



Version: V3.25.2

XW-DT001A

Communication protocol

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May 23, 2024



1 Summary

The XW-DT001A communication protocol is the interface communication protocol for the Wavesonic series security radar of WaveSonic Technology Co., Ltd., including trajectory output, point output, parameter control, etc. It clarifies the communication format and interface between data processing software (DPS) and terminal display software (TDS).

2 Communication protocol

This protocol is based on the standard UDP datagram protocol for communication, with small end byte order.

The port number of DPS is fixed at 12580, and the IP addresses of DPS and TDS are configured to be in the same network segment. After TDS sends a link command to DPS, DPS automatically obtains the IP address and port number of TDS.

The communication between DPS and TDS includes two types of messages: DPS to TDS reporting message; Control query message from TDS to DPS.

2.1 Report message (DPS to TDS)

The report message is sent from DPS to TDS, reporting target orientation, distance, radar status and other data information.

The reporting message consists of two parts: message frame header and data. Each track message includes one message frame header and N data segments. The specific format is: message frame header+data segment * N. The detailed description is as follows.



2.1.1 Track reporting

The first to seventh data items of the trajectory report message, consisting of 12 bytes, are the message frame header. The fifth item, "Number of Tracks," defines the number of tracks N contained in the current trajectory message. N is 0 or a positive integer. When N is 0, it indicates that there are no tracks in the message, and the tracks are scheduled for reporting.

Each track corresponds to a data segment, including multiple data items, with a length of 80 bytes. The first track data segment includes items 8-29, and the second track data segment includes items 29-50 data items, and so on.

Table 1 Track Message Format

Item	Data item	Length (Bytes)	Format	Explanation
Message frame header				
1	Frame header	4	uint	Fixed value: 0xaa aa aa aa
2	Information type	1	byte	Format: 0x01
3	Reserved	2	byte	
4	Site number	1	byte	Range: 0~255
5	Number of tracks	2	ushort	Range: 0~999
6	Reserved	1	byte	Fixed value: 0x00
7	Command response	1	byte	[0]Range: 0/1 [7..1]Reserved
Track data (1)				
8	Batch number	4	uint	Range: 1~999
9	Azimuth	4	float	Range: 0~360 , Unit: °
10	Distance	4	float	单位: m
11	latitude	4	float	Range: -90~+90 , Unit: °
12	longitude	4	float	Range: -180~+180 , Unit: °
13	radial velocity	4	float	Unit: m/s

14	Existence identification	2	byte	[1:0]0 : Disappearance/1: Existence/2: Extrapolation
15	Quality level	1	byte	Default 0, this feature is not available 1-255, quality level from low to high
16	Reserved	1	byte	Default 0
17	Elevation	4	float	Unit: °
18	Course	4	float	°, (reference)
19	Speed	4	float	M/s, (reference)
20	Height	4	float	Unit: m , Relative radar altitude
21	Sequential time	4	uint	Unit: ms
22	Range	2	ushort	Unit: 0.1dB
23	Category	1	byte	0: Large vessel/1: Medium vessel/2: Small vessel 10: Pedestrians/20: Drones/30: Cars Other: Unknown (Reference)
24	Noise amplitude	2	ushort	Unit: 0.1dB
25	Target length	2	ushort	Unit: 0.1m, (reference)
26	Reserved	21	byte	
27	Track type	1	byte	0: Normal radar trajectory 1: Fusion trajectory of two radar trajectories 2: Fusion of passive and radar tracks 3: AIS trajectory 4: The fusion trajectory of AIS and radar tracks
28	Reserved	2	byte	
29	Sum check	1	byte	The sum of all other data (79 bytes in total) in the trajectory data segment
Note:				



- 1) The site number is the sequential number of different sites under the same IP address. When one IP corresponds to one site, the number is 0;
- 2) The reserved data items are all invalid data, usually 0; When the two coordinate radar is working, both the elevation and altitude terms are filled with 0.
- 3) Sequential time=(hours * 3600+minutes * 60+seconds) * 1000+milliseconds
- 4) Command response item, within 1 second after the radar receives the command, there is a command response item with 0x01 in the track message.

2.1.2 Radar trace reporting

The 1- 8 data items of the radar plot report message, totaling 16 bytes are the frame header of the message. Among them, the fifth item "Number of plot" defines the number of dots N contained in the current dot trace message, N is 0 or a positive integer. When N is 0, it indicates that there is no plot in the message, and the plot is reported regularly. Each plot corresponds to a data segment, including 5 data items with a length of 20 bytes. The first plot data segment includes items 9-13, the second plot data segment includes items 14-18, and so on.

Table 1 Format of Plot Message

Item	Data item	Length (Bytes)	Format	Explanation
Message frame header				
1	Frame header	4	uint	Fixed value: 0xaa aa aa aa
2	Information type	1	byte	Format: 0x04
3	Reserved	2	byte	
4	Site number	1	Byte	Range: 0~255
5	Number of plots	2	ushort	Range: 0~1000
6	Front number	1	byte	Altitude measurement array facing 0 Main array facing corresponding 1

Item	Data item	Length (Bytes)	Format	Explanation
				Corresponding to 2 from front 1 Corresponding to 3 from 2 arrays Corresponding to 4 from 3 arrays
7	Rotary Azimuth code	1	byte	0-255 corresponds to 0-360 degrees Original azimuth code of rotary (excluding array orientation angle)
8	Sequential time	4	uint	Unit: ms (hours * 3600+minutes * 60+seconds) * 1000+milliseconds
Plot data (1)				
9	Azimuth	4	float	Range: 0~360, Unit: °
10	Distance	4	float	Unit: m
11	Speed	4	float	Unit: m/s
12	Amplitude	4	float	Unit: dB
13	Height	4	float	Unit: m, Relative radar altitude
Plot data (2)				
14	Azimuth	4	float	Range: 0~360, Unit: °
15	Distance	4	float	Unit: m
16	Speed	4	float	Unit: m/s
17	Speed	4	float	Unit: dB
18	Height	4	float	Unit: m, Relative radar altitude

2.1 Control commands (TDS to DPS)

The control command message is sent from TDS to DPS for modifying or querying radar parameter information.

The interval between sending adjacent command messages shall not be less than 100ms.

2.1.1 Link command

Sent by TDS to DPS, DPS reports the data described in 2.1 to the address port of the TDS after receiving the link command.

The DPS port number is 12580, and the IP is subject to on-site changes. The content is 10 bytes 0xaa, once per minute.

Table 1 Link Message Format

Item	Data item	Length (Bytes)	Format	Explanation
Message frame header				
1	Frame header	10	char	Fixed value: 0xaa aa aa aa aa aa aa aa aa aa

2.1.2 Radar parameter command message A

Radar parameter command message A is used to set data processing related parameters. The 1 to 3 data items, totaling 8 bytes, are the frame header of the message, where the first 2 items are fixed values. The radar parameter command message data corresponds to a data segment with a length of 24 bytes.

Table 1 Format of Radar Parameter Command Message A

Item	Data item	Length (Bytes)	Format	Explanation
Message frame header				
1	Frame header	4	uint	Fixed value: 0xaa aa aa aa
2	Information type	1	byte	Fixed value: 0x0b
3	Revised	3	byte	Default 0x00
Radar parameter				
4	Parameter type	1	byte	Numerical range 1~255,
5	Destination site	1	byte	Destination site number 0~255
6	Target array	1	byte	Target array number 0~7, representative 1~7
7	Checksum	1	byte	Items 9-12, the cumulative sum of 16 bytes of data
8	Revised	4	byte	Revised
9	Parameter 1	4	byte	Each parameter type corresponds to 4 parameter values, content and format, as shown in Table 4-1 (data processing).
10	Parameter 2	4	byte	

11	Parameter 3	4	byte	
12	Parameter 4	4	byte	

Note:

1) When the destination array number is 0, it indicates sending commands (including DP and SP commands, etc.) to all arrays in the corresponding station in data processing. Other numbers are used to send commands to the specified array. The target array numbers 1-5 correspond to the main array, from the 1st array, from the 2nd array, from the 3rd array, and the altitude measurement array, respectively.

2) DP transparently transmits all types of control commands to the specified array SP (signal processing).

Table 4-1 List of radar parameter categories

Parameter type	Data item	Content	Length	Format	Explanation
1 Status query	Parameter 1	Destination site	4	uint32	Query command, parameter type 0x01 is the query command. DPS reports the status of the specified site or array after receiving the change command. The report format is shown in Table 6.
	Parameter 2	State type	4	uint32	Range 0~255.
	Parameter 3	Revised	4	uint32	
	Parameter 4	Revised	4	uint32	
2 GPS and orientation	Parameter 1	Latitude	4	float	Range : -90~+90, Unit: °
	Parameter 2	Longitude	4	float	Range : -180~+180, Unit: ° Note: When longitude, latitude, altitude, and north angle are all 0, the GPS coordinate north angle will be

					used by default.
	Parameter 3	Altitude	4	float	Range: 0-10000m, unit: m
	Parameter 4	North corner	4	float	The orientation of the main formation. Range: 0-360, unit: °
3 Air state exit IP	Parameter 1	External IP address	4	byte	Format: 4 bytes from high to low, for example: 192.168.0.100, corresponding to the following: Byte3/2/1/0:192/168/0/100
	Parameter 2	Revised	4		
	3	Revised	4		
	Parameter 4	Revised	4		
4 Global parameters	Parameter 1	Distance error	4	float	Range: 1.0~20.0, unit: m
	Parameter 2	Distance error	4	float	Range: 0.01~0.99
	Parameter 3	Mobile wave gate	4	float	Range: 1~15
	Parameter 4	Stable trajectory residual time	4	float	Range: 1~25, Unit: s
5 Revised	Parameter 1	Revised	4	byte	
	Parameter 2	Revised	4		
	Parameter 3	Revised	4		
	Parameter 4	Revised	4		
6 Tracking speed limit	Parameter 1	High speed restriction	4	float	Range: 1.0~40.0, unit: m/s To maintain consistency with parameter 2 in the 11 threshold setting for detecting high-speed thresholds
	Parameter 2	Low speed limit	4	float	Range: 0.0~10.0, unit: m/s To maintain consistency with parameter 3 in the 11

					threshold setting for detecting low-speed thresholds
	Parameter 3	Revised			
	Parameter 4	Revised			
7 Revised	Parameter 1	Revised	4	byte	
	Parameter 2	Revised	4		
	Parameter 3	Revised	4		
	Parameter 4	Revised	4		
8 On/Off parameters	Parameter 1	Plot reporting switch	4	uint32	1: Allow reporting/0: Prohibit reporting
	Parameter 2	Revised	4	uint32	
	Parameter 3	Revised	4	uint32	
	Parameter 4	Revised	4	uint32	
9~10	Parameter				Revised
<u>11</u> Threshold setting	Parameter <u>1</u>	Detection threshold	<u>4</u>	<u>float</u>	Range: 11.0~40.0, unit: dB
	Parameter <u>2</u>	Detecting high-speed threshold	<u>4</u>	<u>float</u>	Range: 1.0~40.0, unit: m/s To maintain consistency with parameter 1 in the tracking speed limit of 6
	Parameter <u>3</u>	Detecting low-speed threshold	<u>4</u>	<u>float</u>	Range: 0-10.0, unit: m/s To maintain consistency with parameter 2 in the 6 tracking speed limit low speed limit The low-speed threshold needs to be smaller than the high-speed threshold
	Parameter <u>4</u>	Revised	<u>4</u>	<u>float</u>	
12~19					
20 Single frame command	Parameter 1	Command frame header	1	byte	Fixed value: 0xA5
		ID number	1	byte	Fixed value: 0x10

		Type	1	byte	Fixed value: 0x01
		Address	1	byte	Generate corresponding command parameters by combining address and data 1-8, as detailed in Table 5 Radar Single Frame Command List
	Parameter 2	Data 1	1	byte	
		Data2	1	byte	
		Data3	1	byte	
		Data 4	1	byte	
	Parameter 3	Data5	1	byte	
		Data6	1	byte	
		Data7	1	byte	
		Data8	1	byte	
	Parameter 4	Frame number	1	byte	For each set of commands sent, increment by 1 in a loop
		Checksum	1	byte	The sum of 12 data points, including ID number, type, address, data 1-8, and frame number, is invalid due to overflow
		Revised	1	byte	0x00
		Revised	1	byte	0x00

Note:
 Data 1-8 is of Byte type, data 1-4 is the base command, corresponding to 32 bit commands, data 5-8 is the expansion command, with high bits in the front and low bits in the back.
 Cmdx [31.0] ->dat [4]&dat [3]&dat [2]&dat [1]
 Cmdy [31.0] ->dat [8]&dat [7]&dat [6]&dat [5]

21 Sector parameters	Parameter 1	Starting angle of sector	1	byte	Angle Ang setting range: 0-255
		End angle of sector	1	byte	Actual angle: $\text{Ang}/256 * 360^\circ$ Note: $45^\circ \leq \text{Sector range} \leq 180^\circ$ Starting from 0x00; End 0xff ->Weekly Scan Starting from 0x00; End 0x00-->Stop rotating Note:



					Do not overlap or overlap sectors with silent areas
		Revised	2	byte	
	Parameter <u>2</u>	Revised	4	uint32	
	Parameter <u>3</u>	Revised	4	uint32	
	Parameter <u>4</u>	Revised	4	uint32	
22 Silent parameters	Parameter <u>1</u>	Silent Zone 1 Starting angle	1	byte	Angle Ang setting range: 0-255 Actual angle: $\text{Ang}/256 * 360^\circ$ Note: $45^\circ \leq \text{Silent range} \leq 180^\circ$ The spacing between each silent zone is $\geq 20^\circ$ Actual terminal restrictions $90^\circ \leq \text{Silent range} \leq 180^\circ$ The spacing between each silent zone is $\geq 40^\circ$
		Silent Zone 1 End angle	1	byte	
	Parameter <u>2</u>	Silent Zone 2 Starting angle	1	byte	
		Silent Zone 2 End angle	1	byte	
		Silent Zone 3 Starting angle	1	byte	
		Silent Zone 3 End angle	1	byte	
		Silent Zone 4 Starting angle	1	byte	
		Silent Zone 4 End angle	1	byte	
	Parameter <u>3</u>	Revised	4	uint32	
	Parameter <u>4</u>	Revised	4	uint32	

23~28	Parameter				Revised
29 Tracking mode parameters	Parameter 1	Tracking switch	1	byte	0: Search mode; 1: Tracking mode;
		Revised	3	byte	
	Parameter 2	Batch number	4	uint32	Same as the batch number in the track message
	Parameter 3	Revised	4	uint32	
	Parameter 4	Revised	4	uint32	

The radar single frame command is used to set signal processing related parameters. Each message corresponds to 14 bytes, with the first 3 bytes as fixed values, the 4th to 12th bytes as parameter content, the 13th byte as frame number, and the 14th byte as checksum.

Table 5 Radar Single Frame Command List

Parameter type	Data item	Content	Explanation
1 Working frequency	Address	0x40	Freq corresponds to the working frequency point, with a default value of 0x05. Range: 0x00~0x0A
	Data 1	0x3C	
	Data 2	freq	
	Data 3~8	0x00	
2 Launch switch	Address	0x27	SW is the launch online on/off switch SW=0xff, launch enabled SW=0x00, transmit off The default value is 0xff. Note: Then send the manual calibration command.
	Data 1	SW	
	Data 2	0x01	
	Data 3	SW	
3 Manual calibration	Data 4~8	0x00	
	Address	0x2E	Manual calibration command, sent after switch transmission, capable of updating BIT status
	Data 1	0x01	
	Data 2~8	0x00	
4 Rotary related	Data	0x30	The 7-byte command for PELCO-D. Note: When positioning, the stop turntable command needs to be sent first, and then the positioning command needs to be sent.
	Data 1	0x01	
	Data 2~8		

2.2 Radar status reporting (DPS to TDS)

The 1 to 2 data items of the radar status report message, totaling 8 bytes, are the frame header of the message, where the first two items are fixed values. The radar status reporting message data corresponds to a data segment, including 7 data items, with a length of 24 bytes.

Table 6 Format of Radar Status Reporting Message

Table 6-1 Format of Radar Status Reporting Message				
Item	Data item	Length (Bytes)	Format	Explanation
Message frame header				
1	Frame header	4	uint	Fixed value: 0xaa aa aa aa aa
2	Information type	1	byte	Fixed value: 0x03
3	Revised	3	byte	Default 0x00
Radar status				
4	State type	1	byte	Value range 1 to 255,
5	Destination site	1	byte	Destination site numbers 0-255
6	Target array	1	byte	Target array numbers 1-7
7	Checksum	1	byte	Items 9-12, sum of 16 bytes of data
8	Revised	4	byte	Revised
9	State 1	4		Each state type corresponds to 4 parameter values, content, and format, as shown in Table 6-1.
10	State 2	4		
11	State 3	4		
12	State 4	4		
Note:				
1) The target array numbers 1 to 5 correspond to the main array, from 1 array, from 2 array, from 3 array, and altitude measurement array, respectively.				
2) The status uploaded by SP to DP is filled in with the corresponding station and array numbers in DPS and then reported to TDS.				

Table 6-1 List of radar status categories

State type	Data item	Content	Length	Format	Explanation
1 BIT status	State 1	bit_a	1	byte	Bit0-7 corresponds to the status of receiving channels 1-8. 0/1- Normal/Fault
		bit_b	1	byte	Revised
		bit_c	1	byte	Bit0-7 corresponds to the status of transmission channels 1-8. 0/1- Normal/Fault
		bit_d	1	byte	Revised
	State 2	Revised	4	byte	
	State 3	Revised	4	byte	
	State 4	Revised	4	byte	
2 GPS and orientation	State 1	Latitude	4	float	Range: -90~+90, unit: °
	State 2	Longitude	4	float	Range: -180~+180, unit: °
	State 3	Altitude	4	float	Range: 0-10000m, unit: m
	State 4	North corner	4	float	Main array orientation: Range: 0-360, unit: °
3 Working parameters	State 1	Working mode	1	byte	Range: 0-255
		Working frequency	1	byte	Range: 0-10
		Front type	1	byte	Range: 0-1
		Front number	1	byte	Range: 0-5
	State 2	Power attenuation	1	byte	Range: 0-255
		Revised	3	byte	
	State 3	Revised	4	byte	
	State 4	Revised	4	byte	
4 Global parameters	State 1	Distance error	4	float	Range: 1.0~20.0, unit: m
	State 2	Systematic error	4	float	Range: 0.01~0.99
	State 3	Mobile wave gate	4	float	Scope: 1-15
	State 4	Stable	4	float	Range: 1-25, unit: s

State type	Data item	Content	Length	Format	Explanation
		trajectory residual time			
5	State				Revised
6 Tracking restriction parameters	State 1	Tracking high-speed restrictions	4	float	Unit: m/s
	State 2	Tracking low speed limit	4	float	Unit: m/s Control the speed limit for external reporting of flight paths
	State 3	Tracking altitude upper limit	4	float	Range: -10000.0~10000.0, unit: m
	State 4	Tracking altitude lower limit	4	float	Range: -10000.0~10000.0, unit: m Upper limit>=lower limit, unlimited when the upper and lower limits are equal
7	State				Revised
8 Data switch parameters	State 1	Plot reporting switch	1	byte	1: Allow reporting (default)/0: Prohibit reporting
		Revised	1	byte	
		Revised	1	byte	
		Revised	1	byte	
	State 2	Revised	4	uint32	
	State 3	Revised	4	uint32	
	State 4	Revised	4	uint32	
9~10	State				Revised
11 Threshold setting	State 1	Detection threshold	4	float	Range: 8.0~40.0, unit: dB
	State 2	Detection threshold	4	float	Range: 1.0~40.0, unit: m/s
	State 3	Low speed threshold	4	float	Range: 0.0~10.0, unit: m/s
	State 4	Revised	4	float	

State type	Data item	Content	Length	Format	Explanation
12 Firmware number 1	State 1	Equipment number	4	uint32	All firmware numbers are represented by 8421BCD codes For example: 0x20 06 68 A0, where A0 represents the radar model, applicable to products after August 2021
	State 2	A9 version number	4	uint32	
	State 3	ARM version number	4	uint32	
	State 4	SS version number	4	uint32	System software version number
13 Firmware number 2	State 1	A5 version number	4	uint32	
	State 2	SP version number	4	uint32	
	State 3	DP version number	4	uint32	
	State 4	Revised	4	byte	
21 Sector parameters	State 1	Starting angle of sector	1	byte	Angle Ang setting range: 0-255
		End angle of sector	1	byte	Actual angle: $\text{Ang}/256 * 360^\circ$ Please refer to the 21 sector parameters in the <Radar Parameter Category List> for details
		Revised	2	byte	
	State 2	Revised	4	uint32	
	State 3	Revised	4	uint32	
	State 4	Revised	4	uint32	
22 Silent parameters	State 1	Silent Zone 1 Starting angle	1	byte	Angle Ang setting range: 0-255
		Silent Zone 1 End angle	1	byte	Actual angle: $\text{Ang}/256 * 360^\circ$
		Silent Zone 2	1	byte	Please refer to 22 Silent

State type	Data item	Content	Length	Format	Explanation
		Starting angle	1	byte	Parameters in the<Radar Parameter Category List>for details
		Silent Zone 2 End angle			
	State 2	Silent Zone 3 Starting angle	1	byte	
		Silent Zone 3 End angle	1	byte	
		Silent Zone 4 Starting angle	1	byte	
		Silent Zone 4 End angle	1	byte	
	State 3	Revised	4	uint32	
	State 4	Revised	4	uint32	
23 Product model	State 1	Equipment location and purpose code	3	char	RD-, Example: 023
	State 2	Front code	3	char	AR- Example: B6A/0A0
	State 3	Configuration code	3	char	F-, Example: 001/004
	State 4	Control box configuration code	3	char	K -, fff indicates no such configuration, example: 016
	State 5	Software parameter configuration code	3	char	SC-, Example: 012
	State 6	Revised	1	byte	
24 Custom String 1	State 1	String length	1	byte	
	State 2	Content	15	char	
25 Custom String 2	State 1	Content	16	char	
26 Custom String 3	State 2	Content	16	char	
27 Custom	State 1	Content	16	char	



State type	Data item	Content	Length	Format	Explanation
String 4					
28	State				Revised
29 Tracking mode parameters	State 1	Tracking switch	1	byte	0: Search mode; 1: Tracking mode;
		Revised	3	byte	
	State 2	Batch number	4	uint32	Same as the batch number in the track message
	State 3	Revised	4	uint32	
	State 4	Revised	4	uint32	