QuadTech

Application Note

25 Patents Reference Digibridge

Do a patent search on http://www.uspto.gov/ using the keyword GenRad Digibridge and you'll find there are 25 U.S. patents that reference this highly accurate instrument. Introduced in 1982, the GenRad (now QuadTech) Digibridge instrument offered manufacturers a precise, multi-frequency, microprocessor based, high performance passive component tester. It is still sold today attesting to its enduring quality and durability. The Digibridge product line consisting of the 1657, 1659, 1689, 1689M, 1692 and 1693 models is used around the globe in incoming inspection, material R&D testing, component production lines and calibration laboratories.

Table 1: 25 Patents referencing GenRad Digibridge

Item #	U.S. Patent #	Date	Title
1	6268100	07-31-2001	Carrier particles with halosilanated pigments
2	6232019	05-15-2001	Gel electrolytes for electrochromic and electrochemical devices
3	6187083	02-13-2001	Conductive inks containing sulfonate salts
4	6180311	01-30-2001	Carrier particles with halosilanated pigments
5	6180226	01-30-2001	Method of forming a monolayer of particles and products formed thereby
6	6176909	01-23-1001	Conductive inks containing pyridine compounds
7	6149857	11-21-2000	Method of making films and coatings having anisotropic conductive pathways therein
8	6117223	09-12-2000	Hot melt inks containing polyketones
9	6113678	09-05-2000	Hot melt inks containing polyanhydrides
10	6110399	08-29-2000	Method of making films and coatings having anisotropic conductive pathways and bonds between two sets of conductors
11	6106599	08-22-2000	Inks
12	6096125	08-01-2000	Ink compositions
13	6096124	08-01-2000	Ink compositions
14	6004500	12-21-1999	Methods for producing novel ceramic composites
15	5976418	11-02-1999	Conducting compositions
16	5935408	08-10-1999	Electrolyte for anodizing valve metals
17	5916641	06-29-1999	Method of forming a monolayer of particles
18	5907240	05-25-1999	Method and apparatus for cell differentiation by measuring apparent cell size, membrane integrity and intracellular complexity
19	5851644	12-22-1998	Films and coatings having anisotropic conductive pathways therein
20	5837121	11-17-1998	Method for anodizing valve metals
21	5818149	10-06-1998	Ceramic composites and methods for producing same
22	5769996	06-23-1998	Compositions and methods for providing anisotropic conductive pathways and bonds between two sets of conductors
23	5670250	09-23-1997	Circuit board prepreg with reduced dielectric constant
24	5630919	05-20-1997	Electrode for conductivity cells comprising high surface area metal foil
25	5484675	01-16-1996	Toner compositions with halosilanated pigments

Applications of the QuadTech Digibridge

Investigating the contents of these patents, one determines that the Digibridge is used in quite scientific applications. The language entailed in the full text of these patents begets the sharpest of scientists with the exception of those directly involved in the test process. The Digibridge is employed in the testing and analysis of inks, films & coatings, ceramic composites, valve metals and cell membranes.

Ink & Toner Compositions

In the process of preparing toner pigments, the carrier particles of the ink compounds have to be analyzed for specific properties. Fluorosilinated pigments have increased negative charging compared to an untreated pigment. This charging permits the varying of toner pigment (color) without affecting the toner charge thereby making the construction of printers and copiers that use more than one color toner a lot simpler. The 1689 Digibridge is used to test the resistivity of fluorosilane treated and untreated carbon black samples. The resistance of the 0.1gram carbon black sample is measured in ohms then the resistivity of the carbon blacks is calculated from the measured resistance. Of interest to the toner manufacturer is the conductivity (inverse of calculated resistivity) of the carbon black. To use the carbon black as a carrier coating a high (0.1S) conductivity is preferred.

Films & Coatings

Films and coatings used for bonding conductors in the electronics industry are another substrate tested using the 1689 Digibridge. These films and coatings have anisotropic conductive pathways, those that conduct electricity in one direction (Z) only and eliminate conduction of electricity in the perpendicular plane (X and Y). These anisotropically conductive adhesives are then of great use in connecting semiconductor chips and electronic components to boards to eliminate unintentional electronic cross talk. Pretty cool glue, huh? The 1689 Digibridge is used to measure the contact resistance of the conductive particle-loaded primary-cured epoxy solid coating sandwiched between two conductive plates.

Ceramic Composites

Ceramic and unique composites contain combinations of ceramics, metals, glass and/or polymers and are of significant use in the field of transducers. A piezoelectric ceramic-polymer composite is a polarizable phase in a non-polarizable material. Three advantages of this are: 1) low density (acoustic impedance close to that of the human body); 2) low dielectric constant (therefore a high piezoelectric voltage constant); and 3) ease of material conformability (such that it can be shaped to custom fit the application). The 1689 Digibridge is used to measure the capacitance and dielectric loss factor (tan δ) at 1kHz of a fully formed and cured composite specimen. In this application the user calculates the dielectric constant (K) with the mathematical relation:

K = Cd/.di-elect const..suboA.

d = specimen thickness

A = total electrode area

.di-elect const..sobo = permitivity of free space (8.85×10^{-12} Farads/meter)

K = Cd/($8.8.5 \times 10^{-12}$ Farads/meter)(A)

Applications of the QuadTech Digibridge

Valve Metals

A valve metal is one that forms an electrically insulating oxide film when placed in an electrolytic solution (anodized). Aluminum, tantalum, titanium, zirconium and silicon are valve metals used in film applications like electrolytic capacitors, rectifiers and lightning arrestors. In some applications the anodic film replaces normal electrical insulation as in specialized transformers, motors and relays. If biased positive in the correct electrolytic solution, tantalum (for example) becomes coated with a dielectric film of uniform thickness. This constant dielectric thickness plus the resultant voltage, temperature and current density characteristics allow manufacturers of electrolytic capacitors to produce components for specific voltage and capacitance requirements. The 1692 Digibridge is used to test the capacitance of the anodized film of a tantalum sample at 100Hz. To form the test circuit, the Digibridge is connected with a 600ml beaker equipped with a very high surface area tantalum cathode in 20wt.% nitric acid. The result: C=4.34uF; $1cm^2$ = 0.62uF @ 95V, 85°C; Thickness = CV = 58.9uF volts/cm^2. A high dielectric constant and low film thickness/volt maximize capacitance/surface area of the valve metal at a given anodizing voltage.

Cell Membranes

A very different application of the Digibridge is in the field of hematology analysis wherein cells need to be differentiated in terms of their size (volume), membrane integrity and intracellular complexity (called “voltaic fragility”). In order to obtain this information, cells are suspended in an electrolytic solution. An altering agent is then introduced into the solution to force the cells to separate. A DC voltage is applied across the opening of the container to produce an electric field within and around that opening. The change in current is monitored in response to cell differentiation and a signal is generated (from an amplifier indicative) of the cell’s size and internal structure. The pulse height is indicative of the cell size and the pulse width is indicative of the transit time of a cell within the electric field. The 1657 Digibridge is used to determine the resistance across and current flowing through the ‘opening’ by employing the 4-wire (Kelvin) impedance measurement technique. The current is determined by the setting of a controllable current source. The product of the measured current and resistance determines the applied voltage. Monitoring a change in voltage allows the scientist to differentiate the cell’s activity.

Although these particular applications of the Digibridge seem highly scientific, it’s function is really the basic measurement of impedance parameters. The scientist is then able to utilize these very precise values in determining the electrical characteristics of his own material, component or product.

For complete product specifications on the 1600, 1900 or 7000 Series of precision LCR meters or any of QuadTech’s products, visit us at http://www.quadtech.com/products. Do you have an application specific testing need? Call us at 1-800-253-1230 or email engineering at rroetzer@quadtech.com and we’ll work with you on a custom solution. Put QuadTech to the test because we’re committed to solving your testing requirements.

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