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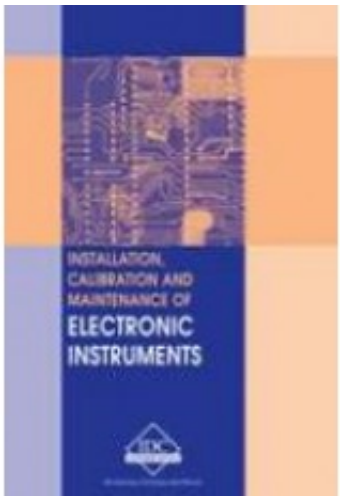
CD-E - Installation, Calibration and Maintenance of Electronic Instruments



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Short Description

This manual is designed for engineers and technicians from a wide range of abilities and backgrounds and will provide an excellent introduction in installation, calibration, commissioning and maintenance of electronic instrumentation. The manual starts with coverage of the basics on electrical measurements and some tips and tricks.

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Instrument performance and calibration principles are then covered with rules for calibrating transmitters. Hereafter the procedures for calibrating and installing smart transmitters are covered.

Typical documentation requirements for instruments are examined with a focus

on instrument data sheets, P&ID's and wiring diagrams. During the life span of any plant, a multitude of different vendors will supply plant modifications and equipment as the plant is continuously enhanced.

The quality of the documentation produced will vary enormously with each new supplier. Instruments in hazardous areas are then detailed. The manual is then finalised with a discussion on integration of the entire system and testing and commissioning procedures for instruments detailed.

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Installation, Calibration and Maintenance of Electronic Instruments - Maintenance

1 Maintenance

1.1 Corrective/preventative/predictive maintenance of instruments

A combination of any actions carried out to retain an item in, or restore it to, conditions in which it is able to meet the requirements of the relevant specification and perform its required functions is termed as maintenance. Maintenance is reduced when there are fewer pieces that will wear, need to be replaced or need to be assembled. There are also savings in the time it takes to service, repair and replace, with the associated procedures being simplified.

Preventative maintenance refers to performing proactive maintenance in order to prevent system problems. This is in contrast to troubleshooting, diagnostic or corrective maintenance, which is performed to correct an existing problem.

Corrective maintenance, as opposed to preventative maintenance, is that which is performed only when equipment or a process breaks down.

Predictive maintenance can be defined as the practice of identifying production equipment that needs maintenance attention before its performance reaches a point where product quality is reduced or an unplanned shutdown occurs. The key to a successful maintenance requirement plan is information about the

condition of the equipment.

Some points to be noted while performing maintenance of instruments:

- A program for preventive and corrective maintenance of instruments should be established and documented.
- Preventive and corrective maintenance should be performed using components and procedural recommendations at least as stringent as those specified by the manufacturer of the instrument.
- The instruments should undergo calibration prior to use following any preventive or corrective maintenance or any adjustment that voids the previous calibration.

1.2 Troubleshooting

Troubleshooting refers to diagnostic or corrective maintenance, which is performed to correct an already-existing problem. This is in contrast to preventive maintenance, which refers to performing proactive maintenance in order to prevent system problems.

We will be looking at the following aspects in this section.

- Determine the relationship between the symptom and cause of a problem
- Conduct a fault analysis

1.2.1 The symptom and the cause

The troubleshooting of electronic circuits involves three steps, which should be done in a specific order. The first step is to identify the defect in the circuit. The second step includes fault analysis and determination of the possible causes. The third step is fixing the problem.

First, it is important to identify the problem. In other words, we have to recognize the symptoms in the defective circuit. A defective circuit can be defined as one where the output parameters are incorrect, although the input parameters are correct. For example, the input signal of the amplifier, depicted in Figure 1.1 is correct, but there is no signal at the output. In this case, the symptom is lack of voltage at the output.

Figure 1.1

This particular symptom does not provide much information about the possible causes of the defect. The failure of various components in the circuit will result in the same symptom (zero voltage at the output). In other cases, a particular symptom points directly to a certain area where the fault is most likely to have occurred. For example, a dc voltage at the output with the level equal to the supply voltage indicates that there is a transistor in a cutoff condition in the circuit. Starting from the stage closest to the output and going backwards, all transistors have to be checked for an internally open pn-junction. The soldered joints and the values of the emitter resistors also have to be checked.

If the amplifier is not defective, the amplified signal appears at the output. The amplitude of the output signal is approximately equal to the value of the rectified power supply. The waveform has to be an exact amplified replica of the input signal, without any kind of distortion.

1.2.2 Troubleshooting techniques

Once the symptom is identified, the reasons that cause it have to be determined. The choice of which of several methods to use depends on the circuit complexity, on symptoms and on the personal preferences of the technician. The most common troubleshooting techniques are listed below:

- **Power check.**This is the first thing you should do. It is amazing how many times a simple issue such as a blown fuse or a flat battery is the cause of the circuit malfunction. So, initially, ensure that the power cord is plugged in and that the fuses are not blown. If the circuit is powered by batteries, make sure that their voltage level is acceptable. If a power supply rectifier is present, check the level of the voltage at the output and make sure that the circuit is powered with the correct polarity.
- **Visual inspection**. This inspection is part of the so-called sensory checks. Sensory checks rely on your senses to detect a possible fault. The visual inspection of the PCB is the simplest troubleshooting technique (and is very effective in half of the cases). The soldered joints have to be inspected thoroughly. If any doubt exists about the quality of a certain joint, it has to be re-soldered. The PCB has to be inspected visually for any burnt components. Sometimes, components that overheat leave a brownish mark on the board. They can be used as “starting points” in the troubleshooting process and the reasons why they overheated must be determined. It is bad practice simply to replace such components without trying to find out what actually caused the

component to overheat. In many cases, the reason is a faulty (or out of range) component in the vicinity of the failed component. It must also be replaced.

- **Using a sense of touch**. This is another sensory check. Overheated components can be detected by simply touching them. However, this check has to be performed with extreme caution. The circuit has to be turned off, and some time allowed for the biggest capacitors to discharge. Always touch the components with your *right*hand only! This is important because in the case of electric shock, it is less likely that the current will pass through your heart. If possible, wear insulated shoes. In addition, care should be taken not to burn your fingers. Using the sense of touch is a very useful troubleshooting technique in circuits, where everything seems to work properly for a while, until the circuit fails, due to overheating of a certain component. Identifying such components helps to detect the possible cause of the fault. Special freezing sprays are available, which allow instant freezing of components. If the circuit begins to operate properly immediately after the heated component is sprayed, this is an indication that this component is causing the circuit failure. Before replacing the component, further investigation is needed to determine what caused the overheating in the first place.
- **Smell check**. When certain components fail due to overheating, it is possible in most cases to detect a smell of smoke. This is usually the case if the technician happens to be there at the time the accident occurred. If not, it is usually possible to detect the failed component by visual inspection afterwards.
- **Component replacement**. This troubleshooting method relies mostly on the operator's skills and experience. Certain symptoms are an obvious indication of a particular component failure. This statement is especially true for an experienced electronic technician. For example, some TV service technicians can unmistakably identify the failed component in a TV set (even before opening it), simply by briefly examining the symptoms. Component replacement is a good troubleshooting technique for an experienced electronics technician, as it saves a lot of time and money. Moreover, this technique guarantees the success of the repair, because if enough components are replaced, eventually the faulty one will be replaced too. However, it is recommended that the amateur technician initially apply some logical thinking to the troubleshooting process.
- **Signal tracing**. This troubleshooting technique is not the most common one but it is the most desirable, as it requires intelligent and logical thinking on the part of the troubleshooter. This method is based on the measuring of the signal at various test points along the circuit. A test point

in the circuit is the point where the operator knows the value of the voltage. This troubleshooting technique relies on finding a point where the signal becomes incorrect. Thus, the operator knows that the problem exists in that portion of the circuit, between the point where the signal becomes incorrect, and the point where the signal appeared correct for the last time. In other words, the operator constantly narrows the searched portion of the circuit, until he finds what causes the fault. There are two basic approaches in conducting the signal tracing. In the first approach, the signal check starts from the input, checking consecutively the test points towards the output. The checks are carried out until a point where an incorrect signal is found. The second approach is to start from the output and to work backwards towards the input in the same manner until a correct signal appears.

1.2.3 Fault analysis

Fault analysis requires a good knowledge of theory and analytical thinking. It is not something which can be learned from books but it can be acquired through constant troubleshooting and experimenting. The basic question in fault analysis is: “What would the symptoms in the circuit be, if component X were faulty?” For any given application, there are no ready answers to this question. If there were, many books devoted to industrial electronics would be meaningless. However, there are certain rules which can be adhered to during the troubleshooting process.

ISO 9000/9001

The International Organization for Standardization (ISO) is a worldwide federation of national standards bodies from around 148 countries, one from each country. ISO is a non-governmental organization established in 1947. The mission of ISO is to promote the development of standardization and related activities in the world with a view to facilitating the international exchange of goods and services, and to developing cooperation in the spheres of intellectual, scientific, technological and economic activity. ISO’s work results in international agreements which are published as International Standards.

It is interesting to learn that ISO is not an acronym for International Organization for Standardization, but a Greek word-meaning equal.

ISO standards are developed by technical committees comprising experts from the industrial, technical and business sectors which have asked for the standards, and which subsequently put them to use. These experts may be

joined by others with relevant knowledge, such as representatives of government agencies, testing laboratories, consumer associations, environmentalists, and so on. The experts participate as national delegations, chosen by the ISO national member institute for the country concerned. These delegations are required to represent not just the views of the organizations in which their participating experts work, but of other stakeholders, as well. According to ISO rules, the member institute is expected to take account of the views of the range of parties interested in the standard under development and to present a consolidated, national consensus position to the technical committee.

ISO 9000 is a set of standards for quality management systems that is accepted around the world. Currently, more than 90 countries have adopted ISO 9000 as national standards. When you purchase a product or service from an organization that is registered to the appropriate ISO 9000 standard, you are assured that the quality of what you receive will be as advertised. In addition, with the year 2000 revision of the standard, quality objectives, continual improvement, and monitoring of customer satisfaction provide the customer with increased assurances that their needs and expectations will be met.

The standard intended for quality management system assessment and registration is ISO 9001. The standards apply uniformly to organizations of any size or description.

ISO 9000:2000

Establishes a starting point for understanding the standards and defines the fundamental terms and definitions used in the ISO 9000 family which you need to avoid misunderstandings in their use. In 1987, the International Organization for Standardization (ISO) 9000 standards were developed to ensure that the companies products and services have consistent, documented approaches that meet the International community’s quality requirements.

ISO 9001:2000

This is the requirement standard you use to assess your ability to meet customer and applicable regulatory requirements and thereby address customer satisfaction. It is now the only standard in the ISO 9000 family against which third-party certification can be carried out. ISO 9001 sets out the requirements for an organization whose business processes range all the way from design and development to production, installation and servicing.