NIDEK

REFRACTOR
RT-5100

RS-232C INTERFACE MANUAL

NIDEK

Eye & Health Care

NIDEK CO., LTD.

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§1 *OUTLINE*

Interface specifications for communication between the RT-5100 and personal computer or external appliances are stated herein.

1.1 Basic Interface Specifications

1)	Basic spec.	:	Corresponding to RS-232C
2)	Connector	:	DIN 8-pin
3)	Synchronous	:	Asynchronous
4)	Line	:	Half duplex
5)	Baud rate	:	2400 bit/sec.
6)	Bit length	:	7 bit
7)	Parity check	:	Even parity
8)	Stop bit	:	2 bit
9)	Datacode	:	ASCII
10)	CR code	:	Yes

1.2 Connector Signal Configuration
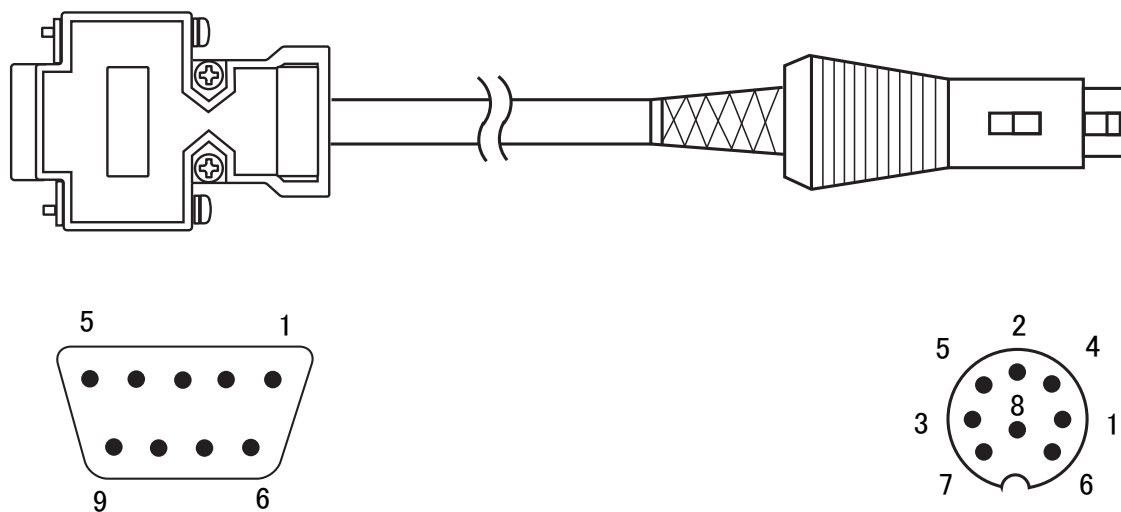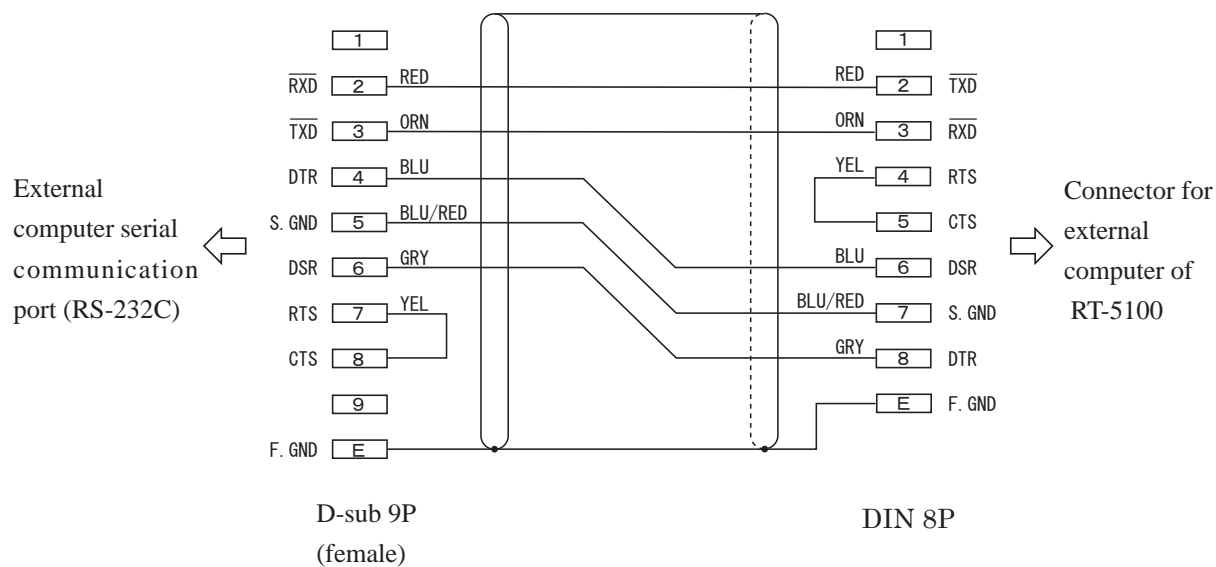
Connect the connector for the external computer of the RT-5100 (PC port) with the external computer serial communication port (RS-232C port) of the external computer with the Interface Cable OPIF-11.

A converter is required when the connector on the external computer side is different from the D-sub 9 pin.
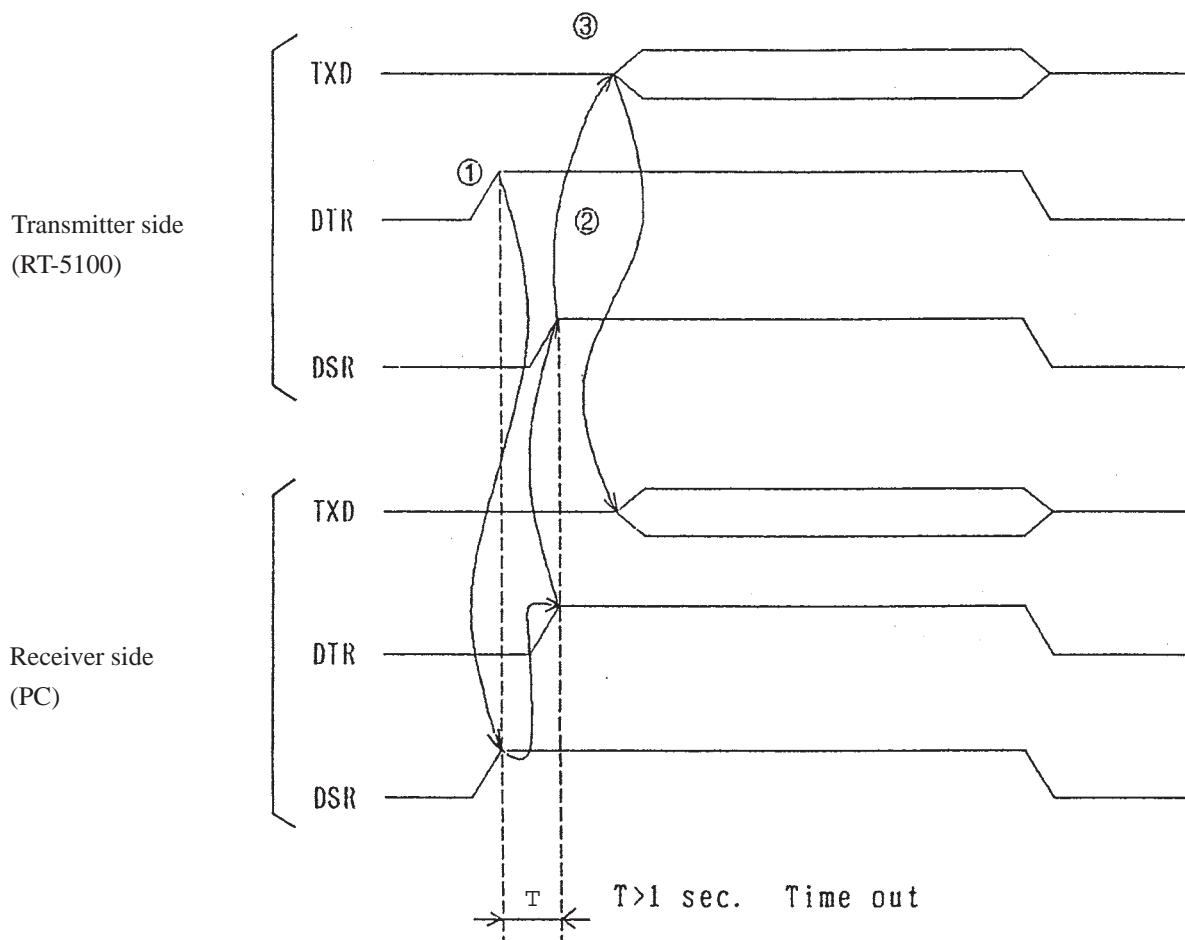
① Before transmitting data, the receiver is informed that the transmitter is "Enabled".
(High on the cable)

② The transmitter confirms that the receiver is "Enabled". (High on the cable)

③ The data is transmitted.

§3 *DATA TRANSMISSION FROM THE RT TO THE PC*

By pressing the ⃞Print⃞ switch on the control box, all measured data can be transmitted to the external appliance such as a personal computer. Any selected data among ⃞Unaided⃞, ⃞LM⃞, ⃞AR⃞, ⃞Subj⃞ and ⃞Final⃞ can also be transmitted at random.

3.1 Output of Refraction Data

The following data are transmitted in sequence.

Unaided measurement data
   ↓
Lensometry data
   ↓
Objective data
   ↓
Subjective data (For Plus Package, data from #7 to #18B [*1] is output here.)
   ↓
Final prescription data
   ↓
Dominant eye data
   ↓
Near point of convergence (NPC) data
   ↓
Near point of accommodation (NPA) data (corresponds to #19 NPA data in Plus Package.)
   ↓
Negative relative accommodation power (NRA) data (corresponds to #21 NRA data in Plus Package.)
   ↓
Positive relative accommodation power (PRA) data (corresponds to #20 PRA data in Plus Package.)
   ↓
AC/A (Gradient, Heterophoria) data (for Plus Package only)
   ↓
#14A Crosscylinder (monocular) data (for Plus Package only)
   ↓
#14B Crosscylinder (binocular) data (for Plus Package only)
   ↓

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*1   The tests from #7 to #18B indicate the following:

#7	Subjective value	#13B	Horizontal phoria (Near)
#8	Horizontal phoria (Far)	#16	Convergence (Near)
#9, 10	Convergence (Far)	#17	Divergence (Near)
#11	Divergence (Far)	#18A	Vertical phoria (Near)
#12A	Vertical phoria (Far)	#18B	Supra/infravergence (Near)
#12B	Supra/Infravergence (Far)		

#15A Horizontal phoria (according to the #14A value) data (for Plus Package only)
↓
#15B Horizontal phoria (according to the #14B value) data (for Plus Package only)
↓
#19 Accommodation data by minus lens addition (for Plus Package only)
↓
Horizontal prism and SPH data meeting the Sheard's criterion (for Plus Package only)
↓
Horizontal prism and SPH data meeting the Percival's criterion (for Plus Package only)
↓
Morgan's system data (for Plus Package only)
↓
Worth test data
↓
Stereoscopic vision test data
↓
Aniseikonia test data
↓
Glare/Contrast VA data (English version only)
↓
ETDRS VA data (English version only)
↓
Working distance (WD) data
↓
Refraction time data
↓
Age data
↓
KM data
↓
NT data

3.2 Output Condition of Refraction Data

• An item with no data cannot be transmitted.

• Only Far vision data of the Lensometry data and the Objective data (without ADD and PRISM values) are transmitted.
Otherwise, both Far and Near vision data are transmitted.

4.1 Heading

(1) When the AR port parameter is set to any other than "HDR"

| SH | NIDEK_RT-5100_ IDΔΔΔΔΔΔΔΔΔΔΔΔ_DAYYYY/MM/DD_SN□□ | CR |

Company Name	:	NIDEK	(5 letters)
Model	:	RT-5100	(7 letters)
ID No.	:	ΔΔΔ.....Δ	(12 figures)
Data of Measurement	:	YYYY (Year)	(4 figures)
		MM (Month)	(2 figures)
		DD (Day)	(2 figures)
System No.	:	□□	(2 figures) (1 to 10)
			"_" indicates a space.

(2) When the AR port parameter is set to "HDR"

SH	NIDEK_RT-5100	CR
SX	IDΔΔΔΔ.....Δ	CR
SX	DAYYYY/MM/DD_SN□□	CR

Company Name	:	NIDEK	(5 letters)
Model	:	RT-5100	(7 letters)
ID No.	:	ΔΔΔ.....Δ	(4 to 20 figures)
Data of Measurement	:	YYYY (Year)	(4 figures)
		MM (Month)	(2 figures)
		DD (Day)	(2 figures)
System No.	:	□□	(2 figures) (1 to 10)
			"_" indicates a space.

4.2 Data Source

SX @ ☐ ☐ CR

LM　: Lensmeter (Lensometry data)
　　　The case for Daytime data or no specified data of
　　　Daytime/Nighttime
lm　: Lensmeter (Lensometry data)
　　　The case for Nighttime data
RM　: Autorefractometer (Objective data)
　　　The case for Daytime data or no specified data of
　　　Daytime/Nighttime
rm　: Autorefractometer (Objective data)
　　　The case for Nighttime data
WF　: Wave Front
　　　The case for Daytime data or no specified data of
　　　Daytime/Nighttime
wf　: Wave Front
　　　The case for Nighttime data
RT　: Refractor (Unaided, subjective and final prescription
　　　data)
　　　The case for Daytime data or no specified data of
　　　Daytime/Nighttime
rt　: Refractor (Unaided, subjective and final prescription
　　　data)
　　　The case for Nighttime
KM　: Keratometer
NT　: Tonometer (Intraocular pressure data)

4.3 Text Data Format of Each Data Source

```
      1   2   3
   SX □ □ □    CR
```

                              Measured data
                              Patient's eye or equivalent
                              Far vision :   R = Right eye
                                             L = Left eye
                                             B = Binocular
                                             D = PD
                                             V = DV/CV
                            Near vision :r =Right eye
                                             l = Left eye
                                             b = Binocular
                                             d = PD
                                             v = DV/DC
                              Description of data
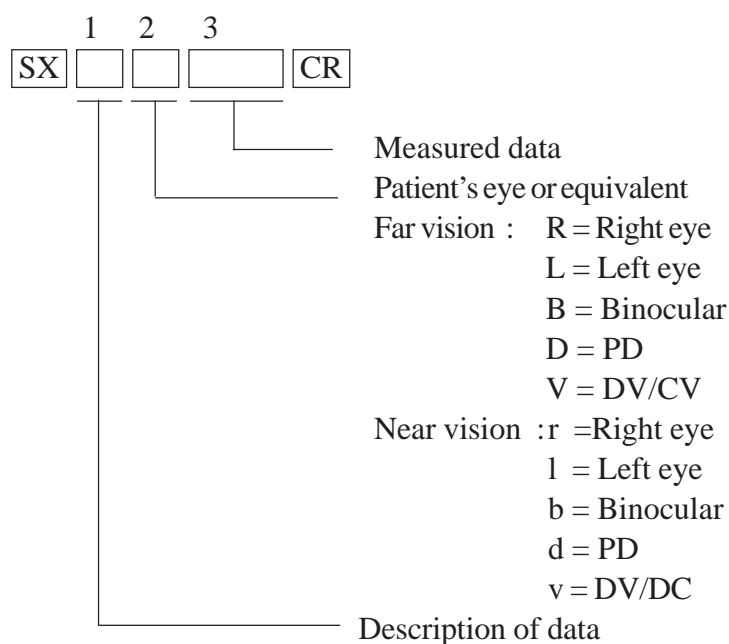
4.3.1 LM data

	1	2	3
SCA	__ *		SPH : 6 CYL : 6 AXIS : 3
ADD	A		ADD : 6
Corrected visual acuity	V		VA : 5

Corrected visual acuity (extended format)

	U		VA : 7

Corrected visual acuity of Daytime refractive power during low-light illumination (extended format)

	Q		VA : 7

Corrected pinhole visual acuity (extended format)

	H		VA : 7
PRISM	P		H-prism : 6 V-prism : 6
PD value	P	D	PD: 4 Space : 8
			or
	P	D	PD Bino : 4 Right : 4 Left : 4

Visual acuity with addition power

	Y		VA: 5

Visual acuity with addition power (extended format)

	J		VA: 7

Blur/Break/Recovery (divergence test)

	D	V	Blur : 5 Break : 5 Recovery : 6

Blur/Break/Recovery (convergence test)

	C	V	Blur : 5 Break : 5 Recovery : 6

* ☐ means space.

4.3.2 RM(AR), WF, and wf data

	1	2	3
Objective SCA	O		SPH : 6 CYL : 6 AXIS : 3
Corrected visual acuity	V		VA : 5
Corrected visual acuity (extended format)			
	U		VA : 7
Corrected visual acuity of Daytime refractive power during low-light illumination (extended format)			
	Q		VA : 7
Corrected pinhole visual acuity (extended format)			
	H		VA : 7
PD value	P	D	PD : 4 Space : 8
or	P	D	PD Bino : 4 Right : 4 Left : 4

4.3.3 RT data

(1) Unaided visual acuity data

	1	2	3
Unaided visual acuity	W		VA : 5
Unaided visual acuity (extended format)	M		VA : 7
Unaided pinhole visual acuity (extended format)	K		VA : 7

(2) Subjective data

	1	2	3
Far vision SCA	f		SPH : 6 CYL : 6 AXIS : 3

* Corresponds to #7 data in Plus Package.

	1	2	3
Near vision SCA	n		SPH : 6 CYL : 6 AXIS : 3
ADD	a		ADD : 6
Corrected visual acuity	v		VA : 5
Corrected visual acuity (extended format)	u		VA : 7
Corrected visual acuity of Daytime refractive power during low-light illumination (extended format)	q		VA : 7
Corrected pinhole visual acuity (extended format)	h		VA : 7
PRISM	p		H-prism : 6 V-prism : 6

* In Plus Package, H-prism corresponds to #8 Horizontal phoria
(Far) data or #13B Horizontal phoria (Near) data.

* In Plus Package, V-prism corresponds to #12A Horizontal
phoria (Far) data or #18A Horizontal phoria (Near) data.

PD value	p	D	PD : 4 Space : 8

or

	p	D	PD Bino : 4 Right : 4 Left : 4

Visual acuity with addition power	y		VA : 5
Visual acuity with addition power (extended format)	j		VA : 7
Divergence test (blur/break/recovery)	d	V	Blur : 5 Break : 5 Recovery : 6

* In Plus Package, the divergence test corresponds to #11
Divergence (Far) data or #17 Divergence (Near) data.

Convergence test (blur/break/recovery)	c	V	Blur : 5 Break : 5 Recovery : 6

* In Plus Package, the convergence test corresponds to #9, 10
Convergence (Far) data or #16 Convergence (Near) data.

Supravergence test (break/recovery)	s		Break: 6 Recovery: 6

* In Plus Package, the supravergence test corresponds to #12B
Supravergence (Far) data or #18B Supravergence (Near) data.

Infravergence test (break/recovery)

| i | | Break: 6 Recovery: 6 |

* In Plus Package, the infravergence test corresponds to #12B
Infravergence (Far) data or #18B Infravergence (Near) data.

(3) Final prescription data

	1	2	3
Far vision SCA	F		SPH : 6 CYL : 6 AXIS : 3
Near vision SCA	N		SPH : 6 CYL : 6 AXIS : 3
ADD	A		ADD : 6
Corrected visual acuity	V		VA : 5

Corrected visual acuity (extended format)

| U | | VA : 7 |

Corrected visual acuity of Daytime refractive power during low-light illumination (extended format)

| Q | | VA : 7 |

Corrected pinhole visual acuity (extended format)

| H | | VA : 7 |

| PRISM | P | | H-prism : 6 V-prism : 6 |

* In Plus Package, H-prism corresponds to #8 Horizontal phoria
(Far) data or #13B Horizontal phoria (Near) data.
* In Plus Package, V-prism corresponds to #12A Horizontal
phoria (Far) data or #18A horizontal phoria (Near) data.

| PD value | P | D | PD : 4 Space : 8 |

or

| P | D | PD Bino : 4 Right : 4 Left : 4 |

Visual acuity with addition power

| Y | | VA : 5 |

Visual acuity with addition power (extended format)

| J | | VA : 7 |

Divergence test (blur/break/recovery)

| D | V | Blur : 5 Break : 5 Recovery : 6 |

Convergence test (blur/break/recovery)

| C | V | Blur : 5 Break : 5 Recovery : 6 |

Supravergence test (break/recovery)

| S | | Break: 6 Recovery: 6 |

Infravergence test (break/recovery)

| I | | Break: 6 Recovery: 6 |

(4) Dominant eye data

1	2	3
M	E	Dominant eye data : 1

(5) Near point of convergence data

1	2	3
C	P	cm data : 3 MA data : 4 PRISM data : 5

(6) Near point of accommodation data

1	2	3
AP		cm data : 3 D data : 6

(17) Morgan's system data (for Plus Package only)

	1	2
Group A data	MGA	Results of group A: 5
Group B data	MGB	Results of group B: 7
Group C data	MGC	Results of group C: 3

(18) Worth test data

	1	2	3
	F	W	Worth test data : 1

(19) Stereoscopic vision test data

The case for Daytime data or no specified data of Daytime/Nighttime

	1	2	3
	S	C	Stereoscopic vision test data : 5

The case for Nighttime data

	1	2	3
	s	c	Stereoscopic vision test data : 5

(20) Aniseikonia data

	1	2	3
Vertical	A	N	Aniseikonia test data : 2
Horizontal	A	H	Aniseikonia test data : 2

(21) Glare/Contrast VA data (English version only)

	1	2	3
Glare/Contrast level	C	G	Contrast level : 3　Glare level : 1
SCA	G		SPH : 6　CYL : 6　AXIS : 3
Glare/Contrast visual acuity	g		VA : 5
Glare/Contrast visual acuity (Extended format)	l		VA : 7

(22) ETDRS VA data (English version only)

	1	2	3
Glare/Contrast level	E	T	Contrast level : 3　Glare level : 1
SCA	E		SPH : 6　CYL : 6　AXIS : 3
ETDRS visual acuity	e		VA : 7

(23) Working distance (WD) data

	1	2	3
	W	D	Working distance data : 2

(24) Final prescription working distance data

	1	2	3
	w	d	Working distance data : 3

(25) LM working distance data

	1	2	3
	W	d	Working distance data : 3

(26) Age data

1	2	3
A	G	Age data : 3

(27) Refraction time data

1	2	3
T	T	Refraction time : 4

4.3.4 KM data

(1) mm data

R1, R2, AXIS

1	2	3
C		R1 : 5 R2 : 5 AXIS : 3

(2) Diopter data

R1, R2

1	2	3
D		R1 : 5 R2 : 5

4.3.5 NT data

(1) mm Hg data

1	2	3
T		mmHg : 4

(2) kPa data

1	2	3
t		kPa : 4

4.4 Format of Each Data

4.4.1 SCA data

| SX | | | SPH : 6   CYL : 6   AXIS : 3 | CR |

(1) SPH data

BYTE	1	2	3	4	5	6
Contents	Polarity	D1	D2	Point	D3	D4

Polarity : +, –, space (when the data is 0.00)
D1 : Tens place digit
D2 : Ones place digit
Point : " . "(Decimal point)
D3 : First place after the decimal point
D4 : Second place after the decimal point

(2) CYL data

The same as "(1) SPH"

(3) AXIS data

BYTE	1	2	3
Contents	D1	D2	D3

D1 : Hundreds place digit (A space is entered when the data is "0".)
D2 : Tens place digit (A space is entered when D1=D2=0.)
D3 : Ones place digit

4.4.2 ADD data   6 BYTE

The same as "4.4.1 SCA data (1) SPH"

4.4.3 Visual acuity data

| SX | | | VA : 5 (7 for " ETDRS visual acuity") | | CR |

Unaided visual acuity = W, Corrected visual acuity = V, Visual acuity with addition power = Y, Glare/Contrast visual acuity = g (English version only), ETDRS visual acuity = e (English version only)

(1) Decimal point display data

BYTE	1	2	3	4	5
Contents	Compare	D1	Point	D2	D3

Compare : When a patient could not see the largest figure on the chart, " > " ,
" < " or " - "(Only Log MAR data) ; otherwise : "space"
D1 : Ones place digit
Point : " . " (Decimal point)
D2 : First place after the decimal point
D3 : Second place after the decimal point (A space is entered when the data is "0".)

(2) Fractional number display data

BYTE	1	2	3	4	5
Contents	Compare	D1	D2	D3	Space

Compare : Same as "(1) Decimal point display"
D1 : Hundreds place digit
D2 : Tens place digit
D3 : Ones place digit

(3) Parinaud test data (French version only)

BYTE	1	2	3	4	5
Contents	Compare	D1	D2	Point	D3

Compare : When a patient could not see the largest figure on the chart, " > "; otherwise: "space".
D1 : Tens place digit (A space is entered when the data is "0".)
D2 : Ones place digit
Point : " . " (Decimal point)
D3 : First place after the decimal point (Spaces are entered in Point and D3 when the data is "0".)

(4) ETDRS data (English version only)

BYTE	1	2	3	4	5	6	7
Contents	D1	D2	D3	Point	D4	Polarity	D5

D1   : Hundreds place digit
D2   : Tens place digit
D3   : Ones place digit
Point   : " . " (Decimal point)
D4   : First place after the decimal point (Spaces are entered in Point and D4 when the data is "0".)
Polarity : + (Correct answer), – (Incorrect answer)
D5   : Number of right answer/fales answer (Spaces are entered in Polarity and D5 when the data is "0".)

4.4.4 Visual acuity data

| SX | | | VA : 7 | CR |

Unaided visual acuity = M, Unaided pinhole visual acuity = K, Corrected visual acuity = U, u, Corrected pinhole visual acuity = H, h, Visual acuity with addition power = J, Glare/Contrast visual acuity = l (English version only)

(1) Decimal point display data

BYTE	1	2	3	4	5	6	7
Contents	Compare	D1	Point	D2	D3	Polarity	D4

Compare : When a patient could not see the largest figure on the chart, " > ", " < " or " - "(Only Log MAR data) ; otherwise : "space"
D1 : Ones place digit
Point : " . " (Decimal point)
D2 : First place after the decimal point
D3 : Second place after the decimal point (A space is entered when the data is "0".)
Polarity : + (Correct answer), - (Incorrect answer)
D4 : Number of right answer/fales answer (Spaces are entered in Polarity and D4 when the data is "0".)

(2) Fractional number display data

BYTE	1	2	3	4	5	6	7
Contents	Compare	D1	D2	D3	Space	Polarity	D4

Compare : Same as "(1) Decimal point display"
D1 : Hundreds place digit
D2 : Tens place digit
D3 : Ones place digit
Polarity : + (Correct answer), - (Incorrect answer)
D4 : Number of right answer/fales answer (Spaces are entered in Polarity and D4 when the data is "0".)

4.4.5 Prism data

☐ ☐ ☐ ☐☐☐☐☐☐☐ ☐

SX   H-prism : 6   V-prism : 6   CR

(1) H-prism data

BYTE	1	2	3	4	5	6
Contents	Polarity	D1	D2	Point	D3	D4

Polarity   : IN   = "I"
            OUT   = "O"
            A space is entered when the data is "0.00".
Otherwise the same as "4.4.1 SCA data (1) SPH".

(2) V-prism data

BYTE	1	2	3	4	5	6
Contents	Polarity	D1	D2	Point	D3	D4

Polarity   : UP   = "U"
            DOWN   = "D"
            A space is entered when the data is "0.00".
Otherwise the same as "(1) H-prism".

4.4.6 PD data

☐ ☐ ☐ ☐☐☐☐☐☐ ☐

SX   PD : 4   Space : 8   CR

☐ ☐ ☐ ☐☐☐☐☐☐☐ ☐

or   SX   PD Bino : 4 Right : 4 Left : 4   CR (Binocular) (Right) (Left)

BYTE	1	2	3	4
Contents	D1	D2	Point	D3

D1   : Tens place digit
D2   : Ones place digit
Point   : " . " (Decimal point)
D3   : First place after the decimal point

4.4.7 Convergence/Divergence data

| SX | | | Blur : 5   Break : 5   Recovery : 6 | CR |

(1) Blur data

BYTE	1	2	3	4	5
Contents	D1	D2	Point	D3	D4

D1 : Tens place digit
D2 : Ones place digit
Point : " . " (Decimal point)
D3 : First place after the decimal point
D4 : Second place after the decimal point

(2) Break data

The same as "(1) Blur"

(3) Recovery data

BYTE	1	2	3	4	5	6
Contents	Polarity	D1	D2	Point	D3	D4

Polarity : + (Correct direction), – (Opposite direction)
Otherwise the same as "(1) Blur".
* If there is no data for these (1)/(2)/(3), the space code (20H) will be inserted.

4.4.8 Supravergence/Infravergence data

| SX | | | Break : 6   Recovery : 6 | CR |

(1)Break data

BYTE	1	2	3	4	5	6
Contents	Polarity	D1	D2	Point	D3	D4

Polarity : + (Correct answer), - (Incorrect answer)
D1 : Tens place digit
D2 : Ones place digit
Point : " . " (Decimal point)
D3 : First place after the decimal point
D4 : Second place after the decimal point

(2) Recovery data

The same as "(1) Break".
* If there is no data for these (1)/(2), the space code (20H) will be inserted.

4.4.9 Dominant eye data

| SX | | | Dominant eye data : 1 | CR |

BYTE   1
Contents   D1

        D1   : "R"   ...   Right eye dominant
                  "L"   ...   Left eye dominant

4.4.10 Near point of convergence (NPC) data

| SX | | | cm data : 3   MA data : 4   Prism data : 5 | CR |

(1) cm data
    The same as "4.4.1 SCA data (3) AXIS"

(2) MA data
BYTE	1	2	3	4
Contents	D1	D2	Point	D3

        D1   : Tens place digit
                  (A space is entered when the data is "0".)
        D2   : Ones place digit
        Point : " . " (Decimal point)
        D3   : First place after the decimal point

(3) Prism data
BYTE	1	2	3	4	5
Contents	D1	D2	D3	Point	D4

        D1   : Hundreds place digit (A space is entered when the data is "0".)
        D2   : Tens place digit   (A space is entered when the data is "0".)
        D3   : Ones place digit
        Point : " . " (Decimal point)
        D4   : First place after the decimal point

4.4.11 Near point of accommodation (NPA) data

| SX | | | cm data : 3   D data : 6 | CR |

(1) cm data

   The same as "4.4.1 SCA data (3) AXIS"

(2) D data

BYTE	1	2	3	4	5	6
Contents	D1	D2	D3	Point	D4	D5

   D1   : Hundreds place digit (A space is entered when the data is "0".)
   D2   : Tens place digit
   D3   : Ones place digit
   Point   : " . " (Decimal point)
   D4   : First place after the decimal point
   D5   : Second place after the decimal point

4.4.12 Negative relative accommodation power (NRA) data

| SX | | | Blur : 6   Recovery : 6 | CR |

(1) Blur data

   Same as "4.4.1 SCA data (1) SPH".

(2) Recovery data

   Same as "4.4.1 SCA data (1) SPH" .

4.4.13 Positive relative accommodation power (PRA) data

| SX | | | Blur : 6   Recovery : 6 | CR |

(1) Blur data

   Same as "4.4.1 SCA data (1) SPH".

(2) Recovery data

   Same as "4.4.1 SCA data (1) SPH".

4.4.14 AC/A data (Plus Package only)

SX			AC/A data: 5	CR

BYTE	1	2	3	4	5
Contents	D1	D2	Point	D3	D4

D1   : Tens place digit
D2   : Ones place digit
Point : " . " (Decimal point)
D3   : First place after the decimal point
D4   : Second place after the decimal point

4.4.15 D data (Plus Package only)

SX			D data: 6	CR

Same as "4.4.1 SCA data (1) SPH".

4.4.16 Horizontal phoria data (Plus Package only)

SX			Prism: 5 Phoria: 3	CR

(1) Prism data

BYTE	1	2	3	4	5
Contents	D1	D2	Point	D3	D4

D1   : Tens place digit
D2   : Ones place digit
Point : " . " (Decimal point)
D3   : First place after the decimal point
D4   : Second place after the decimal point

(2) Phoria data

Exophoria: EXO, Esophoria: ESO, Orthophoria: □ □ □ (Space)

4.4.17 Horizontal prism / SPH data meeting Sheard or Percival criterion (Plus Package only)

SX		H-prism: 6 SPH: 6 AC/A used for SPH calculation: 1	CR

(1) H-prism data
    Same as "4.4.5 Prism data (1) H-prism".

(2) SPH data
    Same as "4.4.1 SCA data (1) SPH data". A space is entered when there is no SPH data.

(3) AC/A used for SPH calculation
    Gradient: G   Heterophoria: H

4.4.18 Morgan's system data (Plus Package only)

SX		Criteria of group A: 5	CR
SX		Criteria of group B: 7	CR
SX		Criteria of group C: 3	CR

(1) Criteria of group A

BYTE	1	2	3	4	5
Contents	D1	D2	D3	D4	D5

A space is entered when there is no data.

D1	: Results of #11 Far divergence (break)	H/L/N
D2	: Results of #17A Near divergence (blur)	H/L/N
D3	: Results of #17B Near divergence (break/recovery)	H/L/N
D4	: Results of #20 Near divergence (blur)	H/L/N
D5	: Results of #19 NPA or #19 accommodation by minus lens addition	H/L/N

(2) Criteria of group B

BYTE	1	2	3	4	5	6	7
Contents	D1	D2	D3	D4	D5	D6	D7

A space is entered when there is no data.

D1	: Results of #9 Far convergence (blur)	H/L/N
D2	: Result s of #10 Near convergence (break/recovery)	H/L/N
D3	: Results of #16A Near convergence (blur)	H/L/N
D4	: Results of #16B Near convergence (break/recovery)	H/L/N
D5	: Results of #19 NPA or #19 accommodation by minus lens addition	H/L/N
D6	: Results of #14A Crosscylinder (monocular)	H/L/N
D7	: Results of #14B Crosscylinder (binocular)	H/L/N

(3) Criteria of group C

BYTE	1	2	3
Contents	D1	D2	D3

A space is entered when there is no data.

D1	: Results of #8 Far horizontal phoria	H/L/N
D2	: Results of #13B Near horizontal phoria	H/L/N
D3	: Results of Gradient AC/A	H/L/N

4.4.19 Worth test data

| SX | ☐ | ☐ | Worth test data : 1 | CR |

BYTE	1
Contents	D1

D1   : " 2 " , " 3 " , " 4 " or " 5 "

4.4.20 Stereoscopic vision test data

| SX | ☐ | ☐ | Stereoscopic vision test data : 5 | CR |

BYTE	1	2	3	4	5
Contents	D1	D2	D3	D4	D5

D1   : Tens place (10′) digit of the minutes (A space is entered when the data is "0".)
D2   : Ones place (1′) digit of the minutes (A space is entered when D1=D2=0.)
D3   : Tens place (10″) digit of the seconds (A space is entered when D1=D2=D3= 0.)
D4   : Ones place (1″) digit of the seconds.
D5   : "space" (When stereovision is detected)
            " X " (When stereo vision is not detected)

4.4.21 Aniseikonia test data

| SX | ☐ | ☐ | Aniseikonia test data : 2 | CR |

BYTE	1	2
Contents	D1	D2

D1   : Tens place digit of the percentage
D2   : Ones place digit of the percentage
     When D1 & D2 are both 0, no Aniseikonia exists.
     When D1 & D2 are both 9, Aniseikonia exists.

4.4.22 Glare/Contrast level data (English version only)

| SX | | | Contrast level : 3, Glare level : 1 | CR |

```
BYTE        1    2    3    4
Contents    D1   D2   D3   D4
```

(1) Contrast level

D1   : Hundreds place digit of the percentage
D2   : Tens place digit of the percentage
D3   : Ones place digit of the percentage
      (In case of "Dusk", D1, D2 & D3 will be "0".)

(2) Glare level

D4   : High = "H"
          Medium = "M"
          Low = "L"
          OFF = "N"

4.4.23 Working distance (WD) data

| SX | | | WD data : 2 | CR |

```
BYTE            1         2
Contents        D1        D2
```

D1   : Tens place (10cm) digit
D2   : Ones place (1cm) digit

4.4.24 Final prescription/ LM working distance data

| SX | | | WD data : 3 | CR |

```
BYTE            1         2         3
Contents        D1        D2        D3
```

D1   : Hundreds place (100cm) digit
D2   : Tens place (10cm) digit
D3   : Ones place (1cm) digit

4.4.25 Age data

| SX | | | Age : 3 | CR |

BYTE	1	2	3
Contents	D1	D2	D3

D1   : Hundreds place (age) digit
D2   : Tens place (age) digit
D3   : Ones place (age) digit

4.4.26 Refraction time data

| SX | | | Refraction time data : 4 | CR |

BYTE	1	2	3	4
Contents	D1	D2	D3	D4

D1   : Tens place (minutes) digit
D2   : Ones place (minutes) digit
D3   : Tens place (seconds) digit
D4   : Ones place (seconds) digit

4.4.27 KM data

(1) mm data

| SX | | | R1 : 5 R2 : 5 AXIS : 3 | CR |

(2) Diopter data

| SX | | | R1 : 5 R2 : 5 | CR |

(a) R1

BYTE	1	2	3	4	5
Contents	D1	D2	Point	D3	D4

D1   : Tens place digit
D2   : Ones place digit
Point : " . " (Decimal point)
D3   : First place after the decimal point
D4   : Second place after the decimal point

(b) R2   Same as "(2) (a) R1".

(c) AXIS   Same as "4.4.1 SCA data (3) AXIS".

4.4.28 NT data

(1) mmHg data

| SX | | | mmHg (4) | CR |

BYTE	1	2	3	4
Contents	D1	D2	Point	D3

D1   : Tens place digit
D2   : Ones place digit
Point   : " . " (Decimal point)
D3   : First place after the decimal point

(2) kPa data

| SX | | | kPa (4) | CR |

BYTE	1	2	3	4
Contents	D1	Point	D2	D3

D1   : Ones place digit
Point   : " . " (Decimal point)
D2   : First place after the decimal point
D3   : Second place after the decimal point

§5 *DATA TRANSMISSION FROM THE PC TO THE RT*

By transmitting the data from computer to the RT-5100, the lens of the RT can be set automatically. The data transmissible are LM data and AR data. After transmitting the data from the personal computer, the RT-5100 goes into SUBJ mode, and it stands by in preparation for refraction. The lens can be set automatically only when refraction is not performed. When the RT-5100 receives the data in midst of refraction, it stores the data.

To recall the stored data , press AR or LM after pressing IN .

(When the "Input sequence from PC" parameter is set to "Pass", the data is received, and the lens of the RT can be set automatically regardless of the existence of the data on the RT-5100.)

§6 *DATA FORMAT (THE PC TO THE RT)*

The following data format is used to transmit all data.

| SH | ID No. block | EB | AR SCA block | EB | AR PD block | EB |

→ | LM SCA block | EB | LM ADD block | EB | LM PRISM block | EB |

→ | LM PD block | EB | ET |
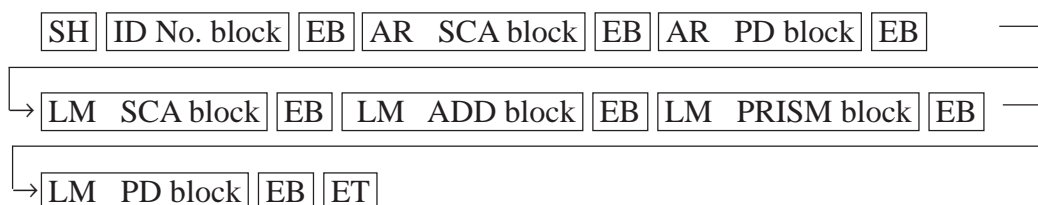
The block which has no data is simply removed when the data is transmitted in the above format.

Example :   In case of ID No. block + AR SCA block + PD block

| SH | ID No. block | EB | AR SCA block | EB | AR PD block | EB | ET |

In case of LM SCA block + ADD block + PRISM block + PD block

| SH | LM SCA block | EB | LM ADD block | EB |

→ | LM PRISM block | EB | LM PD block | EB | ET |
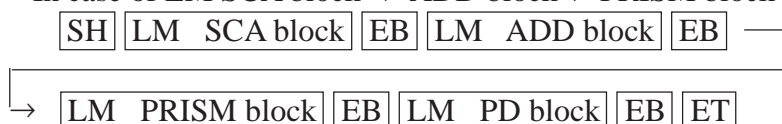
6.1 Format of Each Block

○ **Block data of ID No.**

DRL SX ID ☐☐☐☐☐☐☐☐☐☐

    ID No. data
    Signifies common data of
    AR and LM data

○ **Block data of AR, WF SCA**

D☐ SX OR SCA block EB OL SCA block

    SCA data of Left eye
    SCA data of Right eye

    DRM: AR data of Daytime or no specified data of Daytime/Nighttime
    DWF: Wave Front data of Daytime or no specified data of Daytime/Nighttime
    Dwf: Wave Front data of Nighttime
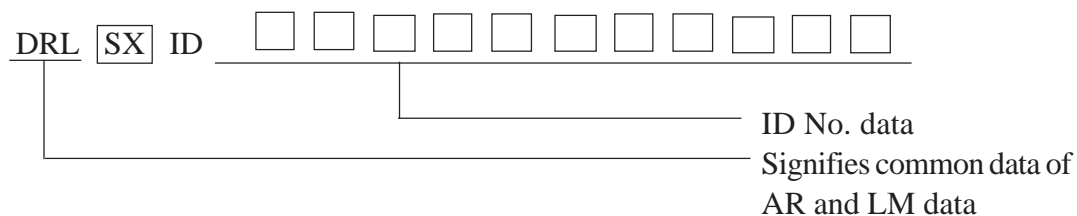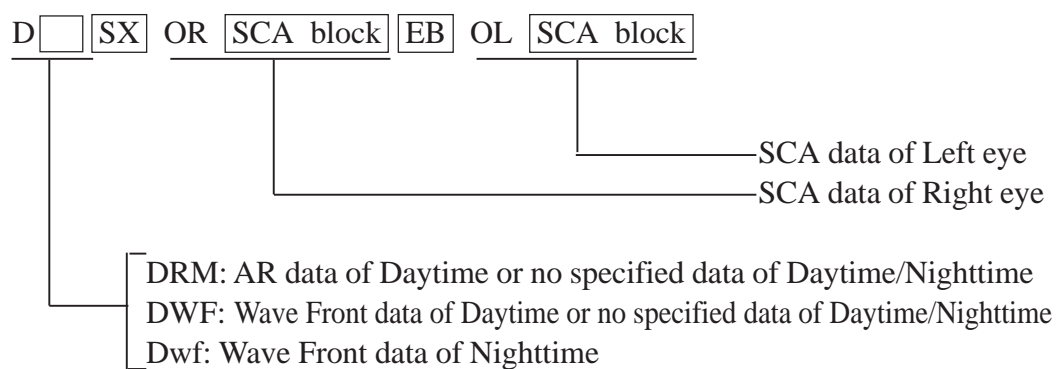
In case

Only right eye data	:	D☐ SX OR SCA block
Only left eye data	:	D☐ SX OL SCA block

○ **Block data of LM SCA**

D ☐ SX ☐ *R SCA block EB ☐ *L SCA block

└─ SCA data of Left eye
└─ SCA data of Right eye

DLM: LM data of Daytime or no specified data of Daytime/Nighttime
Dlm: LM data of Nighttime
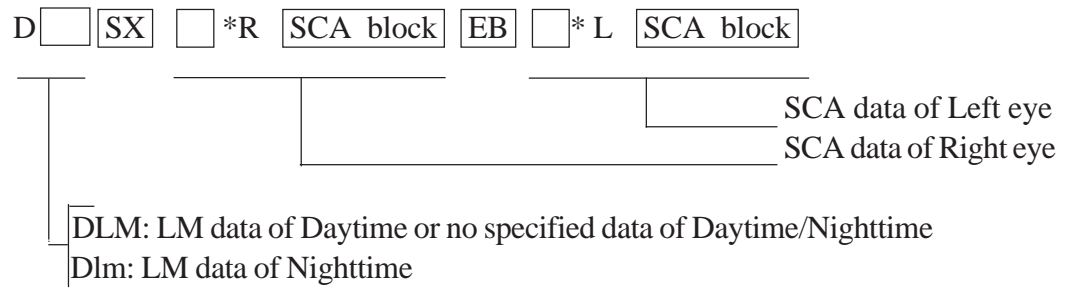
In case
   Only right eye data   : DLM SX ☐ *R SCA block
   Only left eye data   : DLM SX ☐ *L SCA block

☐ * signifies a "space"

○ **Block data of LM ADD**

AR ADD block EB AL ADD block

└─ ADD data of Left eye
└─ ADD data of Right eye
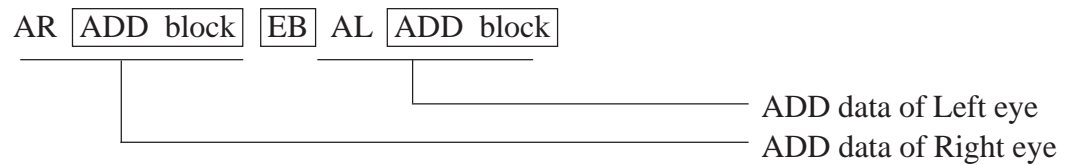
○ **Block data of LM PRISM**

[Rectangular coordinates]

PR PRISM block (Horizontal) EB PR PRISM block (Vertical) ───┐

└→ EB PL PRISM block (Horizontal) EB PL PRISM block (Vertical)

[Polar coordinates]

PR PRISM block EB BR PRISM block EB ───┐

└→ PL PRISM block EB BL PRISM block

○ **SCA block data**

☐☐☐.☐☐ ☐☐☐.☐☐ ☐☐☐
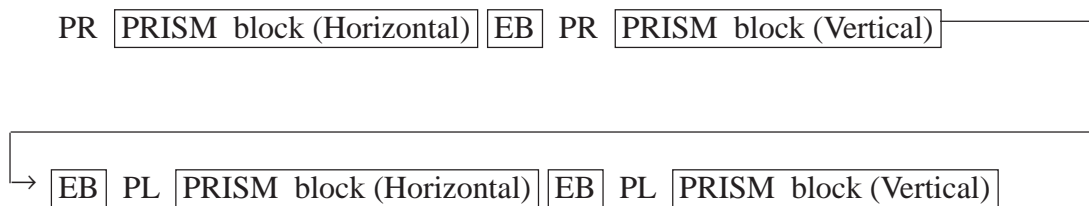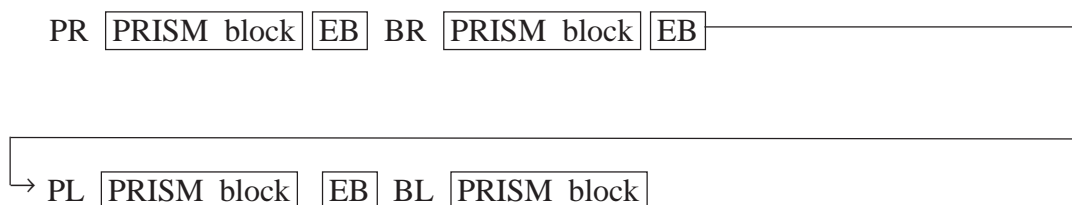
AXIS data
CYL data
SPH data

○ **ADD block data**

☐☐☐.☐☐
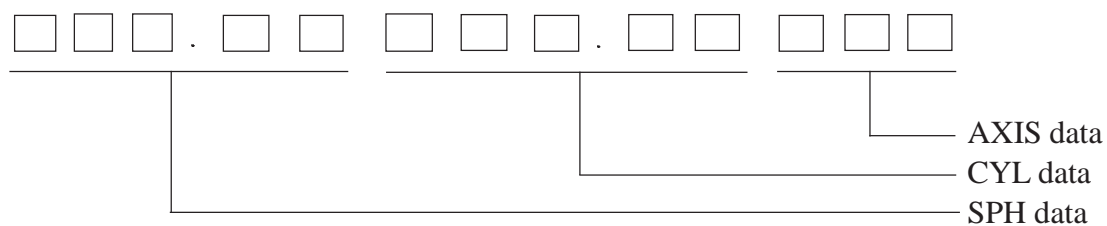
ADD data
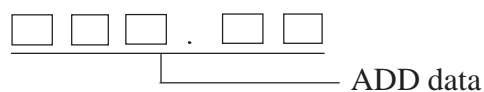
○ **PRISM block data**

[Rectangular coordinates]

☐☐.☐☐☐

PRISM data

[Polar coordinates]

☐☐.☐☐

PRISM diopter data

☐☐☐

PRISM base direction data

○ **PD block data**

PD ☐☐
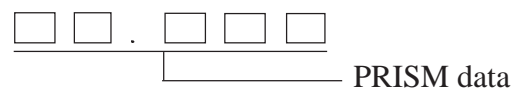
PD data

6.2 Format of Each Item of Data

○ **SPH data**   **6 byte**

BYTE	1	2	3	4	5	6
Contents	Polarity	D1	D2	Point	D3	D4

Polarity   : $+$, $-$
D1   : Tens place digit
D2   : Ones place digit
Point   : " . " (Decimal point)
D3   : First place after the decimal point
D4   : Second place after the decimal point

○ **CYL data**   **6 byte**

The same as "4.4.1 SCA data (a) SPH"

○ **AXIS data**   **3 byte**

BYTE	1	2	3
Contents	D1	D2	D3

D1   : Hundreds place digit
D2   : Tens place digit
D3   : Ones place digit

○ **ADD data**   **6 byte**

The same as "4.4.1 SCA data (a) SPH"

○ **PD data**   **2 byte**

BYTE	1	2
Contents	D1	D2

D1   : Tens place digit
D2   : Ones place digit

O   **PRISM data**

[Rectungular coordinates]

BYTE	1	2	3	4	5	6
Contents	D1	D2	Point	D3	D4	Base

D1   : Tens place digit
D2   : Ones place digit
Point : " . " (Decimal point)
D3   : First place after the decimal point
D4   : Second place after the decimal point
Base   : Base direction I(IN), O(OUT), U(UP), D(DOWN)

[Polar coordinates]
Diopter

BYTE	1	2	3	4	5
Contents	D1	D2	Point	D3	D4

D1   : Tens place digit
D2   : Ones place digit
Point : " . " (Decimal point)
D3   : First place after the decimal point
D4   : Second place after the decimal point

Base direction

BYTE	1	2	3
Contents	D1	D2	D3

D1   : Hundreds place digit
D2   : Tens place digit
D3   : Ones place digit

O   **ID No. data**

BYTE	1	to	12
Contents	D1	to	D12

Represented as a 12-digit number.
Less than 12-digit numbers are justified to the right and spaces are
left to the blanks.

§7 COMMUNICATION BETWEEN THE RT AND THE PC

Computer   RT

① | SH | C** | SX | RS | EB | ET |

② | SH | CRL | SX | SD | EB | ET |

③ (Data)
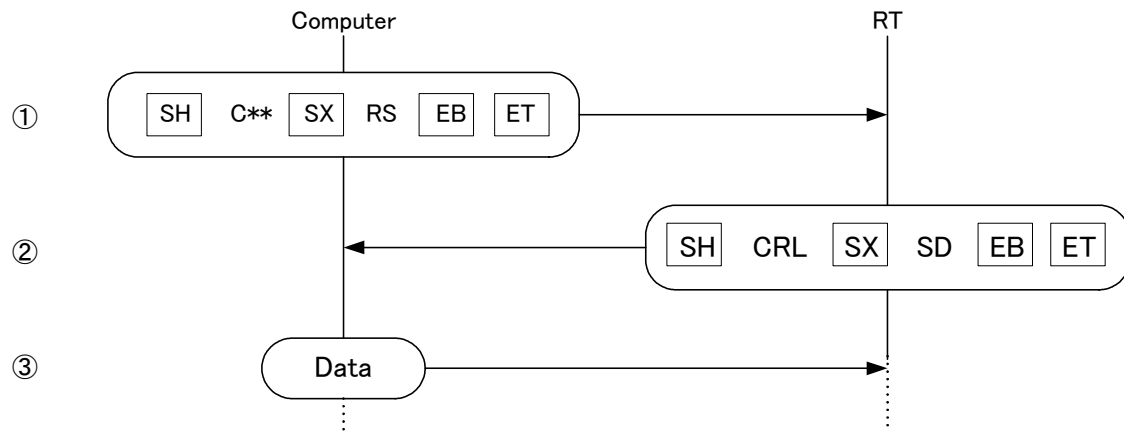
① The computer requires the RT to transmit the data.

   The command is as follows.

   $\boxed{SH}$ C ∗∗ $\boxed{SX}$ RS $\boxed{EB}$ $\boxed{ET}$

② The RT acknowledges the data transmission from the PC.

   The command is as follows.

   $\boxed{SH}$ CRL $\boxed{SX}$ SD $\boxed{EB}$ $\boxed{ET}$

③ The PC transmits the data to the RT according to the transmission data format.

COMPUTER : IBM PC-AT

8.1 Flow Chart at Data Reception

This program is used to receive data from the RT and to store them in memory.
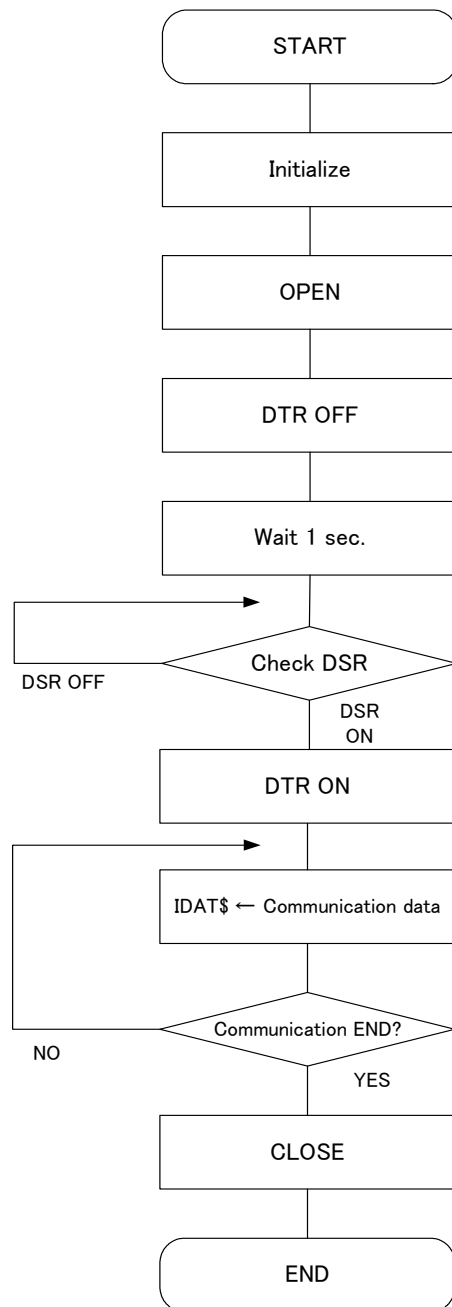
```
        ┌─────────────────┐
        (     START       )
        └────────┬────────┘
                 │
        ┌────────┴────────┐
        │    Initialize   │
        └────────┬────────┘
                 │
        ┌────────┴────────┐
        │      OPEN       │           • The DTR of the PC is turned on.
        └────────┬────────┘
                 │
        ┌────────┴────────┐
        │     DTR OFF     │           • The DTR is turned off.
        └────────┬────────┘
                 │
        ┌────────┴────────┐
        │    Wait 1 sec.  │
        └────────┬────────┘
                 │
          ◇ Check DSR ◇
   DSR OFF          │ DSR ON
        ┌───────────┴─────┐
        │     DTR ON      │
        └────────┬────────┘
                 │
        │ IDAT$ ← Communication data │
        └────────┬────────┘
                 │
        ◇ Communication END? ◇       • It continues to communicate until the EOT
     NO              │ YES             is received.
        ┌────────────┴────┐
        │     CLOSE       │           • The DTR is turned off.
        └────────┬────────┘
                 │
        ┌────────┴────────┐
        (      END        )
        └─────────────────┘
```

8.2 Flow Chart at Data Transmission

This program is used to transmit the data from the PC to the RT.

Flow Chart	Description
START	
Initialize	
OPEN	• The DTR of the PC is turned on.
Check DSR (DSR OFF / DSR ON)	
Transmit C**RS	• Require to transmit the data.
Receive DATA	• Wait for a while until the RT acknowledges the data.
CRLSD? (NO / YES)	
Transmit data	• Transmit the data according to the transmission data format.
CLOSE	• The DTR is turned off.
END	
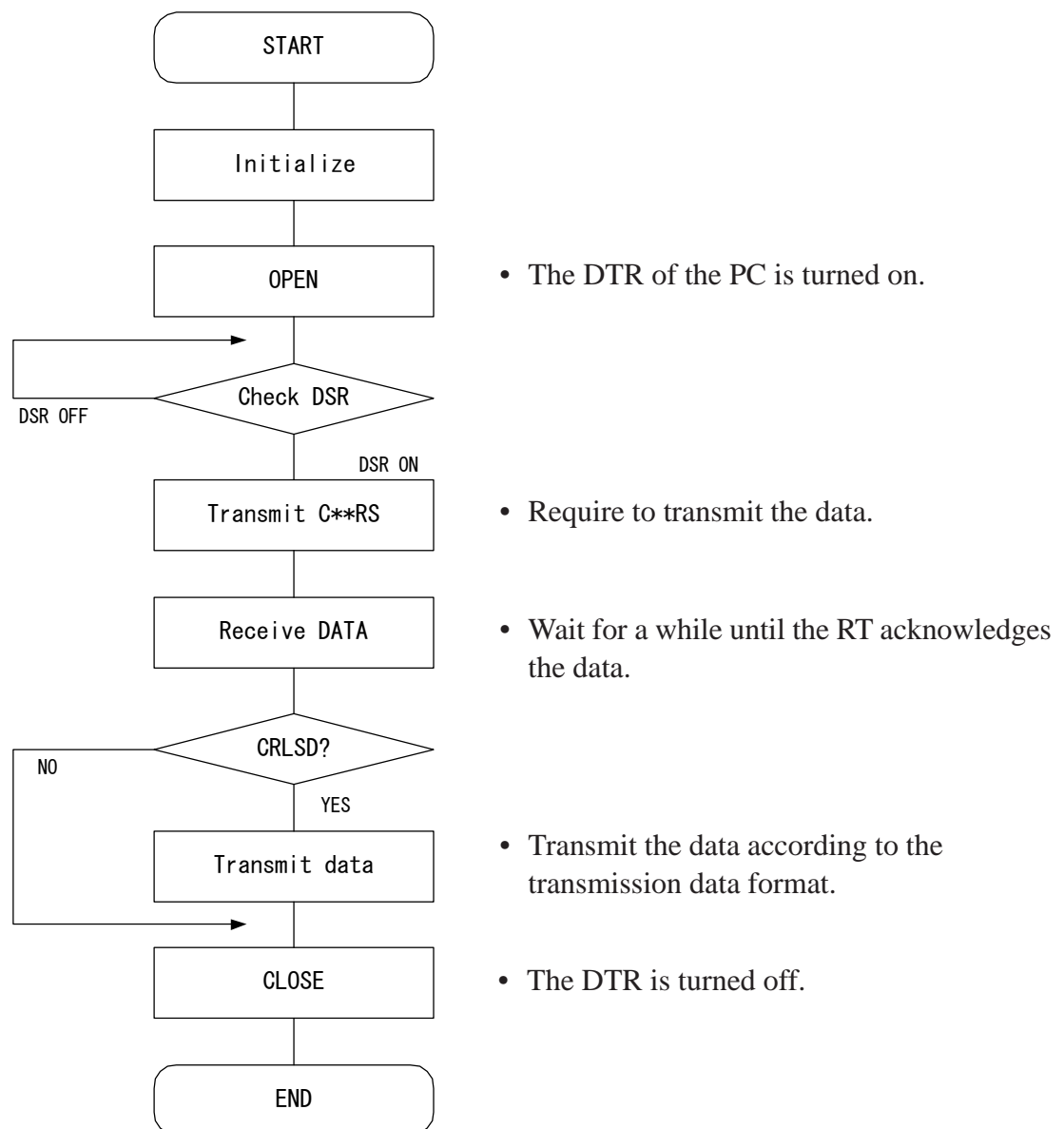
8.3 IBM PC-AT Sample Program

```
1000 '/***********************************************************/
1010 '/*    Sample Program for Communicate with RT-5100         */
1020 '/*      << for IBM PC-AT compatible Qbasic >>   Jul/24/1997 */
1030 '/***********************************************************/
1040 '  save "RS232C.bas",a
1050 '
1060 DIM IDAT$(100)
1070 SH$ = CHR$(1): SX$ = CHR$(2): EB$ = CHR$(&H17): ET$ = CHR$(4)
1080 '*SELECT
1090 CLS
1100 INPUT "PLEASE SELECT INPUT OR OUTPUT DATA.  1=INPUT  2=OUTPUT : ", A$
1110 IF A$ = "1" THEN 1120 ELSE IF A$ = "2" THEN 1320 ELSE 1080
1120 '*INRT
1130 PRINT : PRINT "  PUSH 'PRINT' SWITCH PLEASE !!": PRINT
1140 OPEN "COM1:2400,E,7,2,CS0,DS0" FOR RANDOM AS #1     ' DTR:ON
1150 OUT &H3FC, &HA                                      ' DTR:OFF
1160 FOR i = 1 TO 10000: NEXT i                          ' Wait
1170 IF ((INP(&H3FE)) AND &H20) <> &H20 THEN 1170        ' Check DSR
1180 OUT &H3FC, &HB                                      ' DTR:ON
1190 FOR i = 1 TO 100
1200    INPUT #1, IDAT$(i)
1210    IF IDAT$(i) = CHR$(4) THEN 1230
1220 NEXT i
1230 IEND = i - 1
1240 CLOSE #1
1250 BEEP
1260 FOR i = 1 TO IEND
1270    PRINT IDAT$(i); "|"                              ' Display Text data
1280 NEXT i
1290 A$ = INKEY$: IF A$ = "" THEN 1290
1300 GOTO 1080
1310 '
1320 '*OUTRT
1330 CLS
1340 PRINT " TRANS COMPUTER DATA TO RT-2100"
1350 PRINT " DATA:    <RIGHT>    <LEFT>"
1360 PRINT "<LM>  SPH  -2.25     -3.50"
1370 PRINT "      CYL  -0.75     -1.00"
1380 PRINT "      AXIS  180       75"
1381 PRINT "      ADD  +3.00     +3.00"
1383 PRINT "      PRISM 2.80IN   2.80IN"
1384 PRINT "            3.10UP   3.10DOWN"
1385 PRINT "      PD              62"
1390 PRINT "<AR>  SPH  +2.25     +3.50"
1400 PRINT "      CYL  -0.75     -1.00"
1410 PRINT "      AXIS  180       75"
1420 PRINT "      PD              63": PRINT
1430 PRINT " HIT ANY KEY TO STARTING TRANS."

1440 A$ = INKEY$: IF A$ = "" THEN 1440
1450 LMSCAR$ = " R- 2.25- 0.75180"
1460 LMSCAL$ = " L- 3.50- 1.00 75"
1465 LMADDR$ = "AR+ 3.00"
1466 LMADDL$ = "AL+ 3.00"
1467 LMPSMR$ = "PR 2.80I" + EB$ + "PR 3.10U"
1468 LMPSML$ = "PL 2.80I" + EB$ + "PL 3.10D"
1469 LMPD$ = "PD62"
1470 ARSCAR$ = "OR+ 2.25- 0.75180"
1480 ARSCAL$ = "OL+ 3.50- 1.00 75"
1490 ARPD$ = "PD63"
1500 LMBLOCK$ = "DLM" + SX$ + LMSCAR$ + EB$ + LMSCAL$ + EB$ + LMADDR$ + EB$ +
LMADDL$ + EB$ + LMPSMR$ + EB$ + LMPSML$ + EB$ + LMPD$
1510 ARBLOCK$ = "DRM" + SX$ + ARSCAR$ + EB$ + ARSCAL$ + EB$ + ARPD$
1520 RS$ = SH$ + "C**" + SX$ + "RS" + EB$ + ET$
1525 SD$ = SH$ + "CRL" + SX$ + "SD" + EB$ + ET$
1530 OPEN "COM1:2400,E,7,2,CS0,DS0" FOR RANDOM AS #1     ' DTR:ON
1533 OUT &H3FC, &HA                                      ' DTR:OFF
1534 FOR i = 1 TO 10000: NEXT i                          ' Wait
1535 OUT &H3FC, &HB                                      ' DTR:ON
1540 IF ((INP(&H3FE)) AND &H20) <> &H20 THEN 1540        ' Check DSR
1550 PRINT #1, RS$
1560 INPUT #1, IN$
1570 IF IN$ <> SD$ THEN 1590
1580 PRINT #1, SH$ + ARBLOCK$ + EB$ + LMBLOCK$ + EB$ + ET$
1590 CLOSE #1
1600 BEEP
1610 A$ = INKEY$: IF A$ = "" THEN 1610
1620 GOTO 1080
```