FEDC CORE Electrical Test Support Questionnaire

Rev. 1

May 24, 2021

1. Please provide a general description of your sample:
   1. Terminals:
      1. 2-T (resistor, diode, capacitor, other);
      2. 3-T (transistor, thyristor, other);
      3. 4-T (Kelvin, MOSFET with bulk terminal, other);
      4. >4 terminal
   2. Physical construction and materials composition
   3. Electrical model for the device

*Reason for asking: We need to understand the nature of the device to be tested as this will impact the configuration of the test instrumentation. For example, a four-terminal device may require a customized probe configuration or a parameter analyzer with four dedicated SMUs (Source-Measure Units). Virtually any electronic device should be ultimately describable in terms of fundamental electrical parameters: capacitance, resistance, inductance, Thevenin voltage sources and Norton current sources.*

*A photo or diagram of the device to be tested is always helpful and may be essential for us to understand novel configurations.*

1. What is your sample configuration?
   1. (wafer, square substrate, cleaved sample, etc.)
   2. (glass, silicon, flexible, etc.)
   3. Sample size (150mm wafer, GEN II panel, etc.)

*Reason for asking: We have several probe platforms, both manual and automated. The sample configuration will determine which platforms are suitable.*

1. Please provide a general description of your test needs:
   1. IV test
   2. CV, Cf sweeps
   3. Transistor sweeps
   4. Resistance, Kelvin
   5. Other (See Ques. 5)

*Reason for asking: We first need to make a general assessment as to whether we have the necessary capabilities and instrumentation to meet your needs. In some cases we may be able to add or enhance a capability at additional time/cost. A tabulation of the anticipated input* ***and output*** *parameters and ranges should be included. This is needed to verify that our instrumentation can function withing the needed operational ranges. This information also helps in setting compliance limits to help protect both the instrumentation and device under test (DUT) from electrical damage.*

1. Do you require a backside contact / conductive test chuck?

*Reason for asking: The availability of a conductive chuck depends on the probe platform.*

1. Do you require dynamic (time-varying, ac, pulse) testing?

*Reason for asking: Our primary capability is for dc characterization. We may be able to provide some degree of dynamic test capability but this will be limited and highly dependent upon the customer’s ability to be an active, informed participant in the test definition and configuration..*

* 1. If the answer to question #5 is “yes” please provide timing diagrams for all device input/output terminals as well as measurement timing requirements (e.g., “measure the drain current 50us after termination of the gate pulse”)
  2. If you have a diagram for a preferred instrumentation configuration, please provide that as well.

*Reason for asking: Correct configuration of a dynamic test requires a detailed description of the test requirements and strongly interacts with the instrumentation capability. For example, if you are trying to measure a femto-ampere level current in a time window of a few micro seconds, you are asking to violate the laws of physics. An instrumentation diagram can enable us to understand your test requirements and goals better.*

1. Approximately how many measurements do you anticipate acquiring?

*Reason for asking: If you only need to make a few measurements, or a few tens of measurements a manual probe station and manual test instrument interface will likely suffice. In the language of the semiconductor industry, this makes it easy to “touch the silicon.” Once you get into the realm of hundreds to thousands of measurements, test automation becomes necessary.*

1. What are the range(s) of test voltages you anticipate?

*Reason for asking: Our IV, transistor test instruments differ in their voltage capabilities and current sensitivities. Testing at high voltage, for example, may require the usage of interlocks and the acceptance of reduced current sensitivity.*

1. What are the lowest / highest currents you need to measure?

*Reason for asking: Our IV, transistor test instruments have different current source capabilities (which depend on voltage range.) Measurements of very low current (nA, pA, fA) may require special test fixturing (i.e., guarded connections) and even customized sample configuration.*

1. Other test conditions & ranges (frequency, waveform, timing, etc.)?

*Reason for asking: Trying to be thorough here and to learn as much as possible.*

1. Can you provide a CAD drawing (dxf, GDSII, Gerber, etc.) for your test pads and alignment features on your sample?

*Reason for asking: In order to set up automated probing, we need to “teach” the prober to locate known features and to have exact positional information so that the system can align (calibrate) and “drive” to the devices to be tested.*

1. Do you have a “golden sample” available with known characteristics?

*Reason for asking: A DUT with known behavior is valuable for confirming the test setup and proper instrument operation. This is especially important when you are using a shared test resource that may be altered by other users. If you do not have a golden sample you should at least have an idea of what to expect when your device is tested, i.e. you should be able to predict your results based on device theory or a target specification for your device performance.*

1. Any special test conditions?
   1. Dark / illuminated
   2. Low temp / elevated temp
   3. Other?

*Reason for asking: Again, this is to help us understand the test needs and to determine how our capabilities map into those needs.*

**Comments and Recommendations:**

Please realize that while we act as consultants for the instrumentation we offer, we know nothing about the devices you intend to test. Our expectation is that you are the content experts for your devices. In an industrial setting, the device architect /circuit designer is expected to author a complete test and validation plan prior to bringing any component to the test facility. Planning and preparation will pay big dividends by minimizing your test time ($ cost $) and in the interpretation of your data. Quick start guides and/or manuals are available on the AEP Core web site for all of the instruments offered. While we can assist in the instrumentation setup, the user is responsible for proper and safe operation as well as interpretation of the test results. Asking questions and technical discussion is encouraged, but if you are unwilling to invest the time needed to become familiar with instrument theory and operation (i.e., “Read the manual.”) we are going to have the same lack of enthusiasm for your work. On the other hand, if you make a genuine effort to become knowledgeable we will support that effort. We are privileged to see really interesting research by some users and welcome the opportunity to contribute to their success.