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^2 Antenna Rotor

W8UM: HF Station

HF Operating Station

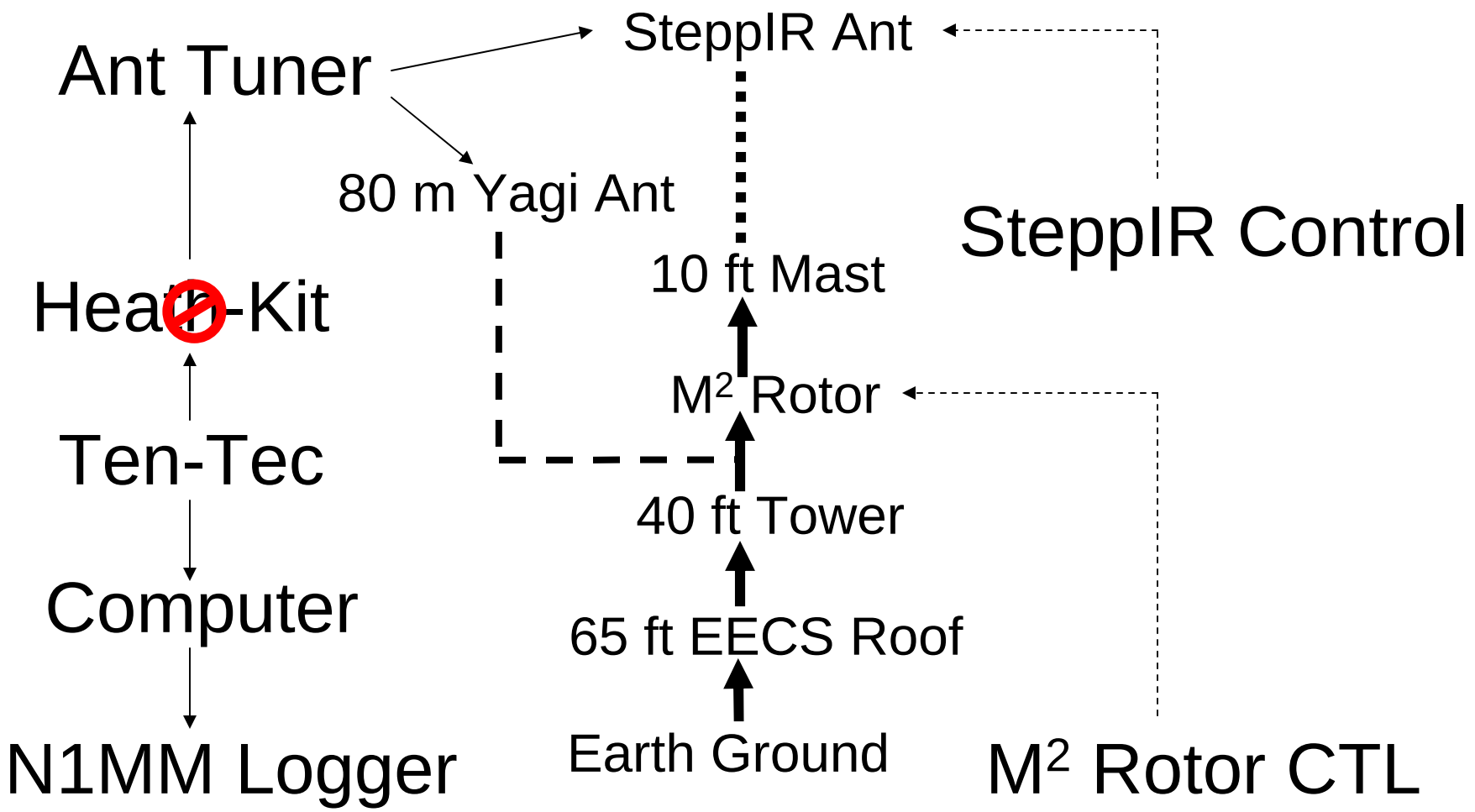
Ten-Tec Omni VI HF Transceiver

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

SteppIR Control

SteppIR 40m-6m Yagi Antenna

Heathkit Linear Amplifier

Do not turn on

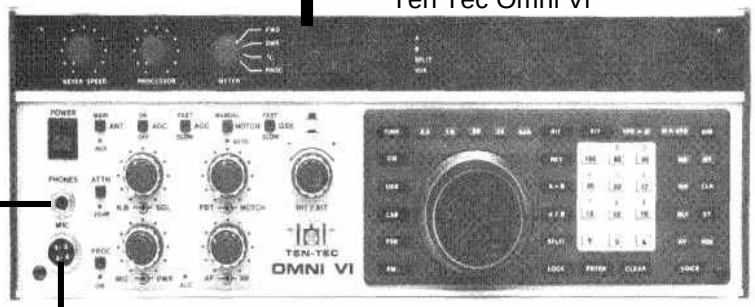
Palstar Antenna Tuner

80m Inverted Vee Antenna

Ear phones

Microphone

Ten Tec Omni Vi



M^2 Antenna Rotor Control

M2 Antenna Rotor

W8UM: HF Station Connections

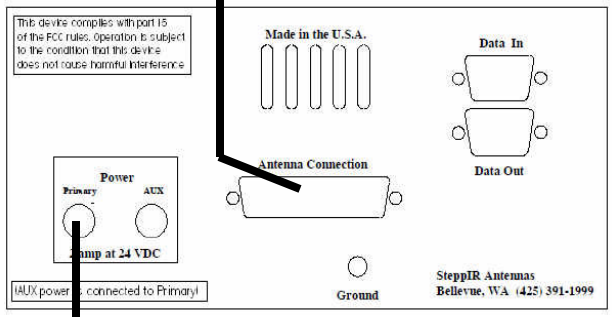
80m Inverted Vee Antenna

SteppIR 40m-6m Yagi Antenna

M2 Rotor System

Palistar ATI KM Antenna Tuner

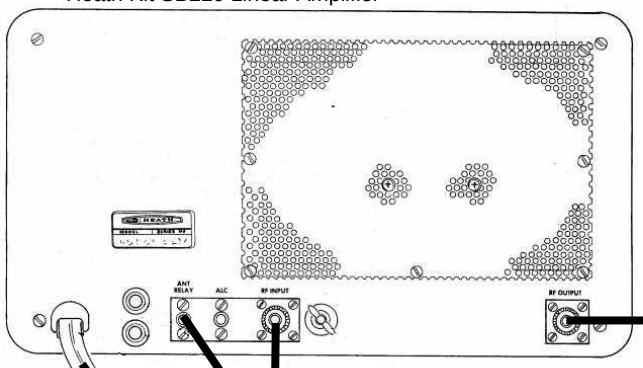
SteppIR 40 – 6m Antenna Controller



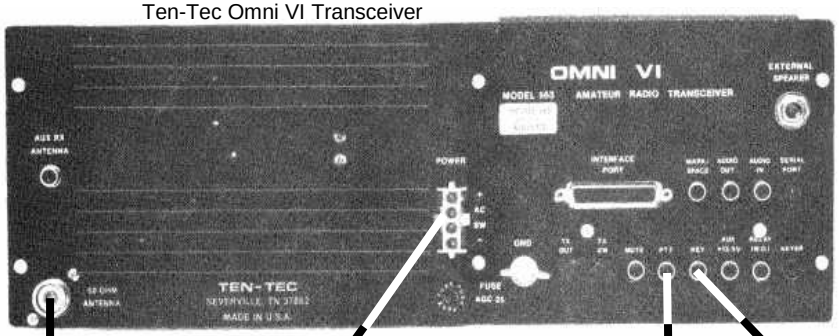
+12 VDC AC Plug Adapter

AC Plug Adapter

Heath Kit SB220 Linear Amplifier



Ten-Tec Omni VI Transceiver

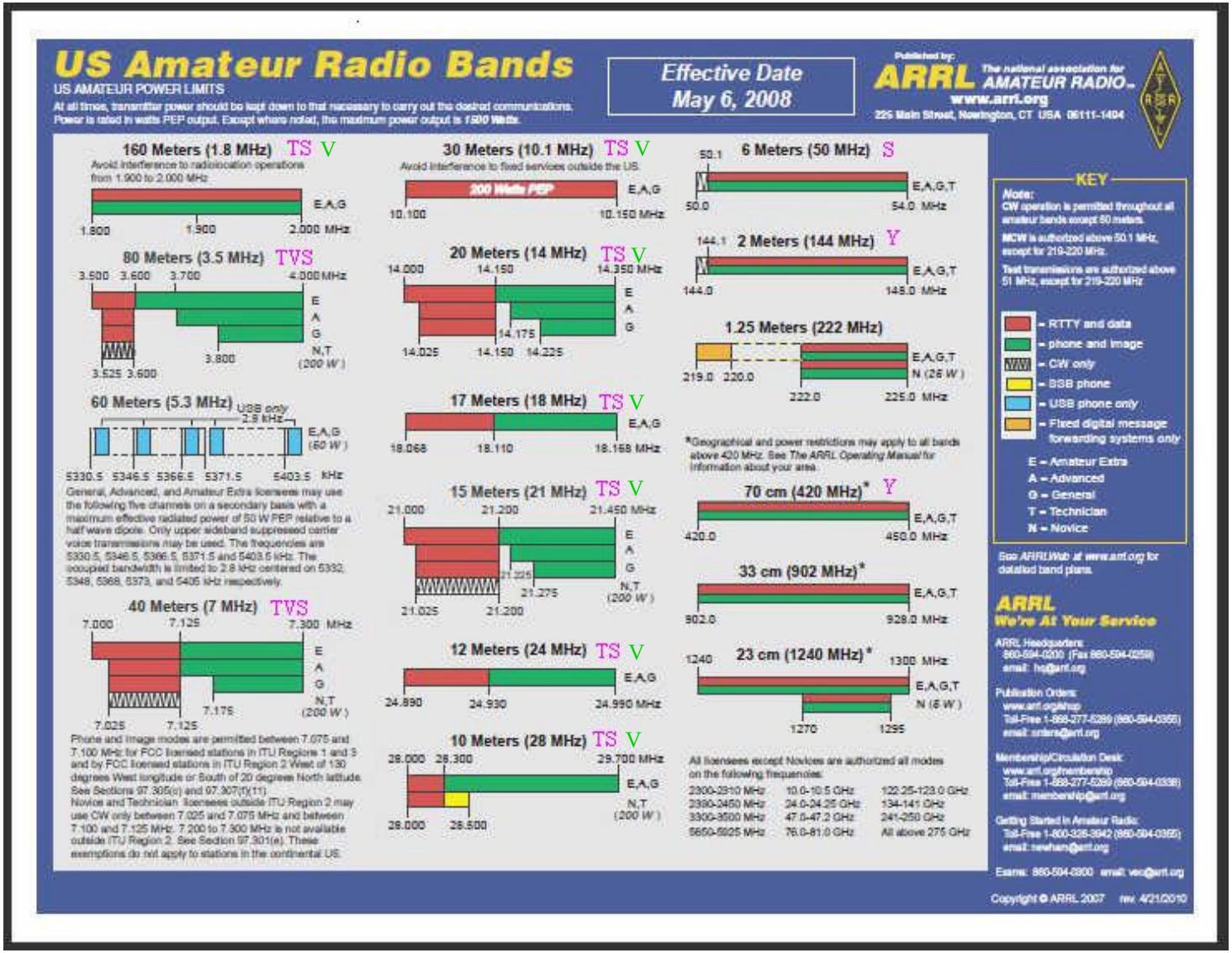


13.5 VDC Supply

CW Key

120 VAC

W8UM Tech Class Radio Bands



Y - Yaseu

T – Ten-Tec

V – Inverted-Vee

S - SteppIR

LSB < 10 MHz

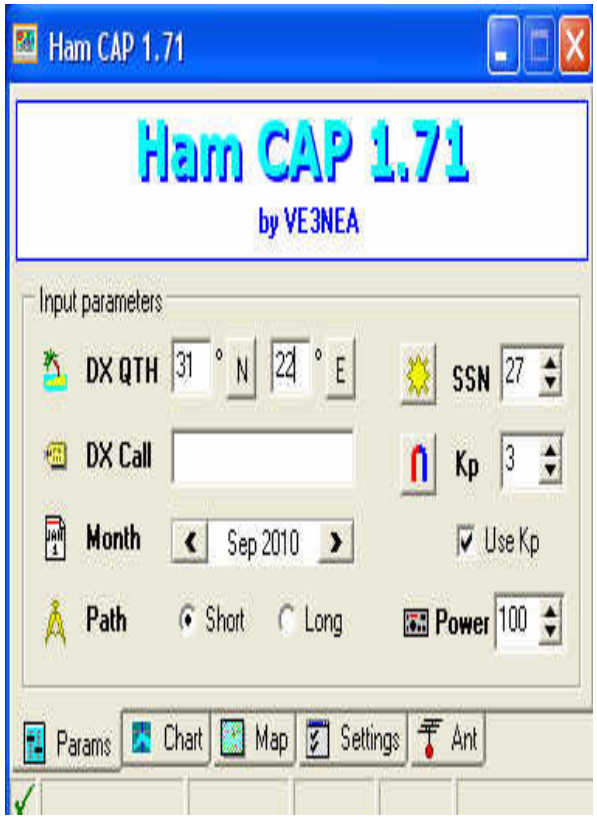
USB > 10 MHz

http://www.arrl.org/files/file/Hambands_color.pdf

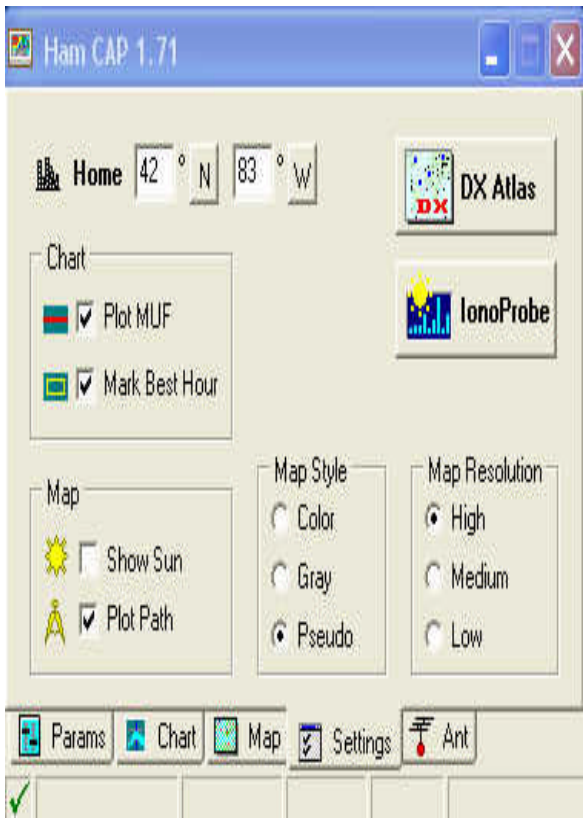
DX to Greece

(9-18-2010)

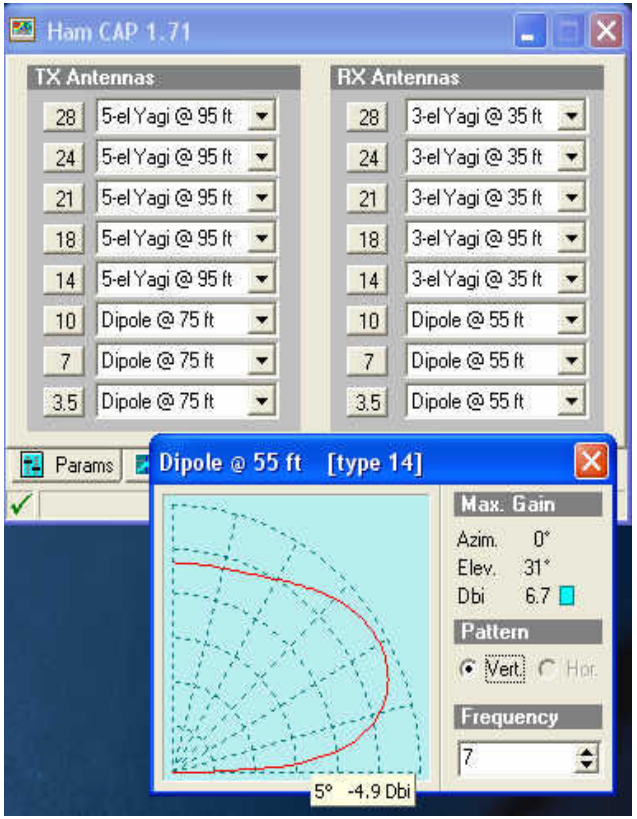
Ham Cap* Propagation Analysis: Setup



Greece: 31° N, 22° E



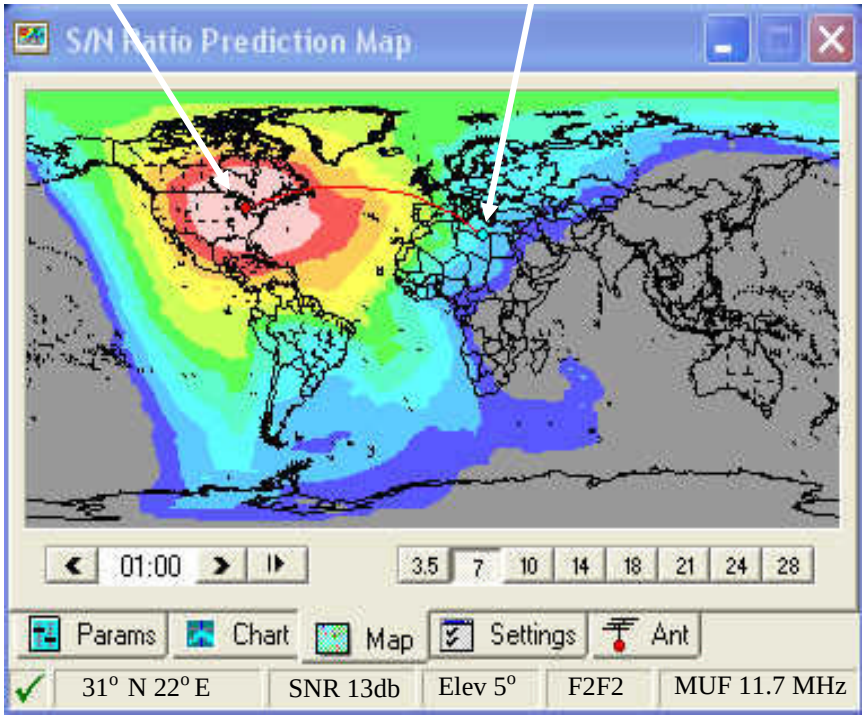
W8UM: 42° N, 83° E

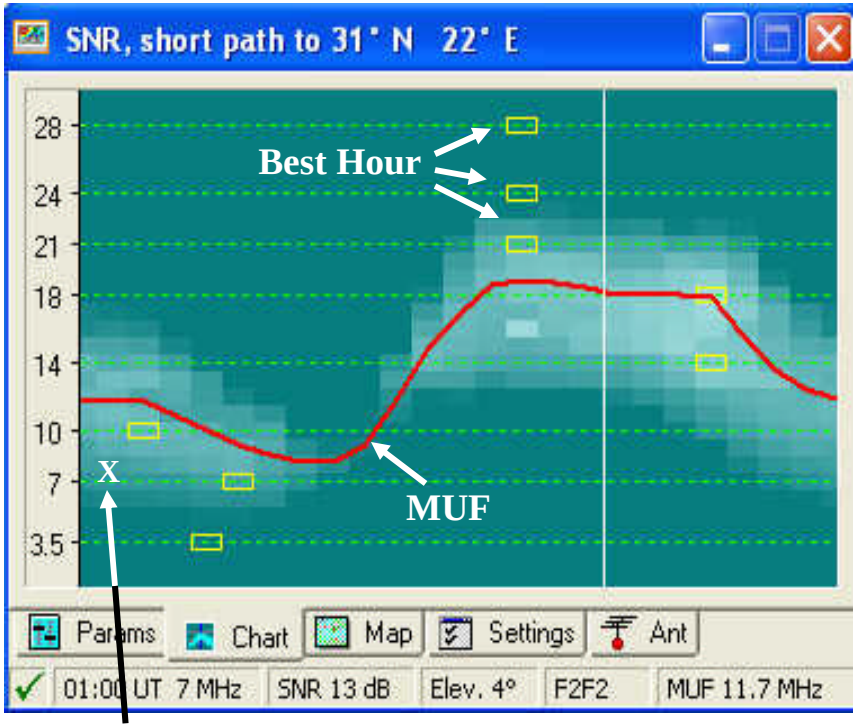


Approx Ant: Dipole @ 55 ft and 7 Mhz (40 m)

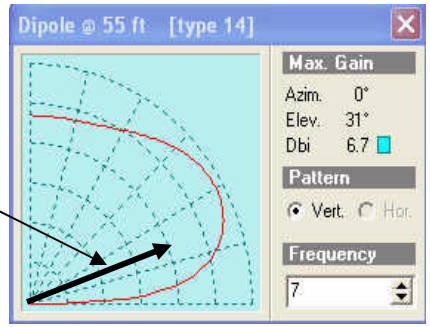
* http://www.dxatlas.com/HamCap/

DX to Greece (9-18-2010)



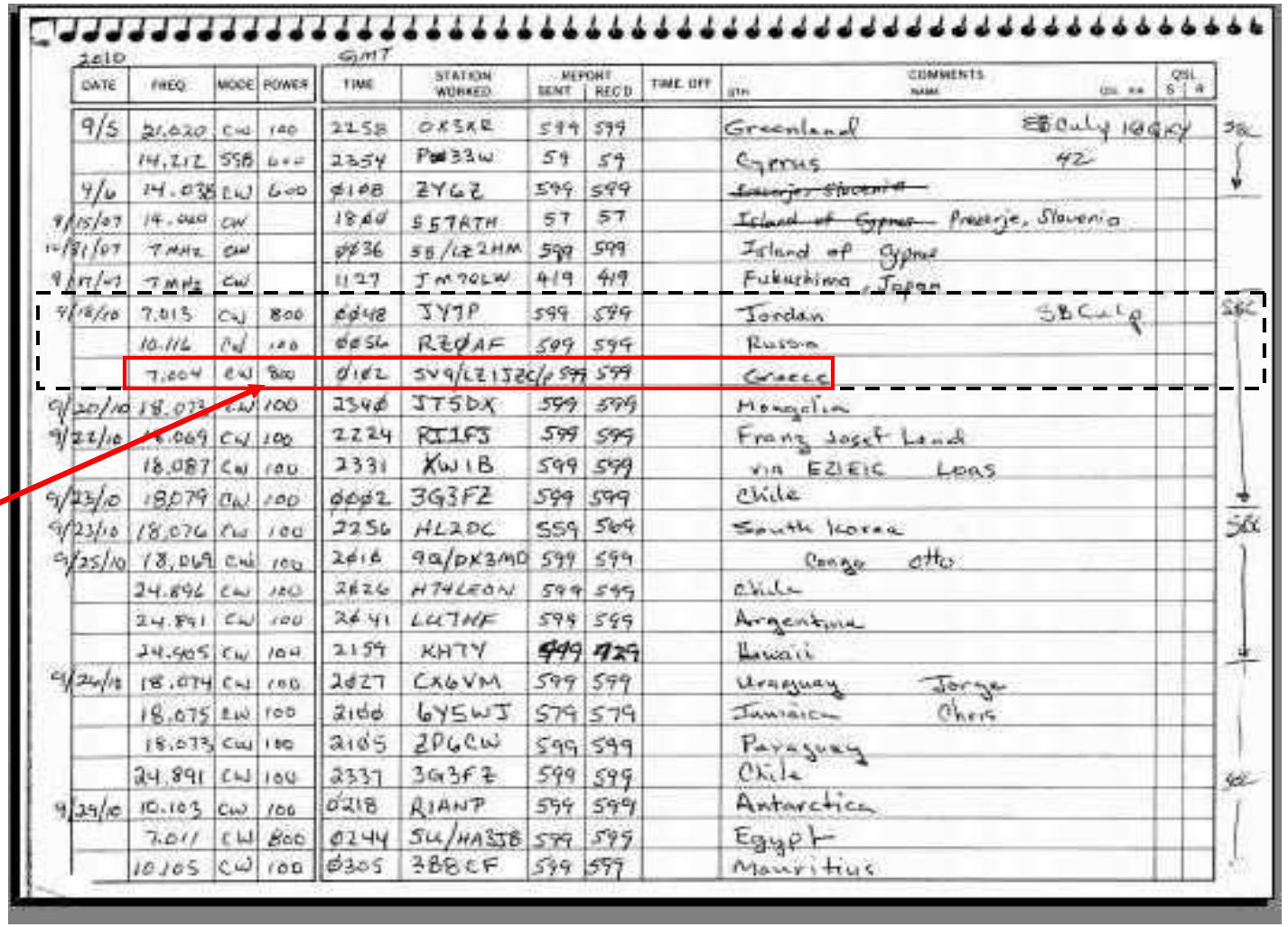


7 MHz @ 01:00 UTC



Approx. elevation vector

Sept 18, 2010 Log Entry

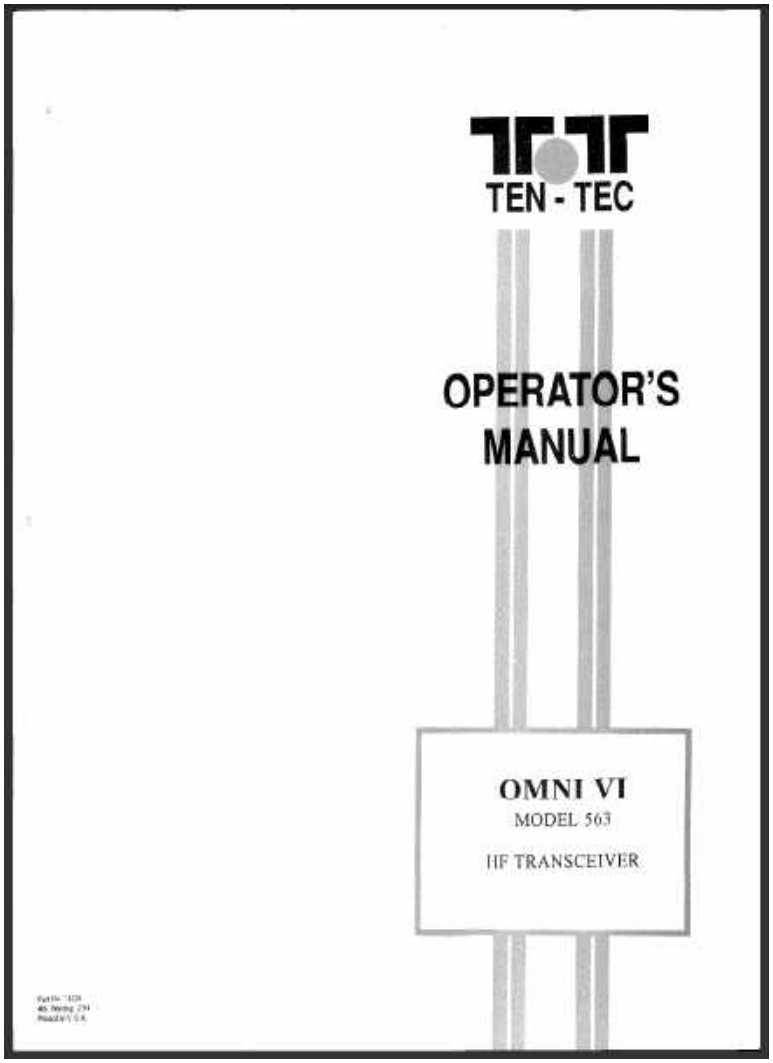


2010 GMT

DATE	FREQ	MODE	POWER	TIME	STATION WORKED	REPORT SENT	REPORT RECD	TIME OFF	COMMENTS (QTH, NAME)	QSL S	QSL R
9/5	21.020	CW	100	2258	OX3XR	599	599		Greenland		
	14.212	SSB	600	2354	PA33W	59	59		Cyprus		
9/6	14.038	CW	600	0108	ZY6Z	599	599		~~Ljubljana, Slovenia~~		
9/15/07	14.040	CW		1800	5Z7ATH	57	57		~~Island of Cyprus~~ Preserje, Slovenia		
10/31/07	7 MHz	CW		0036	5B/LZ2HM	599	599		Island of Cyprus		
9/17/07	7 MHz	CW		1127	JM7QLW	419	419		Fukushima, Japan		
9/18/10	7.015	CW	800	0048	JY7P	599	599		Jordan		
	10.116	CW	100	0056	RZ0AF	599	599		Russia		
	7.004	CW	800	0102	SV9/LZ1JZC/p	599	599		Greece		
9/20/10	18.073	CW	100	2340	JT5DX	599	599		Mongolia		
9/22/10	18.069	CW	100	2224	RI1FJ	599	599		Franz Josef Land		
	18.087	CW	100	2331	KW1B	599	599		via EZ1EIC Laos		
9/23/10	18.079	CW	100	0002	3G3FZ	599	599		Chile		
9/23/10	18.076	CW	100	2256	HL2DC	559	569		South Korea		
9/25/10	18.069	CW	100	2018	9Q/DK3MD	599	599		Congo etc		
	24.896	CW	100	2026	H74LEON	599	599		Chile		
	24.891	CW	100	2041	LU7HF	599	599		Argentina		
	24.905	CW	100	2159	KH7Y	599	599		Hawaii		
9/26/10	18.074	CW	100	2027	CX6VM	599	599		Uruguay Jorge		
	18.075	CW	100	2100	6Y5WJ	579	579		Jamaica Chris		
	18.073	CW	100	2105	ZP6CW	599	599		Paraguay		
	24.891	CW	100	2337	3G3FZ	599	599		Chile		
9/29/10	10.103	CW	100	0218	A1ANP	599	599		Antarctica		
	7.011	CW	800	0244	SU/HA5JB	579	595		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

TRANSMITTER

* RF OUTPUT	0 - 100 watts, ALC stabilized
DC INPUT	Maximum 250 watts @ 14 v DC, 100% duty cycle for up to 20 minutes. Continuous duty with customer 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 SSB, switchable FAST or SLOW QSK on CW, delay on SLOW is adjustable.
IAMBIC KEYER	adjustable 10 - 60 WPM, type 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.

10, 12, 15, 17, 29, 30, 40, 80, 160 MHz

Omni VI Receiver Specs

See Manual, pp viii - ix

RECEIVER

SENSITIVITY

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

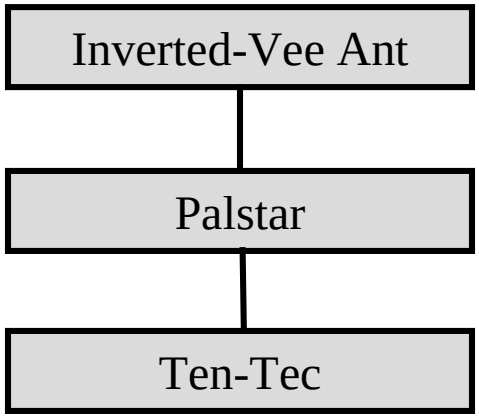
SELECTIVITY

SELECTIVITY / SELECTED FILTER	-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 50μV at S9.
ATTENUATOR	-20 dB
PASSBAND TUNING	+/-1.2KHz
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

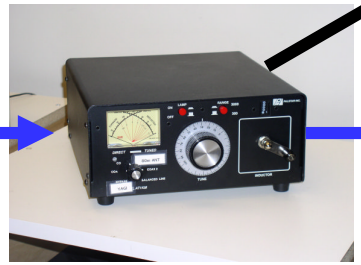
* Power Supply connections not shown

SteppIR Control

SteppIR 40m-6m Yagi Antenna

Heathkit Linear Amplifier

Palstar Antenna Tuner

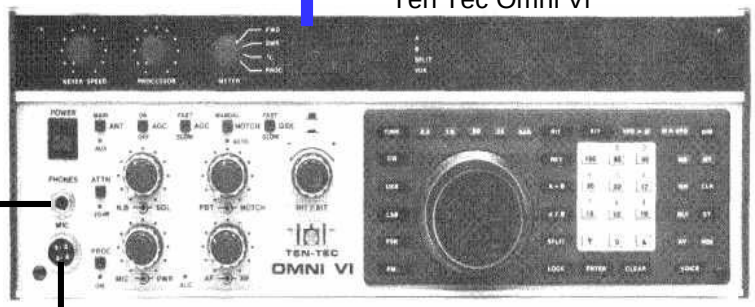


80m Inverted Vee Antenna

Do not turn on

Ear phones

Ten Tec Omni Vi



Microphone

M^2 Antenna Rotor Control

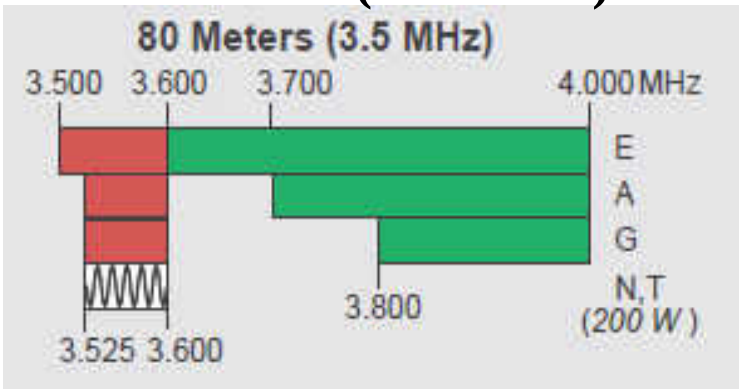
M2 Antenna Rotor

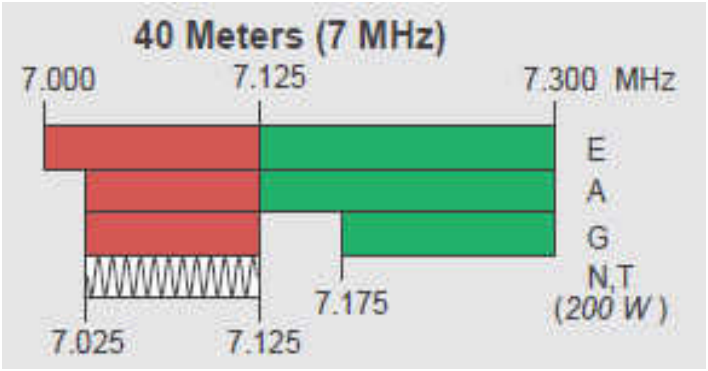
Ten-Tec Omni VI Transceiver

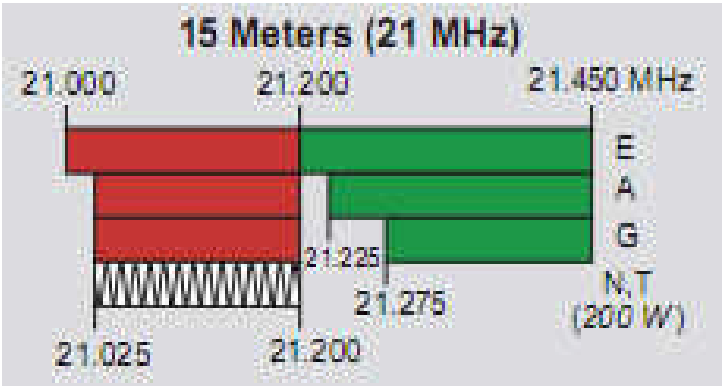
When LISTENING, feel free to play with any of the controls indicated in red, except RF PWR and the Mike PTT must remain OFF.

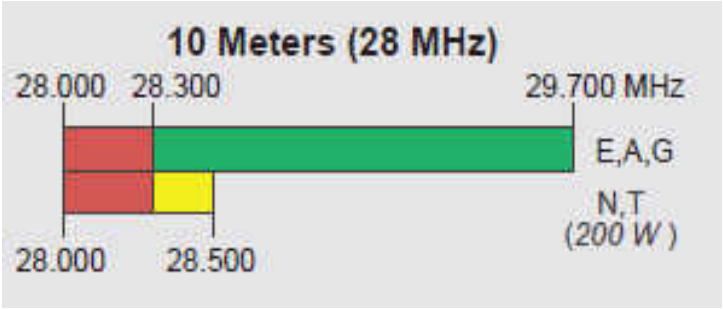
Tech Class HF Bands

(75 meters)



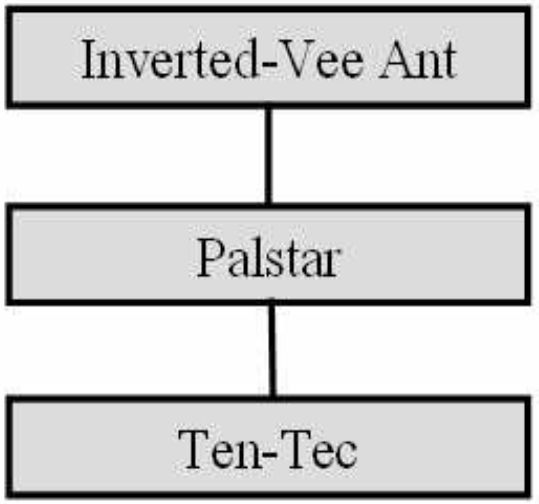






Transmit CW with Inverted-Vee

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

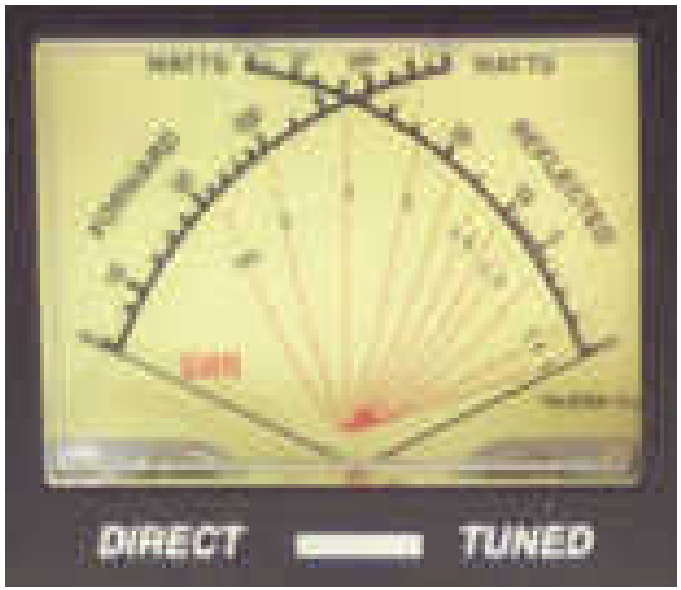


* You are on the air. Do not leave on too long. You must transmit your call sign afterwards

AT1KM Owner's Manual

http://www.palstar.com/manual_at1km.pdf

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 ~~60~~ 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.)

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?
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."
QSX	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?

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

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)

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

Establishing Contact

Are you busy?

(Is frequency in use?)

QRL?

Yes

C

Changed frequency*
& asked again

QRL?

KA7XYZ calling any station

CQ CQ CQ DE KA7XYZ KA7XYZ KA7XYZ K
CQ CQ CQ DE KA7XYZ KA7XYZ KA7XYZ K

3 by 3 sent twice at comfortable receive speed (3x3 voice too)

KA7XYZ KA7XYZ DE N2SN N2SN AR

N2SN responds

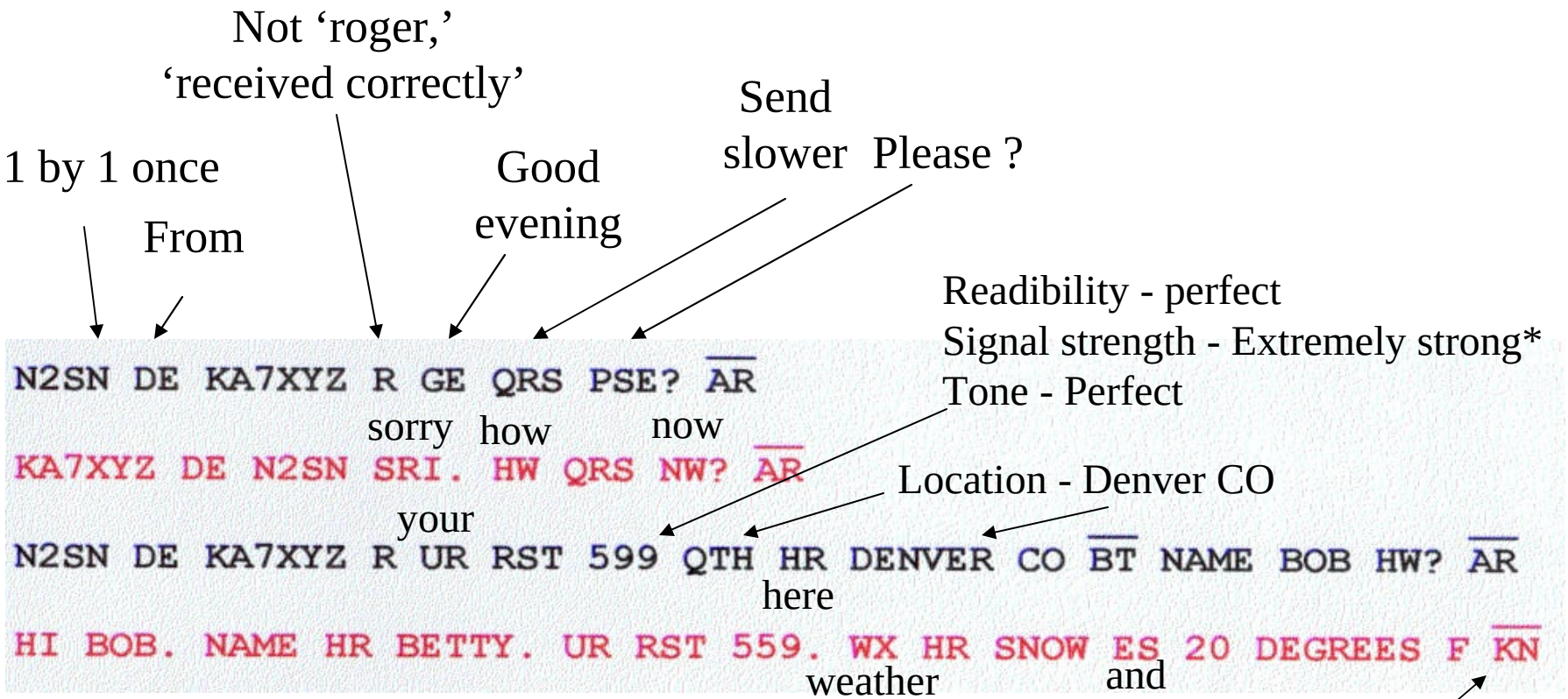
2 by 2 response
(1x1 for voice)

Go ahead
KA7XYZ

Any station transmit

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

Exchanging Data



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

Only KA7XYZ transmit

Switching (QRT) Frequency

Distant station

What's your location?

COLD ES WINDY HR. I ENJOY DX CONTESTS. QTH? KN

interference

Change frequency

QTH IS KEENE, NH. MUCH QRN HR NW. PSE QSY TO 28.15 MHZ KN

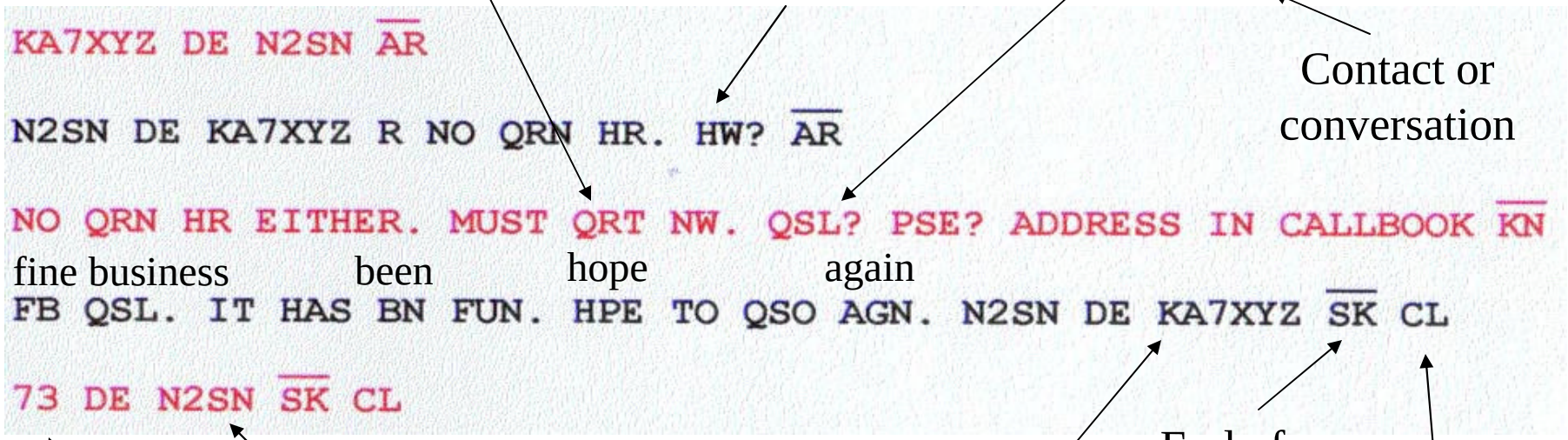
Go ahead

GA QSY 28.15 MHZ. N2SN DE KA7XYZ CL

N2SN CL

Going off the air
(at this frequency)

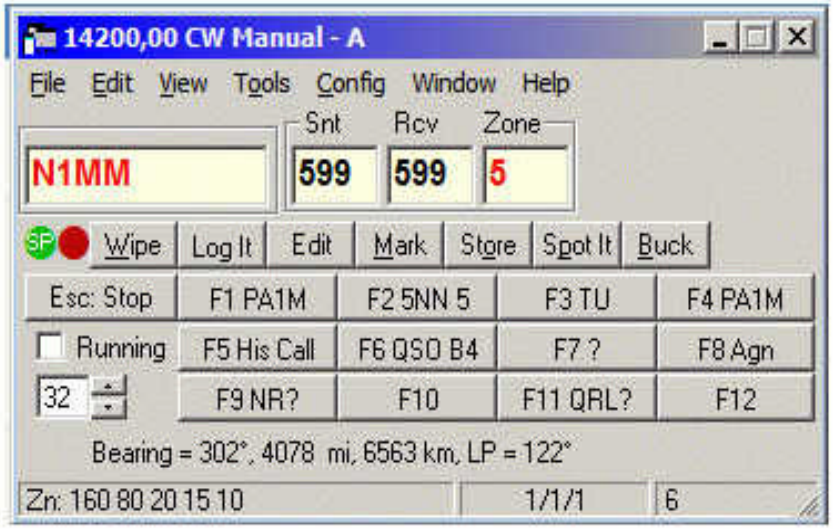
QSO (Continued)



Don’t forget: Sign Logbook

DATE	FREQ.	MODE	POWER	TIME	STATION WORKED	REPORT SENT	REPORT REC'D	TIME OFF	COMMENTS QTH NAME QSL VIA	QSL S	QSL R

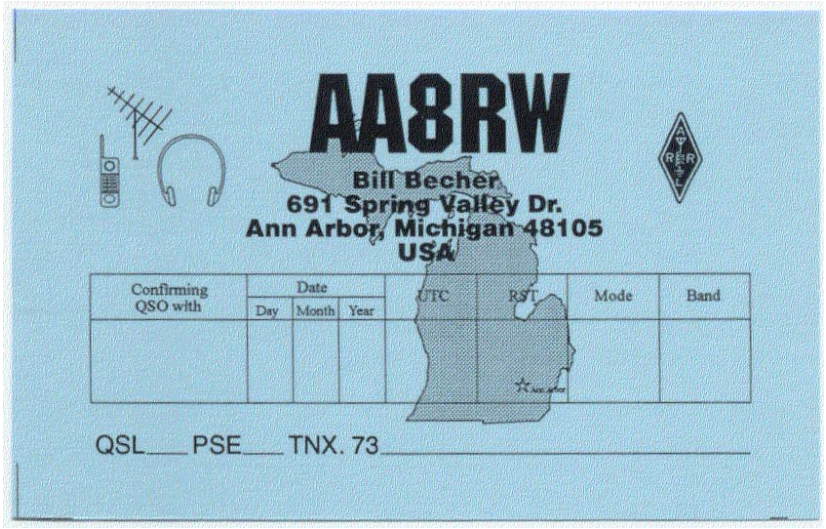
N1MM Logger

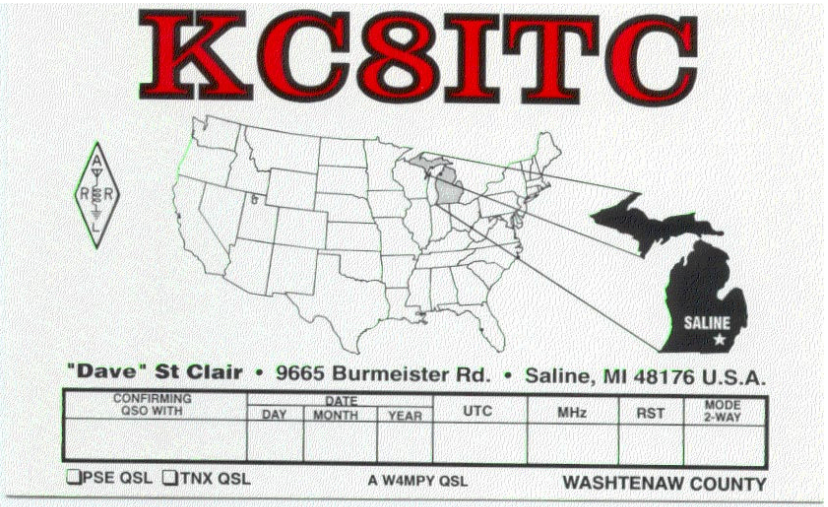


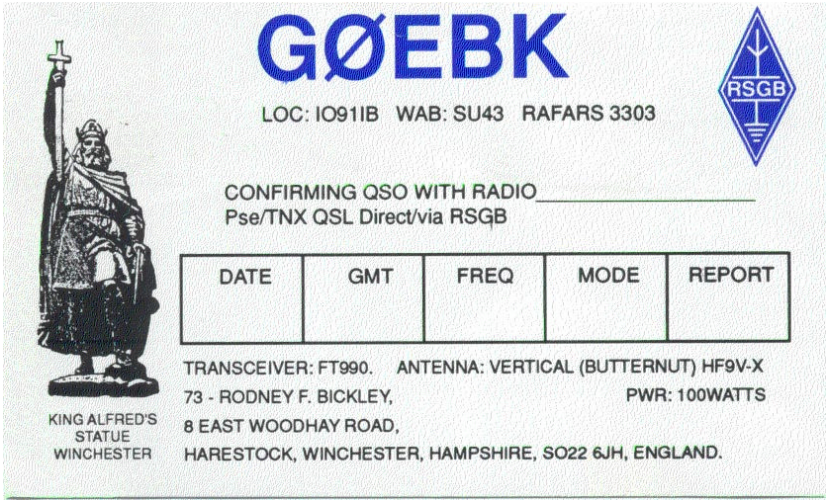
- All major and many minor HF Contests are supported
  - Including General DX logging, DXpedition, DXSatellite and VHF DX.
- SSB, CW and Digital support
- Multi-user support
- Rover support for QSO parties and other contests which support this.
- VHF and up contesting
  - Transverter support (SHF bands supported up to 10, 24, 47, 76, 142 and 241 GHz).
- Dxpedition 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
Day
Month
Year
UTC
RST
Mode
Band
QSL___ PSE___ TNX. 73


KC8ITC
SALINE
"Dave" St Clair • 9665 Burmeister Rd. • Saline, MI 48176 U.S.A.
CONFIRMING QSO WITH
DATE
DAY
MONTH
YEAR
UTC
MHz
RST
MODE 2-WAY
PSE QSL TNX QSL
A W4MPY QSL
WASHTENAW COUNTY


GØEBK
RSGB
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
Day
Month
Year
UTC
RST
Mode
Band
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

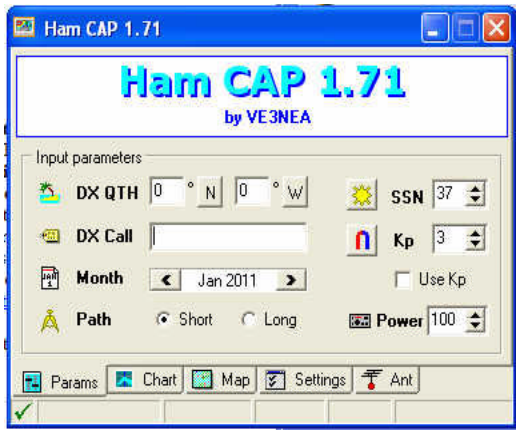
Page 6.4

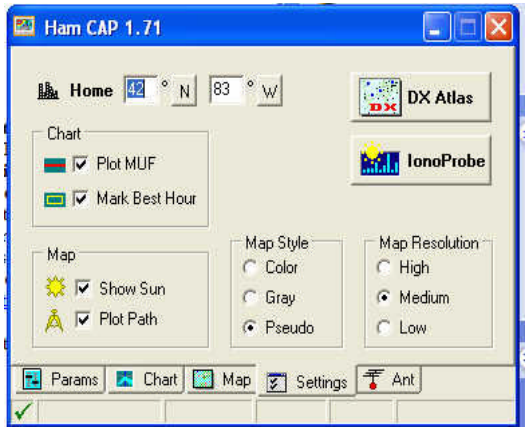
Table 6.1

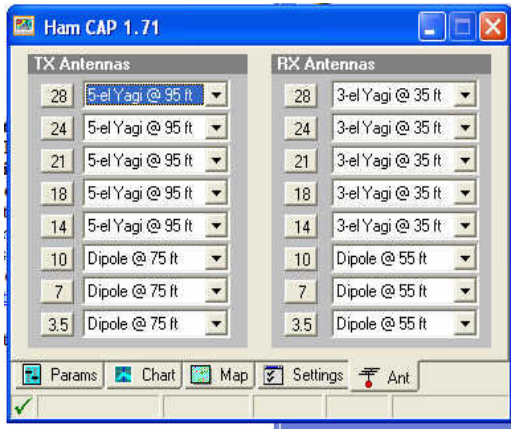
Standard ITU Phonetics

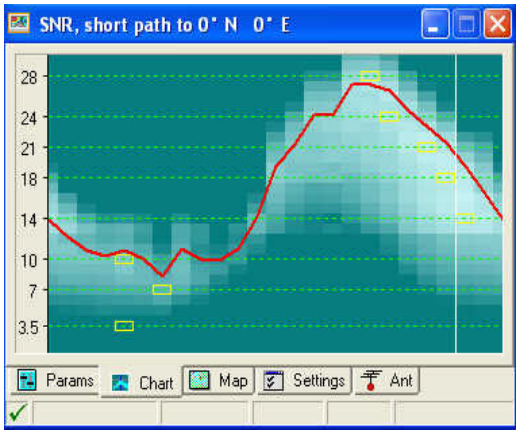
Letter	*Word*	*Pronunciation*
A	Alfa	**AL** FAH
B	Bravo	**BRAH** VOH
C	Charlie	**CHAR** LEE
D	Delta	**DELL** TAH
E	Echo	**ECK** OH
F	Foxtrot	**FOKS** TROT
G	Golf	GOLF
H	Hotel	HOH **TELL**
I	India	**IN** DEE AH
J	Juliett	**JEW** LEE ETT
K	Kilo	**KEY** LOH
L	Lima	**LEE** MAH
M	Mike	MIKE
N	November	NO **VEM**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

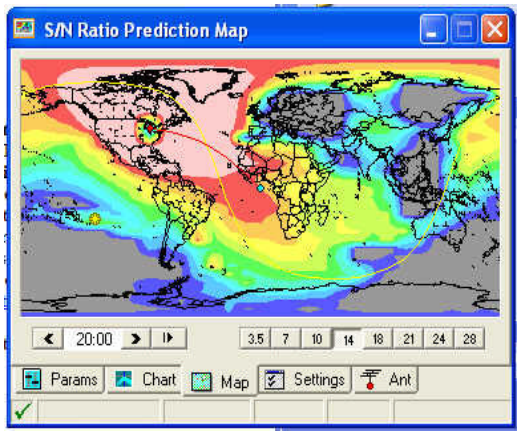
Ham Cap: Helps choose your Band











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

Three other (better) solutions

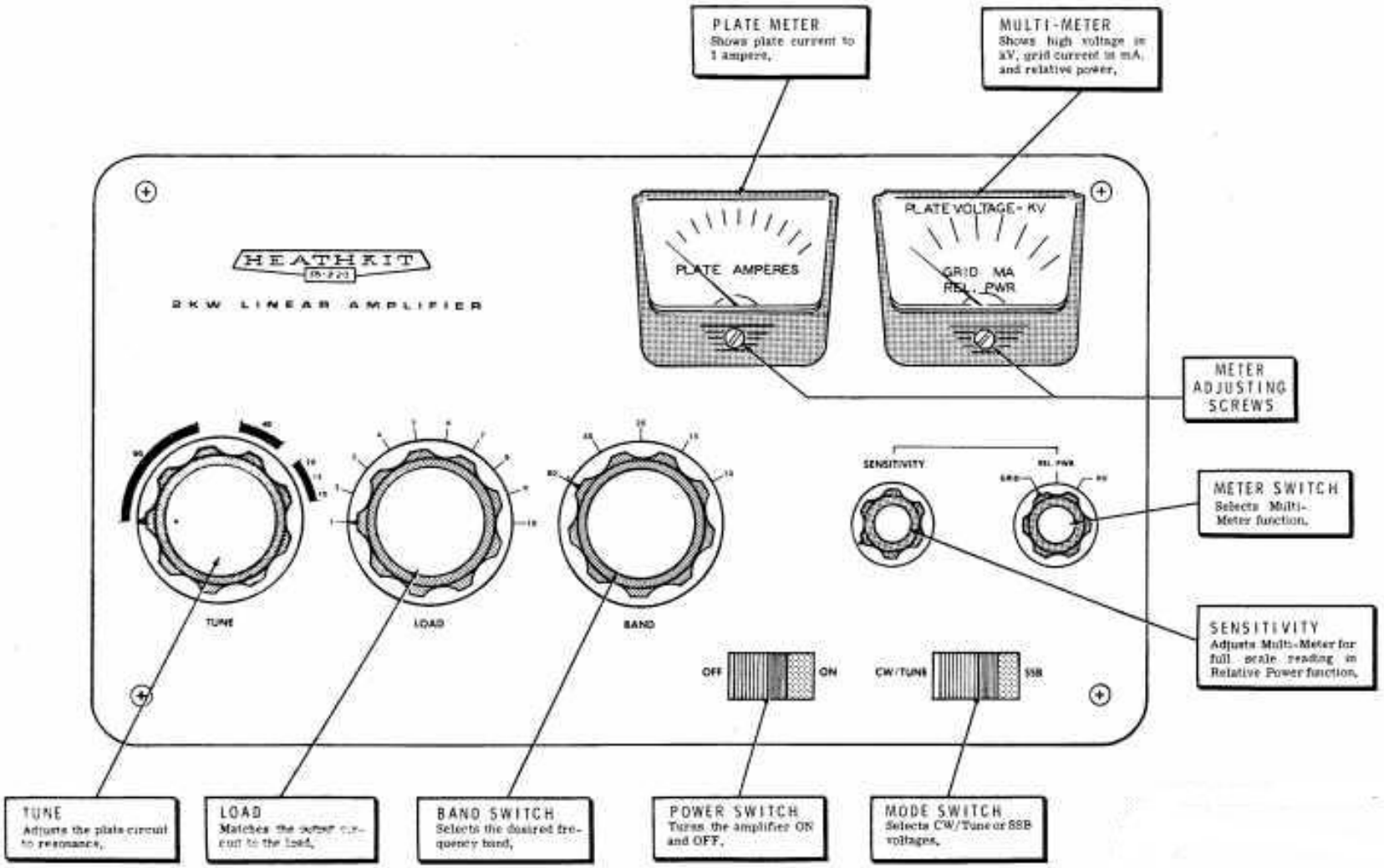
- KLM KT34XA Tri-Bander (20, 15, 10 MHz)
- M^2 Antenna Rotor
- SteppIR 6–40 m Yagi Antenna

KLM KT34XA Tri-Bander

M^2 Ant Rotor

SteppIR

Heath Kit Linear Amp Controls

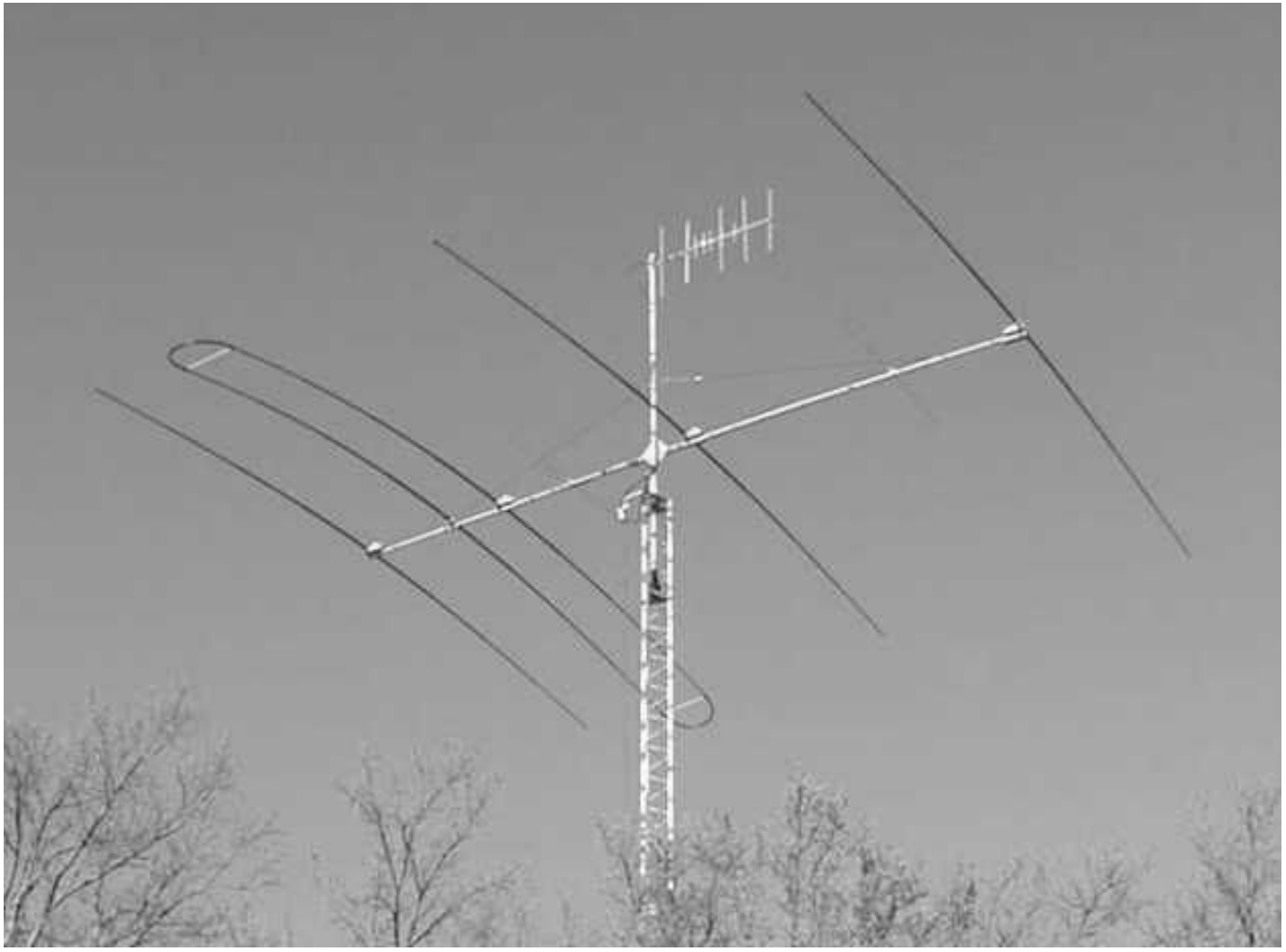


Heath Kit Linear Amp Specifications

SPECIFICATIONS

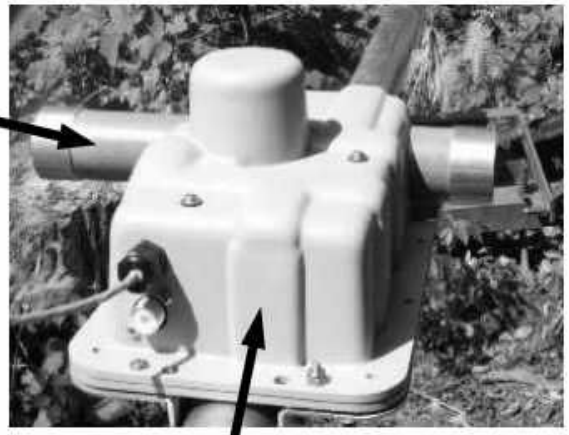
Band Coverage	80,40,20,15 and 10 meter amateur bands
Driving Power	Required 100 watts
Maximum Power Out	SSB: 2000 watts P.E.P. CW: 1000 watts RTTY: 1000 watts
Duty Cycle	SSB: continuous voice modulation CW: Continuous (maximum key-down 10 min'l Utest RTTY: 50% (maximum transmit time 10 minutes)
Third Order Distortion	30 dB or better
Input Impedance	52 Ω unbalanced
Output Impedance	50 Ω unbalanced; SWR 2:1 or less
Front Panel	Tune Load Band switch Sensitivity Meter switch 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



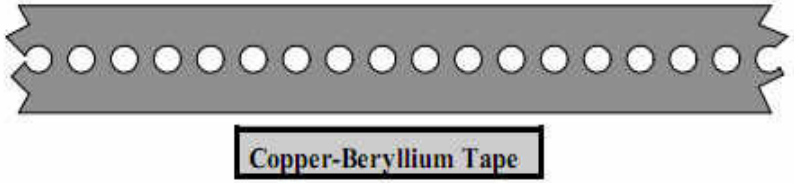
http://www.steppir.com/files/4%20Element%20Assembly.pdf

SteppIR Construction

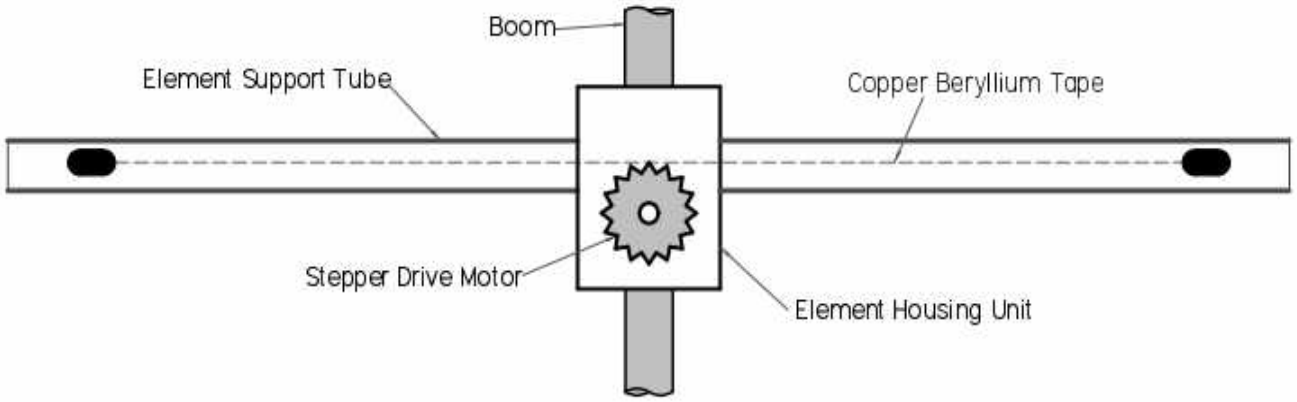


Motor Assembly

Diode Element



Variable length element material



Dipole Assembly

W8UM: HF Components

* Power Supply connections not shown

SteppIR Control

SteppIR 40m-6m Yagi Antenna

Heathkit Linear Amplifier

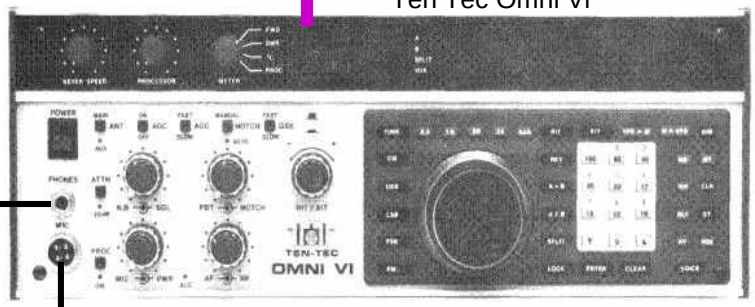
Palstar Antenna Tuner

80m Inverted Vee Antenna

Do not turn on

Ear phones

Ten Tec Omni Vi

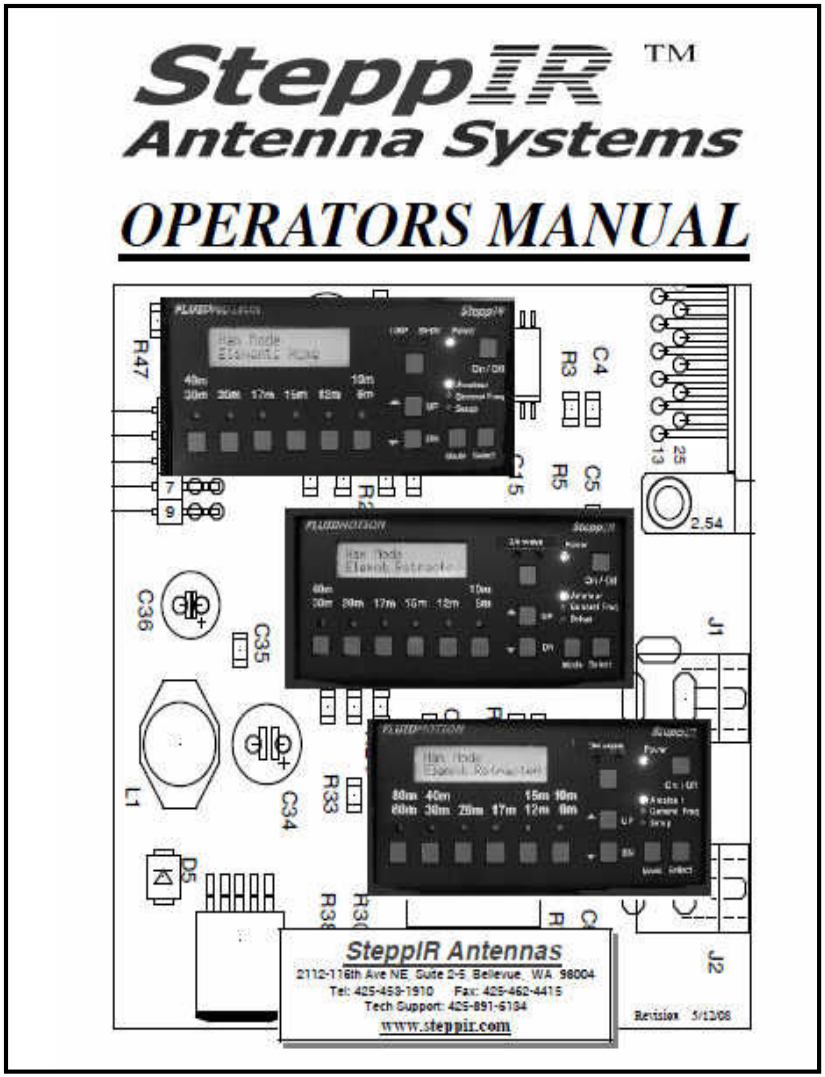


Microphone

M^2 Antenna Rotor Control

M2 Antenna Rotor

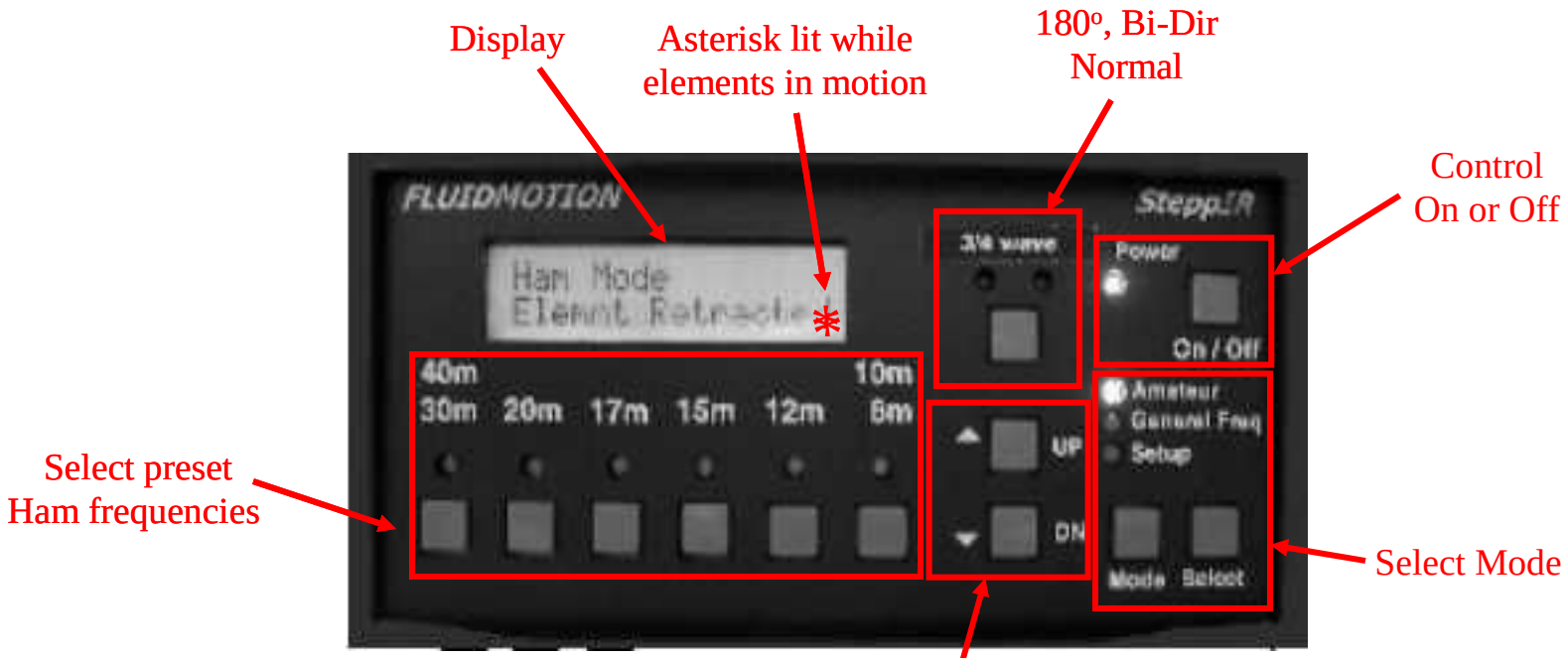
SteppIR Operators Manual



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 1							

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^{o}) 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^{o}
   - 180^{o} 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^{o}

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

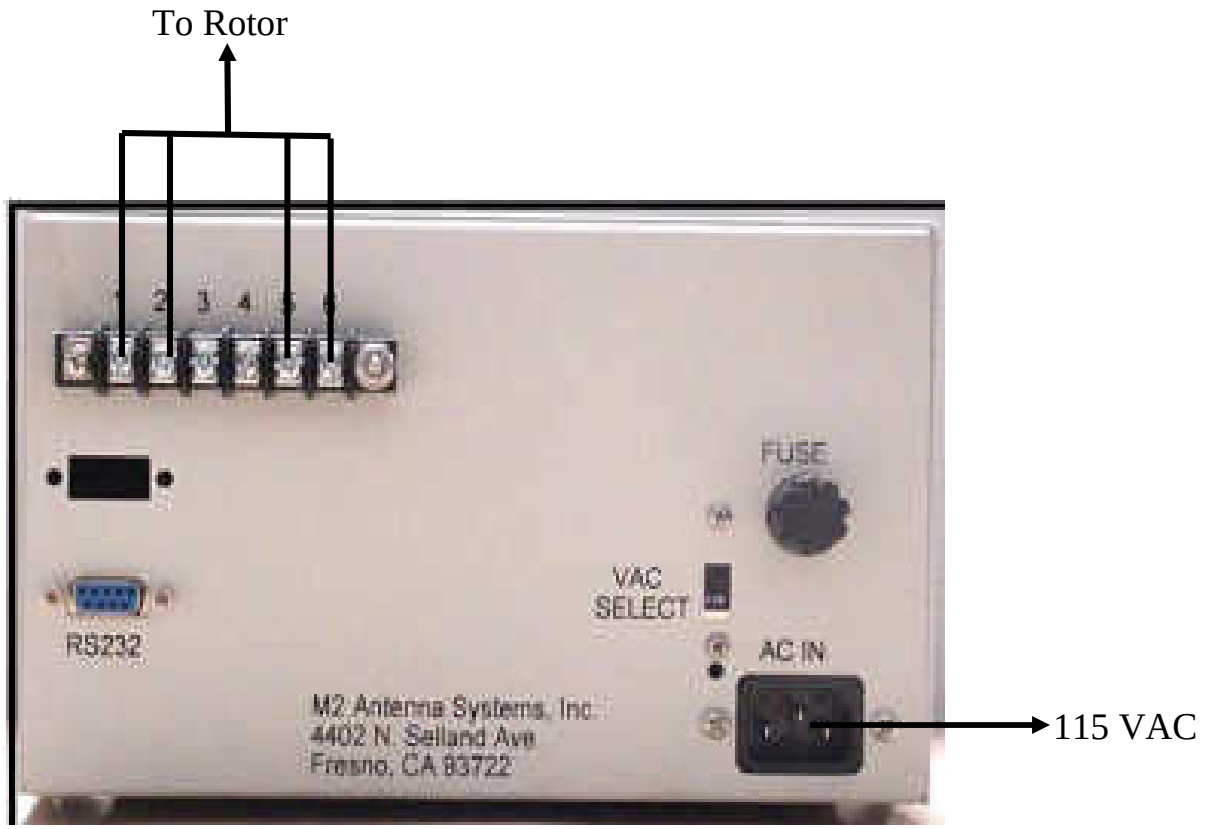
M² Antenna Rotor System

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.hellocq.net/forum/attachment.php?attachmentid=373223

M² Antenna Rotor Rear Panel Connections



M² Antenna Rotor Front Panel Controls

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

Do NOT transmit while rotating

Rotator Control

To select Mode Press **Mode** Δ or ∇ *(Caution: Do Not hold Δ too long or Prog. Mode will begin. Exit Prog. Mode by holding ∇)*

- 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

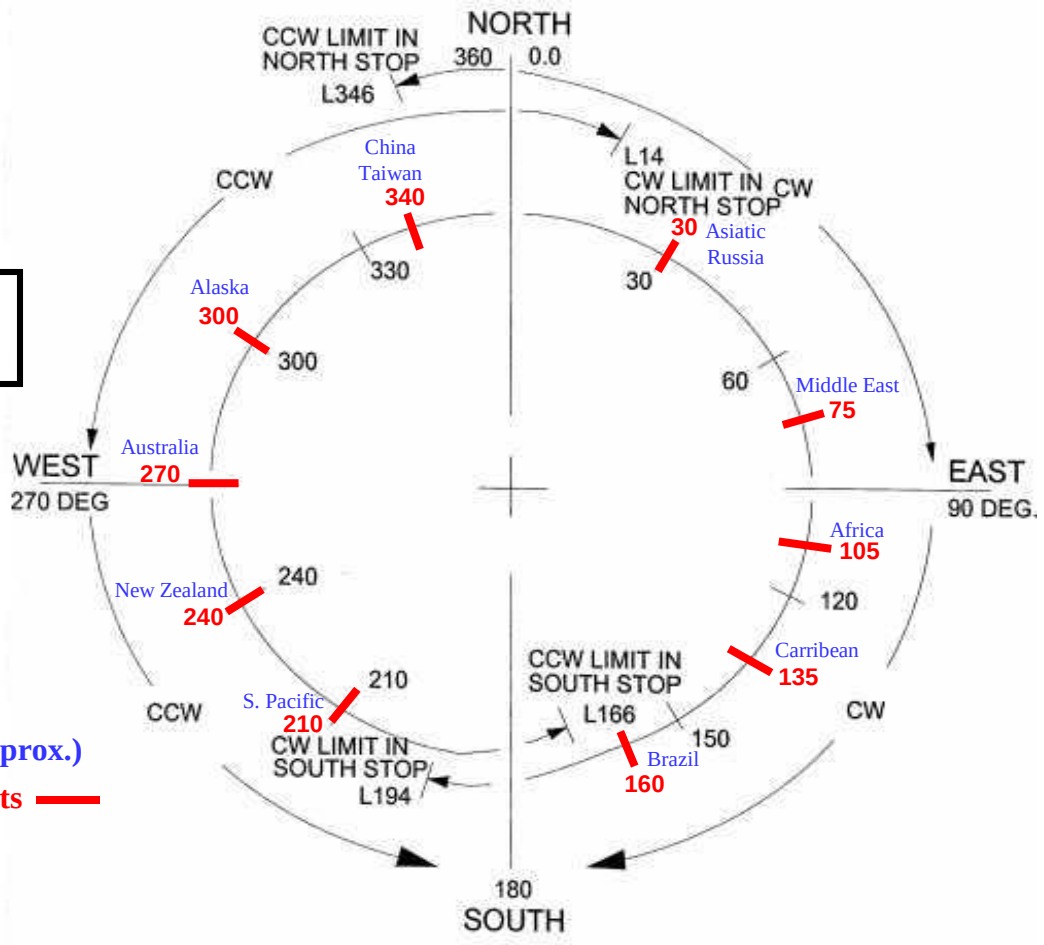
Reminder: When finished using HF station, "Park" antenna at 270°

* 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

Park antenna facing west



QSO Countries (approx.)

Programmed Presets

Country Codes

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

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/El) Antenna Rotor
  - Icom IC-910H Transceiver
- Connections
- Tracking Satellites
  - Ham Radio Deluxe
  - Procedural Synopsis

W8UM Satellite Station

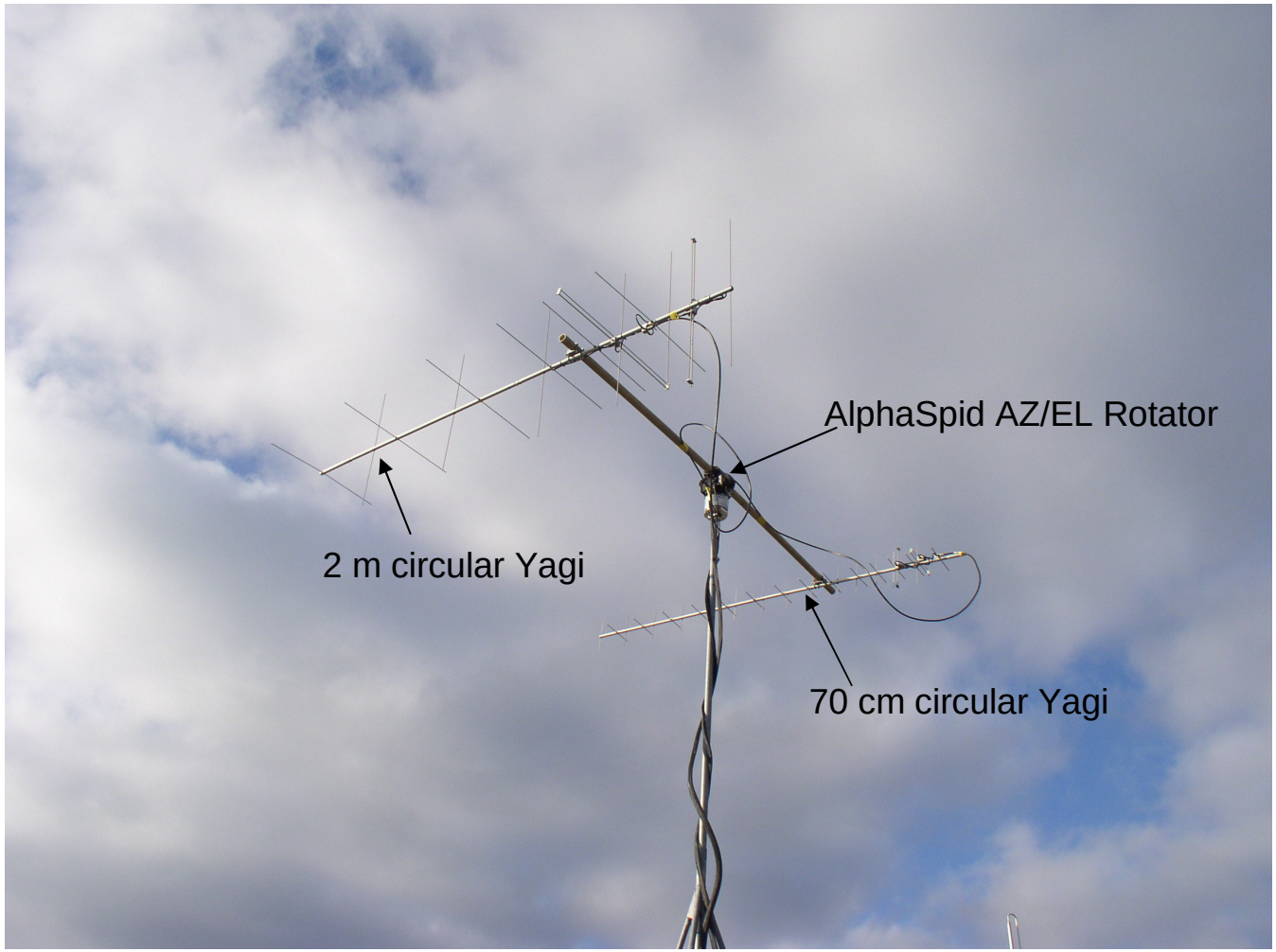
John KB8OIS

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

W8UM Satellite Station

John KB8OIS

Satellite Antennas - a second look



AlphaSpid AZ/EL Rotator

www.alfaradio.com

Controller

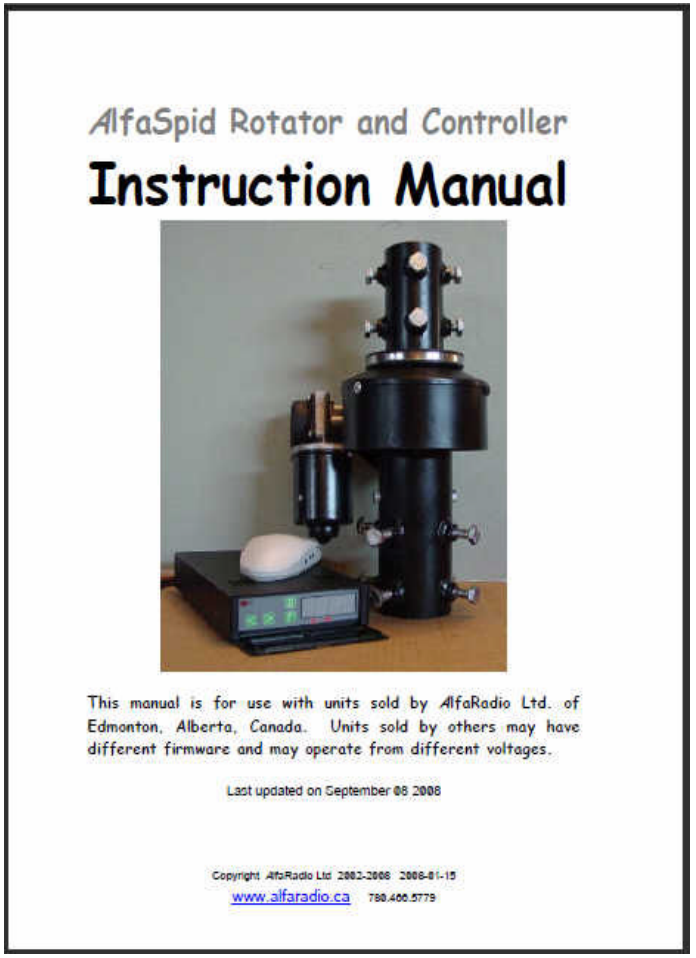
Rot2Prog and RAS

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

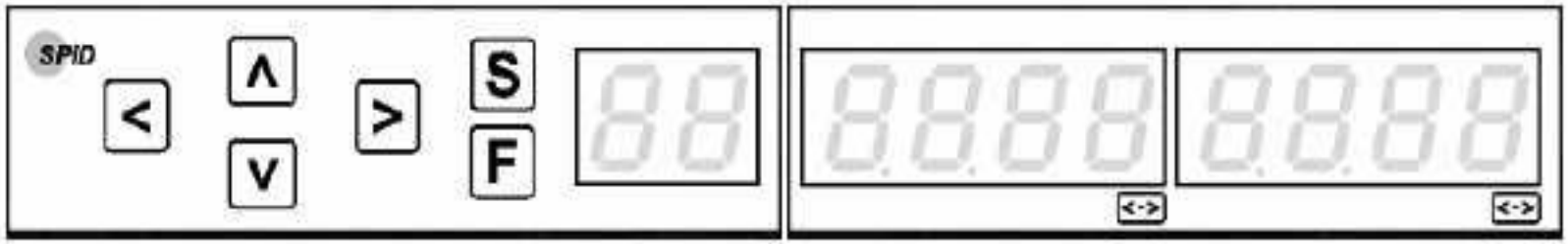
AlphaSpid Manuals


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

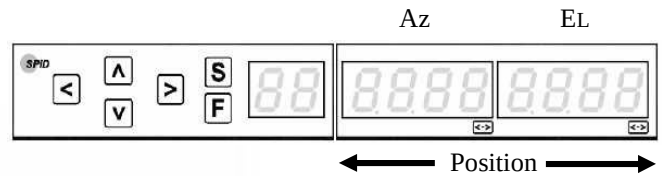

AlfaSpid Rotator and Controller
Instruction Manual
This manual is for use with units sold by AlfaRadio Ltd. of Edmonton, Alberta, Canada. Units sold by others may have different firmware and may operate from different voltages.
Last updated on September 08 2008
Copyright AlfaRadio Ltd 2002-2008 2008-01-15
www.alfaradio.ca 780.466.5779

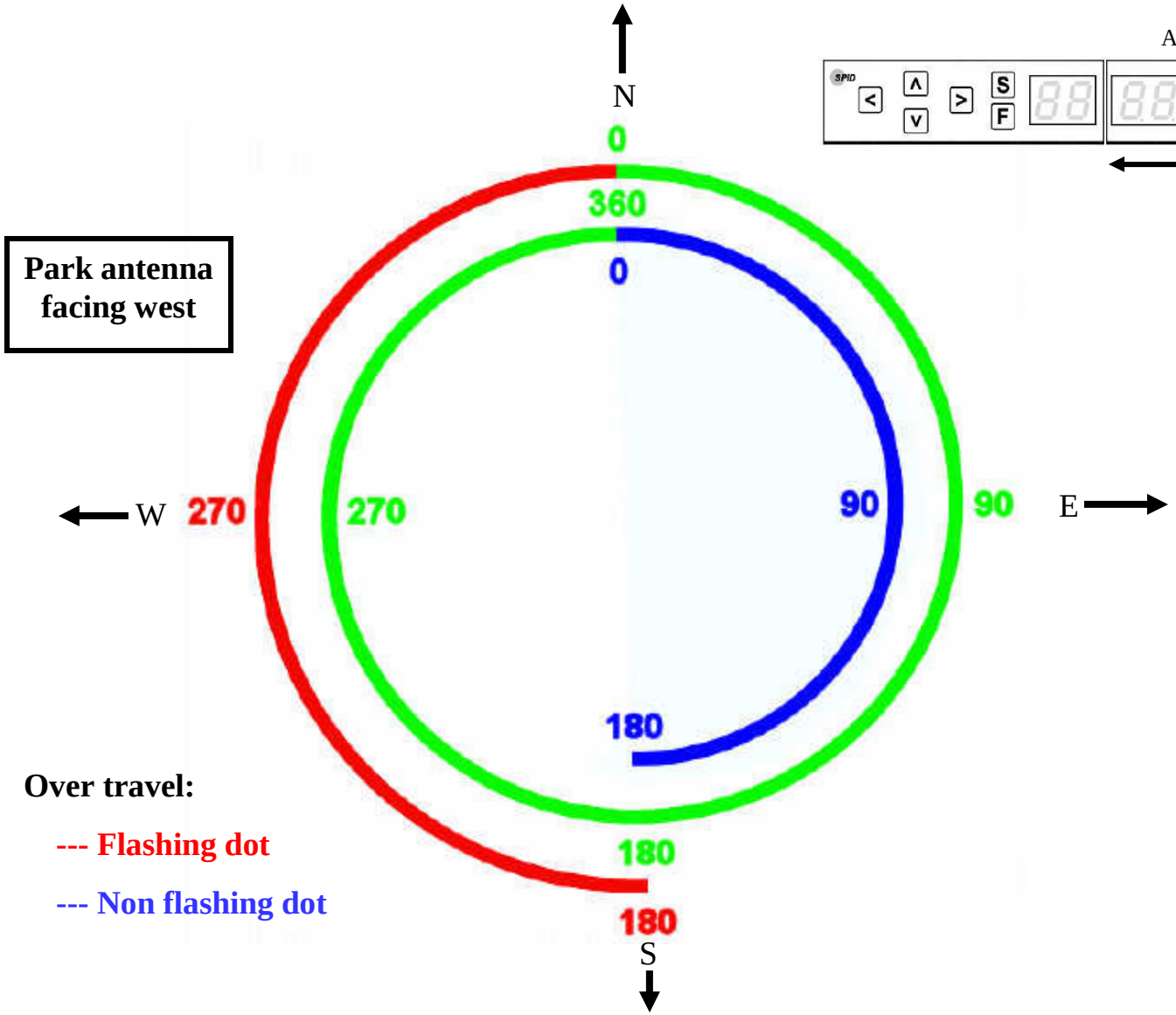
Rotator Controller

Do not adjust



Rotator Travel





Park antenna facing west

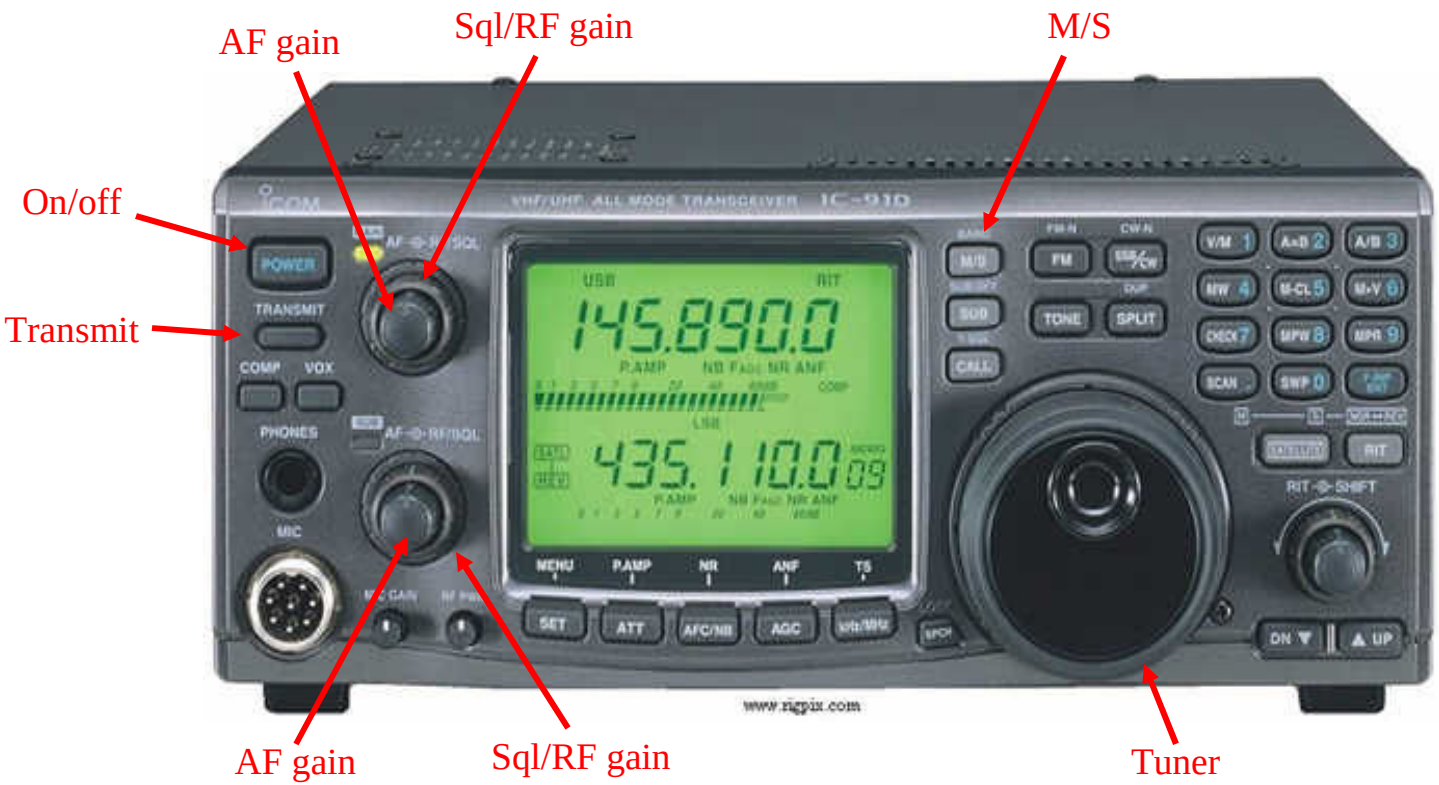
Over travel:

--- Flashing dot

--- Non flashing dot

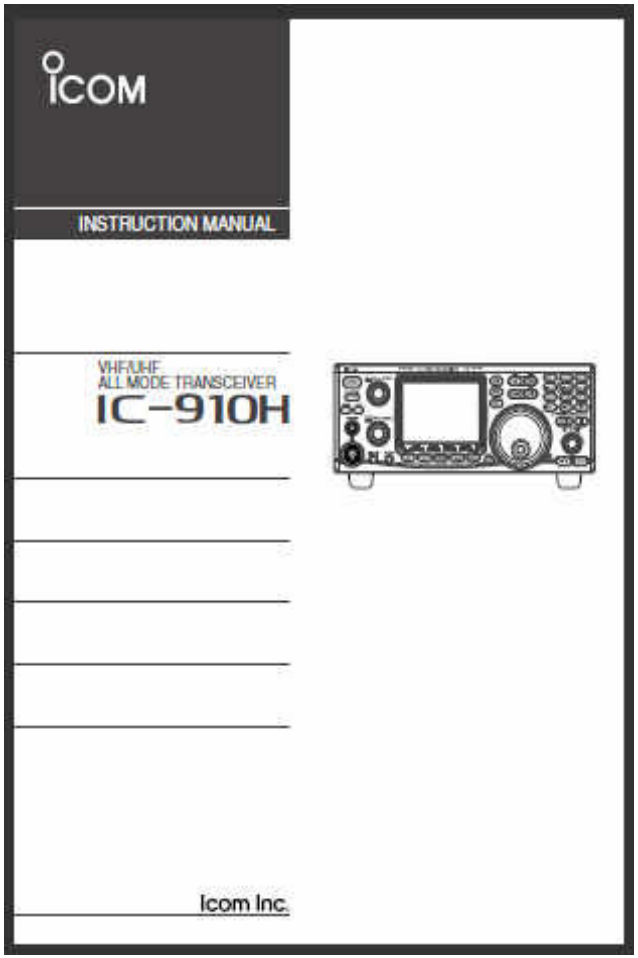
ICOM IC-910H

Cross-Band 144/440 MHzTransceiver



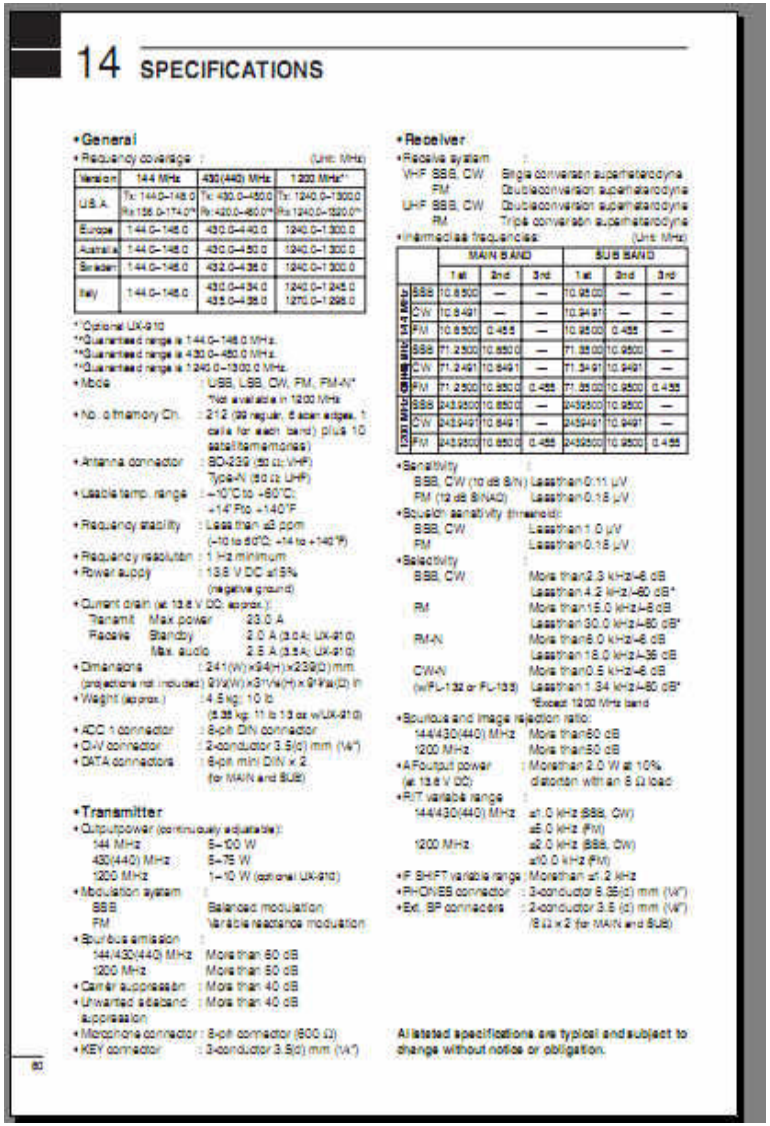
- All Mode FM/LSB/USB/CW
- 100 Watt VHF / 75 Watt UHF
- Continuously Variable Output
- PC Controllable
- Easy to use Soft Key Menus
- Simultaneously Works Two Bands
- Four Scanning Functions
- CTCSS Encode/Decode Tone Scan
- Built-in CW Keyer
- Voice Synthesizer Option
- DSP Option
- 1.2 GHz Band Option

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.	Tx: 144.0–148.0 Rx:136.0–174.0**	Tx: 430.0–450.0 Rx:420.0–480.0**	Tx: 1240.0–1300.0 Rx:1240.0–1320.0**
Europe	144.0–146.0	430.0–440.0	1240.0–1300.0
Australia	144.0–148.0	430.0–450.0	1240.0–1300.0
Sweden	144.0–148.0	432.0–438.0	1240.0–1300.0
Italy	144.0–146.0	430.0–434.0 435.0–438.0	1240.0–1245.0 1270.0–1298.0

* Optional UX-910
** Guaranteed range is 144.0–148.0 MHz.
** Guaranteed range is 430.0–450.0 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 (99 regular, 6 scan edges, 1 calls for each band) plus 10 satellite memories)
• Antenna connector : SO-239 (50 Ω; VHF) Type-N (50 Ω; UHF)
• Usable temp. range : –10°C to +60°C; +14°F to +140°F
• Frequency stability : Less than ±3 ppm (–10 to 60°C; +14 to +140°F)
• Frequency resolution : 1 Hz minimum
• Power supply : 13.8 V DC ±15% (negative ground)
• Current drain (at 13.8 V DC; approx.):
Transmit Max power 23.0 A
Receive Standby 2.0 A (3.0 A; UX-910)
Max. audio 2.5 A (3.5 A; UX-910)
• Dimensions (projections not included) : 241(W)×94(H)×239(D) mm 9½(W)×3¾(H)×9⅜(D) in
• Weight (approx.) : 4.5 kg; 10 lb (5.35 kg; 11 lb 13 oz w/UX-910)
• ACC 1 connector : 8-pin DIN connector
• CW connector : 2-conductor 3.5(d) mm (⅛")
• DATA connectors : 6-pin mini DIN × 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 UX-910)
• Modulation system :
SSB Balanced modulation
FM Variable reactance modulation
• Spurious emission :
144/430(440) MHz More than 60 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 (600 Ω)
• KEY connector : 2-conductor 3.5(d) mm (⅛")

•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)

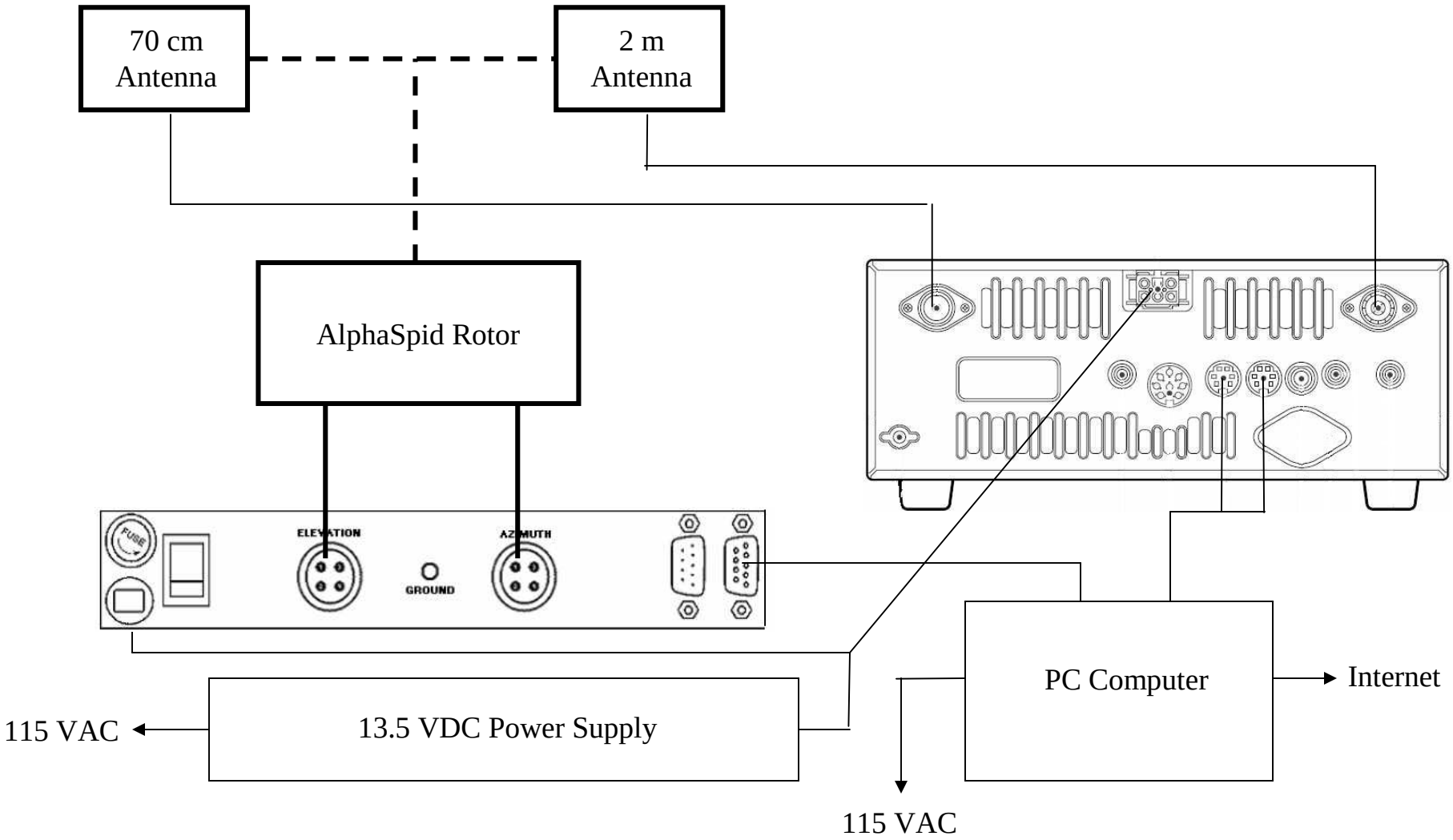
		MAIN BAND			SUB BAND		
		1st	2nd	3rd	1st	2nd	3rd
144 MHz	SSB	10.8500	—	—	10.9500	—	—
	CW	10.8491	—	—	10.9491	—	—
	FM	10.8500	0.455	—	10.9500	0.455	—
430 MHz	SSB	71.2500	10.8500	—	71.3500	10.9500	—
	CW	71.2491	10.8491	—	71.3491	10.9491	—
	FM	71.2500	10.8500	0.455	71.3500	10.9500	0.455
1200 MHz	SSB	243.9500	10.8500	—	243.9500	10.9500	—
	CW	243.9491	10.8491	—	243.9491	10.9491	—
	FM	243.9500	10.8500	0.455	243.9500	10.9500	0.455

• Sensitivity :
SSB, CW (10 dB S/N) Less than 0.11 µV
FM (12 dB SINAD) Less than 0.18 µV
• Squelch sensitivity (threshold):
SSB, CW Less than 1.0 µV
FM Less than 0.18 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 30.0 kHz/–60 dB*
FM-N More than 8.0 kHz/–6 dB
Less than 16.0 kHz/–36 dB
CW-N (w/FL-132 or FL-133) More than 0.5 kHz/–6 dB
Less than 1.34 kHz/–60 dB*
*Except 1200 MHz band
• Spurious and image rejection ratio:
144/430(440) MHz More than 60 dB
1200 MHz More than 50 dB
• AF output power (at 13.8 V DC) : More than 2.0 W at 10% distortion with an 8 Ω load
• RIT 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 SHIFT variable range : More than ±1.2 kHz
• PHONES connector : 3-conductor 6.35(d) mm (¼")
• Ext. SP connectors : 2-conductor 3.5 (d) mm (⅛") /8 Ω × 2 (for MAIN and SUB)

All stated specifications are typical and subject to change without notice or obligation.

80

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

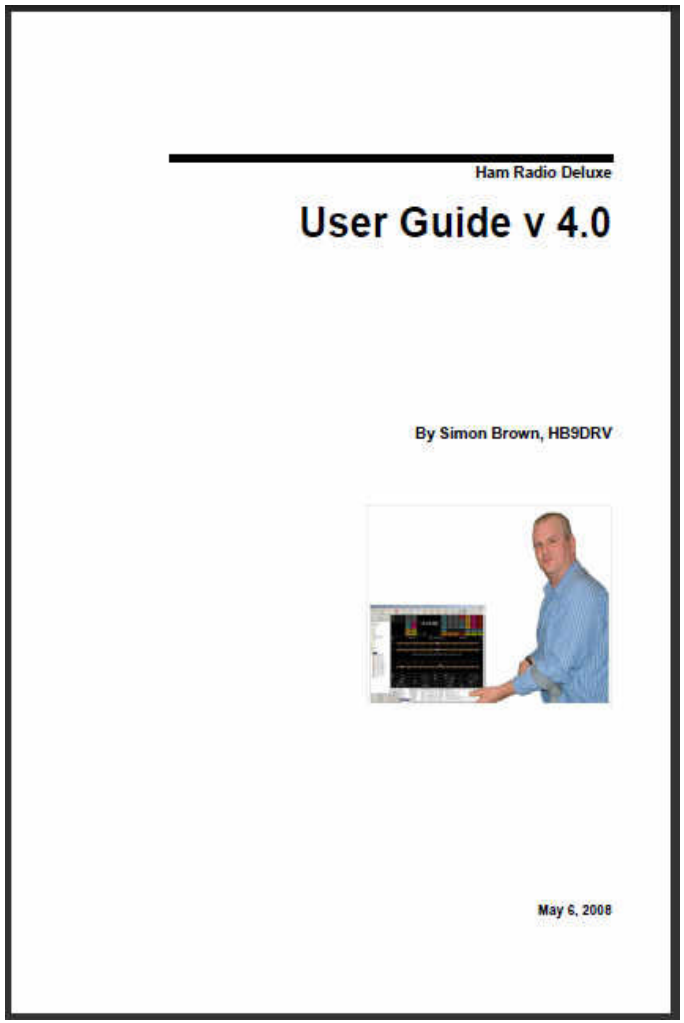
Tracking Satellites*

- 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

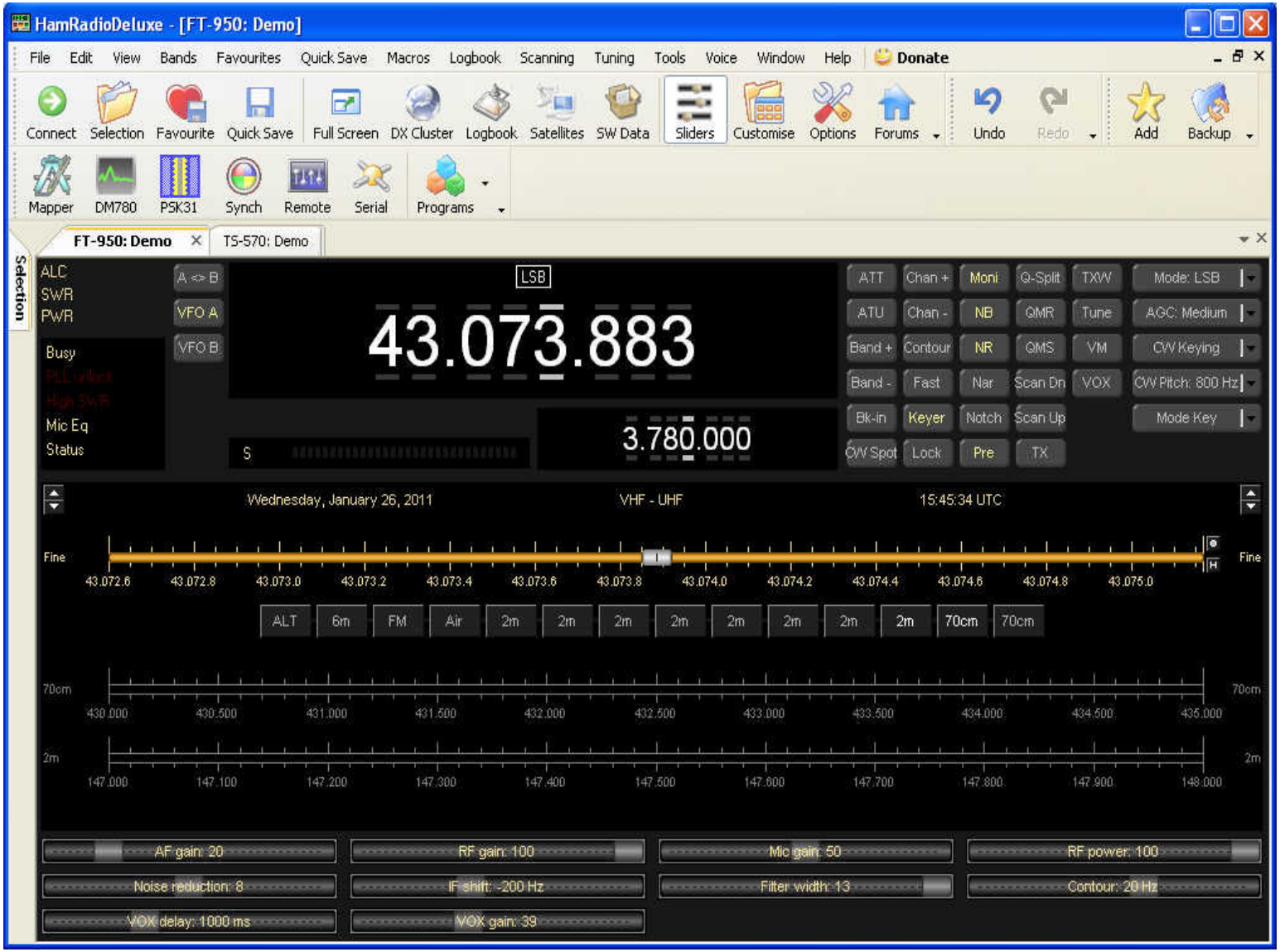
Ham Radio Deluxe User Guide v. 4.0

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.

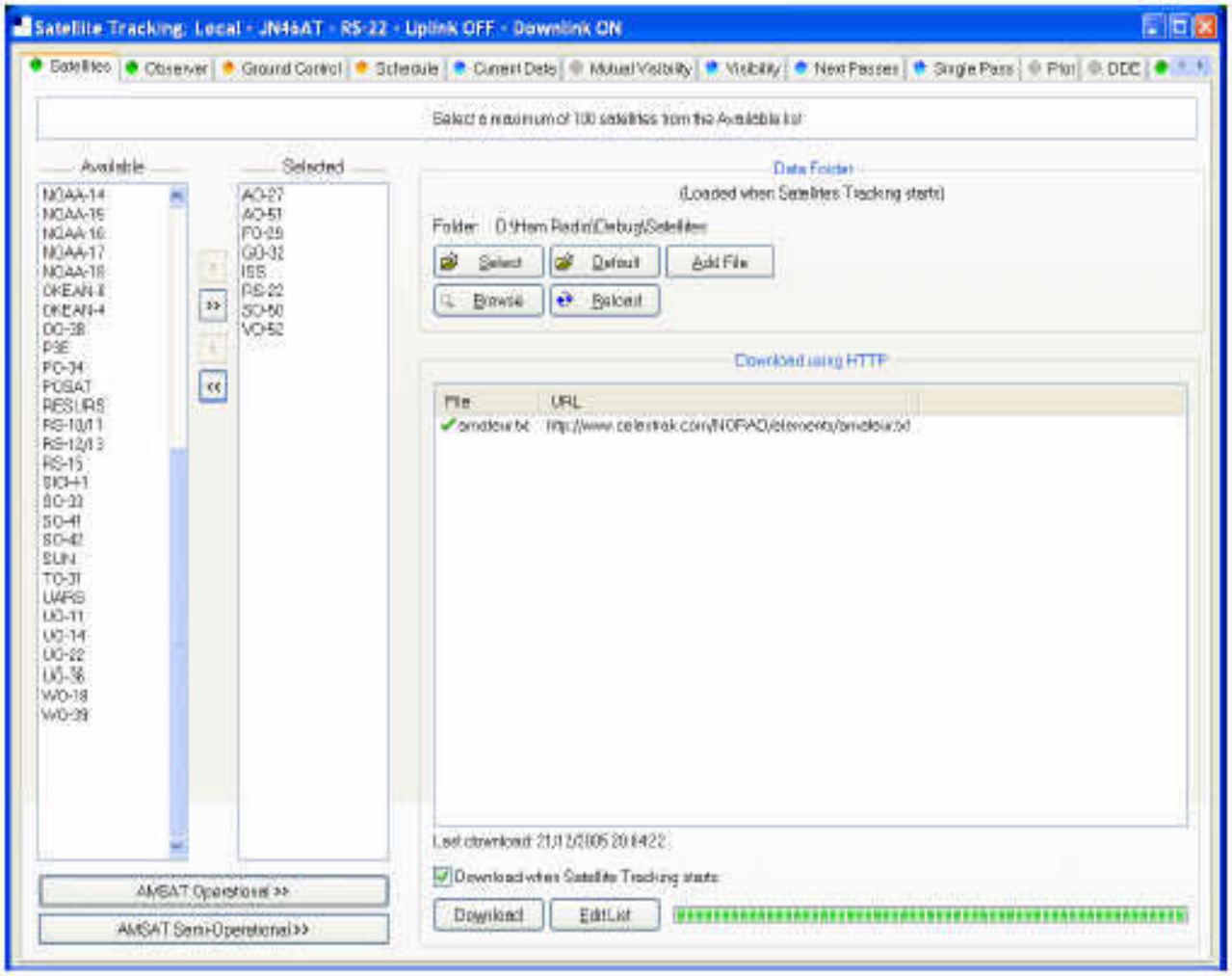


http://www.ham-radio-deluxe.com/

HDR Radio (TS-570 Demo)



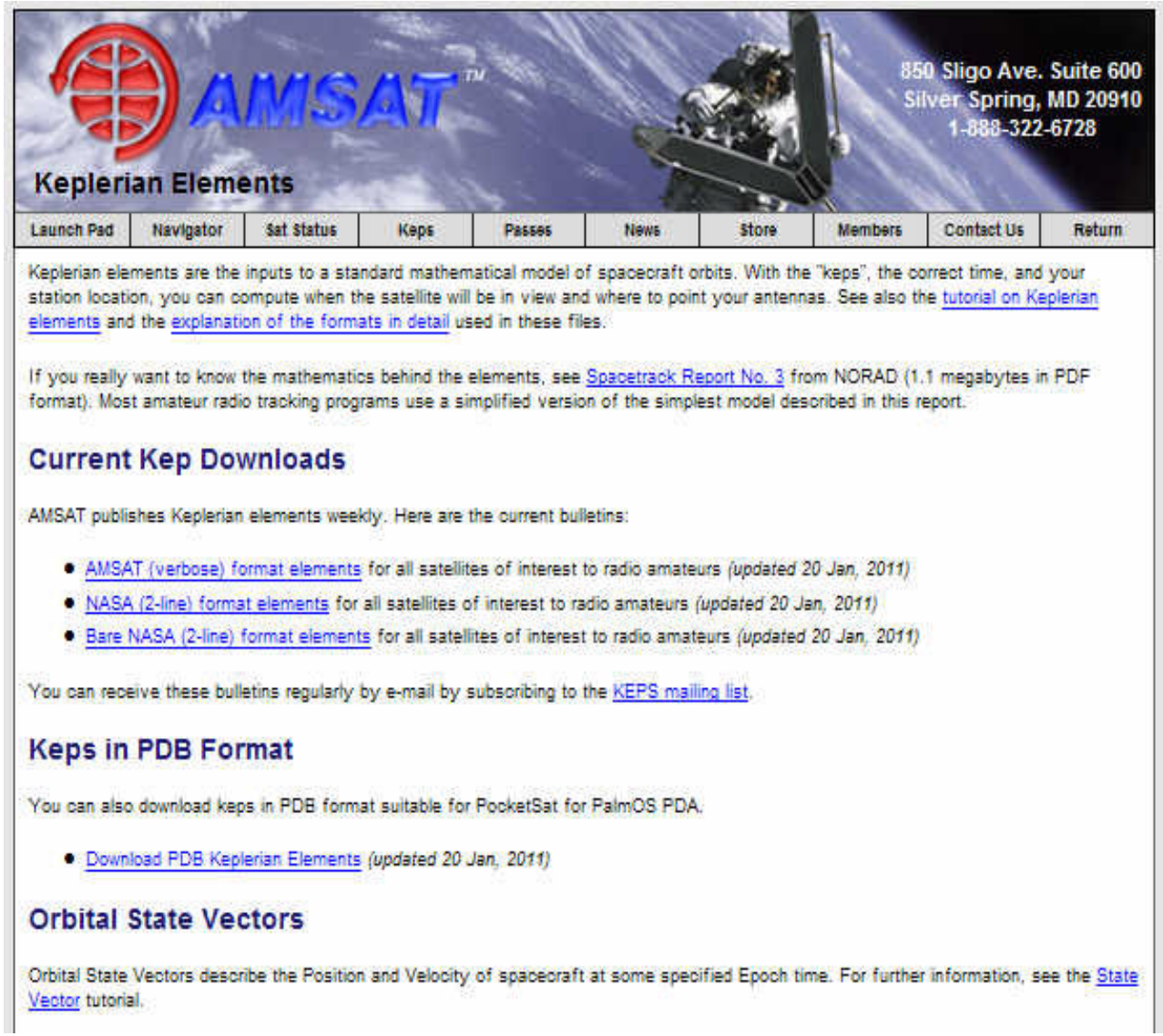
Satellite Window



p. 130

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

Keperian Downloads



AMSAT™

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

Keplerian Elements

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

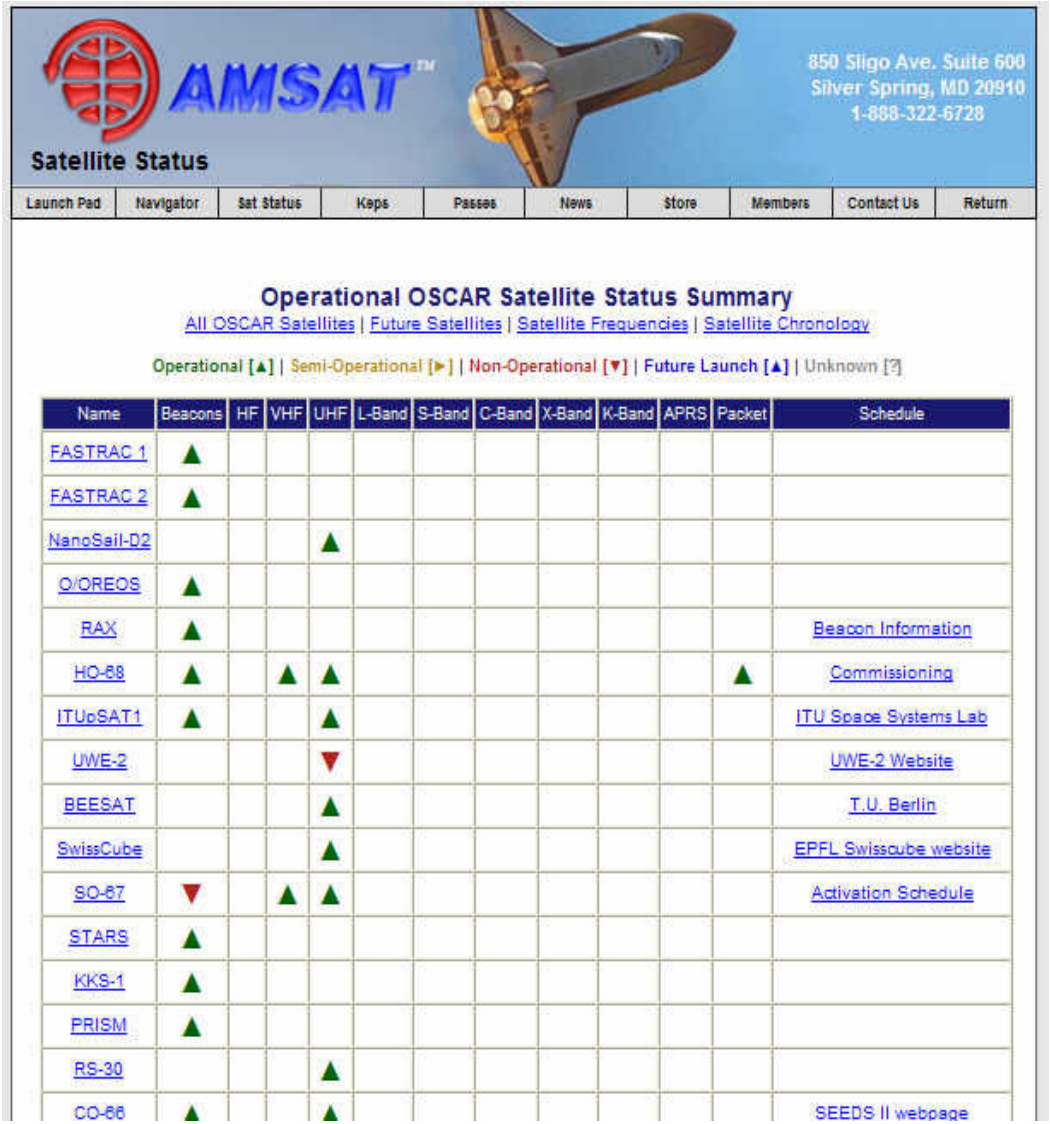
You can also download keps in PDB format suitable for PocketSat for PalmOS PDA.

- 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



AMSAT™

Satellite Status

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

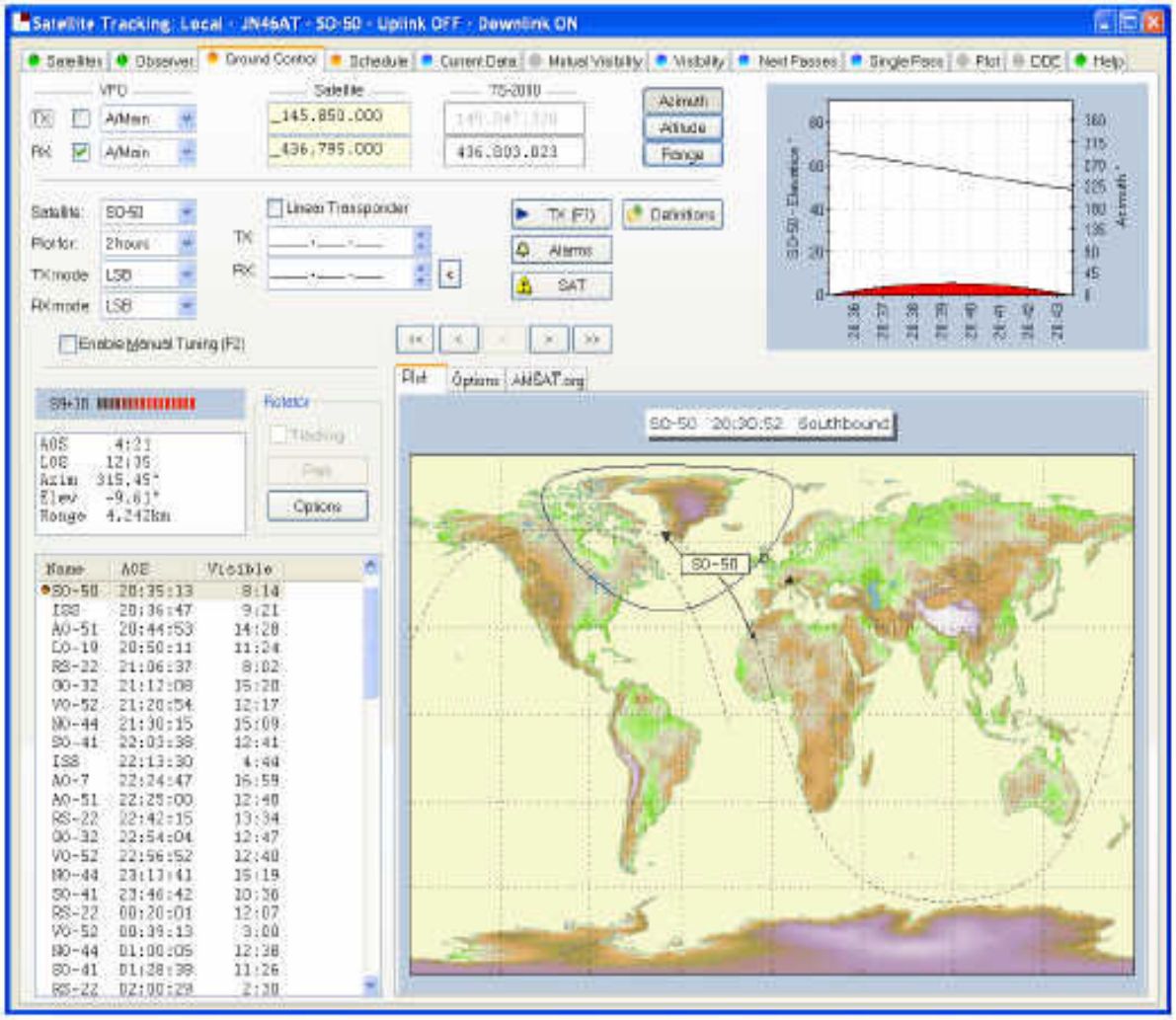
Operational OSCAR Satellite Status Summary

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
FASTRAC 1	▲											
FASTRAC 2	▲											
NanoSail-D2				▲								
O/OREOS	▲											
RAX	▲											Beacon Information
HO-68	▲		▲	▲							▲	Commissioning
ITUpSAT1	▲			▲								ITU Space Systems Lab
UWE-2				▼								UWE-2 Website
BEESAT				▲								T.U. Berlin
SwissCube				▲								EPFL Swisscube website
SO-67	▼		▲	▲								Activation Schedule
STARS	▲											
KKS-1	▲											
PRISM	▲											
RS-30				▲								
CO-66	▲			▲								SEEDS II webpage

Ground Control Window

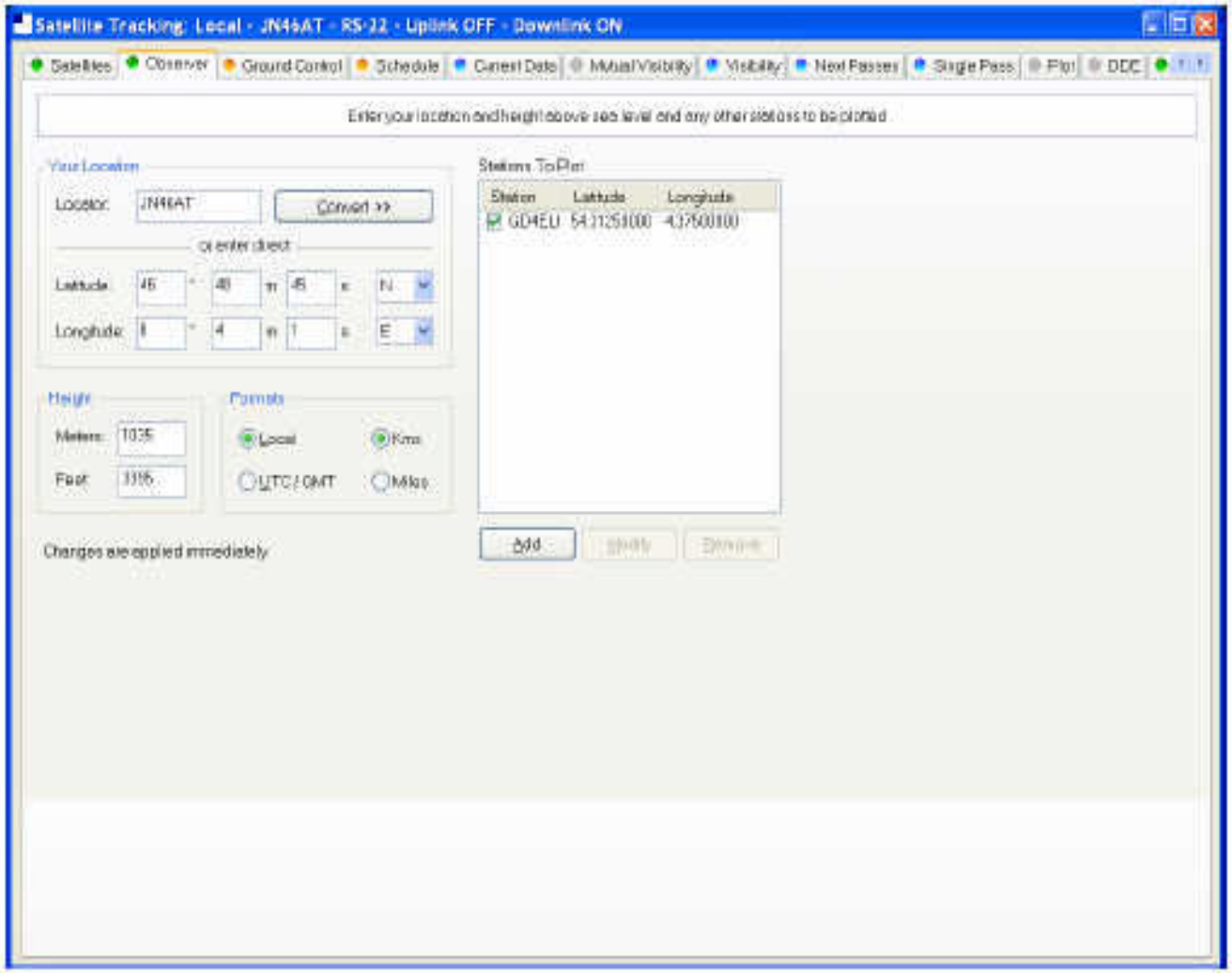


See following slides

p. 133

Enter the satellite uplink and downlink

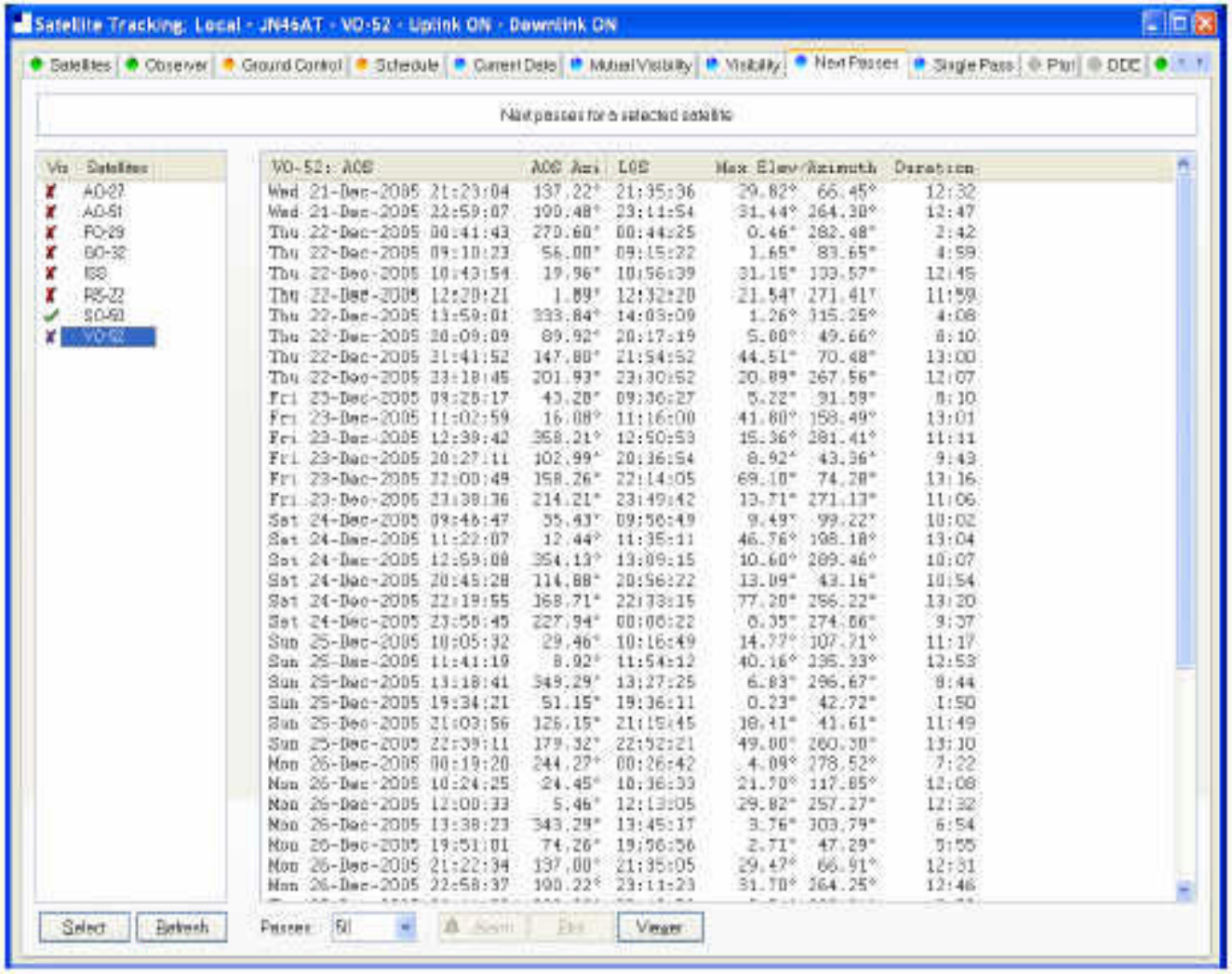
Observer Window



p. 132

- Enter the location for Ann Arbor.(42^{o} 16’ 14” N / 83^{o} 43’ 35” W 805 ft above sea level)
- This should have already been added in the W8UM unit.

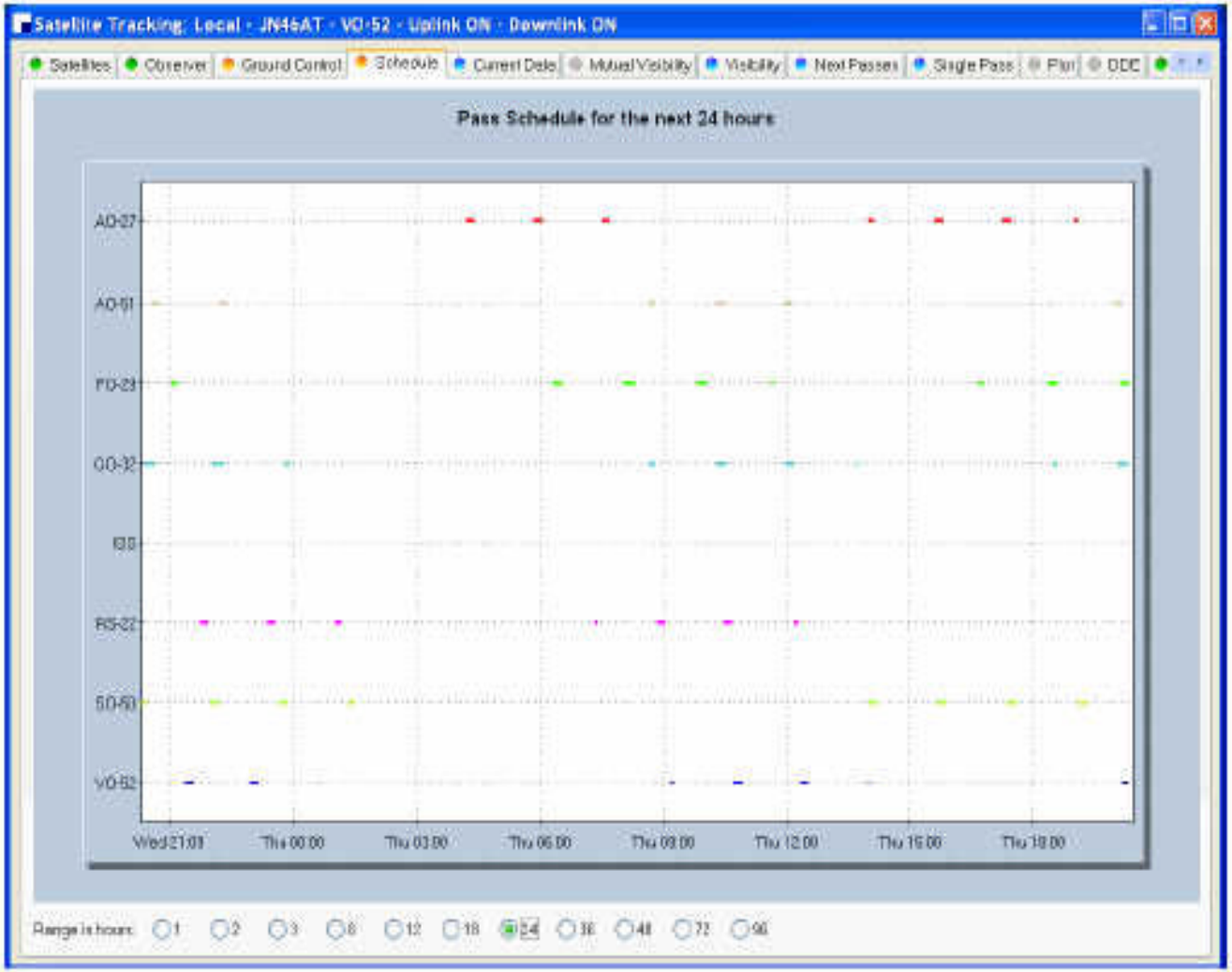
Next Passes Window



p. 142

Lists the time for each pass of a selected satellite

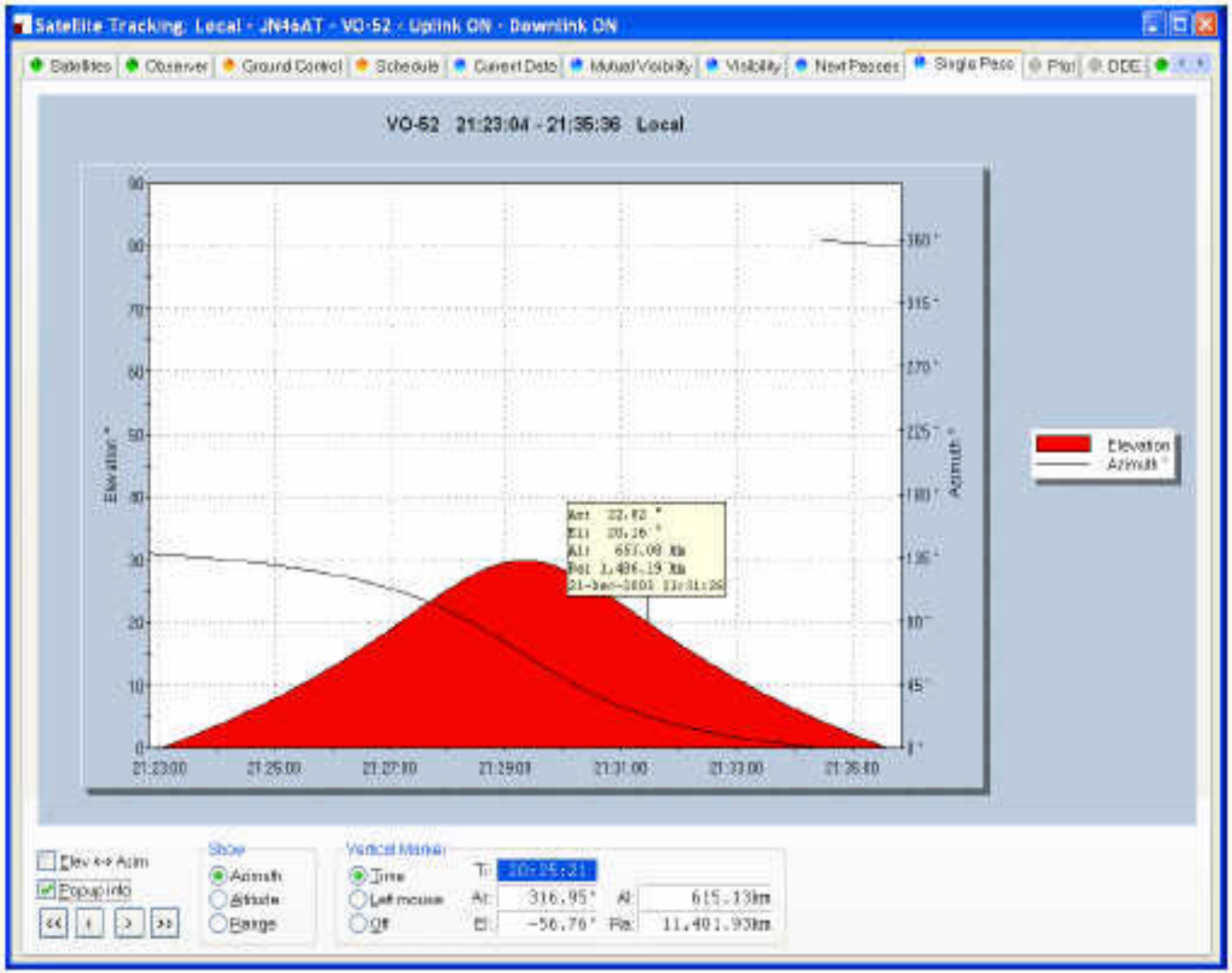
Schedule Window



p. 139

Times satellites selected will be visible

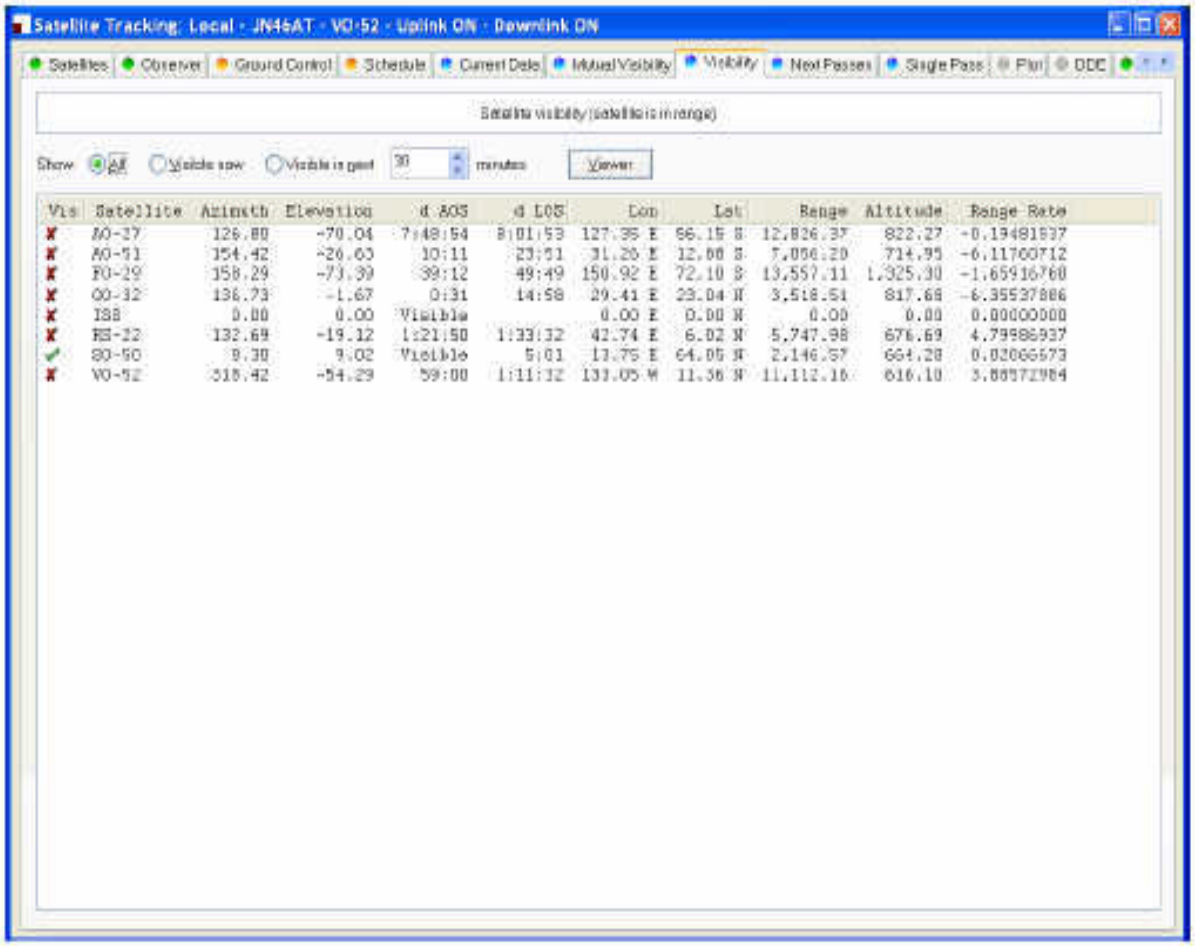
Single Pass Window



p. 142

How the antenna points throughout the passby

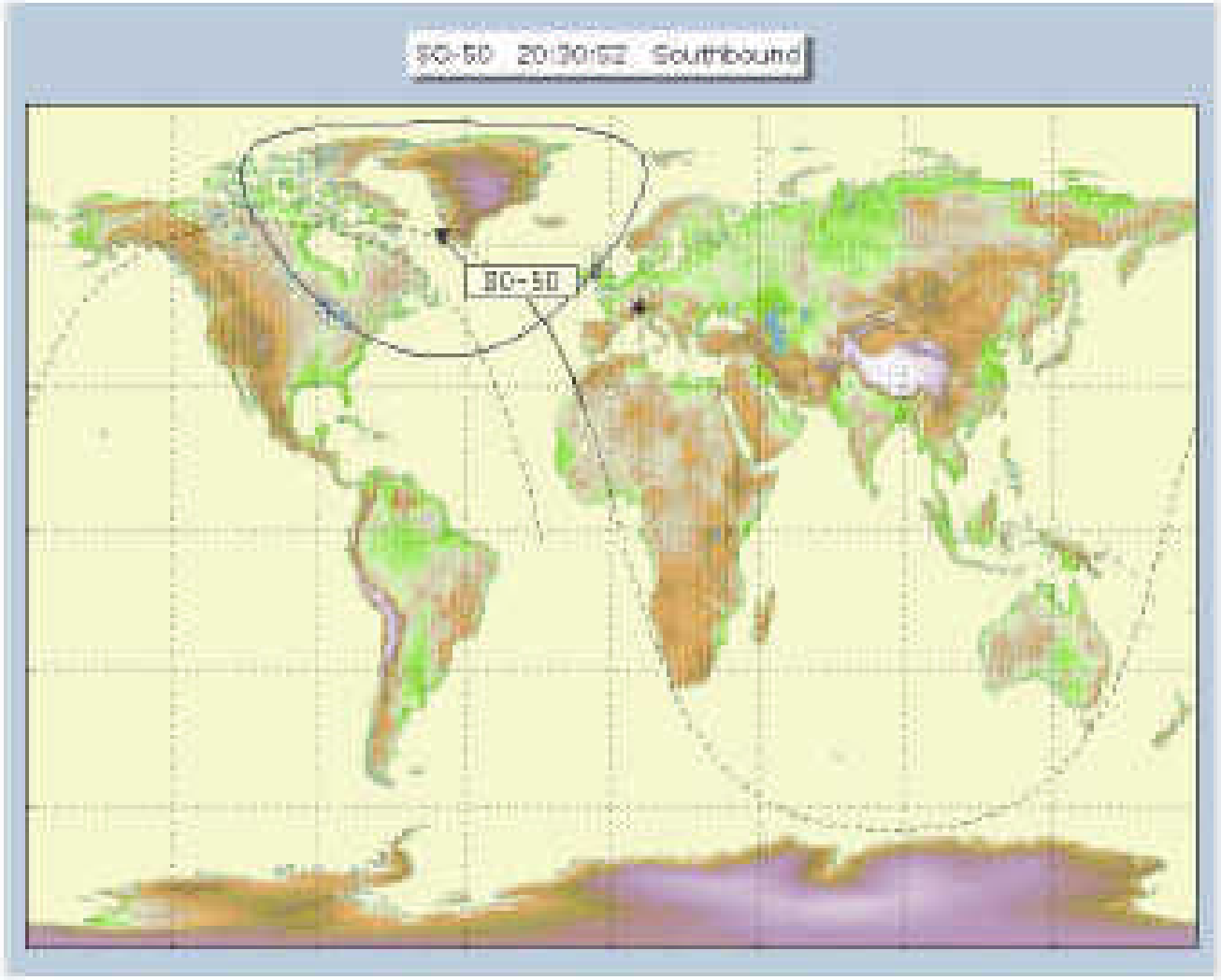
Visibility Window



p. 141

A summary of satellites selected

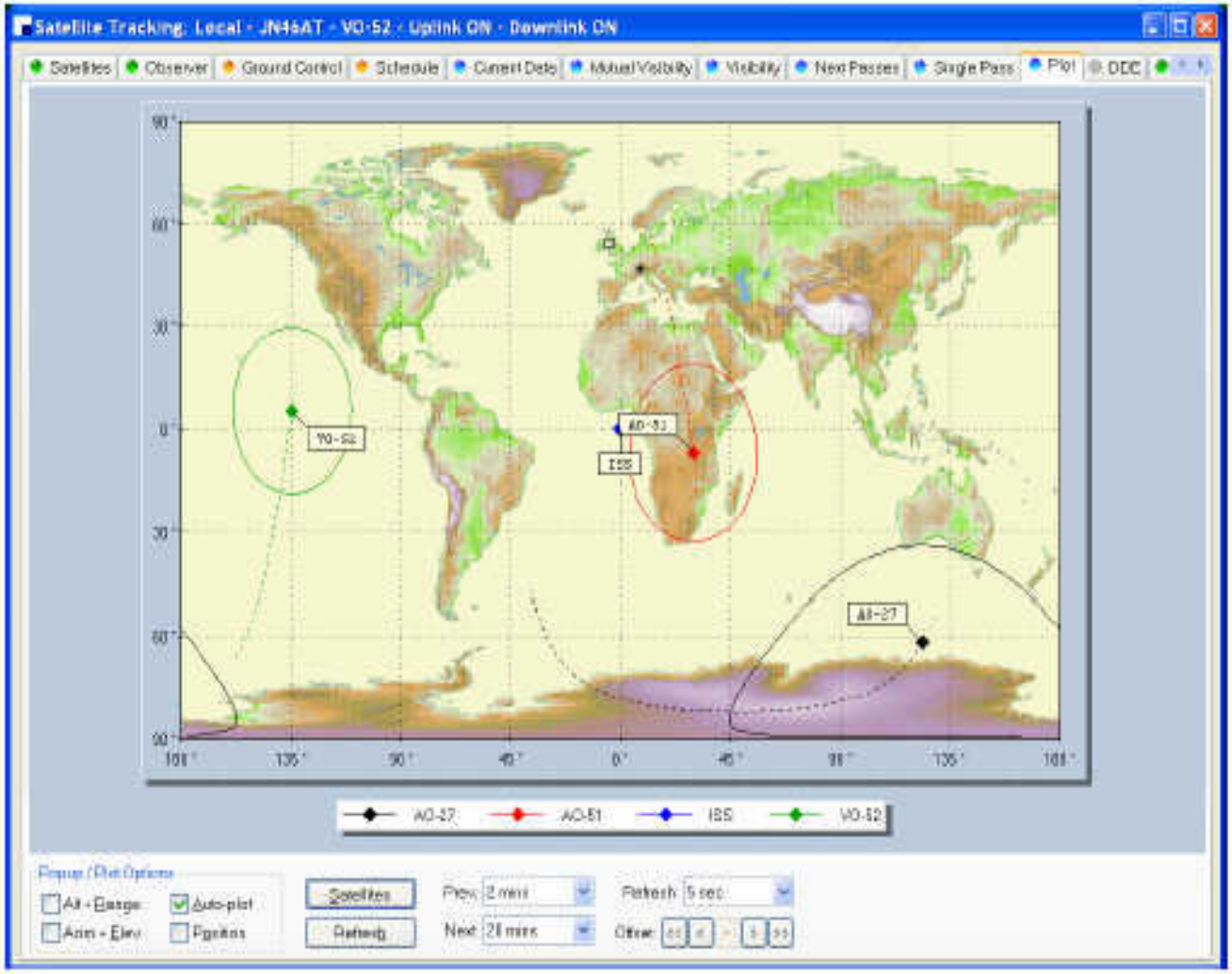
Global Map



p. 133-4

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

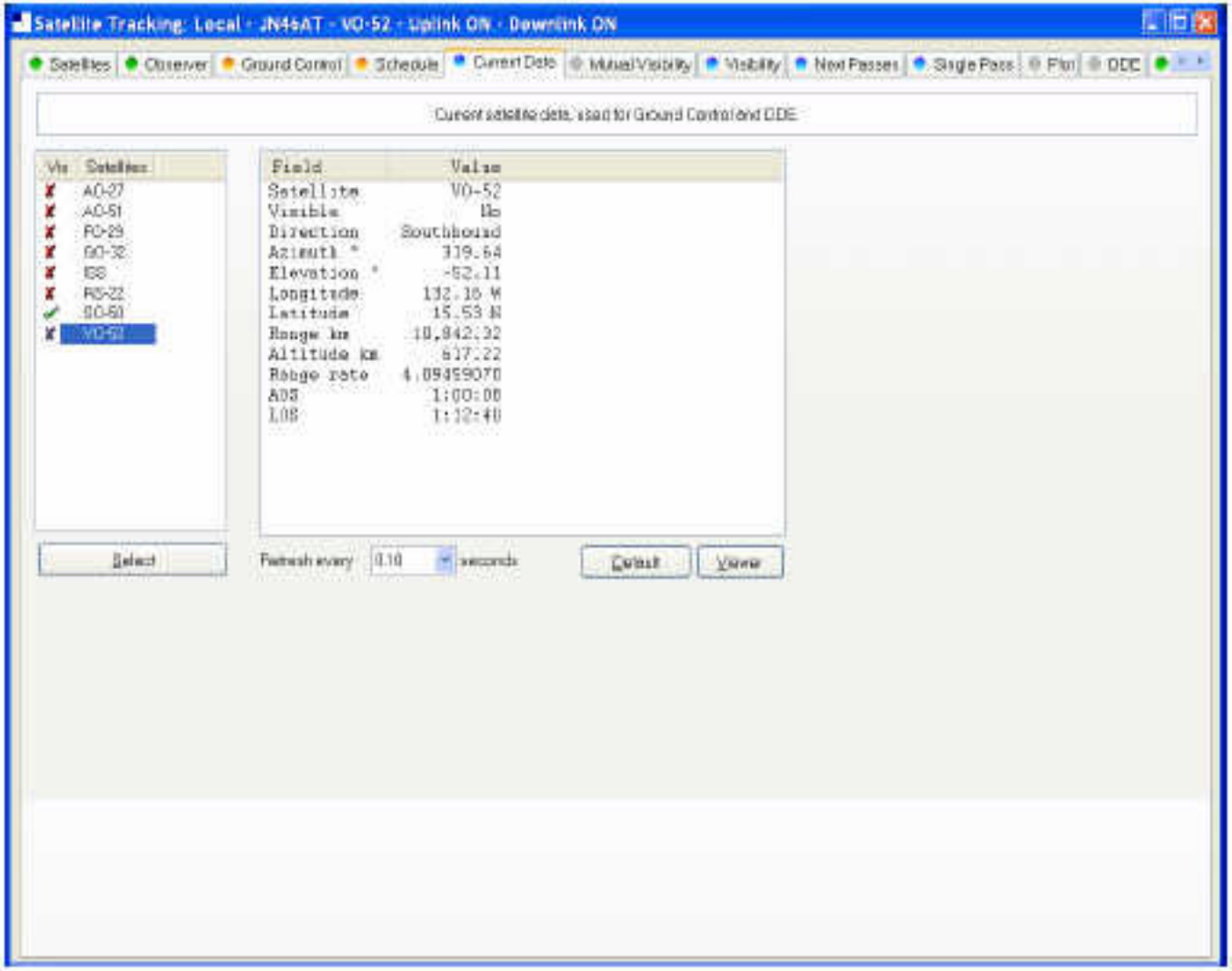
Another Plot Window



p. 143

Another global map showing 4 footprints and area coverages

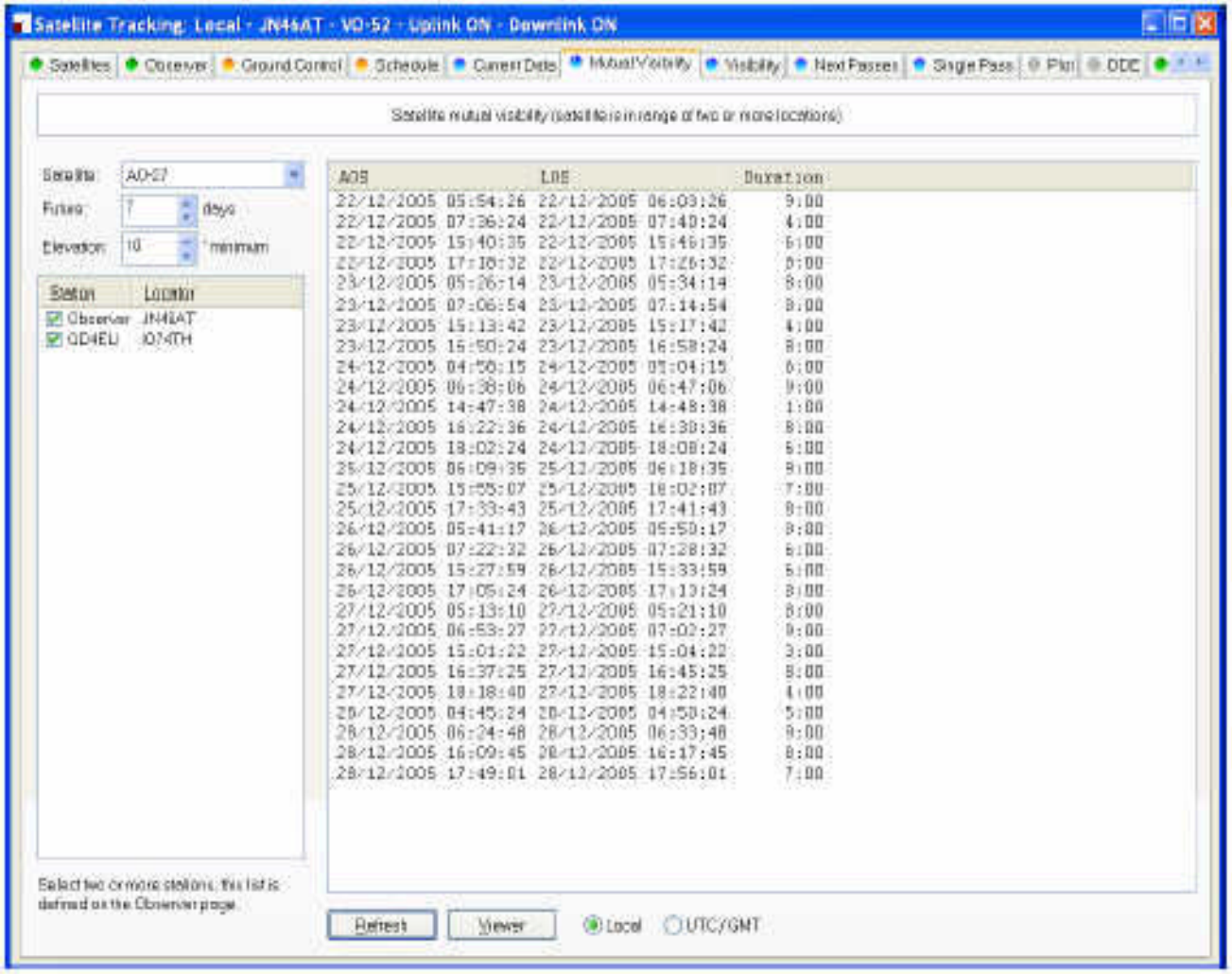
Current Data Window



p. 133-4

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

Mutual Visibility Window



p. 140

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

RF Safety

W8UM Transmitter Outputs
(Antennas on EECS Building roof)

ICOM IC-2100H
Output Power
144 MHz 55/10/5 W

Yaseu FT-8800R
RF Power Output
144 MHz 50/20/10/5 W
430 MHz 35/20/10/5 W

Ten-Tec Omni VI
RF Power Output (ALC stabilized)
10/12/15/17/20/
30/40/80/160 MHz 100 W

Heathkit SB-220
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

ICOM IC-910H
Output power (continuously adjustable)
144 MHz 5 – 100 W
430(440) MHz 5 – 75 W
1200 MHz (Opt UX-910) 1 – 10 W

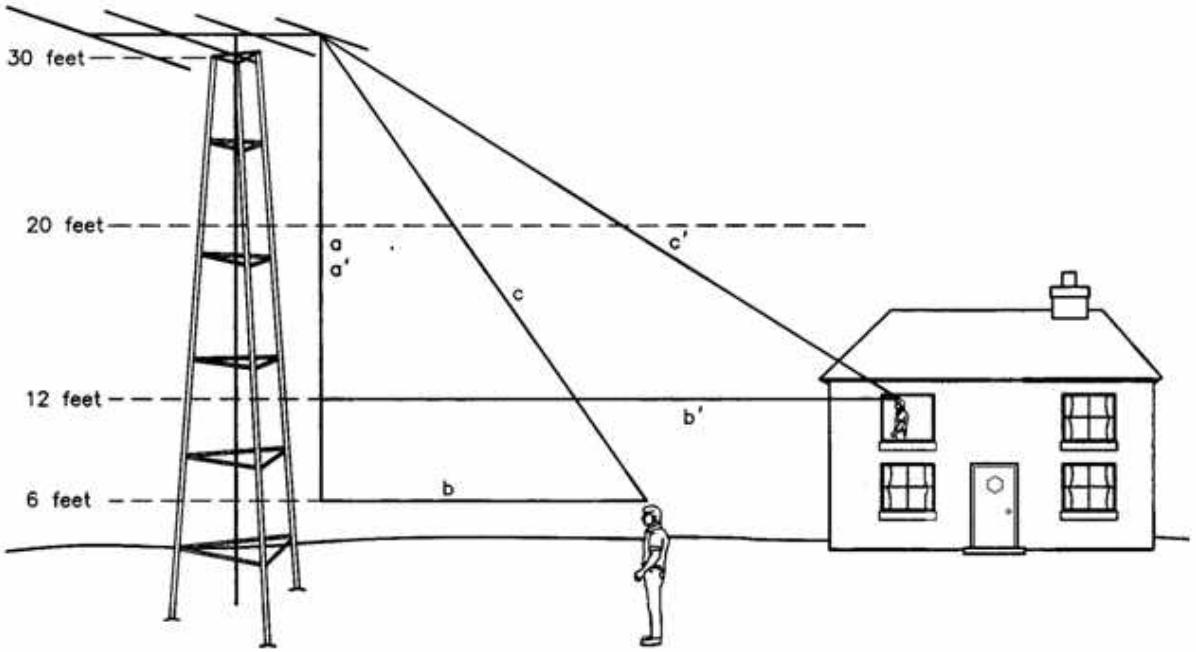
FCC Power Output Maxima
(to avoid further analysis)

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 ≡ 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	2	3
25	0	0	0	0	0	0	2.5	4
50	0	0	0	0	0	0	3	6
100	0	0	0	0	0	0	3.5	8.5
200	0	0	0	0	0	0	5.5	12
250	0	0	0	0	0	0	6	13.5
300	0	0	0	0	0	0	6.5	14.5
400	0	0	0	0	0	0	7.5	17
500	0	0	0	0	0	0	8.5	19
600	0	0	0	0	0	0	9.5	20.5
750	0	0	0	0	0	0	10.5	23
1000	0	0	0	0	0	20	12	27.5
1250	0	0	0	0	0	24	13.5	29.5
1500	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 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 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^2 Antenna rotary system
- http://www.icomamerica.com/en/downloads/Default.aspx?Category=181 ICOM Country Codes
- 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!

Bill aa8rw@arrl.net

becher@eecs.umich.edu