

ISO164
ISO174

Precision, Isolated PROGRAMMABLE GAIN AMPLIFIER

FEATURES

- **RATED**
1500Vrms Continuous
2500Vrms for One Minute
100% TESTED FOR PARTIAL DISCHARGE
- **PROGRAMMABLE GAINS OF**
1, 10, 100
- **HIGH IMR: 115dB at 50Hz**
- **LOW NONLINEARITY: $\pm 0.01\%$**
- **LOW INPUT BIAS CURRENT: $\pm 5\text{nA}$ max**
- **INPUTS PROTECTED TO $\pm 40\text{V}$**
- **BIPOLAR OPERATION: $V_O = \pm 10\text{V}$**
- **SYNCHRONIZATION CAPABILITY**
- **24-PIN PLASTIC DIP: 0.6" Wide**

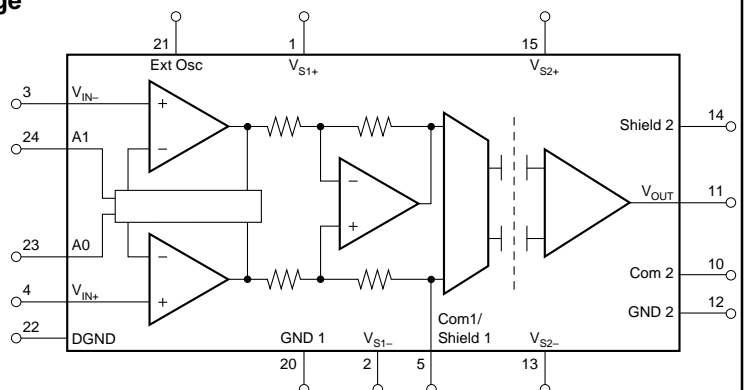
DESCRIPTION

ISO164 and ISO174 are PGA input isolation amplifiers incorporating a novel duty cycle modulation-demodulation technique which provides excellent accuracy. Internal input protection can withstand up to $\pm 40\text{V}$ differential inputs without damage. The signal is transmitted digitally across a differential capacitive barrier. With digital modulation the barrier characteristics do not affect signal integrity. This results in excellent reliability and good high frequency transient immunity across the barrier. Both the amplifier and barrier capacitors are housed in a plastic DIP. ISO164 and ISO174 differ in frequency response and linearity.

These amplifiers are easy to use. No external components are required. A power supply range of $\pm 4.5\text{V}$ to $\pm 18\text{V}$ makes these amplifiers ideal for a wide range of applications.

APPLICATIONS

- **INDUSTRIAL PROCESS CONTROL**
Transducer Isolator, Thermocouple Isolator, RTD Isolator, Pressure Bridge Isolator, Flow Meter Isolator
- **POWER MONITORING**
- **MEDICAL INSTRUMENTATION**
- **ANALYTICAL MEASUREMENTS**
- **BIOMEDICAL MEASUREMENTS**
- **DATA ACQUISITION**
- **TEST EQUIPMENT**
- **POWER MONITORING**
- **GROUND LOOP ELIMINATION**



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ABSOLUTE MAXIMUM RATINGS

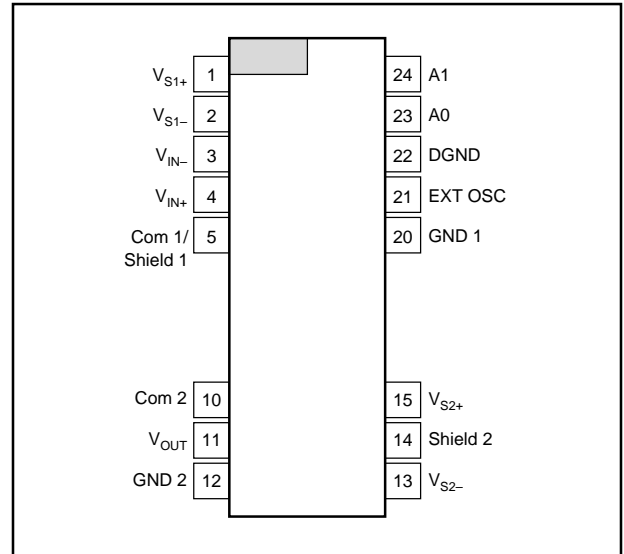
Supply Voltage	±18V
V_{IN} , Analog Input Voltage Range	±40V
External Oscillator Input	±25V
Signal Common 1 to Ground 1	±1V
Signal Common 2 to Ground 2	±1V
Continuous Isolation Voltage	1500Vrms
IMV, dv/dt	20kV/μs
Junction Temperature	150°C
Storage Temperature	-40°C to 125°C
Lead Temperature (soldering, 10s)	+300°C
Output Short Duration	Continuous to Common

ELECTROSTATIC DISCHARGE SENSITIVITY

Any integrated circuit can be damaged by ESD. Burr-Brown recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet published specifications.

PIN CONFIGURATION



PACKAGE INFORMATION

PRODUCT	PACKAGE	PACKAGE DRAWING NUMBER ⁽¹⁾
ISO164P	24-Pin Plastic DIP	167-1
ISO174P	24-Pin Plastic DIP	167-1

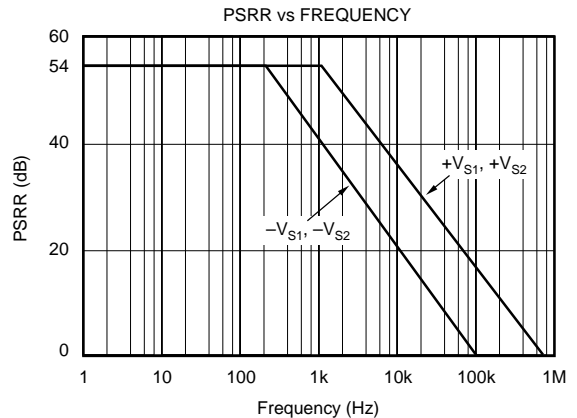
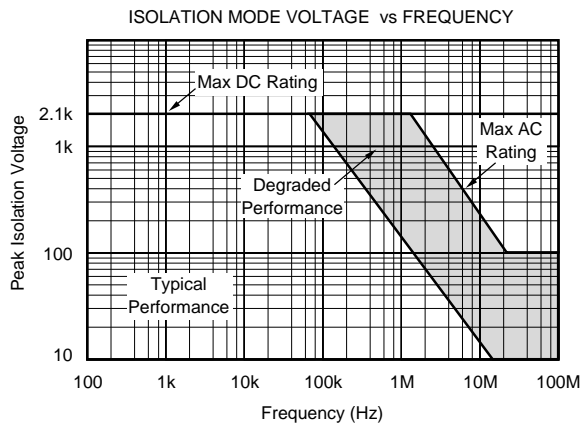
NOTE: (1) For detailed drawing and dimension table, please see end of data sheet, or Appendix C of Burr-Brown IC Data Book.

ORDERING INFORMATION

PRODUCT	PACKAGE	BANDWIDTH
ISO164P	24-Pin Plastic DIP	6kHz
ISO174P	24-Pin Plastic DIP	60kHz

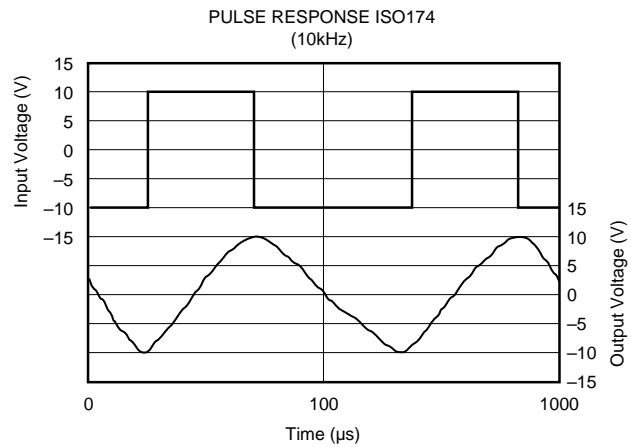
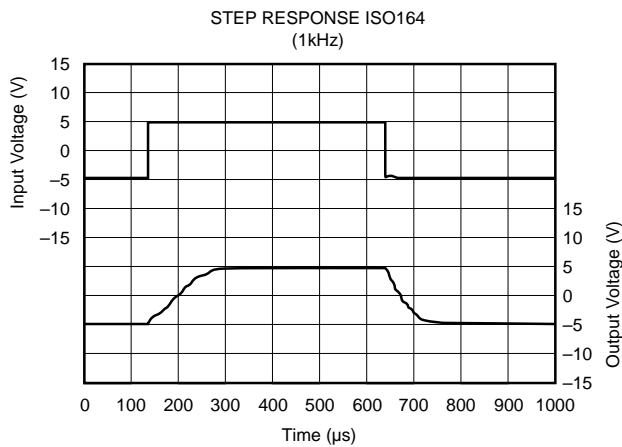
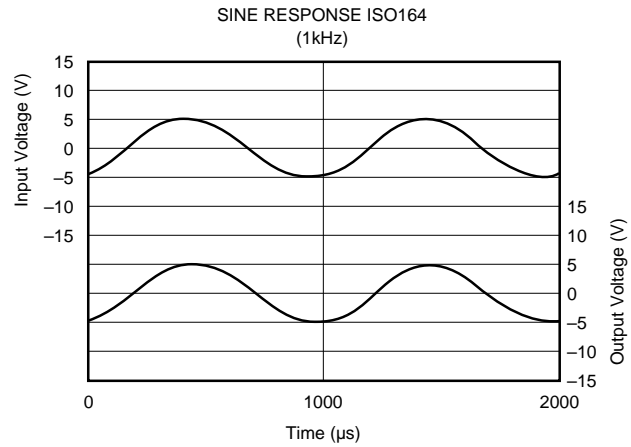
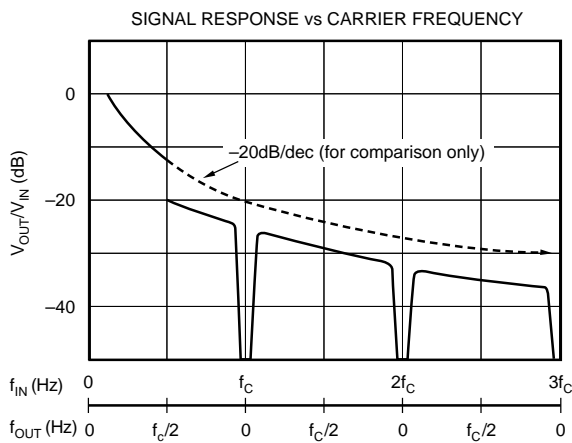
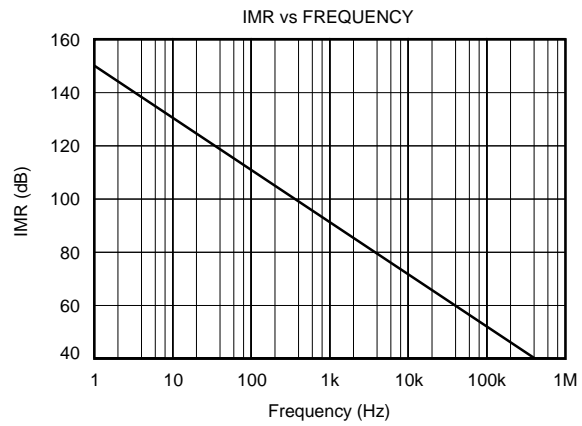
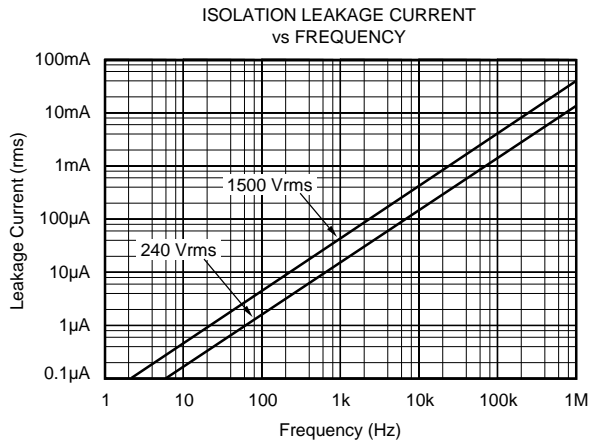
TYPICAL PERFORMANCE CURVES

At $T_A = +25^\circ\text{C}$, $V_{S1} = V_{S2} = \pm 15\text{V}$, and $R_L = 2\text{k}\Omega$, unless otherwise noted.



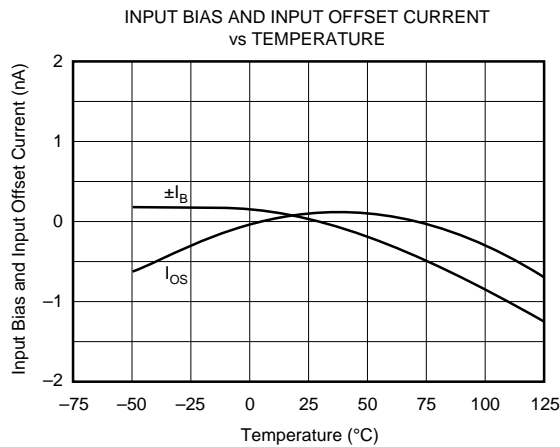
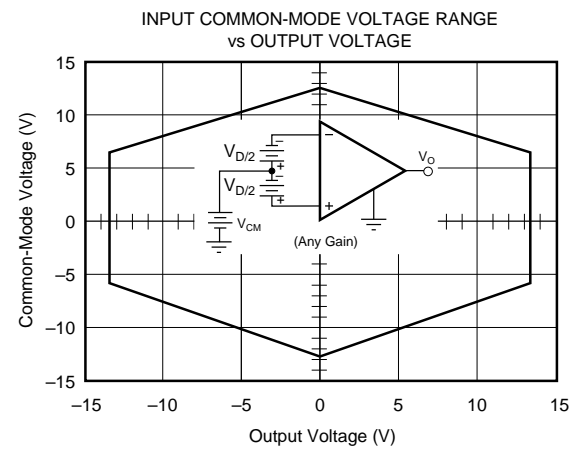
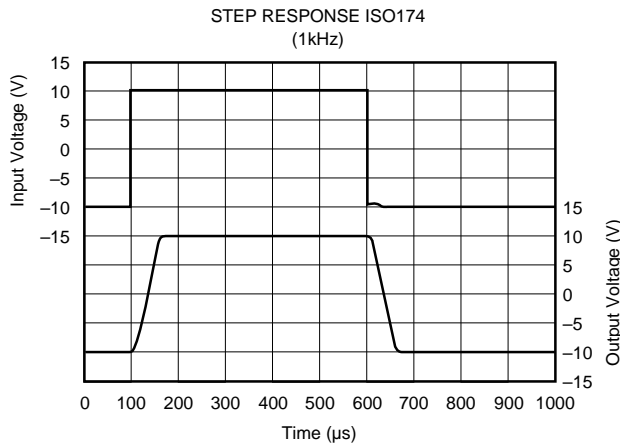
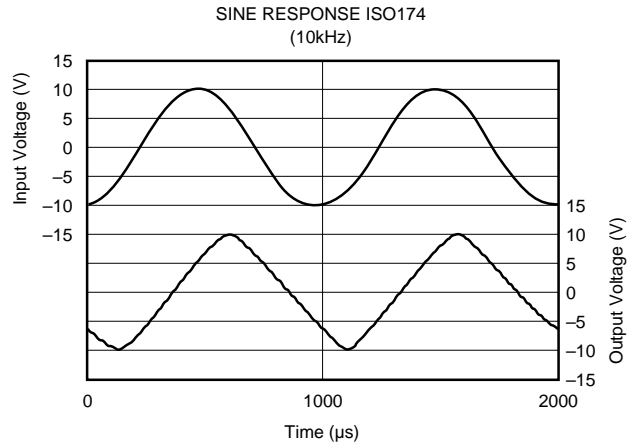
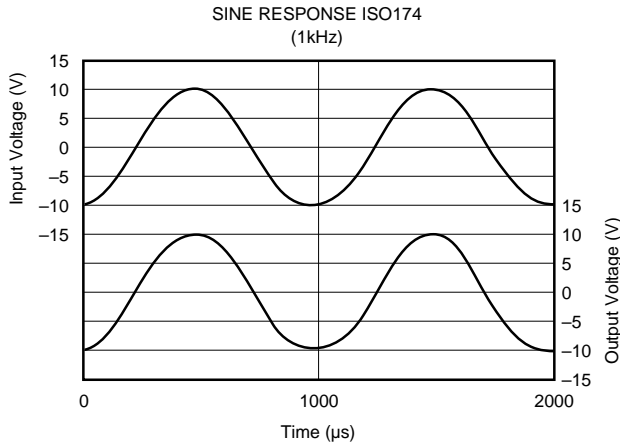
TYPICAL PERFORMANCE CURVES (CONT)

At $T_A = +25^\circ\text{C}$, $V_{S1} = V_{S2} = \pm 15\text{V}$, and $R_L = 2\text{k}\Omega$, unless otherwise noted.



TYPICAL PERFORMANCE CURVES (CONT)

At $T_A = +25^\circ\text{C}$, $V_{S1} = V_{S2} = \pm 15\text{V}$, and $R_L = 2\text{k}\Omega$, unless otherwise noted.



BASIC OPERATION

ISO164 and ISO174 are comprised of a precision programmable gain amplifier followed by an isolation amplifier. The input and output isolation sections are galvanically isolated by matched and EMI shielded capacitors.

SIGNAL AND POWER CONNECTIONS

Figure 1 shows power and signal connections. Each power supply pin should be bypassed with a 1µF tantalum capacitor located as close to the amplifier as possible. All ground connections should be run independently to a common point. Signal Common on both input and output sections provide a high-impedance point for sensing signal ground in noisy applications. Com 1 and Com 2 must have a path to ground for bias current return and should be maintained within ±1V of GND 1 and GND 2 respectively.

INPUT COMMON-MODE RANGE

The linear common-mode range of the input circuitry of the ISO164/174 is approximately ±12.7V (or 2.3V from the power supplies). As the output voltage increases, however, the linear input range will be limited by the output voltage swing of the internal amplifiers. Thus, the linear common-mode range is related to the output voltage of the complete input amplifier—see performance curves “Input Common-Mode Range vs Output Voltage.”

A combination of common-mode and differential input voltage can cause the output voltage of the internal amplifiers to saturate. For applications where input common-mode range must be maximized, limit the output voltage swing by selecting a lower gain of the programmable-gain input.

Input-overload can produce an output voltage that appears normal. For example, an input voltage of +20V on one input and +40V on the other input will obviously exceed the linear common-mode range of both input amplifiers. Since both input amplifiers are saturated to nearly the same output voltage limit, the difference voltage measured by the output amplifier will be near zero. The output of the programmable-gain amplifier will be near 0V even though both inputs are overloaded.

INPUT PROTECTION

The inputs of the programmable-gain amplifiers are individually protected for voltages up to ±40V. For example, a condition of -40V on one input and +40V on the other input will not cause damage. Internal circuitry on each input provides low series impedance under normal signal conditions. To provide equivalent protection, series input resistors would contribute excessive noise. If the input is overloaded, the protection circuitry limits the input current to a safe value (approximately 1.5mA). The inputs are protected even if no power supply is present.

SYNCHRONIZED OPERATION

ISO164 and ISO174 can be synchronized to an external signal source. This capability is useful in eliminating troublesome beat frequencies in multichannel systems and in rejecting AC signals and their harmonics. To use this feature, an external signal must be applied to the Ext Osc pin. ISO164 can be synchronized over the 100kHz to 200kHz range and ISO174 can be synchronized over the 400kHz to 700kHz range.

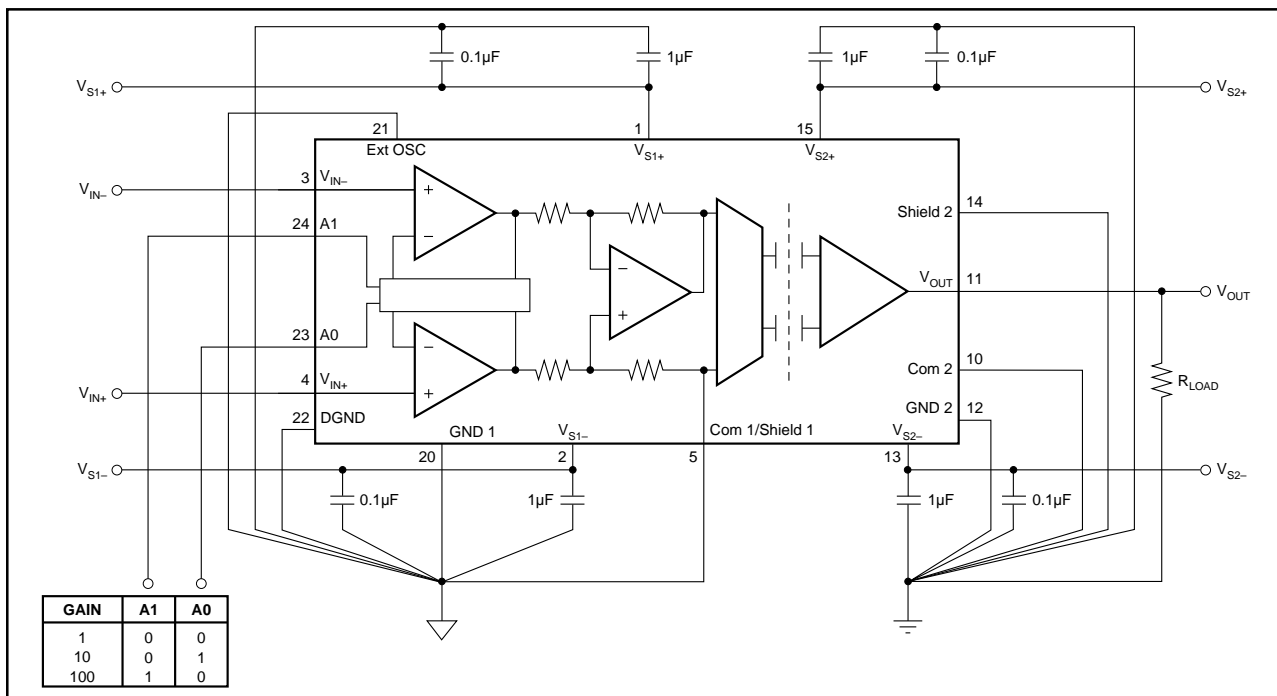


FIGURE 1. Basic Connections.

decrease the dV/dT to 500V/μs for typical performance, but the maximum dV/dT of 20kV/μs remains unchanged.

Leakage current is determined solely by the impedance of the barrier capacitance and is plotted in the “Isolation Leakage Current vs Frequency” curve.

ISOLATION VOLTAGE RATINGS

Because a long-term test is impractical in a manufacturing situation, the generally accepted practice is to perform a production test at a higher voltage for some shorter time. The relationship between actual test voltage and the continuous derated maximum specification is an important one.

Historically, Burr-Brown has chosen a deliberately conservative one: $V_{TEST} = (2 \times AC_{rms} \text{ continuous rating}) + 1000V$ for 10 seconds, followed by a test at rated ACrms voltage for one minute. This choice was appropriate for conditions where system transients are not well defined.

Recent improvements in high-voltage stress testing have produced a more meaningful test for determining maximum permissible voltage ratings, and Burr-Brown has chosen to apply this new technology in the manufacture and testing of the ISO164 and ISO174.

Partial Discharge

When an insulation defect such as a void occurs within an insulation system, the defect will display localized corona or ionization during exposure to high-voltage stress. This ionization requires a higher applied voltage to start the discharge and lower voltage to maintain it or extinguish it once started. The higher start voltage is known as the inception voltage, while the extinction voltage is that level of voltage stress at which the discharge ceases. Just as the total insulation system has an inception voltage, so do the individual voids. A voltage will build up across a void until its inception voltage is reached, at which point the void will ionize, effectively shorting itself out. This action redistributes electrical charge within the dielectric and is known as partial discharge. If, as is the case with AC, the applied voltage gradient across the device continues to rise, another partial discharge cycle begins. The importance of this phenomenon is that, if the discharge does not occur, the insulation system retains its integrity. If the discharge begins, and is allowed to continue, the action of the ions and electrons within the defect will eventually degrade any organic insulation system in which they occur. The measurement of partial discharge is still useful in rating the devices and providing quality control of the manufacturing process.

The inception voltage for these voids tends to be constant, so that the measurement of total charge being redistributed within the dielectric is a very good indicator of the size of the voids and their likelihood of becoming an incipient failure. The bulk inception voltage, on the other hand, varies with the insulation system, and the number of ionization defects and directly establishes the absolute maximum voltage (transient) that can be applied across the test device before destructive partial discharge can begin. Measuring the bulk extinction voltage provides a lower, more conservative voltage from which to derive a safe continuous rating. In production, measuring at a level somewhat below the expected inception voltage and then derating by a factor related to expectations about system transients is an accepted practice.

Partial Discharge Testing

Not only does this test method provide far more qualitative information about stress-withstand levels than did previous stress tests, but it provides quantitative measurements from which quality assurance and control measures can be based. Tests similar to this test have been used by some manufacturers, such as those of high-voltage power distribution equipment, for some time, but they employed a simple measurement of RF noise to detect ionization. This method was not quantitative with regard to energy of the discharge, and was not sensitive enough for small components such as isolation amplifiers. Now, however, manufacturers of HV test equipment have developed means to quantify partial discharge. VDE in Germany, an acknowledged leader in high-voltage test standards, has developed a standard test method to apply this powerful technique. Use of partial discharge testing is an improved method for measuring the integrity of an isolation barrier.

To accommodate poorly-defined transients, the part under test is exposed to a voltage that is 1.6 times the continuous-rated voltage and must display less than or equal to 5pC partial discharge level in a 100% production test.

APPLICATIONS

The ISO164 and ISO174 isolation amplifiers are used in three categories of applications:

- Accurate isolation of signals from high voltage ground potentials
- Accurate isolation of signals from severe ground noise and
- Fault protection from high voltages in analog measurements