Notebook Power System Introduction & Troubleshooting

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Who should attend this e-Learning

Target audience

- All electrical engineers such as:
  - PE, TE, FAE, CSD

Pre-requisite

- Electronic circuits
- Digital logic circuits
- Multi-meter used

Course content

- Power system & Sequence
- Troubleshooting(疑難排解)
- Would not introduce
  - Power transfer principle (PWM-Plus width Modulation & LDO –Low Drop-Out regulator)
  - Charger

After this course, you will

- Know how to debug no power problems

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Outline

Outline(大綱) :

1. Power system architecture :
   - 1.1 NB power system introduction
   - 1.2 Power sequence and control

2. Power plan introduction :
   - 2.1 Power budget(預算) block diagram
   - 2.2 NB power application
   - 2.3 Multi–power device

3. No power debug :
   - 3.1 No power debug notice & sequence
   - 3.2 DCBATOUT short(短路) to GND
   - 3.2 S5 Power No Good
   - 3.3 Power on logic No Good

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Foreword

• Foreword :

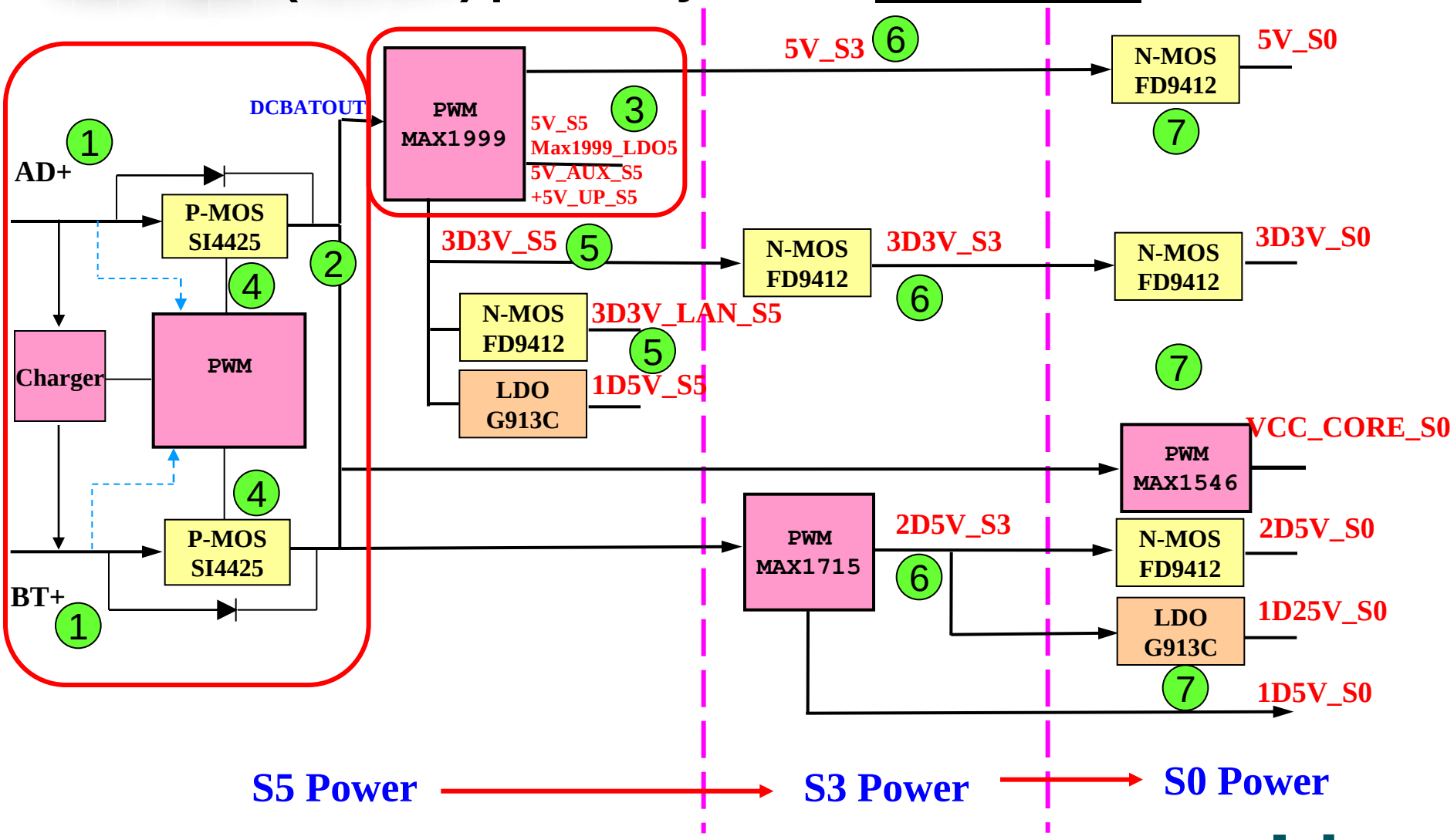
As we know, notebook power is provided by adaptors (19V) or batteries (14.8V). However, the various(不同的) power voltages do not fit(適合) all devices in a notebook unit. So a series of voltage transfer actions are needed to provide power to all devices. (Problems may arise(發生) during the voltage transfer.)

As notebook is a portable computer, saving power is also very important when the system is in battery mode.

In this lesson, we will use the Yuhina power circuit to introduce the notebook power system.

1.Power system architecture

1.1 NB (Yuhina) power system : AUX Power



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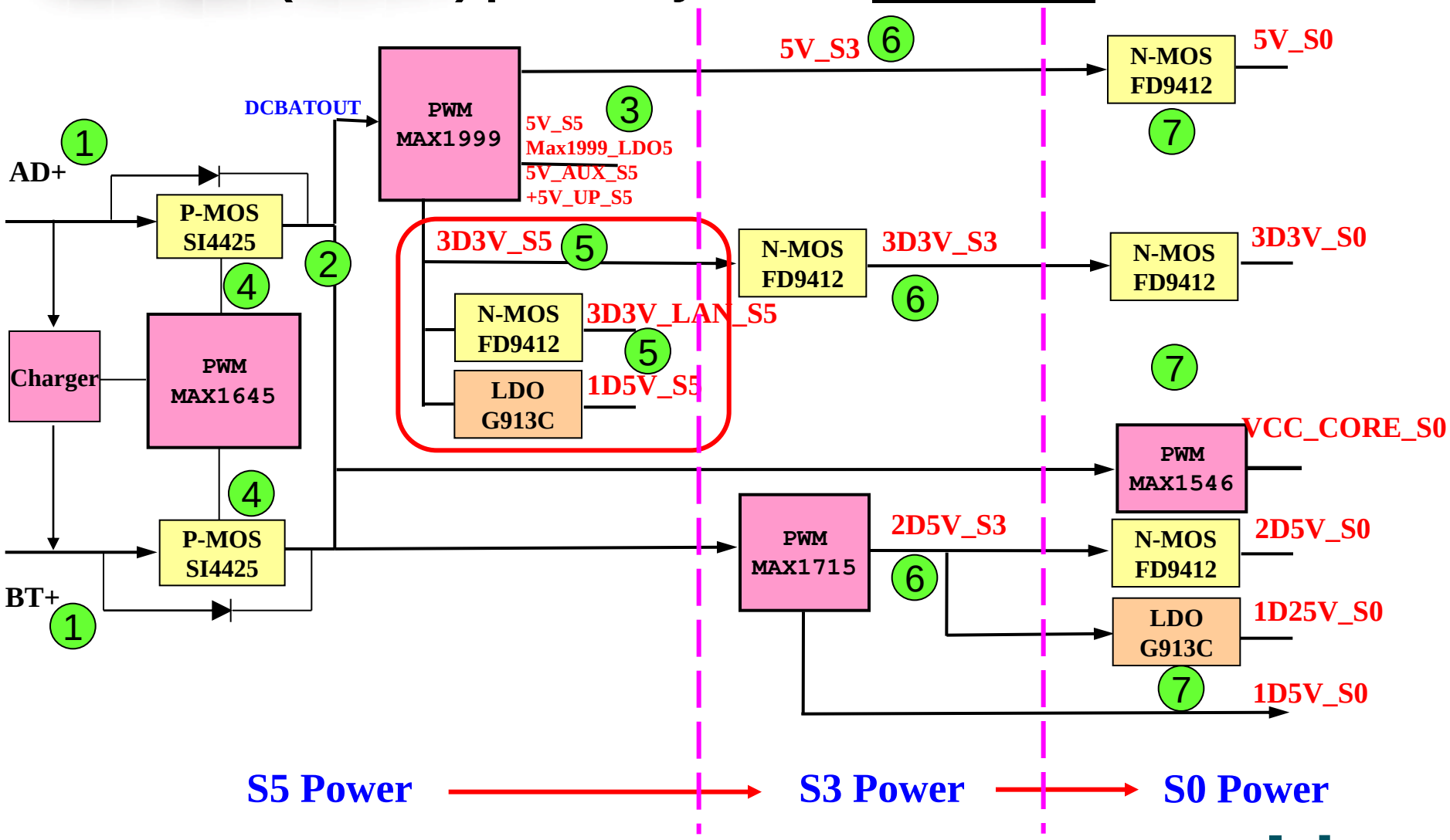
1.Power system architecture

1.1 NB (Yuhina) power system : S5 Power



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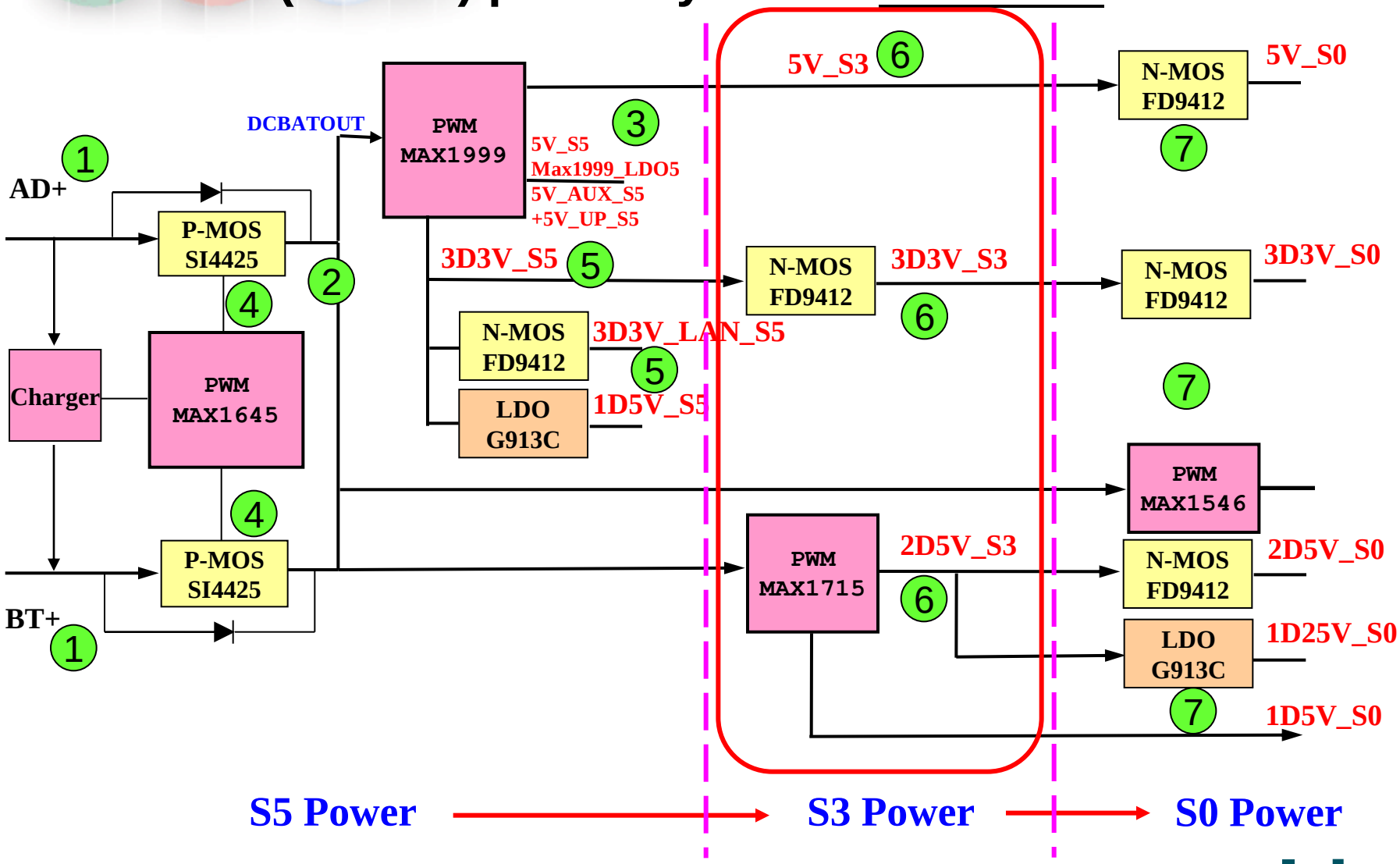
1.Power system architecture

1.1 NB (Yuhina) power system : S3 Power



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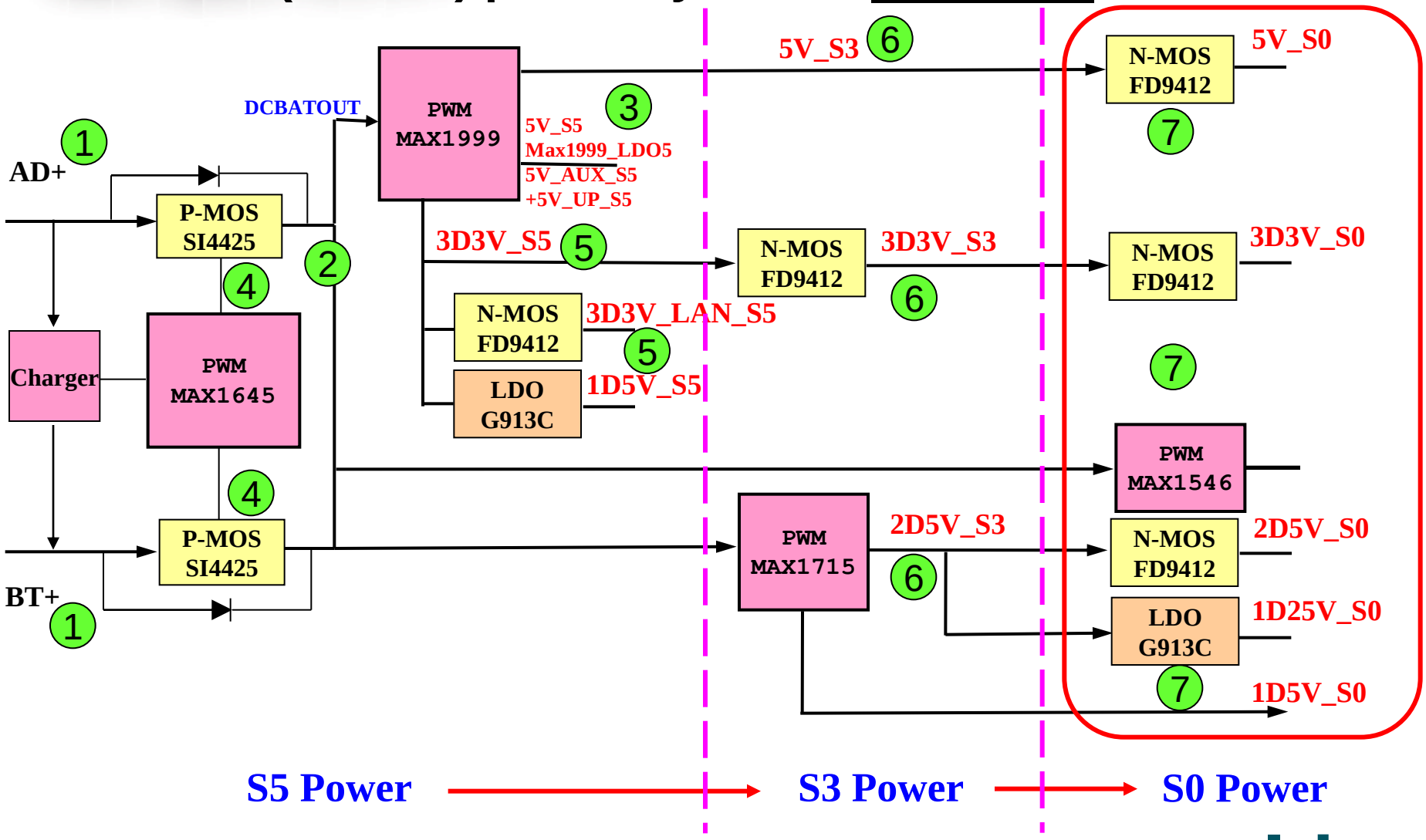
1.Power system architecture

1.1 NB (Yuhina) power system : S0 Power



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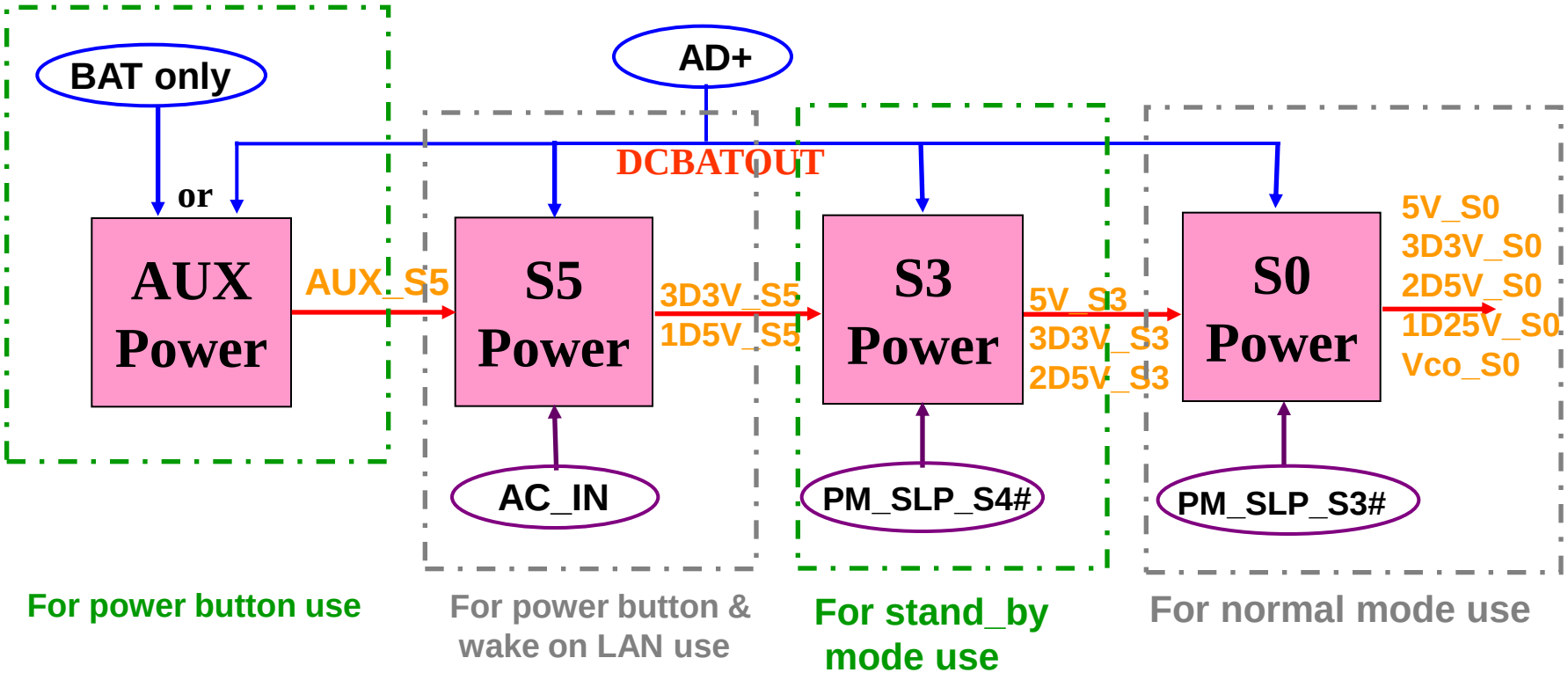
1.2 Power sequence and control :

Why do we need to differentiate power type among(在...之中) AUX,S5, S3,S0 ?How do we control them ?

Here is the answer:

- AUX Power : For power button use , it is turned on with battery only before you press the power button .
- S5 Power : For power button & wake on LAN use , it is turned on with adapter before you press the power button .
- S3 Power : For stand_by mode use , it is turned on with South bridge PM_SLP_S3# after you press the power button .
- S0 Power : For normal mode use , it is turned on with South bridge - PM_SLP_S4# after you press the power button .

Block Diagram :



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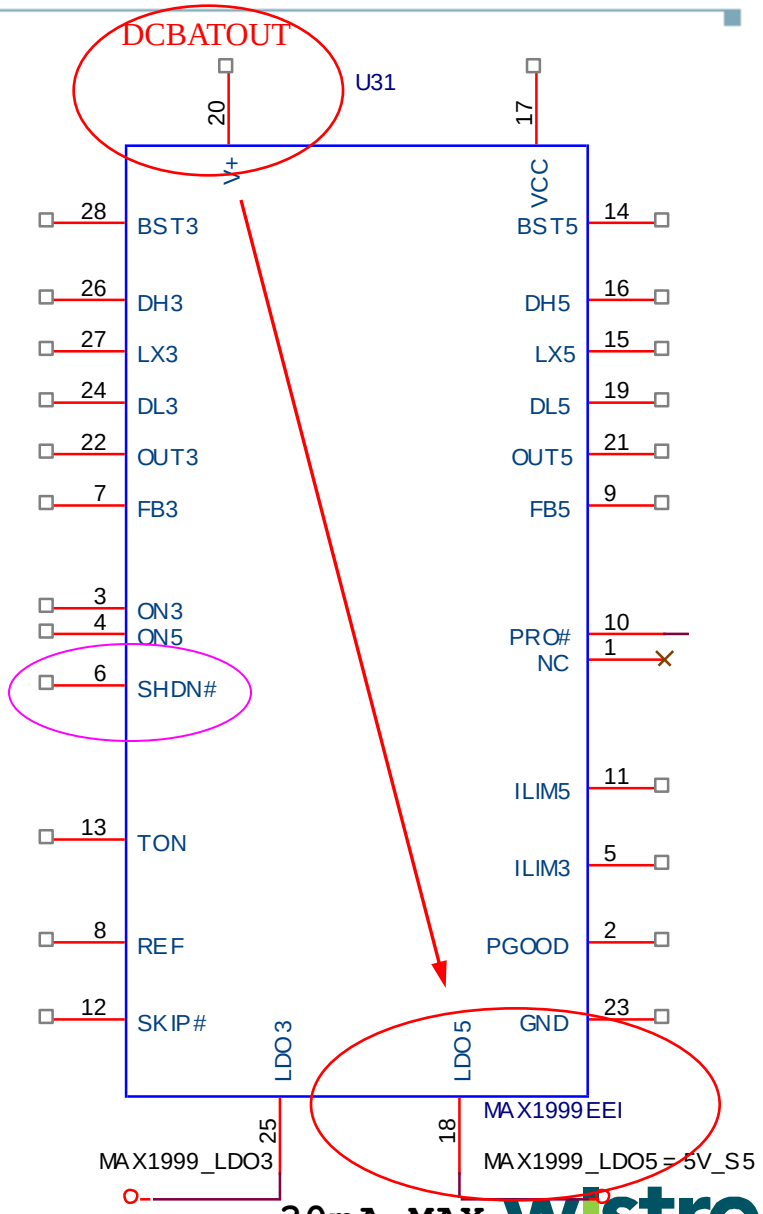
1.2.1 AUX_Power

a. When the battery or adaptor is plugged-in(插入), DCBATOUT will input the power into MAX1999 pin 20_V+ , and pin 18 – LDO5 will provide the 5V_AUX_S5 power .

c. The 5V_AUX_S5 is never off when MAX1999 is working, unless something goes wrong with MAX1999 .

b. The AUX power is used on power on logic & South Bridge. As it is battery only, the leakage current must be as little as possible. In general, it is about 5~6 mA.



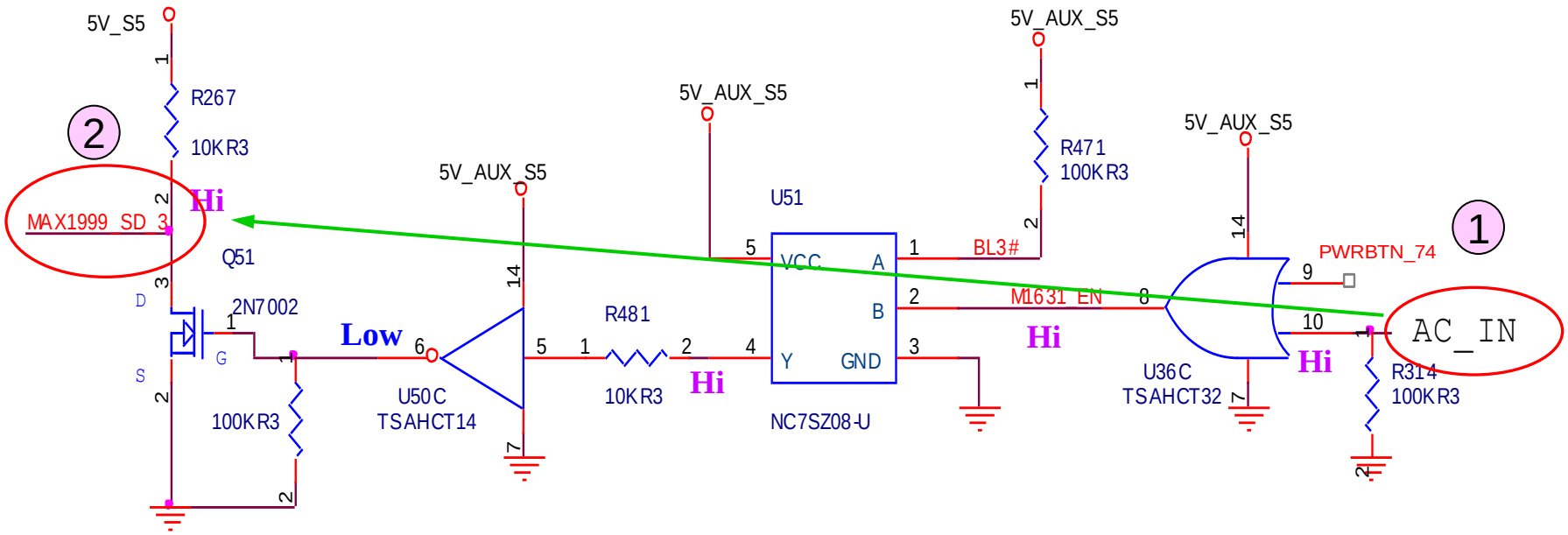
1.2.2 S5_Power

a. Circuit operation – Power on logic :

① The AC_IN signal was pulled hi when Adaptor was inserted .

② Power on logic will output MAX1999_SD hi to trigger 3D3V_S5.

As a result, when Adaptor is inserted but power button has yet been pressed,the S5_power will be turned on first .



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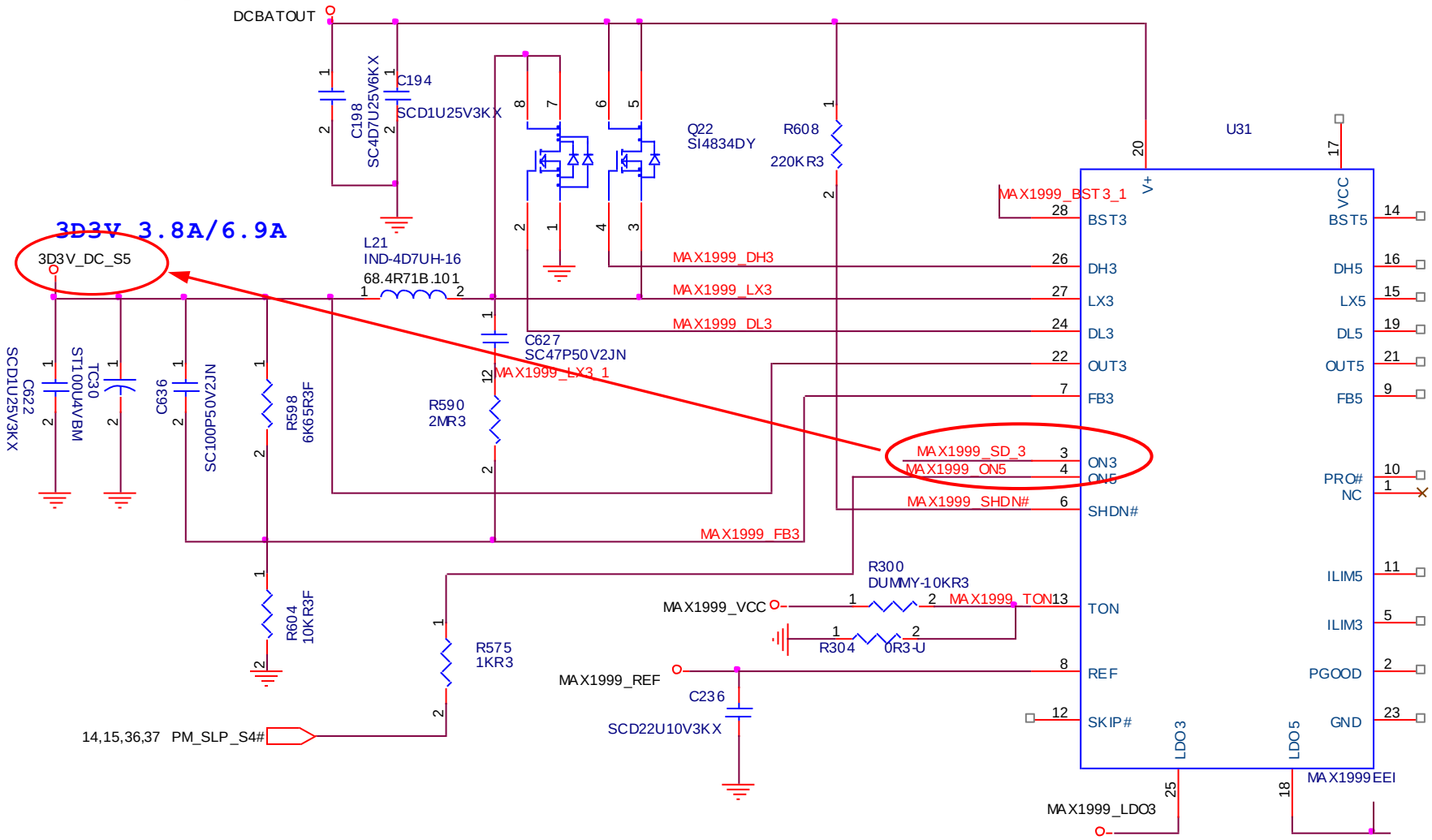
b. Circuit operation – 3D3V_S5 :

When MAX1999 – Pin 3(ON3) pull hi, the 3D3V_S5 will be turn on.



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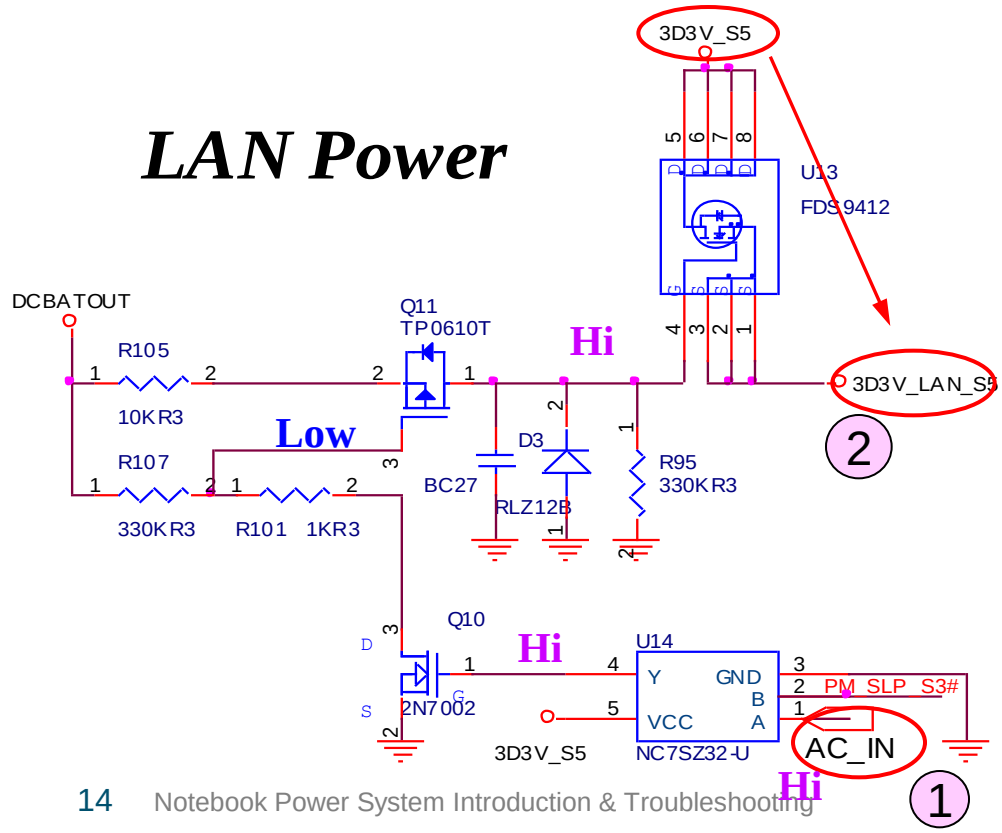
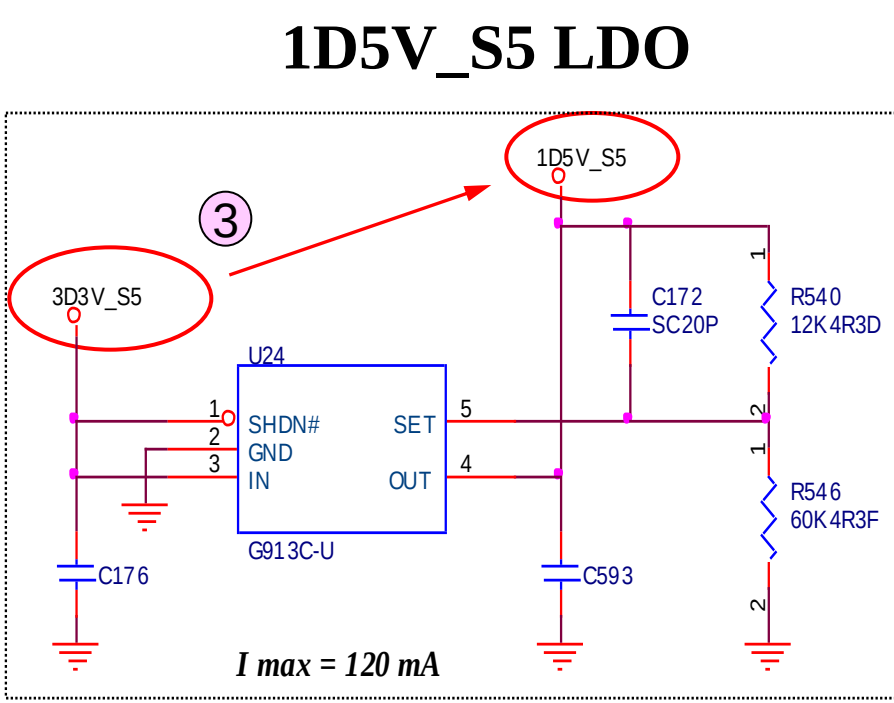
c. Circuit operation – LAN & 1D5V_S5 power :

① When AC_IN is HI,
② The MOS-U13 will be turned on, and 3D3V_LAN_S5 will be generated. This power is for wake on LAN function.
③ The 1D5V_S5 LDO power will be turned on by 3D3V_S5 .
This power is for south bridge for wake on LAN usage .
Because adaptor power was inserted already, the Battery leakage current is not a concern now。

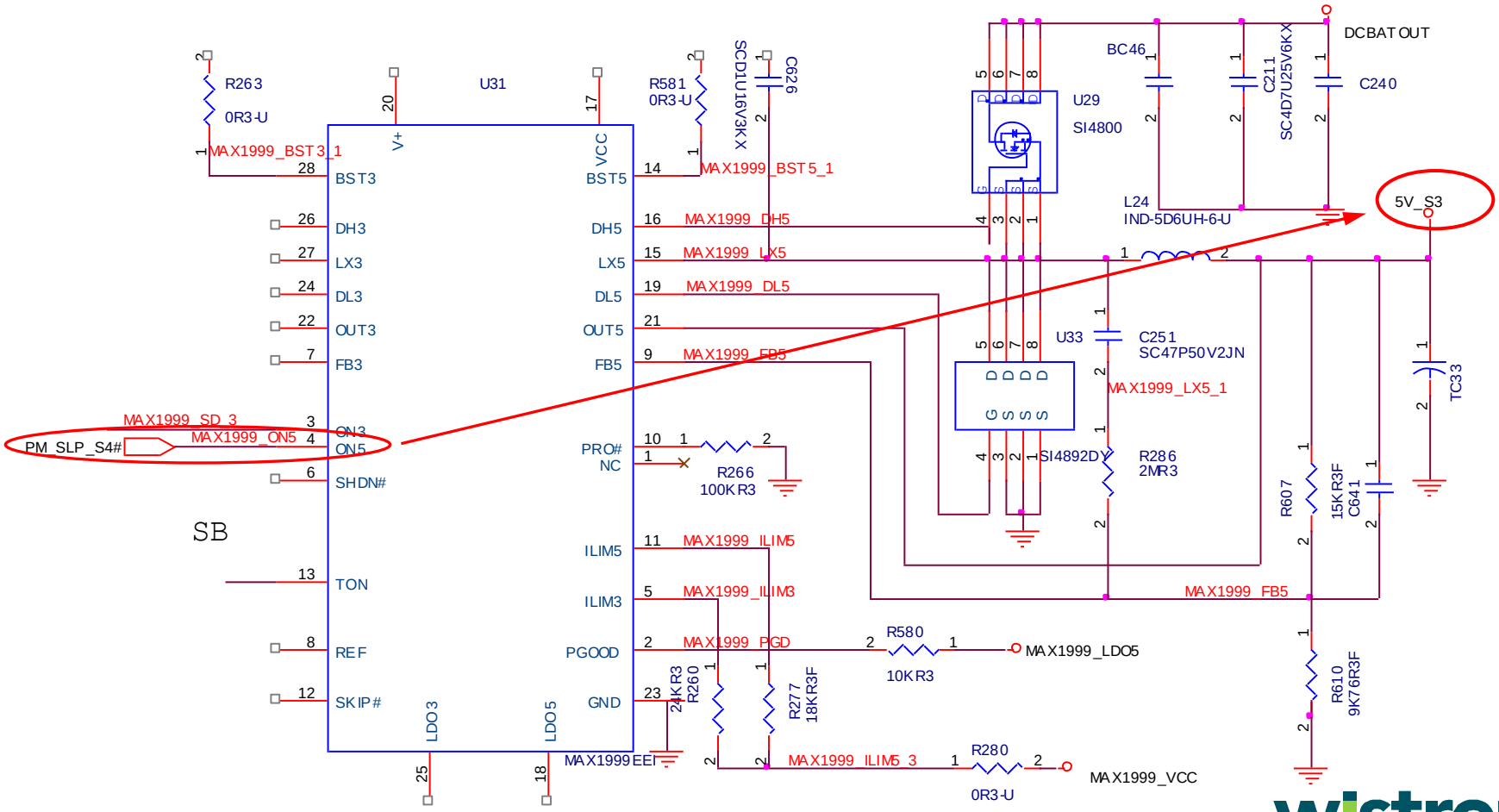




1.2.3 S3_Power :

a. Circuit operation – 5V_S3 :

When the power button was pressed, south bridge will pull hi the PM_SLP_S4#, and 5V_S3 power will be generated .



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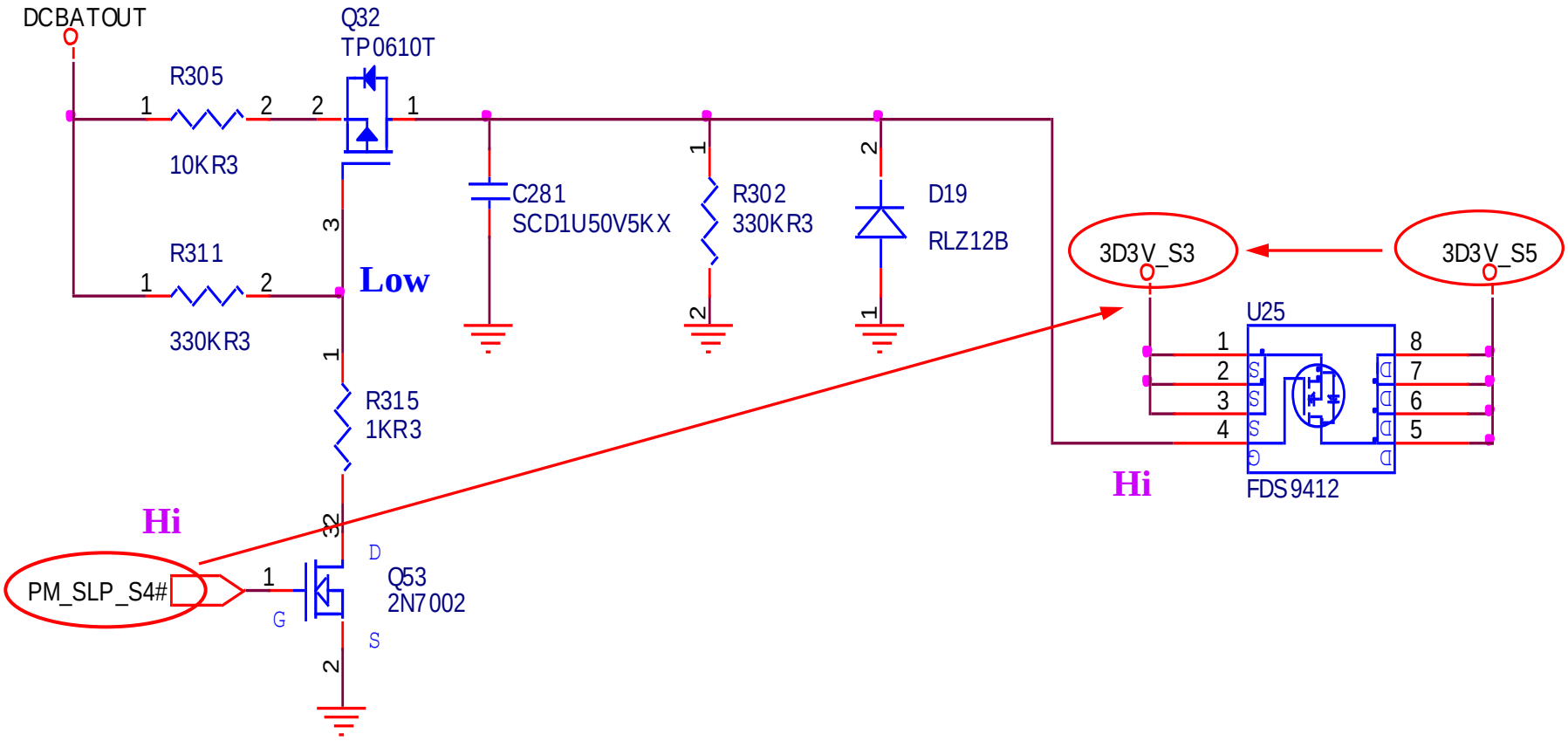
b. Circuit operation – 3D3V_S3 :

3D3V_S3 power is generated by U25 N-MOS from 3D3V_S5 when PM_SLP_S4# is hi .



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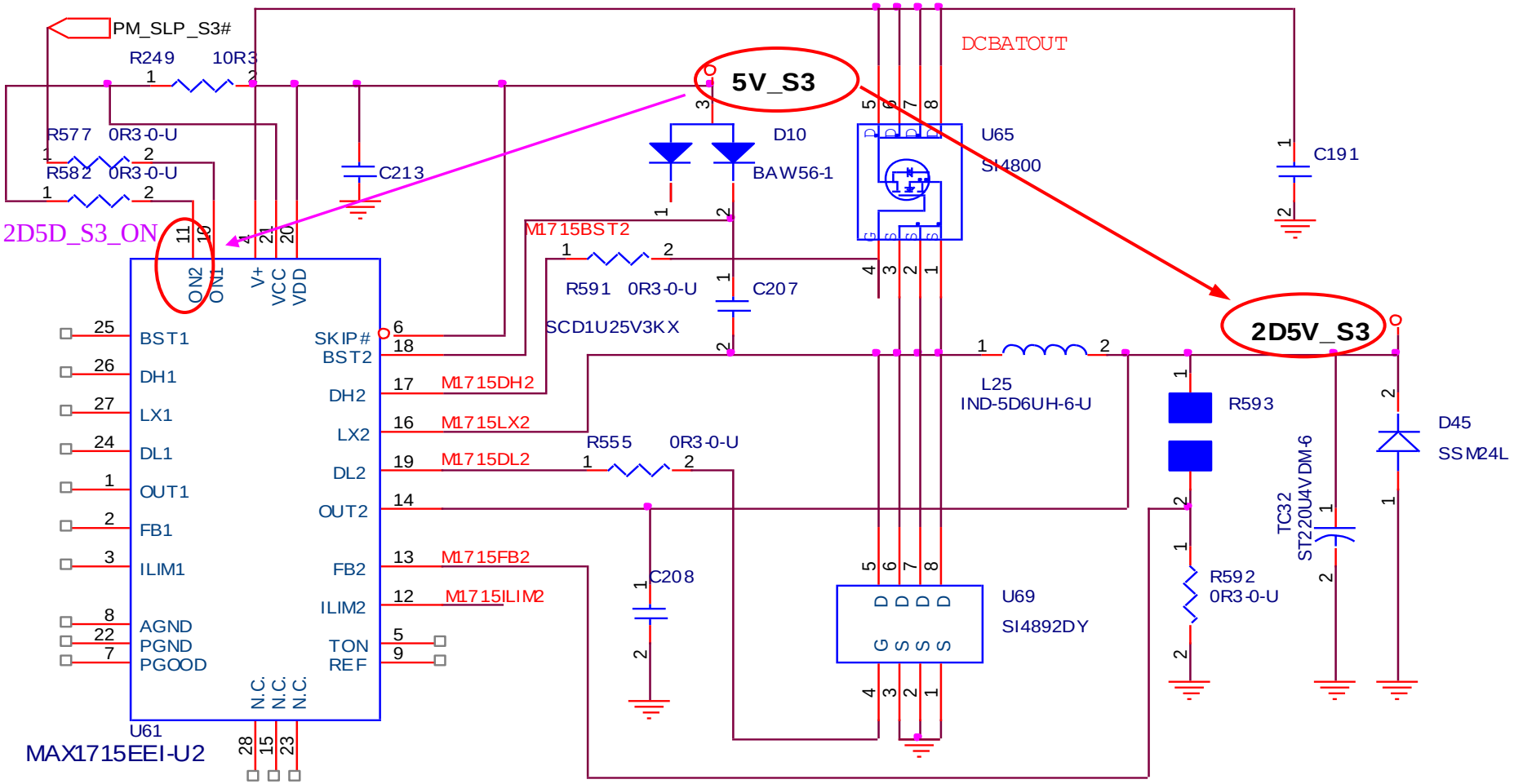
c. Circuit operation – 2D5V_S3 :

When 5V_S3 power was building, MAX1715 pin – 11 is pulled hi, and 2D5V_S3 will be turned on .



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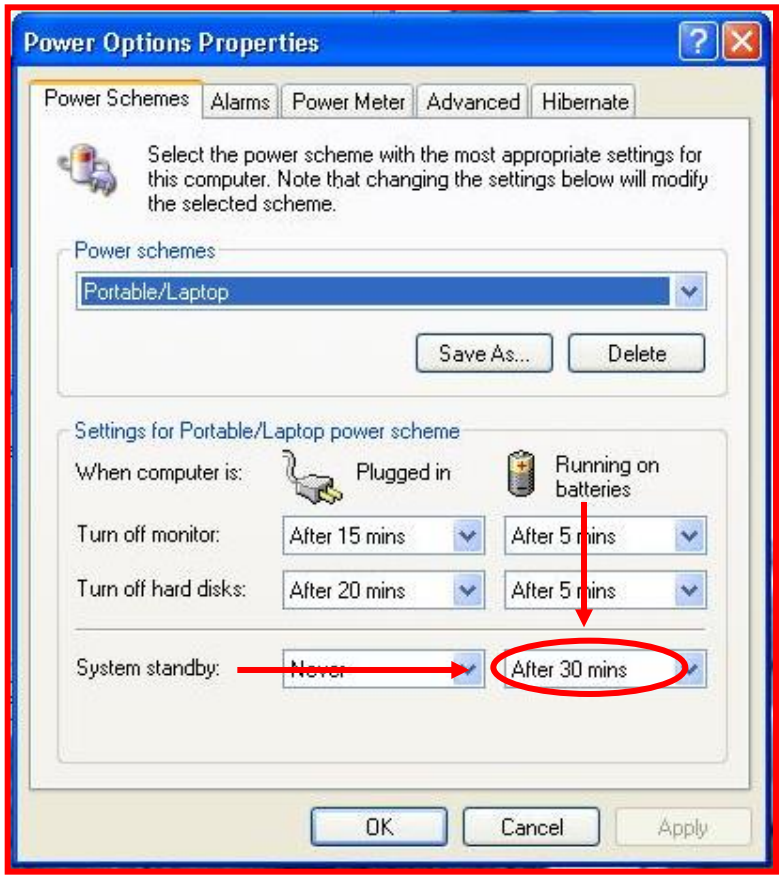
d. S3 power Purpose :

Why Notebook needs S3 power – Stand-by mode function ?

The stand-by mode function is for power saving when the system is not operated just as the below setting. So, the S3 power is for this usage.



- The system will enter the stand-by mode if NB remains not operated during 30 mins.
- During stand-by mode if power button is pushed, the system will return to previous state in 5 sec .
- Because the state is resumed from memory, we need S3 power to keep North Bridge & DDR working while standing by. At this state, the battery leakage current is under 30 mA.

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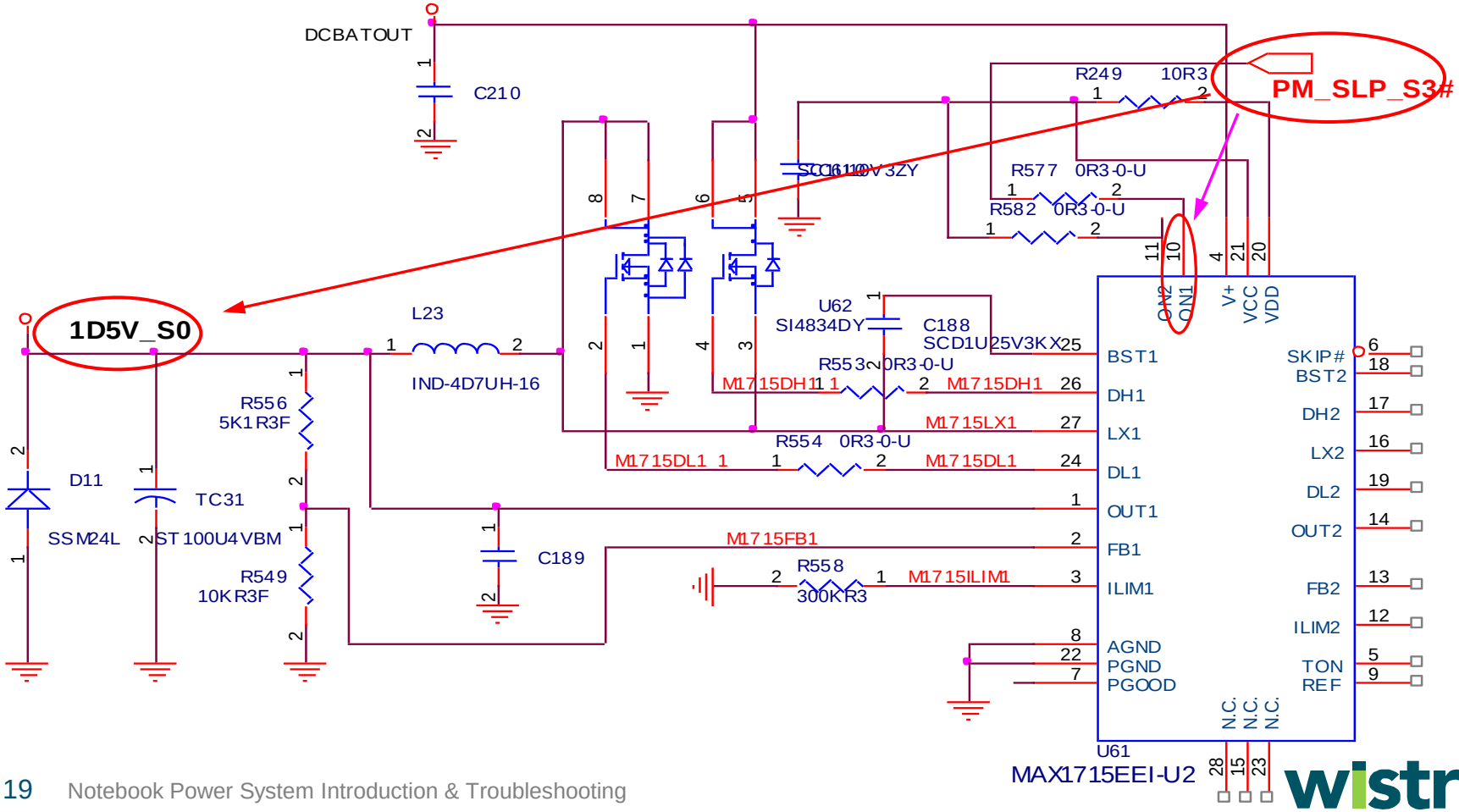
1.2.3 S0_Power：

a. Circuit operation – 1D5V_S0 :

After PM_SLP_S4# signal was generated for a few μ sec , the South Bridge will output PM_SLP_S3# on hi level, and 1D5V_S0 will be turned on .



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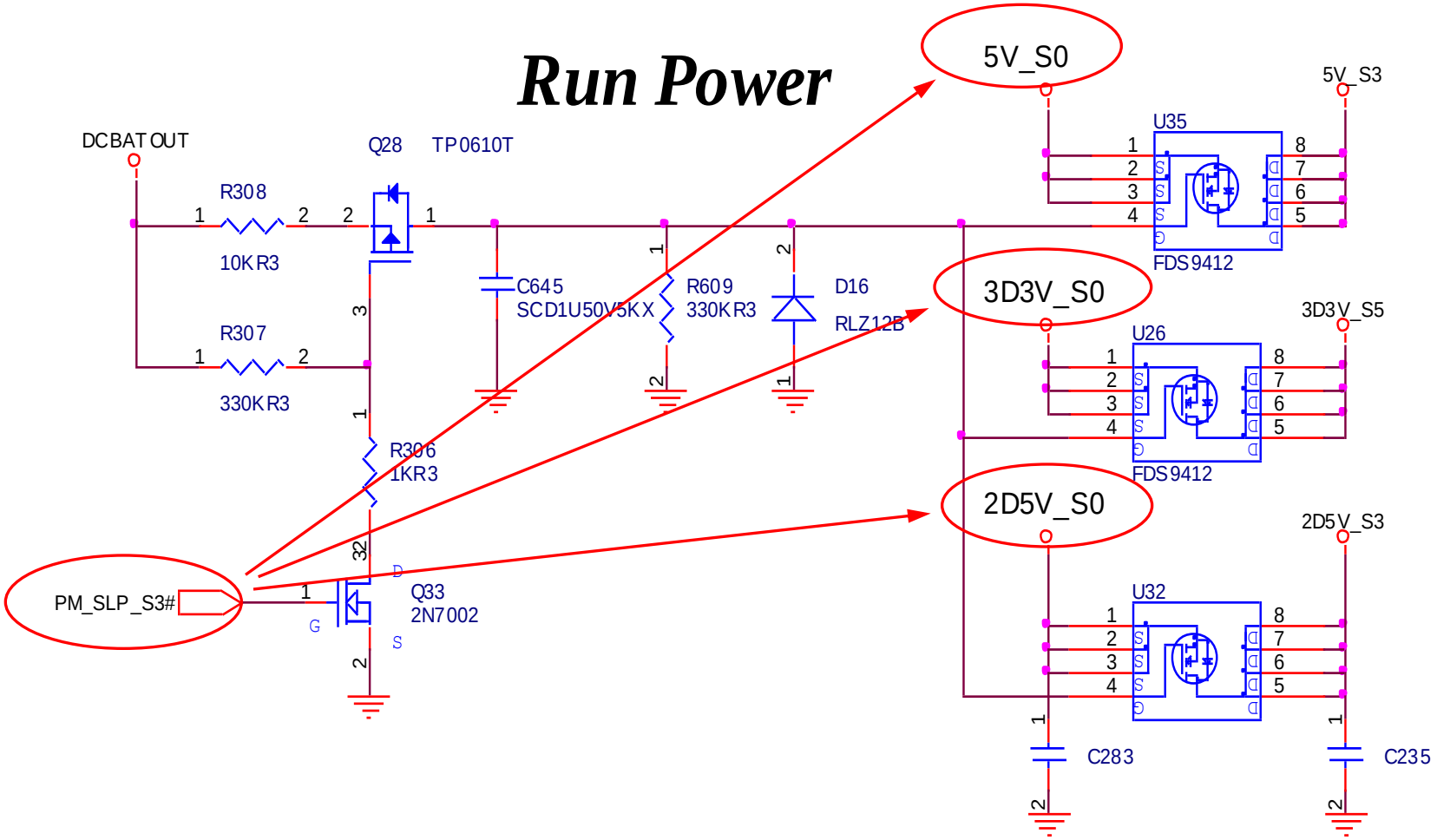
b. Circuit operation – 5V,3D3V,&2D5V_S0 :

PM_SLP_S3# signal is also used to turn on 5V、3D3V、2D5V_S0.



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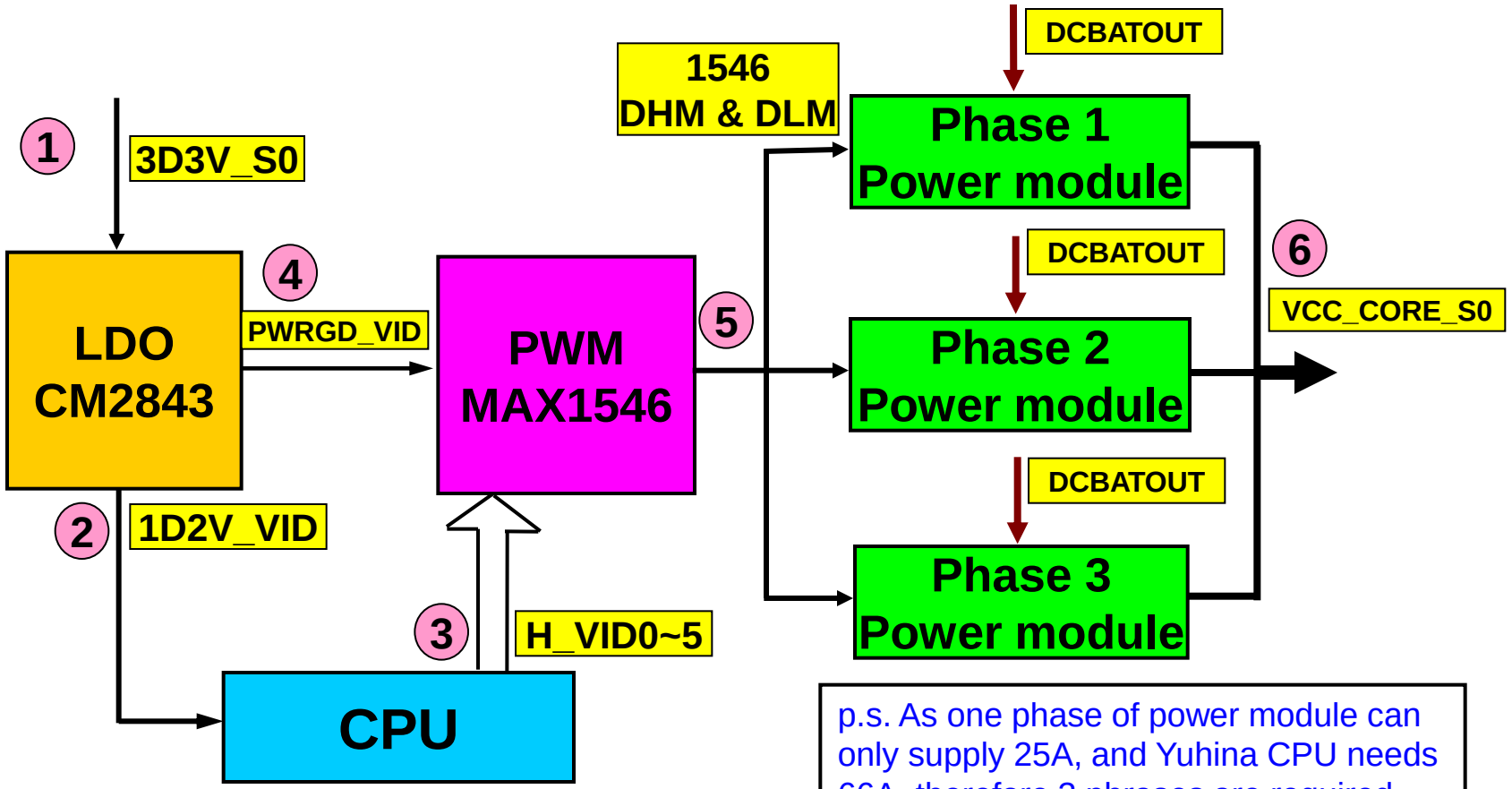
c. Circuit operation – P4 CPU VCC_CORE_S0 :

-- P4 CPU_ VCO power – architecture :



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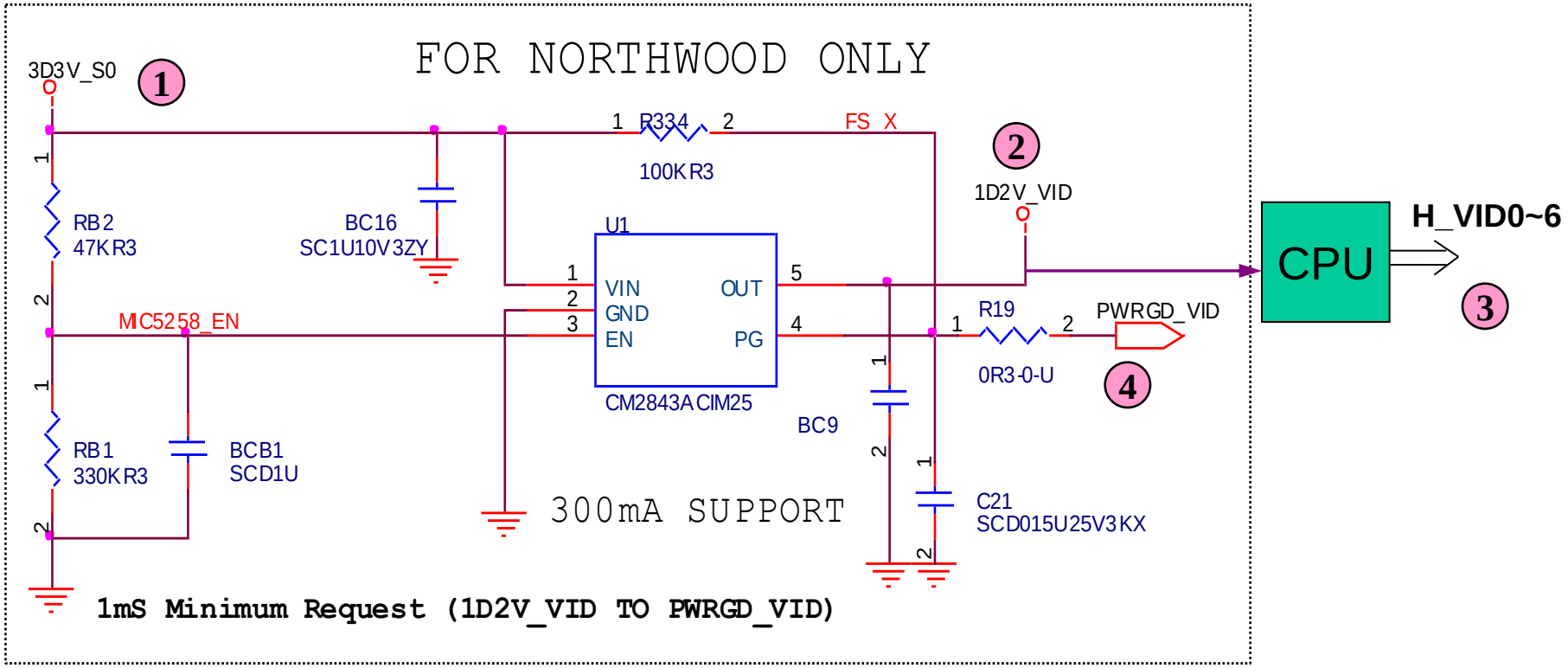
c. Circuit operation – P4 CPU VCC_CORE_S0 :

1. 3D3V_S0 power on .
2. CM2843 provides 1D2V_VID to CPU.
3. CPU provides VID code
4. PWRGD_VID, which is provided by CM2843, will delay 1ms while 1D2V_VID is on. So it will be turned on after the CPU VID code.



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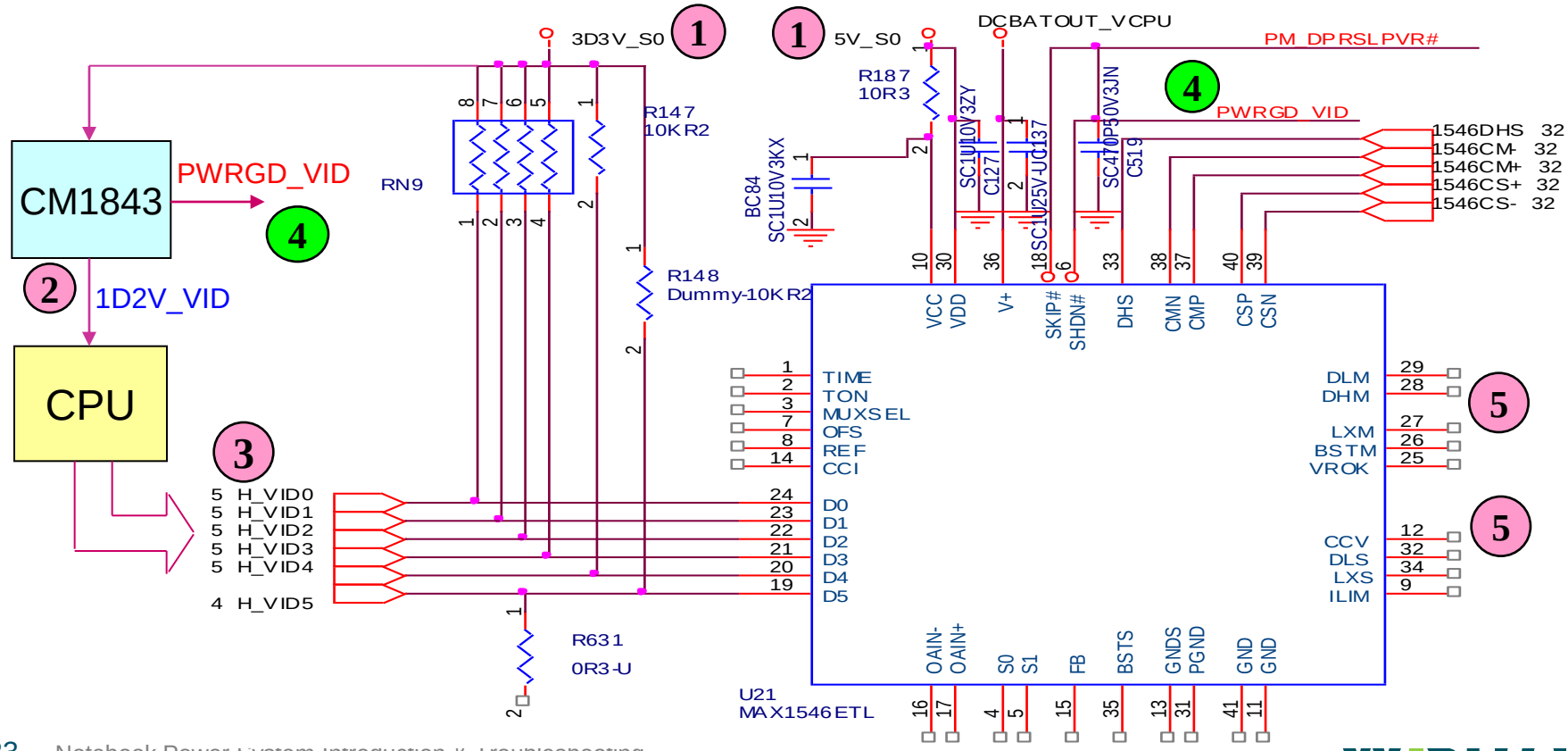
c. Circuit operation – P4 CPU VCC_CORE_S0 :

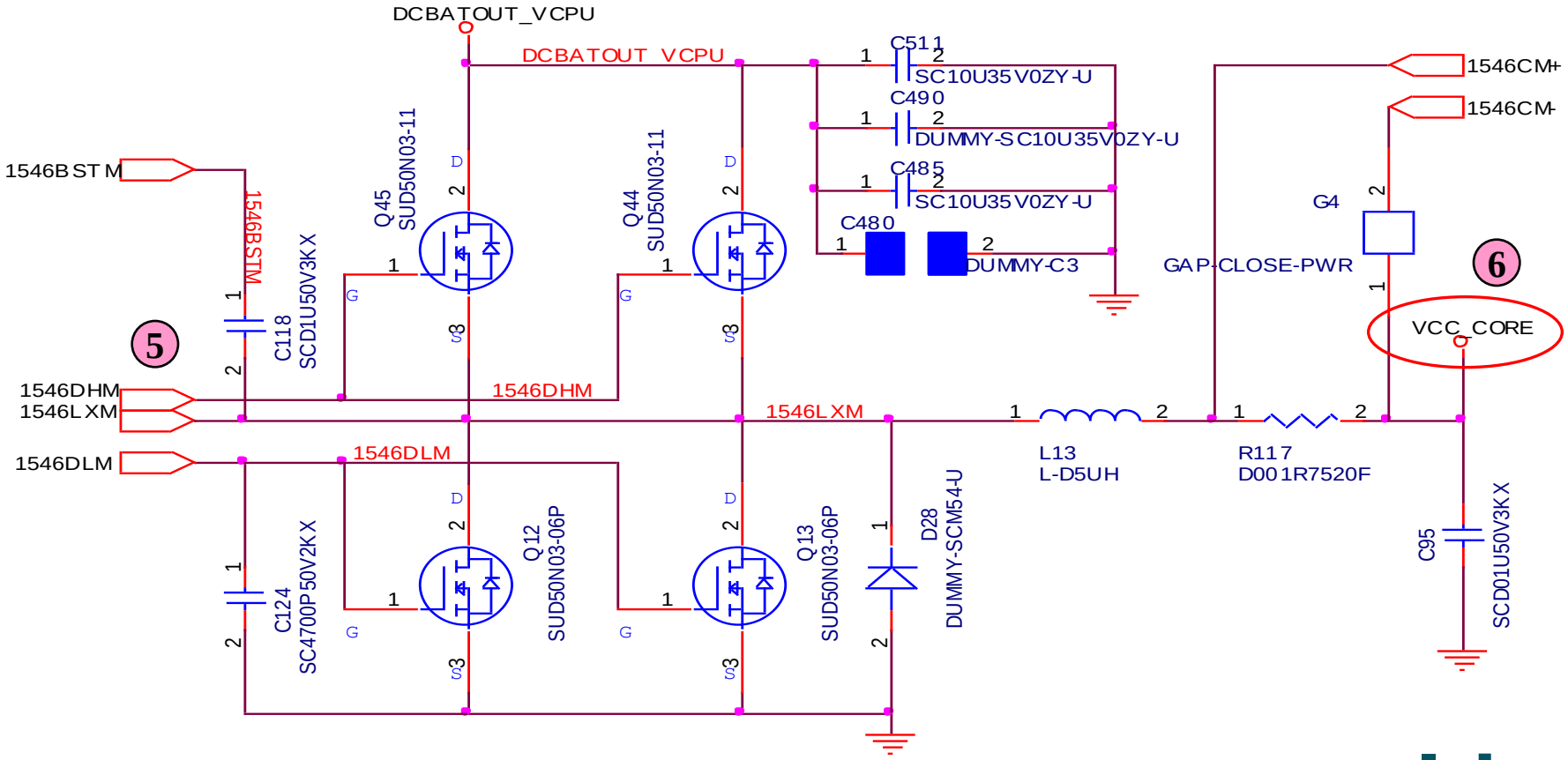
1. MAX1546 Power is ready .
2. CM1843 generates 1D2V_VID to CPU.
3. CPU provides the VID0~5 to the MAX1546 ..
4. CM1843 will send PWRGD_VID as Hi after 1ms that 1D2V_VID was generated.
5. MAX1546 will output the switching signal .



c. Circuit operation – P4 CPU VCC_CORE_S0 :

5 The step-down circuit starts working as soon as the switch signal begins.

6 The VCC_CORE is produced and will provide the CPU's working power .
PS. This is one of the three phases in VCC_CORE.



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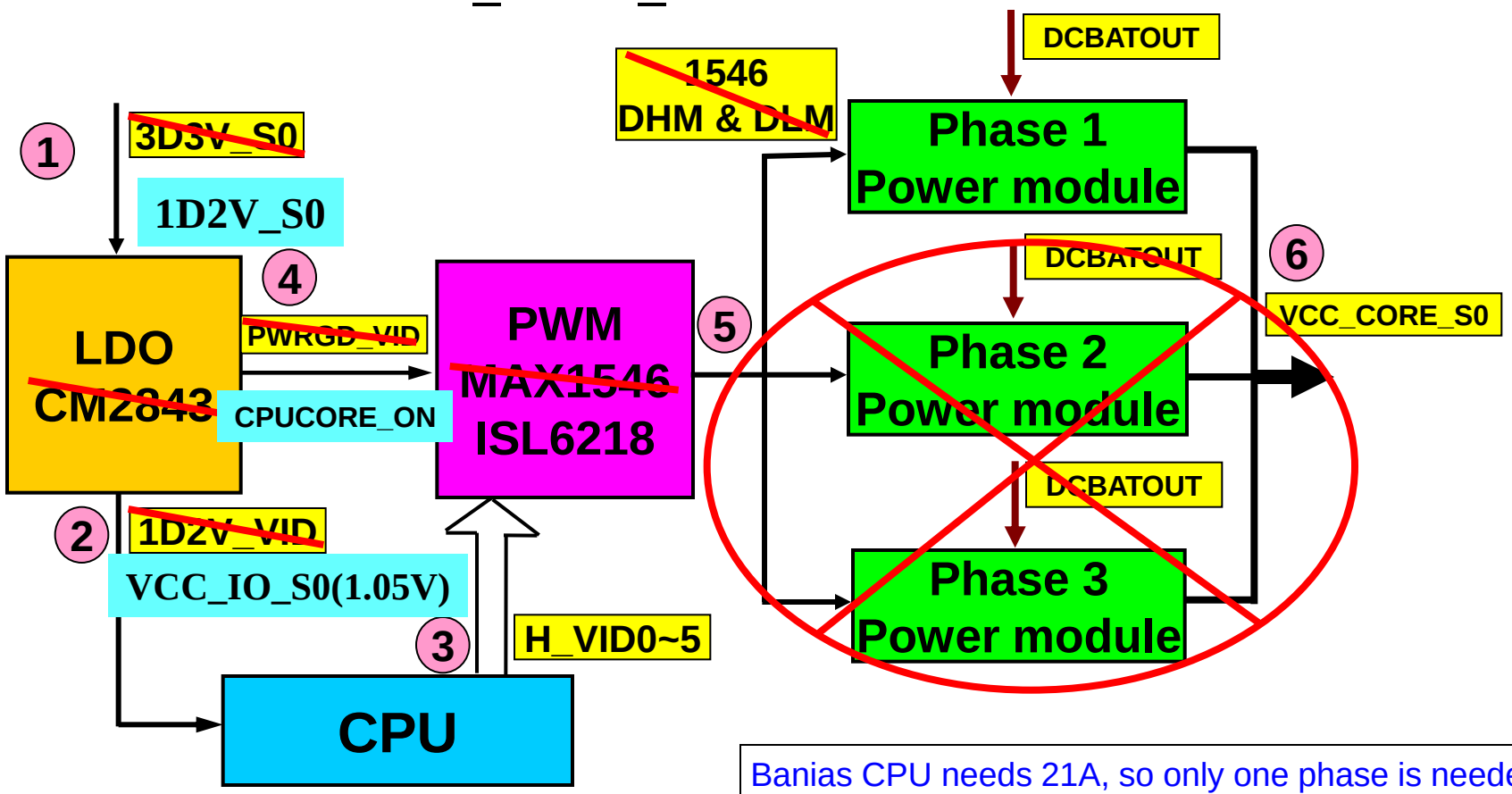
d. P4 & Banias CPU VCC_CORE_S0 difference :

The power system can separate two kinds of architecture for CPU. But the only difference between **P4** and **Banias** CPU power architecture is VCC_COER_S0. Such as below :



Banias CPU needs 21A, so only one phase is needed.

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2. Power plan introduction :

By now we have learned how NB power is generated and why it must be done in a specific sequence. You might start to wonder, “What is other Power application?” In the following section, I will show you the power consumption of all devices in a NB. You will learn:

2.1 Power budget block diagram
2.2 NB power application
2.3 Multi–power device

2. Power plan introduction :(cont'd)

Create a NB power system with fixed procedure, so we can know the power budget of all devices from the power plan procedure .

Design procedure :

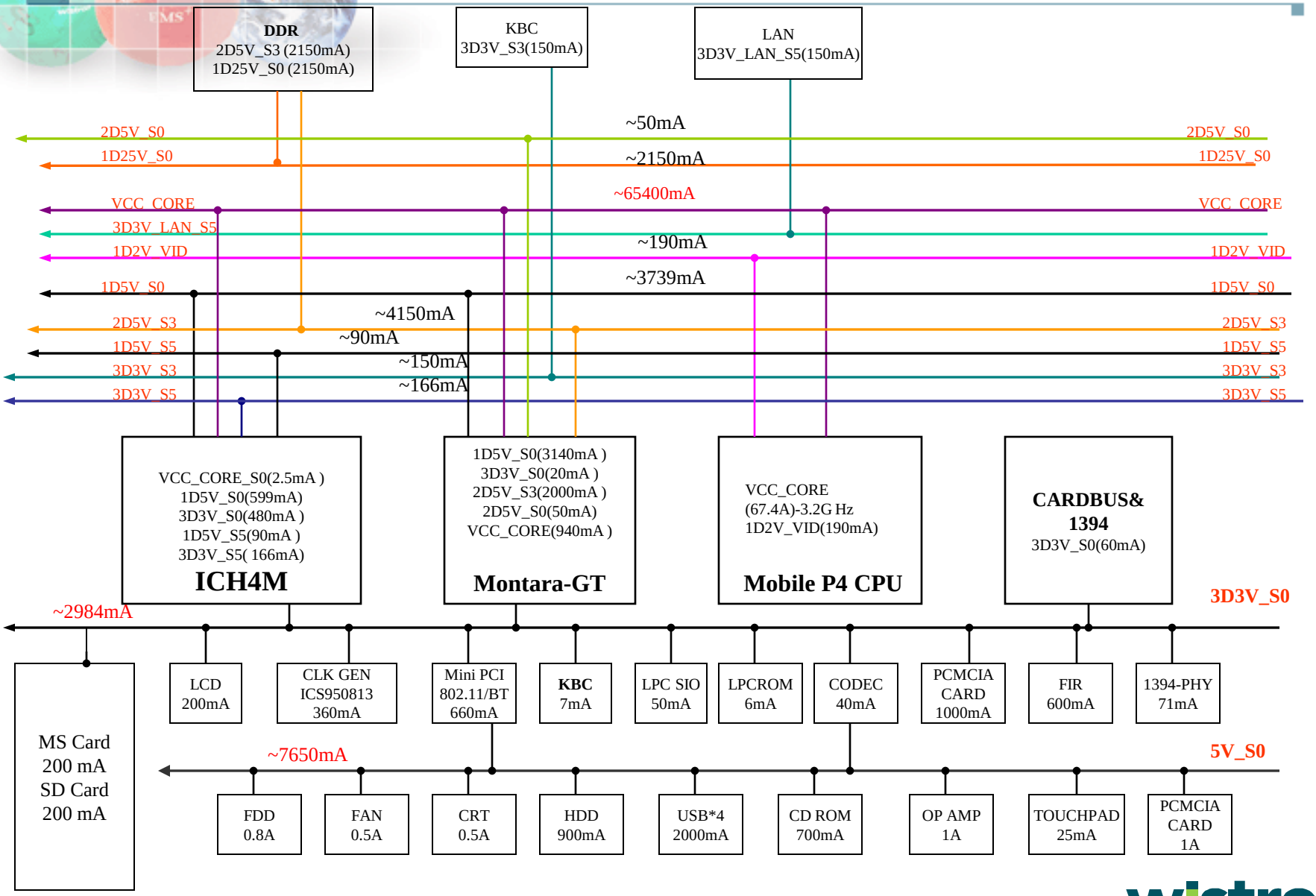
a. Power budget :

We must first know the power category and consumption of all devices, and then we can start to define the SPEC of power.

b. Power application :

After power SPEC was defined, we need to confirm the timing & sequence when power is turned on. And separate them with S5,S3,S0, etc. for the purpose of power saving.

2.1 NB (Yuhina) Power Budget Block Diagram



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2.2 NB power application :

2.2.1 3D3V Device :

S5	ICH4M	LAN	
S3	KBC		
S0	Montara-GT	ICH4M	LPC SIO
	Mini PCI	CODEC	LPC ROM
	1394-PHY	KBC	CLK GEN
	PCMCIA card	LCD	CARBUS
	MS/SD card	FIR	

2.2.2 5V Device :

S5			
S3			
S0	Mini PCI	FDD	CD ROM
	CODEC	HDD	USB*4
	Touch PAD	CRT	OP AMP
	PCMCIA card	FAN	

2.2.3 2D5V Device :

S5		
S3	DDR	Montara - GT
S0	Montara - GT	

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2.2.4 1D5V Device :

S5	ICH4M	
S3		
S0	ICH4M	Montara_GT

2.2.5 1D25V Device :

S0	DDR

2.2.6 1D2V_VID Device :

S0	CPU

2.2.7 VCC_CORE Device :

S0	CPU	ICH4M	Montara-GT

2.3 Multi-power device :

Device	Power source				
ICH4M (South Bridge)	3D3V_S5	3D3V_S0	1D5V_S5	1D5V_S0	VCC_CORE
Montara _ GT (North Bridge)	3D3V_S0	2D5V_S3	2D5V_S0	1D5V_S0	VCC_CORE
Mobile P4 CPU	1D2V_VID	VCC_CORE			
DDR	2D5V_S3	1D25V_S0			

3. No power troubleshooting

No power define :

No power means when the power button is pressed, the power LED is not turned on, and the system is not booted. We can separate no power in four kinds of states :

- 3.1 No power debug notice & sequence
- 3.2 No DCBATOUT or short to GND
- 3.3 S5 Power No Good
- 3.4 Power on logic No Good

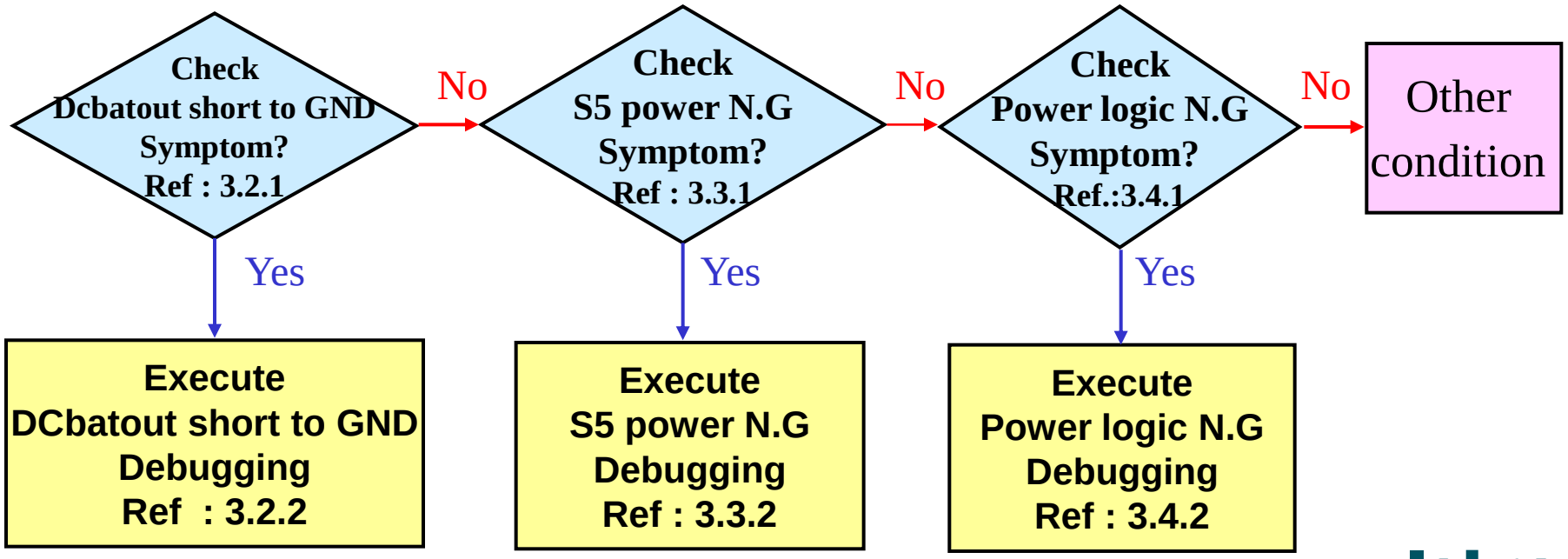
If power system is good & power LED turned on, but the system still N.G., it means the system is “No work”.
You must follow the “No work debugging” process to troubleshoot the problems.

3.1 No power debug notice & sequence :

3.1.1 debug Notice :

- For safety's sake, please use adapter to supply the Notebook power when you execute the debug process .
- This debug procedure can only cover about 90% no power Problems.

3.1.2 debug Sequence :



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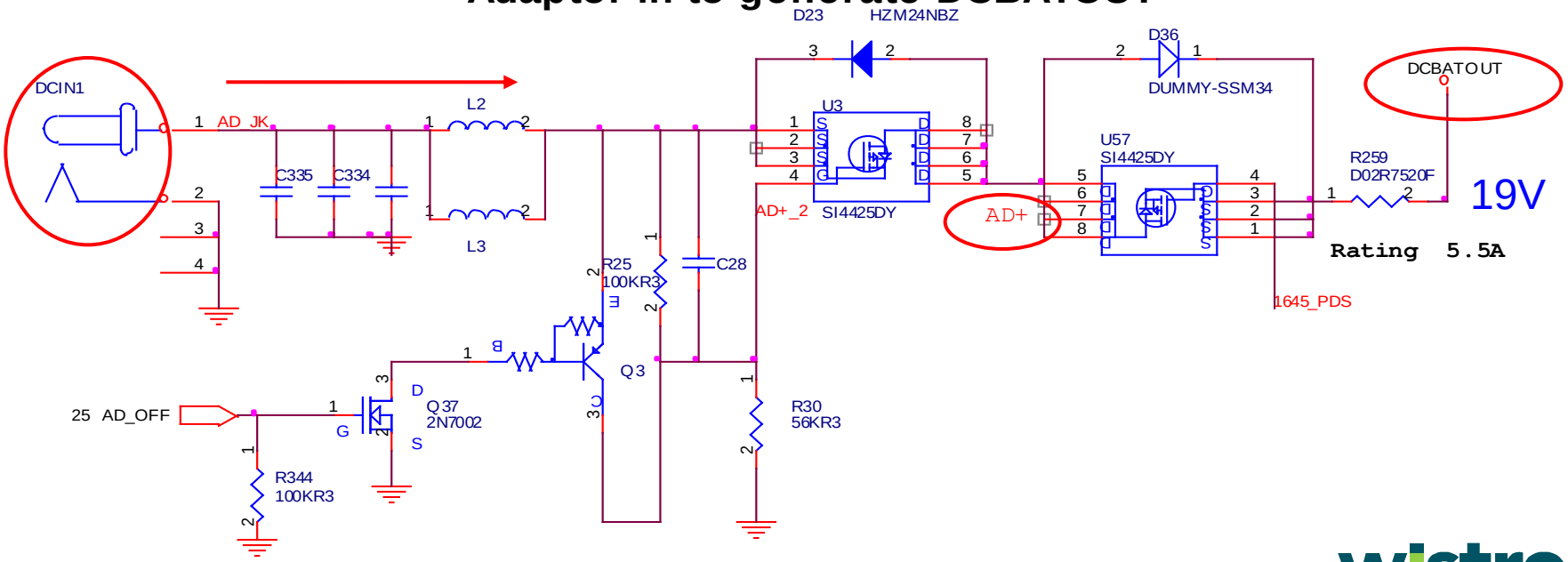
3.2 DCBATOUT short to GND :

3.2.1 Symptoms:

- There is no any response when the power button was pressed and adaptor was already inserted .
- Adaptor power LED flashes or shuts down .

Solution: Open the system case and use the multi-meter 200V scale to check AD+ or DCBATOUT between GND as below . If the voltage is less than 5V,we can make sure it is short to GND .

Adaptor in to generate DCBATOUT



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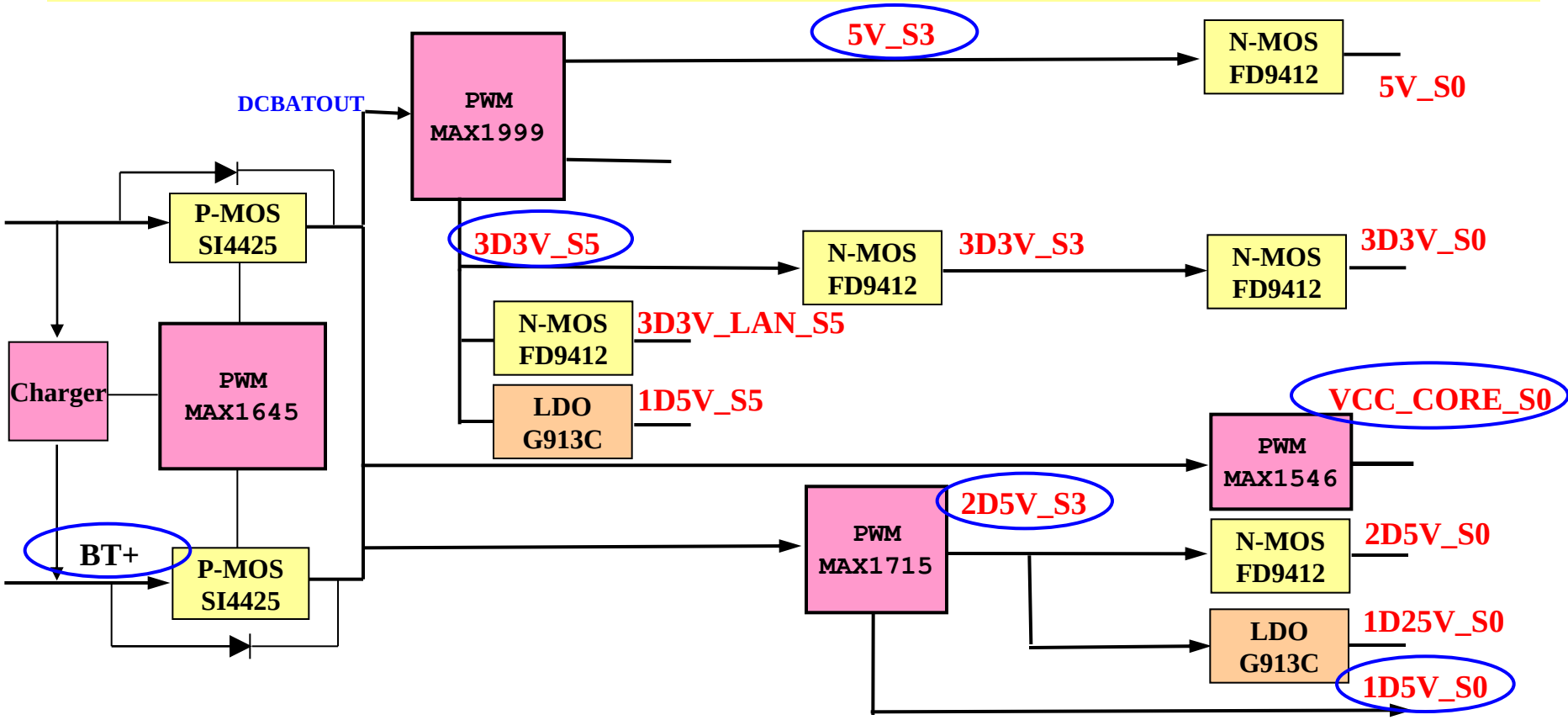
3.2.2 Debugging :

- There are 6 kinds of power sources in the Yuhina system, so we must check all of the power output to see if there is any short to GND.

Solution: Check the 5V_S3,3D3V_S5,2D5V_S3,1D5V_S0,VCC_CORE and charger power one by one .



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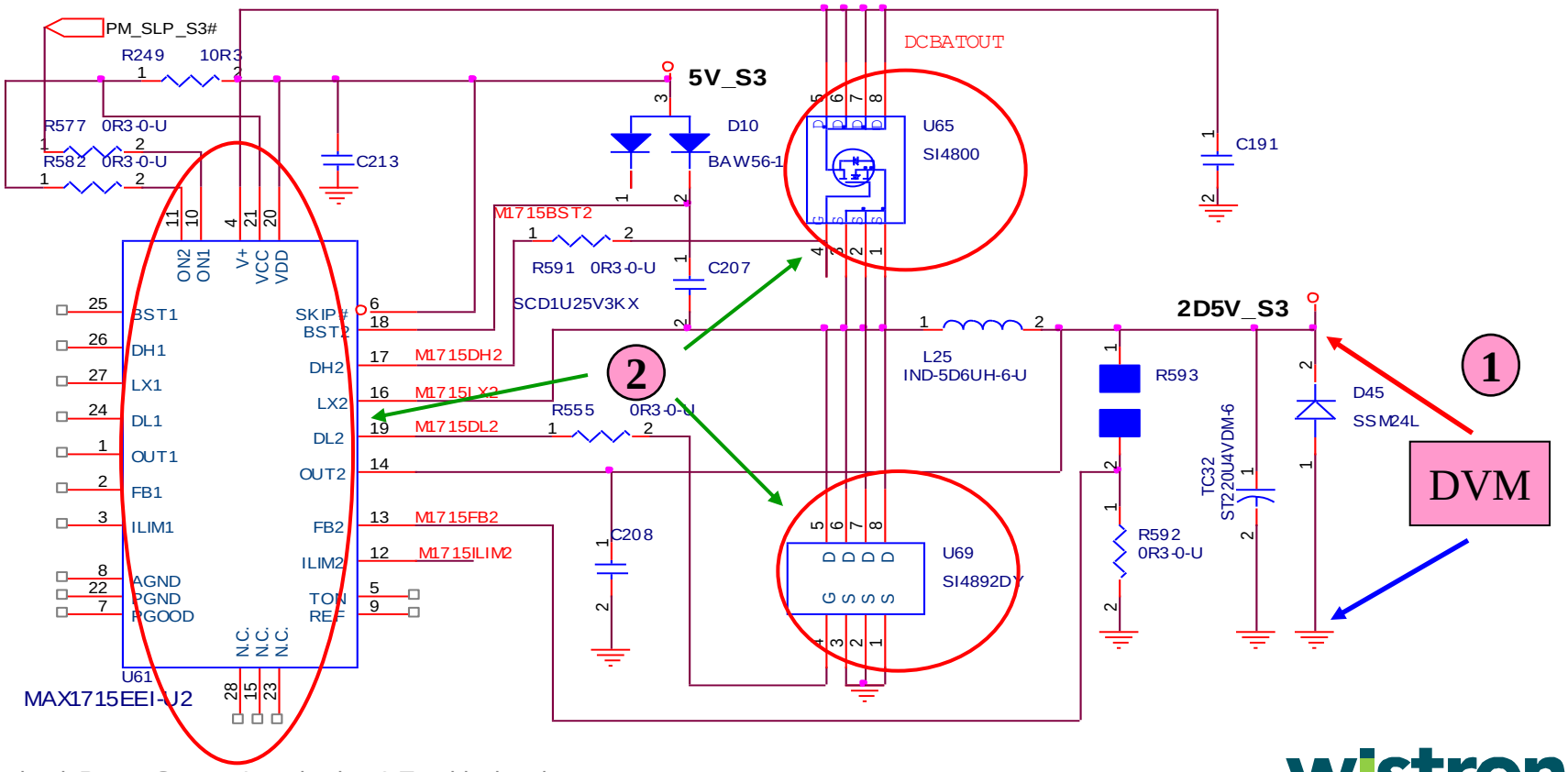
3.2.2 Debugging : (cont'd)

Following is an example of the 2D5V power source.

1. Use multi-meter 200Ω scale to check TC32. The impedance must bigger than 200Ω. If not, it means something short to GND, and we need to find out why.
2. Usually we would remove hi & low side MOS (U65 & U69) and MAX1715. If it's still short to GND, it means some output devices are damaged, and we must try to remove them one by one .



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3.3 S5 Power No Good :

3.3.1 Symptoms:

• There is no any response when the power button was pressed and adaptor has already plugged-in.
•Adaptor power LED is normal .

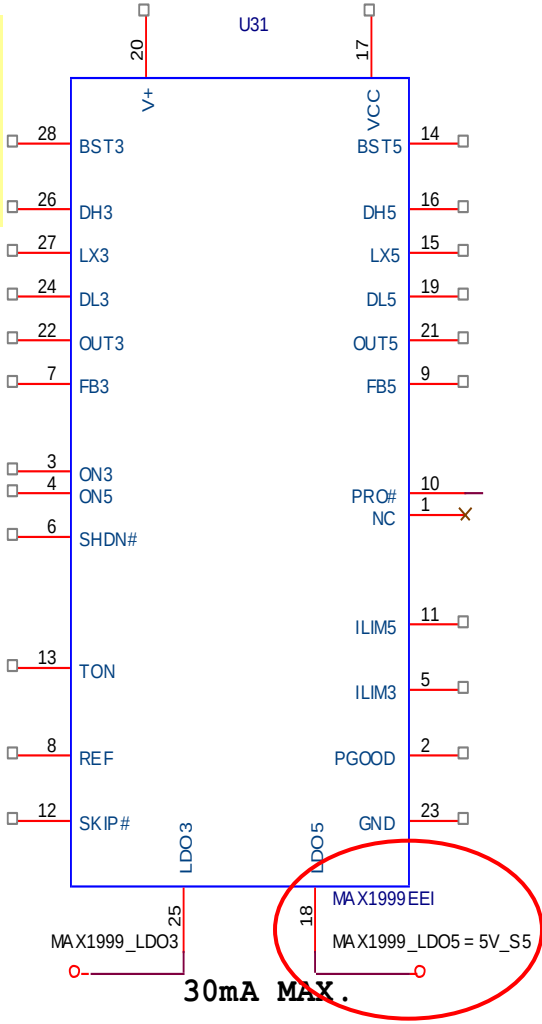
3.3.2 Debugging :

• Open the case, use multi-meter to check if MAX1999 pin18 5V_S5 power is good.

• If not, it means MAX1999 or some 5V_S5 devices are damaged. Remove all powers, use multi-meter to check MAX1999 pin18 Impedance .

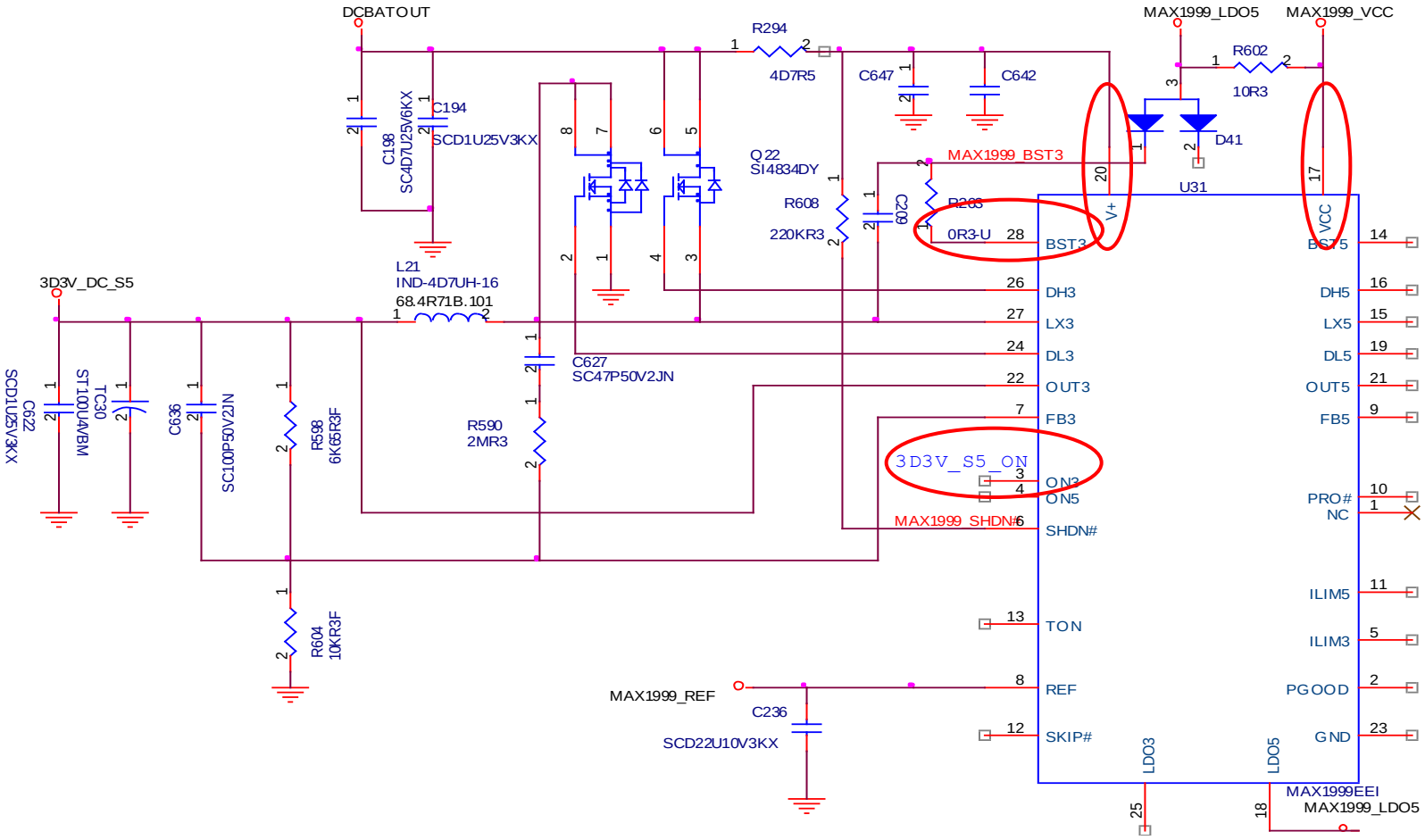
• If the impedance is smaller than 200Ω, it means some 5V_S5 devices are damaged, and we must try to remove the component one by one.

• If the impedance is more than 200Ω, it means the MAX1999 have some problem, and it must be changed.



3.3.2 Debugging : (cont'd)

- Next we must check 3D3V_S5. If 3D3V_DC_S5 is N.G, we could use multi-meter to check MAX1999 pin20 (19V), pin17, 28, 3 (5V) if powers are all good. If N.G, please check the source component.



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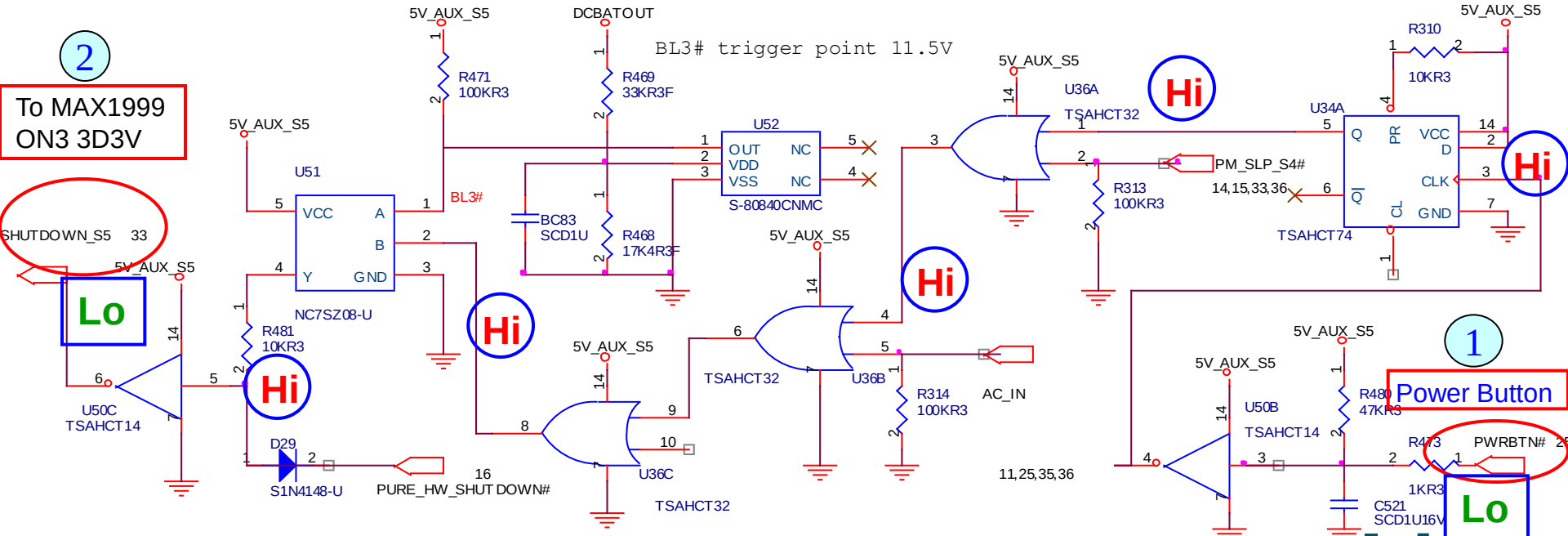
3.4 Power on logic N.G :

3.4.1 Symptom :

- If the previous two symptoms are checked ok, but the system still has no power on, then we should check the power on logic circuit as below .

① When power button was pressed, PWRBTN# will be pulled low.

② After a series of logic actions, the SHUTDOWN_S5 will also be pulled low.



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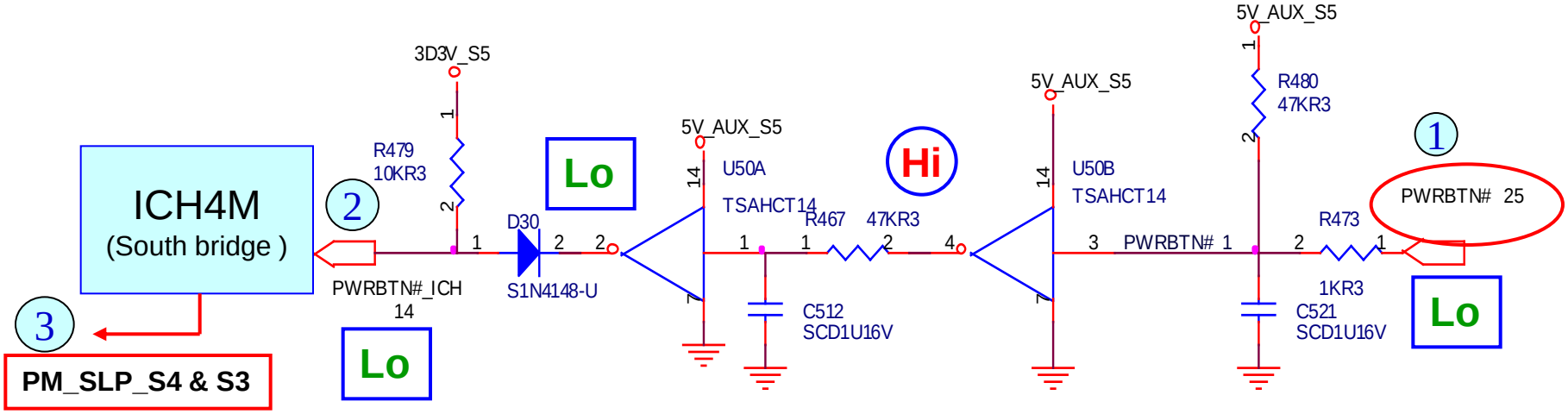
3.4.1 Symptom :

- If the power on logic circuit is correct, we can track the south bridge trigger logic .

① When the power button is pressed, PWRBTN# will be pulled low ,
② After the logic action, the **PWRBTN#_ICH** will also be pulled low. It will trigger south bridge to send **PM_SLP_S4 & S3** signal to turn
③ on S3 & S0 power .



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3. No Power Debug

3.4.2 Debugging :

- If **SHUTDOWN_S5** is not pulled low, it means some logic ICs or components during this path are N.G.. If it is the case, then just follow the circuit to find out the problems, and replace them.

- If the **PWRBTN#_ICH** is not pulled low, it means some logic ICs or components during this path are N.G. If it is the case, then just follow the circuit to find out the problems, and replace them.

- If the **PM_SLP_S4 & S3** is not pulled hi, maybe the south bridge is damaged .

To Sum up :

Above-mentioned are power system & no power debug .
All of the circuit diagram are references from Yuhina .

---------- END ----------

Thank You !

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