KC0JFQ TACHOMETER FEATURES

1 REVERSE POLARITY PROTECTION (SMD FUSE)

2 SWITCHMODE REGULATOR

3 PROGRAMMING CONNECTION VIA POGO-PINS CONNECTION TO PADS
(DOES NOT REQUIRES PROGRAMMING CONNECTOR)

4 ICOM CI-V SERIAL INTERFACE (FULL DUPLEX)

5 NON VOLATILE MEMORY (128Kb)

6 ANALOG CONFIGURATION CHANNEL

7 INPUTS:
TACHOMETER PULSE
SUPPLY VOLTAGE MONITOR
ENGINE ANALOG CHANNEL (W/PULL-UP)

8 TACHOMETER CHANNEL IS LIMITED AND BUFFERED

9 SUPPLY VOLTAGE CHANNEL HAS 10V OFFSET (EXPANDED RANGE)

10 ANALOG CHANNEL IS BUFFERED AND HAS GAIN

11 4 DIGIT NUMERIC DISPLAY

12 4 LED STATUS INDICATORS

13 PROGRAMMING & DEBUG CONNECTIONS THROUGH POGO-PINS
ON 2ND. BOARD INCARNATION (REDUCE PARTS ON PRODUCTION BOARD)

CHANGE LIST

2020-11-23 MOVE "TEST" TO PA0 (FROM I2C-CLK)

2020-12-04 MOVE CURRENT LIMIT RESISTORS FOR LEDs TO
ALLOW MOUNTING ON EITHER SIDE OF BOARD
(LTS-6760P IS SYMMETRICAL, BUT SEGMENT
ASSIGNMENTS CHANGE)
UPDATE BIT PATTERN PAGE

2020-12-10 FLASH DEVICE IS PART OF BASE BUILD
HOUR METER DATA AREA

J2/JH2 RECONFIGURED FOR POGO PINS

2020-12-12 **REVISION 1**

ADD HAYWIRE TO CONNECT PWML2(61)
TO PD4(72)/PD5(71)/PG0(60)
ALLOW PWML2 TO GENERATE INTERRUPT
ON PD4 TO MANAGE DISPLAY BRIGHTNESS
NO CHANGE TO ARTWORK

2020-12-25 ADD EXTERNAL PARTS
(i.e. NOT ON CIRCUIT BOARD)

2020-12-26 ADD MORE EXTERNAL PARTS
REALLOCATE SOME REFERENCE DESIGNATORS

2021-01-13 RE-LABEL U10 TO BE NON-INVERTING
74LVC2G07

2021-04-22 CHANGE DRIVE TO LEDs TO INCREASE BRIGHTNESS

non_flt_cap_common,non_flt_cap_0805,non_flt_cap_0603,non_flt_cap_0805,non_flt_cap_1206,non_flt_cap_tant,non_flt_misc,gse_001,gse_002

TOP_FULL | BOARD ASSY | BOT_COMPACT | BOARD-ID
DRAWING FRAME SHOWN ON CIRCUIT BOARD

Drawn	KC0JFQ	Date 2020-10-10
Designed	KC0JFQ	Date 2020-10-10

MARK ZERO POINT FOR PICK & PLACE FILE ON PRINTED CIRCUIT BOARD

TITLE PAGE

The University of Iowa
Department of Physics & Astronomy
Iowa City, IA, USA

TITLE: TACHOMETER

A102_73189_1

CAGE	Series	Project Name		Number	Rev
2D354	102		B	73189	1

Date: 4/24/21 8:50 AM 4/24/21 8:51 AM

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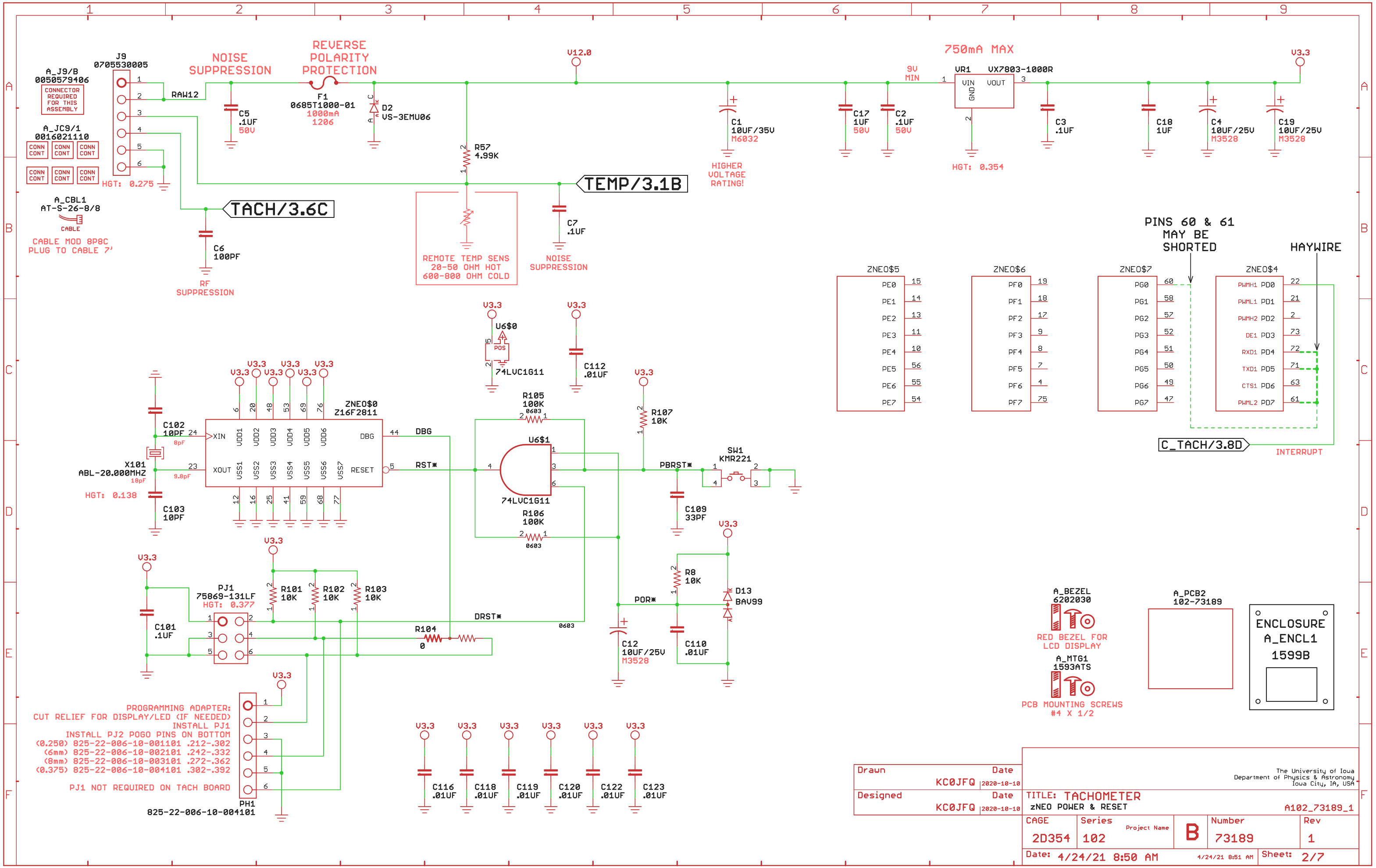

Drawn	KC0JFQ	Date 2020-10-10
Designed	KC0JFQ	Date 2020-10-10

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TITLE: TACHOMETER
zNEO POWER & RESET
A102_73189_1

CAGE	Series	Project Name	Number	Rev
2D354	102	B	73189	1

Date: 4/24/21 8:50 AM 4/24/21 8:51 AM
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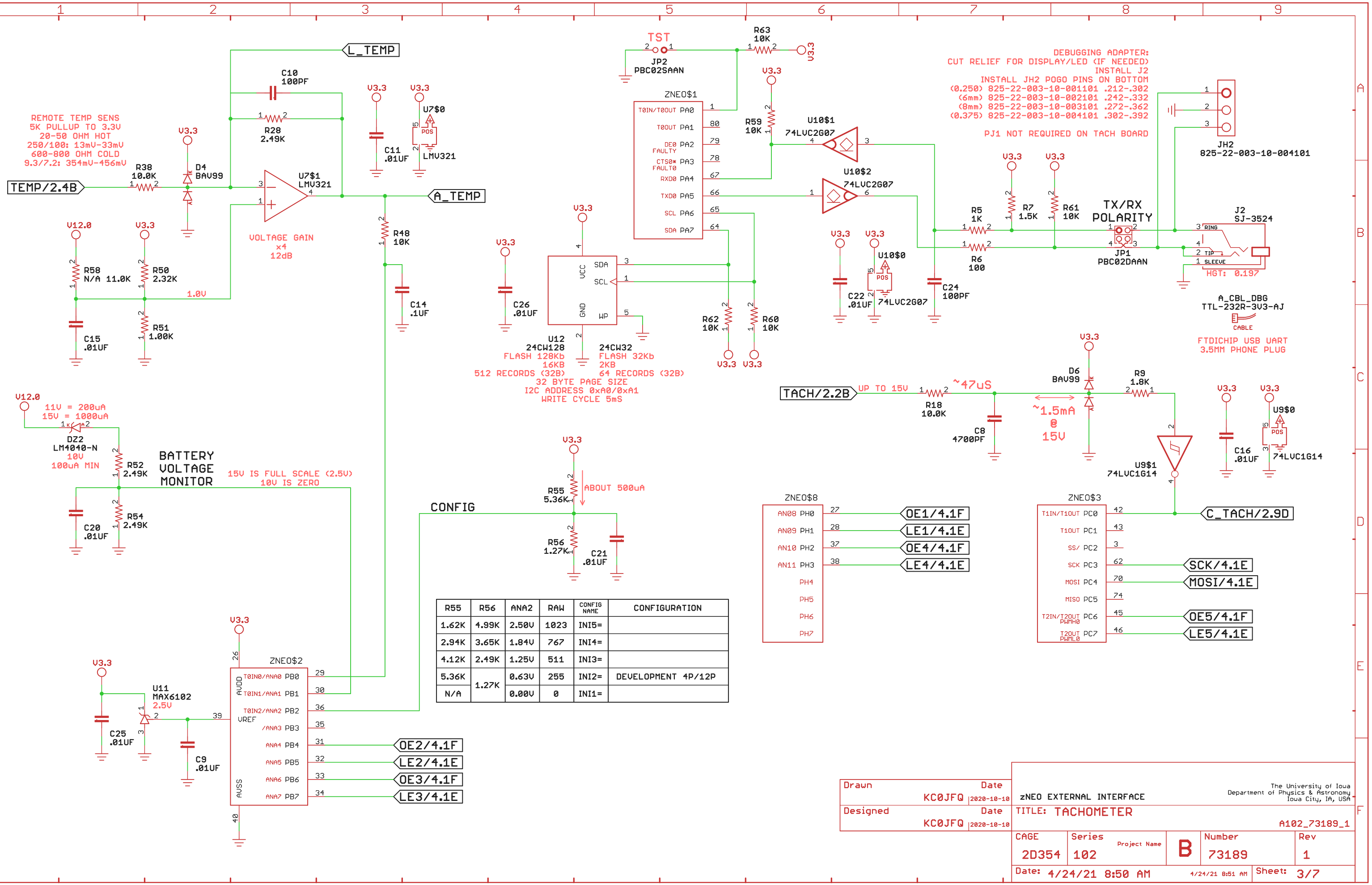

R55	R56	ANA2	RAW	CONFIG NAME	CONFIGURATION
1.62K	4.99K	2.50V	1023	INI5=	
2.94K	3.65K	1.84V	767	INI4=	
4.12K	2.49K	1.25V	511	INI3=	
5.36K	1.27K	0.63V	255	INI2=	DEVELOPMENT 4P/12P
N/A		0.00V	0	INI1=	

Drawn	Date	zNEO EXTERNAL INTERFACE	The University of Iowa Department of Physics & Astronomy Iowa City, IA, USA
KC0JFQ	2020-10-10		
Designed	Date	TITLE: TACHOMETER	A102_73189_1
KC0JFQ	2020-10-10		

CAGE	Series		Number	Rev
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ALL LEDs ON
700mA 2.31W

LTS-6760P
PWR DIS/SEG: 40mW
PK FWD I: 60mA
CONT FWD I: 15mA
TEMP: -35C +85C
FWD V: 2.1V (max 2.6V)
21mW/SEG
HGT: 0.315

LTL-4223
PWR DIS: 100mW
PK FWD I: 120mA
CONT FWD I: 30mA
TEMP: -55C +100C
FWD V: 2.0V (max 2.6V)
20mW/SEG
HGT: 0.340

15 OHM @ 15 mA
DROP 225 mV
POWER 34 mW

DISPLAY 2100 mV
RESISTOR 225 mV
2325 mV
VCC 3300 mV
975 mV

22 OHM @ 15 mA
DROP 330 mV
POWER 50 mW

DISPLAY 2100 mV
RESISTOR 330 mV
2430 mV
VCC 3300 mV
870 mV

2000 mV
220 mV
2220 mV
3300 mV
1100 mV

10mA
220mV
2.2mW

ASSUME 800mV DROP
WORST CASE <100mW
<10C RISE

TLC5917
DRIVE I @ 0.6V: 3mA
DRIVE I @ 1V: 120mA
JCT/AMB C/W: 87
SUPPLY CURRENT: 8mA

U1..U4
9.8 mW/SEG
68.6 mW/DEV
ALL ON 380 mW

U5
11 mW/SEG
44 mW/DEV
ALL ON 210 mW

MOSI/3.8D
SCK/3.8D
LE1/3.7D
LE2/3.3F
LE3/3.3F
LE4/3.7D
LE5/3.8E
OE1/3.7D
OE2/3.3F
OE3/3.3F
OE4/3.7D
OE5/3.8E

Drawn	KC0JFQ	Date 2020-10-10
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TITLE: TACHOMETER
TACHOMETER DISPLAY
A102_73189_1

CAGE	Series		Number	Rev
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Date: 4/24/21 8:50 AM 4/24/21 8:51 AM
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KC0JFQ UNIVERSAL TACHOMETER
PORT BIT ASSIGNMENTS

	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0	BASE
PORT A	A I2C	A I2C	A(O) TXD0	A(I) RXD0				I TEST*	
PORT B	O LE3	O OE3	O LE2	O OE2		A(A) CONFIG	A(A) BAT_V	A(A) TEMP	
PORT C	O LE5	O OE5		A(O) MOSI	A(O) SCK			A(C) C_TACH	
PORT D								INT C_TACH	
PORT E									
PORT F									
PORT G									
PORT H					O LE4	O OE4	O LE1	O OE1	

UART 0	DEBUG PORT (PORT A)
SPI	DISPLAY x 5 (PORT C)
SCK	SHIFT CLOCK
MOSI	SERIAL DATA
TEST*	TEST MODE
CONFIG	CONFIGURATION (5 LEVELS)
BAT_V	BATTERY VOLTAGE (EXTERNAL)
TEMP	WATER TEMPERATURE (EXTERNAL)
I/A**	READ JUMPER AT STARTUP, THEN I2C

I	BIT INPUT
O	BIT OUTPUT
A(I)	ALTERNATE FUNCTION (INPUT)
A(O)	ALTERNATE FUNCTION (OUTPUT)
A(A)	ALTERNATE FUNCTION (ANALOG)
A(C)	ALTERNATE FUNCTION (COUNTER)
INT	INTERRUPT/WAKEUP

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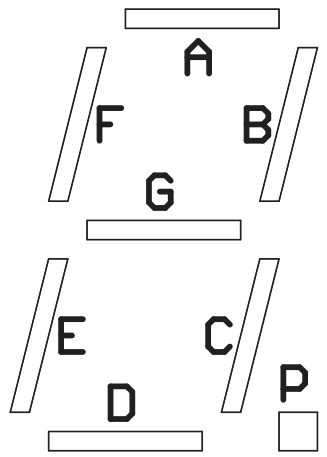
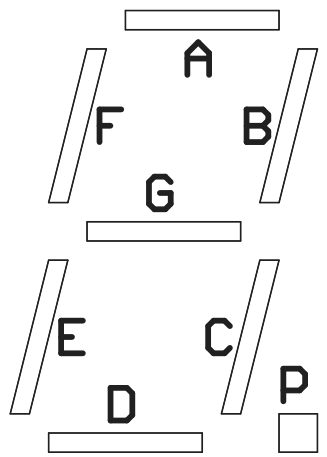
TLC5917 BIT PATTERNS



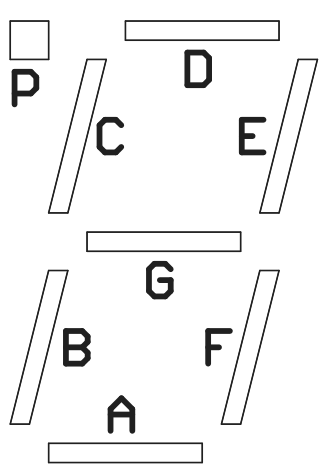
PIN		SEGMENT	0	1	2	3	4	5	6	7	8	9
OUT0	5	CA	1		1	1		1		1	1	1
OUT1	6	CB	1	1	1	1	1			1	1	1
OUT2	7	CC	1	1		1	1	1	1	1	1	1
OUT3	8	CP										
OUT4	9	CE	1		1				1		1	
OUT5	10	CD	1		1	1		1	1		1	
OUT6	11	CG			1	1	1	1	1		1	1
OUT7	12	CF	1				1	1	1		1	1
	TLC5917 PATTERN		B7	06	73	67	C6	E5	F4	07	F7	C7

LED DISPLAY ON BACK SIDE



PIN		SEGMENT	0	1	2	3	4	5	6	7	8	9
OUT0	5	CF	1				1	1	1		1	1
OUT1	6	CG			1	1	1	1	1		1	1
OUT2	7	CD	1		1	1		1	1		1	
OUT3	8	CE	1		1				1		1	
OUT4	9	CP										
OUT5	10	CC	1	1		1	1	1	1	1	1	1
OUT6	11	CB	1	1	1	1	1			1	1	1
OUT7	12	CA	1		1	1		1		1	1	1
	TLC5917 PATTERN		ED	60	CE	E6	63	A7	2F	E0	EF	E3

LED DISPLAY INVERTED



PIN		SEGMENT	0	1	2	3	4	5	6	7	8	9
OUT0	5	CA	1		1	1		1	1		1	
OUT1	6	CB	1		1				1		1	
OUT2	7	CC	1				1	1	1		1	1
OUT3	8	CP										1
OUT4	9	CE	1	1	1	1	1			1	1	1
OUT5	10	CD	1		1	1		1		1	1	1
OUT6	11	CG			1	1	1	1	1		1	1
OUT7	12	CF	1	1		1	1	1	1	1	1	1
	TLC5917 PATTERN		B7	90	73	F1	B4	E5	C7	B0	F7	FC

zNEO ENABLES TO TLC5917

			PORT	
	OE1	THOUSANDS DIGIT	PH0	
	LE1		PH1	
	OE2	HUNDREDS DIGIT	PB4	
	LE2		PB5	
	OE3	TENS DIGIT	PB6	
	LE3		PB7	
	OE4	UNITS DIGIT	PH2	
	LE4		PH3	
	OE5	STATUS LEDS	PC6	
	LE5		PC7	

zNEO ANALOG CHANNELS

CHANNEL	PORT	COEFFICIENTS
CONFIGURATION VOLTAGE (RESISTOR DIVIDER)	PB0	
BATTERY VOLTAGE MONITOR (RESISTOR DIVIDER)	PB1	
TEMPERATURE MONITOR (RESISTOR DIVIDER)	PB2	
NOT USED	PB3	
NOT USED	PB4	
NOT USED	PB5	
NOT USED	PB6	
NOT USED	PB7	

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Project Name

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COUNTER CONFIGURATION

PULSE/REV	PULSE RATE (Hz)				INTEG. PER. MULT.		
	500RPM	1000RPM	5000RPM	6000RPM	1000mS	250mS	100mS
1	8.33	16.66	83.33	100	60.0	240.0	600.
2	16.66	33.33	166.6	200	30.0	120.0	300.
3	25.00	50.00	249.9	300	20.0	80.0	200.
4	33.33	66.66	333.3	400	15.0	60.0	150.
5	41.66	83.33	416.7	500	12.5	50.0	125.
6	50.00	100.0	500.0	600	10.0	40.0	100.
7	58.33	116.6	583.3	700	8.571	34.28	85.71
8	66.66	133.3	666.7	800	7.5	30.0	75.
9	75.00	150.0	750.0	900	6.666	26.66	66.66
10	83.33	166.6	833.3	1000	6.0	24.0	60.
11	91.66	183.3	916.6	1100	5.455	21.80	54.55
12	100.0	200.0	1000.	1200	5.0	20.0	50.

LINE CALIBRATION 60 HZ 3600 PPM	RAW COUNT RATE FROM INTERRUPT ROUTINE			
	CAL MODE: 10 Sec Int Per 600.00	60.00	15.00	6.00

Drawn KC0JFQ 2020-10-10		The University of Iowa Department of Physics & Astronomy Iowa City, IA, USA	
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CAGE 2D354	Series 102 (Project Name)	B	Number 73189 / Rev 1
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