



# The W8UM Shack Primer

*Facts our members should know before seeking Station Manager approval to operate the shack communications equipment*

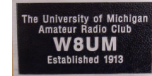
## Part II

**Bill AA8RW**

Thursday, January 27, 2011, 6:30 pm  
EECS 3427

W8UM Amateur Radio Club

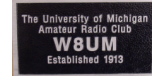
NOTE: A copy of this presentation will appear on a W8UM computer shortly.



# What will be covered

*Compendium of theory, references, setups, specifications, operating procedures, software and safety useful in the W8UM shack.*

- Antennas
- Shack Stations
  - Workbench
  - Two meter
  - EchoLink
  - HF
  - Satellite
- Safety
- References

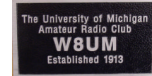


# General Comments

- Many of the following slides were taken from other presentations
  - Please ignore page numbers
  - Figure numbers, though odd, will be referred to occasionally
- Too much detail on slides
  - Intended mainly for reference
  - We'll ignore most detail
  - Refer to it later as you need it
- Apologies for poor slide quality
  - Old or non-existent manuals and references



# Caveats



- This presentation is intended to serve as
  - An **intuitive** background of the W8UM facilities
  - A **jumping off start** for those new to ham communication equipment
  - A review for those who have prior experience
- Much **more study is necessary** to operate any of the stations described in this presentation
  - Many secondary considerations have been neglected
  - Not all connection details have been described
  - Only basic operations have been included
  - Specific FCC rules have not been mentioned
- The **responsibility of learning** the necessary details **is left to the new ham operator**
  - Many of the finer details will be answered during your sessions with K8QKY and other more experienced Elmers. Don't be afraid to ask questions
  - Much will be learned by hands-on experience and by
    - Reviewing your license study material
    - Reading QST, CQ Magazines and other ham journals, manuals and other literature
- I'm not infallible. Let me know of errors, omissions or could-of-done



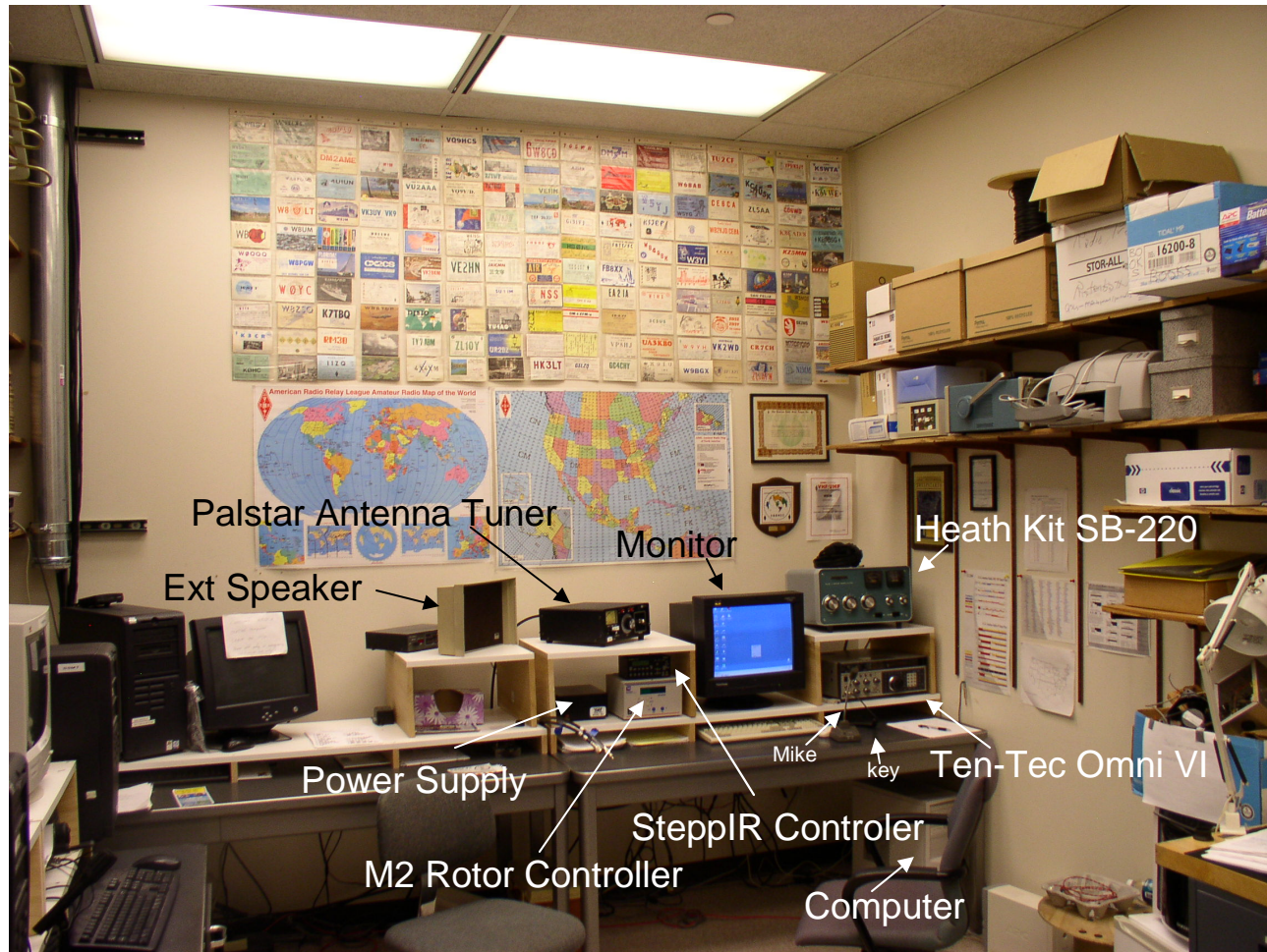
# HF Station

- HF Components
- Interconnections
- Listening
  - Selecting Band
  - Using Inverted-Vee (80-40m Dipole)
  - Operating Ten-Tec Transceiver
- Transmitting with Inverted-Vee
  - Palstar Antenna Tuner
  - CW Operating skills
    - Reference data
    - CW QSO example
  - Choosing Bands with Ham Cap
  - Logging & QSL cards
- Heathkit Linear
- Transmitting with SteppIR & Rotor
  - SteppIR Control
  - M<sup>2</sup> Antenna Rotor





# W8UM: HF Station

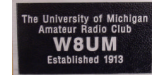


HF Operating Station



# Ten-Tec Omni VI HF Transceiver



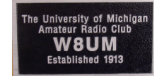


# Omni VI General Specs

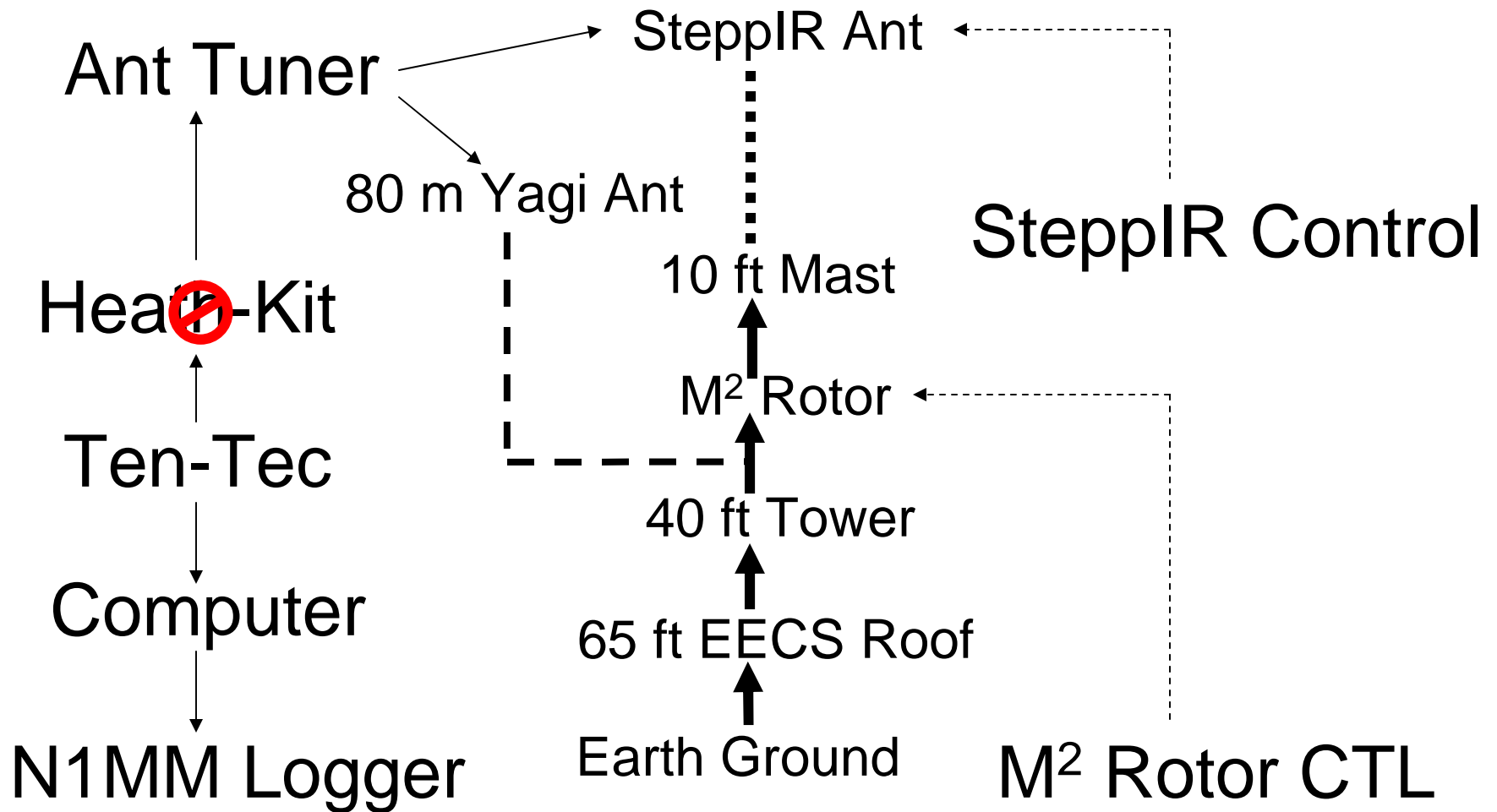
See Manual, pp viii

MODES *	USB, LSB, CW, FSK OR AFSK, FM built-in.
FREQUENCY RANGE *	All ham bands 160 through 10 meters, Twelve 500 KHz segments with 30 KHz over-shoot at upper and lower band edges.
DISPLAY	7 digit to 10 Hz resolution, .56" LED, 2 secondary .3" displays for clock, memory channel and offset.
FREQUENCY CONTROL	LO generated with a crystal oscillator mixed with a low noise 4.97 - 5.53 MHz phase locked loop.
OFFSET TUNING	+/- 9.99 KHz, receive and transmit.
DUAL VFOs	with SPLIT mode
MEMORIES	100 duplex memories, one scratch pad memory (battery backup, 2-3 yr life)
PC INTERFACE	Serial port operation of receive and transmit. Includes two line and RS-232 interface. Runs at 1200, 2400, 4800, 9600 or 19200 baud.
FREQUENCY ACCURACY	+/- 50 Hz @ 25 degrees C. NOTE: The frequency will shift noticeably for 1-2 minutes while the oven heats up when first turned on. Leave power supply on to eliminate the drift.
ANTENNA	50 ohm unbalanced
REMOTE BAND SWITCHING	Selects antenna or other station accessories.
POWER REQUIRED	2 A receive, 20 A transmit @ 12-14 VDC
CONSTRUCTION	20 G10 epoxy glass PC boards, most field replaceable. Extruded aluminum front panel, aluminum chassis, texture painted top & bottom, snap up stainless steel bail.
DIMENSIONS	HWD 5.75" x 14.75" x 17" - 14.6 x 37.5 x 43.2 cm
WEIGHT	16 lbs - 7.25 kg





# HF Component Relationships





# W8UM: HF Components

\* Power Supply connections not shown

Heathkit Linear Amplifier



**Do not turn on**

SteppIR Control



SteppIR 40m-6m  
Yagi Antenna

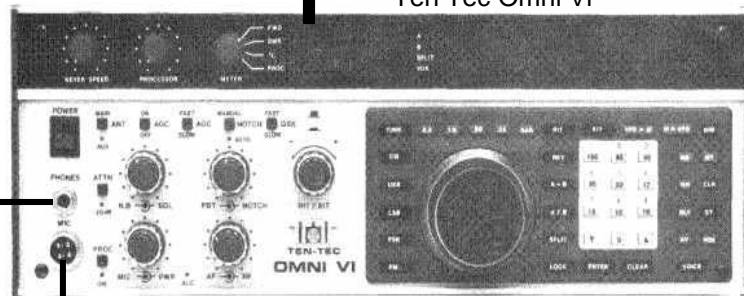
Palstar Antenna Tuner



80m Inverted Vee  
Antenna

Ear phones

Ten Tec Omni Vi



Microphone

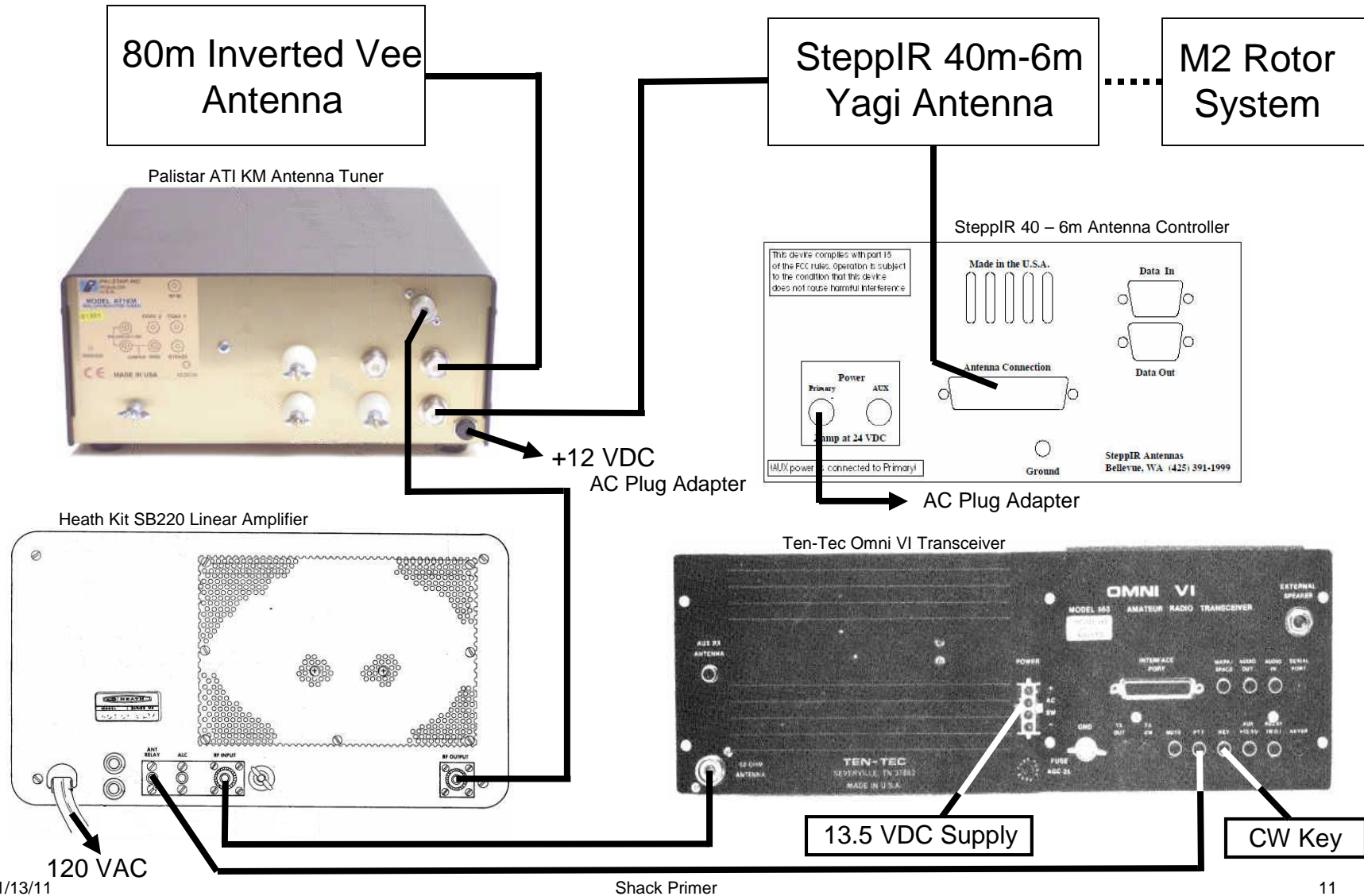
M2 Antenna Rotor Control



M2 Antenna Rotor

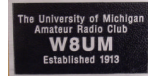


# W8UM: HF Station Connections





# W8UM Tech Class Radio Bands



Y - Yaseu  
 T - Ten-Tec  
 V - Inverted-Vee  
 S - SteppIR

LSB < 10 MHz  
 USB > 10 MHz

**US Amateur Radio Bands**  
 US AMATEUR POWER LIMITS  
 At all times, transmitter power should be kept down to that necessary to carry out the desired communications. Power is rated in watts PEP output. Except where noted, the maximum power output is 1500 Watts.

Effective Date: **May 6, 2008**

Published by: **ARRL** The national association for AMATEUR RADIO. www.arrl.org  
 225 Main Street, Norwalk, CT USA 06111-1494

**KEY**

- RTTY and data
- phone and image
- CW only
- SSB phone
- USB phone only
- Fixed digital message forwarding systems only

**Notes:**  
 CW operation is permitted throughout all amateur bands except 80 meters.  
 MCW is authorized above 50.1 MHz, except for 219-220 MHz.  
 Test transmissions are authorized above 51 MHz, except for 219-220 MHz.

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[http://www.arrl.org/files/file/Hambands\\_color.pdf](http://www.arrl.org/files/file/Hambands_color.pdf)

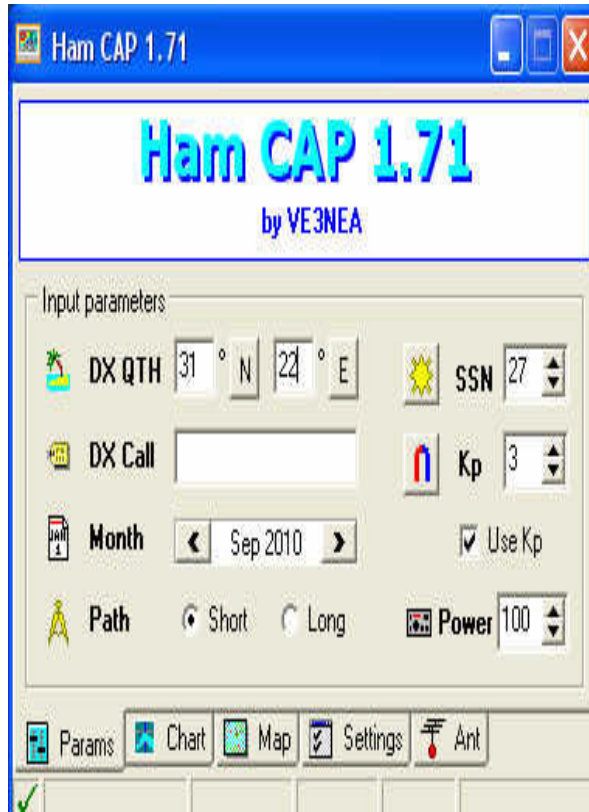


# DX to Greece

(9-18-2010)



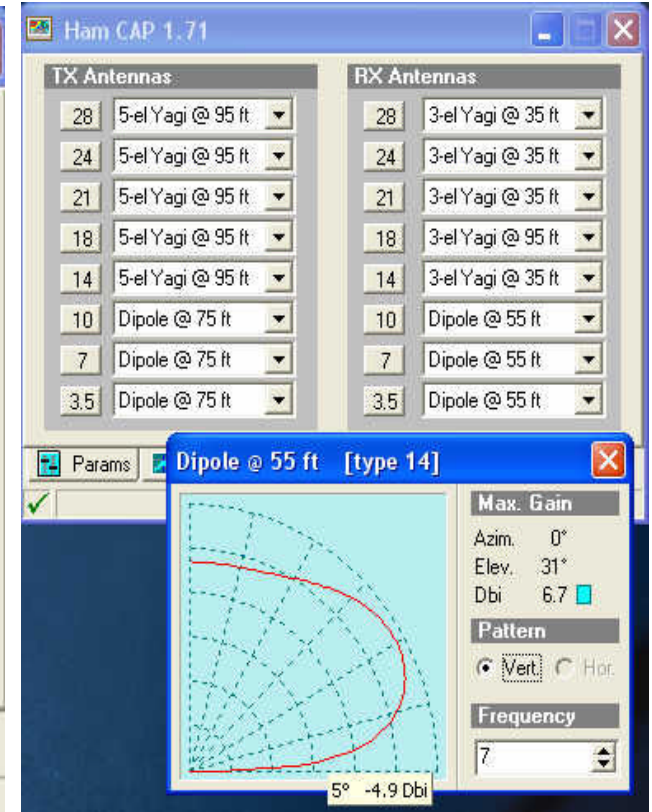
## Ham Cap\* Propagation Analysis: Setup



Greece: 31° N, 22° E

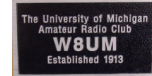


W8UM: 42° N, 83° E

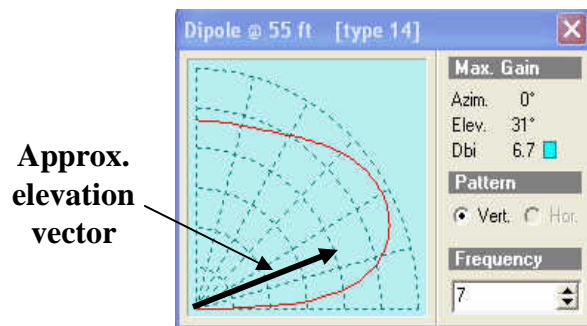
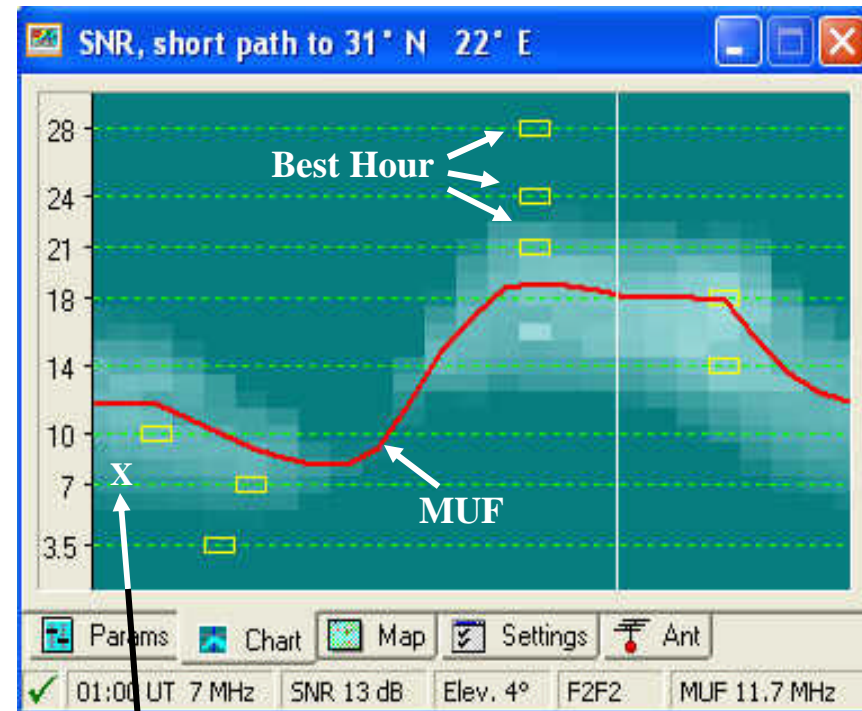
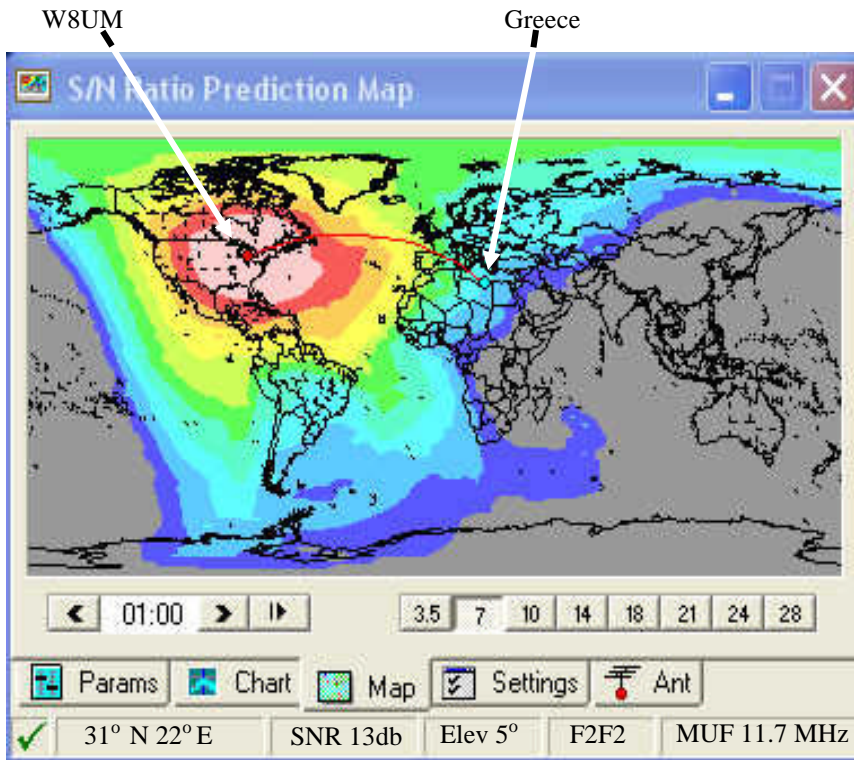


Approx Ant: Dipole @ 55 ft and 7 Mhz (40 m)

\* <http://www.dxatlas.com/HamCap/>



# DX to Greece (9-18-2010)





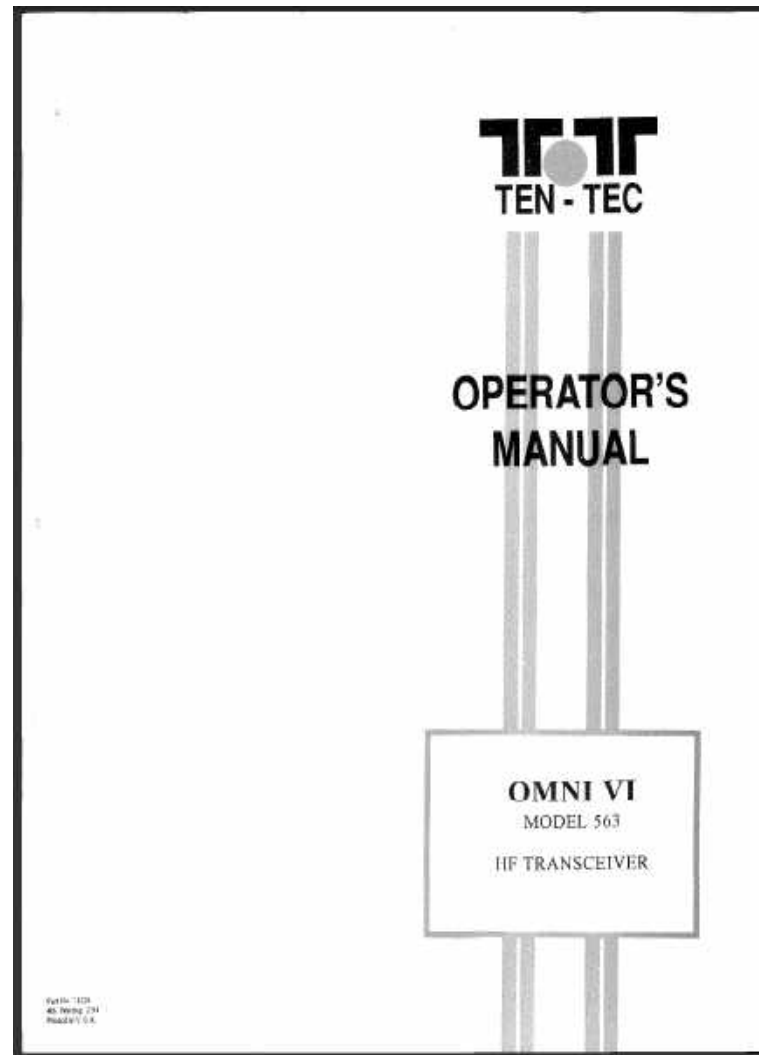
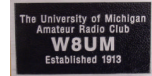
# Sept 18, 2010 Log Entry

2010		GMT		STATION WORKED		REPORT SENT / REC'D		TIME OFF	STN	COMMENTS	QSL	QSL	
DATE	FREQ	MODE	POWER	TIME	STATION	SENT	REC'D			NAME	NO	S	R
9/5	21.020	CW	100	2258	OK3AR	599	599		Greenland	EB Only 100W			
	14.212	SSB	600	2354	PA33W	59	59		Cyprus	42			
9/6	24.038	LW	600	0108	ZY6Z	599	599		<del>Slovenia</del>				
9/15/07	14.040	CW		1840	557ATH	57	57		Island of Cyprus	Prezije, Slovenia			
11/8/07	7MHz	CW		0036	58/122HM	599	599		Island of Cyprus				
9/17/07	7MHz	CW		1127	JM70LW	419	419		Fukushima	Japan			
9/18/10	7.015	CW	800	0048	JY7P	599	599		Jordan	SBCulp			300
	10.116	FD	100	0056	R20AF	599	599		Russia				
	7.004	CW	800	0102	SV9/LZ1J2C/p	599	599		Greece				
9/20/10	18.073	CW	100	2340	JT5DX	599	599		Mongolia				
9/22/10	18.069	CW	100	2224	RI1FS	599	599		Franz Josef Land				
	18.087	CW	100	2331	XW1B	599	599		via EZ1EIG	Leas			
9/23/10	18.079	CW	100	0002	3G3FZ	599	599		Chile				
9/23/10	18.076	CW	100	2256	HL2DC	599	509		South Korea				300
9/25/10	18.069	CW	100	2018	9A/PX3MD	599	599		Congo	otto			
	24.896	CW	100	2026	HT4LEON	599	599		Chile				
	24.891	CW	100	2041	LU7NF	599	599		Argentina				
	24.905	CW	100	2159	KH7Y	999	929		Hawaii				
9/24/10	18.074	CW	100	2027	CX6VM	599	599		Uruguay	Jorge			
	18.075	LW	100	2100	6Y5WJ	579	579		Jamaica	Chris			
	18.073	CW	100	2105	2P6CW	599	599		Paraguay				
	24.891	CW	100	2337	3G3FZ	599	599		Chile				
9/25/10	10.103	CW	100	0218	RIANP	599	599		Antarctica				
	7.011	CW	800	0244	SU/HASJB	599	599		Egypt				
	10.105	CW	100	0305	3B8CF	599	599		Mauritius				

Note  
pwr

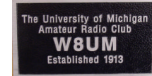


# Ten-Tec Operator's Manual



<http://www.tentec.com/files/Model%20563%20Omni%20VI%20Manual.pdf>

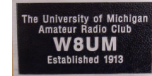




# Omni VI Transmitter Specs

See Manual, pp viii - ix

<b>TRANSMITTER</b>	
* RF OUTPUT	0-100 watts, ALC stabilized <b>10, 12, 15, 17, 29, 30, 40, 80, 160 MHz</b>
DC INPUT	Maximum 250 watts @ 14V DC, 100% duty cycle for up to 20 minutes. Continuous duty with dust baffle supplied air cooling of rear panel heat sink.
MICROPHONE INPUT	200-50K Ohms; accepts microphones with 5mV (-62dB) output. Polarizing voltage for electrets provided.
SPEECH PROCESSOR	Adjustable compression level
T/R SWITCHING	PTT or VOX on SSBC, switchable FAST or SLOW QSK or CW, delay on SLOW is adjustable.
IAMBIC KEYS	adjustable 10-60 WPM, types A or B, weight adjustable from keypad.
CW OFFSET	programmable 400-990 Hz. DSP generated, sidetone automatically matches offset, volume adjustable independent of AF gain control.
FM DEVIATION	+/-5KHz
METERING	Switchable to forward power, SWR, collector current or audio processing level on SSB.
SSB GENERATION	Balanced modulator followed by 9 MHz, 8 pole crystal ladder filter.
CARRIER SUPPRESSION	60 dB typical
UNWANTED SIDEBAND SUPPRESSION	60 dB typical at 1.5 KHz tone.
THIRD ORDER INTERMOD	30 dB below two tone at 100 watts PEP.
SPURIOUS OUTPUT	Better than 45 dB below peak power output.



# Omni VI Receiver Specs

See Manual, pp viii - ix

## RECEIVER

### SENSITIVITY

FREQUENCY MODE	MHz		
	1.8-29.7		
SSB, CW, FSK	.15 $\mu$ V	10dB S/N	
FM	.30 $\mu$ V	12dB SINAD	

### SELECTIVITY

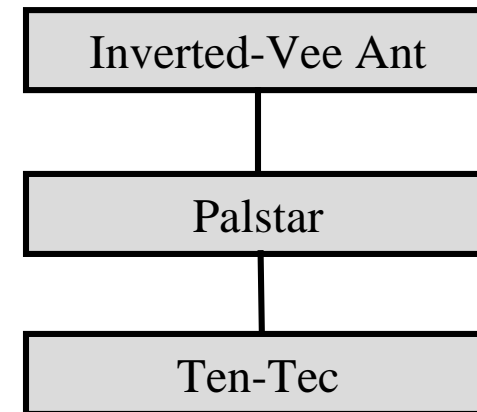
SELECTED FILTER	SELECTIVITY -6 dB	-60 dB	Shape factor
STANDARD 2.4 KHz	2.4 KHz	4.50 KHz	1.87 : 1
OPTIONAL 1.8 KHz	1.8 KHz	3.40 KHz	1.89 : 1
OPTIONAL 500 Hz	500 Hz	1.40 KHz	2.80 : 1
OPTIONAL 250 Hz	250 Hz	850 Hz	3.40 : 1
STANDARD FM	15.0 KHz	30.0 KHz	2.00 : 1

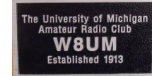
DYNAMIC RANGE	97 dB @ 2.4 KHz bandwidth at 20 KHz spacing, 100 dB + with CW filters.
THIRD ORDER INTERCEPT	+ 10dBm
NOISE FLOOR	-133 dBm @ 2.4 KHz bandwidth
PHASE NOISE	-122 dBc @ 1 KHz, -138 dBc @ 20 KHz.
S-METER	Calibrated to 50 $\mu$ V at S9.
ATTENUATOR	-20 dB
PASSBAND TUNING	+/- 1.2 KHz
I-F FREQUENCIES	1st I-F 9 MHz, 2nd I-F 6.3 MHz (passband tuning IF), 2nd I-F for FM 455 KHz.
NOISE BLANKER	Adjustable threshold
AUTOMATIC DSP NOTCH FILTER	Eliminates multiple heterodynes, notch depth automatically selected for each.



# Start by listening to a few QSOs

1. Components Involved
  - a. Inverted-Vee 80-40 m antenna (#1)
  - b. Palstar antenna Tuner (80-m cable)
  - c. Ten-Tec Omni VI HF Transceiver
2. Prepare to listen
  - a. Set Ten-Tec initial settings
  - b. Select: band, mode and frequency
3. Spend some time listening
  - a. 40 & 80 meter bands
    - i. Explore both CW and Phone
    - ii. Note QSO procedures
    - iii. Watch S-meter
    - iv. Play with Notch
    - v. Once familiar, prepare to transmit





# Omni VI Initial Settings\*

Key: ○ Outer knob  
● Inner knob

- RF ..... Full clockwise RF gain (Full clockwise required for S-meter to be calibrated)
- AF ..... 9 :00 AF gain
- POWER ..... ON Turns Ten-Tec Omni VI 13.8 VDC on and off
- METER ..... FWD RF power out; SWR reflected power; Ic collector current; PROC speech processor out
- ANT ..... MAIN Connects XVCR to main 50 Ω Ant. AUX Connects transceiver to AUX Rx Ant.
- AGC ..... ON Automatic gain control (Must be on for S meter operation)
- AGC ..... FAST Controls attack and decay time of AGC (FAST recommended for CW operation)
- NOTCH ..... MANUAL (no light) Reduces interfering signals (For CW mode, set to MANUAL)
- QSK ..... FAST controls speed of transmitter to receiver switching SLOW normal for CW
- ATTN ..... OFF (no light) When ON inserts a 20db attenuation in receiver to reduce strong signals
- N.B ..... Full counter clockwise Reduces unwanted background pulse noises
- SQL ..... Full counter clockwise In FM mode, used to squelch the background noise
- PBT ..... 12 :00 Moves the pass band to improve the quality of the received signal
- NOTCH ..... Full counter clockwise Shifts the notch filter over the unwanted interfering signal
- /○ RIT/XIT ..... Ignore for now Used to quickly offset the receiver and transmitter frequencies
- PROC ..... OFF (no light) Controls whether the processor is on or off
- MIC ..... 9 :00 Adjusts the microphone output for proper ALC operation
- PWR ~~Full CCW 12 :00~~ Transmitter output power (Keep low (ccw until antenna is tuned.)
- KEYER SPEED Full counter clockwise Adjusts the speed of the built-in electronic keyer
- PROCESSOR... Full counter clockwise Adjusts the voice peaks for better sound quality
- VOX ..... OFF (no VOX light, upper display) When ON and adjusted properly turns on transmitter when talking

\* Consult Chapters 2 and 3 of manual for more detail of how these controls affect the transceiver operation



# W8UM: HF Listening

\* Power Supply connections not shown

Heathkit Linear Amplifier



Do not turn on

SteppIR Control



SteppIR 40m-6m Yagi Antenna

Palstar Antenna Tuner



80m Inverted Vee Antenna

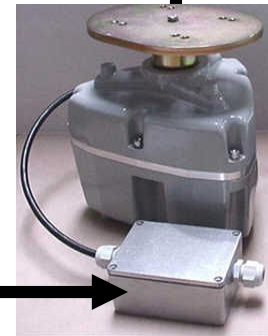
Ear phones

Ten Tec Omni Vi

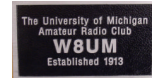


Microphone

M2 Antenna Rotor Control



M2 Antenna Rotor



# Ten-Tec Omni VI Transceiver

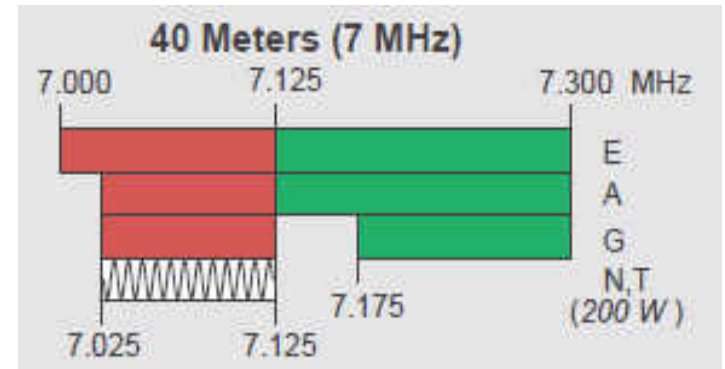
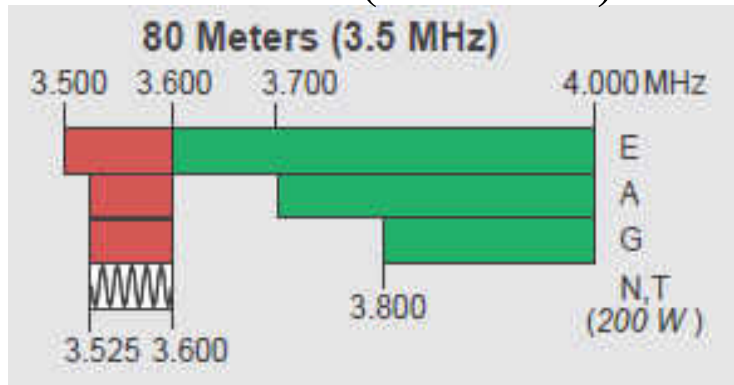


When LISTENING, feel free to play with any of the controls indicated in red, except RF PWR and the Mike PTT must remain OFF.



# Tech Class HF Bands

(75 meters)

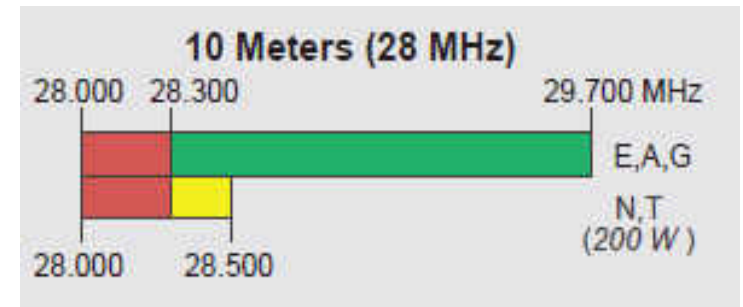
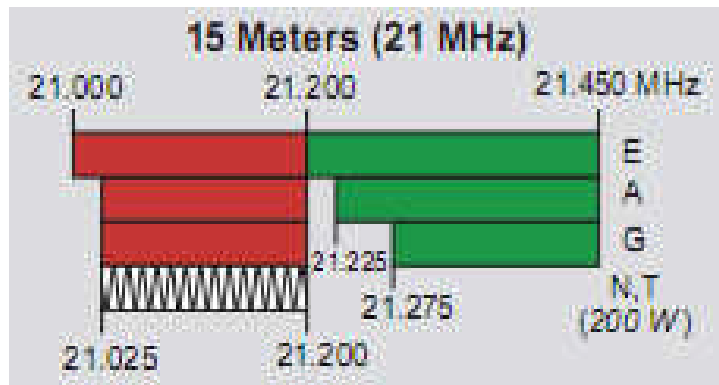


Legend:

- Red = RTTY and data
- Green = phone and image
- Wavy line = CW only
- Yellow = SSB phone
- Light blue = USB phone only
- Orange = Fixed digital message forwarding systems only

Classifications:

- E = Amateur Extra
- A = Advanced
- G = General
- T = Technician
- N = Novice

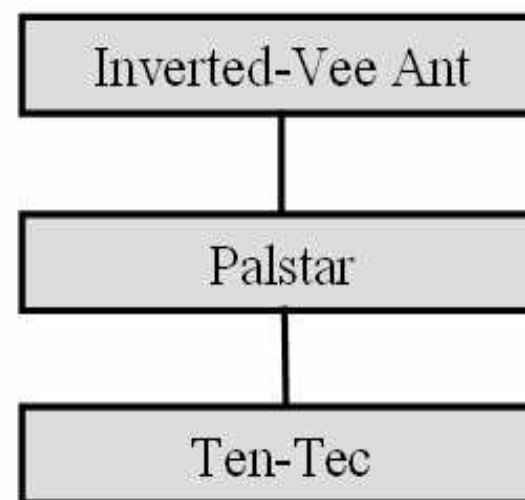




# Transmit CW with Inverted-Vee

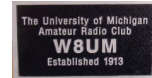


1. Setup as in listen mode (on 80 or 40 m)
2. Check if frequency is in use
3. Apply Ten-Tec RF PWR
  - a. Turn meter switch to SWR
  - b. Press Tune\*
  - c. Increase RF PWR (let's abbreviate PWR)
  - d. Watch SWR on Ten-Tec S-meter.
  - e. If over 2:1, decrease PWR and tune using Palstar antenna tuner
4. Once tuned, you are ready to QSO
  - a. Turn meter switch to FWD
  - b. Adjust PWR appropriately for good QSO
  - c. Continue to monitor SWR on ant. tuner
5. It's time now to get serious about CW



\* You are on the air. Do not leave on too long. You must transmit your call sign afterwards





# AT1KM Owner's Manual



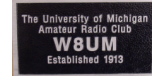
[http://www.palstar.com/manual\\_at1km.pdf](http://www.palstar.com/manual_at1km.pdf)



# Palstar Antenna Tuner

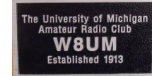


Settings for Inverted-Vee Dipole				
BAND	TUNE		INDUCTOR	
	SUGGESTED	ACTUAL	SUGGESTED	ACTUAL
160 M	55	26	67	4.65
80 M	54	63	264	25.68
75 <del>60</del> M	53	54	304	27.80
40 M	52	32	323	28.94
20 M	49	19	349	33.50
17 M	43	18	350	35.30
15 M	42	14	354	35,10
12 M	45	14	353	36.00
10 M	45	13	350-352	36.25
30 M		48.5		49.50



## CW Operating Skills

- I cannot cover everything
  - Won't remember anyway
- Whenever operating in a new mode
  - Listen first
  - Observe protocol
  - Then operate
- “The ARRL Operating Handbook” - a good help
  - CW (& SSB) good for weak signal (QRP) modes
- To get started - Let's consider CW operation using International Morse Code
  - Refer to Tables 6.2, 6.3 and 6.4 in your text (Shown in the next three slides)
    - Q Signals - Table 6.2, p 6.7
    - Common Abbreviations & Prosigns- Table 6.3, p 6.8
    - The RST System - Table 6.4, p 6.9



# Q Signals

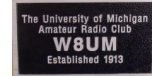
(Table 6.2, p. 6.7)

Table 6.2

## Q Signals

These Q signals are the ones used most often on the air. (Q abbreviations take the form of questions only when they are sent followed by a question mark.)

QSK	I can hear you between signals; break in on my transmission. Can you hear me between your signals and if so can I break in on your transmission?
QSL	I am acknowledging receipt. Can you acknowledge receipt (of a message or transmission)?
QSN	I did hear you (or ___) on ___kHz. Did you hear me (or ___) on ___kHz?
QSO	I can communicate with ___ direct (or relay through ___). Can you communicate with ___ direct or by relay?
QSP	I will relay to ___. Will you relay to ___?
QST	General call preceding a message addressed to all amateurs and ARRL members. This is in effect "CQ ARRL."
QSQ	I am listening to ___ on ___kHz. Will you listen to ___ on ___kHz?
QSY	Change to transmission on another frequency (or on ___kHz). Shall I change to transmission on another frequency (or on ___kHz)?
QTB	I do not agree with your counting of words. I will repeat the first letter or digit of each word or group. Do you agree with my counting of words?
QTC	I have ___ messages for you (or for ___). How many messages have you to send?
QTH	My location is ___. What is your location?
QTR	The time is ___. What is the correct time?
QRG	Your exact frequency (or that of ___) is ___kHz. Will you tell me my exact frequency (or that of ___)?
QRL	I am busy (or I am busy with ___). Are you busy?
QRM	Your transmission is being interfered with ____ (1. Nil; 2. Slightly; 3. Moderately; 4. Severely; 5. Extremely.) Is my transmission being interfered with?
QRN	I am troubled by static _____. (1 to 5 as under QRM.) Are you troubled by static?
QRO	Increase power. Shall I increase power?
QRP	Decrease power. Shall I decrease power?
QRQ	Send faster (___wpm). Shall I send faster?
QRS	Send more slowly (___wpm). Shall I send more slowly?
QRT	Stop sending. Shall I stop sending?
QRU	I have nothing for you. Have you anything for me?
QRV	I am ready. Are you ready?
QRX	I will call you again at ___hours (on ___kHz). When will you call me again?
QRZ	You are being called by ____ (on ___kHz). Who is calling me?
QSB	Your signals are fading. Are my signals fading?



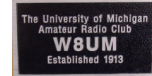
# Common Abbreviations

(Table 6.3, p.6.8)

## Some Common Abbreviations Used on CW

Although abbreviations help to cut down unnecessary transmission, it's best not to abbreviate unnecessarily when working an operator of unknown experience.

AA	All after	GN	Good night	SASE	Self-addressed, stamped envelope
AB	All before	GND	Ground	SED	Said
ABT	About	GUD	Good	SIG	Signature; signal
ADR	Address	HI	The telegraphic laugh; high	SINE	Operator's personal initials or nickname
AGN	Again	HR	Here, hear	SKED	Schedule
ANT	Antenna	HV	Have	SRI	Sorry
BCI	Broadcast interference	HW	How	SSB	Single sideband
BCL	Broadcast listener	LID	A poor operator	SVC	Service; prefix to service message
BK	Break; break me; break in	MA, MILS	Milliamperes	T	Zero
BN	All between; been	MSG	Message; prefix to radiogram	TFC	Traffic
BUG	Semi-automatic key	N	No	TMW	Tomorrow
B4	Before	NCS	Net control station	TNX-TKS	Thanks
C	Yes	ND	Nothing doing	TT	That
CFM	Confirm; I confirm	NIL	Nothing; I have nothing for you	TU	Thank you
CK	Check	NM	No more	TVI	Television interference
CL	I am closing my station; call	NR	Number	TX	Transmitter
CLD-CLG	Called; calling	NW	Now; I resume transmission	TXT	Text
CQ	Calling any station	OB	Old boy	UR-URS	Your; you're; yours
CUD	Could	OC	Old chap	VFO	Variable-frequency oscillator
CUL	See you later	OM	Old man	VY	Very
CW	Continuous wave (that is, radiotelegraphy)	OP-OPR	Operator	WA	Word after
DE	From, this is	OT	Old-timer; old top	WB	Word before
DLD-DLVD	Delivered	PBL	Preamble	WD-WDS	Word; words
DR	Dear	PSE	Please	WKD-WKG	Worked; working
DX	Distance, foreign countries	PWR	Power	WL	Well; will
ES	And, &	PX	Press	WUD	Would
FB	Fine business, excellent	R	Received as transmitted; are	WX	Weather
FM	Frequency modulation	RCD	Received	XCVR	Transceiver
GA	Go ahead (or resume sending)	RCVR (RX)	Receiver	XMTR (TX)	Transmitter
GB	Good-by	REF	Refer to; referring to; reference	XTAL	Crystal
GBA	Give better address	RFI	Radio frequency interference	XYL (YF)	Wife
GE	Good evening	RIG	Station equipment	YL	Young lady
GG	Going	RPT	Repeat; I repeat	73	Best regards
GM	Good morning	RTTY	Radioteletype	88	Love and kisses
		RX	Receiver		



# The RST System

(Table 6.4, p.6.9)

## **READABILITY**

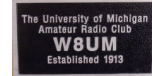
- 1—Unreadable.
- 2—Barely readable, occasional words distinguishable.
- 3—Readable with considerable difficulty.
- 4—Readable with practically no difficulty.
- 5—Perfectly readable.

## **SIGNAL STRENGTH**

- 1—Faint signals barely perceptible.
- 2—Very weak signals.
- 3—Weak signals.
- 4—Fair signals.
- 5—Fairly good signals.
- 6—Good signals.
- 7—Moderately strong signals.
- 8—Strong signals.
- 9—Extremely strong signals.

## **TONE**

- 1—Sixty-cycle ac or less, very rough and broad.
- 2—Very rough ac, very harsh and broad.
- 3—Rough ac tone, rectified but not filtered.
- 4—Rough note, some trace of filtering.
- 5—Filtered rectified ac but strongly ripple-modulated.
- 6—Filtered tone, definite trace of ripple modulation.
- 7—Near pure tone, trace of ripple modulation.
- 8—Near perfect tone, slight trace of modulation.
- 9—Perfect tone, no trace of ripple or modulation of any kind.



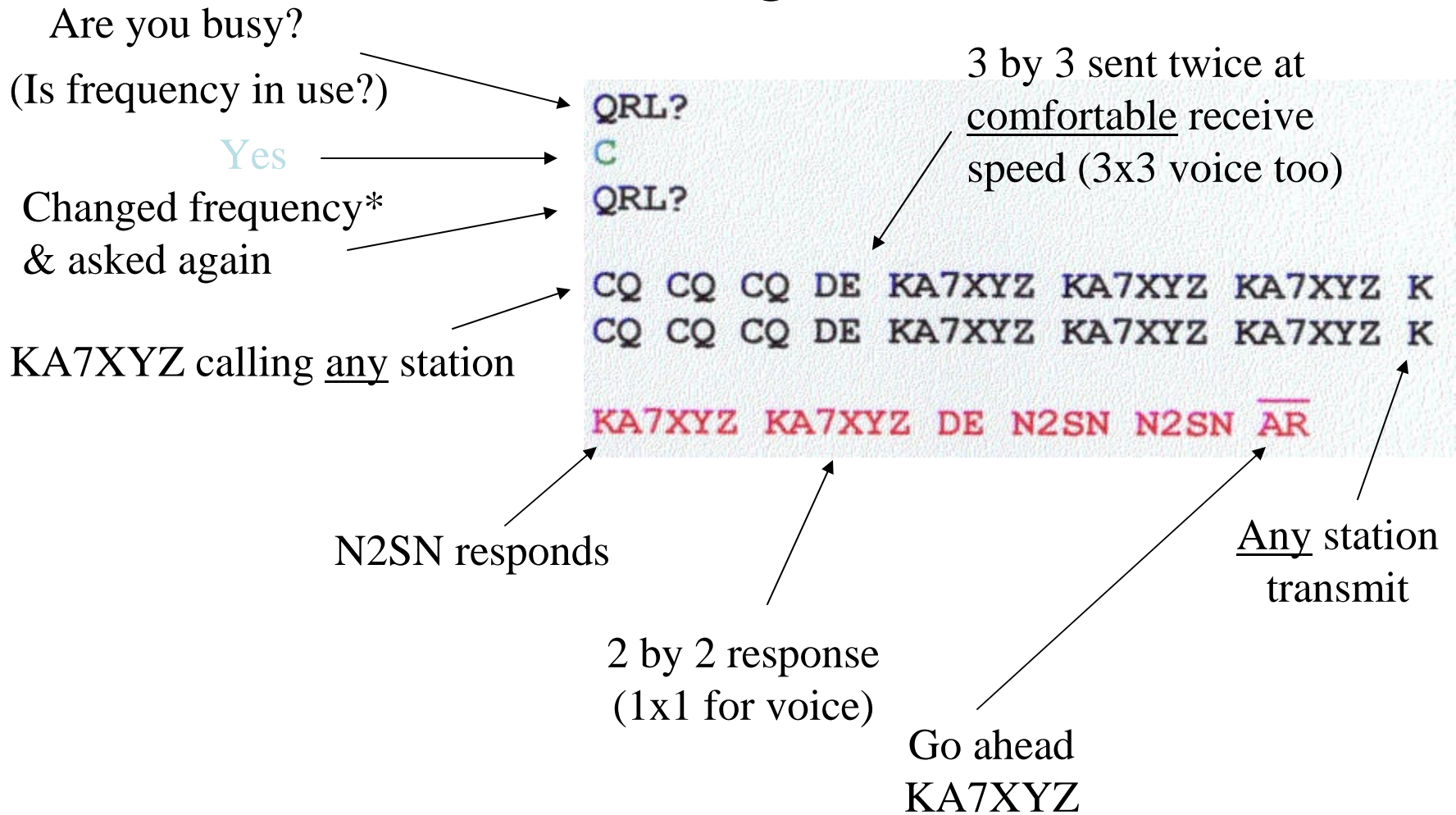
# Common Procedural Signals (Prosigns)

(Table 6.3, p.6.8)

<u>AR</u>	End of transmission or end of message
AS	Please stand by
R	All received correctly
K	Go ahead. Any station transmit
<u>KN</u>	Only called station transmit
<u>SK</u>	End of contact
CL	Closing. Going off the air
<u>BK</u>	Break or Back to you
<u>DN</u>	Slant mark, used to indicate portable, mobile or other additional identifying information with your call sign

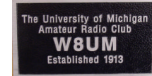


# Establishing Contact



\* Before he starts he checks to make certain he is following the band plan and frequency is not in use





# Exchanging Data

Not 'roger,'  
'received correctly'

1 by 1 once

From

Good evening

Send slower Please ?

Readability - perfect  
Signal strength - Extremely strong\*  
Tone - Perfect

Location - Denver CO

here

weather and

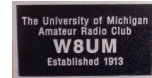
only KA7XYZ transmit

```

N2SN DE KA7XYZ R GE QRS PSE? AR
KA7XYZ DE N2SN SRI. HW QRS NW? AR
N2SN DE KA7XYZ R UR RST 599 QTH HR DENVER CO BT NAME BOB HW? AR
HI BOB. NAME HR BETTY. UR RST 559. WX HR SNOW ES 20 DEGREES F KN
  
```

sorry how now  
your

\* 59 plus 20 db, the very best!  
FM: Full quieting signal overcomes  
all noise



# Switching (QRT) Frequency

Distant station

What's your location?

COLD ES WINDY HR. I ENJOY DX CONTESTS. QTH?  $\overline{\text{KN}}$   
interference Change frequency  
QTH IS KEENE, NH. MUCH QRN HR NW. PSE QSY TO 28.15 MHZ  $\overline{\text{KN}}$   
Go ahead  
GA QSY 28.15 MHZ. N2SN DE KA7XYZ CL  
N2SN CL

Going off the air  
(at this frequency)



# QSO (Continued)

Stop sending (quit) → KA7XYZ DE N2SN AR

How's your interference? → N2SN DE KA7XYZ R NO QRN HR. HW? AR

Send a card acknowledging the QSO → NO QRN HR EITHER. MUST QRT NW. QSL? PSE? ADDRESS IN CALLBOOK KN

Contact or conversation → fine business been hope again

End of contact → FB QSL. IT HAS BN FUN. HPE TO QSO AGN. N2SN DE KA7XYZ SK CL

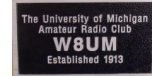
Required! → 73 DE N2SN SK CL

Best regards → Or 88 if a YL sweetheart ← Young lady or XYL married lady

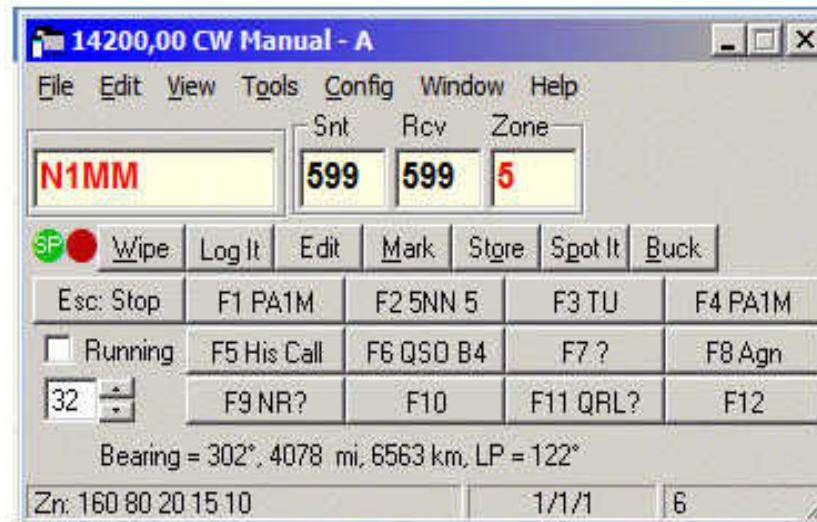
Required! → Or OC old chap, OB old boy, or OM old man

Closing station →





# N1MM Logger



- All major and many minor HF Contests are supported
  - Including General DX logging, DXpedition, DXSatellite and VHF DX.
- SSB, CW and Digital support
- Multi-user support
- Rover support for QSO parties and other contests which support this.
- VHF and up contesting
  - Transverter support (SHF bands supported up to 10, 24, 47, 76, 142 and 241 GHz).
- Dxpediton mode (Stay in Run or S&P)

<http://n1mm.hamdocs.com/>



# QSL Cards



**AA8RW**

Bill Becher  
691 Spring Valley Dr.  
Ann Arbor, Michigan 48105  
USA

Confirming QSO with	Date			UTC	RST	Mode	Band
	Day	Month	Year				

QSL \_\_\_ PSE \_\_\_ TNX. 73

**KC8ITC**

"Dave" St Clair • 9665 Burmeister Rd. • Saline, MI 48176 U.S.A.

CONFIRMING QSO WITH	DATE			UTC	MHz	RST	MODE 2-WAY
	DAY	MONTH	YEAR				

PSE QSL  TNX QSL      A W4MPY QSL      WASHTENAW COUNTY

**GØEBK**

LOC: IO91IB WAB: SU43 RAFARS 3303

CONFIRMING QSO WITH RADIO \_\_\_\_\_  
Pse/TNX QSL Direct/via RSGB

DATE	GMT	FREQ	MODE	REPORT

TRANSCEIVER: FT990. ANTENNA: VERTICAL (BUTTERNUT) HF9V-X  
73 - RODNEY F. BICKLEY, PWR: 100WATTS  
8 EAST WOODHAY ROAD,  
HARESTOCK, WINCHESTER, HAMPSHIRE, SO22 6JH, ENGLAND.

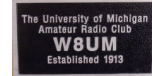
KING ALFRED'S STATUE WINCHESTER

**KG8TQ**

Helen Becher  
691 Spring Valley Dr.  
Ann Arbor, Michigan 48105  
USA

Confirming QSO with	Date			UTC	RST	Mode	Band
	Day	Month	Year				

QSL \_\_\_ PSE \_\_\_ TNX. 73



# Phone Conversation

- Avoid cute phrases when identifying your station use phonetics
- It is important that you be understood correctly, especially by non-English-speaking amateurs
- The letters are more instantly recognized too

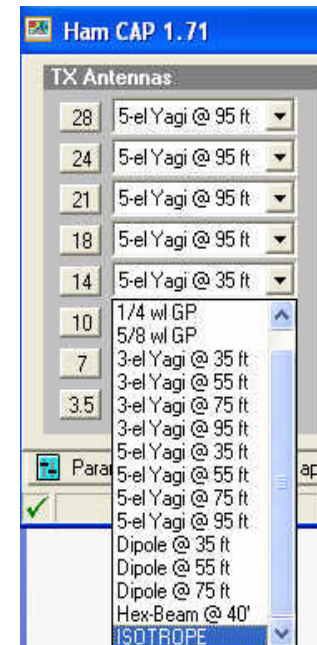
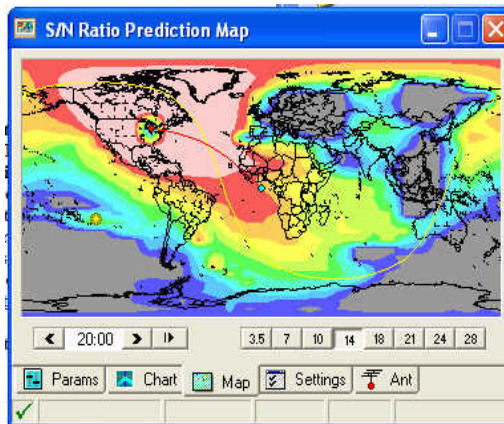
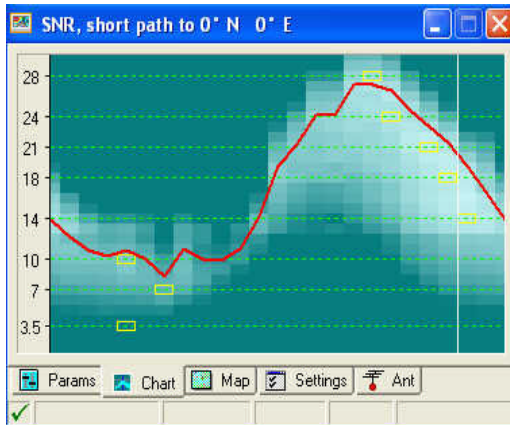
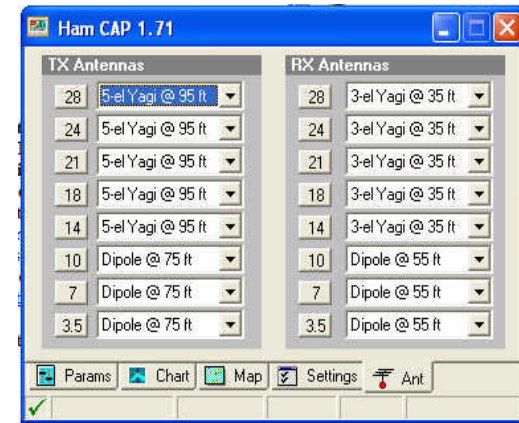
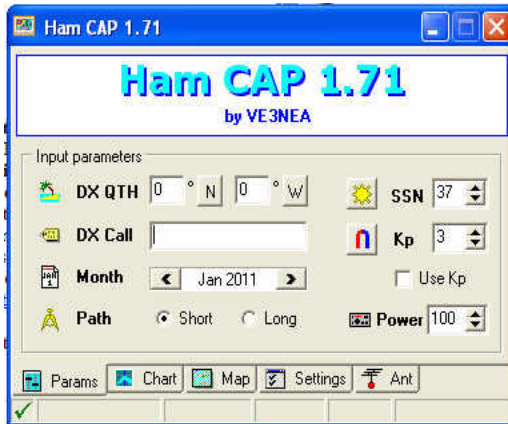
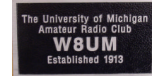
Table 6.1

## Standard ITU Phonetics

<i>Letter</i>	<i>Word</i>	<i>Pronunciation</i>
A	Alfa	<b>AL FAH</b>
B	Bravo	<b>BRAH VOH</b>
C	Charlie	<b>CHAR LEE</b>
D	Delta	<b>DELL TAH</b>
E	Echo	<b>ECK OH</b>
F	Foxtrot	<b>FOKS TROT</b>
G	Golf	<b>GOLF</b>
H	Hotel	<b>HOH TELL</b>
I	India	<b>IN DEE AH</b>
J	Julieta	<b>JEW LEE ETT</b>
K	Kilo	<b>KEY LOH</b>
L	Lima	<b>LEE MAH</b>
M	Mike	<b>MIKE</b>
N	November	<b>NO VEM BER</b>
O	Oscar	<b>OSS CAH</b>
P	Papa	<b>PAH PAH</b>
Q	Quebec	<b>KEH BECK</b>
R	Romeo	<b>ROW ME OH</b>
S	Sierra	<b>SEE AIR RAH</b>
T	Tango	<b>TANG GO</b>
U	Uniform	<b>YOU NEE FORM</b>
V	Victor	<b>VIK TAH</b>
W	Whiskey	<b>WISS KEY</b>
X	X-Ray	<b>ECKS RAY</b>
Y	Yankee	<b>YANG KEY</b>
Z	Zulu	<b>ZOO LOO</b>



# Ham Cap: Helps choose your Band



<http://www.dxatlas.com/HamCap/>





# Need more signal?



## Heath Kit SB220 Linear Amplifier

- RF output: up to 2000 W P.E.P.
- RF input: 100 W (Max) (monitor for distortion)
- Tune-up
  - Use dummy load for tune-up (See manual)
  - Tune antenna before switching ON
- FCC limits
  - Novice, Tech Classes: 200 W. P.E.P.
    - **Keep the PWR switch OFF**
  - Others: 1500 W P.E. P.
- Frequency Range: 80, 40, 20, 15, 10 MHz
- Vacuum tubes: See circuit description
  - Allow warm-up time before tuning
  - After prolonged use, allow time to cool

Heath Kit



KLM  
KT34XA  
Tri-Bander



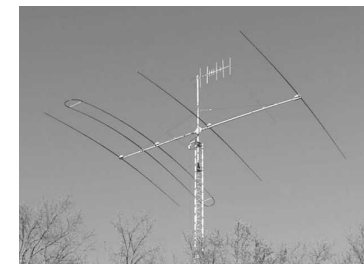
M<sup>2</sup> Ant  
Rotor



## Three other (better) solutions

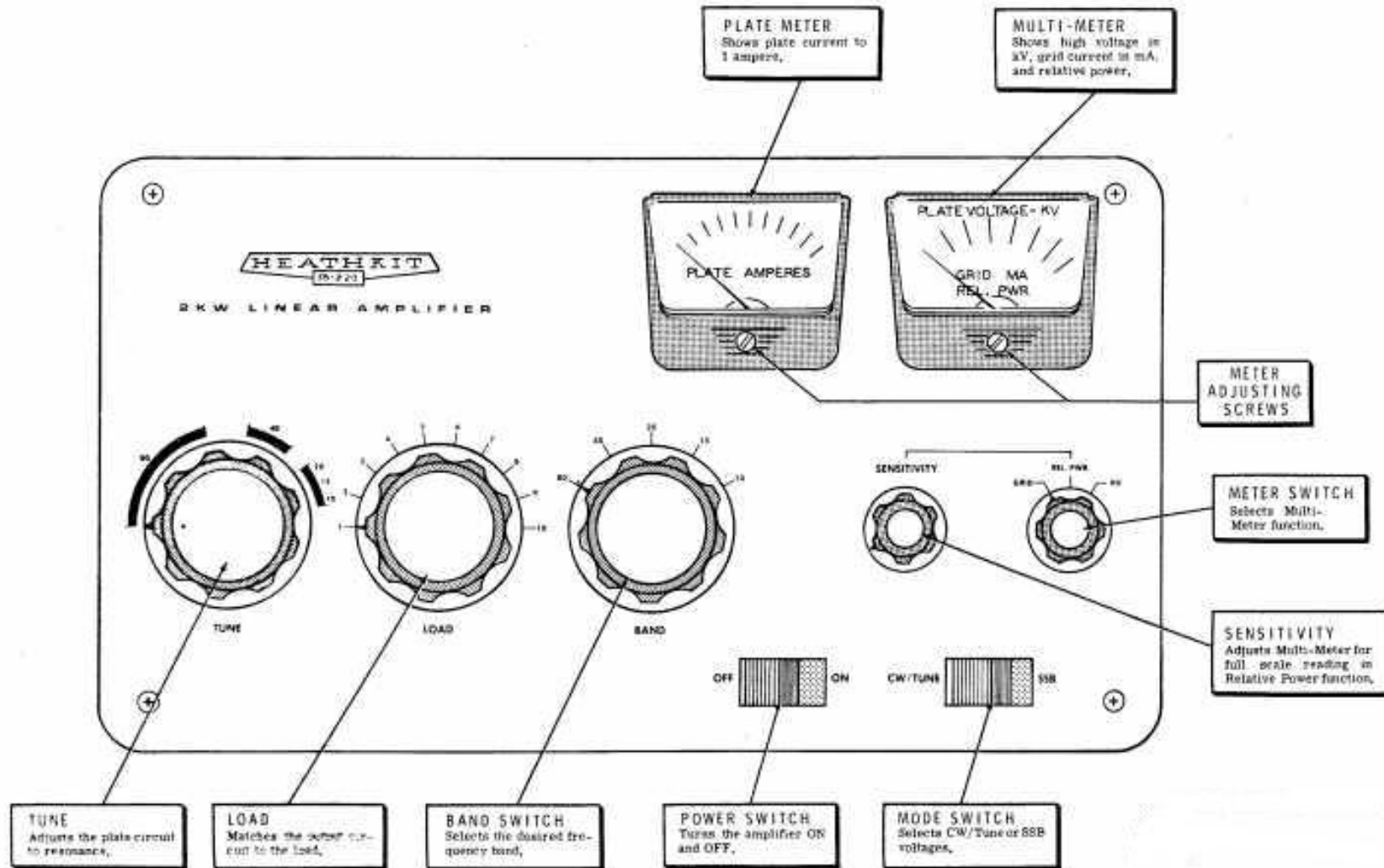
- KLM KT34XA Tri-Bander (20, 15, 10 MHz)
- M<sup>2</sup> Antenna Rotor
- SteppIR 6–40 m Yagi Antenna

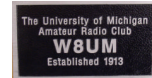
SteppIR





# Heath Kit Linear Amp Controls





# Heath Kit Linear Amp Specifications

SPECIFICATIONS	
Band Coverage	80,40,20,15 and 10 meter amateur bands
Driving Power	Required 100 watts
Maximum Power Out	SSB: 2000 watts PEP. CW: 1000 watts RTTY: 1000 watts
Duty Cycle	SSB: continuous voice modulation CW: Continuous (maximum key-down 10 milliwatts) RTTY: 50% (maximum transmit time 10 minutes)
Third Order Distortion	30 dB or better
Input Impedance	52 $\Omega$ unbalanced
Output Impedance	50 $\Omega$ unbalanced; SWR 2:1 or less
Front Panel	Tune Load Band switch Sensitivity Meterswitch Power CW/Tune - SSB Plate meter Multi-meter (Grid mA, Relative Power, and High Voltage)
Rear Panel	Line cord Circuit breakers (two 10 A) Antenna Relay (phono) ALC (phono) RF input (SO-239) Ground post RF output (SO-239)
Tubes	Two 3-500Z
Power Required	120 VAC, 50/60 Hz, at 20 amperes maximum 240 VAC, 50/60 Hz, at 10 amperes maximum
Cabinet Size	14-7/8" wide, 8-1/4" high, 14-1/2" deep
Net Weight	50 lbs



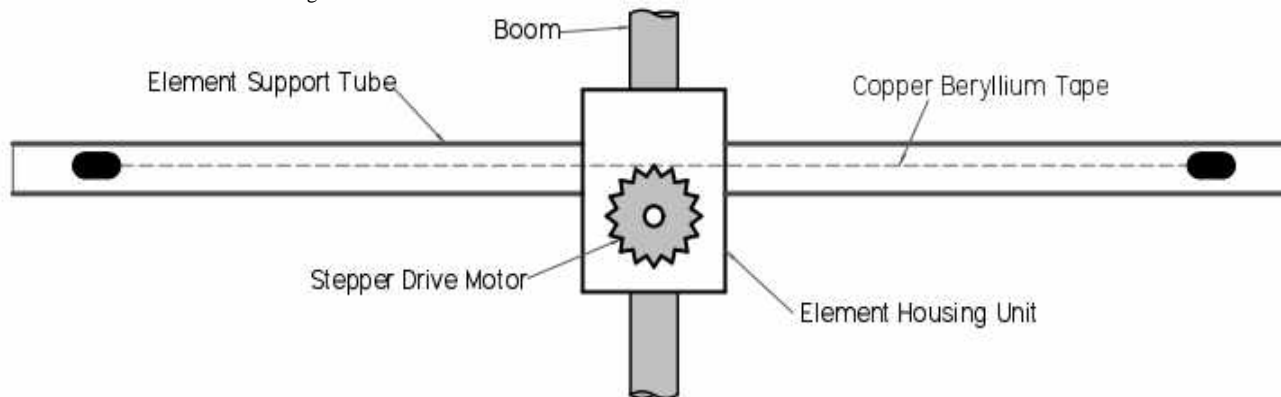
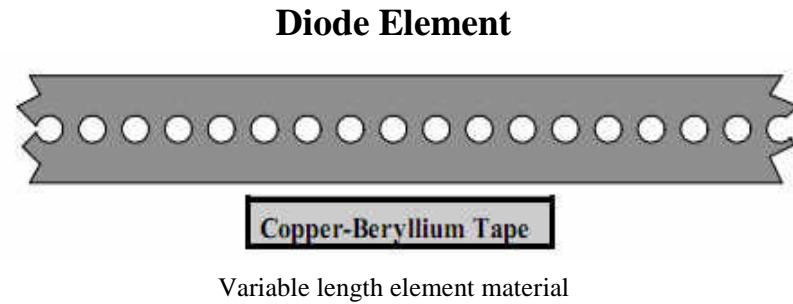
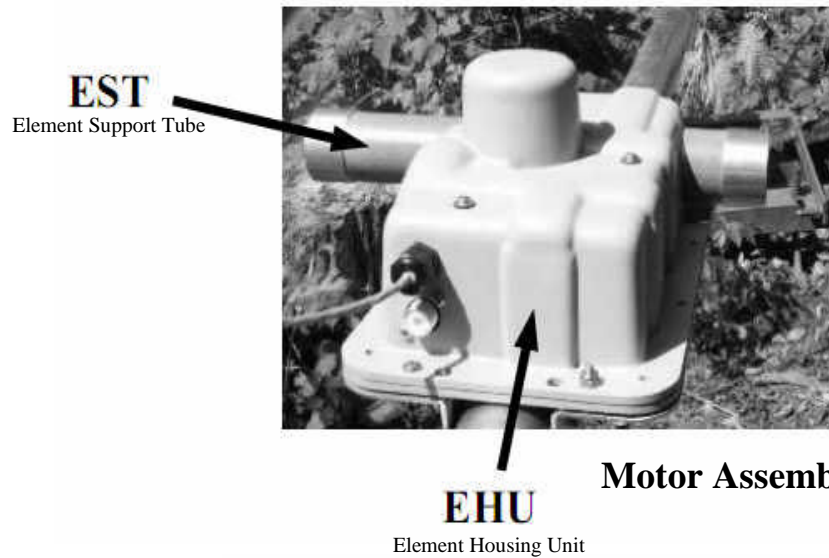
# SteppIR 4-Element Yagi Antenna



<http://www.steppir.com/files/4%20Element%20Assembly.pdf>



# SteppIR Construction



**Dipole Assembly**



# W8UM: HF Components

\* Power Supply connections not shown

Heathkit Linear Amplifier



Do not turn on

SteppIR Control



SteppIR 40m-6m Yagi Antenna

Palstar Antenna Tuner



80m Inverted Vee Antenna

Ear phones

Ten Tec Omni Vi



Microphone

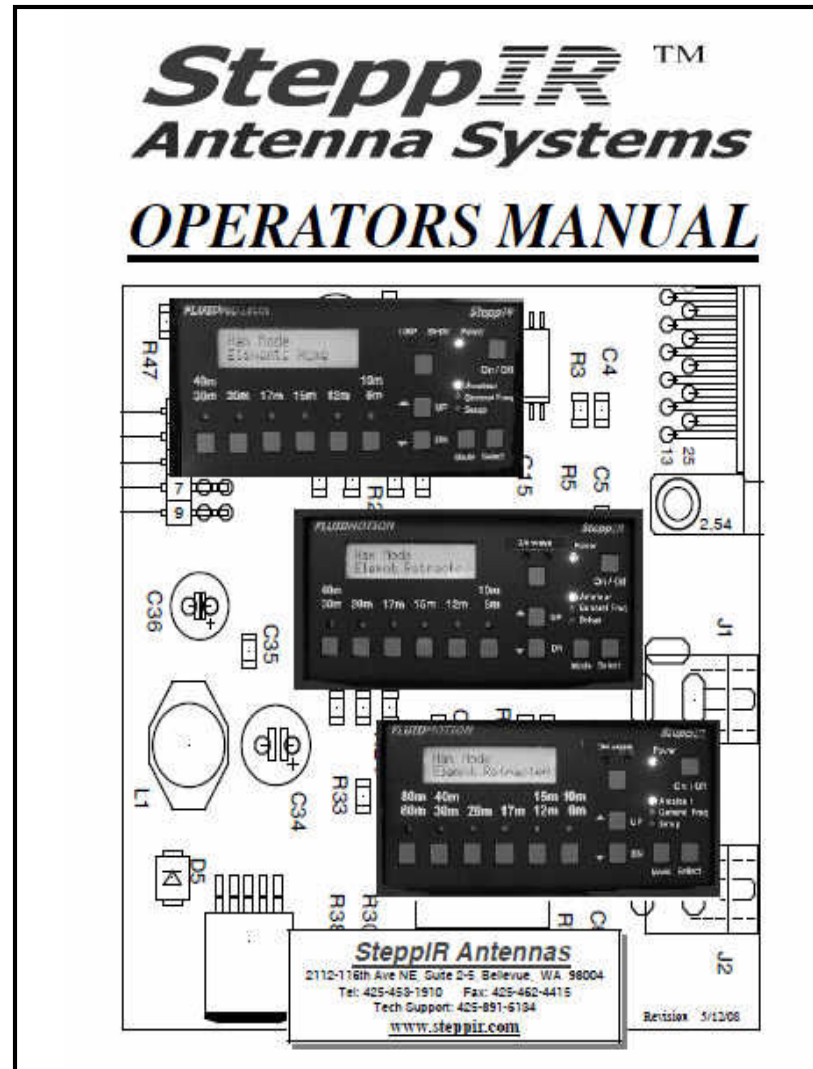
M2 Antenna Rotor Control



M2 Antenna Rotor



# SteppIR Operators Manual

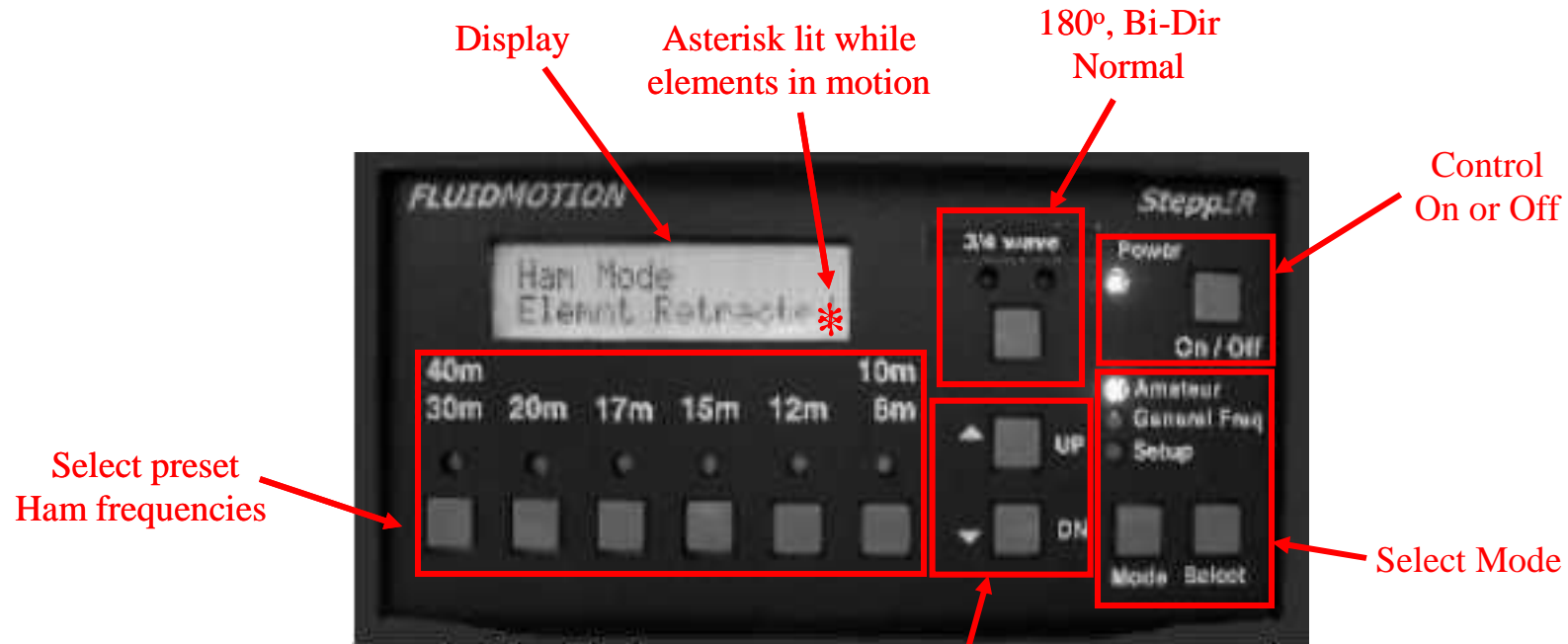


<http://www.steppir.com/files/4%20Element%20Assembly.pdf>



# SteppIR Control Panel

Do Not be impatient when making changes; give SteppIR antenna to change between control steps.



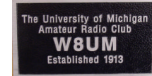
SteppIR Antenna Band Button Pre-Sets for Yagi's							
40m	30m	20 m	17 m	15 m	12 m	10m	6m
7.050	10.100	14.050	18.100	21.050	24.950	28.050	50.100
7.100		14.200		21.200		28.500	
7.200		14.300		21.350		28.800	
						29.200	
Table I							

Factory presets

SteppIR SWR (freq in MHz)			
Band	Preset freq	Tuned freq	SWR
40 m	7.050	7.025	1.0 : 1
30 m	10.100	10.115	2.0 : 1
20 m	14.150	14.025	1.2 : 1
17 m	18.700	18.075	1.0 : 1
15 m	21.600	21.025	1.0 : 1
12 m	25.400	24.900	1.2 : 1
10 m	27.800	28.025	1.3 : 1

W8UM set



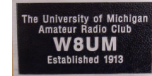


# SteppIR Tuning Procedures\*

- Choose Mode (*Press Mode for choice, then Select*)
  - Amateur (Frequencies within Ham Bands)
    - Press Ham Band (once for each preset within Band)
    - Within Band, press Up and Dn buttons for alternates
  - General Frequency (Adjusts to any frequency)
    - For 50 KHz increments, press Up or Down
    - Hold Up or Dn frequency to ramp up or down
  - Setup (Up to exit, Dn to scroll)
    - Retracting Elements\*\*: Yes – Retract, No – If not
    - Wait until retracted
    - Do Not adjust other Setup choices without Station Manager approval

\* Do Not change when RF power applied or when SteppIR antenna is adjusting (designated by “\*” on display)

\*\* Always retract (i.e., point West (270°) before vacating the shack)



# SteppIR Direction Control\*

Select Direction (Sequentially push button below lights)

## 1. Normal

- Both lights dark
- Antenna main lobe in forward direction (directors in front, reflector in rear)

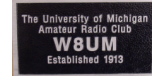
## 2. 180°

- 180° light lit
- Antenna main lobe in reverse direction (reflector in front, director in rear)

## 3. Bi-Dir

- Bi-Dir light lit
- Main lobes in both directions

\* Useful for quick change of direction compared to rotating 180°



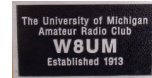
# QSO using SteppIR

1. Set
  - a. Heath Kit Linear: Off
  - b. Antenna tuner: By-pass
2. Choose desired Band: Use Ham Cap
3. Select SteppIR Band and Frequency
4. Ten-Tec:
  - a. Initialize
  - b. Check if frequency is in use
  - c. Press Tune (Tone modulated transmit begins)
  - d. Turn up PWR "slightly"
  - e. Watch SWR (Ten-Tec and/or Palstar)
  - f. Press Tune again
5. Tweak SteppIR Band frequency to improve SWR
6. Ten-Tec: Increase PWR and repeat step 5 if necessary
7. Remember, DO NOT transmit while:
  - a. SteppIR is running, i.e., \* is showing on SteppIR Display
  - b. Linear is being tuned
  - c. Antenna Rotor is moving
8. Start making contacts
9. When finished, Retract SteppIR and Park antenna

And don't forget to enter in logbook



# M<sup>2</sup> Antenna Rotor System



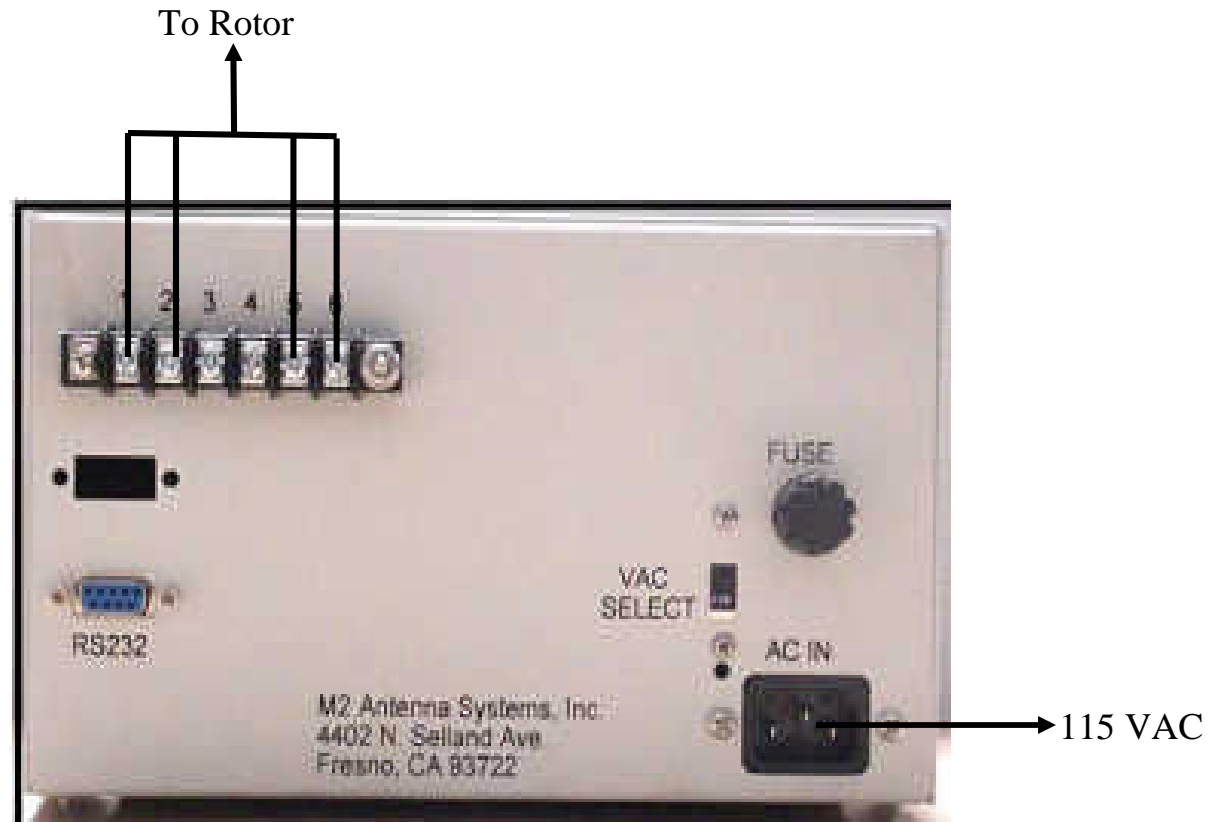
## SPECIFICATIONS

MODEL NUMBER.....	RC2800PX-AZ
POWER REQUIREMENTS.....	115 / 230 VAC @ 5A / 3A, Switchable
ENCLOSURE SIZE.....	W=8.5" / H=5.5" / D=9"
COLOR.....	Gray Powder Coat
DIGIT SIZE.....	.5" Heading / .375" Mode / Speed
CONTROL SWITCHES.....	Tactile .5" Diameter
MICROPROCESSOR TYPE.....	"Microchip" PIC16F876/20-SP
CONTROLS.....	Power Switch, ON / OFF Speed Buttons, Increments 1-9 Clockwise & Counterclockwise Buttons Up & Down Mode Buttons
MODES.....	(3) Operational / Run Modes and 17 Programs
STANDARD OUTPUT VOLTAGE.....	35 VDC @ 3A
COMPUTER INTERFACE.....	RS232 Port

<http://www.helloq.net/forum/attachment.php?attachmentid=373223>



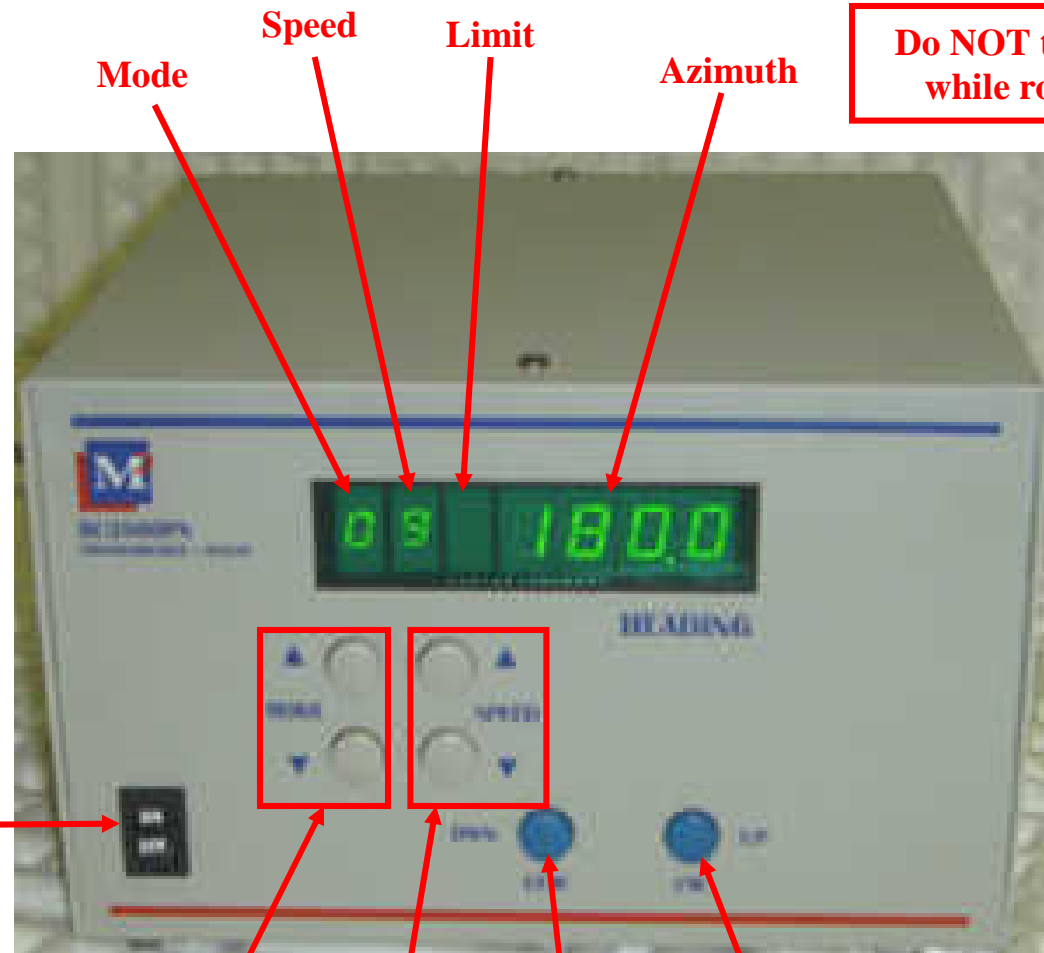
# M<sup>2</sup> Antenna Rotor Rear Panel Connections





# M<sup>2</sup> Antenna Rotor Front Panel Controls

**Do NOT transmit while rotating**

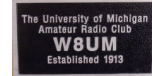


- Modes**
- 0 - Manual
  - 1 - Manual Preset
  - 2 - Programmed Preset
  - P6 - P0 Change Parameters
  - P20 - P29 Change Presets

**AC Power**

**Mode**      **Speed**      **Limit**      **Azimuth**

**Select Mode**      **Select Speed**      **Move Az Down/CCW**      **Move Az Up/CW**



# Rotator Control

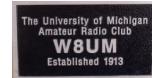
To select Mode Press **Mode**  $\Delta$  or  $\nabla$  (*Caution: Do Not hold  $\Delta$  too long or Prog. Mode will begin. Exit Prog. Mode by holding  $\nabla$* )

- Mode 0
  - Press and hold **CCW\*** or **CW\*** while rotor turns to desired azimuth
- Mode 1
  - Press and hold **CCW** or **CW** while display changes to desired azimuth
  - Release button and rotor will turn with speed ramping up as it turns
- Mode 2
  - Repeatedly press **Down\*\*** or **Up\*\*** until desired preset is reached
  - Release button and rotor will turn to preset position

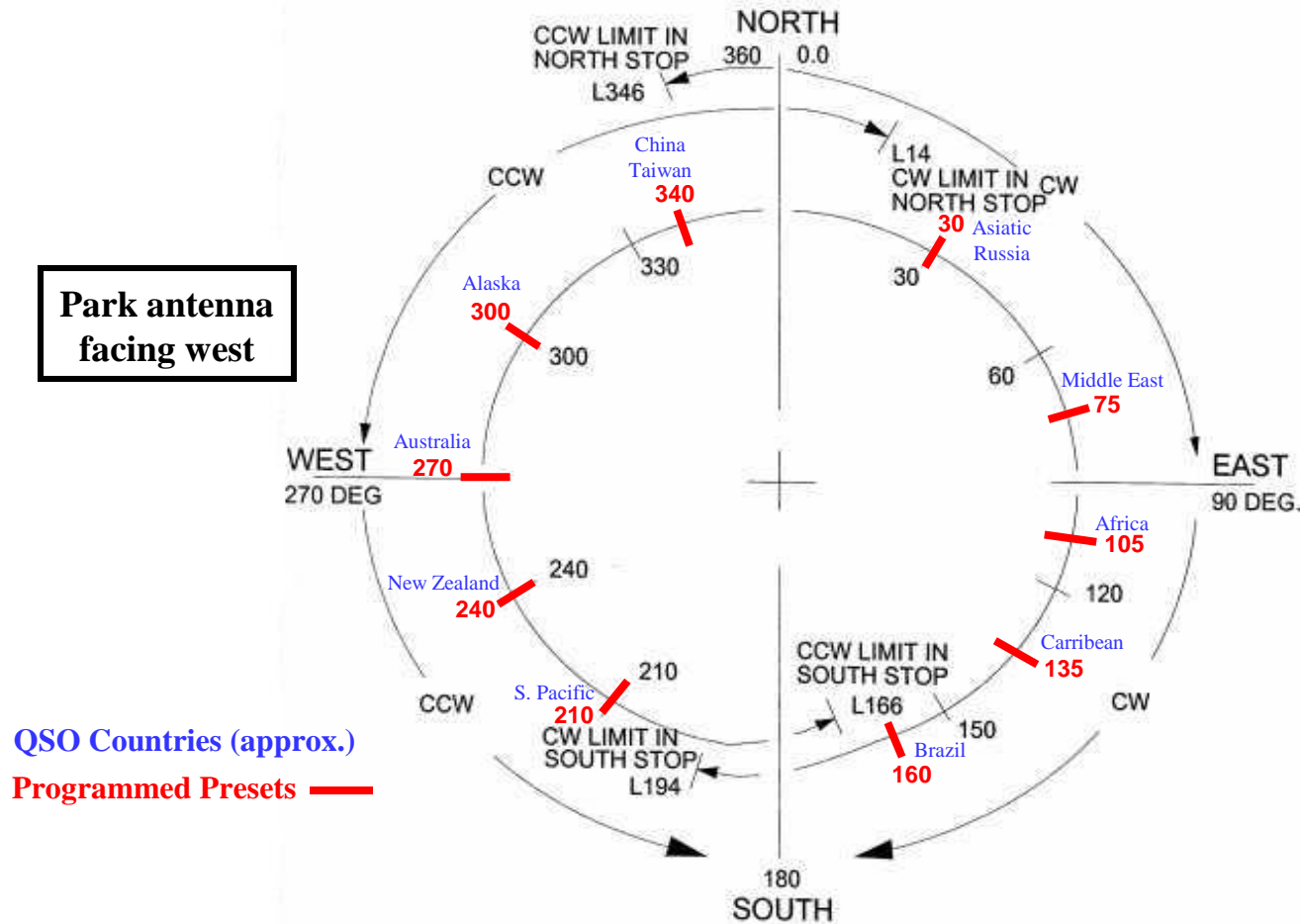
**Reminder: When finished using HF station, “Park” antenna at 270°**

\* CCW and CW are determined looking down from above the antenna

\*\* Down and Up indicates decrease or increase in direction through the presets



# Rotation Limits & Presets







# Country Codes

<b>6D-6J</b> Mexico	<b>DA-DR</b> Germany
<b>6K-6N</b> South Korea	<b>DS-DT</b> Korea, South Korea
<b>6V-6W</b> Senegal	<b>DU-DZ</b> Philippines
<b>6Y</b> Jamaica	<b>E2</b> Thailand
<b>7J-7N</b> Japan	<b>E3</b> Eritrea
<b>7O</b> Yemen	<b>E4</b> Palestine
<b>7P</b> Lesotho	<b>E5</b> Cook Is.
<b>7Q</b> Malawi	<b>E7</b> Bosnia-Herzegovina
<b>7S - 8S</b> Sweden	<b>EA-EH</b> Spain

**ICOM** U.S.A. Amateur Radio HF Band Plan  
Common Country Prefixes (2008)

**ITU Phonetic Alphabet**

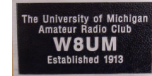
A Alfa	B Bravo	C Charlie	D Delta	E Echo	F Foxtrot	G Golf	H Hotel	I India	J Juliet	K Kilo	L Lima	M Mike	N November	O Oscar	P Papa	Q Quebec	R Romeo	S Sierra	T Tango	U Uniform	V Victor	W Whiskey	X X-ray	Y Yankee	Z Zulu
--------	---------	-----------	---------	--------	-----------	--------	---------	---------	----------	--------	--------	--------	------------	---------	--------	----------	---------	----------	---------	-----------	----------	-----------	---------	----------	--------

**Common Q Signals**

Q11 What is your name and call sign?	Q12 What is the name of your station?	Q13 What is the frequency you are using?	Q14 What is the time of day?	Q15 How are you?	Q16 How much power are you using?	Q17 Are you ready to receive?	Q18 How do you read my signal?	Q19 What is the meaning of your signal?	Q20 What is the meaning of the distress signal you are transmitting?	Q21 How do you interpret the meaning of the distress signal you are transmitting?	Q22 How do you interpret the meaning of the distress signal you are transmitting?	Q23 How do you interpret the meaning of the distress signal you are transmitting?	Q24 How do you interpret the meaning of the distress signal you are transmitting?	Q25 How do you interpret the meaning of the distress signal you are transmitting?	Q26 How do you interpret the meaning of the distress signal you are transmitting?	Q27 How do you interpret the meaning of the distress signal you are transmitting?	Q28 How do you interpret the meaning of the distress signal you are transmitting?	Q29 How do you interpret the meaning of the distress signal you are transmitting?	Q30 How do you interpret the meaning of the distress signal you are transmitting?
--------------------------------------	---------------------------------------	--	------------------------------	------------------	-----------------------------------	-------------------------------	--------------------------------	---	--	---	---	---	---	---	---	---	---	---	---

Download: U.S.A. Amateur Band Plan

<http://www.icomamerica.com/en/downloads/Default.aspx?Category=181>



# W8UM Satellite Station

- Components
  - 2m / 70 cm Antennas
  - ApidSpid (Az/EI) Antenna Rotor
  - Icom IC-910H Transceiver
- Connections
- Tracking Satellites
  - Ham Radio Deluxe
  - Procedural Synopsis



# W8UM Satellite Station

John KB8OIS



See W8UM Home page: Previous Meetings, “Amateur Radios in Space” November 11, 3010



# W8UM Satellite Station

John KB8OIS



**PC Monitor for  
Ham Radio Deluxe**



**Computer**



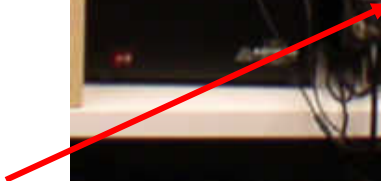
**Power  
Supply**



**Controller**

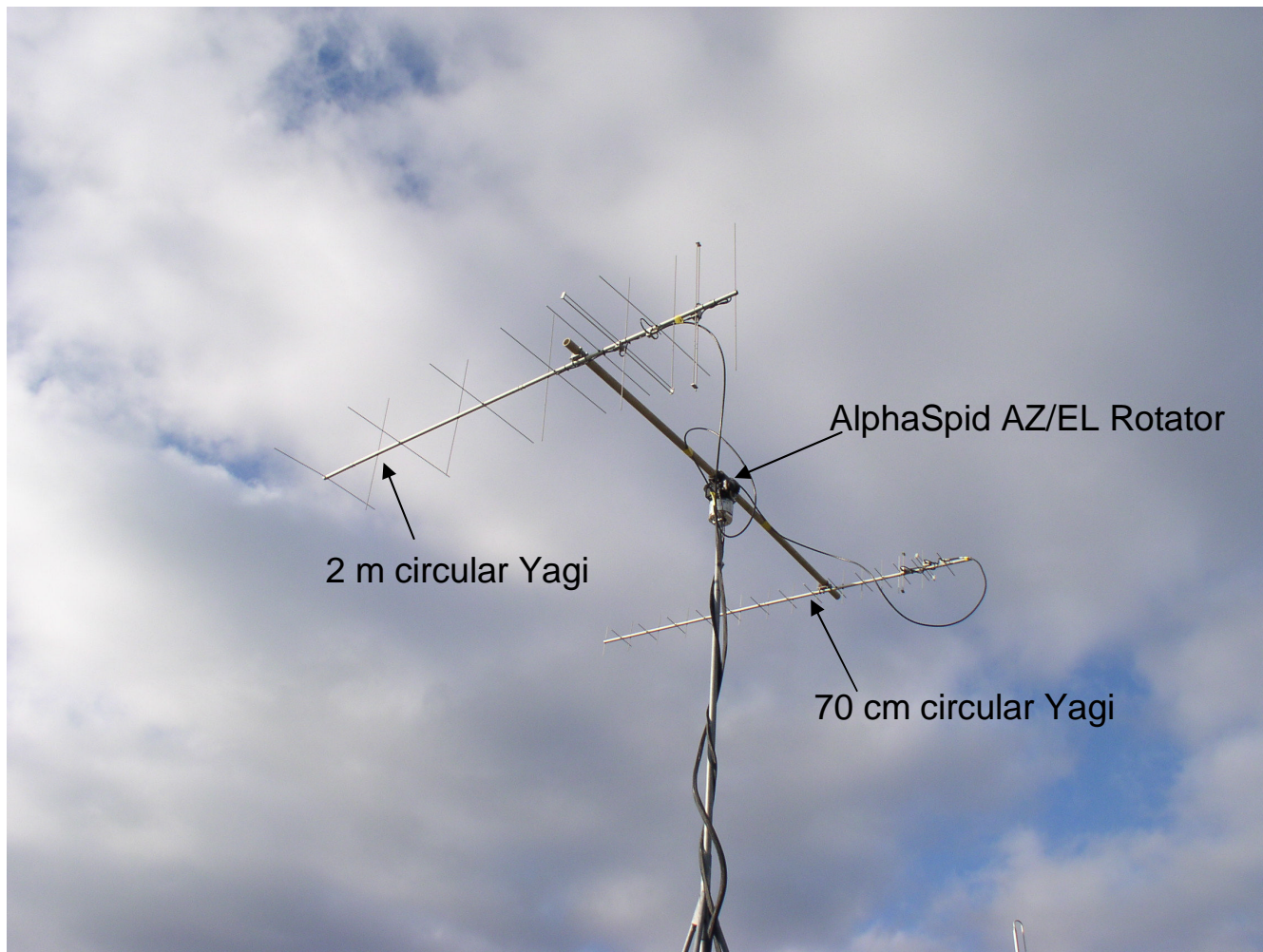


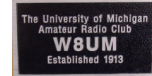
**IC-910H  
Transceiver**





# Satellite Antennas - a second look





# AlphaSpid AZ/EL Rotator

www.alfaradio.com

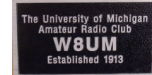


**Controller**

Rot2Prog and RAS

Input Voltage (Typical) .....	12 – 24 Volts DC
Input Current (Nominal Draw) .....	3 – 5 Amps
Motor .....	13.8 – 24 Volts DC
Fuse .....	8.0 AMP GMA
Rotation Speed (azimuth) .....	120 sec (12 V) / 60 sec (24 V)
Rotation Speed (elevation).....	80 sec (12 V) / 40 sec (24 V)
Turning Torque (in-lbs).....	1400 (12 V) / 1740 (24 V)
Braking Torque (in-lbs).....	> 14,000

Controller must have => 13.8 Volts DC or AC for correct operation



# AlphaSpid Manuals


AlfaSpid Rotator RAS  
Controller Rot2Prog  
For use with  
AlfaSpid AZ/EL RAS  
OR  
AlfaSpid EL REAL  
**User Manual**



DRAFT

Copyright Alfa Radio Ltd. 2002-08-15 [www.alfaradio.ca](http://www.alfaradio.ca) 780.400.5779 AlfaSpid-AZ-EL-2002-08-15-manual.doc

AlfaSpid Rotator and Controller  
**Instruction Manual**



This manual is for use with units sold by AlfaRadio Ltd. of Edmonton, Alberta, Canada. Units sold by others may have different firmware and may operate from different voltages.

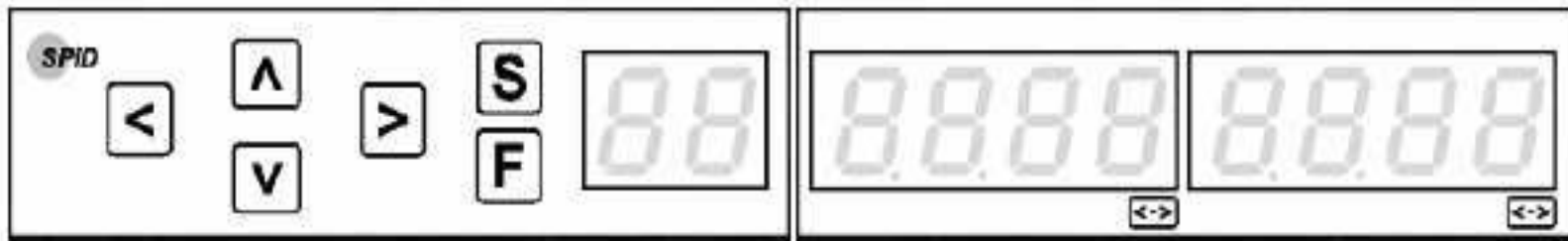
Last updated on September 08 2008

Copyright AlfaRadio Ltd 2002-2008 2008-01-15  
[www.alfaradio.ca](http://www.alfaradio.ca) 780.400.5779



# Rotator Controller

← Do not adjust →

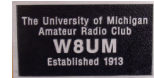


Azimuth

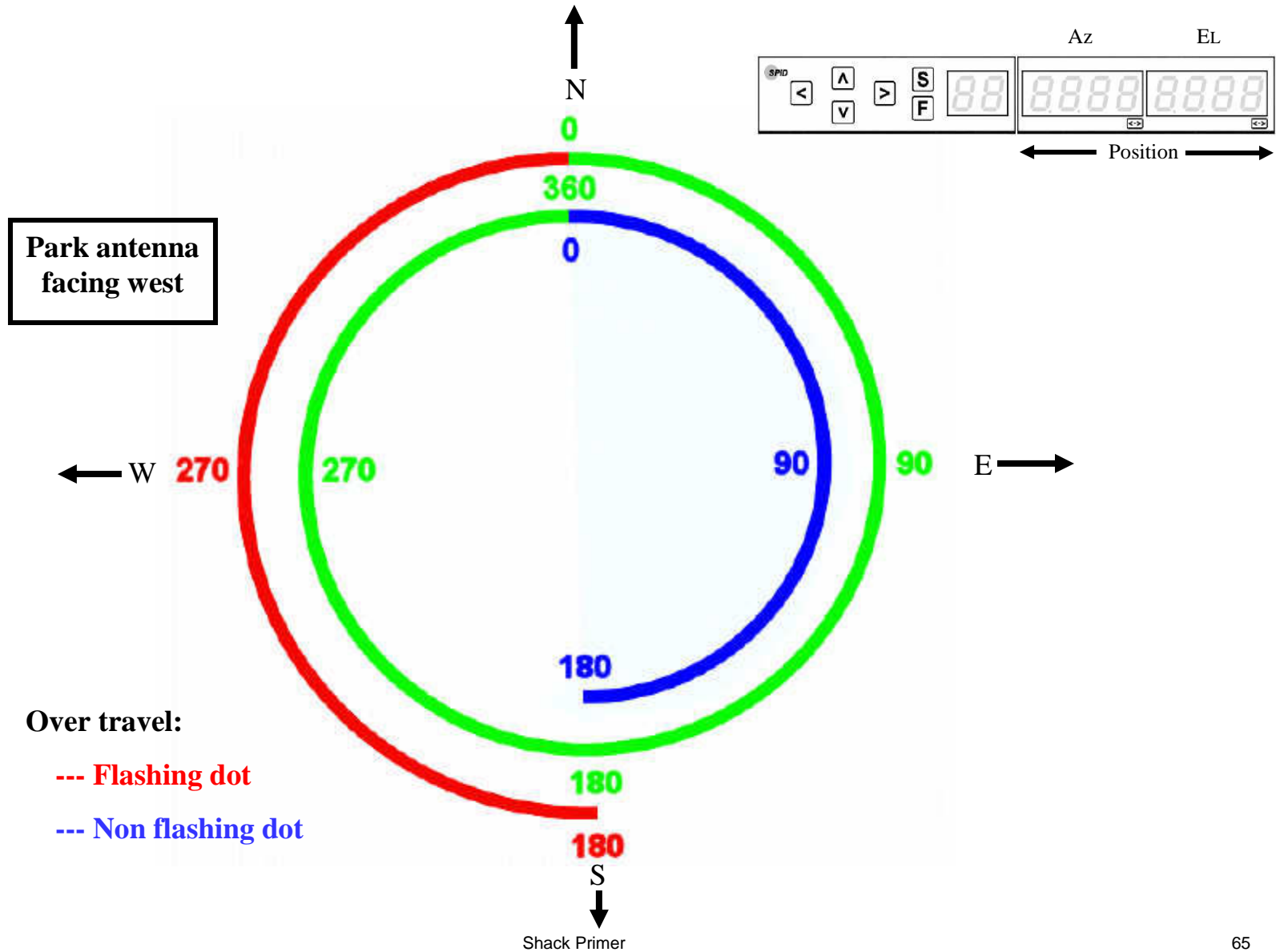
Elevation







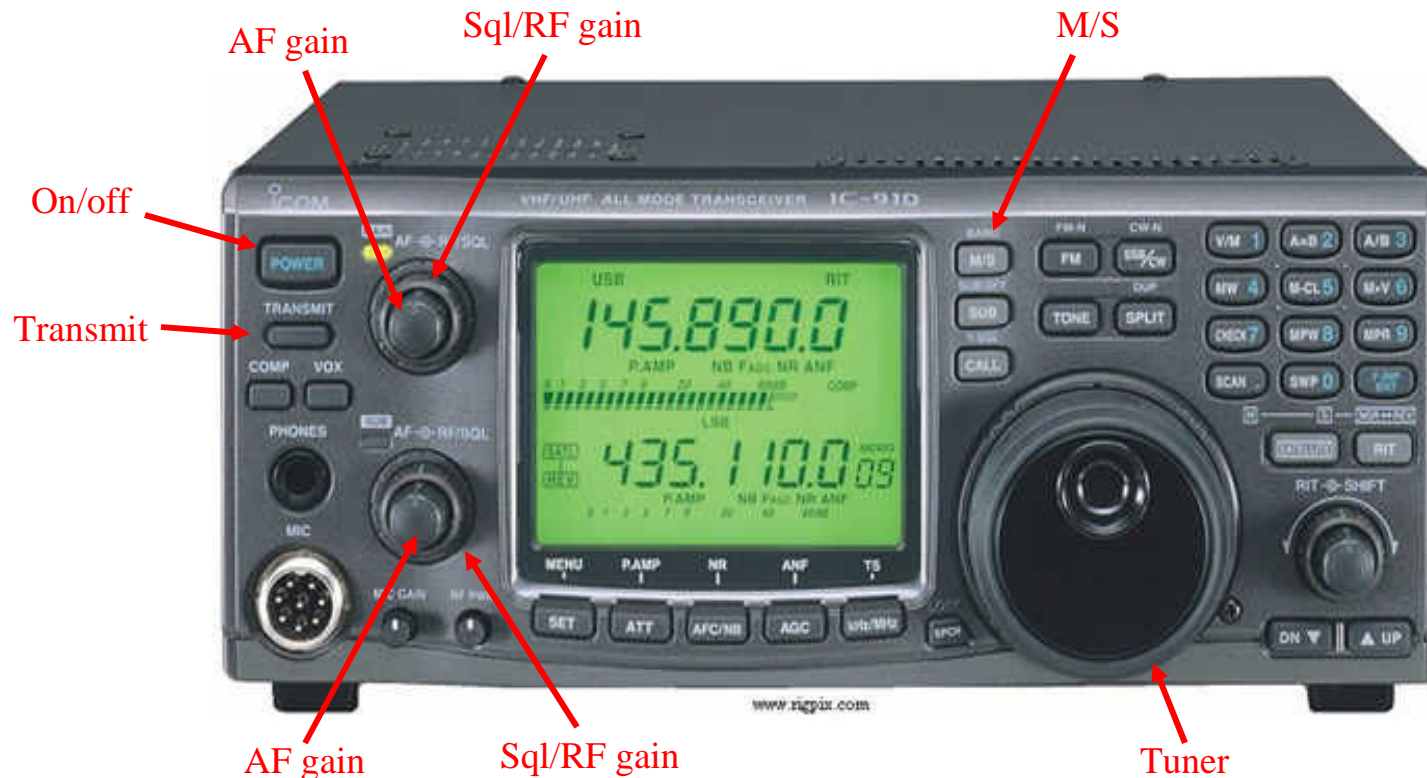
# Rotator Travel



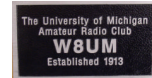


# ICOM IC-910H

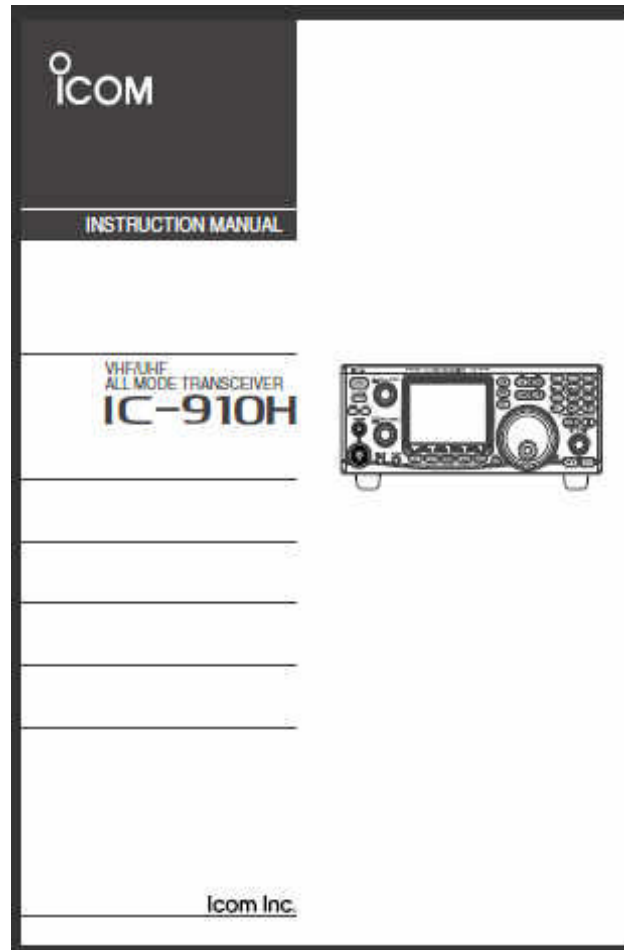
## Cross-Band 144/440 MHz Transceiver



- All Mode FM/LSB/USB/CW
- 100 Watt VHF / 75 Watt UHF
- Continuously Variable Output
- PC Controllable
- Easy to use Soft Key Menus
- Simultaneously Works Two Bands
- Four Scanning Functions
- CTCSS Encode/Decode Tone Scan
- Built-in CW Keyer
- Voice Synthesizer Option
- DSP Option
- 1.2 GHz Band Option



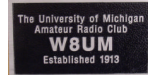
# IC-910H Instruction Manual



<http://www.icomamerica.com/en/downloads/default.aspx?Category=31>



# IC-910H Specifications



## 14 SPECIFICATIONS

**• General**

• Frequency coverage : (Unit: MHz)

Version	144 MHz	430(440) MHz	1200 MHz*
U.S.A.	To: 144.0-148.0 Rx: 138.0-174.0†	To: 430.0-430.0 Rx: 430.0-480.0†	To: 1240.0-1300.0 Rx: 1240.0-1300.0†
Europe	144.0-148.0	430.0-430.0	1240.0-1300.0
Australia	144.0-148.0	430.0-430.0	1240.0-1300.0
Sweden	144.0-148.0	432.0-438.0	1240.0-1300.0
Italy	144.0-148.0	430.0-434.0 435.0-438.0	1240.0-1245.0 1270.0-1298.0

\*Optional UK-910  
 †Guaranteed range is 144.0-148.0 MHz.  
 ‡Guaranteed range is 430.0-480.0 MHz.  
 §Guaranteed range is 1240.0-1300.0 MHz.

• Mode : USB, LSB, CW, FM, FM-N†  
 †Not available in 1200 MHz

• No. of memory Ch. : 212 (20 regular, 8 scan edges, 1 call for each band) plus 10 data/memorization

• Antenna connector : SO-239 (50 Ω VHF)  
 Type-N (50 Ω UHF)

• Usable temp. range : -10°C to +50°C,  
 -14°F to +140°F

• Frequency stability : Less than ±2 ppm  
 (-10 to +50°C, -14 to +140°F)

• Frequency resolution : 1 Hz minimum

• Power supply : 13.8 V DC ±5%  
 (negative ground)

• Current drain (at 13.8 V DC, approx.)  
 Transmit Max. power 23.0 A  
 Receive Standby 2.0 A (3.0 A, UK-910)  
 Max. audio 2.5 A (3.5 A, UK-910)

• Dimensions : 241 (W) x 94 (H) x 230 (D) mm  
 (bracket not included) 9 (W) x 3 1/4 (H) x 9 1/4 (D) in

• Weight (approx.) : 4.5 kg, 10 lb  
 (5.35 kg, 11 lb 13 oz w/UK-910)

• ADC 1 connector : 8-pin DIN connector

• D-V connector : 2-conductor 3.5 (φ) mm (1/4")

• DATA connectors : 8-pin mini DIN x 2  
 (for MAIN and SUB)

**• Transmitter**

• Output power (continuously adjustable):  
 144 MHz : 5-100 W  
 430(440) MHz : 5-75 W  
 1200 MHz : 1-10 W (optional UK-910)

• Modulation system :  
 SSB : Balanced modulation  
 FM : Variable reactance modulation

• Spurious emission :  
 144(430/440) MHz : More than 50 dB  
 1200 MHz : More than 50 dB

• Carrier suppression : More than 40 dB

• Unwanted sideband suppression : More than 40 dB

• Microphone connector : 8-pin connector (500 Ω)

• KEY connector : 3-conductor 3.5 (φ) mm (1/4")

**• Receiver**

• Receive system :  
 VHF SSB, CW : Single conversion superheterodyne  
 FM : Double conversion superheterodyne  
 UHF SSB, CW : Double conversion superheterodyne  
 FM : Triple conversion superheterodyne

• Intermediate frequencies : (Unit: MHz)

	MAIN BAND			SUB BAND		
	1st	2nd	3rd	1st	2nd	3rd
S SSB	10.8500	—	—	10.9500	—	—
S CW	10.8491	—	—	10.9491	—	—
S FM	10.8500	0.455	—	10.9500	0.455	—
S SSB	71.2500	10.8500	—	71.3500	10.8500	—
S CW	71.2491	10.8491	—	71.3491	10.8491	—
S FM	71.2500	10.8500	0.455	71.3500	10.8500	0.455
S SSB	243.9500	10.8500	—	243.9500	10.8500	—
S CW	243.9491	10.8491	—	243.9491	10.8491	—
S FM	243.9500	10.8500	0.455	243.9500	10.8500	0.455

• Sensitivity :  
 SSB, CW (10 dB S/N) : Less than 0.11 μV  
 FM (12 dB S/N42) : Less than 0.15 μV

• Squelch sensitivity threshold :  
 SSB, CW : Less than 1.0 μV  
 FM : Less than 0.15 μV

• Selectivity :  
 SSB, CW : More than 2.3 kHz±6 dB  
 Less than 4.2 kHz±60 dB\*  
 FM : More than 15.0 kHz±6 dB  
 Less than 50.0 kHz±60 dB\*  
 FM-N : More than 6.0 kHz±6 dB  
 Less than 18.0 kHz±36 dB  
 CW-N : More than 0.5 kHz±6 dB  
 (w/FU-132 or FU-133) : Less than 1.34 kHz±80 dB\*  
 \*Exceed 1200 MHz band

• Spurious and image rejection ratio :  
 144(430/440) MHz : More than 50 dB  
 1200 MHz : More than 50 dB

• A-F output power : More than 2.0 W at 10%  
 distortion with an 8 Ω load.

• RTT variable range :  
 144(430/440) MHz : ±1.0 kHz (SSB, CW)  
 ±5.0 kHz (FM)  
 1200 MHz : ±2.0 kHz (SSB, CW)  
 ±10.0 kHz (FM)

• IF BPF variable range : More than ±1.2 kHz

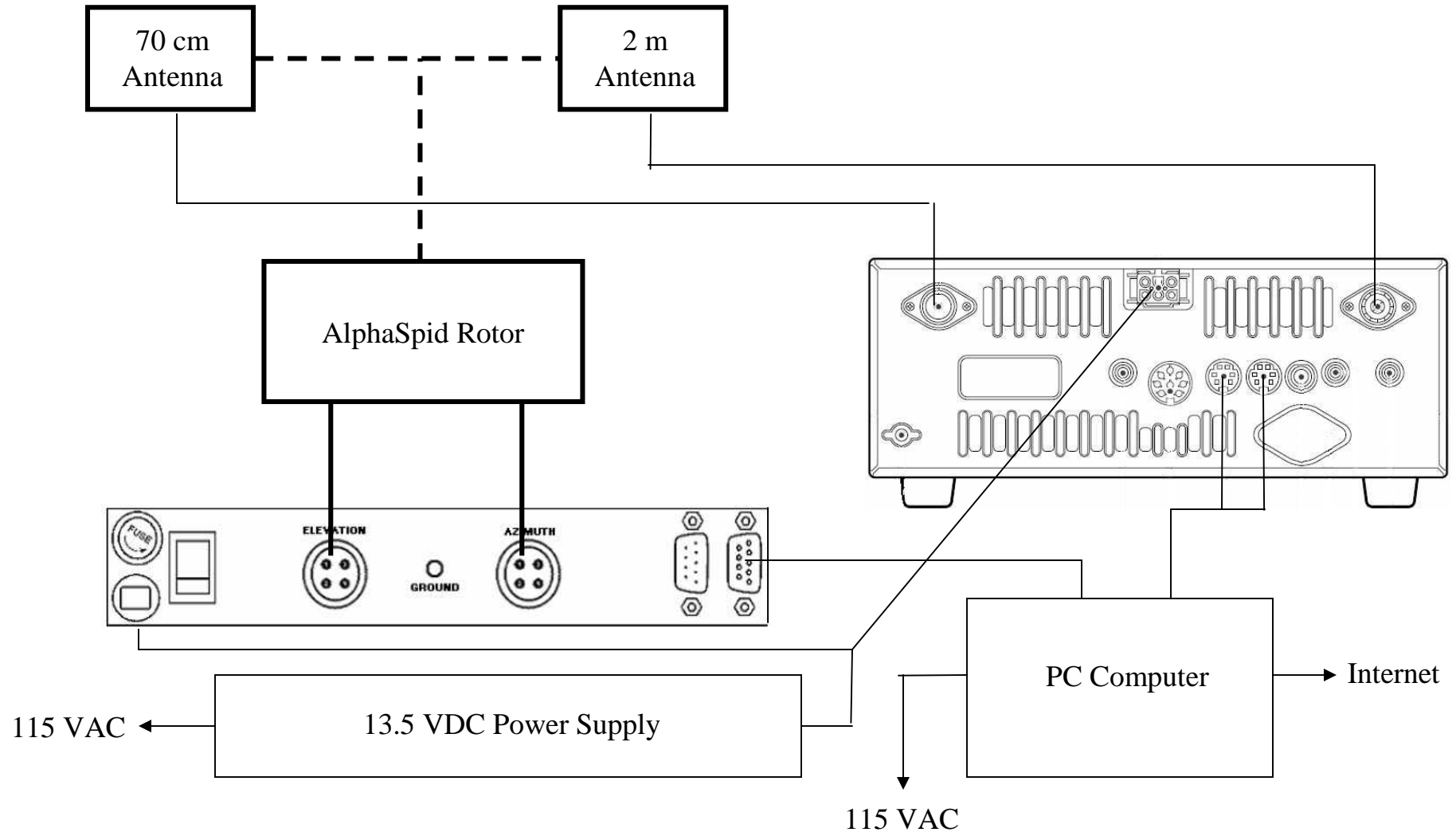
• P-OFFS connector : 3-conductor 3.5 (φ) mm (1/4")

• Ext. SP connectors : 2-conductor 3.5 (φ) mm (1/4")  
 (8 Ω x 2 for MAIN and SUB)

At listed specifications are typical and subject to change without notice or obligation.



# Component connections





# Leave Station Settings & connections as found

- W8UM will soon have 30, or more, members eligible to use the shack stations
- It is, therefore, becoming increasingly important that initial settings and configurations of all station facilities be preserved when leaving the shack
- Failure to do so will lead to a facility that is no longer useful to anyone
- The moral:
  - Leave the shack as you found it
  - Carefully record all changes that had to be made
  - Immediately inform the Station Manager of the alteration
- As a club sponsored by the EECS Department, W8UM members are morally under the College Honor Code.

ACT ACCORDINGLY

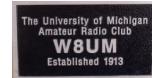


# Tracking Satellites\*



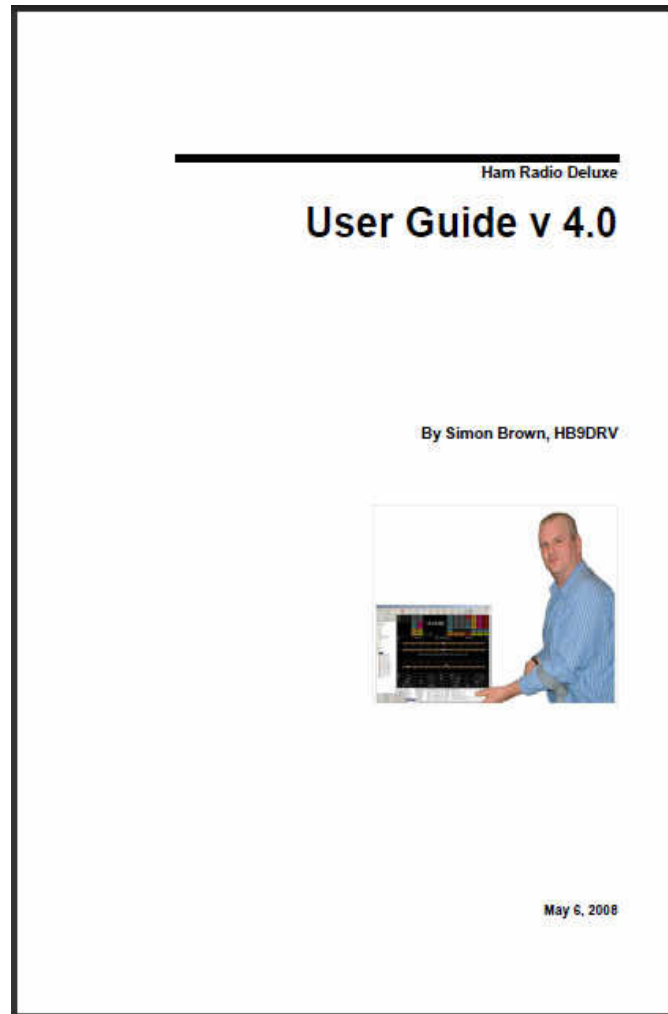
- Turn on all components
- Click on Ham Radio Deluxe icon
  - Select 910H & connect
- Click on Satellites, then:
  - Tools Menu: Keps to Rotator
  - Choose option: Connect
  - Choose Tracking: computer to rotor
- Satellites should be updated
  - If not download from Amsat.org
  - Choose Satellites of interest

\* Illustrations here from HRD v. 4.0, Not from W8UM HDR v. 3.4



# Ham Radio Deluxe User Guide v. 4.0

NOTE: Use this guide as a guideline. Although it does not correspond completely with the W8UM's v. 3.4 it contains all the essentials.

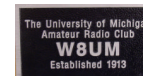


<http://www.ham-radio-deluxe.com/>

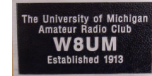




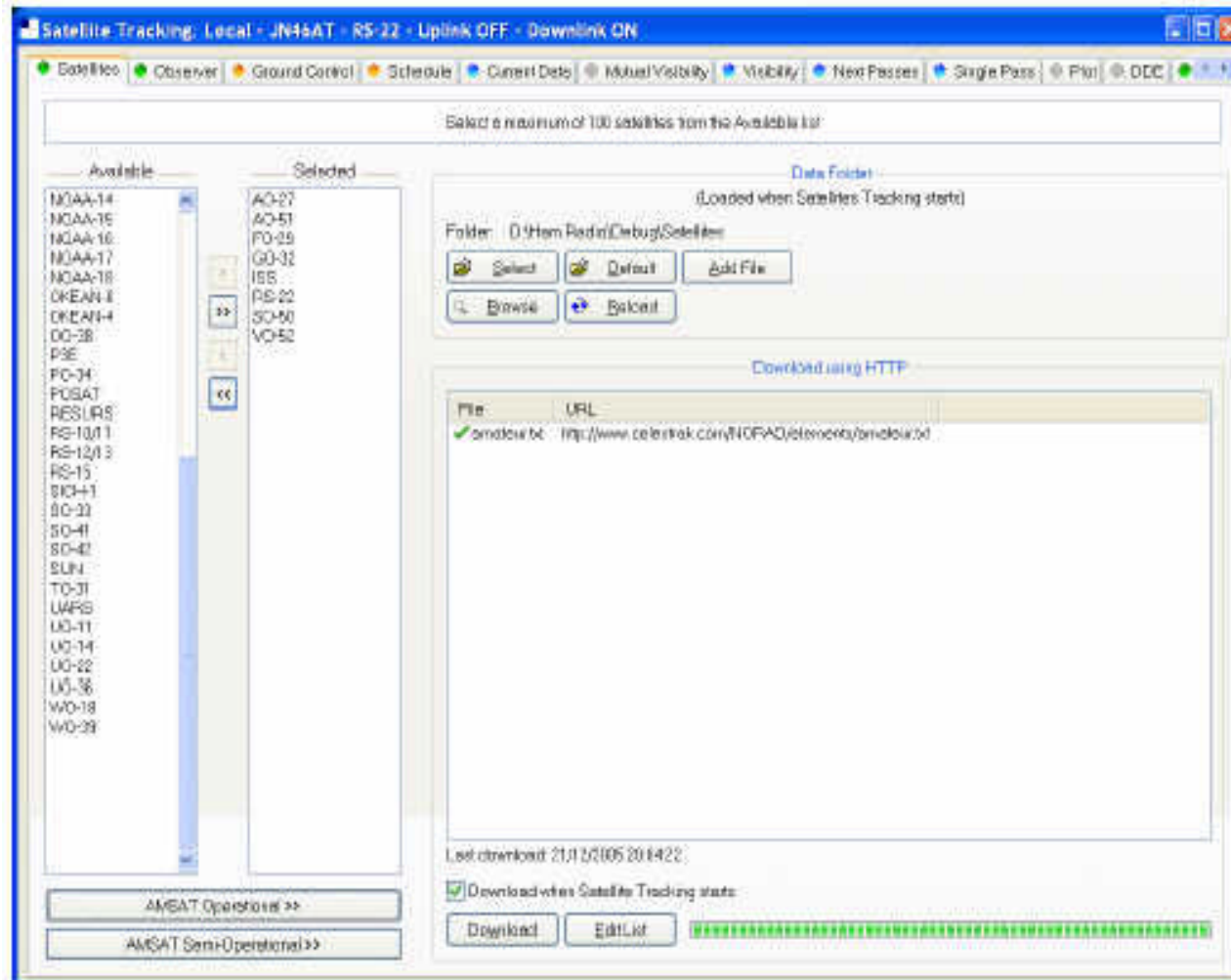
# HDR Radio (TS-570 Demo)



The screenshot displays the HamRadioDeluxe software interface. The title bar reads "HamRadioDeluxe - [FT-950: Demo]". The menu bar includes File, Edit, View, Bands, Favourites, Quick Save, Macros, Logbook, Scanning, Tuning, Tools, Voice, Window, Help, and a Donate button. The toolbar contains icons for Connect, Selection, Favourite, Quick Save, Full Screen, DX Cluster, Logbook, Satellites, SW Data, Sliders, Customise, Options, Forums, Undo, Redo, Add, and Backup. Below the toolbar are icons for Mapper, DM780, PSK31, Synch, Remote, Serial, and Programs. The main window has two tabs: "FT-950: Demo" and "TS-570: Demo". The "Selection" panel on the left shows ALC, SWR, PWR, Busy, PLL lock, High SWR, Mic Eq, and Status. The central display shows "LSB" and a large frequency readout of "43.073.883". Below this is a smaller readout of "3.780.000". The right-hand control panel includes buttons for ATT, Chan +, Moni, Q-Split, TXW, Mode: LSB, ATU, Chan -, NB, QMR, Tune, AGC: Medium, Band +, Contour, NR, QMS, VM, CW Keying, Band -, Fast, Nar, Scan Dn, VOX, CW Pitch: 800 Hz, Bk-in, Keyer, Notch, Scan Up, Mode Key, CW Spot, Lock, Pre, and TX. The main display area shows the date "Wednesday, January 26, 2011", the band "VHF - UHF", and the time "15:45:34 UTC". It features three frequency scales: "Fine" (43.072.6 to 43.075.0), "70cm" (430.000 to 435.000), and "2m" (147.000 to 148.000). A horizontal frequency slider is positioned at the top of the Fine scale. Below the scales are buttons for "ALT", "6m", "FM", "Air", and several "2m" and "70cm" buttons. At the bottom, there are several gain and power sliders: AF gain: 20, RF gain: 100, Mic gain: 50, RF power: 100, Noise reduction: 8, IF shift: -200 Hz, Filter width: 13, Contour: 20 Hz, VOX delay: 1000 ms, and VOX gain: 39.



# Satellite Window




p. 130

- Select satellite of interest from all available satellites
- Each list contains the satellite's Keplerian elements



# Keperian Downloads



AMSAT™  
Keplerian Elements

850 Sligo Ave. Suite 600  
Silver Spring, MD 20910  
1-888-322-6728

Launch Pad	Navigator	Sat Status	Keps	Passes	News	Store	Members	Contact Us	Return
------------	-----------	------------	------	--------	------	-------	---------	------------	--------

Keplerian elements are the inputs to a standard mathematical model of spacecraft orbits. With the "keps", the correct time, and your station location, you can compute when the satellite will be in view and where to point your antennas. See also the [tutorial on Keplerian elements](#) and the [explanation of the formats in detail](#) used in these files.

If you really want to know the mathematics behind the elements, see [Spacetrack Report No. 3](#) from NORAD (1.1 megabytes in PDF format). Most amateur radio tracking programs use a simplified version of the simplest model described in this report.

## Current Kep Downloads

AMSAT publishes Keplerian elements weekly. Here are the current bulletins:

- [AMSAT \(verbose\) format elements](#) for all satellites of interest to radio amateurs (updated 20 Jan, 2011)
- [NASA \(2-line\) format elements](#) for all satellites of interest to radio amateurs (updated 20 Jan, 2011)
- [Bare NASA \(2-line\) format elements](#) for all satellites of interest to radio amateurs (updated 20 Jan, 2011)

You can receive these bulletins regularly by e-mail by subscribing to the [KEPS mailing list](#).

## Keps in PDB Format

You can also download keps in PDB format suitable for PocketSat for PalmOS PDA.

- [Download PDB Keplerian Elements](#) (updated 20 Jan, 2011)

## Orbital State Vectors

Orbital State Vectors describe the Position and Velocity of spacecraft at some specified Epoch time. For further information, see the [State Vector](#) tutorial.



# Satellites of Interest to Hams

850 Sligo Ave. Suite 600  
Silver Spring, MD 20910  
1-888-322-6728

## Satellite Status

Launch Pad
Navigator
Sat Status
Keps
Passes
News
Store
Members
Contact Us
Return

### Operational OSCAR Satellite Status Summary

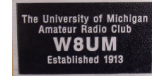
[All OSCAR Satellites](#) | 
 [Future Satellites](#) | 
 [Satellite Frequencies](#) | 
 [Satellite Chronology](#)

[Operational \[▲\]](#) | 
 [Semi-Operational \[▶\]](#) | 
 [Non-Operational \[▼\]](#) | 
 [Future Launch \[▲\]](#) | 
 [Unknown \[?\]](#)

Name	Beacons	HF	VHF	UHF	L-Band	S-Band	C-Band	X-Band	K-Band	APRS	Packet	Schedule
<a href="#">FASTRAC 1</a>	▲											
<a href="#">FASTRAC 2</a>	▲											
<a href="#">NanoSail-D2</a>				▲								
<a href="#">O/OREOS</a>	▲											
<a href="#">RAX</a>	▲											<a href="#">Beacon Information</a>
<a href="#">HO-88</a>	▲		▲	▲							▲	<a href="#">Commissioning</a>
<a href="#">ITUSAT1</a>	▲			▲								<a href="#">ITU Space Systems Lab</a>
<a href="#">UWE-2</a>				▼								<a href="#">UWE-2 Website</a>
<a href="#">BEESAT</a>				▲								<a href="#">T.U. Berlin</a>
<a href="#">SwissCube</a>				▲								<a href="#">EPFL Swisscube website</a>
<a href="#">SO-87</a>	▼		▲	▲								<a href="#">Activation Schedule</a>
<a href="#">STARS</a>	▲											
<a href="#">KKS-1</a>	▲											
<a href="#">PRISM</a>	▲											
<a href="#">RS-30</a>				▲								
<a href="#">CO-86</a>	▲			▲								<a href="#">SEEDS II webpage</a>



# Ground Control Window



The screenshot shows the 'Ground Control' window of a satellite tracking application. It includes several sections:

- Top Panel:** Contains tabs for 'Satellites', 'Observer', 'Ground Control', 'Schedule', 'Current Data', 'Actual Visibility', 'Visibility', 'Next Passes', 'Single Passes', 'Plot', 'DOC', and 'Help'. Below these are fields for VFO, Satellite (75-2010), and various frequency and mode settings.
- Left Panel:** Features a 'Status' section with a signal strength indicator and a table of satellite passes.
- Right Panel:** Contains a graph showing 'Elevation' and 'Azimuth' over time, and a world map with a satellite track overlaid.

Pass	AOE	Visibility
SO-50	20:35:13	8:14
ISS	20:36:47	9:21
AO-51	20:44:53	14:28
CO-10	20:50:11	11:24
RS-22	21:06:37	8:02
OO-32	21:17:08	15:20
VO-52	21:20:04	12:17
NO-44	21:30:15	15:09
SO-41	22:03:38	12:41
ISS	22:13:30	4:44
AO-7	22:24:47	16:59
AO-51	22:25:00	12:40
RS-22	22:42:15	13:34
OO-32	22:54:04	12:47
VO-52	22:56:52	12:40
NO-44	23:17:41	15:19
SO-41	23:46:42	10:36
RS-22	00:20:01	12:07
VO-50	00:39:13	3:00
NO-44	01:00:05	12:38
SO-41	01:28:39	11:26
RS-22	02:00:29	2:30

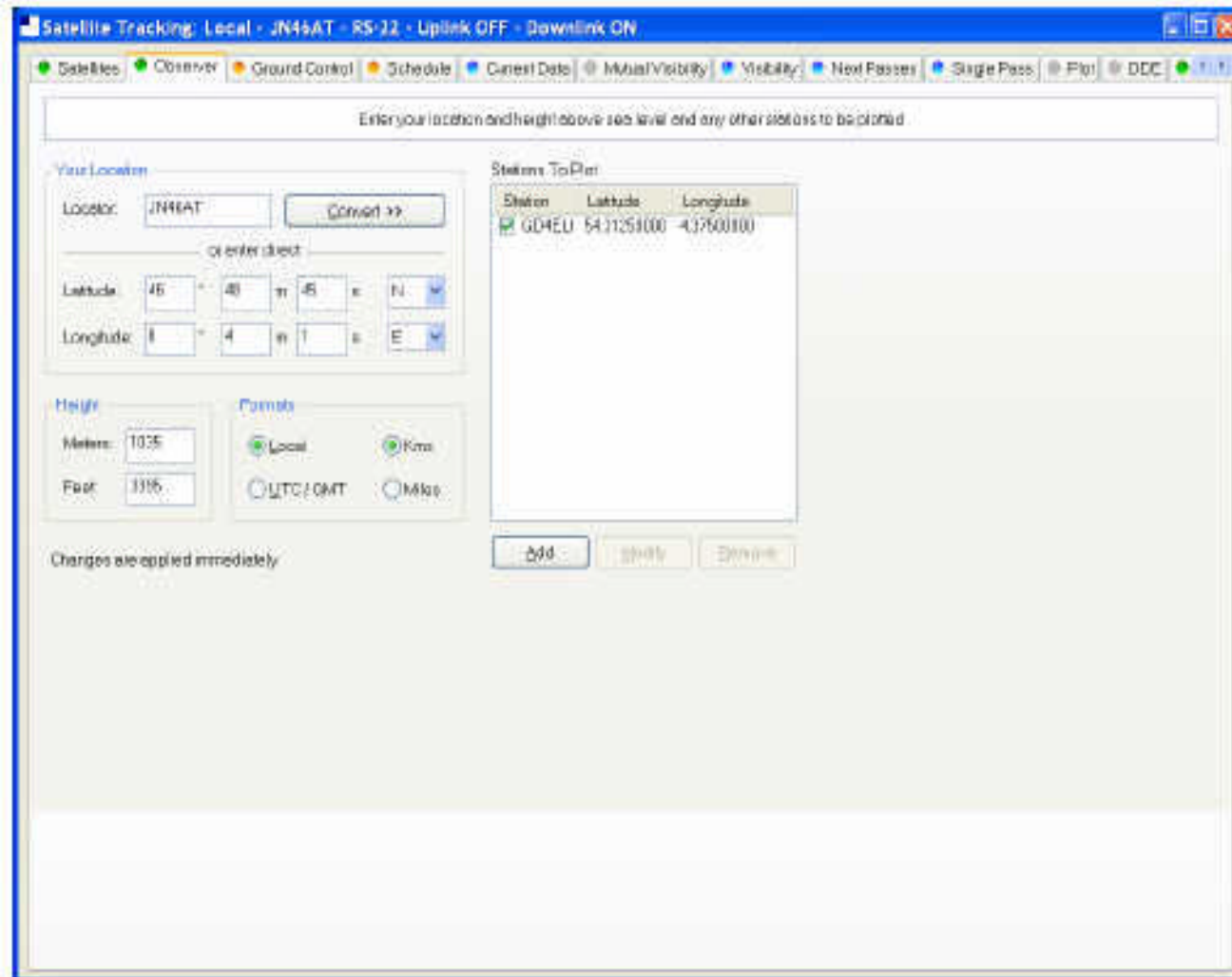
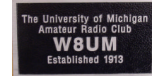
See following slides

p. 133

Enter the satellite uplink and downlink



# Observer Window



p. 132

- Enter the location for Ann Arbor.(42° 16' 14" N / 83° 43' 35" W 805 ft above sea level )
- This should have already been added in the W8UM unit.



# Next Passes Window

Satellite Tracking: Local - JN45AT - VO-52 - Uplink ON - Downlink ON

Satellites
  Observer
  Ground Control
  Schedule
  Current Data
  Mutual Visibility
  Visibility
  Next Passes
  Single Pass
  Plot
  DDC

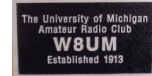
Next passes for a selected satellite

Via	Satellite	VO-52: AOS	AOS Azim	LOS	Max Elev	Max Azimuth	Duration
X	AO-27	Wed 21-Dec-2005 21:23:04	137.22°	21:35:36	29.82°	66.45°	12:32
X	AO-51	Wed 21-Dec-2005 22:59:07	190.48°	23:11:54	31.44°	264.30°	12:47
X	FO-29	Thu 22-Dec-2005 00:44:43	270.60°	00:44:25	0.46°	282.48°	2:42
X	GO-32	Thu 22-Dec-2005 09:10:23	56.00°	09:15:22	1.65°	83.65°	4:59
X	ISS	Thu 22-Dec-2005 10:43:54	19.96°	10:56:39	31.16°	133.57°	12:16
X	RS-22	Thu 22-Dec-2005 12:20:21	1.89°	12:32:20	21.54°	271.61°	11:59
✓	SO-50	Thu 22-Dec-2005 13:59:01	233.84°	14:03:09	1.26°	315.25°	4:08
X	VO-52	Thu 22-Dec-2005 20:09:09	89.92°	20:17:19	5.00°	49.66°	8:10
		Thu 22-Dec-2005 21:41:52	147.80°	21:54:52	44.51°	70.48°	13:00
		Thu 22-Dec-2005 23:18:45	201.93°	23:30:52	20.89°	267.56°	12:07
		Fri 23-Dec-2005 08:26:17	43.28°	09:36:27	5.22°	31.59°	8:10
		Fri 23-Dec-2005 11:02:59	16.08°	11:16:00	41.80°	159.49°	13:01
		Fri 23-Dec-2005 12:39:42	368.21°	12:50:53	15.36°	281.41°	11:11
		Fri 23-Dec-2005 20:27:11	102.99°	20:36:54	8.92°	43.36°	9:43
		Fri 23-Dec-2005 22:00:49	158.26°	22:14:05	69.10°	74.28°	13:16
		Fri 23-Dec-2005 23:38:36	214.21°	23:49:42	13.71°	271.13°	11:06
		Sat 24-Dec-2005 08:46:47	35.43°	09:56:49	9.49°	99.22°	10:02
		Sat 24-Dec-2005 11:22:07	12.44°	11:35:11	46.76°	108.18°	13:04
		Sat 24-Dec-2005 12:59:08	354.13°	13:09:15	10.60°	289.46°	10:07
		Sat 24-Dec-2005 20:45:28	114.88°	20:56:22	13.09°	43.16°	10:54
		Sat 24-Dec-2005 22:19:55	368.71°	22:33:15	77.20°	256.22°	13:20
		Sat 24-Dec-2005 23:56:45	227.94°	00:06:22	0.35°	274.66°	9:37
		Sun 25-Dec-2005 10:05:32	29.46°	10:16:49	14.77°	107.71°	11:17
		Sun 25-Dec-2005 11:41:19	8.92°	11:54:12	40.16°	136.33°	12:53
		Sun 25-Dec-2005 13:18:41	349.29°	13:27:25	6.83°	296.67°	9:44
		Sun 25-Dec-2005 19:34:21	51.15°	19:36:11	0.23°	42.72°	1:50
		Sun 25-Dec-2005 21:03:56	126.15°	21:15:45	18.41°	41.61°	11:49
		Sun 25-Dec-2005 22:39:11	179.32°	22:52:21	49.00°	260.30°	13:10
		Mon 26-Dec-2005 00:19:20	244.27°	00:26:42	4.09°	278.52°	7:22
		Mon 26-Dec-2005 10:24:25	24.45°	10:36:33	21.70°	117.85°	12:08
		Mon 26-Dec-2005 12:00:33	5.46°	12:13:05	29.82°	257.27°	12:32
		Mon 26-Dec-2005 13:38:23	343.29°	13:45:17	3.76°	303.79°	6:54
		Mon 26-Dec-2005 19:51:01	74.26°	19:56:56	2.71°	47.29°	5:55
		Mon 26-Dec-2005 21:22:34	137.00°	21:35:05	29.47°	66.91°	12:31
		Mon 26-Dec-2005 22:58:37	100.22°	23:11:23	51.70°	264.25°	12:48

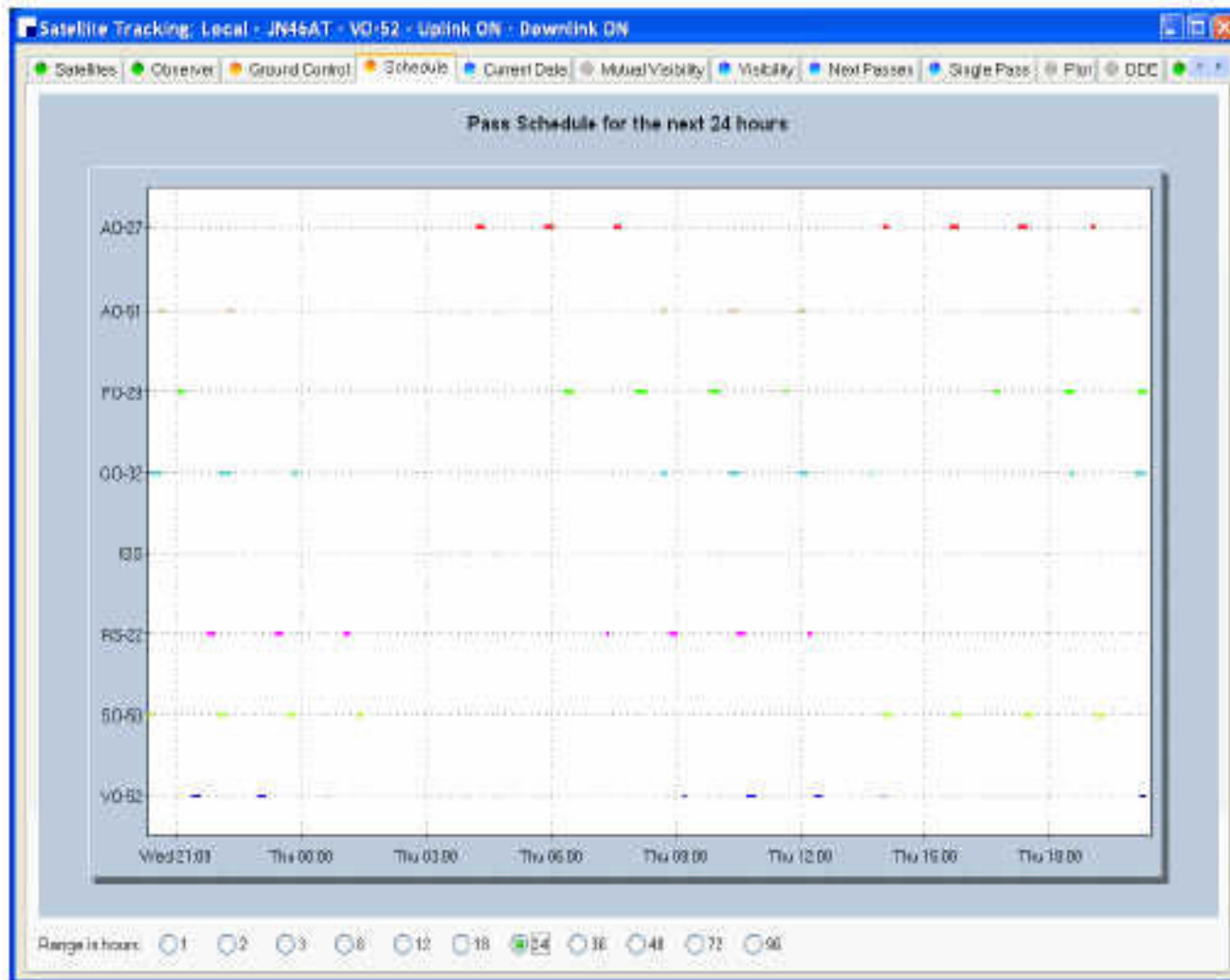
Select Refresh Passes: [R] [A] [E] [V]

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Lists the time for each pass of a selected satellite



# Schedule Window



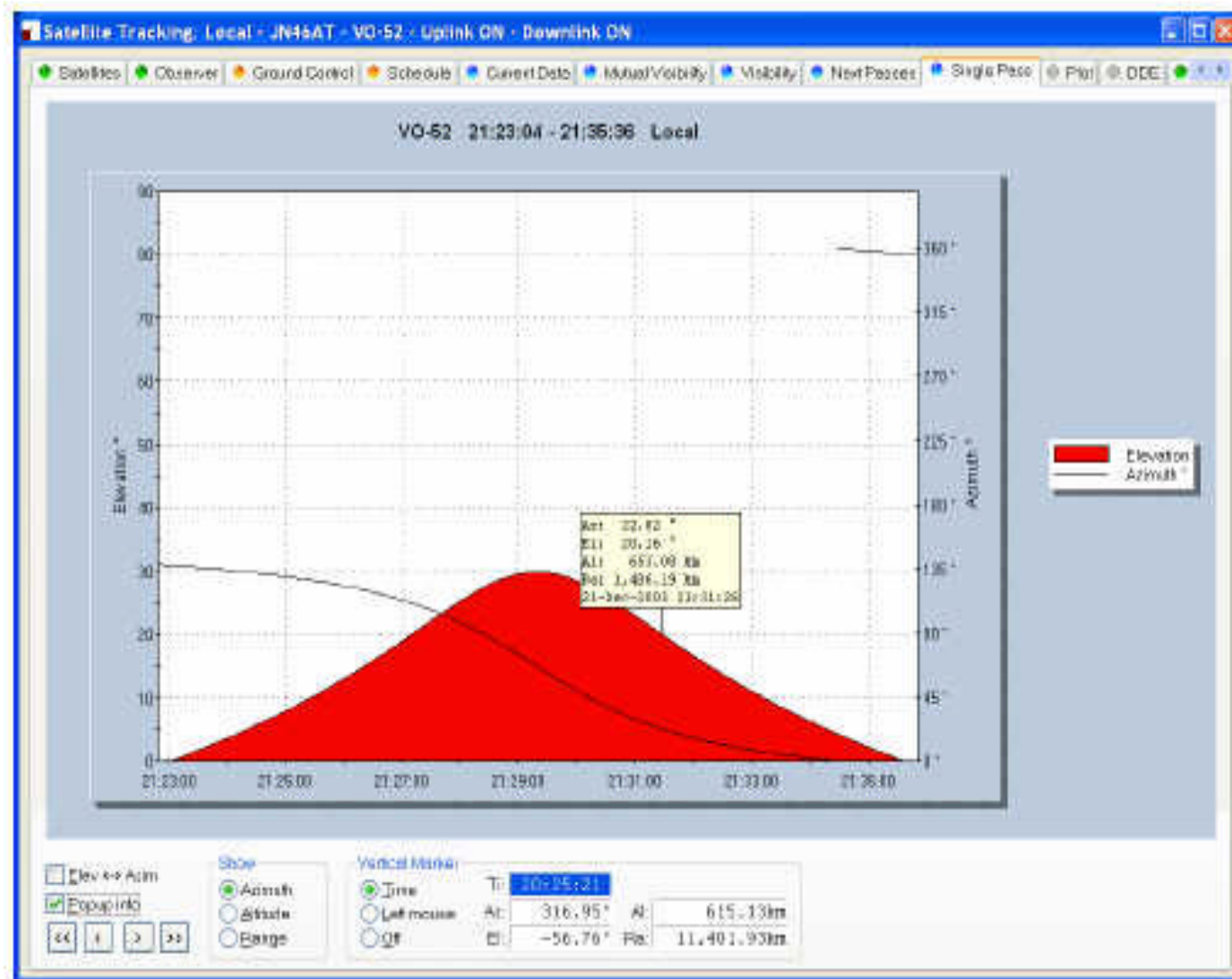
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Times satellites selected will be visible





# Single Pass Window



p. 142

How the antenna points throughout the passby



# Visibility Window

Satellite Tracking: Local - JN44AT - VO-52 - Uplink ON - Downlink ON

Satellite visibility (satellite in range)

Show  All  Visible now  Visible in past 30 minutes

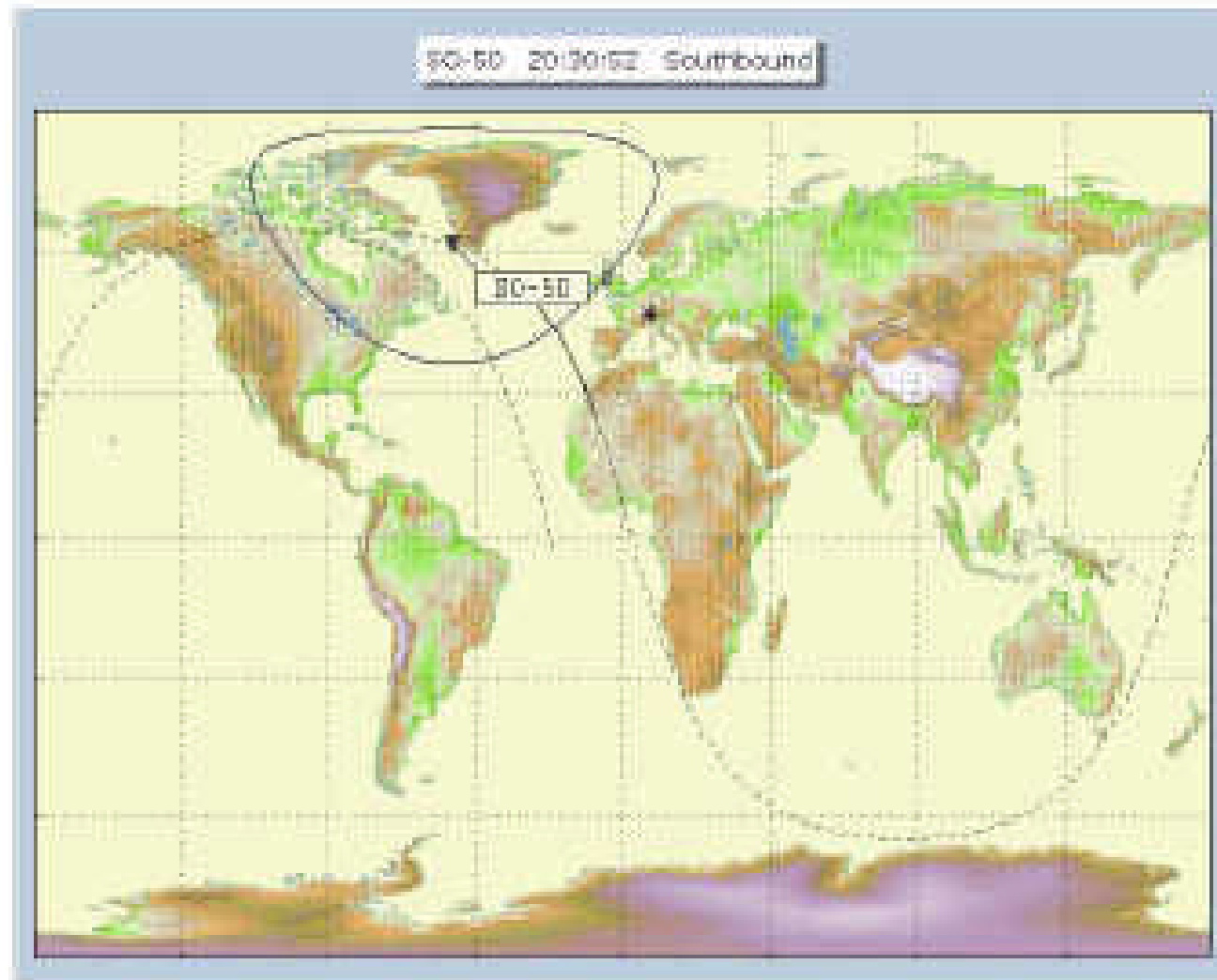
Vis	Satellite	Azimuth	Elevation	d LOS	d LOS	Lon	Lat	Range	Altitude	Range Rate
X	AO-27	126.80	-70.04	7:48:54	8:01:53	127.35 E	66.15 S	12,826.37	822.27	-0.19481937
X	AO-51	154.42	-26.63	10:11	23:51	31.26 E	12.00 S	7,056.20	714.95	-6.11700712
X	FO-29	158.29	-73.39	39:12	49:49	150.92 E	72.10 S	13,557.11	1,325.30	-1.65916760
X	OO-32	136.73	-1.67	0:31	14:58	29.41 E	23.04 W	3,518.51	817.68	-6.35537886
X	ISS	0.00	0.00	Visible		0.00 E	0.00 W	0.00	0.00	0.00000000
X	HS-22	132.69	-19.12	1:21:50	1:33:32	42.74 E	6.02 N	5,747.98	676.69	4.79986937
✓	SO-50	9.30	9.02	Visible	5:01	13.75 E	64.05 W	2,146.57	664.28	0.02066573
X	VO-52	318.42	-54.29	59:00	1:11:12	133.05 W	11.36 W	11,112.16	616.10	3.88572984

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A summary of satellites selected

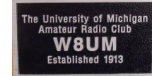


# Global Map

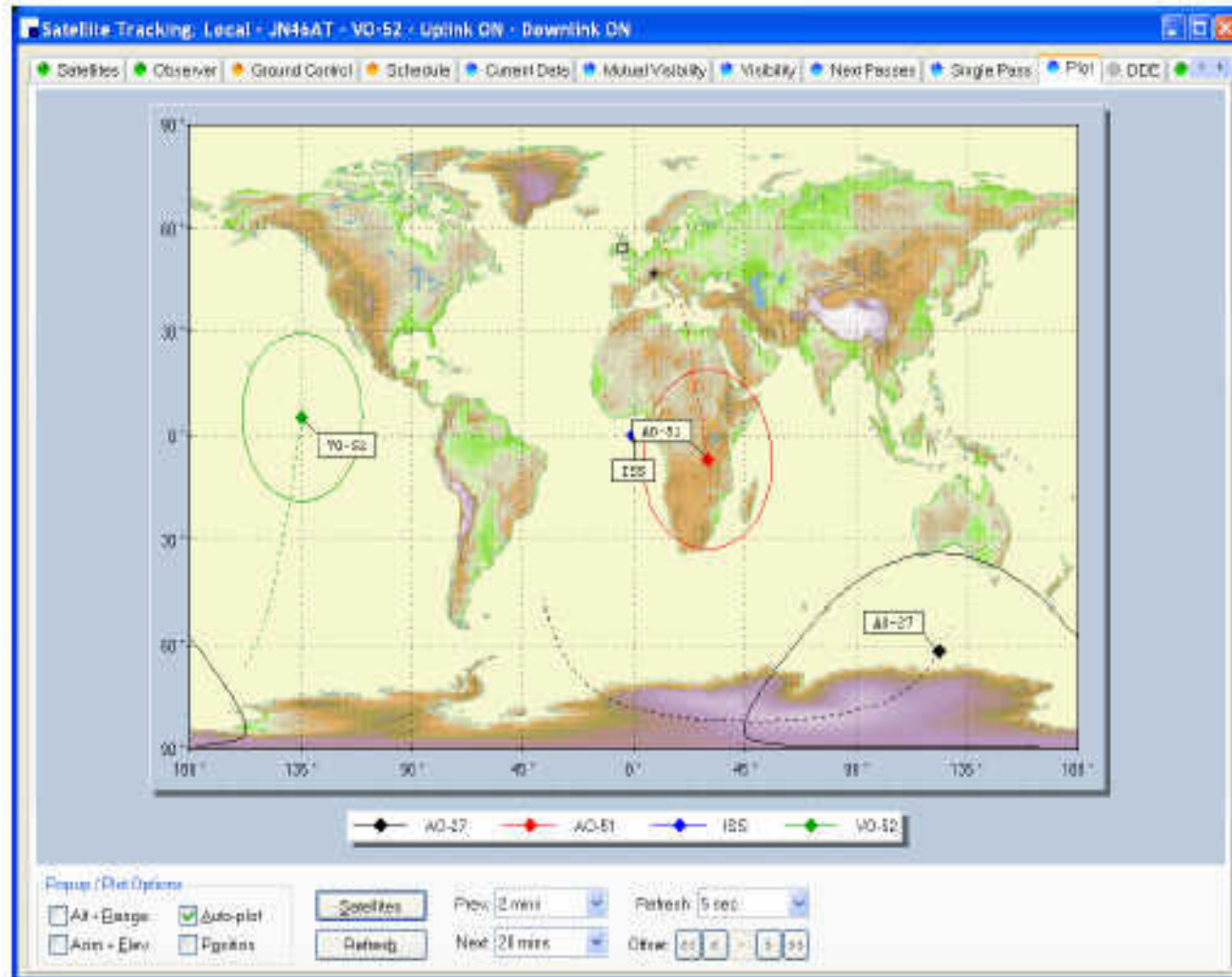


p. 133-4

The footprint of the selected satellite is shown along with the visible area at the present time



# Another Plot Window



p. 143

Another global map showing 4 footprints and area coverages



# Current Data Window



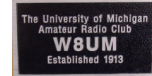
The screenshot shows the 'Current Data' window in the Satellite Tracking software. The window title is 'Satellite Tracking: Local - JN46AT - VO-52 - Uplink ON - Downlink ON'. The interface includes a menu bar with options like Satellites, Observer, Ground Control, Schedule, Current Data, Mutual Visibility, Visibility, New Passes, Single Pass, Plot, and DDC. Below the menu bar, there is a text area that says 'Current satellite data used for Ground Control and DDC'. The main area is divided into two panes. The left pane, titled 'Via Satellites', lists several satellites with checkboxes: AO-27, AO-51, FO-29, GO-32, IS, RS-22, QO-50, and VO-52 (which is selected and highlighted in blue). The right pane, titled 'Field Value', displays the following data for the selected satellite VO-52:

Field	Value
Satellite	VO-52
Visible	No
Direction	Southbound
Azimuth °	339.64
Elevation °	-62.11
Longitude	132.18 W
Latitude	15.53 N
Range km	10,842.92
Altitude km	617.22
Range rate	4.09459070
AOS	1:00:00
LOS	1:12:40

At the bottom of the window, there is a 'Select' button, a 'Refresh every' dropdown menu set to '0.10 seconds', and 'Quit' and 'View' buttons.

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All the data currently known about the selected satellite is displayed here



# Mutual Visibility Window

Satellite mutual visibility (satellite in range of two or more locations)

Satellite: AO-27  
Filter: 7 days  
Elevation: 10 minimum

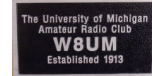
Date	Time	Duration
22/12/2005	05:54:26	9:00
22/12/2005	07:36:24	4:00
22/12/2005	15:40:35	6:00
22/12/2005	17:18:32	8:00
23/12/2005	05:26:14	8:00
23/12/2005	07:06:54	8:00
23/12/2005	15:13:42	4:00
23/12/2005	16:50:24	8:00
24/12/2005	04:50:15	6:00
24/12/2005	06:38:06	9:00
24/12/2005	14:47:38	1:00
24/12/2005	16:22:36	8:00
24/12/2005	18:02:24	6:00
25/12/2005	06:09:35	9:00
25/12/2005	15:55:07	7:00
25/12/2005	17:33:43	8:00
26/12/2005	05:41:17	9:00
26/12/2005	07:22:32	6:00
26/12/2005	15:27:59	6:00
26/12/2005	17:05:24	8:00
27/12/2005	05:13:10	8:00
27/12/2005	06:53:27	9:00
27/12/2005	15:01:22	3:00
27/12/2005	16:37:25	8:00
27/12/2005	18:18:40	4:00
28/12/2005	04:45:24	5:00
28/12/2005	06:24:48	9:00
28/12/2005	16:09:45	8:00
28/12/2005	17:49:01	7:00

Select two or more stations. This list is defined on the Observer page.

Refresh View Local UTC/GMT

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A listing of times when satellites are observable from two different places.



# RF Safety

## W8UM Transmitter Outputs (Antennas on EECS Building roof)

<b>ICOM IC-2100H</b>		
Output Power		
144 MHz		55/10/5 W
<b>Yaseu FT-8800R</b>		
RF Power Output		
144 MHz		50/20/10/5 W
430 MHz		35/20/10/5 W
<b>Ten-Tec Omni VI</b>		
RF Power Output (ALC stabilized)		
10/12/15/17/20/		
30/40/80/160 MHz		100 W
<b>Heathkit SB-220</b>		
RF Power Output		
SSB 80/40/20/10 MHz		2000 W P.E.P
CW 80/40/20/10 MHz		1000 W
RTTY 80/40/20/10 MHz		1000 W
<b>ICOM IC-910H</b>		
Output power (continuously adjustable)		
144 MHz		5 - 100 W
430(440) MHz		5 - 75 W
1200 MHz (Opt UX-910)		1 - 10 W

## FCC Power Output Maxima (to avoid further analysis)

Band (Meters)	Band (Freq.)	Power (Watts PEP)
160 m	1800-2000 kHz	500 W
75-80 m	3.5-4.0 MHz	500 W
40 m	7.0-7.3 MHz	500 W
30 m	10.10-10.15 MHz	425 W
20 m	14.0-14.35 MHz	225 W
17 m	18.068-18.168 MHz	125 W
15 m	21.00-21.45 MHz	100 W
12 m	24.89-24.99 MHz	75 W
10 m	28.0-28.7 MHz	50 W
6 m	50-54 MHz	50 W
2 m	144-148 MHz	50 W
1.25 m	219-225 MHz	50 W
70 cm	420-450 MHz	70 W
33 cm	902-928 MHz	150 W
23 cm	1240-1300 MHz	200 W
13 cm	2300-2450 MHz	250 W
All SHF	3.3-24.5 GHz	250 W
All EHF	47 GHz and above	250 W

Repeaters: All bands

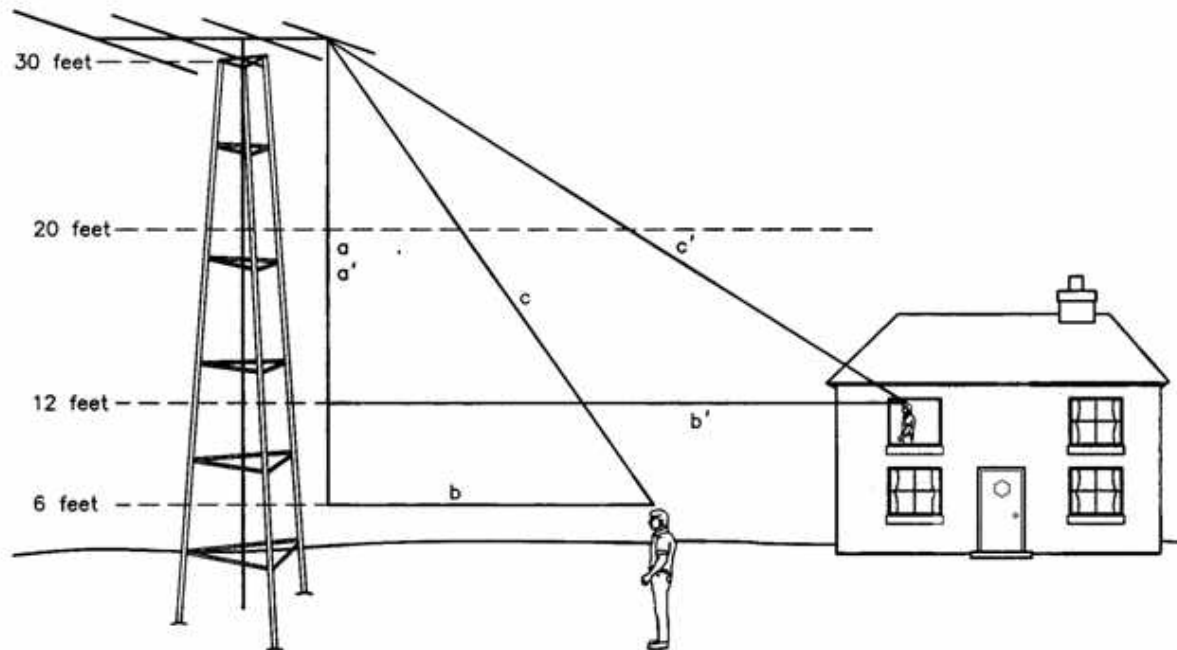
**Non-building-mounted antennas:** If the distance between ground level and the lowest point of the antenna is less than 10 meters and the power is greater than 500 W ERP.

**Building-mounted antennas:** If the power exceeds 500 W ERP.

Preliminary Analysis suggests that the only w8um concern is when the Linear Amplifier is used, but further analysis is required.

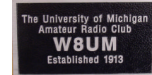


## Calculating Distances when Antenna and Observer are at different heights



- $a \equiv$  antenna height - height of observer above ground =  $\sqrt{c^2 - b^2}$
- $c =$  direct distance from antenna to observer =  $\sqrt{a^2 + b^2}$
- $b =$  horizontal distance between observer and antenna =  $\sqrt{c^2 - a^2}$





## Table 10.7 from ARRL, “RF Exposure and You”

Table 10.7

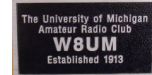
10-meter band horizontal, 3-element Yagi, Frequency = 29.7 MHz, Antenna height = 30 feet

Horizontal distance (feet) from any part of the antenna for compliance with occupational/controlled or general population/uncontrolled exposure limits\*

Power** (watts)	Height above ground (feet) where exposure occurs							
	6 feet		12 feet		20 feet		30 feet	
	con.	unc.	con.	unc.	con.	unc.	con.	unc.
10	0	0	0	0	0	0	8	9
25	0	0	0	0	0	0	8.5	11
50	0	0	0	0	0	0	9	13.5
100	0	0	0	0	0	0	10.5	18.5
200	0	0	0	0	0	21.5	12.5	25
250	0	0	0	0	0	25	13.5	27.5
300	0	0	0	0	0	28.5	14.5	30
400	0	0	0	39	0	35	16.5	34
500	0	0	0	47	0	48	18.5	37.5
600	0	0	0	52.5	0	59.5	20	40.5
750	0	36	0	59	16.5	70.5	22	45.5
1000	0	46.5	0	67	21.5	82.5	25	61.5
1250	0	53	0	73.5	25	91.5	27.5	95.5
1500	0	58.5	0	79	28.5	99	30	108

\* 0 feet indicates that the exposure at the height in the column above or below the antenna is in compliance.

\*\* Power = Average power input to the antenna.



## Table 10.8 from ARRL, “RF Exposure and You”

**Table 10.8**

**2-meter band ground plane, 45-degree radials, Frequency = 146.0 MHz, Height above ground = 30 feet**

Horizontal distance (feet) from any part of the antenna for compliance with occupational/controlled or general population/uncontrolled exposure limits\*

Power** (watts)	Height above ground (feet) where exposure occurs								
	6 feet		12 feet		20 feet		30 feet		
	con.	unc.	con.	unc.	con.	unc.	con.	unc.	
10	0	0	0	0	0	0	0	2	3
25	0	0	0	0	0	0	0	2.5	4
50	0	0	0	0	0	0	0	3	6
100	0	0	0	0	0	0	0	3.5	8.5
200	0	0	0	0	0	0	0	5.5	12
250	0	0	0	0	0	0	0	6	13.5
300	0	0	0	0	0	0	0	6.5	14.5
400	0	0	0	0	0	0	0	7.5	17
500	0	0	0	0	0	0	0	8.5	19
600	0	0	0	0	0	0	0	9.5	20.5
750	0	0	0	0	0	0	0	10.5	23
1000	0	0	0	0	0	0	20	12	27.5
1250	0	0	0	0	0	0	24	13.5	29.5
1500	0	0	0	0	0	0	32.5	14.5	31.5

\* 0 feet indicates that the exposure at the height in the column above or below the antenna is in compliance.

\*\* Power = Average power input to the antenna.

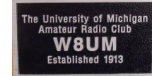


# Useful Links



## Part II

- [http://www.arrl.org/files/file/Hambands\\_color.pdf](http://www.arrl.org/files/file/Hambands_color.pdf) A.R.R.L. Ham Bands page
- <http://www.dxatlas.com/HamCap/> Ham Cap Home page
- <http://www.tentec.com/files/Model%20563%20Omni%20VI%20Manual.pdf>  
Ten-Tec Omni VI Operator's Manual
- [http://www.palstar.com/manual\\_at1km.pdf](http://www.palstar.com/manual_at1km.pdf) Palstar ATK1AM Antenna Tuner
- <http://n1mm.hamdocs.com/> N1MM Logger Home page
- <http://www.steppir.com/files/4%20Element%20Assembly.pdf> SteppIR 4 Element Yagi Instruction Manual
- <http://www.steppir.com/files/Operators%20guide.pdf> SteppIR Operators Manual
- <http://www.hellocq.net/forum/attachment.php?attachmentid=373223> M<sup>2</sup> Antenna rotary system
- <http://www.icomamerica.com/en/downloads/Default.aspx?Category=181>  
ICOM Country Codes
- [www.alfaradio.com](http://www.alfaradio.com) AlphaSpid (AZ/EL) Hpme page
- <http://www.icomamerica.com/en/downloads/default.aspx?Category=31>  
ICOM IC-910H Instruction Manual
- <http://www.ham-radio-deluxe.com> Ham Radio Deluxe User's Guide v 4.0
- <http://www.amsat.org> A great source for all Ham satellite data



# Computer References

- Primer I and II (May be combined into one Primer)
- and all available station device manuals

Access will be available shortly

- On shack computer(s)
- <http://www.eecs.umich.edu/~becher/ShackPrimer/>
- From a link on the W8UM web site

**Happy Hamming!**

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[becher@eecs.umich.edu](mailto:becher@eecs.umich.edu)