

	Standard	Technology
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AUTOMATION HMI
COMMISSIONING GUIDE FOR EHV
SUBSTATIONS**

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Compiled by	Approved by	Authorized by
		
Fareed Ismail Principal Systems Control Engineer	Sagar Dayabhai Systems Control Manager	Tebogo Mohohlo Project Manager
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1. Introduction

This document outlines the necessary steps required to adequately commission the substation HMI and associated peripherals.

2. Supporting clauses

2.1 Scope

This document covers the commissioning procedures for the substation HMI which includes commissioning of the following equipment:

- SEL-3355 computing platform,
- Local KVM extender module,
- Remote KVM Module which is equipped with the remote KVM extender,
- HMI Monitors,
- Keyboard and Mouse,
- External Speaker

2.1.1 Purpose

The purpose of this document is to detail the commissioning guidelines related to the substation HMI to be followed on completion of the physical installation of the Gateway panel and Remote KVM Module. The commissioning guidelines are intended to ensure the safe and proper working of the equipment prior to energising, and to ensure correct operation post-energisation.

2.1.2 Applicability

This document shall apply to all personnel working on this equipment throughout Eskom Holdings SOC Limited's Transmission Division.

2.2 Normative/informative references

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

- [1] ISO 9001 Quality Management Systems
- [2] 240-64100247 – Standard for Earthing of Secondary Plant in Substations
- [3] SEL-3355 Substation, Instruction Manual
- [4] SDR, Eskom Transmission Integrated Protection and Substation Automation Solution System Design Report
- [5] 21-FDS, Functional Design Specification of Substation Control and Automation HMI for EHV Substations
- [6] 21-DDS, Detailed Design Specification of Substation Control and Automation HMI for EHV Substations
- [7] 23-Commissioning, SEL-2488 GPS Time Synchronising Unit Commissioning Guide
- [8] 21-Configuration, Configuration Guide of Substation Control and Automation HMI for EHV Substations
- [9] 21-Maint, Maintenance Standard for the SEL-3355 HMI

2.2.2 Informative

None.

2.3 Definitions**2.3.1 General**

Definition	Description
Ping	Computer network administration software utility used to determine whether a specific IP address is accessible.

2.3.2 Disclosure classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.4 Abbreviations

Abbreviation	Description
AC	Alternating Current
AUX	Auxiliary
DC	Direct Current
DHCP	Dynamic Host Configuration Protocol
DIN	Deutsches Institut für Normung
HMI	Human Machine Interface
IDF	Intermediate Distribution Frame
IEC	International Electrotechnical Commission
IED	Intelligent Electronic Device
IP	Internet Protocol
ISO	International Organization for Standardization
LED	Light Emitting Diode
MCB	Miniature Circuit Breaker
NTP	Network Time Protocol
PC	Personal Computer
RTAC	Real-Time Automation Controller
RTU	Remote Terminal Unit
RX	Receive
SCADA	Supervisory Control and Data acquisition
SEL	Schweitzer Engineering Laboratories
SNTP	Simple Network Time Protocol
TCP	Transmission Control Protocol
TX	Transmit
Vac	Volts Alternating Current

Abbreviation	Description
Vdc	Volts Direct Current

2.5 Roles and responsibilities

Work roles and responsibilities are allocated according to requirements and individual competencies. All Eskom Holdings Limited Transmission Division managers will ensure that this document is complied to with respect to all substation HMI commissioning activities.

2.6 Process for monitoring

Not applicable.

2.6.1 Related/supporting documents

Not applicable.

3. Substation Control and Automation HMI Commissioning Procedure

3.1 Prerequisites

Only personnel who are deemed competent to work on the substation HMI are permitted to perform visual inspection, carry out diagnostics and commission the relevant equipment.

Each substation is equipped with two substation HMI's, designated as HMI 1 for the Main 1 control system and HMI 2 for the Main 2 control system. Figure 1 below illustrates the substation HMI solution and the physical location of the respective devices comprising the solution.

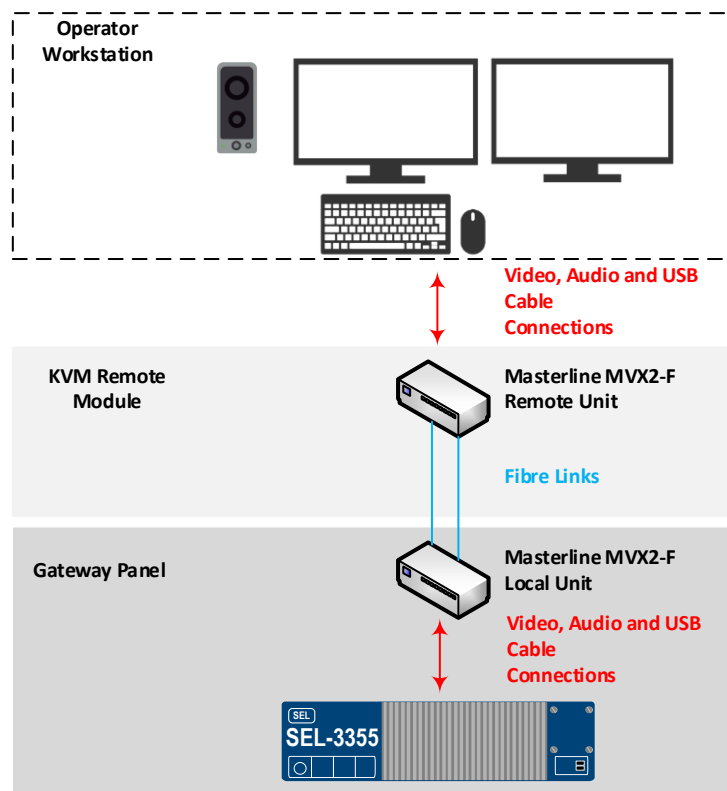


Figure 1: Substation HMI Solution.

3.2 Requirements

- 1) Commissioning of the substation HMI shall be performed per a pre-determined commissioning plan as prepared by the relevant engineer.
- 2) A commissioning report outlining all completed works as well as any outstanding work shall be completed by the commissioning team.
- 3) Substation HMI equipment installed at the substation shall adhere to the relevant installation and earthing standards [2].

3.3 Commissioning plan

- 1) A commissioning plan is necessary to ensure the successful commissioning of the substation HMI.
- 2) The final commissioning plan shall be distributed to all stakeholders prior to commissioning. These parties include but are not limited to:
 - a) Control Centre(s) Managers;
 - b) Protection, Metering/Measurement, DC and substation control commissioning teams involved in the project;
 - c) Project Manager;
 - d) Substation Control Applications Engineer.

4. Required Tools and Equipment

4.1 Hardware

- 5 m Category 5e (or better) Ethernet cable;
- Laptop with the software listed below.

4.2 Software

- Command Prompt – Included with Microsoft® Windows® 10 IoT Enterprise LTSC Windows.

4.3 Pre-commissioning Checks

All pre-commissioning checks are to be performed **PRIOR** to supplying power to any equipment related to the substation HMI.

4.3.1 Drawings

- 1) Ensure that the latest revision of the application drawings have been issued to the commissioning team.
- 2) Any changes that may be necessary must first be verified by the application engineer. All modifications are to be marked up on the issued drawings. A copy of all marked up drawings must be submitted to the responsible application engineer so that the as-built revision of the drawings can be generated.

4.3.2 Equipment Verification

Verify that the equipment supplied and installed for the substation HMI are in accordance with Table 1 below.

Table 1: Substation HMI equipment

Description	Part Number	Configuration Summary
SEL-3355 substation HMI computing platform	3355#C2NB	<p>Operating System Microsoft® Windows® 10 IoT Enterprise LTSC</p> <p>Chassis and Mounting Horizontal Rack Mount, 3U</p> <p>Processor Intel i7-3612QE Quad Core 2.1GHz</p> <p>Power Supply A SEL-9331 - 125/250 Vdc; 120/240 Vac</p> <p>Power Supply B SEL-9331 - 125/250 Vdc; 120/240 Vac</p> <p>PCI Slot 2 SEL-3390S8 PCIe Serial Card</p> <p>PCI Slot 4 SEL-3390E4 PCIe Ethernet Card with 2 RJ-45 10/100/1000 and 2 SFP Fiber slots. Both SFP slots are fitted with 100BASE-FX (1310nm, multimode, 2km) SFP modules.</p>
Masterline MVX2-F KVM extender modules	6802	<p>Remote Unit Port Configuration 2 DVI-Out, 2 SFP kvm Fiber Link, 3 USB -A, 2 Audio 3.5mm, DC Power</p> <p>Local Unit Port Configuration 2 DVI-Out, 2 DVI-In, 2 SFP kvm Fiber Link, 1 USB -B, 2 Audio 3.5mm, DC Power.</p>
19 V DC-DC Converter	GS90A19-P1M	90 W (135-370 VDC)/19 VDC Converter for Monitors.
12 V DC-DC Converter	MDR-20-12	20 W (120-370 VDC)/12 VDC Converter for remote KVM extender
Industrial Mouse	SM502	USB wired mouse.
Industrial Keyboard	SKB-107-TP	USB wired keyboard.
LG Screen / Monitor	24M38H	24inch Full HD LED Monitor

4.3.3 SEL-3355 Substation HMI Computing Platform

The front panel of the SEL-3355 substation HMI computing platform provides access to the status indicators, lamp test push button and diagnostic LEDs as shown in Figure 2.

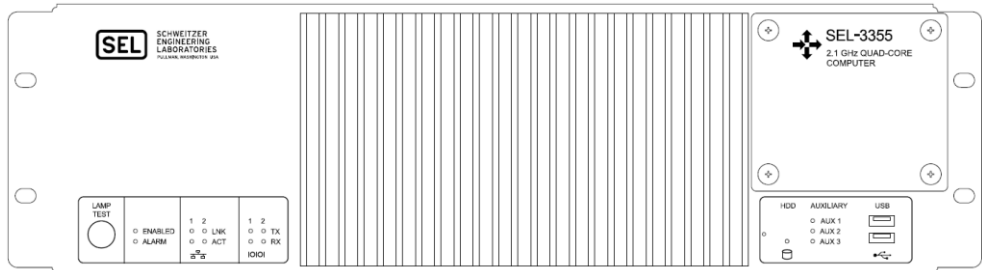


Figure 2: SEL-3355 Front Panel


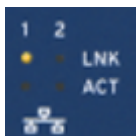

SEL-3355 Substation HMI Computing Platform Front Panel LEDs

The front panel of the 3355 substation HMI computing platform is equipped with diagnostic LEDs to indicate the health and status of the device. Table 2 provides a description of each LED.

Table 2 provides a description of each LED.

Table 2: 3355 Substation HMI Computing Platform Front Panel LED Indicators

LED Section	LED	State	Description
	ENABLED LED	Green	The Unit has passed self-tests and is operational.
		Off	Unit is conducting power-on self-tests; or There is no power to the unit.
	ALARM LED	Red	The Unit is halted or booting, or an alarm condition has occurred.
		Off	No abnormal or alarm condition exists on the relevant unit.
	AUX LEDs	Bicolour	<p>Three bicolour AUXILIARY LEDs which are customizable for the application. By default, these are applied as follows:</p> <ul style="list-style-type: none">The AUX 1 LED is used to indicate the communications status to the Substation Gateway 1. Off = Substation Gateway 1 is online, Red = Substation Gateway 1 is offlineThe AUX 2 LED is used to indicate the communications status to the Substation Gateway 2. Off = Substation Gateway 2 is online, Red = Substation Gateway 2 is offlineThe AUX 3 LED is used to indicate the time synchronization status. Green = Synchronized from the SEL-2488 GPS clocks, Red = Not synchronized from the SEL-2488 GPS clocks.

LED Section	LED	State	Description
	HDD LED	Amber	SATA drives are being accessed.
		Off	SATA drives in idle mode.
	ETH LNK 1 & 2 (not used in this application)	Amber	Indicates that the Port is connected.
		Off	Indicates that the Port is disconnected.
	ETH ACT 1 & 2 (not used in this application)	Green	Data is being transmitted and received.
		Off	Data is not being transmitted or received.
	COM Tx1 & 2 (not used in this application)	Green	Transmit Activity on the serial port
		Off	No Activity on the serial port
	COM Rx 1 & 2 (not used in this application)	Red	Receive Activity on the serial port
		Off	No Activity on the serial port

4.3.4 SEL-3355 Substation HMI Computing Platform Rear View

The rear view of the 3355 substation HMI computing platform provides access to the communication ports and user connections as shown in Figure 3.

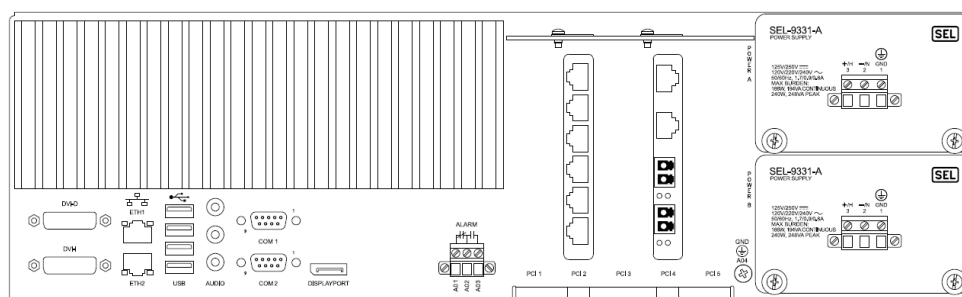


Figure 3: 3355 Substation HMI Computing Platform Rear View

The expansion card LEDs are described per card in Table 3 and Table 4 below. Each expansion card is equipped with ports which are sequentially numbered from Port 1 located at the bottom.

Table 3: SEL-3390E4 Ethernet Expansion Card LED Indicators



Module	LED	State	Description
 SEL-3390E4 Ethernet Expansion Card.	ETHERNET LNK for Network Ports 1 to 4	Amber	Indicates that the Port is connected.
		Off	Indicates that the Port is disconnected.
	ETHERNET ACT for Network Ports 1 to 4	Green	Data is being transmitted and received.
		Off	Data is not being transmitted or received.

Table 4: SEL-3390S8 Serial Expansion Card LED Indicators

Module	LED	State	Description
 SEL-3390S8 Serial Expansion Card (not used in this application)	Transmit LED (located at the bottom) for serial ports 1 to 6 (not used in this application)	Green	Transmit Activity on the serial port
		Off	No Activity on the serial port
	Receive LED (located at the top) for serial ports 1 to 6 (not used in this application)	Red	Receive Activity on the serial port
		Off	No Activity on the serial port

4.3.5 Masterline MVX2-F KVM

The MVX2-F KVM consists out of two separate units, a local unit and a remote unit as shown in Figure 4 below.

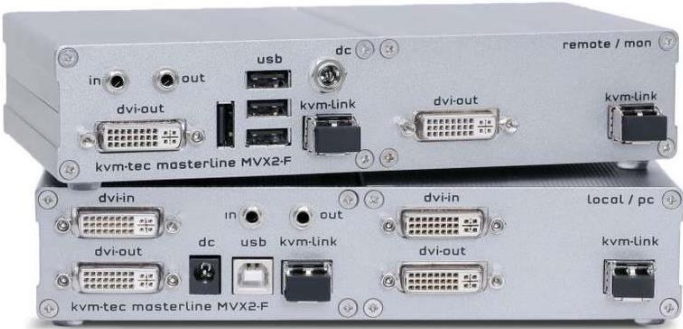


Figure 4: MVX2-F KVM Extenders

4.3.5.1 MVX2-F Local Unit Front View

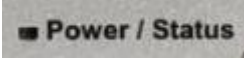
The front panel of the MVX2-F Local unit provides access to the status indicators and diagnostic LEDs as shown in Figure 5 below.



Figure 5: MVX2-F Local Unit - Front View

Table 5 below provides a description of each LED.

Table 5: MVX2-F Local Unit - Front Panel Indicators

LED Section	LED	State	Description
	Power / Status (Left)	Flashing Red	Indicates that the Local Unit (Left side) is in initialisation process.
		Orange	Indicates that the Local Unit (Left side) is connected to the Remote Unit without Video Signal.
		Green	Indicates that the Local Unit (Left side) is connected to the Remote Unit with Video Signal.
	Power / Status (Right)	Flashing Red	Indicates that the Local Unit (Right side) is in initialisation process.
		Orange	Indicates that the Local Unit (Right side) is connected to the Remote Unit without Video Signal.
		Green	Indicates that the Local Unit (Right side) is connected to the Remote Unit with Video Signal.

4.3.5.2 MVX2-F Local Unit Rear

The rear panel of the MVX2-F Local Unit provides access to the DVI ports and user connections as shown in Figure 6 below.



Figure 6: MVX2-F Local Unit Rear Panel

4.3.5.3 MVX2-F Remote Unit Front View

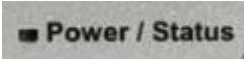
The front panel of the MVX2-F Remote Unit provides access to the status indicators and diagnostic LEDs as shown in Figure 7 below.



Figure 7: MVX2-F Remote Unit Front Panel

Table 6 below provides a description of each LED.

Table 6: MVX2-F Remote Unit - Front Panel Indicators

LED Section	LED	State	Description
	Power / Status (Left)	Flashing Red	Indicates that the Local Unit (Left side) is in initialisation process.
		Orange	Indicates that the Local Unit (Left side) is connected to the Remote Unit without Video Signal.
		Green	Indicates that the Local Unit (Left side) is connected to the Remote Unit with Video Signal.
	Power / Status (Right)	Flashing Red	Indicates that the Local Unit (Right side) is in initialisation process.
		Orange	Indicates that the Local Unit (Right side) is connected to the Remote Unit without Video Signal.
		Green	Indicates that the Local Unit (Right side) is connected to the Remote Unit with Video Signal.

4.3.5.4 MVX2-F Remote Unit Rear

The rear panel of the MVX2-F Remote Unit provides access to the DVI ports and user connections as shown in Figure 8 below.

**Figure 8: MVX2-F Remote Unit Rear Panel**

4.3.6 Gateway Panel Inspection

Before switching in the supply circuits connected to the SEL-3355 substation HMI computing platform and local KVM extender, visually inspect the equipment for any physical damage and perform the following quality checks:

- 1) Verify by visual inspection that the SEL-3355 substation HMI computing platform and Masterline MVX2-F Local unit show no signs of physical damage.
- 2) Verify that the interior of the panel is clean and dry.
- 3) Verify that all metal parts, equipment, and blanking plates are earthed to the panel earth bar and the continuity of all earths are confirmed.
- 4) Verify that all equipment is securely mounted.
- 5) All identifying details, including name, serial numbers or type codes of equipment must be checked and/or recorded.
- 6) Verify that all labels and ferrule numbers are in accordance with the scheme drawing.
- 7) Verify that all terminations are securely fastened.
- 8) Verify that all circuits are as per the Gateway panel scheme drawings.
- 9) Verify that all communication circuits are as per the Gateway panel scheme drawings.
- 10) Verify that all unused fibre optic interfaces have their dust covers in place.

4.3.7 KVM Remote Module Inspection

Before switching in the main supply circuit connected to the Masterline MVX2-F Remote unit and peripheral equipment, visually inspect the equipment for any physical damage and perform the following quality checks:

- 1) Verify by visual inspection that the Masterline MVX2-F Remote unit and peripherals show no signs of physical damage. The peripherals include the two HMI monitors, industrial keyboard and mouse, and an external speaker.
- 2) Verify that the interior of the panel is clean and dry.
- 3) Verify that all metal parts, equipment, the rear chassis plate and enclosure door are earthed to the panel earth bar and the continuity of all earths are confirmed.
- 4) Verify that the earthing cable used to bond the KVM Remote Module to the substation earth mat does not exceed 0.5 m [2]. The continuity of this earth must be confirmed and the impedance must not exceed 0.1 Ω [2].
- 5) Verify that all chassis-mounted equipment, including the Masterline MVX2-F Remote KVM extender are securely mounted.
- 6) All identifying details, including name, serial numbers or type codes of equipment must be checked and/or recorded.
- 7) Verify that all labels and ferrule numbers are in accordance with the KVM Remote Module drawing.
- 8) Verify that all terminations are securely fastened.
- 9) Verify that all circuits are as per the KVM Remote Module drawing.
- 10) Verify that the local KVM extender - Monitor 1 connects to the remote KVM extender - Monitor 1.
- 11) Verify that the local KVM extender - Monitor 2 connects to the remote KVM extender - Monitor 2.

4.3.8 Check External DC Power Connections and MCBs

- 1) Verify the correct rating of the DC MCBs as per the Gateway panel scheme drawings.
- 2) With the supply circuits connecting to the SEL-3355 substation HMI computing platform and Masterline MVX2-F Local unit switched off, measure and verify the voltage applied across each supply MCB.

- 3) Verify that the polarity is correct.
- 4) Verify that the DC supply cable to the Remote KVM Module (Control Desk) is connected to the correct circuit on the DC distribution board and measure and verify the supply voltage from the DC distribution board.
- 5) Verify the correct rating of the input DC MCB of the KVM Remote Module.
- 6) With the Main DC MCB switched off, measure and verify the voltage across the MCB.
- 7) Verify that the polarity is correct.

4.3.9 Power Supply

- 1) Each SEL-3355 substation HMI computing platform is equipped with two SEL-9331 Power Modules. Verify that each power module is rated for the correct DC input voltage as per the order code presented in Table 7 below.
- 2) Verify that both SEL-9331 Power Modules are correctly seated and fastened into the SEL-3355 chassis.

Table 7: Power Supply Input Range

Power Module	Input Voltage Range
SEL-9331 160 W HV (P/N: 9331A001XX)	125/250 Vdc or 120/240 Vac; 50/60 Hz

4.3.10 Check Failsafe Alarm Connections

- 1) Check that the SEL-3355 ALARM contact is correctly connected to the NC (normally closed) and Common terminals on the failsafe relay terminal block as per the Gateway panel scheme drawings.

4.4 Commissioning Checks

4.4.1 Energisation Tests

- 1) Switch on the main MCB in the Remote KVM Module.
- 2) Verify by visual inspection that the Masterline MVX2-F Remote unit and peripherals switch on. The remote KVM will start an automated initialisation process, indicated by blinking red LEDs.
- 3) In the Gateway panel, switch on the MCB's feeding the SEL-3355 substation HMI computing platform and Masterline MVX2-F Local unit.
- 4) Verify by visual inspection that the SEL-3355 substation HMI computing platform and Masterline MVX2-F Local unit both switch on. Once the SEL-3355 substation HMI computing platform has completed its booting cycle, the ENABLED LED will illuminate.
- 5) Confirm that the local KVM status LEDs turns solid green which indicates all signals are being transmitted.
- 6) Verify that the remote KVM extender establishes communication with the local KVM extender in the Gateway panel.

4.4.2 Setting up the SEL-3355 Substation HMI Computing Platform

4.4.2.1 Ethernet Ports

- 1) Verify that the Ethernet Port 2 on the SEL-3390E4 PCIe card is configured as per the IP address allocation for the substation.

4.4.3 SEL-3355 Substation HMI Computing Platform Commissioning

4.4.3.1 Verify Network Reachability of the SEL-3355 Substation HMI Computing Platform

- 1) Refer to the substation's application network communications diagram. Connect the commissioning PC to an engineering port on the network. The engineering ports are dynamically assigned IP addresses from the substation router.
- 2) Verify that the SEL-3355 substation HMI is physically connected to the network as indicated in the application network communication diagram.
- 3) Open a Command Prompt on the configuration PC, and using the ping utility, verify reachability of the SEL-3355 substation HMI computing platform on the network.

4.4.3.2 Time Synchronisation

- 1) The SEL-3355 substation HMI computing platform is time synchronized using (S)NTP directly from the SEL-2488 GPS clock in the gateway panel.
- 2) Verify AUX 3 LED on the SEL-3355 unit is green indicating the unit is GPS time synchronized.

4.4.3.3 Confirm Devices are Online

- 1) Using the HMI utilities page, open the "Device Debug" tool.
- 2) If the correct project and matching CIDs has been loaded, the Gateway "I/O Device Statistics" tool will show the Substation Gateways online and show either "standby" or "primary" depending on which Gateway is switched on and communicating.

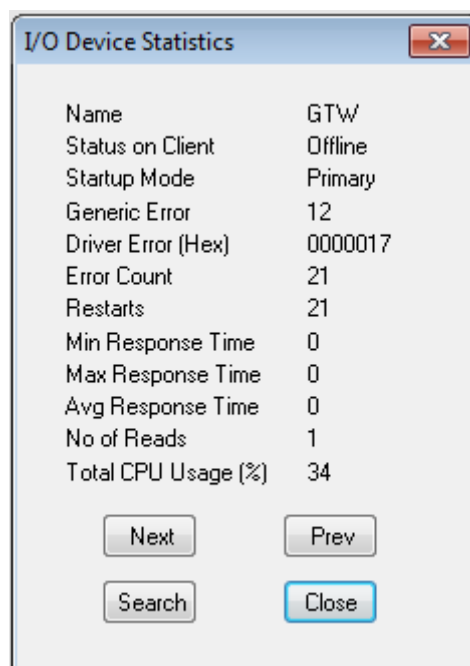


Figure 9: Gateway I/O Device Statistics

- 3) Verify that both SEL-3555 Substation Gateways are communicating to the substation HMI by disconnecting both Substation Gateways individually from the network. Monitor the "Device Debug" tool to confirm if the Gateway online status changes from "primary" to "standby" as well as the inverse.
- 4) AUX 1 LED on the SEL-3355 substation HMI computing platform indicates the communication status to the Substation Gateway 1.

- 5) AUX 2 LED on the SEL-3355 substation HMI computing platform indicates the communication status to the Substation Gateway 2.

4.4.3.4 Plant I/O Testing

- 1) All bays at the substation are to be switched off supervisory for the duration of the commissioning to ensure that no inadvertent plant operation occurs.
- 2) Verify each status of plant against the graphical representation on the substation HMI.
- 3) Test all alarms from the furthest point to the substation HMI. Protection personnel must be available to generate all protection indication, alarm and trip signals.
- 4) Test all controls from the substation HMI to the plant.
- 5) Test all analogue points to the substation HMI by injecting to the IED using an injection test set via the test blocks. Verify the analogue displayed on the substation HMI against the values displayed on the IED front panel.
- 6) For points which cannot be simulated directly from plant, these can be forced from within the Substation Gateway configuration software.
- 7) Capture all results for abovementioned tests using commissioning tick sheets and the HMI signal lists
- 8) Once all bays have been tested, they will be deemed ready to be placed into service.

4.5 Troubleshooting

Table 8 below lists the common issues and indicators with the SEL-3355 HMI which can be used to help identify and resolve common issues.

Table 8: SEL-3355 Substation HMI Computing Platform - Troubleshooting Procedures

Issue/Indicator	Possible Causes	Solution
Front-panel ENABLED LED is off.	Input power is not present, power supply is not properly seated.	<ul style="list-style-type: none"> Remove power source. Verify power cabling and connections. Check MCB.
Front-panel ENABLED LED remains unlit after start-up.	Device has experienced a diagnostics failure that prevents it from operating.	Please refer to the maintenance guide [9].
The SEL-3355 HMI does not respond to connection attempts on the substation network.	Incorrect IP address.	Verify IP address.
	Invalid subnet.	Verify subnet and subnet mask.
	Incorrect or disconnected cable.	Verify cable is crossover if needed.
	Ethernet cable connected to the wrong ethernet port.	Verify that the network connection is made to the correct ethernet port as per network diagram.
	Ethernet port disabled.	Verify settings via HMI Screen.
	More than one port configured for the same subnet.	Use different subnet for each Ethernet port on the SEL-3355 HMI.
	Setting incorrect.	Verify widows setting for date and Time.

Issue/Indicator	Possible Causes	Solution
The SEL-3355 HMI does not synchronize via NTP.	SEL-2488 GPS clocks not reachable on the network.	Verify that the SEL-2488 GPS clocks have been commissioned and are reachable on the network from the SEL-3355 HMI.
	Cable disconnected.	Verify network cable is secure.

5. Authorization

This document has been seen and accepted by:

Name and surname	Designation
Dinesh Bhana	Project Manager
Sagar Dayabhai	Systems Control Manager

6. Revisions

Date	Rev	Compiler	Remarks
Nov 2017	0	F.V. De Beer	First issue
Sep 2018	1	F.V. De Beer	Updated with New Template.
Oct 2018	2	F. Ismail	Updated with Eskoms Comments

7. Development team

The following people were involved in the development of this document:

- Victor de Beer
- Fareed Ismail

8. Acknowledgements

N/A

Appendix A – Commissioning Checklist

Substation	Grid
Device Name	Device IP
HMI	

Section	Description	Pass (✓)/ Fail (X)	Notes
3.2	Commissioning of the SEL-3355 HMI shall be performed per a pre-determined commissioning plan as prepared by the relevant engineer.		
4.3.1	Ensure that the latest revision of the application drawings have been issued to the commissioning team.		
	Any changes that may be necessary must first be verified with the application engineer. All modifications are to be marked up on the issued drawings. A copy of all marked up drawings must be submitted to the responsible application engineer so that the as-built revision of the drawings can be generated.		
4.3.2	Equipment Verification		
	SEL-3355 Substation HMI Computing Platform		
	SEL-3390E4 Ethernet Expansion Card		
	SEL-3390S8 Serial Expansion Card		
	Masterline MVX2-F KVM Remote Unit		
	Masterline MVX2-F KVM Local Unit		
	19 V DC-DC Converter		
	12 V DC-DC Converter		
	Industrial Mouse SM502		
	Industrial Keyboard SKB-107-TP		

Section	Description	Pass (✓)/ Fail (X)	Notes
	LG Screen / Monitor 24M38H		
4.3.6	Gateway Panel inspection		
1)	The SEL-3355 HMI and Masterline MVX2-F Local unit is not physically damaged.		
2)	The interior of the panel is clean and dry.		
3)	All metal parts, equipment, and blanking plates are earthed to the panel earth bar and the continuity of all earths is confirmed.		
4)	All equipment is securely mounted		
5)	All identifying details, including name, serial numbers or type codes of equipment are checked and/or recorded.		
6)	All labels and ferrule numbers are in accordance with the Gateway panel scheme drawing.		
7)	All terminations are securely fastened		
8)	All circuits are as per the Gateway panel scheme drawings		
9)	All communication circuits are as per the Gateway panel scheme drawings.		
10)	All unused fibre optic interfaces have their dust covers in place.		
4.3.7	KVM Remote Module Inspection		
1)	The Masterline MVX2-F Remote unit and peripherals show no signs of physical damage. The peripherals include the two HMI monitors, industrial keyboard and mouse, and an external speaker.		
2)	The interior of the panel is clean and dry.		
3)	All metal parts, equipment, the rear chassis plate and enclosure door are earthed to the panel earth bar and the continuity of all earths is confirmed.		

Section	Description	Pass (✓)/ Fail (X)	Notes
4)	The earthing cable used to bond the KVM Remote Module to the substation earth mat does not exceed 0.5 m [2]. The continuity of this earth is confirmed and the impedance does not exceed 0.1 Ω [2].		
5)	All chassis-mounted equipment, including the Masterline MVX2-F Remote KVM extender are securely mounted.		
6)	All identifying details, including name, serial numbers or type codes of equipment are checked and/or recorded.		
7)	All labels and ferrule numbers are in accordance with the KVM Remote Module drawing.		
8)	All terminations are securely fastened.		
9)	All circuits are as per the KVM Remote Module drawing.		
10)	The local KVM extender - Monitor 1 connects to the remote KVM extender - Monitor 1.		
11)	The local KVM extender - Monitor 2 connects to the remote KVM extender - Monitor 2.		
4.3.8	Check External DC Power Connections and MCBs		
1)	The DC MCBs are correctly rated as per the Gateway panel scheme drawings.		
2)	With the supply circuits connecting to the SEL-3355 substation HMI computing platform and Masterline MVX2-F Local unit switched off, measure and verify the voltage applied across each supply MCB.		
3)	The polarity is correct.		
4)	The DC supply cable feeding the Remote KVM Module (Control Desk) is connected to the correct circuit on the DC Distribution board. Measure and verify the supply voltage from the DC Distribution board.		
5)	The input DC MCB of the KVM Remote Module is correctly rated.		

Section	Description	Pass (✓)/ Fail (X)	Notes
6)	With the Main DC MCB switched off, measure and verify the voltage across the MCB.		
7)	The polarity is correct.		
4.3.9	Power Supply		
1)	Each SEL-3355 substation HMI computing platform is equipped with two SEL-9331 Power Modules. Each power module is rated for the correct DC input voltage as per the order code presented in Table 7 above.		
2)	Each SEL-9331 Power Modules is correctly seated and fastened into the SEL-3355 chassis.		
4.3.10	Check Failsafe Alarm Connections		
1)	The SEL-3355 ALARM contact is correctly connected to the NC (normally closed) and Common terminals on the failsafe relay terminal block as per the Gateway panel scheme drawings.		
4.4	Commissioning Checks		
4.4.1	Energisation Tests		
1)	Switch on the main MCB in the Remote KVM Module.		
2)	The Masterline MVX2-F Remote unit and peripherals switch on. The remote KVM starts an automated initialisation process, indicated by blinking red LEDs.		
3)	In the Gateway panel, switch on the MCB's feeding the SEL-3355 substation HMI computing platform and Masterline MVX2-F Local unit.		
4)	The SEL-3355 substation HMI computing platform and Masterline MVX2-F Local unit both switch on. Once the SEL-3355 substation HMI computing platform has completed its booting cycle, the ENABLED LED illuminates.		

Section	Description	Pass (✓)/ Fail (X)	Notes
5)	The local KVM status LEDs turns solid green indicating that all signals are being transmitted.		
6)	The remote KVM extender establishes communication with the local KVM extender in the Gateway panel.		
4.4.2	Setting up the SEL-3355 Substation HMI Computing Platform		
1)	Ethernet Port 2 on the SEL-3390E4 PCIe card is configured as per the IP address allocation for the substation.		
4.4.3	SEL-3355 Substation HMI Computing Platform Commissioning		
4.4.3.1	Verify Network Reachability of the SEL-3355 Substation HMI Computing Platform		
1)	Refer to the substation's application network communications diagram. Connect the commissioning PC to an engineering port on the network. The engineering ports are dynamically assigned IP addresses from the substation router.		
2)	The SEL-3355 substation HMI is physically connected to the network as indicated in the application network communication diagram.		
3)	Open a Command Prompt on the configuration PC, and using the ping utility, verify reachability of the SEL-3355 substation HMI computing platform on the network.		
4.4.3.2	Time synchronisation		
1)	The SEL-3355 substation HMI computing platform is time synchronized using (S)NTP directly from the SEL-2488 GPS clock in the gateway panel.		
2)	AUX 3 LED on the SEL-3355 unit is green indicating the unit is GPS time synchronized.		
4.4.3.3	Confirm Devices are Online		
1)	Using the HMI utilities page, open the "Device Debug" tool.		

Section	Description	Pass (✓)/ Fail (X)	Notes
2)	If the correct project and matching CIDs has been loaded, the "Device Debug" tool will show the Substation Gateways online and show either "standby" or "primary" depending on which Gateway is switched on and communicating.		
3)	Verify that both SEL-3555 Substation Gateways are communicating to the substation HMI by disconnecting both Substation Gateways individually from the network. Monitor the 'Device Debug' tool to confirm if the Gateway online status changes from "primary" to "standby" as well as the inverse.		
4)	AUX 1 LED on the SEL-3355 substation HMI computing platform indicates the communication status to the Substation Gateway 1.		
5)	AUX 2 LED on the SEL-3355 substation HMI computing platform indicates the communication status to the Substation Gateway 2.		
4.4.3.4	Plant I/O Testing		
1)	All bays at the substation are to be switched off supervisory for the duration of the commissioning to ensure that no inadvertent plant operation occurs.		
2)	Verify each status of plant against the graphical representation on the substation HMI.		
3)	Test all alarms from the furthest point to the substation HMI. Protection personnel must be available to generate all protection indication, alarm and trip signals.		
4)	Test all controls from the substation HMI to the plant.		
5)	Test all analogue points to the substation HMI by injecting to the IED using an injection test set via the test blocks. Verify the analogue displayed on the substation HMI against the values displayed on the IED front panel.		
6)	For points which cannot be simulated directly from plant, these can be forced from within the Substation Gateway configuration software.		

Section	Description	Pass (✓)/ Fail (X)	Notes
7)	Capture all results for abovementioned tests using commissioning tick sheets and the HMI signal lists		
8)	Once all bays have been tested, they will be deemed ready to be placed into service.		
Field Engineer/Technician		Senior Supervisor	Secondary Plant Manager
Name:		Name:	Name:
Date:		Date:	Date:
Signature:		Signature:	Signature: