

Appendix B

TECHNICAL INFORMATION

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1. OUTPUT FORMAT FOR HOST COMPUTER (OPTION)

The bit serial voltage type, which conforms to the RS-232C interface, is used for host computer communication. The serial interface port for the connection with the host computer is on the right panel of the main unit.

1.1 Hardware

1. Connector

- The connector to the host computer is located on the right panel of the main unit.
- Use a 9-pin D-SUB, female connector.
- Fixing screws for this connector are in inch-specification.

2. Connector Signals

Pin No.	Signal name	Signal direction
1		
2	Receive Data (RxD)	from Host to CA-1500
3	Transmit Data (TxD)	to Host from CA-1500
4	Data Terminal Ready (DTR)	to Host from CA-1500
5	Signal Ground (SG)	
6	Data Set Ready (DSR)	from Host to CA-1500
7	Request to Send (RTS)	to Host from CA-1500
8	Clear to Send (CTS)	from Host to CA-1500
9		

Table B-1-1: Pin Assignment

3. Communication Format

The data is communicated in the asynchronous, half duplex mode. (Asterisk mark * indicates the setting at the time of shipment from the factory.)

Baud rate: 600, 1200, 2400, 4800, *9600 (BPS)
 Code: 7 bit, *8 bit
 Stop bit: 1 bit, *2 bit
 Parity: *None, Even, Odd
 Interval: 0, *2, 3, 5, 7, 10, 15 (seconds)

4. Signal Level

Signal level conforms to JIS C6361.

Level	Data signal	Control signal
+3V or higher	Logic "0", Start bit	ON
-3V or lower	Logic "1", Stop bit	OFF

Table B-1-2: Signal Level

5. Interface Circuit

- Output circuit

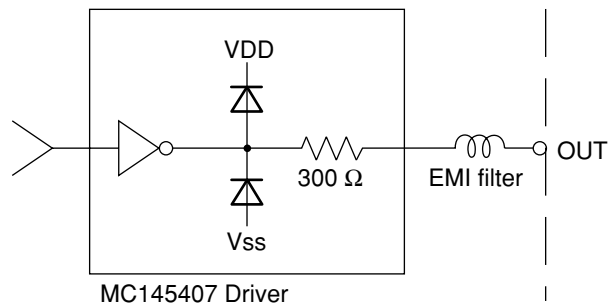


Figure B-1-1: Interface Output Circuit

- Input circuit

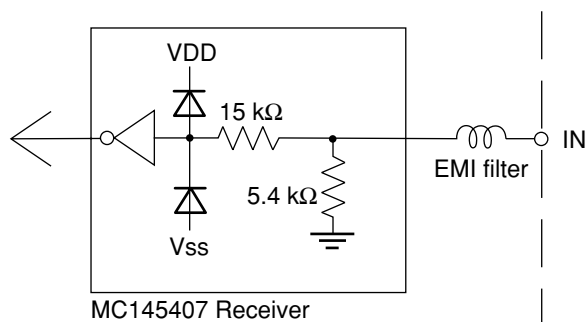


Figure B-1-2: Interface Input Circuit

1.2 Software

1. Communication Format

1) Code

ASCII codes are used for output.

2) Structure of Text

"STX"(02 H) is sent prior to data and "ETX"(03 H) is sent at the end of data.

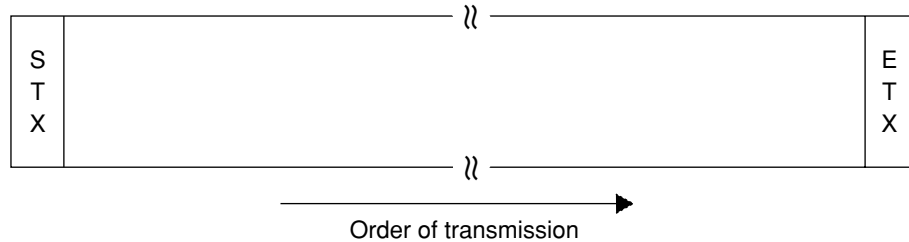


Figure B-1-3: Order of Transmission

3) Communication Protocol

The following two protocols are provided in the system, and can be selected according to the system status.

- Class A
One-way transmission to the host computer without requiring ACK nor NAK from host computer.
- Class B
The CA-1500 transmits data and then waits for ACK or NAK to complete the data transmission.
ACK and NAK can be sent between STX and ETX.

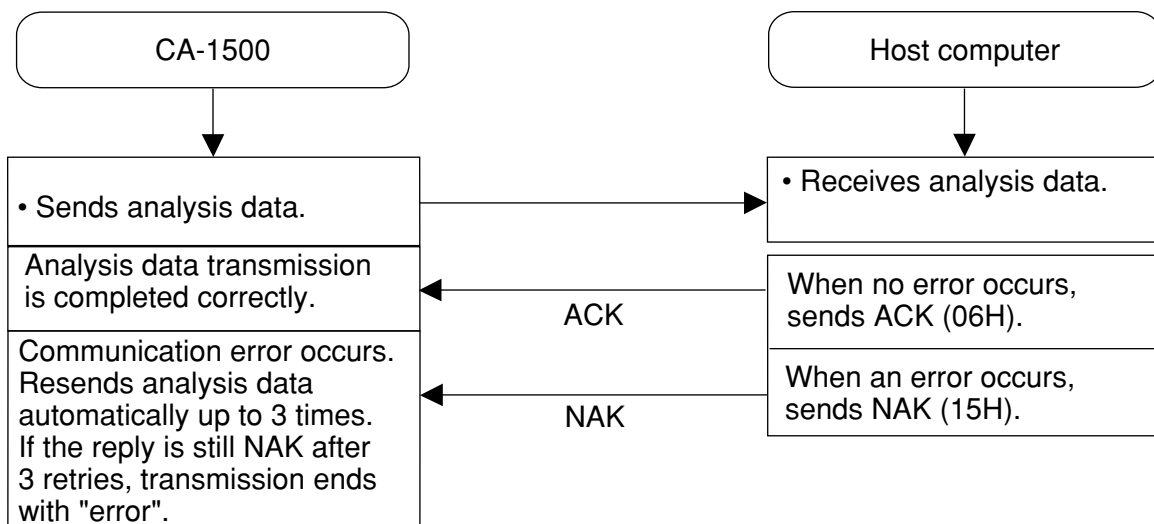


Figure B-1-4: Analysis Data Transmission

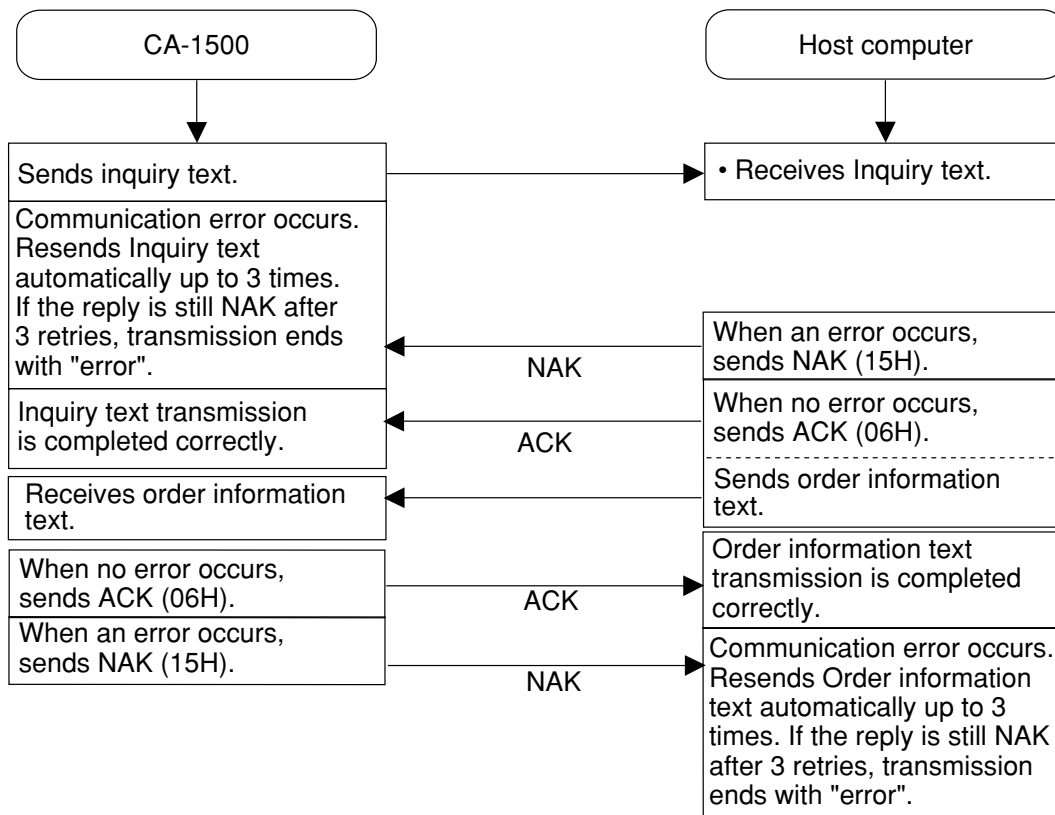


Figure B-1-5: Order Inquiry and Order Information Texts Transmission

4) Transmission Errors

If the CA-1500 detects a transmission error, data transmission is interrupted and an error message is displayed on the LCD screen. Re-transmission is carried out by the operator. Transmission errors occur in the following situations.

- The control signal DSR is OFF.
- After the data is output, the control signal CTS is not turned ON within 5 seconds.
- In case of parity error, overrun error, or frame error
- When the data is transmitted, no response is sent from the host computer within 15 seconds. (Class B only)
- When the data is transmitted, other than ACK and NAK is sent from the host computer. (Class B only)
- When the data is transmitted, NAK is received 4 times. (Class B only. The CA-1500 automatically re-sends the same data up to 3 times when NAK is received.)
- When the transmission initial word (STX) or ending word (ETX) is not received.

5) Transmission Interval

The transmission interval time between the data can be selected. The interval time in the case of class B means the period after receiving the response of ACK/NAK until starting the next data transmission.

6) Process Time Required

If no control signal lines are used, the response to the CA-1500 must be sent with a delay time of 0.2 seconds or more.

1.3 Text Format

There are two types of communication text formats for the CA-1500. Make an appropriate setting on the Host Computer Setting screen. For details, see *Chapter 11, Section 6.1: Host Computer Settings*.

NOTE:

- There are two format types for the host computer output.
Format type: CA-1000, CA-1500
* (When CA-1000 is selected, the sample ID number of the transmission data is 13 digits excluding the most significant 2 digits, the patient name is 11 characters excluding the first (left most) 4 characters, and the rack No. is 4 digits excluding the most significant 2 digits.)
The CA-1500 format is selected at the time of shipment from the factory.

- **Analysis Data Text (Output)**

The analysis data is output.

There are two methods for output: Automatic transmission (real-time basis) after each analysis is completed, and batch transmission from the stored data list.

- **Order Inquiry Text (Output)**

The analysis parameters, or the sample ID number and analysis parameters are inquired for prior to an analysis. There are two methods for inquiry: Inquiry by a sample ID number read from the barcode label, and by pressing the [HC] key from the Work Load List screen.

- **Order Information Text (Input)**

After transmitting the order inquiry text, order information text is received from the host computer for an order instruction.

- * Class B communication is required to use the function of order inquiry and analysis order information.

1.3.1 Analysis Data Format

Value in () indicate the value when CA-1000 is selected.

Parameter	No. of Characters	Example
STX	1	(02 H)
Text Distinction Code I	1	Fixed to "D".
Text Distinction Code II	1	"1" (normal data) or "2" (mean data)
Text Distinction Code III	2	Fixed to "21"
Block Number	2	"01"
Total Number of Blocks	2	"01"
Sample Distinction Code	1	"U", "E", "S", "C"
Date	6	"980313"
Time	4	"1325"
Rack Number	6 (4)	"000001"
Tube Position Number	2	"01"
Sample ID Number	15 (13)	"123-456-789-012"
ID Information	1	"M", "A", "B", "C"
Patient Name	15 (11)	"XX...XX"
Analysis Parameter, Data 1	9	
Analysis Parameter, Data 2	9	
Analysis Parameter N, Data N	9	
ETX	1	(03 H)
Total	60 +9N (52 +9N)	

Table B-1-3: Analysis Data Format

- Order of Transmission**
 The order of transmission is from the top parameter to the bottom; the most significant digit first and the least significant digit last. Zero suppression is not performed.
- Block Number and Total Number of Blocks**
 The analysis data is divided for transmission so that one block contains 255 or less characters.
 The block number is the sequence number of the divided text.
 The total number of blocks is the total number of divided text.
 Normally, block number and number of blocks are "01".

- **Sample Distinction Code**

The types of analysis data are shown.

U: Routine analysis data

E: STAT analysis data

S: Standard curve analysis data

C: Quality control analysis data

- **Date and Time**

Set the date and time when the analysis was performed. The date format conforms to the format set in the date/time setting program. Time follows the 24-hour system.

Zero suppression is not performed.

- **Rack Number**

The rack number indicates the 6-(4-)digit number ("000001" - "999999") assigned to each sample rack. Zero suppression is not performed.

For the STAT sample holder, it becomes "STAT H" (if CA-1000 format is selected, "0000"). For the reagent holder, it becomes "D1" - "D14" (if CA-1000 is selected, spaces (20 H)).

- **Tube Position Number**

The tube position number indicates the sample tube position (01 - 10) in the sample rack, the holder position (01 - 05) of STAT sample, and the reagent holder

(spaces (20 H)). If the tube position number is expressed by numerals, zero suppression is not performed.

- **Sample ID Number**

The sample ID number consists of 15 (13) digit numerals. A hyphen "-" (2D H) may be inserted between numerals. The hyphen "-" is included in the 15 (13) digits. Zero suppression is not performed. The most significant digits are filled with spaces (20 H) if it is less than 15 (13) digits.

- **ID Information**

The ID information indicates the method in which the sample ID number is registered.

M: Manual entry

A: Automatically assigned by the instrument

B: Read by ID barcode reader

C: Set by the host computer order information

- **Patient Name**

The patient name consists of 15 (11) characters with character codes including spaces but excluding control codes.

• **Analysis Parameter, Data**

Parameter	No. of Characters	
Parameter Code	3	(000)
Data	5	(0000.0) [sec], [s]
		(□000.0) [%], [mg/dL], [μg/L]
		(□0.000) [], [g/L], [U/mL], [μg/mL]
		(□00.00) Ratio, INR, [mg/L]
Flag	1	"□", "+", "-", "*", "!", "<", ">", "x"

Table B-1-4: Analysis Parameter, Data

1) **Parameter Code**

04x: PT	05x: APTT	06x: Fbg
08x: TTO#	09x: NT#	12x: Factor II
15x: Factor V	17x: Factor VII	18x: Factor VIII
19x: Factor IX	20x: Factor X	21x: Factor XI
22x: Factor XII	30x: AT III	31x: α2PI
32x: Plg	33x: PC	51x: TT
60x: FDP##	61x: D. Dimer	

Where, x is:

- 1: Time
- 2: Activity percent/concentration
- 3: Ratio
- 4: INR
- 5: dFbg

NOTE: • Additional parameter codes may be added in the future.

- * Additional parameter codes may be added in the future. When the host computer receives a parameter code not mentioned above, prepare a host computer program that will ignore the data of such a parameter code or can allocate a parameter to new codes.
- # Not available in the USA.
- ## Available for use only in Asia.

2) **Data**

Because the decimal point is not transmitted, the host computer must add the appropriate decimal point specified for each parameter.

The position of decimal point varies depending on the unit.

Time:	0000.0	→ 00000 (*1)
Activity percent:	000.0	→ □0000 (*2)
PT ratio:	00.00	→ □0000 (*2)
INR:	00.00	→ □0000 (*2)
Fbg concentration:	□0.000g/L or □000.0mg/dL	→ □0000 (*2)
D-Dimer concentration:	00.00mg/L or 0000μg/L	→ □0000 (*2)
Difference in Optical Density (dOD):		
Chromogenic Method:	00.000	→ 00000 (*2)
Immunoassay Method:	0.0000	→ 00000 (*2)

□ indicates a space (20 H).

- *1. If coagulation time cannot be obtained such as in the case of an analysis error, "*" is entered instead of "O" for the number of characters. However, "/" enters in the case of mean data.
- *2. If data cannot be calculated in cases when the standard curve is not set or the coagulation time is not obtained, "-" is entered instead of "O" for the number of characters. And if the data cannot be calculated due to no coagulation time being obtained in cases of instrument error, space (20 H) is entered instead of "O" for the number of characters.

3) Flags

space:	No error
+	Over the upper control limit
-	Under the lower control limit
*	Analysis error occurred, disparate data of mean data occurred, or Fbg was over analysis range.
!	Coagulation time was obtained by re-dilution analysis.
<	Under the lower report limit
>	Over the upper report limit
×	Calculation parameter is not calculated because standard curve is not set.

1.3.2 Order Inquiry Text Format

Value in () indicate the value when CA-1000 is selected.

Parameter	No. of Characters	Example
STX	1	(02 H)
Text Distinction Code I	1	Fixed to "R".
Text Distinction Code II (Inquiry key)	1	"1" (Rack No., Tube Position No.) or "2" (Sample ID No.)
Text Distinction Code III	2	Fixed to "21"
Block Number	2	"01"
Total Number of Blocks	2	"01"
Sample Distinction Code	1	Fixed to space (20 H)
Date	6	"980131"
Time	4	"1325"
Rack Number	6 (4)	"000001"
Tube Position Number	2	"01"
Sample ID Number	15 (13)	"123-456-789-012"
ID Information	1	"M", "A", "B", space(20 H)
Patient Name	15 (11)	"XX...XX"
Analysis Parameter, Data 1	9	
Analysis Parameter, Data 2	9	
Analysis Parameter N, Data N	9	
ETX	1	(03 H)
Total	60 +9N (52 +9N)	

Table B-1-5: Order Inquiry Text Format

- **Order of Transmission**

The order of transmission is from the top parameter to the bottom; the most significant digit first and the least significant digit last. Zero suppression is not performed.

- **Block Number and Total Number of Blocks**

The analysis data is divided for transmission so that one block contains 255 or less characters.

The block number is the sequence number of the divided text.

The total number of blocks is the total number of divided text.

Normally, block number and number of blocks are "01".

- **Date and Time**

Set the date and time when the inquiry was performed. The date format conforms to the format set in the date/time setting program. Time follows the 24-hour system.

Zero suppression is not performed.

- **Rack Number**

This is the inquiry number in the case of inquiry by rack number, consisting of the 6-(4-)digit number ("000001" - "999999").

For the STAT sample holder, it becomes "STAT H" (if CA-1000 format is selected, "0000").

- **Tube Position Number**

The tube position number indicates the sample tube position (01 - 10) in the rack, and the holder position (01 - 05) for STAT sample.

- **Sample ID Number**

A number is indicated here in the case of inquiry by sample ID number. A hyphen "-" (2D H) may be inserted between numerals. The hyphen "-" is included in the 15 (13) digits. In the case of inquiry by rack number and tube position number, if there is a sample ID number which has been manually input by the user, this manually entered sample ID number is used.

- **ID Information**

The ID information indicates the method in which the sample ID number is registered.

M: Manual entry

A: Automatically assigned ID No. when ID read error occurs (*)

B: Read by ID barcode reader

Space (20 H): When sample ID number is not set

In the case of inquiry by rack number and tube position number, space (20 H) is set.

- * In the case of an ID read error, sequential numbers starting from "□□ERR0000000001" will be assigned. □ indicates a space (20 H).

- **Patient Name**

The patient name consists of 15 (11) characters with character codes including spaces but excluding control codes.

- **Analysis Parameter, Data**

Parameter	No. of Characters	
Parameter Code	3	(OOO)
Reserved	6	six spaces (20 H)

Table B-1-6: Analysis Parameter, Data

1) Parameter Code

040: PT	050: APTT	060: Fbg
080: TTO#	090: NT#	120: Factor II
150: Factor V	170: Factor VII	180: Factor VIII
190: Factor IX	200: Factor X	210: Factor XI
220: Factor XII	300: AT III	310: α 2PI
320: Plg	330: PC	510: TT
600: FDP##	610: D. Dimer	

NOTE: • Additional parameter codes may be added in the future.

* Additional parameter codes may be added in the future. When the host computer receives a parameter code not mentioned above, prepare a host computer program that will ignore the data of such a parameter code or can allocate a parameter to new codes.

Not available in the USA.

Available for use only in Asia.

2) Reserved

All spaces (20 H)

1.3.3 Order Information Text Format

The same format as the Inquiry Text Format is used for the Order Information Text Format.

Value in () indicate the value when CA-1000 is selected.

Parameter	No. of Characters	Example
STX	1	(02 H)
Text Distinction Code I	1	Fixed to "S".
Text Distinction Code II (Inquiry key)	1	"1" (Rack No., Tube Position No.) or "2" (Sample ID No.)
Text Distinction Code III	2	Fixed to "21"
Block Number	2	"01"
Total Number of Blocks	2	"01"
Sample Distinction Code	1	"U", "E", "C"
Date	6	"980131"
Time	4	"1325"
Rack Number	6 (4)	"000001"
Tube Position Number	2	"01"
Sample ID Number	15 (13)	"123-456-789-012"
ID Information	1	"A", "B", "C"
Patient Name	15 (11)	"XX...XX"
Analysis Parameter, Data 1	9	
Analysis Parameter, Data 2	9	
Analysis Parameter N, Data N	9	
ETX	1	(03 H)
Total	60 +9N (52 +9N)	

Table B-1-7: Order Information Text Format

- Order of Transmission**
 The order of transmission is from the top parameter to the bottom; the most significant digit first and the least significant digit last. Zero suppression is not performed.
- Block Number and Total Number of Blocks**
 The analysis data is divided for transmission so that one block contains 255 or less characters.
 The block number is the sequence number of divided text.
 The total number of blocks is the total number of divided text.
 Normally, block number and number of blocks are "01".

- **Sample Distinction Code**

The types of analysis data are shown.

U: Routine analysis data

E: STAT analysis data

C: Quality control analysis data

- **Date and Time**

Set the date and the time when the order was performed. The date format conforms to the format set in the date/time setting program. Time follows the 24-hour system.

Zero suppression is not performed.

- **Rack Number**

This is the Rack Number in which the sample to be analyzed is installed, consisting of 6-(4-)digit number ("000001" - "999999").

For the STAT sample holder, it becomes "STAT H" (if CA-1000 format is selected, "0000").

- **Tube Position Number**

The tube position number indicates the sample tube position (01 - 10) in the rack, and the holder position (01 - 05) for STAT sample.

- **Sample ID Number**

The sample ID number is shown here. A hyphen "-" (2D H) may be inserted between numerals. The hyphen "-" is included in the 15 (13) digits. In the case of ordering QC file number, "QC01" - "QC20" should be used.

- **ID Information**

The ID information indicates the method in which the sample ID number is registered.

C: Input from the host computer

A: Automatically assigned ID No. when ID read error occurs

B: Read by ID barcode reader

M: Manual entry

- **Patient Name**

The patient name consists of 15 (11) characters with character codes including spaces but excluding control codes.

- **Analysis Parameter, Data**

Parameter	No. of Characters	
Parameter Code	3	(OOO)
Reserved	6	Six spaces (20 H)

Table B-1-8: Analysis Parameter, Data

1) Parameter Code

040: PT	050: APTT	060: Fbg
080: TTO#	090: NT#	120: Factor II
150: Factor V	170: Factor VII	180: Factor VIII
190: Factor IX	200: Factor X	210: Factor XI
220: Factor XII	300: AT III	310: α 2PI
320: Plg	330: PC	510: TT
600: FDP##	610: D. Dimer	
000: There is no analysis parameter for the inquired sample. (*1)		
999: There is no analysis parameter for the inquired sample and the later samples. (*2)		

*1: When there is no analysis parameter for the inquired sample ID number, set "000" for the parameter code.

*2: When there is no analysis parameter for the inquired sample and the later samples, set "999" for the parameter code. When the CA-1500 receives "999", CA-1500 will not inquire the following tube positions. This code is provided for the cases when there is no setting of analysis order in the host computer, or when there is no analysis order because the sample ID number, or the rack number and tube position number is not found.

Not available in the USA.

Available for use only in Asia.

<p>NOTE: • Additional parameter codes may be added in the future.</p>
--

2) Reserved

All spaces (20 H)

2. ID BARCODE SPECIFICATIONS

By affixing a barcode label on a sample tube, the sample ID number or QC File No. can be automatically read. When using barcode labels, make sure they meet the barcode label specifications applicable to the CA-1500 ID barcode reader.

The specifications of the barcode label are described in this section.



WARNING • Use the check-digit as much as possible.
If the check-digit cannot be used, the potential of the incorrect reading of the barcode label may be increased.

2.1 Acceptable Barcode

The types of barcode acceptable to the instrument and the check digit(s) are listed below.

(1) Sample ID No.

Type of Barcode	Check Digit	No. of Digits
ITF	Not used	1 - 15 digits (Sample ID No.)
	Modulus 10	1 - 15 digits (Sample ID No.) + 1 digit (Check digit) = 16 digits Max.
NW-7 (CODABAR) (*)	Not used	1 - 15 digits (Sample ID No.)
	Modulus 11	+ 1 digit (Check digit) = 16 digits Max.
	W. Modulus 11	
CODE-39	Not used	1 - 15 digits (Sample ID No.)
	Modulus 43	1 - 15 digits (Sample ID No.) + 1 digit (Check digit) = 16 digits Max.
JAN-13	Modulus 10	12 digits (Sample ID No.) + 1 digit (Check digit) = 13 digits Max.
JAN-8	Modulus 10	7 digits (Sample ID No.) + 1 digit (Check digit) = 8 digits Max.
CODE-128	Modulus 103	1 - 15 digits (Sample ID No.) + 1 digit (Check digit) = 16 digits Max.

*As the Start and Stop codes, use one of the characters "A", "B", "C", "a", "b" and "c".

Table B-2-1: Barcode and Check Digit

NOTE:

- When "C" or "c" is used, make sure that the number is not the same as the QC File number.

- (2) QC File No.
QC File No. can be read if printed with NW-7, CODE-39 or CODE-128.

Type of Barcode	Check-Digit	No. of Digits (File No.)	No. of Digits for Check-Digit
NW-7 (CODABAR) *1	Not Used	4 to 13 digits *2	Not Applied
CODE-39 CODE-128	Either of "Use" or "Not Use"	4 digits "QC01", "QC02", ... "QC20"	Not Used or 1 digit

*1: Start and Stop codes can be any of the characters "C" or "c".

*2: Possible applicable QC File No. is 1 through 9, and must be filled with the same number in all digits.

2.2 Dimension of Barcode Elements

Narrow Element $\cong 200 \mu\text{m}$

Wide Element $\leq 1.2 \text{ mm}$

Narrow element \leq Gap between characters \leq Wide Element

2.3 Narrow/Wide Ratio

For each character, the wide element to narrow element ratio must comply with the following:

Narrow (Max.) : Wide (Min.) = 1 : 2.2 or more

Narrow (Min.) : Narrow (Max.) = 1 : 1.3 or less

Wide (Min.) : Wide (Max.) = 1 : 1.4 or less

2.4 PCS (Print Contrast Signal)

$$\text{PCS} = \frac{\text{Reflectivity of the space} - \text{Reflectivity of the black inked bar}}{\text{Reflectivity of the space}}$$

Standard: PCS value ≥ 0.45

The analysis method conforms to *JIS (Japanese Industrial Standards) X0501, "5.3 Optical Characteristics of Barcode Symbols"*.

2.5 Reflection Characteristics of Label Surface

A laminated label cannot be read.

2.6 Irregularity and Roughness of Printing

When a bar element is magnified by a microscope, the following may be observed.

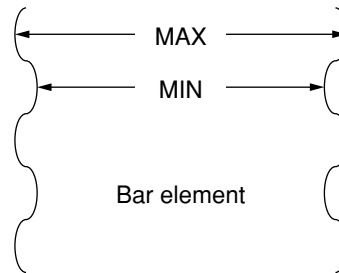


Figure B-2-1: Magnified Bar

When the variation coefficient (S) in the width of a bar is defined:

$$S = \frac{\text{MAX} - \text{MIN}}{\text{MAX}} \times 100\%$$

Then the variation coefficient (S) must be 20 % or less.

2.7 Dimensions of Barcode Label

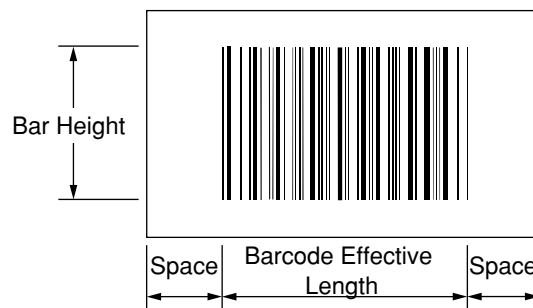


Figure B-2-2: Barcode Label

Space: 5 mm or more

Barcode Effective Length: 48 mm or less (Optimum: 40 mm or less)

Bar Height: 20 mm or more (Rack label height: 6 mm or more)

2.8 Check Digit

To improve the reliability of an ID No. read, check digit(s) can be added.

Taking the sample ID No. of "258416" as an example, this section explains how to calculate the check digit for modulus 11 and weighted modulus 11.

1) Modulus 11

- (1) Each digit is weighted:

	2	5	8	4	1	6
	×	×	×	×	×	×
Weight	7	6	5	4	3	2
	14	30	40	16	3	12

- (2) Add up the multiplied results as given below:

$$S = 14 + 30 + 40 + 16 + 3 + 12 = 115$$

- (3) When S is divided by 11, calculate the remainder and obtain the complement of the remainder. This complement will be the check digit.

$$115 \div 11 = 10 \text{ with remainder } 5$$

$$11 - 5 = 6, \text{ thus the check digit is } 6.$$

However, all English symbols except the numerals of 0 - 9 are regarded as 0 in making the calculation. Also, when S is divisible by 11 with remainder 0 and when calculation of the check digit results in 10, zero is entered as the check digit.

2) Weighted Modulus 11

Weighted modulus 11 has two sets of weight. When the check digit is computed to 10 as a result of applying the first weight set, the second weight set is applied. The result should always be between 0 and 9. The calculation method is exactly the same as modulus 11 except for the difference in weighting.

- (1) Weighing Each Digit.

Weight:	W12	W11	W10	W9	W8	W7	W6	W5	W4	W3	W2	W1
First Set:	6	3	5	9	10	7	8	4	5	3	6	2
Second Set:	5	8	6	2	10	4	3	7	6	8	5	9
	2	5	8	4	1	6						
	×	×	×	×	×	×						
Weight	8	4	5	3	6	2						
	16	20	40	12	6	12						

- (2) Add up the multiplied results as given below:

$$S = 16 + 20 + 40 + 12 + 6 + 12 = 106$$

- (3) When S is divided by 11, calculate the remainder and obtain the complement of the remainder. This complement will be the check digit.
 $106 \div 11 = 9$ with remainder 7
 $11 - 7 = 4$, thus the check digit is 4.
However, all English symbols except the numerals of 0 - 9 are regarded as 0 in making the calculation. Also, when S is divisible by 11 with remainder 0 and when calculation of the check digit results in 10, zero is entered as the check digit.

NOTE: • Weight for the 13th to 15th digits is assumed to be 0.

3) Modulus 10/Weight 3

This Modulus 10/Weight 3 method is used in the bar code symbology such as JAN, NW-7 and ITF (Interleaved 2 of 5). The check digit computation method is shown as follows;

- (1) The least significant digit (most right digit) and all digits that occur on the odd position from right to left within the data digits are defined as odd digits. All the digits are divided into two groups, odd digits and even digits.
- (2) Add all odd digits. Multiply the sum by 3.
- (3) Add all even digits.
- (4) Add the result of (2) and result of (3) above.
- (5) Subtract the foremost (least significant) digit from 10 to obtain the check-digit. In case of the ITF, the total number of the digits must be an even number. In such case, add "0" to the most significant digit (most left digit).

Example No. 1:

Calculation of the check-digit for the JAN code 4912345 (7 digits) is shown below:

- (1) Add odd digits (counted from the least significant digit): $5+3+1+4 = 13$.
Multiply the sum by 3, as: $13 \times 3 = 39$
- (2) Add even digits: $4+2+9 = 15$
- (3) Add the results of (1) and (2) above, as: $39+15 = 54$
- (4) Check-digit is obtained by subtracting the most right digit of the sum of (3) above from 10 as: $10-4 = 6$
Hence the check-digit is 6.

Example No. 2:

Calculation of the check-digit for the ITF code 524362 (6 digits) is shown below:

- (1) Add odd digits : $2+3+2 = 7$.
Multiply the sum by 3, as: $7 \times 3 = 21$
- (2) Add even digits: $6+4+5 = 15$
- (3) Add the results of (1) and (2) above, as: $21+15 = 36$
- (4) Obtain the check-digit as: $10-6 = 4$
Hence the check-digit is 4.

However, in Example No. 2, the sum of the total number of the data digits and the check-digit gives an odd number 7 in this case. Therefore, "0" is added to the most significant digit (most left digit) and check-digit is appended to the data, as 05243624.

4) Modulus 43

Modulus 43 is the check digit computation method used in CODE-39 symbology. A value is assigned to each of the 43 characters. All characters are converted into the value and computed.

The following example uses the ID number **258-416**.

- (1) Add the values of all the data characters. The numerical value of each of the data characters is given below:

Character	Value	Character	Value	Character	Value
0	0	F	15	U	30
1	1	G	16	V	31
2	2	H	17	W	32
3	3	I	18	X	33
4	4	J	19	Y	34
5	5	K	20	Z	35
6	6	L	21	—	36
7	7	M	22	.	37
8	8	N	23	Space	38
9	9	O	24	\$	39
A	10	P	25	/	40
B	11	Q	26	+	41
C	12	R	27	%	42
D	13	S	28		
E	14	T	29		

$$\text{Sum} = 2+5+8+36+4+1+6 = 62$$

- (2) Divide the sum by 43 and get the remainder.

$$62/43 = 1; \text{ remainder} = 19$$

- (3) Find the check-character. The check-character is that character whose value is equal to the remainder. In this example, the letter "J" has the value of 19 which is equal to the remainder. Therefore "J" is the check-character.
- (4) This check-character is appended to the ID number, after the least significant digit. The bar-code label is now "258-416J".

5) Modulus 103

Modulus 103 is the check-digit computation method used in the CODE-128 symbology. CODE-128 takes three different character table depending on the start code. Each of 128 characters is assigned a value as shown in the following table. All characters are then converted to their corresponding values and computed.

- (1) All characters except the stop code are converted to their corresponding values according to the table.
- (2) The first character, such as "Start (Code A)", indicates that the Code A set is used until other code set is specified. Multiply the most significant digit by 1, multiply the second digit by 2, multiply the third digit by 3, and so on.
- (3) Add all the products. Then, divide the sum by 103. To obtain a check-digit, convert the remainder to the corresponding character in the table .

The following example uses the ID number **Start (Code A) 123-4567**.

- (1) Convert each character into values using Code A set, and multiply by the weight.

Start (Code A) 103 = 103

1	17 x 1 = 17
2	18 x 2 = 36
3	19 x 3 = 57
–	13 x 4 = 52
4	20 x 5 = 100
5	21 x 6 = 126
6	22 x 7 = 154
7	23 x 8 = 184

- (2) The sum of the products is 829.
- (3) This sum is divided by 103 as; $829/103 = 8$ and remainder is 5.
- (4) The corresponding character for the value 5 is %. Hence the check-digit is %.

Value	Code A	Code B	Code C	Value	Code A	Code B	Code C
0	(space)	(space)	00	54	V	V	54
1	!	!	01	55	W	W	55
2	"	"	02	56	X	X	56
3	#	#	03	57	Y	Y	57
4	\$	\$	04	58	Z	Z	58
5	%	%	05	59	[[59
6	&	&	06	60	\	\	60
7	'	'	07	61]]	61
8	((08	62	^	^	62
9))	09	63			63
10	*	*	10	64	NUL		64
11	+	+	11	65	SOH	a	65
12	,	,	12	66	STX	b	66
13	-	-	13	67	ETX	c	67
14	.	.	14	68	EOT	d	68
15	/	/	15	69	ENQ	e	69
16	0	0	16	70	ACK	f	70
17	1	1	17	71	BEL	g	71
18	2	2	18	72	BS	h	72
19	3	3	19	73	HT	i	73
20	4	4	20	74	LF	j	74
21	5	5	21	75	VT	k	75
22	6	6	22	76	FF	l	76
23	7	7	23	77	CR	m	77
24	8	8	24	78	SO	n	78
25	9	9	25	79	SI	o	79
26	:	:	26	80	DLE	p	80
27	;	;	27	81	DC1	q	81
28	<	<	28	82	DC2	r	82
29	=	=	29	83	DC3	s	83
30	>	>	30	84	DC4	t	84
31	?	?	31	85	NAK	u	85
32	@	@	32	86	SYN	v	86
33	A	A	33	87	ETB	w	87
34	B	B	34	88	CAN	x	88
35	C	C	35	89	EM	y	89
36	D	D	36	90	SUB	z	90
37	E	E	37	91	ESC	{	91
38	F	F	38	92	FS		92
39	G	G	39	93	GS	}	93
40	H	H	40	94	RS	~	94
41	I	I	41	95	US	DEL	95
42	J	J	42	96	FNC3	FNC3	96
43	K	K	43	97	FNC2	FNC2	97
44	L	L	44	98	SHIFT	SHIFT	98
45	M	M	45	99	CODE C	CODE C	99
46	N	N	46	100	CODE B	FNC4	CODE B
47	O	O	47	101	FNC4	CODE A	CODE A
48	P	P	48	102	FNC1	FNC1	FNC1
49	Q	Q	49	103	START (Code A)		
50	R	R	50	104	START (Code B)		
51	S	S	51	105	START (Code C)		
52	T	T	52		STOP		
53	U	U	53				