

## DigSILENT StationWare

Protection Setting Management System

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# Implementation of Protection Management System

## Extreme Importance of DIgSILENT StationWare

- The complexity of modern protective relays has increased dramatically. It no longer is possible to maintain a paper based documentation of the settings these relays outside in the fields actually have. As being set by the manufacturer software, for each relay a file or set of files in proprietary format contains the settings the relay actually have. As no backup facility is installed, the documentation and integrity of those settings is not guaranteed.
- Furthermore, there is no infrastructure to both quickly find the settings of a certain relay as well as enabling other users to also access this settings data by default.
- It is up to the protective personnel maintaining a repository for protection related files such as documentations, plots or graphs and manuals which also belong to the substation asset. With having no proper infrastructure an appropriate information flow is not possible.
- Without enabling multiple users to quickly access the data requested and without interfacing the repository for accessing the data from other tools or systems like a Power System Simulation Tool a bad workflow and a manual re-entry of settings parameters will be the result.
- The abovementioned situation necessitates the development of a Protection Settings Management System like the DIgSILENT StationWare.

# Implementation of Protection Management System

Albanah LLC has Recently completed DigSILENT StationWare project for Dhofar Power Company [DPC].

## DigSILENT StationWare Key Features

- A central storage system for complete power system protection data.
- User-friendly, full featured substation data management system.
- Web-based secured application that can be accessed by any browser, anywhere, any time.
- Supports Both Oracle and MS SQL Server database.
- Offsite mode enabling users to take the data to site and amend or read it, as required.
- Historic mode to review past data.
- Comprehensive relay type library.
- Range checks and data validation on settings values.
- User-defined workflow sequences for settings management.
- Access rights management for users, functions, and locations.
- Unlimited device lists that can be extended according to the number of devices to be managed.
- Highly flexible software to fit own particular hierarchical requirements.
- Audit Trail enabling deep rooting inside the database to view all changes.
- Flexible Reporting Platform which is extendable according to your requirements.
- Document Management System supporting easy access to relay manuals, test reports or any additional documentation.
- Process type models for different kind of processes, e.g. maintenance, cyclic testing, commissioning, etc.
- Local Support providing all support required including installation, implementation, updates, and training.
- etc.

# Implementation of Protection Management System

The Project Implementation consists mainly of two phases.

## First Phase :

**During this phase all Grid and Primary indoor substations were visited and data was collected for the following equipment:**

- Electromechanical Relays.
- Static Relays.
- Digital Relays
- Numerical Relays.
- Power Transformers.
- Auto Voltage Regulators.
- Capacitor Banks and Controllers.
- Battery Chargers.
- Circuit Breakers.
- Current Transformers.
- Voltage Transformers.

# Implementation of Protection Management System

## Second Phase :

**During this phase all the collected equipment details and relay setting files were modelled by StationWare as per DPC electrical network hierarchy.**

- Numerical and Digital relays native setting files were directly populated to StationWare using the excellent converters for a very wide range of relay manufactures which display the relay settings in actual manufacturer's format and well categorized manner.
- Other types of relays (Electromechanical and Static) and other equipment details (CTs, VTs, Power Transformers, Battery Chargers, AVRs, Capacitor Banks and their Controllers, etc) were entered using predefined templates which can be modified later as per client requirement.
- StationWare library was used to upload all the required documents i.e pdfs of SLDs , as built drawings, relay manuals and also relay operating softwares, such as DIGSI, CAP501, Reydisp Evolution, AcSELerator, Agile, MiCOM Studio, WSOS, etc.
- Installation of StationWare and uploading of the completed database were deployed at Dhofar Power Company servers.

# Implementation of Protection Management System

## StationWare system setup for Dhofar Power

- Client specific needs
- Location Structure
- Users and User groups (rights management)

## Collection and Modelling of existing settings to DPC StationWare database

- Data Collection process
- Downloading the existing settings
- Migration process
- Uniform formatted settings for Dhofar Power's 'relay' and all other substation equipment
- Detailed Relay configuration files



# Implementation of Protection Management System

## Live Data Collection from Relays





# Implementation of Protection Management System

## Live Data Collection from Relays

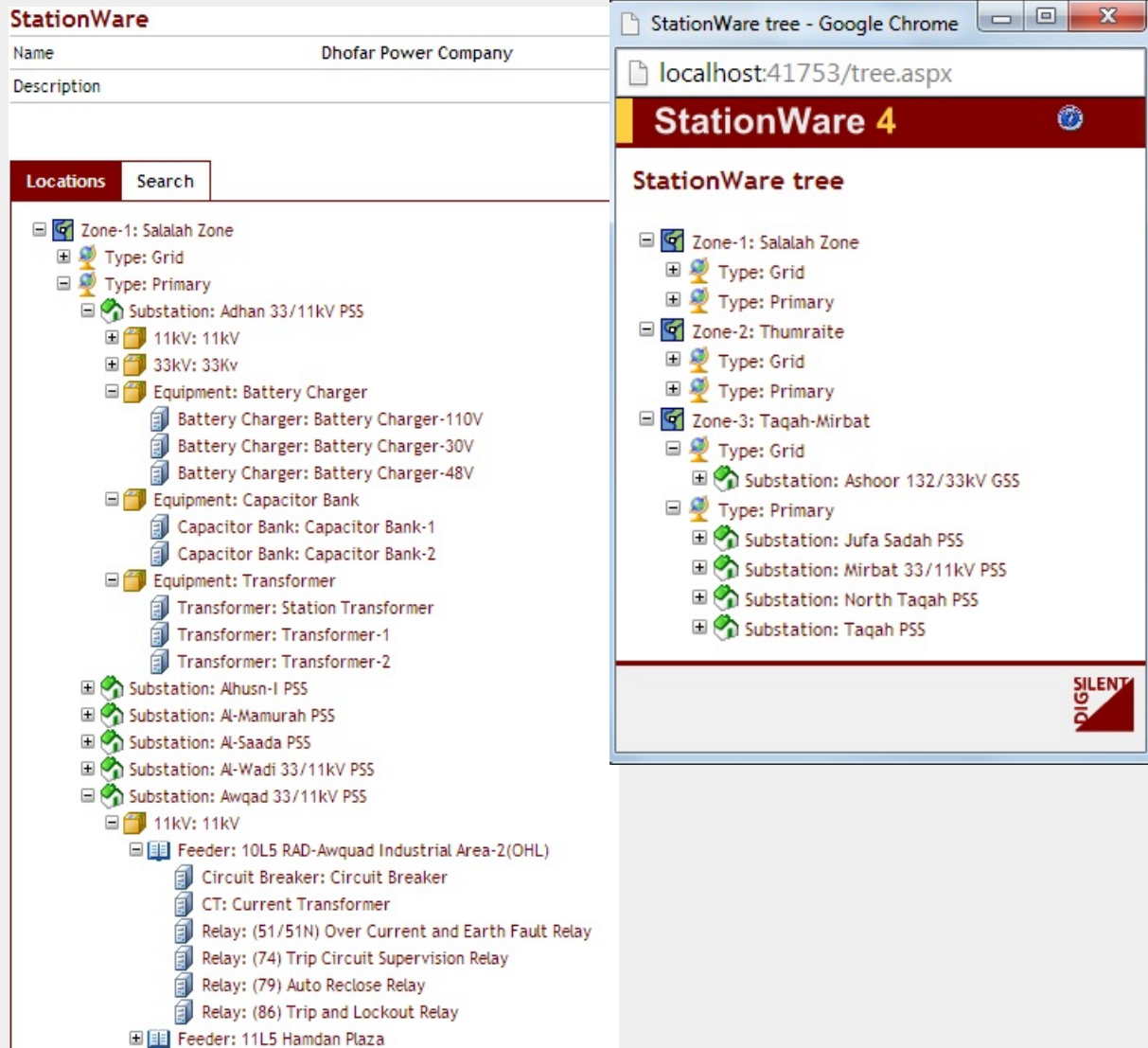




# Implementation of Protection Management System

## Hierarchical Location Structure

- User-defined location types
- User-defined hierarchy
- Modelling the power system as it is requires a tree type structure where the item depth somewhat has to do with the type, as shown.
- This regional hierarchy is found at the Navigator window or a page showing locations and the location that is currently displayed contains locations inside.



The screenshot displays the StationWare software interface. The main window shows a hierarchical tree structure of power system components. The tree is organized into zones and substations, with various equipment types listed under each. The interface includes a search bar and a 'Locations' tab. The tree structure is as follows:

- Zone-1: Salah Zone
  - Type: Grid
  - Type: Primary
    - Substation: Adhan 33/11kV PSS
      - 11kV: 11kV
      - 33kV: 33kV
      - Equipment: Battery Charger
        - Battery Charger: Battery Charger-110V
        - Battery Charger: Battery Charger-30V
        - Battery Charger: Battery Charger-48V
      - Equipment: Capacitor Bank
        - Capacitor Bank: Capacitor Bank-1
        - Capacitor Bank: Capacitor Bank-2
      - Equipment: Transformer
        - Transformer: Station Transformer
        - Transformer: Transformer-1
        - Transformer: Transformer-2
- Substation: Alhusn-I PSS
- Substation: Al-Mamurah PSS
- Substation: Al-Saada PSS
- Substation: Al-Wadi 33/11kV PSS
- Substation: Awqad 33/11kV PSS
  - 11kV: 11kV
    - Feeder: 10L5 RAD-Awquad Industrial Area-2(OHL)
      - Circuit Breaker: Circuit Breaker
      - CT: Current Transformer
      - Relay: (51/51N) Over Current and Earth Fault Relay
      - Relay: (74) Trip Circuit Supervision Relay
      - Relay: (79) Auto Reclose Relay
      - Relay: (86) Trip and Lockout Relay
    - Feeder: 11L5 Hamdan Plaza

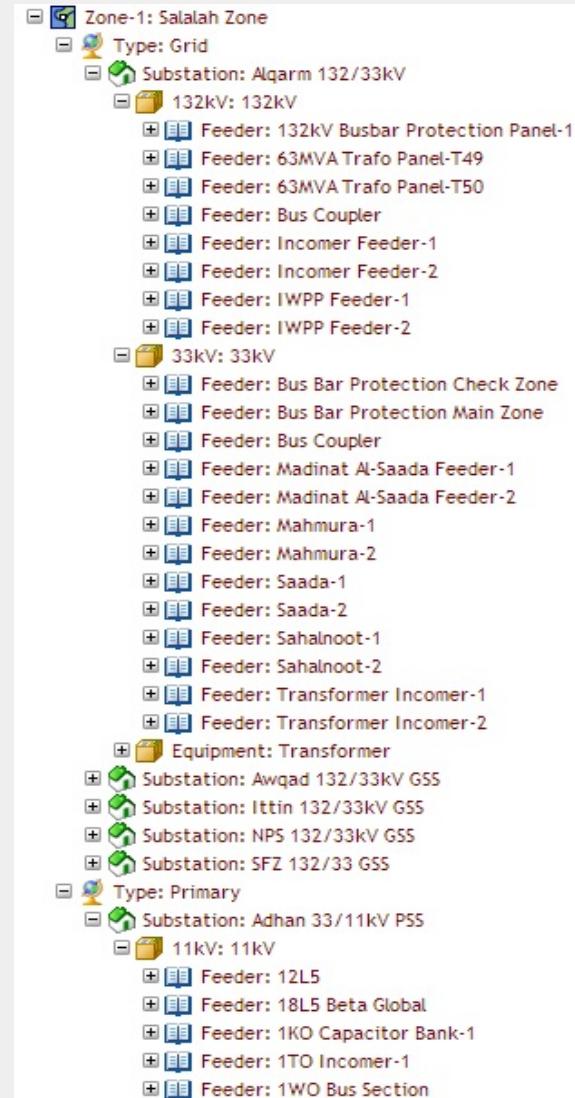
- Zone-2: Thumraite
- Type: Grid
- Type: Primary
- Zone-3: Taqah-Mirbat
- Type: Grid
- Substation: Ashoor 132/33kV GSS
- Type: Primary
  - Substation: Jufa Sadah PSS
  - Substation: Mirbat 33/11kV PSS
  - Substation: North Taqah PSS
  - Substation: Taqah PSS

The interface also shows a 'StationWare tree - Google Chrome' window with the URL 'localhost:41753/tree.aspx' and the title 'StationWare 4'. A 'SILENT DIGENT' logo is visible in the bottom right corner of the browser window.

# Implementation of Protection Management System

## Locations and Zones

- Network was divided into three Zones, including Salah, Thamrait and Taqa-Mirbat
- All substations per Area
- Transformers
- Capacitor Banks
- Battery Chargers
- Bays per substation
- Feeder Bay
- Incomer Bay
- Bus Coupler
- Bus Section
- Adjusted according to voltage levels, for example 11kV, 33kV and 132kV



# Implementation of Protection Management System

## Multi-User Environment

- User accounts
- Access rights management
- Location dependent rights
- Lifecycle dependent rights
- Functional rights
- User administrator
- Template and device manager
- Configuration manager (lifecycle, additional attributes, customized views)

## Users and User Groups

- User groups are used to assign location rights and lifecycle/settings rights to users
- Users divided into 3 main groups
- Administrators – Super Administrator Rights
- Settings Engineers – Configuration rights for all locations devices and settings
- Field Technicians– Read only rights for all locations, devices.
- Each user has a username, password and valid email address.

# Implementation of Protection Management System

## Detailed Relay Import

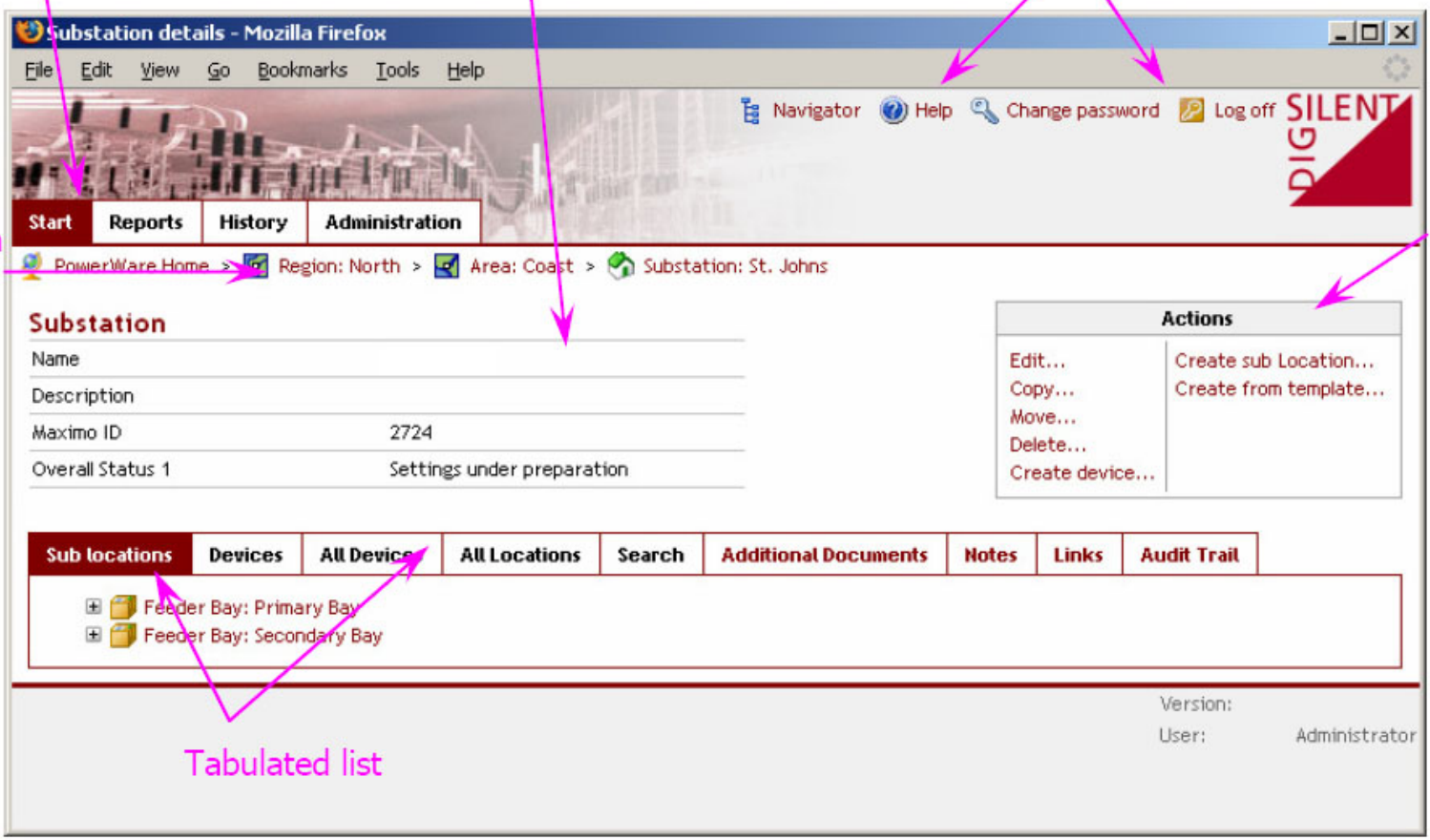
- StationWare has the capability to import the relay configuration files from selected manufacturers and selected models
- Manual creation of relays and import of settings
- Manual creation of transformer, capacitor bank, battery charger, etc
- In the instances where relay configuration files were available, it was imported into StationWare
- Actual relay configuration files stored at device level on 'Settings Documents in StationWare'

## End Result

- Central protection settings management
- Audit trail available – Who changed what and when
- Security of settings
- Import/Export relay configuration files
- Import/Export settings to PowerFactory
- Fault and Test reports upload available

# Implementation of Protection Management System

## StationWare Settings Display



The screenshot shows the 'Substation details' interface in Mozilla Firefox. The browser title is 'Substation details - Mozilla Firefox'. The menu bar includes File, Edit, View, Go, Bookmarks, Tools, and Help. The toolbar contains Navigator, Help, Change password, and Log off. A 'SILENT DIG' watermark is visible in the top right corner.

Annotations with arrows point to various parts of the interface:

- Main StationWare section tabs:** Points to the 'Start', 'Reports', 'History', and 'Administration' tabs.
- Main object properties:** Points to the 'Substation' details section, which includes fields for Name, Description, Maximo ID (2724), and Overall Status 1 (Settings under preparation).
- General functions:** Points to the 'Actions' box, which contains buttons for Edit..., Copy..., Move..., Delete..., Create device..., Create sub Location..., and Create from template...
- Navigation row:** Points to the breadcrumb navigation: PowerWare Home > Region: North > Area: Coast > Substation: St. Johns.
- Actions box:** Points to the 'Actions' box containing various management options.
- Tabulated list:** Points to the list of sub-locations: Feeder Bay: Primary Bay and Feeder Bay: Secondary Bay.

At the bottom right of the interface, the version and user information are displayed: Version: and User: Administrator.

# Implementation of Protection Management System

## StationWare Settings Display

### Settings

Name	Transformer Details
Description	
Device type	TRANSFORMER
Device Usage	
Firmware	
Status	Planning
Last change	10/5/2013 12:22:34 AM [Administrator]
Voltage Level [kV]	0
GlobalNote	

Actions		
Edit...	Export...	[Report] Settings compare...
Change status...	Import...	[Report] Settings views...
Copy...	[Report] Simple settings report...	[Report] Simple settings report...
Delete...	[Report] Settings changes...	
Compare to another device...	[Report] Settings compare...	

<b>Main Settings</b>	Additional documents	Notes	Links	Audit trail
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Attribute	Description	Value	Range	Unit	Assigned
<b>GENERAL SETTINGS</b>					
Manufacturer	Manufacturer	HACKBRIGE HEWITTIC AND EASUN LIMITED		40 Character	<input checked="" type="checkbox"/>
Serial Number	Serial Number	38955		40 Character	<input checked="" type="checkbox"/>
Year of manufacture	Year of manufacture	2001		40 Character	<input checked="" type="checkbox"/>
kVA	Rated Power	10000		kVA	<input checked="" type="checkbox"/>
V1	Rated Voltage H.V	33000		V	<input checked="" type="checkbox"/>
V2	Rated Voltage L.V	11500		V	<input checked="" type="checkbox"/>
A1	Rated Current H.V	206.07		A	<input checked="" type="checkbox"/>
A2	Rated Current L.V	602.33		A	<input checked="" type="checkbox"/>
Z	Impedance	8.05		%	<input checked="" type="checkbox"/>
W1	No Load Loss	NA		W	<input checked="" type="checkbox"/>



# Implementation of Protection Management System

## StationWare Settings Display

### Settings

Name	Settings
Description	
Device type	CAPACITOR_BANK
Device Usage	
Firmware	
Status	Planning
Last change	10/5/2013 12:14:25 AM [Administrator]
Voltage Level [kV]	0
GlobalNote	

Actions		
Edit...	Export...	[Report] Settings compare...
Change status...	Import...	[Report] Settings views...
Copy...	[Report] Simple settings report...	[Report] Simple settings report...
Delete...	[Report] Settings changes...	
Compare to another device...	[Report] Settings compare...	

Main Settings	Additional documents	Notes	Links	Audit trail																																																																																				
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="background-color: #f2f2f2;">Attribute</th> <th style="background-color: #f2f2f2;">Description</th> <th style="background-color: #f2f2f2;">Value</th> <th style="background-color: #f2f2f2;">Range</th> <th style="background-color: #f2f2f2;">Unit</th> <th style="background-color: #f2f2f2;">Assigned</th> </tr> </thead> <tbody> <tr><td colspan="6"><b>GENERAL SETTINGS</b></td></tr> <tr><td>Manufacturer</td><td>Manufacturer</td><td>Power Economy</td><td></td><td>40 Character</td><td style="text-align: center;"><input checked="" type="checkbox"/></td></tr> <tr><td>Serial Number</td><td>Serial Number</td><td>PEME/1112/07</td><td></td><td>40 Character</td><td style="text-align: center;"><input checked="" type="checkbox"/></td></tr> <tr><td>Year of manufacture</td><td>Year of manufacture</td><td>2002</td><td></td><td>40 Character</td><td style="text-align: center;"><input checked="" type="checkbox"/></td></tr> <tr><td>Rated Output</td><td>Rated Output</td><td>3</td><td></td><td>MVAR</td><td style="text-align: center;"><input checked="" type="checkbox"/></td></tr> <tr><td>Stages</td><td>Stages</td><td>3</td><td></td><td></td><td style="text-align: center;"><input checked="" type="checkbox"/></td></tr> <tr><td>Step Size</td><td>Step Size</td><td>1</td><td></td><td>MVAR</td><td style="text-align: center;"><input checked="" type="checkbox"/></td></tr> <tr><td>V</td><td>Rated Voltage</td><td>11500</td><td></td><td>V</td><td style="text-align: center;"><input checked="" type="checkbox"/></td></tr> <tr><td>Phases</td><td>Phases</td><td>3</td><td></td><td></td><td style="text-align: center;"><input checked="" type="checkbox"/></td></tr> <tr><td>F</td><td>Frequency</td><td>50</td><td></td><td>Hz</td><td style="text-align: center;"><input checked="" type="checkbox"/></td></tr> <tr><td>Insulation</td><td>Insulation Level</td><td>28kVrms/75kVp</td><td></td><td></td><td style="text-align: center;"><input checked="" type="checkbox"/></td></tr> <tr><td colspan="6"><b>CONTROLLER SETTINGS</b></td></tr> <tr><td>Manufacturer</td><td>Manufacturer</td><td>MICROELECTRICA SCIENTIFICA</td><td></td><td>40 Character</td><td style="text-align: center;"><input checked="" type="checkbox"/></td></tr> </tbody> </table>					Attribute	Description	Value	Range	Unit	Assigned	<b>GENERAL SETTINGS</b>						Manufacturer	Manufacturer	Power Economy		40 Character	<input checked="" type="checkbox"/>	Serial Number	Serial Number	PEME/1112/07		40 Character	<input checked="" type="checkbox"/>	Year of manufacture	Year of manufacture	2002		40 Character	<input checked="" type="checkbox"/>	Rated Output	Rated Output	3		MVAR	<input checked="" type="checkbox"/>	Stages	Stages	3			<input checked="" type="checkbox"/>	Step Size	Step Size	1		MVAR	<input checked="" type="checkbox"/>	V	Rated Voltage	11500		V	<input checked="" type="checkbox"/>	Phases	Phases	3			<input checked="" type="checkbox"/>	F	Frequency	50		Hz	<input checked="" type="checkbox"/>	Insulation	Insulation Level	28kVrms/75kVp			<input checked="" type="checkbox"/>	<b>CONTROLLER SETTINGS</b>						Manufacturer	Manufacturer	MICROELECTRICA SCIENTIFICA		40 Character	<input checked="" type="checkbox"/>
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## For More Details :

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We are located in Knowledge Oasis Muscat.

**Best wishes from  
Albanah Team**