DSX640 – REX640 Demo box

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1 Introduction

DSX640 is a three phase portable demonstration and sales support system which gives the user possibility to simulate certain power system conditions. Additionally, the user has control over the binary inputs of the relay and can get certain status information out of the relay indicated by output LEDs on both the simulator and the relay itself.

This document describes the features and functionality of the REX640 demo box.

For more information about the REX640 operation, technical description and programming, please refer to the REX640 manuals and documentation.
2 The DSX640 simulator

2.1 Scope of delivery

A DSX640 simulator contains the following parts:

- Simulator
- REX640 protection relay with a custom made configuration.
- Mains lead (IEC320)

2.2 Description of simulator controls

DSX640 is a fifteen channel, three phase system with eight current and seven voltage channels and additionally binary inputs and outputs. The functionality is summarized in Table 1 and Table 2.

Table 1. Potentiometers for analog inputs

<table>
<thead>
<tr>
<th>Potentiometer</th>
<th>Description</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL1-3</td>
<td>Bus bar voltage</td>
<td>The three phase voltage level of UL1–UL3</td>
</tr>
<tr>
<td>Usync</td>
<td>Incoming feeder (generator) voltage</td>
<td>The three phase voltage level of Usync (UL4-6)</td>
</tr>
<tr>
<td>f</td>
<td>Frequency of Usync</td>
<td>The frequency of Usync can be adjusted between 49 and 51 Hz</td>
</tr>
<tr>
<td>Uo</td>
<td>Voltage level of Uo</td>
<td>The voltage level in the neutral</td>
</tr>
<tr>
<td>IL1-3</td>
<td>Current level of IL1-3</td>
<td>The current level in IL1–L3</td>
</tr>
<tr>
<td>IL4-6</td>
<td>Current level of IL4-6</td>
<td>The current level in IL4–L6</td>
</tr>
<tr>
<td>$\Phi$ IL1-6</td>
<td>Current phase angle</td>
<td>IL1-6 phase angle relative to the voltage UL1-3</td>
</tr>
<tr>
<td>Idiff</td>
<td>Differential current in IL4</td>
<td>When Idiff I turned clockwise it will decrease IL4</td>
</tr>
<tr>
<td>Io1</td>
<td>Current level of Io1</td>
<td>The current level in neutral 1</td>
</tr>
<tr>
<td>Io2</td>
<td>Current level of Io2</td>
<td>The current level in neutral 2</td>
</tr>
<tr>
<td>$\Phi$ Io1</td>
<td>Neutral current Io1 phase angle</td>
<td>Io1 phase angle relative to the voltage Uo</td>
</tr>
<tr>
<td>mA</td>
<td>0-20 mA input</td>
<td></td>
</tr>
<tr>
<td>RTD</td>
<td>PT-100 input</td>
<td>Temperature measurement</td>
</tr>
</tbody>
</table>
Table 2. Indication and control of binary signals and controllable objects

<table>
<thead>
<tr>
<th>1/0 buttons</th>
<th>Breaker / disconnector manual control</th>
<th>Opening and closing (forcing) of controllable objects</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCS</td>
<td>Trip circuit supervision</td>
<td></td>
</tr>
<tr>
<td>Inputs</td>
<td>Binary inputs</td>
<td>Freely configurable binary inputs 1-10</td>
</tr>
<tr>
<td>Outputs</td>
<td>LED indication</td>
<td>Freely configurable LED indications 1-4</td>
</tr>
<tr>
<td>TCS button</td>
<td>Trip Circuit Supervision</td>
<td>When the button is pressed the trip circuit supervision current is interrupted to simulate a faulty trip circuit</td>
</tr>
<tr>
<td>MCF button</td>
<td>Measuring Circuit Failure</td>
<td>When activated one phase current is interrupted to simulate a faulty measurement circuit</td>
</tr>
</tbody>
</table>
2.3 Technical data

The technical data of the DSX640 simulator is listed in Table 3.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply</td>
<td>110-240 VAC</td>
<td>50–60 Hz</td>
</tr>
<tr>
<td>Dimensions</td>
<td>H450 x W600 x D500 mm</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>28 kg</td>
<td></td>
</tr>
<tr>
<td>Voltage range</td>
<td>0 – 4 xln</td>
<td>Voltage sensor inputs</td>
</tr>
<tr>
<td>Current range</td>
<td>0 – 1.2 xUn</td>
<td>Current sensor inputs</td>
</tr>
<tr>
<td>Channel phase accuracy</td>
<td>±1°</td>
<td></td>
</tr>
<tr>
<td>Network type</td>
<td>3-phase</td>
<td>120° between phases</td>
</tr>
<tr>
<td>Phase shift between U and I</td>
<td>Adjustable</td>
<td>-90°…+90°</td>
</tr>
<tr>
<td>Binary inputs</td>
<td>24 V</td>
<td>Nominal</td>
</tr>
</tbody>
</table>
3 Physical connections

3.1 Connection between the REX640 and the simulation

Analog measurements, binary inputs and outputs are already connected to the REX640. Please note that these connections must not be modified.
3.2 Binary inputs/outputs of card in slot B

**SLOT B**

- **BIO1001/ BIO1003**

- **X1**
  - CB1 Closed position
  - CB1 Open position
  - Input 1 (pushbutton)
  - SW2 Closed position
  - SW2 Open position
  - Input 2 (pushbutton)
  - SW3 Closed position
  - SW3 Open position
  - Input 3 (pushbutton)
  - SW4 Closed position
  - SW4 Open position
  - Input 4 (pushbutton)
  - Input 5 (pushbutton)

- **X2**
  - BI1
  - BI2
  - BI3
  - BI4
  - BI5
  - BI6
  - BI7
  - BI8
  - BI9
  - BI10
  - BI11
  - BI12
  - BI13
  - BI14

- SW5 Open command
- SW5 Close command
- SW6 Open command
- SW6 Close command
- SW7 Open command
- SW7 Close command
- Spare
- Spare
3.3 RTD and mA inputs of card in slot C
3.4 Binary inputs/outputs of card in slot D

SLOT D

- **SW5 Closed position**: Bl1
- **SW5 Open position**: Bl2
- **Input 6 (pushbutton)**: Bl3
- **SW6 Closed position**: Bl4
- **SW6 Open position**: Bl5
- **Input 7 (pushbutton)**: Bl6
- **SW7 Closed position (3-state)**: Bl7
- **SW7 Open position (3-state)**: Bl8
- **SW7 Earthed position (3-state)**: Bl9
- **Input 8 (pushbutton)**: Bl10
- **Input 9 (pushbutton)**: Bl11
- **Input 10 (pushbutton)**: Bl12
- **Spare**: Bl13

**Input/output descriptions**:
- **mA Up**: (motorized potentiometer)
- **mA Down**: (motorized potentiometer)
- **UL1-3 Up**: (motorized potentiometer)
- **UL1-3 Down**: (motorized potentiometer)
- **Usync Up**: (motorized potentiometer)
- **Usync Down**: (motorized potentiometer)
- **Frequency Up**: (motorized potentiometer)
- **Frequency Down**: (motorized potentiometer)
3.5 Analog inputs of card in slot E
3.6 Analog inputs of card in slot F
3.7 Binary inputs/outputs of card in slot G

SLOT G

PSM100x

X1

1

2

3 4 5

Uaux

RF

SO1

SO2

SSO1

SSO2

POSP1

POSP2

X2

SO3

PODP1

PO1_TCS

PODP2

PO2_TCS

PODP3

PO3_TCS

SW4 Open command

SW4 Close command

Spare

Spare

SW1 Close command

SW2 Close command

SW3 Close command

SW1 Open command

SW2 Open command

SW3 Open command
4 Configuration

4.1 The standard configuration

The REX640 demo box is preconfigured with a standard configuration. Please note that editing the configuration may affect the usability of the demo box. A copy of the original configuration can always be downloaded from ABB Library or from the Demo box web page.

The standard configuration file is named DSX640BX1A.pcmi.

The standard configuration consists of a generator connecting to a bus bar using the auto-synchronizer feature in REX640.

![Diagram showing the standard configuration of the REX640 demo box.]
Protection functions:

- Generator differential protection (MPDIF)
- Overcurrent protection (DPHLPD, DPHHPDOC, PHIPTOC)
- Earth fault protection (DEFHPDEF, EFLPTOC, EFHPPTOC)
- Thermal overload protection (T1PTTR)
- Negative-sequence overcurrent protection (MNSPTOC)
- Inrush detector (INRPHAR)
- Undervoltage protection (PHPTUV)
- Overvoltage protection (PHPTOV)
- Residual overvoltage protection ROVPTOV
- ARC protection (ARCSARC)
- Frequency protection FRPFRQ1
- Out of step protection OOSRPSB1
- Reverse power protection DOPPDPR1
- Underimpedance protection UZPDIS1
- Underpower protection DUPPDPR1
- Underexcitation protection UEXPDIS1
5 Demonstration

5.1 Demonstration of the auto synchronization

To start the autosynchronizer demonstration, the bus bar must be energized to the nominal voltage of 11kV. This is done by closing the CB1 switch manually and adjusting the UL1-3 until it is 11kV.

The generator breaker is represented by SW2.

Then adjust the generator voltage to 10kV by adjusting Usync and the generator frequency to 49.5Hz.

Touch the generator breaker on the screen and set the Auto Syn mode to Automatic.

Live dead mode should be set to Off

Touch the green S and confirm the synchronization.

Now the auto synchronizer will adjust the generator voltage and frequency until they are inside the allowed limits and close the generator breaker automatically when in phase with the bus bar.