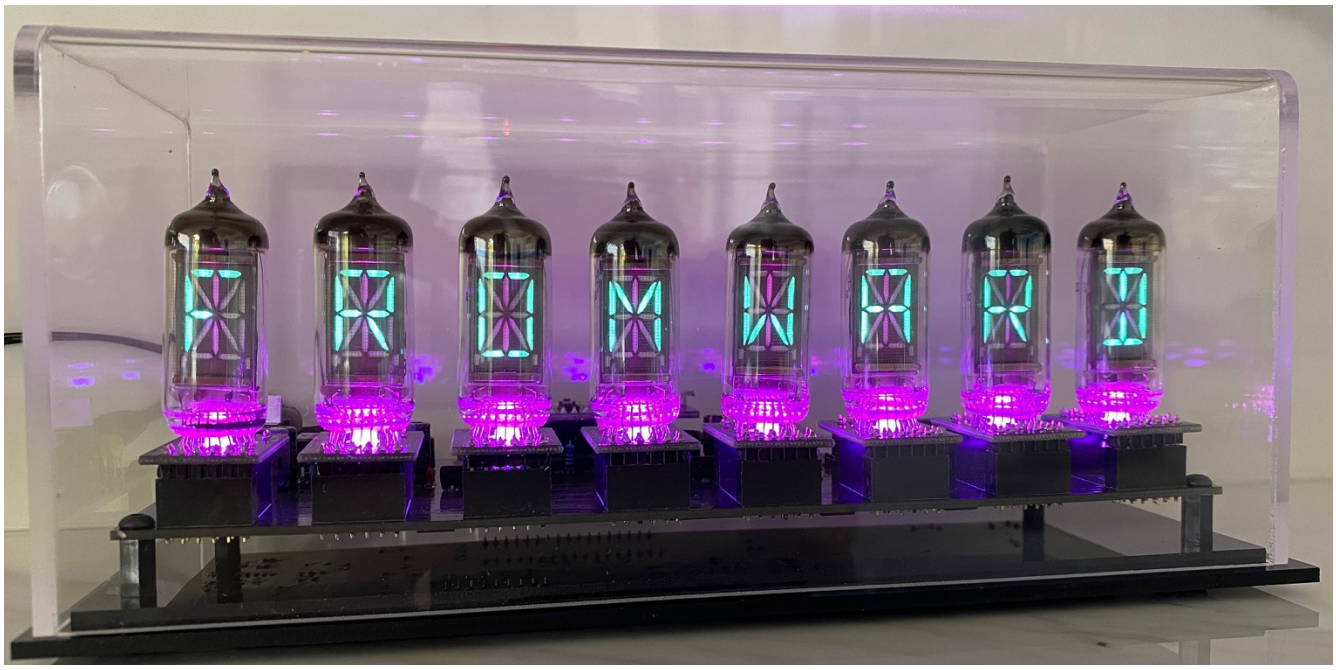
WordClock-3 Assembly Guide



Contents

Introduction 2

Assembly 2

- Case 2
- Step 1 – Build the Main Board 3
- Step 2 – Build the Tube Boards 4
- Step 3 – Final Assembly 5

Bill of Materials 6

Schematic 8

Warranty Terms and Conditions 13

WordClock-3 Assembly Guide 2/1/22 Version 0.9

Introduction

WordClock-3 assembly should be attempted only by experienced builders. Although assembly is straightforward and not difficult for experienced kit builders, there are several surface mount parts that must be carefully soldered to the boards. The kit may be returned for a full refund less shipping within 30 days of purchase, only if assembly has not been attempted. There are some slight differences in components between the 6/8 tube boards and the larger 16 tube version. Please check the component table prior to construction and if you have any questions, then please contact me.

IV-17 TUBES ARE ONLY INCLUDED IN THIS KIT IF PURCHASED AS SUCH.

Assembly

WARNINGS!

IT IS RECOMMENDED TO DRILL HOLES IN A CASE BASE FIRST USING THE CIRCUIT BOARD AS A TEMPLATE.

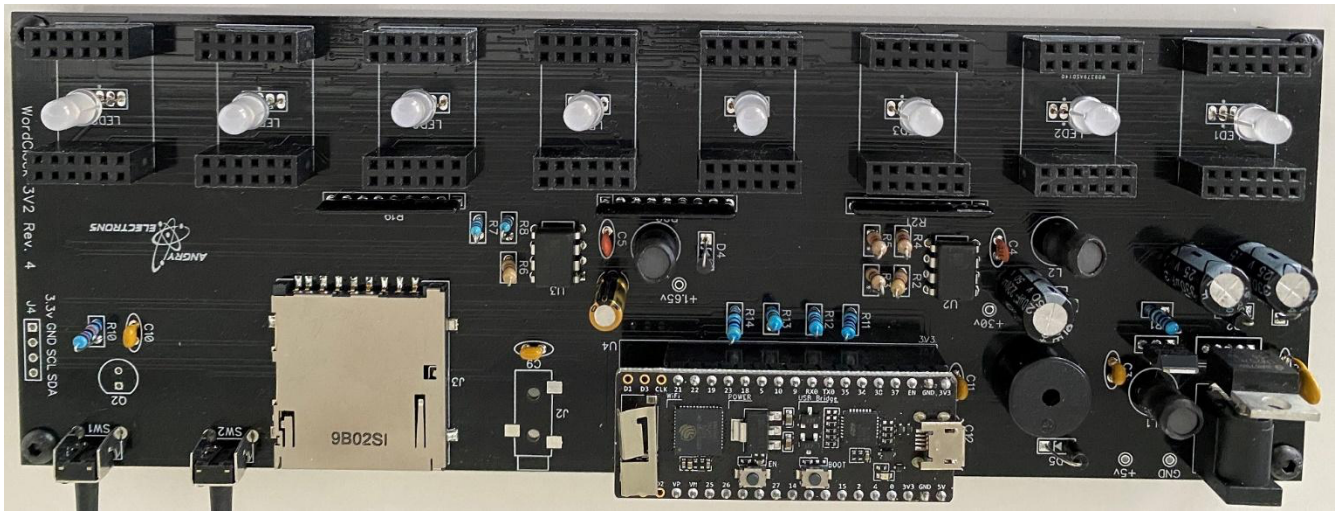
DO NOT SOLDER THE MICROCONTROLLER DIRECTLY TO THE BOARD, USE THE HEADERS PROVIDED.

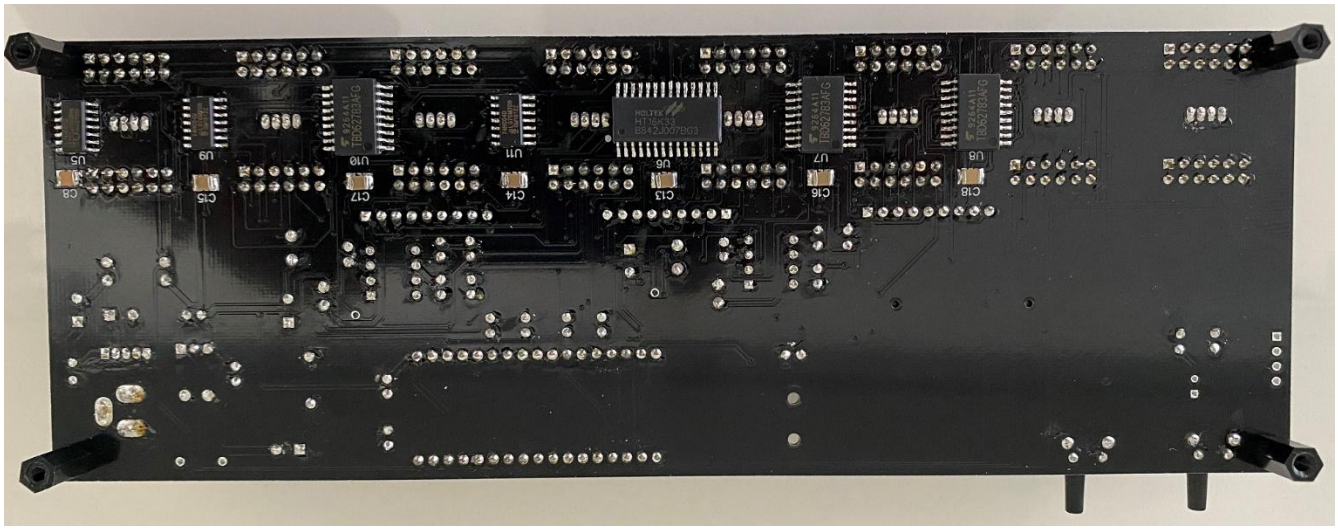
USE A GOOD QUALITY, UL LISTED, 12V POWER SUPPLY IF THE KIT IS NOT SUPPLIED WITH ONE (OUTSIDE OF THE USA).

Case

If you purchased the optional acrylic case, this would be a good time to mark and drill the holes in the base. It is easiest to use an unpopulated circuit board for this purpose. The precise distance between holes is 205mm wide by 68mm deep.

Step 1 – Build the Main Board (8 Tube Board Pictured for Reference)





- Note, some quantities of components may differ depending on the number of tubes in the kit purchased. **Always check resistor values with a multimeter**.
- Install the 2x6 pin female headers on the top of the board.
- Cut the 40-pin female header into two, 17 pin pieces. Install at the U4 location.
  DO NOT solder the microcontroller to the board!
- Build the 5V supply on the main board. Install J1, F1, C1, C2, C3, D1, D2, L1, and U1. Note that C1, C2, D1, and D2 must be installed in the direction noted on the board.
- Connect a 12V-18V power supply with a center positive, 2.1mm connector to J1, and check the test point for 5V. Do not continue assembly if 5V is not present at the test point.

- Build the 35V and 2.4V (note the voltage markings on the PCB are outdated) power supplies. Install R1-R8, L2, L3, D3, D4, C4-C7, Q1, U2, and U3. Note that D3, D4, C6, C7, U2, and U3 must be installed in the direction noted on the board.

- Temporarily connect the ENABLE pad to GND.

  Do not install the microcontroller while the jumper is in place!

  Connect the power supply, and check the test points for approximately 35V and 2.4V. Do not continue assembly if these voltages are not present at the test points. Remove the temporary jumper.

- Install the components on the bottom of the board, starting with the surface mount ICs, U5-U11. The line or dot on one side of the chip must be installed toward the cutout on one side of the silkscreened pattern. The best way to install a surface mount chip is to add a very small amount of solder to one of the corner pads on the board. Then quickly and carefully solder the corresponding pin to the pad. Check the alignment of all pins and if correct, solder the opposite corner pin. Check the alignment again, then solder the remaining pins quickly and carefully. Always use a magnifier to check for solder bridges and bad solder joints.

- Install the remaining surface mount parts on the bottom of the board, C8, and C13-C18 (there are some other chips for the 16-digit version to be soldered also).

- Install the SD card connector next. Be sure to solder all leads to the board. Solder quickly and carefully. The plastic chassis can easily be damaged by too much heat. Several pins on one side of the connector are very close to the grounded case. Be careful that they are only soldered to the pc board, not the case. Then install J3, the GPS connector.

- Install all of the remaining parts on the top of the board, **except for the RGB LEDs**, LED1-LEDX (number depends on board type). These will be installed last.

- The ambient light sensor, Q2, should be installed about 10mm above the board. The shorter lead goes toward the back of the board.

- Install the remaining parts to the main board. J4 is not used.

- Insert the microcontroller, U4, into the headers, aligning the direction of the USB connector and the antenna with the marks on the board.

Step 2 – Build the Tube Boards

- Cut the leads of all the IV-17 tubes progressively smaller, to make insertion of the leads into the tube boards easier.
- Insert the leads into the tube boards, noting the markings, “Front,” and “Tube Other Side” when orienting the tubes.
- Solder one lead of each tube first, then check the front to back and side to side alignment. Then solder another lead 90 degrees from the first soldered lead, and check again. If the alignment is correct, solder the remaining 20 leads. It pays dividends to take your time with this and make sure that all the tubes are at the same height off of each tube board for a nice even look.
- Install two, 12 pin male headers on each tube board.

Step 3 – Final Assembly

- Insert the RGB LEDs, LED1-LEDX (number depends on board type), into the board, but do not solder them in place. Note the orientation. The long lead (or leads) go toward the dot on the solder mask.
- Insert each tube board into its corresponding female headers on the main board.
- Turn the main board over, and adjust each RGB LED so that it is about 1mm below the bottom of the IV-17 tube, then solder all four leads.
- Install the microcontroller board, correctly orienting the USB connector and antenna, with the markings on the board. Install the SD Card.
- Install the 10mm standoffs into the holes on the bottom of the main board, using the supplied screws.

This completes WordClock-3 assembly. Refer to the User Manual for setup and operation instructions.

Bill of Materials (8 digit Version)

Reference	Qty	Part	Value	Note
C1-C2	2	Capacitor	330µF 25V-50V	electrolytic
C3, C9-C12	5	Capacitor	100nF	through hole
C4	1	Capacitor	330pF	
C5	1	Capacitor	180pF	
C6	1	Capacitor	220µF 50V	
C7	1	Capacitor	100µF 16V	
C8, C13-C18	7	Capacitor	100nF	surface mount
D1	1	Diode	1N4007	
D2-D5	4	Diode	1N5819	Schottky
F1	1	Poly Fuse	.5A – 1A	
J1	1	Power Jack		2.1mm power jack
J2	1	GPS Jack		3.5mm SMD SJ-3523-SMT-TR
J3	1	SD Card Connector		DM1AA-SF-PEJ SD card jack
J4	1	Header		Not Used
L1-L3	3	Inductor	100µH	
LED1-LED8	8	RGB LED		APA106
PZ1	1	Buzzer		buzzer
Q1	1	IRFU5305		
Q2	1	Sensor	TEPT4400	light sensor
R1, R11, R12	3	Resistor	10k ¼ watt	
R2, R6	2	Resistor	0.47R ¼ watt	
R3	1	Resistor	180R ¼ watt	
R4	1	Resistor	2.7k ¼ watt	
R5	1	Resistor	62k ¼ watt	
R7	1	Resistor	5.1k ¼ watt	

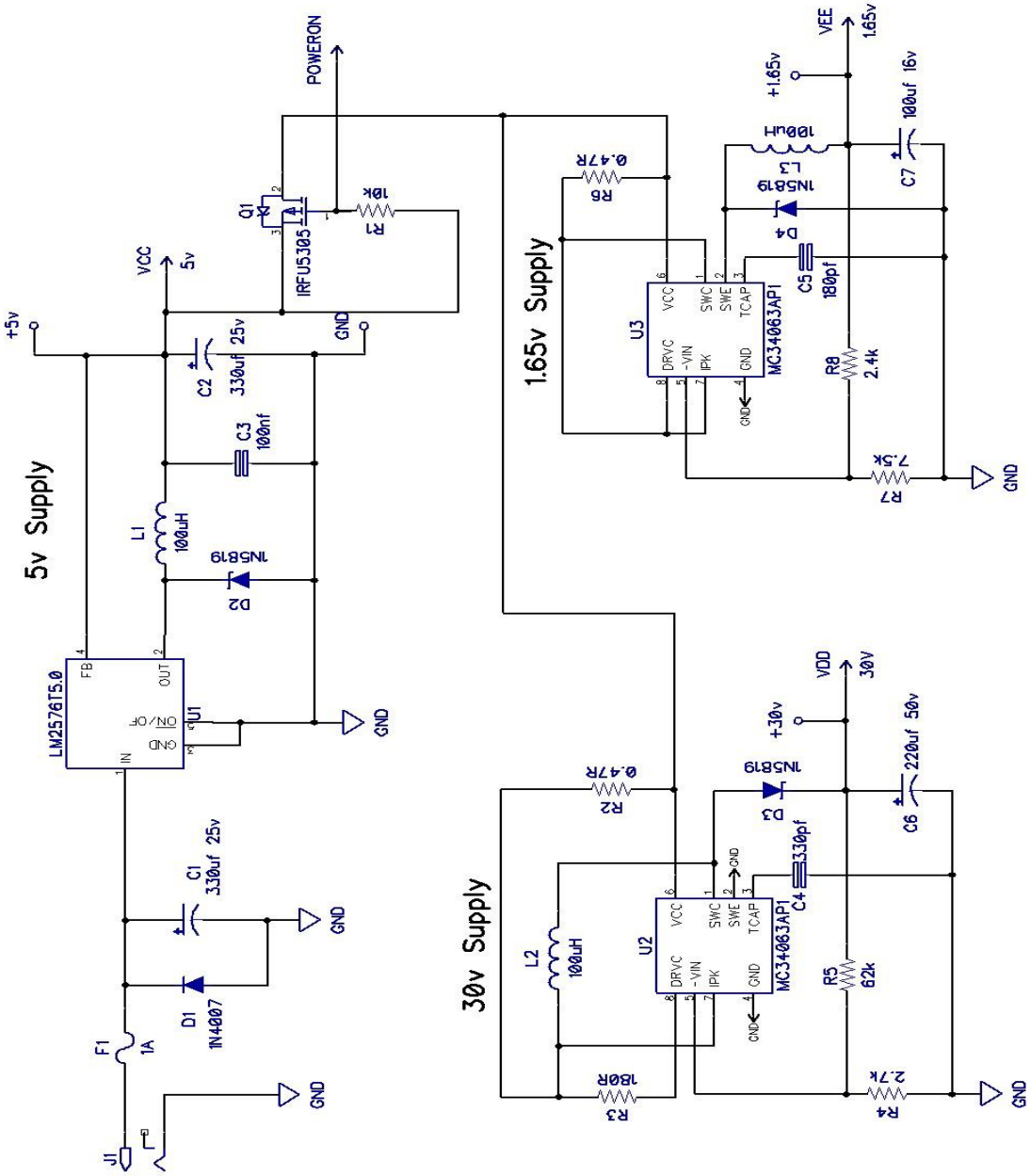
R8	1	Resistor	4.7k ¼ watt	
R10	1	Resistor	120k ¼ watt	
R13-R14	2	Resistor	4.7k ¼ watt	
R19-R21	3	Resistor Array	4.7k ¼ watt	
SW1-SW2	2	Button		90 degree pushbutton
U1	1	IC	LM2576T5.0	
U2-U3	2	IC	MC3406AP1	
U4	1	Microcontroller	ESP32-PICO-KIT	programmed with WordClock firmware
U5	1	IC	74AHC125D	
U6	1	IC	HT16K33	
U7-U8, U10	3	IC	TBD62783	
U9, U11	2	IC	74HC04D	
	4	Screw		M3 8mm
	4	Standoffs		10mm
	1	SD Card		programmed with WordClock languages database
	1	Main Board		
	8	Tube Boards		for IV-17 tubes
	8	2x6 Male Header		
	8	2x6 Female Header		
	1	1x40 Female Header		for ESP32 microcontroller

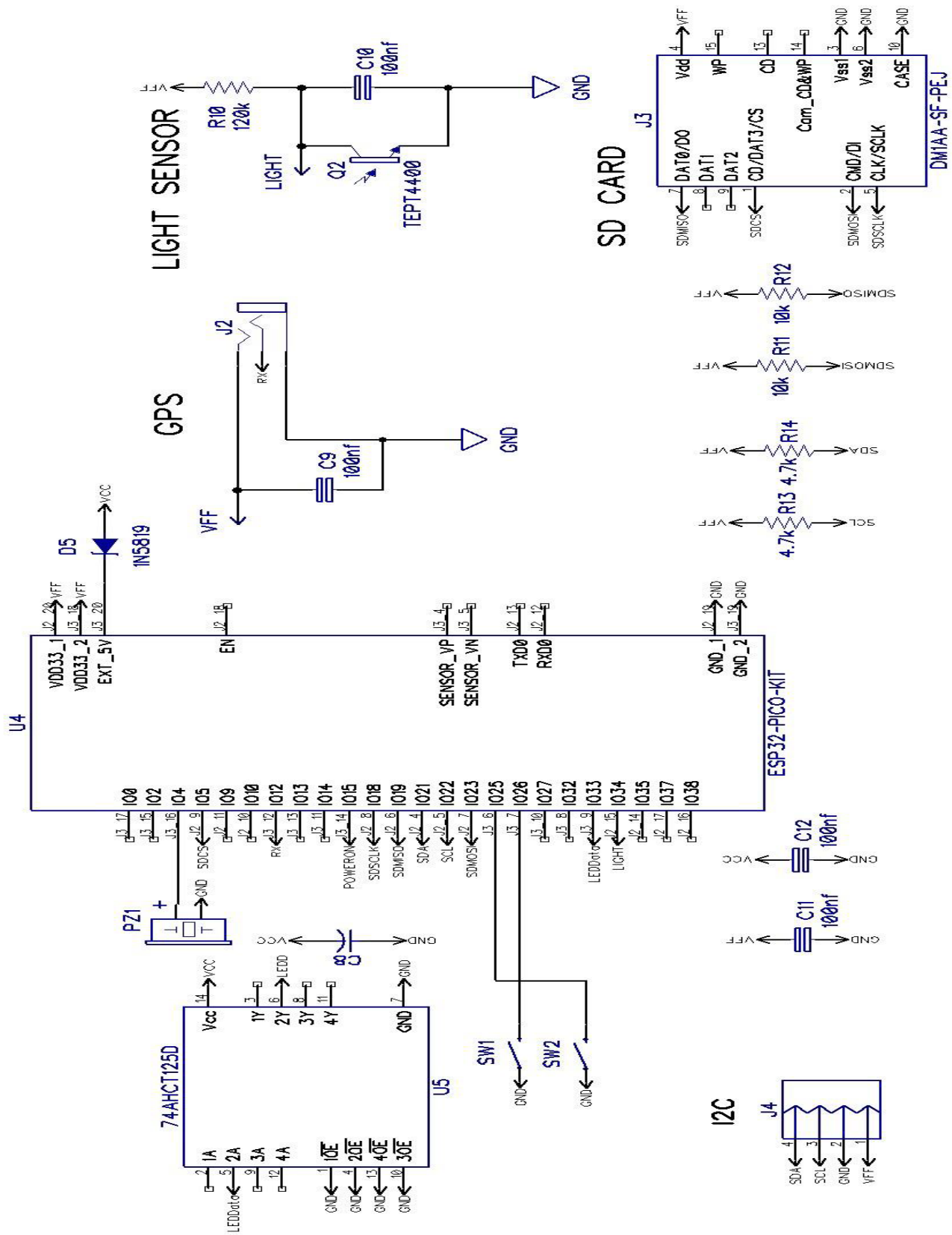
Bill of Materials (16 digit Version)

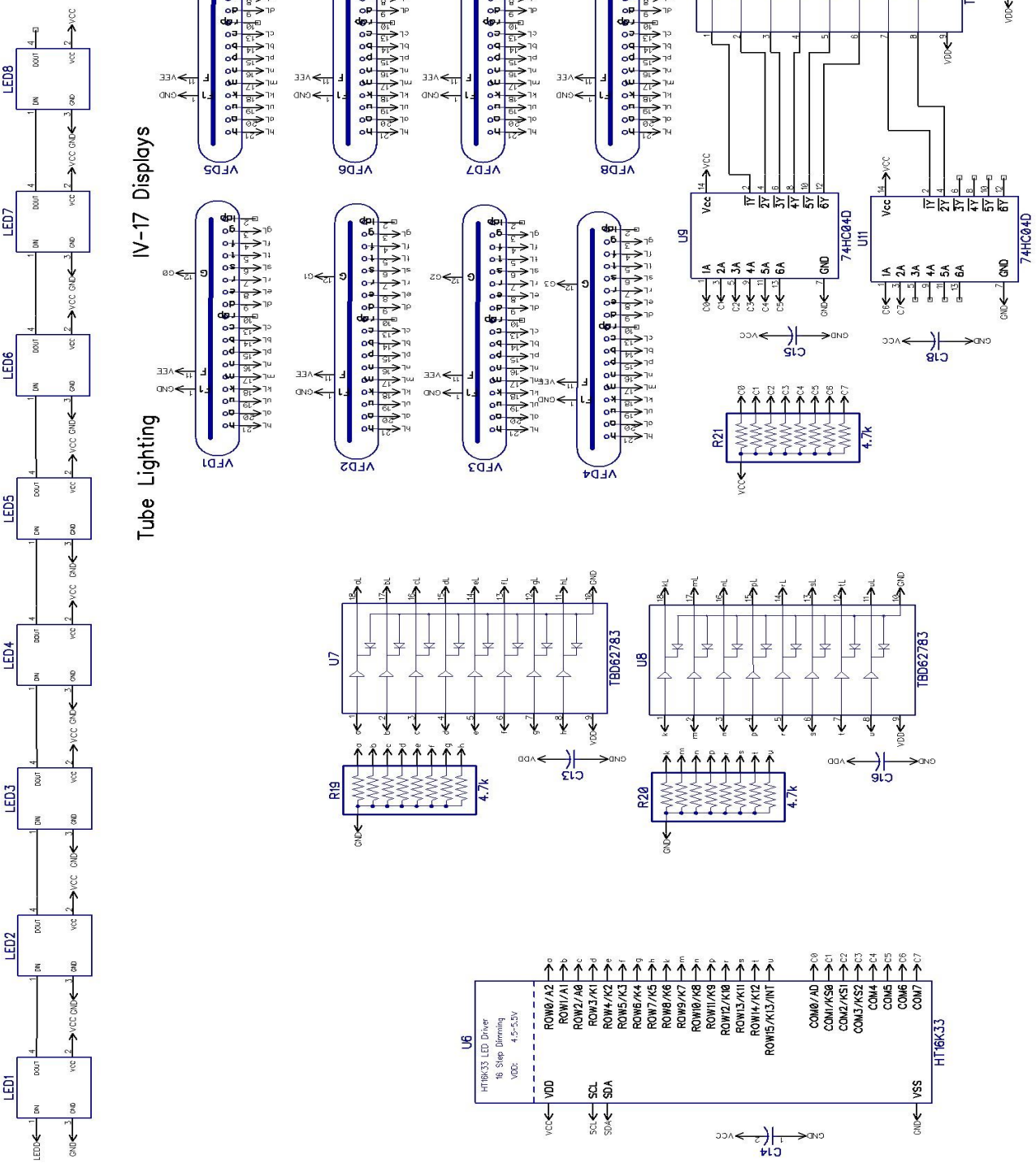
Reference	Qty	Part	Value	Note
C1-C2	2	Capacitor	330µF 25V-50V	electrolytic
C3, C7, C9-C12	6	Capacitor	100nF	through hole
C4	1	Capacitor	330pF	
C5	1	Capacitor	330µF 16V	
C6	1	Capacitor	220µF 50V	
C8, C13-C21	9	Capacitor	100nF	surface mount
D1	1	Diode	1N4007	
D2-D5	4	Diode	1N5819	Schottky
F1	1	Poly Fuse	1A	
J1	1	Power Jack		2.1mm power jack
J2	1	GPS Jack		3.5mm SMD SJ-3523-SMT-TR
J3	1	SD Card Connector		DM1AA-SF-PEJ SD card jack
J4	1	Header		Not Used
L1-L3	3	Inductor	100µH	
LED1-LED16	16	RGB LED		APA106
PZ1	1	Buzzer		buzzer
Q1	1	IRFU5305		Metal plate to rear of board
Q2	1	Sensor	TEPT4400	light sensor
R1, R11, R12	3	Resistor	10k ¼ watt	
R2	1	Resistor	0.47R ¼ watt	
R3	1	Resistor	180R ¼ watt	
R4	1	Resistor	1k ¼ watt	
R5	1	Resistor	27k ¼ watt	
R6	1	Resistor	1.5k ¼ watt	
R7	1	Resistor	1.6k ¼ watt	
R18	1	Resistor	330R ¼ watt	

R10	1	Resistor	120k ¼ watt	
R8, R13, R14, R17	4	Resistor	4.7k ¼ watt	
R15, R16, R19-R21	6	Resistor Array	4.7k ¼ watt	Note dote aligns with square on PCB
SW1-SW2	2	Button		90-degree pushbutton
U1	1	IC	LM2576T5.0	
U2	1	IC	MC3406AP1	
U3	1	IC	74HC14D	
U4	1	Microcontroller	ESP32-PICO-KIT	programmed with WordClock firmware
U5	1	IC	LM2576ADJ	
U6, U12	2	IC	HT16K33	
U7, U8, U10 U13, U14, U16	6	IC	TBD62783	
U9, U11, U15	3	IC	74HC04D	
	6	Screw		M3 8mm
	6	Standoff		10mm
	1	SD Card		programmed with WordClock languages database
	1	Main Board		
	16	Tube Board		For IV-4 or IV-17 tubes
	32	2x6 Male Header		
	32	2x6 Female Header		
	1	1x40 Female Header		Cut in two for ESP32 microcontroller
	2	Heatsinks		Attach with supplied screws and nuts

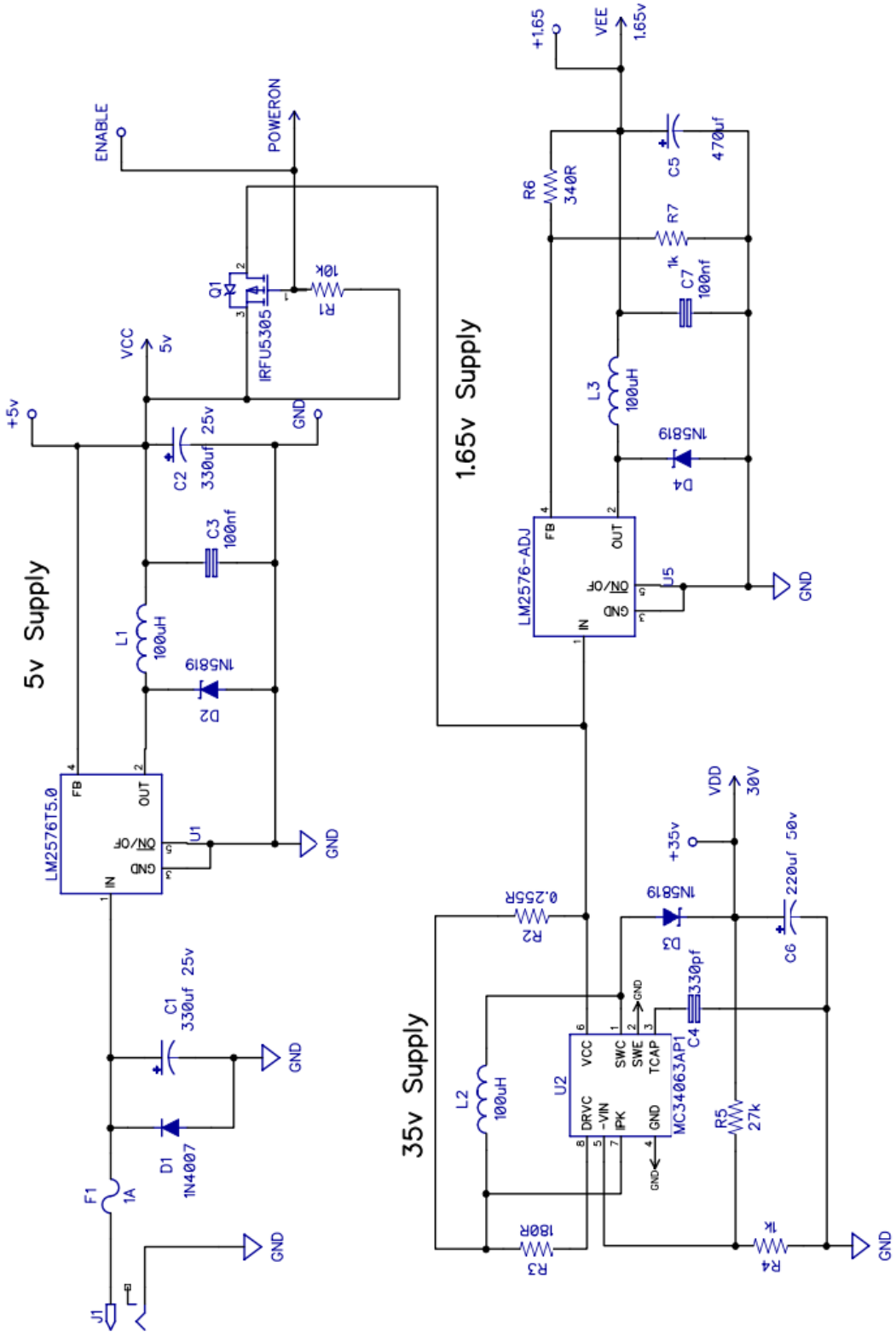
Schematic (8 Tube, Note 35V and 2.4V supplies used)

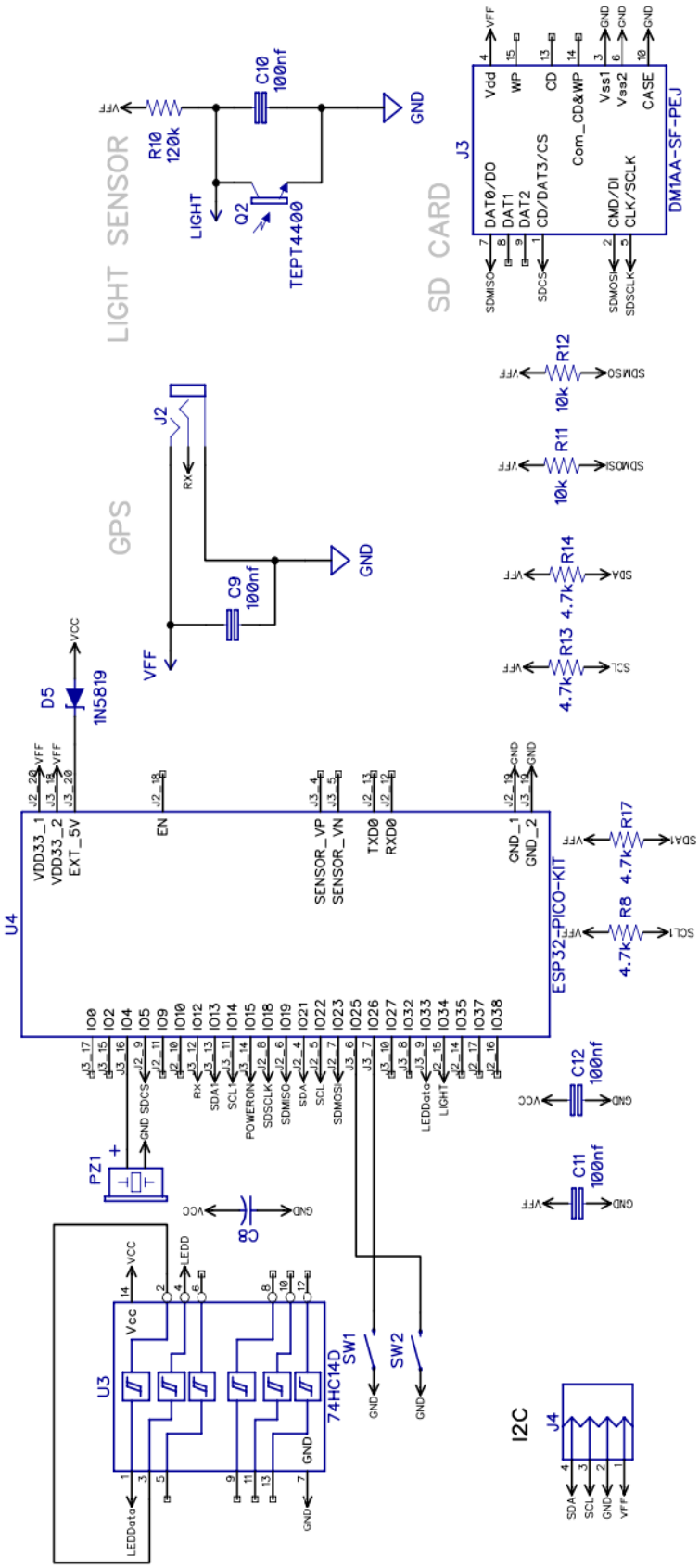


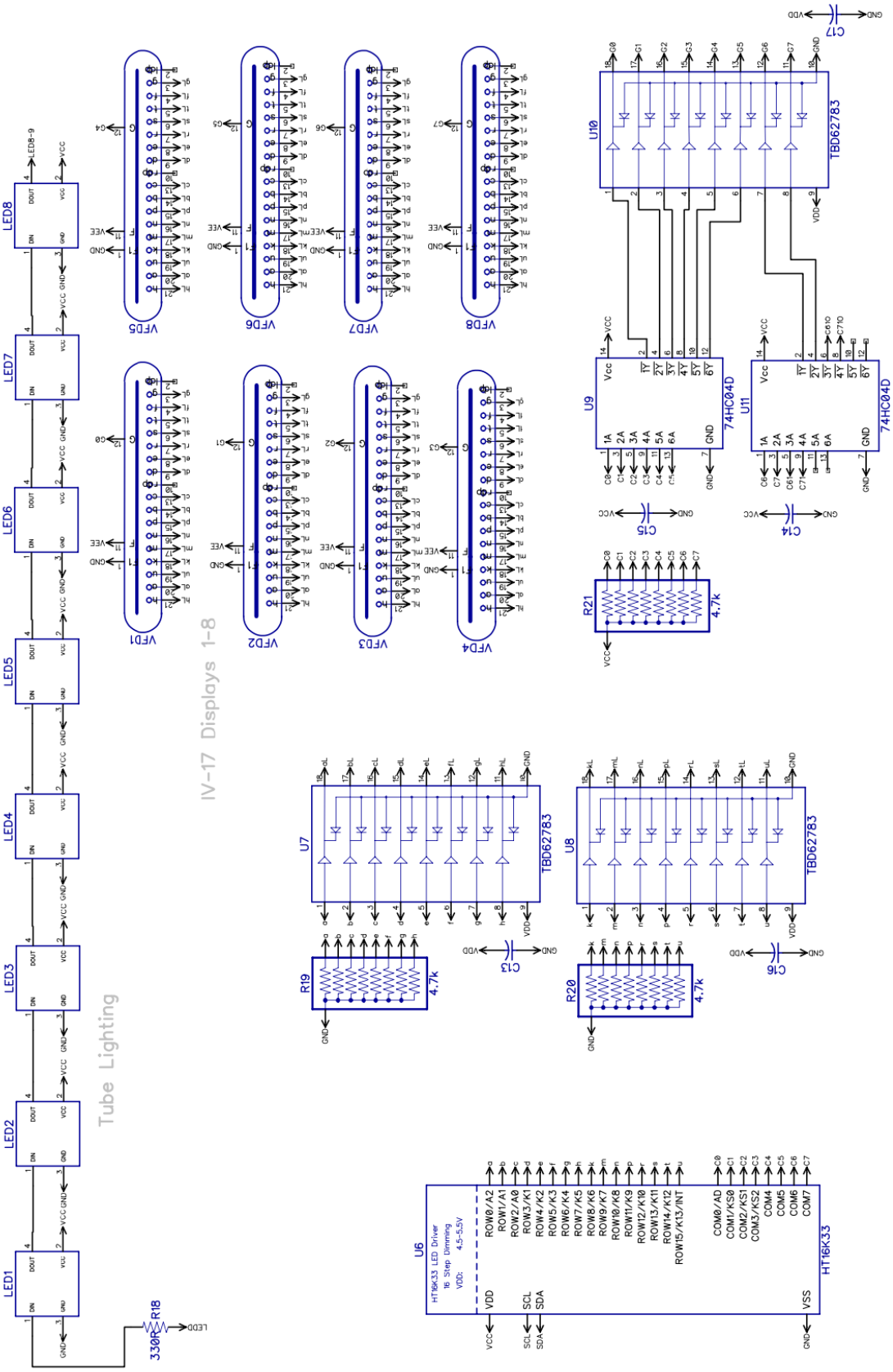

LIGHT SENSOR
R10
120k
C10
100nf
LIGHT
Q2
TEPT4400
GND
SD CARD
J3
DM1AA-SF-PEJ
GPS
J2
C9
100nf
VFF
D5
1N5819
VCC
R12
10k
R11
10k
R14
4.7k
R13
4.7k
SDMISO
SDMOSI
SDA
SCL
U4
ESP32-PICO-KIT
VDD33_1
VDD33_2
EXT_5V
EN
SENSOR_VP
SENSOR_VN
TXD0
RXD0
GND_1
GND_2
C12
100nf
C11
100nf
C8
PZ1
U5
74AHCT125D
SW1
SW2
I2C
J4

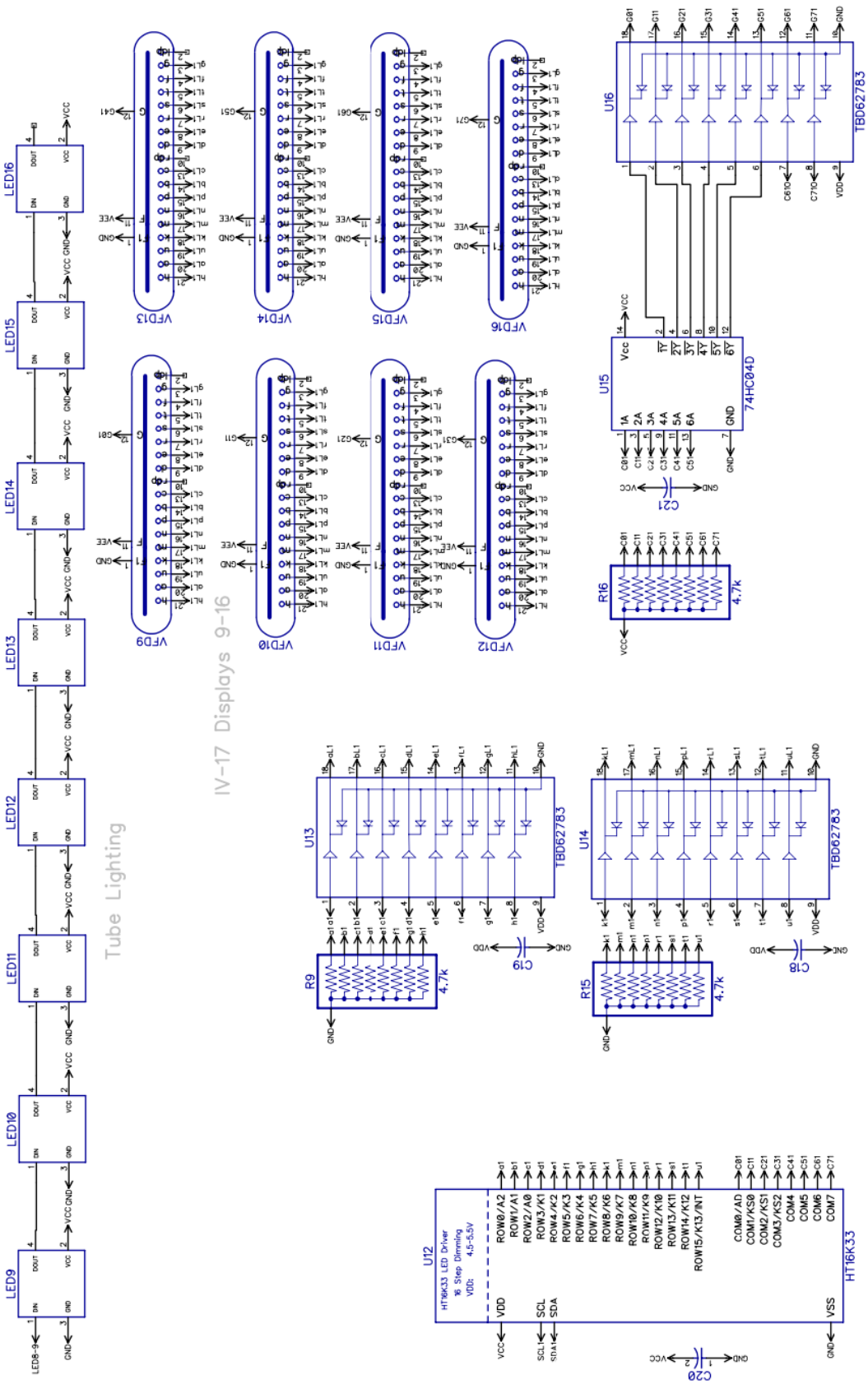

IV-17 Displays
Tube Lighting
VFD1
VFD2
VFD3
VFD4
VFD5
VFD6
VFD7
VFD8
LED1
LED2
LED3
LED4
LED5
LED6
LED7
LED8
U6
HT16K33 LED Driver
16 Step Dimming
VDD: 4.5~5.5V
HT16K33
U7
U8
U9
U10
U11
TBD62783
74HC04D
R19
R20
R21
4.7k
C13
C14
C15
C16
C17
C18

Schematic (16 Tube – Note 35V and 2.4V supply now used)




LIGHT SENSOR
R10 120k
C10 100nf
LIGHT
Q2
TEPT4400
SD CARD
J3
DM1AA-SF-PEJ
GPS
J2
C9 100nf
VFF
D5 1N5819
VCC
R12 10k
R11 10k
R14 4.7k
R13 4.7k
R17 4.7k
R8 4.7k
U4
ESP32-PICO-KIT
PZ1
C12 100nf
C11 100nf
C8
U3
74HC14D
SW1
SW2
I2C
J4


IV-17 Displays 1-8
Tube Lighting
LED1
LED2
LED3
LED4
LED5
LED6
LED7
LED8
R18
330R
VFD1
VFD2
VFD3
VFD4
VFD5
VFD6
VFD7
VFD8
U6
HT16K33 LED Driver
16 Step Dimming
VDD: 4.5-5.5V
HT16K33
U7
U8
U9
U10
U11
TBD62783
74HC04D
R19
R20
R21
4.7k
C13
C14
C15
C16
C17


IV-17 Displays 9-16
Tube Lighting
LED16
LED15
LED14
LED13
LED12
LED11
LED10
LED9
LED8-9
VFD13
VFD14
VFD15
VFD16
VFD9
VFD10
VFD11
VFD12
U16
TBD62783
U15
74HC04D
U13
TBD62783
U14
TBD62783
U12
HT16K33 LED Driver
16 Step Dimming
VDD: 4.5~5.5V
HT16K33
R16
4.7k
R9
4.7k
R15
4.7k
C21
C19
C18
C20

Warranty Terms and Conditions

This software and hardware product is Copyright (C) 2019 by Mitchell Feig. It is exclusively distributed by StocksClocks LLC. All Rights Reserved. StocksClocks warrants that for a period of 90 days following delivery, kit parts will (a) perform in accordance with published specifications, and (b) will be free from defects in materials and workmanship. In the event a kit part does not meet this warranty, subject to the conditions set forth in these terms and conditions, StocksClocks sole obligation will be, at its election, to repair or replace the kit part in question. We may require return of the part for examination and replacement. Replacement will be completed at the sole discretion of StocksClocks, after examining the returned part. Correct assembly is the responsibility of the builder.

StocksClocks MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY, NON-INFRINGEMENT, AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. IN NO EVENT WILL Stocksclocks BE LIABLE FOR PUNITIVE, SPECIAL OR CONSEQUENTIAL DAMAGES, OR FOR AN AMOUNT IN EXCESS OF THE PURCHASE PRICE OF THE DEFECTIVE Stocksclocks PART OR PRODUCT.