

The logo for 'embit' is positioned on a green horizontal bar. It features the word 'embit' in a lowercase, sans-serif font. To the right of the text is a graphic element consisting of several curved, overlapping lines that suggest a signal or a stylized 'e'.

EMB-WMB169PA

EMB-WMB868

Datasheet

Document information

Versions & Revisions

Revision	Date	Author	Comments
1.0	09/08/2011	Embit	Preliminary version
1.1	01/02/2012	Embit	Updated pinout
1.2	26/04/2012	Embit	Updated with PA version
1.3	28/06/2012	Embit	Updated data
1.4	10/07/2012	Embit	Update footprint
1.5	06/12/2012	Embit	Added information
1.6	09/01/2013	Embit	Minor edits
1.7	28/03/2013	Embit	Minor edits
1.8	21/05/2013	Embit	Updated soldering information, notes, RF characteristics and compliance
1.9	30/05/2014	Embit	Fixed some typos, added suggested footprint, removed EMB-WMB169T, corrected 868 MHz compliance

References

Ref	Version	Date	Author	Title
1	EN 13757-4	2013	CEI UNI	Communication systems for meters and remote reading of meters – Part 4: Wireless meter readout (Radio meter reading for operation in SRD bands)

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1 Description

EMB-WMB is the latest wireless module for Wireless M-Bus applications developed by Embit. The module combines high performance to small dimensions and low cost, providing the system integrator a simple and easy way to add Wireless M-Bus wireless connectivity and multi-hop networking into existing products.

EMB-WMB is configured as an embedded micro system or simple data modem for low power applications in the 169 MHz or 868/915 MHz ISM band. It is based on Texas Instruments CC1120 transceiver coupled with a MSP430F534x MCU equipped with up to 64/96/128 kByte of Flash memory and 6/8/10 kByte of RAM memory.

The RF section guarantees best-inclass performance in terms of covered area and power consumption. The output power can be increased up to +14 dBm (+15 dBm for 169 MHz) by simple software configurations, while sensitivity goes beyond -122 dBm. An amplified version (PA) exists for the 169 MHz band that achieves up to +30 dBm maintaining the same pinout and power supply requirements (single 3,3 V power supply).

EMB-WMB can communicate with other devices through different serial interfaces: two UART ports and an SPI port. In addition several digital I/O ports are available. Targets of the module are flexibility and power-awareness: **EMB-WMB** can be configured as network concentrator, router/repeater, translator or meter thanks to the extremely reduced power consumption.

1.1 Specifications

- 16 bit MSP430F534x MCU (MSP430F5340 / MSP430F5341 / MSP430F5342)
- 64/96/128 kB Flash, 6/8/10 kB RAM
- RF output power: up to +15 dBm (up to +30 dBm for the PA version)
- RF sensitivity: beyond -122 dBm
- Wire antenna, U.FL connector, wire antenna and PCB pads
- Edge SMD connector

1.2 Applications

- Smart meter
- Smart grid concentrator
- Smart grid router/repeater or translator
- Proprietary solutions

1.3 Block diagram

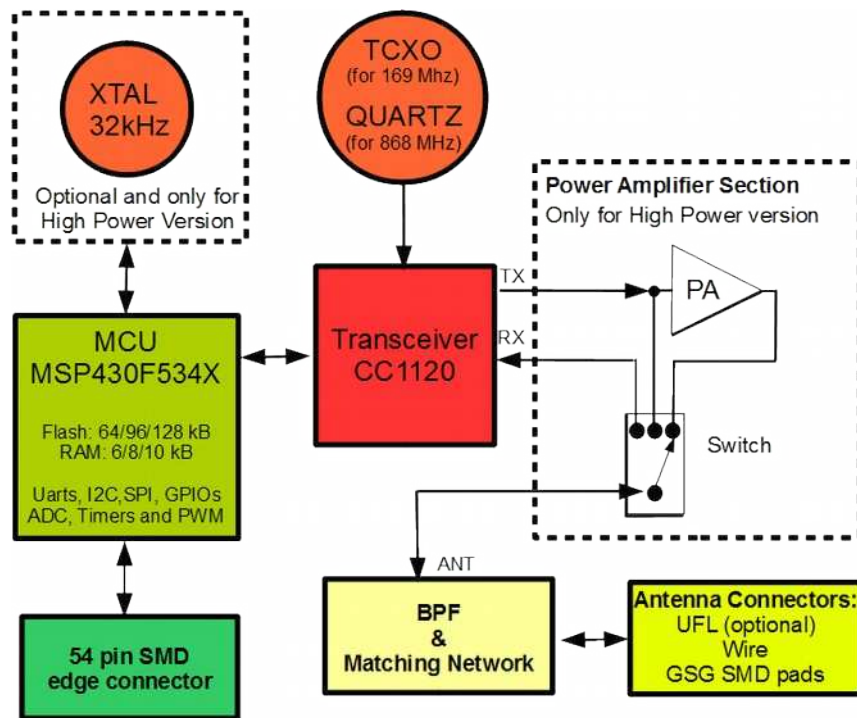


Image 1: Block diagram for the EMB-WMB

1.4 Microcontroller

The EMB-WMB includes a MSP430F534x 16 bit microcontroller from Texas Instruments. It features very interesting low power functionality and a good amount of processing power for wireless metering applications. The microcontroller communicates with the RF transceiver through an SPI line and some GPIOs.

1.5 Antenna

The EMB-WMB offers three options for the antenna:

- External antenna connector (optional): 50 Ohm single ended U.FL connector
- Wire antenna soldering hole
- PCB pad for printed or external antennas mounted on hosting board

1.6 Firmware

The **EMB-WMB** can be operated with the Wireless M-Bus protocol stack provided by Embit. A serial bootloader can be provided to program the device without the need for additional hardware.

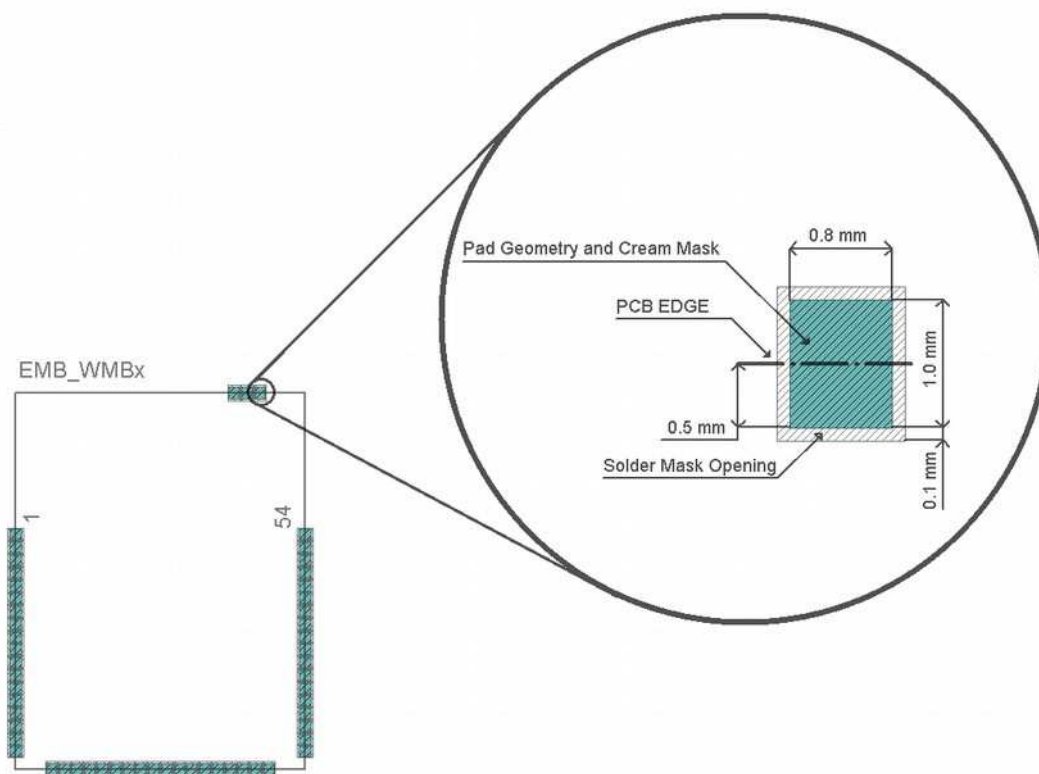
1.7 Development tools

To work with the EMB-WMB module, the following software tools are suggested:

- Texas Instruments Code Composer Studio 5.5 (Integrated Development Environment). It is required to develop applications using the Embit Wireless M-Bus stack library.
- Texas Instruments “MSP430 Flasher - Command Line Programmer” (Command Line programmer / batch programmer for MSP-FET430UIF)
- Elprotronic “FET Pro430 Lite” (Windows-based programmer)

2.2 Suggested footprint

The EMB-WMB footprint consists in 57 smd pads 1,00 x 0,80 mm in dimensions positioned as following:



2.3 Antenna connection

The Antenna output of the module is matched to 50 Ohm. By using a 50 Ohm antenna, no additional matching is required. Connection with antenna should be as short as possible, and must represent a characteristic impedance of 50 Ohm. A grounded coplanar waveguide is suggested to minimize the interaction with the external environment.

2.4 Notes

- The area underneath the module must be kept free of components (both top and bottom layers) and must be covered with solder resist.
- The PCB top layer underneath the module must be free of nets, power planes and vias. The bottom layer shall provide a ground plane.
- The power supply of the module must be as clean as possible; it must be decoupled placing a ceramic capacitor as near as possible at the Vcc pins, additional filtering made by a ferrite bead is recommended.
- Noisy electronic components (such as switching power supply) must be placed as far as possible and adequately decoupled.
- The ground pins of the module shall be connected to a solid ground plane.

Note: Taking no account this recommendations may affect the radio performances.

3 Connections

3.1 Module pinout

Pin #	Pin Name	Type	Description	IC Pin #
1	GND	GND	GND	--
2	VREFL	Analog input or digital I/O	Negative analog voltage reference/P5.1	5
3	VREFH	Analog input or digital I/O	Positive analog voltage reference/P5.0	4
4	N.C.	Not connected	Not connected pin	--
5	P6.3_ADC0	Analog input or digital I/O	ADC analog input Channel 0/P6.3	1
6	P6.4_ADC1	Analog input or digital I/O	ADC analog input Channel 1/P6.4	2
7	P6.5_ADC2	Analog input or digital I/O	ADC analog input Channel 2/P6.5	3
8	N.C.	Not connected	Not connected pin	--
9	N.C.	Not connected	Not connected pin	--
10	N.C.	Not connected	Not connected pin	--
11	N.C.	Not connected	Not connected pin	--
12	TEST	JTAG	JTAG test pin (pulled down)	41
13	PJ.0_TDO	JTAG	JTAG test data output/PJ.0	42
14	PJ.1_TDI	JTAG	JTAG test data input/PJ.1	43
15	PJ.3_TCK	JTAG	JTAG test clock input/PJ.3	45
16	PJ.2_TMS	JTAG	JTAG test mode select input/PJ.2	44
17	N.C.	Not connected	Not connected pin	--
18	VCC	Power Input	Supply voltage	--
19	N.C.	Not connected	Not connected pin	--
20	P4.5_UART2_RX	Digital Input/Output	UCA1 RX data input/P4.5	34
21	P4.4_UART2_TX	Digital Input/Output	UCA1 TX data output/P4.4	33
22	P1.2_UART1_RTS	Digital Input/Output	UCA0 request to send input/P1.2 with port interrupt	15
23	P6.2_UART1_CTS	Digital Input/Output	UCA0 clear to send output/P6.2	48
24	P3.4_UART1_RX	Digital Input/Output	UCA0 RX data input/P3.4	26
25	P3.3_UART1_TX	Digital Input/Output	UCA0 TX data output/P3.3	25
26	N.C.	Not connected	Not connected pin	--
27	N.C.	Not connected	Not connected pin	--
28	N.C.	Not connected	Not connected pin	--
29	P1.6_TMR2 / N.C. (on PA)	Digital Input/Output	TA1CLK/P1.6 with port interrupt (Not connected on PA version)	19
30	P1.1_TMR1	Digital Input/Output	TA0.0/P1.1 with port interrupt	14
31	P1.0_TMR0	Digital Input/Output	TA0CLK/P1.0 with port interrupt/ACLK	13

Pin #	Pin Name	Type	Description	IC Pin #
32	P3.2_SPI_SCK	Digital Input/Output	UCB0 Clock/P3.2	24
33	P3.0_SPI_MOSI	Digital Input/Output	UCB0 MOSI/P3.0	22
34	P3.1_SPI_MISO	Digital Input/Output	UCB0 MISO/P3.1	23
35	P2.7_SPI_SS	Digital Input/Output	UCB0 Slave Select/P2.7	21
36	N.C.	Not connected	Not connected pin	--
37	VCC	Power Input	Supply voltage	--
38	N.C.	Not connected	Not connected pin	--
39	N.C.	Not connected	Not connected pin	--
40	N.C.	Not connected	Not connected pin	--
41	N.C.	Not connected	Not connected pin	--
42	N.C.	Not connected	Not connected pin	--
43	GPIO4	Digital Input/Output	TA0.2/P1.3 with port interrupt	16
44	GPIO5	Digital Input/Output	TA0.3/P1.4 with port interrupt	17
45	N.C.	Not connected	Not connected pin	--
46	N.C.	Not connected	Not connected pin	--
47	GPIO6	Digital Input/Output	P5.3	40
48	GPIO7	Digital Input/Output	P5.2	39
49	P5.4_XIN / N.C. (on PA)	Digital Input/Output/Xtal	Opt. 32,768KHz crystal oscillator input/P5.4 (Not connected on PA version)	7
50	P5.5_XOUT / N.C. (on PA)	Digital Input/Output/Xtal	Opt. 32,768KHz crystal oscillator output/P5.5 (Not connected on PA version)	8
51	RESET#	Reset Input	System reset input (active low)	46
52	N.C.	Not connected	Not connected pin	--
53	N.C.	Not connected	Not connected pin	--
54	GND	GND	GND	--

3.2 Typical application circuit

The external supply shall include protection from spikes, short circuits and it requires adequate decoupling.

Note:

- Voltage glitches on VCC supply may cause reset or malfunctioning of the microcontroller.
- Slow voltage ramp on VCC or RESET# may cause malfunctioning of the microcontroller.
- Do not reset or turn off the power of the module while writing to the flash; otherwise memory corruption may occur.

4 Electrical characteristics

4.1 Absolute Maximum Ratings

	Value	Unit
Power Supply Voltage	+3,6	Vdc
Voltage on any pin	Vcc+0,3 (Max 3,6)	Vdc
RF input power (P _{MAX})	10	dBm
Storage Temp. Range	-40 ~ +125	°C

4.2 Operating Conditions

Parameter	Min	Max	Unit
Power Supply Voltage (Vcc)*	2,5	3,6	Vdc
Operating Temperature Range	-40	85	°C
Logic Input Low Voltage	0	0,2xVcc	Vdc
Logic Input High Voltage	0,8xVcc	Vcc	Vdc
Logic Output Low Voltage	0	0,18xVcc	Vdc
Logic Output High Voltage	0,82xVcc	Vcc	Vdc

* On the PA version the supply voltage affects the maximum power achievable.

4.3 Power Consumption

Mode	Typ. value	Unit
Transmit	57*	mA
Receive	23	mA
Sleep	2**	µA

* with +15 dBm of output power in model without PA or PA version with PA turned off.

** with RTC running.

4.4 RF Characteristics

EMB-WMB169PA RF Characteristics ($V_{CC}=3.3V$ 25 °C):

	Min	Typ.	Max	Unit	Note
RF Frequency range	169,400		169,475	MHz	
Frequency tolerance			3,5	ppm	Excluding ageing typ. ± 1 ppm / year
RF Data Rate	0		200	kbps	
Programmable Output Power Range	-7		+27	dBm	Std conditions: 3,3V 25 °C
Rx Bandwidth	8		200	kHz	
Receiver Sensitivity 4.8 kbps GFSK		-117		dBm	
RF Input saturation		+10		dBm	
Blocking ± 2 MHz ± 10 MHz		78 81		dB dB	As specified in EN 300 220

EMB-WMB868 RF Characteristics ($V_{CC}=3.3V$ 25 °C):

	Min	Typ.	Max	Unit	Note
RF Frequency range	868,000		869,650	MHz	Subband g1, g2, g3
Frequency tolerance		15		ppm	± 15 ppm over temperature range
RF Data Rate	0		200	kbps	
Programmable Output Power Range	-7		+15	dBm	Std conditions, 3,3V 25 °C
Rx Bandwidth	8		200	kHz	
Receiver Sensitivity 4.8 kbps GFSK		-117		dBm	
RF Input saturation		+10		dBm	
Blocking ± 2 MHz ± 10 MHz		TBD TBD		dB dB	As specified in EN 300 220

4.5 MCU Characteristics

	Min	Typ.	Max	Unit	Note
MCU core frequency		8		MHz	
UART data rate	1,2		115,2	kbps	

5 Soldering

Temperature profile for reflow soldering:

Pre-heating	Ramp-up	3°C/sec. max
Minimum pre-heating temperature	tsoak min	150°C
Maximum pre-heating temperature	tsoak max	200°C
Pre-heating interval	Tsoak	60-120 sec.
Reflow temperature	tl	217°C
Reflow interval	Tl	60-150 sec.
Peak temperature	tpeak	260°C
Interval to 5°C from tpeak	--	20-30 sec.
Interval to 25°C from tpeak	--	8 min. max
Cool down	Ramp-down	6°C/sec. max

Pb-Free Soldering Paste: it is suggested to use soldering pastes that don't need later clean for residuals.

Cleaning: it's not suggested to clean the module. Solder paste residuals underneath the module cannot be removed.

- Water cleaning: the cleaning process using water can involve water entering underneath the module between the two PCBs creating short circuits.
- Alcohol cleaning: the cleaning process with alcohol can damage the module.
- Ultrasound cleaning: the cleaning process with ultrasound can damage the module.

It is suggested to use no clean solder paste to avoid any need for cleaning.

Cycles: it is suggested to do only one soldering cycle.

In case of reflow soldering, a drying bake should be done in order to prevent a popcorn effect. Re-baking should be done following IPC standards. Any unused modules that has been open for more than 168 hours or not stored at <10% RH should be baked before any subsequent reflow.

6 Ordering information

6.1 Types

Module variations:

Part No.	Mcu	Description
EMB-WMB169PA/PC	MSP430F5340	EMB-WMB169PA without U.FL connector (GSG pads only)
EMB-WMB169PA/UL	MSP430F5340	EMB-WMB169PA with U.FL connector
EMB-WMB868/PC	MSP430F5340	EMB-WMB868 without U.FL connector (GSG pads only)
EMB-WMB868/UL	MSP430F5340	EMB-WMB868 with U.FL connector

Related products:

Part No.	Mcu	Description
EMB-WMB169PA-EVK	MSP430F5340	EMB-WMB169PA Evaluation Kit
EMB-WMB868-EVK	MSP430F5340	EMB-WMB868 Evaluation Kit

6.2 Packaging

Embit's modules are delivered in tubes, each tube including 20 items.

The tube dimensions are approximately: 508mm x 33mm x 8mm.

7 Regulatory compliance

The radio module has been designed to comply with the RTTE directive (1999/5/EC) of the European Union. Restrictions in terms of maximum allowed RF power or duty cycle may apply. This radio module has been designed to be embedded into other products ("final products"). According to the RTTE directive, the declaration of compliance and the "CE" labeling is within the responsibility of the manufacturer of the final product.

8 Disclaimer

The user must read carefully all the documentation available before using the product. In particular, care must be taken in order to comply with the regulations (e.g., power limits, duty cycle limits, etc.).

8.1 Handling precautions



This product is an ESD sensitive device. Handling precautions should be carefully observed.

8.2 Limitations

Every operation involving a modification on the internal components of the module will void the warranty.

8.3 Disclaimer

The information provided in this and other documents associated to the product might contain technical inaccuracies as well as typing errors. Regulations might also vary in time. Updates to these documents are performed periodically and the information provided in these manuals might change without notice. The user is required to ensure that the documentation is updated and the information contained is valid. Embit reserves the right to change any of the technical/functional specifications as well as to discontinue manufacture or support of any of its products without any written announcement.

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