



SPACE PRODUCTS



DowKey Microwave
CORPORATION
A DOVER COMPANY

OUR EXPERIENCE, YOUR SWITCH SOLUTION SINCE 1945



OUR HERITAGE, YOUR SWITCH SOLUTION

Space business experts stress the three most critical aspects of supplier selection: heritage, heritage, heritage.

Dow-Key Experience

We have been a premier supplier of space qualified coaxial and waveguide switches since 1970. Dow-Key Microwave designs, fabricates and test all integrated switch blocks assemblies and individual switches in our Ventura, California facility, about 1 hour drive north of Los Angeles international airport. Our switches have had an in-flight failure free record in over 100 different space programs using 150 different product designs. With decades of experience and knowledge we are confident in providing High Reliability solutions which can withstand the severe environments that space imposes on complex systems.

Dow-Key Space Team

We have an entire team of experts — from devoted sales and program managers, QA and procurement personnel to design, test, and manufacturing engineers — dedicated solely to space production that is supported by a well trained and certified group of technicians and production personnel. Our entire staff is fully dedicated to our customer base, with comprehensive focus on each project from the design phase through final test and beyond.

Dow-Key Facility, Quality and Equipment

Dow-Key Microwave has heavily invested in technical staff and capital equipment to provide the right environment and tools for manufacturing products of the highest quality and reliability for use in manned and unmanned space vehicles.

Facility/Test Equipment

- Two Class 7 Clean Rooms with humidity and temperature controlled environment
- Prohibited materials and screening chamber
- Three full time T-VAC test stations
- RF Power and Multipaction stations
- Vibration Room

Design Software:

- AutoCAD
- SolidWorks
- HFSS (High Frequency Structural Simulator)
- Cosmos FEA (validation and failure mode simulation)

Quality Certifications:

- Quality Management System (QMS) evolved from MIL-Q-9858A & MIL-I-45208
- DOD classified certifications
- AS9100/ISO-9001:2000 Certified through BSI Management Systems

| 1970-1979 | |
|--------------|---------------|
| 1972 | |
| 818-SPDT | SYMPHONIE |
| 1975 | |
| 700-TRANSFER | METEOSAT |
| 1976 | |
| 33-WAVEGUIDE | TELESTAR |
| 300-TRANSFER | MAROTS |
| 707-TRANSFER | SPACE SHUTTLE |
| 1977 | |
| 700-TRANSFER | CRRES |
| 700-TRANSFER | SCATHA |
| 909-SPDT | SEASAT |
| 1978 | |
| 707-TRANSFER | EXOSAT |
| 707-TRANSFER | INTELSAT V |
| 1979 | |
| 707-TRANSFER | SATCOM |
| 800-SPDT | TDRSS |
| 808-SPDT | INSAT |
| 909-SPDT | RADARSAT |

| 1980-1989 | |
|--------------|---------------------|
| 1980 | |
| 909-SPDT | ANIK D |
| 1981 | |
| 33-WAVEGUIDE | TELECOM1 |
| 305-TRANSFER | SPACE SHUTTLE |
| 808-SPDT | NAVSTAR GPS |
| 1982 | |
| 33-WAVEGUIDE | NATO III |
| 33-WAVEGUIDE | ECS |
| 406H-SPDT | IUS |
| 1983 | |
| 33-WAVEGUIDE | TV SAT |
| 33-WAVEGUIDE | ISPM |
| 402H-SPDT | GPS2F |
| 707-TRANSFER | GIOTTO |
| 1984 | |
| 33-WAVEGUIDE | IBS |
| 700-TRANSFER | DSP1 |
| 805-SPDT | SKYNET |
| 909-SPDT | LSAT |
| 909-SPDT | SKYNET IV |
| 1985 | |
| 700-TRANSFER | TOPEX |
| 707-TRANSFER | HIPPARCOS |
| 707-TRANSFER | DFS |
| 808-SPDT | SHUTTLE/ CENTAUR |

| | |
|--------------|--------------|
| 1986 | |
| 707-TRANSFER | EURECA |
| 707-TRANSFER | ERS 1 |
| 909-SPDT | SKYNET |
| 1987 | |
| 707-TRANSFER | EUTELSAT |
| 959-DP3T | ANIK E |
| 1988 | |
| 33-WAVEGUIDE | EUTELSAT II |
| 33-WAVEGUIDE | ENVISAT RA-2 |
| 707-TRANSFER | INSAT II |
| 737-T-SWITCH | ITALSAT |

| 1990-1999 | |
|---------------|-------------------------|
| 1990 | |
| 33-WAVEGUIDE | SPOT 4 HELIOS |
| 737-T-SWITCH | TELCOM II |
| 1992 | |
| 33-WAVEGUIDE | TURKSAT |
| 33-WAVEGUIDE | AMOS |
| 707-TRANSFER | SAX |
| 818-SPDT | CENTAUR |
| 1993 | |
| 401H-SPDT | EUROPEAN MOBILE SAT. |
| 780-SP8T | INMARSAT |
| 1994 | |
| 411H-TRANSFER | INMARSAT III |
| 1995 | |
| 411H-TRANSFER | PANAMSAT |
| 1996 | |
| 33-WAVEGUIDE | HOT BIRD 3 |
| 707-TRANSFER | LANDSAT VII |
| 909-SPDT | SARSAT |
| 1997 | |
| 33-WAVEGUIDE | SKYNET IV |
| 818-SPDT | DELTA LAUNCH |
| 919-SPDT | TIROS |
| 1998 | |
| 33-WAVEGUIDE | SICRAL |
| 406H-SPDT | METEOSAT |
| 421H-SPST | MILSTAR |
| 1999 | |
| 818-SPDT | ATLAS V |
| 406H-SPDT | SAP-308 |

| 2000-2013 | |
|-----------------|-------------|
| 2000 | |
| 406H-SPDT | ALOS |
| 413H-TRANSFER | FOS |
| 919-SPDT | SST |
| 406H-SPDT | OPTUS |
| 411H-TRANSFER | NEW SKIES |
| 700-TRANSFER | CORIOLIS |
| 426H-SPDT | GOES |
| 2001 | |
| 707-TRANSFER | SMART I |
| 707-TRANSFER | CLOUD SAT |
| 249-SPDT | DOCOMO |
| 2002 | |
| 33-WAVEGUIDE | DEEP IMPACT |
| 401H-SPDT | GPS |
| 401H-SPDT | GE 15/16 |
| 411H-TRANSFER | INMARSAT IV |
| 511H-T-SWITCH | INSAT III |
| 707-TRANSFER | DEEP IMPACT |
| 2003 | |
| 401-SPDT | PEGASUSA |
| 33-WAVEGUIDE | LRO |
| 511H-T-SWITCH | ISRO |
| 2004 | |
| 33-WAVEGUIDE | KEPLER |
| 2005 | |
| 511H-T-SWITCH | MUOS |
| 818-SPDT | ULA |
| 2006 | |
| 406H-SPDT | ARG. GOVT |
| 2007 | |
| H9-SWITCH BLOCK | KOMPSAT |
| 818-SPDT | ATLAS V |
| 2008 | |
| 402H-SPDT | GPS-2F |
| 401H-SPDT | LOUTCH |
| 406H-SPDT | SOLAR SAT. |
| 406H-SPDT | H-2A |
| 2009 | |
| 406H-SPDT | GLONASS |
| H9-SWITCH BLOCK | GPS III |
| 2010 | |
| 511H-T-SWITCH | GALILEO |
| 700-TRANSFER | GALILEO |
| 2013 | |
| 700C77800 | GOES |
| 461HQ-730832 | AMOS IV |

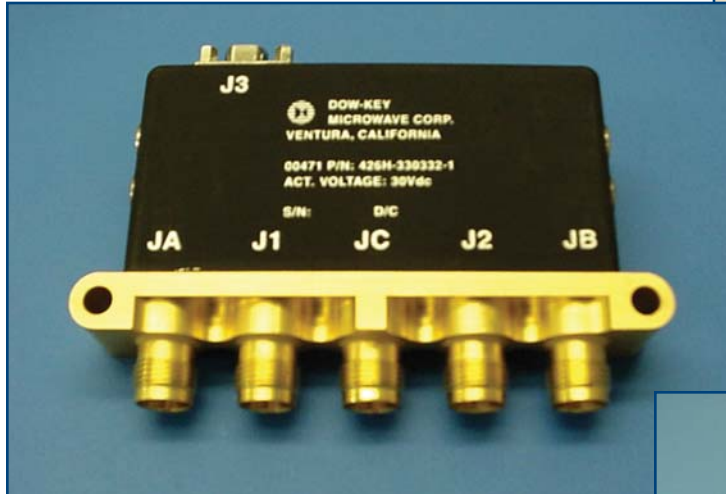
This represents only a fraction of the hundreds of Dow-Key switches that have been a part of space missions over the past 40 years.

SPDT

Dow-Key's innovative and proven high reliability, superior RF performance, and low current/magnetic latch SPDT switches have played a part in hundreds of successful space missions since the 1970s. Some of these missions include: GPS III (Global Positioning System), Atlas (launch vehicle), Pegasus (rocket), Milstar (satellite communication system), and Optus (leading operator of satellites in the Asia Pacific region).



421H SPDT



426H SPDT



401H SPDT

| Series* | Description | Frequency GHz | VSWR (max) | Isolation dB (min) | Ins. Loss dB (max) | Weight g (max) | Life Cycles (min) | Power W CW |
|---------|--------------------|---------------|------------|--------------------|--------------------|----------------|-------------------|------------|
| 401H | SPDT, Low Power | DC-22 | 1.45 | 65 | 0.45 | 55 | 200,000 | 7 |
| 401HY | SPDT, Low Power | DC-27 | 1.45 | 60 | 0.45 | 55 | 100,000 | 2 |
| 401HY | SPDT, Low Power | DC-40 | 1.75 | 55 | 0.70 | 58 | 100,000 | 2 |
| 402H | SPDT, High Power | DC-10 | 1.50 | 60 | 0.50 | 130 | 100,000 | 160 |
| 406H | SPDT, Medium Power | DC-12 | 1.50 | 60 | 0.40 | 100 | 100,000 | 20 |
| 406H | SPDT, High Power | DC-10 | 1.50 | 60 | 0.45 | 115 | 200,000 | 140 |
| 421H | 2/3, Low Power | DC-22 | 1.45 | 60 | 0.45 | 118 | 100,000 | 2 |
| 426H | 2/3, High Power | DC-10 | 1.45 | 60 | 0.45 | 135 | 100,000 | 25 |
| 818 | SPDT, High Power | DC-6 | 1.30 | 60 | 0.40 | 175 | 100,000 | 20 |
| 909 | SPDT, Low Power | DC-18 | 1.50 | 60 | 0.50 | 60 | 100,000 | 4 |

* All listed products are Pulse Latching, except for 818-Series which is BBM Pulse Latching.

DPDT (Transfer)



707 DPDT



411HQ DPDT

Dow-Key's rigorous quality assurance processes allow transfer switches to be used in critical programs such as Inmarsat-4 satellite system, which supports Broadband and Global Area Network to deliver Internet and intranet content solutions (video, fax, email, LAN access). On other space missions like the ACE (Advanced Composition Explorer – an explorer mission), our lightweight (less than 55 grams) and highly reliable qualified transfer switches were a perfect fit.

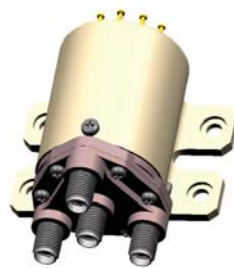
| Series* | Description | Frequency GHz | VSWR (max) | Isolation dB (min) | Ins. Loss dB (max) | Weight g (max) | Life Cycles (min) | Power W CW |
|---------|--------------------|---------------|------------|--------------------|--------------------|----------------|-------------------|------------|
| 700 | DPDT, Medium Power | DC-10 | 1.45 | 60 | 0.45 | 140 | 100,000 | 30 |
| 707 | DPDT, Low Weight | DC-18 | 2 | 60 | 0.50 | 70 | 100,000 | 6 |
| 411H | DPDT, Low Power | DC-18 | 1.50 | 60 | 0.50 | 110 | 100,000 | 7 |
| 411HQ | DPDT, Low Weight | DC-27 | 1.45 | 65 | 0.45 | 55 | 200,000 | 2 |
| 4113HAC | DPDT, High Power | 1.25-1.65 | 1.20 | 60 | 0.2 | 185 | 50,000 | 50 |

* All listed products are Pulse Latching.

T-Switch



High Power T-Switch



Medium Power T-Switch

The benefit of a T-switch over a transfer switch is that up to three combinations of RF paths are available, which is perfectly suited for space applications where more than two path combinations (DPDT) are required. In addition to superior RF performance and lightweight/high power capabilities, Dow-Key distinguishes itself from others by introducing random drive (minimizing the switching time) rather than forcing the application to switch RF paths in sequential order. These switches have been qualified in programs including MUOS (space craft), Isro (Indian Space program), and Insat-3 (multipurpose satellite design providing telecommunications, television broadcasting, meteorological, search and rescue services).

| Series* | Description | Frequency GHz | VSWR (max) | Isolation dB (min) | Ins. Loss dB (max) | Weight g (max) | Life Cycles (min) | Power W CW |
|---------|--------------|---------------|------------|--------------------|--------------------|----------------|-------------------|------------|
| 511H | Medium Power | 01.0-8.8 | 1.25 | 60 | 0.24 | 670 | 100,000 | 35 |
| 511H | High Power | 0.36-0.38 | 1.22 | 60 | 0.10 | 210 | 100,000 | 200 |
| 511H | High Power | 2.5-4.38 | 1.25 | 60 | 0.20 | 195 | 100,000 | 140 |
| 511H | High Power | DC-4 | 1.25 | 60 | 0.25 | 95 | 100,000 | 260 |

* All listed products are Pulse Latching.

Waveguides: DPDT (Transfer)



33D13700 WR-15



33C96600 WR-34



33C98100 WR-28

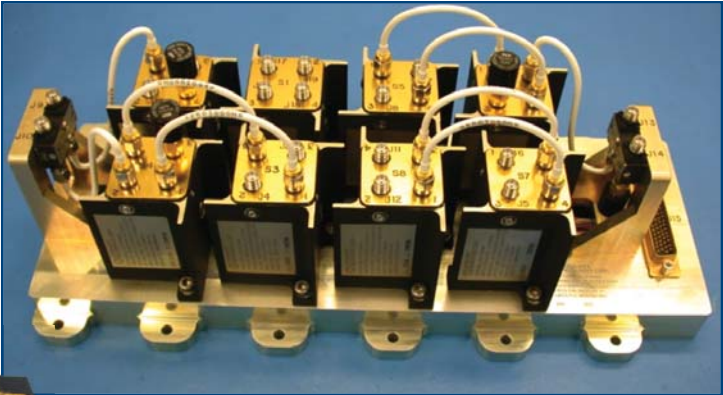
In 1993 Dow-Key expended its involvement in Hi-Rel space programs with the acquisition of the Transco Space Qualified Products from Datron/Transco Systems in Southern California, including space programs dating back to 1968. In addition to inheriting many of the Hi-Rel (and commercial) waveguide switches, many of the veteran Transco design engineers stayed with Dow-Key and are still employed with us today. Thus, this unique combination of experience and innovation enhances our capabilities. The waveguide switches listed below were included in high profile space missions such as Kepler (flight system) and Deep Impact (NASA space probe).

| Part Number | Waveguide Size | Dimensions (inches) | Actuator Type | Voltage (Vdc) | Mass (grams) |
|--------------|----------------|-----------------------|---------------|---------------|--------------|
| 33D13700 | WR 15 | 2.225 x 3.765 x 1.850 | Latching | 28 | 180 |
| 33C98100 | WR 28 | 2.045 x 3.035 x 2.045 | Latching | 28 | 158 |
| 33C96600 | WR 34 | 1.510 x 2.510 x 1.510 | Latching | 28 | 150 |
| 33C96100 | WR 42 | 2.042 x 3.424 x 2.042 | Latching | 28 | 135 |
| 33C96000 | WR 62 | 1.810 x 3.414 x 1.810 | Latching | 28 | 150 |
| 33C94100 | WR 75 | 2.640 x 4.060 x 1.880 | Latching | 28 | 140 |
| 33C51200 | WR 90 | 2.637 x 3.900 x 1.875 | Latching | 28 | 360 |
| 33C51400 | WR 112 | 2.173 x 4.400 x 2.175 | Latching | 28 | 490 |
| 33C13200 | WR 15R | 2.225 x 3.765 x 1.850 | Latching | 28 | 180 |
| 33HJ-7351C30 | WR 51 | 2.04 x 3.37 x 1.48 | Latching | 28 | 160 |

Note: Other configurations are available including "R"

Switch Block

Over the years, Dow-Key's outstanding Hi-Rel track record has generated interest in combining space qualified switches and other components such as power dividers in a block of switches to achieve the matrix complexity needed in programs such as GPS-3, Kompsat-3 (satellite), Inmarsat-4, and other classified programs. Experience gained in over 150 years of combined knowledge and practice in design, test, and manufacturing of Hi-Rel products, makes Dow-Key a perfect investment for custom and complex switching needs.



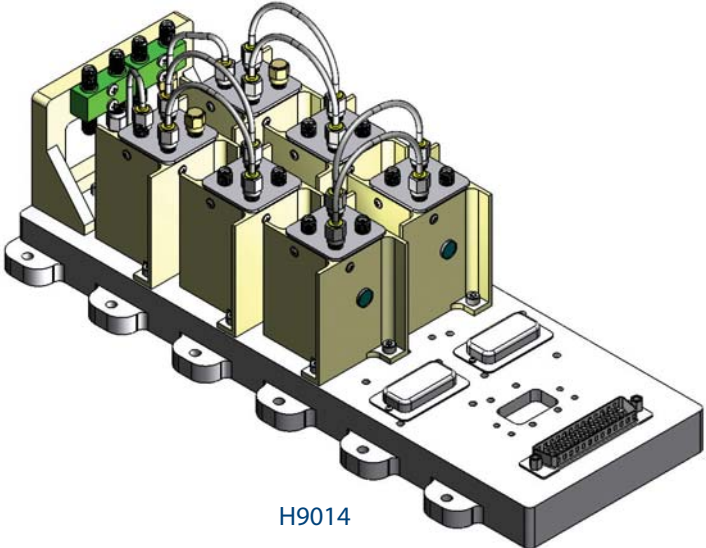
H9010 Switch Block



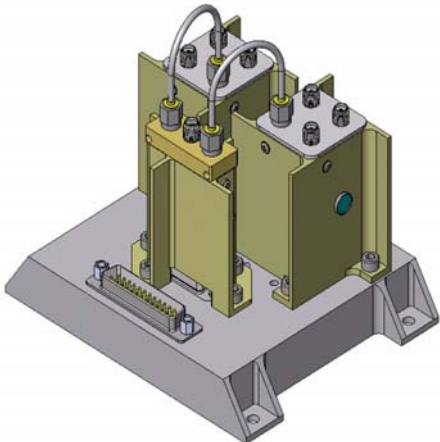
222D50600

| Series* | Description | Frequency GHz | VSWR (max) | Isolation dB (min) | Ins. Loss dB (max) | Weight g (max) | Life Cycles (min) | Power W CW |
|-----------|---------------------------------------|---------------|------------|--------------------|--------------------|----------------|-------------------|------------|
| H9001 | (5) Multi-throw Switches | L-band | 1.24 | 55 | 0.15-0.25 | 670 | 100,000 | 15 |
| H9010 | (8) C-switches, (2) Power dividers | S-band | 1.45 | 60 | 0.15-4.50 | 2,660 | 100,000 | 7 |
| H9014 | (6) C-switches, (2) Power dividers | L/S-band | 1.45 | 60 | 4.28 | 2,190 | 100,000 | 7 |
| H9016 | (2) C-switches, (1) SPDT | X-band | 1.45 | 60 | 0.60 | 840 | 100,000 | 15 |
| 222D50600 | WR-51 Waveguide R-Switch Block | Ka-band | 1.10 | 60 | 0.08 | 480 | 100,000 | 100 |

* All listed products are Pulse Latching.



H9014



H9016



Facility

Our facility includes two 400 square foot Class 7 clean room with controlled humidity and temperature that are allocated for the most critical assembly processes and in-process testing. Our Environmental Lab is fully equipped with three Thermal Vac chambers as well as a sophisticated vibration table that is fully equipped to perform random and sine vibration, in addition to limited levels of mechanical shock.



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