Introduction

Thank you for purchasing the MFJ-890 DX Beacon Monitor. This beacon monitor enables you to track the 18 NCDXF/IARU beacon transmissions that make up the International Beacon Network. Tracking these beacons is very useful because it allows you to know how the propagation is around the world, and what transmitting frequency is the best. Once the MFJ-890 is synched, an LED will light to tell you which beacon is being heard.

The MFJ-890 has a built-in time signal receiver for synchronization. This provides a very precise timing to track the beacon transmissions. It automatically performs daily synchronization to correct and adjust any timing error. The firmware works with signals from WWVB (United States), MSF (Great Britain), DCF 77 (Germany), and JJY (Japan) transmitters; however, the proper time signal receiver must be installed to use signals other than WWVB. In this manual, only the USA transmitter WWVB will be referenced.

The International Beacon System

The International Beacon Network is a worldwide network of high-frequency radio beacons on 14.100, 18.110, 21.150, 24.930, and 28.200 MHz. There are currently 18 beacons located around the world transmitting continuously. The purpose of these beacons is to allow one to know how the propagation is in different parts of the world, and at what frequency it is best.

The beacons' transmit sequence starts on the hour and runs continuously in three-minute cycles. A transmission consists of the callsign of the beacon, sent at 22 words per minute, followed by four one-second dashes. The callsign and the first dash are sent at 100 watts, while the remaining dashes are sent at 10 watts, 1 watt and 0.1 watts, respectively. The four power levels of dashes allow the listener to know how the propagation is in that section of the world. The more dashes that are heard, the better the propagation.

Each of the 18 beacons has a specific time and frequency at which they transmit. This allows the user to know which beacon is being heard. The first beacon to transmit on the hour is the United Nations beacon, 4U1UN on 14.100 MHz. Once its transmission is complete, the Canada beacon, VE8AT, transmits on the same frequency. This sequence continues throughout all the beacons and then repeats itself.

When the MFJ-890 is synched and on the 14.100 MHz frequency, tune your radio to 14.100 MHz. *You can see which beacon is transmitting by looking to see which LED is lit on the MFJ-890.* You will then notice the LED light at the next transmitting beacon, and cycle throughout all of them.

IMPORTANT:	If the MFJ-890 does not sync, allow the unit to sync overnight. The WWVB signal is the best at 0600 UTC (12:00 am CT).

Once a beacon has transmitted on the 14.100 frequency, it steps up to the next frequency and repeats the transmission on the same beacon. This process continues until the beacon has transmitted throughout all 5 frequencies. It then pauses for 130 seconds and starts over again at 14.100 MHz. Each transmission is 10 seconds long on each band.

You can follow a particular beacon throughout all of its frequencies by simply changing the frequency of your radio up to the next frequency after the beacon has transmitted. If you have a radio with preset buttons on it, this is very easy. Program all five frequencies into the preset buttons on your radio and change the frequency immediately after the beacon has transmitted. This is useful if you want to talk to one particular part of the world and you want to know what is the best transmitting frequency. For each frequency transmission, listen to the four power level dashes. The more dashes you hear, the better that frequency is for transmitting.

The table located in Appendix A gives the exact minute and second of the start of the first transmission within the hour for each beacon on each frequency. This table shows the allotted time at which the beacon should transmit. If a beacon is not heard it usually means that the propagation in that area is very poor. However, sometimes a beacon may not transmit on certain frequencies, or it may not be transmitting at all. To view the latest beacon scheduling and availability, go online to http://www.ncdxf.org/beacon and check out the most recent postings.

The 18 beacons are strategically located to give even coverage around the world. The current locations of the beacons are shown in the table in Appendix B. These locations are subject to change, so to get the most up-to-date locations visit http://www.ncdxf.org/beacon.

For a more comprehensive explanation of the International Beacon Network, see the October and November 1994, and September 1997 issues of QST magazine. Also see the January 1999, September and December 2001, and January 2002 issues of Practical Wireless (of Great Britain). These articles spawned the idea for this unit.

Front Panel
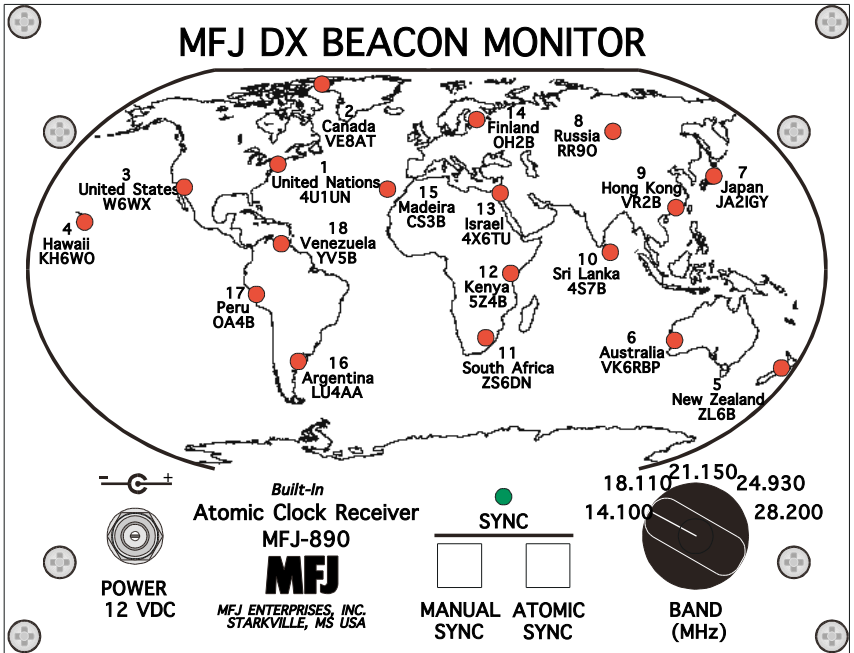
Power: The Power jack accepts a 2.1 mm coaxial plug with positive center and negative sleeve. This unit requires 12 volts DC. An optional power supply, the MFJ-1315, is available from MFJ Enterprises, Inc. This unit uses a minimum of 4 mA during standby and a maximum of 10 mA during synchronization. A 9-volt backup battery can be connected inside the unit.

WARNING:	**Do not apply voltages greater than 18 volts to this unit, or permanent damage to the unit may result.**

Manual Sync Button: Press to reset the slot LED to the beginning of the 3-minute cycle. It is disabled when the unit is already synched, or in the process of synchronization when it was synched before the process started.

Atomic Sync Button: Press to perform synchronization of the MFJ-890 with the local time signal such as WWVB.

Band Switch: Selects the DX band of 14.100, 18.110, 21.150, 24.930 or 28.200 MHz.

Slot LEDs: There are 18 red slot LEDs representing the 18 DX beacons around the world. Only one slot LED is lit at a given time indicating the current beacon at the selected band.

Sync LED: A green LED indicates the synchronization status. It blinks during synchronization, remains lit when synchronized, or off when it is not synchronized.

Interior Components

These components are located inside the unit. To access them, remove the front panel by removing the four corner screws. Do not remove the four inner screws.

Battery: This unit uses a 9-volt battery as backup in case of power loss. Alkaline batteries are recommended. Make sure the battery is not in contact with any electronic components.

Jumpers: There are six jumpers inside the unit. Jumpers JMP1 to JMP3 select the time zone. Jumpers JMP4 to JMP6 enable and disable the power saving feature.

Operation

Configure jumpers JMP1, JMP2 and JMP3 to select your time zone (or country). The factory default time zone (indicated by *) is USA Central. The MFJ-890 performs a daily synchronization for 10 minutes at 3:00, 4:00, 5:00 and 6:00 a.m. local time. The standard time signal receiver is for USA use only. The proper time signal receiver must be installed in order for use in United Kingdom, Germany and Japan. Currently only 60 kHz receivers are available.

JMP1	JMP2	JMP3	Time Zone	Transmitter
L	L	L	USA Pacific	WWVB, 60 kHz
L	L	H	USA Mountain	WWVB, 60 kHz
L	H	L	USA Central *	WWVB, 60 kHz
L	H	H	USA Eastern	WWVB, 60 kHz
H	L	L	United Kingdom	MSF, 60 kHz
H	L	H	Germany	DCF77, 77.5 kHz
H	H	L	Japan	JJY, 40 kHz
H	H	H	Reserved	Reserved

"Reserved" is defaulted to USA Central.

Unless you are using battery only, standby mode should be set to Never. Press and hold the Atomic Sync button for four seconds to place the MFJ-890 into power saving mode; this will turn off all slots LEDs and the Sync LED. Press any button or turn the Band switch to wakeup. Take care not to press the Manual Sync button twice; otherwise, the LED sequence will be reset to the beginning of the hour. The factory default (**) is disabled in standby mode.

JMP4	JMP5		Go Into Standby Mode	
L	L		Never	*
L	H		After 1 hour	
H	L		After 3 hours	
H	H		After 6 hours	
		JMP6	LED Status During Standby Mode	
		L	Completely off	*
		H	On 2 seconds and off 8 seconds	

When power is first applied to the MFJ-890, all slot LEDs blink once and the unit goes into synchronization mode every hour on the hour until it is synched. The LED sequence starts at the beginning of the hour. To manually set the MFJ-890, tune in WWV or WWVH at 5, 10 or 15 MHz. Wait for a minute that is evenly divisible by three (0, 3, 6, 9, etc.). At the sound of the beep, briefly press the Manual sync button. Then observe the synchronization on successive minutes. If it is off, repeat this procedure again. The MFJ-890 will automatically synchronize itself with WWVB every morning at 3:00 a.m. local time. If it is not synchronized in 10 minutes, it will try again at 4:00, 5:00 and 6:00 a.m. Synchronization is performed at these hours because signal reception is at its best. During signal reception, the Sync LED is blinking. If synchronization is achieved, the Sync LED remains lit; otherwise, it is off. The Atomic Sync button can be pressed at any time to manually synchronize with WWVB. For good signal reception, the MFJ-890 must be located away from interference sources, such as televisions, computers or other electronic equipment. The MFJ-890 timing is precisely kept with a tuning fork clock crystal between synchronizations. In the worst case, the crystal tolerance of ±20 ppm (parts per million) yields an error of up to ±1.7 seconds per day. Any error will be corrected and adjusted daily via synchronization with WWVB.

Self Test

A self-test routine will check the functions of the MFJ-890. This routine checks the LEDs, the buttons, the knob and the jumper connections. You may stop the self-test by turning off the unit. The self-test can be completed in approximately two minutes.

Here is the self-test procedure:

1. Unplug the power and remove the backup battery. Wait about 10 seconds for the unit to fully power-down.
2. Set all six interior jumpers to the "L" position.
3. Set the Band switch to 14.100 MHz position (1st position).
4. Press and hold the Manual Sync button while plugging in the power.
5. The test begins by blinking all the LEDs.
6. Release the Manual Sync button. Take care not to press it again.
7. All the connections are checked for shorts.
8. Press the Manual Sync button and the Sync LED should blink once.
9. Press the Atomic Sync button and the Sync LED should blink once.
10. Turn the Band switch to 18.100, 21.150, 24.930 and 28.200 positions. The Sync LED should blink once for each position.
11. Set jumpers JMP1, JMP2 and JMP3 to "LLH" positions and then press the Manual Sync button. The Sync LED should blink once. Repeat this for "LHL", "LHH", "HLL", "HLH", "HHL" and "HHH" positions.
12. Perform previous step for jumpers JMP4, JMP5 and JMP6.
13. If the unit is okay, the Sync LED will remain lit and the slot LEDs will cycle continuously. If there is a problem, the Sync LED will blink. In addition, a slot LED will blink to indicate which part is malfunction.
14. Unplug the power jack and wait about 10 seconds.

Failure Message Meanings:
   LED #1 blinking: Manual Sync button is shorted or improperly connected.
   LED #2 blinking: Atomic Sync button is shorted or improperly connected.
   LED #3 blinking: Band position 14.100 is improperly connected.
   LED #4 blinking: Band position 18.110 is improperly connected.
   LED #5 blinking: Band position 21.150 is improperly connected.
   LED #6 blinking: Band position 24.930 is improperly connected.
   LED #7 blinking: Band position 28.200 is improperly connected.
   LED #8 blinking: Jumpers JMP1 to JMP3 circuitry is bad.
   LED #9 blinking: Jumpers JMP4 to JMP6 circuitry is bad.

Firmware Version Number

To get the firmware version number, perform the following procedure:

1. Unplug the power and remove the backup battery. Wait about 10 seconds for the unit to fully power-down.
2. Set the Band to 14.100 MHz position (1st position).
3. Press and hold the Atomic Sync button while plugging in the power.
4. Two slot LEDs will light to indicate the firmware version number X.YY, where the single-digit LED is X and the double-digit LED is YY. For example, LEDs #1 and #10 are lit for firmware version 1.10.
5. Normal operation resumes in 10 seconds.

Jumper Settings

To find out the jumper settings without removing the front panel, perform the following procedure:

1. Unplug the power and remove the backup battery. Wait about 10 seconds for the unit to fully power-down.
2. Set the Band to 18.110 MHz position (2nd position).
3. Press and hold the Atomic button while plugging in the power.
4. Two slot LEDS will light to indicate the jumpers' settings. The single-digit LED shows the setting for jumpers JMP1 to JMP3 and the double-digit LED for jumpers JMP4 to JMP6.

Jumpers Position	Is Indicated By LEDs
L L L	#1 and #11
L L H	#2 and #12
L H L	#3 and #13
L H H	#4 and #14
H L L	#5 and #15
H L H	#6 and #16
H H L	#7 and #17
H H H	#8 and #18

5. Normal operation resumes in 10 seconds.

Time Signal Receiver Test

To test the time signal receiver and the signal quality, perform the following procedure:

1. Unplug the power and remove the backup battery. Wait about 10 seconds for the unit to fully power-down.
2. Set the Band to 21.150 MHz position (3rd position).
3. Press and hold the Atomic Sync button while plugging in the power.
4. The Sync LED will light steady.
5. When there is good signal reception, all slot LEDs will blink in synchronization with the time signal. The time signal consists of one-second pulses, usually with three different pulse widths. The LEDs will blink erratically or not at all for poor signal reception.
6. Press either button to resume normal operation.

Troubleshooting

The MFJ-890 will not sync to WWVB.

Allow the unit to synchronize overnight. The signal is the best at 0600 UTC (12:00 am CT).

Try rotating it 90 degrees. The antenna is directional and you may be able to improve the signal strength by turning the unit.

Point the antenna toward Colorado. The antenna in the MFJ-890 is located in the upper right hand corner of the unit.

Move it away from any electronics that may interfere with the unit. This includes computer monitors, TV's and other equipment that may interfere with the reception.

Make sure that you are in the coverage area of the WWVB signal. This signal covers most of North America.

Technical Assistance

If you have any problem with this unit, check the appropriate section of this instruction manual. If this manual does not reference your problem, you may call *MFJ Technical Service* at **662-323-0549** or the *MFJ Factory* at **662-323-5869**. Please have your unit, this manual, and an accessible workstation.

Other ways to contact MFJ are by facsimile at **662-323-6551**, by email at techinfo@mfjenterprises.com, or by mail at:

MFJ Enterprises, Inc.
300 Industrial Park Road
Starkville, MS 39759

When writing MFJ, please send a complete description of your problem, an explanation of exactly how you are using your unit, and a complete description of your station.

Appendix A

Callsign	Location	14.100	18.110	21.150	24.930	28.200	Operator
4U1UN	United Nations	00:00	00:10	00:20	00:30	00:40	UNRC
VE8AT	Canada	00:10	00:20	00:30	00:40	00:50	RAC/NARC
W6WX	United States	00:20	00:30	00:40	00:50	01:00	NCDXF
KH6WO	Hawaii	00:30	00:40	00:50	01:00	01:10	NOARG/HARC
ZL6B	New Zealand	00:40	00:50	01:00	01:10	01:20	NZART
VK6RBP	Australia	00:50	01:00	01:10	01:20	01:30	WIA
JA2IGY	Japan	01:00	01:10	01:20	01:30	01:40	JARL
RR9O	Russia	01:10	01:20	01:30	01:40	01:50	SRR
VR2B	Hong Kong	01:20	01:30	01:40	01:50	02:00	CRSA/HARTS
4S7B	Sri Lanka	01:30	01:40	01:50	02:00	02:10	RSSL
ZS6DN	South Africa	01:40	01:50	02:00	02:10	02:20	ZS6DN
5Z4B	Kenya	01:50	02:00	02:10	02:20	02:30	ARSK
4X6TU	Israel	02:00	02:10	02:20	02:30	02:40	IARC
OH2B	Finland	02:10	02:20	02:30	02:40	02:50	SRAL
CS3B	Madeira	02:20	02:30	02:40	02:50	00:00	ARRM
LU4AA	Argentina	02:30	02:40	02:50	00:00	00:10	RCA
OA4B	Peru	02:40	02:50	00:00	00:10	00:20	RCP
YV5B	Venezuela	02:50	00:00	00:10	00:20	00:30	RCV

Appendix B

Slot	DX Entity	Callsign	Location	Latitude	Longitude
1	United Nations	4U1UN	New York City	40º 45' N	73º 58' W
2	Canada	VE8AT	Eureka, Nunavut	79º 59' N	85º 57' W
3	United States	W6WX	Mt. Umunhum	37º 09' N	121º 54' W
4	Hawaii	KH6WO	Laie	21º 38' N	157º 55' W
5	New Zealand	ZL6B	Masterton	41º 03' S	175º 36' E
6	Australia	VK6RBP	Rolystone	32º 06' S	116º 03' E
7	Japan	JA2IGY	Mt. Asama	34º 27' N	136º 47' E
8	Russia	RR9O	Novosibirsk	54º 59' N	82º 54' E
9	Hong Kong	VR2B	Hong Kong	22º 16' N	114º 09' E
10	Sri Lanka	4S7B	Colombo	6º 54' N	79º 52' E
11	South Africa	ZS6DN	Pretoria	25º 54' S	28º 16' E
12	Kenya	5Z4B	Kiambu	1º 1' S	37º 3' E
13	Israel	4X6TU	Tel Aviv	32º 03' N	34º 46' E
14	Finland	OH2B	Karkkila	60º 32' N	24º 06' E
15	Madeira	CS3B	Santo da Serra	32º 43' N	16º 48' W
16	Argentina	LU4AA	Buenos Aires	34º 37' S	58º 21' W
17	Peru	OA4B	Lima	12º 04' S	76º 57' W
18	Venezuela	YV5B	Caracas	10º 25' N	66º 51' W

Schematic