Queercon

~~2018~~ 1983

Badge Documentation

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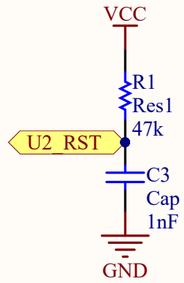
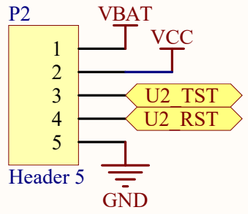
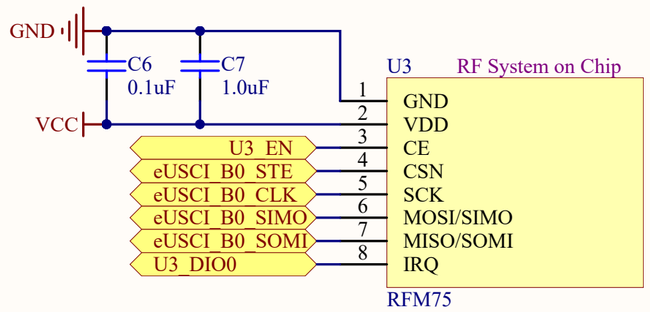
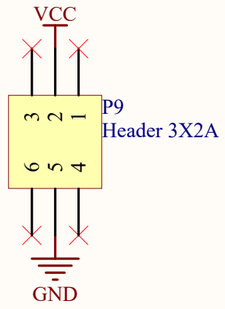
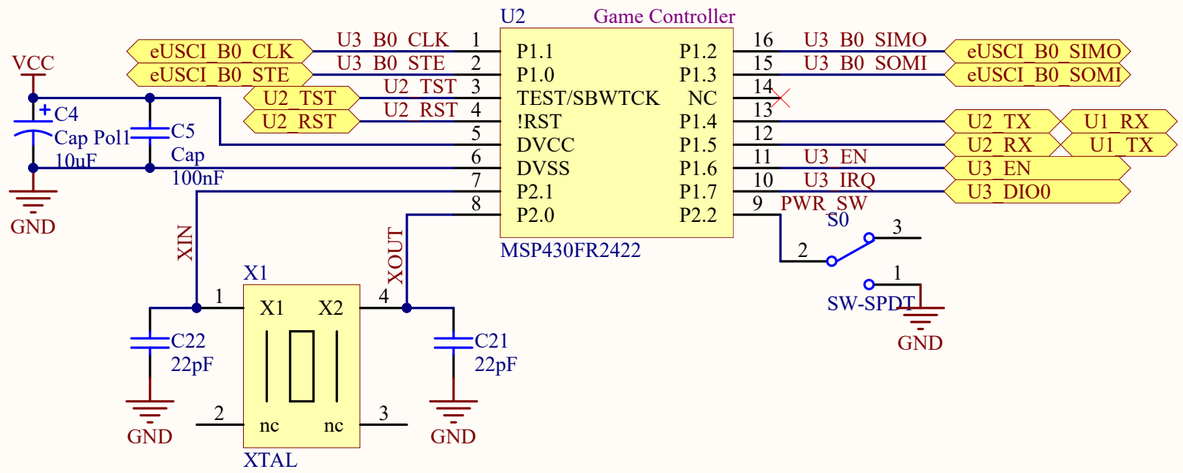


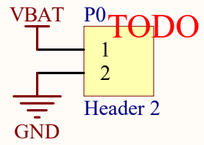


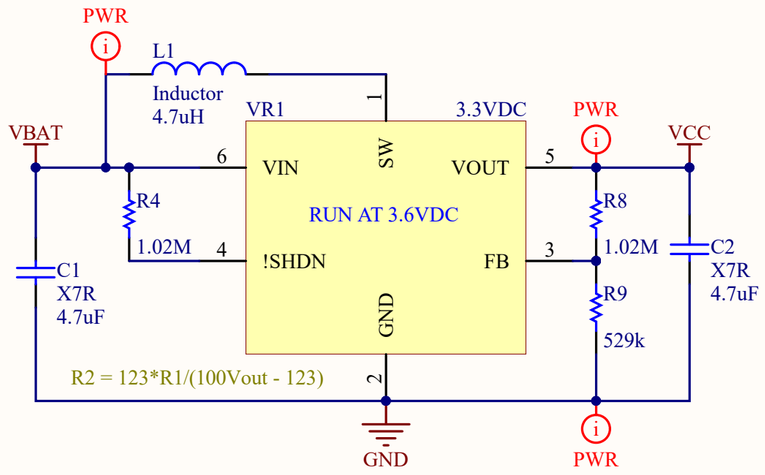


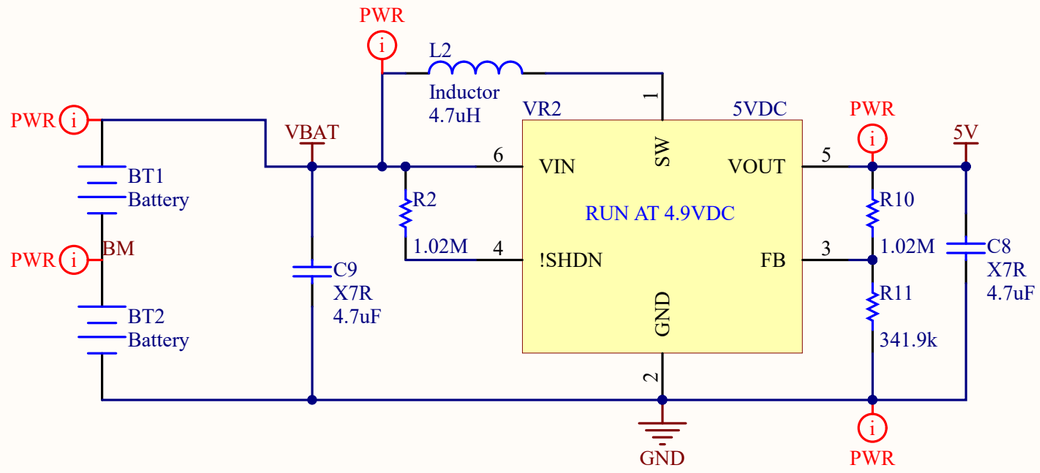


Shitty Add-on port









BOM is document of record on all part numbers and values

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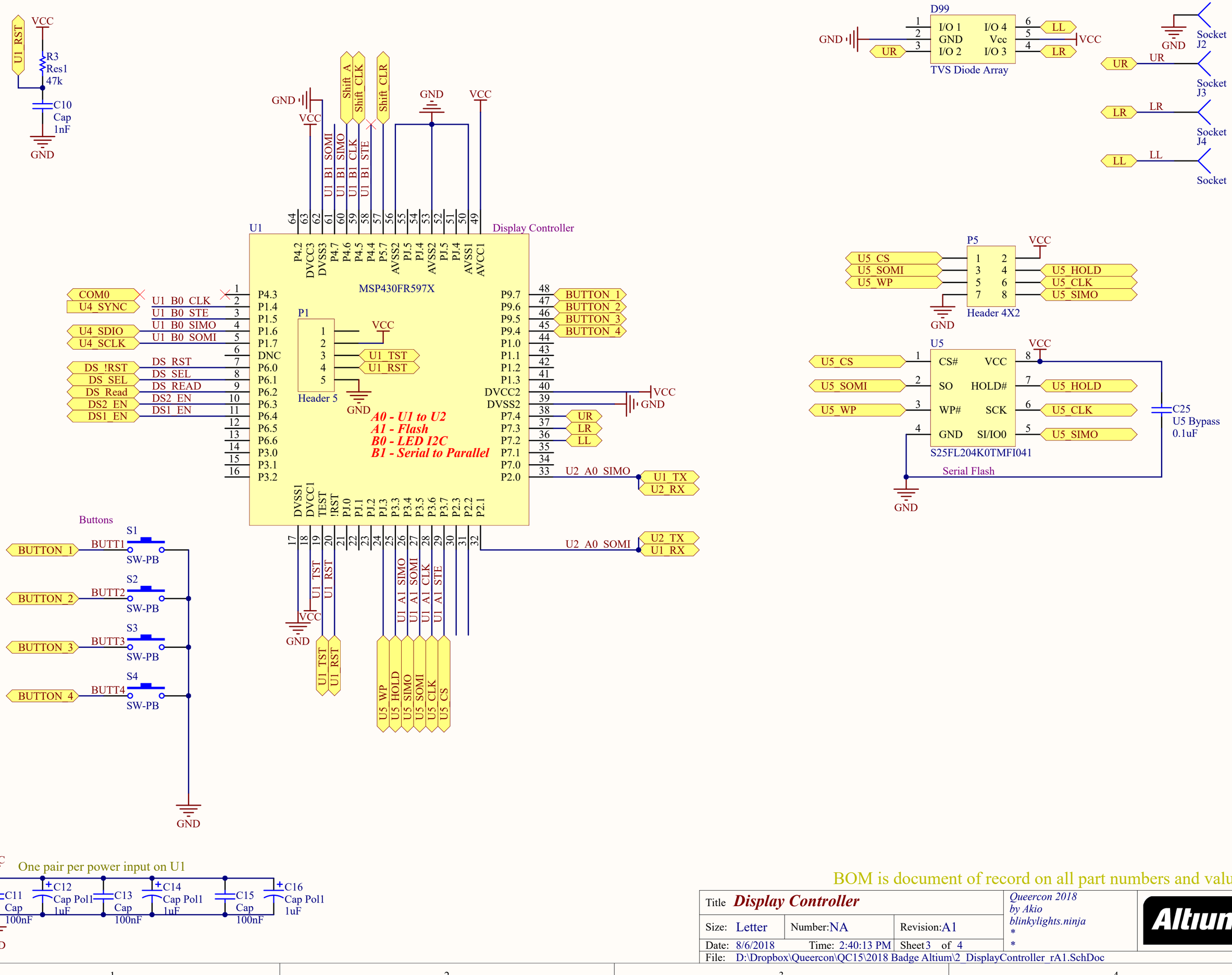
File: D:\Dropbox\Queercon\QC15\2018 Badge Altium\1_MainController_rB0.SchDoc			

Altium


U1_RST
VCC
R3
Res1
47k
C10
Cap
1nF
GND
D99
I/O 1
GND
I/O 2
I/O 4
Vcc
I/O 3
TVS Diode Array
J1
Socket
J2
J3
J4
Shift_A
Shift_CLK
Shift_CLR
U1_B1_SOMI
U1_B1_SIMO
U1_B1_CLK
U1_B1_STE
U1
Display Controller
MSP430FR597X
P4.2
DVCC3
DVSS3
P4.7
P4.6
P4.5
P4.4
P5.7
AVSS2
PJ.5
PJ.4
AVSS2
PJ.5
PJ.4
AVSS1
AVCC1
COM0
U4_SYNC
U1_B0_CLK
U1_B0_STE
U1_B0_SIMO
U1_B0_SOMI
U4_SDIO
U4_SCLK
DS_!RST
DS_SEL
DS_READ
DS2_EN
DS1_EN
DS_RST
DS_SEL
DS_Read
DS2_EN
DS1_EN
P4.3
P1.4
P1.5
P1.6
P1.7
DNC
P6.0
P6.1
P6.2
P6.3
P6.4
P6.5
P6.6
P3.0
P3.1
P3.2
P1
Header 5
U1_TST
U1_RST
A0 - U1 to U2
A1 - Flash
B0 - LED I2C
B1 - Serial to Parallel
P9.7
P9.6
P9.5
P9.4
P1.0
P1.1
P1.2
P1.3
DVCC2
DVSS2
P7.4
P7.3
P7.2
P7.1
P7.0
P2.0
BUTTON_1
BUTTON_2
BUTTON_3
BUTTON_4
UR
LR
LL
U2_A0_SIMO
U2_A0_SOMI
U1_TX
U2_RX
U2_TX
U1_RX
DVSS1
DVCC1
TEST
!RST
PJ.0
PJ.1
PJ.2
PJ.3
P3.3
P3.4
P3.5
P3.6
P3.7
P2.3
P2.2
P2.1
U1_A1_SIMO
U1_A1_SOMI
U1_A1_CLK
U1_A1_STE
U5_WP
U5_HOLD
U5_SIMO
U5_SOMI
U5_CLK
U5_CS
P5
Header 4X2
U5
CS#
SO
WP#
GND
VCC
HOLD#
SCK
SI/IO0
S25FL204K0TMFI041
Serial Flash
C25
U5 Bypass
0.1uF
Buttons
S1
S2
S3
S4
BUTT1
BUTT2
BUTT3
BUTT4
SW-PB
One pair per power input on U1
C11
C12
C13
C14
C15
C16
Cap
Cap Pol1
100nF
1uF
BOM is document of record on all part numbers and values
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Sheet 3 of 4
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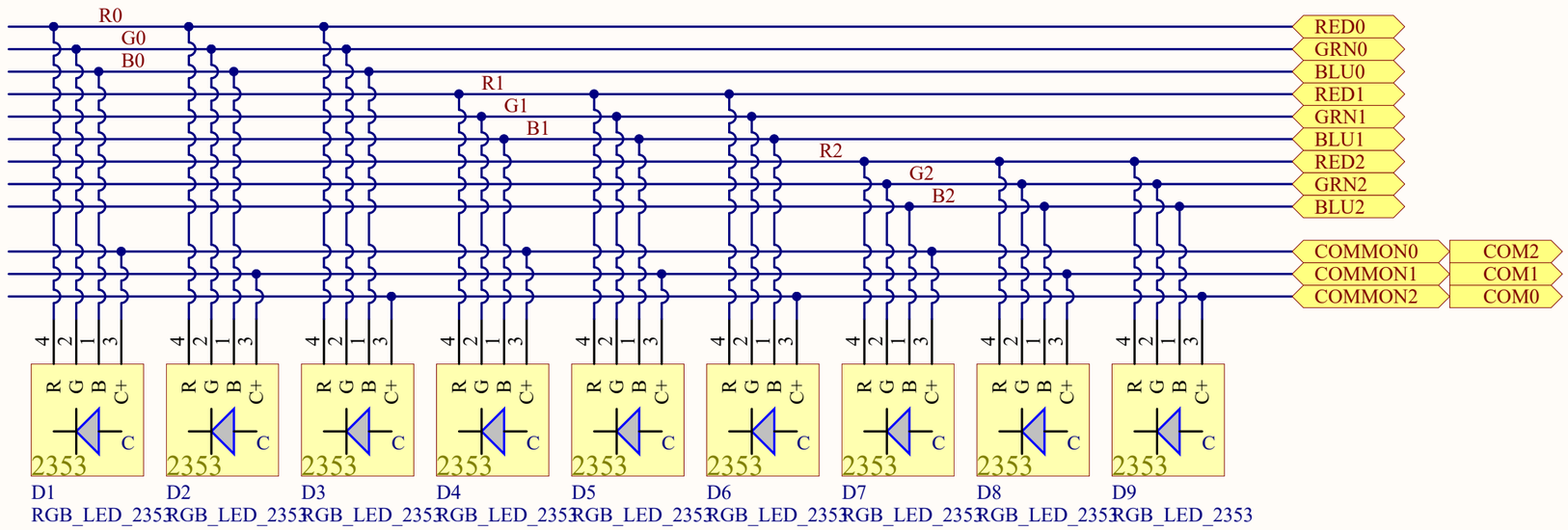
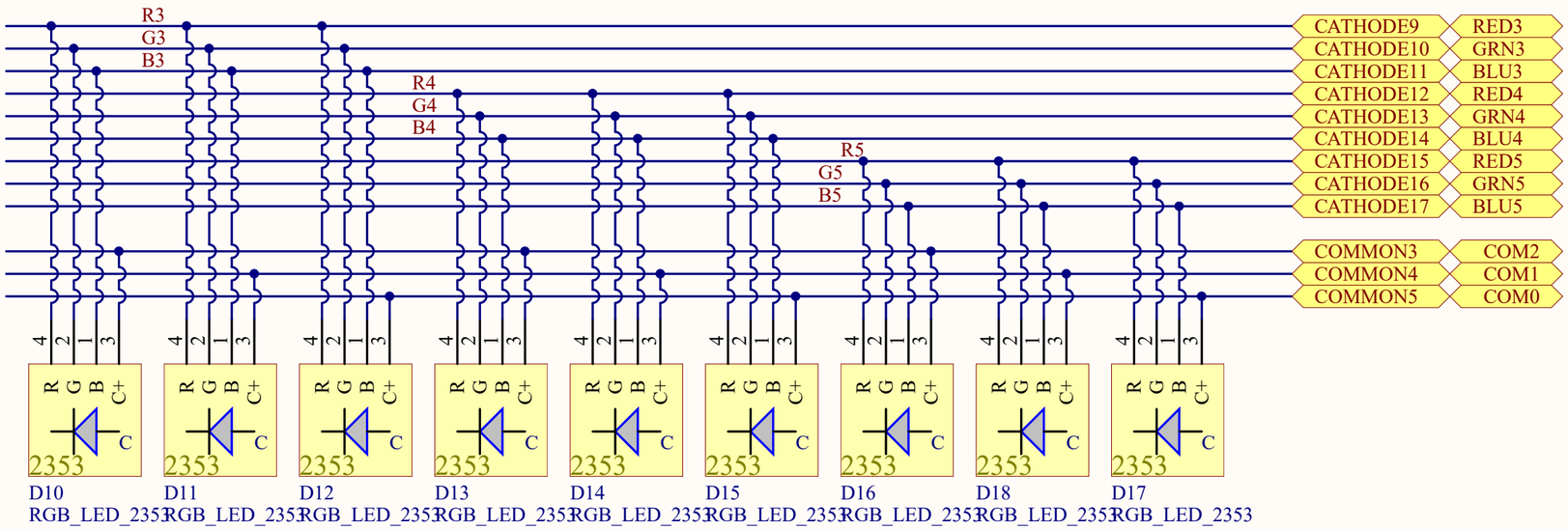
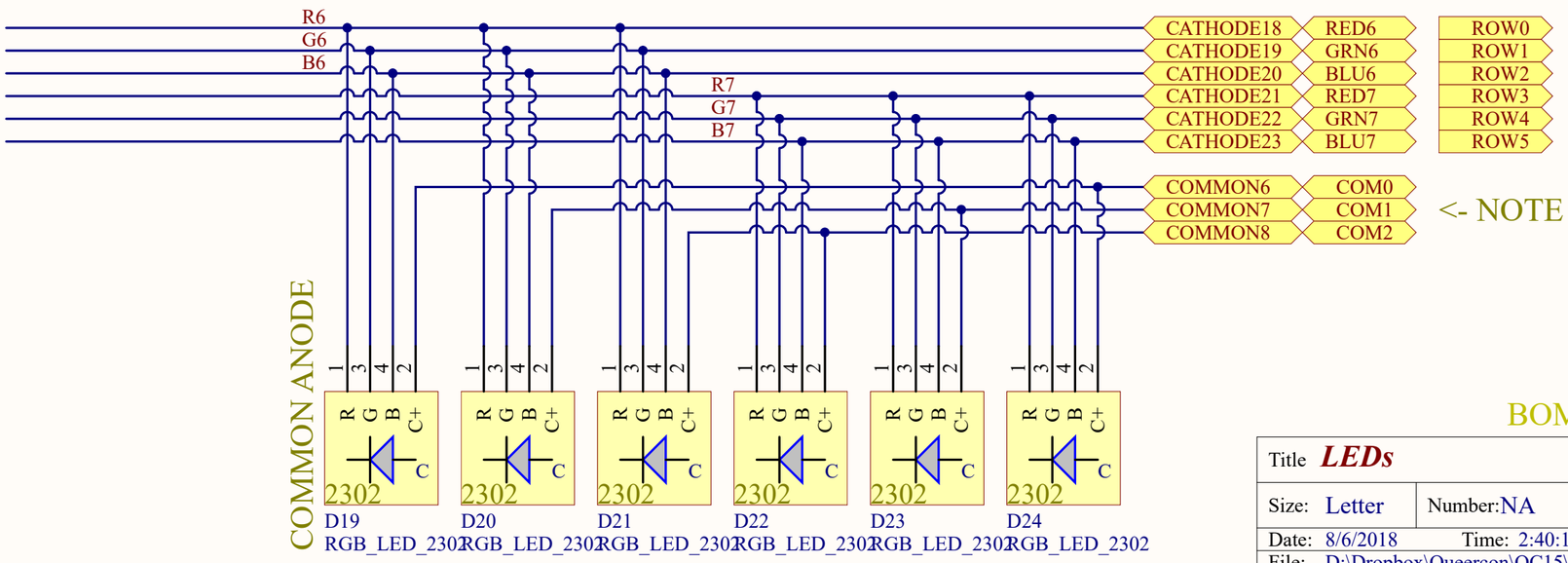
by Akio
blinkylights.ninja
Altium



COMMON ANODE (+)



D19 - D24 are bettween Display LEDs, all else edge COMMON ANODE



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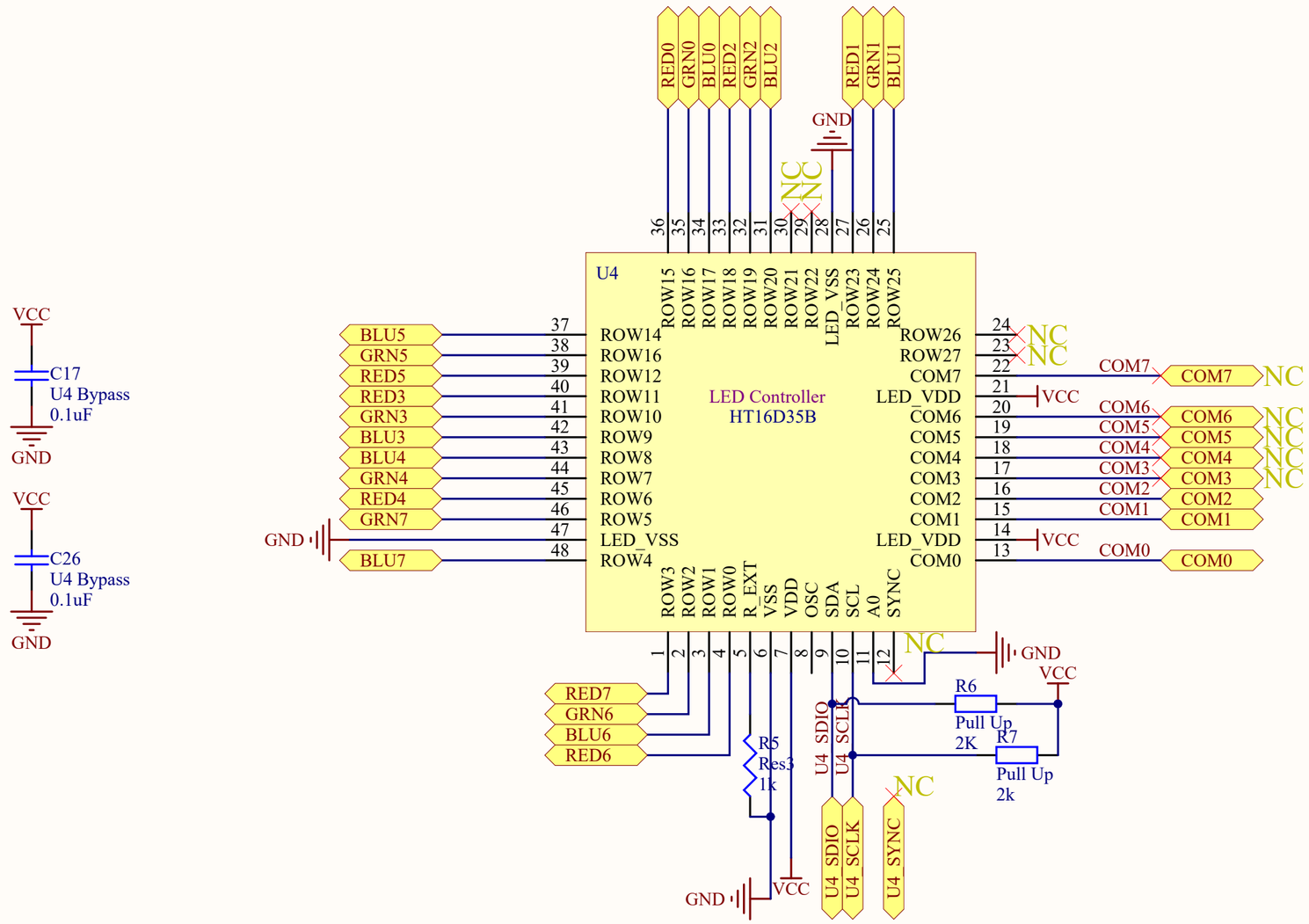

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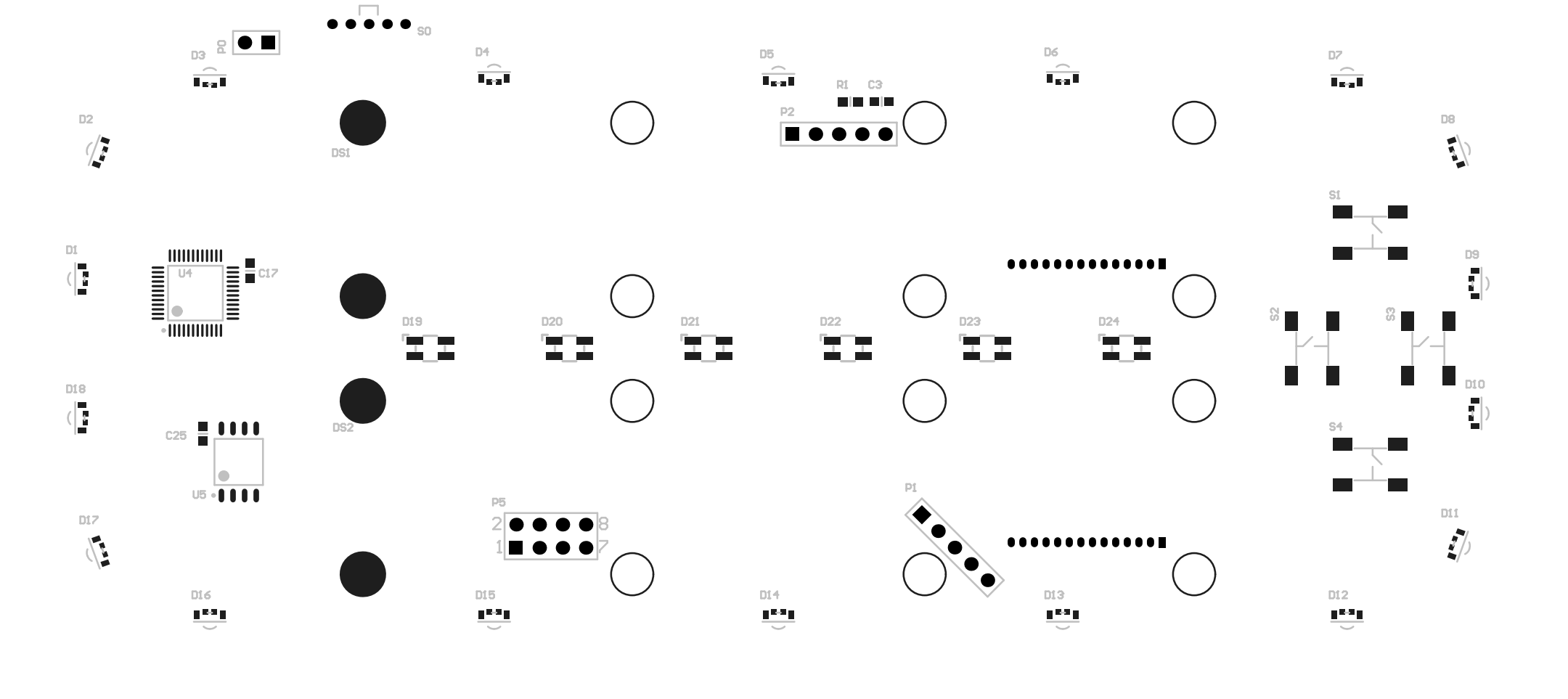
File: D:\Dropbox\Queercon\QC15\2018 Badge Altium\4_Displays_rA1.SchDoc			

QC2018 Main Badge BOM - rB4									
#	**Designator**	**Name**	**Spec**	**Manufacturer**	**PN**	**Footprint**	**Pads**	**THs**	**QTY**
1	BT1, BT2	Battery holder	Battery holder AA	Keystone	2460	TH	0	2	2
2	C1, C2, C9, C8	Pwr caps	4.7uF, X7R	Samsung	CL10B475KQ8NQNC	0603	2		4
3	C12, C14, C16, C7	Bypass	1uF, POL	Samsung	CL10B105KP8NNNC	0603	2		4
4	C21, C22	Xtal Caps	22pF, 1%x 16V	KEMET	C0603C220K3GACTU	0603	2		2
5	C3, C10	Reset Cap	1nF (1000 pF)	Vishay	VJ0603Y102JXQCW1BC	0603	2		2
6	C4	Bypass	10uF, Pol	Murata	GRM188C80G106ME47D	0603	2		1
7	C5, C11, C13, C15, C6, C25, C26, C27, C28, C29, C17	Bypass	100nF / 0.1u	Samsung	CL10F104ZO8NNNC	0603	2		11
8	D1 - D18	Side View LED	1204 Side View	Harvatek	HQ12-2353RGBC	1204	4		18
9	D19 - D24	RGB	0603 Top View 20mA	Harvatek	HQ67-2302RGBC	0605	4		6
10	D99 - DNP	TVS	4xBi	Diodes Inc	DT1446-04S-7	SOT-363-6	6		
11	DNP	Screws	4-40 ??"			NA			4
12	DNP	Acrylic	1/4" cut			NA			1
13	DNP	Top Board	NA	Queercon	DNP	NA			1
14	DS1, DS2	Character Disp	1x24 character display	Wintek	WD-C2401P-1GNN	TH		14	2
15	J1, J2, J3, J4	Recepticles	4-40, 0.375"	Keystone	4881	SMT	1	0	4
16	L1, L2	Pwr ind	4.7uH	Bourns	CV201210-4R7K	0805	2		2
17	P0	Power Header	DNP	DNP	DNP	2.54			0
18	P1	U1 Prog	5x2.54	DNP	DNP	2.54			0
19	P2	U2 Prog	5x2.54	DNP	DNP	2.54			0
20	P5	U5 Prog	2x4x2.54	DNP	DNP	2.54			0
21	P9	Crappy Add On	6x2.54	DNP	DNP	2.45			1
22	R1, R3	Reset Res	47k	Bourns	CR0603-JW-473GLF	0603	2		2
23	R11	Div Res 5V	342k, 1%	Vishay	CRCW0805340KFKEA	0805	2		1
24	R2, R4, R8, R10	Pwr res	1.02M, 1%	Yageo	RC0603JR-131ML	0603	2		4
25	R5	Reference resistor	1k 0603 TBD	Rohm	ESR03EZPJ102	0603	2		1
26	R6, R7	Pull Up Resistor	2k	KOA Speer	RK73B1JTTDD202J	0603			2
27	R9	Div Res 3.3	529k, 1%	Yageo	RC0805FR-07536KL	0805	2		1

#	Designator	Name	Spec	Manufacturer	PN	Footprint	Pads	THs	QTY
28	S0	Slide switch	SPDT	TE Connectivity	1825232-1	2.0mm		5	1
29	S1, S2, S3, S4	Buttons	13mm	Apem	ADTSM66NVTR	6x6mm 13h	4		4
30	U1	Display CPU		TI	MSP430FR5972IPMR	TSSOP/ RGC	64		1
31	U2	Game CPU		TI	MSP430FR2422	PW	48		1
32	U3	Radio		HopeRF	RFM75	SMT	12		1
33	U4	LED Controller		Holtek	HT16D35B	SOP-24	48		1
34	U5	Flash Chip	16 Mbit	Cypress	S25FS064SAGMFV01	8-SOIC	8		1
35	U6	Shift	8 bit shift register	Toshiba	74HC164D(BJ)	SOIC-14	14		1
36	VR1, VR2	Boost Regulator	Boost Regulator	Skyworks	AAT1217ICA-1.2-T1	TSOT23-6	6		2
37	X1	Clock XTL	32k Crystal	ABRACON	ABS25-32.768KHz-4-T	4-SOJ	4		1
			Total Badges	450					
			Number of Pads	396					
			Number of Holes	37					
			Number of Unique Components	29					
			Total Number of Components	90					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D3
R0
D4
D5
R1
C3
D6
D7
D2
P2
D8
DS1
S1
D1
U4
C17
D9
D19
D20
D21
D22
D23
D24
S2
S3
D18
D10
C25
DS2
S4
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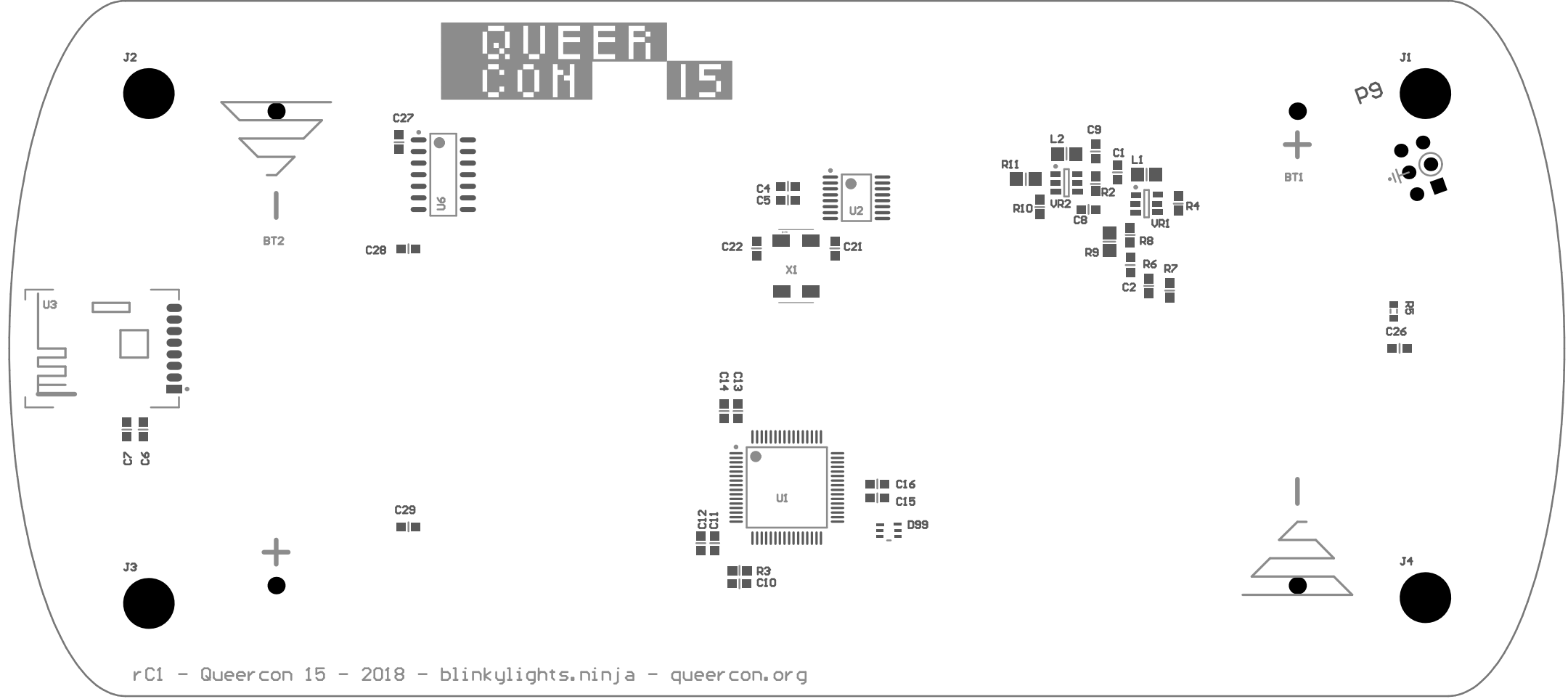
QUEER
CON 15
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J1
J3
J4
BT2
BT1
C27
U6
C28
C4
C5
U2
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X1
L2
C9
C1
L1
R11
R10
VR2
R2
C8
VR1
R4
R9
R8
R6
R7
C2
U3
C7
C6
C13
C14
U1
C16
C15
C12
C11
D99
C29
R3
C10
R5
C26
P9
rC1 - Queercon 15 - 2018 - blinkylights.ninja - queercon.org

QC15 Badge Debugging Quick Sheet

Button Orientation

The buttons are referred to by orientation assuming you are holding the badge with the power switch towards the top, and the buttons on the right.

Power-on Self-test

To enter POST, do a hard power-on (remove batteries and reinsert) while holding the DOWN button. The following POST errors are possible:

LED driver POST FAIL A simple mode-set command on the LED driver (HT16D35B, U4) has failed to return the expected result. This means the driver has failed, or there is a problem with I2C communication between U1 (MSP430FR5972) and U4. Try a power cycle first as there is a small chance this is a bus error that the software may be able to auto-recover from. Also check the pull-up resistors (R6 and R7.)

SPI NOR flash POST FAIL A very basic test of SPI communication with the external flash has failed. This test reads the model number, then tries to enable and disable writing to the module. If this fails, it is likely that the flash module, or the SPI connection to it, has failed.

SPI NOR bad sentinel The MCU attempted to read a designated address (0x000000) of the external SPI flash for a specific value (0xAB) and got something different. All correctly programmed external flash modules for QC15 will have 0xAB, 0xBA as the first two bytes of their data. This is a fatal error that will cause the badge to degrade to failsafe (rainbow animation) mode. This should be recoverable by reflashing the SPI flash (if it has not degraded to read-only), or by replacing it with new SPI flash (if it has). A generic image for an already-booted-once QC15 badge is located at http://dupli.co/qc15_files/flash_image.hex (Intel Hex format), or at http://dupli.co/qc15_files/flash_image.bin (raw binary image). Both have checksums available at http://dupli.co/qc15_files/flash_image.bin.md5 or http://dupli.co/qc15_files/flash_image.hex.md5.

SPI NOR bad I/O ops The MCU attempted a simple write/readback operation to the SPI flash, which has failed. This is NOT FATAL. Likely because we are seriously driving these flash modules over voltage, they regularly seem to degrade to read-only. If this has happened, this error will occur on longboot only. In normal operation, a badge never needs to write to its external flash, so this is OK. The external flash module will need to be replaced if writing to it is required.

RADIOMCU: MCU FAIL The radio MCU (U2, MSP430FR2422) has reported some kind of horrible disaster, because the code that generates this error should not be reachable under normal operation. It will likely need to be replaced.

RADIOMCU: XT1 FAIL The crystal oscillator for U2 (MSP430FR2422) has failed to power up, and the MCU is using its less accurate internal oscillator. This is not fatal, but it will likely result in poorer animation performance, clock-skew over time, and an inability for this badge to share its clock with other badges. Check the crystal and its load capacitors (C21 and C22).

RADIOMCU: RFM75 FAIL The radio MCU has failed to establish valid simple SPI communication with the RFM75 radio module (U3). Check pins 1,2,4,5,6,7 of U3. If this is the result of lifted pads or a broken trace (both of which we have observed), then this may require a helper wire to repair. Removing the battery holder nearest U3 can be helpful for reflowing, reworking, or removing the RFM75.

IPC POST general fail The UART connection between U2 and U1 has timed out. This usually means that U2 is hung or damaged. Try a hard power restart before checking for good physical connection between U1 and U2.

Common Failures and Problems

Poor radio performance

Some of the radios just perform poorly. Sometimes reflowing the RFM75 module can help with radio performance. Check and reflow its connection to the board. We have also occasionally seen radio performance improved by reflowing the visible (non-potted) joints on the RFM75 (U3) module itself. The worse case is to replace the radio with a new unit, which should be done by hand.

If a new radio is added, or if the poor performance persists, it may be useful to re-activate radio calibration learning mode. Note that without a continuously transmitting reference, the calibration mode may take quite a while to select a new frequency unless many other Queercon badges are around. See the Radio Recalibration section below.

No radio TX or RX at all

This could either be (a) a more serious version of the above, or (b) a failure of the radio IRQ or Enable connection. Check and repair the continuity between radio (U3) pin 3 and small MCU (U2, MSP430FR2422) pin 11; and continuity between radio (U3) pin 8 and small MCU (U2, MSP430FR2422) pin 10.

Dead lines or areas in LCD displays

DO NOT REPLACE THE LCD MODULE AS A FIRST STEP! It's a major pain to replace, and most LCD issues can be resolved without replacing the module. If the easier options have been exhausted, however, we have a lot of spare LCDs. They are also available at All Electronics for <= $0.50 each, with a MOQ of 2 units <https://allelectronics.com/item/lcd-111/24-x-1-lcd-incredible-price/1.html>. They only have 74,000 of them in stock last time I checked, though, so don't dawdle.

The most common issue is that one of the holddown tabs on the LCD's bezel is not tight enough. The most likely suspect is usually the bottom-left one. On some badges, it may be soldered to the board. This joint is not needed for good connection and may be removed. Melt the solder and twist the tab while pushing down on the bezel. This will generally improve the internal connections on the LCD screen.

If the problem is elsewhere, apply pressure/torque to various sections of the LCD to determine which corner may be able to be adjusted to fix the issue. Sometimes the torque may be maintained by soldering one of the corner tabs down into place to work around the problem.

If none of the above works, replace the LCD.

Badge won't power on with fresh batteries

Check position of power switch. Toward the buttons is OFF, and away from the buttons is ON.

Overheating voltage regulators

The most common symptom of over-current on the badge (usually a power to ground fault) is a very hot voltage regulator (VR1 and VR2, Skyworks AAT1217-1.2). If VR1 is hot, it's a 3V short. If it's VR2, then it's on the 5V side. Other symptoms of a 3V short include gibberish on the LCDs during gameplay, and LED colors changing incorrectly. NB: Don't try to play the game or interact with the badge much at all in an over-current or short-circuited situation! This

could lead to an inconsistent state that will have to be solved by clearing the MCU's memory.

For 5V shorts, the most common culpret are pins 1 and 2 on either of the LCD headers.

For 3V shorts, check pin pairs 17 & 18, 39 & 40, 49 & 50, and 62 & 63 on the big MCU (U1, MSP430FR5972); also check pins 5 & 6 on the small MCU (U2, MSP430FR2422); and pins 1 & 2 on the RFM75 (U3). We have also (once) seen what appeared to be either an internal short, or an issue underneath the package, in U2 (MSP430FR2422) that had to be resolved by removing and replacing that MCU.

Radio Recalibration

The RFM75 radios appear to suffer from center frequency calibration mismatches. Their center frequency is supposed to be 2416 MHz. However, in practice some need to be calibrated to 2415 or 2417 to interoperate. The radio MCU (U2) stores its calibration data persistently, but if the radio is replaced it may need to be recalibrated.

Checking radio calibration

To check the current status of the radio calibration, please enter the STATUS menu. This can be done from most game modes through the on-screen interface. Additionally, most QC badges (labeled with "LAB") can enter the status menu by switching OFF the switch, then holding the UP button and returning the switch to the ON position.

In the status menu, when the screens display the EXIT option on the bottom screen, and the badge name (and possibly ID) on the top screen, press the SQUARE button (left) to display the radio calibration status. It will indicate the current center frequency if the radio is calibrated.

Forcing radio recalibration

ONLY DO A MANUAL FREQUENCY CALIBRATION AS A LAST RESORT, or if the radio module has been swapped. Instructing the badges to perform a manual recalibration PERMANENTLY DELETES the badge's stored calibration data.

In a manual radio recalibration, the badge will perform successive sweeps of radio frequencies until it detects enough messages in a 2-second window to decide on a new frequency. Recalibration performance is proportional to the number of queercon badges or beacons nearby.

Because of the window size (and the fact that normal queercon badges only beacon every 16 seconds), this should only be done when other QC badges are around - preferably a lot of them. George also has a board that emits messages continuously to aid in this process, if necessary. However, even without the continuous send board the badge should eventually lock on a frequency calibration if enough other queercon badges are nearby.

In order to force the radio recalibration, do a hard power off (pull the batteries), then hold the UP button while powering the badge back on. When the badge locks on a new frequency, the lights will flash green for half a second.