Powering the DM335 and DM355 with the TPS650061

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ABSTRACT

This document details the design considerations of a low-cost power solution for the TMS320DM335 and TMS320DM355 (DM335/55) low-power application processors with a TPS650061, three-rail Power Management Unit (PMU) or Power Management IC (PMIC).

Portable application solution size demands a high level of integration and the DM335/55 require at least three different voltage rails with specific sequencing and reset requirements. The TPS6500061 is a highly integrated low-cost power solution that can provide the 1.3 V, 1.8 V and 3.3 V rails and $\overline{\text{RESET}}$ signal required by the DM335/55. 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 DM335/55. Power requirements, illustrated schematic, operation waveforms and bill of materials are included.

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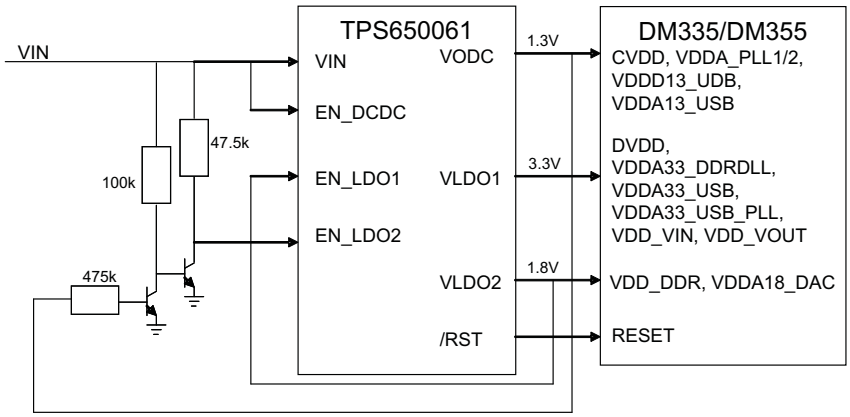

Figure 1. TPS650061 and DM335/55 Simplified Block Diagram

1 Power Requirements

The DM335/55 power requirements are listed in Table 1.

Table 1. DM335/55 Power Requirements

Rail Name	Voltage (V)	Imax (mA)	Tolerance	Power-On	Power-Off
CVDD, VDDA_PLL1, VDDA_PLL2, VDDD13_USB, VDDA13_USB	1.3	210	±5%	1st	2nd
VDD_DDR, VDDA18_DAC	1.8	30	±5%	2nd	1st
DVDD, VDDA33_DDRDLL, VDDA33_USB, VDDA33_USB_PLL, VDD_VIN,VDD_VOUT	3.3	95	±5%	2nd	1st

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

1.1 Power-On Sequence

To meet the DM335/55 power-on requirements, the 1.3V rail must power on first, then both the 1.8V rail and the 3.3V. After all 3 rails are powered on $\overline{\text{RESET}}$ may be released.

The power-on sequence is described in the following text from the DM335/355 datasheet.

Per the excerpt from the DM335/55 datasheet, the device should be powered-on in the following order:

1. Power on 1.3 V: CVDD, VDDA_PLL1/2, VDDD13_USB, VDDA13_USB
2. Power on 1.8 V: VDD_DDR, VDDA18_DAC
3. Power on 3.3 V: DVDD, VDDA33_DDRDLL, VDDA33_USB, VDDA33_USB_PLL, VDD_VIN, VDD_VOUT

You may power-on the 1.8 V and 3.3 V power supplies simultaneously

1.2 Power-Off Sequence

The DM335/55 power-down requirements state that the 1.8 V and 3.3 V supplies should power off together, before the 1.3 V supply as describe in the DM335/355 datasheet excerpt below:

1. Power off 3.3 V: DVDD, VDDA33_DDRDLL, VDDA33_USB, VDDA33_USB_PLL, VDD_VIN, VDD_VOUT
2. Power off 1.8 V: VDD_DDR, VDDA18_DAC
3. Power off 1.3 V: CVDD, VDDA_PLL1/2, VDDD13_USB, VDDA13_USB

You may power-off the 1.8 V and 3.3 V power supplies simultaneously.

Power-off the 1.8V/3.3V supply before or within 10usec of power-off of the 1.3 V supply

1.3 Power Solution

To best achieve this power up/down sequence and minimize cost, two 2N222 transistors are used in conjunction with the TPS650061.

- The enable for the 1.3V supply (EN_DCDC) is connected to VIN.
- The output, VODC, is connected to the base of an NPN transistor, Q1. The collector of Q1 has a 100 kΩ pull-up to VIN; the emitter is connected to ground.
- The collector of Q1 is also connected to the base of another NPN transistor, Q2. The collector of Q2 has a 47.5k pull-up to VIN; the emitter is connected to ground
- The collector of Q2 is also connected to the enable of the 1.8 V supply (EN_LDO2).
- The 1.8 V supply (VLDO2) is connected to the enable of the 3.3 V supply (EN_LDO1).
- When VIN is applied, it will turn on the 1.3 V supply (VODC) and Q2; keeping EN_VLDO2 tied to ground.
- VODC will then turn on Q1 which will turn-off Q2 and enable VLDO2 when EN_LDO2 gets pulled-up to VIN.
- VLDO2 will enable VLDO1.
- During power-off, the 3.3 V rail ramps down with VIN as VIN nears VOUT, then the 1.8 V rail, then the 1.3 V rail.
- A resistor divider connects RSTSNS to VLDO1, the $\overline{\text{MR}}$ pin is connected to VODC and the pin $\overline{\text{RST}}$ is pulled up to VLDO2. This will assert the reset to 1.8 V only when all three supplies are up.
- Additionally, to add deglitch time to the $\overline{\text{RESET}}$, a capacitor (C5) can be added in parallel with the top resistor of the RTSNS divider.

The proper connections for the power-on/off sequence are shown in Figure 1.

2 Schematic, Waveforms, and Bill of Materials

2.1 Schematic

This is the schematic of the power solution for the DM335/55.

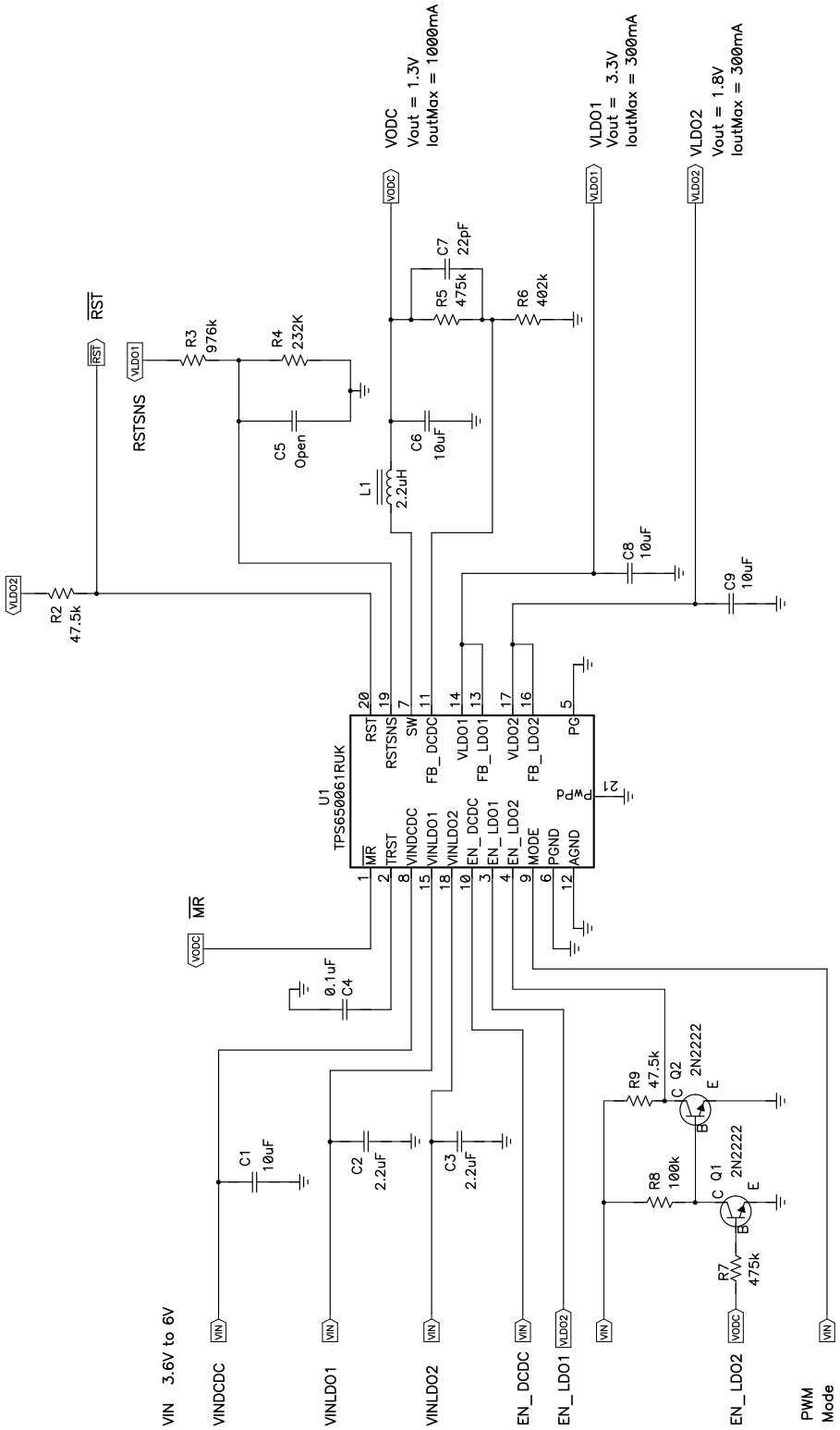

Figure 2. TPS650061 Schematic Diagram

2.2 Waveforms

The following waveforms demonstrate the startup and power down sequence of the TPS650061 as required by the DM335/55. Figure 3, shows the TPS650061 power on sequence of 1.3V then 1.8 V and 3.3 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 5 shows the power down sequence, 3.3 V and 1.8 V then the 1.3 V supply. For the following tests, the 1.3V supply had a 200mA load, the 1.8V supply had a 95mA load and the 3.3V supply had a 30mA load.

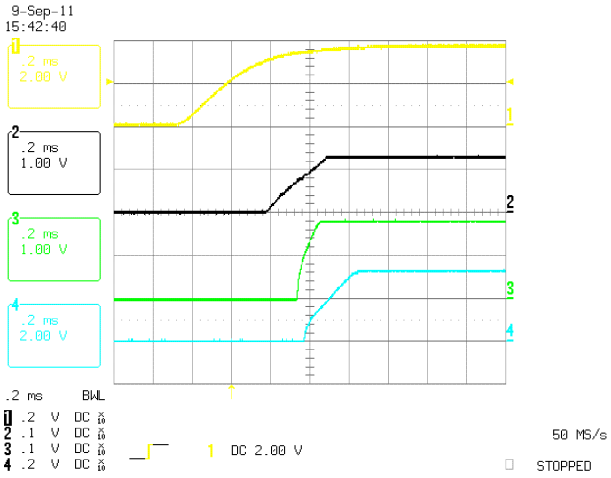

Figure 3. TPS650061 Power-Up, Ch. 1 - VIN, Ch. 2 - 1.3V Rail, Ch. 3 - 1.8V Rail, Ch. 4 - 3.3V Rail

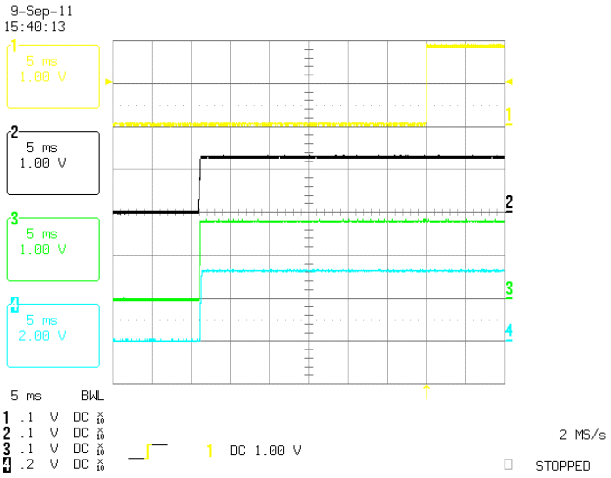

Figure 4. TPS650061 Power-Up and $\overline{RESET}$, Ch. 1 - $\overline{RESET}$, Ch. 2 - 1.3V Rail, Ch. 3 - 1.8V Rail, Ch. 4 - 3.3V Rail

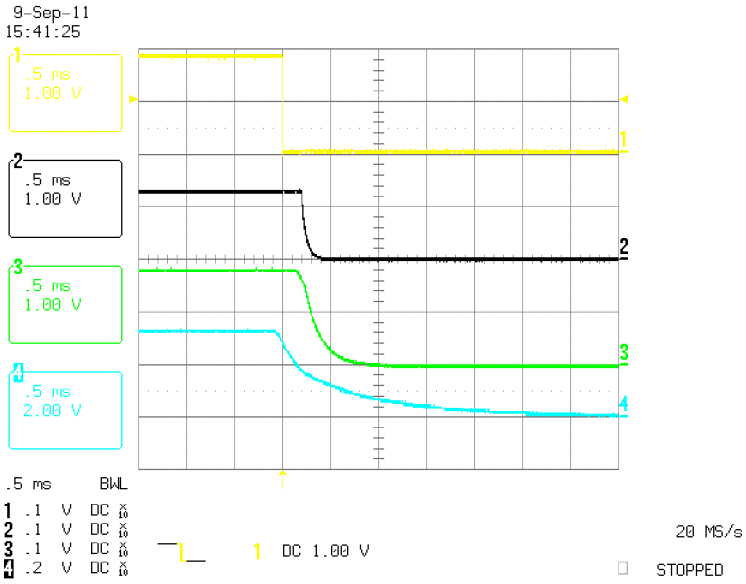

Figure 5. TPS650061 Power-Off Sequence, Ch. 1 - $\overline{RESET}$, Ch. 2 - 1.3V Rail, Ch. 3 - 1.8V Rail, Ch. 4 - 3.3V Rail

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
2	C2, C3	2.2uF	Capacitor, Ceramic, 10V, X5R, 10%	0603	Std	Std
1	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
2	Q1, Q2	2N2222	Transistor, NPN, 40V	SOT-23	2N2222	Std
2	R2, R9	47.5k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R3	976k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
2	R5, R7	475k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R4	232K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R6	402k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R8	100k	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 DM335/55. A 1.3 V rail (capable of supplying 1 A) is powered on followed by a 1.8 V rail (300 mA) then a 3.3 V rail (300 mA). Once all three supplies have reached regulation, $\overline{\text{RESET}}$ goes high (i.e. rises to its pull-up voltage). For power-down, the 1.8 V and 3.3 V turn off before the 1.3 V rail. This meets the power requirements of the DM335/55.

4 References

1. TPS650061 Datasheet (SLVS810B)
2. DM335 Datasheet (SPRS528)
3. DM355 Datasheet (SPRS463)
4. 5Vin DM355 Power using LDO's (SLVR331B)

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