HR SERIES

INSTRUCTION MANUAL

PRECISION ELECTRONIC BALANCE
Options
OP-03
OP-05

A&D

A&D Company, Limited
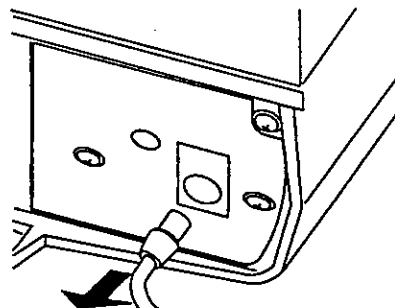
⬇ Serial Interface (OP-03)

Option 03, is a serial interface that consists of two sections, a bi-directional EIA RS-232C interface and a 20mA passive current loop.
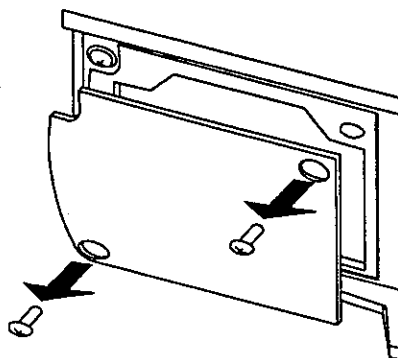
⬇ Installation

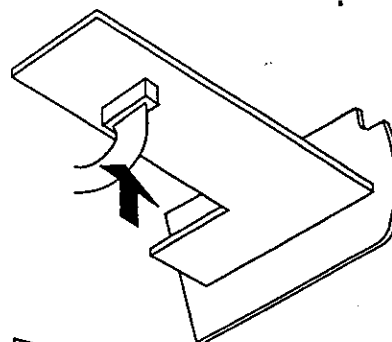**1** Turn off the balance and remove the AC adapter.

2 Remove two screws securing the blank cover on the rear of the balance.
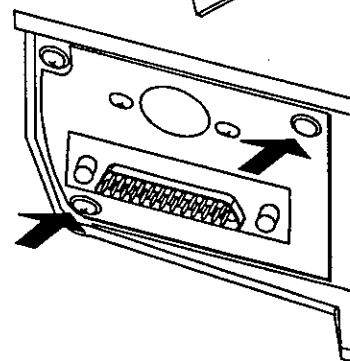
3 Remove the cable connected to this panel and connect it to the option card as shown.

4 Install the option using the screws removed in step 1.

▼ Specifications

Transmission system : EIA RS-232C, 20mA current loop (passive)
Transmission form   : Asynchronous, bi-directional, half duplex
Data format   : Baud rate : 600, 1200, 2400, 4800, 9600 bps
                        Data   : 7 or 8 bits
                        Parity   : Even, Odd (7 bit)
                                      None (8 bit)
                        Stop bit   : 1 or 2 bits
                        Code   : ASCII

DATA	RS-232C levels	Current loop
1	- 5V to - 15V	20mA
0	+ 5V to + 15V	0mA

Pin connections

RS-232C

Pin No.	Signal name	Direction	Description
1	FG	-	Frame ground
2	R x D	Input	Receive data
3	T x D	Output	Transmit data
4	RTS	Input	Ready to send
5	CTS	Output	Clear to send
6	DSR	Output	Data set ready
7	GND	-	Signal ground

Current loop

Pin No.	Signal name
1	N.C.
2	N.C.
3	Loop
4	N.C.
5	Loop
CASE	Frame GND

13 12 11 10 9 8 7 6 5 4 3 2 1
25 24 23 22 21 20 19 18 17 16 15 14

RS-232C

1	FG
2	RXD
3	TXD
4	RTS
5	CTS
6	DSR
7	SG
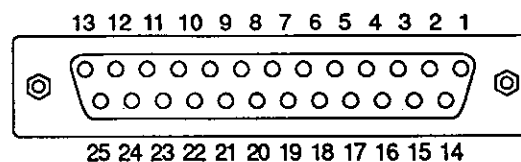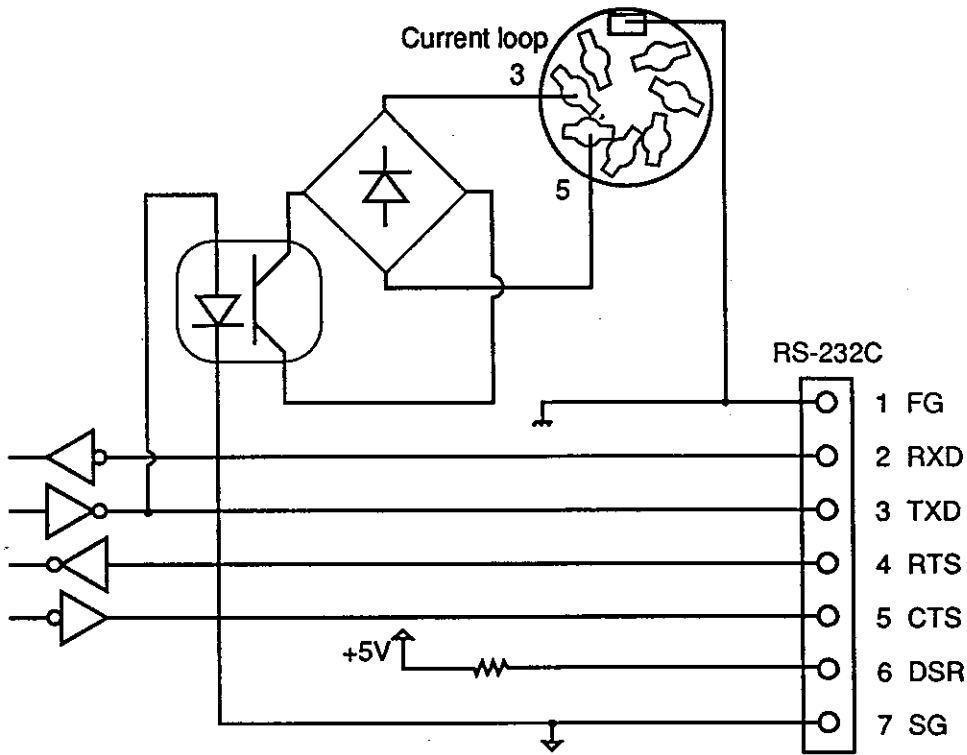
⬎ Connection to Other Equipment

- The current loop is of the passive type. It requires an external source of 20mA DC.

- The RS-232C is of the DCE type (Data Communications Equipment) and can use standard DCE cables.

- When connecting to another piece of equipment, consult the manual for that equipment for proper settings and connections.

⬎ Connection to an AD-8121

The following balance functions must be set to use the AD-8121 printer

"C" function	Settings
C-4 Print 0. 1 2. 3	Select a print mode
C-4 AP-P	Select the polarity for the auto-print mode
C-4 AP-b	Set the auto-print band
C-5 bPS	Select "2400bps"
C-5 bt-Pr 0	Select "7 bits, Even parity check"
C-5 Cr-LF 0	Select "CR, LF"
C-5 tYPE 0	Select "A&D Standard" format
C-5 t-uP 1	Set the receive timing to 1 second
C-5 t-Cod 0	Select "Error codes are not output"
C-5 CtS 0	Select "Not using CTS and RTS"

⬇ Data Output

There are four modes to control the transmission of the weighing data.

Key Mode

When you press the PRINT key, the balance transmits the weighing data when the display is stable (the stability indicator is on). When the data is transmitted the display will blink one time.

C-4 $Print$ 0 .... Print key mode

Auto-print Mode A

The balance transmits the weighing data when the display is stable (the stability indicator is on), meets the conditions of "Auto-print polarity and "Auto-print band". The reference for the auto-print band is the zero point. When the data is transmitted the display will blink one time.

C-4 $Print$ 1 .... Auto-print mode A

C-4 AP-P X   .... Auto-print polarity $X = 0, 1, 2$

C-4 AP-b X   .... Auto-print band $X = 0, 1, 2$

Auto-print Mode B

The balance transmits the weighing data when the display is stable (the stability indicator is on), meets the conditions of "Auto-print polarity and "Auto-print band". The reference for the auto-print band is the last weighing data printed. When the data is transmitted the display will blink one time.

C-4 $Print$ 2 .... Auto-print mode B

C-4 AP-P X   .... Auto-print polarity $X = 0, 1, 2$

C-4 AP-b X   .... Auto-print band $X = 0, 1, 2$

Stream Mode

The balance transmits the weighing data continuously.

C-1 $SEEd$ X   .... Display update rate. $X = 0, 1, 2$

C-5 bPS X   .... Baud rate. $X = 0, 1, 2, 3, 4$

NOTE:

If the baud rate is set to 600 or 1200bps, The display will update at a rate that is faster than the transmitted data.

▼ Data Format Examples

In the following examples, a space is represented by a "␣" symbol

STABLE   ° 0.0000 g

A&D	S	T	,	+	0	0	0	.	0	0	0	0	␣	␣	g	CR	LF
D.P.	W	T	␣	␣	␣	␣	0	.	0	0	0	0	␣	␣	g	CR	LF
KF	␣	␣	␣	␣	0	.	0	0	0	0	␣	g	CR	LF			
Gen.	S	␣	␣	␣	␣	␣	0	.	0	0	0	0	␣	g	CR	LF	

UN-STABLE   -9832 10 g

A&D	U	S	,	−	0	9	8	.	3	2	1	0	␣	␣	g	CR	LF
D.P.	U	S	␣	␣	␣	−	9	8	.	3	2	1	0	␣	␣	g	CR	LF
KF	−	␣	␣	9	8	.	3	2	1	0	␣	␣	␣	CR	LF		
Gen.	S	D	␣	␣	␣	−	9	8	.	3	2	1	0	␣	g	CR	LF

OVERLOAD   E   Positive error

A&D	O	L	,	+	9	9	9	9	9	9	9	E	+	1	9	CR	LF
D.P.	␣	␣	␣	␣	␣	␣	␣	␣	E	␣	␣	␣	␣	␣	␣	␣	CR	LF
KF	␣	␣	␣	␣	H	␣	␣	␣	␣	␣	␣	␣	␣	CR	LF		
Gen.	S	I	+	CR	LF												

OVERLOAD   - E   Negative error

A&D	O	L	,	−	9	9	9	9	9	9	9	E	+	1	9	CR	LF
D.P.	␣	␣	␣	␣	␣	␣	␣	␣	−	E	␣	␣	␣	␣	␣	␣	␣	CR	LF
KF	␣	␣	␣	␣	L	␣	␣	␣	␣	␣	␣	␣	␣	CR	LF		
Gen.	S	I	−	CR	LF												

␣	Space,	ASCII 20H
CR	Carriage Return,	ASCII 0DH
LF	Line Feed,	ASCII 0AH

⬇ Data Format

There are four formats for transmission of the weighing data. The setting of $C-5$ $tYPE$ selects the data format

A&D Standard Format $tYPE$ 0

This format is used when the peripheral equipment is capable of receiving A&D format. If an AD-8121 is to be used and you are sending a 15 character data string (excluding the terminator), set the printer to mode 1 or 2.

* A two character header indicates the status of the stability.

* The weighing data (with leading zeros) plus sign and decimal point, followed by a three character "unit of weight" make up the body of the data.

* A terminator consisting of CR, LF to indicate to the peripheral equipment that all of the data has been sent.

Dump Print Format $tYPE$ 1

This format is used when the peripheral equipment is not capable of receiving A&D format. If an AD-8121 is to be used and you are sending a 16 character data string (excluding the terminator), set the printer to mode 3.

* A two character header indicates the status of the stability if not overloaded or the display is zero.

* The weighing data (with leading zeros replaced by spaces) plus sign and decimal point, followed by a three character "unit of weight" make up the body of the data.

* A terminator consisting of CR, LF to indicate to the peripheral equipment that all of the data has been sent.

KF Format $tYPE$ 2

This is the Karl-Fischer moisture meter format is used when the peripheral equipment can not communicate using A&D format.

* The data consists of 13 characters (excluding the terminator).

* The sign of the weighing data is first if the balance is not in overload. The sign is omitted if the balance is at zero.

* The sign is followed by the weighing data (with leading zeros replaced by spaces) and decimal point. The weight data is followed by the unit code "g" only if the balance is stable.

* A terminator consisting of CR, LF to indicate to the peripheral equipment that all of the data has been sent.

General Format $tYPE$ 3

* The data consists of 15 characters (excluding the terminator) if not in overload.

* The weighing data is proceeded by a header of two characters. If stable, one character and a space are transmitted.

* The minus sign will be next if the weighing data is negative. The sign is omitted if the weighing data is positive or at zero. Leading zeros are replaced by spaces.

* If the balance is in overload, the weighing data is omitted.

▼ Commands

Command list

Commands to request weighing data	Description of the command
Q	Request for weighing data immediately
SI	Request for weighing data immediately
S	Request for weighing data when stable
SIR	Request for weighing data continuously
C	Clear the SIR command
Commands to control the balance	
P	Display ON/OFF (same as ON/OFF key)
ON	Display ON
OFF	Display OFF
R	Display RE-ZERO (same as RE-ZERO key)
CAL	Perform calibration
U	Change weighing unit (same as MODE key)
PRT	Print (same as PRINT key)
RNG	Change Range (same as RANGE key)
Commands to set values	
CW:	Set the calibration weight
PT:	Set the digital tare weight
ID:	Set the ID number
FC:	Set a function parameter
?CW	Request for the calibration weight
?PT	Request for the digital tare weight
?ID	Request for the ID number
?FC	Request for a function parameter
?UT	Request the current unit of weight
?SN	Request the serial number of the balance
?LT	Request for all function parameters

▼ Commands to Request Weighing Data

Q   Query for weighing data
(the balance will respond with the weighing data immediately)

Command | Q | C_R | L_F |

Reply | S | T | , | + | 0 | 1 | 2 | . | 7 | 8 | 3 | 5 | ␣ | ␣ | g | C_R | L_F |

SI   Send the weighing data immediately (same as Q)
(the balance will respond with the weighing data immediately)

Command | S | I | C_R | L_F |

Reply | U | S | , | + | 0 | 1 | 2 | . | 7 | 8 | 3 | 5 | ␣ | ␣ | g | C_R | L_F |

[S] Send the weighing data when it is stable
(the balance display will blink when the data is transmitted)

Command $\boxed{S}\boxed{C_R}\boxed{L_F}$

Reply $\boxed{S}\boxed{T}\boxed{,}\boxed{+}\boxed{0}\boxed{1}\boxed{2}\boxed{.}\boxed{7}\boxed{8}\boxed{3}\boxed{5}\boxed{\sqcup}\boxed{\sqcup}\boxed{g}\boxed{C_R}\boxed{L_F}$

[S][I][R] Send the weighing data continuously
(the balance sends the data in stream mode)

Command $\boxed{S}\boxed{I}\boxed{R}\boxed{C_R}\boxed{L_F}$

Reply $\boxed{U}\boxed{S}\boxed{,}\boxed{+}\boxed{0}\boxed{1}\boxed{2}\boxed{.}\boxed{7}\boxed{8}\boxed{3}\boxed{5}\boxed{\sqcup}\boxed{\sqcup}\boxed{g}\boxed{C_R}\boxed{L_F}$

⋮

$\boxed{S}\boxed{T}\boxed{,}\boxed{+}\boxed{0}\boxed{1}\boxed{2}\boxed{.}\boxed{7}\boxed{8}\boxed{3}\boxed{5}\boxed{\sqcup}\boxed{\sqcup}\boxed{g}\boxed{C_R}\boxed{L_F}$
$\boxed{S}\boxed{T}\boxed{,}\boxed{+}\boxed{0}\boxed{1}\boxed{2}\boxed{.}\boxed{7}\boxed{8}\boxed{3}\boxed{5}\boxed{\sqcup}\boxed{\sqcup}\boxed{g}\boxed{C_R}\boxed{L_F}$

[C] Cancel the SIR command
(the balance will stop sending data in stream mode)

Command $\boxed{C}\boxed{C_R}\boxed{L_F}$

☡ Commands to Control the Balance

[P] Display ON/OFF (same as pressing the ON/OFF key)
(if the balance is on it will turn off, if it is off it will turn on)

Command $\boxed{P}\boxed{C_R}\boxed{L_F}$

[O][N] Display ON (If the balance is OFF, it will turn ON)
(if the balance is already on, nothing will happen)

Command $\boxed{O}\boxed{N}\boxed{C_R}\boxed{L_F}$

[O][F][F] Display OFF (If the balance is ON, it will turn OFF)
(if the balance is already off, nothing will happen)

Command $\boxed{O}\boxed{F}\boxed{F}\boxed{C_R}\boxed{L_F}$

[R] RE-ZERO the balance (same as pressing the RE-ZERO key)
(the balance display will zero and the value of PT will be updated)

Command $\boxed{R}\boxed{C_R}\boxed{L_F}$

[C][A][L] Preform calibration
(the balance will enter the calibration mode)

Command $\boxed{C}\boxed{A}\boxed{L}\boxed{C_R}\boxed{L_F}$

[U] Change the mode (same as pressing the MODE key)
(the balance will shift to the next selected unit of weigh, to the counting or percent mode)

Command $\boxed{U}\boxed{C_R}\boxed{L_F}$

[P][R][T] Print (same as pressing the PRINT key)
(if the balance will send data dependent on the function parameters)

Command $\boxed{P}\boxed{R}\boxed{T}\boxed{C_R}\boxed{L_F}$

[R][N][G] Change range (same as pressing the RANGE key)

Command $\boxed{R}\boxed{N}\boxed{G}\boxed{C_R}\boxed{L_F}$

▼ Commands to Set Data

| C | W | : | Command | C | W | : | 2 | 0 | 0 | . | 1 | 2 | 3 | 4 | ␣ | ␣ | g | ^C_R | ^L_F |

When in the calibration mode, this command is used to set the actual value of the calibration weight. The calibration weight is reset to the standard value upon entry into the calibration mode.

Caution, only grams can be used as the unit of weight when setting the value.
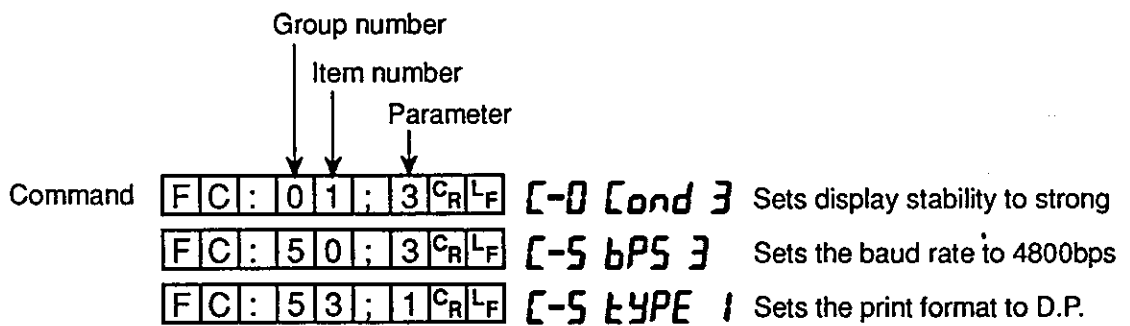
| P | T | : | Command | P | T | : | 1 | 0 | 0 | . | 5 | 6 | 7 | 0 | ␣ | ␣ | g | ^C_R | ^L_F |

This command is used to set the digital tare weight.

Caution, pressing the RE-ZERO key or commanding RE-ZERO will clear this value.

| I | D | : | Command | I | D | : | 1 | 2 | 3 | - | A | B | C | ^C_R | ^L_F |

When using GLP (Good Laboratory Practice), this command is used to set the ID number to be printed out for verification of calibration. The ID can consist of seven characters, A through F, numbers 0 through 9, spaces or the negative sign (-).

| F | C | : | Setting a "C" parameter

Group number
Item number
Parameter

Command | F | C | : | 0 | 1 | ; | 3 | ^C_R | ^L_F | **C-0 Cond 3** Sets display stability to strong

| F | C | : | 5 | 0 | ; | 3 | ^C_R | ^L_F | **C-5 bPS 3** Sets the baud rate to 4800bps

| F | C | : | 5 | 3 | ; | 1 | ^C_R | ^L_F | **C-5 tYPE 1** Sets the print format to D.P.

Group Number	Item and Item Number						
	Group	0	1	2	3	4	5	6
0	**C-0** Environment	**Stb-b** Stability band	**Cond** Resp. / Environ.	**trc** Zero tracking				
1	**C-1** Display	**SPEEd** Refresh rate	**Poı nt** Decimal point	**P-on** Auto start function				
2	**C-2** Auto re-zero	**Ar-0** Auto re-zero on/off	**Ar-b** Auto re-zero band	**Ar-t** Detection time				
3	**C-3** Calibration	**CAL** Calibration inhibit						
4	**C-4** Data out	**Prı nt** Data out mode	**AP-P** Auto print polarity	**AP-b** Auto print band	**PAUSE** Data pause	**At-F** Auto feed	**Ar-d** Zero after data out	**ı nFo** Cal verification
5	**C-5** Serial interface	**bPS** Baud rate	**bt-Pr** Parity bit	**Cr-LF** Terminator	**tYPE** Data format	**t-UP** Receive time	**E-Cod** Error code	**CtS** CTS control
6	**C-6**	Response/environment is common data with the condition of resopnse accessable using the keyboard. If a value is set in the C parameters, it will be changed if new conditions of response are set.						
7	**C-7**							
8	**C-8**							
9	**C-9** Parameter control	**Pn** ID protect	**PF** Parameter protect					

⬇ Commands to Request Data

`?CW` Request for the calibration weight.

Command `?CW`^{C_R}^{L_F}

Reply `CW,+200.1234⎵⎵g`^{C_R}^{L_F} "⎵"= a space

Caution, If the calibration mode has been entered sense the calibration weight was last entered, the value returned will be the standard calibration weight. The unit of weight will always be grams.

`?PT` Request for the digital tare weight.

Command `?PT`^{C_R}^{L_F}

Reply `PT,+100.5670⎵⎵g`^{C_R}^{L_F}

Caution, If the RE-ZERO key has been pressed sense the last digital tare was registered, the value returned will be the last point at which the RE-ZERO key was pressed. The unit of weight will be the unit of weight currently in use.

The fact that the value returned after RE-ZERO has been pressed is the actual tare weight, this can be used to read the tare weight into a program.
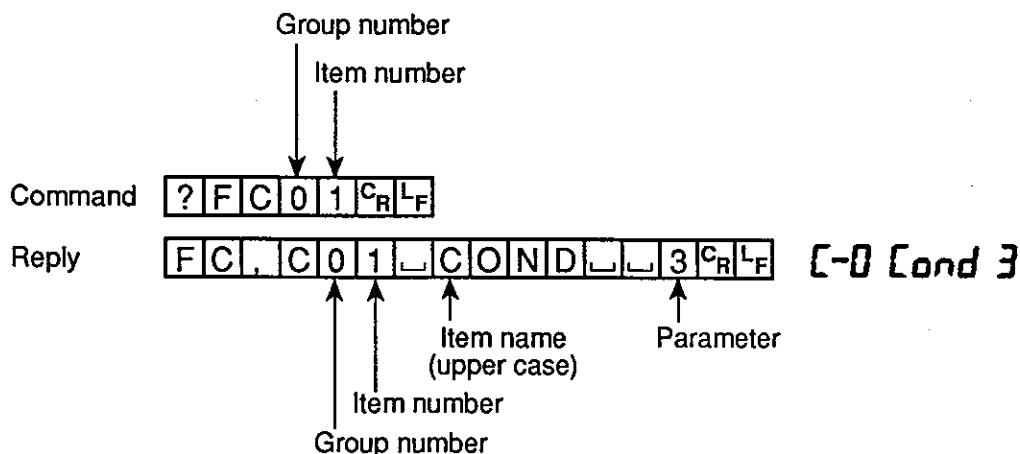
`?ID` Request for the ID number.

Command `?ID`^{C_R}^{L_F}

Reply `ID,+123-ABC`^{C_R}^{L_F}

The number returned can be used as a lot control number or to identify the balance.

`?FC` Request for the set value of a specific C parameter.

Group number
Item number

Command `?FC01`^{C_R}^{L_F}

Reply `FC,C01⎵COND⎵⎵3`^{C_R}^{L_F} *C-0 Cond 3*

Item name (upper case)   Parameter
Item number
Group number

The table on the previous page lists the group number, item and item numbers. For a breakdown of the parameters, please refer to the C parameters in the function section of the instruction manual.

`?` `U` `T` Request for the current unit of weight or the mode if using percent or counting. The unit is returned as three digits.

Command `?` `U` `T` `CR` `LF`

Reply `U` `T` `,` `␣` `␣` `g` `CR` `LF`   "␣"= a space

`U` `T` `,` `␣` `m` `g` `CR` `LF`

`U` `T` `,` `d` `w` `t` `CR` `LF`

`?` `S` `N` Request for the serial number of the balance. This command can be used to inventory the instruments in a LIM system or for other record keeping such as GLP (Good Laboratory Practice). This number can not be changed in the C parameters.

Command `?` `S` `N` `CR` `LF`

Reply `S` `N` `,` `1` `2` `3` `4` `5` `6` `7` `8` `CR` `LF`

`?` `L` `T` Request for all parameters. The balance will respond by sending the C parameters in sequence.

Command `?` `L` `T` `CR` `LF`

Reply `F` `C` `,` `C` `0` `0` `␣` `S` `T` `B` `-` `B` `␣` `1` `CR` `LF`

`F` `C` `,` `C` `0` `1` `␣` `C` `O` `N` `D` `␣` `␣` `2` `CR` `LF`

`F` `C` `,` `C` `0` `2` `␣` `T` `R` `C` `␣` `␣` `␣` `2` `CR` `LF`

`F` `C` `,` `C` `1` `0` `␣` `S` `P` `E` `E` `D` `␣` `0` `CR` `LF`

⋮

`F` `C` `,` `C` `9` `0` `␣` `P` `N` `␣` `␣` `␣` `␣` `0` `CR` `LF`

`F` `C` `,` `C` `9` `1` `␣` `P` `F` `␣` `␣` `␣` `␣` `0` `CR` `LF`
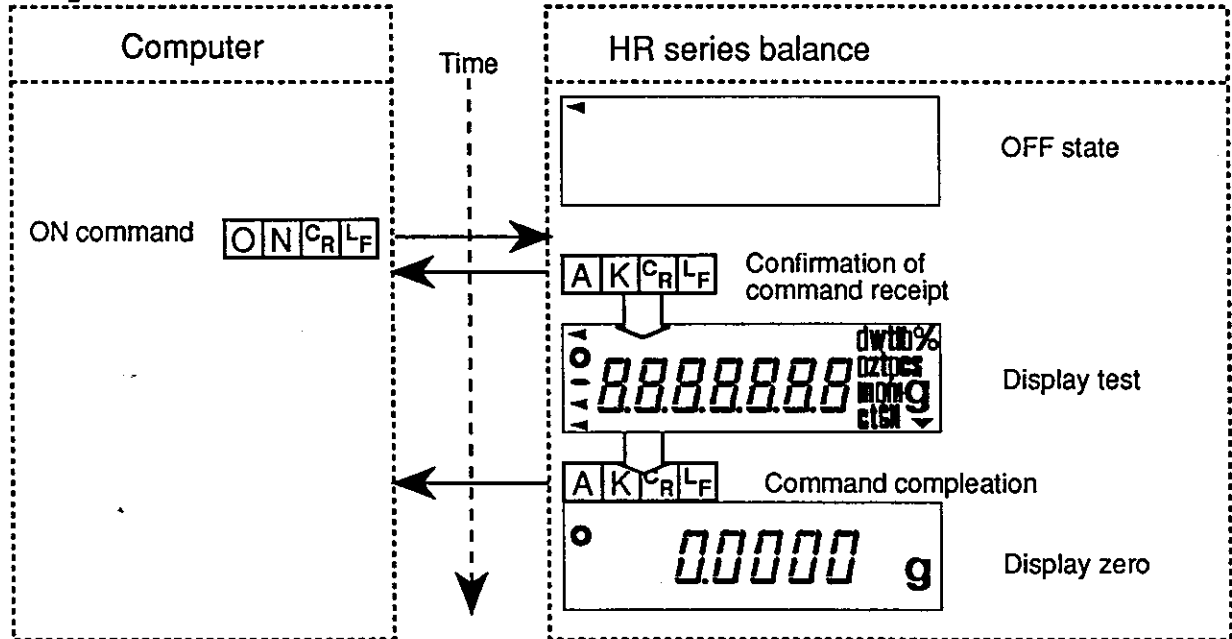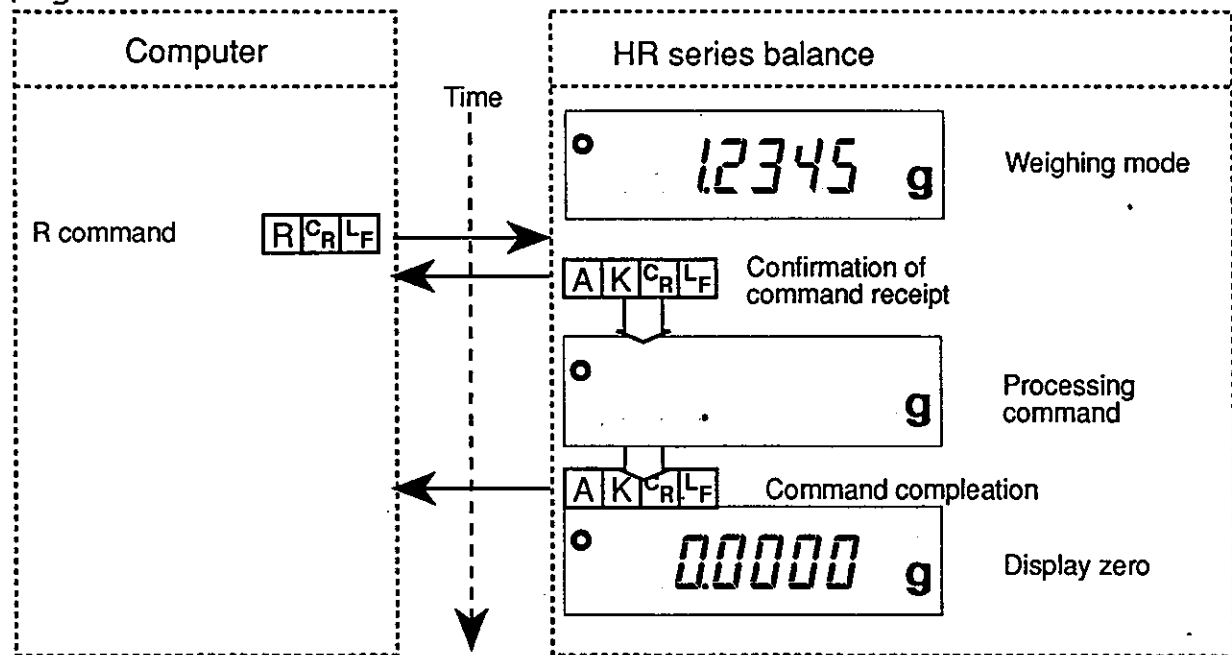
☒ Error Codes

Error code	Description of the error
E00	Communications error There is a protocol error in communications. Check the format, baud rate and parity.
E01	Undefined error The command received was not in the list of commands recognized by this balance.
E02	Balance not ready The command can not be received due to a timing error or the balance is busy. Commands that the balance can not respond to such as "Q", when the balance is in the counting mode.
E03	Time over error The balance did not receive all of the characters of a command within the time limit of one second.
E04	Excess characters error The command has more characters than is required or the range of the data is beyond what the balance will accept. Example; when the calibration weight entered is greater than the range of the balance.
E05	Terminator error A command is followed by other than CR, LF (carriage return and a line feed).
E06	Format error A command that should include numerical data has none or the data is in the wrong place in the command.
E07	Out of range error The data entered exceeds the range that the balance will accept.
E10	Internal operation error The balance is in an abnormal operating condition.
E11	Stability error The balance can not stabilize due to vibration or other environmental problem.
E20	Calibration error The calibration weight is to heavy. `CAL E`
E21	Calibration error The calibration weight is to light. `-CAL E`
E22	Zero out of range error The balance can not zero the display as the zero point offset exceeds the range `- - - - - - -`

⬇ Command Examples

[ON] Command

Computer	Time	HR series balance	

ON command [O][N][C_R][L_F] ⟶

◀ (blank display) **OFF state**

[A][K][C_R][L_F] ⟵ Confirmation of command receipt

`8.8.8.8.8.8.8.` dwt%/ozt/pcs/mom/g/ct/Sl **Display test**

[A][K][C_R][L_F] ⟵ Command compleation

`0.0000 g` **Display zero**

[R] Command (RE-ZERO)

Computer	Time	HR series balance	

R command [R][C_R][L_F] ⟶

`1.2345 g` **Weighing mode**

[A][K][C_R][L_F] ⟵ Confirmation of command receipt

`g` **Processing command**

[A][K][C_R][L_F] ⟵ Command compleation

`0.0000 g` **Display zero**

📝 Please note that there needs to be a delay time of one second between the balance acknowledgment <AK> and the next command transmission to the balance. Line 124 sets the delay time. To change the delay, set "100" to another value. Example: 124 FOR I = 1 TO 200: NEXT I.

An example using a BASIC language program

```
1...
123   LINE INPUT #1, AK$          Receive <AK>
124   FOR I = 1 TO 100: NEXT I    Delay time (the '100' sets the delay)
125   PRINT #1, "Q"               TX: 'Q' command
1...
```

⌈R⌋ Command (RE-ZERO)

Computer		HR series balance

Time

0.0000 g — Weighing mode

CAL command

[C][A][L][C_R][L_F] →

← [A][K][C_R][L_F]   Confirmation of command receipt

CAL 0 — Ready for zero calibration

R command

[R][C_R][L_F] →

CAL 0 — Zero calibration in progress

CAL 200 — Ready for span calibration

Place the calibration weight on the weighing pan

R command

[R][C_R][L_F] →

CAL 200 — Span calibration in progress

CAL End — Calibration completed

Remove the calibration weight from the weighing pan

g — Zeroing the display

0.0000 g — Weighing mode

⌈R⌋ Command (RE-ZERO)

⬇ Current Loop Interface (OP-05)

Option 05 is a 20mA current loop interface. As this option is similar to option 03, please refer to that section for characteristics and use.

This option is passive and requires an external current source to operate. It is a transmit only device and as such is best used with external displays or printers. Many such devices supply the current required by this interface.
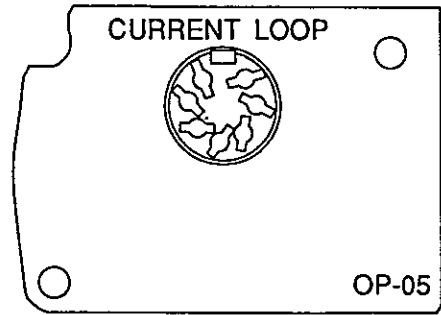
⬇ Installation

The installation of this option is the same as option 03, please refer to that section for the installation.

⬇ Circuit Diagram and Connector Drawing

Pin	Discription
1	No connection
2	No connection
3	Current loop (positive or negative)
4	No connection
5	Current loop (positive or negative)
6	No connection
7	No connection
Shell	Frame ground

7 Pin DIN Connector

Circuit Diagram