OMICRON

Instructions

Network–based CMC Test Sets
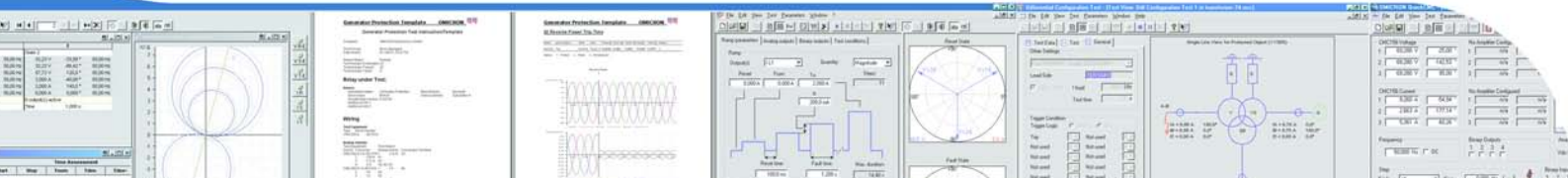
Manual Version CMC-NETWORKING.AE.2

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1 Network-based CMC Test Sets

The following instructions will help you to incorporate network-capable CMC test sets, such as *CMC 256* with NET-1 option, the *CMC 256plus* or the *CMC 356* into a computer network.

For the sake of readability, these instructions use the abbreviation "test set" to refer to any of the network-based CMC test sets.

1.1 Establishing a Physical Connection

Before you begin to work with the test set, you need to establish a physical network connection between the test set and the computer that runs the *Test Universe* software.

You can either use a direct connection from your computer to the test set or use a network with a hub/switch in-between to establish this connection.

Use the ETH1 connector on the test set's rear side and the network cables provided together with the test set. The ETH1 Ethernet connector provides auto-crossover; that way you do not have to use different cables to connect either to a network or directly to a computer.

If you power up the test set, you can check the physical connection with the green link LEDs on the network connectors of both the CMC test set and either the computer or the hub/switch on the other end of the cable.

1.2 Starting the Test Set and the Computer for the First Time

After you have installed the *Test Universe* software on your computer, start the OMICRON Test Universe *Start Page*. Power up the test set that is physically connected to the computer, and wait until the test set has performed its hardware checks (i.e., the relays inside the test set finished clicking). Wait a few more seconds for the sake of safety.

If you then start any test module from the Test Universe *Start Page*, a pop-up message asks to automatically associate the test set to your computer. Press the "Associate" button on the back of the test set once before you confirm the message with "Yes". After that you should be able to work with the test module and the test set.

If you do not get the above mentioned pop-up message box, and the test module is running offline, follow the instructions of chapter 1.3 "Setting Up the Connection between the Test Set and the Computer" on page 6.

1.3 Setting Up the Connection between the Test Set and the Computer

If you did not succeed with the instructions in the chapter 1.2, setup the connection between the test set and your computer as follows:

- Close all *Test Universe* software modules.

- Start the *Test Set Association and Configuration* tool from the OMICRON Test Universe *Start Page*. You find the corresponding hyperlink "Test Set Association" in the "Setup" section of the *Start Page*.

- Power up the test set and wait until it has performed its hardware checks (i.e., the relays inside the test set finished clicking). Wait a few more seconds for the sake of safety. You should now see the test set with its serial number listed in the *Test Set Association and Configuration* tool. If you do not see the test set listed, refer to chapter 3 "Troubleshooting" on page 11.

- If the status column of the list of test sets displays the message: "Test set is not associated to this computer...", use the ASSOCIATE command of the *Test Set Association and Configuration* tool. A message box reminds you to press the "Associate" button on the back of the test set before you confirm the message box.

Now the test set should be ready to use.

☞ If the status column of the list of test sets displays the message: "IP configuration of test set and computer are incompatible...", use the SET IP CONFIGURATION... command of the *Test Set Association and Configuration* tool. The tool will propose a valid IP configuration for the test set. If you accept this and then associate the test set as explained above, the test set should be ready to use.

2 Communication of CMC Test Set and Computer via Network

2.1 Principles of Network Communication

The CMC test set and the computer that runs the OMICRON *Test Universe* software communicate via an Ethernet network connection. The physical connection between these two devices is established by network cables plugged into the network connectors on both the test set and the computer.

The network connection can be either a direct point-to-point connection with a single cable from the test set to your computer, or the test set and the computer are connected to a computer network with hubs/switches and other network and computer equipment to interconnect multiple devices in-between.

Every Ethernet network adapter has a world-wide unique MAC address (**M**edia **A**ccess **C**ontroller), which is a 48 bit number (e.g., 00:50:C2:20:F0:18), but which is normally not seen by the end-user and which cannot be changed.

For communication of the computer with the test set the TCP/IP protocol (**T**ransmission **C**ontrol **P**rotocol/**I**nternet **P**rotocol), which is well known from the Internet, is used. For TCP/IP every network adapter has to have a logical IP address, which is a 32 bit number (e.g. 172.22.1.213).

An IP address has a subnet mask associated to build different logical networks on a single physical network (e.g. 255.255.0.0). Network adapters on the same subnet need to have the same numbers in their IP address where the bits in the subnet mask are 1. E.g., for the subnet mask 255.255.0.0 the first two 8 bit numbers of the IP address need to be identical (e.g. 172.22.*.*).

Within bigger computer networks IP addresses are set automatically from a server via DHCP (**D**ynamic **H**ost **C**onfiguration **P**rotocol). Then both the IP configuration of the test set and your computer are set to obtain the IP address automatically.

If there is no DHCP server available, AutoIP/APIPA (**A**utomatic **P**rivate **IP A**ddressing) will generate a random IP address out of the range 169.254.*.*.

As an alternative the IP addresses of all the network adapters can be set manually to fixed numbers, which are then called static IP addresses. All IP addresses within a network need to be different so that they do not conflict. Such static IP addresses are managed by network administrators manually so that there are no conflicting addresses on the network.

Via a router, with TCP/IP it is possible for two partners that are not on the same network to communicate. Therefore the gateway IP address has to be set for the network adapter, which identifies the IP address where all the traffic is sent to, which is not within the own logical IP network (deduced from the own IP address and subnet mask).

The OMICRON *Test Universe* and the test set additionally use UDP (**U**ser **D**atagram **P**rotocol also from the Internet protocol suite), to find test sets in the network and to do settings within the test set.

To find test set test sets on the network, the test sets communicate their presence with IP-multicast packets, which everyone can receive. For routers and gateways it is necessary to configure them to allow IP-multicasting to pass.

The endpoint of a TCP/IP connection from one partner to another is associated with a port, which is identified by its port number. Well-known port numbers are used for servers so that clients can establish a connection to a known endpoint (e.g., HTTP is using port number 80).

A firewall is used to block certain unwanted network traffic, e.g., by blocking traffic to certain port numbers on a specific endpoint. Most server applications run within the test set. The programs on the PC communicating with the test set are clients (except for the OMFIND service). Only the OMFind service running on your computer needs to be allowed to pass a personal firewall.

For the communication of the OMICRON test modules to the test set the DCOM (**D**istributed **C**omponent **O**bject **M**odel) from Microsoft is used on top of the TCP/IP connection. DCOM has to be configured on the controlling PC and allowed to have access through your personal firewall.

2.2 Communication Features of Network-Based CMC Test Sets

Network-based CMC test sets have two Ethernet connectors: ETH1 and ETH2.

ETH1 is a 10/100BaseTX twisted pair Ethernet connector with auto-crossover. It is full duplex with auto-negotiation for 10 and 100 MBit/s. ETH1 is typically used to control the test set from a computer.

ETH2 is 100BaseFX fiber optical Ethernet connector with an MTRJ connector. It is full duplex 100 MBit/s.

The network settings for the test set are done by means the *Test Universe* software running on your computer. *Test Universe* software defines the network setup of the individual test set(s) according to the requirements of your computer or company network. However, *Test Universe* will never change any basic network settings of your computer; that way you will always be able to continue working within your previous environment.

Any network-based test set supports separate settings for the IP configuration of the two adapters. Both of them support static IP addresses, DHCP and AutoIP/APIPA (Automatic Private IP Addressing). For AutoIP the test set will automatically choose a random IP address from the range 169.254.*.* with a subnet mask 255.255.0.0.

Additionally, there is a DHCP server in the test set, which will provide your computer with a valid IP address if there is no other DHCP server, e.g., when using a point-to-point connection. This is done to speed up the connection time after powering up the test set without the need to reconfigure the IP settings of your computer.

Within the *Test Universe* software, there is the OMFind service to find a test set in the network and to do basic network settings within the test set using UDP via IP-multicasting on multicast IP address 234.5.6.7. If you have your computer and the test set in a company network, possibly present routers have to be configured to allow IP-multicasting with UDP in both directions from your computer to the test set and then back.

If you have a personal firewall on your computer then you have to allow the OMFind service to use port 4987 for inbound UDP traffic, since the test set will send UDP packets to announce its presence on the network to this port. Additionally OMFIND.exe and CMEngAI.exe have to do outbound network traffic.

For firewalls within gateways or proxies in between the network, the servers running within the test set have to be accessible with their ports from your computer (DCOM, Telnet, TFTP, FTP, HTTP and port 4988 for UDP used by the OMFind service).

2.3   System Requirements for Your Computer

In addition to the system requirements for running the OMICRON *Test Universe* 2.0 software (or later) on your computer, working with a network-based test set calls for the following requirements:

- Operating system Microsoft Windows 2000, XP or Vista
- Ethernet network adapter
- TCP/IP network protocol installed (this is installed for Windows 2000, XP or Vista by default)
- DCOM protocol installed and enabled (this is installed and enabled for Windows 2000, XP or Vista by default.)

2.4 Association of the Test Set with Your Computer

For the OMICRON *Test Universe* software to work with a test set connected to your computer via a network connection it is necessary that the user explicitly associates the test set with the computer. This is due to security reasons to avoid that someone takes control over someone else's test set connected to the same network.

To establish this association you have to press the "Associate" button on the back of the test set when the corresponding dialog from the *Test Universe* software running on the computer requests it, as it is described in chapter 1 "Network-based CMC Test Sets". If there is only one test set found in the network and it is currently not associated to any computer (which is the case for the factory defaults), the association can be done automatically during the first startup of a test module. Otherwise the association can be done within the *Test Set Association and Configuration* tool.

From then on a test set once associated to your computer can be used without any user interaction. For the association, the MAC address of the corresponding computer is remembered. Therefore, if you change the network adapter or switch between different adapters on your computer then you have to renew the association.

Optionally, it is possible to have multiple computers associated with a single test set simultaneously and to establish an association without the need to explicitly press the "Associate" button. See the online help topics of the *Test Set Association and Configuration* tool for details.

3 Troubleshooting

The following instructions will give you some hints on how to troubleshoot connection problems that may occur around network-based test sets.

3.1 The Test Set Does not Appear in the List of Test Sets within the Test Set Association and Configuration Tool

- First turn on your test set and check for a proper physical connection of both the test set and your computer. The green link LED of the network connectors indicate proper cabling.

- Close all *Test Universe* software modules. Start the *Test Set Association and Configuration* tool from the OMICRON Test Universe *Start Page*. You find the corresponding hyperlink "Test Set Association" in the "Setup" section of the *Start Page*.

- Turn the test set that is connected to the network cable off and then back on again. Wait until the test set has performed its hardware checks (finished clicking of the relays within the test set), then wait a few more seconds.

- If the test set does not appear in the list then check for proper configuration of any personal firewall or network protection software on your computer as described in FAQ 4.11 on page 17, or temporarily disable your firewall program.

- If the test set still does not appear in the list, try to use a direct point-to-point connection between the test set and your computer (without any network in between) and turn the test set off and on again.

- If the test set still does not appear in the list, check your IP address settings for conflicting IP address, and eventually reset the IP setting as described in FAQ 4.2 on page 13.

- You may have to reboot your computer to get a correct setup of the network settings of your computer.

- If this still does not work then check the status LED A on the back of the test set. If the LED is not lit you probably have to reset the device to factory defaults to recover from a corrupt flash file system, or do an emergency firmware upgrade as described FAQ 4.10 on page 17.

- If you cannot see the test set within a network but it works with a direct connection, check FAQ 4.12 on page 18 or ask your network administrator for assistance.

3.2 The Test Set Appears in the List of Test Sets but Cannot be Used from a Test Module

-   If the test set does appear in the list of test sets within the *Test Set Association and Configuration* tool then check the messages in the status column of the corresponding test set.

-   Check for proper IP configuration of the test set and possibly set the IP configuration with the SET IP CONFIGURATION… command. Accept the suggested settings for a unique IP address compatible to the IP address of your computer.

-   Additionally check whether the test set is associated with your computer as described in the chapter 1 "Network-based CMC Test Sets" on page 5.

4 FAQ (Frequently Asked Questions)

4.1 What Network Cables Can I Use with ETH1 Connector?

For the ETH1 connector you can use any twisted pair category 5 Ethernet cable. You do not have to use a special cross cable for a direct connection to your computer, since the test set's ETH1 port will do auto-crossover.

Check the green link LEDs on both sides, the test set and your computer or network switch/hub for proper cabling.

4.2 How Can I Reset the IP Configuration of the Test Set to Factory Defaults?

The factory default IP configuration of the test set is DHCP/AutoIP. If you have set a static IP address for the test set then you can reset the IP configuration to the factory defaults if you press the "Associate" button on the back of the test set while you turn on the test set.

This could be necessary if you have conflicting static IP addresses in your network and cannot see the test set in the *Test Set Association and Configuration* tool. After resetting the test set to DHCP/AutoIP you should see it in the *Test Set Association and Configuration* tool and be able to set a compatible static IP address again.

4.3 How Can I Work with a Computer with Two Network Adapters?

You can connect the test set to any of your computer's network adapters. If you have two network adapters then you can use one adapter to connect to your company network and use the other one to connect to the test set only. Then the test set is available only on your PC and cannot be accessed via the company computer network.

It is suggested to use static IP addresses for a dedicated network connection to the test set as described in the next FAQ.

4.4 How Can I Speed Up the Start of the Test Set with Static IP Addresses?

Static IP addresses for both the test set and your computer provide the fastest startup time for the test set and the *Test Universe* software on your computer, since there is no time delay due to the distribution of IP addresses via DHCP or AutoIP. Therefore it is necessary to configure both your computer and the test set with compatible static IP addresses.

First you have to set the IP address of the network adapter of your computer where the test set is connected to a static IP address. This is done in the Internet Protocol (TCP/IP) Properties settings of the Network Connections settings within Windows. Ask your system or network administrator for help on how to change the network settings on your computer.

E.g., you could set the IP address of your computer to 192.168.0.1. Then you have to set the IP address of the test set via the *Test Set Association and Configuration* tool to a compatible IP address. Accept the address suggested automatically or choose a compatible address manually (for the computer configured as above e.g., use 192.168.0.2). IP addresses have to be different for every network adapter on the same network.

If you do not want to change the IP configuration of the network adapter in your computer, which you normally use to connect to your company network, you can use a second network adapter, e.g., a PC-card in a notebook, with static IP address configuration exclusively to be used with the test set and a point-to-point connection. Do not use the second statically configured network adapter to connect your comptuer to the company network.

4.5 How Can I Access the Test Set Association and Configuration Tool from a Test Module?

The *Test Set Association and Configuration* tool is accessible from a test module via the **Hardware Configuration** settings on the **General** page. If you choose "Configure Test Sets connected by Network" in the test sets combo box on the top left, the *Test Set Association and Configuration* dialog box is shown.

4.6   What is the ETH2 Interface Used for?

The fiber optical ETH2 interface is available as an alternative network adapter to the ETH1 interface. For future applications in substation communications, it will be used simultaneously with the ETH1 interface. Some of the emergency procedures like recovering from a failed firmware upgrade are only possible with the ETH1 interface.

4.7   What Do the Status LEDs at the Back of the Test Set Mean?

The status LED A (yellow) indicates that the test set is ready to be controlled by a computer. This LED lights up after the hardware checks in the test set are finished and the test set is properly connected to a PC or a computer network.

If the status LED A is not on, consult section 4.10 on page 17. In that case the LED B (green) signals the following conditions:

LED B (green) blinks slowly: CMC test set waits for a download
                                 (TFTP-download) of a software-image.

LED B (green) lit: TFTP-download of software-image in progress.

As long as the status LED B (green) is blinking, the test set is writing to the flash memory. Do not turn off the test set as long as the writing is in progress.

4.8 How Do I Do a Firmware Image Upgrade/ Downgrade for the Test Set?

A normal firmware image upgrade/downgrade is done from the *Test Set Association and Configuration* tool with the Up-/Downgrade Software command.

First you have to choose the image file to be used, which is provided with your *Test Universe* installation. Then you get a download dialog where you are asked to press the "Associate" button on the back of the test set to initiate the download. After transferring the software image file to the test set, the information will be written to the flash memory. This procedure can take a while, where you may not turn off the test set. Otherwise, you have to follow the procedure described in FAQ 4.10 on page 17.

If the firmware image upgrade was successful then the test set will restart automatically. Sometimes a firmware image upgrade will need to reformat the flash memory upon the next restart of the test set. This process can take up to a minute. So be patient after the reboot until you see the test set again in the list of test sets within the *Test Set Association and Configuration* tool.

If the download of the firmware image cannot be done successfully via your network connection you should connect the test set directly to your computer (without any network equipment in between) and try again.

4.9 How Can I Recover from a Corrupt Flash File System?

Due to a power failure during a write operation to the flash memory under certain circumstances it can happen that the flash file system gets corrupted. Then the device will not start up properly, and the status LED A (yellow) will not be on. To recover from this fault you have to do the following:

Press the "!" button on the back of the test set with a pointed tool such as a paper clip about one to two seconds after you turned on the device, and keep the button pressed until the LED A (yellow) is on. If you press the "!" button at the moment you turn on the test set, you will recover from a failed firmware image upgrade as described in section 4.10. If you do not want to do an image upgrade, just turn off the device and try again.

After you pressed the "!" button successfully until the status LED A (yellow) is on, the flash file system will be formatted. This takes about one minute; the status LED B (green) will blink during that time. Then the test set will be reset to factory defaults and ready to be operated from any PC again.

4.10 How Can I Recover from a Failed Firmware Image Upgrade?

Due to an unsuccessful firmware up-/downgrade or due to other emergency reasons, the firmware image within the test set can get corrupted. Then you cannot work with the test set properly until you do a new firmware image upgrade successfully.

If the test set shows up in the list of test sets within the *Test Set Association and Configuration* tool after turning it on then do a normal software image upgrade as described in the FAQ 4.8 on page 16 (without the need to press the "Associate" button on the back of the test set).

If the test set does not appear in the list of test sets after turning it on then you should press the "!" button on the back of the test set with a pointed tool such as a paper clip at the moment you turn on the test set. Then you should see the test set in the list and be able to do a software image upgrade.

If this does not help then contact OMICRON for support or repair.

4.11 How Do I Have to Configure a Personal Firewall to Work with a CMC Test Set?

If you have a personal firewall or any other network protection tool installed on your computer then you probably have to configure the firewall to allow the *Test Universe* software to communicate with the test set via a network connection.

For the Windows firewall included with Windows XP SP2 and higher, the configuration of the firewall will be done automatically during the installation of the *Test Universe* software. For other firewall or protection programs see the documentation of the specific program or ask your system administrator on how to do the configuration.

You have to allow the service OMFind.exe for outbound UDP traffic and for inbound UDP traffic on port 4987. Then you should see the test set test set in the list of test sets within the *Test Set Association and Configuration tool*.

Additionally you have to allow CMEngAL.exe to have a DCOM connection to the test set.

4.12 How Can I Setup a Connection to a Test Set behind a Network Router?

You can work with a test set within a network, even if you do not see it in the list of test sets within the *Test Set Association and Configuration* tool, if the network connection is set up properly.

If you know the IP address of the test set in the network (probably because it was assigned a static IP address) and you have an IP connection to the test set, you can add the test set to the list with the TEST SETS/ADD TEST SET command manually.

To check if you have an IP connection to the test set you can use the ping command line utility on your computer as follows:

```
C:\ >ping 172.22.1.15

Pinging 172.22.1.15 with 32 bytes of data:

Reply from 172.22.1.15: bytes=32 time=1ms TTL=128

Reply from 172.22.1.15: bytes=32 time=2ms TTL=128

Reply from 172.22.1.15: bytes=32 time=1ms TTL=128

Reply from 172.22.1.15: bytes=32 time=2ms TTL=128

Ping statistics for 172.22.1.15:

    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

Approximate round trip times in milli-seconds:

    Minimum = 1ms, Maximum = 2ms, Average = 1ms
```

If there is no response, you get timeouts as follows:

```
C:\ >ping 172.22.2.2

Pinging 172.22.2.2 with 32 bytes of data:

Request timed out.

Request timed out.

Request timed out.

Request timed out.

Ping statistics for 172.22.2.2:

    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

In this case check the IP configuration both for the test set and on your computer, especially if you have set the correct gateway IP address. To do IP configuration changes within the test set you have to use another network connection once, probably with a direct cable or from another computer in the network which is within the same IP subnet.

On the other hand you could configure your router or gateway in between the test set and your computer to allow to transfer UDP packets via IP-multicasting to destination address 234.5.6.7. Then the test set should appear in the list of test sets within the *Test Set Association and Configuration* tool automatically.

Please consult your network or system administrator for support or contact OMICRON for advanced connection setup.

4.13 How Can I Recover from an Error in OMFind.exe?

OMFind.exe is a service started automatically together with the *Test Universe* software (e.g., with the *Start Page* or any test module). To recover from an application error in OMFind.exe you have to kill the OMFind.exe service manually.

You can use the Windows Task Manager and choose "End Process" on the **Processes** page for OMFind.exe. If you are not allowed to kill the service you have to use the following command line commands:

```
C:\>net stop omfind

The OMFind service is stopping.

The OMFind service was stopped successfully.
```

If this still does not succeed then reboot your PC.

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