Several key solutions are addressed in this work to solve the fabrication issues. The source/drain contact is developed using droplets of silver ink printed on the source/drain areas prior to applying CNT thin-film. The wet silver ink droplets allow the silver to "wet" the CNT thin-film area and enable good contact with the source and drain contact after annealing. A passivation layer to protect the device channel is developed by bonding a thin Kapton film on top of the device channel. This film is also used as the media for transferring the aligned CNT thin-film on the device substrate.

A simple and cost-effective technique to form multilayer metal interconnections on flexible substrate is developed and demonstrated. Contact vias are formed on the second substrate prior to bonding on the first substrate. Inkjet printing is used to fill the silver ink into the via structure. The printed silver ink penetrates through the vias to contact with the contact pads on the bottom layer. It is then annealed to form a good connection. One-dimensional and two-dimensional PAAs were fabricated and characterized. In these circuits, multilayer metal interconnects were used to make a complete PAA system.

This work was done by Harish Subbaraman of Omega Optics, Inc., Ray T. Chen of the University of Texas at Austin, Xuejun Lu of University of Massachusetts – Lowell, and Maggie Yihong Chen of Texas State University for Glenn Research Center. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steven Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-19035-1.

Battery Charge Equalizer with Transformer Array

Lyndon B. Johnson Space Center, Houston, Texas

High-power batteries generally consist of a series connection of many cells or cell banks. In order to maintain high performance over battery life, it is desirable to keep the state of charge of all the cell banks equal. A method provides individual charging for battery cells in a large, high-voltage battery array with a minimum number of transformers while maintaining reasonable efficiency. This is designed to augment a simple high-current charger that supplies the main charge energy.

The innovation will form part of a larger battery charge system. It consists of a transformer array connected to the battery array through rectification and filtering circuits. The transformer array is connected to a drive circuit and a timing and control circuit that allow individual battery cells or cell banks to be charged. The timing circuit and control circuit connect to a charge controller that uses battery instrumentation to determine which battery bank to charge. It is important to note that the innovation can charge an individual cell bank at the same time that the main battery charger is charging the high-voltage battery.

The fact that the battery cell banks are at a non-zero voltage, and that they are all at similar voltages, can be used to allow charging of individual cell banks. A set of transformers can be connected with secondary windings in series to make weighted sums of the voltages on the primaries.

This work was done by Francis Davies of Johnson Space Center. Further information is contained in a TSP (see page 1).

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Johnson Space Center, (281) 483-1003. Refer to MSC-25026-1.

An Efficient, Highly Flexible Multi-Channel Digital Downconverter Architecture

This technology can be used for any digital recording device that requires a flexible way to break a large input bandwidth into many smaller channels.

NASA's Jet Propulsion Laboratory, Pasadena, California

In this innovation, a digital downconverter has been created that produces a large (16 or greater) number of output channels of smaller bandwidths. Additionally, this design has the flexibility to tune each channel independently to anywhere in the input bandwidth to cover a wide range of output bandwidths (from 32 MHz down to 1 kHz). Both the flexibility in channel frequency selection and the more than four orders of magnitude range in output bandwidths (decimation rates from 32 to 640,000) presented significant challenges to be solved.

The solution involved breaking the digital downconversion process into a two-stage process. The first stage is a 2× oversampled filter bank that divides the whole input bandwidth as a real input signal into seven overlapping, contiguous channels represented with complex samples. Using the symmetry of the sine and cosine functions in a similar way to that of an FFT (fast Fourier transform), this downconversion is very efficient and gives seven channels fixed in frequency. An arbitrary number of smaller bandwidth channels can be formed from second-stage downconverters placed after the first stage of downconversion.

Because of the overlapping of the first stage, there is no gap in coverage of the entire input bandwidth. The input to any of the second-stage downconverting channels has a multiplexer that chooses one of the seven wideband channels from the first stage. These second-stage