

AN13213

Using i.MX RT117x Processor with PF5020 PMIC for Auto Application

Rev. 0 — 30 June 2021

Application Note

1 Description

The i.MX RT1170 is a new processor family featuring NXP advanced implementation of the high performance Arm® Cortex®-M7 Core and power efficient Arm Cortex-M4 core. It provides high CPU performance and real-time response.

The i.MX RT1170 integrates advanced power management module with DC-DC and LDOs that reduce complexity of external power supply and simplify power sequencing.

The on-chip DC-DC regulator of the processor is suitable for consumer and industrial applications up to 105 °C. For automotive applications, the core platform power consumption may exceed the internal DC-DC capacity as the T_j is increased to 125 °C. In such cases, use i.MX RT1170 with NXP PF5020 PMIC.

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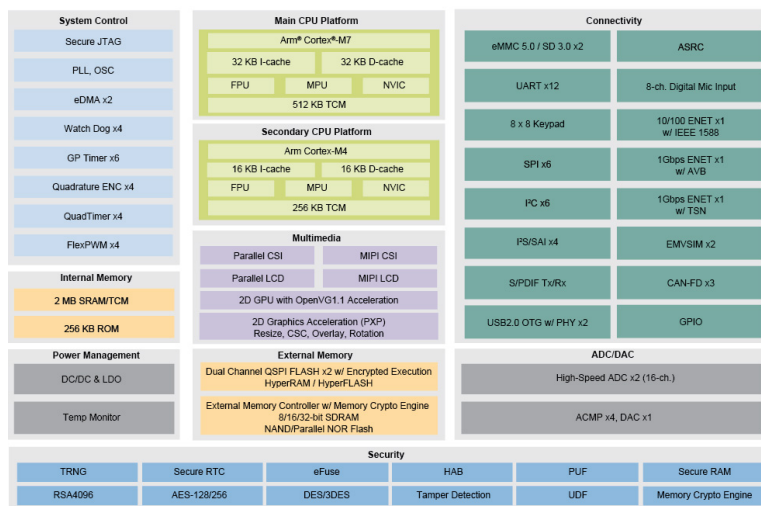


Figure 1. i.MX RT1170 block diagram

The PF5020 is NXP multi-channel Power Management Integrated Circuit (PMIC) device designed to be used for high performance automotive and industrial applications. The PF5020 accommodates various system level power requirements. PF5020 integrates independent voltage monitoring circuits ensure compliance with ISO 26262 standard and functional safety up to ASIL-B level. PF5020 built in one-time programmable memory stores key startup configurations, drastically reducing external components typically used to set output voltage and sequence of external regulators. Regulator parameters are adjustable through high-speed I²C after starting up offering flexibility for different system states. The PF5020 is also available as a standard non-safety device for applications that do not require the ISO compliance. Figure 2 shows the PF5020 PMIC block diagram.



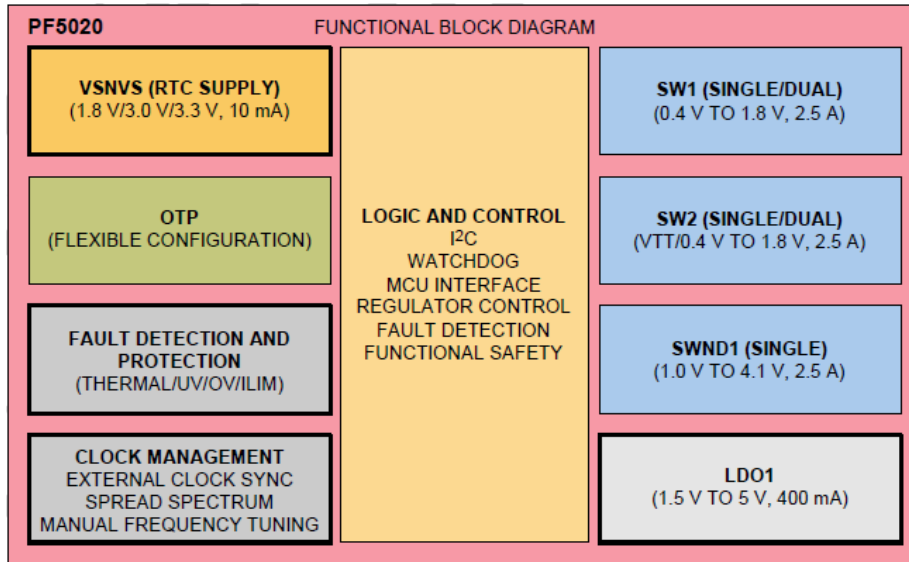


Figure 2. PF5020 PMIC block diagram

2 Power solution

The PF5020 is fully suitable for various automotive applications based on i.MX RT117x processor. PF5020 contains three high-efficient buck regulators and one linear regulator with load switch option. Each buck regulator of PF5020 is rated up to 2500 mA and linear regulator is rated up to 400 mA. Two of the PF5020 buck converters, SW1 and SW2, support Dynamic Voltage Scaling (DVS).

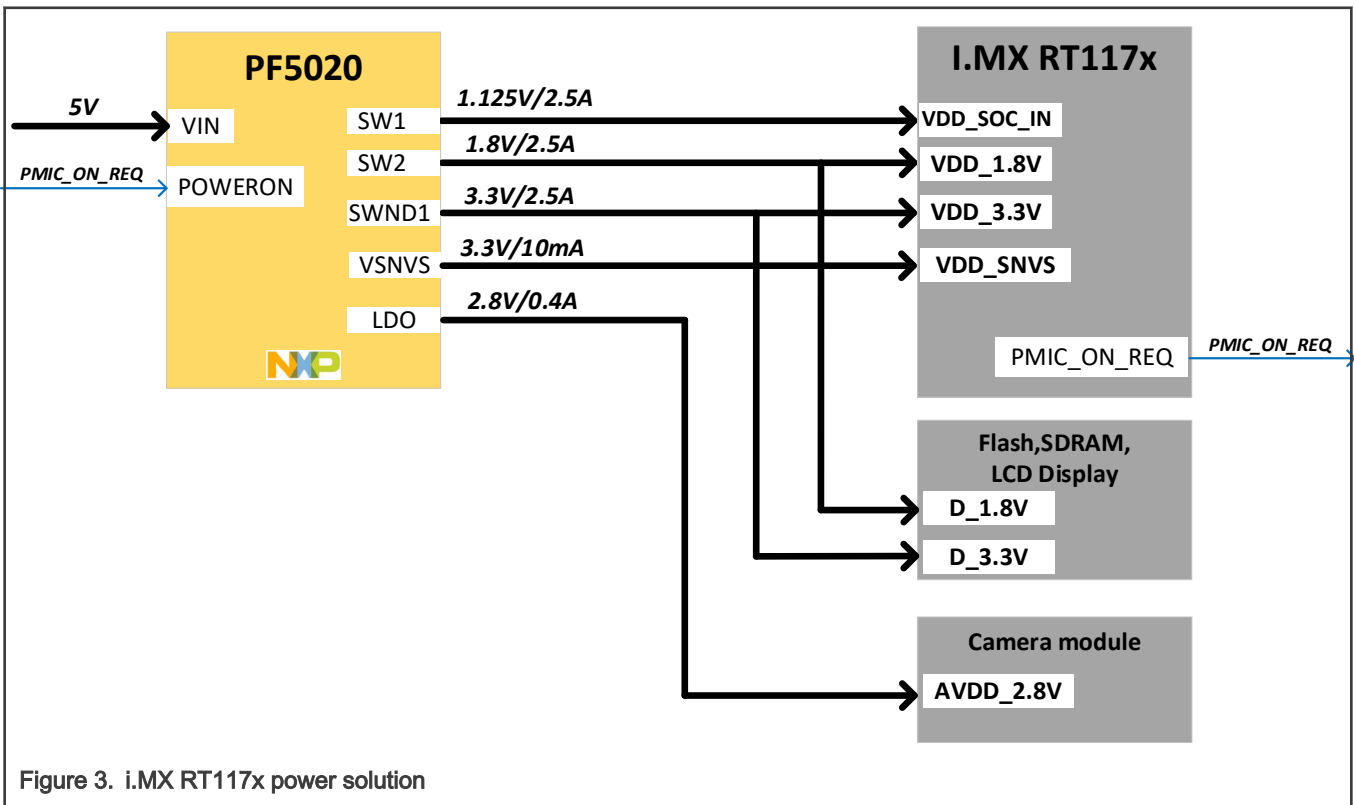


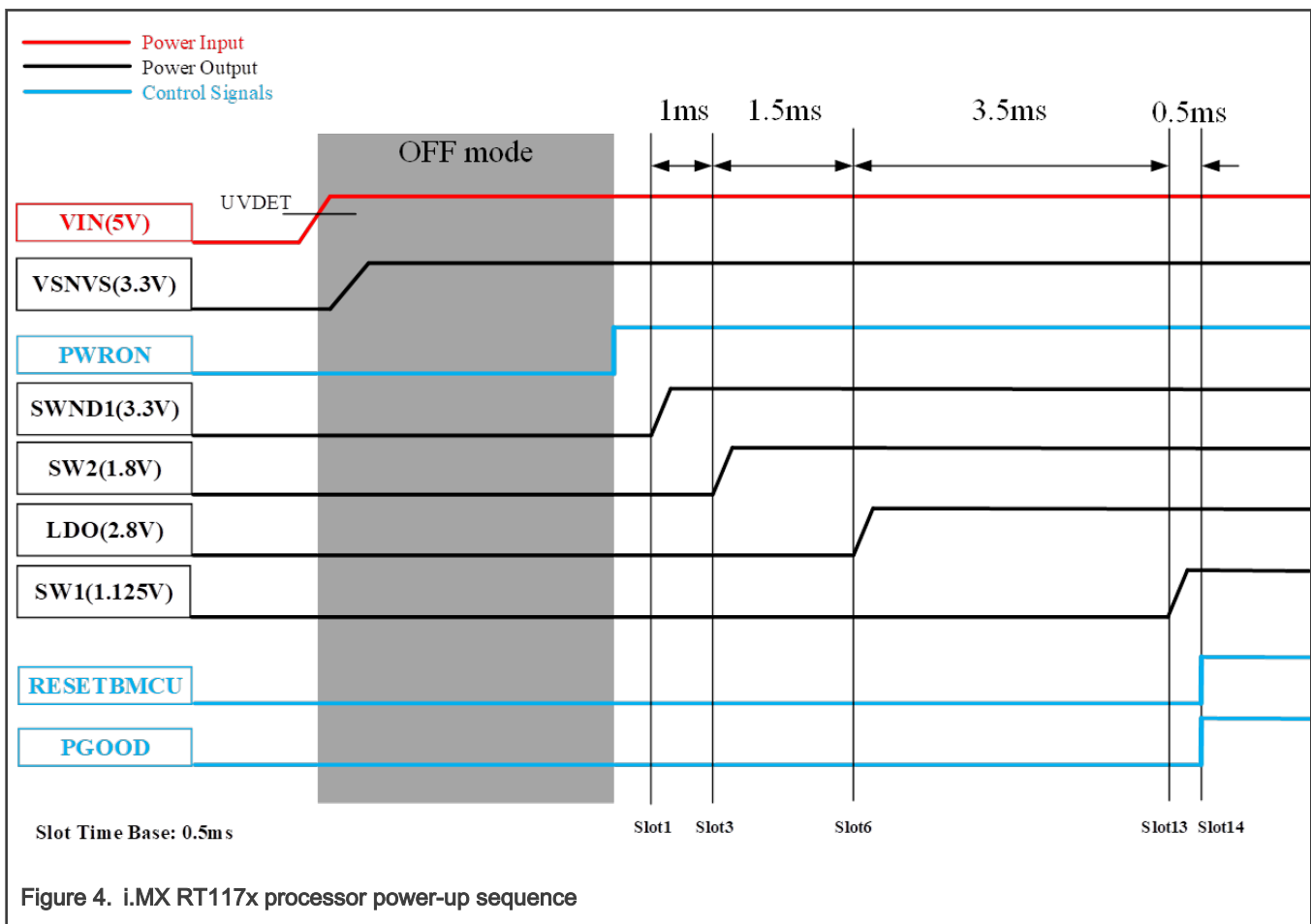
Figure 3. i.MX RT117x power solution

Table 1 shows i.MX RT117x power rails requirements and PMIC output configuration.

Table 1. PMIC configurations

PF5020 connection	Output voltage/V	Current capability/mA	RT117x power rails	Power-up sequence	Power-down sequence
SW1	1.125	2500	VDD_SOC_IN	5	2
SW2	1.8	2500	VDD_1.8V	3	4
SWND1	3.3	2500	VDD_3.3V	2	5
LDO	2.8	400	AVDD_2.8V	4	3
VSNVS	3.3	10	VDD_SNVS	1	6
RESETBMCU	—	—	RST_B	6	1

The default sequence slots for PF5020 are programmed via the OTP configuration registers. Figure 4 illustrates RT117x processor power-up/down sequence. PF5020 OTP registers program the specific power sequence configurations for RT117x. When VIN of PF5020 exceeds UNVDET threshold, VSNVS powers on. When PWRON is pulled high, PMIC starts a power-on event. Regulators automatically power up by following the power-up sequence configured in the PF5020 OTP file. When RESETBMCU of the PF5020 is released, the power-up sequence is completed and RT117x boots up. RT117x power-down sequence mirrors the power-up sequence.



3 Schematic

Figure 5 shows the i.MX RT117x processor power solution schematic based on PF5020. i.MX RT1170 users can use this image as a guideline.

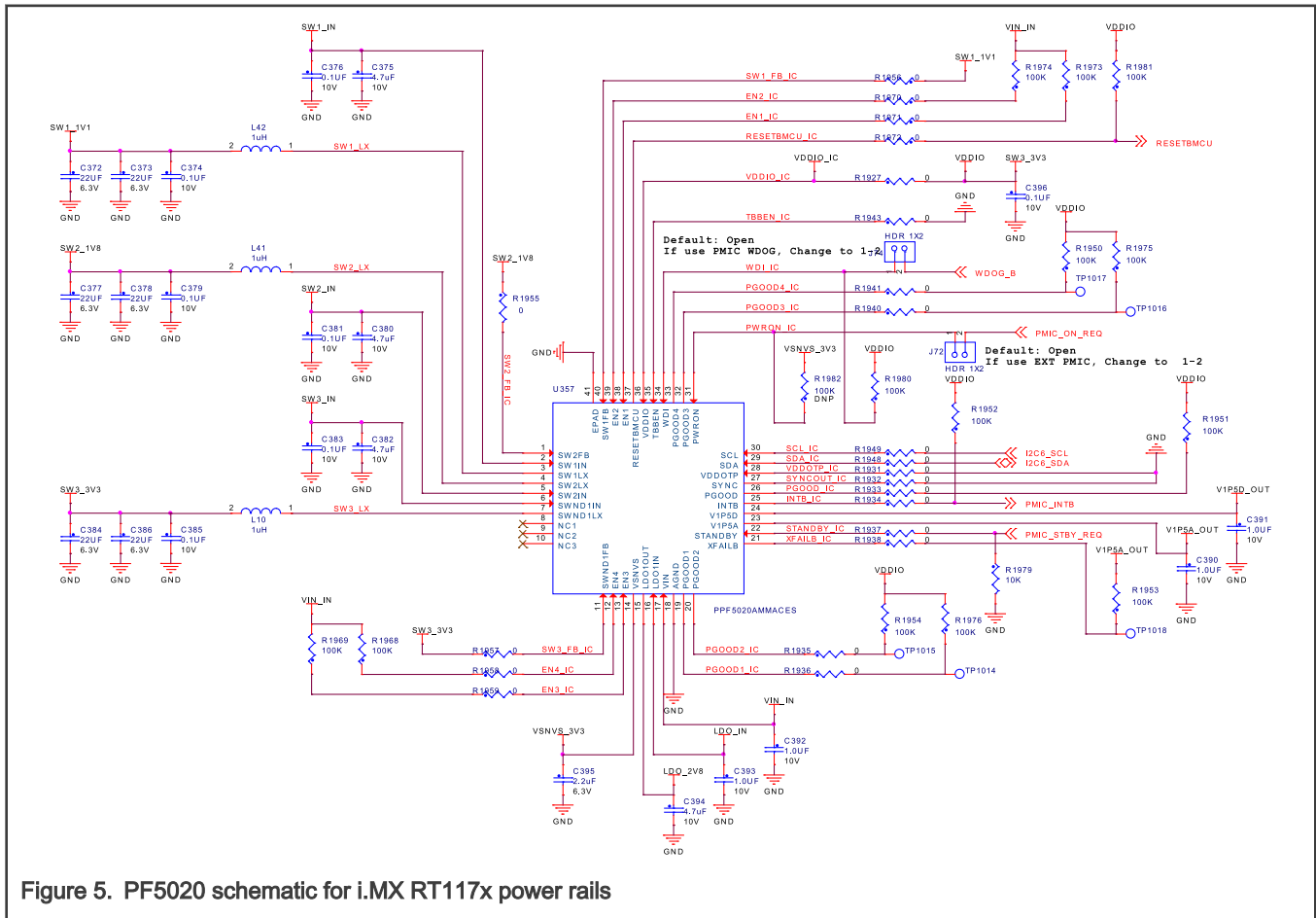


Figure 5. PF5020 schematic for i.MX RT117x power rails

4 Software

4.1 PF5020 driver feature

- SW1, SW2, SWND1, and LDO1 configuration, such as output voltage and operating mode in the run/standby state
- Voltage monitor (OV/UV/ILIM) related configurations
- Get/clear/enable/disable interrupts
- Internal watchdog timer configurations
- Power up/down sequence configurations
- Internal high-speed clock configurations
- Temperature sensor configurations
- Analog Multiplexer configurations

4.2 PF5020 driver example

- Demonstrate how to change the output voltage and operate mode in the run/standby state of regulators

- Demonstrate how to tune the frequency of the internal clock
- Demonstrate how to set PF5020 to standby state
- Demonstrate how to dump the value of the internal registers of PF5020
- Use software method to achieve set point 0/1/5/10 change, when RT1170 is not in the standby mode
- Use hardware method to achieve set point 0/1/5/10 change, when RT1170 enters the standby mode
- SNVS mode

4.3 Power control demo

- Power_mode_switch_demo + PMIC

NOTE

The board with PMIC software is not a public-released kit. Contact your NXP representative for more information.

5 Bill of Material

Table 2 provides a list of the recommended components on i.MX RT117x power solution with PF5020. The components are provided with an example part number and equivalent components may be used.

Table 2. PF5020 power solution Bill of Material

Value	Qty.	Part number	Description	Vendor	Component
	1	MPF5020CMMACES	Power management IC	NXP	PMIC
1.0 μ F	4	GCM155C71A105KE38D	10 V 10 % X7S 0402	MURATA	Input capacitor
2.2 μ F	1	GRT155C71A225KE13	10 V 10 % X7S 0402	MURATA	Output capacitor
4.7 μ F	4	GRT188C81E475KE13	25 V 10 % X6S 0603	MURATA	Output capacitor
0.1 μ F	7	GCM155R71C104KA55D	16 V 10 % X7R 0402	MURATA	Input and Output capacitor
22 μ F	6	GRT21BC81A226ME13	10 V 20 % X6S 0805	MURATA	Output capacitor
1.0 μ H	3	TFM252012ALMA1R0MTAA	4.7 A 20 % SMD	TDK	Output inductor

6 References

i.MX RT1170

- **i.MX RT1170**
Datasheet and application notes, on [i.MX RT1170 Documentation](#)
- **RT-4-Digit community**
[RT-4-Digit Documentation](#)
- **PF5020**
 - Datasheet and application notes, on [PF5020 Documentation](#)
 - NXP GUI (with integrated OTP configuration and power tool), on [PF5020 Tools and Software](#)
 - EVM board PCB and schematic, on [PF5020 Multi-Channel PMIC Evaluation Board](#)

- **Power Management community**

[Power Management](#)

7 Revision history

Rev.	Date	Description
0	30 June 2021	Initial release

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