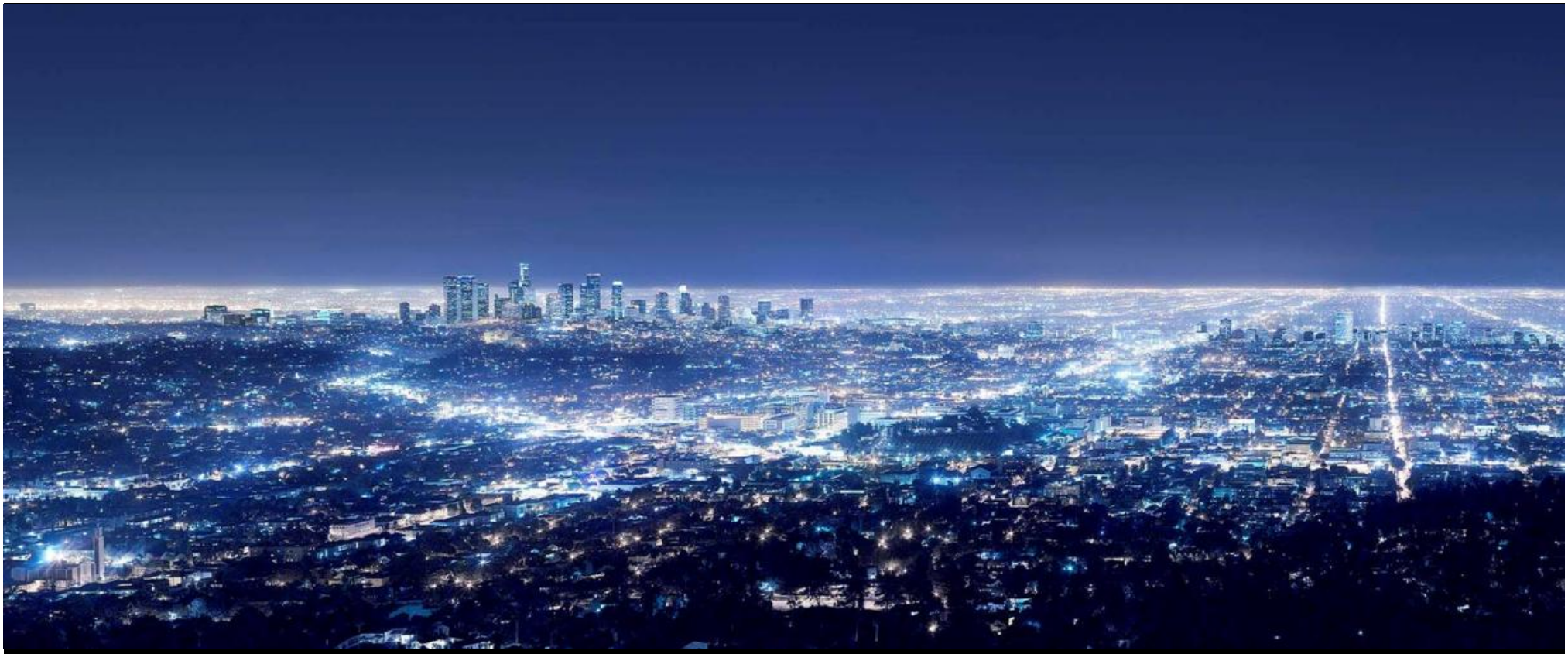


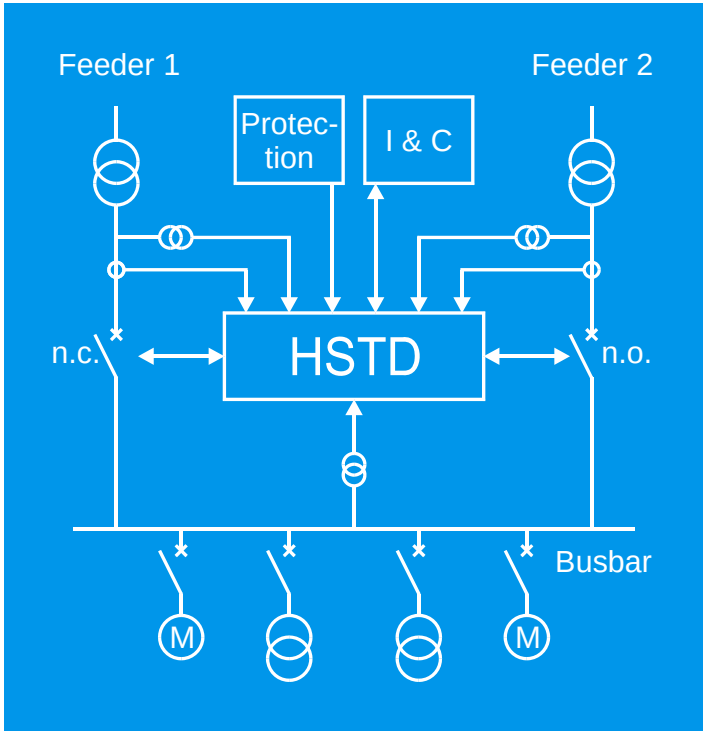
High Speed Transfer Device and System SUE 3000

Power and productivity for a better world™

Agenda

- **High-speed transfer *device SUE 3000***
  - Philosophy / Benefits
  - Construction
  - Functional modes
- **High-speed transfer *system***
  - Idea
  - Concept / construction
  - A real system approach

Task of High Speed Transfer Devices



- Ensuring continuous power supply to essential electrical equipment by changing over from a main to a stand-by feeder as fast as possible

Interruption of processes results in

- Lost productivity
- Damaged production equipment
- Damaged products
- Delays in delivery
- Lost confidence of clients
- Injury to people
- Pollution of environment

Key issues

- Power quality
- Uninterrupted power supply
- Permanent availability of electricity
- Assurance of continuous processes
- Prevention of outages
- Protection of facilities
- Protection of employees

Application of High Speed Transfer Devices

- Supply systems of power stations
  - Steam-power stations
  - Combined cycle power stations
  - Nuclear power stations
- Environmental plants
  - Flue gas cleaning systems
  - Incineration plants
- Chemical plants
  - Fiber industry
  - Petrochemical plants
- Industrial plants with sensitive load

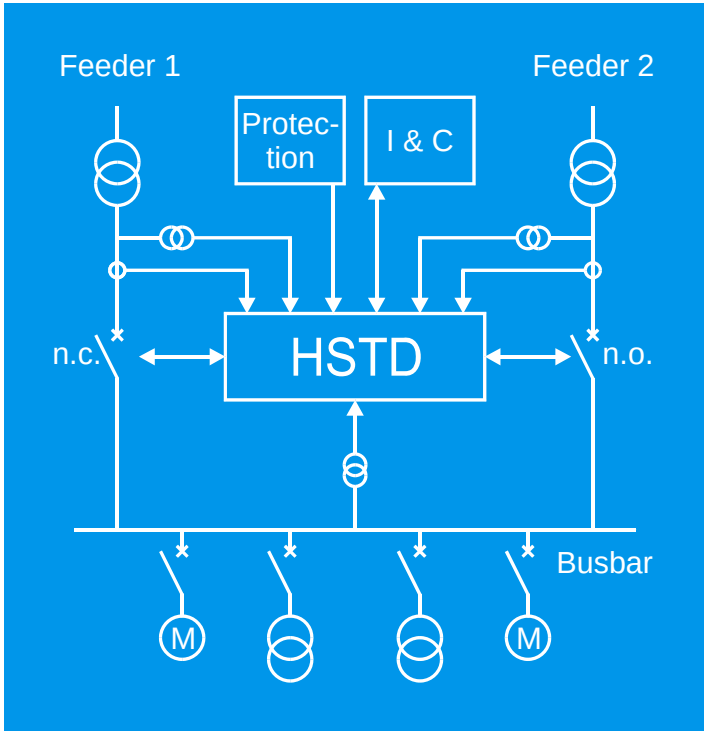
Important processes

- Pumps
  - Boiler feed-water pump
  - Condensate extraction pump
  - Cooling water pump
  - District heating circulation pump
  - Limestone slurry feed and absorbent circulation pump
- Fans
  - Primary and secondary air fan
  - ID and ID booster fan
- Other
  - Conveyor
  - Coal mill
  - Oxidation air compressor
  - Gas turbine starter
  - Fuel gas booster compressor

Prerequisites for the application

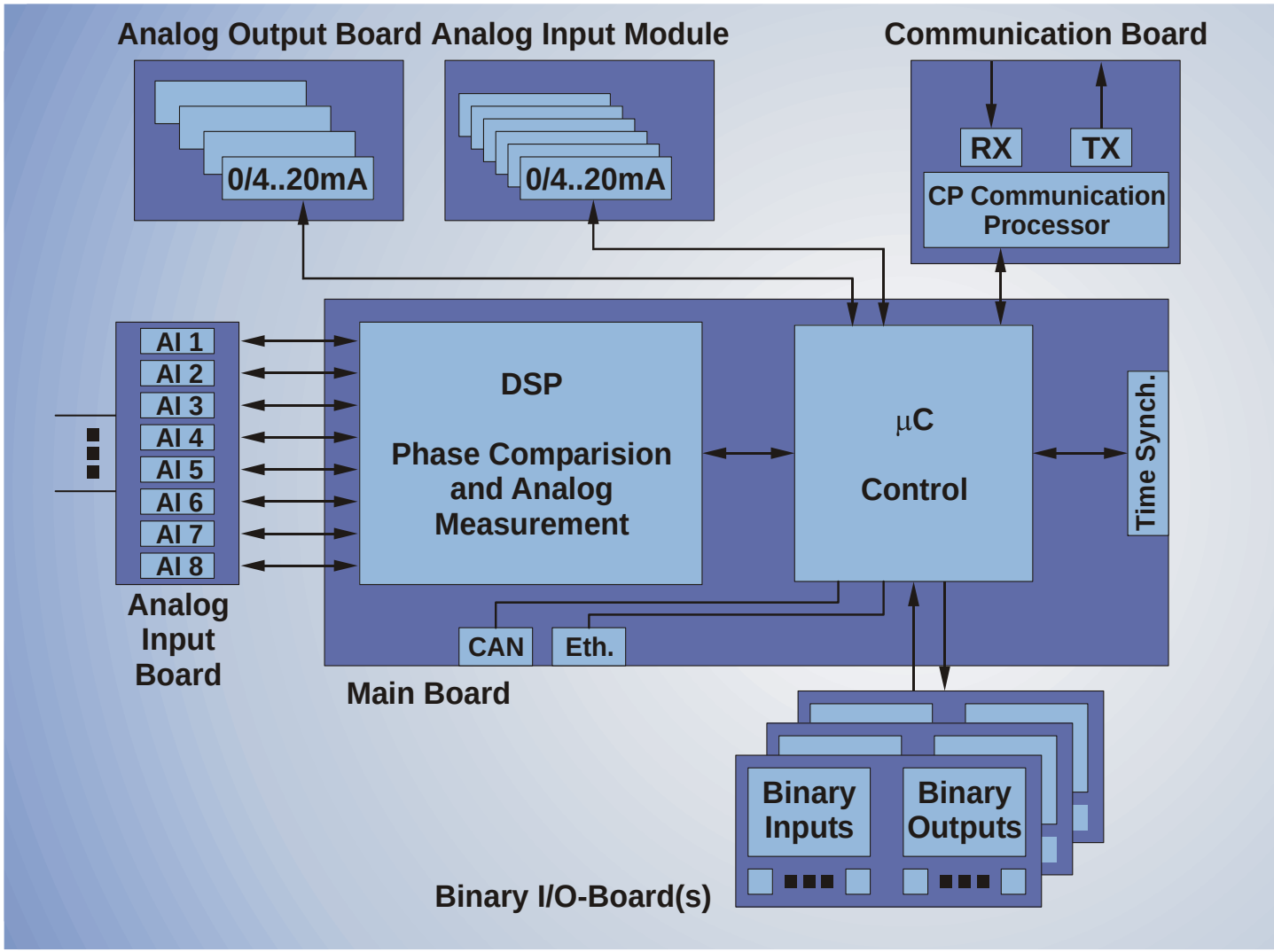
- Existence of at least two - usually independent - synchronous feeders
- Circuit-breakers with short operating times
- General suitability of plant for network change-over
- Load configuration with rotating devices
- Existence of appropriate initiation devices

Interfaces



- Circuit Breakers
  - Control
  - Indication
- Analogue Measurements
  - Voltage
  - Feeder current (optional)
- External protection
- Instrumentation & Control

Block diagram

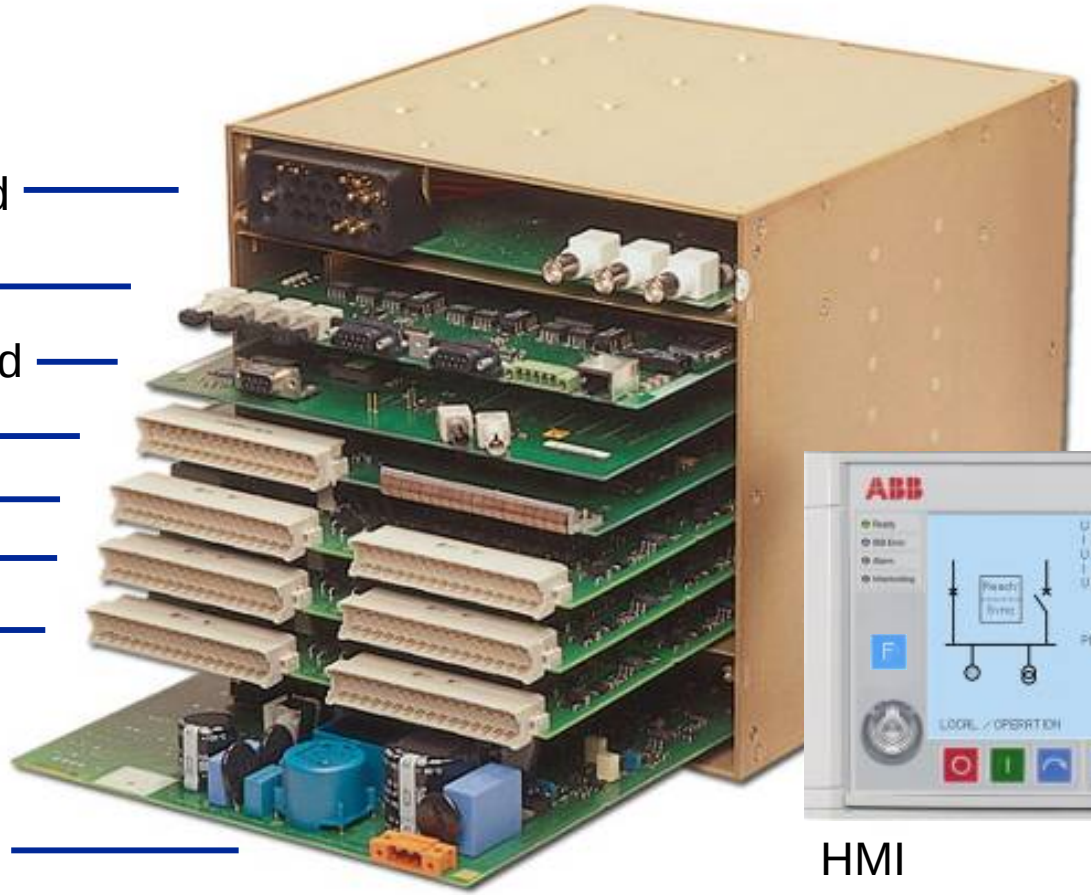


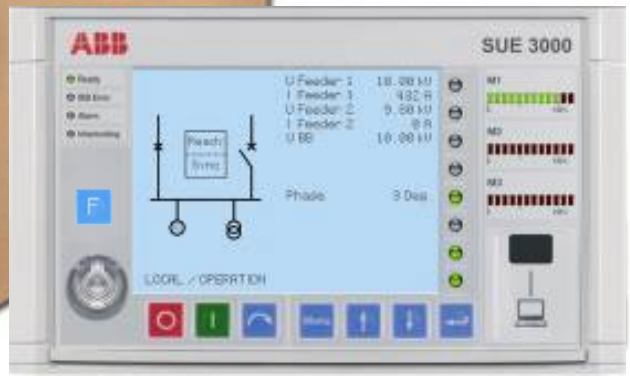
Communication capability

- IEC 61850-8-1
- LON / LAG 1.4 according to IEC 60870-5-101/103 with interbay communication
- IEC 60870-5-103 interface according to VDEW recommendation
- MODBUS RTU interface
- SPA interface
- Ethernet interface
- PROFIBUS DP (with protocol conversion)

Construction of the device

- Analogue input board
- Main board
- Communication board
- Analogue output board
- 3 x I/O Board
- Power supply board





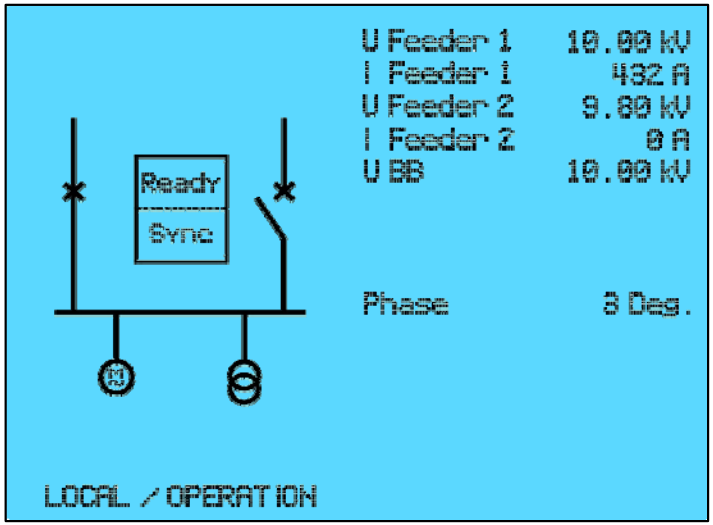
HMI

Mechanical options

- Installation in LV-Compartment of MV-Switchbay

- Installation in a steel sheet cubicle

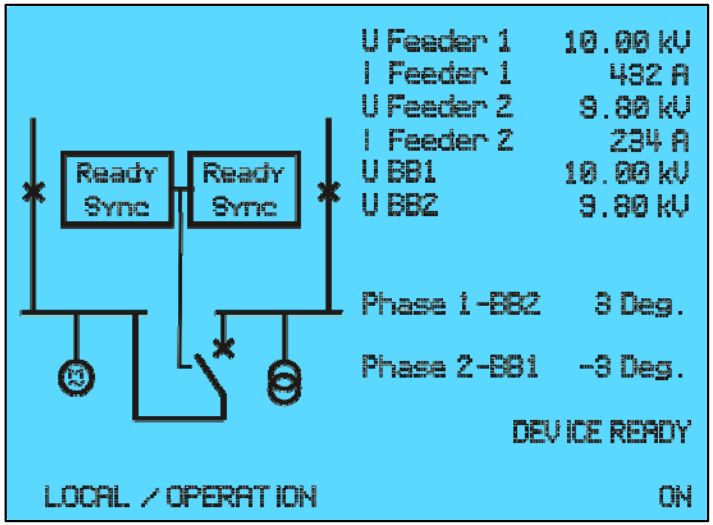
SUE 3000 – High Speed Transfer Device
Available Configuration – Variant 1



2-Circuit-breaker configuration

- One busbar
- Transfer takes place between the two feeders

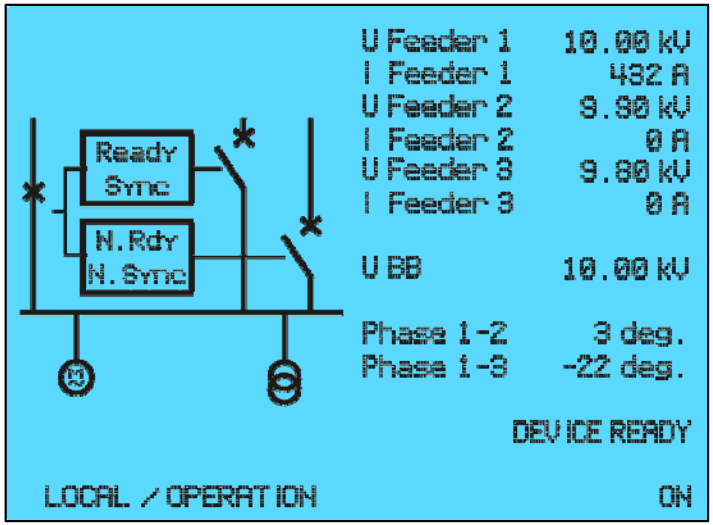
SUE 3000 – High Speed Transfer Device
Available Configuration - Variant 2



3-Circuit-breaker configuration

- 2 busbar sections,
  Busbar coupling breaker
- Transfer between each feeder and busbar coupling breaker

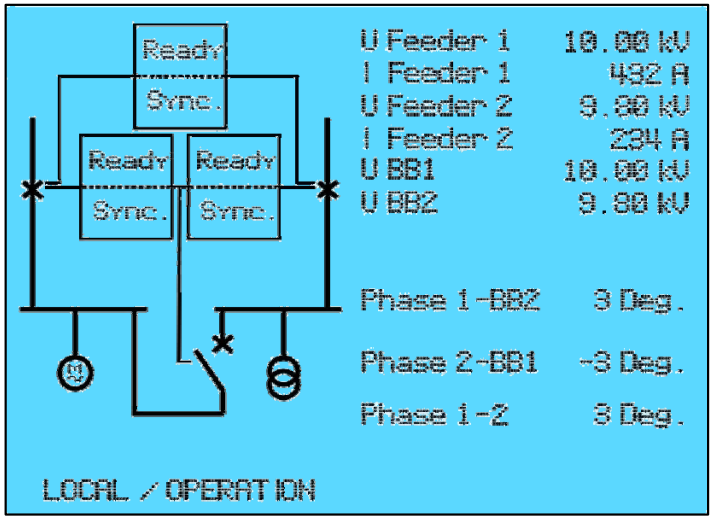
SUE 3000 – High Speed Transfer Device
Available Configuration - Variant 3



3-Circuit-breaker configuration with internal pre-selection

- One busbar
- 2 of 3 selection

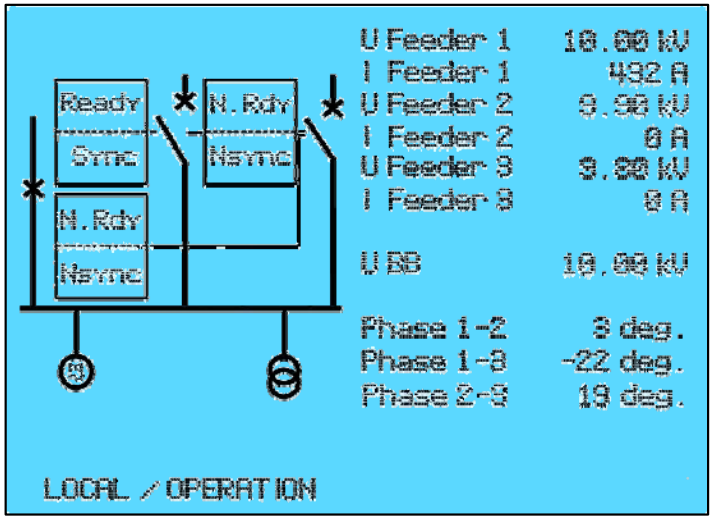
SUE 3000 – High Speed Transfer Device
Available Configuration - Variant 4



3-Circuit-breaker configuration with internal pre-selection

- 2 busbar sections, Busbar coupling breaker
- Transfer between:
  - Each feeder and busbar coupling breaker and
  - Feeder 1 and feeder 2 when bus coupler breaker is closed

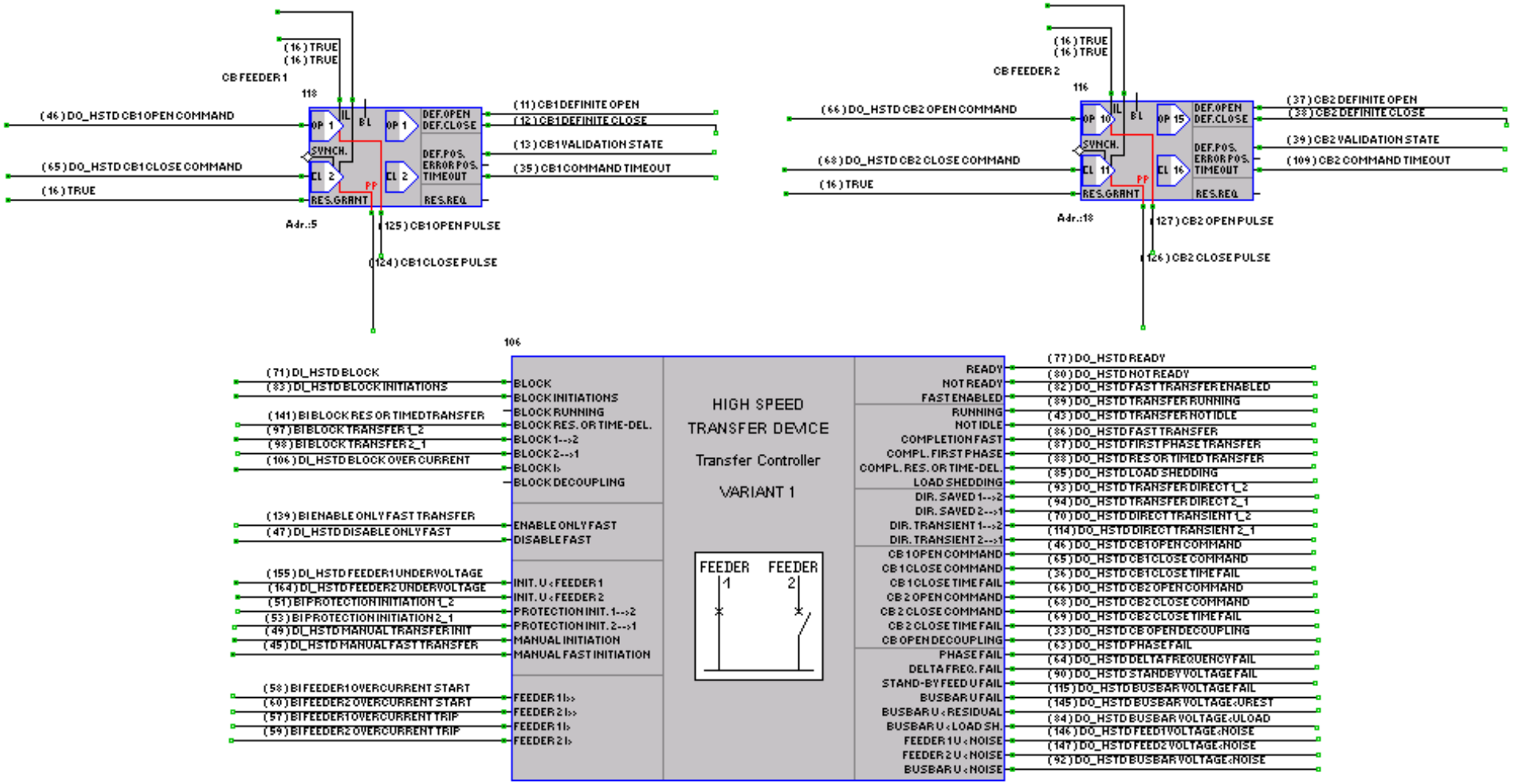
SUE 3000 – High Speed Transfer Device
Available Configuration - Variant 5



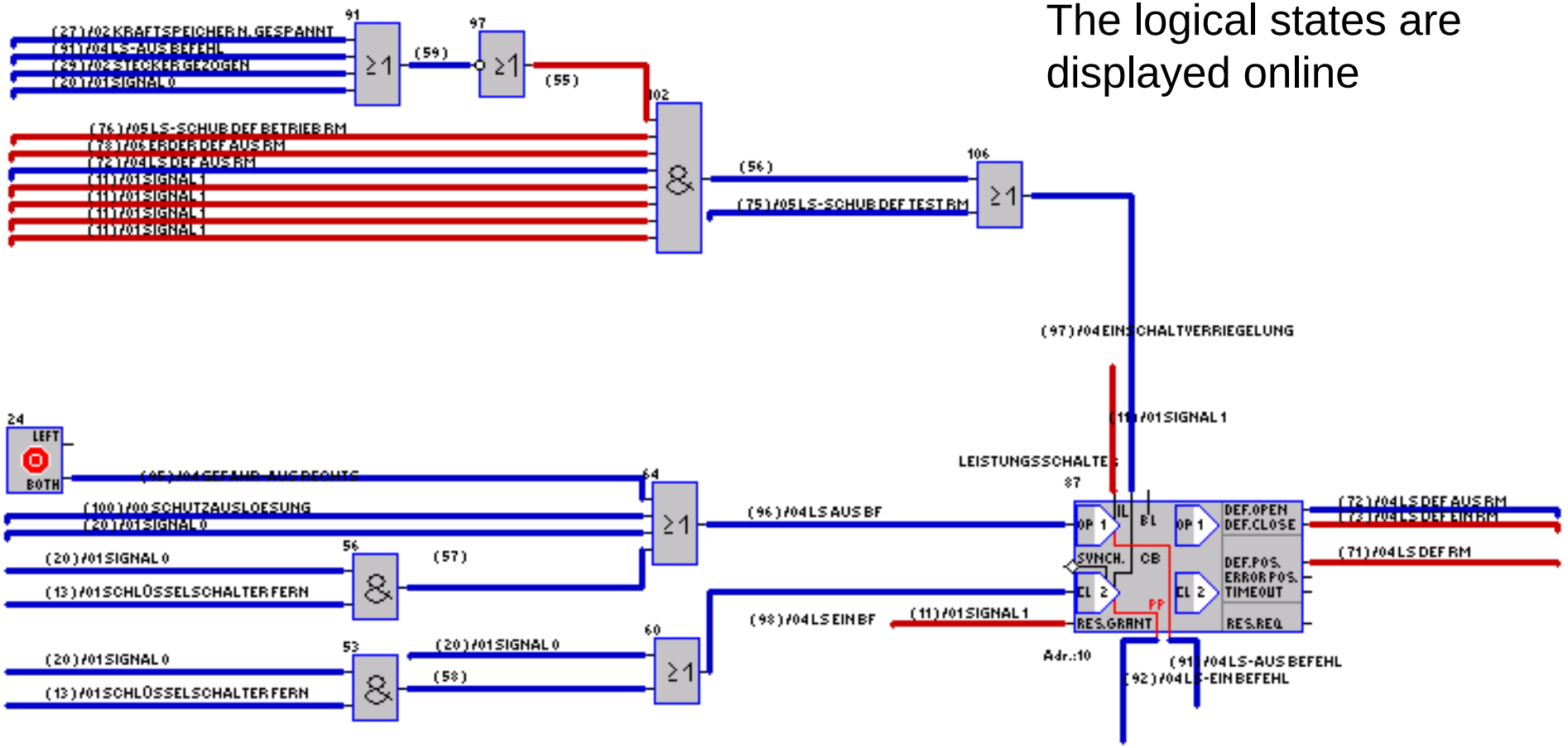
3-Circuit-breaker configuration with internal pre-selection

- One busbar
- Transfer between each feeder

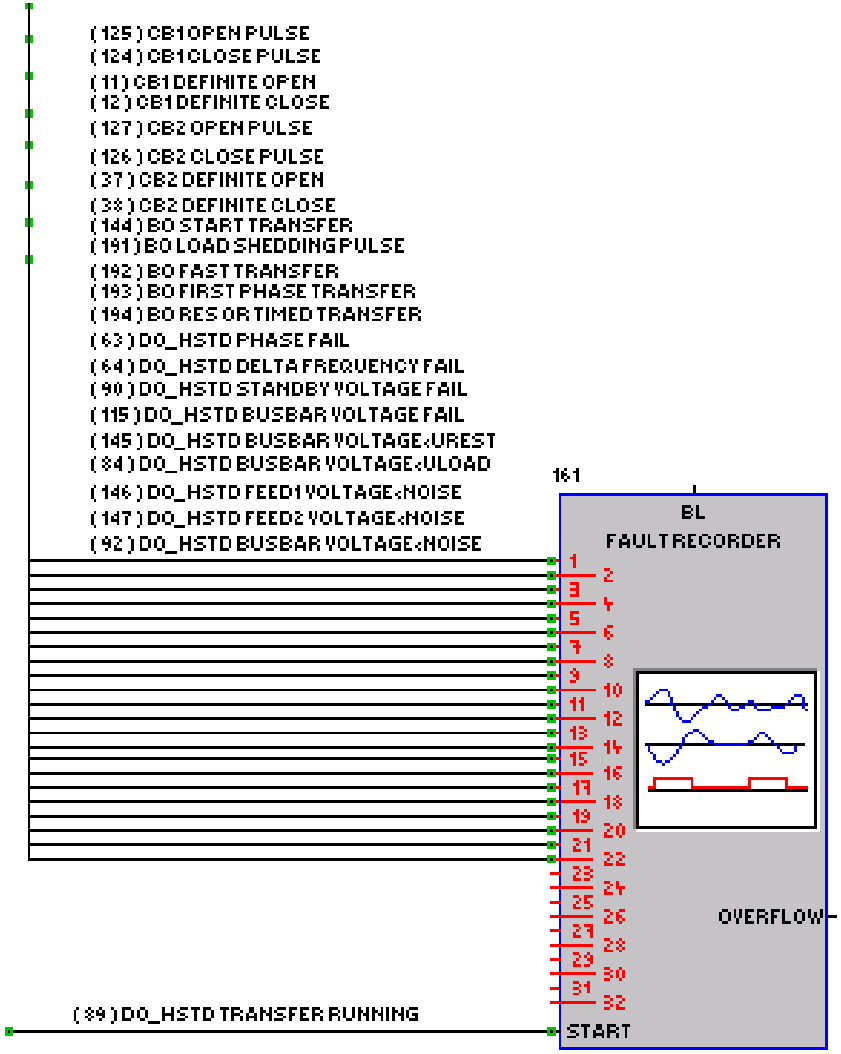
FUPLA

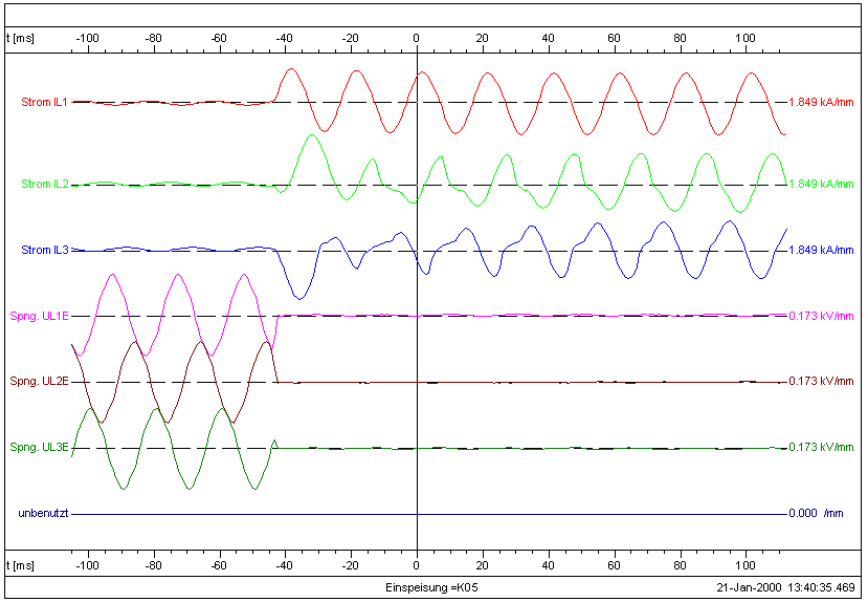

(16) TRUE
(16) TRUE
CB FEEDER 1
118
(46) DO_HSTD CB1 OPEN COMMAND
(65) DO_HSTD CB1 CLOSE COMMAND
(16) TRUE
OP 1
IL
BL
OP 1
DEF.OPEN
DEF.CLOSE
SYNCH.
CL 2
CL 2
DEF.POS.
ERROR POS.
TIMEOUT
PP
RES.GRANT
RES.REQ.
(11) CB1 DEFINITE OPEN
(12) CB1 DEFINITE CLOSE
(13) CB1 VALIDATION STATE
(35) CB1 COMMAND TIMEOUT
Adr.:5
(125) CB1 OPEN PULSE
(124) CB1 CLOSE PULSE
(16) TRUE
(16) TRUE
CB FEEDER 2
116
(66) DO_HSTD CB2 OPEN COMMAND
(68) DO_HSTD CB2 CLOSE COMMAND
(16) TRUE
OP 10
OP 15
CL 11
CL 16
(37) CB2 DEFINITE OPEN
(38) CB2 DEFINITE CLOSE
(39) CB2 VALIDATION STATE
(109) CB2 COMMAND TIMEOUT
Adr.:18
(127) CB2 OPEN PULSE
(126) CB2 CLOSE PULSE
106
(71) DI_HSTD BLOCK
(83) DI_HSTD BLOCK INITIATIONS
(141) BI BLOCK RES OR TIMED TRANSFER
(97) BI BLOCK TRANSFER 1_2
(98) BI BLOCK TRANSFER 2_1
(106) DI_HSTD BLOCK OVER CURRENT
BLOCK
BLOCK INITIATIONS
BLOCK RUNNING
BLOCK RES. OR TIME-DEL.
BLOCK 1-->2
BLOCK 2-->1
BLOCK I>
BLOCK DECOUPLING
(139) BI ENABLE ONLY FAST TRANSFER
(47) DI_HSTD DISABLE ONLY FAST
ENABLE ONLY FAST
DISABLE FAST
(155) DI_HSTD FEEDER1 UNDERVOLTAGE
(164) DI_HSTD FEEDER2 UNDERVOLTAGE
(51) BI PROTECTION INITIATION 1_2
(53) BI PROTECTION INITIATION 2_1
(49) DI_HSTD MANUAL TRANSFER INIT
(45) DI_HSTD MANUAL FAST TRANSFER
INIT. U< FEEDER 1
INIT. U< FEEDER 2
PROTECTION INIT. 1-->2
PROTECTION INIT. 2-->1
MANUAL INITIATION
MANUAL FAST INITIATION
(58) BI FEEDER1 OVERCURRENT START
(60) BI FEEDER2 OVERCURRENT START
(57) BI FEEDER1 OVERCURRENT TRIP
(59) BI FEEDER2 OVERCURRENT TRIP
FEEDER 1I>>
FEEDER 2I>>
FEEDER 1I>
FEEDER 2I>
HIGH SPEED
TRANSFER DEVICE
Transfer Controller
VARIANT 1
FEEDER 1
FEEDER 2
READY
NOT READY
FAST ENABLED
RUNNING
NOT IDLE
COMPLETION FAST
COMPL. FIRST PHASE
COMPL. RES. OR TIME-DEL.
LOAD SHEDDING
DIR. SAVED 1-->2
DIR. SAVED 2-->1
DIR. TRANSIENT 1-->2
DIR. TRANSIENT 2-->1
CB 1 OPEN COMMAND
CB 1 CLOSE COMMAND
CB 1 CLOSE TIME FAIL
CB 2 OPEN COMMAND
CB 2 CLOSE COMMAND
CB 2 CLOSE TIME FAIL
CB OPEN DECOUPLING
PHASE FAIL
DELTA FREQ. FAIL
STAND-BY FEED U FAIL
BUSBAR U FAIL
BUSBAR U< RESIDUAL
BUSBAR U< LOAD SH.
FEEDER 1 U< NOISE
FEEDER 2 U< NOISE
BUSBAR U< NOISE
(77) DO_HSTD READY
(80) DO_HSTD NOT READY
(82) DO_HSTD FAST TRANSFER ENABLED
(89) DO_HSTD TRANSFER RUNNING
(43) DO_HSTD TRANSFER NOT IDLE
(86) DO_HSTD FAST TRANSFER
(87) DO_HSTD FIRST PHASE TRANSFER
(88) DO_HSTD RES OR TIMED TRANSFER
(85) DO_HSTD LOAD SHEDDING
(93) DO_HSTD TRANSFER DIRECT 1_2
(94) DO_HSTD TRANSFER DIRECT 2_1
(70) DO_HSTD DIRECT TRANSIENT 1_2
(114) DO_HSTD DIRECT TRANSIENT 2_1
(46) DO_HSTD CB1 OPEN COMMAND
(65) DO_HSTD CB1 CLOSE COMMAND
(36) DO_HSTD CB1 CLOSE TIME FAIL
(66) DO_HSTD CB2 OPEN COMMAND
(68) DO_HSTD CB2 CLOSE COMMAND
(69) DO_HSTD CB2 CLOSE TIME FAIL
(33) DO_HSTD CB OPEN DECOUPLING
(63) DO_HSTD PHASE FAIL
(64) DO_HSTD DELTA FREQUENCY FAIL
(90) DO_HSTD STANDBY VOLTAGE FAIL
(115) DO_HSTD BUSBAR VOLTAGE FAIL
(145) DO_HSTD BUSBAR VOLTAGE<UREST
(84) DO_HSTD BUSBAR VOLTAGE<ULOAD
(146) DO_HSTD FEED1 VOLTAGE<NOISE
(147) DO_HSTD FEED2 VOLTAGE<NOISE
(92) DO_HSTD BUSBAR VOLTAGE<NOISE

FUPLA-Monitor

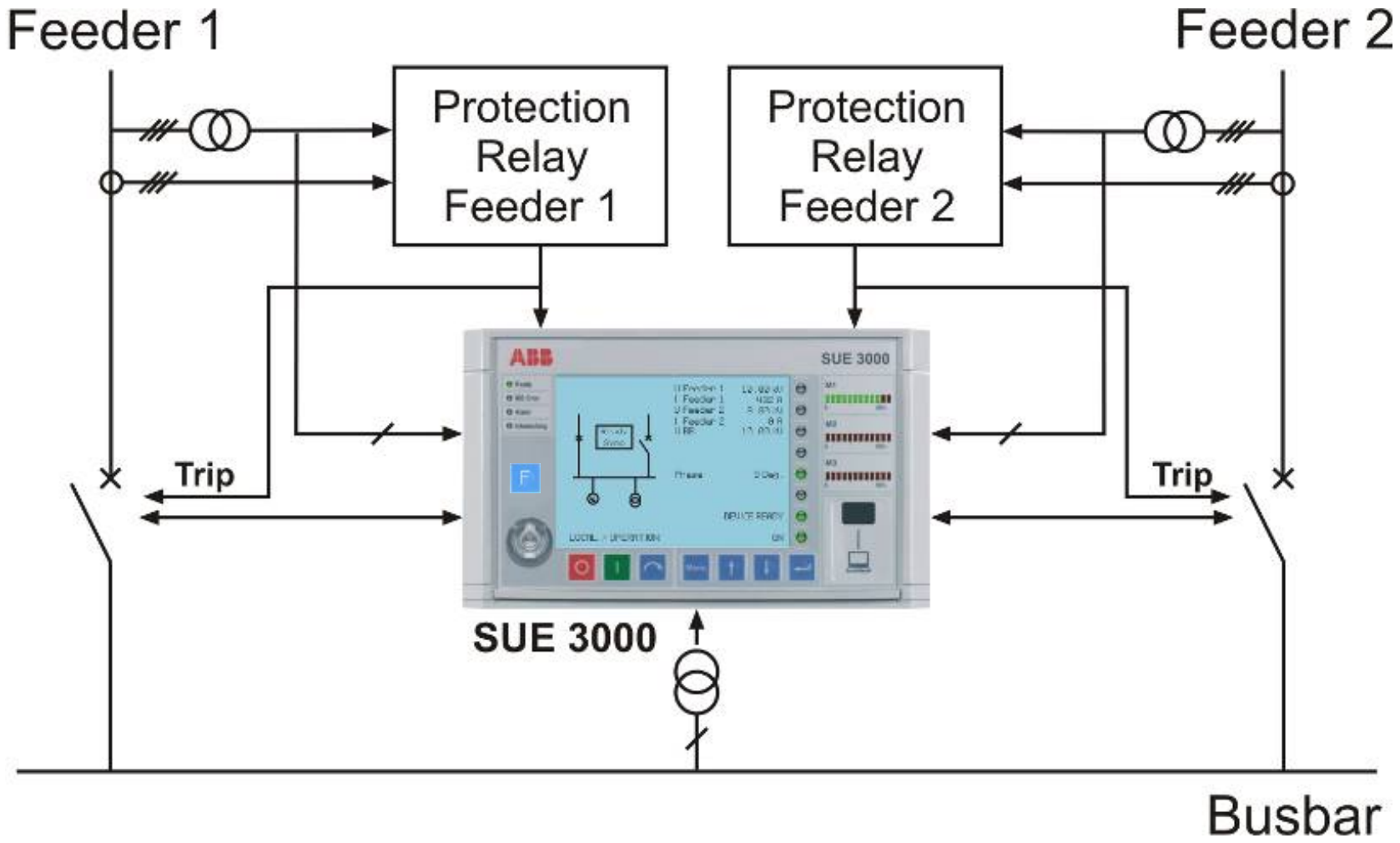


Fault recorder module and visualization

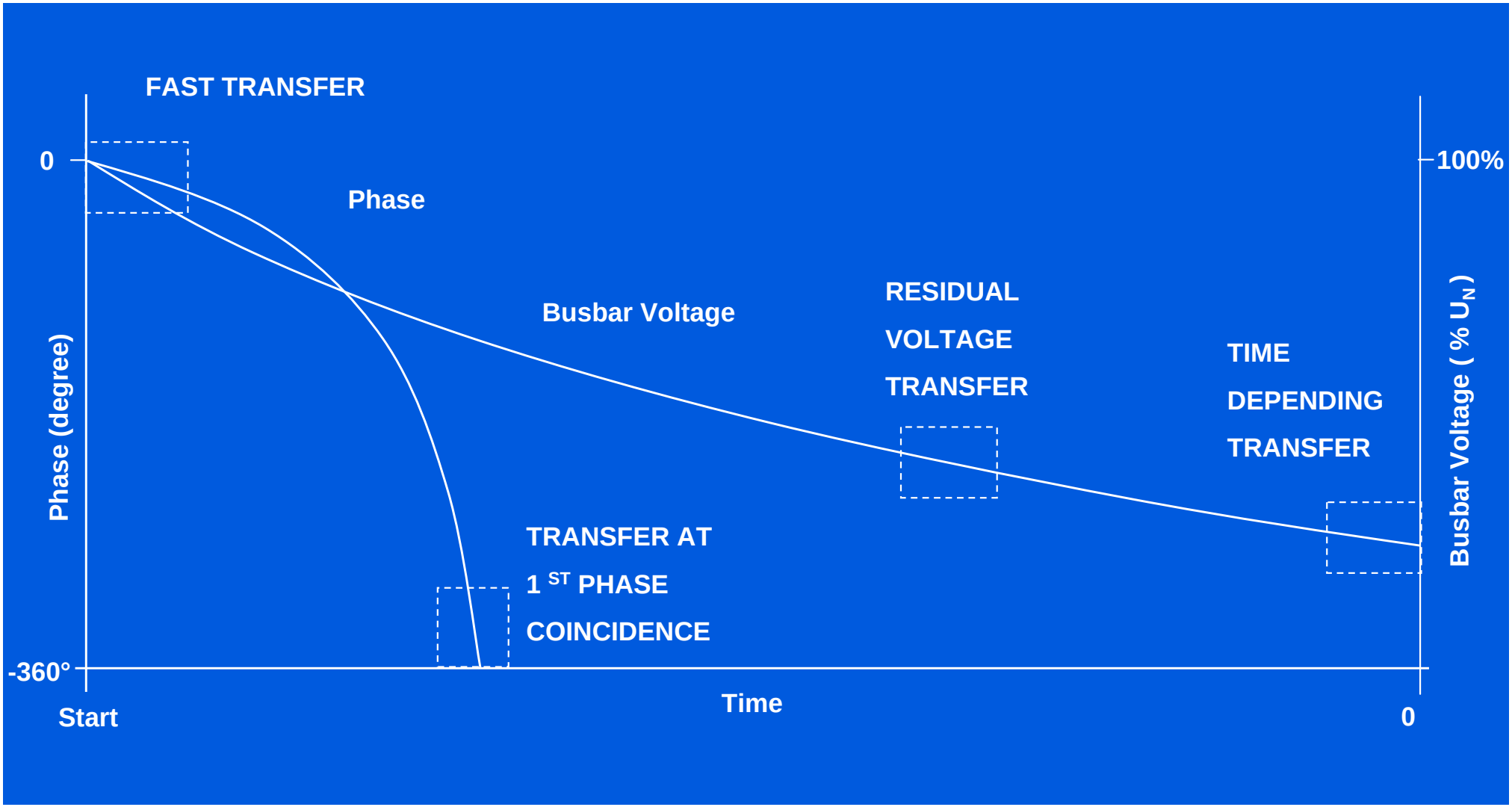




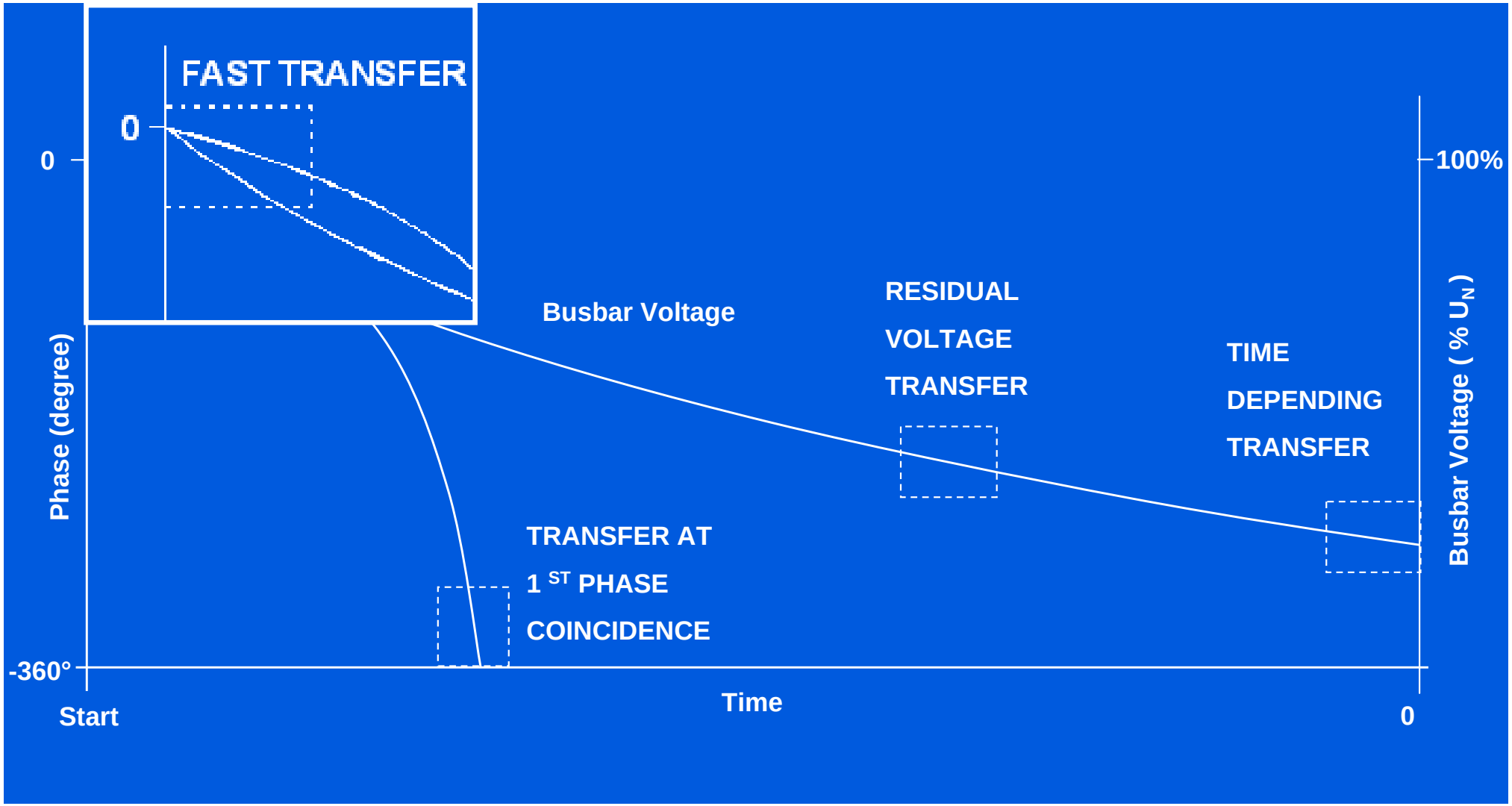
HSTD (High Speed Transfer *Device*)



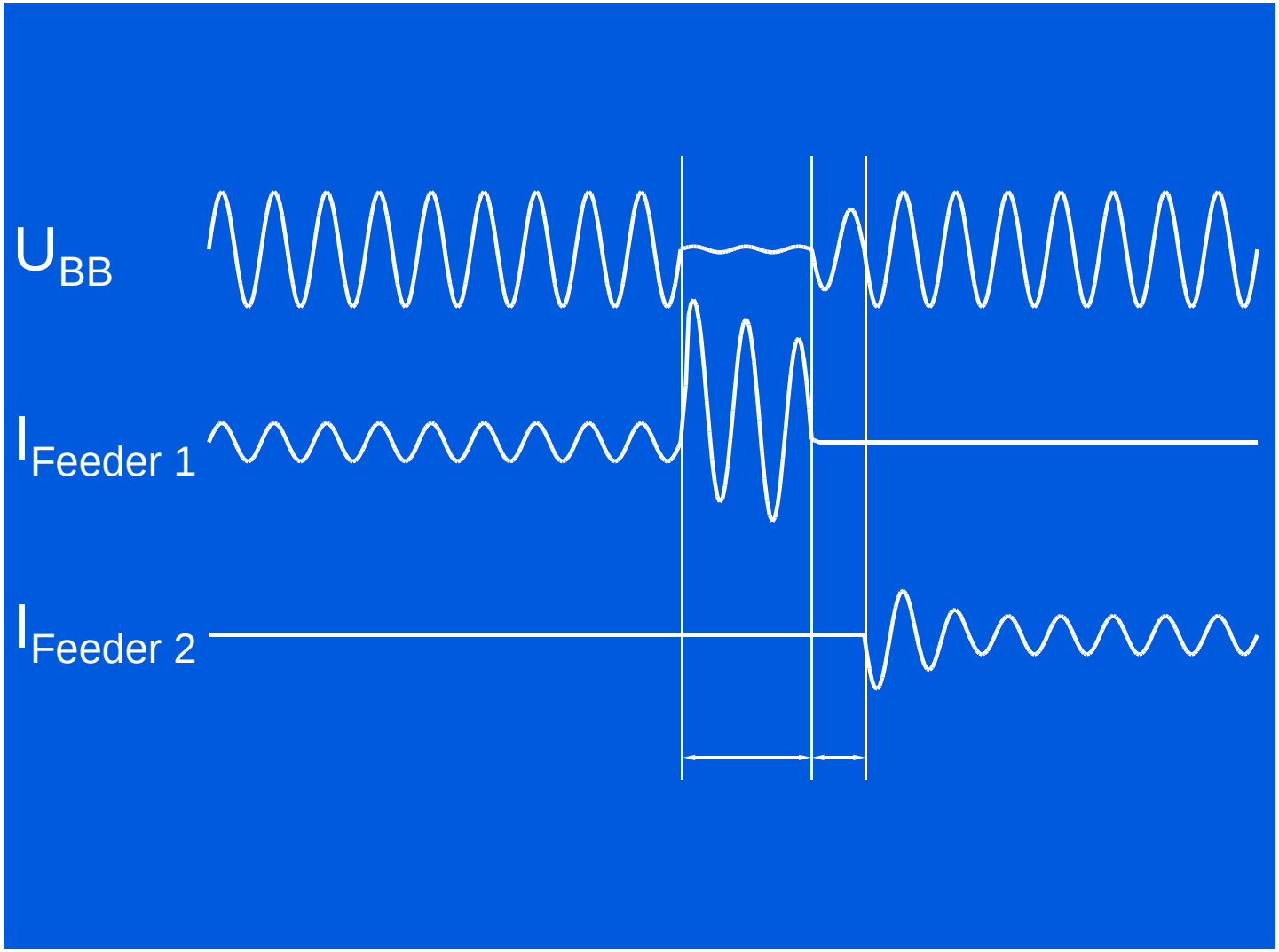
Transfer modes



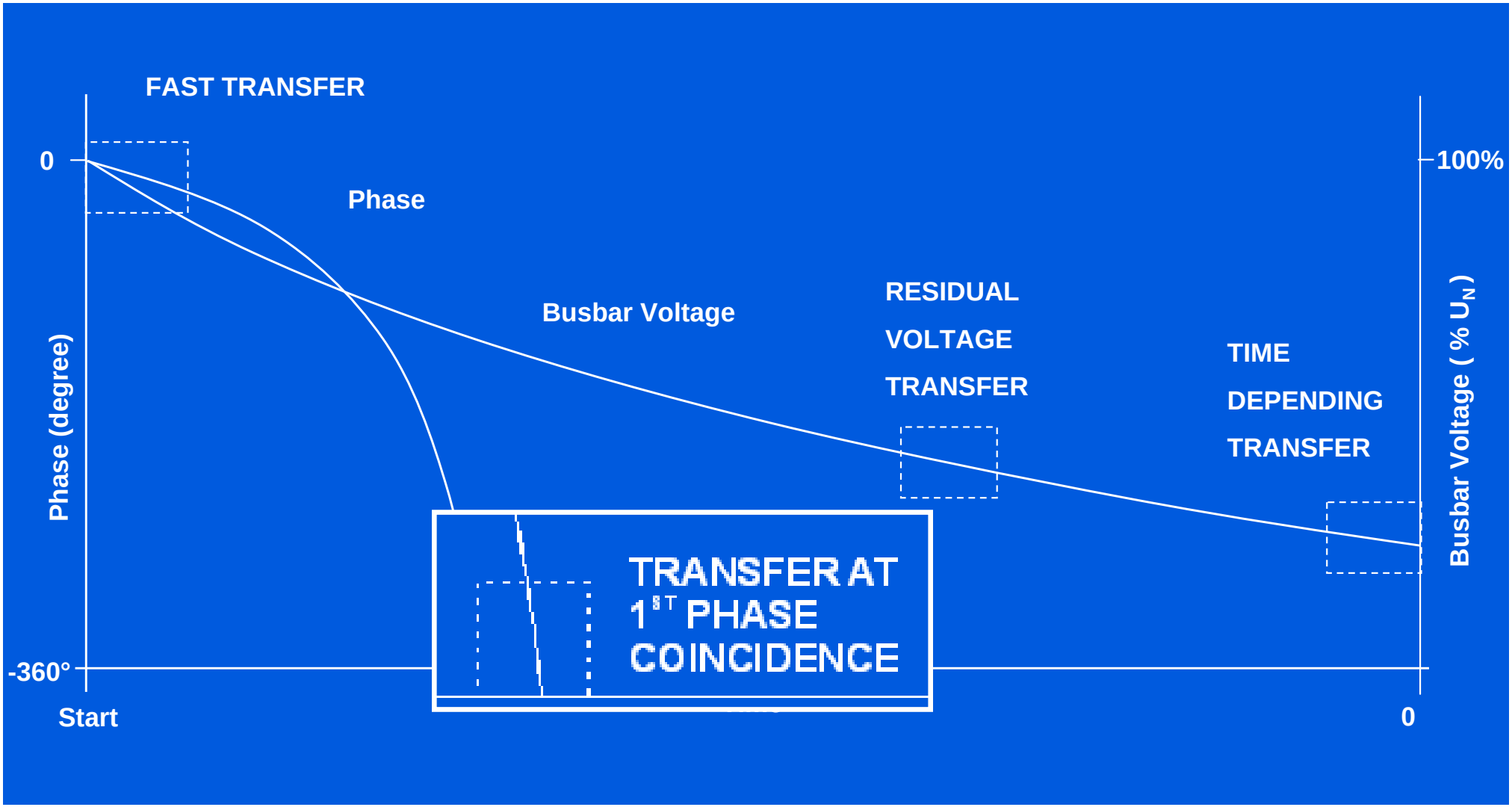
Transfer modes
Fast Transfer



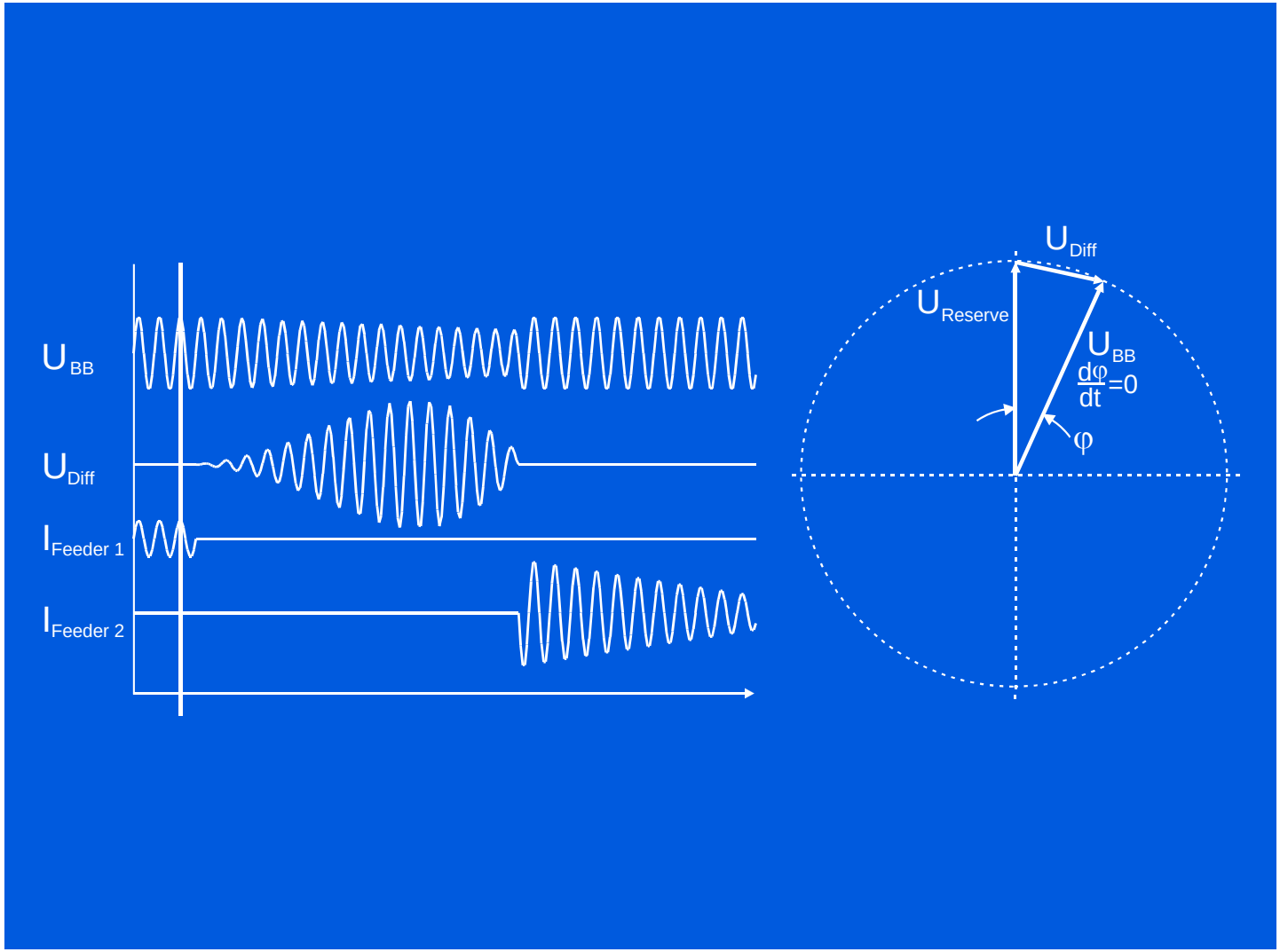
Fast transfer



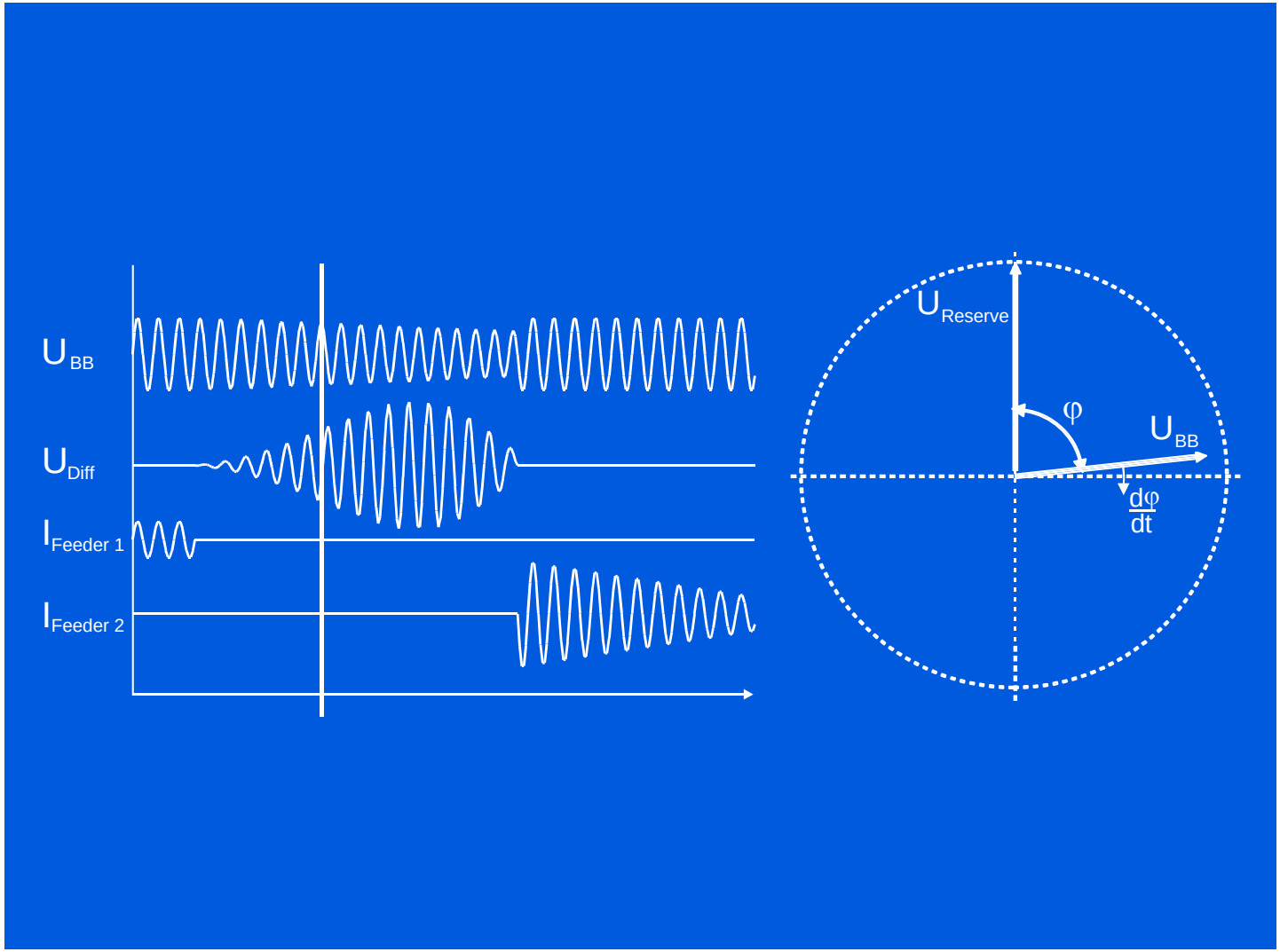
Transfer modes
Transfer at first coincidence



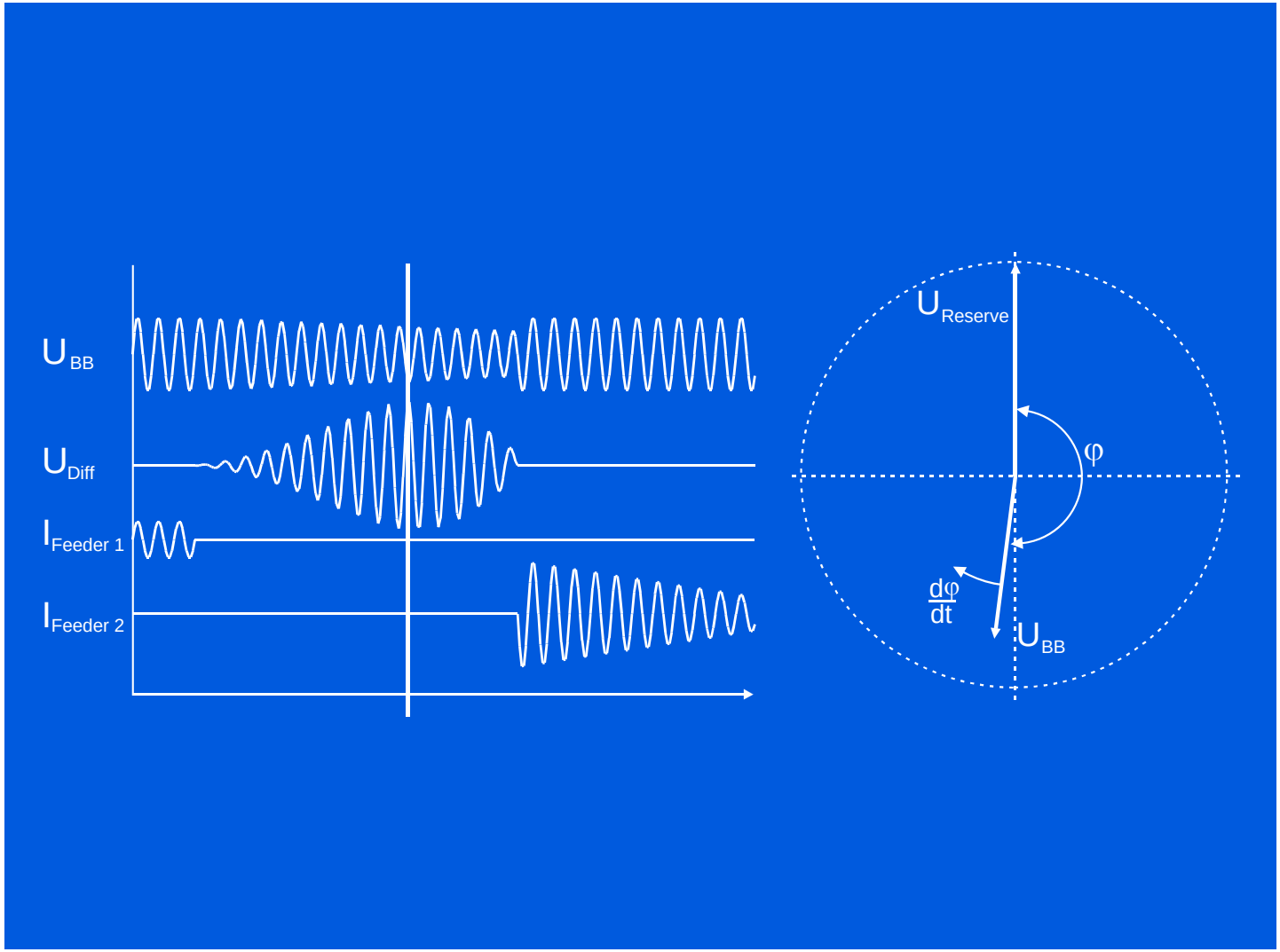
Transfer modes
Transfer at first coincidence (1)



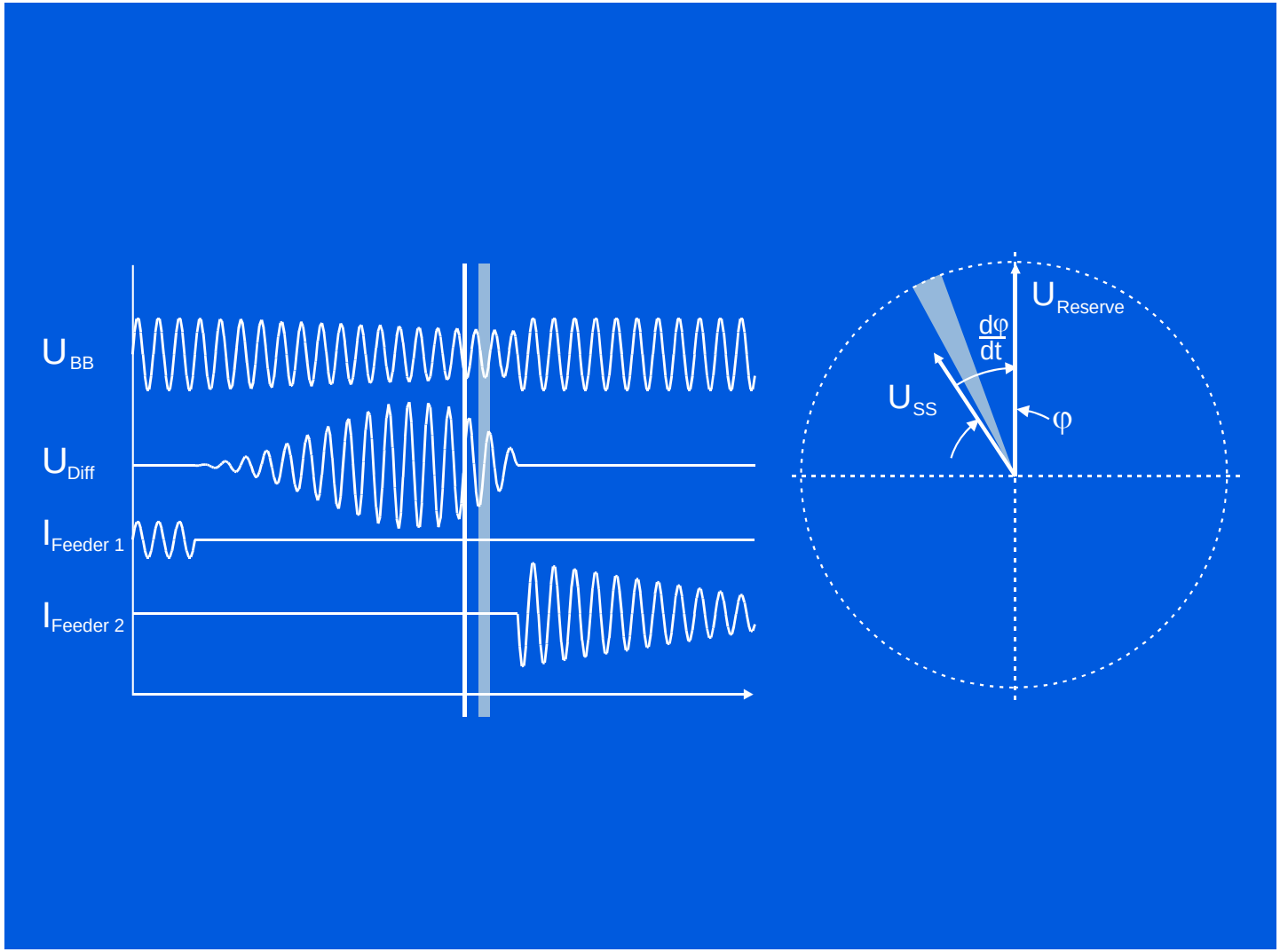
Transfer modes
Transfer at first coincidence (2)



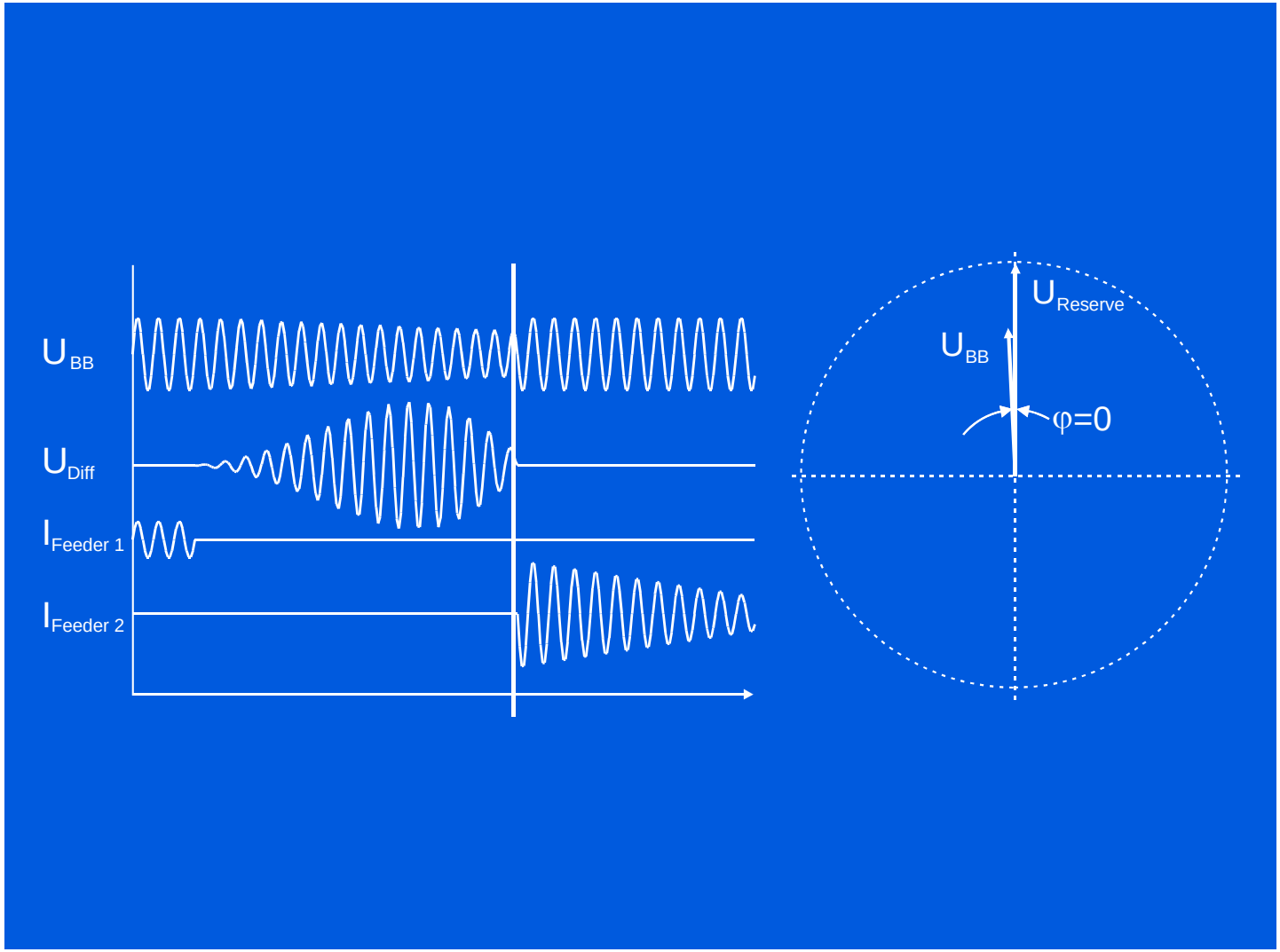
Transfer modes
Transfer at first coincidence (3)



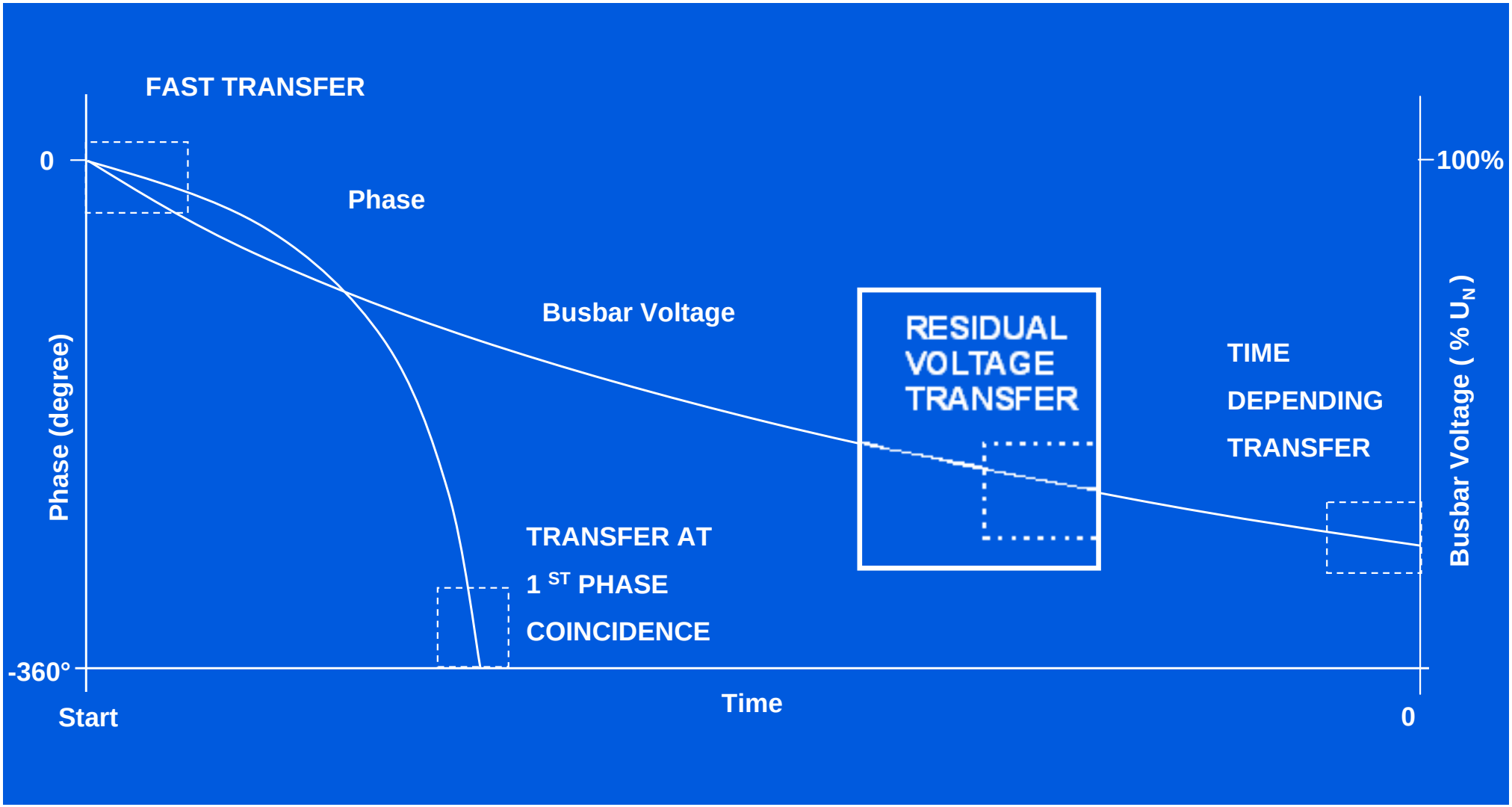
Transfer modes
Transfer at first coincidence (4)



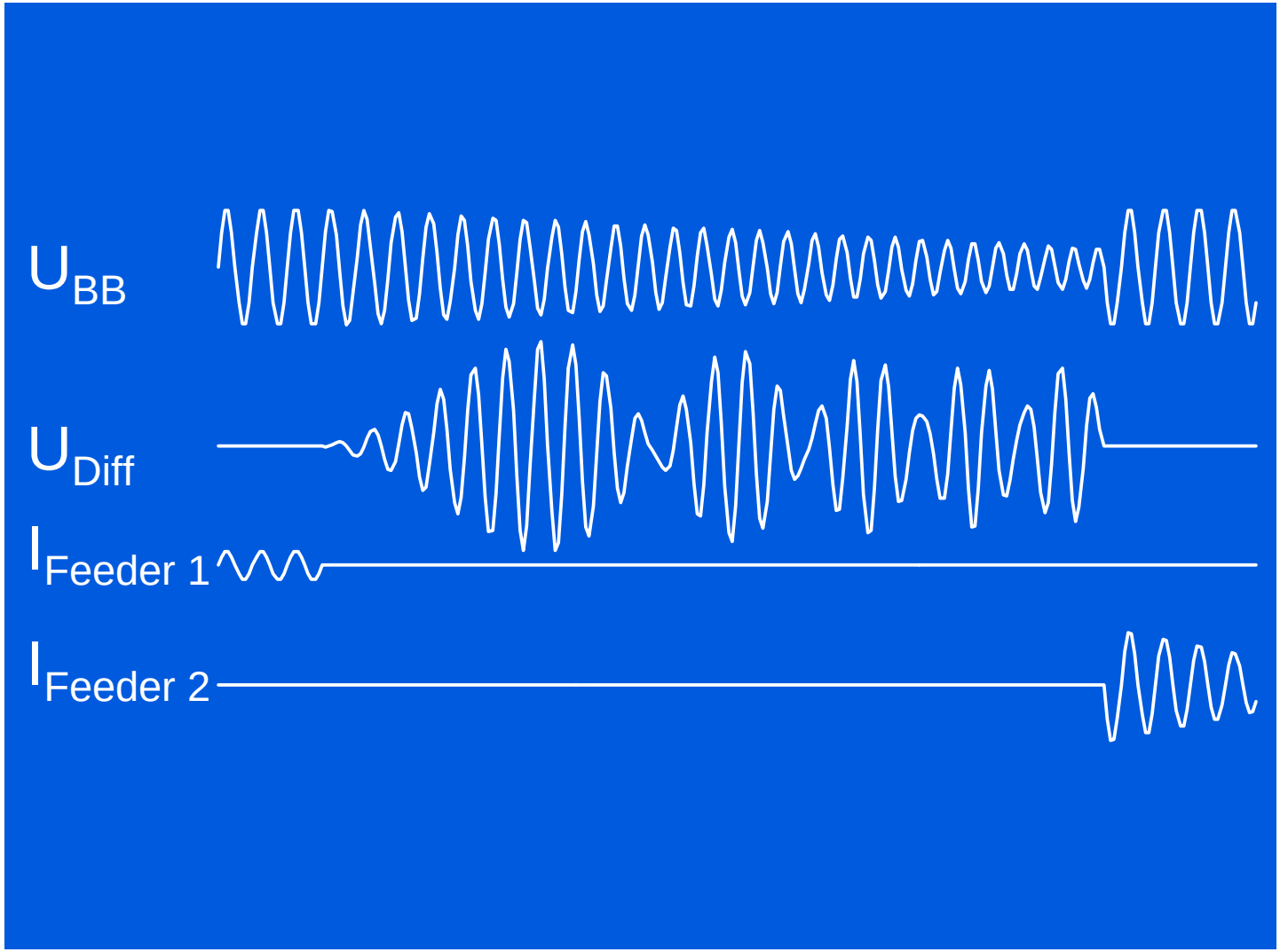
Transfer modes
Transfer at first coincidence (5)



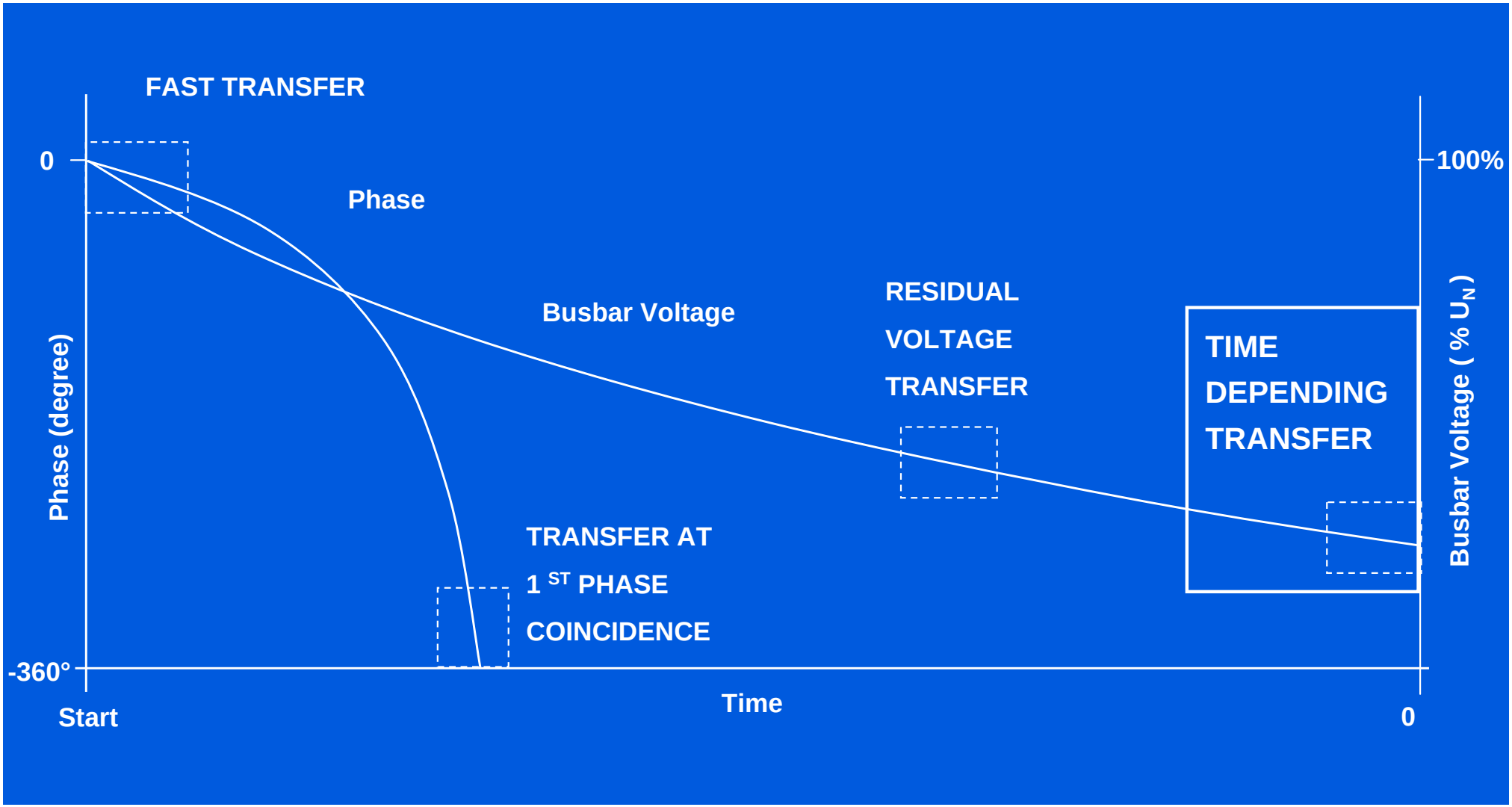
Transfer modes
Residual Voltage Transfer



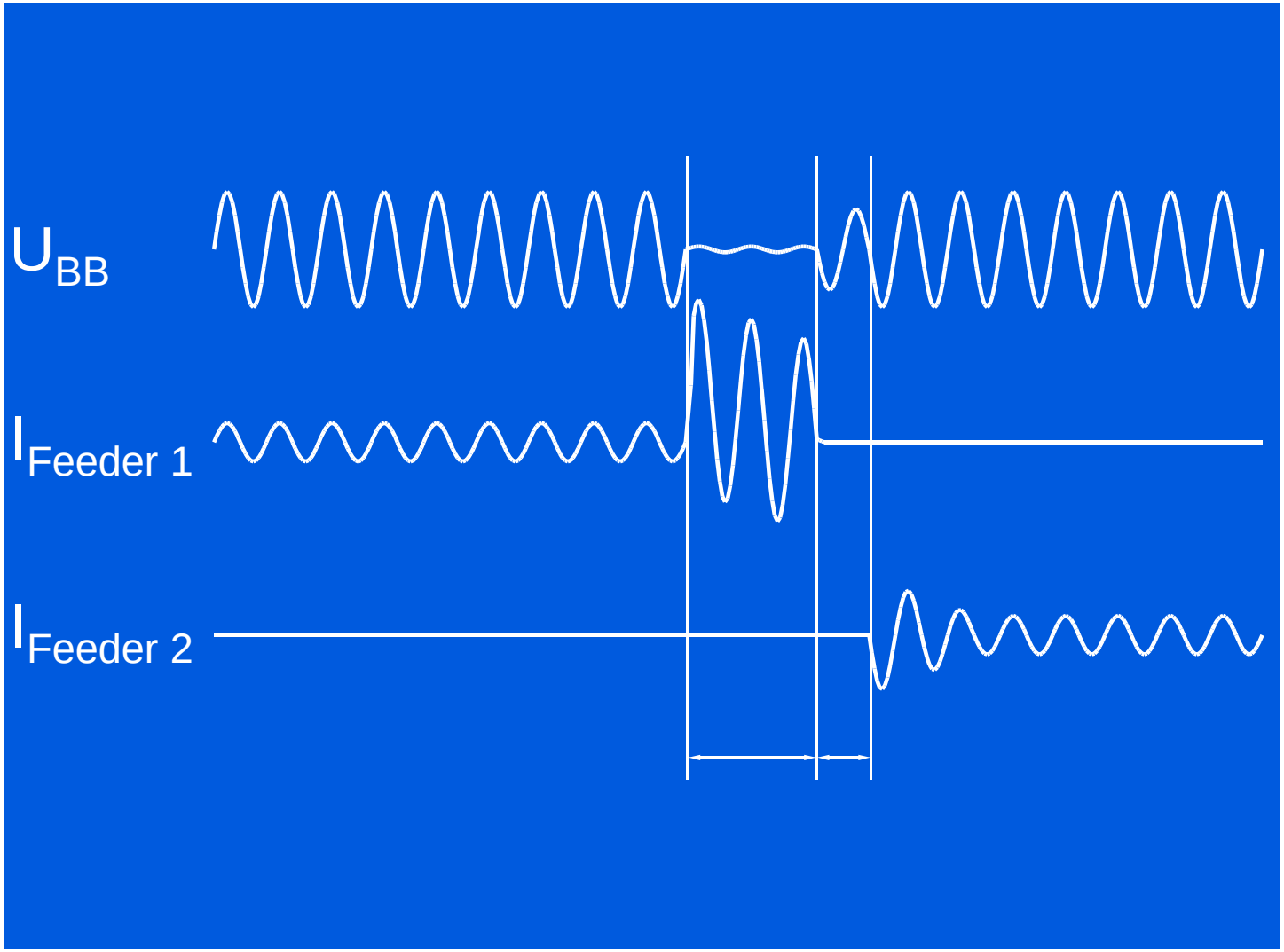
Transfer modes
Residual Voltage Transfer



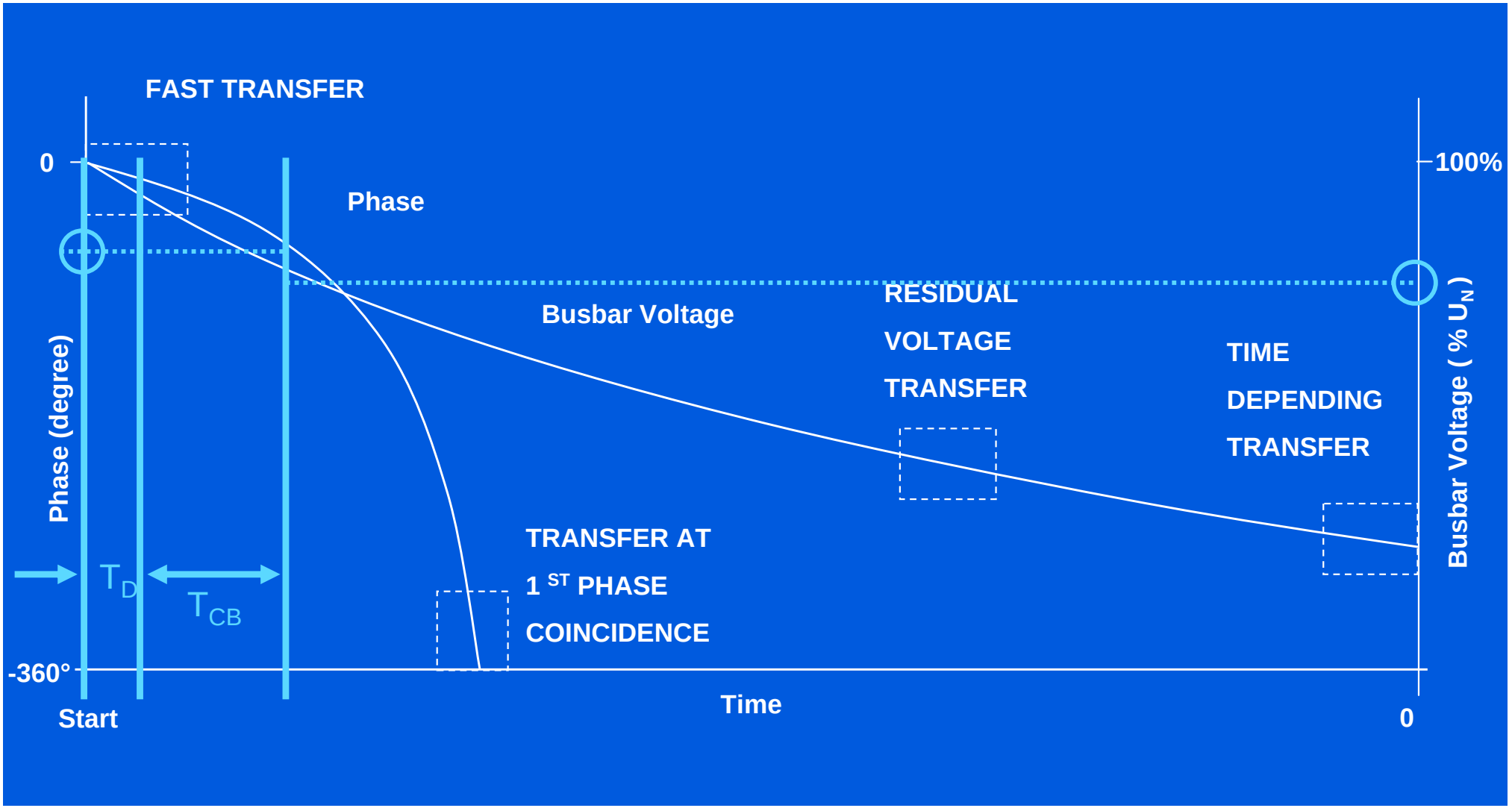
Transfer modes
Time depending Transfer



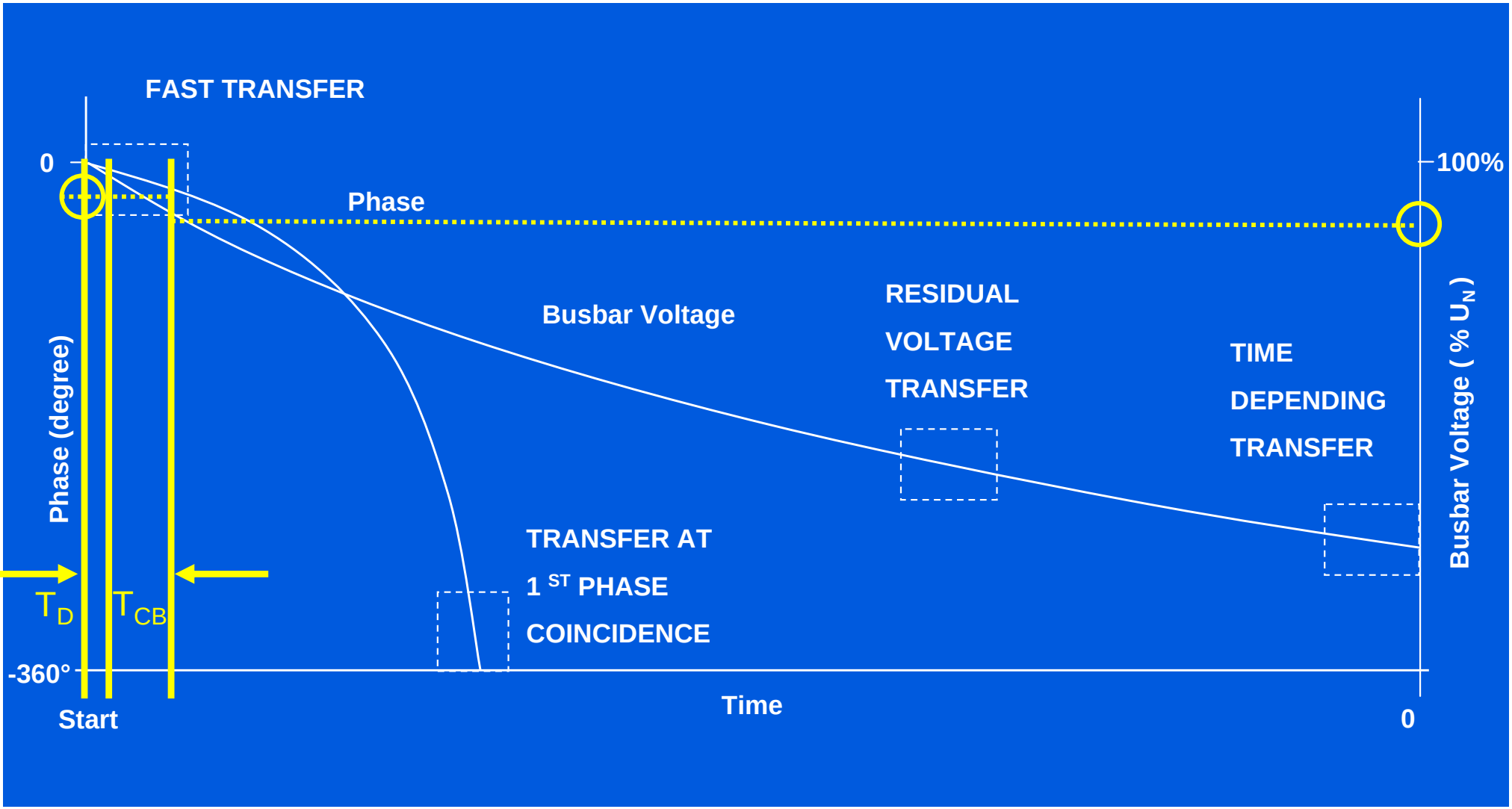
Fast transfer



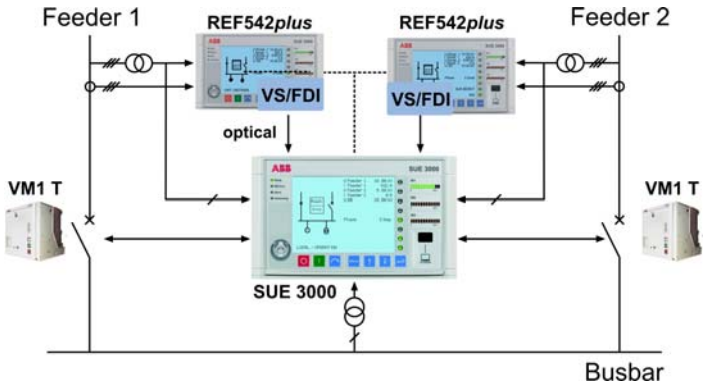
Transfer modes - from fast to …



super-fast!

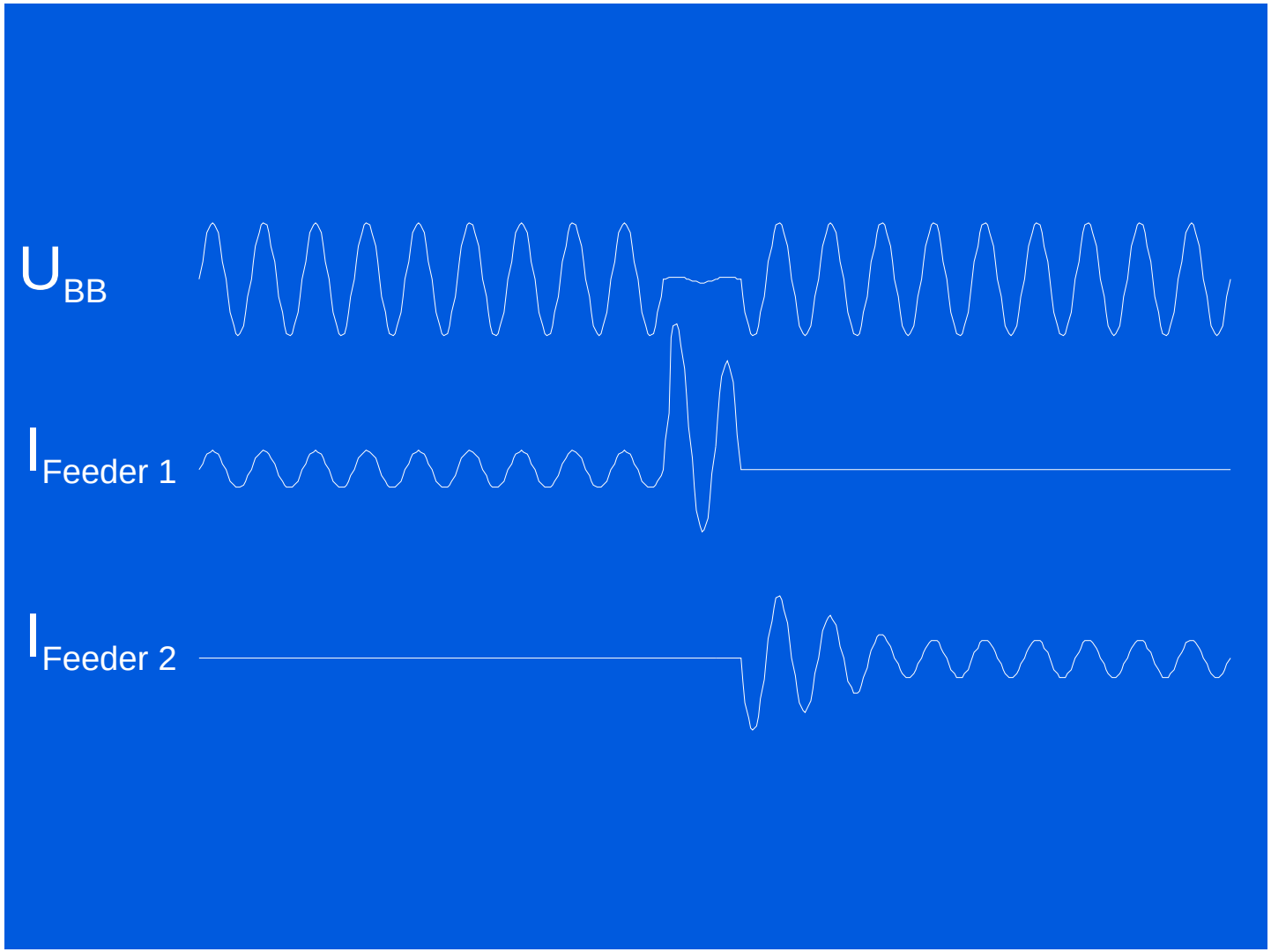


30ms High Speed Transfer *System*

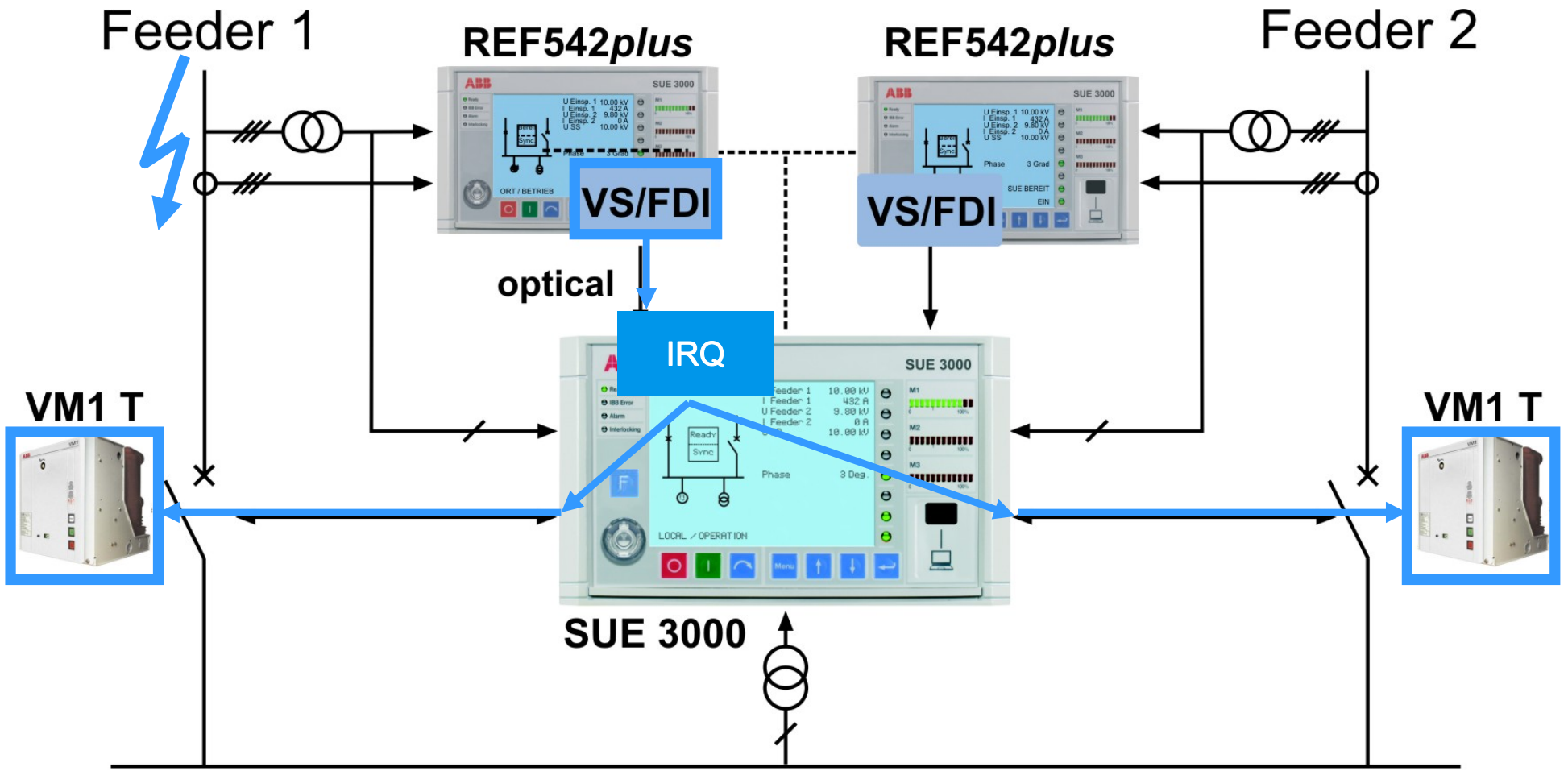


- For sensible plants with **highest** demands like
  - Semiconductor industry
  - Plants with high degree of automation, etc.
- Unique performance
  - VM 1-T Circuit breaker
    - 16 ms Making-time
    - 9 ms Breaking time
- References
  - Otto Versand (mail-order business)
  - Philips Semiconductors
  - Wiegand Glas factory
  - Petrochemicals (RU)

30ms Transfer

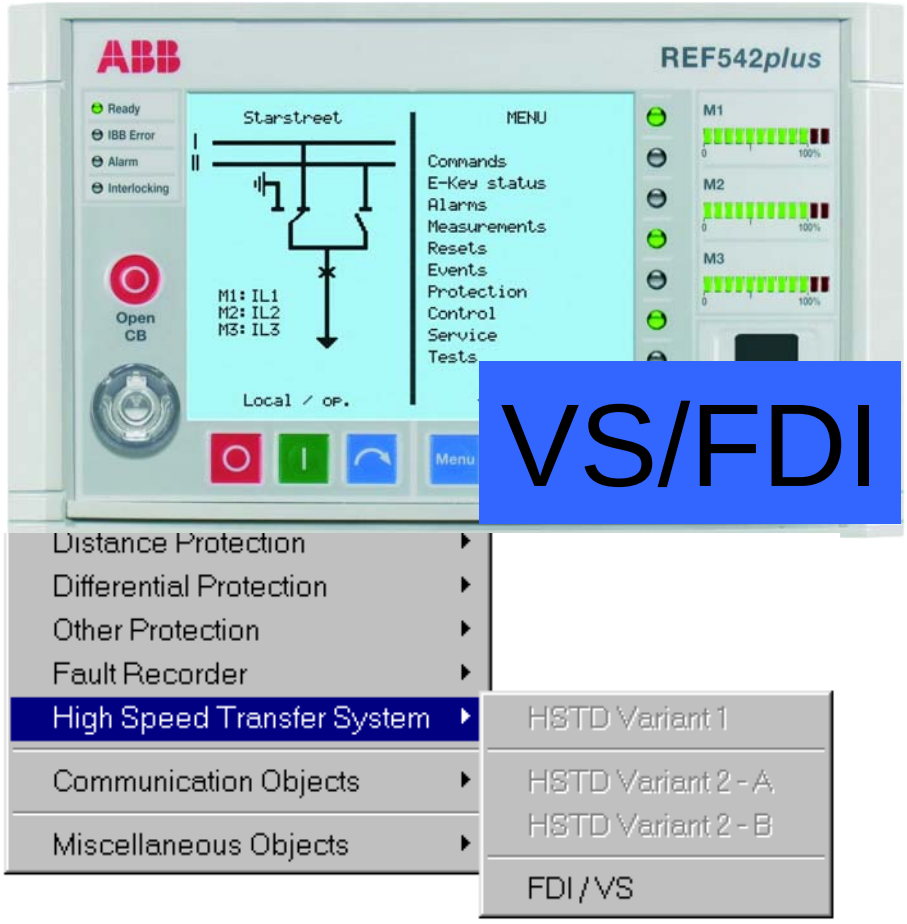


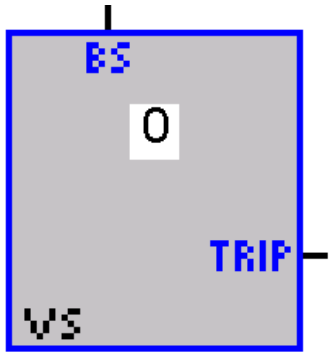
30ms HSTS – optimized architecture

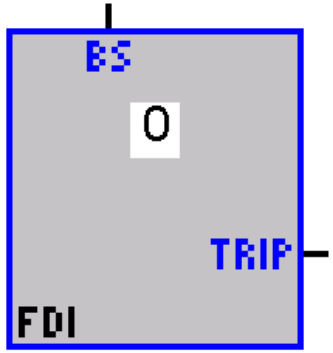


30ms-Transfer animation

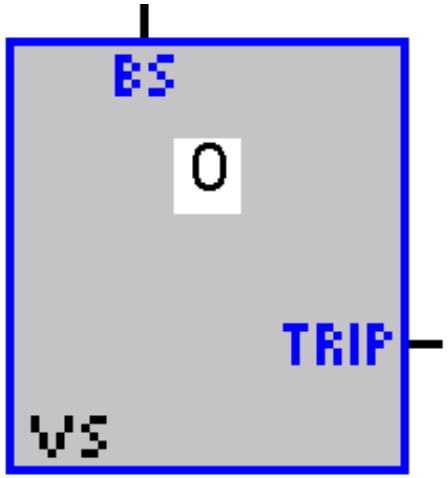
FDI/VS-Object



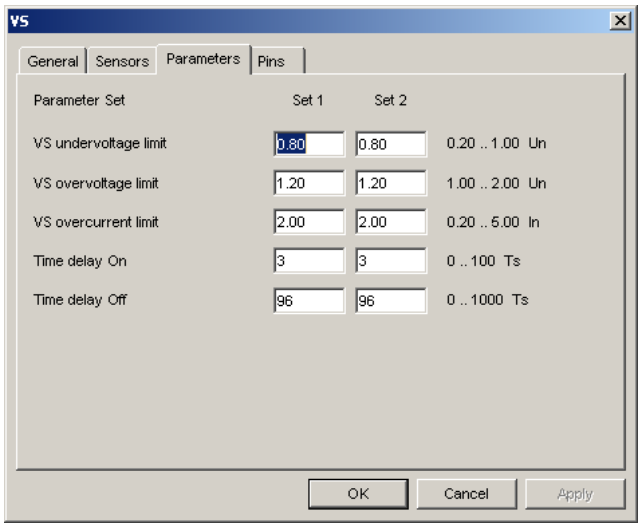




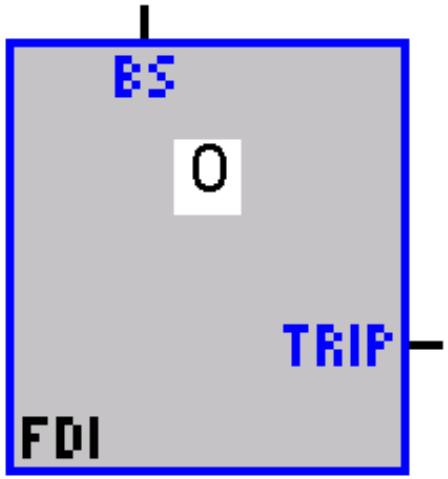
VS-Object



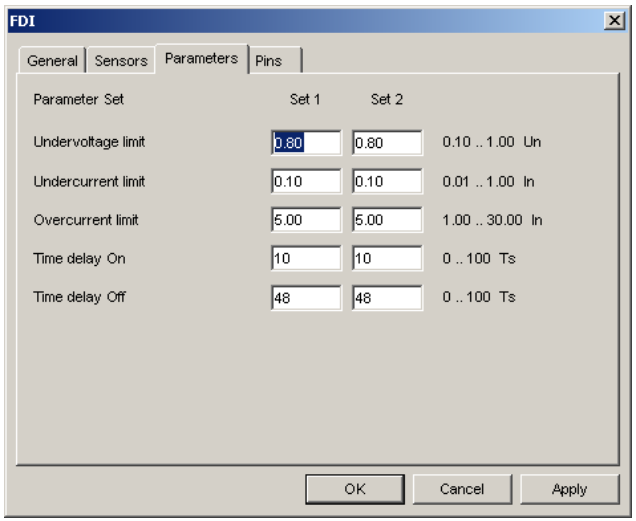
- VS: **V**oltage **S**upervision
  - Extremely fast (undelayed) Under- and Overvoltage detection
  - Blocking by substantial overcurrent



FDI-Object



- FDI: **F**ast **D**irection **I**ndication
  - Determination of reverse power case
  - Blocking by substantial overcurrent



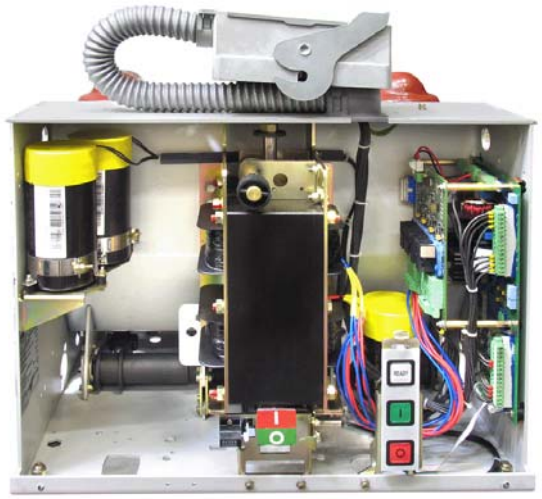
Requirements for HSTS (30ms transfer time)

- Integration of Fast fault detection
  - VS (Voltage supervision)
  - FDI (Fast direction indication)
- Optimized Controller
  - Improvements on REF542plus architecture
- Accelerated Circuit breakers
  - VM1-T (ca. 16ms operating time)
- Optimized signal flow
  - Optical links
  - IRQ-architecture

Transfer duration

Transfer mode	Average transfer duration
Fast Transfer	30 – 100 ms
Transfer at 1st phase coincidence	250 – 500 ms
Residual voltage dependent transfer	400 – 1200 ms
Time delayed transfer	> 1500 ms

VM1-T (Transfer Switch)



Used for High Speed Transfer Systems to ensure uninterrupted power supply

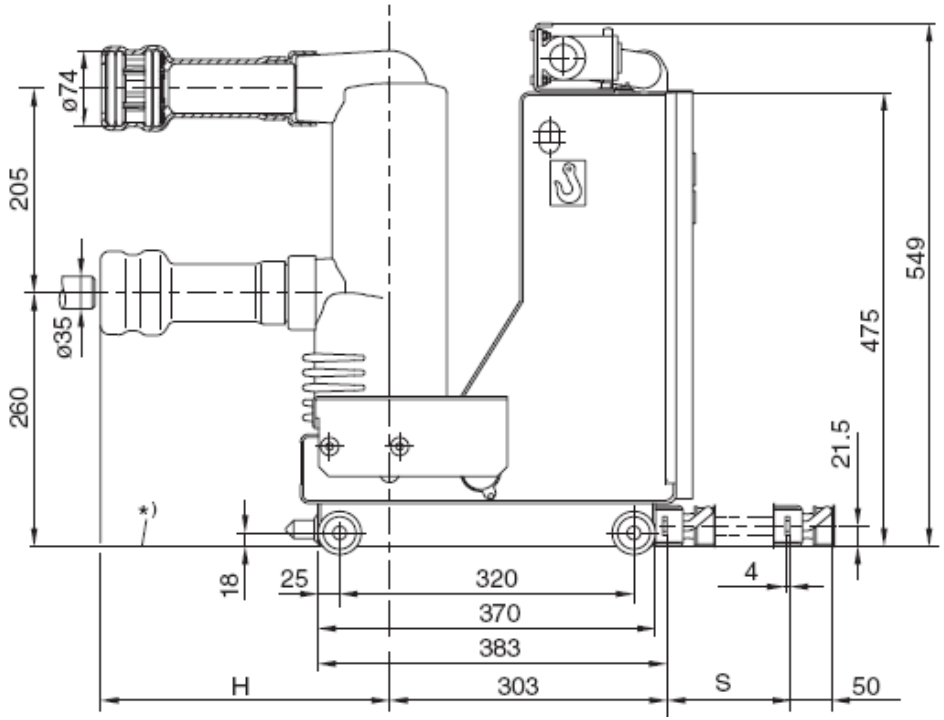
- **Ratings available (fixed & withdrawable):**
  - 12/17,5kV, ...2500A, ...25kA
  - 24kV, ...1250A, ...25kA
- **Faster opening / closing times:**

	VM1-T	VM1
Closing time	approx. 16ms	approx. 45…60ms
Opening time	approx. 10ms	approx. 35…50ms
Arcing duration (50Hz)	<=15ms	<=15ms
Total opening time	<=25ms	<=60ms

- **Hardware differences (compared to VM1):**
  - Electronic board with booster board
  - More capacitors
  - Less windings of the actuator coils

VM1-T
Truck version

- Frame and contact system for the following switchgear types available:
  - UniGear ZS1
  - UniSafe
  - PowerBloc
  - ZS 8.4



Major benefits

- Improvement of plant availability
- Protection of production facilities
- Prevention of costly outages
- Improvement of product quality
- Protection of employees and environment

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