DRONES AND ROVERS
Suggested Components for Drones and Rovers
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DRONES AND ROVERS CAN BE FULLY POWERED BY NXP
With decades of experience in automotive, radar, aerospace, RF, security, motor control and battery management systems, NXP provides semiconductor solutions for every aspect of drones and rovers, providing the world’s most complete technology portfolio.

If you’re ready to design an industrial drone or rover, use this parts list as a starting point. You can also find many more products that may meet your specific needs on our [website](#).
**FLIGHT MANAGEMENT UNIT**

FMU’s are the real time component of a drone that reacts to input from a variety of inertial and other sensors. In addition it can include communications channels and act upon input from the user or follow a flight plan. FMUs can be stand alone or cooperate with a companion computer. NXP offers a complete PX4 software reference using Kinetis K66. Other processors offer higher reliability or improved price/performance.

### Kinetis K66
- 180MHz ARM M4, 2M Flash
- Linux Foundation, Dronecode.org
- PX4.io flight stack drone ref design

### i.MX RT1050
- 600MHz ARM M7, External Encrypted QSPI Flash, $3
- Capable as full feature FMU or potentially a single chip entry drone solution

### S32K Family
- **Automotive Microcontrollers** ARM M4/M0 + General purpose MCU
- AEC-Q100 ASIL-B ISO26262 Functional Safety

### Other Notes
- Many options to consider from Kinetis, LPC, Layerscape and Automotive family parts
- **Automotive** parts preferred for functional safety in UAV applications
- Higher end MPUs with heterogeneous cores such as i.MX and S32V often include M4 cores which could be used for real time FMU operation
Suggested Components for Drones and Rovers

COMPANION COMPUTERS, VISION & ARTIFICIAL INTELLIGENCE

Sense and avoid technologies, machine vision, real time mission planning and advanced robotics take place on a companion computer where it communicates its intent to the FMU. ROS is a popular open source meta-operating system framework for developing robotics on Linux based computers. This provides services, simulation, and a high level operating system in which to develop algorithms.

i.MX 7  
1GHz Dual core ARM A7 + 200MHz ARM M4

i.MX 6 SoloX  
1GHz Single core ARM A9 + 227MHz ARM M4

i.MX 6 Dual/Quad  
1.2GHz ARM A9, Multicore, GPU, MIPI CSI, IMU, LCD  
Well proven, best availability, software and support

SCM-i.MX 6DQ  
Tiny 14mm x 17mm size i.MX processor plus Integrated MMPF0100  
Power supply, Flash, LPDDR DRAM, Passives  
Easy “SOM in a Chip”

QorIQ Layerscape  
MPUs with 1 to 8 cores of Cortex-A53 or A72 or v.8. 8x 10GHz SERDES PCIe, SATA  
Use for Camera system, Radar, Lidar high speed on board networking, processing or storage. From our Digital Networking group.

Suggested Components for Drones and Rovers
## COMPANION COMPUTERS, VISION & ARTIFICIAL INTELLIGENCE

<table>
<thead>
<tr>
<th>Device</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>i.MX 8</td>
<td>Multicore A53/A72 + M4, GPU, 2x 4Ch MIPI CSI, Open VX, H264 Codec</td>
</tr>
<tr>
<td>i.MX 8x</td>
<td>Multicore Efficient A35 + M4&lt;br&gt;Automotive ECC Memory, Efficiency, 1080p h.264</td>
</tr>
<tr>
<td>S32V234</td>
<td>Automotive Multicore A53 + M4 Vision Processor&lt;br&gt;3D GPU, APEX-2 vision accelerators, security, SafeAssure™ ISO 26262, functional safety up to ASIL-C, IEC 61508 and DO 178, machine learning and sensor fusion applications</td>
</tr>
</tbody>
</table>

**Other Notes**
- S32 family are the high reliability family of parts for ADAS systems
- S32K and S32M are the corresponding automotive microcontrollers and are modern ARM versions of the legacy Automotive S08 and S12 parts
MOTOR & MOTOR DRIVE

Brushless DC (BLDC) motors are used in Drones and rovers due to their high reliability, low weight, and high torque. Simple control algorithms function on the lowest cost silicon, where more advanced and efficient field oriented control (FOC) and ADRC control loops require additional processing power and analog feedback. Processors for motor control may include complete software enablement, high resolution timers and even high voltage analog components such as integrated voltage regulators, amplifiers, FET gate drive and CAN-FD physical layer interfaces. Automotive rated parts offer functional safety.

SU16
- S08L @40MHz core
- Low cost BLDC integrated Analog and Gate driver

LPC11C2x
- ARM M0 @50MHz MCU with integrated CAN PHY
- Small Size, Low pin count, low power consumption

S12ZVMC256
- Automotive S12Z@50MHz + Analog, CAN
- FOC BLDC (See also S32M)
MOTOR & MOTOR DRIVE

Kinetis V

KV1x/3x/V42/V5x ARM M0+/M4/M7 Motor drive MCU with KMS (Kinetis Motor Suite) rapid development software for Field Oriented Control of BLDC with ADRC control loop
- NXPESC-UF1 Drone/Rover ESC reference design uses KV42 with UAVCAN interface

i.MX RT1050

M7@ 600MHz <$3 low cost
External encrypted QSPI Flash
PWMs to support 4-6 BLDC motors (not FOC) could be used for single component low cost drone
Feature rich processor for building peripherals
- New

S32M

Automotive M4 M0+ Single chip with Analog Voltage Regulators, CAN -FD PHYs, Gate Drivers, FOC motor control. Other Analog drivers
AEC-Q100 ASIL-B ISO26262
- FOC ESC reference design with CAN Q1 2018
- Next generation high reliability Automotive motor controller family
Inertial sensors and sensor fusion algorithms enable the robot to accurately know its position in space, or the movement and orientation of an actuator. Pressure sensors can be used to measure relative height above ground or as a measurement device for speed or turbulence. Magnetic sensors provide high reliability angular or rotational measurement. Small low cost microcontrollers with appropriate interfaces create smart sensor modules for these or any other type of sensor with signal conditioning and communications to the rest of the larger system.

**SENSORS**

LPC11C2x
- ARM M0 @50MHz MCU with integrated CAN PHY
- Small size, low pin count, low power consumption

S32M
- **Automotive** M4 M0+ Single chip with Analog Voltage Regulators, CAN PHY, Gate Drivers, Other Analog drivers
- AEC-Q100 ASIL-B ISO26262

FXOS8700CQ
- 3-Axis Accelerometer (±2g/±4g/±8g) + 3-Axis Magnetometer

FXAS21002CQ
- 3-Axis Gyroscope, (±250/±500/±1000/±2000°/s), Very low power

BRKTSTBC-AGM04
- Low cost evaluation board for Accel/Gyro/Mag

MPL3115A2
- Barometer/Atmospheric Pressure Sensor

KMA2xx KMZxxx
- **Automotive** Magneto Resistive Rotational and Angular Sensors

Please visit our [website](https://www.nxp.com) for other Pressure (Absolute/Ratiometric, Single/Multiport, Pitot tube), Touch sense capacitive sensors, and Temperature sensors/I2C.
### IN-VEHICLE NETWORKING & INTERFACING

Much like the modern automobile, modern robots are quickly moving to a networked architecture, and are able to leverage the same high reliability LIN, CAN, CAN-FD, and newest 2-Wire rugged automotive Ethernet interfaces. In addition to our large portfolio of independent interface components, some MCUs include CAN or LIN PHY internally using HV Analog Silicon. Automotive system basis chips are ideal to reuse in robotics applications where rugged PHYs and multiple power supplies are also required.

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TJA1042</td>
<td>CAN transceiver (representative part, many others)</td>
</tr>
<tr>
<td>TJA1100</td>
<td><strong>Automotive</strong> 100-Base-T1 2-wire UTP Ethernet PHY, capacitively coupled</td>
</tr>
<tr>
<td>SJA1105</td>
<td><strong>Automotive</strong> 5-Port Ethernet switch IEEE1588, Time Sensitive Networking</td>
</tr>
<tr>
<td>S32M</td>
<td><strong>Automotive</strong> M4 M0+ Single chip with Analog Voltage Regulators, CAN PHY, Gate Drivers, Other Analog drivers AEC-Q100 ASIL-B ISO26262 - New Q4 2017</td>
</tr>
</tbody>
</table>

**Other Notes**

Extensive Automotive CAN, CAN-FD and Flexray, System Basis Chips
## WIRELESS CONNECTIVITY

Robotic systems require many different types of communications interfaces. NXP offers purpose built silicon and MCUs for proprietary secure radio systems, sub-GHz radios, SigFox, Wireless MBUS, BLE, ZigBee and 802.15.4 Thread mesh networking. Our 802.11p V2X RoadLINK™ DSRC Software defined radio solution is an industry leading solution for trucks and automobiles today that may find application in autonomous vehicles in the future.

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>KW01</td>
<td>ARM M0+ Sub-GHz 290-340, 424-510, 862-1020MHz FSK, GFSK, MSK, GMSK &amp; OOK</td>
</tr>
<tr>
<td>OL2385</td>
<td><strong>Automotive</strong> “Mantra G” 160-950 MHz ISM Automotive transceiver 400 kbit/s 4GFSK, 4(G)FSK, 200 kbps 2(G)FSK, ASK, OOK SIGFOX, WMBUS</td>
</tr>
<tr>
<td>OL2387</td>
<td><strong>Automotive</strong> “Mantra D” 315-950 MHz <strong>DSSS</strong> 600 kChips/s Single chip transceiver</td>
</tr>
<tr>
<td>KW31Z</td>
<td>ARM M0+ 2.4GHz BLE 4.2</td>
</tr>
<tr>
<td>QN908x</td>
<td>ARM M4F 2.4GHz BLE 4.2 / 5.0</td>
</tr>
<tr>
<td>KW21Z</td>
<td>ARM M0+, 2.4GHz IEEE 802.15.4</td>
</tr>
</tbody>
</table>
WIRELESS CONNECTIVITY

KW41Z  
ARM M0+, 2.4GHz IEEE 802.15.4 + BLE  
Thread IPV6-based Ad-Hoc self-healing Mesh networking, 6Lowpan, Multi-Gateway, Security  
- Thread Stack supported on 802.15.4 but potential to run on Sub-GHz network

SAF5x00  
NXP RoadLINK™ V2X DSRC/802.11p 5.9/5.8GHz Automotive radio modem for Intelligent Traffic Systems. Low latency software defined radio supporting secure OTA updates, Video and IP communications as well as global standards WAVE/ETSI ITS G5. Complete hardware security solution for message authentication and anonymity/tracking prevention. Full Software stack from Cohda Wireless. Modular solutions from uBlox and others.

NXH2261UK  
MiGLO® NFMI (Near Field Magnetic induction) radio for wireless audio and data streaming  
- Thought provoking: MiGLO radios are Designed for ultra-low power audio headsets. Because it is based on magnetic field transmission there is potential to use for short range digital auto and data transmission to underwater rover or sensors. You could be the first to experiment and develop this application.
The battery is part of the “fuel” system for your robot, and careful battery cell management provides accurate range and operational time estimates as well as overall system health and maintenance information. In some use cases, wireless charging will allow for 24/7 operation or coordination of multiple vehicles. System basis chips can provide optimized solutions for robust power supplies and analog interfaces.

**MC3377x**
Automotive 14+ Channel Li-Ion Battery Cell controllers
Cell Balancing, differential V and I measurement, coulomb count, isolated HV communications

**MWCTxxx**
WPC Qi Multi Coil “free position” wireless charging 5W/15W/65W/200W+

**MC34671/73/74**
600mA-1.2A Single-cell Li-Ion/Li-Polymer Battery Charger

**BC3770**
2A Single cell Switch-Mode Li-ion/Li-polymer Battery Charger
Dual-path output allows system boot even with fully discharged battery. I2C interface

**Analog – System Basis Chips**
Optimized CAN and LIN interfaces with integrated power supply voltage references and other analog required to create nodes in a vehicle.
ANALOG - LED LIGHTING

Rugged, high reliability, high power Automotive LED lighting drivers can be used to create specialty lighting for drones for floodlighting, vision and filming applications. A matrix controller could allow different sets of LEDs to be illuminated to obtain directional or specific focal patterns without the need for mechanical movement.

AH1302
ASLx41xSHN
Automotive (1/2/3 LED String) Multi Channel Dimmable HB-LED Buck Driver Family. Up to 1.5A drive current, Vin up to 80V, LED and system Diagnostics, Limp mode, SPI Interface. AEC Q100

AH1610
ASL4501SHN
Automotive (1/2/4) Multi Phase Boost Converter. Optimized supply for ASLx41xSHN (above). 5v-40Vin, 10V-80Vout. Load dump and transient protection. Control and diagnostics via SPI Interface. AEC Q100

AHxxxx
ASL5xxxSHN
Automotive matrix LED controller

Contact the UAV Solutions Team for further information on these automotive parts.
**RF POWER**

Please visit our [website](#). Below are some highlights. NXP portfolio includes a multitude of Specialty tuners, Digital processors, mixers, PLL, Oscillators, and control circuits for RF systems.

**ADS-B Power Amplifiers solutions for 960-1215 MHz:**

<table>
<thead>
<tr>
<th>Product</th>
<th>Frequency (MHz)</th>
<th>Peak Power (W)</th>
<th>Voltage (V)</th>
<th>Gain (dB min.)</th>
<th>Drain Efficiency (%)</th>
</tr>
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<tbody>
<tr>
<td>MMRF1018N</td>
<td>978</td>
<td>90</td>
<td>50</td>
<td>17</td>
<td>56</td>
</tr>
<tr>
<td>MRF6VP3091N</td>
<td>960-1215</td>
<td>90</td>
<td>50</td>
<td>17.3</td>
<td>53.5</td>
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<tr>
<td>AFIC10275N</td>
<td>978-1090</td>
<td>250</td>
<td>50</td>
<td>30.1</td>
<td>59.1</td>
</tr>
<tr>
<td>MMRF2011N</td>
<td>978</td>
<td>15</td>
<td>28</td>
<td>34</td>
<td>55</td>
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RF POWER

LDMOS Rugged 25-2500W Power amplifiers 900MHz - 3.5GHz
- HF, VHF and UHF Radar (1-1000 MHz)
- Avionics (960-1215 MHz)
- L-Band Radar (1200-1400 MHz)
- S-Band Radar (2700-3500 MHz)
- Mil Communications (1-2700 MHz)

Low Power TX/RX
- Bipolar RF power transistors plus dedicated solutions for LNAs, mixers, frequency multipliers, buffers, amplifiers & drivers
- JFETs for switching and general RF applications
- MOSFETs for switching and general RF applications

Discrete Transistors

PLLs and Oscillators
- Microwave LO Generators
- Integrated PLL VCOs

77GHz Automotive ADAS Radar
- 77 GHz multi-channel transceiver chipset, RX/TX/VCO Baseband processor
- Electronic Beam Steering, wide Field of view, Long and mid-range (SiGe and CMOS)

- **Note!** Spectrum is currently not allocated for UAV use in NA/EMEA
- **VERY NEW**, extreme demand from priority automotive customers. To be supported eventually via 3rd party module vendors only. Complex system, requires extensive expertise. Automotive S32 companion processor and software pending.
As drones and rovers mature, customers, governments and manufactures are quickly realizing that security is of paramount importance. NXP’s trusted solutions for Banking, Passports and other secure identity can be used for secure key storage, and authentication. Low cost authentication solutions permit validation of safety certification markings such as UL or TUV, as well as brand security for authorized “quality” of modular components like batteries or motor drivers.

A700X

“Secure Element” Dedicated security hardened authentication MCU JCOP
A7001CM Public market version, 100 kbit/s I²C slave interface, optional ISO/IEC 7816 contact interface, Optional ISO/IEC 14443 a Contactless Interface Unit
- Payment Services, ePassports, Embedded Security
- Counterfeit protection of hardware and software
  • Anti-cloning
  • Brand integrity of original goods
- Profile of service
  • Conditional access to software, content and features
  • Secure access to online services
- Device identity
  • Signing transactions
  • Secure machine to machine (M2M) communication
SECURITY & AUTHENTICATION

A1006
Asymmetric Crypto-based Authentication Anticounterfeit Tamper resistant IC
Unique key pair per device
Use for:
- Secure authentication of hardware modules
- Safety certification e-registration (UL/CE/TUV/FCC)
- Insurance probe of modular systems
- Battery quality certification

Kinetis K80
ARM Cortex M4F MCU with advanced security architecture including anti-tamper
hardware features, encrypted firmware updates, Flash access control, secure ses-
sion RAM
Software reference design for secure POS terminal

Other Notes
Most NXP MCU/MPU include hardware cryptographic accelerators and advanced
security features. However, secure element/authentication components should be
considered for holistic system wide security, security management, cryptographic
key storage, modularity, ease of use, and security policy integrity. Some MPUs
have secure element derivative included.
Rain UCODE UHF RFID Tags - Billions of smart labels on goods annually. Use drone, rover or robot for indoor survey of warehouse goods and logistics. In outdoor applications, count items in staging lots or storage, identification of objects, tracking, counting, identifying waypoints, messaging speed limits or regulations. 10 meters+ distance.
NFC provides interesting opportunities in drone and rovers for secure payment, authentication of a pilot, validation of insurance, secure local updating of parameters, data logging and low cost weatherproof interface to a rich smartphone GUI, and more unique uses are being imagined daily.

**PN7150B0HN**

NFC Controller with integrated firmware
0cm to 5cm with a cell phone or smart card
Use for:
- Pilot identification, drone registration
- Insurance purposes
- Updating of parameters, No fly Zones
- Identification or acceptance of package delivery
- Pairing of devices or IoT configuration
Linux and Arduino dev board and software

**NT4H1321G0DUF**

NTAG 413 DNA “Secure Unique NFC Message (SUN)” automatically generates tap-unique tag authentication data upon each read-out
AES cryptographic authentication
Secure Unique NFC Message for Direct Access to Web Services without installing a cell phone app
NFC, UHF TAG

NHS3152

NTAG Smartsensor + MCU, ultra-low power data logger
Use for sealed smart interface to system or modules
Redundant sensor measurement logging. Storage or shipment monitoring.

NT3H2111W0FT1

NTAG I²C plus, NFC Forum Type 2 Tag with I²C interface
NFC tag interactions, works like secure EEPROM, SRAM pass-through
Use for data up/download, advanced device pairing, personalization and configuration, and device maintenance
Can be RF field powered for use when powered off, during loss of power, or destruction of drone
Use for:
- Simple Datalogger, flight recorder black box
- Local storage
TOOLS FOR GETTING STARTED

**HGDron* - HoverGames Drone Reference design**

Complete Linux foundation, Dronecode.org, PX4.io robotic reference drone with K66 based NXPhlite FMU and NXPESC-UF1 FOC BLDC motor controllers. Supporting UAVCAN and 2 Wire Automotive Ethernet interfaces. PX4 is used extensively for research and commercial drone platforms. BSD license preserves ability to include proprietary IP. Focus on open source FAA approved high reliability BVLOS flight stack Quadcopter frame, Rover frame in planning

- Contact the **UAV Solutions Team** or **Iain Galloway** for Beta Testing in Q1 2018

**NXP IOT-RPK IoT reference design and HDIB adapter**

IoT processor system with modular sensors and Thread mesh radio and CLICK sensor modules. Integrate with HGDron*e NXPhlite or other FMU using HDIB adapter board and UAVCAN or UART connection

- **Q1 2018**
## TOOLS FOR GETTING STARTED

<table>
<thead>
<tr>
<th>Alternative to</th>
<th>Technexion PICO-IMX Modules, Edison drop in replacement</th>
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</thead>
<tbody>
<tr>
<td>Intel Edison</td>
<td></td>
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<table>
<thead>
<tr>
<th>Performance</th>
<th>PJRC.com Teensy3.x Arduino &amp; mbed Processor modules using Kinetis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arduino option</td>
<td>Industrial and Automotive quality i.MX 3rd party i.MX SOMs and single board computers. Guaranteed longevity, Cost and feature competitive</td>
</tr>
<tr>
<td>RaspberryPi</td>
<td></td>
</tr>
</tbody>
</table>

NXP provides evaluation boards, hardware and software reference designs for most products for quick and easy evaluation. Please explore the [NXP website](https://www.nxp.com) for details.
The **NXP UAV Solution Team** or your local NXP sales office or distributor will be happy to assist if it is not clear what tools or products to use. We are also interested in hearing about your drone projects and requirements.

**Local NXP Office** or **Distributor support**

**NXP UAV Webpage**

**Email UAV Solutions Team**

**Email Iain Galloway**