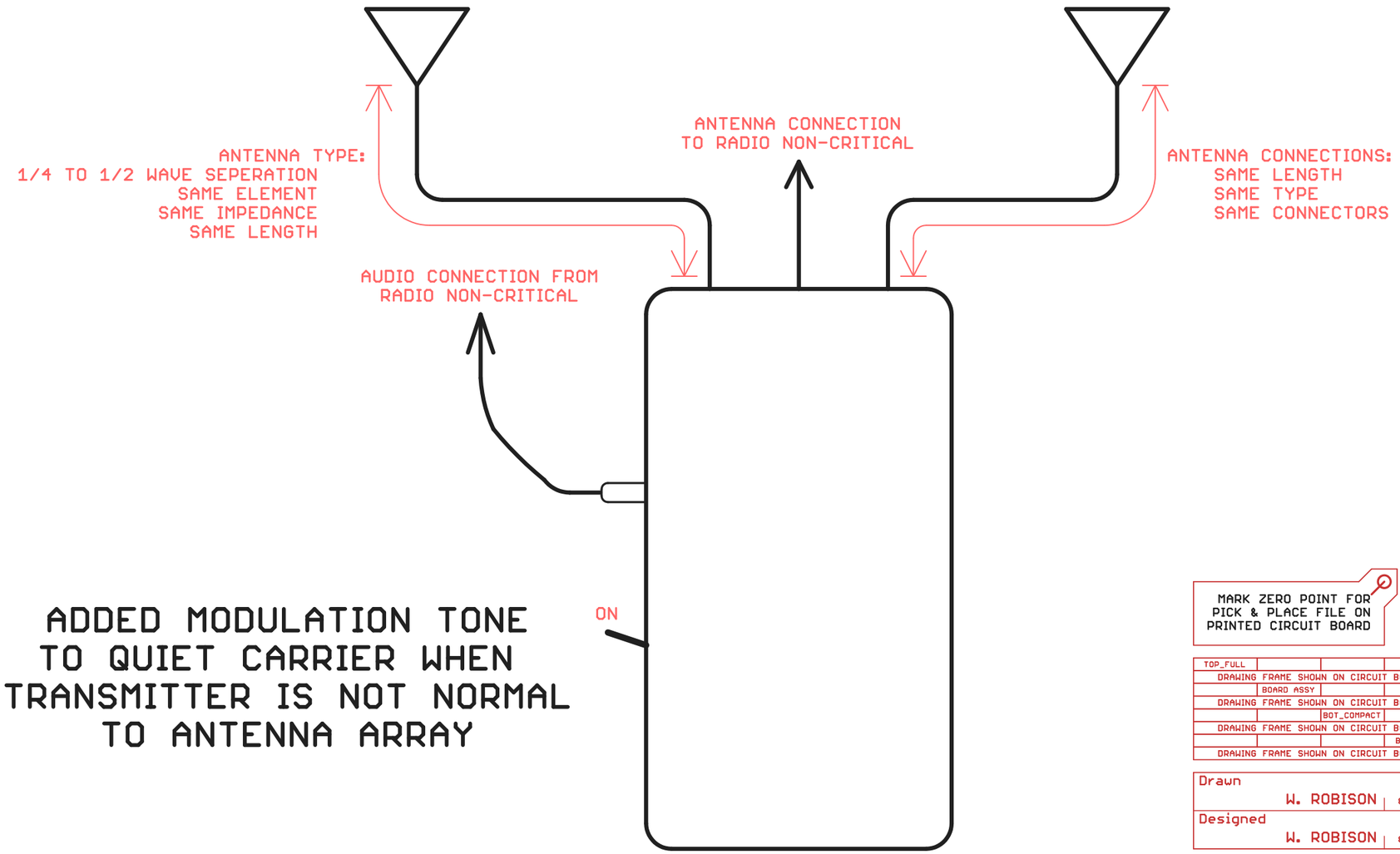
TIME DIFFERENCE OF ARRIVAL DIRECTION FINDER



ADDED MODULATION TONE
TO QUIET CARRIER WHEN
TRANSMITTER IS NOT NORMAL
TO ANTENNA ARRAY

UPDATES&CHANGES

FROM 102-73170-20:
ADD SYNCHRONOUS DETECTION
AND LED METER

CIRCUIT BOARD SIZE CHANGED
TO FIT HAMMOND 1599E ENCLOSURE

INTERNAL SPEAKER ADDED

SYNCHRONOUS DETECTOR ADDED

ANALOG METER EMULATION
(USING LEDs)

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

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

Drawn	Date
W. ROBISON	8/2019
Designed	Date
W. ROBISON	8/2019

KC0JFQ

PWB RELEASED AS 2D354 102-73170-62

PWA RELEASED AS 2D354 102-73170-62

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

TITLE: ICARC TDOA, SYNCHRONOUS

A102_73170_62

CAGE	Series		Number	Rev
2D354	102 ICARC FOX HUNT	B	73170 2 Layers	62

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Synchronous FM Detector Circuit
Mike Mladejovsky, WA7ARK
(U1, U3, U4)

http://ka7oei.blogspot.com/2016/11/tdoa-direction-finder-systems-part-1.html

AUDIO FROM RADIO — J6 SJ-3524 (RING, TIP, SLEEVE) — JP1 PBC03SAAN — AUDIO

EXTERNAL SPEAKER — J9 0705430002 — SP1 CVS-1508

C45 10UF/16V — C2 10UF/16V

V5.0 — R19 10K — R15 10K — R16 82.5K — +4.5V to +0.5V

U3$1 CD4017 — DECADE COUNTER +3V - +18V

DECADE COUNTER — CLOCK — INHIBIT — RESET — CARRY_OUT

R10 10 — R1 N/A 10 — R2 N/A 10 — R3 N/A 10 — R4 N/A 10 — R5 10 — R6 N/A 10 — R7 N/A 10 — R8 N/A 10 — R9 N/A 10

SLOT1 — INSTALL ONE RESISTOR TO SELECT SLOT1 (R10..R4) AND ONE RESISTOR TO SELECT SLOT2 (R5..R9) — SLOT2

DRIVE/3.1C

CLOCK/4.8E — RESET/4.7E

V9.0 V9.0 — C3 .01UF — U3$0 CD4017 — POS

CARRY OUT NOTE:
CARRY OUT GOES 'HI' AT END OF BIT 9
CARRY OUT GOES 'LO' AT END OF BIT 4

APPROX 10KHz — R56 4.7K — U1$3 HEF4093B — U1$4 HEF4093B — R17 10K — R12 N/A 20K — R12 FOR TESTING (LEAVE R17 OUT) — C12 .01UF — R27 10K — RESET/4.7E

SYNCHRONOUS DETECTOR/INTEGRATOR

U4$1 TS12A4514 — D, IN, S2 — ANALOG SWITCH +2.4V - +12V

U7$1 TS12A4514 — D, IN, S2

INTEG1 — R11 825K — C51 1UF X7R

INTEG2 — R13 825K — C61 1UF X7R

BUFFER AMP

U5$1 NCS20072 — UNITY GAIN +3V - +36V RAIL TO RAIL

U5$2 NCS20072

POL SEL — JP2 PBC02DAAN

R48 10K — ANA2/4.1B

R14 10K — R20 10K — R22 10K — R49 10K — ANA3/4.1B

DIFFERENTIAL AMPLIFIER — R21 10K — U6$1 NCS20072

R46 10K — ANA1/4.1A

DIFF — LEVEL SHIFT GAIN CONTROL — R26 100K — R28 200K — GAIN ADJUST — U6$2 NCS20072

R47 10K — ANA0/4.1A — J5 0705430002 METER

V5.0 — R23 1.0K — R25 5K — R24 1.0K — OFFSET ADJUST — C8 .01UF

POWERED DIRECT FROM BATTERY — V9.0 V9.0 — U1$0 HEF4093B — C1 .01UF

POWERED DIRECT FROM BATTERY — U7$0 TS12A4514 — C7 .01UF

POWERED DIRECT FROM BATTERY — U4$0 TS12A4514 — C4 .01UF

POWERED DIRECT FROM BATTERY — U5$0 NCS20072 — C5 .01UF

POWERED FROM SPLIT SUPPLY — V9.0 V9.0 — C65 .01UF — C6 .01UF — U6$0 NCS20072 — V-5.0 V-5.0

PCB1 CIRCUIT BOARD

AUDIO
CLOCK
D0 — 0 — RESET STATE
D1 — 1
D2 — 2
D3 — 3
D4 — 4
D5 — 5
D6 — 6
D7 — 7
D8 — 8
D9 — 9
CARRY OUT — RESET STATE

NEGATIVE BIAS GENERATOR

V5.0 V5.0 V5.0 — C43 .01UF — C13 .1UF — C18 10UF/16V — U8 MAX1721 (VCC, C1+, C1-, OUT, SHDN, GND, OSC) — C42 1UF — C9 1UF — C11 .01UF — C14 1UF — C10 10UF/16V — V-5.0

D2 1N4148

GP1 PAD — GP2 PAD

Drawn	W. ROBISON	Date	8/2019
Designed	W. ROBISON	Date	8/2019

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TITLE: ICARC TDOA, SYNCHRONOUS — A102_73170_62

CAGE	Series		Number		Rev
2D354	102 ICARC FOX HUNT	B	73170	2 Layers	62

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ANTENNA SWITCHING DRIVE FROM 102-73170-20

CHEESY DELAY LINE
PULL GLITCH INTO SAMPLING WINDOW

DRIVE/2.3C

U1$2 HEF4093B

U1$1 HEF4093B

V9.0

THIS BETTER BE A SQUARE WAVE!

U2$4 CD4049

U2$5 CD4049

U2$6 CD4049

U2$1 CD4049

U2$2 CD4049

U2$3 CD4049

U13$4 CD4050

U13$5 CD4050

U13$6 CD4050

U13$1 CD4050

U13$2 CD4050

U13$3 CD4050

DC ISOLATION

C24 10UF/16V

C22 10UF/16V

C23 10UF/16V

8V (BATTERY)

0V

RF ISOLATION

C3A 47PF RF TRAP

C3B 47PF RF TRAP

C3C 47PF RF TRAP

L1A 100nH

L1B 100nH

L1C 100nH

-3V

-11V

+11V

+3V

+4V

-4V

POWERED DIRECT FROM BATTERY

U13$0 CD4050

U2$0 CD4049

C21 .01UF

BNC FROM ANTENNA

J2$1 5414373-1 RF2-49B

J3$1 5414373-1 RF2-49B

MAY SUBSTITUTE 0 OHM

C5A 1000PF

C5B 1000PF

Silicon PIN Diode
Vr = 50V
Ct(5V) = 0.3pF
Rp(0V) = 500K Ohm
Rf(5mA) = 1 Ohm
Vf ~= 850mV

D1 1SV267 BAR63-04

2mA Rf(+850mV) 2 Ohm

0mA Rp(-8V) 500K OHM

R5A 2.00K

R4A 825K

R4C 825K

R5B 2.00K

R4B 825K

5uA

LEFT_BIAS

RIGHT_BIAS

RADIO_BIAS

U2 PROVIDES BIAS CURRENT

THE BIAS VOLTAGE ON D1-3
IS ALWAYS OPPOSITE D1-1 AND D1-2
R4x3 PROVIDES A GROUND REFERENCE
R5x3 LIMITS FORWARD BIAS CURRENT
TO ABOUT 1.75mA
D1 IS ABOUT 850mV WHEN FORWARD BIASED
D1 IS ABOUT 1.5 x BATTERY VOLTAGE
WHEN REVERSE BIASED

D1 IS THE ANTENNA SWITCH

THE FORWARD BIASED DIODE
CARRIES THE RF SIGNAL
NOTE THE RF IMPEDANCE IS LOW
THE REVERSE BIASED DIODE
BLOCKS THE RF SIGNAL
NOTE HERE THE RF IMPEDANCE
IS VERY HIGH (500K)

R5C 2.00K

C17 1000PF

RADIO_RF

J1$1 RF2-49B 5414373-1

SMA TO RADIO

R18 825K RECEIVER ACCOMMODATION

RF SWITCHING

D1 BIAS LEVELS		
BATTERY	Vf	Vr
8V	850mV	-15V
7V	850mV	-13V
6V	850mV	-11V

J4 0705530002

$3.84 TINY BAT (RECESSED)
$9.54 EXPOSED BAT
SW2 ET01MD1ABE
200USP1T1A1M6RE

F1 500MA

CONNECTION POINT FOR FUSE!

D10 ER502

REVERSE PROTECTION 8A

C73 10UF

INPUT FILTER

C19 .1UF

C15 .01UF

VR3 R-78K5.0-0.5

VIN GND VOUT

C16 .1UF

C46 .1UF

C28 10UF

C44 10UF

V9.0

V5.0

ENCLOSURE
ENCL1
1599EBKBAT

THIS BOARD CONTAINS STATIC SENSITIVE DEVICES. HANDLE ONLY IN STATIC SAFE ENVIRONMENT

Drawn	W. ROBISON	Date 8/2019
Designed	W. ROBISON	Date 8/2019

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TITLE: ICARC TDOA, SYNCHRONOUS

A102_73170_62

CAGE	Series		Number		Rev
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ANALOG INPUTS FROM SYNCHRONOUS DETECTOR

ANA0/2.9B — METER DRIVE
ANA1/2.8B — DIFFERENCE
ANA2/2.7B — BUFFERED INTEGRATOR 1
ANA3/2.7C — BUFFERED INTEGRATOR 2
ANA4 — SPARE/CONFIG

V3.3 — N/A R55

R52 10K

C38 .01UF — R51 10K
C39 .01UF — R50 10K
C40 .01UF — R54 N/A
C41 .01UF — R53 N/A

REVERSE VOLTAGE PROTECTION
D4 BAS100
D5 BAS100
LOW REVERSE LEAKAGE SCHOTTKY DIODE
VF < 0.59V
IR < 5nA

U9$B
PB0 ANA0
PB1 ANA1
PB2 ANA2VREF
PB3 ANA3
PB4 ANA4/7
AVDD
AVSS

C33 .01UF
C34 .01UF

U12 MAX6102 2.5V

eZ8 Encore! (Z8F1680)

THE Z8 IS USED TO IMPLEMENT A LOW RESOLUTION METER (i.e. ANALOG METER SIMULATION)
ANALOG METERS ARE DIFFICULT TO FIND, SO THIS PROVIDES A METER REPLACEMENT.

THE CIRCUIT BOARD MAY BE CUT OUT AROUND THE EZ8 TO MAKE ROOM FOR AN ANALOG METER, THE RING OF LEDs RUN ALONG A CUTTING GUIDE TO ALLOW THE REMOVAL OF EVERYTHING ON THIS SHEET OF THE SCHEMATIC.

THE Z8F1680 DEVICE HAS 16KB OF PROGRAM FLASH AND 2KB OF DATA RAM. THE SOFTWARE SIMPLY IMITATES AN ANALOG METER MOVEMENT. THE 'LD5' LED IS THE MID-RANGE POINT.

ANALOG METER EMULATION

CCW				CENTER				CW
BR-RED	RED	ORANGE	YELLOW	GREEN	YELLOW	ORANGE	RED	BR-RED
2.1V	2.0V	2.0V	2.1V	2.1V	2.1V	2.0V	2.0V	2.1V
10mA	10mA	10mA	10mA	10mA	10mA	10mA	10mA	10mA
657nm	635nm	621nm	588nm	569nm	588nm	621nm	635nm	657nm
V5.0	V5.0	V5.0	V5.0	V5.0	V5.0	V5.0	V5.0	V5.0
LD1 LTL-4213	LD2 LTL-4223	LD3 LTL-4293	LD4 LTL-4253	LD5 LTL-4233	LD6 LTL-4253	LD7 LTL-4293	LD8 LTL-4223	LD9 LTL-4213

U9$C
PC0 — R32 270
PC1 — R33 470
PC2 — R30 470
PC3 — R31 470
PC4 — R34 470
PC5 — R35 270
PC6 — R36 470
PC7 — R37 470

R29 470

Z8F 3.3V FLASH PROGRAMMER

J7 75869-131LF
R43 10K
R44 10K
R45 10K
0 R38
SW1 KMR221
R39 3.3K
U10$1 74LVC1G11
R40 10K
D3 BAV199
C32 10UF/16V

Z8F OSCILLATOR AND RESET

X1 ECS-200-20-4X
C35 .1UF
C31 10PF
C30 10PF
U9$0 Z8F1680
XIN
XOUT
VDD
VSS
DBG
RESET

U10$0 74LVC1G11
C37 .01UF

U11$0 74LVC2G17
C36 .01UF

Z8F 3.3V SUPPLY

VR2 ZLDO1117-3.3
VIN
VOUT
GND
VOUT1
C25 .1UF
C20 .01UF
C26 .01UF
C27 .1UF
C29 10UF

Z8F 3.3V DEBUG PORT

J8 SJ-3524
TTL-232R-3V3-AJ
3.5mm TIP-SLV-RNG
TIP Tx
RING Rx
R57 10K
R41 10
R42 10
U11$1 74LVC2G17
U11$2 74LVC2G17
RESET/2.3C
DYNAMIC STATE
J2 SELECTED
EZ8 10KHZ CLOCK GENERATE or INTERRUPT
CLOCK/2.1B

PA2 PAD

U9$A
XIN T0IN
XOUT T0OUT
PA2 DE0
PA3 CTS0
PA4 RXD0
PA5 TXD0
PA6 T1IN SCL T1OUT
PA7 T1OUT SDA

Drawn	W. ROBISON	Date	8/2019	The University of Iowa Department of Physics & Astronomy Iowa City, IA, USA	
Designed	W. ROBISON	Date	8/2019	TITLE: ICARC TDOA, SYNCHRONOUS	A102_73170_62
CAGE 2D354	Series 102 ICARC FOX HUNT	B	Number 73170	2 Layers	Rev 62
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