

COMPARE.

TRINITY F90+ // WINGTRAONE

quantum
systems

Introduction

For the product comparison in this document we used a Trinity F90+ UAV and a WingtraOne (not the WingtraOne Gen II) with RX 1 RII RGB camera.

After Wingtra introduced the WingtraOne Gen II in August 2021 this document was updated with accessible information, e.g. from Wingtra website, webinars and presentations. These are marked as **"Update"** and highlighted in orange color. The results of the flights and data quality and accuracy are not affected.



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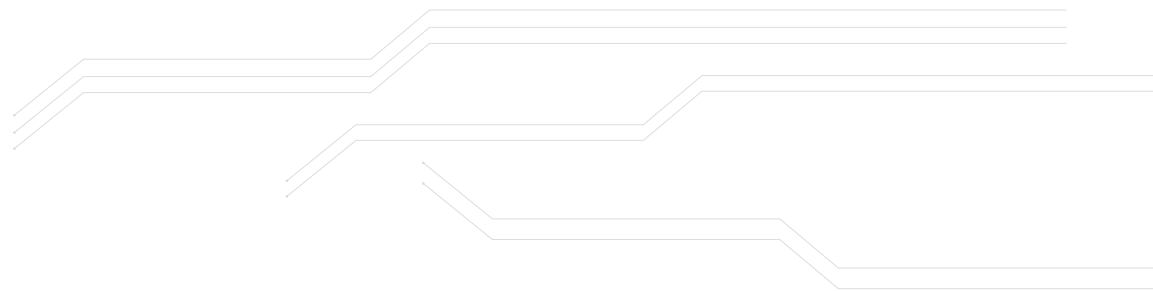
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01. TRANSPORTATION & PACKAGING

Case

The Trinity F90+ comes well protected in one transport case that fits into the trunk of a standard car (Audi A4).



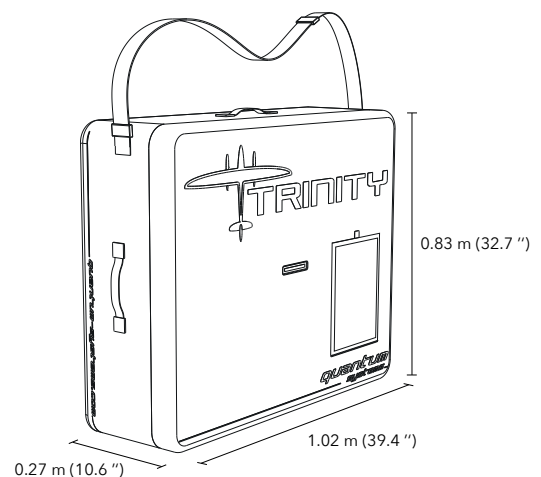
Accessories

Always required on site

- Laptop (X64 compatible Windows PCs/tablets) with QBase 3D installed
- Remote Controller
- QBase 3D Modem
- One battery

Also included in delivery

- 1 Battery Pack and Charger
- iBase reference GNSS station and PPK incl. USB power bank (always included)
- Live-Air-Traffic ADSB in (receiver set)
- Anti-Collision Lights
- Anemometer



Case

For missions with WingtraOne two pieces of luggage are needed. The soft-shell backpack option for the UAV and a hard case box for the WingtraPilot base station, both fit into a small car.



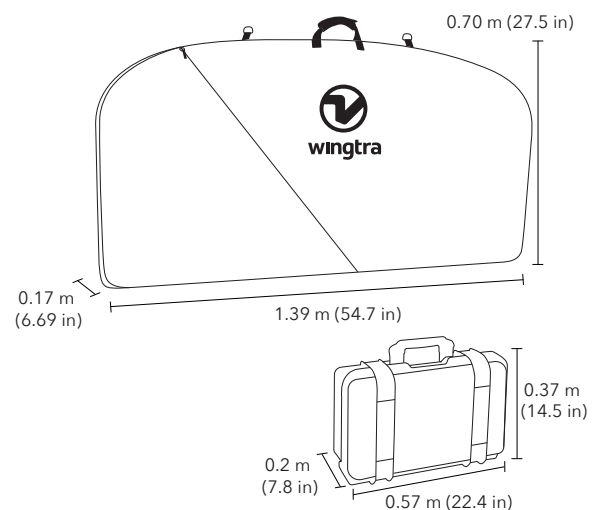
Accessories

Always required on site

- Remote Control FRSky Taranis X9D+ (regulatory legal requirement)
- Samsung Active Tablet (WingtraPilot installed)
- Two batteries per flight
- Antenna Set (telemetry link via USB-C)
- Pitot tube protection for calibration

Also included in delivery

- Micro SD, USB-C adapter
- 2 Batteries and battery charging unit
- Tablet charging cable
- Anemometer
- Torx Screw Driver (tool)
- PPK optional, upgrade at a later point possible



OUR CONCLUSION

- ◆ Trinity F90+ comes well protected in a ready to fly box. Having just one piece for storage and transportation is convenient on the one hand but makes it a little heavier on the other.
- ◆ The Wingtra soft-shell backpack is less protective for the UAV but lightweight and let one person carry it easily on the back. The complete base station must be carried in a separate hard case box.



02. SET-UP & HANDLING

Assembly

1. Attach payload compartment
2. Attach rear fuselage to main body
3. Attach outside wing left and right
4. Attach elevator
5. Attach battery (nose)



Payload change

Changing the camera is possible in just a few seconds by exchanging the entire payload compartment. All cameras are fully integrated in a Quantum-Systems customized payload compartment that is secured via a lock mechanism. No tools required.

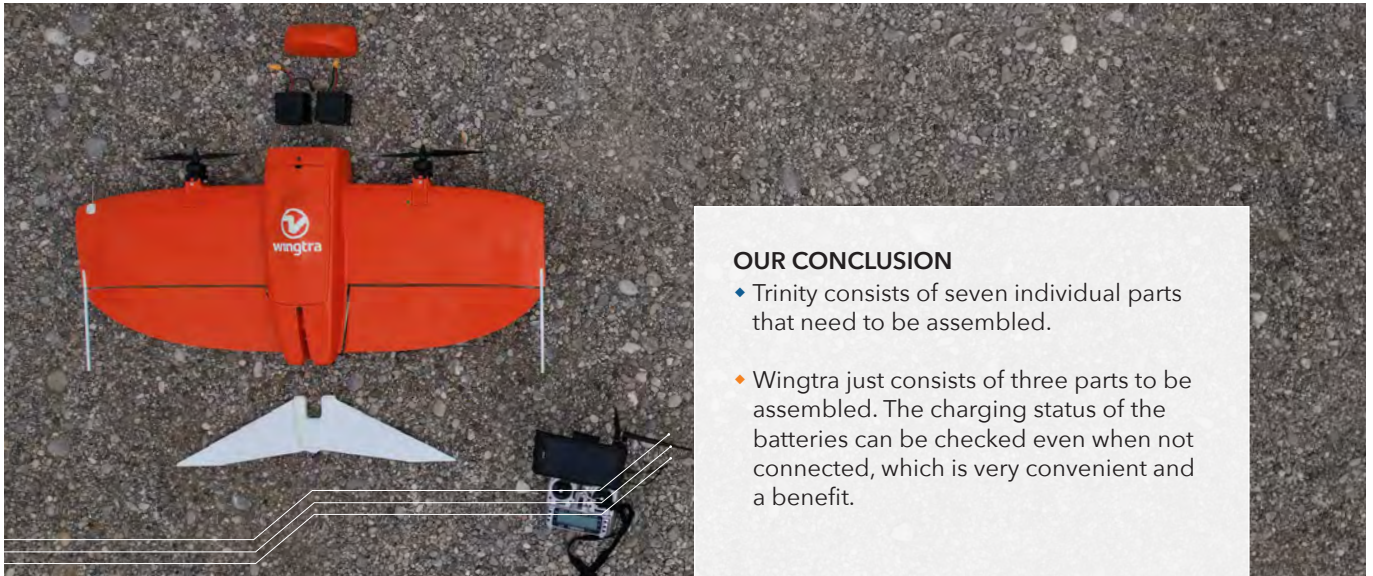


OUR CONCLUSION

- ◆ Changing the payload of a TrinityF90+ literally takes just 10 seconds with the quick lock mechanism.
- ◆ The payload change on the WingtraOne is more complex than on the Trinity. It requires more handling, a tool and definitely more time.

Assembly

1. Secure the middle stand (fin) to the airframe
2. Insert two batteries into the "nose" and connect the two data and the two power plugs / cables.

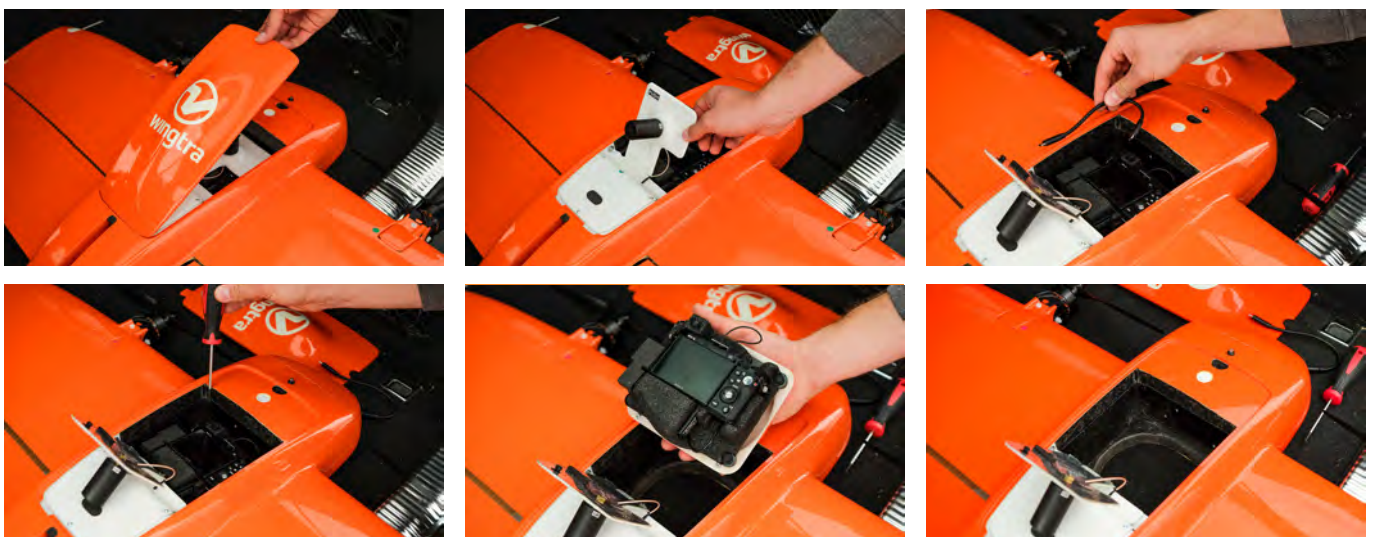


OUR CONCLUSION

- ◆ Trinity consists of seven individual parts that need to be assembled.
- ◆ Wingtra just consists of three parts to be assembled. The charging status of the batteries can be checked even when not connected, which is very convenient and a benefit.

Payload change

Wingtra claims in their official communication, that the WingtraOne is designed to make payload swapping quick and easy. It allows to use the best suited configuration for each specific application.





03. MATERIALS & QUALITY

Materials

- The Trinity F90+ is mainly made of **Elapor™** foam, leading to less air and ground risk.
- The inner structure/ skeleton is made of carbon fibre. Critical areas are reinforced.
- The air speed sensor is secured in place by a magnet - avoiding breakage.
- The low weight allows for long flight times of 90 minutes and more.
- Trinity F90+ is landing on a shock absorbing landing gear, which is produced from carbon reinforced polyamid.
- It supports the safety of the components by offering additional flex. For a long service life of the UAV and the integrated-sensors.



Materials

- The WingtraOne has a glass fiber airframe featuring replaceable side stands and a middle stand.
- The payload compartment cover and battery cover (nose) are secured with magnets only. This may have changed with latest updates.
- WingtraOne has a ground distance sensor, to ensure smooth landing on the tail and little harm on the materials.
- The airspeed sensor is prone to damage due to its exposed position.

Update: The WingtraOne Gen II no longer has a airspeed sensor.



OUR CONCLUSION

Both UAVs are designed and constructed in a different way.

- ◆ Trinity comes in very light weight Elapor foam which leads - in combination with its efficiency - to the flight time of 90 minutes and more. Trinity is assembled of seven individual parts, allowing for cost-efficient maintenance and repair.
- ◆ Except for the middle stand (fin) the WingtraOne comes in one single piece made of glass fiber which gives it an appealing, robust appearance. In our view, downside is the short maximum flight time and that in case of a damage/ breakage, the entire UAV needs to be replaced (no single parts).



04. FLIGHT PLANNING

QBase 3D

- QBase 3D is the platform to plan aerial survey missions with Quantum-Systems UAS.
- Runs on a laptop (x64 compatible), which offers a very good overview and visibility due to the larger screen, when compared to a tablet.
- Automatically generates efficient flight paths after the observation areas and the mission parameters have been defined with just a few clicks.
- For advanced missions, the pilot is in complete control over the photogrammetric aerial survey mission and can adjust all relevant parameters to generate professional and optimum results.
- During flight mode, QBase 3D provides accurate information on aircraft and mission status to ensure flight safety and mission success up to 7.5 km (4.7 mi) distance.
- After mission completion, QBase 3D enables precision enhancement with the built-in PPK solution.



WingtraPilot

- Samsung Tab Active 2 as ground station, passed military spec testing for 21 environmental conditions, including temperature, dust, shock/vibration and extreme pressures.
- Ground station features a setting to auto adjust brightness for maximum visibility in any environment.
- WingtraPilot is an intuitive drone software to manage WingtraOne's data acquisition process.
- WingtraPilot provides live feedback from the WingtraOne up to 10 km (6 mi) away during the entire flight.

WingtraHub

- In-office flight planning, administration, and changing of existing flight plan.
- Submission of flight plans to remote locations.
- Used for PPK post-processing, but no online access to free CORS data. Only the use of Rinex files. Extra hardware dongle needed.





Benefits per planning step

Planning/Terrain following. The integrated 3D view is an efficient tool to plan precisely and to keep the overview during flight. Quantum-Systems is an official and licensed ESRI partner and uses curated ESRI maps/data, including elevation data and off-line maps.

The flight plan must be completed before starting the mission.

Flexible. "No-fly zones" (polygons) can be set manually and individually, giving more flexibility.

Preflight Check. Checklist is available in QBase 3D software as well as on the remote control. Warning messages related to the flight plan are displayed while planning and can be fixed immediately. Internal electronic checks evaluate whether the UAV is ready to fly the mission.

Transition. The maximum transition height is by default set to 40m.

PPK Data Processing. Easily export your PPK processed data with direct compatibility of Pix4D, Agi-Soft, Propeller and Trimble Business Center for further post-processing.



Features	QBase 3D	WingtraPilot
3D Planning	✓	✗
Terrain Following	✓	✓
Displayed Payload Trigger Points	✓	✗
No Fly Zones	Geoawareness (polygons)	Geofencing (cylinder)
Displayed Waypoint	✓	✗
Offline Maps	✓	✓
Mission planning time	pre error correction/time-saving	first check of the flight plan before upload, if adjustments are necessary, very time consuming
Command & Control Range	7.5 km (4.7 mi)	10 km (6.1 mi)
Transition altitude	8 - 40 m (26.2 - 131 ft)	20 - 120 m (65.6 - 393 ft)

Benefits per planning step

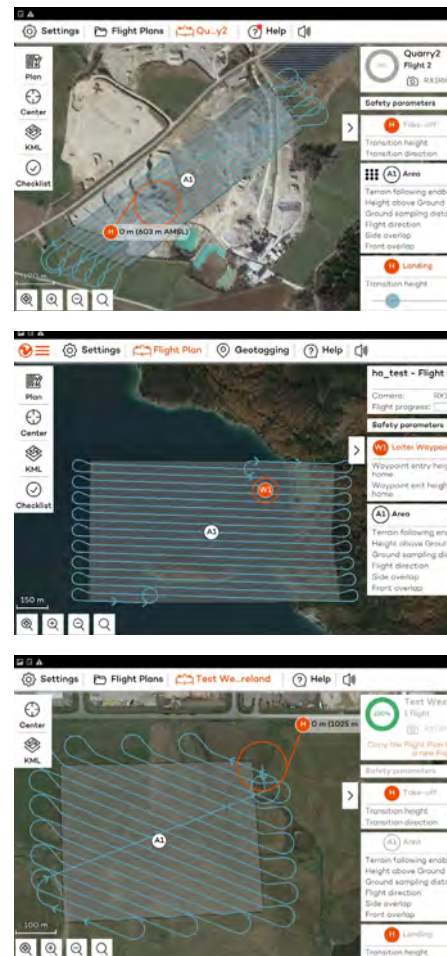
Planning. 2D planning only. No 3D view which makes it difficult for alpine / hilly areas. Flight plan does indicate potential collisions right before uploading the mission. The flight plan must be completed before starting the mission.

Flexible. "No-fly zones" can be set as geofencing cylinder.

Preflight Check. Very detailed checklist that needs to get checked and confirmed prior to each flight. Planning related warnings are displayed during preflight check/when starting transfer to UAV. Airspeed sensor calibration prior to every flight is necessary (takes a few minutes).

Transition. The maximum transition height is by default set to 120 m. The (re)transition circle can not altered.

PPK Data Processing. PPK is supported, but PPK-Module and license needs to be bought as an additional option. The PPK post-processing software is WingtraHub. No online access to free CORS data, but RINEX files. The usability, speed and accuracy is the same as QBase 3D PPK.



OUR CONCLUSION

- ◆ The operator brings Trinity up and flying within no-time, saving valuable resources. The time to plan a mission and be ready for take-off might be shorter with Trinity due to quicker planning process and less time-consuming pre-flight check. PPK included at no additional costs. 3D view and terrain following options increase security for the operation with Trinity.
- ◆ What we like about WingtraPilot is that it runs on a Windows PC (Wingtra Pilot 2.0) and on a tablet (Android) allowing for intuitive operation with pen and slide controls (nice!). The flight planning difference can not be overstated - trying to edit flight plans or create them on a small tablet in the field in only 2D mode is very difficult. The pre-flight check is time consuming. What is missing is the 3D view in planning, which is difficult especially in alpine areas. The possibility to set no-fly zones as geofencing cylinders is an advantage. As well as the maximum transition height.



05. TAKE-OFF AND LANDING

Flight phases Trinity F90+

- Trinity F90+ is a typical eVTOL fixed-wing UAV.
- Max. transition height is 40 m (131 ft).

Trinity F90+	
Sustained wind measured on ground	Tipping expectations
0-5 m/s (0-11 mph)	no tippings
5-9 m/s (11-20 mph)	no tippings
> 9 m/s (>20 mph)	Not recommended to fly



1

Vertical take-off. In hover mode the electric motors are vertically positioned. All three motors operate. Front motors are optimized for hover and climb.

2

Transition mode. In transition mode the electric motors and rotors tilt downwards into horizontal position for cruise flight mode. When preparing for landing they swivel back to their vertical position.

3

Efficient cruise flight mode. In cruise flight mode, the UAS operates at its aerodynamic efficiency optimum. Only the rear motor operates at a highly efficient low power cruise setting. In this mode the UAS can fly for 90 minutes.

4

Vertical landing. All three motors are tilted back to vertical position. The UAS lands smoothly and controlled on its shock absorbing landing gear.

Flight phases WingtraOne

- *The WingtraOne is a tailsitter VTOL drone. Strong winds and uneven ground can cause the WingtraOne to tip over (see table below).*
- *Max. transition height is 120 m (393 ft).*
- *WingtraOne has a ground distance sensor, to ensure smooth landing on the tail and auto-landing accuracy.*
- *In fact, the motors turn off, when 10 cm of distance are measured. Sometimes leading to not so soft landings.*
- *There is no shock absorbance. The sensor needs to work properly.*

WingtraOne	
Sustained wind measured on ground	Tipping expectations
0-5 m/s (0-11 mph)	Tippings rarely occur
5-8 m/s (11-19 mph)	Tippings can occur
> 8 m/s (>19 mph)	Not recommended to fly



1 **Vertical take-off.** WingtraOne performs a motor check, where both motors spin up separately. After four seconds, WingtraOne rises vertically to a pre-set transition height in hover mode.

2 **Transition mode.** While ascending, WingtraOne orients itself to ensure the front side faces the transition direction.

3 **Cruise flight mode.** After transition, WingtraOne flies to the loiter circle, where it rises to the mission height. After completing the planned flight area(s), WingtraOne flies back to the loiter circle to fly down to transition height.

4 **Vertical landing.** WingtraOne first hovers horizontally to the home position and then starts descending. Before initiating the descent, the WingtraOne turns its back side (Wingtra logo) towards the wind to achieve better gust response and a smaller tilt angle for the touchdown.

OUR CONCLUSION

- ◆ Trinity F90+ has a shock absorbing landing gear to reduce harm to the material.
- ◆ Wingtra has a ground distance sensor, to ensure smooth landings on the tail, which looks very beneficial at first glance. We observed several times during our tests, that the motors turn off, when 10 cm of distance are measured which leads to hard landings. As there is no shock absorbance this may lead to damage. The sensor needs to work properly.



06. AIRBORNE

Modes

Fully autonomous. Normally the flight is carried out in automatic mode. The UAV is not controlled by the pilot but flies automatically based on the flight plan that was generated in QBase and transferred to the UAV. Waypoints must be set and transferred to the UAV in order to fly in automatic mode.

Manual take-over. Only in emergency situations, it is recommended to switch to assisted flight to control the UAV manually with the help of the transmitter. If switched to assisted flight, the waypoint mission is paused. It is possible to switch between the modes at any time.

Emergency Mode. All emergency buttons on the remote control or in QBase 3D need a final confirmation.



Features in common

- Intelligent Battery Estimation, incl. strong wind - return home
- Custom Elevation Data
- Anti-collision lights
- Link Lost - return home
- Terrain Following

Differentiating features

- Aileron/Elevator Failure - return home
- Airspeed Failure - return home
- ADS-B in/ out
- Eagle Avoidance Mode
- Land Now - at current location
- No Fly Zones - Geoawareness (polygons)
- Wind Tolerance - return home

Modes

Fully autonomous. WingtraOne takes off and lands smoothly, and you can track its flight on the tablet through WingtraPilot software.

Manual take-over. If the altitude or transition angles need to be adjusted, you can choose the manual mode on the remote control and choose how it moves and lands. The manual controls are intuitive.

Emergency Mode. The emergency button on the remote control is not covered/protected, nor is a final confirmation required. If pressed by accident, the UAV will turn off in the air, leading to an uncontrolled crash.



Features in common

- Battery too low - return home
- Custom elevation data
- Position lights (green and red)
- Link Lost - return home
- Terrain following

Differentiating features

- Predictive self-diagnosis (WingtraOne diagnoses component malfunctions for batteries, motors and servos and notifies via WingtraPilot)
- Redundant sensors
- Adaptive geofence (cylinders)

OUR CONCLUSION

- ♦ Danger! The emergency button on the WingtraOne remote control creates a potential risk of an uncontrolled crash!
- ♦ In the meantime, Wingtra is not offering physical RC any more, but ships a tablet with digital joysticks as a standard. This makes it extremely difficult to manually control the drone in emergency cases. The pilot is essentially relying on only one connection from the tablet to the drone for control.

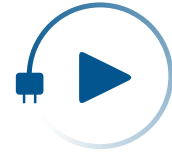


Batteries and area coverage

The battery. The Trinity is powered by UN-certified 6S 4P Li-Ion batteries. Each battery provides an energy of 65 Wh. The battery is enclosed by fire resistant ARPRO material. Charging cycles are counted by an on-board/in-built memory to inform about "battery health".

Flight time. The Trinity F90+ can fly 90 minutes, under ideal conditions even longer. This has been tested and evaluated repeatedly.

Take-off altitude. Quantum-Systems has just recently adjusted the maximum take-off altitude for the Trinity F90 from 3000 m (9,843 ft) to 4500 m (14763.8 ft). Changes in flight time and wind tolerance needs to be observed when flying at higher altitudes.



connect & fly

Trinity F90+	
Camera	Sony RXI RII
Altitude	120 m AGL
Flight time	90 minutes*
Overlap (Side/Forward)	60 % / 70 %
Battery Consumption	1 Battery
No. of flights	1
Coverage	364.3 ha



Batteries and area coverage

The battery. The WingtraOne's UN-certified Li-ion smart batteries can transmit their state of health and charge to the WingtraPilot.

Flight time. Wingtra advertises a flight time of 55 minutes, and this has been tested repeatedly. Observe reduced flight times in heavy winds and when flying at higher altitudes.

Take-off altitude. Wingtra introduces high-altitude propellers, which enable unprecedented accuracy and coverage for a professional mapping drone capturing data above 2500 m (8200 ft) AMSL. Specifically, the new high-altitude propellers and supporting software allow take-off at altitudes of up to 4800 m (15,700 ft) AMSL and flight at altitudes of up to 5000 m (16,400 ft) AMSL.



WingtraOne	
Camera	Sony RXI RII
Altitude	120 m AGL
Flight time	55 minutes
Overlap (Side/Forward)	60 % / 70 %
Battery Consumption	2 Batteries
No. of flights	1
Coverage	180 ha





07. AVAILABLE CAMERAS

Payload Compartments available for Trinity F90+

Sony UMC 20 mm /
Sony UMC 16 mm



Sony RX1RII



LiDAR Qube 240



MicaSense RedEdge-MX



MicaSense Altum



Dual payloads

MicaSense
RedEdge-MX Dual



Double Payload Sony UMC
+ MicaSense RedEdge-MX



Double Payload
Sony UMC + TX Thermal
19 mm



Payload Compartments available for WingtraOne & WingtraOne Gen II

Sony RX1RII



Sony a6100
*Available for WingtraOne
Gen II only*



Oblique Sony a6100
*Available for WingtraOne
Gen II only*



MicaSense RedEdge-MX



MicaSense Altum



OUR CONCLUSION

- ◆ Trinity F90+ comes with a significantly higher number of cameras: 8 in total, thereof 3 are even dual payloads! This ensures there is always the right fit for any application.

08. PPK VS. RTK/PPK & ACCURACY

PPK capability in every situation. PPK and RTK (post-processing kinematics and real-time kinematics) are the algorithms that allow the user to cancel most of GNSS errors via processing data from two receivers that are close enough to each other. They share the same common errors for most error sources such as ionospheric and tropospheric influence on the signal transmission, satellites ephemeris and clock errors.

As it is clear from the names, RTK is performed in real time, PPK - in post-processing. When properly applied, these algorithms reduce positioning errors from several meters (typical for standalone GNSS receivers) down to centimeters.

The Trinity F90+ and the WingtraOne are using PPK for survey grade precise geotagging. However, there are a few differences, the user should be aware about.



Accuracy test Trinity F90+

PPK is not an option, it's a standard feature for all users.

The Trinity F90+ comes with PPK for all sensors and it even includes an L1/L2 Band GNSS Base Station (iBase) for logging RINEX files, which are needed to do the post processing. The workflow is embedded in the QBase 3D flight planning and mission control software. No other software is needed to do the post processing after the flight. The user can decide whether he wants to use a RINEX file from the iBase or any Rinex files from any other GNSS base station.

Even the use of free of cost RINEX files from the internet is an option. The QBase 3D software offers a free download of nearby CORS-Stations. Processing is easy and intuitive and runs as batch process for a number of flights if needed. The QBase 3D software can be used on multiple computers at the same time.

Accuracy test WingtraOne

PPK is an expensive additional option and not included in the basic bundle.

A GNSS base station is not included and the user has to buy a base station separately or he has to buy RINEX files from local providers.

There is no direct online access to any free of cost RINEX files from nearby CORS-Stations.

The PPK processing is done with the WingtraHub Software which is another software in addition to the flight planning and mission control software. The PPK processing is easy and intuitive but not working as a batch process for a number of flights. The Software is protected with a dongle so that it can be only used on one computer at the same time.

PPK Unlimited costs 5,600€: Image geo-tagging without GCPs. License for all WingtraOne cameras (Sony RX1R II included).

PPK accuracy

When working with the same RINEX file (e.g. the file from the iBASE), both PPK processes resulted in approximately the same accuracy. Two flights have been done with both UAVs and the final results have been compared to 4 GCPs. Flight 1 was on a calm day in February while the second flight was executed on a windy day.

PPK accuracy Trinity F90+		PPK accuracy WingtraOne	
Flight 1: 24 th February 2021	Flight 2: 27 th April 2021	Flight 1: 24 th February 2021	Flight 2: 27 th April 2021
X error: 0.95 cm	X error: 2.39 cm	X error: 0.84 cm	X error: 1.52 cm
Y error: 0.75 cm	Y error: 0.38 cm	Y error: 0.88 cm	Y error: 1.53 cm
Z error: 2.45 cm	Z error: 1.61 cm	Z error: 1.60 cm	Z error: 3.04 cm
Total error: 2.74 cm	Total error: 2.91 cm	Total error: 2.00 cm	Total error: 3.72 cm
Mean total error for both flights: 2.83 cm		Mean total error for both flights: 2.86 cm	



09. TEST IMAGES & QUALITY

Both UAVs are using the Sony RX1 full frame camera, but the results are quite different due to different flight profiles and camera settings as well as camera controls.

Trinity F90+

Images are sharper with less motion blur and better color balanced. With the following camera settings: 2,000 shutter speed, ISO Auto (200, sometimes 400), Aperture 4.

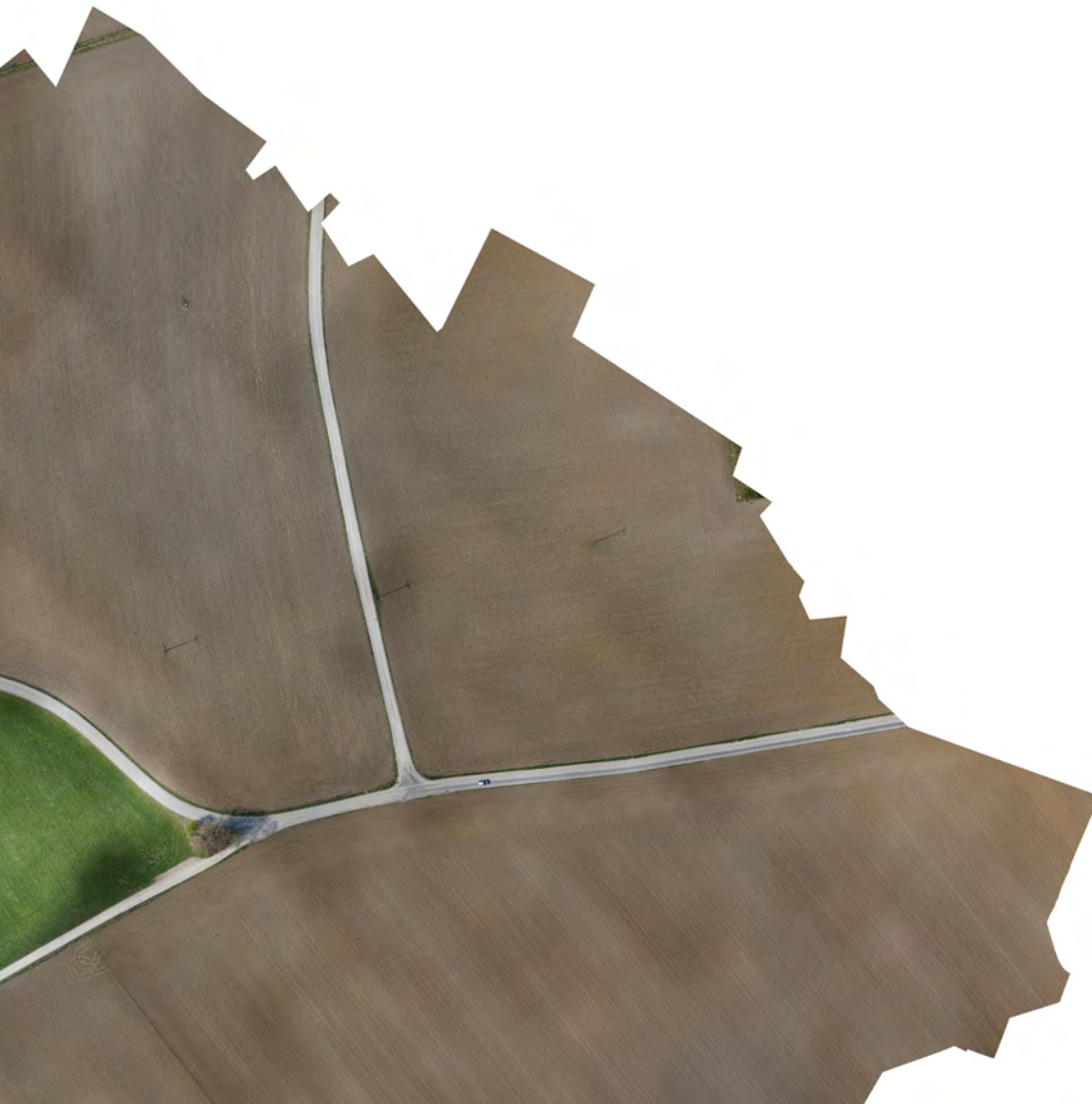


Sony
RX1RII



WingtraOne

Images are slightly less sharp with a bit more motion blur and colors are mostly oversaturated. With the following camera settings: 2,000 shutter speed, ISO Auto (250 -350), Aperture 4.5.
The motion blur might be caused by payload design and flight characteristics

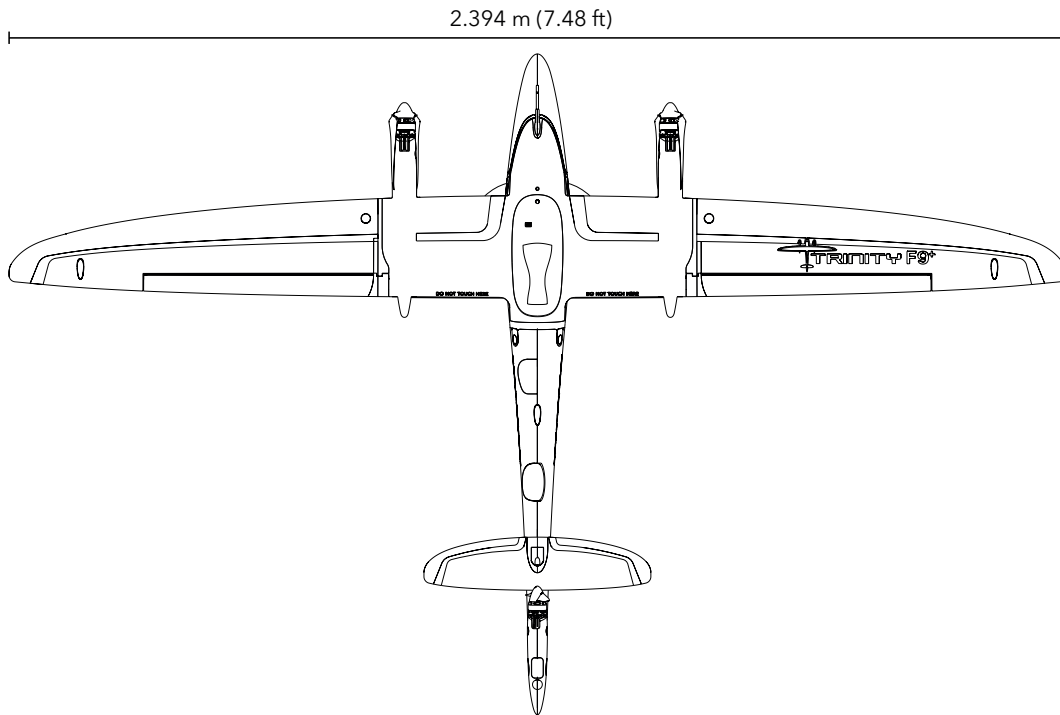


Sony RX1RII





10. SPECIFICATIONS



Trinity F90+	
Max. Take-off Weight	5.0 kg (11.0 lbs)
Max. Flight Time	90+ min ¹
Maximum Flight Altitude (MSL)	4500 m (14763.8 ft) ²
Payload	max. 700 g (1.54 lbs)
Optimal Cruise Speed	17 m/s (33 kn)
Wind Tolerance (ground)	up to 9 m/s (17.5 kn) ³
Wind Tolerance (cruise)	12 m/s (23.3 kn)
Operating Temperature Range	-12°C to 50°C (10.4°F to 122°F) ⁴
Wingspan	2.394 m (7.85 ft)
Transport Case Dimension	1002x830x270 mm (39.4x32.7x10.6 inch)

¹ Subject to export regulation, may require export permission.

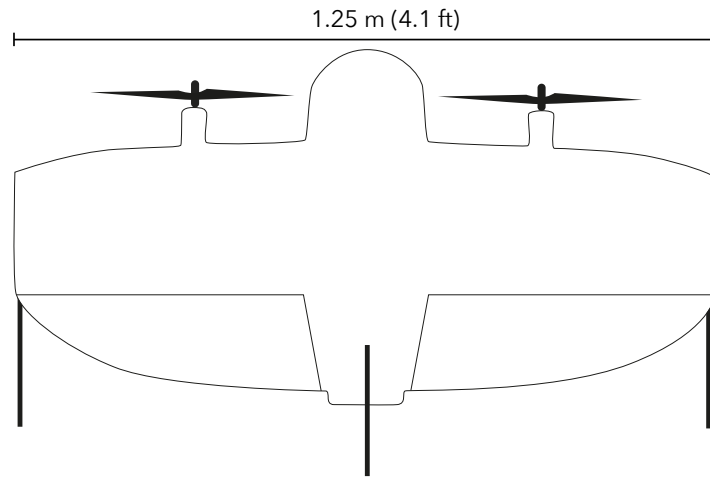
² Please be aware that the flight time and max. wind tolerance are reduced with increasing flight altitude. Depending on the weather conditions; tested at 15° C (59° F). For further details read the user manual chapter 3.1.

³ Please be aware that the max. wind tolerance is reduced with increasing flight altitude.

⁴ For outside temperature < 10°C (<50°F):

Heat up the battery to 25°C (77°F) for at least 5 hours.

For outside temperature < 0°C (<32°F) the flight time will be reduced to max. 70 minutes.



<i>WingtraOne</i>	
4.5 kg (9.9 lb)	Max. Take-off Weight
55 min (Update: 59 min WingtraOne Gen II)	Max. Flight Time
4800 m (15700 ft)	Maximum Flight Altitude (MSL)
max. 800 g (1.8 lbs)	Payload
16 m/s (31 kn)	Optimal Cruise Speed
8 m/s (15.5 kn)	Wind Tolerance (ground)
12 m/s (23.3 kn)	Wind Tolerance (cruise)
-10°C to 40°C (14°F to 104°F)	Operating Temperature Range
1.25 m (4.1 ft)	Wingspan
1370 x 670 x 230 mm (54 x 26 x 9 inch)	Travel Hardcase + Pilot Box
570 x 370 x 200 mm (22.4 x 14.5 x 7.8 inch)	



11. TOTAL COST OF OWNERSHIP

Maintenance and repair

A replacement coverage plan is offered to extend warranty for self-inflicted drone damage, ensuring quick and easy replacement at predictable costs.

Trinity F90+ is built as a modular system. Single items are attached via lock mechanism. This makes maintenance and repair of single parts possible at low cost, reducing TOC of the entire system.

List price for a basic configuration

Trinity F90+	15,900 EURO
+ Sony RX1R II	5,450 EURO

21,350 EURO

incl. PPK and iBase reference GNSS station

Exchangeable parts are

- Batteries
- Propellers
- Elevator
- Outside wing left/right
- Strobe lights
- Air Data Sensor
- Payload compartment

Repairable parts are

- Motor front & rear
- Servo front & rear



Maintenance and repair

Wingtra is offering Extended Services to help customers fly safer, and cover maintenance or broken equipment. They offer Total Maintenance Plans including Accidental Damage Protection.

The WingtraOne body is a singular piece where the entire body needs to be replaced if there is any damage.

A spare drone is 9,300 Euro list price and available under these conditions:

- Excluding camera, PPK module, batteries, pilot box and accessories
- Can only be purchased as backup or as a replacement for a drone from a bundle
- The spare drone may not be used simultaneously with the drone it is replacing.

List price for a basic configuration

WingtraOne Gen II	17,900 EURO
+ SONY RX1R II	6,500 EURO
+ PPK Unlimited License	5,600 EURO

30,000 EURO

no GNSS reference station included

Exchangeable parts are

Batteries
Propellers
Middlestand and
Sidestands

OUR CONCLUSION

- ♦ The Trinity F90+ platform offers way more for the money, PPK as standard, one piece of software, easy interchangeable payloads and a broader choice, easy repair. Plus LiDAR!



quantum
systems

www.quantum-systems.com