Powering the AM1705 and AM1707 With the TPS650061

Daniel Acevedo *Battery Power Applications*

ABSTRACT

This document details the design considerations of a power solution for the AM1705 and AM1707 (AM1705/07) low-power application processor with a TPS650061, three-rail, Power Management Unit (PMU) or Power Management Integrated Circuit (PMIC).

Portable application solution size demands a high level of integration and the AM1705/07 requires at least three different voltage rails with specific sequencing and reset requirements. The TPS6500061 is a highly integrated power solution that can provide the 1.2-V, 1.8-V, and 3.3-V rails and $\overline{\text{RESET}}$ signal required by the AM1705/07. The TPS650061 has a single, step-down converter, two low-dropout regulators, and a voltage supervisor.

Included in this document is a power solution for the AM1705/07. Power requirements, illustrated schematic, operation waveforms, and bill of materials are detailed.

1 Power Requirements

Figure 1 presents the block diagram for the TPS650061 and AM1705/07.

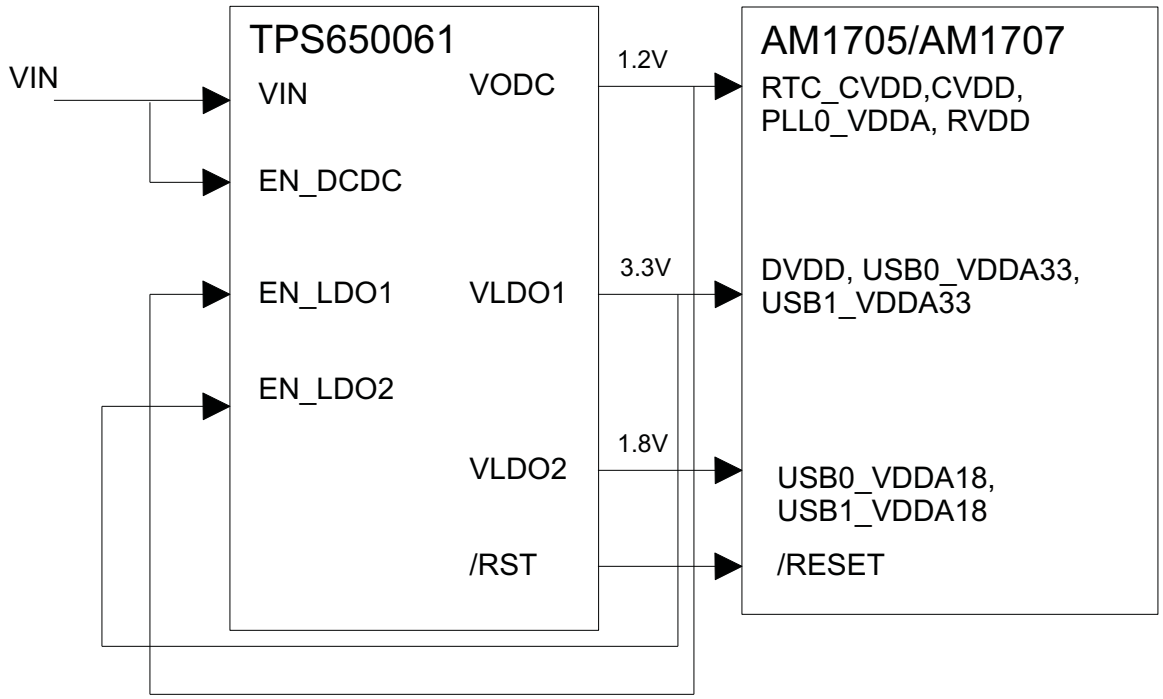

Figure 1. TPS650061 and AM1705/07 Simplified Block Diagram

The AM1705/07 power requirements are listed in Table 1.

Table 1. AM1705/07 Power Requirements

Rail Name	Voltage (V)	Imax (mA)	Tolerance (%)
RTC_CVDD,CVDD, PLL0_VDDA, RVDD	1.2	435	–5, +10
USB0_VDDA18, USB1_VDDA18	1.8	50	±5
DVDD, USB0_VDDA33, USB1_VDDA33	3.3	115	±5

The TPS650061 meets these power requirements with its single, step-down converter, two low-dropout (LDO) regulators, and voltage supervisor.

1.1 Power-On Sequence

To meet the AM1705/07 power-on requirements, the 1.2-V rail must power on first, then the 1.8-V rail and the 3.3-V rail in any order. After all three rails are up, the RESET may be released. To ensure this power-up sequence, the 1.2-V enable is connected to VIN and the output is connected to EN_LDO1. The output of the first LDO regulator, VLDO1, is connected to EN_LDO2. To assert the reset only after all three supplies are up, $\overline{\text{RST}}$ is pulled up to VLDO1, and RSTSNS is connected to VLDO2 with a resistor divider. The proper connections for this power-on sequencing are shown in Figure 1.

Consider the following when selecting components for the circuit:

- VODC must be targeted above 1.2 V at full load to be used as enable for other supplies.
  - VIH for the TPS650061 is rated at a minimum of 1.2 V which ensures that the device recognizes an input as HIGH if it is at or above 1.2 V.
    - The AM1705/07 RTC_CVDD, CVDD, PLL0_VDDA, and RVDD tolerance of –5%, +10% makes targeting at or above 1.2 V at full load possible while remaining within the AM1705/07 recommended operating conditions.
- The resistor divider on RSTSNS is such that if VLDO2 goes below 1.8 V – 5% (1.71 V), reset becomes active.
  - Because $\overline{\text{RST}}$ is pulled up to VLDO1, it only goes high if VLDO1 and VLDO2 are present.

Per the excerpt from the AM1705/07 data sheet, the device must be powered on in the following order:

1) RTC (RTC_CVDD) may be powered from an external device (such as a battery) prior to all other supplies being applied or powered up at the same time as CVDD. If the RTC is not used, RTC_CVD must be connected to CVDD.

2a) CVDD core logic supply

2b) Other 1.2-V logic supplies (RVDD, PLL0_VDDA). Groups 2a) and 2b) may be powered up together or 2a) first followed by 2b). Groups 1 and 2 may be powered up together if the real-time clock is only needed when the core is powered.

3) All 1.8-V I/O supplies (USB0_VDDA18).

4) All digital I/O and analog 3.3-V PHY supplies (DVDD, USB0_VDDA33). USB0_VDDA33 is not required if USB0 is not used and may be left unconnected.

Group 3) and Group 4) may be powered on in either order [3 then 4, or 4 then 3] but group 4) must be powered on after the core logic supplies.

No specific voltage ramp rate is required for any of the supplies. $\overline{\text{RESET}}$ must be maintained active only after all power supplies have reached their nominal values.

1.2 Power-Off Sequence

For the AM1705/07, the power supplies can be powered off in any order. The AM1707 has the additional requirement that the 3.3-V supplies do not remain powered with the other supplies unpowered.

2 Schematic, Waveforms, and Bill of Materials

2.1 Schematic

Figure 2 is the schematic of the power solution for the AM1705/07.

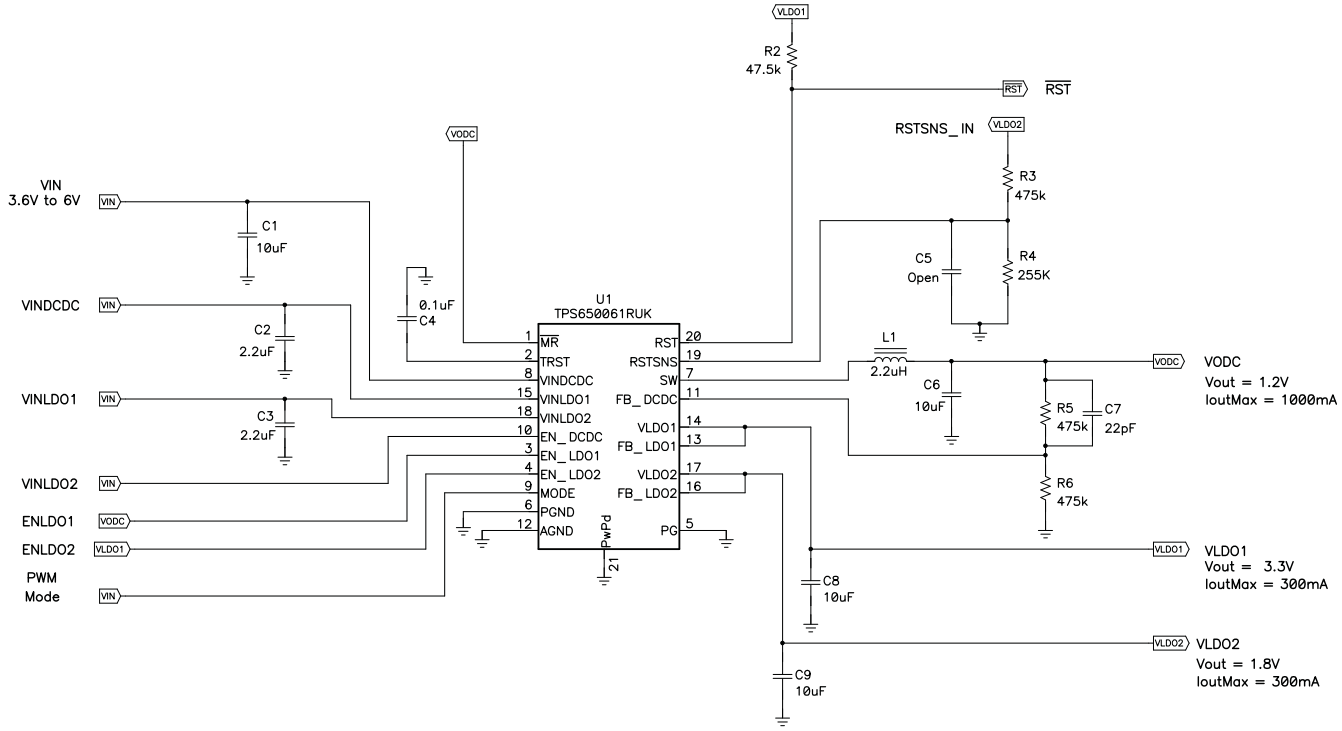

Figure 2. TPS650061 Schematic Diagram

2.2 Waveforms

The following waveforms demonstrate the start-up sequence and the reset of the TPS650061 as required by the AM1705/07. Figure 3, shows the TPS650061 power-on sequence of 1.2 V, then 3.3 V and 1.8 V. Figure 4 shows the reset pin, $\overline{RST}$, being released after the voltage on RSTSNS rises above the threshold and after the reset recovery time, t_{RST}, is exceeded.

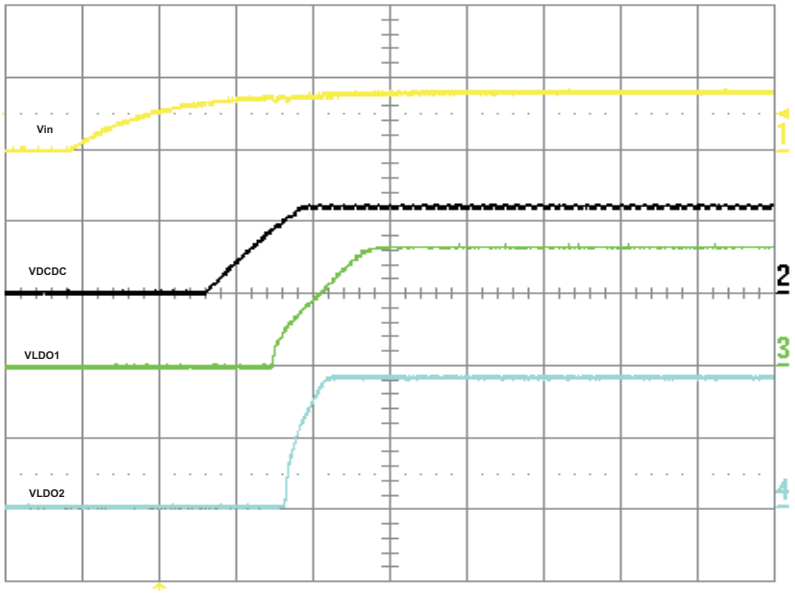

Figure 3. TPS650061 Power Up – Ch1-Vin, 5 V/div; Ch2-VDCDC, 1 V/div; Ch3-VLDO1, 2 V/div; and Ch4-VLDO2, 1 V/div

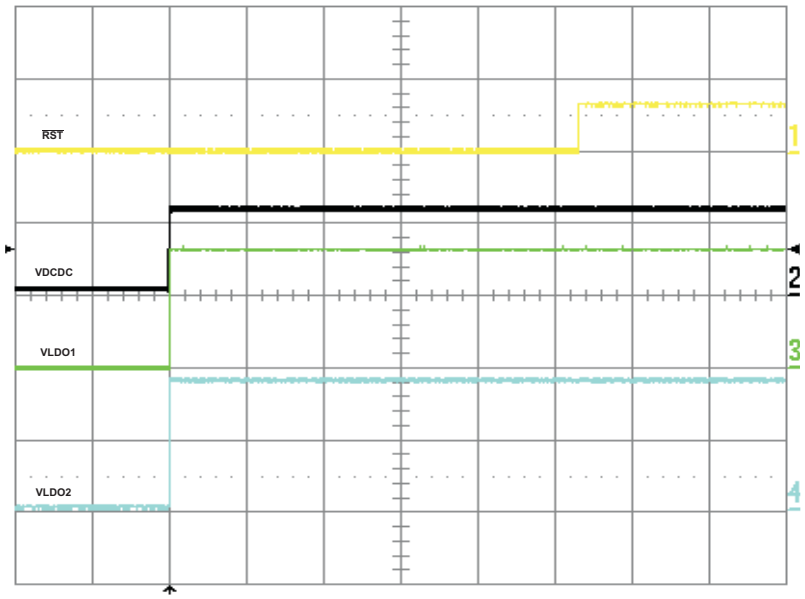

Figure 4. TPS650061 Power Up and $\overline{\text{Reset}}$ – Ch1-/RST, 5 V/div; Ch2-VDCDC, 1 V/div; Ch3-VLDO1, 2 V/div; and Ch4-VLDO2, 1 V/div

2.3 Bill of Materials

The bill of materials is displayed in Table 2.

Table 2. Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
4	C1, C6, C8, C9	10uF	Capacitor, Ceramic, 10V, X5R, 10%	0805	Std	Std

Table 2. Bill of Materials (continued)

Count	RefDes	Value	Description	Size	Part Number	MFR
2	C2, C3	2.2uF	Capacitor, Ceramic, 10V, X5R, 10%	0603	Std	Std
2	C4	0.1uF	Capacitor, Ceramic, 16V, X7R, 10%	0603	Std	Std
1	C7	22pF	Capacitor, Ceramic, 50V, C0G, 5%	0603	Std	Std
1	L1	2.2uH	Inductor, SMT, 2.0A, 110milliohm	0.118 x 0.118 inch	LPS3015-222ML	Coilcraft
3	R1, R2,	47.5k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
3	R3, R5, R6	475k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R4	232K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	U1	TPS650061RUK	IC, 2.25 MHz Step Down Converter with Dual LDOs and SVS	QFN	TPS650061RUK	TI

3 Conclusion

The TPS650061 provides a low-cost, comprehensive power solution for the AM1705/07. A 1.2-V rail (capable of supplying 1 A) is powered on, followed by a 3.3-V rail (300 mA), then a 1.8-V rail (300 mA); once all three supplies have reached minimum regulation, $\overline{\text{RESET}}$ goes high (I.e., rises to its pullup voltage). This meets the power requirements of the AM1705/07.

4 References

1. *TPS650061, 2.25 MHz Step Down Converter with Dual LDOs and SVS* data sheet (SLVS810)
2. *AM1705 ARM Microprocessor* data sheet (SPRS657)
3. *AM1707 ARM Microprocessor* data sheet (SPRS637)

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