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780 pH Meter

781 pH/Ion Meter

Program version 5.780.0020 und 5.781.0020

Operation via RS232

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1 General rules

The 780 pH Meter and 781 pH/Ion Meter have an extensive remote control facility that allows full control of the instrument via the **RS232 interface**, i.e. the pH/Ion Meter can receive data from an external controller or send data to an external controller.

In most instances, the following description applies to both instruments, 780 and 781. Those sections describing concentration measurement parameters are valid for the 781 pH/Ion Meter only.

Carriage-return (C_R) and *Line-feed* (L_F) are used as terminators for the data transfer. The pH/Ion Meter sends $2 \times C_R$ and L_F as termination of a **data block**, to differentiate between a **data line** which has C_R and L_F as terminators. The controller terminates its commands with C_R and L_F . If more than one command per line is sent by the controller, “;” is used as a separator between the individual commands.

The commands are grouped logically and easy to understand. Thus, e.g., for the selection of the pH mode, the following must be sent

&Mode.Select "pH"

whereby it is sufficient to transmit the boldface characters only:

&M.S "pH"

The quantities of the pH/Ion Meter are collected in groups, e.g.:

&Config

This group is divided in subgroups containing configuration data, e.g.:

&Config.Aux

This subgroup in turn contains the individual inquiries for auxiliaries settings, e.g.:

&Config.Aux.Language

for setting the dialog language or

&Config.Aux.Display

for choosing the positive or negative display setting.

The data are hierarchically structured (tree form). The quantities that occur in this tree are called **objects** in the following. For example, the dialog language is an object.

If one is in the desired location in the tree, the value of the object can be queried:

&Config.Aux.Language \$Q (Q means Query)

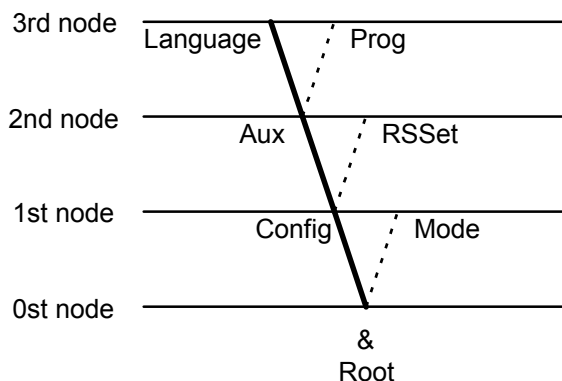
The query command \$Q triggers the output of the value from the instrument. All entries which start with \$ are thus called triggers.

Values of objects can not only be queried, they can also be modified. Values are always entered in quotes, for example:

&Config.Aux.Language "english"

1.1 Call up of objects

All objects of the 780/781 pH/Ion Meter are grouped hierarchically in a tree structure:



Rules	Example
The root of the tree is designated by &.	
The branches (levels) of a tree are marked with a dot (.) when calling up an object.	
When calling up an object, it is sufficient to give only as many letters as necessary to uniquely assign the object. If the call is not unequivocal, the first object in the series will be recognized.	Calling up the dialog language &Config.Aux.Language or &C.A.L
Upper- or lowercase letters may be used.	&C.A.L or &c.a.l
An object can be assigned a value. Values are signified at the beginning and end by quotes ("). They may contain up to 24 ASCII characters.	Entering the dialog language: &C.A.L"english"
Numerical values can contain up to 6 digits, a negative sign, and a decimal point. Numbers with more than 6 characters are not accepted; more than 4 decimal places are rounded off. For numbers <1, it is necessary to enter leading zeros.	correct entry of numbers: "0.1" incorrect entry of numbers "1,5" or "+3" or ".1"
The current object remains until a new object is called.	entry of another dialog language: "deutsch"
New objects can be addressed relative to the old object:	From the root to node 'Aux': &C.A
A preceding dot leads forwards to the next level in the tree.	Forward from node 'Aux' to 'Prog': .P
More than one preceding dot leads one level backwards in the tree. n node backwards require n+1 preceding dots.	Jump from node 'Prog' to node 'Aux' and select a new object 'Language' at this level: ..L
If you must jump back to the root, enter a preceding &.	Change from node 'Language' via the root to node 'Mode': &M

1.2 Triggers

Triggers initiate an action on the pH/Ion Meter. They are marked by the introductory symbol \$.

The following triggers are possible:

\$G	Go	Starts processes, for ex. starting the mode run or setting the RS232 interface parameters
\$S	Stop	Stops processes
\$Q	Query	Queries all information from the current node in the tree forward up to and including the values
\$Q.P	Path	Queries the path from the root of the tree up to the current node
\$D	Detail-Info	Queries the detailed status information
\$U	qUit	Aborts the data flow of the instrument, for example, after \$Q

The triggers \$G and \$S are linked to particular objects, see *section 1.1*.

All other triggers can be used at any time and at all locations on the object tree.

Examples:

Querying the value of the baud rate: **&Config.RSSet.Baud \$Q**

Querying all values of the node "RSSet": **&Config.RSSet \$Q**

Querying the path of the node "RSSet": **&Config.RSSet \$Q.P**

Start of pH calibration: **&Mode.pH.Cal \$G**

Querying the detailed status: **\$D**

1.3 Status messages

In order to have an efficient control by an external control device, it must also be possible to query information on the status of the pH/Ion Meter. The trigger \$D initiates output of the status.

Status messages consist of the global status (e.g. \$R) and the detailed status:

\$R.Mode.pH.DriftOk (measuring pH; drift is OK)

They also may contain error messages:

\$R.Mode.T.Drift; E135. (Mode T; drift is not OK; error message due to missing temperature sensor)

The **global status** informs on the activity of the process, while the **detailed status** conditions show the exact activity within the process.

The following global status conditions are possible:

\$R Ready: The pH/Ion Meter has executed the last command and is ready.

\$G Go: The pH/Ion Meter is executing the last command.

\$S Stop: A process has been aborted in an "unnatural manner". e.g. stopped or aborted because there was an error.

1.3.1 Detailed status conditions of the global \$R

The process has been concluded in the normal way or has not been actively started.

\$R.Mode.pH.Drift	: Measuring in pH mode, drift criterion not met.
.DriftOK	: Drift criterion met.
\$R.Mode.T.Drift	: Measuring in T mode, drift criterion not met.
.DriftOK	: Drift criterion met.
\$R.Mode.U.Drift	: Measuring in U mode, drift criterion not met.
.DriftOK	: Drift criterion met.

(781 only:)

\$R.Mode.Conc.Drift	: Direct measuring in Conc mode, drift criterion not met.
.DriftOK	: Drift criterion met.
\$R.Mode.Conc.Add.Inac	: Add sequence finished in Conc mode.

1.3.2 Detailed status conditions of the global \$G

\$G.Mode.pH	.Stirrer	: Waiting for stirring time during measurement.	
	.Cal	.Inac : At beginning of calibration.	
		.Stirrer : Calibrating, waiting for stirring times.	
		.Req.Temp1 : Requesting temperature.	
		.Meas.TempX : Temperature measurement in buffer X.	
		.Meas.BufX : Calibrating, measuring buffer X.	
		.Req.BufX : Requesting pH or buffer X.	
		.Data : Display of data, data output.	
	.ElTest	.Inac : At beginning of electrode test.	
		.Req.TempX : Requesting X th temperature.	
		.Meas.BufX : Performing X th measurement.	
		.Req.BufX : Waiting for X th buffer.	
		.Meas.IncX : Measuring X th increment.	
		.Data : Data output.	
\$G.Mode.T	.Stirrer	: Waiting for stirring time during measurement.	
\$G.Mode.U	.Stirrer	: Waiting for stirring time during measurement.	
(781 only:)			
\$G.Mode.Conc	.Add	.Inac : At beginning of standard addition.	
		.Stirrer : Calibrating, waiting for stirring times.	
		.Req.Temp0 : Requesting temperature.	
		.Meas.Temp0 : Measuring temperature.	
		.Meas.Inc0 : Measuring initial solution.	
		.Req.IncX : Requesting X th increment.	
		.Add.IncX : X th increment is being added.	
		.Data : Data output.	
	.Direct	.Stirrer : Waiting for stirring time during measurement.	
		.Cal	.Inac : At beginning of calibration.
			.Stirrer : Calibrating, waiting for stirring times.
			.Req.Temp1 : Requesting temperature during calibration.
			.Meas.Temp1 : Measuring temperature during calibration.
			.Meas.StdX : Measuring X th standard.
			.Req.StdX : Requesting X th standard.
			.Add.StdX : X th standard is being added.
			.Data : Data output.

1.3.3 Detailed status conditions of the global \$\$

The process has been stopped arbitrarily because of an error. The condition from which the process has been stopped is indicated. Example:

\$S.Mode.Conc	.Add	.Inac	: Stopped at very beginning of standard addition.
		.Stirrer	: Stopped when waiting for stirring times.
\$S.Mode.XX	.Drift(Ok)		: Measurement stopped via RS232.

1.4 Error messages

Error messages are added to the status messages and separated from them by a semicolon
";".

Error	Description	How to exit
E21	Check electrode, short circuit.	Rectify fault or &m \$S?.
E22	Check electrode, break.	Rectify fault or &m \$S?.
E26	Manual stop.	\$G, \$S or change mode.
E27	Stop volume reached.	\$G, \$S or change mode.
E28	Wrong object call up	Send correct path for object. Start path at root.
E29	Wrong value or no value allowed.	Send correct value or call up new object.
E30	Wrong trigger, this trigger is not allowed or carrying-out of action not possible.	Send correct trigger or call up new object.
E31	Command is not possible in active status. Repeat command in inactive status.	Send new command.

RS receive errors

E36	Parity.	<QUIT> and ensure settings of appropriate parameters at both devices are the same.
E37	Stop bit.	<QUIT> and ensure settings of appropriate parameters at both devices are the same.
E38	Overrun error. At least 1 character could not be read (wrong baud rate).	<QUIT>
E39	The internal receive buffer of the pH/Ion Meter is full.	<QUIT>

RS send errors

E42	CTS=OFF. No proper handshake for more than 1 s.	<QUIT>, Is the receiver switched on and ready to receive?
E43	The transmission of the pH/Ion Meter has been interrupted with XOFF for at least 3 s.	Send XON or <QUIT>.

Other

E120	Overrange of the primary measured value.	Rectify fault or change mode; in running process: \$G.
E121	Measured value memory full.	<QUIT> and delete measured values.
E135	Check temperature sensor in mode T .	Rectify fault or change mode.
E136	Same buffer / standard.	\$G, \$S and rectify fault.
E137	XXX Bytes are missing during method storage.	<QUIT> and delete methods.
E138	Buffer not defined.	\$G or \$S.
E139	Buffer allocation impossible.	\$G or \$S.
E140	Delta T > 2°C.	\$G or \$S.
E141	Cal. data out of limits.	\$G or \$S.

E142	Electrode test failed.				\$S or change mode.
E143	V add too small.				\$S or change mode.
E144	V add too large.				\$S or change mode.
E145	Check working conditions.				\$S or change mode.
E146	Evaluation error in Mode Conc.				\$S or change mode.
E147	Plot data overflow.				\$S or change mode.
E148	Buffer unsuitable for electrode test.				\$S or change mode.
E152	Limit error.				
E198	Validate instrument.				
E199	Service is due.				
E205	Calibration interval expired.				
E212	Transmission error (PC connection).	keyboard		Rectify fault.	
E213	Time Out PC-Keyboar.			Rectify fault.	

2 Remote control commands

The internal object tree can be divided into the following branches:

& Root	
└ .Hotkey	Keys with direct access
└ .Mode	Method parameters
└ .UserMeth	Administration of the internal user memory for methods
└ .Config	Instrument configuration
└ .Info	Current Data
└ .Assembly	Component data
└ .Setup	Setting the operating mode
└ .Diagnose	Diagnostics program

&HotKey

Object	Description	Input range
&HotKey	Keys with direct access	
└ : └ .User	User name	
└ └ .Name	Input of user name	up to 12 ASCII char.
└ └ .Delete	Delete user	\$G
└ └ └ .Name	Input of user name	up to 12 ASCII char.
└ └ .DelAll	Delete all users	\$G
└ └ .List	List of users	
└ └ └ .1	User 1	
└ └ └ └ .Name	Name of user	read only
└ └ └ .2	User 2	
└ └ └ └ .Name	Name of user	read only
└ └ up to 99		

&Mode

Object	Description	Input range
&Mode	Mode	\$G, \$S, \$H, \$C
: .Select	Mode selection	pH , U, T, Conc
pH	Measuring mode pH	
.Cal	Start or stop calibration	\$G, \$S
.ElTest	Start or stop electrode test	\$G, \$S
MeasPara	Measuring parameters	
.ElectrodeId	Electrode identification	12 ASCII char.
.Drift	Drift for meas.value acquisition [/min]	0.001... 0.050 ...9.999, OFF
.Temperature	Measuring temperature [°C]	-999.9... 25.0 ...999.9
.MethodId	Method name	8 ASCII char. (read only)
.Delta	Delta measurement	
.Status	Status of delta measurement	ON, OFF
.Reference	Reference for delta measurement	-19.999... 0.000 ...19.999
Stirrer		
.Status	Status of stirrer	ON, OFF , control
.Rate	Stirring rate	1... 5 ...15
.PreStirTime	Pause before stirring [s]	0 ...99999
.StirTime	Stirring time [s]	0 ...99999
.PostStirTime	Pause after stirring [s]	0 ...99999
CalPara	Calibration parameters	
.CalTemp	Calibration temperature [°C]	0.0... 25.0 ...99.0
.Drift	Drift f. meas. val. acquisition [mV/min]	0.1... 0.5 ...9.9
.Report	Automatic printout of calibration report	full, short, OFF
.CallInterval	Calibration interval [h]	1...999, OFF
Buffer		
.Number	Number of calibration buffers	1... 2 ...9
.Type	Type of calibration buffer set	Metrohm , NIST, DIN, Fisher, Fluka-BS, Mettler, Merck Tit., Merck Cer., Beckman, Radiometer, Baker, Hamilton, Precisa, special, own, mixed
Special	Special buffers	
.1		
.Val	pH value for buffer 1	-19.999... 7.000 ...19.999
.2		
.Val	pH value for buffer 2	-19.999... 4.000 ...19.999
.3		
.Val	pH value for buffer 3	-19.999... 7.000 ...19.999
up to 9		
Own	Definition of own buffers	
.1	Buffer 1	
.1	Temperature 1 = 0 °C	
.Val	pH value for buffer 1 at 0 °C	-19.999...19.999, OFF
up to 20	Temperature up to 95 °C in 5 °C steps	
up to 5	Up to 5 own buffers	
Mixed	Definition of mixed buffers	
.1	Buffer 1	
.Select	Selection of buffer 1	Met4 , Met7, Met9, NIST1, NIST4, NIST7, NIST9, NIST13, DIN1, DIN3, DIN4, DIN7, DIN9, DIN12, Fis2, Fis4, Fis7, Fis10, FBS4, FBS7, FBS9, MT2, MT4, MT7, MT9, MT11, Mer1, Mer2, Mer3, Mer4, Mer4.66, Mer5, Mer6, Mer6.88, Mer7, Mer8, Mer9, Mer9.22, Mer10, Mer11, Mer12, Mer13, MerC4.01, MerC7.00, MerC9.00, MerC10.0,

		Bec4, Bec7, Bec10, Rad1.09, Rad1.68, Rad4.01, Rad6.84, Rad7.00, Rad7.38, Rad9.18, Rad10.01, Bak4, Bak7, Bak9, Bak10, Ham4.01, Ham7.00, Ham9.21, Ham10.01, Pre4, Pre7, Pre9, Own1, Own2, Own3, Own4, Own5
.2	Buffer 1	
.Select	Selection of buffer 1	Met7 , same select. as for buffer 1
.3	Buffer 1	
.Select	Selection of buffer 1	Met9 , same select. as for buffer 1
.4	Buffer 1	
.Select	Selection of buffer 1	NIST1 , same select. as for buffer 1
.5	Buffer 1	
.Select	Selection of buffer 1	NIST4 , same select. as for buffer 1
.Limits	Limits for calibration data	
.SlopeMin	Lower limit for slope [%]	0.1... 95.00 ...999.9
.SlopeMax	Upper limit for slope [%]	0.1... 103.0 ...999.9
.OffsetMin	Lower limit for pH (0)	0.0... 6.400 ...99.999
.OffsetMax	Upper limit for pH (0)	0.0... 8.000 ...99.999
.UOffset	Acquisition of measured values	\$G
.Status	Status of UOffset	ON, OFF
.Value	UOffset [mV]	-2200.0... 0.0 ...2200.0
.LimitspH		
.Status	Status limits pH	ON, OFF
.UpperLim	Upper limit pH	-19.999... 14.000 ...19.999
.UHystereses	Upper hysteresis pH	-19.999... 0.020 ...19.999
.LowerLim	Lower limit pH	-19.999... 0.000 ...19.999
.LHystereses	Lower hysteresis pH	-19.999... 0.020 ...19.999
.LimitsT		
.Status	Status limits T	ON, OFF
.UpperLim	Upper limit T [°C]	-999.9... 100.0 ...999.9
.UHystereses	Upper hysteresis T [°C]	-999.9... 0.2 ...999.9
.LowerLim	Lower limit T [°C]	-999.9... 0.0 ...999.9
.LHystereses	Lower hysteresis T [°C]	-999.9... 0.2 ...999.9
.PlotPara	Parameters for live plot on a printer	
.LeftMargin	Left margin of pH scale	-19.9... 0.0 ...19.9
.RightMargin	Right margin of pH scale	-19.9... 14.0 ...19.9
.TLeftMarg	Left margin of temperature scale [°C]	-999... 20 ...999
.TRightMarg	Right margin of temperature scale [°C]	-999... 30 ...999
.Presel	Preselections	
.IReq	Request of identifications after start	id1, id1 & id2, OFF
.EITestPara	Electrode test parameters	
.Type	Type of pH electrode	standard , gel, non-aq., own
.EiExc	Excellent electrode	
.EiParam	Electrode parameters	
.StreamPot	Streaming potential [mV]	-999.9... 2.5 ...999.9
.Drift	Drift [mV/min]	0.1... 2.0 ...9.9
.MinSlope	Minimum slope [%]	0.1... 96.50 ...999.9
.MaxSlope	Maximum slope [%]	0.1... 101.0 ...999.9
.Response	Response time [s]	0... 45 ...9999
.EiGood	Good electrode	
.EiParam	Electrode parameters	
.StreamPot	Streaming potential [mV]	-999.9... 3.0 ...999.9
.Drift	Drift [mV/min]	0.1... 2.5 ...9.9
.MinSlope	Minimum slope [%]	0.1... 96.00 ...999.9
.MaxSlope	Maximum slope [%]	0.1... 102.0 ...999.9
.Response	Response time [s]	0... 50 ...9999
.EIPass	Excellent electrode	

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.LeftMargin .RightMargin .Presel .IReq	Left margin of temperature scale [°C] -999.9...0.0...999.9 Right margin of temp. scale [°C] -999.9...100.0...999.9 Preselections Request of identifications after start id1, id1 & id2, OFF
.Conc .MeasType .IonPara .Ion .Select .Own .Name .Charge .Unit .Select .Own	Measuring mode Conc (concentration) (781 only) Selection of measuring type direct, std.add, smpl.add Ion/Concentration \$G, \$S Selection of ion type Ag(+1), BF4(-1), Br(-1), Ca(+2), Cd(+2), Cl(-1), CN(-1), Cu(+2), F(-1), I(-1), K(+1), Na(+1), NH4(+1), NO2(-1), NO3(-1), Pb(+2), S(-2), SCN(-1), SO4(-2), own Name of ion 7 ASCII char. Charge of ion -9...-1, 1...9 Unit for concentration mol/L, %, ppm, g/L, mg/L, µg/L, mEq/L, own String for own unit 5 ASCII char.
.MeasPara .ElectrodeId .Drift .Temperature .MethodId .Delta .Status .Reference .Stirrer .Status .Rate .PreStirTime .StirTime .PostStirTime	Measuring parameters Electrode identification 12 ASCII char. Drift f. meas. val. acquisition [mV/min] 0.1...1.0...999.9, OFF Measuring temperature [°C] -999.9...25.0...999.9 Method name 8 ASCII char. (read only) Delta measurement Status of delta measurement ON, OFF Reference for delta measurement -1.00E+30...0.00...1.00E+30 Status of stirrer ON, OFF, control Stirring rate 1...5...15 Pause before stirring [s] 0...99999 Stirring time [s] 0...99999 Pause after stirring [s] 0...99999
.CalcPara .SmplSize .VTotal .Factor .SmplUnit	Calculation parameters Sample size [mL] or [g] 0.0001...1.0...99999.9, OFF Total starting volume [mL] 0.001...100.0...9999.9 Factor (result multiplier) -1.0E+30...1.0...1.0E+30 Unit for sample size mL, g
.Direct .Cal .CalPara .CalTemp .Drift .Report .CalInterval .NumberStd .Type .Manual .1 .Conc .2 .Conc - up to 19 .AutoDefinition .CMin	Parameters for direct measurement \$G, \$S Calibration parameters Calibration temperature [°C] 0.0...25.0...99.0 Drift for meas. val. acqu. [mV/min] 0.1...0.5...9.9 Automatic printout of calibration report short, full, OFF Calibration interval [h] 1...999, OFF Number of standards 1, 2...19 Type of standard handling manual, auto Manual calibration Concentration of standard 1 1.0E-30...0.01...1.0E+30 Concentration of standard 2 1.0E-30...0.01...1.0E+30 of own buffers Minimal concentration of standard 1.0E-30...0.1...1.0E+30

.CMax .VInit .NoExUnit .1 .Conc .ExV	- Maximal concentration of standard - Total initial volume (TISAB etc.) [mL] - Number of exchange units - Conc. of standard in exchange unit 1 - Volume of exchange unit 1 [mL] - Up to 5 exchange units	1.0E-30...1.0...1.0E+30 0.001...100.0...999.9 1...5 1.0E-30...100.0...1.0E+30 1, 5, 10, 20, 50
.LimitsConc		
.Status .UpperLim .UHystereses .LowerLim .LHystereses	- Status limits concentration - Upper limit conc - Upper hysteresis conc - Lower limit conc - Lower hysteresis conc	- ON, OFF -1.00E+30...1.00E+30 -1.00E+30...2.00...1.00E+30 -1.00E+30...0.00...1.00E+30 -1.00E+30...2.00...1.00E+30
.LimitsT		
.Status .UpperLim .UHystereses .LowerLim .LHystereses	- Status limits T - Upper limit T [°C] - Upper hysteresis T [°C] - Lower limit T [°C] - Lower hysteresis T [°C]	- ON, OFF -999.9...100.0...999.9 -999.9...0.2...999.9 -999.9...0.0...999.9 -999.9...0.2...999.9
.PlotPara	Parameters for live plot on a printer	
.LeftMargin .RightMargin .TLeftMarg .TRightMarg	- Left margin of Conc scale - Right margin of Conc scale - Left margin of temperature scale [°C] - Right margin of temperature scale [°C]	-1.0E+30...0.0...1.0E+30 -1.0E+30...1.0E+30 -999...20...999 -999...30...999
.StdAdd	Parameters for standard addition	\$G, \$S
.Type .Conc .Report .Add .DeltaU .DosRate .NumberAdd .Bur .Increment .1 .Val .StopV	- Type of standard addition - Concentration of standard solution - Selection of report type - Type of standard addition - For automatic additions [mV] - Dosing rate for addition - Number of additions - Volume of exchange unit [mL] - Size of increment - First increment - Volume [mL] - Up to 19 additions - Stop volume [mL]	add, sub 1.0E-30...1.0...1.0E+30 - short, full, line, OFF manual, auto dos, auto 1...10...999 - slow, medium, fast 1...19 1, 5, 10, 20, 50 1.0E-30...0.1...99.999 0.0...99.99...9999.99
.SmplAdd	Parameters for sample addition	\$G, \$S
.Type .Conc .Report .Add .DeltaU .DosRate .NumberAdd .Bur .Increment .1 .Val .StopV	- Type of sample addition - Concentration of standard solution - Selection of report type - Type of sample addition - For automatic additions [mV] - Dosing rate for addition - Number of additions - Volume of exchange unit [mL] - Size of increment - First increment - Volume [mL] - Up to 19 additions - Stop volume [mL]	add, sub 1.0E-30...1.0...1.0E+30 - short, full, line, OFF manual, auto dos, auto 1...10...999 - slow, medium, fast 1...19 1, 5, 10, 20, 50 1.0E-30...0.1...99.999 0.0...99.99...9999.99
.Presel	Preselections	
.IReq .SReq .ActivatePulse	- Request of identifications after start - Request of Sample size after start - Output of a pulse	- id1, id1 & id2, OFF - value, unit, all, OFF - ON, OFF

&UserMeth

Object	Description	Input range
&UserMeth	Method memory	
: .FreeMemory	Memory available	read only
- .Recall	Load method	\$G
- .Name	Method name	8 ASCII char.
- .Store	Save method	\$G
- .Name	Method name	8 ASCII char.
- .Delete	Delete method	\$G
- .Name	Method name	8 ASCII char.
- .DeleteAll	Delete all methods	\$G
- .List	List of methods	
- .1	Method 1	
- .Name	Method name	read only
- .Mode	Mode	read only
- .Bytes	Method size in bytes	read only
- .Checksum	Checksum of method	read only
- .n	for each method	

&Config

Object	Description	Input range
&Config	Instrument configuration	
: .Report	Report configuration	
- .Id1	Identification 1 for report header	16 ASCII char.
- .Id2	Identification 2 for report header	16 ASCII char.
- .IdReport	Ids for report header	ON, OFF
- .ReDevName	Print device name	ON, OFF
- .ReDateTime	Print date and time	ON, OFF
- .ReMethod	Print method name	ON, OFF
- .ReEId	Print electrode identification	ON, OFF
- .ReVisum	Print signature line	ON, OFF
- .ReLineFeed	Paper feed after report printing	0,1,2,3...999, form
- .PrintMeasVal	Print measured values	
- .PrintCrit	Criterion for printing measured values	immediate, time, drift, plot, OFF
- .DateTime	Print date & time with measured value	ON, OFF
- .PrintHead	Print header with measured value	once, always, OFF
- .CalRep	Print calibration report with meas. val.	ON, OFF
- .Time		
- .Interval	Time interval for printing meas. val. [s]	0.1...4.0...99999.0
- .StopTime	Stop time for printing [s]	1...999999, OFF
- .Plot		
- .Interval	Time interv. for printing meas. point [s]	0.1...4.0...99999.0
- .TimeScale	Time scale for plot [s/cm]	5, 10, 30, 60, 120, 180... 99960
- .TLabel	Clock time or seconds on time scale	abs, rel
- .StopTime	Stop time for printing [s]	1...999999, OFF
- .StoreMeasVal	Store measured values	
- .StoreCrit	Criterion for storing measured values	immediate, time, drift, OFF
- .Time		
- .StoreInterval	Time interv. for storing meas. val. [s]	0.1...4.0...99999.0
- .StoreStopTime	Stop time for storing [s]	1...999999, OFF

.Aux	Miscellaneous	
.RunNo	Current run number	0...999, OFF
.LastDigit	Last digit of display	ON, OFF
.Language	Dialog language	english, deutsch, français, español
.Display	Display type	positiv, negativ
.ScreenSave	Switch LCD display off after [min]	1,2...999, OFF
.Set	Sets date and time	\$G
.Date	Current date	YYYY-MM-DD
.Time	Current time	hh:mm:ss
.TimeZone	Text for time zone	12 ASCII char.
.TSensor	Type of temperature sensor	PT1000, NTC
.NTCFactor	Factors for NTC sensor	
.NTC25	R(25°C) value	10000...30000...100000
.TSlope	Slope, 'B value'	1000...4100...9999
.TempUnit	Temperature unit °C or °F	C, F
.DevName	Device label	12 ASCII char.
.Beeper	Number of acoustic signals	1,2,3, OFF
.Prog	Program version number	read only
.Monitor	Monitoring functions	
.Valid	Validation monitoring	
.VState	Status of validation monitoring	ON, OFF
.VInterval	Time interval for validation [d]	1...365...9999
.VCounter	Time counter [d]	0...9999
.ClearCount	Clears the counter above	\$G
.Service	Monitoring of Metrohm service	\$G
.SState	Status of service monitoring	ON, OFF
.SDate	Date of next service	YYYY-MM-DD
.SysTestReport	Printing of system test report	ON, OFF
.Periph	Selection of peripheral units	
.CharSet	Selection of character set	IBM, Epson, Seiko, Citizen, HP
.Dosimat	Selection of Dosimat type	665, 725, 765, 776
.SelStirrer	Selection of stirrer type	7xx, 8xx
.PcKeyb	Type of keyboard	US, deutsch, français, español, schweiz.
.Barcode	Input of barcode reader	input, id1, id2
.RSset	Settings RS232	
.Baud	Baud rate	38400, 19200, 9600, 4800, 2400, 1200, 600, 300
.DataBit	Number of data bits	7, 8
.StopBit	Number of stop bits	1, 2
.Parity	Parity	none, odd, even
.Handsh	Handshake	HWs, SWchar, SWline, none

&Info

Object	Description	Input range
&Info	Current data	
: .Report	Transmission of formatted reports	\$G
.Select	Selection of report type	user memory, calib short, calib full, config, param, el.test, result short, result full, mv memory, all
.pHCalData	pH calibration data	
.ElectrodeId	Identification of calibrated electrode	read only
.MethodId	Name of calibration method	read only
.Slope	Slope [%]	0.1...100.0...999.9
.pH0	Electrode zero point	-99.999...7.0...99.999
.CalTemp	Calibration temperature	read only

.TempType	Temperature sensor type	read only
.DateTime	Date and time of calibration	read only
.CalInterval	Calibration interval	read only
.Variance	Statistics parameter	read only
.BufferType	Type of calibration buffer set	read only
.NoBuffer	Number of calibration buffers used	read only
.CalTab	Calibration buffer table	
.Select	Select and edit buffer table	original , delete n, reset cal
.DeleteN	Delete measurement with buffer n	1...9
.MeasData		
.1	Buffer 1	
.pH	Nominal pH value	read only
.U	Measured potential	read only
.dpH	Calculated deviation	read only
up to 9		
.EITestData	Electrode test data	
.ElectrodeId	Identification of tested electrode	read only
.MethodId	Name of test method	read only
.EIType	Type of pH electrode	read only
.Temp	Temperature	read only
.TempType	Type of temperature sensor	read only
.DateTime	Date and time of electrode test	read only
.Message	Result of electrode test	read only
.ConcCalData	Cal. data for direct concentration measurement (781 only)	
.IonType	Ion type	read only
.ElectrodeId	Identification of calibrated electrode	read only
.MethodId	Name of calibration method	read only
.Slope	Slope	-999.9... -59.2 ...999.9
.E0	Electrode zero point [mV]	-999.9... 0.0 ...999.9
.CBlank	Blanc value	0.0 ...1.0E+30
.CalTemp	Calibration temperature	read only
.TempType	Type of temperature sensor	read only
.DateTime	Date and time of calibration	read only
.CalInterval	Calibration interval	read only
.Variance	Statistics parameter	read only
.NoStd	Number of calibration standards used	read only
.CalTab	Calibration standard table	
.Select	Select and edit standard table	original , delete n, reset cal
.DeleteN	Delete measurement with standard n	1...19
.MeasData		
.1	Standard 1	
.conc	Nominal concentration	read only
.U	Measured potential	read only
.dconc	Calculated deviation	read only
up to 19		
.AddData	Data of standard addition or sample addition for conc. measurement (781 only)	
.IonType	Ion type	read only
.MeasType	Type of concentration measurement	read only
.ElectrodeId	Identification of electrode	read only
.Variance	Statistics parameter	read only
.Slope	Slope	-999.9... 59.2 ...999.9
.E0	Electrode zero point [mV]	-999.9... 0.0 ...999.9
.Conc	Measured concentration	read only
.DateTime	Date and time of measurement	read only
.MethodId	Method name	read only
.Temp	Measuring temperature	read only
.TempType	Type of temperature sensor	read only
.VTotal	Total start volume	read only

└─ .StdConc	Concentration of standard	read only
└─ .Analyte	Potential measured in initial solution	read only
└─ .Factor	Factor (result multiplier)	read only
└─ .SmplSize	Sample size	read only
└─ .MeasData		
└─ .1	Standard or sample volume 1	
└─ .AddV	Volume added	read only
└─ .U	Measured potential	read only
up to 19		
└─ ActualInfo	Current data	
└─ .Inputs	I/O inputs	
└─ .Status	Line status	read only
└─ .Change	Change of line status	read only
└─ .Clear	Clear change	\$G
└─ .Outputs	I/O outputs	
└─ .Status	Line status	read only
└─ .Change	Change of line status	read only
└─ .Clear	Clear change	\$G
└─ .MeasValue	Measured value	
└─ .Primary	Primary measured value	read only
└─ .Secondary	Secondary measured value	read only
└─ .Display	Display	
└─ .L1	Text line 1	up to 32 ASCII char.
up to line 8		
└─ .DelAll	Delete display	\$G
└─ .Assembly	Assembly	
└─ .CycleTime	Meas. value display refresh rate [s]	read only

&Assembly

Object	Description	Input range
&Assembly	Assembly control	
└─ .Meas	Measurement	
└─ .Status	Switch measurement on/OFF	ON, OFF
└─ .Outputs	I/O outputs	
└─ .SmplX	Sample changer assignment	ON, OFF
└─ .AutoEOD	Automatic output of EOD signal	ON, OFF
└─ .SetLines	Set I/O lines	\$G
└─ .L0	Signal on L0	active, inactive, pulse, OFF
up to line 13		
└─ .ResetLines	Reset I/O lines	\$G
└─ .Stirrer	Stirrer	
└─ .Status	Switch measurement on/OFF	ON, OFF

&Setup

Object	Description	Input range
&Setup	Settings for the operating mode	
: .Keycode	Send key code	ON, OFF
.Trace	Message on changed values	ON, OFF
.Lock	Lock key functions	
.Keyboard	Lock all keyboard keys	ON, OFF
.Config	Lock <CONFIG> key	ON, OFF
.Parameter	Lock <PARAM> key	ON, OFF
.Cal	Lock <CAL> key	ON, OFF
.UserMeth	Lock user method functions	
.Recall	Lock recall function	ON, OFF
.Store	Lock store function	ON, OFF
.Delete	Lock delete function	ON, OFF
.CalData	Lock <CAL DATA> key	ON, OFF
.Mode	Lock <MODE> key	ON, OFF
.ElTest	Lock <EL.TEST> key	ON, OFF
.AutoInfo	Automatic message for status changes	
.Message	Definition of message	
.DateTime	Date and time of occurrence	ON, OFF
.P	When mains is switched on	ON, OFF
.G	When method id started	ON, OFF
.R	When "ready"	ON, OFF
.S	When stopped	ON, OFF
.E	Error	ON, OFF
.Re	Request after start	ON, OFF
.D	When drift condition OK	ON, OFF
.I	Change upon inputs	ON, OFF
.O	Change upon outputs	ON, OFF
.InputAssign	Assignment of I/O line inputs	
.pH	Mode pH	0...1...15
.T	Mode T	0...2...15
.U	Mode U	0...3...15
.pHcal	Start pH calibration	0...5...15
.ElTest	Start electrode test	0...6...15
.Conc	Mode Conc	0...8...15
.ConcCal	Start concentration calibration	0...9...15
.Enter	<ENTER> key	0...15
.Graphics	Changing graphics output	
.Grid	Grid on curve	ON, OFF
.Frame	Frame around curve	ON, OFF
.Recorder	Length of axis	
.Right	Length of measured value axis	0.4...0.8...1.0
.Feed	Length of paper drive axis	0.4...1.0
.InstrNo	Device identification	\$G
.Value	Input of device identification	8 ASCII char.

&Diagnose

Object	Description	Input range
&Diagnose	Diagnose	
- .Init	Set default values	\$G
- .Select	Selection of value	ACTMODE , MODES, SETUP, CONFIG, ASSEMBLY, ALL
- .ADCTest	Start ADC test	\$G, \$S
- .LcdTest	Start LCD test	\$G, \$S
- .IoTest	Start IO test	\$G
- .SelloTest	Selection of IO test	MSB , REMOTE
- .BarcodeTest	Start barcode test	\$G
- .SelBarcode	Selection of barcode test	TESTPLUG , KEYBOARD
- .RsTest	RS232 interface test	\$G, \$S
- .KeyTest	Key test	\$G
- .SimulateKey	Simulates pressing of key	0...23
- .Adjust	Setting of adjustment data	
- .Report	Report of Adjustment	\$G
- .FlashLoad	Start flash load	\$G, \$S
- .PowerOn	Simulation of power on	\$G

3 RS232 interface properties

3.1 Data transfer protocol

The pH/Ion Meter is configured as DTE (Data Terminal Equipment).

The RS232 interface has the following technical specifications:

- Data interface according to the RS232C standard, adjustable transfer parameters, see *page 16*.
- Max. line length: 80 characters (incl. CR LF)
- Control characters: C_R (ASCII DEC 13)
L_F (ASCII DEC 10)
XON (ASCII DEC 17)
XOFF (ASCII DEC 19)
- Cable length: max. approx. 15 m

Start	7 or 8 Data Bit	Parity Bit	1 or 2 Stop Bit
-------	-----------------	------------	-----------------

Only a shielded data cable (for example, Metrohm 6.2125.110 DB-9/DB-25 or 6.2134.100 DB-9/DB-9) may be used to couple the pH/Ion Meter with foreign devices. The cable shield must be properly grounded on both instruments (pay attention to current loops; always ground in a star-head formation). Only connectors with sufficient shielding may be used

3.2 Handshake

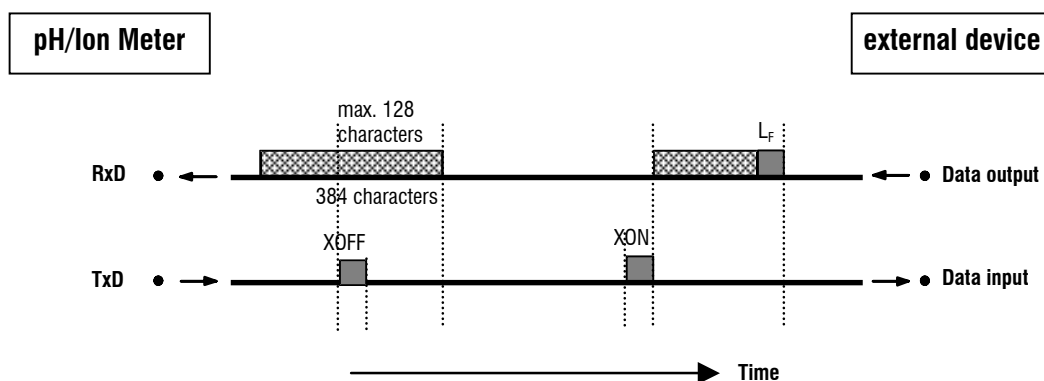
Software-Handshake, SWchar

Handshake inputs on the pH/Ion Meter (CTS) are not checked.

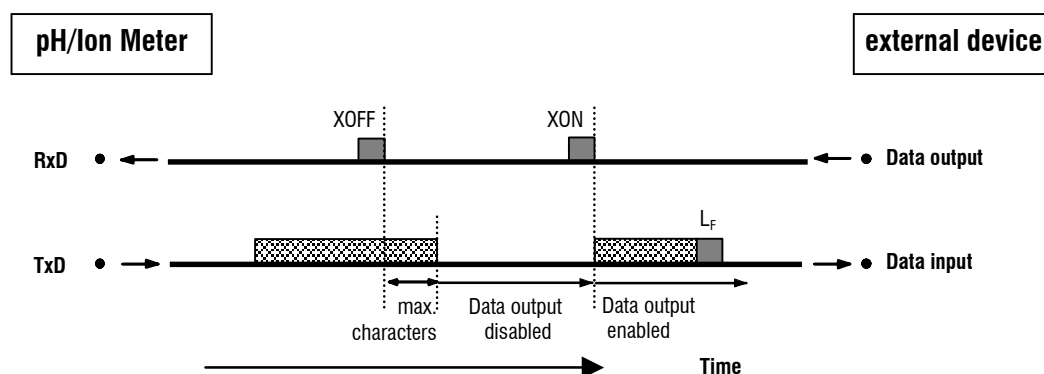
Handshake outputs (DTR, RTS) are set by the pH/Ion Meter.

The pH/Ion Meter sends XOFF when its input buffer contains 384 characters. After this it can receive 128 extra characters (including L_F).

pH/Ion Meter as receiver :



pH/Ion Meter as sender :



max. characters: 2 characters at 300...9600 baud
16 characters at ≥ 19200 baud

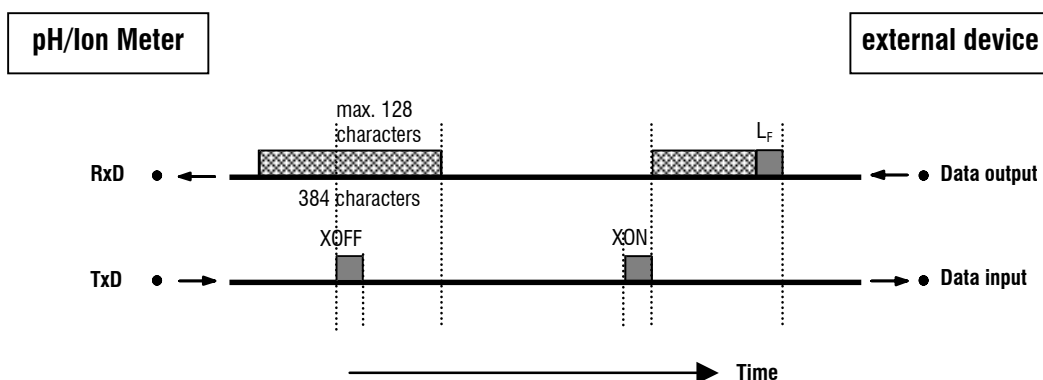
Software-Handshake, SWline

Handshake input ports on the pH/Ion Meter (CTS) are not checked.

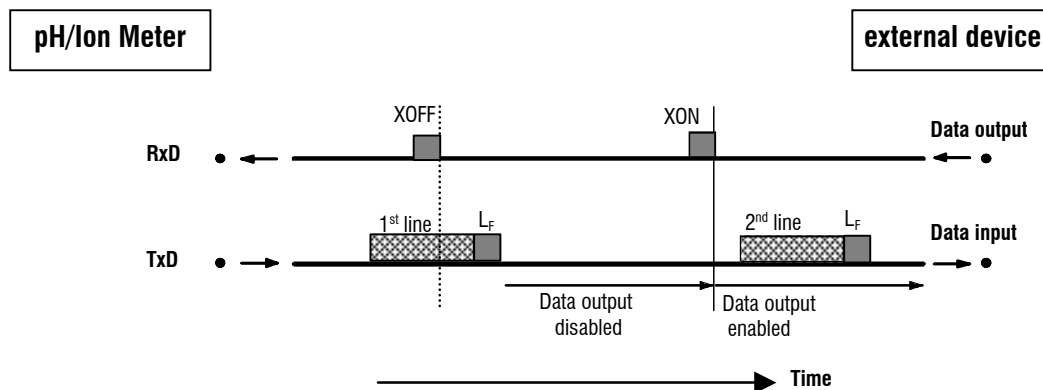
Handshake output ports (DTR, RTS) are set by the pH/Ion Meter.

The pH/Ion Meter has an input buffer which can accept up to 512 characters.

pH/Ion Meter as Receiver :



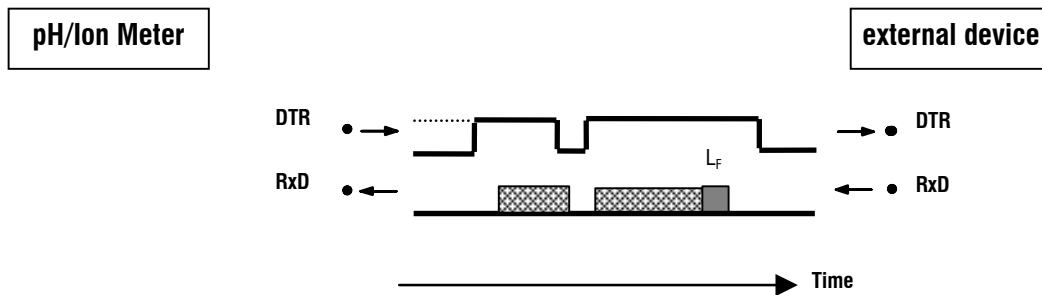
pH/Ion Meter as Sender:



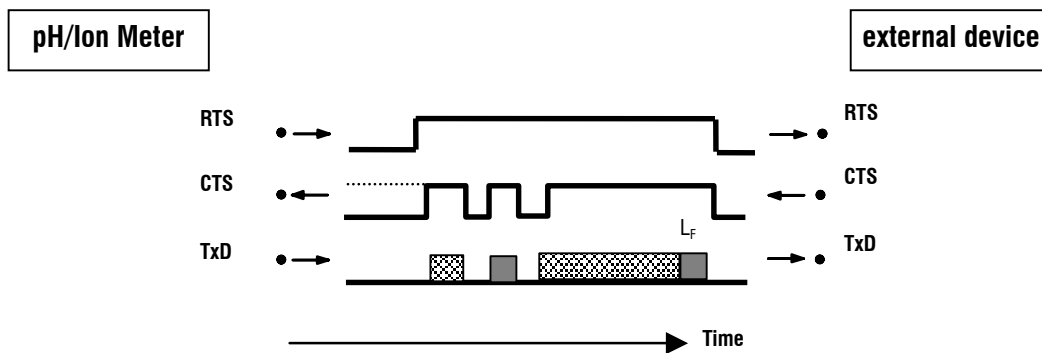
pH/Ion Meter transmission can be stopped by external instruments with XOFF. After XOFF is received the pH/Ion Meter completes sending the line already started. If data output is disabled for more than 6 s by XOFF, E43 appears in the display.

Hardware-Handshake, HWs

pH/Ion Meter as Receiver :



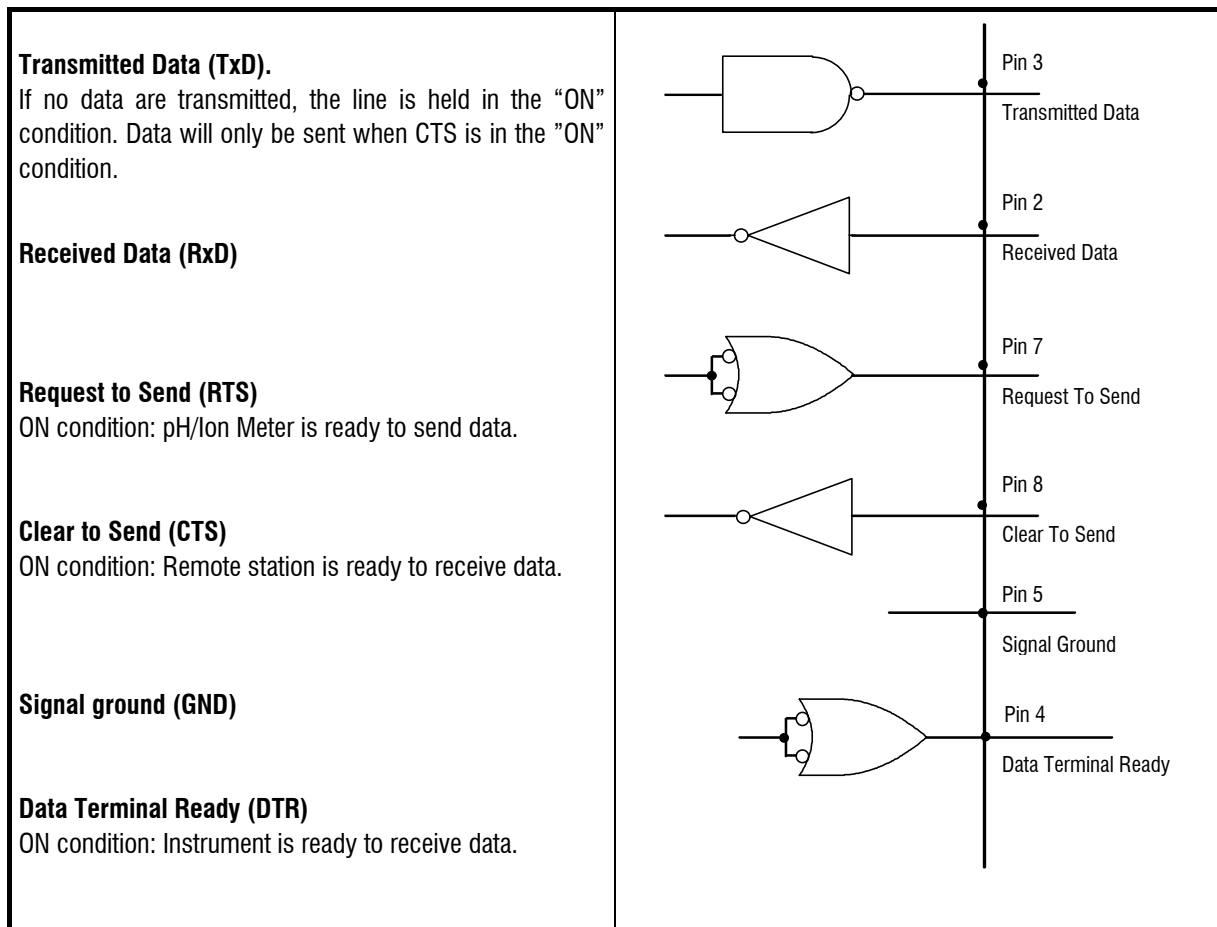
pH/Ion Meter as Sender:



The data flow can be interrupted by deactivating the CTS line.

3.3 Pin assignment

RS232C Interface



Protective earthing

Direct connection from cable plug to the protective ground of the instrument.

Polarity allocation of the signals

- Data lines (TxD, RxD)
 - voltage negative (< -3 V): signal state "ON"
 - voltage positive ($> +3$ V): signal state "ZERO"
- control or message lines (CTS, RTS, DTR)
 - voltage negative (< -3 V): OFF state
 - voltage positive ($> +3$ V): ON state

In the transitional range from $+3$ V to -3 V the signal state is undefined.

Driver according to EIA RS232C specification.

Receiver according to EIA RS232C specification.

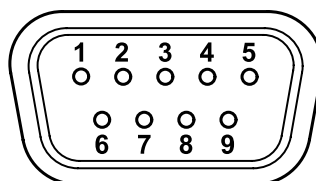
Contact arrangement at plug (female) for RS232C socket (male)

Fig. 1: View of soldered side of plug

No liability whatsoever will be accepted for damage or injury caused by improper interconnection of instruments.

4 Troubleshooting

Problem	Questions for remedical action
No characters can be received on a connected printer.	• Are the instruments switched on and cables plugged in correctly? • Is the printer set to "on-line"? • Are baud rate, data bit and parity the same on both instruments? • Is the handshake set properly? If everything seems to be ok, try to print a report with the key sequence <PRINT> <SMPL DATA> <ENTER>. If this report is printed out correctly, check if reports are defined in key <DEF>.
No data transmission and the display of the pH/Ion Meter shows an error message.	• error 42: Transmission error. Is the printer set to "on-line"? Is the connection cable properly wired? • error 43: Data output of the pH/Ion Meter disabled for longer than 6 s by XOFF. • error 36-39: Receive error. Are the RS settings the same on both devices?
The received characters are garbled.	• Are the RS settings the same on both devices? • Has the correct printer been selected? • Data transfer has been interrupted on the hardware side during the printout of a curve. Re-establish connections and switch printer off/on.
Wrong line spacing.	The printer does not emulate completely the preset mode. Usually these problems arise with the IBM mode. Set the printer to a different mode (e.g. Epson).
Printout of curve is not ok. Other reports are printed ok.	Handshake is necessary for the printout of curves. • Is your cable correctly wired? (The DTR of the printer has to be connected to the CTS of the pH/Ion Meter.) • Set "HWs" for the handshake of the pH/Ion Meter. Configure the printer such that its DTR is set (possibly with DIP switches).