Visiting an Old Friend

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PREFACE

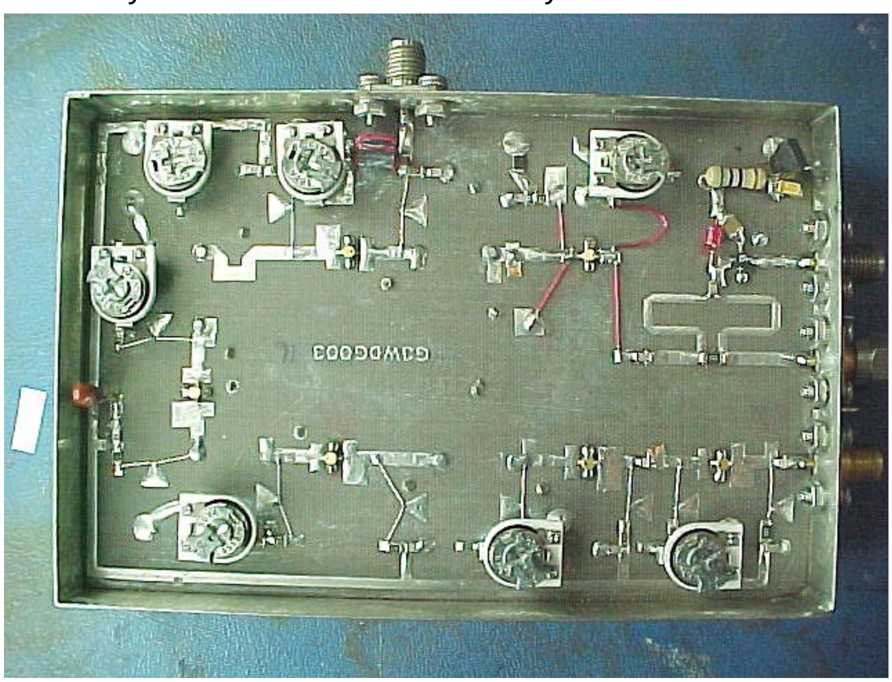
I know most of you, like me, have an old friend sitting on the shelf or the workbench that you keep around, not because of its performance, but because of its nostalgia. You know what I am talking about! I am sure you have something around? For me, it's the 10 GHz transverter I made that first "real" contact with! I would not dream of ever using it again but I would never part with it. Well this paper is a little info on how you could possibly revitalize your old friend and maybe if not part with, pass it along to someone else for his or her first QSO on maybe his or her new favorite band.

PROGRESS, A WONDERFUL THING!

Back in the mid to late '70's, commercial microwave transverters started to become available to the average ham. Names such as LMB, LMW, MMT, SHF, and others became common names through the 80's and into the 90's. There were many other homebrew and published designs in the RSGB handbook along with other Ham related circuit designs published in proceedings from various conferences such as this one. All of the designs had their quirks and quandaries, but all got us on our chosen band of operation, somewhere within the band plan! This paper will specifically address one popular 10 GHz design (my old friend) and cover a problem and a solution that is applicable to many of the "Old Friends" that are still around.

The G3WDG 10 GHz TRANSVERTER

I don't know how to describe it, but no matter what I did in the hobby, No matter where I moved my Ham shack to, or what particular interest I had through the years, my first G3WDG transverter was always around somewhere. I always knew where it was even though I have not used it since 1991-92. The Local Oscillator was missing (or trashed) after being rebuilt a few times (along with a few others that belonged to other Hams) but the "RF" stuff was intact and still quite useable! Yes, the local oscillator has caused many a stressful moment in my hobby. It would operate on the wrong multiple or would be sensitive to



temperature that would affect the output power and frequency. Therefore, it was placed aside for many years.

After working on my own product line of transverters, I began to understand how advanced the designs of the early equipment were. Yes, things are much simpler now. With basic soldering skills, you can get on the air with a voltmeter or just purchase one assembled and ready to go! The early Microwave stuff was strings of expensive GaAs FETs, meticulous coil winding, and specific and precise filtering. So, in a way, with a few component upgrades, (replace adjustable bias components) the RF works of most of the first microwave transverters were sound.

Recently, (last two-three years or so) much development has been made towards frequency stability and accuracy through the Microwave bands. The latest is a Synthesizer with low enough phase noise and frequency agile enough to be used as the local oscillator in some of these older deign microwave transverters. Again, some of the following details in modifying the G3WDG design may be utilized with other types of transverters on other bands.

Let us look at the G3WDG 10 GHz design. Like today's designs, it was based on a 100 MHz oscillator (106.5 MHz I believe) and multiplied, filtered, and amplifier to produce a +10dBm signal at 2556 MHz. Details are spared on the LO because it is what we wish to replace. The point is, a +7 to +13 dBm 2556 MHz. signal was supplied to the transmit module where the LO power was amplified and split to send a LO signal to the RX and TX converters separately. Also note that the LO was a separate self-contained module as are the TX and RX converters. Figure 1 shows the LO spliter/multiplier and TX chain.

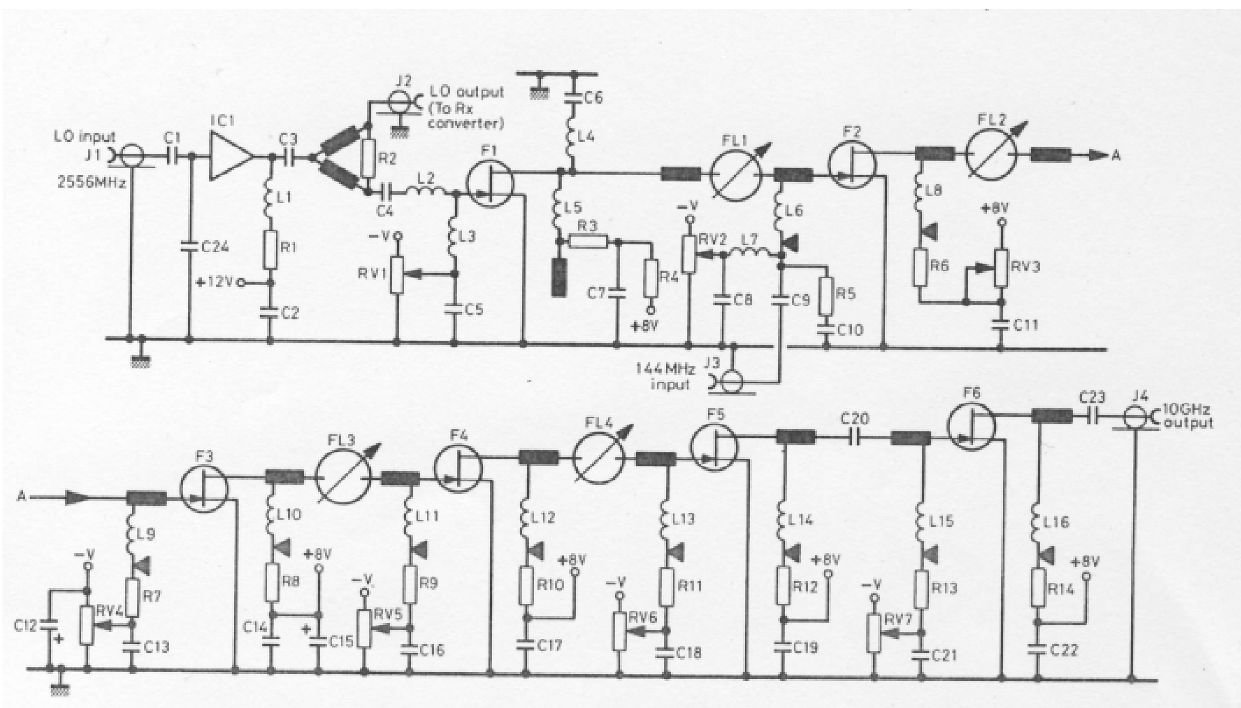


Fig 18.181. Circuit of the G3WDG–003 144MHz to 10GHz transmit converter. Component values are given in Table 18.12

Figure 1. G3WDG TX Converter and LO splitter,

The split LO signal is amplified, filtered then mixed with 144 MHz in an active mixer before entering 3 more filters and four more GaAsFET amplifiers to produce 100 mW's or so. It is a simple basic design we use today except the FET's have been replaced with MMIC's and simple bias circuits.

On Receive, see Figure 2., the LO signal enters the converter, is amplified and filtered, then mixed in a diode pair with the 10 GHz RF signal that has been amplified by two GaAs FETs and filtered once. The output of the mixer then enters into a IF bipolar amplifier with a tuned stage providing some additional filtering.

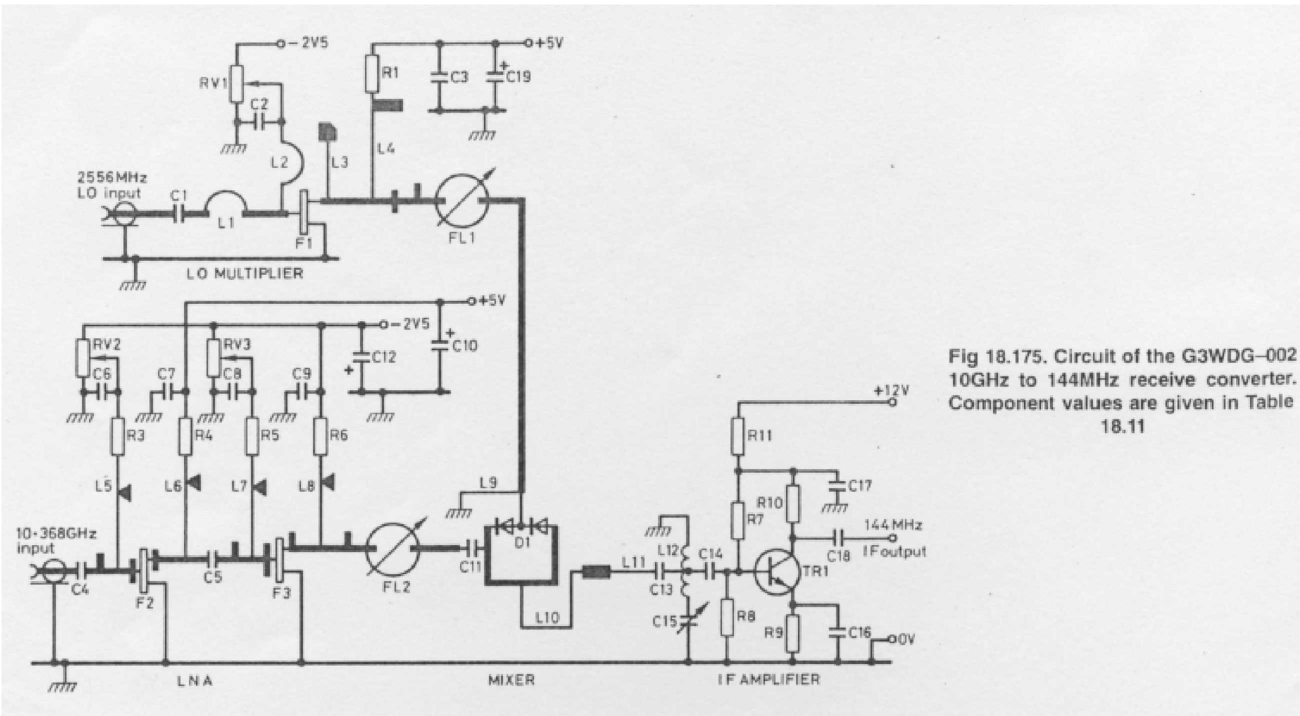


Figure 2. G3WDG RX Converter

The LO replacement

I decided to attempt to replace the G3WDG 2256 Local Oscillator with the A-32 synthesizer. The A-32 synthesizer was initially designed with 32 frequencies that can be utilized with any 2304 and up DEMI transverter, but because of its success and customer desires for other no-standard frequencies to experiment with, the list has been opened to beyond 60 frequencies. After working with the synthesizer and discovering its true value in frequency accuracy and realizing the level of phase noise generated will not degrade the G3WDG transverters original performance, the required frequency for the G3WDG transverter was added to today's offering of frequencies. Please review the partial frequency list below. For further technical description of the A32 synthesizer, and all frequencies available, please see www.downeastmicrowave.com/PDF/A32_pd.pdf

Band	IF	Frequency	REV	Predicted PN, dBc/Hz @ 1 kHz
2304	144	1080		-81
“	145	1079.5		-79
“	147	1078.5		-79
2320	144	1088		-81
2424	144	1140		-81
3456	144	1104		-81
“	145	1103.6667		-78
“	147	1103		-81
3400	144	1085.3333		-80
“	145	1085		-81
5760	144	1123.2		-78
“	145	1123		-81
“	147	1122.6		-76
“	432	1065.6		-78
“	435	1065		-81
10368	144	1136		-81
“	145	1135.8889		-74
“	147	1135.6667		-78
“	432	1104		-81
“	435	1103.6667		-78
“	1296	1008		-81
24192	144	1002		-81
“	147	1001.875		-80
“	432	990		-81
“	435	989.875		-75
24048	144	996		-81
“	147	995.875		-75
“	432	984		-81
“	435	983.875		-75
903.1	WSS	903.1		-74
915	WSS	915		-81
1296.1	WSS	1296.1		-74
1152.02	WSS	1152.022		-74
2401	WSS	1200.5		-79
902.1	WSS	902.1	C2	-74
1275	WSS	1275	C2	-81
1420	WSS	1420	C2	-81
1296	144	1152	C2	-81
2400	144	1128	C2	-81
5760	1296	1116	C2	-81
1296	28	1268	C2	-81
1296	145	1151	C3	-81
2300	145	1077.5	C3	-79
2300	144	1078	C3	-81
2400	145	1127.5	C3	-81
10368	145	1022.3	C3	-74
10368	144	1022.4	C3	-78
1296	147	1149	C3	-81
1296	29	1267	C3	-81
1420	144	1276	C3	-81
10368WDG	144	1278	C3	-81

Understand that the A-32 output is centered around 1150 MHz. the synthesizer has an operating range that has been fully exploited with the provided programming! Therefore, we cannot just dial up 2556 MHz and connect it to the G3WDG transverter. BUT--- with one of the programmed frequencies (1278 MHz.) that is ½ of the desired frequency, a simple multiplier should and would work.

So, time for the experiment! The transmit converter has the LO buffer amp before it is split for both converters. Can the buffer operate as a "2 X Multiplier"? It was tried with the standard MSA1104 (MAV-11) but the result did not have enough output power to drive both mixers. The 2556 signal was down about 6 dB. The MAS1104 is a wonderful stable buffer amp, but it will produce enough power as a doubler and there is no room for an additional amplifier.

Now, Lets add some modern technology! Substitute the MAV-11 with a different MMIC. I chose the ERA-5 because of its high gain and higher output power at frequencies up to 5 GHz. Also, because of its gain level, it has shown that a second harmonic level of +10dBm is an easy task for it. Only other changes to the circuit are the bias resistor and a addition of a recommended 9 VDC voltage regulator to keep the voltage steady. It was a drop in and test type of operation. See figure 3

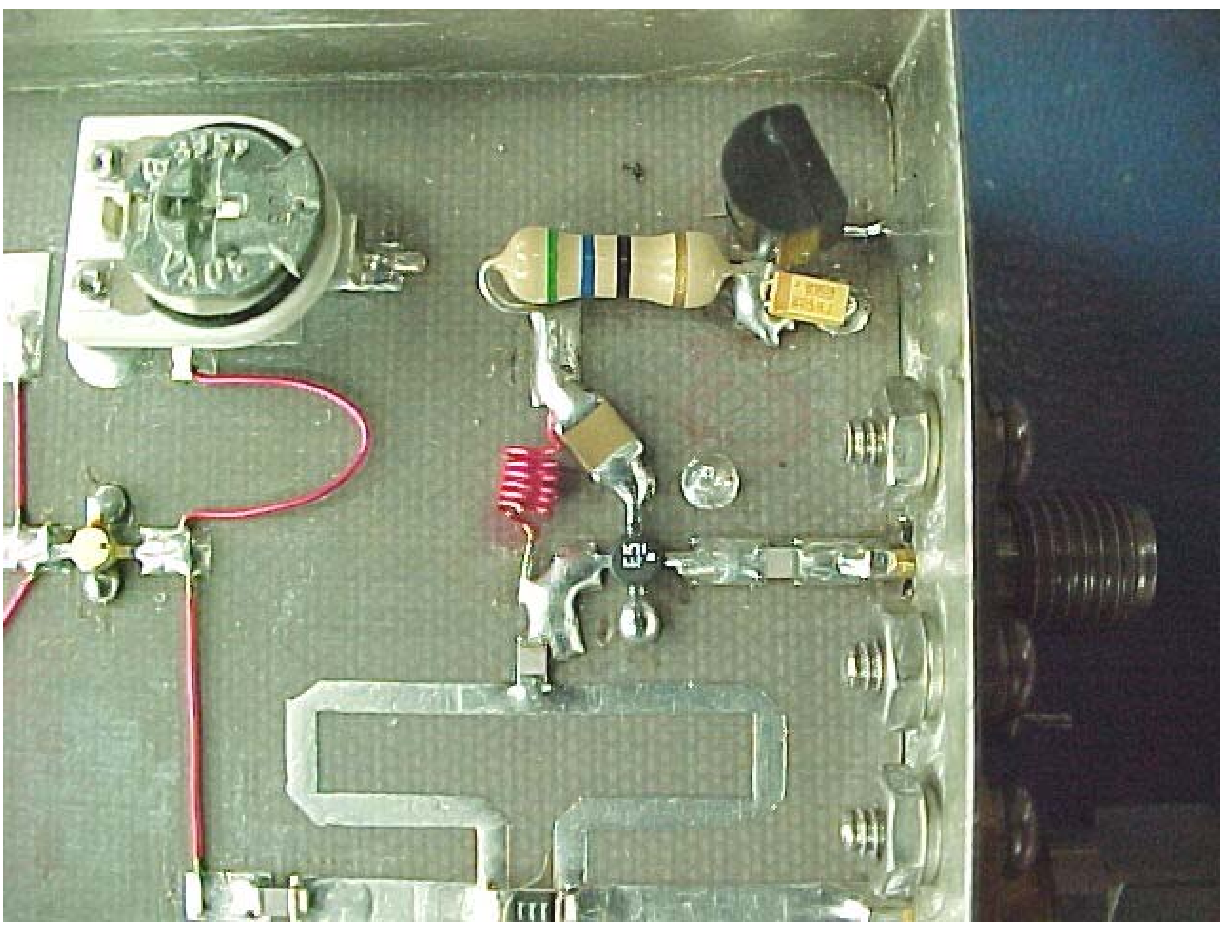
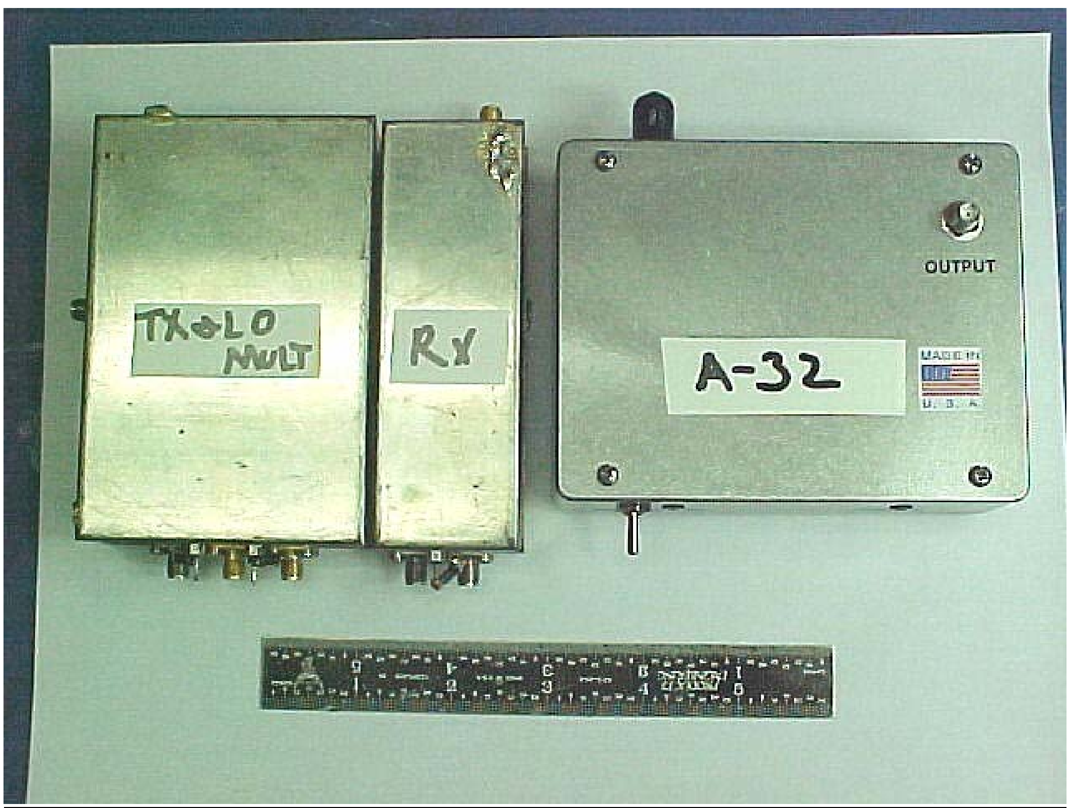


Figure 3. The 2556 Multiplier Stage

The Wilkerson power divider after the new multiplier stage helps attenuate the fundamental 1278 MHz. signal and is designed to promote the 2556 MHz signal passage. All other harmonics that squeeze through are filtered out of the TX stages and levels wind up being as originally specified.

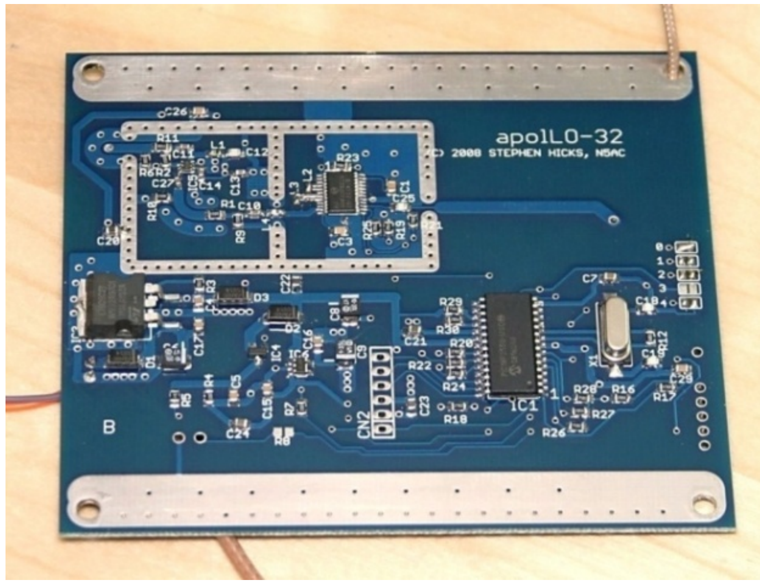
On the receive side, the 2556 MHz signal after the power divider is amplified, then filtered before it enters the mixer. I attempted to re-tune the filters in both modules for better performance but did not yield any noticeable improvement. The A-32 in this case is a simple and quick fix to produce a frequency stabile and accurate 10 GHz transverter locked to a 10 MHz. source ready for action.

As always, the G3WDG transverter would benefit an additional LNA RX amplifier to improve the system noise figure and the addition of a power amplifier to provide some help. But even in its “New” stock form, it makes an excellent portable unit again with a lot less frustration of the past performance. One recommendation that I suggested before was to replace the variable potentiometers in the bias circuits with either newer sealed units or fixed resistors. The open frame units have oxidized, are difficult to adjust and are sensitive to vibration. They are the most unreliable components in the units. I still have the original GaAs FETs in mine and see no reason for replacement. This transverter is documented in many publications so bias information is available along with data for testing. The complete “New” setup is pictured below. The original LO was the same size as the RX unit, so except for a size increase of the system, The overall performance has been improved.



A complete 10 GHz Transverter

CONCLUSION:



This was only one example of how to upgrade a labeled "Obsolete" transverter by today's standards and what can be done with the A-32 synthesizer. There are many "older design" transverters that can benefit from an upgrade as described here in this paper. Most have sound RF sections that may only need the help of a LNA or power amplifier. The A-32 can provide many frequencies that are steady and frequency stable. The A-32 can also be the basis for a multiband transverter design, such as other transverters based on the G3WDG 2556 MHz LO or installing a multiband switch to change frequencies on the fly in your own design! Or you can just replace an old LO that operated at almost any multiplier scheme in your homebrew gear. Most of all, if the RF stuff is working in your "Old Friend", give 'em a Visit and spruce 'em up a bit! You may find it fun and have the desire to make a contact or two and find out how good the old stuff was compared to what is available now. Then again, maybe just provide someone a new band from something that was just sitting around being nostalgic in your shack. Whatever the reason, check out all of the possible frequency applications and watch the list for updates of other frequencies as we find a use for them in the future.

Have fun and catch you on the bands!

73,
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