



# DRONES AND ROVERS

Suggested Components for Drones and Rovers







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A drone is flying in the upper right quadrant of the image against a dramatic sunset sky. The sky transitions from a deep blue at the top to a bright orange and yellow near the horizon, with scattered clouds catching the low light. In the foreground, the dark silhouettes of a mountain range and a field of trees are visible against the bright horizon. The drone is a quadcopter with a camera mounted underneath.

# DRONES AND ROVERS CAN BE FULLY POWERED BY **NXP**



# NXP TECHNOLOGIES



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



# 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 <b>Well proven, best availability, software and support</b>
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.



# COMPANION COMPUTERS, VISION & ARTIFICIAL INTELLIGENCE

i.MX 8

Multicore A53/A72 + M4, GPU, 2x 4Ch MIPI CSI, Open VX, H264  
Codec

i.MX 8x

Multicore Efficient A35 + M4  
Automotive ECC Memory, Efficiency, 1080p h.264

S32V234

Automotive Multicore A53 + M4 Vision Processor  
3D GPU, APEX-2 vision accelerators, security, SafeAssure™ ISO 26262, func-  
tional safety up to ASIL-C, IEC 61508 and DO 178, machine learning and sensor  
fusion applications

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*



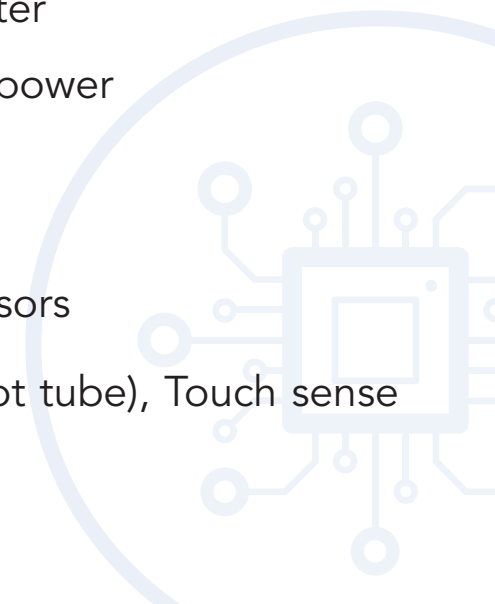


# SENSORS

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.

LPC11C2x	ARM M0 @50MHz MCU with integrated CAN PHY Small size, low pin count, low power consumption
S32M	<b>Automotive</b> M4 M0+ Single chip with Analog Voltage Regulators, CAN PHY, Gate Drivers, Other Analog drivers AEC-Q100 ASIL-B ISO26262
FXOS8700CQ	3-Axis Accelerometer ( $\pm 2g/\pm 4g/\pm 8g$ ) + 3-Axis Magnetometer
FXAS21002CQ	3-Axis Gyroscope, ( $\pm 250/\pm 500/\pm 1000/\pm 2000^\circ/s$ ), Very low power
BRKTSTBC-AGM04	Low cost evaluation board for Accel/Gyro/Mag
MPL3115A2	Barometer/Atmospheric Pressure Sensor
KMA2xx KMZxxx	<b>Automotive</b> Magneto Resistive Rotational and Angular Sensors

Please visit our [website](#) 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.

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

KW01	ARM M0+ Sub-GHz 290-340, 424-510, 862-1020MHz FSK, GFSK, MSK, GMSK & OOK
OL2385	Automotive "Mantra G" 160-950 MHz ISM Automotive transceiver 400 kbit/s 4GFSK, 4(G)FSK, 200 kbps 2(G)FSK, ASK, OOK SIGFOX, WMBUS
OL2387	Automotive "Mantra D" 315-950 MHz DSSS 600 kChips/s Single chip transceiver
KW31Z	ARM M0+ 2.4GHz BLE 4.2
QN908x	ARM M4F 2.4GHz BLE 4.2 / 5.0
KW21Z	ARM M0+, 2.4GHz IEEE 802.15.4

# 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 rovers or sensors. You could be the first to experiment and develop this application.*



# ANALOG - BATTERY & POWER

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.







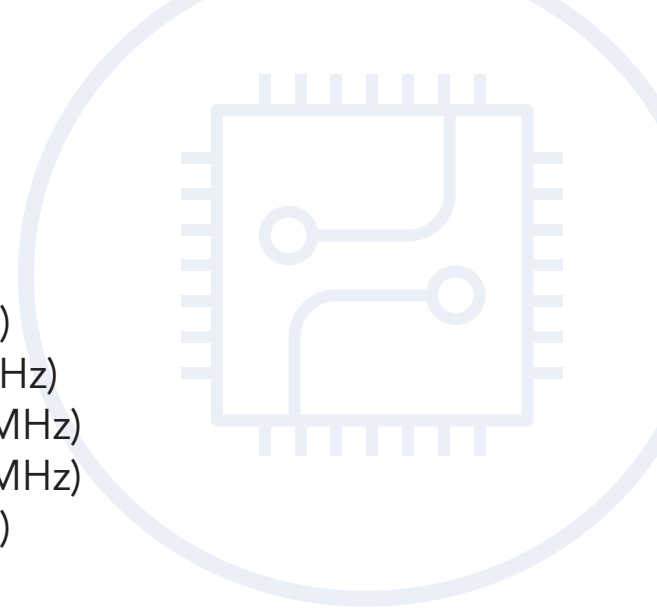
# RF POWER

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:

Product	Frequency (MHz)	Peak Power (W)	Voltage (V)	Gain (dB min.)	Drain Efficiency (%)
MMRF1018N	978	90	50	17	56
MRF6VP3091N	960-1215	90	50	17.3	53.5
AFIC10275N	978-1090	250	50	30.1	59.1
MMRF2011N	978	15	28	34	55

# RF POWER



LDMOS Rugged 25-2500W Power amplifiers 900MHz - 3.5GHz

HF, VHF and UHF Radar  
Avionics  
L-Band Radar  
S-Band Radar  
Mil Communications

(1-1000 MHz)  
(960-1215 MHz)  
(1200-1400 MHz)  
(2700-3500 MHz)  
(1-2700 MHz)

Low Power TX/RX Discrete Transistors

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

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.*

# SECURITY & AUTHENTICATION

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 I<sup>2</sup>C 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	<p>Asymmetric Crypto-based Authentication Anticounterfeit Tamper resistant IC Unique key pair per device Use for :</p> <ul style="list-style-type: none"><li>- Secure authentication of hardware modules</li><li>- Safety certification e-registration (UL/CE/TUV/FCC)</li><li>- Insurance probe of modular systems</li><li>- Battery quality certification</li></ul>
Kinetic K80	<p>ARM Cortex M4F MCU with advanced security architecture including anti-tamper hardware features, encrypted firmware updates, Flash access control, secure session RAM Software reference design for secure POS terminal</p>
Other Notes	<p>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.</p>

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, UHF TAG

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 I<sup>2</sup>C plus, NFC Forum Type 2 Tag with I<sup>2</sup>C 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

HGDrone -  
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 HGDrone NXPhlite or other FMU using HDIB adapter board and UAVCAN or UART connection

- *Q1 2018*



# TOOLS FOR GETTING STARTED

Alternative to  
Intel Edison

Technexion PICO-IMX Modules, Edison drop in replacement

Performance  
Arduino option

PJRC.com Teensy3.x Arduino & mbed Processor modules using Kinetis

Alternative to  
RaspberryPi

Industrial and Automotive quality i.MX 3rd party i.MX SOMs and single board computers.

Guaranteed longevity, Cost and feature competitive

NXP provides evaluation boards, hardware and software reference designs for most products for quick and easy evaluation. Please explore the [NXP website](#) for details.



# SUPPORT

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](#)





