ABOUT

This document was created as an additional source of information to raise awareness of the EW/EI/RTI units of the Armed Forces of Ukraine, other units, companies, volunteers and enthusiasts who develop and use solutions for detecting and combating enemy UAVs.

Даний документ створено як додаткове джерело інформації для підвищення обізнаності підрозділів РЕБ/РЕР/РТР ЗС України, інших підрозділів, компаній, волонтерів та ентузіастів, які розробляють та використовують рішення для виявлення ворожих БПЛА та боротьби з ними.

The information in this document was obtained from:

- Open sources
- Found photos of captured and downed equipment
- Patents
- Groups of volunteers and enthusiasts engaged in R&D and radio monitoring

Інформація в даному документі отримана із/від:

- Відкритих джерел
- Знайдених фотографій захопленої та збитої техніки
- Патентів
- Групи волонтерів та ентузіастів, які займаються R&D та радіо моніторингом

You can leave additional information, comments, links to IQ Streams of signals, traces, logs, images, firmware and other information in the comments.

В коментарях можете залишати додаткову інформацію, зауваження, посилання на IQ Stream'и сигналів, трейси, логи, зображення, прошивки та іншу інформацію.

For interesting ideas, suggestions, wishes, use [**FORM**]

Для цікавих ідей, пропозицій, побажань використовуйте [**ФОРМУ**]

Додаткова інформація:

- СИГНАЛИ БОРТОВИХ ПЕРЕДАВАЧІВ БЕЗПІЛОТНИХ ЛІТАЛЬНИХ АПАРАТІВ ПРОТИВНИКА
- АЛЬБОМ з силуетами, розпізнавальними знаками і основними тактико-технічними характеристиками літальних апаратів
- РЕКОМЕНДАЦІЇ ОБСЛУГАМ ЗАСОБІВ РАДІОЕЛЕКТРОННОЇ БОРОТЬБИ ЩОДО ПРОТИДІЇ БЕЗПІЛОТНИМ АВІАЦІЙНИМ КОМПЛЕКСАМ
- БЕЗПІЛОТНІ ПОВІТРЯНІ ЗАСОБИ УРАЖЕННЯ СИЛ ВТОРГНЕННЯ РФ

Glossary

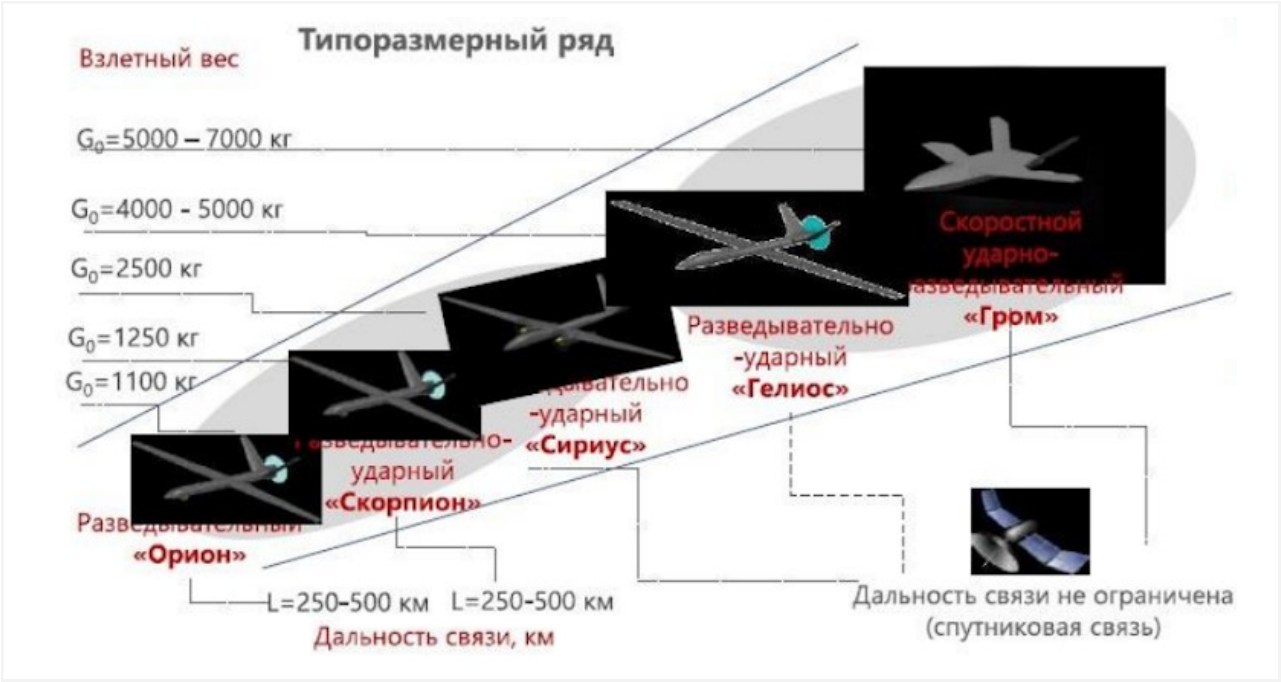
ADC - Analog to digital converter
DAC - Digital to analog converter
FCU - Flight Controller Unit
GNSS - Global Navigation Satellite System
LNA - Low Noise Amplifier

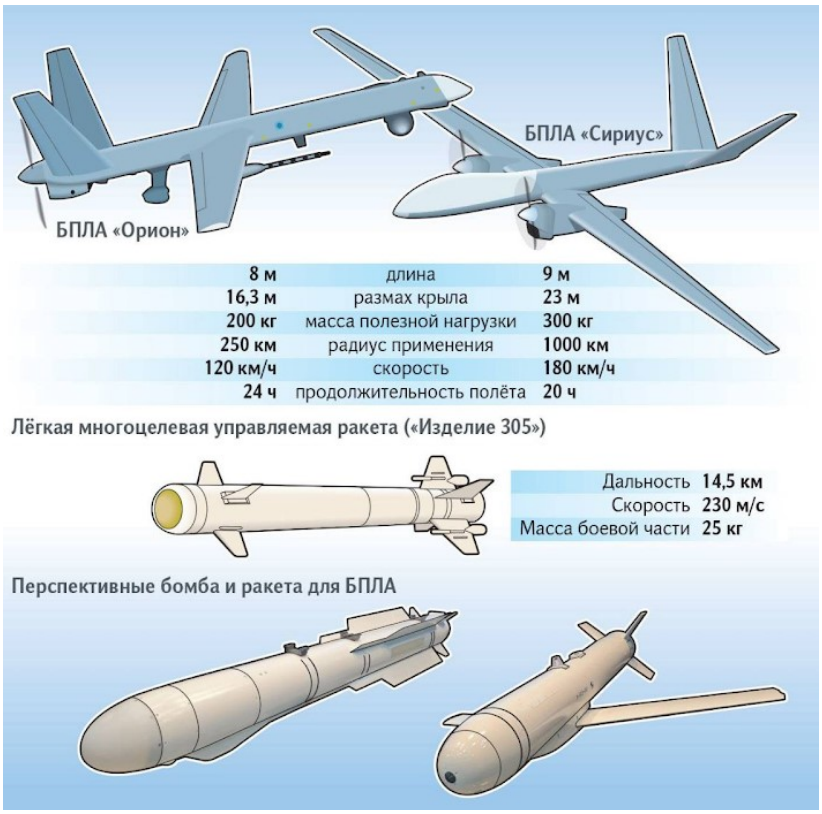
PA - Power Amplifier
PDM - Power Distribution Module
UAV - Unmanned Aerial Vehicle
UCAV - Unmanned Combat Aerial Vehicle
UGV - Unmanned Ground Vehicle
ULPS - Ultra Low Pressure Sensors
UUV - Unmanned Underwater Vehicle

UAV List

Model	UAV Tx	UAV Rx	UAV GNSS/GPS
Granat 1	800 - 950 MHz 2400 - 2485 MHz	865 - 870 MHz 2400 - 2485 MHz	
Granat 2	800 - 950 MHz 2400 - 2485 MHz	865 - 870 MHz 2400 - 2485 MHz	
ZALA KYB-UAV	700 - 1000 MHz ?	868 - 870 MHz 902 - 928 MHz	?
ZALA LANCET	700 - 1000 MHz ?	868 - 870 MHz 902 - 928 MHz	?
ZALA 421-16E2	700 - 1000 MHz ?	868 - 870 MHz 902 - 928 MHz	
Shahed 131/136	-	?	1525 - 1560 MHz
Eleron 3 (Microhard)	902 - 928 MHz 1203 - 1253 MHz	902 - 928 MHz	
Eleron 3 (Modig)	860 - 1020 MHz 1203 - 1253 MHz	860 - 1020 MHz	
Phoenix (Modig)	860 - 1020 MHz 2300 - 2700 MHz	860 - 1020 MHz 2300 - 2700 MHz	
Orlan-10 Orlan-30	863 - 870 MHz 902 - 928 MHz 865 - 922 MHz 2300 - 2700 MHz	863 - 870 MHz 902 - 928 MHz 865 - 922 MHz 2300 - 2700 MHz	
AS-CAM UAVs	880 - 915 MHz	880 - 915 MHz	
Albatros M8 Griflion	806 - 826 MHz	806 - 826 MHz	
Supercam S350	902 - 928 MHz	1215 MHz 2320 - 2400 MHz	

АО «Кронштадт»

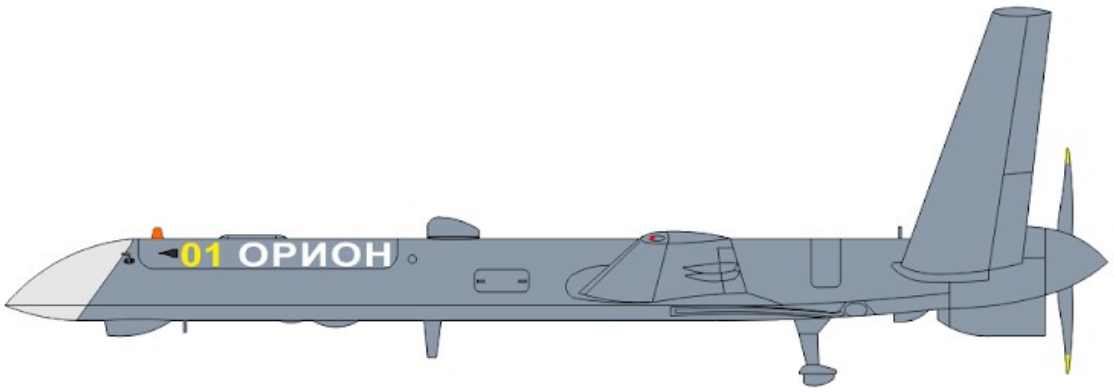




Orion

Main use: **Reconnaissance UAV**

[Орион],[Иноходец]


01 ОРИОН


01 ОРИОН


КРОНШТАДТ
КТ

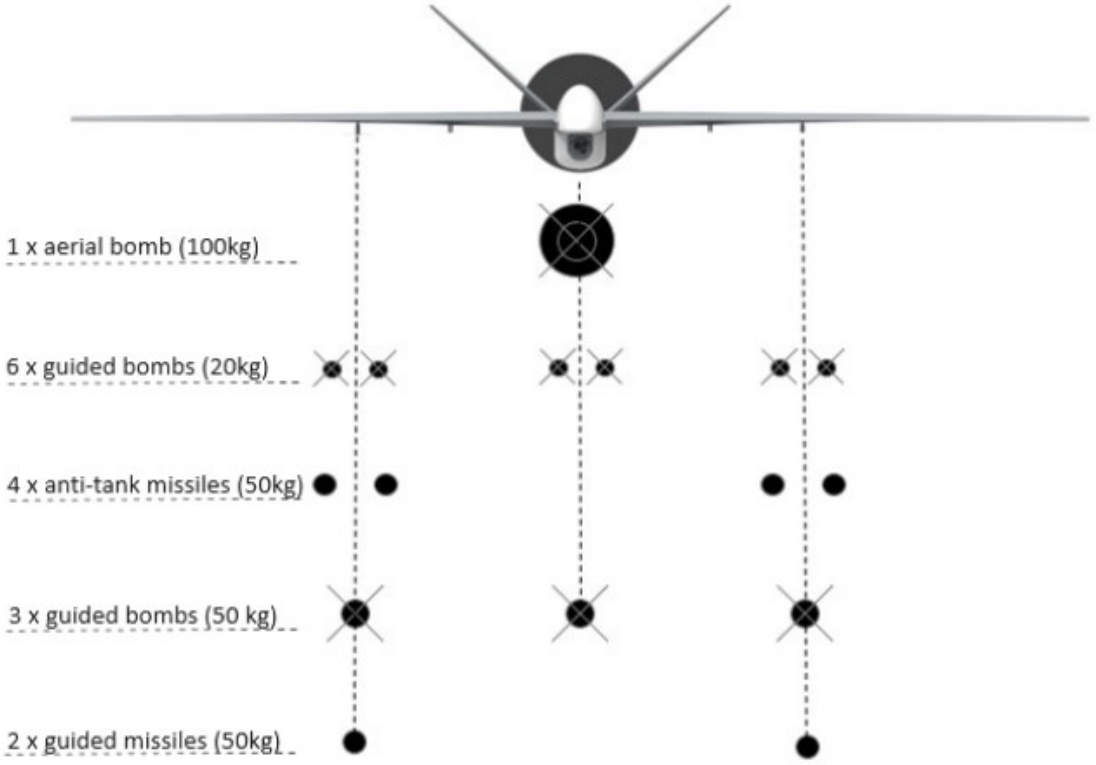

КТ

Multifunctional airborne radar system
Radio and electronic intelligence system

Orion-E

Main use: **Reconnaissance UAV**

[Орион-Э]


1 x aerial bomb (100kg)
6 x guided bombs (20kg)
4 x anti-tank missiles (50kg)
3 x guided bombs (50 kg)
2 x guided missiles (50kg)


IKT

PURPOSE

- Air reconnaissance
- Air patrol
- Determining the coordinates of ground and surface objects
- Topographic survey of the area

The range of application of UAVs varies from intelligence and information support of the army to fire safety and delivery of goods to hard-to-reach areas.

INNOVATION AND TECHNOLOGY

The airframe is almost entirely made of carbon fiber, including the power structure.
In the production of the Orion complex, unique advanced technologies and modern automated means of objective quality control are used.

During the creation of Orion, an energy-efficient electric impulse anti-icing system was introduced for the first time. Thanks to it, the complex is able to perform its tasks even in the most severe weather conditions.

The Orion complex is equipped with systems for monitoring and obtaining the necessary information in real time.

Orion is an autonomous and mobile complex that is able to relocate even to the most remote areas in the shortest possible time.

Thanks to an economical engine, the complex can be in flight mode for up to 24 hours.

The outstanding stability and control characteristics of the Orion make it possible to fly in all weather conditions.

All stages of the flight, including taxiing, takeoff and landing of the UAV, are carried out automatically according to a pre-approved flight program.

The satellite communication system (SATCOM) provides the transmission of command-telemetry and target information at any distance from the operator module in near real time.

The autonomous radar system for determining the coordinates allows the takeoff and landing of the device in the absence of satellite navigation or signal suppression.

The low acoustic visibility of the device allows for silent observation.

Information about the operation of UAV systems and data received from target loads are displayed on automated workstations of operators.

Specifications	
Wing span	16 m
Height	3 m
Length	8 m
Maximum take-off weight	1150 kg
Maximum payload weight	250 kg
Cruising speed	200 km/h
Maximum flight altitude	7500 m
Flight endurance	Not less than 30 h (maximum) Not less than 24 h (with standard payload)
Radius of application	250 km (direct radio visibility from RM) Unlimited (Using SATCOM)
AVIATION WEAPONS:	• Up to 50 kg guided aerial bombs • Up to 100 kg aerial bombs • Up to 50 kg guided missiles
INTERCHANGEABLE PAYLOADS	• EO/IR • Airborne radar system • SIGINT • Electronic warfare equipment • Aviation armament set

Scorpion

Main use: **Reconnaissance and strike UAV**

[Скорпион]

Sirius

Main use: **Reconnaissance and strike UAV**

[Сириус]


ANNA
NEWS AGENCY
КРОНШТАДТ
КТ


КТ

Helios

Main use: **Reconnaissance and strike UAV**

[Гелиос]


ПСБ
SAID AMINOV
saidpvo.ji.com


КРОНШТАДТ


макет
«Гелиос»


КРОНШТАДТ
КТ

Стратегический разведывательный комплекс «Гелиос»

Летно-технические характеристики

- Максимальная взлетная масса – 4000-5000 кг
- Масса целевой нагрузки – 800-1000 кг
- Максимальная скорость – 450 км/ч
- Продолжительность полета – 40 часов

Возможные задачи

- Сбор разведывательной информации, в том числе радиолокационная разведка
- Мониторинг воздушного пространства и целеуказание ПВО
- Применение противолодочных торпед и авиабомб
- Расстановка гидроакустических буев
- Ретрансляция сигналов радиосвязи
- Противопожарный мониторинг и тушение пожаров
- Патрулирование Арктики (трассы СМП)
- Доставка оборудования и грузов (МЧС, корпоративные клиенты)

Конкуренты

- В отличие от остальных продуктов Гелиос конкурирует с БПЛА «Альтиус» (разработка УЗГА в рамках НИР и ОКР по заказу МО РФ).
- При сопоставимой массе полезной нагрузки у Гелиоса продолжительность полета составляет 40 часов, у Альтиуса – 17 часов.
- Уточненная максимальная высота полета Альтиус – 7 тыс. м, у Гелиос – 12 тыс. м., что позволяет Гелиосу охватывать при разведке большую площадь.

Перспективы

Минобороны старается не создавать конкурентов на военном рынке. Для финансирования разработки требуется дополнительная работа с МО РФ.

Grom

Main use: **High-speed strike and reconnaissance UAV**

[Гром], [Thunder]


D
КТ


КТ

[photo] (2021 - mockup)

Specifications	
Weaponry:	КАБ-250, КАБ-500, Изделие-85
Wingspan:	10 m
Length:	13.8 m
Height:	3.8 m
Payload weight:	1300 - 2000 kg
Maximum takeoff weight:	7000 kg
Max speed:	1000 km/h
Cruise Speed:	800 km/h
Maximum flight altitude:	12 000 m
Maximum flight duration:	4 h
Flight Range:	800 km

Скоростной ударный БЛА «Гром»

Летно-технические характеристики

Максимальная взлетная масса – 7000 кг
Масса боевой нагрузки – 1300 кг
Максимальная скорость – 1000 км/ч
Продолжительность полета – 4 часа

Задачи

- Работа «ведомым» в передовом атакующем эшелоне во взаимодействии с пилотируемой авиацией
- Вскрытие и поражение комплексов войсковой и объектовой ПВО
- Поражение управляемым высокоточным оружием наземных целей в тактической и оперативно-тактической глубине
- Поражение надводных целей и береговых объектов

Перспективы

- Контрактация на ОКР от Минобороны в 2021 г. (18 млрд. руб.)
- Серийное производство будет передано ПАО «Корпорация «Иркут»
- Поставки МО РФ с 2025 года. Прогнозируемый объем поставок в 2025-2026 гг. – 10 КБЛА ежегодно, прогнозируемый объем поставок в 2027-2030 гг. – 20 КБЛА ежегодно

МО РФ будет объявлен конкурс на ОКР. Поскольку права на результаты ОКР «Гром» будут принадлежать Российской Федерации, а серийное производство будет передано ПАО «Корпорация «Иркут», АО «Кронштадт» должно стать разработчиком и единственным поставщиком наземной части и иных комплектующих КБЛА «Гром».

💧 Leaks

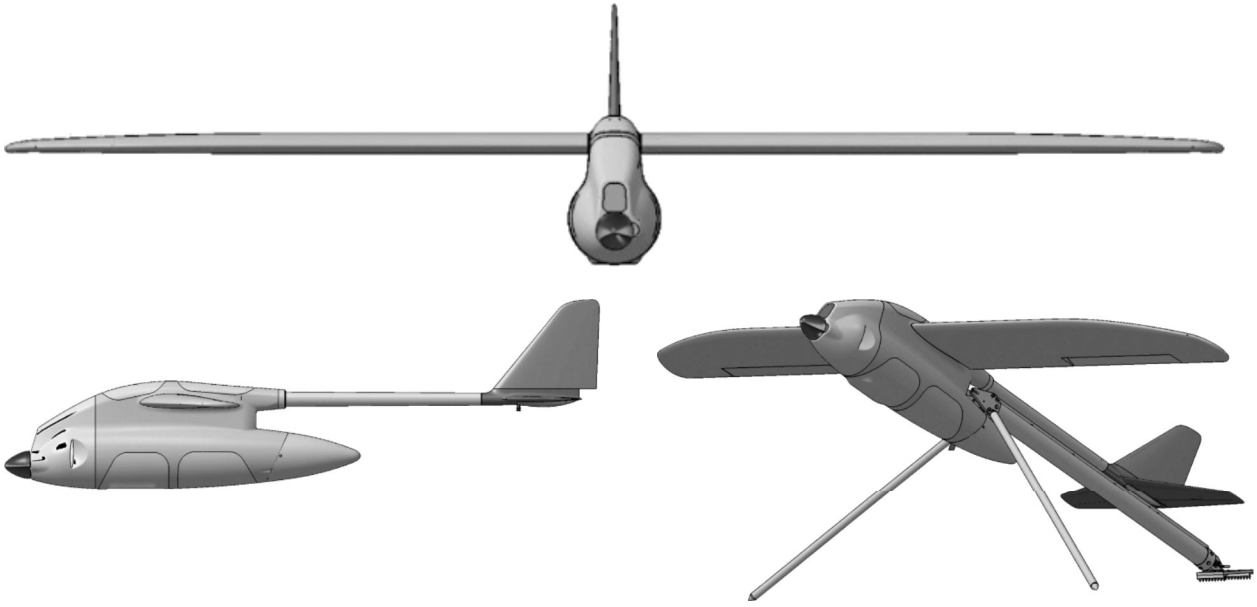
KD-UAV.pdf	[Road map of the Kronshtadt UAVs],[Helios UAV project],[Financing structure],[Strategic session],[SWOT-analysis],
KD-RESEARCH.pdf	

АО «НИИ СТТ»

Merlin-21B

*"**NII STT**" has been manufacturing "**Ptero**" developed by "**AFM-Servers**" since 2013.*

[Мерлин-21Б], [Флибустьер], [Птеро], [Ptero], [Птеро-G1]



[photo][description]


НИИ СТТ
СМОЛЕНСК


НИИ СТТ
СМОЛЕНСК

Merlin-VR

[Мерлин-ВР]

Merlin-207

[Мерлин-207]

АО «РКЦ «Прогресс»

Company: Акционерное общество «Ракетно-космический центр «Прогресс»
Address: Россия, 443009, Самара, ул.Земеца, 18
Phone: +7 (846) 955-13-61
Site: https://www.samspace.ru
E-Mail: mail@samspace.ru
press@samspace.ru

Photon-601

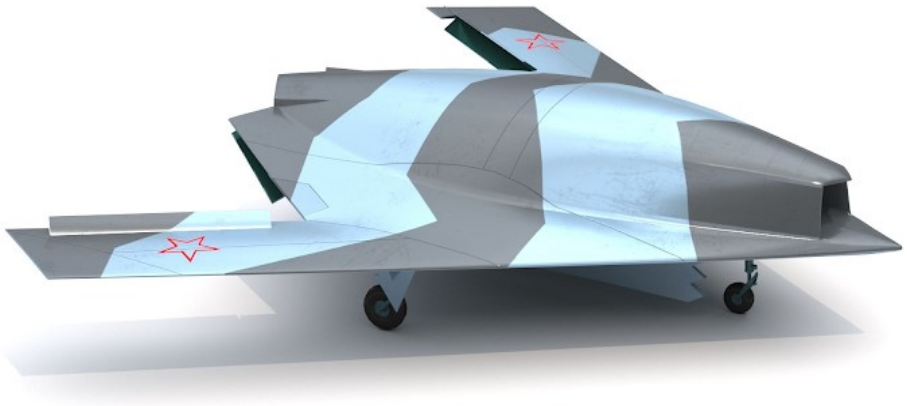
[ФОТОН 601], [БЕСПИЛОТНЫЙ АВИАЦИОННЫЙ КОМПЛЕКС "ФОТОН-601"]

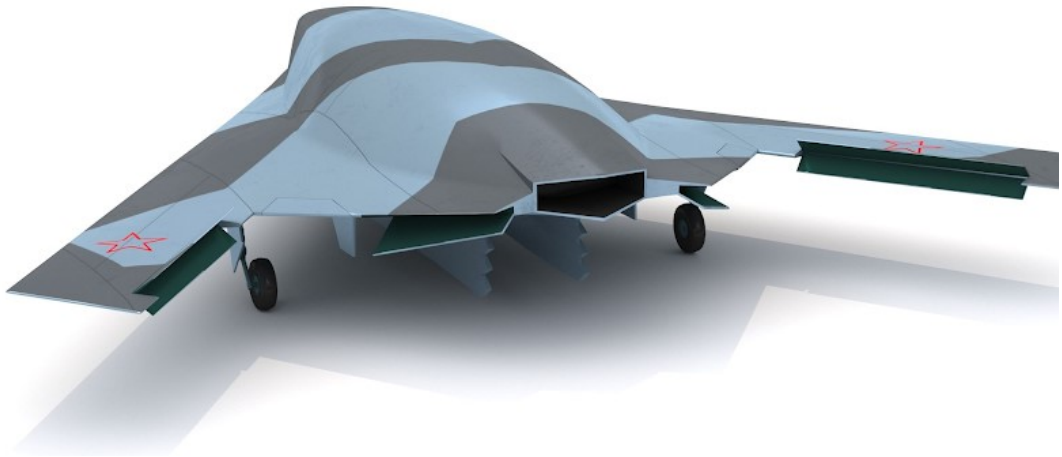
[photo][photo][photo]

АО «РСК «МиГ»

Stingray

[Скат], [Skat]



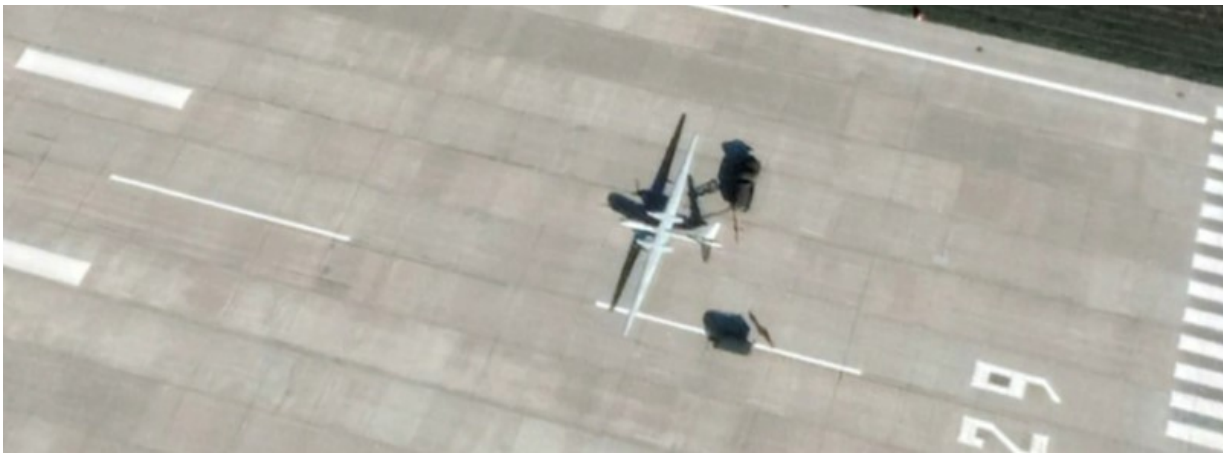


АО «УЗГА»

JSC «Ural Civil Aviation Plant»
ОАО Научно-производственное объединение «Опытно-конструкторское бюро имени М. П. Симонова»

Site: http://www.uwca.ru

Altius



[link], [link]

Frequency

Payload

UAV Tx: 13.7 - 14.5 GHz @ 43 dBm
UAV Rx: 10.7 - 12.7 GHz

Components

Payload

Accent-SM

Акцент-СМ

Modem: **Comtech EF CDM-650** (datasheet)
Modem: **Comtech EF CDM-570L** (datasheet)

Forpost

Разведывательный беспилотник «Форпост-РМ»
Recon UAV “Forpost-RM”

[photo]

АО «Эникс»

Eleron-3SV (Microhard)

[Элерон 3], [Елерон 3], [Элерон-3СВ], [Микрохард], [Microhard n920], [Domotactical], [DTC], [Cobham]

Frequency

Radio Control Link

UAV Rx: 902 - 928 MHz
UAV Tx: 902 - 928 MHz 30 dBm (1W)

Payload

UAV Tx: 1203 - 1253 MHz

Components

Radio Control Link

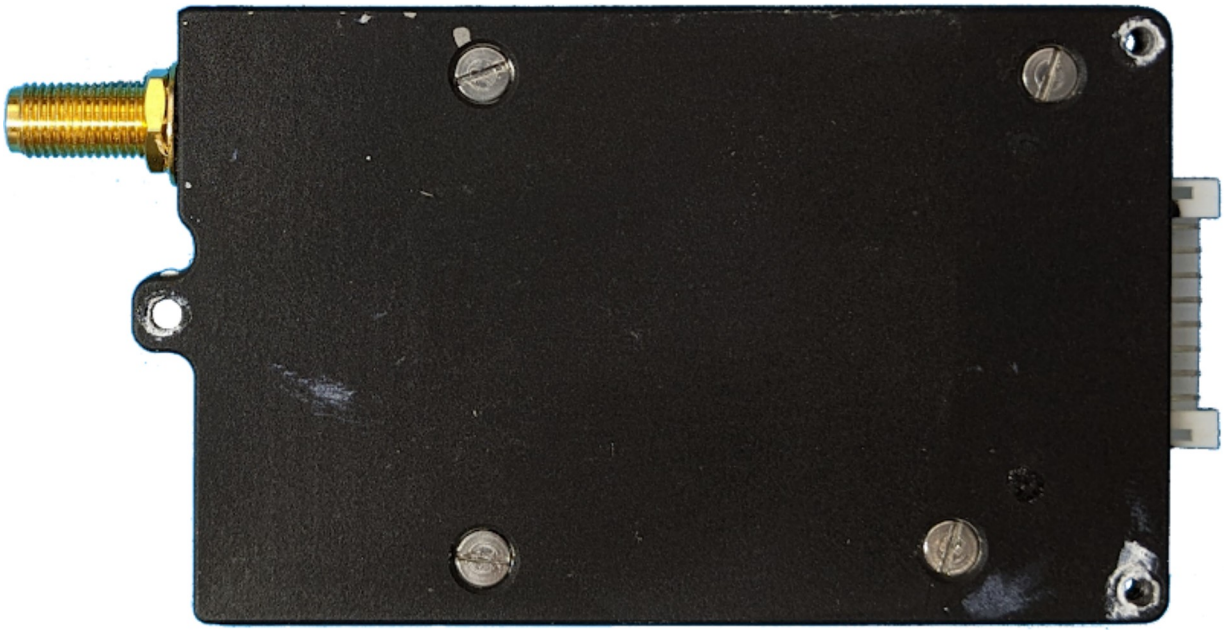
Microhard n920

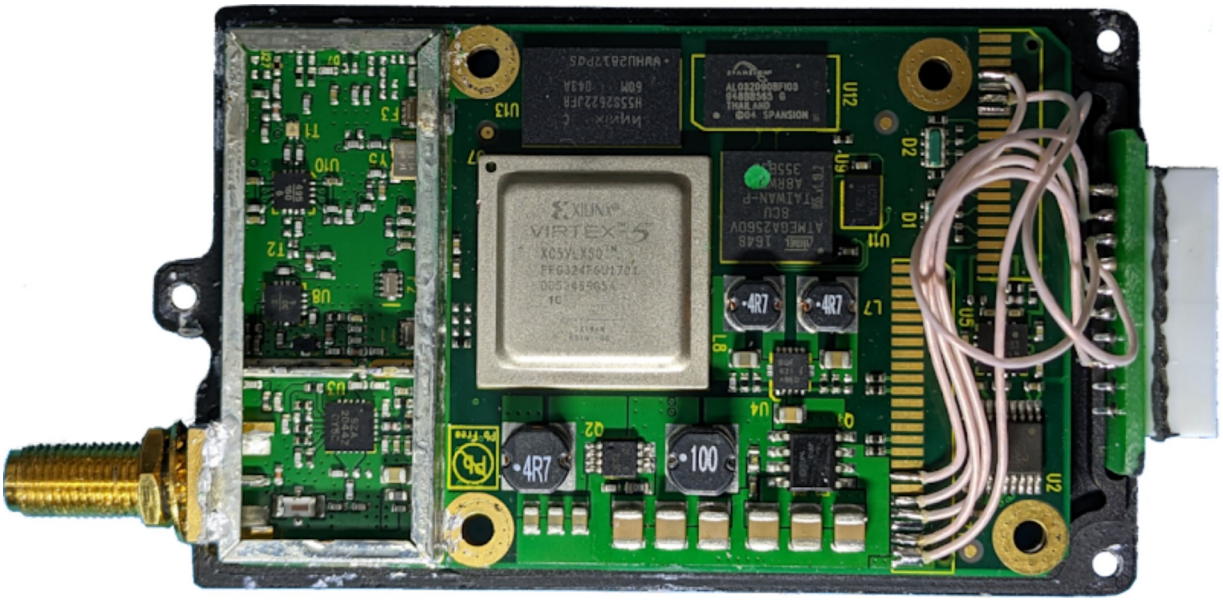
NANOMOD 2.2 __/__/2015

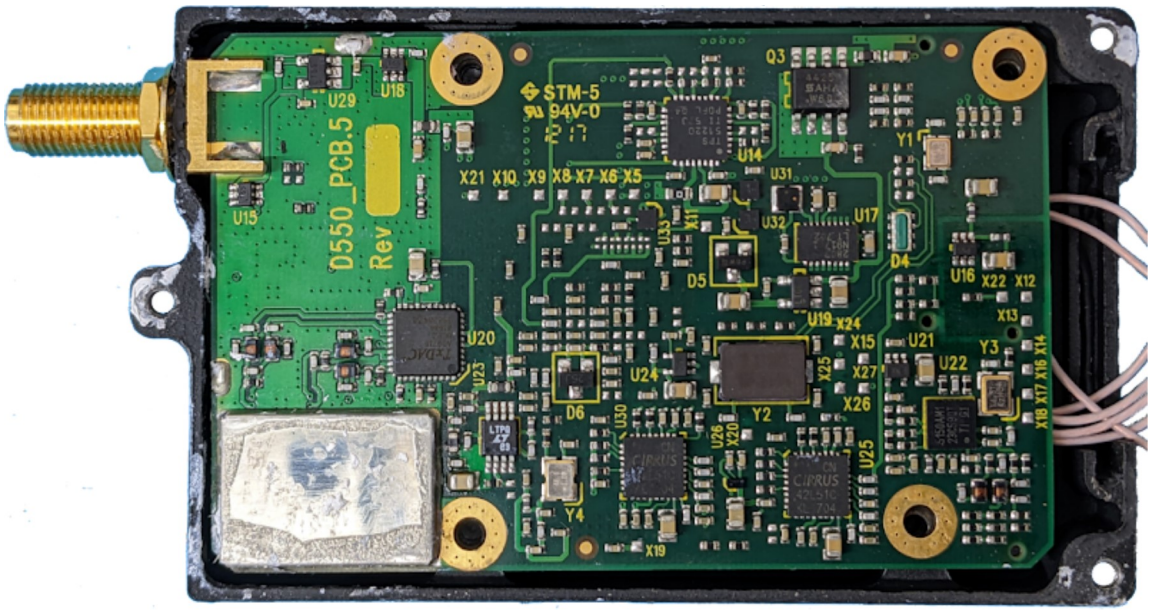
RC module: **Microhard n920** [description][manual][vuln]
Serial: **ADM3202**

Payload

D550_PCB.5 (XRFSOLOMTX)




XILINX
VIRTEX-5
4R7
4R7
100

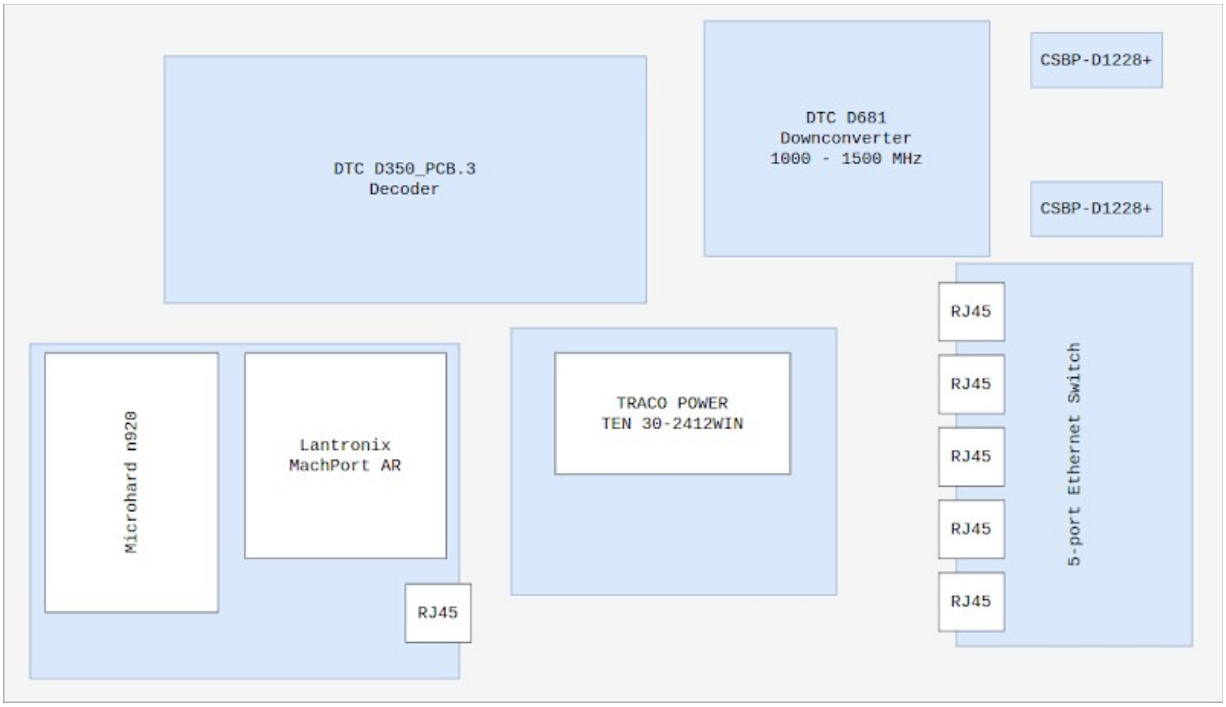


MCU: **ATMEGA2560V8CU** (datasheet)
NOR Flash: **SPANSION AL032D90BF103**
SDRAM: **Hynix H55S2622JFR** (datasheet)
FPGA: **Xilinx Virtex-5 XC5VLX50**

[**User Manual**]

UAV Ground Control Station

[video 00:02:34]



Cobham / Domotactical. The DTC D350 PCB is a digital diversity video receiver PCB, designed specifically for compact mobile receiver applications. The system allows wireless digital video and audio reception in mobile, urban and non-line-of-sight scenarios.

RC module: **Microhard n920** [description][manual][vuln]
Decoder: **DTC D350_PCB.3** [description]
Downconverter: **D681-NOJ3** [description]
** 1000 - 1500 MHz Downconverter*
Filter: **CSBP-D1288+**
Ceramic Resonator Band Pass Filter, 1203 - 1253 MHz
Serial to Ethernet: **Lantronix MachPort AR** [description]
** PCB Lantronix 330-191-R Rev D*
** Lantronix DSTni-EX-R*
PDM: **TEN 30-2412WIN** [description]

Waveform characteristics

Radio Control Link

Module: Microhard n920
Frequency band: 902-928 MHz
Modulation: 2FSK
Frequency hopping channels: channel n = 902.4+ ((n-1) x 0.280)MHz
(Spectrum Analyzer - page 56)
Hop: 40 ms
Hopping pattern: Depends on the Network Address
(parameter S104 - page 63)
Baudrate: 115200 symbols per second
Frequency deviation: not measured
Preamble / sync word: 104 bits
Sync word in HEX: 0x69696969696a5555556955aaaa
Forward Error Correction: Golay(23,12,7)
(parameter S158 - page 72)
Static Mask: Scrambling (data whitening) is applied
Scrambling pattern is the ASCII characters
(parameter S107 - page 63)

Payload

Video is often transmitted on **1214 MHz**. It is **not encrypted**.

The D350 supports standard DVB-T and proprietary narrowband. Narrowband is used for the Eleron. It has a bandwidth of 2.5 MHz. It is most likely very similair to DVB-T. From the webinterface of the D350 is known: bandwidth 2.5 MHz, FEC 2/3, constellation QPSK, Guard Interval 1/16.

Symbol duration: 170,67 us
(excl guard interval)
FFT size: 512
Carrier spacing: 5859,375
Sample rate: 3 MHz
(assumed to be a round value)
Used subcarriers: 399

There are pilots on every 12th subcarrier. For even lines this starts on subcarrier 1 (counting from 0), for odd lines this starts on subcarrier 7. For both odd and even lines, there are two patterns of values for the pilots. The two patterns are the negative of each other.

Sources

2019-07-12	Українські воїни на Донбасі перехопили російський військовий БПЛА “Елерон-3” (ВІДЕО) / UAF soldiers in Donbas intercepted russian army UAV “Eleron-3” (video)
2019-06-29	На Донбасі знищили російський БПЛА “Елерон-3СВ” (ВІДЕО). Розкриті цікаві факти / Russian UAV “Eleron-3SV” was destroyed in Donbas (video). Interesting facts revealed.

Eleron-3SV (Modig)

[Элерон 3], [Елерон 3], [Элерон-3СВ], [Modig], [Модиг], [НСОД], [НСОД - Низкоскоростная Система Обмена Данными], [Domotactical], [DTC], [Cobham]

Frequency

Radio Control Link

UAV Rx: 860 - 1020 MHz
UAV Tx: 860 - 1020 MHz
824 - 849 MHz @ 35 dBm
880 - 915 MHz @ 35 dbm

Payload

UAV Tx: 1203 - 1253 MHz

Frequency Ranges

Channel:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Frequency Range:	865 870	870 875	875 880	880 885	885 890	890 895	895 900	900 905
Channel:	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Frequency Range:	905 910	910 915	915 920	920 925	925 930	930 935	935 940	940 945
Channel:	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Frequency Range:	945 950	950 955	955 960	960 965	965 970	970 975	975 980	980 985
Channel:	**25**	**26**	**27**	**28**	**29**	**30**	**31**	

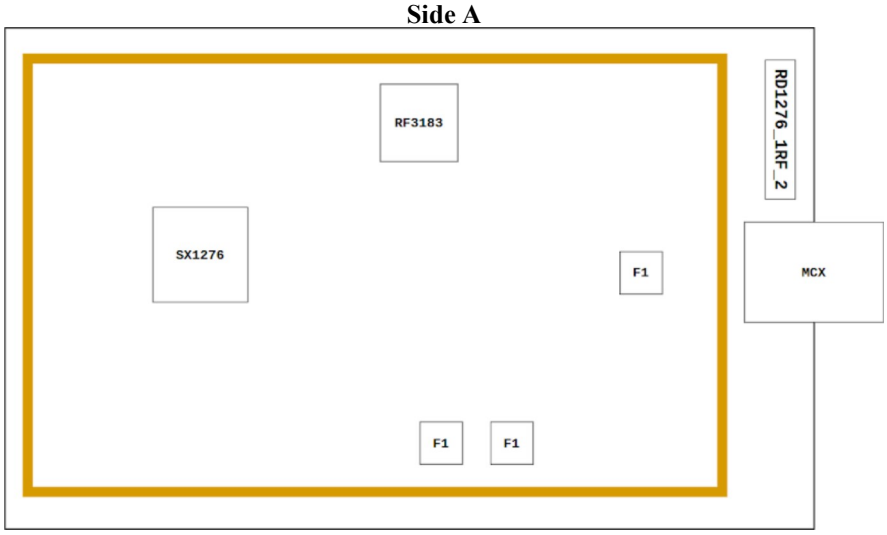
Frequency Range:	985 990	990 995	995 1000	1000 1005	1005 1010	1010 1015	1015 1020	

Components

Radio Control Link

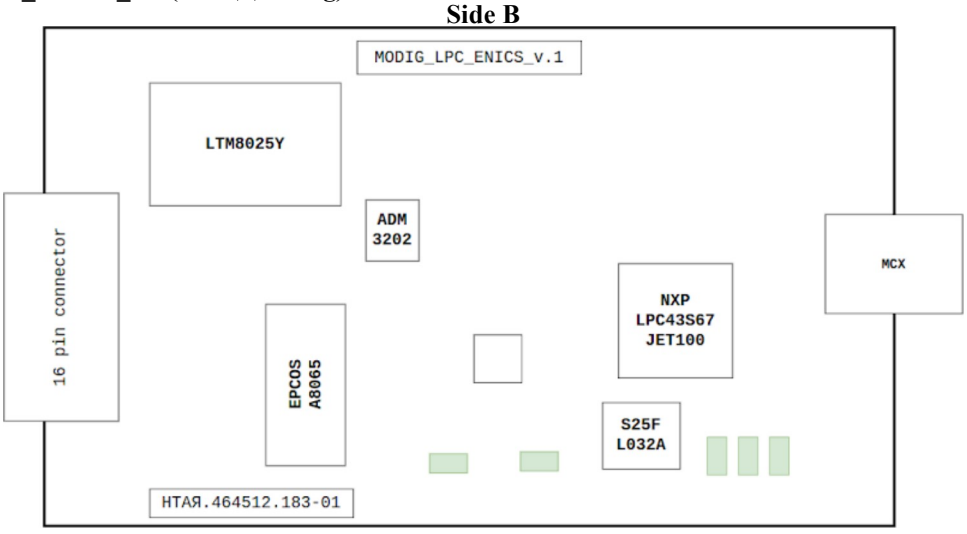
RD1276_1RF_2

Side A



MODIG_LPC_ENICS_v.1 (НСОД Modig)

Side B



MODIG_LPC_ENICS_v.1 Components

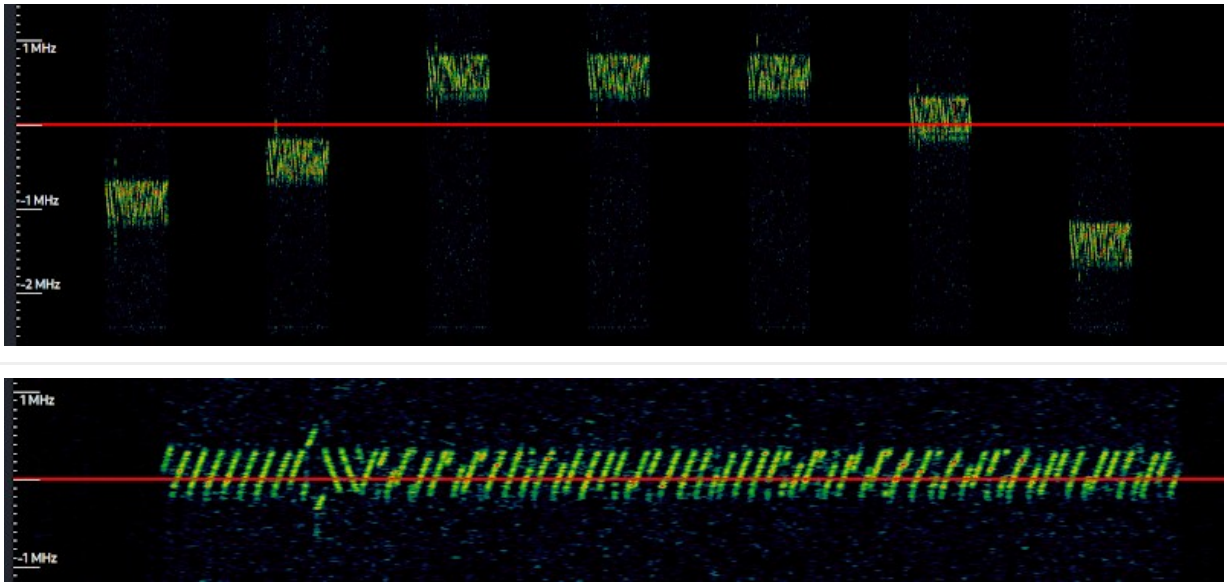
RF Chip: **SX1276** [datasheet]
PA: **RF3183** [datasheet] (824 - 849, 880 - 915 MHz)
Filter (F1): **ML 7**
MCU: **NXP LPC43S67JET100** [datasheet]
SPI Flash: **CY15B104Q** [datasheet]
Voltage Regulator: **LTM8025Y** [datasheet]
Serial: **ADM3202**

Waveform characteristics

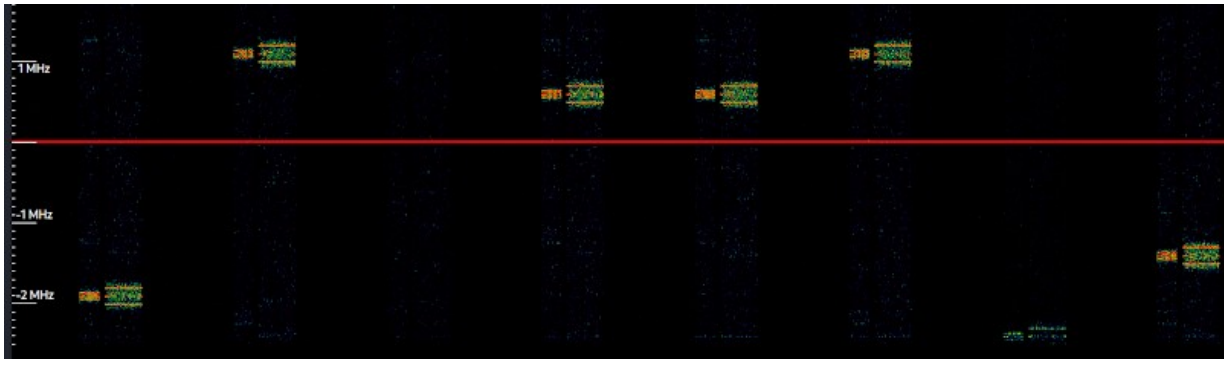
Radio Control Link

```
BW=500 kHz
SF=6
symbol time = 128 us (2^SF/BW)
preamble length = 8
sync word = 0x14 (possible can be changed with webinterface setting, to be determined)
CR 4/5
payload length 26
```

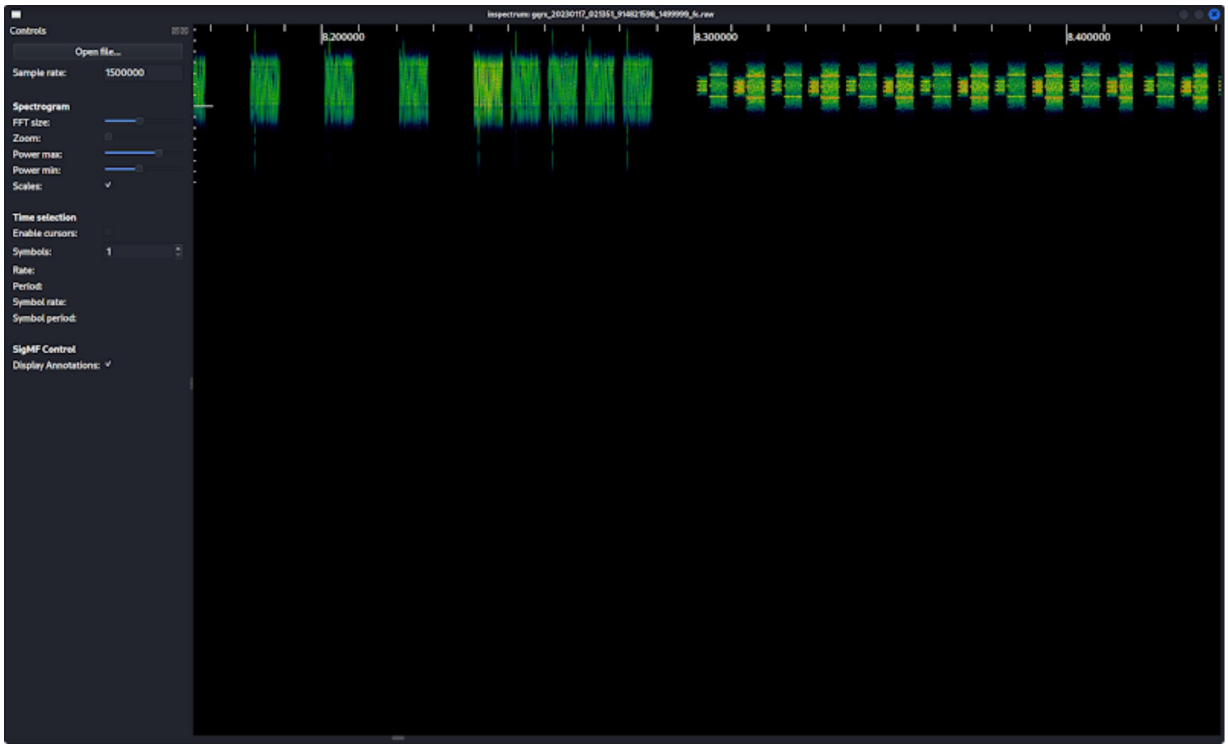
Sync (FHSS)

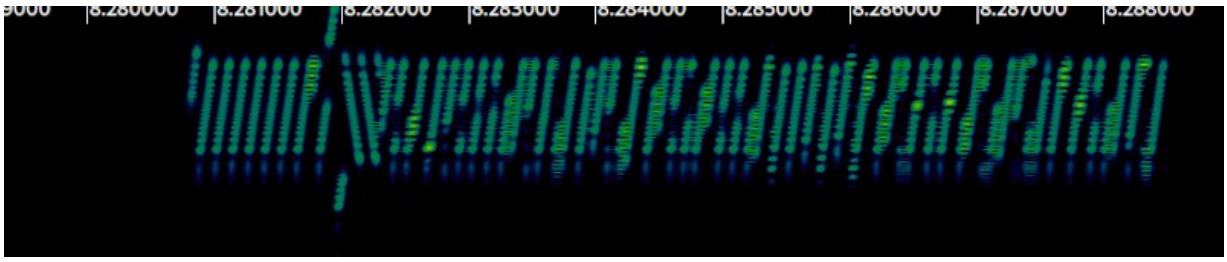


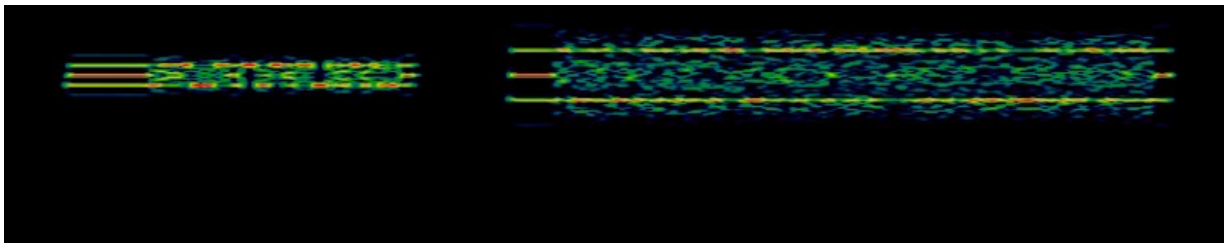
Data (FHSS)



An example of a signal at the time of establishing a connection







Samplerate: 250MS/s
Saleae Session File: [006 - SX1276.sal]
Session in TXT: [006 - SX1276.txt]
Decoded Session: [006 - SX1276.dec]

IQ Stream: [gqrx_20230117_021351_914821598_1499999_fc.raw]

Eleron-10SV

[Элерон-10СВ]

[photo]

Eleron-T16

[Элерон-Т16], [Валдай-М], [Valdai-M]

[photo]

Eleron-T28

[Элерон-Т28], [Элерон-Т28МЭ]

[photo]

E95

[E95]

[photo]

ООО «Альбатрос»

M8 Griflion

ООО «Альбатрос»

[Альбатрос], [Грифлион], [VTOL]

Frequency

Radio Control Link + Payload

UAV Rx: 806 - 826 MHz
UAV Tx: 806 - 826 MHz

Характеристики

Тип аппарата	самолет вертикального взлета и посадки
Схема аппарата	двухбалочная с подъемными двигателями
Размах крыла	2.5 м
Тип двигателя	толкающий, электрический (бесколлекторный)
Система позиционирования	GPS / Глонасс
Аккумуляторные батареи	Li-Po
Общая емкость аккумуляторных батарей	22000 мАч
Максимальное время полета	2.5 ч
Крейсерская скорость полета	90 км/ч
Диапазон рабочих высот	50-1000 м
Диапазон скоростей полета	90-126 км/ч
Максимальная высота полета	5000 м
Максимальная длина маршрута	200 км
Масса пустого	5.5 кг
Максимальная взлетная масса	12 кг
Максимальная масса полезной нагрузки	2 кг
Частота радиолинии	915 МГц
Бортовая запись данных телеметрии	есть
Метод взлета	вертикальный, в автоматическом режиме
Метод посадки	вертикальный, в автоматическом режиме
Габариты площадки для взлета/посадки	от 10x10 м
Устойчивость к ветру	до 12 м/с
Диапазон эксплуатационных температур	-30°C ... +50°C
Степень защиты	IP56
Время развертывания	5 мин
Транспортировочные габариты	1200x800x150 мм
Крепление полезной нагрузки	универсальное (тип 2)
Высота перехода в горизонтальный полет	120 м
Ресурс корпуса	до 100 циклов взлет/посадка
Дальность работы в прямой радиовидимости	15 км
Скороподъемность вертикального взлета	7 м/с
Полет в условиях отсутствия связи	есть

Characteristics:

Unit type	vertical take-off and landing type aircraft	**Radio frequency**	915 MHz
Unit design	double-beam with lifting engines	**Telemetry on-board recording**	present
Wingspan	2.5 m	**Take-off**	vertical, in auto mode
Engine type	propelling, electric (brushless)	**Landing**	vertical, in auto mode
Positioning system	GPS/GLONASS	**Landing/take-off pad dimensions**	from 10x10m
Battery	Li-Po	**Wind resistance**	up to 12m/s
Battery capacity	22000 mAh	**Operating temp range**	-30C to +50C
Max time of flight	2.5 hours	**Protection level**	IP56
Cruising speed	90 km/h	**Time to deploy**	5 mins
Operating altitudes	50-1000 m	**Dimensions when transporting**	1200x800x150 mm
Speed range	90-126 km/h	**Useful payload attachment**	universal (type2)
Max altitude	5000m	**Altitude of switching to horizontal flight mode**	120 m
Max flight range	200km	**Frame lifespan**	up to 100 cycles take-off/landing
Net weight	5.5 kg	**Direct radio sight work range**	15km
Max take-off weight	12kg	**Vertical take-off speed**	7m/s
Max useful payload weight	2kg	**Possibility of operation without radio connection**	present

Radio Modem

MAINLINK AERO MK6601N Wireless Transmission Data Module
Used for Radio Control Link + Payload in M8 Griflion

[**link**]

Ports: Ethernet, UART

ООО «АФМ-Серверс»

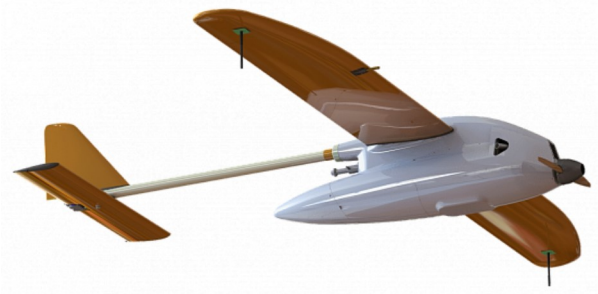
If earlier the developer "Ptero" himself produced devices, then since the beginning of 2013 the production of drones has been transferred to the Smolensk company "**NIISTT**", which has great production capabilities. In Smolensk, the production of the first batch of Ptero-SM drones has already been launched in the amount of 65 copies, half of which will be received by the developer - AFM-Servers LLC, and the rest will be sold on the aviation market.

Если ранее разработчик "Птеро" сам изготавливал аппараты, то с начала 2013 года производство беспилотников передано смоленской компании "**Научно-исследовательский институт СТТ**", которая имеет большие производственные возможности. В Смоленске уже запущено производство первой партии беспилотников "Птеро-СМ" в количестве 65 экземпляров, половина из которых получит разработчик - ООО "АФМ-Серверс", а остальные будут продаваться на авиарынке.

[info]

Ptero-Gx / Ptero-Ex

[Ptero-G0], [Ptero-G1], [Ptero-E], [Птеро-G0], [Птеро-G1], [Птеро-E4], [Птеро-E5], [Ptero-SM], [Птеро-СМ], [Ptero-H1]



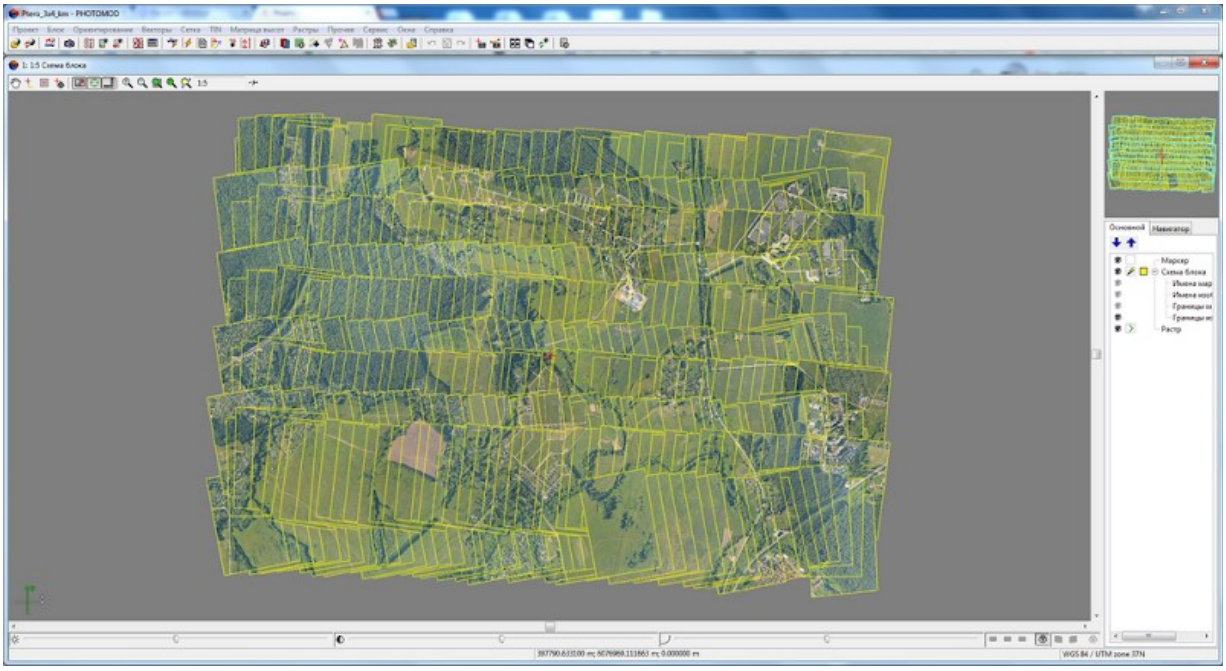
[info]

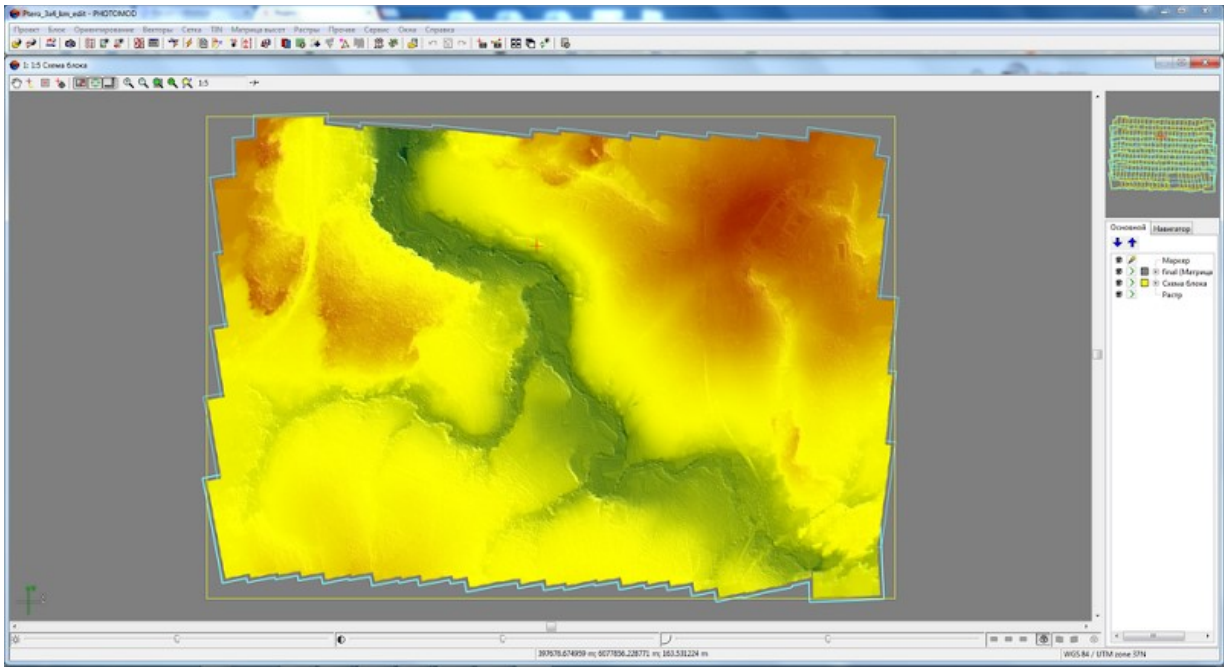
Ptero-G0/G1	ICE	**Ptero-H1**	Hybrid
Ptero-E4/E5	Electric	**Ptero-SM**	?

Specifications

Modification:	Ptero-G0	Ptero-G1	Ptero-E4	Ptero-H1
Wingspan:	3.13 m			
Length:	2.14 m			
Height:	0.68 m			
Height on the catapult:	1.12 m			
Wing area:	1.03 m^2			
Empty weight:	10.5 kg			

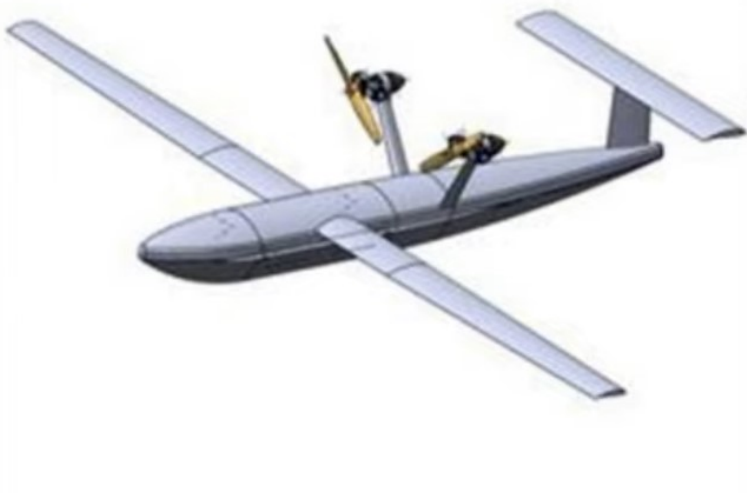
Maximum takeoff weight:	22.2 kg			
Fuel weight:	3.75 kg			
Payload weight	5 kg			
Engine's type:	1 ICE (ДВС)	1 ICE (ДВС)	Electric	Hybrid (ICE + Generator)
Power:	1 x 2.7 kW			
Max speed:	170 km/h			
Cruise Speed:	85-115 km/h			
Flight Range:	800 km	1300 km		
Flight duration:	8 h	15 h		
Maximum flight altitude:	3000 m			2500 m
Comunication channel:		IRIDIUM modem		





Ptero-G2

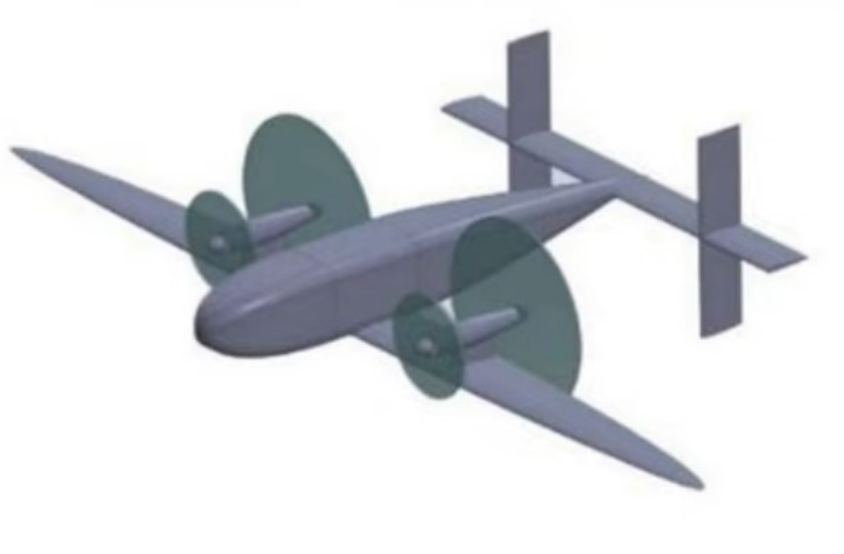
[Ptero-G2], [Птеро-G2]



(2021 in developing)

Ptero-G3 VTOL

[Ptero-G3], [Птеро-G3], [Ptero VTOL]



(2021 in developing)

ООО «Аэрокон»

LLC «Aerokon»

Aspeed

[АСПИД]

[photo]

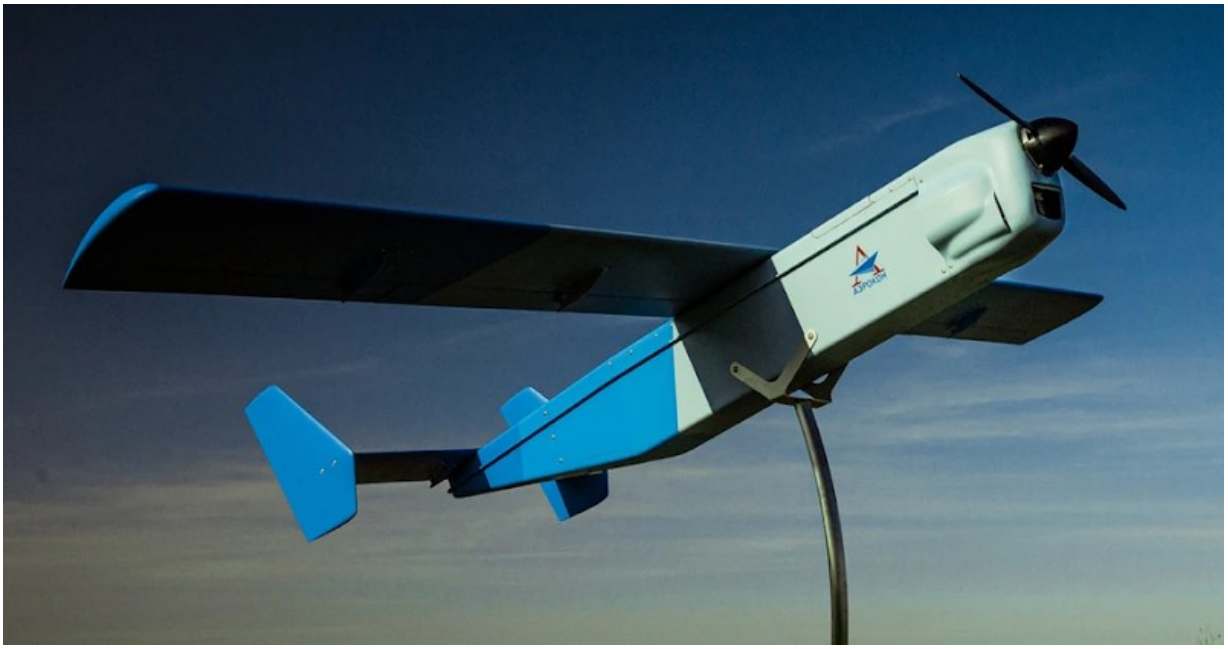
Kukushka

[Кукушка]

[photo]

Orlenok

[БПЛА Орленок], [БЛА Орлёнок]



[photo]

RS-4H

[RS-4H], [VTOL], [277], [Granat-4]

RS-11H

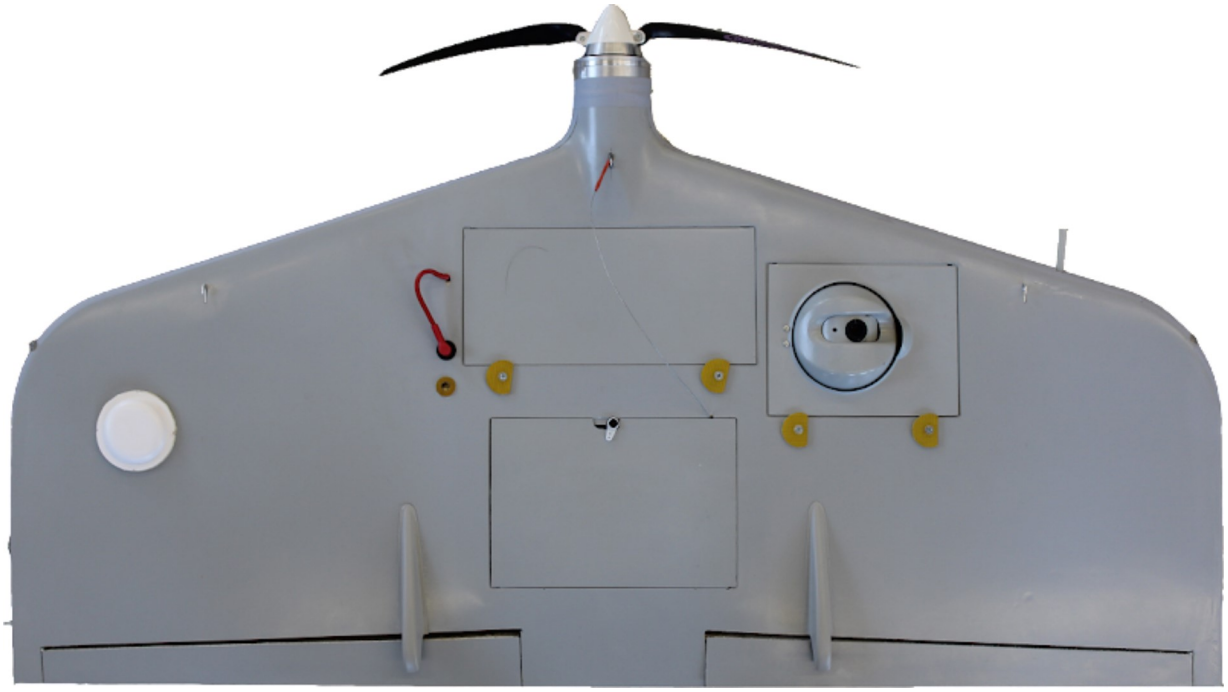
[RS-11H], [VTOL], [275]

ООО «НПО «ИжБС»

«RPA «IZH-BS» LLC

Granat-1

[Гранат-1]



[photo]

Frequency

Radio Control Link

UAV Rx: 865 - 870 MHz
UAV Tx: 865 - 928 MHz @ 32 dBm

Payload

UAV Rx: 2400 - 2485 MHz
UAV Tx: 2400 - 2485 MHz @ 25 dBm

Granat-2

[Гранат-2]

Frequency

Radio Control Link

UAV Rx: 865 - 870 MHz
UAV Tx: 865 - 928 MHz @ 32 dBm

Payload

UAV Rx: 2400 - 2485 MHz
UAV Tx: 2400 - 2485 MHz @ 25 dBm

Granat-3

[Гранат-3]

[info][photo][photo]

Frequency

Radio Control Link

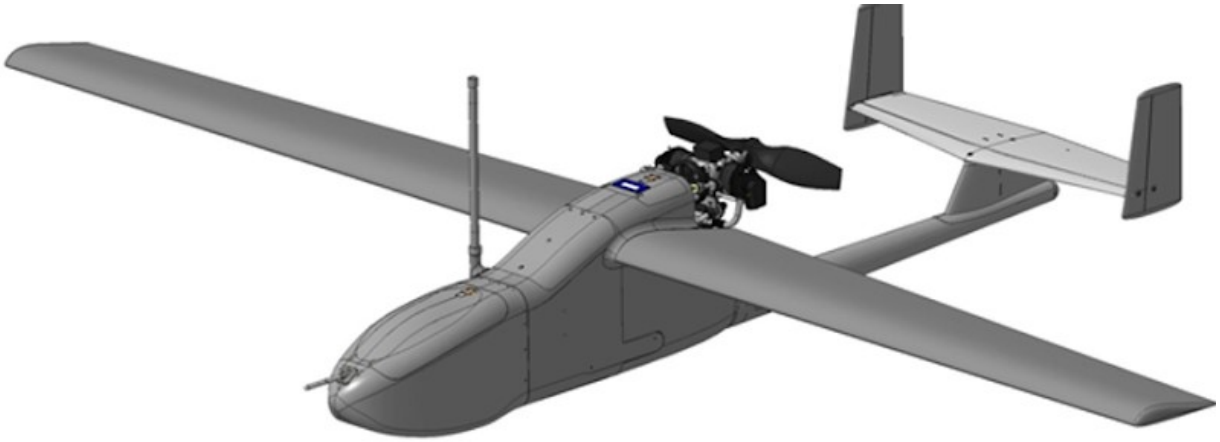
More likely:
UAV Rx: *865 - 870 MHz*
UAV Tx: *865 - 928 MHz @ 32 dBm*

Payload

More likely:
UAV Rx: *2400 - 2485 MHz*
UAV Tx: *2400 - 2485 MHz @ 25 dBm*

Granat-4

[Гранат-4]



Многоцелевой беспилотный летательный аппарат, разработанный компанией ООО «Аэрокон» по заказу НПО «ИжБС» в 2011 году
[video]

Frequency

Radio Control Link

More likely:
UAV Rx: *865 - 870 MHz*
UAV Tx: *865 - 928 MHz @ 32 dBm*

Payload

More likely:
UAV Rx: *2400 - 2485 MHz*
UAV Tx: *2400 - 2485 MHz @ 25 dBm*

ООО НТЦ «ЮРИОН»

Company: ООО НТЦ «ЮРИОН»
Address: г. Москва, ул. 3-я Гражданская, д. 2А
Phone: +7 (495) 645-68-50
+7 (495) 367-07-57
Site: https://yurion.ru
E-Mail: yurion@yurion.ru

Направления деятельности:
- Спецтехника
- Накопители
- Радиосвязь
- Робототехника
- Беспилотная авиатехника

Repeater

ZALA Aero Group

Site: https://zala-aero.com

KYB-UAV

[КУБ-БЛА], [КУБ-БПЛА], [Cube-UAV]

[video]

Frequency

Radio Control Link

UAV Rx: 868 - 870 MHz
902 - 928 MHz
UAV Tx: 700 - 1000 MHz @ 30 dBm (1W)
870 MHz

[video]

Components

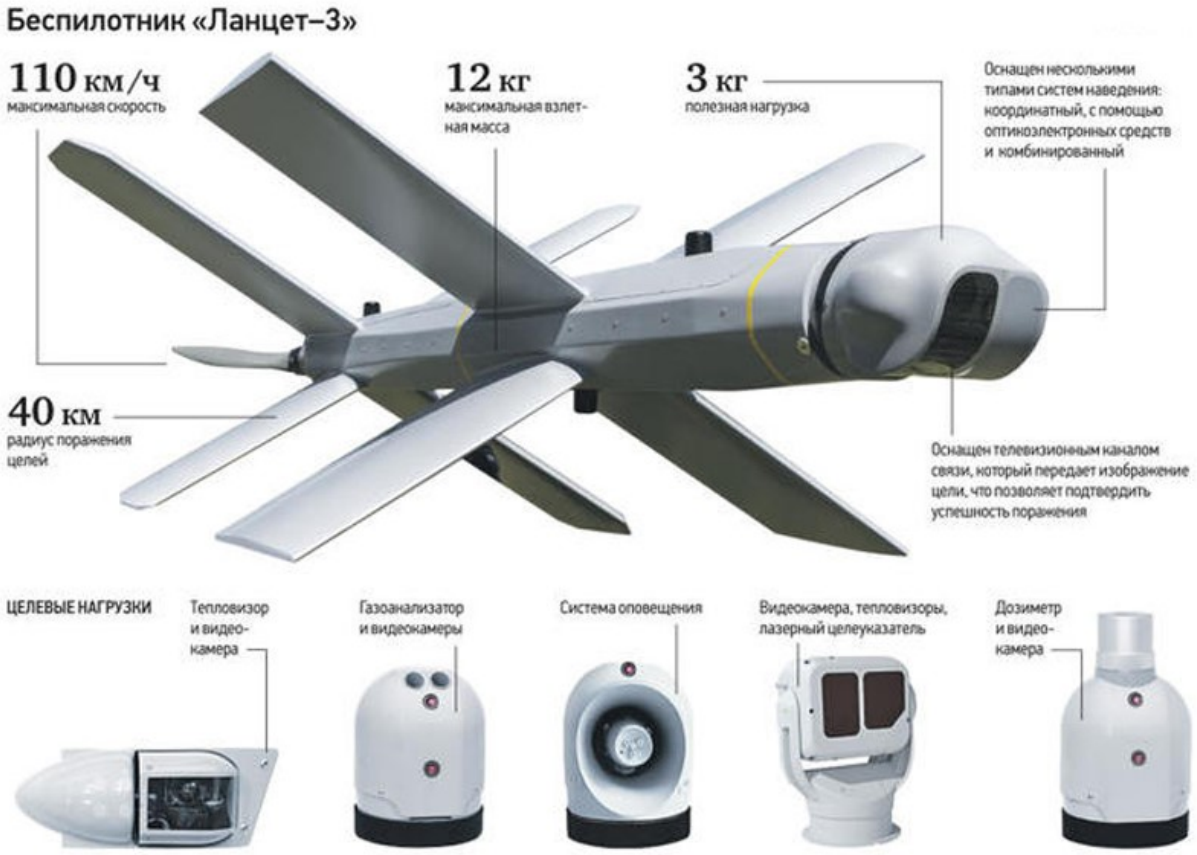
Battery

Li-ion 29.4V 28Ah (7S)

Lancet-1 / Lancet-3

[Ланцет-1], [Ланцет-3], [Камикадзе], [Барражирующий боеприпас], [Изделие-51], [Изделие-52]

- МЕТОДИЧНІ РЕКОМЕНДАЦІЇ “ЩОДО РАДІОЕЛЕКТРОННОЇ ПРОТИДІЇ БЕЗПІЛОТНИМ ЛІТАЛЬНИМ АПАРАТАМ “ЛАНЦЕТ”



[video]

Frequency

Radio Control Link

UAV Rx: 868 - 870 MHz
902 - 928 MHz
UAV Tx: 700 - 1000 MHz @ 30 dBm (1W)
870 MHz

Payload

UAV Tx: 2200 - 2400 MHz

[photo][news]

Specifications		
UAV:	**Lancet-1**	**Lancet-3**
Speed:	80 - 110 km/h	
Flight endurance:	30 min	40 min
Radus of application:	55 km	66 km
Target hit radius:		40 km

Maximum flight altitude:	3000 m	
Radio Control Frequency:	868-870 MHz, 902-928 MHz	
Video Frequency:	2200 - 2400 MHz	
Engine type:	Electric	
Launcher:	Catapult	
Maximum take-off weight:	5 kg	12 kg
Maximum payload weight	1 kg	3 kg
Fuze:	non-contact/contact	
Warhead type:	High-Explosive/Fragmentation	High-Explosive/Fragmentation, Cumulative
Equipped with several types of aiming systems:		coordinate, optic-electronic and combined
Purpose of payloads:		thermal camera and video camera; gas sensor and cameras; notification system; video camera, thermal camera, laser aiming device; dosage meter and video camera

421-16E2

[Зала]

[catalog]

Frequency

Radio Control Link

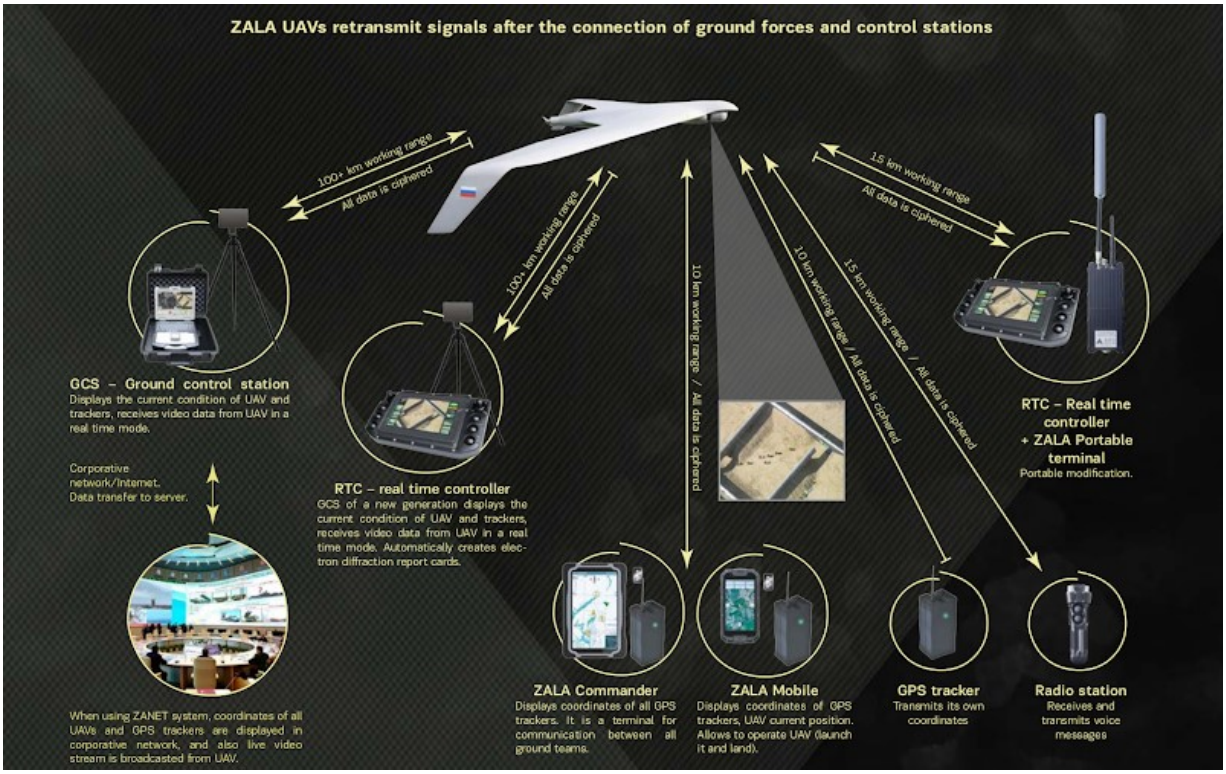
UAV Rx: 868 - 870 MHz
902 - 928 MHz
UAV Tx: 700 - 1000 MHz @ 30 dBm (1W)
Detected on: 870 MHz, 915 MHz, 928 MHz

Payload

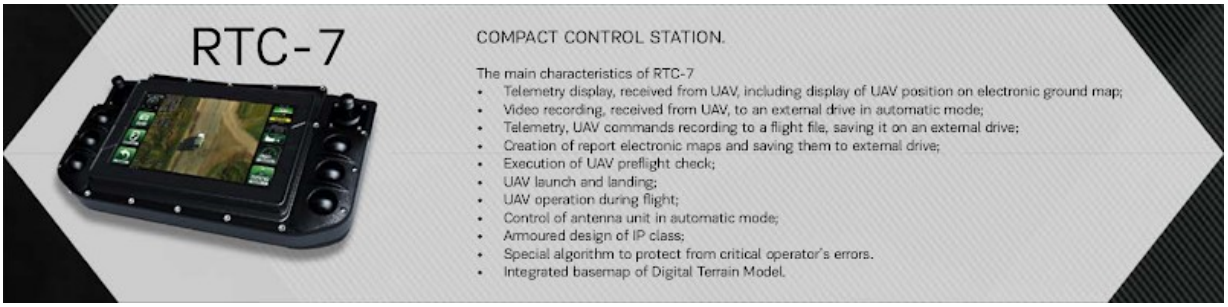
UAV Tx: 2170-2380 MHz @ 40 dBm (10W)
Detected on: 2215 MHz, 2245 MHz, 2250 MHz, 2260 MHz, 2365 MHz

UAV Ground Control Station

[НЦУ], [Наземный Центр Управления], [RTC-7]



COMPACT CONTROL STATION RTC-7



VEHICLE BASED GROUND CONTROL STATION

Geoscan

Geoscan-701

Группа компаний Геоскан

[Геоскан-701]

[photo]

Iranian UAVs

Qods Aviation Industry Company, IAMCO, Shahed Aviation Industries


Mohajer 6
Shahed 123
Ababil 3
Mohajer 4B
Shahed 121
Shahed 129
Mohajer 4
Oghab-1
Yasir "Sayed-2"
Mohajer 2
Saeghe
Fotros
Shahed 171 "Simorgh"

Ababil-5


IslamicWorldNews
Analysis & Intelligence
ABABIL 5

Arash-2

IAIO Fotros

Kaman-12

Kaman-22

Mohajer-6

Shahed-129

[Шахед-129]

Similar in size to Orion/Orion-E UAV


027


030
IRNA


باید قدرتمند باشیم تا بتوانیم از خودمان و از
هدف و عقایدمان در مقابل دشمن دفاع کنیم.
نمایشگاه افتدار ۴۰
۱۲۹

Shahed 131/136

[Shahid], [Шахед], [Шахід], [Шахид], [Мопед], [شاهد], [Герань-1], [Герань-2], [Балалайка]

- МЕТОДИЧНІ РЕКОМЕНДАЦІЇ ПІДРОЗДІЛАМ ЩОДО БОРОТЬБИ З БЕЗПІЛОТНИМИ ЛІТАЛЬНИМИ АПАРАТАМИ ІРАНСЬКОГО ВИРОБИЦТВА "SHAHED-136" ("ГЕРАНЬ-2") / Information recommended for the units to counter Iranian made UAVs Shahed-136 (Geran-2)
- МЕТОДИЧНІ РЕКОМЕНДАЦІЇ ПІДРОЗДІЛАМ ЩОДО БОРОТЬБИ З БЕЗПІЛОТНИМИ ЛІТАЛЬНИМИ АПАРАТАМИ ІРАНСЬКОГО ВИРОБНИЦТВА "SHAHED-136" ("ГЕРАНЬ-2")_v2 / Information recommended for the units to counter Iranian made UAVs Shahed-136 (Geran-2) v2
- Shahed-136 - Tracking usage & expanding understanding

[info][photo][info][video]

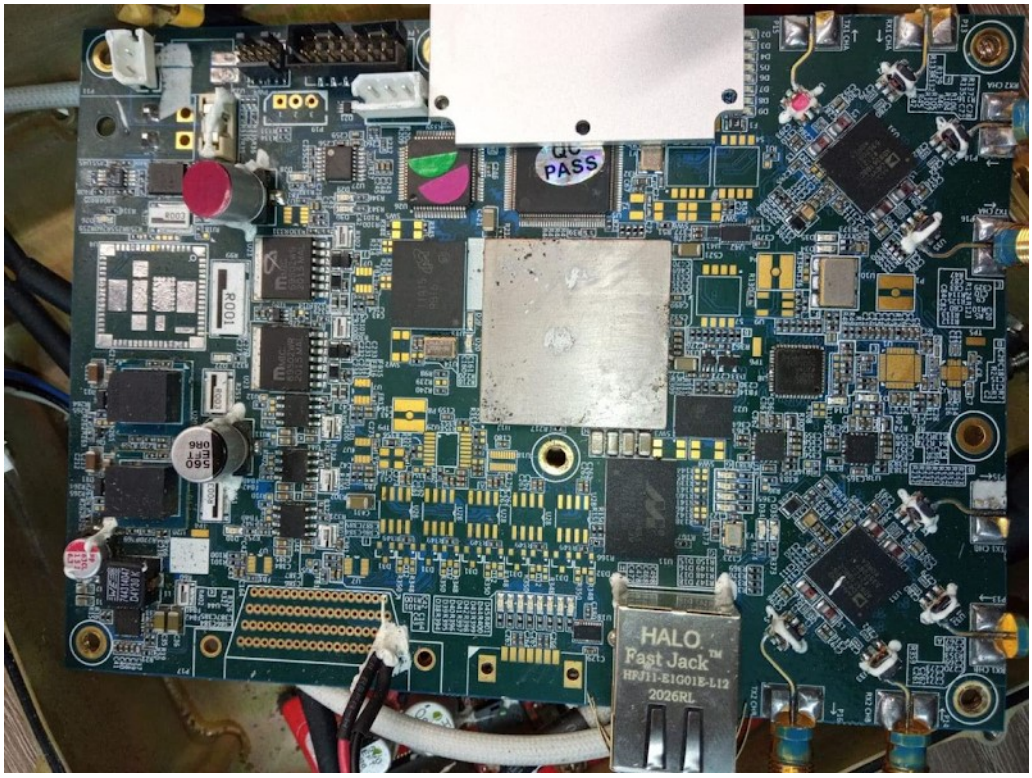
Frequency

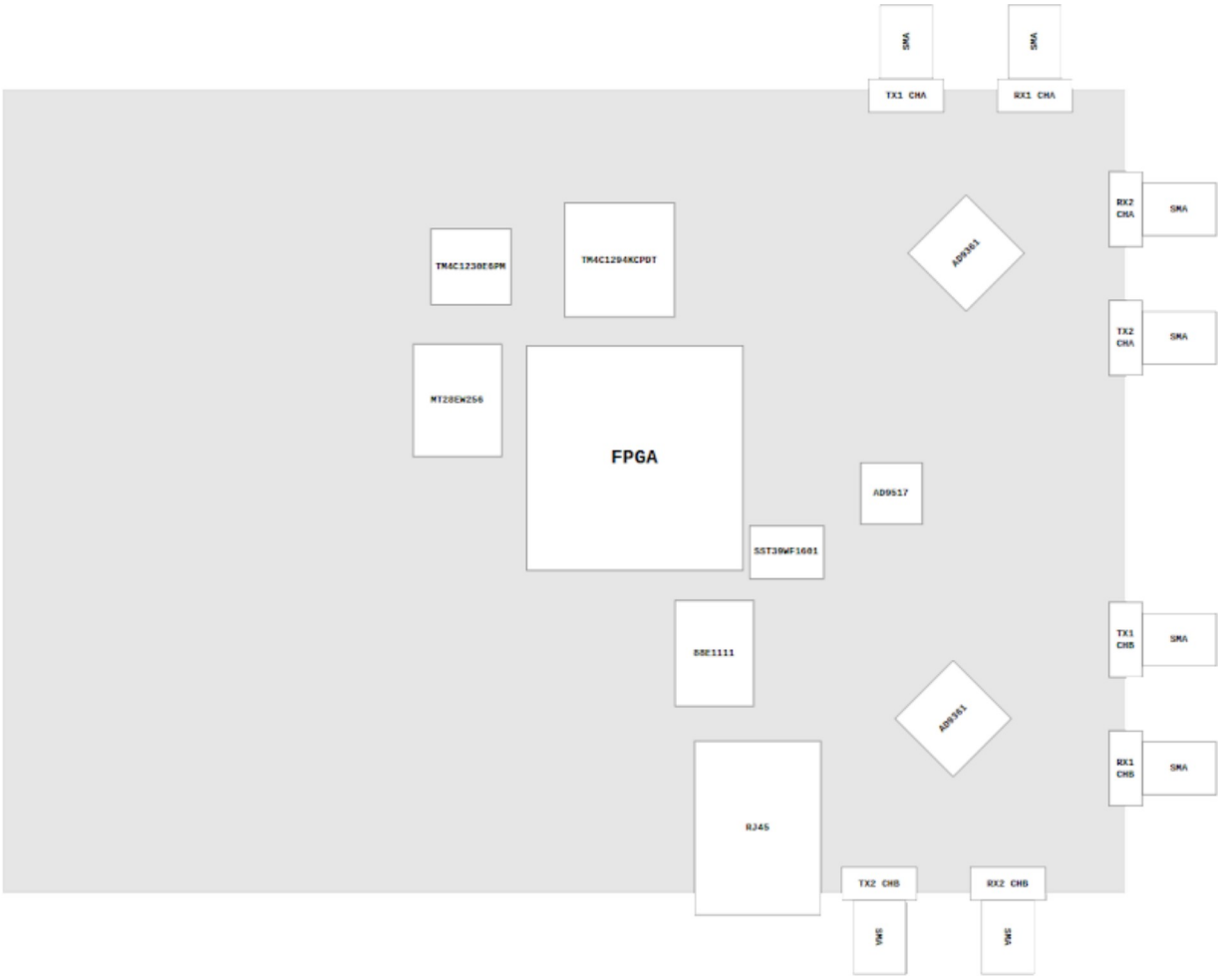
GNSS

UAV Rx: 1525 - 1560 MHz @ -130 dBm

Components used in Shahed-131/136

SDR Transceiver

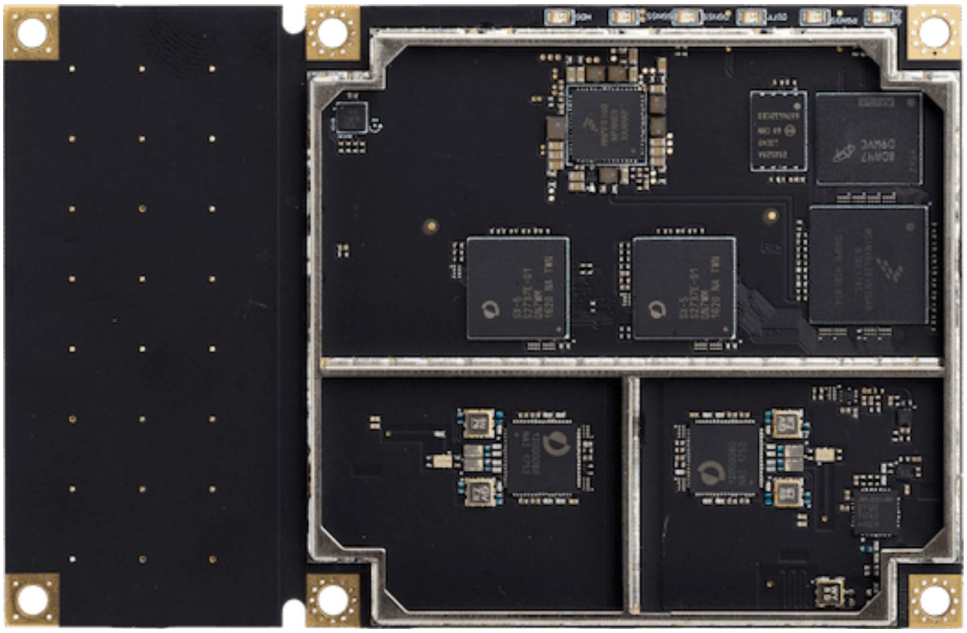




[photo_1][photo_2]

RF Transceiver 1: **AD9361** [datasheet]
RX Band: ***47 - 6000 MHz***
TX Band: ***70 - 6000 MHz***
RF Transceiver 2: **AD9361** [datasheet]
Clock Generator: **AD9517** [datasheet]
Parallel Flash: **Microchip SST39WF1601** [datasheet]
Parallel NOR: **Micron MT28EW256** [datasheet]
Ethernet Transceiver: **Marvell 88E1111** [datasheet]
RJ45 Connector: **HALO Fast Jack HFJ11-E1G01E-L12RL** [datasheet]
MCU 1: **TM4C1294KCPDT** [datasheet]
MCU 2: **TM4C1230E6PM** [datasheet]
FPGA: *Looks like* **Xilinx KINTEX-7**

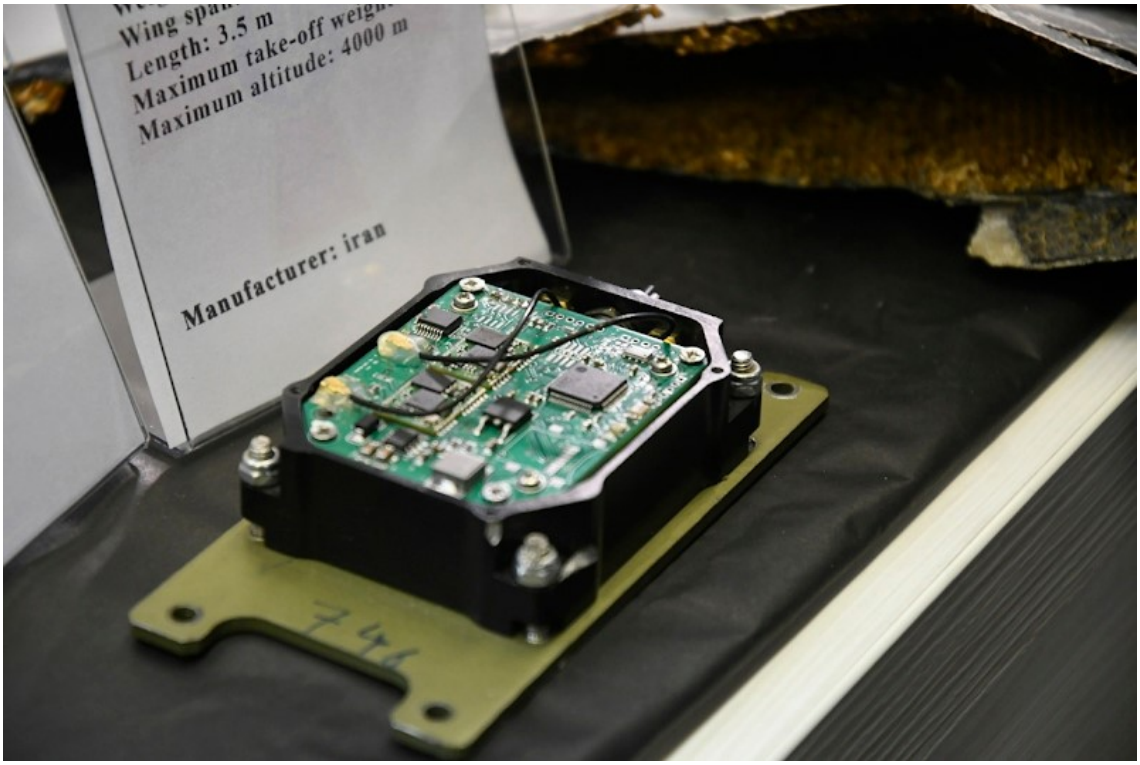
H220 GNSS Board



GNSS receiver: **H220** [description]

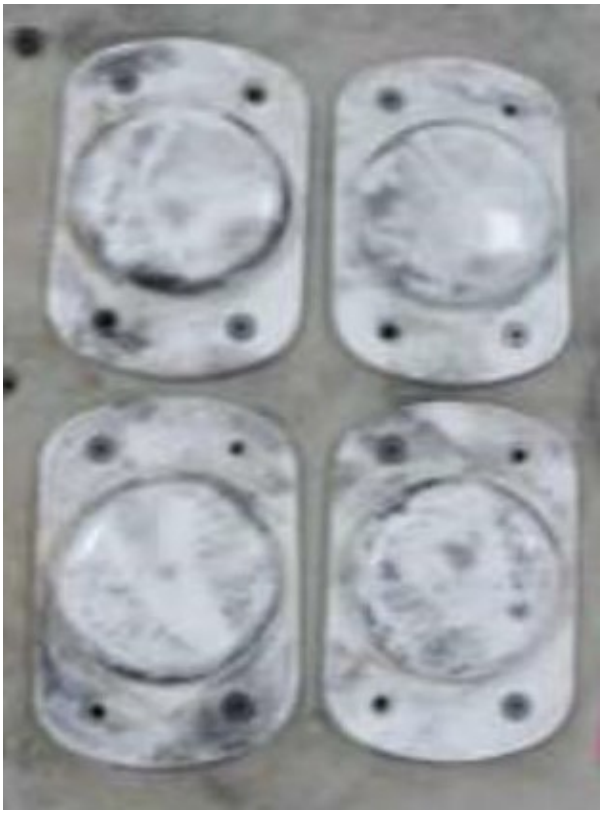
IMU + Dual GNSS module

Looks like **SNC100C-X0** [description][description]



IMU: Looks like **ADIS16488** [description]
GNSS module 1: Looks like **Quectel L26-T** [description]
GNSS module 2: Looks like **Quectel L26-T** [description]

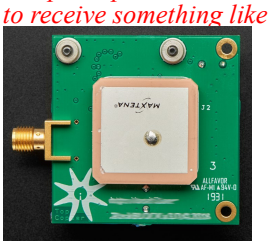
4 array CRPA



CRPA - Controlled reception pattern antenna.

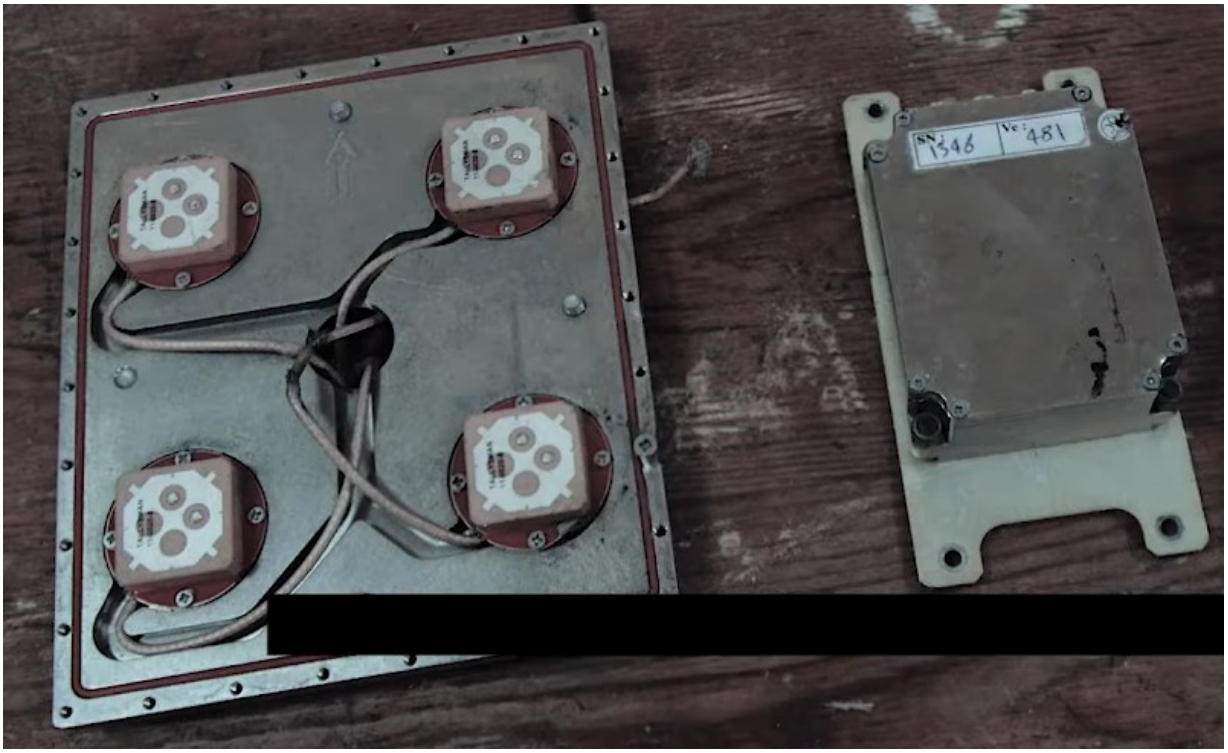
If the antenna are connected directly to the SDR transceiver, it can be used to receive control commands and program a flight route.

The principle can be like Iridium modems. Or can be used to receive something like BDS SMS.



SAT modem example

4x antennas: **TALLYSMAN 11-0020-8**



Single GNSS antenna

[video][video]

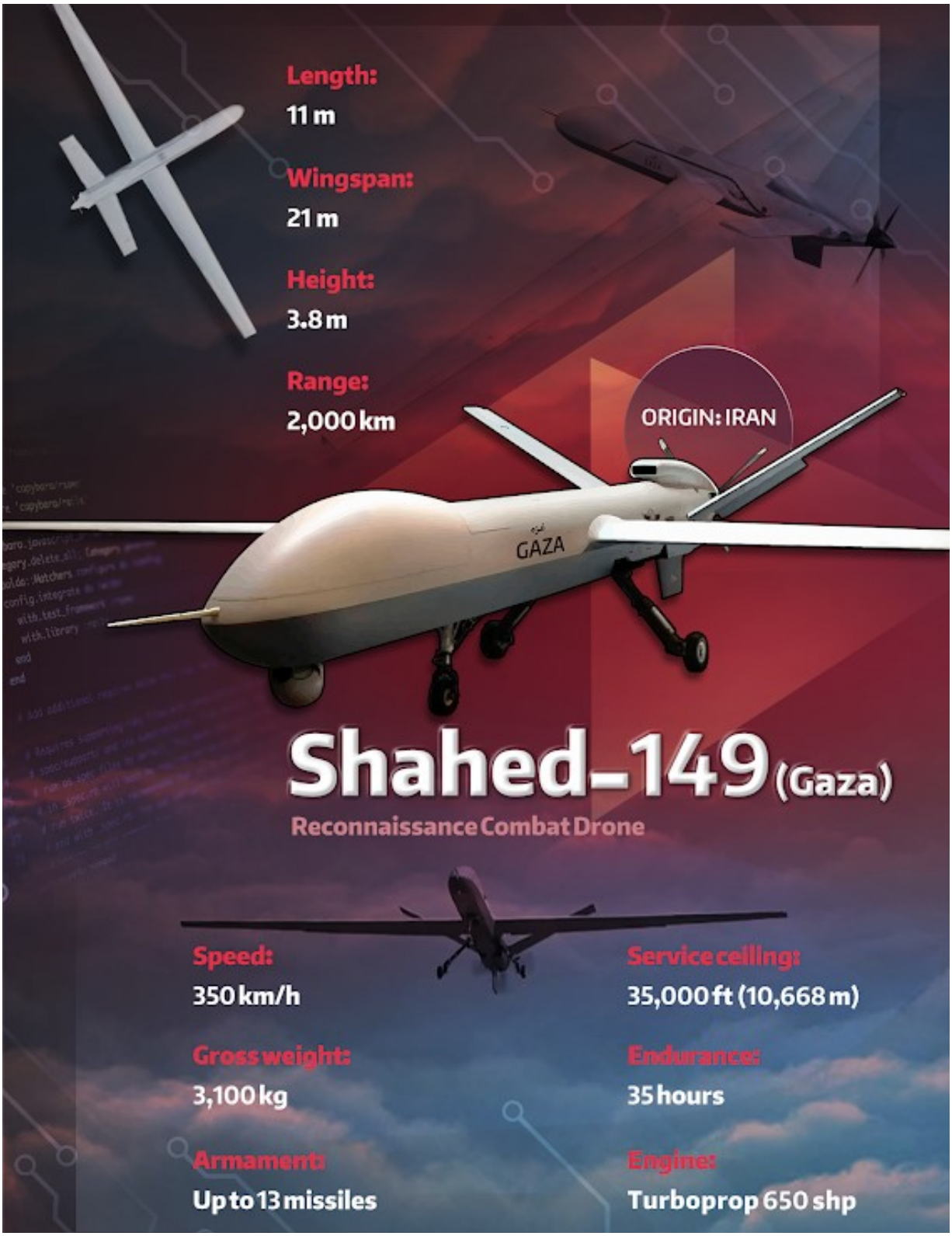
Additional Info

Looks like Shahed-136 can be controlled through Air Bridge with next UAV's:
- Ababil-5
- IAIO Fotros
- Kaman-12
- Kaman-22
- Shahed-129
- Shahed-149

[info]

Shahed-149

[Шахед-149]



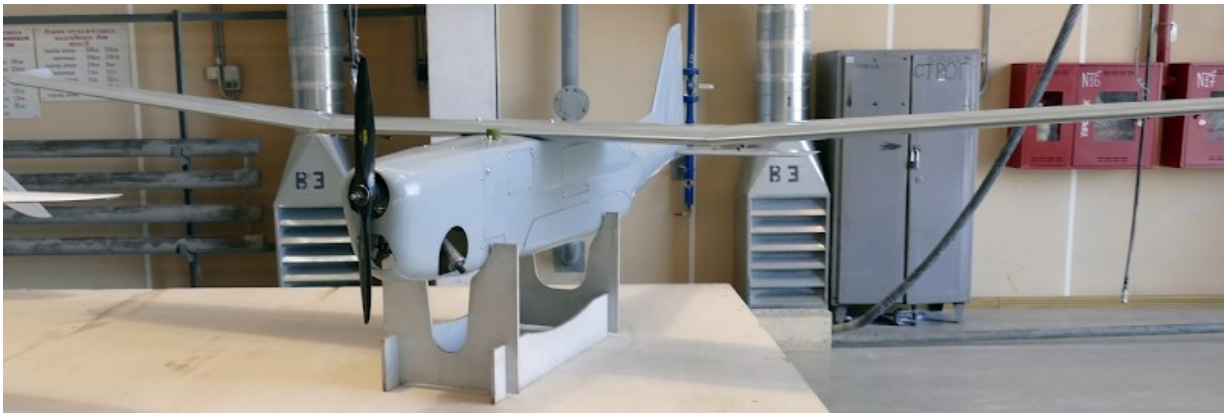
ООО НПП «НТТ»

Lastochka-M

[Ласточка-М]

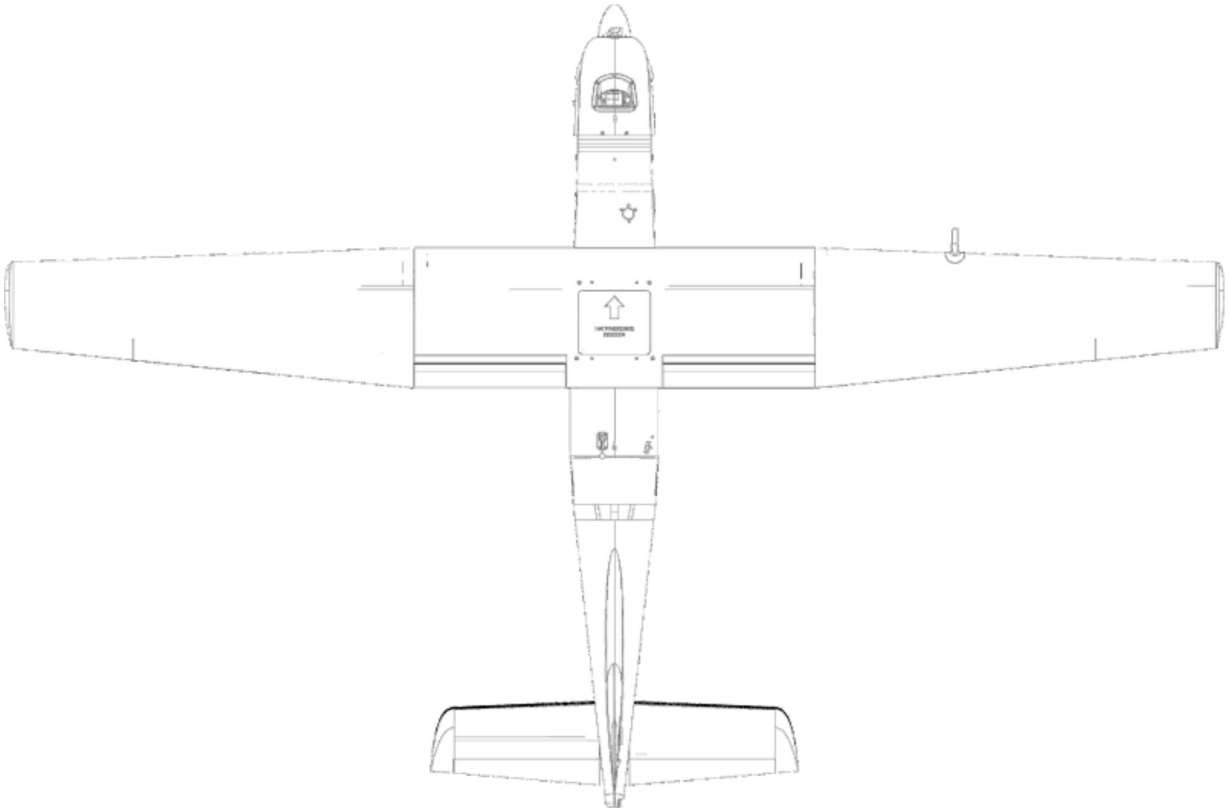
Phoenix

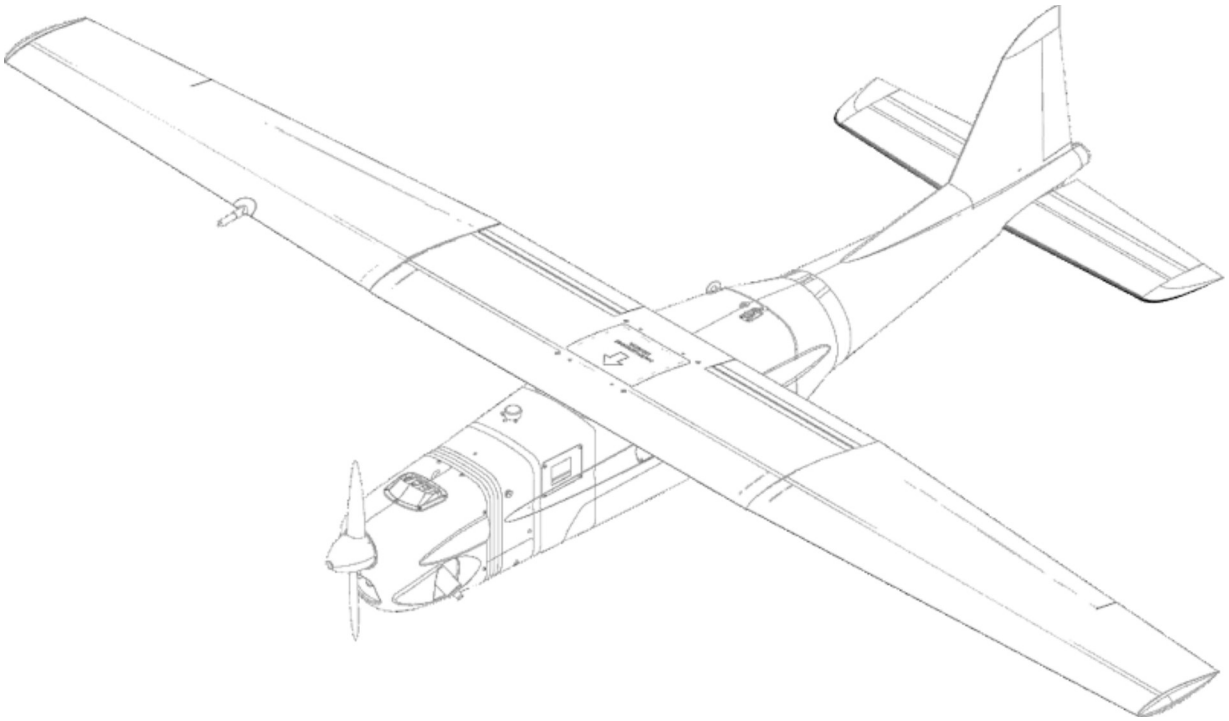
[Феникс], [Fenix]



Phoenix UAV looks like Orlan-10. This UAV uses slightly different avionics and instead of the KTR module uses the **Modig** radio module identical to that of Eleron UAV.

[photo][photo]





Frequency

Radio Control Link

UAV Rx: 860 - 1020 MHz (Modig)
UAV Tx: 860 - 1020 MHz (Modig)

Frequency Ranges

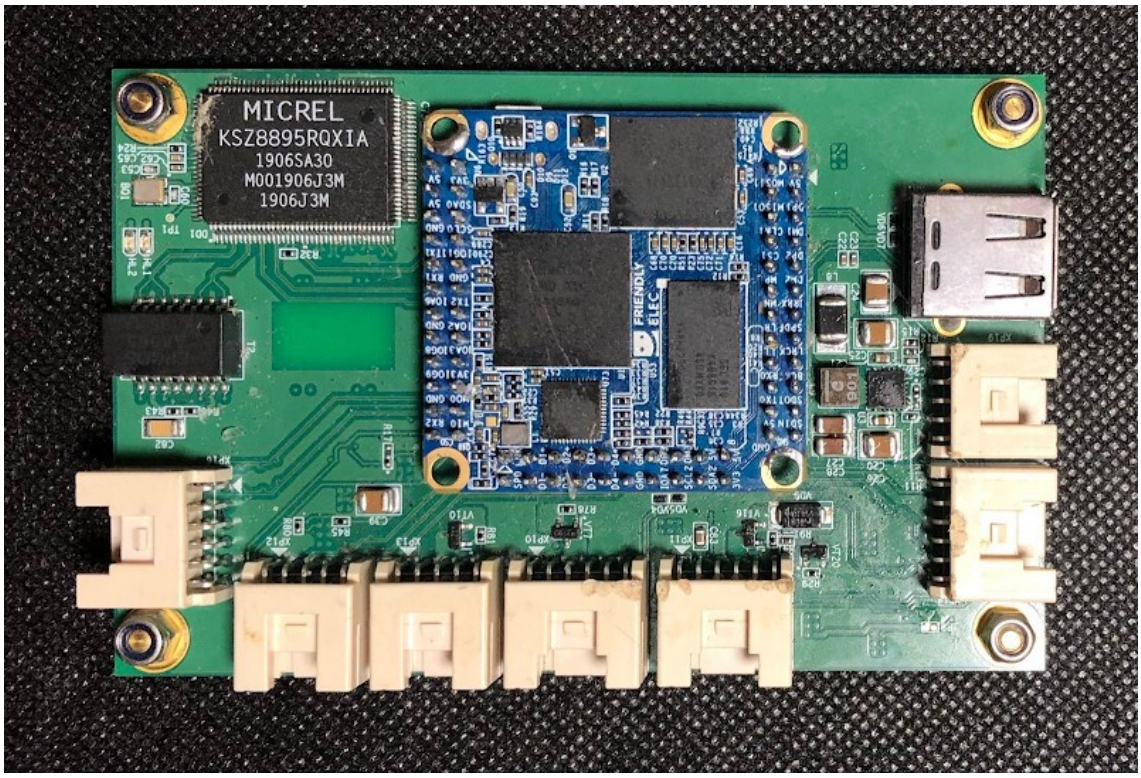
Channel:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Frequency Range:	865 870	870 875	875 880	880 885	885 890	890 895	895 900	900 905
Channel:	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Frequency Range:	905 910	910 915	915 920	920 925	925 930	930 935	935 940	940 945
Channel:	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Frequency Range:	945 950	950 955	955 960	960 965	965 970	970 975	975 980	980 985
Channel:	**25**	**26**	**27**	**28**	**29**	**30**	**31**	
Frequency Range:	985 990	990 995	995 1000	1000 1005	1005 1010	1010 1015	1015 1020	

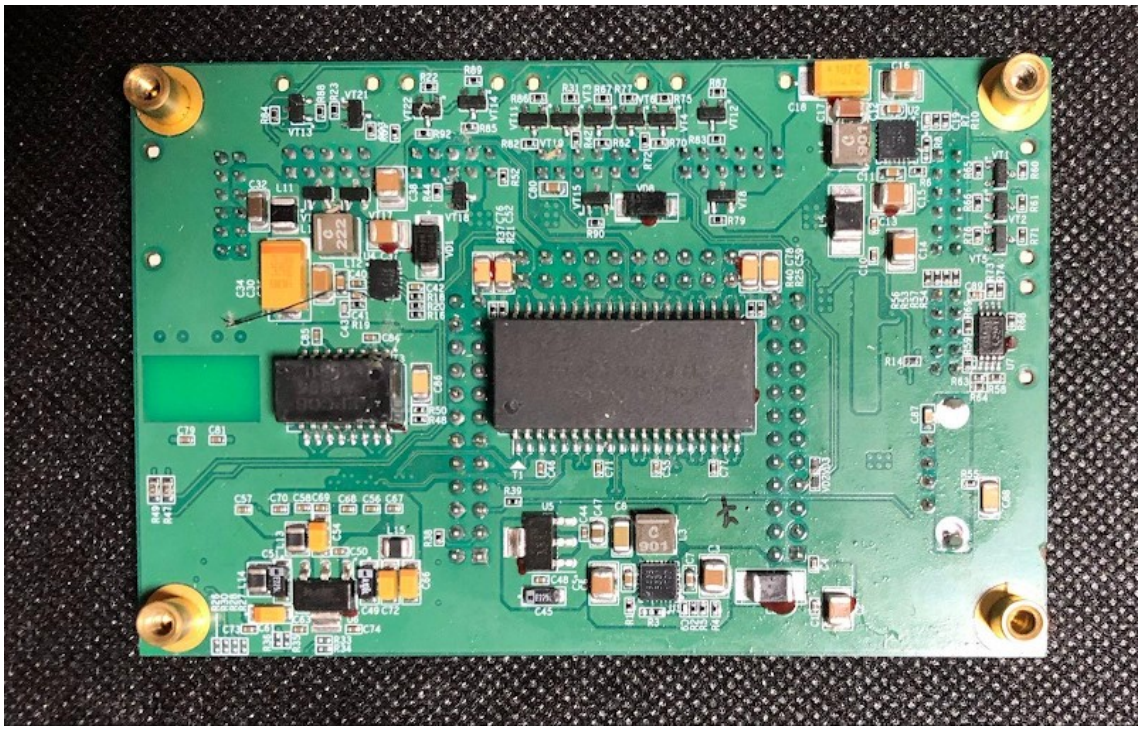
Payload

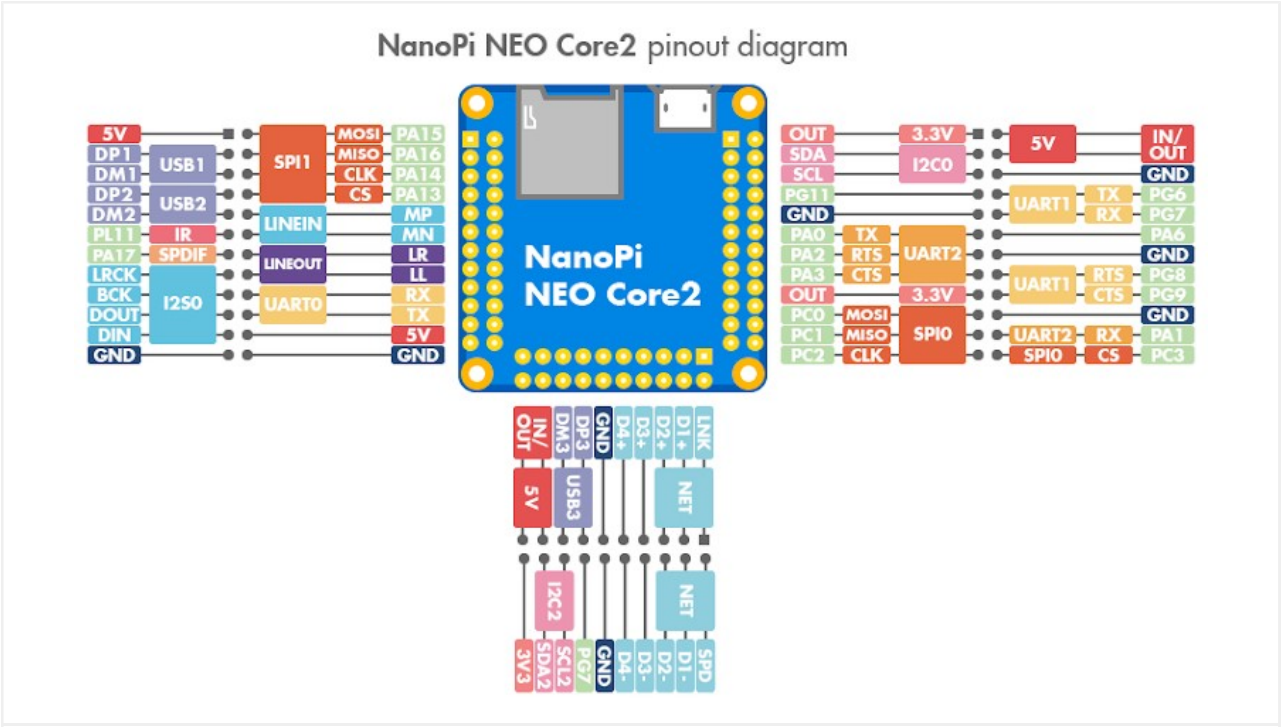
UAV Tx: 2300 - 2700 MHz

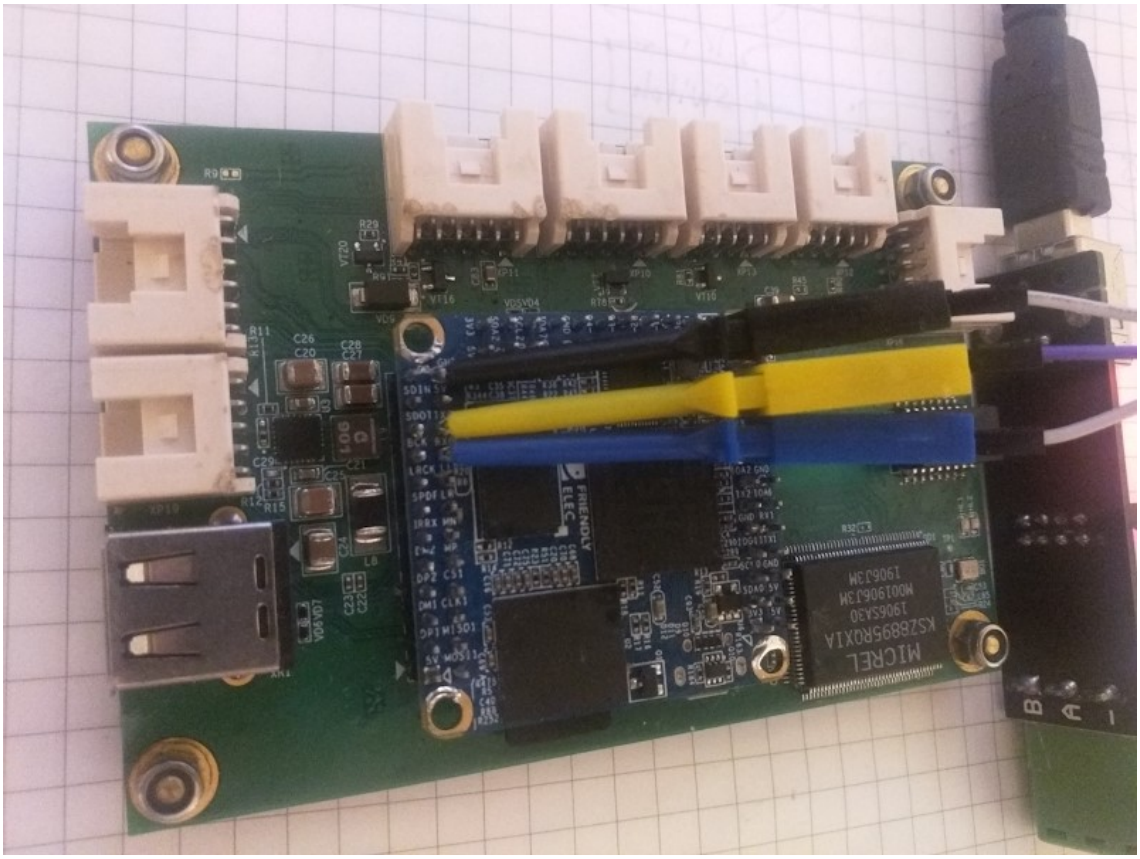
Components

EmbeddedPC + Ethernet switch module






NanoPi NEO Core2 pinout diagram
NanoPi
NEO Core2
5V
DP1
DM1
DP2
DM2
PL11
PA17
LRCK
BCK
DOUT
DIN
GND
USB1
USB2
IR
SPDIF
I2S0
SPI1
LINEIN
LINEOUT
UART0
MOSI
MISO
CLK
CS
PA15
PA16
PA14
PA13
MP
MN
LR
LL
RX
TX
5V
GND
OUT
SDA
SCL
PG11
GND
PA0
PA2
PA3
OUT
PC0
PC1
PC2
3.3V
I2C0
TX
RTS
CTS
UART2
3.3V
MOSI
MISO
CLK
SPI0
5V
UART1
TX
RX
UART1
RTS
CTS
UART2
RX
CS
SPI0
IN/
OUT
GND
PG6
PG7
PA6
GND
PG8
PG9
GND
PA1
PC3
IN/
OUT
5V
DP3
DM3
USB3
GND
D4+
D3+
D2+
D1+
LNK
NET
I2C2
SDA2
SCL2
PG7
GND
D4-
D3-
D2-
D1-
SPD
NET
3V3



ООО «Плаз»

Company: ООО «Плаз»
Address: 194021, Россия, Санкт-Петербург, ул. Политехническая, д.22, лит. В
Phone: +7 (812) 363-33-67
Site: https://www.plazlink.com
E-Mail: plaz@plazlink.com

В составе компании «ПЛАЗ» функционируют:

- КБ беспилотных летательных аппаратов
- КБ авионики
- КБ оптико-электронных систем
- КБ устройств и систем связи
- КБ вычислительной техники
- отдел геоинформационного ПО
- отдел ПО систем управления
- отдел ПО компьютерного зрения
- участок прототипирования
- завод по производству беспилотных летательных аппаратов
- отдел производства электронных, вычислительных и оптико-электронных систем

Grifon-11

[Грифон-11]

Grifon-12

[Грифон-12]

[info]

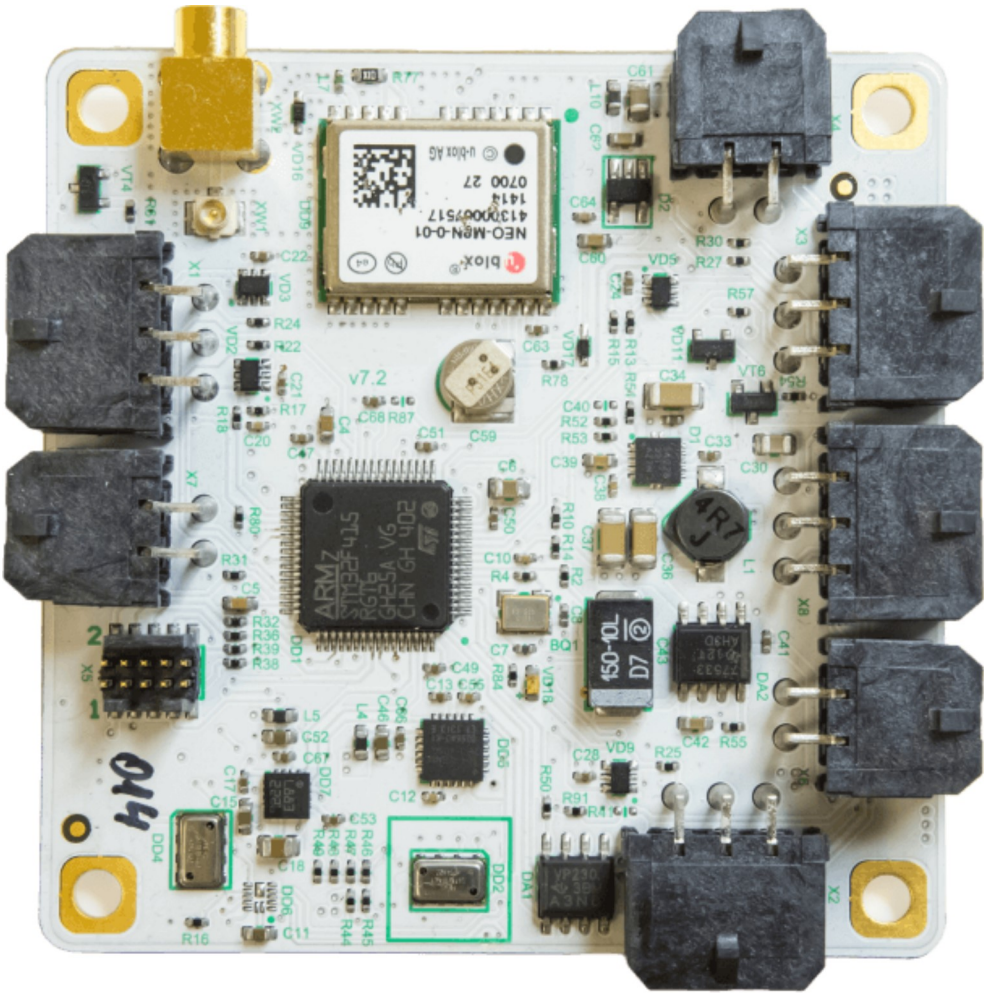
Grifon-17

[Грифон-17]

Looks like Geoscan-701

Flight Controller

ПЛАС.468339.301



[info]

ООО «СТЦ»

LLC "Special Technology Center"

ООО «Специальный технологический центр»

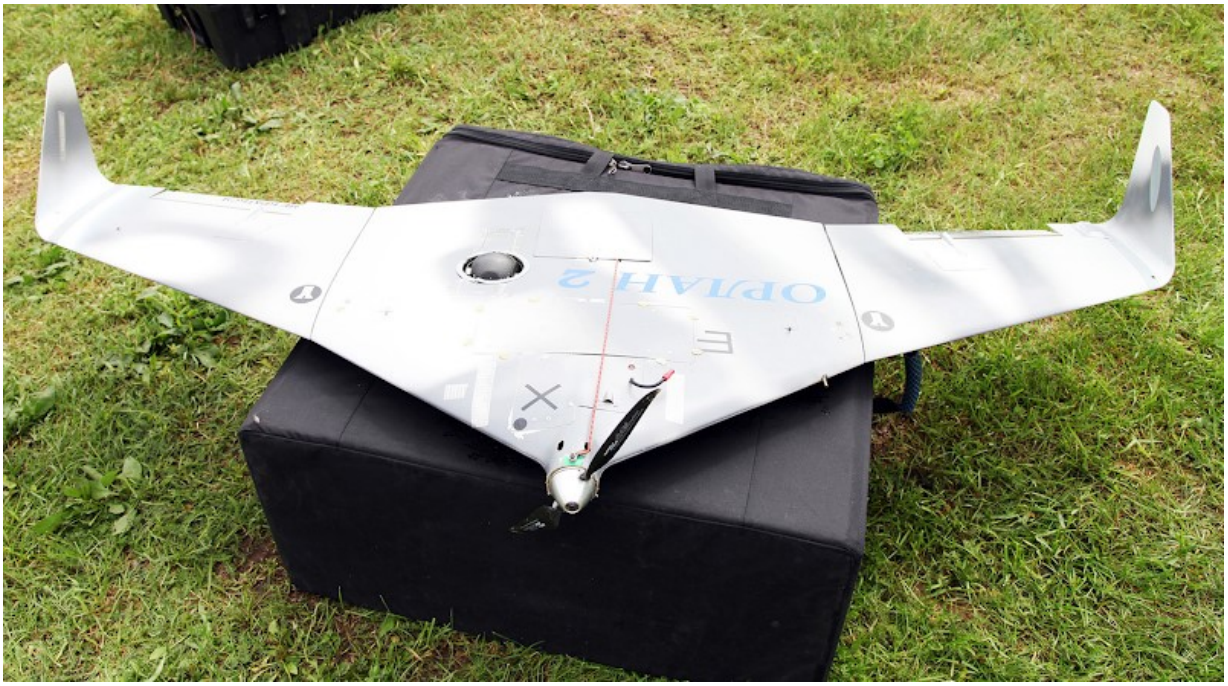
Orlan-1

[Орлан 1]

[info]

Orlan-2

[Орлан 2]



Orlan-3

[Орлан-3]

[orlan-3]

Orlan-3M

[Орлан-3М], [Гранат-3]

UAV Orlan-3M and Granat-3 visually look the same. *Most likely they will differ only in electronics*.

[orlan-3m][granat-3]

Orlan-3M

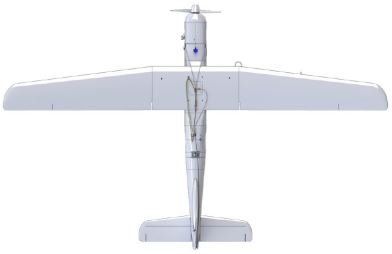
UAV Ground Control Station

Orlan-5

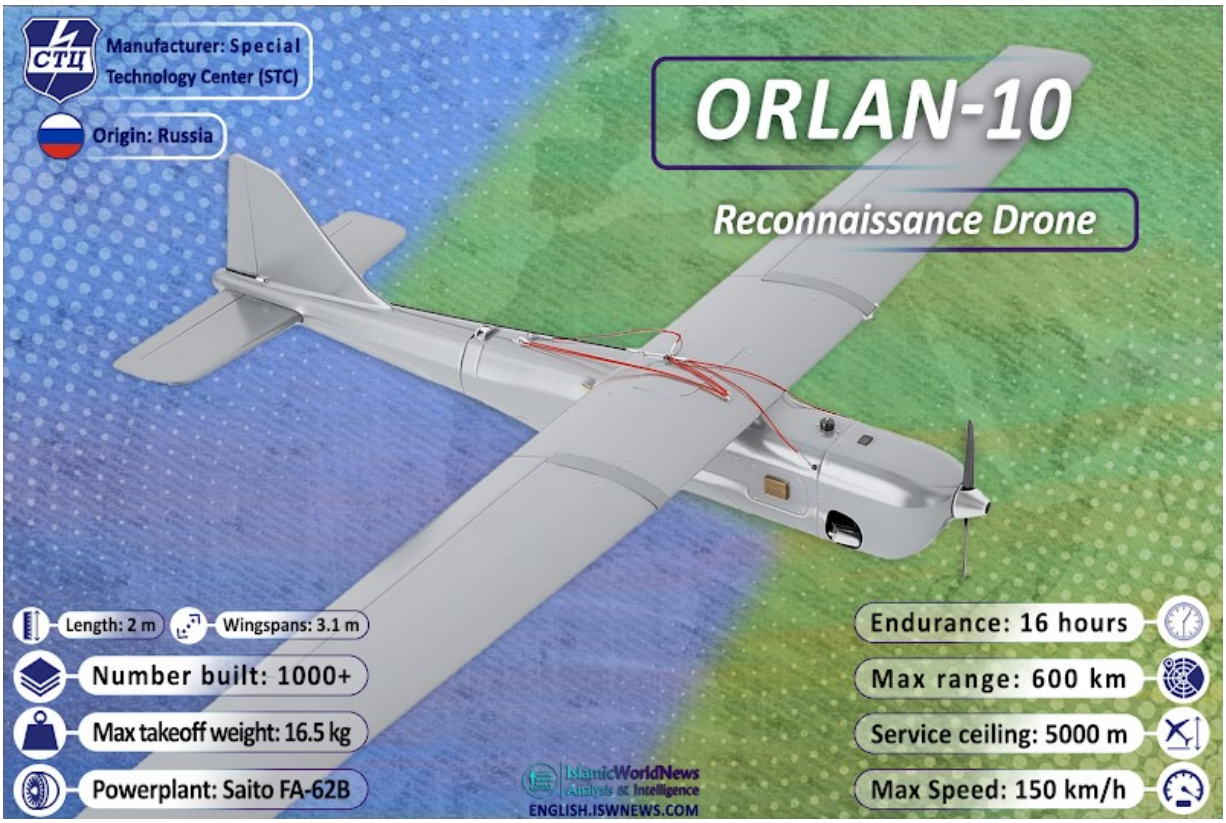
[Орлан 5]

Orlan-10 / Orlan-30

[Орлан 10], [Орлан 10М], [Орлан 10У], [Орлан 30]



Orlan 10 **Orlan 30**

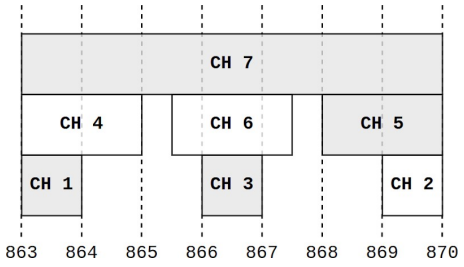


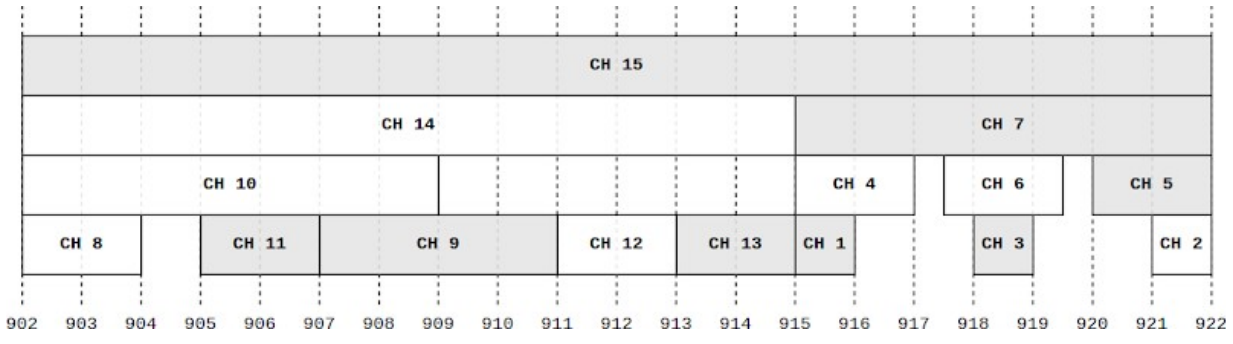
Frequency

Radio Control Link

UAV Rx: 902 - 922 MHz
863 - 870 MHz
865 - 922 MHz
UAV Tx: 902 - 922 MHz
863 - 870 MHz
865 - 922 MHz

Channels





Payload

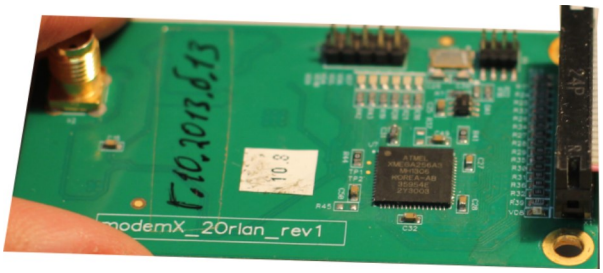
UAV Rx: 2300 - 2700 MHz
UAV Tx: 2300 - 2700 MHz @ 38 dBm (6.3W)
960 - 1215 MHz
3300 - 3800 MHz

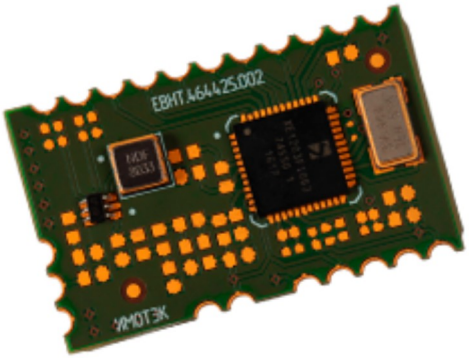
Components

[list_1]

Radio Control Link

ModemX_2Orlan_rev1





915 MHZ RADIO MODULE

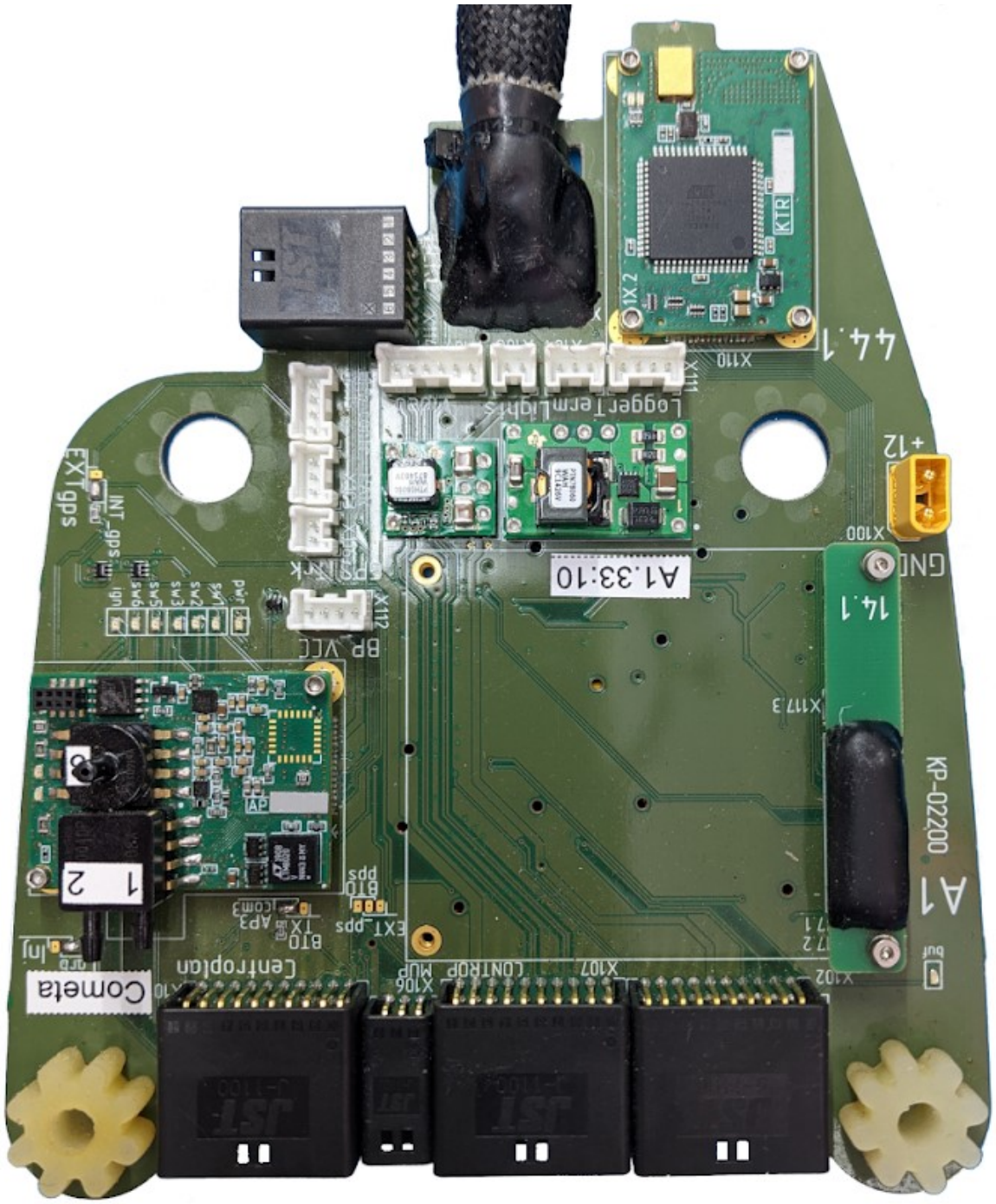
Replacement for: DP1203/DP1205;
Frequency: 915 MHz;
Power supply: 2.4-3.6 B;
Dimensions: 18.5*30.5 mm;
Modulation: 2FSK;
Interface: TxRx, SPI;
Data rate: up to 152.3 Kbps,
up to 304.7 Kbps
Operation temperature: -40 to +85 °C;

RF Module: **imoTech DP1205-C915** (datasheet,datasheet)(info)
MCU: **ATxmega256A3U** (documents)
PA: **RF3110** (datasheet) 880 - 915 MHz @ 35 dBm

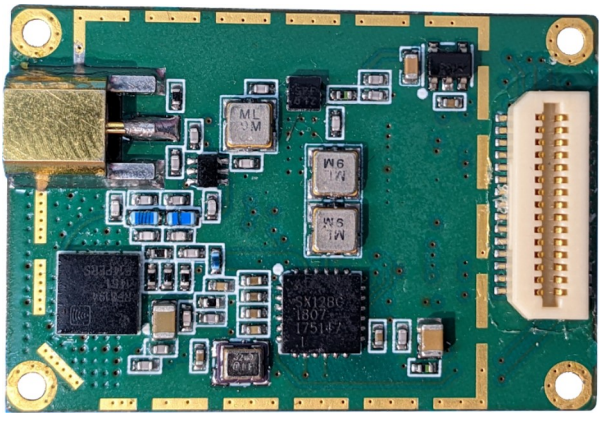
KTR-3

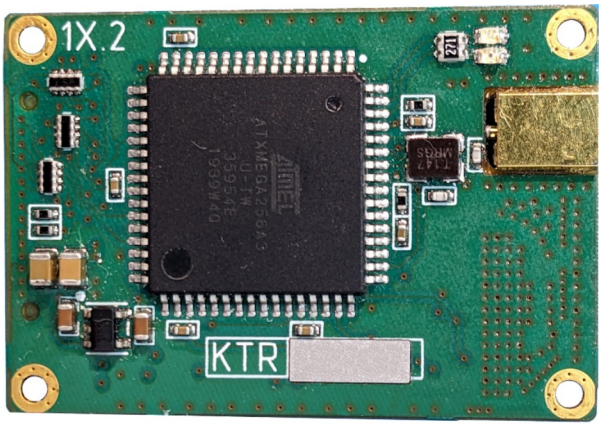
КТР - Командно-Телеметрическая Радиолиния - Command-Telemetry Radio Link
НСОД - Низкоскоростная Система Обмена Данными - Low Speed Communication System

[КТР], [КТР-3], [НСОД], [Модем]



Main board + FCU + KTR





SAW Filter: **TA1163A** (datasheet) [907 - 922 MHz]
LNA: **SPF5122Z** (datasheet)
PA: **RF3194** (datasheet)
RF Chip: **SX12BC** (datasheet)
MCU: **ATxmega256A3U** (documents)

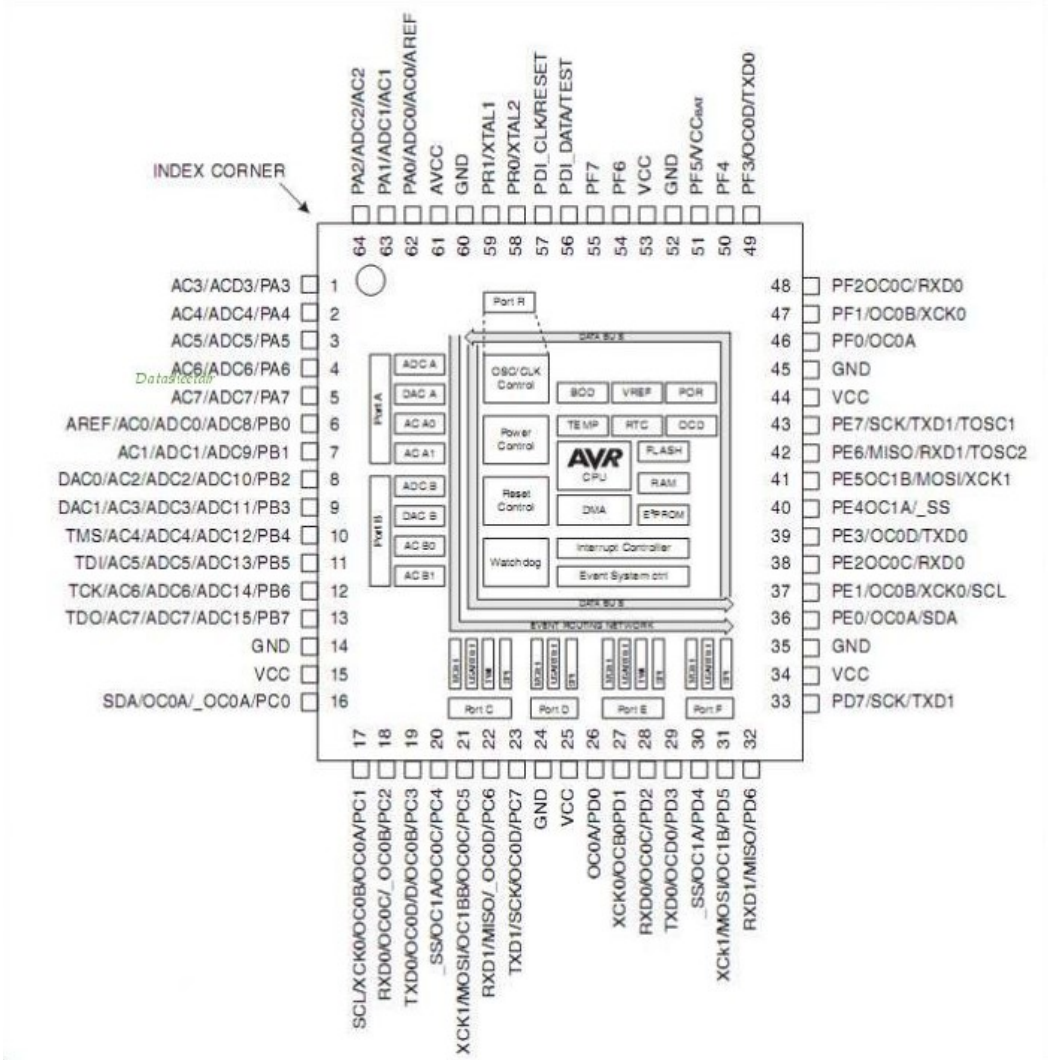
Waveform characteristics

Modulation: FSK
Baudrate: 76100
Pattern: 0xf17c1599
CCF: 101 (count of carrier frequencies)

Modulation parameters
Modulation - FSK-2;
Modulation index -2;
Possible baudrate, Bod: 38100, 76200,152300, 100000
FHSS parameters
Constant hops durations, ms: 12.8, 13.5
FHSS speed, hops/s: 33

Pinout

ATxmega256A3U

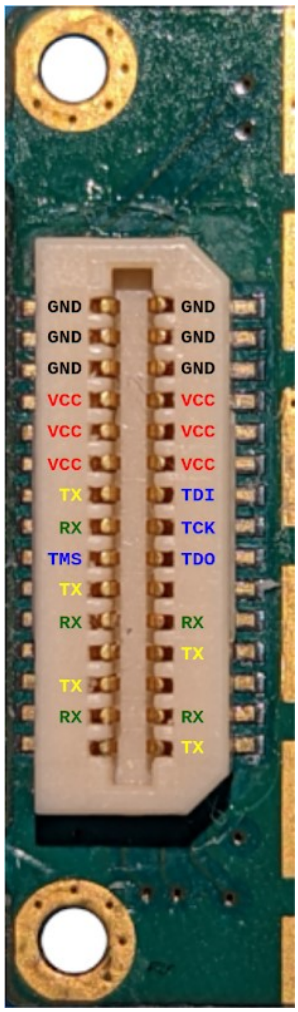


TMS	10	JTAG Test Mode Select
TDI	11	JTAG Test Data In
TCK	12	JTAG Test Clock
TDO	13	JTAG Test Data Out
PDI_DATA	56	Program and Debug Interface Data pin
PDI_CLOCK	57	Program and Debug Interface Clock pin

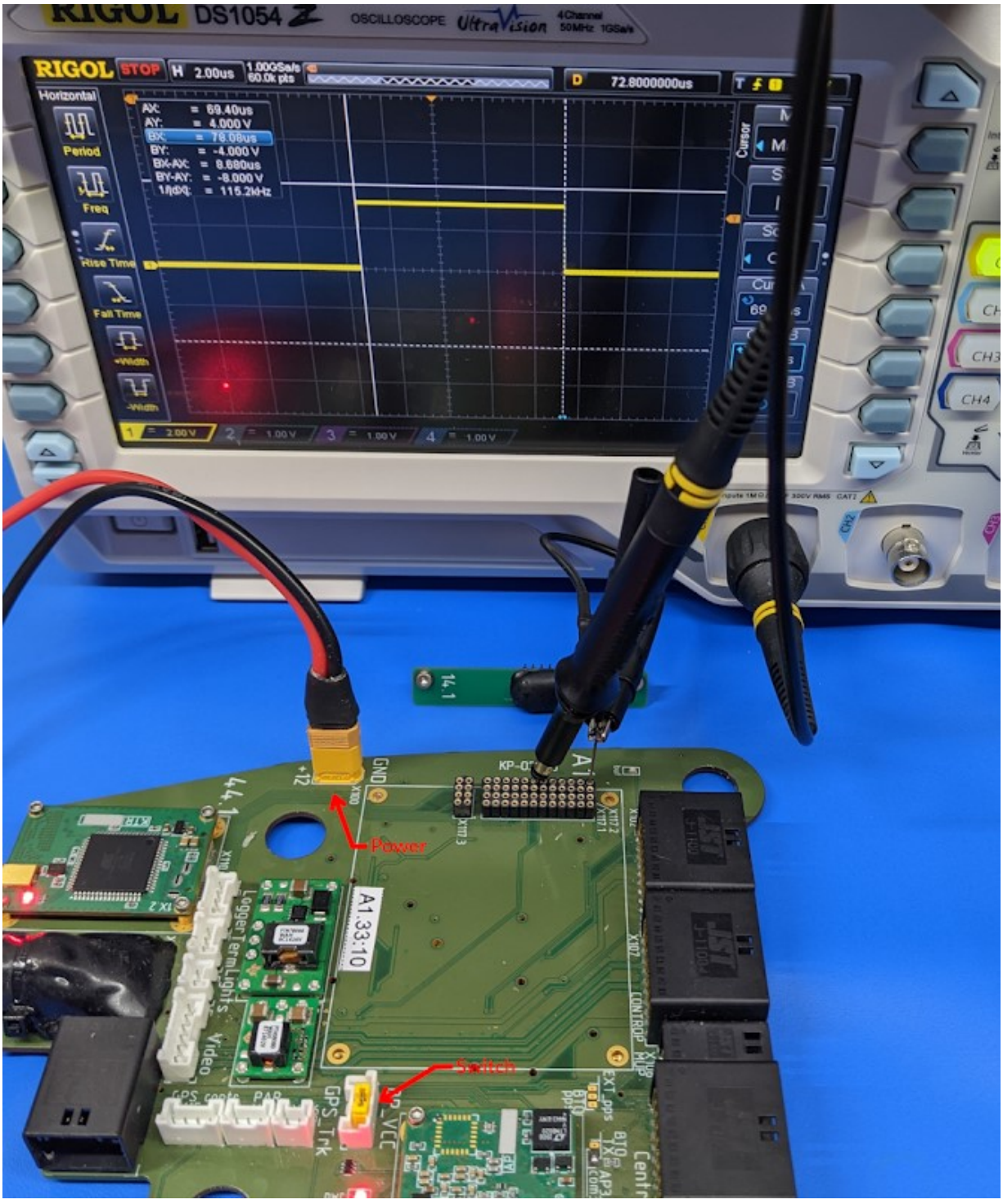
AXN330038S

ATxmega256A3U	AXN330038S		AXN330038S		ATxmega256A3U	AXN330038S

	1	GND	30	GND	
	2	GND	29	GND	
	3	GND	28	GND	
	4	VCC	27	VCC	
	5	VCC	26	VCC	
	6	VCC	25	VCC	
19	7	TX(1)	24	TDI	11
18	8	RX(1)	23	TCK	12
10	9	TMS	22	TDO	13
23	10	TX(2)	21		37
22	11	RX(2)	20	RX(5)	38
21	12		19	TX(5)	39
29	13	TX(3)	18		31
28	14	RX(3)	17	RX(4)	32
27	15		16	TX(4)	33

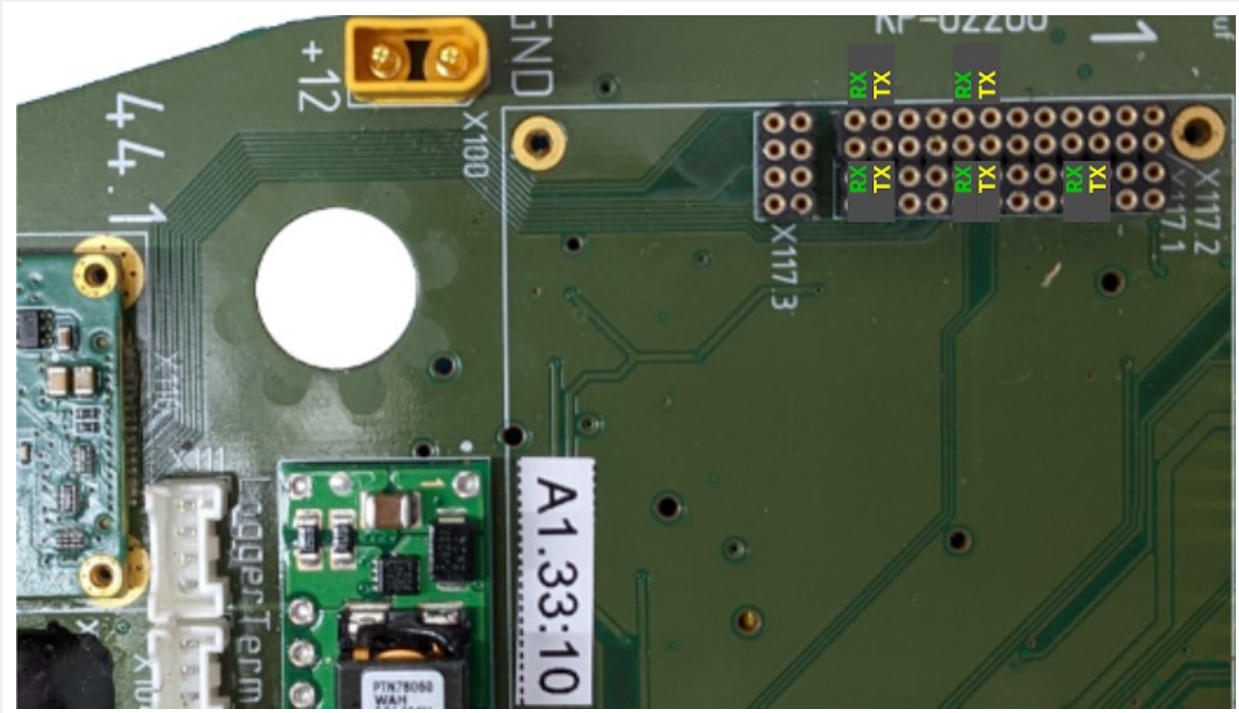


Power On



Serial Ports

The serial ports of the **KTR** module are routed to the **X117.2** connector.



X117.2 (to X110)

RX(2)	TX(2)	12	GND	RX(4)	TX(4)	18	GND				GND
RX(1)	TX(1)		GND	RX(3)	TX(3)	15	GND	RX(5)	TX(5)	21	GND

X117.1 (via adapter)

	[X101] Centroplan			[X114] BCKC						
GND	RX(2)	TX(2)	GND	RX(4)	TX(4)		GND			
GND	RX(1)	TX(1)	GND	RX(3)	TX(3)		GND	RX(5)	TX(5)	
	[X105.1] FCU			[X101] Centroplan				[X107] CONTROP		

UART(1) - [X105.1] FCU

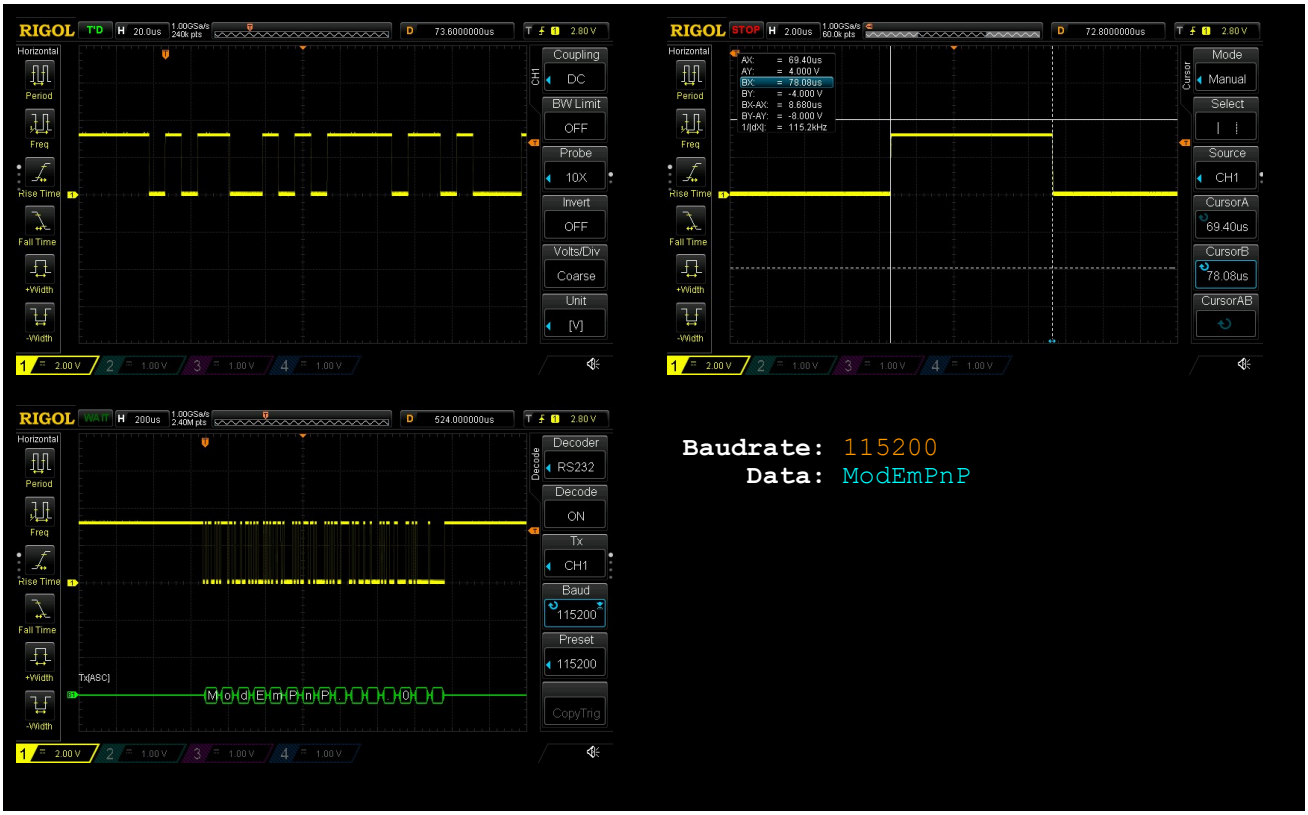
UART(2) - [X101] CENTROPLAN

UART(3) - [X101] CENTROPLAN

UART(4) - [X114] BCKC

```
# Screenshot (Rigol DS1054z)

└─$ echo ':display:data?' | netcat -w 5 192.168.0.200 5555 | tail -c +12 > $(date +%Y%m%d_%H%M%S).bmp
```



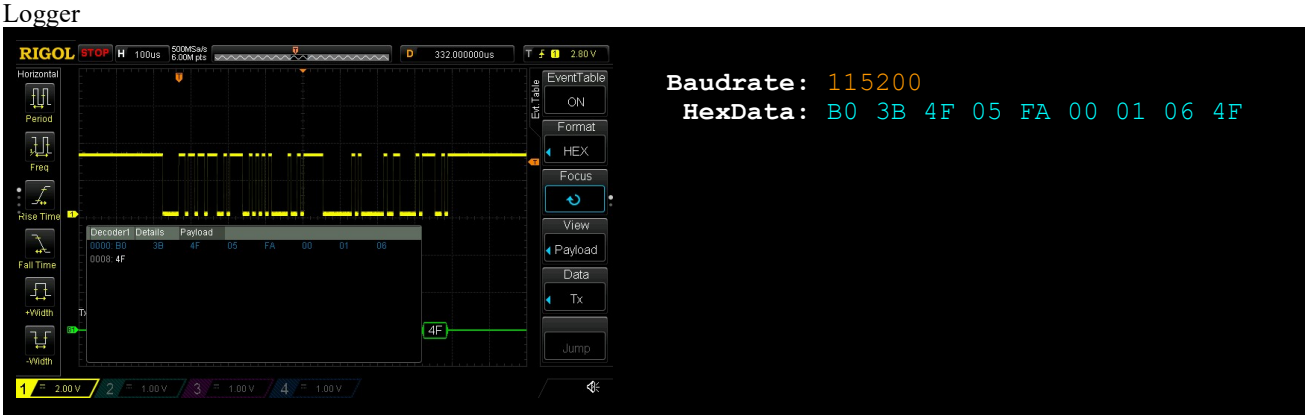

```
└─# stty -F /dev/ttyUSB0 115200
└─# (stty raw; cat > /tmp/capture.txt) < /dev/ttyUSB0
└─# hexdump -C /tmp/capture.txt
```

```
00000000  4d 6f 64 45 6d 50 6e 50  f3 29 04 8d 30 01 00 4d  |ModEmPnP.)..0..M|
00000010  6f 64 45 6d 50 6e 50 f3  2a 04 8d 30 01 00 4d 6f  |odEmPnP.*..0..Mo|
00000020  64 45 6d 50 6e 50 f3 2b  04 8d 30 01 00 4d 6f 64  |dEmPnP.+..0..Mod|
00000030  45 6d 50 6e 50 f3 2c 04  8d 30 01 00 4d 6f 64 45  |EmPnP.,..0..ModE|
00000040  6d 50 6e 50 f3 2d 04 8d  30 01 00 4d 6f 64 45 6d  |mPnP.-..0..ModEm|
00000050  50 6e 50 f3 2e 04 8d 30  01 00 4d 6f 64 45 6d 50  |PnP....0..ModEmP|
00000060  6e 50 f3 2f 04 8d 30 01  00 4d 6f 64 45 6d 50 6e  |nP./..0..ModEmPn|
00000070  50 f3 30 04 8d 30 01 00  4d 6f 64 45 6d 50 6e 50  |P.0..0..ModEmPnP|
00000080  f3 31 04 8d 30 01 00 4d  6f 64 45 6d 50 6e 50 f3  |.1..0..ModEmPnP.|
00000090  32 04 8d 30 01 00 4d 6f  64 45 6d 50 6e 50 f3 33  |2..0..ModEmPnP.3|
000000a0  04 8d 30 01 00 4d 6f 64  45 6d 50 6e 50 f3 34 04  |..0..ModEmPnP.4.|
000000b0  8d 30 01 00 4d 6f 64 45  6d 50 6e 50 f3 35 04 8d  |.0..ModEmPnP.5..|
000000c0  30 01 00 4d 6f 64 45 6d  50 6e 50 f3 36 04 8d 30  |0..ModEmPnP.6..0|
000000d0  01 00 4d 6f 64 45 6d 50  6e 50 f3 37 04 8d 30 01  |..ModEmPnP.7..0.|
000000e0  00 4d 6f 64 45 6d 50 6e  50 f3 38 04 8d 30 01 00  |.ModEmPnP.8..0..|
000000f0  4d 6f 64 45 6d 50 6e 50  f3 39 04 8d 30 01 00 4d  |ModEmPnP.9..0..M|
00000100  6f 64 45 6d 50 6e 50 f3  3a 04 8d 30 01 00 4d 6f  |odEmPnP.:..0..Mo|
00000110  64 45 6d 50 6e 50 f3 3b  04 8d 30 01 00 4d 6f 64  |dEmPnP.;..0..Mod|
00000120  45 6d 50 6e 50 f3 3c 04  8d 30 01 00 4d 6f 64 45  |EmPnP.<..0..ModE|
00000130  6d 50 6e 50 f3 3d 04 8d  30 01 00 4d 6f 64 45 6d  |mPnP.=..0..ModEm|
00000140  50 6e 50 f3 3e 04 8d 30  01 00 4d 6f 64 45 6d 50  |PnP.>..0..ModEmP|
00000150  6e 50 f3 3f 04 8d 30 01  00 4d 6f 64 45 6d 50 6e  |nP.?..0..ModEmPn|
00000160  50 f3 40 04 8d 30 01 00  4d 6f 64 45 6d 50 6e 50  |P.@..0..ModEmPnP|
00000170  f3 00 18 00 00 00 00 55  0f f1 4b 2b 00 00 00 00  |.......U..K+....|
00000180  12 00 fb 00 00 00 00 00  00 01 05 4d 6f 64 45 6d  |...........ModEm|
00000190  50 6e 50 f3 01 04 8d 30  01 00 4d 6f 64 45 6d 50  |PnP....0..ModEmP|
000001a0  6e 50 f3 02 04 8d 30 01  00 4d 6f 64 45 6d 50 6e  |nP....0..ModEmPn|
000001b0  50 f3 03 04 8d 30 01 00  4d 6f 64 45 6d 50 6e 50  |P....0..ModEmPnP|
000001c0  f3 04 04 8d 30 01 00 4d  6f 64 45 6d 50 6e 50 f3  |....0..ModEmPnP.|
000001d0  05 04 8d 30 01 00 4d 6f  64 45 6d 50 6e 50 f3 06  |...0..ModEmPnP..|
000001e0  04 8d 30 01 00 4d 6f 64  45 6d 50 6e 50 f3 07 04  |..0..ModEmPnP...|
000001f0  8d 30 01 00 4d 6f 64 45  6d 50 6e 50 f3 08 04 8d  |.0..ModEmPnP....|
00000200  30 01 00 4d 6f 64 45 6d  50 6e 50 f3 09 04 8d 30  |0..ModEmPnP....0|
00000210  01 00 4d 6f 64 45 6d 50  6e 50 f3 0a 04 8d 30 01  |..ModEmPnP....0.|
```

```
00000220  00 4d 6f 64 45 6d 50 6e  50 f3 0b 04 8d 30 01 00  |.ModEmPnP....0..|
00000230  4d 6f 64 45 6d 50 6e 50  f3 0c 04 8d 30 01 00 4d  |ModEmPnP....0..M|
00000240  6f 64 45 6d 50 6e 50 f3  0d 04 8d 30 01 00 4d 6f  |odEmPnP....0..Mo|
00000250  64 45 6d 50 6e 50 f3 0e  04 8d 30 01 00 4d 6f 64  |dEmPnP....0..Mod|
00000260  45 6d 50 6e 50 f3 0f 04  8d 30 01 00 4d 6f 64 45  |EmPnP....0..ModE|
00000270  6d 50 6e 50 f3 10 04 8d  30 01 00 4d 6f 64 45 6d  |mPnP....0..ModEm|
00000280  50 6e 50 f3 11 04 8d 30  01 00 4d 6f 64 45 6d 50  |PnP....0..ModEmP|
00000290  6e 50 f3 12 04 8d 30 01  00 4d 6f 64 45 6d 50 6e  |nP....0..ModEmPn|
000002a0  50 f3 13 04 8d 30 01 00  4d 6f 64 45 6d 50 6e 50  |P....0..ModEmPnP|
000002b0  f3 14 04 8d 30 01 00 4d  6f 64 45 6d 50 6e 50 f3  |....0..ModEmPnP.|
000002c0  15 04 8d 30 01 00 4d 6f  64 45 6d 50 6e 50 f3 16  |...0..ModEmPnP..|
000002d0  04 8d 30 01 00 4d 6f 64  45 6d 50 6e 50 f3 17 04  |..0..ModEmPnP...|
000002e0  8d 30 01 00                                       |.0..|
000002e4
```

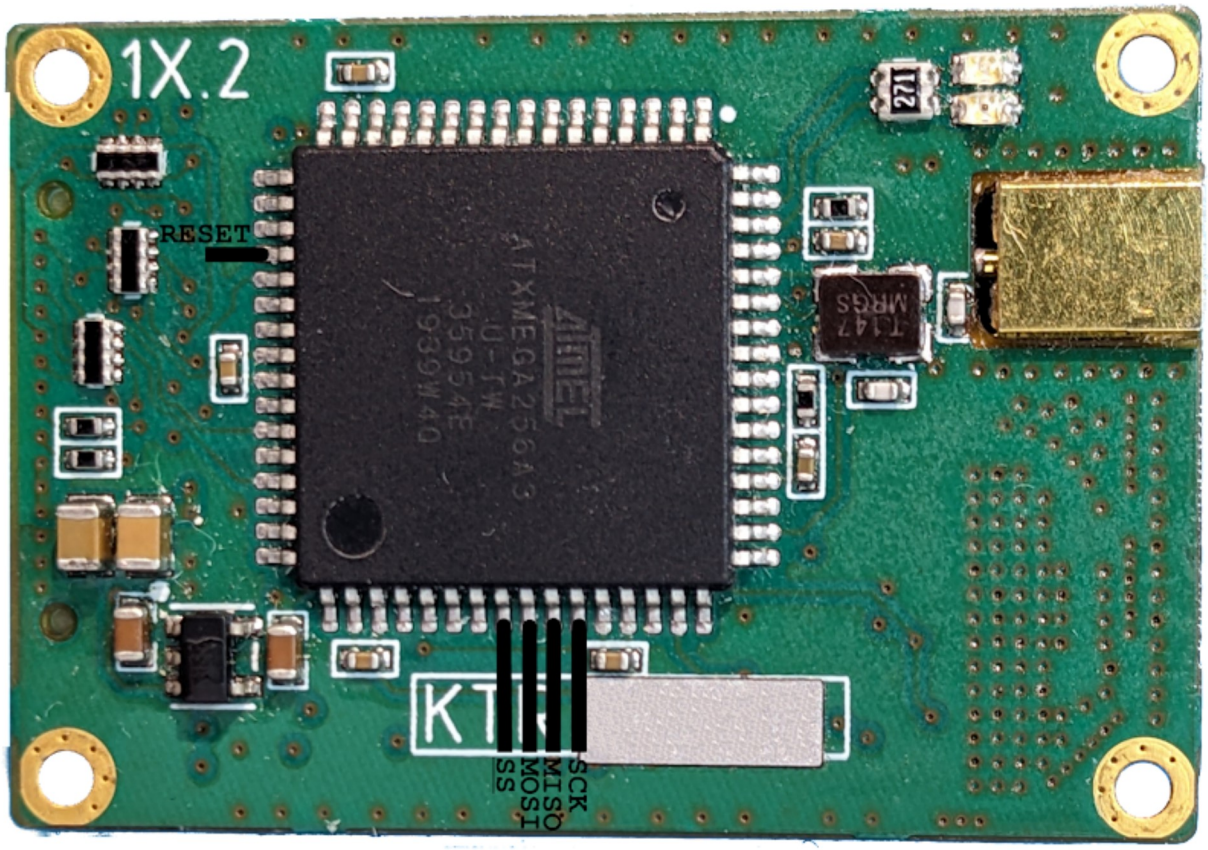
UART(5) - [X107] CONTROP

Logger

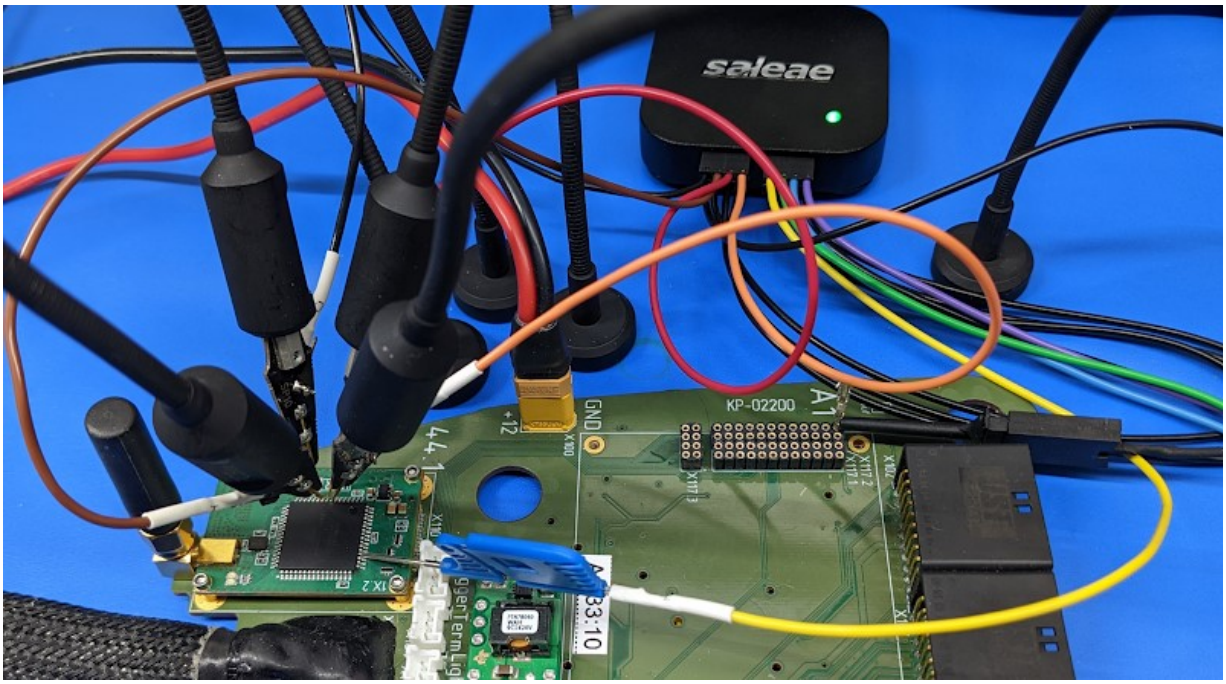


SPI Interface

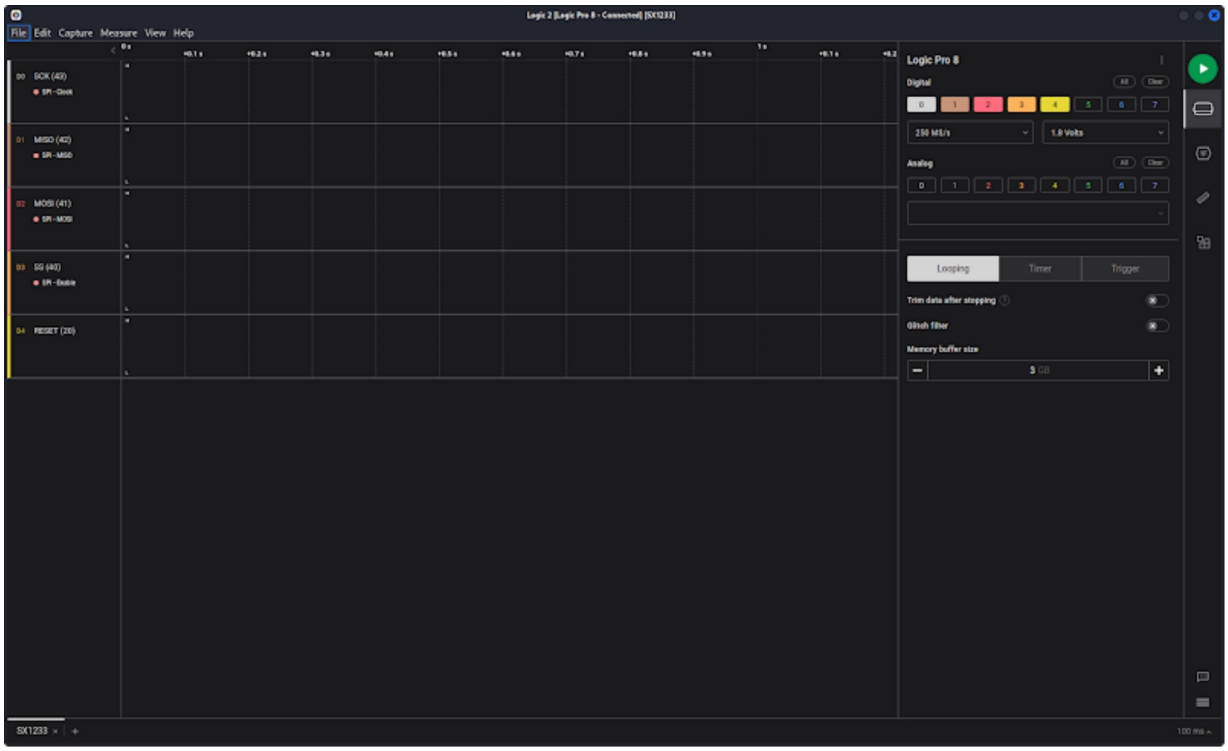
	[SX1233 Datasheet]		[ATxmega256A3U Datasheet]		
		SX1233	**ATxmega256A3U**		
	CS	18	40	SS	Slave Select for SPI_E
	MOSI	17	41	MOSI	Master Out Slave In for SPI_E
	MISO	16	42	MISO	Master In Slave Out for SPI_E
	SCK	15	43	SCK	Serial Clock for SPI_E
	RESET	6	20	PC4	PORT_C
	GND			GND	



Prepare Saleae Logic Pro 8 + Logic 2



Connect **SCK**, **MISO**, **MOSI**, **SS**, **RESET**, **GND** wires from **ATxmega256A3U** to **Logical Analyzer**



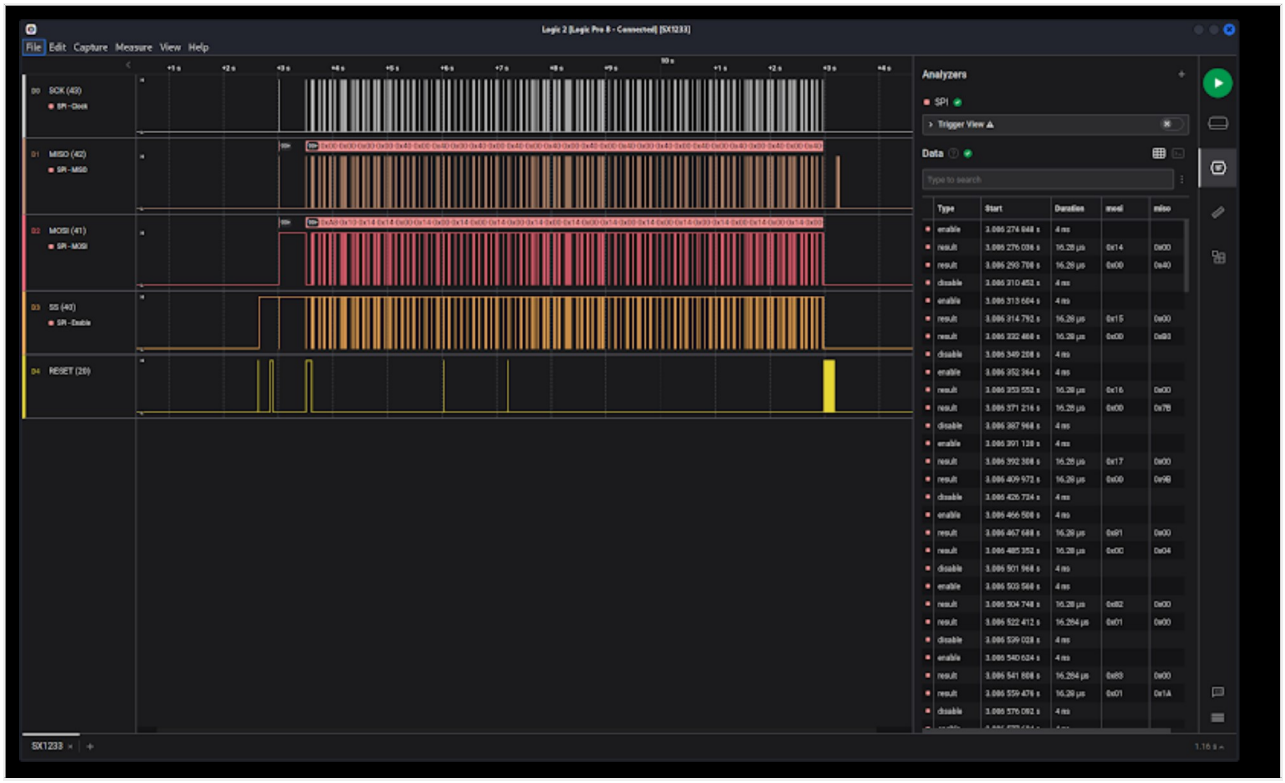
[Download Logic 2]

SX1233 SPI Decode

```
└─$ python3 sx1233.py '001 - SX1233.txt' > '001 - SX1233.dec'
```

Capture Session

001

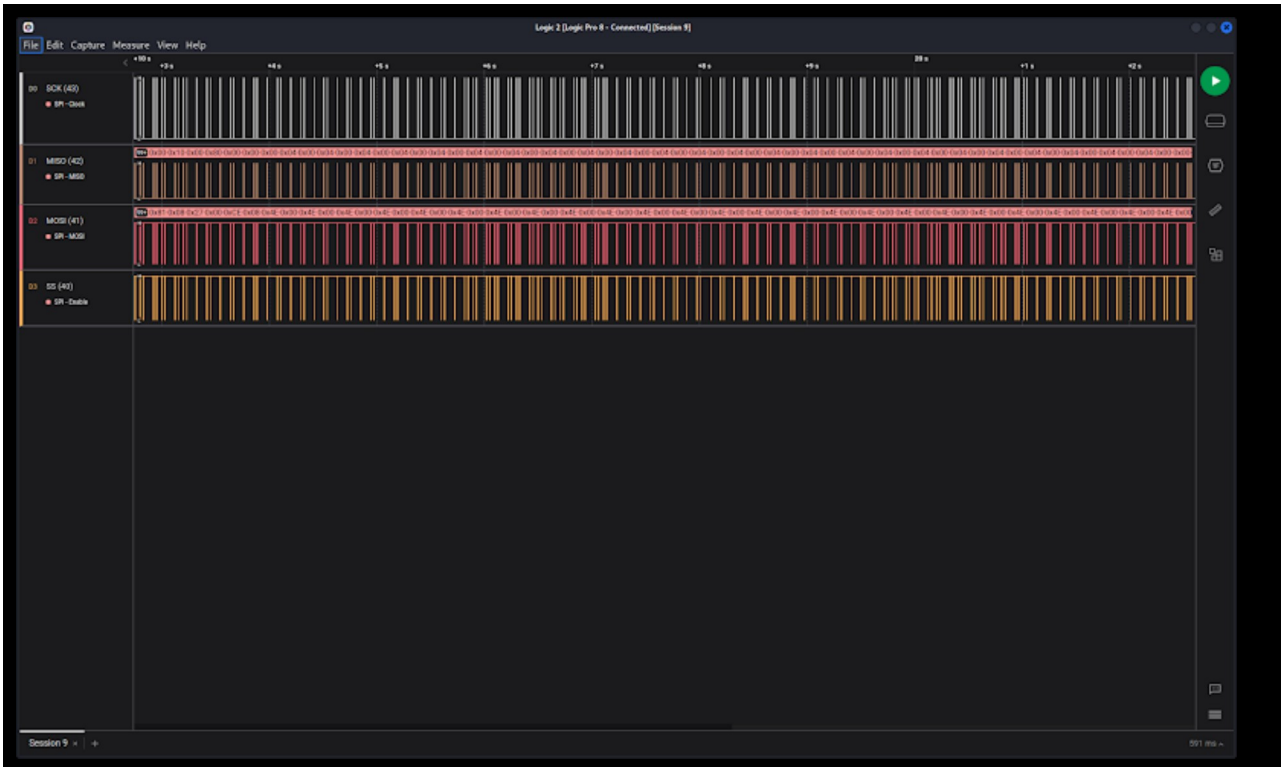


1. Start Capture
2. Power On KTR
3. Wait 10 sec
4. Power Off KTR
5. Stop Capture

Samplerate: 250MS/s
Saleae Session File: [001 - SX1233.sal]
Session in TXT: [001 - SX1233.txt]
Decoded Session: [001 - SX1233.dec]

- Frequency hopping occurs but nothing is being transmitted, so it must be in slave mode trying to receive a beacon signal from the master.
- There may be glitches in the capture.

002



1. Start Capture
2. Power On KTR
3. Wait 9 sec
4. Stop Capture
5. Power Off KTR

Samplerate: 250MS/s
Saleae Session File: [002 - SX1233.sal]
Session in TXT: [002 - SX1233.txt]
Decoded Session: [002 - SX1233.dec]

```
# FHSS from 894.0 MHz to 926.0 MHz

└─$ python3 sx1233.py '002 - SX1233.txt' | grep freq | sort | uniq -c

      5 -- frequency deviation set to 24408           125 -- frequency set to 910.4 MHz
    125 -- frequency set to 894.0 MHz                 125 -- frequency set to 910.8 MHz
    125 -- frequency set to 894.4 MHz                 125 -- frequency set to 911.2 MHz
    125 -- frequency set to 894.8 MHz                   7 -- frequency set to 911.4 MHz
      7 -- frequency set to 895.0 MHz                 125 -- frequency set to 911.6 MHz
    125 -- frequency set to 895.2 MHz                 125 -- frequency set to 912.0 MHz
    125 -- frequency set to 895.6 MHz                 125 -- frequency set to 912.4 MHz
    125 -- frequency set to 896.0 MHz                 125 -- frequency set to 912.8 MHz
    125 -- frequency set to 896.4 MHz                 125 -- frequency set to 913.2 MHz
    125 -- frequency set to 896.8 MHz                 125 -- frequency set to 913.6 MHz
      8 -- frequency set to 896.9 MHz                   8 -- frequency set to 913.7 MHz
    125 -- frequency set to 897.2 MHz                 125 -- frequency set to 914.0 MHz
    125 -- frequency set to 897.6 MHz                 125 -- frequency set to 914.4 MHz
    125 -- frequency set to 898.0 MHz                   9 -- frequency set to 914.6 MHz
    125 -- frequency set to 898.4 MHz                 125 -- frequency set to 914.8 MHz
    125 -- frequency set to 898.8 MHz                 125 -- frequency set to 915.2 MHz
    125 -- frequency set to 899.2 MHz                 125 -- frequency set to 915.6 MHz
    132 -- frequency set to 899.6 MHz                 125 -- frequency set to 916.0 MHz
    125 -- frequency set to 900.0 MHz                 125 -- frequency set to 916.4 MHz
      7 -- frequency set to 900.1 MHz                   8 -- frequency set to 916.6 MHz
    125 -- frequency set to 900.4 MHz                 125 -- frequency set to 916.8 MHz
    125 -- frequency set to 900.8 MHz                 125 -- frequency set to 917.2 MHz
    125 -- frequency set to 901.2 MHz                 125 -- frequency set to 917.6 MHz
    125 -- frequency set to 901.6 MHz                 125 -- frequency set to 918.0 MHz
    134 -- frequency set to 902.0 MHz                 125 -- frequency set to 918.4 MHz
    125 -- frequency set to 902.4 MHz                 125 -- frequency set to 918.8 MHz
    125 -- frequency set to 902.8 MHz                 125 -- frequency set to 919.2 MHz
    125 -- frequency set to 903.2 MHz                 125 -- frequency set to 919.6 MHz
    125 -- frequency set to 903.6 MHz                   9 -- frequency set to 919.7 MHz
    125 -- frequency set to 904.0 MHz                 125 -- frequency set to 920.0 MHz
    125 -- frequency set to 904.4 MHz                 125 -- frequency set to 920.4 MHz
      7 -- frequency set to 904.5 MHz                   7 -- frequency set to 920.5 MHz
    125 -- frequency set to 904.8 MHz                 125 -- frequency set to 920.8 MHz
    125 -- frequency set to 905.2 MHz                 125 -- frequency set to 921.2 MHz
    125 -- frequency set to 905.6 MHz                 125 -- frequency set to 921.6 MHz
    125 -- frequency set to 906.0 MHz                 125 -- frequency set to 922.0 MHz
      8 -- frequency set to 906.2 MHz                 132 -- frequency set to 922.4 MHz
    125 -- frequency set to 906.4 MHz                 125 -- frequency set to 922.8 MHz
    125 -- frequency set to 906.8 MHz                 125 -- frequency set to 923.2 MHz
    125 -- frequency set to 907.2 MHz                 125 -- frequency set to 923.6 MHz
    125 -- frequency set to 907.6 MHz                 125 -- frequency set to 924.0 MHz
    125 -- frequency set to 908.0 MHz                 125 -- frequency set to 924.4 MHz
    125 -- frequency set to 908.4 MHz                   8 -- frequency set to 924.6 MHz
      9 -- frequency set to 908.7 MHz                 125 -- frequency set to 924.8 MHz
    125 -- frequency set to 908.8 MHz                   4 -- frequency set to 925.0 MHz
    125 -- frequency set to 909.2 MHz                 125 -- frequency set to 925.2 MHz
    125 -- frequency set to 909.6 MHz                 125 -- frequency set to 925.6 MHz
    125 -- frequency set to 910.0 MHz                 125 -- frequency set to 926.0 MHz
```

Firmware list

KTR-?

[КТР], [КТР-4], [НСОД], [Модем]

Firmware list

Payload

RF Amplifier for VSKS

AMP: **AMCOM 1535WM-R** [datasheet] (1500 - 3500 MHz @ 36 dBm)
Coupler: **XC2500P-20S** [datasheet] (2300 - 2700 MHz)
Filter 1: **2400A 1644** (2300 - 2500 MHz)
Filter 2: **2600A 1726** (2500 - 2700 MHz)

VSKS_Rev4

ВСКС - Высокоскоростной Канал Связи - High-Speed Communication Channel

ВСОД - Высокоскоростная Система Обмена Данными - High Speed Communication System

[ВСКС], [Высокоскоростной Канал Связи], [ВСОД], [ВСОД-4]

FPGA: Virtex-6
SoM: Gumstix GUM3703FEBY [datasheet][description]

Ports: **Ethernet, UART**

Waveform characteristics
Video standart DVB-S
Modulation PSK4
Baudrate, Bod: 15500000

VSKS_Rev5

[ВСКС], [Высокоскоростной Канал Связи], [ВСОД-5], [Высокоскоростная Система Обмена Данными]

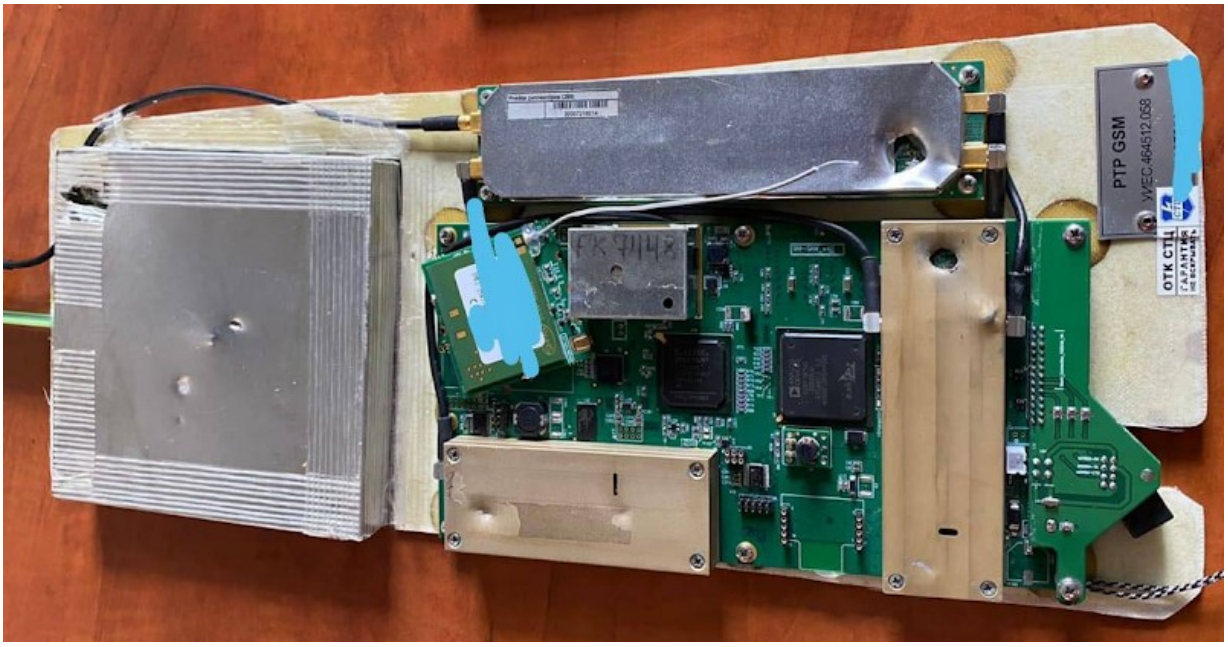
FPGA: **XILINX ZYNQ XC7Z030** (datasheet)
RF Tranceiver: **AD9361** (datasheet)

Leer-3

SAM100

[Leer-3], [JIeep-3], [IMSI Catcher], [Fake BTS], [PTP GSM], [SAM100], [Virtual BTS]

IMSI catcher - used to locate mobile terminals, send SMS and mobile communications jamming. [**info**][**video**]



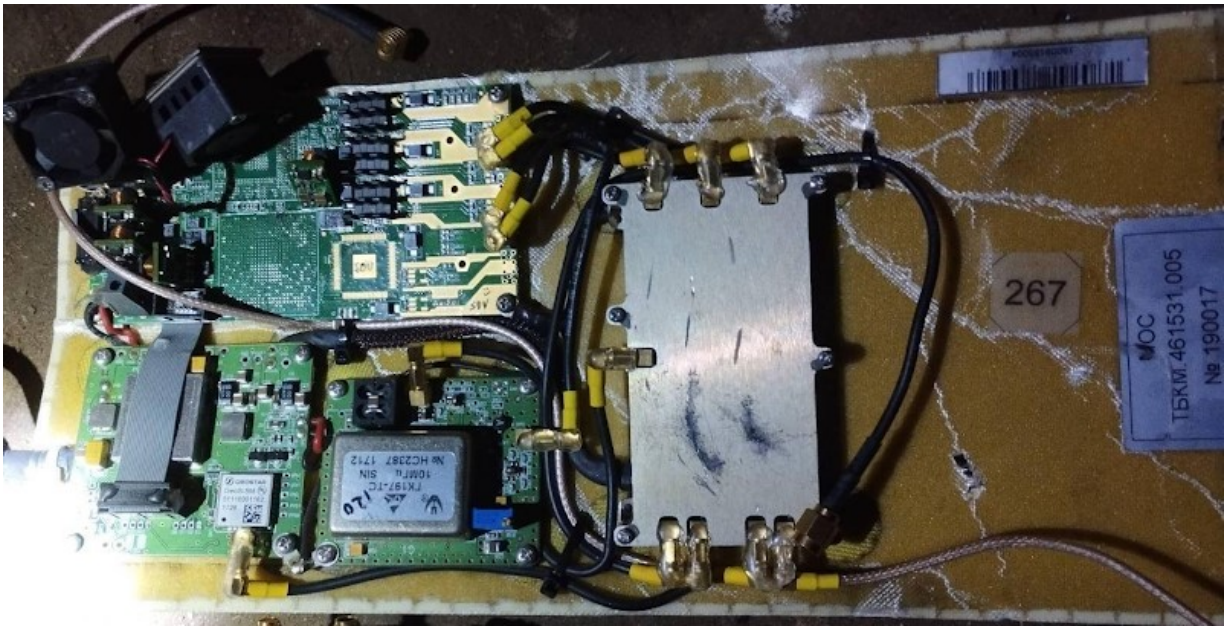
GSM module: **SIM300Z**
** Used for network monitoring*
Bluetooth module: **LMX9838SB** [datasheet]
TXCO: **Изделие100-SAM_V4_600_01**
Multiplexer: **Ячейка диплексора (289)**
FPGA: **XILINX SPARTAN**

Control: **RS232, Bluetooth**
Software: **PostWin**

new version

other layout

МОС

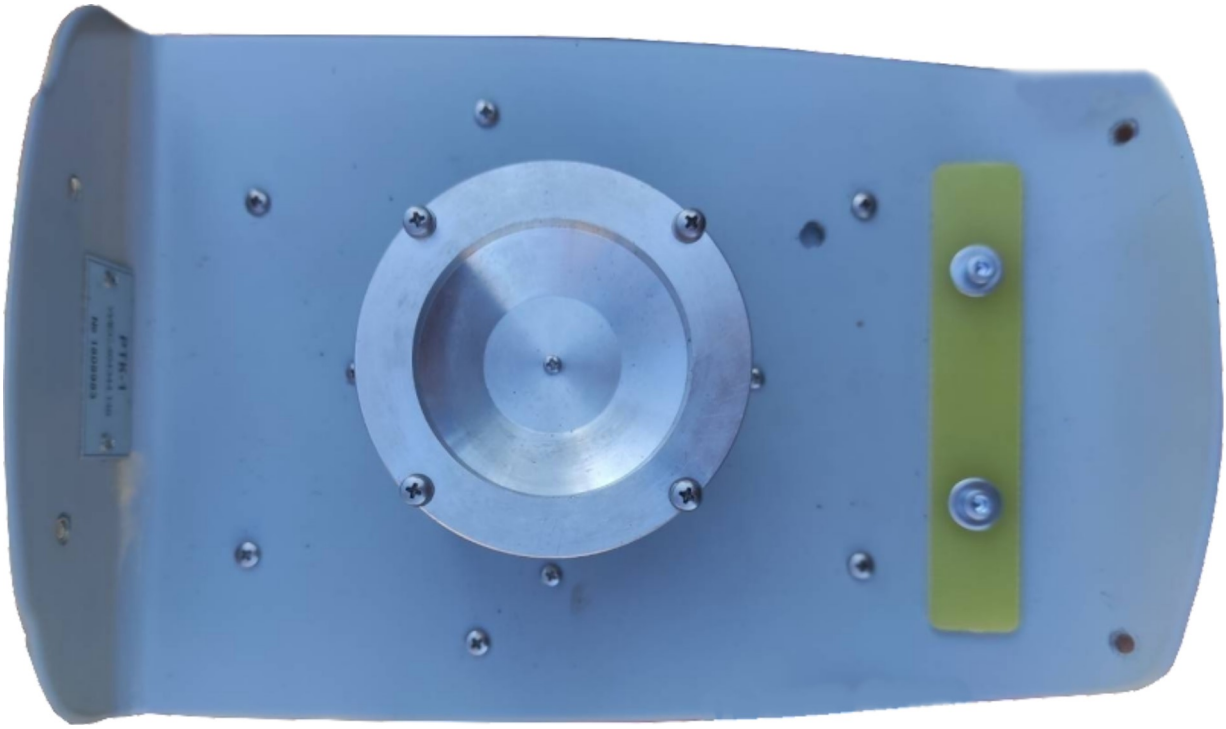


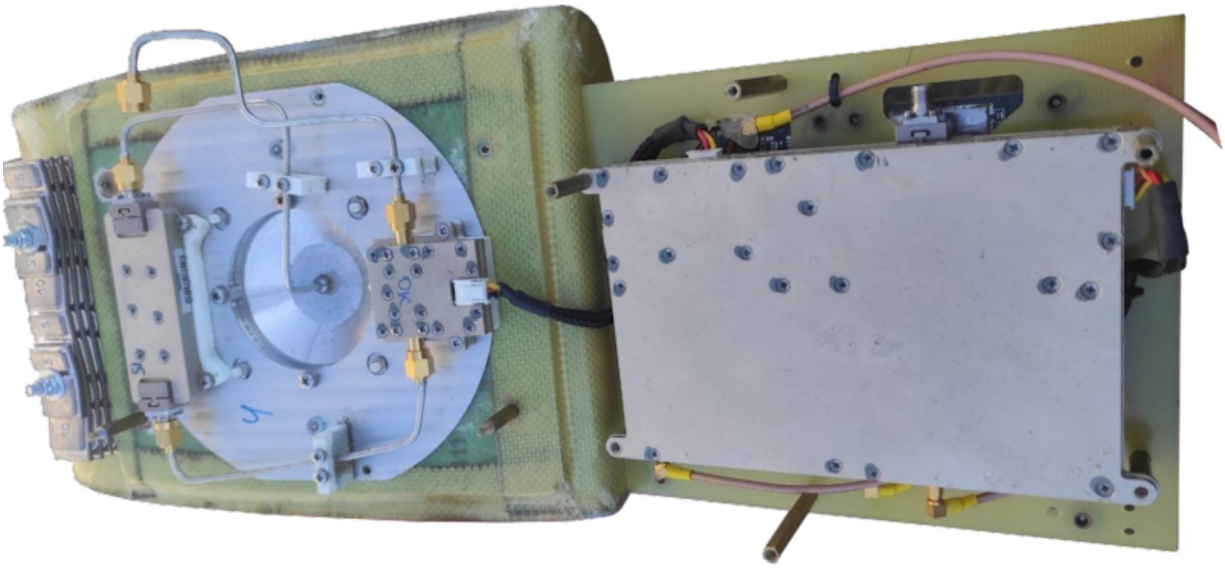
МОС ТБКМ.461531.005 №190017

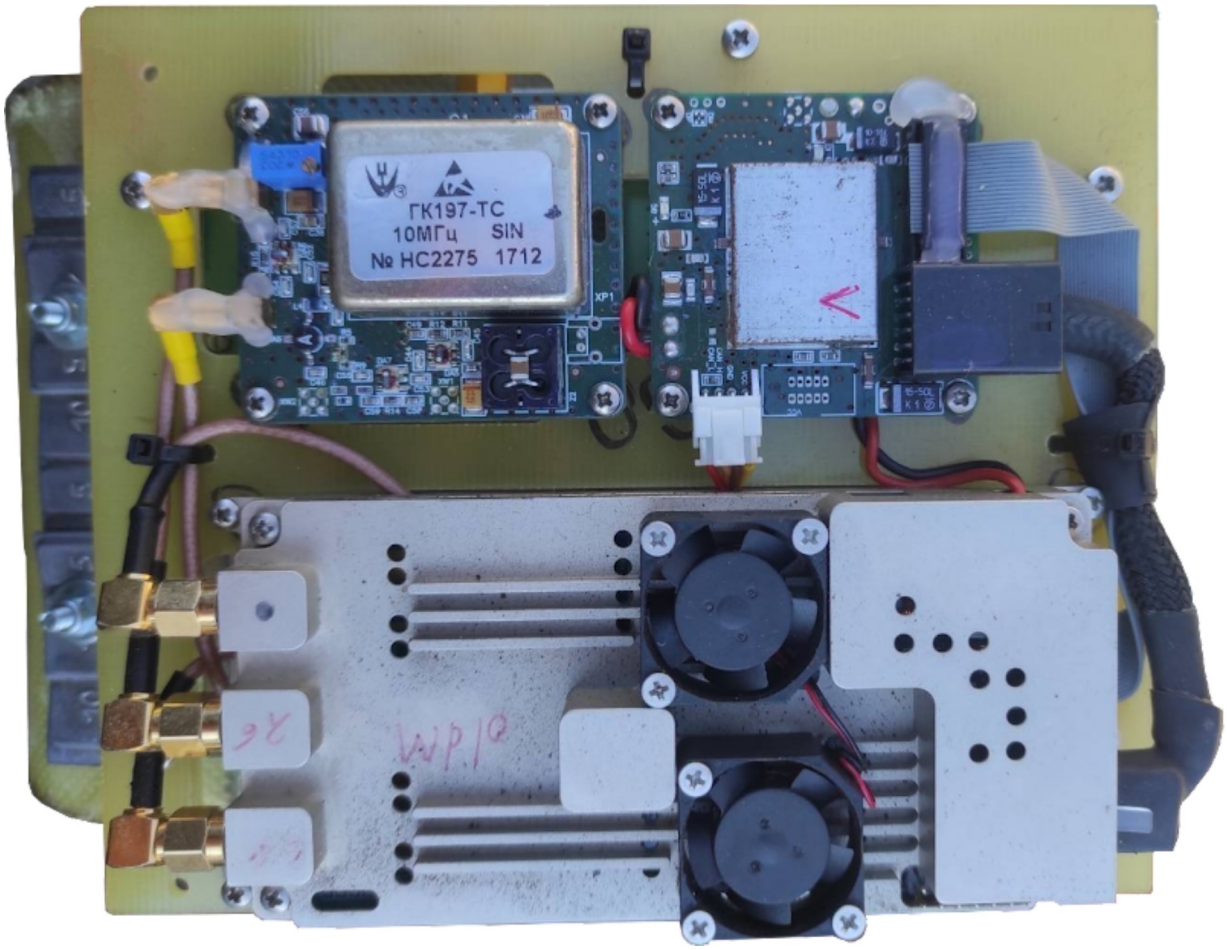
Generator: **ГК197-ТС** [datasheet]
PRECISION LOW NOISE QUARTZ GENERATOR
GNSS: **GEOSTAR GeoS-5M** [datasheet]

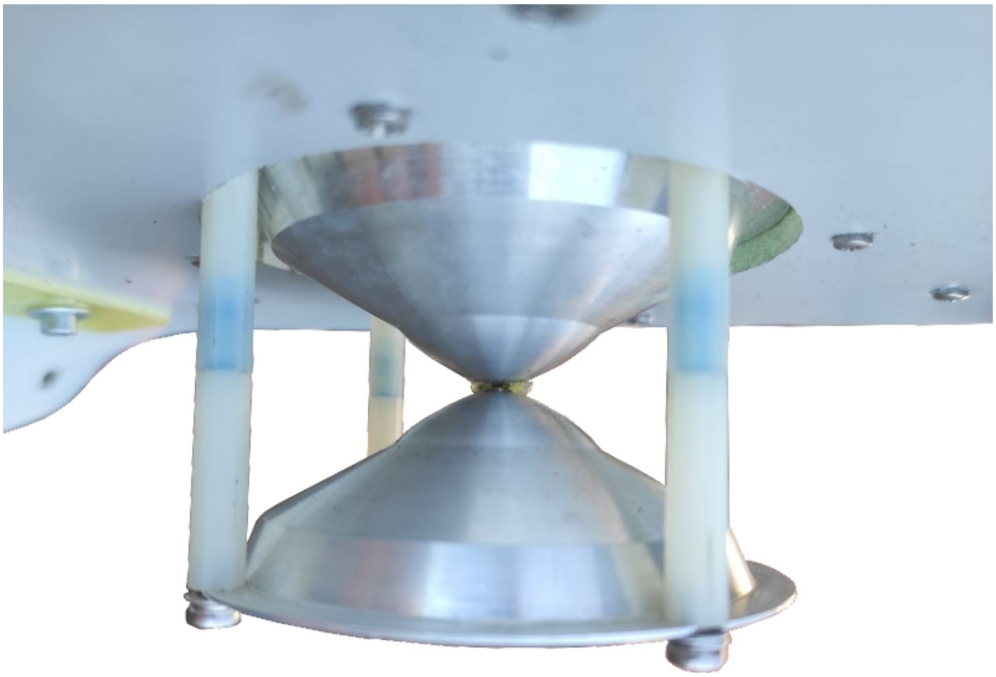
PTK-1

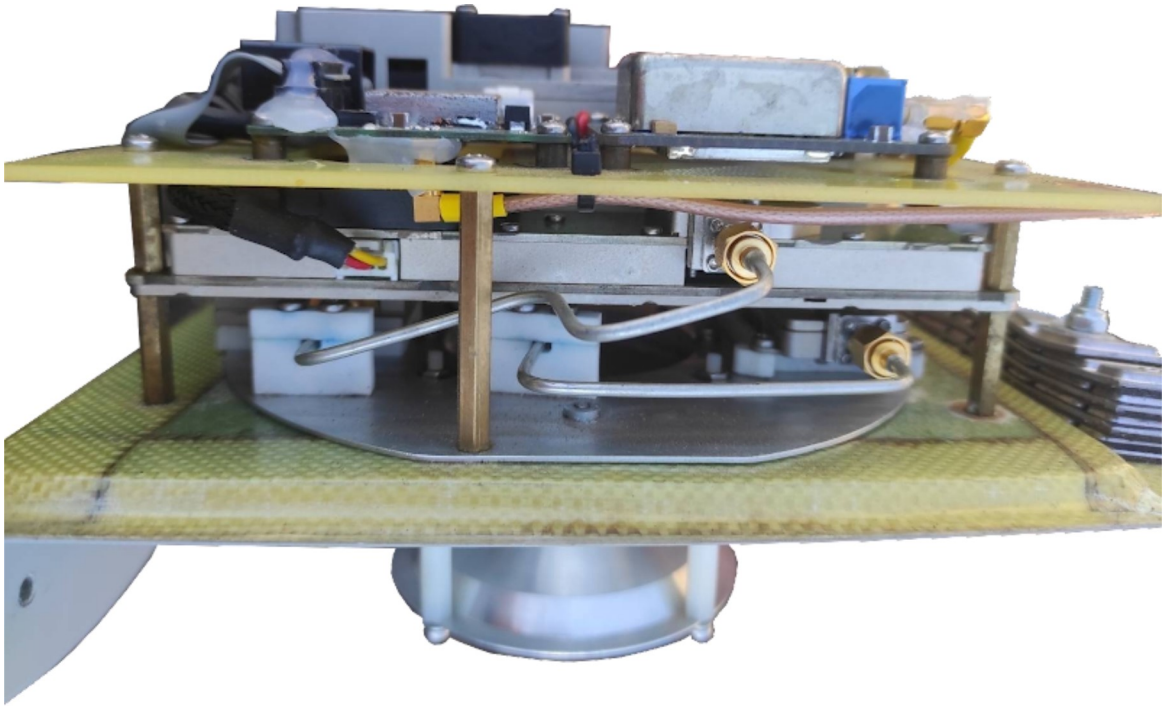
*It looks like a system for detecting **10GHz – 15GHz** signals. Theoretically, it can be used to determine the location of the **Starlink** terminal.*
[antenna]

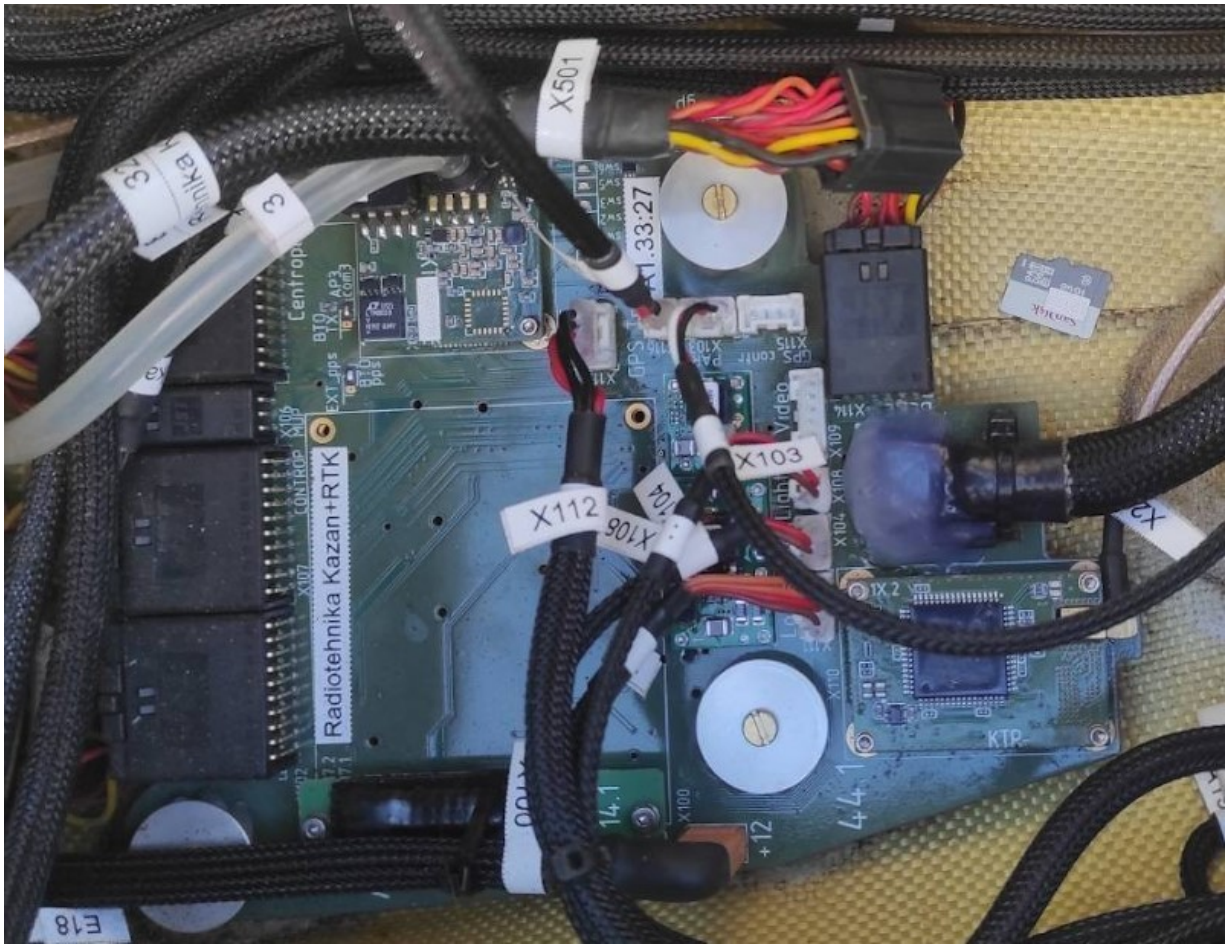





ГК197-ТС
10МГц SIN
№ НС2275 1712
XP1

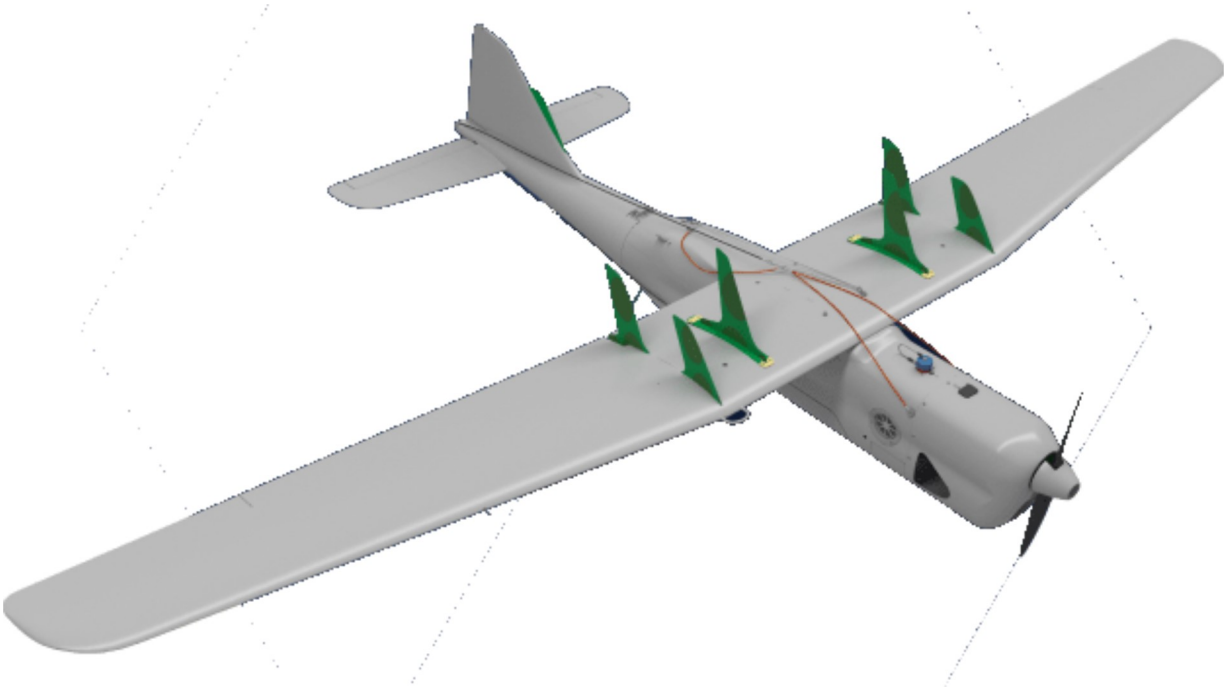






VHF Direction Finder

[Орлан-10 Пеленгатор], [Electronic Warfare], [Orlan], [VHF direction finder], [УКВ Пеленгатор], [Дракон]



Orlan-10 + VHF Direction Finder

[info]

The news report says that this is an electronic warfare UAV with a radio signal suppression radius of 5 km. ***Most likely this is false information****.*

[video]

Drop system

Fliers

Munitions

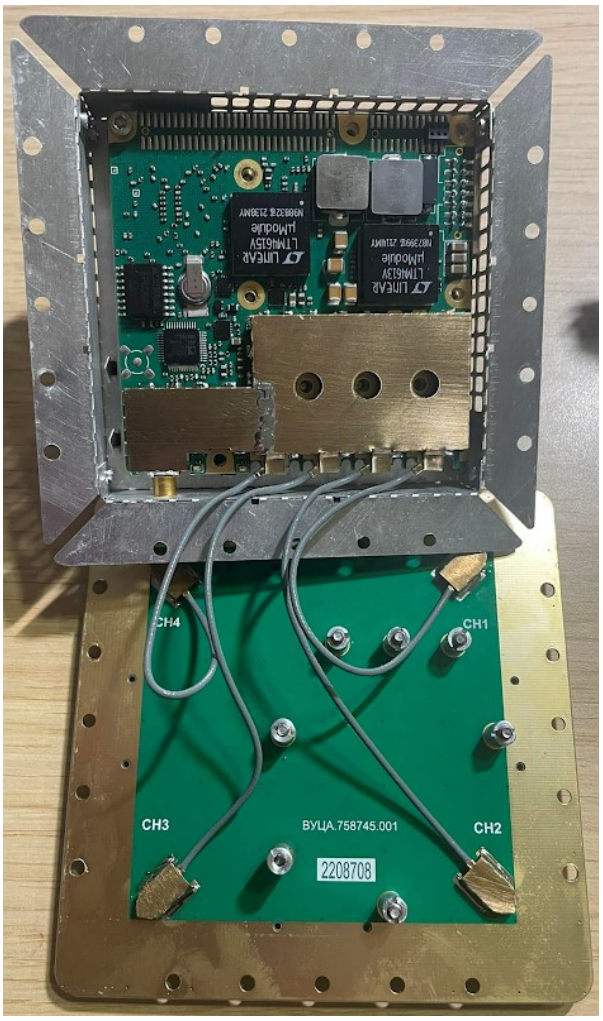
Type: **ОФСП-08-А133** [details]
Count: **4 pcs** [video]

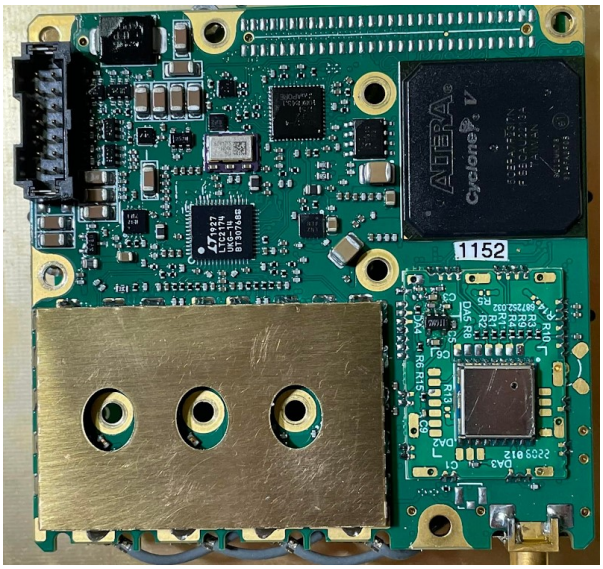
Navigation System

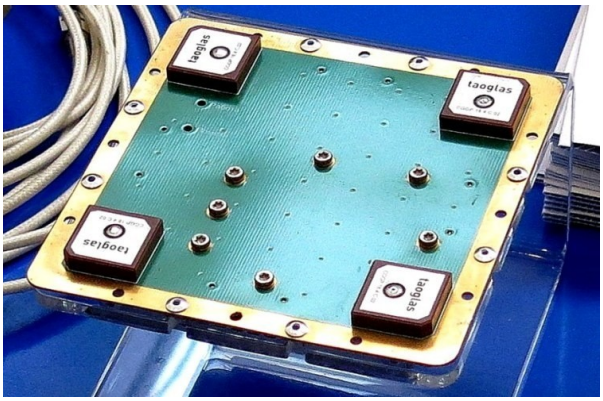
Cometa-M

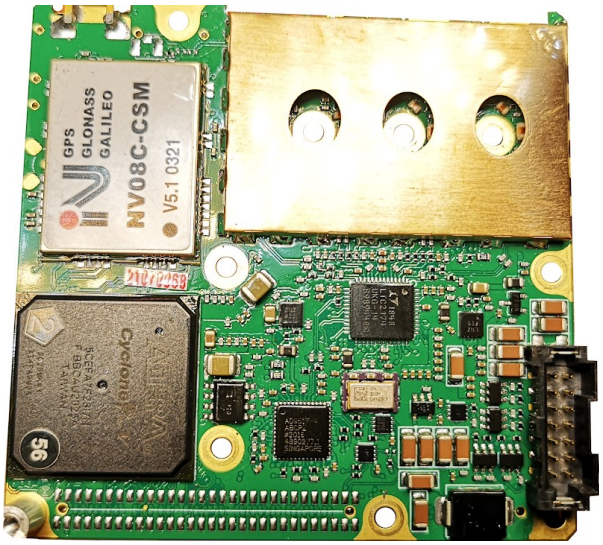
АО «ВНИИР Прогресс»

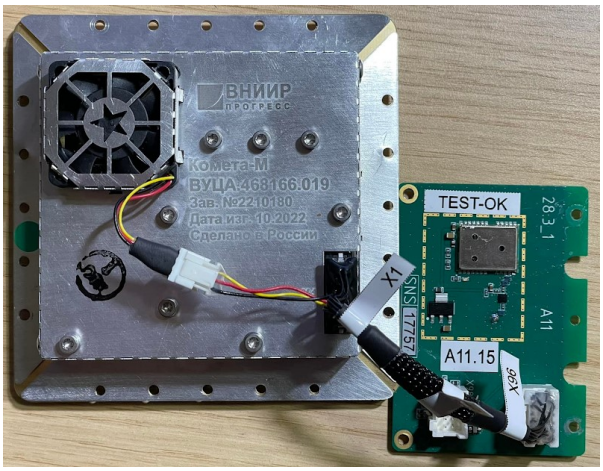
[Комета-М]

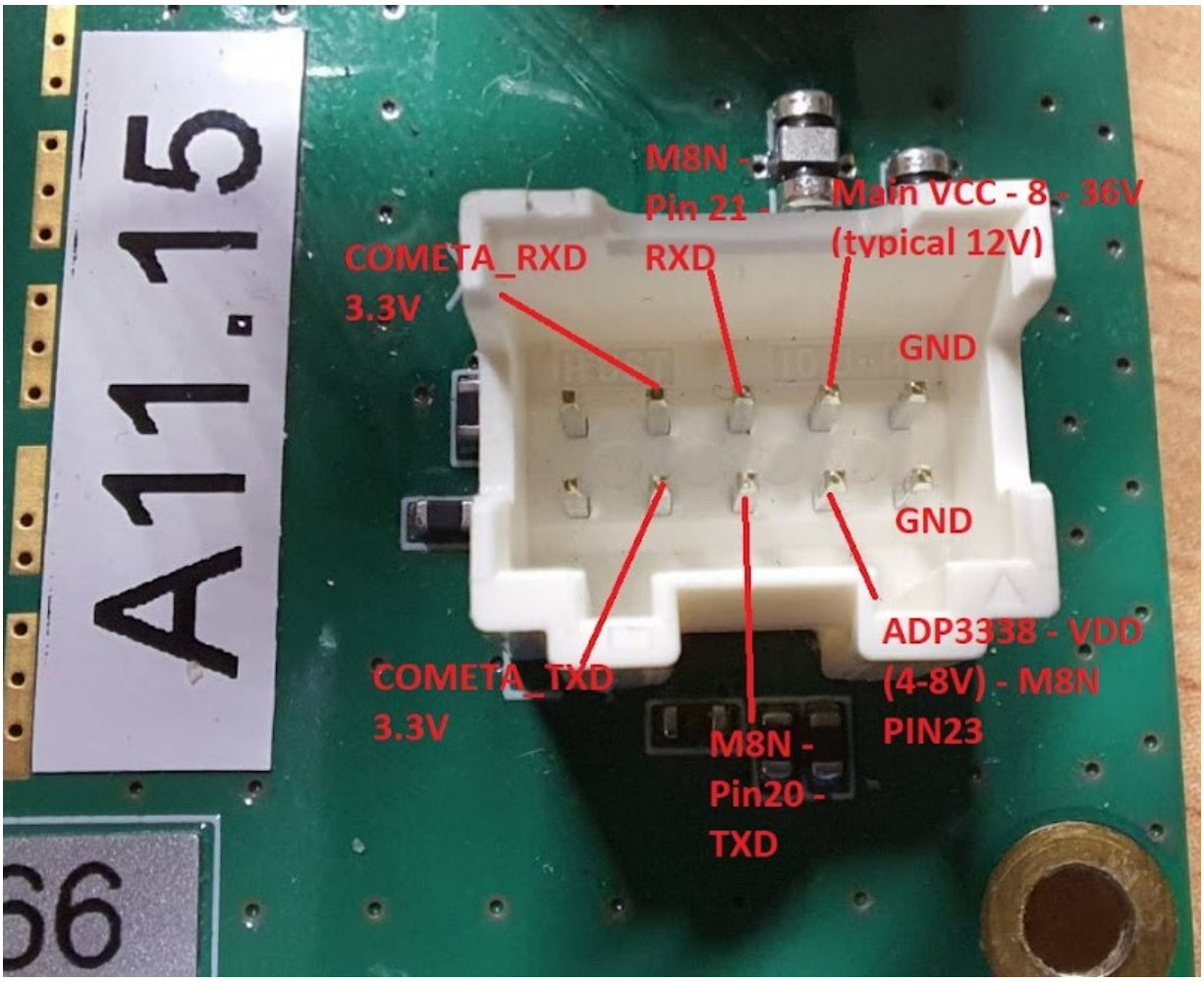

CH4
CH1
CH3
ВУЦА.758745.001
CH2
2208708


ALTERA
Cyclone V
1152


taoglas
taoglas
taoglas
taoglas


GPS
GLONASS
GALILEO
NV08C-CSM
V5.1 0321


ВНИИР
ПРОГРЕСС
Комета-М
ВУЦА.468166.019
Зав. №22.10180
Дата изг. 10.2022
Сделано в России
TEST-OK
28_3_1
A11
X1
SNS 17757
A11.15



Camera Gimbal

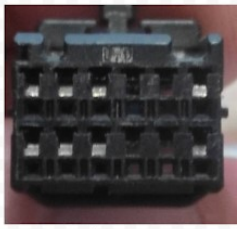
Orlan 10 has two types of gyro stabilized gimbals, with thermal imaging and optical camera.

Typical optical gimbal is using SONY FCB-EV7520

Typical thermal camera is using Lynred PYCO-640-046 thermal sensor

Following is the connection diagram so that the trophy gimbals can be reused:

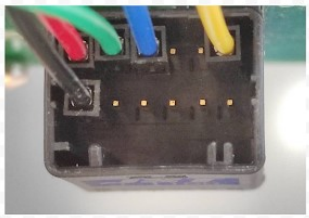
FRONT VIEW
ON THE CABLE



LOCK

GND	GND		Empty	Empty	
VCC (~14V)	Gimbal TX, UART RX (CONV 232R)	Gimbal RX, UART TX (CONV 232T)	Empty	Empty	VIDEO

FRONT VIEW ON THE GIMBAL:



VCC
GND
Gimbal TX-UART-RX/Gimbal RX-UART-TX
ANALOG VIDEO

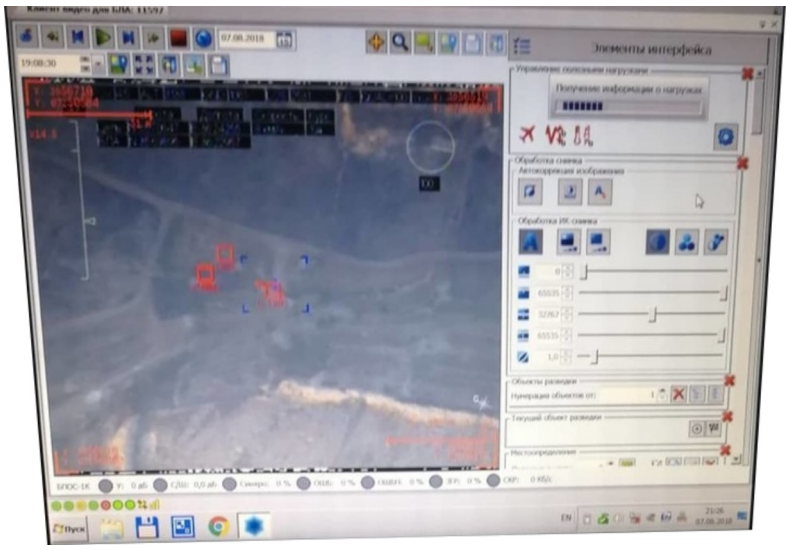
Gimbal uses RS232

UAV Ground Control Station

Links:
- https://www.facebook.com/pasha.k.kashchuk/posts/5532360240119820

2DNPU-M (software)

[VIDEO]



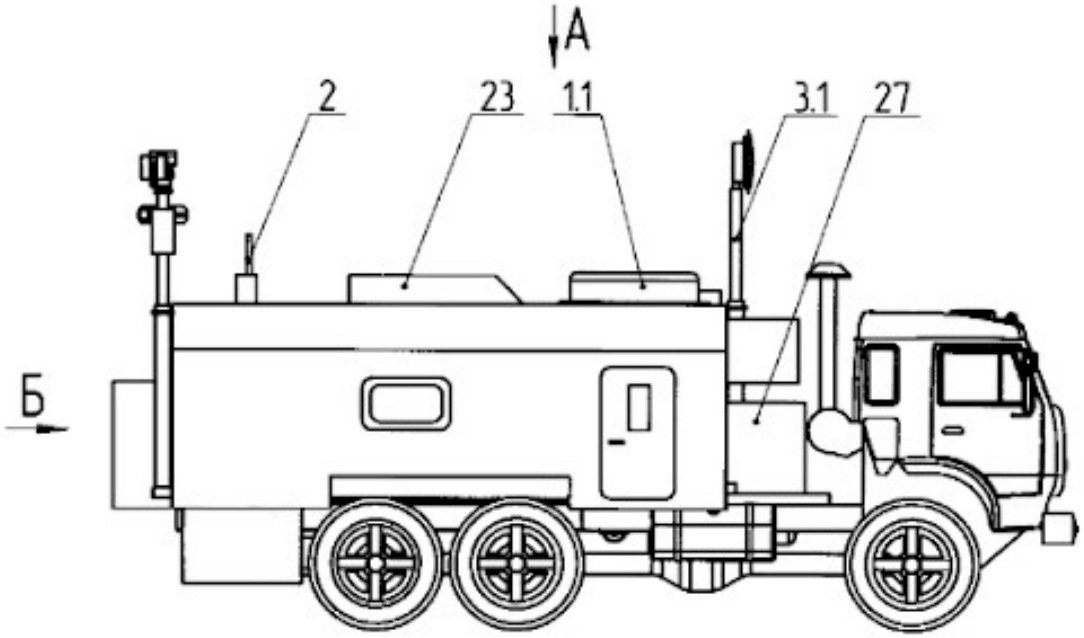
KTR-N module

[КТР-Н], [Наземка], [Наземная станция], [НПУ], [Наземный пункт управления]

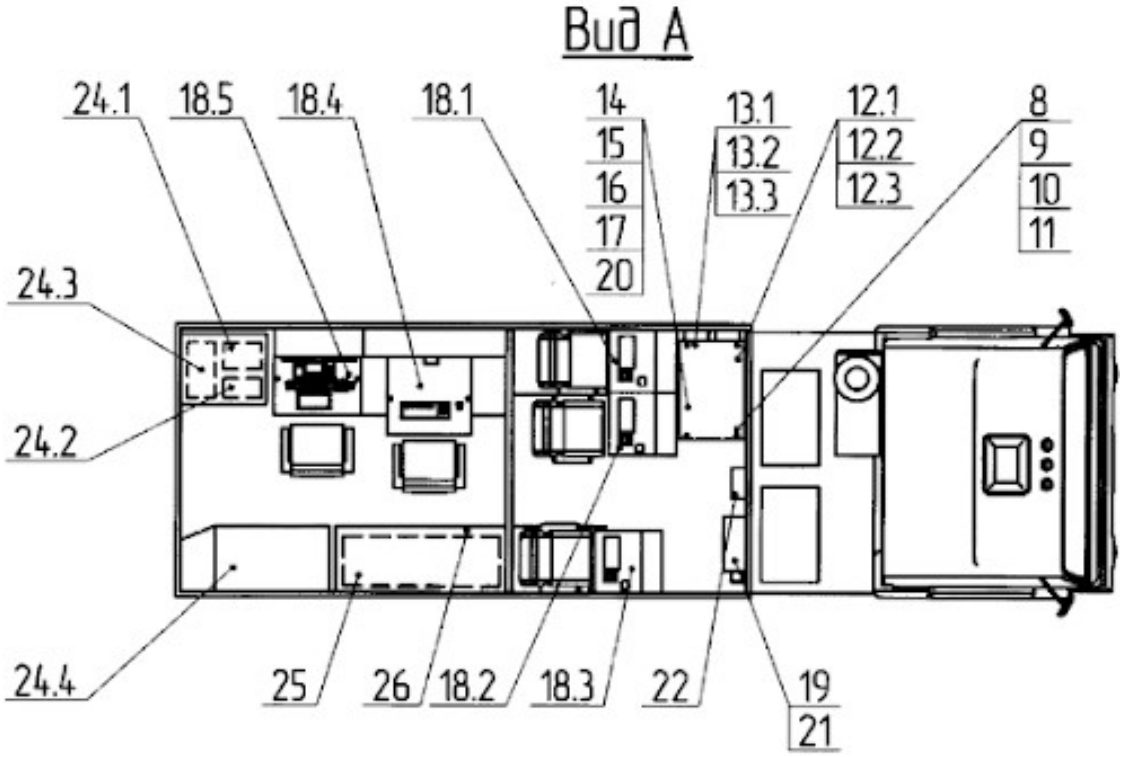
Antenna 1: **PicoCell AL-900-14** [description]
Antenna 2:

Ports: **Ethernet**

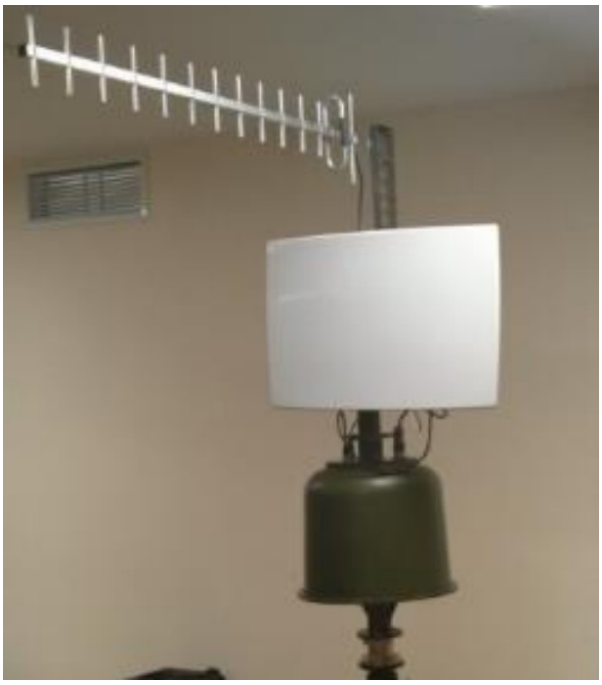
Наземный пункт управления робототехническими комплексами



Фиг. 2



Фиг. 3



Air control post based on the Mi-8 helicopter

Комплект для ВзПУ для Ми-8 / Воздушный пункт управления на базе вертолета Ми-8

Additional Info

Target loads (TL) for Orlan–10M
- Optoelectronic reconnaissance of the earth's surface
- Meteorological reconnaissance
- Radiation reconnaissance
- Providing public warnings and search for victims
- Providing communications in the emergency situation areas as well as for the search and rescue operations

Optoelectronic reconnaissance of the earth's surface is carried out in the visible and infrared ranges of the radio waves. Gyro stabilized video or infrared cameras are installed on the carrier for that purpose.

The target load for public warning and victim search on UAVs provides:

1. SMS-notifications to public about emergency situations.
2. Defining locations of mobile stations (long-range/stadiametric method) with an accuracy of up to 100 meters.
3. The ability for combine search with helicopters and UAVs.
4. Supported Communication Standard – GSM / DCS.
5. Number of simultaneously supported networks (operators) of communication using UAV–1.
6. Number of mobile phones that can be detected simultaneously – up to 100.

The target load of meteorological reconnaissance allows for quick remote track of changes in temperature, pressure, speed and wind direction in the lower atmosphere.

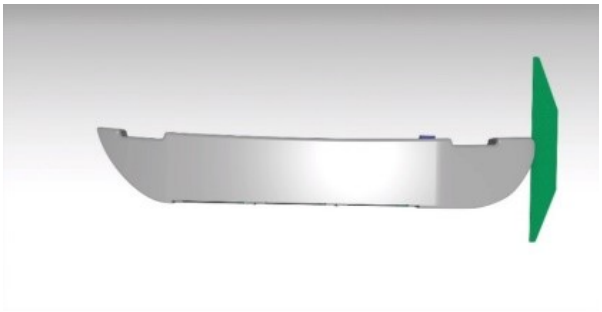
Целевые нагрузки (ЦН) для Орлан-10М:
– оптико-электронной разведки земной поверхности;
– метеорологической разведки;
– радиационной разведки;
– оповещения населения и поиска пострадавших;
– связи в районах ЧС и проведения поисково-спасательных операций.

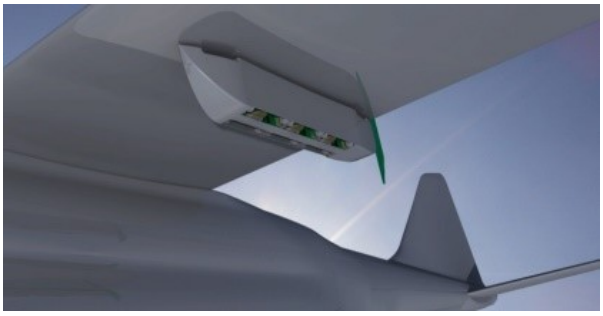
Оптико-электронная разведка земной поверхности ведется в видимом и инфракрасном (ИК) диапазонах длин волн. Для этого на носитель устанавливается гиростабилизированная телевизионная или ИК-камера.

Целевая нагрузка оповещения населения и поиска пострадавших на БЛА обеспечивает:

1. Оповещение населения о чрезвычайных ситуациях путем sms-информирования.
2. Определение местоположения мобильных станций (дальнометрический способ) с точностью до 100 метров.
3. Возможность совместного использования поисковых вертолетов и БЛА.
4. Поддерживаемый стандарт связи – GSM/DCS.
5. Количество одновременно поддерживаемых сетей (операторов) связи с помощью БЛА – 1.
6. Количество одновременно обнаруживаемых мобильных телефонов – до 100.

Целевая нагрузка метеорологической разведки позволяет оперативно дистанционно отслеживать изменения температуры, давления, скорости и направления ветра в нижних слоях атмосферы.





Radiation reconnaissance target load is designed to solve the following problems:

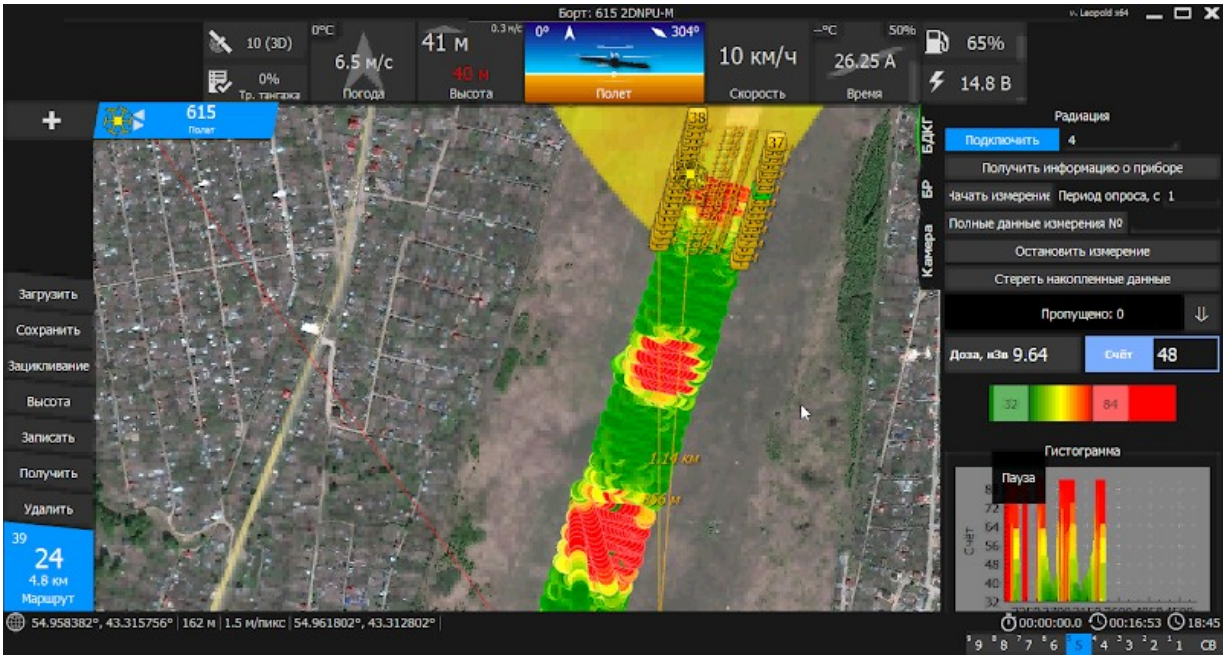
1. Determination of the boundaries of the zones of radioactive contaminated areas (RCA) and assessment of its radionuclide composition.
2. Automatic search for radioactive anomalies (single point sources and contaminated areas).
3. Engineering reconnaissance.
4. Receiving and transferring of data from stationary posts.
5. Automatic creation of a RCA maps.
6. Studying the dynamics and forecasting the development of the radioactive situation of the affected territory and the radioactive spreading processes.
7. Data transfer using jam-resistant protocol.

Целевая нагрузка радиационной разведки предназначена для решения следующих задач:

1. Определения границ зон радиоактивного загрязнения местности (РЗМ) и оценка его радионуклидного состава.
2. Автоматического поиска радиационных аномалий (точечных источников и загрязнённых областей).
3. Инженерной разведки.
4. Получения и передачи данных со стационарных постов.
5. Автоматического построения карты РЗМ.
6. Изучения динамики и прогнозирования развития радиационной ситуации на пострадавшей территории и процессов распространения радиоактивности.
7. Передачи данных по помехоустойчивому протоколу.

Characteristics of the radiation reconnaissance detectors			
Detector	**АСКРБ1У.60**	**АСКРБ1У.60Н**	**БДКГ-04**
Scintillator size	Ø45x45	Ø45x2	Ø25x25
Sensor type	NaI	NaI	NaI
Energy range, MeV	0.03-3.0	0.01-3.0	0.06-3.0

Ambivalent dose output, mcSv/h	0.1-10^4	up to 5-10^4	0.05-10^4



Communications management in the emergency area is possible with the following target loads:

1. Rebroadcasting of the wireless self-organized communication network (mesh-network)
2. Detection of mobile cellular stations of GSM/DCS standard, alert and communications stations.
3. Detection of mobile cellular stations of the LTE standard and communication stations.
4. Rebroadcasting of VHF radio signals (analog AM/FM, digital and analog trunking)

The advantage of deploying cellular networks is the ability to use public mobile phones. Target loads are specialized base stations, capable of adapting to any cellular network electronic settings. Mobile network carrier billing information is not tempered with in this case. I order to use LTE standard network, special SIM cards are required.

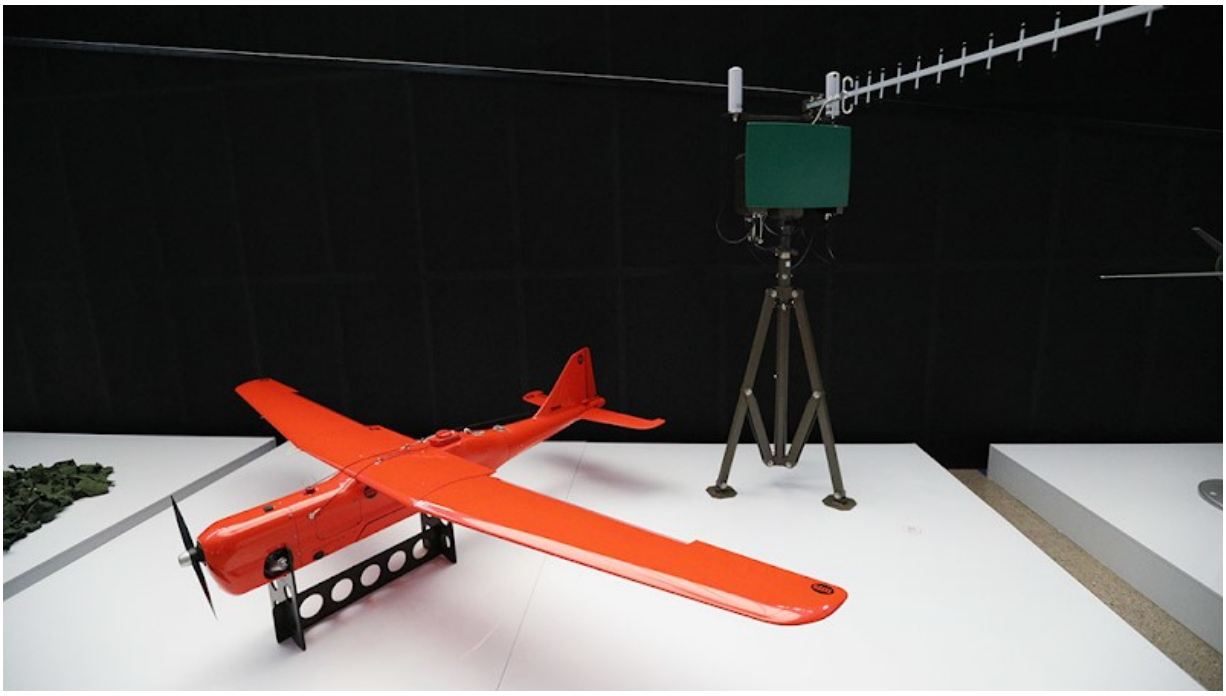
The payload for the rebroadcasting of the VHF radio signals allows to increase the range of communications for emergency services standard issued equipment[a][b][c].

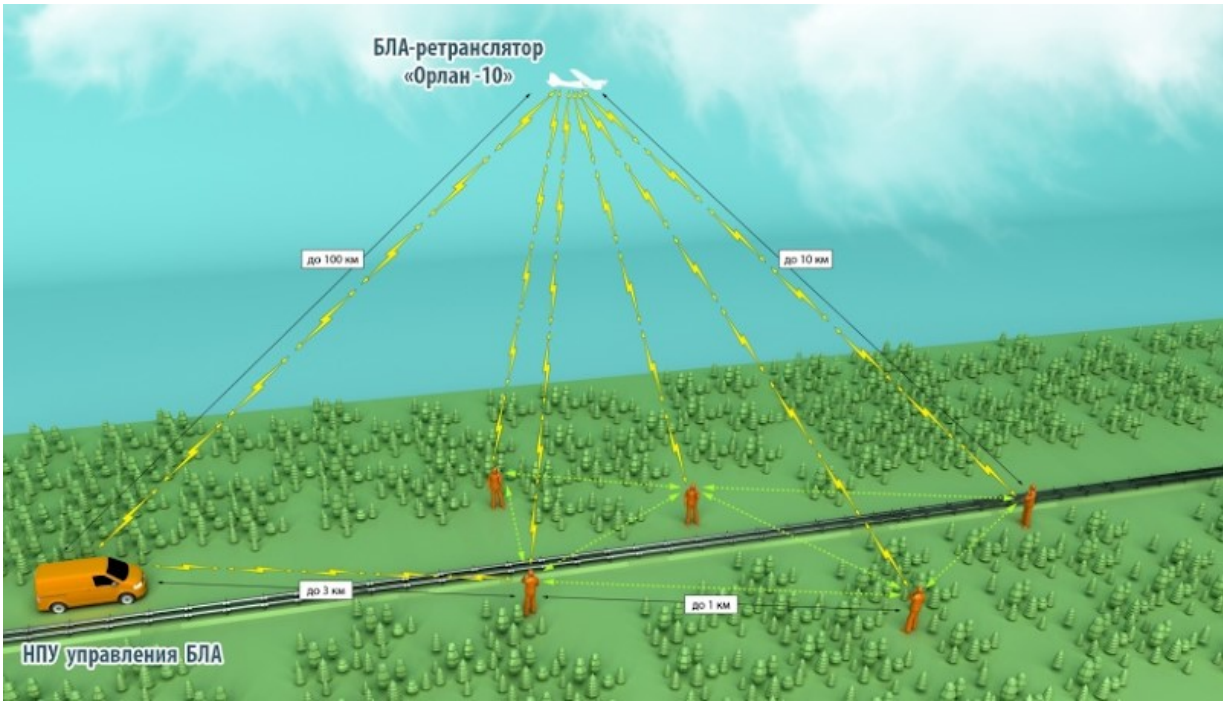
Организация связи в районе чрезвычайной ситуации возможна следующими ЦН:

1. Ретрансляции беспроводной самоорганизующейся сети связи (mesh-сети).
2. Обнаружения мобильных станций сотовой связи стандарта GSM/DCS, оповещения и связи.
3. Обнаружения мобильных станций сотовой связи стандарта LTE и связи.
4. Ретрансляция сигналов УКВ-радиосвязи (аналоговые АМ/ЧМ, цифровой и аналоговый транкинг).

Преимуществом развертывания сетей сотовой связи является возможность использования в них мобильных телефонов общего пользования. Целевые нагрузки представляют собой специализированные базовые станции, способные адаптироваться к любой радиоэлектронной обстановке в сетях сотовой связи. Биллинговая информация операторов сотовой связи при этом не искажается. Для сети связи стандарта LTE требуется использование специальных sim-карт.

Целевая нагрузка ретрансляции сигналов УКВ-радиосвязи позволяет увеличить дальность связи штатных средств, находящихся на вооружении экстренных служб.




БЛА-ретранслятор
«Орлан -10»
до 100 км
до 10 км
до 3 км
до 1 км
НПУ управления БЛА

Терминалы БССС

Использование БЛА для ретрансляции сигналов систем связи

Patents

[RU2594759C1]	**СПОСОБ И УСТРОЙСТВО ОПРЕДЕЛЕНИЯ КООРДИНАТ ИСТОЧНИКОВ РАДИОИЗЛУЧЕНИЙ**
[RU2510044C1]	**СПОСОБ И УСТРОЙСТВО ОПРЕДЕЛЕНИЯ КООРДИНАТ ИСТОЧНИКОВ РАДИОИЗЛУЧЕНИЙ**
[RU2459218C1]	**КОНТРОЛЬНО-ИЗМЕРИТЕЛЬНАЯ СИСТЕМА РАДИОМОНИТОРИНГА**
[RU2572083C1]	**СПОСОБ И УСТРОЙСТВО (ВАРИАНТЫ) СОЗДАНИЯ ПРЕДНАМЕРЕННЫХ ПОМЕХ** - Модуль цифровой обработки сигналов УИЕС 467415.004 - Модуль приема и преобразования УИЕС 468151.013 - Модуль генераторов частот УИЕС 467871.006

[RU2661264C1]	**НАЗЕМНЫЙ ПУНКТ УПРАВЛЕНИЯ РОБОТОТЕХНИЧЕСКИМИ КОМПЛЕКСАМИ** - РТК «Орлан-10» и «Леер-3» - РТК «Элерон-3СВ - РТК «Тахион» - РТК «МРК- 02»

Sources

2018-01-30	Російський БПЛА “Орлан-10” складається з деталей виробництва США та інших країн — фотозвіт
2017-10-25	РФ з 2014 року агресивно порушує повітряний простір України, — звіт волонтерів
2017-01-05	Начальник разведки 2-го АК под контролем UCA. Part 1: БЛА «Орлан-10»
2016-04-02	Российский комплекс РЭБ РБ-341В «Леер-3» в Донецке

Orlan-50

[Орлан 50]

[info]

AS-CAM UAVs

Company: ООО «АС-КАМ»
ИНН: 6165205064
ОГРН: 1166196114083
Address: Ростов-на-Дону, ул. Нансена, 150Б
Phone: +7 (863) 294 04 66
+7 (863) 230 69 69
Site: https://ascam.aero
E-Mail: info@ascam.aero

[АС-КАМ], [АСКАМ], [ASCAM]

AS-32-XX Series

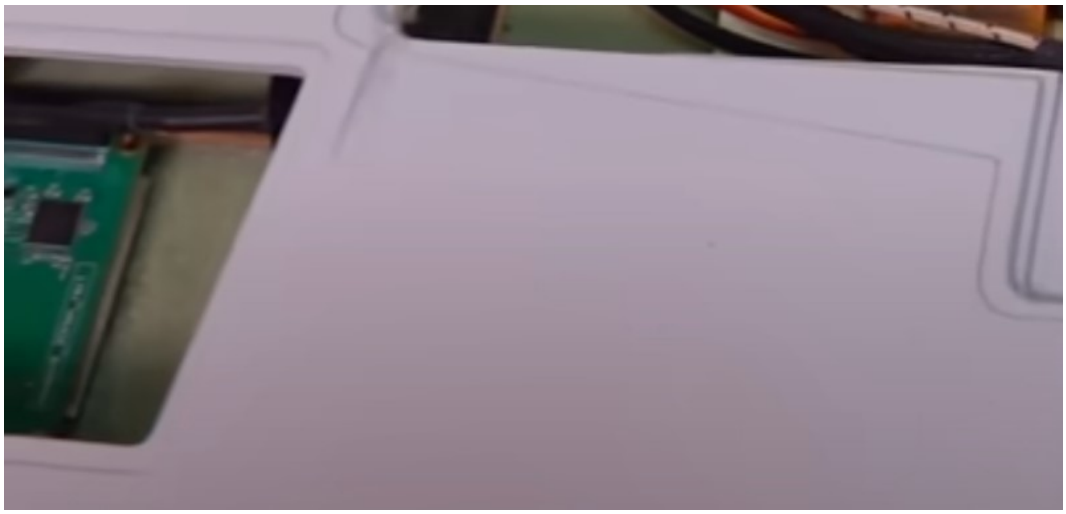
[AC-32-08], [AC-32-10]

AS-32-08

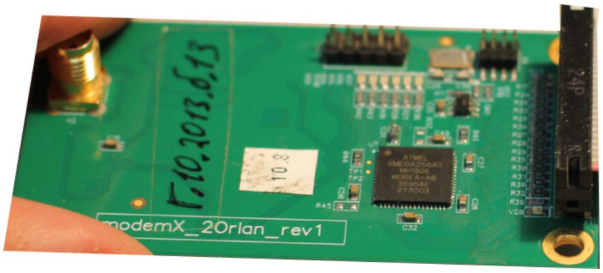
AS-32-10

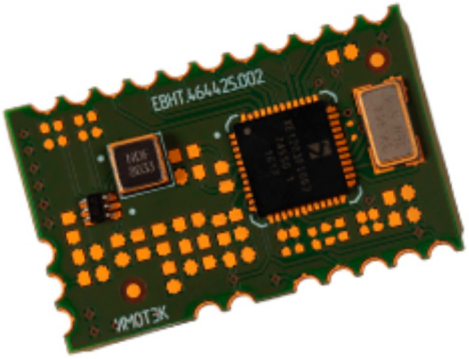
Radio Control Link

ModemX_2Orlan_rev1



[video 02:45]





915 MHZ RADIO MODULE

Replacement for: DP1203/DP1205;
Frequency: 915 MHz;
Power supply: 2.4-3.6 B;
Dimensions: 18.5*30.5 mm;
Modulation: 2FSK;
Interface: TxRx, SPI;
Data rate: up to 152.3 Kbps,
up to 304.7 Kbps
Operation temperature: -40 to +85 °C;

RF Module: **imoTech DP1205-C915** (datasheet,datasheet)(info)
MCU: **ATxmega256A3U** (documents)
PA: **RF3110** (datasheet) 880 - 915 MHz @ 35 dBm

Payloads

Курсовая камера	Мультиспектральная камера Slant range 3p
Фотоаппарат Sony A6000 (24 МП)	Тепловизионная камера Flir TAU 640
Фотоаппарат Sony RX1 (24 МП)	Тепловизионная камера Flir vue Pro R
Фотоаппарат Sony A7 (42 МП)	Тепловизионная камера SmartCor
Детектор гамма-излучений	ГНСС Topcon

Нелинейный локатор		Javad GNSS
Оценка РЭО	Лидар	Septentrio GNSS +IMU
GPS tracker	ВБС 2G	ВБС 2G Pro (IMEI, IMSI)
Wi-Fi детектор	ВБС 2/3/4G	ВБС 2/3/4G Pro (IMEI, IMSI)
[info]		

Battery

Supercam

ООО "Финко"

[Supercam], [Суперкам]

Supercam SX350 (VTOL)

- Wingspan – 3.2 m
- Endurance – up to 120 min
- Radio link range – 50 km
- Video transmission range – up to 50 km
- Max flight range – 160 km

→

Supercam S100

- Wingspan – 1 m
- Endurance – up to 60 min
- Radio link range – up to 20 km
- Video transmission range – up to 20 km
- Max flight range – 50 km

→

Supercam S150

- Wingspan – 1.5 m
- Endurance – up to 2 hours
- Radio link range – up to 30 km
- Video transmission range – up to 25 km
- Max flight range – 110 km

→

Supercam S250

- Wingspan – 2.55 m
- Endurance – up to 3 hours
- Radio link range – up to 50 km
- Video transmission range – up to 25 km
- Max flight range – 180 km

→

Supercam S350

- Wingspan – 3.2 m
- Endurance – up to 4.5 hours
- Radio link range – 70-100 km
- Video transmission range – up to 50-100 km
- Max flight range – 240 km

→

Supercam S450

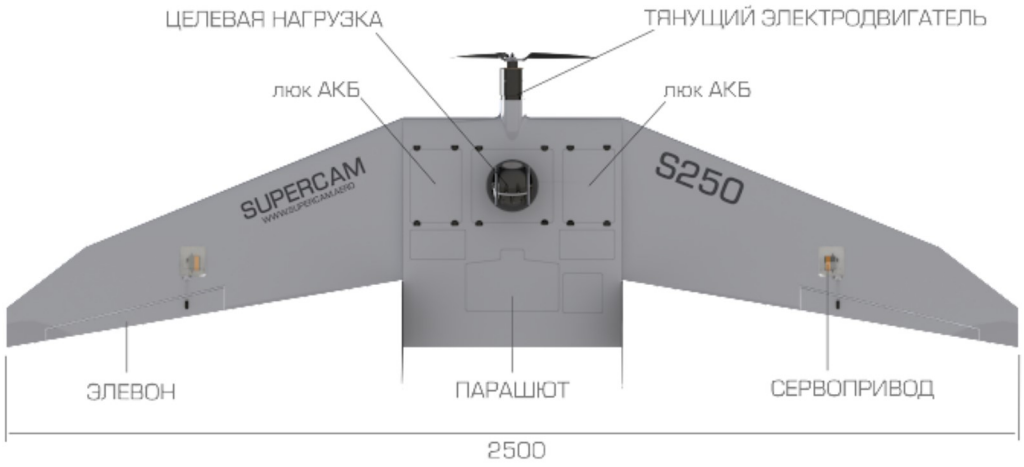
- Wingspan – 4.5 m
- Endurance – up to 7 h
- Radio link range – 110 km
- Video transmission range – up to 100 km
- Max flight range – 450 km

→

S100

S150

S250 / S250F



Frequency

Radio Control Link

UAV Rx: *Looks like 433 MHz*
UAV Tx: *Looks like 433 MHz*

Payload

UAV Tx: *Looks like 1200 MHz (Analog video transmitter)*

S350 / S350F

[link]

Frequency

Radio Control Link

UAV Rx: 902 - 928 MHz
UAV Tx: 902 - 928 MHz

Payload

UAV Tx: 2320 - 2400 MHz (Analog video transmitter)
UAV Tx: 1215 MHz (OFDM video transmitter)
1128 MHz (Sector Tx2)

Наземный блок антенны

SX350

Payload

Antenna

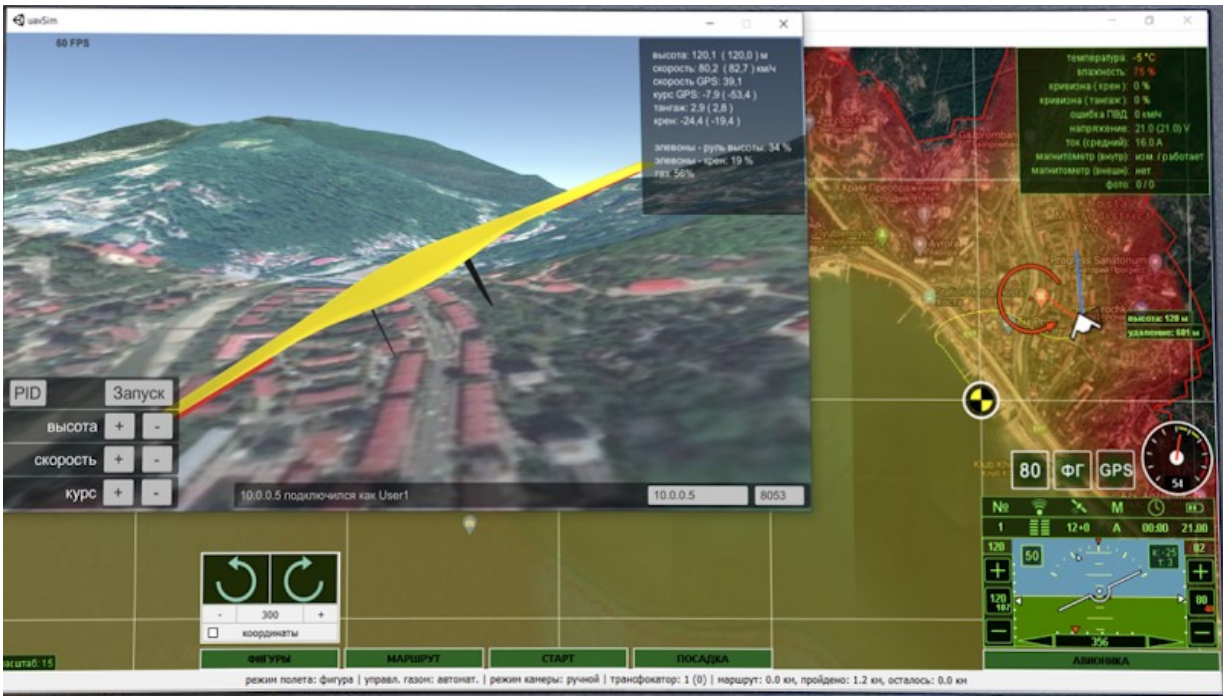
Looks like 2.4 GHz / 5.8 GHz Antenna

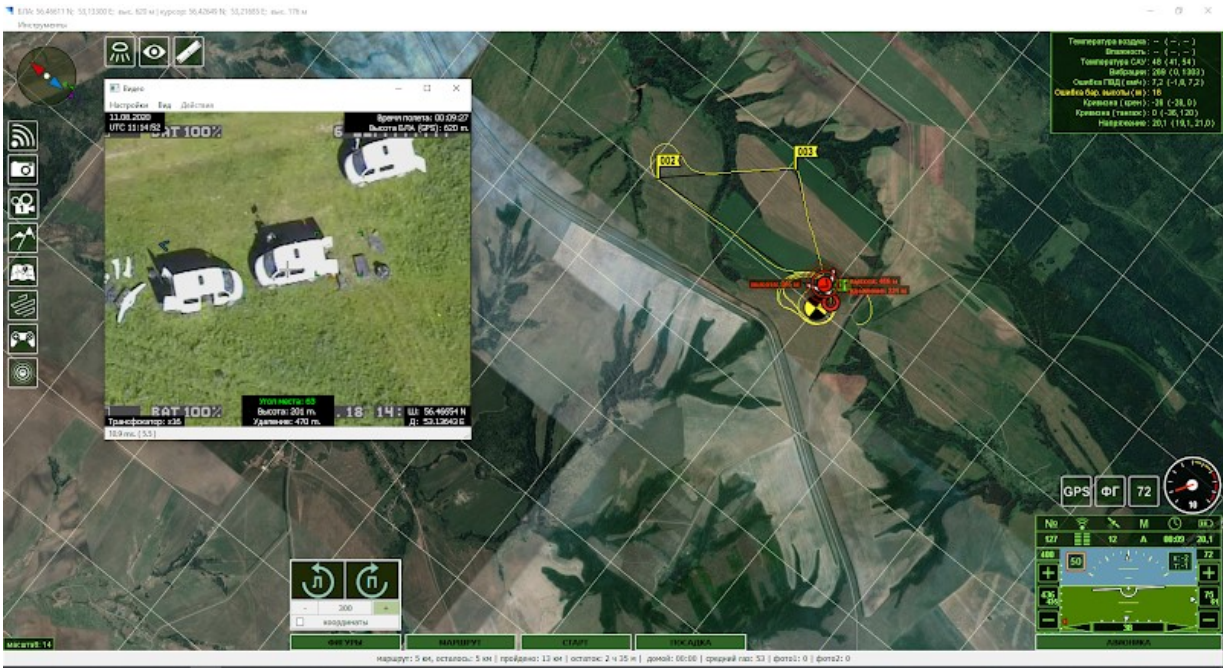
UAV Ground Control Station

Antenna

Looks like Dual-Band antenna

Software





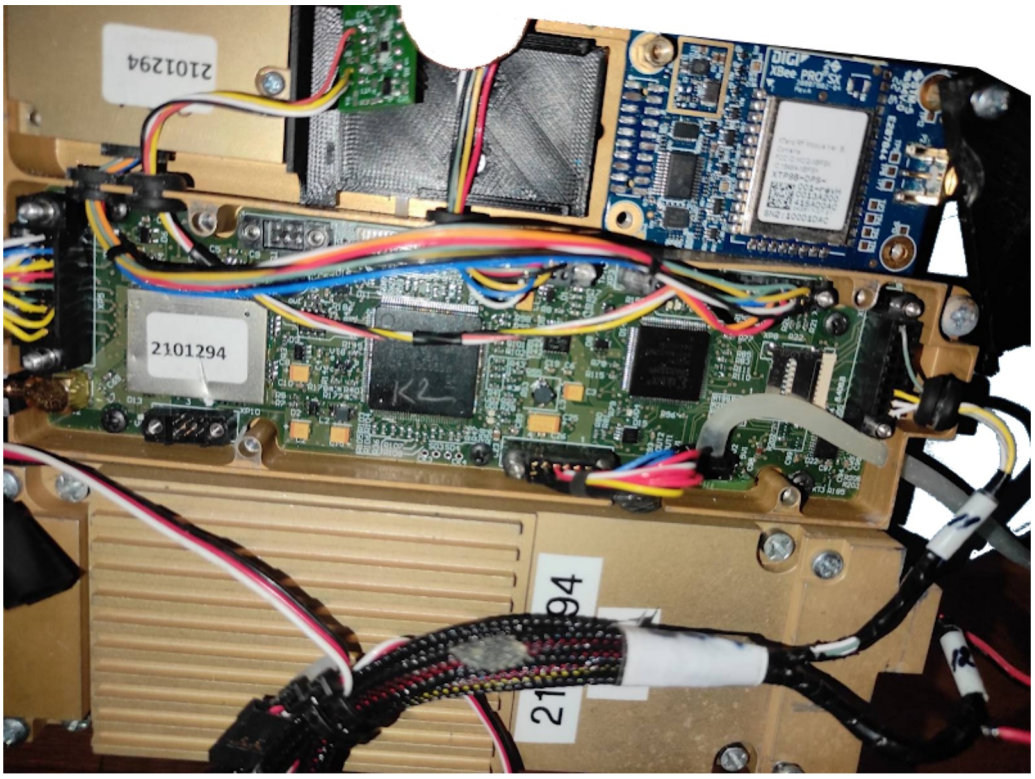
Unknown manufacturer

Cartographer

The manufacturer may not be AFM-Server. Possibly Geoscan or STC.

[Cartographer], [Картограф]

[photo]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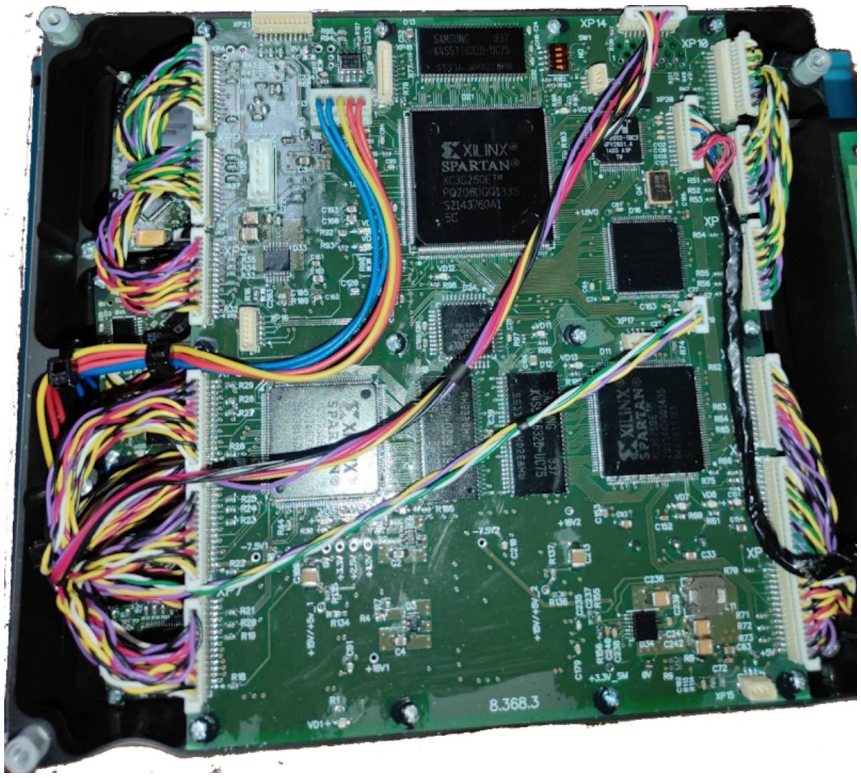
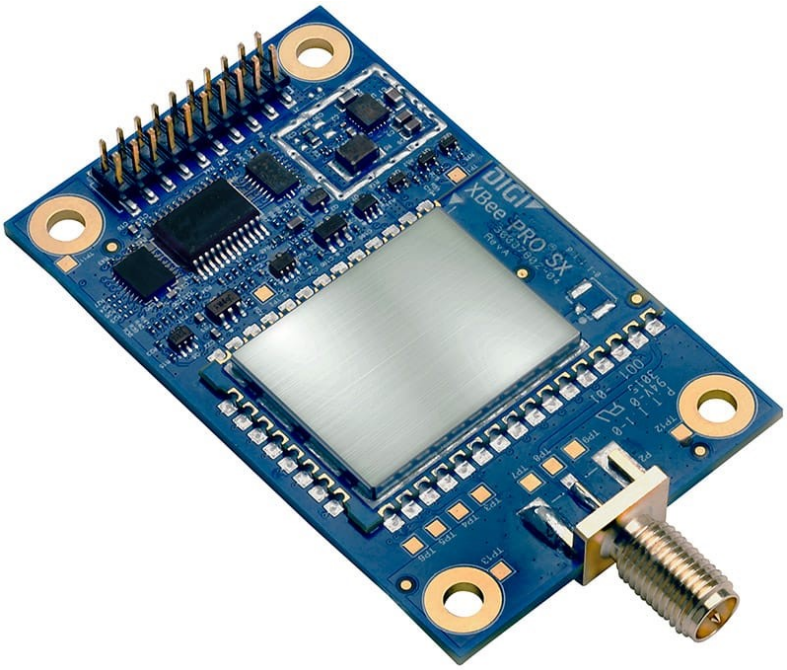


Specification	
Optical System:	12x 2MP multi-angle sensors
RC module:	DIGI XBee Pro SX

Components

Radio Control Link

XBEE PRO SX



(XTP9B-DPS-001)

ОАО «ОКБ Сухого»

Okhotnik

[С-70 "Охотник"], [Okhotnik], [Okhotnik-B], [Hunter], [S-70]

С-70 "Охотник"

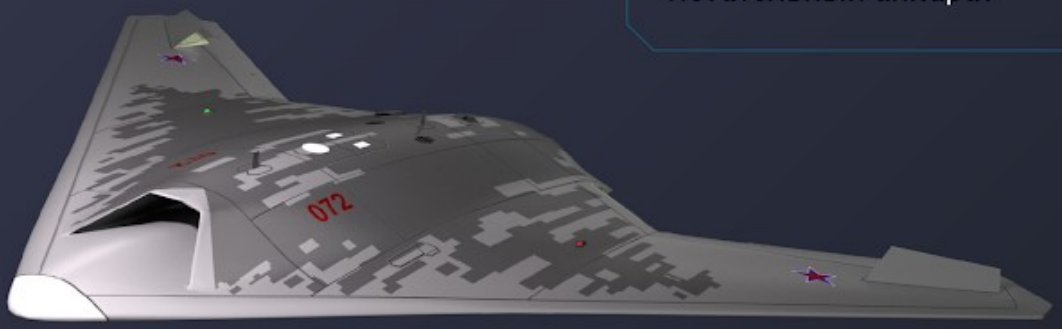
LIFE

Вооружение

8 точек подвески внутри фюзеляжа, корректируемые бомбы и ракеты

Тип

тяжёлый ударный беспилотный летательный аппарат



Максимальная скорость

900 километров в час

Боевой радиус

3000 километров

Масса бомбовой нагрузки (макс.)

7 тонн

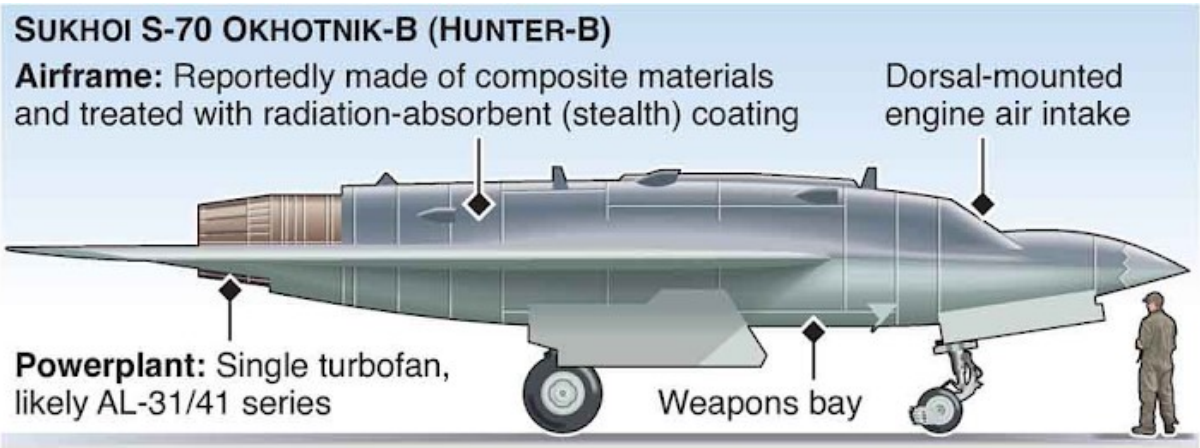
Вспомогательное оборудование

- модуль навигации ГЛОНАСС,
- блоки РЭБ "Хибины" на внешних подвесках,
- РЛС Н036 "Белка"

Силовая установка

реактивный двигатель АЛ-31Ф с экранированным плоским соплом

SUKHOI S-70 OKHOTNIK-B (HUNTER-B)

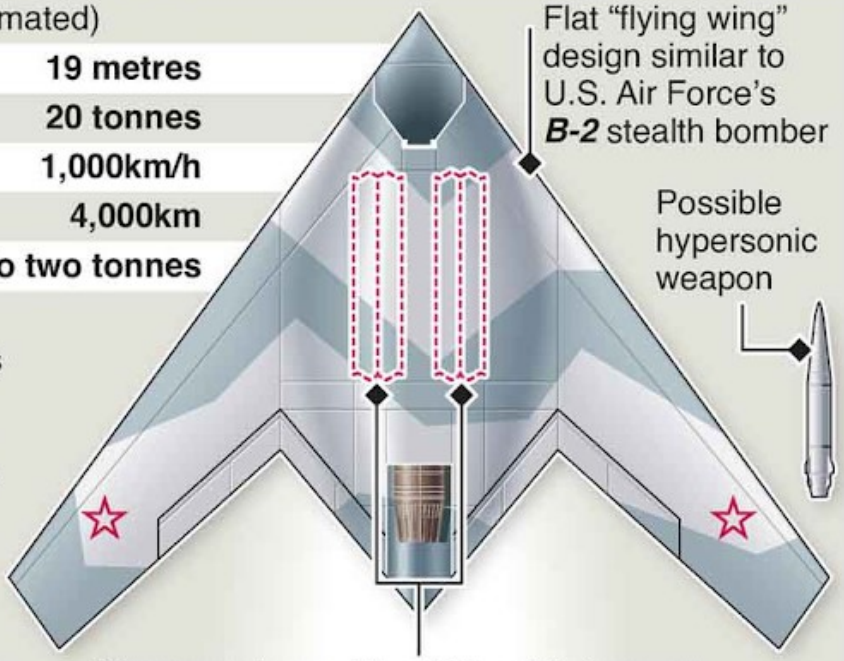


SPECIFICATIONS (estimated)

Wingspan	**19 metres**
Take-off weight	**20 tonnes**
Maximum speed	**1,000km/h**
Range	**4,000km**
Payload	**Up to two tonnes**

Armament
Air-to-surface missiles and array of bombs carried inside ventral bay or bays to reduce drone's visibility on enemy radar

"Fully robotized" vehicle capable of making independent combat decisions – only requiring human operator to deploy weapons



Weapons bays: Should be able to carry most, if not all, missiles and munitions being developed for Russia's ***Su-57*** multirole aircraft, including hypersonic missile with characteristics similar to ***Kh-47M2 Kinzhal***

Sources: GlobalSecurity, Jane's 360, The National Interest

Specifications	
Wing span	14 m
Height	
Length	19 m
Flight endurance	

Electronic Warfare Equipment

[link] [link]

НИИ "Вектор"

СЕРП-ВС

[info]

СЕРП-ВС5

[info]

- Possibility of integration with radio monitoring means
- Compact design that allows quick installation of the module
- Works in passive mode, no active radiation
- Jamming of GPS, GLONASS, Galileo, Beidou signals and UAV control signals
- Range up to 5 km
- Year-round operation in all weather conditions
- Protection of mobile or stationary objects
- Drone suppression 360º on the horizontal axis
- Operating modes in each of the 4 azimuth sectors are set independently of each other

- Возможность комплексирования со средствами радиомониторинга
- Компактная конструкция, которая позволяет оперативно установить модуль
- Работает в пассивном режиме, отсутствует активное излучение
- Подавление сигналов GPS, ГЛОНАСС, Galileo, Beidou и сигналы управления БПЛА
- Дальность действия до 5 км
- Круглогодичная эксплуатация в любых погодных условиях
- Защита мобильных или стационарных объектов
- Подавление дронов на 360º по горизонтальной оси
- Режимы работы в каждом из 4 азимутальных секторов задаются независимо друг от друга

Specifications

Signal jamming	GPS, GLONASS, Galileo, Beidou and UAV control signals in the bands: 900 MHz / 2.4 GHz / 5.2 GHz / 5.8 GHz

Suppression range	up to 5 km
Sector of suppression in the horizontal plane	4 sectors of 90°
Sector of suppression in the vertical plane	-20 to +60°
Management Interface	Ethernet
Power consumption from 220V network	no more than 550 W

ООО НПП «НТТ»

Strizh-3

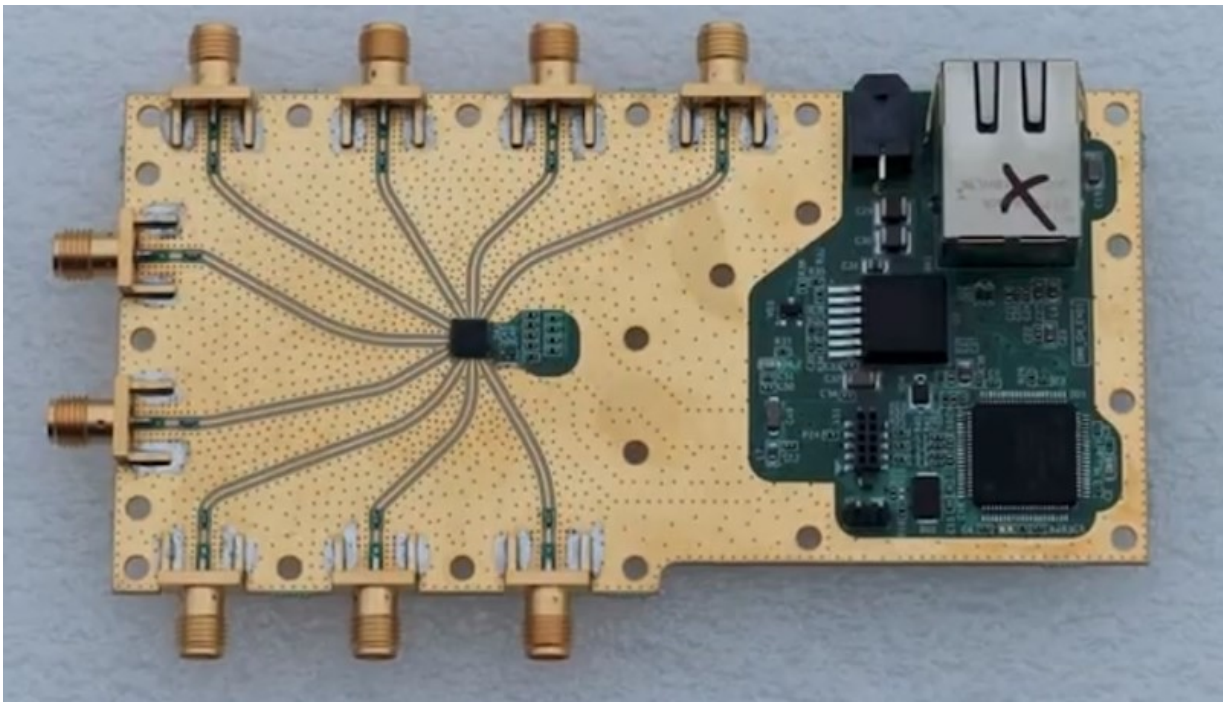
[Стриж-3]

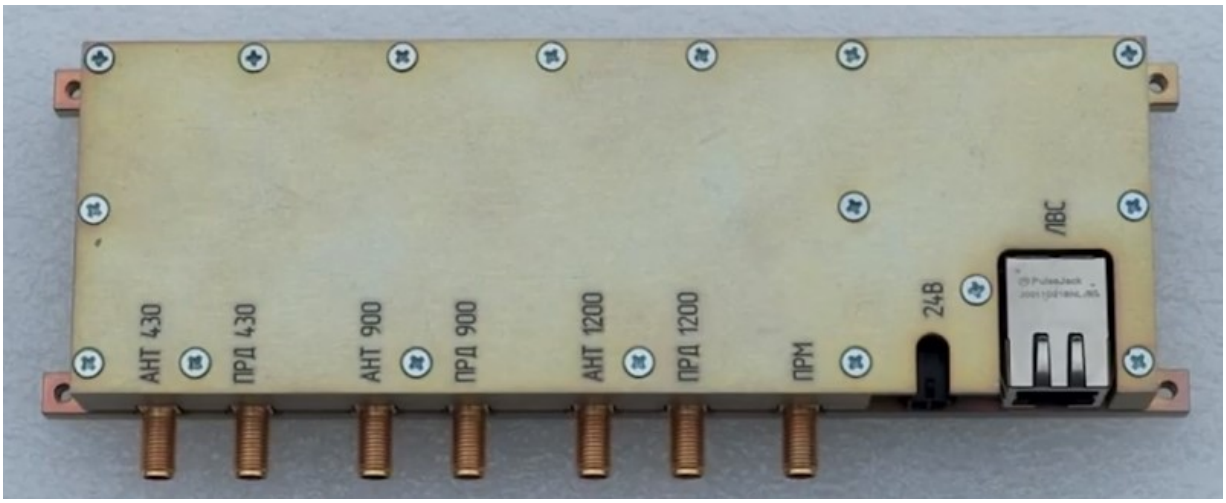
Mobile counter UAV defense system. System is designed for: detection of UAVs, transfer of alarm signal to the control and alert post/console, obstruction of the UAV’s control and navigation channels.

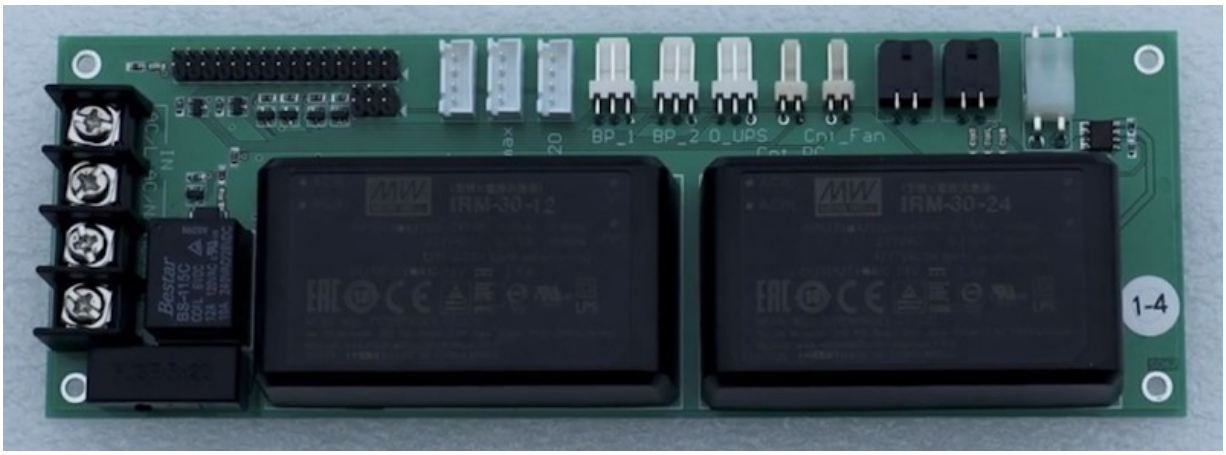
Мобильная система защиты от беспилотных летательных аппаратов (БЛА). Аппаратура предназначена для обнаружения БЛА, передачи сигнала тревоги на пульт управления и сигнализации, блокирования каналов управления и навигации беспилотных летательных аппаратов.

[link][info]

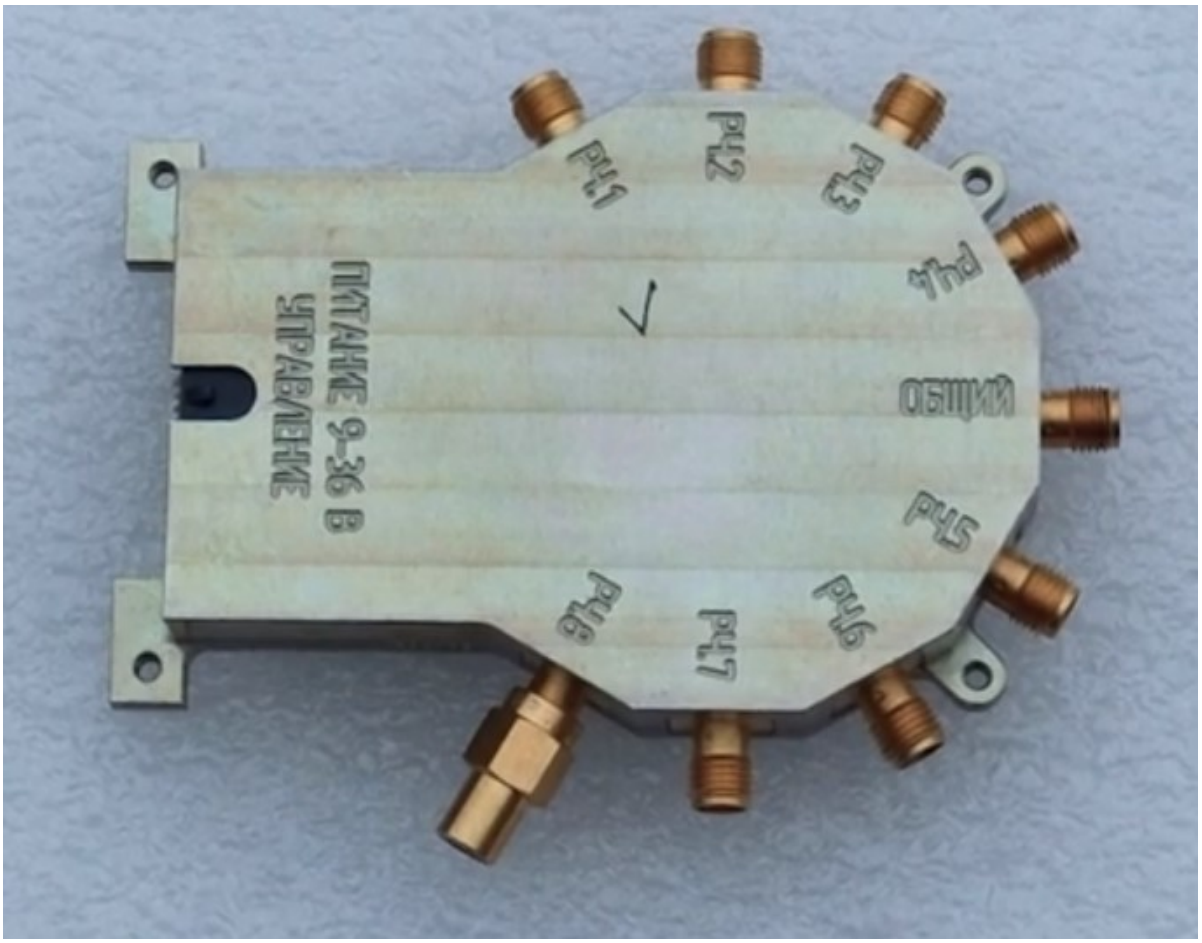
FPGA + 2xSP8T + IndustrialPC + USRP B205 mini


SP8T Ethernet RF Switch

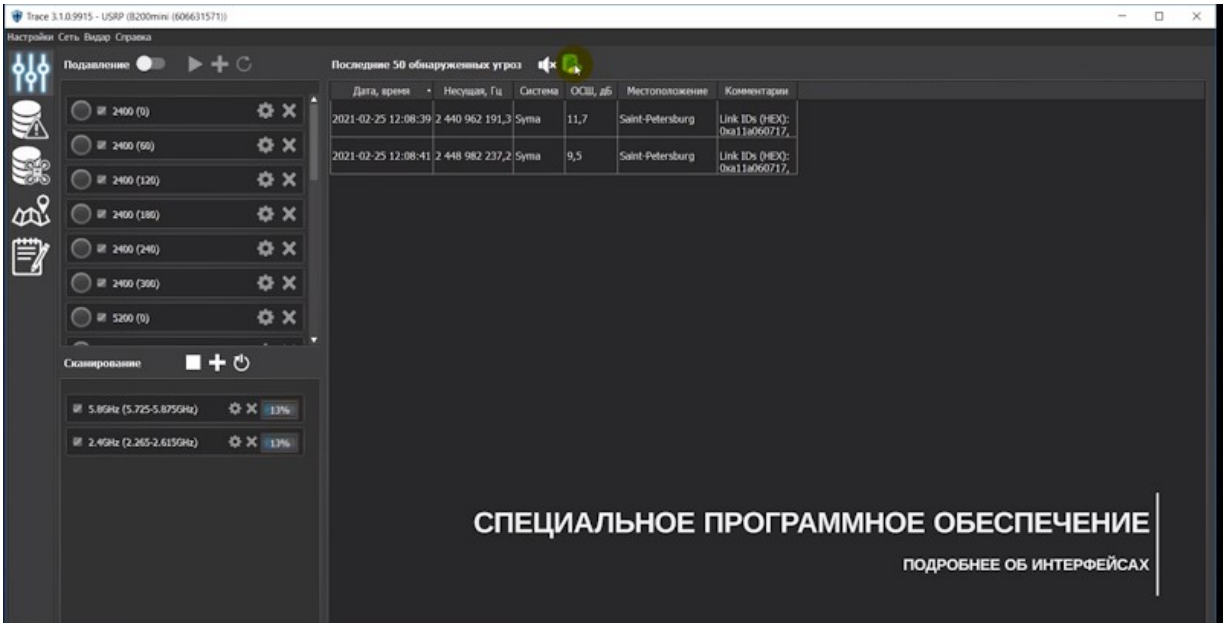


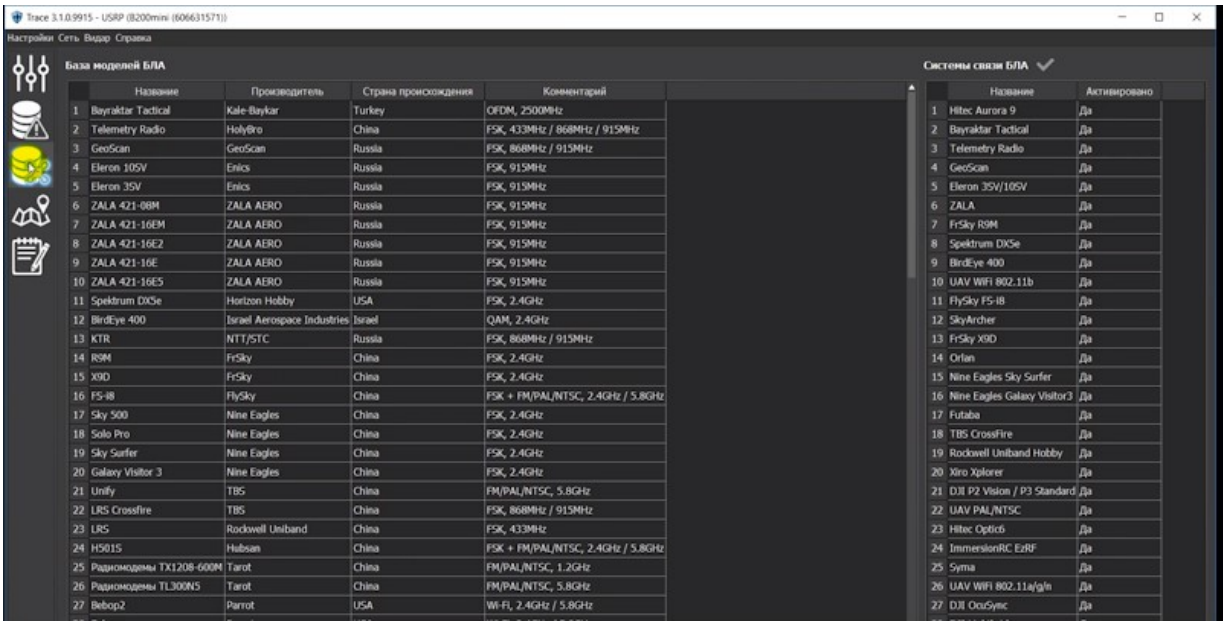


Mean Well Dual Channel PSU 12V/24V



SP8T RF Switch





	Название	Производитель	Страна происхождения	Комментарий
1	Bayraktar Tactical	Kale-Baykar	Turkey	OFDM, 2500MHz
2	Telemetry Radio	HolyBro	China	FSK, 433MHz / 868MHz / 915MHz
3	GeoScan	GeoScan	Russia	FSK, 868MHz / 915MHz
4	Eleron 10SV	Enics	Russia	FSK, 915MHz
5	Eleron 3SV	Enics	Russia	FSK, 915MHz
6	ZALA 421-08M	ZALA AERO	Russia	FSK, 915MHz
7	ZALA 421-16EM	ZALA AERO	Russia	FSK, 915MHz
8	ZALA 421-16E2	ZALA AERO	Russia	FSK, 915MHz
9	ZALA 421-16E	ZALA AERO	Russia	FSK, 915MHz
10	ZALA 421-16E5	ZALA AERO	Russia	FSK, 915MHz
11	Spektrum DXSe	Horizon Hobby	USA	FSK, 2.4GHz
12	BirdEye 400	Israel Aerospace Industries	Israel	QAM, 2.4GHz
13	KTR	NTT/STC	Russia	FSK, 868MHz / 915MHz
14	R9M	FrSky	China	FSK, 2.4GHz
15	X9D	FrSky	China	FSK, 2.4GHz
16	FS-i8	FlySky	China	FSK + FM/PAL/NTSC, 2.4GHz / 5.8GHz
17	Sky 500	Nine Eagles	China	FSK, 2.4GHz
18	Solo Pro	Nine Eagles	China	FSK, 2.4GHz
19	Sky Surfer	Nine Eagles	China	FSK, 2.4GHz
20	Galaxy Visitor 3	Nine Eagles	China	FSK, 2.4GHz
21	Unify	TBS	China	FM/PAL/NTSC, 5.8GHz
22	LRS Crossfire	TBS	China	FSK, 868MHz / 915MHz
23	LRS	Rockwell Uniband	China	FSK, 433MHz
24	H501S	Hubsan	China	FSK + FM/PAL/NTSC, 2.4GHz / 5.8GHz
25	Радиомодемы TX1208-600M	Tarot	China	FM/PAL/NTSC, 1.2GHz
26	Радиомодемы TL300N5	Tarot	China	FM/PAL/NTSC, 5.8GHz
27	Bebop2	Parrot	USA	Wi-Fi, 2.4GHz / 5.8GHz

	Название	Активировано
1	Hitec Aurora 9	Да
2	Bayraktar Tactical	Да
3	Telemetry Radio	Да
4	GeoScan	Да
5	Eleron 3SV/10SV	Да
6	ZALA	Да
7	FrSky R9M	Да
8	Spektrum DXSe	Да
9	BirdEye 400	Да
10	UAV WiFi 802.11b	Да
11	FlySky FS-i8	Да
12	SkyArcher	Да
13	FrSky X9D	Да
14	Orlan	Да
15	Nine Eagles Sky Surfer	Да
16	Nine Eagles Galaxy Visitor3	Да
17	Futaba	Да
18	TBS CrossFire	Да
19	Rockwell Uniband Hobby	Да
20	Xiro Xplorer	Да
21	DJI P2 Vision / P3 Standard	Да
22	UAV PAL/NTSC	Да
23	Hitec Optic6	Да
24	ImmersionRC EzRF	Да
25	Syma	Да
26	UAV WiFi 802.11a/g/n	Да
27	DJI OcuSync	Да

Hardware Analysis

SET-1

The equipment of this company is used and found in the following UAVs: Supercam S350, Albatros M5.

Sector

[CEKCTOP]

Sector-Tx2
(transmitter)

Sector-Rx2
(receiver)

Info:

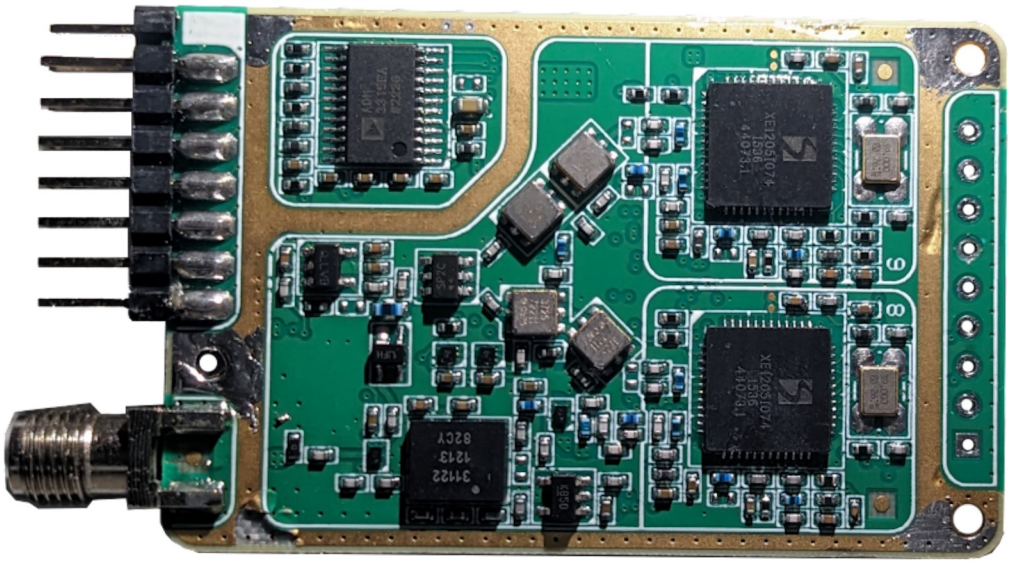
- https://t.me/enemy_uav_spec/619
- https://t.me/enemy_uav_spec/776

Zala Aero Group

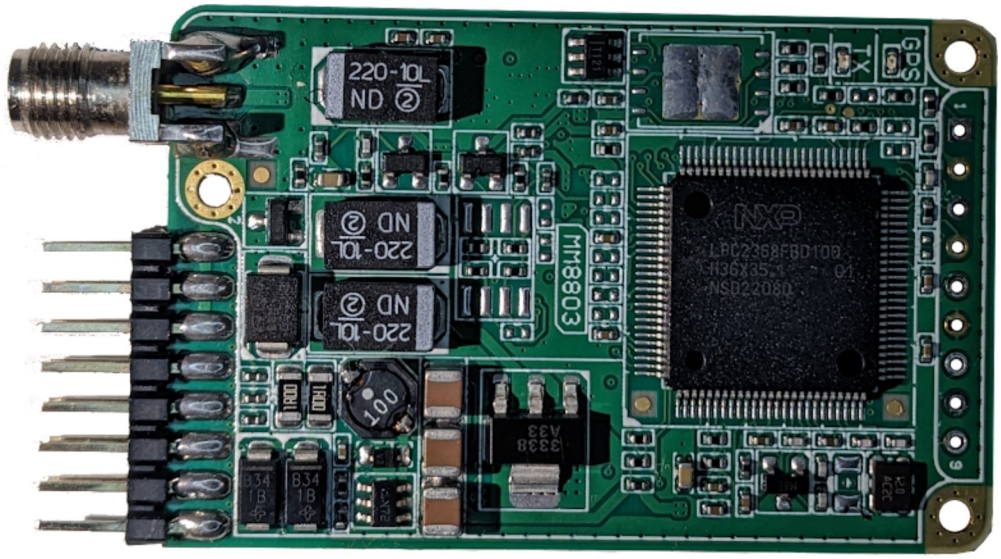
Radio Control Link + GNSS

Used in: **Zala Lancet, Zala KYB-UAV, Zala 421-16E2**

MM8803

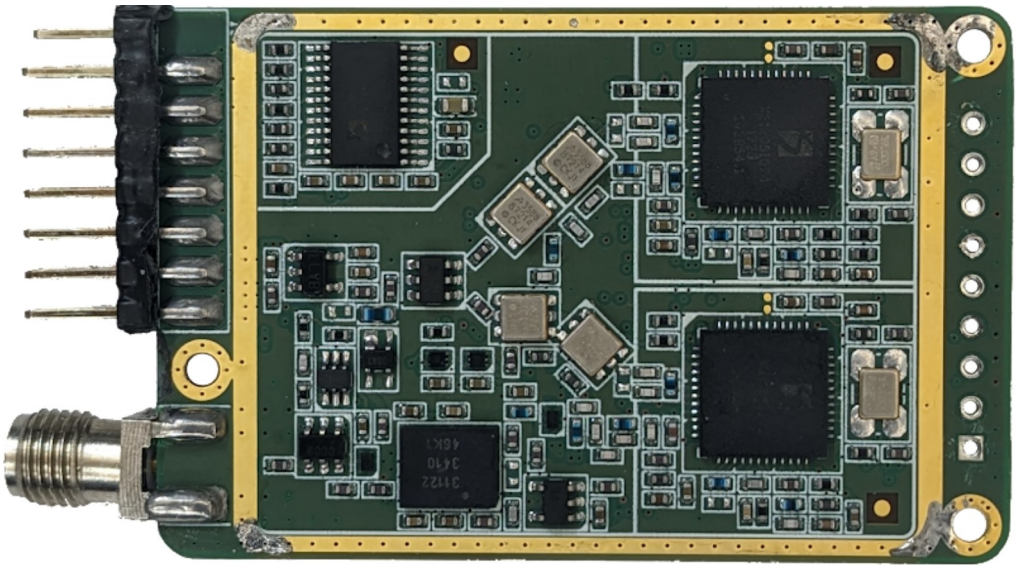


Zala Lancet Modem MM8803 (Side A) + [photo]

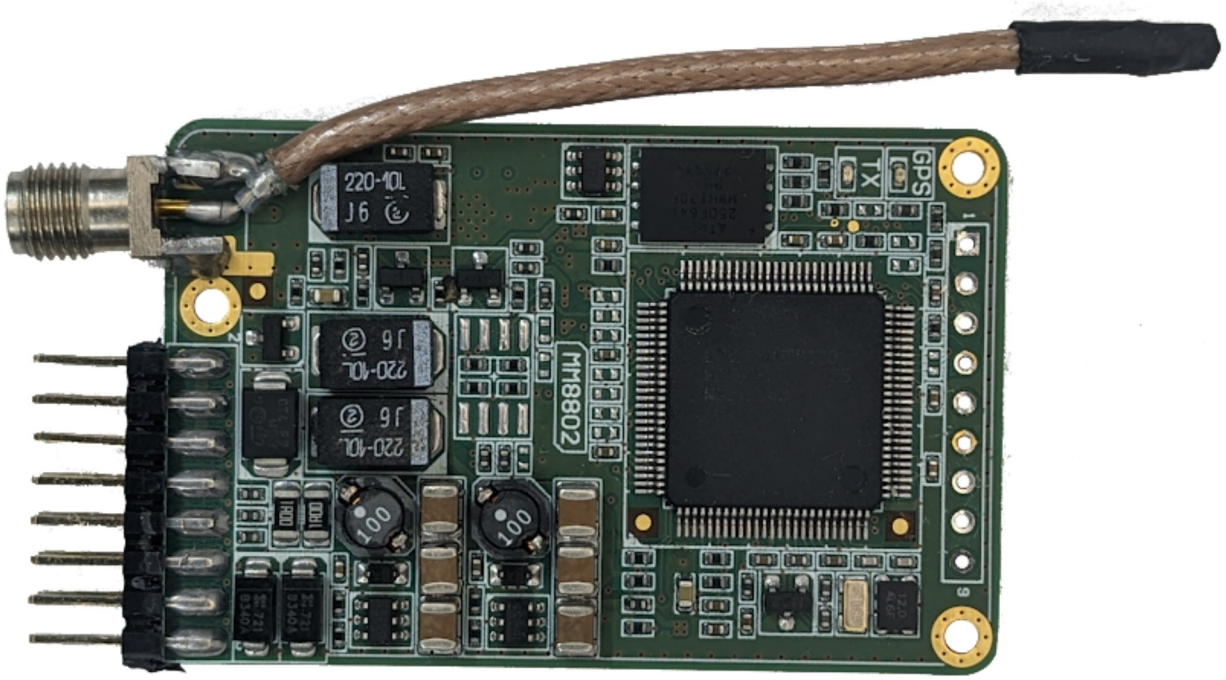


Zala Lancet Modem MM8803 (Side B)

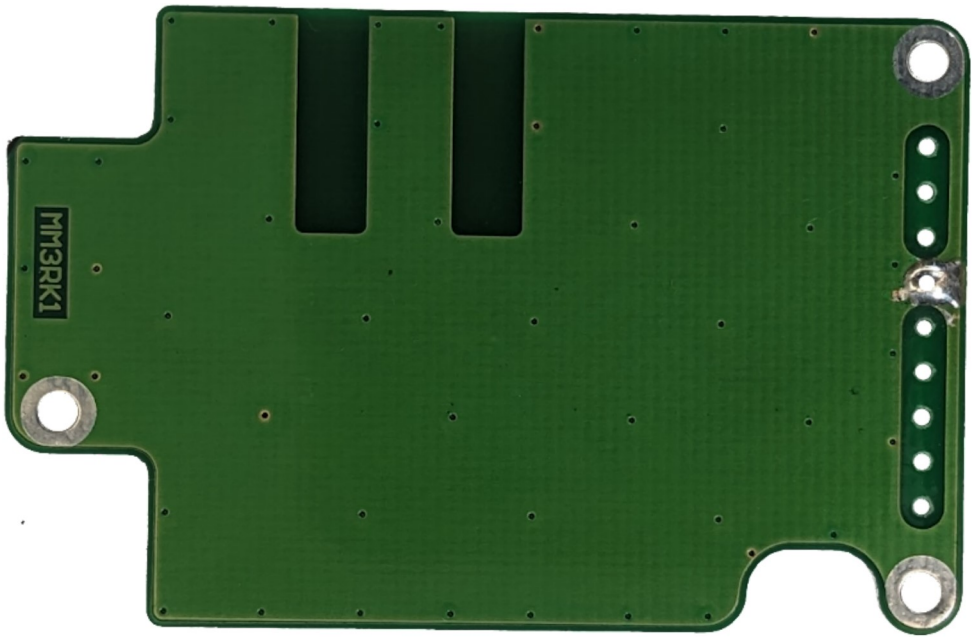
MM8802



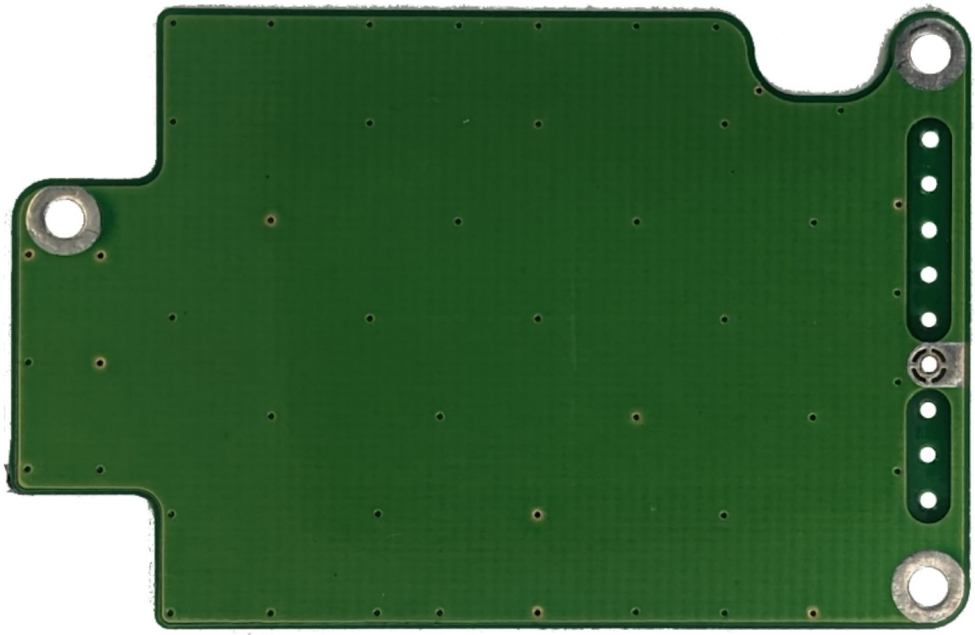
Zala 421-16E2 Modem MM8802 (Side A)



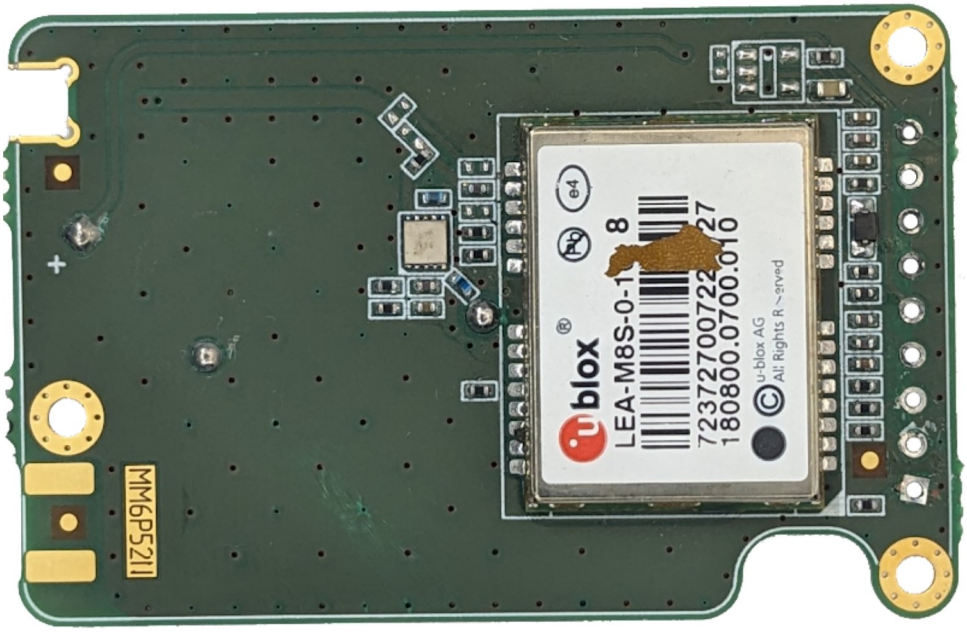
Zala 421-16E2 Modem MM8802 (Side B)



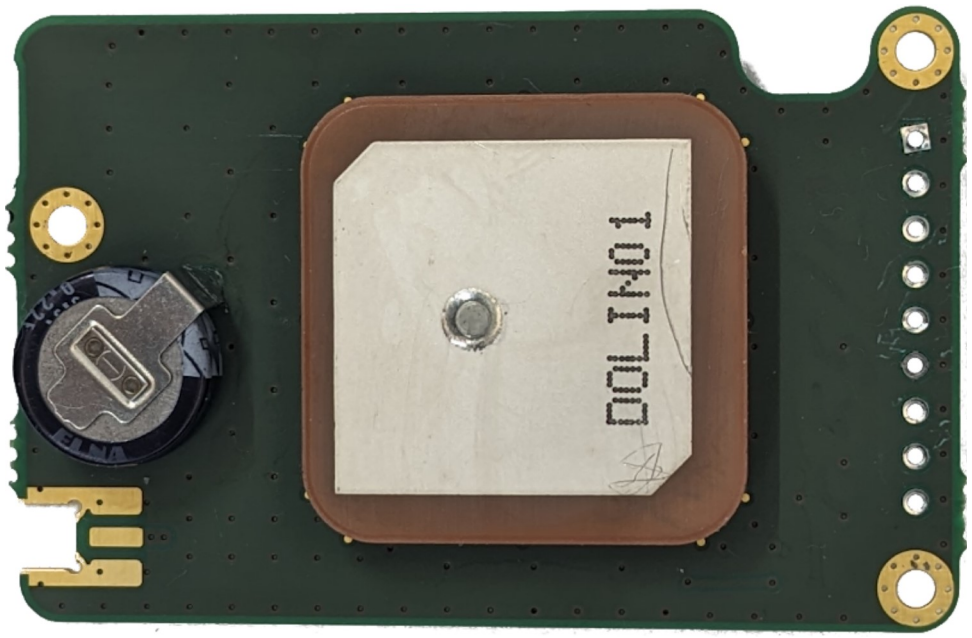
Shield MM3RK1 (Side C)



Shield MM3RK1 (Side D)



GNSS Module MM6P5211 (Side E)

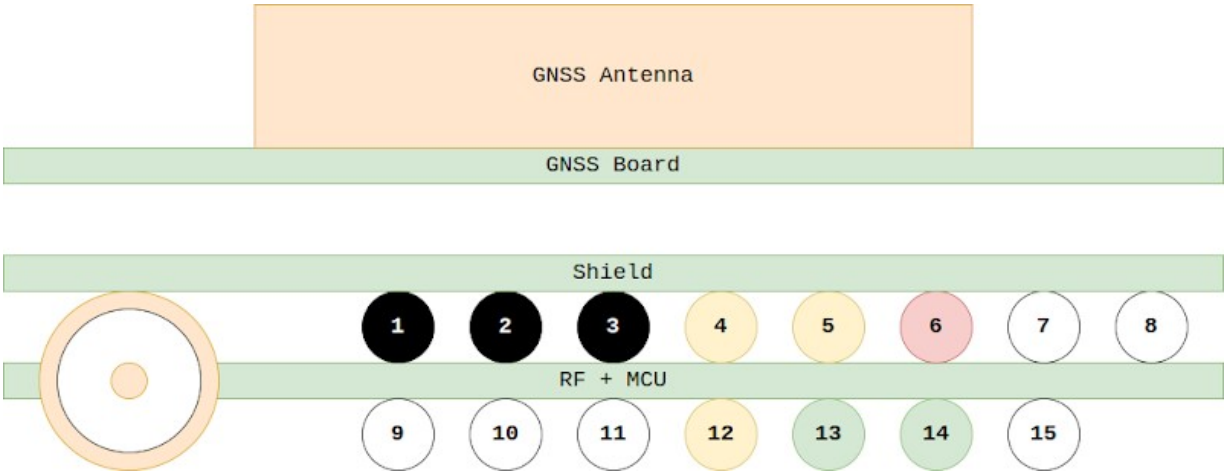


GNSS Module MM6P5211 (Side F)

MM8802 / MM8803 Components

RF Chip 1: **Semtech XE1205L074** [datasheet]
Filter (F1): **Epcos B3725** [datasheet]
Oscillator: **39.000**
RF Chip 2: **Semtech XE1205L074** [datasheet]
Filter (F2): **Epcos B3588** [datasheet]
PA: **ALM-31122** [datasheet]
Serial: **ADM-3315EA** [datasheet]
MCU: **NXP LPC2368FBD100** [datasheet]
MCU SPI Flash: **ATMEL AT25DF641** [datasheet] (only MM8802)
GNSS Module: **uBlox LEA-M8S-0-10** [datasheet] ~ 1560 - 1610 MHz

Pinout



1 - GND
2 - GND
3 - GND
4 - TX GNSS @38400bps
5 - TX (unknown)
6 - VCC
7 -
8 -
9 -
10 -
11 -
12 - TX @57600bps
13 - RX @57600bps
14 - RX
15 -

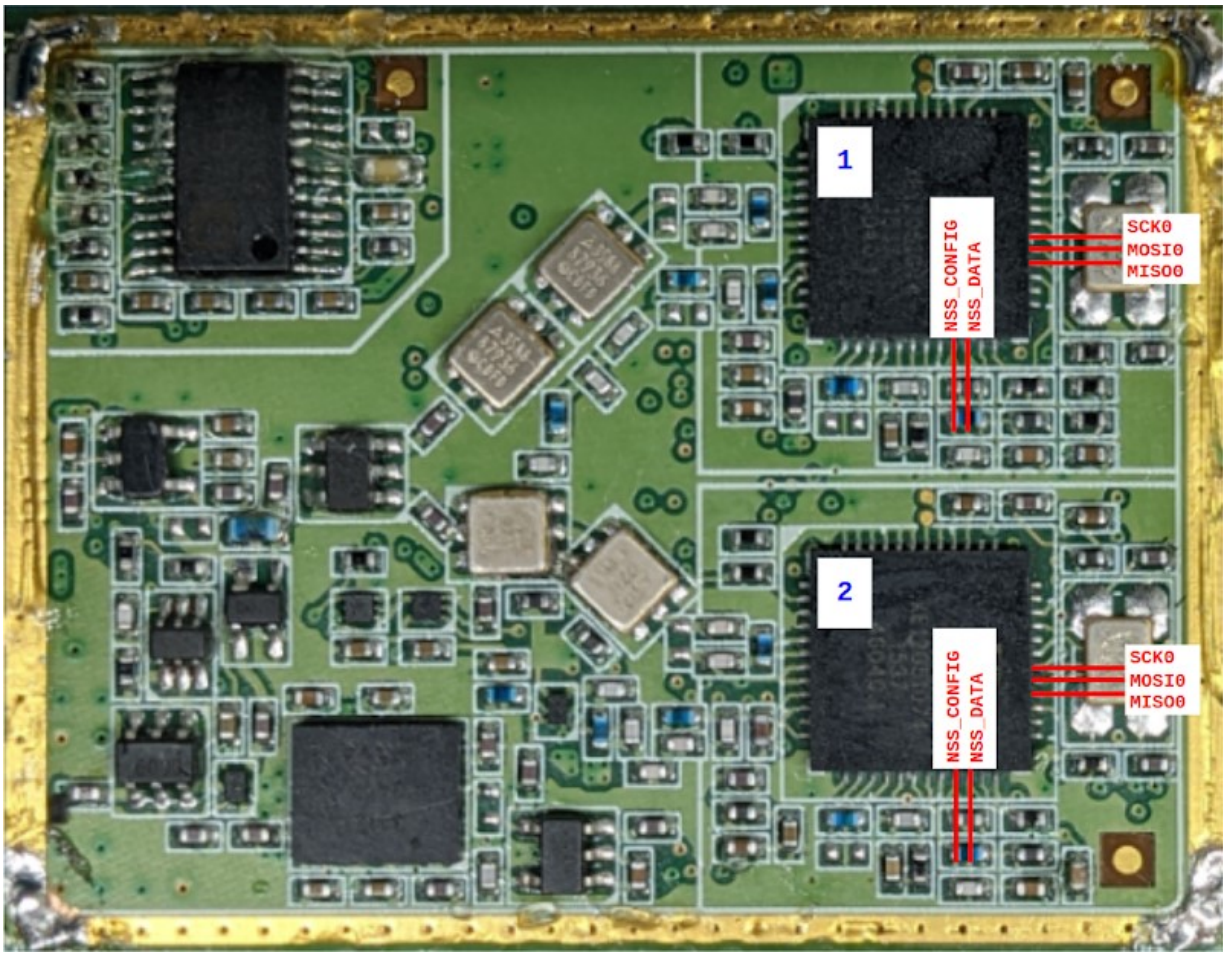
UART Analysis

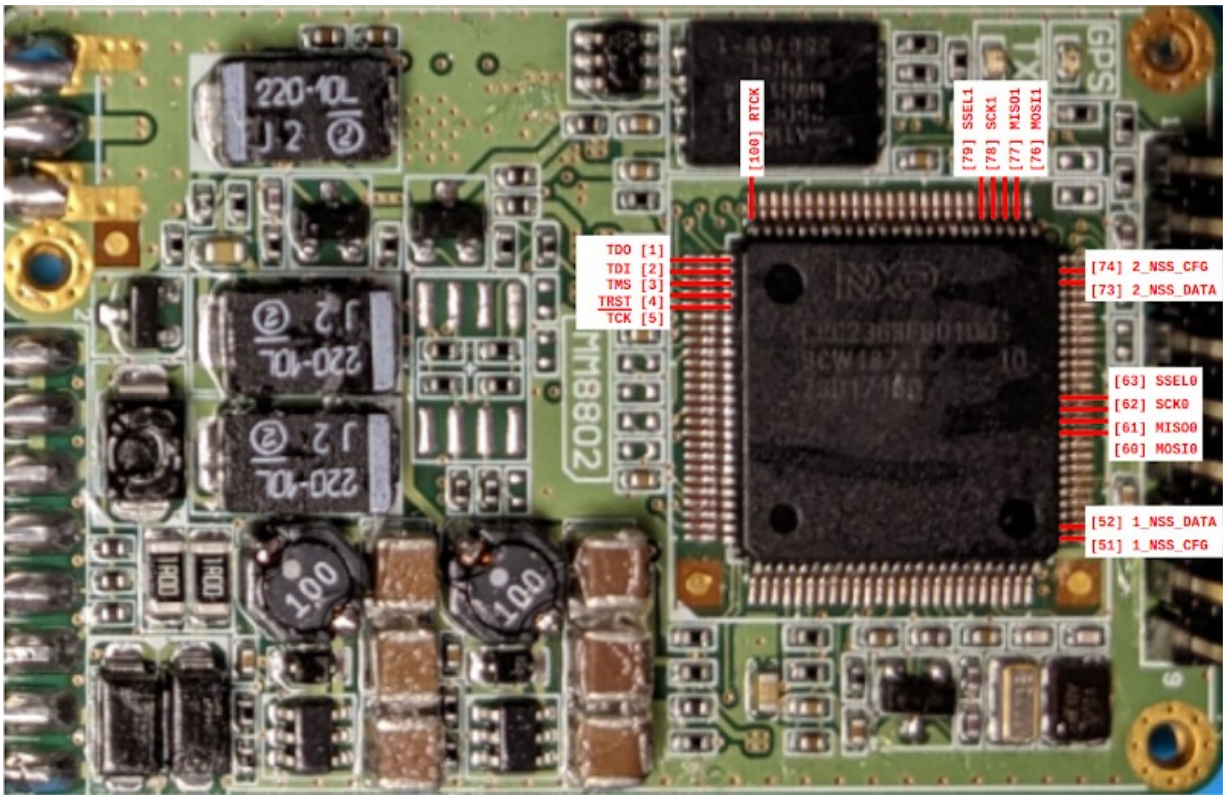
```
# Pin 12 - TX @57600

└─# picocom /dev/ttyUSB0 -b 57600

$A Jun 12 2019 89 168 129 0 4 1 U8 R N1 NAV
$R K0 P4 R0
$A Jun 12 2019 89 168 129 0 4 1 U8 R N1 NAV
$R K0 P4 R0
$A Jun 12 2019 89 168 129 0 4 1 U8 R N1 NAV
$R K0 P4 R0

# Pin 4 - TX (GPS) @38400

└─# picocom /dev/ttyUSB0 -b 38400

$GNGGA,,,,,,0,00,99.99,,,,,,*56
$GNRMC,,V,,,,,,,,,,N*4D
$GNGGA,,,,,,0,00,99.99,,,,,,*56
$GNRMC,,V,,,,,,,,,,N*4D
$GNGGA,,,,,,0,00,99.99,,,,,,*56
$GNRMC,,V,,,,,,,,,,N*4D
$GNGGA,,,,,,0,00,99.99,,,,,,*56
$GNRMC,,V,,,,,,,,,,N*4D
$GNGGA,,,,,,0,00,99.99,,,,,,*56
$GNRMC,,V,,,,,,,,,,N*4D
$GNGGA,,,,,,0,00,99.99,,,,,,*56
$GNRMC,,V,,,,,,,,,,N*4D
$GNGGA,,,,,,0,00,99.99,,,,,,*56
$GNRMC,,V,,,,,,,,,,N*4D
$GNGGA,,,,,,0,00,99.99,,,,,,*56
```

JTAG

	NXP LPC2368FBD100
TDO	1
TDI	2
TMS	3
TRST	4
TCK	5
RTCK	100

SPI Analysis





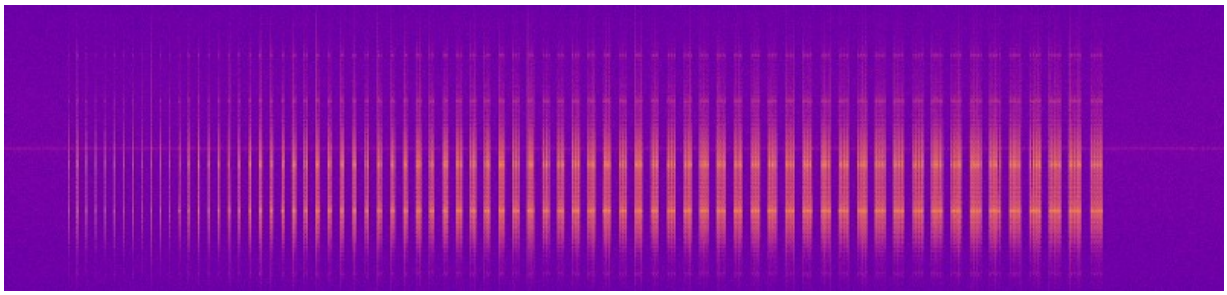
XE1205L074@1	XE1205L074@2	NXP LPC2368FBD100

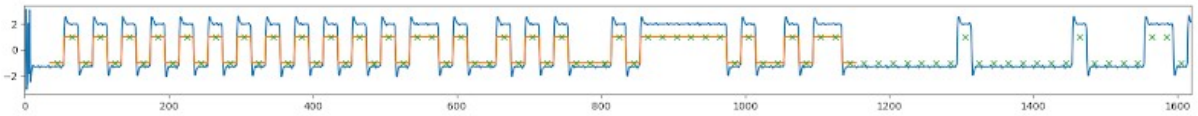
30	SCK	30	SCK	62	SCK0
28	MISO	28	MISO	61	MISO0
29	MOSI	29	MOSI	60	MOSI0
21	NSS_CONFIG			51	P2[12] - CONFIG
22	NSS_DATA			52	P2[11] - DATA
		21	NSS_CONFIG	74	P2[1] - CONFIG
		22	NSS_DATA	73	P2[2] - DATA

Firmware dump

MCU: [NXP_LPC2368FBD100.bin]
Flash: [ATMEL_AT25DF641.bin]

Waveform characteristics





Packet Size: 10 - 72 bytes

Preamble	Sync Word	Packet Length	Payload
3 bytes	4 bytes	2 bytes	1 - 63 bytes
0x555555	0x69517e96	0x41, 0x41	0x41 (A)

Modulation: FSK
Baudrate: 15200
Packet Size: 10 - 72 bytes
Preamble: **0x555555 [0b010101010101010101010101]**
(3 bytes)
Sync word: **0x69517e96**
(4 bytes)
Packet Length: **2 bytes [length, length]**
Payload size: **1-63 bytes**

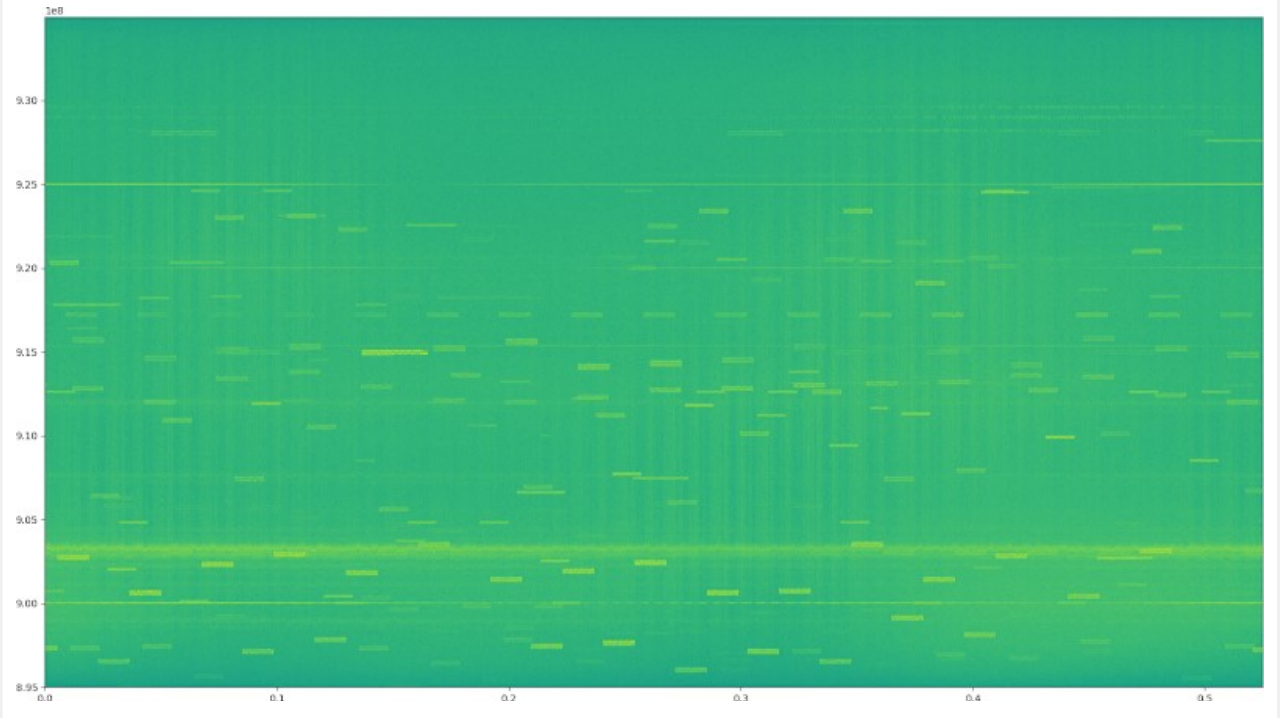
#	Date	UAV	Signal

007	2023-02-10	Zala UAV	**Frequency:** 915 MHz **Samplerate:** 40 MS/s **Download:** 2023-02-10_007_915_40.sigmf-data 2023-02-10_007_915_40.sigmf-meta

```
└─$ python3 zala_demodulate.py 2023-02-10_007_915_40.sigmf-meta
```

```
555555695 17e962d2d3ed6dfb1929ec6caea93d4aaefa5ecf4e0bcbedfa398dc9eefc69c9dd597f5919ad8d9
```

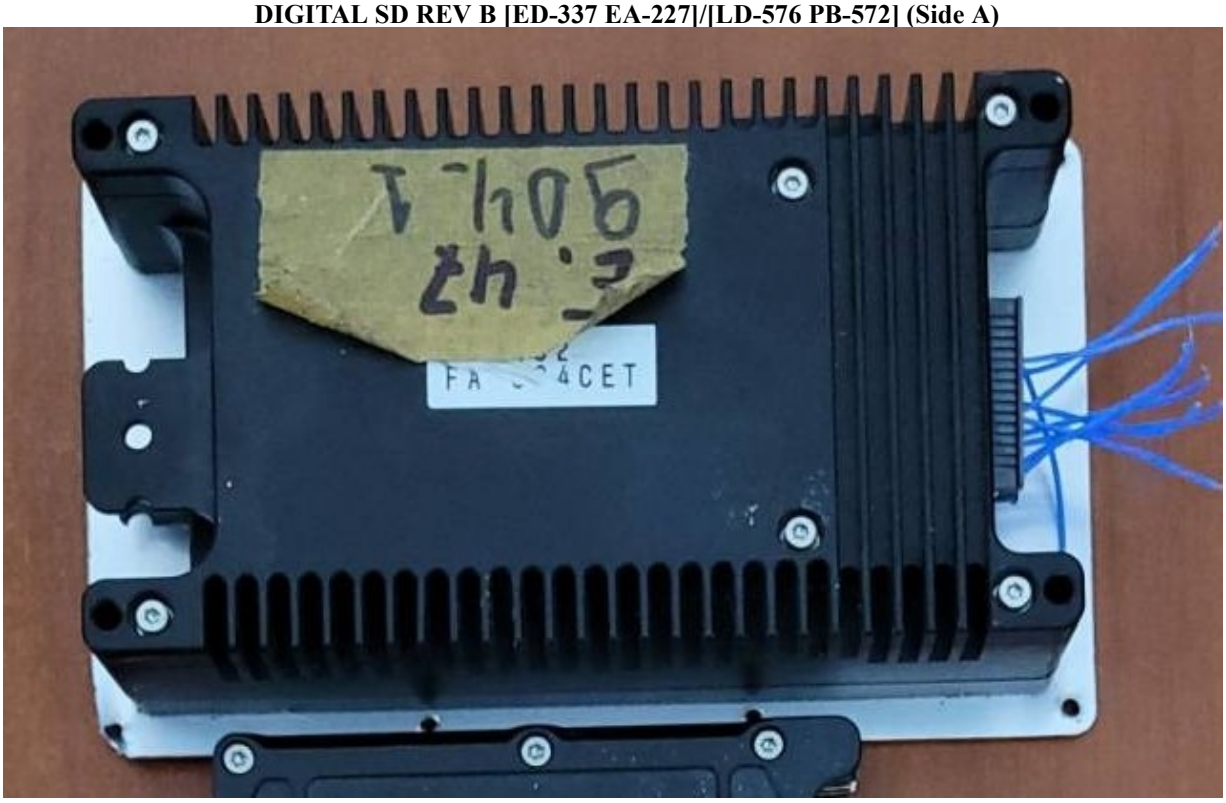
```
└─$ python3 SigMF_analysis.py 2023-02-10_007_915_40.sigmf-data
```



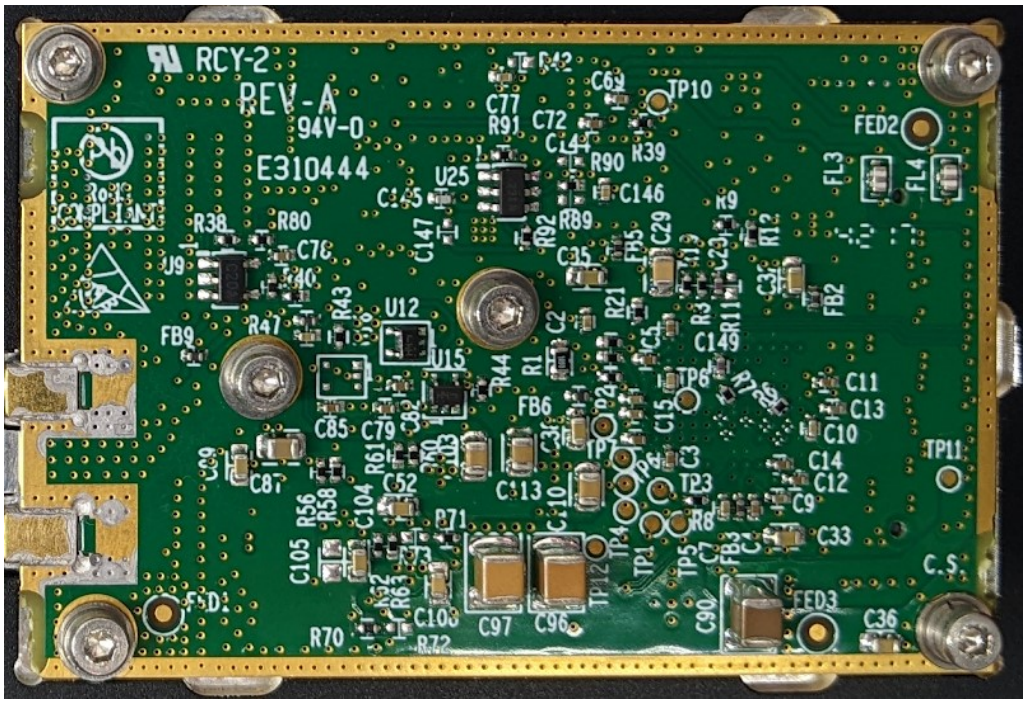
Digital Video Tranceiver

Used in: **Zala 421-16E2, Lancet**

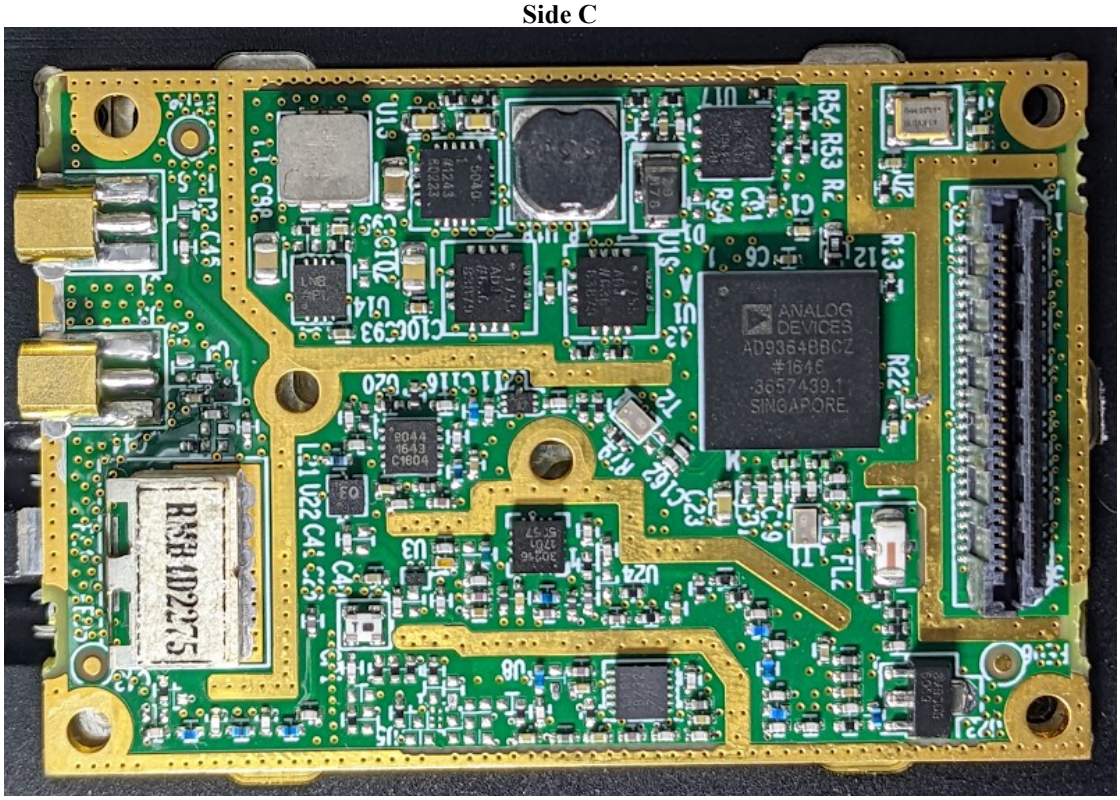
DIGITAL SD REV B [ED-337 EA-227]/[LD-576 PB-572] (Side A)



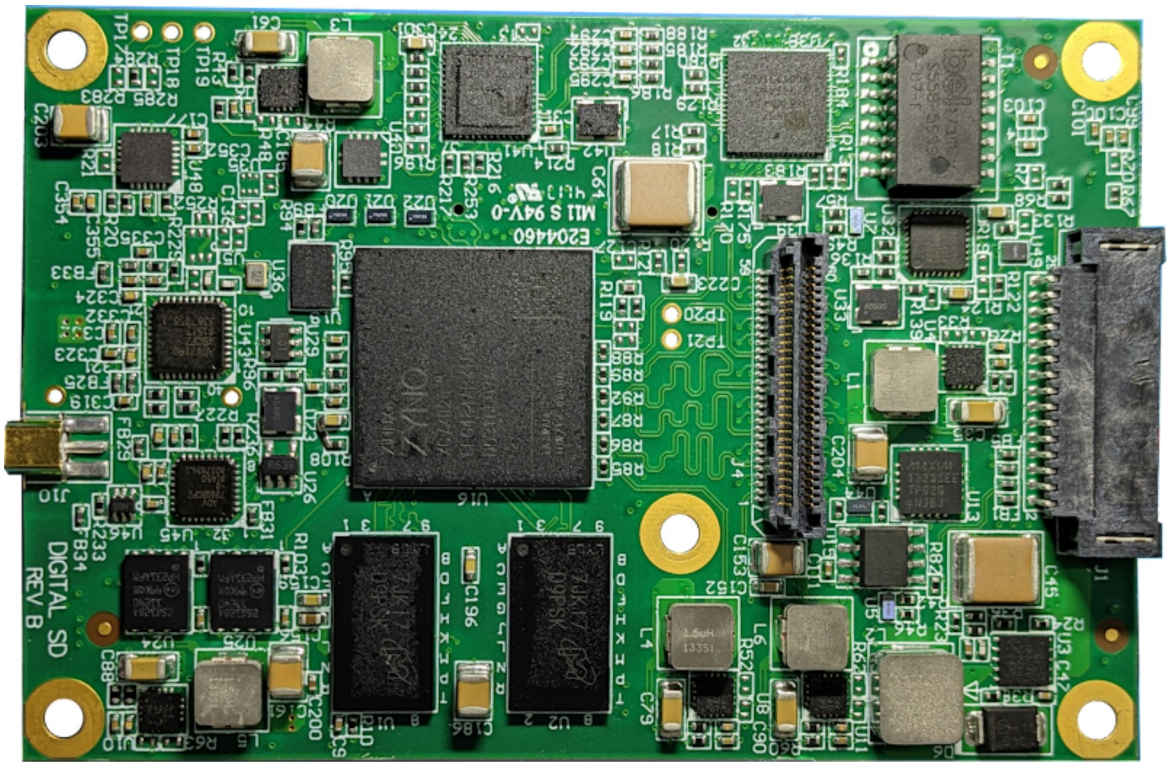
Side B


RCY-2
REV-A
94V-0
E310444

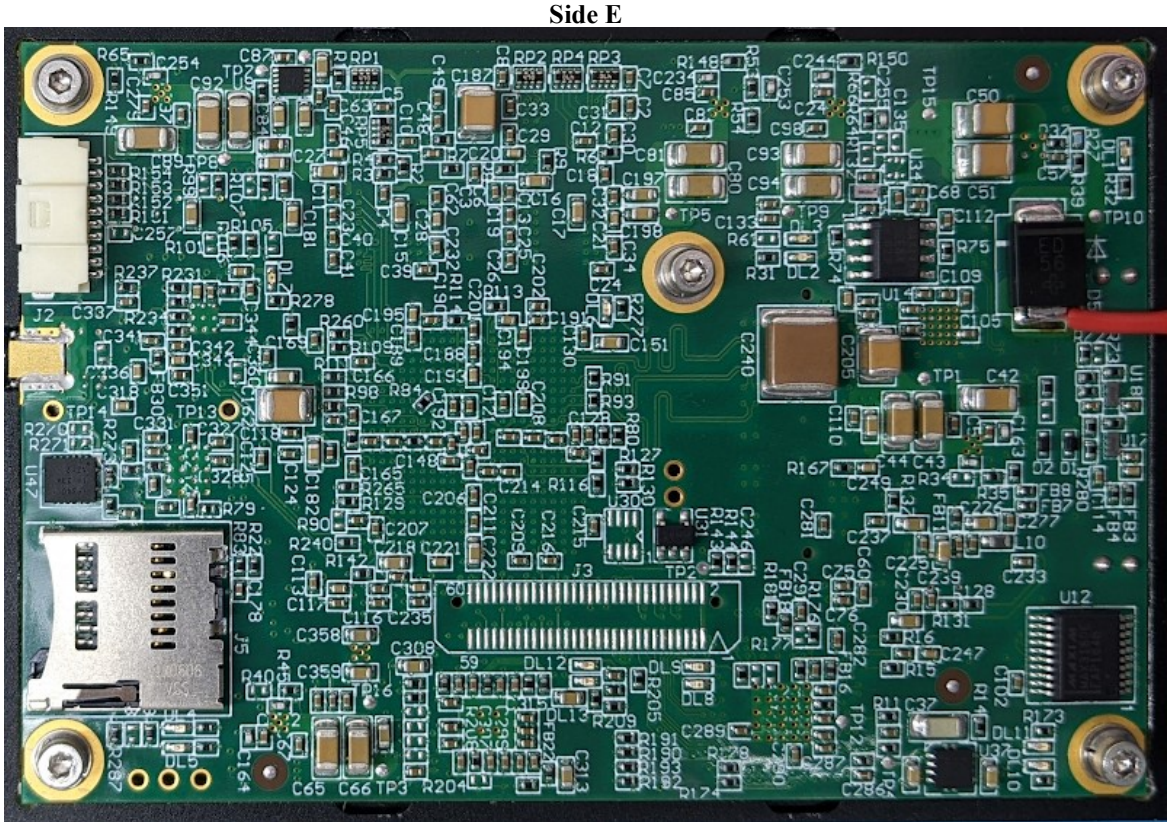
Side C


ANALOG
DEVICES
AD9364BBCZ
#1646
3657439.1
SINGAPORE

Side D



Side E



Side F

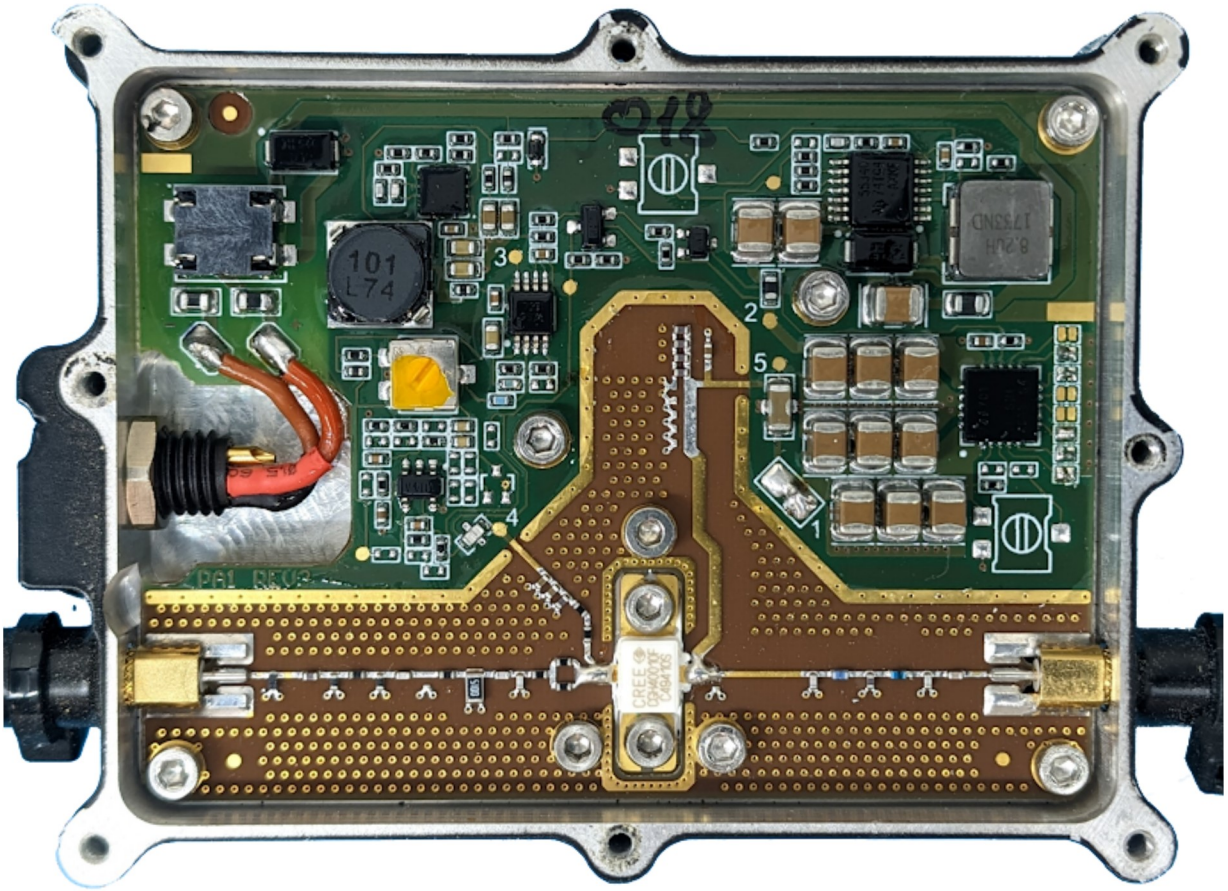
Serial: **MAX3160**
Filter: **RMB4D2275** *looks like Band Pass Filter* *overview*, *link*
RF Transceiver: **AD9364BBCZ** (datasheet) [70 ... 6000 MHz]
FPGA: **XILINX ZYNQ XC77020** (overview)
DAC: **AD7391BCPZ** (datasheet)
SDTV Video Decoder: **ADV7180** (datasheet)
RS232: **MAXIM 13235EE** (datasheet)

MAX3160 (Pin 16) @115200bps

Microblaze SW version: 01261649
PLATFORM = SBAND

Zala Multi-Band RF Amplifier + Filter

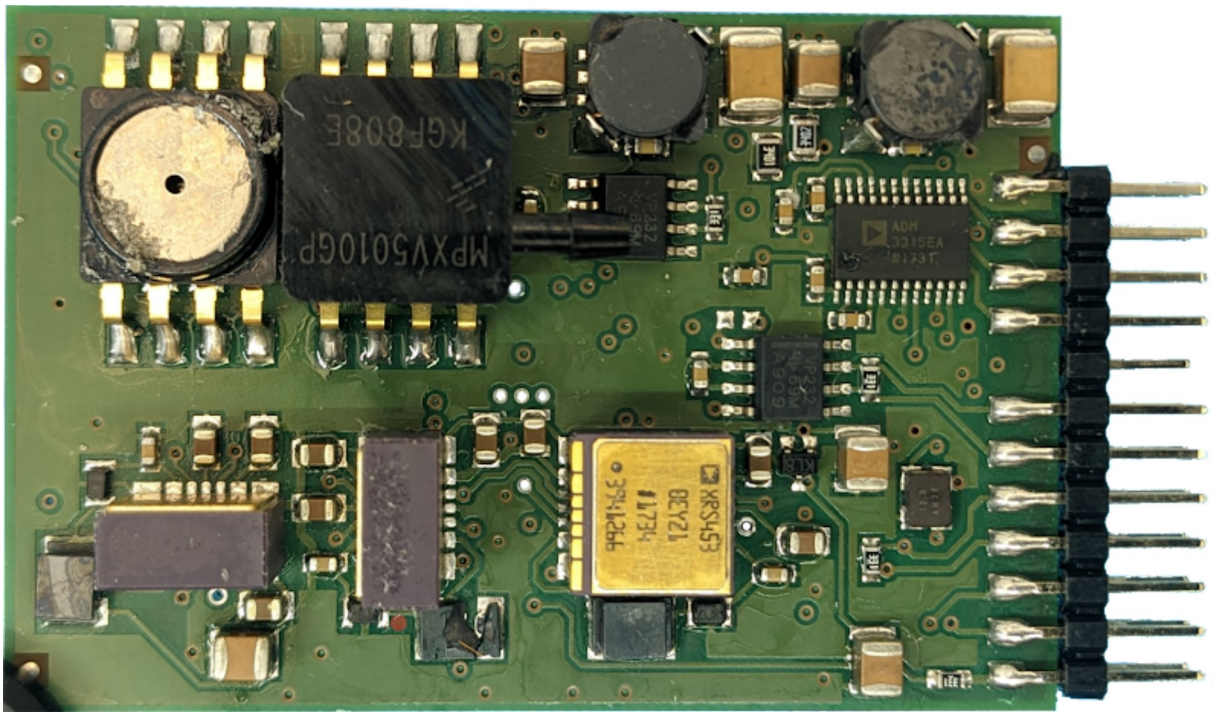
PA1 REV2



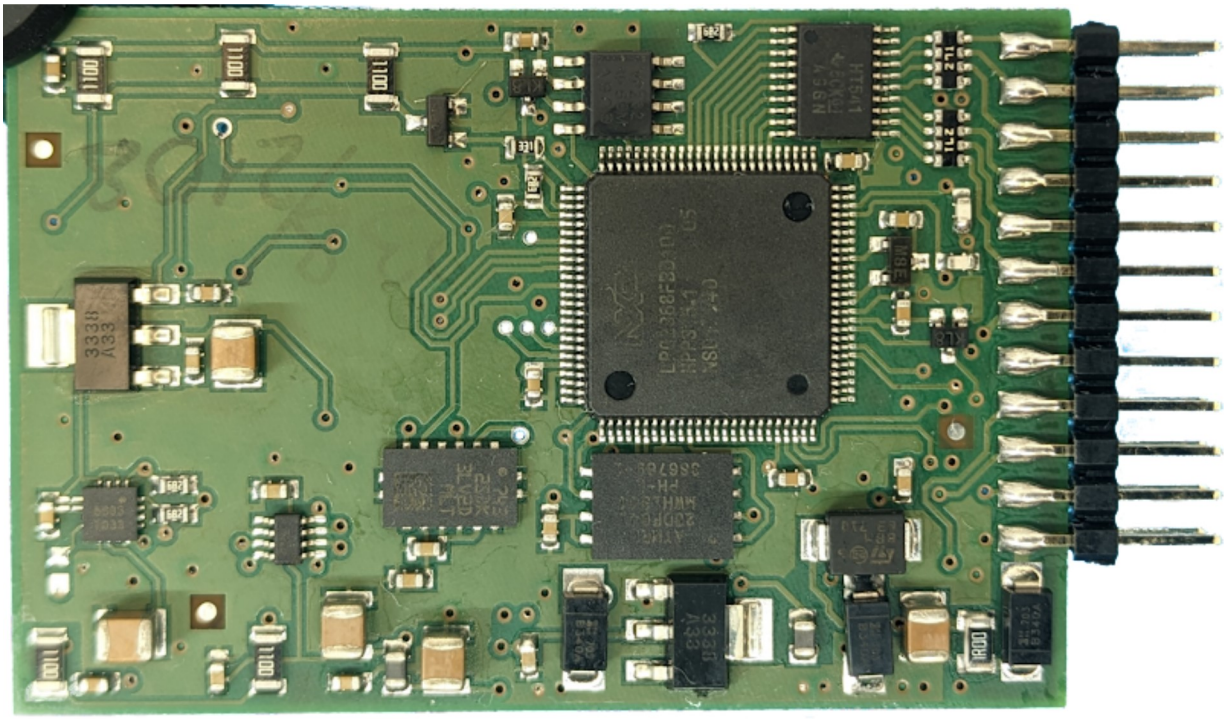
PA: **CGH40010F** (datasheet) 40dBm 10W
LDO: **TPS7A4701** (datasheet)
DC/DC: **TPS55340** (datasheet)
LNR: **TPS7A30** (datasheet)
Filter: **CSBP-01228** (datasheet) Bandpass filter 1203 - 1253 MHz
** connected to input*

Zala Flight Controller

Side A



Side A



Side B

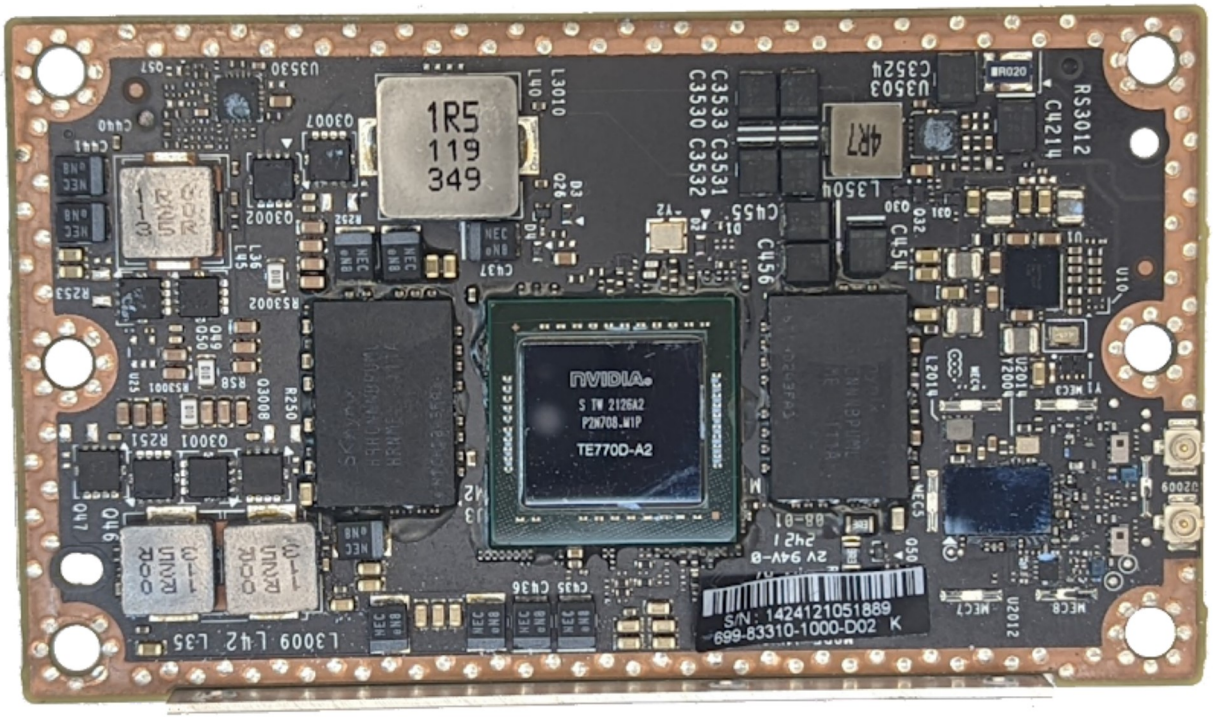
Zala Flight Controller Components

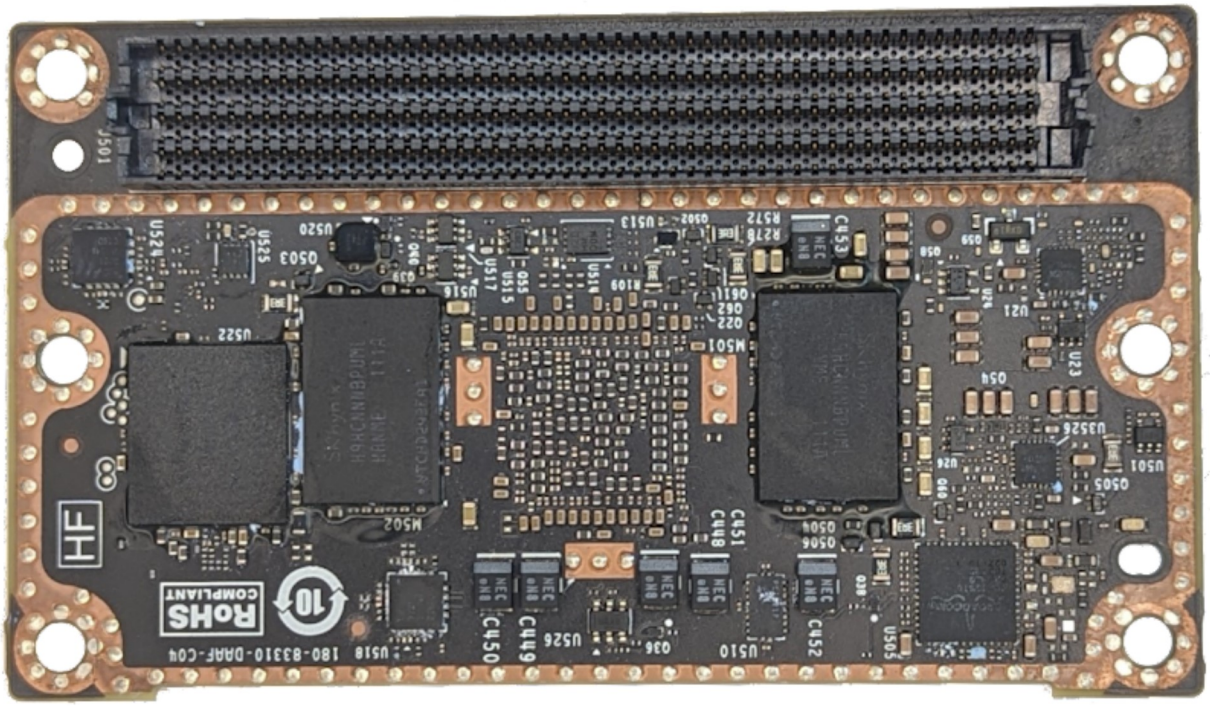
Gyroscope: **ADXRS453BEYZ**	(datasheet) 3x pcs
MEMS Sensor: **3LV2D**	(datasheet)
Compass: **HMC5883L**	(datasheet)
MCU: **NXP LPC2368FBD100**	(datasheet)
NOR Flash: **AT25DF641**	(datasheet) 64-Mbit
Serial: **ADM3315EA**	(datasheet)
ULPS: **MPXV5010GP**	(datasheet)
ULPS: **MPXA4115A**	(datasheet)
CAN: **VP232**	(datasheet) 3x pcs
Buffer: **HT541**	(datasheet)

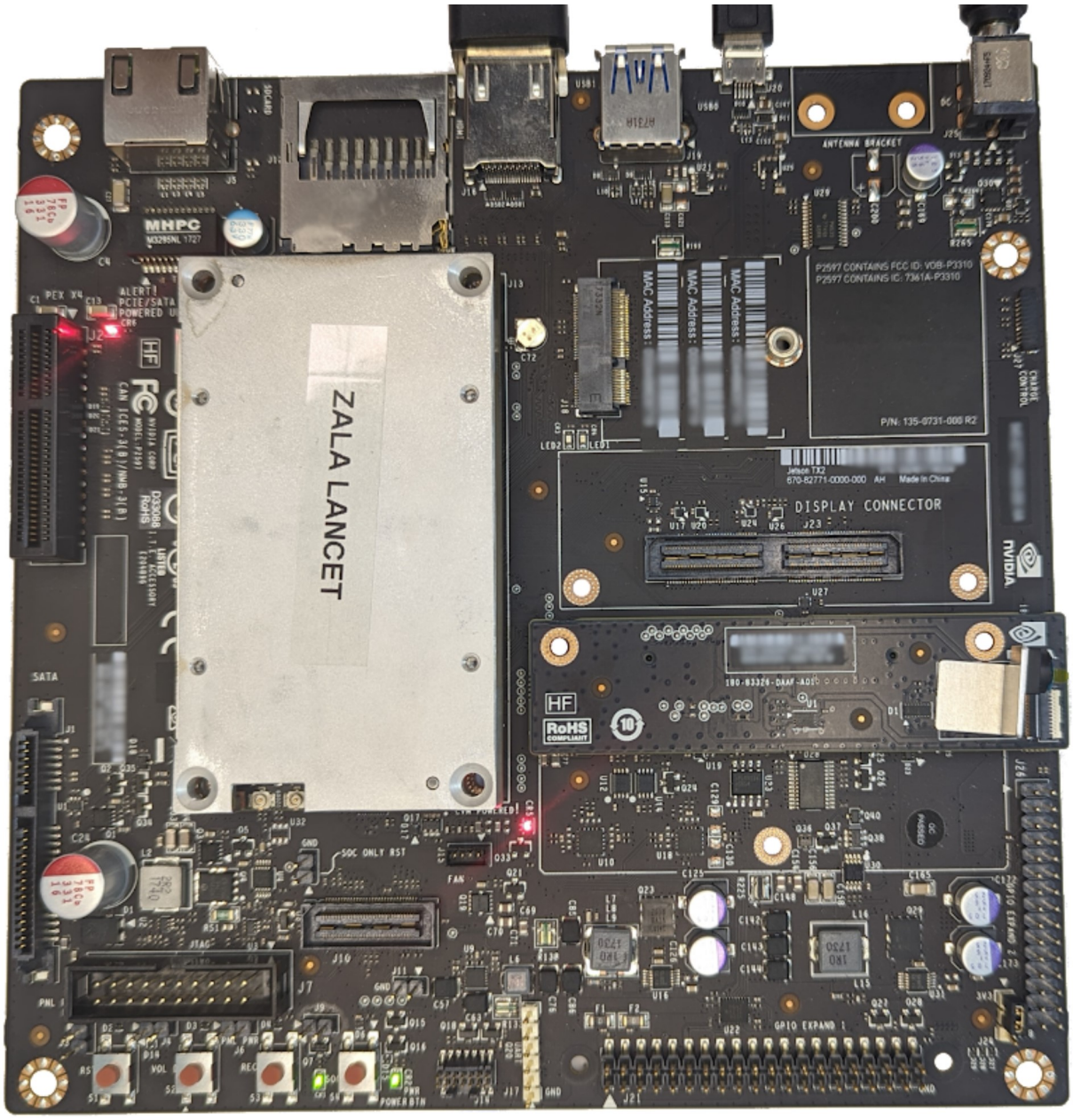
Interfaces: **3xCAN, 2xUART**

Zala Video Targeting System

Used in: **Zala Lancet**







NVIDIA Jetson TX2 Developer Kit & Zala Lancet Jetson TX2 Module

- [NVIDIA Jetson TX2 NX Pin and Function Names Guide]
- [JETSON TX2 DEVELOPER KIT User Guide]

UART

UART can be used to enter U-Boot mode

```
## U-Boot
U-Boot 2016.07 (Dec 18 2019 - 14:12:50 +0500)

TEGRA186
Model: NVIDIA P2771-0000-500
 DRAM: 7.8 GiB
   MC: Tegra SD/MMC: 0, Tegra SD/MMC: 1
*** Warning - bad CRC, using default environment

In:    serial
```

```
Out:   serial
Err:   serial
Net:   eth0: ethernet@2490000
*Hit any key to stop autoboot:  0
Tegra186 (P2771-0000-500) # printenv
arch=arm
baudrate=115200
board=p2771-0000
board_name=p2771-0000
boot_a_script=load ${devtype} ${devnum}:${distro_bootpart} ${scriptaddr} ${prefix}${script};
source ${scriptaddr}
boot_efi_binary=load ${devtype} ${devnum}:${distro_bootpart} ${kernel_addr_r} efi/boot
/bootaa64.efi; if fdt addr ${fdt_addr_r}; then bootefi ${kernel_addr_r} ${fdt_addr_r};else
bootefi ${kernel_addr_r} ${fdtcontroladdr};fi
boot_extlinux=sysboot ${devtype} ${devnum}:${distro_bootpart} any ${scriptaddr}
${prefix}extlinux/extlinux.conf
boot_net_pci_enum=pci enum
boot_net_usb_start=usb start
boot_prefixes=/ /boot/
boot_script_dhcp=boot.scr.uimg
boot_scripts=boot.scr.uimg boot.scr
boot_targets=mmc1 mmc0 usb0 pxe dhcp
bootcmd=run distro_bootcmd
bootcmd_dhcp=run boot_net_usb_start; run boot_net_pci_enum; if dhcp ${scriptaddr}
${boot_script_dhcp}; then source ${scriptaddr}; fi;setenv efi_fdtfile ${fdtfile}; setenv
efi_old_vci ${bootp_vci};setenv efi_old_arch ${bootp_arch};setenv bootp_vci
PXEClient:Arch:00011:UNDI:003000;setenv bootp_arch 0xb;if dhcp ${kernel_addr_r}; then tftpboot
${fdt_addr_r} dtb/${efi_fdtfile};if fdt addr ${fdt_addr_r}; then bootefi ${kernel_addr_r}
${fdt_addr_r}; else bootefi ${kernel_addr_r} ${fdtcontroladdr};fi;fi;setenv bootp_vci
${efi_old_vci};setenv bootp_arch ${efi_old_arch};setenv efi_fdtfile;setenv efi_old_arch;setenv
efi_old_vci;
bootcmd_mmc0=setenv devnum 0; run mmc_boot
bootcmd_mmc1=setenv devnum 1; run mmc_boot
bootcmd_pxe=run boot_net_usb_start; run boot_net_pci_enum; dhcp; if pxe get; then pxe boot; fi
bootcmd_usb0=setenv devnum 0; run usb_boot
bootdelay=2
calculated_vars=kernel_addr_r fdt_addr_r scriptaddr pxefile_addr_r ramdisk_addr_r
cbootargs=root=/dev/mmcblk0p1 rw rootwait console=tty0 fbcon=map:0 net.ifnames=0 video=tegrafb
no_console_suspend=1 earlycon=uart8250,mmio32,0x3100000 nvdumper_reserved=0x2772e0000 gpt
usbcore.old_scheme_first=1 tegraid=18.1.2.0.0 maxcpus=6 boot.slot_suffix=
boot.ratchetvalues=0.983071.1 bl_prof_dataptr=0x10000@0x275840000
sdhci_tegra.en_boot_part_access=1
cpu=armv8
defaultdevplist=1
distro_bootcmd=for target in ${boot_targets}; do run bootcmd_${target}; done
efi_dtb_prefixes=/ /dtb/ /dtb/current/
ethaddr=48:b0:2d:1f:2c:0f
fdt_addr=80000000
fdt_addr_r=82400000
fdt_addr_r_align=00200000
fdt_addr_r_offset=00000000
fdt_addr_r_size=00200000
fdt_copy_node_paths=/chosen/plugin-manager:/chosen/reset:/memory@80000000
fdt_copy_prop_paths=/bpmp/carveout-start:/bpmp/carveout-size:/chosen/nvidia,bluetooth-mac:/chosen
/nvidia,ether-mac:/chosen/nvidia,wifi-mac:/chosen/ecid:/chosen/linux,initrd-start:/chosen
/linux,initrd-end:/serial-number
fdt_copy_src_addr=80000000
fdt_high=ffffffffffffffff
fdtcontroladdr=ffb2e280
initrd_high=ffffffffffffffff
kernel_addr_r=80280000
kernel_addr_r_aliases=loadaddr
kernel_addr_r_align=00200000
kernel_addr_r_offset=00080000
kernel_addr_r_size=02000000
load_efi_dtb=load ${devtype} ${devnum}:${distro_bootpart} ${fdt_addr_r} ${prefix}${efi_fdtfile}
loadaddr=80280000
mmc_boot=if mmc dev ${devnum}; then setenv devtype mmc; run scan_dev_for_boot_part; fi
```

```
pxefile_addr_r=82800000
pxefile_addr_r_align=00200000
pxefile_addr_r_offset=00000000
pxefile_addr_r_size=00200000
ramdisk_addr_r=82a00000
ramdisk_addr_r_align=00200000
ramdisk_addr_r_offset=00000000
ramdisk_addr_r_size=02000000
scan_dev_for_boot=echo Scanning ${devtype} ${devnum}:${distro_bootpart}...; for prefix in
${boot_prefixes}; do run scan_dev_for_extlinux; run scan_dev_for_scripts; done;run
scan_dev_for_efi;
scan_dev_for_boot_part=part list ${devtype} ${devnum} -bootable devplist; env exists devplist ||
setenv devplist $defaultdevplist; for distro_bootpart in ${devplist}; do if fstype ${devtype}
${devnum}:${distro_bootpart} bootfstype; then run scan_dev_for_boot; fi; done
scan_dev_for_efi=setenv efi_fdtfile ${fdtfile}; for prefix in ${efi_dtb_prefixes}; do if test -e
${devtype} ${devnum}:${distro_bootpart} ${prefix}${efi_fdtfile}; then run load_efi_dtb;
fi;done;if test -e ${devtype} ${devnum}:${distro_bootpart} efi/boot/bootaa64.efi; then echo Found
EFI removable media binary efi/boot/bootaa64.efi; run boot_efi_binary; echo EFI LOAD FAILED:
continuing...; fi; setenv efi_fdtfile
scan_dev_for_extlinux=if test -e ${devtype} ${devnum}:${distro_bootpart}
${prefix}extlinux/extlinux.conf; then echo Found ${prefix}extlinux/extlinux.conf; run
boot_extlinux; echo SCRIPT FAILED: continuing...; fi
scan_dev_for_scripts=for script in ${boot_scripts}; do if test -e ${devtype}
${devnum}:${distro_bootpart} ${prefix}${script}; then echo Found U-Boot script
${prefix}${script}; run boot_a_script; echo SCRIPT FAILED: continuing...; fi; done
scriptaddr=82600000
scriptaddr_align=00200000
scriptaddr_offset=00000000
scriptaddr_size=00200000
soc=tegra186
stderr=serial
stdin=serial
stdout=serial
usb_boot=usb start; if usb dev ${devnum}; then setenv devtype usb; run scan_dev_for_boot_part; fi
vendor=nvidia
Environment size: 5010/8188 bytes

Tegra186 (P2771-0000-500) # mmcinfo
Device: Tegra SD/MMC
Manufacturer ID: 45
OEM: 100
Name: DG403
Tran Speed: 52000000
Rd Block Len: 512
MMC version 5.1
High Capacity: Yes
Capacity: 29.1 GiB
Bus Width: 8-bit
Erase Group Size: 512 KiB
HC WP Group Size: 8 MiB
User Capacity: 29.1 GiB WRREL
Boot Capacity: 4 MiB ENH
RPMB Capacity: 4 MiB ENH
```

Copying eMMC memory

HowTo: https://elinux.org/Jetson/TX2_Cloning

Prepare OS: Ubuntu 18.04
GoTo: https://developer.nvidia.com/embedded/linux-tegra-r321
Download: [L4T Driver Package (BSP)]

```
└─$ tar -xvf ./JAX-TX2-Jetson_Linux_R32.1.0_aarch64.tbz2
└─$ cd Linux_for_Tegra
```

Backup system partition

```
# Connect Jetson TX2 USB to Host PC
# Boot Jetson-TX2 to Recovery mode: Hold [Recovery] button & power on
# It is recommended to perform all actions on Ubuntu 18.04

└─$ sudo ./flash.sh -r -k APP -G APP.img jetson-tx2 mmcblk0p1
└─$ sha256sum APP.img.raw
f14c9b0be85a19be1499e38e7e925aa1551a426dfb3ade2e79b68a08366d0eae
```

Backup other partitions

Partitions can be found in bootloader/flash.xml

```
└─$ cat bootloader/flash.xml | grep "partition name" | cut -d '"' -f 2

└─$ sudo ./flash.sh -r -k adsp-fw -G adsp-fw.img jetson-tx2 mmcblk0p1
└─$ sudo ./flash.sh -r -k APP -G APP.img jetson-tx2 mmcblk0p1
└─$ sudo ./flash.sh -r -k BMP -G BMP.img jetson-tx2 mmcblk0p1
└─$ sudo ./flash.sh -r -k bootloader-dtb -G bootloader-dtb.img jetson-tx2
mmcblk0p1
└─$ sudo ./flash.sh -r -k bpmp-fw -G bpmp-fw.img jetson-tx2 mmcblk0p1
└─$ sudo ./flash.sh -r -k bpmp-fw_b -G bpmp-fw_b.img jetson-tx2 mmcblk0p1
└─$ sudo ./flash.sh -r -k bpmp-fw-dtb -G bpmp-fw-dtb.img jetson-tx2 mmcblk0p1
└─$ sudo ./flash.sh -r -k cpu-bootloader -G cpu-bootloader.img jetson-tx2
mmcblk0p1
└─$ sudo ./flash.sh -r -k kernel -G kernel.img jetson-tx2 mmcblk0p1
└─$ sudo ./flash.sh -r -k kernel_b -G kernel_b.img jetson-tx2 mmcblk0p1
└─$ sudo ./flash.sh -r -k kernel-dtb -G kernel-dtb.img jetson-tx2 mmcblk0p1
└─$ sudo ./flash.sh -r -k kernel-dtb_b -G kernel-dtb_b.img jetson-tx2
mmcblk0p1
└─$ sudo ./flash.sh -r -k secure-os -G secure-os.img jetson-tx2 mmcblk0p1
└─$ sudo ./flash.sh -r -k secure-os_b -G secure-os_b.img jetson-tx2 mmcblk0p1
└─$ sudo ./flash.sh -r -k SOS -G SOS.img jetson-tx2 mmcblk0p1
└─$ sudo ./flash.sh -r -k spe-fw -G spe-fw.img jetson-tx2 mmcblk0p1
```

How to run this image on another module from a flash drive

```
# Boot Jetson-TX2 to Recovery mode: Hold [Recovery] button & power on
# Use 32GB+ USB Flash Drive (host PC: /dev/sdb1 & Jetson: /dev/sda1)

└─$ sudo BOOTDEV=sda1 ./flash.sh --no-flash jetson-tx2 sda1
└─$ sudo mkfs.ext4 /dev/sdb1
└─$ sudo mount /dev/sdb1 /media/
└─$ mkdir ./mount
└─$ sudo mount -o loop APP.img.raw ./mount/
└─$ sudo rsync -axHAWX --numeric-ids --info=progress2 --exclude=/proc ./mount/
/media
 16,427,986,031  97%   16.50MB/s    0:15:49 (xfr#191757, ir-chk=1146/255299)
└─$ sudo umount /media
└─$ sudo umount ./media

# Boot Jetson-TX2 to Recovery mode: Hold [Recovery] button & power on
# Connect USB Flash Drive to Jetson TX2

└─$ sudo ./flash.sh jetson-tx2 sda1

# Reboot
# Also you may need to:
       Copy ./mount/boot to ../Linux_for_Tegra/rootfs/boot
       Copy ./mount/boot/Image ../Linux_for_Tegra/kernel/ & DTB files
       Replace Kernel on Jetson-TX2 module
```

File System Analysis

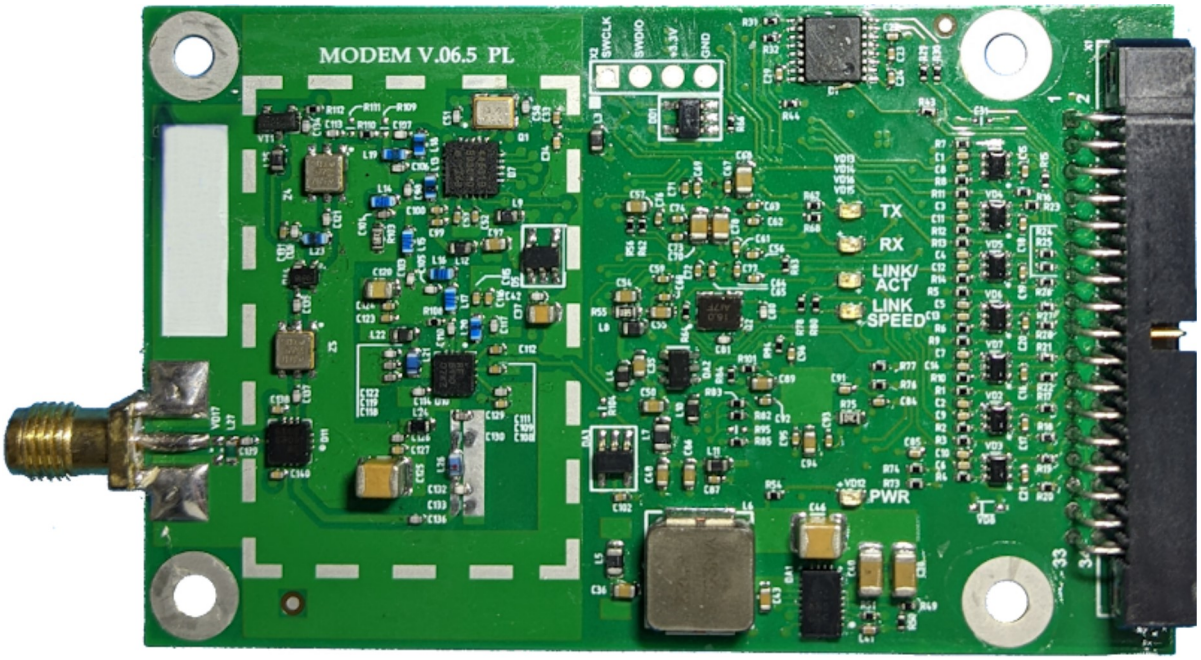
```
└─# du -sh /*
9,7M    /bin
51M     /boot
4,0K    /dev
12M     /etc
62M     /home
1,3G    /lib
16K     /lost+found
4,0K    /media
28K     /mnt
17M     /opt
4,0K    /proc
4,0K    /README.txt
128K    /root
4,0K    /run
11M     /sbin
8,0K    /snap
4,0K    /srv
4,0K    /sys
44K     /tmp
8,8G    /usr
12G     /var
└─# cat /etc/shadow
nvidia:$6$BK1i/MQD$uPq5H1.aS/w.EUm8qgLQuuON0wW8QB1EgK1BOg1hZQ1LqsvniLtKH84aQ0K8LTz1AjGb1eCn4r346/g2zC8OG.:17559:0:99999:7:::
datadownloader:$6$ecNSAvHs$MyARBfeBKIfgavEuuw3XqEZVdW3U5mjb0SWvvw8L01DNXpgRa./UJ8JYDRBuWbPYN/A5pfkI3ni7yGVigzwoY1:17559:0:99999:7:::
└─# cat /etc/network/interfaces
auto eth0
allow-hotplug eth0
iface eth0 inet static
       address 192.168.88.125
       netmask 255.255.255.0
       gateway 192.168.88.99
└─# cat /etc/network/interfaces.can.txt
auto can1
iface can1 inet manual
       pre-up /sbin/ip link set $IFACE type can bitrate 421052 dbitrate 2000000 berr-reporting on fd on
       up /sbin/ifconfig $IFACE up
       down /sbin/ifconfig $IFACE down
└─# find / -name *Zala*
/var/home/nvidia/ZalaAero
/var/home/nvidia/ZalaAero/ZalaTegraConnectionDuplicator
/var/home/nvidia/ZalaAero/ZalaTegraVideo
/home/nvidia/ZalaAero
/home/nvidia/ZalaAero/ZalaTegraVideoComRepeater
/home/nvidia/ZalaAero/ZalaTegraTestJM
/home/nvidia/ZalaAero/ZalaTegraConnectionDuplicator
/home/nvidia/ZalaAero/ZalaTegraVideo
└─# tree /home/nvidia/ZalaAero/
/home/nvidia/ZalaAero/
├── core.conf
├── duplicator.conf
├── libfastmcd.so -> libfastmcd.so.1.0.0
├── libfastmcd.so.1 -> libfastmcd.so.1.0.0
├── libfastmcd.so.1.0 -> libfastmcd.so.1.0.0
├── libfastmcd.so.1.0.0
├── libudt.so -> libudt.so.1.0.0
├── libudt.so.1 -> libudt.so.1.0.0
├── libudt.so.1.0 -> libudt.so.1.0.0
├── libudt.so.1.0.0
├── repeater.conf
├── ZalaTegraConnectionDuplicator
├── ZalaTegraTestJM
├── ZalaTegraVideo
└── ZalaTegraVideoComRepeater
└─# stat /home/nvidia/.bash_history
Access: 2023-04-17 15:27:01.541122294 +0300
Modify: 2020-06-19 18:48:38.344000000 +0300
Change: 2020-06-19 18:48:38.348000000 +0300
└─# find / -type f -newermt '2020-01-01 00:00:00' -exec tar -czvf Zala_Jetson-
TX2_FS.tar.gz {} +
```

[Download]

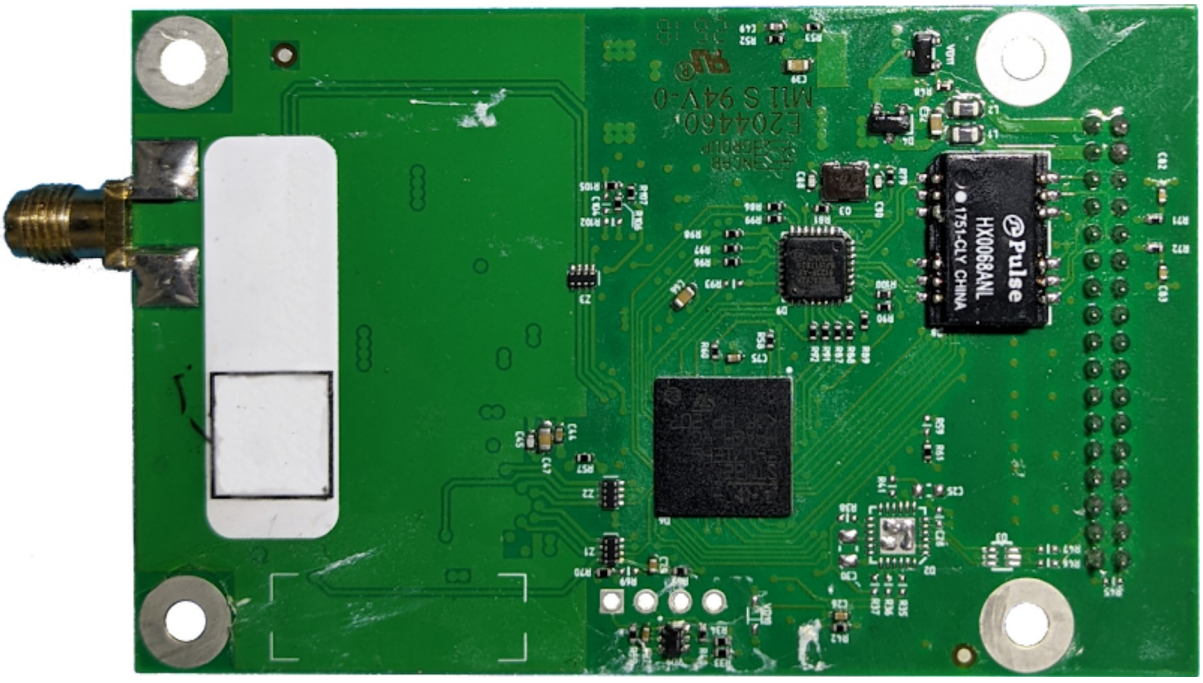
ООО «НПО «ИжБС»

Radio Control Link

Used in: **Granat-1 & Granat-2**



Granat-1/Granat-2 MODEM V.06.5 PL (Side A)



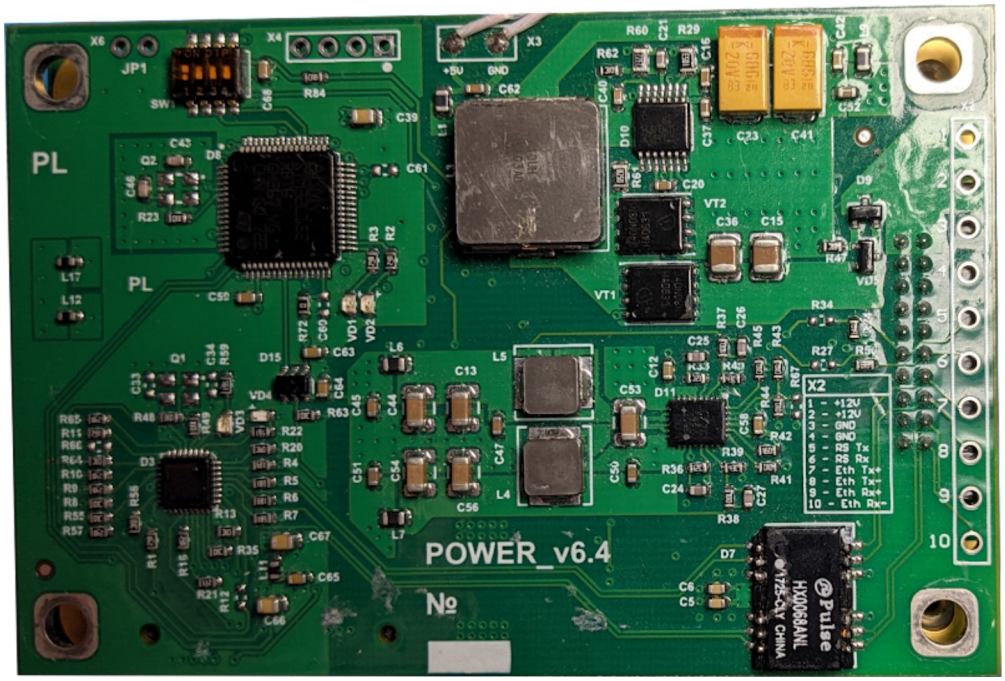
Granat-1/Granat-2 MODEM V.06.5 PL (Side B)

RF Chip: **Si4463** [datasheet]
SAW Filter: **Epcos B3717** [datasheet]
LNA: **0618**
PA: **RF5110** [datasheet]
Serial: **ADM3202**
Ethernet: **SMSC 8710A**
MCU: **STM32F417IE** [datasheet]

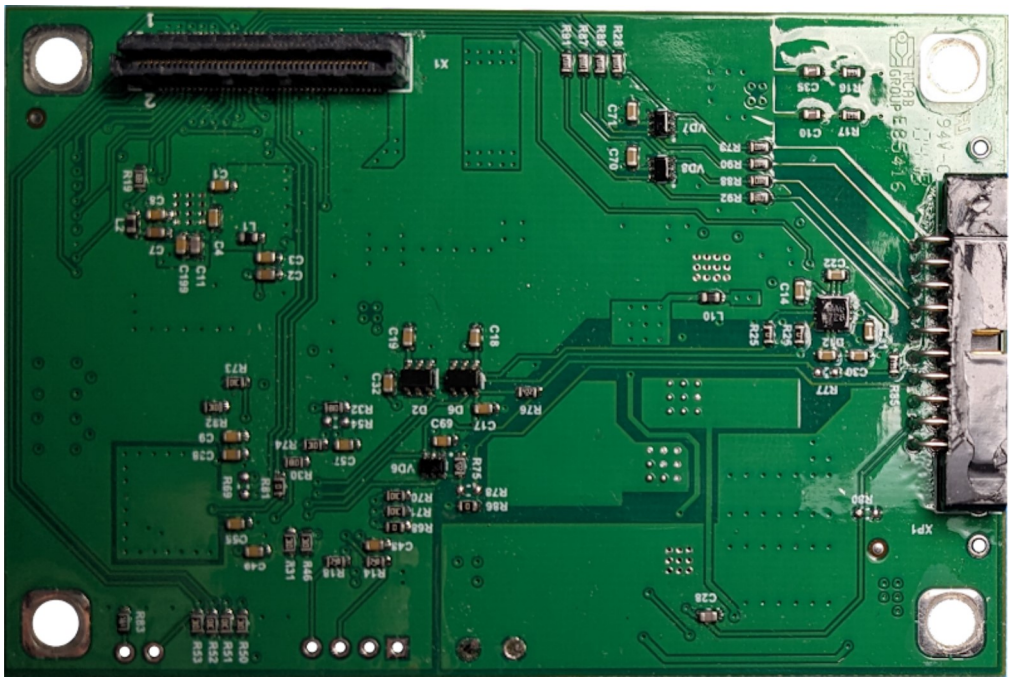
Ports: **SWD debug, Ethernet, UART**

IP Video Link

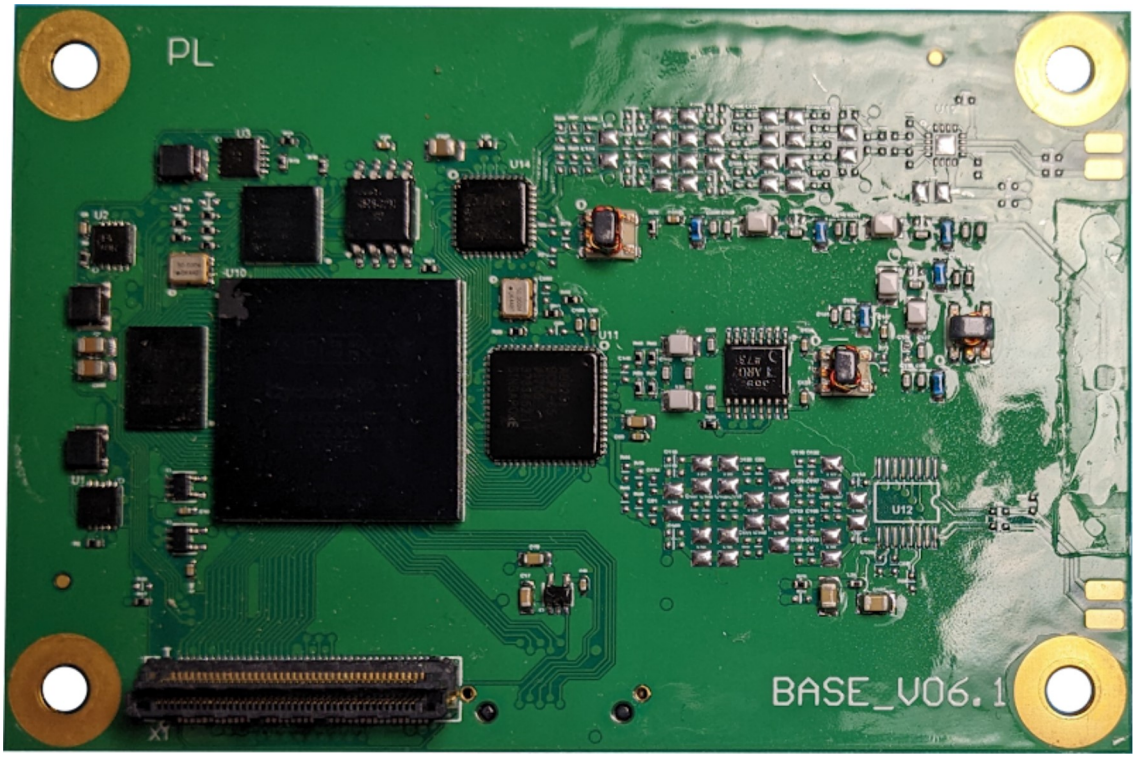
Used in: **Granat-1 & Granat-2**



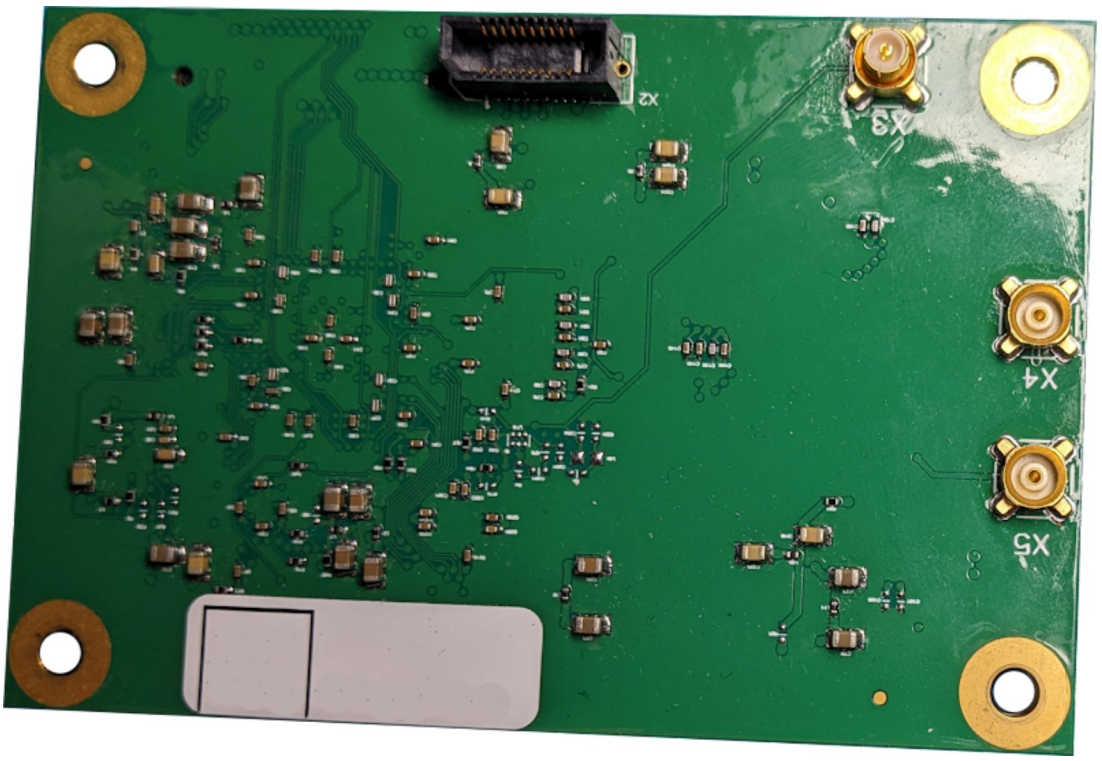
POWER_v6.4 (Side A)



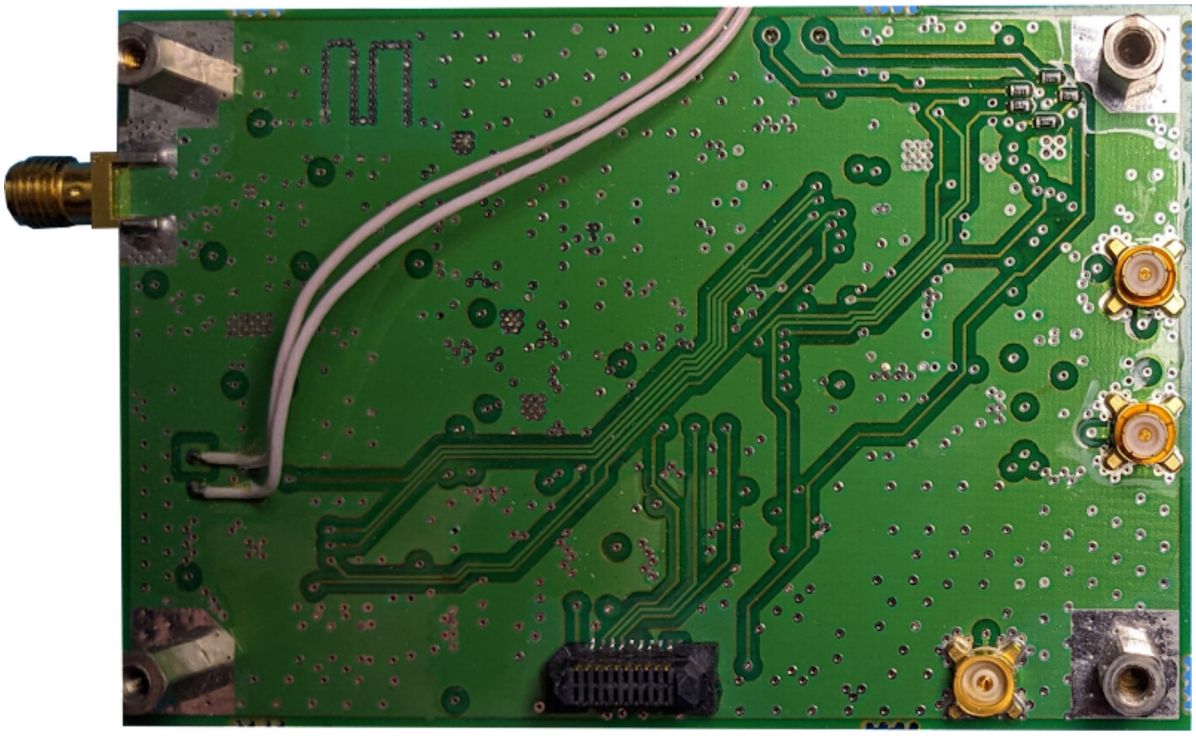
POWER_v6.4 (Side B)



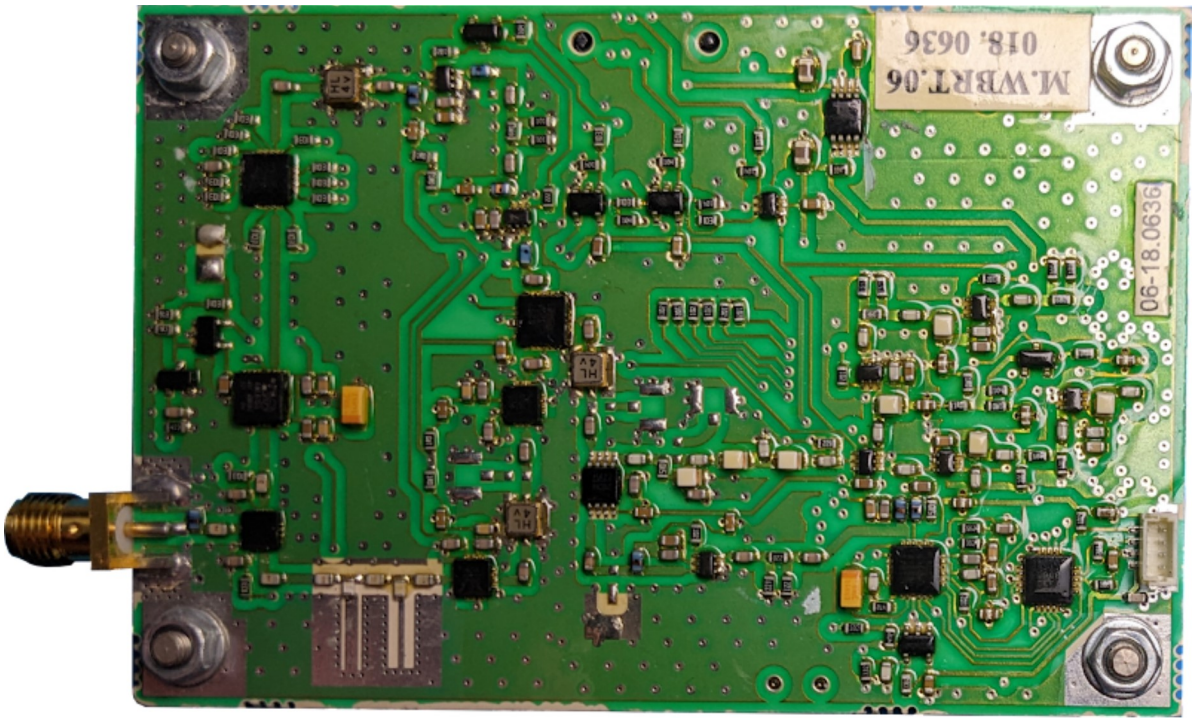
BASE_V06.1 (Side C)



BASE_V06.1 (Side D)



M.WBRT.06-018.0636 (Side E)



M.WBRT.06-018.0636 (Side F)

POWER_v6.4 + BASE_V06.1 + M.WBRT.06-018.0636 Components

PA: **AWL6153** [datasheet]
DA: **PE4306** [datasheet]
RF Switch: **PE4257** [datasheet]
FPGA: **ALTERA Cyclone IV EP4CE55U19I7N**
ADC: **AD9251-BCPZ-65** [datasheet]
DAC: **AD9717** [datasheet]
SPI Flash: **AT45DB321D** [datasheet]
CPLD: **Altera 5M570ZT100** [datasheet]
RAM: **CY62147** [datasheet]
MCU: **STM32L152**
Ethernet: **SMSC 8710A**
Mosfet: **340N08N** [datasheet]

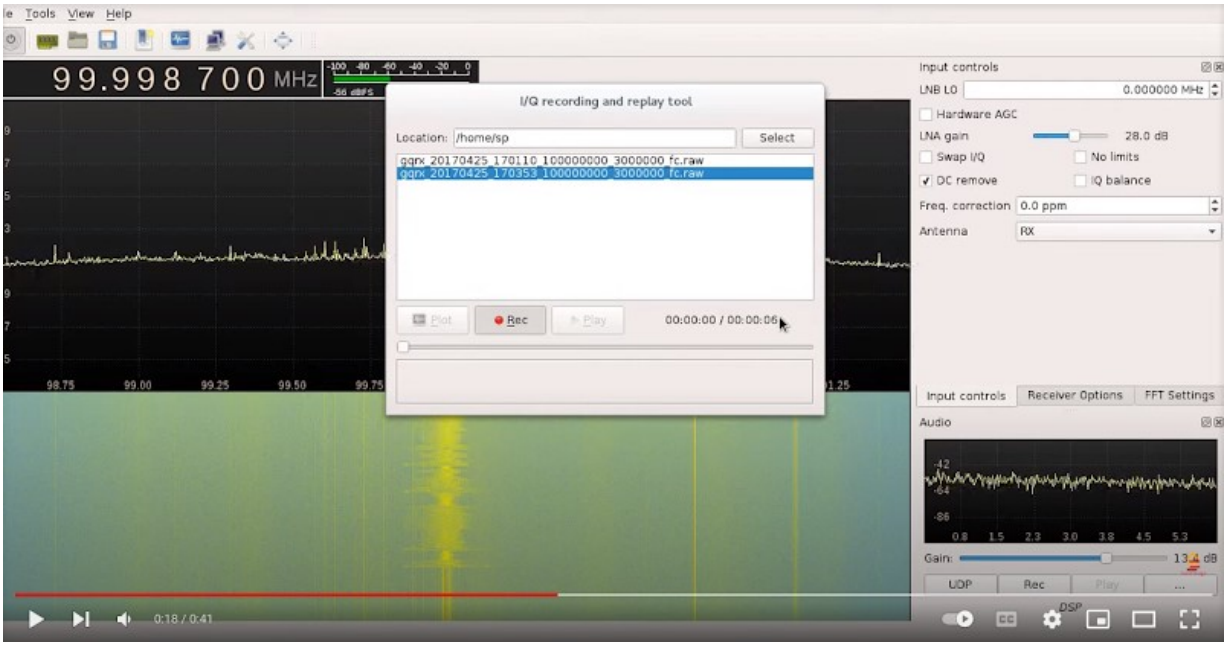
Ports: **SWD, Ethernet, UART**

HOWTO

Theory

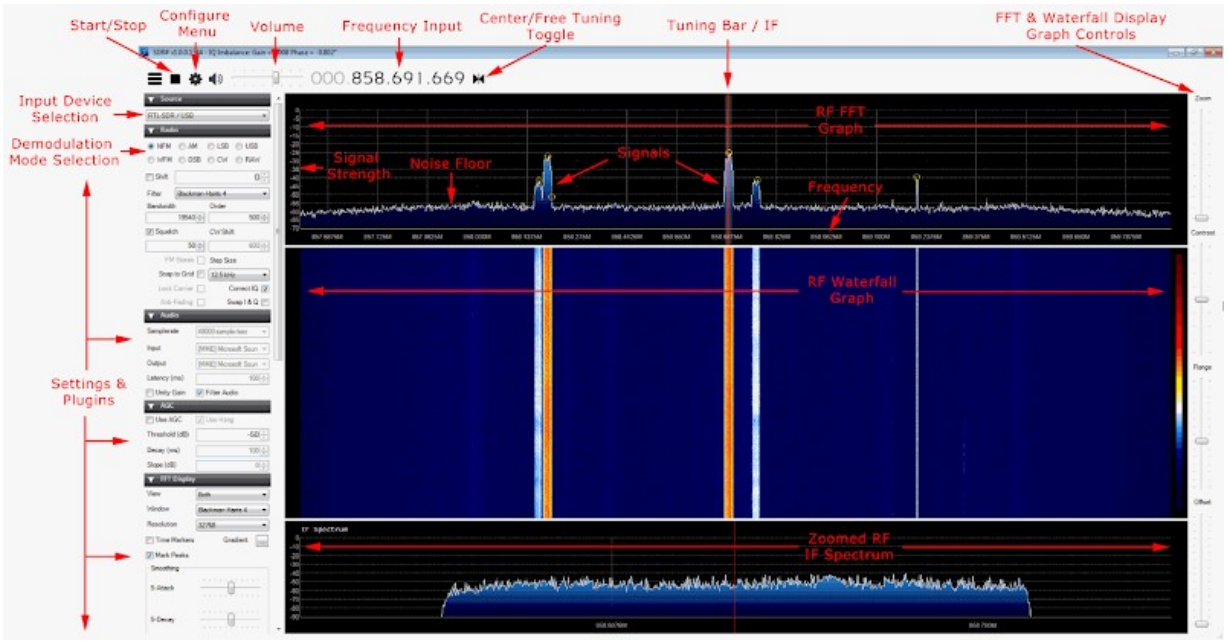
- Digital Modulation (Part One)
- Noise and the Shannon Limit
- Bits, Bauds and Bandwidth
- Electromagnetic Waves
- Whole Packet Clock Recovery, Michael Ossmann

Recording IQ using GQRX



IQ recording file in GQRX with RTL-SDR

SDRSharp



SDRSHARP USERS GUIDE

Converting IQ Using SOX

```
*.sigmf-meta, *.sigmf-data - SigMF recordings
*.cf32, *.cfile, *.complex - Complex 32-bit floating point samples (GNU Radio, osmocom_fft)
*.cf64 - Complex 64-bit floating point samples
*.cs16 - Complex 16-bit signed integer samples (BladeRF)
*.cs8 - Complex 8-bit signed integer samples (HackRF)
*.cu8 - Complex 8-bit unsigned integer samples (RTL-SDR)
```

```
*.f32 - Real 32-bit floating point samples
*.f64 - Real 64-bit floating point samples (MATLAB)
*.s16 - Real 16-bit signed integer samples
*.s8 - Real 8-bit signed integer samples
*.u8 - Real 8-bit unsigned integer samples
```

- https://pysdr.org/content/iq_files.html
- https://pysdr.org/content/sampling.html
- https://triq.org/rtl_433/IQ_FORMATS.html#i-q-sample-data-formats

SigMF > cs8 (HackRF)

```
└─$ sox -e signed-integer -t raw -r 48000 -b 16 -c 2
SDRSharp_20221210_000000Z_915000000Hz_IQ.sigmf-data -t raw -e signed-integer
-b 8 -c 2 -r 48000 HackRF_20221210_000000Z_915000000Hz_sample.cs8
```

Transmit IQ using HackRF

```
└─$ hackrf_transfer -t HackRF_20221210_000000Z_915000000Hz_sample.cs8 -x 20 -f
915000000 -s 12800000 -a 1 -R
```

Transmit IQ using BladeRF

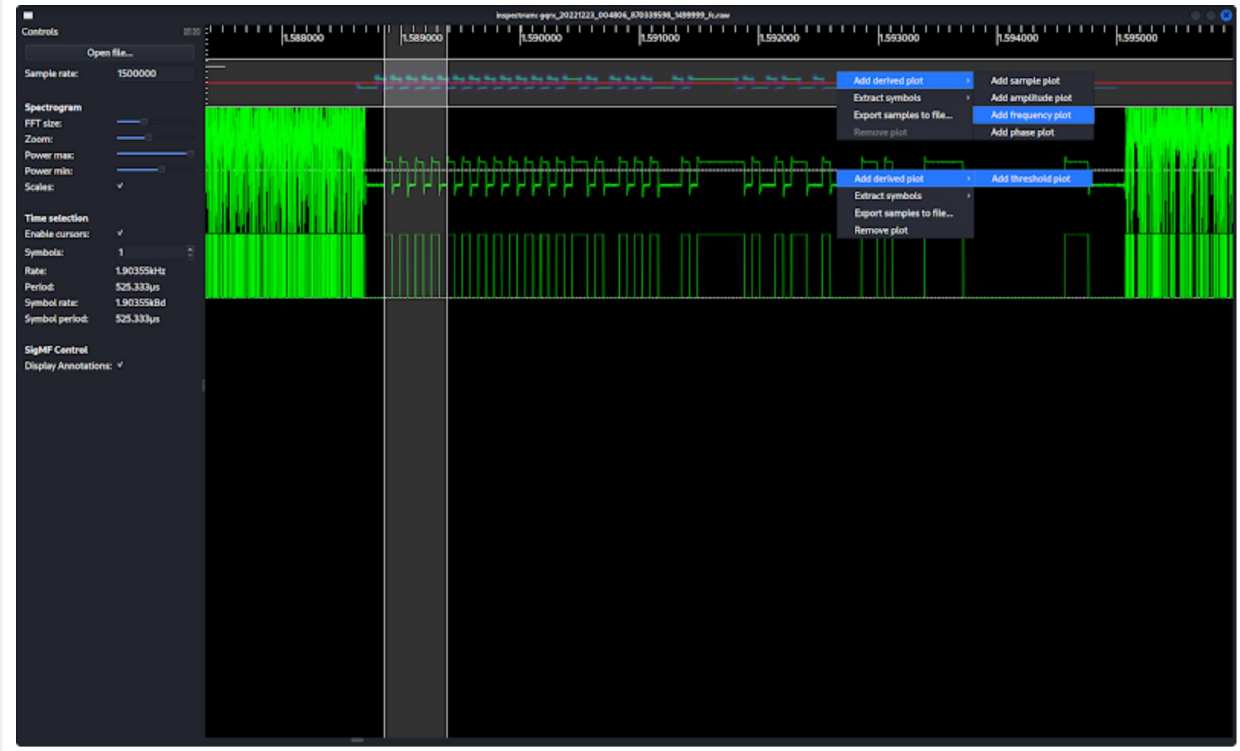
HowTo:

- https://github.com/Nuand/bladeRF/wiki/bladeRF-CLI-Tips-and-Tricks

Signal Analysis with Triq

- https://triq.org/iqs

Signal Analysis with Inspectrum



Baudrate Table

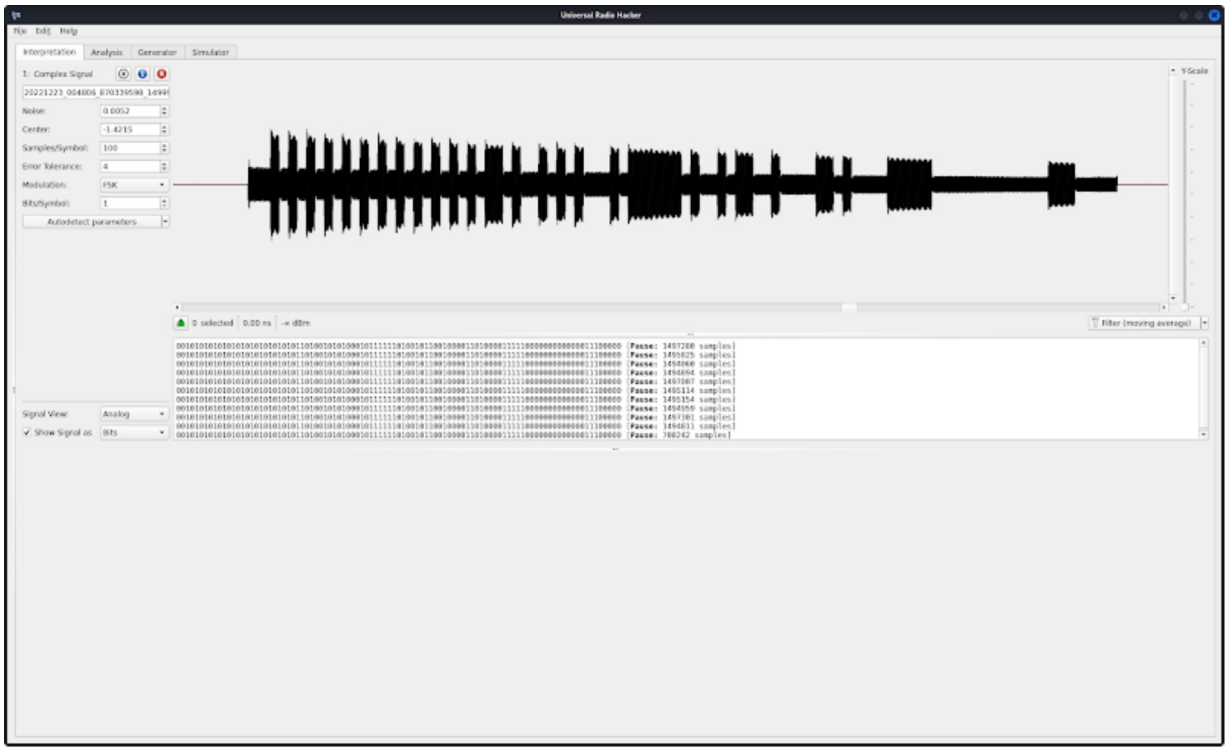
Most common baud rates table

Bauds	Bits/s	Bit duration	Speed	Actual speed	Actual byte duration
50 bauds	50 bits/s	20.000 ms	6.25 bytes/s	5 bytes/s	200.000 ms
75 bauds	75 bits/s	13.333 ms	9.375 bytes/s	7.5 bytes/s	133.333 ms
110 bauds	110 bits/s	9.091 ms	13.75 bytes/s	11 bytes/s	90.909 ms
134 bauds	134 bits/s	7.463 ms	16.75 bytes/s	13.4 bytes/s	74.627 ms
150 bauds	150 bits/s	6.667 ms	18.75 bytes/s	15 bytes/s	66.667 ms
200 bauds	200 bits/s	5.000 ms	25 bytes/s	20 bytes/s	50.000 ms
300 bauds	300 bits/s	3.333 ms	37.5 bytes/s	30 bytes/s	33.333 ms
600 bauds	600 bits/s	1.667 ms	75 bytes/s	60 bytes/s	16.667 ms
1200 bauds	1200 bits/s	833.333 µs	150 bytes/s	120 bytes/s	8.333 ms
1800 bauds	1800 bits/s	555.556 µs	225 bytes/s	180 bytes/s	5.556 ms

2400 bauds	2400 bits/s	416.667 µs	300 bytes/s	240 bytes/s	4.167 ms
4800 bauds	4800 bits/s	208.333 µs	600 bytes/s	480 bytes/s	2.083 ms
9600 bauds	9600 bits/s	104.167 µs	1200 bytes/s	960 bytes/s	1.042 ms
19200 bauds	19200 bits/s	52.083 µs	2400 bytes/s	1920 bytes/s	520.833 µs
28800 bauds	28800 bits/s	34.722 µs	3600 bytes/s	2880 bytes/s	347.222 µs
38400 bauds	38400 bits/s	26.042 µs	4800 bytes/s	3840 bytes/s	260.417 µs
57600 bauds	57600 bits/s	17.361 µs	7200 bytes/s	5760 bytes/s	173.611 µs
76800 bauds	76800 bits/s	13.021 µs	9600 bytes/s	7680 bytes/s	130.208 µs
115200 bauds	115200 bits/s	8.681 µs	14400 bytes/s	11520 bytes/s	86.806 µs
230400 bauds	230400 bits/s	4.340 µs	28800 bytes/s	23040 bytes/s	43.403 µs
460800 bauds	460800 bits/s	2.170 µs	57600 bytes/s	46080 bytes/s	21.701 µs
576000 bauds	576000 bits/s	1.736 µs	72000 bytes/s	57600 bytes/s	17.361 µs
921600 bauds	921600 bits/s	1.085 µs	155200 bytes/s	92160 bytes/s	10.851 µs

	Transmission speed			Real transmission speed	
Bauds	**Bit/s**	**Bit duration**	**Speed**	**Speed**	**Byte duration**
50 Bd	50 bits/s	20.000 ms	6.25 bytes/s	5 bytes/s	200.000 ms
75 Bd	75 bits/s	13.333 ms	9.375 bytes/s	7.5 bytes/s	133.333 ms
110 Bd	110 bits/s	9.091 ms	13.75 bytes/s	11 bytes/s	90.909 ms
134 Bd	134 bits/s	7.463 ms	16.75 bytes/s	13.4 bytes/s	74.627 ms
150 Bd	150 bits/s	6.667 ms	18.75 bytes/s	15 bytes/s	66.667 ms
200 Bd	200 bits/s	5.000 ms	25 bytes/s	20 bytes/s	50.000 ms
300 Bd	300 bits/s	3.333 ms	37.5 bytes/s	30 bytes/s	33.333 ms
600 Bd	600 bits/s	1.667 ms	75 bytes/s	60 bytes/s	16.667 ms
1200 Bd	1200 bits/s	833.333 µs	150 bytes/s	120 bytes/s	8.333 ms
1800 Bd	1800 bits/s	555.556 µs	225 bytes/s	180 bytes/s	5.556 ms
2400 Bd	2400 bits/s	416.667 µs	300 bytes/s	240 bytes/s	4.167 ms
4800 Bd	4800 bits/s	208.333 µs	600 bytes/s	480 bytes/s	2.083 ms
9600 Bd	**9600 bits/s**	**104.167 µs**	**1200 bytes/s**	**960 bytes/s**	**1.042 ms**
19200 Bd	19200 bits/s	52.083 µs	2400 bytes/s	1920 bytes/s	520.833 µs
28800 Bd	28800 bits/s	34.722 µs	3600 bytes/s	2880 bytes/s	347.222 µs
38400 Bd	38400 bits/s	26.042 µs	4800 bytes/s	3840 bytes/s	260.417 µs
57600 Bd	57600 bits/s	17.361 µs	7200 bytes/s	5760 bytes/s	173.611 µs
76800 Bd	76800 bits/s	13.021 µs	9600 bytes/s	7680 bytes/s	130.208 µs
115200 Bd	**115200 bits/s**	**8.681 µs**	**14400 bytes/s**	**11520 bytes/s**	**86.806 µs**
230400 Bd	230400 bits/s	4.340 µs	28800 bytes/s	23040 bytes/s	43.403 µs
460800 Bd	460800 bits/s	2.170 µs	57600 bytes/s	46080 bytes/s	21.701 µs
576000 Bd	576000 bits/s	1.736 µs	72000 bytes/s	57600 bytes/s	17.361 µs
921600 Bd	921600 bits/s	1.085 µs	115200 bytes/s	92160 bytes/s	10.851 µs

Signal Analysis with URH



Signal Analysis with GNU Radio

Manuals

- https://community.element14.com/products/roadtest/rv/roadtest_reviews/966/digilent_1x1_usb_sof_2
-

SigMF

- https://github.com/sigmf/SigMF

IQEngine

- https://www.iqengine.org

Detection

Eleron-3	Elescope
Orlan-10 / Orlan-30	Elescope
DJI	DJI Aerocope, Джміль

Counter UAS

- The Counter UAS Directory and Buyer's Guide

Educational materials

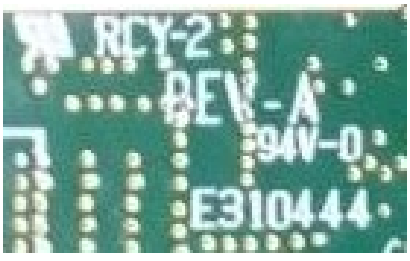
[download]

OSINT

Zala	[Twitter: Zala UAV], [Twitter: Zala БЛА], [Twitter: Zala БПЛА], [Twitter: #ZalaAero],
НПП НТТ	[Презентация],
НИИ СТТ	[Завод "Эдельвейс"],
	- УЧЕБНО-ТЕМАТИЧЕСКИЙ ПЛАН подготовки специалистов по программе «Эксплуатация комплексов с беспилотными летательными аппаратами» - https://www.drive2.ru/c/630468489655616115/ - https://aeronext.aero/press_room/news/261860 - https://www.neter.pro/
ООО СТЦ	- https://spb.hh.ru/employer/2519536

MANUFACTURING & SUPPLIERS

Printed Circuit Board Production

	**PCB production for Granat UAV** NCAB GROUP E204460 M11 S 94V-0 **2618** - NCAB GROUP https://www.ncabgroup.com - GUANGZHOU FAST-PRINT CIRCUIT TECHNOLOGY CO LTD https://en.chinafastprint.com
	**PCB production for Zala UAV** E204460 M11 S94V-0 **4117** - GUANGZHOU FAST-PRINT CIRCUIT TECHNOLOGY CO LTD https://en.chinafastprint.com
	**PCB production for Zala UAV** RCY-2 REV-A 94V-0 E310444 - SHENZHEN REN CHUANG YI ELECTRONIC CO LTD https://www.szrcypcb.com

Key element base suppliers

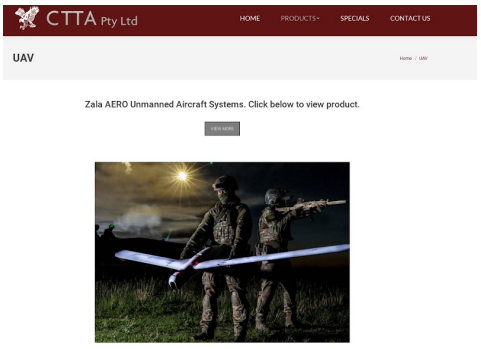
S/N list	Origin	Company, parts, site
	Canada	**Wireless modem for Eleron-3SV** Microhard n920 - https://www.microhardcorp.com
	UK	**COFDM transmitters, decoders & receivers for Eleron-3SV** D350 decoder D681 downconverter - https://www.cobham.com - https://www.domotactical.com
	RU	**RF modules for Orlan UAV** imoTech DP1205-C915 - https://imotech.ru
- 1424121105307	US	**Modules for Zala Lancet UAV** nVidia Jetson TX2 - https://nvidia.com

Factory equipment

 [**video 00:00:24**]	Italy	**Enics UAV manufacturing plant** - Eleron UAV - TWS AUTOMATION s.r.l. - https://www.tws-automation.com
 [**video 00:05:09**]	South Korea	**Zala Aero manufacturing plant** - Zala Lancet - Zala KYB-UAV - Hyundai WIA - https://machine.hyundai-wia.com

	Switzerland Germany France USA	**Zala Aero manufacturing plant** - Essem - https://essemtec.com - https://www.nano-di.com

Resellers

	**CTTA Pty Ltd - ZALA UAV Seller in South Africa** **Phone:** +27 86 68 40089 +27 21 79 40512 +27 82 82 88812 **Mail:** sales@grenadier.co.za **Address:** P.O. Box 30366 Tokai 7966 South Africa **Site:** https://www.grenadier.co.za **Catalog:** [**link**][**link**]

Company Structure

- АО «ВНИИ «Сигнал»
- АО «ВНИИР Прогресс»
- АО «ИТТ»
- АО «КБ «Луч»
- АО «Концерн «Созвездие»
- АО «КТ»
  - *АО «Кронштадт Технологии»*
  - *https://kronshtadt.ru*
- АО «КТРВ»
  - *АО «Корпорация Тактическое Ракетное Вооружение»*
  - *http://www.ktrv.ru*
- АО «НИИ СТТ» (Завод «Эдельвейс»)
  - *https://www.niistt.ru*
- АО «НПК «КБМ»
- АО «ПКК МИЛАНДР»
  - *https://www.milandr.com*
- АО «РПКБ»
- АО «Эникс»
  - *https://enics.aero*
- АО «УЗГА»
  - *АО «Уральский Завод Гражданской Авиации»*
  - *http://www.uwca.ru*
- **ГК «Аэроскан»**
  - ООО «Аэроскан»
    - *https://scan.aero*
    - *https://aeroscanavia.ru*
  - ООО «Индустриальные технологии»
- **ГК «Геоскан»**

- **ГК «Ростехнологии»**
  - *https://www.rostec.ru*
  - **Kalashnikov Group**
    - *АО «Концерн «Калашников» (в составе Группы компаний «Калашников»)*
    - *https://kalashnikovgroup.ru*
    - ООО «ЦСТ» (Zala Aero Group)
      - *Ижевск, улица 40 лет Победы, 118*
      - *https://zala-aero.com*
    - ООО «НПО «ИжБС»
      - *ООО «Научно-производственное объединение «Ижевские беспилотные системы»*
      - *http://www.izh-bs.ru*
- НПП «Цифровые решения»
- ООО «Альбатрос»
  - *https://alb.aero*
- ООО «АС-КАМ»
  - *https://ascam.aero*
- ООО «АФМ-Серверс»
  - http://www.a4m.ru
  - ООО «АФМ-Каскад»
  - ООО «АФМ-»
- ООО «Аэрокон»
  - *https://www.aerokon.su*
- ООО НПП «НТТ»
  - «Научно-производственное предприятие новые телекоммуникационные технологии»
  - *https://nppntt.ru*
  - ООО «ТАиП»
    - *https://taip.su*
- ООО НТЦ «ЮРИОН»
  - *http://www.yurion.ru*
- ООО «Плаз»
  - *https://www.plazlink.com*
- ООО «СТД-Радикс»
  - *Разработка гиростабилизированных подвесов и оптико-электронных систем, в т.ч. для беспилотных летательных аппаратов.*
- ООО «СТЦ»
  - ООО «Специальный Технологический Центр»
  - *https://www.stc-spb.ru*
- ГНИИЦ РТ МО РФ
  - *Главный научно-исследовательский испытательный центр робототехники Министерства обороны Российской Федерации*

List of Technical Specifications

Zala UAV Detector

Portable device for detecting the command exchange channel between MM8802/MM8803 modems and the Ground Control Station.

MM8802/MM8803 modems have been found in the following UAVs:

- Zala Aero Group **Lancet-1**
- Zala Aero Group **Lancet-3**
- Zala Aero Group **KYB-UAV**
- Zala Aero Group **421-XX**

[Lancet Detector], [Zala Detector], [KYB Detector], [MM8802/MM8803 Detector], [Детектор Ланцетів], [Система виявлення БПЛА Zala]

UAV Finder

System for detecting and targeting on low-flying low-speed aircrafts / UAVs.

[Shahed Finder]

[a]Can you please let me know, if any other slides need to be translated. Thanks

[b]_Marked as resolved_

[c]_Re-opened