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Never stop thinking

SmartLEWIS™ MCU

Smart Low Energy Wireless Systems with a Microcontroller Unit

PMA51xx

RF Transmitter ASK/FSK 315/434/868/915 MHz,
Embedded 8051 Microcontroller,
10-bit ADC,
125 kHz ASK LF Receiver

PMA5110 Version 1.0
PMA5105 Version 1.0

Data Sheet

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Wireless Control

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PMA51xx RF Transmitter ASK/FSK 315/434/868/915 MHz,
Embedded 8051 Microcontroller,
10-bit ADC,
125 kHz ASK LF Receiver

Revision History: 2010-06-02, Revision 2.1

Previous Revision: 2.0

Page	Subjects (major changes since last revision)
101, 86	Added note to use Library function LFSensitivityCalibration() for LF Carrier Detector Threshold Level Selection.

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1 Product Description

1.1 Overview

The SmartLEWIS™ MCU family comprises an ASK/FSK multiband transmitter for the sub 1GHz ISM frequency bands with an embedded 8051 microcontroller as base functionality. Additionally, the highly integrated single chip family has internal sensors and optional peripheral functions like an analog to digital converter (ADC) and a LF Receiver on chip. The operating voltage range of 1.9 to 3.6 V, the high efficiency Power Amplifier and an advanced power control system make the PMA51xx family ideal for battery operated applications where low current consumption is necessary. The pin-compatible product family requires only a few external components and is the basis for flexible wireless control transmitter platforms enabling applications for different frequency bands, output power levels and feature sets based on only one design - just through different mounting options.

The multiband ASK/FSK transmitter for 315/434/868/915 MHz frequency bands contains a fully integrated VCO, a PLL synthesizer, an ASK/FSK modulator and a high efficiency Power Amplifier with selectable output power. Fine tuning of the center frequency can be done by an on-chip capacitor bank.

The integrated microcontroller is instruction set compatible to the standard 8051 processor. It can be clocked with an internal 12 MHz RC HF or an external oscillator. 6 clock cycles are needed for the execution of one instruction. This results in 2 MIPS[1)] when using the 12 MHz RC HF oscillator. The microcontroller is equipped with various peripherals like a hardware Manchester/BiPhase Encoder/Decoder and a CRC Generator/Checker. To store the microcontroller application program code, a 6 kbyte on-chip FLASH memory is integrated. This FLASH memory is also used for saving the unique ID-number of the chip. A comprehensive software function library with high level commands in ROM allows easy and fast time to market development. The library provides many powerful functions like AES-encryption and EEPROM emulation, what helps to reduce the user code size.

Additional peripherals are an integrated temperature sensor and a low battery voltage sensor. Measurements via these internal sensors and reading signals from analog inputs (e.g. from an external analog sensor) are performed under software control.

Depending on the product variant, PMA51xx offers an embedded multi-channel 10-bit analog to digital converter with flexible high-gain settings as interface for a broad variety of analog sensors and an integrated 125 kHz LF Receiver. The LF Receiver enables wireless wake-up in battery operated applications with ultra-long-lifetime or even contactless configuration of the device.

1) MIPS .. Million Instructions Per Second

1.2 PMAx1xx Product Family

The PMAx1xx product family contains various product variants listed in **Table 1 "PMA51xx and PMA71xx Family" on Page 14**.

Note: This data sheet documents the full feature set of the PMA5110, which has the full feature set of the PMA51xx product family available. When using the PMA51xx family data sheet for product variants other than the PMA5110, please keep in mind that not all of the features and data described are relevant for these other members of the family.

Following table shows the functional differences of the PMA51xx and PMA71xx family members:

Table 1 PMA51xx and PMA71xx Family

Product Name	Ordering Code	RF Transmitter	Embedded 8051 MCU	ADC	125 kHz LF Receiver	Automotive Qualified
PMA7110	SP000430596	X	X	X	X	no
PMA7107	SP000450412	X	X		X	no
PMA7106	SP000450410	X	X	X		no
PMA7105	SP000450408	X	X			no
PMA5110	SP000373573	X	X	X	X	yes
PMA5105	SP000463432	X	X			yes

The PMA51xx products are supporting a temperature range from -40 to +125°C and are full automotive qualified, tailored for automotive applications and industrial applications in harsh environment. Additionally, Infineon offers the PMA71xx product family with a temperature range of -40 to +85°C, tailored for consumer and industrial applications.

1.3 Applications

- Remote Keyless Entry (RKE)
- Security and alarm systems requiring high quality standards
- Industrial controls in harsh environments
- Wireless sensing

1.4 Key Features

General:

- Supply voltage range from 1.9 V up to 3.6 V
- Operating temperature range from -40 to +125°C
- Low power down current consumption < 0.6 µA
- Advanced power control system for lowest system current consumption, switching the microcontroller or transmitter part into POWER DOWN or IDLE state whenever possible
- PG-TSSOP-38 package

Transmitter:

- Multiband RF Transmitter for ISM frequency band 315/434/868/915 MHz
- SW configurable transmit power of 5/8/10 dBm into 50 Ohm load
- Selectable transmit data rates up to 32 kbit/s (64 kchips/s) for the temperature range -40°C to +85°C and 20 kbit/s (40 kchips/s) for temperatures above +85°C
- RF Encoder supporting Manchester-, BiPhase- or NRZ coded data (Chip Mode)

- ASK/FSK modulation capability
- FSK frequency deviation up to 100 kHz
- Fully integrated VCO and PLL synthesizer
- Crystal oscillator tuning on chip

Microcontroller:

- 8051 instruction set compatible microcontroller (cycle-optimized)
- 6 kbyte free programmable FLASH code memory
- 2 blocks of 128 byte FLASH data memory, alternatively usable as 31 byte emulated EEPROM
- ROM embedded software function library with preprogrammed functions and high level commands for easy programming
- 128 bit AES (Advanced Encryption Standard) embedded as software function
- 256 bytes RAM (128 bytes configurable to keep content in POWER DOWN state)
- 16 bytes XData memory (supplied in POWER DOWN state)
- 2 MIPS when using internal 12 MHz RC HF oscillator

Peripherals:

- 125 kHz ASK LF Receiver
- LF Receiver data rate for typical 3.9 kbit/s (Manchester/BiPhase coded)
- 10 bit ADC with 3 pair differential channels and flexible high-gain settings (e.g. as inputs for external sensors)
- 10 free programmable bidirectional General Purpose Input Output pins (GPIO) with on-chip pull-up/pull-down resistors. 8 of them have wake-up functionality
- On-chip temperature sensor
- On-chip voltage sensor for low battery voltage measurement
- Brownout Detector
- Manchester/BiPhase Encoder and Decoder
- 16 bit hardware CRC Generator
- 8 bit Pseudo Random Number Generator
- I^2C bus interface
- SPI bus interface

Miscellaneous:

- Watchdog Timer
- 4 independent 16 bit timers
- Wake-up from POWER DOWN state possible by different sources: Interval Timer, Watchdog Timer, LF Receiver or external wake-up sources connected to GPIOs
- On-chip debugging via I^2C interface
- 48 bit unique-ID on chip

1.5 Pin Diagram

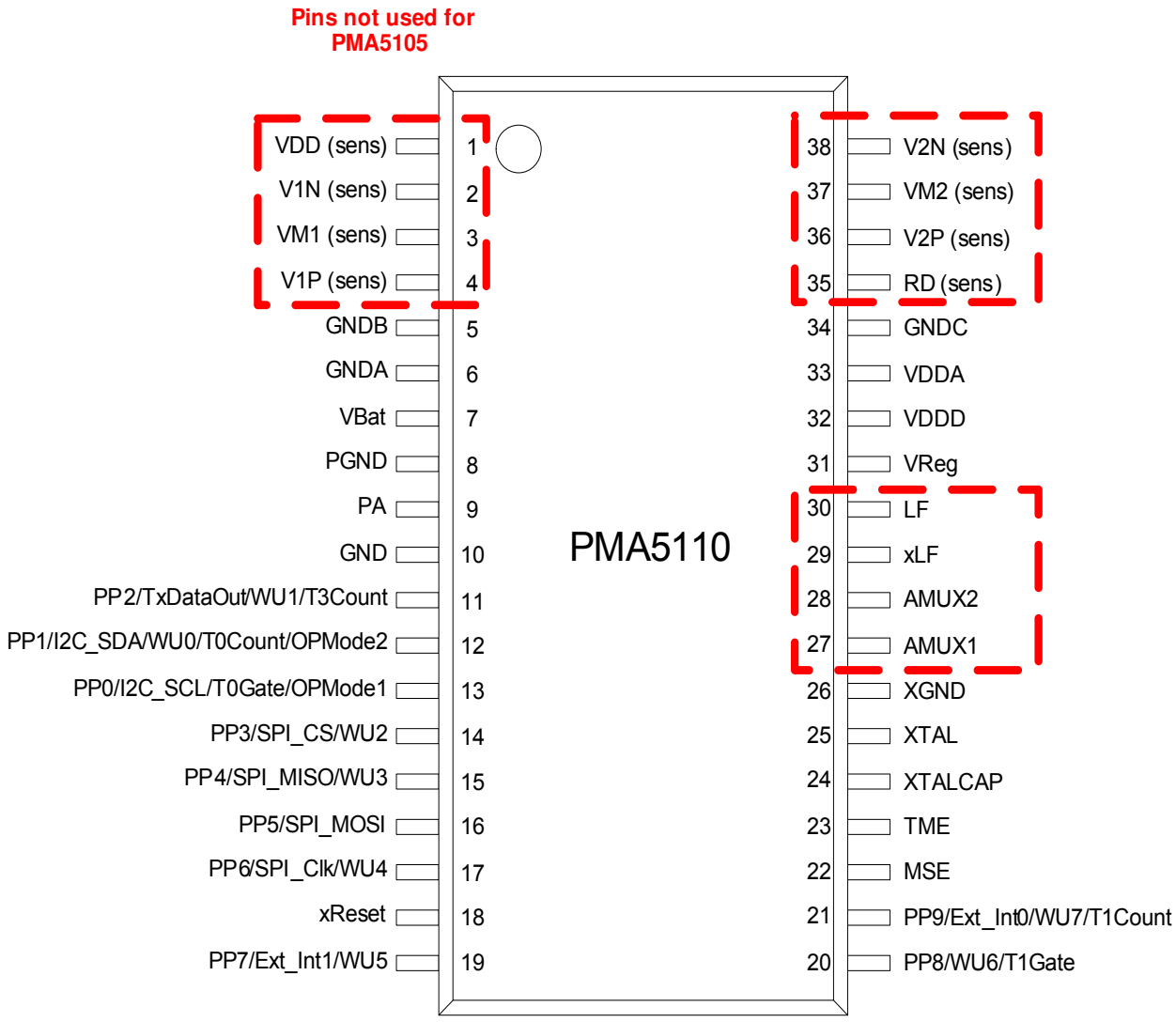


Figure 1 Pin-outs of PMA51xx

1.6 Pin Description

Abbreviations

Standard abbreviations for I/O are shown in **Table 2**.

Table 2 Abbreviations for Pin Type

Abbreviations	Description
I	Standard input-only pin. Digital levels.
I/O	I/O is a bidirectional input/output signal.
AI	Input. Analog levels.
AO	Output. Analog levels.
AI/O	Input or Output. Analog levels.
PWR	Power
GND	Ground

Table 3 Pin Description

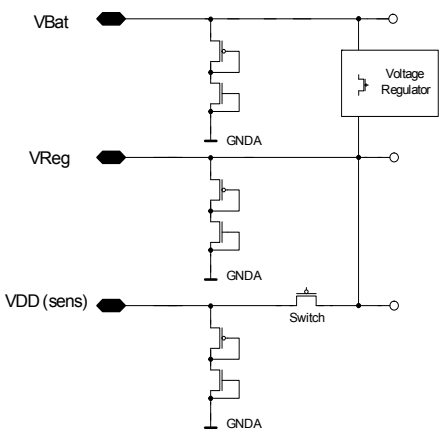
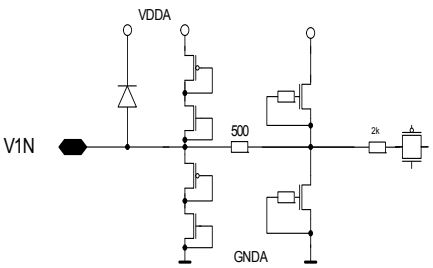
Pin No.	Name	Pin Type	Buffer Type	Function
1	VDD_sens	AO	Supply_output 	**Sensor Bridge Positive Supply** Output of V_{Reg} during measurement.
2	V1N_sens	AI	Analog 	**Channel 6, High-gain ADC Input** Negative input connect to sensor bridge. Output of wheatstone bridge sensor

Table 3 Pin Description (cont'd)

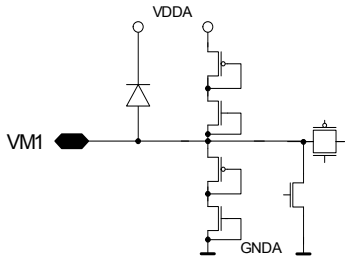
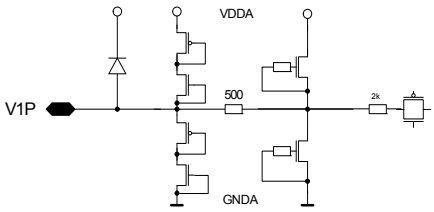
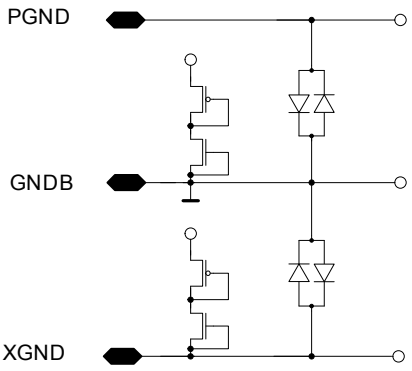
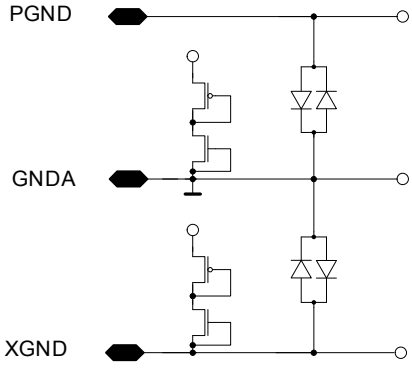
Pin No.	Name	Pin Type	Buffer Type	Function
3	VM1_sens	GND	Supply 	**Channel 6, High-gain ADC Input** Sensor bridge negative supply. Same voltage as chip GND.
4	V1P_sens	AI	Analog 	**Channel 6, High-gain ADC Input** Positive input connect to sensor bridge. Output of wheatstone bridge sensor
5	GNDB	GND	Supply 	**Ground**
6	GNDA	GND	Supply 	**Ground**

Table 3 Pin Description (cont'd)

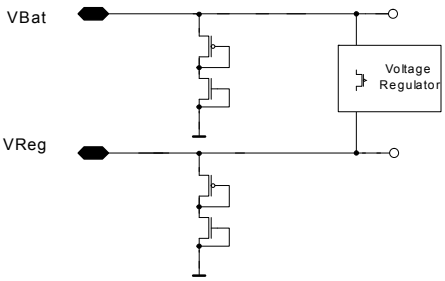
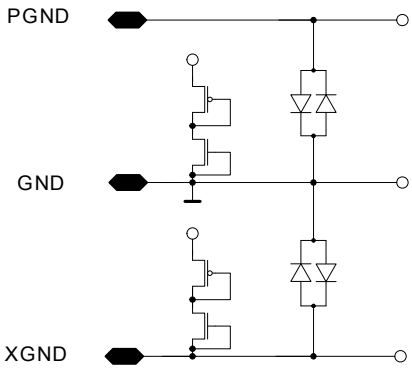
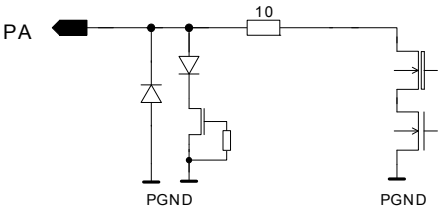
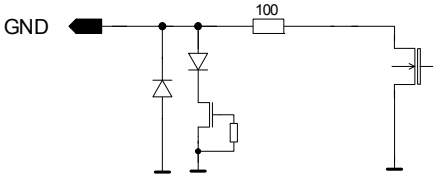
Pin No.	Name	Pin Type	Buffer Type	Function
7	VBat	PWR	Supply 	**Battery Supply Voltage Regulators**
8	PGND	GND	Supply 	**Power Amplifier Ground** Double bond
9	PA	AO	Analog 	**Power Amplifier Output Stage**
10	GND	GND	Supply(Analog) 	**Ground**

Table 3 Pin Description (cont'd)

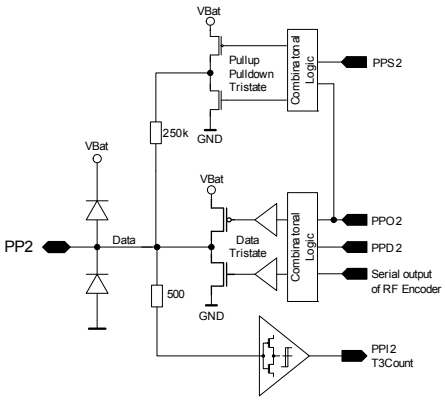
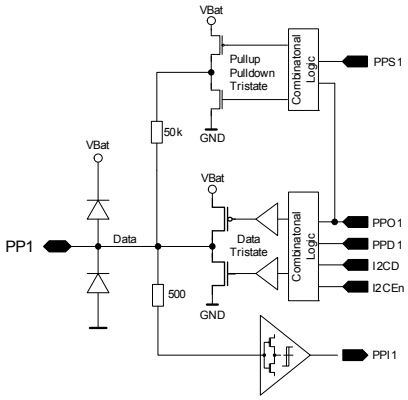
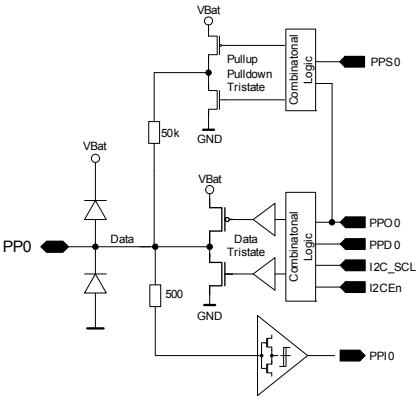
Pin No.	Name	Pin Type	Buffer Type	Function
11	PP2/TxDataOut/ WU1/T3Count/	I/O	Digital 	**PP2** -) Serial output of Manchester / Biphase encoded data. -) GPIO -) External wake-up source 1 -) Clock source for Timer 3 -) Internal, switchable pull-up/pull-down.
12	PP1/I2C_SDA/ WU0/T0Count/ OPMode2	I/O	Digital 	**PP1** -) I2C bus interface data -) GPIO -) External wake-up source 0 -) Clock source for Timer 0 -) Select operation mode -) Internal, switchable pull-up/pull-down.
13	PP0/I2C_SCL/ T0Gate/OPMode1	I/O	Digital 	**PP0** -) I2C bus interface clock -) GPIO -) External enable for Timer 0 -) Select operation mode -) Internal, switchable pull-up/pull-down.

Table 3 Pin Description (cont'd)

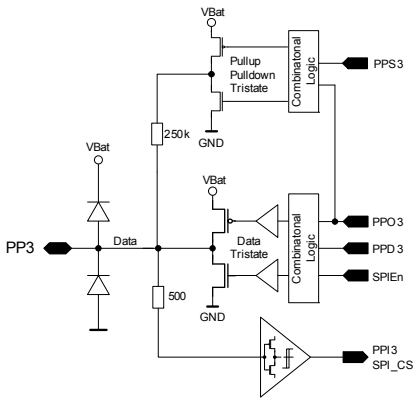
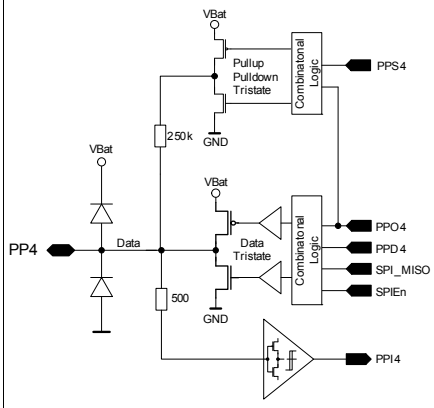
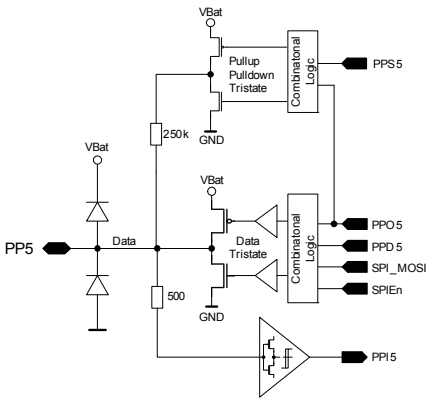
Pin No.	Name	Pin Type	Buffer Type	Function
14	PP3/SPI_CS/WU2	I/O	Digital 	**PP3** -) SPI bus interface chip select -) GPIO -) External wake-up source 2 -) Internal, switchable pull-up/pull-down.
15	PP4/SPI_MISO/ WU3	I/O	Digital 	**PP4** -) SPI bus interface master in slave out -) GPIO -) External wake-up source 3 -) Internal, switchable pull-up/pull-down.
16	PP5/SPI_MOSI	I/O	Digital 	**PP5** -) SPI bus interface master out slave in -) GPIO -) Internal, switchable pull-up/pull-down.

Table 3 Pin Description (cont'd)

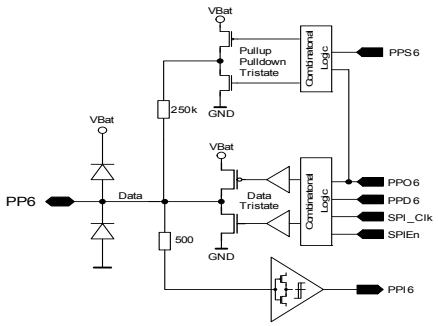
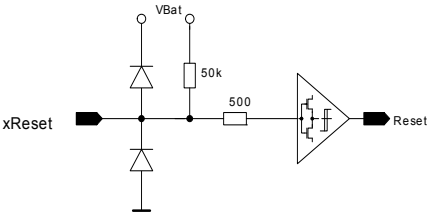
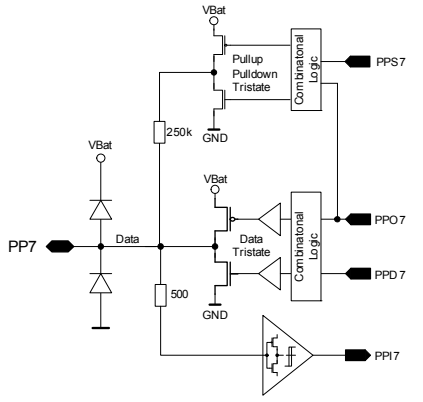
Pin No.	Name	Pin Type	Buffer Type	Function
17	PP6/SPI_Clk/WU4	I/O	Digital 	**PP6** -) SPI bus interface clock -) GPIO -) External wake-up source 4 -) Internal, switchable pull-up/pull-down.
18	xReset	I	Digital 	**External Reset** Low active
19	PP7/Ext_Int1/WU5	I/O	Digital 	**PP7** -) GPIO -) External interrupt source 1 -) External wake-up source 5 -) Internal, switchable pull-up/pull-down.

Table 3 Pin Description (cont'd)

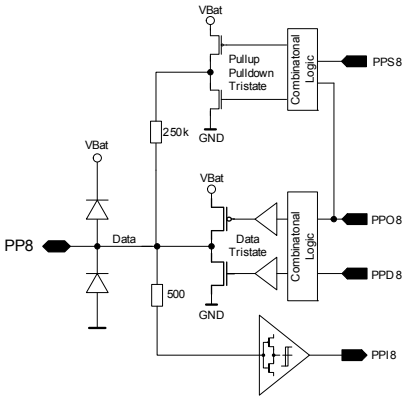
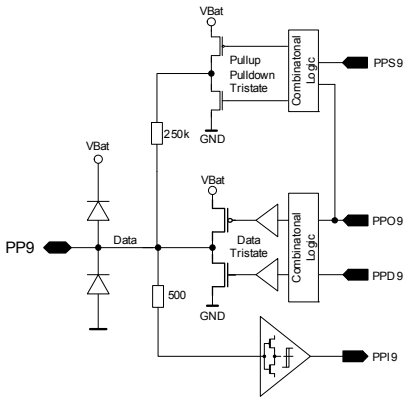
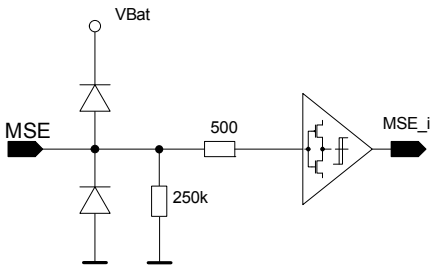
Pin No.	Name	Pin Type	Buffer Type	Function
20	PP8/WU6/T1Gate	I/O	Digital 	**PP8** -) GPIO -) External wake-up source 6 -) External enable for Timer 1 -) Internal, switchable pull-up/pull-down.
21	PP9/Ext_Int0/WU7 /T1Count	I/O	Digital 	**PP9** -) GPIO -) External interrupt source 0 -) External wake-up source 7 -) Clock source for Timer 1 -) Internal, switchable pull-up/pull-down.
22	MSE	I	Digital 	**Mode Select Enable** High active, set to GND in NORMAL Mode.

Table 3 Pin Description (cont'd)

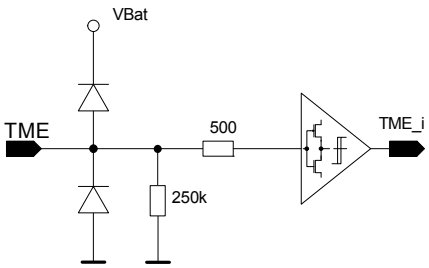
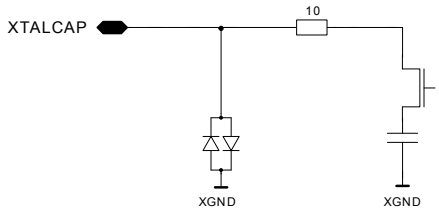
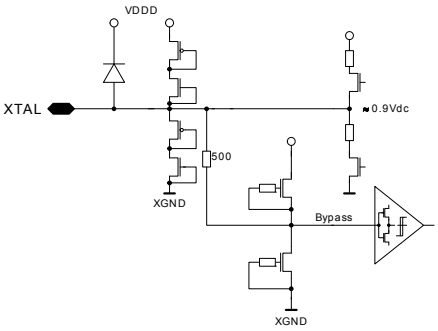
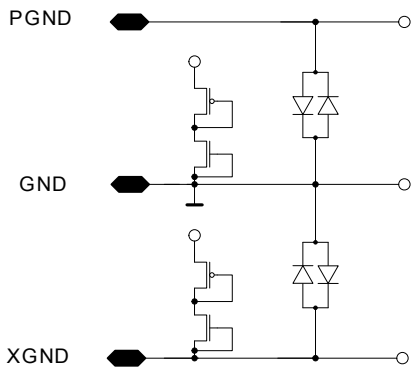
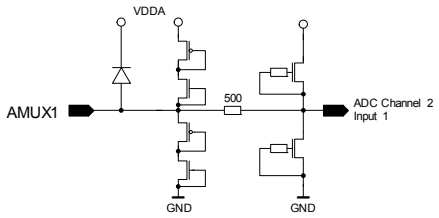
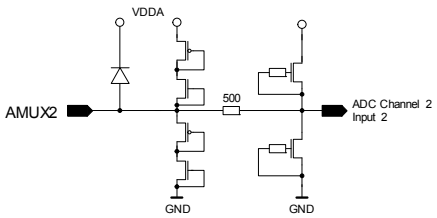
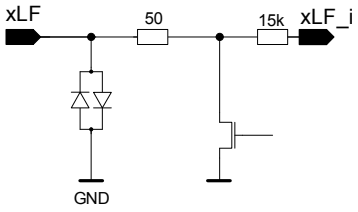
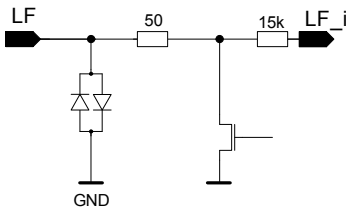
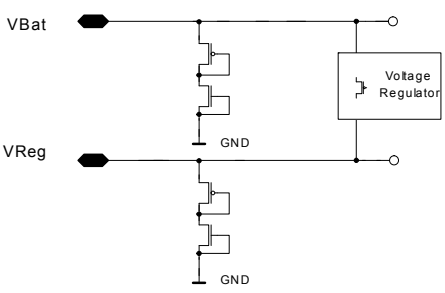
Pin No.	Name	Pin Type	Buffer Type	Function
23	TME	I	Digital 	**Test Mode Enable, n.a. for Normal Application** Has to be set to GND in NORMAL Mode
24	XTALCAP	AI	Analog 	**Crystal Oscillator Load Capacitance**
25	XTAL	AI	Analog 	**Crystal Oscillator Input**
26	XGND	GND	Supply 	**Crystal Oscillator Ground**

Table 3 Pin Description (cont'd)

Pin No.	Name	Pin Type	Buffer Type	Function
27	AMUX1	AI	Analog 	**Additional Differential ADC Standard Input1 for External Sensor** Connect to GND if not use.
28	AMUX2	AI	Analog 	**Additional Differential ADC Standard Input2 for External Sensor** Connect to GND if not use.
29	xLF	AI	Analog 	**Differential LF Receiver Input2** 125kHz Input.
30	LF	AI	Analog 	**Differential LF Receiver Input1**
31	VReg	AO	Supply 	**Internal Voltage Regulator Output** Connect to decoupling capacitor (C_{BCAP}=100 nF) Regulated Power supply.