Propagation-Prediction Files

For the CD-ROM bundled with the 21st Edition of *The ARRL Antenna Book*, ARRL has added a number of propagation-prediction tables. There are now data sets for 170 different transmitting QTHs throughout the world, including 41 locations in the USA. Each file is in PDF format for viewing and printing using Adobe *Acrobat Reader*. On the following pages you will find instructions on how to use and interpret the tables.

Summary Propagation Tables

USA
W1B Boston, MA
W2A Albany, NY
W2N Buffalo, NY
W3D Washington, DC
W3P Pittsburg, PA
W4A Montgomery, AL
W4F Miami, FL
W4G Atlanta, GA
W4K Louisville, KY
W4N Raleigh, NC
W4T Memphis, TN
W5A Little Rock, AR
W5H Houston, TX
W5L New Orleans, LA
W5M Jackson, MS
W5N Albuquerque, NM
W5O Oklahoma City, OK
W5T Dallas, TX
W6L Los Angeles, CA
W6S San Francisco, CA
W7A Phoenix, AZ
W7I Boise, ID
W7M Helena, MT
W7N Las Vegas, NV
W7O Portland, OR
W7U Salt Lake City, UT
W7W Seattle, WA
W7Y Cheyenne, WY
W8M Detroit, MI
W8O Cincinnati, OH
W8W Charleston, WV
W9C Chicago, IL
W9I Indianapolis, IN
W9W Milwaukee, WI
WØC Denver, CO
WØD Bismarck, ND
WØI Kansas City, MO
WØK Middle of US, KS
WØM St. Louis, MO
WØN Omaha, NE
WØS Pierre, SD

Other, North America
6Y Kingston, Jamaica
HP Panama City, Panama
J3 Grenada
KL7 Anchorage, Alaska
KP2 Virgin Islands
TI San Jose, Costa Rica
V3 Belmopan, Belize
VE1 Halifax, Nova Scotia
VE2 Montreal, Quebec
VE3 Toronto, Ontario
VE4 Winnipeg, Manitoba
VE5 Regina, Saskatchewan
VE6 Calgary, Alberta
VE7 Vancouver, BC
VE8 Yellowknife, NWT
VO1 St. John's, NFL
VP2 Anguilla
VP5 Turks & Caicos
VP9 Bermuda
XE1 Mexico City, Mexico
ZF Cayman Island

Europe
CT Lisbon, Portugal
DL Bonn, Germany
EA Madrid, Spain
EI Dublin, Ireland
ER Kishinev, Moldava
F Paris, France
G London, England
I Rome, Italy
JW Svalbard
OH Helsinki, Finland
OK Prague, Czech Republic
ON Brussels, Belgium
OZ Copenhagen, Denmark
S5 Slovenia
SP Warsaw, Poland
SV Athens, Greece
TF Reykjavik, Iceland
UA3 Moscow, Russia
UA6 Rostov, Russia
UR Kiev, Ukraine
YO Bucharest, Romania
YU Belgrade, Yugoslavia

South America
8P Barbados
CE Santiago, Chile
CP La Paz, Bolivia
FY Cayenne, French Guiana
HC Quito, Ecuador
HC8 Galapagos Islands
HK Bogota, Columbia
LU Buenos Aires, Argentina
OA Lima, Peru
P4 Aruba
PY1 Rio de Janeiro, Brazil
PY0 Fernando de Noronha
YV Caracas, Venezuela
YV0 Aves Island
ZP Asuncion, Paraguay

Asia
1S Spratly Islands
3W Ho Chi Minh City, Vietnam
4J Baku, Azerbaijan
4S Columbo, Sri Lanka
4X Jerusalem, Israel
9N Katmandu, Nepal
AP Karachi, Pakistan
BS7 Scarborough Reef
BY1 Beijing, China
BY4 Shanghai, China
BY0 Lhasa, China
HS Bangkok, Thailand
HZ Riyadh, Saudi Arabia
JA1 Tokyo, Japan
JA3 Osaka, Japan
JA8 Sapporo, Japan
JT Ulan Bator, Mongolia
TA Ankara, Turkey
UA9 Perm, Russia
UA0 Khabarovsk, Russia
UN Alma-Ata, Kazakh
VR2 Hong Kong
VU New Delhi, India
VU4 Andaman Islands
XZ Rangoon, Myanmar

Oceania
3D2 Fiji Islands
3Y Peter I
DU Manila, Philippines
FO Tahiti
H4 Honiara, Solomon Islands
KH0 Saipan, Mariana Islands
KH6 Honolulu, Hawaii
KH7K Kure
KH8 American Samoa
V7 Kwajalein, Marshall Islands
VK2 Sydney, Australia
VK4 Brisbane, Australia
VK6 Perth, Australia
VK8 Darwin, Australia
VK9 Cocos-Keeling Island
YB Jakarta, Indonesia
YJ Vanuatu
ZL1 Aukland, New Zealand
ZL3 Christchurch, New Zealand

Africa
3B7 St Brandon
3B9 Rodrigues
3C Bata, Equatorial Guinea
5N Lagos, Nigeria
5R Antananarivo, Madagascar
5U Niamey, Niger Republic
5Z Nairobi, Kenya

6W Dakar, Senegal
7Q Lolongwe, Malawi
7X Algiers, Algeria
9J Lusaka, Zambia
9L Freetown, Sierra Leone
9X Kigali, Rwanda
C5 The Gambia
C9 Maputo, Mozambique
CN Casablanca, Morroco
D2 Luanda, Angola
EA8 Canary Islands
FT5X Kerguelen
J2 Djibouti
ST Khartoum, Sudan
SU Cairo, Egypt
T5 Mogadisho, Somalia
VQ9 Chagos, Diego Garcia
XT Burkina Faso
ZS1 Capetown, So. Africa
ZS6 Johannesburg, So. Africa

Detailed Propagation Tables

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W2A Albany, NY
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W6S San Francisco, CA
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W7I Boise, ID
W7M Helena, MT
W7N Las Vegas, NV
W7O Portland, OR
W7U Salt Lake City, UT
W7W Seattle, WA
W7Y Cheyenne, WY
W8M Detroit, MI
W8O Cincinnati, OH
W8W Charleston, WV
W9C Chicago, IL
W9I Indianapolis, IN
W9W Milwaukee, WI
WØC Denver, CO
WØD Bismarck, ND
WØI Kansas City, MO
WØK Middle of US, KS
WØM St. Louis, MO
WØN Omaha, NE
WØS Pierre, SD

Other, North America
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V3 Belmopan, Belize
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VE3 Toronto, Ontario
VE4 Winnipeg, Manitoba
VE5 Regina, Saskatchewan
VE6 Calgary, Alberta
VE7 Vancouver, BC
VE8 Yellowknife, NWT
VO1 St. John's, NFL
VP2 Anguilla
VP5 Turks & Caicos
VP9 Bermuda
XE1 Mexico City, Mexico
ZF Cayman Island

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CT Lisbon, Portugal
DL Bonn, Germany
EA Madrid, Spain
EI Dublin, Ireland
ER Kishinev, Moldava
F Paris, France
G London, England
I Rome, Italy
JW Svalbard
OH Helsinki, Finland
OK Prague, Czech Republic
ON Brussels, Belgium
OZ Copenhagen, Denmark
S5 Slovenia
SP Warsaw, Poland
SV Athens, Greece
TF Reykjavik, Iceland
UA3 Moscow, Russia
UA6 Rostov, Russia
UR Kiev, Ukraine
YO Bucharest, Romania
YU Belgrade, Yugoslavia

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8P Barbados
CE Santiago, Chile
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FY Cayenne, French Guiana
HC Quito, Ecuador
HC8 Galapagos Islands
HK Bogota, Columbia
LU Buenos Aires, Argentina
OA Lima, Peru
P4 Aruba
PY1 Rio de Janeiro, Brazil
PY0 Fernando de Noronha
YV Caracas, Venezuela
YV0 Aves Island
ZP Asuncion, Paraguay

Asia
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3W Ho Chi Minh City, Vietnam
4J Baku, Azerbaijan
4S Columbo, Sri Lanka
4X Jerusalem, Israel
9N Katmandu, Nepal
AP Karachi, Pakistan
BS7 Scarborough Reef
BY1 Beijing, China
BY4 Shanghai, China
BY0 Lhasa, China
HS Bangkok, Thailand
HZ Riyadh, Saudi Arabia
JA1 Tokyo, Japan
JA3 Osaka, Japan
JA8 Sapporo, Japan
JT Ulan Bator, Mongolia
TA Ankara, Turkey
UA9 Perm, Russia
UA0 Khabarovsk, Russia
UN Alma-Ata, Kazakh
VR2 Hong Kong
VU New Delhi, India
VU4 Andaman Islands
XZ Rangoon, Myanmar

Oceania
3D2 Fiji Islands
3Y Peter I
DU Manila, Philippines
FO Tahiti
H4 Honiara, Solomon Islands
KH0 Saipan, Mariana Islands
KH6 Honolulu, Hawaii
KH7K Kure
KH8 American Samoa
V7 Kwajalein, Marshall Islands
VK2 Sydney, Australia
VK4 Brisbane, Australia
VK6 Perth, Australia
VK8 Darwin, Australia
VK9 Cocos-Keeling Island
YB Jakarta, Indonesia
YJ Vanuatu
ZL1 Aukland, New Zealand
ZL3 Christchurch, New Zealand

Africa
3B7 St Brandon
3B9 Rodrigues
3C Bata, Equatorial Guinea
5N Lagos, Nigeria
5R Antananarivo, Madagascar
5U Niamey, Niger Republic
5Z Nairobi, Kenya

6W Dakar, Senegal
7Q Lolongwe, Malawi
7X Algiers, Algeria
9J Lusaka, Zambia
9L Freetown, Sierra Leone
9X Kigali, Rwanda
C5 The Gambia
C9 Maputo, Mozambique
CN Casablanca, Morroco
D2 Luanda, Angola
EA8 Canary Islands
FT5X Kerguelen
J2 Djibouti
ST Khartoum, Sudan
SU Cairo, Egypt
T5 Mogadisho, Somalia
VQ9 Chagos, Diego Garcia
XT Burkina Faso
ZS1 Capetown, So. Africa
ZS6 Johannesburg, So. Africa

Instructions

There are two types of propagation data sets. The first is a single-page *Summary Table* of propagation. Each applies to a specific month and level of solar activity and shows the predicted signal levels to seven generalized receiving areas throughout the world, abbreviated as:

EU = Europe (all of Europe, centered on London, England, and Kiev, Ukraine)
FE = Far East (centered on Tokyo, Japan)
SA = South America (centered on Asuncion, Paraguay)
AF = Africa (centered on Lusaka, Zambia)
AS = southern Asia (centered on New Delhi, India)
OC = Oceania (centered on Sydney, Australia)
NA = North America (all of USA, Canada and Mexico).

There are six levels of solar activity, related to the SSN (Smoothed Sunspot Number) level:

Very Low: SSN between 0 to 20, equivalent to solar flux from 64 to 79
Low: SSN between 21 to 40, equivalent to solar flux from 80 to 94
Medium: SSN between 41 to 60, equivalent to solar flux from 95 to 111
High: SSN between 61 to 100, equivalent to solar flux from 112 to 145
Very High: SSN between 101 to 150, equivalent to solar flux from 146 to 193
Ultra High: SSN above 151, equivalent to solar flux above 194

The second data set is for those who really like details. Each *Detailed Table* is a six-page, band-by-band listing (160, 80, 40, 20, 15 and 10 meters), for each transmitting QTH for a particular month and a particular level of solar activity, to all 40 CQ Zones.

Both the Summary and the Detailed Tables show the highest predicted signal strength (in S-units) throughout the receiving area. Here, the calibration is followed of S9 for 50 μV, with each S-unit equal to 4 dB of change. This is the nominal response of many modern transceiver S meters. If the signal strength is followed by an asterisk (*), then the path is a *long path* rather than the short path.

All signal levels are computed for a 1500-W transmitter and rather good antennas (but antennas that are quite practical for many amateur stations) on both sides of the circuit. The antennas are 100-foot high inverted-V dipoles for 80 and 40 meters, a 3-element Yagi at 100 feet for 20 meters and a 4-element Yagi at 60 feet for 15 and 10 meters. Discount the S-Meter readings to reflect a smaller station, using the following rules of thumb:

Subtract 2 S units for a dipole instead of a Yagi (20 meters and above)
Subtract 3 S units for a dipole at 50 feet instead of a Yagi (for 20 meters)
Subtract 1 S unit for a dipole at 50 feet rather than a dipole at 100 feet (160 to 40 meters)
Subtract 3 S units for 100 W rather than 1500 W (all bands).
Subtract 6 S units for 5 W rather than 1500 W (all bands).

For example, a 100-W station operating on 20 meters with a dipole at 50 feet would be down 6 S-units from a station using 1500 W and a 3-element Yagi at 100 feet. If the prediction for a particular path is for S8 signals, then the smaller station would have an S2 signal at that time. Note well that all these predictions are for *undisturbed* ionospheric conditions. All bets are off when the Earth's magnetic field is disturbed as a result of solar flares, coronal mass ejections or sudden disappearing filaments on the Sun!

Note that the 160-meter signal strength estimations are created using a simple algorithm derived by K1KI from his extensive experience on that band. The 160-meter levels are simply the 80-meter levels minus 3 S-units. This gives more reasonable predictions in practice than do any of the *IONCAP* -based programs, which are not designed to work at this low frequency since they do not explicitly take into account the Earth's magnetic field.

To access the propagation tables directly from Adobe *Acrobat Reader*, click **File**, **Open**. Then select your CD-ROM drive and double-click on the **Propagation** subdirectory. Select the **Prop-Index.pdf** file. Follow the links to the Summary or Detailed Tables Index pages, which are organized by Continent.

From the Summary or Detailed tables index page, choose the transmitting QTH that is closest to your own location (or the QTH for the DXpedition from which you intend to operate) and double-click to bring you to the second level. This shows a table from which you choose the specific month and level of solar activity for a particular QTH. Let's go through an example, step-by-step, assuming that the computer has a CD-ROM in drive Q:

1. Start *Acrobat Reader* by double-clicking the icon for it.
2. With the mouse, select **File** and then **Ope**n.
3. Select the Q: drive (or whatever letter your own CD-ROM drive is).
4. Double-click the **Prop-Index.pdf** file.
5. Click the link for the *Summary Table* index, which shows all the transmitting QTHs.
6. Click once on **W1B Boston, MA**, the first line under the **USA** label.
7. Click on the month November in the SSN High column and examine it on-screen.
8. Print this *Summary Table* by clicking **File**, **Prin**t. A screen will ask you if you wish to print All 73 pages, or the Current page. Unless you want to do a lot of printing, we suggest that you print only the current page! Examine this page carefully. Note the 15-meter prediction to the Far East (FE) at 11 and 12 UTC shows asterisks with levels of 1* and 6*. These are long-path openings.
9. Now, let's look at the *Detailed Table* for November at SSN High.
10. Click **File**, **Open** and select **Prop-Index.pdf** again.
11. Click on the link to the **Detailed Propagation Tables** screen. Select **W1B Boston, MA** again by clicking on it.
12. Click on the month **November** in the SSN **High** column.
13. You will see the signal-level predictions for all 40 CQ Zones for the 80-meter band from Boston in the month of November at a High level of solar activity. The format is different from the *Summary Table* in that the time is listed horizontally across the top and bottom of each page, while the 40 CQ Zones are listed vertically.

14. Scroll down to the next page (40 meters) using the vertical scroll bar on the right-hand side. Subsequent clicks in the vertical scroll bar will eventually get you to the last page for this month/ solar level, which is for 160 meters. Further clicks will get you into the month of December.
15. You can print a single page of this Detailed Table by clicking **File, Print** and then selecting **Current Page**, as you did for the *Summary Table*. However, you will probably want to print out all six pages associated with a particular month and solar-activity level. You will have to specify the range of pages carefully, lest you print out 433 pages automatically! In this case you would take the first page (page 206, shown at the bottom left in *Acrobat Reader*, for 80 meters) and add *5 pages*, yielding a range from 206 to 211.

Document windows in *Acrobat Reade*r: When you click on a link that takes you to a new file in *Acrobat Reader* (such as the links on the Summary and Detailed Tables pages), *Acrobat Reader* will open the new file in the current document window, first closing the current document, or it will open a new window. You can control which it does by selecting **File**, **Preferences** from the menu, then selecting **General** from the submenu. This will display a dialog that includes a checkbox labeled **Open Cross-Document Links in Same Windo**w. Check this box if you want *Acrobat Reader* to close the current document each time you click on a link to anther file. Uncheck the box if you want *Acrobat Reader* to open a new window for each document.