

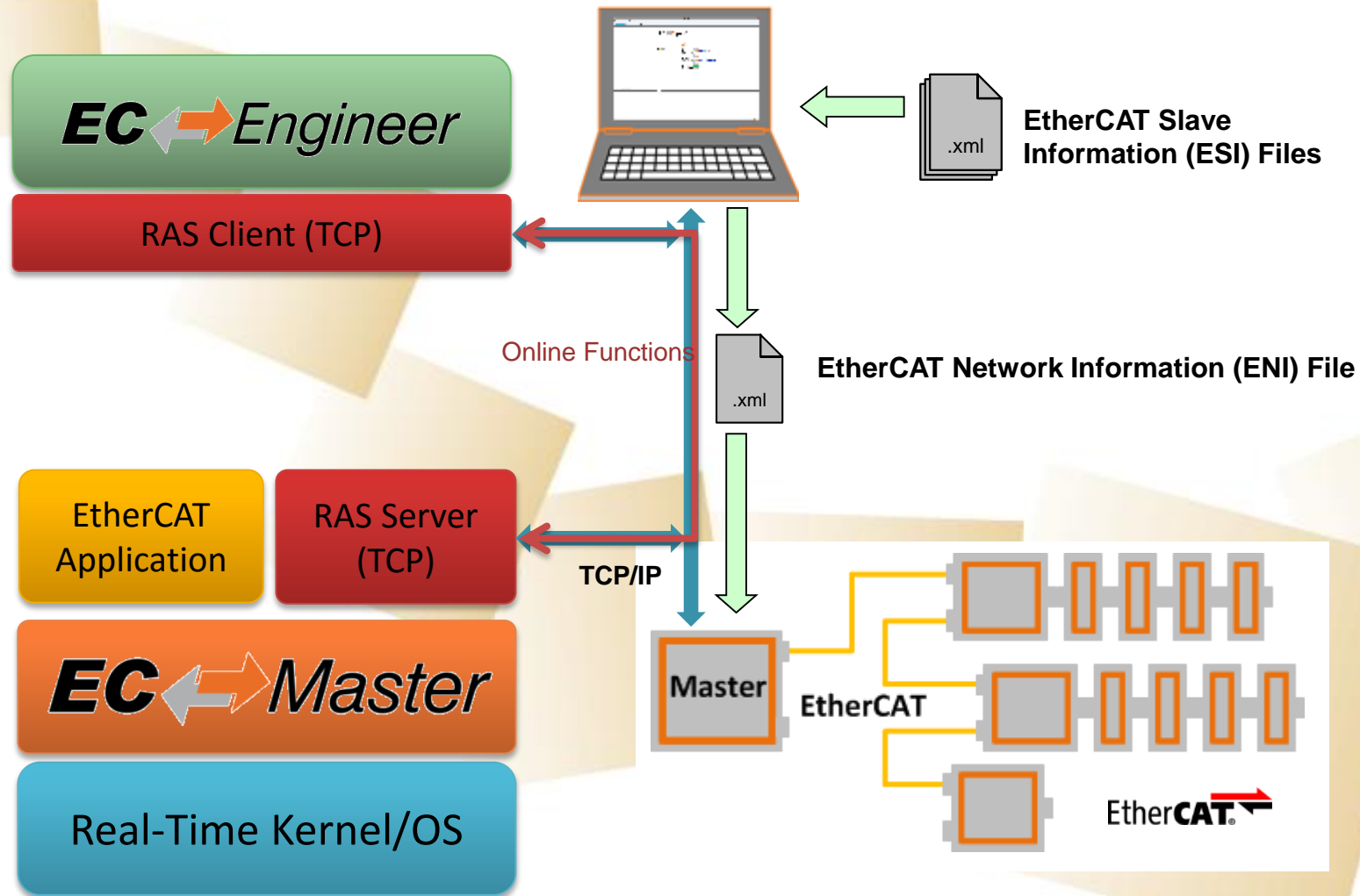
EC-Master EtherCAT Master

Quick Start Guide

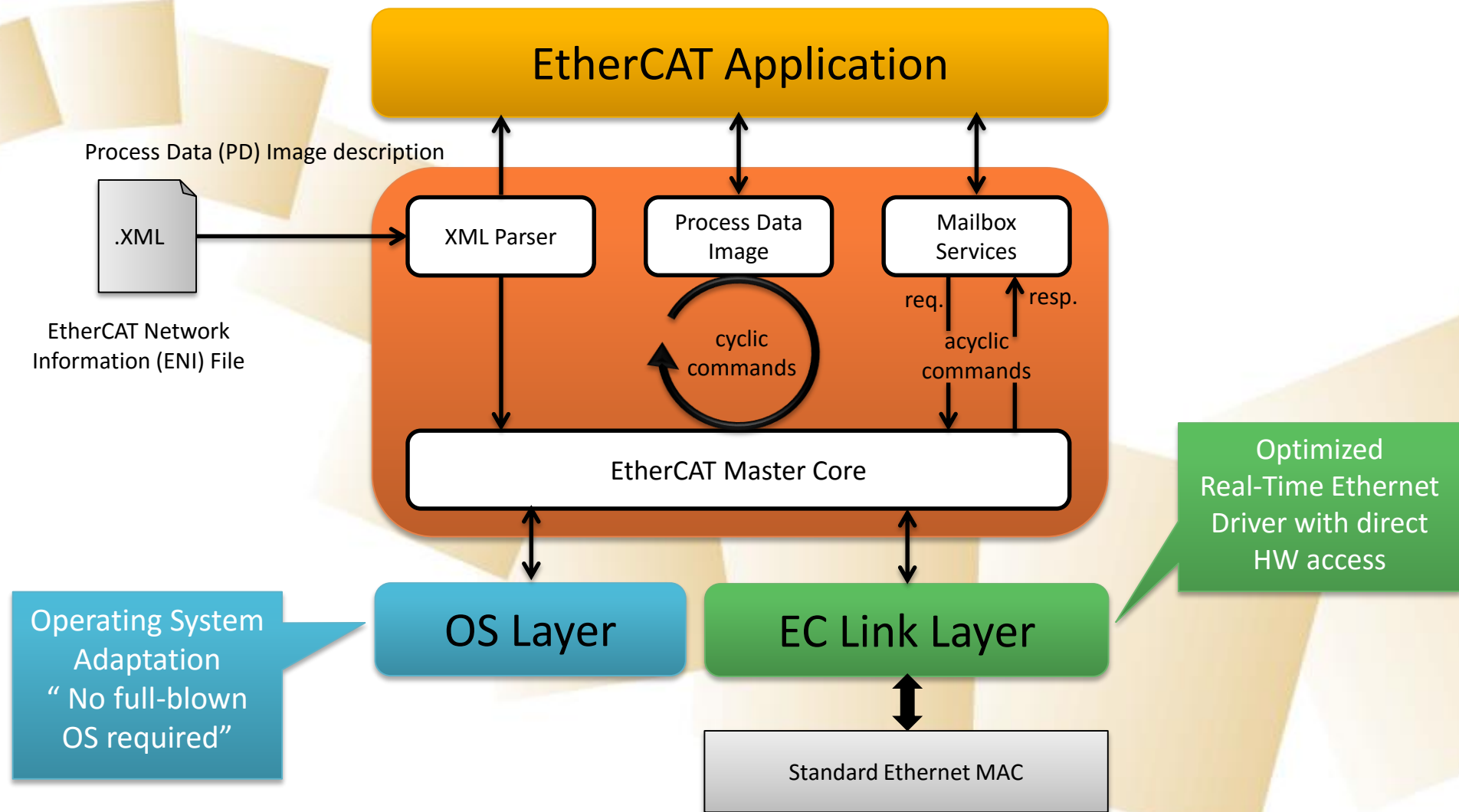
- EtherCAT System Architecture
- EtherCAT Master Architecture
- EtherCAT Master Building Blocks
- Generate bus configuration with EC-Engineer
- Operate slaves with EC-STA EtherCAT Slave Test Application
- Connect EC-Engineer with EC-STA Application
- Next steps

EtherCAT System Architecture

EC  **Master**



EC-Master Architecture



EC-Master according to ETG.1500 Master Classes Directive

Class A Core

- Compare network configuration
- Cyclic process data exchange
- All mailbox protocols: CoE, SoE, EoE, FoE, AoE, VoE
- Slave to slave communication
- **Distributed Clocks with master synchronization**

Class B Core

- Compare network configuration
- Cyclic process data exchange
- Mailbox protocol CoE
- Mailbox protocol SoE
- Mailbox protocol EoE
- Slave to slave communication

Feature Pack
Cable Redundancy

Feature Pack
Hot Connect

Feature Pack
Remote Access

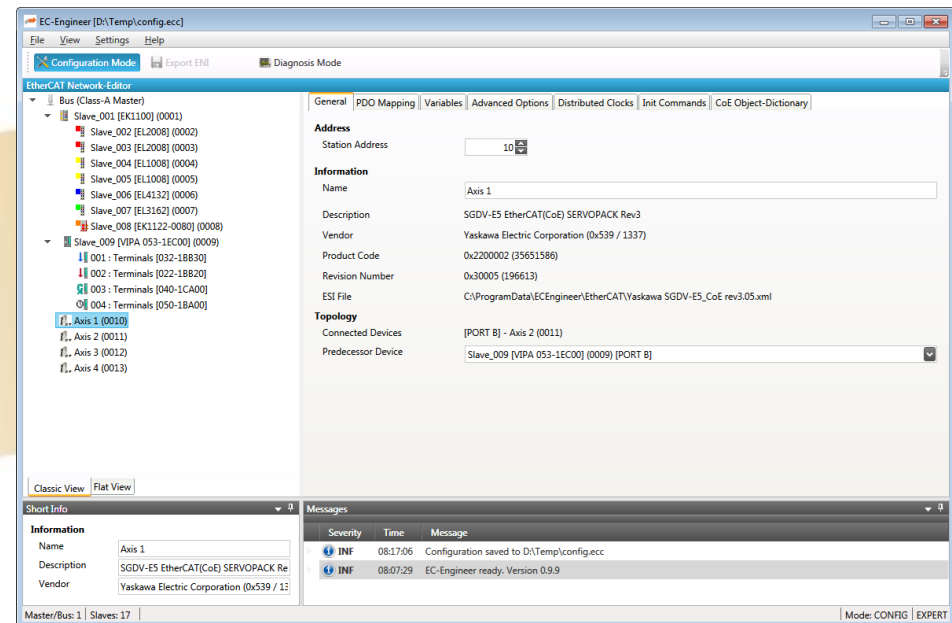
Feature Pack
Superset ENI

Feature Pack
EoE Endpoint

Feature Pack
Master Obj. Dict.

EC-Engineer: Overview

- One single tool for EtherCAT configuration and diagnosis
- Perfect supplement to EC-Master
- Import of EtherCAT Slave Information (ESI) files
- Export of EtherCAT Network Information (ENI) file
- Register here to get a free evaluation version:
<http://www.acontis.com/eng/products/downloads/index.php>



EC-Engineer Operating Modes

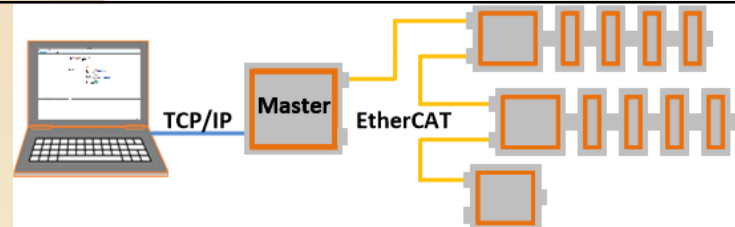
Offline **Configuration:**
(In the Office)



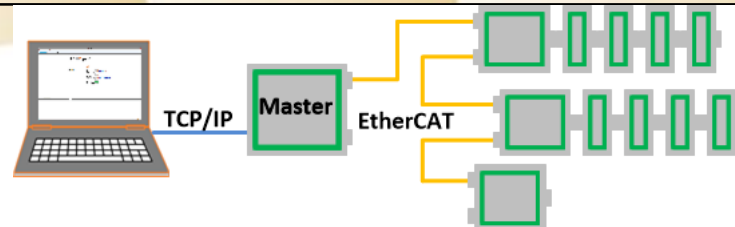
Online **Configuration:**
Slaves connected to
Engineering System



Remote **Configuration:**
Slaves connected to
Target System



Remote **Diagnosis:**
Slaves connected to
Target System



Generate bus configuration with EC-Engineer

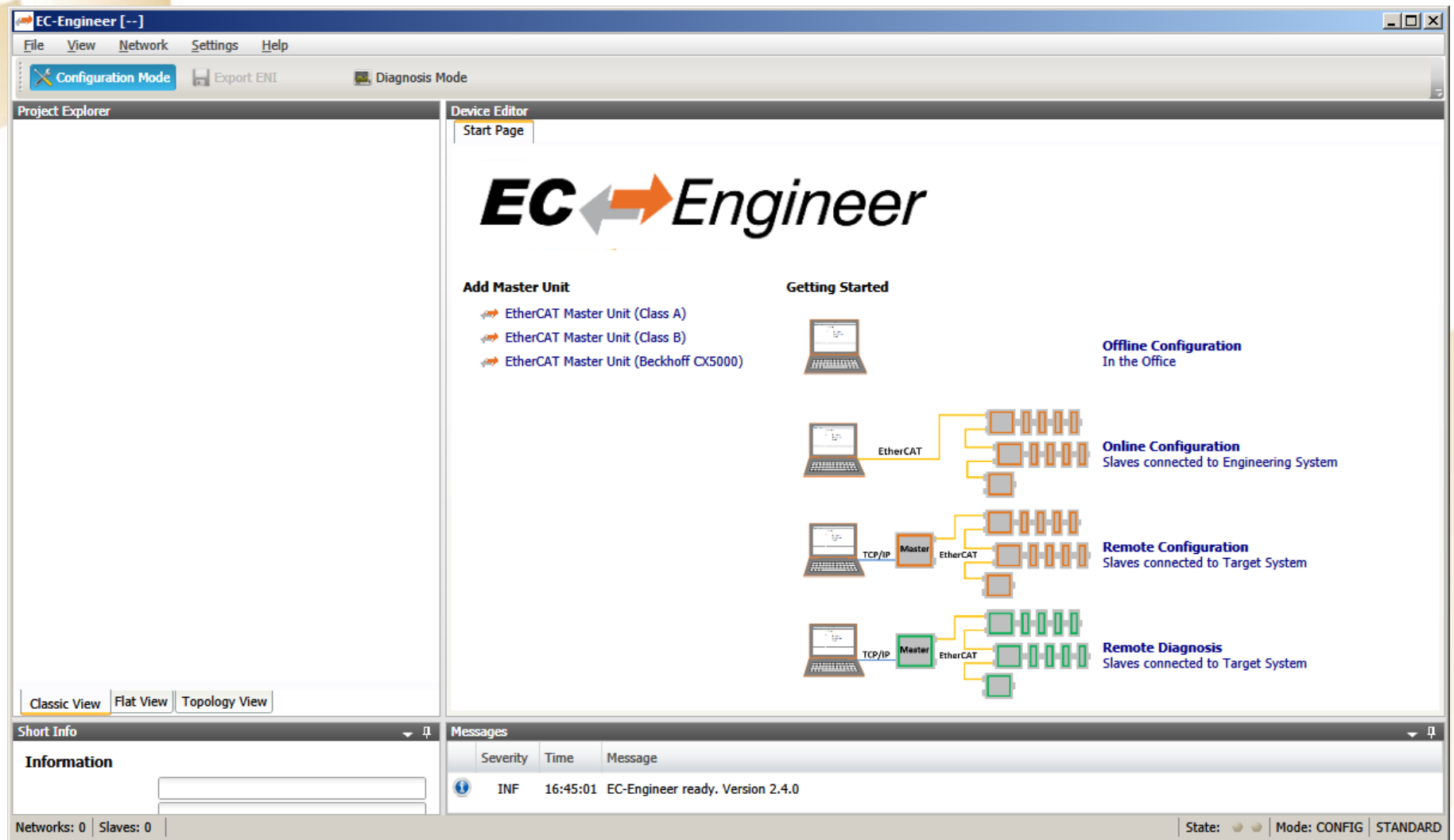
Step 1: Connect EtherCAT Slaves

- EC-Engineer comes with an integrated EtherCAT master for scanning the connected EtherCAT slaves
- Every Ethernet Network Interface with an valid Windows driver can be used
- A second, dedicated Network Interface for EtherCAT is recommend
- Warning: Do not connect any EtherCAT slaves to your Office LAN



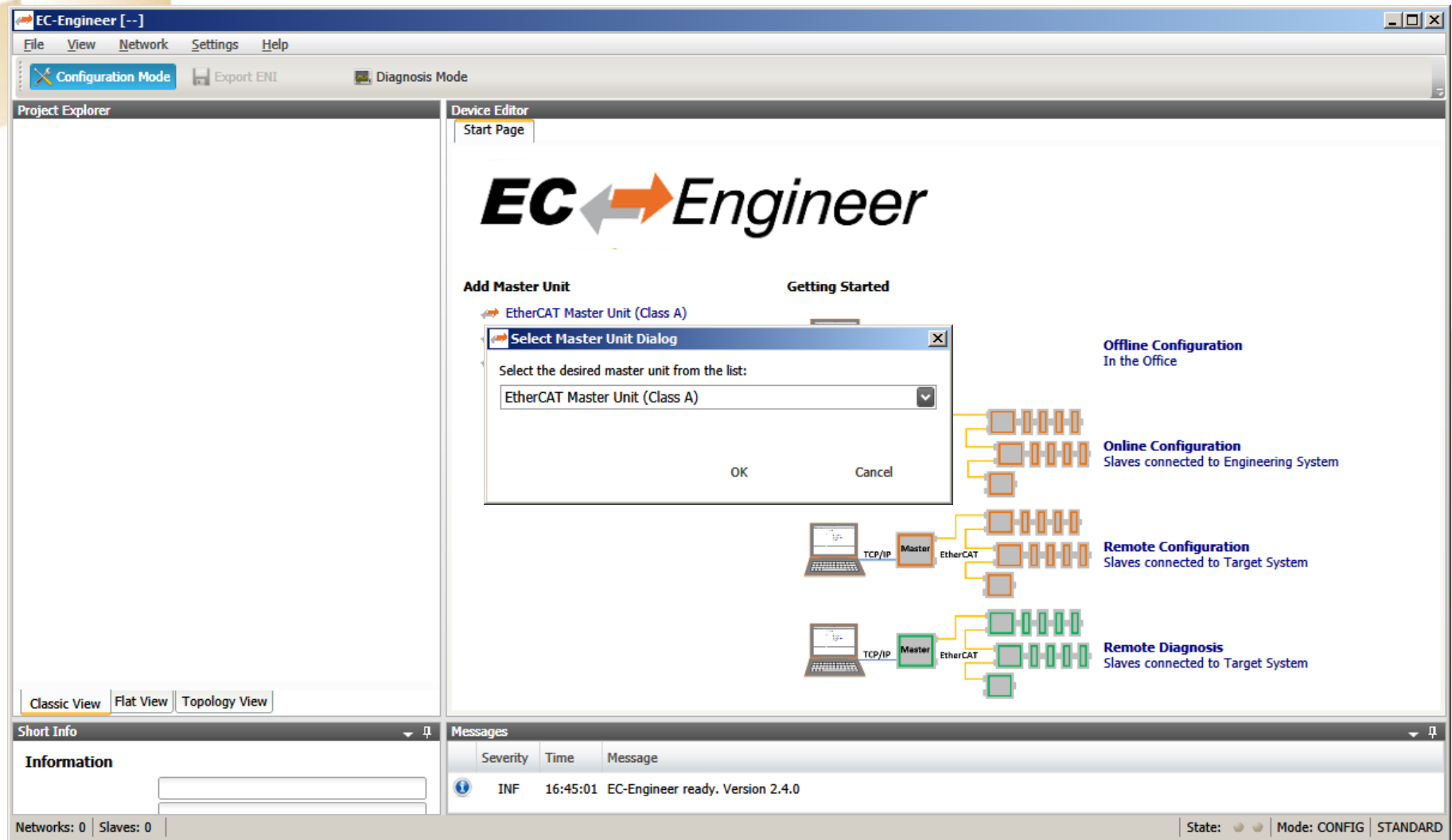
Generate bus configuration with EC-Engineer

Step 2: Install and start EC-Engineer



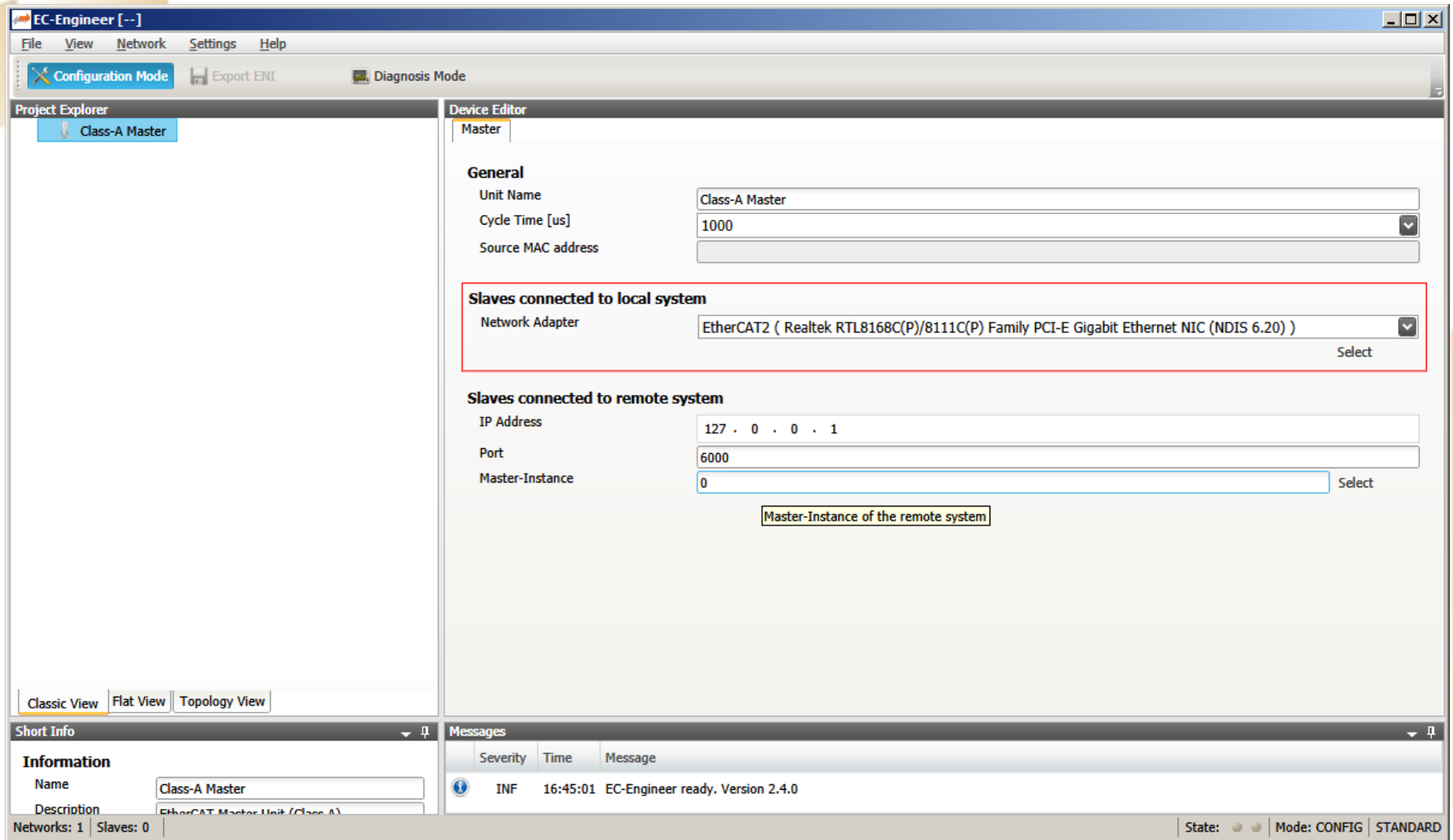
Generate bus configuration with EC-Engineer

Step 3: Select "Online Configuration" and "EtherCAT Master Unit (Class A)"



Generate bus configuration with EC-Engineer

Step 4: Choose network adapter from list and press "Select"



The screenshot shows the EC-Engineer software interface. The main window is titled "EC-Engineer [--]" and has a menu bar with "File", "View", "Network", "Settings", and "Help". Below the menu bar is a toolbar with "Configuration Mode" (selected), "Export ENI", and "Diagnosis Mode".

The interface is divided into several panels:

- Project Explorer:** Shows a tree view with "Class-A Master" selected.
- Device Editor:** Contains configuration fields for the selected device.
 - General:**
 - Unit Name: "Class-A Master"
 - Cycle Time [us]: "1000" (with a dropdown arrow)
 - Source MAC address: (empty field)
 - Slaves connected to local system:** (Highlighted with a red box)
 - Network Adapter: "EtherCAT2 (Realtek RTL8168C(P)/8111C(P) Family PCI-E Gigabit Ethernet NIC (NDIS 6.20))" (with a dropdown arrow and a "Select" button)
 - Slaves connected to remote system:**
 - IP Address: "127 . 0 . 0 . 1"
 - Port: "6000"
 - Master-Instance: "0" (with a "Select" button)
 - Below the Master-Instance field is a label: "Master-Instance of the remote system"
- Short Info:** Contains information about the selected device.
 - Information:
 - Name: "Class-A Master"
 - Description: "EtherCAT Master Unit (Class-A)"
 - Networks: 1 | Slaves: 0
- Messages:** A log of messages.
 - Severity: "INF" (Information)
 - Time: "16:45:01"
 - Message: "EC-Engineer ready. Version 2.4.0"

At the bottom of the interface, there is a status bar with "State: (indicators)" and "Mode: CONFIG | STANDARD".

Generate bus configuration with EC-Engineer

Step 5: The found slave devices are listed in the tree

The screenshot displays the EC-Engineer software interface. The **Project Explorer** on the left shows a tree structure under **Class-A Master** with the following slave devices:

- Slave_1001 [EK1100] (1001)
- Slave_1002 [EL2004] (1002)
- Slave_1003 [EL2004] (1003)
- Slave_1004 [EL1014] (1004)
- Slave_1005 [EL1014] (1005)
- Slave_1006 [EL4132] (1006)
- Slave_1007 [EK1110] (1007)

The **Device Editor** on the right shows the configuration for the selected master:

- General**
 - Unit Name: Class-A Master
 - Cycle Time [us]: 1000
 - Source MAC address: 00-0A-CD-16-BD-DD
- Slaves connected to local system**
 - Network Adapter: EtherCAT2 (Realtek RTL8168C(P)/8111C(P) Family PCI-E Gigabit Ethernet NIC (NDIS 6.20))
- Slaves connected to remote system**
 - IP Address: 127 . 0 . 0 . 1
 - Port: 6000
 - Master-Instance: 0

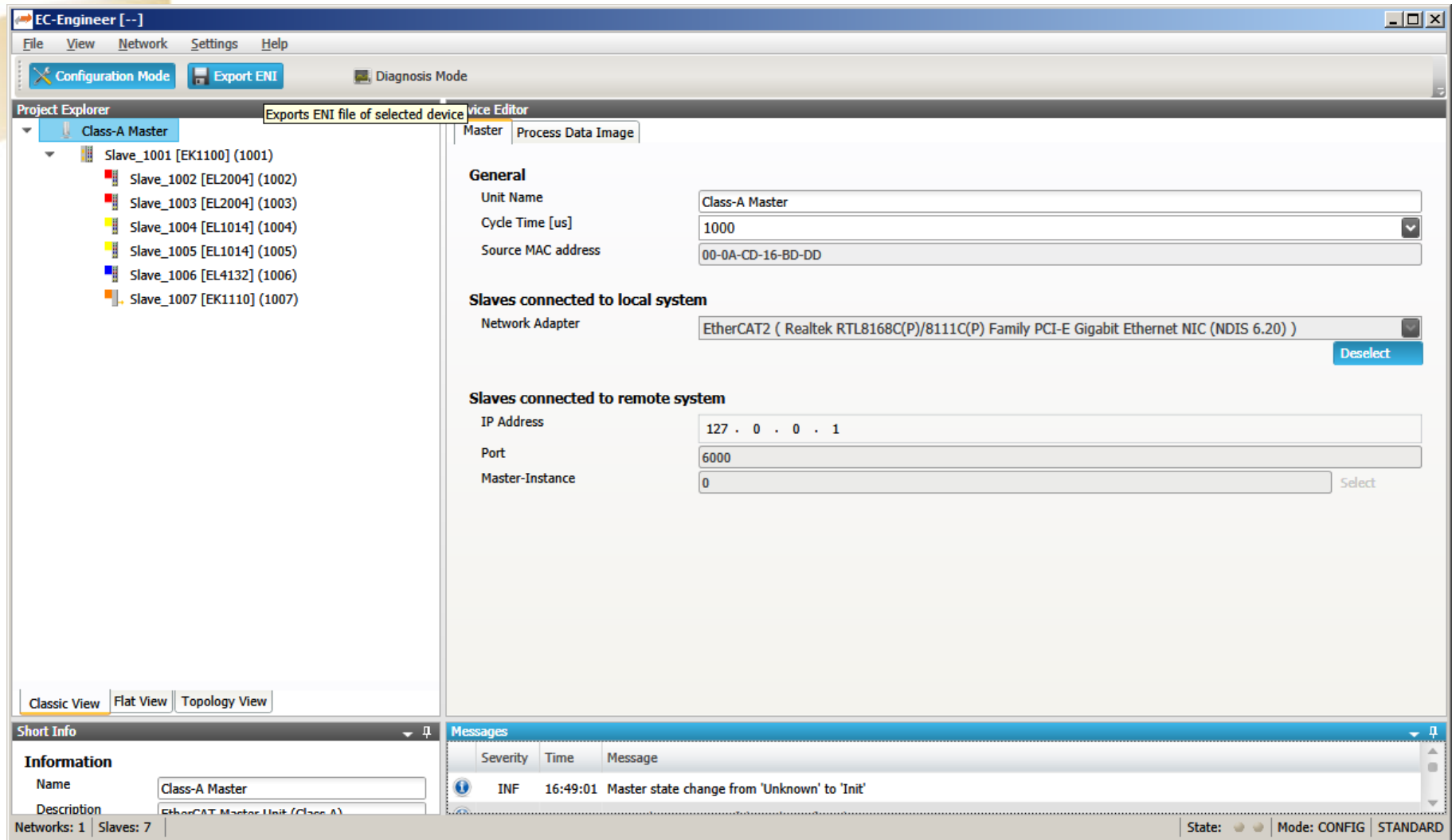
The bottom status bar shows **Networks: 1** and **Slaves: 7**. The **Messages** pane at the bottom right displays a log entry:

Severity	Time	Message
INF	16:49:01	Master state change from 'Unknown' to 'Init'

The bottom right corner of the interface shows the **State** as **Mode: CONFIG** and **STANDARD**.

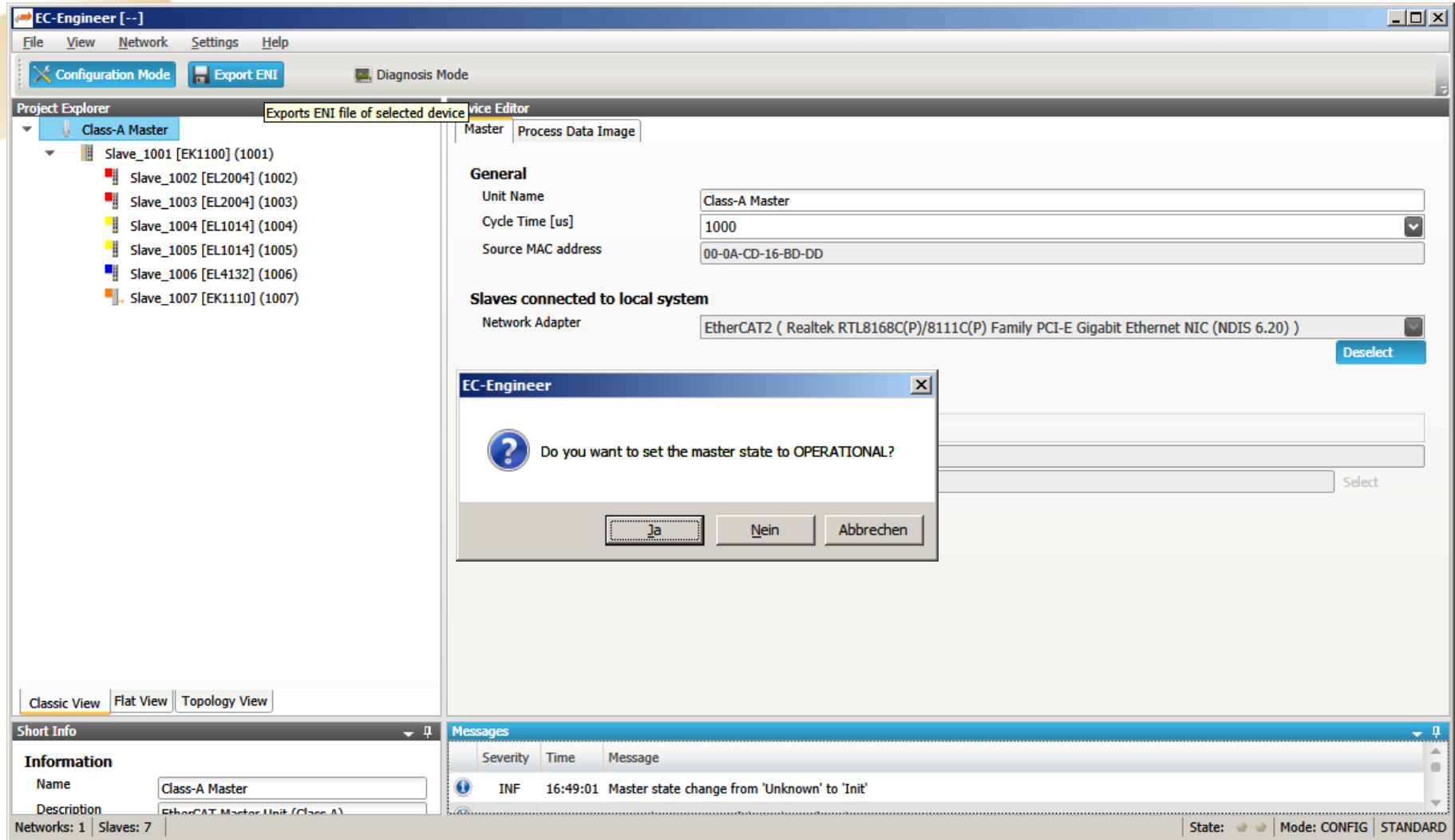
Generate bus configuration with EC-Engineer

Step 6: Export ENI file



Generate bus configuration with EC-Engineer

Step 7: Switch to "Diagnosis Mode" and set state to OPERATIONAL



Generate bus configuration with EC-Engineer

Step 8: Bus is OPERATIONAL

The screenshot displays the EC-Engineer software interface, which is used for configuring and monitoring a bus system. The interface is divided into several panels:

- Project Explorer:** Shows a hierarchical tree of the bus configuration. It includes a 'Class-A Master <connected>' and seven slaves: 'Slave_1001 [EK1100] (1001)', 'Slave_1002 [EL2004] (1002)', 'Slave_1003 [EL2004] (1003)', 'Slave_1004 [EL1014] (1004)', 'Slave_1005 [EL1014] (1005)', 'Slave_1006 [EL4132] (1006)', and 'Slave_1007 [EK1110] (1007)'. All components are marked with green circles, indicating they are operational.
- Device Editor:** Contains tabs for 'General', 'Process Data Image', and 'Watch list'. The 'General' tab is active, showing the 'State Machine' and 'Information' sections.
 - State Machine:** Displays the current state as 'Op' (Operational) and the requested state as 'Op'. It also shows transition states: 'Init', 'Bootstrap', 'Pre-Op', 'Safe-Op', and 'Op'.
 - Information:** Provides various status metrics:

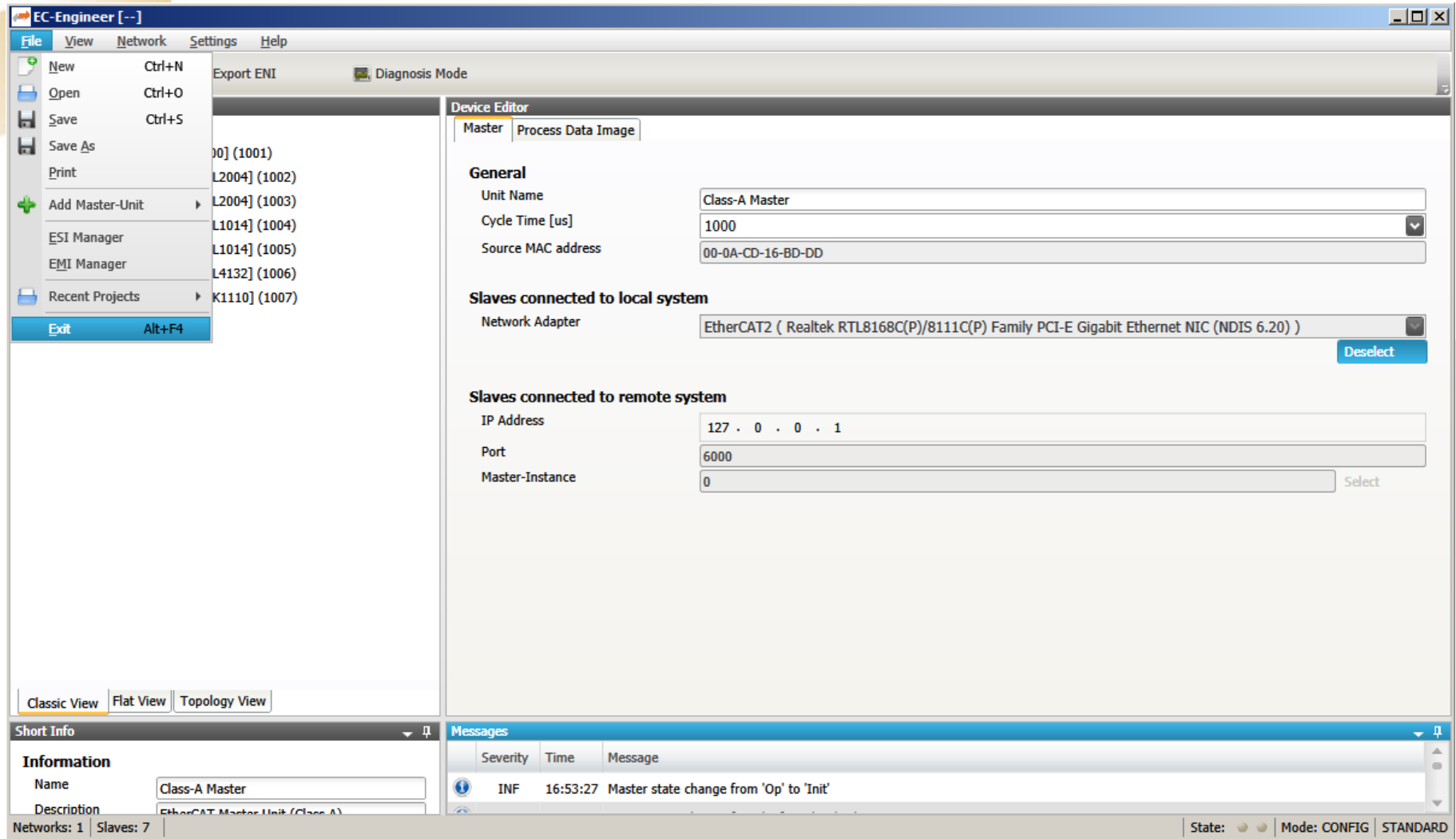
Parameter	Value
Number of found slaves	7
Number of slaves in configuration	7
Number of DC slaves	0
DC in-sync	-
Topology Ok	Yes
Link Connected	Yes
Slaves in Master State	Yes
 - Frame Counter:** Displays frame statistics:

Parameter	Value
Sent frames	52532
Lost frames	0
Cyclic frames	52416
Acyclic frames	116
- Short Info:** Located at the bottom left, it provides a quick overview of the system, including the name 'Class-A Master' and the description 'EtherCAT Master Unit (Class A)'. It also shows 'Networks: 1' and 'Slaves: 7'.
- Messages:** Located at the bottom right, it displays a log of system events. The most recent message is 'Master state change from 'Safe-Op' to 'Op'', dated 16:52:50.

The bottom status bar indicates the current state as 'State: [Green Circle]' and the mode as 'Mode: DIAGNOSIS | STANDARD'.

Generate bus configuration with EC-Engineer

Step 9: Switch back to "Configuration Mode" and Exit

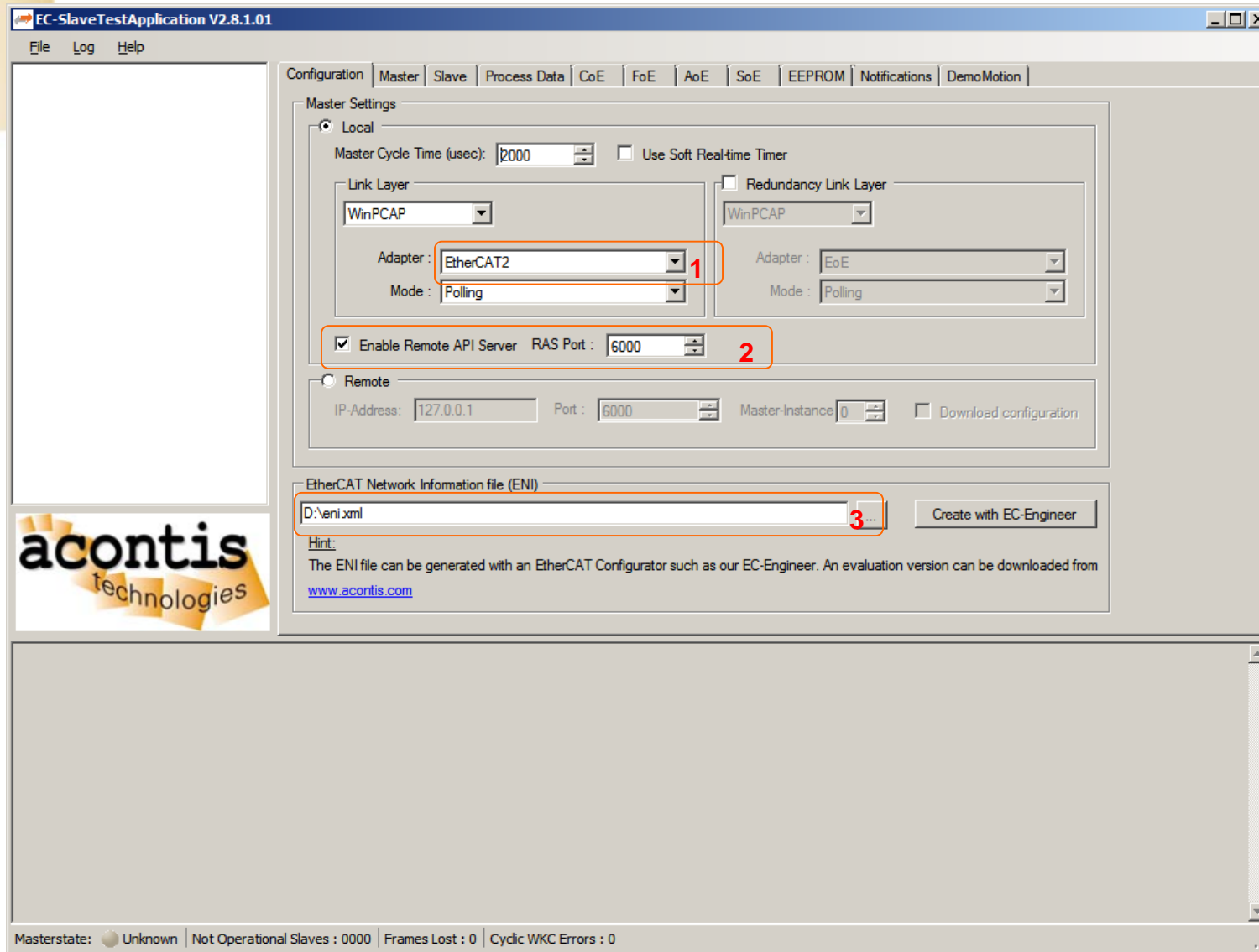


Install the EC-Master

- Extract/Install the EC-Master by running setup.exe
 - Note: Some platforms as ZIP/tar.gz archive, not as setup.exe
- The documentation including this Quick Start Guide is in folder “Doc”
- There is an EC-SlaveTestApplication starter in the Windows start menu

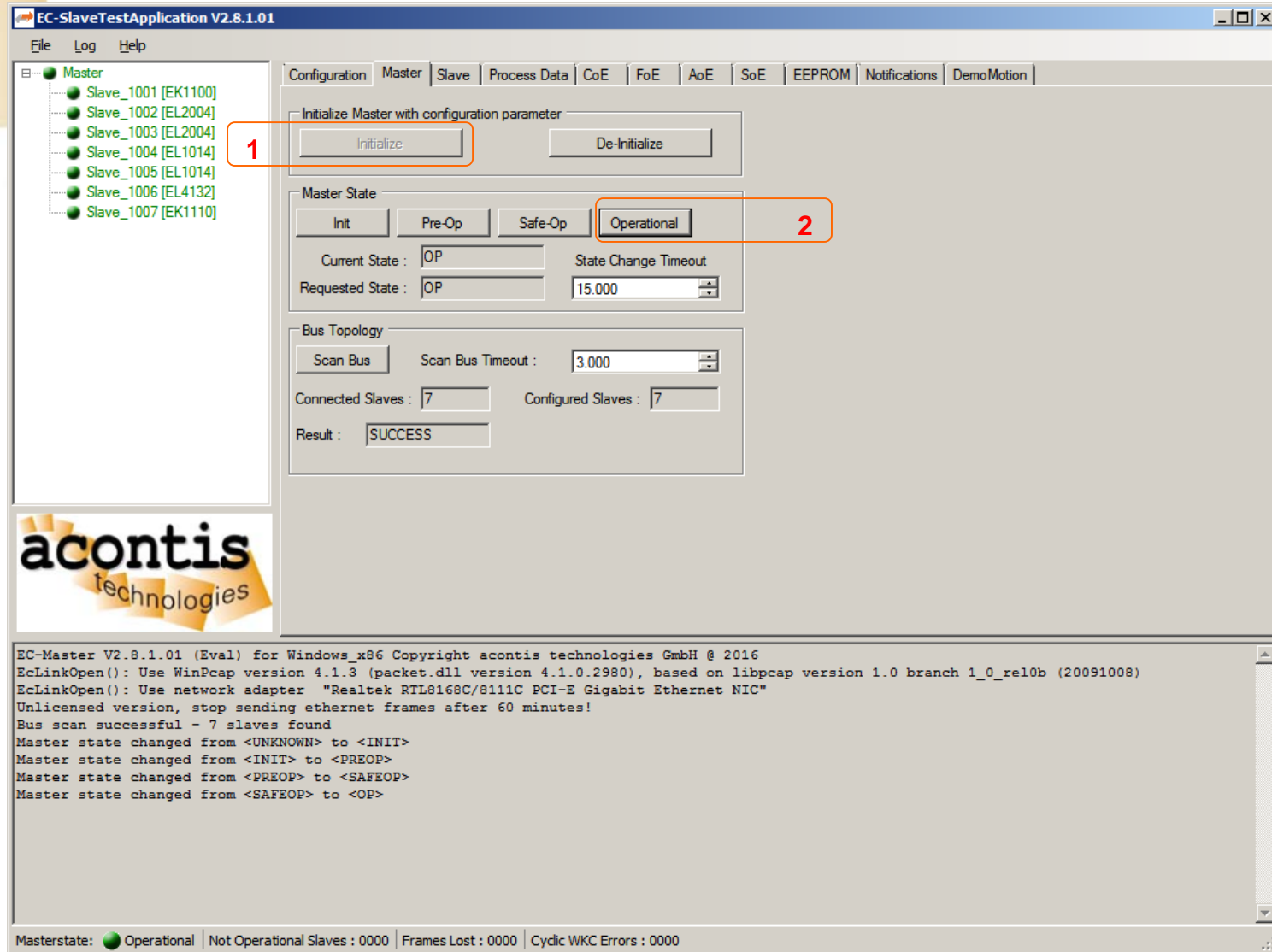
Operate slaves with EC-STA Slave Test Application

Step 1: Start EC-STA from the start menu and configure



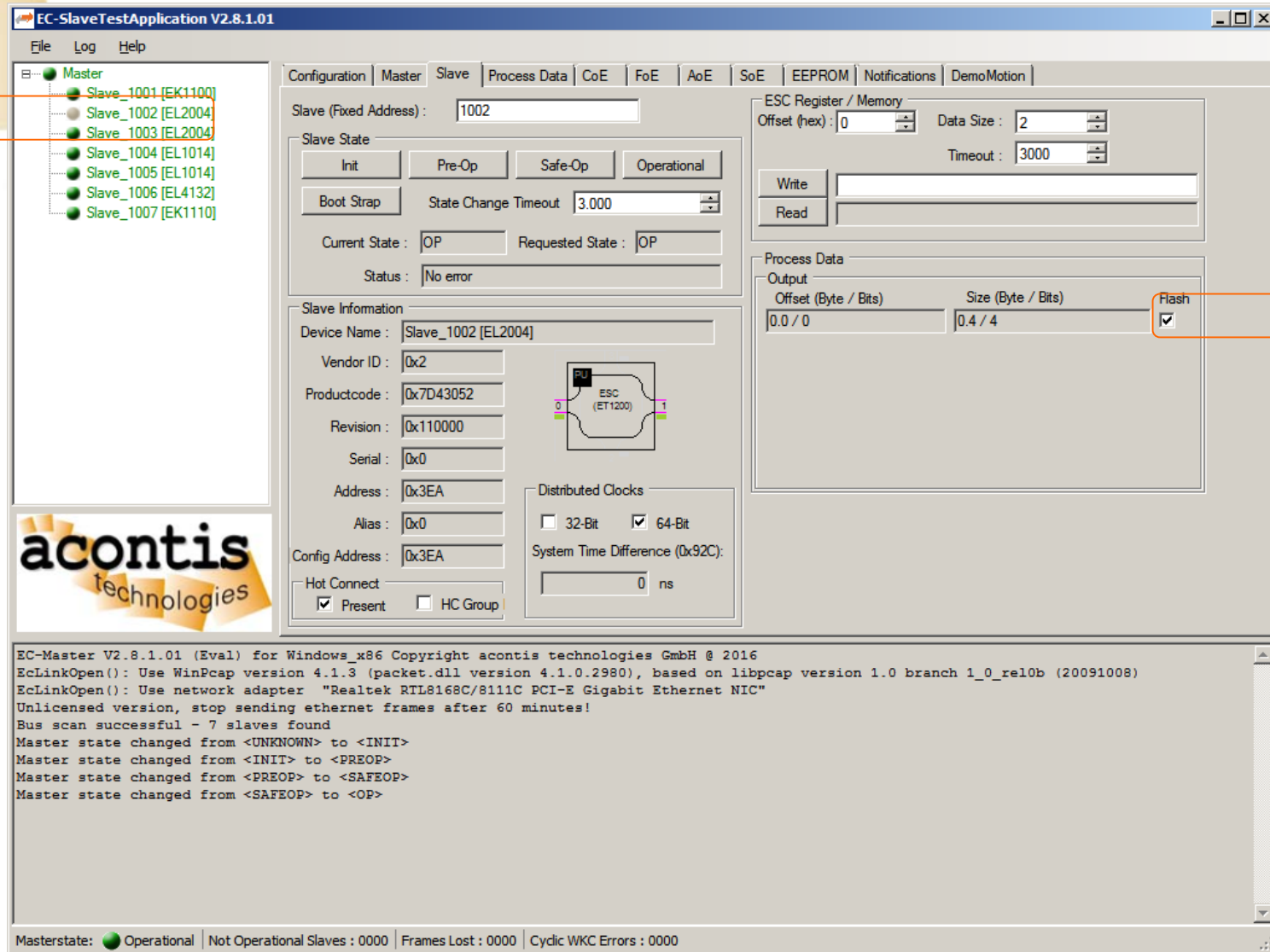
Operate slaves with EC-STA Slave Test Application

Step 2: Initialize and set master state to operational



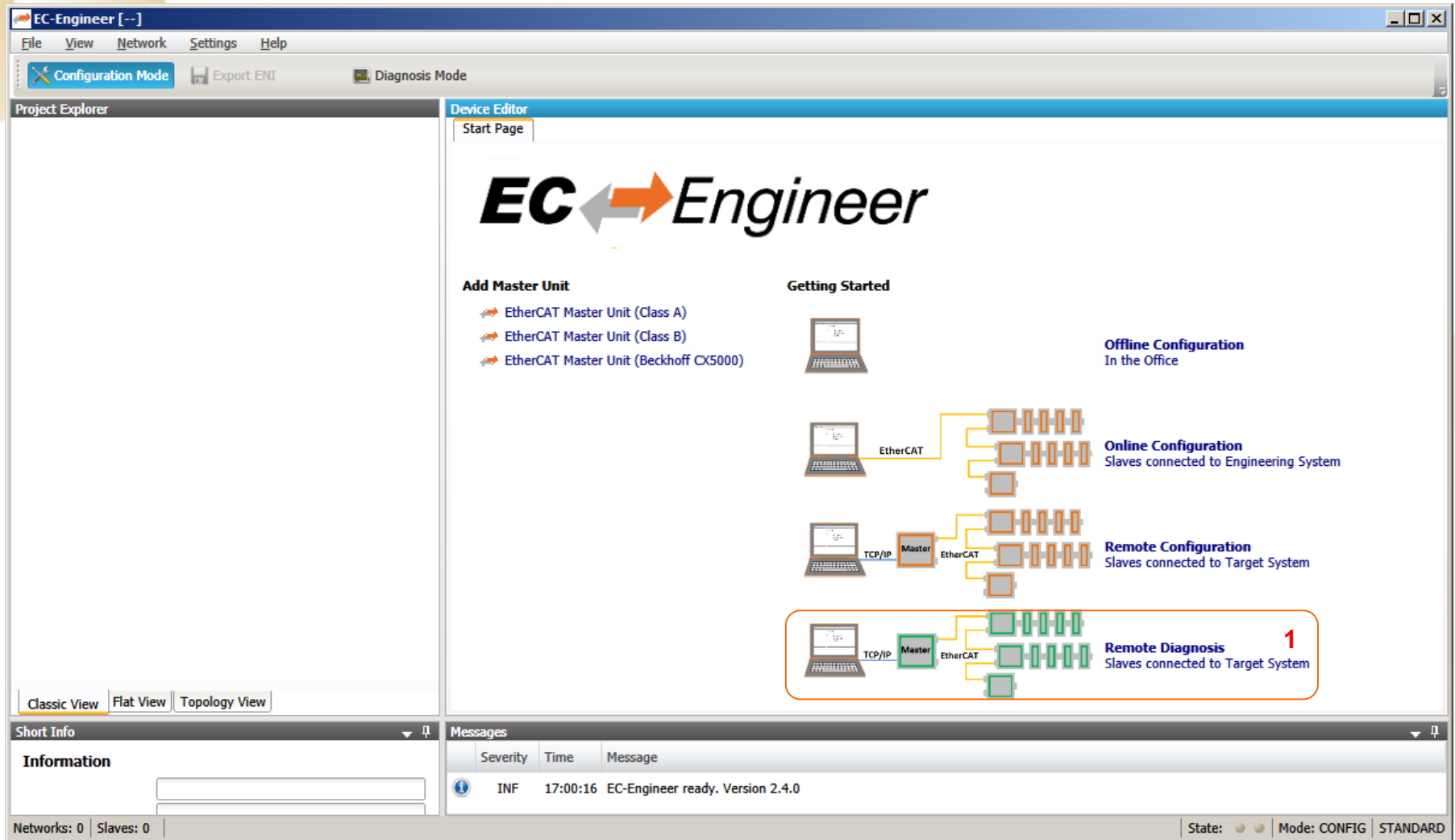
Operate slaves with EC-STA Slave Test Application

Step 3: Do further tests, e. g., flashing outputs



Connect EC-Engineer with EC-STA Application

Step 1: Start EC-Engineer and select "Remote Diagnosis"



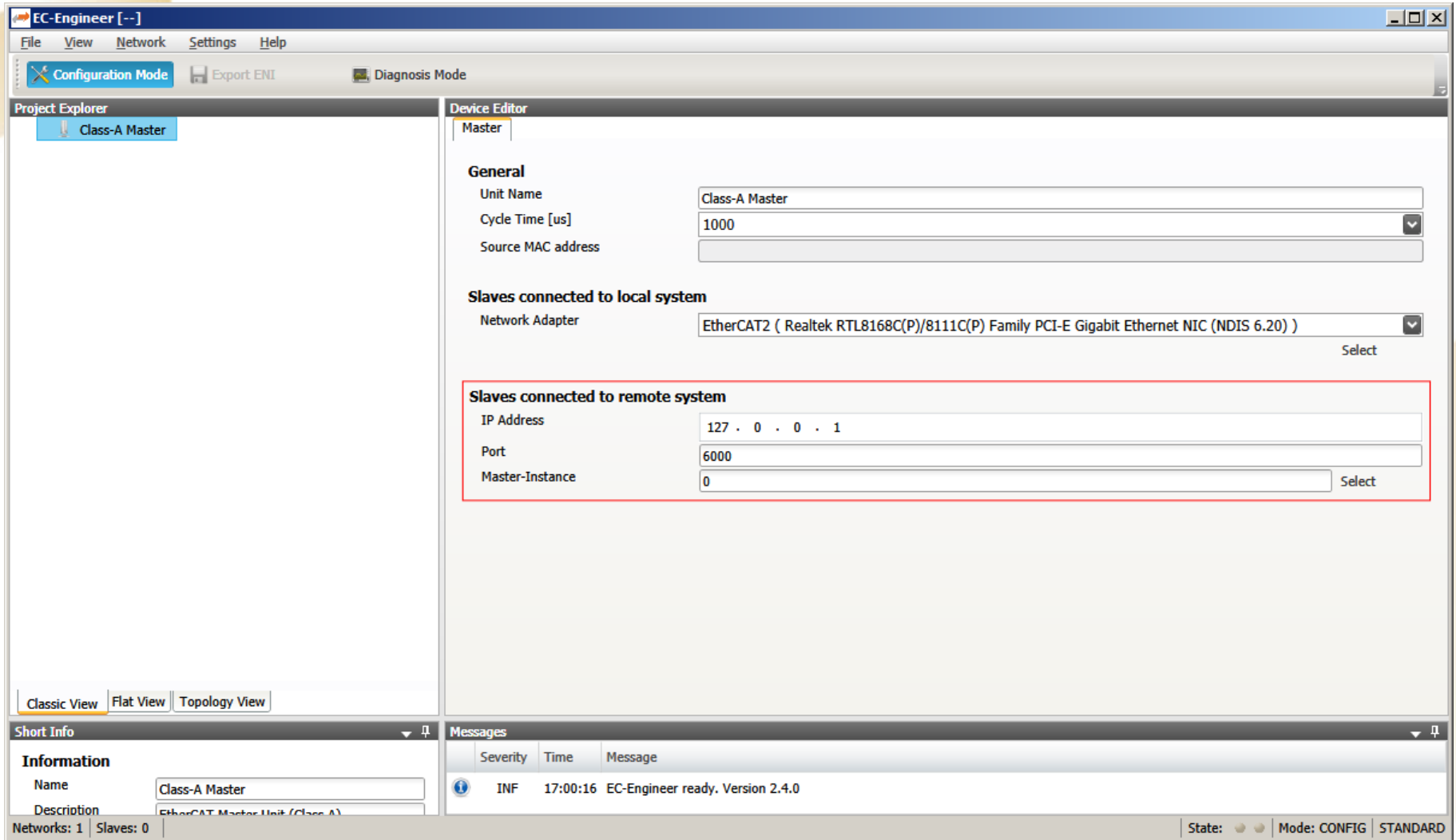
The screenshot displays the EC-Engineer software interface. The main window is titled "EC-Engineer [--]" and features a menu bar with "File", "View", "Network", "Settings", and "Help". Below the menu bar, there are buttons for "Configuration Mode" (highlighted), "Export ENI", and "Diagnosis Mode". The interface is divided into two main panes: "Project Explorer" on the left and "Device Editor" on the right. The "Device Editor" pane shows the "Start Page" with the "EC Engineer" logo. Under the "Add Master Unit" section, there are three options: "EtherCAT Master Unit (Class A)", "EtherCAT Master Unit (Class B)", and "EtherCAT Master Unit (Beckhoff CX5000)". The "Getting Started" section contains a diagram illustrating four connection scenarios:

- Offline Configuration:** In the Office. Shows a laptop connected to a single master unit.
- Online Configuration:** Slaves connected to Engineering System. Shows a laptop connected to a master unit, which is then connected to a network of slave units.
- Remote Configuration:** Slaves connected to Target System. Shows a laptop connected to a master unit via TCP/IP, which is then connected to a network of slave units.
- Remote Diagnosis:** Slaves connected to Target System. This scenario is highlighted with a red box and a red number "1". It shows a laptop connected to a master unit via TCP/IP, which is then connected to a network of slave units.

At the bottom of the interface, there is a "Short Info" pane on the left and a "Messages" pane on the right. The "Short Info" pane shows "Information" and "Networks: 0 | Slaves: 0". The "Messages" pane shows a table with columns "Severity", "Time", and "Message". A message is displayed: "INF 17:00:16 EC-Engineer ready. Version 2.4.0". The bottom status bar shows "State: [icon] Mode: CONFIG STANDARD".

Connect EC-Engineer with EC-StA Application

Step 2: Choose "Slaves connected to remote system"



The screenshot shows the EC-Engineer software interface. The main window is titled "EC-Engineer [--]" and has a menu bar with "File", "View", "Network", "Settings", and "Help". Below the menu bar are three tabs: "Configuration Mode" (selected), "Export ENI", and "Diagnosis Mode".

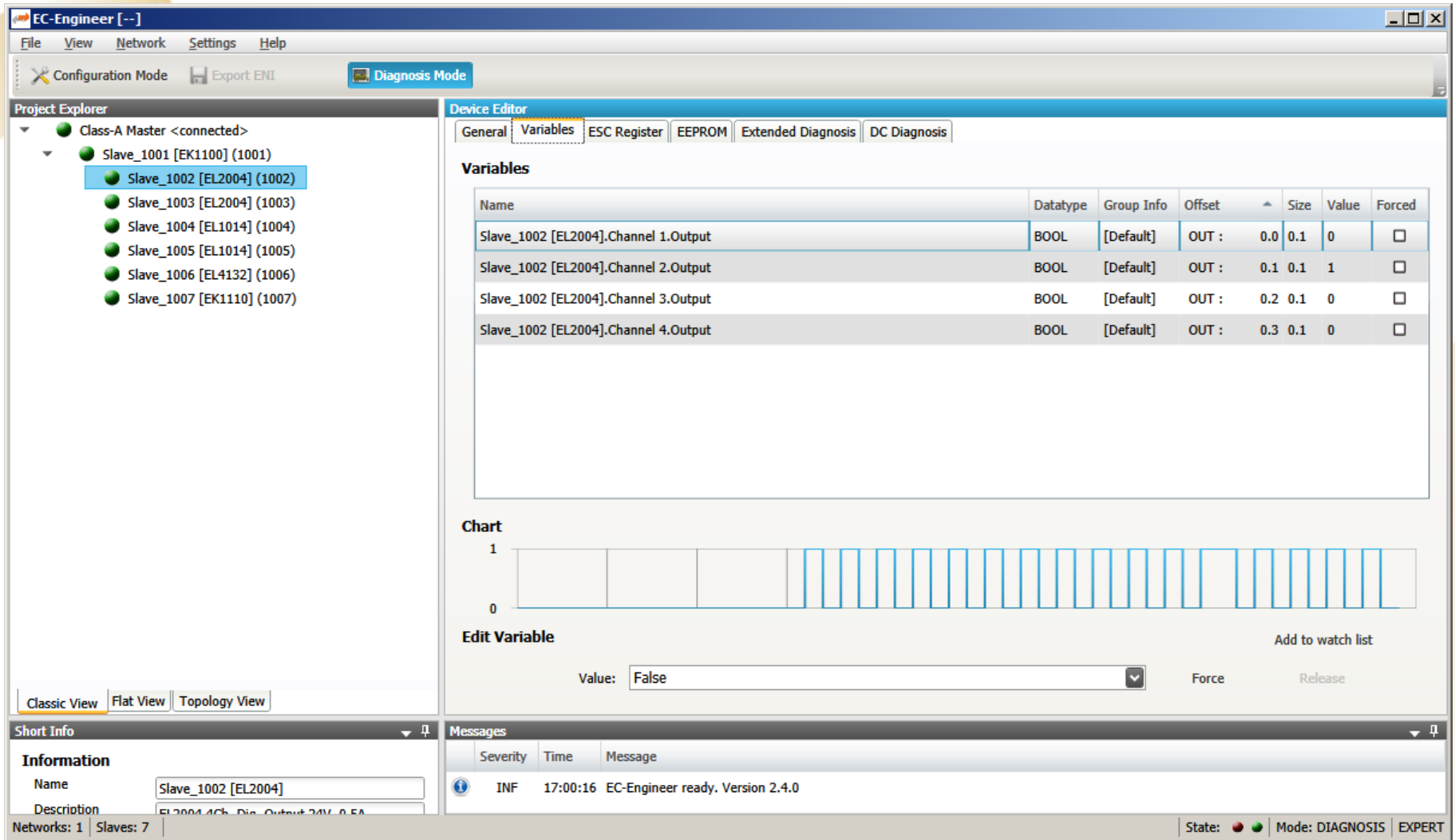
The interface is divided into several sections:

- Project Explorer:** Located on the left, it shows a tree view with "Class-A Master" selected.
- Device Editor:** Located on the right, it shows the configuration for the selected device. It has a tab labeled "Master".
 - General:** Contains fields for "Unit Name" (Class-A Master), "Cycle Time [us]" (1000), and "Source MAC address".
 - Slaves connected to local system:** Contains a "Network Adapter" dropdown menu showing "EtherCAT2 (Realtek RTL8168C(P)/8111C(P) Family PCI-E Gigabit Ethernet NIC (NDIS 6.20))".
 - Slaves connected to remote system:** This section is highlighted with a red border. It contains fields for "IP Address" (127 . 0 . 0 . 1), "Port" (6000), and "Master-Instance" (0).
- Short Info:** Located at the bottom left, it shows "Information" for the selected device, including "Name" (Class-A Master) and "Description" (EtherCAT Master Unit (Class A)).
- Messages:** Located at the bottom right, it shows a log of messages. The first message is "INF 17:00:16 EC-Engineer ready. Version 2.4.0".

At the bottom of the interface, there are status indicators: "Networks: 1", "Slaves: 0", "State: ", "Mode: CONFIG", and "STANDARD".

Connect EC-Engineer with EC-STA Application

Step 3: Check input or output variables



The screenshot displays the EC-Engineer software interface. The **Project Explorer** on the left shows a tree structure with **Class-A Master <connected>** expanded, revealing several slave devices. **Slave_1002 [EL2004] (1002)** is selected. The **Device Editor** on the right has the **Variables** tab active, showing a table of variables for the selected device.

Name	Datatype	Group Info	Offset	Size	Value	Forced
Slave_1002 [EL2004].Channel 1.Output	BOOL	[Default]	OUT :	0.0 0.1	0	<input type="checkbox"/>
Slave_1002 [EL2004].Channel 2.Output	BOOL	[Default]	OUT :	0.1 0.1	1	<input type="checkbox"/>
Slave_1002 [EL2004].Channel 3.Output	BOOL	[Default]	OUT :	0.2 0.1	0	<input type="checkbox"/>
Slave_1002 [EL2004].Channel 4.Output	BOOL	[Default]	OUT :	0.3 0.1	0	<input type="checkbox"/>

Below the table is a **Chart** area showing a digital signal waveform. The **Edit Variable** section at the bottom shows the **Value** set to **False**, with **Force** and **Release** buttons. An **Add to watch list** button is also present.

The **Short Info** panel at the bottom left shows information for the selected device: **Name** is **Slave_1002 [EL2004]** and **Description** is **EL2004 4Ch. Dig. Output 24V, 0.5A**. The **Messages** panel at the bottom right shows a log entry: **INF 17:00:16 EC-Engineer ready. Version 2.4.0**. The status bar at the bottom indicates **State** (green dot) and **Mode: DIAGNOSIS**.

Next Steps

- Run EcMasterDemo on your target system
 - See EC-Master User Manual Chapter 2 “Getting Started”
 - 2.3 Operating system configuration
 - 2.3.1 Link Layer selection
 - 2.4 Running EcMasterDemo
- Learn more about EcMasterDemo and the application framework
 - See EC-Master User Manual Chapter 3.1 “Application Framework”