The AMA History Project Presents:
Biography of
DOUGLAS (DOUG) CARDER SPRENG

February 7, 1932 – April 19, 2010

Written & Submitted by JRA (9/2002), Transcribed & Edited by SS (2/2003), Updated by JS (10/2008), Reformatted by JS (02/2010)

Career:

- Helped develop a "hard tube" (1AG4), super regen single-channel receiver
- 1960: Designed his famous Stormer pattern model; it was pattern champion at that year's AMA Nats
- 1962: Developed the concept of a digital proportional radio system; he named it the Digicon proportional system
- 1966: Won a place on the AMA international team using his Thunderstormer model; placed third in Corsica at the international competition
- Late-1960s: Designed and built the Spreng-Brook Radio Control system sold mainly in the United Kingdom
- 1970-1976: Developed the IC servo amplifier, a two-channel glider Radio Control unit and the Kraft Signature Series Radio Control units while working for Kraft Systems
- Mid-1970s: Published some construction articles in Radio Control Modeler magazine

Honors:

- 1976: Vintage Radio Control Society Hall of Fame
- 1976: Howard McEntee Award
- 2003: Model Aviation Hall of Fame

Digital Proportional Radio Control – The Beginning

By Jack R. Albrecht

Everyone now takes for granted our current highly reliable digital proportional Radio Control systems. So how did we get where we are today? We will have to go back some 47 years and start from the beginning. Doug Spreng started flying Radio Control using a gas tube super-regenerative receiver and escapement in 1955. He worked for Babcock Engineering Inc. for a while and helped develop a "hard tube" (1AG4), super regen single-channel receiver.

I first met Doug in 1956 when stationed with the U.S. Army in Los Angeles, while flying my Rockwood five-channel reed system in my six-foot Schneider Cub at the Sepulveda Basin Model Airport. At that time he had graduated to a three-channel Babcock BCR-3 unit using a Bonner "Mail-Box" type servo on trimable elevator, e.g., there was no neutral return. We used to go to the LARKS (Los Angeles Radio Kontrol Society) meetings together. In 1957, Doug made a home brew five-channel resonant reed system using a super regen detector.

About this time, he met Don Mathes. Don designed a superhetrodyne receiver and they made a few sets for sale using Bill Deans' five- and eight-channel reed banks. Doug won his first contest flying this equipment in 1957. He was not too lucky at the 1958 and 1959 AMA Nationals since he crashed.

In 1960 when Doug was 28, he designed his famous Stormer pattern model powered by a Lee 45, controlled by a Mathes designed 10-channel reed system and was pattern champion at the 1960 AMA Nationals. The plans for this model with Doug's descriptive comments on its design were published in the April 1961 issue of American Modeler magazine. Doug also placed third at the 1960 Nationals in AMA pylon using the Mathes/Spreng reed system. Don Mathes was third in pattern and he won pylon flying his own design Sliver pylon model. In 1961, Doug again won the AMA pattern event flying his Flat-Top Stormer.

Doug was flying at the Sepulveda Basin model airport one Sunday when Jerry Pullen of Pullen Proportional fame was there. He asked Jerry to pull the wing off his model so he could eyeball Jerry's analog proportional system. Located on the PC board were some TO-5 transistors painted bright red. Doug asked Jerry what they were and he replied they were PNP silicon transistors, Raytheon 2N329.

Doug was amazed since he didn't know PNP silicon devices even existed. He knew they were making NPN silicon transistors but these were fabulously expensive since they were brand new at that time. Doug asked Jerry "where did you obtain these?" Jerry said he got them at work. Doug's next question was "where do you work" and he was told "at the Jet Propulsion Lab [JPL] in Pasadena." This was in December 1957. Later that month, Doug quit his present job and went to work at JPL!

Doug credits Jerry as being a tremendous influence on him. Jerry was and still is a very clever chap with a passion and talent for circuit design. They became fast friends after Doug started working at JPL. Jerry's analog proportional system worked very well and Doug flew one for a while but it was just too slow to react since it was based on analog tones in the low kilohertz range. The necessary low pass filtering in the tone detection circuits made the response so slow that it interfered with the natural human response time.

For instance, you would ask for a little elevator stick control; it does not happen right away so you ask for a little more. By that time the first amount you asked for appears and the little more you asked for when you did not see the result of the first bit is just too much. This results in "analog gallop" and it takes all the joy out of flying. Doug just knew the system reaction time had to be less. He figured 10 times less would be needed to take human reaction time out of the loop.

Of course, this was impossible using audio tones due to bandwidth constraints on the transmitted control signal. You can't just increase the tone frequencies by 10 and stay within the FCC mandated bandwidth. This meant the tones had to go! This caused Doug to rethink the design of the entire servo amplifier. It was now 1962 and Doug was still working at JPL. This was the time when Doug developed the original concept for a digital proportional radio system. Prior to this time, most Radio Control models were being flown with either eight- or 10-channel resonant reed units or analog proportional systems. Doug decided that the key to solving the response time problem was the servo amplifier. He concluded that by tracking the transmitted pulse width with a servo-driven pot driving a one-shot triggered by the incoming pulse, the tones would be gone, and the response time could be lowered to tens of milliseconds instead of hundreds of milliseconds.

Doug randomly chose one to two milliseconds for the pulse width because it was realistic to transmit the variation and the variation was 100% of the minimum; therefore, stability would be

easy to achieve. Howard Bonner's Digimite 8 proportional system was transmitting millisecond pulses but his servo amplifiers were analog, hence they were slow acting. It took Doug's pulse width tracking system to get rid of the delay. Doug's Digicon proportional system block diagram dated April 30, 1962 is at figure number one. This diagram includes the key part, which is the pulse width-tracking servo. Interesting enough is that the concept to working prototype was only a few days. Doug's first tries at the pulse width and frame time were right on target. It was one of those naturals. He said, "It just makes good sense."

Thus came the development of Digicon. The Digicon pulse width tracking servo amplifier block diagram is figure two.

The concept, developed by Doug, shown in these figures is identical to that now used in all of our current servos. Doug essentially gave the concept for the digital servo away. He did not make a dime off it. A patent was prohibitively expensive and of doubtful merit. A copyright would have been useless. A cleverer individual with money to spend may have been able to patent the concept and make a bunch of money, but to Doug the concept was art and a service to model-dom!

Later in 1962, Doug flew the first digital proportional system, which Doug and Don named Digicon, for digital control. Flight test of the Digicon system was performed with the system installed in a model called the Digester, a very large high wing model designed by Don Mathes, which had inherent stability and was powered by a Veco 45 engine. They needed a test vehicle for the Digicon proportional system, thus the name Digester – Digicon Tester! The Digester was flown utilizing two complete radio systems, e.g., the various proportional rigs undergoing flight tests, plus a permanent resonant reed system with its servos cross-coupled by trim bars to proportional servos. The first prototype Digicon units used modified Bonner Duramite servos with a wire wound pot embedded where the contacts formerly were located on the reed versions. Later on, they used Orbit servo mechanics.

Doug and Don Mathes built a dozen or so Digicon systems for sale but there were glitch problems, e.g., neutral shift with signal strength variations due to the modulation scheme. Note that the entire square waveform was being transmitted, hence there were long off periods, and maintaining AGC (automatic gain control) was difficult. Remember everyone was still transmitting an AM signal. (FM Radio Control units were not developed until 1975 at Kraft Systems.) The amplitude variations in signal strength could have been eliminated by using a super-regen receiver since the amplitude never changes with that type of receiver. However, the super-regen receiver was no longer practical due to the assignment of adjacent Radio Control frequencies by the FCC.

Late in 1963 Frank Hoover, of F&M Electronics from Albuquerque, New Mexico, visited Doug and Don and told them about how the "spike-off" scheme solved the impulse noise and neutral drift problems. They modified the Digicon systems they had previously sold and that cured the modulation and AGC problems.

During the 1962 to 1963 timeframe, while they were still manufacturing the Digicon systems, Doug and Don had received a contract from a customer to develop a weather drone model for the U.S. Weather Service for analyzing the air. They built and equipped a large model that had a Radio Control system in it in addition to a homing system. The model was to take off under control and then be switched to automatic control. If it got lost, it was supposed to return to the transmitter area, circle and then be captured by the Radio Control transmitter for landing. The

first time Doug and Don filled the fuel tank and let the model do its own thing was memorable. The model was basically a Free Flight with radio direction control. It had a loop-sense antenna, which would drive the rudder servo such that it would fly big figures around the transmitter. It contained a resonant reed radio system for take-off, landing and emergency take-over of control. It was designed to carry a metrological package as high as it would fly and remain basically over the transmitter. Control was to be taken over by the reed system on the way down and then it was to be landed.

On the day Doug and Don chose to test the weather drone model there were numerous small puffy cumulous clouds from horizon to horizon. In hindsight, they should have waited for better visibility conditions, but they were under a deadline to demonstrate it to the customer; therefore, they had to fly it that day. So, they filled the tank with a considerable amount of fuel, fired up the trusty Fox 59 and launched it.

They set the Radio Control transmitter on the ground and proceeded to watch it do its lazy figure eights around the transmitter. They watched it disappear into the fluffy clouds. Now, they couldn't see it and they long ceased to hear the engine. Doug and Don waited and waited. It seemed like hours and they gave it up for lost. The model had identification on it so they reckoned that if it were found it might be returned to them.

Of course, they had no time to build a replacement and meet the customers time constraints. Don decided to go to the nearest police station and report it missing while Doug stayed behind at the field and waited to see if it would return. The transmitter was kept transmitting just in case they got lucky. Don returned from the police station and they discussed the situation. They decided they might as well shut down the transmitter and head for home.

Don reached over to turn off the transmitter, Doug looked up one more time, and there it was! The model was down wind of the field heading right towards the transmitter antenna. It was still quite a ways up, just a speck, but you can imagine their joy at spotting it. They watched it figure eight down and manually landed it using the reed system. Doug and Don removed the wing and took out the metrological recorder. The trace was on a roll of heat sensitive paper the size of adding machine tape, and there was the most beautiful recording you ever saw. You could tell when it had flown through clouds and the change in temperature as it climbed out. The altitude was indicated by the barometric pressure trace; therefore, they could tell what altitude had been reached. The people who made the metrological recorder looked at the chart and said the model had flown to over 5,000 feet.

It was taken out to the desert in a few days to demonstrate it to the customer, and this time there were no fluffy clouds. They were able to keep it in sight during the entire flight. The demonstration flight was successful; however, they never did get any contract for further development or manufacture. This helped close the Digicon doors, as this contract was needed to see Doug and Don's company over the hard times due to the expense of modifying all of the early Digicon units they had sold with the new spike off modification.

After that, Doug went back to JPL and Don Mathes then started Micro-Avionics with the assistance of Bob Dunham (Orbit Electronics). Later on Doug quit work at JPL and went to work at Micro-Avionics where Doug and Don manufactured the excellent green anodized case units.

In 1966, Doug won a place on the AMA international team using his Thunderstormer model controlled by a Micro-Avionics system. It was a low wing variation of the Stormer. He placed

third in Corsica where the Internats were held. Later on Doug was approached by Harry Brooks of England to design and build a Radio Control model system in England. Doug accepted the proposition and moved to England in August 1967. He designed and built the Spreng-Brook Radio Control system, which was sold in the UK as well in other parts of the world. He later did the same type of design work for the Stavely Tool Company.

The damp cold of England finally persuaded Doug to return to California in mid 1970, where he went to work for Phil Kraft at Kraft Systems in Vista, California. While at Kraft, Doug developed the IC servo amplifier, a two-channel glider Radio Control unit, and the famous Kraft Signature Series Radio Control units, which were the first programmable transmitters.

We came full circle since I joined Kraft Systems in February 1976 where we got reacquainted again. Doug left Kraft and did some magazine construction articles with Don Dewey of Radio Control Modeler (RCM) magazine. Don Mathes moved to Lake Havasu City in Arizona and Doug followed him there in December 1976. They did some commercial radio work and Don built Radio Control systems, which were sold under the name of Mathes Systems. Unfortunately, Don Mathes is no longer with us. Doug no longer flies in Radio Control contests anymore, but he is still involved in Radio Control.

He is now working with Darrell Yonker (who was also employed at Micro-Avionics) in the development of a twin-engine sync throttle system using the Stamp microcomputer. Doug is also still pursuing his hobby of Ham radio (W7MCF.) He retired from Pacific Gas and Electric Company in March 1997, where he was employed for many years. He now is doing two-way radio service work under the name of HAVACOMM.

(signed) Jack R. Albrecht
September 6, 2002

The following was published in the July 2010 issue of Model Aviation *magazine, written by AMA staff.*

Doug Spreng: 1932-2010

Douglas Carder Spreng passed away April 19, 2010, in Lake Havasu City, Arizona – his home of 38 years. He was born on February 7, 1932, in Chicago, Illinois.

He started flying RC in 1955, using a gas-tube super-regenerative receiver and escapement. Doug worked for Babcock Engineering for a while and helped develop a “hard tube” (1AG4), super-regenerative single-channel receiver.

He met Don Mathes, who designed a superhetrodyne receiver, and the pair made a few sets for sale using Bill Deans’ five- and eight-channel reed banks. Doug won his first contest flying with this equipment in 1957.

In 1960, when Doug was 28, he designed his famous *Stormer* RC Aerobatics (Pattern) model powered by a Lee .45 and controlled by a Mathes-designed, 10-channel reed system. He and the *Stormer* won Pattern at the 1960 AMA Nats. Plans for this model, with Doug’s descriptive comments on its design, were published in the April 1961 *American Modeler*.

Two years later, Doug developed the concept of a digital proportional radio system, called the "Digicon" proportional system. The idea was identical to that used in current servos. Because applying for a patent was expensive, Doug essentially gave away this concept for the digital servo.

Doug and Don were contracted to develop a weather drone for the US Weather Service. They built and equipped a large model that had an RC system and a homing device. The aircraft was to take off under control and then be switched to automatic control.

If the drone got lost, it was designed to return to the transmitter area, circle, and then be captured by the RC transmitter for landing.

The first time Doug and Don tested the model, there were numerous small, puffy cumulous clouds above. Once launched, the aircraft flew lazy figure eights above the transmitter, rising into the clouds and out of sight. Soon it was our of audio range as well.

Hours later, Doug and Don were about to give it up for lost when the model reappeared. They landed it and removed the meteorological recorder.

The recorder indicated when it had flown through clouds and the change in temperature as it climbed out. The altitude was documented by the barometric pressure trace, and the model had flown higher than 5,000 feet.

In 1966, Doug won a place on the AMA international team using his *Thunderstormer*, a low-wing variation of the *Stormer*, controlled by a Micro-Avionics system. He placed third in Corsica, where the Internats was held.

… He was inducted into the Vintage Radio Control Society Hall of Fame in 1976 and received the Howard McEntee Award the same year. Doug was inducted into the Model Aviation Hall of Fame in 2003.

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