NUC972 Development Board
User's Manual

Rev. A2.0

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1 General Description

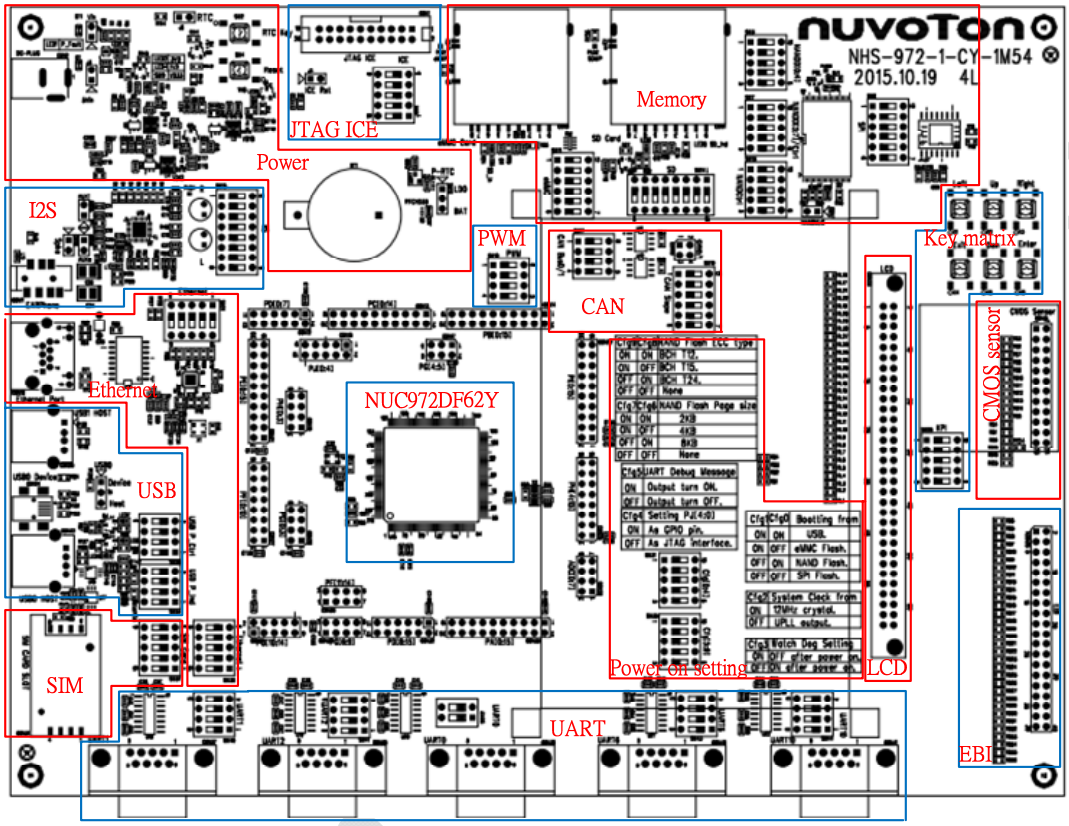
The user's guide describes the operation and use of the NUC972DF62Y development board, NHS-972-1-CY-1M54. The board places NUC972DF62Y's almost of the functions, which includes the peripheral interfaces as memory (NAND flash, SPI flash, SD x 2), UART x5, IIS, 2 x 3 Key matrix, 24-bit LCD interface, Ethernet, USB host/device, CMOS sensor, SIM card, and reserve EBI port.

In order to easier-check for user, the description is based on the functional block with the sheet of schematic. User can check out what the function port is they would like to design on their system. The schematic is attached for the system reference design.

On the NUC972DF62Y development board, almost of the GPIO pin headers are traced to peripheral device via the dip switches. In which the system designer can easier to verify their module circuit by wire out from the pin header if the corresponding peripheral devices are turned off.

Meanwhile, the board reserves a JTAG ICE port for program development and a UART 0 for debugging message. In which is convenient for the designer to develop their system.

2 Peripheral Device



3 Board Description

3.1 Power Block –

CON2 is 5VDC power adaptor input jack terminal which provides the system power for the DC/DC converters, 3.3V is for system I/O and peripheral devices, 1.2V is for CPU's core power, 1.8V is for CPU's internal RAM.

Plug the 5Vdc adaptor into the CON2, in which will supply RTC power and system power DC/DC convertors input.

When J6 1-2 short: Toggle the RTC key; system power control key, the RTCWkUp will go low, and then the RTCPWREn output Hi to enable DC/DC convertor U3 (3.3V for IO power), U8 (1.2V for core power), U4 (1.8V for DDR power). Mine while, the power LED2 (3.3V), LED4 (1.2V) and LED3 (1.8V) are light, too.

When J6 1-2 open: Plug the 5V dc adaptor into CON2 direct to enable DC/DC convertor U3 (3.3V for IO power), U8 (1.2V for core power), U4 (1.8V for DDR power)

To prevent the input power is over the development board specification, the system board adds a power protection device U1 (APL3211A). The system power will be terminated and LED1 lighting when the input voltage is over 5.85V (APL3211A) or the current is over 1A.

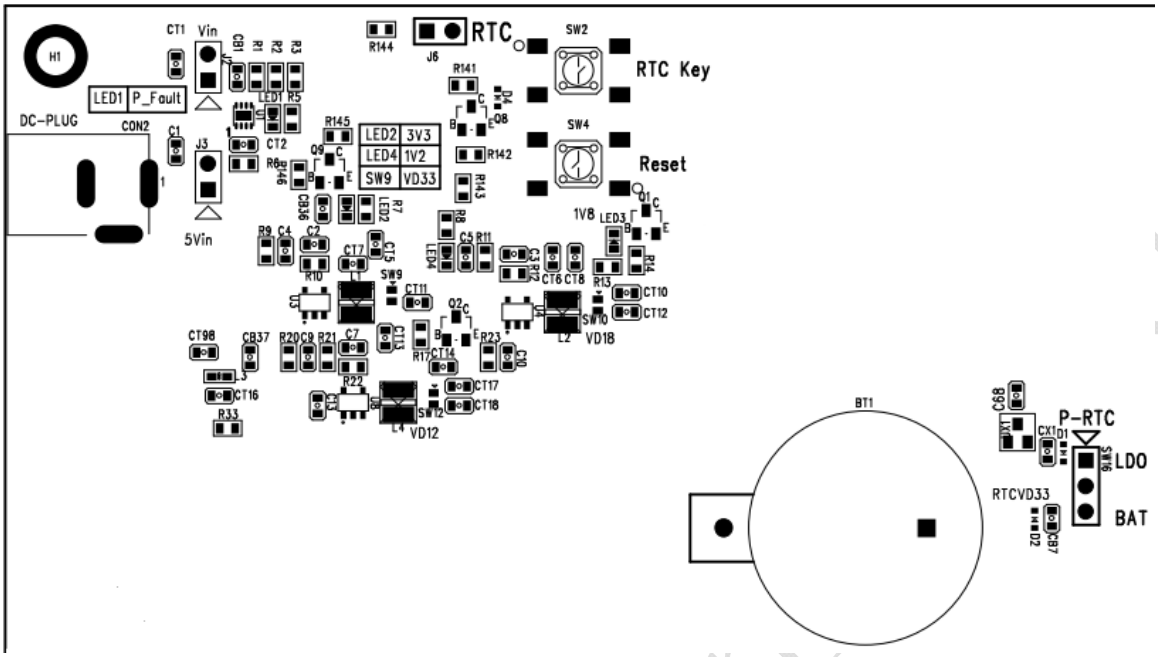
For the over current protection defines formula is as below:

$$I_{OCP} = \frac{K_{ILim}}{R_{ILim}} \qquad K_{ILim} = 25000AK \quad , \quad R_{ILim} = 24K\Omega$$

CON2, 5V power adaptor input terminal, polarity as below:

1: Center hole is positive for 5V+
2: External ring is negative for ground.

J6	1-2 short: SW2(RTC key) for system power control on/off. 1-2 open: No need RTC key for system power control
SW4	Reset key.
BT1	Battery socket is for CR2032.
SW16	1-2: RTC power from LDO 2-3: RTC power from BT1

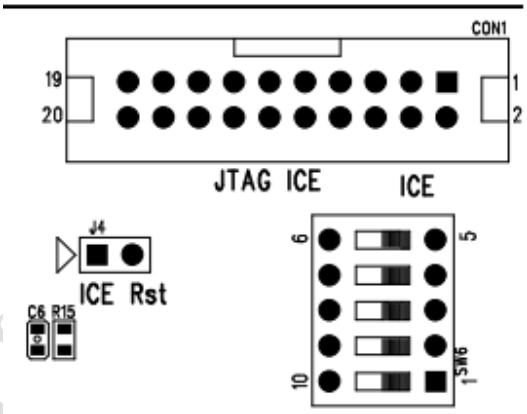


3.2 JTAG ICE Block –

CON1 is a connector for JATG ICE port which function has to turn on SW6.

ICE port PJ[0:4] SW6 CON1 | J4

Note: J4 1-2 ICE reset connector to CPU system reset



3.3 Memory Block –

Memory block includes eMMC socket, SD socket, NAND flash and SPI flash.

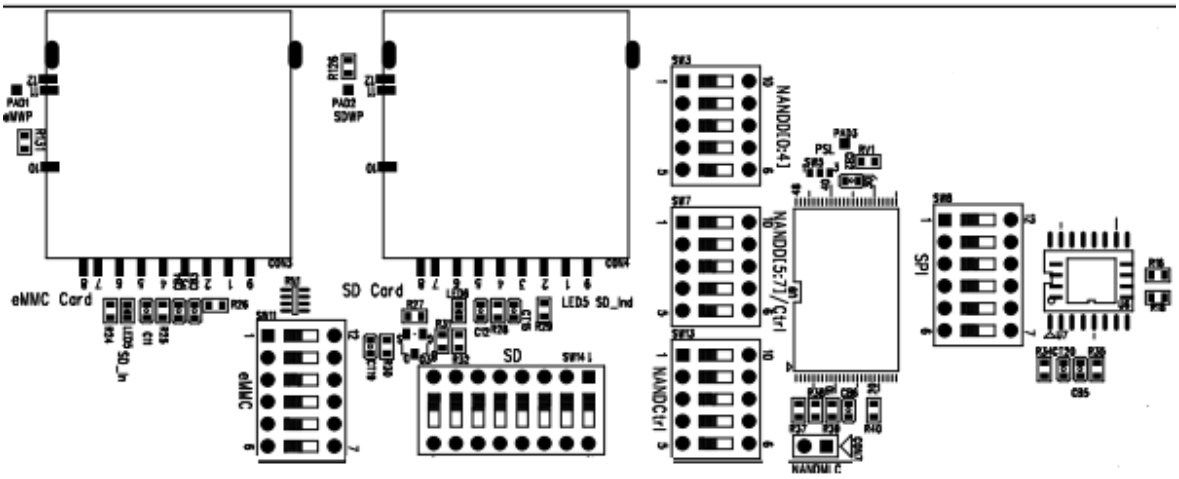
Each one of the device has to be turned on by the corresponding switch which all of the GPIO and DIP switched are listed as below:

eMMC	PC[0:5]	SW11	CON3
SD	PD[0:7]	SW14	CON4
NAND Flash	PC[0:14]	SW3, SW7, SW13	U9
SPI Flash	PB[6:11]	SW8	U6/U7

Note:

1. The PC[0:5] of eMMC conflicts with NAND flash.

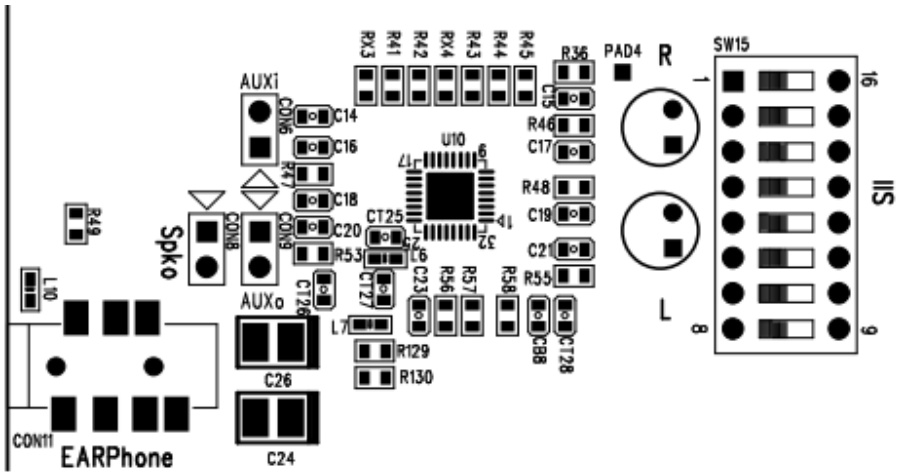
2. Only one (U6 or U7) SPI flash can be used.



3.4 I2S Block –

Add one CODEC chip (NUC8822L) to IIS port which is easier to verify.

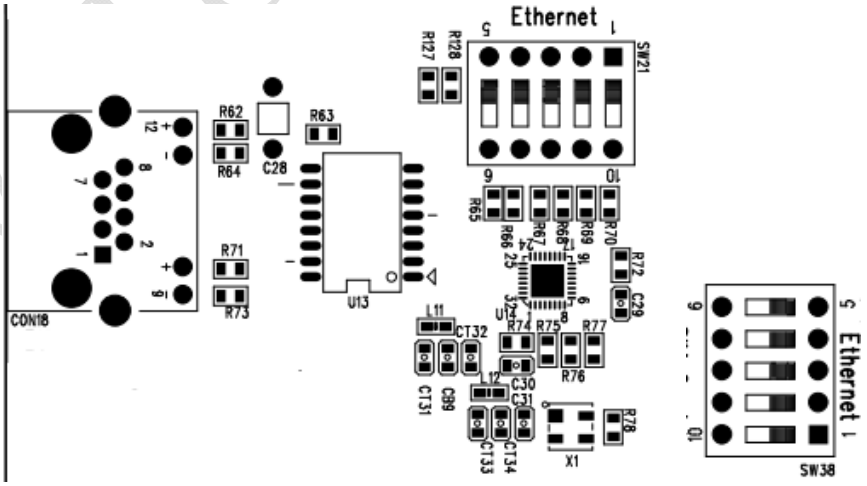
I2S	PG[0:1], PG[10:14], PE12	SW15	U10



3.5 Ethernet Block –

For Ethernet port, the NUC972 support RMII interface which add one Ethernet PHY (IP101GR) to RJ45.

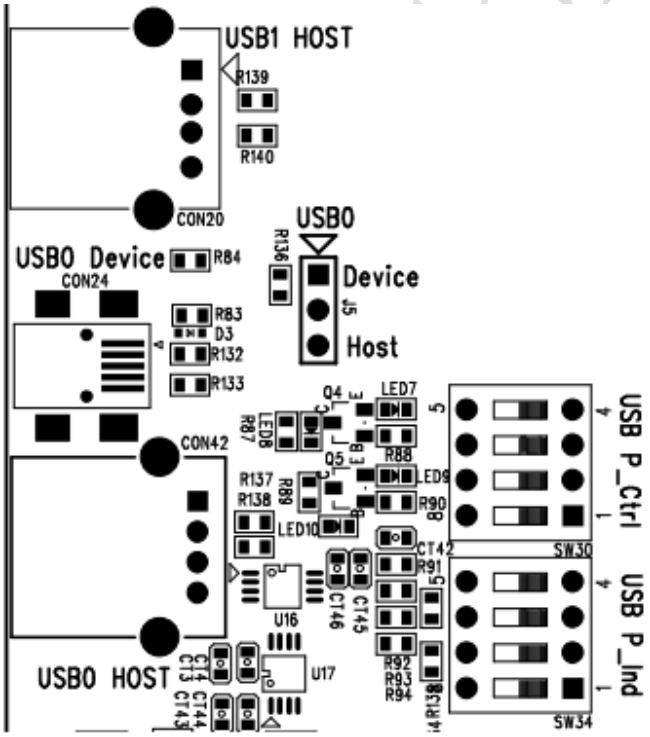
Ethernet	PF[0:9]	SW21, SW38	U13, U14, CON18



3.6 USB Block –

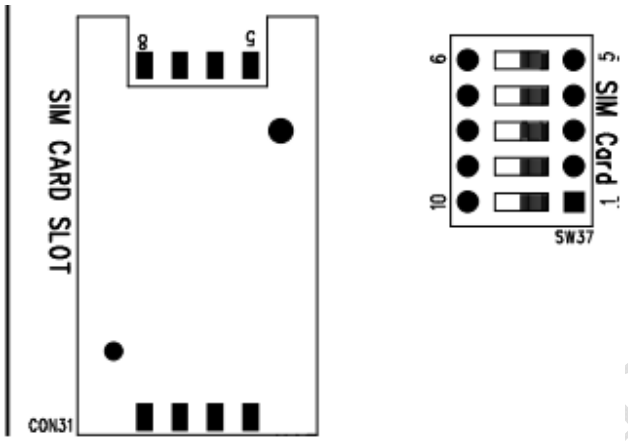
The corresponding DIP switches have to be turned on for the power control. If the USB power control chip isn't control by GPIO, the system is reserved a switch for manual control. The OC pin will active low when the USB power is fault, the fault LED will be turned to red from green.

USB0 Device/HOST	UDO0/UDO1/UDO2, PE14, PH0, PH1	J5, SW30.1/2, SW34.1/2	U16, CON24/CON42
USB1 HOST	UDH0/UDH1, PE15, PH1	SW30.3/4, SW34.3/4	U17, CON20
Note: 1. SW34 is USB power chip enable by hardware force and fault LED setting. 2. J5 1-2: USB0 for Device (CON24) J5 2-3: USB0 for HOST (CON42)			



3.7 SIM Block –

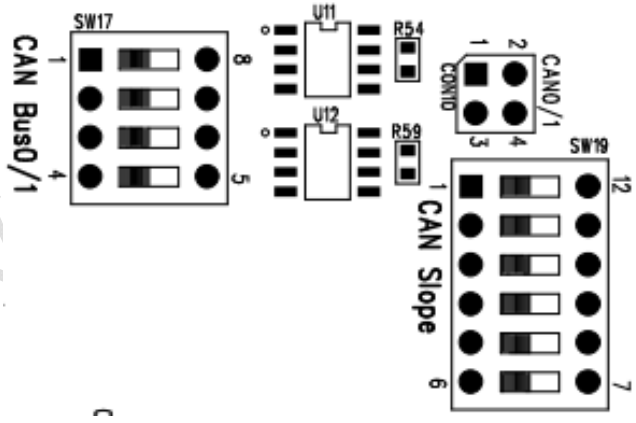
SIM card	PG[10:14]	SW37	CON31



3.8 CAN Block –

Is only reserved two CAN bus ports with pin headers on the board.

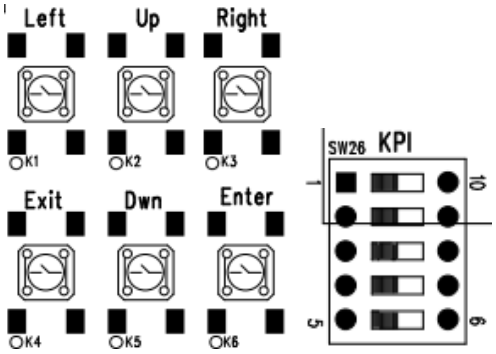
CAN bus 0	CON10.1/2	PH[2:3]	U11, SW17, SW19
CAN bus 1	CON10.3/4	PH[14:15]	U12, SW17, SW19
Note: SW19 for CAN slope control			



3.9 Key Matrix Block –

2x3 matrix keypads.

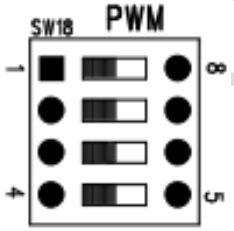
Key pads	PH[4:6]: Row[0:2] PH[8:9]: Col[0:1]	SW26	K[1:6]



3.10 PWM Block –

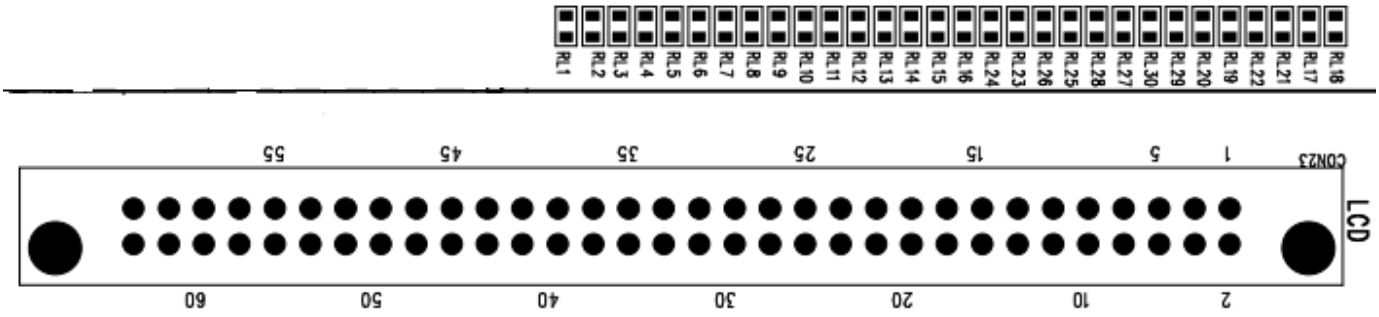
PWM is only reserved with pin header. The LCD backlight could be controlled by the PWM if one of the PWM switch is switched on.

PWM	PH[2:3], PB[2:3]	SW18	CON23



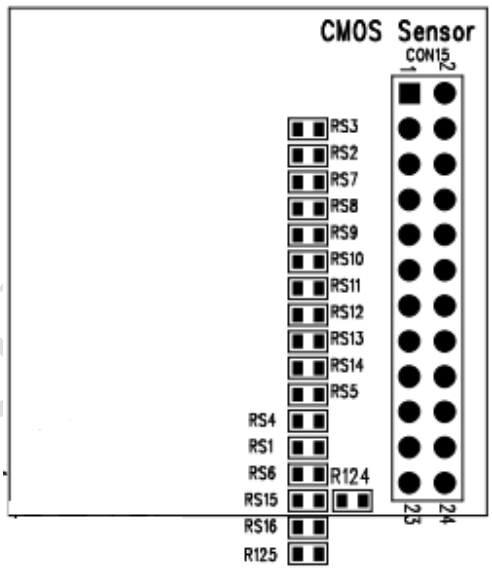
3.11 LCD & Touch ADC Block –

LCD	PA[0:15], PD[8:15], PG[2:3], PG[6:9]	CON23
Touch ADC	ADC4:YM, ADC5: YP, ADC6: XM, ADC7: XP	CON23



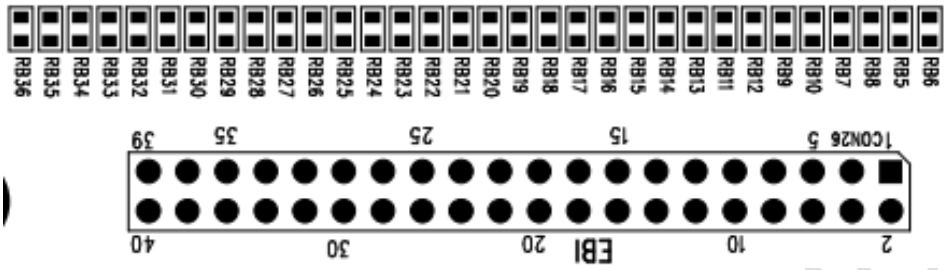
3.12 CMOS Sensor Block –

CMOS Sensor	PI[0:15], PB[0:1]	CON15



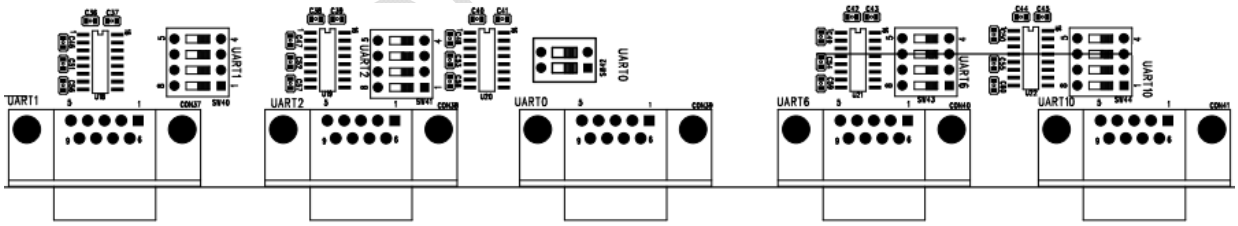
3.13 EBI Block –

EBI	PD[8:15], PH[4:15], PI[0:15]	CON26



3.14 UART Block –

UART1	PE[2:5]	SW40	CON37
UART2	PF[11:14]	SW41	CON38
UART0	PE[0:1]	SW42	CON39
UART6	PB[2:5]	SW43	CON40
UART10	PB[12:15]	SW44	CON41



3.15 Power Setting Block –

CPU will recognize the state as the port setting in power on initial. The system designer has to know which one of the state want to use by oneself. Causing there is a scanning time; these pins are in input mode. If possible, the system designer should prevent to use these pins as input mode in this period. All of the configuration setting is listed as below.

Configure Bit	Configured Function	SW
Cfg[1:0] =	00 : Boot from USB. 01 : Boor from eMMC. 10 : Boot from NANA Flash. 11 : Boot from SPI Flash.	SW31.2, SW31.1
Cfg2 =	0 : System clock is from 12 MHz crystal. 1 : System clock is from UPLL output.	SW31.3
Cfg3 =	0 : WDT is OFF after power-on. 1 : WDT is ON after power-on.	SW31.4
Cfg4 =	0 : Pin PJ[4:0] used as GPIO pin. 1 : Pin PJ[4:0] used as JTAG interface.	SW31.5
Cfg5 =	0 : UART 0 debug message output ON. 1 : UART 0 debug message output OFF	SW35.1
Cfg[7:6] =	00 : NAND Flash page size is 2KB. 01 : NAND Flash page size is 4KB. 10 : NAND Flash page size is 8KB. 11 : Ignore Power-On Setting.	SW35.3, SW35.2
Cfg[9:8] =	00 : NAND Flash ECC type is BCH T12. 01 : NAND Flash ECC type is BCH T15. 10 : NAND Flash ECC type is BCH T24. 11 : Ignore Power-On Setting.	SW35.5, SW35.4

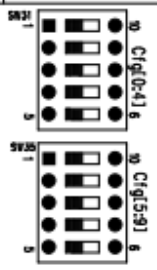
Note: The configured pin should be pulled low with a 10KΩ.

Cfg9	Cfg8	NAND Flash ECC type
ON	ON	BCH T12.
ON	OFF	BCH T15.
OFF	ON	BCH T24.
OFF	OFF	None

Cfg7	Cfg6	NAND Flash Page size
ON	ON	2KB
ON	OFF	4KB
OFF	ON	8KB
OFF	OFF	None

Cfg5	UART Debug Message
ON	Output turn ON.
OFF	Output turn OFF.

Cfg4	Setting PJ[4:0]
ON	As GPIO pin.
OFF	As JTAG interface.



Cfg1	Cfg0	Bootting from
ON	ON	USB.
ON	OFF	eMMC Flash.
OFF	ON	NAND Flash.
OFF	OFF	SPI Flash.

Cfg2	System Clock from
ON	12MHz crystal.
OFF	UPLL output.

Cfg3	Watch Dog Setting
ON	OFF after power on.
OFF	ON after power on.

4 Pin Function assignment

Pin No.	NUC972	1st Function	2nd Function	3rd Function
1	PG.3	LCD BL En		
2	PG.2	LCD En		
3	PG.1	IIC0SDA		
4	PG.0	IIC0SCK		
5	PG.14	IIS LRCk	SMC0 CD	
6	PG.13	IIS BClk	SMC0 PWR	
7	PG.12	IIS Di	SMC0 DAT	
8	PG.11	IIS Do	SMC0 CLK	
9	PG.10	IIS MClk	SMC0 RST	
10	VDD33			
11	VSS			
12	VDD12			
13	MVSS			
14	MVDD			
15	MVSS			
16	MVDD			
17	MVSS			
18	MVDD			
19	MVSS			
20	VDD33			
21	VDD12			
22	PF.14		UR2CTS	
23	PF.13		UR2RTS	
24	PF.12		UR2Rx	
25	PF.11		UR2Tx	
26	PG.9	LCD DEN		
27	PG.8	LCD Vsync		
28	PG.7	LCD Hsync		
29	PG.6	LCD Clk		
30	PD.15	LCD D23		EBI nWait

31	PD.14	LCD D22		EBI nOE
32	PD.13	LCD D21		EBI nWE
33	PD.12	LCD D20		EBI nCS4
34	PD.11	LCD D19		EBI nCS3
35	PD.10	LCD D18		EBI nCS2
36	PD.9	LCD D17		EBI nCS1
37	PD.8	LCD D16		EBI nCS0
38	PA.15	LCD D15		
39	PA.14	LCD D14		
40	PA.13	LCD D13		
41	PA.12	LCD D12		
42	PA.11	LCD D11		
43	PA.10	LCD D10		
44	VDD33			
45	PA.9	LCD D9		
46	PA.8	LCD D8		
47	PA.7	LCD D7		
48	PA.6	LCD D6		
49	PA.5	LCD D5		
50	PA.4	LCD D4		
51	PA.3	LCD D3		
52	PA.2	LCD D2		
53	PA.1	LCD D1		
54	PA.0	LCD D0		
55	ADC0			
56	ADC6			
57	ADC4			
58	AVSS			
59	AVDD			
60	ADC7			
61	ADC5			
62	ADC1			
63	ADC3			

64	ADC2			
65	VREF			
66	RTC_VDD			
67	SYS_PWREn			
68	SYS_nWkUp			
69	X32_IN			
70	X32_OUT			
71	PH.4	Key Row0		EBI Add0
72	PH.5	Key Row1		EBI Add1
73	PH.6	Key Row2		EBI Add2
74	PH.7			EBI Add3
75	PH.8	Key Col0		EBI Add4
76	PH.9	Key Col1		EBI Add5
77	PH.10			EBI Add6
78	PH.11			EBI Add7
79	PH.12			EBI Add8
80	VDD33			
81	VSS			
82	VDD12			
83	PH.13			EBI Add9
84	PH.14	CAN1Rx		EBI nBE0
85	PH.15	CAN1Tx		EBI nBE1
86	PI.0	VCAP PwDn		EBI D0
87	PI.1			EBI D1
88	PI.2			EBI D2
89	PI.3	VCAP SCLKo		EBI D3
90	PI.4	VCAP SPCLK		EBI D4
91	PI.5	VCAP SHsync		EBI D5
92	PI.6	VCAP SVsync		EBI D6
93	PI.7	VCAP SField		EBI D7
94	PI.8	VCAP SD0		EBI D8
95	PI.9	VCAP SD1		EBI D9
96	PI.10	VCAP SD2		EBI D10

97	PI.11	VCAP SD3		EBI D11
98	PI.12	VCAP SD4		EBI D12
99	PI.13	VCAP SD5		EBI D13
100	PI.14	VCAP SD6		EBI D14
101	PI.15	VCAP SD7		EBI D15
102	VDD12			
103	VSS			
104	VDD33			
105	PB.0	IIC1SCK		
106	PB.1	IIC1SDA		
107	PB.2		UR6Tx	PWM0
108	PB.3		UR6Rx	PWM1
109	PB.4		UR6RTS	
110	PB.5		UR6CTS	
111	PB.6	SPI0 CS0		
112	PB.7	SPI0 CLK		
113	PB.8	SPI0 DoD0		
114	PB.9	SPI0 DiD1		
115	PB.10	SPI0 D2		
116	PB.11	SPI0 D3		
117	PB.12		UR10Tx	
118	PB.13		UR10Rx	
119	PB.14		UR10RTS	
120	PB.15		UR10CTS	
121	PG.4			
122	PG.5			
123	PC.0	ND0	eMMC D0	
124	PC.1	ND1	eMMC D1	
125	PC.2	ND2	eMMC D2	
126	PC.3	ND3	eMMC D3	
127	PC.4	ND4	eMMC CMD	
128	PC.5	ND5	eMMC CLK	
129	PC.6	ND6		

130	PC.7	ND7		
131	PC.8	NCS0		
132	PC.9	NALE		
133	PC.10	NCLE		
134	PC.11	NWE		
135	PC.12	NRE		
136	PC.13	NRDY0		
137	PC.14	NWP		
138	PJ.3			TDO
139	PJ.0			TCK
140	PJ.1			TMS
141	PJ.2			TDI
142	PJ.4			nTRST
143	nRESET			
144	VDD33			
145	VSS			
146	VDD12			
147	MVSS			
148	MVDD			
149	MVSS			
150	MVDD			
151	MVSS			
152	MVDD			
153	VSS			
154	VDD33			
155	PD.0	SD0 CMD		
156	PD.1	SD0 CLK		
157	PD.2	SD0 D0		
158	PD.3	SD0 D1		
159	PD.4	SD0 D2		
160	PD.5	SD0 D3		
161	PD.6	SD0 CD		
162	PD.7	SD0 PWR		

163	VDD12			
164	PLL_VDD12			
165	PLL_VSS			
166	VDD12			
167	PH.3		CAN0Tx	PWM3
168	PH.2		CAN0Rx	PWM2
169	PE.13			
170	PE.12	I2S CS		
171	PE.11			
172	PE.10			
173	PE.9			
174	PE.8			
175	PE.7			
176	PE.6			
177	PE.5			UR1CTS
178	PE.4			UR1RTS
179	PE.3			UR1Rx
180	PE.2			UR1Tx
181	PE.1			UR0Rx
182	PE.0			UR0Tx
183	VDD33			
184	MainXi			
185	MainXo			
186	VSS			
187	PF.9	RMII0 RxErr		
188	PF.8	RMII0 CRSDV		
189	PF.7	RMII0 RxD1		
190	PF.6	RMII0 RxD0		
191	PF.5	RMII0 RefCLK		
192	PF.4	RMII0 TxEn		
193	PF.3	RMII0 TxD1		
194	PF.2	RMII0 TxD0		
195	PF.1	RMII0 MDio		

196	PF.0	RMII0 MDC		
197	PH.1	USB0 OC		
198	PH.0	USB0 VbusDet		
199	PF.10	USB0 PWREn		
200	PE.15	USB1 PWREn		
201	PE.14	USB0 PWREn		
202	VSS			
203	VDD12			
204	USBPll1 VDD			
205	USB1 VSS			
206	USB1 DM	Host DM		
207	USB1 DP	Host DP		
208	USB1 VDD			
209	USB1 REXT	12.1K		
210	USBPll0 VDD			
211	USB0 VSS			
212	USB0 DM	OTG DM		
213	USB0 DP	OTG DP		
214	USB0 VDD			
215	USB0 REXT	12.1K		
216	USB0 ID	OTG ID		

5 Document Revision History

Date	Revision	Remarks
09/10/2014	A1.0	Release version A1.0.
11/27/2015	A2.0	For NHS-972-1-CY-1M54 Board

Important Notice

NuvoTon products are not designed, intended, authorized or warranted for use as components in systems or equipment intended for surgical implantation, atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, or for other applications intended to support or sustain life. Furthermore, NuvoTon products are not intended for applications wherein failure of NuvoTon products could result or lead to a situation wherein personal injury, death or severe property or environmental damage could occur.

NuvoTon customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify NuvoTon for any damages resulting from such improper use or sales.

6 Schematics

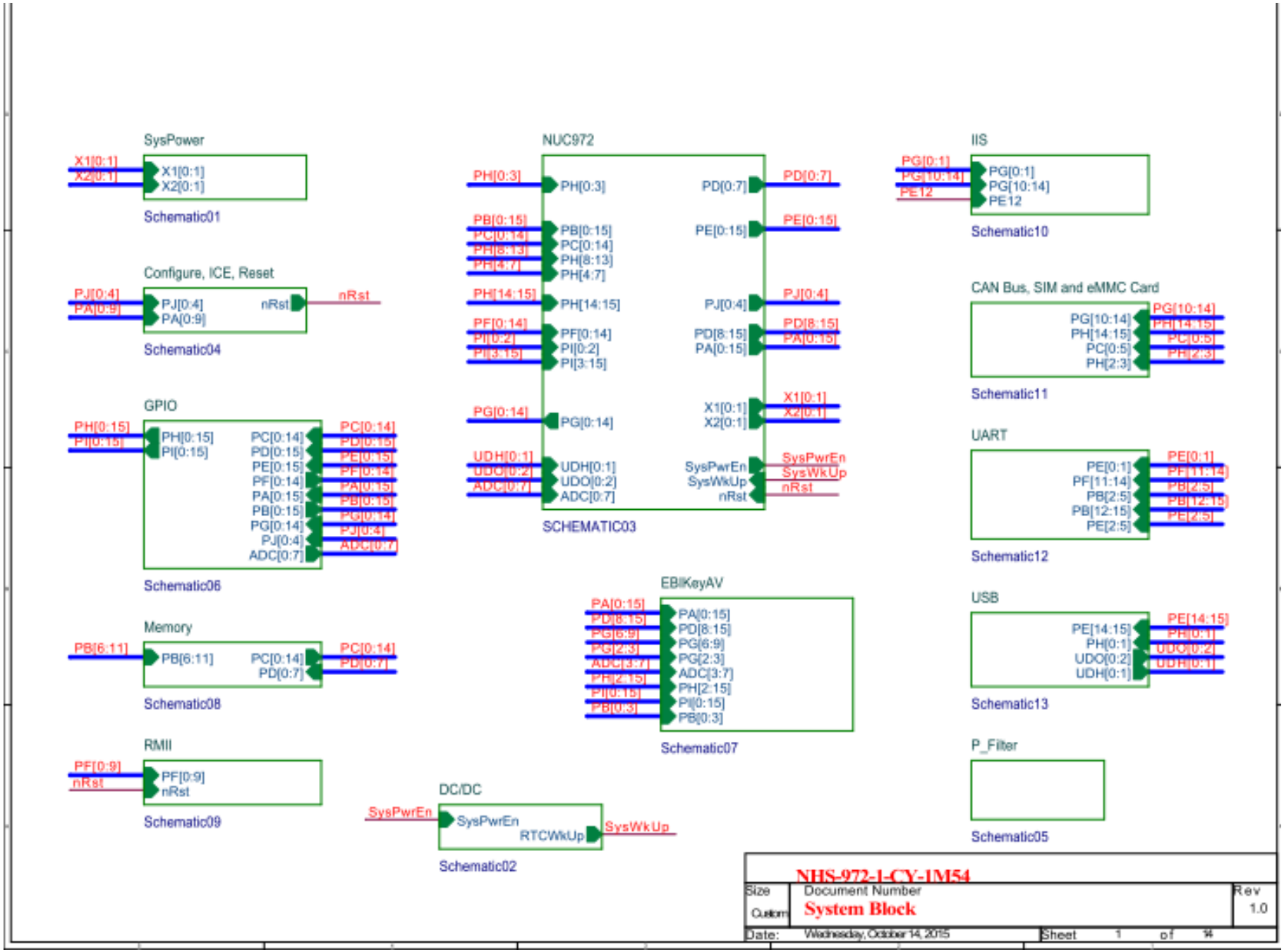


Figure 6-1Block Diagram

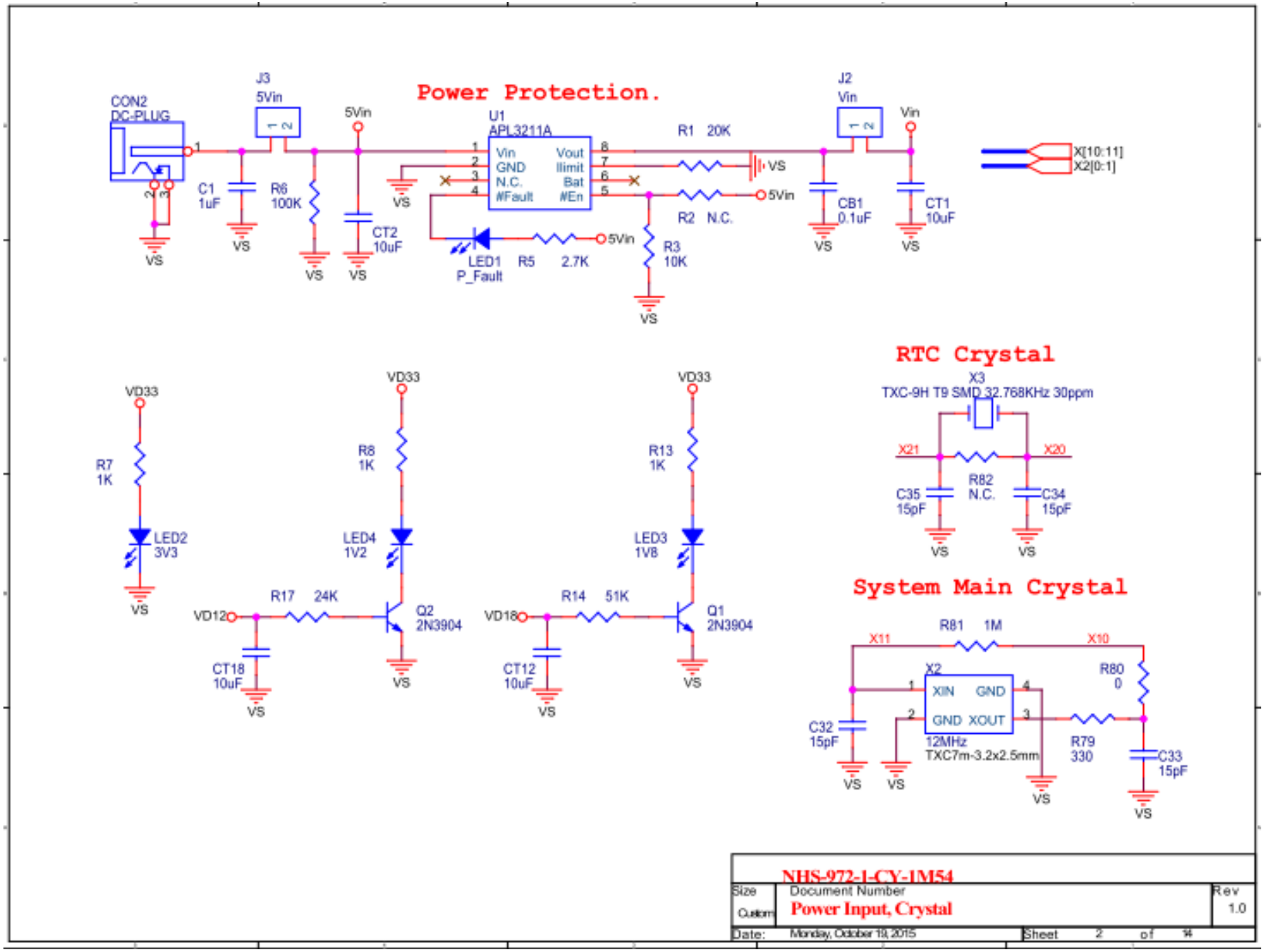


Figure 6-2 System Power

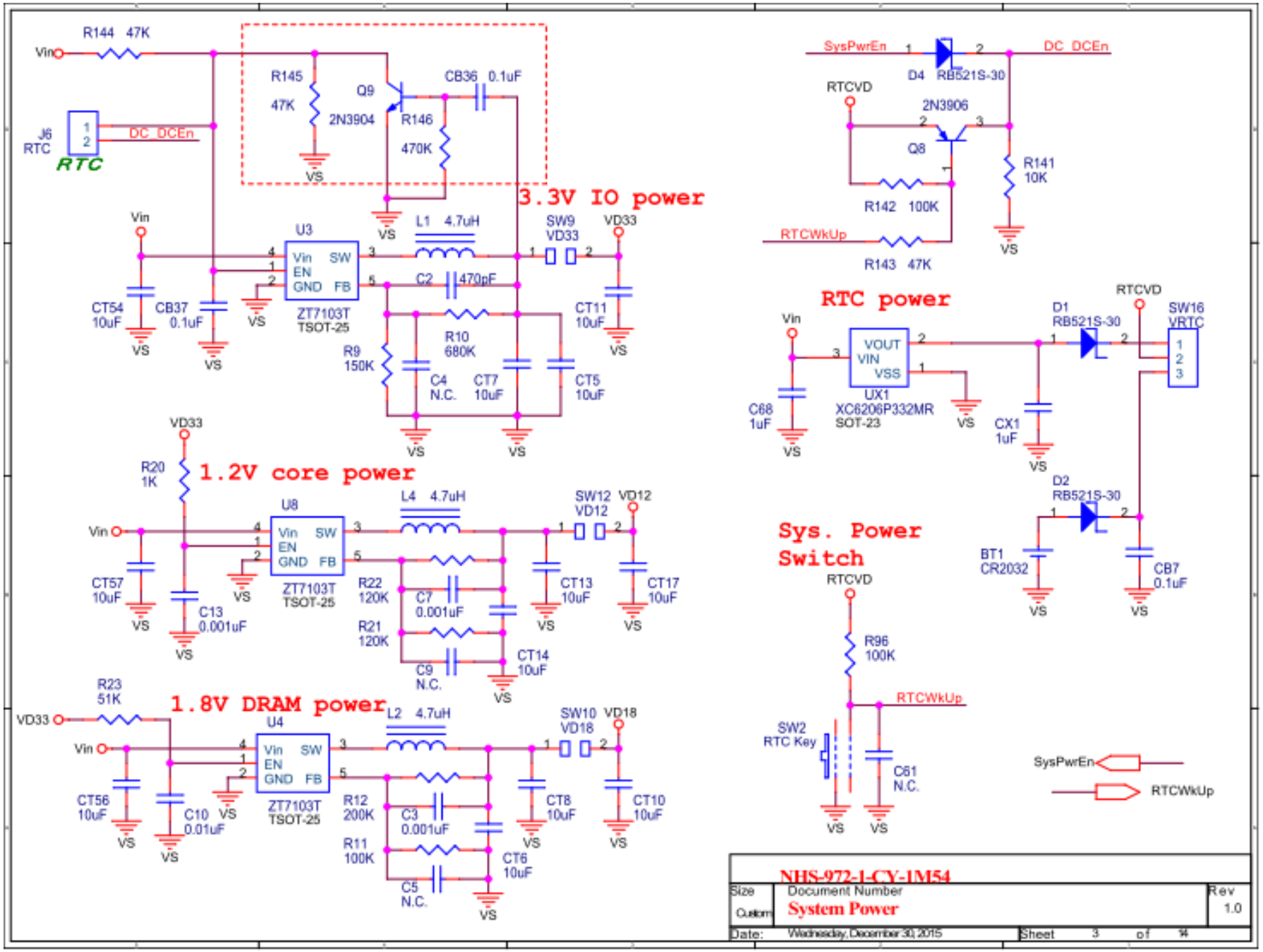


Figure 6-3 DC/DC

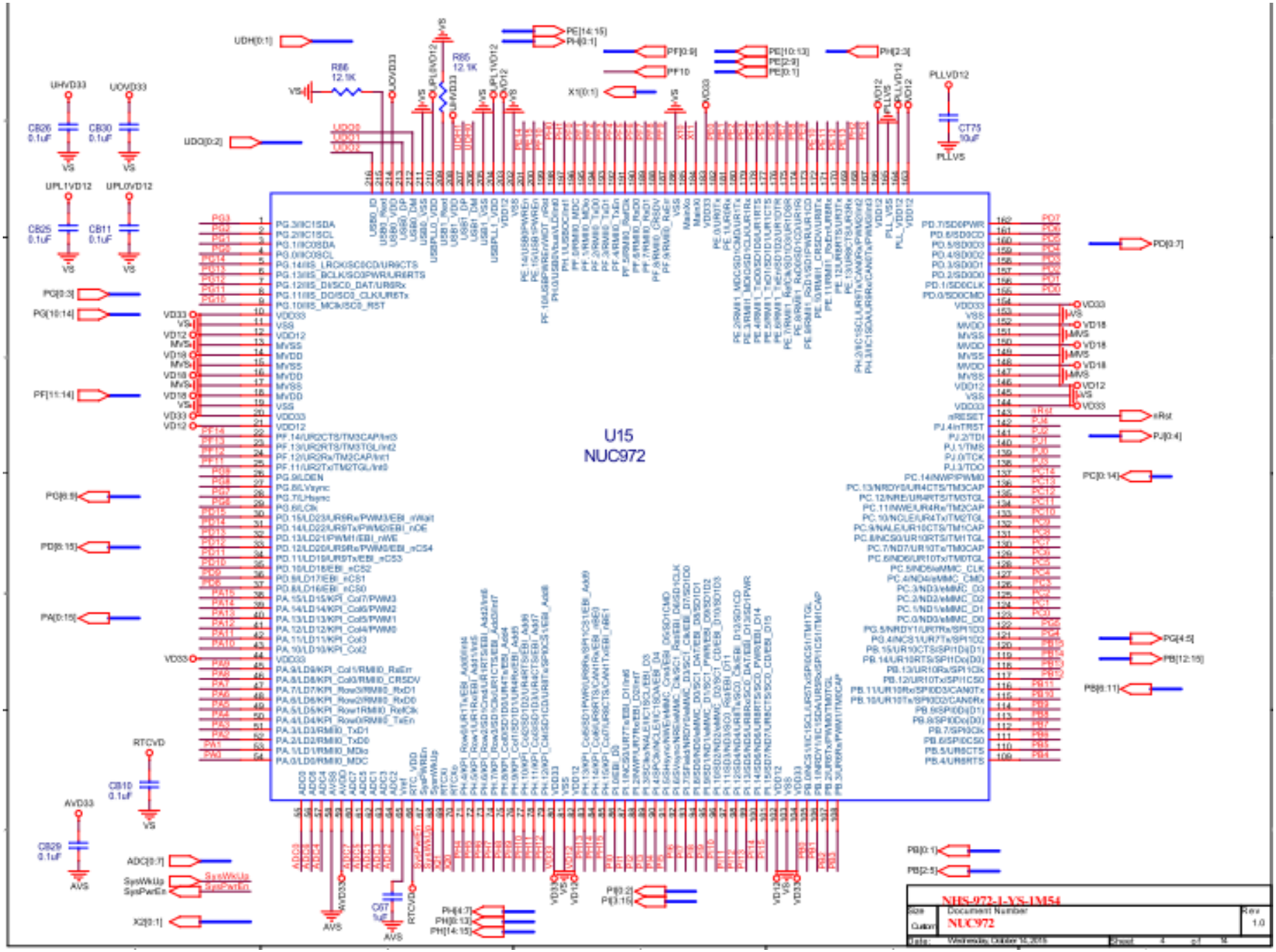


Figure 6-4 NUC972

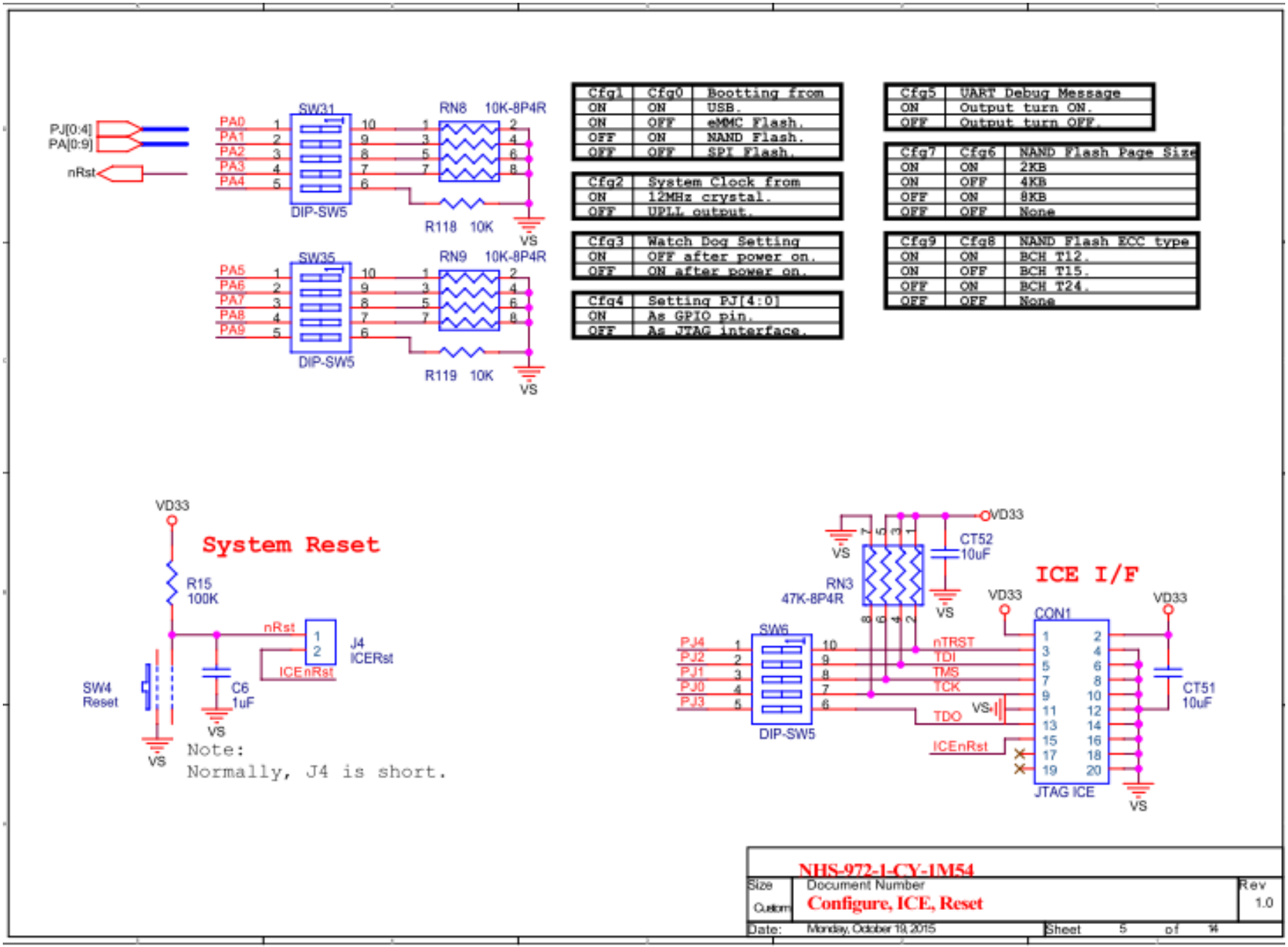


Figure 6-5 Configure, ICE Reset

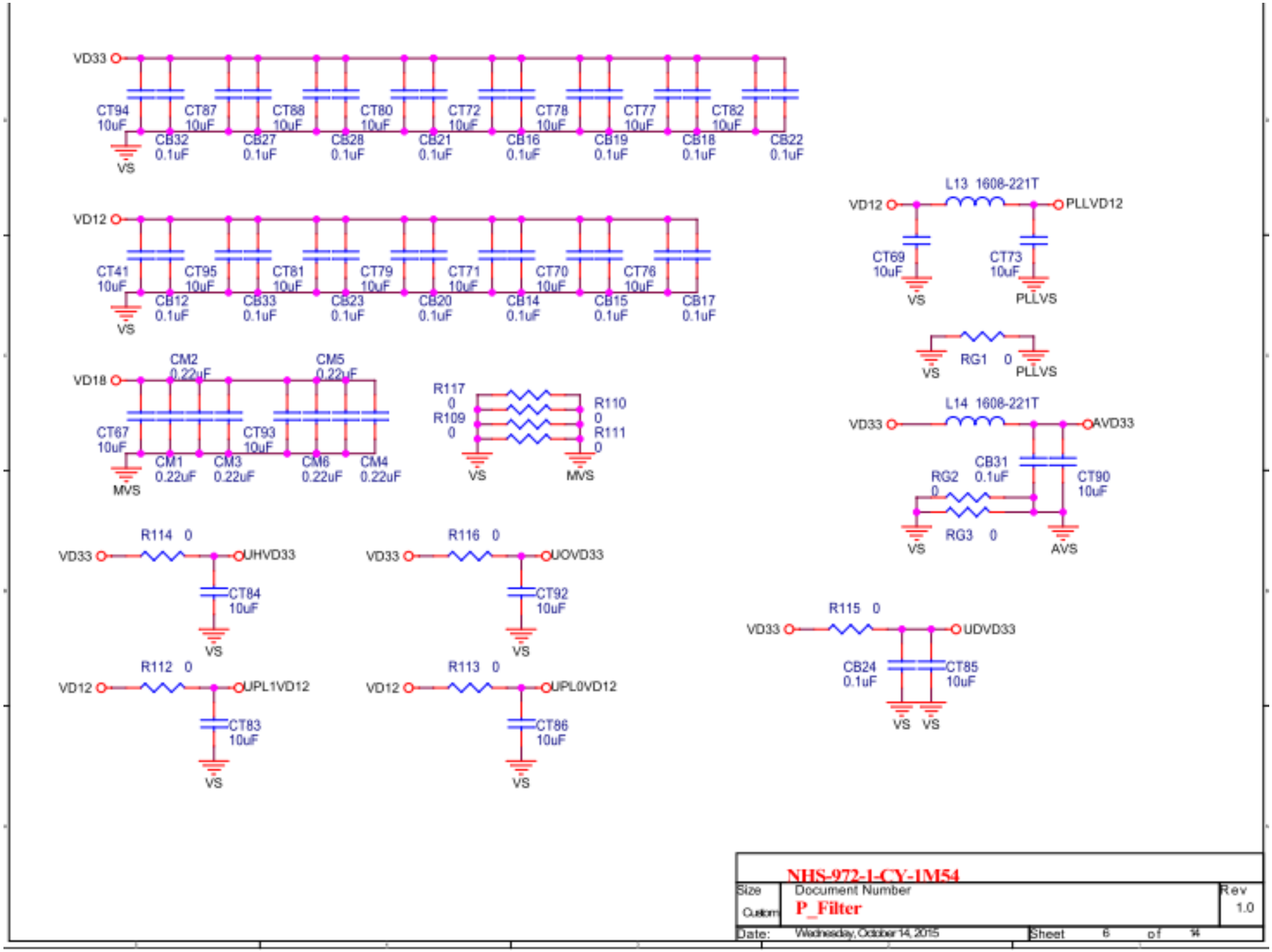


Figure 6-6 P_Filter

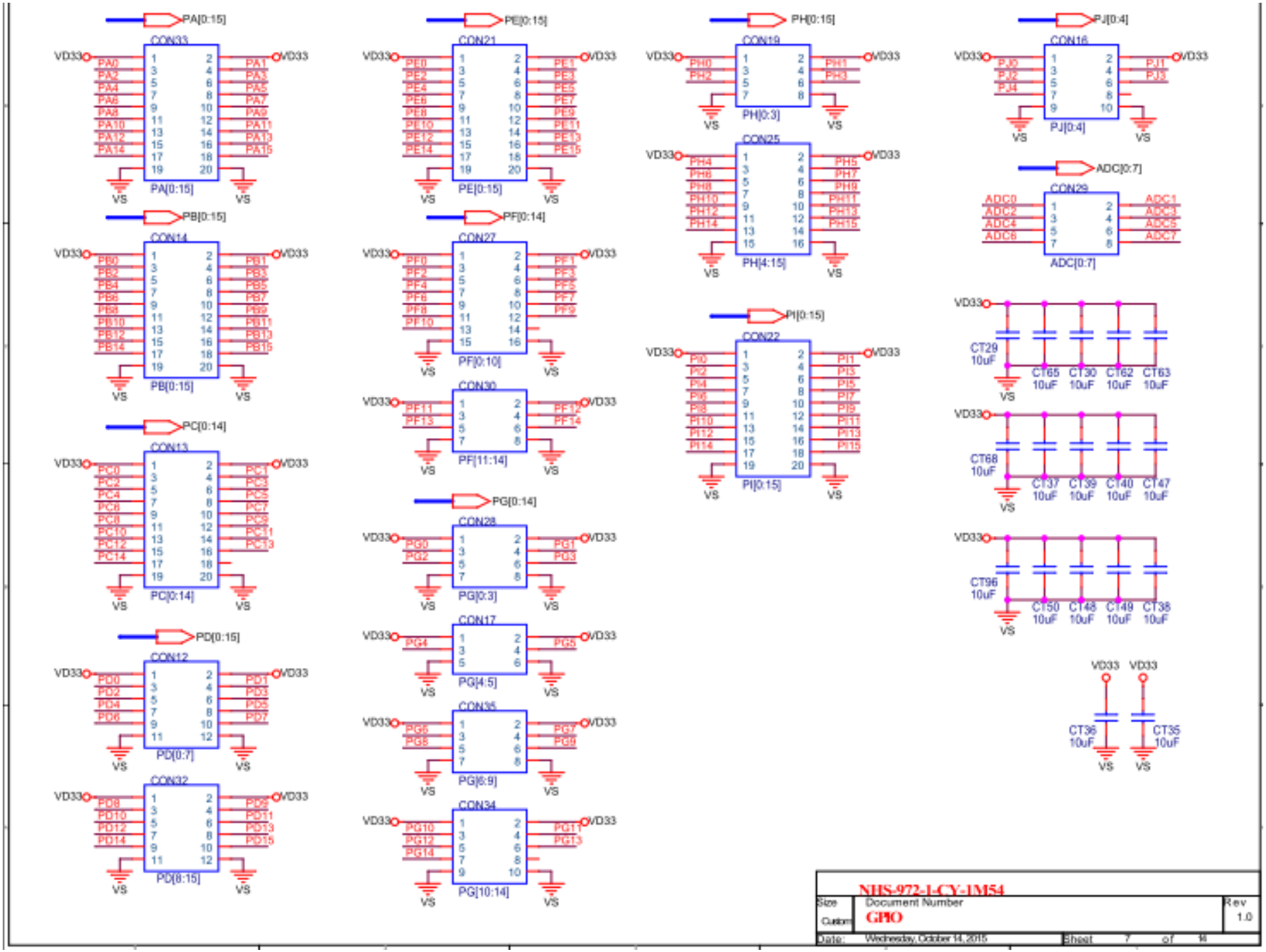


Figure 6-7 GPIO

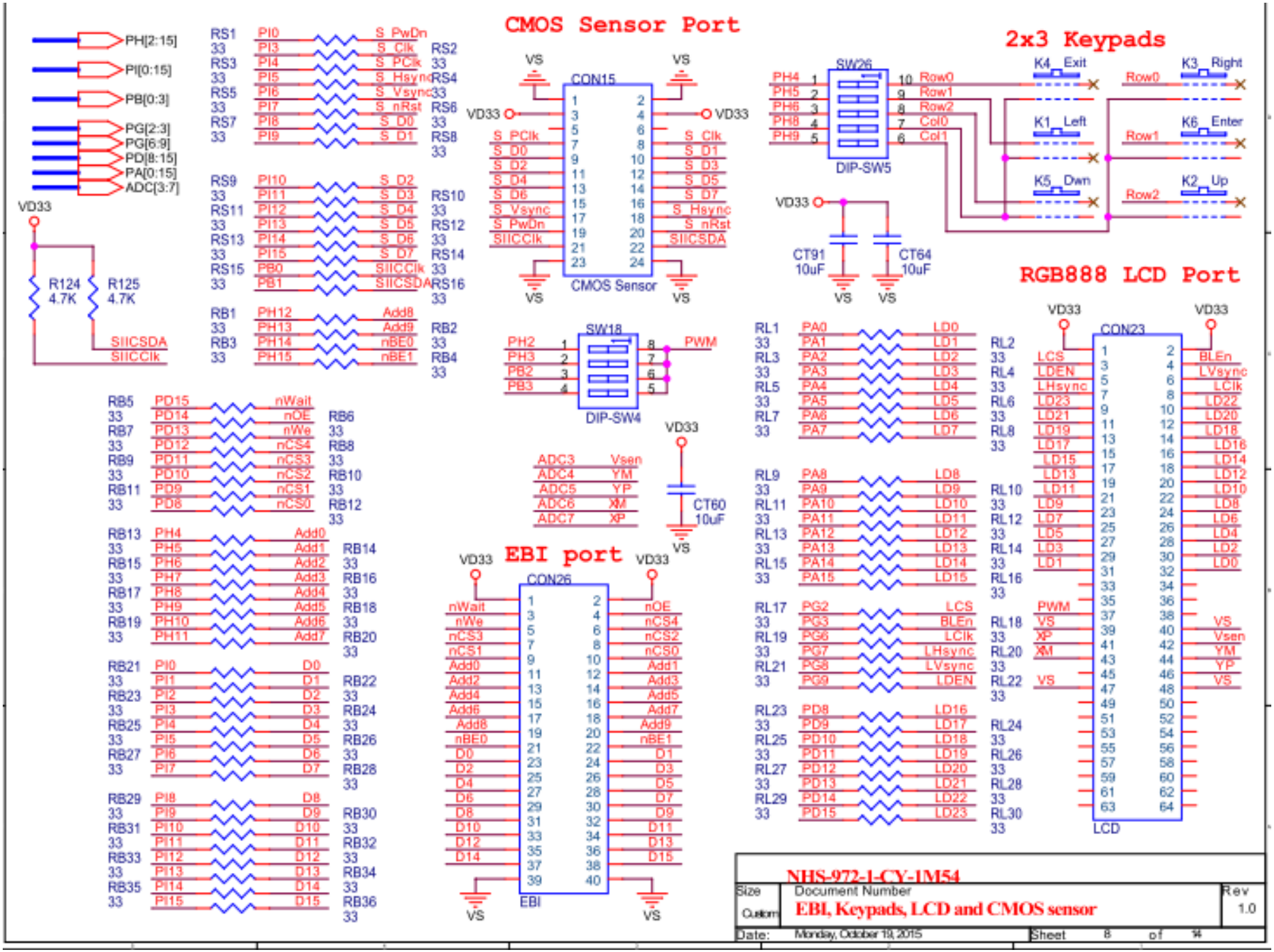


Figure 6-8 EBI, Keys, AV

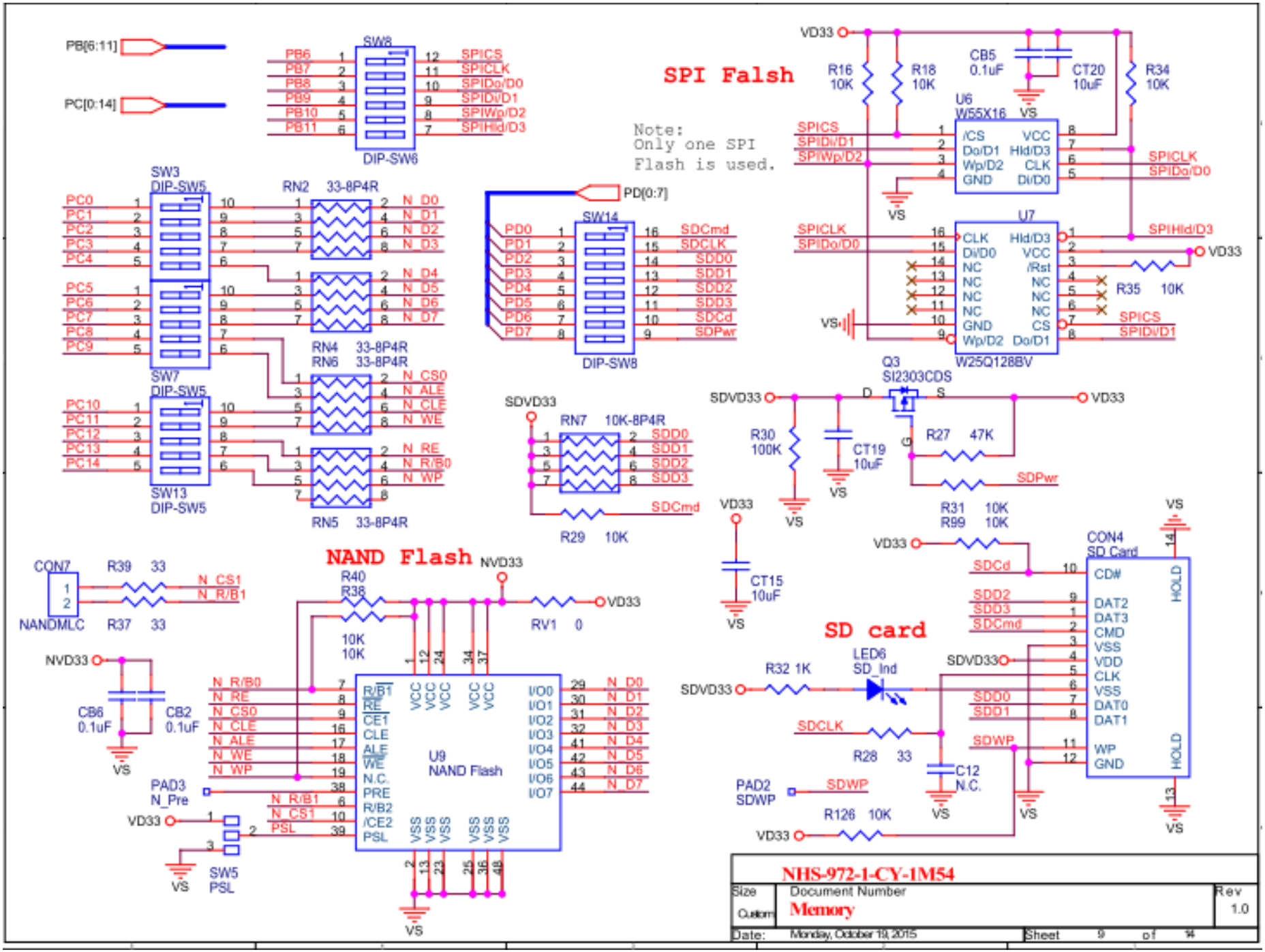


Figure 6-9 Memory

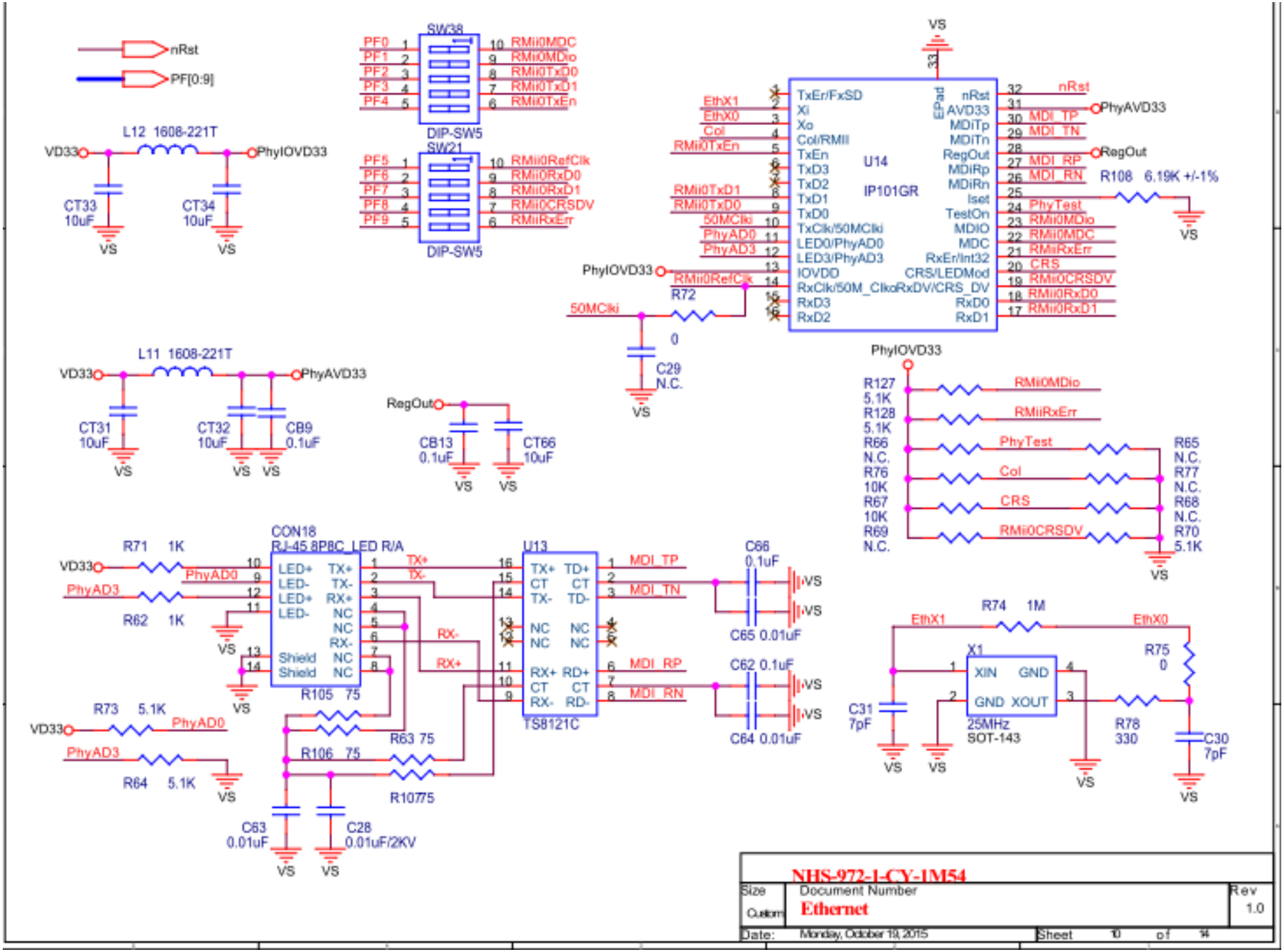


Figure 6-10 RMII

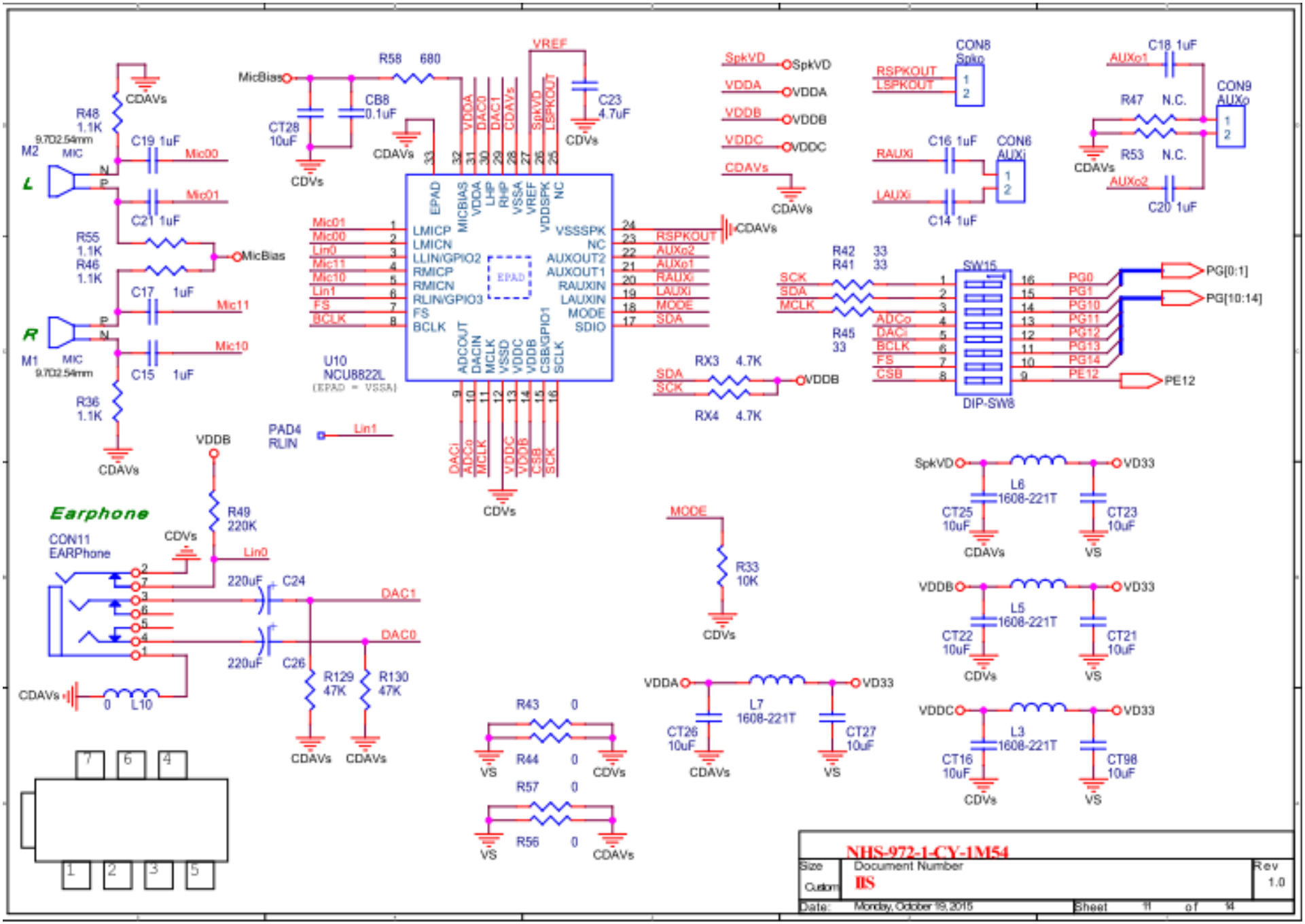


Figure 6-11 IIS

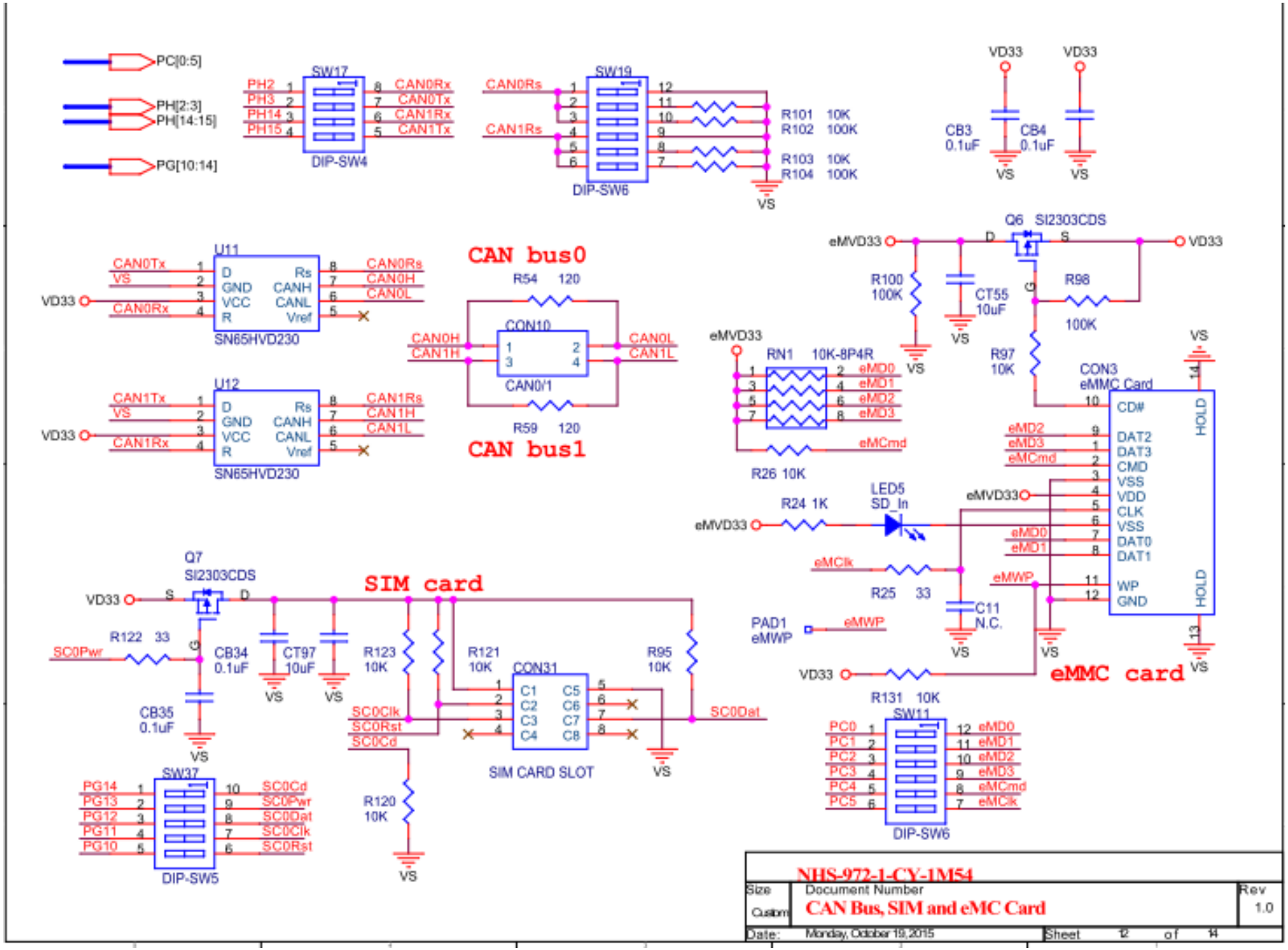


Figure 6-12 CAN Bus, SIM card and eMMC

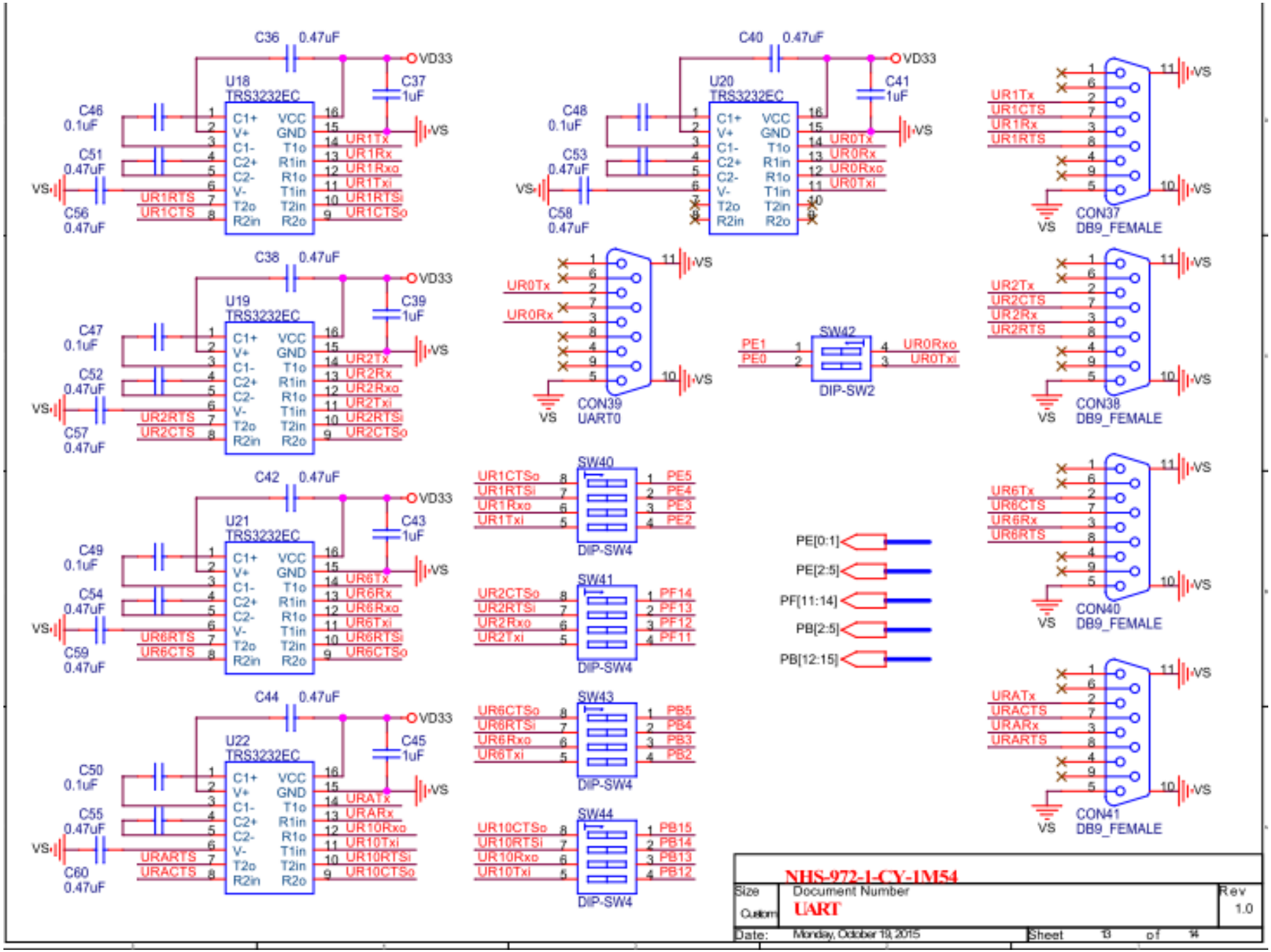


Figure 6-13 UART

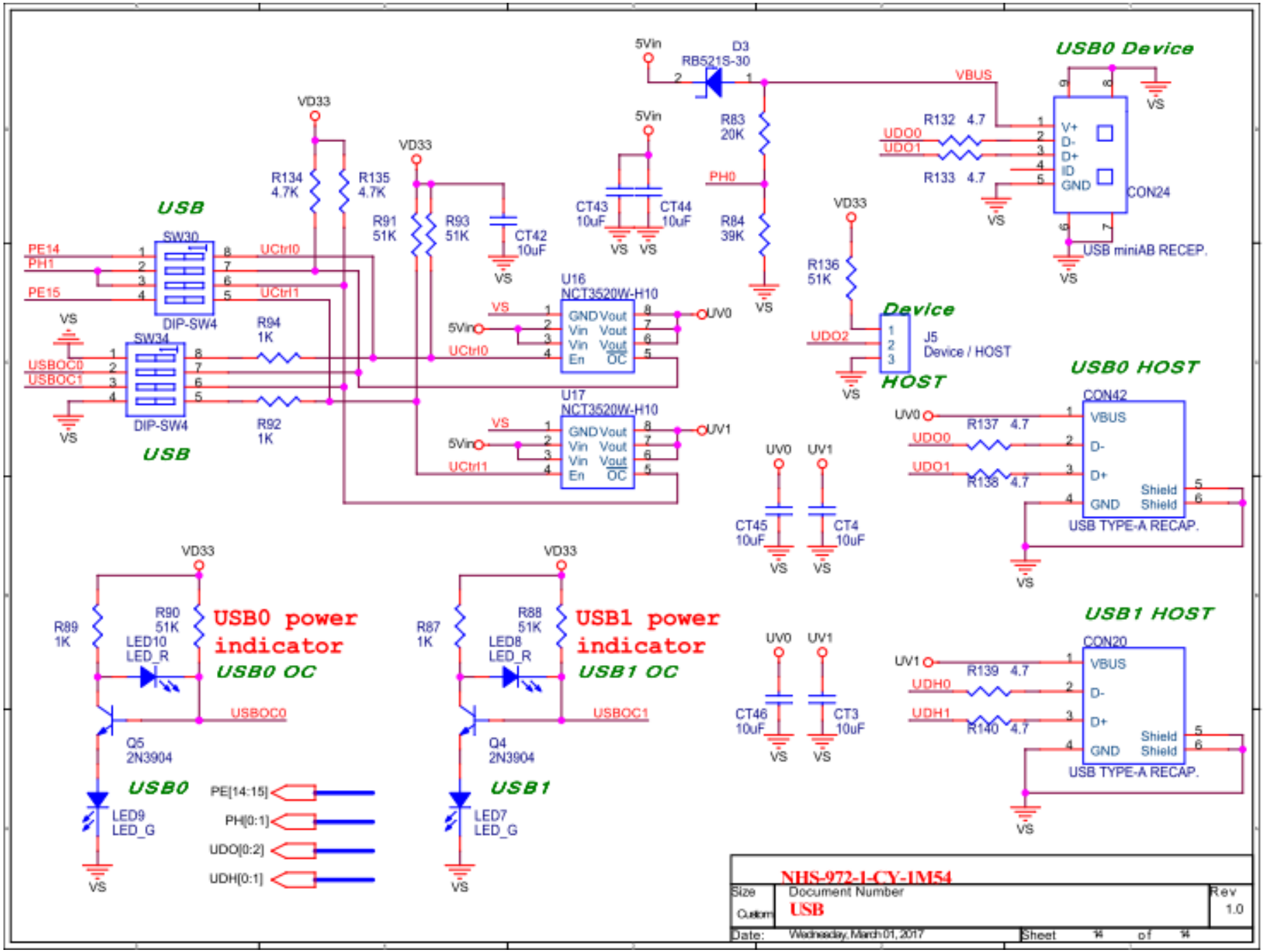


Figure 6-14 USB