



## This Issue's Feature

### *We are going to Jupiter!*

*(From Dr. Snyder's letter to all Employees August 2008)*

RS Microwave has been selected to provide filters for use in a sensitive receiver, in a spacecraft shortly to be heading for Jupiter!

The program is called Juno (after the Greek Goddess wife of Jupiter), and the launch is scheduled for 2011. The spacecraft should arrive at Jupiter in 2016 then serve to gather data from the King of Planets for about 5 years. We will be building the filters for the next six months or so, and putting them through an extraordinarily difficult series of tests.

For those of you wishing to learn more about the program, please go to <http://juno.wisc.edu/spacecraft.html>, and look at the Microwave Radiometer, that is the instrument containing our filters.

This is a very important program to RS Microwave, but it is even more important to the people of the Earth, as we gather this data regarding the largest planet in our Solar System.

I am very proud of our efforts on the program to date (we have already provided non-space filters, for use in the preliminary tests). It is now very important for each person that has anything to do with this work (and many of you will) to ensure that our work is perfect so that our filters survive the trip, performing at their maximum potential, in the violent and difficult environment found near the great planet.

I offer my congratulations to each and every person in the company for their support and effort, and ask that we all make even greater efforts to help this program succeed.

## Our Latest Technical Developments

### *"The Next Generation of Notch Filters"*

That is what is described in our latest technical article written for our website (<http://www.rsmicro.com/TECHORN.HTM>). Entitled "Improving Temperature Stability of Resonators", a portion of the article is excerpted herebelow. It discusses the technique we have developed to satisfy the interference-rejection requirements of the most advanced systems communication systems, to be carried by the newest high-performance aircraft.

One of the problems with narrow filters is temperature stability, coupled with the need to achieve small size. Our latest Patent Applied For Composite Resonator design is the newest stage in the continuing development of ever smaller and better notch filters produced by RS Microwave. The article which follows describes exactly how we have achieved this milestone.

### *Improving Temperature Stability of Resonators*

The temperature stability of narrow-band filters that are based on coaxial resonators is a serious problem. The passband of a bandpass filter or the notch band for a band reject filter are usually specified with performance requirements that do not allow for much drift in the frequency domain. There have been many solutions to this problem over the years, but all have had shortcomings or have traded size and weight against stability.

For example, the filters can be constructed using metal enclosures with very low temperature coefficients of expansion, such as Invar. This is a nickel-steel that has about six times the weight per volume of aluminum based structures,

*(cont'd p.2)*

## Company News

*Dr. Snyder is awarded IEEE's William Terry Distinguished Lifetime Service Award*



At a ceremony and dinner held in May, Dr. Snyder was awarded one of IEEE's highest honors, for a lifetime of sustained, dedicated, and wide-ranging service to his profession while his proud wife and daughter looked on.

Dr. Snyder currently serves IEEE's MTT-S (Microwave Theory and Techniques Society), an important technical branch of IEEE. He is an elected member of its ADCOM, the administrative arm of the society. He also serves as Chair of the MTT-S Technical Coordinating Committee, as well as being its Standards Coordinating Committee chair. Within the North Jersey Section of the IEEE, he also chairs the Electron Device Society and Circuits and Systems Society Chapters.

Our own Dr. Snyder is at the forefront of all the new developments in Microwave theory. For the upcoming 2009 MTT International Symposium to be held in Boston, he has initiated a panel debate between the proponents of the phrase and technology known as "metamaterials" and the filter and network experts. They will be disputing both the usage and the technology on the subject of "Harry Potter type" invisibility. Dr. Snyder is the lead for the filters and networks side of the debate. This historic panel discussion will be covered by the media including Science, Nature, NY Times, and Boston Globe. Stay Tuned! [No filter pun intended]

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## RS Technical Developments

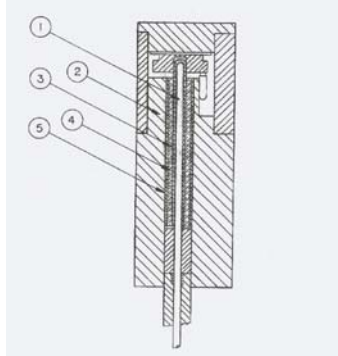
(cont'd from p.1)

but about one-sixth the thermal coefficient of expansion (TCE), and thus essentially solves drift with a significant penalty of weight. Many filters employ resonators supported with dielectric material, either to provide some loading capacitance or simply to support the resonator such that vibration and shock are not a problem. However, the dielectric material also has a significant TCE and frequently contributes to the filter drift problem.

It is possible to construct filters using dielectric materials that have very low TCE and avoid the drift. The cost in these cases is typically limited bandwidth performance, either narrow passband or narrow stopband, because of higher order modes that are more readily supported by the dielectric material. In these cases, the enclosures can be lightweight aluminum, so no weight penalty is imposed...but the limited frequency domain performance is not always acceptable.

RS Microwave has recently developed a new approach to resonator design, called "Composite Resonators" (**Patent Applied For**). Coaxial resonators consist of an inner conductor and an outer conductor, separated by a composite dielectric structure consisting of three layers: an inner layer of soft dielectric, acting as a cushion; a second layer of higher dielectric constant, low-loss material such as alumina, acting to provide the main dielectric support; and finally, an outer layer of soft dielectric, again acting as a cushion. The coaxial line resonator is either shorted, open circuited, capacitively coupled to the next resonator, or some combination, based on the particular filter design intended. The effective dielectric constant ( $\epsilon_r$ ) between the inner and outer conductor determines the electrical length of the resonator, and with proper selection of layer materials and thicknesses, is typically in the range of  $\epsilon_r=5$  to 7. The temperature stability of the resonator is primarily determined by the relatively thick second layer of high dielectric constant material, and is very close to what might be obtained using the

heavy steel (Invar) for the entire structure. Fig. 1 illustrates the new resonator design.



**Fig. 1 Temperature stable resonator**

Item 1: Inner conductor

Item 2: Outer conductor

Item 3: Inner soft dielectric layer

Item 4: Second layer, higher dielectric constant, temperature stable material

Item 5: Outer soft dielectric layer

The new resonator design has been applied to several existing filter applications, to establish the temperature stability and ability of the composite structure to withstand significant shock goals! The initial applications have been and vibration. Extensive testing has shown the resonator to achieve the both to notch filters with stopbands in the L-band area. There are two basic reasons (called Case 1 and Case 2) to employ the new composite approach:

1. Improved performance, maintaining form, fit and function. (Case 1);
2. Size reduction, maintaining original performance. (Case 2).

To read the rest of the article please refer to it, in its entirety, on our website at <http://www.rsmicro.com/TECHORN.HTM>

## Personnel News

**Look who joined us in 2008!**



Welcome to Steve and Tim!

The newest members of our Assembly/Technician teams are Steve Shenickey and Tim Capone. We welcome them, again formally, and wish them a long association with RS!

## CONGRATULATIONS TO OUR NEWEST CITIZEN!

Alba Valdivia has successfully passed the test! She was sworn in as a citizen of the United States on March 31.

## IN OUR EMPLOYEES' FAMILIES

The RS employee family has a new baby! Liljana and Harry welcomed their son, Sam, into the world on July 17, weighing in at 8.4 lbs and 21 inches long!

Rosa and Mary also became grandmothers to baby boys. Rosa's little one visited his grandma all the way from his home in Australia! Mary's grandson is a premie and we wish them all well!

## Photo Gallery



Baby Sam Raupp

## RS Products In Brief

### Filters - 1 MHz to 40 GHz

High Power - Low Loss

Blind-Mate - Drop In

Dielectric Resonator

Notch Filters

Coax or Waveguide

Tunable, Higher Order Mode

### Multiplexers - 1 MHz to 40 GHz

Contiguous

Non - Contiguous

Switched

### Subsystems - 1 MHz to 20 GHz

Combinations, including:

Filters

Circulators

Amplifiers and Switches

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