HARRIS
SEMICONDUCTOR
PRODUCTS DIVISION
A DIVISION OF HARRIS CORPORATION

HM-7602/03

32 x 8 PROM

HM-7602 — Open Collector Outputs
HM-7603 — "Three State" Outputs

Features

- 50ns MAXIMUM ADDRESS ACCESS TIME
- "THREE STATE" OR OPEN COLLECTOR OUTPUTS
- SIMPLE HIGH SPEED PROGRAMMING PROCEDURE ONE PULSE/BIT. ASSURES FAST PROGRAMMING AND SUPERIOR RELIABILITY.
- FAST ACCESS TIME – GUARANTEED FOR WORST CASE N^2 SEQUENCING OVER COMMERCIAL AND MILITARY TEMPERATURE AND VOLTAGE RANGES.
- INDUSTRY'S HIGHEST PROGRAMMING YIELD

Description

The HM-7602/03 is a fully decoded high speed Schottky TTL 256/Bit Field Programmable ROM in a 32 word by 8 bit/word format with open collector (HM-7602) or "Three State" (HM-7603) outputs. These PROMs are available in a 16 pin D.I.P. (ceramic or epoxy) and a 16 pin flatpack.

All bits are manufactured storing a logical "1" (Positive Logic) and can be selectively programmed for a logical "0" in any one bit position.

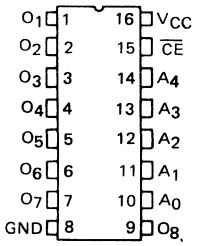
Nickel-chromium fuse technology is used on this and all other Harris Bipolar PROMs.

The HM-7602/03 contains test rows which are in addition to the storage array to assure high programmability and guarantee parametric and A.C. performance. The fuses in these test rows are blown prior to shipment.

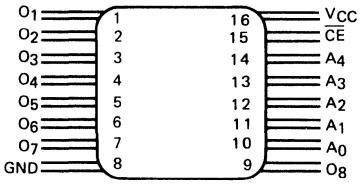
There is one chip enable input on the HM-7602/03. $\overline{CE}$ low enables the chip.

Pinouts

TOP VIEW – DIP



TOP VIEW – FLATPACK



PIN NAMES

A0 – A4	Address Inputs
O1 – O8	Data Outputs
$\overline{CE}$	Chip Enable Inputs

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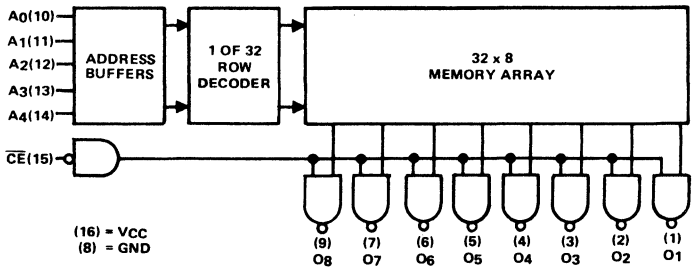
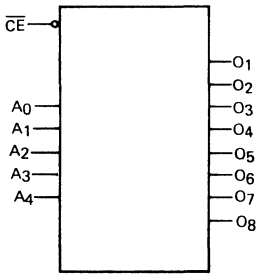
Functional Diagram



Logic Symbol



Specifications HM-7602/03

ABSOLUTE MAXIMUM RATINGS

Output or Supply Voltage (Operating)	-0.3 to +7.0V	Storage Temperature	-65°C to +150°C
Address/Enable Input Voltage	5.5V	Operating Temperature (Ambient)	-55°C to +125°C
Address/Enable Input Current	-20mA	Maximum Junction Temperature	+175°C
Output Sink Current	100mA		

*CAUTION: Stresses above those listed under the "**Absolute** Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and functional operation of the device at these or at any other conditions above those indicated in the operational sections of this specification is not implied. (While programming, follow the programming specifications.)*

D.C. ELECTRICAL CHARACTERISTICS (Operating)

HM-7602/03-5 (V_{CC} = 5.0V ±5%, T_A = 0°C to +75°C)
HM-7602/03-2 (V_{CC} = 5.0V ±10%, T_A = -55°C to +125°C)
Typical measurements are at T_A = 25°C, V_{CC} = +5V

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
I_{IH}	Address/Enable "1"	–	–	+40	μA	V_{IH} = V_{CC} Max.
I_{IL}	Input Current "0"	–	-50.0	-250	μA	V_{IL} = 0.45V
V_{IH}	Input Threshold "1"	2.0	1.5	–	V	V_{CC} = V_{CC} Min
V_{IL}	Voltage "0"	–	1.5	0.8	V	V_{CC} = V_{CC} Max.
V_{OH}	Output Voltage "1"	2.4*	3.2*	–	V	I_{OH} = -2.0mA, V_{CC} = V_{CC} Min.
V_{OL}	"0"	–	0.35	0.45	V	I_{OL} = +16mA, V_{CC} = V_{CC} Min.
I_{OHE}	Output Disable "1"	–	–	+100	μA	V_{OH}, V_{CC} = V_{CC} Max.
I_{OLE}	Current "0"	–	–	-100	μA	V_{OL} = 0.3V, V_{CC} = V_{CC} Max.
V_{CL}	Input Clamp Voltage	–	–	-1.2	V	I_{IN} = -18mA
I_{OS}	Output Short Circuit Current	-15*	–	-100*	mA	V_{CC} = V_{CC} Max., V_{OUT} = 0.0V One Output Only for a Max. of 1 Second.
I_{CC}	Power Supply Current	–	90	130	mA	V_{CC} = V_{CC} Max. All Inputs Grounded

NOTE: Positive current defined as into device terminals
* "Three State" only

A.C. ELECTRICAL CHARACTERISTICS (Operating)

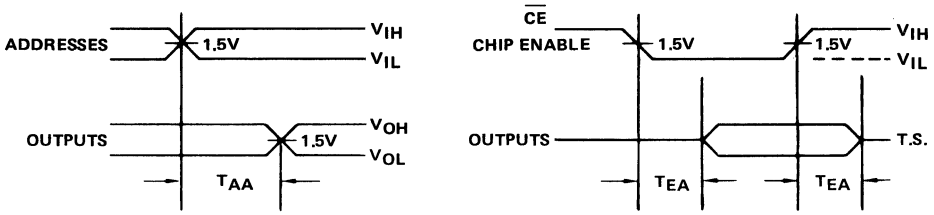
		HM-7602/03-5 5V ±5% 0°C to +75°C			HM-7602/03-2 5V ±10% -55°C to +125°C			
SYMBOL	PARAMETER	MIN	TYP	MAX*	MIN	TYP	MAX*	UNITS
T_{AA}	Address Access Time	–	30	50	–	–	60	ns
T_{EA}	Chip Enable Access Time	–	20	35	–	–	50	ns

*A.C. limits guaranteed for worst case N2 sequencing with maximum test frequency of 5MHz.

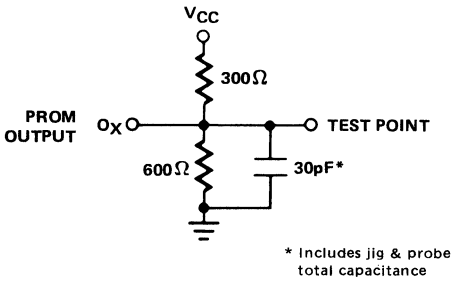
CAPACITANCE: T_A = 25°C

SYMBOL	PARAMETER	MAXIMUM	UNITS	TEST CONDITIONS
C_{INA}, C_{INCE}	Input Capacitance	12	pF	V_{CC} = 5V, V_{IN} = 2.0V, f = 1MHz
C_{OUT}	Output Capacitance	12	pF	V_{CC} = 5V, V_{OUT} = 2.0V, f = 1MHz

SWITCHING TIME DEFINITIONS



A. C. TEST LOAD



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Generic PROM Programming

All 76xxx series devices utilize the same programming method which is one of the characteristics that lends to the term "Generic" PROM.

Harris Generic PROMs have the industry's highest programming yield and exhibit an extremely high level of reliability in the field, however, this level of device quality can only be obtained if the PROM has been properly programmed to the data sheet specifications. Outlined below are the key points which deserve attention to assure that programming has been optimumly performed.

- Be certain that you are following the latest revision status of programming specifications.
- If you are utilizing a commercial programmer, be sure that the card set for Harris Generic PROMs is certified for the most recent revision level.
- Have the Programmer calibrated at routine intervals to assure that the electrical and mechanical characteristics are acceptable. This would include such things as:
  - Making certain that the socket which the device is placed into is clean, free of corrosion and is mechanically sound.
  - Check ribbon cable connectors for good continuity.
  - Making sure that all voltage levels conform to the programming specifications.
  - Assuring that all pulses are clean of distortion and exhibit the correct timing characteristics.

If there is any problem in determining how to follow any of these guidelines, contact a local Harris office for assistance.

PROGRAMMING PROCEDURE

The following is the generic programming procedure which is used for all Harris Generic 76xxx PROMs. Please note that the PD input(s) on power down devices can be considered equivalent to chip enable input(s) during the programming procedure in that they both disable the device. Also, the logic levels required to place the strobe input into the "transparent read" mode (essential during programming) will vary among the various device types.

The HM-76xxx PROMs are manufactured with all bits storing a logical "1" (output high). Any desired bit can be programmed to a logical "0" (output low) by following the simple procedure shown below. One may build their own programmer to satisfy the specifications described in the table, or use any of the commercially available programmers which meet these specifications. This PROM can be programmed automatically or by the manual procedure shown on the next page.

Programming Specifications

SYMBOL	PARAMETER	MINIMUM	RECOMMENDED OR TYPICAL	MAXIMUM	UNITS
V_{IH} V_{IL}	Address Input Voltage (1)	2.4 0.0	5.0 0.4	5.0 0.8	V V
V_{PH} (2) V_{PL} (3)	Programming/Verify Voltage to V_{CC}	12.0 4.5	12.0 4.5	12.5 5.5	V V
I_{ILP}	Programming Input Low Current at V_{PH}	–	-300	-600	μA
t_r t_f	Programming (V_{CC}) Voltage Rise and Fall Time	1.0 1.0	1.0 1.0	10.0 10.0	μs μs
t_d	Programming Delay	10	10	100	μs
t_p	Programming Pulse Width (4)	90	100	110	μs
P.D.C.	Programming Duty Cycle	–	50	90	%
V_{OPE} V_{OPD}	Output Voltage Enable (6) Disable (5)	10.5 4.5	10.5 5.0	11.0 5.5	V V
I_{OPE}	Output Voltage Enable Current	–	–	10.0	mA
T_a	Ambient Temperature	–	25	75	°C

During programming the chip must be disabled for proper operation.

NOTES:
1. No inputs should be left open for V_{IH}.
2. V_{PH} source must be capable of supplying one ampere.
3. It is recommended that dual verification be made at V_{PL} min and V_{PL} max.
4. Note step 11 in programming procedure.
5. Disable condition will be met with output open circuited.
6. V_{OPE} supply must be capable of supplying 10mA.

1. If the device has latched outputs (HM-76xxR): apply a logic "1" to the strobe input to place the device into the "transparent read" mode which is essential during programming. The strobe must remain in the "transparent read" mode throughout the entire programming procedure.

2. Address the PROM with the binary address of the word to be programmed. Address inputs are TTL compatible. An open circuit should not be used to address the PROM.

3. Bring the $\overline{CE}_X$ (PD_X) input(s) high and the CE_X ($\overline{PD}_X$) input(s) low to disable the device. The disabling of the device during programming is an essential step in correctly programming all Harris PROMs. The chip enables are TTL compatible. An open circuit should not be used to disable the device. (Disregard this step for devices which have no chip enable or power down inputs.)

4. Disable the programming circuitry by applying a voltage disable of V_{OPD} to the outputs of the PROM. Any output may be left open to achieve the disable.

5. Raise V_{CC} to V_{PH} with rise time $\leq t_r$.

6. After a delay $\geq t_d$, apply a pulse with amplitude of V_{OPE} and duration of t_p to the output selected for programming. Note that the PROM is manufactured with fuses intact which generate an output high. Programming a fuse will cause the output to be in the V_{IL} state in the verify mode.

7. Other bits in the same word may be programmed while the V_{CC} input is raised to V_{PH} by applying output enable pulses to each output which is to be programmed. The output enable pulses must be separated by a minimum interval of t_d.

8. Lower V_{CC} to 4.5 volts following a delay of t_d from the last programming enable pulse applied to an output.

9. Enable the PROM for verification by applying V_{IL} to $\overline{CE}_X$ (PD_X) and V_{IH} to CE_X ($\overline{PD}_X$).

10. Repeat verification (step 9) at V_{CC} = 5.5 volts.

11. If any bit does not verify as programmed, repeat steps 2 through 9 until the bit has received a total of 1msec of programming time. Bits which do not program within 1msec are programming rejects. No further attempt to program these parts should be made.

12. Repeat steps 1 through 11 for all other bits to be programmed in the PROM.

13. Programming rejects returned to the factory must be accompanied by data giving address, desired data, and actual output data of the location in which a programming failure has occured.

Typical Programming Circuit

The circuit and timing diagrams shown in Figures 1 and 2 will establish the proper programming conditions for the output enable pulses. This allows the use of standard TTL parts for all logic inputs to the PROM. Note the gate which senses the output must withstand up to 11.0 volts during programming.

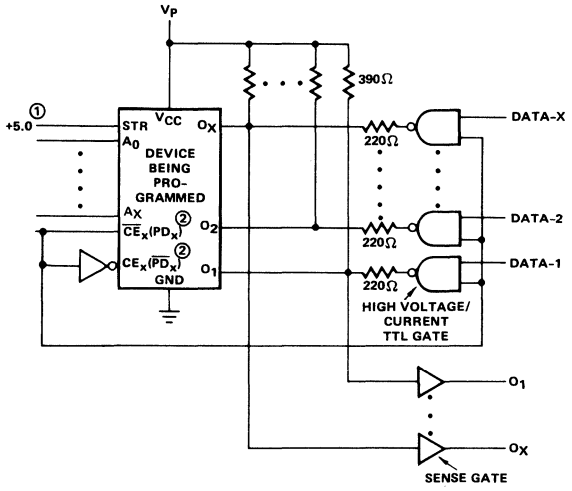


FIGURE 1

① The strobe input must remain at V_{IH} throughout the procedure. (for latched output devices only.)

② Disregard for devices with no enable inputs.

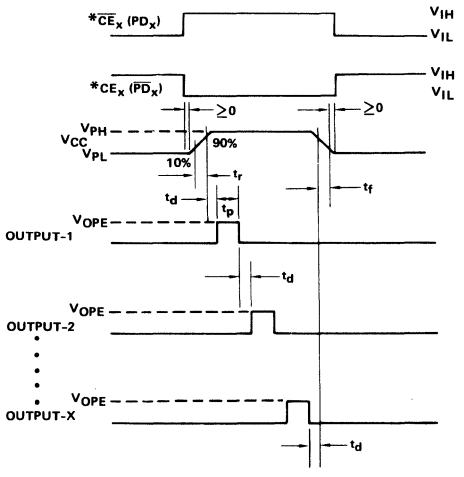


FIGURE 2

* Disregard for devices with no enable inputs.

The strobe input must remain at V_{IH} throughout the procedure. (for latched output devices only.)

This timing diagram shows device terminal conditions. Each positive going data pulse at the terminal blows the corresponding bit, resulting in a low output for that bit. Therefore, a low input at the DATA-X points of the Figure 1 circuit results in a permanent low output of a bit.

Programmer Evaluation

Programming equipment models identified in the accompanying list have been spot checked by Harris Semiconductor and found to be acceptable for use in programming HARRIS PROMs. This list is provided only as a convenience to purchasers of HARRIS PROMs to identify programmer models potentially suitable for programming the PROMs. It is neither intended to be a representation or warranty by Harris of the capability of all listed programmer models nor an indication of unsuitability of other programmer models not contained in the list. PROM purchasers are advised to adhere to the programming requirements specified in HARRIS current data sheets applicable to the PROMs to be programmed. Responsibility for programmer performance lies solely with the equipment manufacturer. The programmer user is cautioned to verify operation and performance according to the manufacturer's instructions and specifications prior to each use, and to determine that the programming complies with the applicable HARRIS PROM data sheet. Harris accepts no responsibility for PROMs which have been subjected to incorrect or faulty programming.

DATA I/O Main Frame: All in which 909-XXXX card sets are specified.

CARD SET	PRODUCTS	COMMENTS
950-0099 UNI PAK	HM-76XX	No Additional hardware required.
909-1063-4 Rev S	HM-76XX	Preferred Requires specified socket adapter.
909-1063-4 Rev H	HM-76XX	Acceptable Requires specified socket adapter.
909-1319-3 Rev D	HM-6611/6661-X	Requires specified socket adapter.
909-1054-3 Rev E	HMX-0512-X	

PROLOG Main Frame: Model M909

MODULE	PRODUCTS	COMMENTS
PM 9031	HM-7602	
PM 9027	HM-7610/11	
	HM-7620/21	
PM 9029	HM-7640/41	
PM 9036	HM-7642/43	
PM 9039A	HM-76XX	Preferred Generic Module requires respective
PM 9039	HM-76XX	Acceptable socket and configurator.
PM 9055	JAN-0512	
PM 9056	HM-6611	

INTERNATIONAL MICROSYSTEMS INC. Main Frame: IM 1000

MODULE	PRODUCTS	COMMENTS
IM-1063	HM-76XX	Generic Module requires specified socket adapter.

DIGITRONICS, ISRAEL LTD. Main Frame: UPP/801

MODULE	PRODUCTS	COMMENTS
PM 106	HM-76XX	Generic Module requires specified interface socket.
PM 130	HM-6611	Requires specified interface socket.

SUNRISE ELECTRONICS Main Frame: Smarty SM-100

MODULE	PRODUCTS	COMMENTS
Family Slave	HM-76XX	Sockets are part of slave unit.

KONTRON ELECTRONICS Main Frame: MPP805

MODULE	PRODUCTS	COMMENTS
#6	HM-76XX	Requires specified socket adapter.

STOLZ AG Main Frame: Maestro M2

MODULE	PRODUCTS	COMMENTS
HM-76XX	HM-76XX	Requires specified socket adapter.

Data Entry Formats for Harris Custom Programming *

For Harris to custom program to a user data pattern specification, the user must supply the data in one of the following formats:

1. Master PROM of same organization and pinout as device ordered. Two pieces required, three preferred.
2. Paper tape in Binary or ASCII BPNF.

* BINARY PAPER TAPE FORMAT

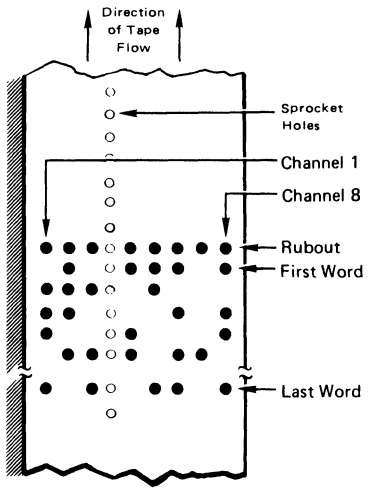
- A minimum of six inches of leader.
- A rubout (all eight locations punched).
- Data words beginning with the first word (word "0"), proceeding sequentially, ending with the last word (word "N"), with no interruptions or extraneous characters of any kind.
- Specifiy whether a punched hole is a VOH = "1" = logic high or is a VOL = "0" = logic low.
- A minimum trailer of six inches of tape.

* ASCII BPNF FORMAT

- A minimum leader of twenty rubouts (all eight locations punched).
- Any characters desired (none necessary) except "B".
- Data words beginning with the first word (word "0"), proceeding sequentially, ending with the last word (word "N").
- Data words consist of:
  1. The character "B" denoting the beginning of a data word.
  2. A sequence of characters, only "P" or "N", one character for each bit in the word.
  3. The character "F" denoting the finish of the data word.
- No extraneous characters of any kind may appear within a data word (between any "B" and the next "F").
- Errors may be deleted by rubouts superimposed over the entire word including the "B", and beginning the word again with a new "B".
- Any text of any kind (except the character "B") is allowed between data words (between any "F" and the next "B"), including carriage return and line feed.
- A minimum trailer of twenty-five rubouts.
- Specify whether a "P" is a "1" = VOH = logic high or is a "0" = VOL = logic low.
- The use of even or odd parity is optional.

* *Harris can not assume responsibility for PROMs programmed to data tapes or masters which contain errors. The user must insure the accuracy of the data provided to Harris. Harris guarantees that the programmed PROMs will contain the information provided if either of the following formats are followed.*

BINARY PAPER TAPE EXAMPLE



Punched Hole = "0" = VOL = Logic Low

Word					PROM Output Data ①							
AX ··· A2	A1	A0		Channel Output	8 O_8	7 O_7	6 O_6	5 O_5	4 O_4	3 O_3	2 O_2	1 O_1
0 ···· 0	0	0	First		0	1	0	0	0	1	0	1
0 ···· 0	0	1	Second		1	1	1	0	1	0	0	0
0 ···· 0	1	0	Third		0	1	0	1	1	1	0	0
0 ···· 0	1	1	Fourth		0	1	1	1	0	1	1	0
0 ···· 1	0	0	Fifth		1	0	0	1	0	0	0	1
1 ···· 1	1	1	Last		0	1	0	0	1	0	1	0

NOTES:

① PROMs with 4 bit wide data outputs require punching only first 4 channels on tape (Channels 1 thru 4).

② On HARRIS PROMs O_X (Example: O_1) designates a respective output pin on the device. O_1 (Output 1) is always LSB.

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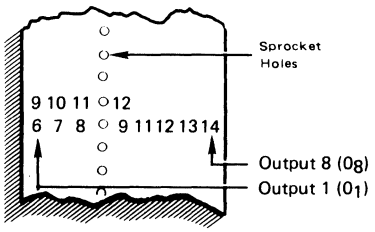
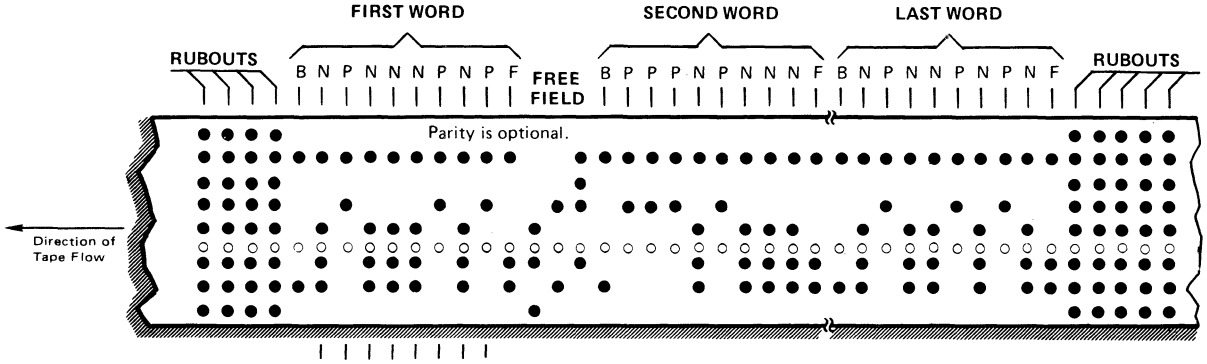
DEVICE OUTPUT PACKAGE PINS

EXAMPLE:



Package	Device Type
16 Pin CMOS	HM-6611
20 Pin Bipolar	HM-7649

ASCII BPNF PAPER TAPE EXAMPLE



EXAMPLE	PACKAGE TYPE	DEVICE OUTPUT PINS
HM-6611	16 Pin Pkg.	12 11 10 9 (MOS)
HM-7649	20 Pin Pkg.	14 13 1211 9

Truth Table
Character "D" = "1" = VOH = Logic High
Character "V" = "0" = VOL = Logic Low

Word					PROM Outputs Data ①							
AX ···· A2	A1	A0			O_8	O_7	O_6	O_5	O_4	O_3	O_2	O_1
0 ····· 0	0	0	First		0	1	0	0	0	1	0	1
0 ····· 0	0	1	Second		1	1	1	0	1	0	0	0
1 ····· 0	1	0	Last		0	1	0	0	1	0	1	0

NOTES:

① In the ASCII BPNF format, MSB data is punched after "B". On devices with 8 outputs, O_8 (Output 8) data is punched after "B". On devices with 4 outputs, O_4 (Output 4) data is punched after "B".