NUM 1020/1040/1060 FIPWAY INTEGRATION MANUAL

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Despite the care taken in the preparation of this document, NUM cannot guarantee the accuracy of the information it contains and cannot be held responsible for any errors therein, nor for any damage which might result from the use or application of the document.

The physical, technical and fonctional characteristics of the hardware and software products and the services described in this document are subject to modification and cannot under any circumstances be regarded as contractual.

The programming examples described in this manual are intended for guidance only. They must be specially adapted before they can be used in programs with an industrial application, according to the automated system used and the safety levels required.

Contents

Record of revisions

REVISIONS OF THE DOCUMENTATION

Date	Index	Description
02 - 97	0	Document creation.
03 - 98	1	Update of document.

1 FIPWAY overview

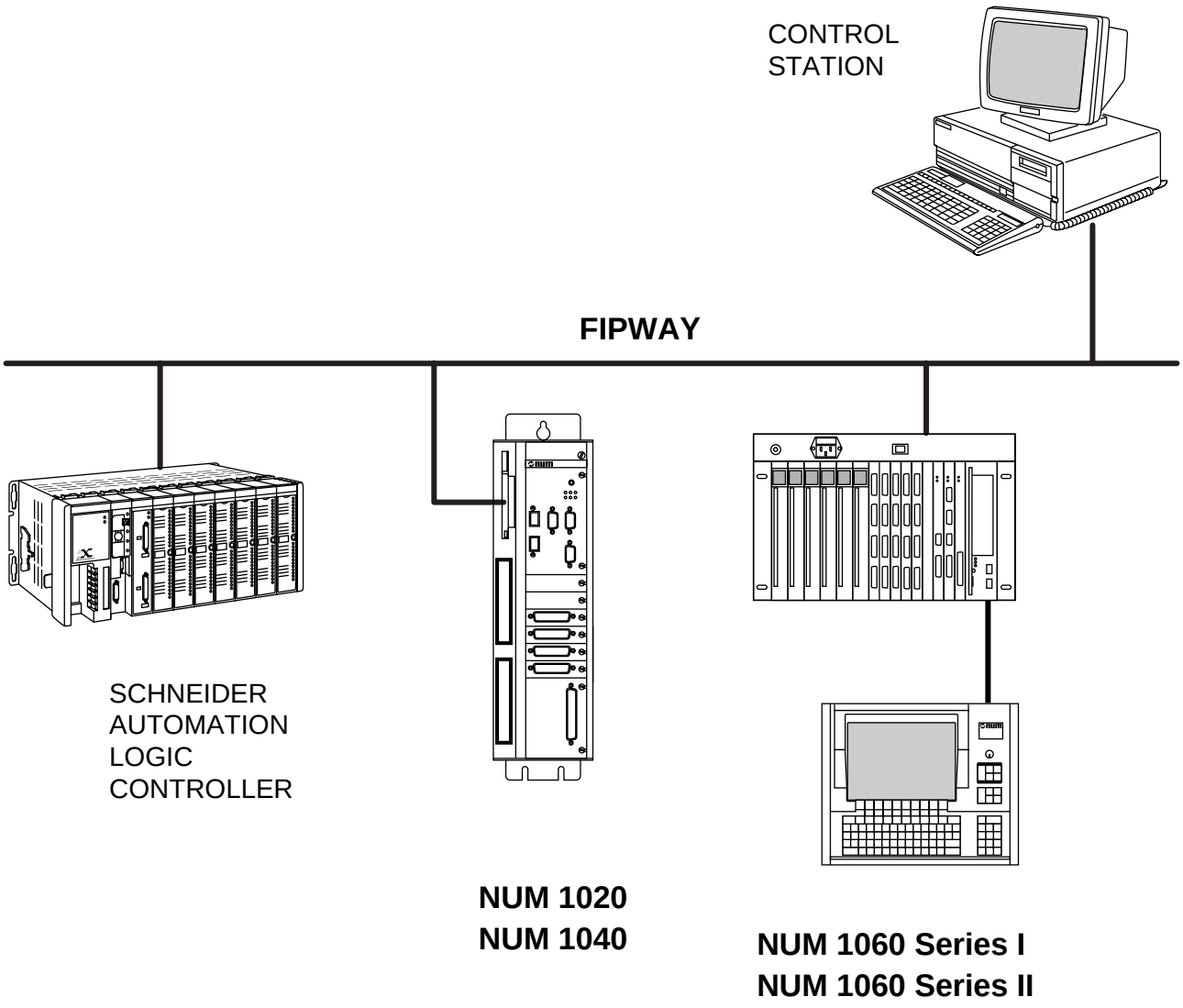
1.1 General

FIPWAY is a cell network used to interconnect the process control equipment installed on a manufacturing line, i.e.: logic controllers, numerical control units, control or monitoring station (PC).

It is also used for production control, through the use of the company's messaging network to exchange data with the business-oriented data processing equipment: production, quality, performance statistics, etc.

> ⚠ **CAUTION**
>
> Turn the equipment off before handling the FIPWAY board or setting up addresses.

1.2 Example



1.3 Operating principle

An equipment on the FIPWAY cell network is identified by a unique address comprising the network number and the station number.

Network number

The network number values are:
- 0 in single-network architectures,
- 1 to 127 in multi-network architectures or in single-network architectures which may be connected at a later date.

Station number

The station number is the physical address of the equipment on the network. It is assigned a value between 0 and 63.

In the case of FIPWAY, the network address/station address pair of an equipment unit is used to build link-level addresses:
- for addressing of the variables produced (broadcast) by the equipment,
- for addressing the messages from/to the equipment.

Link-addressing of a variable is achieved by an identifier coded on a 16-bit integer. The application variables are common words (%S variables). They use the cyclic variable transfer link service.

Each transmitted link message contains the address of the sending entity and that of the receiving entity. Each address is coded on 24 bits.

FIPWAY offers two types of application messages:
- telegrams, which use the cyclic transfer link service for acknowledged messages (the telegrams are always equivalent to a point-to-point communication),
- datagrams, which use the aperiodic transfer service for messages which are:
  - either acknowledged, in the case of point-to-point messages,
  - or not acknowledged, in the case of broadcast messages.

Bus arbitrator

On a FIPWAY network, at a given time, a single station enables data exchanges: this is the active bus arbitrator, responsible for handling access to the medium.

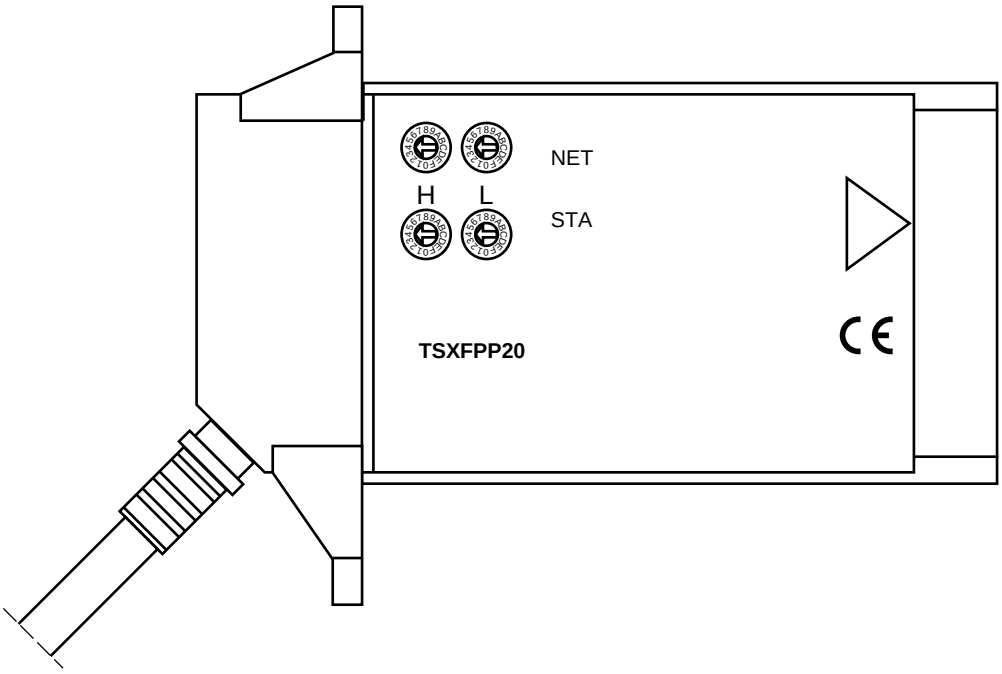
The bus arbitrator's mission is simple. It consists in running the list of cyclic exchanges of variables and messages to be sent, then in handing control over for aperiodic exchanges of requested variables and messages.

The list of cyclic exchanges followed by the windows allocated for aperiodic exchanges comprise a macrocycle. This macrocycle is scanned and repeated endlessly by the active bus arbitrator.

On a FIPWAY network, the macrocycle is the same regardless of the application program. It is used, in particular:
- to scan every 10 ms the telegrams transmitted by the stations with numbers between 0 and 15,
- to scan every 40 ms the common word variables transmitted by stations with numbers between 0 and 31,
- to allocate an aperiodic window for exchange of messages with a maximum of 210 x 128-byte per second messages to be shared by all stations.

2 Installation

2.1 FIPWAY communication board: TSX FPP20



The FIPWAY communication board is equipped with a 3-meter TSX FP CG030 cable and two screws for attachment to the motherboard. The SubD connector of this cable connects to a TSX FP ACC4 unit (not supplied).

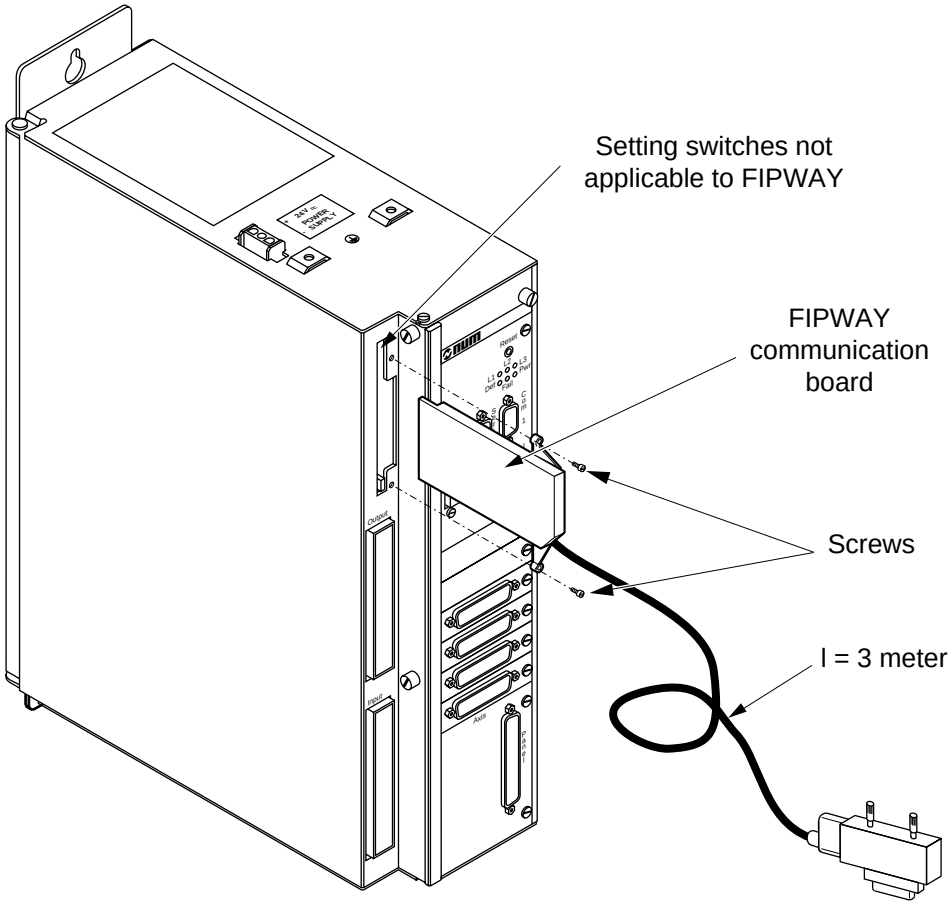
The network number is set using the 2 rotary switches identified NET (0 to F for each switch). This number is transmitted on one byte: the right-hand switch corresponds to LSBs (L), while the left-hand switch corresponds to MSBs (H). The number is coded 0 to 127.

The station number is set using the 2 rotary switches marked STA (0 to F for each switch). This number is transmitted on one byte: the right-hand switch corresponds to LSBs (L), while the left-hand switch corresponds to MSBs (H). The number is coded 0 to 63.

The front face of the board features two LEDs:
- the top ERR LED indicates an address fault or an incorrect configuration,
- the bottom COM LED indicates that a communication is in progress.

NOTE: The FIPWAY communication board must be attached using the 2 screws provided for this purpose to ensure ground continuity through its metal cover.

2.2 Installation on NUM 1020/1040



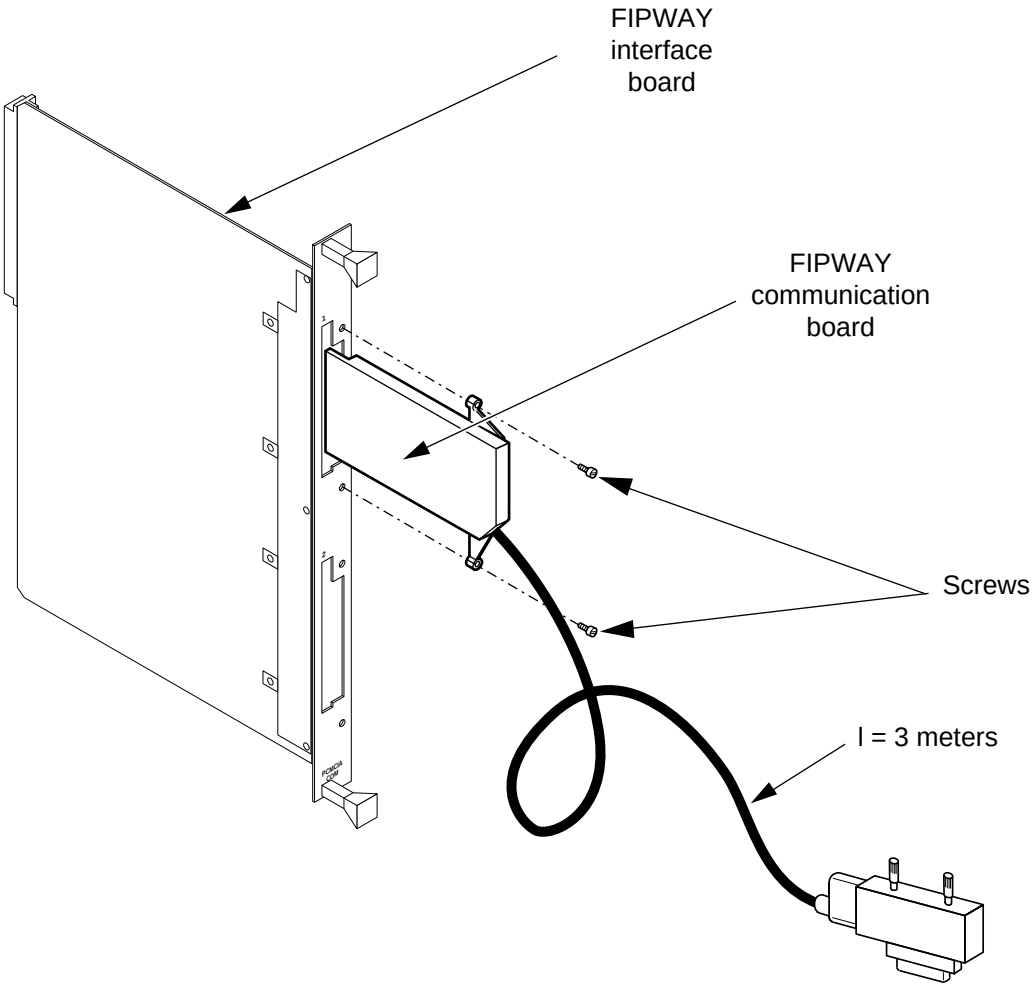
1 - Set the network number and the station number using the rotary switches as described in the above paragraph.

2 - **With the equipment off**, insert the FIPWAY communication board in the slide provided for this purpose.

3 - Secure using the 2 screws.

2.3 Installation on NUM 1060

2.3.1 FIPWAY interface board and communication board for NUM 1060

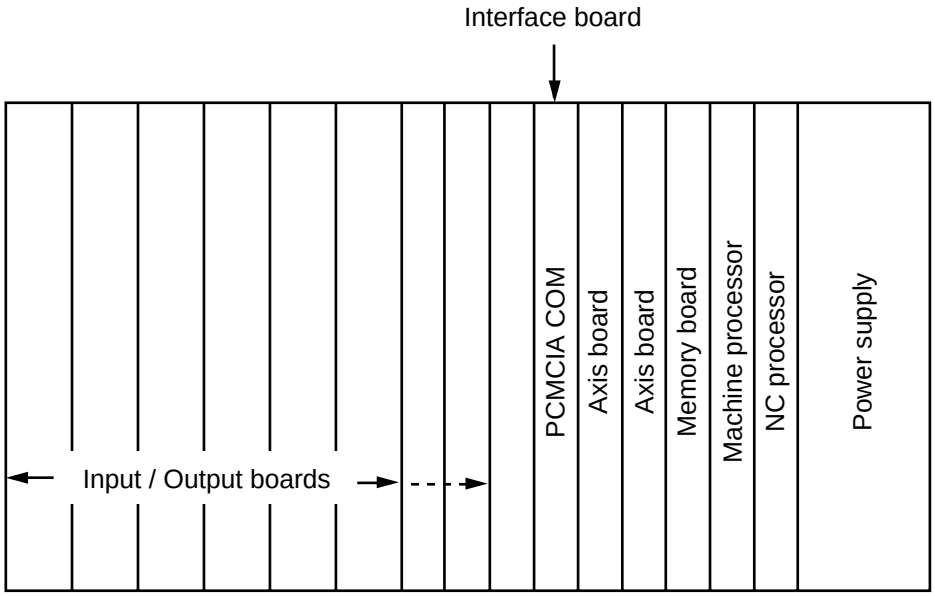


1 - Set the network number and the station number using the rotary switches as described in the above paragraph.

2 - **With the equipment off**, insert the FIPWAY communication board in the slide provided for this purpose in the interface board at location 1 or 2. The software automatically detects at start-up the presence and location of the board.

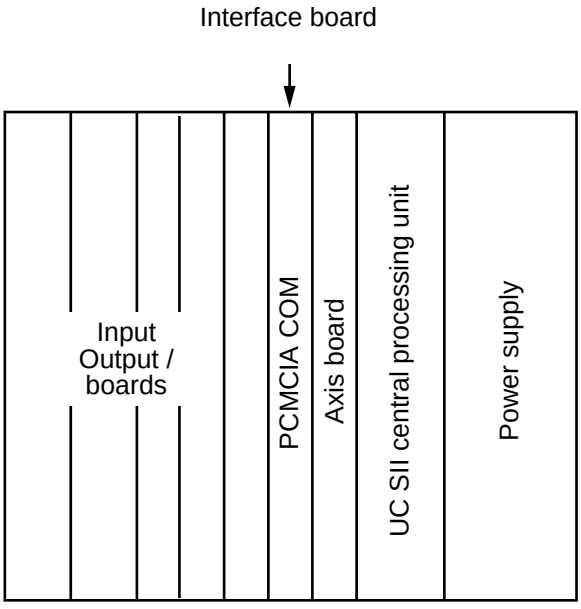
3 - Secure using the 2 screws provided for this purpose.

2.3.2 NUM 1060 Series I



There must be no free slot between the interface board and the NC processor.

2.3.3 NUM 1060 Series II



There must be no free slot between the interface board and the UC SII central processing unit.

2.4 Connection to the FIPWAY network

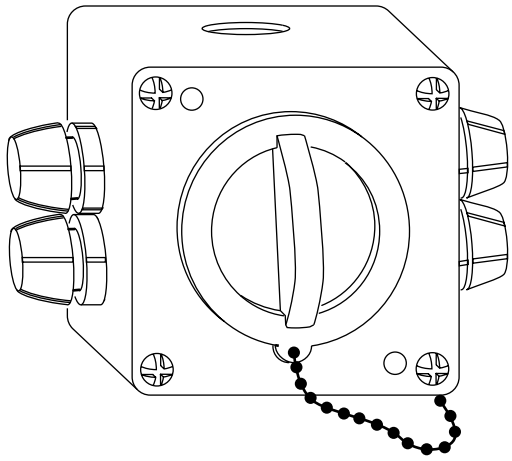
The accessories needed for wiring and installing a FIPWAY network are off-the-shelf items and should be procured from SCHNEIDER.

The main part numbers are listed below:

Main FIPWAY cable

This 8-mm dia. flexible cable comprises a shielded twisted pair with a characteristic impedance of 150 ohms.
Three part numbers are available:
- TSX FP CA 100 for a 100-m long reel,
- TSX FP CA 200 for a 200-m long reel,
- TSX FP CA 500 for a 500-m long reel.

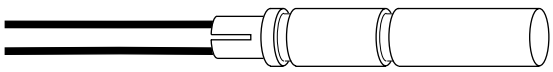
Junction box TSX FP ACC4



This sealed unit is used to connect the main FIPWAY cable to a screw terminal block. The unit also incorporates a 9-pt female connector (located under the plug) for connection of an equipment unit to the network using cable TSX FP CG030.

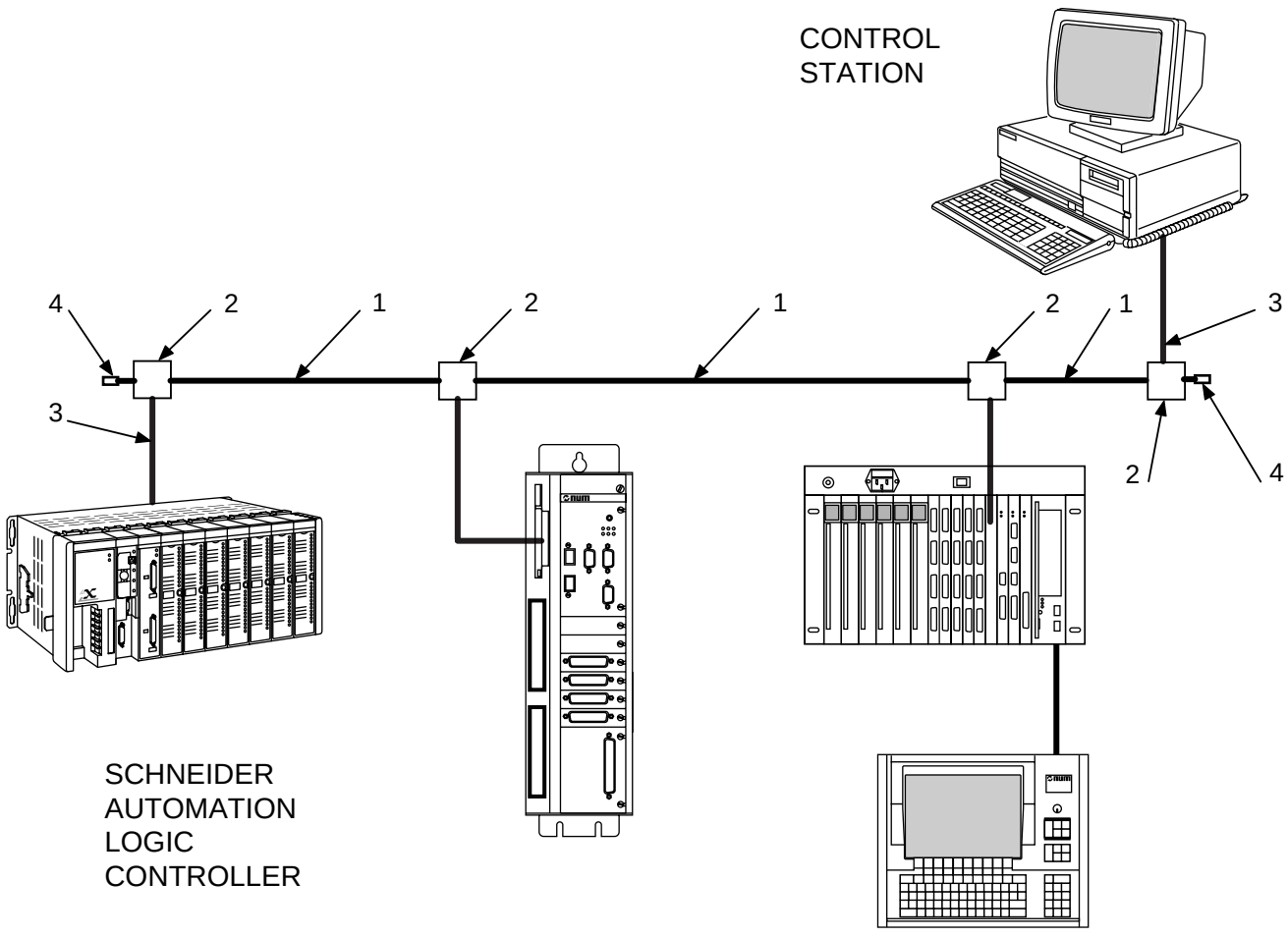
Each equipment unit requires a junction box.

Line terminator TSX FP ACC7



This accessory is essential to match the line impedance at both ends. Two line terminators are therefore necessary. The line terminator connects inside the junction box described above.

2.5 Example



NUM 1020 **NUM 1060 Series I**
NUM 1040 **NUM 1060 Series II**

1 - TSX FP CA xxx : main cable
2 - TSX FP ACC4 : junction box
3 - TSX FP CG030 : junction cable
4 - TSX FP ACC7 : line terminator

3 Software implementation

3.1 Services: common words and JNET table

The services provided make up a database distributed among all or part of the equipment units in a FIPWAY network. The database consists of a total of 128 x 16-bit works configurable per one of the following services:

- one known as «common words» or «COM», allows a shared database of 128 x 16-bit words to be setup.The first 32 stations of the network accommodate 4 words (or 8 bytes) each.
  The «common words» variables (256 bytes) are addressable as follows:
  station 0: %S0.B to %S7.B
  station 1: %S100.B to %S107.B
  «
  etc.
  station 31: %S1F00.B to %S1F07.B
  The % variables are coded on 4 hexadecimal digits. The 2 least significant digits denote the number of the byte in the station (00 to 07) and the most significant digits denote the station number (00 to 1F).
- the other service, known as «JNET table» allows the user to distribute the 128 words among the first 32 stations, with a maximum of 32 words per station.
  The 256 bytes of the JNET table are addressable as follows:
  from %S0.B to %S7.B for the first 128 bytes
  from %S100.B to %S107.B for the next 128 bytes.
  Selecting the «JNET» service leads to invalidating the «COMs».

Both services can not be used simultaneously.

The common words or the JNET table are exchanged cyclically and automatically, without programming. Their use is recommended for periodic exchanges of status variables between the various items of equipment of the network.

3.2 UNI-TE messaging

The UNI-TE messaging service allows data to be exchanged between two stations by a query/answer mechanism known as request/report. Numerical control can be:

- CLIENT: takes the initiative for communication by making a request, transmitting data (write) or sending a command to an equipment of the network. These requests obviously depend on the application to be implemented and must be programmed by the user in its logic controller program.
- SERVER: conversely, it answers the queries made by providing a report. This service allows the logic controller or NC variables to be read.

CAUTION

Communication to the NC is to INTEL format.

3.3 Priority messages or telegrams

This service is a special case of the above service, used to transmit via UNI-TE urgent messages, and consequently infrequent data between two equipment units of the network. The telegram is transmitted as a priority over the network relative to all the requests which may be waiting. The maximum size of telegrams is limited at 16 bytes.

> ⚠ **CAUTION**
>
> Communication to the NC is to INTEL format.

4 Setting up - Programming

4.1 Setting up

At system start-up, after power up, the «common words» or «JNET table» services are inactive. One of these services must be set up by software to take advantage of the distributed database.

Setting up is through a function of the Ladder language which must be programmed in the %INI task of the logic controller program.

Instruction syntax

SetCom+Fp(type, size, JNET address)

type:	Type of configuration, = 1 for common word configuration, = 2 for JNET table configuration.
size:	Number of bytes specific to the station (mandatorily even), = 8 if common words, = 2 to 64 if JNET table.
JNET address:	Address expressed as words, = 0 if common words (unsignificant), = address of 1st word in the zone belonging to the station; mandatorily an even number from 0 to 254. example: for a zone start from %S.B, set JNET address = 4 (4th word in the table).

NOTES: On a single FIPWAY network, the stations must be set up either as «common words» or as «JNET table»: the 2 services are mutually exclusive.

On a FIPWAY network, if one station has not been set up, it is inactive, i.e. it transmits no data and can not read the data transmitted by the other stations.

Returned code

code 0x00 if configuration OK,

code different from 0x00 if configuration not valid with:

code 0x01 if «size» parameter incorrect,

code 0x06 if FIPWAY option not present in the NC or if FIPWAY coupler absent,

other codes: JNET address higher than 31 or request for configuration as JNET table and COM on same network.

The red LED of the FIPWAY communication board then blinks.

⚠ CAUTION

Programming requires PLCTool issue D6 or higher.

4.2 Programming

The exchanges with a remote station are through UNI-TE requests.

A request is issued using the «neto» instruction and an answer is read using the «neti» instruction.

Instruction syntax

neto(porte_source, &datagramme)

neti(porte_source, &datagramme)

These instructions are documented in the programming manual of the process control-Ladder language function (938846). These instructions are programmed and debugged on a PC using PLCTool. See «Ladder language programming PLCTool» manual (938859).

⚠ CAUTION

To issue a telegram (priority request), or upon reception of a telegram, the «reserved» byte of the transmission or reception buffer must contain value 5.

4.3 Diagnostic variables

4.3.1 Refresh indicators

Each station on the network has 32 «bit» type variables, called refresh indicators, addressable as follows:

%S3F70.0 : refresh bit of station 0

%S3F70.1 : refresh bit of station 1

.

.

etc.

%S3F73.7 : refresh bit of station 31.

Each one of these indicators is set to 1 by the system when the common words or JNET words of the corresponding station have just been written. The user program is responsible for setting them to 0.

Using these bits, presence of a station on the network can be checked and its activity monitored.

4.3.2 Station number

Reading byte %S3F79.B, a station can find out its address on the network. This variable is only significant when one of the common word or JNET table services is active.

5 Characteristics - Performance data

5.1 Characteristics

Structure

Nature:	Open industrial network to FIP standard.
Topology:	Equipment interconnected by chaining or branching.
Access method:	Bus managed by bus arbitrator.
Privileged exchanges:	Telegrams, common words and UNI-TE messages.

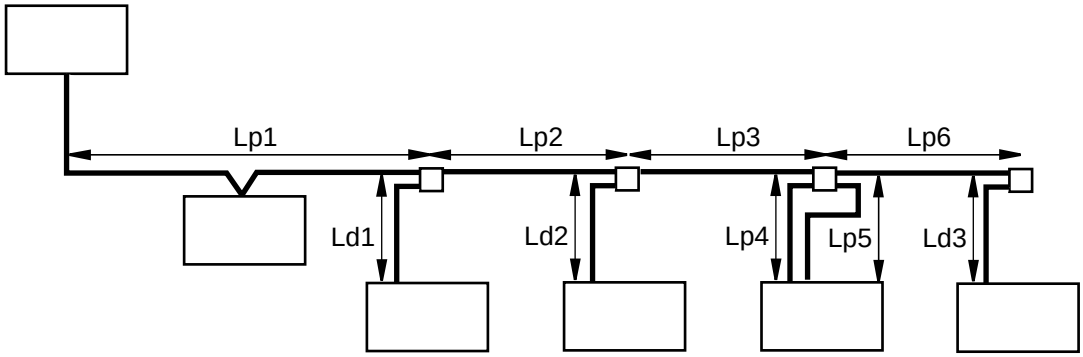
Transmission

Mode:	Physical layer in baseband on shielded twisted pair per NF C46 604 standard.
Bit rate:	1 Mb/s.
Medium:	Shielded twisted pair (150-ohm characteristic impedance).

Configuration

Number of stations:	32 stations per segment (64 maximum on the complete segments).
Number of segments:	5 maximum (cascaded) using electrical or optical repeaters (4 maximum, cascaded).
Length:	The length of a segment depends on the type of junctions. Maximum length is 1000 meters without repeater for one segment, and 5000 meters maximum between the most remote equipment units (5 segments).
Multi-network:	Interconnection of 127 FIPWAY, MAPWAY, TELWAY, ETHWAY or MMS/ ETHERNET networks.
Branches:	Branches are provided from a junction box using a branch cable or possibly using a main cable crossover. If a branch cable is used, the branch length is equal to 3 equivalent main cable lengths. A segment length is therefore equal to:

L = sum of Lpx + 3 * sum of Ldx (≤ 1000 m)



Lp: main cable
Ld: branch cable

Services

COM:	Distributed databases of 128 words maximum (4 words per station); the NUM NCs have 0 to 4 common words for address stations 0 to 31.
UNI-TE:	Point-to-point request services with 128-byte maximum report, usable by all stations. The size of the messages is 128 bytes maximum for the NUM NCs.
Application-to-application:	Point-to-point 128-byte maximum messages, usable by all stations. The size of the application-to-application messages is 128 bytes maximum for programmable logic controllers model 45.
Telegram:	Point-to-point priority messaging of 16-byte maximum. It is limited to address 0 to 15 stations.
Security:	Control characters on each frame and acknowledgement of point-to-point messages to NF C46 603 standard.

Maximum size of the transmitted data

Variables:	128 bytes.
Messages:	128 bytes.
Message rate:	210 x 128-byte messages per second.

5.2 Performance data

The FIPWAY network operating principle allows, for a given configuration, guaranteed and constant network cycle times to be achieved, regardless of traffic and number of stations (2 to 64). This allows a FIPWAY installation to be upgraded or downgraded by adding or deleting stations without impacting performance.

Maximum transmission times

Telegrams (TLG)

The priority application messages are transmitted in less than 10 ms, with a maximum of one TLG per station.

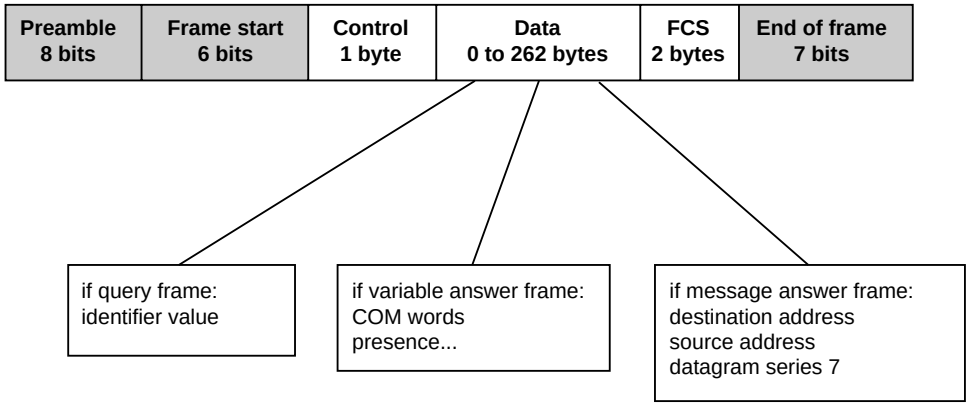
Common words (COM)

The complete common words database is updated every 40 ms.

Appendix 1 Format of a FIPWAY exchange

An exchange over FIPWAY comprises two frame transfers:
- a query frame containing the identifier of the variable to be transmitted or of the source entity of a message to be transmitted,
- an answer frame containing the value of the identified variable or the transmitted application message.

The FIPWAY frame breaks down as follows:



Preamble

This 8-bit sequence allows the receivers to synchronize on the transmitter clock.

Frame start

This frame start separator, comprising 6 bits, allows the data link layer to locate the beginning of the relevant information.

Control

This byte specifies which type of frame is being exchanged:
- query frame: identified variable, message or request,
- answer frame: identified variable, message acknowledged or not, acknowledgement or request, etc.

Data

This field contains:
- the value of the identifier (2 bytes) for a query frame,
- the value of the application variable (2 to 128 bytes) for an identified variable answer frame,
- a source address (3 bytes), a destination address (3 bytes) and a datagram series 7 for a message answer frame,
- a sequence of identifiers for a request answer frame (system service).

FCS (Frame Control Sequence)

These two bytes are used to check whether the exchange ran correctly or not. The control code is calculated by the transmitting station then sent to the data sequence. The receiving station calculates this code then compares it with the code transmitted by the transmitter. In the event an inconsistency is detected, the frame is rejected by the destination.

End of frame

This end of frame separator, comprising 7 bits, allows the data link layer to locate the end of the relevant information.