Kachina 505DSP Software Interface Specifications

Adapted from 10 Dec. 1998 Version Q35 Kachina Document
Revised by AE5K – Last Revision 2009 April 02

The following information is intended for software developers who wish to write software to control the 505DSP Transceiver or to those doing troubleshooting.

This document describes the command and telemetry communication interface between the firmware in the 505DSP radio and the control software in the user's personal computer (PC). All command and telemetry data will be sent as ASCII character data. Each command "packet" will have a preamble ASCII STX character (02h) and a postamble ASCII ETX character (03h).

Note: there may be some commands in the following table which are not implemented in even the latest firmware. Some were added as firmware changed.

COMMAND STRUCTURE (PC to Radio)

Upon receipt of each command, the radio will send a single acknowledgment byte to the PC. The format of this byte will be:

FFh - good command
FEh - error

On error, the PC will make 2 retries before declaring a problem to the user. (This, of course, is applicable only to the original Kachina control program.)

Command	Definition
(STX)A(xxH)(ETX)	AGC speed, 00H to FFH (00H = fast, FFH = slow)
(STX)a(00H)(ETX)	Amplifier off.
(STX)a(01H)(ETX)	Amplifier on.
(STX)B(01H)(ETX)	RX BW filter, SSB 3.5kHz.
(STX)B(02H)(ETX)	RX BW filter, SSB 2.7kHz
(STX)B(03H)(ETX)	RX BW filter, SSB 2.4kHz.
(STX)B(04H)(ETX)	RX BW filter, SSB 2.1kHz
(STX)B(05H)(ETX)	RX BW filter, SSB 1.7kHz.
(STX)B(06H)(ETX)	RX BW filter, CW 1kHz.
(STX)B(07H)(ETX)	RX BW filter, CW 500Hz.
(STX)B(08H)(ETX)	RX BW filter, CW 200Hz.
(STX)B(09H)(ETX)	RX BW filter, CW 100Hz.
(STX)B(0aH)(ETX)	Data High Filter
(STX)B(0bH)(ETX)	Data Medium Filter
(STX)b(00H)(ETX)	BITE - Serial #, H/W & S/W version request.
(STX)b(01H)(ETX)	BITE - Request antenna impedance data.
(STX)b(02H)(ETX)	BITE - Send antenna impedance data.
(STX)b(03H)(ETX)	BITE - Request S-Meter calibration table.
(STX)b(04H)(ETX)	BITE - Send S-Meter calibration table.
(STX)b(05H)(ETX)	BITE - Perform S-Meter calibration.
(STX)b(06H)(ETX)	BITE - Request freq. ref. calibration table.
(STX)b(07H)(ETX)	BITE - Send freq. ref. calibration table.
(STX)b(08H)(ETX)	BITE - Perform freq. ref. cal.
(STX)b(09H)(ETX)	BITE - Request phase det. calibration table.
(STX)b(0aH)(ETX)	BITE - Send phase det. calibration table.
(STX)b(0bH)(ETX)	BITE - Perform phase det. cal.

```
(STX)b(0cH)(ETX)    BITE - Request carrier balance value.
(STX)b(0dH)(ETX)    BITE - Send carrier balance value.
(STX)b(0eH)(ETX)    BITE - Perform carrier balance.
(STX)b(0fH)(ETX)    Reserved.
(STX)b(10H)(ETX)    BITE - S-Meter cal -130 dBm.
(STX)b(11H)(ETX)    BITE - S-Meter cal -120 dBm.
(STX)b(12H)(ETX)    BITE - S-Meter cal -110 dBm.
(STX)b(13H)(ETX)    BITE - S-Meter cal -100 dBm.
(STX)b(14H)(ETX)    BITE - S-Meter cal  -90 dBm.
(STX)b(15H)(ETX)    BITE - S-Meter cal  -80 dBm.
(STX)b(16H)(ETX)    BITE - S-Meter cal  -70 dBm.
(STX)b(17H)(ETX)    BITE - S-Meter cal  -60 dBm.
(STX)b(18H)(ETX)    BITE - S-Meter cal  -50 dBm.
(STX)b(19H)(ETX)    BITE - S-Meter cal  -40 dBm.
(STX)b(1aH)(ETX)    BITE - S-Meter cal  -30 dBm.
(STX)b(1bH)(ETX)    BITE - S-Meter cal  -20 dBm.
(STX)b(1cH)(ETX)    BITE - S-Meter cal  -10 dBm.
(STX)b(1dH)(ETX)    BITE - S-Meter cal    0 dBm.
(STX)b(1eH)(ETX)    BITE - S-Meter cal   10 dBm.
(STX)b(1fH)(ETX)    BITE - S-Meter cal   20 dBm.
(STX)b(20H)(ETX)    Reserved.
(STX)b(21H)(ETX)    BITE - Send AGC DVM value.
(STX)b(22H)(ETX)    BITE - Send lock detector 1 DVM value.
(STX)b(23H)(ETX)    BITE - Send lock detector 2 DVM value.
(STX)b(24H)(ETX)    BITE - Send forward power DVM value.
(STX)b(25H)(ETX)    BITE - Send reflected power DVM value.
(STX)b(26H)(ETX)    BITE - Send phase detector DVM value.
(STX)b(27H)(ETX)    BITE - Send Tx audio DVM value.
(STX)b(28H)(ETX)    BITE - Send temperature A DVM value.
(STX)b(29H)(ETX)    BITE - Send temperature B DVM value.
(STX)b(2aH)(ETX)    BITE - Send R->T switching data.
(STX)b(2bH)(ETX)    BITE - Send T->R switching data.
(STX)b(2cH)(ETX)    BITE - Send synthesizer lock time 1 data.
(STX)b(2dH)(ETX)    BITE - Send synthesizer lock time 2 data.
(STX)b(2eH)(ETX)    BITE - Send ALC over-shoot data.
(STX)b(2fH)(ETX)    BITE - Request on time value.
(STX)b(30H)(ETX)    BITE - Reset on time value.
(STX)b(31H)(ETX)    BITE - Request fault data.
(STX)b(32H)(ETX)    BITE - Reset fault data.
(STX)b(33H)(ETX)    BITE - Set firmware serial number.
(STX)b(34H)(ETX)    BITE - Perform power up self test.
(STX)b(35H)(ETX)    BITE - Set password.
(STX)b(36H)(ETX)    BITE - Request TCXO DVM value.
(STX)b(37H)(ETX)    BITE - Request DDS value for Rx frequency.
(STX)b(38H)(ETX)    BITE - Request mode.
(STX)b(39H)(ETX)    BITE - Request maximum power setting.
(STX)b(3aH)(ETX)    BITE - Perform freq. ref. tilt
(STX)C(03H)(ETX)    CW Offset freq - 300Hz.
(STX)C(04H)(ETX)    CW Offset freq - 400Hz.
(STX)C(05H)(ETX)    CW Offset freq - 500Hz.
(STX)C(06H)(ETX)    CW Offset freq - 600Hz.
(STX)C(07H)(ETX)    CW Offset freq - 700Hz.
(STX)C(08H)(ETX)    CW Offset freq - 800Hz.
(STX)c(00H)(ETX)    CW Filter default - wide.
(STX)c(01H)(ETX)    CW Filter default - narrow.
(STX)D(xxH)(ETX)    CW keyer dynamics, 00H-FFH  (00H=soft, FFH=hard).
(STX)d(00H)(ETX)    NO-OP keep alive command. Sent every 15 seconds so radio does
                     not close modem connection to the PC
(STX)E(xxH)(ETX)    Transmit equalization shift frequency, Bass - Treble. The
                     values range from -128 to 127
```

(STX)e(00H)(ETX) Speech monitor off.
(STX)e(01H)(ETX) Speech monitor on.
(STX)F(01H)(ETX) Simplex on, Rx and Tx are equal.
(STX)F(02H)(ETX) Listen on the receive frequency.
(STX)F(03H)(ETX) Listen on the transmit frequency.
(STX)F(04H)(ETX) Split on.
(STX)f(xxH)(ETX) CTCSS tone frequency for FM, 00H to 2AH (0 is off and 01-2A correspond to 42 frequency codes).
(STX)G(00H)(ETX) Receive attenuator off.
(STX)G(01H)(ETX) Receive attenuator on.
(STX)g(xxH)(ETX) AGC action, 00H to FFH (00H = min, FFH = max).
(STX)H(xxH)(ETX) Speech compression. Hex value is relative compression with 00H being minimum compression and 0FFH being maximum compression.
(STX)h(xxH)(ETX) Transverter on/off. 00h = off, 01h = on
(STX)I(xxH)(ETX) IF filter shift frequency. Step size is 10Hz. Hex value is determined by the equation (Hz / 10) +128. The frequency range is -1280Hz to 1270Hz.
(STX)i byte1-0(ETX) Impedance matching, used by KCCAL to get 50 ohm capacitance/inductance load. Value is determined by the following bits:
Bit 0 : 20 PF
Bit 1 : 40 PF
Bit 2 : 80 PF
Bit 3 : 160 PF
Bit 4 : 320 PF
Bit 5 : 640 PF
Bit 6 : 1280 PF
Bit 7 : 0 = output cap., 1 = input cap.
Bits 8-13 : inductance 0-63
(STX)J(xxH)(ETX) RIT 100Hz steps, -99 to -8 and 8 to 99. This covers the ranges -9900Hz to -800Hz and 800Hz to 9900Hz.
(STX)j(xxH)(ETX) RIT 10Hz steps, -79 to 79. This covers the range -790Hz to790Hz.
(STX)K(01H)(ETX) CW keyer mode, left hand.
(STX)K(02H)(ETX) CW keyer mode, right hand.
(STX)K(03H)(ETX) CW keyer mode, straight.
(STX)k(00H)(ETX) CW spotting tone off.
(STX)k(01H)(ETX) CW spotting tone on.
(STX)L(xxH)(ETX) Level sensitive squelch value, 00H to 7FH.
(STX)l(xxH)(ETX) Transmit bandwidth. 00H= ??, 01h = 4 kHz, 02h = 3.1 kHz
(STX)M(01H)(ETX) Mode, AM.
(STX)M(02H)(ETX) Mode, CW.
(STX)M(03H)(ETX) Mode, FM.
(STX)M(04H)(ETX) Mode, USB.
(STX)M(05H)(ETX) Mode, LSB.
(STX)m(xxH)(ETX) Mic/CW gain. Hex value is relative gain level with 00H being minimum gain and 0FFH being maximum gain.
(STX)N(xxH)(ETX) Notch width; 0=wide, 1=medium, 2=narrow, 3=automatic.
(STX)n(xxH)(ETX) Notch frequency in 10Hz steps. Hex value is determined by the equation (Hz / 10) – 20. The range is 210Hz to 2750Hz and a value of zero indicates the notch is turned off.
(STX)O(00H)(ETX) Noise reduction off.
(STX)O(01H)(ETX) Noise reduction on.
(STX)o(xxH)(ETX) Noise reduction level control. Hex value is relative level with 00H being minimum and 0FFH being maximum.
(STX)P(00H)(ETX) Speech processor off.
(STX)P(01H)(ETX) Speech processor on.
(STX)p(00H)(ETX) Pre amp off.
(STX)p(01H)(ETX) Pre amp on.
(STX)Q(00H)(ETX) Level sensitive squelch (level set to 127).

```
(STX)Q(01H)(ETX)    Syllabic squelch (level set to 127).
(STX)q(00H)(ETX)    CW keyer QSK off.
(STX)q(01H)(ETX)    CW keyer QSK on.
(STX)R byte3-0(ETX) DDS value for receive frequency. The allowable range will be
                        30kHz to 30MHz. The uppermost 2 bits of the high byte will
                        indicate antenna port as follows:
                        00 - port B/A
                        01 - port A
                        10 - port B
                        11 - port A/B
                     The DDS value is computed using:
                        DDS = 2.2369621333 * (75000000 + freq)
                     where freq = input frequency in Hz.
(STX)r byte3-0(ETX) DDS value for reference calibration frequency. The allowable
                     range will be 30kHz to 30MHz.
                     The DDS value is computed using:
                        DDS = 2.2369621333 * (75000000 + freq)
                     where freq = input frequency in Hz.
(STX)S(xxH)(ETX)    CW keyer speed, 00H to FFH (00H = 5 wpm, FFH = 80 wpm).
(STX)s(xxH)(ETX)    CW keyer/Speech monitor sidetone, 00H to FFH (00H=min, FFH=max)
(STX)T byte3-0(ETX) DDS value for transmit frequency. The allowable range will be
                     30kHz-30MHz (the radio will restrict the range to 1.8-30MHz).
                     The uppermost 2 bits of the high byte will indicate antenna
                        port as follows:
                        00 - port B/A
                        01 - port A
                        10 - port B
                        11 - port A/B
                     The DDS value is computed using:
                        DDS = 2.2369621333 * (75000000 + freq)
                     where freq = input frequency in Hz.
(STX)t byte3-0(ETX) Save DDS value for transmit frequency but do not tune the radio
(STX)U(00H)(ETX)    Antenna tuning off.
(STX)U(01H)(ETX)    Antenna tuning on.
(STX)U(02H)(ETX)    Antenna tuning start. A radio with with an ATU will make an
                     audible pass/fail tone after the antenna tuning cycle
                     completes
(STX)U(03H)(ETX)    Clear port A antenna impedance data.
(STX)U(04H)(ETX)    Clear port B antenna impedance data.
(STX)V(xxH)(ETX)    Audio volume. Hex value is relative volume level with 00H being
                     minimum volume and 0FFH being maximum volume.
(STX)v(00H)(ETX)    Transmit a CW dit.
(STX)v(01H)(ETX)    Transmit a CW dah.
(STX)v(02H)(ETX)    Transmit a CW interletter space.
(STX)v(03H)(ETX)    Transmit a CW interword space.
(STX)v(04H)(ETX)    Abort transmit of CW message.
(STX)v(05H)(ETX)    Constant tune carrier off.
(STX)v(06H)(ETX)    Constant tune carrier on.
(STX)W(xxH)(ETX)    Max power out 1 - 100 watts.
(STX)w(xxH)(ETX)    CW keyer weight, 00H to FFH (00H = light, FFH = heavy)
(STX)X(xxH)(ETX)    VOX level, 00H to FFH (00H = off).
(STX)x(xxH)(ETX)    Push to talk (01H = Tx, 00H = Rx).
(STX)Y(xxH)(ETX)    AntiVOX level, 00H to FFH.
(STX)y(xxH)(ETX)    VOX Delay, 00H to FFH. (00H = short, FFH = long).
```

When the mode is commanded to AM, the radio will automatically change the Bandpass Filter to 6 kHz. When the mode is commanded from AM to USB or LSB, the radio will automatically change the Bandpass Filter to 2.4 kHz. When the mode is commanded from AM to CW, the radio will automatically change

Bandpass Filter to 2.4 kHz (CW filter default wide) or 500 Hz (CW filter default narrow).

If mode is changed to AM, squelch will be set to Level Sensitive.

If mode is changed from AM to CW, LSB, or USB, then squelch will be restored to what it was before going to AM.

During transmit, a VFO transition from split to simplex will not be allowed.

The command inhibit table given below shows the conditions when commands are inhibited from being sent to the radio.

TX = radio transmitting
AM/FM = AM and FM modes
CW = CW mode

Command	Definition	Inhibit Conditions		
A	AGC speed	--	AM/FM	------
a	Amplifier	--	-----	------
B	Bandpass Filter	--	AM/FM	------
b	BITE	TX	-----	------
C	CW Offset freq.	--	-----	------
c	CW Filter default	TX	-----	------
D	CW keyer dynamics	--	-----	------
d	NO-OP Keep Alive	--	-----	------
E	Tx equal. freq.	--	-----	------
e	Speech monitor	--	-----	------
F	VFO	TX	-----	------
G	Receive attenuator	--	-----	------
g	AGC knee	--	AM/FM	------
H	Speech Compression	--	-----	------
I	IF shift freq.	--	AM/FM	------
i	Impedance matching	--	-----	------
J	RIT (100Hz)	--	-----	------
j	RIT (10Hz)	--	-----	------
K	CW keyer mode	--	-----	------
k	CW spotting tone	--	-----	------
L	Level sens. squelch	--	-----	------
M	Mode	TX	-----	------
m	Mic gain	--	-----	------
N	Notch width	--	AM/FM	------
n	Notch frequency	--	AM/FM	------
O	Noise reduction	--	AM/FM	------
o	Noise red. level	--	AM/FM	------
P	Speech processor	--	-----	------
p	Pre-amplifier	--	-----	------
Q	Squelch	--	-----	------
q	CW keyer QSK	--	-----	------
R	Rx. frequency tune	--	-----	------
r	Reference Cal freq.	TX	-----	------
S	CW keyer speed	--	-----	------
s	CW keyer sidetone	--	-----	------
T	Tx. frequency tune	TX	-----	------
t	Tx. frequency save	TX	-----	------

U	Antenna tuning	--	-----	------
V	Audio volume	--	-----	------
v	CW Tx buffer	--	AM/FM	------
W	Max power out	--	-----	------
w	CW keyer weight	--	-----	------
X	VOX level	--	-----	------
x	Push to talk	--	CW	------
Y	AntiVOX level	--	-----	------
y	VOX Delay	--	-----	------

TELEMETRY STRUCTURE (Radio to PC)

The radio will send telemetry to the PC automatically at a 50 millisecond rate. The telemetry format will be a single byte using the following values:

Value(dec.)	Hex	Definition
0-127	00-7F	Receive signal in dBm.
128	80	Squelch open (busy).
129	81	Squelch closed.
130-139	82-8B	Automatic Level Control 0 - 20 (each increment is 2 ALC)
140-189	8C-BD	Forward power in percent, 0 - 100% (each increment is 2%)
190-214	BE-D6	Reflected power in percent, 0 - 50% (each increment is 2%)
215	D7	Heat sink over-temperature alarm.
216	D8	Loss of synthesizer lock.
217	D9	Self test failure.
220-249	DC-F9	Heat sink temperature in degrees C, 17.5 - 90 degrees C, each increment is 2.5 degrees C.
253	FD	Start of data transfer. (see paragraphs following)
254	FE	Error.
255	FF	Good command acknowledge.

Current radio settings data. If the DDS value for receive frequency is requested, the 4 byte DDS value will be sent, highest byte first, plus a 2 byte checksum. The uppermost 2 bits of the high byte will indicate antenna port. See 'R' command section above for converting between DDS value and frequency. If mode is requested, a single byte identifying the mode will be sent without a checksum. See 'M' command section above for value description. If maximum power setting is requested, a single byte containing the power setting in watts, 1 - 100, will be sent without a checksum.

Antenna impedance data. A total of 256 bytes of data will always be sent (64 points x 4 bytes) plus a 2 byte checksum. The 64 points will contain data for antenna port A and B. In each 4 byte group, bytes 0-1 will always contain the 2 most significant bytes of DDS. The 2 uppermost bits of byte 0 will indicate the format of bytes 2-3 and the antenna port as follows:

bits	bytes 2-3	port
00	rho/phi	A
01	cap/ind (network data)	A
10	cap/ind (network data)	B
11	rho/phi	B (no tuner)

When bytes 2-3 contain rho/phi data, their values will be as follows:

byte 2 Rho (increment is 1 / 256).
byte 3 Phase angle (increment is 2pi * (1 / 256)).

S Meter calibration table. 16 one byte values will always be sent plus a 2 byte checksum.

Frequency reference calibration table. 32 one byte values will always be sent plus a 2 byte checksum.

Phase detector calibration table. 16 one byte values will always be sent plus a 2 byte checksum.

Carrier balance value. A 2 byte value will be sent without a checksum.

Version data. 4 byte integer serial number, 2 byte hardware version number (MSB alpha, LSB digit), 2 byte firmware version number, and a 2 byte checksum.

Hour meter data. 4 byte integer hours of operation will be sent plus a 2 byte checksum. (apparently not implemented)

Fault record data. 10 two byte numbers will always be sent plus a 2 byte checksum.

R->T switching data. 50 1 byte forward power values in percent, 0 - 100% (each increment is 2%), plus a 2 byte checksum.

T->R switching data. 50 1 byte values (DVM format) plus a 2 byte checksum.

Synthesizer lock time 1 data. 50 1 byte values (DVM format) plus a 2 byte checksum.

Synthesizer lock time 2 data. 50 1 byte values (DVM format) plus a 2 byte checksum.

ALC over-shoot data. 50 1 byte forward power values in percent, 0 - 100% (each increment is 2%), plus a 2 byte checksum.

Digital Volt Meter data can be one of the following types: AGC, lock detector 1, lock detector 2, forward power, reflected power, phase detector, Tx audio, temperature A, temperature B, and TCXO. A 1 byte value (DVM format) will be sent without a checksum.

DVM format: Digital Volt Meter (DVM) data will be contained in a single byte representing the voltage. Positive values will range from 0 - 127, 128 will be zero, and negative values will range from 129 to 255. Each increment in value will represent 1/16th of a volt or 0.0625 volts.

The PC will calculate the Voltage Standing Wave Ratio (VSWR) using the following formula:

```
RP = 100 * RP / FP
RHO = SQRT (RP / FP)
VSWR = (1 + RHO) / (1 - RHO)
```

where FP = forward power, RP = reflected power, RHO = reflection coefficient.

A high VSWR level will trigger a warning based on the following criteria:

```
0.0 - 1.999 = normal (no warning)
2.0 - 2.999 = caution (yellow warning)
3.0 - above = alarm (red warning)
```

Data Transfer Specifications

Baud Rate	9600
Data Bits	8
Stop Bits	1
Parity	none