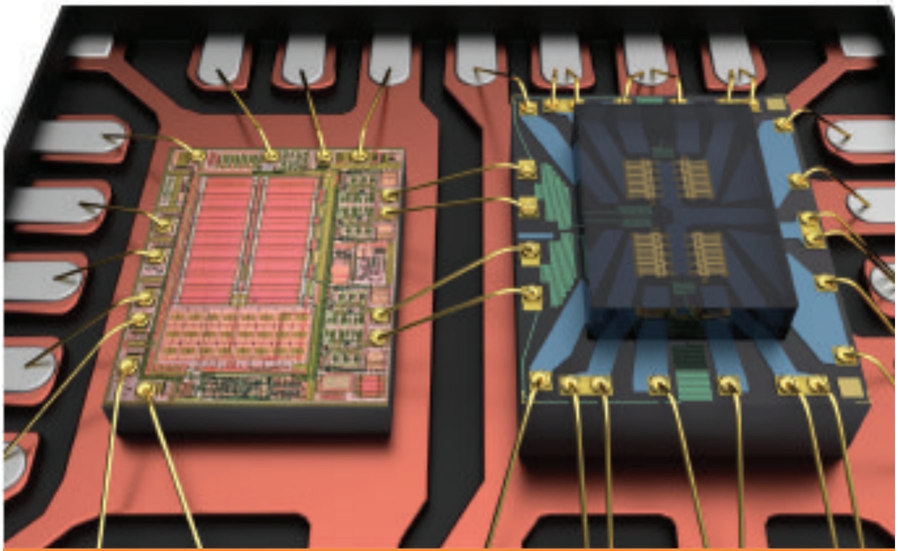

Figure 5. Drive IC (left), MEMS switch die (right) mounted on and wire-bonded to a metal lead frame

Such ramping helps to control how the switch beam is attracted and pulled down, and improves the actuation, reliability and cycle lifetime of the switch. Figure 5 shows the driver IC and MEMS die in situ in a QFN package. The driver IC only requires a low-voltage, low-current supply, and is compatible with standard CMOS logic drive voltages. This co-packaged driver makes the switch very easy to use – and it has very low-power requirements, in the region of 10 mW to 20 mW.

Test Name	Specification
HTOL 1 kHz, 1 Billion Cycles, 1000 Hours	JESD22-A108
HTOL II Switch Continuously on at +85°C, 1000 Hours	JESD22-A108
ELF 5 kHz Burst Mode Cycling, 85°C, 48 Hours	MIL-STD-883, M1015
HAST +130°C, 85% RH, Biased, 96 Hours	JESD22-A110
SHR MSL 3 Precondition	J-STD-20
Random Drop	AEC-Q100 Test G 5, 0.6 m
Vibration Testing Cond B, 20 Hz to 2000 Hz at 50 g	MIL-STD-883, M2007.3
Mechanical Shock 1500 g 0.5 ms Vibration 50 g Sine Sweep 20 Hz to 2000 Hz Acceleration 30,000 g	Group D Sub 4 MIL-STD-883, M5005
Temperature Cycle 1 Cycle per Hour –40°C to +125°C, 1000 Cycles	JESD22-A104
High Temp Storage +150°C, 1000 Hours	JESD22-A103
Autoclave 121°C, 100% RH, 96 Hours	JESD22-A102

Table 1. MEMS switch technology qualification tests

Reliability

A key tenet to any new technology is, of course, how reliable it is, and the new MEMS technology manufacturing process was the base that enabled the development of mechanically-robust, high-performance switch designs. This, coupled with a hermetically-sealed, silicon capping process were both crucial to the delivery of truly reliable long-life MEMS switches. To successfully bring the MEMS switch to commercialisation required extensive reliability testing specific to MEMS, such as switch cycling, lifetime testing and mechanical shock testing. In addition to this qualification, and to guarantee the highest level of quality possible, the part has been qualified using a whole range of standard IC reliability tests.

Long-switch actuation lifetimes are of utmost importance in RF instrumentation applications. The MEMS technology has been developed to bring an order of magnitude improvement in cycle lifetimes compared to electromechanical relays. The high temperature operation lifetime (HTOL) test at 85°C, and the early-life failure (ELF) qualification test, rigorously guarantee the cycle lifetime of the part.

Continuously on lifetime (COL) performance is another key parameter for MEMS switch technology. For example, RF instrumentation switch usage can be varied, and a switch can be left in its ‘on’ condition for extended periods of time. ADI has recognised this fact and has focused on achieving excellent COL lifetime performance for the MEMS switch technology to mitigate lifetime risks. From an initial COL performance level of seven years (mean time before failure) at 50°C, ADI has further developed the technology to deliver a class-leading 10 years of COL at 85°C.

The MEMS switch technology has undergone a comprehensive suite of mechanical robustness qualification tests. Table 1 lists a total of five tests that ensure the mechanical endurance of the MEMS switch. Due to the small size and low inertia of the MEMS switch element, it is significantly more robust than electromechanical relays.

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