

# NOJA POWER<sup>®</sup>

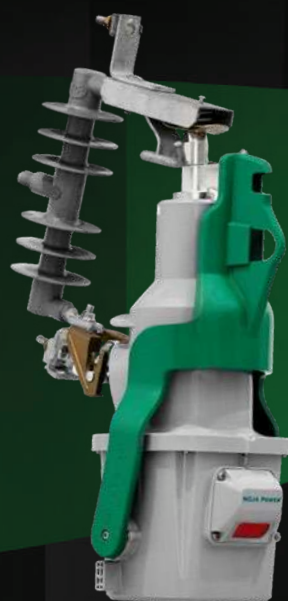
## ECL

**EcoLink<sup>®</sup>**

FUSE LINK MOUNTED RECLOSER

**USER MANUAL**

15 kV Model



# USER MANUAL

# **NOJA POWER<sup>®</sup>**

ECL 15kV

EcoLink<sup>®</sup> User Manual

Revision History

| Rev | Author | Date       | Comment                                                                                        |
|-----|--------|------------|------------------------------------------------------------------------------------------------|
| 00  | AM     | 10-11-2023 | Initial Release.                                                                               |
| 01  | AM     | 24-10-2024 | Second Release.                                                                                |
| 02  | BOS/AM | 03-09-2025 | Removed 100A rating. Added wireless compatibility statements and Sectionalising functionality. |

Source: S:\Marketing-500\User Manuals\EcoLink\NOJA-5205-02 EcoLink User Manual - EN.pdf

**NOJA POWER®**, OSM®, NOJA Power VISI-SWITCH®, EcoLink® and EcoBreaker® are registered trademarks of NOJA Power Switchgear Pty Ltd. This document is copyright and is intended for users and distributors of NOJA Power Switchgear product. It contains information that is the intellectual property of NOJA Power Switchgear and the document, or any part thereof, should not be copied or reproduced in any form without written permission from NOJA Power Switchgear.

NOJA Power Switchgear applies a policy of ongoing development and reserves the right to change product without notice. NOJA Power Switchgear does not accept any responsibility for loss or damage incurred as a result of acting or refraining from action based on information in this document.

## CONTENTS

|          |                                                                                  |           |
|----------|----------------------------------------------------------------------------------|-----------|
| <b>1</b> | <b>INTRODUCTION .....</b>                                                        | <b>1</b>  |
| 1.1      | APPLICABILITY .....                                                              | 1         |
| 1.1.1    | <i>Firmware .....</i>                                                            | <i>1</i>  |
| 1.1.2    | <i>EcoLink® Manager .....</i>                                                    | <i>1</i>  |
| 1.2      | SAFETY INFORMATION .....                                                         | 1         |
| 1.2.1    | <i>Personnel Competence .....</i>                                                | <i>1</i>  |
| 1.2.2    | <i>Hazard Statements .....</i>                                                   | <i>1</i>  |
| 1.2.3    | <i>Safety Instructions .....</i>                                                 | <i>2</i>  |
| 1.3      | CUSTOMER ACCEPTANCE AND INITIAL INSPECTION .....                                 | 2         |
| <b>2</b> | <b>SPECIFICATIONS .....</b>                                                      | <b>3</b>  |
| 2.1      | BASIC OPERATING PARAMETERS .....                                                 | 3         |
| 2.2      | RATINGS .....                                                                    | 3         |
| 2.3      | SENSOR ACCURACY .....                                                            | 4         |
| 2.4      | MEASUREMENT ACCURACY .....                                                       | 4         |
| 2.5      | PROTECTION ACCURACY .....                                                        | 4         |
| 2.6      | ELECTROMAGNETIC COMPATIBILITY (EMC) PERFORMANCE .....                            | 5         |
| 2.7      | BREAKING DUTY .....                                                              | 6         |
| <b>3</b> | <b>SWITCHGEAR MANAGEMENT .....</b>                                               | <b>7</b>  |
| 3.1      | OVERVIEW .....                                                                   | 7         |
| 3.2      | OPERATION .....                                                                  | 7         |
| <b>4</b> | <b>ECOLINK® .....</b>                                                            | <b>8</b>  |
| 4.1      | OVERVIEW .....                                                                   | 8         |
| 4.1.1    | <i>Dimensions .....</i>                                                          | <i>8</i>  |
| 4.2      | POWER MANAGEMENT .....                                                           | 9         |
| 4.2.1    | <i>Wireless performance based on EcoLink® System Energy Status .....</i>         | <i>10</i> |
| 4.2.2    | <i>EcoLink® Startup Time at 25°C for Different Input Currents .....</i>          | <i>10</i> |
| 4.2.3    | <i>Time to perform a Full Sequence from being Fully discharged at 25°C .....</i> | <i>11</i> |
| 4.2.4    | <i>EcoLink® Fully Charged at 25°C .....</i>                                      | <i>11</i> |
| 4.2.5    | <i>Time to trip from No Charge .....</i>                                         | <i>12</i> |
| 4.3      | ECOLINK® MANAGER .....                                                           | 12        |
| 4.3.1    | <i>Wireless Connection .....</i>                                                 | <i>12</i> |
| 4.3.2    | <i>EcoLink® Manager Language .....</i>                                           | <i>13</i> |
| 4.4      | SAVING OF SETTINGS .....                                                         | 13        |
| 4.5      | LED FUNCTIONALITY .....                                                          | 13        |
| <b>5</b> | <b>MEASUREMENT .....</b>                                                         | <b>14</b> |
| 5.1      | TIMESTAMPING .....                                                               | 14        |
| <b>6</b> | <b>PROTECTION .....</b>                                                          | <b>15</b> |
| 6.1      | OVERCURRENT PROTECTION .....                                                     | 15        |
| 6.1.1    | <i>Protection Elements for OC1 and OC3 (ANSI 50P, 51P) .....</i>                 | <i>15</i> |
| 6.1.2    | <i>Protection Settings for OC1 and OC3 .....</i>                                 | <i>15</i> |
| 6.1.3    | <i>Time Current Characteristic (TCC) Settings .....</i>                          | <i>15</i> |
| 6.1.4    | <i>TCC modifiers .....</i>                                                       | <i>17</i> |
| 6.1.5    | <i>Inrush Restraint (IR) .....</i>                                               | <i>17</i> |
| 6.2      | AUTO RECLOSING (AR OC) (ANSI 79) AND SECTIONALISING .....                        | 18        |
| 6.3      | FREQUENCY PROTECTION (FE) .....                                                  | 19        |
| 6.3.1    | <i>Under Frequency (UF) (ANSI 81U) .....</i>                                     | <i>19</i> |
| 6.3.2    | <i>Over Frequency (OF) (ANSI 81O) .....</i>                                      | <i>19</i> |
| 6.4      | RATE OF CHANGE OF CURRENT (ROCOC) .....                                          | 20        |
| 6.5      | TEMPERATURE-DEPENDENT RECLOSING CONTROL .....                                    | 20        |
| 6.6      | FAULT PROFILE .....                                                              | 21        |
| 6.7      | ALARM LATCHING .....                                                             | 21        |
| 6.8      | FAULT PASSAGE INDICATION (FPI) .....                                             | 21        |
| 6.9      | CIRCUIT BREAKER FAILURE (CBF) (ANSI 50BF) .....                                  | 22        |
| 6.10     | LOSS OF SUPPLY DETECTION (LSD) .....                                             | 22        |
| 6.11     | FREQUENCY DETECTION .....                                                        | 22        |
| <b>7</b> | <b>MONITORING .....</b>                                                          | <b>23</b> |
| 7.1      | USER NOTIFICATIONS .....                                                         | 23        |
| 7.1.1    | <i>Alerts .....</i>                                                              | <i>23</i> |
| 7.1.2    | <i>Malfunctions &amp; Warnings .....</i>                                         | <i>23</i> |
| 7.2      | EVENT LOG .....                                                                  | 23        |

|           |                                                                                                       |           |
|-----------|-------------------------------------------------------------------------------------------------------|-----------|
| 7.3       | COUNTERS .....                                                                                        | 24        |
| 7.3.1     | Lifetime counters.....                                                                                | 24        |
| 7.3.2     | Fault counters.....                                                                                   | 24        |
| 7.4       | FAULT TARGETS.....                                                                                    | 24        |
| <b>8</b>  | <b>CONTROL AND INDICATION.....</b>                                                                    | <b>26</b> |
| <b>9</b>  | <b>CONFIGURATION .....</b>                                                                            | <b>27</b> |
| 9.1       | CONFIGURATION PACKAGE SETTINGS.....                                                                   | 27        |
| <b>10</b> | <b>SECURITY .....</b>                                                                                 | <b>28</b> |
| 10.1      | ENCRYPTION .....                                                                                      | 28        |
| 10.2      | AUDIT LOGS.....                                                                                       | 28        |
| 10.3      | CHANGING PASSWORD.....                                                                                | 29        |
| 10.4      | MANAGE USERS.....                                                                                     | 29        |
| 10.4.1    | Add User .....                                                                                        | 29        |
| 10.4.2    | Remove User.....                                                                                      | 29        |
| 10.4.3    | Edit User.....                                                                                        | 29        |
| <b>11</b> | <b>SYSTEM ADMINISTRATION.....</b>                                                                     | <b>31</b> |
| 11.1      | FIRMWARE UPDATE.....                                                                                  | 31        |
| <b>12</b> | <b>INSTALLATION.....</b>                                                                              | <b>32</b> |
| 12.1      | UNPACKING .....                                                                                       | 32        |
| 12.2      | PRE-INSTALLATION CONDITION REQUIREMENTS FOR MEDIUM VOLTAGE FUSE CUTOUTS (IEEE C37.41 COMPLIANCE)..... | 32        |
| <b>13</b> | <b>MAINTENANCE.....</b>                                                                               | <b>33</b> |
| 13.1      | FAULT FINDING.....                                                                                    | 33        |
| 13.1.1    | Warning Signals.....                                                                                  | 33        |
| 13.1.2    | Malfunction Signals.....                                                                              | 33        |
| 13.2      | FACTORY RESET .....                                                                                   | 34        |
| <b>14</b> | <b>APPENDICES.....</b>                                                                                | <b>35</b> |
| 14.1      | APPENDIX A – TIME CURRENT CHARACTERISTIC (TCC) CURVES .....                                           | 35        |
| 14.1.1    | User Defined Universal Inverse TCC (UDC) .....                                                        | 35        |
| 14.1.2    | Default settings of the Fuse Configuration .....                                                      | 37        |
| 14.2      | APPENDIX B – ANSI SUPPORT .....                                                                       | 39        |
| 14.3      | APPENDIX C – INDICATION SIGNALS.....                                                                  | 40        |
| 14.4      | APPENDIX D – EVENTS.....                                                                              | 41        |
| 14.4.1    | Protection Events.....                                                                                | 41        |
| 14.4.2    | Status Events.....                                                                                    | 41        |
| 14.4.3    | Warning Events.....                                                                                   | 42        |
| 14.4.4    | Malfunction Events .....                                                                              | 42        |
| 14.5      | APPENDIX E – AUDIT LOGS .....                                                                         | 42        |
| 14.6      | APPENDIX F – FAULT PROFILE.....                                                                       | 43        |
| 14.7      | WIRELESS COMMUNICATIONS COMPATIBILITY STATEMENTS.....                                                 | 44        |
| <b>15</b> | <b>INDEX .....</b>                                                                                    | <b>45</b> |
|           | <b>REFERENCED STANDARDS AND DOCUMENTS .....</b>                                                       | <b>46</b> |

## LIST OF FIGURES

|                                                                             |    |
|-----------------------------------------------------------------------------|----|
| Figure 1: Number of Electrical Operations vs Current .....                  | 6  |
| Figure 2: EcoLink® Dimensions .....                                         | 9  |
| Figure 3: Wireless performance based on EcoLink® System Energy Status ..... | 10 |
| Figure 4: EcoLink® Startup Time vs Primary Current at 25°C.....             | 10 |
| Figure 5: Time to perform a Full Sequence at 25°C.....                      | 11 |
| Figure 6: EcoLink® Fully Charged at 25°C.....                               | 11 |
| Figure 7: Time to trip from No Charge .....                                 | 12 |
| Figure 8: Operation of the Inrush element .....                             | 17 |
| Figure 9: Temperature-Dependent Reclosing Control .....                     | 20 |

---

## ABBREVIATIONS/ACRONYMS

|       |                                                                |
|-------|----------------------------------------------------------------|
| AR    | Auto Reclosing                                                 |
| BIL   | Basic Insulation Level                                         |
| CBF   | Circuit Breaker Failure                                        |
| CCM   | Counter with Cipher block chaining Message authentication code |
| CT    | Current Transformer                                            |
| DFU   | Device Firmware Upgrade                                        |
| FPI   | Fault Passage Indicator                                        |
| HIB   | Harmonic Inrush Blocking                                       |
| IR    | Inrush Restraint                                               |
| LED   | Light Emitting Diode                                           |
| LSD   | Loss of Supply Detection                                       |
| OC    | Overcurrent                                                    |
| OF    | Over Frequency                                                 |
| RBAC  | Role-Based Access Control                                      |
| ROCOF | Rate of Change of Current                                      |
| RTC   | Real Time Clock                                                |
| SMP   | Simple Management Protocol                                     |
| TCC   | Time Current Curve                                             |
| UDC   | User Defined Curve                                             |
| UF    | Under Frequency                                                |

DEFINITION OF TERMS

|                                       |                                                                                                                                                                                          |
|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AR (Auto Reclose) Reset Time          | AR Reset Time refers to the period of time subsequent to a close after which the Auto Reclosing (AR) element is ready to perform its full sequence.                                      |
| Fault Reset Time                      | Defines the time after which a pickup is no longer active before the protection timer resets.                                                                                            |
| Lockout                               | Lockout is when the device opens and cannot perform any auto reclosing operation.                                                                                                        |
| Pickup                                | Pickup is an event which is initiated when the measured value exceeds the pickup value configured by the user.                                                                           |
| Protection Operation/<br>Trip Request | When a protection element detects a fault, a pickup occurs. When the protection time elapses, if the fault is still present a protection operation is requested such as a trip or alarm. |
| Protection Trip                       | A Protection Trip is when the device goes into the open position when a protection operation is requested.                                                                               |

# 1 Introduction

This manual applies to the EcoLink® device, a compact and cost-effective cutout mounted recloser to replace fuses on MV distribution networks, manufactured by NOJA Power. The device is self-powered using capacitors and is able to operate at 0.15 A of primary current.

## 1.1 Applicability

The following products are covered by this manual:

- ECL15-4-200 (Fuse Circuit Breaker rated at 15.5 kV)

### 1.1.1 Firmware

This manual applies to Device Firmware Version 1.3.0.0.

### 1.1.2 EcoLink® Manager

The EcoLink® Manager communicates with EcoLink® through a wireless connection to read/modify individual configuration parameters, export logs and load/retrieve a configuration package. The current release of firmware requires EcoLink® Manager Version 1.2.0.0 or later.

## 1.2 Safety Information

Installation, use and servicing should only be carried out by trained and experienced personnel who are familiar with the equipment and electrical safety requirements.

### 1.2.1 Personnel Competence

It is the responsibility of the purchaser to ensure the personnel installing, using and maintaining the equipment described in this manual are competent. Minimum personnel competency requirements include:

- Familiarity with this manual and its contents.
- Training in industry accepted safe operating procedures associated with both low and medium voltage equipment.
- Training and appropriate authorisation to energise, de-energise and earth power distribution equipment.
- Training in the care and use of protective equipment associated with low and medium voltage applications.

### 1.2.2 Hazard Statements

This manual contains three types of hazard statements, as follows:



**DANGER:** Indicates an immediately hazardous situation that, if not avoided, will result in death or serious injury.



**WARNING:** Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.



**CAUTION:** Indicates a potentially hazardous situation that, if not avoided, could result in personal injury or equipment damage.

### 1.2.3 Safety Instructions

Before working with equipment ensure you read, understand and follow all safety instruction contained in this manual.



**DANGER:** Contact with hazardous voltage will cause death or severe personal injury. Contact with Device terminals should only be undertaken when equipment is isolated from applicable sources of voltage.



**WARNING:** This equipment is not intended to protect human life. Follow all locally approved safety procedures when installing or operating this equipment. Failure to comply may result in death or severe personal injury.



**WARNING:** Before working with equipment described in this manual carefully read and understand the contents of this manual. Improper handling, installation, operation or maintenance can result in death, severe personal injury or damage to equipment.



**WARNING:** Power distribution equipment must be properly selected for the intended operation. It must be installed, used and maintained by competent personnel who have been trained in and understand all relevant safety procedures. Failure to comply can result in death, personal injury or equipment damage.

## 1.3 Customer Acceptance and Initial Inspection

NOJA Power products are assembled, tested, inspected, packaged and dispatched from the factory meeting all the required quality criteria.

Inspect the shipping packaging for any external signs of damage. Unpack the product and inspect it thoroughly for any signs of transit damage. File a claim with the carrier if transit damage is found.

Product damaged by incorrect handling, installation or other misuse by the customer or carrier will not be covered by a supplier warranty.

## 2 Specifications

### 2.1 Basic Operating Parameters

| ECL Type                                                                                        | ECL15-4-200           |
|-------------------------------------------------------------------------------------------------|-----------------------|
| Frequency, Hz                                                                                   | 50 / 60               |
| Maximum solar radiation, W/m                                                                    | 1100                  |
| Maximum wind velocity, km/h                                                                     | 200                   |
| Ingress Protection                                                                              | IP66                  |
| Pollution level                                                                                 | Heavy                 |
| Minimum operating temperature, °C                                                               | -40                   |
| Maximum operating temperature, °C                                                               | +55                   |
| Maximum Humidity, %                                                                             | 100                   |
| Altitude, m                                                                                     | <1000 <sup>(1)</sup>  |
| Overall dimensions (length x width x height), mm                                                | 261 x 212 x 506       |
| Design Service Life                                                                             | 15 Years              |
| Duty Cycle                                                                                      | O-0.1s-CO-1s-CO-1s-CO |
| Weight                                                                                          | 7.4 kg (16.31 lb)     |
| Hold up time after loss of Primary Current with 100% System Energy Status, hours <sup>(2)</sup> |                       |
| • between -40°C to 25 °C                                                                        | >30                   |
| • at +55°C                                                                                      | >20                   |

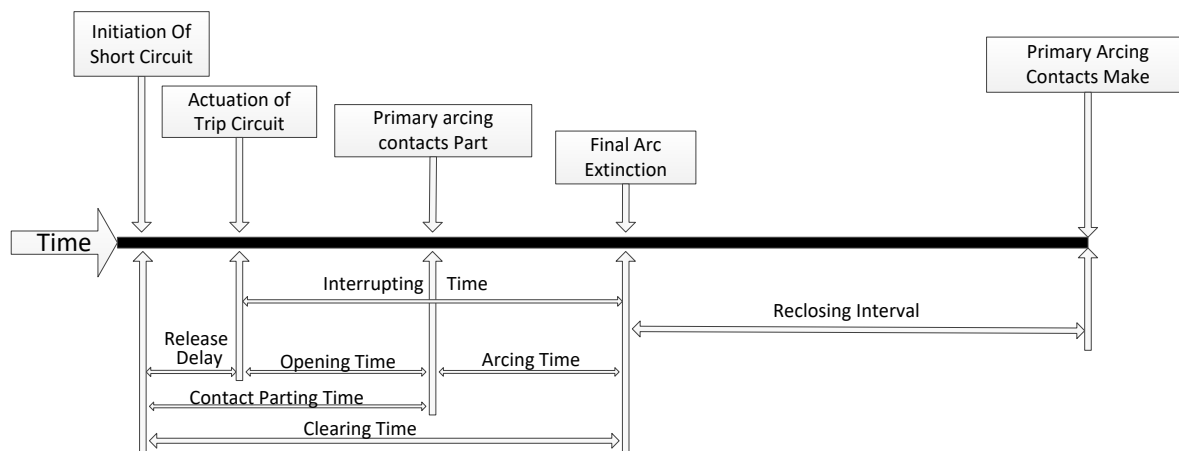
**Notes:**

1. For altitudes above 1000 m, ratings should be corrected in accordance with ANSI C37.60.
2. Conditions during hold up:
  - No wireless operation.
  - FPI LED flashes every 30 seconds, each flash lasts for at least 150 ms.
  - If in the closed state, a full sequence can occur (1 – 4000 A).

### 2.2 Ratings

| ECL Type                                                         | ECL15-4-200 |
|------------------------------------------------------------------|-------------|
| Rated maximum voltage, kV                                        | 15.5        |
| Rated continuous current, A                                      | 200         |
| Fault make capacity Peak, kA                                     | 10.4        |
| Fault break capacity RMS, kA                                     | 4           |
| Mechanical operations                                            | 2000        |
| Mechanical at Max Interrupt                                      | 38          |
| Short time current withstand 3 seconds, kA                       | 4           |
| BIL, kV                                                          | 110         |
| Power frequency withstand dry and wet across the interrupter, kV | 50          |
| Cable charging current, A                                        | 10          |
| Line charging current, A                                         | 2           |
| Closing Time, ms                                                 | <60         |
| Opening Time, ms                                                 | <30         |

### Interruption and Closing Operation Timing Diagram



**Note:** Release Delay is the protection operating time and it is defined as the time from when the fault occurs to when the protection operation is triggered. This time will vary depending on what protection settings have been configured.

## 2.3 Sensor Accuracy

| Sensor Type   | Accuracy |
|---------------|----------|
| Rogowski coil | 1%       |

## 2.4 Measurement Accuracy

| Measured value             | Accuracy                                                                          | Ranges where accuracy guaranteed |
|----------------------------|-----------------------------------------------------------------------------------|----------------------------------|
| Phase Current              | the greater of $\pm 5\%$ or $\pm 0.3$ A<br>the greater of $\pm 5\%$ or $\pm 10$ A | 1 – 200 A<br>200 – 4000 A        |
| ROCOF                      | the greater of $\pm 5\%$ or $\pm 1$ kA/s                                          | 1 – 200 kA/s                     |
| Frequency                  |                                                                                   | 45 – 65 Hz                       |
| – at $dF/dt < 0.2$ Hz/s    | $\pm 0.05$ Hz                                                                     |                                  |
| – at $dF/dt < 0.5$ Hz/s    | $\pm 0.1$ Hz                                                                      |                                  |
| Temperature                | $\pm 5$ °C<br>$\pm 7$ °C                                                          | -20 to 55 °C<br>-40 to -20 °C    |
| <b>Harmonics</b>           |                                                                                   |                                  |
| Phase current (Harmonic 2) | the greater of $\pm 5\%$ or $\pm 4$ A                                             | H <sub>1</sub> , 0 – 4000 A rms  |

## 2.5 Protection Accuracy

| Parameter                                       | Accuracy                                                                          | Accuracy Range                                 |
|-------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------|
| Operational pickup current <sup>(1,2)</sup>     |                                                                                   |                                                |
| – for Phase overcurrent elements                | the greater of $\pm 5\%$ or $\pm 0.3$ A<br>the greater of $\pm 5\%$ or $\pm 10$ A | 1 – 200 A<br>200 – 4000 A                      |
| – for Instantaneous overcurrent elements        | the greater of $\pm 5\%$ or $\pm 0.3$ A<br>the greater of $\pm 5\%$ or $\pm 10$ A | 5 – 200 A<br>200 – 4000 A                      |
| Tripping time for time current characteristics: | the greater of:                                                                   |                                                |
| Definite time                                   | $\pm 1\%$ or $\pm 35$ ms / $-10$ ms                                               | 0 – 120 s for all-time current characteristics |
| ANSI / IEC / IEEE / U / UDC /                   | $\pm 5\%$ or $\pm 50$ ms / $-10$ ms                                               |                                                |
| Additional IDMT curve /                         |                                                                                   |                                                |
| Fuse Curves                                     |                                                                                   |                                                |
| Reclose time                                    | the greater of $\pm 1\%$ or $\pm 10$ ms                                           | 0.1 – 180 s                                    |

| Parameter                                 | Accuracy                                 | Accuracy Range |
|-------------------------------------------|------------------------------------------|----------------|
| Reset time                                | the greater of:                          |                |
| ANSI / IEEE / U                           | $\pm 5\%$ or $+50$ ms / $-10$ ms         | 0 – 120 s      |
| IEC / UDC / Additional IDMT / Fuse Curves | $\pm 1\%$ or $\pm 10$ ms                 | 0 – 10 s       |
| Reclosing                                 | $\pm 1\%$ or $\pm 10$ ms                 | 5 – 180 s      |
| Harmonic Inrush Blocking ( $H_1 > 10$ A)  | the greater of $\pm 5\%$ or $\pm 4$ A    | 10 – 4000 A    |
| ROCOF                                     | the greater of $\pm 5\%$ or $\pm 1$ kA/s | 1 – 200 kA/s   |
| Over Frequency                            | $\pm 0.05$ Hz                            | 50 – 65 Hz     |
| Under Frequency                           | $\pm 0.05$ Hz                            | 45 – 60 Hz     |

**Notes:**

1. Pickup is initiated at 100% of pickup current value and drops off at 97.5% (2.5% difference). When a current multiplier is applied to the pickup value the same percentage (2.5%) applies to the new calculated current.
2. Applies to all curves, accuracy in the range ( $I / I_p < 4000$ ).

## 2.6 Electromagnetic Compatibility (EMC) Performance

|                                                | Rated value                            | Applicable standard |
|------------------------------------------------|----------------------------------------|---------------------|
| RF Emissions Conducted & Radiated              | Class B                                | CISPR 11 & 32       |
| Harmonic Current Emissions                     |                                        | IEC 61000 – 3 – 2   |
| Voltage Flicker Emissions                      |                                        | IEC 61000 – 3 – 3   |
| Electrostatic Discharge                        |                                        | IEC 61000 – 4 – 2   |
| – contact                                      | 8 kV                                   |                     |
| – air                                          | 15 kV                                  |                     |
| Immunity to Radiated Electromagnetic Fields    | 1 kHz 80% AM<br>10 V/m                 | IEC 61000 – 4 – 3   |
| Electrical Fast Transient/Burst Immunity       | 4 kV AC Supply                         | IEC 61000 – 4 – 4   |
| Surge Immunity (external AC voltage terminals) | 4 kV                                   | IEC 61000 – 4 – 5   |
| Immunity to Conducted Disturbances             | 1 kHz 80% AM<br>10 Vrms                | IEC 61000 – 4 – 6   |
| Power Frequency Magnetic Field Immunity        |                                        | IEC 61000 – 4 – 8   |
| – 1 s                                          | 1000 A/m                               |                     |
| – 1 min                                        | 100 A/m                                |                     |
| Pulse Magnetic Field Immunity                  | 1000 A/m                               | IEC 61000 – 4 – 9   |
| Damped Oscillatory Magnetic Field Immunity     | 100 A/m                                | IEC 61000 – 4 – 10  |
| Immunity to Voltage Dips and Interruptions     | 0, 40, 70 %                            | IEC 61000 – 4 – 11  |
| High Frequency Disturbance                     | Class 3<br>100 kHz<br>2.5 kV AC Supply | IEC 61000 – 4 – 12  |
| Burst Disturbance                              | 1 MHz                                  | IEC 61000 – 4 – 18  |

**Notes:**

1. This equipment is not affected by harmful interference and operates within a duly authorized system.
2. Refer to Section 14.7 for wireless compatibility statements.

2.7 Breaking Duty

Vacuum interrupter contact life is a function of interrupting current as illustrated in the graph below.

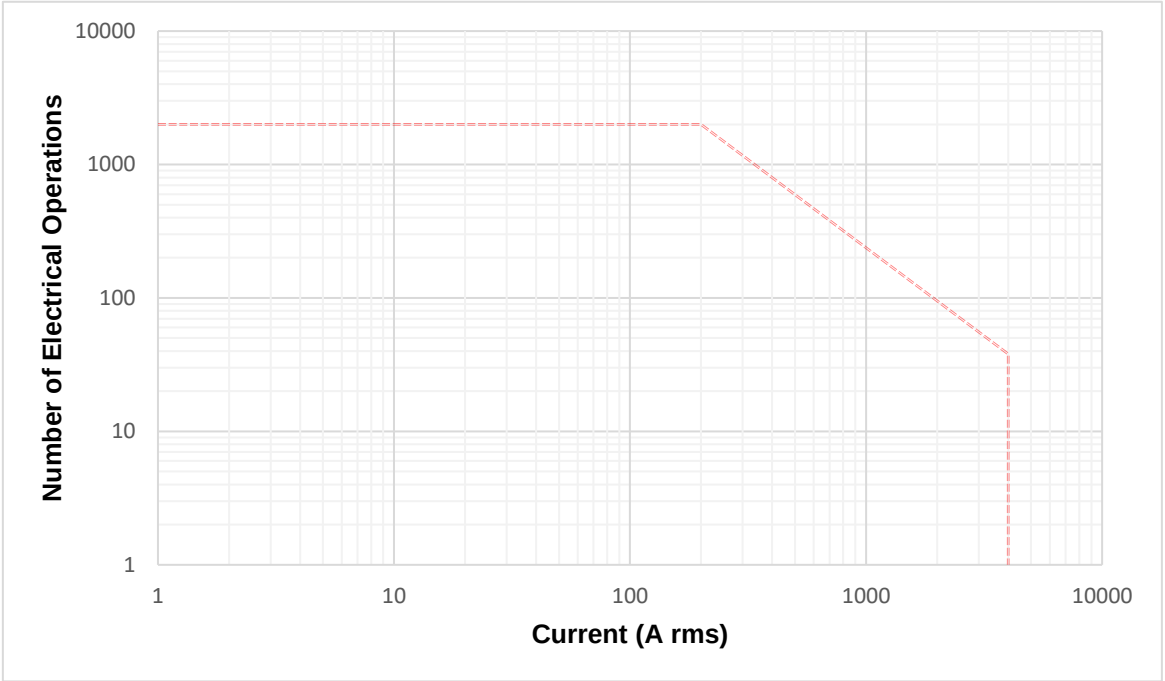


Figure 1: Number of Electrical Operations vs Current

| Rated Number of Operations |               |
|----------------------------|---------------|
| Continuous current         | 2000 at 200 A |
| Interrupting current       | 38 at 4 kA    |

## 3 Switchgear Management

### 3.1 Overview

The EcoLink® is manufactured from glass-reinforced polypropylene. It has a 15 year operating design life and it is rated to IP66. It is a single phase recloser with a vacuum interrupter driven by a magnetic actuator. The vacuum interrupter is surrounded by a glass-reinforced polypropylene case for maximum weather resistance. The EcoLink® replaces MV fuses and fits into the standard size MV Fuse Holders. It clears transient faults on the overhead distribution lines by its reclosing capabilities.

The interlock manual lever ensures the opening of the internal VI contacts to interrupt the line current and prevent external arcing, prior to removal of EcoLink® from the Fuse Holder for isolation. The operating lever is pulled downwards using a hook stick thereby mechanically tripping the device. When the operating lever is pulled downwards, the VI contacts are opened. When the operating lever is pushed upwards, the VI contacts are closed. Position/Status indication can be viewed by an operator on the ground. The Indicator colour is RED when the VI is closed and GREEN when the VI is open.

The EcoLink® goes into sleep mode when the switchgear is opened or when there is insufficient operating current. Energy for operation is provided by a capacitor bank located in the EcoLink®. A Rogowski coil is used for current measurement and protection. The capacitor bank is charged by a separate harvesting CT when sufficient energy is available on the line.

The advantages of the NOJA Power EcoLink® is that it is light weight, no batteries are required as it is powered by Supercapacitors, operates at 0.15 A of primary current and allows manual open/close operations.

### 3.2 Operation

The EcoLink® can be manually operated using a hook stick by pulling the operating lever downwards to trip the device and then pushing the operating lever upwards to close the device. In both cases, spontaneous change in position will be detected by the position reed sensor and “Breaker Open” or “Breaker Closed” will be reported in the Event Log with a source of “Manual”.

The EcoLink® can also be operated from the “Online Controls” screen in the EcoLink® Manager. To trip/close the device, first enable the “Controls” option in the Application.

4      **EcoLink®**

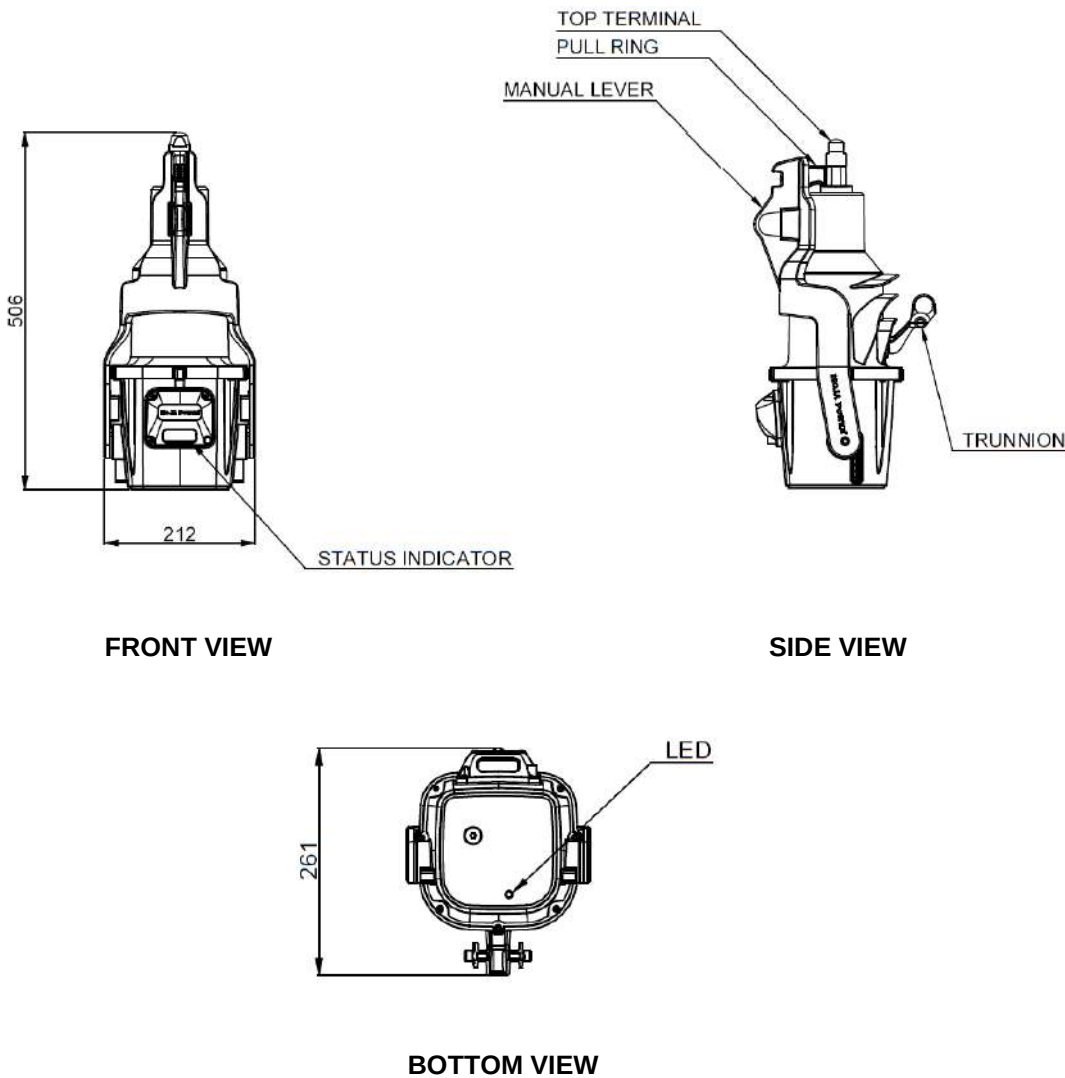
**4.1 Overview**

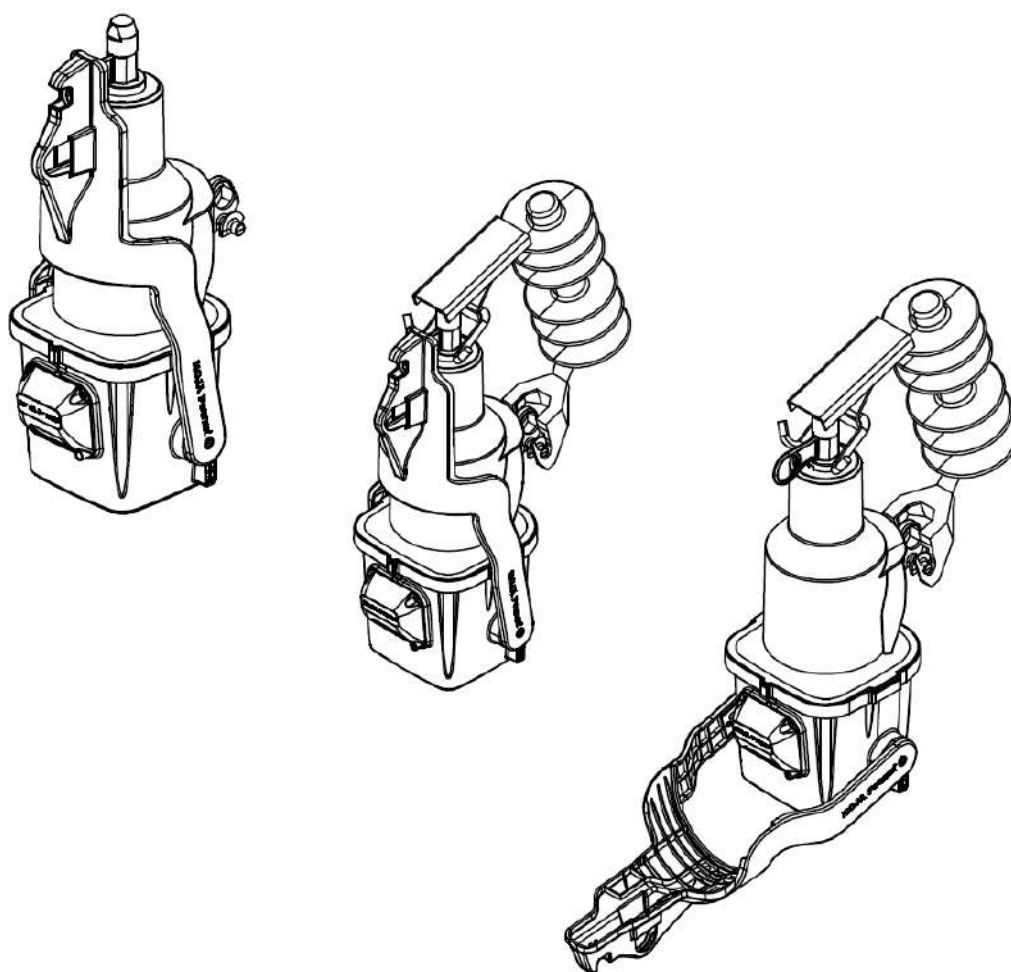
The EcoLink® is manufactured from glass-reinforced polypropylene and provides IP66 rated protection.

The NOJA Power EcoLink® is designed to provide the following creepages and taut string distances.

| Model       | Creepage Distance | Taut String Clearance |
|-------------|-------------------|-----------------------|
| ECL15-4-200 | 364 mm            | 182 mm                |

**4.1.1 Dimensions**





ISOMETRIC VIEW

Figure 2: EcoLink® Dimensions

**Note:** The LED blinks in 2 colours - Green (for Status) and Red (Fault Passage Indicator).

## 4.2 Power Management

The EcoLink® has the capability to boost the voltage in the actuator capacitor bank by utilizing the charge from the storage capacitors. Automatic Capacitor Boost occurs when the switch is closed, less than 0.5 A is flowing through the switch, Full Sequence capacitors are below 70 V, Bulk capacitors are above 6 V and at least 5 minutes have passed since the previous Automatic Capacitor Boost. When the switch is closed and more than 0.5 A is flowing, a Capacitor Boost will be forced if the capacitors are insufficiently charged after a trip or close operation. Depending on the state of charge in the storage capacitors, it will take up to 10 seconds to recharge the actuator capacitor bank. If the Bulk capacitors have sufficient energy ( $\geq 6$  V), then this energy is transferred to the Full Sequence capacitors to perform Trip and Close operations.

The different modes in the EcoLink® are described as follows:

1. Non-running - If there is not enough charge in the capacitors and operating current is zero, EcoLink® will go into sleep mode to conserve energy.
2. Powered up - When EcoLink® is powered on, the green status LED indicates that the device can be communicated with. The Quick Capacitors gets quickly charged when the device powers on and it is possible to perform a quick trip to lockout if there is a fault.
3. Full trip/close sequence - The Full Sequence Capacitors perform a full trip/close sequence.
4. Fully charged - When the capacitor banks are full, the EcoLink® is fully charged to perform a quick trip to lockout or a full trip/close sequence.

#### 4.2.1 Wireless performance based on EcoLink® System Energy Status

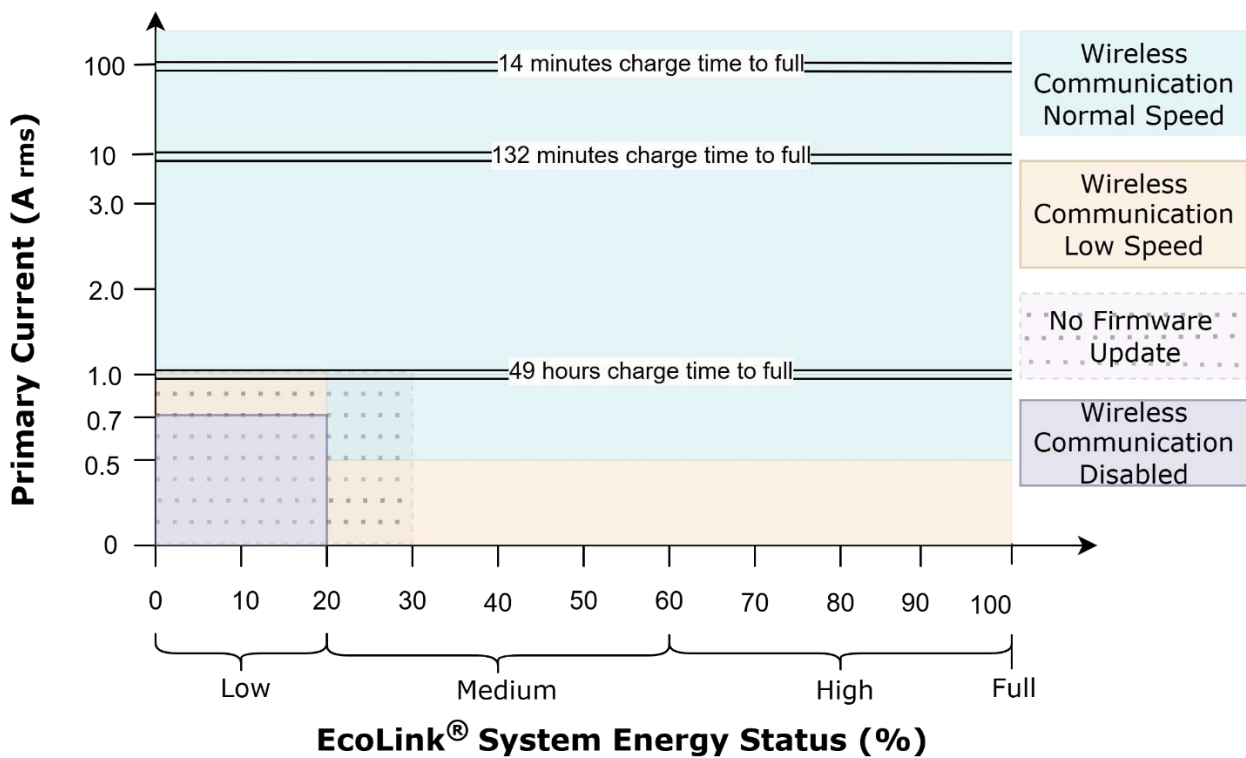


Figure 3: Wireless performance based on EcoLink® System Energy Status

#### 4.2.2 EcoLink® Startup Time at 25°C for Different Input Currents

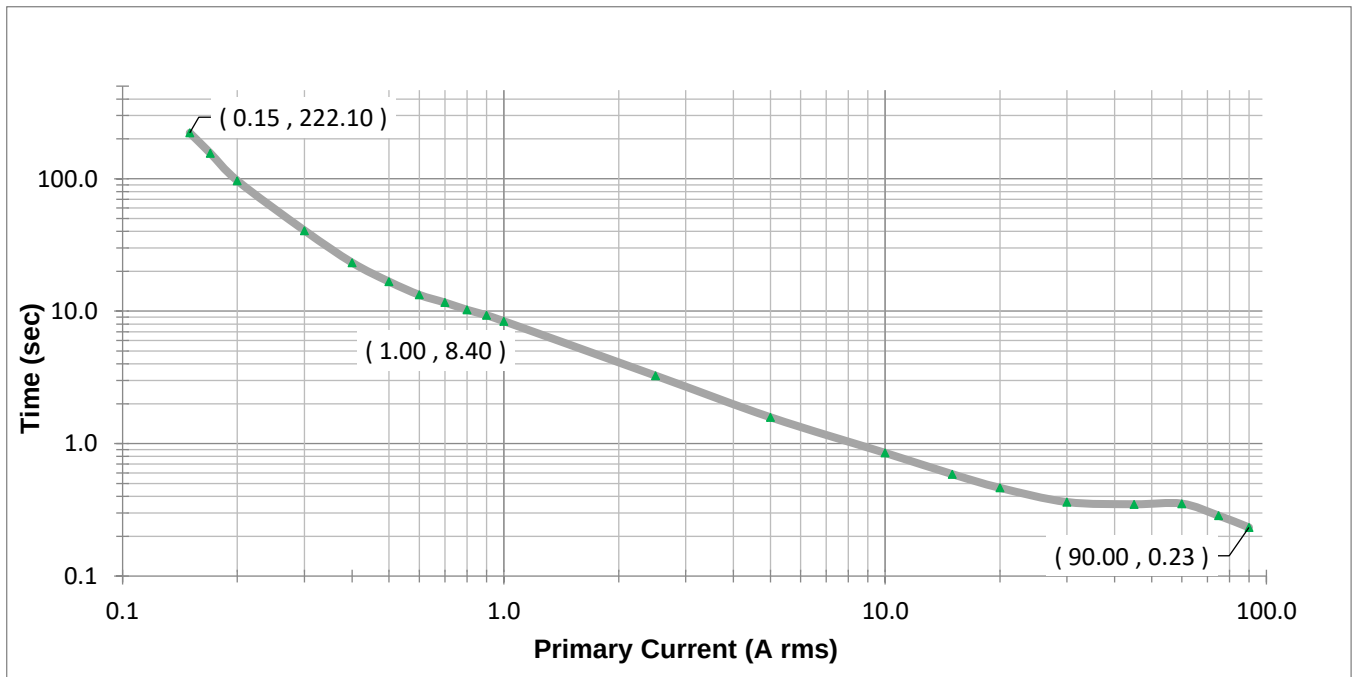


Figure 4: EcoLink® Startup Time vs Primary Current at 25°C

### 4.2.3 Time to perform a Full Sequence from being Fully discharged at 25°C

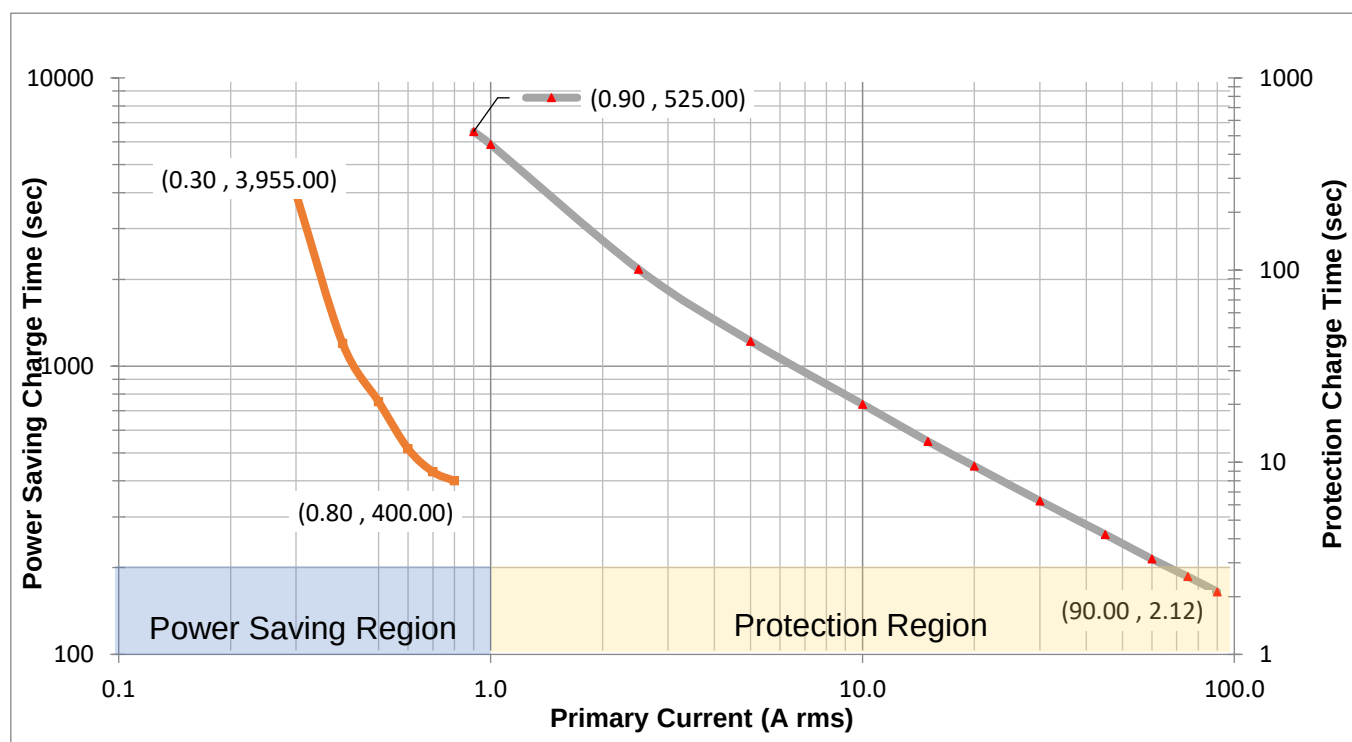


Figure 5: Time to perform a Full Sequence at 25°C

Power Saving Charge Time is the time the EcoLink® takes to charge to a programmed full sequence capacity. Protection Charge Time is the time the EcoLink® takes to charge to be able to perform a full trip/close sequence.

### 4.2.4 EcoLink® Fully Charged at 25°C

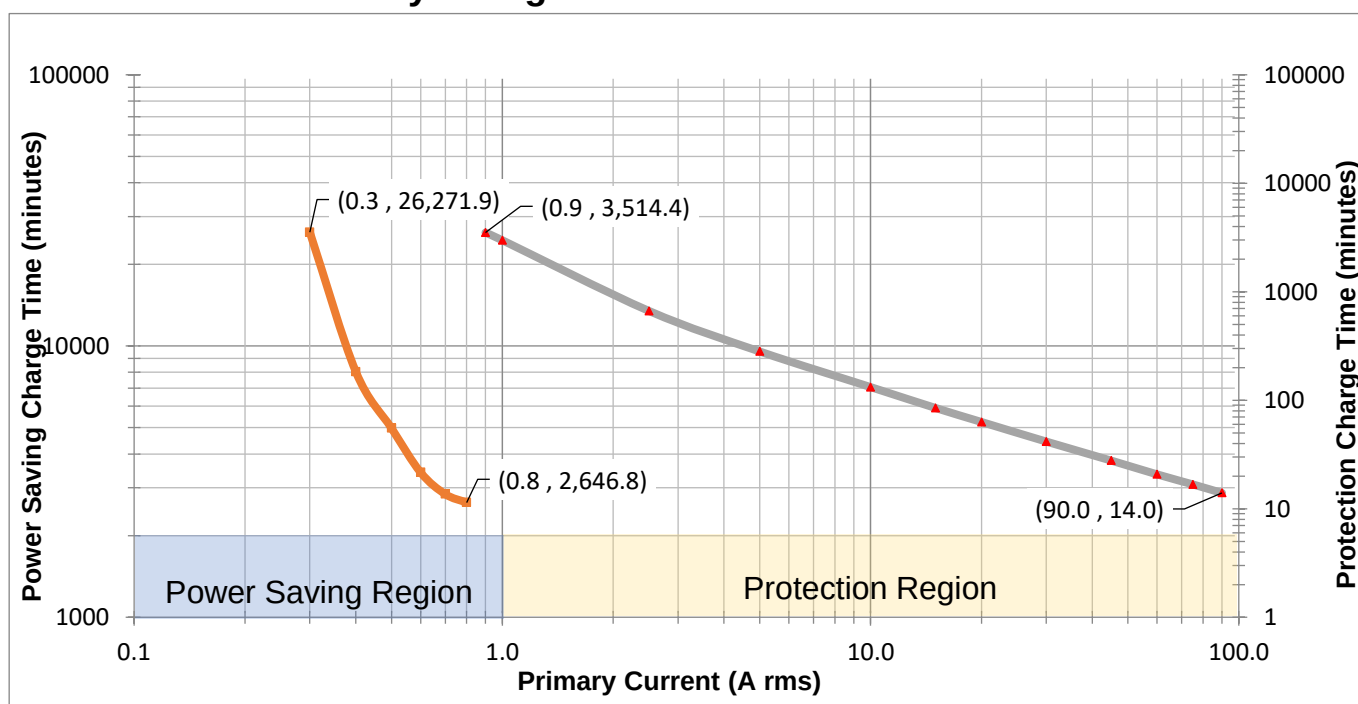


Figure 6: EcoLink® Fully Charged at 25°C

Power Saving Charge Time is the time the EcoLink® takes to charge to a programmed capacity. In the Power Saving Region ( $< 1\text{A}$  Primary Current), some current is used to power the device and the remaining current is used to charge the Bulk Capacitors. Protection Charge Time is the time the EcoLink® takes to charge the Full Sequence and Quick Capacitors for performing a complete sequence or a quick trip to lockout.

#### 4.2.5 Time to trip from No Charge

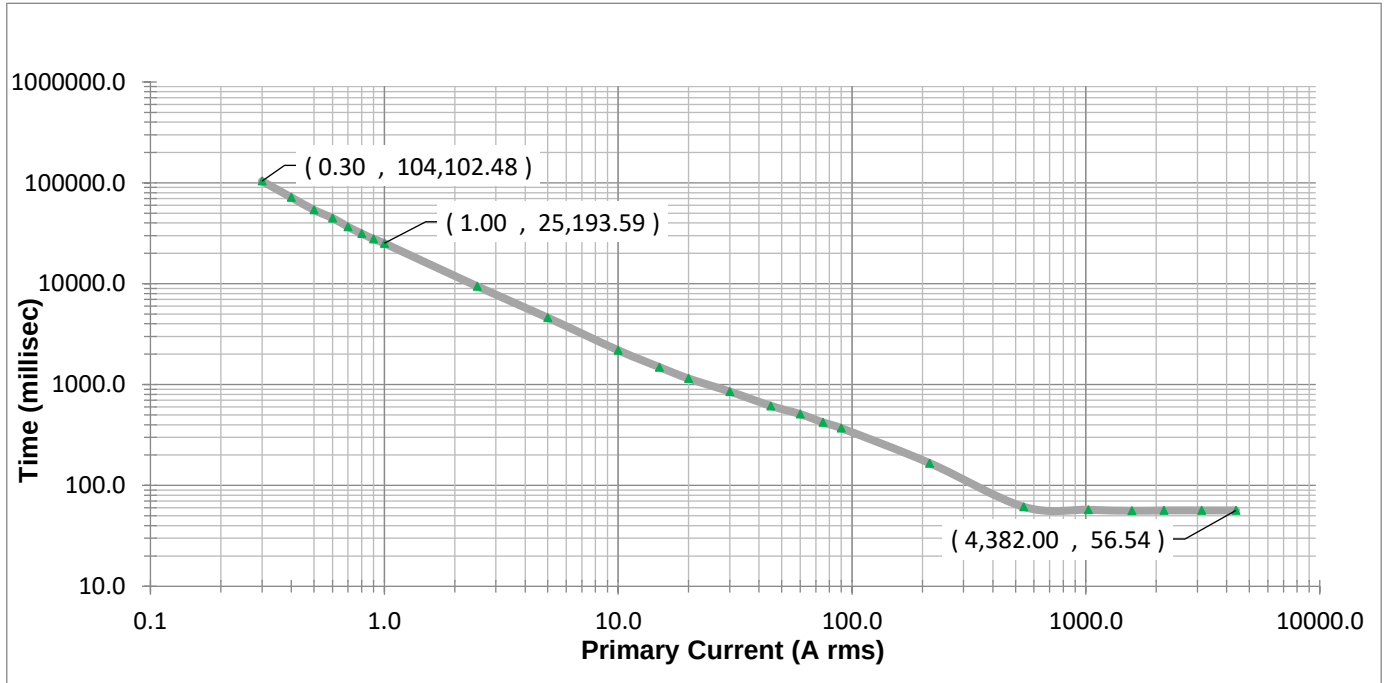


Figure 7: Time to trip from No Charge

### 4.3 EcoLink® Manager

EcoLink® Manager is an application running on PC, Mobile (Android and IOS) platforms. The user can configure EcoLink® using the application through a wireless connection to read/modify individual configuration parameters, export logs and load/retrieve a configuration package. It allows the user to:

- Update the settings by loading the Configuration package into the device via the EcoLink® Manager.
- Retrieve the Configuration package from the device.
- Go Online with the device and view the system status, operate the switch, configure the Protection Group, etc.
- View logs and to assist in analysis of data.
- Update Protection Configuration and Firmware Online.
- User-Defined curves, standard Time Current Characteristics, and Fuse Curves are configured in the Configuration package which is loaded into the device through the EcoLink® Manager.

#### 4.3.1 Wireless Connection

The wireless client (the EcoLink® Manager) scans for devices that advertise as NOJA EcoLink® to discover an EcoLink® device prior to connecting.

The low intensity green status LED flashes 150 ms every 15 s when the device is powered on and capable of being connected to via the wireless technology. When wireless communications are not possible, the green status LED will blink once when the microcontroller first powers on and will not blink any more until there is sufficient power to allow wireless communications.

When the EcoLink® Manager is connected to EcoLink®, the low intensity green status LED blinks twice every 5 seconds.

Once the EcoLink® Manager connects, it performs a handshake with the EcoLink® to identify itself as an authentic NOJA Configuration software.

When EcoLink® decides to turn the wireless technology off to save power, there will be a 10 seconds delay before the wireless technology is disabled. If EcoLink® has a low charge, the user can quickly trip and close using the EcoLink® Manager within this time and restore power to the wireless technology. If the user takes more than 10 seconds to request a close using the EcoLink® Manager, the user must manually operate the mechanism with the hook stick to restore wireless connectivity.

#### 4.3.1.1 Connecting to an EcoLink® device

To connect to the device, ensure that Bluetooth on the PC or Mobile is turned On and the EcoLink® Manager is installed. Open the EcoLink® Manager, scan for devices and then select the device from the list of devices.

The user will then be prompted to login with Username as "admin" and an empty password for the first time, after which the first user will be prompted to set the admin password via the "Set New Password" screen. Refer to Section 10.3 Changing Password for the rules for entering the Password.

After setting the new admin password, click on the "Save" button and the user will be directed to the "Dashboard" screen.

After setting the new admin password, next time when the user logs in, the user will be directed to the "Device Login" screen.

Refer to the NOJA-5220 EcoLink® Manager User Guide for more details.

**Note:** Only 1 user can connect to the EcoLink® device at a time.

#### 4.3.2 EcoLink® Manager Language

The user will also be able to select the language in which the EcoLink® Manager will be displayed. The options are English-AU, English-US, Spanish and Portuguese. The default language will be the current platform language.

When a user connected to the EcoLink® device changes the EcoLink® Manager language, Logs and Configuration package will be retrieved from the device in the EcoLink® Manager language. Please note that if the EcoLink® Firmware doesn't support the EcoLink® Manager language, then the logs and configuration file will be exported in English.

### 4.4 Saving of Settings

Changes to individual non-volatile values like Settings, Fault Counters, and Lifetime Counters will be saved within 1s. An immediate save of the entire configuration and events that were being logged is forced whenever a Configuration package is loaded into the EcoLink® and applied. There is no periodic saving of values, to preserve system power.

Some recent entries may be lost if there is a sudden unexpected shutdown of the device.

### 4.5 LED functionality

The LED on the EcoLink® will blink as shown below:

| Status                                                          | LED                                                            |
|-----------------------------------------------------------------|----------------------------------------------------------------|
| When wireless communications are not possible                   | One green blink when the microcontroller first powers on.      |
| When there is sufficient power to allow wireless communications | One green blink every 15 seconds                               |
| When the EcoLink® Manager connects to the device                | Two green blink every 5 seconds.                               |
| Fault Passage Indicator                                         | One red blink every 10 seconds.                                |
|                                                                 | After 60 minutes of operation, one red blink every 30 seconds. |

## **5 Measurement**

### **5.1 Timestamping**

The EcoLink® keeps a track of the number of milliseconds since the last restart. This relative time is logged on events in the Event Log and Audit Log.

Time synchronisation occurs every time the EcoLink® Manager connects. Once time synchronisation with the EcoLink® Manager occurs, the EcoLink® continues to adjust relative timestamps for future events as they occur, even if the EcoLink® Manager is no longer connected. The time synchronisation will be lost upon the next power restart.

The Real Time Clock (RTC) drifts at less than 30 minutes a year over the full temperature range. "RTC Setting Change" will be logged in the Event Log and "Date/Time Changed" will be logged in the Audit Log whenever the time on the device is synchronised.

## 6 Protection

Four individual groups of Protection Settings are available. Each group has the following protection functions:

- Phase Overcurrent (51P)
- Instantaneous Overcurrent (50P)
- Under Frequency (81U)
- Over Frequency (81O)
- Loss of Supply Detection (LSD)
- Auto Reclosing (79)
- Rate of Change of Current (ROCO)
- Inrush Restraint (based on current multiplier)
- Inrush Restraint (2<sup>nd</sup> Harmonic Blocking).

Settings are loaded via the EcoLink® Manager. Refer to the NOJA-5220 EcoLink® Manager User Guide for more details.

Protection may also be configured through the universal Configuration package which can be loaded into the EcoLink® using the EcoLink® Manager.

**Note:** If the charge on the capacitors are below the level where a trip is possible, the protection engines will not pickup and will be held in reset. Once the capacitors are sufficiently charged, the protection engines will pickup and start counting towards trip if a fault condition is present.

### 6.1 Overcurrent Protection

The EcoLink® device is installed on one of the 3 phases of the network either A, B or C. The phase current measured by the Current Transformer on the device are monitored for Overcurrent (OC) protection.

The Auto Reclosing element is responsible for the reclosing sequence associated with OC1, OC3 and ROCOC.

The Auto Reclosing Map is used to set independent OC1, OC3 and ROCOC parameters to define the operations in a reclose sequence.

Inrush Restraint (IR) elements allow effective customising of protection to match system characteristics.

#### 6.1.1 Protection Elements for OC1 and OC3 (ANSI 50P, 51P)

OC has two overcurrent protection elements:

- OC1  
Used to set the maximum number of operations to lockout and provide time delayed protection operations in a reclose sequence.
- OC3  
High set elements are used to minimise exposure of downstream equipment to high fault currents.

#### 6.1.2 Protection Settings for OC1 and OC3

OC1 can be set with a Time Current Characteristic (TCC) curve. TCC curves are selected and can be modified for OC1 elements independently via the Configuration package. OC3 element is a definite time element.

#### 6.1.3 Time Current Characteristic (TCC) Settings

The curves are provided in the form of a curve library in CSV format. Configuration of the curves is done in the Configuration package by cutting and pasting the chosen curve definition into the configuration package for the EcoLink® device.

UDC curves (IEEE, U, 43 Non-Standard Curves, ANSI, IEC and Fuse Curves) and Definite Time (TD) curves are available. Refer to APPENDIX A for more details.

### 6.1.3.1 Time current characteristic (TCC) types

| Designation | Range                                                                                                                                                                                                                                                                                                                                                                                                     | Factory Default |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| TCC Type    | TD                                                                                                                                                                                                                                                                                                                                                                                                        | TD              |
| TCC Type    | UDC<br>ANSI: EI / VI / I / STI / STEI / LTEI / LTVI / LTI<br>IEC: EI / VI / I / LTI<br>IEEE: EI / VI / MI<br>U: EI / VI / MI / I / STI<br>TCC: 101 102 103 104 105 106 107 111 112 113 114<br>115 116 117 119 120 121 122 131 132 133 134 135<br>136 137 138 139 140 141 142 151 152 161 162 163<br>164 165<br>200 201 202<br>400 401 402<br>Fuse Curves – Tap, Main, E-Speed, K-Speed and T-Speed Curves | NA              |

### 6.1.3.2 Settings for OC1

The following settings can be applied to the OC1 element.

| Title                                     | Designation            | Range      | Resolution | Factory Default |
|-------------------------------------------|------------------------|------------|------------|-----------------|
| TCC Type                                  | TCC                    | TD / UDC   | NA         | TD              |
| Pickup current (A)                        | I <sub>p</sub>         | 1 – 4000 A | 1          | 10              |
| Time Multiplier                           | TM                     | 0.01 – 15  | 0.01       | 1.00            |
| Minimum Current Multiplier <sup>(1)</sup> | I <sub>min</sub>       | 1 – 20     | 0.01       | 1.00            |
| Definite Tripping time (s)                | T <sub>dt</sub> Min, s | 0 – 120    | 0.01       | 1.00            |
| Minimum Tripping Time (s)                 | T <sub>min</sub> , s   | 0 – 10     | 0.01       | 0.01            |
| Maximum Tripping Time (s)                 | T <sub>max</sub> , s   | 1 – 120    | 0.01       | 120.00          |
| Additional Time (s)                       | T <sub>a</sub> , s     | 0 – 2      | 0.01       | 0.00            |
| Fault Reset Time <sup>(2)</sup> (s)       | FLTR <sub>es</sub> , s | 0 – 10     | 0.01       | 0.05            |

**Notes:**

1. Set as a multiple of the pickup current (I<sub>p</sub>) setting.
2. Not applicable for ANSI, IEEE and U TCC whose reset timer simulates a rotating disk reset characteristic.

### 6.1.3.3 Definite Time Settings for OC3

The OC3 element can only be set to a definite time characteristic using the settings below:

| Title                      | Designation            | Range    | Resolution | Factory Default |
|----------------------------|------------------------|----------|------------|-----------------|
| Pickup current (A)         | I <sub>p</sub>         | 5 – 4000 | 1          | 200             |
| Definite Tripping Time (s) | T <sub>dt</sub> Min, s | 0 – 2    | 0.01       | 0.10            |
| Fault Reset Time (s)       | FLTR <sub>es</sub> , s | 0 – 10   | 0.01       | 0.05            |

### 6.1.4 TCC modifiers

Each ANSI, IEC, IEEE and U Time Current Characteristic can be modified with the aid of the following operators:

**Minimum Tripping Time (Tmin)**

Defines the minimum time that the device can operate. By default this is set to 0.10 s. This may be used to define desired behaviour when an IDMT curve intersects a high set curve.

**Maximum tripping time (Tmax)**

Defines the maximum time that the device can operate. By default this is set to 120 s.

**Minimum current multiplier (Imin)**

**Additional time (Ta)**

Adds a constant time to the selected TCC curve. By default this is set to 0 s.

**Fault reset time (FLTRes)**

Defines the time after which a pickup is no longer active before the protection timer resets.

### 6.1.5 Inrush Restraint (IR)

Inrush Restraint has 2 modes of operation.

In the first mode, the inrush element applies a temporary multiplier to the level of pickup current on detection of loss of supply which is ramped back down to one when the supply is restored. "Inrush Restraint Time" determines how long it takes for the multiplier to be ramped down.

In the second mode, the ratio of second harmonic to the fundamental harmonic is calculated and a trip is blocked for up to the maximum block time or until the ratio of second harmonic drops below the pickup value.

Inrush restraint is only applicable to the OC1 element.

Operation of the Inrush element is illustrated in the diagram below.

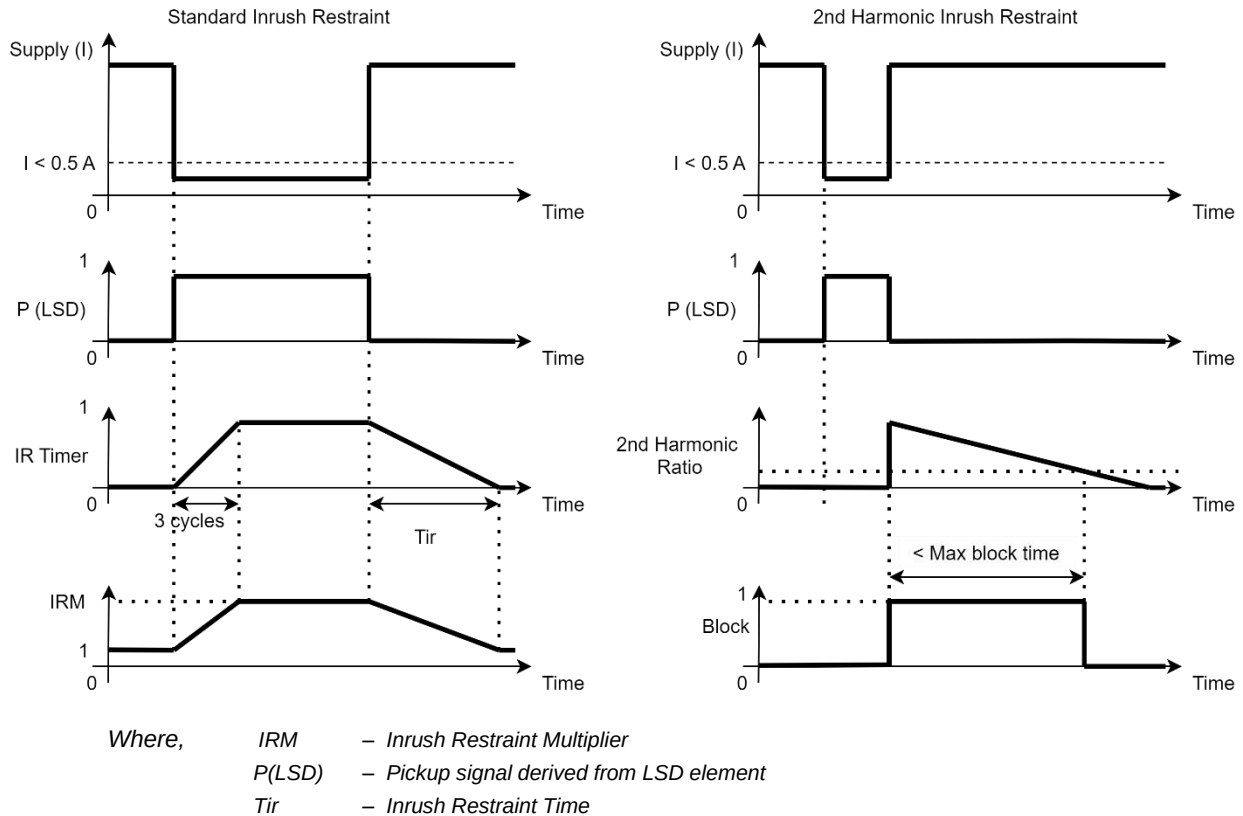


Figure 8: Operation of the Inrush element

Inrush Restraint settings

| Title                          | Designation | Range            | Resolution | Factory Default |
|--------------------------------|-------------|------------------|------------|-----------------|
| Inrush Restraint Mode          | IR Mode     | Enabled/Disabled | NA         | Enabled         |
| Inrush Restraint Multiplier    | IRM         | 1 – 20           | 0.1        | 5.0             |
| Inrush Restraint Time (s)      | Tir,s       | 0.01 – 10        | 0.01       | 0.10            |
| 2nd Harmonic IR Mode           | 2HIR Mode   | Enabled/Disabled | NA         | Disabled        |
| 2nd Harmonic IR, %             | 2HIR%       | 5 – 100          | 1          | 20              |
| 2nd Harmonic Blocking Time (s) | 2HIR T, s   | 0.04 – 120       | 0.01       | 1.00            |

## 6.2 Auto Reclosing (AR OC) (ANSI 79) and Sectionalising

The Reclosing element is responsible for reclosing sequences associated with the Phase and Instantaneous Overcurrent protection elements.

When Auto Reclosing is Active and a protection trip occurs, the device closes after the Reclose Time has passed. The sequence counter is then incremented and the Reset Timer is started. If a fault occurs within the Reset Time, the device will operate in accordance with the next trip in the AR reclose sequence. When the Reset Time expires, AR is ready to perform its full sequence. A user can configure separate reclose times for each trip in a reclose sequence before the device goes to lockout.

**Notes:**

- Auto Reclosing is active when Protection and Auto Reclosing are ON and one of the protection elements has “R” in the reclose map.
- The OC protection element groups have their own sequence counter which is only incremented when an element in that group generates a protection trip.

Reclose Sequence Settings

| Title                            | Designation | Range     | Resolution | Factory Default |
|----------------------------------|-------------|-----------|------------|-----------------|
| 1 <sup>st</sup> Reclose Time (s) | Tr1,s       | 0.1 – 180 | 0.01       | 10.00           |
| 2 <sup>nd</sup> Reclose Time (s) | Tr2,s       | 1.0 – 180 | 0.01       | 20.00           |
| 3 <sup>rd</sup> Reclose Time (s) | Tr3,s       | 1.0 – 180 | 0.01       | 20.00           |
| AR Reset time                    | Tres        | 5.0 – 180 | 0.01       | 30.00           |

The following AR map is provided for each group, where the values shown are the defaults:

| Element | 1st trip    |         | 2nd trip    |         | 3rd trip    |         | 4th trip  |         |
|---------|-------------|---------|-------------|---------|-------------|---------|-----------|---------|
|         | Allowed     | Default | Allowed     | Default | Allowed     | Default | Allowed   | Default |
| OC1     | R/L/A/D/C/S | L       | R/L/A/D/C/S | L       | R/L/A/D/C/S | L       | L/A/D/C/S | L       |
| OC3     | R/L/A/D/C/S | L       | R/L/A/D/C/S | L       | R/L/A/D/C/S | L       | L/A/D/C/S | L       |
| ROCO    | R/L/A/D     | D       | R/L/A/D     | D       | R/L/A/D     | D       | L/A/D     | D       |

Available operating modes for each of the elements (OC1 and OC3) are;

trip and Reclose

trip and Lockout

Alarm only

Disabled

Count<sup>(1)</sup>

Sectionalise<sup>(2)</sup>

**Notes:**

- “C” (Count) - Sectionaliser Count: When the fault current exceeds the pickup settings and the protection timer expires, the device will wait for detection of Loss of Supply (LSD) before increasing the sequence counter in the AR map.
- “S” (Sectionalise) - Sectionaliser Trip: When the fault current exceeds the pickup settings and the protection timer expires, the device will wait for detection of Loss of Supply (LSD) before opening the device.

The AR maps for OC1 and ROCOC operate independently. The allowed sequences common for OC1, OC3 and ROCOC are:

- D D D D
- A A A A
- R R R L
- R R L L
- R L L L
- L L L L

For OC1 and OC3 only, the extra sequences are:

- S S S S
- C S S S
- C C S S
- C C C S
- C L L L
- C C L L
- C C C L

If OC1 is set to “D D D D” or “A A A A”, then OC3 can only use the above 13 sequences.

Please note that OC3 is partially dependent upon OC1. Also, some trips in OC3 can be disabled if the corresponding element in OC1 is R, L, C, or S i.e.,

- OC1: R R R L
- OC3: D R D L

**Note:** The EcoLink® will trip immediately to lockout when a manual or operator-initiated close is performed onto a fault, even if sectionalising is configured in the AR map.

## 6.3 Frequency Protection (FE)

Frequency Protection monitors measurement of HV supply frequency and responds to changes in system frequency. The Frequency elements can be set to Alarm, Disable or trip to Lockout.

Auto Reclose is not available for Frequency protection.

### 6.3.1 Under Frequency (UF) (ANSI 81U)

Under Frequency responds to dips in system frequency.

UF settings

| Title                 | Designation | Range                      | Resolution | Factory Default |
|-----------------------|-------------|----------------------------|------------|-----------------|
| Mode                  | Mode        | Lockout / Alarm / Disabled | –          | Disabled        |
| Pickup Frequency (Hz) | Fp          | 46 – 60                    | 0.01       | 49.50           |
| Tripping Time (s)     | Tdt,s       | 0.05 – 180                 | 0.01       | 10.00           |

### 6.3.2 Over Frequency (OF) (ANSI 81O)

Over Frequency responds to a rise in system frequency.

OF settings

| Title                 | Designation | Range                      | Resolution | Factory Default |
|-----------------------|-------------|----------------------------|------------|-----------------|
| Mode                  | Mode        | Lockout / Alarm / Disabled | –          | Disabled        |
| Pickup frequency (Hz) | Fp          | 50 – 65                    | 0.01       | 50.50           |
| Tripping time (s)     | Tt          | 0.05 – 180                 | 0.01       | 10.00           |

## 6.4 Rate Of Change Of Current (ROCO)C

ROCO evaluates the rate of change of current over two consecutive samples with twenty samples occurring per AC cycle. If both samples are greater than the pickup rate and the load current is greater than 10 A, then the ROCOC protection will immediately pickup. The settings are as follows:

| Title         | Designation | Range   | Resolution | Factory Default |
|---------------|-------------|---------|------------|-----------------|
| Pickup (kA/s) | dIp/dt      | 1 – 200 | 1          | 10              |

**Note:** There is no delay in tripping time for ROCOC. When two consecutive samples are over the pickup level, a trip will be immediately sent to the device. The pickup will end with a single sample below the pickup level minus 2.5% hysteresis.

## 6.5 Temperature-Dependent Reclosing Control

The Temperature-Dependent Reclosing Control is intended for extreme temperature conditions where Group 4 is configured with settings to apply when the set temperature is exceeded.

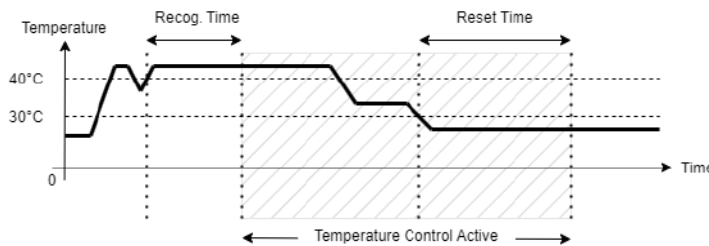


Figure 9: Temperature-Dependent Reclosing Control

For example, if the set level is 40°C and the recognition time is 60 mins, then the device switches to Group 4 if the temperature is greater than or equal to 40°C for 60 mins. The element resets if the temperature falls below 40°C during the recognition time. The device returns to the original Active Group setting when the temperature drops to less than or equal to 30°C for the reset time (10°C hysteresis).

If Temperature Control was Active when protection is turned Off or the setting is disabled, then Temperature Control will end, and the device will revert to the original Active Group.

Turning Auto-Reclosing On or Off has no effect on this setting.

| Title                                        | Designation | Range                                      | Resolution | Factory Default |
|----------------------------------------------|-------------|--------------------------------------------|------------|-----------------|
| Temperature Reclosing Control <sup>(1)</sup> | Temp Mode   | Enabled/Disabled                           | NA         | Disabled        |
| Temperature Level                            | Temp, °C    | -30 to 70                                  | 1          | 40              |
| Temperature Direction                        | Temp Dir    | Above <sup>(2)</sup> /Below <sup>(3)</sup> | NA         | Above           |
| Temperature Recognition Time (min)           | Temp Recog  | 1 – 50000                                  | 1          | 60              |
| Temperature Reset Time (min)                 | Temp Reset  | 1 – 50000                                  | 1          | 10              |

**Notes:**

1. Temperature Reclosing Control will be disabled when a Temperature Sensor Fault condition is present as it is not possible to detect the actual temperature.
2. If the Temperature Direction is "Above", then the temperature must fall to less than or equal to the set level minus 10°C for the reset time for Temperature-Dependent Reclosing Control to end.
3. If the Temperature Direction is "Below", then the temperature must be greater than or equal to the set level plus 10°C for the reset time for Temperature-Dependent Reclosing Control to end.

## 6.6 Fault Profile

Whenever a fault occurs, there may be many pickup, reset, inrush, and other events.

When a Trip event occurs due to protection, the device collects 1.5 s of quarter-cycle readings for the current and frequency, together with digital signals for pickup, reset, and inrush. 1 s of the readings is taken before the Trip event and the remaining 0.5 s after the Trip event.

Each quarter-cycle record contains the following:

- Timestamp of the quarter-cycle in microseconds relative to the start of the trace.
- Ia current in Amps.
- Ia 2nd harmonic magnitude in Amps.
- Frequency in Hz.
- The prevailing Inrush multiplier OIRM.
- Up to 32 digital channels for the switch state, pickup, reset, alarm, and open signals.

The Trip event is placed into the Event Log and has critical parameters for the Operation number, the maximum pickup level prior to the trip, and a number for the fault profile trace. Up to 10 traces are kept in non-volatile settings and then older traces are overwritten.

Refer to Appendix F for a full list of the fields in the Fault profile.

## 6.7 Alarm Latching

Alarms are activated when a protection element detects that a protection operation is required. If alarms are configured as “Unlatched”, they will reset when the protection element resets. If alarms are configured as “Latched”, they will remain active. This is only applicable when configured to “A” in the AR map.

Alarms will reset automatically on a close operation if “Reset Flags on Close” is enabled and can be manually reset using the “Reset FPI” option in the EcoLink® Manager.

**Note:** While a protection element is active, the alarm for that element cannot be reset.

### Alarm Latching Settings

| Title            | Designation      | Range               | Resolution | Factory Default |
|------------------|------------------|---------------------|------------|-----------------|
| Alarm Latch Mode | Alarm Latch Mode | Latched/Not Latched | N/A        | Latched         |

## 6.8 Fault Passage Indication (FPI)

The Fault Passage Indicator (FPI) is configured to operate when the switch is in Lockout, when an Alert condition is present, or to be Off permanently. The FPI LED flashes every 10 s. After sixty minutes of operation, the time between blinks will be increased to 30 s to extend the hold up time.

Alerts may persist even if the switch has subsequently reclosed after clearing a fault based on the “Reset Fault Flags On Close” and “Alarm Latch Mode” settings.

FPI can be reset manually when Online via the EcoLink® Manager. The FPI LED continues flashing until the Alerts are reset via the “Reset FPI” option.

| Title                                      | Designation | Range             | Resolution | Factory Default |
|--------------------------------------------|-------------|-------------------|------------|-----------------|
| Fault Passage Indication                   | FPI Mode    | Off/Alert/Lockout | NA         | Off             |
| Fault Passage Reset Time (hr) <sup>1</sup> | FPI Reset   | 0 – 48            | 1          | 24              |

**Note:**

1. Specifies the number of hours that the FPI will operate before turning Off automatically. The range is between 0 – 48 hours, where 0 indicates to continue indefinitely. The FPI will turn Off automatically before this time if the stored energy falls below the level required to perform a reclose operation, or if the condition for the FPI to be on is no longer present.

## 6.9 Circuit Breaker Failure (CBF) (ANSI 50BF)

Circuit Breaker Failure (CBF) ensures that the EcoLink® has correctly opened when a trip operation occurs.

CBF will be detected if the switch is open and there is current flowing, if the switch has been opened with the manual operation lever, if the user requests an open via the EcoLink® Manager or if a protection trip occurs.

## 6.10 Loss of Supply Detection (LSD)

LSD starts when the input current falls below 0.4 A and LSD ends when the input current is  $\geq 0.5$  A. Please note that the LSD level is not configurable by the user.

It is presumed that LSD is present when the EcoLink® first powers on, and the Inrush Restraint Multiplier is at its maximum. In case of close-onto-fault at system power on, Inrush Restraint is instantly applied.

**Note:** When LSD conditions are present, the frequency value will be reported to the user as zero and the UF protection engine will not operate.

## 6.11 Frequency Detection

Frequency is detected automatically where the minimum current should be 0.5 A.

The System frequency is displayed as "???" in the EcoLink® Manager if it is outside the range of 45 Hz to 65 Hz or current is below 0.5 A.

## 7 Monitoring

The EcoLink® generates and maintains the following records:

- |                     |                                                             |
|---------------------|-------------------------------------------------------------|
| • Fault Profile     | Fault episode data                                          |
| • Event Log         | Event data                                                  |
| • Lifetime Counters | Number of Close/Open operations and associated Contact Wear |
| • Fault Counters    | Number of Protection Trips                                  |

Refer to the NOJA-5220 EcoLink® Manager User Guide for more details.

### 7.1 User Notifications

Notifications are displayed when Online via the EcoLink® Manager to inform the operator when particular events are generated. These include Alerts, Warnings and Malfunctions and are displayed in the corresponding tabs when Online via the EcoLink® Manager.

Warnings and Malfunctions are automatically generated by the EcoLink® device. For a list of indication signals, please refer to APPENDIX C.

#### 7.1.1 Alerts

Alerts include “Open” Fault Flags, Alarm signals that are currently active and Fault Measured Values (Trip, Min, Max). When the device is at 100% Contact Wear, “Lifetime Limit Reached” is displayed.

Alerts for multiple protection elements may be displayed if “Alarm Latch Mode” is set to “Latched” and “Reset Fault Flags on Close” is disabled.

Alerts are volatile and will reset to their default values when the system loses power and restarts.

The ability to Reset FPI is provided. Selecting this option will turn off the FPI LED. Reset FPI does not affect “Lifetime Limit Reached”. Refer to Section 6.8 for more details.

#### 7.1.2 Malfunctions & Warnings

Refer to Section 13.1 for the names of the Malfunctions & Warnings displayed in the EcoLink® Manager.

### 7.2 Event Log

The Event Log registers up to 500 events associated with changes of particular signals or parameters. The Event Log can be viewed using the EcoLink® Manager. Each event is described by the following characteristics:

- Date and time registered
- Event title
- Source of event
- Relevant phase
- Critical parameter

The Event Log works on a FIFO basis thereby overwriting oldest entries when the maximum number is reached.

The user will be able to retrieve the fault profile trace associated with a specific Trip event by clicking on “Download Trace” displayed under Critical parameter in the Event Log. Refer to Appendix F for a full list of the fields in the Fault profile.

Please note that log history is not saved in the application. Only the logs which are currently retrieved from the Online device will be displayed and can be exported to a file.

All entries in the Event Log are recorded with the time that they occurred relative to the Last Power Restart. If the EcoLink® Manager is connected at any time after a restart, then the time of all the events in the session will be adjusted. Once the time is adjusted, all future events will be logged in real time rather than relative time. All events up to that point will be recorded with a relative time. If the EcoLink® Manager never connected between Restart and Shutdown, then the events will be recorded with a relative time.

For the full list of Events, refer to Appendix D – Events.

## 7.3 Counters

The EcoLink® monitors the number of operations and energy throughput during a fault and calculates the percentage of contact wear remaining after each Close – Open operation.

Two lifetime counters are maintained, one for Mechanism wear and the other for Contact wear.

Fault counters provide indication of the number and type of each fault the EcoLink® has operated for.

Fault Counters can be erased when Online via the EcoLink® Manager.

### 7.3.1 Lifetime counters

Lifetime counters calculate and record the total number of Close/Open (CO) Operations, Mechanical wear and Contact wear. They are accessible when Online via the EcoLink® Manager.

- Close/Open Total – The total number of close/open operations that have been performed.
- Mechanical wear (%) – Percentage of Mechanical wear that has accumulated, which is  $100 * \text{"Close/Open Total"} / 2000$ .
- Contact wear (%) – Percentage of Contact wear that has accumulated, which takes into consideration the fault current at the point in time when the contacts part.

When “Contact Wear (%)” reaches 100%, “Lifetime Limit Reached” will be raised as a Malfunction and as an Alert. If the Fault Passage Indicator (FPI) is enabled, the Alert will be visible to the user on the FPI LED. This type of Alert cannot be reset using the “Reset FPI” control or with the “Reset Fault Flags On Close” configuration option.

The device will continue to operate and perform protection even after the “Lifetime Limit Reached” Malfunction is raised.

**Note:** It is recommended to replace the device if the “Lifetime Limit Reached” malfunction is raised as further operations will eventually damage the mechanism or fuse the contacts.

### 7.3.2 Fault counters

Fault counters record the number of protection operations (faults) provided by each of the following:

- Phase Overcurrent (OC)
- Rate of Change of Current (ROCO)
- Under Frequency (UF)
- Over Frequency (OF)

Records are calculated and updated after each protection operation (fault). They are accessible when Online via the EcoLink® Manager.

## 7.4 Fault Targets

Fault Targets include the following:

- Fault Flags Set when a protection operation has been initiated. E.g. Open(OC1) is set when the recloser has opened due to phase overcurrent protection.
- Fault Measured Values (Trip, Min, Max) The “Trip” Fault Measured Values are updated when a trip occurs and the “Max” and “Min” Measured Values are recorded from pickup to operation of the device.

If “Reset Fault Flags on Close” is Enabled:

- Fault Flags and Fault Measured Values are automatically reset to zero when the switch transitions from open to close.

If “Reset Fault Flags on Close” is Disabled:

- Fault Flags will remain set unless the relay restarts or they are reset manually.
- Fault Measured Values will retain their value until the next protection operation or they are reset manually.

Fault Flags and Fault Measured values can be reset manually when Online via the EcoLink® Manager.

Fault Flags Setting

| Title                      | Designation                | Range            | Resolution | Factory Default |
|----------------------------|----------------------------|------------------|------------|-----------------|
| Reset Fault Flags on Close | Reset Fault Flags on Close | Enabled/Disabled | N/A        | Enabled         |

Reset Methods

| Reset Method | What is reset?                                                                                                               | Where from?      |
|--------------|------------------------------------------------------------------------------------------------------------------------------|------------------|
| Reset FPI    | <ul style="list-style-type: none"> <li>Open and alarm fault flags</li> <li>Fault measured values (Trip, Min, Max)</li> </ul> | EcoLink® Manager |

Fault Targets

| Fault Flags           |                                                                                     |
|-----------------------|-------------------------------------------------------------------------------------|
| Open                  | Open(OC1), Open(OC3), Open(ROCOC), Open(UF), Open(OF)                               |
| Alarm                 | A(OC1), A(OC3), A(ROCOC), A(UF), A(OF)                                              |
| Fault Measured Values |                                                                                     |
|                       | Trip(Ia), Trip(Ib), Trip(Ic), Max(Ia), Max(Ib), Max(Ic), UF Min, OF Max, Max(dI/dt) |

**Notes:**

1. Trip(Ia) will be changed to Trip(Ib) or Trip(Ic) if the "Phase" configuration setting is set to B or C respectively.
2. Max(Ia) will be changed to Max(Ib) or Max(Ic) if the "Phase" configuration setting is set to B or C respectively.

## 8 Control and Indication

The Control and Indication capabilities are handled by the EcoLink® Manager.

### Control Capabilities

| Control Data    |                      | Screens applicability in the EcoLink® Manager |
|-----------------|----------------------|-----------------------------------------------|
| Control Signals | Trip/Close           | Online Controls                               |
|                 | On(Prot)/Off(Prot)   | Online Controls                               |
|                 | 1 Group On (of 4)    | Online Controls                               |
|                 | On(AR)/Off(AR)       | Online Controls                               |
|                 | Erase Fault Counters | Online Controls                               |
|                 | Erase Event Logs     | Online Controls                               |
|                 | Reset FPI            | Alerts                                        |

### Indication Capabilities

| Indication Data    |                             | Screens applicability in the EcoLink® Manager |
|--------------------|-----------------------------|-----------------------------------------------|
| Indication Signals | Lockout                     | Dashboard                                     |
|                    | Pickup Signals              | Event Log (Fault Profile)                     |
|                    | Alarm Signals               | Alerts / Event Logs (Fault Profile)           |
|                    | Open Signals                | Alerts / Event Logs (Fault Profile)           |
|                    | Malfunctions                | Malfunctions & Warnings                       |
|                    | Warnings                    | Malfunctions & Warnings                       |
| Counter Readings   | Lifetime Counters           | Counters                                      |
|                    | Fault Counters              | Counters                                      |
| Records            | Total Close/Open Operations | Counters                                      |
|                    | Fault Profile               | Event Logs                                    |
|                    | Event Log                   | Event Logs                                    |
|                    | Audit Log                   | Security                                      |

## 9 Configuration

The user will be able to load a configuration package into the device to modify the settings as well as retrieve the configuration package from the device.

The Offline settings are edited in a CSV file using Excel or an appropriate Editor and the Configuration package (CSV file) must be loaded into the device using the EcoLink® Manager. The user can also select from a pre-defined list of configurations for Fuses (Fuse Library) that is provided along with the application. Refer to Section 14.1.2 Default settings of the Fuse Configuration for more details.

Curves will also be part of the Configuration package (CSV file) along with the Offline Settings where the user will be provided with a list of standard curve definitions up to 32 points for Overcurrent (OC1) which can be copied into the Configuration package CSV file. Each point defines the I/Ip ratio for the current and the tripping time in seconds. An optional reset curve can also be provided. "TCC Type" must be set to "UDC" to use the provided curve points. The provided curve points will be ignored if "TCC Type" is set to "TD".

### 9.1 Configuration Package Settings

The Wireless Device Name shall contain up to 20 ASCII characters. The Site Description shall contain up to 40 ASCII characters.

"Phase" is used to indicate which phase of the network the EcoLink® is installed on for reporting purposes.

The Login Max Attempts (number of unsuccessful login attempts) and Login Lockout time is user configurable via the Configuration Package.

## 10 Security

Users can be created/removed/edited in the EcoLink® Manager.

Access control to the device is via the Username and Password. By default, there is a single user called “Admin” with an empty password. The user is prompted by the EcoLink® Manager to set the Admin Username and Password the first time they login to the device.

Up to 10 users can be configured with individual roles and passwords. The Username shall contain 1-12 characters. Please note that the username is case-sensitive. For example, “Admin” and “admin” is considered as different users. EcoLink® will support any Username in the UTF-8 encoding. Refer to Section 10.3 Changing Password for more details on the Password requirements.

| Group       | Default Roles |          |          |           |                |       |
|-------------|---------------|----------|----------|-----------|----------------|-------|
|             | Viewer        | Operator | Engineer | Installer | Security Admin | Admin |
| View Data   | X             | X        | X        | X         |                | X     |
| View Config |               | X        | X        |           | X              | X     |
| Control     |               | X        |          |           |                | X     |
| Config      |               |          | X        |           |                | X     |
| Firmware    |               |          |          | X         |                | X     |
| Security    |               |          |          |           | X              | X     |
| Audit       |               |          |          |           | X              | X     |
| Factory     |               |          |          |           |                | X     |

The below table describes the Group based on the requirements of IEEE 1686-2022.

| Group       | Description                                                                                                                                                                             |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| View Data   | The ability to view operational data (current, frequency, status, alarms, etc.) of the device that are not intended to be available as general information display.                     |
| View Config | The ability to view configuration settings and firmware version numbers. The ability to view settings in the Protection settings screen.                                                |
| Control     | The ability to control the device, to enable/disable PROT and AR, modify the active group, and operate device.                                                                          |
| Config      | The ability to download and upload configuration files to the unit and/or effect changes to the existing configuration. The ability to edit settings in the Protection settings screen. |
| Firmware    | The ability to load new firmware that does not require a corresponding hardware change.                                                                                                 |
| Security    | The ability to create, remove, or modify user IDs, passwords, and role authorization levels.                                                                                            |
| Audit       | The ability to view and download the audit trail.                                                                                                                                       |
| Factory     | The ability to perform a factory reset.                                                                                                                                                 |

Please note that there must be at least one user with the “Admin” role. Each role supports multiple users and a user can have multiple roles.

For the Default roles, Role to Group mapping cannot change i.e., it is not possible to modify the Group that are assigned to a role or to individually assign Group to users.

### 10.1 Encryption

128-bit AES in CCM mode is used to provide authentication and confidentiality over the COMMS connection.

### 10.2 Audit Logs

The EcoLink® maintains an Audit trail facility of 200 entries, with all other requirements as per IEEE 1686-2022. The Audit Log works on a FIFO basis thereby overwriting oldest entries with the newest entries. Each event is described by the following characteristics:

- Log ID
- Date and time registered
- User ID
- Event Title
- Monitor Type (Event/Alarm)
- Critical parameter

All entries in the Audit Log are recorded with the time that they occurred relative to the Last Power Restart. If the EcoLink® Manager is connected at any time after a restart, then the time of all the Audit entries in the session will be adjusted. Once the time is adjusted, all future Audit entries will be logged in real time rather than relative time. All Audit entries up to that point will be recorded with a relative time. If the EcoLink® Manager never connected between Restart and Shutdown, then the Audit entries will be recorded with a relative time.

For the full list of Audit Logs, refer to Appendix E – Audit Logs.

## 10.3 Changing Password

Users can change their password through the EcoLink® Manager.

In case of loss of other users' password, any user with administrative privileges will be able to change other users' password in the EcoLink® Manager.

### Password requirements

As per IEEE 1686-2022 requirements, the Password shall contain 12-64 characters. All printing ASCII characters shall be supported, with an option to use Unicode characters.

**Note:** EcoLink® supports any password in the UTF-8 encoding between 12 and 64 Unicode characters in length.

In case the Administrator's password has been forgotten, a Factory Reset is required to remove the security package and revert to the default "Admin" user. There is a device-specific password to perform a Factory Reset. The user shall provide the serial number of the device to NOJA Power. NOJA Power then generates the device-specific password and provides it to the user. The user should then login with Username as "factory" and enter the device-specific password to login to the device and perform a Factory Reset.

## 10.4 Manage Users

The user will be able to do the following operations:

1. Add a New User
2. Remove an existing User
3. Edit User details

### 10.4.1 Add User

The default roles available are "Admin", "Viewer", "Operator", "Installer", "Engineer" and "Security Admin". Up to 10 individual users can be added. More than 1 user with the Admin role can be added. The user must be assigned at least one role.

When a user with "Security" Group access rights creates a new user along with the password, the new user when accessing the device for the first time will be forced to change the password. Refer to Section 10.3 Changing Password for more details on the Password requirements.

When a user is added successfully, "Add User" will be reported in the Audit Log.

### 10.4.2 Remove User

Please note that there should be at least one user assigned to the Admin role and a warning will be displayed when the user tries to delete all the users.

When a user is removed, "Remove User" will be reported in the Audit Log.

### 10.4.3 Edit User

The user must be assigned at least one role.

The users with “Security” Group access rights can change other user’s password by filling in the Password and Confirm Password fields with the new password. In such circumstances, the user whose password was changed will be forced to change the password upon logging into the device.

If there are 2 users assigned to the Admin role, the logged in Admin will be able to change the Role and password of the second Admin. If the second admin is the default admin user, only the Password can be updated.

When a users’ detail is edited, “Update Roles” or “Change Password” will be reported in the Audit Log.

## 11 System Administration

The user will be able to load new firmware into the device, restart the device and perform a factory reset.

The ability to install new firmware and request a System Restart is only possible for users that belong to the “Firmware” Group. Refer to Section 11.1 Firmware Update for more details. Once the device is restarted, the user must connect and login to the device.

The ability to perform a factory reset is only possible for users that belong to the “Factory” Group. Refer to Section 13.2 Factory Reset for more details.

### 11.1 Firmware Update

Firmware updates use the standard Device Firmware Upgrade over wireless technology thereby providing a secure method to upgrade the firmware of the device.

The user will be able to install a firmware update on the device through the EcoLink® Manager. Only users who belong to the “Firmware” Group will be able to initiate a Firmware Update.

For an update to commence, at least 1 A of current must be flowing or the System Energy Status should be at least “Medium”. The Current and Energy Status can be viewed under the Dashboard tab in the EcoLink® Manager.

The user will be logged out of the device when the device restarts to load the device with the new firmware. Once the update is successful, the user must connect to the device by clicking on the Device name and then click on the “Connect” option in the EcoLink® Manager.

“Update Initiated” will be logged in the Event Log when the update starts. When the update is completed, either “Update Successful” or “Update Failed” will be logged in the Event Log depending on whether the update was successful or unsuccessful.

## 12 Installation

Installation of the device must be done by a suitably qualified Electrical worker. Installation is performed using an insulated, suitably rated, hook stick. Suitable Personal Protective Equipment (PPE) must be used to get close to the Cutout mount and place the device into the Trunnion pocket on the Cutout. The hook stick should be inserted through the Pull Ring to engage the Fuse Tip to the upper contact of the Cutout. After installation, the manual lever should be closed by pushing the lever upwards using a hook stick thereby closing the VI contacts.

### Notes:

1. Ensure that the manual lever is pulled downwards and the VI contacts are open before installing the device.
2. Ensure to remove the hook stick from the Pull Ring carefully to avoid disengaging the EcoLink® device from the Cutout mount.
3. In some cases, a new Cutout mount will need to be installed before fitting the device. Please contact NOJA Power if you require a new Cutout mount.



**CAUTION:** Failure to comply with installation recommendations may result in equipment damage.



**WARNING:** Follow all locally approved safety procedures when installing or operating this equipment. Failure to comply may result in death or severe personal injury.

### 12.1 Unpacking

The EcoLink® is packed in a cardboard box containing:

- Routine Test Summary and Quick Reference sticker that contains a QR Label pointing to the User Manual
- EcoLink® device.

The cardboard box is recyclable. The contents of the box can easily be removed by opening the top side of the box.



**CAUTION:** Inappropriate lifting of the device can result in personal injury or equipment damage.

### 12.2 Pre-Installation Condition Requirements for Medium Voltage Fuse Cutouts (IEEE C37.41 Compliance)

Prior to installing an EcoLink® as a replacement for a fuse in a pre-existing fuse cutout, the existing medium voltage fuse cutout must be evaluated to ensure compliance with IEEE C37.41 standards. The cutout assembly must be free from mechanical damage, including cracks, warping, or signs of overheating. Insulating components should exhibit no signs of contamination, tracking, or degradation that could compromise dielectric integrity. All conductive parts, including terminals and contact surfaces, must be clean, corrosion-free, and capable of maintaining reliable electrical continuity. The hinge mechanism and trunnion must operate smoothly without excessive wear. Mounting hardware must be secure and properly aligned to maintain structural integrity under fault conditions. If any component fails to meet these criteria, the cutout must be replaced in its entirety to ensure safe and effective operation in accordance with IEEE guidelines.

## 13 Maintenance

The EcoLink® is non-serviceable. Regular inspections can be conducted to check for any build-up of foreign material on the device and clean off debris if necessary.

This section provides recommendations for monitoring equipment condition.

### 13.1 Fault Finding

1. When the Manual lever cannot be moved for some reason, remove the device from the Cutout mount, inspect the manual lever in open or closed position for obstructions and ensure free movement. If the issue persists, contact NOJA Power.

2. In the event of a discrepancy in the Ambient Temperature displayed on the EcoLink® Manager, restart the device by clicking on “Restart System” option under the System Administration tab. After the device restarts, the correct temperature will be displayed upon next login.

#### 13.1.1 Warning Signals

The following table describes a number of warning events and signals available from the device and what they indicate. It also suggests steps to assist in determining why the event/signal was generated and recommended actions.

| Signal                          | Description                           | Possible Cause                                                                                                                           | Recommended actions                                                                                           |
|---------------------------------|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Mechanically Locked             | Device is Mechanically Locked.        | Operating lever has been pulled down.                                                                                                    | Return the operating lever to the normal position.                                                            |
| Caps Not Charged <sup>(1)</sup> | Capacitors are not fully charged.     | Less than 60 seconds after the device was connected.                                                                                     | Wait for 60 seconds.                                                                                          |
|                                 |                                       | Too many operations in a row and the electronic circuit exceeds the duty cycle and does not have enough time to recharge the capacitors. | Wait for 2 minutes to charge the Quick and Full Sequence capacitors to the recommended minimum current of 2A. |
|                                 |                                       | Faulty device.                                                                                                                           | Replace the device.                                                                                           |
| Not Calibrated                  | Device current coefficients required. | Device faulty or requires calibration.                                                                                                   | Contact NOJA Power.                                                                                           |

**Notes:**

1. Refers to the capacitors for operating the actuator mechanism. Other capacitors are used for system hold-up; the system will power down if they are depleted or faulty.

#### 13.1.2 Malfunction Signals

The following table describes a number of malfunction events and signals available from the device and what they indicate. It also suggests steps to assist in determining why the event/signal was generated and recommended actions.

| Signal                      | Description                                                     | Possible Cause                        | Recommended actions                                                                                                                                         |
|-----------------------------|-----------------------------------------------------------------|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Capacitor Voltage Abnormal  | The capacitor voltage dropped too much during an operation.     | Faulty Actuator.                      | Wait for 2 minutes to charge the Quick and Full Sequence capacitors to the recommended minimum current of 2A. Replace the device if the condition persists. |
| CBF Malfunction             | Current is still present after a trip operation.                | Faulty Actuator or Mechanism Failure. | Replace the device.                                                                                                                                         |
| Excessive Tc                | The requested close operation failed.                           | Faulty Actuator or Mechanism Failure. | Replace the device.                                                                                                                                         |
| Excessive To                | The requested trip operation failed.                            | Faulty Actuator or Mechanism Failure. | Replace the device.                                                                                                                                         |
| Lifetime Limit Reached      | Contact Wear has reached 100%.                                  | Contact Wear has reached 100%.        | Replace device.                                                                                                                                             |
| Limit Switch Fault          | Device is both closed and mechanically locked at the same time. | Faulty Actuator or Mechanism Failure. | Replace the device.                                                                                                                                         |
| Non-Volatile Storage Failed | Non-volatile memory storage device has failed.                  | Faulty device.                        | Replace the device.                                                                                                                                         |

| Signal                   | Description                                                  | Possible Cause                                                                                                | Recommended actions                                                                                |
|--------------------------|--------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| Temperature Sensor Fault | Temperature sensor is not reporting an accurate temperature. | A firmware update or system reset caused the microcontroller to become confused as to the actual temperature. | Perform another system reset with System Administration. Contact NOJA Power if the fault persists. |

## 13.2 Factory Reset

Users who belong to the “Factory” Group will be able to perform a Factory Reset through the EcoLink® Manager.

Performing a Factory Reset will result in the following:

- Removes all local users and reverts to a single “Admin” account.
- Reverts all non-volatile database settings to their defaults.
- Resets all Fault counters to zero.
- Erases the Event Log.
- Adds a “Factory Reset” event to the Audit Log.
- Erases any information about previously connected EcoLink® devices.
- Resets the device to reload the database defaults.

Please note that a Factory Reset will not erase the following:

- Serial number and hardware revision information.
- Calibration parameters.
- Lifetime wear counters.
- Audit Log.

In the case of loss of Admin password, the EcoLink® device can be recovered by entering a device-specific factory reset password. Firstly, the user should send the serial number of the device to NOJA Power to get the the device-specific password. The user should then login with Username as “factory” and enter the device-specific password to login to the device and perform a Factory Reset.

**Notes:**

1. There is no limit on the number of times that a user can perform a Factory Reset.
2. In case of loss of Admin password, if a Factory Reset is performed, all settings will be reset to their defaults and Protection will be disabled.

## 14 Appendices

### 14.1 Appendix A – Time Current Characteristic (TCC) Curves

#### 14.1.1 User Defined Universal Inverse TCC (UDC)

##### 14.1.1.1 ANSI TCC

ANSI TCCs are described by the following general equation:

$$T_t = \left( \frac{A}{\left( \frac{I}{I_p} \right)^p - 1} + B \right) * TM$$

where:

- $A, B, p$  constants
- $TM$  time multiplier
- $I_p$  pickup current
- $T_t$  tripping time
- $I$  fault current

The ANSI TCCs are defined by the parameters in the following Table, as applied to the above equation.

| TCC type                     | Designation | A       | B      | D     | p    |
|------------------------------|-------------|---------|--------|-------|------|
| Extremely Inverse            | EI          | 6.407   | 0.025  | 3     | 2.0  |
| Very Inverse                 | VI          | 2.855   | 0.0712 | 1.346 | 2.0  |
| Inverse                      | I           | 0.0086  | 0.0185 | 0.46  | 0.02 |
| Short Time Inverse           | STI         | 0.00172 | 0.0037 | 0.092 | 0.02 |
| Short Time Extremely Inverse | STEI        | 1.281   | 0.005  | 0.6   | 2.0  |
| Long Time Extremely Inverse  | LTEI        | 64.07   | 0.250  | 30    | 2.0  |
| Long Time Very Inverse       | LTVI        | 28.55   | 0.712  | 13.46 | 2.0  |
| Long Time Inverse            | LTI         | 0.086   | 0.185  | 4.6   | 0.02 |

ANSI TCCs are provided with a disk emulating reset timer described by the following general equation:

$$T_{res}(I) = \frac{D}{1 - 0.998 * \left( \frac{I}{I_{min}} \right)}$$

where:

- $T_{res}(I)$  reset time at given current  $I$
- $D$  constant
- $I_{min}$  minimum operating current

$$I_{min} = MIN \times I_p \times max(IRM)$$

where:

- $MIN$  minimum current multiplier
- $I_p$  pickup current
- $IRM$  Inrush restraint multiplier

##### 14.1.1.2 IEC TCC

IEC TCCs are described by the following general equation:

$$T_t = \frac{A * TM}{\left( \frac{I}{I_p} \right)^p - 1}$$

where:

- $TM$  time multiplier
- $A, p$  constants
- $I_p$  pickup current
- $T_t$  tripping time
- $I$  fault current

The IEC TCCs are defined by the parameters in the following Table, as applied to the above equation.

| TCC type          | Designation | A    | p    |
|-------------------|-------------|------|------|
| Extremely Inverse | EI          | 80   | 2.0  |
| Very Inverse      | VI          | 13.5 | 1.0  |
| Inverse           | I           | 0.14 | 0.02 |
| Long Time Inverse | LTl         | 120  | 1.0  |

IEC TCCs have a user configured, definite time reset timer. Consequently the IEC TCC reset characteristic is independent of current.

#### 14.1.1.3 IEEE and U TCC

IEEE and U time current curves are defined by the following equations:

**Tripping time:**  $(I/I_p) > 1$

$$T_t = \left( \frac{A}{\left(\frac{I}{I_p}\right)^p - 1} + B \right) * TM$$

where:

$A, B, D, p$

constants

$TM$

Time multiplier

$I$

Input current

$I_p$

Pickup current

$T_t$

Tripping time

$T_{res}(I)$

Reset time at given current  $I$

**Reset Time:**  $(I/I_p) < 1$

$$T_{res}(I) = \left( \frac{D}{1 - \left(\frac{I}{I_p}\right)^2} \right) * TM$$

| TCC type                | Designation | A       | B       | D     | p    |
|-------------------------|-------------|---------|---------|-------|------|
| <b>IEEE Curves</b>      |             |         |         |       |      |
| IEEE Moderately Inverse | MI          | 0.0515  | 0.1140  | 4.85  | 0.02 |
| IEEE Very Inverse       | VI          | 19.61   | 0.491   | 21.6  | 2    |
| IEEE Extremely Inverse  | EI          | 28.2    | 0.1217  | 29.1  | 2    |
| <b>U Curves</b>         |             |         |         |       |      |
| U1 – Moderately Inverse | MI          | 0.0104  | 0.0226  | 1.08  | 0.02 |
| U2 – Inverse            | I           | 5.95    | 0.180   | 5.95  | 2    |
| U3 – Very Inverse       | VI          | 3.88    | 0.0963  | 3.88  | 2    |
| U4 – Extremely Inverse  | EI          | 5.64    | 0.02434 | 5.64  | 2    |
| U5 – Short-Time Inverse | STI         | 0.00342 | 0.00262 | 0.323 | 0.02 |

#### 14.1.1.4 Additional TCC Curves

43 additional TCC curves are available. These are designed to emulate curves available in older protection equipment.

The available curves are:

101, 102, 103, 104, 105, 106, 107, 111, 112, 113, 114, 115, 116, 117, 119, 120, 121, 122, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 151, 152, 161, 162, 163, 164, 165, 200, 201, 202, 400, 401, 402.

Additional TCC Curves have a user configured, definite time reset timer.

#### 14.1.1.5 Fuse Curves

| TCC type       | A   | B     | D | p   |
|----------------|-----|-------|---|-----|
| Tap Curves     | 2   | 0.007 | 1 | 1.9 |
| Main Curves    | 2   | 0.045 | 1 | 2   |
| E-Speed Curves | 5.5 | 0     | 1 | 2   |

| TCC type                      | A       | B | D | p |
|-------------------------------|---------|---|---|---|
| K-Speed Curves <sup>(1)</sup> | -       | - | - | - |
| T-Speed Curves                | 13.4075 | 0 | 1 | 2 |

**Note:**

1. There are no documented A, B, p, and D parameter sets for these K-Speed Curves.

## 14.1.2 Default settings of the Fuse Configuration

| Title                         | Value                                         | Units | Min  | Max  |
|-------------------------------|-----------------------------------------------|-------|------|------|
| Site description              | None                                          |       |      |      |
| Reset Fault Flags on Close    | Enabled                                       |       |      |      |
| Alarm Latch Mode              | Enabled                                       |       |      |      |
| Language                      | English                                       |       |      |      |
| Inactivity Timeout            | 15                                            | min   | 1    | 60   |
| Fault Passage Indication      | Disabled                                      |       | 0    | 2    |
| Phase                         | A                                             |       |      |      |
| Temperature Reclosing Control | Disabled                                      |       |      |      |
| Max Login Attempts            | 3                                             |       | 2    | 10   |
| Login Lockout Time            | 30                                            | s     | 10   | 900  |
| Protection                    | Disabled                                      |       |      |      |
| Auto Reclose                  | Disabled                                      |       |      |      |
| AR: Tr1, s                    | 10                                            | s     | 0.1  | 180  |
| AR: Tr2, s                    | 20                                            | s     | 1    | 180  |
| AR: Tr3, s                    | 20                                            | s     | 1    | 180  |
| AR: Tres, s                   | 30                                            | s     | 5    | 180  |
| IR: IRM                       | 5                                             |       | 1    | 20   |
| IR: Tir, s                    | 0.1                                           | s     | 0.01 | 10   |
| OC1: Ip, A                    | Based on Fuse rating selection <sup>(1)</sup> | A     | 1    | 4000 |
| OC1: TCC Type                 | Based on Configured Group selection           |       |      |      |
| OC1: Tdt Min, s               | 1                                             | s     | 0    | 120  |
| OC1: FLTRes, s                | 0.05                                          | s     | 0    | 10   |
| OC1: TM                       | 1                                             |       | 0.01 | 15   |
| OC1: MIN                      | 1                                             |       | 1    | 20   |
| OC1: Tmin, s                  | 0.01                                          | s     | 0    | 10   |
| OC1: Tmax, s                  | 120                                           | s     | 1    | 120  |
| OC1: Ta, s                    | 0                                             | s     | 0    | 2    |
| OC1 Mode, Trip 1              | Reclose                                       |       | 0    | 3    |
| OC1 Mode, Trip 2              | Reclose                                       |       | 0    | 3    |
| OC1 Mode, Trip 3              | Reclose                                       |       | 0    | 3    |
| OC1 Mode, Trip 4              | Lockout                                       |       | 0    | 3    |
| OC3: Ip, A                    | 200                                           | A     | 5    | 4000 |
| OC3: Tdt Min, s               | 0.1                                           | s     | 0    | 2    |
| OC3: FLTRes, s                | 0.05                                          | s     | 0    | 10   |
| OC3 Mode, Trip 1              | Lockout                                       |       |      |      |
| OC3 Mode, Trip 2              | Lockout                                       |       |      |      |

| Title               | Value    | Units | Min | Max |
|---------------------|----------|-------|-----|-----|
| OC3 Mode, Trip 3    | Lockout  |       |     |     |
| OC3 Mode, Trip 4    | Lockout  |       |     |     |
| UF: UF mode         | Disabled |       |     |     |
| OF: OF mode         | Disabled |       |     |     |
| IR: Mode            | Enabled  |       |     |     |
| ROCOC: Mode, Trip 1 | Disabled |       |     |     |
| ROCOC: Mode, Trip 2 | Disabled |       |     |     |
| ROCOC: Mode, Trip 3 | Disabled |       |     |     |
| ROCOC: Mode, Trip 4 | Disabled |       |     |     |
| HIB2 Mode           | Disabled |       |     |     |

**Note:**

1. To use pre-defined list of configurations for Fuses, the user must
  - a. Select the CSV file consisting of the required Fuse rating.
  - b. Once the appropriate Fuse Configuration is loaded into the device, selecting the Configured Group from Online Controls will select the following TCC Types:

- i. ANSI TCC

| Groups  | TCC Type           |
|---------|--------------------|
| Group 1 | Extremely Inverse  |
| Group 2 | Very Inverse       |
| Group 3 | Inverse            |
| Group 4 | Short Time Inverse |

- ii. IEC TCC

| Groups  | TCC Type          |
|---------|-------------------|
| Group 1 | Extremely Inverse |
| Group 2 | Very Inverse      |
| Group 3 | Inverse           |
| Group 4 | Long Time Inverse |

- iii. IEEE TCC

| Groups  | TCC Type           |
|---------|--------------------|
| Group 1 | Extremely Inverse  |
| Group 2 | Very Inverse       |
| Group 3 | Moderately Inverse |

- iv. U TCC

| Groups  | TCC Type                |
|---------|-------------------------|
| Group 1 | U1 – Moderately Inverse |
| Group 2 | U2 – Inverse            |
| Group 3 | U3 – Very Inverse       |
| Group 4 | U4 – Extremely Inverse  |

- v. Fuse Curves

| Groups  | TCC Type |
|---------|----------|
| Group 1 | E-Speed  |
| Group 2 | K-Speed  |
| Group 3 | T-Speed  |
| Group 4 | Tap      |

## 14.2 Appendix B – ANSI Support

ANSI / IEEE standard C37.2, 1996 provides definition and application of function numbers for devices used in electrical substations, generating plants and in installations of power utilisation and conversion apparatus.

The table below links device protection functions to the relevant ANSI device number.

| ANSI Device Function Number | Definition                                                                                                                                                                                                                                           | Comment                                                                          |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| 50                          | <b>Instantaneous Overcurrent Relay</b><br>A device that operates with no intentional time delay when the current exceeds a preset value.                                                                                                             |                                                                                  |
| 50BF                        | <b>Circuit Breaker Fault (CBF)</b>                                                                                                                                                                                                                   | CBF ensures that the EcoLink® has correctly opened when a trip operation occurs. |
| 51                          | <b>AC Time Overcurrent Relay</b><br>A device that functions when the ac input current exceeds a predetermined value, and in which the input current and operating time are inversely related through a substantial portion of the performance range. |                                                                                  |
| 79                          | <b>Reclosing Relay</b><br>A device that controls the automatic reclosing and locking out of an ac circuit interrupter.                                                                                                                               |                                                                                  |
| 81                          | <b>Frequency Relay</b><br>A device that responds to the frequency of an electrical quantity, operating when the frequency or rate of change of frequency exceeds or is less than a predetermined value.                                              |                                                                                  |

## 14.3 Appendix C – Indication Signals

Indication Signals provides diagnostic functions by monitoring operation of the device, internal communications and opening/closing times of the device. If any change of state in operation is detected, an indication signal is generated. These indications appear in Alerts, Malfunctions, Fault Profile, etc.

| Signal                      | Description                                                                                          |
|-----------------------------|------------------------------------------------------------------------------------------------------|
| <b>TYPE: PICKUP</b>         |                                                                                                      |
| P(OC1)                      | Pickup output of any OC1 element activated.                                                          |
| P(OC3)                      | Pickup output of any OC3 element activated.                                                          |
| P(ROCO)                     | Pickup output for ROCOC is activated.                                                                |
| P(OF)                       | Pickup output of OF activated.                                                                       |
| P(UF)                       | Pickup output of UF activated.                                                                       |
| P(LSD)                      | Pickup output of LSD activated.                                                                      |
| P(HIB)                      | Pickup output of HIB activated.                                                                      |
| <b>TYPE: OPEN</b>           |                                                                                                      |
| Open(OC1)                   | Open due to any OC1 element tripping.                                                                |
| Open(OC3)                   | Open due to any OC3 element tripping.                                                                |
| Open(ROCO)                  | Open due to any ROCOC element tripping.                                                              |
| Open(OF)                    | Open due to any OF element tripping.                                                                 |
| Open(UF)                    | Open due to any UF element tripping.                                                                 |
| <b>TYPE: ALARM</b>          |                                                                                                      |
| A(OC1)                      | Alarm due to any OC1 element activated.                                                              |
| A(OC3)                      | Alarm due to any OC3 element activated.                                                              |
| A(ROCO)                     | Alarm due to any ROCOC element activated.                                                            |
| A(OF)                       | Alarm due to any OF element activated.                                                               |
| A(UF)                       | Alarm due to any UF element activated.                                                               |
| <b>TYPE: STATUS</b>         |                                                                                                      |
| AR On                       | Auto Reclosing for OC1, OC3 and ROCOC are switched on.                                               |
| Prot On                     | Protection is switched on                                                                            |
| <b>TYPE: MALFUNCTION</b>    |                                                                                                      |
| Capacitor Voltage Abnormal  | The capacitor voltage dropped too much during an operation.                                          |
| CBF Malfunction             | CBF Malfunction has occurred due to device not opening successfully.                                 |
| Excessive Tc                | Closing time exceeds 100ms or no confirmation received that close command was executed successfully. |
| Excessive To                | Opening time exceeds 60ms or no confirmation received that open command was executed successfully.   |
| Limit Switch Fault          | Device is both closed and mechanically locked at the same time.                                      |
| Non-Volatile Storage Failed | Non-volatile memory storage device has failed.                                                       |
| <b>TYPE: WARNING</b>        |                                                                                                      |
| Mechanically Locked         | Device is mechanically locked, Operating lever has been pulled down.                                 |
| Caps Not Charged            | Capacitors are not fully charged.                                                                    |
| Not Calibrated              | Device current coefficients required.                                                                |

## 14.4 Appendix D – Events

### 14.4.1 Protection Events

| Event Title |     | Relevant signal/parameter |                               | Source of event             | Critical parameter                                                                                                                                              |
|-------------|-----|---------------------------|-------------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             |     | Title                     | Old value → New value         |                             |                                                                                                                                                                 |
| Alarm       | N/A | A(E)                      | 0→1                           | Any Protection Element      | N/A                                                                                                                                                             |
| Trip        | N/A | T(E)                      | 0→1                           | Any protection element, HMI | Lockout, Open 2, Open 3, Open 4<br>Max(Ia), A=N <sup>(1)</sup> ; Max(di/dt), kA/s=N; Min Freq, Hz=N.NN; Max Freq, Hz=N.NN<br>Trace #1, Trace #2, ..., Trace #10 |
| Close       | N/A | C(E)                      | 0→1                           | AR, HMI                     | Close 1, Close 2, Close 3, Close 4                                                                                                                              |
| Count       | N/A | Count                     | C1 → C2<br>C2 → C3<br>C3 → C4 | OC1, OC3                    | O2, O3, O4<br>Max(Ia), A=N                                                                                                                                      |

**Note:**

1. Max(Ia) will be changed to Max(Ib) or Max(Ic) if the “Phase” configuration setting is set to B or C respectively.

### 14.4.2 Status Events

| Event Title                       |       | Relevant signal/parameter     |                       | Source of event           | Critical parameter                                                                                                                                                                                                             |
|-----------------------------------|-------|-------------------------------|-----------------------|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                   |       | Title                         | Old value → New value |                           |                                                                                                                                                                                                                                |
| Calibration Status <sup>(1)</sup> | N/A   | Calibration Status            | N/A                   | Device, HMI               | Calibrated, Not Calibrated, Cal Values Corrupted                                                                                                                                                                               |
| Configuration Package Changed     | N/A   | Configuration Package Changed | N/A                   | HMI                       | Configuration package is changed                                                                                                                                                                                               |
| Fault Counters Erased             | N/A   | Fault Counters Erased         | N/A                   | HMI                       | N/A                                                                                                                                                                                                                            |
| Update Initiated                  | N/A   | Update Initiated              | N/A                   | HMI                       | N/A                                                                                                                                                                                                                            |
| Update Successful                 | N/A   | Update Successful             | N/A                   | Device                    | N/A                                                                                                                                                                                                                            |
| Group Settings Changed            | N/A   | Group Settings Changed        | Old→New               | HMI, Temp Control         | New active group                                                                                                                                                                                                               |
| Breaker Open                      | N/A   | Breaker Open                  | N/A                   | Prot, Manual, Device, HMI | Trip(Ia), A=N (actual current at the time that the VI opened) <sup>(2)</sup><br>Power Supply (for the first position indication at power on)<br>Retry=N (number of retries when energising the coil before the breaker opened) |
| Breaker Closed                    | N/A   | Breaker Closed                | N/A                   | Prot, Manual, Device, HMI | Power Supply (for the first position indication at power on)                                                                                                                                                                   |
| Protection Status Changed         | N/A   | Protection Status Changed     | Old→New               | HMI                       | New status                                                                                                                                                                                                                     |
| Restart                           | N/A   | Restart                       | N/A                   | HMI                       | System process                                                                                                                                                                                                                 |
| Reset FPI                         | N/A   | Reset FPI                     | N/A                   | HMI                       | N/A                                                                                                                                                                                                                            |
| Temperature Control               | Start | Temperature Control           | 0→1                   | Device                    | Temp, °C=N, Max(Temp), °C=N or Temp, °C=N, Min(Temp), °C=N                                                                                                                                                                     |
|                                   | End   | Temperature Control           | 1→0                   | Device                    | Temp, °C=N, Max(Temp), °C=N or Temp, °C=N, Min(Temp), °C=N                                                                                                                                                                     |
| RTC Setting Change                | N/A   | RTC Setting Change            | N/A                   | HMI                       | N/A                                                                                                                                                                                                                            |
| Simulator Step                    | Start | Simulator Step                | Change                | HMI                       | Simulation Step number                                                                                                                                                                                                         |
| Simulator Run                     | Start | Simulator Run                 | Off→On                | HMI                       | N/A                                                                                                                                                                                                                            |

| Event Title     |       | Relevant signal/parameter |                       | Source of event | Critical parameter                   |
|-----------------|-------|---------------------------|-----------------------|-----------------|--------------------------------------|
|                 |       | Title                     | Old value → New value |                 |                                      |
|                 | End   | Simulator Run             | On→Off                | HMI             | N/A                                  |
| Capacitor Boost | Start | Capacitor Boost           | 0→1                   | Device          | N/A                                  |
|                 | End   | Capacitor Boost           | 1→0                   | Device          | N/A                                  |
| Energy Status   | N/A   | Energy Status             | Old→New               | Device          | Low, Medium, High, Full              |
| Charge State    | N/A   | Charge State              | Old→New               | Device          | Discharging, Charging, Fully Charged |

**Notes:**

1. "Calibration Status/Not Calibrated" or "Calibration Status/Cal Values Corrupted" will be logged at start up if the device has not yet been calibrated or the values are invalid. Please contact NOJA Power for support.
2. Trip(Ia) will be changed to Trip(Ib) or Trip(Ic) if the "Phase" configuration setting is set to B or C respectively.

### 14.4.3 Warning Events

| Event Title         |       | Relevant signal/parameter |                       | Source of event | Critical parameter |
|---------------------|-------|---------------------------|-----------------------|-----------------|--------------------|
|                     |       | Title                     | Old value → New value |                 |                    |
| Update Failed       | N/A   | Update Failed             | N/A                   | Device          | N/A                |
| Mechanically Locked | Start | Mechanically Locked       | 0→1                   | Device          | N/A                |
|                     | End   | Mechanically Locked       | 1→0                   | Device          | N/A                |

### 14.4.4 Malfunction Events

| Event Title                |       | Relevant signal/parameter |                       | Source of event | Critical parameter                                                                                                               |
|----------------------------|-------|---------------------------|-----------------------|-----------------|----------------------------------------------------------------------------------------------------------------------------------|
|                            |       | Title                     | Old value → New value |                 |                                                                                                                                  |
| Capacitor Voltage Abnormal | N/A   | Capacitor Voltage         | 0→1                   | Device          | Close capacitor voltage drop too high or Trip capacitor voltage drop too high                                                    |
| CBF Malfunction            | N/A   | CBF Malfunction           | 0→1                   | Device          | Ia, A=N <sup>(1)</sup>                                                                                                           |
| Excessive Tc               | N/A   | Excessive Tc              | 0→1                   | Device          | N/A                                                                                                                              |
| Excessive To               | N/A   | Excessive To              | 0→1                   | Device          | N/A                                                                                                                              |
| Trip Request Fail          | N/A   | Trip Request Fail         | Off→On                | Device          | Excess Actuator Current Draw, Duty Cycle Exceeded, Mechanically Locked                                                           |
| Close Request Fail         | N/A   | Close Request Fail        | Off→On                | Device          | Close Cap Not Ok, Excess Actuator Current Draw, Duty Cycle Exceeded, Already Closed, Mechanically Locked, Lifetime Limit Reached |
| Limit Switch Fault         | Start | Limit Switch Fault        | 0→1                   | Device          | N/A                                                                                                                              |
|                            | End   | Limit Switch Fault        | 1→0                   | Device          | N/A                                                                                                                              |
| Temperature Sensor Fault   | N/A   | Temperature Sensor Fault  | N/A                   | Device          | N/A                                                                                                                              |

**Note:**

1. Ia will be changed to Ib or Ic if the "Phase" configuration setting is set to B or C respectively.

## 14.5 Appendix E – Audit Logs

| Event Title          | Monitor Type | Critical parameter                             |
|----------------------|--------------|------------------------------------------------|
| Login                | Event        |                                                |
| Manual Logout        | Event        |                                                |
| Timed Logout         | Event        |                                                |
| Configuration Access | Event        |                                                |
| Configuration Change | Event        |                                                |
| Firmware Change      | Event        | Version of the new firmware that was installed |

| Event Title           | Monitor Type | Critical parameter                                                                        |
|-----------------------|--------------|-------------------------------------------------------------------------------------------|
| Add User              | Event        | Identifier of the user that was added                                                     |
| Remove User           | Event        | Identifier of the user that was removed                                                   |
| Change Password       | Event        |                                                                                           |
| Update Roles          | Event        | Identifier of the user whose RBAC roles were updated                                      |
| Audit Log Access      | Event        |                                                                                           |
| Date/Time Changed     | Event        |                                                                                           |
| Reboot                | Alarm        | Power Supply, User Shutdown, Protection Stalled, Internal Error, Running firmware version |
| Unsuccessful Login    | Alarm        | Retry=N                                                                                   |
| Invalid Configuration | Alarm        |                                                                                           |
| Invalid Firmware      | Alarm        |                                                                                           |
| Factory Reset         | Event        |                                                                                           |
| Erase Event Logs      | Event        |                                                                                           |

## 14.6 Appendix F – Fault Profile

Fault profile traces are saved in COMTRADE-2013 format with the columns from the following table. Each 40-byte record contains the readings for a quarter-cycle during the trace.

| Column | Name        | Units | Type    | Description                                                     |
|--------|-------------|-------|---------|-----------------------------------------------------------------|
| 1      | Sample #    |       |         | Sample number                                                   |
| 2      | Timestamp   | μs    |         | Timestamp since the start of the trace                          |
| 3      | Ia          | A     | Analog  | RMS of the current                                              |
| 4      | IaHrm2nd    | A     | Analog  | RMS of the 2nd harmonic                                         |
| 5      | Freq        | Hz    | Analog  | Frequency                                                       |
| 6      | OIRM        |       | Analog  | Active multiplier for Inrush Restraint during the quarter cycle |
| 7      | Open        |       | Digital | 1 if the switch is open, 0 otherwise                            |
| 8      | Closed      |       | Digital | 1 if the switch is closed, 0 otherwise                          |
| 9      | Pickup      |       | Digital | 1 if any of OC1, OC3, ROCOC, UF, or OF are in pickup, or 0      |
| 10     | Alarm       |       | Digital | 1 if any of OC1, OC3, ROCOC, UF, or OF are alarmed, or 0        |
| 11     | P(OC1)      |       | Digital | 1 if OC1 is in pickup, 0 if not                                 |
| 12     | P(OC3)      |       | Digital | 1 if OC3 is in pickup, 0 if not                                 |
| 13     | P(ROCO)     |       | Digital | 1 if ROCOC is in pickup, 0 if not                               |
| 14     | P(UF)       |       | Digital | 1 if UF is in pickup, 0 if not                                  |
| 15     | P(OF)       |       | Digital | 1 if OF is in pickup, 0 if not                                  |
| 16     | P(LSD)      |       | Digital | 1 if LSD conditions are present, 0 if not                       |
| 17     | P(HIB)      |       | Digital | 1 if Harmonic Inrush Blocking (HIB) is in effect, 0 if not      |
| 18     | Reset(OC1)  |       | Digital | 1 if OC1 is reset, 0 if not                                     |
| 19     | Reset(OC3)  |       | Digital | 1 if OC3 is reset, 0 if not                                     |
| 20     | Reset(ROCO) |       | Digital | 1 if ROCOC is reset, 0 if not                                   |
| 21     | Reset(UF)   |       | Digital | 1 if UF is reset, 0 if not                                      |
| 22     | Reset(OF)   |       | Digital | 1 if OF is reset, 0 if not                                      |
| 23     | A(OC1)      |       | Digital | 1 if OC1 is alarmed, 0 if not                                   |
| 24     | A(OC3)      |       | Digital | 1 if OC3 is alarmed, 0 if not                                   |
| 25     | A(ROCO)     |       | Digital | 1 if ROCOC is alarmed, 0 if not                                 |
| 26     | A(UF)       |       | Digital | 1 if UF is alarmed, 0 if not                                    |
| 27     | A(OF)       |       | Digital | 1 if OF is alarmed, 0 if not                                    |
| 28     | Open(OC1)   |       | Digital | 1 if the switch was opened due to OC1, 0 if not                 |
| 29     | Open(OC3)   |       | Digital | 1 if the switch was opened due to OC3, 0 if not                 |
| 30     | Open(ROCO)  |       | Digital | 1 if the switch was opened due to ROCOC, 0 if not               |
| 31     | Open(UF)    |       | Digital | 1 if the switch was opened due to UF, 0 if not                  |
| 32     | Open(OF)    |       | Digital | 1 if the switch was opened due to OF, 0 if not                  |

Each fault profile trace will also record the following in the COMTRADE file header:

- Serial number of the device that the trace occurred on.
- Time that the trace started, which may be relative to the last power restart.
- Time of the Trip event that triggered the trace, which may be relative to the last power restart.

A(X) and Open(X) digitals will reset to 0 in accordance with the “Reset Fault Flags on Close” and “Alarm Latch Mode” settings, or if the FPI is reset via the EcoLink® Manager during the trace.

## 14.7 Wireless Communications Compatibility Statements

FCC ID: 2BPOM-NOJA-ECL501

IC: 34018-NOJAECL501

### United States of America – FCC (Federal Communication Commission)

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

### RF Exposure Compliance

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines. To ensure compliance, this equipment should be installed and operated with a minimum distance of 20 cm between the radiator and any person's body.

### Canada – ISED (Innovation, Science & Economic Development Canada)

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference.
2. This device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil contient des émetteurs/récepteurs exempts de licence conformes aux normes CNR d'Innovation, Sciences et Développement économique Canada. Son utilisation est soumise aux deux conditions suivantes:

1. Cet appareil ne doit pas causer d'interférences.
2. Cet appareil doit tolérer toute interférence, y compris celles pouvant entraîner un fonctionnement indésirable.

CAN ICES-003(B) / NMB-003(B)

### ISED RF Exposure Compliance

This equipment complies with ISED RSS-102 for radio frequency (RF) exposure. To ensure compliance with RF exposure limits, a minimum separation distance of 20 cm must be maintained between the device and any person during operation.

### Conformité à l'exposition aux RF

Cet équipement est conforme à la norme RSS-102 d'ISED concernant l'exposition aux radiofréquences (RF). Pour garantir la conformité aux limites d'exposition aux RF, une distance minimale de 20 cm doit être maintenue entre l'appareil et toute personne pendant son fonctionnement.

MODIFICATION: Any changes or modifications not expressly approved by NOJA Power Switchgear Pty Ltd could void the user's authority to operate the equipment.

# 15 Index

## A

|                        |        |
|------------------------|--------|
| Accuracy               |        |
| Measurement.....       | 4      |
| Protection.....        | 4      |
| Alarm Latching .....   | 21     |
| Alerts.....            | 23     |
| Altitude .....         | 3      |
| Audit Logs.....        | 28, 42 |
| Auto Reclose           |        |
| Phase Overcurrent..... | 18     |

## C

|                                    |    |
|------------------------------------|----|
| Circuit Breaker Failure (CBF)..... | 22 |
| Configuration .....                | 27 |
| Counters .....                     | 24 |
| Curve Modifiers .....              | 17 |

## D

|               |   |
|---------------|---|
| Dimensions    |   |
| EcoLink ..... | 3 |

## E

|                                    |        |
|------------------------------------|--------|
| Electromagnetic Compatibility..... | 5      |
| Event Log.....                     | 23, 41 |
| Malfunction Events.....            | 42     |
| Protection Events .....            | 41     |
| Status Events.....                 | 41     |
| Warning Events.....                | 42     |

## F

|                               |        |
|-------------------------------|--------|
| Factory Reset.....            | 34     |
| Fault Finding .....           | 33     |
| Malfunction Signals .....     | 33     |
| Warning Signals.....          | 33     |
| Fault Flags.....              | 24     |
| Fault Passage Indication..... | 21     |
| Fault Profile.....            | 21, 43 |
| Fault Targets .....           | 24     |
| Reset Methods.....            | 25     |
| Firmware Update.....          | 31     |

## H

|                |   |
|----------------|---|
| Humidity ..... | 3 |
|----------------|---|

## I

|                         |    |
|-------------------------|----|
| Indication Signals..... | 40 |
| Inrush Restraint .....  | 17 |
| Installation.....       | 32 |

## L

|                                |    |
|--------------------------------|----|
| Logs.....                      | 23 |
| Loss of Supply Detection ..... | 22 |

## M

|                               |    |
|-------------------------------|----|
| Malfunction Signals.....      | 33 |
| Malfunctions & Warnings ..... | 23 |
| Measurement .....             | 14 |
| Monitoring.....               | 23 |
| Counters .....                | 24 |
| Event Log.....                | 23 |

## O

|                      |    |
|----------------------|----|
| Over Frequency ..... | 19 |
|----------------------|----|

## P

|                       |    |
|-----------------------|----|
| Protection.....       | 15 |
| Current (OC) .....    | 15 |
| Frequency.....        | 19 |
| Over Frequency .....  | 19 |
| Under Frequency ..... | 19 |

## R

|                                 |    |
|---------------------------------|----|
| Rate Of Change Of Current ..... | 20 |
|---------------------------------|----|

## S

|                             |    |
|-----------------------------|----|
| Sectionalising .....        | 18 |
| Security.....               | 28 |
| Settings                    |    |
| Alarm Latching .....        | 21 |
| Inrush Restraint .....      | 18 |
| Over Frequency .....        | 19 |
| Overcurrent .....           | 15 |
| Reclose Sequence .....      | 18 |
| Under Frequency .....       | 19 |
| Specifications              |    |
| EcoLink.....                | 3  |
| System Administration ..... | 31 |

## T

|                                              |    |
|----------------------------------------------|----|
| Temperature.....                             | 3  |
| Temperature Dependent Reclosing Control..... | 20 |
| Time Current Characteristic (TCC) Curves     |    |
| Additional TCC .....                         | 36 |
| ANSI .....                                   | 35 |
| IEC .....                                    | 35 |

## U

|                       |    |
|-----------------------|----|
| Under Frequency ..... | 19 |
|-----------------------|----|

## W

|                       |    |
|-----------------------|----|
| Warning Signals ..... | 33 |
|-----------------------|----|

## **Referenced Standards and Documents**

- AS 1931.1 IEC 60060-1: Amendment 1: High-voltage test techniques - Part 1: General definitions and test requirements
- AS 1931.2 IEC 60060-2: High-voltage test techniques - Part 2: Measuring systems
- AS 2067: Substations and high voltage installations exceeding 1 kV a.c.
- AS 62271.1 IEC 62271-1: High-voltage switchgear and controlgear - Part 1: Common specifications
- AS 4436 IEC 60815-1: Guide to selection of insulators in respect to polluted conditions
- AS 60044.1 IEC 60044-1: Instrument transformers – Current transformers
- AS 60137 IEC 60137: Insulated bushings for alternating voltages above 1000 V
- AS 62271.100 IEC 62271-100: High-voltage switchgear and controlgear – Part 100: Alternating current circuit-breakers AS 60044.1 IEC 60044-1: Instrument transformers – Current transformers
- AS 62271.110 IEC 62271-110: High-voltage switchgear and controlgear – Part 110: Inductive load switching
- AS 62271.301 IEC 62271-301: High-voltage switchgear and controlgear - Part 301: Dimensional standardization of high-voltage terminals
- IEC 62271-302: High-voltage switchgear and controlgear - Part 302: Alternating current circuit-breakers with intentionally non-simultaneous pole operation
- AS 60270 IEC 60270: High-voltage test techniques - Partial discharge measurements
- IEC 61869-5: Additional requirements for capacitor voltage transformers
- IEC 60815: Selection and dimensioning of high-voltage insulators for polluted conditions.
- ENA TS 41-36: Distribution Switchgear for Service up to 36kV (Cable and Overhead conductor Connected)
- ANSI C37.60 IEC 62271-111: Standard requirements for overhead, pad-mounted, dry vault and submersible Automatic Circuit Reclosers and Fault Interrupters for AC systems up to 38kV
- ENA TS 98-1: Guidelines for Coatings
- IEEE Std 1686-2022: Standard for Intelligent Electronic Devices Cyber Security Capabilities
- IEEE C37.41: Medium Voltage Fuses

# NOJA POWER®

## NOJA Power Australia Corporate Office & Factory

NOJA Power Switchgear Pty Ltd  
16 Archimedes Place, Murarrie  
Brisbane Qld 4172  
Australia

Phone: +61 (7) 3907 8777  
Email: [sales@nojapower.com.au](mailto:sales@nojapower.com.au)  
Web: [www.nojapower.com.au](http://www.nojapower.com.au)

## NOJA Power BRAZIL Office & Factory

NOJA Power do Brasil Ltda  
Avenida Pierre Simon de Laplace,  
965A Techno Park, Campinas, SP  
Brasil

Phone: +55 (19) 3283 0041  
Email: [vendas@nojapower.com.br](mailto:vendas@nojapower.com.br)  
Web: [www.nojapower.com.br](http://www.nojapower.com.br)

## NOJA Power UK Sales Office

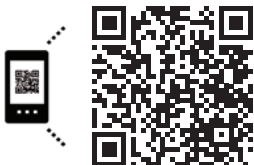
NOJA Power Ltd  
John Eccles House  
Robert Robinson Ave, Littlemore,  
Oxford, OX4 4GP  
England

Email: [sales@nojapower.co.uk](mailto:sales@nojapower.co.uk)  
Web: [www.nojapower.co.uk](http://www.nojapower.co.uk)

## NOJA Power USA Sales Office

NOJA Power LLC  
7300 State Highway 121, Suite 307  
McKinney TX 75070  
United States of America

Mobile: +1 850 890 6724  
Email: [sales@nojapower.com](mailto:sales@nojapower.com)  
Web: [www.nojapower.com](http://www.nojapower.com)



Scan to learn more

Distributor: