NK

DS0141-002 Issue 11

K4xxx Communications Protocol

1. Communications Protocol

1.1. Data format

The data format for debug communications is 9600 baud, 8 data, 1 stop bit and no parity. Full duplex. No hardware or software handshaking.

1.2. Protocol

The communications protocol is ASCII, commas separate output values. Messages sent to the unit should be terminated with a carriage return only. The message returned by the unit is terminated by carriage return and line feed pair. When saved as a file using a terminal emulator these results can be read into an Excel spreadsheet.

All commands have a positive response, either the requested data is returned or for set-up commands the 'ok' string is returned.

1.3 Returned Measurement ASCII Abbreviations

Measurement data, as indicated above, is returned as a comma separated list (like a .csv file) of ASCII characters. Certain commands (such as the 'B' command) will return a header line containing abbreviations for the various measurements and a second header line containing abbreviations for the units associated with each measurement. The abbreviations and possible units are described in the tables below:

Table 1: Measurements

Measurement	ASCII Abbreviation	Possible Units
Air Density	AD	kg/m^3, lb/ft^3
Air Flow	AF	cfm, m^3/h, m^3/min, m^3/s, L/s
Altitude	AL	m, ft
Absolute Pressure	AP	mb, inHg, hPa, psi
Air Velocity	AV	m/s, km/h, kt, mph, fpm, Bft
Barometric Pressure	BP	mb, inHg, hPa, psi
Concrete Temperature	CT	°C, °F
Crosswind	CW	m/s, km/h, kt, mph, fpm, Bft
Density Altitude	DA	m, ft
Dew Point	DP	°C, °F
Date and Time in seconds since 1st January 2000,	DT	Seconds
Evaporation Rate	EV	$kg/m^2/h$, $lb/ft^2/h$
Globe Temperature	GT	°C, °F
Heat Index	HI	°C, °F
Humidity Ratio	HR or MO	g/kg, gpp
Headwind	HW	m/s, km/h, kt, mph, fpm, Bft
Compass Magnetic Direction	MG	Mag
Mean Radiant Temperature (not implemented, all values will be "***")	MRT	N/A
Natural Wet Bulb Temperature	NWB	°C, °F
Relative Air Density	RA	%
Relative Humidity	RH	%
SC is not a measurement	SC	N/A
Temperature,	TP	°C, °F
Compass True Direction	TR	True

Thermal Work Limit	TWL	w/m^2
Wet Bulb Temperature	WB	°C, °F
Wet Bulb Globe Temperature	WBGT	°C, °F
Wind Chill	WC	°C, °F
Wind Speed	WS	m/s, km/h, kt, mph, fpm, Bft

Table 2: Measurement Units and Associated Abbreviations

Unit of Measure	Standard Abbreviation	ASCII Abbreviation
Beaufort	Bft	Bft
Count	Cnt	Cnt
Cubic Feet per Minute	cfm	cfm
Cubic Meters per Hour	m^3/h	m<0xB3>/h
Cubic Meters per Minute	m^3/min	m<0xB3>/m
Cubic Meters per Second	m^3/s	m<0xB3>/s
Degrees Celcius	°C	<0xB0>C
Degrees Fahrenheit	°F	<0xB0>F
Feet	ft	ft
Feet per Minute	fpm	fpm
Grains per Pound	gr/lb or gpp	gpp
Grams per Kilogram	g/kg	g/kg
Hecto Pascal	hPa	hPa
Inches of Mercury	inHg	inHg
Kilogram per Cubic Meter	kg/m^3	kg/m<0xB3>
Kilograms per Square Meter per Hour	$kg/m^2/h$	kg/sm/h
Kilometers per Hour	km/h	km/h
Knots	kt	kt
Liters per Second	L/s	L/s
Magnetic North	Mag	Mag
Meters	m	m
Meters per Second	m/s	m/s
Miles per Hour	mph	mph
Millibars	mb	mb
Pounds per Cubic Foot	lb/ft^3 or lb/f^3	lb/f<0xB3>
Pounds per Square Inch	psi	psi
Pounds per Square Foot per Hour	$lb/ft^2/h$	lb/sf/h
Seconds	s	s
True Magnetic	True	True
Watts per Meter Squared	w/m^2	w/m<0xB2>

1.4 Command format

Clear data log

Syntax: A

Response: ok
Note:- the log clear takes several seconds and hence the 'ok' is transmitted at the end of this period.

Request date and time

Syntax: D?

Response: D=<m>

Where m is the number of seconds since 1st January 2000.

Set date and time

Syntax: D<m>

Where m is the number of seconds since 1st January 2000.

Response: ok

Identification

Syntax: I?

Response:
SW VERSION <m>.<nn> where m is the major revision and nn is the minor revision
Status=<s>
RH cal 1: < dd/mm/yyyy hh:mm:ss >
RH cal 2: < dd/mm/yyyy hh:mm:ss >
T2_correct: (a correction applied to thermistor 2, derived during humidity calibration)
Kxxxx: (Model number, followed by BT for Bluetooth versions)
S/N: xxxxxx (Serial number)
Battery state
Followed by build information as follows:
Processor
PCB
LCD
EEPROM size,
Compass
DCOCTL (a check on an internal oscillator)

The status is a bit field, each bit is defined in the table below.

Table 3

Bit	Description
0	0 = EEPROM configuration bank 1 operational 1 = EEPROM configuration bank 1 failed
1	0 = EEPROM configuration bank 2 operational 1 = EEPROM configuration bank 2 failed
2	0 = EEPROM calibration bank 1 operational 1 = EEPROM calibration bank 1 failed
3	0 = EEPROM calibration bank 2 operational 1 = EEPROM calibration bank 2 failed
5 – 7	Not used

Download logged data

Syntax: B

Response:

The Kestrel outputs a line of column headings, followed by a line of units, followed by lines of comma separated the data.

K4000: DT,WS,TP,WC,RH,HI,DP,WB,BP,AL,DA
or
K4100: DT,AV,AF,TP,WC,RH,HI,DP
or
K4200: DT,AV,AF,TP,WC,RH,HR,HI,DP,WB,BP,AL,DA
or
K4250: DT,WS,TP,WC,RH,MO,HI,DP,WB,AP,BP,AL,DA,AD,RA
or
K4300: DT,WS,TP,WC,RH,EV,CT,HI,DP,WB,BP,AL,DA
or
K4400: DT,WS,TP,WC,RH,HI,DP,WB,BP,AL,DA,GT,MRT,NWB,WBGT,TWL,SC
or
K4500: DT,MG,TR,WS,CW,HW,TP,WC,RH,HI,DP,WB,BP,AL,DA
or
K4600: DT,MG,TR,WS ,CW,HW TP,WC,RH,HI,DP,WB,BP,AL,DA,GT,MRT,NWB,WBGT

The following example is a short log from a K4500:

DT,MG,TR,WS,CW,HW,TP,WC,RH,HI,DP,WB,BP,AL,DA<LF>
s,Mag,True,mph,mph,mph,°F,°F,%,°F,°F,°F,inHg,m,m<LF>
673347308,353,353,0.0,0.0,0.0,79.3,79.3,61.9,81.0,65.1,69.6,29.86,15,501<LF>
673347310,347,347,0.0,0.0,0.0,79.4,79.5,64.2,81.7,66.3,70.3,29.85,16,508<LF>
673347312,356,356,6.3,0.4,6.3,79.3,79.3,65.6,81.7,66.8,70.5,29.86,15,507<LF>
673347314,355,355,5.8,0.5,5.8,79.2,79.2,65.7,81.3,66.8,70.5,29.86,15,504<LF>
673347316,356,356,5.3,0.4,5.3,79.1,79.0,64.5,81.0,66.1,70.0,29.86,15,500<LF>
673347318,351,351,4.1,0.6,4.1,79.1,79.2,62.6,80.8,65.2,69.6,29.85,16,499<LF>
673347320,347,347,2.7,0.6,2.6,79.0,79.0,60.6,80.2,64.2,68.9,29.86,15,493<LF>
673347322,347,347,1.6,0.4,1.6,79.0,79.0,58.8,79.9,63.3,68.4,29.86,15,490<LF>
673347324,347,347,1.2,0.3,1.2,79.0,79.0,57.3,79.7,62.6,68.0,29.86,15,487<LF>
673347326,346,346,1.0,0.2,0.9,79.0,79.0,56.1,79.5,62.1,67.6,29.86,15,488<LF>
673347328,347,347,0.8,0.2,0.8,79.2,79.2,55.4,79.7,61.8,67.6,29.86,15,489<LF>
673347330,348,348,0.0,0.0,0.0,79.2,79.2,54.8,79.5,61.5,67.5,29.86,15,489<LF>

Output data (polled)

Syntax: O
Response: DT,WS,TP,RH,BP,CD

Note that CD is output only for units containing a compass (K4500 and K4600). BP is not output from a K4100.

Output continuous data

Syntax: P

Start transmission once per second.

Response: DT,WS,TP,RH,BP,CD

Note that CD is output only for units containing a compass (K4500 and K4600). BP is not output from a K4100.

Note:- Output is not available when logging is enabled. Enabling logging disables continuous output.

Output a full data snapshot

Syntax: S

Response:

The Kestrel outputs a line of column headings, followed by a line of units, followed by lines of comma separated the data.

K4000: DT,WS,TP,WC,RH,HI,DP,WB,BP,AL,DA
or
K4100: DT,AV,AF,TP,WC,RH,HI,DP
or
K4200: DT,AV,AF,TP,WC,RH,HR,HI,DP,WB,BP,AL,DA
or
K4250: DT,WS,TP,WC,RH,MO,HI,DP,WB,AP,BP,AL,DA,AD,RA
or
K4300: DT,WS,TP,WC,RH,EV,CT,HI,DP,WB,BP,AL,DA
or
K4400: DT,WS,TP,WC,RH,HI,DP,WB,BP,AL,DA,GT,MRT,NWB,WBGT,TWL,SC
or
K4500: DT,MG,TR,WS,CW,HW,TP,WC,RH,HI,DP,WB,BP,AL,DA
or
K4600: DT,MG,TR,WS ,CW,HW TP,WC,RH,HI,DP,WB,BP,AL,DA,GT,MRT,NWB,WBGT

The following example output is from a K4500:

DT,MG,TR,WS,CW,HW,TP,WC,RH,HI,DP,WB,BP,AL,DA<LF>
s,Mag,True,mph,mph,mph,°F,°F,%,°F,°F,°F,inHg,m,m<LF>
673346601,333,333,0.0,0.0,0.0,76.1,76.1,51.6,75.0,57.0,63.9,29.86,15,419<LF>

1.4 Service commands

Reset calibration parameters to defaults

Syntax: N&<p>

Where <p> is one of the following :-
'H' – Resets humidity.
'P' – Resets pressure.

This command allows each of the calibration parameters to be individually reset to their defaults.
Service continuous output

Syntax: Q

Start transmission once per second.

Response: DT,TP,RH,BP,AL

Note that the K4100 does not output AL or BP.

Restore parameters to defaults

Syntax: R<p>

Where <p> is one of the following:-
'0' – restores user parameters to metric and non-US date format and 24 hour clock. Calibration data unaffected.
'1' – restores user parameters to imperial and US date format and 12 hour clock. Calibration data unaffected.
'&C' – restores calibration data to default. User parameters unaffected.

Response: ok

EEPROM read location

Syntax: ER<m>

Where m is the byte address of the location to be read.

Response: <p>
Where p is the value read from EEPROM.

EEPROM write location

Syntax: EW<m>,<n>

Where n is the data to be written to the location specified in m. e.g. to write 7 to location 12 type 'EW12,7'.
Response: ok

Pressure calibration

Syntax T<m>

Where m is the current pressure to 0.1hPa resolution. The range is 3000 to 11000.

Response: ok

Compass output

Syntax: X

Start transmission once per second.

Response: DT,X,Y

Where:-
DT is the date and time in seconds since 1st January 2000,
X is the raw compass x value
Y is the raw compass y value

RH point 1 calibration

Syntax: Y<m>

Where m is the expected humidity to 0.1 %. Range of m is 50 to 950. Using a value of zero cancels the calibration process.

Response: ok

For code versions up to 4.28, when the Y command is executed the K4xxx adjusts the calibration point and then runs the humidity calibration with no countdown.

For code versions 4.29 and later, when the Y command is executed the K4xxx adjusts the calibration point only.

RH point 2 calibration

Syntax: Z<m>

Where m is the expected humidity to 0.1 %. Range of m is 50 to 950. Using a value of zero cancels the calibration process.

Response: ok

For code versions up to 4.28, when the Z command is executed the K4xxx adjusts the calibration point and then runs the humidity calibration with no countdown.

For code versions 4.29 and later, when the Z command is executed the K4xxx adjusts the calibration point only.

Set Serial Number

Syntax: :#nnnnnn (nnnnnn = six numeric digits)

This command is used during production. Once the serial number is set this command is disabled.

Simulate keystrokes

Syntax: *x where x is U,D,L,R,C,P,B or G

U,D,L,R,C,P,B or G corresponding to keys Up,Down,Left,Right,Center,Power,Backlight, manual log

Launch Bootloader

Syntax: :]

Launches Kestrel bootloader for code update. Contact NK for further instructions if a code update is required.

1.3. Bluetooth commands

Request Bluetooth information

Syntax: :B

Response: BT Name, Address, Version and PIN

Toggle serial port between optical and Bluetooth

Syntax: :S

Turn Bluetooth on and optical off at next power up

Syntax: :SB0

Turn Bluetooth off and optical on at next power up

Syntax: :SB1

Bluetooth connect

Syntax: %C

Bluetooth disconnect

Syntax: %D

1.4. *Summary*

Command	Parameter	Description
A	None	Clear data log
B	None	Download data log
C	-	Not used
D	?,0 to 2^31	Date and time
E	R<m> or W<m>,<n>	EEPROM
F	-	Not used
G	-	Not used
H	-	Not used
I	?	Ident
J	-	Not used
K	-	Not used
L	-	Not used
M	-	Not used
N	&H,&P	Reset humidity or pressure cal values.
O	None	Single parameter output (polled)
P	None	Instantaneous parameter output
Q	None	Instantaneous output for pressure testing
R	0,1,&C	Restore default settings
S	-	Output a full data snapshot
T	3000 to 11000	Pressure calibration
U	-	Not used
V	-	Not used
W	-	Not used
X	-	Compass test output
Y	50 to 950	RH calibration point 1 (Note 1)
Z	50 to 950	RH calibration point 2 (Note 1)
*	U,D,L,R,C,P,B or G	Simulate keystrokes
:B		Request Bluetooth (BT) information Response: BT Name, Address, Version and PIN
:S		Toggle serial port between optical and BT
:#	nnnnnn	Set Serial Number (nnnnnn = six numeric digits)
:]		Launches the bootloader
%C		Bluetooth connect
%D		Bluetooth disconnect

Note 1

For code versions up to 4.28, when the Y or Z command is executed the K4xxx adjusts the calibration point and then runs the humidity calibration with no countdown.

For code versions 4.29 and later, when the Y or Z command is executed the K4xxx adjusts the calibration point only.