

EPSY Earthfault Protection System



TRENCH

Introduction

EPSY (Earthfault Protection System) is the comprehensive earth fault protection system from Trench Austria, designed specifically for compensated networks. Compared with other methods of power system earthing, earth fault compensation offers major advantages for the safety of personnel, the security of supply and the reduction in consequential damage during earth faults.

However, compared to alternative earthing methods, earth fault compensation demands the highest requirements on the capability and reliability of the protection devices for detecting and locating earth faults. These standards are met by Trench Austria's EPSY system.

On the other hand, devices and systems of traditional earth fault protection engineering can not meet these stringent requirements.

The protection system EPSY consists of:

- an **arc suppression coil** (ASC, continuously adjustable type),
- an **automatic compensation controller** and
- an **earth fault detection device** (selective, highly sensitive type).

The enhanced approach for the selective detection of high-impedance earth faults, which is integrated in the EFD20 device, offers reliable detection

of earth faults for the operators of medium-voltage networks. It performs for both high and low impedance faults to earth, including difficult intermittent faults where frequent restrikes occur.

The electronic components of EPSY and their configuration possibilities are summarised in the following pages.

Earthfault Compensation Controller EFC20 / EFC20i



Fig.1 Earthfault Compensation Controller EFC20

The Earthfault Compensation Controller EFC20 determines the resonance point by marginally moving the ASC.

- For details see EFC20/EFC20i brochure.



Fig. 2 Earthfault Compensation Controller EFC20i with 19"-rack mounted Current Injection Device ECI

The Earthfault Compensation Controller EFC20i uses a current injection into the zero-sequence system for determination of the resonance point. Therefore a detuning of the Arc Suppression Coil is no longer necessary for the calculation procedure.

- The operation mode EFC20i requires the installation of the current injection device ECI (see also page 10).
- For details see EFC20/EFC20i brochure.

Earthfault Detection Device EFD20 / EFD20c

Fundamental aspects of detecting the faulty feeder

When an earth fault occurs in a compensated network, the immediate problem faced by the utility is how to reliably detect which feeder is the faulty one. It is well known that traditional earth fault relays cannot reliably locate the faulty feeder for both high and low impedance faults. There are fundamental reasons for this, which include the instrument transformer errors, the small zero-sequence currents involved, but most of all because they measure signals from only the one feeder to which they are connected. Taking a new and wider approach, the signals that are readily available for earth fault measurement in a substation are the neutral-to-ground voltage (V_0) and the zero-sequence currents ($I_{01} \dots I_{0n}$) of all those feeders that are supplied by the busbar. To detect which feeder is faulty, the amplitude of the zero-sequence current cannot be used as the only criterion. It is essential to evaluate the phase position of each zero-sequence current with respect to the neutral-to-ground voltage or to evaluate an additionally resulting term (e.g. feeder admittance).

Earthfault Detection System EFD20

The core of the electronic part of EPSY is the earthfault detection device EFD20. This is available as a separate earth fault detection device and also as part of the combined control and detection unit (EFD20c). The new system family EFD20 is based on its successful predecessor EFD10/40, which fulfils the highest requirements in the selective detection of earth faults. This detection system is patented by Trench Austria. In the EFD20 family, the neutral-to-ground voltage and the zero-sequence currents are vectorially measured and combined in a central unit for their further processing. The natural asymmetry (zero-sequence admittance) and the line-to-earth capacitance of each individual feeder are determined while the power system is healthy. This is best achieved by injecting a defined current into the power auxiliary winding of the Arc Suppression Coil.

The neutral-to-ground voltage (V_0) and the zero-sequence current (I_0) of each feeder are monitored all the time. The feeder indicating the greatest fault asymmetry is recognised and signalled as the faulty one. The combination of the admittance method with additional algorithms implemented in the EFD20 offers reliable and selective earthfault detection of low and high impedance earth faults up to a few ten-thousands of Ohms. The EFD has also been proven in the field to reliably detect intermittent earth faults, that is where frequent restrikes occur. In conclusion, the new EFD20 family sets high standards that can not be achieved with traditional earth fault protection techniques.

Device concept EFD20 / EFD20c

Hardware

- microprocessor based device 19"-rack mounted (6U)
- easy operation by means of a scroll wheel and **function keys**
- extended operation via PC by means of a **terminal program**
- **flexible hardware configuration**

- **LED indication** of status and control signals
- serial interfaces
- **analogue output module**
0 ... 20 mA output for external indication of several measurement signals
- prepared for easy upgrade to the compact device EFD20c with additional control function for an arc suppression coil

Hardware Options

- housing
- cover strips for panel installation
- alternative power supply
- extension of the number of digital I/O by means of the expansion unit **EFX20**

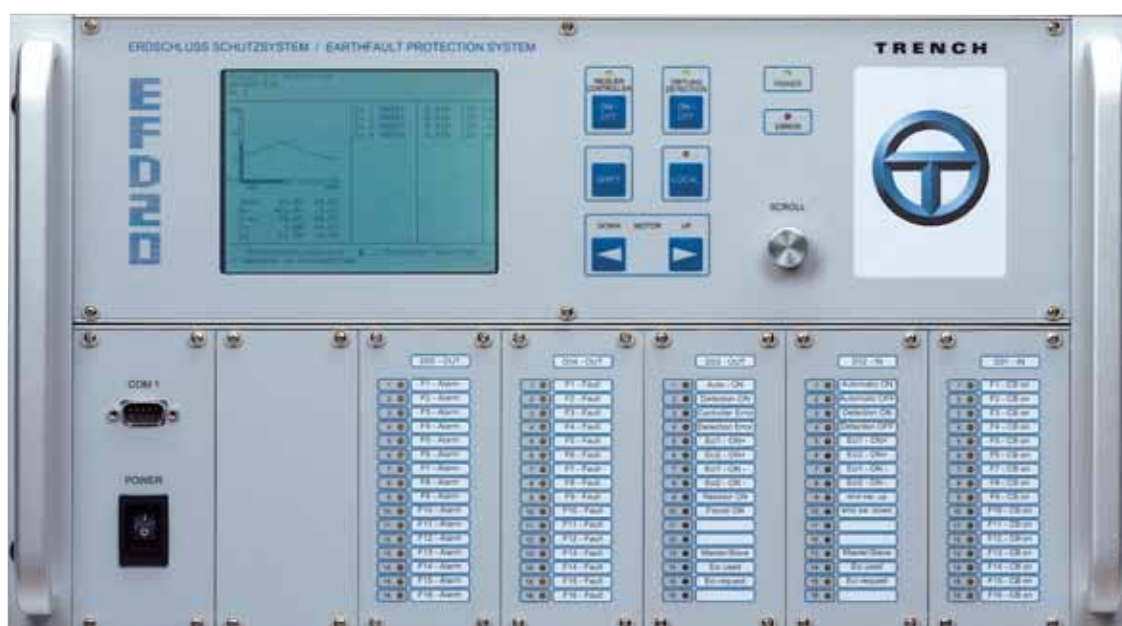


Fig. 3 Compact Device EFD20c (control & detection)

Operating

- **easy operating** by means of
 - integrated display
 - scroll wheel
 - clearly arranged function keys
- **clear menu guide** with „help“ – text
- separated display for control and detection mode
- **automatic, adaptive menu** according to activated software options
- terminal program **EFDTerm** for Windows for parameter setting and on-site operating
- **remote control** by means of a modem



Fig. 4 Operating panel of compact device EFD20c

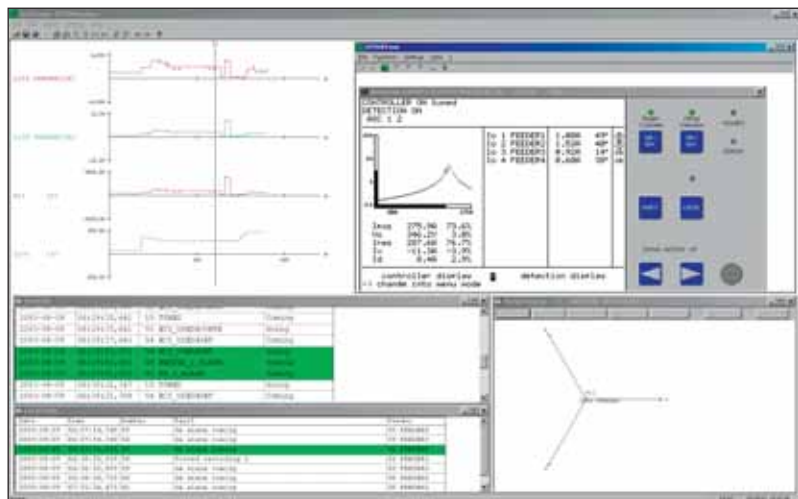


Fig. 5 EFDTerm

Software

- **easy upgrade** from detection device EFD20 to the compact device EFD20c
- **high flexibility** in parameter settings due to the implemented PLC-functionality
- indication of operating status via **text messages**
- **measurement buffer** for recording of various network incidents
- remote parameter changes by means of a PC connected via modem to the serial interface
- **3 menu access levels** for different users
- **software-update** via serial interface

Software Options

- **automatic reclosing unit**
short-time disconnection of faulty feeders for self-healing of earth faults
- **fault location**
determination of fault location in case of an earth fault
- **SCADA**
SPABus or IEC60870-5-101/103/104
- software options for the earth fault compensation control function in the compact device EFD20c see EFC20/EFC20i brochure

Technical Data EFD20 / EFD20c

	Basic device		Expansion unit
	EFD20	EFD20c	EFX20
Hardware			
operation 24 line display, 53 symbols per line, 6 keys, scroll wheel	x	x	-
serial interface for SCADA, PC or modem: RS 232 Ethernet (LAN)/CAN-BUS	4 1/1	4 1/1	1 - /1
analogue voltage inputs 0 ... 110 V AC 50 Hz rated burden < 0,5 VA	4	4	-
analogue current inputs for zero-sequence current measurement / current injection 0 ... 5 A AC; rated burden < 0,2 VA	8 ... 32 ^{1,2}	8 ... 32 ^{1,2}	-
analogue outputs for Vo, coil position, fault location 0 ... 20 mA, software programmable	(2)*	2	-
coil position indication by linear potentiometer 0 ... 200 ohm / 0 ... 2000 ohm or by 0 ... 20 mA input signal	-	1	-
digital inputs potential free contacts, 24 ... 230 V AC/DC	16 ... 112 ³	16 ... 112 ³	16 ... 144 ³
digital outputs potential free contacts, 230 V AC/DC, max 5 A continuous max contact current closing rating 1000 VA max contact interrupting rating 30 VA	16 ... 112 ³	16 ... 112 ³	16 ... 144 ³
auxiliary voltage 230 V AC/DC 110 V DC (other voltages upon request)	x (x)*	x (x)*	x (x)*

¹ current inputs allocatable via menu for zero sequence current measurement resp. for current injection (max. 3 pcs.)

² in steps of 4 available (8, 12, 16, ... 32)

³ depending on the system configuration; in steps of 16

*optional

	Basic device		Software options	
	EFD20	EFD20c	EFD20	EFD20c
Software				
detection of low- and high-impedance earth faults	x	x		
automatic earth fault compensation control of stepless adjustable plunger core coils		x		
terminal program EFDTerm for Windows	x	x		
automatic adaptive menu	x	x		
non-volatile measurement buffer	x	x		
3 menu access levels for users	x	x		
software-update via serial interface	x	x		
implemented PLC-functionality	x	x		
fault location at loop configuration			x	x
automatic reclosing unit			x	x
SCADA			x	x
predefined coil position ¹				x
automatic resistor control ¹				x
fix coil control ¹				x
ideal compensation ($v=0$) ¹ during earth fault condition				x
automatic switching if V_0 exceeds V_{max} ¹				x

Mechanical data	
dimensions	width 483.0 mm height 266.0 mm depth 350.0 mm
weight	approx. 13 kg
temperatures	operating 0°C ... +40°C storage -25°C ... +55°C transport -25°C ... +70°C
humidity	class G acc. to DIN 40040
protection class	IP20

¹ for details see EFC20/EFC20i brochure

Current Injection Device ECI

The Current Injection Device ECI is used to produce differential measurement values by means of the current injection into the zero-sequence system. This approach is used by both the Earthfault Compensation Controller EFC20i and the Earthfault Detection Device EFD20.

The current injection into the zero-sequence system is usually done via a suitable power auxiliary winding of the arc suppression coil. The Current Injection Device ECI essentially consists of a transformer, capacitors for current limiting, relays, control- and signal contacts.

Following designs are available:

- cubicle for indoor or outdoor design
- mounting plate for installation in an existing cubicle
- 19"-rack mounted (3U)



Fig. 6 ECI in conventional design (indoor design, outdoor design and design on mounting plate available)



Fig. 7 ECI 19"-rack mounted

Examples for System Configurations

Single-busbar configuration

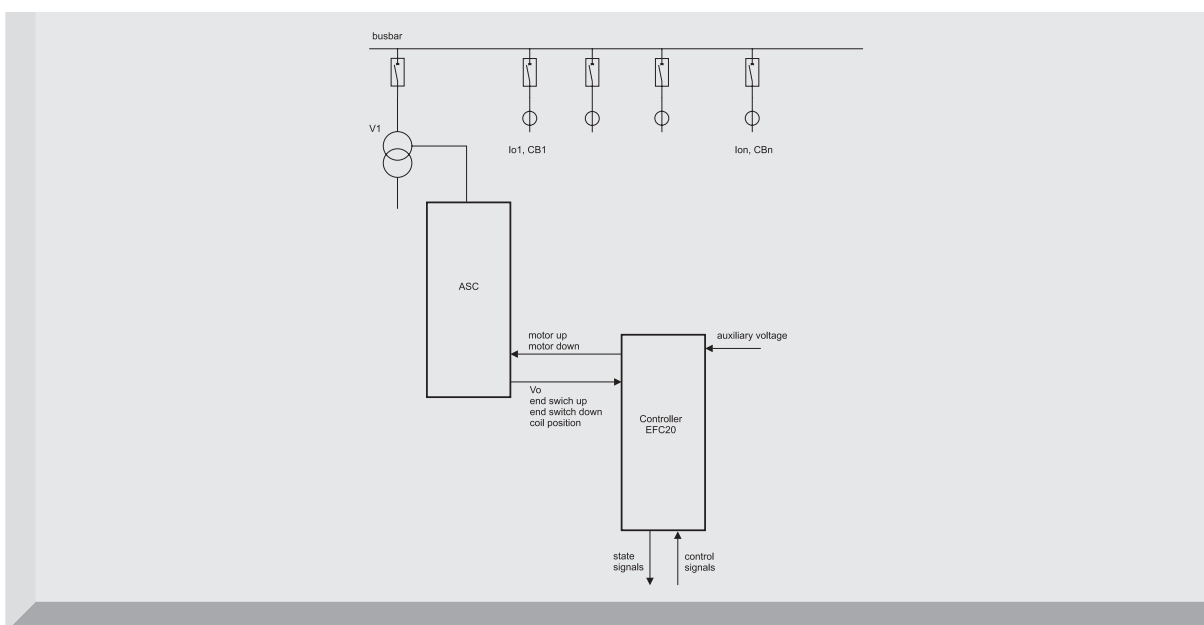


Fig. 8 EFC20 at single-busbar configuration

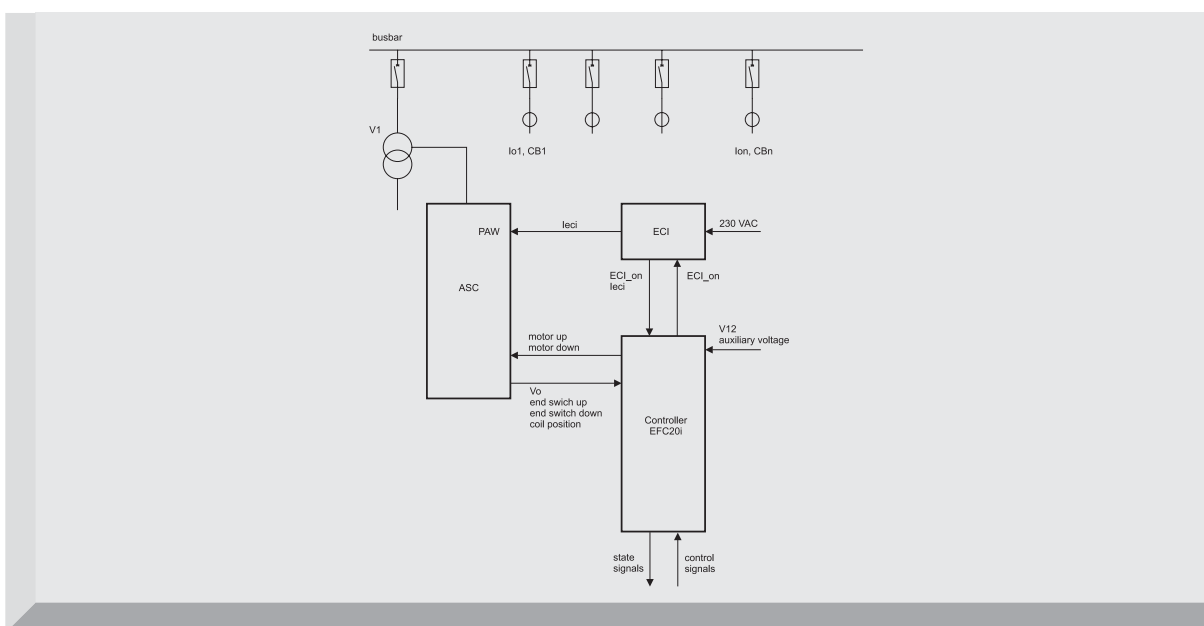


Fig. 9 EFC20i at single-busbar configuration

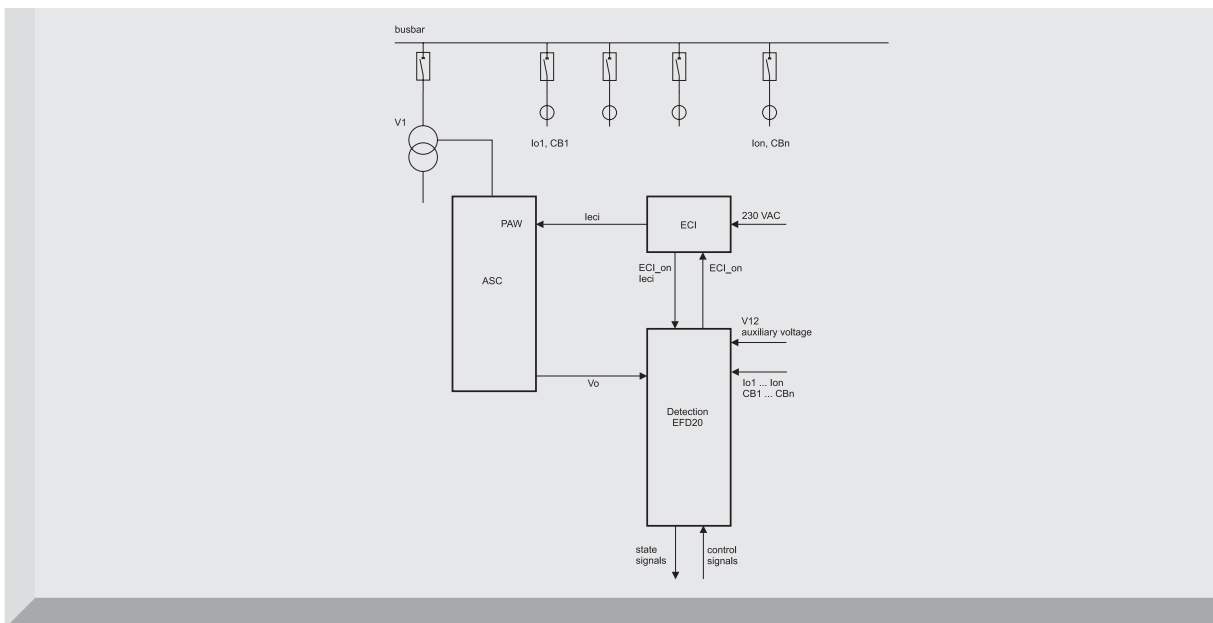


Fig. 10 EFD20 at single-busbar configuration

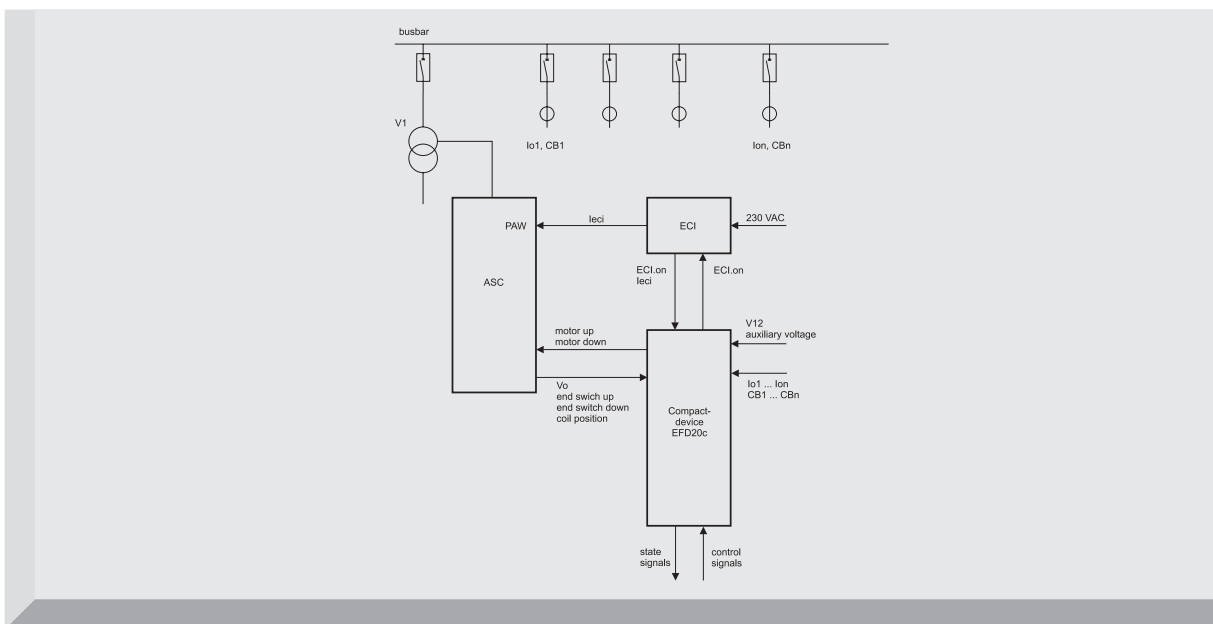


Fig. 11 Control and detection EFD20c at single-busbar configuration

Double-busbar configuration

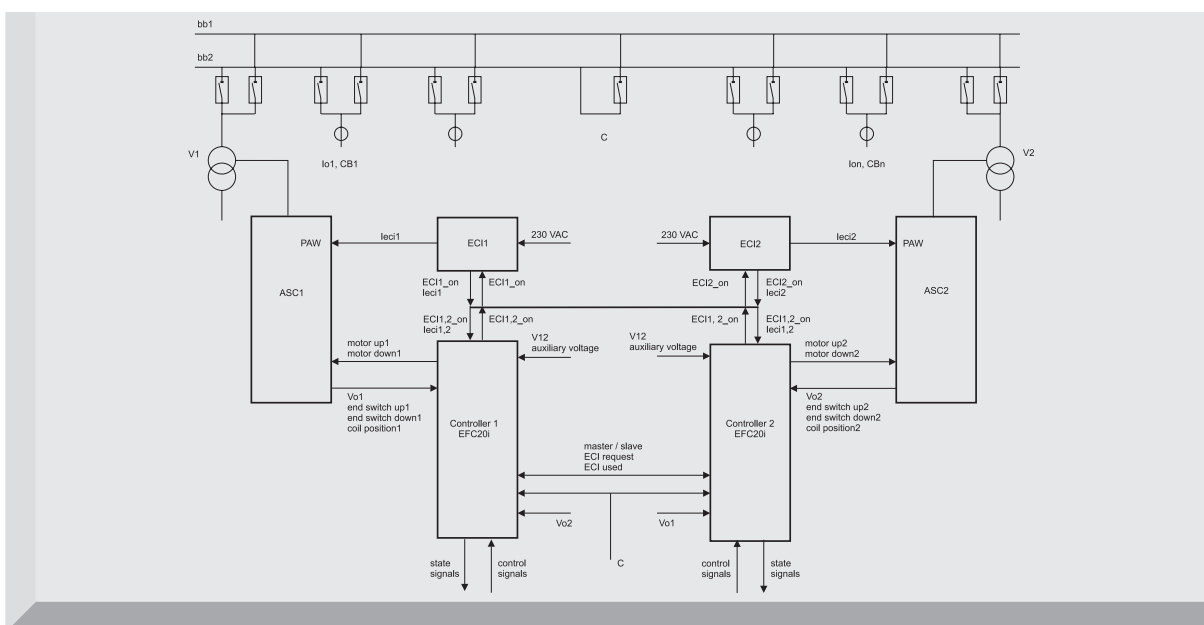


Fig. 12 EFC20i at double-busbar configuration

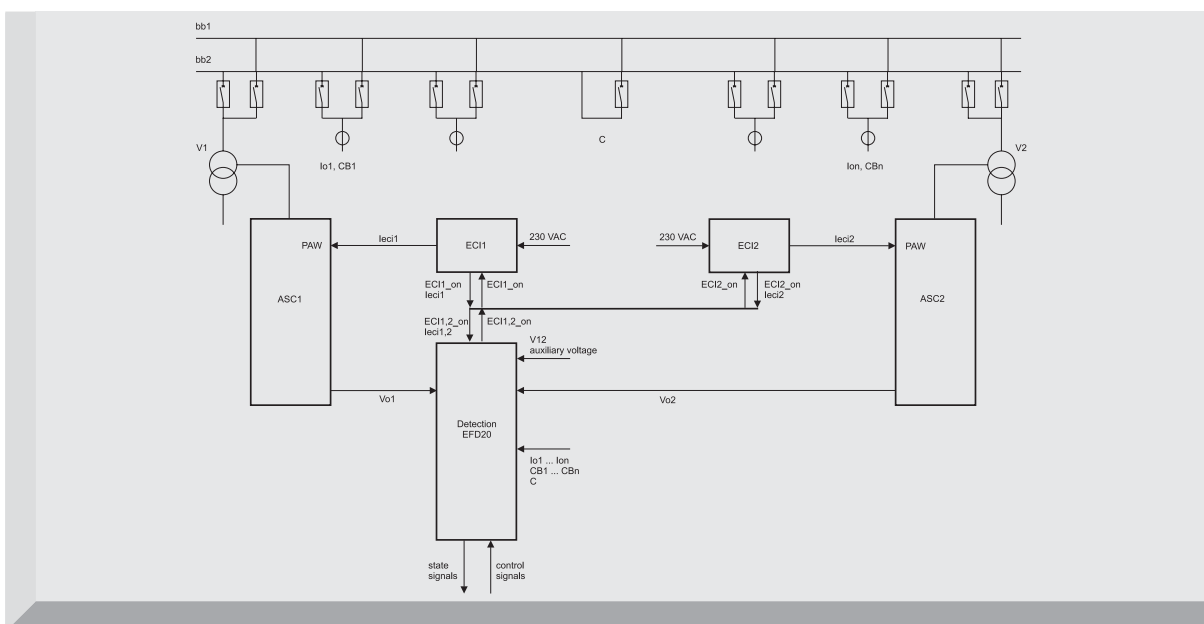


Fig. 13 EFD20 at double-busbar configuration

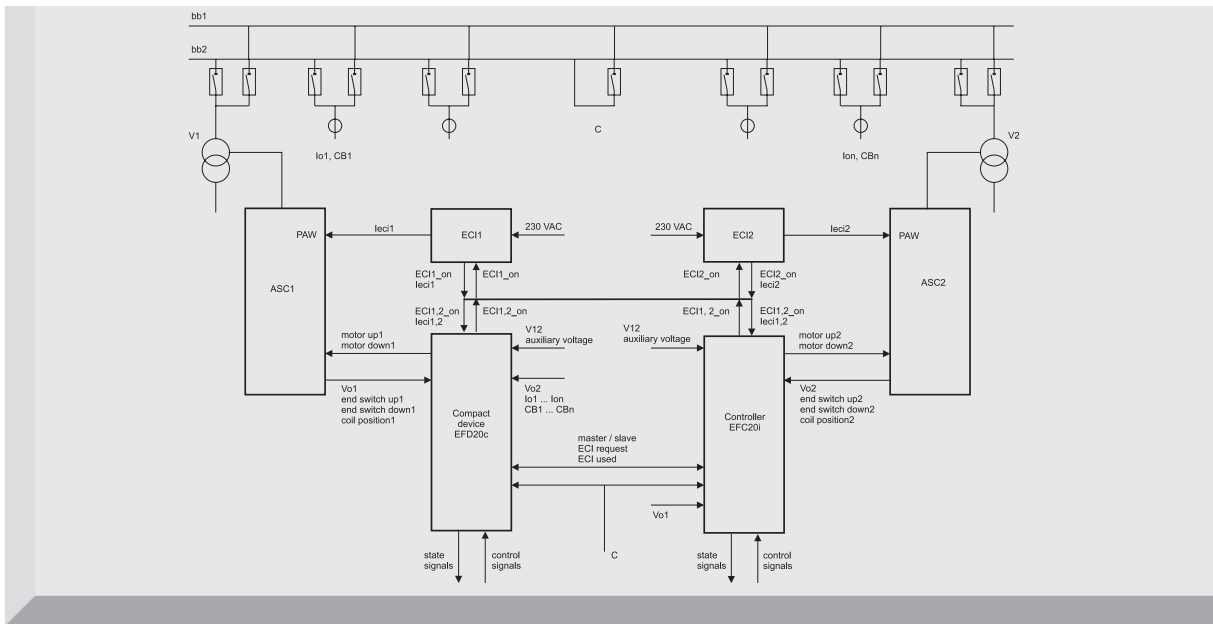


Fig. 14 Control and detection EFD20c at double-busbar configuration

www.trenchgroup.com



TRENCH

- Trench Austria GmbH
Paschinger Straße 49, Postfach 36
A-4060 Linz-Leonding/Austria
Phone +43.732.6793-0
Fax +43.732.67 13 41
email sales@trench.at
- Trench Limited
Instrument Transformer Division
390 Midwest Road, Scarborough
Ontario, Canada M1P 3B5
Phone +1.416.751-8570
Fax +1.416.751-6952
email sales@ca.trenchgroup.com
- Trench Limited
Coil Product Division
71 Maybrook Drive, Scarborough
Ontario, Canada M1V 4B6
Phone +1.416.298-8108
Fax +1.416.298-2209
email sales@ca.trenchgroup.com
- Trench France S.A.
16, rue du Général Cassagnou
B.P. 70
F- 68302 St-Louis/France
Phone +33.3.89 70 23 23
Fax +33.3.89 67 26 63
email sales@trench.fr
- Trench Germany GmbH
Nürnberger Straße 199
D-96050 Bamberg/Germany
Phone +49.951.1803-0
Fax +49.951.1803-224
email sales@trench.de
- Trench Switzerland AG
Lehenmattstraße 353
CH - 4028 Basel/Switzerland
Phone +41.61.315 51 11
Fax +41.61.315 59 00
email sales@trench-tsf.com
- Trench (UK) Limited
South Drive
Hebburn
Tyne & Wear
NE 31 1 UW
Phone +44-191-483-4711
Fax +44-191-430-0633
email sales@trench-uk.com
- Trench Brasil LTDA
Via Expressa de Contagem, 2685
CEP 32370-485
Contagem, Minas Gerais/Brasil
Phone +55.31.391-5959
Fax +55.31.391-1828
email trenchbrasil@ca.trenchgroup.com
- Trench China Limited
3658 Jiang Cheng Road
Minhang, Shanghai 200245
P.R. China
Phone +86.21.64630088
Fax +86.21.64637828
email sama@trenchcn.com