SIEMENS

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VISONIK®

Building Level Network, SDLC Ring

The Building Level Network (BLN) is used to exchange building services data between process stations and a server. In VISONIK, such data communication is carried out via SDLC rings.

The SDLC ring (SDLC = Synchronous Data Link Control) as employed in VISONIK, uses supplier-specific data communication. Object data such as process values, operating states, status indications, etc., are transmitted according to the company's own conventions.

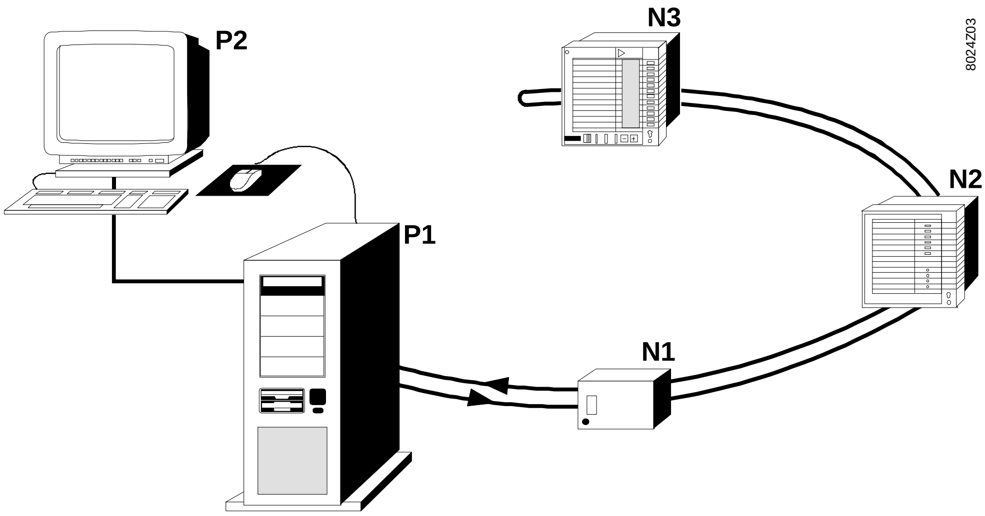
Use

In VISONIK, the Building Level Network (BLN) is based on SDLC ring technology to communicate data between the following types of equipment:

– between the process station (PS) types EKL, PRV1 and BPS
– between process stations and an Enhanced Communication Unit (ECU)
– between process stations and a Data and Communication Server (DCS)
– between Data and Communication Servers in a link system

BLN structure with SDLC ring

The drawing below shows the principal structure of a BLN with an SDLC ring in its most common application: 'PSs in a ring connected to a DCS'. The ring is wired with a 4-core shielded cable.
The ring structure is formed by looping back the wiring at the last physical PS in the ring.



N1	Process station, type EKL controller
N2	Process station, type PRV1 controller
N3	Process station, type BPS (PRV2)
P1	Data and Communication Server, type PLD
P2	"VISONIK Insight" operator station

Note

This data sheet describes only the Building Level Network or SDLC ring as employed in VISONIK for the application - 'PSs in a ring connected to a DCS'. Other applications such as PS with an ECU, DCS in a link system and connections via telephone are not described in this document.

Function

Before explaining how data transmission on an SDLC ring functions, some expressions must be defined.

SDLC/FSK ring

The precise name is SDLC/FSK ring where SDLC (= Synchronous Data Link Control) designates the data transmission protocol. The associated communications conventions are defined (analogous to language rules) in this protocol.

The abbreviation FSK stands for ‘Frequency Shift Keying’, i.e., data is transmitted using frequency modulation.

Note

In VISONIK documents, an SDLC ring connection with no intermediate modem link is usually called an SDLC ring (not SDLC/FSK ring).

Ring signals

Data is transmitted with a carrier frequency modulated at 9.6 kHz or 19.2 kHz. The signals are a sine wave output of approximately 2.3 volts, peak-to-peak. At the receiver side, the minimum permissible attenuated signal level is 150 mVp-p. Ring signals are transmitted using an NRZI code (‘Non Return to Zero Inverted’). A frequency shift takes place with bit "0", but not with bit "1".

Ring masters, DCS or ECU, BPS

A Data and Communication Server (DCS) is the most common ring master. But, there are also applications where an Enhanced Communication Unit (ECU) or a BPS-type Process Station, in vice master mode, can operate as a ring master.

Ring slaves

Ring slaves are stations with which the associated ring master communicates data. Ring slaves cannot actively control data traffic.
Basically, all process stations are ring slaves but, if a BPS station operates in vice master mode, it is classified as the ring master.

Process station

This data sheet uses the term ‘process station’ (PS) without giving the type designations for EKL and PRV1 controllers and the Building Process Station BPS (= PRV2).

V.24/FSK converter

Some SDLC rings can only be connected to their ring master through a dedicated telephone line. In such cases, V.24/FSK converters are used to demodulate/modulate the FSK ring signals for V.24 interface and vice versa. The subject of ‘V.24/FSK Converters for Dedicated Telephone Lines’ is not handled in this document but details are provided in ‘Engineering notes’ under the application ‘V.24/FSK Converter as a ring Signal Amplifier’.

Data transmission

The following description of data transmission on an SDLC ring applies to a Data and Communication Server (DCS) as ring master and process stations (PS) as ring slaves.

Flags

Flags are used as synchronising and control characters for data transmission on an SDLC ring. A flag has a length of one byte (8 bits).

Flag stream

To monitor an SDLC ring, repeated flags (so-called flag streams) are transmitted between data telegrams. Flag stream phases allow ring participants to process their received telegrams or to prepare new data telegrams.

Idle time

‘Idle time’ is inserted between two independent telegram chains. This 'idle time' has two functions:

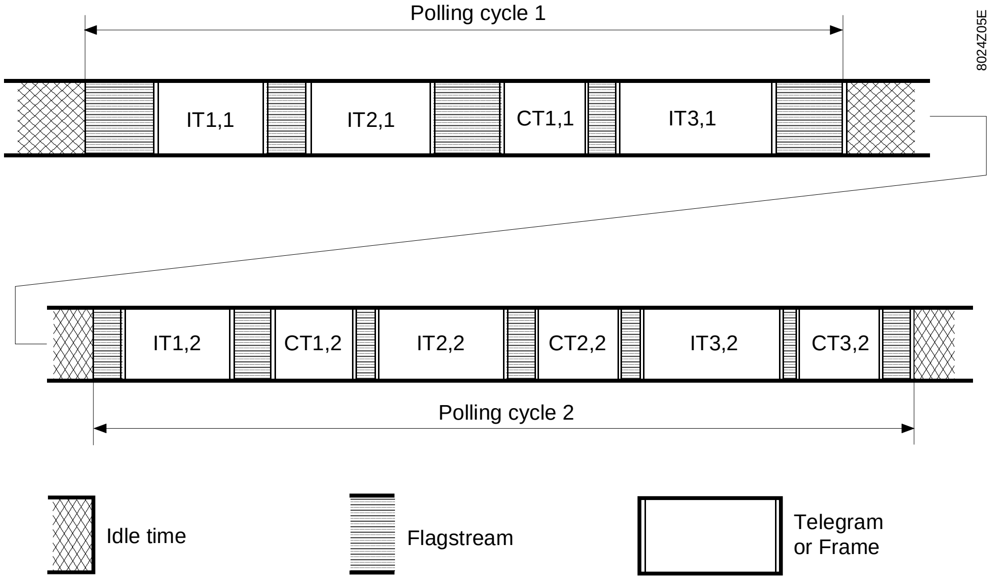
– as soon as data transmission from a DCS to one or more PS(s) is finished, the DCS terminates transmission and goes to ‘idle time’
– when a PS recognises ‘idle time’, permission to transmit is then given.

In order to stop all PSs from sending their existing information once ‘idle time’ has been detected, previously transmitted control telegrams containing explicit addresses determine who may send data (transmit priority).

Polling cycle

'Idle time' brackets a polling cycle. In an SDLC ring, the polling cycle is variable with regard to the number of telegrams and cycle time. With normal ring loading (not as shown in the figure shown below), typically 10 to 30 telegrams are transmitted per polling cycle and the polling cycle time is <2 seconds.

One polling cycle can contain telegrams coming from the DCS for different PSs as well as telegrams that have been added by different PSs for transmission to the DCS.



IT1,1	Info telegram 1 in polling cycle 1	IT1,2	Info telegram 1 in polling cycle 2
IT2,1	Info telegram 2 in polling cycle 1	IT2,2	Info telegram 2 in polling cycle 2
IT3,1	Info telegram 3 in polling cycle 1	IT3.2	Info telegram 3 in polling cycle 2
CT1.1	Control telegram 1 in polling cycle 1	CT1.2	Control telegram 1 in polling cycle 2
		CT2.2	Control telegram 2 in polling cycle 2
		CT3.2	Control telegram 3 in polling cycle 2

PS check

In a 'Process Stations Check', the DCS carries out a check every minute to ensure that at least one information telegram has been received from each PS. If not, the DCS sends an information telegram to the PS(s) involved.

The DCS then expects to receive, in the next polling cycle, a telegram acknowledgement from the PS involved. If there is no acknowledgement from the PS, it is re-initialised after a certain time-out and data transmission is re-established.

Telegram and frame

A telegram is enclosed between a start flag and a stop flag byte which in total is also called a frame instead of a telegram.

Control telegram

A control telegram (or control frame) contains control information for data transmission on an SDLC ring and comprises the following six bytes:

start flag byte / address byte / control byte /
checksum bytes (two bytes) and stop flag byte.

In a control telegram from DCS to all PSs, all 8 bits in the address byte are set to "1". In a control telegram from the DCS addressed to itself (e.g. for diagnostic purposes), all 8 bits in the address byte are reset to "0".

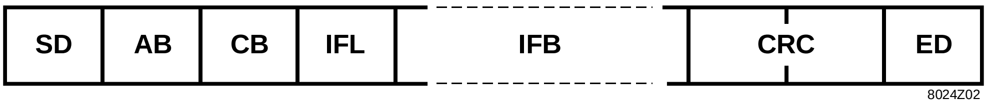
There are several types of control telegrams which are transmitted by the DCS or PS. The respective control information is contained in the control byte.

For example, one kind of control information sent by the DCS is the PS transmission priority, i.e. which PSs may send their data after 'idle time'. Control information from a PS could be, for instance, 'RNR (Receiver not Ready)', i.e. the receiver is to ready to process telegrams.

Info-telegram

If data exists (e.g. point status changes, measurements or switch command outputs), an information telegram or frame is assembled. Upon detecting an ‘idle time’, this assembled info-telegram is then output to the respective ring.

An info-telegram begins with a start delimiter (or start flag byte) followed by an address byte and a control byte that tells the addressed PS which type of telegram is involved (e.g. call-up, acknowledgement, answer). Subsequently, an ‘I-frame length byte’ follows which shows the number of actual info-bytes contained in the telegram.



SD	Start delimiter, start flag byte ‘01111110’	IFB	Info-bytes (1 to 255 bytes)
AB	Address byte	CRC	CRC bytes (2 bytes)
CB	Control byte	ED	End delimiter, stop flag byte’ 01111110’
IFL	I-frame length byte		

Then follows the actual data to be transmitted which can be up to 255 bytes depending on the amount of information. The telegram is terminated with two CRC bytes for data security checking and finally an end delimiter (or stop flag byte).

Notes

In an info-telegram sent from a DCS, the address byte contains the receiving PS’s address. In a telegram sent to a DCS, the address byte provides the sending PS’s address.

The data in one info-telegram from a sender is meant for exchanging with a defined receiver. However, a polling cycle can contain multiple info-telegrams to various receivers.

Cyclic Redundancy Check

All ring stations carry out a check on a telegram's address byte. If a station’s own address matches the telegram's address byte, the telegram is analysed and the received checksum compared with its own calculated CRC value.

If no transmission error is found, the receiver acknowledges the respective telegram in the next polling cycle. If, however, a CRC error is detected, no acknowledgement is returned to the original sending station which then repeats the unacknowledged telegram in the next polling cycle.

Unacknowledged telegrams are repeated up to 255 times. If there is still no further acknowledgement, an automatic ‘reset’ is started in the offending PS.

Notes

Checksums are calculated using a Cyclic Redundancy Check (= CRC) code. (VISONIK uses a 2-byte CRC with a calculation formula according to CCITT regulations).

I-frame length byte

A further data transmission monitor for info-telegrams involves an I-frame length byte containing the number of info-bytes in the subsequent telegram.

If a receiver detects no CRC error but, through the I-frame length byte, discovers a discrepancy between the transmitted information (number of bytes) and that received (number of bytes), a BAD-DL message is displayed on VISONIK’s display screen (BAD-DL = bad data length).

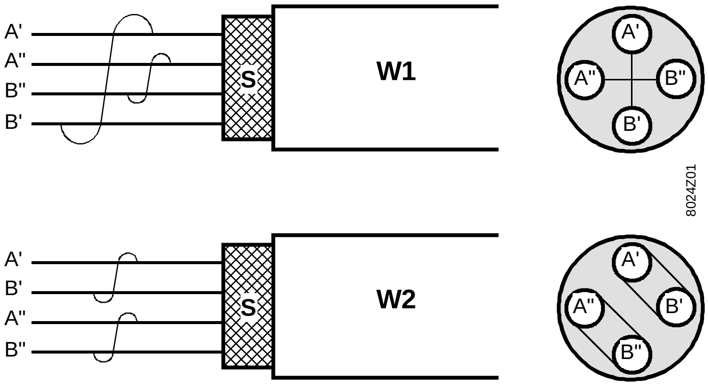
The cause of a BAD-DL lies either before the CRC is calculated at the sender or after the CRC test at the receiver during further processing (e.g. on Direct Memory Access). Refer to BAD-DL in document CM2T8336E.

**Failed CRC test,
Noise, Noise counter**

Corrupted telegrams or frames which fail a CRC test come under the general diagnosis ‘Noise’. Bad telegrams are counted in individual noise counters in each ring station (BAD-DL cases do not increase a noise counter’s number).

Ring cables

Ring wiring requires a **4-core, shielded cable** of the following types:



S	Cable shield
W1	Cable type 1 x 4 (Quad, all four cores twisted together)
W2	Cable type 2 x 2 (Two twisted pairs, with the pairs again twisted together)

Ring wiring

Ring signals from the master to its slaves are transmitted on the first core pair, lines A' and B' (= outgoing lines).

Ring signals are returned to the master on the second core pair, lines A'' and B'' (return lines).

Field telephone lines, PHONE

If a field telephone is also to be wired in the ring cable, a shielded six-core, 3 x 2 twisted pairs, must be used.

Engineering notes

This section discusses the **basic** wiring of an SDLC ring. A more detailed description is provided in document CM2T8336E, chapter 2, 'SDLC Ring Wiring'.

⚠ **Warning**

When engineering the ring layout wiring, always observe all local and country-specific regulations.

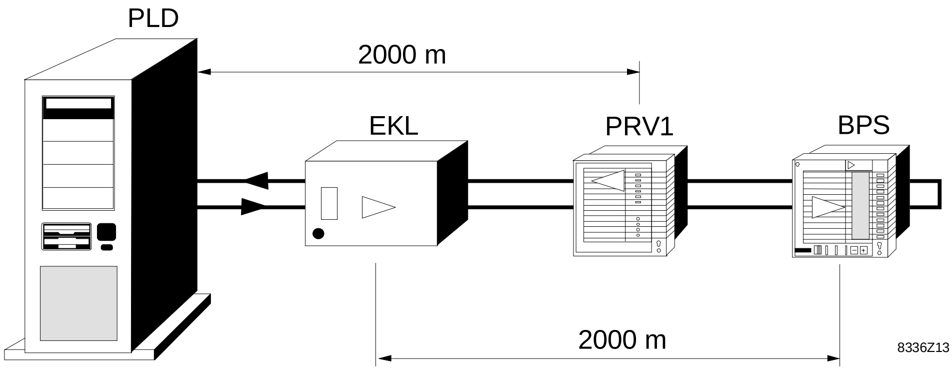
Ring structure

An SDLC ring must be laid out as an electrical closed loop, beginning and ending at the ring master or at the FSK connection card. Only the topology can be regarded as a ring in which the stations are integral parts. An SDLC ring can be several kilometres in length. Note that:

– the maximum length of a ring section between two stations with **no** line amplifier is 2000 metres (see figure below).

Ring extension over 2000 metres

If a ring is to be extended over a distance of more than 2000 metres, the ring signals must be amplified in both the outgoing and return lines. This means that ring signals are amplified by alternate process stations in the outgoing and return ring lines respectively.



Note

When planning an SDLC ring's layout and its cabling, ensure that the **actual cable length** between two stations (DCS to PS and PS to PS) does not exceed 2000 metres. Signal amplification in the outgoing and return lines is more important than the local straight-line distance between stations.

Note

- All ring stations (DCS, ECU and PS as well as V.24/FSK converter) repeat or amplify ring signals. The distance between two stations must not exceed 2000 metres. When planning the distance between stations, remember to account for the ‘ring station failure’ situation(a station failure must not cause a break in the ring).
- If a ring section of more than 200 metres is to be bridged, two V.24/FSK converters type LVZ4.4201 (connected face to face) may be installed as line amplifiers (there is no individual line amplifier unit as such).

Cable shield grounding

A general definition on grounding or bonding cable screens cannot be provided. Shield grounding very often depends on the conditions at the equipment location. Primarily, grounding should occur as described in the following **rule 1.**

Rule 1

– The respective country’s local regulations permitting, a cable’s shield should be grounded **locally at both ends**, i.e. the cable shields should be grounded at all ring stations.

Rule 2

– Cable shields must at least **be locally grounded at one end**.

Note

For more information on grounding cable shields, refer to the following comments on lightning protection and to the example under ‘SDLC Ring Wiring’ in the section ‘Connection diagrams’.

Lightning protection

Landis & Staefa does not issue any specifications on lightning protection for a Building Level Network which uses SDLC rings. Always observe all applicable local regulations on lightning protection and equipment bonding. However, remember that absolute lightning protection can never be guaranteed.

The following precautions serve as a **measure of lightning protection**:

– if cable shields are grounded at both ends, a bonding link between buildings to avoid earth potential differences is essential. At each point where line feeds enter or leave a building, suitable external lightning arresters must be fitted.

– if there is no earth potential bonding line between buildings, the cable shielding must be grounded at one end only. The ungrounded shield end must be connected to a so-called nonlinear resistance arrester.

Ring terminating resistor

Ring lines must be fitted with terminating resistors following special rules.

The EKL controllers are delivered with 180 ohms ring terminating resistors (clamped to the rear of the unit’s housing). Where necessary, such a resistor must be inserted into the slots labelled 5 and 6 on the EKL base socket.

For PRV1 controllers and BPS, 180 ohms terminating resistors must be ordered separately. Order reference for a package of 10 resistors: PVR1.180. Where necessary, such a resistor must be fitted to the vertical screw terminals 1A and 2B of terminal block III (PVX1.1C).

Rules for ring terminating resistor

A terminating 180 ohms resistor must be fitted:

– if a ring section between a sending process station (EKL-X, PRV1, BPS) and a receiver is more than 100 metres. A terminating resistor must be fitted at the receiving process station.

– if two or more process stations are connected to a ring section less than 25 metres, a terminating resistor is required only at the PS nearest to the DCS.

Installation notes

Ring wiring and grounding of cable shields must be made as described in document CM2T8336E, chapter 2, 'SDLC Ring Wiring'.

SDLC ring accessories

The following accessories can be ordered for SDLC ring installation:

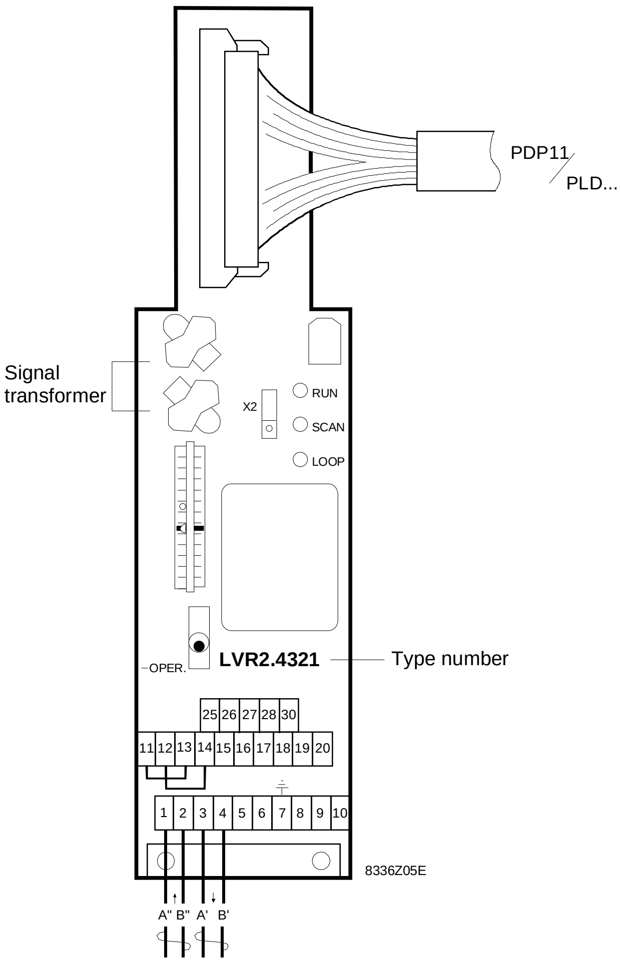
– Cable, DCS to FSK connection card	6 metres	LVR1.4401
– Cable, DCS to FSK connection card	12 metres	LVR1.4402
– FSK connection card		LVR2.4321
– COM1 communication card, for BPS only	SDLC only	PVC1.1S
– COM1 communication card, for BPS only	SDLC & V.24	PVC1.1ST
– Ring terminating resistor, for PRV1 and BPS only	pack of 10	PVR1.180
– Terminal block III, for PRV1 and BPS only	pack of 4	PVX1.1C

Basis for ring wiring

The basis for ring wiring is the cables to the FSK connection card. Use only connection cards with type number LVR2.4321 for VISONIK DCS stations of type PLD. LVR2.4321 cards can be recognised by the two signal transformers fitted to them (earlier LVR1.4321 connection cards have no signal transformers).

Important

Never lay a ring cable alongside lines carrying 24 VAC and three-phase mains supply lines of 3 x 400 VAC.



Notes

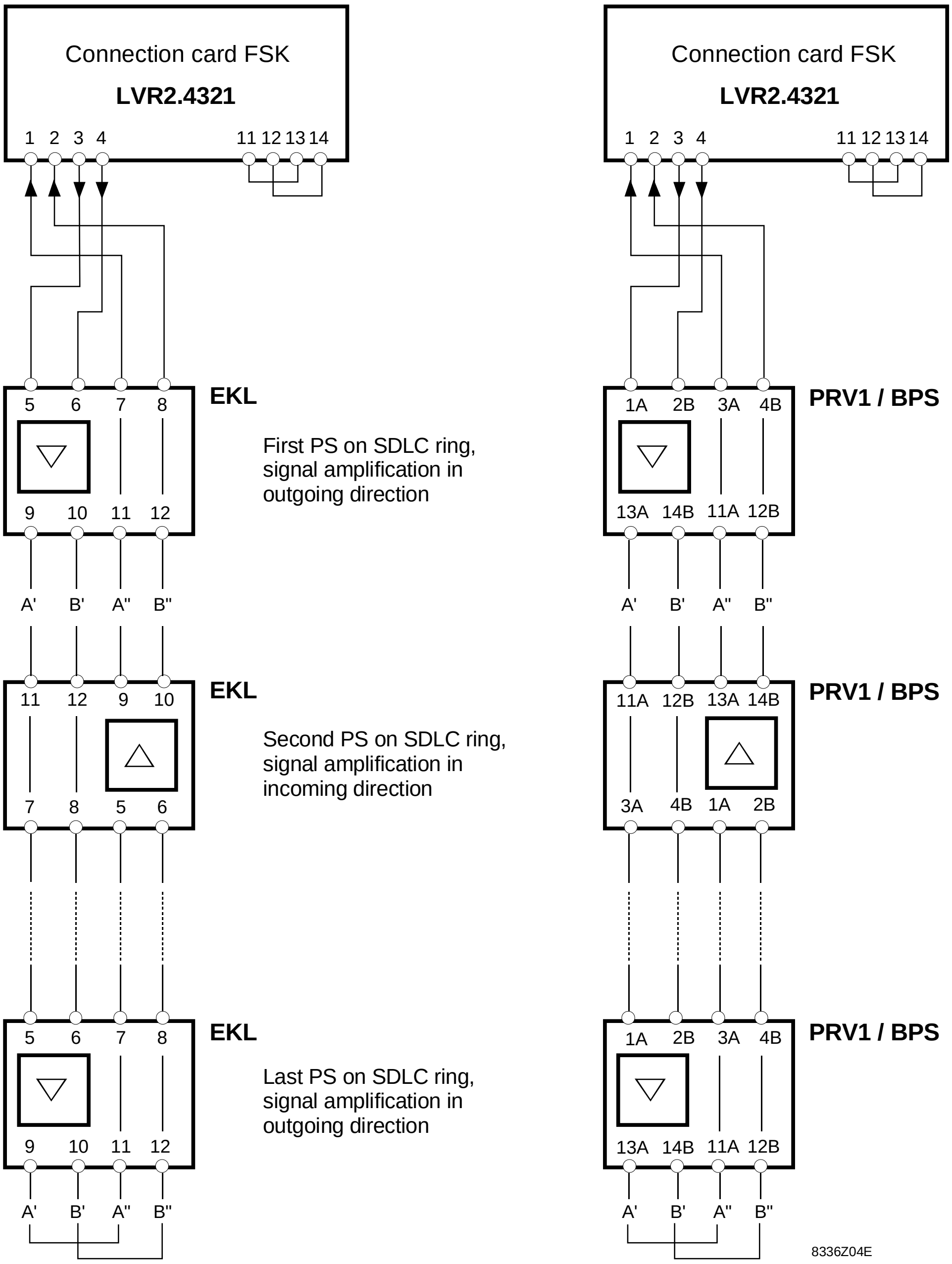
In a VISONIK system with only one DCS, the associated FSK connection card must have bridges fitted across its terminals **11, 13** and **12, 14** (see drawing above).

In VISONIK systems with two DCSs as **dual computers** or with two or more DCSs as **link computers**, the ring cable to the second computer is wired to terminals 11 to 14.

Ring wiring

In accordance with the guidelines for ring wiring, the signals should be alternately amplified in the outgoing and return lines in each successive process station. The following points apply assuming that the related SDLC ring is wired throughout with the one cable:

- the wire colour coding on terminals 3 and 4 of the FSK card is for **outgoing lines** (ring signals **to** the process stations). Outgoing lines are wired through to the last ring PS at which point they are looped back as return lines.
  The twin core outgoing lines are marked in this document as A' B'.
- the wire colour coding on terminals 1 and 2 of the FSK card is for the **return lines** (ring signals **from** the process stations). Return lines are wired from the last ring PS through to the FSK card.
  The twin core return lines are marked in this document as A'' B''.



Notes

Ensure that PSs with line amplifiers in the outgoing and those with amplifiers in the return lines strictly adhere to the correct wire colour coding and terminal allocations.

Excepting the last ring PS, each station has two ring cable sections connected to it.

Commissioning notes

SDLC/FSK cards are already installed on delivery of DCS types PDP and PLD as well as in EKL and PRV1 controllers.

In delivered BPS basic units, PVC1.1S or PVC1.1ST COM1 communication cards must be fitted on-site whenever a BPS is to be connected to an SDLC ring.

- **PVC1.1S** for Building Level Network, SDLC ring
- **PVC1.1ST** or Building Level Network, SDLC ring and V.24 to TTY1 and TTY2

Refer to data sheet CM2N8311E for details on the COM1 communication card.

Communication points

For SDLC ring data communications, the system automatically generates communication points $Rn (n=1..6) in the DCS, @RING in the BPS, and TTY3 in the EKL and PRV1 controllers. A communication point in the BPS is generated only when a PVC1.1S or PVC1.1ST type COM1 card is fitted. The following checks or settings must also be carried out:

Ring baud rate

– Parameter BAUD or BD

DCS with computer type PLD...	$Rn.BD, n=1..6	(read/write)	
DCS with computer type PDP...	$Rn.BAUD, n=1..6	(read-only)	1)
BPS process station	@RING.BD	(read/write)	
EKL and PRV1 controllers	TTY3.BD	(read-only)	2)

1) ring baud rate in $Rn.BAUD in a DCS with a PDP computer type is a hardware setting and is copied to parameter BAUD after boot BOO,I.

2) ring baud rate TTY3.BD in EKL and PRV1 controllers is a hardware setting; in the EKL, this is set by a jumper on the SDLC/FSK card (see CM2T8336E); in the PRV1, this is set by a slide switch on the unit's front panel.
In both the EKL and PRV1 controllers, the set baud rates only become effective after the unit has been initialised with 'reset'.

BLN Comm. Way and inhibit telephone function

– Parameter SWAY and PHON (BPS only)

Communication on SDLC ring	@BLN.SWAY=2	(read/write)	1)
Inhibit telephone function	@PHON.PHON=0	(read/write)	1)

1) If a value is reset, it will only become effective after initialisation with 'reset'.

SDLC ring commissioning

SDLC ring commissioning occurs in several stages; however, the following preconditions must first be fulfilled:

– the DCS must be supplied with mains power and started. Ring $Rn (max. n=6) must be set 'in service' by software, i.e. $Rn.OSV=No).

– an LVR1.4401 (6 metres) or an LVR1.4402 (12 metres) ring cable must be fitted between the FSK connection card to the DCS. The FSK connection card's two-way switch (only LVR2.4321 allowed with PLD computers) must be set to OPER (Operate) and the blue jumper on X2.

Note

The following section briefly describes how an SDLC ring is commissioned in steps. Refer to document CM2T8336E for a detailed description.

Step 1: Ring test VISONIK DCS

There is small test plug-in board on the FSK card which can be used to test ring section 'DCS to FSK connection card'. For this test, the card's side marked TEST must be plugged into the socket connector.

Ring electrical continuity

If there is electrical continuity in the ring section 'DCS to FSK connection card', the FSK card's lamps RUN and LOOP are lit and the SCAN lamp blinks.

Important

When the section ‘DCS to FSK connection card’ functions, the ring test card **must** be reversed and plugged in again with side NORMAL inserted.

Step 2: Commissioning without PSs

Plant operating permitting, rings should be commissioned without process stations. A check must be made to ensure that all PSs are connected to their associated ring cable and that there is a loopback wired at the last PS and that terminating resistors are fitted where necessary (see ‘Project Planning Notes’).

See step 1 for reaction when ring electrical continuity or wiring is in order.

Step 3: Commissioning with PSs

In the following description, we assume that steps 1 and 2 have been carried out correctly. However, check first the following:

- In all PSs:
  the same baud rate has been set throughout (on hardware in EKL and PRV1 controllers and via software in BPS with parameter @RING.BD).
- In all EKL controllers:
  address matrix cards are inserted and mains supply of 230 VAC is connected.
- In PRV1 and BPS:
  PRV1 ==> address plug is inserted at ADR in the front panel.
  BPS ==> station address has been defined with parameter @BPS.NR or SYSNR.
  Terminal block III at the housing’s rear is firmly seated correctly in its holding bracket.
  24 VAC operating voltage is connected to terminal block I (G, G0).

Step 4: Commissioning in order

Ring commissioning is o.k. when RUN and LOOP lamps on the FSK connection card are lit and SCAN blinks. The following is displayed on VISONIK’s display terminal after entering <Ctrl> <P> and $R1 (as an example):

```
11:24:44 Function=PNT : $R1
                  normal,PS total =7
```

“Break before Master”
“Break before PS”

The system reports “Break before Mstr” if the DCS does not receive ring signals. The message “Break before PS” appears if the outgoing line is broken before the referred PS, but not if there is a break in the return line.

```
11:24:44 Function=PNT : $R1
                  Break before Mstr
```

‘Beacon’ signal

A ‘Beacon’ signal is transmitted if, for example, the carrier signal is lost or if selective frames are not received within approximately three minutes.

Technical data

The following technical data apply to SDLC rings as installed and operated in VISONIK systems:

Transmission protocol / transmission format (IBM standard)	SDLC (= Synchronous Data Link Control)
Data bits / bit coding	8 / NRZI (= Non Return to Zero Inverted)
Interface definition (with 9.6 kHz and 19.2 kHz)	FSK (= Frequency Shift Keying)
Permissible signal attenuation	24 dB
Transmission mode	full duplex
Rate of transmission	1200, 2400, 4800 bps
for BPS only	2400 and 4800 bps
Line length without signal amplifiers	max. 2000 m
Line length with signal amplifiers	several kms

Technical data continued	Ring cable (without field PHON lines)	4 core, shielded
	Wire cross section	0.8 mm (min. 0.6 mm)
	Cable impedance	120 ohms at 100 kHz
	Interface coupling, ring cable to ring station	galvanic isolation

VISONIK equipment

Information on VISONIK equipment which connects to an SDLC ring can be found in the following technical data sheets:

– Building Process Station (overview)	BPS	8301
– COM1 communication card for BPS	PVC1...	8311
– Controller	PRV1...	8341
– Data and Communication Server DCS	PLD3...	8546..8549
– Data and Communication Server DCS	PLD4...	8556

Connection diagrams

The connection diagrams below show ring components which are **wired directly to an SDLC ring cable**.

Ring wiring

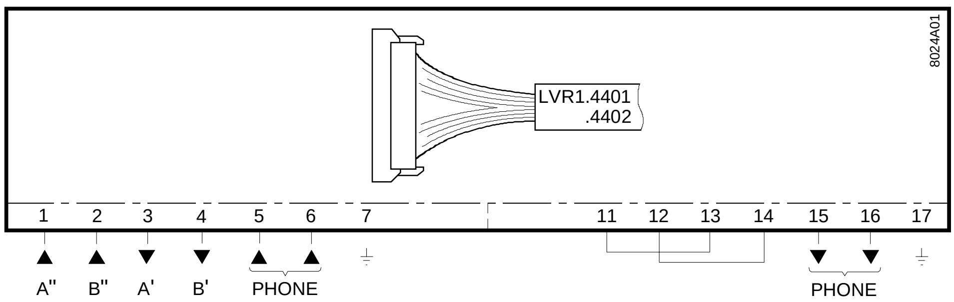
Twisted core pair A' and B' carry signals from the ring master to the ring slaves (outgoing lines) and the twisted core pairs A'' and B'' form the return lines for signals back to the ring master.

PHONE field telephone connection

If PHONE lines are to be included in ring cable a 6-core, 3 x 2 pairs shielded cable must be used.

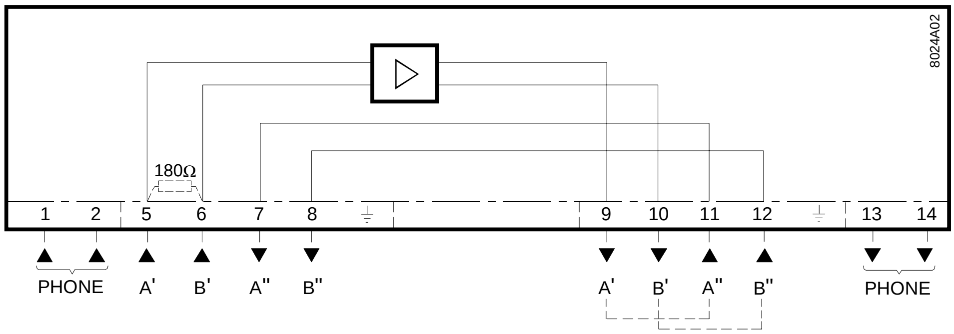
FSK connection card

LVR2.4321



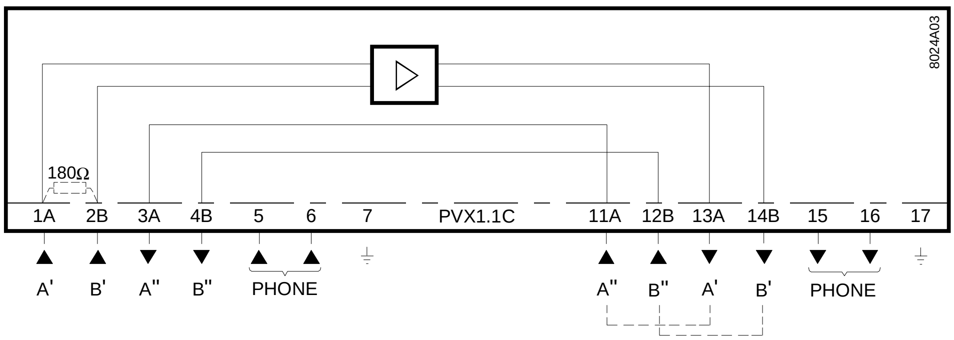
Ring to EKL controller

EKL



Ring to PRV1 and BPS

PRV1 / BPS



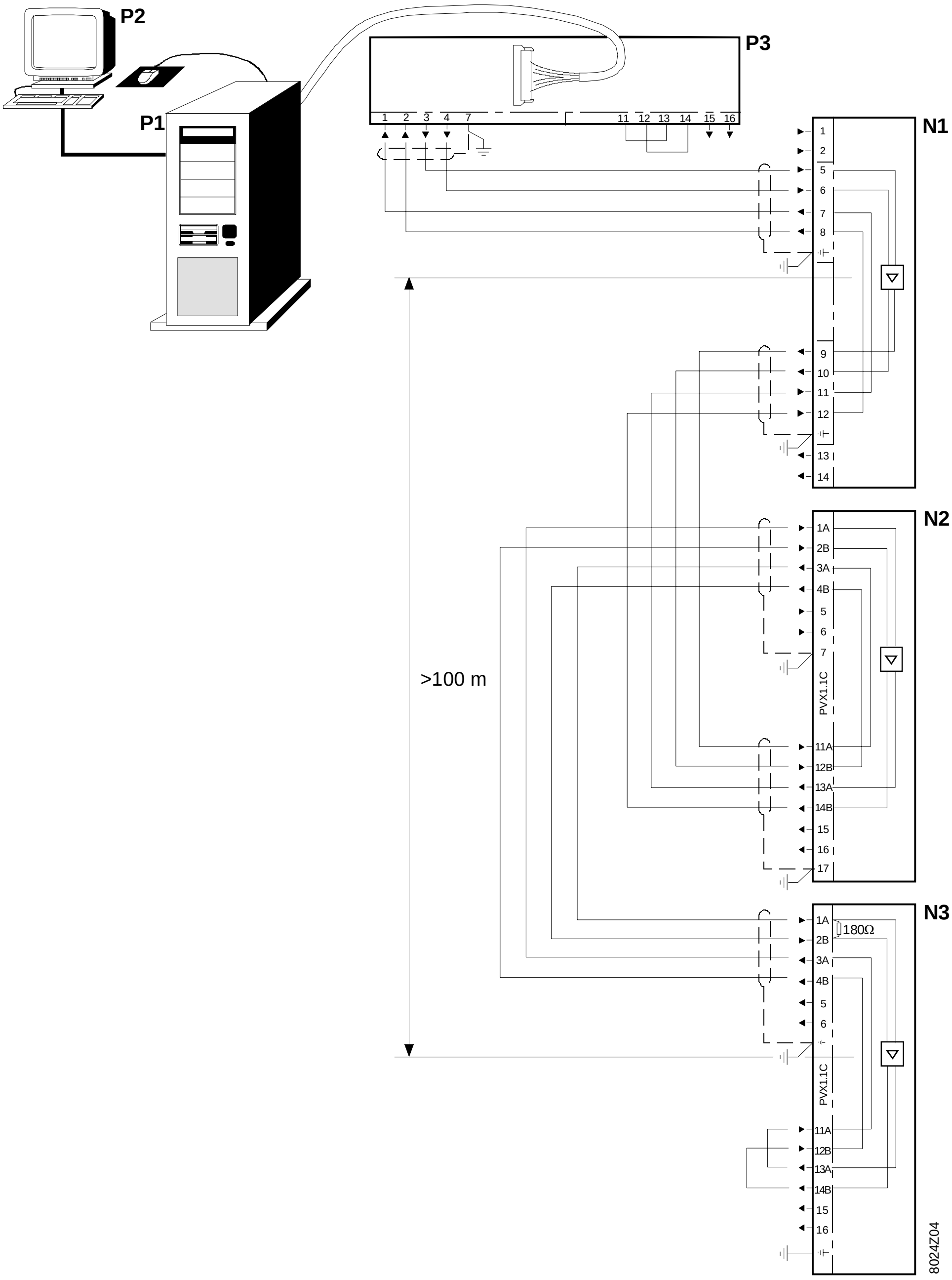
SDLC ring wiring

Note the following points in the SDLC ring wiring diagram below:

– ring signals are repeated in both the outgoing and return lines., i.e. outgoing at the first and third process stations N1 and N3 and in the return line at the second process station N2

– cable shielding is grounded at both ends as per rule 1 (see Engineering notes)

– a terminating resistor is fitted at the third process station N3, as the section from the sending station N1 to the receiver N3 exceeds 100 metres in length.



N1	Process station, type EKL
N2	Process station, type PRV1
N3	Process station, type BPS
P1	Data and Communication Server, type PLD
P2	"VISONIK Insight" operator station
P3	FSK connection card, type LVR2.4321