

Multi-Target 3-D Data Format for the DynaSight™ Sensor

The DynaSight sensor employs an efficient binary-encoded format for real-time reporting of three-dimensional measurements. This default format is referred to as the DYSTM format in sensor documentation and software utilities. DYSTM is a streaming data format that supports both single target and multiple target applications of the DynaSight sensor. Three-dimensional measurements are reported in a Cartesian coordinate system with an origin at the fiducial mark on the front center of the sensor.

The default communication parameters for 3-D measurements are asynchronous serial RS232 at 19200 baud, 8 bits per character, no parity, and one stop bit. The period between updates is dependent upon the sensing and reporting modes selected. However, typical update rates range from thirty to sixty-five updates per second. Eight bytes are transferred per measurement update, and high order bytes are transferred first:

	Byte 0 High Order Byte	Byte 1 Low Order Byte
Word 0	1000TTEE	1000LRSS
Word 1	XXXXXXXX	XXXXXXXX
Word 2	YYYYYYYY	YYYYYYYY
Word 3	ZZZZZZZZ	ZZZZZZZZ

Word 0 contains synchronization fields, a two-bit target indicator field, a two-bit binary exponent for data scaling, a single-bit field related to the SYNC input/output connector, a single-bit reserved field, and a two-bit sensor status field. If the receiving system loses synchronization with the data stream, it can always identify Word 0 by looking for the bit pattern "1000" in the high order bits of successive bytes. This pattern can occur in the low-order byte of X, Y, or Z values, but it is guaranteed not to occur in the high-order byte of those values. Thus, the synchronization word can always be identified as the last two bytes in a run of two or three bytes that have the bit pattern "1000" in the high order nibble (4 bits).

Bits 2 and 3 of Byte 0, Word 0 are the target indicator field ("TT") and Bit 2 of Byte 1, Word 0 ("R") is reserved for use as an extension. When operating with multiple targets, a separate 8-byte packet is reported for each target. Together, the R and TT fields indicate the target with which the data packet is associated. (Standard DynaSight firmware supports a maximum of four targets when used with the Active Target Adapter.) The decode of the 1-bit R field and the 2-bit TT field are as follows:

'R' Value	'TT' Value	Target Number
0	00	Target 0
0	01	Target 1
0	10	Target 2
0	11	Target 3
1	00	Target 4
1	01	Target 5
1	10	Target 6
1	11	Target 7

Bits 1 and 0 of Byte 0, Word 0 are a base-2 exponent field ("EE"). The 16-bit X, Y, and Z values should be left-shifted by the count contained in this exponent for proper scaling. This approach provides a wide dynamic range without sacrificing the very high measurement resolution that is available at short sensor-to-target ranges. The X, Y, and Z values should typically be sign extended to 32-bits before the shift to prevent overflow.

A Sync Input/Output field is defined for Bit 3 of Byte 1, Word 0:

SYNC I/O Field "L"	Message Meaning
0	The SYNC input/output line is high or undriven (50 msec debounce delay). In StereoSync modes: Internal synchronization.
1	The SYNC input/output line is driven low (50 msec debounce delay). In StereoSync modes: External synchronization.

The "R" field in Bit 2 of Byte 1, Word 0, is reserved for use as an extension to the target indicator field. This "R" field is transferred as 0 by standard DynaSight firmware.

A Sensor Status field is defined for Bits 1 and 0 of Byte 1, Word 0:

Status Field "SS"	Message Meaning
00	SEARCH: Target not in track, Search in progress
01	COAST: Target lost, Attempting to reacquire
10	CAUTION: Track in progress, Conditions are marginal, Imminent loss-of-track possible
11	TRACK: Track in progress, Signal-to-noise satisfactory

If the sensor status field is TRACK ("11") or CAUTION ("10"), then the X, Y, and Z values correspond to current, updated measurements. If the sensor status field is COAST ("01") or SEARCH ("00"), then the X, Y, and Z values and the "EE" exponent are unchanged from the most recent TRACK or CAUTION packet.

Measurements are reported in a Cartesian coordinate system with X, Y, and Z formatted as 16-bit integer twos-complement values, each encoded as two successive bytes. The X, Y, and Z values are nominally scaled at 0.05mm per least significant bit when the "EE" exponent field is zero. The default coordinate system is right-handed and is defined such that, for a user facing the sensor, rightward head movement is in the direction of positive X, upward head movement is in the direction of positive Y, and movement away from the sensor is in the direction of positive Z.



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