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
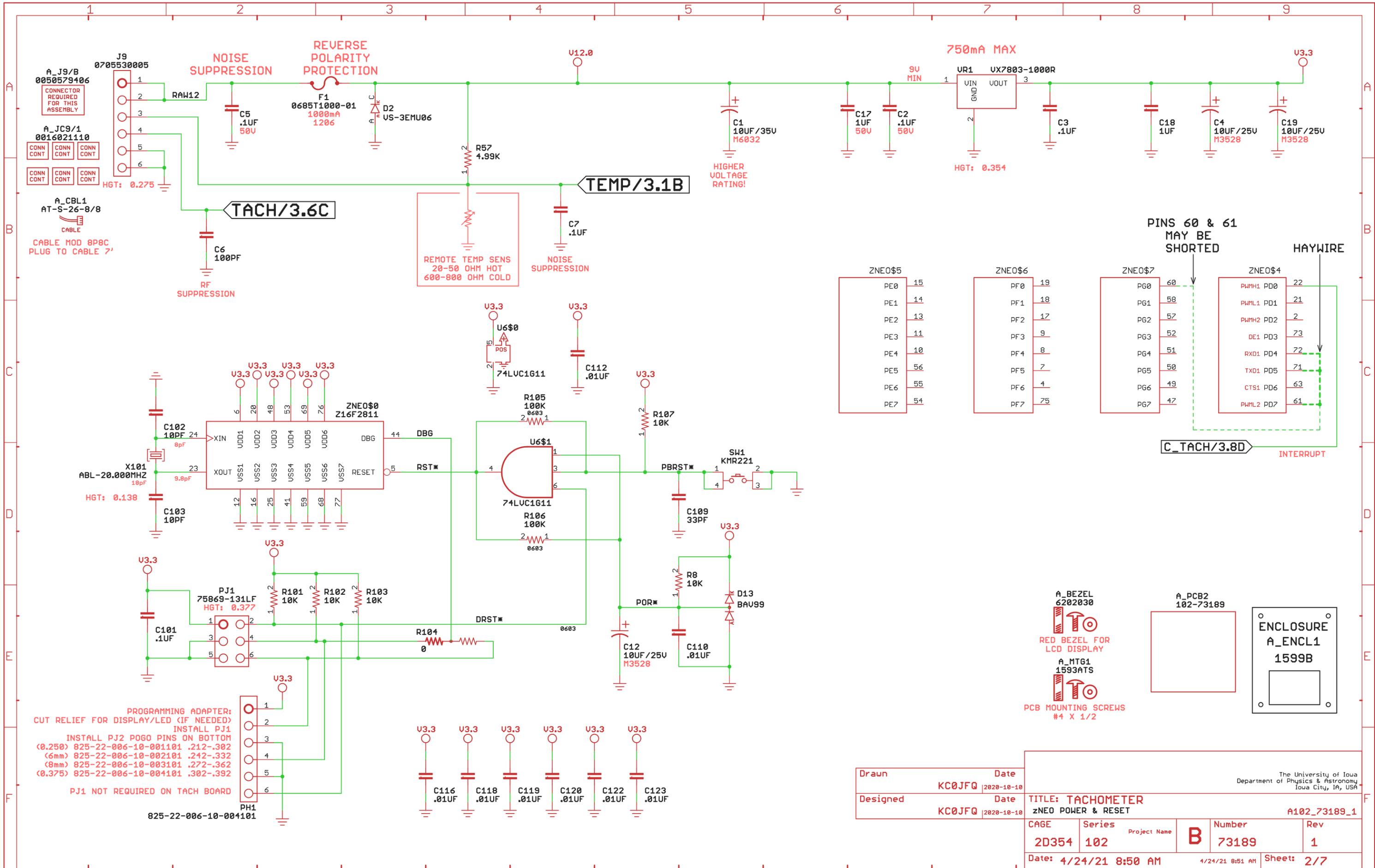   ON 2ND. BOARD INCARNATION (REDUCE PARTS ON PRODUCTION BOARD)

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

NOISE SUPPRESSION

REVERSE POLARITY PROTECTION

750mA MAX

J9
0705530005

A_J9/B
0050579406
CONNECTOR REQUIRED FOR THIS ASSEMBLY

A_JC9/1
0016021110
CONN CONT (×6)

RAW12

A_CBL1
AT-S-26-8/8
CABLE

CABLE MOD 8P8C PLUG TO CABLE 7'

C5 .1UF 50V

F1 0685T1000-01 1000mA 1206

D2 VS-3EMU06

V12.0

9V MIN

VR1 VX7803-1000R
VIN VOUT GND

V3.3

C1 10UF/35V M6032

C17 1UF 50V

C2 .1UF 50V

C3 .1UF

C18 1UF

C4 10UF/25V M3528

C19 10UF/25V M3528

HGT: 0.354

HIGHER VOLTAGE RATING!

R57 4.99K

TEMP/3.1B

TACH/3.6C

HGT: 0.275

C6 100PF

RF SUPPRESSION

REMOTE TEMP SENS 20-50 OHM HOT 600-800 OHM COLD

C7 .1UF

NOISE SUPPRESSION

PINS 60 & 61 MAY BE SHORTED

HAYWIRE

ZNEO$5
PE0 15
PE1 14
PE2 13
PE3 11
PE4 10
PE5 56
PE6 55
PE7 54

ZNEO$6
PF0 19
PF1 18
PF2 17
PF3 9
PF4 8
PF5 7
PF6 4
PF7 75

ZNEO$7
PG0 60
PG1 58
PG2 57
PG3 52
PG4 51
PG5 50
PG6 49
PG7 47

ZNEO$4
PWMH1 PD0 22
PWML1 PD1 21
PWMH2 PD2 2
DE1 PD3 73
RXD1 PD4 72
TXD1 PD5 71
CTS1 PD6 63
PWML2 PD7 61

C_TACH/3.8D

INTERRUPT

V3.3

U6$0
POS
74LVC1G11

C112 .01UF

V3.3

R105 100K 0603

R107 10K

V3.3

C102 10PF 8pF

ZNEO$0
Z16F2811
XIN VDD1 VDD2 VDD3 VDD4 VDD5 VDD6
XOUT VSS1 VSS2 VSS3 VSS4 VSS5 VSS6 VSS7
DBG 44
RESET 5

V3.3 (×6)

X101 ABL-20.000MHZ 10pF 9.8pF

HGT: 0.138

C103 10PF

DBG

RST*

U6$1
74LVC1G11

R106 100K 0603

PBRST*

SW1 KMR221

C109 33PF

C101 .1UF

V3.3

PJ1 75869-131LF
HGT: 0.377

R101 10K
R102 10K
R103 10K

DRST*

0603

POR*

R8 10K

D13 BAV99

V3.3

R104 0

C12 10UF/25V M3528

C110 .01UF

A_BEZEL 6202030
RED BEZEL FOR LCD DISPLAY

A_PCB2 102-73189

ENCLOSURE A_ENCL1 1599B

A_MTG1 1593ATS
PCB MOUNTING SCREWS #4 X 1/2

PROGRAMMING ADAPTER:
CUT RELIEF FOR DISPLAY/LED (IF NEEDED)
INSTALL PJ1
INSTALL PJ2 POGO PINS ON BOTTOM
(0.250) 825-22-006-10-001101 .212-.302
(6mm) 825-22-006-10-002101 .242-.332
(8mm) 825-22-006-10-003101 .272-.362
(0.375) 825-22-006-10-004101 .302-.392

PJ1 NOT REQUIRED ON TACH BOARD

PH1
825-22-006-10-004101

V3.3 (×6)

C116 .01UF
C118 .01UF
C119 .01UF
C120 .01UF
C122 .01UF
C123 .01UF

zNEO EXTERNAL INTERFACE — Schematic (Sheet 3/7)

L_TEMP

C10 100PF

V3.3 V3.3 U7$0
POS
LMV321

REMOTE TEMP SENS
5K PULLUP TO 3.3V
20-50 OHM HOT
250/100: 13mV-33mV
600-800 OHM COLD
9.3/7.2: 354mV-456mV

R28 2.49K

C11 .01UF

V3.3
R38 10.0K
D4 BAV99
TEMP/2.4B
U7$1 LMV321

A_TEMP

VOLTAGE GAIN
×4
12dB

V12.0
R58 N/A 11.0K
R50 2.32K
1.0V
C15 .01UF
R51 1.00K

R48 10K
C14 .1UF

V12.0
11V = 200uA
15V = 1000uA
DZ2 LM4040-N
10V
100uA MIN
R52 2.49K

BATTERY
VOLTAGE
MONITOR

15V IS FULL SCALE (2.5V)
10V IS ZERO

C20 .01UF
R54 2.49K

CONFIG

V3.3
R55 5.36K
ABOUT 500uA
R56 1.27K
C21 .01UF

V3.3
R63 10K
V3.3
TST
JP2 PBC02SAAN

ZNEO$1
T0IN/T0OUT PA0	1	
T0OUT PA1	80	
DE0 FAULTY PA2	79	
CTS0* FAULT0 PA3	78	
RXD0 PA4	67	
TXD0 PA5	66	
SCL PA6	65	
SDA PA7	64	

R59 10K

U10$1 74LVC2G07

U10$2 74LVC2G07

V3.3
C26 .01UF
U12
SDA SCL
VCC
GND WP
24CW128
FLASH 128Kb
16KB
512 RECORDS (32B)

24CW32
FLASH 32Kb
2KB
64 RECORDS (32B)
32 BYTE PAGE SIZE
I2C ADDRESS 0xA0/0xA1
WRITE CYCLE 5mS

R62 10K   R60 10K
V3.3 V3.3

V3.3 V3.3
U10$0 POS
74LVC2G07
C22 .01UF
C24 100PF

DEBUGGING ADAPTER:
CUT RELIEF FOR DISPLAY/LED (IF NEEDED)
INSTALL J2
INSTALL JH2 POGO PINS ON BOTTOM
(0.250) 825-22-003-10-001101 .212-.302
(6mm) 825-22-003-10-002101 .242-.332
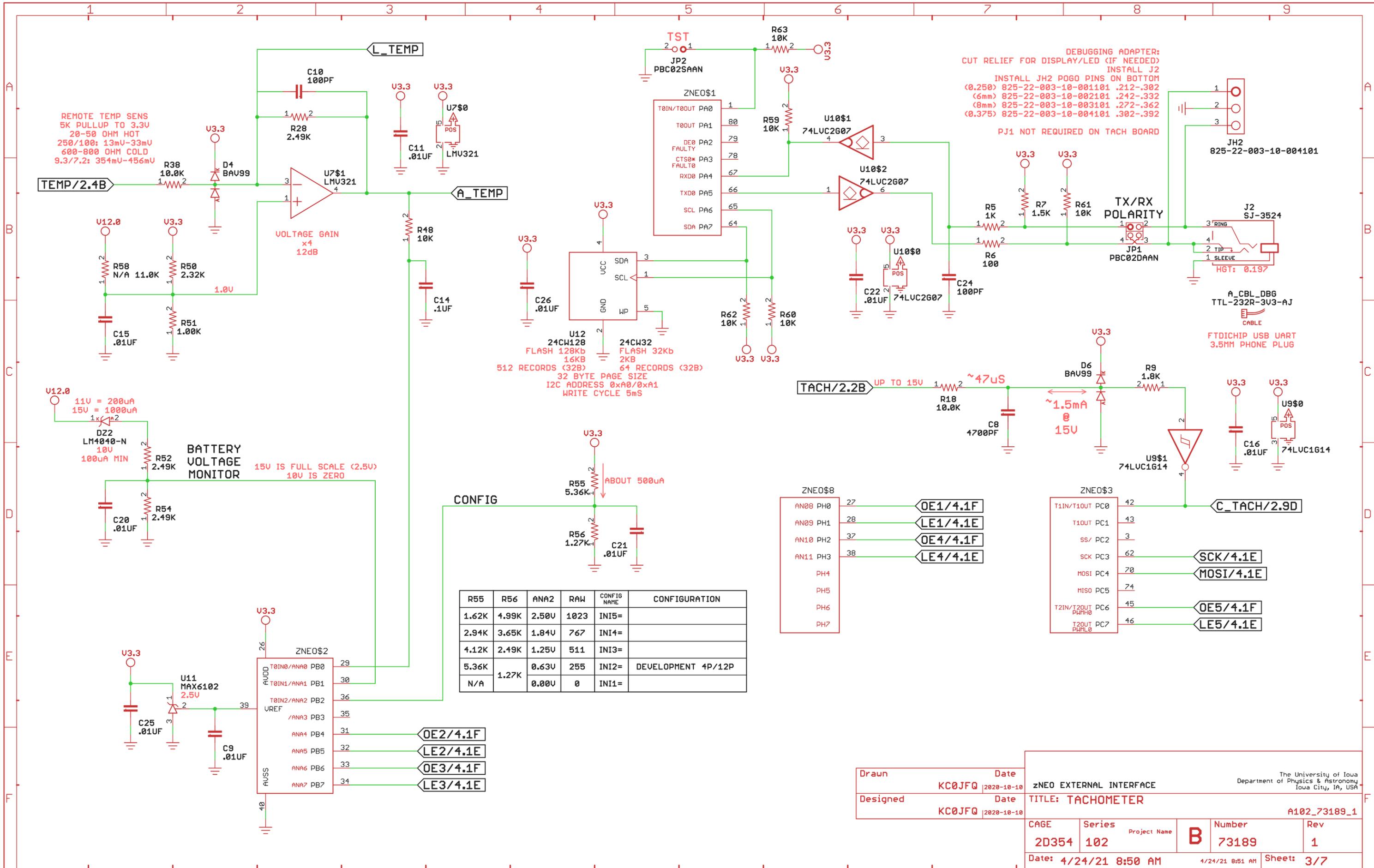(8mm) 825-22-003-10-003101 .272-.362
(0.375) 825-22-003-10-004101 .302-.392

PJ1 NOT REQUIRED ON TACH BOARD

JH2
825-22-003-10-004101

V3.3 V3.3
R5 1K
R7 1.5K
R61 10K
TX/RX
POLARITY
R6 100

J2 SJ-3524
RING
TIP
SLEEVE
JP1 PBC02DAAN
HGT: 0.197

A_CBL_DBG
TTL-232R-3V3-AJ
CABLE

FTDICHIP USB UART
3.5MM PHONE PLUG

TACH/2.2B UP TO 15V
R18 10.0K
~47uS
C8 4700PF
~1.5mA @ 15V
D6 BAV99
R9 1.8K
V3.3 V3.3
C16 .01UF
U9$0 POS
74LVC1G14
U9$1 74LVC1G14

C_TACH/2.9D

ZNEO$8
AN08 PH0	27	OE1/4.1F
AN09 PH1	28	LE1/4.1E
AN10 PH2	37	OE4/4.1F
AN11 PH3	38	LE4/4.1E
PH4		
PH5		
PH6		
PH7		

ZNEO$3
T1IN/T1OUT PC0	42	C_TACH/2.9D
T1OUT PC1	43	
SS/ PC2	3	
SCK PC3	62	SCK/4.1E
MOSI PC4	70	MOSI/4.1E
MISO PC5	74	
T2IN/T2OUT PWMH0 PC6	45	OE5/4.1F
T2OUT PWML0 PC7	46	LE5/4.1E

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	1.27K	0.00V	0	INI1=	

V3.3
U11 MAX6102
2.5V
C25 .01UF
C9 .01UF

ZNEO$2
T0IN0/ANA0 PB0	29	
T0IN1/ANA1 PB1	30	
T0IN2/ANA2 PB2	36	
/ANA3 PB3	35	
ANA4 PB4	31	OE2/4.1F
ANA5 PB5	32	LE2/4.1E
ANA6 PB6	33	OE3/4.1F
ANA7 PB7	34	LE3/4.1E

AVDD 26
VREF 39
AVSS 40

V3.3   V3.3   V3.3   V3.3

ALL LEDs ON
700mA 2.31W

LED1 CDSA56
LED2 CDSA56
LED3 CDSA56
LED4 CDSA56

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

R17 22   R11 22
R16 22   R19 22
R14 22   R10 22
R12 22   R15 22

R27 22   R21 22
R26 22   R29 22
R24 22   R20 22
R22 22   R25 22

R37 22   R31 22
R36 22   R39 22
R34 22   R30 22
R32 22   R35 22

R47 22   R41 22
R46 22   R49 22
R44 22   R40 22
R42 22   R45 22

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

V3.3   V3.3   V3.3   V3.3

D1 LTL-4223   D3 LTL-4223   D5 LTL-4223   D7 LTL-4223

R4 22   R3 22   R2 22   R1 22   10mA
                                    220mV
                                    V2.2mW

2000 mV	220 mV
2220 mV	
3300 mV	
1100 mV	

TLC5917 U1   OUT0 OUT1 OUT2 OUT3 OUT4 OUT5 OUT6 OUT7 SDO
VCC GND REXT SDI CLK LE OE
V3.3 C13 .01UF R13 1.2K

TLC5917 U2
V3.3 C23 .01UF R23 1.2K

TLC5917 U3
V3.3 C33 .01UF R33 1.2K

TLC5917 U4
V3.3 C34 .01UF R43 1.2K

TLC5917 U5
V3.3 C54 .01UF R53 1.2K

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

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

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

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

TITLE: TACHOMETER
TACHOMETER DISPLAY

A102_73189_1

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

Date: 4/24/21 8:50 AM   4/24/21 8:51 AM   Sheet: 4/7
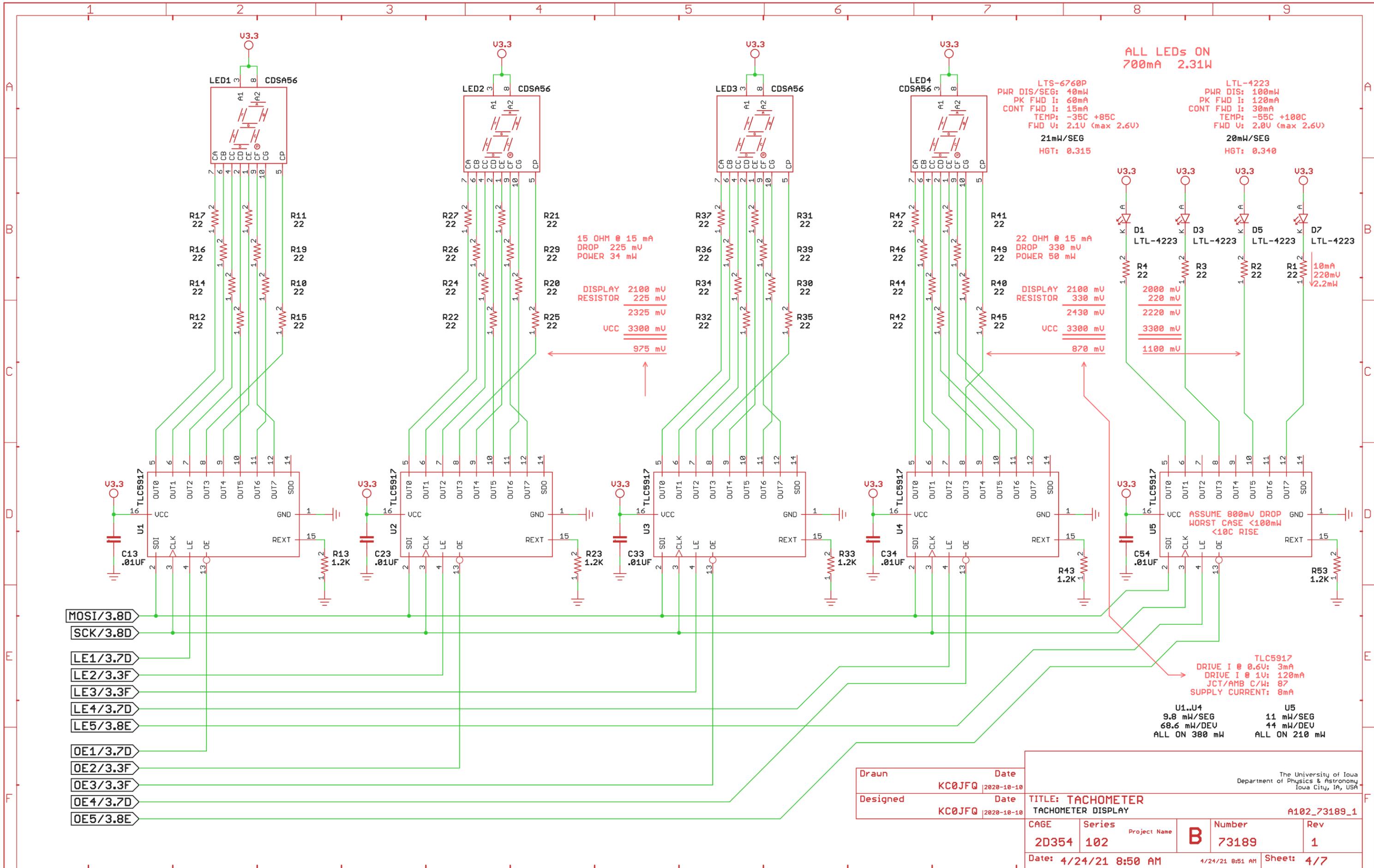
KC0JFQ UNIVERSAL TACHOMETER
PORT BIT ASSIGNMENTS

	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
```

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	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	

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