	Standard use	Reversed use CRP10 attached on reflector
		
PoleHeight**	✓	–
Tilt Compensation**	✓	✓ Refer to the manual of the field software for information about the setting.
TargetID**	✓	✓

a GLS51
b MPR122
c GRZ122
d CRP10 with optional CRP13*

* Feet adapter for the CRP10 tip

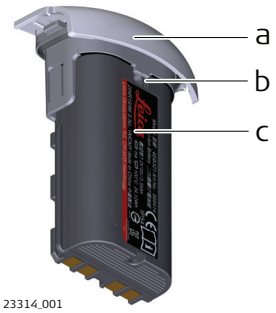
** Features depending on AP20 variant

☞ For reversed use, the target height must be entered manually.

Reflector	Target height with exchangeable pole tip			
	CRP10		CRP10 + CRP13	
Unit	[m]	[ft]	[m]	[ft]
MPR122	0.200	0.656	0.305	1.000
GRZ122	0.228	0.748	0.333	1.093

Change battery step-by-step

GEB321 batteries must be used in the AP20. GEB211/GEB212 do NOT work with AP20.



a Battery holder
b Notch of battery holder
c Battery GEB321

1.	Push the slide fastener of the battery holder in the direction of the arrow with the open-lock symbol.
2.	Remove the battery holder from the compartment. Remove the battery from the holder.
3.	To insert the battery, attach the battery to the batter holder. Align the battery to fit notch of battery holder.
4.	Insert the battery holder into the compartment.
5.	Push the slide fastener in the direction of the arrow with the close-lock symbol.

13 Software Update

Software upload

In case a software upload for AP20 is indicated, the correct firmware file has to be selected. The firmware file depends on the AP20 model.

Model	Software type
AP20 H AP20 ID	AP20H_ID_Firmware.swu Covers all functions required.
AP20 T AP20	AP20_T_Firmware.swu Covers all functions required.

☞ Uploading software can take some time. Ensure that the battery is at least 20% full before you start the upload. Do not remove the battery during the upload process.

Software update instructions for all AP20 models:

1. Download the most recent firmware file from https://myworld.leica-geosystems.com to your local PC.
2. Connect AP20 to PC using GEV284 cable.
3. Copy the firmware file onto the AP20 memory device.
4. Disconnect GEV284 cable.
5. Switch AP20 off.
6. Switch AP20 on.
7. The upload starts automatically.
   During the upload, all three LEDs are flashing consecutively.
8. The update is complete when the Power LED on AP20 is constantly lit.

14 Working with the AutoPole

14.1 Overview

AutoPole functionality

Functionalities are listed according to the individual sales variants.

Functionality	AP20 H	AP20 ID	AP20 T	AP20
PoleHeight	✓	–	✓	✓
Tilt Compensation	–	–	✓	✓
TargetID	–	✓	–	✓

☞ AP20 can only be used in combination with an AP Reflector Pole (CRP4, CRP5, GLS51 and GLS51F).

☞ Establish a Bluetooth connection between the AP20 and the field controller or the total station in order to be operative. Use the connection wizard.

Supported connection types

AutoPole functionalities are supported in 2-person operation and 1-person operation. Use the field software on the total station or field controller to establish a Bluetooth connection.

In case of 1-person operation, first establish a connection between field controller and total station. Then use the field software on the field controller to establish a connection to the AutoPole.

☞ AP20 T and AP20 require a RH18 attached to total station.

14.2 PoleHeight

Description

The AP Reflector Pole can be extended to any of the given snap-lock positions in order to overcome obstacles.

As soon as a snap-lock position is reached, the attached AP20 receives the detected height from the AP Reflector Pole and transmits it to the field software of the connected total station or field controller.

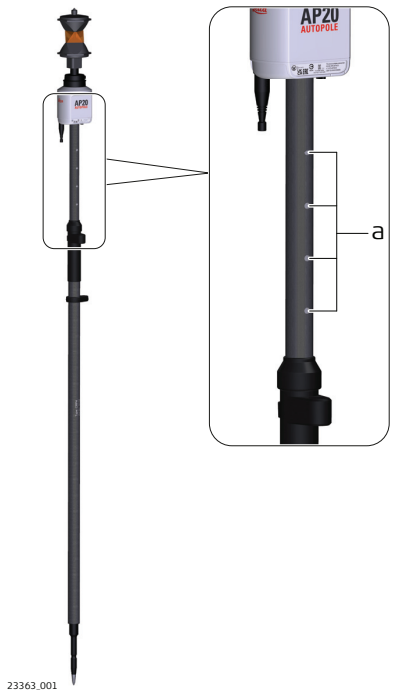
The transmitted height corresponds to the current length between prism centre and pole tip, which is equivalent to the printed scale on the pole and the height input field within the field software.

☞ Valid height detection is limited to the snap-lock positions. Intermediate positions are indicated as invalid. Enter the height manually.

☞ Optional pole extensions are not taken into account.

☞ Transmitted heights can be overwritten manually.

Diagram



a Snap-lock positions

PoleHeight step-by-step

Action	
☞	PoleHeight is only supported with sales variants AP20 H, AP20 T and AP20.
☞	PoleHeight can be used with: • Total station only (2-person operation) • Total station and field controller (1-person operation)
1.	Enter a survey app, for example **Measure** or **Stake points**.
2.	Physically extend or compress the pole to overcome obstacles.
☞	The height input field within Captivate will automatically update to current snap-lock height.
☞	3D viewer is updated with the current height of the pole.
3.	Measure or stake a point. The current height is applied to the coordinate calculation.

14.3 Tilt Compensation

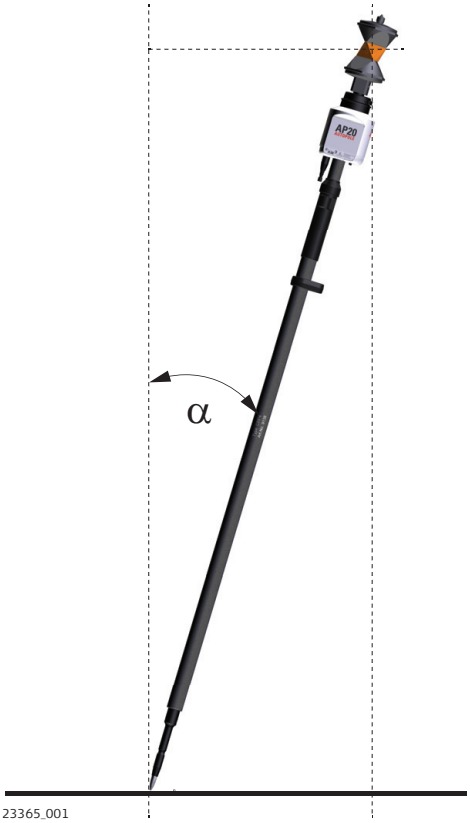
Description

The AP Reflector Pole can be held in a slanting position over the point to be measured without checking the circular bubble on the pole.

When measuring a point, the pole tip must be stable on the point while the pole should be in slight movement. Tilt compensation is indicated by an icon and the Tilt LED and is maintained by natural pole movement, for example while moving to the next point to be measured.

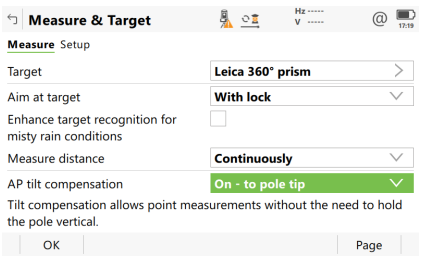
Measurements are reliable and accurate even if the pole is not levelled as the tilt values are calculated by an Inertial Measurement Unit. Tilt values contain information about the 3D position of the pole.

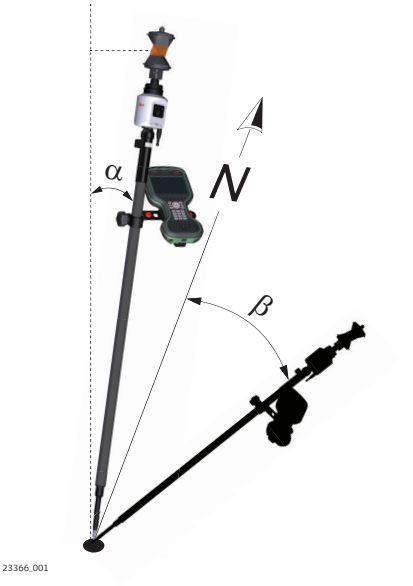
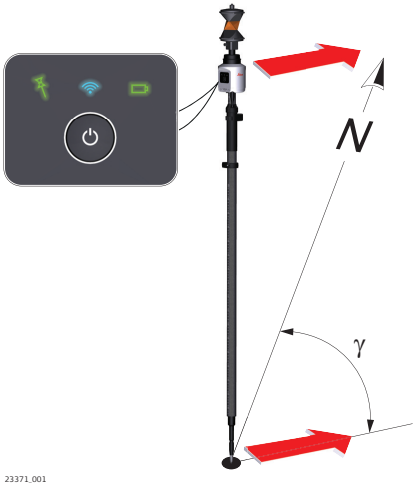
Diagram

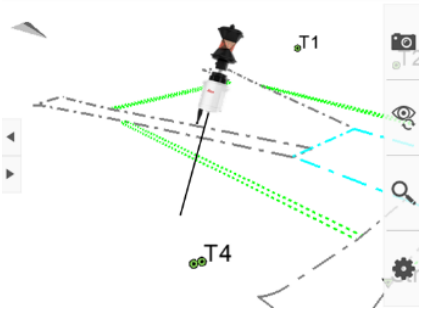
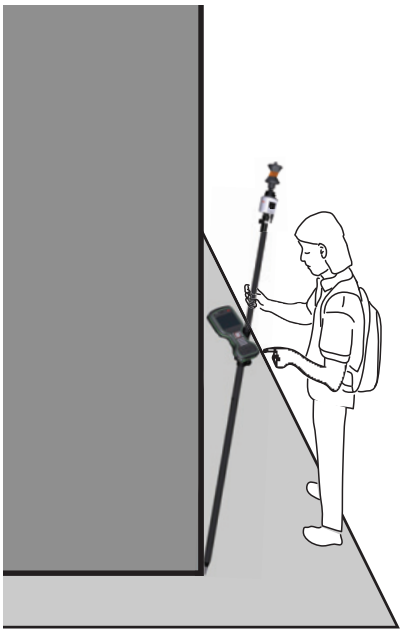
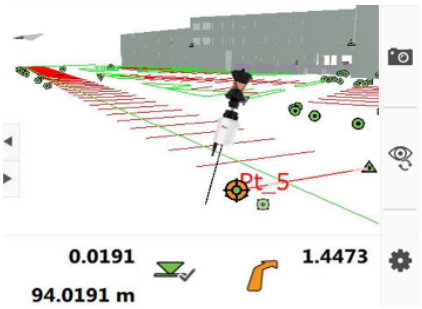


α Tilt

Tilt Compensation step-by-step

Action	Result
☞	Tilt Compensation is only supported with sales variants AP20 T and AP20 connected via RH18 to an automated total station supporting Target Lock.
☞	Tilt Compensation can be used with total station only (2-person operation) or with an additional field controller connected to a total station (1-person operation).
1.	**Leica Captivate - Home**: **Settings\TS instrument\Measure & target**
2.	**AP tilt compensation** 
3.	**OK**
4.	Enter a survey app, for example **Measure** or **Stake points**.
☞	Tilt Compensation is not supported within the **Setup** app.
5.	Press **Start tilt**.

Action		Result
☞	Move the pole for initialisation. Walking to the survey mark is sufficient. A message and a voice promt indicate that the tilt compensation is being applied.	
☞	The Tilt LED on the AP20 and the green background of the Target Lock icon within Captivate indicate when a tilt compensated measurement is possible. Refer to 15 LED Indicators.	
6.	3D viewer is updated with the current pole alignment. The heading direction is the opposite side to the LED screen and ON/OFF button.	 α Tilt toward vertical line β Direction of tilt toward North  γ AP heading

Action		Result
7.	**Measure points** **Leica Captivate - Home**: **Measure** The position of the tilted AP20 is shown in the 3D viewer. Store points by pressing **Store**.	
	Application example:	 23383_001
8.	**Stake points** **Leica Captivate - Home**: **Stake points** The position of the tilted AP20 is shown in the 3D viewer. Stake out the point. The values are valid for the tip of the pole.	

14.4 TargetID

Description

TargetID provides an automatic target search and identification on-the-fly.

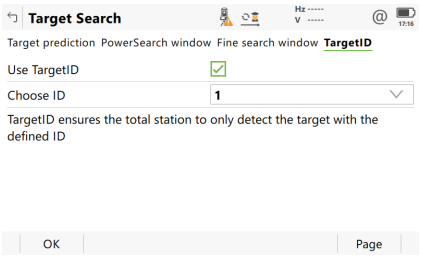
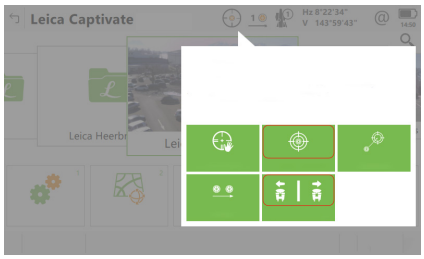
The common search methods, such as PowerSearch, are extended with an additional verification of an ID which is transmitted from the AP20.

While the total station is performing a search, it ignores any other target or foreign reflections and only stops and locks onto the target above the AP20.

Diagram

a TargetID window, 360° coverage

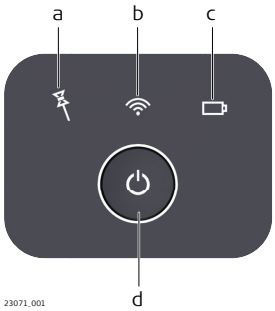
TargetID step-by-step

Action	Result
☞	TargetID is only supported with sales variants AP20 ID and AP20.
☞	TargetID functionality requires a total station with PowerSearch capability.
1. **Leica Captivate - Home**: **Settings\TS instrument\Target search**, **TargetID** page.	
2. **Use TargetID**: Check the check box.	
3. **OK**	
4. Start a target search. For example, use the icon **Search & lock** or **PowerSearch**.	
☞ The search includes identification on-the-fly and only stops at and locks onto the target above the AP20.	

15 LED Indicators

Description of the AP20 ON/OFF button and status LEDs

Diagram



a Tilt Compensation LED
b Connectivity LED
c Power LED
d ON/OFF button

Description of the LED Indicators

LED	LED Status	Status of the Instrument
Tilt Compensation LED	off	Tilt compensation is unavailable or switched off.
	green	Tilt compensation is activated, compensation values are stored. Tilt compensation is being applied to the point measurement.
	red	Tilt compensation is activated, but currently not being applied to the point measurement.
Connectivity LED	off	AP20 is not powered or module is not ready.
	green	Bluetooth is visible for other instruments and ready for connecting.
	blue	Bluetooth has connected.
Power LED	off	Battery is not connected, flat or AP20 is switched off.
	green	Power is 21% - 100%.
	red	Power is 11% - 20%. The remaining time for which enough power is available depends on the type of survey, the temperature and the age of the battery.
	flashing red	Power is low (<10%).

16 Care and Transport

16.1 Transport

Transport in the field

When transporting the equipment in the field, always make sure that you carry the product in its original container.

Transport in a road vehicle

Never carry the product loose in a road vehicle, as it can be affected by shock and vibration. Always carry the product in its container and secure it.

For products for which no container is available use the original packaging or its equivalent.

Shipping

When transporting the product by rail, air or sea, always use the complete original Leica Geosystems packaging, container and cardboard box, or its equivalent, to protect against shock and vibration.

Shipping, transport of batteries

When transporting or shipping batteries, the person responsible for the product must ensure that the applicable national and international rules and regulations are observed. Before transportation or shipping, contact your local passenger or freight transport company.

16.2 Storage

Product

Respect the temperature limits when storing the equipment, particularly in summer if the equipment is inside a vehicle. Refer to 17 Technical Data for information about temperature limits.

Li-Ion batteries

- Refer to 17 Technical Data for information about storage temperature range
- Remove batteries from the product and the charger before storing
- After storage recharge batteries before using
- Protect batteries from damp and wetness. Wet or damp batteries must be dried before storing or use
- A storage temperature range of 0 °C to +30 °C / +32 °F to +86 °F in a dry environment is recommended to minimize self-discharging of the battery
- At the recommended storage temperature range, batteries containing a 40% to 50% charge can be stored for up to one year. After this storage period the batteries must be recharged

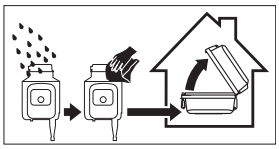
16.3 Cleaning and Drying

Product and accessories

- Use only a clean, soft, lint-free cloth for cleaning. If necessary, moisten the cloth with water or pure alcohol. Do not use other liquids; these may attack the polymer components.

Damp products

Dry the product, the transport container, the foam inserts and the accessories at a temperature not greater than 40 °C /104 °F and clean them. Remove the battery cover and dry the battery compartment. Do not repack until everything is completely dry. Always close the transport container when using in the field.



AP reflector pole

In case of water ingress in the AP reflector pole, remove the tip of the pole to release water.

Cables and plugs

Keep plugs clean and dry. Blow away any dirt lodged in the plugs of the connecting cables.

17 Technical Data

17.1 PoleHeight

Range

AP Reflector Pole	PoleHeight Minimum		PoleHeight Maximum		Snap-lock spacing	
	[m]	[ft]	[m]	[ft]	[m]	[ft]
CRP4	1.55	-	2.20	-	0.05	-
CRP5	-	6.0	-	7.0	-	1.0
GLS51	1.55	-	2.20	-	0.05	-
GLS51F	-	4.7	-	7.0	-	0.2

Accuracy in reading of PoleHeight

± 1.0 mm

☞ Valid for engaged snap-lock positions of the AP Reflector Pole.

☞ The centring accuracy of the attached prism is not included.

17.2 Tilt Compensation

Range

Tilt range

Tilt Compensation works in arbitrary alignments of the pole as long as the target has free line-of-sight to the total station and positions can be measured continuously.

Range from total station

The maximum measuring range between the tilted pole and the total station depends on the achievable target lock and the remote connection range, typically 300 m.

☞ A total station with target locking and continuous distance measurement is required.

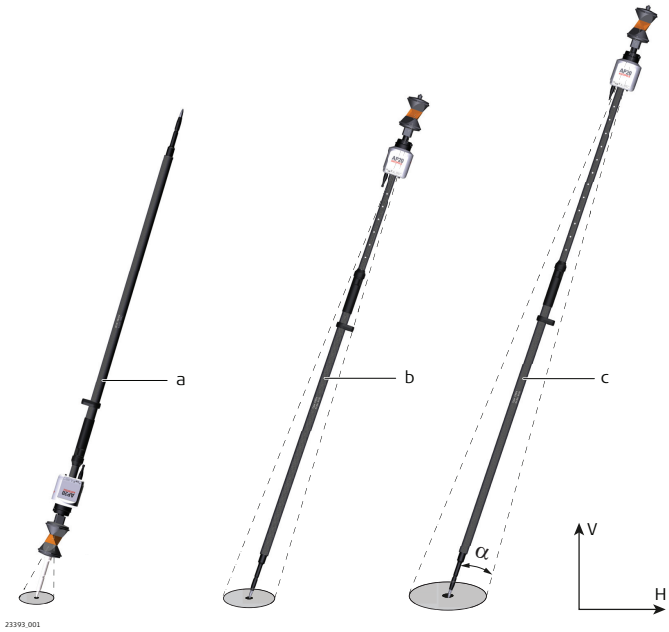
☞ A RH18 is required on the total station to support AP20 Tilt Compensation.

Accuracy

Since the Tilt Compensation uses continuous total station observations for the determination of the pole tilt, the tilt accuracy depends on various factors.

- Angular accuracy of the total station
- Distance accuracy of the total station
- Target type
- EDM measurement frequency of the total station
- Environmental and atmospheric conditions
- Target height
- Level of pole tilt

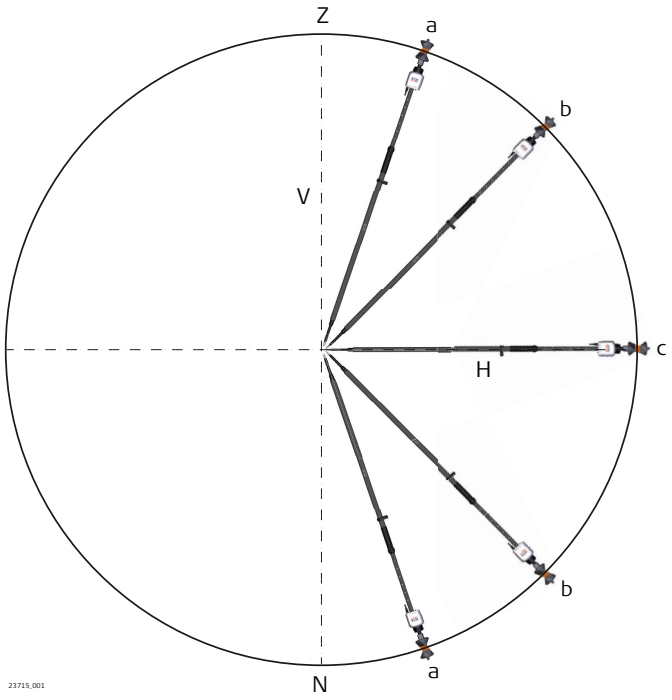
The derived additional pole tip accuracy in 2D and 1D, given as root mean square, depends on the level of tilt and the used target height. The lower the target height, the higher the pole tip accuracy.



a Target height 0.228 m
b Target height 1.600 m
c Target height 2.000 m
α Tilt accuracy
H Horizontal
V Vertical

The less the pole is tilted from zenith/nadir to a horizontal pole alignment, the higher the pole tip accuracy.

	Target height	Additional pole tip uncertainty for tilt down to 90°, typically
Horizontal (2D)	0.228 m	1 mm + 0.1 mm/° tilt
	1.600 m	3 mm + 0.6 mm/° tilt
	2.000 m	4 mm + 0.7 mm/° tilt
Vertical (1D)	0.228 m	1 mm + 0.05 mm/° tilt
	1.600 m	1 mm + 0.05 mm/° tilt
	2.000 m	1 mm + 0.1 mm/° tilt



a 15° tilt from zenith/nadir
b 45° tilt from zenith/nadir
c 90° tilt from zenith/nadir
Z Zenith
N Nadir
V Vertical alignment
H Horizontal alignment

When carrying the AP20 on the pole:

- Avoid dropping it and toppling over.
- In case of mechanic shock, test measurements are recommended to check the accuracy.

Measurement principle

Combining the reflector position with attitude information from an Inertial Measurement Unit (IMU) results in a tilt compensated pole tip position.

17.3 TargetID

Range

Pole alignment	Range	
	[m]	[ft]
Vertical	150	500
Tilted ±30°	100	325

TargetID uses PowerSearch technology. Measurements at the vertical limits of the PowerSearch fan or under unfavourable atmospheric conditions may reduce the maximum range.

Shortest measuring distance: 3 m

Separability

Number of different IDs: 16

Principle of TargetID

Type	Description
Principle	Digital image processing
Type	Infrared laser

☞ A total station with PowerSearch is required.

AP20 dimensions

Weight

Type	Value
All AP20	0.4 kg
Internal battery	0.1 kg

Power consumption

Type	Power consumption	
	Typically	Maximum
AP20 H	1.2 W	1.5 W
AP20 ID	1.5 W	13.1 W
AP20 T	3.2 W	4.0 W
AP20	3.6 W	15.6 W

Instrument port

Name	Description
USB type C port	Cable connection from USB devices for firmware update

Internal battery

Type	Battery	Nominal Voltage	Capacity
GEB321	Li-Ion	7.2 V ⎓	3.35 Ah

Operating times

Model	Operating time, typical
AP20 H AP20 ID	> 16 h

Model	Operating time, typical
AP20 T AP20	6 h

Environmental specifications

Temperature

Type	Operating temperature [°C]	Storage temperature [°C]
All AP20	–30 to +60	–40 to +80

Protection against water, dust and sand

	Protection
All AP20	IP67 (IEC 60529)

Humidity

Type	Protection
All AP20	Max 95% non condensing The effects of condensation are to be effectively counteracted by periodically drying out the AP20.

17.5 Conformity to National Regulations

Labelling AP20

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

24805_001

Labelling GEB321

24804_001

Frequency band

Type	Value
Bluetooth	2402 - 2480 MHz
NFC	13.56 MHz

Output power

Type	Value
Bluetooth	≤ 8 dBm (e.i.r.p)

Antenna

Type	Antenna	Gain
Bluetooth Classic	Planar Inverted-F Antenna (PIFA)	Internal antenna
Bluetooth Low Energy	1/4 wavelength whip antenna	3.5 dBi (Peak)
Near-Field Communication (NFC)	Coil flex	-

EU

CE

Hereby, Leica Geosystems AG declares that the radio equipment type AP20 is in compliance with Directive 2014/53/EU and other applicable European Directives.
The full text of the EU declaration of conformity is available at the following Internet address: http://www.leica-geosystems.com/ce.

USA

Contains FCC ID: XPYNINAB22 (AP20 H), XPYNINAB22 (AP20 ID), RFD-AP20T (AP20 T), RFD-AP20T (AP20)
Part 15 B

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, it may cause harmful interference to radio communications.

However, there is no guarantee that interference does not occur in a particular installation.
If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Canada

CAN ICES-003 B/NMB-003 B
IC: 8595A-NINAB22 (AP20 H), 8595A-NINAB22 (AP20 ID), 3177A-AP20T (AP20 T), 3177A-AP20T (AP20)

Canada Compliance Statement
This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference
2. This device must accept any interference, including interference that may cause undesired operation of the device

Canada Déclaration de Conformité
L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. L'appareil ne doit pas produire de brouillage
2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement

Japan

- This device is granted pursuant to the Japanese Radio Law (電波法).
- This device should not be modified (otherwise the granted designation number will become invalid).

Others

The conformity for countries with other national regulations has to be approved prior to use and operation.

18 Software Licence Agreement/Warranty

Software Licence Agreement

This product contains software that is preinstalled on the product, or that is supplied to you on a data carrier medium, or that can be downloaded by you online according to prior authorisation from Leica Geosystems. Such software is protected by copyright and other laws and its use is defined and regulated by the Leica Geosystems Software Licence Agreement, which covers aspects such as, but not limited to, Scope of the Licence, Warranty, Intellectual Property Rights, Limitation of Liability, Exclusion of other Assurances, Governing Law and Place of Jurisdiction. Please make sure, that at any time you fully comply with the terms and conditions of the Leica Geosystems Software Licence Agreement.

Such agreement is provided together with all products and can also be referred to and downloaded at the Leica Geosystems home page at Hexagon – Legal Documents or collected from your Leica Geosystems distributor.

You must not install or use the software unless you have read and accepted the terms and conditions of the Leica Geosystems Software Licence Agreement. Installation or use of the software or any part thereof, is deemed to be an acceptance of all the terms and conditions of such Licence Agreement. If you do not agree to all or some of the terms of such Licence Agreement, you must not download, install or use the software and you must return the unused software together with its accompanying documentation and the purchase receipt to the distributor from whom you purchased the product within ten (10) days of purchase to obtain a full refund of the purchase price.

Open Source information

The software on the product may contain copyright-protected software that is licenced under various open source licences.

Copies of the corresponding licences

- are provided together with the product (for example in the About panel of the software)
- can be downloaded on http://opensource.leica-geosystems.com

If foreseen in the corresponding open source licence, you may obtain the corresponding source code and other related data on http://opensource.leica-geosystems.com.

Contact
opensource@leica-geosystems.com in case you need additional information.

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PART OF HEXAGON

- when it has to be right

Leica Geosystems