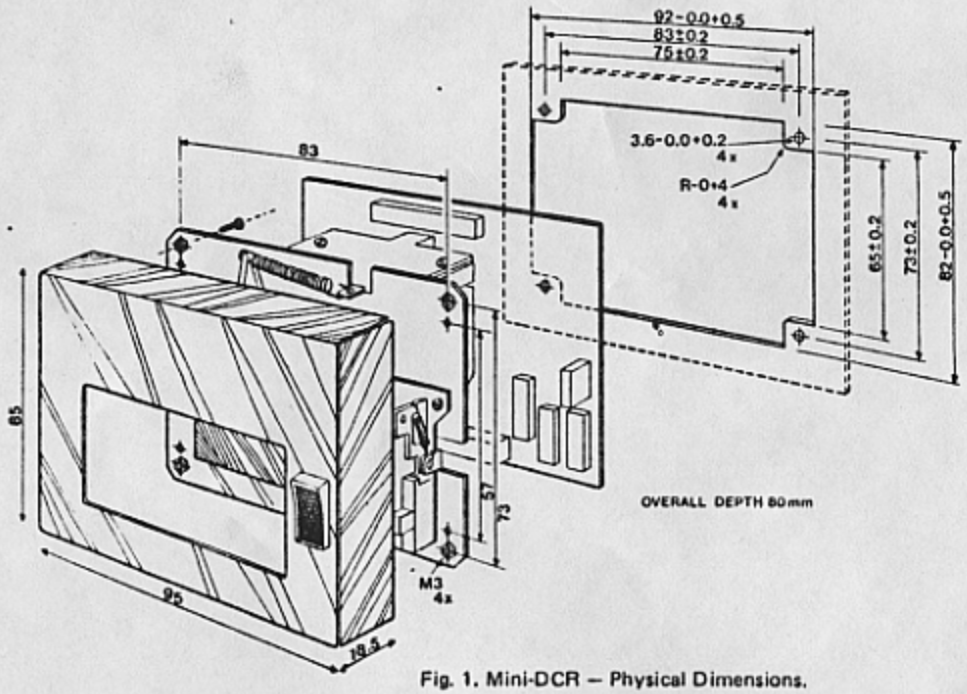


Fig. 1. Mini-DCR – Physical Dimensions.

List of Contents

List of illustrations

I. General

1. Introduction

This manual provides the description, timing diagram, interfacing signals as well as operating and maintenance instructions for the Philips mini-digital cassette recorder.
The Philips Mini-DCR has been specially designed for O.E.M.'s and users that need a fast and low-cost serial memory device for data storage and interchange.
The Mini-DCR is available in either a read-only or read-and-write version.
The recorder uses the Philips mini-cassettes, certified for freedom from drop-outs.

The whole system is based on Philips' extensive know-how gained in many years experience of digital cassette recording systems and their applications.
Advantages of economy, cassette convenience and high performance have made this technique internationally accepted and Philips quality and reliability have made them a major O.E.M. supplier of this type of equipment.

The Philips Mini-DCR is an ideal unit for micro-processor based systems, terminals, mini-computers and scientific calculators to be used in program loading, memory back-up and data capture applications.

2. Technical specification

Number of heads	:	two; a read/write head and an erase head
Recording head	:	single gap, single track, half width, read/write head
Number of tracks	:	two; A-side and B-side
Recording method	:	phase encoding character/bit serial
Tape length	:	36 m
Data transfer rate	:	6000 bits per second
Recording density	:	300 - 500 bpi (12-20 b/mm)
Irrecoverable error rate	:	1 in 10^9 bits
Tape transport	:	single motor hub driven 360 rpm ± 5%
Tape speed	:	12 - 20 ips (300 - 500 mm/sec.)
Read/write time	:	95 sec. for full tape length
Start time read/write	:	< 100 msec.
Stop time read/write	:	30 - 100 msec.
Start distance	:	1.8 - 2.0 inch (15 - 50 mm)
Stop distance	:	0.6 - 1.0 inch (5 - 25 mm)
Rewind time	:	< 95 sec.
Data capacity	:	64k octads per track
Medium	:	Philips 3.81 mm mini cassette certified for freedom of drop-outs

Electronics
Read/write electronics, tape transport

Control logic	:	one printed circuit board
Signal interface	:	the signal interface is a MOS-compatible (HEF 4000p series) interface
Signal levels/output signals	:	logic "1" Vs minus 0.5 V logic "0" < 0.5 V
Signal levels/input signals	:	logic "1" 8 V–Vs logic "0" < 3 V
Power interface	:	DC-power Vs = 12 volt ± 5%
Power load	:	400 mA peak (100 msec.) 120 mA nominal 30 mA stand-by
Thermal dissipation	:	1.4 Watt nominal
Electrical connections	:	via Amp. connector. 14 Pins cis serie Amp. code 163691-1 (13 pins) Housing 1-163690-3

Environmental conditions

Operating temperature range:		+5°C to +55°C
Thermal shock	:	< 11°C per hour
Relative humidity	:	10% - 90% (no condensation)
Air pressure	:	780 - 1100 mbar
Vibration (IEC 68-2-6)	:	5 - 200 Hz at 1g curve
Heat radiation	:	direct sunlight radiation on the cassette drive is not allowed
Physical dimensions	:	see fig. 1
Weight of Mini-DCR	:	about 400 grams

3. Type-numbers

8920 405 10101	:	basic read-only unit (MCR 210)
8920 405 10201	:	basic read and write unit (MCR 220)
8920 405 10301	:	MCR 210 with front cover (see fig. 1)
8920 405 10401	:	MCR 220 with front cover (see fig. 1)
8920 405 10601	:	MCR 220 with front cover and write enable switch
8920 440 10101	:	certified mini-cassette in plastic cover
	:	cleaning kit

II Use of the Mini-DCR

1. Interfacing

The plug connections are given in fig. 6/7 and the interface signals and their function are listed in the following section. The timing diagram in fig. 10 gives information about the various interface signals and commands.

– To guard against any fire hazard the following measures should be taken:
A. insert a fuse 0.5 A in the positive leads of the 12 Volt supply.
B. the supply leads and earth leads must each have a minimum cross-section of 0.38 mm^2.
– It is recommended that cassettes be entirely (re-)wound before they are removed from the recorder.
This prevents the tape from being touched by the fingers during loading and unloading.
Formation of unwanted loops is also avoided.
– If the direction of the tape movement is changed the start time will be about 50 msec. longer.
The start distance will be between 30 and 65 mm.
– To prevent false writing the unit shall not be switched-on or -off in case a cassette has been loaded unless the rise/fall time is < 1 μsec.
– Each mini-cassette can be equipped with a write-enable plug in order to prevent writing on a recorded tape.
The position of the write-enable plug determines wether writing is enabled on track 1 or 2 (see fig. 3).

2. Operating instructions

Since the Mini-DCR is intended for use by O.E.M. customers, operation of the device will depend upon individual system requirements.

Cassette loading is accomplished by depressing the button adjacent to the cassette cover and inserting the mini-cassette, open end first, into the cassette cover and closing the cover.

3. Operators maintenance

The only maintenance required for the user is cleaning of the read/write head every working week or 100 hours.
A special cleaning cassette kit is available for this purpose. (Refer to I-3).

4. Survey of interface signals

Name	Stands for:	Cat.	Description:	If "0"	If "1"
$\overline{WDA}$	Write data	D	Input channel of the write amplifier accepting information in digital form to be recorded on tape (6000 Hz ± 1%)	According to ECMA data "0" is a neg. going signal. Data "1" is a positive going signal. GAP is continuous "1".	
$\overline{BET}$	Begin/end of tape	S	Indicates whether begin of tape or end of tape has been detected.	Begin or end of tape had been detected.	
$\overline{WCD}$	Write command	C	Enables information entering via WDA-line.	Gate is open.	Gate is closed.
$\overline{REV}$	Reverse	C	Causes tape transport in the reverse direction.	Initiates tape transport.	Stops tape transport.
$\overline{FWD}$	Forward	C	Causes tape transport in forward direction.	Initiates tape transport.	Stops tape transport.
RDC	Read clock	D	Separately generated clock to strobe read-data free of jitter.	Positive going edge should be used to clock read-data.	
$\overline{RDA}$	Read data	D	Output channel of the read amplifier, supplies digital data that has been read from the tape.	According to ECMA data "0" is a negative going signal. Data "1" is a positive going signal. GAP is continuous "1".	
$\overline{CIP}$	Cassette in position	S	Indicates that a cassette is in position and the door has been closed.	Cassette is present.	No cassette.
$\overline{WEN}$	Write enable	S	Indicates whether a write enable plug (file protect) is present in the cassette.	Allows writing on tape (plug is present).	Write action prohibited

Note: C = control signal; D = data signal; S = status signal.

III Service information

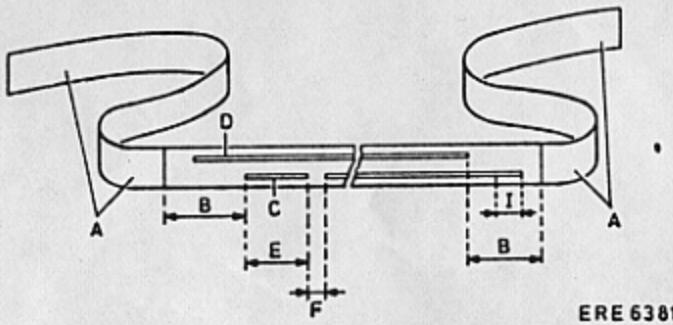
1. Technical Description

Cassette Composition
Figure 2 shows the physical composition of the tape.
Figure 4 shows the composition of the data blocks.

Gaps
Initial gaps, interblock gaps and end of data gaps are all erased to the same polarity.
This polarity is called the reference polarity.
For this purpose the $\overline{\text{WDA}}$-line should remain high.

Phase encoding (see fig. 5)
Data bits (i.e. "zeroes" and "ones") are written as flux transitions such that a "1" bit causes a transition to the reference polarity and a "0" bit causes a transition opposite to the reference polarity.
When successive "1" or "0" bits are written, it is necessary to insert extra transitions between the data bits to establish the correct polarity. These transitions are known as phase flux transitions.

Write Data
The phase encoded (PE) $\overline{\text{WDA}}$-signal is input at 15 IC1 and appears in-phase at 11 IC1 and anti-phase at 9 IC1.



A – Tape leader.
B – Initial gap.
C – Track 1.
D – Track 2.
E – Data block.
F – Interblock gap.
I – End of block gap.

ERE 6381

Fig. 2. Mini-DCR – Physical Composition of Tape.

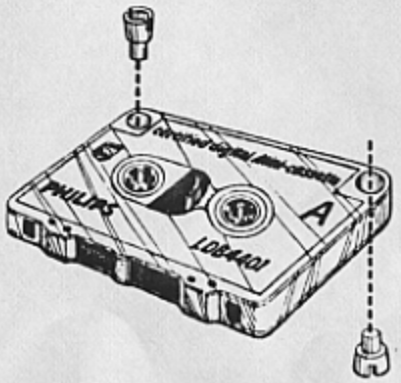


Fig. 3. Mini-DCR – Physical Composition of the Mini-Cassette

These two signals are applied across the read/write head when the $\overline{\text{WCD}}$ signal 9 IC6 is LOW and the WEN switch closed (8, 9 IC9-high). Enabling IC1 (4 IC1-low) also causes a low level; from 2 IC1, to be fed via R56 to the base of TS6 causing current to flow through the erase head.

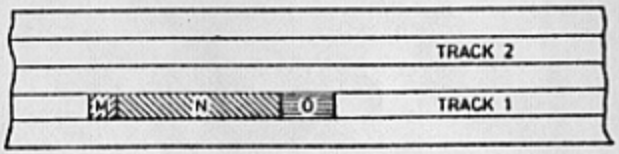
Read Data
The read signal from the read/write head is amplified via 2, 1 IC2 and applied to the pulse-shaper and rectifier ciircuit. The negative pulses inverted and amplified via 6, 7 IC2 and recombined with the amplified positive pulses from 8 IC2. Further shaping and squaring is carried out via TS7 and IC6.

The square-wave read data signal is phase-coded via 3, 1 IC7 and appears at output pin 12 ($\overline{\text{RDA}}$).
The read clock signal is derived from the read data signal via 2, 3 IC3 and appears at output pin 11 (RDC) to indicate a valid $\overline{\text{RDA}}$ output when positive.

Motor Control Logic
A low signal on either the $\overline{\text{FWD}}$ or $\overline{\text{REV}}$ inputs will cause switch "on" of TS2, TS5 or TS3, TS4 respectively.
The amount of current flowing through these transistors (and the motor) is controlled by TS1.
TS1 is driven by the servo loop formed by the motor, the tacho generator and IC's 4, 5 and 6.

BET and Tape Stopped Retector
A sample of the positive output from 8 IC5 is fed to 3 IC5 to hold the BET line high; should the tape jam or the motor stop, the output 8 IC5 goes negative causing a low on the $\overline{\text{BET}}$ line.

Clear Logic
When both $\overline{\text{REV}}$ and $\overline{\text{FWD}}$ lines are high the CLEAR signal output ate 11 IC9 goes high causing the following:
i) $\overline{\text{BET}}$ line high via 2 IC5.
ii) TS1 cut-off via 12 IC5.
iii) Preset of the RDA and RDC flip-flops IC7.



M – preamble = 10101010.
N – data undefined block length least significant bit is read and written first.
O – CRC character 16 bits.

Fig. 4. Mini-DCR – Data Block Composition. ERE 6380

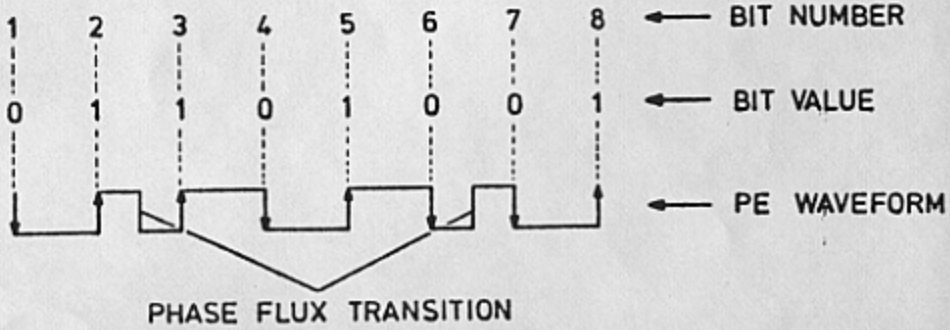


Fig. 5. Mini-DCR – Phase Encoded Write Data. ERE 6383

2. Timing Diagram

T1: The length depends on selected block-length and the relative position on the tape.
T2-T3-T4-T5: Depend on selected block-length, the total number of blocks and the start/stop, distances/times.
T6-T7: The pulses on the FWD line are necessary for clearing the Read Electronics.

How to use tape capacity efficiently
1. Required tape capacity: 32k-bytes per track (128 blocks of 256 bytes each).
T2 = 1/3 T1; T3 = 40 m sec.;
T4 = 250m sec.; T5 = 0. In case of re-write one block T4 = 350m sec.
2. Required tape capacity: 24k-bytes per track (96 blocks of 256 bytes each).
T2 = 198m sec.; T3 = 40m sec.;
T4 = 450m sec.; T5 = 0.
3. Required tape capacity: 40k-bytes per track (40 blocks of 1024 bytes each).
T2 = 198 m sec.; T3 = 40m sec.;
T4 = 450 m sec.; T5 = 0.
4. Required tape capacity: 64k-bytes per track (1 block of 64k-bytes).
T2 = Rewind time till BOT; T3 = time to write end of data gap; T4 is not applicable.

Remarks
– During a continuous write operation (no backspace or control-read) T3 = 0m sec. in order to obtain optimum data capacity.
– Repeated updating of a data-block positioned between two other blocks, may cause overwriting of the first part of the next data block.
– The pre-amble is used to synchronise the Read-clock (see detail A of the timing diagram).
– Read DATA is TRUE at the positive pulse edge of the signal Read clock.
– To read two or more blocks of data continuously it is necessary to reset Read clock in the inter-block gaps. This can be achieved by a pulse on the FWD-line of:
$1\ \mu s < T < 0.5$m sec.
– During Read operation signal $\overline{WDA}$ may not change level, because this causes cross-talk on $\overline{RDA}$.
– Signal $\overline{BET}$ indicates both begin and end of tape.
– In case of rewriting blocks, T4 shall be at least 100 msec. longer as indicated.

3. Maintenance

The only maintenance required for the Mini-DCR is cleaning of the read/write head every week or 100 working hours.

4. Adjustments

Electronic
1. The motor speed can be adjusted via R4 to give a mean tacho frequency of 1075 Hz (i.e. approximately 45 seconds after starting forward with a cassette loaded).

Mechanical
1. The mechanical forward/reverse switching element has two stop-screws that should be adjusted individually to give minimum motor current in either direction.

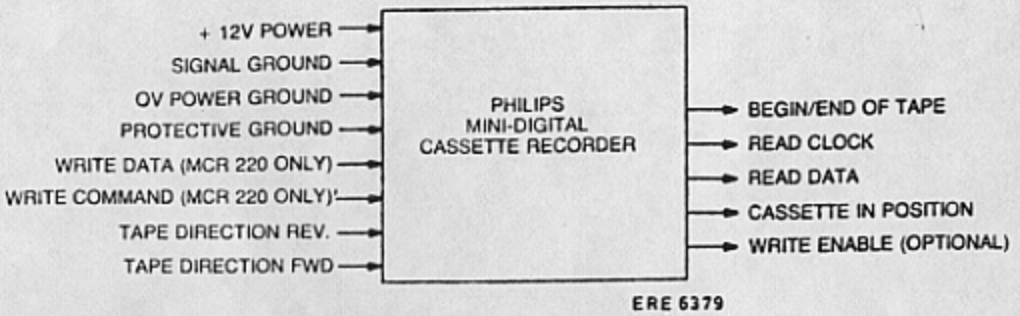
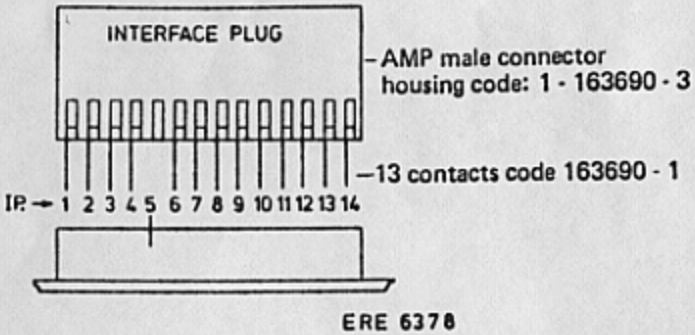


Fig. 6. Mini-DCR – Interface Diagram.



Pin No.	Signal
1	12V
2	OV (Signal Ground)
3	OV (Power)
4	Earth (Protective Ground)
6	$\overline{WDA}$
7	$\overline{BET}$
8	$\overline{WCD}$
9	$\overline{REV}$
10	$\overline{FWD}$
11	RDC
12	$\overline{RDA}$
13	$\overline{CIP}$
14	$\overline{WEN}$

Fig. 7. Mini-DCR – Interface Connector.

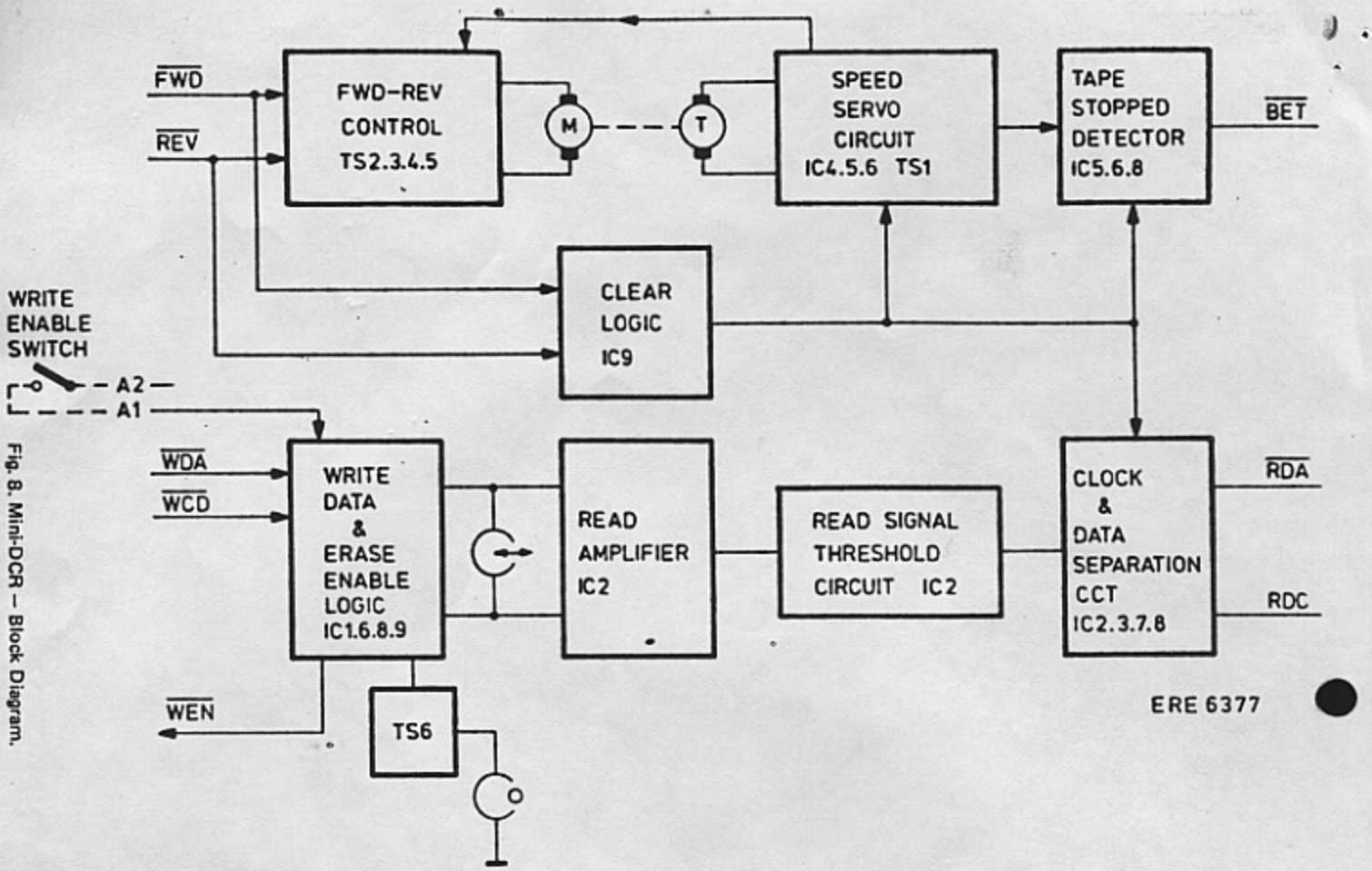


Fig. 8. Mini-DCR – Block Diagram.

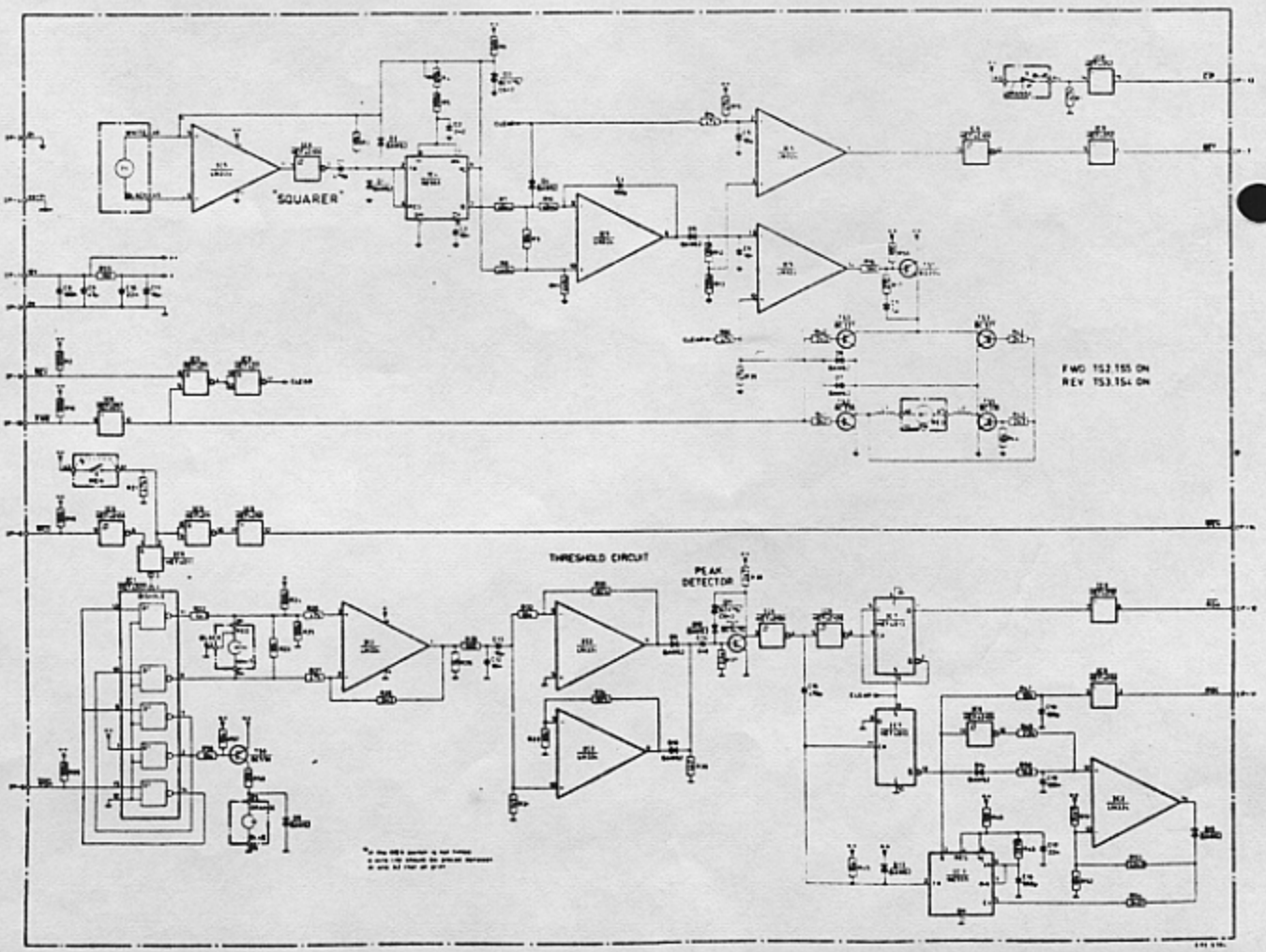
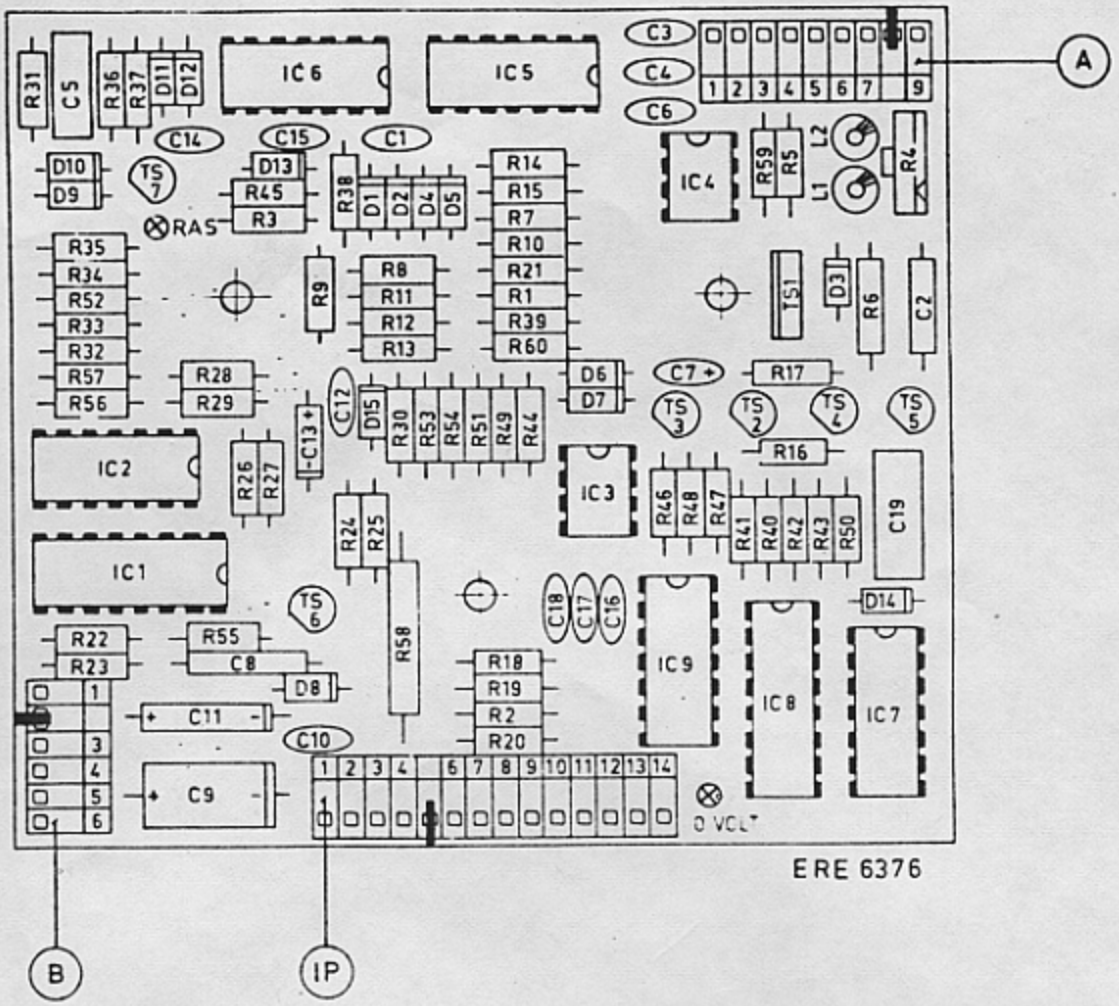


Fig. 9. Mini-DCR – Circuit Diagram.

Fig. 10. Mini-DCR – PCB Layout.



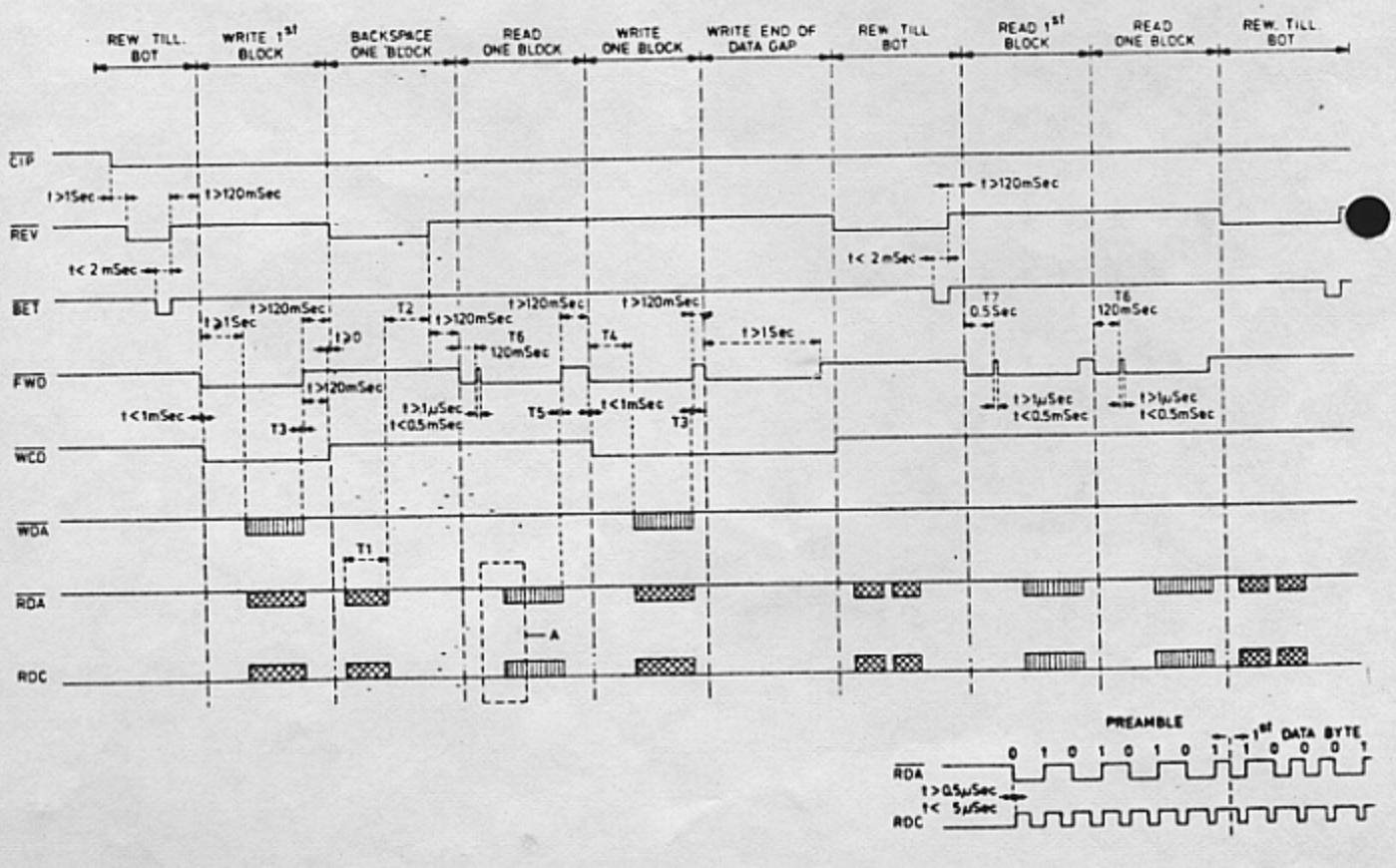


Fig. 11. Mini-DCR – Timing Diagram.