞ Measurement precision, accuracy in position and height, reliability and time for initialisation are dependent upon various factors including the number of satellites tracked, the observation time, the ephemeris accuracy, the atmo-

[14)] Applies to GPS, for all other 41 dB-Hz

[15)] Applies to GPS, for all other 39 dB-Hz

[16)] Applies to Non-Galileo, for Galileo 31 dB-Hz

spheric conditions, multipath and resolved ambiguities. Figures quoted assume normal to favourable conditions.

The following accuracies, given as root mean square (rms), are based on measurements processed using receiver firmware, Leica Geo Office, Leica Infinity and the Bernese Software.

The use of multiple GNSS systems can increase accuracy by up to 30% relative to GPS only.

GNSS measurements

Fully independent code and phase measurements of all frequencies.

	Phase	Code
Precision[17)] GPS L1/L2/L5	0.2 mm rms	20 mm rms
Resolution	0.01 mm	0.0005 m

Resolution of Carrier to Noise ratio (C/No): 0.05 dB-Hz

Accuracy (rms) single receiver navigation mode

Navigation accuracy 5-10 m rms for each coordinate.

Degradation possible due to Selective Availability.

Leica VADASE - Velocity & Displacement Engine

- Velocity accuracy: 0.003 m/s rms horizontal, 0.005 m/s rms vertical.
- Typical velocity derived displacement sensitivity: 1 cm/s horizontal, 2 cm/s vertical.
- Velocity Limit: 515 m/s.
  (Export licensing restricts operation to a maximum of 515 m/s)

Accuracy in differential code mode

Typical position accuracy of a differential code solution for static and kinematic surveys:

- SBAS (GPS-only): 0.6 m
- DGNSS: 0.25 m + 1 ppm (horizontal), 0.5 m + 1 ppm (vertical)

Accuracy in differential phase mode

Accuracy (rms) with Post-Processing[18)]		
	Horizontal	Vertical
Static (phase) with long observations	3 mm + 0.1 ppm	3.5 mm + 0.4 ppm
Static and rapid static (phase)	3 mm + 0.5 ppm	5 mm + 0.5 ppm
Kinematic (phase)	8 mm + 1 ppm	15 mm + 1 ppm

Accuracy (rms) with Real-Time (RTK)[18)]	
Standard of compliance	Compliance with ISO17123-8

[17)] For satellites with C/No higher than 42 dB-Hz; Galileo and BeiDou values are expected to be similar.

[18)] Additional signals from modernised GNSS and a full constellation of emerging satellites such as BeiDou and Galileo will further increase measurement performance and accuracy.

Accuracy (rms) with Real-Time (RTK)[20)]						
Site Monitor Positioning Modes[19)]	Reference Station		Monitoring		Network RTK Rover	
(**H**orizontal/ **V**ertical)	H	V	H	V	H	V
Single Baseline (<30 km)	6 mm + 1 ppm	10 mm + 1 ppm	8 mm + 1 ppm	15 mm + 1 ppm	8 mm + 1 ppm	15 mm + 1 ppm
Network RTK	6 mm + 0.5 ppm	10 mm + 0.5 ppm	8 mm + 0.5 ppm	15 mm + 0.5 ppm	8 mm + 0.5 ppm	15 mm + 0.5 ppm
Sampling	Smoothed		Instantaneous		Instantaneous	
On-the-fly (OTF) initialisation						
RTK technology	Leica SmartCheck technology					
Reliability of OTF initialisation[20)]	≥ 99.999%		≥ 99.999%		≥ 99.99%	
Time for initialisation(typ.)[21)]	10 seconds		10 seconds		4 seconds	
OTF range[21)]	Up to 80 km		Up to 70 km		Up to 70 km	
Network RTK						
Network technology	Leica SmartRTK technology					
Supported RTK network solutions	VRS, FKP, i-MAX					
Supported RTK network standards	MAC (Master Auxiliary Concept) approved by RTCM SC104					

[20)] Additional signals from modernised GNSS and a full constellation of emerging satellites such as BeiDou and Galileo will further increase measurement performance and accuracy.

[19)] Three positioning modes are available:
–**Reference Station:** This mode is designed for monitoring the stability of the antenna position of a reference station. It is optimized for long baselines as used within RTK networks. Movements will be detected with a high reliability while the positioning results are smoothed to prevent outliers from triggering false alarms.
–**Monitoring:** In this mode the position calculation is optimized for monitoring applications with short baselines. Positioning results are less smoothed than in Reference Station mode as outliers are less likely. Therefore, a position change may be detected slightly faster than in Reference Station mode.
–**Network RTK:** In this mode the position calculation will behave as on a real rover.

[21)] Might vary due to atmospheric conditions, signal multipath, obstructions, signal geometry and number of tracked signals.

☞ The mentioned accuracy values for post-processing are based on using the Leica Geo Office and Leica Infinity. Using specialist scientific software (Bernese) available from Leica Geosystems, the following accuracies can be achieved in static post-processing mode, even on very long baselines:

- 2–4 mm in plan
- 3–6 mm in height

1.3 Data Recording

Data recording

	GR30/GR50
Data Storage	
Primary storage (internal, removable)	SD/SDHC (yes)
Secondary storage (external)	USB mass storage device (GR50 only)
Logging sessions	12
Multi-session logging	●
Auto-delete	●
Smart Clean-up	●
User-defined folders	●
Data Types	
Leica raw (MDB)[22)]	●
RINEX v2.11, v3.04[23),24)]	❍
NMEA[25)]	❍
Hatanaka	❍
Zipping of raw files	●
Zipping of RINEX files	❍
File Length	
Maximum [h]	24
Minimum [min]	5
Data Rates	
Standard (MDB, RINEX) [s]	1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30
Low (MDB, RINEX) [s]	60, 120, 180, 240, 300
High (MDB, RINEX) [s]	0.5, 0.2, 0.1, 0.05
Ultra high (MDB) [s/Hz]	0.02
Logging Types	
Continuous	●
Timed	●

● Standard ❍ Optional

[22)] Includes logging of GNSS raw data and external meteorological or tilt device measurements.

[23)] RINEX logging generates files in real time, i.e. without any intermediate binary logging and conversion. RINEX files are logged independently without the need to log raw Leica MDB files.

[24)] Includes Leica RINEX AUXiliary files format to log external meteorological or tilt device measurements.

[25)] Supports data recording from Velocity & Displacement Engine.

1.4 Data Streaming

Data streaming

	GR30	GR50
Data Streaming		
Maximum number of streams	20	20
Maximum number of real-time streams	10	10
Streaming Port		
Serial ports	1	2
TCP/IP ports	20	20
USB client port	1	1
Slot communication port	1	1
Bluetooth port	–	1[26)]
Data Types and Maximum Rates[27)]		
Leica [Hz]	10	10
Leica 4G [Hz]	10	10
RTCM 2.1, 2.2 and 2.3 [Hz]	10	10
RTCM 3.0, 3.1, 3.2 [Hz]	10	10
CMR/CMR+ [Hz]	10	10
BINEX records 0x00, 0x01, 0x7d, 0x7e, 0x7f [Hz]	10	10
Leica Proprietary LB2 [Hz]	50	50
NMEA-0183 v4.11 and LeicaProprietary[28)] [Hz]	20	20
Time slicing of RTK output	●	●
Multi-Clients[29)]		
Clients per TCP/IP NET port	10	10
Ntrip Caster	unlimited[30)]	unlimited[30)]

● Standard ❍ Optional – Needs upgrade

1.5 Memory

Memory Type

Type	Card	Capacity
GR30	Secure Digital (SD and SDHC)	Up to 32 GB

[26)] Only GR50BT variant.

[27)] Generally available streaming rates (in seconds): 0.02 (50 Hz), 0.05 (20 Hz), 0.1 (10 Hz), 0.5 (5 Hz), 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60 (1 minute).

[28)] Includes output from Velocity and Displacement Engine.

[29)] Requires GRL115 Multi-Client and Ntrip Caster option.

[30)] Whilst the Ntrip Caster supports unlimited client connections, the performance and data latency will depend on the quality and bandwidth of the communications used. Users should limit the number of clients depending on the communications being used.

Type	Card	Capacity
GR50	Secure Digital (SD and SDHC)	Up to 32 GB

Data capacity all receivers

Data can be recorded on the SD cards.

The figures shown are accurate to about 1%. They depend on the tracking settings configured on the instrument and are valid for all receivers.

8 GB card, GPS (L1+L2), 12 satellites

Rate [s]	MDB only [h]	RINEX v2 only [h]	RINEX v2 Hatanaka only [h]	RINEX v3 only [h]	RINEX v3 Hatanaka only [h]
1	6000 9000*	1430 5000*	5200 14300*	1450 5000*	5200 14400*
30	169200 222200*	41500 130400*	112200 312200*	42100 130300*	119300 316600*

* Size when zipped

8 GB card, GPS + GLONASS (L1+L2), 12/10 satellites

Rate [s]	MDB only [h]	RINEX v2 only [h]	RINEX v2 Hatanaka only [h]	RINEX v3 only [h]	RINEX v3 Hatanaka only [h]
1	3300 4900*	780 2700*	2900 7800*	800 2700*	2900 7900*
30	92600 119500*	22400 70800*	63900 168200*	23100 70700*	64800 170300*

* Size when zipped

8 GB card, GPS + GLONASS + BDS (B1+B2), 12/10/12 satellites

Rate [s]	MDB only [h]	RINEX v2 only [h]	RINEX v2 Hatanaka only [h]	RINEX v3 only [h]	RINEX v3 Hatanaka only [h]
1	2100 3200*	–	–	520 1750*	1900 5100*
30	59800 77700*	–	–	14900 45800*	42000 110700*

* Size when zipped

8 GB card, GPS + GLONASS + Galileo (E1+E5a+E5b+AltBOC), 12/10/10 satellites

Rate [s]	MDB only [h]	RINEX v2 only [h]	RINEX v2 Hatanaka only [h]	RINEX v3 only [h]	RINEX v3 Hatanaka only [h]
1	1840 2600*	420 1460*	1590 4200*	430 1460*	1610 4300*
30	50300 64900*	12200 38500*	34700 91400*	12500 38400*	35200 92500*

* Size when zipped

8 GB card, GPS + GLONASS + Galileo + BDS (B1+B2), 12/10/10/12 satellites

Rate [s]	MDB only [h]	RINEX v2 only [h]	RINEX v2 Hatanaka only [h]	RINEX v3 only [h]	RINEX v3 Hatanaka only [h]
1	1410 2000*	–	–	330 1130*	1230 3300*
30	38700 50200*	–	–	9600 29600*	27200 71600*

* Size when zipped

1.6 User Interface

1.6.1 Overview

Buttons/LEDs

	GR30	GR50
ON/OFF button	●	●
Functions buttons	1	6
LEDs	6	7

RefWorx Web Interface

The RefWorx firmware of the GR30/GR50 Series provides an integrated web interface functionality that delivers full status information and convenient configuration options. The RefWorx web interface contains a detailed Event/Message log that keeps the user informed of all important activities. The RefWorx web interface also contains a comprehensive built-in online help.

- **Server status:** View the status of important server/receiver information, such as the configured logging sessions, the satellite tracking, an overview of the ports in use and the power and memory available.
- **Server set-up:** Configure all server/receiver related settings such as network connections, FTP push locations and the user management. Or use the tools to upgrade the receiver firmware, add new option keys or switch to your preferred language.
- **GNSS management:** Configure all GNSS data-related settings, such as logging sessions, data streams and the tracking settings. Or enter site-specific information such as the site name, position and antenna details.
- **Server support:** Send receiver information and questions to your Leica support contact, stay informed about new firmware releases or browse the Leica FAQs to quickly find a solution for common questions.

GNSS Spider

The GR30/GR50 Series can be configured and maintained using the Leica GNSS Spider Software.

1.6.2 GR30 User Interface

GR30 button functionality

- Receiver power up/power down
- Start/stop all logging sessions
- Start/stop all data streams
- Initialize the measurement engine
- Reset receiver settings
- Format SD card

GR30 LED status indicator

- Power LED
- SD card LED
- Raw data logging LED
- RT out data stream LED
- RT in data stream LED
- Position LED

1.6.3 GR50 User Interface

GR50 button functionality

- Functionality
  - Receiver power up/power down
  - Network Configuration, including IP address, DHCP, Hostname and Bluetooth
  - Site code and antenna configuration
  - Start/stop of data logging and streaming sessions
- Maintenance
  - Format SD card or USB device
  - Format Systems Settings
  - Stop USB device
  - Initialize the measurement engine
- Status
  - Tracking
  - Position
  - Power Memory

GR50 LED status indicator

- Power LED
- SD card LED
- Raw data logging LED
- RT out data stream LED
- RT in data stream LED
- Position LED
- Bluetooth LED

1.6.4 Operation

Internet connectivity

The convenient and comprehensive Leica RefWorx web interface allows for remote configuration, operation and status displays. Supports HTTP and HTTPS. Leica RefWorx additionally supports DHCP/DNS and a unique host name.

Web interface accessibility

- Ethernet port
- Mobile Internet (for example GPRS)
- USB Client Port – GR30/GR50 only
- Bluetooth Port – GR50BT only
- Wireless LAN – GR50W only
- Simultaneous access is fully supported

Security Access restrictions (configurable in User Management)

- Viewers (status only)
- Users/GNSS Managers (configuration and status)
- Administrators
- SSL/TLS 1.2 encryption

E-mail

Sending of message log in scheduled intervals, or Leica Interference Detection and VADASE displacement events instantly by e-mail. Supports connection security with SMTPS (SMTP over SSL/TLS) & STARTTLS, and user name/password authentication.

FTP/SFTP Push (optional)

Automated FTP Push of raw data and/or RINEX files to a remote (S)FTP server. Ethernet and PPP connection to the Internet is supported.

Ntrip

Leica RefWorx includes comprehensive Ntrip Caster/Client/Server capabilities for example for receiver communication with Leica GNSS Spider, receiving RTK Network corrections, providing RTK services to rover users or passing through data streams from other Ntrip sources.

RTK Multiplexing/Multi-Client (optional)

Option to allow RTK data streaming direct from the sensor, through TCP/IP, for up to 10 clients per TCP/IP port. Unlimited clients supported on the GR30/GR50 using Ntrip Caster.

DynDNS

Allows receiver addressing with a dynamic IP address through a static host name, Requires registration with a DynDNS service.

OWI interface	Leica proprietary Outside World Interface - OWI - for receiver control commands from PC etc., for receiver configuration, control and status, e.g. using Leica GNSS Spider. Binary and ASCII version of the OWI protocol are available. Supported via serial and TCP/IP ports. Simultaneous access, control and message output is fully supported. The OWI use requires a license option to be used with third party software. Using the GR30/GR50 with Leica GNSS Spider does not require the OWI license option.

1.7 Connectors, Ports and Devices

1.7.1 Connector Ports Overview

Connector ports GR30

Type	Description
Power	1 × Lemo-1 female, 5 pin
Serial P1	1 × Lemo-1 female, 8 pin
GNSS Antenna	1 × TNC female
Communication Slot port	1 × UART Serial/USB for removable internal communication devices
P3 Slot-in Antenna	1 × TNC female
External Oscillator	1 × MMCX female, 24QMA-50-2-3/133,5/10 Mhz
Ethernet	1 × RJ45 ruggedised, 10/100 Mbit
USB	USB client (Mini B)

Connector ports GR50

Type	Description
Power	1 × Lemo-1 female, 5 pin
Serial P1	1 × Lemo-1 female, 8 pin
Serial P2/Event	1 × Lemo-1 female, 8 pin
Communication Slot port	1 × UART Serial/USB for removable internal communication devices
GNSS Antenna	1 × TNC female
P3 Slot-in Antenna	1 × TNC female
External Oscillator	1 × MMCX female, 24QMA-50-2-3/133,5/10 Mhz
Ethernet	1 × RJ45 ruggedised, 10/100 Mbit
PPS	1 × Lemo ERN.OS.250.CTL
USB	USB client (Mini B)
USB Host	Standard Type A
Bluetooth/WLAN antenna	SMA Male

Data Links

	GR30	GR50
Serial ports (incl. one Slot-In device port)	2	3
TCP/IP ports[31)]	20	20
Bluetooth (Serial)	–	1[32)]
Simultaneous data streams	20	20
Concurrent RTK formats	10	10

[31)] Using any available hardware interface (Ethernet, WLAN, Bluetooth, USB, mobile device internet).

[32)] GR50BT only.

1.7.2 Connectors

GNSS Antenna

All receivers

Connector	TNC female, 50 Ω nominal impedance
Output voltage	5.0 V DC nominal
Maximum output current	200 mA
Gain at input	15 dB minimum (20 dB min. with HDR enabled) 55 dB maximum
Recommended antennas	AR25/AR20/AR10/AS11
Other antennas	Older legacy Leica antennas and some third-party antennas can also be used. Third-party antennas might require an additional inline amplifier or attenuator.

Power port

All receivers

Description	5 pin LEMO supporting dual power inputs
Connector	LEMO-1, 5 pin, LEMO HMG.1B.305.CLNP

Ethernet network interface

All receivers

IEEE Standards:	802.3 10BASE-T Ethernet 802.3u 100BASE-TX Fast Ethernet 802.3 Auto-negotiation
Link Speed:	10/100 MB, Half/Full Duplex
Protocol:	CSMA/CD
Connector:	Ruggedised RJ45

Bluetooth

Type:	Bluetooth 2.0
Enhanced Data Rate:	EDR maximum 2.1 Mbits/s
Connector:	SMA male

WLAN

Type (single stream):	IEEE 802.11 b/d/g/n
Band support:	Station Mode: 2.4 GHz, channel 1-13*
Network authentication:	Open, Shared, WPA-PSK (no server), WPA2-PSK (no server)
Encryption type:	Disabled, WEP, TKIP, AES
Maximum radiated output power:	17 dBi EIRP**
Connector:	SMA male

* Maximum supported channels for IEEE82.11 d depends on region.

** RF power including maximum antenna gain (2 dBi).

Serial ports

All receivers

Description	8 pin LEMO supporting 2400-115200 baud, incl. RTS/CTS
Default setting	115200/N/8/1/N
Connector (P1/P2/P3)	LEMO-1, 8 pin, LEMO HMA.1B.308.CLNP

☞ Please note, when using external devices the current draw is:
- 1 A/12 V with external power supply on power port
- 0.5 A/12 V with internal battery
- High power radios (PDL:2 W, 35 W Booster, etc) have to be powered separately with Y-cable!

External oscillator

Frequency:	5 MHz or 10 MHz
Input impedance:	50 Ω nominal
Input VSWR:	2:1 maximum
Signal level:	0 dBm minimum to +10.0 dBm maximum
Frequency stability:	±0.5 ppm maximum
Wave shape:	Sinusoidal
Connector:	MMCX female - 24QMA-50-2-3/133

☞ On the GR30/GR50, remove the External oscillator port cover before connecting the cable.

☞ Internal Oscillator aligned to GPS time within 20 ns.

Pulse Per Second (PPS)*

GR50 only

Peak	5 V DC = High
Impedance	50 Ω nominal
Pulse length	1 ms
	Leading edge coinciding with the beginning of each epoch
Positive/negative edge	Selectable via Web interface.
Cable connectivity	Matched with an appropriate impedance of 50 Ω
Connector	LEMO ERN.OS.250.CTL

* PPS pulse typically accurate to 20 ns

Event input

GR50 only

Pulse type	TTL, positive or negative going pulse
Pulse length	150 ns at minimum
Voltage	TTL level, ~ 5 V DC, range ±25 V DC
Voltage level	High = minimum 2.4 V DC Low = maximum 0.6 V DC
Pin definition	Pin 7 = signal, Pin 3 = ground
Connector	LEMO-1, 8 pin, LEMO HMI.1B.308.CLNP

USB client port

GR30/GR50 only

Connector	Mini B
Support	USB 2.0
Speed	Full speed, 12 Mbit/s (1,5 MB/s)

USB host port*

GR50 only:

Connector	Standard Type A
Support	USB 2.0
Speed	High speed: 480 Mbit/s (60 MB/s) Output power: 500 mA (5 V) → Support devices up to 2.5 W

* USB 3.0 data mass storage devices are also supported if they fully comply with USB 2.0 standard.

1.7.3 Communications Devices

Supported communication devices

The GR30/GR50 Series support various communication devices. All receivers support the use of external serial devices. Leica Geosystems offers many devices in external ruggedised GFU housing. Additionally, the GR30/GR50 supports the use of removable slot-in communication devices.

Currently supported and available devices are listed subsequently to this paragraph.

The Leica RefWorx firmware supports more legacy devices not listed here. With newer versions of RefWorx firmware, even more communication devices can be supported. Consult your local Leica Geosystems representative for the latest information.

Supported Radio modems

- Support of any suitable UHF/VHF radio with RS232 interface and operating in transparent mode
- Satelline in Leica GFU housing, fully sealed and protected, IP67
- Pacific Crest PDL in Leica GFU housing, fully sealed and protected, IP67

Supported GSM / UMTS (HSDPA) phone modems

- Support of any suitable GSM / GPRS / UMTS (HSDPA) modem
- Devices in Leica GFU housing, fully sealed and protected, IP67

Supported CDMA phone modems

- Support of any suitable CDMA modem
- Multitech MTMMC CDMA in Leica GFU housing, Dual-Band 800 / 900 MHz, 1 × RTT, fully sealed and protected, IP67

Supported Landline phone modems

- Support of any suitable Landline phone modem, based on US Robotics or Courier V.90.

Supported Slot in devices for GR30/ GR50

Support of a variety of removable slot in devices to be easily plugged into the GR/GM receivers

- Satelline TA11 radio, 403–470 MHz TXO
- Telit 3G GSM / GPRS / UMTS module, 5-Band 850 / 900 / 1800 / 1900 / 2100 MHz
- Cinterion MC75i GSM / GPRS / EDGE module, 4-Band 850 / 900 / 1800 / 1900 MHz
- Satelline M3-TR1 / TR4+ 403–470 MHz transmit/receive UHF radio module
- Telit-Cinterion PLS63-W 4G / LTE Cat. 1 module for global use with multi-band technology (700 / 800 / 850 / 900 / 1800 / 1900 / 2100 / 2300 / 2500 / 2600 MHz) supporting all GSM / GPRS / EDGE / UMTS and LTE FDD / TDD network providers

1.7.4 External Controllers

GR30/GR50

The GR Series has a built in web server software called RefWorx. Any Web enabled device can be used to configure the GR30/GR50. The CS10/CS15/ CS20/CS25/CS35 controllers can be used to configure the GR30/GR50 only using the built-in web browser and a USB or network connection to the GR30/ GR50.

1.8 Networking Services

Services

	GR30/GR50
TCP/IP[33)]	●
Static IP	●
DHCP	●
SLAAC (IPv6 only)	●
DNS[33)]	●
Hostname support[33)]	●
DynDNS	●
HTTP[33)]	●
HTTPS[33)]	●
User-defined HTTP port[33)]	●
User-defined HTTPS port[33)]	●
Secure SSL/TLS[33)]	●
Custom SSL/TLS certificates[33)]	●
FTP Server	●
User-defined FTP ports	●
Passive mode FTP	●
Active mode FTP	●
Simultaneous FTP clients	6
Anonymous FTP	●
FTP/SFTP push[33)]	❍/●[34)]
File download via HTTP[33)]	●
SNMP	●
TCP/IP server[33)]	●
TCP/IP client[33)]	●
Ntrip server (source)[33), 35)]	●
Ntrip client[33), 35)]	●
Ntrip caster[33)]	❍
TCP/IP over USB[33)]	●
Web interface event log	●
E-mail alerts	●

● Standard ❍ Optional

[33)] In addition to standard IPv4 protocol, RefWorx firmware also supports IPv6 protocol for this service.

[34)] For the GR30/GR50 Baseline, FTP push is optional. For all other GR30/GR50 models FTP is standard.

[35)] Supports Ntrip version 1.0 and 2.0

1.9 Weight & Dimensions

Dimensions

The dimensions are given for the housing without the sockets.

Type	Length [mm]	Width [mm]	Thickness [mm]
GR30/GR50	210	190	78
GR30/GR50 with bumpers	220	200	94

Weight

GR30:	1.50 kg (without bumpers), 1.67 kg (with bumpers)
GR50:	1.84 kg (without bumpers), 2.29 kg (with battery and bumpers)

1.10 Environmental Specifications

Environmental specifications

Environmental specifications apply to the receiver including all connectors on the back panel.

Temperature

Type	Operating temperature [°C]	Storage temperature [°C]
All receivers	–40 to +65	–40 to +80
Leica SD cards	–40 to +85	–40 to +125

Compliance with ISO9022-10-08, ISO9022-11-special,
MIL-STD-810H, Method 502.7-II,
MIL-STD-810H, Method 501.7-II (operating) and
MIL-STD-810H, Method 502.7-I,
MIL-STD-810H, Method 501.7-I (storage).

Protection against water, dust and sand

Type	Protection
All receivers	IP68 (IEC 60529) and MIL-STD-810H Methods 506.6-I / 510.7-I / 512.6-I Dust tight. Protected against water jets. Protected against continuous immersion in water. Tested for 2 h in 1.40 m depth.

Humidity

Type	Protection
All receivers	Up to 100% condensing. Compliance with ISO9022-13-06, ISO9022-12-04 and MIL-STD-810H, Method 507.6-I For GR50 additionally: NEBS GR0-63 Sec. 4.1.2 or GR-3108-CORE R4-24 [132] class 1, R4-26 [18] (Operating temperature and humidity cycling)

Vibration

Type	Protection
All receivers	Withstands strong vibration during operation, compliance with ISO9022-36-08 and MIL-STD-810H, Method 514.8 E-1 Cat.24. For GR50 additionally: NEBS GR-63-CORE Sec. 4.4 Earthquake and wall-mounted equipment framework and anchor.

Drops

Type	Protection
All receivers	Withstands 1 m drop onto hard surfaces

1.11 Power & Electrical Certifications

Operating times

Designed for continuous operation.

Supply voltage

All receivers

Nominal 24 V DC, voltage range 10.5–28 V DC

Power consumption

GR30	3.5 W typically, 24 V @ 145 mA
GR50	3.1 W typically, 24 V @ 130 mA

Power supply

All receivers

- Dual input. Up to two external power sources can be connected simultaneously.
- Automatic reboot when power is restored after failure, supporting two configurable recovery scenarios.

For the GR50

Power over Ethernet and internal rechargeable battery. It is possible to configure one external source as the primary power input and the other as the backup.

Batteries

	GR30	GR50
Battery internal	–	●
Battery external	●	●
Internal charger	–	●

Internal

Type (GEB243)	Rechargeable Li-Ion battery.
Voltage	14.4 V
Capacity	GEB243: 6.4 Ah/92.1 Wh
Weight	0.41 kg
Operation time	Powers receiver plus antenna for up to 24/29 hours.

External

	GEB171	GEB373
Type	Rechargeable NiCd	Rechargeable Li-Ion
Voltage	12 V	14.4 V
Capacity	9.0 Ah/108 Wh	20.1 Ah/298 Wh
Weight	2.1 kg	2.0 kg
Operation time	Powers receiver plus antenna for about 27–35 hours.	Powers receiver plus antenna for about 75–93 hours.
Uninterruptible Power Supply (UPS)		Use with 833 864 GEV277 Y-cable and 774 437 GEV242 charger

Certifications

Compliance to	FCC, CE Local approvals (as IC Canada, C-Tick Australia, Japan, China) RoHS REACH http://www.leica-geosystems.com/en/Reach-Compliance_79929.htm

2 GNSS Antennas

Description and use

The antenna is selected for use based upon the application. The table gives a description and the intended use of the individual antennas.

Type	Description	Use
AR25	GPS, GLONASS, Galileo, BeiDou, QZSS, NavIC, L-Band antenna, using a classical Dorne & Margoline element with a 3D choke ring ground plane. Optional protective radome.	High end applications, including all reference station and monitoring. Especially good for scientific studies where excellent low elevation tracking is required.
AR20	GPS, GLONASS, Galileo, BeiDou, QZSS, NavIC, L-Band reference station and monitoring antenna using an innovative planar quad-feed radiating element with a gold choke ring ground plane. Optional protective radome.	High end applications, including all reference station and monitoring. Especially suited for Network RTK, where excellent multipath rejection and the best phase centre stability is required.
AR10	GPS, GLONASS, Galileo, BeiDou, QZSS, NavIC, L-Band reference station and monitoring antenna using an innovative planar quad-feed radiating element with a large ground plane and built-in radome.	General use for standard and high accuracy reference station and monitoring applications.
AS11	Compact geodetic GPS, GLONASS, Galileo, BeiDou, QZSS, NavIC antenna with a built-in ground plane.	Standard Network RTK and monitoring applications.

IGS accreditation

All our antennas are accredited by the International GNSS Service (IGS). Please consult the relevant publications from the IGS Antenna work group for reference.

Dimensions

Type	AR25	AR20	AR10	AS11
Height [cm[	20.0	16.3	14.0	6.0
Diameter [cm[	38.0	32.0	24.0	16.5

Connector

AR25:	N-Type female, with TNC adapter supplied
AR20:	N-Type female, with TNC adapter supplied
AR10:	TNC female
AS11:	TNC female

Mounting

All antennas: 5/8" Whitworth Thread

SECO 2072-33 Adjustable Tilt Monument Mount accessory characteristics:

- Suitable for Male 5/8 × 11 TPI screw thread
- Diameter: 3.20 inch (8.19 cm)
- Overall heights: 3.036 inch (7.71 cm)
- Weight: 6.32 lb (2.87 kg)
- Includes a removable brass 5/8 ×11 male stud adjustable in azimuth and held in location by two set screws
- Allow levelling by three screws with a tilt range ±7°
- Height above the pivot point to the stud shoulder is 1.37 inch (3.50 cm)
- Height below the brass 5/8 stud to the shoulder is 0.463 inch (1.18 cm)
- Axis height is engraved on the outside of the monuments

Weight

AR25:	8.1 kg, radome 1.1 kg
AR20	5.9 kg, radome 0.9 kg
AR10:	1.1 kg
AS11:	0.44 kg

Electrical data and characteristics

Type	AR25	AR20	AR10	AS11
Voltage[36)] [V DC]	3.3–12	3.3–12	3.3–12	3.8–18
Current max (@5V) [mA]	150 (100 mA typical)	100	100	60
Nominal impedence [Ω]	50	50	50	50
Frequency:				
GPS	L1, L2 (including L2C), L5	L1, L2 (including L2C), L5	L1, L2 (including L2C), L5	L1, L2 (including L2C), L5
GLONASS	L1, L2, L3, L5	L1, L2, L3, L5	L1, L2, L3, L5	L1, L2, L3, L5
Galileo	E2-L1-E1, E5a, E5b, E5a+b (AltBOC), E6	E2-L1-E1, E5a, E5b, E5a+b (AltBOC), E6	E2-L1-E1, E5a, E5b, E5a+b (AltBOC), E6	E2-L1-E1, E5a, E5b, E5a+b (AltBOC), E6
BeiDou	B1, B2, B3	B1, B2, B3	B1, B2, B3	B1, B2, B3
QZSS:	L1, L1C, L2C, L5, L1-SAIF, L6	L1, L1C, L2C, L5, L1-SAIF, L6	L1, L1C, L2C, L5, L1-SAIF, L6	L1, L1C, L2C, L5, L1-SAIF, L6
NavIC	L5	L5	L5	L5
L-Band	SBAS, OmniSTAR, Veripos, CDSGPS	SBAS, OmniSTAR, Veripos, CDSGPS	SBAS, OmniSTAR, Veripos, CDSGPS	SBAS, OmniSTAR, Veripos, CDSGPS

[36)] Typically supplied directly from the GNSS receiver or through a powered antenna splitter, using an antenna cable connection.

Type	AR25	AR20	AR10	AS11
Minimuim tracking elevation [degree]	0	0	0	0
Practical tracking elevation [degree]	> 3	> 5	> 3	> 3
LNA Gain [dB] (typ.)	40	30/40[37)]	30/40[37)]	29
Noise Figure [dB] (typ.)	< 1.2 max	< 2	< 1.8	< 2
Phase Center Repeatability [mm] (typ.)	< 1	< 1	< 1	< 1
Phase Center Accuracy [mm] (typ.)	< 2	< 1	< 2	< 2
Axial ratio [dB] (at zenith)	< 1.5	< 1.2	< 1.4	< 0.8
Group Delay Variation [ns] (typ.)	< 6	< 7	< 7	≤ 5
VSWR	1.5:1	1.8:1	2.0:1	2.0:1
Polarisation	RHCP	RHCP[38)]	RHCP	RHCP
Mounting thread [″] (female)	5/8	5/8	5/8	5/8
Connector	N[39)]	N[39)]	TNC	TNC

Lightning protection

Type	Protection
AR10 & AR20	Integrated three stages surge protector to comply with at least 4 kV surge waveform (IEC 61000-4-5 class 4 voltage level)

☞ In-line surge protectors close to the antenna and the receiver are still recommended and required.

Environmental specifications

Temperature

Type	Operating temperature [°C]	Storage temperature [°C]
AR25	−55 to +85	−55 to +90
AR20	−55 to +85	−55 to +85
AR10	−40 to +70	−55 to +85
AS11	−40 to +85	−55 to +85

Operating temperatures in compliance with ISO9022-10-08, ISO9022-11-05 and MIL-STD-810H, Method 502.7-II; MIL-STD-810H, Method 501.7-II

Storage temperatures in compliance with ISO9022-10-08, ISO9022-11-06 and MIL-STD-810H, Method 502.7-I; MILSTD-810H, Method 501.7-I

[37)] 40 dB: Optionally available as sales variant on request.

[38)] LHCP-Variant available on demand.

[39)] N to TNC adapter is included.

Protection against water, dust and sand

Type	Protection
AR25, AR20, AR10	IP67 (IEC 60529) Dust tight, protected against water jets Waterproof to 1 m temporary immersion
AS11	Rain, dust, sand and wind: IP68 and IP69K

Humidity

Type	Protection
AR25, AR20, AR10	Up to 100% condensing. Compliance with ISO9022-13-06, ISO9022-12-04 and MIL-STD-810H, Method 507.6-I
AS11	95% (IEC 60068-2-30: 1999)

Vibration

Type	Rating
AR25	ISO9022-36-05, 10-55 Hz; ±0.15 mm, 5 cycles
AR20	ISO9022-36-05, 10-55 Hz; ±0.15 mm, 5 cycles
AR10	ISO9022-36-05, 10-55 Hz; ±0.15 mm, 5 cycles
AS11	Random: MIL-STD-810G, Method 514.6 IEC 60068-2-27 Sinusoidal: IEC 60068-2-6

Drops

Type	Description
AR25	Withstands 0.6 m drop onto hard surfaces (upside down excluded)
AR20	Withstands 1.0 m drop onto hard surfaces (upside down excluded)
AR10	Withstands 1.2 m drop onto hard surfaces
AS11	Withstands topple over from a 2 m survey pole onto hard surfaces

Cable length

	Available cable lengths for all antennas [m]	Attenuation [dB/100 m]
Coaxial (5 mm)	1.2, 2.8 and 10	71.00[40)]
Coaxial (11 mm)	2, 10, 30, 50 and 70	16.60[41)]

☞ The Leica AR20/AR10 antennas are suitable for use with antenna cables of up to 70 m length without the need for an in-line amplifier. The AR25 antenna and 40 dB variants of AR20/AR10 antennas can be used with even longer cables, depending on the type of cable.
For information about custom type and length cables, attenuator or amplifier please contact your local Leica Geosystems representative.

[40)] Frequency 1,5 GHz, nominal, sea level 25 °C ambient temperature.

[41)] Frequency 1,5 GHz, nominal, sea level 20 °C ambient temperature.

Certifications	Compliance to	FCC, CE Local approvals (as IC Canada, C-Tick Australia, Japan, China) RoHS REACH http://www.leica-geosystems.com/en/Reach-Compliance_79929.htm

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PART OF HEXAGON

- when it has to be right

Leica Geosystems