Technical description
Facit 4020-tape reader
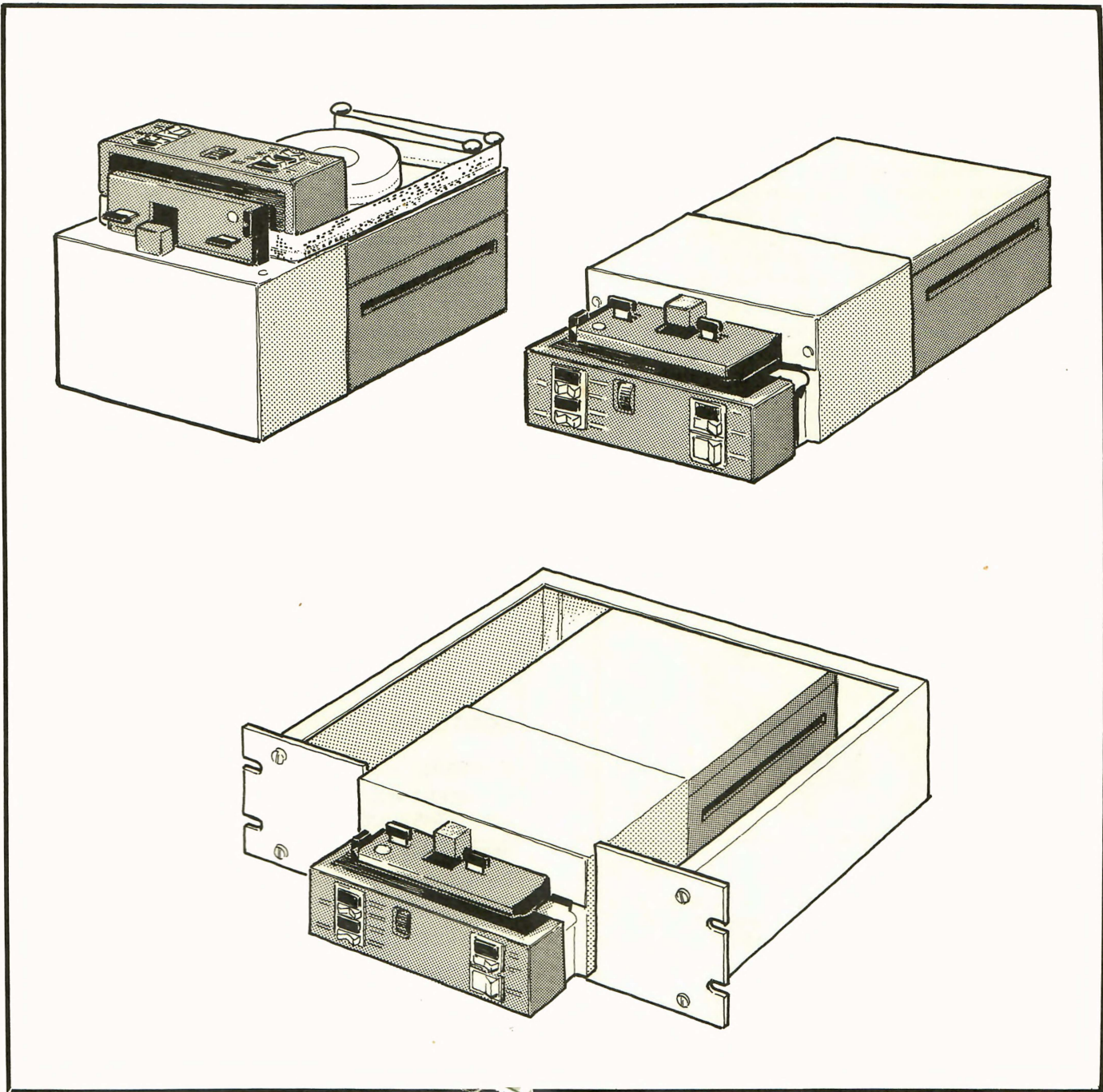
FACIT 4020

TAPE READER

CONTENTS

GENERAL

The Facit 4020 family of tape readers, which features an entirely new and up-to-date design, is intended for applications such as data transmission, typesetting, numerical control, data processing systems, etc. In short, these readers are ideal for all applications that impose stringent requirements regarding reliability and easy adaptability to individual environments and systems.

Facit 4020 tape readers operate at speeds ranging from 0 to 300 characters per second. Reading is carried out optically. All tape widths and all tape materials normally encountered on the market can be read in either direction. Reading can be interrupted after any character as desired. Facit 4020 readers contain modern components, and they are designed to withstand highly unfavourable industrial environments.

Facit 4020 tape readers make use of an entirely new and unique reading method that eliminates the disadvantages previously inherent in optical readers. As a result, these readers are virtually unaffected by tape quality, tape material and tape colour. Even tapes that are almost transparent can be read, and variations in ambient light and temperature have virtually no effect on reading.

Facit 4020 is a collective designation for a whole family of tape readers. This family includes table-top and rack versions

— all of which come complete with electronics and power supply. There are two basic versions of the electronics — one for the Facit SP1 standard interface for parallel data transfer, and one for the universal interface. All versions are designed to accommodate an extra printed circuit board on which supplementary electronics can be mounted as desired.

Facit 4020 tape readers are easy to operate. They require no special care and minimal maintenance and are ideal for office environments thanks to their unusually silent operation. A simple manipulation suffices to reset Facit 4020 tape readers for different tape widths. These readers can read many different types of hole configurations.

Tapes can be fed both forward and backward by the pinch roller and rubber capstan. The rubber capstan ensures extraordinarily low tape wear and unusually silent operation. It is spring-loaded to accommodate tapes of different thicknesses and tape splices as well. The stepping motor that drives the capstan provides bidirectional tape feed — an important feature in numerical control applications where work cycles must be repeated. Tape feed (both direction and speed) is governed by externally applied signals. Reading speed can be set as desired throughout the entire range of 0 to 300 characters per second.
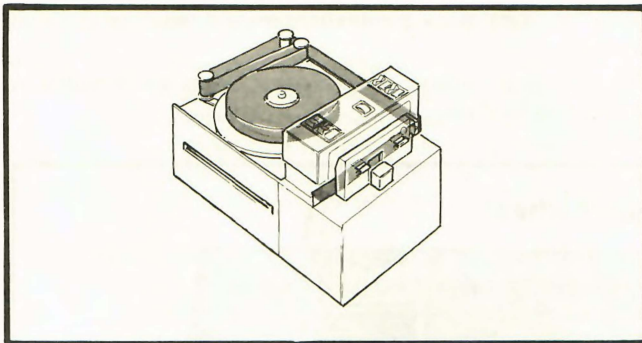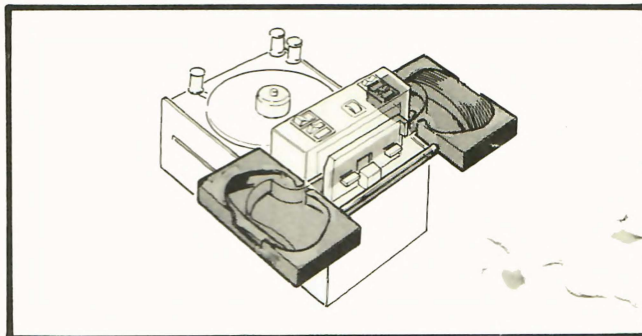

Facit 4021

Top-loaded, table-top version with supply reel for tape coils having outside diameters of up to 200 mm.
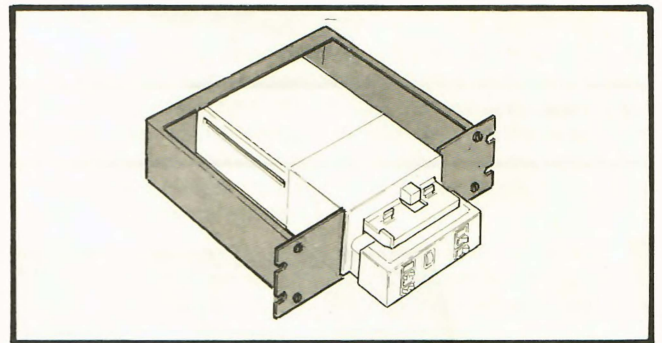
Facit 4022

Front-loaded, rack version for standard 19'' rack. Ideal for reading short tapes and tape loops. Can also be used for reading fan-folded tape from cassettes.

Facit 4021

Same as above and equipped with fan-folded tape cassette that accommodate up to 60 metres of fan-folded tape with an inter-fold distance of 216 mm (8 1/2'').
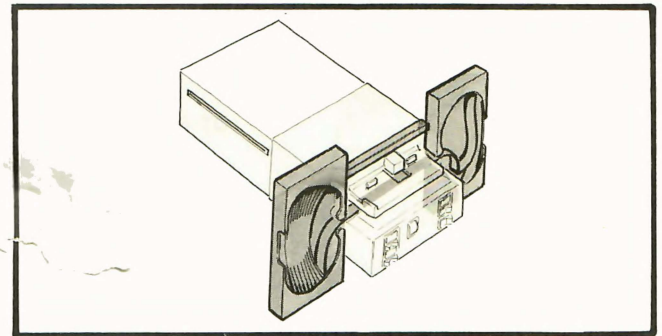
Facit 4022

Front-loaded, table-top version equipped with fan-folded tape cassettes. Without cassettes the reader is ideal for reading short tapes and tape loops.

Thanks to a host of customer-oriented design features, the Facit 4020 family of tape readers fulfils a wide variety of requirements with regard to performance and environmental adaptability. Modular design enables these readers to be easily adapted for collaboration with other equipment. There are three main modules.

- Read module with read amplifier
- Control module
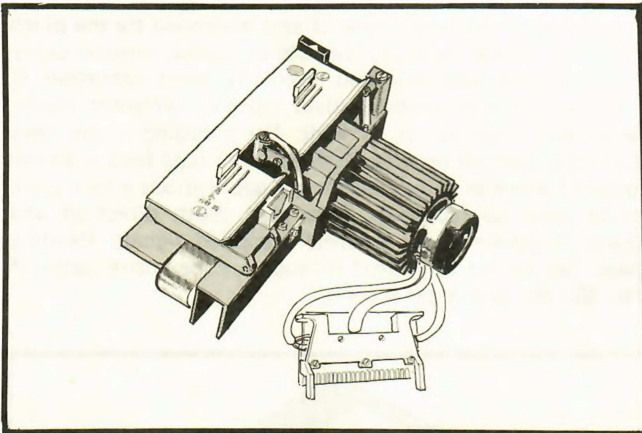- Electronics module with power supply and voltage regulator

Fig. 1 Read module

Read module

The read module, fig 1, contains the read head with read amplifier as well as the stepping motor with capstan and pinch roller. This module also includes the tape guides used to reset for different tape widths and a thumbwheel used to reset for different tape configurations. The read module — perhaps the most important of the main modules — fulfils extraordinarily stringent reliability requirements. The integral read head has been designed to ensure high-precision reading and insensitivity to extraneous light. The tape feed mechanism and the tape guides are designed to ensure gentle tape handling with minimal noise. The rubber capstan has brought the noise level down as low as 62 dB(A) at maximum reading speed.

Control module

The control module, fig 2, contains all controls and indicator lamps. It also contains the changeover switch used to reset the tape reader for different mains voltages. To simplify operation, the basic table-top version is provided with top-mounted controls, and the basic rack version has front-mounted controls. This feature also extends to the insertion of tapes — the table-top version is top-loaded while the rack version is front-loaded. Differently coloured indicator lamps facilitate quick comprehension and response to visual signals.

The following controls and indicator lamps are included in the control module.
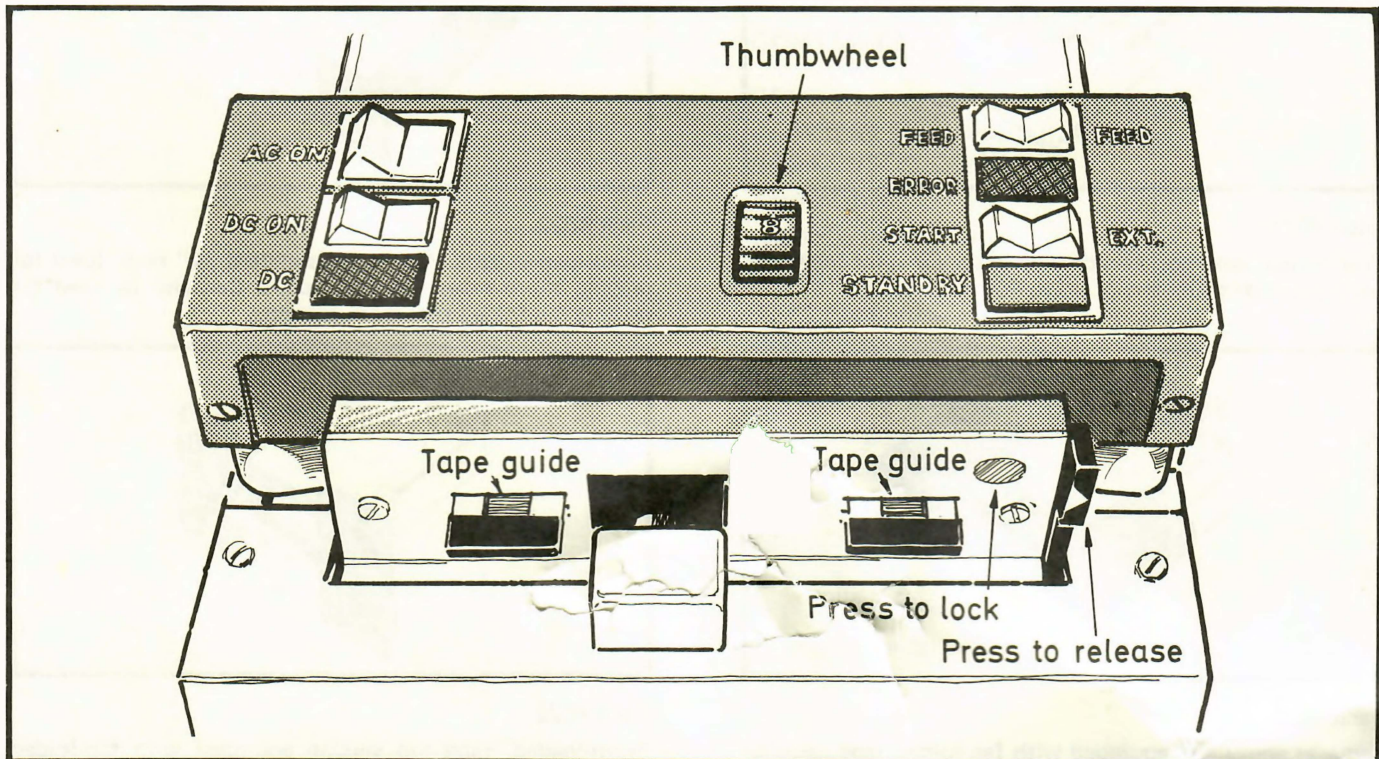

Fig. 2 Control module

Controls

- **AC ON** — Turns on mains voltage supplied to power supply.

- **DC ON** — Turns on regulated DC voltage supplied to electronics. When DC voltage is on, green DC lamp lights.

- **FEED** — Feeds tape in either direction.

- **START** — Used before starting to read or to restart after an error. When this control is released after being depressed, the ERROR lamp is extinguished, thereby permitting a reading instruction signal to be sent to the reader.

- **EXT** — Used for sending signals manually, e.g. to the data acceptor.

- **Tape guides** — Used to reset reader for different tape widths.

- **Thumb-wheel** — Used to reset reader for different tape configurations.

- **Lock & release** — Used to open and lock cover when loading tape.

Lamps

- **DC** — This green lamp lights to indicate that the reader is ready for operation. In the event of a short mains power failure or a drop in mains voltage that can cause a reading error, the DC voltage. supplied to the electronics is turned off and this lamp goes out.

- **STANDBY** — This orange lamp lights when the tape pathway cover is open, thereby indicating that all reading functions are temporarily inoperable.

- **ERROR** — This red lamp lights on the following occasions:

  1. From the time when the DC voltage is turned on until the START control is actuated, thereby making certain that the proper initial conditions for reading are established.

  2. When tape is fed using the FEED control, thereby indicating that the tape is fed without being read.

  3. If an attempt is made to read a tape having no feed holes.

  4. If an attempt is made to start reading without having inserted tape into the reader.

  5. If, for any reason, the tape is under excessive tension. Example: at the end of a tape that is taped to the coil core.

  6. When the tape-feed distance stepped for each character is too short, when tape feed speed is to low, etc. That is to say, when the internal monitoring system that ensures proper feeding and reading issues an alarm.

  7. When a parity error is detected (if the parity option was chosen).

Electronics module

The electronics module contains the power unit with transformer and fan, the connector unit with power supply, the fuses and the mains voltage inlet. Moreover, this module contains the cabinet, fig 3, that houses the three printed circuit boards designated PC1, PC2 and PC3. These boards are inserted at locations designated Pos 1, Pos 2 and Pos 3. Pos 1 is intended for main electronics board PC1 that contains the main electronics which carry out all reader functions such as tape feed, reading, monitoring etc. Since all signals and supply voltages are available at both Pos 2 and Pos 3, each of them can be used for either PC2 or PC3.

Printed circuit board PC2 normally contains the buffer register and the adaptation electronics. The adaptation electronics is available in two standard versions — one for Facit SP1 standard interface for parallel data transfer and one for the universal interface.

The power supply contains the rectifier and the +5 V DC voltage regulator. It also contains voltage monitoring circuits that automatically turn off the DC voltage regulator if, for example, the mains voltage should drop more than 15% below the value specified for the reader. This voltage monitoring feature eliminates the risk of reading errors caused by a drop in the mains voltage.

The power supply provides a certain amount of excess DC intended for the adaptation or supplementary electronics. The voltages provided by the power supply are also available at the data output connector.

All versions of the Facit 4020 tape reader are provided with identical interconnections, a feature that offers a number of advantages. Examples: it is possible to interchange printed circuit boards among a number of tape readers, and the user can insert his own special-function electronics into any tape reader.
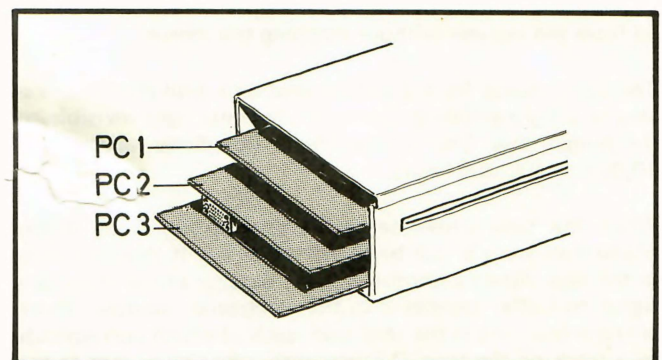

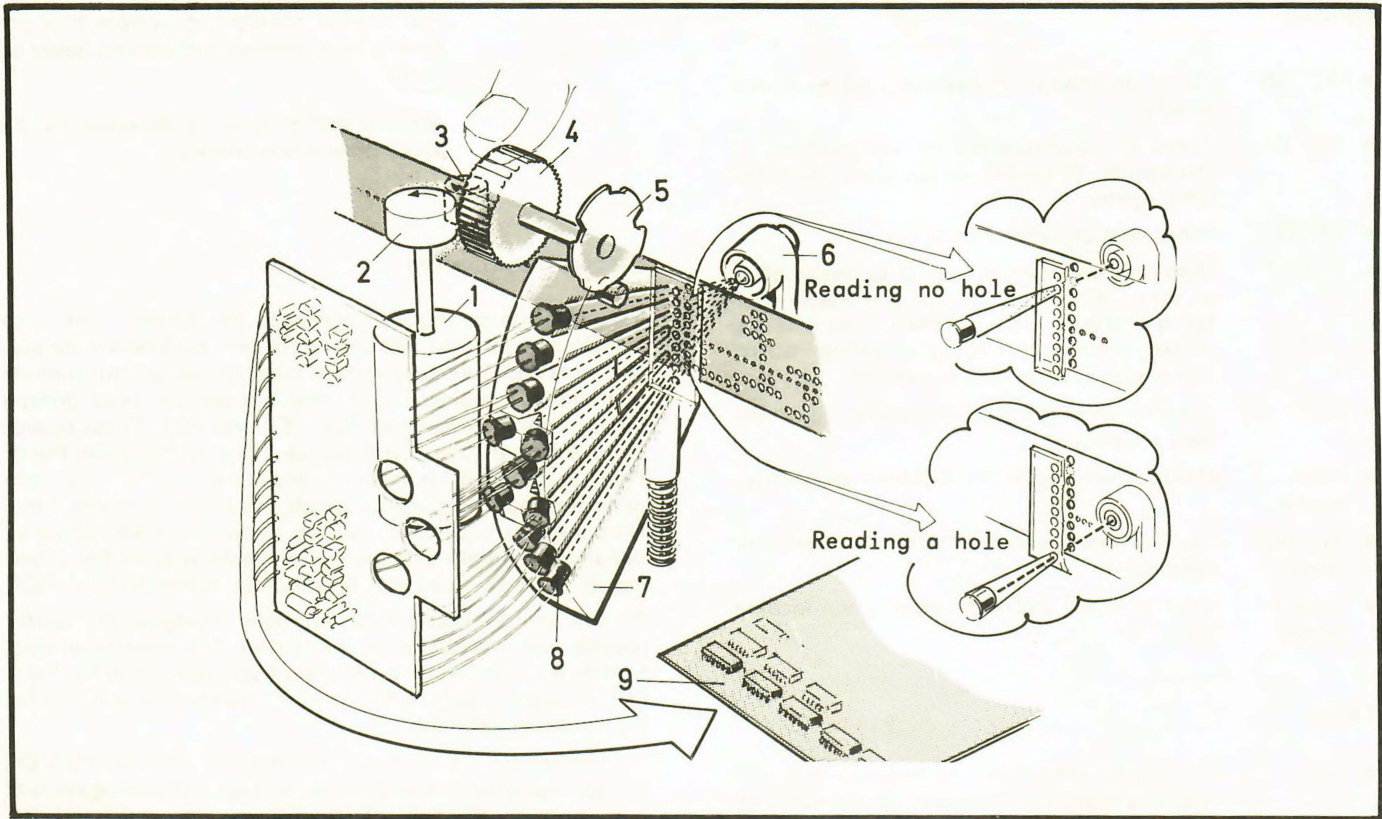**Fig. 3 Cabinet with three printed circuit boards**

Fig. 4

To ensure maximum reliability and reading precision, the stepping motor, capstan, pinch roller and read unit have been incorporated into a single module, fig. 4. The rubber capstan ensures gentle tape handling and a low noise level. This module includes stepping motor 1, rubber capstan 2, pinch roller 3, light source 6 and phototransistor unit 7. It also includes thumbwheel 4 and cam 5 that are used to reset the reader for different tape configurations.

The stepping motor feeds the tape slightly more than one inter-character space at a time, thereby making certain that the read unit will read one character each time the motor is stepped. This feature enables tapes with inaccurate inter-character spacing to be read properly. When the buffer register is full (contains three characters), one character is fetched from the register without stepping the motor.

The light source for the optical read unit with phototransistors is a light-emitting diode which emits light invisible to the human eye. The service life of this diode ranges from 10,000 to 100,000 hours.

When the tape passes beneath light-emitting diode 6, the phototransistors 8 will be illuminated only if there is a hole in the tape. When a phototransistor detects a hole, it sends a signal to buffer register 9 in the electronics module. There are nine channels in the read unit, each of which corresponds to a track on the tape. Consequently, the signals sent to the buffer register in the electronics module in response to each

character read from the tape provide an image of the character that was read. It is possible for the electronics module to store the three last characters that were read.

One might ask just what it is that distinguishes the Facit 4020 from conventional optical readers. Answer: a new, unique reading method that utilizes light dispersion. The illustration shows how the phototransistors in the read head are mounted at the end of a fan-shaped assembly of the slender tubes. Thanks to this unique arrangement, only directly incident light emitted by light-emitting diode 6 has sufficient intensity to actuate a phototransistor at the end of a tube. Any light that passes through the tape material is dispersed enough to prevent it from actuating a phototransistor. As a result, Facit 4020 tape readers can read tapes that are up to 80% transparent. When such tapes are the long slender tube permits only about 2% of the that passes through the tape material from reaching the phototransistor.

This new reading method also enables the reader to remain unaffected by the type of tape material and the colour of the tape. Oil-spotted or otherwise dirtied tapes can be read without difficulty. What's more, Facit 4020 tape readers can function fully satisfactorily under conditions that would disturb conventional tape readers — strong extraneous light and wide temperature variations for example.

Another design feature of the Facit 4020 eliminates the need for adjustment due to the aging of photoelectric components.
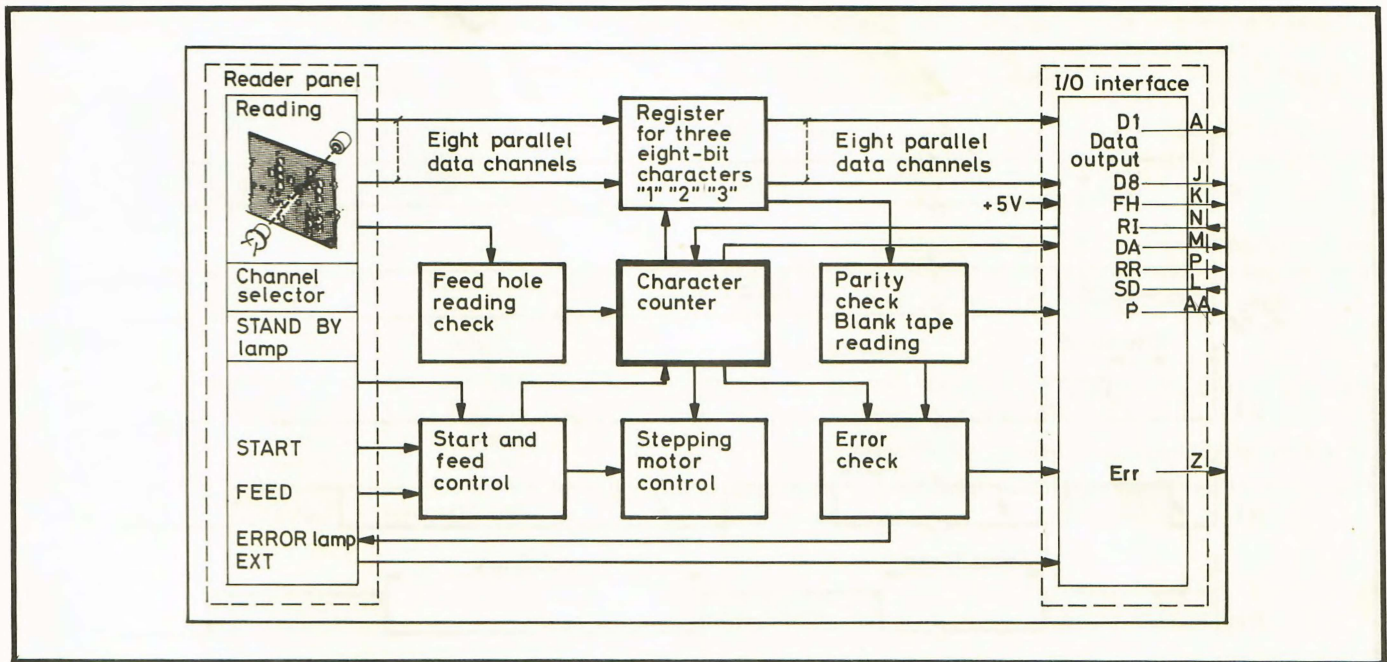
ELECTRICAL OPERATION

Fig. 5 Block diagram

Facit 4020 tape readers are designed for simple adaptation to different systems. The electronics are built up using modern integrated components that fulfil stringent reliability requirements.

The main electronics board PC1 contains the circuitry that drives the stepping motor and carries out reading. Printed circuit board PC2 contains the buffer register and the adaptation electronics as well as the connectors used by the data acceptor. Pos 3 does not normally contain any electronics — it is intended for supplementary special-function electronics provided by the customer. This customer designed printed circuit board can be provided with its own data connector. All printed circuit boards are easily accessible from outside the cabinet, and as a result they can easily be shifted among different readers if so desired.

The block diagram, fig. 5, is functionally oriented and does not take into account the boundaries between printed circuit boards. Signals appearing in the block labeled "I/O interface" normally proceed via the data connector on printed circuit board PC2, and consist of signals used in the universal interface. Signals used in the Facit SP1 interface are described in the technical description of the Facit SP1 standard interface.

All signals appearing on the block diagram also appear in the signal diagrams for the universal interface as well as in the specifications. The block diagram includes only those signals that are of interest with regard to the following:

- Data signals sent out from read unit
- Buffer register used for storing three characters
- Reading feed hole track to determine number of characters read
- Character counter
- Parity check

- Tape feed (stepping the motor)
- Start circuit and stop circuit
- Monitoring functions

Reading conditions are established by actuating the START control on the control panel. The reader then advances the tape two steps. The characters read are stored in the buffer register, the first in register position 3 and the second in register position 2. The character counter counts the number of characters read by counting the number of incoming signals from the feed hole channel.

When the reader has read the second character it generates signal RR, Reader Ready. This signal indicates to the data acceptor that a character is available. By sending signal RI, Read Instruction, to the reader, the data acceptor initiates read-out via the eight parallel data lines designated D1 through D8.

The parity checking circuits which are normally connected to check odd parity can be changed over for even parity by disconnecting a jumper. If the tape being read contains characters having no parity bits, the parity checking circuits can be used to generate parity bits.

When blank tape (feed holes only) is fed through the tape reader it normally reads each row and sends out an RR signal for each row. However, if an internal jumper is disconnected, the tape reader advances to the first character. This feature is very useful when reading blocked information and in other situations where an RR signal is desired only when data characters are encountered on the tape.

The error check circuit issues an Err signal in the event that the tape is pulled in the wrong direction for any reason. It also issues an Err signal if tape tension becomes excessive or if the tape ruptures — or if an attempt is made to read tape having no feed holes. Error causes are listed on page 7.
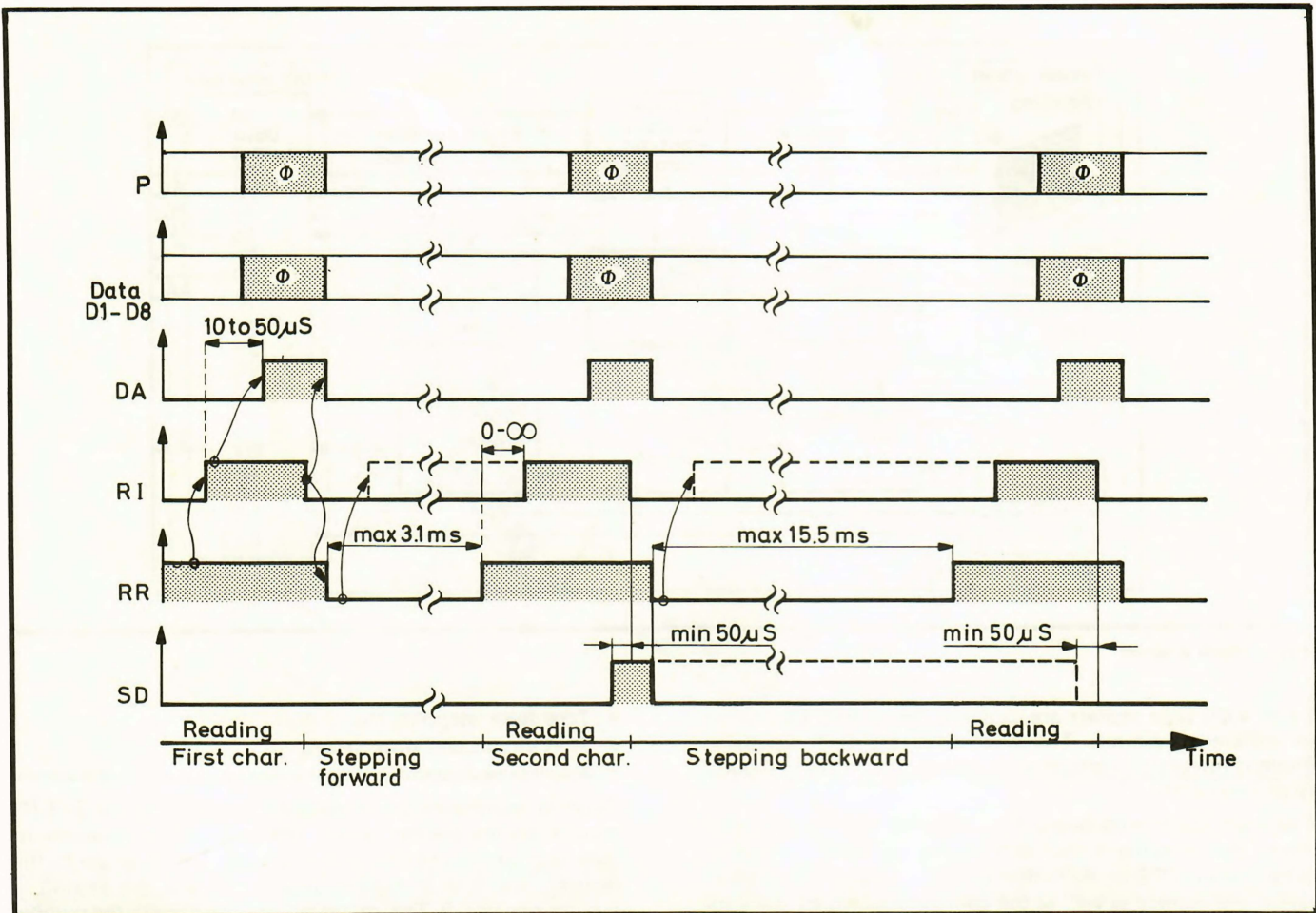
Fig. 6 Signal diagram for universal interface

Universal interface

The control signals and data signals appearing in fig. 6 proceed to and from the data connector on board PC2. See specifications on page 12 for signal level data etc.

Data is available after the START push-button is actuated to commence reading. The reader informs the data acceptor that data is available by setting RR high. The data acceptor then sends an RI signal to the reader which initiates the sending out the Data and the P, Parity, signals. The reader then answers by setting the DA, Data Available, signal high throughout the interval during which the Data signals and P signal shall be considered valid. In the above diagram this interval is represented by Ø. The data acceptor then sets RI low, thus completing the cycle.

If the SD, Stepping Direction, signal is high, the tape is fed backwards and read.

If an error should occur for any reason (see page 7) the Err signal is generated. While Err is present, RR is kept low.

Facit SP1 standard interface

Signals used in the Facit SP1 standard interface are described in the technical description of the Facit SP1 standard interface for parallel data transfer which has document No. SP1.15.01.Eng.10M.09.71.

Signal AM is used as illustrated below for readers equipped with the Facit SP1 standard interface. Signal AM specifies the reading direction. AM=0 means forward reading and AM=1 means backward reading.
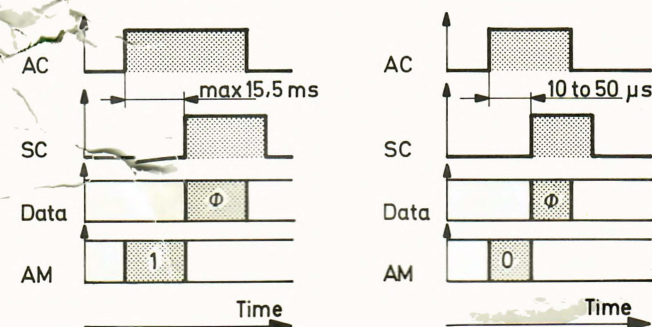
Data connector used with universal interface

Data connector — on board PC2 (Burndy)

Pin	Signal	Pin	Signal	Pin	Signal
A	D1 (Data)	P	RR	BB	START
B	D2 (Data)	R	reserved	CC	EXT
C	D3 (Data)	S	unused	DD	unused
D	D4 (Data)	T	unused	EE	unused
E	D5 (Data)	U	unused	FF	+24 V
F	D6 (Data)	V	unused	HH	DC ON

Pin	Signal	Pin	Signal	Pin	Signal
H	D7 (Data)	W	unused	JJ	0 V (24 V return)
J	D8 (Data)	X	unused	KK	unused
K	FH	Y	unused	LL	Ground (chassis)
L	SD	Z	Err	MM	+5 V
M	DA	AA	P	NN	0V (5 V return and signal ground)
N	RI				

Pin numbers and signals for this 34-pin data connector appear above. Unused pins are available to the user for supplementary electronics or for other signals as desired.

Mating connector:

Burndy MS 34 PM-150 GE 18 without contact pins and according to BSD 901393 rev 0.

Pin and sockets: RM/RC 28M to 16M depending on wire area.

One mating connector with pins is delivered with each reader.

SPECIFICATIONS

General technical data

Reading speed	0 to 300 characters per second. Tape can be read in both directions.
Buffer register	Stores three characters. One character for acceptor and two characters for synchronization.
Error rate	Max one error in 10^8 characters.
Tape feed	Stepping motor, rubber capstan and pinch roller. Bidirectional feed. External, asynchronous control.
Tape widths	5 track, 17.5±0.1 mm (11/16'') 6 and 7 track, 22.2±0.1 mm (7/8'') 8 track, 25.4±0.1 mm (1'') Typesetting, 6 track, 22.2±0.1 mm (7/8'') Japanese telex, 6 track 22.2±0.1 mm (7/8'')
Punch hole configurations	5, 6/7 and 8 track ISO standard tape. 6 track typesetting tape (forward direction only). 6 track Japanese telex tape.
Inter-character spacing	2.54 mm ± 5% accumulative over 50 rows 2.54 mm ±10% between adjacent rows
Thickness of tape	0.08 mm to 0.25 mm tapes including splices
Tape material	All types of punched tape materials now being marketed.
Transmissivity	Up to 80 %.
Tape supply	● Tape dispenser with supply reel for coils with max 200 mm outside diameter. Inside diameter shall be 51 to 52 mm. ● Fan-folded tape (8 1/2'') in cassettes that accommodate max 60 metres.
Interfaces	1. Universal interface 2. Facit SP1 standard interface.
Noise levels	Idling 40 dB (A) 10 ch/s 55 dB (A) 50 ch/s 60 dB (A) 300 ch/s 62 dB (A)
Environment	Ambient temperature, +5° to +40°C. Relative humidity, 25 to 75 %.

As standard, Facit 4020 tape readers are equipped with the Facit SP1 interface for parallel data transfer or the universal interface. Information about the former is presented in the technical description of the Facit SP1 standard interface for parallel data transfer. Note that signal AM is used to read tape backwards. Principal data for the universal interface are presented below.

Input signals

Input signals RI and SD are IC-compatible.

Read instruction (RI - pin N)	Logical 1: +3.5 V to +12 V Logical 0: +1.5 V to −12 V Input impedance, min 22 kohms
Stepping direction (SD - pin L)	Forward feed: +1.5 V to −12V (or floating) Backward feed: +3.5 V to +12 V Input impedance, min 22 kohms
External DC on (DC ON pin HH)	Substitute for DC ON control function. Pin HH shall be connected to +24 V via pin FF for 500 ms.
External start (START-pin BB)	Substitute for START control function. Pin BB shall be grounded via pin NN for 1 ms.

Output signals

All output signals are IC-compatible.

Reader Ready (RR - pin P)	Logical 1: +5 V, output impedance 2.2 kohms Logical 0: max +0.4 V, max output current 10 mA
Data Available (DA - pin M)	Logical 1: +5 V, output impedance 2.2 kohms Logical 0: max +0.4 V, max output current 10 mA
Data (D1 to D6 - pins A to F, D7 - pin H, D8 - pin J)	Logical 1: +5 V, output impedance 2.2 kohms Logical 0: max +0.4 V, max output current 10 mA
Error (Err - pin Z)	From logical 0 to logical 1 when Err signal is generated. Logical 1: +5 V, output impedance 2.2 kohms Logical 0: max +0.4 V, max output current 10 mA
Feed Hole (FH - pin K)	+5 V (internally connected to +5 V DC)
Parity (P - pin AA)	From logical 0 to logical 1 when P signal is generated. Logical 1: +5 V, output impedance 2.2 kohms Logical 0: max +0.4 V, max output current 10 mA

Note: Output signals RR, DA, D1 to D8, Err, FH and P can be raised to higher voltage by connecting them to the internal +24 V supply via 2.2 kohms. This provides:

Logical 1: +11 V to +16 V
Logical 0: max 0,4 V, max output current 2 mA

| External (EXT - pin CC) | 0 V when EXT is depressed. Floating when EXT is not depressed. This signal can be used to send a special message from the operator to the data acceptor for example. |

DC supply voltages

Available both internally and externally.

+5 V (±5 %) - pin MM	Max current output 1 A
+24 V (+20 to +32 V) - pin FF	Max current output 1 A
0 V - pin NN	5 V return and signal ground
0 V - pin JJ	24 V return (shall not be connected to signal ground).

Power data

| Mains voltage | Selectable by a rotary switch: 100, 115, 220 and 240 V AC $^{+15\%}_{-10\%}$ |
Mains frequency	49 to 100 Hz
Power consumption	Max 180 W, min 60 W
Mains inlet	Grounded
Automatic DC cutoff	If the mains voltage drops below 85 % of the value specified for the reader, the regulated DC voltage is turned off. Moreover, the DC voltage is cut off if the mains voltage should fail for more than 15 ms.
Chassis - pin LL	Connected to mains ground

Designations, dimensions and weights
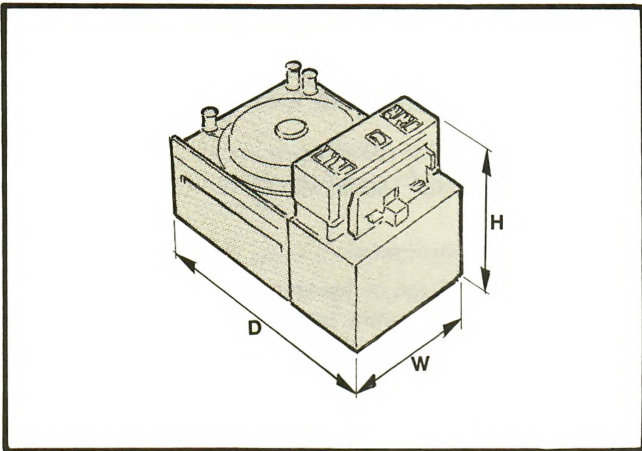
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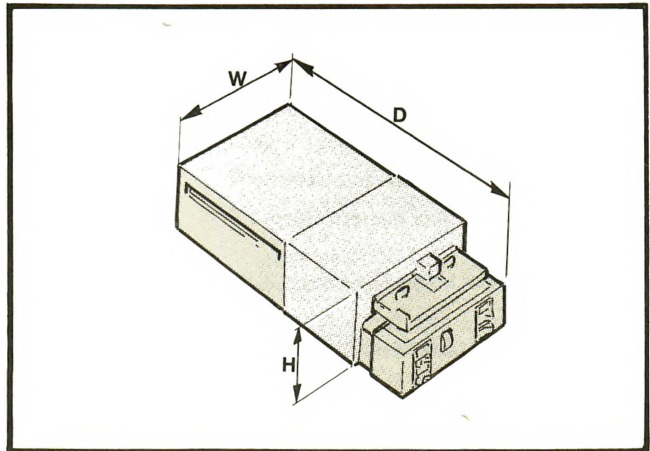
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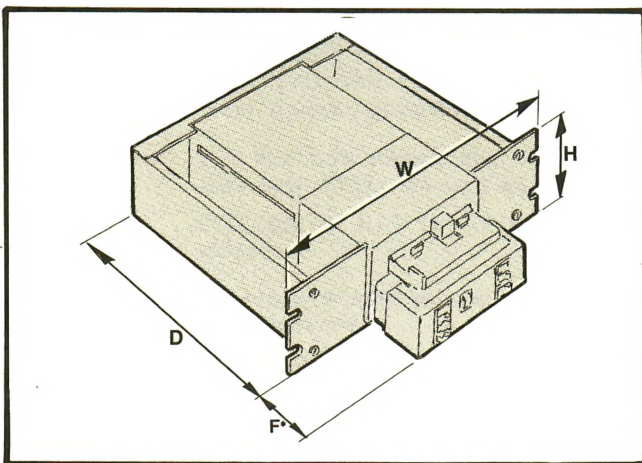
Facit 4022 - rack version
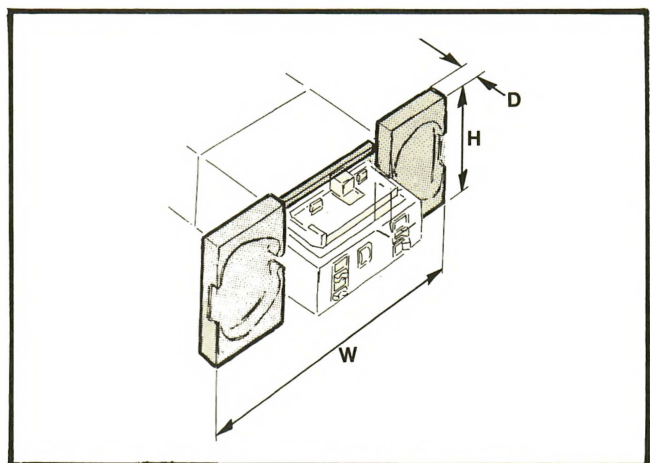
Cassette

Designation	Width		Depth		Height		Weight	
	mm	in	mm	in	mm	in	kg	lb
4021 Table-top version	226	9	352	14	208	8 1/4	10	22
4022 Table-top version	226	9	455	18	108	4 1/4	9.5	21
1507 02 70-00 Rack	482	19	364	14 3/8	132.6	5 1/4	3.5	7.7
1507 02 80-00 Cassette	482	19	46	13/16	220	8 11/16	1.6	3.3

✷ Dimension F can be varied between 89 mm and 106 mm, by positioning the Facit 4022 as desired in the rack.

Because Facit products undergo continuous improvement, equipment and specifications are subject to change without notice.