E76-2G4M20S User Manual

EFR32 2.4GHz 100mW Multifunction SoC Wireless Module

Contents

1 Product Overview

1.1 Brief Introduction

Based on EFR32 from Silicon Labs, E76-2G4M20S is a 2.4GHz SMD wireless module independently developed by Ebyte, integrating 32 bits ARM MCU and 38.4MHz high-precision low-temperature drift active crystal oscillator with high performance wireless transceiver.

38.4MHz high-precision low-temperature drift active crystal oscillator ensures its industrial characteristics and stability. All IO ports of the microcontroller are lead out. The chip comes with a high-performance 32-bit ARM® Cortex®-M4 core, an integrated power amplifier, powerful peripherals and up to 31 GPIOs for multi-faceted development. EFR32 is a wireless controller with great potential to become the priority for smart furniture, IoT transformation and industrial automation in the future.

Since this module is a pure hardware SoC module, it needs to be programmed by users.

1.2 Features

- For Zigbee and 2.4GHz transparent transmission;
- Built-in high performance low power Cortex-M4 processor；
- Rich resources including 256KB FLASH，32KB RAM；
- Data transfer rate: 0.1kbps～1000kbps;
- Global license-free ISM 2.4GHz band;
- 1.85V~3.8V power supply, power supply over 3.3V guarantees the best performance;
- Industrial grade standard design enables -40 ~ 85 °C for working over a long time；
- PCB and IPEX antenna interface optional.

1.3 Application

- Smart homes and industrial sensors;
- Security system, positioning system;
- Building automation solutions;
- Wireless remote control, drone；
- Wireless game remote control；
- Health care products；
- Wireless voice, wireless headset；
- Advanced Metering Infrastructure(AMI)；
- Automotive industry applications.

2 Specification and parameter

2.1 Limit parameter

| Main parameter	Performance		Remark
	Min	Max	
Power supply （V）	1.85	3.8	Voltage over 3.8V will cause permanent damage to module
Blocking power（dBm）	-	10	Chances of burn is slim when modules are used in short distance
Operating temperature（℃）	-40	85	-

2.2 Operating parameter

Main parameter		Performance			Remark
		Min	Type	Max	
Operating voltage （V）		1.85	3.3	3.8	≥3.3 V ensures output power
Communication level （V）		-	3.3	-	For 5V TTL, it may be at risk of burning down
Operating temperature （℃）		-40	-	85	Industrial grade
Operating frequency（GHz）		2400	-	2480	Support ISM band
Power Consum -ption	TX current（mA）	-	135	-	Instantaneous power
	RX current（mA）	-	11.6	-	-
	Sleep current（μA）	-	2.5	-	Shut down by software
Max TX power（dBm）		19.6	20.0	20.5	-
Receiving sensitivity（dBm）		-100.5	-101	-101.5	Air data rate 1kbps
Air data rate（bps）		1k	-	100k	User programming to control

Main parameter	Description	Remark
Reference distance	2500m	clear and open area, antenna gain: 5dBi， antenna height: 2.5m，air data rate 1kbps
Crystal Oscillator	38.4MHz	-
Protocol	Zigbee	2.4GHz transparent transmission
Package	SMD	-
Interface	1.27mm	Stamp hole
IC	EFR32MG1P232F256GM48	-
FLASH	256 KB	-
RAM	32 KB	-

Core	Cortex-M4	-
Size	17.5 * 28.7 mm	-
Antenna	PCB/IPEX	50 ohm impedance

3 Size and pin definition
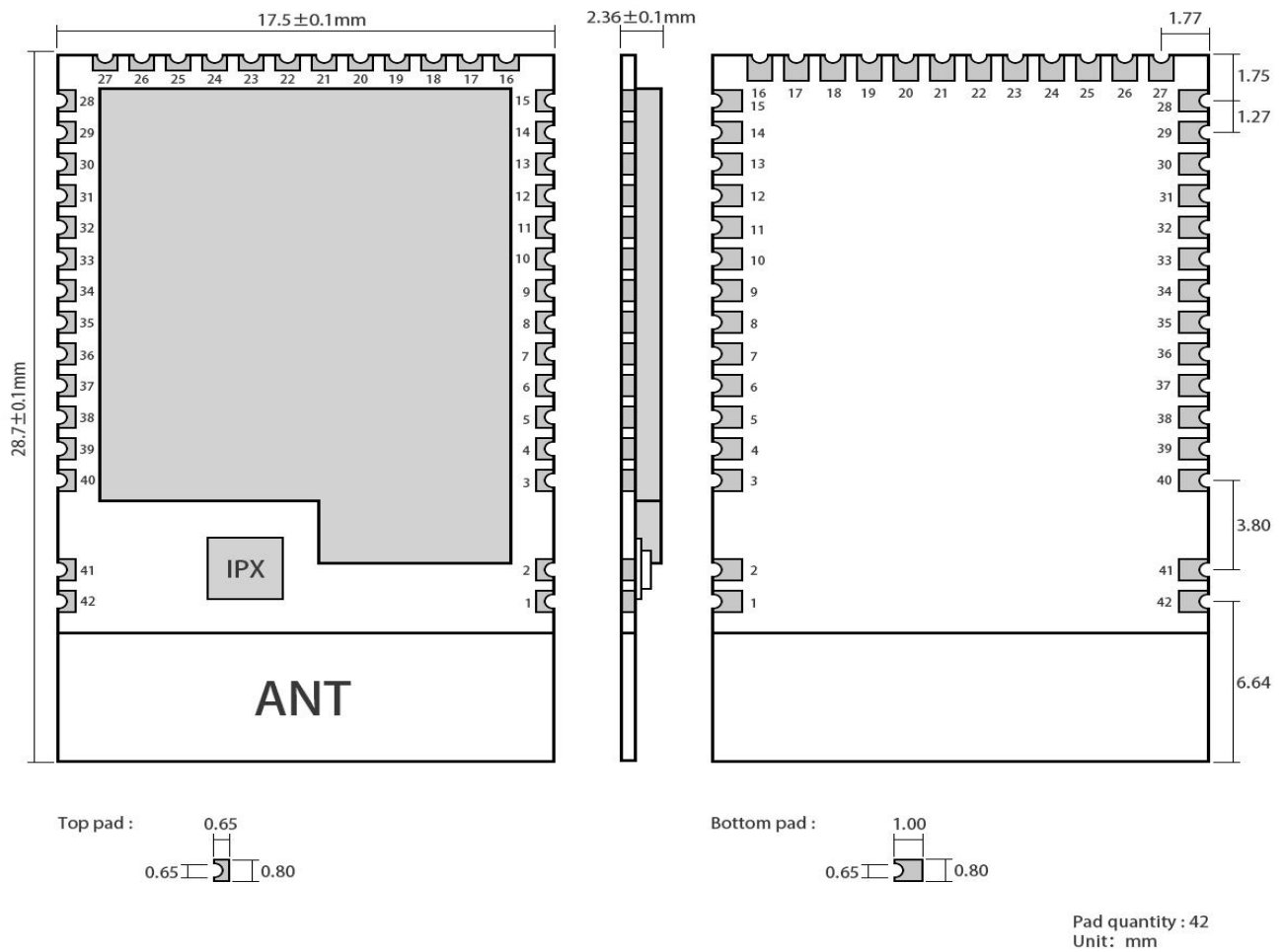
No.	Pin item	Pin direction	Application
1	GND	Input/Output	Ground, connecting to power source referential ground
2	GND	Input/Output	Ground, connecting to power source referential ground
3	VDD	Input	Positive power reference ground, 1.85V~3.8V
4	GND	Input/Output	Ground, connecting to power source referential ground
5	PD10	Input/Output	General IO port（See EFR32MG1 manual for details）
6	PD11	Input/Output	General IO port（See EFR32MG1 manual for details）
7	PD12	Input/Output	General IO port（See EFR32MG1 manual for details）
8	PD13	Input/Output	General IO port（See EFR32MG1 manual for details）

9	PD14	Input/Output	General IO port（See EFR32MG1 manual for details）
10	PD15	Input/Output	General IO port（See EFR32MG1 manual for details）
11	PA0	Input/Output	General IO port（See EFR32MG1 manual for details）
12	PA1	Input/Output	General IO port（See EFR32MG1 manual for details）
13	PA2	Input/Output	General IO port（See EFR32MG1 manual for details）
14	PA3	Input/Output	General IO port（See EFR32MG1 manual for details）
15	PA4	Input/Output	General IO port（See EFR32MG1 manual for details）
16	PA5	Input/Output	General IO port（See EFR32MG1 manual for details）
17	PB11	Input/Output	General IO port（See EFR32MG1 manual for details）
18	PB12	Input/Output	General IO port（See EFR32MG1 manual for details）
19	PB13	Input/Output	General IO port（See EFR32MG1 manual for details）
20	GND	Input/Output	Ground, connecting to power source referential ground
21	PB14	Input/Output	General IO port（See EFR32MG1 manual for details）
22	PB15	Input/Output	General IO port（See EFR32MG1 manual for details）
23	GND	Input/Output	Ground, connecting to power source referential ground
24	GND	Input/Output	Ground, connecting to power source referential ground
25	GND	Input/Output	Ground, connecting to power source referential ground
26	PC6	Input/Output	General IO port（See EFR32MG1 manual for details）
27	PC7	Input/Output	General IO port（See EFR32MG1 manual for details）
28	PC8	Input/Output	General IO port（See EFR32MG1 manual for details）
29	PC9	Input/Output	General IO port（See EFR32MG1 manual for details）
30	PC10	Input/Output	General IO port（See EFR32MG1 manual for details）
31	PC11	Input/Output	General IO port（See EFR32MG1 manual for details）
32	SWCLK	Input/Output	DBG_SWCLKTCK，General IO port（See EFR32MG1manual for details）
33	SWDIO	Input/Output	DBG_SWDIOTMS，General IO port（See EFR32MG1manual for details）
34	PF2	Input/Output	General IO port（See EFR32MG1 manual for details）
35	PF3	Input/Output	General IO port（See EFR32MG1 manual for details）
36	PF4	Input/Output	General IO port（See EFR32MG1 manual for details）
37	PF5	Input/Output	General IO port（See EFR32MG1 manual for details）
38	PF6	Input/Output	General IO port（See EFR32MG1 manual for details）
39	PF7	Input/Output	General IO port（See EFR32MG1 manual for details）
40	RESETN	Input	Reset pin
41	GND	Input/Output	Ground, connecting to power source referential ground
42	GND	Input/Output	Ground, connecting to power source referential ground

4 Module schematics
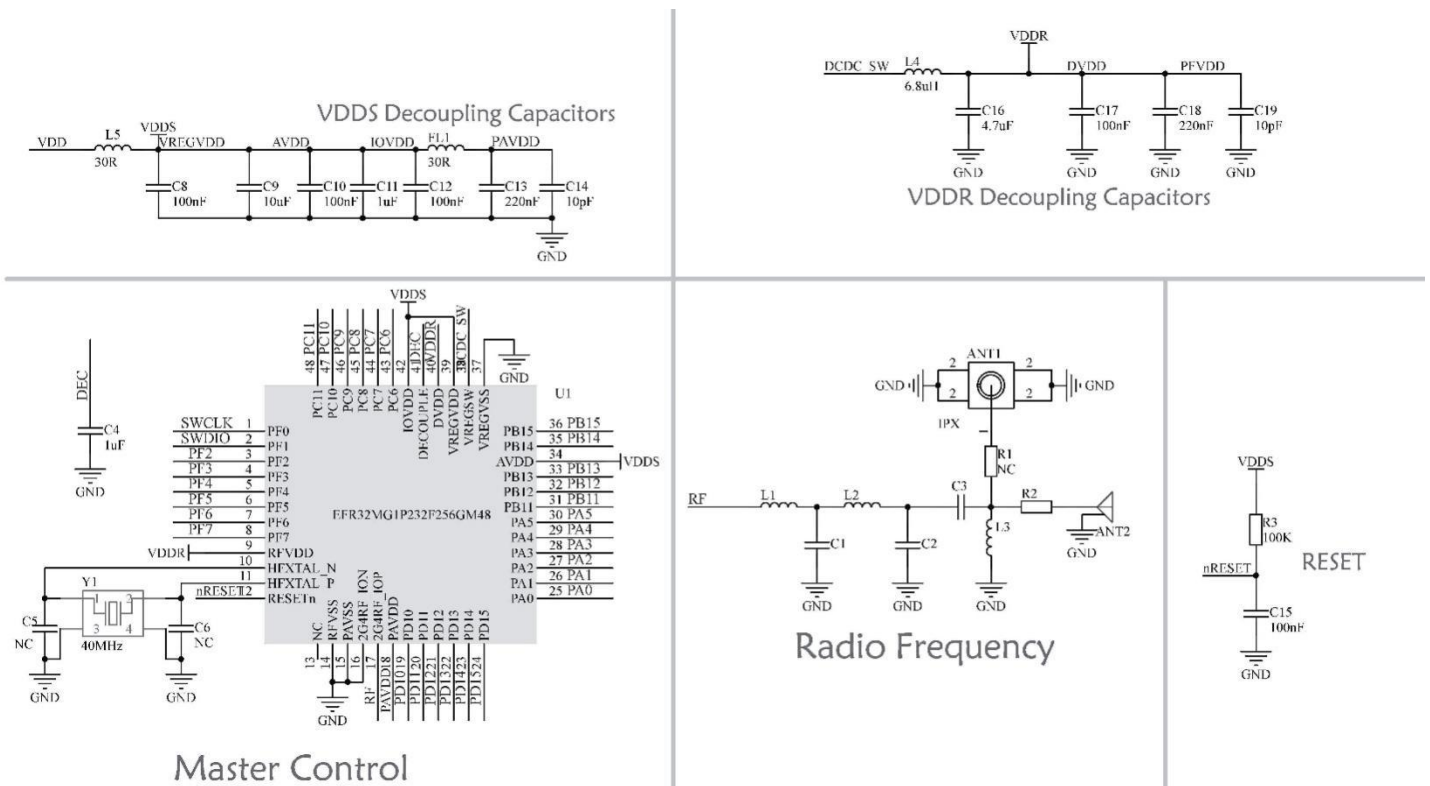
5 Development and Usage

Serial No.	Key words	Notes
1	Burn Firmware	The module is SoC with GPIO port. Only the J-LINK can be used for program downloading. We provide demo for reference. Users can directly download our compiled HEX files or change the primary code to realized the function needed. Pin definition of software downloading | E76 series pin	J-LINK interface | |---|---| | VCC | VCC | | PF0 | SWCLK | | PF1 | SWDIO | | GND | GND |
2	Testing Board	Testing board is not available.。

6

6 Basic operation

6.1 Hardware design

- It is recommended to use a DC stabilized power supply. The power supply ripple factor is as small as possible and the module needs to be reliably grounded.

- Please pay attention to the correct connection of the positive and negative poles of the power supply, reverse connection may cause permanent damage to the module.

- Please check the power supply to ensure that between the recommended supply voltage, if exceeding the maximum, the module will be permanently damaged;

- Please check the stability of the power supply. Voltage can not fluctuate greatly and frequently;

- When designing the power supply circuit for the module, it is often recommended to reserve more than 30% of the margin, so the whole machine is beneficial for long-term stable operation;

- The module should be as far away as possible from the power supply, transformers, high-frequency wiring and other parts with large electromagnetic interference;

- Bottom Layer High-frequency digital routing, high-frequency analog routing, and power routing must be avoided under the module. If it is necessary to pass through the module, assume that the module is soldered to the Top Layer, and the copper is spread on the Top Layer of the module contact part(well grounded), it must be close to the digital part of the module and routed in the Bottom Layer;

- Assuming the module is soldered or placed over the Top Layer, it is wrong to randomly route over the Bottom Layer or other layers, which will affect the module's spurs and receiving sensitivity to varying degrees;

- It is assumed that there are devices with large electromagnetic interference around the module that will greatly affect the performance. It is recommended to keep them away from the module according to the strength of the interference. If necessary, appropriate isolation and shielding can be done;

- Assume that there are traces with large electromagnetic interference (high-frequency digital, high-frequency analog, power traces) around the module that will greatly affect the performance of the module. It is recommended to stay away from the module according to the strength of the interference.If necessary, appropriate isolation and shielding can be done;

- If the communication line uses a 5V level, a 1k-5.1k resistor must be connected in series (not recommended, there is still a risk of damage);

- Try to stay away from some physical layers such as TTL protocol at 2.4GHz , for example: USB3.0;

- The mounting structure of antenna has a great influence on the performance of the module. It is necessary to ensure that the antenna is exposed, preferably vertically upward. When the module is mounted inside the case, use a good antenna extension cable to extend the antenna to the outside;

- The antenna must not be installed inside the metal case, which will cause the transmission distance to be greatly weakened.

6.2 Programming

- The core of this module is EFR32, its driving method is completely equivalent to EFR32, the user can operate according to the EFR32 chip manual (see EFR32 manual for details);
- Burn Firmware: The module is SOC module with its own GPIO port. The program download uses the J-LINK dedicated downloader.
- Program download interface definition:

E76 Pin	J-LINK Interface
VCC	VCC
PF0	SWCLK
PF1	SWDIO
GND	GND

7 FAQ

7.1 Communication range is too short

- The communication distance will be affected when obstacle exists;
- Data lose rate will be affected by temperature, humidity and co-channel interference;
- The ground will absorb and reflect wireless radio wave, so the performance will be poor when testing near ground;
- Sea water has great ability in absorbing wireless radio wave, so performance will be poor when testing near the sea;
- The signal will be affected when the antenna is near metal object or put in a metal case;
- Power register was set incorrectly, air data rate is set as too high (the higher the air data rate, the shorter the distance);
- The power supply low voltage under room temperature is lower than recommended value, the lower the voltage, the lower the transmitting power;
- Due to antenna quality or poor matching between antenna and module.

7.2 Module is easy to damage

- Please check the power supply and ensure it is within the recommended range. Voltage higher than the peak will lead to a permanent damage to the module.
- Please check the stability of power supply and ensure the voltage not to fluctuate too much.
- Please make sure anti-static measures are taken when installing and using, high frequency devices have electrostatic susceptibility.
- Please ensure the humidity is within limited range for some parts are sensitive to humidity.
- Please avoid using modules under too high or too low temperature.

7.3 BER(Bit Error Rate) is high

- Here are co-channel signal interference nearby, please be away from interference sources or modify frequency and channel to avoid interference;
- Poor power supply may cause messy code. Make sure that the power supply is reliable;
- The extension line and feeder quality are poor or too long, so the bit error rate is high.

8 Production guidance

8.1 Reflow soldering temperature

Profile Feature	Curve characteristic	Sn-Pb Assembly	Pb-Free Assembly
Solder Paste	Solder paste	Sn63/Pb37	Sn96.5/Ag3/Cu0.5
Preheat Temperature min (Tsmin)	Min preheating temp.	100℃	150℃
Preheat temperature max (Tsmax)	Max preheating temp.	150℃	200℃
Preheat Time (Tsmin to Tsmax)(ts)	Preheating time	60-120 sec	60-120 sec
Average ramp-up rate(Tsmax to Tp)	Average ramp-up rate	3℃/second max	3℃/second max
Liquidous Temperature (TL)	Liquid phase temp	183℃	217℃
Time(tL)Maintained Above(TL)	Time below liquid phase line	60-90 sec	30-90 sec
Peak temperature(Tp)	Peak temp	220-235℃	230-250℃
Aveage ramp-down rate(Tp to Tsmax)	Average ramp-down rate	6℃/second max	6℃/second max
Time 25℃ to peak temperature	Time to peak temperature for 25℃	6 minutes max	8 minutes max

8.2 Reflow soldering curve
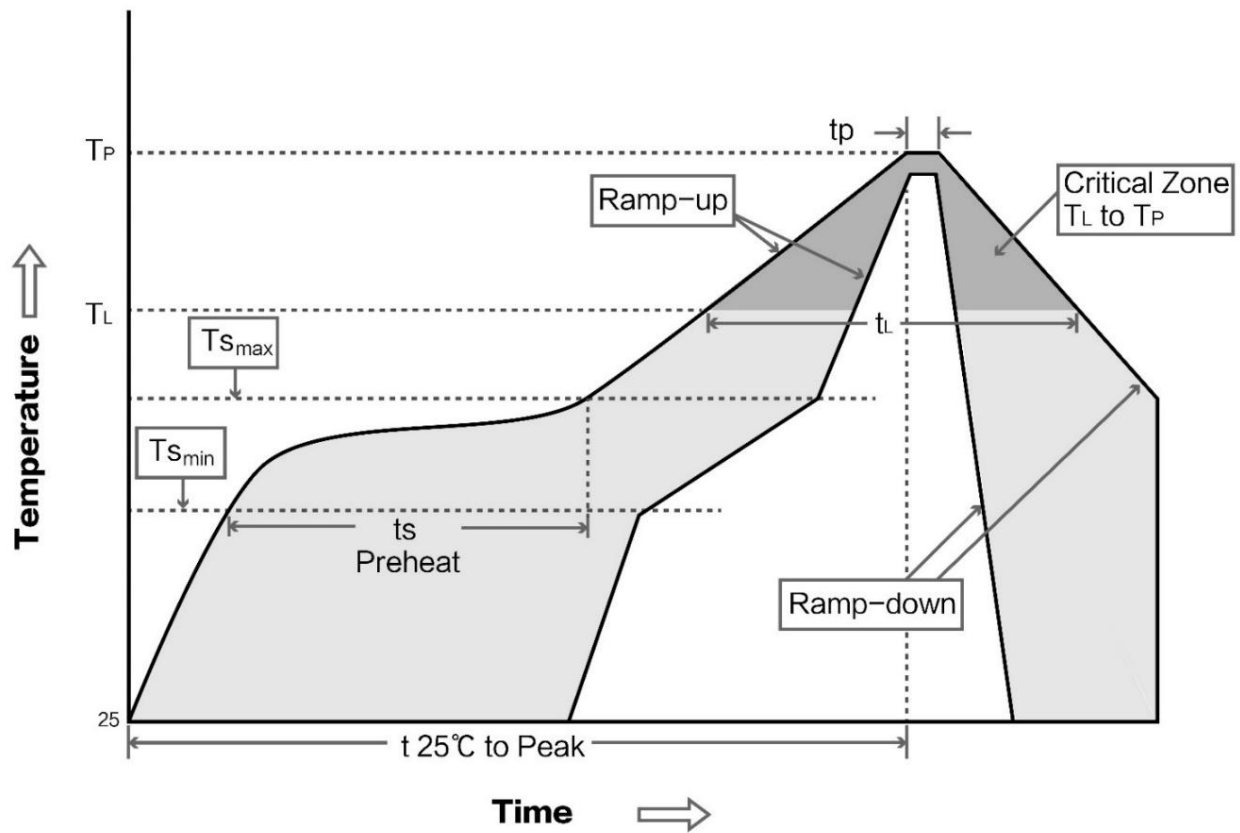
9 E76 series

Model	IC	Frequency Hz	Tx power dBm	Distance km	Air data rate bps	Package	Size mm	Antenna
E76-2G4M20S	EFR32	2.4G	20	2.5	0.1k~2M	SMD	17.5 * 28.7	PCB/IPEX
E76-868M20S	EFR32	868M	20	2.5	0.1k~2M	SMD	16 * 26	Stamp hole/IPEX
E76-915M20S	EFR32	915M	20	2.5	0.1k~2M	SMD	16 * 26	Stamp hole/IPEX
E76-433M20S	EFR32	433M	20	2.5	0.1k~2M	SMD	16 * 26	Stamp hole/IPEX

10 Antenna recommendation

10.1 Recommendation

　　The antenna is an important role in the communication process. A good antenna can largely improve the communication system. Therefore, we recommend some antennas for wireless modules with excellent performance and reasonable price.

Model No.	Type	Frequency Hz	Interface	Gain dBi	Height	Cable	Feature
TX2400-NP-5010	Flexible Antenna	2.4G	SMA-J	2	50*10mm	-	FPC soft antenna
TX2400-XP-150	Sucker antenna	2.4G	SMA-J	3.5	15cm	150cm	High Gain
TX2400-JK-20	Rubber antenna	2.4G	SMA-J	3	200mm	-	Flexible&omnidirectional
TX2400-JK-11	Rubber antenna	2.4G	SMA-J	2.5	110mm	-	Flexible&omnidirectional
TX2400-JZ-3	Rubber antenna	2.4G	SMA-J	2	30mm	-	Short straight &omnidirectional

Revision history

Version	Date	Description	Issued by
1.00	2018/8/30	Initial version	huaa
1.10	2018/9/28	Version split	huaa
1.30	2018/11/6	New version update	huaa
1.40	2019/7/19	Content update	Lyl

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