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Atmel[®]



Car Access **PEPS, RKE, AES Immobilizer**

Atmel Car Access System Solutions

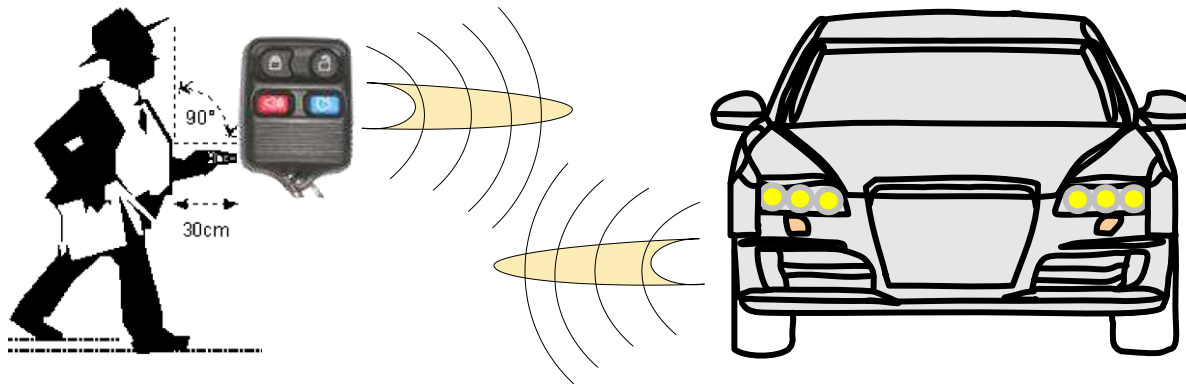
- Atmel® launched the first dedicated transmitter PLL U2741B for Remote Keyless Entry (RKE) applications in 1997
- Atmel is a leading car access supplier and delivered already more than 250 Mio ICs in this application
- Strong relationships to the key players in the automotive market



Car Access – Basic of RKE

Remote Start

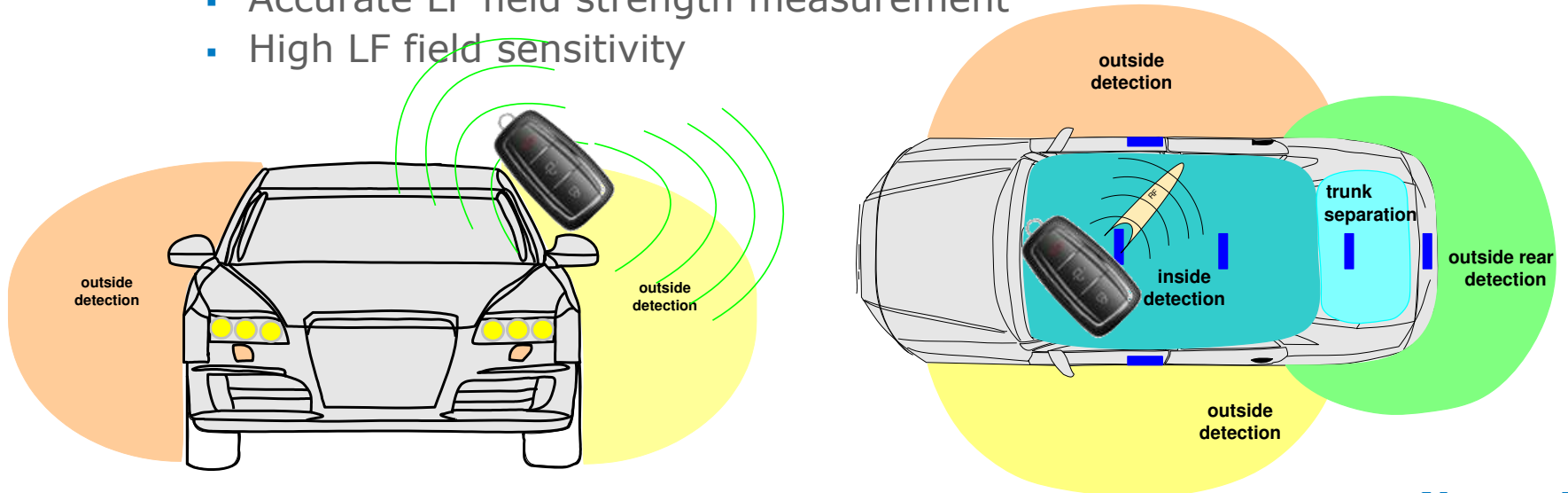
- Like RKE but RF is typically 2-way
 - Fob sends RF to car to "start engine"
 - Car replies with RF to fob "engine running"
- Important Design Considerations
 - Very long range, > 300m, requires high RF link budget
 - RF Link budget = f (TX power, RX sensitivity, antenna efficiencies)
 - Higher TX power by managing R (averaging)
 - Higher RX sensitivity with narrower IF bandwidth & lower data rate
 - Requires tight frequency control & compensation (temp/voltage/lot)



Car Access – Basic of PEPS

Passive Entry / Passive Start

- From outside the vehicle: Touch car door (PE)
- From inside the vehicle: Press "start" button on dashboard (PS)
- LF from car awakens fob (LF downlink)
- Fob measures field strength vectors & sends info to vehicle
 - Fob orientation is arbitrary - must measure x, y, & z axis (3D)
 - Fob localized: Allow "Unlock" if outside (confirm if 2-way RF)
 - Fob localized: Allow "Start" if inside (confirm if 2-way RF)
- Important system design considerations:
 - LF field strength regulation over across voltage/temp/coil variation
 - Accurate LF field strength measurement
 - High LF field sensitivity

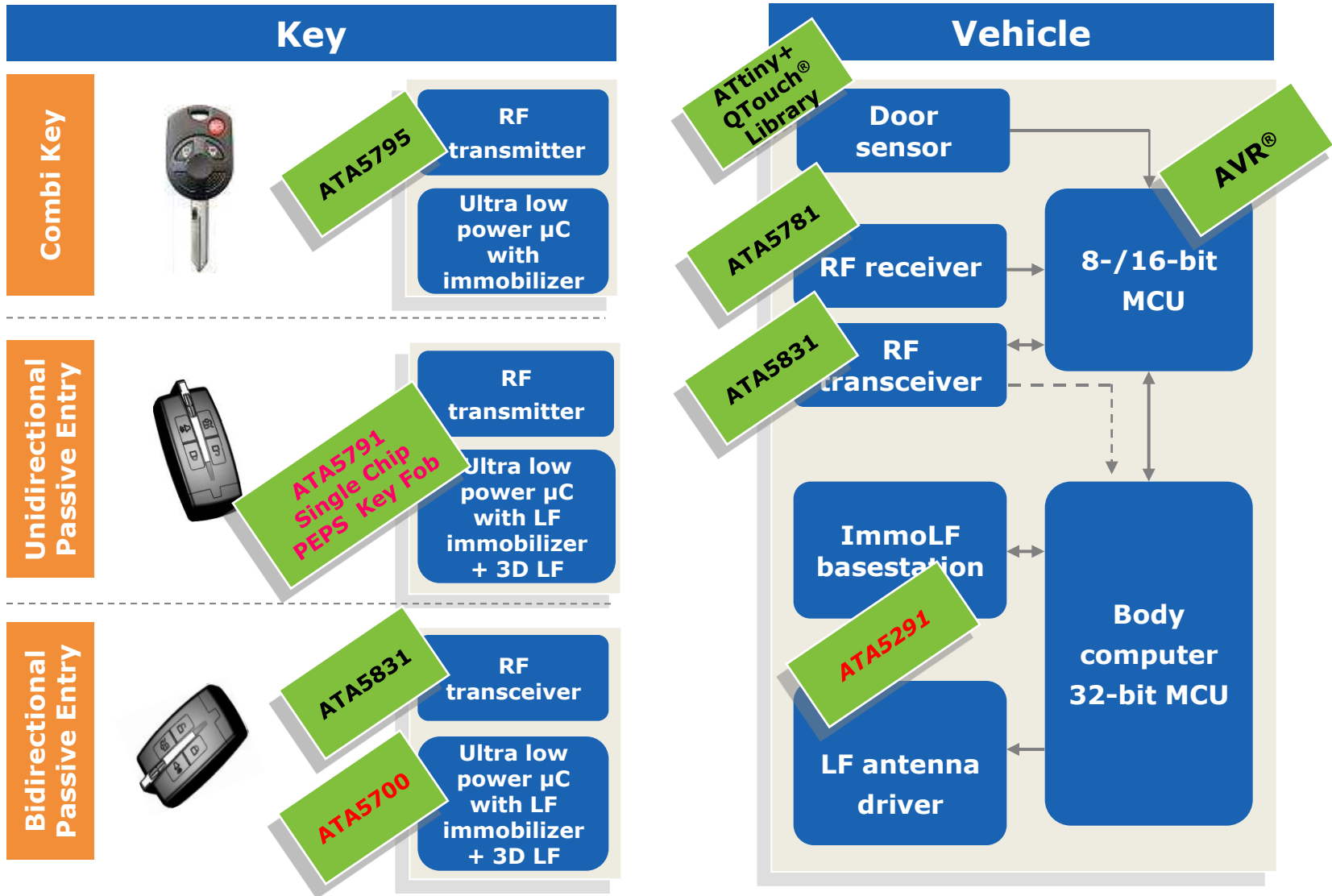


Wide Range Of Car Access Solutions





RKE	RKE + Immo	PKE + Immo	Optional
<p>Single chip key solution, best in class performance – ATA5774C</p> <p>Best in class receiver, with minimum external component, no external IF filter, supports self polling – ATA5724C / ATA5781</p>	<p>Single chip key solution, 128 bit AES H/W encryption engine, up to 12.5dBm output power, works down to 1.9V – ATA5795C</p> <p>Best in class receiver, with minimum external component, no external IF filter, supports self polling – ATA5724C / ATA5781</p> <p>Immo transponder with built in coil, AES standard – ATA5580</p>	<p>Single chip MCU, Immo + 3D LF Wake up – ATA5791</p> <p>Single chip LF driver + Immo Basestation – ATA5291</p> <p>Immo transponder with built in coil, AES standard – ATA5580</p>	<p>RF transceiver for smart key and 2 way BCM basestation – ATA5831</p> <p>Smart RF receiver with Flash+MCU – ATA5782</p> <p>TPMS Receiver support</p> <p>Door handle touch</p>



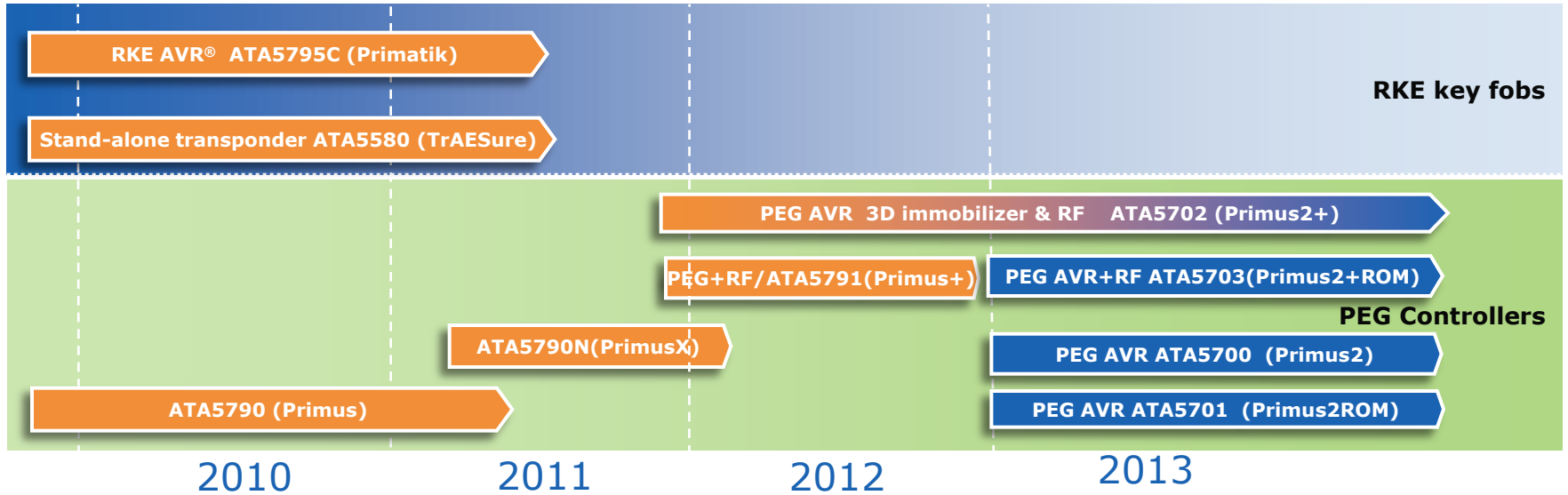
Car Access: System Solution



Product Availability

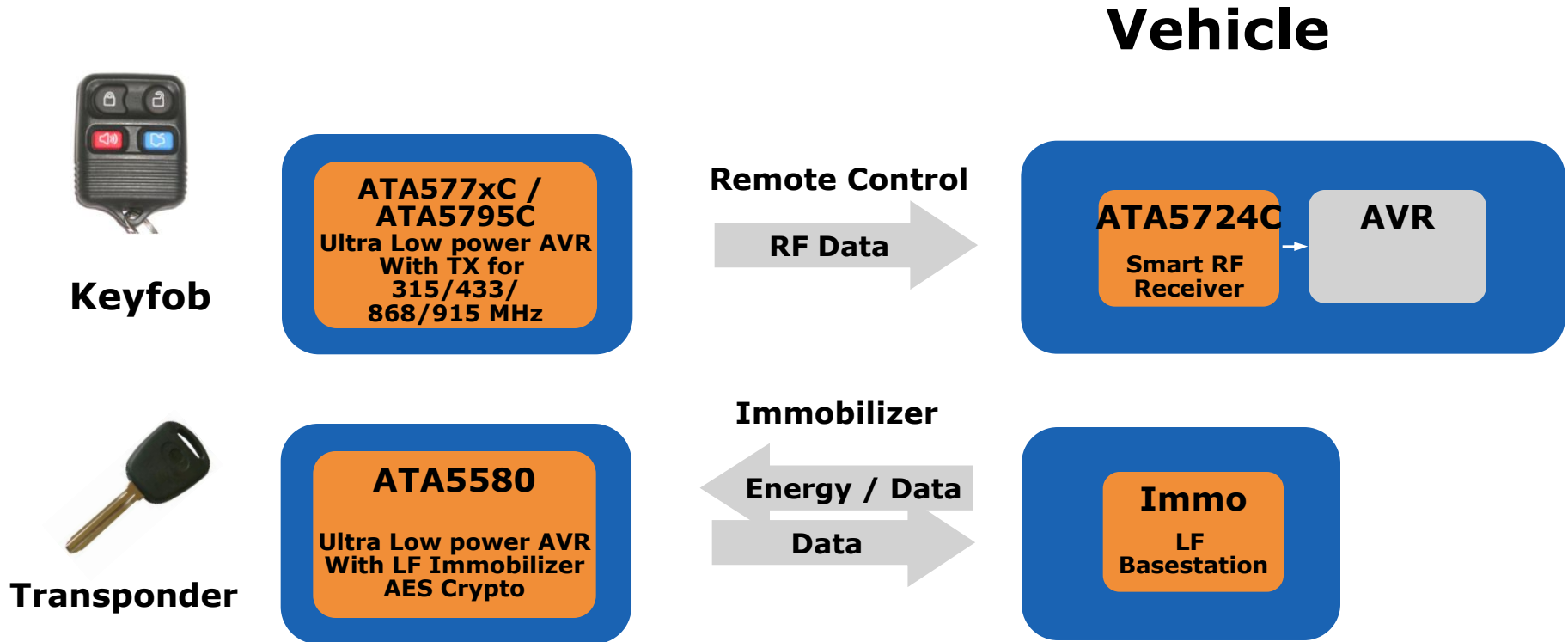
Car / Fob	Function	Embedded AVR	Part Number	Availability
Both	Immobilizer protocol stack		Software	Production
Key fob	AES immobilizer transponder		ATA5580	Production
Key fob	AES RKE AVR with immobilizer and RF transmitter		ATA5795	Production
Key fob	AES PEG AVR with immobilizer and 3D wake-up		ATA5791	Production
Key fob	Fractional-N RF transmitter		ATA5749C	Production
Both	Fractional-N RF transceiver AVR [®]		ATA5831	Production
Car	Fractional-N RF receiver		ATA5781	Production
Car	Fixed-frequency RF receiver		ATA572x	Production
Car	6-channel LF driver		ATA5279C	Production
Car	4-channel LF driver with Immobilizer Basestation		ATA5291	Sampling

Car Access Key Fob Controllers



Part Number	Description
ATA5795	RKE AVR® controller with AES-128, 315/433MHz RF transmitter and immobilizer
ATA5580	Stand-alone AES-128 transponder, 8K Flash, 2K EEPROM
ATA5790	PEPS AVR controller with AES-128, 3D LF, immobilizer, 16K Flash, 2K EEPROM
ATA5790N	PEPS AVR controller with AES-128, 3D LF (enhanced), immobilizer, 16K Flash, 2K EEPROM
ATA5791	PEPS AVR controller with AES-128, 3D LF (enhanced), immobilizer, 315/433MHz RF transmitter, 16K Flash, 2K EEPROM
ATA5700	PEPS AVR controller with AES-128, 3D LF, 3D immobilizer, 16K/32K Flash, 1K/2K EEPROM
ATA5701	PEPS AVR controller with AES-128, 3D LF, 3D immobilizer, 16K/32K ROM, 1K/2K EEPROM
ATA5702	PEPS AVR controller with AES-128, 3D LF, 3D immobilizer, 315/433/868/915MHz, 16K/32K Flash, 1K/2K EEPROM
ATA5703	PEPS AVR controller with AES-128, 3D LF, 3D immobilizer, 315/433/868/915MHz, 16K/32K ROM, 1K/2K EEPROM

Remote Keyless Entry (with Immo)



Two different ICs for Keyfob and Transponder allows a cost optimized approach on the key side

Transmitter with AVR μ C: ATA577xC

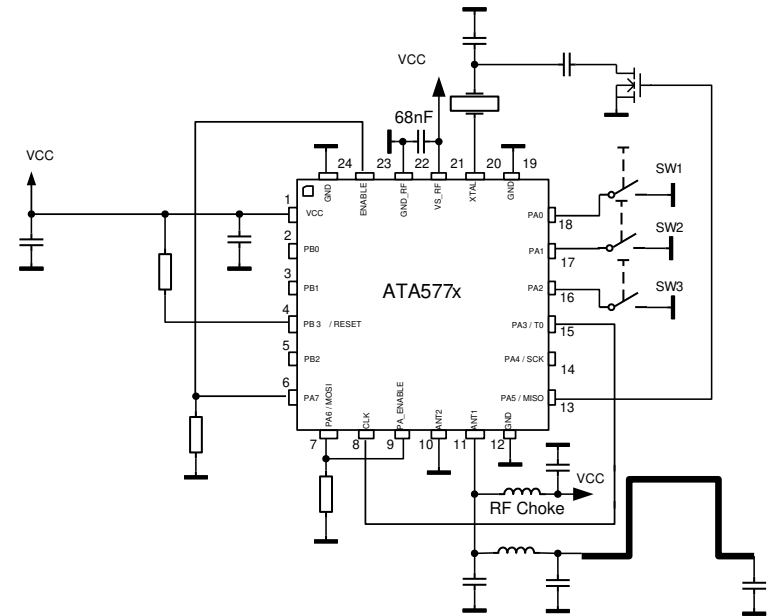
Remote Keyless Entry: key

Key characteristics

- Highly integrated micro-transmitter based on AVR[®] microcontroller
- Highly integrated with low external BOM
- Limited software design effort required

Key features

- 4kbytes Flash, in-system programmable
- Perfect current consumption due to optimized AVR microcontroller
- Wake-up interrupt for all I/Os
- Small package and low external component count allows small board design
- Integrated temperature sensor
- 10-bit ADC, brown-out detection
- ESD protection: 2kV HBM
- Temperature range - 40° C to +85° C



Package:
Samples available:
PPAP available:

QFN24, 5x5mm
now
now

Single Chip LF + RF with μ C: ATA5795C

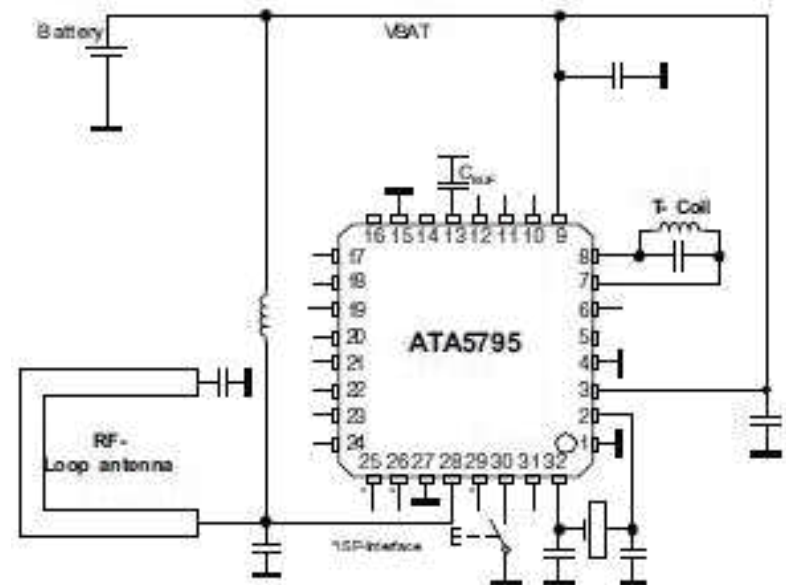
Remote Keyless Entry: key

Key characteristics

- RKE low-power AVR[®] with immobilizer and RF TX
- 125kHz immobilizer interface compatible to existing base-station ICs
- 315MHz – 433MHz Fractional-N RF TX with 12.5dBm Pout
- Fast AES hardware crypto engine for both RF and LF
- CMMI-certified immobilizer stack

Key features

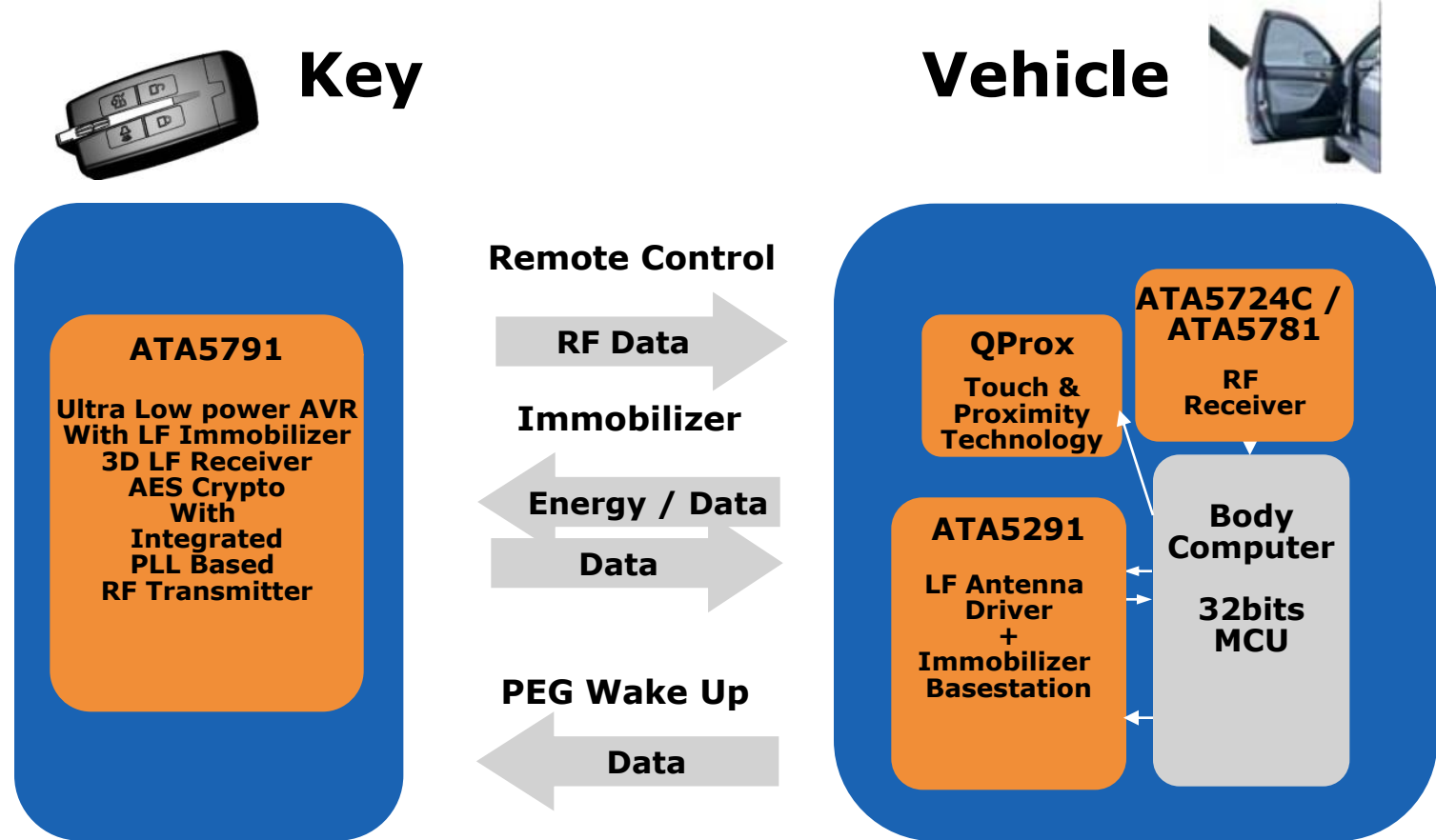
- AES is basis for open-source immobilizer software library
- Highest security level for encryption (128bit)
- Special memory protection secures immobilizer software
- High power TX allows extended coverage
- Easy software design with existing AVR tool set
 - Low-power effective AVR microcontroller
 - 6kB Flash for customer software available
- Small package and low external component count allows small board design
- 1.9V to 3.6V supply voltage



Package:
Samples available:
PPAP available:

QFN32, 5x5mm
now
now

Passive Entry Go - Unidirectional



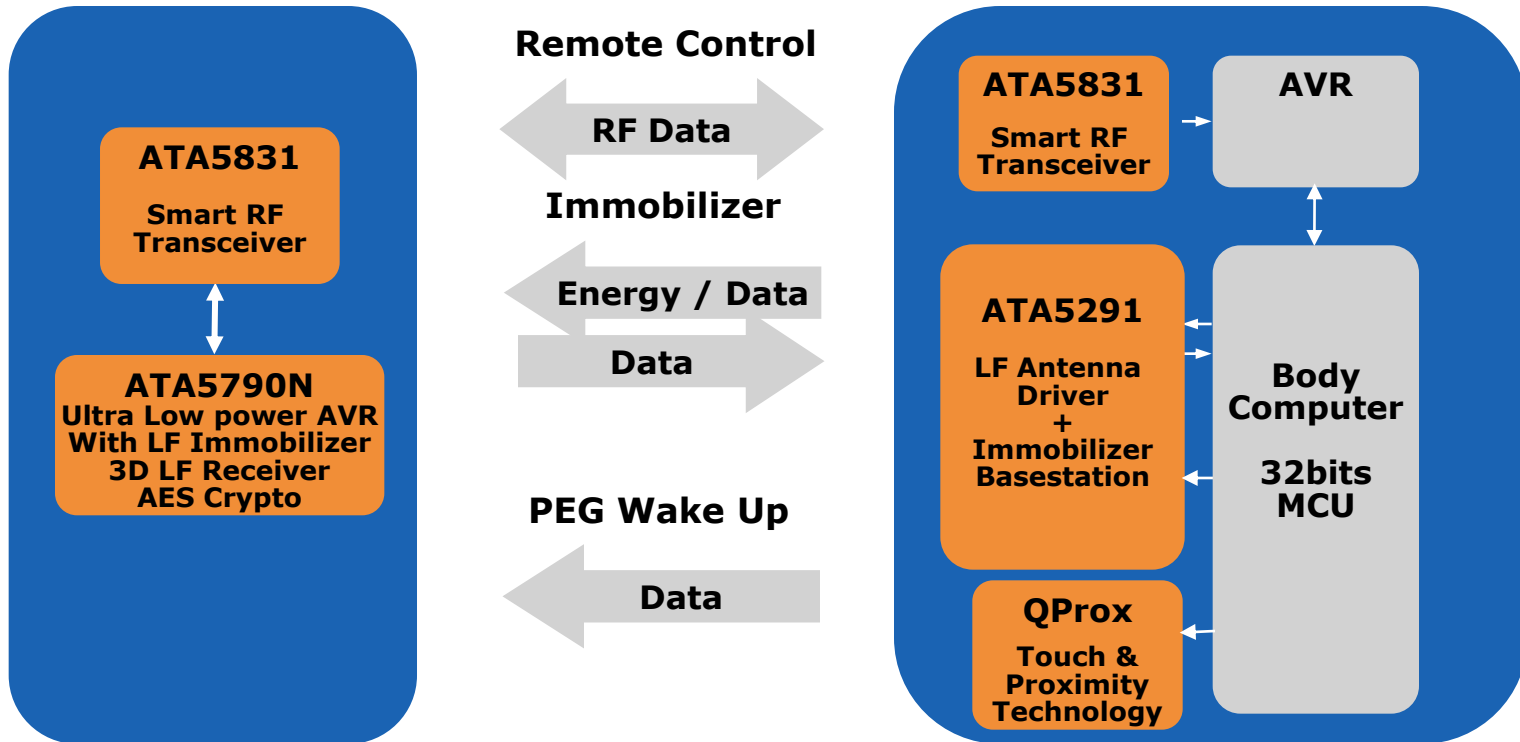
- Single chip PEPS Keyfob solution

Passive Entry / Go – Bidirectional RF



Key

Vehicle



- Complete PEPS solution with Atmel chipset, including capacitive sensing

Microcontroller with Immobilizer, 3D LF and RF Transmitter: ATA5791

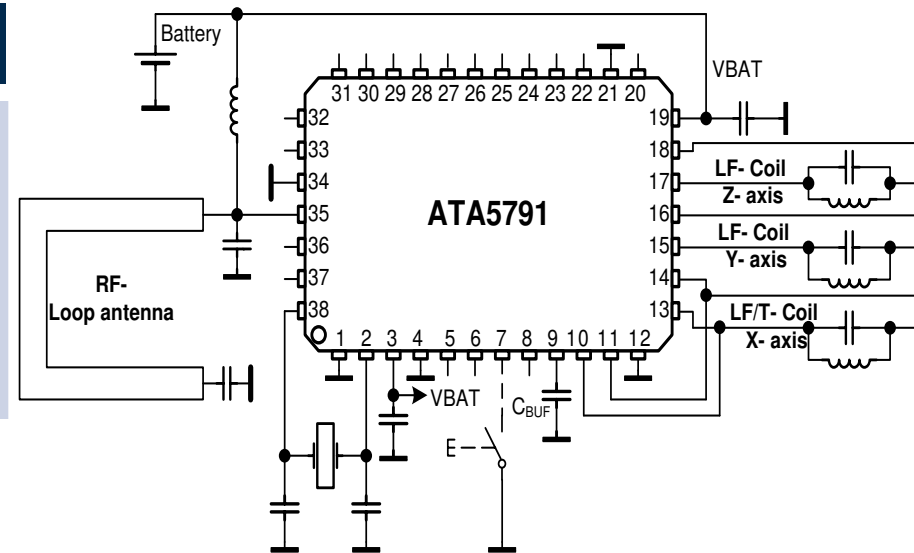
Passive Entry Go: key

Key characteristics

- Low-power AVR® with immobilizer and 3D LF
- 125kHz immobilizer interface
- 3D LF receiver with RSSI: 1.5mVpp worst case
- Current consumption in listening mode $\sim 4\mu\text{A}$
- 300 to 450MHz RF Transmitter up to 12.5dBm
- Fast AES hardware crypto engine

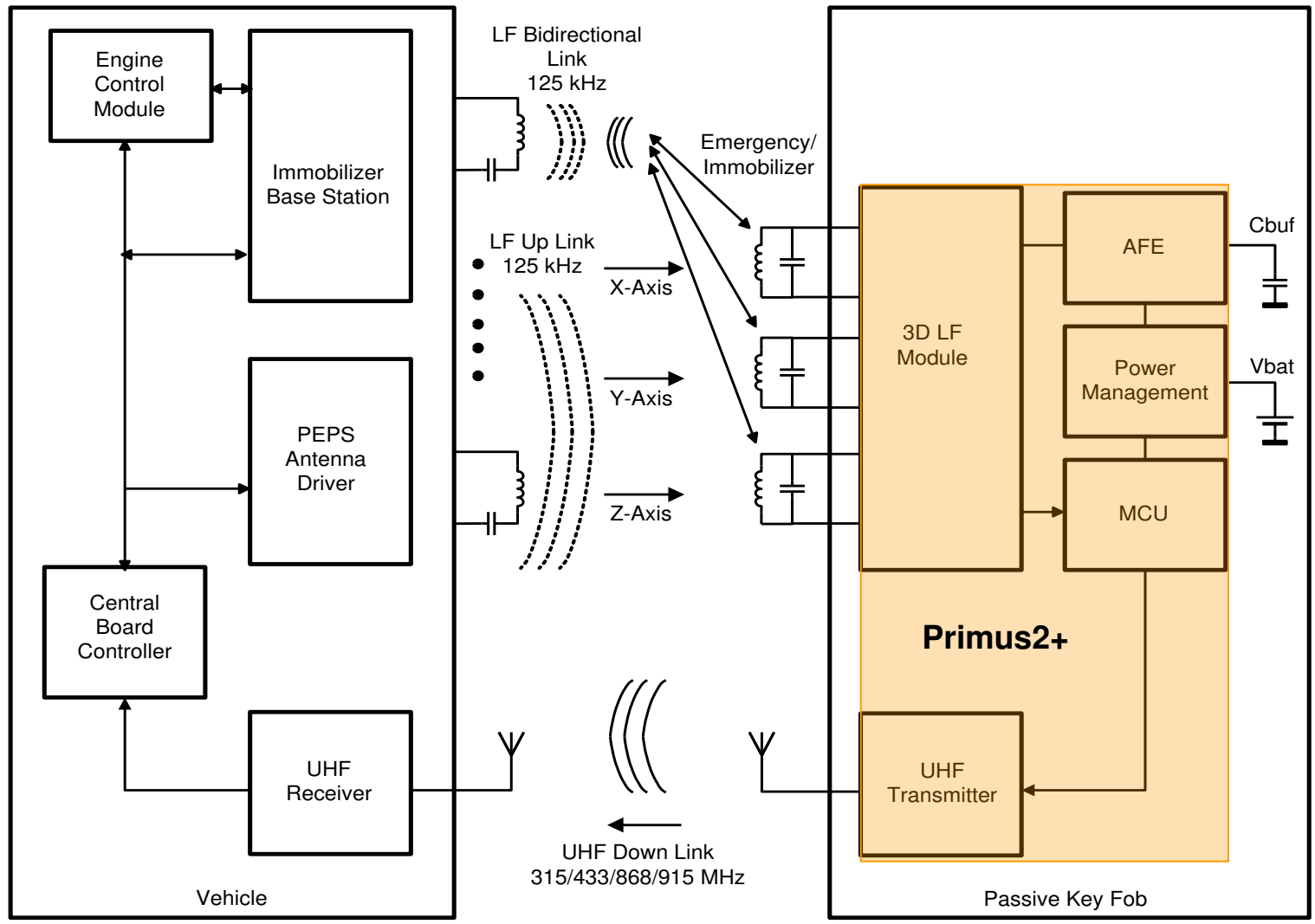
Key features

- AES is basis for open-source immobilizer SW library and comes along with integrated fast AES encryption engine
 - 32-bit unique identification number
 - Two 128-bit secret keys, one 128-bit transponder key
- Highest security level for encryption (128bit)
- Special memory protection secures immobilizer software
- Highly sensitive 3D LF RSSI measurement allows fast wake-up
- Tolerance compensation for 3D RSSI measurement
- Easy software design with existing AVR tool set
 - Low-power, effective AVR microcontroller
 - 14kB Flash for customer software available
- Frac-N RF Transmitter (300MHz – 450MHz) up to 12.5dBm
- 1.9V to 4.2V supply voltage



- **Package:** QFN38 5x7mm
- **Samples available:** Now
- **PPAP available:** Now

ATA5702 – 3rd Gen PEPS KeyFob with 3D Immobilizer



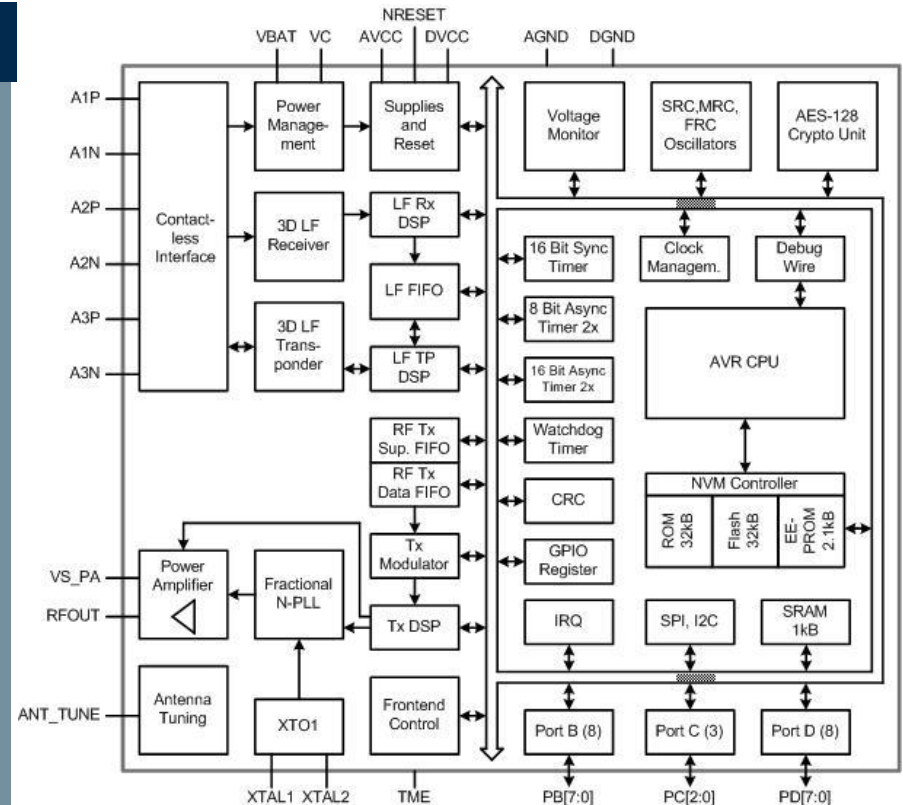
ATA5702 – One chip PEPS Keyfob

2nd Generation Key Fob uC with AES-128, 3D IMMO & RF TX

RKE + PEPS + IMMO: Key

Key Features

- Monolithic Immobilizer/PEPS solution with AES 128
- Open immobilizer Stack
- LF Interface:
 - 3D Transponder and 3D LF wake-up
 - Programmable sensitivity: 100uV_{pp} / 250uV_{pp} / 500uV_{pp}
 - 4.7uA current consumption at 250uV_{pp}
 - Programmable LF bitrates: 1.95k / 3.9k / 7.8kbits/s
 - Logarithmic RSSI measurement for better spatial localization
 - RSSI measurement on 3 channels simultaneously <2.4ms
 - 3D LF Battery charging capability
- AVR Core:
 - 16kB/32kB User Flash, 1/2kB EEPROM, 1kB SRAM
 - 32kB System Firmware (RF protocol handling, LF handling)
- RF Transmitter:
 - Programmable Frac-N PLL covering 310 – 318MHz, 418-477MHz, 836-956MHz in 93Hz / 185Hz steps
 - Programmable RF Output Power: -12 to 14.5dBm
 - Up to 80kBit/s Manchester coded data stream
- Controller Interfaces:
 - 19 GPIOs, SPI & I2C interfaces, Debug-wire
 - Supply voltage: 1.9V to 4.2V
 - QFN 5x7 – 38 pins



Status:

Engineering samples:

Final Samples:

PPAP:

In Design

Nov 2013

Jun 2014

Sep 2014

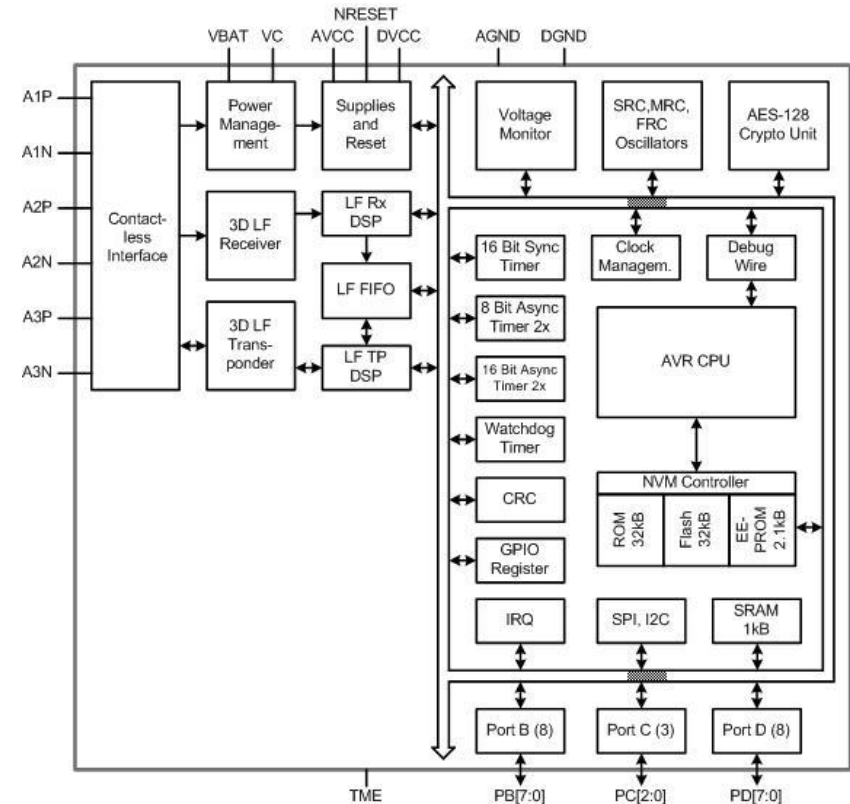
ATA5700 – Primus2 (No Transmitter)

2nd Generation Key Fob uC with AES-128 & 3D IMMO

PEPS + IMMO: Key

Key Features

- Monolithic Immobilizer/PEPS solution with AES 128
- Open immobilizer Stack
- LF Interface:
 - 3D Transponder and 3D LF wake-up
 - Programmable sensitivity: 100uV_{pp} / 250uV_{pp} / 500 uV_{pp}
 - 4.7uA current consumption at 250uV_{pp}
 - Programmable LF bitrates: 1.95k / 3.9k / 7.8kbits/s
 - Logarithmic RSSI measurement for better spatial localization
 - RSSI measurement on 3 channels simultaneously <2.4ms
 - 3D LF Battery charging capability
- AVR Core:
 - 16kB / 32kB User Program Memory, 1/2kB EEPROM, 1kB SRAM
 - 32kB System Firmware (RF protocol handling, LF handling)
- Controller Interfaces:
 - 19 GPIOs, SPI & I2C interfaces
 - Debug-wire
 - Supply voltage: 1.9V to 4.2V
 - QFN 5x7 – 38 pins



Status: In Design
Engineering samples: Nov 2013
Final Samples: Jun 2014
PPAP: Sep 2014

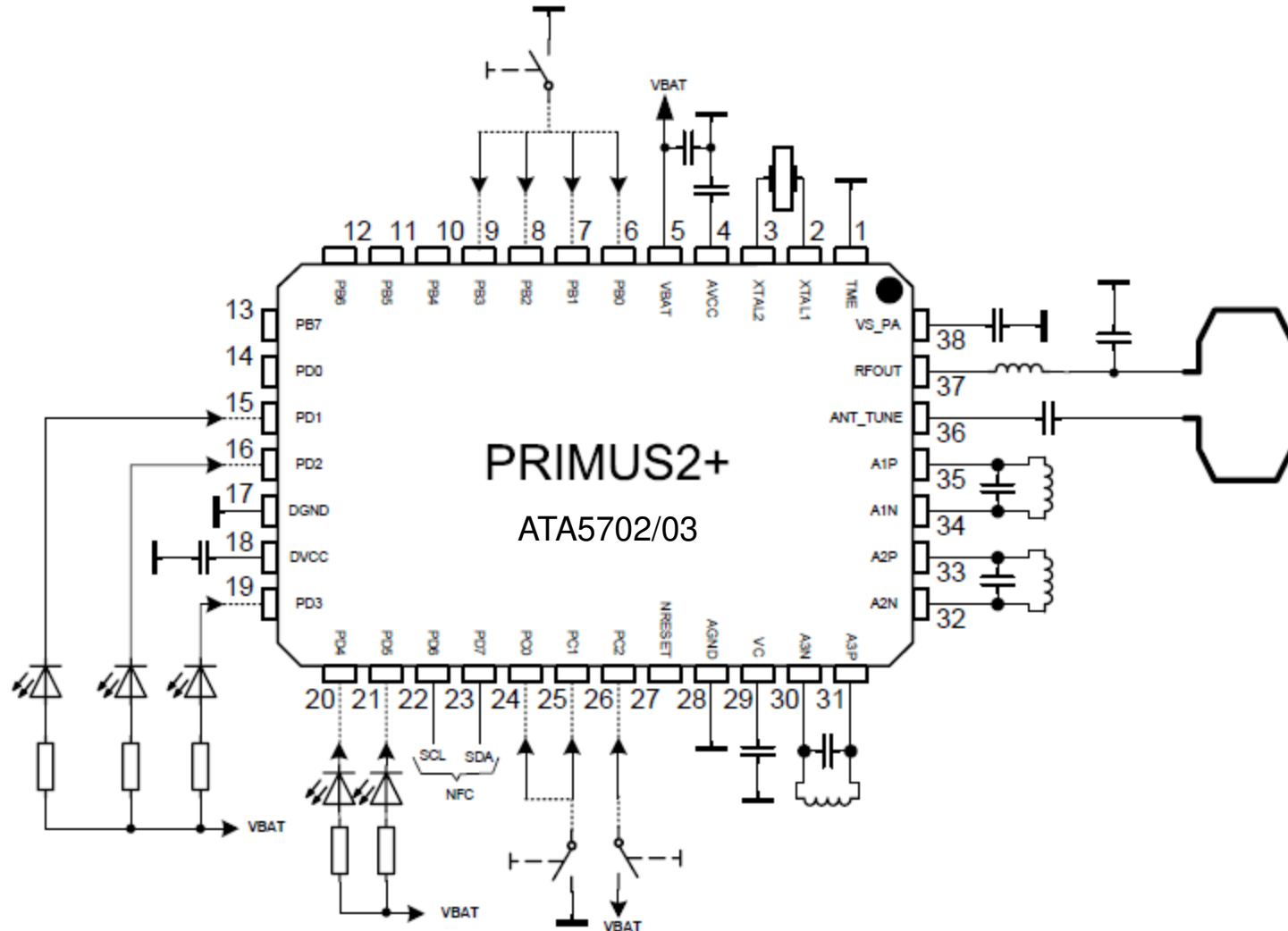
Primus2plus – ATA5700

Competitive Assessment

- ✓ 3D Immobilizer , no direction base
- ✓ Best in class range detection (sensitivity - 100uVpp) vs battery lifetime (power consumption) with good out of band blocking
 - ✓ Allows approach lighting/walk away with acceptable battery lifetime
 - ✓ Possible range measurement for Convertible cars
- ✓ Fastest in/out car detection thanks to direct RSSI measurement on 3 channels simultaneously
- ✓ Best in class RF performance due to the integration of PLL based Transmitter
- ✓ Compatible with almost all Immobilizer Base-station in the market
- ✓ Small package to accomodate small keyfob

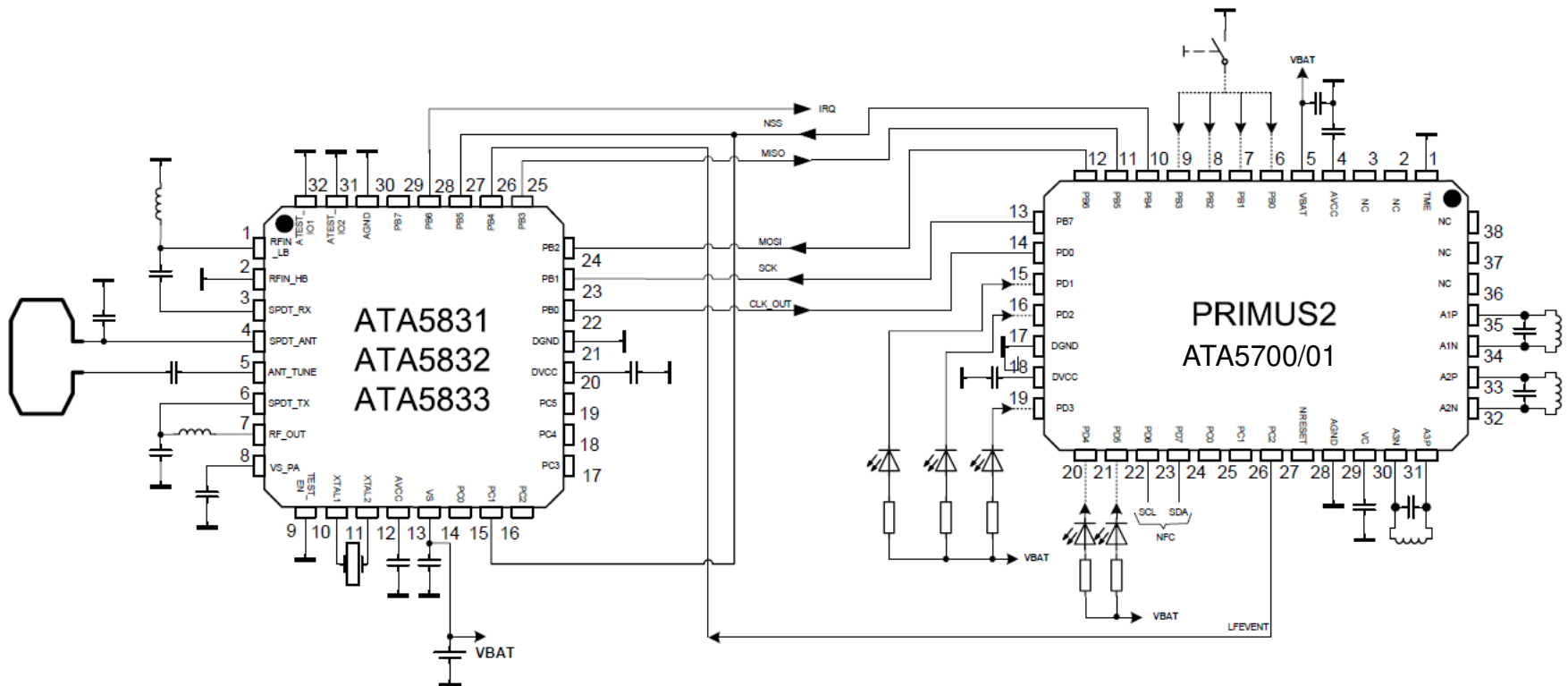
ATA5702/Primus2+

Application 3D-LF/RF-Transmitter



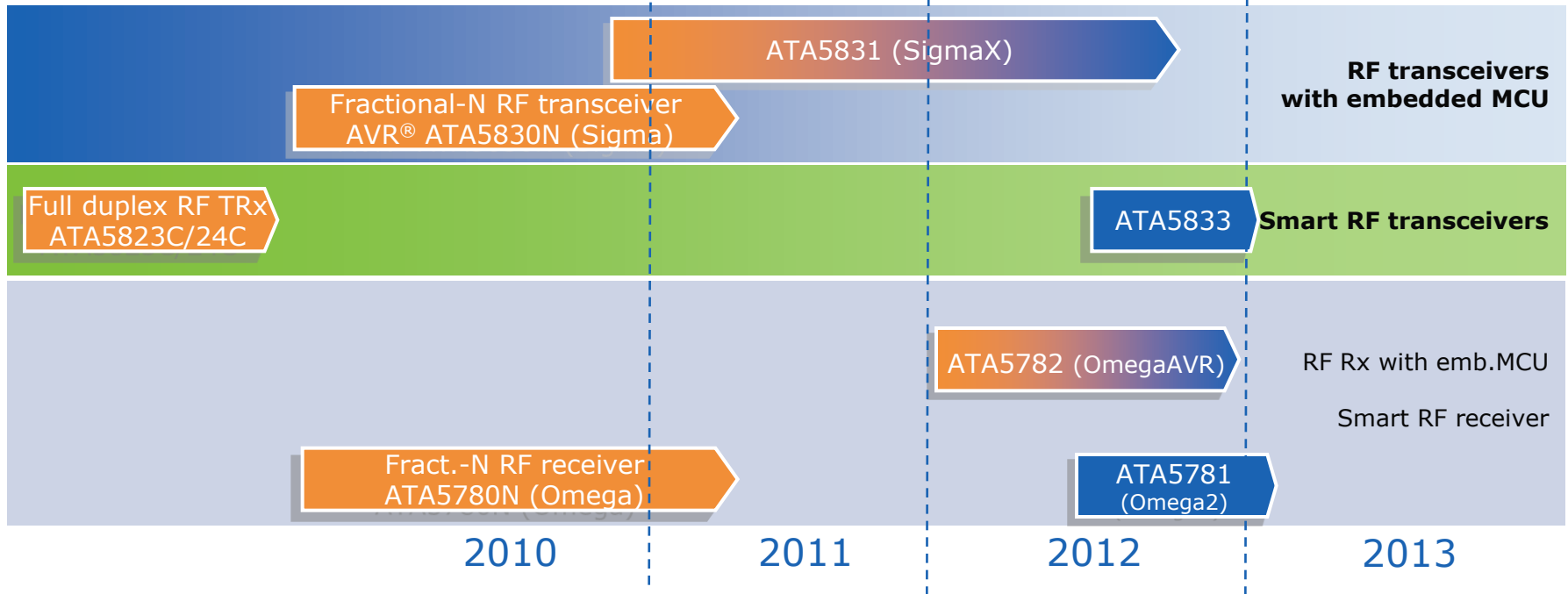
ATA5702/Primus2+

Application 3D-LF/Rf-Transceiver



- LFEVENT: Trigger Signal for fast TRX wake up: <math>< 2\text{ms}</math>
- SPI-Builder: Library for easier SPI communication between Primus2 and TRX
- Crystal clock from TRX

RF Roadmap



Part Number	Frequencies	Description
ATA5823C	315MHz	Full duplex RF transceiver
ATA5824C	433/868MHz	Full duplex RF transceiver
ATA5830N	315/433/868-915MHz	RF transceiver AVR® microcontroller – 6KByte user Flash
ATA5831	315/433/868-950MHz	RF transceiver AVR microcontroller – 20KByte user Flash
ATA5833	315/433/868-950MHz	Fractional-N smart RF transceiver for key fobs
ATA5780N	315/433/868-915MHz	Fractional-N smart RF receiver
ATA5781	315/433/868-950MHz	2nd-generation Fractional-N smart receiver
ATA5782	315/433/868-950MHz	RF receiver AVR microcontroller – 20KByte user Flash

Sigma (TrX) & Omega (Rx) Family Roadmap

	ATA5830N	ATA5780N	ATA5831		ATA5781	ATA5782
Flash (KB)	6	—	20		—	20
User ROM (KB)	—	—	—	20	—	—
RF Transmitter	✓	—	✓		—	—
Independent Services	3	3	5	5	5	5
Enhanced RF switch time	—	—	✓		✓	✓
Enhanced sensitivity	—	—	✓		✓	✓
			Transceiver		Receiver	

Common Features

Best in class Blocking RF Receiver

24kB ROM RF Library

Package & pin compatible

Advanced RF TRX: ATA5831

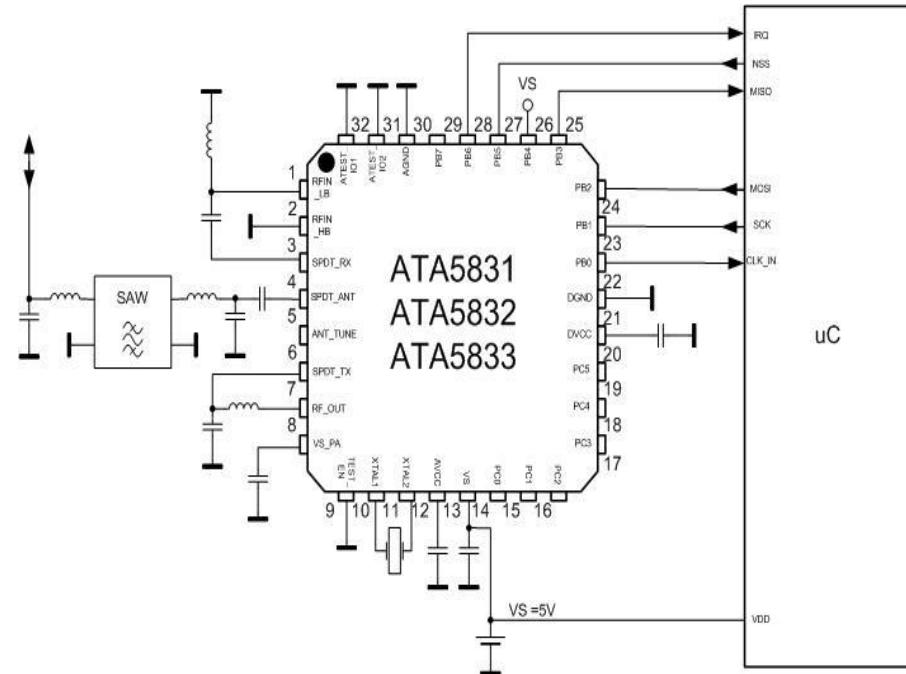
RKE / PEG & TPMS RF Transceiver

Key Characteristics

- UHF Transceiver AVR with Excellent RF Performance
- Pin, package & Software Compatible with ATA578x family (Rx)
- One Device & Crystal Covers All Frequencies
- Integrated RF Switch
- ATA5831@20 KB user Flash, ATA5832@20KB user ROM and ATA5833 @no user ROM(+24 kB ROM firmware lib. For all versions)
- Autonomous operation possible

Key Features

- **UHF transceiver with excellent RF performance**
- **ASK Sensitivity (Manchester) at 433.92MHz:**
 - 109dBm @ 20kBit/s IFBW=366 kHz
 - 119dBm @ 1kBit/s IFBW=366 kHz
- **FSK Sensitivity (Manchester) at 433.92MHz:**
 - 108dBm @ 20kBit/s $\Delta f = \pm 20\text{kHz}$ IFBW=165 kHz
 - 114dBm @ 5kBit/s $\Delta f = \pm 5\text{kHz}$ IFBW=165 kHz
 - 123dBm @ 0.75kBit/s $\Delta f = \pm 0.75\text{kHz}$ IFBW=25 kHz
- **Best in Class blocking performances**
e.g. 64 dBc@IFBW=165kHz) and 48dBc@IFBW=225kHz at Freq. Offset of 1MHz
- **High image rejection:** e.g. 55dB @ 315/433MHz; 50 dB @868.3MHz/915MHz without calibration
- **Automatic antenna tuning for loop antenna**
- **Programmable output power:** -10 to 14 dBm
- **5 independent services with 3 channels each**
- **Supply range:** 1.9V – 3.6 V; 4.5 - 5.5 V
- **Temperature range** - 40° C to +105° C



Wettable flanks package: **QFN32 5x5mm**
 Samples Available: **Now**
 PPAP Available: **Now**

Advanced RF RX: ATA5781/82

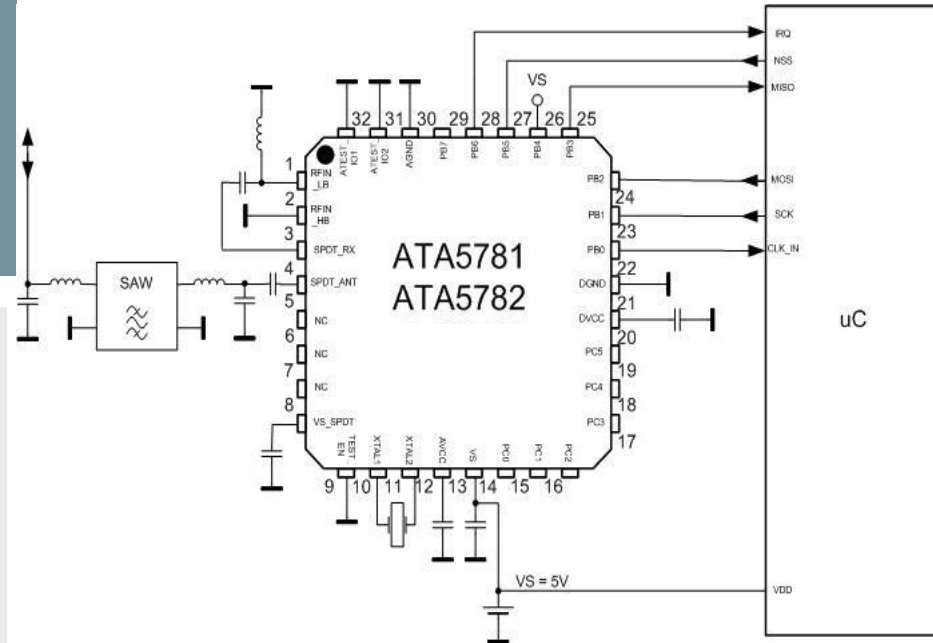
RKE / PEG & TPMS RF Receiver

Key Characteristics

- UHF Receiver AVR with Excellent RF Performance
- Pin, package & Software Compatible with ATA583x family (TRX)
- One Device & Crystal Covers All Frequencies
- Integrated RF Switch
- ATA5782@20 KB user Flash, and AT5781@no user ROM(+24 kB ROM firmware lib. For all versions)
- Autonomous operation possible

Key Features

- **UHF Receiver with excellent RF performance**
- **ASK Sensitivity (Manchester) at 433.92MHz:**
 - 109dBm @ 20kBit/s IFBW=366 kHz
 - 119dBm @ 1kBit/s IFBW=366 kHz
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- **Temperature range** - 40° C to +105° C



Package: Wettable flanks QFN32 5x5mm
Samples Available: Now
PPAP Available: Now

Competitive Battery Lifetime and Blocking Behavior

Operating Mode	ATA5831	A	B
Receive 433MHz	11mA	22mA	22mA
Transmit 433MHz (10dBm)	18mA	25mA	33mA
Off (2.7V, 85C)	0.5uA	5uA	5uA
Multi-profile wake-up	✓	✗	✗

ATA5781	C
11mA	12mA
N/A	N/A
0.5uA	27uA
✓	✗

Operating Mode	ATA5831	A	B
Blocking (typical)	62dBc	40dBc	40-50dBc
Image rejection (typical)	55dBc	45dBc ¹	31dBc ²

ATA5781	C
62dBc	tbd
55dBc	40dBc ³

- 1 ... Requires calibration
- 2 ... Narrower channel selected
- 3 ... 10.7MHz IF filter

