EUROPROT+

# METRA2 Automatic Bus Transfer Configuration Description


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User's manual version information

| Version | Date | Modification | Compiled by |
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| 1.0 | 2017-12-01 | First edition based on the former EP version | Erdős |
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CONTENTS

# 1 Introduction

The METRA factory configuration produced by PROTECTA Electronics Co. Ltd. is assembled to perform automatic transfer between an operating and a reserve power transformer, supplying a busbar. The transfer is triggered by trip signals of the operating transformer, received from other protective devices.

The automatic transfer assures that the reserve power supply will not be switched on a fault. To perform this requirement the function checks if the circuit breaker of the faulty transformer is in OFF position, then the close command can be generated to the circuit breaker of the reserve power supply. Closing the circuit breaker is effective only if the reserve transformer is energized from the primary side. Before generating the close command, this status is checked as well. As a consequence the transfer is performed with a short dead-time. During this time no power is supplied to the busbar. The device can be implemented in substations, where there is a high requirement to minimize the breakdown time due to the loss of power supply.

# 2 Substation schemes

The configuration is built in a way that it can adapt to several kinds of busbar systems with minimal changes:

- Single HV busbar, single MV busbar with sectionalizer
- Double HV busbar, single MV busbar with sectionalizer
- Single HV busbar, double MV busbar with sectionalizer
- Double HV busbar, double MV busbar with sectionalizer

By default it deals with a single busbar on both side and a sectionalizer on the MV side (see the example in *Chapter 6*). Other types of schemes may also be built by using the EuroCAP software.

## 2.1 Permitted states of the substation

Based on the circuit breaker and disconnector positions indicated by status signals, the states of the substation are recognized by the device. The permitted states are programmed according to the user's requirements (see an example in *Chapter 6*) In a permitted state a trigger impulse initiates the transfer: the circuit breaker of the faulty transformer is disconnected, and the circuit breaker of the pre-defined reserve power supply is closed. The reserve power supply can be a reserve transformer or a bus coupler of the busbar configuration.

The scheme picture of the graphic LCD indicates the actual positions (including intermediate/bad statuses) of the switchgear.

## 2.2 Not permitted states

The device detects incongruous states of the substation, when neither of the pre-defined states can be recognized based on the status signals of the switchgear. In this case the transfer function gets disabled until a permitted state is achieved.

## 2.3 Switchgear status signals

Errors in the status signals result also in disabling the transfer function. Time delay can be set for each circuit breaker and disconnector to indicate status error.

During the transfer procedure the function preserves the starting state (duration is settable by timer parameter) of the substation to avoid contradictory operating commands. (It is possible, that e.g. the circuit breaker of the faulty transformer is disconnected by the corresponding protection device before triggering the transfer procedure; without storing the starting state this would disable the transfer function.)

During the transfer procedure the function does not check the changing state of the substation.

# 3 Operating states of the transfer function

## 3.1 Enabled/disabled

There are two ways where the function gets disabled. First is done automatically every time when the substation is in a not permitted state (see Chapter 2.2).

Other way is to manually disable the function via a command from the SCADA system or from the device HMI (local or remote). In this case the disabling persists until the user enables the function again.

## 3.2 Blocked

Successful triggering (*see Chapter 14* below) also starts a timer (set by the Transfer Max. Time parameter) during which the transfer should be made. After expiry the transfer function gets in blocked state regardless of the outcome.

To leave this blocked operating state the a reset signal must be received (via local or remote HMI command)

# 4 Triggering signals

If the function is enabled (see *Chapter 3.1*), the triggering will cause the breakers of the initial source transformer to trip immediately.

Dedicated binary input signals start the transfer function; these signals are operated by other protection devices in the substation.

| | |
|---|---|
| TR1 Fault | Trip from the protection of transformer TR1 (e.g. differential) |
| TR1 Bus Failure | Bus protection trip on the secondary side bus of TR1 (e.g. breaker failure signal) |
| TR1 Foreign Bus* Failure | Bus protection trip on the secondary side bus of TR2 (e.g. breaker failure signal) |
| TR2 Fault | Trip from the protection of transformer TR2 (e.g. differential) |
| TR2 Bus Failure | Bus protection trip on the secondary side bus of TR2 (e.g. breaker failure signal) |
| TR2 Foreign Bus* Failure | Bus protection trip on the secondary side bus of TR1 (e.g. breaker failure signal) |
| (…) | (other start signals according to the requirements) |

*Foreign bus: part of the MV bus that is on the other side of the sectionalizer

*Table* 4-1 *Triggering signals of the transfer function*

# 5 Technical summary

## 5.1 Technical data

The times below are showing the times that depend only on the METRA device.

The actual transfer time depends on the switching times of and durations of the intermediate statuses of the circuit breakers which will add to these values.

| Function | Value | Accuracy |
|---|---|---|
| Switch-off time* | 25 ms | ±10 ms depending on the logic |
| Switch-on to backup | 25 ms | ±10 ms depending on the logic |

*if the CB of the transformer has not tripped already by its protection device and the trip is to be given by the METRA device

*Table* 5-1 *Technical data of the transfer function*

## 5.2 Parameters

There are several parameters that have influence on the behavior of the function. The following table is an example for the simplest solution (see the example in *Chapter 6*); **its content mainly depends** on the actual substation and the other requirements of the user, the modifications are made via the EuroCAP software.

| Parameter Title | Unit | Min | Max | Step | Default |
|---|---|---|---|---|---|
| HV Busbar is double busbar (LCD scheme has to be changed accordingly) | | | | | |
| HV Double Bus | - | FALSE | TRUE | - | FALSE |
| MV Busbar is double busbar (LCD scheme has to be changed accordingly) | | | | | |
| MV Double Bus | - | FALSE | TRUE | - | FALSE |
| There is a second disconnector present in the sectionalizer. | | | | | |
| 2. Sect. DC | - | FALSE | TRUE | - | FALSE |
| If there is a failure on the MV bus and the transfer is triggered because of this, the faulty bus will be also disconnected (sect. CB trip) along with the transformer. The remaining (healthy) side of the bus will still be switched on to the backup source. | | | | | |
| Half Bus Rescue | - | FALSE | TRUE | - | FALSE |
| Maximum waiting time for issuing a close command to the backup MV CB. After this time the function gets into Blocked state. It is advised to set this timer above the maximum expected duration of a transfer operation. | | | | | |
| Transfer Max. Time | msec | 100 | 2000 | 10 | 500 |
| The function remembers the last operating state for this interval. | | | | | |
| Oper. State Holding Time | msec | 100 | 2000 | 10 | 500 |
| Delay of issuing the close command to the MV CB of the backup source | | | | | |
| MV Close Delay | msec | 1 | 1000 | 1 | 10 |
| Length of the impulse of the open and close commands | | | | | |
| Open-Close Pulse Time | msec | 100 | 1000 | 10 | 200 |

*Table* 5-2 *Parameters for the transfer function*

## 5.3 The binary output signals

The following table is an example for the simplest solution (see the example in *Chapter 6*); **its content mainly depends** on the actual substation and the other requirements of the user, the modifications are made via the EuroCAP software.

| **Binary output signal title** | **Explanation** |
|---|---|
| Disabled | Status signal: the function is disabled by the user |
| Blocked | Status signal: the function is in blocked state (e.g. after an operation) |
| Not permitted state | Status signal: the substation switchgear is in a state where the transfer function is not allowed to run. |
| State error | Status signal: there is at least one part of the switchgear which has state error (no opened/closed signal or both signals are active) |
| Operated | Status signal: the function was triggered in a permitted state. Note that this means only a valid start, not a successful transfer. |
| (…) | (other signals according to the requirements) |
| TR1 HV CB Open<br>TR1 HV CB Close | Open/Close command to the circuit breaker on the HV side of transformer TR1 |
| TR1 MV CB Open<br>TR1 MV CB Close | Open/Close command to the circuit breaker on the MV side of transformer TR1 |
| TR2 HV CB Open<br>TR2 HV CB Close | Open/Close command to the circuit breaker on the HV side of transformer TR2 |
| TR2 MV CB Open<br>TR2 MV CB Close | Open/Close command to the circuit breaker on the MV side of transformer TR2 |
| Sect. CB Open<br>Sect. CB Close | Open/Close command to the circuit breaker of the sectionalizer |
| (…) | (other switchgear status signals according to the substation) |

*Table* 5-3 *The binary output signals of the transfer function*

## 5.4 The binary input signals

Input signals from the optical inputs consist of the switchgear status signals and the triggering signal(s). The following table is an example for the simplest solution (see the example in *Chapter 6*); **its content mainly depends on the actual substation** and the other requirements of the user, the modifications are made via the EuroCAP software.

| Binary input signal title | Explanation |
|---|---|
| TR1 HV DC Opened<br>TR1 HV DC Closed | Opened/Closed status signals of the disconnector on the HV side of transformer TR1 |
| TR1 HV CB Opened<br>TR1 HV CB Closed | Opened/Closed status signals of the circuit breaker on the HV side of transformer TR1 |
| TR1 MV DC Opened<br>TR1 MV DC Closed | Opened/Closed status signals of the disconnector on the MV side of transformer TR1 |
| TR1 MV CB Opened<br>TR1 MV CB Closed | Opened/Closed status signals of the circuit breaker on the MV side of transformer TR1 |
| TR2 HV DC Opened<br>TR2 HV DC Closed | Opened/Closed status signals of the disconnector on the HV side of transformer TR2 |
| TR2 HV CB Opened<br>TR2 HV CB Closed | Opened/Closed status signals of the circuit breaker on the HV side of transformer TR2 |
| TR2 MV DC Opened<br>TR2 MV DC Closed | Opened/Closed status signals of the disconnector on the MV side of transformer TR2 |
| TR2 MV CB Opened<br>TR2 MV CB Closed | Opened/Closed status signals of the circuit breaker on the MV side of transformer TR2 |
| Sect. DC1 Opened<br>Sect. DC1 Closed | Opened/Closed status signals of the disconnector of the sectionalizer on the side of TR1 |
| Sect. DC2 Opened<br>Sect. DC2 Closed | Opened/Closed status signals of the disconnector of the sectionalizer on the side of TR2 |
| Sect. CB Opened<br>Sect. CB Closed | Opened/Closed status signals of the CB of the sectionalizer |
| (…) | (other status signals according to the substation) |
| TR1 Fault | Trip from the protection of transformer TR1 (e.g. differential) |
| TR1 Bus Failure | Bus protection trip on the secondary side bus of TR1 (e.g. breaker failure signal) |
| TR1 Foreign Bus* Failure | Bus protection trip on the secondary side bus of TR2 (e.g. breaker failure signal) |
| TR2 Fault | Trip from the protection of transformer TR2 (e.g. differential) |
| TR2 Bus Failure | Bus protection trip on the secondary side bus of TR2 (e.g. breaker failure signal) |
| TR2 Foreign Bus* Failure | Bus protection trip on the secondary side bus of TR1 (e.g. breaker failure signal) |
| (…) | (other start signals according to the requirements) |

*Foreign bus: part of the MV bus that is on the other side of the sectionalizer

*Table* 5-4 *The binary input signals of the transfer function*

# 6 Example

The following example shows what the function does in a typical situation when there is a fault in transformer TR1 and a transfer is requested.

## 6.1 Starting conditions

Initially the substation is in a permitted state and the function is not disabled.

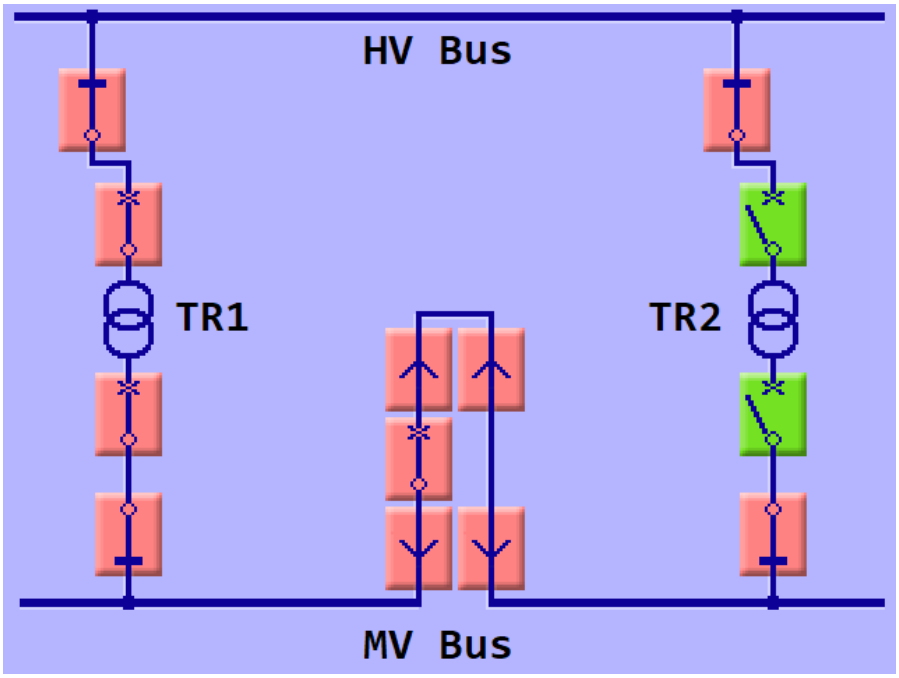


*Figure* 6-1 *Switchgear before the transfer (a permitted state)*

## 6.2 Triggering the function

The differential protection will trip both CBs of TR1 and a signal is sent to the METRA device to start the transfer of the MV Bus to TR2. Because the function remembers the previous permitted state, the transfer operation will start.

With this trigger the METRA device gives a close command to the CB on the HV side of TR2.

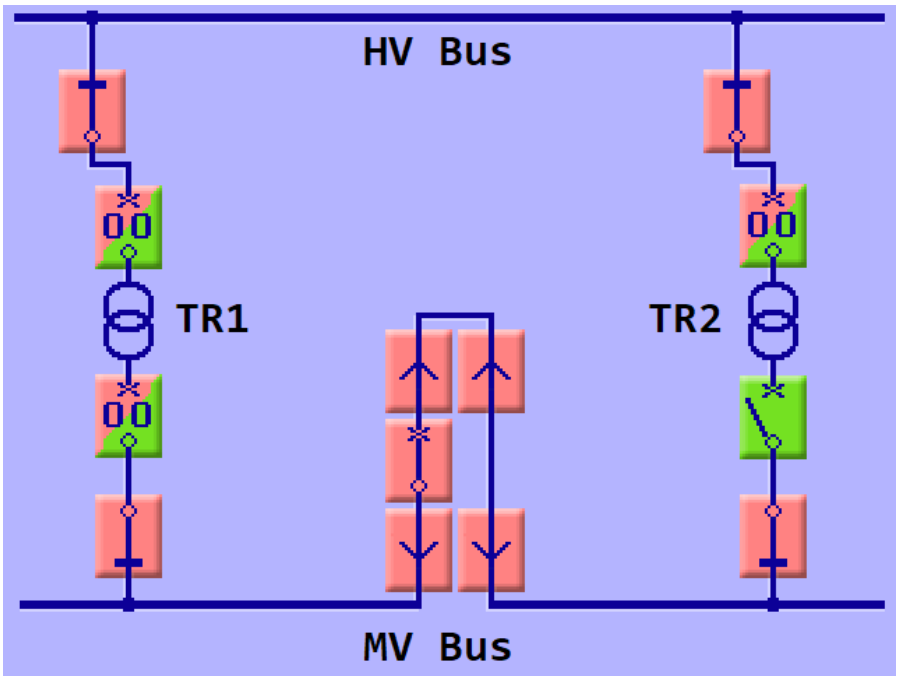


*Figure* 6-2 *Switchgear during the start of the transfer operation*

## 6.3 Switching to the other source

The function waits until the statuses of the CBs are cleared: CB on the HV side of TR2 is closed, CB on the MV side of TR1 is opened. After this it issues close command to the MV CB of TR2.

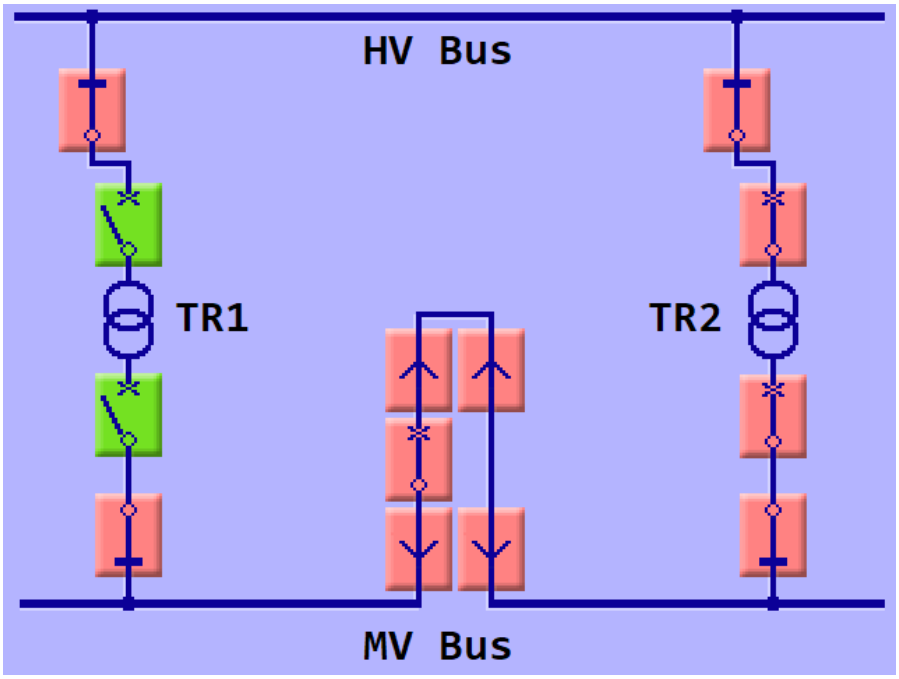


*Figure* 6-3 *Switchgear after the transfer*