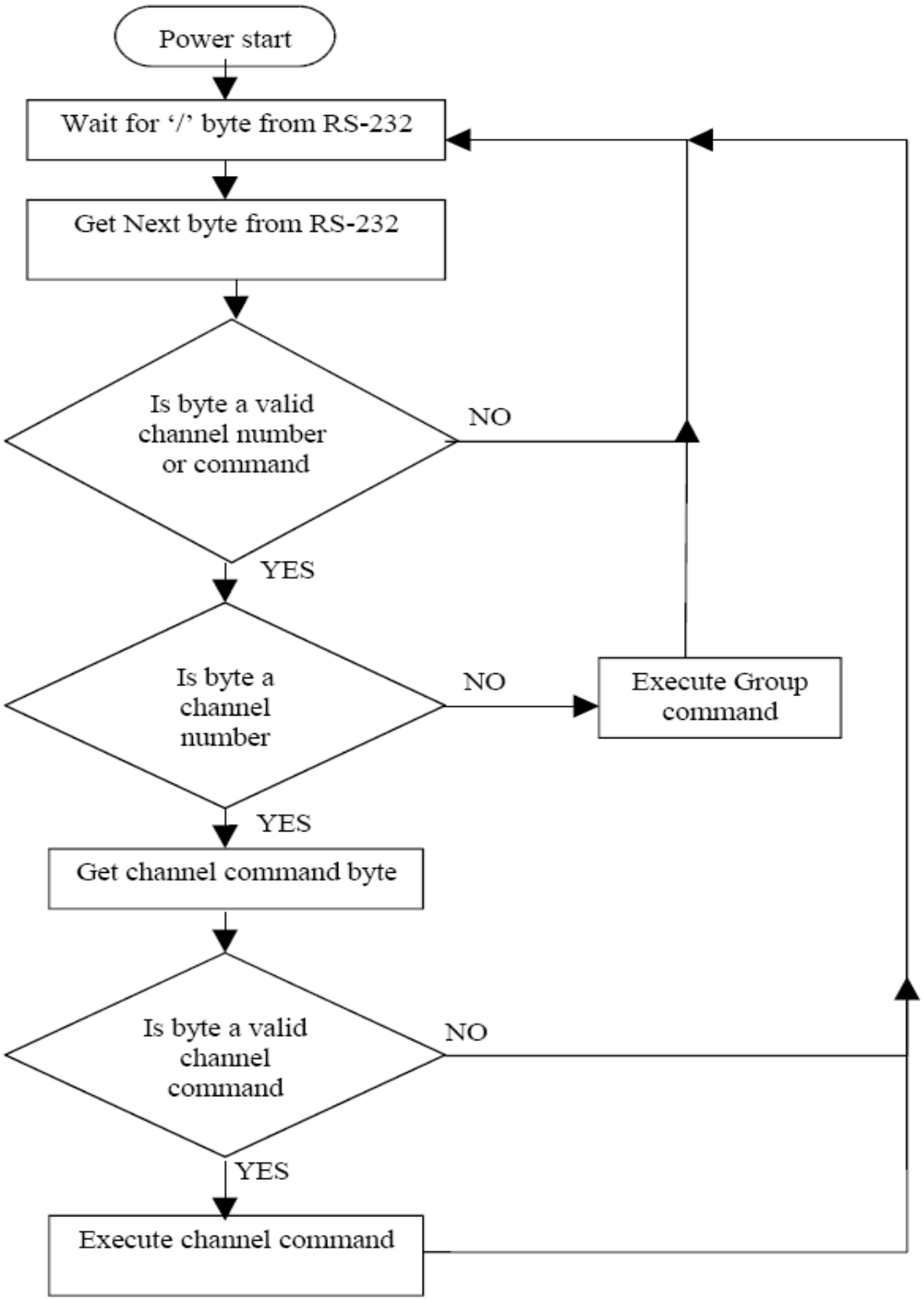
Philtec DMS RS232 Command Set

RS-232 communication principles



Quick Start Examples:
Start your terminal program with a setting of 19.2Kbps, 8 start bits, no parity, and 1 stop bit. After the sensor is powered up make sure you have selected the correct com port number in your terminal program and the serial cable is connected. Hyperterminal (included with all versions of windows) was used for these examples but any terminal program will work.
Data that you type in the terminal program is labeled as PC→Sensor:
Data that is sent from the sensor back to the terminal program is labeled as Sensor→PC:

To read the current distance:

PC→Sensor: /1
Sensor→PC: 1:
Note: Channel 1 is now ready for a command. Channel command 'A' will send the current distance.
PC→Sensor: A
Sensor→PC distance:mI:123.4:

Example: to change the sensor average to 16:

PC→Sensor /f
Sensor→PC average=16:

Example: to change the sensor UOM to metric the following characters need to be sent to the sensor:

PC→Sensor /i
Sensor→PC UOM=metric:

Serial Port Setup
The system communicates through a 9 pin connector using the RS-232 protocol at 8 data bits, no parity, 1 stop bit. Flow control should be set to none or hardware. Default speed is 19.2 Kbps. Windows hyperterminal or any other terminal program can be used for testing.

Group Commands -- received by all channels connected to serial port
Access from root menu with a forward slash '/'.

Dec	ASCII	
47	/	command/channel select prefix
97	a	rs232 low speed (9.6Kbps)
98	b	rs232 high speed (19.2Kbps)
99	c	rs232 custom speed (use channel command 'c' to setup custom speed)
100	d	Average of 4096 readings for output
101	e	Average of 256 readings for output
102	f	Average of 16 readings for output
103	g	No averaging (highest speed)
104	h	uom=mINCH
105	i	uom=micron
106	j	Average of 128 readings for output
107	k	Average of 64 readings for output
108	l	Average of 32 readings for output
109	m	rs232 speed 57.6Kbps
110	n	rs232 speed 115.2Kbps
111	o	uom=mm

112	p	uom=nm
115	s	rs232 speed 38.4Kbps
118	v	Average of 4 readings per output
65	A	near side pipeline (D model)
66	B	far side pipeline (D model)
67	C	reflectivity pipeline (0-100%)
68	D	ADC pipeline (D model) (raw 20bit value(s) from AD converters)
72	H	RC distance pipeline (RC model)
73	I	distance and reflectivity pipeline (RC model)
49-57	1-8	channel select

Channel Commands--if channel was selected from group command menu

Dec	ASCII	
65	A	label + D model near side distance or RC model distance
66	B	label + far side distance
67	C	label + reflectance percentage
68	D	label + ratio value
69	E	label + temperature (temperature of optical detector(s))
70	F	label + distance (16bit lookup table)
71	G	label + distance + reflectivity (RC model)
72	H	label + channel 1 distance + channel 2 distance (RC model or D near side)
73	I	RC model =label + ch.1 dist. + ch.1 reflect + ch.2 dist. + ch.2 reflect D model =label + channel 1 far side distance + channel 2 far side distance
74	J	label + RC value + SNR value (factory diagnostic-not for standard use)
76	L	single channel burst (512 readings @ 5208 per second)
77	M	dual channel burst (256 readings @ 5208 per second)
78	N	single channel distance streaming mode (RC model)
79	O	single channel distance + reflectivity streaming mode (RC model)
80	P	dual channel distance streaming mode (RC model)
81	Q	dual channel distance + reflectivity streaming mode (RC model)
82	R	single channel ratio streaming mode (raw nonlinear output -factory diagnostic)
83	S	single channel near side streaming mode (D model)
84	T	single channel far side streaming mode (D model)
85	U	dual channel near side streaming mode (D model)
86	V	dual channel far side streaming mode (D model)
87	W	label + minimum + maximum distance
88	X	single channel far side streaming mode (not for standard use -factory diagnostic)
97	a	trigger control on and off (menu)
99	c	rs232 custom speed setup (menu)
100	d	set scaling factor (RC model) (menu)
101	e	scaling on/off toggle (RC model)
105	i	edit calibration description (menu)
106	j	list calibration descriptions
107	k	group command configuration response (toggle off/on --default is off)
108	l	lock / unlock keypad and display
109	m	optical gain setting (menu)

110	n	amplifier temperature (menu)
111	o	load cal table from RS-232 data (menu)
112	p	set optical peak (D model) (menu)
113	q	new cal (menu)
114	r	force RS-232 bps to 19.2Kbps on power up (menu)
115	s	print cal table (menu)
116	t	load cal (menu)
117	u	copy cal (menu)
118	v	print channel settings (menu)
119	w	change sensor address (menu)
120	x	binary mode off/on toggle
121	y	timestamp mode off/on toggle (timestamp only applies to steaming mode)
122	z	change sensor signature string

Label Format (used in channel command responses)

A (D model)	near side:UOM:
A (RC model)	distance:UOM:
B	far side:UOM:
C	reflect:percent:
D	adc value:19bit:
E	temperature:C:
F	distance:UOM:
G	distance:UOM:reflectance:percent:
H	distance 1:UOM:distance 2:UOM:
I	distance 1:UOM:reflectance 1:percent:distance 2:UOM:reflectance 2:percent:
J	RCval:slope:reflect:

Pipeline Format

A	ch1 distance:ch2 distance:
B	ch1 distance:ch2 distance:
C	ch1 reflect%:ch2 reflect%:
D	ch1 ADC:ch2 ADC
H	ch1 distance:ch2 distance:
I	ch1 distance:ch1 reflect%:ch2 distance:ch2 reflect%:

Burst Format

L + M read buffer:ch#:max pt #:
pt#:distance:reflect%: (repeats for each pt# = 0 to max pt #)

Stream Data Format

ASCII mode

N	RC distance
O	distance:reflect%:
P	ch1 distance:ch2 distance:
Q	ch1 distance:ch1 reflect%:ch2 distance:ch2 reflect%:
R	RC function value --factory diagnotic
S	D model near side distance
T	D model far side distance

Binary mode

N	RC distance as 16bit (2 bytes)
O	RC distance as 16bit (2 bytes) then 8bit (1byte) reflection value
P	channel 1 RC distance (16bit) then channel 2 RC distance (16bit)
Q	channel 1 RC distance + reflection (16 + 8bit) then channel 2 distance + reflection (16 + 8bit)
R	RC function value --factory diagnostic
S	D model near side distance as 16bit (2 bytes)
T	D model far side distance as 16bit (2 bytes)

Command Examples:

When the sensor is powered up it will start at the root menu and waiting for a command. A sensor command sequence begins with a forward slash character (ASCII '/' code 47). After sending the '/' the channel selection and group commands are available. (see 'group commands' section)

Example: to change the sensor average to 16:

PC→Sensor /f
Sensor→PC average=16:

Example: to change the sensor UOM to metric the following characters need to be sent to the sensor:

PC→Sensor /i
Sensor→PC UOM=metric:

To send a channel command (see 'channel commands' section) send the channel number after the '/'.

Example: to read current distance from channel 1:

PC→Sensor: /1
Sensor→PC: 1:
Note: Channel 1 is now ready for a command. Channel command 'A' will send the current distance.
PC→Sensor: A
Sensor→PC distance:mI:123.4:

The sensor will now return to the root menu and wait for the next command sequence.

Notes: ascii ':' (decimal 58) delimits each part of a command response from the sensor.
pipeline commands are used for high speed operation when multiple sensors share the same com port. If only one sensor is connected to a serial port or the data is low speed the pipeline commands are not needed.

Single channel example:

PC→Sensor: /1
Sensor→PC: 1:
Note: channel one has responded and is now ready for a command.
PC→Sensor: A
Sensor→PC: distance:micron:123.45:
Note: Sensor now returns to 'off' state

Pipeline:

Notes: Channels are grouped in pairs (12,34,56,78) on multi-channel units.
Sending a value greater than 8 (decimal 57) or less than 1 will terminate pipeline mode.

Pipeline commands are used to increase sensor speed if multiple sensors are placed on a single serial port.

PC→Sensor: /A
Note: All channels on serial port will compute distance data.
PC→Sensor: 1
Note: Request data from channels 1 and 2.
Sensor→PC: 1.234:2.345:
Note: Distance data from channels 1 and 2 is sent to PC.
PC→Sensor: 3
Note: Request data from channels 3 and 4.
Sensor→PC: 3.456:4.567:
Note: Distance data from channels 3 and 4 is sent to PC.
PC→Sensor: 0
Note: Channel was outside of allowed range (value >8 and <1). Pipeline command will now terminate and sensor will return of 'off' state.

Stream:

Notes: Used for high speed. Sensor will continue to send data until interrupted by the PC. Any data sent to the sensor will stop the data stream. Stream commands are not needed for low speed data.

Binary codes are scaled to maximum value.
Example(16bit): if max distance = 250mINCH and current distance = 200mINCH
16bit value = 11001100 11001100 (80% of 11111111 11111111)
Example(8bit): if reflectivity = 70% 8bit value = 10110010 (70% of 11111111)

Notes: 2 bytes of decimal 58 (::) will be sent at start of stream and then after every 255 readings
Example: for data stream command 'N' (RC distance) in binary mode starting from main menu
PC→Sensor: /1
Sensor→PC: 1:
PC→Sensor: N
See Note 2
Sensor→PC: :: (2 bytes decimal 58 will be first 2 bytes of data stream)
Sensor→PC: 510 bytes (255 distance readings (each reading = 2bytes for 510bytes total)
Sensor→PC: :: (2 bytes decimal 58)
Sensor→PC: 510 bytes (255 distance readings (each reading = 2bytes for 510bytes total)
Note: cycle will repeat until a byte is sent to the sensor (any value will terminate stream)
Note 2:If the requested calibration is not already loaded in the high speed table a delay of approximately 30 seconds will occur at this point. If the correct calibration table has already been loaded there will be no delay. You can use the 'print channel settings' command to see which table is currently loaded. ('flash cal' and 'flash side' values)

5 KHz sampling rate (maximum speed):

The highest continuous sampling rate for the sensor is approximately 5 KHz. To reach this speed the following setup is needed:

-Set com port speed to 115.2 Kbps
-Set averaging to 1 (group command 'g')

-Select binary mode (channel command ‘x’ will toggle setting)
-Turn off timestamp (channel command ‘y’ will toggle setting)

Once the sensor is configured you can start the data stream with the ‘N’ channel command.
This command sends only the distance and uses 2 bytes (16 bits) per reading.
Other stream commands and the timestamp will send additional data and will have a slower data rate.

Explanation of top speeds: (stream delimiter ‘::’ is sent at start and then every 255 readings)
115.2Kbps = 10K Bytes per second (8bits + start and stop bits + inter byte delay)
‘N’ distance command = 2 bytes = 10000/2 = 5KHz max
‘O’ distance + reflectance = 3 bytes = 10000/3 = 3333KHz max

Timestamp Mode:

Notes: If timestamp mode is ‘on’ a timestamp will be added to each reading of the data stream.
Binary mode: an additional 2 bytes(timestamp data) will be added to the start of each reading.
Example: for data stream 'N' (RC distance) in binary mode starting from main menu
PC→Sensor: /1
Sensor→PC: 1:
PC→Sensor: N
Note: sensor will now start data stream as follows:
Sensor→PC: :: (2 bytes decimal 58 will be first 2 bytes of stream)
Sensor→PC: 255 distance readings (each reading = 2bytes T.S. + 2bytes distance for 1020 bytes total)
Sensor→PC: :: (2 bytes decimal 58)
Sensor→PC: 255 distance readings (each reading = 2bytes T.S. + 2bytes distance for 1020 bytes total)
Note: cycle will repeat until a byte is sent to the sensor.
ASCII mode: an additional integer (timestamp) will be added to the start of each distance reading
Example: for data stream 'N' (RC distance) in ASCII mode starting from main menu
PC→Sensor: /1
Sensor→PC: 1:
PC→Sensor: N
Note: sensor will now start data stream as follows:
Sensor→PC: timestamp(integer) : distance(float):
Note: cycle will repeat until a byte is sent to the sensor (any value will terminate stream)

Calculating timing based on timestamp:
Timestamps indicate the elapsed time between 2 consecutive readings (delta T).
Example: Datastream = ……distance1:396:distance2:393:distance3:395:distance4:…….
In this example 396, 393, and 395 are the timestamps.
To convert these integers to time use the formulas:

Average set to 1 or 2	Time(sec) = (timestamp+1) / 5208
Average set to 4 or higher	Time(sec) = (timestamp+1) / (5208/average)

Time is the delay (delta T) between each reading.

Channel Command Set Sub Menus

Trigger Mode

Sensor→PC: trigger:
PC→Sensor: y or n (trigger is on or off)
notes:
Trigger control setting applies to both channels of dual channel sensor.
Trigger mode works with the stream commands to control when measurements are taken.
A logic high (3.5V - 9V) at the trigger port will allow the stream commands to send data.
A logic low (0V - 1.5V) will pause the data stream.
You must select a data stream command in order for the trigger input to send data.
example:

PC→Sensor: /1
Sensor→PC: 1:
PC→Sensor: a
Sensor→PC: trigger:
PC→Sensor: y
Sensor→PC: y:
Note: Trigger has now been activated on channel 1
PC→Sensor: /1
Sensor→PC: 1:
PC→Sensor: T
Notes: D far side data stream begins. (channel command 'T')
trigger input high = data is sent to PC
trigger input low = data stream will pause
sending any character to the sensor will end the data stream command

RS-232 Custom Speed

Sensor→PC: Enter serial delay number:
PC→Sensor: send serial delay number (1-255) and line feed
Sensor→PC: custom RS-232 speed=:BPS:
Notes: serial delay number = (2000000 / BPS) - 1
BPS=bits per second
If you want to see the exact BPS generated by a serial delay number the formula is:
BPS=2000000 / (delay# + 1)
The sensor BPS does not have to be an exact match but should be within 2%
Example: for a BPS of 19.2Kbps
serial delay # = (2000000 / 19200) - 1
serial delay # = 103.17
round serial delay to closest integer (103.17 ~ 103)
BPS = 2000000 / (103 + 1)
BPS = 19230.77 bps
bps error = +0.16%

Set Scaling Factor

Sensor→PC: enter scaling distance:###.##:max distance=:###.##:
Notes: First value (###.##) is current scaling distance
Second value is maximum calibration distance
PC→Sensor: Enter the distance you will be setting at the sensor tip and a line feed
Notes: Move sensor probe to distance entered in the above step.
This value must be less than or equal to max distance.
Sensor→PC: send 'y' when in position or 'n' to abort:(y/n):
Note: Confirm that ###.## and UOM is correct
PC→Sensor: send 'y' to rescale the current calibration table
Sensor→PC: scaling on:
Sensor→PC: scaling factor=#.###:
Note: Scaling can be turned on/off with the 'e' channel command.

Edit Calibration Description
Sensor→PC: enter cal number(1-24):
PC→Sensor: send number 1-31 and line feed (decimal=10)
Sensor→PC: cal:#:calibration description:
PC→Sensor: enter new description, send up to 24 characters and a line feed
Sensor→PC: cal:#:new calibration description:

Optical Gain Setting
Sensor→PC: Signal level:##:Enter gain setting 0-100:
PC→Sensor: send '0' - '100' and line feed
Sensor→PC: LED power=:###:
Notes: If signal level reaches 100 then clipping will result.
Reduce gain if signal level reaches 100%. Signal will clip at 100%.
Sending 0 will turn off light source of sensor.
Sending only a line feed will report the current gain setting

Set Amplifier Temperature
Sensor→PC: Enter target temperature:
PC→Sensor: send the desired temperature in Celsius and line feed (decimal=10)
Sensor→PC: target temperature=:##.#:
Notes: Sending line feed only will return the current target temperature
Amplifier only has heating capability--enter a temperature above ambient
Heater is low power (2.5W)--it is designed to increase temperature only a few degrees C.
Procedure for calculating appropriate target temperature:
set target temperature to 1 (this will turn heater off)
allow sensor to fully warm up (wait approximately 30 minutes)
set target temperature to 2 degrees above current sensor temperature
heater will now turn on to raise amplifier temperature to target temperature

Load New Calibration Table from RS-232
Sensor→PC: enter calibration description(24 characters max):
PC→Sensor: send up to 24 character description and line feed
Sensor→PC: enter LED power setting used during calibration(1-100):

PC→Sensor: send LED power setting used during calibration and line feed
Sensor→PC: enter UOM for X data:(1=mInch 2=microns):
PC→Sensor: send '1' or '2'
--START OF INPUT LOOP--
Sensor→PC: cal position:#:
PC→Sensor: send distance for cal point number (#) and line feed
Note: sending any number less than 0 will signal the end of x-y-z data
Sensor→PC: y:
PC→Sensor: send RC number for cal point (#) and line feed
Sensor→PC: z:
PC→Sensor: send reflection number for cal point (#) and line feed
--END OF INPUT LOOP--
Sensor→PC: enter target cal number(1-31):
PC→Sensor: send cal number and line feed
Sensor→PC: cal # on channel # complete:
Notes: ‘x’ and 'y’ data will be a floating point numbers (1.234)
‘z’ data will be integer numbers (123)
RC number is given by the 'J' channel command (first part of response)
Reflection number is given by the 'J' channel command (last part of response)

Set Peak (D model)
Sensor→PC: peak adjust started(channel #):
Sensor→PC: r=read reflection value:
Sensor→PC: s=set peak reflection:
Sensor→PC: x=abort:
Note: adjust gap between sensor tip and target for peak reflection value
PC→Sensor: send 's' when sensor is at peak value

New Calibration
Sensor→PC: start calibration?(Yes/no):
PC→Sensor: send 'Yes' and line feed (decimal=10) (case sensitive)
Sensor→PC: enter calibration description(24 characters max):
PC→Sensor: send up to 24 character description and line feed
Sensor→PC: enter UOM used for cal(1=mInch/2=microns):
PC→Sensor: send '1' or '2' ('x' will abort cal)
Sensor→PC: cal position: #:
PC→Sensor: move to cal point number (#) then send distance and line feed
Notes: sensor will ask for next calibration point (cal position: #)
this process will repeat until all cal points are entered
send '-1' and line feed when all calibration points have been entered
Sensor→PC: enter target cal number(1-31):
PC→Sensor: send calibration number and line feed
Sensor→PC: (cal #)->(cal #) on channel #:
Sensor→PC: copy complete:
Notes : Any old calibration data in this slot will be overwritten.
Each channel has 31 calibration storage slots

Force Sensor bps to 19.2Kbps on Power Up

Sensor→PC: RS232 force:
PC→Sensor: y or n (y will force sensor to 19.2Kbps after power up)
Sensor→PC: y or n (sensor sends current setting)
Notes: The default for this setting is ‘y’ (force to 19.2Kbps)
The advantage of setting Force to ‘y’ is that the sensor will power up at a know speed.

Print Calibration Table

Sensor→PC: print cal number(1-31):
PC→Sensor: send calibration slot number and line feed
Sensor→PC: description:(calibration description):
Sensor→PC: LED power setting:###:
Sensor→PC: channel:#:
Sensor→PC: calibration table:#:
Sensor→PC: UOM:uom:
Sensor→PC: peak pt:#:
Sensor→PC: max pt:#:
Sensor→PC: point:###:x:###.##:y:#####:z:###:
Note: point line will repeat for each calibration point.

Load Calibration

Sensor→PC: load cal number(1-31):
PC→Sensor: send calibration number and line feed
Sensor→PC: Loading table :cal #: percent completed
Note: Loading calibration table takes 30-60 seconds

Copy Calibration

Sensor→PC: enter source cal number(1-31):
PC→Sensor: send source calibration number and line feed
Sensor→PC: enter target cal number(1-31):
PC→Sensor: send target calibration number and line feed
Sensor→PC: (cal #)->(cal #) on channel #:
Sensor→PC: copy complete:

Change Channel Address

Sensor→PC: update address(Yes/no)
PC→Sensor: send 'Yes' and line feed (decimal=10) (‘Yes’ is case sensitive)
Sensor→PC: enter base address (1,3,5,7):
PC→Sensor: send '1', '3', '5', or '7' (this will be the address of the first channel)
second channel's address will be the first channel + 1
Sensor→PC: sensor address =:#:#:

Print Channel Settings

Channel settings are sent in label/value pairs with all data separated by a colon (ASCII code 58)
Order of the label/value pairs:
Sensor→PC:

LABEL	VALUE	NOTES
channel	integer	current sensor channel
cal	integer	current calibration slot in use
side	n or f	near or far side for D models only (RC is always near side)
uom	mI / um / mm	Unit Of Measure for distance data
peak dist	floating point	distance at peak reflectance for D model (RC peak dist = max dist)
max dist	floating point	maximum distance of current calibration table
cal pts	integer	number of calibration points in current calibration table
ADC average	integer	number of readings averaged together for each data request
ratio peak	floating point	factory diagnostic--Sensor response before linearization
gain	0-100 integer	gain percentage
target temperature	floating point	set point for internal heater
group response	y or n	suppress response from group commands (used for multi-channel sensors)
binary mode	y or n	16 bit (2 byte) binary data or ASCII characters used for stream
display on	y or n	LCD and keyboard active
scaling on	y or n	scaling applied to calibration table
scaling distance	floating point	distance used as reference for scaling set point
scaling ratio	floating point	ratio at scaling distance
model type	R or D	sensor is RC or D model
timestamp	y or n	timestamp is sent with stream data
signature	string	24 character (maximum) string which can be written and read by the user
stream trigger	y or n	use trigger input to start (TTL high) and pause (TTL low) stream data
reserved	integer	factory use only
reserved	integer	factory use only
version	floating point	sensor firmware version 2.xxx
serial	integer	sensor's serial number
flash cal	integer	calibration table currently loaded in high speed memory section (data is used by the stream commands only)
flash side	n or f	calibration side (near or far) loaded in high speed section (always 'n' for RC models, can be 'n' or 'f' for D models)