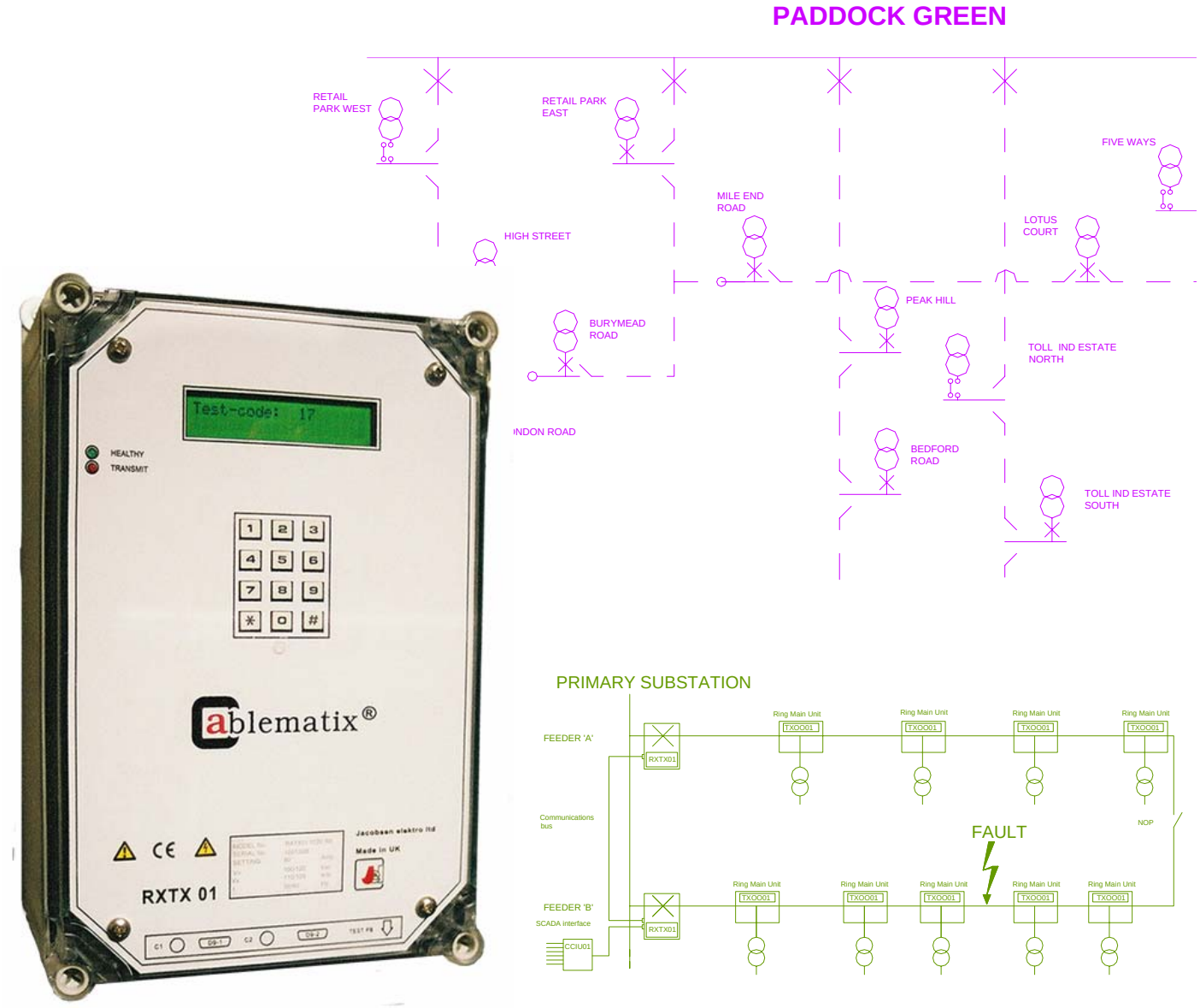
EARTH FAULT INDICATION SCHEME FOR URBAN CABLE DISTRIBUTION SYSTEMS



Jacobsen elektro

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INTRODUCTION AND APPLICATION

Medium-voltage cable distribution systems are inherently reliable, normally comprising a 132kV/11kV primary substation that feeds several Ring Main Unit (RMU) secondary substations in an open-ring configuration.

Within the ring a normally open point (NOP) allows each RMU to be fed from either side, to facilitate the isolation of faulty sections.

When a cable fault occurs, the nature of the urban environment in conjunction with the present switchgear technology prevents fast restoration of supply, resulting in "Customer Minutes Lost" (CML) with subsequent financial penalty.

The Cablematix system identifies and locates the faulted cable section, provides instant communication with the Control Room, and enables restorative action to commence immediately.

The Cablematix system uses existing communications paths, without requiring further investment in additional communications infrastructure.

This provides an extremely cost effective way to locate faulted cable sections and convey the information to the control room engineering staff.

CABLEMATIX SYSTEM

The Cablematix system comprises; -

- Transmitter unit (TXOO01) plus associated CTs located at selected RMU points on the cable network
- Receiver unit (RXTX01) plus associated CTs and voltage transducer, located on each cable feeder at the primary substation
- SCADA interface unit (CCIU01) to collate cable fault location information, display it locally and convey this to the control room staff using an existing SCADA system.

The standard Cablematix system comprises up to 7 cable feeders with up to 16 transmitters on each feeder. Lager schemes can by configured using a split system arrangement in the primary sub-station.

FEATURES

- A reliable earth fault detection scheme with definite minimum operating time
- Self-powered at RMU sites no batteries required to operate
- Commissioning via a built-in auto-test feature.
- Uses the power cable as a communication medium

BENEFITS

- No investment required in an alternative communication media and its associated operational costs
- Provides information to an existing or new SCADA system via voltage free contacts
- Event driven, zero routine maintenance
- Reduced ‘Customer Minutes Lost’ by fast identification of the cable fault position at the Control Room

PRINCIPLE OF OPERATION

Earth fault-sensing transmitters TXOO01 and associated current transformers are deployed along the corresponding cable-feeder at RMU locations.

A receiving unit RXTX01 and associated current transformers, and voltage transducer are housed at the primary switchgear cable-feeder panel.

The receiver units within a primary substation are linked via a communications bus to the SCADA interface CCIU01

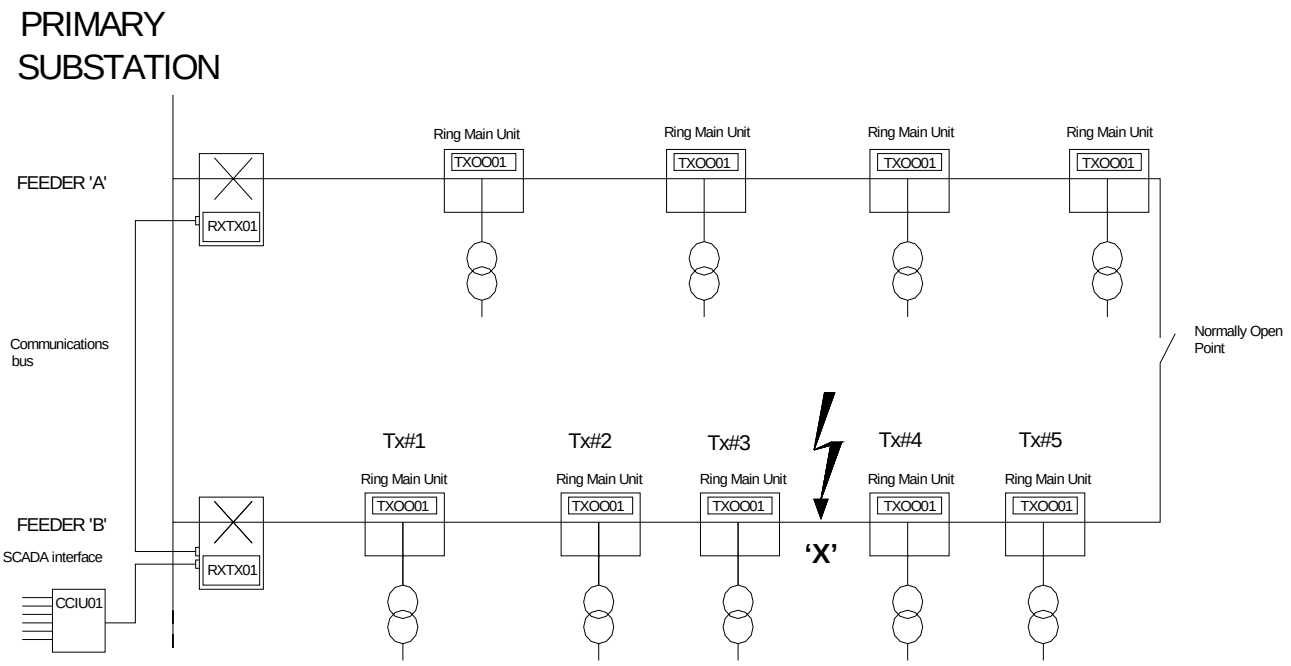

Fig.1 General System Arrangement

Each transmitter communicates with a receiver by sending a unique digitally coded message over the primary cable medium.

During a fault condition, the transmitters senses the passage of fault current and transmit digitally coded messages to the receiver over a dead line i.e. with the primary circuit breaker "open".

The receiver decodes the incoming messages, deduces the fault location and informs the SCADA system via a control unit CCIU01 located at a convenient viewing point in the primary substation.

Under cable healthy conditions, each transmitter periodically sends a test-mode message to the receiver, over the live line, verifying its healthy status. Each receiver also sends test messages to the SCADA interface, verifying the healthy status of the communications bus

Any message errors or absent messages are detected by the receiver and then a warning alarm is relayed to the SCADA system.

EXAMPLE

If a cable fault occurs at point ‘X’ on the cable feeder (ref. Fig1), the circuit breaker at the primary substation will be tripped by the feeder protection relay. Feeder ‘B’ receiver and transmitters number 1, 2 and 3 will sense the passage of fault current and transmit a digitally coded message to the receiver via the 11kV power cable. The receiver will process the received signals and pass information to the SCADA interface unit via the communications bus. The SCADA interface will then convey the information to the SCADA system.

INSTALLATION

The installation of the transmitter unit at the Ring Main units requires a 110/240V ac supply from the local auxiliary supply e.g. lighting circuit. If there is no 110/240V ac available at the RMU the periodic auto test feature will not be available however the cable fault locator will still operate. The connections for the fault passage measurement and signalling are non intrusive, requiring no primary system outages during installation.

The installation of Receivers at the primary substation is the same as the Transmitters, plus a voltage transducer circuit connected to the CT screen point in the LV compartment of the 11kV swichgear.

The SCADA interface is installed at a convenient location in the primary substation, connection between the SCADA interface and the receiver units is by a 'daisy-chain' screened twisted pair cable.

COMMISSIONING

The system has been designed to facilitate the installation and commissioning of transmitter units in a single visit to a ring main unit. The auto-test feature is then used to verify the communication operation during the installation and commissioning of the receiver units at the primary substation.

TECHNICAL DATA:

SETTINGS
Transmitter Current Setting Ip:
60Amps rms
Receiver Current Setting Ip:
80Amps rms
Address Codes: 1 to 254
Time Slots: 16

CT REQUIREMENTS.
Solid core CT for signalling, max earth strap size 50mm
Split core CT for fault current detection, max cable diameter 110mm

RATINGS
Auxiliary Voltage (Vn): 110V ac or 240V ac, fused at 5A
Frequency : 50/60Hz
RXTX01 only
DC Auxiliary Supply (Vx):
110/125V, fused at 5A

BURDENS
AC Voltage (Vn) at rated Voltage <6.5VA
DC Auxiliary Supply (Vx) at rated Voltage <2.8 W

ELECTRICAL ENVIRONMENT
- Insulation

IEC60255-5 :1977
- Insulation Resistance

IEC60255-5: 1977 >100MΩ
- DC Interruption

IEC60255-11: 1979
20ms without de-energising.
- Ripple on DC

IEC60255-11: 1979
- Electrostatic Discharge

IEC60255-22-2: 1989
- Radiated Immunity
- Radiated Emissions
- Conducted Emissions

ATMOSPHERIC ENVIRONMENT
- Temperature

IEC60255-6:1988
Operating -25°to 70°C
Storage -25°to 70°C
IEC60068-2-2: 1990/A2 1994
IEC60068-2-2: 1974/A2 1994
- Humidity

IEC60068-2-3:1969
- Enclosure protection

IEC60529:1989
IP65

MECHANICAL ENVIRONMENT
- Vibration

IEC60255-21-1:1996 (Class 1)
- Shock and Bump

IEC60255-21-2:1995 (Class 1)
- Seismic

IEC60255-21-3:1995 Class 2

TIMING
- Fault detection time at setting 10 seconds
- Fault detection time, minimum 20mS at 100 times setting
- Location transmission time 3.5 sec max from end of fault
- Time to initiate SCADA interface 6 sec max
- Pulse duration of SCADA interface contacts 1 second

HOW TO SPECIFY

The information to specify a systems requirement is as follows
- Number of primary substations to be equipped
- Number of cable feeders within each of the primary substations
- Number of fault location units on each of the cable feeders
- Number of outdoor installations on the cable feeders

Rated voltage for transmitter units 110V or 240V ac
Rated voltage for receiver units 110V or 240V ac (dc supply 110/125 V)
Rated voltage for the SCADA interface is 110/125 V dc