GARS

Glenn Amateur Radio Society

KJ6HCG

Prez Says **_The GARS Repeater_** November 2024

Salutations from the lair of KF6OBI! – The month of October was full of surprises. I know that last month I told you that it was going to be busy but it turned out that the business planned turned in to something else. Marlene and I have Emily, our oldest daughter back home to take care of her and follow up on her medical care. We have been doing a couple of trips to Chico for her, and Marlene's doctors visits every week. As for the month of November, I have not locked in any new plans or activities as my calendar changes daily.

In the meantime I have been getting ready for winter and most of that work is completed as I write this. What is left can be done between rain and wind events. There is at least one more trip up to the Saint John site to winterize it and to hopefully reinstall the Outback AXS port. I have things just about ready to test the Outback inverter which will power up the AXS port so I can connect directly to it with my laptop. The hope is that I will be able to correct anything wrong in the setup and to also be able to update the firmware if needed.

Remember on the 8th of October I had reset the Rigrunner before leaving the site. Well it ran for 17 days this time with not a problem then on the 26th of October the web interface stopped working again. During this time I was in communication with West Mountain Radio and they were asking questions. On the last attempt to communicate with them, the 26th of October, they have not replied. Hum… sometimes customer support is good and sometimes it is not!

So I have a direct current power relay and a control relay on there way. The power relay will be controlled by the smaller control relay which will have its coil connected to the LAN. This, when connected up, will allow the remote ability to turn on the Power over Ethernet (PoE) on the LAN port it is connected to thus closing its normally open contact applying DC power to the main DC power relay coil thus opening its normally closed contacts removing the main DC power to the Rigrunner. When the PoE is turned off the control and power relays states will reverse to their non-energized states thus applying DC power back to the Rigrunner. This in theory should restore the Rigrunner web interface for an unknown period of time. I hope to have this auxiliary control system installed this month.

So another project is now on the drafting board; that of designing a similar device to the Rigrunner. It may not have a beautiful web interface but it will work just as well.

The good news is that all the solar panel work is complete and in service. Will we be adding more solar capacity? Yes, we may have to depending on how we redesign the 24/48 VDC power system to accommodate LiFePO4 (Lithium) batteries. The membership will entertain this discussion starting this months meeting.

I have not had time to revisit the EMI/RFI issues but plan on getting back on that horse within the next two weeks.

Reminders: Dues are due; if you have not paid yet, please consider doing so soon. Nominations for President, Secretary, and Treasure, plus one board are up for renewal. Voting to be conducted this membership meeting.

Up and coming events are: **–See notices are on the GARS Website <https://www.garshamradio.org/>; Winter Field day 25-26 January 2025 at the Spurlock Ranch.**

This months membership meeting will be on the second Friday, the 8th of November, at the Lutheran Fellowship Hall, 565 Main Street, Artois CA, at 7:00pm. Late arrivals and guests are always welcome. Also remember that one does not have to be a member of the club to participate in our membership meetings and activities. Be safe in all you do and may you all have many blessings in the days and months ahead!

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Types Of Dc To Ac Converters

To convert DC to AC power, a DC to AC converter utilizes an H-Bridge circuit to alter the one-way flow of DC power into the alternating flow of AC. The converter consists of an amplifier, transistor, and oscillator, with the oscillator generating a 50Hz square wave signal for the AC supply frequency.

Discover more in ‘The Complete DC to AC Converter Guide’.

Square Wave Inverters: Working Principle And Applications

- Square wave inverters are a type of DC to AC converter that produce an output waveform resembling a square wave.
- They work by rapidly switching the DC input voltage on and off to create alternating current.
- This type of inverter is commonly used in low-power applications such as powering small electronic devices like laptops, smartphones, and lights.
- However, square wave inverters are not suitable for sensitive equipment that requires a pure sine wave output, as they can introduce harmonics and distortions into the electrical system.

Modified Sine Wave Inverters: Advantages And Disadvantages

- Modified sine wave inverters are another type of DC to AC converter that produce an output waveform similar to a sine wave but with some distortion.
- These inverters use a more complex switching technique to create an approximation of a sine wave.
- One advantage of modified sine wave inverters is that they are more cost-effective compared to pure sine wave inverters.
- However, they may not be compatible with certain devices that have sensitive electronics or motors. Some equipment may not operate efficiently or may even get damaged when powered by a modified sine wave inverter.

Pure Sine Wave Inverters: Superior Power Quality And Usage Scenarios

- Pure sine wave inverters produce a smooth and consistent waveform that replicates the AC power provided by the utility grid.
- They offer high-quality power with low total harmonic distortion (THD) and are suitable for all types of electronic devices and appliances.
- Pure sine wave inverters are commonly used in applications such as RVs, boats, solar power systems, medical equipment, and sensitive electronics.
- These inverters provide a stable and clean power supply, ensuring optimal performance and longevity for connected devices.

Modular AC line EMI filters explained

Posted by doEEEt Media Group On December 16, 2020

Matching modular EMI AC line filters to DC supply needs is explained in EDN article by Gary Bocock, technical director at XP Power.

For AC mains-powered equipment, it’s common practice to use a modular AC line filter fitted either integral to a connector or as a chassis mount part, particularly in professional environments such as industrial, healthcare, and ITE. The equipment typically includes an embedded AC-DC converter, or power supply, which might also be chassis-mount or sometimes rackor PCB-mounted. In each case, the power supply will invariably meet the statutory requirements for emissions as a stand-alone part, typically EN55011/EN55032 for conducted and radiated interference. But additional filtering may still be necessary.

Seasoned equipment designers have long known that an EMC compliance ‘pass’ on an end-product is not guaranteed by simply using compliant components. The reasons are various. Compliance tests on an equipment AC-DC converter, for example, are performed under very specific conditions of assumed AC line impedance, output loading, length and routing of cables, and position of the part with respect to ground. When an end product is tested with this AC-DC converter fitted internally, all of these conditions vary, leading to a different and often worse conducted EMI signature. Radiated EMI from other components can also be picked up on power cabling, adding to conducted levels.

Modular filters can enable system EMI compliance

An external modular filter can be the solution but, with hundreds to choose from, which is optimum? Let’s first look at the internal circuit of a typical commercial filter and consider how each component contributes (**Figure 1**).

Capacitor CX attenuates differential mode noise, signals, and spikes that appear from line to neutral created by rapid changes in current within the converter. Capacitors will be rated as X1, X2, or X3 for their ability to withstand voltage transients on the AC line.

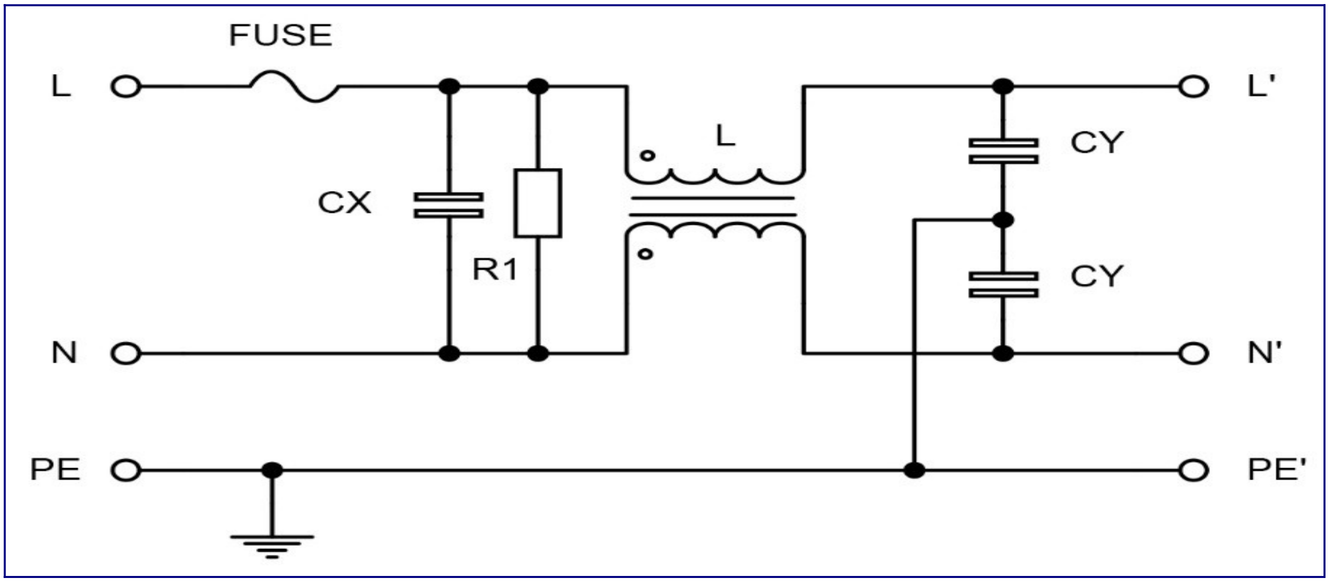

Figure 1 This typical modular EMI filter uses the CX capacitors to attenuate differential mode noise, and an inductor-capacitor combination to reduce common mode noise.

Inductor L is a common mode or current compensated choke with two windings phased as shown. Common mode noise, created by rapid changes in voltage within the converter, from line and neutral to ground see the choke as a high impedance, with each CY capacitor diverting noise current to ground. The normal-running current through the two windings on the choke cause field cancellation in the core so that high inductance values can be used without fear of magnetic saturation. Often, L is wound with less-than-perfect coupling between the windings so that some leakage inductance is created, appearing as a separate series inductance which increases differential mode attenuation.

While CX can be any capacitance value within practical limits, the two CY values are limited by earth leakage current requirements. They are available in Y1, Y2, Y3, and Y4 types with decreasing rated operating and transient voltages. Leakage current through the Y capacitors is a potential problem as they bridge a safety barrier – line and neutral to ground. If the protective ground connection to equipment metalwork fails, the casing ‘floats’ up to line voltage through a Y capacitor and could cause an electric shock. These Y capacitor values are therefore limited to allow no more than a prescribed current to flow through the casing, an amount set by the standard used for the specific application environment. Limits can vary from tens of milliamps in industrial systems down to less than 10µA in cardiac floating healthcare applications.

Resistor R1 is a high value resistor, typically 1M ohm, there to discharge CX if the AC supply is abruptly removed and the load cannot be relied upon to drain that charge away, leaving a potentially dangerous voltage on the AC connector pins. Standards such as IEC 62368-1 for ITE and media equipment safety dictate that R1 should discharge the capacitor to less than 60V after two seconds for CX > 300nF (nano farad), with higher voltages allowed for CX < 300nF. Similarly, for equipment only accessible to trained personnel, the allowed voltage limits are higher.

Other standards are different, though. IEC 60601-1 for medical equipment, for example, requires discharge to less than 60V after one second but there is no requirement if CX is less than 100nF. Standards such as IEC 62368-1 also put requirements on the resistor to withstand transient voltages with no more than 10% deviation in resistance if the resistor is fitted before a fuse. Resistor R1 will therefore be a high specification part. In some applications, the power dissipated in R1 under normal conditions can limit its opportunity to be in compliance with limits for standby or no-load losses specified by bodies such as the US Department of Energy (DoE) and the European ErP directive.

The fuse shown in Figure 1 can be included in modular filters, particularly panel mount types such as the popular IEC320-C14 type (**Figure 2**).

Figure 2 Fused panel mount EMI filters such as this IEC320-C14 are popular modular filter options.

In commercial applications, a single fuse in the line is normal. If the fuse element is compliant with standards, it eases the specifications of downstream components such as R1 as mentioned. Some applications, such as medical devices and class II IT, require both line and neutral to be fused to cover the possibility of accidental connection reversal. A connection reversal, in a single fuse situation, would leave the live line unfused and reliant on upstream fuses or breakers in the supply opening when a short from live to protective earth occurs. But these upstream devices may be rated at a high current value to protect wiring for multiple loads and would not be guaranteed to open quickly for an equipment fault, potentially allowing a fire hazard. Double fusing does have the disadvantage, however, that a line to neutral over-current could open just the neutral fuse, leaving the equipment apparently dead but still with live connections inside.

Selecting the filter

The filter's mechanical format is a natural starting point for the selection process. Mechanical variants are available as IEC inlets with a screw or snap-in mounting with options for a switch and none, one, or two fuses, according to the application requirement. IEC inlet types are rated to 10A for C14 and 16A for C20, with chassis mount parts available to 20A and higher. Chassis mount filters, which typically have 6-sided shielding along with a direct fixing to conductive grounded metalwork, offer very effective EMI attenuation.

For all types, medical versions are available, which omit the Y capacitors to reduce leakage current to typically 5 µA maximum. This omission necessarily means that common mode attenuation is reduced and may need to be compensated for elsewhere, such as by cascading filters.

A filter's rated current need can be easily calculated from the load power requirements given the lowest input voltage and load power factor. For example, a load on the filter that takes 200 W with a power factor of 0.9 at 90 VAC would draw a current of 200 W/ (0.9 x 90 VAC) = 2.47A. In this case, a 3A-rated filter may be chosen.

Choosing the attenuation required from a filter is best done by measuring system performance without a filter fitted, then calculating what extra is needed from an external filter to meet specifications. Attenuation curves in filter data sheets will give an indication of filter performance but bear in mind that the data sheet performance is under specified test conditions, typically 50-ohm source and load impedance. Although the AC source can be standardized with the use of a line impedance stabilizer network (LISN), the application load is likely to be very different from the data sheet's test conditions.

A filter module cascaded with the internal filter in AC-DC power supplies can also cause unexpected results, with potential resonances occurring that can even cause amplification of EMI at critical frequencies. As an example, an EMI plot was taken from a typical AC-DC converter from XP Power, part PBR500PS12B, run at 230 VAC and 180 W shown in **Figure 3**. The plot shows good compliance with the EN 55032 curve B emissions limit line for quasi-peak detection. A filter was then inserted in the AC line, the XP Power FCSS06SFR, with the resulting attenuation characteristics shown in **Figure 4**. The dotted line is differential mode and the solid line common-mode attenuation. The overall combined result is given in **Figure 5**.

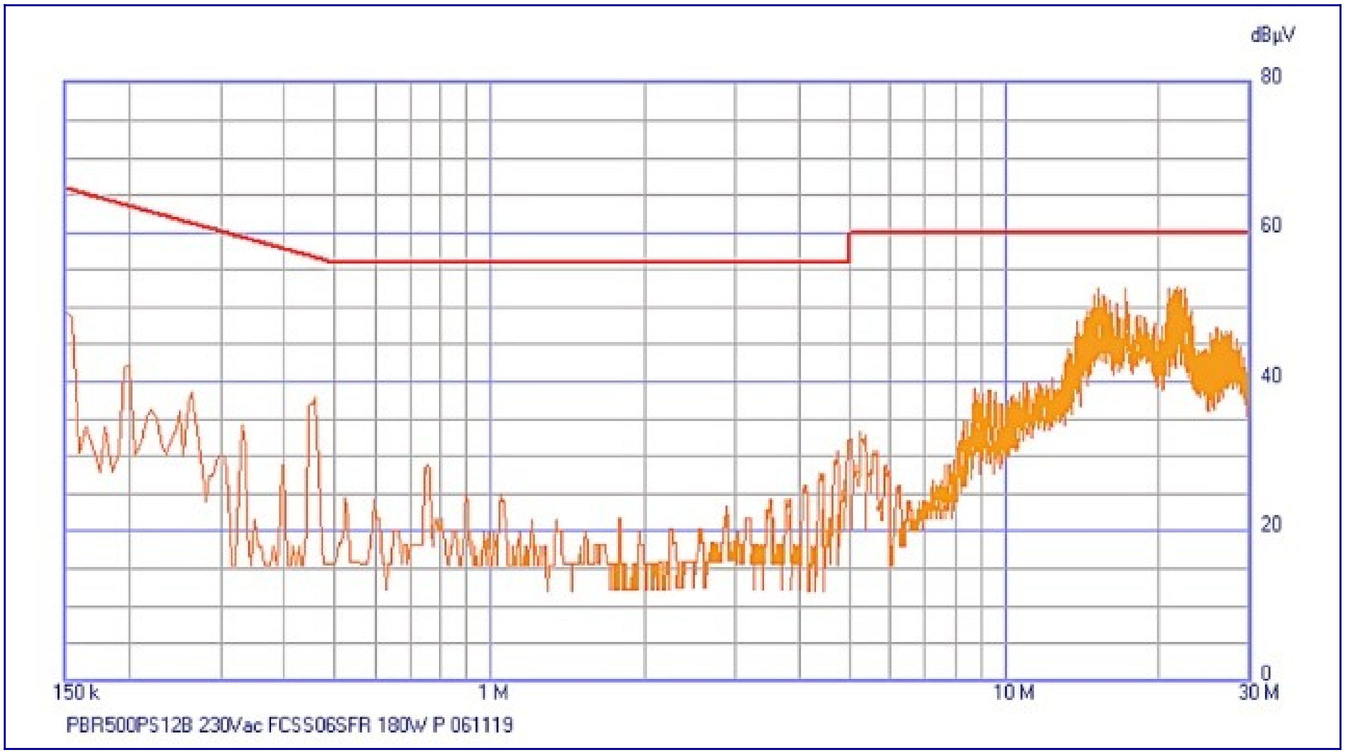

Figure 3 This EMI plot for an AC-DC power supply with internal filter shows good compliance with the emission limits.

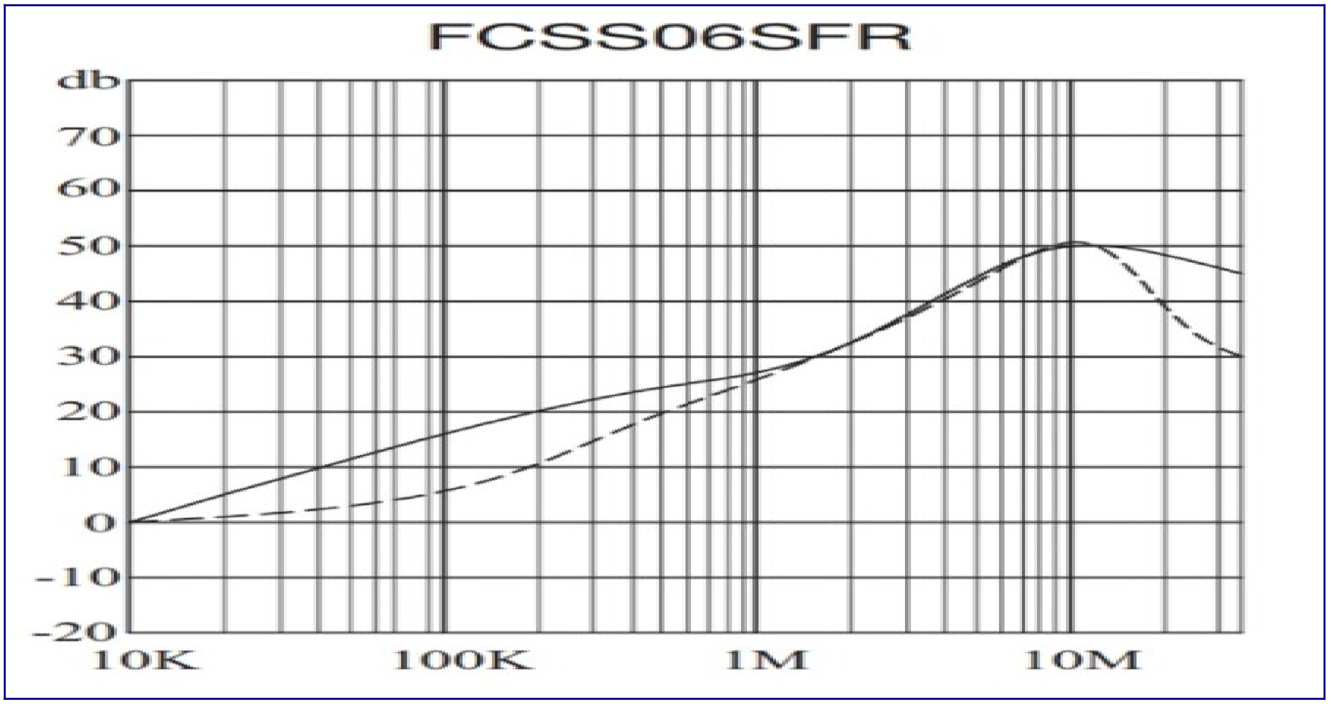

Figure 4 The EMI plot for modular filter type XP FCSS06SFR shows differential and common mode attenuation.

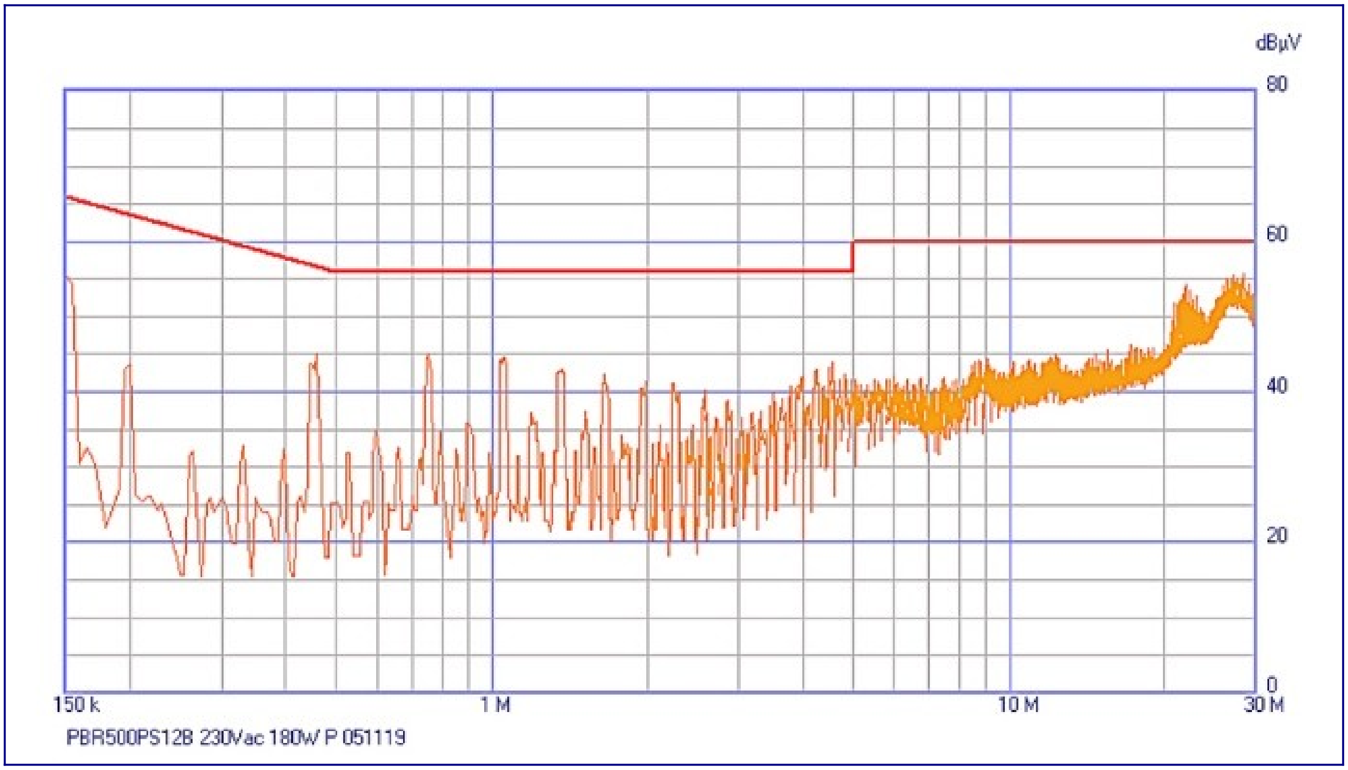

Figure 5 The AC-DC power supply of Figure 3 with external filter of Figure 4 added shows less total attenuation above 10 MHz than might be expected, demonstrating the need for confirmation measurements.

It can be seen that up to around 1 MHz, the filter attenuation drops emissions by the expected amount, but at 10 MHz and above, the improvement is not in line with expectations, signifying that the modular filter is not 'seeing' 50 ohms as a termination at these frequencies. It is giving lower attenuation than might be expected. This result confirms the necessity to make practical measurements to confirm compliance.

GARS Officers: (Board of Directors)

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Radio Officer …………… Phil Zabell, KI6SMN
Emcomm Officer ………. Vacant

Board Meeting, 2nd Wednesday of each month, meetings starting at 6:30 PM via Google Meets
General Membership Meeting, 2nd Friday of each month, meetings starting at 7:00 PM

GARS Meeting locations: Main site is the Lutheran Fellowship Hall, 565 Main Street, Artois CA, our alternate meeting site is the Willows Seventh-Day Adventist Church, 543 1st Avenue, Willows, CA.

GARS Net: Mondays, 8:00 PM Primary: 147.105 (N6YCK) (+) 110.9 PL; Secondary: 145.170 (AF6OA) (-) 110.9 PL

GEARS Club Net: Tuesday, 7:30 PM 146.850 MHz-PL 110.9

Sacramento Valley Traffic Net: Nightly 9:00 PM 146.850 MHz-PL 110.9

ARES Nets:
Butte Mondays 20:00 146.850 MHz-PL 110.9
Yuba Sutter Thursdays 19:00 146.085+MHz PL 127.3

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Editor ……………...…….. Michael A. Ellithorp, KF6OBI **Distribution—via email—monthly**